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Practical Wireless

The Radio Magazine

Build the PW "Orwell" High Performance MW Receiver

Part 1

Directivity Gain in Transmitting Antennas

The ICOM IC-761 HF Transceiver Reviewed

Yaesu's FT-736R. Because you never know who's listening.

Why just dream of talking beyond earth?

With Yaesu's new FT-736R VHF/UHF base station, you can discover some of the best DX happening in ham radio. Via moonbounce. Tropo. Aurora. Meteor scatter. Or satellites.

You see, the FT-736R is the most complete, feature-packed rig ever designed for the serious VHF/UHF operator. But you'd expect this of the successor to our legendary FT-726R.

For starters, the FT-736R comes factory-equipped for SSB, CW and FM operation on 2 meters and 70 cm, with two additional slots for optional 50-MHZ or 1.2-GHz modules (220-MHz North America only).

Crossband full duplex capability is built into every FT-736R for satellite work. And the satellite tracking function (normal *and* reverse modes) keeps you on target through a transponder.

The FT-736R delivers 25 watts RF output on 2 meters, 220-MHz, and 70 cm. And 10 watts on 6 meters and 1.2-GHz. Store frequency, mode and repeater shift in each of the 100 memories.

For serious VHF/UHF work, use the RF speech processor. IF shift. IF notch filter. *CW Narrow Optional and FM wide/ narrow IF filters. VOX. Noise blanker. Three-position AGC selection. Preamp switch for activating your tower-mount preamplifier. Even an offset display for measuring observed Doppler shift on DX links.

And to custom design your FT-736R station, choose from these popular optional accessories: Iambic keyer module. FTS-8 CTCSS encode/decode unit. FVS-1 voice synthesizer. FMP-1 AQS digital message display unit. 1.2-GHz ATV module. MD-1B8 desk microphone. E-736 DC cable. And CAT (Computer Aided Transceiver) system software.

Discover the FT-736R at your Yaesu dealer today. But first make plenty of room for exotic QSL cards. Because you *never* know who's listening.

YAESU

*CW narrow optional

UK Sole Distributor ***South Midlands Communications*** *S.M. House, School Close, Chandlers Ford Industrial Estate, Eastleigh, Hants SO5 3BY. Tel: (0703) 255111*

Prices and specifications subject to change without notice. FT-736R shown with 220-MHz option installed.

Practical Wireless
The Radio Magazine

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THIS MONTH

Regular Features

NEXT MONTH

Beginning A New Series For Beginners: Understanding Circuit Diagrams

A "Digital Dial"

The Howes SWB30 SWR/Power Meter Reviewed

plus

All the usual features

Don't miss it—place your order with your newsagent now!

On sale February 11

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Specification

Frequency coverage	30kHz to 30 MHz continuous coverage
Detection Modes	AM SSB (USB, LSB) CW FM (narrow band) (Optional with D-125 unit) Synchronous AM (Optional with D-125 unit)
Tuning	By spin-wheel – continuous tuning in 15.6 Hz steps. Step size increases with faster tuning knob rotation. MHz quick selection by push button. Keypad frequency entry. (Optional with K-125 keypad unit and interface).
Memories	30 frequency memories in two banks of 15
I.F. Filter bandwidths	2.5kHz, 4kHz, 7kHz, 10kHz 400 Hz audio filter (CW mode only). (Filters are user selectable).
Sensitivity (>500kHz)	SSB mode: <0.3μV for 10 dB S/N AM mode: <0.7μV for 10 dB S/N @ 70% mod.
Dynamic range	>90 dB at 50 kHz from tuned frequency. >80 dB at 20 kHz from tuned frequency.
Image and spurious responses	>75 dB rejection.
Audio output	0.75 W into internal loudspeaker. 1.25 W into external 4 ohm loudspeaker.
Connections	Antenna input: 50 ohm via SO-239 socket. 600 ohm + GND terminals. Active whip antenna. (Optional P-125 unit) External loudspeaker output – 3.5mm jack. Headphone output – 6mm mono/stereo jack. Record output (100 mV) – 3.5mm jack. 12V DC power input – 2.1mm power jack.
Power supply	External 12V DC supply at approx 250 mA. Internal NICAD batteries and charger to give typically 8 hrs. operation (Optional P-125 unit).
Size	Approx. 255 × 100 × 200mm (W×H×D)
Weight	Approx. 1.8 kg (Basic receiver) Approx. 2.5 kg with P-125 option fitted.

Specification subject to change without notice.

HF125	**£375.00 inc VAT,** carriage £8.00
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	**£25.88 inc VAT,** carriage £2.50

HF 125 SHORT WAVE RECEIVER

Why did we design and produce the HF125 receiver? Simply to provide the keen short wave listener with a receiver which offered not only all the facilities he or she needed in an HF receiver, but to give at the same time a level of performance which would cope easily with HF conditions likely to be encountered in Europe.

You all know the problems, high power broadcast stations pounding in at night. blotting out the weak signals you wanted to hear – and many of the unwanted signals were generated in your receiver itself. That we succeeded in designing a receiver which could solve the listening difficulties is obvious from comments from reviewers, but we also did it at an attractive price.

The HF125 performance ranks equal to or better than imported receivers at twice its price, and its success stretches around the world.

So what did the reviewers say. I'll give you a few comments, but for the full story why not send a stamped addressed envelope marked "HF125" and we will return a fully descriptive brochure with all the review comments included.

Quotes

"What is particularly important is the fact that so much attention has been paid to RF and IF performance; areas so lacking in many Japanese sets. Short Wave Listeners will be particularly pleased about the many choices of selectivity on AM." – Angus McKenzie

"I tuned straight to the 40 metre amateur band to see how it stood up to the battering from high powered propaganda broadcasters when attempting to resolve relatively weak amateurs striving to get contacts. The simple answer was, no problem." – Chris Lorek

"After an hour, drift was less than 50Hz in each instance. This is comparable with receivers in much higher price classes." – World Radio and TV Handbook

"I have no doubt that the Lowe HF125 represents extremely good value for money, and the performance far exceeds so much of its competition, including some receivers costing rather more." – Angus McKenzie

"It's refreshing to find a receiver that does exactly what it claims." – World Radio and TV Handbook

The HF125 costs £375 including vat. Need I say more?

For the Air Enthusiast

R535 VHF/UHF

As the hobby of airband listening has grown, many people have become fascinated by the to and fro of radio contacts between pilot and control. Much of this takes place on the VHF airband between 118 and 136 Mhz, and one specialist manufacturer in particular has produced a range of receivers designed to give the finest performance one could ask for. That manufacturer is Signal Communications, and thousands of listeners all over the world are using Signal radios.

As a good manufacturer, Signal have listened to comments from users of their receivers, and have noted that there has been an increasing demand for a receiver to listen not only to the VHF airband, but also to the UHF airband as well.

That receiver is the new R535, and is destined to be a landmark in airband listening. The R535 has all the performance we have come to expect from Signal, and the sensitivity is outstanding. However, the story does not end there because Signal have also put in every possible operating feature that the airband listener could possibly want, including 60 memory channels which can all be scanned at high speed; frequency scanning where the receiver will continuously look for stations between any frequency limits the user wishes to choose; and so on and so on.

Too much to say in a small space, so why not drop us a line and ask for full details of this listeners dream receiver. VHF and UHF airband in a small package of high performance. What more can we ask apart from the price? Well, **it costs just £249 including vat.**

BY THE WAY

The scanning monitor receiver which led the way to wide range coverage with high performance is still available. I'm talking about the AR2001, which has 25 to 550 MHz coverage, AM, communications FM and broadcast FM, memories, scanning etc. etc. This landmark in radios now costs only £325 including vat, and I should hurry if I were you because stocks are strictly limited.

FURTHER NEWS comes of a synthesised hand held airband radio which has caused us all to say "Just what we wanted". This latest advance in pocket size (yes, pocket size) receivers has everything you could ask for. Its called the WIN-108, and covers the entire VHF airband from 108 to 136 MHz in 25kHz steps. Scanning, memories, searching for new signals, direct frequency keypad entry, – everything. Ask for details; by the time you read this, we will have them in stock.

Kantronics packet radio

When I first heard of packet radio, I said "What?", and that is the reaction of many radio amateurs. However, I never expected it to be so much fun, and judging by the demand and the queue to get at our demonstration station here at Matlock, a lot of other people are also finding it truly fascinating.

There are several companies offering ready made packet systems, and the descriptions are usually full of terms you don't understand (including some of our own ads in the past). What for example is "enhanced generic command structure"? Sounds very much like something taught at Sandhurst or West Point.

From the equipment available, we chose to represent Kantronics, because their units are sheer delight to see, to use, and to enjoy. **For full information on this most interesting aspect of our hobby, just send a couple of first class stamps and ask for "Kantronics".**

Prices range from £159 to £298, and I know I haven't told you what packet radio will do – send for the info . . .

Glasgow: 4/5 Queen Margaret Road.	Tel. 041-945 2626.	**Cardiff:** c/o South Wales Carpets, Clifton Street.	Tel. 0222 464154.
Darlington: 56 North Road.	Tel. 0325 486121.	**London:** 223/225 Field End Road, Eastcote, Middlesex.	Tel. 01-429 3256.
Cambridge: 162 High Street, Chesterton.	Tel. 0223 311230.	**Bournemouth:** 27 Gillam Road, Northbourne.	Tel. 0202 577760.

Note. All our shops open Tuesday to Saturday inclusive.

The TS140S from Kenwood

Every once in a while, something comes along which marks a true turning point in amateur radio equipment. Such was the case when **Trio-Kenwood** introduced the **TS120 series;** the first of the small solid state transceivers to appear.

Following the trends of the last few years towards more "sophisticated" equipment (really meaning more and more complicated), we have seen Kenwood engineering directed more towards better performance, particularly in HF transceivers; performance which has become a standard of excellence for others to try to match.

Study of recent reviews of equipment which has been introduced to try to match **Kenwood's TS940S** reveals just how far behind some manufacturers have fallen: I am reminded of some lines from Kipling which run (more or less): "They stole everything I had, but they couldn't steal my mind, So I left them sweating and stealing, A year and a half behind."

Well, the chaps at Kenwood have not been asleep, and they have come up with a new transceiver which I believe will mark another turning point in HF equipment. This is the **TS140S,** and I can tell you that from a short "hands-on" session which I was given in Germany recently, I am certain that the **TS140S** will satisfy many many users.

The new **TS140S** is about the same size as the **TS430** or **TS440,** and on the face of it is similar (yawn) to other transceivers of the genre in that it gives you 100 Watts of RF on all the amateur bands, in all modes including FM; has a general coverage receiver covering 500 kHz to 30 MHz; and has loads of facilities that you might expect – BUT – Kenwood have studied what the radio amateur has been saying and have refined and simplified the operation of the **TS140S** to make it a real dream to use.

Not only that, they have given the user a receiver section with real performance which matches today's expectations, and remember that Kenwood have consistently set the standards for the last few years.

Obviously it is imposible to describe all the features and facilities of the TS140S in a few paragraphs, so why not drop us a line and ask for complete information. What's that? Oh, the price. Not yet finally determined, but quite a bit less than £950 but not quite as low as the £750 we have been asking for the TS530S and TS430S in recent weeks.

In my opinion, the **TS140S** in combining performance with simplicity at an attractive cost will give real satisfaction to the radio amateur who wants to enjoy his hobby of communicating, rather than counting the buttons on the front panel. And who am I to make this pronouncement? Well, I'm John Wilson and I am one of the original gang of three which became Lowe Electronics Ltd. I haven't written for the magazines for many years, but the **TS140S** really attracted me so I thought I should tell you about it rather than bore you with a specification. Hope you like it too.

73, G3PCY/5N2AAC

LOWE ELECTRONICS LTD.

Chesterfield Road, Matlock, Derbyshire DE4 5LE
Telephone 0629 580800 (4 lines)

ICOM

RECEIVERS

IC-R7000, 25-2000MHz. Commercial quality scanning receiver

The ICOM IC-R7000 has established itself as an advanced technology, continous coverage communications receiver. With 99 programmable memories the IC-R7000 covers aircraft, Marine, FM Broadcast, Amateur Radio, television and weather satellite bands. For simplified operation and quick tuning the IC-R7000 features direct keyboard entry. Precise frequencies can be selected by pushing the digit keys in sequence of the frequency or by turning the main tuning knob. FM wide/FM narrow/AM upper and lower SSB modes with six tuning speeds: 0.1, 1.0, 5, 10, 12.5, 25KHz. The IC-R7000 has 99 memories available to store your favourite frequencies including the operating mode. Memory channels can be called up by pressing the memory switch then rotating the memory channel knob, or by direct keyboard entry. A sophisticated scanning system provides instant access to the most used frequencies. By depressing the Auto-M switch, the IC-R7000 automatically memorises frequencies that are in use whilst it is in scan mode, this allows you to recall frequencies that were in use. The scanning speed is adjustable and the scanning system includes the memory selected frequency ranges or priority channels. All functions including the memory channel readout are clearly shown on a dual-colour fluorescent display. Other features include dial-lock, noise-blanker, attentuator, display dimmer and S-meter and optional RC-12 infra-red remote controller, voice synthesizer and HP2 headphones.

IC-R71E, General coverage receiver.

The ICOM IC-R71E 100KHz to 30MHz general coverage receiver features keyboard frequency entry and infra-red remote controller (optional) with 32 programmable memory channels, SSB, AM, RTTY, CW and optional FM. Twin VFO's scanning, selectable AGC, noise blanker, pass band tuning and a deep notch filter. With a direct entry keyboard frequencies can be selected by pushing the digit keys in sequence of frequency. The frequency is altered without changing the main tuning control. Options include FM, voice synthesizer, RC-11 infra-red controller, CK70 DC adaptor for 12 volt operation, mobile mounting bracket. CW filters and a high stability crystal filter.

Icom (UK) Ltd.
Dept PW, Sea Street, Herne Bay, Kent CT6 8LD. Tel: 0227 363859. 24 Hour.

Count on us!

MOBILE

IC-900 Super multiband FM system

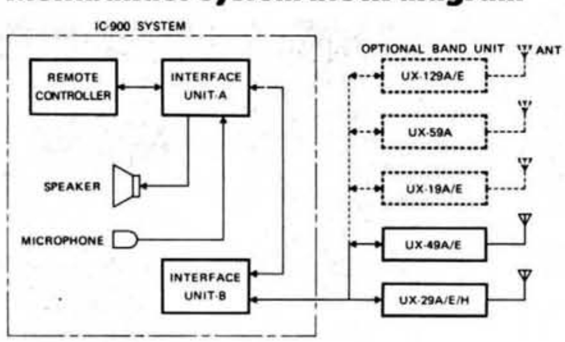
This new addition to ICOM's Ham radio equipment is a multiband FM transceiver system that allows the mobile operator to customize a communications system for his favourite bands. Up to 5 optional band-units can be installed with the IC-900 for instant access to a wide range of frequencies from the 28MHz HF band to the 1240MHz UHF band. Only a small remote controller is necessary for control of all these bands. A flexible optical fibre is used between the Remote Controller and the Interface Unit. The IC-900 has independent full duplex capability on all bands, providing simultaneous receive and transmit operation. The function display on the Remote Controller shows two separate operating frequencies simultaneously. The IC-900 system transceiver is equipped with 10 fully programmable memory channels in each Band Unit. The system can therefore store up to 50 different memory channels. This revolutionary new concept is available from your ICOM dealer. Also feel free to contact ICOM(UK) LTD for assistance or information. The IC-900 Multi-band system consists of a Remote Controller, Interface unit B and a series of specially designed Band Units.

UX19	28–30MHz	10 watts
*UX59	50–54MHz	10 watts

*(No mobile operation allowed in UK)

UX29	144–146MHz	25 watts
UX29H	144–146MHz	45 watts
UX49	430–440MHz	25 watts
UX129	1240–1300MHz	10 watts

Multibander system block diagram



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Count on us!

MORE BASE STATIONS

IC-1271E, 1.2GHz Multimode Transceiver

ICOM, a pioneer in 1.2GHz technology are proud to introduce the first full feature 1240–1300MHz base station transceiver. Features include: multimode operation, 32 memories, scanning and 10 watts RF output. The IC-1271E allows you to explore the world of 1.2GHz thanks to a newly developed PLL circuit that covers the entire band, a total of 60MHz, SSB, CW, and FM modes may be used anywhere in the band making the IC-1271E ideal for mobile, DX, repeater, satellite or moonbounce operation. The IC-1271E has outstanding receiver sensitivity, the RF amplifiers use a low noise figure and high-gain disc type GaAs FET's for microwave applications. The rugged power amplifier provides 10 Watts which can be adjusted from 1 to 10 Watts. A sophisticated scanning system includes memory scan, programme scan, mode-selective scan and auto-stop feature. Scanning of frequencies and memories is possible from either the transceiver or the HM12 scanning microphone. 32 programmable memories are provided to store the mode and frequency in 32 different channels. All functions including memory channel are shown clearly on a seven digit luminescent dual colour display. The IC-1271E has a dial-lock, noise blanker, RIT, AGC fast or slow and VOX functions. With a powerful 2 Watt audio output the IC-1271E is easily audible even in a noisy environment. The transceiver operates with either a 240V AC (optional) or 12 volt DC power supply.

IC-AG1200 Masthead pre-amp. Designed to use with the IC-1271E, the D.C. voltage and T/R switching for the amplifier is superimposed on the R.F. coaxial cable and switched by the pre-amp switch on the IC-1271E front panel. The new pre-amp provides excellent performance as a low noise microwave amplifier (0.6 noise figure typical).

IC-575, 28/50MHz Dual band multimode base station.

The ICOM IC-575 base station was developed to meet the demand for advanced communications for the recently acquired 6m band. Similar in appearance to the IC-275/475 2m and 70cm base stations, the beauty of this new transceiver from ICOM is that it gives you the best of both worlds, 6 & 10m in one compact unit. The IC-575 covers 28-30Mhz and 50-54MHz. Operating modes are SSB, CW, AM & FM. Power output is 10 watts (AM 4 watts) with a front panel control to reduce output for QRP operations. A pass band tuning circuit narrows the I.F. passband width, eliminating signal in the passband. A built-in notch filter eliminates beat signals with sharp attenuation characteristics. Some PLL systems have difficulty meeting the lockup time demands placed on them by new data communications. This is why ICOM developed the DDS (Direct Digital Synthesizer) method. With a lockup time of just 5msec the DDS method allows the IC-575 to handle data communications such as packet or AMTOR. 99 programmable memories can store frequency, mode, offset frequency and direction. A total of four scanning functions for easy access to a wide range of frequencies, memory scan, programmed scan, selected mode memory scan and lock out scan. The IC-575 has an internal A.C. power supply, but can also be used on 13.8v DC for mobile or portable operation. Optional accessories available are the UT36 voice synthesizer, the IC-FL83 CW narrow filter, SP7 external loudspeaker, HP2 communication headphones and SM8/SM10 desk microphones. Other transceivers available in this range are: IC-275E 2m multimode 25w, IC-275H 2m multimode 100w, IC-475E 70cm multimode 25w, IC-475H 70cm multimode 75w.

Helpline: Telephone us free-of-charge on 0800 521145, Mon-Fri 09.00-13.00 and 14.00-17.30. This service is strictly for obtaining information about or ordering Icom equipment. We regret this cannot be used by dealers or for repair enquiries and parts orders, thank you.
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INTRODUCING THE FT736R FROM YAESU

The FT-736R is a solid-state, frequency-synthesised VHF and UHF amateur transceiver incorporating up to four band modules covering the 50, 144, 430 and 1200 MHz amateur bands. The standard model provides 25 watts RF power output on the 144 and 430 MHz amateur bands in SSB, CW, and FM modes, with any two of the remaining three bands installable as options (10 watts output on the 50 and 1200 MHz bands). An 8-bit CMOS main microprocessor and 4-bit i/o coprocessor provide exceptional digital integration and control: including selectable tuning rates or mode-dependent channelized tuning in selectable steps for each mode. Operating conveniences usually found only on HF transceivers, such as front panel adjustable IF shift and IF notch, a noise blanker, all-mode VOX and three-speed selectable AGC are included. GaAs FET receiver RF amplifiers are provided in the 430 and 1200 MHz band modules. The innovative memory system includes one hundred general purpose memories plus ten full duplex cross-band memories, all of which store mode and receive and transmit frequencies independently. In addition, fourteen vfos are provided: two general purpose plus one PMS (Programmable Memory limit Scanning) on each band, two special-purpose full duplex vfos, and up to four clarifier (receiver offset) memories, one per band. Each of the two full duplex vfos can be selected so that its receive and transmit frequencies and modes can be displayed and tuned independently, or linked to tune synchronously in opposite directions for satellite operation. You can retain twelve satellite uplink/downlink modes in the special vfos and ten full duplex memories at all times. Of course, metering of either transmitter or receiver parameters is selectable during full duplex communications. For CW operators, the FT-736R offers quick-changeover semi break-in and includes provisions for an optional internal electronic keyer and narrow (600Hz) CW crystal filter. Naturally, with FM the predominant mode on the VHF and UHF bands, the FT-736R includes all manner of convenient features for both FM simplex and repeater operation, special narrow FM mode (to cut adjacent channel interference in crowded areas), Automatic Repeater Shift when tuned to 2-meter repeater subbands and a 1750Hz Burst Tone Generator is installed as standard. An enhanced CAT (Computer Aided Transceiver) System allows addition and customization of features and user-designed controls from an external computer. The FT-736R also includes a t/r-switched DC supply line for masthead preamplifiers, activated from the front panel, and digital input connection directly to the modulator for high performance packet radio tnc interfacing. Optional add-on accessories include the TV-736 Amateur Television Modulator/Demodulator for ATV operation, FIF-series CAT Interface Units, SP-767 External Loudspeaker, FMP-1 AQS Message Processor, and FVS-1 Voice Synthesiser and FTS-8 CTCSS Tone Squelch Unit (both mount internally).

OPTIONAL ACCESSORIES

FEX 736/50	50MHz module	£239.00	XF455MC	600Hz CW Filter	£60.00
FEX 736/1.2	1.2GHz module	£425.00	SP767	External Spkr c/w Audio Filters	£69.95
FMP-1	AQS Message Processor c/w display	£189.00	MD-1B8	Desktop Microphone	£79.00
FTS-8	CTCSS Tone Squelch Unit	£45.00	MH-1B8	Hand Scanning Microphone	£21.00
FVS-1	Voice Synthesiser Unit	£33.00	FIF232Cvan	CAT/INC Interface for Packet & CAT	£T.B.A.
Keyer Unit B	Internal Iambic Keyer Unit	£15.95	FIF232C	CAT Interface for RS232 O/P	£75.00
TV-736	Fast Scan TV (ATV) Mod/Demod Unit	£159.00	FIF65A	CAT Interface for Apple II series	£60.00

See inside front cover for more details.

FT736R R.R.P. £1450.00 complete with 2m × 70cms.

A SELECTION FROM OUR CATALOGUE

VHF/UHF FIXED ANTENNAS

5% off new prices

JAYBEAM 2 Metre

		Normal Price	Offer Price
HO/2M	Halo head only	£9.78	£9.29
HM/2M	Halo with 2ft. mast	£11.50	£10.93
UGP/2M	Ground plain folded radiator	£16.96	£16.11
C5/2M MK2	Vertical Colinear 4.8dbd	£90.85	£86.31
LR1/2M	Vertical Colinear 4.3dbd	£37.95	£36.05
LR2/2M	Vertical omnidirectional	£29.61	£28.13
LW5/2M	5 Element Yagi 7.8dbd	£18.69	£17.76
LW8/2M	8 Element Yagi 9.5dbd	£23.98	£22.78
LW10/2M	10 Element Yagi 10.5dbd	£29.04	£27.59
LW16/2M	16 Element Yagi 13.4dbd	£42.55	£40.42
PBM10/2M	10 Element Parabeam 11.7dbd	£57.50	£54.63
PBM14/2M	14 Element Parabeam 13.7dbd	£70.15	£66.64
Q4/2M	4 Element Quad 9.4dbd	£37.09	£35.24
Q6/2M	6 Element Quad 10.9dbd	£48.59	£46.16
D5/2M	5 over 5 slot fed Yagi 10.0dbd	£33.93	£32.23
D8/2M	8 over 8 slot fed Yagi 11.1dbd	£46.58	£44.25
5XY/2M	5 Element crossed Yagi 7.8dbd	£36.23	£34.42
8XY/2M	8 Element crossed Yagi 9.5dbd	£46.00	£43.70
10XY/2M	10 Element crossed Yagi 10.8dbd	£57.50	£54.63
PMH2/C	2 Way harness circ. polarisation	£13.51	£12.83
PMH2/2M	2 Way harness for 2 Metres	£14.89	£14.15
PMH4/2M	4 Way harness for 2 Metres	£36.80	£34.96

JAYBEAM 4M/6M

DB4	4M/6M Dual Band 4 Ele	£117.88	£111.99
4Y6M	6M 4 Ele 7dBd	£49.45	£46.98
4Y4M	4M 4 Ele 7dBd	£40.54	£35.81
PMH2/4M	4M 2 Way Phasing	£20.87	£19.83

POSTAGE ON SMALL ITEMS £1.50
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Limited Offer

VHF LINEAR AMPS

B.N.O.S.

LPM144-3-50	2M 50W out 3W in	£145.00
LPM144-10-50	2M 50W out 10W in	£145.00
LPM144-1-100	2M 100W out 1W in	£275.00
LPM144-3-100	2M 100W out 3W in	£275.00
LPM144-10-100	2M 100W out 10W in	£205.00
LPM144-3-180	2M 180W out 3W in	£355.00
LPM144-10-180	2M 180W out 10W in	£355.00
LPM144-25-180	2M 180W out 25W in	£305.00
LPM432-1-50	70cms 50W out 1W in	£255.00
LPM432-3-50	70cms 50W out 3W in	£255.00
LPM432-10-50	70cms 50W out 10W in	£215.00
LPM432-3-100	70cms 100W out 3W in	£395.00
LPM432-10-100	70cms 100W out 10W in	£395.00
LPM432-25-100	70cms 100W out 25W in	£355.00
LPM50-3-50	6m 50W out 3W in	£175.00
LPM50-10-50	6m 50W out 10W in	£175.00
LPM50-10-100	6m 100W out 10W in	£235.00

MET ANTENNAS

144/7T	2M 7 Ele Yagi 10.0dBd	£27.77
144/14T	2M 14 Ele Yagi 13.0dBd	£53.72
144/19T	2M 19 Ele Yagi 14.2dBd	£64.26
432/5B	70cm 5 Ele Yagi 9.2dBd	£19.49
432/17X	70cm 17 Ele crossed	£56.55
432/17T	70cm 17 Ele Yagi	£45.08
50/2	6M 2 Ele Yagi 4.7dBd	£32.00
50/3	6M 3 Ele Yagi 7.1dBd	£39.95
50/5	6M 5 Ele Yagi 9.2dBd	£59.90
CK50	50/2-50/3 Conv. Kit	£11.50

ANTENNA ROTATORS

KR250	Bell type twist switch control	£78.00
AR40	Bell type turn push control	£125.00
KR400RC	Bell type 360 deg. round meter	£169.00
AR50	Bell type 5 position pre-select	£149.00
CD45	Bell type meter readout	£219.00
KR600RC	Bell type 360 deg. round meter	£219.00
HDR300	Bell type digital readout	£699.00
KR800SDX	Bell type 450 deg. variable speed	£325.00
KR1000SDX	Bell type 450 deg. variable speed	£368.00
KR2000RC	Bell type heavy duty round meter	£445.00
KR2000	Bell type meter control +/− 90 deg.	£445.00
KR400	Bell type meter control +/− 180 deg.	£139.00
KR500	Elevation meter calib. +/− 90 deg.	£149.95
KR500B	Heavy duty version of KR500	£259.95
KR5400	Azimuth/elevation dual control	£279.00
KR5400A	Azimuth/elevation computer control	£339.00
KR5600	Azimuth/elevation heavy duty	£369.00
KR5600A	Azimuth/elevation HD comp. control	£389.00
KRO10	Intell. i/face KR5400A/KR5600A	£275.00

ROTATOR HARDWARE

50425	Ubolt clamps AR22/AR40 std.	£10.18
50463	Ubolt clamps CD45 etc. heavy duty	£16.68
KS050	Rotary bearing 1⅝" mast	£19.95
KS065	Rotary bearing 2" mast	£29.95
KC038	Rotary bearing for KR400/KR600	£16.95

ROTATOR CONTROL CABLE

RC5W	5way for KR400RC etc.	per mtr. £0.48
RC6W	6way for KR250/400/500 etc.	per mtr. £0.66
RC8W	8way for CD45/KR2000RC etc.	per mtr. £0.72

Carriage on Rotator Cable £1.90 up to 20 metres, over 20 metres £2.65.

Prices subject to fluctuation.

FREE FINANCE . . .

On many regular priced items SMC offers. Free finance (on invoice balances over £120) 20% down and the balance over 6 months or 50% down and the balance over a year.

You pay no more than the cash price!

Details of eligible items available on request.

FREE S.M.C. SERVICE INTERLINK DELIVERY . . .

Free Interlink delivery on major equipment.

Small items, Plugs, Sockets, etc. by post £1.75. Antennas, Cables, Wire & larger items. Roadline up to £5.00. Interlink delivery available, upon request, for items other than radios, from £7.30 depending on weight.

Same day despatch whenever possible.

GUARANTEE

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

● **2 years warranty on regular prices Yaesu products.**

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

Cheque Books and Black Boxes

STAR £10 LETTER

Amateur radio is becoming more and more a cheque-book and black-box hobby. I feel this is for two main reasons, the main one being RAE instructors teaching people to pass the exam rather than teaching them amateur radio. There is to me a large difference, and it shows when listening to h.f. or 144MHz.

If one has the nerve to talk technically on GB3WD about satellites, TNCs, or even something basic like resistors in series, then the QSO suffers from dead keys and the inevitable "break-break" without a callsign. When one responds to the station calling "break" there is no response.

But if the QSO consists of drivers commenting on the standard of the other drivers around them, complete with colourful descriptions of the offending driver's lack of a father or the like, there never seems to be a "break-break" or dead keying.

In the 3½ years that I have had a licence, standards have fallen, and I wonder what they will be like in five years time. The RSGB in their wisdom are trying to get licence conditions changed to be more flexible, but is this a good idea? Looking at their proposals, I cannot really believe that they represent the majority of decent amateurs. There is certainly a place for a novice licence on, say, 28MHz with a maximum 10 watts for a probationary period of one year after passing the RAE. Then allow the newcomers above 30MHz if all is well with their operating procedure. Doing this should discourage some of the "lids" currently on v.h.f. and more so these days on h.f. Having to wait a year would clear a lot as they would not have the patience to wait.

Vince Bobin G1FBH
Kingsbridge, S. Devon

Scrap the RAE?

I am one of many who read of those who wish to abolish the Morse test in pursuit of an "A" licence. I have been an s.w.l. for many years, and although I can read c.w. at over 25 w.p.m. and feel confident at passing the RAE, I am happy to remain an s.w.l.

I listen to some of the late G4 and early G0 amateurs and am appalled by their operating practice (or lack of it). I can only conclude that they never listened on the h.f. bands before entering the hobby.

To then listen to the same type of people advocating the abolition of the Morse test is too much for me to bear. I feel that Morse is part and parcel of amateur radio

PW COMMENT

Realism

IN DEVELOPED COUNTRIES where the business and private use of radio is expanding at a near-explosive rate, there have been moves over the past couple of years to tighten up legislation relating to casual listening. In particular, the cellular telephone lobbies in several countries have been pressurising governments to bring in swingeing laws restricting availability and ownership of scanning receivers.

Now, don't get me wrong. I like to think my telephone conversations are private to just me and the person at the far end. I know, though, that if they are carried over an open radio link without some form of encryption or scrambling, it's quite likely that someone else will be able to hear us too. That eavesdropping may not even be deliberate—cordless phones have been known to break through on medium wave broadcast receivers and on audio systems; cellular telephones have been heard on TV receivers.

So, although confiscating every listening enthusiast's scanner or general coverage receiver may appeal to the companies trying to sell their radio telephone equipment, it's not a practical solution. It would take a police state even to begin to gather in the receivers made illegal. Not convinced? Well, consider for example the fact that there are reckoned to be around 700 million receivers in use in the USA, 63½ million receivers in the UK; every one of these would need to be checked out by the "thought police" to ensure they didn't cover any "naughty" frequencies. And even that does nothing to reduce that risk of conversations being accidentally overheard.

In the USA, radio listening was in the past covered by the Communications Act, which in essence allowed an individual to listen to any radio transmission, providing they didn't divulge the contents of what they heard. The Electronic Communications Privacy Act (ECPA) was brought in there recently, removing the American citizens' age-old right to listen to public service, government, marine or aeronautical transmissions. The Federal Communications Commission (FCC) said the proposed law was unenforceable, and more or less intimated that they wouldn't waste time and effort by even trying to enforce it. But the Bill became law even so.

Now, in the state of California at least, a new realism has dawned. The Public Utility Commission there now requires all cellular phones to be labelled to warn users that their conversations are not private. The Commission found that most cellular phone users had no idea that they could be overheard on even an old TV set.

Robert A. Hanson, writing in the October 1987 issue of the US magazine *Popular Communications*, points out that a cellular telephone salesperson claiming that "federal law protects cellular privacy" doesn't make privacy a fact. In fact, the ECPA, far from achieving the Cellular Telephone Industry Association's desire of securing the prevailing public impression that "a phone is a phone", has focused a very bright spotlight on the lack of cellular phone privacy. Many people who use cellular in the USA for important business deals or other matters requiring privacy are shocked by the revelation that they are actually broadcasting on an ordinary f.m. transmitter. A typical reaction is that, "I've stopped using cellular except for the most casual conversations. I really question whether cellular is worth having any more."

This idea that conversations using radio links are somehow private extends even to CB users. A few years ago, I heard two locals on 27MHz who were shocked to discover, following a comment from another station "on the side", that their discussions could be overheard. They seemed to think that shifting off the calling channel onto a working channel conferred some magical power by which they could be heard by no-one but each other!

As I mentioned in October 1986 *PW*, i.c.s are available for incorporation into cordless and cellular phones, which will encrypt speech signals using a digital time division multiplexing system. The solution to the problem will be for all these instruments to use such a system, which would certainly secure them against accidental reception, and will also defeat all but the most sophisticated intentional listening.

Labelling cellular and cordless phones with the modern-day equivalent of the wartime "Walls have ears" posters is a step in the right direction, at least making users aware of the problem, but the real solution is the addition of some rather more modern technology.

In the UK, too, a new realism is dawning in some quarters. Reading a British Telecom International brochure describing the Maritime "Data over VHF Radio" service for offshore sailors, I was impressed to see the following statement, under a heading "Security at Sea", "Radio frequencies are entirely within the public domain and voice transmissions of a confidential nature clearly run certain risks. A considerable reduction in the risk of interception is one of the many benefits of data transmission over conventional means of communication." Obviously it's part of a sales drive for the new Data service, but the BTI Coast Stations still provide and sell the traditional v.h.f. voice services too. Full marks, BTI, for warning the customer about the problem! ***Geoff Arnold*** and that anyone too lazy or incapable of learning the code has no right on the amateur bands—h.f. or otherwise. Perhaps the next thing will be demands to scrap the RAE because it, too, has no bearing on amateur radio.

R. N. Bell
Reading

Database

I have been reading *Practical Wireless* for just over a year with interest. In your lists of stations you make a long story of changes to wavelengths, times of broadcasts and so on.

I would have thought there would be a call for these lists to be put on tape or microdrive for all these amendments. After all, that is what computers are for, to call up the answers.

J. F. Richards
Reading

We don't know of anyone that produces a computer database of broadcast station frequencies and schedules for distribution to enthusiasts, though organisations like WRTH *are now keeping their own records on computer.*

For the listening enthusiast, whether a computer database would be the best way of holding the data will depend on the particular interest and way of working. For some applications, a card index or a book can still beat a computer hands down for speed and convenience of reference.—Ed.

Another Bouquet

Whenever I read one of the radio magazines, there is always someone complaining about this, complaining about that. What about a compliment for a change?

Late one Friday night (10.30pm), I rang Spectrum Communications to place an order for a kit, and got an answerphone. Fine—I gave my name, address, charge card details and what I wanted, and then waited about a week. Nothing!

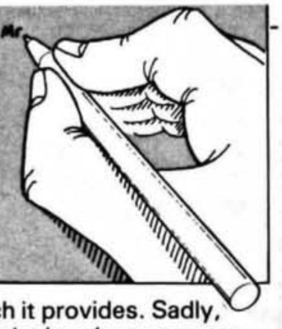
I rang them again after 4pm one Monday, and spoke to a very pleasant young lady who apologised for the delay, due to their answerphone having gone wrong. I gave her all the details and she promised the order would be in the post first thing on Tuesday, and should be with me within a few days. It arrived first post on the Wednesday. All I can say is "Thank you Spectrum, for a very fine service".

C. Horwood G1NPK
London E11

PS: I only hope I can build it now!

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*.



The London 2m Repeaters

I am concerned that the London 144MHz repeaters are bringing amateur radio into disrepute. Any repeater is vulnerable to abuse, of course, and this must be weighed against the utility which it provides. Sadly, with the London repeaters, the balance seems to lie in favour of the abusers.

The nature of this abuse ranges from mere vulgarity to the extremes of obscenity, blasphemy, racial insults and personal vilification. Vendettas are quite common, taking forms which vary between persistent jamming and off-the-air dirty tricks. Although some of the offenders are anonymous "pirates", many give their callsigns without fear.

Do these repeaters serve the legitimate interest of amateur radio? I doubt it, and believe that the argument for closing the London repeaters is very strong.

J. Winsor G1XYC
London SE20

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

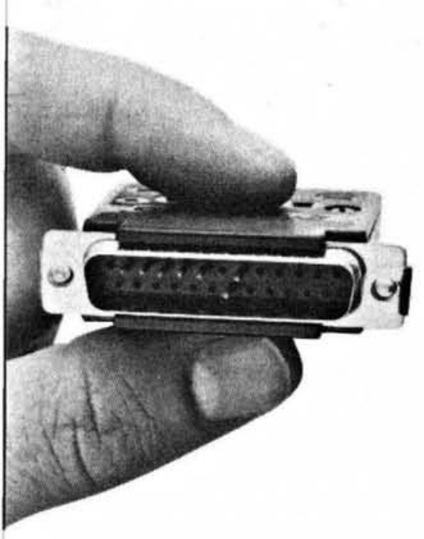
Orders for p.c.b.s, back numbers and binders, *PW* computer program cassettes and items from our Book Service, should be sent to **PW Publishing Ltd., FREEPOST, Post Sales Department, Enefco House, The Quay, Poole, Dorset BH15 1PP,** with details of your credit card or a cheque or postal order payable 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 40 of this issue. Airmail rates for overseas subscriptions can be quoted on request.

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



Loopback Plug

The RS232 Loopback plug, available from Inmac, is a quick way to check the performance of an RS232 terminal, MODEM, multiplexor or transmission line without the need for a breakout box.

It works by interconnecting pins 2 to 3, 4 to 5, 6 and 8 to 20 to verify data transfer. Male and female versions are available at a cost of £12 each.

Inmac (UK) Ltd., Westerly Point, Market Street, Bracknell, Berks RG12 1EW.

Eisteddfod 1988

The Newport ARS will be running GB1ECC on v.h.f. and GB2EC on h.f. Both stations will count towards the award. Short wave listeners can claim the award for hearing the required number of stations, the details must include the date and QSO number heard.

MARS AGM

At the AGM of the Midland Amateur Radio Society they elected a new committee. In the photograph you can see the new club President, Peter Haylor G6DRN, being congratulated by Stewart Laing G8ODT, the retiring President.

The club now has a committee of 11 and 6 club officials. If you would like to know more about the club and their meetings, then contact:

Tom Brady G8GAZ, MARS Publicity Manager, 57 Green Lane, Great Barr, Birmingham B43 5LE.

Can You Help?

A. Pinnington has a CR100/B28 receiver and would like to know if anyone has a manual for it. A list of components would be useful too. If you can help, contact Mr Pinnington at 73 Overchurch Road, Wirral, Merseyside L49 4NW.

Bill Barrett has a combined s.w.r. and power meter manufactured by Oskerblock Electronic Eng. Co. Ltd. of Tokyo. The model number is SWR200-B. Does anyone have any information about this equipment? Write to Bill Barrett, Stevina, Ludchurch, Narbeth, Dyfed SA67 8JF.

Another reader is looking for information on mods for the SX-200 scanner, the Philips PL-2999 and the Yaesu FT-290R. If you can help, then write to Jimenez. Hotel Balj, 29630 Benalmadena, Spain.

Rally Calendar

January 31: The Belle Vue/Norbreck radio rally will be held in Norbreck Castle Hotel Exhibition Centre, Queens Promenade, North Shore, Blackpool. Doors open at 11am and admission is £1, OAPs 50p and under 14s free. Many large traders will be there as well as many lesser known specialists. There will be a bring and buy stand, RSGB Morse tests and Talk-in on S22. There is ample free car parking. ***Peter Denton G6CGF 051-630 5790.***
March 6: The Barry College of Further Education Radio Society are holding their 8th radio rally at the Barry Leisure Centre. The doors open at 11am (10.30am for the disabled). Many trade stands will be there as well as the usual bring and buy as well as an RSGB book stand and Morse testing facilities. The Leisure Centre facilities (swimming pool), licensed bar and cafeteria) will also be available. ***Mike Adcock GW8CMU on 0446 711426.***
March 13: The Bury Radio Society are holding their annual "Hamfeast" at the Castle Sports Centre, Bolton Street, Bury. More details from ***C. D. W. Marcroft G4JAG, Bury RS, Mosses Community Centre, Cecil Street, Bury.***
March 13: The 3rd Wythall radio club rally will be held at Wythall Park, Silver Street, Wythall. It's south of Birmingham on the A435, 3km from Junction 3 on the M42. The doors open 12 noon. There will be the usual trade stands, RSGB Morse tests, flea market, free parking and Talk-in on S22. Admission is 50p but OAPs and accompanied children free. ***Chris G0EYO on 021-430 7267.***
March 20: The 1988 Cambridgeshire Repeater Group Junk Sales Rally Extravaganza will be held at the Philips RCS (Pye Telecom) Canteen, St Andrew's Road, Chesterton, Cambridge. Doors open at 10.30am The day features trade stands, the monster junk sale auction and the bring and buy. Refreshments will be available and there is ample free car parking. All proceeds from the event go to finance the Group's repeaters.
June 5: The Bolton ARC are holding their rally at the Deane Sports Complex, New York, Bolton. The newly built complex is complemented by excellent access from the motorway network, and offers full catering, parking and disabled facilities including lifts to the main areas and a licensed bar. More details from ***D. Bates G6HFF, 3 Braemar Gardens, Bolton Greater Manchester BL3 4TU.***
July 31: The Scarborough ARS Mobile Rally will be held at the Spa, Scarborough. Doors open 11am. As well as traders there will be a licensed bar and cafeteria facilities. More details from ***I. G. Hunter G4UQP on 0723 376847.***
September 18: The Bristol Radio Rally will take place at the Historic Bristol Old Station located at Temple Meads in central Bristol. More details from ***D. S. Farr G4WUB on 0272 839855.***

Drillboy

For those who still believe in "chassis bashing" one of the biggest problems is the front panel. Even if you buy a ready-formed box, you still need to drill holes for the various controls.

Electronic & Computer Workshop Ltd have a gadget that sounds very useful. It fits to almost any popular electric drill and ensures that the drill is kept at 90 degrees to the work. It is a spring-loaded guide that will grip firmly onto most surfaces—flat, curved and angles.

Drillboy also has the advantage of collecting and holding the waste material—sawdust, metal swarf, etc., from the drilling operation.

The all-in mail-order price direct from ECW, including P&P and VAT is £8.95.

Electronic & Computer Workshop Ltd. Unit 1, Cromwell Centre, Stepfield, Witham, Essex CM8 3TH.

Desoldering Pump

Cooper Tools have introduced two anti-static models to their Weller manual desoldering pump range.

They come with either a fine (1.9mm) or general (3.2mm) anti-static nozzle and both allow one-handed operation. When used in conjunction with a soldering iron, they remove, by suction, all the solder around components requiring replacement on circuit boards.

Cooper Tools Ltd,
Sedling Road,
Wear,
Washington,
Tyne & Wear NE38 9BZ.

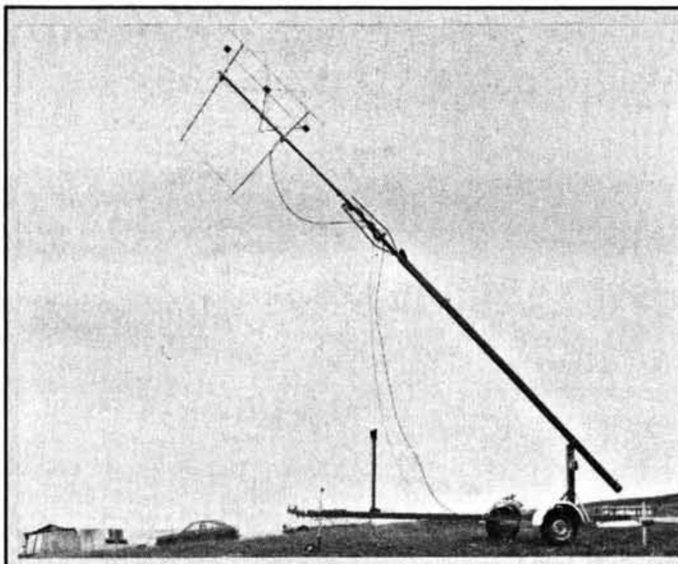
Conductive Silver Epoxy

The Silverfast 650 silver filled epoxy adhesive has the excellent electrical properties of pure silver and is simple to mix and apply for all types of electrical bonding.

Supplied as a two-part (resin and hardener) adhesive, Silverfast 650 is mixed using equal volumes or weights of each part. Once mixed, working life is from one to two hours. Curing time is 24 hours at room temperature or two hours at 60°C.

Applications for the epoxy range from bonding heat-sensitive components to p.c.b.s to waveguide plumbing.

More details from:
Silverfast Ltd.,
Anglia Microwaves Ltd.,
Radford Business Centre,
Radford Way,
Billericay,
Essex CM12 0BZ.



Tennamast

You may recall the name Tennamast from a few months back when we published our QRP Contest Results. They were the company who sponsored the Scottish award.

For those of you who don't know, they make wind-up and tilt-over masts. They have many different types available, as their catalogue shows, but they can always build specials to order.

If you want more information you can write or telephone, they have a 24-hr answering service.

Tennamast (Scotland),
81 Mains Road,
Beith,
Ayrshire KA15 2HT.
Tel: 05055 3824.

From the AGM

The 1987 Annual General Meeting of the RSGB on December 5 was attended by 193 members. Among interesting points to emerge from discussion of the accounts for the year ending 30 June 1987 were: book sales were down 20 per cent in volume; the recent large increases in book prices were currently under discussion by Council; the Morse Test operation had yielded an income of around £20 000 against costs of about £15 600; the recent mailshot to non-members had cost about £5000, and had produced some 950 new members.

The Extraordinary General Meeting which followed approved two changes to the Society's Articles of Association. The first now allows a member to instruct a proxy-holder how to vote on individual resolutions. The second requires a candidate for Council who will have reached the age of 70 before the end of his or her term of office to state that fact on the ballot paper.

The Open Forum discussions which concluded the meeting included the following topics:

1. The future of the hobby, and the likely effect of the proposed "Student" licence on recruitment of new blood. Discussions with the DTI and other interested parties such as Scouts and educational bodies were continuing. The net increase in UK Amateur Licences during the 12 months to June 1987 had been only 60.
2. The revised form of UK Amateur Licence was still under consideration by the DTI. Mid-1988 was the current target date for completion, and full UK participation in the CEPT (European) Amateur Licence arrangements was expected to follow.
3. A proposal for overcoming the QRM suffered by RSGB 144MHz Slow Morse transmissions in the London area was currently under consideration by the VHF Committee.

It was announced that the 1988 AGM would be held on Saturday, December 10. The idea of holding AGMs outside London was discussed, and not surprisingly met with a mixed response. Wherever they may be held, the check-in procedure needs to be streamlined drastically compared with this year. To take 25 minutes to transit the queue up the front steps and across the foyer of the IEE building, as I did at this year's meeting, is not really on!

G3GSR

Transformers

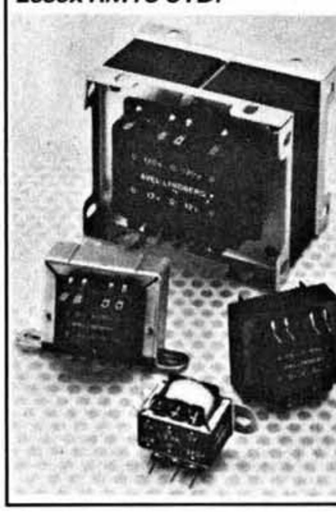
Avel-Lindberg are marketing a range of stacked lamination transformers with secondary load ratings of 1.2, 3, 6, 12 and 20VA.

This new range have completed-item plating of the bright zinc and passivated clamp mounting, where appropriate, p.c.b. tags plated to BS2011, fine winding wires skeined to the tags for extra mechanical strength and an optional insulated terminal cover which gives mechanical and electrical protection on the clamped versions.

The range is designed to operate at full rating at 25°C and with a maximum temperature rise of 55°C.

The twin primary windings of 0 to 120V, can be series or parallel connected, operate from 50 to 60Hz. The numbers of turns on the secondary windings are very accurately controlled by electronic digital counters which ensure a correct voltage balance for the twin 3.0, 4.5, 6, 9, 12, 15, 17.5, 20 and 24V windings which can be series, parallel or independently connected.

More details from:
Avel-Lindberg Ltd.,
South Ockendon,
Essex RM15 5TD.

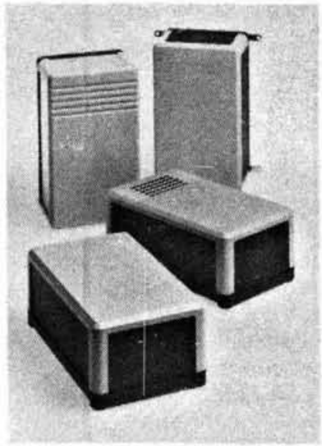


Enclosures

A versatile range of small electrical/electronic housings has been launched by West Hyde Developments.

The Elesett case range is moulded in a two-tone grey colour scheme in high-impact polystyrene. The side and end panels come in either polystyrene or anodised aluminium. They are removable and completely flat for ease of machining or printing. The plastics panels are reversible to provide an additional choice between recessed or flush external surfaces.

As an extra feature, the top moulding offers a choice of a plain surface or shallow grooves. Small ventilation



louvres in the top and base are a further option.

West Hyde Developments, 9-10 Part St Ind Estate, Aylesbury, Bucks HP20 1ET.

BARTG

At the recent AGM, the subscription rates for the membership year of 1988 were set at:

UK	£8.00
Europe	£11.00
Overseas surface mail	£11.00
Overseas air mail	£16.00

The 1988 membership years runs from January to December. All members will receive 4 copies of *Datacom*, BARTG's quarterly journal, which usually runs to 100+ pages.

BARTG is the specialist interest group for those interested in using amateur radio with teleprinters, facsimile,Packet and AMTOR.

BARTG. Mr and Mrs Beedie, Ffynnonlas, Salem, Llandeilo, Dyfed SA19 7NP.

Coaxial Antenna Switch

The CAS-A2 remote coaxial antenna switch has been designed and manufactured in the UK to enable the remote switching at the masthead of two antennas from one feeder.

The unit is fully weatherproofed and uses Greenpar silver-plated "N" type connectors. It has a low insertion loss and may be used up to 1000MHz with a maximum power of 150W p.e.p.

The unit requires 11-14V d.c. fed by a supply wire through a fully r.f. decoupled d.c. input to the relay.

The price for the unit is £59.95 from:

Nevada Communications. 189 London Road, North End, Portsmouth, Hants PO2 9AE.

Coaxial Connectors

Greenpar are producing fully crimped versions of their 50Ω sub-miniature coaxial connectors.

These connectors feature crimp retention of both braid and contact for a fast, consistent and reliable termination. The new parts are available as plug, jack and bulkhead jack and they conform to the standard SMB specifications.

Also available in SMB and SMC versions are low profile elbow connectors which have a solder centre contact and crimped outer.

The standard finish is a gold plated or bright nickel plated body with gold plated centre contacts. New data sheets are available, showing part numbers, dimensioned outline drawings, performance data and step assembly instructions.

More details about these connectors from:

Greenpar Connectors, Cambridge Road, Harlow, Essex CM20 2ER.

AX.25 TNCs

Siskin Electronics have announced two more AX.25 terminal node controllers from Pac-Comm.

The Tiny 2 is a new low-cost TNC designed for use on v.h.f. and u.h.f. at a speed of 1200 baud. It uses standard TNC-2 ROMS and so is capable of being used for NET/ROM, TCP/IP, etc.

Its main features are: 32K RAM and 32K ROM standard, latest 1.1.5 software, extruded aluminium case only 127 × 178mm, supports RS-232 and t.t.l. computers and needs 12V d.c.

The Tiny-2 is being introduced at a special price of £99.95 inc VAT (plus P&P).

The Micropower-2 is a very low power TNC drawing only 40mA at 9-13V d.c. It is small and lightweight (127 × 178 × 35mm and 624g) and is perfect for portable or solar power operation! It is similar in features to the Tiny-2, but built and tested to a higher specification, with additional options available early this year. The Micropower-2 is £159.95.

Siskin Electronics. PO Box 32, Hythe, Southampton SO4 6WQ.

Soldering Stations

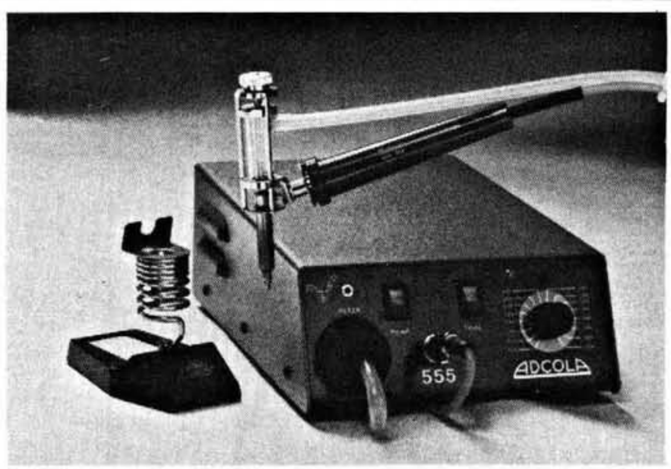
Adcola have added to their range of soldering stations. The 151 had an l.e.d. temperature read-out. Adcola claims that this visual indications is of the actual tip temperature and is accurate within ±2 per cent.

As with all Adcola equipment, it is available in the FumeX form. This is a system for removing soldering iron fumes from the tip of a soldering iron.

For full information, Adcola will supply a Hand

Soldering Catalogue.

Adcola Products Ltd, Adcola House, 113 Gauden Road, London SW4 6LH.



Desoldering Station

The Adcola 555 desoldering station has a heating element in the tip which gives a uniform temperature throughout its length. This, coupled with the use of a diaphragm pump, should get over the problems of continual tip blockages sometimes suffered when doing lots of desoldering.

The 555 normally requires a 5A 240V supply, but is available in 110 and 220V versions.

Adcola Products Ltd. Adcola House, 113 Gauden Road, London SW4 6LH.

CQ-TV Award

This award is available to both transmitting and receiving enthusiasts, in any part of the world, whether they are members of the BATC or not.

The award is for contacts made using fast-scan high definition television systems only.

The **Transmitting Award** is available for pictures transmitted which have been successfully identified by another station. Two points may be claimed per kilometre. If the contact becomes a successful two-way exchange of pictures, then 10 bonus points may be claimed by each station regardless of distance. For contacts on the 1.3GHz band or above, points are doubled.

The **Receiving Award** is available for any picture positively identified—claim for a one-way contact. Otherwise the rules are as for the transmitting award.

The points are divided into five grades. **Bronze** for 1000 points. **Silver** for 5000 points. **Gold** for 10 000 points and **Diamond** for 100 000 points.

Points gained for an existing award may be added in when applying for a higher grade.

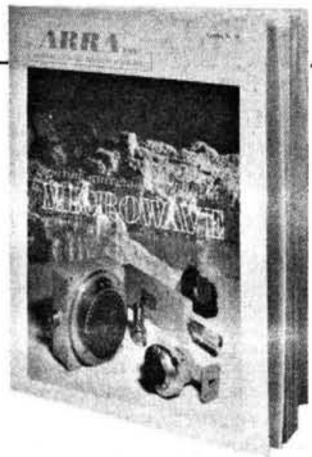
A station may be worked only once per day for the purpose of this award, but it is quite possible for it to be gained by working the same station many times. Contacts through TV repeaters do not count.

Upon qualification for the Bronze award, a certificate will be issued together with a Bronze seal. The certificate may be up-graded later with silver and gold seals. The Diamond Award is in the form of a specially made trophy.

Applications should include log details consisting of callsign, date of QSO, band, location of the station worked and points claimed. Contacts made from other than the home station should be clearly marked. QSL cards are not required, but the application should be checked and signed by either a licensed amateur or a BATC member.

Certificate applications should include a large (12 × 8.5in) s.a.e. Applications to:
Awards Manager,
Mike Wooding G6IQM,
5 Ware Orchard,
Barby,
Nr Rugby CV23 8UF.

Catalogues



We have received a copy of the Solex catalogue this month. It's full of laboratory, test and measuring equipment. Products range from Thandar logic probes at about £21 each to Soar cable length checkers at about £550. If you would like more details, contact:
Solex International,
44 Main Street,
Broughton Astley,
Leics LE9 6RD.

A greatly expanded selection of phase shifters and wide-band couplers feature in the latest edition of the Arra (Antenna and Radome Research Associates) microwave device catalogue. It is now available from the UK distributor, Anglia Microwaves Ltd.

More details from:
Anglia Microwaves Ltd.,
Radford Business Centre,
Radford Way,
Billericay,
Essex Cm12 0BZ.

Signal Generator

STC Instrument Services now offers the compact Marconi 2022C signal generator. This has frequency, phase and amplitude modulation over a wide frequency range from 10kHz to 1000MHz.

It is designed for use in maintenance, service applications, production and education. The unit features microprocessor control which enhances the speed of operation via direct keyboard entry of the required settings. A non-volatile memory which stores up to 100 settings further reduces measurement time.

For further details, contact:
STC Instrument Services,
Dewar House,
Central Road,
Harlow,
Essex CM20 2TA.

Blank Tape Levy

A few months ago we reported that a blank tape levy was being discussed in Parliament. Now we have received a press release from the IFPI (International Federation of Phonogram and Videogram Producers).

"The British Government has made a hasty and unprincipled *volte face* in deciding to retain the existing law on home taping of pre-recorded music. This will perpetuate an anomalous state of affairs and in the view of many will be in breach of the UK's obligations under the Berne Convention to protect the rights of copyright owners."

Micro-ohmmeter

Megger Instruments Ltd have introduced the Ducter D203 to their range of low resistance ohmmeters.

This new addition automatically compensates for thermal e.m.f. effects, which means that readings are faster and more accurate.

The eight full-scale ranges, from 199.9μΩ to 1999Ω, give resolution down to 0.1μΩ on the 3.5 digit l.c.d. display. The unit can be operated from either mains supplies or internal rechargeable batteries.

Megger Instruments Ltd.
Archcliffe Road,
Dover,
Kent CT17 9EN.

Derby 144MHz Contest

Following their successful first DADARS 144MHz contest, the club have decided to repeat the event this year. Briefly, the rules are:

Date: 13 March 1988
Time: 1300 to 1700UTC
Mode: Any mode, but band plans must be observed. Fixed, /A and /P all permitted.
Exchange: Callsign, RS(T), serial number (starting 001) and administrative county.
Scoring: G3ERD = 10 points, all others score 2. Final score is number of points by number of counties. Each country outside UK counts as a county.
Logs: Must be sent to Derby & District ARS, 119 Green Lane, Derby DE1 1RZ by March 30.
Awards: (1) Full legal power, (2) Low power—30W max output and (3) s.w.l. Specify whether single or multi-op.

If you require a full list of the rules, send an s.a.e. to the club.

PW REVIEW

On first making the acquaintance of the Icom IC-761 "top of the line" transceiver, at the Birmingham National Exhibition Centre during the April 1987 RSGB Exhibition, Ken Michaelson G3RDG was frankly rather overawed by the sheer size of it. Having tested it at his home QTH, he found it to be a thoroughly workmanlike unit, and tells us about his impressions of it. The test measurements were made in the PW *lab by Geoff Arnold G3GSR.*

The IC-761 is an all-mode multi-purpose base station h.f. transceiver incorporating a general-coverage receiver. It contains everything including the power supply. There is a built-in antenna tuner, the Icom IC-CR64 special high stability crystal unit which uses a temperature compensating oven heater and provides a frequency stability of better than ±100Hz between −10° and +60°C, and for the c.w. man, full as well as semi break-in. Automatic keying is also available with the simple connection of an iambic paddle.

An RTTY mode caters for both RTTY and AMTOR. The only snag about this is that it is impossible to use f.s.k. with the European tones of 1275 and 1445Hz. The IC-761 is set up to respond to the tones used in the USA, what I call the "high" tones of 2125 and 2295Hz. Of course, one can use a.f.s.k., injecting the tones into the rig via the microphone socket, but when this option is employed the c.w. filters cannot be used. There is a "narrow" setting of the existing RTTY tones using the filters, but this also operates at 2125/2295Hz. The point about all this is that pretty well all modems available in the UK are designed to respond to the European tones, and will not respond to 2125/2295Hz. I do not know what modification, if any, is available for the IC-761 to lower the frequency for those of you who wish to operate f.s.k.

The Manual

Reading the manufacturer's specifications reveals only the bare bones of the unit; actual operation puts flesh on the bones. First, however, a thorough inspection of the Instruction Manual is necessary. I have commented before on the excellent quality of the printing of Icom manuals and the amount of clearly given information available. This one, comprising 68 A4 (210 × 297mm) pages plus circuit and block diagrams, is no exception.

The manual begins with an exploded drawing of the front panel controls, with the function of each clearly labelled, plus a reference to every page where you will find further information about that particular knob, button or indicator. The rear panel connectors are similarly dealt with in another drawing.

The following pages carry more detailed descriptions of each feature, and alongside each one there is a small drawing of the front or rear panel in dotted lines, with the item under discussion picked out in heavy black lines. Further sections deal with installation, system interconnections, general operation and antenna tuner operation, functions operation, memory and scanning operation, circuit description, maintenance and adjustments, and finally, installing options. A number of internal views identify major components and preset adjustments.

Control

The IC-761 has 32 memories which store both frequency and mode. It can be linked to any computer having an RS-232 socket, by using the serial port on the rear panel and the CI-V remote control interface which is fitted as standard. This facility enables a computer to control frequency, mode, VFO A/B selection and memories. The transceiver's operating system is held permanently in ROM and is not dependent on the lithium battery, which is used only for memory back-up.

I think that the tuning knob is really the heart of operating a transceiver, and the control on the IC-761 in my opinion makes the rig. It is beautifully smooth and has a soft-touch rubber ring around it, which adds to the pleasure of operation. There is also the facility of an adustable friction brake, by which means the operator can alter the "drag" to suit his or her preference. I have commented on the smoothness of the Icom tuning knobs in past reviews, and I think that other manufacturers could well learn something from Icom in this regard.

The tuning knob has three rates of frequency change. When turned relatively slowly, the frequency changes in 10Hz steps, but turning the knob faster

★ MAKER'S SPECIFICATIONS

TRANSMITTER

Frequency coverage:
1.8 – 2.0MHz (160m)
3.45– 4.1MHz (80m)
6.95– 7.5MHz (40m)
9.95–10.5MHz (30m)
13.95–14.5MHz (20m)
17.95–18.5MHz (17m)
20.95–21.5MHz (15m)
24.45–25.1MHz (12m)
27.95–30.0MHz (10m)

RF power output: a.m.: 40W max.
c.w./f.m./RTTY: 100W max.
s.s.b.: 100W p.e.p. max

Carrier suppression: More than 40dB below peak output

Unwanted sideband: Better than −55dB with 1kHz a.f. input

Spurious emissions: More than 60dB below peak output

Microphone: Impedance 600Ω

Deviation (f.m.): ±5kHz max.

RTTY shift: 170Hz, 850Hz

RECEIVER

Frequency coverage: General coverage: 100kHz–30.0MHz Ham bands (as for Transmitter)

Intermediate frequencies: 70.4515MHz, 9.01MHz, 455kHz, 9.01MHz*
*not used on f.m.

Sensitivity: Input in μV for 10dB S/N with pre-amp ON less than:

Mode	100 to 500kHz	0.5 to 1.6MHz	1.6 to 30MHz
s.s.b./c.w./RTTY	0.5	1.0	0.15
a.m. (Narrow)	3.0	6.0	1.0
f.m. (for 12dB SINAD)	0.3 from 28–30MHz		

Squelch sensitivity: Less than 0.3μV

Selectivity: (−6/60dB)

s.s.b. (filter switch on)	2.4/3.8kHz
c.w./RTTY (filter switch on)	500/1000Hz
a.m.	6/18kHz
f.m.	15/30kHz

Notch filter: Better than −45dB

RIT variable range: ±9.9kHz

Audio output: More than 2.6W into 8Ω with 10% t.h.d.

ANTENNA TUNER

Output matching range: 16.7–150Ω unbalanced

Minimum power output: 8W

Band switching time: 3 seconds or less

Auto tuning time: 3 seconds or less

Auto tuning accuracy: To v.s.w.r. 1.2:1 or less

Insertion loss: 0.5dB or less (when tuned)

GENERAL

Antenna impedance: 50Ω unbalanced (tuner off)

Power requirements: 200–240V a.c.
650VA max. transmit
80VA max. receive

Frequency stability: Better than ±100Hz in the range −10° to +60°C

Dimensions: W424 × H150 × D390mm excluding projections

Weight: 17.5kg

★ PW LAB TESTS

TRANSMITTER

Outputs in c.w. mode:

Freq. (MHz)	Max. Output (W)	Spurious outputs at 100W (dBc)			
		Harmonics			Other
		2nd	3rd	Higher	
1.81	110	−60	−67	—	—
3.51	115	−68	−66	—	—
7.01	120	−70	—	—	—
10.11	120	−63	−64	—	—
14.01	120	−60	−66	—	—
18.11	120	—	−62	—	—
21.01	120	—	—	—	—
24.91	120	—	—	—	—
28.01	115	—	—	—	—
29.01	115	—	—	—	—

Notes: dBc = dB referenced to carrier.
— = better than −70dB.

2-tone Intermodulation products:
(100W p.e.p. at 14.1MHz using 700 and 1900Hz tones)

Wanted signals	0dBc
3rd order products	−45/−45dBc
5th order products	−44/−46dBc
7th order products	−47/−46dBc
9th order products	−48/−48dBc

Carrier suppression: 46dB (1kHz modulation)

Unwanted sideband suppression: −70dB (1kHz modulation)

Audio response (s.s.b.): 280–2550Hz (−3dB)

Maximum deviation (f.m.) 5kHz

RECEIVER

Sensitivity: (input p.d. in μV for 10dB S+N/N with pre-amp in circuit and Filter switch in Out position)

Freq. (MHz)	c.w./ s.s.b.	a.m. (70% mod)	f.m. (3kHz dev)	Input for S9
1.81	0.13	0.41	—	27
3.51	0.12	0.34	—	24
7.01	0.14	0.34	—	23
10.11	0.11	0.33	—	19
14.01	0.12	0.35	—	24
18.11	0.13	0.39	—	24
21.01	0.13	0.32	—	24
24.91	0.11	0.38	—	21
28.01	0.09	0.31	—	20
29.01	0.10	0.57	0.21*	20

Note: * = for 12dB SINAD

Blocking dynamic range (s.s.b.): (single signal, 20kHz off-channel) 110dB

Dynamic range (s.s.b.): (two-signal)

Signal separation from carrier (kHz)	Dynamic range (dB)
20/40	86
50/100	108

Squelch threshold: 0.9–460μV (f.m.)

S-Meter calibration: (at 14.01MHz u.s.b.)

Reading	Input required	
	μV p.d.	dBμV
S1	1.13	1.0
S2	1.36	2.7
S3	1.72	4.7
S4	2.27	7.2
S5	2.96	9.4
S6	4.5	13
S7	7.3	17
S8	13	22
S9	23	27
S9 + 20dB	244	48
S9 + 40dB	2.2mV	67
S9 + 60dB	14.1mV	83

Image and i.f. rejection: Better than 88dB

AGC threshold: 1dB gain reduction threshold 1.1μV (s.s.b.)

RF attenuator: 22dB at 14.01MHz

Pre-amplifier: 8dB at 14.01MHz

Selectivity: (−6/60dB)

c.w.	0.50/1.0kHz
s.s.b.	2.1/3.4kHz
a.m.	5.9/16*kHz
f.m.	15.8/24*kHz

* for −50dB

I.F. Notch filter: 52dB

Audio output: 3.1W into 8Ω with 10% t.h.d.

Test equipment used:
2017 and 2019 signal generators, TF2370 spectrum analyser, 2435 frequency meter, TF2304 modulation meter, TF2337A distortion and SINAD meter, TF2005R two-tone generator, TF893A power meter, TF2163S attenuator, all by Marconi Instruments; Bird Model 43 r.f. power meter plus power attenuators; Hatfield Instruments signal combiner.

increases the steps to 50Hz. The third option is brought into operation by pressing the TS (tuning speed) switch, which increases the steps to 1kHz, ideal for moving rapidly up or down the band.

There are three other ways of changing frequency, the first of which is by use of the UP and DOWN keys. In the HAM BAND mode, these keys step between the amateur bands, going to a preset "initialisation frequency" in each band. In the GENERAL COVERAGE mode, the tuned frequency changes in 1MHz steps. In both modes, the band change "rolls over" to the opposite extreme of the frequency coverage when the upper or lower limit is reached.

The second tuning method is to enter the required frequency directly, using the keypad to the right of the main tuning knob. One can either key in just the megahertz reading, for example "14" for 14MHz—the display will show 14.000.0—or key in the actual frequency required. Frequencies below 1MHz require the "0" key to be pressed first. Having keyed in a frequency, it is activated by pressing ENT to enter, or cancelled by pressing CE (clear entry). The action of the keypad microswitches is very definite and satisfying.

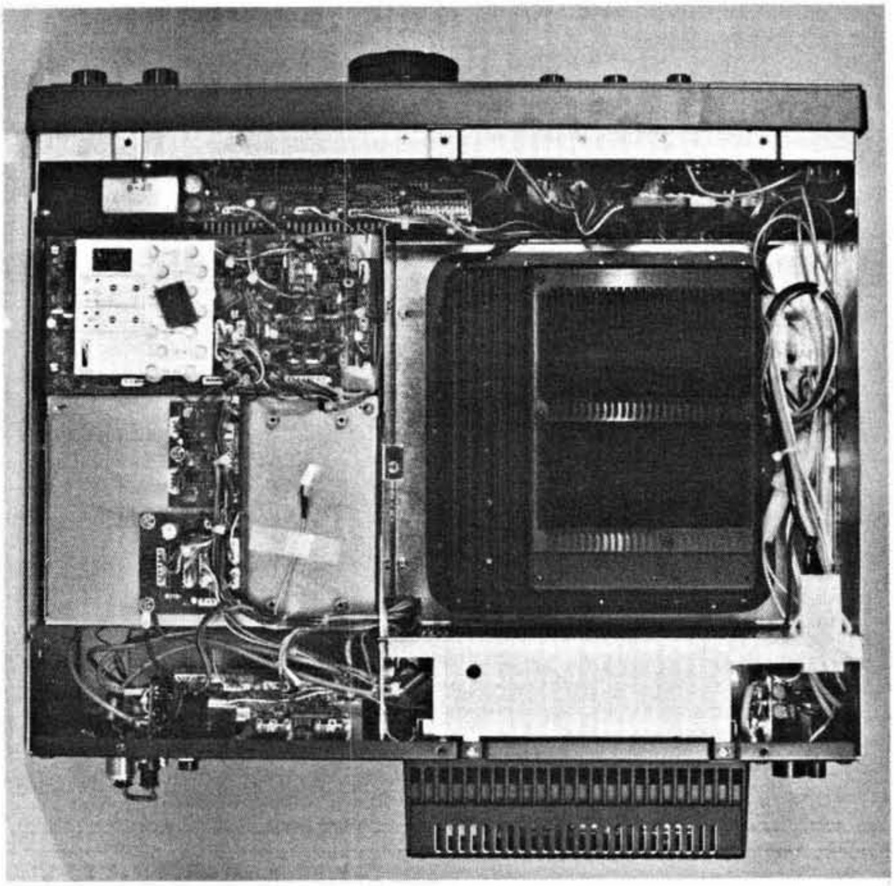
The third tuning method is to use the UP and DOWN buttons on the associated microphone. These change the frequency at the rate of 10Hz for a single press. Sustained pressure on the button results in a continuous change in frequency in the direction selected.

The frequency display, in addition to showing the operating frequency in 10mm-high digits at 100Hz resolution, also includes indication of emission mode, scanning and filter status, r.i.t. and ΔTX offset, v.f.o. in use, split frequency operation, and memory channel selected.

If the optional voice synthesiser board type IC-EX310 is fitted, a touch on the VOICE button will cause the rig to announce the current tuned frequency in a "female" voice. The speed and volume of the speech are adjustable internally.

The various emission modes and the optional narrow c.w. and RTTY filters (if fitted) are selected by means of four MODE buttons and a FUNCTION button. Pressing a MODE button alone selects s.s.b ("normal" sideband—in other words, l.s.b. below 10MHz and u.s.b. above 10MHz), c.w., RTTY or a.m. Pressing the FUNCTION button before a MODE button gives s.s.b. ("reversed" or opposite sideband—u.s.b. below 10MHz and l.s.b. above 10MHz), c.w. narrow, RTTY narrow or f.m.

Different values of receive bandwidth are selected by means of the FILTER switch, using different combinations of internal 2nd (9MHz) and 3rd (455kHz) i.f. filters. At the −6dB points, the bandwidths available are 2.4/2.6kHz on s.s.b., 2.4kHz/500Hz on c.w. and RTTY, 6kHz/2.6kHz on a.m., and a fixed bandwidth of 15kHz on f.m. The optional narrow filters previously mentioned give a further selection of 500Hz/250Hz on c.w. and RTTY.



Combined with the facilities of IF SHIFT and PBT (passband tuning), which as usual with Icom rigs, work like magic, these filters allow a contact to be continued in spite of seemingly impossible QRM.

The transmitter r.f. power output is adjustable from about 8 watts up to the full rated ouput of the transceiver by means of the RF PWR control. The transverter socket on the rear panel gives an output of approximately 30mV.

Scanning

The IC-761 offers three scanning modes, with the option of either having the scanning stop permanently when a signal opens the squelch, or pausing for 10 seconds and then resuming scanning. The three modes are:

1. Programmed scan—the receiver scans between the frequencies entered in memory channels 01 and 02. When in HAM BAND mode, these two frequencies must be in the same amateur band.

2. Memory channel scan—the receiver scans every memory channel having frequency information programmed into it, but skips blank channels.

3. Selected mode memory scan—the receiver scans every memory channel containing frequencies with the same emission mode as the displayed frequency.

Operation

The antenna system at this QTH is by no means an elaborate one, being just a compressed 80m dipole. It is fed with 4.5 metres of 300Ω ribbon, changing to 50Ω coaxial cable for the remainder of its run to the shack. The antenna is really a little short for my favourite part of the 3.5MHz band, but with the aid of a KW109 Supermatch it is possible to get a 1:1 v.s.w.r. reading. I was therefore very interested to see how the automatic a.t.u. provided in the IC-761 functioned.

To operate it one has to be in RTTY mode, with the RF PWR control at the 9 o'clock position to give about 15W output. Activating the TRANSMIT switch for a couple of seconds was followed by a few clicks and whirrs, and when the tuner had completed its job the s.w.r. reading was about 1:1. The auto tuner does not function in the GENERAL COVERAGE mode or when scanning. This was not a great hardship in my case at least, as the dipole was sufficient to get good signals from most of the available spectrum.

I tried a CQ call on about 3.650MHz l.s.b., and after a few tries back came a station in Littleport, Cambs. We had a pleasant QSO, and the distant station reported that the transmitter audio quality was excellent. Several more satisfactory contacts were made on the same band during the next few hours, and then in the early evening several 'phone QSOs were made on 40m, where the rig's excellent filtering facilities were utilised to the full. The automatic a.t.u. successfully coped with my 80m antenna on this band.

While on 40m, I heard a packet radio station, and connected up my PK-232, micro and monitor to see what it was. In due course, I decoded the station, which turned out to be I2LLO starting a new experimental bulletin board. Quickly arranging various leads, I called I2LLO using a.f.s.k., and received an immediate reply. This proved that the IC-761 would work perfectly on packet, without having to use f.s.k., though I must admit that conditions were quite good at the time.

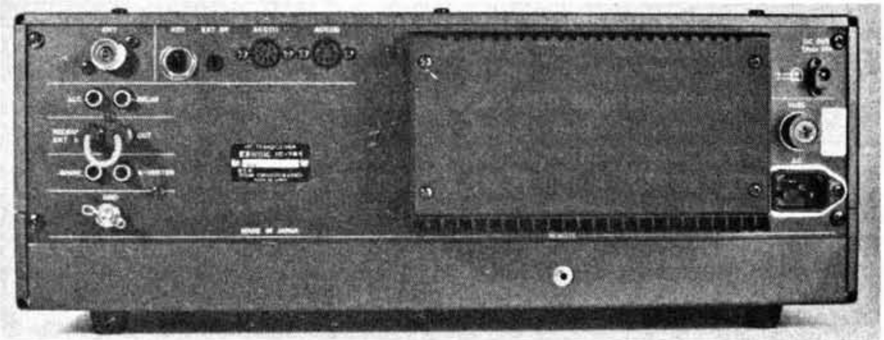
While the leads were connected, I decided to try both RTTY and AMTOR, and contacted G3PLX's mailbox using AMTOR without any trouble on 7.030MHz. It was obvious that the transmit/receive changeover time was sufficiently fast to operate the mode without any modifications being required. I then went on to complete an RTTY contact on 14MHz. The auto a.t.u. also coped with my antenna on that frequency, and although the power output was a little below the maximum, I was given a 599 report.

The performance on the lowest frequencies was very good, sufficient for me to copy the FAX transmissions from the German Meteo station Offenbach on 134.2kHz. Even with the untuned antenna, the signal strength appeared adequate. Using the general coverage receiver on the broadcast bands gave perfect copy on pretty well every station heard, even with my limited antenna.

Conclusions

I could continue at length describing the IC-761. It is a very sophisticated, high-precision unit, giving an impression of silky smoothness in operation. During the short time I have used it, only the top of the many and varied facilities has been touched. It incorporates the best features of the recent Icom designs; the keypad and the rotary memory switching control from the IC-R71/R7000 receivers, together with a clear, unambiguous display area and correctly positioned controls. I would consider that any amateur deciding on this rig would have no cause to change it for a number of years.

The price of the IC-761 is £2459.00 including VAT. Thanks are due to **Icom (UK) Ltd., Sea Street, Herne Bay, Kent CT6 8LD, telephone 0227 363859,** for the loan of the review units. ***PW***



NEWS DESK EXTRA

Mobile Radio Microphone

The new IQD 900 series mobile radio microphone offers both f.f.s.k. encoding and decoding and is particularly suitable for use of Band III. Housed in a telephone style handset, and microprocessor controlled, the unit provides automatic numerical identification and selective calling.

When used with IQD's radio-to-telephone interconnect Smartpatch 5700, the 900 series allows full call-logging. It can also act as a MODEM and, when connected to a mini printer, allows the mobile to receive printout of data sent from the base station.

The microphone is used in a manner similar to a cellular telephone, except that the user presses the p.t.t. before speaking into the mouthpiece. The keyboard allows digits to be entered and stored. These are then sent in a burst of f.f.s.k. on pressing the SEND button. Microphone audio is muted during tone transmission and the microphone element is used as a tone monitor speaker.

IQD Ltd.
North Street,
Crewkerne,
Somerset TA18 7AR.

Digital Multimeter

TMK Instruments model G60 is a fully autoranging digital multimeter with a range hold facility. Results are shown on a large, clear $3\frac{1}{2}$ digit, l.c.d. together with polarity, decimal point, units of measurement, overrange indication and a low battery early warning indicator.

Functions include d.c. volts in five ranges to 1000V with a basic accuracy of 0.5%, a.c. volts in four ranges to 750V, resistance in six ranges to 20MΩ with a switchable continuity buzzer and diode test facility. Current measurement, both d.c. and a.c., is available in two ranges to 10A.

Dual slope integration is the operating principle employed with a measurement sample rate of two per second. All voltage ranges are protected to 1000V d.c. or d.c. plus a.c. peak, and have an input impedance of > 10MΩ, other ranges protected to 250V a.c. and fused.

Harris Electronics (London) Ltd.,
138 Grays Inn Road,
London WC1X 8AX.

Inductors

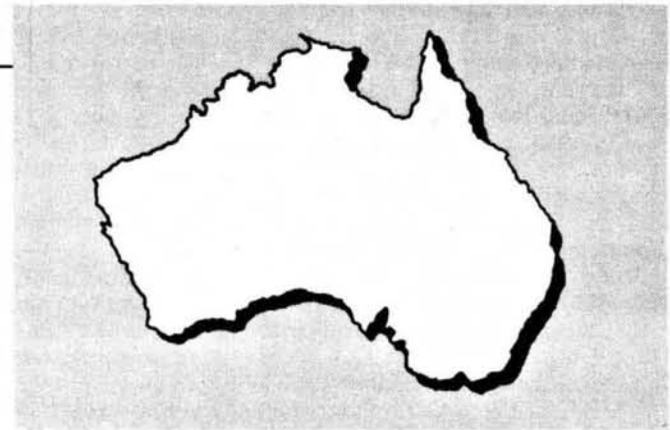
Toko Inc., have announced the introduction of their 43 Series of Chip Inductors. They are available with inductances ranging from 1µH to 1mH with rated currents up to 250mA d.c.

The Toko range have been developed for surface mounting and the structure is such that the function and performance are comparable with inductors currently used in various electronic equipment.

The 43 series are available in two versions for either dip or reflow soldering and packed in trays or reels for automatic insertion. Full technical data and price information can be obtained from:

Cirkit Holdings PLC.
Park Lane,
Broxbourne,
Herts EN10 7NQ.

Amateur Radio in Australia



Here's the next report from Greg Baker, keeping us up to date with the news from Down Under.

Summer is over and good February rains at my QTH seem to have reduced the fire danger somewhat. When you live in the bush, as I do, fires are a constant summer worry and I am always glad when autumn arrives.

Repeaters

VK5RWH, Australia's first 1.3GHz (23cm) ATV repeater became operational in December 1986. With input frequencies of 444.250MHz (vision) and 449.750MHz (sound) and output frequencies of 1246.250MHz (vision) and 1251.250MHz (sound), VK5RWH is installed on Willunga Hill, 40km south of Adelaide. It uses an Alford slot transmitting antenna, and until finances of the Southern Amateur Television Group allow upgrading, has power output of 1 watt. The repeater was needed because the existing Adelaide 430MHz (70cm) ATV repeater VK5RTV gave poor coverage into southern Adelaide.

From September 1986, the Department of Communications (DOC), permitted repeater cross-linking within Australia. In general, up to three repeaters can be interlinked to extend the range and area of coverage of individual operators. In addition, DOC will consider requests to interlink more than three repeaters for Wireless Institute of Austrialia (WIA) regular scheduled broadcasts or for the Wireless Institute Civil Emergency Network (WICEN) during emergencies.

Repeater linking frequencies will be authorised only on amateur bands above 50MHz. Apart from usual repeater licensing conditions, the cross-links will need to be set up so that amateurs are not re-transmitted on bands they are not authorised to use. This provision is to ensure that holders of limited licences who are restricted to 50MHz and over are not retransmitted through 29MHz f.m. repeaters. In addition, provisions have been made to enable repeaters to be permanently or temporarily interlinked to give flexibility at all times.

The first interlinked repeaters will be 144MHz (2m) repeaters in Victoria. The Victorian Division of the WIA, following the disastrous 1983 Ash Wednesday fires, plans to cross link three separate sets of three repeaters in bush fire prone areas to extend the range of emergency traffic. These will be in East Gippsland, 300km east of Melbourne (VK3REG Cann River, VK3REB Nowa Nowa and VK3RGO Omeo), in north eastern Victoria, 250km north east of Melbourne near the New South Wales (NSW) border (VK3RNE Wodonga, VK3RPB Bright, and VK3RNC Corryong), and in north western Victoria, 400km north west of Melbourne, near the NSW–South Australian border (VK3RMA Mildura, VK3RVL Robinvale, and VK3RON Ouyen). VK3RVL is located on top of a wheat silo!

Given the cost of providing mains power to mountain top locations and the relatively high solar radiation incidence in Australia, it is often more economical to power repeaters by solar energy. Typical installations are those of the Glen Innes Radio Club's northern NSW 144MHz repeater VK2RNE and the Swan Hill District Radio Club's Murray River 144MHz VK3RSH.

These systems use solar panels putting out 12 volts nominal regulated into a 12 volt battery bank. VK2RNE uses two Solarex panels, charging at over 5 amps in good conditions, with a locally designed and built regulator and two Century 613PG 110Ah 6 volt home-lighting batteries in series. This is sufficient for the 144MHz repeater and a heavily used co-sited v.h.f. CB repeater. To overcome the problem of electrolyte stratification which arises when stationary cells are continuously trickle charged, the cells are charged at 10 to 15 amps from a generator during regular maintenance perhaps four times a year. This allows the cells to gas and stir the electrolyte.

VK3RSH uses a single panel putting 2.4 amps peak unregulated into a bank of six ex-Australian Telecom 200Ah two volt cells. While these lead acid cells have a high leakage current, they have proved very satisfactory since October 1985 when they were installed. One problem with solar power is, of course, the possibility of insufficient solar radiation to charge the cells either due to heavy usage or to inclement weather. VK3RSH has been no exception, with poor weather closing the repeater on several occasions. Unfortunately, inclement weather also means impassable roads to the repeater, so boost charging from a generator has not been possible. Nonetheless, the choice between a solar-powered repeater with a few days a year out, and no repeater is not really a choice at all. Australia has two solar panel manufacturers, Solarex and BP Solar. The silicon cells themselves are imported, but connected and encapsulated locally. Retail prices are about $A11.50 (£5 at current exchange rates) for the cheapest panes per peak watt (Solarex X100GT 42 watt peak polycrystalline, silicon encapsulated, $A490 (£210), and BP Solar BP1244HP 45 watts peak monocrystalline, ethylene vinyl acetate encapsulated, $A520 (£220)).

My own QTH, though only 300m from an 11 000 volt main, would cost in the vicinity of $A6 000 (£2 600) to grid connect. Given this large outlay, we have chosen to run the house on solar power exclusively, and currently have two interconnectable systems, the smaller as an emergency back up to the larger.

One has 12 GL3641/12 (now BP1238) BP Solar panels putting 40 peak watts into three banks of six series connected Century 227PG two volt cell each of 225Ah capacity. This makes 675Ah at 12 volts. The other system uses one X100G and one X100GT Solarex panel putting about 80 peak watts into another six Century 227PG two volt cells.

Total capacity is thus about 900Ah used for lighting, radio, equipment, television and refrigeration.

Examples and Licensing

The number of licensed amateurs has increased marginally to 16 480 (3010 novice, 2960 limited, 1170 combined, 9240 full call, and 100 beacons), the annual licence fee for full calls has grown to $A26 (£11) and WIA membership fees are up to about $A34 (£14.50) depending on state division.

The licensing debate sparked by Jim VK3PC and Roger VK2ZTB has died down with no changes in sight, to be replaced by discussion on examinations. DOC has floated the idea that amateur organisations become responsible for amateur examinations and licence recommendations to DOC. It has requested comment from amateur clubs, colleges of Technical and Further Education (TAFE), the WIA and the commercial amateur press.

Subject to strict DOC guidelines, educational institutions and amateur clubs would be able to conduct radio certificate examinations, including telegraphy receiving and sending tests at five and 10 w.p.m.

The move to devolve amateur exams is part of a continuing process for DOC, which has already withdrawn from all examination functions except those for amateurs and certain marine operators. Apart from the obvious cost and manpower savings to DOC from such a proposal, they see that prospective amateurs would be able to be given greater choice of examination times, dates and places. At the moment, examinations are only conducted four times per year, during business hours of weekdays, and only in major cities and towns. DOC believes that out of hours examinations would become possible as well as examinations in more centres if their proposal was put in place.

Amateur press debate to date (which no doubt has parallels with the UK experience) hinges around two main points. The first is what role the WIA would play and the second is the issue of conflict of interest.

Debate on the role of the WIA appears to be a continuation of a tussle between members and non-members which has been underway for some years. Many non-members are concerned at what they see as the "big brother" position of the WIA. They fear that if the DOC proposal to hand over the current question bank to WIA goes ahead, WIA will be in a more dominant position with respect to amateurs and prospective amateurs than they are at the moment.

In addition, given the purely voluntary nature of WIA positions and the fact that personnel are stretched to the limit with their current work load, there is the fear that the WIA would not be able to handle examinations in any case.

As regards telegraphy tests, there has also been suggestion in some circles that the WIA is not able to provide sufficient competent or willing operators to conduct c.w. transmitting examinations. In part this could be overcome by recording candidates' Morse transmissions for later marking, and this too would be of help to those in areas remote from examination centres.

Other critics of the proposal see that a conflict of interest could arise if course instructors were to devise examinations or when self-taught non-members front an examination set by an organisation such as the WIA. This is in part a maintenance of standards argument. With many schools and colleges already adjusting pass marks to improve pass rates, whether to attract students or course funding, the fear in some circles is that despite DOC's watchdog role, standards would fall. This is countered by those who suggest that DOC maintain, as it does now, a large question bank that are drawn on by examining bodies, and that completed examination papers be returned to DOC or WIA for marking. Others suggest, on the other hand, that current DOC standards are not strict enough in any case, and that handing over the question bank to WIA would help improve standards.

DOC wants to have the examination question resolved and a new system in place by 1 January 1988.

VK amateurs, s.w.l.s and anyone else with information of interest to *PW* readers can contact me at PO Box 93, Braidwood, NSW, 2622, Australia.

Other News

An Australian company, Captain Communications, have developed a new re-usable, solderless and easy to use PL259 connector. The centre conductor is crimped and the braid and outer sheath are held with a so-called shield lock. Confident that the connector is secure they have challenged anyone to part the connector from the cable. Given that most conventional PL259's are not re-usable and the new Teflock PL259 is at least on the local market, cheaper than imports. Captain Communications are confident of good sales.

And an item from *Amateur Radio Action* magazine on personalised number plates. For an annual fee, some Australian states allow motor vehicle owners to specify their own number plates. In NSW this fee is $A180 (£77) per annum. Currently there are 4 000 such plates, including four amateur call-signs—VK2AGE, VK2AOT, VK2COD and VK2KEW. South Australia apparently does not yet have a system flexible enough to handle VK5 call signs, but authorities are working to allow it in the future.

Vertical Antennas

Vertical antennas are an interesting section of a fascinating subject. Many is the operator, on the 3.5MHz band or elsewhere, who will declare roundly that on the basis of his tests "verticals just don't work!" and will produce some "evidence" in support of his proposition, says P. Newton.

Imagine, if you will, a pin, stuck to a sheet of polished metal with Blu-Tack or similar. Note the reflection of the pin in the metal, Fig. 1. Now, do the same experiment but with a piece of matrix board, Fig. 2. In one case, there is quite clearly an image of the pin in the substrate, and in the other there is virtually no reflection. Don't be confused by any shadows from the lighting. You can always use a "borrowed" handbag mirror, of course, but remember the mirror is silvered on the underside so the analogy isn't exact.

Bear in mind that light waves and radio waves are the same animal; only the frequency has changed. Then, place the shiny metal and pin on a table and look at it. Notice a few things:

1: If you look at it from vertically above the pin, you can't really say it is visible, and certainly the image is quite invisible. Therefore, we can say that vertically upwards is hardly a preferred direction!

2: If now you bring the eye slowly downwards until you are looking horizontally across the mirrored surface, now you can see the pin but not the image. As you slowly traversed down to this position from the first one, note that initially you could see all of the reflected image, but as you come nearer to the horizontal there came a time when the image progressively started to disappear off the edge of the mirror, until at the horizontal the image was invisible.

What is the difference between the shiny metal or mirror analogy and the vertical in the back yard? Simply that the pin is thousands of wavelengths long (it's a perfect analogy of a vertical a couple of kilometres high!) and, of course, that our practical ground looks far less conductive than the metal base, although not quite as bad as the matrix board used in the experiment. Even if we used the handbag mirror, the reflector equates to an estate which is tens of kilometres square. So, at first sight the best (and only) place a vertical is of use is /MM over a calm sea!

Questions

We should now be asking ourselves just what has the last few minutes of experimentation added to our antenna knowledge?

1: Quite clearly, any vertical antenna fed against ground requires us to carry out operations analogous to the silvering on the back of the mirror, to create the image. When a vertical antenna is operating, fed against ground, the capacitance between the vertical above ground and the image in the ground must set up currents in the ground which need to get back to the feed point. Thus we "silver the mirror" by laying down as many radials as we can, Fig. 3.

2: The currents induced in the ground are only going to be significant (in terms of feed-impedance questions) within a short distance from the feed-point. For example, even the broadcasters only use a radial farm extending out no more than a half wavelength long. Beyond this distance, the currents are small enough that longer radials won't have a significant effect on the feed point impedance. However, were we able to take a large estate of land, smoothe it and copper-plate it, we would see a difference in the radiation pattern of the antenna.

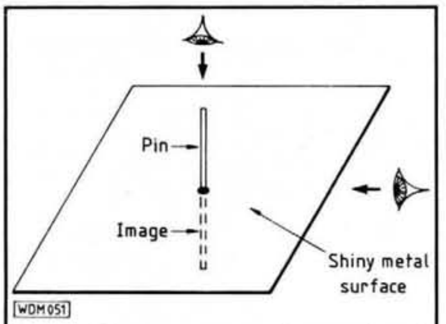


Fig. 1: The "pin on a shiny surface" analogy

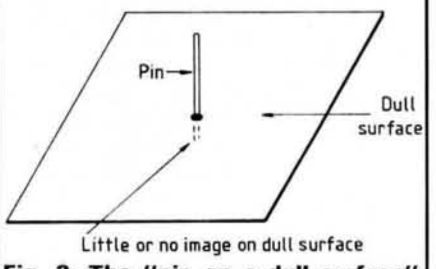


Fig. 2: The "pin on a dull surface" analogy

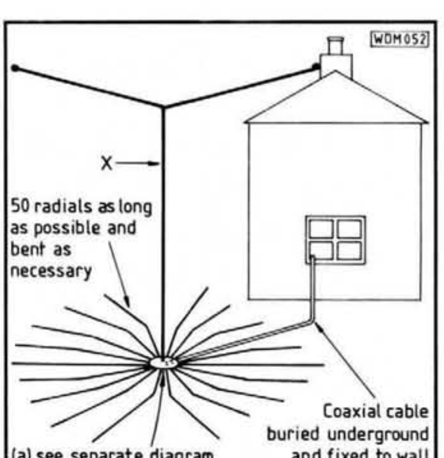


Fig. 3

The diagrams shown in the text books indicate that maximum radiation occurs straight along the ground, but clearly this must assume perfect ground extending from under the antenna in all directions out to infinity. This never occurs in practice, and the degree to which any given site deviates from perfection varies enormously. Thus a vertical antenna, fed against ground, needs a super earthing system to both "silver the mirror" to provide a good image and to provide good-to-better soil conductivity outwards for many wavelengths.

Why the inconsistency in behaviour, then, of grounded systems as compared with horizontal dipoles? Basically the horizontal dipole has both "legs" up in the air. "Silvering the mirror" under a horizontal dipole will serve to reveal an "image" dipole in the ground. This image will, in conjunction with the real dipole, operate as a phased pair, but this is only a matter of, at most, 3dB.

In the vertical case, we have other effects to take into consideration. There is the effect of varying ground conductivity under the antenna (and hence the formation of the image without which the quarter-wave vertical can't be fed), the effect of the ground quality out in the deep field and the further effects in the ground closer in. So a variation of 50dB would not seem in any way amiss, and is indeed quite clearly seen in practical cases. This is why people who are prepared to take the trouble, or to find a suitable site, or both, can manage to brew up such enormous signals on the 1.8MHz band by attention to the earth rather than the antenna itself. The commonly offered explanation of, "Oh, he's running over the top in power!" doesn't ring true.

What to Do

Obviously, if one only has a small garden, there is going to be a big attraction for the vertical antenna, if only because of its small space requirement. This being the case, we must simply work at everything that is within our control and accept that we may have a site where grounded vertical "won't work", in which case we are going to have to scratch about a bit.

First and foremost we must "silver the mirror". In my garden, which is about 7.5 × 7.5m, the vertical sits in the middle (or as near as I can get it). Running outwards from it are fifty radials, each buried about two or three centimetres in the ground, all soldered to a couple of "earth tags" made from the lid of a food tin. In turn, these are bolted to the earth fixings holding the antenna to the stub post sticking out of the ground. The coaxial feed is also buried two or three centimetres and runs into my house.

In my case, there are no trees of any significant size near enough to be a nuisance, although at a previous QTH a ground-mounted vertical was totally useless simply because it was surrounded by trees. So, if you have trees, then get your vertical up and into a ground-plane configuration.

However, how do we satisfy ourself that a vertical will work at our QTH before parting with hard-earned cash? The best solution is to build a single-band one, on a favoured band, and "see what happens" for a few operating sessions. Don't forget to compare notes with someone else to get a comparison view of "conditions".

If the ground-mounted arrangement won't work well enough you can try using a vertical dipole; bear in mind that the vertical dipole and the elevated ground-mounted arrangement requires the presence of the image before it can be even fed properly.

Traps and Loading Coils

Almost all the books will tell you that the losses in these are quite devastating, but keep a sense of proportion about this. In truth, a 1.8MHz mobile whip might have a radiation resistance of 0.1Ω and coil resistance of 25Ω, plus another 100Ω or so in the earthy side of the system. So only the odd milliwatt can ever radiate. However, if the 1.8MHz mobile whip is, say, 100kHz off tune, far less still will be radiated.

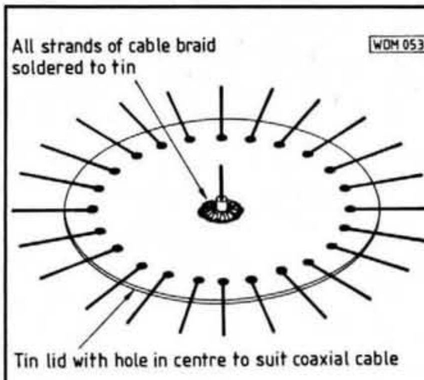


Fig. 4: Apply sealant (RTV738 or similar) both above and below the tin to seal the coaxial cable against the entry of moisture

To give a practical example. A series of whips having loading coils from "superb" to "abysmal" were made. At resonance they all produced 59 signals out to 48km or more; off resonance none was audible at 2km! All the tests used the same rig, and the field-strength meter used for tune-up confirmed that our results were sensible. The loading coils accounted for maybe 6dB variation, but incorrect tuning could produce a 60dB fall-off simply because you can't get the power into the antenna. If you can bring the system to resonance with your a.t.u., you can make it accept power, but you can't predict where it will put the power.

Thus, if you use a trapped vertical, follow the instructions at first. Get it tuned, as per the instructions, measure field strength for a given power and then see if you can improve it. Check each time with the field strength meter and the same power and compare the v.s.w.r., which should not normally get worse. As far as I can tell, on 14MHz, a grounded quarter-wave cut for the band, compared with 14MHz from the 14 AVQ over the same ground is down by a dB or less. Certainly a difference small enough that I can't measure it with home-brewed test equipment, even though I can see it.

Possibly the easiest way to create a "temporary" ground-mounted vertical for tests, is to hang it up from a catenary suspended between a mast and the house. To connect the coaxial cable, perhaps the easiest arrangement is to take a tin-lid and drill a hole in its centre, through which the coaxial cable can be poked. The sheath can then be unstranded and the strands soldered to the tin and some fifty radials soldered around the periphery. The inner can be soldered to a piece of wire of the right length, and the other end tied to the catenary without benefit of insulator if you use terylene cord for the catenary. Lay the radials about two or three centimetres under the soil surface; bear in mind that they will be detuned by the presence of earth around them, so the length of the radials isn't too critical. If you come to the fence and have a bit left over, bend it round and cut it off!

Go back to the shack and measure your s.w.r. across the band. If the best s.w.r. falls near the bottom of the band a bit needs to be trimmed off; if too high, a bit added on. Get the best s.w.r. to lie in the middle of the band, or of your favoured section.

Conclusions

Vertical antennas take up little real-estate when ground-mounted, but to get them to work properly calls for a vast amount of time to be spent on laying out ground radials. Even then your site may not prove to be amenable.

SWAP SPOT

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 PRO-30 16 channel v.h.f. Hi/Lo scanner direct access to 22 884 frequencies, boxed. Archer antenna and Garex antenna, charger plus re-chargeables inc, less than 12 months old. Would exchange for incubator to the value of £300. Tel: 0676 40679 Thursdays. *D622*

Have Yaesu FT-757 line up. Rig, FP-757HD. p.s.u. and FC-757 auto a.t.u. guaranteed till February '88, as new, boxed, 5hrs on the air. Would exchange for ham band transceiver (7B?) or general coverage receiver plus cash. Garry Grigg. Tel: (0625) 530200 (evenings). *D624*

Have Standard C58 multimode 144MHz portable/mobile, scanning mic, Heatherlite mic, soft case plus strap, NiCads, mobile mount, MM linear/pre-amp. Would exchange for handheld 144MHz f.m. only transceiver plus cash. Garry Grigg. Tel: (0625) 530200 (evening). *D624a*

Have 144MHz/430MHz multimode, base/mobile comprising FDK Multi 750E, FDK 430MHz Expander, matching FDK mains p.s.u. (scanning, duplex, etc, etc.). Would exchange for h.f. gear or w.h.y? Also wanted 144MHz linear and accessories for Trio 2400. John. Tel: 08482 314. *D628*

Have photographic lights, two Courtney electronic flash heads, flash meter, brollys, snoot, tripods, reflector, back drops, barns, etc. Immaculate, cost £400, also Akai 4000 reel-to-reel tape deck. Would exchange for u.h.f. scanner or general coverage receiver. Derek. Tel: 09252 21416. *D646*

Part 1 of this series showed how to calculate the field strength and power flux density in free space at a given distance when the transmitter power and the gain of the antenna system are known. We found out in Part 2 how to calculate the received voltage or power when an antenna of known characteristics is placed in a wave front. Putting these together enables us to obtain a basic formula for the performance of a communication system and is fairly easy to do, says A. J. Harwood C Eng MIERE G4HHZ.

Making Waves—A Guide to Propagation

Part 3—Getting it together

Let's specify the conditions of our system as one having a transmitter of power P_t watts and a transmitting antenna with a power gain of G_t over isotropic source. The receiving antenna has an isotropic gain of G_r and is D metres from the transmitter. We know that the field strength E is given by:

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

and the power flux density is:

$$\frac{P_t}{4\pi \times D^2} \text{ watts per square metre.}$$

Also the aperture A of the receiving antenna is related to the gain by:

$$A = G \times \frac{\lambda^2}{4\pi}$$

The power P_r delivered to a matched load is equal to the power flux density multiplied by the aperture, so we get:

$$P_r = P_t \times G_t \times G_r \times \left(\frac{\lambda}{4\pi \times D}\right)^2 \quad \text{watts}$$

The received power is equal to the product of the transmitted power, the transmit and receive antenna isotropic gains and the expression in brackets.

$$\left(\frac{\lambda}{4\pi \times D}\right)^2$$

which is often referred to as the path attenuation. However, this is a little misleading as it gives the impression that the attenuation due to propagation increases as the frequency increases. As we saw in the last article, however, the factor λ^2 in fact belongs to the receiving antenna aperture, the attenuation of the wavefront is in fact independent of frequency for free space.

We now have our basic formula which holds good for free space, it certainly gives the correct result for communication between two satellites and, provided the receiving dish is looking well up into the sky and not at some obstruction then the results are quite useful if one of the satellites is mother earth although we do have to take into account some effects due to the presence of the atmosphere. Let's have another look at the DBS satellite problem just to see how to use our formula.

If we take the 0.6m diameter dish with a gain of 2860 (34.6dB) we used previously to deliver 7 picowatts to a satellite receiver, what do we need up in the sky? The distance from the British Isles to the satellite in the allotted orbital position at 31 degrees west over the equator is 39 000 kilometres or 3.9×10^7 metres and the wavelength is 0.025 metres. By rearranging the formula we can get:

$$P_t \times G_t = \frac{P_r}{G_r} \times \frac{(4\pi \times D)^2}{\lambda}$$

Putting in the numbers gives:

$$P_t \times G_t = \frac{(7 \times 10^{-12})}{2860} \times \frac{(4\pi \times 3.9 \times 10^7)^2}{0.025}$$

which gives a product of transmitter power and transmitting antenna gain of 94 0591 watts, almost a megawatt! In practice it is intended that the effective isotropic radiated power or e.i.r.p. (which is what the product or transmitter power and isotropic antenna gain is known as) directed towards the edge of the satellite service area will be about 800 000 watts and the maximum e.i.r.p. at the centre of the area will be over one and a quarter megawatts provided by a travelling wave tube delivering about 110 watts to an antenna with a gain of around 14 000 (41.5dB). I leave it to the interested reader to work out the dimensions of such an antenna.

Problems like this are often presented in the form of a link budget, usually expressed in dB, as shown in the right hand column below:

Parameter	Factor	dB
Transmitter power	120 watts	20.8dBW
Losses transmitter to antenna	0.9	0.5dB
Transmit antenna gain	14 000	41.5dB
Path loss	2.6×10^{-21}	205.8dB
Additional path loss	0.7	1.5dB
Receive antenna gain (for 0.6m dish)	2860	34.6dB

Multiplying the factors and adding the dB figures gives:

Power to receive front end	8.8pW	−110.9dBW

(The slight discrepancy between the 8.8pW and the −110.9dBW is due to rounding off numbers but is not important in this type of calculation.)

This gives the received power level at the centre of the service area and to ensure that we get the desired coverage the transmitting antenna must have a radiation pattern which gives the correct e.i.r.p. at the edge of the area. The additional path loss is something that must be considered in the real world and is caused by attenuation due to the atmosphere, in particular the water vapour content which absorbs some energy at these frequencies. How much absorption is calculated from statistical experimental evidence obtained from measurements taken over a period of many years on existing satellites. This is an area where experimental work is continuing in order to refine the propagation prediction techniques used.

Now that we know how to do the basic calculations for a system in free space we can begin to look at what happens when we come down to earth. The idea that power is transferred by a wavefront passing through an area leads to the question as to how much of the area can be obstructed before there is a significant effect on the received signal. This problem was studied by the physicist Fresnel as part of his work on the propagation of light.

Fresnel considered what happens when the wave passes through an area centred on a point on the path from the transmitter to receiver and at right angles to the path. He divided this area into a number of zones as shown in Fig. 3.1. The boundary of the first zone is defined by all the points on the circle where the path length from the transmitter to the edge of the zone and on to the receiver is a half wavelength longer than the direct path; the second zone is bounded by the circle for which the path is two half wavelengths longer and

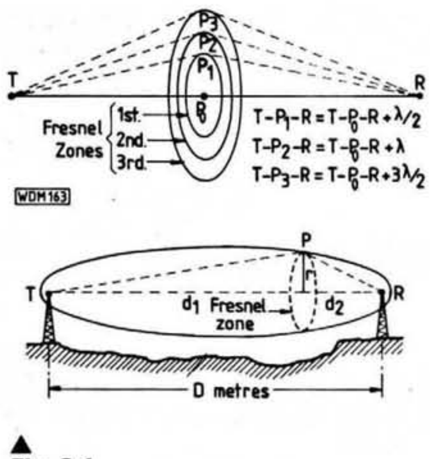


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Fig. 3.1

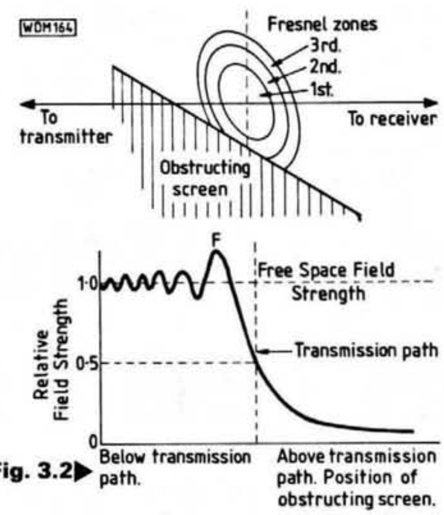


Fig. 3.2▶

Fig. 3.1. The first Fresnel zone is bounded by points such that the distance (T – P – R) is one half wavelength longer than T – R. It is an ellipsoid with a radius:

$$r = \sqrt{\frac{d_1 \times d_2 \times \lambda}{(d_1 + d_2)}}$$

At the midpath this is $0.5 \times \sqrt{D \times \lambda}$

Fig. 3.2. If an obstructing screen is brought into the transmission path the field strength varies as shown. When the first Fresnel zone is just unobstructed, the field strength is a little greater than the free space value, if the obstruction just touches the transmission path the received field strength is a half the free space value

so on; the zones are referred to as Fresnel zones. Plotting the edges of a zone at all the possible locations along the path results in an ellipsoid with the transmitting and receiving antennas at the focii.

The energy passing through the first zone is in antiphase to that passing through the second and in phase again with that of the third, and the total energy arriving at the receiver is the sum of that arriving through all the zones after taking into account the phase difference and this sum can be evaluated.

Using the notation of Fig. 3.1, the radius of the first Fresnel zone can be calculated and, to a close approximation, is given by:

$$r = \sqrt{\frac{d_1 \times d_2 \times \lambda}{(d_1 + d_2)}}$$

We can see that the zone is largest at the centre point of the path and its radius is then given by:

$$r = \frac{\sqrt{D \times \lambda}}{2}$$

since $d_1 = d_2 = D/2$

At each antenna it is a half wavelength in radius and extends for a quarter wavelength behind them. It is also possible to work out what happens if a screen is brought into the transmission path and it is found that when the screen just touches the lower edge of the first zone then the received signal is about 20 per cent greater than the free space value, whilst if the screen just touches the transmission path thus bisecting all the zones then the received field strength is equal to half the free space value. How the field strength at the receiving point varies as the screen is brought into the transmission path is shown in Fig. 3.2. For practical purposes it can be assumed that if the first Fresnel zone is clear of any obstruction then the received field strength is approximately the freespace value.

Let's look at some common transmission paths to see what sort of clearance we need at the midpoint to ensure free space propagation conditions. If we take a microwave link operating on 3GHz (a wavelength of 0.1 metres) over a 15 kilometre path the mid path clearance needs to be:

$$0.5 \times \sqrt{15000 \times 0.1} = 19.36 \text{ metres}$$

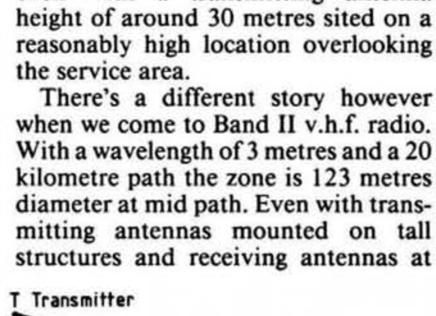
which can easily be achieved if the terminals are placed reasonably high.

For u.h.f. television at 600MHz (λ = 0.5 metres) and a path of 20 kilometres, the clearance works out at 50 metres which for a main station with say a 250 metre mast on an elevated site will ensure Fresnel clearance for most roof mounted receiving antennas. For a small relay with a path length of 5 kilometres the Fresnel zone is about 25 metres radius at the mid path so clearance can also be achieved even with a transmitting antenna height of around 30 metres sited on a reasonably high location overlooking the service area.

There's a different story however when we come to Band II v.h.f. radio. With a wavelength of 3 metres and a 20 kilometre path the zone is 123 metres diameter at mid path. Even with transmitting antennas mounted on tall structures and receiving antennas at rooftop height it is unlikely that Fresnel zone clearance will be obtained for a large number of the receiving locations.

A knowledge of the received signals which are found in situations where the path is obstructed is also useful when planning a communications system. It is common to refer to an area where the obstruction is out of the transmission path as being in the illuminated zone; one where the obstruction comes above the path as the diffraction region. Calculation of signal levels in the diffraction region is important when it comes to estimating the level of a signal which is a possible source of interference such as a distant transmitter using the same frequency in a broadcasting network.

One other way in which the Fresnel zone is important is when we consider reflections. In this case the area which needs to be considered is one where the path from the transmitter through the centre of the reflecting area and on to the receiver is a half wavelength shorter than the path via the edge of the area as shown in Fig. 3.3. For a coherent reflection to occur this area must be clear of obstructions and have a high reflection coefficient, that is little energy is absorbed by the surface



▲
Fig. 3.3. For a strong reflection to occur the reflecting area must be at least as big as the first Fresnel zone

$T - F_1 - R = T - F_2 - R = T - C - R + \lambda/2$

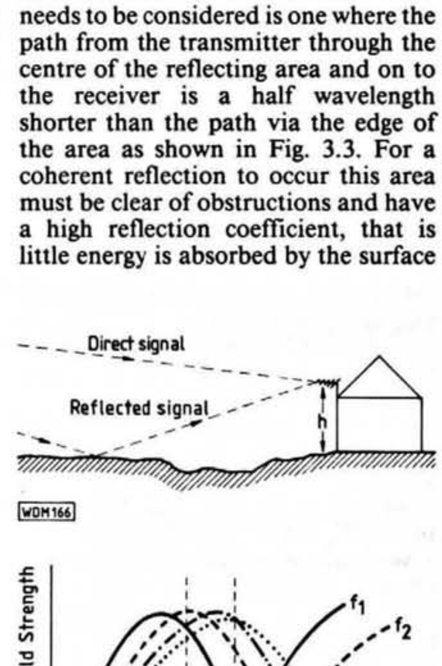


Fig. 3.4. In television reception, the maximum and minimum field strengths occur at different heights on different channels since, although the difference in path length is the same for each channel, the phase difference is due to the difference in wavelengths ▶

and most of it reflected. If these conditions are met then the field strength at the receiver can be calculated by considering the direct and reflected signals as simple rays. They can then be added taking account of their amplitudes and relative phase. Their phase difference is equal to the path length difference in wavelengths, with one wavelength corresponding to 360 degrees of phase, and a phase change of about 180 degrees at the reflection point.

An interesting case of reflections occurring is often encountered in normal domestic television reception. In the United Kingdom four channels are transmitted from each station on frequencies in u.h.f. Bands IV and V with a spread of about 80MHz from the highest to the lowest (although it can be over twice as great for certain stations). Because for a particular location the transmitting and receiving antennas are common to all four services then the geometry is the same for each channel and hence the path length difference will also be the same. However the phase difference between the direct and the reflected signal also depends on the wavelength which varies between channels. The maximum and minimum values of the combined direct and reflected signal occur where these are in phase and antiphase respectively and will consequently happen at different locations for each channel. If the transmission path is unobstructed and the reflection is a strong one then the maximum signal level will be about twice the free space field strength and the minimum can be extremely small. The sort of plot of the resultant field strength to be expected for different heights above ground is shown in Fig. 3.4. It is quite possible in practice to have positions where the field strengths are approximately equal on three channels, since the direct and reflected signals are almost in phase, but on the remaining channel they almost cancel and a much lower signal is received. The solution is to choose the position of the receiving antenna carefully and aim for a location such as A on Fig. 3.4, where the spread between channels is not great, and avoid those such as B.

SWAP SPOT

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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 nearly new Theasby bandpass filter 2.5kHz to 80MHz, Sony active antenna, Sony ICF-2001 three years old in excellent condition. Would exchange for radio capable of good reception of 473, 792, 1197 USA programmes. Tel. Longdown 370. Tegenza, Ranchi, Longdown, Exeter, Devon. *D728*

Have brand new Pan-Crusader 'X' 12-band all mode professional digital receiver plus instruction handbook. Would exchange for Sony CRF-230 onward models of receiver, or for Grundig, Panasonic or other modern digital receiver. Amoroso, 60 Highfield Road, Salford, Lancashire M6 5LA. Tel: 061-743 1570. *D729*

Have 8K ram pack and Cosmic Cruncher cartridge for VIC20. Would exchange for CEFAX/ORACLE TV adaptor unit plus cash if necessary. 16 Lateward Road, Brentford, Middlesex TW8 0PL. Tel: 01-751 4135. *D735*

Have Datong v.h.f. 144MHz receiver converter Type 144/28 in mint condition. Would exchange for legal CB rig in good condition or 50MHz or w.h.y? Walshe, 9 St Stephens Gardens, Northallerton. Tel: 0609 71636. *D740*

Have FDK-725X 144MHz f.m. 30 watt mobile, dual v.f.o., variable power, Heatherlite mobile safety mic to suit, gutter mount with 5/8λ and 8/8λ whips v.g.c. Would exchange for Cobra 148, Nato 2000 etc., (28MHz?). Tel: 01-247 6097 daytime. *D743*

Have Protel 6000 base mic graphic equalizer 3 compression settings suitable for ham or CB, I.C. ES880 echo chamber, both boxed in mint condition value £130. Would exchange for any 0-30MHz receiver, digital preferred. T. Atkinson, 41 Willow Crescent, Leadgate, Consett, Durham. *D751*

Have FT-790R all mode 430MHz transceiver plus B.N.O.S. 432 1-50 watts linear amp, and Welz-SP-425 s.w.r.-power meter. Would exchange for RTTY terminal unit ST5/MC (BARTG approved), must be in mint condition. (cash adjustment also) or w.h.y? B. J. West, 11 Mynydd Court, Blaendare Road, Pontypool, Gwent NP4 5RR. *D762*

Have 432MHz receiver, crystal controlled on RB2 repeater, s.s.b. generator around 5.2MHz, transceive (on 3.5MHz low power) with 8MHz crystals. Would exchange for Microdrive + cartridge (any condition) J. Brown, 45 Marlborough Avenue, Falmouth, Cornwall TR11 4HS. *D763*

Have CWR-610E RTTY c.w. decoder complete with Novex monochrome monitor and HK-704 Morse key, self-contained needs no computer. May also be used for c.w. practice both sending and receiving. Exchange for 144MHz/430MHz hand-held, test equipment or w.h.y? Tom. Tel: 01-582 7444. *D769*

Have FT-270RH 45 watt f.m. 144MHz mobile in excellent condition box, etc. Would exchange for 144MHz handheld (with cash adjustment) or w.h.y? Jon. Tel: 0249 712009 (Wilts). *D773*

Have military v.h.f. receiver (19 to 157MHz) plus matching p.s.u. No 24 inch leads. Modes c.w., s.s.b., f.m., a.m. all in v.g.c. Would exchange for Europa "C" v.h.f. transverter for 144MHz or FRG-7. Cash adjustment either way (EI/GI only). G. Fitz-Gerald EI6DP. 40 Maigue Way, John Carew Park, Limerick. Tel: Limerick 061-43584. *D778*

Have HRO (5T) table model plus 2 sets of general coverage coils and manual. Would exchange for Codar CR70A or Lafayette HA600. Gerry, Rose Cottage, Church Lane, Newtimber, Hassocks BN6 9BT. Tel: Poynings 538, after 6pm. *D800*

Have Marconiphone model 248 wood cabinet, and Eddystone metal cabinet for Eddystone type 358X receiver. Would exchange or cash adjustment for Eddystone diecast 688 loudspeaker and signal strength meter 669 for Eddystone 888A receiver. Tel: 0926 400876. *D806*

PW REVIEW

Having recently become plagued at his home QTH by severe interference from nearby TV receivers and home computers, Geoff Arnold G3GSR has been trying out a QRM Eliminator from S.E.M.

The principle of this type of interference eliminator is that a signal taken from an auxiliary antenna is mixed with the signal from the main antenna in such a way that the interference is cancelled out.

Ideally, if the main antenna is picking up "wanted" signal plus interference, the auxiliary antenna should pick up only the interference, otherwise some of the "wanted" signal will also be cancelled out in the mixing process. Difficult though this may sound, it is usually possible to come quite close to the ideal.

Several factors come into play here. First, much of the interference from TV sets, computers and the like is propagated by the magnetic field rather than by electromagnetic radiation, and so has a very limited range. Anyone who has tried to operate, for example, a 2m hand-held alongside a computer will have discovered this.

Secondly, a vertical auxiliary antenna will favour the reception of man-made noise such as TV timebase interference, which is generally vertically polarised, whereas a horizontal main antenna, such as a dipole, will give maximum rejection of such noise.

Finally, close to any source of electromagnetic radiation, although the famous "inverse square law" still applies, the field strength effectively falls off much more quickly than at a great distance. Perhaps a simple example will help to explain why this is so.

Imagine two identical antennas, spaced 10 metres apart, with one of them, *A*, at 10m from the source of interference, *I*, and the other one, *B*, at 20m from *I*. As the distance *BI* is twice *AI*, the interference at *B* will be only a quarter as strong as at *A* (because $2^2 = 4$). If the "wanted" signal is coming from a transmitter that is perhaps hundreds of kilometres away, an extra 10m will produce no noticeable difference between the strength of that signal picked up by the two antennas (Fig. 1).

So, though we can't prevent the auxiliary antenna picking up "wanted" signal, we can generally arrange that it picks up the interference more strongly than the main antenna. When the interference signal from the auxiliary antenna is then attenuated to the correct level to balance out the interference picked up by the main antenna, the "wanted" signal from the auxiliary antenna will be attenuated by the same amount. It should therefore be very much smaller than the "wanted" signal coming from the main antenna, which is just the state of affairs we require.

Practice

So much for the theory, now for the practice. The S.E.M. QRM Eliminator is housed in a two-part metal box measuring 158 × 60 × 58mm, with the four controls, Band-change, Gain and Phase A and Phase B, on the front panel. At the rear are three SO-239

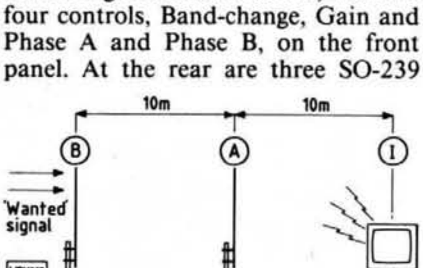


Fig. 1: A simple example of the "inverse square law"

sockets for the two antennas and receiver, plus a "phono" socket for the 12V d.c. 50mA power supply. A second "phono" socket allows the unit to be controlled and protected by the p.t.t. line of an associated transceiver.

The operating instructions (a single A4 sheet) supplied with the unit describe a simple procedure for adjustment of the Gain and Phase controls until the sharpest notch is achieved, plus advice on the selection of a suitable auxiliary antenna. Either a second h.f. antenna or the feeder of a 144MHz band antenna are suggested.

As already discussed, the ideal arrangement for the two antennas is that their pick-up of the interference field should be as different in strength as possible. It follows, therefore, that the worst arrangement is where the two antennas have to be close together and of similar layout—perhaps where your antenna farm is limited to "long wires" in a loft immediately above the operating room.

With this in mind, our testing of the review unit was carried out under what were perhaps rather unfair "worst case" conditions, with a 10 metre "long wire" in the bungalow loft for the main antenna, and an adjustable length of wire strung up to the curtain rail in the operating room for the auxiliary antenna. If the QRM Eliminator would work with this set-up, it should work virtually anywhere.

Did it work? Yes, it did, though with some pretty delicate adjustment of the three variable controls. Obviously my auxiliary antenna was much shorter than it should have been—I found that

▶39

This m.w. receiver designed by Raymond Haigh uses signal processing techniques normally associated with communications grade receivers. The combination of high sensitivity and good selectivity with provision for accepting a variety of antennas, makes this design the "ultimate" medium wave DX receiver.

The PW "Orwell" Medium Wave Receiver Part 1

Eavesdropping on the domestic, medium wave broadcasts of distant towns and countries can be a fascinating pastime. Real DX reception is, however, much more difficult than on the short wave bands, and good receiver selectivity and a directional antenna system are essential.

Low cost portables are not suitable for serious medium wave listening. Inadequate selectivity, spurious responses and poor audio quality make the clear reception of all but the most powerful local transmissions difficult. Even the best portable receivers have limited DX capability: it is not easy to connect a loop antenna, and any attempt to use a long wire invariably results in overloading and cross modulation problems.

For this reason communications type equipment is often used by medium wave enthusiasts. This is an expensive solution if one's interests lie mainly in medium wave listening, and the receiver described in this article has been designed as a more economical means of achieving an acceptable level of performance.

Circuit Description

The complete circuit of the receiver is given in Fig. 1.1.

Long wire and loop antennas are connected to the m.o.s.f.e.t. signal frequency amplifier via antenna transformer T1 which provides alternative coupling ratios. The r.f. amplifier stage increases sensitivity and selectivity, reduces spurious responses and improves a.g.c. performance.

Ferrite rod antenna, L1, is connected into circuit by means of a switched stereo jack socket (SK5) which isolates T1 when the rod antenna is in use. Ganged variable capacitor C3 tunes either of these inductors, and C1 and C2 are individual trimmer capacitors.

The r.f. signal from the antenna is applied to gate 1 of Tr1 via the d.c. blocking capacitor C4. This capacitor is required here because gate 1 is held positive with respect to earth in order to improve the a.g.c. and r.f. gain control action. The operation of the a.g.c. circuit, which includes d.c. amplifier Tr2, is described in detail later.

The amplified r.f. output at the drain of Tr1 is developed across the primary of h.f. transformer T2. A tap on the secondary winding ensures the necessary match to the low impedance input at pin 2 of the Hitachi HA1197 i.c. The primary/secondary turns ratio of T2 is, in fact, too high for optimum signal transfer. However, the receiver has gain to spare and under-coupling increases the selectivity of the tuned circuit formed by T2 and ganged capacitor C10.

The Hitachi a.m. tuner i.c. contains a further stage of r.f. amplification, the frequency changer, two i.f. amplifiers, automatic gain control and signal strength meter circuitry, together with an extremely linear detector. The 24 transistors and 17 diodes on the chip afford high sensitivity, exceptional a.g.c. performance, and low distortion.

Resistor R16 is included, in accordance with the manufacturer's recommendations, to protect the input stage of the device. The load resistor for the r.f. amplifier is R15; pre-set R17 adjusts the S-meter range, and R18 fixes the gain of the second i.f. amplifier.

Most of the i.f. selectivity is derived from X1, a Toko combined i.f. transformer and ceramic filter assembly. The manufacturers claim that this unit is equivalent to at least four single-tuned i.f. transformers, and quote a performance of 25dB down at a bandwidth of ±9kHz.

The first and second i.f. amplifier stages are coupled by means of the series tuned i.f. coil, L2. This arrangement, together with the r.f. and h.f. stage signal frequency tuning, gives the receiver a degree of selectivity at least equal to the best portable receivers, but not so great that audio quality is excessively degraded. If additional selectivity is desired then the receiver can be used with a *Q* multiplier type loop antenna, a suitable design of which, can be found in the *PW* reprint *Wires & Waves.*

Padder capacitor C13 ensures correct tracking with the 158μH oscillator coil, T3. The a.g.c. voltage is filtered by means of R20, R21, C25 and C26. Resistor R22 and capacitor C27 filter any residual r.f. from the audio output, which is wired to a phono socket (SK6) so that signals can be tape recorded at a permanently set level.

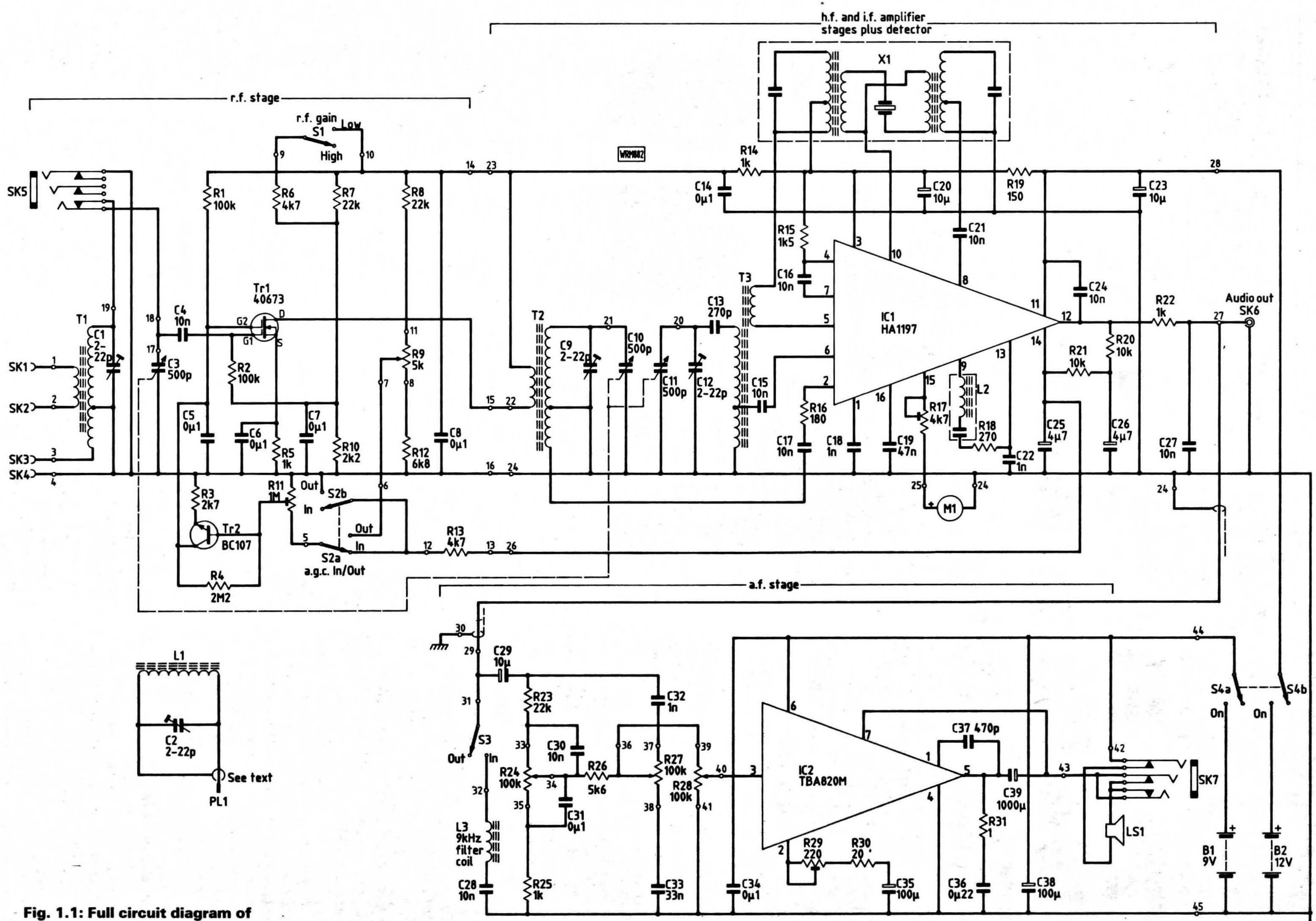


Fig. 1.1: Full circuit diagram of receiver

A simple audio processing unit precedes the internal a.f. amplifier. European channel spacing is 9kHz and this can result in an audio whistle at this frequency. The 36mH inductor, L3, and the 10nF capacitor, C28, form a series-tuned notch filter, resonant at 9kHz, which eliminates the problem without noticeably affecting treble response. Potentiometers R24 and R27, with associated resistors and capacitors, form a conventional passive tone control network offering bass and treble boost and cut. Because of the modest power output of the audio amplifier, maximum bass boost should only be applied at low volume levels or when using earphones.

The a.f. gain or volume control, R28, adjusts the input to the TBA820M audio amplifier i.c. Powered by a 9 volt supply, this device is capable of delivering a low distortion 1.5 watts into the receiver's 4 ohm speaker. Low quiescent current, typically 4mA, make it particularly suitable for battery powered equipment. External component count is reduced to a minimum in this application by omitting the ripple rejection capacitor at pin 8, and by connecting the speaker to battery positive. Pre-set potentiometer R29 controls the negative feedback at pin 2: reducing its resistance increases the gain of the i.c.

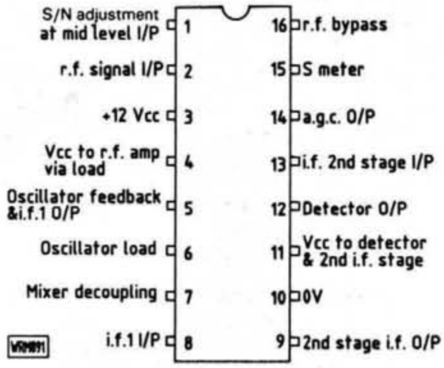


Fig. 1.2: Pin-out details of HA1197 a.m. receiver chip

A switched jack socket (SK7) isolates the internal speaker when phones are being used. A stereo socket is fitted in the prototype, as most phones are now wired in this way.

The r.f. amplifier and tuner section of the receiver require a 12 volt supply for proper operation. The audio amplifier power supply must not, however, exceed 9 volts with the specified 3 ohm speaker. Current drains are modest, amounting to 17mA for the r.f. amplifier and tuner, and 30mA for the audio amplifier when speech is being reproduced at good volume. Battery operation was accordingly chosen for the prototype receiver. This avoids any connection with the domestic electricity supply and the risk of direct injection of mains borne interference. Separate batteries are used: a pack of 8 R6 (AA) size cells for the tuner, and a PP9 for the audio amplifier.

Automatic Gain Control

The HA1197 i.c. produces an a.g.c. voltage which becomes increasingly positive with respect to earth as the signal level rises. This voltage ranges from 1.3 volts under no-signal conditions, to 2.3 volts with signals almost strong enough to saturate the device.

SHOPPING LIST

Resistors

0.5W 5% Carbon film

1Ω	1	R31
20Ω	1	R30
150Ω	1	R19
180Ω	1	R16
270Ω	1	R18
1kΩ	4	R5, 14, 22, 25
1.5kΩ	1	R15
2.2kΩ	1	R10
2.7kΩ	2	R3
4.7kΩ	2	R6, 13
5.6kΩ	1	R26
6.8kΩ	1	R12
10kΩ	2	R20, 21
22kΩ	3	R7, 8, 23
100kΩ	2	R1, 2
2.2MΩ	1	R4

Potentiometers

5kΩ lin	1	R9
100kΩ	3	R24, 27, 28

Horizontal skeleton preset

220Ω	1	R29
4.7kΩ	1	R17
1MΩ	1	R11

Capacitors

Ceramic

470pF	1	C37
1nF	3	C18, 22, 32
10nF	7	C4, 15, 16, 17, 21, 24, 27
47nF	1	C19
0.1µF	6	C5, 6, 7, 8, 14, 34

Polystyrene 5%

270pF	1	C13

Polyester

10nF	2	C28, 30
33nF	1	C33
0.1µF	1	C31
0.22µF	1	C36

Electrolytics

4.7µF	2	C25, 26
10µF	3	C20, 23, 29
100µF	2	C35, 38
1000µF	1	C39

Trimmers

2–22pF	4	C1, 2, 9, 12

Variable capacitors ganged

500pF	3	C3, 10,11

Inductors

RWO6A6408N	2	Antenna and h.f. transformers T1, T2
YMRS16726Z	1	Oscillator transformer T3
CFU050 D	1	2 × IFT plus ceramic filter, unit X1
YMCS2A740A	1	i.f. coil L2
CLNS30569Z	1	9kHz filter L3

(All the above inductors are manufactured by Toko, available from Cirkit[1])

Semiconductors

Transistors

40673	1	Tr1
BC107	1	Tr2

Integrated circuits

HA1197	1	IC1[1]
TBA820M	1	IC2

Miscellaneous

Ferrite rod 9.5mm dia × 140mm, F14 grade (1)[1]; 26 s.w.g. enamelled copper wire; ¼ inch stereo jack sockets chassis mounting with 3 sets of insertion break contacts (2); ¼ inch stereo jack plug; Phono socket chassis mounting; 4mm terminal (4); Toggle switch s.p.s.t. (2); Toggle switch d.p.d.t. (2); Jacksons 6/36 dial drive assembly (Cat No 4103/A)[2]; 50µA f.s.d. meter; Control knobs (5); 4Ω 2W loudspeaker; p.c.b.s; 14 pin d.i.l. i.c. holder; 8 pin d.i.l. i.c. holder; Veropins; Connecting wire; miniature screened cable; Battery holder; Battery connectors; Nuts; Bolts; Washers; Materials for cabinet.

[1] Cirkit Holdings plc, Park Lane, Broxbourne, Hertfordshire EN10 7NQ. Tel: (0992) 444111

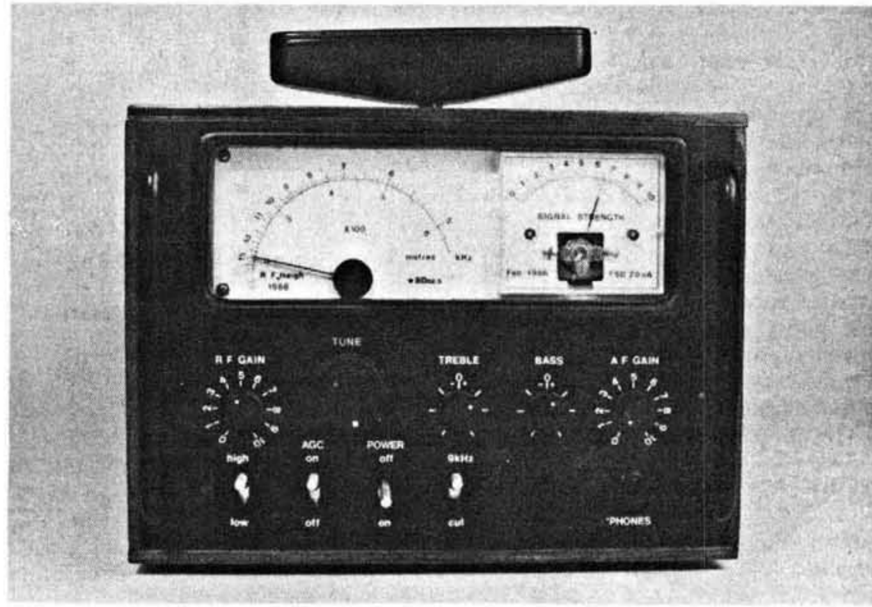
[2] Electrovalue Ltd, 28 St Judes Road, Englefield Green, Egham, Surrey TW2 0HB. Tel: (0784) 33603

How Much? & How Difficult?
£85
Advanced

Control of the gain of the m.o.s.f.e.t. r.f. stage can be achieved by varying the voltage on gate 2 of the device. The gain increases as gate 2 becomes more positive with respect to gate 1, reaching a maximum when the difference is approximately 2.5 volts. The a.g.c. voltage produced by the i.c. must, therefore, have its polarity reversed and amplified before it is applied to gate 2 or Tr1. This function is performed by Tr2, the necessary control voltage being developed across the collector load resistor, R1. Pre-set potentiometer R11 determines the a.g.c. voltage input to the base of Tr2, thereby setting the operating range of the circuit.

The voltage on gate 2 of the Tr1 cannot be reduced to zero by this means, and accordingly gate 1 has to be made approximately 1 volt positive with respect to earth in order to optimise a.g.c. performance. This is done by connecting R2 to the potential divider network formed by R7 and R10. The high/low gain switch brings R6 into circuit, increasing the potential on gate 1 to approximately 3 volts, and thereby reducing the gain of the r.f. stage to less than unity.

Switch S2 immobilises the whole a.g.c. network by shorting the control voltage to earth. (The value of isolating resistor R13 is too low to prevent this.) This switch also connects the manual r.f. gain potentiometer, R9, into circuit. Without this facility for switching out the a.g.c. function, it would be difficult to resolve weak signals very close or identical in frequency to powerful transmissions as the latter would actuate the a.g.c. system and reduce the gain of the receiver.



Tuning Capacitor

The three-gang 500pF section air-spaced capacitor used in the prototype, is no longer available commercially. However, this kind of component can often be salvaged from the older types of valve receiver; commonly found in second-hand shops and jumble sales. If a second-hand component is used, make sure it is clean and dry, and that the vanes do not short together. Its maximum capacitance should not be less than 365pF or the l.f. coverage of the receiver will be curtailed. Any built-in trimmers must be removed. Provision has been made to use Varicap diodes as an alternative form of tuning, details will appear in the Appendix in Part two of this project.

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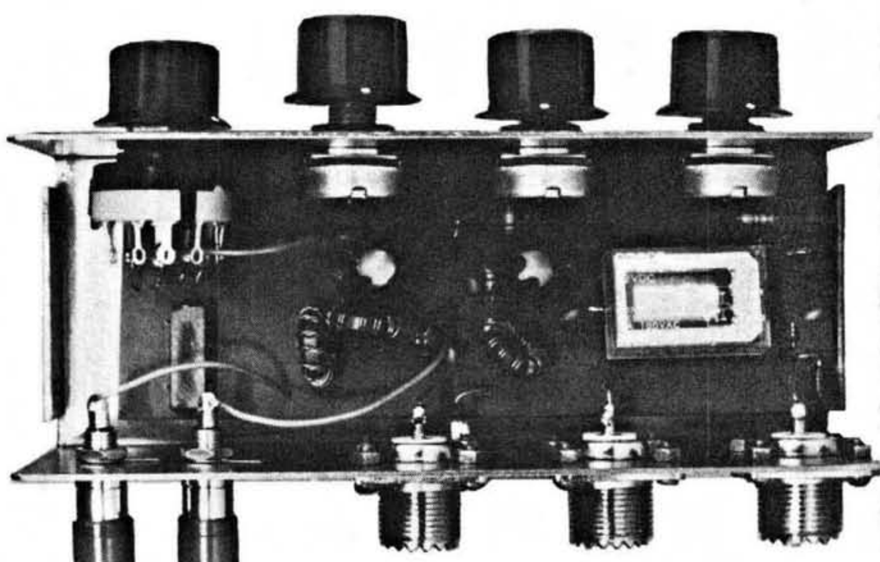
an odd bit of wire about 2 metres long would give a noticeable improvement in signal-to-noise ratio when TV time-base QRM was affecting the 21 and 28MHz bands, but to be effective down at 1.8 and 3.5MHz, it had to be increased to around 4 metres in length.

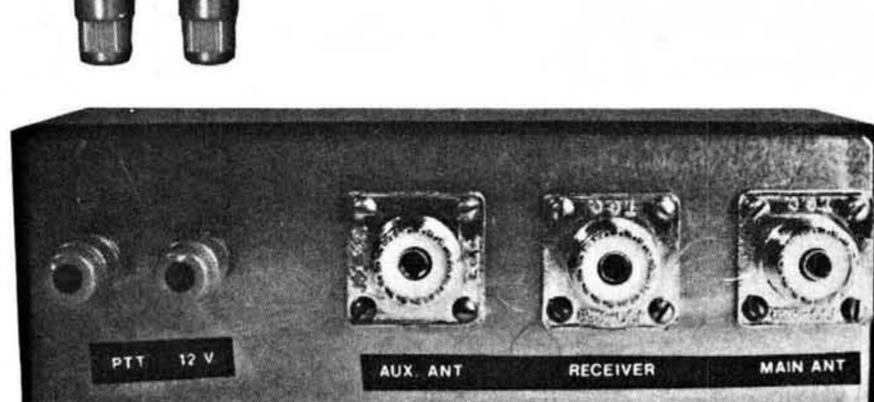
Although S.E.M. specify that the unit works only down to 1.5MHz, I found it still to be extremely effective at 828kHz (our local ILR station Two Counties Radio), but it had pretty well run out of steam by the time it was down to around 750kHz.

Mechanical Finish

It is a great pity that the overall impression of this very effective little unit was let down by the detail of the mechanical finish. For example, the four controls had shafts cropped to different lengths, so that each knob stood off the panel by a slightly different amount. Similarly, inside the unit, a corner of the p.c.b. had been filed off to make it fit within the case. None of these points affect the working of the QRM Eliminator but I felt that it deserves a better standard of presentation.

The QRM Eliminator is available price £85.00 including carriage and VAT from **S.E.M., Union Mills, Isle of Man, telephone 0624 851277**, to whom we give our thanks for the loan of the review unit. ***PW***





Directivity Gain Transmitting Antennas

This article, written by F.C. Judd G2BCX, is a complete revision and update of that published in August 1980 (also in Wires and Waves) which covered the directivity gain versus beam width of uni-directional (beam) antennas.

In this article, we will look at omni-directional antennas and bi-directional antennas as well as beams.

Radiation Directivity

All transmitting antennas are directive, i.e. radiation is always in some particular direction, or directions, both horizontally and vertically. For example, a dipole is directional although the magnitude of radiation is equal at all angles in the plane perpendicular to the axis of the antenna. In the opposite plane, it varies from maximum to zero twice in 360 degrees. Thus the measured, or calculated, magnitude of the radiation in that plane provides the well-known cosine or figure-of-eight pattern. Therefore when a dipole is operated vertically it is said to be omni-directional but the vertical radiation maintains the familiar cosine (figure-of-eight) pattern. When a dipole is operated horizontally, the horizontal radiation is directive (cosine pattern) and the vertical radiation is omni-directional. The above assumes a "free-space" location.

However, there is no antenna that radiates equally in all directions around it, both horizontally and vertically, although it would be desirable to have one for the purpose of estimating the directivity gain of directional antennas, as well as to provide a reference to which such gain may be related.

The Isotropic Radiator

This is a purely hypothetical conception otherwise known as a "point source radiator" and which is assumed to radiate equally in all directions at the same time. The point source can best be visualised as being at the centre of a sphere, as illustrated in Fig. 1(a), the sphere having a surface area equal to $4\pi r^2$. If the power radiated from the source is P_r, then, for the distance r to any point P on the surface of the sphere, the unit power (P_u) will be:

$$P_r/4\pi r^2$$

Because the radiation from an isotropic (point source) radiator can be regarded as uniform in *all* directions, its "gain" would be absolute unity. This what makes this otherwise non-existent radiator useful as a reference against which to compare the directivity gain of antennas with maximum radiation in specific directions. For example, if the point source radiator could be replaced by a real directional antenna, the radiation from this reaching the surface of the sphere, as in Fig. 1 (b), would be concentrated over an area formed by the cross-section of that radiation taken between the angles intersecting the points where the magnitude of the radiation is 3dB down from maximum, (−3dB = 0.707 of magnitude at maximum).

Assuming the cross-section area to be circular, as in Fig. 1(b), and with a diameter of say, 30 degrees, then its area would be:

$$\frac{\pi}{4} \times (d)^2 = \frac{\pi}{4} \times (30)^2$$
$$= 706.8 \text{ square degrees}$$

The ratio of this area to that of the sphere, also in square degrees, is a direct ratio of the directivity of the real antenna with reference to the isotropic source. From this, the "directivity gain" of the real antenna can also be determined with reference to either the isotropic radiator or to a dipole. First the surface area of the sphere from:

$$4\pi \times (57.295)^2 \simeq 41253 \text{ square degrees}$$

where 57.295 is the number of degrees in a radian. The directivity power gain of the real antenna with a cross-section area of 706.8 square degrees would be:

$$\frac{41253}{706.8} = 58.36$$

The directivity gain in decibels would be:

$$10\log_{10} \times 58.36 = 17.66\text{dBi}$$

in which the "i" simply indicates "gain over an isotropic"

Radiation Patterns

As will be seen later, these play an important part in the application of the

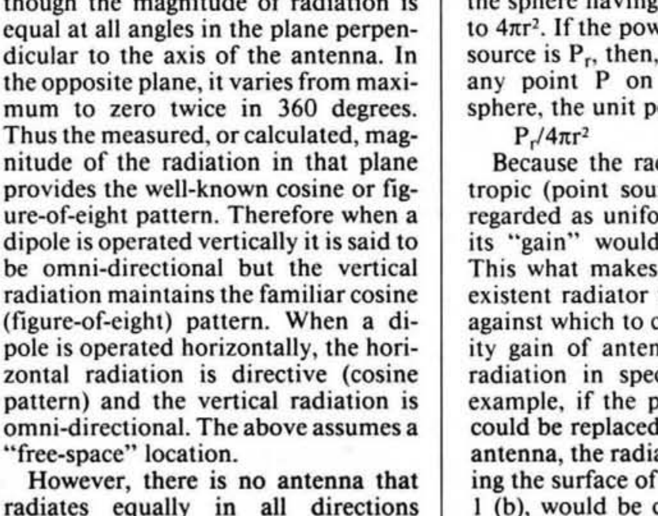


Fig.1: Conception of the isotropic source radiator

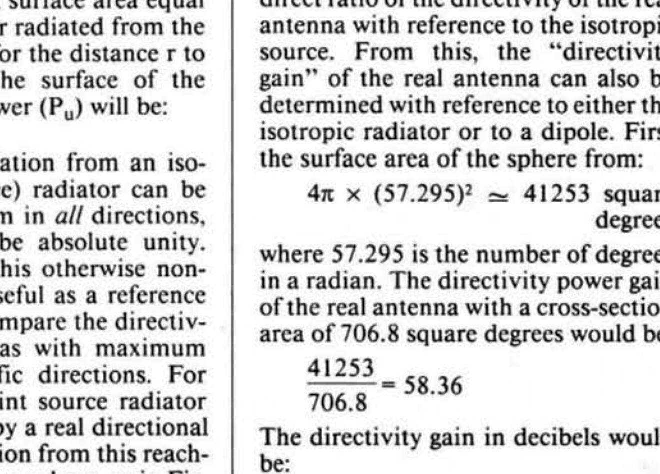


Fig. 2: Cross-section area. Main lobe of uni-directional (beam) antennas

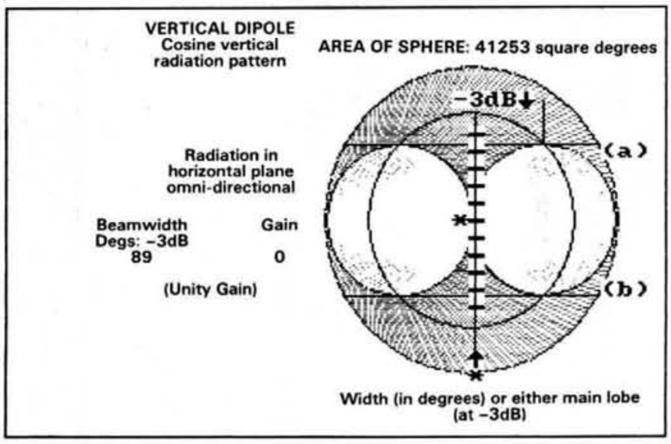


Fig. 3: Vertical dipole, beamwidth and gain

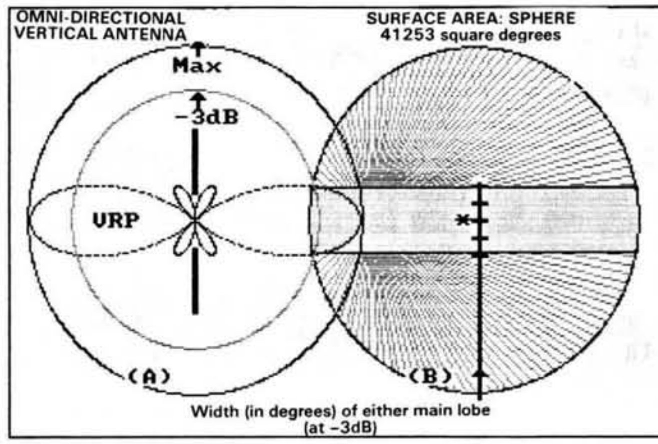


Fig. 4: Total beamwidth, omni-directional antennas

theory dealt with in this article. Radiation patterns are normally plotted in polar co-ordinates against a linear scale commonly calibrated 0 to 10 for the magnitude or radiation as the example in Fig. 2. This also shows how the 0.707 point (−3dB) is established for a major lobe or lobes.

It should be noted however, that the cross-section area of a major lobe may not always be circular and with uni-directional (beam) antennas may be slightly elliptical, if the main lobe width, at −3dB, is greater for the vertical than for the horizontal radiation for example. The gain is then derived from the beamwidth for both modes of operation. For example, if the beamwidths were respectively 40 degrees (horizontal) and 35 degrees (vertical) the directivity gain would be:

$$10\log_{10} \times \frac{41253}{0.78534 \times 40 \times 35}$$
$$= 15.74\text{dBi}$$

It is more usual and perhaps better understood by most to refer to directivity gain with reference to a dipole (gain expressed as dBd). Since the **power gain** of a dipole over an isotropic radiator is 1.64 (2.14dBi) it is only necessary to subtract 2.14 from the directivity gain of an antenna quoted in dBi (reference to an isotropic source). In the example given previously, this would be 15.74 − 2.14 which gives 13.6dBd.

Unfortunately few manufacturers of transmitting antennas for the amateur bands provide radiation patterns for both horizontal and vertical radiation. If a polar pattern is supplied it may be for horizontal radiation only. Often only a brief and not always accurate description of an antenna may be supplied together with a figure for "gain" which may be doubtful and/or misleading. In order to make use of the tables given in this article one must know the beamwidth of the main lobe, or lobes, for horizontal or vertical radiation. From this a fair approximation of directivity gain may be obtained. An accurate figure for gain in either dBd or dBi is necessary to obtain the beamwidth of the main lobe or lobes.

The tables included with this article take into account the fact that the main lobe (or lobes) may be slightly elliptical so the beam width for either horizontal or vertical radiation from uni-directional antennas may be used. For bi-directional antennas (simple broadside or endfire antennas) the cross-sectional area of the two main lobes may be taken as being circular. Measurements made with real antennas indicate that the tables will provide directivity gain to within 1dB or less, and beamwidth to within a very few degrees.

Side and Rear Lobes

Most uni-directional and bi-directional antennas have small side or rear lobes, (or both) and these radiate some of the total r.f. power supplied to the antenna. Generally the percentage is small, at least for the types of antenna dealt with in this article. Nevertheless it must be remembered that power radiated by the main lobe(s) will be the total power supplied less that radiated by any side or rear lobes.

This does of course determine the e.r.p. (effective radiated power) from any main lobe. The e.r.p. is derived from the power supplied to the antenna multiplied by the **power gain** of the antenna main lobe or lobes. For example a 100 watts is supplied to a uni-directional antenna with a main-lobe directivity gain of say 12dBd which is a power gain of 15.85. Assuming no loss in either the transmission line or the antenna and that there are no side or rear lobes, the e.r.p. would be 100 × 15.85 or 1585 watts. If a total of say 10 per cent of the power supplied were radiated by side or rear lobes then the main lobe e.r.p. would be 1585 less 10 per cent which equals 1426.5 watts.

Whilst the directivity gain in dBd or dBi, or related power gain for major lobes, is constant it remains that the larger the magnitude of any side or rear lobes, the greater will be the per cent power loss in the major lobes. Hence one reason for making sure that directional antennas have minimal side and/or rear lobes and another good reason why manufacturers of transmitting antennas should supply true radiation patterns for both horizontal and vertical radiation or quote the relevant side/read lobe magnitudes with reference to that of major lobe(s).

Directivity Gain and Beamwidth

The basic terms for deriving these factors have been dealt with and illustrated by Figs. 1 and 2, but can be extended to include omni-directional and bi-directional as well as uni-directional antennas.

When operated vertically, the radiation from a dipole becomes omni-directional on the horizontal plane but the vertical radiation retains the conventional cosine (figure-of-eight) pattern as in Fig. 3. The area of radiation is formed by the beamwidth at −3dB of one of the main lobes (approximately 89 degrees) and by (a) and (b) in Fig. 3, which extends all round the sphere (360 degrees). The total area of radiation is therefore 89 × 360 = 32040 square degrees. Although 89 is very close, it is a computer "rounded" figure. Taking 32027/360 we get a beamwidth of 88.96388889 degrees which is much more precise, but why 32027?

First an allowance is made for the fact that the cross-section of a major lobe may be circular or elliptical. Taking the area of a sphere, 41253/0.78534 gives 52525, which divided by the power gain (1.64) of a dipole over an isotropic radiator is 32027. Directivity gain in dBd now becomes:

$$10\log_{10}\left(\frac{32027}{\theta_h \times \theta_v}\right)$$

in which θ_h and θ_v are the horizontal and vertical dimensions (in degrees) for the cross-section area of the main lobe, or lobes. Using this for the directivity gain of a vertical dipole in dBd it becomes:

$$10\log_{10}\left(\frac{32027}{360 \times 88.96388889}\right) = 0\text{dBd}$$

The same would apply with a dipole horizontal (remember in a free-space location) in which the vertical radiation becomes omni-directional with the −3dB beamwidth of either main lobe at very nearly 89 degrees. Hence the dipole has unity gain (0dBd).

Other Vertical Omni-directional Antennas

The most popular is the vertical collinear antenna normally consisting of two or more half-wave radiators driven in phase. Radiation in the horizontal plane is omni-directional but vertical radiation is similar to that of the dipole except that the beamwidth of the two main lobes is narrower and there are usually four small side lobes, depending on the number of half-wave sections and the spacing between each. See the vertical radiation pattern (v.r.p.) in Fig. 4. Like the vertical dipole, the area of vertical radiation is formed by a main lobe half-power beamwidth as (A) and the 360 degrees around the sphere as (B).

Directivity gain (dBd) is obtained from:

$$10\log_{10}\left(\frac{32027}{\text{beamwidth (degrees)} \times 360}\right)$$

Tables 1 and 2 cover a −3dB beamwidth range from 20 to 59 degrees and take element spacing into account.

Remember that e.r.p. (main lobes) is determined by the percentage of power taken by the side lobes from the total power supplied to the antenna.

Bi-directional Antennas

When operated horizontally, the dipole is a bi-directional antenna. Others

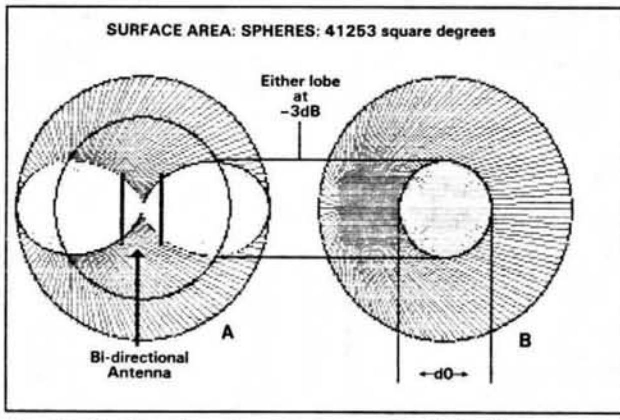


Fig. 5: Bi-directional antennas, major lobe(s) cross-section area at −3dB

such as simple broadside or endfire antennas also have two major lobes of equal magnitude but with a circular cross-section area at −3dB from maximum directivity as illustrated in Fig. 5. Part (A) shows the vertical radiation pattern of a two-element endfire antenna and (B) the circular cross-section area of either of the two major lobes. **If the antenna were horizontal the radiation pattern and the cross-section area would be the same.**

However, the r.f. power supplied to the antenna is shared equally by each major lobe and this must be taken into account when determining the directivity gain from either main lobe. Note however, that the radiation patterns of even simple two-element broadside or endfire antennas depend on the spacing between the elements and the phase relationship of the current flowing in each element. The directivity gain in dBd for either of two symmetrical lobes is:

$$10\log_{10} \times \left(\frac{32027}{\text{Beamwidth (degrees)}}\right) \Big/ 2$$

Example: Beamwidth at −3dB = 60 degrees. Directivity gain is:

$$10\log_{10}\left(\frac{32027}{60}\right) \Big/ 2$$

= 4.746 (rounded 4.75)dBd
See Table 3

The Tables 3, 4 and 5 cover a beamwidth range from 20 to 169 degrees in steps of 2 degrees. Note: These tables cannot be used for broadside or endfire antennas if the two major lobes are not symmetrical or if there are more than two major lobes.

Uni-directional (Beam) Antennas

As with each of the antenna systems already dealt with, a "free-space" location is assumed particularly where vertical radiation is concerned. Refer to Fig. 2 for an illustration concerned with the gain of uni-directional antennas with reference to a point source (isotropic) radiator. However, Tables 6 and 7 cover a range of beamwidths at −3dB from 20 to 122 degrees in steps of 2 degrees. The directivity gain (dBd) is derived from:

$$10\log_{10}\left(\frac{32027}{\text{beamwidth (degrees)}^2}\right)$$

The beamwidth may be that for horizontal or vertical mode but again a reminder that any side and rear lobes use some percentage of the total power supplied to the antenna and which be taken into account when determining the main lobe e.r.p. from antenna power gain and the power supplied. The directivity gain of the main lobe is not affected by side or rear lobes.

Gain: Vertical omni-directional antennas
Using beamwidth (vertical radiation)
and either of the two main lobes

Beamwidth −3dB Degrees	(Gain) dBd	Beamwidth −3dB Degrees	(Gain) dBd
20	6.5	30	4.7
21	6.3	31	4.6
22	6.1	32	4.4
23	5.9	33	4.3
24	5.7	34	4.2
25	5.5	35	4.1
26	5.3	36	3.9
27	5.2	37	3.8
28	5.0	38	3.7
29	4.9	39	3.6

Note: With vertical collinear antennas the beamwidth also depends on the spacing between each driven element

Table 1: For vertical omni-directional antennas: Gain versus beamwidth

Gain: Vertical omni-directional antennas
Using beamwidth (vertical radiation)
and either of the two main lobes

Beamwidth −3dB Degrees	(Gain) dBd	Beamwidth −3dB Degrees	(Gain) dBd
40	3.5	50	2.5
41	3.4	51	2.4
42	3.3	52	2.3
43	3.2	53	2.2
44	3.1	54	2.2
45	3.0	55	2.1
46	2.9	56	2.0
47	2.8	57	1.9
48	2.7	58	1.9
49	2.6	59	1.8

Note: With vertical collinear antennas the beamwidth also depends on the spacing between each driven element

Table 2

Gain: Bi-directional antennas
Using beamwidth (horizontal or vertical)
or either main lobe

Beamwidth −3dB Degrees	(Gain) dBd	Beamwidth −3dB Degrees	(Gain) dBd
20	9.52	37	6.85
22	9.10	39	6.62
24	8.73	41	6.40
26	8.38	43	6.19
28	8.06	45	6.00
30	7.76	47	5.81
32	7.48	49	5.63
34	7.21	51	5.45
36	6.96	53	5.28

Applies: Broadside and endfire antennas with two symmetrical main lobes and side lobes smaller than −15dB

Table 3: Bi-directional antennas. Gain and beamwidth

Gain: Bi-directional antennas using the beamwidth (horizontal or vertical) of either main lobe			
Beamwidth −3dB		Beamwidth −3dB	
Degrees	(Gain) dBd	Degrees	(Gain) dBd
54	5.20	71	4.01
56	5.05	73	3.89
58	4.89	75	3.78
60	4.75	77	3.66
62	4.60	79	3.55
64	4.47	81	3.44
66	4.33	83	3.34
68	4.20	85	3.23
70	4.08	87	3.13
Applies: Broadside and endfire antennas with two symmetrical main lobes and side lobes smaller than −15dB			

Table 4

Gain: Bi-directional antennas using the beamwidth (horizontal or vertical) of either main lobe			
Beamwidth −3dB		Beamwidth −3dB	
Degrees	(Gain) dBd	Degrees	(Gain) dBd
88	3.08	129	1.42
93	2.84	134	1.26
98	2.62	139	1.10
103	2.40	144	0.94
108	2.19	149	0.80
113	2.00	154	0.65
118	1.81	159	0.51
123	1.63	164	0.38
128	1.46	169	0.25
Applies: Broadside and endfire antennas with two symmetrical main lobes and side lobes smaller than −15dB			

Table 5

Gain: Uni-directional (beam) antennas from beam-width of main lobe at −3dB			
Beamwidth −3dB		Beamwidth −3dB	
Degrees	(Gain) dBd	Degrees	(Gain) dBd
20	19.0	46	11.8
22	18.2	48	11.4
24	17.5	50	11.1
26	16.8	52	10.7
28	16.1	54	10.4
30	15.5	56	10.1
32	15.0	58	9.8
34	14.4	60	9.5
36	13.9	62	9.2
38	13.5	64	8.9
40	13.0	66	8.7
42	12.6	68	8.4
44	12.2	70	8.2

Table 6: Uni-directional beam antennas. Gain and beamwidth

Linear Antennas N Half-waves Long

It is possible to get an appoximation of directivity gain from the main lobes of linear antennas N half-waves in length as such antennas always have four defined major lobes. The method used is based on that featured in this article and which might be dealt with at a later time.

Effective Radiated Power

To calculate the effective radiated power in a major lobe it is necessary to know the power gain for that lobe

$$\text{Power gain} = 10^{xy}$$

$$\text{with } xy = \left(\frac{\text{Gain dBd major lobe}}{10}\right)$$

Example:
The e.r.p. for a uni-directional (beam) antenna (single major lobe).
Gain (Table 6) 12.2dBd: Power gain $10^{1.22} = 16.59$: r.f. power to antenna 10 watts: e.r.p. $10 \times 16.59 = 165.9$ watts

Example:
The e.r.p. for omni-directional antenna.
Gain (Table 1) 5dBd: Power gain $10^{0.5} = 3.16$:
r.f power to antenna 20 watts: e.r.p. $20 \times 3.16 = 63.2$ watts

Example:
The e.r.p. for a bi-directional antenna (two lobes).
Gain (Table 3) each main lobe 5dBd: Power gain (each lobe) $10^{0.5} = 3.16$:
r.f. power to antenna 20 watts: e.r.p. (each lobe) $20 \times 3.16/2 = 31.6$ watts

As already mentioned, the percentage of power radiated by any side or rear lobes must be deducted from the e.r.p. for a major lobe

Gain: Uni-directional (beam) antennas from beamwidth of main lobe at −3dB			
Beamwidth −3dB		Beamwidth −3dB	
Degrees	(Gain) dBd	Degrees	(Gain) dBd
72	7.9	98	5.2
74	7.7	100	5.1
76	7.4	102	4.9
78	7.2	104	4.7
80	7.0	106	4.5
82	6.8	108	4.4
84	6.6	110	4.2
86	6.4	112	4.1
88	6.2	114	3.9
90	6.0	116	3.8
92	5.8	118	3.6
94	5.6	120	3.5
96	5.4	122	3.3

Table 7

References

Antennas by John D. Kraus PhD. McGraw-Hill Book Co. Inc. *Antenna Radiation Patterns Computerised* by Dr L. W. Brown and F. C. Judd. *Practical Wireless* Feb and March 1987. *Power Gain from TX Aerials* by F. C. Judd. *Practical Wireless* August 1980. *VHF/UHF Manual* by Jessop 4th Edition. RSGB.

NEWS DESK EXTRA

One Megawatt Radio Source

Marconi Communication Systems has received an order from the UK Atomic Energy Authority for the second phase of a project connected with a particle beam acceleration.

Marconi was commissioned to provide a design specification for a one megawatt radio frequency source. Now they have been contracted to design the equipment. The third stage will be to construct, install and commission it.

The r.f. source consists of a klystron, which is capable of delivering one megawatt, continuous wave at 350MHz, a waveguide system for transmitting the power to the experiment or a test load and a control and instrumentation package for the system.

When operated at full power, the klystron consumes approximately 1.4MW from a 90kV d.c. supply and requires a tonne of cooling water per minute!

DXpedition

Regular listeners to the Voice of the Andes realise that few countries in the world can boast the variety of contrasting environments found in the small nation of Ecuador — snow covered volcanoes where ice meets fire, exuberant and intricate jungles, colonial cities and beautiful Pacific beaches.

Listeners have been able to hear about it for years on HCJB. Now the station is organising a listeners tour to Ecuador.

You can combine a South American holiday and a DXpedition from March 27 to April 9. The two weeks will cost $650 excluding air fares from Europe.

HCJB-UK.
131 Grattan Road,
Bradford,
West Yorkshire BD1 2HS.

FT-102 User

If you are the owner of an FT-102, then this user group will be of interest to you.

The aim is to provide a forum for exchange of information about the 102 series of equipment and the range of accessories/add-ons which are/were available for this range. So if you have information, or want information about either the FT-102 or the group then write to:

FT-102 User Group,
c/o GI4PCQ,
58 William Alexander Park,
Belfast.

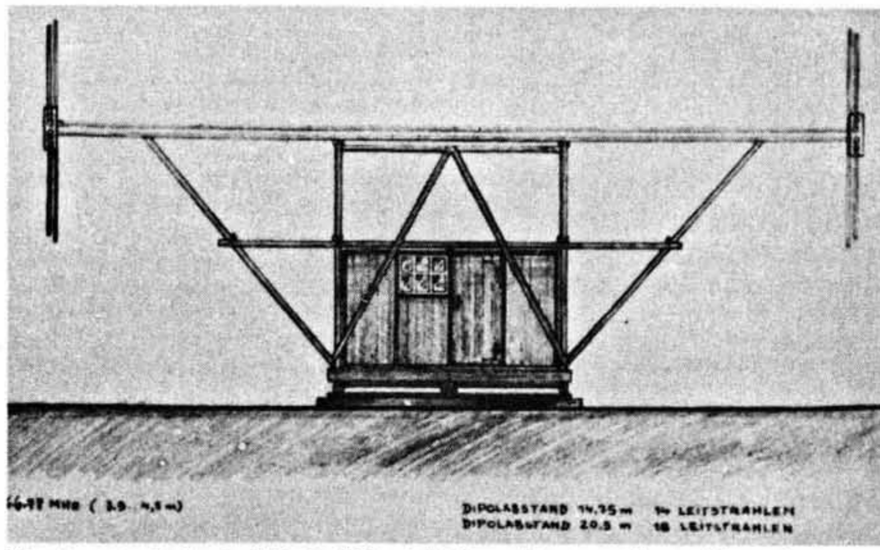
Feature

The Battle of the Beams–Part 2

D. V. Pritchard Dip Ed G4GVO continues the story of the "Crooked Beams" as he tells us about X-Gerät—The Secret Apparatus.

As early as 1934, when *Knickebein* was in its infancy, a German scientist began to have doubts about its efficiency if exposed to jamming. He was Staatsrat (Privy Councillor) Dr H. Plendl of the Deutsche Versuchanstalt für Luftfahrt (German Aeronautical Research Establishment) and he began to produce designs for a new system for accurate blind bombing.

Under his leadership, a new department was formed at Rechlin (the German equivalent of Farnborough) which began research in June of that year. This was in co-operation with another department led by a Dr W. Kühnold which was also engaged on beam techniques for blind landing. The beams of Kühnold's system, however, had an aperture angle of about 5°, corresponding to an 8km beamwidth at a range of 100km, and were clearly unsuitable for accurate pin-pointing of targets. Obviously a beamwidth of not more than 0.1° was required and this, at that time, could only be attained with reasonable antenna dimensions and suitable power if a frequency between 66 and 77MHz was employed. Accordingly, experiments were begun with an 80-watt transmitter designed by a Dr Ochmann which was code-named *Bertha 1*, but as this was not powerful enough a second was designed, *Bertha 2*, which delivered 500W and was tunable over the required range.

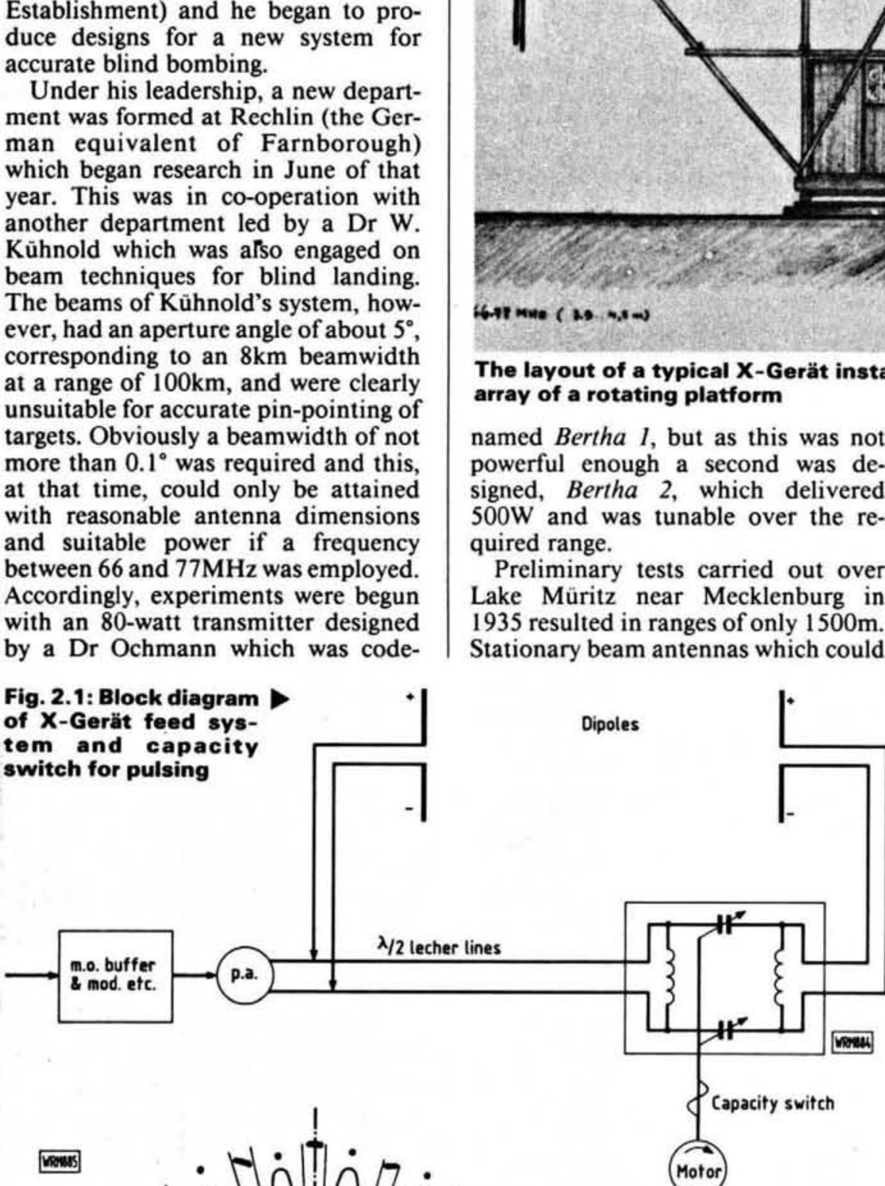


The layout of a typical X-Gerät installation with operating cabin and antenna array of a rotating platform

Photographs by courtesy of Fritz Trenkle

Preliminary tests carried out over Lake Müritz near Mecklenburg in 1935 resulted in ranges of only 1500m. Stationary beam antennas which could be phased to swing through about 10° were used, and the airborne equipment consisted of two t.r.f. receivers developed at Rechlin and an analyser for unlocking the 2000Hz modulated dot-dash system of the adopted and improved Knickebein apparatus. Unfortunately full details of both transmitter and receivers are no longer available.

Fig. 2.1: Block diagram of X-Gerät feed system and capacity switch for pulsing



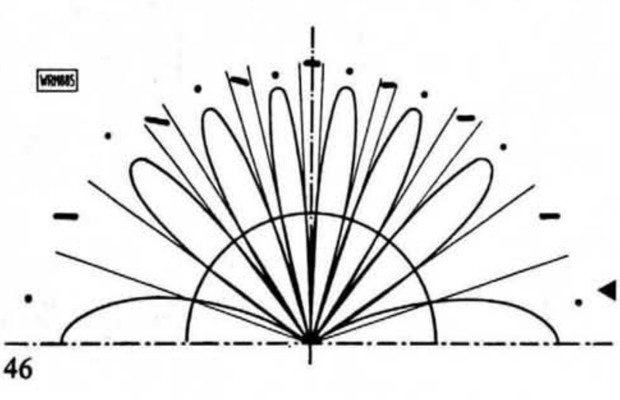


Fig. 2.2: Antenna pattern of X-Gerät system

Wotan 1

By 1938, the system had been greatly improved. Dr Kühnold had developed ground installations capable of easy dismantling and removal, with an operating cabin and antenna array mounted on a platform which could rotate through 360°. The antennas were mounted on a gantry and spaced at 14.75m (3.5 wavelengths). Originally, simple half-wave dipoles were employed, but before long directors and reflectors were added for extra power and range; these were energised with pulses at 120 per minute via a vacuum switch (soon replaced by a capacitor, nicknamed a "mill switch", designed by Dr K.H. Fischer). The schematic block diagram of this system is shown in Fig. 2.1 A half-wave Lecher line is used in conjunction with the "capacity" switch and its associated inductances to pulse both dipoles with the required dot-dash sequence.

The array generated a fan of 14 beams each with a bandwidth of 0.05° (Fig. 2.2), and 8 of these installations were erected in Germany, followed by many more on the coasts of occupied Europe. By now the airborne equipment had also been drastically improved by Dr H. Hanel and Dr Rücklin of Telefunken, who had designed and developed a superhet for 66 to 77MHz (code-named *Anna*), while an analysing system designed by Dr Plendl known as the AVP (Anzeige-Verfahran von Plendl) was being mass-produced by Siemens.

At the same time a Dr K. Müller set up a Mobile Research Unit which produced some versatile mobile stations under the code-name *Möbelwagen* or "Furniture Vans". He was also responsible for the clever camouflaging of their antenna—a feature which was later to prove troublesome for British counter attacks.

The complete system was known as *Wotan 1.*

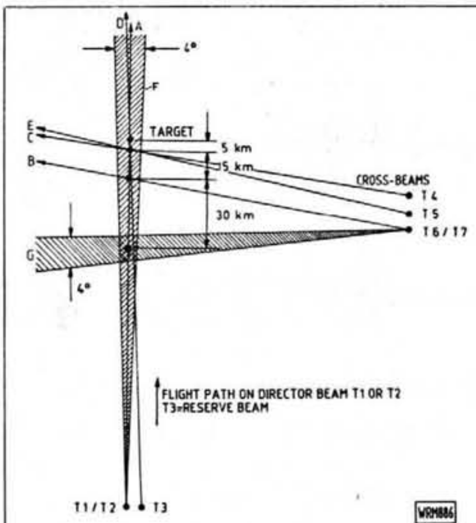


Fig. 2.3: Official German layout of the X-Gerät system

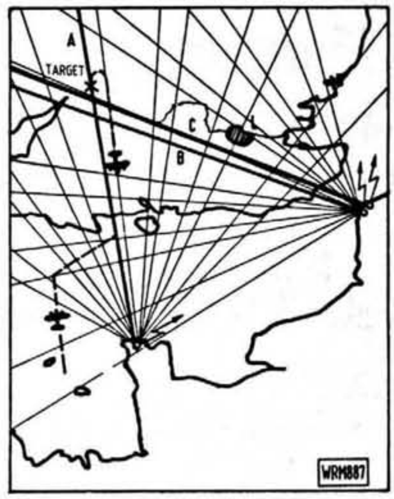


Fig. 2.4: German layout of beams showing main beams and associated fans

Principle of Operation

One of the 14 beams was selected to act as a director beam which, on being aimed towards the target, provided a flight-path for the aircraft; this system was similar to Knickebein in that the pilot could plot his course according to a direction indicating meter which told him if he was right or left of the beam. The official German layout of the beam approach system and its associated cross beams at points before the target is shown in Fig. 2.3, while Fig. 2.4 represents not only the director beam and reserve beam, but also the cross beams and the associated fans of beams which enabled stray aircraft to plot their courses to the correct one. The main beams of the system used for the devastating raid on Coventry in 1940 is shown in Fig. 2.5, and Fig. 2.6 is another official German layout showing the disposition of all beam systems in use at that time. (In this series the author has concentrated only on the more widely known systems.)

In practice the bombers did not fly along the director beam immediately after take-off, but used either normal navigational methods or one of the fan beams in order to present a smaller target for British radar and to try and cause confusion. The director beam was usually joined sometime after crossing the English coast.

At approximately 30km before the target, the aircraft would encounter the coarse advanced cross beam which, like the other beams, was similarly pulsed with dots and dashes but on a different frequency. Before reaching this point the bomber's radio operator would have consulted a table giving the characteristics of his particular type of machine and fed them into a combined calculator and stopwatch called the *X-Uhr*, or "X-Clock". This was an incredibly accurate mechanism designed at Rechlin by a Dr Hepper. A small upper dial on the left-hand side showed how long the instrument had been running, while the lower dial was used for calculating the "flight-path ratios"—that is to say, information about the aircraft's type, height and speed was inserted to give a flight-path ratio of, say, 2.78:1 for 18km, or 3:1 for 6km according to circumstances.

On arriving in the dash-zone of the advanced cross beam the operator would listen for the (very brief) continuous note produced by the merging of dots and dashes, and press the clock's top button. This started the green "minute" hand and the black sweep-hand simultaneously and, according to the inserted data, the time taken for the bombs to drop was now fed in.

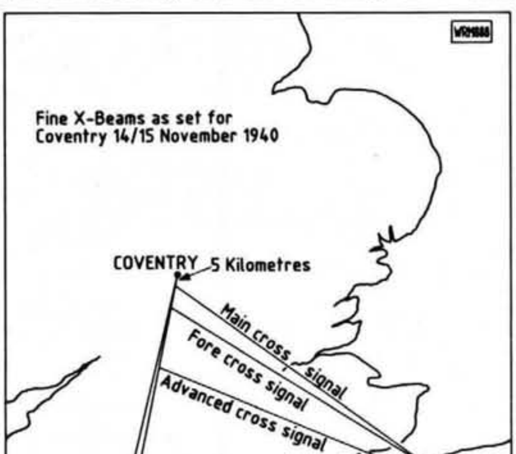


Fig. 2.5: The X-Gerät system for K. Gr. 100

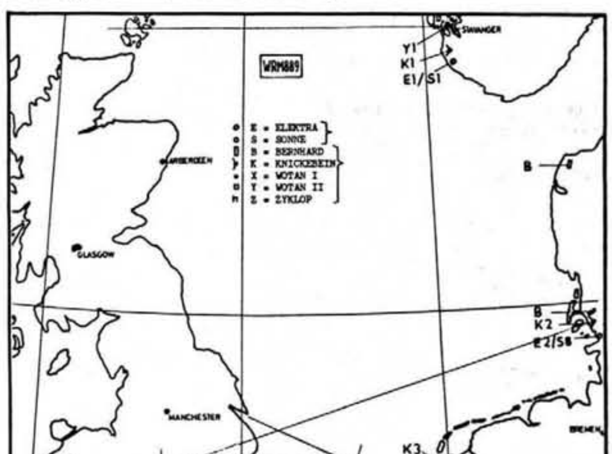


Fig. 2.6: Official German layout showing the disposition of all beam systems in use at that time

At the "fore-cross-signal" a button on the left was pressed whereupon the green and black hands stopped and the red "hour" hand started. By pressing the third button at the main cross beam the red hand would stop at the same point as the previous ones and, if the correct data had been given, the bombs would be automatically released.

After tests by a research squadron, the system was finally installed in Ju 52's and He 111's of *Kampf-Gruppe 100*, a Group led by an outstanding Luftwaffe officer, Major Viktor von Lossberg. Quarter-wave whips were mounted on top of the fuselage behind the cockpit and these, in conjunction with the whip antenna for RT operation which was situated further back, gave rise to the nicknamed "Three-master".

The airborne equipment was installed in the radio operator's position and repeaters for the course meters were fitted in the cockpit for the pilot's benefit. A motor generator fed from the aircraft's batteries (rotary converter) was placed at the bottom of the installation and immediately above it were two audio units, to the left of which was the power distribution panel and, above, the twin receivers for the director and cross beams, the Anna receiver being on the right.

Intelligence Breakthrough

The phone shattered Dr R.V. Jones' sleep in the early hours of a morning during the first week of September, 1940.

"We've got something new here! God knows what it is, but I'm sure it's something for you!"

The excited voice of Professor Frederick "Bimbo" Norman, a cryptographer at Bletchley Park, shook Jones into consciousness. They had broken some new Enigma traffic in which radio beams were mentioned, including the information that the beam-width was 8 to 10 seconds of arc, or an angle of 1:20 000, suggesting that *the beam was no wider than about 20m at 320km!*

Then came the electrifying word X-Gerät! Whatever X-Gerät was, it was being installed in aircraft of Kampf-Gruppe 100, one of the Luftwaffe's crack squadrons.

Jones hustled the intelligence services into greater activity. Across the Channel the Resistance organisations pulled out all the stops, and British Signals Intelligence (including Voluntary Interceptors—a body of dedicated radio amateurs) doubled their efforts. Their activities prompted Jones to record his appreciation: *"Our community of radio amateurs in Britain was to prove an invaluable reserve, both in Signals Intelligence and Signals proper, as well as furnishing many of the staff for our rapidly increasing number of radar stations".*

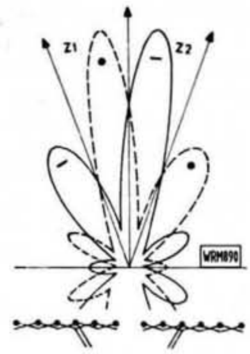


Fig. 2.7: Beam patterns of mobile X-Gerät

It was that well-known amateur of his day, Rowley Scott-Farnie G5GI, then an officer in RAF Signals Intelligence and a close friend of Jones, who reported beam signals from the Calais and Cherbourg areas around 70MHz. By September 24, 6 beam stations were identified: 2 north-west of Cherbourg, 3 near Calais and the last near Brest. The Germans had code-named them *Weser, Spree, Rhein, Elbe, Isar* and *Oder*. Evidently K.Gr.100 was working through a book of numbered targets and by the time the stations were identified Jones had the actual directions for the beams—and even that the Germans had specified them to the nearest 5 seconds of arc, *an accuracy of about 10m at 320km!*

But how could such an accuracy be possible on 70MHz?

The "Anna" Numbers

Further decoded German transmissions revealed the existence of coarse and fine beams, including a mention of centimetres. This latter, however, referred to the precision with which a monitoring vehicle had to be positioned to orientate the director beam. Frequent mention of something called "Anna" was made, usually associated with a number between 10 and 85, and often a multiple of 5. By October 17, Jones had collected 10, 15, 25, 30, 35, 44, 47, 55, 60, 75 and 85. Another set of numbers gave crystal frequencies (typically 8750kHz, since 8750kHz × 8 = 70MHz) and he suspected that Anna referred to the dial on the aircraft receiver, if not the aircraft itself. Since one set of numbers ended in 0 or 5, and the other in 0 or 0.5, simple deduction showed that the Anna reading had to be divided by 10 and either added to, or subtracted from, a constant number.

Learning from the Enigma traffic that a certain Feldwebel Schumann at a beam station at den Helder had signed a return for 3 crystals for 69.5, 70 and 71.1MHz and that his station was ordered to transmit on Anna numbers 30 and 35, it was clear that the constant had to be 66.5 if one-tenth of the Anna number had to be added, or 73 if it had to be subtracted. As he knew that crystals for 75MHz existed, the second possibility could be dismissed; and when he obtained further confirmation from the two crystals whose frequencies were not exact or half integers, the problem was solved. Other information that emerged from the Anna numbers was that both the coarse and fine beams lay between 66.5 and 75MHz.

Measurement Inaccuracy

The immense value of Anna numbers was that if the transmitted orders to the beam stations could be decoded in time, he could then tell 80 Wing the frequencies to be jammed. Incredibly, his interpretation of the numbers was rejected because our monitoring services thought there were frequencies outside the range he had found. Dr Jones' hackles rose—a posture they were seldom slow in assuming—and plain words were spoken. *"These, it transpired, were due to bad measurement of the frequencies of the German beams on the part of the countermeasures organisation, a feature that was to plague us through the whole battle. The fault in this case probably lay not with the observers, but with the calibration of our receivers which were not up to the German standards of precision".* His findings were accepted.

Dr Robert Cockburn of the Telecommunications Research Establishment, having successfully prescribed "Aspirins" for the Knickebein "Headaches", now developed "Bromides" for this new system which was code-named "Ruffian". We now knew that the director beam was radiated from near Cherbourg and the cross beams from the Calais area; as insurance against the failure of the main director beam (Weser) a reserve beam was provided by the adjacent station (Spree). The accuracy of the beams was so great that in calculating their paths it was necessary to take into account that the earth is not a sphere, but flattened towards the poles; this made a difference of 275m in where a beam from Cherbourg would cross London!

Countermeasures and Counter Arguments

Cockburn's jammers came into operation in October, but at this time K.Gr.100 began to drop flares over its targets and this was hailed by some of Jones' antagonists as proof that the beams didn't work, or that the Germans were so unsure of them that they were using flares to find out where they were. However, Jones silenced these critics by pointing out that there was no evidence that K.Gr.100 was upset by our countermeasures (which was true) and were not only using the system, but acting as pathfinders for other Luftwaffe groups.

Yet other problems had to be overcome.

If the Enigma transmissions to the beam stations could be broken in time (they were usually sent out in the afternoon preceding a raid) we would know where and when K.Gr.100 was going to attack, and our fighters could be ready for them; our jammers, too, could be set on the correct frequencies. For this to be possible the cryptographers at Bletchley Park strained all their resources—and it was a *magnificent* effort, for they achieved this incredible feat late in October. Dr Jones was then able to tell Fighter Command the exact place of the attack, the time of the first bomb to within 10 minutes, the exact speed of the bombers, their line of approach to within 90m, and their height to within 2 or 3 hundred metres!

Yet our night fighters repeatedly failed to find the enemy. Jones wrote: *"I almost began to wonder whether the only use the Duty Air Commodore made of my telephone calls was to take a bet with the rest of the Command as to where the target would be for that night"*. On top of this was the growing suspicion that our jamming was not working. Why not?

The answer soon came—but not before tragedy struck.

Moonlight Sonata

On November 10 Jones received an Enigma decrypt of a transmission to the beam stations which told them to prepare operations against target numbers 51, 52 and 53, giving the beam settings at the same time. It took only a few minutes to work out that 51 was Wolverhampton, 52 was Birmingham, and Coventry was 53. Then another signal was passed to him which contained orders for a major operation under the code-name *Moonlight Sonata*. Four target areas were mentioned but there was no indication of the *order* of the attacks. Frantic guesses were made by the Air Staff and the best they could come up with was that Moonlight Sonata might mean a target in southern England. Strangely, no attack had been made on Wolverhampton, and on November 14 everyone braced themselves for the coming night and whatever Moonlight Sonata might mean.

Tragically, it was one of those afternoons when Bletchley Park failed to break the Enigma signals in time, and 80 Wing asked Jones which frequencies should they set their jammers on, giving a list of frequencies as determined by our monitoring aircraft. *"I could see at once that the measurements must be wrong, in that they did not match up with the figures I knew from the Anna code. I therefore made a mental correction of the measurements as far as I could—for example, 68.6 should have been 68.5, if our receivers had been properly calibrated, or 70.9 should have been 71.0. But deciding what, for example, 66.8 meant was more of a lottery. The only other clue that I spotted was that there seemed to be a convention that the director beams would generally be on frequencies between 66.5 and 71.5 and the cross beams between 71.5 and 75.0MHz, the division being presumably due to operational convenience. Remembering that we needed to knock out the main and reserve director beams and at least one of the cross beams, I then made my mental gamble and suggested a set of frequencies to Addison which he said he would adopt. All this took no more than five minutes on the telephone: but I was well aware that in these snap decisions I was probably gambling with hundreds of lives. Sobering though this thought was, the fact remained that someone had to do it, and I was easily in the best position."*

Then on the night of November 14/15 Coventry was attacked, with heavy civilian casualties. What had gone wrong? The next day the decoded Enigma signals to the beams stations arrived and Jones' wretchedness turned to bewilderment. He had guessed the frequencies correctly—so where was the failure?

Incompetence and Carelessness

The failure arose originally from a silly inter-service squabble which led on to a ghastly mistake. On November 6 one of K.Gr.100's Heinkels became lost over southern England and ditched on Chesil Beach. The Army took over, secured a rope around the fuselage and set about salvaging it, when a naval inshore vessel arrived and demanded to know what the Army thought it was doing. As the aircraft was in the water salvage was a Navy matter and, taking the rope aboard, dragged the aircraft deeper into the sea, breaking the rope in the process. The X-Gerät equipment aboard, now heavy with silt and corrosion, was fortunately discovered and rushed to 80 Wing and then on to Farnborough for investigation.

On November 21 Jones, accompanied by Scott-Farnie and their assistants, went to see it for themselves. They learned that Farnborough had examined the audio filter and found it set to 2000Hz. But our jammers had been modulated at *1500Hz*, which meant that while our carrier frequencies were correct the modulation tone had no effect on the beams.

"It was one of those instances, of which I have since found many, where enormous trouble is taken to get the difficult parts right and then a slip-up occurs because of lack of attention to a seemingly trivial detail. Of all the measurements in connection with the German beams, easily the simplest was to determine the modulation note, because this could be done at any time in comfort; and yet whoever had done it had either been tone deaf or completely careless, and no one had ever thought of checking his measurements. I was so indignant that I said whoever had made such a mistake ought to have been shot." It is hard to believe that the citizens of Coventry would have disagreed with this opinion.

Jones' anger was further increased by the fobbing-off he encountered. He was told that the modulation note was originally 1500Hz but the Germans had changed their filters to avoid jamming. This ridiculous excuse was countered by Jones who pointed out that if that had been the case we would obviously have heard the change in note for ourselves. In any event he was able to prove that K.Gr.100 had been using the same filters since the start of their operations.

On his insistence the jamming modulation frequency was changed and when, later, the Germans attacked Birmingham their bombs fell wide of the target, most of them outside the city. Gradually they came to realise we had broken X-Gerät and their confidence in the system diminished, and Britain which knew nothing about Dr Jones and his scientific war went on "business as usual".

In Part 3, G4GVO tells how Wotan's "other eye"—the Y-System—was successfully countered.

ERRORS & UPDATES

Letter—"Morse" January 1988

The Morse code equivalent of "ES" is, of course, "dit di-di-dit", and not as was shown on page 14 of that issue in the letter about American Morse.

Making Waves, Part 2 January 1988

The decibel equivalent of 50 picowatts is −103dBW, not as shown in the third column of page 52, where the minus sign became separated from the figures.

Practically Yours

By Glen Ross G8MWR

Several readers have mentioned a need for a simple method of testing diodes and transistors. The two requirements are easily combined into a single piece of test gear and have the added advantage that construction and setting up are well within the scope of the newcomer to home construction.

Measurement System

It is easy enough to roughly check transistors using only a simple multirange testmeter, but all that this method will tell you is whether the unit is basically in good condition or is a dud. The tester to be described will also measure the actual current gain of the transistor with reasonable accuracy and so gives a far better picture of the device. It can handle both *npn* and *pnp* devices and will also measure forward and reverse conduction of diodes. The current gain, or beta, of the transistor is measured on one of two ranges giving full scale readings of 100 and 300, and is therefore capable of handling all the gains likely to be found in practice.

The Circuit

This is shown in Fig. 1 and consists of the actual test circuit and a stabilised supply to power it. Basic power may be obtained from a 12 volt supply but it is probably better to fit a PP3 battery inside the case as the maximum current drawn is only around 25 milliamps and even that is only drawn for the few seconds it takes to complete a test. The supply is Zener stabilised to 4.7 volts and it is essential that this value of Zener is used if the readings are to mean anything as the various biasing resistors are calculated for this voltage. An l.e.d. is fitted to remind you to switch off when not in use. Switch S1a is used to select *npn* or *pnp* operation and this is achieved by simply reversing the supply lines to the transistor. The same switch also changes the voltage applied to a diode when it is being tested for forward and reverse current.

Gain Test

This is achieved by injecting a known current into the base of the transistor and reading the collector current, the ratio of the two currents being the gain of the transistor. Two levels of bias current are provided by R1 and R3 and these are selected by S2b. The meter is shunted to read 10 milliamps full scale deflection by R2 and is protected against an accidental short circuit, perhaps due to a faulty transistor, by the Zener dropper R5 which, even on a 12 volt supply, will limit the meter current to a safe level.

The Meter

This is a one milliamp unit and one should be chosen which has a good length open scale, preferably with a 0-10 scale divided into fifty units. This will give easy reading on the 300 beta scale where the actual reading has to be multiplied by three. The internal resistance of the meter is of no importance as it is shunted by a variable resistor to give the required ranges.

Build and Set-up

The front panel layout is in no way critical. The setting up procedure is simple and requires no extra instruments to do the job. It is important that the following steps should be carefully followed and completed in the order shown.

Connect the unit to a suitable power supply or fit the PP3 battery. Switch the unit on and the l.e.d. D2 should light, if it does not then try reversing the connections to the l.e.d. Now switch the range switch S2 to the diode position and set R4 to the maximum resistance position. Connect a short length of wire between the test terminals marked E and C and carefully adjust R4 to give full scale deflection on the meter. Leave everything connected as before and switch the supply off. Next connect a length of wire between the points marked X and Y on the circuit diagram and set R2 to minimum resistance. Switch the unit on and slowly adjust R2 until a reading of one tenth of full scale is shown on the meter. Switch off and remove both wires that were fitted in the previous steps.

Setting Beta Ranges

Connect a small transistor which is known to be in good working order with the emitter, base and collector leads going to terminals E, B, and C respectively and switch the selector switch to NPN or PNP as required. The range switch should be set to 100 and when the unit is switched on a reading will be obtained and this should be noted. Switch off and set the preset R1 to the maximum resistance position and the range switch to 300. Switch the unit on and slowly adjust R1 until a reading of one third of full scale is shown on the meter. This completes the calibration of the unit.

Using It

To test a transistor connect it to the terminals, set the range switch to 300 and the selector switch to NPN or PNP. Switch the power on and if the reading is less than one third of full scale switch to the 100 range. If there is no reading throw the transistor away.

To test a diode connect it between the E and C terminals and set the selector to the diode position. Operate the PNP/NPN switch and you should get a high reading in one position and a low one in the other, if not scrap the diode. Sometimes you get something for nothing; the meter can also be used as an ohmmeter by connecting the resistor as though it were a diode, a graph of the calibration should be drawn up using a few test resistors of known values. ***PW***

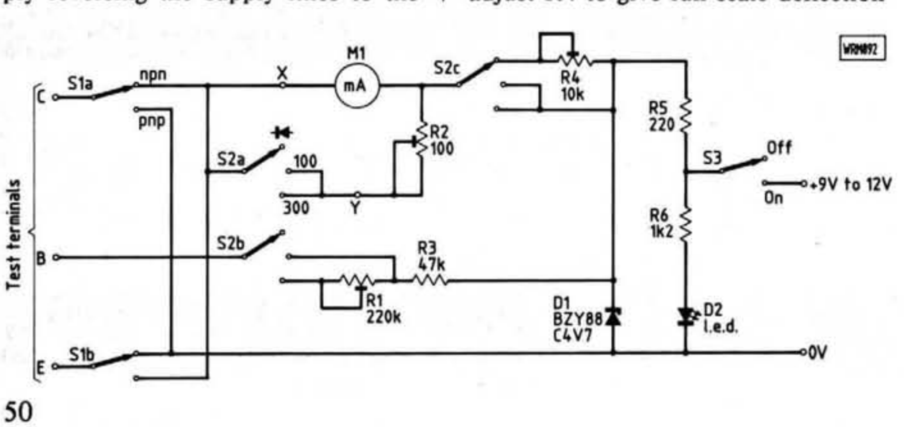


Fig. 1: The actual test circuit and a stabilised supply

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On The Air
On The HF Bands

Reports to Paul Essery GW3KFE
287 Hoel-y-Coleg, Vaynor, Newtown, Powys SY16 1AR.

There is to be a change in postal arrangements this end, please send your letters direct, to arrive by or if possible a bit before the due date. Address them to: E. P. Essery GW3KFE, 287 Heol-y-Coleg, Vaynor, Newtown, Powys SY16 1AR.

Conditions

As always, some days are better than others. However, there is no doubt the bands are far livelier than they were a year ago, even on the bad days. Since writing last month's piece, there have been some more gales, plenty enough to make me peep out of the window to see whether the familiar sight of mast and guys was still there on several occasions; and for the end-fed there has been no lack of rain to keep the earth resistance low! The 28MHz band has been better than for many a year, as we shall see.

Forthcoming Events

Brought to us by courtesy of my ears, *DX News Sheet, The DX Bulletin, W1WY, The Canadian Amateur,* and your good selves. Thanks to everyone!

VK2AU is to be in 5W1 and KH8 over the December/January period. The QSL address will be: PO Box 99, Merrylands 2160, Australia.

Jan Mayen activity is scheduled for the rest of the winter by JX8XY.

That S0RASD station has been noted again, as has SO1A on the 3.5MHz band.

Returning to the Mount Athos effort, DXNS has it that G0BTY was told by SV1JG that two IRCs only were required for those needing a QSL to ensure a direct reply. IF that is so—and at the time of writing it is unconfirmed—then they have removed a large barrier to acceptance of the operation for DXCC credit. On the other hand, may I ask if those who were fool enough to fork out the original exorbitant charge will receive a refund? If not, I still believe that the operation should be disallowed, as the only way to prevent this habit of daylight robbery spreading.

ZL1AMO's DXpedition to Auckland & Campbell Is., ZL9 is due in February. It will, I understand, be supported by NCDXF—and I hear that Ron will be accompanied by ZL1BQD and ZL1BN.

It is nice news to hear that the USSR and Canada have signed reciprocal licence agreements—initially this was to aid communications with the joint USSR/Canada ski expedition to cross the North Pole from Russia to Canada; the agreement is between November 1987 and February 1988, but one hopes it will lead to something more permanent.

Baker/Howland Is are becoming increasingly rare in DXCC terms; Jim Smith VK9NS and Kirsti VK9NL are proposing an operation there in March, with up to ten in the party. By the time you get to read this it's probably too late to volunteer, but those who go will probably find this uninhabited spot unpleasant but interesting and with plenty of action.

XU1SS is being heard of more lately, usually around 14.165MHz, usually Mondays to Thursdays.

JE3MAS, who also sports WH6X, will be on Zanzibar Island for a couple of years, using the call 5H3HK—QSL via JH4RHF.

The 28MHz Band

David Corfield (Matlock) has made a return to the bands recently, and has an FRG-7 receiver fed either from a random wire or an active antenna. He noted much activity at times, and in the DX line, W4ZR and PY5EG.

GM4ELV (Glasgow) says he found the bands very varied: however his QRP at 5 watts produced contacts with 4X4HQ, 5B4TI, AY3F, YV1AVO, PY3PG, A22BW, ZS6ARM, ZS6P, ZS6AOO, ZS1ESC, ZS1ZO, ZP5HF, ZD8MB, PZ1AP, ZD8MAC, ZP5JAL, SV1DO, SV1AHH, 4X5000, KP4VZ, LU7EMZ, WD8KWT, PT2ZDR, VU2RCK, J28DN and Z23JO.

G3NOF (Yeovil) notes the big improvement in conditions on the band, although there has been a daily variation; some days just edging open, others wide open. Don made his number on s.s.b. with A71BJ, CE3DFY, CP6XD, CP8HD, CX2AAL, EA9IB, EA9RY, FH8CB, FM5CL, FM5WQ, FR5DX, FY5EM, J28EO, J37ZY, J73LC, JW0B, HI8FHD, HK3GHI, K5WA, KP4BZ, KV4AD, PY5CC, PY5EG, PY5ZBA, TU1BS, TZ6FIC, V1KS/4U (=YKI), VP8BKK, VU4GDG/CE (Andaman Is.), YB0BAQ, YB0TK, YI3BGD, Z23JO, ZC4AP, ZD8MAC, ZS6AOJ, 3D6BW, 4X5000, 5H3RB, 5T5NU, 9J2BO and 9M2HB.

G4HZW (Knutsford) noted quite a bit of activity, with contacts out to 4X6MH, 5N27BHF, 8P9HQ, 9J2EZ, 9Q5NW, CE3DQO, D44BC, FR5DX, HC1OT, I, HB0, J28EO, LU1ABT, P40V, S79WS, SP, TI8CBT, UA6, UL7ACI, VU2SJV, VU4GDG on Andaman Is., YB0WR, YV3BKC, ZC4DX, ZC4EE, Z21GT, ZS3BI, ZS4NS, ZS7ANT (Antarctica) and ZY5EG. As usual, the rig was TS-820 plus 2-element quad.

G4WJM's doings on the band were mentioned by **G3BSN;** he seems to have found VU2ZAP on c.w., and KP4FBA on sideband for DX, plus Europeans such as DL, EA, F, I, UA and UK. The rare ones included such as AY1DZ from Argentina, CX9DH, PS8AM, PT7DX, PT7WX, VK2UZ, YB0TK, ZS6TB, ZS6WRS, plus OD5PL, and ZB2IP.

I noticed that November also has been blessed with good conditions; it seems that the solar flux got up to between 95 and 100 for all the first three weeks of November, while the A index, which tells about absorption, stayed below 10 most of the time. I suspect the latter was an enormous help—and of course the presence of activity is the final piece in the jigsaw.

So: G3NOP noted short-path openings to VS6, JA, BY, VU, VK in the mornings, Africans morning and afternoon, and North Americans 1300–1600Z, mostly from the East Coast but some Middle West signals. Nothing was heard of the West Coast Ws, the VEs were mostly VE3s, and ZL and the Pacific were absent. QSOs using s.s.b. were made with CE5HFQ, CE6OS, FP5HL, FR5DX, 5EL, HB0/DL8OH, HI8HFD, HI8PJP, HSOA, J28EO, JF6FVC, JI6BVF, KB5DVD, KP2J, KP4JN, N5FJ, N0IDW, ON7VD/5N6, PY1ZAO, PY2ZDR, S0RASD, S79WS, SU1ER, TI2JJP, TI8CBT, TR1G, TU2QT, VK2JHW, VK2NYA, VS6CT, VU2CVP, VU2RSK, VU4GDG/APR, WB5SKQ, WB0CEI, WB0RMO, W5UAW, YB0HOB, YB0JH, ZC4EE, ZD7AF, ZD7BJ, ZS3BI, ZS3GB, ZS6AOJ, 4S7NMR, 5H3RB, 5N27BHF, 5N9BHA and 8P9HQ.

G4HZW (Knutsford) says November was the best month on the band for three years; as he says, "not weak Ws using kilowatts but 50 watts to a dipole at S9+". Tony notes particularly AP2P, BV2DA, BV2FA on c.w., GD4XTT, JH6QPD, OH, UA3-4-5-6, UL7AAC, UM8MIG, RA9XBM, RA0AA, S79WS, SM, TR8SA, VK4KRP, VK8NHM, VK8RC, W1-2-3-4-5-8-9-0, XX9WW and YB0HOB. Quite like old times!

The 1.8MHz Band

It seems as though most of the 1.8MHz band merchants suffered in the October breezes; hence not much news. **G3BDQ** (Hastings) was in the thick of it: although the guys held, the mast broke at about the 6m level below the top, damaging three of the sections. In addition the high point 6m above at the house end broke—the fixings broke and saved the mast, thankfully. So John has now only a piece of wire about 2.4m high and 600mm from the wall, rising to a maximum of 6m. Before the storm, G3BDQ worked RA9ABK, RA9SSN, UC2AGC, UZ3TWY, UA3YCE, UB5EAQ and YO3CD; after the wind, the improvised antenna just mentioned managed to make it to OK3KII, C31LBB, UC2WAZ, RA9CSV, SP9GDB all on c.w., plus IK0BYO on phone who said John was the biggest signal on the band, thus causing a hollow laugh! Everyone locally lost antennas; John's Tonna for 50MHz survived, but although the garage roof was still off when he wrote, the house and greenhouse roofs have been repaired. Windspeeds of 177 k.p.h. were recorded, sustained for 15 seconds at a time, while the average was 137–145 k.p.h. No wonder they were short of electricity for three days!

G2HKU (Sheppey) has had to drop his mast for repairs after a guy parted in the hurricane but he was thankful that he lost nothing worse than a few tiles off the ridge of the house. Ted managed s.s.b. with ON7BW and ON4CW, while the c.w. went over to UQ2GKL, UA2FGA, DF1LX, DJ1RL, OL1BLN, LA5UF and GI3PDN.

BY on the 1.8MHz band? I hear that BY4WNG is active on all bands 1.8–28MHz; he is Chao Meng, who is a student at Nanjing Institute of Technology. You might catch him on the DU9RG net on 7.088MHz for a sked.

The 3.5MHz Band

Unusually, G3NOF mentions this band; he made it on s.s.b. to RW9USA and S0RASD.

G3BDQ was moved to try out his improvised skywire on the band with s.s.b., when lots of EUs were worked to celebrate "Hastings Day" on October 14.

The c.w. of **GM3JDR** connected with VU2GDG/TS; nothing else mentioned.

A new reporter is **GI0GDF**, who is ex-

G0GDF and G6PYE. He first became interested at the age of eight and has been interested ever since, leading to the tickets mentioned. In England he had a dipole at 4.5m on 3.5MHz, and a couple of watts out; but in GI he has a garden 7.6m long, alas. Were that not bad enough, he has the Radio Ulster transmitter 1km away to add a bit of receiver-overload QRM to the story; nonetheless GI0GDF is still playing with antennas and hoping to work a few countries; as he says, at this power level every QSO is an adventure and a pleasure.

G0HGA (Stevenage) also uses QRP, and on this band she had a one-hour ragchew with GM3TMK, plus QSOs with DL1BAC, YU3VD, and Gotaways IK2DZR and DL9MCD.

The 7MHz Band

GM3JDR (Aukengill) has a long list for both periods, so we must mention the best of the bunch for this month: FT8XD, C21XX, ZL7TZ, VU4GDG/TS, FG4BO, ZS, UA9s, UI8, ZL1MN, YBs, YCs, UL7s, VK1BA, lots of JAs, OAs, UJ9XWA, TP2CE, VKs, PY, VK8MQ, UA0s, 4Z9AAC, VU40TTG, TR8JJC, VU2DX, W6s, VK7GK, VS6UO, RO4OR, RO5OY, 4K1A, 4K1C, 4K0E, KV7Q, SORASD, VK8AV and SU1MR.

G2HKU used c.w., after completing repairs, to work UA3ABM and RG0G.

G3BDQ also preferred c.w. for VK8AV, VK3MR, UL7CAD, K3IPK at 2017Z on October 29 which was a mite early, VU40HSM, 4S7RO, UA9LQ, UA9SIH, VE1CJO. N2RM was worked around 2000Z on November 22, when all around was Ws at 599!

Unusually, G3NOF had a spin round and he raised EA8ACH, KP2A, FJ5BL and UB4CWW all on s.s.b.

Just one station is mentioned by GM4ELV; his QRP made it on c.w. over to OY9JD.

New Bands

Locally, there has been much noting of American s.s.b. activity on 24MHz during the good conditions. GM3JDR offers VE2JR on 18MHz, this month, and the previous month made it to FG5XC and UL7MU on 10MHz, plus VE2LI on 18MHz.

A first report from **G4ZAU** (Oswestry) who stayed with 10MHz; Dudley has a TS-930S and a dipole at 6m above ground. This yielded contacts with 9H1BB, VP2MDY, JA2IFP, C30BBE, VE3DZR, VK2EZA, VK3IO, VK6AKG, WB2QHQ, PZ1BV, F/3A2ALR, JR8AUT, VE1BB, LA3YY/MM, VK2OO, VK5NM, W1FZY, W3ARK, K1GOW, KA1PCQ, KA3PDR, KA8VLW, N2CPL, UA1ZQ, UQ5GBQ, UA9IWZ, G3DOT/LA, OZ9N/SM7KFD, KB1DA, K3DV, K4RF, K4AWY, UA1NH, UB3JWA, UA6XE, UV9UWW, PA0VG/EA5 and three QSOs with JA3SVG/MM who was heading northwards from the Western Approaches up the Irish Sea.

G3BSN (London SW9) noted the beacon DK0WCY as a good condition-indicator on 10MHz, so Phil contacted the usual Europeans plus CT3DJ, F2DW, HB0XDJ, HB9GDV, OH2BGG, KB1CV and K2SWZ.

The 14MHz Band

G3BDQ used the remains of his antenna system, as already described, to work 4K1AH (Mirny Base) for whom QSLs go via UZ1AWO, W6THN, 4K0E (QSL to UA1ADQ), N8BZK, K7GN, KD6JD and W0JCB (Nebraska) all on the key, while s.s.b. made it to VK2EQ, VK4ABT, UH9BWD, 4B2V and EA9UE.

G3NOF noted long-path openings to VK/ZL/JA between 0730–9030, but little from the Pacific. T32BB was worked, short path, at 1743 and around noon there were openings to Asia. QSOs using s.s.b. were made with A92EM, AA4VK/CT3, CT3EU, FJ5AB, FP5CJ, FR5DX, FR/G/FH4EC, FY5EM, FY5YE, HC8DX, P40SS, PJ1B, PJ0J, S79D, T32BB, VE7DGI, VE8CDX (The Canadian/USSR expedition), VK2CLB, VK3AQI, VK6ZQ, VK9ZG, VP8BDD (Antarctica), VP9AD, WB4PJB/VP5, ZL2BEJ, ZL4AK, ZS3GB, 3B1FP, 7X4CV and 8P9HR.

Just the one contact for G2HKU, a c.w. one with HK3RQ. As for David Corfield, he offers NM4H, plus dozens of East Coast Ws and Europeans, with the band still open as late as 2030.

G0FUS used his FT-200 and c.w. to raise VE6EO, W0MLD/ID9, VE3PVW, UZ9WWR, UA9MCT, RA9UM, VK6WT, 4X6IT, JA8BGR, RV0YF and UL8GBI, while s.s.b was the mode for 4X6KF, VP9LB, TK5UC, W5ESI/MM1 in the Atlantic, G6ZY/EA6, G4GEO/EA5, SK0SX and ZL1BYC.

On now to GM3JDR; Don made it to UA0LFS, UA0ZDN and VU4GDG/TS.

Your next three deadlines are: January 27, March 2 & March 26

The 21MHz Band

Naturally, with activity so high on 28MHz, 21MHz has been really popping. G0HGA found here 3 watts to a CB vertical enough for EA5AIO, UA3LHA, UA3DNJ, UA1AEP, RA3GKJ, UB5SBX, YU4YA, UA3LHE, LZ1KBG, YO8CF, UY5MV, SP5YQ, HA3KX and EA4RCT.

G3NOF says he found the long path to JA open around 0800, YB/YCs peaking aorund noon, along with VKs, South America around 1700, and band closure about 1800Z. Don made his s.s.b. react at BY5QA, BY5RA, BYAC, C30W, CW4C, DF9ZP/VP9, DX1DBT, FM4DN, FM5CL, FY5YE, HB0/DL8OH, HC8DX, HL1AZE, HL5FEE, HU1YS (=YN!), JF6ITM, JG3AGC, JG6KLB, K7EHI (Utah), KG4GN, KT7V (Wyoming), P40V, PJ1B, PJ0J, RL8PYL, S79WS, TA2/N4EXR, TA4A, TZ1GH, TZ6MG, VE7DGI, VE7IG, VE7JY, VP9AD, VU2XX, VU40SMN, VU4GDG/TS, VK2EQ, VK2JU, VK8NHM, W7EG (Oregon), WA4TLI/CT3, XX9T, YCs, YI0BIF, ZF2KK/9, ZL2ADX, 5T5MH, 5T5BC, 5N8ZHN, 7P8DP and 9Y4DG.

GM4ELV (Glasgow) managed JH7WKQ and H25MF, using his QRP to a half-sized G5RV but with a good take-off.

Just one for G2HKU, thanks to all the hurricane repairs, and that was a c.w. one with W1HT.

David Corfield noted N2OR, WB6FDR and many other American and Canadian stations.

Next we have G0FUS (Winchester), he sticks as far as he can to c.w. with his FT-200 and dipoles which vary between 3 and 4.5m a.g.l. The band gave AY5HOD (=LU), LU1HDC, LU8OYH, RB5LAF, U1CZ and T77T, the last on s.s.b.

Turning to GM3JDR, we find he worked AY1DZ, ZS1AAX, JAs, VK9AB, FM/F6EYS, UA0YM and VS6BL.

Final Thought

An editorial by VY1CW in the *Canadian Amateur* covers the question of encroachment on our bands as seen over there. Bill makes the point that lots of these people keep using our bands because the gear is cheaper, and competitors don't overhear them. Information overheard giving precise locations of fishing pots and lines was passed to another amateur who had access to "proper" marine radio, and who broadcast the information to everyone else. Thus when the pirate went to pull his pots, he found the whole area thick with competitors. Apparently, both the pirates promptly sold the amateur gear on returning to port—reason given, "no secrecy any more!"

VHF Up

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

Thanks to a fine spell of tropospheric propagation at the beginning of November, there are plenty of reports from readers this month. The event was a good example of how a widespread temperature inversion can make real DX QSOs possible from v.h.f. to microwaves.

Awards News

Another two readers have joined the 144MHz QTH Squares Century Club. **Jaap Nap PE1JVH** from Breukelen (CM65d) is the third Dutch operator to achieve a QTHCC award and his certificate, No. 83, was issued on Nov 5 for 101 squares confirmed out of 139 worked up to Oct 26.

Jaap's station consists of Yaesu transceivers FT-480R and FT-290R, a BF981 pre-amp, 60W Yaesu amplifier type FL-2050 and 14-ele Parabeam at 15m a.s.l. fed by Pope H-100 cable. 94 QSOs were on tropo, six via Es and one by Ar mode. Best tropo DX was EA1OD at 1244km, best Es contact EA8BEX at 3172km.

Howard Staddon G6STI from Hayes End in Middlesex (ZL38d) was issued with certificate No. 84 on Nov 7 for 101 confirmed out of 123 worked. His station comprises a Yaesu FT-726, a 250W amplifier and 17-ele Yagi antenna from Tonna. High power is seldom used due to TVI problems. The confirmations were for QSOs from June 1983 onwards but no propagation mode breakdown was listed.

Any reader thinking of applying for QTHCC membership should first write to the Poole address requesting a copy of the rules and an application form, enclosing an s.a.e. Please do not send any cards without the form.

Worked All Britain

John Fitzgerald G8XTJ (BKS) reports that the WAB Large Squares award for 70MHz has gone to Jerry Russell G4SEU and that some 50MHz awards are probably in the pipeline. The Winter Activity Award continues till the end of February under the same rules as last winter.

WAB nets take place on 144.43MHz as

follows: London area, Fridays 2030, Sundays 1030; North of England, Wednesdays and Fridays from 2000; Hampshire, Tuesdays from 2030. Most serious WAB activity takes place in the 144.43-144.46MHz part of the band.

Beacon Matters

Geoffrey Holland G3GHS, Honorary Secretary of the Mid Cornwall Beacon and Repeater Group, has written about the situation of the GB3CTC beacons. The 70MHz and 144MHz ones have been back in service for some time, the Gas Board having agreed to the antennas being re-installed on the old mast, yet to be dismantled, due to delays elsewhere. They might suddenly cease when site work starts however.

The Group are being given a new 432MHz TX which should give a cleaner signal. If the old antenna and cable are in reasonable condition service could be resumed on this band. Final papers concerning the 1296MHz beacon were still awaited at Nov 12.

The RSGB has offered the Group equipment for a 50MHz beacon and they have agreed to install it, provided the necessary site clearance and paperwork could be obtained quickly. More news is awaited.

In the December VHF Up, I mentioned that Godfrey Hands PA3EUS, alias G0FBG, (JO21NX) promised more details of an intelligent beacon PI7PRO. He has now sent further information as follows: QRG 144.840MHz, temporary location CM67e, power 10W, antenna 10m above street level vertically polarised. In the future it will be 120m a.s.l. with a horizontally polarised antenna.

Its frequency will be phase locked to the MSF TX with a crystal oscillator taking over if Rugby goes off the air. The beacon is semi-intelligent and will report propagation conditions as they occur. Godfrey quotes two typical messages; "PI7PRO—A40" which signifies Auroral conditions at QTE 40° and "—T150" meaning a tropo opening in the direction 150°. Once every ten minutes all this information will be sent at about 180 words per minute for m.s. operators. All reports to PA2VST whose QTH is R.V. Broderodestr 32, NL-1471 CP, Kwadyk, Netherlands.

Meteor Shower Information

The next recognised major shower is the Lyrids in April, however there are a couple of minor ones, which could be useful, coming up. The Kappa Cygnids peaks on Jan 17 and its Right Ascension is 295° and the Declination +51° so the radiant is above the horizon all day in the UK. The best times for the various directions are: NE/SW 1530-2030; E/W around 0430 and 2000; NW/SE 0400-0900; N/S 0600-0930 and 1500-1830.

The Alpha Aurigids shower lasts from Feb 5 to 10, RA 74° and DEC +43° and is available again all day as far as radio reflections are concerned. Best times are: NE/SW 0000-0330 and around 1700; E/W around 0300 and midday; NW/SE 1230-1630 and around 2300; N/S 2230-0230 and 1330-1800. There is no guarantee that either shower will be all that useful and sometimes better results are obtained on so-called random meteors.

The 50MHz Band

The t.e.p. tests from southern Africa were successful with G and GM being worked as reported last month. The informative *VHF News* sheet from Hal Lund ZS6WB includes news that ZS3E worked CT4KQ and 9H1FL on Oct 16 and later 9H1BT. The 5B4CY and 9H1SIX beacons have been copied in Bulawayo by Z21FT. During October A22KZ had many QSOs with 9H1BT, 9H1CG and 9H1FL in Malta and with SZ2DH in Greece. Since Nov 7 the Pretoria beacon on 50.0225MHz has been beaming towards Australia. It sends on c.w. "de ZS6LW" continuously. Plans are afoot to install an omni-directional antenna, and beams towards the UK and South America, using time-sharing with the VK beam.

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

Station	70MHz		144MHz		430MHz		1296MHz		Total Points
	Counties	Countries	Counties	Countries	Counties	Countries	Counties	Countries	
G1KDF	—	—	98	16	70	12	33	8	237
G4NBS	54	7	68	19	53	19	*42*	*10*	220
G6XVV	—	—	89	26	60	14	20	9	218
G6HKM	—	—	75	27	54	13	33	7	209
G1LSB	—	—	75	29	63	23	—	—	190
G1SWH	—	—	97	12	58	11	—	—	178
G1GEY	—	—	74	26	47	12	—	—	159
G1EHJ	—	—	58	12	53	9	—	—	132
G4MUT	26	1	49	16	29	10	*11*	*4*	131
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	19	10	126
G4ZTR	36	5	32	11	24	6	*21*	*6*	114
ON1CAK	—	—	80	34	—	—	—	—	114
G4VOZ	61	6	—	—	34	7	—	—	108
G6MXL	22	5	42	11	18	7	*8*	*3*	105
GW4FRX	—	—	77	28	—	—	—	—	105
GW6VZW	—	—	68	24	9	2	—	—	103
G3FPK	—	—	78	24	—	—	—	—	102
G4WJR	—	—	78	10	—	—	—	—	88
G4TGK	—	—	66	19	—	—	—	—	85
G8XTJ	—	—	66	17	—	—	—	—	83
G4AGQ	15	1	31	12	13	4	*1*	*1*	76
G4YIR	—	—	60	15	—	—	—	—	75
G1CRH	—	—	64	11	—	—	—	—	75
G6OKU	—	—	54	15	4	1	—	—	74
G0HDZ	—	—	53	11	—	—	—	—	64
G6MGL	—	—	25	6	25	2	1	3	62
GM4CXP	2	2	33	17	3	4	—	—	61
GW4HBK	48	7	—	—	—	—	—	—	55
G0HGA	—	—	43	11	—	—	—	—	54
G1VTR	—	—	16	2	22	5	—	—	45
G2DHV	11	2	21	5	3	1	—	—	43
G3EKP	13	3	12	3	7	3	—	—	41
GU4HUY	—	—	32	6	—	—	—	—	38
G4WND	25	4	—	—	—	—	—	—	29
G6XRK	—	—	8	6	—	—	—	—	14

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

Dave Ackrill G0DJA (WMD) is modifying his relay control of his *PW* Meon transverter to facilitate running packet radio on the band. **Ron Reynolds G6WEM** (ESX) is building a Meon transverter so hopes to be QRV soon. **John Pilags G8HHI** (SRY) is already active on the band.

John Palfrey G4XEN took part in the Oct 18 contest, his best DX being CT4KQ at 1407km, thanks to Es propagation. But John's 10W to a dipole did not attract GJ4ICD's attention even though Geoff was peaking to S5 at times. **Paul Thompson G6MEN** (SPE) would like some cross-band skeds with Europeans who cannot transmit on 50MHz. Anyone interested can contact him via PO Box 32, Shrewsbury, England SY1 1ZZ. He can conduct conversions in French and German if required.

Geoff Brown GJ4ICD sent Issue No. 1 of the *International 6 Metre Digest* published by Harry Schools KA3B. This mammoth number ran to 26 pages of A4. It includes letters from 50MHz operators from many countries, DX and beacon news, photographs of stations, etc., e.m.e. and Ar notes and a long history of the 50MHz band from 1 March 1946 up till 1982. He plans to cover from then to now in later issues. Geoff wrote that anyone wanting copies of the November and December issues should send a large self-addressed envelope and five IRCs. UK readers please note that UK stamps are **not** valid in the Channel Islands or in the Isle of Man.

Bob Nixon G1KDF (LNH) thought the Oct 18 contest poorly supported and wondered if that was in part due to some having lost antennas in the gales a couple of days earlier. Via Es he worked EA1MO who was worth 149 points.

The 70MHz Band

Denis Jones G3UVR (MSY) has now worked 49 locator squares on the band thanks to some of the expeditions of last summer. In the Fixed Contest on Oct 25 **Tony Collett G4NBS** worked 48 stations in 28 counties in rather poor conditions. He thinks activity is on the increase and best DX were G3JYP and G3FDW (CBA) from Cambridge.

John Jennings G4VOZ (LEC) has been concentrating on f.m. mode with a horizontal antenna both to build up his counties score and with an eye to packet radio. Recent QSOs were with G1DOX (CBA), G6WZA (SOM), G4IJE (ESX), G8CVF (MSY), G6REG (NHM), GW6ZMN near Cardiff and G6SKO (DYS). On Nov 17 he had a three-way c.w. QSO with G3CJ (GLR) and G4GYK/P (AVN), a somewhat rare event on the mode.

The 144MHz Band

Most of the reports this issue refer to the excellent tropo conditions between November 3 and 8. But first, mention of an Aurora on Nov 3 about which I was alerted by **John Nelson GW4FRX** (PWS) at 1735. John worked SM6CLU/6 (JO68), LA9UX (JO59), SK7JD (JO87 and quite rare), OH1AU (KP10), SM0HAX (JO99) and SM7GWU (JO78) between 1816 and 1837.

At G3FPK, GM0EWX (WR49j) was

heard at 1813, later SM0HAX. Three minutes after I worked LA8SJ (JO59HQ) someone switched the Ar off and GW4FRX noted the same phenomenon. The only other reader mentioning this event was G6MEN who worked GM4ISM (XP) at 1825.

Now to the tropo starting with **Johan Van De Velde's ON1CAK** letter. The Belgian stations worked into LA, OZ and SM from Nov 3. On the 4th, Johan worked GW3KJW (XM), GMOHNX (YP), SP6HEI (IL), SP3RBF (HL) plus GM, OK, SM and Y stations. The 5th brought GD, GI and GM contacts and OY9JD (WW) for a new tropo record QRB of 1420km, plus EI stations. The next day brought more GD, GI, GM, OZ, SM and Y QSOs and on the 7th, amongst British Isles stations, Johan worked into OK and SP, the latter in new squares JK and JL. His British Isles counties tally for 1987 on Nov 8 was 80, a performance most Gs, will envy. He is still looking for Fermanagh, Orkney and Shetland.

G0DJA kept to c.w. 2.5 or 25W only and using an indoor 5-ele Yagi. In the contest weekend, Nov 7/8, Dave worked OK1DEF (JO60), OK2TU (JN89), GU4HUY (GUR), nearer Europeans but missed Y23MB.

Angela Sitton G0HGA (HFD) is a c.w. devotee for whom OK and Y contacts provided two all-time new countries. She found that, "With just 10W and very deaf 'front end' to a 4-ele . . . only 3m a.g.l. . . ." she was able to work lots of continentals so is now a confirmed v.h.f. DX-er. She has recently installed a vertically polarised HB9CV antenna as an experiment.

New for **Mark Page G1EGC** (BKS) were SP3MIC (IM) and SP2NJI (JM) on the 7th. SP9DAB (JK) was heard plus stations working YO, YU and UB5. **Tony Wayland G1HJW** (ESX) reports the band opening up to OZ and SM in the late evening of the 3rd, with DLs and GM8FFX (GRN) the next day, and more OZ and SM contacts on the 5th. On the 6th the band was wide open to both German states, OK and SP, best DX being OK2KZR/P (JN89), OK3KGW/P (JN99), SP6HEI and SP3RBF. The conditions were still good on the 7th, QSOs being made with two more OZs, five OK1s, two Y3s and SP6GZZ (JO81).

Welcome to **John King G1XFE** (DYS) who runs just one watt of s.s.b. to a 5-ele. Jaybeam antenna. He copied the ON4VHF beacon on 144.985MHz for the first time on Nov 5 and then worked ON4KFM and ON4BG. The next day he contacted DC0KV and ON1KVL. Apologies to **Dick Bacon G3WRJ** (HFD) for omitting his c.w. ladder entry last time. He now has 157 stations worked this year in 11 countries.

Welcome to **John King G1XFE** (DYS) who runs just one watt of s.s.b. to a 5-ele Jaybeam antenna. He copied the ON4VHF beacon on 144.985MHz for the first time on Nov 5 and then worked ON4KFM and ON4BG. The next day he contacted DC0KV and ON1KVL. Apologies to **Dick Bacon G3WRJ** (HFD) for omitting his c.w. ladder entry last time. He now has 157 stations worked this year in 11 countries.

Bryan Llewellyn G4DEZ (ESX) was home for the lift and spent most of his time on other bands. In a ten minute period in the early hours of the 7th he worked OK, SP3 and Y3 stations. He reckons he has only been QRV for about 20 days in the last eight months. **David Sewell G4FVK** (CBE) lists D and F stations on Nov 6/7 and OK1ADS/P (JO60) worked on c.w.

G4NBS only re-erected his antenna about half an hour before working 11 new squares in the lift. Tony lists DL4RU (JN69), Y31VA (JO64), OZ1KYG (JO55), OK1UMA (JN79), OK2KZR/P, OK1KRU/P and OK1VRU/P (JN79), Y23NL (JO61), OK3KGW/P, OZ5BU and OZ1EAJ (JO65 and 100th square), DC7MH (JO62) all on s.s.b. plus SP3JBI (JO91) on c.w. Subsequently he worked more of the same plus F and HB9.

Ian Cornes G4OUT (SFD) was able to boost his c.w. ladder total considerably during the four days of the lift and his total was 262 up to Nov 8. On the 5th and 6th OK and Y were two new countries and he worked seven new squares. The c.w. contest produced another 13 new squares and Ian listed 36 DX contacts in D, F, GM, HB9, ON and PA.

G4XEN worked many stations on Nov 6 but none were in new squares. On c.w. John worked 14 OK1s, three OK2s, five OK3s, SP2DDV (JN), SP6AAT (IL), SP6BIB (IK), SP9EWU and SP9HWY (JK). He participated in the six hours c.w. contest on the 8th when conditions were beginning to go down. But they were still good into Germany and his final score for 1987 was 40 per cent up on 1986.

June Charles G4YIR (ESX) worked, on c.w., four OKs, two Ys, a DF in Berlin and an HB9, missing out on the SPs though. **Colin Ford G4ZVS** (WMD) is another keen c.w. operator and the lift coincided with his winter holiday period so he spent a lot of time operating. In two hours from 1500 on the 6th he worked 18 OKs, seven Ds, five Ys and one each EI, F, ON and OZ. Best DX was OK3KGW/P at 1451km.

Colin entered the c.w. contests on the 7/8 Nov when many DX stations were available. Among others he mentions HB9BZA/P (JN36), OK1KEI (JO70) and F6IOC/P (JN36). While many continentals were worked, not many G stations were, but perhaps they were all beaming to the east?

Keith Killigrew G6DZH (HWR) added five new squares in the Nov 3-7 period. He lists contacts in D, GM, OK, Y and probably the best DX, SP3MFI (JO91BS) at 0104 on the 7th. **Ela Martyr G6HKM** (ESX) sent a colour print of the collapsed telescopic tower laying across the roof of the wooden shack. However, she can use another mast but can only have one antenna on it at a time. Using a 9-ele Tonna Yagi she did add another five squares in the lift, HL, HM, IL, GO and JK. To further complicate matters, the rotator malfunctioned requiring a visual check to see where it was aiming the antenna.

On the evening of the 4th, Ela worked four SPs, five Y2s, an OK and many Ds, rounding off with GM4DGT (CTR). The 6/7th was very rewarding with 23 OZs, seven SMs, six each Y2s and SPs and 10 OKs including her first YL OK station. Most QSOs came from her CQ calls.

G6MEN did not operate much in the lift but Paul did work some D and OK stations, best DX from YM27j being OK3KGW/P on c.w. **Mike Law G6OKU** (DYS) added six more countries and ten squares in the periods Nov 4-7 and the best DX were OK1VFA (JO70), SP6GZZ (JO81) and OK2VQF/P (JN99) at 1435km.

G6WEM remarks on the greatly improved operating standards during the lift. Ron's list starts at 2020 on Nov 3 with OZ1KLB (JO55). The following day brought GM0FRT and three Ds one of whom DK3NZ/A (JO51GT) was running 20W to 16 8-ele Yagis. The 5th brought

QTH Locator Squares Table

Station	Band (MHz)			Total
	1296	430	144	
G3IMV	17	116	405	538
G8GXP	30	140	307	477
GJ4ICD	59	119	253	431
G4KUX	—	80	345	425
G3UVR	75	125	224	424
G4NQC	63	99	250	412
G3XDY	81	137	185	403
G4RGK	38	106	253	397
G3JXN	82	129	175	386
G6DER	70	105	182	357
G4XEN	—	106	250	356
G1EZF	32	86	234	352
DL8FBD	—	69	274	343
G8XVJ	18	88	236	342
G3COJ	44	102	186	332
G4DEZ	44	38	246	328
G4DHF	—	—	307	307
G6HKM	26	101	177	304
G6XVV	25	64	211	300
G4SWX	—	—	293	293
G4TIF	—	106	184	290
G8PNN	62	97	128	287
G8HHI	31	106	148	285
G4FRE	63	136	84	283
HB9AOF	55	80	141	276
G6MGL	50	89	135	274
G0DAZ	—	91	183	274
I4YNO	—	—	270	270
G8ATK	42	89	138	269
G4NBS	59	103	102	264
G6YLO	32	104	128	264
G4MUT	28	90	145	263
G1KDF	27	86	144	257
G4SSO	—	67	190	257
G1LSB	—	126	125	251
G1EGC	—	70	171	241
G6DZH	—	87	149	236
G3NAQ	—	75	154	229
G3FPK	—	—	224	224
G4IGO	—	—	223	223
G4SFY	—	—	222	222
G4MJC	—	33	184	217
GM4CXP	—	31	184	215
G4MEJ	—	—	211	211
GW8UCQ	—	81	128	209
G6STI	21	58	123	202
G8LFB	—	—	202	202
G4HGT	—	52	142	194
G4YCD	—	36	155	191
G1GEY	—	48	139	187
GM0BPY	—	57	129	186
G8MKD	—	49	137	186
G4XEK	—	—	178	178
G4YUZ	—	—	177	177
EI5FK	—	35	137	172
G8ZDS	—	43	129	172
G4DOL	—	—	172	172
ON1CAK	—	—	167	167
G6AJE	5	63	97	165
GJ6TMM	—	31	128	159
G4CQM	—	52	100	152
GW8VHI	—	48	102	150
GI1JUS	—	—	146	146
G4AGQ	1	41	102	144
GW4FRX	—	—	144	144
G4FVK	20	46	75	141
G6XRK	—	1	117	118
G1DOX	28	34	53	115
G8LHT	2	31	81	114
G4TGK	—	—	113	113
G6MXL	10	36	66	112
GW6VZW	—	6	103	109
G8XTJ	—	—	106	106
PA3EUS	—	18	57	75
GM0GDL	—	17	54	71
G4ZTR	17	15	37	69
G0FEH	—	—	65	65
G1CRH	—	—	59	59
G0HDZ	—	—	55	55
GU4HUY	—	—	54	54
G1NVB	—	—	49	49
G8PYP	—	—	49	49
G2DHV	1	4	27	32
G1VTR	—	23	6	29

Starting date 1 January 1975.
No satellite or repeater QSOs.

two Fs and G1YAA (ZP) for a new square. The 6th was an excellent day, 18 DX QSOs logged including SP6HEI, SP3RBF and several OKs and Ys.

Jim Rabbitts G8LFB (LDN) started his "innings" on Nov 3 with OZ and SM contacts, the next day bringing OK and Y stations, with OZs again on the 5th. On the 6th he worked SP6GZZ, SP3JBI, SP3CMX (HM), SP6HEI and SP2NJI (JM). The next day, more SPs, 3MFI, 3BLR (HM), 3MIC, 6GWB/6 (IK) and 6BTI (IL), finally finishing in the early hours of the 8th with two HB9s. Yet all that only brought two new squares.

Julie Yates G8MKD (WMD) lists 57 DX stations worked in the Nov 4-7 period, the 6th being the most rewarding day. Her tally was 27 Ds, 10 OKs, eight Ys, seven ONs, two each HB and PA and one F contact, best DX being OK3KGW/P at 1457km.

Steve Damon G8PYP (DOR) reports that the lift conditions appeared to favour stations to the north and east of Wimborne, Nov 6 being the best day with DL3LAL (JO43) and DL4EBX (JO31) new squares. On the 7th Steve observed strange conditions; a series of fast-moving ducts more like Sporadic-E. This reminds me that someone else mentioned this and christened it Sporadic Tropo. He struggled to get an RS41 report from HB9SLU/P (JN37) at 0250 on the 8th when those in ZL square were exchanging S9 reports.

G8XTJ worked F6DUA (ZG) on Nov 5 and the next day was excellent for John. G4IJM (CVE) was the first station heard from that county in seven years and has already QSLed. Next he contacted DF0RR (JO62), OK1KEI/P and then SP6HEI after 90 minutes trying to "get in." The SP's signal ranged from inaudible to S9. OZ2KSR/P was new and the first time John has worked into the "I" column of squares. On the 7th, OK1AQF/P (JO60) was contacted.

Irwin Brown GI1JUS (ATM) worked six new squares in the Nov 4-7 period being F3GJ (CI), DF8WS (DJ), DK8ZB/P (EK), DL/I4BXN (FJ), OK1KRY/P (GJ) and OE5KE (HI) at 1558km. Lots of QSOs were made with stations worked in earlier lifts.

Alex McCreadie GM0BPY (BDS) wrote that the opening was the first decent one for a long time for his part of Scotland. On Nov 4-6 the duct seemed to be very narrow just to CK, BK and DK squares. On the 5/6th it moved further north and deeper into W Germany with the OKs appearing on the 7th, best DX being OK3KGW/P. Alex quotes GU3EJL (ALD) as his most satisfying contact as he is unique and reckons the "D" in DX stands not for distance but difficulty.

M Rodgers GM0GDL (CTR) also reports narrow ducting up to Nov 5 with the better DX worked on the 6th and 7th. The afternoon of the 6th brought OK1KEI, DL3LBK (JO54), OE5MKM (JN78) and OK1JKT/P (JO60). On the 7th, best DX was DL6FBL/P (JO40). Much the same pattern reported by **Derrick Dance GM4CXP** (BDS) whose tally on the 7th was 17 OKs, eight Fs, six Ds and one HB9 and ON.

Paul Baker GW6VZW (GWT) lists DK3NZ/A (FL), DL8HCZ (FN) and F6DDW (DI) as new squares worked over the Nov 4-7 period. Also contacted were OK1KHI (HK) and the TV6BAZ station on Batz Island (XI). Later Paul discovered a faulty connector which resulted in his only hearing the loudest signals.

One of the most favoured stations in the lift seems to have been John Nelson GW4FRX (PWS) whose final totals were 23 SPs, 59 Ys, 84 OKs plus assorted OZ, SM7, OE and HB9 at times. The stations up to the "J" column of squares were all very strong, many only running low e.r.p. Nothing was heard from east of longitude 20° and I have no reports of anyone working into the "K" column of squares.

At 1725 on the 6th, John had a ten minute "pile-up" of SPs calling him, many around 50dB over noise. Using the IARU standard of S9 for a 5μV signal at the RX, that equates to 11dB over S9.

John was able to get the power and antenna details from several stations while noting the accurate signal strengths in terms of dBn. The strongest station for which he has their information was SP2NJI whose 10W to a 6-ele Yagi registered 60dBn or slightly over.

I have calculated the free space path loss for the distances involved in six cases using John's known station performance and the estimated performance at the DX end. The calculated losses range from 9dB to a "gain" of 11dB in the case of SP2JNI who should have been only 49dBn.

From his local RAF station, John has obtained data for 0001 on Nov 7 which shows a surface temperature of +4°C dropping to +1° at 1500ft. Thereafter it rose to +10° in the next 600ft, a substantial inversion. Moreover the tephigram suggests this inversion extended to about 10°E longitude, i.e. the D/Y border, from a point a little west and north of GW4FRX (YM26h). Another observation was that John's two 17-ele Yagis had to be aimed 10-15° more northerly than the calculated great circle QTE, for the strongest received signals.

The 430MHz Band

G1EGC's station consists of an Icom IC-490E, 100W 4CX250B amplifier, muTek pre-amp in the shack and two 17-ele Cue Dee Yagis fed through LDF4-50 cable. Mark worked 23 new squares in the Nov 4-7 period and from his long list of DX I pick out F6CCH (ZG) and SP6GZZ on the 5th, OZ1JPT (GO), OK1KKH/P (HJ) and SP6MLK/P6 (IK) on the 6th and OK2KZR/P on the 7th. At 0425 on the 7th he had a half hour chat with SP6GWB/P6 and Mark advises it is well worth while staying up for these lifts as the middle Europeans never seem to go to bed.

Paul Brockett G1LSB (LCN) also sent a long list of choice DX in the Nov 3-8 period and which gave him eight new squares. These were FC1CLQ (DI) and DF1NP/A (FI) on the 4th; Y35YC (HN), Y25QL (GL), OK2KZR (IJ) and F6HEO (BG) on the 6th and on the 7th, SP6GZZ (IL) and OE5XBL (GI).

Les Coote G3AHB (AVN) worked Y22ME at 1630 on the 6th for his best DX so far at 1110km and the next day HB9AMH/P at 2330 who was very loud. G3UVR added AG, GL, HL, II, IJ, IL and JJ squares in the lift but did not identify actual stations. **G4FVX**, now with 46 squares, worked Y22ME and OK1KKH/P on c.w. and DJ5GR on s.s.b.

G4NBS has been having awful interference problems with a neighbour for ages now and seems to be under threat of a licence change if the DTI receives further complaints of interference ". . to anything in the house . ." to quote Tony. Nevertheless he has added some nice DX in the lift including OK2KZR/P on c.w., his 100th square, OK3LQ (II), SP3JMZ (IM) and SP6MLK/6. All the more interesting DX was on c.w.

Annual c.w. ladder

Station	Band (MHz) 70	144	430	μWave	Points
G4ZEC	—	601	—	—	601
G4XEN	—	400	34	—	434
G4ZVS	—	310	—	—	310
G4OUT	—	262	—	—	262
G4NZU	2	243	4	—	249
G0HGA	—	198	—	—	198
G3WRJ	—	157	—	—	157
G4WHZ	—	139	—	—	139
G4YIR	—	129	—	—	129
G4VOZ	102	—	23	—	125
G4ZNI	—	112	—	—	112
G0DJA	—	101	—	—	101
GM4CXP	—	87	—	—	87
G0GKN	—	84	—	—	84
EI5FK	—	29	35	—	64
GU4HUY	—	63	—	—	63
G6XVV	—	31	16	12	59
G4YTR	—	56	—	—	56
G4AGQ	15	21	14	1	51
G2DHV	15	28	1	—	44
GW4HBK	27	—	—	—	27
G0HDZ	—	9	—	—	9

Number of different stations worked since January 1.

G4VOZ worked eight countries outside the UK on Nov 6/7 including Y23LI/M and F6BJH but few were interested in any other than rubber stamps QSOs. G4XEN worked SP6GZZ on the 4th, LX1JX (DK) on the 5th and in a ". . marvellous c.w. session . ." on the 6th, OK3LQ and OK3CGX, the later his best DX of 1339km, OZ2KZR and OK1KKH plus three Y2s.

While most contributors seemed to concentrate on the continental DX, a few did listen to the west, one being G6DZH who worked EI5FK (VL) and EI4EY (VM) in the late evening of the 6th. Keith also worked his share of the D, F, OZ, OK and Ys on offer, though.

G6MEN uses a Yaesu FT-790R, 30W amplifier and 19-ele Tonna Yagi. OK1KHI (HK) was Paul's best DX and Y22ME his first Y contact, both on the 7th. G6STI has been on the band since Feb 86 and also runs a '790R and 19-ele Tonna but with a 40W amplifier. New squares in the lift were F6IPG (YH) and OZ7IS (GP) on the 5th, FC1GXX (ZF) and Y24BO (GM) on the 6th and Y24XN/P (GK) on the 7th plus Fs in BF, BG and BI.

David Law G6OYL (YSS) wrote a first contribution and his station consists of a Kenwood TS-770E, 2C39A 50W amplifier, BFQ69 pre-amp and two home-made 17-ele Yagis to the DL3WU design. From 1730 on Nov 5 he started working into southern France, later into Y, OK and SP, OZ and SM. In fact, the opening was virtually in all directions during the 5th to 7th. David's choicest DX included SP6MLK/6, SP6GZZ, SP9EWU, and SP6BTI (IL), OE1RVW/3 (HH) running one watt to a single Yagi, OE5VRL/5 and OE5XDL (HI) and OK2BSO (JJ).

G8HHI worked OZs and an LA in EQ, GP and DS squares on Nov 5. Next day John worked three Y2s in GL, GM and HM, Y35YC, DL8FBD (EK), OK1DIG/P (GK), OK1KKH/P (HJ) and SM7DEZ (GP). On the 7th SP6MLK/6, OK1MAC/P and HB9AMH/P were worked. Gordon Emmerson G8PNN (NLD) lists three new squares: OE3XUA (HH) and OK1KKH/P on the 6th and F6HEO (BG) on the 7th.

From Eyemouth, GM0BPY found the band "patchy" with something interesting now and then such as HB9MIN/P on the 4th and Y23BD on the 5th. GM0GDL reports the same very selective ducting on the 5th as noted on 144MHz. The next day brought DH3NAN (FK76j) at 1615 but FD1GYA/P (BF) faded out while GM6BIG was working him but as some consolation, three Fs in BI were contacted. ON7ZM and ON5RU gave GM4CXP an all-time new country on the band.

The Microwave Bands

G0DJA mentions RSGB promoted Microwave Activity Days throughout the winter being the first Sunday in the month. G3AHB is on 1.3GHz and Les reports reception of beacon GB3MHL at S7 on Nov 6 at 1537, it remaining audible till 0715 on the 8th. **G3TDG** (KNT) was worked on the 6th and on the 7th, HB9AMH/P at 2335, the QRB being 820km.

G3UVR found six new squares on 1.3GHz in the lift: AG, BF, BG, EK, FP and IK which brings Denis's total to 75. **John Tye G4BYV** (NOR) worked DL6NAQ/P and DC9BU/A in EK on 3.4GHz, QRB 672km and DK0NA (FK) at 775km. They were heard on 5.6GHz but John's 10W they could not find. He mentions the Martlesham Microwave Round Table on Nov 8 at which test gear was available and RSGB microwave components and a bring and buy sale were on offer.

G4DEZ spent most of the lift period on 1.3GHz and worked into D, Y, LX and OK. On the morning of the 8th Bryn had a ten minute chat with HB9AMH/P at S9 each way. G4FVX is at 20 squares worked on 1.3GHz and David worked DD3KL (DK) and DK0NA (FK) in the Nov lift.

G6HKM came on 1.3GHz towards the end of the lift. On the 8th a CQ call produced QSOs with seven German and three Dutch stations. Ela also added AVN, CNL, GLR, LNH, LEC and SRY to her county tally for the 1987 table. In the Nov 17 leg of the Cumulatives she had 16 QSOs and heard GI4OPH for her first ever GI. Stations worked included PE1EWR now running 80W, G8TFI (GLR), G8NEY/P (AVN), G4TCP/P (SRY) and G1KDF (LNH) just completed at RS31 each way.

G6STI has been on 1.3GHz since the end of May 1987 and Howard uses a Yaesu FT-726 with transverter running one watt ". . to a very old 24-ele quad . ." Best DX to date is 682km and in the lift new squares were DL2KBB (DK) and seven Fs in AK, BF, BG, BI, ZF, ZG and ZH.

Haydn Barker G6XVV (YSS) has had little time for the hobby lately but did get on 1.3GHz in the lift with 0.5W to a 1.4m dish below roof height. He managed to work to BI and BG squares. G8HHI on 1.3GHz worked G1DOX (CBA), G8PNN and F1EAN (AG) on Nov 5, DL6NAQ/P, OK1DIG/P and DL2KBB on the 6th and DK3FB/P (DL) on the 7th to bring John's band squares total to 31. He runs a Kenwood TS-780, Microwave Modules transverter and 2C39 PA at 50W to a Jaybeam 15-over-15 antenna.

G8PNN is now up to 62 squares on 1.3GHz, latest additions being F9MJ (ZG), FD1GYA/P, F6DKW (BI) and F6HEO in the lift.

Finally it is certainly **not** the intention to drop the microwave bands reports as a couple of readers thought. The remark on page 64 in the December issue referred to the microwave column of figures in the Annual c.w. ladder. A reminder that this year the v.h.f./u.h.f. table will include 50MHz and that all bands will count for points but do not be put off entering if you only use one or two bands since there is an individual band table at the end of the year as will be seen in next month's VHF Up.

The Dutch to get 50MHz

From March 1, all Dutch amateurs can apply for 50MHz permits for c.w. only, 30W TX output. No antenna restrictions are planned and the allocation is from 50 to 50.45MHz. This is for an experimental period of 5 years.

Your deadlines for the next three issues are: January 27, March 2 & March 26

RTTY

Reports to Mike Richards G4WNC
200 Christchurch Road, Ringwood, Hants BH24 3AS.

This month's logging has been interrupted by a very interesting trip to The Gambia so my apologies for the small chart.

RTTY

Despite the small amount of time available for logging, I did manage to catch a couple of very good openings on 28MHz. The first one was fairly short-lived and occurred in the late afternoon. During this opening I logged CE3BBW working WB7AJO, both stations were only about S2–3 but the band noise was very low so they were good solid copy.

The second opening lasted from midday through to late afternoon and produced lots of good DX. My log included the following on 28MHz RTTY: S79WS (Seychelles), 3B8FP (Mauritius), LU2DGO (Argentina), 9Q5BG (Zaire) and PS7KM (Brazil). Signals during this second opening were much stronger and very stable producing some very good copy.

Reports

I'm still desperately short of reports from readers. The column will represent your interests much more accurately if I could have some feedback. Reports can comprise whatever is most convenient for you, the basic requirement is callsign, band, date and time. If you have access to a photocopier then the simplest way is to just copy your log for the period concerned. Any information can either be posted to the address above or to my Prestel mailbox 925470071.

AMTOR Tutorial

I know AMTOR has been around for quite some time, but I'm sure there are plenty of newcomers who would like to know a little more about it.

I suppose the first question must be what is AMTOR and why is it used? Well, the name AMTOR is an acronym for Amateur Teleprinter Over Radio and comprises a computer controlled data transmission system which features full error correction with an effective transmission rate of 50 baud. It is generally used in a similar way to conventional RTTY, i.e. for live keyboard QSOs with fellow amateurs. The main advantage is that any errors are automatically corrected leaving the operator free to converse normally without having to repeat essential information like reports and QTH. This all sounds very good but how did it start and who invented AMTOR?

AMTOR is based on a commercial system called TOR (Teleprinter Over Radio). The first use of TOR is reported to be by Dr Van Duuren of the Netherlands PTT in 1958, where it was used to provide error correction on a radio link between Karachi and Amsterdam. This original set-up was rather large comprising about 4 or 5 racks of valved equipment occupying about 60 cubic feet!

Since this original use TOR has been expanded and standardised and one of the most common commercial versions is known as SITOR (Simplex Teleprinter Over Radio) and is defined in CCIR recommendation 476-4. This sytem is used extensively for ship-to-shore communications and is the basis of the present AMTOR system.

AMTOR was actually pioneered by Peter Martinez G3PLX in an article in the RSGB magazine *Radio Communication* in August 1979. This initial introduction was followed by a constructional article in June/July 1980 which described a single board convertor to enable stations equipped with RTTY to convert to AMTOR. This was the turning point for AMTOR and resulted in it being accepted as a standard. In fact I still use the mark 2 version of this convertor in my shack.

That's a simplified history so now on to the details of how it actually works.

There are actually two main operating modes in AMTOR. The first is known as FEC (Forward Error Correction) or mode B. This mode is used primarily for CQ calls. The second is known as ARQ (Automatic Repeat Request) or mode A and is used for the main part of the QSO and provides the full error correction.

Before I discuss the inner workings of AMTOR you need to understand the codes used. In conventional RTTY the typed characters are converted into a 5 unit code called ITA2 (International Telegraph Alphabet No. 2). When using AMTOR the

Your deadlines for the next three issues are: January 27, March 2 & March 26

typed characters are converted into a special 7 unit code. This 7 unit code although having a possible 128 different values only actually uses 35 values. The reason for this is explained by the error correction technique employed. If we imagine that each unit of the 7 unit code can either be a *1* or *0* then in AMTOR each of the 35 possible combinations comprises four *1*s and three *0*s. This makes error detection easy as any character that does not contain four *1*s and three *0*s must be an error, simple isn't it.

Mode A or ARQ is the main AMTOR mode and is easily recognised by the characteristic "chirp chirp" signal it produces. If we assume that contact has been established between two stations A and B I will describe the error correction system used by AMTOR.

Characters that are typed at the keyboard of station A are transmitted in groups of three characters at a time. Once the first three characters have been sent station A drops to receive mode and awaits a response from station B. When station B receives the group of three characters the AMTOR software will check to see if the characters are valid. If all is well station B will send an acknowledgement, conversely if there were any errors station B will send a repeat request. One other possibility is that due to interference, etc. station B may not receive anything and so will not send any acknowledgement. This is catered for by the fact that station A will only wait 240ms for a response from station B before automatically re-sending the three characters.

As you can see this simple system ensures error free transmission of messages. The only weakness in the error correction system is that if a character is corrupted but still contains four 1s and three 0s it will not be detected as an error. Experience has shown that this is only a very minor weakness.

The AMTOR ARQ system relies very much on timing in order to achieve a satisfactory throughput of data and error correction. The timing elements comprise 210ms to send the three character group followed by 240ms to receive the acknowledgement. This makes a total of 450ms for the transmission of three characters and corresponds to an effective rate of 50 baud but requires a rate of 100 baud over the radio link. In order to continue this timing sequence the AMTOR software automatically sends idle characters during breaks in typing.

One feature not yet mentioned is the selcal. This is a very powerful feature which allows you to enter a selcal comprising four alphabetic characters to make contact with a particular station. The selcal normally comprises your callsign with the number omitted i.e. my callsign is G4WNC so my selcal would be GWNC. In order to start a QSO with a station you select mode A, ARQ and enter the selcal of the station you want to contact. If that station is on frequency and in AMTOR mode then his transmitter will automatically respond to your call. One other special feature is the change-over from transmit to receive which is achieved by using a unique combination of two characters (+?). When this sequence is detected a transmit/receive change-over is automatically executed.

Now to describe the second AMTOR mode known as mode B or FEC. This mode uses the same 7 unit code as mode A but comprises a continuous transmission rather than the alternate transmit/receive switching of mode A.

The use of the 7 unit code means that the same error detection method can be used as in mode A, i.e. four *1*s and three *0*s for a valid character. The error correction employed is rather different in that the transmitting station sends each group of three characters twice. These groups are spaced five characters apart to minimise the chance of both groups being affected by the same burst of interference. As with mode A any gaps in the flow of characters from the keyboard are automatically filled with idle characters.

This error correction system produces results significantly better than conventional RTTY but not as good as ARQ.

When operating AMTOR, mode B is normally used to make a CQ call which would normally include your selcal so that any potential contact can respond in mode A using your selcal. One point to note when making a CQ call is that the receiving station can only lock on to your signal when you are sending idle characters so make sure you send plenty of idles at the start and during your CQ call.

The only other mode to mention is a mode exclusive to AMTOR known as mode L. This mode allows you to monitor a QSO between two stations using mode A. Although this is very useful you will find that you receive quite a few double characters or have some characters missing, this is because the error correction system only works between the two stations in QSO.

	Band (MHz)				
Prefix (Country)	3·5	7	14	21	28
A, K, W (USA)			AR	R	R
CE (Chile)					R
DA, F, J, K, L, (W. Germany)	R	R	R		
EA, C (Spain)			R		
EA6 (Balearic Is)				R	
F (France)		R	R		
G (England)	AR	R	AR		
GI (N. Ireland)		R			
GM (Scotland)	R				
GW (Wales)	R		R		
HB (Switzerland)			A		
I (Italy)			APR	R	R
LA (Norway)			A		
LU (Argentina)					R
LZ (Bulgaria)			R	R	R
OE (Austria)			AR		R
OH (Finland)			R		
OK (Czechoslovakia)					R
PP, Y (Brazil)				R	R
PZ (Surinam)					
S79 (Seychelles)					R
SG, K, L, M (Sweden)			AR		
SO, P (Poland)			R		
UA, V (USSR)			R	R	R
VE (Canada)				R	
Y (E. Germany)			R		R
YO (Romania)				R	
YU (Yugoslavia)			R	R	
ZS (South Africa)			AR		
3B8 (Mauritius)					R
5L2 (Liberia)				R	
9Q6 (Zaire)					R

The much-depleted data communications chart

Well that's a simple summary of how AMTOR works, perhaps in another issue I will give some more practical details of how to get the best out of AMTOR. One point I will make is that in my view, and several other amateurs I have spoken to, AMTOR is by far the best mode for live keyboard QSOs and is more effective than Packet!

That's all for this month but please, please send me some reports.

Amateur Satellites

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

OSCAR-10

The return of AO–10 on November 16 was greeted with delight by many of the keen operators who had waited patiently for the chance to re-employ the transponders. Almost without exception, operator behaviour has been impeccable, with users aware of the necessity of keeping away from the eclipse periods, and utilising just that amount of power in maintaining effective communications to sustain the spacecraft's batteries. Your scribe, who had not been on the satellite for over a year, seized the opportunity, and made some good QSOs with VK2, W1, 2, 6, 9, and 0, plus several old friends around Europe.

At first it was thought that the beam antennas had self switched in during the power-off period, as the characteristic "spin modulation" consisting of two slow signal strength peaks followed by one larger one with each rotation of the satellite rotation were evident, but signal analysis showed that it is in fact the monopole antenna that is responsible for radiating the downlink. Signals are quite weak when the satellite is at apogee, especially to the east, but substantial when it is at or close to perigee, and inverse square law sums show that the signal enhancement at this time is mainly due to sheer proximity.

The spin fade is due to one either looking at the monopole through the rotating beam antennas, or by passive reflection by them, this producing the rapid QSB normally associated with using a linearly polarised antenna for the satellite. Indeed, a change of polarisation or circularity can give very different effects even though the radiator on the spacecraft in itself linearly polarised. A change of vertical to horizontal, or even right-hand circular to left-hand circular polarisation on the uplink and on the 145MHz downlink through a pass, as the satellite changes in its orientation to the observer, can often produce far clearer and much smoother signals.

The spin rate of the satellite has noticeably decreased now, and current observations put this currently at 24 r.p.m. and slowing down still. Like the satellite attitude, nothing can be done about this, as the radiation damaged memory of the internal housekeeping unit dictates that the translation of commands into action by the magno-torquers is impossible, so future angulation for optimum sun-angle, earth antenna pointing, and attitude maintenance cannot be determined. Even so, we are fortunate to have a functioning satellite still, which if used with care, should continue to provide us with all continent DX communications.

The period to use the satellite in early January is from Mean Anomaly 221, through perigee, to MA 139, soon after which follows the period of eclipse. Later schedules, when prepared, will be given out on the numerous AMSAT nets, and these should be followed closely to avoid

Satellite	RS5	RS7	RS10/11	METEOR 1/30	COSMOS 1766	METEOR 2/14	METEOR 2/15	METEOR 2/16
Internat Design	81-120C	81-120E	87-054A	80-051A	86-055A	83-039A	87-001A	87-068A
Object	12999	13001	18129	11848	168810	16735	17290	18312
Epoch Year	1987	1987	1987	1987	1987	1987	1987	1987
Epoch Day	303.19061229	304.03387348	301.50039549	300.75641396	306.71436462	304.59301838	304.36698026	304.08367078
Inclination	82.9630	82.9678	82.9239	97.7217	82.5269	82.5452	82.4630	82.5589
RAAN	194.9473	186.1813	319.5943	27.3526	224.4732	359.0325	270.7825	330.9856
Eccentricity	0.0009246	0.0023607	0.0010257	0.0043473	0.0023623	0.0013124	0.0014109	0.0013871
Arg of Perigee	97.7019	8.3702	269.8809	77.4009	220.4696	238.0335	121.0993	67.4400
Mean Anomaly	262.5074	351.7766	90.1071	283.2073	139.4836	121.9557	239.1555	292.8198
Mean Motion	12.05067730	12.08702803	13.71881116	14.98335553	14.73548305	13.83763587	13.83569646	13.83326960
Decay Rate	$1.2e^{-7}$	$1.3e^{-7}$	$9.7e^{-7}$	$1.184e^{-05}$	$8.9e^{-07}$	$6.0e^{-8}$	$6.0e^{-8}$	$4.0e^{-07}$
Orbit Number	25809	25897	1744	40196	6801	104.12286	104.13756	104.14429
Nodal Period	119.55187	119.19258	105.02429	96.16553	97.78378	26.15952	26.16366	26.16476
Long. Increm.	30.01488	29.92496	26.38191	24.04118	24.75555	7222	4136	1023
Beacon Freq.	29.330	29.340	29.357	137.020	137.400	137.850	137.850	137.400
	29.452	29.501	29.403			04 Nov 1987	04 Nov 1987	04 Nov 1987
			145.857			7270	4187	1078
			145.903			0131.84	0119.45	0129.03
			29.407			69.45	154.80	97.19
			29.453					
			145.907					
			145.953					
Ref. EQX	06 Nov 1987	06 Nov 1987	01 Nov 1987	03 Nov 1987	08 Nov 1987			
Orbit No.	25892	25970	1792	40290	6879			
Time (HHMM. MM)	0157.29	0149.82	0001.74	0048.82	0015.78			
Long. W	242.87	249.33	83.18	20.39	191.01			

Satellite	OSCAR-9	OSCAR-10	OSCAR-11	NOAA9	NOAA10	FO12	SALYUT 7	MIR
Internat Design	81-100B	83-058B	84-021B	86-123A	86-073A	86-61B	82-033A	86-017A
Object	12888	14129	14781	15427	16969	16909	13138	16609
Epoch Year	1987	1987	1987	1987	1987	1987	1987	1987
Epoch Day	305.03708608	299.31218565	299.74776146	294.34653927	304.23391457	296.50546216	308.63839241	308.92682777
Inclination	97.6405	27.4526	98.0868	99.0669	98.7109	50.0144	51.6113	51.6248
RAAN	326.2911	355.5741	2.9363	261.1519	333.2037	350.8958	297.9920	149.4408
Eccentricity	0.0003910	0.6026677	0.0014471	0.0014638	0.0013080	0.0011163	0.0001773	0.0042643
Arg of Perigee	97.0673	251.2486	48.2436	210.5027	169.8184	252.2286	50.6872	351.7425
Mean Anomaly	263.1016	37.1198	311.9999	149.5293	190.3260	107.7322	309.4347	8.2289
Mean Motion	15.30475640	2.05883145	14.62174702	14.11524737	14.22523117	12.44393694	15.31536210	15.84604728
Decay Rate	$4.877e^{-5}$	$-7.3e^{-07}$	$2.23e^{-06}$	$8.5e^{-07}$	$2.04e^{-6}$	$-2.5e^{-7}$	$1.9985e^{-04}$	$4.9191e^{-04}$
Orbit Number	33766	3286	19492	14711	5808	5436	31750	9828
Nodal Period	94.14701	699.17370	98.54176	102.05113	101.28568	115.65326	93.95449	90.80333
Long. Increm.	23.53403	175.34837	24.63595	25.51099	25.32114	29.23935	23.88756	23.09229
Beacon Freq.	21.002	145.810	145.826	137.620	137.500	435.797	19.953	143.625
	145.825	145.987	435.025	137.770	136.770	435.913	142.42	166.140
	435.025		2.4015GHz					
	2.401GHz							
Ref. EQX	06 Nov 1987	03 Nov 1987	06 Nov 1987	06 Nov 1987	04 Nov 1987	04 Nov 1987	10 Nov 1987	08 Nov 1987
Orbit No.	33842	3302	19642	14932	5862	5580	31833	9877
Time (HHMM. MM)	0008.59	0157.30	0018.06	0017.33	0046.27	0141.94	0117.56	0024.05
Long. W	75.43	76.76	36.22	132.05	77.35	112.92	156.19	279.37

damage to the batteries and power system. It may well be that as the satellite saw 100 per cent facing solar illumination on December 28, an increase in user time may be permitted when the period of apogee eclipse has passed, but for the next few months they will last up to 101 minutes each orbit.

The beacon, whilst only a plain carrier devoid of content, thus serves as a useful indicator of spin rate and approximate attitude. It also suggests limits of battery discharge, as it will frequency modulate with peaks of power demand if low in voltage supply. Users, whilst using the lowest possible power uplink to the spacecraft, should keep an eye on the beacon, and if any sign of frequency instability occurs, cease operations immediately, or a danger evolves that the current transponder on lock could be negated for all time, leaving a totally dead satellite.

Ariane & Phase III-c

The postponed Ariane V-20 launch from the 0217 to 0321 UTC window of November 18 to 21, due to minor launch vehicle problems, brought a slight further delay to the future OSCAR-13 mission, as the V-21 launch, originally set for December 1987 is now deferred to February 1988 to permit a change of the third stage. This probably means that we shall see the V-22 launch of Phase III-c in mid-March if all goes according to the new plan.

Fifty-four satellites are now awaiting launch via ESA, at a budget of some 2.5 billion $US, and fifty Ariane launch-rockets are now bulk ordered for the 1990–1997 time frame.

Although the V-20 mission was a perfect launch, problems occurred on the direct broadcasting TV-SAT-1, which failed to deploy one of the two solar panels on which it depends for power. When finalised in geostationary position, attempts will be made to free the jammed panel by firing all fourteen of its thrusters to jolt the mechanism. If this fails, then only two of the four channels planned will be operable, and much diplomacy will be required to decide who has what!

Work on our new Phase III-c elliptical orbiter is now proceeding at a fast pace, and in Marburgh final thermal-vacuum tests are underway, as well as tests of the thrust booster, to be ready for final integration with Ariane IV.

AMSAT have launched a plea for funds to insure the new satellite at a cost of $10 000, and already AMSAT-UK have donated $1000 toward this. If any enthusiasts wish to contribute they may send donations via AMSAT-UK, G3IOR, or direct to AMSAT, P.O. Box 27, Washington DC 20044, USA.

Fuji-OSCAR-12

It would appear that FO-12 has been maintaining its planned schedule at last, the operating modes and periods being dictated by the times it is in line of sight of Tokyo for commanding.

Partly thanks to the lack of use, brought about in the main by the lack of knowledge as to when it is on, the satellite exhibits a highly sensitive receiver, non-attenuated by many strong signals. Many QSOs result between users of the RS satellites and FO-12 users, each not realising that the respondant is in fact listening to a different spacecraft. It also picks up signals emanating from the downlink of OSCAR-10, producing clear although relatively weak signals on the FO-12 downlink. On Thursday November 26, OSCAR-10 and FO-12 were in line of sight to each other, and although weak, perfectly readable signals originating from I8CVS were heard as l.s.b. via FO-12, having resulted from a QSO on u.s.b. he was having with I2EF and I0LYL on AO-10.

On the same day at 2136, G4CUO made a QSO with WA3ETD, ably assisted by John's XYL N1DYL, transmitting 435.060MHz l.s.b. to AO-10, which downlinked on 145.940MHz as u.s.b. to FO-12, which re-transmitted the signal back as l.s.b on 435.860MHz, giving a readable signal at both ends of the contact. OSCAR-10 was at MA 35 at the time, fairly close to perigee. The next step planned by David G4CUO, following much pathfinding, is to find a time when AO-10 is in sight of FO-12, and FO-12 is in sight of RS-11, so that a triple trans-satellite test can be performed.

Fuji-Oscar-12 is found to be exhibiting marked circular polarisation changes as it performs a pass. Here in the UK, on approach from the west, "JA" mode shows considerable enhancement of signal using left-hand circular polarisation. When it recedes to the east, right-hand circular is much to be preferred. On Mode

"JD" the situation is reversed, as opposite polarisation is transmitted. This tells us that the satellite is "flat-on" to earth, and that we are seeing the top-side of the spacecraft on approach, and the bottom as it goes away from us, as dictated by the on-board stabilising magnets within earth's field. When at a high angle at the time of closest approach, little difference can be seen.

RS-10 & 11

All systems are go on the new RS-10/11 system, with the ROBOT, Transponder(s), Telemetry and Codestore all performing well. The codestore messages are providing regular equatorial crossing data, and news of contests, activity periods and results, though mainly in the Russian language. It would appear that the COSMOS 1861 Navsat is on stand-by, as regular Mode "KA" (21 + 145MHz to 29MHz) transponding has been running now for many weeks alternating between RS-10 and 11.

A very new and desirable feature has been incorporated in the transponders that explains the enormous dynamic range of the systems. Apparently the bandpass can be sectionalised into individually ground command computer controlled 4kHz segments, each with their own a.l.c. level. This can be changed by command to 24 or 16kHz bandpasses, 6 or 4 sections of 4kHz according to level and requirement.

With the rapid improvement of the 21MHz band, many stations using the 15m uplink section for terrestrial s.s.b. QSOs can be heard at enormous strength on the 29MHz downlink. Whilst this is very interesting propogationally speaking, it can be a problem finding a clear frequency for more than a few minutes at a time. The ten metre band is now coming to life, and should be demonstrating similar downlink sub-horizon DX to that of the 15m uplink as the solar-flux improves.

Further sources of QRM are resulting in blocking the ROBOT, they being QSOs on the uplink frequency, the presence of OSCAR-9 and 11 using 145.825, but mainly the fact that despite the IARU agreement of over ten years ago, f.m. repeaters persist in using 145.825MHz in the space-band, it once being R-9 before the agreement. Even simplex v.h.f. f.m. QSOs are often evident on the downlink, due to indiscriminate use of the 145.800—146.000MHz reserved for the amateur satelite service.

The recent threat of Mexico to use the 435MHz space band for land-mobile has been averted by prompt action of AMSAT through the IARU, but now the JARL are considering allowing 10kHz channel spaced f.m. simplex from their 727 000 radio amateurs (30 per cent of whom are in Tokyo) in the band, a suggestion that is provoking much protest among the international community of satellite users. In the UK, the Syledis system is an existing constant source of QRM, and there are now rumours that Fylingdales will be moving up in frequency to our band!

OSCAR-9 & 11

The UoSAT pair continued with regular transmissions providing WOD surveys on various channels of interest (mainly the Channel 3 radiation data), DIGITALKER, and CCCD attempts to obtain good pictures. A new diary, for the first time in a new 4th language was loaded in November, but despite the fact that all worked perfectly on ground tests, problems possibly due to multipathing in the increased ionised layers arose, with the result that many readers were unable to obtain the bulletins. **Walter Unsworth G1LKY** of Lincoln was one so afflicted, getting just a line of "6s" instead of the needed information. Walter, after checking his Spectrum and G4HLX programme, rang G3IOR then **Jeff Ward G0/K8KA** at the University of Surrey command centre, who explained the situation, adding that with the existing inoperable software installed, it was impossible to load the bulletins, or indeed new software to bring about the change required. As the UoS have found a way out of impossible problems many times before now, we hope that all is functional by the time you read this information!

AMSAT-UK Colloquium 1988

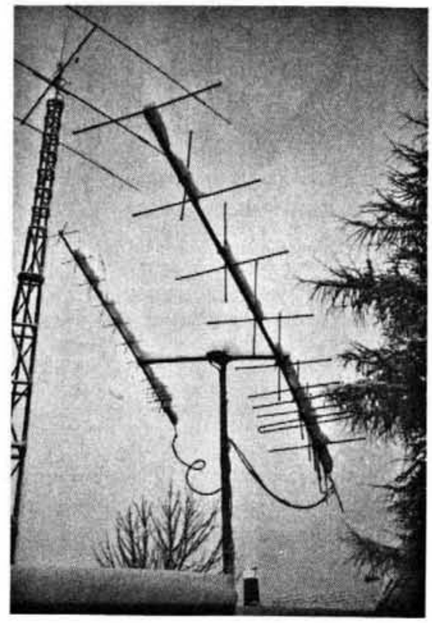
The date set for the next event at the University of Surrey is set for the 29–31 July 1988. As it was very heavily booked last year, visitors are recommended to book early with G3AAJ rather than risk disappointment. Papers on the event are called for, and should be supplied by 2 May 1988.

Keplerian Elements

This set has been resolved from the NASA two line element set for us by **Birger Lindholm** of Dalsbruck, Finland. We have included precision equatorial crossing and nodal periods this time, as several readers have used the rounded up EQX's and to single decimal point add-on values, which can result in an incremental drift from the precise times. A number of readers have been dividing the Keplerian mean motion (number of orbits per day) into 1440 (the number of minutes per day) to give the period, but the result is the anomalistic period, which differs from the nodal period according to the satellite inclination. The anomalistic period is the elapsed time, in minutes, between each perigee of the satellite, whilst the nodal period is that time between two successive ascending nodes of the satellite, hence equator crossings. They are only alike if the inclination of the satellite is 63.4 degrees, the intended inclination for the comping Phase III-c, to maintain the perigee in the south and hence the apogee at that latitude north.

A further point is that as the earth appears to rotate 360 degrees per day (24 hours or 1440 minutes), a satellite with a two hour period (120 minutes) would have the earth rotate by 360/24 × 2 degrees, e.g. 30 degrees increment, it would at first seem feasible to merely divide the period in minutes by four to get the increment. Alas, this is not the case, as even if the earth did not rotate, we would still see a mid-night, dawn, mid-day and dusk back to mid-night annually as a "day" because the earth goes round the sun close to once a year. This gives us the difference of a **Solar** day, e.g. exactly 24 × 60 = 1440 minutes per day, the time it takes the earth to rotate about its axis slightly greater than 360 degrees with respect to fixed stars, and the **Sidereal** day, that amount of time that it takes for the earth to rotate exactly 360 degrees with respect to fixed stars. A solar day is 1440 minutes, but a sidereal day is 1436.07 minutes. Thus, if one ratios the nodal period and the increment, it is rarely 4:1. The "RS" satellites have a ratio of some 3.953, are thus a little earlier each 'day' for the same equivalent crossing, whilst weather-satellites such as NOAA-10, dependant upon constant earth lighting angles, are almost exactly four.

Your dates for the next three months are: Jan 27, March 2 & March 26



A "Christmas card" scene of the G3IOR satellite antenna system for 144 and 430MHz, well detuned by snow

Those using some satellite computer programs may find that with the coming of the new year their predictions may go astray. It is possible that the new sidereal time values, usually as lines stating "IF Y2 = '87' LET G2 = 0.2753606" may not automatically update in some of the older programs. Whilst this can be overcome by calling January 1 1988 December 32 1987, January 2 December 33, etc., it is better to update your program with the new values following:

1987—0.2753606
1988—0.27469296
1989—0.27676777

UA/VE Polar Expedition

The joint Soviet-Canadian expedition is all set now to take off on February 7, with UA3CR currently signing UA3CR/VE8 where he is path and route planning. As planned, the UoSAT digitalker and DCE will be used for COSPAS/SARSAT positioning and QTCs, and the RS-10 & 11 satellite for transponded and codestore loaded messages. The COSMOS-1861 housed with RS-10/11 carries a COSPAS/SARSAT system, so it should serve well. Listeners to UoSAT and RS-10/11 should be able to follow progress of this all-amateur adventure first-hand.

DIY SAT

If any affluent readers wish to have a try, the USSR Glavkosmos launch agency are offering "Get Away Special" type launches for small satellites at $US 15 000 per kilogram as packages aboard or put out from MIR.

Propagation

Reports to Ron Ham
Faraday, Greyfriars, Storrington, West Sussex RH20 4HE.

Although the sun, seen through cloud in Fig. 1, is 149 million kilometres away, its random activity has a marked and often sudden effect on the propagation of terrestrial radio waves. Periodically, dark patches, called sunspots, appear on the sun's disc. For over 50 years, communications engineers and short wave enthusiasts have known that eruptions from active areas around these spots are responsible for fade-outs and sometimes total blackouts on the h.f. bands and aurora, which has strange effects on propagation in the v.h.f. bands. Radio waves reflected from an auroral display are easy to identify because c.w. transmissions develop a low pitched rasp, described as tone-A and s.s.b. signals become a ghostly whisper.

One object of this column is to place the date and time of such events and associated happenings, on record for posterity. Therefore, the regular reports that I receive about auroral and magnetic disturbances from **Neil Clarke G0CAS** (Ferrybridge) and **Ron Livesey** (Edinburgh), about filaments, solar flares and radio noise from **Cmdr Henry Hatfield** (Sevenoaks), the numbers of sunspots observed by **Jim Knight**'s group in Johannesburg, members of the London Solar Society, **Patrick Moore** (Selsey) and **Ted Waring** (Bristol) are most valuable.

This time, Henry, using his spectrohelioscope, observed 6 filaments on October 26, 9 on November 5 and 12 on November 21. "The groups on November 21, were large and probably contained more than 10 spots in each, but this observation was greatly hampered by cloud," said Henry. He also recorded radio noise from the sun, at 136MHz, on October 26 and 31 and November 2 and 22.

Neil tells me that the mean sunspot number for October was 61.1 compared to 33.5 in September and he enclosed his computer print out, Fig. 2, showing the variations in solar flux for the month and the peak of 119 s.f.u. on the 15th.

From Patrick's log, I selected his sunspot drawings for October 13 and 28 and November 16, Figs. 3a b and c. Despite overcast skies, which limited the number of observations, Ted counted 8 spots on November 3 and 21 on the 20th.

"The magnetometer used by Karl Lewis (Saltash) indicated unsettled-to-storm conditions on days 14 and 15, storm from 1420 to 2145 on the 11th, after 1200 on the 13th, between 1700 and 2015 on the 21st, after midday on the 27th and up to 2145 on the 28th," wrote Ron Livesey in his October report. Ron is the auroral co-

Fig. 1

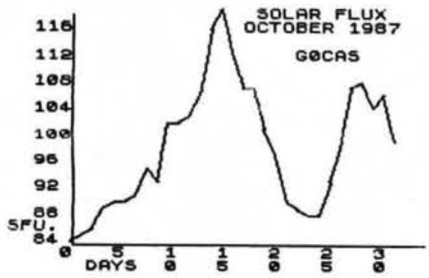


Fig. 2

ordinator for the British Astronomical Association. He tells me that aurorae, including arcs and active ray structures, were seen on the nights of 14/15, 17/18 and 22/23 by observers in north Scotland, 24/25 from Ulster and 27/28 from Ireland, Nova Scotia and Scotland.

Dave Coggins (Knutsford) noted that a number of broadcast stations between 7 and 15MHz took on an auroral tone around 2150 on the 20th. "They were weak and some had a ghostly whisper," said Dave.

The 28MHz Band

November 9 was a "Red Letter Day" for **Jim Hicks G4XRU** (Worthing) because, at 1550 he heard a WD4 calling "CQ" on 29.6MHz f.m. While driving between Horsham and Worthing, at 1615, he had a RS59, both ways, QSO for 3 minutes before the band closed suddenly with a K6 in Florida. Jim, secretary of the Southern 10 Metre FM Group, used a converted CB rig, with a 50W p.a. feeding a 610mm helical antenna mounted on the rear of his car.

"During the last few weeks I have heard signals from CE, LU, OY, PY, S79, VO, VU, Ws 1, 2, 3, 4 and 5, ZC4, ZS, Z21, 5N and 9K," wrote Dave Coggins on November 17. **Greg Lovelock G3III** (Shipston-on-Stour) has also noticed the band perking up and in Bransgore.

John Levesley G0HJL, using modified CB equipment and a loaded vertical antenna, received signals from CT, DL, EA, F, HA, I, LU, OK, SP, TR, UB, VU, YU, ZC4 and 4Z4 on October 23, worked UA6 and logged HAs on the 24th, received EA, UA and ZS on the 30th, SV and SV5 on November 7, SV5, UA and VK on the 8th, UA, VO and VK on the 9th and UA on the 20th.

Propagation Beacons

One of the most important contributions that the amateur movement has made to scientific research is the installation of a world-wide chain of radio beacons. New readers may like to know that a beacon is strategically sited, by international agreement and provides a low-power signal on a fixed radio frequency. Periodically this signal, usually a tone, is interrupted with the beacon's ident and sometimes information about the site.

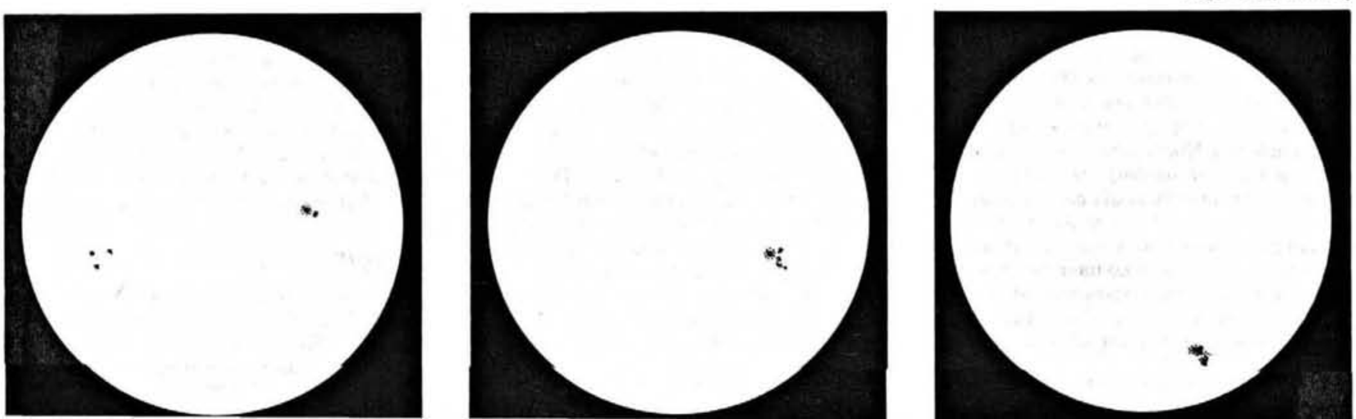
I learnt from the October issue of *Region 1 News*, that the beacons CT3B (Funchal), JA2IGY (Ise City), KH6O/B (Honolulu), LU4AA (Buenos Aires), OH2B (Espoo), W6WX/B (Standford), ZS6DN/B (Pretoria), 4U1UN/B (New York) and 4X4TU/B (Tel Aviv) which are operational on 14.100MHz are sponsored and supported by the Northern California DX Foundation.

Dave Coggins has been listening around the 24MHz band and reports hearing the Brazilian beacon, PY2AMI, on 24.900 MHz.

As usual my thanks are due to **Chris van den Berg** (The Hague), Dave Coggins, Henry Hatfield, **Don Hodgkinson G0EZL** (Hanworth), **Bill Kelly** (Belfast), Greg Lovelock, **Ted Owen** (Maldon), **Fred Pallant G3RNM** (Storrington) and Ted Waring for their consistent monitoring of the 28MHz beacon channels which enabled me to compile the monthly chart seen in Fig. 4.

Chris and Fred added VE3TEN (Ottawa—28.175MHz) to their scores on October 27 and November 9, 15, 16, and 25. The highlight for Don and Ted Owen was hearing VS6TEN (Mt Matilda—28.290MHz) for the first time on November 13 and again on days 18, 20 and 23. It is possible that Don also heard VU2BCN (28.295MHz) at 1332 on the 14th, "It was not strong enough for me to positively identify," he said. Ted Owen was pleased to add VK4RTL (Townsville—28.270MHz) on the 22nd, to his list

Fig. 3 (a, b & c)



of first-timers. "The Bermuda beacon, VP9BA, was loud and clear on November 4," remarked Henry.

Tropospheric

The atmospheric pressure indicated the right conditions, Fig. 5, which gave us the tropospheric-opening between November 4 and 8. While it was in progress, many continental operators were heard working through the 144MHz repeaters in the UK.

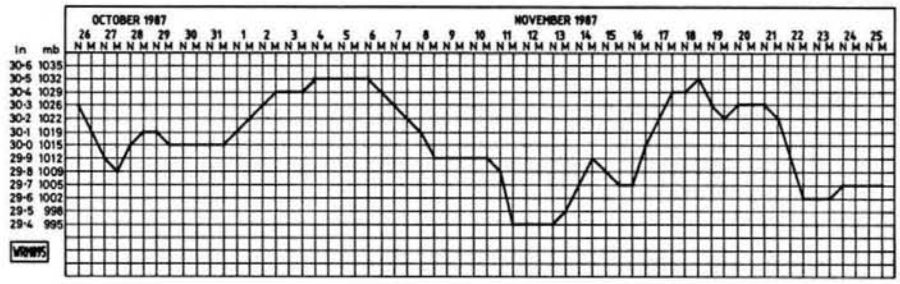
"I expect there are a few hoarse amateurs at the moment!" wrote **Ian Davidson** (Carmarthen) on the 7th. He heard stations from France, Germany, Guernsey, Northern Ireland and the West Midlands working through GB3WW, his local repeater in Dyfed.

Some of the signals that Bill Kelly heard through the repeaters in Appleby (GB3EV-R4), Buxton (HH-R4), Dover (KS-R1) Maidstone (KN-R4), Princetown (WD-R4), Reading (RD-R3), Stockport (MN-R2), St. Ives (SI-R1) and Waterford (EI3WRC-R2), between the 5th and 7th, came from stations in Belgium, France, Germany, Guernsey and Northern Ireland.

"144MHz was chock a block with signals from areas similar to v.h.f/u.h.f. TVDX booming in," wrote **Simon Hamer** from New Radnor.

October 87 — November 87 — WRM894

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					I									I						I											
DK0TEN			I					I						I							I										
DL0IGI	I	I	I		I	I	I	I	I	I	I	I		I	I	I	I	I	I	I	I	I	I		I				I	I	
EA6RCM			I	I			I							I					I												
IY4M			I			I		I	I				I	I	I	I		I	I	I			I								
KD4EC									I																				I		
LU1UG																				I									I		
PY2AMI	I	I		I	I	I	I	I	I	I	I	I	I	I	I	I		I	I	I	I	I			I				I	I	I
PY2GOB	I			I						I	I	I				I		I	I	I	I	I							I	I	I
VP9BA		I						I	I		I	I		I	I				I	I	I	I	I						I	I	I
VS6TEN																			I					I		I			I		
ZS1LA	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
ZS6PW	I	I	I	I	I		I	I	I	I	I	I	I		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Z21ANB	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4N3ZHK						I																									
5B4CY	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I		I



934MHz

"During the evening of October 29, Ralph Rowlet GR-587 (Upper Caldecote) found lift conditions and worked stations in Birmingham and Leicestershire," wrote **John Raleigh DW-04** from Bedford. John, secretary of The Four County 32cm Club told me that he contacted stations in Leeds, Lincoln and Nottingham on November 5, Kent, London and Sussex on the 6th and Essex on the 7th. "Many other stations were heard calling from all over southern England on the 6th," said John.

Also on the 6th, Ralph Rowlet, had contacts in Doncaster and Liverpool and Tony Collins WAC-01 (Bedford) exchanged words with operators in Gainsborough and Lincoln.

John Levesley UK-627, contacted a station in Jersey at 166km and heard signals ranging from Cornwall to East Sussex on the 5th and worked into Swansea (210km) at 2135 on the 6th and Coventry (160km) at 1503 on the 7th. Between 1940 and 2100 on the 7th, John operated from Stoney Cross in the New Forest and made 11 contacts with stations from Bath to Southend-on-Sea. On the 14th and 15th, he made local contacts while mobile or portable in south Yorkshire, his best being Leeds, around 64km.

Despite appalling weather conditions, nearly 190 members were on the air from 17 counties and 574 contacts were made during the contest, on October 18, organised by John Levesley, the contest manager and Dorset area representative for the 934MHz Club UK.

Our congratulations to the leading point scorers, UK-78, UK-1154 and UK-612 and UK-1243, UK-1132 and UK-310 in the home-base and mobile/portable single-operator sections, respectively. The longest home-base contact of 164km was achieved by UK-975, North Yorkshire and UK-1132 in Lincolnshire and 121 miles was chalked up in the portable section by UK-409, Mull of Galloway and UK-387 in Limavady.

The next three deadlines are: January 27, March 2 & March 26

Broadcast Round-up

Peter Shore

With long winter nights there's little better than to closet oneself in front of a receiver and tune around the short wave bands to see what is happening here, there and everywhere. However, conditions at the beginning of December were not as good as they might have been, and reception from the west, particularly during the evening, was poor. Let us hope that reception improves as winter continues.

The mystery surrounding the Radio Beijing relays which I mentioned in last month's column appears to have been solved. You will recall that Radio Beijing had been noted between 0000 and 0300 on 9.77MHz in English and Chinese, and it was thought that the transmitter was located either in North America or in south-west Europe. It transpires that, after much research and scratching of heads, relays of Radio Beijing are now coming from the African country of Mali, where short wave transmitters near Bamako have been renovated by the People's Republic of China. Back in the early 1970s, these transmitters were used for an external service from Mali (the 1971 *WRTH* lists frequencies for this service as 15.145, 17.71 and 17.725MHz, all with 100kW power). Satellite equipment has been installed by the Chinese, and the service seems to have been inaugurated at the beginning of November. Further details of times and frequencies are in the News section.

Meanwhile, Radio Exterior de Espana is to be relayed over transmitters in the People's Republic in return for the use of the Noblejas transmitting site, south-east of Madrid. No date has yet been given for the commencement of these relays.

Where will it all end—will Radio Beijing's programmes be coming from BBC sites like Rampisham and Daventry before too long? Or will there be an agreement between Moscow and Beijing . . ?

Radio Australia is to be broadcast nationwide to Australia between midnight and dawn starting on Australia Day, 26 January 1988. No details of the frequencies for this service have yet been given.

The use of the 13MHz band by private short wave broadcasters has been approved by the Federal Communications Commission in the United States. WYFR already uses 13.695, and WHRI is using 13.76. This band provides excellent clear channels at the present, and the Soviet Union together with some other Eastern Bloc countries, as well as Deutsche Welle are installed comfortably here. Radio Australia is also reported to hope to be able to use the new band "very soon" according to an item in the station's communication programme *Talkback*. I wonder when the BBC will grab a piece of the action.

Have you ever listened to *Six Continents* on BBC Radio—it's a review of what the world's radio stations have been saying, taken from programmes monitored by the BBC at their Caversham Park Monitoring Service. Now the Poles have a similar programme, called *The West Calling*, which opens with the interval signals of a number of Western broadcasters. The programme broadcasts a selection of recording taken off air from VoA, Radio Free Europe, the BBC and other radio stations in Polish. A new idea generated by glasnost, perhaps.

Europe

NOTE: all times are UTC (GMT)

BRT Brussels is on the air in English:
0030-0055 on 5.91 and 9.925MHz
0800-0825 on 5.91 and 17.60MHz
1000-1025 on 15.51 and 17.61MHz
1330-1355 on 15.59 and 17.60MHz

1630-1655 on 15.51 and 17.61MHz
1830-1855 on 9.86, 6.035 and 1.512MHz
2200-2225 on 5.91, 6.035 and 1,512MHz
in French:
1030-1055 on 15.51 and 17.61MHz
1400-1425 on 15.59 and 9.86MHz
1730-1755 on 15.51, 17.61 and 1.512MHz
2030-2055 on 6.035 and 1.512MHz
2230-2255 on 5.91 and 9.925MHz

In Czechoslovakia, a relay of Moscow First domestic radio has begun on 1.584MHz with 1kW from the roof of the Soviet Embassy in Prague. Radio Finland continues to have problems with its transmitters at the Pori site. However, when the station does manage to get on the air, its schedule is:
0530-0555 on 6.12, 9.605 and 11.755MHz
0730-0755 on 6.12, 9.56, 11.766MHz and 963kHz
1505-1530 on 11.85 and 15.185MHz
1930-1955 on 6.12, 9.53, 11.755MHz and 963kHz
2200-2225 on 6.12, 9.67MHz and 963kHz

You can tune into Rome when RAI broadcasts in English:
0100-0120 on 9.575 and 11.80MHz
0350-0410 on 9.71, 11.905 and 15.33MHz
0425-0440 on 5.99 and 7.275MHz
1935-1955 on 7.275, 7.29 and 9.71MHz
2025-2045 on 7.235, 9.575 and 11.80MHz
2200-2225 on 5.99, 9.71 and 11.80MHz
in Italian:
0415-0425 on 5.99 and 7.275MHz
0435-0510 on 9.71, 11.80 and 15.33MHz
0830-0930 on 9.585, 11.81, 15.33, 17.78 and 21.615MHz
1555-1635 on 5.99, 7.29 and 9.575MHz
1700-1745 on 7.235, 9.71, 15.385, 17.78 and 21.69MHz
1830-1905 on 15.245, 15.45 and 17.78MHz

From Lithuania, Radio Vilnius has broadcasts to Europe in English at 2230 on 6.10MHz and 666kHz medium wave. Lithuanian can be heard on the same channel in the half-hour before at 2200.

Radio Moscow's hour for Great Britain and Ireland is currently heard at 2000 on 5.905, 5.92, 5.935, 6.02, 6.03, 6.175, 7.115, 7.15 and 7.17MHz, although reception can sometimes be very poor.

Middle East

Iran's domestic programming can be heard well in the United Kingdom on 6.22 and 4.99MHz—try from 1500 and throughout the evening. Iraq's External Service to Europe can be heard with French at 1900, German at 2000 and English at 2100 on a new frequency of 7.295MHz.

Israel Radio come back on the air late in November following a strike by journalists. The current English language schedule is:
0000, 0100 and 0200 on 9.845, 9.435 and 7.46MHz
0500 on 17.615, 11.655, 9.46, 9.435, 9.385, 7.41 and 7.355MHz
1100 on 21.625, 17.635, 15.65, 15.64, 15.485, 15.095 and 9.385MHz and 1800 on 11.585, 9.925, 9.46 and 9.385MHz
2000 and 2230 on 11.655, 9.845, 9.435, 9.01, 7.46 and 7.355MHz

Easy Hebrew can be heard at 2300 on 9.845, 9.435, 9.01 and 7.46MHz.

Africa

The BBC World Service relay in Lesotho has changed frequency to 3.255, although day-time 6.19 continues. Radio Mozambique is heard in English at 1800 on 4.855.

Some rearrangement of South Africa's domestic frequencies has taken place—R Suid Afrika is now broadcasting on 7.23 and 9.555MHz, whilst Radio Oranje has moved to 7.285. Radio 5 continues on 9.665. Reports come from the United States that Radio Uganda has been heard in English on 15.435, but no time has been given. Other reports suggest that 15.325 might be used.

Asia

Radio Afghanistan moved some frequencies at the beginning of November: the European service with Dari and Pashto at 1730, German at 1830 and English at 1900 are now heard on 6.02 and 4.76, with both transmissions thought to come from the USSR.

The schedule for Radio Beijing has become rather more complex in recent weeks with the additions of numerous relays in various parts of the world. However, a summary of English and one or two other important languages appears to be:
0000 in English, 0100 in Cantonese, 0200 in Standard Chinese to North America on 11.715-M; 9.77-M and 9.665MHz
1600 in English to Africa on 15.13-M; 11.715-M; 11.60; 9.57 and 5.25MHz.
1700 in English to Africa on 11.60, 9.57 and 4.13MHz and 1900 in English to Europe on 11.50, 9.74 and 5.25MHz
1930 in French to Africa on 11.79-M, 9.88, 9.745-M; 7.80, 7.31, 7.185 and 4.02MHz
2030 in English to Mid East and Africa on 11.79-M; 11.515; 9.745-M, 9.44 and 6.955MHz
2230 in English to Europe on 3.985-S
2230 in Portuguese to Europe on 6.165-S

The suffix "M" indicates that the transmitter is thought to be located in Mali, and "S" indicates that the transmitter is known to be in Switzerland. The 2230 English service is heard well in the United Kingdom.

Voice of Free China programmes from Taiwan can be heard in English: 0200 and 0300 on 15.345, 11.745, 11.74, 9.765, 7.445, 5.985 and 5.945MHz
0700 on 5.985MHz
2200 and 15.37, 11.805, 9.955 and 7.355MHz

North and South America

The station which was mentioned in last month's column, KUSW in Salt Lake City, Utah, was due to go on the air on December 7, using the frequencies given last month, with the exception of 0000-0300 when 11.66 might be utilised in place of 11.68. The station's address is: PO Box 7040, Salt Lake City, Utah 84107, USA.

The Voice of America's *Worldwide Shortwave Spectrum* programme has been replaced by a new show *Communications World*. The new show, which will be produced and presented by Gene Reich, will form part of the weekend *Magazine Show* sequence, and is to be broadcast at 1210 and 1710 (to Asia), at 2110 to Europe and to the Americas at 0110 on Sundays.

WCSN, the Christian Science Monitor from Boston, altered some frequencies recently and can now be found:
0000-0600 on 9.85MHz
0800-1000 on 7.365MHz
1000-1200 on 11.945MHz
1600-1800 on 15.28MHz
1800-2200 on 21.515MHz
2200-2400 on 9.495MHz

Radio Surinam International has a new frequency of 17.838 for its transmission at 1700 in Dutch, English and Sranan Tongo.

SWAP SPOT

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Have IC-202 144MHz s.s.b./c.w. rig. Would exchange for HW8, Micron or similar QRP rig. Tel: (0742) 421781. *D652*

Have KW2000A transceiver, recently overhauled by manufacturers. Demonstration with owners pleasure. Would exchange for ICF-7600D in good condition. G0AQI QTHR. Tel: 01-445 0528 (evening or weekends). *D662*

Have Realistic PRO-2009 8-channel scanner v.h.f./u.h.f. hardly used. Would exchange for any short wave receiver in good condition with good antenna. Mr. M. Mayer. Tel: 0203 373294. *D665*

Have CBM 64, datasette, joystick, business/games programs, Comm-in 64 board, ST5 t.u., IC-2E, IC-27E, all in very good condition. Would exchange for general coverage receiver (portable or base); 430MHz module for FTV-901, 144MHz/430MHz dual bander, h/d rotator; h.f. beam or w.h.y? Mr J. Merson GM4MOA, 4 Low Street, Buckie, Banff AB5 1UX. *D680*

Have Pan-Crusader "X" 12-band digital communications receiver, m.w., l.w., 4 s.w., 5 v.h.f., u.h.f. Modes u.s.b., l.s.b., c.w. Would exchange for Sony ICF-2001D of w.h.y? Tel: 061 743 1570. *D684*

Have AR88D unmodified, perfect example of this receiver. Would exchange for SRX30 or FRG-7 or similar "lightweight", cash adjustment if required. Allan. Tel: 031-661 6085. *D692*

Have Yaesu FT-23R 144MHz transceiver, mint and still under guarantee. Charger, manual, mobile extras including antenna. Would exchange for h.f. digital receiver Trio, Yaesu, Sony ICF-2001D, ICF-7600DS, or Grundig Satellit, Panasonic, with s.s.b. w.h.y? Cash adjustments. G4VLB. Tel: 061-480 1549. *D693*

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For Tomorrow's Radio Technology

TODAY

BASE STATIONS

ICOM IC735

Good News for FT767 owners. Kenwood owners take note!

IMPROVED YAESU FT767 RWC/MK2 HF-UHF BASE STATION

We are pleased to announce that we have now improved the synthesizer (see reviews) leading to better dynamic range by up to 20dB which now puts this transceiver in a class of its own! This modification is only available from RWC and is fitted FREE to all New units sold by us, or we will modify any existing unit for £59.50 inc. return carriage. Available at some Yeasu dealers.

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FRG 9600

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RWC MOD KITS, ANNOUNCEMENT

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