MARCH 1988 £1·20

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Practical Wireless

The Radio Magazine

A New Series For Beginners
UNDERSTANDING CIRCUIT DIAGRAMS

Reviewed
The Howes SWB30 SWR/Power Meter

WIN A £390 Cap. Co Magnetic Loop!

Announcing the HF/VHF/UHF base station you'll hear about on the air.

Listen for Yaesu's FT-767GX everywhere you might hear it: HF, 6 meters, 2 meters and 70 cms.

You'll hear operators calling it the ideal HF/VHF/UHF base station.

And they'll rave about its full-featured performance and highly attractive price.

You see, the FT-767GX continues the price/performance tradition of our popular FT-757GX. But with even more features.

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As standard equipment, you get a built-in HF automatic antenna tuner, AC power supply, digital SWR meter, digital power output meter, electronic keyer, and CW filter.

And operation is smooth and intuitive with keyboard frequency entry. Dual VFOs that tune in 10-Hz steps. A digital display in 10-Hz steps. And ten memories that store mode, frequency, and CTCSS tone information.

The FT-767GX is ready to operate full duty cycle at full rated power output for up to 30 minutes. And it listens from 100 kHz to 30 MHz.

Plus your station is really complete with full CW break-in, our patented Audio Peak Filter for CW operation, a CW TX offset variable 500/600/700 Hz, IF shift, an IF notch filter, a Woodpecker noise blanker, a VFO tracking system for slaved A/B VFO tuning. And that's just a partial list!

But the best way to discover its full-featured performance is to visit your Yaesu dealer today.

Yaesu's FT-767GX. The affordable way to be heard on HF, VHF and UHF.

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Prices and specifications subject to change without notice.

Practical Wireless
The Radio Magazine

MARCH 1988 (ON SALE 11 FEBRUARY 1988) VOL. 64 NO. 3 ISSUE 972

THIS MONTH

We are sorry that, due to technical difficulties, the promised article about a Digital Dial has had to be held over until next month

Regular Features

NEXT MONTH

A Modular VHF Monitor Receiver

A "Digital Dial"

The Alinco ALX-2E 2m Handheld Reviewed

plus

HF Beacon Chart Pull-out

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

On sale March 10

Contents subject to last-minute revision

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TM221E

The 45 watt wonder for 2 metres. Common sense facilities, ease of use, and a massive 45 watt output make the TM221E probably the most wanted FM mobile around. All this and an amazing receiver (see Ham Radio Today July 1987). All you need in a compact package, including all channel spacings (5, 10, 12.5, 15, 20, and 25 kHz). P.S. it also has a 70 cm. brother, the TM421E, and a remote controller available for operating them both together.

TM221E . . . £317.50 (carr. £8) **TM421E . . . £352.84**

TS711E

Called by many "The perfect 2 metre Base station", the TS711E is as close to perfection as state of the art can make it. All mode operation, full band coverage, continuous tuning or step tuning for FM channels. Two separate VFOs, 40 memories storing frequency, mode, repeater shifts, even whether or not you need a tone burst. Optional voice synthesiser, the list of features is almost endless. (And it too has a 70 cm brother, the TS811E.)

TS711E . . . £940.00 (carr. £8) **TS811E . . . £1094.00**

TR751E

Versatile 2 metre multi mode mobile or fixed station, the TR751E again shows that Kenwood magic touch in making a complex transceiver so easy to use. Virtually a miniature version of the TS711E, the TR751E set new standards of performance at its introduction, and has continued to win friends ever since, continuing as it did the line started by the TR9000 and TR9130. (And, you guessed, it has a 70 cm counterpart, the TR851E.)

TR751E . . . £599.00 (carr. £8) **TR851E . . . £699.00**

RZ1

To be perfectly honest, the RZ1 came as a surprise to us. We didn't expect Kenwood to come up with a mobile monitor receiver covering 500 kHz to 900 MHz, but here it is. Designed to fit in a standard car radio slot, the RZ1 seems to have everything. Direct frequency entry, manual tuning, 100 memories, readout of station name on display, scanning, stepping, am/fm modes, unbelievable . . . Of course this level of facilities does not come cheaply, but the RZ1 really adds a new dimension to the wide range monitor market.

RZ1 . . . about £495.00 not yet fixed)

TS940S

Top of the range, the TS940S has everything the discerning HF operator requires. Amateur bands from 160 to 10 metres, together with a general coverage receiver tuning from 150 kHz to 30 MHz. Operating modes USB, LSB, CW, AM, FM, FSK. Forty memory channels, each effectively a separate VFO. Easy keyboard frequency entry. Leadership in the field. The TS940S is the transceiver everyone wants to own one day.

TS940S . . . £1995.00 (carr. £8)

TS440S

The latest in the "4" series HF transceivers from Kenwood, the TS440S covers all bands from 160 to 10, and also has general coverage receive from 100 kHz to 30 MHz. Keypad frequency entry as well as twin VFO and 100 memories. Full break in for the advanced user, and provision for an internal automatic ATU. USB, LSB, CW, AM, FM, FSK; in other words – everything. Performance? Would you expect Kenwood to give you anything less than the best.

TS440S . . . £1138.81 (carr. £8)

R5000

Virtually the receive section of a TS940S, the R5000 is probably the best HF receiver right now. Notice the family resemblance to the TS440S which gives it a clean, easy to operate look, and of course Kenwood have applied all their ergonomic skills to make you "at home" the moment you begin to use the R5000. All mode of course, and has an optional internal VHF converter which extends coverage to 108-174 MHz.

R5000 . . . £875.00 (carr. £8)

TL922

You Brute. If it wasn't for all the safety interlocks I would operate my TL922 with all the covers off, just to admire the sheer engineering beauty of the innards. The TL922 is THE linear amplifier, and once you own it you will never part. The effortless ease with which the TL922 produces RF power has to be experienced to be believed, and it is probably the world's most sought after station accessory.

TL922 . . . £1495.00 (carr. £8)

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

You will remember (I hope) that last month I wrote in enthusiastic terms about the new **TS140S** transceiver from **Kenwood.** Well, the first shipment arrived and was quickly sold, and so far all reports are that the new owners are as enthusiastic as I am. However, I can't help smiling a little, because I quoted some fractured lines from Kipling in the same text, and they seem to have come true.

In a huge centre spread ad. in this and other magazines, I saw a slogan reading "The New Face of HF". I looked twice at the photographs under this slogan because I thought that the largest transceiver looked familiar, in fact I thought that it was a **TS940S. WRONG:** it was a "new" transceiver from another manufacturer, but the resemblance is uncanny. You **TS940S** owners should take a look and see if you recognise the style, the knobs, the S meter, the size, the colour, the main readout, and so on, and so on.

It is said that imitation is the sincerest form of flattery, and I have no doubt that **Kenwood** are flattered, but of course the **TS940S** has been around for two years now so Kipling's line about "sweating and stealing, a year and a half behind" seems oddly appropriate. No offence meant chaps, but I wonder what will follow the lead set by the **TS140S?**

Actually, there is another version of the **TS140S** around called the **TS680.** This was originally intended for the Japanese home market and any that have appeared in the UK are of course the product of that well known phenomenon, the shady importer. However, we think that the **TS680** should be made available in the UK, because it is basically a **TS140S** but with a 10 Watt 6 metre section added.

The addition of 6 metres obviously increases the cost, and also carries a small penalty in that the VOX facility disappears (Can't imagine why) but if you want the **TS140S** (less VOX) but with added 6 metres (sounds like a miracle ingredient in a washing powder) **ask us about the TS680.**

If you already bought a **TS680** from a shady source then Good Luck to Ye Sorr. I hope you trust his service and backup ability. Getting a discount isn't necessarily the end of the story; it's often the beginning of a sorry melodrama.

Soapbox time over. The fact is that the **TS140S** and **TS680S** are leaders in a new direction for amateur radio equipment, and I predict we are going to see the gradual demise of the complicated HF table topper (that takes you back a bit doesn't it). Table topper for you youngsters under 50 used to mean something of the size, shape, and weight of an **ABSE,** i.e. about a hundredweight (oh, if you must 50kg). The **TS140S** weighs 6kg.

Incidentally, we find out more every day. The **TS140S** specification reads as though the receiver covers from 500 kHz to 30 MHz, but in fact it tunes 50 kHz to 35 MHz. The performance falls off a bit at the low frequency end, but the coverage up to 35 MHz is really useful for VHF and UHF converters, where the 28 to 30 MHz range is often too limited. **Nice touch Kenwood.**

Do you get the impression that I rather like the **TS140S?** I have to admit that I see it as the ideal transceiver where cost and performance are nicely balanced, and the facilities provided are all that anyone could need. For full details, just send a stamped addressed envelope and we will fire back a leaflet which includes details of all the matching accessory units available. Better still, why not call in at one of our branches and get a "hands-on" impression of a really satisfying rig.

73, G3PCY/5NRAAC

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?

HF125
Short Wave Receiver

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Features:

- **AC power supply**
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- **Twin passband tuning**
- **Dual-watch**
- **99 memories**

Advanced engineering from ICOM has produced the most sophisticated Amateur HF transceiver on the market today, whether DX'ing, contesting or simply enjoying top performance the IC-781 is a top of the line performer. A unique multi-functional CRT displays frequencies, modes, memory contents, operating notes, RIT, two menu and seventeen optional screens. The soft orange display also serves as a display for DATA modes such as RTTY, AMTOR and PACKET.

The PAN display continuously indicates all signal activities and pile-ups with your operating frequency in the centre. Selectable frequency spans of 50kHz, 100kHz and 200kHz. Vertical range indicates relative signal strength. Twin passband tuning with separate controls for second and third IF stages increases selectivity and narrows bandwidth, independently varies low and high frequency response or functions as a IF shift.

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TH HF TRANSCEIVER IC-781

The IC-781 has a dual-watch function which allows simultaneous receive of two frequencies in the same band. Balance controls adjust VFO A/B receive strength levels. This feature is especially useful on Dx-expeditions or contests to check band activity or to tune in your next contact. The newly developed ICOM DDS (Direct Signal Synthesizer) system is incorporated to provide a fast transceiver lock-up time. This is essential for data communication systems.

The IC-781 communication system includes a built-in 100% AC supply, high speed automatic antenna tuner, iambic keyer, semi-automatic, or full QSK CW break in to 60 wpm, audio peaking filter, RF speech processor, multi-scanning plus much more. Look into the future of Amateur communications, ICOM products will be setting the pace others try to follow. For more information on the IC-781 contact your local authorised ICOM dealer or phone ICOM (UK) Ltd direct.

- **SSB, CW, FM, AM, RTTY**
- **160-10m/general coverage receiver**
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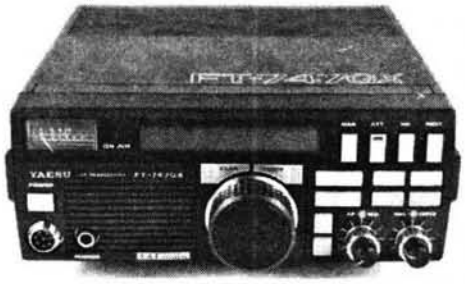

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We are pleased to announce a new series of FM VHF and UHF mobile transceivers for the amateur. The 45/5W FT-212RH and the 35/4W FT-712RH. Smaller than their predecessors these models utilize a new cpu with greatly expanded features, most notable of which are 19 memories and support for the DVS-1 Digital Voice System, which can digitally record and playback from the microphone or the receiver.

FT212RH ..... £349.00.
FT712RH ..... £375.00.
DVS1 Voice Memory Unit £79.00
FTS12 CTCSS Unit £60.38

FT212RH & FT712RH
NEW FROM YAESU

EQUIP YOURSELF FOR THE DX SEASON

6m 'ES' 2m DX

CROSSBAND DX

WITH THE FT726R(2)

FOR ONLY £699 inc. VAT

Remember reading the VHF columns last year and wishing you'd been able to work some of those exotic call signs!! "Well now you can", SMC have acquired from Yaesu a limited quantity of the last available stocks of the famous FT726R at a special price and all the 6m and HF modules Yaesu had left in Japan. Fit the FT726R with the optional 6m, HF and SAT modules and you are now equipped in one package with the facilities for 2m 'ES', tropo, aurora, etc, and 6m 'ES' crossband DX and full duplex between 6m and 10m without having to buy a separate HF rig! This allows you to call CQ on 50.11 and tune around 28.885 for replies while transmitting!! But don't leave it too long as we have only limited numbers of these sets left. If you miss out on this bargain you may miss out on the DX too!!

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** Special offer only available when purchased with FT726R(2).*

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NEW

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

FT736R R.R.P. £1450.00 C/W 2M & 70cms.

HY-GAIN – LOW PRICES

Due to the strong pound and our special purchase we can now offer for a limited period up to 15% discount on their range of antennas and 10% on their larger rotator Ham IV. Buy now whilst stocks last (from January 1st they increased their prices and if the dollar recovers prices could go up by 30% to 40%).

			Offer Price	p&p
12AVQ	Vert. 10-15-20M	~~£78.95~~	£ 71.00	£3.75
14AVQ	Vert. 10-15-20-40M	~~£106.00~~	£ 95.00	£3.75
18AVT	Vert. 10-15-20-40-80M	~~£172.00~~	£146.00	£3.75
18V	Vert. 10-80M tapped coil	~~£48.50~~	£ 43.65	£4.50
TH2Jnr	3 Ele. Yagi 10-15-20M	~~£299.00~~	£254.00	£4.50
TH2MK3	2 Ele. Yagi 10-15-20M	~~£278.00~~	£249.00	£4.50
EX14	5 Ele. 10-15-20M Explorer	~~£499.00~~	£449.00	£7.50
QK710	EX14 to cover 40M	~~£139.00~~	£115.00	£6.50
TH5MK2	5 Ele. 10-15-20M T'bird	~~£649.00~~	£575.00	£7.50
TH7DXX	7 Ele. 10-15-20M T'bird	~~£755.00~~	£669.00	£7.70
103BA	3 Ele. Yagi 10M	~~£ 99.00~~	£ 89.00	£3.95
105BA	5 Ele. Yagi 10M	~~£220.00~~	£187.00	£3.95
153BA	3 Ele. Yagi 15M	~~£135.00~~	£121.00	£3.95
155BA	5 Ele. Yagi 15M	~~£338.00~~	£288.00	£5.90
203BA	3 Ele. Yagi 20M	~~£269.00~~	£233.00	£4.90
204BA	4 Ele. Yagi 20M	~~£420.00~~	£357.00	£7.30
205BA	5 Ele. Yagi 20M	~~£499.00~~	£425.00	£9.40
DB10-15A	3 Ele. Yagi 10-15M	~~£299.00~~	£199.00	£4.80
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HO/2M	Halo head only	~~£9.76~~	£9.29
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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	~~£29.81~~	£28.13
LW5/2M	5 Element Yagi 7.8dbd	~~£18.69~~	£17.76
LW8/2M	8 Element Yagi 9.5dbd	~~£23.96~~	£22.78
LW10/2M	10 Element Yagi 10.5dbd	~~£29.04~~	£27.59
LW16/2M	16 Element Yagi 13.4dbd	~~£42.56~~	£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	~~£23.93~~	£32.23
D8/2M	8 over 8 slot fed Yagi 11.1dbd	~~£46.56~~	£44.25
5XY/2M	5 Element crossed Yagi 7.8dbd	~~£36.25~~	£34.42
8XY/2M	8 Element crossed Yagi 9.5dbd	~~£46.00~~	£43.70
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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	~~£117.68~~	£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

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Kenwood

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			P&P
TW4100E	2M/70CMs Dual Band Transceiver	ONLY 499.00	(5.00)
TS440S	NEW Amateur band transceiver General coverage RX	1138.81	(7.00)
PS50	Heavy Duty PSU for TS440S	222.49	(5.00)
AT440	Auto ATU for TS440S	144.82	(3.00)
TS940S	9 Band TX General Cov RX	1995.00	(7.00)
AT940	Auto ATU for TS940S	244.88	(4.00)
TS930S	9 Band TX General Cov RX	1695.00	(7.00)
TS830S	160-10m Transceiver 9 Bands	1098.00	(7.00)
AT230	All Band ATU/Power Meter	208.87	(5.00)
SP230	External Speaker Unit	68.49	(5.00)
PS430	Matching Power Supply	173.78	(5.00)
SP430	Matching Speaker	40.81	(3.00)
MB430	Mobile Mounting Bracket	15.00	(2.50)
FM430	FM Board for TS430	48.05	(1.50)
LF30A	HF Low Pass Filter 1kW	32.26	(2.50)
YK88A	6KHz AM filter for TS430S/440S	49.37	(1.50)
YK88C	500Hz CW filter for TS430/440/830/530	46.00	(1.50)
YK88CN	270Hz CW filter for TS430/440/830/530	54.64	(1.50)
YK88SN	1.8KHz SSB filter for TS430/440/830/530	46.71	(1.50)
MC50	Dual Impedance Desk Microphone	46.00	(2.50)
MC35S	Fist Microphone 50K ohm IMP	21.72	(1.50)
MC85	Deluxe Desk Mic with Audio Compensator	107.50	(3.00)
MC43S	Up-Down Hand Mic 8-Pin 500 Ohm	22.22	(1.50)
MC40S	Up-Down Hand Mic 6-Pin 500 Ohm	19.07	(1.50)
MC60A	Desk Mic with built-in Pre-amp	88.22	(3.00)
MC55	Mobile Microphone with control box (up/down etc.) 6 or 8 pin	52.67	(2.50)
TR751E	2M Multimode (mobile)	599.00	(5.00)
MU1	DCL option for TR751E	30.05	(1.00)
TS711E	2M Base Stations	748.00	(7.00)
HS5	Deluxe Headphones	37.54	(2.50)
SP40	Mobile External Speaker	21.06	(2.00)

NEW

TS140SHF			
TH205E	2M Handheld Transceiver	215.26	(4.00)
TH215E	2M Handheld with Keypad Entry	252.13	(4.00)
PB1	Nicad Pack 12v 800mAh	57.27	(2.00)
PB2	Nicad Pack 8.4v 500mAh	34.22	(2.00)
PB3	Nicad Pack 7.2v 800mAh	38.82	(2.00)
PB4	Nicad Pack 7.2v 1600mAh	63.19	(2.00)
BT5	Dry Battery Case	11.00	(1.50)
BC7	Rapid Charger	97.42	(3.00)
SC12	Case for (PB2/3)	13.82	(1.50)
SC13	Case for (PB1/4)	14.49	(1.50)
PG2V	DC Power Cable for TH205E/215E	3.96	(1.50)
SMC30	Speaker Mic for TH21E/41E/2600/3600E	28.31	(2.00)
HMC1	Headset Unit with VOX for TH21E/41E/2600/3600E	32.91	(2.00)
RA2	Rubber Flexible Antenna for TR2400/2500/2600E	9.87	(1.50)
RA3	Telescopic Whip Antenna for TR2400/2500/2600E	13.74	(1.50)
TM221E	2M FM Mobile Transceiver 45W	317.38	(5.00)
TM421E	70cms FM Mobile Transceiver 35W	372.00	(5.00)
TH405E	70cms Handheld Transceiver	268.00	(4.00)
TH415E	70cms Handheld with Keypad Entry	298.85	(4.00)
TR851E	70cms All Mode Transceiver	699.00	(5.00)

Yaesu

PA3	Car Adaptor/Charger	21.05	(2.00)
MH1B8	Hand 600 8pin mic	21.00	(1.50)
MD1B8	Desk 600 8pin mic	79.00	(3.00)
MF1A3B	Boom mobile mic	25.00	(2.00)
YH77	Lightweight phones	19.99	(2.00)
YH55	Padded phones	19.99	(2.00)
YH1	L/weight Mobile H/set-Boom mic	19.99	(1.50)
YH2	L/weight Mobile H/set-Boom mic	19.95	(1.50)
SB1	PTT Switch Box 208/708	22.00	(1.50)
SB2	PTT Switch Box 290/790	22.00	(1.50)
SB10	PTT Switch Box 270/2700	22.00	(1.50)
FT690RMKII	2.5W 6M multimode portable/mobile/base	399.00	(5.00)
FT211RH	2M 45W Mobile	309.00	(4.00)
FT767GX	HF Gen. Coverage trans. with optional VHF/UHF/6M modules	1550.00	(—)
FEX-767-2	2m module for FT767	169.00	(3.00)
FEX-767-7(B)	70cms module for FT767	215.00	(3.00)
FEX-767-6	6m module for FT767	169.00	(3.00)
FL7000	Solid State linear with built in auto ATU	1600.00	(—)
FT727R	Dual Band handheld transceiver 144-146MHz, 430-440MHz up to 5W on each band	425.00	(3.00)
FT290RMK II	2M multimode portable/mobile/base	429.00	(3.00)
FT23R/FNB10	2M mini handheld with LCD display 5W	249.00	(3.00)
FT73R/FNB10	70cms mini handheld with LCD display 5W	269.00	(3.00)

Aerial Rotators

DAIWA MR750E	Heavy Duty rotator. Can have up to 4 motors	254.10	(5.00)
KR400	Med/H Duty	139.00	(5.00)
KR500	6 core Elevation	149.95	(5.00)
KR400RC	5 core Medium Duty	169.00	(5.00)
KR600RC	6 core Heavy Duty	219.00	(5.00)
KC038	lower mast clamps	17.45	(2.00)
KS065	Rotary Bearing	29.95	(2.50)
AR1002	Lightweight VHF Rotator	52.95	(4.00)

Second Hand List

		P&P
TRIO R5000 HF Receiver + VC20 VHF Converter + SSB Narrow Filter and Speech Synthesiser (condition as new)	799.00	(7.00)
YAESU FT101Z HF Transceiver. VGC	425.00	(7.00)
ICOM IC735 HF Transceiver. Excellent cond.	770.00	(7.00)
TEN-TEC Corsair with matching PSU, only 6 mths old	1050.00	(7.00)
AR2002 VHF/UHF Scanner 2 mths old	387.00	(5.00)
YAESU FRG9600 VHF/UHF All Mode Scanner. Ext. coverage	399.00	(5.00)
SONY ICF Pro 80 HF/VHF/UHF Handheld Scanner (as new)	249.00	(4.00)
TRIO TR9000 2M Multimode 10W	255.00	(5.00)
DRAE 12Amp Power Supply	65.00	(4.00)
CD670 RTTY/AMTOR/CW/ASCII Decoder with built in LCD display	250.00	(4.00)
YAESU FT209RH 2M Handheld. Demo model	285.00	(4.00)
MML144/100S 2M 100W Linear 10W input	85.00	(4.00)
MML144/30LS 2M 30W Linear 1 or 3W input	59.85	(4.00)

Receivers

Trio R2000 HF general coverage receiver	595.00	(7.00)
Trio VC10 VHF converter for R2000 118-174MHz	161.94	(3.00)
Trio R5000 NEW HF general coverage receiver	875.00	(7.00)
Trio VC20 VHF converter for R5000 108-174MHz	167.21	(3.00)
Yaesu FRG8800 HF general coverage receiver	639.00	(7.00)
Yaesu FRV8800 VHF converter for FRG8800 118-175MHz	100.00	(3.00)
Icom R71E HF general coverage receiver	825.00	(7.00)
Icom RC11 remote control unit for ICR71E	82.00	(2.00)
AR2002 VHF/UHF scanner 25-550MHz and 800-1300MHz	487.00	(5.00)
FRG9600 VHF/UHF scanner 25-950MHz	509.00	(5.00)
Icom R7000 VHF/UHF scanner, all modes 25-2000MHz	957.00	(7.00)
Icom RC12 remote control unit for R7000	82.00	(2.00)
R537S Air band portable. Tunable 118-136MHz	69.51	(3.00)

NEW

R535 VHF/UHF Airband Receiver. 60 memory channels, memory scan, programmable scan with RS232 interface	249.00	(3.00)
Black Jaguar BJ200 MKII. Handheld VHF/UHF Scanner	225.00	(3.00)
HF125 HF general coverage receiver 30KHz-30MHz (Made in Britain)	375.00	(5.00)

Icom

IC751A	HF Transceiver	1465.00	(—)
IC735	New HF Transceiver	949.00	(—)
PS15	P.S. Unit	158.00	(4.00)
PS30	Systems p.s.u. 25A	343.85	(—)
SM6	Base microphone for 751/745	46.00	(1.00)
IC290D	2m 25w M/Mode	542.00	(—)
IC505	10W/3W 6M multimode, portable/base	459.00	(5.00)
IC3200E	2m/70cms dual band mobile, with built in duplexer	556.00	(5.00)
IC02E	2m H/Held	299.00	(—)
IC04E	70cm handheld	299.00	(—)
BC35	Base Charger	78.15	(1.50)
HM9	Speaker mic	21.85	(1.50)
BP3	Std Battery Pack	29.90	(1.50)
BP4	Empty Battery Pack	9.20	(1.50)
BP5	High Power Battery Pack	69.95	(1.50)
CP1	Car Charging Lead	6.90	(1.50)
DC1	12v Adaptor	17.25	(1.50)
IC48E	10W 70cms FM mobile	449.00	(3.00)
IC28E	25W FM mobile (Tiny)	359.00	(3.00)
IC-Micro	2 mini hand portable LCD display 1W	239.00	(3.00)

NEW

IC-275E	2M Multimode Base Station inc. PSU. 25W	1039.00	(7.00)
IC-475E	70cms Multimode Base Station inc. PSU. 25W	1125.00	(7.00)
IC-1200	23cm FM Mobile, 10W output, style similar to 28E	559.00	(4.00)
ICOM 761	HF general coverage transciever with internal PSU and auto ATU	2459.00	(7.00)
ICOM IC575	6 metre Base Station	999.00	(10.00)

Power Supplies

DRAE			BNOS		
4 amp	48.30	(3.00)	6 amp	75.00	(3.00)
6 amp	71.53	(3.00)	12 amp	125.00	(3.00)
12 amp	95.16	(3.00)	25 amp	185.00	(5.00)
24 amp	137.54	(5.00)	40 amp	385.00	(7.00)

BNOS NEW 'E' SERIES POWER SUPPLIES

12/5E 5Amp PSU	50.00	(3.00)
12/10E 10Amp PSU	65.00	(4.00)
12/20E 20Amp PSU	115.00	(5.00)
12/30E 30Amp PSU	170.00	(5.00)

Switches

Sigma	2 way SO239	20.20	(1.50)
Sigma	2 way 'n' Skts	22.95	(1.50)
Welz CH20A	2 way SO239	30.75	(1.50)
Welz CH20N	2 way 'n' Skts	54.00	(1.50)
Drae	3 way SO239	17.00	(1.50)
Drae	3 way 'n' Skts	21.95	(1.50)

CW/RTTY/Equipment

BENCHER			P&P
BY1	Squeeze Key, Black base	67.42	(3.00)
BY2	Squeeze Key, Chrome base	76.97	(3.00)
HI-MOUND MORSE KEYS			
HK708	Straight Key	21.50	(2.50)
HK702	Deluxe version of above on Marble Base	42.50	(3.00)
HK706	Straight key	23.00	(2.50)
HK707	Straight key	22.25	(2.50)
MK704	Squeeze paddle	26.00	(2.50)
MK705	Squeeze paddle on Marble Base	32.20	(3.00)

NEW

RTTY-EQUIPMENT			
PK-232	Packet, Amtor, RTTY, CW, ASCII, FAX transceive in one unit. Works with any computer equipped with an RS232 interface. 12V operated	269.95	(4.00)
NEW FAX option for existing PK232 users (includes new manual)		49.95	(2.00)
NEW PK-87 1200 Baud Amateur Packet Radio TNC		169.50	(4.00)
NEW PK-90 Commercial Packet Radio TNC		465.25	(4.00)
SOFTWARE PACKAGES			
PK232/C64/128 Cartridge, overlays, cable, handbook		69.00	(1.50)
PK232/BBC-B & Master. E-PROM, overlay, cable, handbook		35.00	(1.50)
PK232/IBM-PC & Compatibles. Disc, handbook		39.00	(2.50)
P87/C64/128. Cartridge, overlays, cable, handbook		69.00	(1.50)
PK87/BBC-B & Master. E-PROM, overlay, cable, handbook		35.00	(1.50)
NEW FAX-1 Radio Facsimile Weather Map demodulator with double screened printer cable. Includes mounting bracket and NEW RTTY receive facility.		279.95	(4.00)
CD660	Data Receiver for CW/RTTY/TDR/AMTOR/ASCII	284.97	(5.00)
CD670	As above but with built in LCD display	327.77	(5.00)
KEYERS & ACCESSORIES			
Star Master Key	Electronic Keyer	54.70	(3.00)
NEW Star	Masterkey electronics CMOS memory keyer	95.00	(3.00)
TRX3	Morse Oscillator	13.85	(1.50)
Datong	070 Morse Tutor	56.50	(2.50)

Howes Kits

SWB30	SWR Meter Kit	11.90	(1.50)
CV220	2M Receive Converter, for use with 20M RX	17.50	(1.50)
CV620	6M Receive Converter, for use with 20M RX	17.50	(1.50)
DCRX20	20M Amateur Band Receiver	15.30	(1.30)
DCRX40	40M Amateur Band Receiver	15.30	(1.50)
DCRX80	80M Amateur Band Receiver	15.30	(1.50)
DCRX160	160M Amateur Band Receiver	15.30	(1.50)
DCS2	'S' Meter Kit	6.30	(1.50)
CSL4	Dual Bandwidth Filter. Improves selectivity. Internal use.	9.90	(1.50)
ASL5	External Filter Unit. Improves selectivity on your receiver	14.90	(1.50)
TRF3	Shortwave Broadcast Receiver. 5-7 to 12.8MHz	14.50	(1.50)
MTX20	10W 20M CW Transmitter Crystal Controlled	21.00	(1.50)
CTX40	3W 40M CW Transmitter. Crystal Controlled	13.40	(1.50)
CTX80	5W 80M CW Transmitter. Crystal Controlled	13.40	(1.50)
CVF	20, 40 or 80M VFO's. Fully featured VFO units for use with the MTX or CTX range of transmitters, or a DCRX receiver for transceive operation	9.90	(1.50)
CTU30	Antenna Tuning Unit. 1.8 to 30MHz. Up to 30W RF	24.90	(1.50)
AP3	Automatic Speech Processor	15.90	(1.50)
ST2	CW Side Tone or Practice Oscillator	8.00	(1.50)
XM1	Crystal Calibrator	16.00	(1.50)

NEW

HC266	2M to 6M Transverter, fully assembled and tested, 10W RF output	179.95	(3.00)

Aerials

6M Dipole		6.50	(3.00)
6M HB9CV 2 ele beam		12.95	(4.00)
6M 3 ele Beam		22.00	(12.00)
6M 5 ele Beam		32.00	(12.00)
AH-7000	Wideband Discone Antenna. 25-2000 MHz	82.00	(4.00)
Revcone	Wideband Discone Antenna. 25-550 MHz	31.50	(4.00)
G5RV	Full size 102'	16.75	(3.00)
G5RV	Half size 51'	14.25	(3.00)
HB9CV	2 metres	3.95	(3.00)
HB9CV	70cms	3.95	(2.00)
2 metre	Slim Jim	8.95	(3.00)
4-1	Baluns	12.95	(2.00)
3.7 and 7.1MHz	Traps (pair)	9.50	(2.00)
Dipole	Centrepieces	2.25	(0.50)
Copper wire	50M rolls hard drawn	7.95	(2.50)
3" Feeder spreaders in lots of 20		3.60	(1.50)
3" Ribbed end insulators (Polypropylene)		0.60	(0.75)
Limpet Mag Mounts		20.50	(3.00)
BOOKS	Confidential Frequency List (NEW Edition)	5.95	(1.00)
	Air Traffic Radio	2.25	(0.75)
	The Complete guide to VHF/UHF frequencies 25-2000MHz (NEW)	4.95	(1.00)
	The International VHF FM guide	2.00	(0.75)
	GUIDE TO FACSIMILE STATIONS	9.95	(1.00)
	Towards the RAE (Questions and answers book)	4.25	(0.75)
	Logbooks	3.50	(1.00)
	HF Oceanic Airband Communications	3.05	(1.00)

SPECIAL OFFER

Alinco ALM-203E	2M Handheld C/W 30W Amplifier, Nicad, Charger	269.95	(4.00)
Alinco ALD-24E	2M/70CMs Dual Band Transceiver	449.00	(5.00)

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The problem:

I want to operate 2m and 70cm mobile. I want full duplex facilities so that I can transmit on one band whilst listening on the other. What are my choices and what is the best solution?

2m FM transceiver	**£300.00**
70cm FM transceiver	**£350.00**
2m/70cm duplexer	**£26.00**
Total cost of above:	**£686.00**

The above are based on typical market prices.

The solution: ALINCO!

DUAL BANDER ALD-24E

★ 2M/70cm
★ 25 Watts
★ Full Duplex
★ Built-in Diplexer/Dual VFO
★ Small size/21 memories

£449!

What can you say about this transceiver other than praise? The new ALINCO ALD-24E has brought the cost of dual banders down to a price that makes it a serious option to the 2 metre only rig. Just think of the pleasure of being able to select 2m or 70cm at the press of a button. No aerial switching (duplexer built in) and full duplex operation. The ALINCO actually has two completely separate transceivers built into its small case measuring 5.5" × 2" × 6.5". It has all the features of the ALR-22E (see below) at a huge saving over its competitors. We could mention the optional extended receiver coverage of 138-174MHz & 420-454MHz at no extra charge, but then everybody would want one! So we thought that we'd simply invite you to send for the full colour brochure instead.

ALR-22E 2M FM MOBILE

THE RADIO COSTS £249

THE SCANNER COMES FREE!

★ 25 Watts FM
★ 21 Memories
★ Rx 138-174MHz
★ Mini-size

ALINCO products are hitting the market in a big way. And the ALR-22E must rank as today's best buy. When you buy the ALR-22E you don't just purchase a 2 metre mobile, you purchase a vhf scanner as well. For no extra cost we will extend the frequency coverage to 138-174MHz. All this for a price that puts the competition in the shade! Features include 21 memory channels, programmable scan, priority channel options, programmable splits, reverse repeater button, dual speed scanning, optional delay, back-lighted LCD display, dual vfo, lithium battery back-up, 25/12.5kHz steps, mini size measuring 5.5" × 1.5" × 6.5", up/down microphone control, quick release mobile bracket plus mounting hardware, superb sensitivity, 5 watt low power position, manual or electronic tuning, 12 months parts and labour warranty etc. With a specification like this we suggest you phone for colour brochure, today.

2M MICRO HANDHELD

£189!

★ 3 Watts FM
★ Memory Channel
★ Battery Save
★ Smallest in World

ALX-2E

The ALX-2E is a truly pocket transceiver. Capable of 3 watts output it covers the full 140-150MHz using the familiar thumbwheel dial. Features include memory channel, scanning, priority, battery saver, tone-burst, 600kHz shift etc. Supplied complete with nicad pack, AC charger, 12v DC charger, and helical. Accessories available include case, car cigar adaptor, headphone/mic, various batt. packs etc.

BASE STATION OR PORTABLE IT'S UNBEATABLE VALUE!

£329 Free Securicor

The Sony ICF 2001D is rightly earning a reputation for performance at a competitive price. No other portable can match its specification, and it performs equally well as a base station. Digital readout to 100Hz and switchable filters for AM and SSB plus comprehensive memories make this the number one choice, Dual speed tuning, scanning, synchronous detector, RF gain control, external ant. socket etc., all go to make the most comprehensive package available at anywhere near this price. Send for colour brochure.

SONY ICF 2001D

AM/USB/LSB/CW 0.15-30MHz
76-108MHz 118-136MHz

AN-1 Active aerial £49 + £2 pp

SONY AIR-7

★ 0.15-2.2MHz
★ 76-108MHz
★ 108-136MHz
★ 140-174MHz

£247 Free Securicor

The Sony Air-7 has rightly earned the reputation as one of the best hand-held scanners on the market today. Its superb sensitivity together with rugged construction have proved a winning combination. And it is not only enthusiasts who have realised its potential, a number of government and professional organisations are using them too. Features include digital key entry, 40 memories, band & memory scanning, delay, priority, lockout, key-lock, illuminated dial etc. Send today for the full colour brochure.

NEW 1988 EDITION!

★ 26-2250MHz
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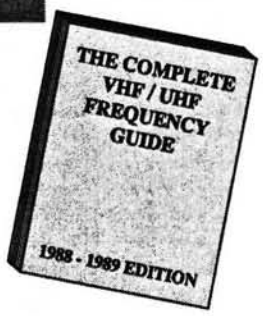
★ Aeronautical
★ Maritime
★ Emergency Services
★ PMR & Telephones
★ Space & Satellite



Completely updated and revised to January 1988, this new edition is packed with the kind of information most enthusiasts ask for! The entries are divided up into band allocations and full details of mobile and base station splits are provided. Professionally printed and illustrated, this is the UK's only comprehensive guide and offered at a sensible price. Available now from stock.

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

STAR £10 LETTER

Novices—Yes or No?

In answer to Chris Charles' letter in January 1988 *PW*, I realise that he does not understand the privileged position of the radio amateur.

The radio amateur is the only person, who is allowed to transmit, who does not have to use type-approved equipment. Everybody else, such as CB, PMR (private mobile radio), yachtsmen, etc., must use type-approved equipment; this is why they just pay a fee to use their equipment, and why the radio amateur passes a technical examination, so that he has some knowledge of what goes on inside his equipment. This enables him, hopefully, to be able to build or modify equipment to be used on our bands.

I must admit that I myself did not realise this for many years after getting my licence. Maybe it should be written into the books on how to get a licence.

It is only since s.s.b. took over from a.m. that commercial rigs came onto the market in large quantities, almost ousting home-brew, although the latter is making a comeback, especially in the QRP world. Remember that your all-singing, all-dancing, top of the range, very expensive Japanese transceiver is not type-approved. If they had to be, probably their designs wouldn't change so frequently. *(And they would cost even more than they do now, as type-approval testing is a very expensive operation indeed.—Ed.)*

With regard to the driving test reference, this is of course analogous to the CB, PMR users, etc. They use their rigs but do not know what goes on inside the black box. All cars are type-approved, and after three years they need a check on their type-approval: it's called the MOT Test!

If Chris were to design and build a car and attempt to put it on the road, he would find that he needs to visit the police for them to check that it meets the Vehicle Construction and Use regulations, i.e. type approval.

So really, we radio amateurs are lucky that we can use almost anything to get on the air, without requiring type-approval. I consider that taking the RAE and Morse examinations is a small price to pay for the freedom it gives us. Let us hope that Chris passes his examinations and joins us.

One final point, and one that is often overlooked, is that amateur radio is controlled by international requirements and not just national ones.

J. P. Olway G3RMA
Paignton

Sir,

There has been some discussion recently about the merits (or otherwise) of introducing novice licences. Rather than releasing unskilled novices in an already overcrowded spectrum, would it not be a good idea to revive the old "artificial aerial" licence?

In 1937 I was licensed as 2ARN and then had a whole year in which to learn (mainly by making mistakes) about designing, building and operating receivers, transmitters and frequency measuring equipment. All this was done without disturbing other users of the air and the resultant experience far outweighed any amount of book learning.

In those days there was no technical examination but licence conditions were very restrictive. I was permitted, on passing my Morse test, to use only crystal-controlled c.w. on a frequency of 14.380MHz with a power input not exceeding 10 watts. Also

PW COMMENT

Thanks a Billion

LOOKING AT SOME OF THE STANDARDS AND ABBREVIATIONS which we use in radio and electronics, and outside, I am sometimes driven to wonder why on earth some of them were adopted, or were even dreamed up in the first place. Take, for example, the multipliers which we use with units of resistance, capacitance, frequency and so on. It would seemingly have been so easy if **all** the multipliers greater than "one"—kilo, mega, giga, etc., had their abbreviations in capital letters, and all the multipliers less than "one" — milli, micro, pico, etc., in small letters. Then there would have been no confusion even for beginners, but no!

I can see there was a problem having both milli (x0.001) and micro (x0.000001) starting with the same letter, and that was fairly neatly got round by using the small letter "m" for milli, and the Greek letter "μ" (mu) for micro, though for old-timers used to seeing the abbreviation "mfd" for microfarad, it was perhaps not quite so straightforward.

But why, oh why, did the powers-that-be lay down that for a few of the multipliers greater than "one", the abbreviations should use small letters. In radio work, the most commonly used is "k" meaning kilo (x1000), yet mega (x1000000) is a capital "M", giga (x1000000000) is a capital "G", etc. There seems to be no logical reason for it.

Of course, if it **had** been "K" for a thousand, the computer industry would have had to find a different abbreviation for the so-caller "binary" thousand, by which they describe memory capacities. The "K" is actually 1024, which is equal to 2^{10}, the number of different states which can be assumed by a chain of 10 binary (2-state) circuits. The use of the capital "K" for this purpose originated in the USA, but has since been adopted by the British Standards Institute for use in the UK.

Another somewhat confusing set of rules resulted from the SI (Systeme Internationale) system of units adopted at an international weights and measures conference way back in 1948, and intended to replace the earlier CGS (centimetre — gram — second) and MKS (metre — kilogram — second) systems of engineering measurements. In the SI system, units which are named after famous persons are abbreviated to a capital letter, but start with a small letter when spelled out in full. So, we have "H" which stands for the unit of inductance, the henry, which was named after Joseph Henry. Similarly we have the volt (V) named after Volta, and the ampere (A) named after Ampere.

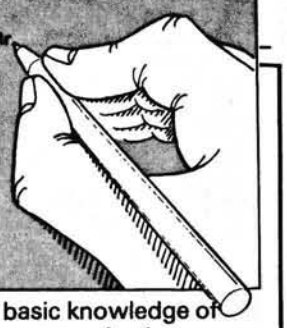
SI units which are not named after famous people are generally abbreviated to a small letter, so that a metre is "m" and a second is "s". Watch that last one, though, because a capital "S" stands for a siemens, the unit of conductance, which used to be called a mho. Mho, in case you haven't come across it before, is ohm spelled backwards, and the ohm is the unit of electrical resistance, which is abbreviated to "Ω", the Greek letter omega. Mathematically speaking, conductance is the reciprocal of resistance, which led to the classic statement that "Two ohms equals half-a-mho!"

Engineers and scientists aren't the only ones who have to contend with strange and illogical units, though. When I went to school, we were taught about units, tens, hundreds, thousands and so on, and for really big numbers like the population of a country there were millions. For absolutely enormous numbers, like how many marbles or conkers you owned, there was that fabulous thing, the billion! And a billion was a million millions. But not any more — the Americans, it seems, were the first to decide that they would call a paltry thousand millions a billion, and now this misuse of the word has spread across the globe in the world of high finance. There was already a perfectly good word meaning a thousand million — a milliard, and I've also heard the gillion (stemming from the multiplier giga) used. So why on earth take an accepted word like billion and reduce its value a thousand-fold, with a risk of confusion for ever after?

Geoff Arnold G3GSR

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*.



before getting final approval I had to submit to the Post Office (as the then controlling authority) a circuit diagram of my transmitter and a certificate verifying the accuracy of the crystal to be used.

I am not suggesting a return to such strict control, but I think a year of practical use and experiment, using dummy loads, for each prospective radio amateur would be of benefit all round and would ensure that each station going on the air for the first time would be competently operated.

Frank Spencer G4AH
Bournemouth

Sir,

I used to be one of those people who was vociferously against the introduction of a novice licence in the UK. I saw it becoming the demise of amateur radio, but I now subscribe to the opposite view.

Our hobby desperately needs the enthusiasm and youthful imagination that a novice or student licence (call it what you like) could bring to amateur radio. Unfortunately there are many amongst us whose draconian and short-sighted vitriol would suffocate any such innovation. These same people would rather see amateur radio become an elitist clique—we must reject this retrograde ideology.

The world-wide phenomenon that is affecting our hobby here in the UK, in other words the proliferation of the old instead of the young, not forgetting the ubiquitous black-box syndrome, must be reversed.

Perhaps we all need to be more visionary with regard to our hobby, and throw off the shackles of negative thinking, because the future of our wonderful hobby deserves nothing less.

R. J. Howes G4OWY
Weymouth

Sir,

As a regular reader of *PW* I have read with interest the many comments raised over recent years with regard to the implementation of a novice licence for use on the amateur bands. Surely the main and true reason for this outcry is from those who wish to gain access onto the bands with the minimum possible prior personal effort.

I studied for a complete year including attending night school, and this not only gained me my "B" Class Licence, but just as important made me value and respect Amateur Radio. Should Chris Charles of Cheadle want novice radio why doesn't he try 934MHz CB. I for one would be only too pleased to give him a QSO. Yes, I still use 934 and find it a marvellous band to meet the novice or people who are wanting to further their basic knowledge of radio communication.

R. W. Bygrave G1PLW
Didcot

Thank You!

I would like to say thank you to *PW* and to the two friends who kindly sent me information on my query concerning the Trio Model 9R59DS Communications Receiver.

I received two replies but unfortunately no addresses where I could write to thank them personally. One was D. C. (Pete) Morris GW2FVZ, the other person just signed himself Roger (postmark Rotherham, S. Yorks). To them both and to you for your kindness I express my thanks and appreciation.

A. Wilkinson
Glasgow

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 50 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 51 of this issue. Airmail rates for overseas subscriptions can be quoted on request.

Calling All Young Radio Amateurs

Anybody under the age of 18, who has made waves in the world of amateur radio, should enter the Young Amateur of the Year Award now.

The award, sponsored by the DTI as part of the 75th anniversary celebrations of the RSGB, is designed to increase awareness of amateur radio amongst young people and highlight the skills and benefits that participation in this unique activity can bring.

The £250 prize will be awarded to the person judged to have made an individual contribution of outstanding merit, (between 1 April 1987 and 31 March 1988) in any area of amateur radio. This might include technical innovation, exceptional operating skill, success in promoting amateur radio to a wider audience, the fostering of international goodwill, social work for the handicapped or emergency communications. It is hoped that the prizegiving will take place at the RSGB's national convention in July 1988.

The winner will also spend a day with the Department's Radiocommunications Division learning at first-hand about the varied work of the Department in the radio field.

The closing date is 31 March 1988. Applications or nominations must be sent to:

The Secretary,
RSGB,
Lambda House,
Cranborne Road,
Potters Bar EN6 3JE.

Mobile Switching Regulators

A range of ruggedised d.c. to d.c. switching regulators is available from Avel-Lindberg. The solid-state components are encapsulated in resin and packed in an all-steel case, as a protection from any hostile environmental conditions such as water, oil, sand or other deleterious substances.

The combinations of input-to-output voltage include 12V to 12V, 12V to 24V and 24V to 12V d.c. The range also includes 0 to 50W, 100W, 200W and 300W output power ratings.

Applications cover virtually any situation where a battery or d.c. generator does not match the input voltage requirements of: Cellnet radio-telephones in vehicles, navigation or communications gear on small boats, etc.

High frequency switching technique (100kHz) enables efficiencies of typically 80 to 90 per cent to be achieved in very compact units. The 50 and 100W versions measure 140 x 76 x 34mm, the 200W units measure 140 x 184 x 34mm and the 300W version 140 x 255 x 34mm.

More information can be obtained from:

Avel-Lindberg Ltd.,
South Ockendon,
Essex RM15 5TD.

AMSAT-UK

This is the Radio Amateur Satellite Organisation of the United Kingdom.

Donations from all members are due on January 1 each year. Prospective members should apply to the Hon. Sec. with an s.a.s.e.

Members may deposit six self-addressed stamped envelopes with the Secretary. These will be used for the "Hot News" service on an "ad hoc" basis. If the s.a.s.e.s are numbered, the lowest number will always be used first.

For more details, contact:

AMSAT-UK,
Ron Broadbent G3AAJ,
94 Herongate Road,
Wanstead Park,
London E12 5EQ.

ICPUG

The Independent Commodore Product Users Group has recently started. They will be covering all parts of computer communications and hopefully will find some more uses for computers in fields that have not yet been covered.

There is an ICPUG magazine and they would welcome input from anyone who has a Commodore.

They are working on a small public domain software library and are looking for any software which people may think will be useful.

For further information on the group, contact:

Jack Cohen,
30 Brancaster Road,
Newbury Park,
Ilford,
Essex IG2 7EP.

Forthcoming AGM

The AGM of the Banbury Amateur Radio Society will take place on March 23 at 7.30pm. The venue is The Mill Club, Spiceball Park, Banbury.

All Members and anyone else who has an interest in radio are invited to attend.

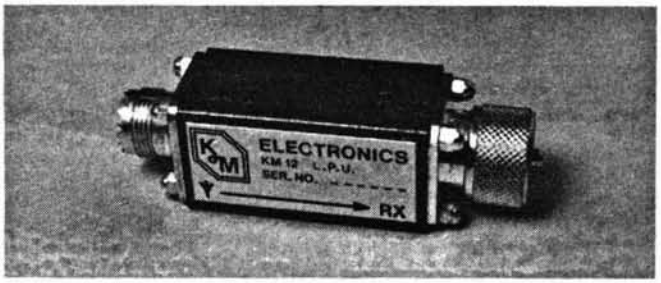
Further details may be obtained from the secretary:

Bryan Thornton G1IIO,
QTHR.
Tel: 0295 51774.

Lightning Protection

Secondary lightning strikes can produce spikes up to 4kV. These can cause considerable damage to solid state h.f. rigs.

The KM12 provides protection for the receiver from lightning induced surges, with no degradation of input signal.



The frequency range of the KM12 is from 2-30MHz with an insertion loss of less than 0.1dB.

The unit is packaged in a Greenpar Circuit box and can be supplied with BNC or UHF connectors.

More details can be obtained from:

K & M Electronics,
Highcroft Industrial Estate,
Unit 29/30, Enterprise Road,
Horndean,
Hants PO8 0BT.

Rally Calendar

March 5: The Blue Star Rally will be held at the High Gosforth Park Racecourse, which is 8km north of Newcastle-on-Tyne. There will be trade stands, Morse tests, a bring and buy and refreshments. Talk-in will be on S22 under the callsign GB0BSR. For more details contact ***Terry G6VEG on 091-286 6908.***

May 8: The Swindon & District ARC have arranged with the British Science Museum to set their rally against the backdrop of the Exhibits at its outstation at Wroughton Airfield, near Swindon. The Science Museum at Wroughton houses aircraft, agricultural equipment, fire appliances, hovercraft, expedition vehicles, commercial transport vehicles and much more. These exhibits have been set out in several very large hangars. The rally organisers and traders will be accommodated between the various exhibits in the hangars so that the visitors will be able to view all.

Outside on the Airfield there will be helicopter sightseeing trips around Swindon, a model steam engine rally and various other attractions for all the family. Access to the site is from Junction 15 of the M4, signposted to the Science Museum.

June 18: The Royal Air Force Halton Air Show and Amateur Radio Rally will take place at RAF Halton, near Aylesbury, Bucks. The RAFARS (Golden Jubilee) Rally will be held inside a hangar. For more details, you should contact ***Terry F. Owen G4PSH on 0296 85760.***

July 31: The Scarborough ARS Rally will be held at The Spa, Scarborough. Doors open at 11am. Talk-in will be on S22 and SU8 as well as GB3NY. More details from: ***Ian Hunter G4UQP.QTHR or Tel: 0723 376847.***

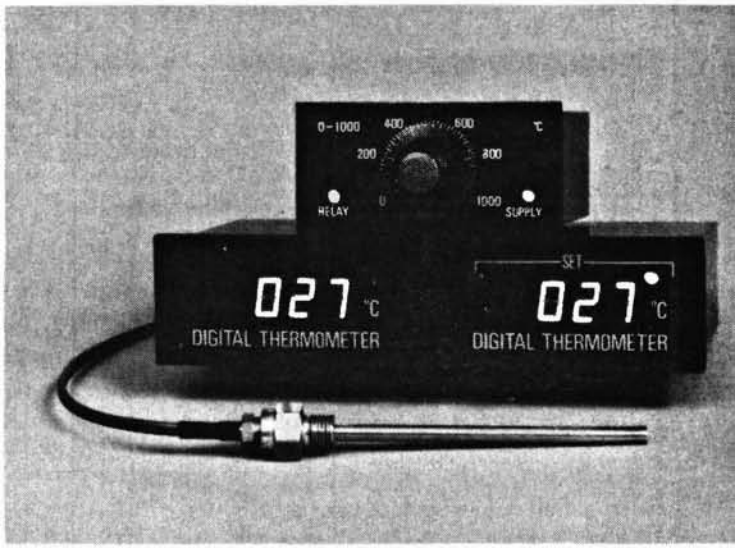
September 11: The Lincoln Hamfest will take place at the Exhibition Centre on the Lincolnshire Show Ground. Admission will be by lucky programme. More details from the club at their HQ, the City Engineers Club, Central Depot, Waterside South, Lincoln.

Digital Thermometer

The Therma D40 range of panel instruments covers both the measurement and control of temperature in a trio of high accuracy indicators.

The series of units display temperature between –50° to +1150°C with a resolution and accuracy of 1°C. Both digital instruments have an analogue output of 1mV per 1°C for chart recorders or ancillary control equipment. All units operate from type "K" NiCr/NiA1 thermocouples and are designed to give years of trouble-free service.

The 96 x 48mm DIN case is custom designed for easy panel assembly, simple securing clamps allow quick and easy mounting. All input and output connections are made at the rear by screw terminals.



The most sophisticated in the range is the D40/R which measures and controls temperature via the on/off relay, whilst the lower cost alternative is the D40 indicator. Completing the range is the D40/C controller, a low-cost on/off temperature controller or alarm unit.

The prices are from £34.50, with more details from:

ETI Ltd,
PO Box 81,
Worthing,
West Sussex BN13 3PW.

Panelware

West Hyde have become the sole UK distributors for Rohde and Leonhardy, two companies who manufacture panelware.

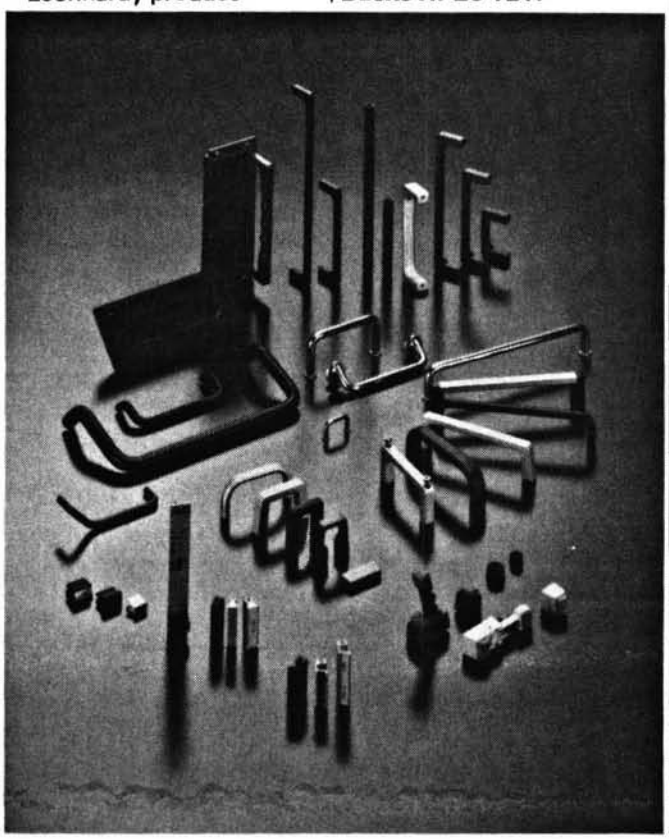
Rohde produce a range of conventional and folding tray handles in both steel and aluminium.

Leonhardy produce electro-mechanical front panel components such as l.e.d.s, switches and test sockets.

West Hyde have the complete range from both companies in stock.

For more details, contact:

West Hyde Developments,
9–10 Part St. Ind. Est.,
Aylesbury,
Bucks HP20 1ET.



Repeater Group

The North Western Repeater Group meets on the third Thursday of each month at 8pm at Willows Lane, Accrington.

At the present time they have two repeaters under their wing, GB3RF in the 144MHz band and GB3PF in the 430MHz band. Plans are afoot for a third repeater.

If you would like to get involved with the group, then contact:

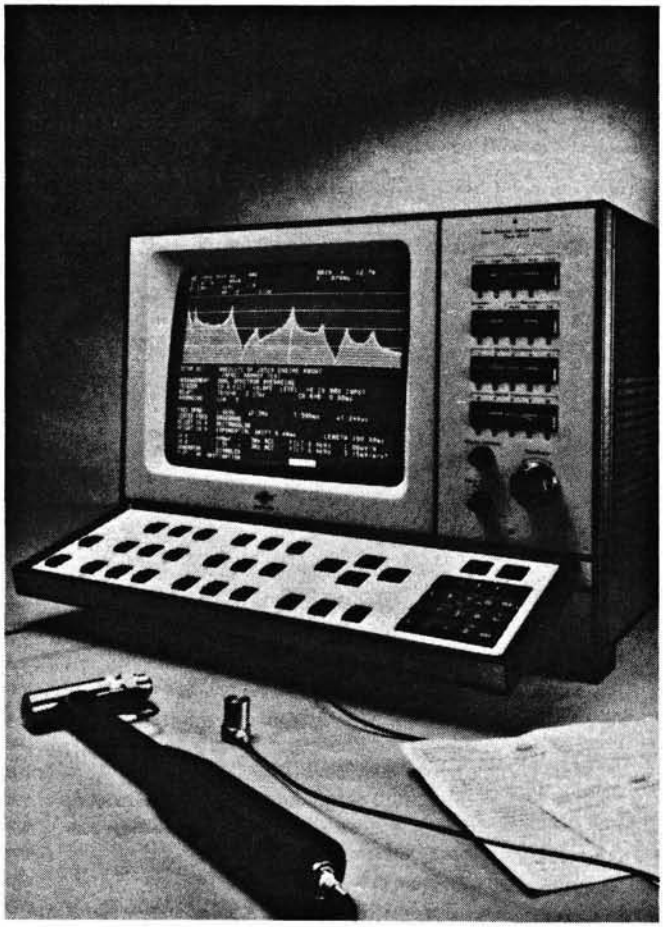
K.M. Sumner G0DTI.
7 Largs Road,
Shadsworth,
Blackburn,
Lancs. BB1 2JQ.

CB Info Sheets

The DTI have now produced CB Information sheets B, C and D.

Information Sheet B covers Equipment, C covers Interference and Abuse and D covers Emergency Monitoring and Channel 9. If you would like a copy of these sheets, then send to:

The DTI,
Radiocommunications Division,
CB Licensing Section (RD),
Room 613,
Waterloo Bridge House,
Waterloo Road,
London SE1 8UA.



Special Event Stations

GB0BSR: This callsign will be used on 144MHz, mainly as the talk-in station for the Blue Star Rally, Newcastle-on-Tyne on March 5. More details from ***Terry G6VEG on 091-286 6908.***

GB4OOR: The Plymouth Radio Club have obtained this callsign for use during the month of July 1988. July is the celebration of the 400th Anniversary of the routing of the Spanish Armada by Sir Francis Drake. It is being marked, not only in Plymouth in Devon but also in many Plymouths worldwide.

Plymouth Radio Club have organised a massive operation from Plymouth Hoe which will enable radio amateurs to obtain a very rare QSL card in the period July 21 to 28. The station will be on the air every day and probably late into the night.

GB2FFR: The Porthmadog & District ARS will be running this special event station on the weekend of April 30 to May 2. It's to celebrate "125 Years of Steam" and will be operating from The Harbour Railway Station of the Ffestiniog Railway.

GB4GOS: The Sheffield ARC are running this special event station from the Guides' HQ in Trippet Lane, Sheffield. It is to commemorate Guides' Thinking Day. They are hoping to cover as many bands and modes as possible (including TV, Packet, etc.) and to have local media coverage for the event. For more information please contact: ***Alan Pemberton G0ILG, PO Box 365, Sheffield S1 1BY.***

Signal Analyser

Bruel & Kjaer have announced the new 2034 dual-channel signal analyser.

The 2034 offers dual channel processing with digital zoom and 801 lines resolution. A powerful and flexible signal generator is included, avoiding the need to use an extra instrument to provide stimulus signals. Advanced built-in functions include Hilbert transform for calculation of time envelope functions.

Frequency response measurement (with two alternative methods) and signal-to-noise measurement can be used to characterise electrical networks in electronic and power engineering.

The Hilbert transform functions allow direct measurement of an acoustic system's impulse response or energy-time curve. The 2034 can also measure sound intensity directly, using Bruel & Kjaer's 3519 sound intensity probe.

Bruel & Kjaer (UK) Ltd.
92 Uxbridge Road,
Harrow HA3 6BZ.

Anti-Static Mats

Inmac has introduced two new anti-static mats that have been specifically designed for field engineers repairing or servicing computers and similar electronic devices. Both have earthing leads and wrist straps to drain away static.

The Conductive Table Mat provides a large anti-static work area measuring 1200 x 600mm and costs £79. The Foldable Conductive Workstation Mat costs £89 and is fireproof so that it can be safely used for soldering. Measuring 540 x 550mm, it can be folded in half for easy transportation.

For more details, or a free copy of Inmac's catalogue, please contact:

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

Catalogues

Universal Instruments have the 10th edition of their Test and Measurement Catalogue out. The latest edition contains over 400 instruments plus a wide range of useful accessories from some 40 suppliers, 30 of the items are new.

Included in this 76-page edition are instruments to accommodate all applications both simple and complex from analogue multimeters to X-Y recorders. All major manufacturers are represented with units available ex-stock, including Avo, Clare, Edgcumbe, Fluke, Hioki, Megger, Robin, Seaward and TMK to mention but a few.

For a copy of the catalogue, telephone ***0533 750123***.

STC Instrument Services has produced its largest ever catalogue which features items ranging from d.m.m.s and power suppliers to oscilloscopes and complete computer systems.

Offering products from over 70 leading suppliers, the 336-page catalogue has a new section on technical books.

Amongst the new products available are over 20 Hitachi oscilloscopes/storagescopes, 200W power supplies and the Avo M2000 Series Multimeters.

Copies of the catalogue are available on request from:

STC Instrument Services,
Dewar House,
Central Road,
Harlow,
Essex CM20 2TA.

Eagle International have launched their new colour catalogue with over 60 new models in the fields of Public Address, Video Door Entry, Nurse Call and Test Equipment.

The catalogue is freely available to trade and business users, and can be obtained by phoning or writing to:

Eagle International,
Unit 5,
Royal London Estate,
29/35 North Acton Road,
London NW10 6PE.
Tel: 01-965 3222.

Technical Software

Methodia Design of Norway have introduced KwikKalk, the latest software in their technical series.

This program is designed to take the hard work out of radio calculations. You just enter the circuit values you already have and it provides the component values you need. The current value of all components is held in the program so that you don't have to keep entering them in every time when performing a series of related calculations.

The program is menu-driven, very easy to use and contains useful explanations and hints for its operation.

There are versions for Spectrum, CBM64 and BBC-B/Master computers, price are £12 on tape or £14 on CBM or BBC disk or Spectrum microdrive cartridge. BBC disk users should state if they want 40 or 80 tracks.

Technical Software.
Fron, Upper Llandwrog,
Caernarfon LL54 7RF
Tel: 0286 881886.

RadioGram

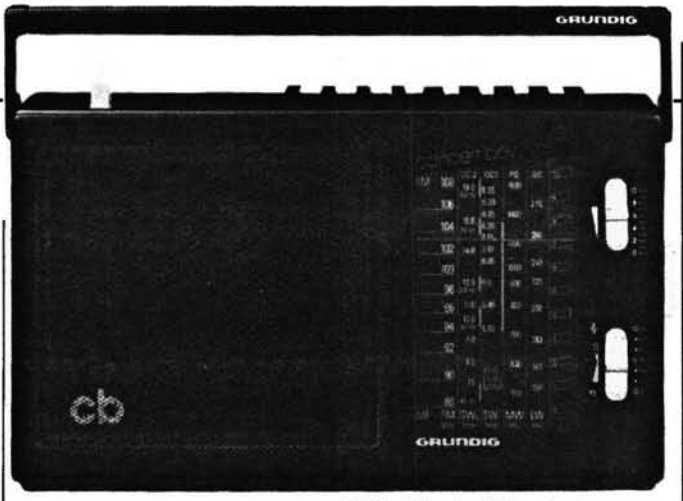
This is published bi-monthly, available on subscription, it's designed for all valved radio enthusiasts.

The Christmas 1987 issue made for interesting reading. There were articles on detectors, what to do with redundant 405-line valves, the EMI story and lots of special offers like paper smoothing capacitors and the like.

If you think you may be interested in RadioGram, the subs are £6.50 for UK and Eire, £8.10 for Europe and Scandinavia and elsewhere by arrangement. To avoid confusion, when a subscription commences the current issue of RadioGram will be sent as the first, unless otherwise specified. This means a subscription may expire in less than 12 calendar months, but six issues will be received.

More details can be obtained from:

The RadioGram,
"Larkhill",
Newport Road,
Woodseaves,
Stafford ST20 0NP.



Concert Boy 225

Grundig have added the new Concert Boy 225 to their range of audio products, this now brings their portable radio range up to four.

This compact 4-band radio, m.w., l.w., f.m. (with a.f.c. and four pre-sets) and two s.w. The short wave coverage is 5.8-6.4MHz (49m) and 6.8-18.5MHz (41-16m). Other features include slider volume and tone controls, large wideband loudspeaker, 1.5W music power output, 3.5mm headphone socket and can be mains or battery operated.

The Concert Boy 225 measures 315 × 185 × 72mm and weighs about 1.5kg. The price is about £39.95.

The Fixer

This is a universal work clamp which is equally suitable for left and right-handed users. It clamps a workpiece up to 500mm deep into position.

It may be either permanently fixed to a workbench or clamped to any handy surface. Its design allows for work of virtually any length and rapid clamping and removal of the work without screwing and unscrewing the fixing each time.

The Fixer will hold wood, metal and other objects with equal success. The cost of the Fixer is £6.36 including VAT. For more details, contact:

Freetrade TEP Ltd.,
Moor Lane,
Witton,
Birmingham B6 7HH.

Young Electronic Designers Awards

The 1988 Young Electronic Designer Awards Scheme was launched with renewed sponsorship from Cirkit Holdings plc and Texas Instruments Ltd.

It offers exciting prospects for young people in the junior (under 15), intermediate (15–18) and senior (19–25) age groups, who attend educational institutions in the UK.

To enter the scheme, students must produce an electronic device of their own which is original, effective and has a useful application in everyday life. A trophy and cash prizes are presented to the winners in each category, and in the senior age group there are the prospects of a job in electronics and course sponsorship.

For further information, and entry forms contact:

The YEDA Trust,
24 London Road,
Horsham,
West Sussex RH12 1AY.

BAEC

The latest copy of the British Amateur Electronics Club's newsletter has landed in the office.

This issue, number 87, has part 20 of Electronics A–Z, a freezer alarm project, News, Views and Reminders and a cassette recorder problem solved.

If you think you would be interested in joining BAEC, then write to:

Mr C. Bogod,
"Dickens",
26 Forrest Road,
Penarth, S. Glam.

Temperature and Humidity

Solex, the sole UK representative for the Soar range of test and measuring equipment, have recently launched the HT-150 multifunction temperature and humidity measuring module.

The unit is suitable for panel mounting and has a high resolution, °C or °F selectable, large liquid crystal display.

In addition to the basic function, the HT-150 provides Hi-Lo alarm, max–min record and discomfort index display functions.

Simultaneous data signal output of both temperature and humidity allow the unit to be used in connection with external devices such as controllers and printers.

External long probes up to 100mm maximum for remote control of both humidity and temperature are available as an optional extra for various kinds of applications.

Solex International,
95 Main Street,
Broughton Astley,
Leics LE9 6RE.

So far in this series we've seen how to generate and receive electromagnetic waves in free space and how to calculate what we can expect to receive when we transmit over a given path. Now the time has come to look at a real path in the real world; we're coming down to earth says A. J. Harwood C Eng MIERE G4HHZ

Making Waves—A Guide to Propagation

Part 4—Coming Down to Earth

We saw in Part 3 the importance of keeping at least the first Fresnel zone free from obstruction if we want to receive something like the free space field strength. For frequencies above about 50MHz this was a practical proposition. I would like therefore to consider systems operating at v.h.f. and above leaving the more difficult case of h.f. and m.f. to a later date.

Supposing we were to site our transmitter at a very high point, such as on a cliff looking out to sea, then the first obstruction we would encounter would be the earth (or sea) at the horizon. So it is useful to know how far the distance to the horizon is from a given height above ground. The geometry for this is shown in Fig. 4.1 and gives the relationship (to a very close approximation).

$$D=\sqrt{(2\times r\times h)}$$

where:

D is the distance to the horizon,
h the height of the transmitting point and
r is the radius of the earth in metres

Putting in the value of the earth's radius as 6 370 000 metres would give us:

$$D=\sqrt{12\,740\,000\times h}$$

or

$$D_{km}=3569\times\sqrt{h}$$

if we want the answer in kilometres.

However, it's not quite that simple in the radio case since the wave travels through air and, although at the lower v.h.f. and u.h.f. frequencies the amount of power absorbed by the air is negligible, it has an effect on the way the wave travels through it.

In Part 1 we learnt that the speed of the wave depends on the relative permeability and permittivity of the medium through which it travels. In the case of air the relative permeability is one but the permittivity is slightly greater than one by an amount dependent on the actual constituents of the air, in particular the amount of water vapour present. This means that the wave travels at a slightly slower speed than it does in free space. Also, the make-up of the air varies with height and so the velocity of propagation of radio waves through the air varies with height. If any wave passes from one medium to another in which the speed of the wave differs, then the phenomenon of refraction occurs and the wave changes direction as it passes between the media.

The air can be considered as being made up of a number of very thin layers, each with a different speed of propagation. Considering the normal conditions that exist for at least 50 per cent of the time over Europe, then the wavefront changes direction in a way which makes it bend back towards the earth as shown in Fig. 4.2. This means that a wave which would otherwise pass above the horizon and go off into space is bent down and touches the ground some distance beyond the linear horizon. In effect this extends the horizon distance for radio waves to what is referred to as the radio horizon.

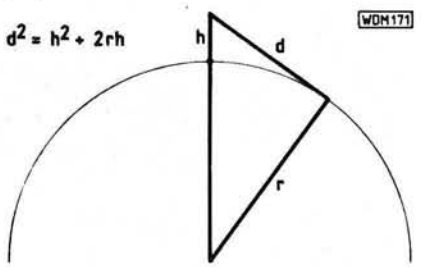


Fig. 4.1: The geometry of a path from h metres a.g.l. to the horizon. If $h << r$ then the approximation $d^2 = 2 \times r \times h$ holds good

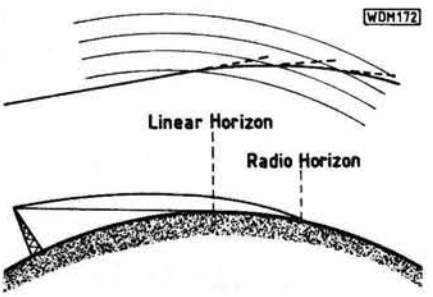


Fig. 4.2: As the wave passes through the adjacent layers of a normal atmosphere refraction occurs and the wave is bent back towards the earth. This extends the horizon for radio waves

Another way of looking at this effect is to consider the refracted wave as if it travels in a straight line over an earth which has a radius greater than its true geometric one and for which the horizon is the radio horizon. For the 50 per cent European conditions, which are referred to as standard refraction conditions, the effective radius is the actual radius increased by about one third or 8500km. This is often referred to as the 4/3 earth radius condition and if we put this value into our height distance equation we get a radio horizon distance of:

$$D=\sqrt{17\,000\,000\times h}$$
$$=4120\times\sqrt{h}$$

which we can express in kilometres as:

$$D_{km}=4.12\times\sqrt{h_m}$$

An even easier version to remember is when D is in miles and h in feet when we get:

$$D_{miles}=\sqrt{2\times h_{ft}}$$

as a close approximation.

From this we can calculate that from 200ft above sea level the radio horizon under 4/3 earth radius conditions is 20 miles away.

For calculations of the performance of a radio path it is frequently necessary to draw a profile of the ground between the transmitter and the receiver. This is done on specially prepared path profile paper which takes into account the effective radius of the earth.

Under different atmospheric conditions, the wave is refracted in a different manner and the effective radius of the earth has a different value. In some cases the earth appears to be flat over quite large distances and super refraction is said to occur. At other times, substandard refraction causes the wave to bend away from the earth rather than towards it and the radio horizon is much nearer giving the effect of an

earth with a much smaller radius. The conditions under which the effective radius is about 2/3 or 4247km exist for only a very small percentage of the time, under 1 per cent, but can nevertheless have an effect on the performance of a link.

Perhaps the best known atmospheric phenomenon affecting propagation is that known as ducting or a lift. Here the distribution of the components of the atmosphere changes and allows waves to be propagated in a manner similar to that operating inside a waveguide. Signals can then travel very long distances with little attenuation giving received signal strengths equal to, or greater than, the free space values. The duct can last for long periods of times as the anticyclone conditions which produce it can be very stable. It can form immediately above ground level or can be elevated in which case it can redirect energy which would otherwise go off into space back down to earth. Such conditions are a delight to the radio amateur interested in long distance v.h.f. and u.h.f. communication, but are a nuisance to the television viewer or f.m. radio listener who receives very distant stations, which would otherwise be undetectable, as interference. The radio equivalent of one man's meat being another's poison?

Let's see how we can use this information in the design of a reliable radio circuit. The ground profile between two points over which we would like to set up a radio link are shown in Fig. 4.3(a). It has been plotted on the special paper with scales corresponding to 4/3 earth radius conditions. The highest point is at the mid-path. From ground level at one end, the other is out of sight behind the obstruction. We know that if we want to receive free space field strengths, then we must have clearance over the obstruction of at least the first Fresnel zone. If our link is on a frequency of 7.5GHz with a wavelength of 0.04 metres and our path is 40km long, then the radius of the first Fresnel zone at the mid point is:

$$=0.5 \times \sqrt{40\,000 \times 0.04}$$
$$=20 \text{ metres}$$

From Fig. 4.3(a), we can see that we can get this clearance over the mid-path obstacle with a transmitting antenna height of 40m and a receiving antenna at 40m above ground level.

Now look at Fig. 4.3(b) where the path is plotted for 2/3 earth radius conditions. With the transmit and receive antenna heights of Fig. 4.3(a), the obstruction is well into the Fresnel zone. If we were to use these antenna heights, then the signal would fade to below free space values for the times when the atmospheric conditions were those giving an equivalent earth radius of 2/3. This is probably unacceptable, particularly if the radio circuit is carrying important information such as telephone traffic or commercial data. To avoid this, we must put our antennas higher, say at 70 metres above ground for the transmit end and the same for the receive.

These considerations are also of great importance in a system such as television broadcasting where the frequencies have to be re-used at a great number of locations. Calculations must be made, not only of the field strength within the service area of the transmitter which is intended to provide the service, but of the effect of all other transmitters on the same channel in order to determine the levels of interference likely to be encountered.

Planning must ensure that these are tolerable and that the periods of time for which they are likely to occur are as short as possible. The calculations need to be made for both the average conditions and the periods when the earth appears to be flat to radio waves when the interference levels are at their greatest. Needless to say this is too big a task to be carried out manually and very powerful computer programs have been developed which can draw on data banks containing the details of frequencies, terrain and the characteristics of known television stations. It can then calculate the levels of field strength at a given location from all the known sources using a particular channel, for the various propagation conditions likely to be encountered.

One of the scarcest commodities in radio is transmission spectrum space and a system which uses more than one transmitter on one or more frequencies must take into account a number of factors if interference free communication is to be assured. In particular the directional characteristics of the transmitting and receiving antennas must be considered, together with the ability of the receiver to cope with more than one signal at its input. Next month we'll look at how antenna directivity is achieved and how it can be used together with the direction of polarisation of the wave to assist us in re-using frequencies.

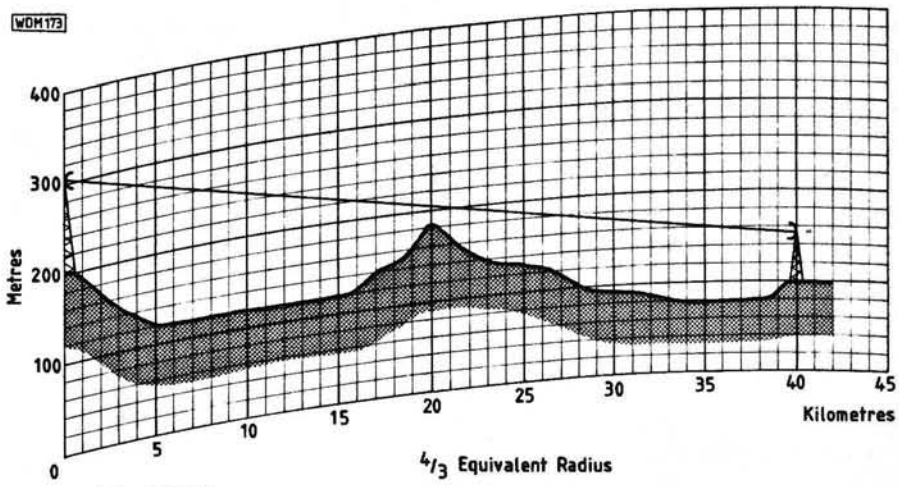


Fig. 4.3(a)

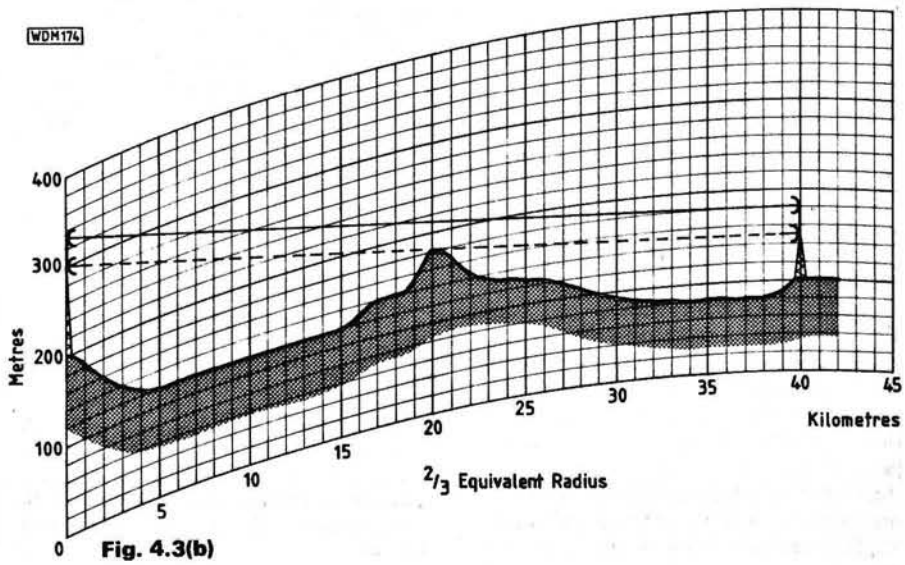


Fig. 4.3(b)

Fig. 4.3(a): Under normal refraction conditions for the path shown Fresnel clearance is obtained for antenna heights of 105 and 50m a.g.l.

Fig. 4.3(b): When refraction conditions give an effective earth radius of 2/3 the antennas need to be considerably higher for Fresnel clearance

Kitchen Konstruktion

Richard Q Marris G2BZQ, continues his occasional series, by imparting another pearl of wisdom regarding the use of d.i.y. hardware in coil winding.

In common with most radio amateurs, the author finds difficulty in locating a supplier of largish diameter coil formers with suitable mounting arrangements, for use in transmitter output stages and antenna tuning units (a.t.u.), etc. Discarded cardboard kitchen foil or toilet roll tubes can be used, but they are far from rigid, and generally have poor insulation characteristics. Gone are the days when you could readily buy, at a reasonable cost, a wide variety of ceramic or Paxolin, tubing and formers.

Help is at Hand

Local d.i.y. stores are a veritable treasure house of things that can be utilised in our hobby. One of these gems is standard $\frac{3}{4}$in diameter white plastics waste pipe. It has an internal diameter of $\frac{3}{4}$in and an external diameter $\frac{7}{8}$in. Though the diameter is quoted in inches, the length is quoted "by the metre"! Such is progress since we went metric. The tube costs about 60p per metre, and a metre length will make a lot of coil formers. The tubing is easily cut, and can be drilled for wire terminations or taps.

To mount this piping, stockists sell what they call "plastic wallclips—stand off—single hole fixings". These clips snap onto the tubing like a rat trap, and make an ideal means of rigidly mounting and supporting the tubing. The clips locally costing 5p each, are easily fixed to any flat surface with one countersunk screw.

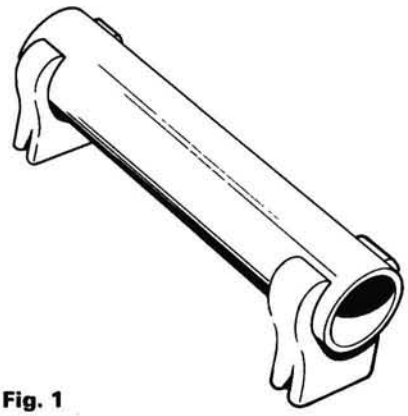


Fig. 1

The result is a very robust, neat, securely mounted coil former (Fig. 1). If the question of turns slipping arises, during winding, then the surface of the tube can be roughened with glass paper. To get the even turns spacing needed on some coils, small grooves or slots can be filed into the surface of the tube at required intervals.

Cheap?

Cost per coil former? Well—a coil former 75mm long, with two mounting clips, costs about 15p! Can you beat that? Much better than paying an asking price, recently received, for Paxolin tubing at 30p per linear inch, plus £1.00 post and packing, not forgetting VAT. Larger diameter plastics tubing is also available with suitable mounting clips. ***PW***

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PW REVIEW

Do you need a low cost dummy load and s.w.r. meter? If so this economical kit from C. M. Howes, reviewed by Mike Richards G4WNC, could be the answer for you.

This rather interesting kit functions as a dummy load, attenuator, s.w.r. meter and power indicator with a frequency range of 1MHz to 200MHz. For those of you who have not encountered the range of kits from C. M. Howes Communications, they are always very well presented and particularly suitable for the newcomer to kit construction.

Construction

The SWB-30 was supplied very neatly packaged with a four page (A4) instruction leaflet and a single page information sheet. After a brief description of the benefits of the SWB-30 the instructions began with a list of tools that will be required, this is a particularly useful item for the beginner.

The total number of components in the kit is only 33 so the checking of the parts list did not take long. The supplied tinned glass fibre p.c.b. was of very good quality with plenty of copper to minimise resistive losses. The top side of the p.c.b. was very clearly marked with all the component locations, there was even a line drawn between the holes for each component to minimise any confusion. One very nice touch was the inclusion of a section covering the basics of soldering, this is very helpful for the beginner.

The identification of the components proved to be very easy thanks to the inclusion of a very good sketch of each component. The identification of the resistors was further simplified as the components list had the colour code printed alongside each resistor.

Of the 33 components 19 were two-watt resistors used for the attenuator and resistive bridge. In order to make a neat job it is worth taking time to get the lead spacing of the first one spot-on. Once this has been achieved, the taper on your pliers can be marked with a pencil to show the correct bending point for all the other resistors. The fitting of all the other components was very simple and I managed to complete the p.c.b. in about 30 minutes, so a beginner should be able to comfortably do the same in an evening.

One common problem with s.w.r. kits is that the constructors are often left to find their own meter. This is not the case with this kit as a smart meter complete with a dedicated scale is supplied with the SWB-30.

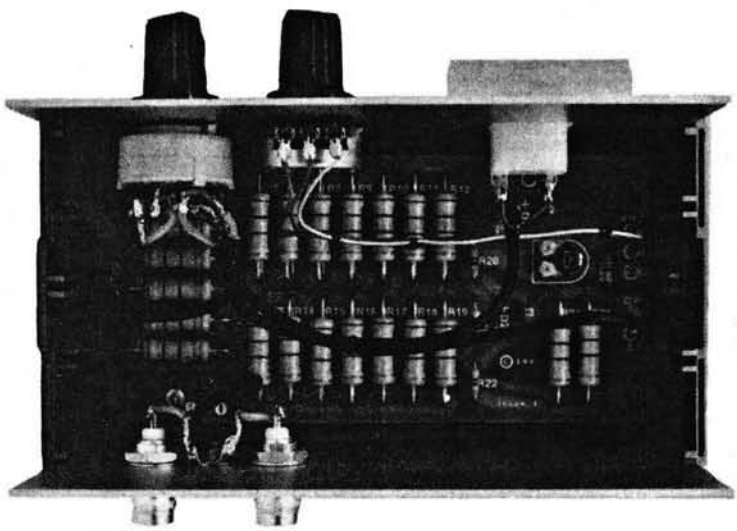
The only additional items required to complete the SWB-30 are a case, control knob, two coaxial sockets and a two pole, three way switch. There is a good reason for omitting the switch from the kit as the type of switch depends on the power levels you intend to use, this point is well explained in the instructions.

For best results the wiring of the sockets and switches to the p.c.b. should be as short as possible using miniature screened cable for any r.f. connection longer than 25mm.

Any observant reader will have noticed that the review kit was housed in a plastics case, this is not a good idea and a metal case should be used for best performance particularly at v.h.f. You may also notice that the meter has been mounted incorrectly with the whole movement on the outside of the case. The correct way is to mount the meter from behind the front panel with a rectangular cut-out for the face. We all make mistakes sometimes!

Circuit Description

The circuit is very simple, even if it is a little unconventional. The heart of



the unit is a resistive bridge and attenuator using 19 two-watt carbon film resistors. The use of high wattage resistors means that the unit will happily dissipate 15 watts continuously or up to 100 watts in very short bursts which is very useful.

The title of s.w.r. indicator is a little inaccurate as the SWB-30 really functions as an impedance bridge. But as both a s.w.r. meter and an impedance bridge are most commonly used to adjust antenna systems or a.t.u.s for best matching, I suppose C. M. Howes can be forgiven.

The measurement technique involves connecting the impedance to be measured in one leg of the bridge whilst an a.c. source of the appropriate frequency is applied across the bridge. Correct matching is indicated by a null in the reading of a detector connected across the opposite side of the bridge.

In the SWB-30 the antenna is connected as the unknown impedance whilst a diode detector and meter indicate the null. The r.f. source for the bridge comprises the transmitter output which is applied to the bridge via a resistive attenuator.

The switching of the transmitter and antenna for the various measurements is controlled by a mode switch on the front panel which has three positions, MONITOR, SWR and CAL. When the mode switch is set to SWR the transmitter output and antenna are applied to the bridge. Whilst in this mode the bridge acts as a 12dB attenuator which means that the signal fed to the antenna is some 12dB lower than that from the transmitter. When set to CAL the antenna is disconnected from the bridge, this represents a worst case mismatch and the front panel potentiometer is adjusted for full scale deflection on the meter. With the switch set to MONITOR, the output from the transmitter is switched directly to the antenna and a sample of the r.f. is extracted and passed to a diode detector and meter. In this mode the meter gives an indication of the forward r.f. power.

This may all sound terribly complicated but as you will see later the operation is actually very simple.

Performance

Once the SWB-30 has been completed the first job was to set up the single pre-set potentiometer. This was a very simple operation which required the use of an r.f. power source, i.e. transmitter and a dummy load. During this operation I found a mistake in the otherwise excellent instruction sheet. I'm sure C. M. Howes will correct it as soon as possible, but just in case your sheet is wrong this is the correct procedure:

(1) Connect a 50Ω dummy load to the antenna socket and the transmitter to the TX socket.
(2) Apply a low power signal from the transmitter, between 1 and 30 watts.
(3) Set the switch to CAL.
(4) Adjust VR2 for full scale, i.e. the CAL mark.
(5) Switch to MONITOR and adjust VR1 for the same full scale reading.

Once this simple setting-up procedure is complete the instrument is ready for use.

Operation of the unit was very straightforward. Once the transmitter and a.t.u. or antenna are connected to the input and output sockets of the SWB-30, all the operations are controlled by the mode switch on the front panel. One feature I particularly liked was that, while checking the impedance match, the signal to the antenna was attenuated by about 12dB. This means that even if you apply the maximum power of 30 watts in this mode the power to the antenna is only about 2 watts which will obviously minimise any QRM during tune-up.

The only disadvantage from the use of a bridge for impedance measurement is that you cannot continuously check the match whilst transmitting. This is not a serious problem as most amateurs seem to prefer to monitor ouput power rather than s.w.r.

The accuracy of the SWB-30 was perfectly adequate for this type of instrument. The power indication was within 20% for power levels between 3 and 30 watts on the h.f. bands. I did find that the sensitivity was rather frequency dependent and required very careful wiring of the switches and sockets for satisfactory performance on v.h.f.

The main use for the SWB-30 is to aid the adjustment of a.t.u.s, and in this respect it performs very well with a very clear null indicated with applied power levels from about 1 watt upwards.

I think the SWB-30 is a very well thought out kit which, if used on h.f., is particularly suitable for the beginner. I'm also sure that QRP devotees could find this a very useful instrument.

The SWB-30 is available from **C. M. Howes Communications, Eydon, Daventry, Northants NN11 6PT.** The price is £11.90 for the kit or £16.50 for an assembled p.c.b., both prices include VAT but post and packing is an additional 90p. My thanks to C. M. Howes for the review kit.

SWAP SPOT

Have 5¼in DSQD 80 track drive, 1.2Mbyte capacity with p.s.u. and case. Plus Olympic OM10 35mm camera with zoom lens, etc. Would exchange for FT-290 or similar. Clive. Tel: 01-560 8792. *D819*

Have Neal cassette deck with some drive spares plus Eagle amp. Would exchange for good condition RCA AR88D, cash adjustment if necessary. Can collect. Tel: 0734 722480. *D822*

Have Racal RA17L in good working order. Too heavy for me to move! Would exchange for KW202 or Eddystone 888A amateur bands only receiver. Duncan G4IZM. Tel: Rugby 811295. *D824*

Have Realistic DX300 with digital readout frequency coverage 10kHz–30MHz in good condition. Would exchange for Trio bandspread general coverage receiver or similar valve or solid-state in good condition. Tel: Preesall 810467. *D833*

Have brand new FT-73R 430MHz plus speaker mic Mk12HZB plus mobile pack and case plus spare FBA10 NiCad, FNB-10, PA6, NC28C total cost £366. Would exchange for Dayton PC1 h.f. converter and ARA30 h.f. AE from Dressler. Peter. Tel: 0473 85203. *D840*

Have Matmos (Triumph Adler) computer, 64K, CP/M2.2, Microsoft Basic, dual 5¼in disk drives, ROM word processor, CP/M plus and terminal emulation ROM available. Pristine. Would exchange for FT-290 or handheld, ICF-7600, R-600 or similar, w.h.y? Jon Baker G1PGH. Tel: 01-399 1606. *D855*

Have Heathkit HR-1680 amateur bands s.s.b./c.w. RX; 12 AVQ vertical; SEM QRM Eliminator; SEM Ezitune; Capacitance meter (Beckman); RSGB Handbook. All v.g.c. Would exchange for w.h.y? N. Cameron, 16 St Mary's Cresecent, Westport, Co. Mayo, Eire. *D860*

Have 1920s Gecophone-style crystal set, working with original cat's whisker, basket wound coil and Browns "A" period headphones. Would exchange for good s.l.r. camera. G4FFO. Tel: Cambridge 860150. *D868*

ERRORS & UPDATES

PW "Otter" 50MHz Receiver January 1988

In Table 1, the voltages for TR3, 4 and 6 should read as follows:

Device	Emitter	Base	Collector
Tr3	6.4	7	12
Tr4	0	0.7	7
Tr6	2	1.6	12

Practically Yours

By Glen Ross G8MWR

We all fancy the idea of having a beam antenna for use on the h.f. bands, but the big problem with these is that they tend to be expensive and, as well as making a nice perch for the local birds, they tend to raise outcries of complaint from the neighbours, who rarely see eye to eye with us on the beauty of these devices! Is there a way of getting round these problems?

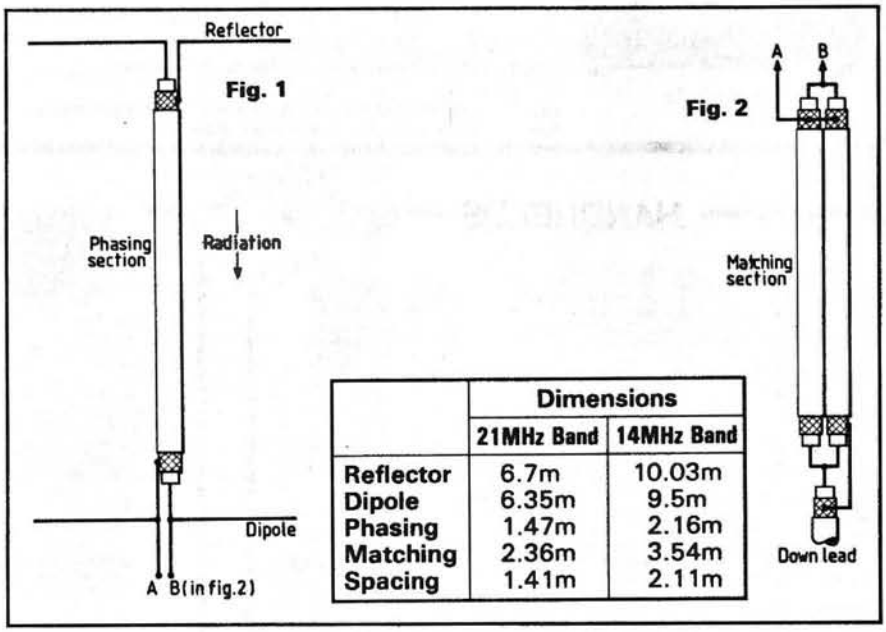
The Answer

There is no problem provided that you are prepared to get busy with the soldering iron and also cut a few pieces of wire and coaxial cable. The answer is in the Old Timers' two-element phased array using wire elements. A unit made up for the 21MHz bands has elements only around 6m long and a boom of about 1.4m; see the table of dimensions for the exact lengths.

Construction

This can take two forms depending upon your requirements and capabilities. If you are interested in getting out well in one direction, perhaps because you have a regular sked or maybe you like talking to Italians, then the simple answer is to make the thing up in the form of a clothes drier. This involves using two pieces of wood to hold the ends of the elements and then to suspend the whole contraption on the same lines as you would put up a hammock.

The second method, and the one which makes it simple to rotate, is to make it up in the more traditional manner using metal pipes for the elements and a central boom which can conveniently be made of wood, a piece of nominal 50mm square will do the trick nicely. This should be properly prepared before use by giving it several coats of good quality paint so as to make it waterproof. The colour of the paint can help with the disguise job and a nice light grey is a good choice; think of the colour of an average sky. The elements can be made from the type of piping used for domestic water supplies. The diameter is not critical and something around 12 to 25mm would do nicely.



	Dimensions	
	21MHz Band	14MHz Band
Reflector	6.7m	10.03m
Dipole	6.35m	9.5m
Phasing	1.47m	2.16m
Matching	2.36m	3.54m
Spacing	1.41m	2.11m

Matching and Phasing

The phasing section is made from cheap domestic TV cable with a velocity factor of 0.82 and cut to the length shown. If you are using a wooden boom then the phasing section should be taped to it for security. The feed point impedance is around 100 ohms and this must be matched to the coaxial cable downlead. This is achieved by using a quarter wave matching transformer made from two pieces of 50 ohm cable made up as shown in Fig. 2. It is essential that the connections are made exactly as shown and that the ends of the coaxial cable are well waterproofed. The main down lead should be the usual 50 ohm type.

The Spec

Unless you put figures on something no one seems to take it seriously so, for the spec collectors, here they are. The power gain is a nominal 4dB over a reference dipole and the front to back ratio should be an easily achievable 20dB. The antenna exhibits good bandwidth and an a.t.u. should not be required provided the array has been carefully tuned in to the centre of the band. This can be achieved by carefully cutting the element lengths whilst keeping an eye on both an in-line s.w.r. meter and, preferably, also a remote field strength indicator.

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The Schottky Diode

Brian Dance takes a look at these unconventional barrier diodes. Part 1

Most ordinary diodes are of the conventional *pn*-junction type. Charge is carried across the *pn*-junction by the positive holes which move in the direction of the conventional current from the *p*-type to the *n*-type material and by negative electrons which move in the opposite direction. Thus the holes and electrons are known as charge carriers and a current can flow under forward biasing conditions with the *p*-type material made positive because these charge carriers can flow across the junction.

One of the deficiencies of simple *pn*-junction diodes is that some of the charge carriers are stored in the junction region for a very short time when a reverse bias is suddenly switched to a conducting diode; the stored charge carriers prevent the diode from suddenly switching to the non-conducting state so that it continues to pass a diminishing current for a very short time.

Stored charge carriers thus limit the performance of junction diodes at very high frequencies, especially in the GHz microwave spectrum. In power diodes stored charge carriers become important at much lower frequencies and lead to power losses at frequencies of the order of 200kHz in equipment such as switched mode power supply units.

The difficulty arises because the conduction of a forward biased *pn*-junction diode involves the passage of holes into the *n*-type material where they are minority carriers and of electrons into the *p*-type material where they too become minority carriers. (The term minority carriers means that the concentration of these carriers per unit volume of the material is far less than that of the carriers of the opposite sign). Although the minority carriers will combine with charges of the opposite sign, this process takes a short time to occur. When the applied voltage is suddenly changed to the reverse biased condition, the carriers stored in the junction region are drawn back across the junction, thus producing a relatively high transient reverse current. The use of majority carrier devices (in which minority carriers play no important part) enables this problem to be avoided.

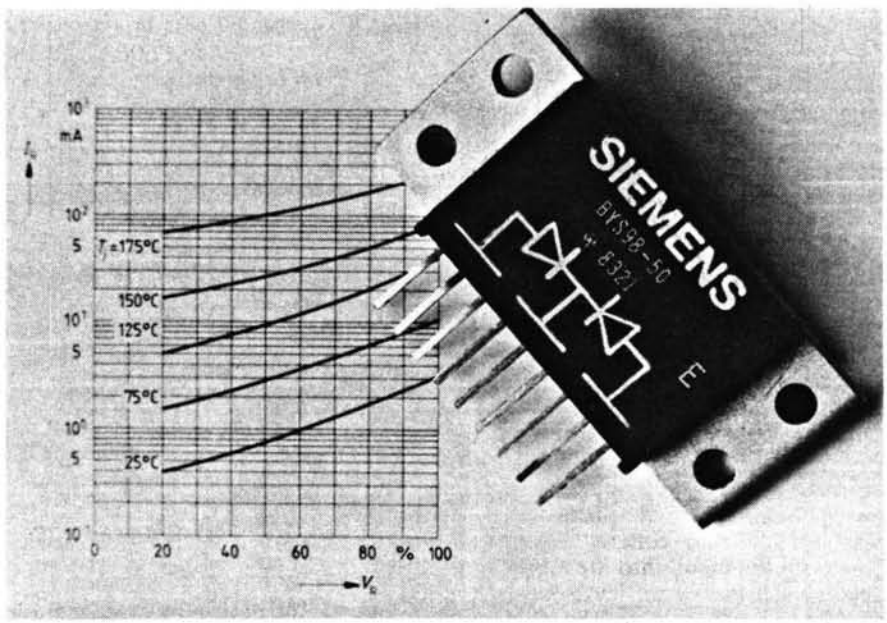
The Schottky Diode

Schottky barrier diodes contain a metal-semiconductor junction instead of the conventional *pn*-junction and are majority carrier devices, so they do not suffer from charge storage effects. They can provide a very fast switching performance. Small, low-power, economical Schottky diodes, often encapsulated in glass envelopes with axial leads, can be used for frequencies up to the microwave region. Higher power Schottky diodes are used in moderately high power switching circuits operating at relatively high frequencies (usually up to a few hundred kHz). Schottky diodes are also employed as internal components of various high speed monolithic devices, such as Advanced Schottky Logic (a.l.s.) and Low-Power Schottky Logic integrated circuits.

However, it is not only the switching speed of Schottky diodes which distinguishes them from conventional *pn*-junction types. Any diode requires a certain forward voltage across it before it commences to conduct, this voltage depending mainly on the energy band gap of the material in the device. A silicon junction diode will conduct when a forward voltage of about 0·65V is applied to it, whereas a germanium diode will conduct at a forward voltage of under 0·2V. (The values quoted in the data sheets for forward voltages at some specified current may be higher than these values, the additional voltage being needed to drive the current through the resistance of the diode.)

Schottky diodes require a forward voltage of typically around 0·4V; this is lower than that of a conventional silicon diode, but higher than that of a germanium junction diode. This relatively low forward voltage gives Schottky diodes an advantage over silicon types for detector and mixer applications. Similarly, it gives them an advantage in power circuits, since less power is wasted in the diode than in silicon types.

Although germanium junctions offer a lower forward voltage then Schottky diodes, the reverse current of a germanium diode is quite significant and very temperature dependent so that germanium types are unsuitable for many applications. A germanium diode with a small junction area designed for low power circuits may pass some tens or hundreds of microamps at room temperature when a small



A Siemens Schottky diode

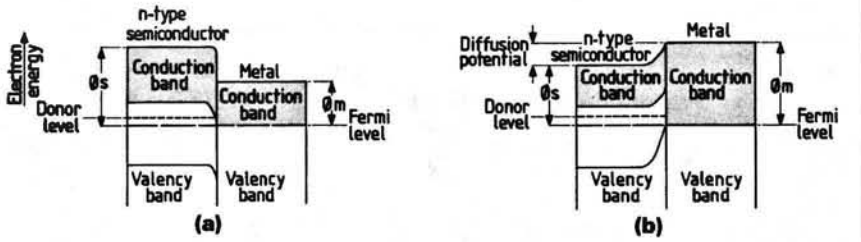


Fig. 1.1: Energy band diagrams for (a) an ohmic contact; (b) a Schottky barrier

reverse bias is applied, whereas a low power Schottky diode will have a typical reverse current of perhaps some hundreds of nanoamps. Germanium types cannot be used above about 90°C because the small band gap of this material leads to excessive reverse or "leakage" current, whereas Schottky diodes can be used at much higher temperatures. However, planar silicon diodes can have reverse currents much less than those found in Schottky diodes, picoamp values being normal.

Silicon diodes can be made with higher reverse voltage breakdown ratings than Schottky diodes. Microwave low power Schottky diodes often have breakdown ratings of between 5 and 70V, while those of high power Schottky diodes cannot be so very much greater than these values and this excludes their use in high voltage circuits.

It should now be clear that Schottky diodes have fields of application which are different from those of conventional silicon diodes, although there is a considerable overlapping of these fields where much thought must be given to the type of component selected.

Metal-Semiconductor Junctions

A metal-semiconductor junction may have ohmic characteristics (current proportional to the applied voltage in either direction) or rectifying characteristics. The most important determining factor is the work functions of the materials concern (that is, the energy required to liberate an electron from the surface of the materials).

An ohmic junction is formed when the work function of the metal is less than that of the semiconductor material with which it is in contact. The energy band diagram for an *n*-type semiconductor material of work function Φs in contact with a metal of work function Φm, where $\Phi s > \Phi m$ is shown in Fig. 1.1. By definition the Fermi levels in each material have a 50 per cent probability of being occupied by electrons. When the materials are first brought into contact, electrons flow from the metal into the semiconductor until the Fermi levels become the same as in Fig. 1.1(a). The conduction bands in the two materials overlap and electrons can flow easily in either direction, so a resistive or ohmic contact is formed.

A Schottky barrier junction is produced when the work function of the metal exceeds that of the semiconductor material employed. The energy band diagrams for an *n*-type semiconductor material in contact with a metal of smaller work function is shown in Fig. 1.1(b) with the Fermi levels coinciding as in Fig. 1.1(a). When the junction is first formed, electrons flow from the semiconductor material into the metal so that the semiconductor material gains a net positive charge relative to the metal. The potential difference thus formed across the junction as a result of this diffusion of charge carriers is known as the diffusion potential. As in the case of a *pn*-junction formed between two semiconductor materials, a depletion region is formed in the Schottky barrier junction which is depleted of charge carriers, since the electrons from this region have diffused into the metal.

Current can flow easily through such a Schottky junction only if a potential greater than the diffusion potential is applied across the junction in such a direction that is opposes the diffusion potential. That is, the applied external bias must make the metal positive with respect to the *n*-type semiconductor material.

Thus there is an energy barrier known as the Schottky barrier at the interface between the two materials of the device. As in the case of a *pn*-junction diode, this energy barrier is decreased by a forward bias and increased by a reverse bias, so Schottky diodes act as rectifying junctions. When forward biased, the electron majority carriers of the *n*-type material are injected into the metal.

Similar junctions can be made using *p*-type semiconductor material and a suitable metal, in which case the current is carried across the junction by holes. However, *n*-type semiconductor material is almost always employed in practical devices, since the electron mobility is greater than the hole mobility in the semiconductor material and this results in a higher device switching speed being obtained with the *n*-type material.

It is interesting to note that the old types of selenium rectifiers and the even earlier copper oxide/copper types (sometimes used as metal rectifiers) are Schottky barrier devices.

Modern Schottky barrier diodes are fabricated by the deposition of a metal layer onto a suitable semiconductor substrate.

Schottky diodes have also been known as "hot carrier diodes", since the relatively energetic or "hot" electrons are injected into the *n*-type metal at a higher energy level than the existing free electrons of the metal. However, the injected electrons give up their energy very quickly to the metallic lattice with times of 100fs (100×10^{-15} seconds) being reported.

It should be noted that only electrons carry the current in *n*-type semiconductor-to-metal Schottky barrier diodes and these electrons are majority carriers on both sides of the junction. Minority carriers play no part in conduction in a Schottky diode, so charge storage time is negligible.

Construction

Low-power Schottky barrier diodes are made in various geometries according to the reverse bias breakdown voltage required, the maximum operating frequency, etc. Silicon planar passivated epitaxial techniques are normally employed.

The structure of a "mesh" diode is shown in Fig. 1.2. A structure of this type can be fabricated by depositing metal through a screen onto the semiconductor surface. Many closely

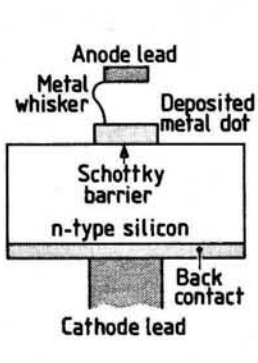


Fig. 1.2: Structure of a mesh diode

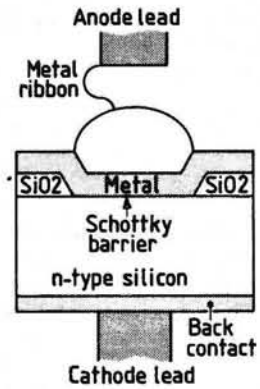


Fig. 1.3: Structure of a passivated diode

spaced diodes are thus created on a single chip. The diode contacts are too small for thermocompression bonding, but contact can be made by randomly pressing a sharp metal point against one of the metal contacts on the diode. The large number of contact points provide a good yield of satisfactory devices in this operation.

Unfortunately it is impossible to fabricate this type of diode with reliable contact regions which are small enough for operation at frequencies above about 7GHz. Hewlett-Packard suggest a maximum test frequency of 3GHz for mesh diodes. The reliability of diodes of this type is excellent, but the random probing techniques used in their fabrication raises their cost.

The development of a passivated diode process solved the problem of creating small area contacts. A passivated layer of silicon dioxide is first formed over the entire silicon surface, after which a small hole is opened in the oxide and the chosen metal is deposited in the hole to form the Schottky barrier structure of Fig. 1.3. Gold or silver is deposited to provide a surface for bonding, the metallisation overlapping the surface of the oxide to form an area of ample surface for wire bonding the connection.

Diodes produced in this way can be used at frequencies of up to some 40GHz, although Hewlett-Packard suggest a maximum test frequency of 16GHz for this type of product. The edge of the diode is protected by a layer of silicon dioxide and this improves the yield of satisfactory devices. Unlike mesh diodes, mass production techniques can be employed to reduce costs. Unfortunately diodes of this type have a maximum breakdown voltage under reverse bias of only a few volts, since the passivation process produces very high local electric fields which lead to breakdown.

Devices with a much greater reverse breakdown voltage may be produced by a hybrid process. The diffused guard ring of *p*-type silicon shown in

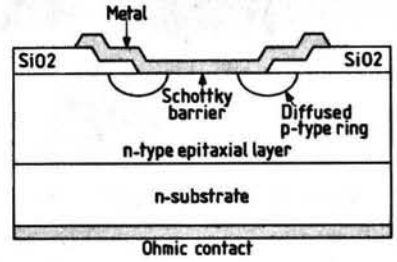


Fig. 1.4: Structure of a hybrid diode

Fig. 1.4 is made to extend in a planar fashion under the layer of passivating oxide and the Schottky barrier is formed in the interior of the ring, making electrical contact with the *pn*-junction. The guard ring reduces the edge effects so effectively that devices with reverse breakdown voltages of hundreds of volts have been fabricated, although the typical value is nearer to 65V.

Although hybrid Schottky diodes can be produced at low cost, they have a relatively high junction capacitance and this limits their maximum operating frequency to about 2GHz.

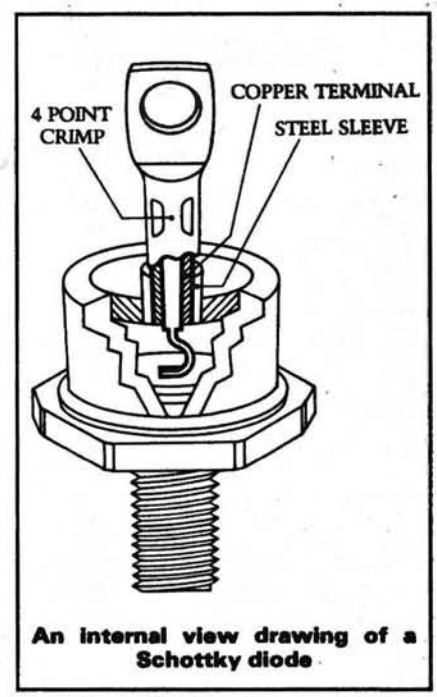
Diode Characteristics

When no bias is applied across a Schottky barrier diode, the electrons can freely diffuse across the junction in either direction and the net current passing through the device is zero. If a "saturation" current Is flows as electrons from the semiconductor to the metal under this no-bias condition, the current-voltage relationship of the diode is given by the approximate equation:

$$\text{Diode current} = I_S\,(e^{(V/0{\cdot}026)}-1)$$

You can see that Is is dependent on the junction area, the Schottky barrier potential and the temperature.

In practice it is found that Schottky diodes conform fairly closely to this characteristic. However, at high voltages above the breakdown value, the reverse current increases rapidly with the applied voltage and avalanche multiplication occurs (as in *pn*-junction diodes).



An internal view drawing of a Schottky diode

The forward characteristic of the Hewlett-Packard 5082-2300 series of unpassivated Schottky diodes at three temperatures is shown in Fig. 1.5. It can be seen that the forward voltage required to produce a given current falls considerably as the temperature of the material rises.

Another log-log plot showing the reverse bias characteristics of the Ferranti ZC2800 and ZC5800 Schottky diodes. As in the case of a junction diode, the reverse current rises very rapidly with the temperature.

The junction capacitance of Schottky diodes is important at high frequencies. The diagram in Fig. 1.7 shows how it decreases with an increasing reverse voltage in the case of the Hewlett-Packard HSCH-1001 economical general purpose low-power Schottky diode.

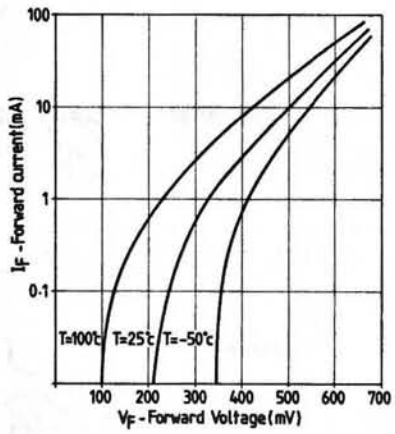


Fig. 1.5: Forward characteristics of the 5082–2300 diode

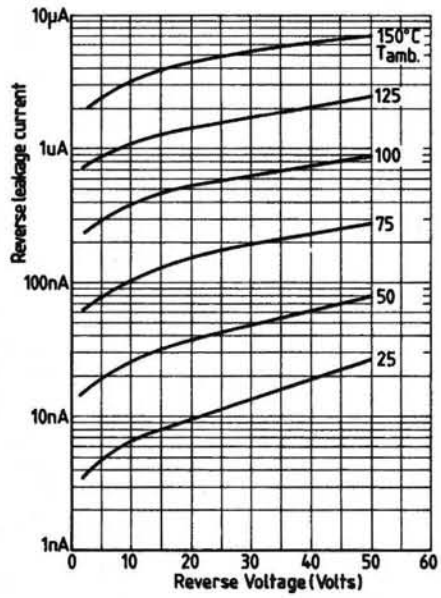


Fig. 1.6: Reverse characteristics of the ZC2800 and ZC5800 diodes ▶

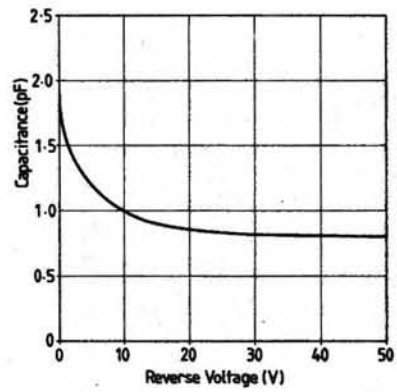


Fig. 1.7: Capacitance plotted against reverse voltage for the HSCH-1001 diode

In Part 2, Brian Dance concludes his look at Schottky diodes

The Battle of the Beams—Part 3

Ever since 1939, Dr Plendl of the German Aeronautical Research Establishment entertained doubts about the effectiveness of X-Gerät in the face of strong jamming; accordingly, schemes for a new system were put in hand at that time. D. V. Pritchard Dip Ed G4GVO concludes this most interesting story.

Ideally, such a system would have only one director beam for the guidance of the bomber and another for a range-measurement system which would enable ground control to drop the bombs accurately. Clearly improved accuracy would be needed, and it was possible that owing to the nature of the system the number of aircraft on the beam at any one time would be necessarily low.

Early Experiments

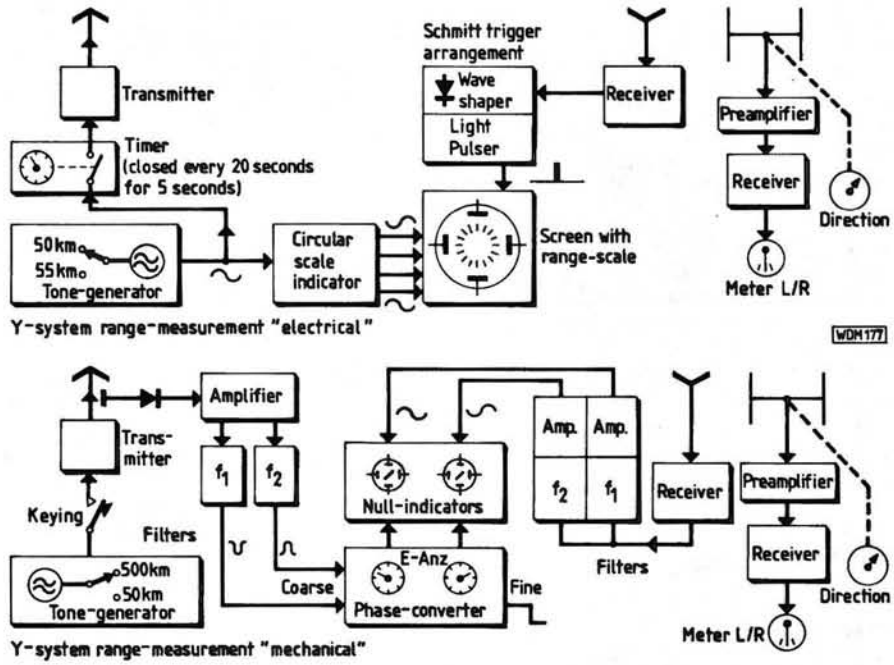
Since the only aircraft receiver available was the FuG 17 (42 to 48MHz), a multi-beam beacon was designed for it by a Dr Herzog of the Götz Company and given the code-name *Wotan 2*. A system similar to X-Gerät was also built which used the *Bertha 1/–2* television transmitter, with similar pulsing and modulation having a dot-dash ratio of 1:7 modulated at 2000Hz. Plendl's analyser was also employed: this system was envisaged as the director beam for the aircraft's flightpath.

For range-measurement another special "dash-system" was developed at Rechlin. A transmitter tunable between 42 and 48MHz was modulated for 10 seconds at 300Hz, its signal being received in the aircraft on a later mark of Herzog's receiver—now the FuG 17 E and on the German production line. Its output was fed through a tone filter and the resulting note modulated an airborne transmitter which returned the signal to the ground on another frequency in the 42 to 48MHz range. There the returned modulation note was compared with the original one sent from the ground and the phase difference, after deduction of the time lag in the aircraft's equipment, gave a direct measure of the range between the ground transmitter and the aircraft.

Different Ideas

In fact several systems were tried for the early Y-System, but the one chiefly employed was the "Y-Range Measuring System Mechanical" developed by Dr H. J. Schmidtmann at Rechlin and a Dr Jenns of Siemens. Two tone frequencies of 300Hz (corresponding to 500km, the "coarse measuring range") and 3000Hz (equalling 50km, the "fine tuning range") were transmitted. Rectifiers loosely coupled to the transmitting antennas fed both frequencies via separate filters and phase converters to two small c.r.t.s, to which were also fed the filtered frequencies from the receiver tuned to the aircraft's return signal. Tuning of the phase converter resulted in diagonal strokes appearing on the screens which served as null-point indicators, and range was read from a scale marked in kilometres.

Siemens also produced a range-measurement known as the *Electrical Notebook* which recorded the ultimate range of five simultaneously measured aircraft. This incorporated a fine-measuring system devised by a Dr Bekker which used a larger c.r.t. with a circular range-scale showing a range from 0 to 20km. A transmitted tone of 7500Hz generated a "dark pulse" circular time zone calibrated against a further circular "bright zone", the phase-converted voltage from the receiver being then transformed into a pulse which the electron beam converted into light-points so that a change in range could be observed directly. This system was somewhat unreliable in that a 5km variation in range was sometimes observed, but nevertheless it was of some help when enemy jamming was strong.



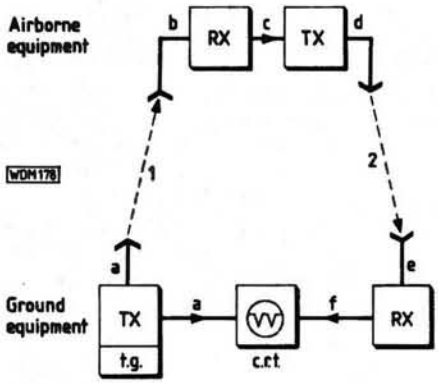
Block diagram of the Y-system range-measurement systems electrical and mechanical

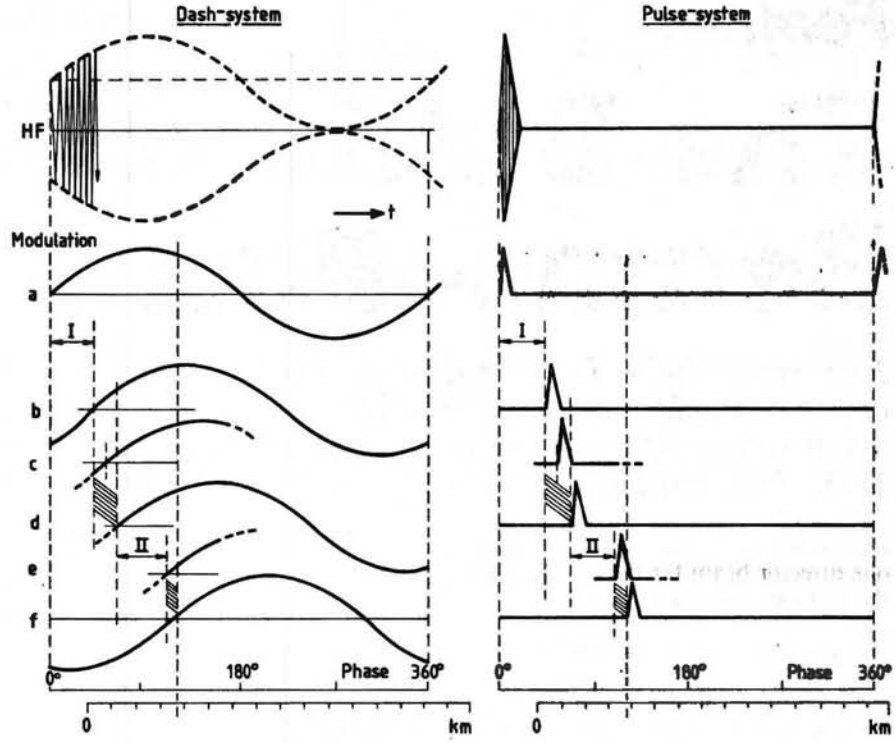
Later, Dr Bekker introduced another device known as the "Y-System Measuring Electrical" which was produced by the Graetz Company. A modulation note of 300Hz corresponded to 50km, but it could also be used for an indication at, say, 20km and by switching to a frequency 10 per cent higher the range was extended to 32km, and so on. Little more, unfortunately, is known about this method.

First Trials

These systems were, however, only useful at first for random location: only an all-round representation of an aircraft was given. For example, the aircraft flew to a given point by standard navigational methods and its range was then measured by these various electronic systems. Its approach to the point was ascertained by coupling the system to an ultra-short-wave Adcock

1—Outward Beam. 2—Return Beam. t.g.—tone generator. TX—transmitter. RX—Receiver. c.r.t.-c.r.t. with range scale. The running-time inside the equipment is shown on the shaded parts of the graphs, the range-scale is therefore displaced by this value on the right-hand graph





General layout of the Y-system with graphs of range, modulation and timing

direction finder, code-named *Heinrich.* Variants of the earlier X-Gerät system were often incorporated wherein a director beam was used, but where the old cross beams would have been empoyed instead of the X-Uhr combined clock/calculator would indicate the precise timing according to range-measurement from the ground. On approaching the bomb-release point the X-Uhr received a nine-second Morse signal and on the last dot the bombs were released.

Final Form

Under the direction of Dr Plendl a development was devised from this method by Dr Herzog in 1940. This new system retained the code-name Wotan 2, the full title of which was the "Y-Double-Beam Beacon System" and included parts of the multi-beam system already described.

Although the same rotating installation with transmitter and operating cabin was used, new antennas were introduced with seven parallel dipoles and reflectors which generated a long club-shaped lobe with smaller side lobes. At a half-wavelength in front of these were two further dipoles spaced at a wavelength apart which, on an opposite phase, produced a "washed out" cardioid pattern; thus two sets of beams were sent out, one for the flightpath to the target and the other for the aircraft's return.

Keying the system was originally effected by mercury switches or vacuum relays, but as they gave rise to key-clicks they were replaced by the so-called "capacitive mill" designed by a Dr Escherish. This was a motor-driven differential capacitor which used a light bulb to take the transmitter load between the pauses in transmission. The long-lobed directional antennas were keyed at 176 pulses per minute, followed by the cardioid-shaped dipoles; this resulted in a slower dot-dash pulse with much shorter gaps at a ratio of 8.8:1, and was acoustically more acceptable.

In addition, a new receiver based upon Herzog's FuG 17 E was developed by Dr H. Donn and Dr W. Hepper and designated the FuG 28a; manufactured by the Heliowatt Company, this was combined into one unit with Plendl's improved AW 28 analyser. This latter contained a motor driving a cam making 180 contacts per minute which conducted the receiver output to two series-connected capacitors: their differential voltages then biased the grids of two valves so that one was bridge-switched and a balance existed if the field strength of the two pulses from either transmitter was the same—that is, if the aircraft was found on one of the two beams. Variation to left or right gave opposing bridge currents with corresponding responses on the indicating meters.

The gap between transmissions in each case caused a magnetic coupling between the motor and the switch to drop and only to be re-instated when the next cycle of transmissions commenced. In this way a positive synchronisation between the ground station and the aircraft was established. To position himself on the correct beam the pilot switched on his equipment which also incorporated a sensitive (and heavy duty) relay with an extra winding. The relay operated according to course variations by switching over the polarity for left and right directions: thus the motor would be in the correct rotation sense when switched on until a potentiometer connected between the motor and the additional winding on the relay delivered sufficient voltage to release the relay.

The Y-System could probably have been the most effective (if not dangerous) system of all the German beams had it not been for one small item the Germans, in spite of their customary thoroughness, had somehow overlooked . . .

Norse Mythology —The Give-Away

As early as June 1940 when Dr R. V. Jones had final proof of the existence of Knickebein he received an Enigma decode from Bletchley Park: *It is proposed to set up Knickebein and Wotan installations near Cherbourg and Brest.*

Wotan was certainly something new, but what did it mean? He knew that Wotan was the greatest of the German gods, but was there anything unusual about him—what attributes did he possess that moved the Germans to use his name as a code-word?

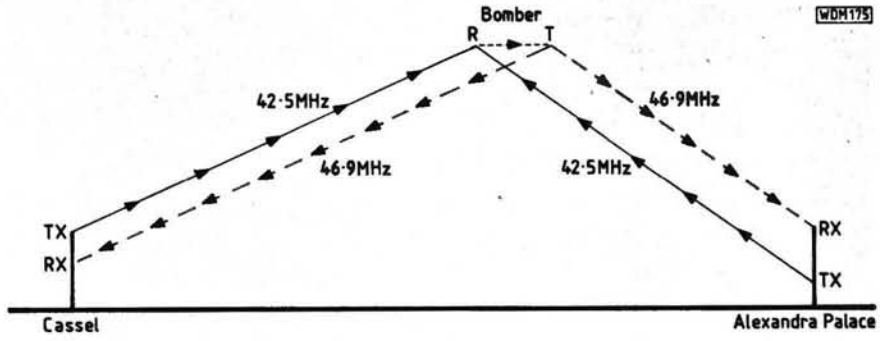
Jones phoned his friend Frederick "Bimbo" Norman, Professor of German at King's College, London, then one of the cryptographers at Bletchley Park. "Bimbo" was renowned for his lightning-fast mind and at once gave proof of it.

"Yes, Wotan was the chief German god—wait a moment, he had only one eye . . . One eye—one beam! Can you think of a system that would only use one beam?"

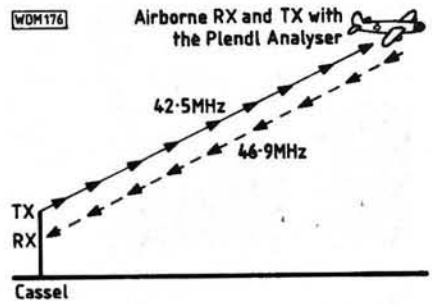
Dr Jones could, in principle; but it was not until the end of 1940, when X-Gerät was finally mastered, that he and his assistant Dr F. C. Frank suspected that another German beam system might be making its appearance. Could this be the Wotan they were looking for? The new system seemed to involve a director beam plus a means for

ranging and Jones' suspicions were aroused when on October 6 an Enigma transmission to what appeared to be a station called "Wotan 2" north-west of Cherbourg read: *Target No. 1 for "Y" co-ordinates 50°41'49.2" north, 2°14'21.2" west.*

Study of a map revealed these to be the co-ordinates of an army depot at Bovington in Dorset, and they showed a great difference from the X-Gerät system in which a number of beam directions were always sent out, each station having to set its beam in the required direction. With this new method, however, the position of the target was given to a single station which suggested that the station had the entire means of directing the bomber to its target. This seemed to be confirmed when Bovington was attacked a few days later by two aircraft with results which, though somewhat inaccurate in direction, were good as regards range.



The method of interfering with the Y-beam system



Ranging principle of the Y-system

Frequencies and Cyphers

Signals Intelligence and our monitoring services soon began to report the existence of beams on frequencies between 40 and 50MHz which had very different characteristics from Knickebein and X-Gerät. Instead of the left and right transmissions being modulated with dots and dashes, the emissions were of equal duration except for a short pause in transmission when one signal, for example the left, came directly after the pause and the other signal followed in a sequence thus: pause—left, right, pause—left, and so on.

Dr Robert Cockburn and his assistants at the Telecommunications Research Establishment put the signal on an oscilloscope and immediately observed its principle. The beam emitted three directional transmissions per second and seemed to have been designed to operate a beam-flying indicator in the aircraft. As things turned out, more surprising developments were to be revealed.

Jones discovered that the aircraft using the new system were not from K.Gr.100 but from the Third Group of KG 26. He also learned that the scientist who had developed the system was none other than Dr Plendl who had devised X-Gerät. Plendl was the German equivalent of T. L. Eckersley, our leading radio propagation expert, and when Jones asked Eckersley what he thought of Plendl he replied, "He's not much good, he bases his theory on experiment!"

(Amateurs please note!)

On 19 January 1941 an aircraft of KG 26 was shot down and though it was badly damaged it could be seen that it carried equipment similar, though not identical, to X-Gerät. But of greater significance was the charred radio operator's notebook:

Loge	*244*	*142*	*10*
Schmalstigel	*454*	*149*	*11*
Bruder	*372*	*120*	*11*
Suden	*272*	*117*	*11*
Bild	*405*	*137*	*11*

Rückflug

Knowing that KG 26's base was at Poix, south-west of Amiens, and that "Loge" was the German code-name for London, Jones and Charles Frank were able to make the following interpretation:

Objective	*Distance to Poix*	*Rhumb Bearing to Poix*	*Magnetic Variation*
London	*244km*	*142°*	*10°*
Sheffield	*454km*	*149°*	*11°*
Bristol	*372km*	*120°*	*11°*
Southampton	*272km*	*117°*	*11°*
Birmingham	*405km*	*137°*	*11°*

Homeward flight

The second table in the notebook gave:

Hinflug	
294	*10*
318	*11*
283	*11*
274	*11*
302	*11*

By assumimg that these entries referred to the same cities as those in the first table and that they were bearings,

Professor R. V. Jones at Clarendon Laboratory, Oxford 1936

Apologies to the inhabitants of Retford, Nottinghamshire, for "relocating" their town in Part 1 of this series.

the intersection point appeared to be at Cassel in north France, which gave them:

Outward flight

Objective	*Approach Bearing from Cassel*	*Magnetic Variation*
London	*294°*	*10°*
Sheffield	*318°*	*11°*
Bristol	*283°*	*11°*
Southampton	*274°*	*11°*
Birmingham	*302°*	*11°*

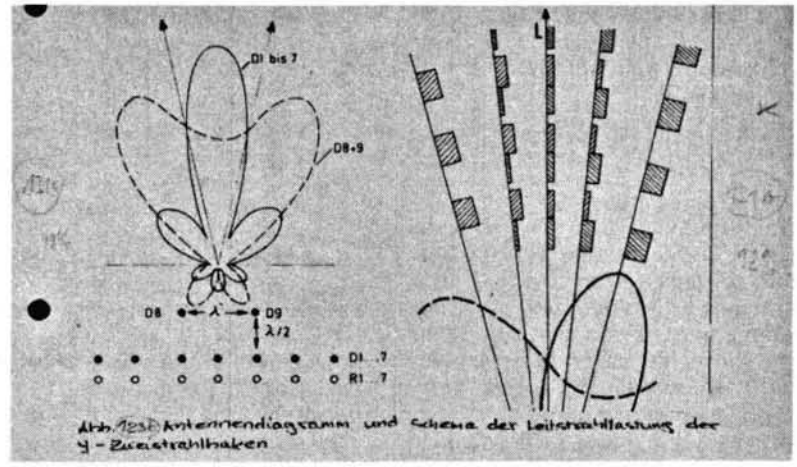
Jones could therefore deduce that: *(a) the aircraft approached its target from the direction of Cassel; (b) it was not concerned with distance calculations, which would be consistent with the distance being determined by a distant ground station; (c) after it had reached its target it intended to return direct to an airfield near Poix, and since it was navigating on its own it needed to know the distance from the target back to Poix, as well as the direction.*

A third table in the notebook contained the frequencies for both the beam itself and the ranging system. Typically, the station radiated a sinusoidally modulated signal to the aircraft on 42.5MHz and its modulated note was then detected, amplified, and used to modulate a transmitter in the aircraft which sent a signal on 46.9MHz back to the ground station —which then determined the distance of the aircraft by the delay in the return signal. As we know, an analyser was used.

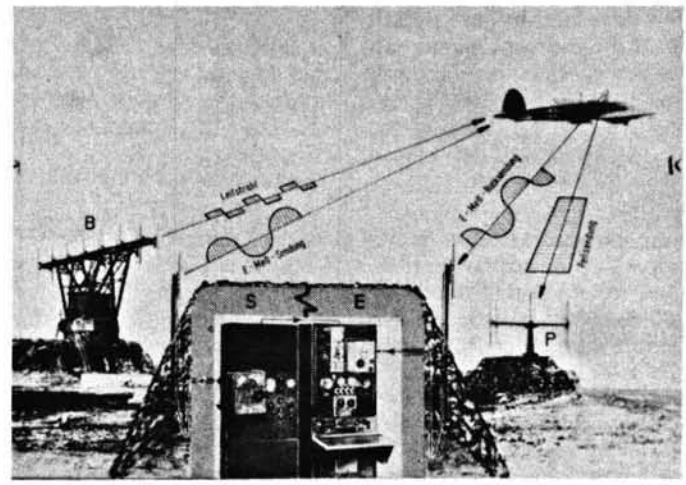
The Delicious Leg-Pull!

From a security viewpoint it is remarkable that the Germans failed to ensure that notebooks and tables giving important information were not taken aboard aircraft: it would have been a simple matter to memorise these things for a single operation. On the other hand it could be said that the Germans were completely unaware that we had broken their Enigma signal system, which gave away so much more vital information. At all events, these matters added up to British intelligence being able to glean much information which the enemy confidently believed to be secure.

Dr Jones immediately spotted a "delicious method" of upsetting the Y-System. (Doubtless his prowess in practical joking came to his assistance here—after all, if disguised as a telephone engineer he had been able to persuade an Oxford physicist to plunge a telephone into a bucket of water, finding a way to bamboozle the enemy was likely to come quite readily to mind.) We in England could receive the 46.9MHz signal from enemy aircraft even better than their ground station could, and so we could *re-radiate the already re-radiated signal back to the aircraft on 42.5MHz, the frequency used by the ground station.* As Dr Jones pointed out, *"This would therefore be fed into the aircraft receiver, along with the signal coming in from the ground station, and in turn be fed back to the ground station again. The effect would be rather like that which occurs in public address systems where the noise from the loudspeakers impinges on the original microphone, and is therefore picked up and relayed back to the speakers again. The effect on the ground station would be to make it think that the aircraft was at a false distance, because the returning waves would have travelled round an extra loop between the aircraft and our own station before getting back to their original base; and if we used a powerful transmitter ourselves the whole system would 'ring' just as a public address system squeals if the gain of the amplifier is made too high".*



Official German diagrams of antenna patterns for (left) return path and (right) directional pulsed beam



Official German lay-out of a Wotan 2 Y-system station B—Leitstrahl (Double-beam Beacon). S—Meft-Sendung (Range measurement transmitter, 1kW "Bertha"). E—Meft-Rucksendung (Control centre with range measurement equipment). P—Peilsendung (Direction finder "Heinrich")
Photographs courtesy of Fritz Trenkle

The BBC television transmitter at Alexandra Palace was just right for the task because it operated in the right frequency band. Dr Cockburn immediately requisitioned it for the purpose and it transpired that this countermeasure, code-named *Domino,* was first put to use the very night that KG 26 took over from K.Gr100—because we had now successfully jammed X-Gerät.

Jones advised that for the first few nights only a minimum of power should be used, just enough to inject a small signal into the Y-System to give the Germans a false range without arousing their suspicions (a process of "acclimatisation" by slow change). The first results were not only successful but afforded a source of innocent merriment: one aircraft became involved in an acrimonious exchange with the ground station who suggested he must have a loose wire in his receiver and that he should abandon the attack for that night. Over the following nights Alexandra Palace gradually increased its power and the Germans woke up to the fact that we were now successfully jamming the system, whereupon they abandoned it.

Dr Jones' original aims were that, since he was not entirely sure for how long the Germans had successfully used the system, he should break their confidence by making them think that we had been interfering with it in a way that had remained undetected for a considerable time. This policy reaped a further (and at times hilarious) bonus because once the Germans suspected we were interfering with the system other alarms entered their heads: *"Since the aircraft had to be instructed*

by the ground station when to release its bombs, it had to be monitored all the time during its bombing run, and the ground station could handle only one aircraft at a time. The aircraft would therefore fly to a convenient area from which it could be ordered onto the beam by the ground station, and so commence its bombing run. In principle, all we needed to do was transmit false orders to the aircraft. In fact we did not do this, but it seemed such an easy countermeasure that the German crews thought we might, and they therefore began to be suspicious about the instructions they received."

Substance was added to this later when an aircraft was ordered by the ground station to steer due west (possibly because it was east of the beam) to bring it onto the start of its bombing run. Failing to hear further ground station orders, the aircraft flew a considerable distance west then returned to base to complain that the British had given false orders. On other occasions when the power of Alexandra Palace had been increased, aircraft became confused and were ordered back to their bases after being told, again, that a wire was probably loose somewhere in the equipment. *"What with our real countermeasures and those imagined by aircrews, Y-operations became a fiasco and the system was withdrawn; we had restored our moral ascendency for the rest of the winter."*

Only later did Dr Jones learn that the Y-System was really *Wotan 2*, and X-Gerät was *Wotan 1*. *"And so, while Wotan may have had one eye for 'Y' he could not have crossed eyes for 'X'..."* In fact the Y-System was nicknamed "Benito" because Mussolini was considered to be the one-eyed end of the Axis!

So ends the battle of the beams. The author hopes that some interest may have been aroused to prompt readers to study further this aspect of scientific warfare and to live again those momentous days of the 1940s in the company of such distinguished (if then secret) servants who unravelled the enemy beam systems.

But to one man, above all, must go the highest recognition: R. V. Jones, the young scientist who defied the experts, confounded officialdom, and quietly saved the country from a terrible disaster—yet inexplicably, is still denied the knighthood he so richly deserves. The man who, to repeat Churchill's words, *"Broke the bloody beams."*

Acknowledgements

I am grateful to Professor R. V. Jones, Emeritus Professor in the Department of Natural Philosophy, University of Aberdeen, for his kind help and advice, and also for his permission to use extracts from his book *Most Secret War*, published by Hamish Hamilton. My thanks must also go to AEG (formerly Telefunken) for their permission to use extracts from *Die deutschen Funklenkverfahren bis 1945*, and especially to Dr Colin Hamilton, manager of the Airborne Early Warning Department, for his kind assistance and advice. I am also grateful for the help received from some old and respected opponents, notably Herr Fritz Trenkle, author of *Die deutschen Funk-Navigations und Funk-Führungsverfahren bis 1945*; Dr Rudolph Kühnhold, designer of the *Freya* and *Seetakt* radars; the late Professor Dr Wilhelm T. Runge, designer of the *Mannheim, Darmstadt, Würzburg* and *Lichtenstein* series of radars, who was able to give valuable help regarding Telefunken's work in the field of beam systems; and Dr Herbert Kümmritz, Dr B. Röde and Dr Gotthardt Müller.

Further Reading

Most Secret War by R. V. Jones. Published by Hamish Hamilton.
The Bruneval Raid by George Millar. Published by The Bodley Head.
The Ultra Secret by F. W. Winterbotham. Published by Nicolson.
The Rise of the Boffins by Clark.
Instruments of Darkness by Alfred Price.

For our German speaking readers:
Die deutschen Funk-Navigations und Funk-Führungsverfahren bis 1945 by Fritz Trenkle. Published by Motorbuch Verlag.

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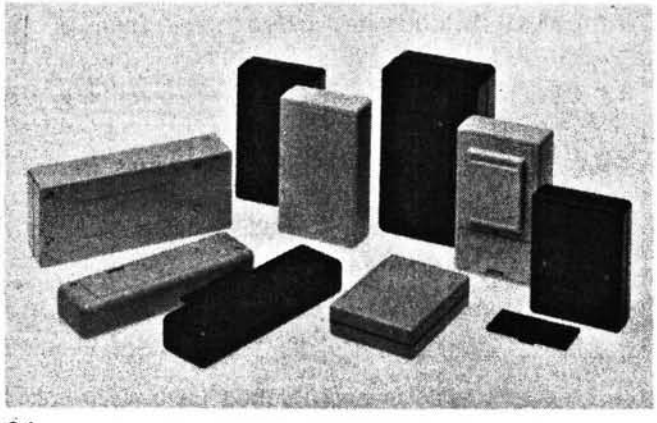

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Reading & Understanding

(with a bit of theory thrown in)

Before attempting to understand circuit diagrams, it is as well to become familiar with the symbols representing the various electronic and radio components. In Part 1, this is just what R. F. Fautley G3ASG does.

At least a pageful of these radio and electronic symbols can be found in various publications, but here we will deal with only a few at a time as they become necessary to understand the circuit being described.

The Series Circuit (d.c.)

Let's start with a very simple series circuit, just three components.
(i) A battery
(ii) A simple on-off switch
(iii) A resistor
The sketch in Fig. 1.1 shows how each one of these three separate components is represented by its own particular circuit symbol. The symbols, as drawn, do not represent any sort of circuit as they are not connected together in any way. If we join the three components **in series**, as in Fig. 1.2, this then becomes a simple circuit. By connecting components in series, we mean that they are connected end-to-end, rather like children forming a circle by joining hands!

The lines joining the components together are electrical connections, either wires or the copper tracks on a printed circuit board. A physical representation of the Fig. 1.2 circuit is shown in Fig. 1.3. In the circuit diagram, the switch is shown in the open or OFF position. Conventionally, on-off switches are drawn in the OFF position, and this one has been labelled "S1" meaning switch 1. The resistor is marked "R1" meaning resistor 1 and the battery symbol is marked "9V" indicating a 9 volt battery.

When switch S1 is closed, direct current (d.c.) will flow through the resistor, this is the current provided by batteries or d.c. supplies. The value of the d.c. flowing will depend on two things:

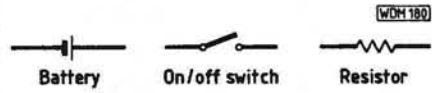


Fig. 1.1

(i) The voltage of the battery
(ii) The value of the resistor R1 in ohms (Ω)
Remember Ohm's Law?

$$I = \frac{E}{R}$$

where: I is the current flowing in amperes (A)
E is the battery voltage in volts (V)
R is the resistor value on ohms (Ω)

Thus, the larger the value of the resistor in ohms, the smaller will be the current (in amps) flowing. This effect of the resistor in restricting the current flow is called **resistance**.

Then for Fig. 1.2:

$$I = \frac{9}{100}$$
$$= 0.09A \text{ or } 90mA$$

The Series Circuit (a.c.)

The next type of circuit to be looked at is another series circuit, the series **tuned circuit**. For this circuit, three different components again with their own symbols are required:
(i) An inductor
(ii) A capacitor
(iii) An alternating supply
They are shown in Fig. 1.4. Both the inductor and the capacitor possess a characteristic which tends to impede the flow of alternating current; rather as the resistor in Fig. 1.2 restricted the flow of direct current in the d.c. series

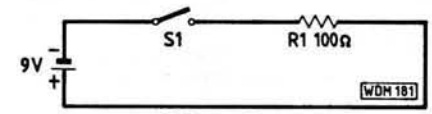


Fig. 1.2

circuit. This characteristic (due to the inductance of the inductor and the capacitance of the capacitor) is called **reactance**.

The reactance due to the inductance of the inductor (or the capacitance of the capacitor) can be considered as a measure of its ability to oppose the flow of alternating current when an alternating voltage is applied across it.

There is a fundamental difference, though, between the effect of current flowing through a resistor and alternating current flowing a capacitor or and inductor. This difference is due to **phase**.

What is Phase?

Current, whether it is a.c. or d.c., flowing through resistance is **always in phase** with the voltage across it. This means that whatever the shape of the voltage waveform, the shape of the current waveform flowing through a resistor is always **exactly the same. Peaks or troughs in the waveform appear at exactly the same instant in time in both voltage and current waveforms.** In the d.c. case, there is no waveform as the voltage is constant, but so then is the current!

Alternating current flowing through a capacitor or an inductor, however, is certainly **not** in phase with the voltage across it. In the case of a theoretically pure inductance having a sinusoidal alternating voltage applied across it, the current (although still sinusoidal) will lag the voltage by the time taken by a quarter of the cycle. This time is electrically equal to 90° (as a full cycle is 360°). The alternating current flowing through a capacitor, however, leads the voltage across it by 90°, again, if the shape of the voltage waveform is sinusoidal, so is the current waveform.

Voltage and current are referred to as being in **quadrature** when there is a phase difference of 90° (a quarter of a cycle) between them, either leading or lagging.

When both a capacitor and an inductor are connected in series as in Fig.

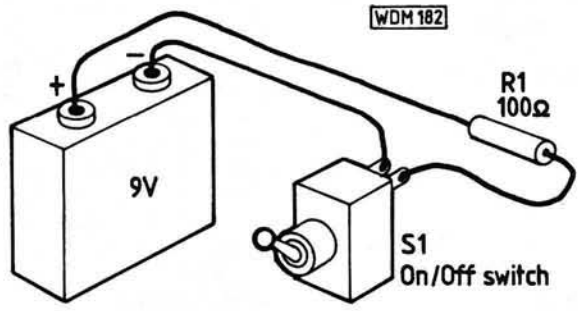


Fig. 1.3

Circuit Diagrams

Fig. 1.4

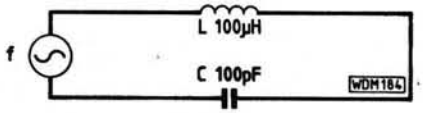


Fig. 1.5

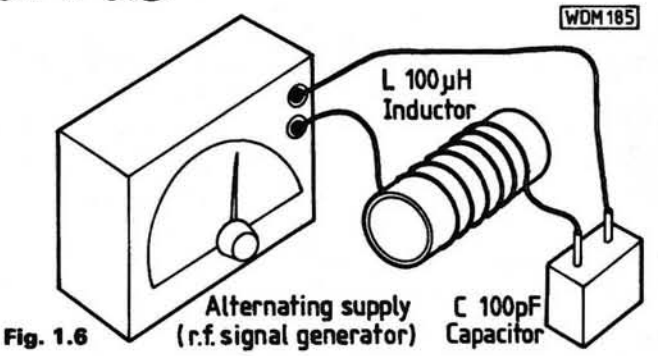


Fig. 1.6

1.5, together with an alternating voltage of variable frequency (such as a signal generator), it would be found (if we had a means of measuring it) that by varying the frequency only of the alternating voltage, the amplitude of the alternating current through the circuit would vary. It would also vary if the supply voltage were changed, and that is why in the last sentence we said we would vary only the frequency.

The current would vary in such a way that at one particular frequency (call it f_0) it would reach a maximum value, diminishing both at higher and lower frequencies than f_0. This phenomenon is called **resonance** and the frequency f_0 of maximum current is the series **resonant** frequency of the circuit. This frequency is not affected by the amplitude of the alternating voltage.

Remember the formula for the frequency of resonance?

$$f_0 = \frac{1}{2\pi\sqrt{(LC)}}$$

where:

f_0 is the resonant frequency in hertz (Hz)

π is a constant, 3.1416

L is the inductance in henrys (H)

C is the capacitance in farads (F)

Let's digress for a few moments to take a simple theoretical look at this series tuned circuit. To determine the frequency of resonance of the circuit in Fig. 1.5:

$$f_0 = \frac{1}{2\pi\sqrt{(LC)}}$$

and so, using basic units, H and F

$$f_0 = \frac{1}{2\pi\sqrt{(100 \times 10^{-6})\,(100 \times 10^{-12})}}$$

where L=100μH or 100×10^{-6}H
and C=100pF or 100×10^{-12}F

$$f_0 = \frac{1}{2\pi\sqrt{10^{-14}}}$$

$$= \frac{1}{2\pi \times 10^{-7}}$$

$$= \frac{10^7}{2\pi}$$

$$= 1591549.4\text{Hz}$$

or, by dividing by 10^6, $\simeq$ 1.59MHz

Also, at this particular frequency, f_0, the numerical value of the inductive reactance of the inductor, L, will be exactly equal to the numerical value of the capacitive reactance, C. Think back to the formula for inductive reactance:

$$X_L = 2\pi fL$$

where:

X_L is the numerical value of the inductive reactance in ohms (Ω)

π is constant 3.1416

f is the frequency at which the value of the inductive reactance is required in hertz (Hz)

L is the inductance of the inductor in henrys (H)

Inductive reactance is conventionally considered to be a positive (+) quantity. Note: All the terms in the previous equations are expressed in their **basic units** (ohms, hertz and henrys). If you **always** convert multiples or sub-multiples (e.g. kHz, MΩ, μH, mV, mA) to **basic units**, you are much less likely to make numerical mistakes.

Now let's look at the capacitive reactance:

$$X_c = \frac{1}{2\pi fC}$$

where:

X_c is the numerical value of the capacitive reactance in ohms (Ω)

π is constant, 3.1416

f is the frequency at which the value of the capacitive reactance is required in hertz (Hz)

C is the capacitance in farads (F)

Capacitance reactance is conventionally considered to be a negative (–) quantity. Let's work out the inductive and capacitive reactances at the resonant frequency, f_0, for the previous worked example.

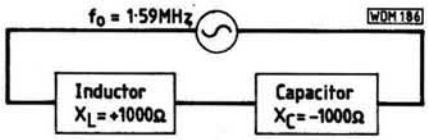


Fig. 1.7

First, the inductive reactances:

$$X_L = +2\pi fL$$
$$= +2\pi\,(1.59 \times 10^6)\,(100 \times 10^{-6})$$
$$= +2\pi\,(1.59)\,(100)$$
$$\simeq +1000\Omega$$

Now the capacitive reactance:

$$X_c = -\frac{1}{2\pi fC}$$

$$= -\frac{1}{2\pi(1.59 \times 10^6)\,(100 \times 10^{-12})}$$

$$= -\frac{1}{2\pi(1.59)\,(100) \times 10^{-6}}$$

$$= -1000\Omega$$

Look back to the circuit of Fig. 1.5. Now put the reactance values on the circuit as in Fig. 1.7. As the two components are in series, and as they are **both reactances** we can add them together arithmetically in a similar way to adding two resistances in series —but the sum is **not** 2000Ω! This is because the inductive reactance is positive and the capacitive reactance is negative, so:

$$X_{total} = (+1000) + (-1000)$$
$$= +1000 - 1000$$
$$= 0\Omega$$

This means that the opposition to the flow of alternating current in this example, at the series resonant frequency f_0, is zero! At least, it would be if we had theoretically perfect components having inductive and capacitive characteristic only, with no resistive losses. Unfortunately, practical components all have some losses, although most capacitors are usually far less lossy than inductors. The effect of resistance in the series resonant circuit is to limit the current flow at resonance, for in its absence the current would be infinite!

In Part 2 we will look at a.c. and d.c. parallel circuits.

PW REVIEW

Cap.Co Magnetic Loop Antenna AMA 5

During the autumn of 1987, Cap.Co Electronics Ltd. of Skelmersdale, Lancs, announced a new range of "home-grown" magnetic loop antennas for the s.w.l., amateur and professional markets, claimed to be a major technological breakthrough "rendering skyscraper antennas . . . as archaic relics of the past".

Being the proud possessor of a few of these archaic relics himself, Ron Stone GW3YDX decided he would like to put a magnetic loop to the test. His XYL Janet reports here on his findings.

The literature accompanying the antenna explains that it functions on the magnetic portion of the electromagnetic wave, and that this feature distinguishes it from "electrical antennas such as Yagis, dipoles, etc.". This review, however, focuses on the practicalitites rather than on the theory behind the antenna.

Arrangements were made to borrow from Cap.Co the Model AMA 5, which covers the frequency range 3.5 to 10MHz, and costs £390 including its associated control unit. Tony Johnston G4OGP, Technical Director of Cap.Co Electronics Ltd., invited GW3YDX to collect the antenna from the factory at Skelmersdale, and at the same time to have a look round the production line for the loops and for the well-known range of antenna tuning units.

For some strange reason, GW3YDX had always imagined that the Cap.Co operation was conducted with a man and a boy from the back of a garage in the leafy suburbs of Skelmersdale. Nothing is further from the truth, for the factory already employs seven people, and three more were to be taken on during the week of the visit. Throughout the company, the issues of quality were evidently given the highest priority. GW3YDX, who is professionally engaged in electronics, was impressed both by the total quality attitude and the company's modern machine tool and electronic test equipment.

Prices for the loop antennas range from around £80 for a receive-only model, up to over £3000 for the high-power professional versions which come with microprocessor-based automatic control units. Sizes range from 680mm to 3.4m in diameter, depending on the frequency coverage. The claim that the antenna does not need planning permission holds true for all the loops except the big AMA 1. The 1.7m-diameter AMA 5 and smaller loops don't need permission unless any part of them exceeds 3m above ground level. This means that the AMA 5 on a 1m stand can go into any garden and the local authority cannot tell you to take it down on planning grounds. Table 1 gives full details of the range of magnetic loops available.

Mechanical Details

The quality of construction of the review antenna was very good, and it was obviously built to last. The tubing is heavy gauge aluminium alloy about 32mm in diameter, with the associated fittings heavily plated to resist corrosion. Heavy duty polypropylene plumbing fittings are used to waterproof the joints between the tubing and the large plastics tube containing the remotely tuned components. The reviewer has pledged to Tony Johnston that he will not divulge manufacturing details, but can reveal that the antenna consists of a loop which couples by transformer action into the tuned circuit comprising the tubing loop and a motor-driven variable capacitor. It sounds simple, but the capacitor is a very special high-voltage component, and the motor and drive have several unique features. The mysterious piece of plastics drainpipe conceals some expensive precision components, which account for the high price of the antenna, and also mean that this is not an easy home-brew project even if only medium transmitter powers are involved.

All the antennas come with a mains-powered manual controller which connects to a waterproof socket on the antenna via an ordinary screened single-conductor cable. The r.f. connects via 50Ω coaxial cable to a PL259/SO239 connector on the antenna. Connections were quick and easy to make.

The controller has fine and coarse tuning buttons marked HF and LF, in other words 4 buttons in all, a toggle switch to go from fine to coarse tuning, a "speed" control to vary the rate at which the reactive components tune, and a press-button mains on/off switch. Several loops can be driven from a single controller.

Operation

To make it all work, the receiver or transceiver is tuned for a peak in noise from the loudspeaker. Using the coarse tuning buttons is the fastest way to tune the antenna, but because the beast has such a very high *Q* it is very easy to miss the tuning peak. Once a peak is found with the coarse controls, you then switch to fine tune and repeat the process. Then it is time to tune up, "bearing in mind other band users" as the instructions quite rightly say. Pressing the fine HF or LF buttons as appropriate, whilst watching the v.s.w.r. will obtain the desired low reading. You are then ready to go.

It all sounds much more complicated than it is to do, and the procedure was quickly got used to, using the excellent instructions supplied. It is a good idea to bear in mind whether one had moved l.f. or h.f. around the band, as usually a quick touch on the appropriate fine tune button would return the antenna to 1:1 v.s.w.r. after a QSY.

The match after tuning was at worst 1.3:1, and more usually 1:1. This should satisfy the fussiest transmitter. No TVI or BCI was evident, although of course this usually has more to do with the quality of the receiving equipment than the transmitter/antenna combination.

The very small bandwidth of the antenna is at the same time both a blessing and a curse. On the one hand it in effect adds another high-*Q* stage to the receiver, which would be of great benefit if a local medium wave broadcast transmitter so overloads the front end of your receiver as to make listen-

ing on the 3.5MHz band impossible, or if you have a receiver with poor strong-signal handling capabilities. In this case, the sharp tuning of the loop may well be able to suppress the QRM. On the other hand, the sharp tuning makes a rapid QSY, especially around 80m, a bit of a tedious task. The very high *Q* of the antenna and its narrow bandwidth are claimed as two of the principal features by the manufacturer. So they can be, but there can also be a negative side, as already outlined.

The 2:1 v.s.w.r. bandwidth was measured on each band and compared with the claimed figures with the following results:

Frequency Band MHz	Bandwidth for 2:1 v.s.w.r.	
	Claimed kHz	Measured kHz
3.5	3	4.5
7.0	8	12
10.0	18	21

The overall frequency coverage of the antenna was 3.2 to 13.2MHz. It is a pity that it does not extend a little higher to give coverage of the 14MHz band, but there are other models which do.

On the Air

The performance of the antenna was compared with the main station antennas at GW3YDX. For the 3.5MHz band the choices are a 16.5m vertical with some 600m of radials, or a G5RV at 12m. For 7MHz there is a 2-element Yagi at 29m or the G5RV. On 10MHz only the G5RV is available.

Although it is possible to mount the antenna with loop parallel to the ground, in most cases it will be mounted upright, and it was tested in that mode only. Band by band, the results of comparative tests are as follows:

3.5MHz: On DX signals the loop was generally about 10dB down on the vertical. Bearing in mind the small size of the loop this is a very good result. Remember that 10dB is equivalent to about 1½ S-points. It was quite easy to work the USA. For local QSOs the loop was run against the G5RV, and again it was about 10dB down. It was easy to put a good signal into most of Europe.

7MHz: Obviously the beam "blew the loop away" with signals up about 30dB compared to the loop. Using the G5RV on European signals, the loop varied from equal to about 10dB down. In view of the minute size of the loop compared with the G5RV, this is a surprisingly good result. Some good Caribbean DX was worked during the CQ WW Contest, though the loop was found to be about 10dB down on the G5RV for distant signals. This again was quite a good result, but not as good as with local signals.

10MHz: Results on this band were the most interesting of all. It soon became evident that the G5RV, being a full wavelength long on 10MHz, possessed some deep directional nulls on that band. Very often, signals that could be heard at good strength with the loop were completely inaudible on the G5RV. When a signal was in the null of the loop and a good signal on the main antenna, it could usually be equalised by turning the loop. At worst, the loop was 5dB down, and frequently many dB up on the G5RV, because of the nulls of the latter. Not being able to turn a G5RV, this was a significant and major plus for the loop.

The theoretical gain figures on the data sheet do not seem to be realised. The dBd (decibels with reference to a dipole) figures are –7.05 on 3.5MHz, –1.82 on 7MHz and –0.03 on 10MHz. Having said that, theoretical gains are very difficult to achieve in reality, especially when it comes to miniaturisation and/or multi-banding. Without the attention of good construction and quality components that Cap.Co have put in on the production line, the field test comparisons against the main station antennas would have been a great deal worse for a small loop. Anybody who imagines that you can build a miniature multi-band antenna 1.7m in diameter and not lose a little must be a bit naïve!

The literature that comes with the antenna claims that a rotator is not necessary. This is true in the sense that the loop, being at ground level, can be turned by hand. However, one of the big benefits was the ability to turn the antenna so as to drop signals into the null of the loop, thereby removing either the hash from the junior op's micro-computer, or dear old Vlad who never listens before calling CQ. A rotator can save a lot of running to and fro, and would be a useful extra. It need not be a big one, as the loop is very light.

Power handling of the AMA 5 is claimed as 150W. Ever curious, the GW3YDX linear was fired up. The power accepted on each band before the v.s.w.r. shot up, indicating flash-over, varied between 190 and 210W depending on the band. This is plenty for most transceivers, and gives a little to spare in the unlikely event of not being able to tune the antenna to give a good match.

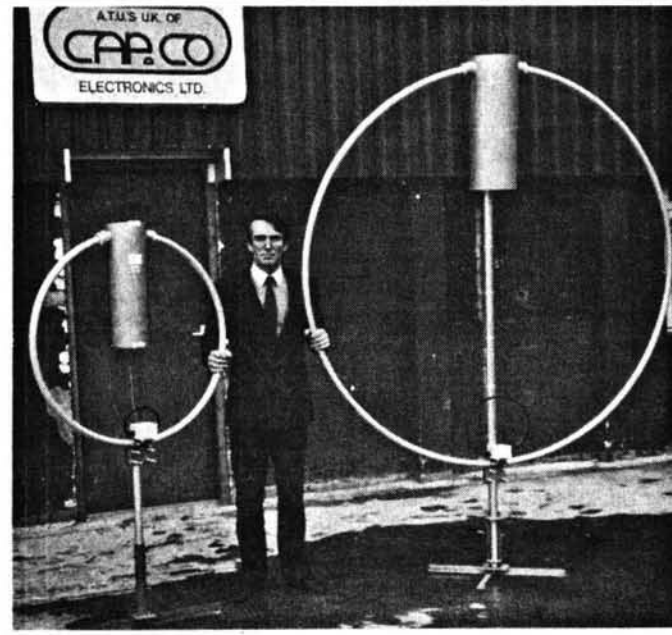
Conclusions

Is a Cap.Co loop going to grace the GW3YDX QTH? The answer is probably not, bearing in mind the excellent antennas that are already in place. Furthermore, noise is not usually a problem there. Having said that, the receiving version would frequently be of use in reducing the European QRM on Top Band And Eighty, so purchase is being actively considered. For the amateur who has severe QTH or planning problems, the Cap.Co range of magnetic loops could offer a solution.

Thanks go to **Cap.Co Electronics Ltd., 63 Hallcroft, Birch Green, Skelmersdale, Lancs WN8 6QB, telephone 0695 27948,** for the loan of the review antenna. ***PW***

TABLE 1: THE CAP.CO RANGE

Type	Freq. (MHz)	Power/Use	Size (m)	Weight (kg)	Price
AMA 1	3.5/7.2	200W/TX or RX	3.4	15	£390
AMA 2	6.9/14.5	200W/TX or RX	1.7	10	£322
AMA 3	13.9/30	200W/TX or RX	0.8	5	£286
AMA 4	1.8/4.2	100W/TX or RX	3.4	16	£456
AMA 5	3.5/11	150W/TX or RX	1.7	11	£390
AMA 6	7/26.8	200W/TX or RX	0.8	6	£342
AMA 7	7/30	Receiving only	0.68	5	£79.95
AMA 8	1.6/10	Receiving only	1.0	6	£89.95
AMA 9	7/30	Commercial models for 500–1200W continuous, with auto-controller			£2—3k
AMA 10	1.8/7				£3.5—4k



Tony Johnston G4OGP, pictured with two of his magnetic loop antennas, standing outside the Cap. Co Electronics factory at Skelmersdale

WIN A CAP.CO MAGNETIC LOOP ANTENNA!

Yes—you can win a Cap.Co Electronics Ltd AMA 5 magnetic loop antenna, which usually sells for £390.00. The AMA 5 can handle up to 150 watts of transmitted power in the frequency range 3.5-11MHz. It is 1.7 metres in diameter and weighs 11 kilograms.

All you have to do is to write the answers to the eight questions in the spaces provided on the Competition Entry form, and say in not more than 50 words why you would like to win a Cap.Co AMA 5 Magnetic Loop Antenna. The answers to all the questions are to be found in articles appearing in this issue of *Practical Wireless*.

We regret that this competition is open only to residents of England, Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man.

Complete the form with your name and address, ensuring that all the details and your answers are clearly printed. Send the completed form (photocopies not accepted) in an envelope addressed to PW Publishing Ltd., FREEPOST, Cap.Co Competition, Enefco House, The Quay, Poole, Dorset BH15 1PP. No postage stamp is required.

The closing date for receipt of Competition Entries is Friday, March 11. Each entry form having all eight answers correct will be judged for the aptness of the reason given for wanting to win a Cap.Co AMA 5. The judging panel will comprise Geoff Arnold G3GSR, Editor of *Practical Wireless*, and Tony Johnston G4OGP, Technical Director of Cap.Co Electronics Ltd. The winner will be notified by post, and the winner's name will be published in the June 1988 issue of *PW*, together with the answers. For full details of the prize, see page 39.

THE QUESTIONS

A. Which is the only antenna to have a bandwidth of 1.5kHz on the 1.8MHz (160m)amateur band?

B. You live in the centre of a city in a second-floor flat, with no garden, and you are forbidden to put up any outside antennas. You want to operate on 15, 20 and 40m—which antenna could you use inside your room?

C. You are standing on a clifftop, 200ft above the sea. How far away will the radio horizon be, using the 4/3 earth radius rule?

D. You live in the stockbroker belt and have about an acre of fabulous garden, but you cannot put up a tower, a beam or even a dipole. What antenna could you get away with using if it was only 0.8m tall and could stand on the floor of your patio?

E. What is the reactance of a lossless series *LC* (acceptor) circuit at its resonant frequency?

F. You have a tiny garden measuring only 3 metres square, and you want to operate on all the h.f. bands. Which antennas could you use?

G. You can go on the air only at weekends on the 3.5 or 7MHz bands, but there is always too much QRN from electric drills, motor bikes and noisy TV timebases, and another amateur over the road operates on the same bands. Which antenna could you use in order to get rid of the QRN and your fellow operator?

H. You add a whistle filter to your medium wave broadcast receiver to cut out heterodyne interference from European stations operating on adjacent channels. To what frequency should you tune the filter?

Complete the following form, ensuring that your answers and name and address are clearly printed, and send it in an envelope, addressed to PW Publishing Ltd., FREEPOST, Cap.Co Competition, Enefco House, The Quay, Poole, Dorset BH15 1PP, to arrive no later than Friday, 11 March 1988. Photocopies of the form will not be accepted.

This competition is open to all readers of *Practical Wireless*, except for employees of Cap.Co Electronics Ltd., PW Publishing Ltd., and their families.

YOUR ANSWERS	
A	E
B	F
C	G
D	H

YOUR NAME & ADDRESS

.....

.....

.....

.....

..... Postcode .....

WHY I WOULD LIKE TO WIN A CAP.CO AMA 5 MAGNETIC LOOP ANTENNA.....

.....

.....

.....

..... (Not more than 50 words)

BI-PAK BARGAIN

THE UNDISPUTED PACK KING FOR OVER 20 YEARS, we offer you the very best in Electronic Components and Semiconductors that your money can buy. Look at our lists and prices, they are unbeatable in value and quantity and you always have our "Satisfaction or money back guarantee". For 1988 we offer more and more Super Value Packs. All goods advertised in stock at time of going to press. Please note our new mail order address: BI-PAK, PO BOX 33, ROYSTON, HERTS, SG8 5DF. Telephone orders: 0763-48851.

RESISTORS.

Pak No	Qty	Description	Price
VP1	300	Assorted Resistors, mixed values and types	£1.00
VP2	300	Carbon Resistors, ¼-½watt, preformed, mixed	£1.00
VP4	200	½-1watt Resistors, mixed values and types	£1.00
VP16	50	Wirewound Resistors, mixed watt values	£1.00
VP140	50	Precision Resistors, 1% tolerance	£1.00
VP181	100	1 and 2 watt Resistors, assorted values	£1.00
VP287	100	Close tolerance Resistors, 05-2%, 10-910 ohms, mixed	£1.50
VP288	100	Close tolerance Resistors, 05-2%, 1K-820K, mixed	£1.50
VP289	100	Metal oxide high stab. Resistors, ¼w 2%, mixed values	£1.50

CAPACITORS.

VP5	200	Assorted Capacitors, all types	£1.00
VP6	200	Ceramic Capacitors, min. mixed values	£1.00
VP9	100	Assorted Polyester/Polystyrene Capacitors	£1.00
VP10	80	C280 Capacitors, metal foil, mixed values	£1.00
VP11	50	Electrolytics, all sorts	£1.00
VP12	40	Electrolytics, 47mf-150mf, mixed volts	£1.00
VP13	30	Electrolytics, 150mf-1000mf, mixed volts	£1.00
VP14	50	Silver Mica Caps, mixed values	£1.00
VP15	25	.01/250v Min. Layer Metal Caps	£1.00
VP180	25	Tantalum Bead Caps, assorted values	£1.00
VP182	4	1000uf 50v Electrolytics	£1.00
VP192	30	Min. Electrolytics, mixed values .47mf-1000mf 6/16v	£1.00
VP193	6	Sub Min. Electrolytics, 2 x 1000/2200/3300mf, 10/16v	£1.00

OPTOS.

VP24	10	.125" clear lens showing Red LED's	£1.00
VP25	10	Mixed shape and colour LED's	£1.00
VP26	15	Small .125" Red LED's	£1.00
VP27	15	Large .2" Red LED's	£1.00
VP28	10	Rectangular .2" Red LED's	£1.00
VP57	25	Opto Special Pack. Assorted, super value	£3.00
VP130	6	RED 7 Seg. CC 14mm x 7.5mm RDP FND353 LED Display	£2.00
VP131	4	GREEN 7 Seg. CA .6" LDP XAN6520 LED Display	£2.00
VP133	8	RED Overflow .6" 3 x CA 3 x CC 6630/50 LED Display	£2.00
VP134	5	GREEN Overflow .6" CA XAN6530 LED Display	£2.00
VP138	20	Assorted LED Displays. Our mix, with data	£5.00
VP147	1	Pair Opto Coupled Modules	£0.60
VP199	4	LD707R LED Displays, CA	£1.00
VP203	15	Triangular shape LED's, mixed colours	£1.00
VP204	10	Large Green LED's, 5mm	£1.00
VP205	10	Small Green LED's, 3mm	£1.00
VP206	10	Large Yellow LED's, 5mm	£1.00
VP207	10	Small Yellow LED's, 3mm	£1.00
VP208	10	Large LED's clear showing Red, .2"	£1.00
VP241	2	ORP12 Light Dependant Resistor	£1.50
VP242	3	Tri-colour LED's, 5mm dia., 5mA 2v, R.G.Y	£1.00
VP243	3	Tri-colour LED's, Rectangular 5mm, R.G.Y	£1.00
VP266	10	Orange LED's, 5mm large	£1.00
VP267	8	Stackable LED's. Rectangular, mixed, R.G.Y	£1.00
VP268	15	LED Panel Mounting Clips, metal and plastic. 3-5mm	£1.00
VP269	2	Red Flashing LED's, 5mm	£1.00
VP284	2	Opto-Isolator IL74-4N27, single	£1.00
VP285	1	Dual Opton-Isolator ILD74	£1.00

TRANSISTORS.

Pak No	Qty	Description	Price
VP172	10	SM1502 PNP TO-39 Sil. Transistors, 100v 100mA Hfe100+	£1.00
VP200	30	OC71 type germanium AF Transistors, uncoded	£1.00
VP201	25	OC45 germanium RF Transistors	£1.00
VP261	4	Programmable Unjunction Transistors, MEU22	£1.00
VP270	10	FET's UHF/VHF Amplifiers, switching & choppers, data	£1.00
VP271	10	FET's general purpose like 2N3819-2N5457, data	£1.00
VP272	10	MOS-FET's Signetics, SD304	£1.00
VP280	12	ZTX300 NPN Silicon Transistors	£1.00
VP290	15	MPSA06 Sil. Transistors NPN 80v 500ma Hfe50+ TO92	£1.00
VP428	10	AC128K PNP Germanium Transistors, 1A 32v	£1.00
VP429	10	AC176K NPN Germanium Transistors, 1A 32v	£1.00
VP430	4	2N3055 Sil. Power Transistors, full spec	£2.00
VP431	25	PNP Sil. Transistors, TO-39 like 2N2905A	£1.00

LC.S

VP40	40	TTL I.C.S all new gates - Flip Flop - MSI, data	£4.00
VP54	20	Assorted I.C. DIL Sockets, 8-40 pin	£2.50
VP59	20	Assorted I.C.s linear, etc, all coded	£2.00
VP209	12	74LS00	£2.00
VP210	12	74LS74	£2.00
VP211	10	CD4001B	£2.00
VP212	10	CD4011B	£2.00
VP214	10	CD4069B	£2.00
VP215	10	741P 8 pin	£2.00
VP216	10	555 Timers 8 pin	£2.00
VP223	50	Asst 74 TTL I.C.s. "ALL GATES" new & coded our mix 7400-7453	£6.00
VP224	100	Asst 74 TTL I.C.s "ALL GATES" new & coded our mix 7400-7453	£10.00
VP282	1	Prog. Sound Gen. Chip. AY-3-8912	£3.00
VP291	1	Z80ACPU Microprocessor. 40 pin DIL	£2.00
VP292	1	Z80AP10 Parallel Interface Controller, 40 pin DIL	£2.00
VP293	1	Z80ACTC Counter Timer Circuit, 28 pin DIL	£2.00
VP294	1	2732D 32K Eprom	£3.00
VP295	1	8821P Pengheral Interface Adaptor (PIA)	£1.50
VP298	6	LM324 14 pin DIL Quad Op-Amp	£2.00
VP257	5	CA3130E MOS-FET I/P, CMOS O/P, Op-Amp	£2.00
VP298	3	MC1310P Stereo Decoder, 14 pin DIL	£2.00
VP299	3	CA3085 Pos. Volt. Regulator, 1.7v-46v, 8 pin TO5	£2.00
VP400	1	27128 128K Eprom	£2.50
VP401	2	LM317T Adjst, Voltage Regulator, 1.5A	£1.00
VP402	1	2114 4K Static Ram	£2.00
VP403	1	TA7204 Audio Amp I.C. 4.2w, 12v, 2-4 ohms	£1.00
VP404	1	TBA461 Audio Power Amp, 4.5w	£1.50
VP432	8	CD4016B	£2.00
VP433	6	CD4017B	£2.00
VP434	10	CD4024B	£2.00
VP435	10	CD4028B	£2.00
VP7413	4	7413 Dual Nand Schmitt Trigger, 4-input	£1.00
VP7440	4	7440 Dual 4-input, Positive-Nand Buffer	£1.00
VP7470	4	And-gated Positive-edge-triggered Flip-Flop with preset	£1.00
VP7480	4	7480 Gated full Adder	£1.00
VP7481	4	7481 16-bit Random Access memories	£1.00
VP7490	4	7490 Decade Counter	£1.00
VP7491	4	7491 8-Bit Shift Register	£1.00

MISC.

Pak No	Qty	Description	Price
VP177	1	Pack assorted Hardware, nuts, bolts, etc	£1.00
VP178	5	Assorted Battery Holders and Clips, PP3/9, AA/D, etc	£1.00
VP223A	6	Tag Boards, 18 way paxaline	£1.00
VP225	20	DIN Plugs, plastic 2-8 pin, 180°/240°/360° mixed	£2.50
VP226	20	DIN Chassis Skts, metal 2-8 pin 180°/240°/360° mixed	£2.50
VP227	18	DIN In-line Skts, plastic, 2-8 pin 180°/240°/360° mixed	£2.50
VP228	10	C15 Computer Cassette Tapes. leadless	£3.00
VP232	1	Cassette Head Cleaner/Demagnetizer, in case	£2.00
VP233	1	Revolving Cassette Rack, holds 32, smokey perspex	£2.50
VP244	1	High Power Piezo Electric Siren. Emits earpiercing warbling sound. Ideal alarm. White plastic body with mounting bracket. Power 12vDC 150mA. Output 100dB (A) at 1m typ. freq. 2.5KHz. Size: 57 x 42 x 37mm	£6.00
VP260	1	9" x 6" Elliptical 8 ohms 10W RMS Speaker. Freq. Res. 60-10000 Hz. Gauss 10000. Centre HF cone	£4.50
VP280A	1	2¼" Transducer Waterproof Speaker. Polyester film diaphragm. Moisture res. 8 ohms 300mW Freq. Res. 20-20000 Hz	£1.00
VP273	10	10K Lin Rotary Potentiometers, slim spindle	£1.00
VP281	4	Plug-in Relays. Mixed volts, etc	£1.00

TOOLS.

VP95	1	Plastic Vice, small, with suction base	£1.75
VP97	1	Logic Probe/Tester, supply 4.5v-18v, DTL, TTL, CMOS	£8.50
VP99	1	Universal Tester, with ceramic buzzer	£5.00
VP103	1	8 Pc STANLEY Screwdriver Set. Flat and crosspoint	£3.50
VP139	1	Pick-up Tool, spring loaded	£1.75
VP217	1	Helping Hand	£4.00
VP218	1	Watchmakers Screwdriver Set, 6 pieces	£1.75
VP219	1	Minature Side Cutters	£1.55
VP220	1	Minature Bent-nose Pliers	£1.55
VP221	1	Minature Long-nose Pliers	£1.55
VP237	1	Universal Ni-Cad Battery Charger. AA-HP11-HP2-PHP3	£6.00
VP238	4	AA Ni-Cad Batteries. 1.25v 500mAH C/R mA	£4.00
VP239	2	C-HP11 Ni-Cad Batteries. Rechargeable	£3.50
VP240	2	D-HP2 Ni-Cad Batteries. Rechargeable	£4.00
VP246	1	25w Quality Low Cost Soldering Iron. 240vAC	£3.50
VP247	1	15w "Lightweight" Quality Low Cost Soldering Iron. 240vAC	£3.50
VP248	1	High Suction Desoldering Pump. Teflon nozzle. Auto eject. heavy duty return spring	£4.00
VP250	1	Long Finger Grip. Soldering aid. Heavy metal base. Serrated jaws with rev. tweezer action. Ideal for holding small components. Fully adjustable	£3.00
VP254	1	250 grams Etchant Granules (Ferric Chloride) makes ½ pint	£1.00
VP255	1	Etching Pen. Etch resistant. Spare tip. Blue	£1.00
VP258	1	Multicore Solder. 5m total. 10 and 22 SWG	£1.00
VP259	1	PCB Holder. Fully adjustable from 0-320mm wide and to any angle. Complete with iron stand and sponge. Strong metal construction with rubber feet. Very high quality	£15.00
VP286	2	Etch Resist PCB Transfer Sheets. Asst. symbols/lines	£1.00
VP405	2	Steel Rules 1 x 4", 1 x 10", measuring ins and mm	£1.00
VP406	1	Junior Hacksaw & 3 blades + hobby knife & 2 blades	£1.00
VP407	1	10 Piece Needle File Set	£3.00
VP408	1	4 Piece Stainless Steel Tweezer Set	£4.00
VP409	1	Set of 4 mm. low cost Side & End Cutters, snipe & combination Pliers. 5" insul. handles	£4.50

DIODES & SCRS.

Pak No	Qty	Description	Price
VP29	30	Assorted volt Zeners. 50mw-2w	£1.00
VP30	10	Assorted volt Zeners. 10w, coded	£1.00
VP31	10	5A SCR's TO66, 50-400v, coded	£1.00
VP32	20	3A SCR's TO66, up to 400v, uncoded	£1.00
VP33	100	Sil. Diodes like IN4148	£1.00
VP34	200	Sil. Diodes like OA200/BAX13-16, 40v 200mA	£1.00
VP35	50	1A IN4000 Diodes, all good, uncoded, 50v min	£1.00
VP49	30	Assorted Sil. Rectifiers 1A-10A, mixed volt	£1.00
VP141	40	IN4002 Sil. Rectifiers, 1A 100v, preformed pitch	£1.00
VP142	4	40A Power Rectifiers, silicon, TO48 300 PIV	£1.00
VP143	5	BY187 12KV Sil. Diodes, in carriers, 2.5MA	£1.00
VP184	3	4A 400v Triacs, plastic	£1.00
VP187	10	SCR's 800MA, 200v, 2N5064, plastic, TO92	£1.00
VP194	50	OA91 point contact, germanium Diodes, uncoded	£1.00
VP195	50	OA47 gold bonded germanium Diodes, uncoded	£1.00
VP196	50	OA70-79 detector germanium Diodes	£1.00
VP197	50	OA90 type germanium Diodes, uncoded	£1.00
VP198	40	BA248 Sil. Diodes, 350v 2A, fast recovery	£1.00
VP222	20	3A Stud Rectifiers, 50-400v, assorted	£1.00
VP274	12	SCR's (Thyristors) 1A 100-400v, TO-39	£1.00
VP275	3	5A 400v SCR's, TO220, TIC106D	£1.00
VP276	5	SCR's standard type, 5-16Amp to 400v	£1.00
VP277	4	Triacs 2Amp 400v TO-39	£1.00
VP278	4	6Amp 1000v plastic Silicon Rectifiers	£1.00
VP283	5	Diac BR100, triac trigger	£1.00

TRANSISTORS

VP38	100	Sil. Transistors, NPN plastic, coded, with data	£3.00
VP38	100	Sil. Transistors, PNP plastic, coded, with data	£3.00
VP47	10	Sil. Power Transistors, similar 2N3055, uncoded	£1.00
VP48	5	Pairs NPN/PNP plastic Power Transistors, 4A, data	£1.00
VP50	80	NPN Sil. Switching Transistors, TO-18 and TO-92	£1.00
VP51	80	PNP Sil. Switching Transistors, TO-18 and TO-92	£1.00
VP60	100	Asst shorts Transistors, NPN/PNP	£1.00
VP150	20	BC183B Sil. Transistors, NPN 30v 200mA Hfe240+ TO92	£1.00
VP151	25	BC171B Sil. Transistors, NPN 45v 100mA Hfe240+ TO92	£1.00
VP152	15	TIS90 Sil. Transistors, NPN 40v 400mA Hfe100+ TO92	£1.00
VP153	15	TIS91 Sil. Transistors, PNP 40v 400mA Hfe100+ TO92	£1.00
VP154	15	MPSA56 Sil. Transistors, PNP 80v 800mA Hfe50+ TO92	£1.00
VP155	20	BF595 Sil. Transistors, NPN eqvt BF184 H.F. TO92	£1.00
VP156	20	BF495 Sil. Transistors, NPN eqvt BF173 H.F. TO92	£1.00
VP157	15	ZTX500 series Sil. Transistors, PNP plastic	£1.00
VP158	15	ZTX107 Sil. Transistors, NPN eqvt BC107 plastic	£1.00
VP159	15	ZTX108 Sil. Transistors, NPN eqvt BC108 plastic	£1.00
VP161	25	BC183L Sil. Transistors, NPN 30v 200mA TO92	£1.00
VP162	5	SJE5451 Sil. Power Transistors, NPN 80v 4A Hfe20+	£1.00
VP163	2	NPN/PNP pairs, Sil. Power Transistors, like SJE5451	£1.00
VP164	4	2N6289 Sil. Power Transistors, NPN 40v 40w 7A Hfe30+	£1.00
VP165	6	BFT33 NPN Sil. Transistors, 80v 5A Hfe50-200 TO39	£1.00
VP166	5	BFT34 NPN Sil. Transistors, 100v 5A Hfe50-200 TO39	£1.00
VP187	1	BUY69C NPN Transistors, TO3 VCB 500, 10A, 100w, Hfe15+	£1.00
VP188	10	BC478 eqvt BCY71 PNP Sil. Transistors. TO18	£1.00
VP169	10	BXS21 eqvt BC394 NPN Sil. Transistors, 80v 50mA TO18	£1.00
VP170	10	Assorted Power Transistors, NPN/PNP coded and data	£1.00
VP171	10	BF255 NPN TO-39 Sil. Transistors, eqvt BF258 225v 100mA	£1.00

LC.S.

Pak No	Qty	Description	Price
VP7462	4	7492 Divide by 12 Counter	£1.00
VP7483	4	7493 4-bit Binary Counter	£1.00
VP7494	4	7494 4-bit Shift Register	£1.00
VP7495	4	7495 4-bit Shift Register	£1.00
VP74111	4	74111 Dual J-K Master Slave, Flip-Flop	£1.00
VP74141	4	74141 BCD-Decimal Decoder/Driver	£1.00
VP74151	4	74151 1 of 8 Data Selectors/Multiplexers	£1.00
VP74153	4	74153 Dual 4 line to 1 line Data Selectors/Multiplexers	£1.00
VP74164	4	74164 8-bit Parallel Output Serial Shift Registers	£1.00
VP74167	4	74167 Synchronous Decade Rate Multipliers	£1.00
VP74174	4	74174 Hex D type Flip-Flops	£1.00
VP74181	4	74181 Arithmetic Logic Units/Function Generators	£1.00
VP74193	4	74193 Synchronous Up/Down Dual Clock Counters. Binary clear	£1.00
VP74279	4	74279 Quad S-R Latches	£1.00
BPX6	1	TTL Data Book 74 series, including "LS". Complete with Pin out diagrams. 7400-74670. TTI interchangeability guide. Function selection guide and explanation of function tables. "NO VAT"	£1.00
BPX5	1	IC555 PROJECTS BOOK (TIMER). 167 pages. Over 50 project circuits to build and other information on IC555 Timers. Plus FREE with our compliments, 3 x IC 555 Timer, worth 80p. **Special offer price just £2.95. "NO VAT"**	
BPX4	1	INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE, Babani Publishing's latest edition BP85, plus FREE with our compliments, 10 popular Silicon Transistors, worth £1.00. **Special offer price just £3.50. "NO VAT"**	

MISC.

VP17	50	Metres PVC single strand Wire, mixed colours	£1.00
VP18	30	Metres PVC multi strand Wire, mixed colours	£1.00
VP19	40	Metres PVC single/Multi strand Wire, mixed colours	£1.00
VP22	200	Sq. inches total Copper Clad Board	£1.00
VP23	10	40mm Track Slider Pots. 100K Lin	£1.00
VP42	10	Black Heatsinks, fit TO3 and TO220, drilled	£1.00
VP43	4	Power-fin Heatsinks, 2 x TO3, 2 x TO66	£1.00
VP44	15	Assorted Heatsinks, TO1/3/5/18/220	£1.00
VP56	100	Semiconductors from around the world, mixed	£1.00
VP82	1	Electronic Buzzer, 3v, 25MA	£0.95
VP83	1	Electronic Buzzer, 6v, 25MA	£0.95
VP84	1	Electronic Buzzer, 9v, 25MA	£0.95
VP85	1	Electronic Buzzer, 12v, 25MA	£0.95
VP86	1	TECASBDTY Components Pack, semiconductors, caps, wire, etc	£1.00
VP87	1	Telephone Pick-up Coil with 3.5mm jack plug	£1.25
VP88	1	Pillow Speaker with 3.5mm jack plug	£1.45
VP107	1	Piezo Buzzer, miniature, 12v	£1.25
VP108	1	Piezo Buzzer, miniature, 240v	£1.25
VP113	1	Coax Antenna Switch, 2 way	£4.50
VP114	1	Coax Antenna Switch, 3 way	£4.75
VP115	1	High Pass Filter/Suppressor, CB/TV	£0.50
VP116	1	Low Pass Filter, VHS/TV bsnd	£3.00
VP122	1	Precision Morse Key, fully adjustable	£1.85
VP144	4	100K Lin multi turn Pots, ideal van. cap. tuning	£1.00
VP145	10	Assorted Pots, inc dual and switched types	£1.00
VP148	30	Presets, horizontal and vertical, mixed values	£1.00
VP174	5	DIL Switches, 1 and 2 way slide, 6 way SPST, assorted	£1.00
VP176	30	Fuses, 20mm and 1¼" glass, assorted values	£1.00

TOOLS.

Pak No	Qty	Description	Price
VP410	1	18 Pc Hex Wrench Keys. AF sizes in wallet	£1.50
VP411	1	16 Pc Hex Key Wrench Set. SAE and Metric	£2.00
VP412	1	Crimping Pliers, Wire Strippers & Bolt Cutters	£1.00
VP413	2	IC Extraction Tools, jaw width 18 and 29mm	£2.00
VP414	1	End Action Stripping Pliers. Adjustable jaws	£1.00
VP415	1	5" Grip Locking Pliers	£3.00
VP416	1	6" Long Nose Grip Locking Pliers	£3.00
VP417	1	6" Adjustable Wrench. Forged alloy steel	£2.50
VP418	1	8" Tin Snips. Hardened steel, spring joint	£2.00
VP419	2	"Chubby" Screwdrivers. Crosspoint No 1 and 2	£1.50
VP420	2	"Chubby" Screwdrivers. Flat blade 4.5 and 6mm	£1.50
VP421	1	Screwdriver 400mm long, 6mm flat blade	£3.00
VP422	1	Screwdriver 400mm long, No 2 crosspoint	£3.00
VP423	1	Vernier Caliper-Crosahorns. Depth gauge. Vernier Cap. 4½"/110mm reading 1/128", 1/10mm	£2.50
VP424	1	Helping Hand with Magnifier	£4.50
VP425	1	7 Pc high quality Screwdriver Set	£8.50
VP426	1	7 Pc high quality Screwdriver Set 1000v	£12.50
VP427	1	6 Pc Cushion Grip Screwdriver Set	£4.00

LEADS.

VP300	1	10m Speakar Lead 2 pin DIN Plug to 2 pin DIN Skt	£1.00
VP301	1	2m Video Lead Coaxial Skt to Coaxial Skt + 2 adaptors	£1.20
VP302	1	3m 4 core cable indv. screned 5 pin DIN Plug-5 pin DIN Plug	£1.80
VP303	1	TV Ext. Lead. Coax plug to Coax Plug. White	£1.00
VP304	1	1.5m 4 core indv. screen. 5 pin DIN Plug-tinned open end	£1.00
VP305	1	1.5m cable 5 pin DIN Plug-3.5mm Jack Plug. Pin 1 & 4 connect	£1.00
VP306	1	2m Typewriter/Calculator Lead. 3 pin Plug, angled European IEC configuration. 6A 250vAC	£2.00
VP307	1	80cm Patch Lead. PL259 Plug to PL259 Plug	£1.00
VP308	1	1.2m Patch Lead. PL259 Plug to PL259 Plug	£1.50
VP309	1	1.2m Lead 4 Phono Plugs to 4 Phono Plugs	£1.50
VP310	1	20cm Lead 2 x 2 pin DIN Plug to Stereo Inline Jack Skt	£1.00
VP311	1	2m Lead Scart Plug to 5 pin DIN Plug & 2 BNC Plugs	£6.00
VP312	1	1.2m Video Lead. BNC Plug to Phono Plug	£1.50
VP313	1	3m Headphone Lead. 3.5mm Jack Plug to 3.5mm Jack Skt	£1.00
VP314	1	2m Coax Lead BNC Plug to BNC Plug. 75 ohms	£3.00
VP315	1	2m Coax Lead BNC Plug to UHF Plug. 75 ohms	£3.00

TELEPHONE ACCESSORIES.

VP316	1	5m Telephone Ext. Lead. Plug to Socket	£4.50
VP317	1	10m Telephone Ext. Lead. Plug to Socket	£6.00
VP318	1	3m Line Jack Cord. BT 4 way Plug to 4 Spade Terminals	£1.75
VP319	1	Double Adaptor. One IDC plug, 2 socket	£3.50
VP320	1	IDC Telephone Plug 4 way	£0.50
VP321	1	Telephone Master Socket Surface Box. Screw terminals	£3.50
VP322	1	Telephone Slave Socket Surface Box. Screw terminals	£2.25

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BI-PACK price per 100 pieces R100 £1.00 per pk. R200 £1.30 per pk.

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Neg. 1 Amp 7905-12-15-18-24	40p each
Pos. 100mA 78L05-12-15-18-24	28p each
Neg. 100mA 79L05-12-15-18-24	30p each

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The PW "Orwell" Medium Wave Receiver

Part 2 by Raymond Haigh

Construction

The three sections of the receiver are assembled on separate printed circuit boards. This gives maximum scope for varying the layout of the receiver, and enables the constructor to use the tuner section, and/or the amplifier, as stand-alone units. The supply decoupling capacitors (C8 and C14) are duplicated to facilitate this. Even without the additional r.f. amplifier, the tuner section still forms a selective and sensitive receiver.

Full details of the printed circuit boards and component placement are given in Figs. 2.1 to 2.3. Wherever possible, the copper lands have been made large enough to accommodate the usual slight variations in component size. Despite the receiver's high sensitivity, with the component layout shown there is absolutely no tendency to instability.

The tuner and amplifier i.c.s are mounted in holders in the prototype. This makes the substitution and testing of these devices an easy process. Veropins are inserted at lead-out points and for the transistors. This aids inter-board wiring and the removal, testing and replacement of the transistors.

With the exception of the antenna leads, and the connections to the tuning capacitor which must be kept as short and direct as possible, all lead-outs from the printed circuit boards carry d.c. or audio frequencies. There is, therefore, considerable flexibility in the design of the front panel layout.

Alignment and Setting Up

The receiver should be aligned and tested before being installed in a case. First, check all soldered connections and ensure that adjacent copper tracks are not shorted together, and that the transistors and i.c.s. have been correctly inserted.

Set R17 to minimum resistance, R29 and C12 at half travel, and turn a.f. gain control, R28, to maximum. Connect the speaker, the signal strength meter and 9 and 12 volt batteries. Do not connect the r.f. board into circuit at this stage. Instead, connect a short (approximately 6 metre) wire antenna to pin 6 of the h.f. transformer, T2.

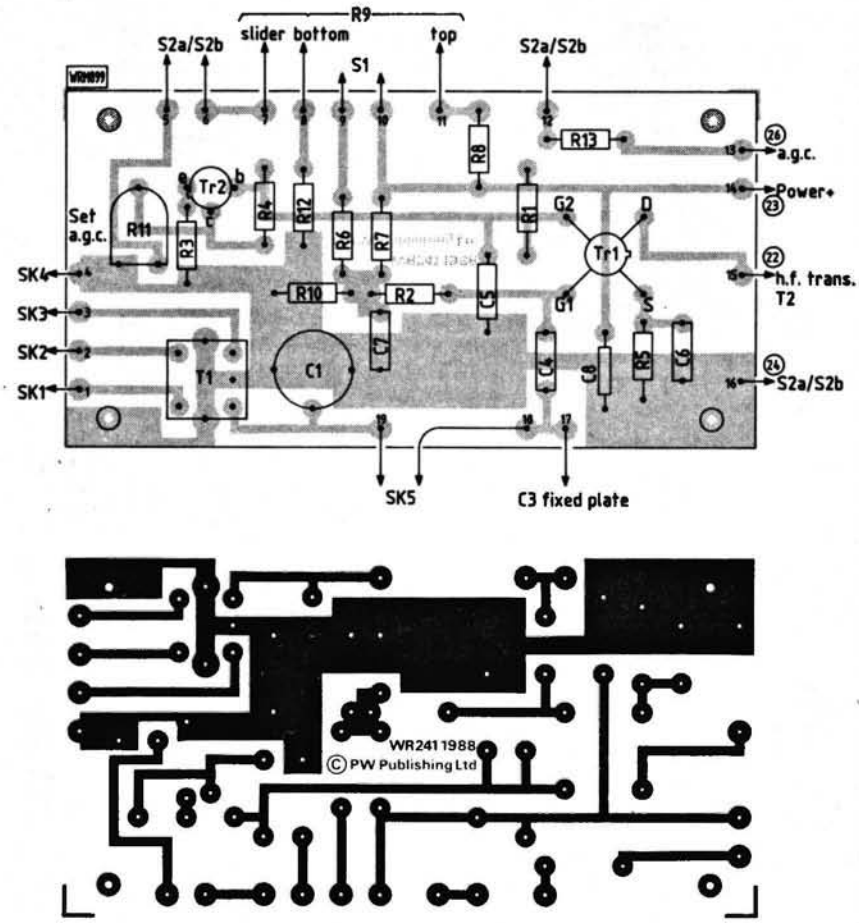


Fig. 2.1: Single-sided track pattern (shown full size) and component overlay of r.f. stage p.c.b.

Rotate the tuning capacitor spindle. Some signals should be received. Select one, and adjust the cores of X1 for highest signal strength meter reading, using R17 to reduce meter sensitivity as necessary. Only a slight, but critical, adjustment of these cores should be required. Next, set the core of i.f. coil, L2. This adjustment is fairly broad and not so sharply defined. Adjust C9 for maximum signal strength meter reading.

It should now be possible to receive stations "around the dial". Select a steady transmission at the h.f. end of the band (i.e., with the tuning capacitor vanes almost open) and adjust C9 and C12 for strongest reception, keeping them at the lowest capacity setting consistent with proper alignment in order to extend h.f. coverage.

Select a steady transmission with the tuning capacitor vanes as fully meshed as possible, and adjust the cores of h.f. transformer T2, and oscillator coil, T3, for optimum results. Adjustment of T3 has a marked effect on tuning, and the ganged variable capacitor will have to be rocked gently back and forth in order to "hunt" for the signal while this core is being carefully rotated. It should not be driven down more than about two turns or the h.f. coverage of the receiver will be curtailed.

The process of adjusting trimmers C9 and C12 with the receiver tuned to the h.f. end of the band, and adjusting the cores of T2 and T3 at an l.f. setting, should be repeated until no further improvement can be obtained. The ceramic element in the i.f. filter unit pre-determines the intermediate frequency, and the signal strength meter gives a clear indication of optimum

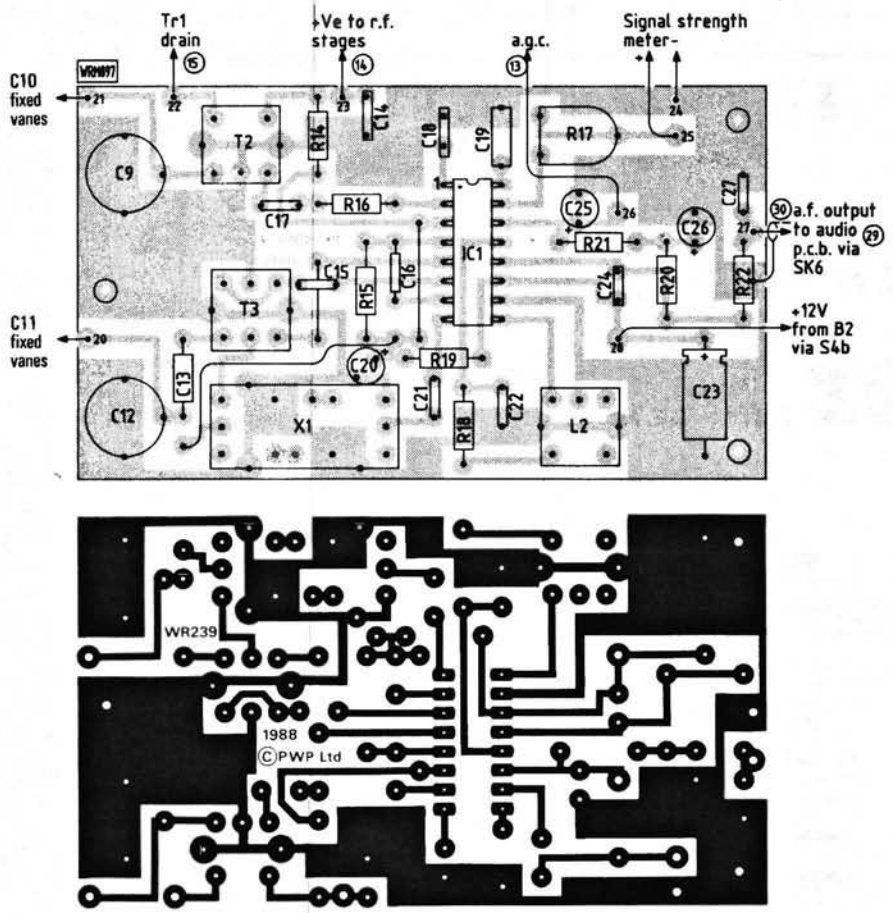


Fig. 2.2: Single-sided track pattern (shown full size) and component overlay of h.f., i.f. and detector p.c.b.

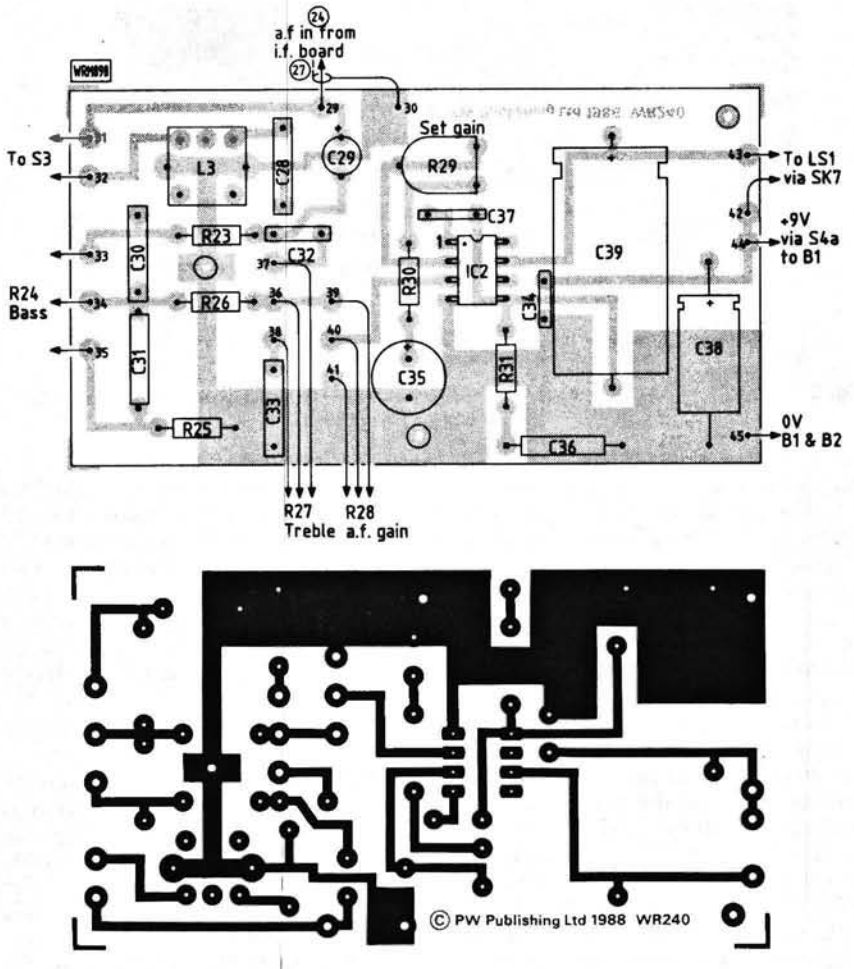


Fig. 2.3: Single-sided track pattern (shown full size) and component overlay of a.f. amplifier p.c.b.

adjustment. The alignment procedure is, therefore, easier to carry out than describe.

Disconnect the batteries and the antenna, and connect the r.f. amplifier board into circuit. Set R11 at half travel, switch r.f. gain to "high". and switch the a.g.c. on. Connect the antenna to SK3, reconnect the batteries, then adjust C1 for maximum reading with the receiver tuned to a signal at the h.f. end of the band, and T1 with the set tuned to a l.f. station. Check the high/low r.f. gain switch and, with a.g.c. off, the operation of the manual r.f. gain control. Note that the signal strength meter drops to zero when the a.g.c. line is shorted out.

A sensitive test meter (50kΩ per volt or better) is required for the precise adjustment of R11. However, whilst developing the design, more than ten random samples of BC107 were tried, and optimum a.g.c. performance was always obtained with R11 at, or about, the half-way setting. Moving the slider of R11 too far away from the earth end of the potentiometer needlessly reduces the gain of Tr1, while a setting too close to the earth end inhibits a.g.c. action.

If a suitable voltmeter is available, set S1 to "high gain" and check that the voltage at the junction of R7 and R10 is of the order of 1 volt. Then connect the meter between gate 2 of Tr1 and earth, remove the antenna to ensure zero signal, and set R11 so that the voltage on gate 2 is about 2.7 volts. Tune to a very strong signal, and the gate 2 potential should have fallen to between 0.5 and 1 volt. The above readings assume a fresh 12 volt battery pack.

Ferrite Rod Antenna

Inductor L1 consist of 65 turns of 26 s.w.g. enamelled copper wire, wound on a 10mm diameter rolled paper former; this should be a sliding fit on the 9.5mm dia × 140mm F14 grade ferrite rod. Note that the outer shank and innermost tip of the stereo jack plug (PL1) are used, to minimise the effects of intercontact capacitance. If this precaution is not observed the h.f. coverage of the receiver will be curtailed.

The housing for the prototype antenna, as shown in Fig. 2.4 was constructed from 3-ply and softwood battening, the whole assembly being filled and smoothed before painting, to give it a commerical look. If this proves too much for your woodworking skills, then you could try building the ferrite antenna assembly into a length of plastics mini trunking, which is available from most hardware stores.

Once the antenna has been constructed, plug it into SK5 and adjust the internal trimmer C2 on a signal at the h.f. end of the band, and the position of the coil on the rod, on a signal at the l.f. end of the band. If the trimmer has to be fully open for best performance, trimmers C1, C9 and

C12 will have to be adjusted again so that alignment can be optimised with the ferrite antenna in circuit. These final adjustments are best carried out after the receiver has been installed in a case.

The arrangement described permits instant comparison of ferrite rod and long wire antenna performance, and the ability to rotate the ferrite rod is useful for nulling out interference.

Casing Up the Receiver

If the receiver is to be used for DX reception with the loop or ferrite antenna, it should be completely screened in order to prevent signals being picked up by the internal wiring. Sensitivity is high enough for antenna terminals projecting outside a metal case to pick up strong signals. If complete immunity to unwanted pick-up is required, antenna inputs must, therefore, be via coaxial sockets.

A suitable metal case can be fabricated by the constructor or purchased ready made, but remember that mechanical rigidity is important, particularly if the receiver is to be accurately calibrated.

Remember the loudspeaker speech coil is connected to battery positive, therefore, if the speaker is to be included within the metal receiver enclosure, it would be prudent to isolate its frame from the case metalwork. This precaution will, in the unlikely event of speaker becoming defective, prevent the 9 volt power rail from being shorted.

A reduction drive makes accurate fine tuning much easier. In the prototype, a Jackson type 4113 epicyclic cord drive was used to turn a 50mm diameter drum. Due to the complexity of this system constructors might like to take a slightly easier, but more expensive route, by using a Jackson 6/36 dial drive, type No 4103/A. This unit although being more expensive, contains a slow-motion drive in addition to a complete scale and cursor assembly.

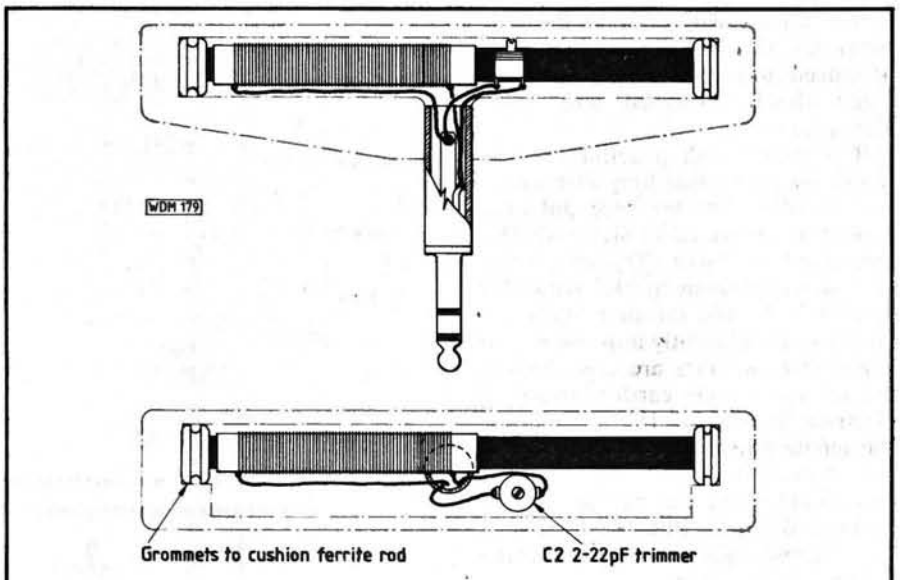


Fig. 2.4: Physical construction diagram of ferrite antenna assembly

The prototype receiver, as shown in the photographs, is housed in a decorative plywood outer case measuring 190 × 280 × 180mm, which in turn provides rigidity to an inner 20 s.w.g. aluminium screening box measuring approximately 90 × 165 × 175mm. A white card dial is fixed to the front panel and protected by a framed glass cover, which extends over the clear plastics bezel of the signal strength meter. The frame is made from "hockey stick" beading with car body filler used to round the corners. An aerosol of matt-black cellulose is used to finish the dial cover frame and the front panel, and switch functions are marked with white rub down lettering. All other exposed plywood is stained and French polished.

Final Setting Up and Calibration

When the receiver has been mounted in its case, any final slight adjustments should be made to the trimmer capacitors, coil cores and the ferrite antenna coil. Adjust R17 to set the signal strength meter range, and R29 to set the gain of the audio amplifier.

Turn up the treble control and tune the receiver across the band until a high-pitched whistle is heard, then switch in the 9kHz filter and adjust the core of L3 until the whistle disappears. This adjustment is best carried out after dark when heterodynes are more common, and whilst listening with earphones: phones generally have a more extended frequency response than low-cost speakers.

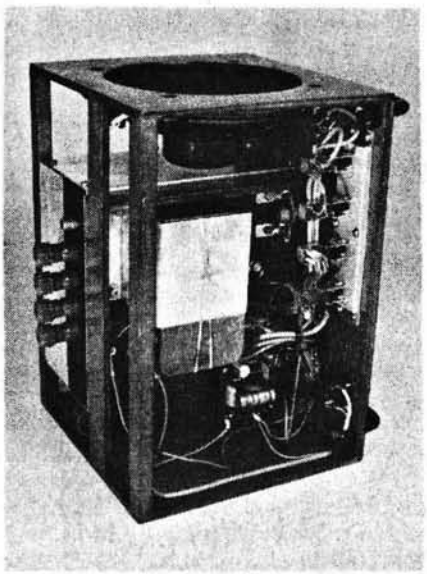
If the receiver is to be used for serious listening, an accurately calibrated dial is essential. A crystal oscillator with i.c. dividers giving spot frequencies of 10, 25, 50, 100 and 1000kHz was used to calibrate the prototype. A suitable design of crystal calibrator can be found on page 35 of the January 1986 issue of *PW*. The dial can, however, be calibrated against transmissions of known frequency if equipment of this kind is not available.

Operating the Receiver

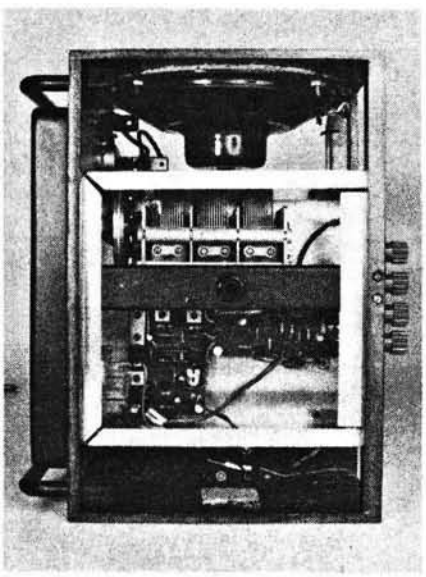
The receiver will be found to be sensitive, selective and refreshingly free from spurious responses. Broadcasts degraded by, or even submerged under, the receiver noise level of domestic portables are clearly audible; and stations overlaid by sideband splatter can be clarified by turning the bass and treble controls to minimum setting.

Audio quality is good and receiver output more than adequate, but keep volume levels low, or use 'phones, when the bass control is turned up, or the low frequencies will overload the amplifier.

It sometimes helps to switch out the a.g.c. circuit and use the manual gain control when trying to receive weak signals, especially if there is interference from powerful transmissions. With the a.g.c. switched out, very



Upper internal view of receiver



Lower internal view of receiver

strong signals will saturate the a.m. tuner i.c. if the r.f. gain control is advanced too far. Output then becomes badly distorted and drops almost to zero.

Best results will generally be obtained by connecting long wire antennas to SK3. Shorter wire antennas should be connected to SK1 with SK2 connected to earth. Try connecting very short antennas to SK1 with SK2 and SK3 shorted together. An earth connection will greatly improve results when wire antennas are used, SK4 is the receiver's main earth terminal. If electrical interference is a problem, use the ferrite antenna. Signal pick up is less than with a long wire, but its directional properties can be used to null-out the offending noise. Serious DX listening calls for the loop antenna as mentioned earlier.

The receiver is tolerant of falling power supply voltages, and feeble signal strength meter operation is an indication of seriously run-down tuner section batteries.

Appendix: Alternative Tuning Techniques

The ganged air-spaced tuning capacitors C3, C10 and C11, can be replaced by Varicap diodes. The alternative circuit is given in Fig. 2.5, where D1, D2 and D3 are diodes from a KV1235 triple, snap-apart package. Reverse tuning bias is applied via resistors R32, R33 and R34, and d.c. blocking capacitors C40, C41 and C42 prevent it being shorted to earth via the tuned circuit inductors.

Potentiometer R35 controls the amount of reverse bias, thereby acting as the receiver tuning control. Resistor R36 and Zener diode D4 produce a stabilised 9 volt supply for the bias network.

The manufacturers specify that the diodes are matched to within 1.5 percent, present a circuit capacitance of 450pF at 2 volts reducing to 30pF at 8.5 volts reverse bias, and have a *Q* of 200. This alternative arrangement certainly represents an acceptable substitute for the traditional variable capacitor. The somewhat higher minimum capacitance does, however, limit the h.f. coverage to 1.6MHz, and this can only be achieved by opening out trimmers C1, C10 and C12 as much as possible.

The printed circuit board for the alternative Varicap diode tuning is also shown in Fig. 2.5. This board has similar plan dimensions and lead-out points to the specified variable capacitor. It is important to earth this board only via the fixing screw in the hole adjacent to D2. Failure to observe this precaution may result in instability. **PW**

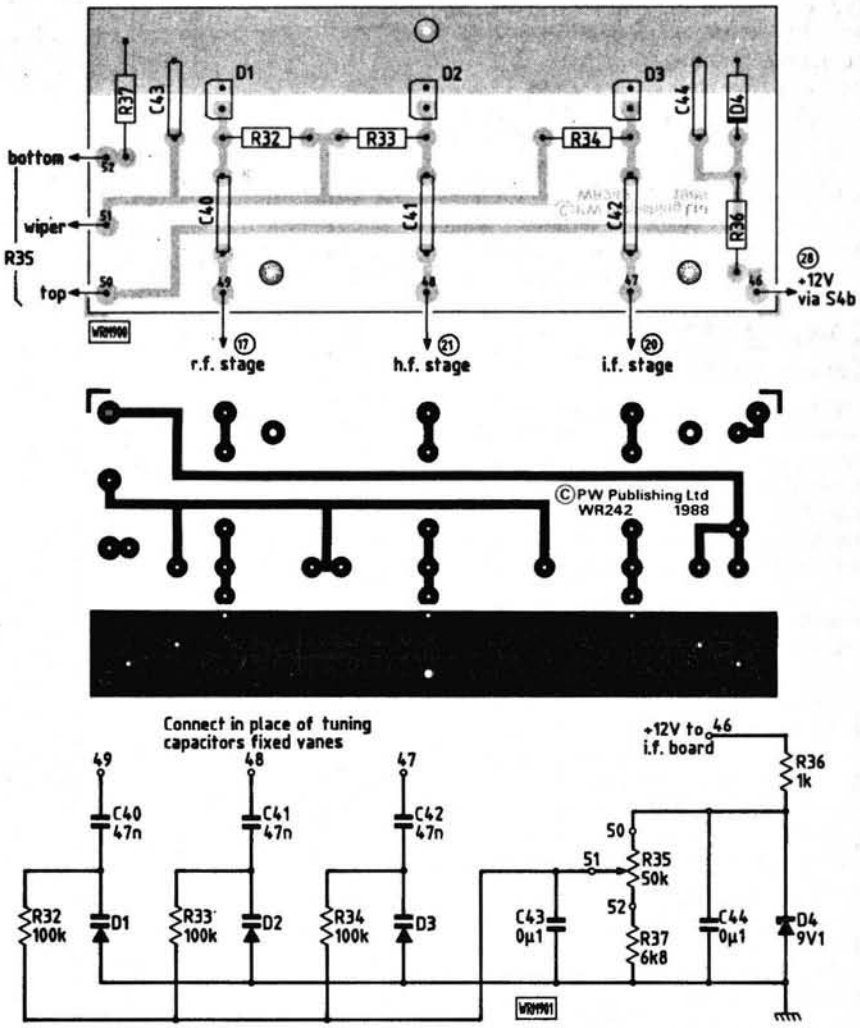


Fig. 2.5: Circuit diagram and single-sided track pattern (shown full size) and component overlay of varicap tuning p.c.b.

SHOPPING LIST

Resistors

0.5W 5% Carbon film

1kΩ	1	R36
6.8kΩ	1	R37
100kΩ	3	R32, 33, 34

Potentiometer

50kΩ lin	1	R35

Capacitors

Disc ceramic

47nF	3	C40, 41, 42
0.1µF	2	C43, 44

Semiconductors

Diodes

BZY88C9V1	1	D4
KV1235	1	D1, 2, 3[1]

Miscellaneous

Printed circuit board, Veropins, hook-up wire.

[1] See Part 1

Author's well crafted version of the "Orwell"

Feature

Every magazine's style and appearance is governed by a set of rules, peculiar to that magazine, and called its "House Style". These rules are based on other rules and standards, both national and international, which for a radio or electronics magazine such as ours, include British Standards, the SI System of Units, etc.

When the decisions was made some years ago that the UK was to "go Metric", Practical Wireless went along with the change. To ease people as gently as possible into the new measurements, PW had a transitional period of several years during which both Metric and Imperial measurements were given. Nowadays, only Metric measurements are quoted, except when talking about something where Imperial measurements are still the norm. For example, standard Veroboard is punched with a pattern of holes spaced at 0.1in intervals, and is still known as "0.1 inch" Veroboard, rather than "2.54mm".

Whilst preparing an article for publication, we check that all measurements are given in Metric units, converting any that the author has put in Imperial, though we realise that quite a few readers still "think Imperial", and even blame our authors for using these new-fangled units, when it may not be their fault, but ours! One such author is Chas. E. Miller, who was moved to pen the following for our amusement!

Something's A-304.8mm . . .

OR Sex1015.873kg and the Missing Formula

One May morning, Sex1015.873kg Blake was at ease in his favourite armchair when he heard heavy and urgent 30.48cm-steps on the stairs. A moment later someone 453.6g-ed on the door.

"Blake, are you there?" cried a familiar voice. Blake recognised it at once as belonging to 1609.344m's of New Scotland 91.44cm. He sprang to his 30.48cm's and flung open the door.

"Come in, old friend!" he cried. "How can I help you?"

1609.344m's 5.0292m-ed himself on the edge of Blake's desk. "A most serious matter," said he in grave tones. "Some scoundrel has stolen the British Standard 91.44cm from Trafalgar Square!"

Blake's face hardened, as if turned to 6.3504kg. "Great Scott!" he exclaimed. "That can only mean . . !"

"Exactly!" 1609.344m's broke in with a groan. "Moriarty the Mad Metricator has struck again! You realise that until he is brought to book none of us is safe from his machinations! Blake, you must assist the 91.44cm with every 28.35g of your strength, or Britain as we know it today is surely doomed!"

Blake bared his teeth in a mirthless smile. "Fear not!" he said quietly. "I shall find Moriarty, and when I do I will show him no 12.7008kg. It shall be his life or mine!"

Blake called for his faithful assistant. "Tinker, there's not a moment to lose. The game's a-0.3048ml"

Events moved swiftly. Blake's investigations took him to an office in Long 0.405hectare, where Moriarty, under an alias, ran a seedy publishing business. The door of the building was locked, and refused to budge an 25.4mm. Blake ran to the rear, where there was a folding fire escape. He pulled on a rusty 20.1168m and the escape dropped to his 0.3048m's. He ran up it and clambered into Moriarty's private office. The arch-criminal was standing with his back to the window, holding a length of metal that Blake recognised immediately as the missing British Standard 0.9144m.

Moriarty spun round as he heard Blake's 0.3048's hit the floor. "Sex1015.873kg Blake!" he hissed. "Come in! You are just about to witness a 1.609km6.35kg in the annals of crime! I am about to melt the British Standard 0.9144m down into scrap metal! The last bastion of Imperialism shall be destroyed!"

"You swine!" Blake burst out. "Stay your hand, or you shall answer to me!"

Moriarty laughed evilly. "Don't you know I always pack a 5.0292m?" he asked, producing a 0.09576m automatic. He motioned Blake to a chair, and within seconds the detective was bound hand and 0.3048m. "And now I leave you — forever!"

"You are only making a 5.0292m for your own back by this villainy," gritted Blake between clenched jaws. "I will track you down, even if you travel to the North 5.0292ml"

Moriarty laughed again. "You fool. Had you a 0.065g of sense you would realise that you shall never leave here alive! Beneath your chair is a 568ml beer mug packed with a lethal mixture of baked beans and senna pods, connected electrically to that clock on the wall. When the hands reach noon you shall be blown to the wind! Keep watching that clock, Blake. It's very accurate, for it's controlled by 1.136l-z. You have precisely eleven minutes to doom!" So saying, he fled from the room, the Standard 0.9144m clasped to his arms . . .

Will Sex1015.873kg Blake escape? Will he prevent Moriarty from destroying the standard 0.9144m and save Britain from the Mad Metricator? Will there be another thrilling instalment?

Did you understand the story? If so, send in your translation to "Metrication", Practical Wireless, Enefco House, The Quay, Poole, Dorset BH15 1PP, to arrive not later than February 29. All correct entries will go into a box, from which one will be selected at random on March 1 by Geoff Arnold G3GSR. The lucky winner will receive a PW £10 Gift Voucher, which can be used towards any purchase from our Book or PCB Services, or on PW Subscriptions or Binders. No correspondence will be entered into, and the Editor's decision is final.

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A New Future for Four Metres

David A. Dodds MA(Hons) G4WLL, takes a look at 70MHz in the light of recent licence changes

The recent rise in popularity and addition to the licence schedule of the 50MHz band (6m) has called attention to one of the older, but less used, v.h.f. bands: 70MHz (4m). Traditionally, four has always been a quiet band, but when experimental 50MHz permits were first issued many 70MHz enthusiasts were attracted to the new allocation, leaving 70MHz somewhat neglected. However, now that both bands are available to Class B licence-holders the future of 70MHz seems assured, due partially to the attention attracted to the lower v.h.f. spectrum and the influx of 50MHz equipment which is easily modified for four.

History

The 70MHz allocation was first made in 1956, at a time when a great deal of attention was being paid to the low v.h.f. spectrum. Amateurs in the USA and Canada already had a 50MHz allocation; in France and the Soviet Union they were permitted to operate between 72 and 72.8MHz and elsewhere the five metre band (56–60MHz) was still in existence.

From the start 70MHz was a secondary allocation, with the army as the primary users. Although today it is little used by them, it is still possible to hear signals emanating from TA weekend exercises. Popular rumour has it that amateurs were only ever permitted to use the band because it was then used for the c.w. training of army radio operators and it was thought that the signals emanating from amateurs would cause QRM and thus increase the value of the training. This would explain the fact that for thirty years the band was a Class A only allocation, despite a 1979 ITU ruling that Class B licence-holders should be permitted to use all allocations above 30MHz. This year has finally seen the end of this anomaly and the issue of both six and 70MHz to Class B licensees, which has been received by the old hands on the band with mixed feelings. However, one thing is certain: activity on this under-used band is now likely to increase.

The lack of other countries with a 70MHz allocation has always been a reason for the band's relatively low number of adherents. Apart from the UK and Eire the only countries with a regular 70MHz allocation are Gibraltar, Cyprus Crown Territory (where there is a beacon but nobody with equipment) and Iceland (where there is presently no activity at all). In addition, an expedition to Andorra in 1968 were permitted to use 70MHz and worked a number of English and Irish stations via Sporadic E. Due to the lower frequency, four metres is considerably more prone to Es openings than two metres and it is often possible to hear East European f.m. broadcasting stations, such as that at Gdansk, on 70.310MHz. Most summers ZB2 is worked via the same mode. There are also quite a number of continental amateurs equipped with receive converters and antennas who are willing to try crossband tropospheric and meteor scatter skeds.

Equipment

At the one time almost all equipment for four was home-built. But although it always has been something of a constructors' band there are now a number of manufacturers who supply equipment ready-built, or in kit form.

Microwave Modules have for some time produced a pair of 10W transverters for 70MHz, one with a two metre i.f., the other for use with a ten metre transceiver. There are quite a number of people using these on the air with IC-202s and FT-290s, or with h.f. rigs. Until recently they also produced a 100W linear amplifier. Unfortunately that was discontinued, but BNOS have displayed their faith in the future of the band by bringing out a new 100W linear this year. It is capable of producing full output with 500mW–15W input and has an in-built preamplifier.

Lowe Electronics recently imported a number of Mizuho MX4 s.s.b/c.w. hand-helds. Although these are actually modified 50MHz transceivers with a power output of only 200mW they have, like the two metre version, the MX2, an extremely sensitive receiver and a fairly clean signal.

For those who are willing to make use of kits, Spectrum Communications market a range of 70MHz converters, transverters and preamplifiers which are available in kit or ready-built form. Similarly, Cirkit make 70MHz preamplifier and converter kits and they have just introduced a transverter kit as a spin-off from their new 50MHz transverter. Wood and Douglas have long claimed to be able to supply any of their wide range of two metre kits for four.

On the antenna front Jaybeam still make their 4-element Yagi which has formed part of many 70MHz stations for several decades. MET have begun marketing three and five element Yagis for the band. For those who are interested in both six and four, Sandpiper make an excellent range of dual-band antennas.

The Future

Despite the fears of some amateurs there is now plenty of hope for the future of 70MHz. Many of the band's most ardent proponents are holders of late G0 or late G4 callsigns, suggesting that it is not true that it is an "old-timers' band". Now, of course, Class B licence-holders are starting to be heard on the band and activity is increasing.

In some areas private nets using modified PMR rigs on a.m. or f.m. have sprung up. This is an excellent way of providing a means of communication between friends without much risk of QRM and without tying up the main rig. It is usually possible to get a second-hand Pye Westminster or Cambridge crystalled up and modified for 70MHz for less than £20, making it a viable proposition for RAYNET groups, several of which already use 70MHz in this way.

For many years one thing which has helped to ensure activity on four is the regularity of RSGB 70MHz contests. For those who have only ever tried contests on two metres or h.f. a 70MHz contest can be a breath of fresh air. They tend to start later, finish earlier and be considerably more polite. What is more the QTH element in the exchange, which was removed from two metre contests three years ago still

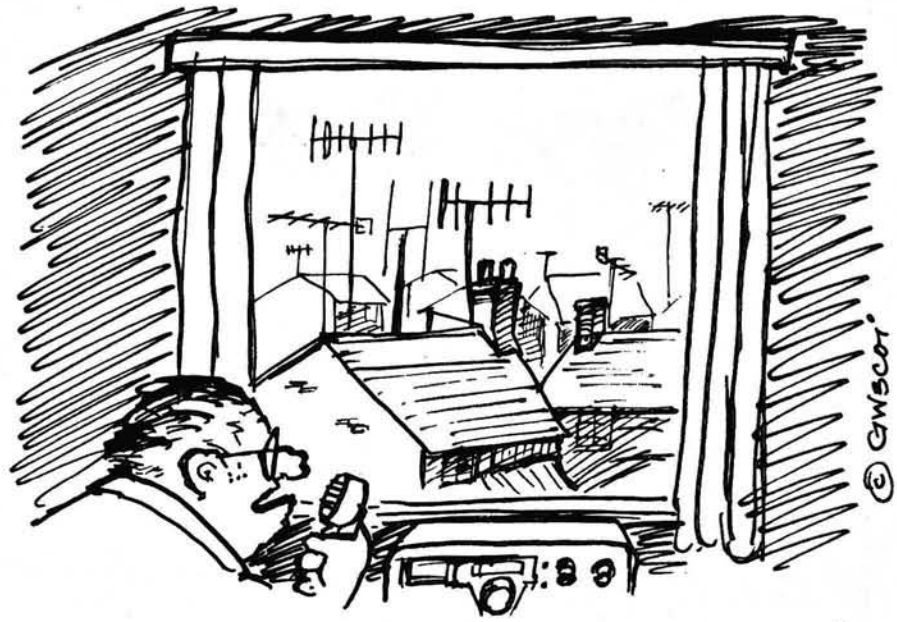
exists for contests on four. The result, as one 70MHz enthusiast put it, is that "70MHz contests are more civilised". It is to be hoped that the arrival of Class B licence-holders on the band will not induce the RSGB to change the state of affairs.

There have always been a surprising number of amateurs who are fully equipped for 70MHz who simply did not come onto the band because of the low level of activity.

Fortunately, a group of people in the Midlands have rectified this problem by making Tuesday evening 70MHz activity evening. This now has the support of the RSGB v.h.f. committee, making Tuesday evening a time when it is possible to go onto the band with an excellent likelihood of finding some stations to work.

Sunday morning is traditionally a good time to find activity on the 70MHz band, brought about by the difficulties of interference caused to v.h.f. television. Now that all television transmitters are standardised on u.h.f. this is no longer a problem, but Sunday morning remains a popular time for a leisurely session of operating on four.

For amateurs who want a haven from the bedlam of h.f. or the other v.h.f. bands a 70MHz transverter provides the answer without costing too much. It is a band were polite operating practices are not yet out of date and where over-used repeaters, jammers and CB terminology are completely unheard of. It is only to be hoped that the fears of some amateurs are unfounded and the extension of the band to Class B licence-holders will not change this situation and they will come to love the band as much as some of the "old hands". ***PW***



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Launch Date

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Dublin Calling

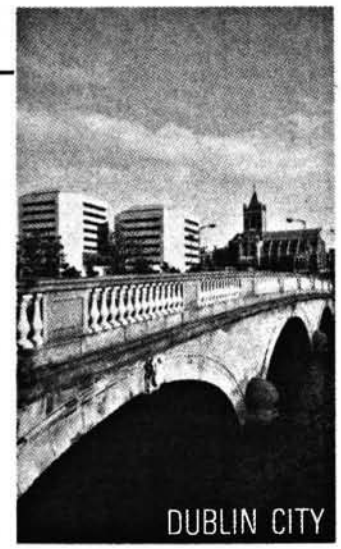
The amateur radio operators of EI are planning great things for 1988, the reason for this is that Baile Atha Cliath, or Dublin as it is better known, is celebrating 1000 years of its foundation as a city.

Dublin is one of Europe's oldest capital cities. To commemorate this Millennium, a group of Dublin-based amateurs are organising some major events throughout the year.

St Patrick's Day, which is on March 17, will be the most ambitious undertaking. They are attempting to make contacts with the many towns and cities called Dublin around the globe. It is estimated that there are over 20. They'll be using not only s.s.b. but also, with the help of pre-arranged skeds, amateur slow-scan TV.

The Lord Mayor of Dublin, The Right Honourable Carmencita Hederman, has agreed (if at all possible) to partake in the exchanging of St Patrick's Day greetings with these other Dublins.

The callsign for this station will be very unusual, EI1000. The station will be located in Dublin's main thoroughfare of O'Connell Street.



The other major event will be on July 10, The Millennium birthday. It is hoped they will be able to demonstrate amateur radio in emergency and portable conditions.

The Phoenix park will be the host for the city's birthday celebrations and the special callsign will be in operation for the last time.

A special QSL card will be available via the IRTS bureau, or direct upon receipt of three IRCs.

For further information, please contact:
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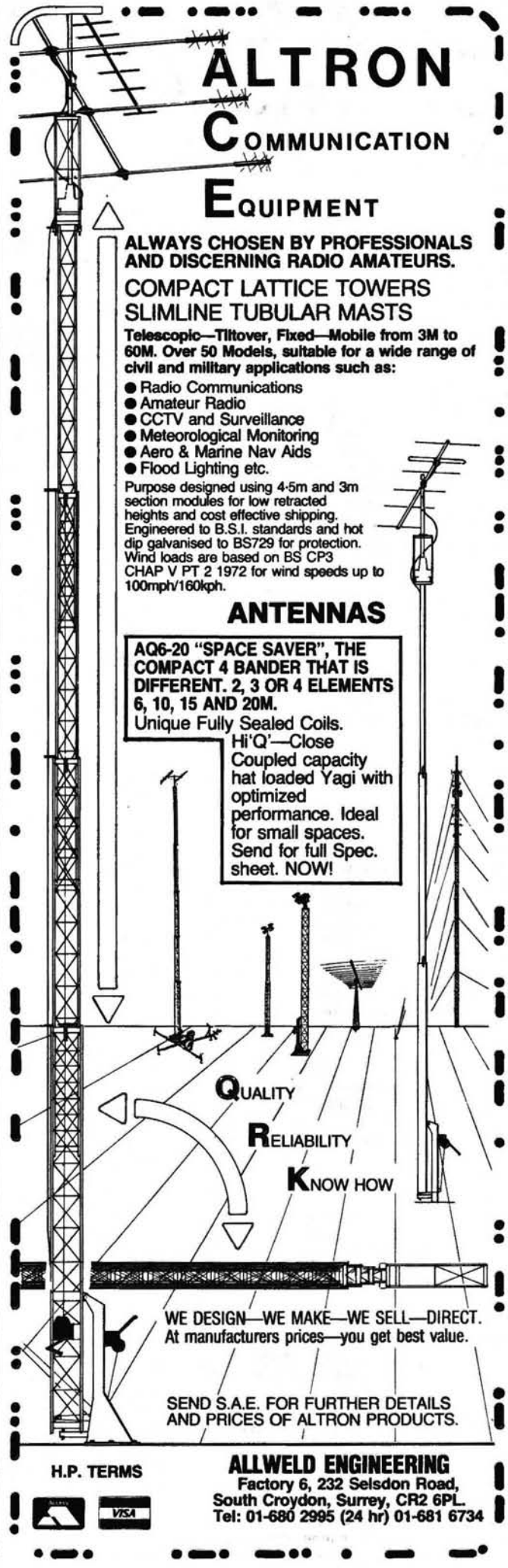

On The Air
On The HF Bands

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

I seem to have spent a distressingly large proportion of my time this month looking out of the window and wondering whether my mast and antenna will survive the winds, gales, rains, and other manifestations of the British climate. As to whether the spring project to take it up another 5m comes to anything, I'll wait and see if it survives this quarter!

Correction

G4BUO was all hot under the collar because I attributed his contest result to G4BUE recently; from which I owe an apology to both G4BUE and G4BUO, which is of course freely given.

Recent Events

Thanks to *The DX Bulletin,* and *DX News Sheet,* in the main, with accompanying input from W1WY for their information.

I feel I must start with the question of that "XW8AC" who was, shall we say, puzzling the faithful a few days back. According to *DXNS,* Steve G4EDG came to the conclusion that this was in fact BY8AC, pushing along at 30w.p.m. The key was that he was asking for QSLs to "FM8GUZ", that could be translated as "3BGUZ", which is interesting when one realises that BY8AC is at 3B Guzhongsi Street . . . Sherlock Holmes, eat your heart out!!

Now to the DXCC status of Aruba. It seems that the DXCC recommendation has been accepted. This means there are now 318 current DXCC countries and Aruba contacts after January 1 1986 will count. However, do NOT submit your QSL for credit until AFTER 1 April 1988.

Still with DXAC, the decision on Western Sahara is in the pipeline, and will possibly have been promulgated in the weekly sheets by the time you get to read this.

A different tack now: *DXNS* commented on my recent proposal that one IRC should be the norm for a QSL, with "green stamps" only allowable where IRCs are not acceptable under the country's postal rules. *DXNS* is of the opinion that a QSL Manager shouldn't be out of pocket for a DX station's activity, and points out there are some parts of the world where one IRC won't buy a stamp to anywhere. Fair comment. On the other hand, I seem to recall that before someone invented the QSL Manager (and made a killing out of it, I believe) we all managed quite easily by doing our own QSLing.

Nowadays, while everyone says "QSL 100%" one can be pretty sure one's rubber-stamp QSOs won't trouble the QSL Manager or the Bureau system unless either the other chap wants your card for some reason or alternatively you chat him up for one specially. Indeed the QSL system has become something of a farce thanks to the misuse of it by amateurs and despite the best efforts of DXers, Managers and above all the QSL Bureau network. After all, one can't blame the Bureau system for the delay due to the chap at the far end not bothering to keep his chores up to date!

DXNS mentions the proposition that there are around twenty "amateurs" operating from Teheran on a verbal say-so, and that they hope to be licensed "after the war is over". I am prepared to lay long odds that if there were a firm administration in that unhappy country, these characters would be rooted out as the pirates they are, though one would hope that they at least receive the chance to pass the tests and receive a legal licence.

Contests

Here, of course, I am indebted to W1WY and his "Contest Calendar" activity. The CQ WW 160 SSB covers February 26–28, between 2200Z on the Friday and 1600Z Sunday. Rules are as they have been for several years past. Entries to either N4IN, 3074 Florida Avenue, Melbourne, FL 32904 or the *CQ Magazine* office 76 North Broadway, Hicksville, NY 11801. Indicate CQ WW Contest SSB on the envelope, and mail it by March 31. All c.w. contest entries should be mailed by February 29.

The ARRL DX Contest covers c.w. on February 20–21, and phone on March 5–6; midnight Friday/Saturday to midnight Sunday/Monday. No /AM or /MM stations can be worked for credit, nor can contacts on 10, 18, 24MHz bands, but only 1.8, 3.5, 7, 14, 21 and 28MHz bands. Rules are as last year, and include a QRP all-band category at five-watt output level or below. Stations outside USA give RS (T) plus three-digit number indicating power input.Outside USA, work the Ws and VEs; the multiplier is the number of States worked—48 US States, DC, VE districts 1–8, VO and VY1, making a possible multiplier of 58. Score three points for each QSO, and final total is the QSO points times the sum of the multipliers from each band. If you have 500 or more QSOs you must include a QSO check sheet. Disqualification regulations to be rigorously applied. Mailing deadline is April 7, to ARRL DX Contest, 225 Main Street, Newington, CT 06111.

The RSGB 7MHz Contest has s.s.b. on February 6–7 and c.w. on February 20–21. Hours are noon on Saturday to 0900Z on Sunday. For s.s.b. use 7.040–7.100, for c.w. 7.000–7.030MHz. All s.s.b. logs to be received by RSGB HF Contest Committee, G3HCT, Brooklands, Ullenhall, Near Henley-in-Arden, Warks B95 5NW by March 30 (s.s.b.) and April 23 (c.w.). Don't forget the summary sheet and signed declaration. As a footnote to this one, W1WY enquires why there is no reference to Ws operating split-frequency to play in this one. My own thought on the point is that provided that both ends of the QSO in such a case are operating within their licence conditions, and the UK end within the specified part of the band, then honour is satisfied; but since the rules are there to be obeyed, anyone thinking of entering should check the position by reference to the Contest Committee.

Now I must mention the UBA Contest. This is one by the Belgians, and will in future years appear on the last full weekends of January and February. The 1988 dates are January 30–31 for c.w., and February 27–28 for s.s.b., 1300Z Saturday to 1300Z Sunday. Bands 3.5–28MHz, not including WARC allocations. Classes are single-op single band, single-op all band, multi-operator single transmitter all band, QRP (10 watts) and s.w.l. Single operators are limited to 18 hours, and must take their off periods in chunks of at least one hour. Exchange RST and QSO number starting at 001.

Belgians will include their Province (AN, BT, HT, LB, LG, LU, NR, OV, WV). QSOs with ON, DA1, DA2 count ten. With other European communities 3 points (DL, I, F/TK, LX, PA, EI, G, OZ, SV, CT, EA), other countries one point. Own country may be worked once per band for QSO credit. The multiplier comprises nine Belgian provinces, eight Belgian prefixes and eleven European communities, a maximum of 28 on each band.

Final score, total QSO points times multiplier on each band. Awards for class winners in each country, certificates to other entries. Use a different log sheet for each band, include a summary sheet showing scoring, off periods, other essential details and signed declaration. All entries to be postmarked not later than 30 days from the end of the contest, and sent to UBA Contest Committee, Galicia Jan ON6JG, Oude Gendaraeriestraat 62, B-3100 Heist op Den Berg, Belgium.

Lloyd and Iris Colvin are at the time of writing in Nepal; they made some 8000 contacts from Mexico despite their hotel being at the centre of a couple of earthquakes. I gather that although things fell off shelves, not much other damage was done. Much help was obtained from XE2CN, to whom their thanks.

TU4BR/5U7 has, I hear, been accepted by the DXAC, and this one now counts in terms of DXCC scoring.

Letters

G2HKU (Minster, Sheppey) has been playing with a Butternut HF6V vertical, plus the extras for 1.8, 18 and 24MHz. Ted says that he has found an acceptable s.w.r. on all nine bands, although of course the bandwidth is limited on 1.8 and 3.5MHz. Nevertheless there isn't a problem if you use an a.t.u. On a different line, Ted has been playing with a Ten-Tec Paragon rig, though I understand that just as soon as KW Electronics get some stock in, they are sold; Ten-Tec just can't build them fast enough.

After the autumnal gales brought down the **G3BDQ** antennas John decided that he would accept the loss of the top 4.5m of antenna mast bringing him down to a maximum of 10.6m. On the other hand, the rigger has called, and the wire is now refixed to the pole on the chimney; prior to that G3BDQ had a temporary lash-up comprising 6m of grounded vertical wire, which then ran back to the house, sloping down to 2.5m, whence it ran round the side and front of the house, spaced about 600mm off by nylon cord, to reach into the shack.

On 1.8MHz, this last lash-up succeeded in reaching, on c.w., UV6AAX, RA9SVT,

RA9CTK, UA9FAR, UA9LCU, JR1EBE (which amazed G3BDQ somewhat!), UL7ACI, W1CF, KA1PE, EA9EA, EA9JL, IS0QDV, 9H1CG, SV1NA/SV9 and some small fry. The JR and the UL7 were both raised on the evening of December 8, when, as some readers will be aware already, the "A" Index was down to zero, giving minimum absorption over the Arctic paths. On the new antenna, I note UA9FAR, RV9CFU and W2QD, the latter at 2134Z. A Gotaway was VK6HD, heard on 1.8MHz around 2100 on December 16, as weak as 229 and working USSR stations.

The 1.8MHz activities at G2HKU seem to have been mainly to Europe, with an s.s.b. QSO with ON7BW, plus c.w. to ON4CW, PA0DML, OL8CSR, OK1OA, HB9AMO and LX9BV.

The 3.5MHz Band

I have about the most basic antenna for this band that can be imagined—a bit of thin wire bent around the garden with most at no more than 1.5m, approaching a half-wave in length. This works surprisingly well, and managed to find most of Europe on c.w. during the evenings, when the 14, 21 and 28MHz bands are dead. On s.s.b. I seem to put out quite a decent signal over the UK and into Europe, though not using my full power output.

G3BDQ (Hastings) used his temporary antenna to raise JH3BGG and JA7FUJ on the key, while s.s.b connected him to CN8CC, TK/ON6EB, EA6WV, T77G, OX3SG, JR1CSA and UA0FF (Sakhalin) all the latter three on the evening of December 8. With the antenna repaired, J20YD was snapped up on s.s.b., while the key raised UA9CPC and JA1HQT. One has to comment that, above all else, the results John has obtained with so much of a temporary lash-up give an absolute proof yet again of the importance of the earth with Marconi-fed systems.

The 7MHz Band

Here we have a band whose devotees keep quiet about what's what. However, for those who have good receivers and the skill to operate them to the best, there is much of interest. G2HKU mentions that he raised, on c.w., TA1A, RG0G, W3LPL and UA9SIH.

At G3BDQ, before the antennas were repaired, John made it to VU40TTC and TA1L; this was s.s.b., with c.w. tackling SV5CM, UO5ON, UA9CQ, JA8AZN, RA0JZ and UA0ALI, both the latter on December 8 when the A index was so low. When the re-rigging was complete, c.w. went out to DJ4SO/EA8, JE5DVI, JH1DTC and UL7MAX.

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

The 14MHz Band

Most of my usual reporters were missing this time, probably due to doubts about being able to get letters to me through the Christmas rush. However, G2HKU mentions his regular ZL3FV contact on s.s.b. on this band.

As far as I went, by the time I managed to get to the rig of an evening I was in TVI trouble, so most of my calls were of the form "TVI Test de . . .". However, I did manage to work the odd morning session, though not on any worth-while days—but at least it keeps one's hand in.

As for G3BDQ, John found the band conditions on 14MHz and up pretty poor, so he only menions CS7QF and K200YTL, both on s.s.b.

The 21MHz Band

G3BDQ is the only reporter with KT2V, VE3UK, and ZS1RL on s.s.b. as his crop; John found conditions poor on the h.f bands, and indeed there were times when all bands seemed to be ailing.

Finis

That's the end of my first offering to be actually penned in 1988. I can forecast a steady improvement in conditions over the next couple of years, and so there should be much more to report to you. Various expeditions are in the pipeline, and of course those who are, because of antenna shortcomings—the "G5RV over a window-box" merchants—will begin with the improvement in conditions to reach to the DX. I hope that when you do, I can report your successes in this column.

VHF Up

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

The 1987 Tables

Looking back on the 1986 results, last year's tables, printed in Short Wave Magazine, seem very similar.

Repeater Notes

Kelvin Fay G0AMZ is Secretary of the Kent Repeater Group and has sent a copy of its Newsletter. He suggests many similar groups do not publicise their activities enough to attract members, and thence funds, to enable them to provide, maintain and run repeaters. He makes the plea that radio amateurs should support their local group, adding that repeaters, ". . . serve a useful purpose, even if only to keep wafflers away from your favourite simplex frequency. They have been known to carry important emergency traffic which might otherwise not have got through."

Kelvin mentions that with current demands for antenna space by commercial users, amateur repeaters could be vulnerable. He estimates that the KRG could face site rentals of £750 per annum within the next five years.

To quote further, "Couple this with the currently fashionable attitude in some circles that repeaters should be provided by some unknown benefactor and that no charges should be met by the local users, and we have a 'no-win' situation".

The group is responsible for seven repeaters in the county. If you regularly use any and are not a KRG member, why not contact Kelvin at 37 Sandringham Road, Rainham, Gillingham, Kent ME8 8RP. His

Annual v.h.f./u.h.f. table Final placings at 31 December 1987

Station	70MHz		144MHz		430MHz		1296MHz		Total
	Counties	Countries	Counties	Countries	Counties	Countries	Counties	Countries	Points
G1KDF	—	—	99	19	73	15	36	9	251
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	—	—	99	12	59	12	—	—	182
G4SEU	63	6	58	18	22	6	—	—	173
G1GEY	—	—	75	28	49	18	—	—	170
G1EZF	—	—	84	34	21	11	—	—	150
G4ZTR	*38*	*5*	32	12	36	10	35	9	134
G6AJE	—	—	54	17	41	12	7	2	133
G1EHJ	—	—	58	12	53	9	—	—	132
G4MUT	26	1	49	16	29	10	*11*	*4*	131
G8LHT	—	—	66	22	29	10	3	1	131
G4DEZ	—	—	34	10	42	11	19	10	126
G4VOZ	63	7	—	—	41	12	—	—	123
ON1CAK	—	—	80	34	—	—	—	—	114
G6MGL	—	—	43	13	28	2	15	5	106
G8MXL	22	5	42	11	18	7	*8*	*3*	105
GW4FRX	—	—	77	28	—	—	—	—	105
GW6VZW	—	—	68	24	9	2	—	—	103
G3FPK	—	—	79	24	—	—	—	—	103
G4WJR	—	—	78	10	—	—	—	—	88
G4AGO	15	1	40	13	13	4	*1*	*1*	86
G4TGK	—	—	66	19	—	—	—	—	85
G8XTJ	—	—	68	17	—	—	—	—	85
G4YIR	—	—	60	15	—	—	—	—	75
G1CRH	—	—	64	11	—	—	—	—	75
G6OKU	—	—	54	15	4	1	—	—	74
G0HDZ	—	—	53	11	—	—	—	—	64
GM4CXP	2	2	33	17	3	4	—	—	61
G1VTR	—	—	21	7	24	5	—	—	57
GW4HBK	48	7	—	—	—	—	—	—	55
G0HGA	—	—	43	11	—	—	—	—	54
G2DHV	15	2	24	6	3	1	—	—	51
G3EKP	13	3	12	3	7	3	—	—	41
GU4HUY	—	—	33	7	—	—	—	—	40
G4WND	25	4	—	—	—	—	—	—	29
G6XRK	—	—	8	6	—	—	—	—	14

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

telephone number is Medway (0634) 376991.

Steve Damon G8PYP (DOR) reports an interesting "encounter" on Dec 20 during a tropo lift to the south in which he accessed the French repeater FZ5THF which is in AC08e, close to the border with Andorra. Its output is on 145.425MHz (S17) with input 600kHz lower on 144.825MHz. When accessed a synthesised voice says, "Bonjour" and then gives a spoken signal report. When it shuts down the voice says, "Au revoir" followed by its callsign and the time, finishing off with a few bars of the French national anthem.

Steve had a QSO through FZ5THF with G6WWR/A near Aldershot which he reckons involved a round path of over 1500km. **Paul Pasquet G4RRA** (SRY) also accessed this relay which has exceptional coverage from its high site in the Pyrenées mountains. Now he knows it is there, Paul says he can often hear it much better than the conventional beacon FX4VHF (AF69c).

Contest News

Due to the non-availability of the rules, I can only give the dates of a few forthcoming events. The first leg of the 70MHz Cumulatives is now history, the next three sessions being scheduled for Feb 11, 28 and March 13. On Feb 21 there is the 432MHz Fixed and AFS and s.w.l. event which last year was from 0900–1500.

The first really major contest is on Mar 5/6, 1400 to 1400 in the shape of the 144/432MHz and s.w.l. event. It can only be guessed that, as last year, 144MHz only entries will not be accepted.

Vale John Haydon

Ron Glaisher G6LX passed along the sad news of the death of **John Haydon G3BLP** in early December. In the late 1940s he was active on the then available five metres band and, jointly with Ron, ran the popular "Five Band Dinners" and later the "VHF Dinners". Older readers will recall the big signal Johnny used to put out from Selsdon and Woldingham on 144MHz and he won a number of contests from the former QTH.

In the 1960s he moved to Dunstable. He was taken ill while en-route to New Zealand to visit family last November. He was flown back to the UK. His funeral was on December 7 and among amateurs who attended were G6LX and G8TB, representing the Surrey Radio Contact Club, and the Chairman and President of the Dunstable Downs Radio Club.

Mediterranean DX

Dave Dibley G4RGK (BKS) passed along the news that HG1YI will be active again from his ship from February with better equipment. Some readers have contacted him –/MM via Es when he was in choice "wet" squares. He should be running 150W to decent antennas on 144MHz with some 430MHz activity, too.

Meteor Scatter News

There are a few minor meteor showers in the run up to the Lyrids in April but I do not propose to devote any space to them as you would probably do just as well via random meteors.

Don Stoker G1GEY (TWR) thought the Geminids shower not too good but he did complete on 144MHz with OH5LK (NU) in 75 minutes for a new country, and with DL5MAE (FI) in 50 mins. Both were new squares.

G1EZF concluded his results on c.w. in the Geminids were rather poor but Mick did complete with SM3AKW (JW) and SM3LBN (IU) in skeds and with YU7EF (KE) and OE3JPC (II) on the random c.w. frequency. Random s.s.b. QSOs were completed with OE3JPC, OE3OBC (II), IONLK, F6DRO (AD), YU3TS (HF), FC1FIH (CD) and I1KTC (EF) which was the only single burst contact. The general impression from comments on the air is that the 1987 Geminids shower was a bit of a non-event.

70MHz annual table
Final placings at 31 December 1987

Station	Counties	Countries	Total
G4VOZ	63	7	70
G4SEU	63	6	69
G4NBS	54	7	61
GW4HBK	48	7	55
G4ZTR	38	5	43
G4WND	25	4	29
G6MXL	22	5	27
G4MUT	26	1	27
G2DHV	15	2	17
G3EKP	13	3	16
G4AGQ	15	1	16
GM4CXP	2	2	4

The 50MHz Band

First, remember that this year the Annual v.h.f./u.h.f. Table includes 50MHz counties and countries but please only include countries where amateurs are licensed to use the band by their equivalent of our DTI. Also I have substituted 50MHz for the microwave column in the c.w. ladder.

Apart from this, there are no reports of activity but G1SWH is now QRV on the band with a Yaesu FT-690R at 20W with a 4-ele Yagi. **Dave Storrs G8GXP** (YSW) mentioned that he is also equipped for the band now but did not say what he was using.

The 70MHz Band

Pat Billingham G4AGQ (SRY) took part in the contest on Dec 13 working six of the seven stations heard. His take-off to the north is blocked and he has no space for a beam so operates under quite a handicap.

G4VOZ reports the contest being better supported than in 1986. John did a lot of listening and worked 15 stations, best DX being EI9FK/P at 1213. It would seem that about 50 stations took part. All-time new stations in December were G4AHN (SRY) on c.w. on the 8th and G4CWH (HFD) on s.s.b. on the 12th.

G4ZTR also took part in the contest but John only worked one new county. He very much wants to work GI and GD on the band and still needs East and West Sussex. EI9FK/P was his best DX in the c.w. contest, too. G8GXP writes that he is also QRV on 70MHz.

The 144MHz Band

In 1987 ON1CAK worked 55 new squares so is very pleased with that. Johan is still looking for QSOs with FMH, OKE and SLD. In his Dec 9 letter he lists recent DX as EA1BCB (WD) and EA2BUF (ZD) on Nov 18 and on Dec 6, GM0FRT (YR), GM4YXI (YO) and GM0BQM/P (YP).

G1EZF now has his 4CX1000A amplifier giving a very clean maximum legal output with just 2W of drive. In the November tropo lift, covered in last month's VHF Up, Mick worked 52 OKs in assorted G, H, I and J column of squares, SPs in IK, IL and JK and OEs.

144MHz annual table
Final placings at 31 December 1987

Station	Counties	Countries	Total
G1EZF	84	34	118
G1KDF	99	19	118
G6XVV	89	26	115
ON1CAK	80	34	114
G1SWH	99	12	111
GW4FRX	77	28	105
G1LSB	75	29	104
G1GEY	75	28	103
G3FPK	79	24	103
G6HKM	75	27	102
GW6VZW	68	24	92
G8LHT	66	22	88
G4WJR	78	10	88
G4NBS	68	19	87
G4TGK	66	19	85
G8XTJ	68	17	85
G4SEU	58	18	76
G4YIR	60	15	75
G1CRH	64	11	75
G6AJE	54	17	71
G1EHJ	58	12	70
G6OKU	54	15	69
G4MUT	49	16	65
G0HDZ	53	11	64
G6MGL	43	13	56
G0HGA	43	11	54
G4AGQ	40	13	53
G6MXL	42	11	53
GM4CXP	33	17	50
G4ZTR	32	12	44
G4DEZ	34	10	44
GU4HUY	33	7	40
G2DHV	24	6	30
G1VTR	21	7	28
G3EKP	12	3	15
G6XRK	8	6	14

The November tropo brought 16 new squares for G1GEY and Don now has 105 confirmed out of the 158 worked so will be applying for his QTHCC membership any time. G1KDF, in his letter of Dec 20, reports the band very flat in December with just one Aurora heard, on the 11th around 1900. Bob heard GM1KHU but believes G4KUX worked some Russians on c.w. His earlier letter just missed last month's deadline but I note he worked some fine DX in the Nov 4-7 period.

G1SWH's last two counties for 1987 were GM8PNP (SLD) back on Oct 3 and GU2FRO (SRK) on Dec 22 to make it 99 for the year. Gerry tipped me off that GU2FRO has a sked most mornings with G3KFT (GLR) at 1000 on 144.425MHz so Eric was my last county too, worked on Dec 29.

Stuart Field G1VTR (SFK) put his antennas back after the October storm and lists some good DX worked in the Nov 5-7 period in D, OK, OZ and Y. **Dick Bacon G3WRJ** (HFD) found things rather quiet on c.w. by the end of the year but did end up with 174 different stations in the ladder using only half a watt.

G4AGQ thinks 1987 was a thin year, partly due to Pat's being unable to take part in major contests due to work commitments, and partly due to his transceiver being "in hospital" for some ten weeks. He asks if anyone else heard YU7CV on c.w. on 144.061MHz on Nov 7 around 1445? He was a steady RST579 calling CQ but Pat could not raise him.

Ian Cornes G4OUT (SFD) reached his 300 c.w. stations goal by Dec 30 thanks to G4EYY. He reports reception of the EI2WRB beacon on 144.920MHz most of the time thanks to the sensitive "front end" fitted to his Icom transceiver.

1296MHz annual table
Final placings at 31 December 1987

Station	Counties	Countries	Total
G4NBS	42	10	52
G1KDF	36	9	45
G4ZTR	35	9	44
G6HKM	33	7	40
G4DEZ	19	10	29
G6XVV	20	9	29
G6MGL	15	5	20
G4MUT	11	4	15
G6MXL	8	3	11
G6AJE	7	2	9
G8LHT	3	1	4
G4AGQ	1	1	2

Martyn Jones G4TIF (WKS) lists D, OK, SP and Y stations in twelve squares worked in the November tropo with OK2KZR/P (IJ), SP6HEI (IL) and OK3KGW/P (JJ) all new ones.

G4ZEC is a meticulous record keeper and went through his list of 1987 c.w. contacts very thoroughly to find eight duplicates, seven of which were B licensees who were worked again under their new G0 calls. Roger's station comprises a Kenwood TS-711E, BNOS LPM10-180 amplifier, MuTek GFBA pre-amp, 13-ele Tonna Yagi, the keys being either a Star Masterkey or a Swedish brass one. A valve p.a. and antenna improvements are possible.

G4ZVS was not very active after the November lift and when he did manage to get on, conditions were very flat. His last DX was F9QE on c.w. on Dec 22 but his 1987 total of 316 in the ladder is excellent.

Mike Johnson's G6AJE (LEC) last letter just missed the deadline for last issue and his news is also of DX worked in the early November period. QSOs over 1000km included Y25QL/A (GL), OK1JKT/P (GK), OK1KKH/P (HJ) and Y76ZL (HL). All were contacted on Nov 6. **Keith Hewitt G6DER** (YSS) was very active in the early November period but spent most of the time on other bands. However, in the early hours of the 7th he came on for a while to work 30 assorted OKs and SPs in eight squares.

Howard Staddon G6STI (LDN) has some TVI problems but thinks the complainant will be moving soon. His last DX was F6BQX/P (YG10d) worked on Dec 20. **Philip Ruder G6MGL** (LDN) wrote that 1987 was not a very good year with equipment failures and the loss of all the antennas in the October hurricane. He plans to re-build the latter, of course.

G8GXP's letter reviewed Dave's radio year and he was able to listen on the band from an aircraft 42 000ft up on his way back from his summer vacation in Rhodes. He heard lots of beacons and s.s.b. activity but the further east he was, the more the latter was concentrated in a mere 20kHz straddling the calling frequency. This is obviously the reason for the huge pile-ups around 144.3MHz during Es openings.

G8PYP found conditions very quiet up to Dec 19. Steve operated in the Fixed Contest for a few hours on Dec 6 making 15 QSOs by answering CQ calls. There was a lift to the south on the 19/20th which brought his 50th square F6DRO (AD) at 2255. F6BQX/P and F6APE (IN97QI) were worked the next day.

John Fitzgerald G8XTJ (BKS) also operated in the Dec 6 contest, best DX being G4KUX (DHM) and G4VBG and G1GEY (TWR) but nothing heard from Scotland. His 107th square was F6BQX/P on the 20th.

Welcome to new contributor **Gerard Elliott GI4OWA** from Kilfennan (LDR). He started as a GI8 in early 1981 with 10W of s.s.b. Many GMs but only one G were worked before a change of QTH to the proverbial r.f. black hole. The take-off from the present QTH is much better with all directions available. In six months Gerard has worked 78 squares in 20 countries on tropo, Ar and Es.

Eleven countries were worked in the November lift, best DX being OK1KTL/P (JO60LJ) but it proved difficult to get through the continental stations. GI4OWA has just started on 50MHz with half a watt but expects to increase the power. His antenna for the band is a 3-ele Yagi.

430MHz annual table
Final placings at 31 December 1987

Station	Counties	Countries	Total
G1KDF	73	15	88
G1LSB	63	23	86
G6XVV	60	14	74
G4NBS	53	19	72
G1SWH	59	12	71
G6HKM	54	13	67
G1GEY	49	18	67
G1EHJ	53	9	62
G4VOZ	41	12	53
G6AJE	41	12	53
G4DEZ	42	11	53
G4ZTR	36	10	46
G4MUT	29	10	39
G8LHT	29	10	39
G1EZF	21	11	32
G6MGL	28	2	30
G1VTR	24	5	29
G4SEU	22	6	28
G6MXL	18	7	25
G4AGQ	13	4	17
GW6VZW	9	2	11
G3EKP	7	3	10
GM4CXP	3	4	7
G6OKU	4	1	5
G2DHV	3	1	4

The 430MHz Band

Dave Thickett G0FEH from Chesterfield has just bought a Yaesu FT-790 and 18-ele Parabeam. He is only running one watt but has a 4CX250B amplifier and a masthead pre-amp on the stocks. He finds the band very quiet after 144MHz.

G1EZF was only running QRP in the November tropo lift when his best DX were SP6MLK/6 (IK), OE5VRL/5 (HI) plus OKs in GK, HJ and HK, various Ds in southern Germany, some Ys, HB9MIN/P and HB9AMH/P (DH) and Fs in AG, BF, BG and ZG.

For G1GEY in the November event, ON, OK, SP, Y, OE and HB9 were all-time new countries and Don worked 16 new squares to bring his total to 68. G1KDF worked similar DX and on Nov 6 GM6TKS (WS) in the Western Isles. This was Bob's 76th UK county on the band leaving just OKE and SLD for the proverbial game, set and match. On the 7th OE5DXL (HI) was best DX to date at 1384km.

G1SWH also worked OE5DXL for his 12th country of 1987 on the 7th and Gerry worked his final county on the 18th, G4XEN (NHM). **John Quarmby G3XDY** (SFK) found conditions to the south good on Dec 20 and worked F1EAN (AG), F6HYE (DG), FC1GTU (AF) and HB9AMH/P (DH). Beacon FX3UHF (ZD) peaked to S9.

The November tropo brought square No. 107 for G4TIF. In the period Nov 4-7 Martyn lists as worked on s.s.b. OK1KHI, Y22ME (HM) the new square, Y24BO and DK7AKL (GM), OK1DIG/P (GK), EI5FK (VL), Y21NB (FN) and HB9AHP/P (DH).

Annual c.w. ladder
Final placings at December 31 1987

Station	Band (MHz) 70	144	430	µWave	Points
G4ZEC	—	652	—	—	652
G4XEN	—	400	34	—	434
G4ZVS	—	316	—	—	316
G4WHZ	—	308	—	—	308
G4OUT	—	300	—	—	300
G4NZU	2	243	4	—	249
G0HGA	—	218	—	—	218
G4AGQ	19	148	15	1	183
G3WRJ	—	174	—	—	174
G4VOZ	104	—	28	—	132
G4YIR	—	129	—	—	129
G4ZNI	—	112	—	—	112
G4YTR	—	111	—	—	111
G0GKN	—	111	—	—	111
G0DJA	—	101	—	—	101
G2DHV	23	74	3	—	100
GM4CXP	—	87	—	—	87
GU4HUY	—	67	—	—	67
EI5FK	—	29	35	—	64
G6XVV	—	31	16	12	59
GW4HBK	27	—	—	—	27
G0HDZ	—	9	—	—	9

Number of different stations worked in the year.

G6AJE was very pleased with the results of his 10W in the November lift. New squares on the 6th were OK1DIG/P, Y22ME, OZ1JPT (GO) and Y23DL (GL). A short "CQ DX" call at 1233 brought replies from DJ9RX (EN), DL7AKL (GM) and father and son stations DG2BAW and DG6BM (EN). (N.B. Who is right; was it DL7- or DK7AKL?).

The next day Mike worked ON1KPW/LX at 1835 in CJ for a new country and square, also FD1GYA/P (BF) and HB9AMH/P. At 1200 on the 6th he copied beacons OZ7IGY (EQ), SK6UHF (GR), OK0EA (HK), DB0OS (EK) which only runs 700mW, HB9F (DG) and another not in the *DUBUS* list ON4UHF on 432.982MHz. For once Mike reckons he was in the right place at the right time.

G6DER found conditions up a little on Nov 2 and Keith worked a couple of Germans in DL and DM. Nothing much the next day but increased activity on the 4th, best DX being OK1KHI, OK1AIY/P (HK), SP6MLK/6 and DJ9UN (FI). New squares on the 5th were OE5VRL/5 and Y23DL who was only running two watts. On the 7th he found OK1XW/P and OK1KEI (HK), SP6GZZ (IL) and new, OE5UXL/5 (HI), Y24XN/P (GK) and many Germans.

New squares in the November lift for G6STI were F6IPG (YH), FC1GXX (ZF), FD1GYA/P, F6HEO (BG), F6DKW (BI), Y24XN/P, Y24BO and OZ7IS (GP). This brings Howard's total for the band to 58.

G8GXP took advantage of the November tropo to fill in a hole in his squares map on 430MHz. Dave added EJ, EK and FJ, plus an OE in GI for another new square and country. His total of 151 squares on the band puts him at the top of that section of the Squares Table.

The Microwave Bands

First let me make it quite clear that this section of VHF Up will continue as in the past. Several readers still think microwave happenings are being dropped.

G1KDF wrote about the November tropo between the 5th and 7th. On the 5th Bob worked ON5NY (BK) on 1.3GHz for a new square and country, then F1EAN (AG) and F6ECI (AF) both new. He heard F6HPP/P (BJ) but was unable to work him. FC1GXX

(ZF) was another new square and best DX on the band at 918km.

On the 6th, Bob worked GM6LBV (XP) and the next day heard F1DED (BI) and FD1GYA. On Nov 28 he worked G6HKM (ESX) at last for a new county. He remarks that the 1.3GHz and 430MHz Cumulatives were very poor with few stations to work.

On Dec 20 G3XDY found better activity on 1.3GHz than on the lower bands. John worked the following: FC1FYE/P (AI), F1CDI and FE8CF (ZD) and a new square, F1BUU, F1FLN, F6CBC and F6HLG all in ZE, FC1GTU and F6HKA (AF), FD1HLR and F6ACA (BI), F6HEO and HB9AMH/P. His squares total is now 82 on the band, the same as G3JXN who has not updated his figures lately.

John Tye G4BYV (NOR) writes that anyone wanting to work Norfolk on any band from 1.3GHz to 5.7GHz bands may telephone him on 0362 83 8142 or call him on 432.2MHz. G4ZTR has spent a fair proportion of his time on 1.3GHz but agrees that the Cumulatives were not very special. But John did work GI4OPH (XO) and GU2FRO (SRK) in the last leg on Dec 19, the latter being unique. G4ZTR has also been on 2.3GHz.

Going back again to the November lift, G6DER worked DC0DA, PA3AOH and DF7JE (DL), HB9AMH/P and PA2HJS (CK) on the 4th. The next day Keith found F1EAN, FC1DNB/P (AK), ON4YZ (CK), DL2KBB and DD3KL (DK) and DC8UG. On the 6th he worked F1EHN (BI), F6HEO, ON7YK (CL), DK8UR (DJ), DC3KP (DK), PA0FRE and DF1EQ (DL), DK2EG (FJ), DK0NA (FK), OK1DIG/P and OK1KKH/P, all on 1.3GHz.

On the 7th F6DZK (AI), FD1GYA/P, F6HEO, F1DED, DD3KL, DG8EAJ and DL1EAF (DL), DL5FAB/P (EK), DC3KP, OE5UXL/5 and SP6GWB/6 were contacted. Keith operated on 2.3GHz as well and on the 4th worked DC0DA and PA2HJS (CK) for a new square. The following day brought DC8UG, DD3KL and DL7QY (FJ) with OE5VRL/5 another new square.

Another new square was worked on the 6th, DK0NA (FK) plus DC9BU/A, DD8FI and DL6NAQ/P (EK), DF1EQ and DL5FAB/P. EK square was new, too. Keith spent a lot of time searching for signals on 3.4GHz until he realised his GaAsf.e.t. preamp had blown up. After taking it out of circuit he worked PA0EZ (CM).

G6STI was on in the November lift on 1.3GHz and from his computer printout of squares worked I pick FC1GXX, F9MJ (ZG), FC1DUZ (ZH), FD1GYA/P, F6HEO, F6DKW, FC1DBN/P (G6DER listed FC1DNB; who was right?) and DL2KBB.

On 1.3GHz in the November event G8GXP got 13 new squares, the best ones being GI, HI, GM, HK, HJ and IK all on just 5W. Dave has acquired some Mitsubishi power modules so hopes to up the power to 20W. He has a pair of water-cooled 2C39s available as well so should really put Ossett on the microwave map.

Antenna Notes

A regular topic of conversation on the v.h.f. bands is antennas; the merits of one design and/or make over another and the concept of grouping them for more gain. On the latter topic, in *DUBUS Informationen* issue 4/87 there is an interesting article by Rainer Bertelsmeier DJ9BV.

It is entitled, "Effective Noise Temperatures of 4-Yagi Arrays for 432MHz", and is the result of extensive investigation by computer simulation of the performance of single and four-Yagi systems. To carry out such an exercise you need megabytes of memory and lots of time.

He has looked into the performance of the Tonna 21-ele, KLM-16 and Cush-Craft 424B Yagis plus several other well publicised designs. One conclusion is that Gunther Hoch's DL6WU stacking formula of $D_{opt} = \frac{\lambda}{2\sin(\varnothing/2)}$ is just about optimum for Yagis with "clean" side lobe pattern, where D is in metres, λ is the wavelength in metres and $\varnothing$ is the −3dB beamwidth in the stacking plane.

Other conclusions are that the pattern of the 21-ele Tonna Yagis is improved by using balanced feed and adopting wider spacing than Tonna recommends. The calculated group gain with DL6WU spacing and balun feed was 23.85dBi and that of a single antenna 17.9dBi with balun against the calalogue claim of 18.2.

The simulation revealed that the Cush-Craft 424B, ". . . has a very poor pattern with strong sidelobes." The manufacturer's recommended spacing gave a worse performance than with the wider DL6WU figures.

Bob Ainge G4XEK (SFD) wrote with some queries about M.E.T. Yagis which are based on the N.B.S. designs. He asks if anyone has seen any gain/pattern measurements for the 19-ele model for 144MHz and of results obtained with stacked and/or bayed arrays.

Worked All Britain

John Fitzgerald G8XTJ (BKS) has sent along the dates of this year's WAB contests so you can note them in your new diaries. These are: 144MHz s.s.b. QRO June 19 0900–1600; 144MHz s.s.b. QRP (3W) July 10 0900–1300; 432MHz s.s.b. July 10 1400–1800 and 50MHz s.s.b. Oct 9 0900–1200, all times UTC.

The first Winter Activity Award for 144MHz went to G8UYD. On Dec 13 GW6JNE/P operated from various WAB areas in Mid Glamorgan and Powys and on the 20th G1IUY did a long mobile run in Kent and East Sussex so John has now worked all the Kent areas.

A reminder that on 144MHz there are nets from London on .43 from 1030 on Sundays and 2030 on Fridays; from Hampshire, same QRG, from 2030 on Tuesdays and from the east Midlands and Yorkshire on .44 from 2000 on Wednesdays and Fridays with some Sunday morning activity.

The 1988 Tables

In the April issue, the first entries in the 1988 c.w. ladder and Annual Tables will appear, so remember to submit your scores however modest. The c.w. one will now cover 50, 70, 144 and 430MHz but not the microwave bands. The main Annual v.h.f./u.h.f. one will henceforth be a five band affair, 50, 70, 144, 430 and 1296MHz with all bands counting for points now that everyone has access to them.

A reminder that the counties are the 78 starting with "G" and the 26 in the Irish Republic making 104 possible. Countries are the DXCC ones plus Shetland and Sicily (IT9). John G0GKN asked if working different operators at special event stations count as extra stations in the c.w. ladder. Sorry but no. It states "Number of different stations worked . . ." not operators, just like in Multi-op contests.

As this is being written at the beginning of January, gales are once again doing their best to break a few masts and beams and tropo conditions are the proverbial "pits." May I wish you all the very best of DX in 1988, thank you for your Christmas cards and hope you will continue to provide interesting copy of all kinds.

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

RTTY

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

It seems that most of you took time out from your logging during the Christmas break as I've received very few reports. I can't say I blame you as I took a break too. As a change this month I'm omitting the chart to enable me to include more items in the column.

RTTY

I received a very interesting letter from **Les Robertson G4WTL**. Les set himself up for operating RTTY about 2 months ago and seems to be enjoying things. Although he is a keen 14MHz rag-chewer on phone he tends to move on to RTTY when the phone section gets congested, which is quite often these days. The equipment in use comprises a Commodore C-64 computer with an ICS Mk 1 terminal unit. This all links into a Trio TS-430S transceiver running about 50 watts into a $2\frac{1}{2}$ element beam! Actually Les uses a three element beam but one element was destroyed in the gales and he hasn't got around to repairing it yet.

Like many readers his main interest is in chatting with other amateurs rather than DXing or contesting, but despite being new to RTTY Les has managed to work some good DX as follows: JA3MQY (Japan), VK5B1 (Whyalla), VK6NB (Perth), YB5QZ (Indonesia), DU1AUJ (Manila), P43SF (Aruba Island), OA4BLW (Lima Peru), HC5K (Ecuador), YV5GNC (Venezuela), 3XOHBR (Guinea), CE4UW (Chile), VU4GDG/JX (Jan Mayen Island). My thanks to Les for taking the trouble to write.

Getting Started

Mr J. N. Speddy (Morecambe, Lancs) has written to me with a common problem in that he would like to be able to receive RTTY but is not sure of the best way to start. Mr Speddy's existing station comprises a Realistic DX-302 receiver fed by a 33m long wire antenna at about 9m above ground. Fortunately he already has a Commodore C-64 computer and printer so the choice of RTTY equipment is simplified somewhat. The C-64 is actually quite a good computer for radio use as it is very

ICOM HAS MOVED

Yes, ICOM (UK) Retail has moved in beside big brother ICOM (UK) LTD at Unit 8, Sea Street, Herne Bay, Kent. The new larger shop enables the display and demonstration of even more amateur radio products. Andy Rudd G6MRI will be on hand to give good advice and demonstrations. Other top names in amateur radio such as Yaesu, Kenwood, MET, Tono, Jaybeam, Welz, Drae, Uniden/Bearcat, BNOS and RGSB publications will also be on sale. We look forward to seeing you. 73's.

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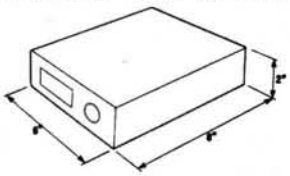

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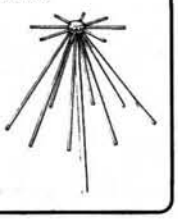

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compact, produces tolerable levels of QRM and there is plenty of radio software available. For those of you who have yet to buy a computer the best bets for radio are, BBC B, Commodore C-64, Vic-20 or the Dragon 32 or 64. If you are keen to buy a more up-to-date computer I would recommend that you check the availability of software before you buy.

Once you have your computer you need to make another decision regarding whether or not to incur the additional expense of a separate terminal unit. The function of the terminal unit is to convert the received tones from your receiver into a digital signal that your computer can deal with. You may think from this description that the terminal unit is pretty essential, but with the aid of some clever software the computer can accept the tones directly. As with all good things though, there is always a snag and in this case it appears in the form of generally inferior performance when receiving weak and noisy signals, particularly over a long path. The performance can be improved by including some filtering in the audio path but it will not normally rival the performance of a top quality terminal unit. For the beginner who does not want to spend a lot of money experimenting with a new mode, the programs which operate without a terminal unit represent a very cost effective way of getting started.

There is another alternative, if you have about £250 to £300 to spend, in the form of a multi-mode terminal unit. These units normally connect to the serial port of your computer and all the decoding and filtering is performed in the multi-mode terminal unit itself. A couple of the most popular units of this type are the Kantronics KAM and the AEA PK-232, both of these are able to transceive in many modes including RTTY, ASCII, CW, and packet radio. If you are interested in all the data modes then these multi-mode units can often work out cheaper and they are certainly much tidier.

One point to watch out for is interference from the computer. A lot of operators are disappointed by the high level of QRM caused by their computers. This is not always easy to cure, but a few simple precautions can minimise the problems. First, make sure that all your equipment is well earthed to a single good quality earth. Second, keep your antenna system as far away as possible from the computer and any other source of interference, the use of a coaxial fed antenna can sometimes help. Finally the computer is often blamed for noise which actually originates from a peripheral device, colour v.d.u.s and printers being the worst offenders. The best plan here is to move these devices as far away from the receiver as possible and to use screened inter-connecting leads.

I think that covers the basics of getting started, but if you have any experiences which you think would be useful for the beginner then please drop me a line.

BARTG Spring RTTY Contest

Yes spring is on the way despite the weather. This contest is the major UK organised h.f. RTTY event of the year so how about giving it a crack this year. I know some of you are rather nervous about entering contests but it really is good fun and well worth the effort.

For those of you who have not operated in a contest before, here are a few tips on how it's done. First of all what do you have to send? Well, each contact involves the exchanging of a message and this message must contain the time in GMT, the RST and a three digit serial number. The time is simple enough, though it must be sent as four digits i.e. 1430. The RST is just the normal signal report i.e. 579 and the serial number is a number starting at 001 which you increment by one for every contact you make. That's simple enough isn't it.

If you are lucky enough to have a RTTY program that supports contest working you will usually find that you can send the time and possibly the serial number from a user memory leaving you only the RST to type.

Now for that first contact, I would recommend that you find a good strong signal that is not too busy for your first call. Once a suitable signal has been found wait for the end of his QRZ or CQ call and reply:

G1ABC de G4WNC G4WNC G4WNC G4WNC G4WNC K

Please note that you do not need to start your transmission with RYs and make sure you repeat your call plenty of times and not his as he already knows his! If the other station has received your call he will probably reply as follows:

G4WNC de G7ABC G7ABC RST 599 599 No 023 023 TIME 1340 1340GMT QSL? BK

Your reply back to him should be:

G7ABC de G4WNC G4WNC QSL RST 599 599 No 001 001 Time 1340 1340GMT QSL? BK

If all has been received the other station would usually wish you '73 good luck in the contest and start calling QRZ or CQ again. This example shows the bare minimum for a QSO and you may well find that a lot of stations will spend more time thanking you for the QSO and wishing you luck. The most common mistakes made by beginners are sending too many RYs and stringing out the QSO with unnecessary information and repeats.

Now you know how to operate here are the contest details:

Times: 0200UTC Saturday March 19 until 0200UTC Monday March 21.

The total operating period must not exceed 30 hours during this period and breaks in operating must not be less than 3 hours.

Categories: Single operator, multi-operator and short wave listener.

Bands: 3.5MHz, 7.0MHz, 14.0MHz, 21.0MHz and 28MHz

Contacts: Stations may not be contacted more than once on any one band but additional contacts may be made with the same station on a different band.

Amateur FAX probably from DL9MDI

Countries: The ARRL DX Countries list will be used and in addition each W/K, VE/VO and VK call area will be counted as a separate country.

Message: As described above, time GMT, RST and serial number.

Points: (A) Any two-way contact with stations in one's own country will score two points.
(B) Contact with stations outside one's own country will score ten points.
(C) A bonus of 200 points can be claimed for each country worked, including one's own.

Scoring: (A) Two-way contact points times the number of countries worked.
(B) Total country points times the number of continents worked (Max 6).
(C) Add A and B together to give the final score.

Log sheets: These are available from the contest manager, Peter Adams G6LZB (1), on receipt of an A4 s.a.e.

For further information refer to the winter 1987 BARTG newsletter *DATACOM*. Good luck in the contest.

FAX

Graham G0ENF has written in response to my suggestion of a FAX activity night on the first Monday of each month. Graham uses a Telecopier 400 and lives in Lydney, Gloucester. It would seem that there is quite a bit of activity around that area as Graham reports that he regularly works Pat GW1SXU in Chepstow and Jean G0AWX in Bristol on 144.7MHz. So how about some reports on the success or otherwise of the FAX night.

RTTY on IBM PC Compatibles

Julian Moss G4ILO of Colchester writes to tell me of his experiences starting RTTY with an Amstrad PC 1512 computer. The first problem was software or should I say the lack of it. As he is employed as a computer programmer the obvious solution was to write his own and the result is a program titled appropriately Radiocom. The program has been designed to be very simple to operate and uses drop-down menus to select the various functions. As well as standard RTTY the program allows the transmission and reception of ASCII and c.w. from 6 to 40 w.p.m. I don't as yet have details of the availability of the program, but I understand that it is to be made available as Shareware with registration costing about £12. Hopefully I will have further details for next month's column.

(1) Peter Adams, 464 Whippendell Road, Watford, Herts.

OSCAR-10

The graph shown in Fig. 1, from AMSAT's Satellite Report, is an aid to the transponder users. It gives the translation frequencies at zero Doppler, i.e. the resultant downlink at 145MHz from a given 435MHz uplink, and vice versa. When signals are weak it will assist immediate downlink location, and stop any unnecessary annoying v.f.o. "swishing".

With the monopole antenna now activated on the spacecraft only, signals when the satellite is at apogee have been naturally rather weak when compared to those when the end-of-the-arm beam antennas were employed. Even so, those blessed with quiet noise levels, low-noise front-ends, and good 145MHz receiving antennas with high gain and few sidelobes have been able to benefit from the continuing period of mode "B" activity. At perigee, signals have been quite strong, the 21.3dB improvement resulting from the path loss difference allowing the downlink to be copied even under mobile conditions.

Your scribe spent a few hours on OSCAR-10, and had excellent QSOs with HB9XJ, I8CVS, JA0's TIB and BBW, UA0OB, and several old friends in the USA and Canada. Some seventy different stations around the globe are now active again on the re-born satellite. Unfortunately, the attitude of the satellite panels to the sun is now degrading again, and by the end of February the power production will be less than 50 per cent, this meaning a probable termination of transponder operation for users.

Phase III-C

Dick Daniels W4PUJ reports that all the propulsion, shake and vibration tests performed on the coming satellite in Germany went perfectly, and Phase III-c has passed all its examinations with flying colours.

If plans for the launch of the V-22 Ariane mission do not slip again, we shall now see the launch of Phase III-C from French Guiana on 4 April 1988, a slight further delay from the earlier mid-March intention given by ESA. It will be injected into space from the *Ariane IV* third stage, 4797.1 seconds after lift-off, the springs determining the separation velocity of 59 centimetres per second, when it will be spinning at a rate of 29.47 degrees per second.

The planned injection Keplerian parameter elements for the "parking" orbit prior to operation of the first burn of the kick-motor are:

Epoch:	Instant of separation from 3rd stage as Year, Julian day and decimal day
Inclination:	9.997 degrees
Argument of Perigee:	178.148
True Anomaly:	127.554 degrees
Apogee Altitude:	36 076.636 kilometres
Perigee Altitude:	222.504 kilometres
Ascending Mode Longitude:	135.541 degrees

It cannot stay at that low frictional perigee for long without meeting drag and thus losing injection power, so the first burn towards transformation to the functional OSCAR-13 will follow within a few days for perigee height adjustment then further testing. Later burns will finely adjust the perigee and apogee heights and the inclination to that earlier explained. A bonus has arrived in that the final spacecraft mass is 10 per cent less than expected, this giving a major fuel saving available for fine tuning and later further adjustment of parameters. All users are asked at this early stage to remember not to try to use the satellite until it has been fully tested, commissioned, and handed over for amateur use.

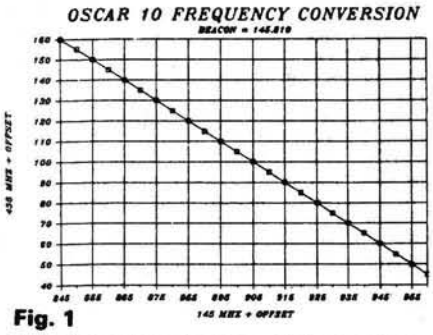

Fig. 1

Incredible as it might seem, some concern was voiced at terming the satellite OSCAR-13, the superstition undoubtedly well fuelled by the earlier misfortunes of *Apollo-13*! The fear of "bad luck" apparently has its advantages, as the AMSAT plea for donations for insuring the satellite for launch has already resulted in over $5000 US contributed, 50 per cent of the total premium needed.

Phase III-D

Here are the latest specifications on the satellite planned for launch by ESA on *Ariane-IV* in the 1990 to 1991 time slot.

Downlink output power of transponder: 250 watts p.e.p.
Bandwidth: 500kHz.
Antenna gains: Up to 15dBi.
Minimum mode "L" user uplink power required: 13dBi (1 watt to 13dB gain antenna, e.g. 10-el Yagi, or 2W to 10dB, e.g. 7-el Yagi, or 20W to 0dB, e.g. dipole, etc.).
Minimum antenna gain for 435MHz station downlink receiver: 5dBi for 300K receiver.
Spacecraft mass: 400kg at launch (including kick motor plus fuel). Diameter: 3 metres, height 0.7 metres.
Power supply budget: 200 watts average d.c. power.
Expected lifetime: 8 years nominal.
Orbit details: Molniya, with 12 hour period, Apogee 35 000km, Perigee 1500km, Inclination 63.4 degrees.
Communications possibility: Worldwide, with the singular exception of antipodeal opposites, e.g. ZL for G. Visibility (communications time per day) 15 hours per day in northern hemisphere, 5 hours plus per day in southern hemisphere.

How Phase III-D will be integrated within the third stage of *Ariane-IV*, in conjunction with other satellites co-launched, is shown in Fig. 2.

Fuji-OSCAR-12

Activity has certainly improved on FO-12 since a more reliable schedule has been maintained. It would appear, although unconfirmed, that the days to look for activation of the transponders are Tuesdays, Thursdays, Saturdays and Sundays, with alternate weeks of "JA" analogue mode for s.s.b./c.w. and "JD" mode for digital packet-radio communications. If the current schedule continues, then we have "JD" week from February 8, and "JA" week from February 15, and so on.

Dave Rowan G4CUO is probably the most active station on the satellite, most certainly from "G", and has worked the following North American stations in the past month: W1NU, KT2K, KC2GG, WA3ETD, WA8EBM, W9ODI, W0EQZ (South Dakota, a very DX QSO), VE2LI (who is very active on c.w.) and VE3ELU (also very active). Around Europe, Dave has had regular QSOs with DL1CF, ON6UG, PE1EVH, I5TDJ, DL1SBY, I1CTA, I5IT, I4CAW, and I8CVS.

Domenico Marini I8CVS, who is a regular user of all the satellites, was delighted to make his first FO-12 transatlantic QSO with John WA3ETD.

Virtually all of the activity on FO-12 seems to take place close to 435.860MHz, with hardly a station ever heard above 435.880MHz, leaving the top 20kHz of the downlink band empty. Yet, s.s.b. stations are sometimes heard with signals coming down as low as 435.830MHz, well into the c.w. section of the band. Fuji-OSCAR-12 is very sensitive, and readily picks up the f.m. signals of those terrestrial stations using the two metre space exclusive band for simplex f.m. QSOs, who thus advertise their violation of the IARU band plan agreement.

RS-10 & 11

Our main report on the USSR born satellites this month comes from **Don Shirreff G3BGM**, of Swindon, Wiltshire, who started in space communications by using RS-5 and 7 in August 1986. Don prefers to use the satellites when they are well out to his west, they then being out of range and immune from some of the attenuating excessive powers run by so many of the European stations. Naturally, his log shows lots of W's, with the following indicated in his first year's operation:
W1AX, JSM, NU, IZ, W3TFA, MOY, K7BBO, WB8JAY, WJ8IKJ, KA8HOK, K8ZOA/A, WB8UWK, W8VXH, KA9SPC, WD9FCH, KJ9I, N9GHV, VE5XU, VE6AMB and UL7CBD.

Since the launch of RS-10/11, Don has been using this satellite, and his log shows good contacts with VE1BB, VE2LI, VE3QO, KA1AJF, WA1SKQ, NJ1H, W1WXZ, KT1N, W1WM, W1NU, W1JSM, NC1K, KB2E, KS3S, ND3E, KS3F, W3TFA, W8MRR, W8VXH and N2DAN.

Don finds the ROBOT, not sharing the combined band input of both 21 and 145MHz simultaneously, to be far more sensitive, responding to his call immediately when just above horizon.

He uses a Kenwood 9130 running 25 watts on c.w. going to a 2-element collinear ground plane fixed to the chimney stack for the uplink, and for receiving the downlink either a dipole or a 3-element Yagi on 29MHz.

"The heart of my system," says Don, "is my faithful ZX81 computer, total cost £17.50. I started by using tracking programs in the *RSGB Software Handbook*, but have now gone on to a TENSAT program that I have modified to give me maximum great circle ranges, DX footprints, easily

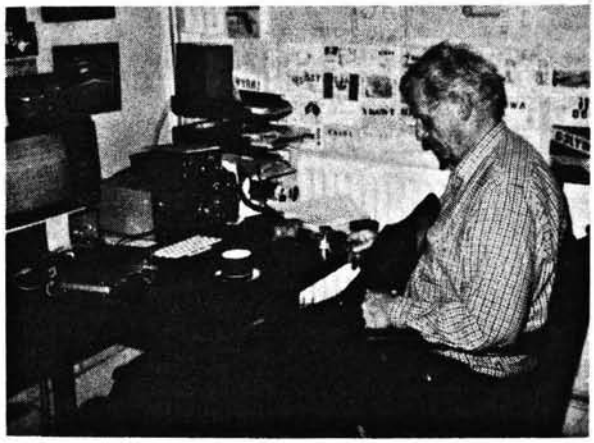

Fig. 3 ▲

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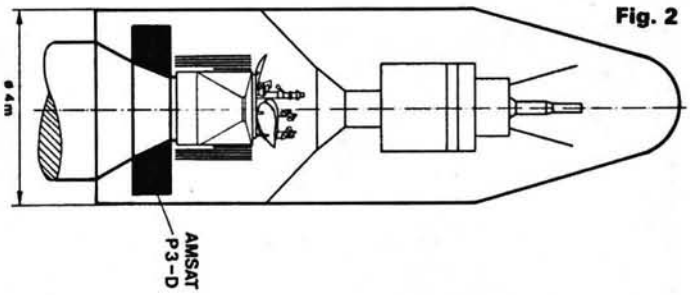
Satellite Choice

 1. Fuji 12
 2. Radio Sport 5
 3. Radio Sport 7
 4. MIR Station
 5. Salyut Station
 6. Radio Sport 1
 7. Uosat 1
 8. Uosat 2
 9. NOAA 9
10. NOAA 10
11. Meteor 2/16
12. Meteor 2/14
13. Meteor 1/30
14. Radio Sport 10/11
15. Cosmos 1870
16. Meteor 2/15
17. Ajisai
```

```
                ALLSATS EQX ON 28/2/88
     UTC   Brg  Next Orbit  Next Day
SAT  EQX    W   +min  +inc  +min+deg
F12  0105  214  115.7 29.2  64.3   20
RS5  0143  53   119.4 30    113.4  30
RS7  0118  56   119.1 29.9  108.7  29
Mir  0022  247  91.4  23.2  23.6   12
Sal  0114  73   94    23.8  64.1   22
RS1  0020  126  120.3 30.2  3.9    3
UO1  0004  69   94    23.5  65.2   16
UO2  0026  39   98.4  24.6  37.2   9
NO9  0132  148  102   25.5  90.2   23
N10  0025  72   101.2 25.3  78.4   20
M16  0010  284  104   26.1  17.3   6
M14  0104  269  104   26.1  16.8   6
M/1  0112  26   96.1  24    1.7    0
R10  0036  297  104.9 26.3  29.5   9
ER5  0126  283  89.5  22.6  82.7   25
M15  0115  1    104   26.1  17     6
Aji  0122  218  115.7 29.2  64.3   20
```

Fig. 2



repeatable orbits on other days, and a time clock to indicate where my RX Yagi should be pointing at any point of the pass".

Don is pictured at his satellite operating position in Fig. 3, accompanied by his dog Gemma, who apparently gets the blame for any c.w. errors, for nudging his elbow whilst he is keying!

Regular reporter **Bill Kelly** of Belfast sends in his log of stations heard on RS-10/11, covering some forty different callsigns copied. RS-1 was heard, but despite careful periodic monitoring, nothing from any of the older RS satellites.

Bill, in common with other users, sometimes finds the downlink very weak, which is due to the high ionisation that we had attenuating the 29MHz signal on daylight paths. At late night time passes, and in the early hours, the signal is up to 22dB stronger when the solar flux is low. A further problem brought about by the improved propagation has been the opening of the 21MHz band, this producing some extremely strong signals working simplex in the satellite uplink passband, blocking the ROBOT and activating high a.l.c. levels in the transponder.

At many times it has been quite difficult to work the ROBOT whilst the satellite is over Europe, as on the 21MHz uplink there has been QRM and on the 145MHz uplink, illicit repeaters use 145.825MHz. This produces continuous blocking and interruption of the required calling sequence, effectively stopping all QSOs until out of range of the offenders.

OSCAR-9 & 11

The problem of cessation of intelligence following the FORTH DIARY software loading into OSCAR-11 was remarkably overcome on December 11 following much intensive prolonged detective and remedial work by the UoS team. It was impossible to re-create the problem by simulation, and before loading the satellite the system worked perfectly on ground, so conjecture has it that the 32K byte memory bank on the satellite had a bad location.

This was a very critical situation, as one cannot overcome a problem with normal commands whilst the system seems not to respond, thus some high degree of risk was present, necessitating much diagnostic information provision with ultra-careful procedures. The care and effort taken has paid off, and again we have full operation after what at first appeared to be a gloomy future—not for the first time!

UA/VE Polar Expedition

Leonid Labutin UA3CR, has been in Canada laying the foundations for project "NORDSKI", the joint Soviet-Canadian amateur-radio ski trip across the Pole. He has been active from Frobisher Bay (69N, 64W) where he and Barry Garratt VE3CDX are establishing the expedition base camp. Leo has been active as UA3CR/VE8, on Packet Radio, the satellites, and on 14.182MHz around 1300–1400, when he reported that the digitalker tests with UoSAT-OSCAR-9 were successful, with good signals heard on the expedition's hand-held transceivers.

Conditions permitting, the expedition is due to commence on March 1, and will take some 90–100 days to complete the 1730 kilometre journey across the harsh terrain. We shall be able to plot progress by listening to the COSPAS/SARSAT position relay by the UoSAT digitalkers, which can be heard by the team in polar regions for part of every single orbit. We should also be able to keep a look out for transmissions from the expedition and the base camp through the RS-10 and 11 codestore system and the transponders, with a special EK0 prefix in use from the venture.

MIR

Listeners on 143.625MHz will have had a ball over the Christmas holiday period, by radio observation of the installation of the new crew of three, one of whom is a medical doctor, and the return of the present team. Cosmonaut Yuri Romanenko has been suffering from the effects of prolonged weightlessness, and his intended 400 day duration mission has had to be aborted after 329 days in the space station.

His recent transmissions, identified by his callsign "Tamir" have sounded as if he had a heavy cold, and he has been suffering from poor sleep and loss of muscle tissue. The passes have been rather difficult to follow, as not only has the orbit been changing faster than new Keplerian elements could keep up with it, with a new "burn" happening every few weeks, but the usual transmission routine has been altered to permit more activity in the southern hemisphere where X-ray observation of the 1987 super-nova in the lesser Magellenic cloud has taken priority. Added to this, some transmissions now go via "SAFIR", a TDRS set up at about 40 degrees east.

John Branegan GM4IHJ continues with his in depth observation of the space station and has sent in an edited set of recordings of MIR v.h.f. traffic, including EVA transmissions, contact with communication ships, heart-beat telemetry transmissions, RTTY relays, and some delightful snatches of Yuri, accompanied by his guitar singing some really good songs that he composed in the Cosmos. John points out that the needed swing of some 5 degrees from quiet sky to the X-ray target in the INERTIA gyroscopically stabilised MIR for the four minute exposure needed necessitates a massive work load, yet another good reason why northern hemisphere communications have been a little terse of late.

He also points out that the massive bulk of MIR and its modules do not have a fixed orientation in space with respect to its forward motion as is commonly supposed. The various manoeuvres that take place can alter MIR's attitude and visual aspect as seen from earth, and this can change the drag factor. The orientation of its antennas can also change, which could affect audibility of the signals. John has sent us enough fascinating information gleaned from the MIR mission to fill a good book, so we shall try to relate as space becomes available.

SPACENET-1, transponder 9H, (channel 17) on 6.3 audio has uplinked to it the Westlink Radio News, an amateur radio news programme of topical interest. It comes on each Sunday, as part of the FM America talk show, and is re-linked from Andover, Massachusetts, to INTELSAT and fed to Europe.

Despite the successful launch from the last Ariane on the V-20 mission delayed from November 18 to November 21, TV-SAT-1 failed to deploy both solar panels in orbit, giving only 50 per cent of the power needed for the four TV channels intended. Despite attempts to shake it free by firing all the thruster motors, it remained stuck at the time of writing around Christmas. The position is in fact far worse, as the panel is covering the receiving antenna, preventing all uplink access.

Karl Cooper (Orkney) reports that Radio Sweden International are broadcasting propagation/aurora predictions in English on Tuesday evenings. The transmission goes out between 2100 and 2130UTC and the actual forecast is usually made about 2125. The frequency is 1179kHz," wrote **Ron Livesey** (Edinburgh). I found this out from his report for the December issue of the Journal of the British Astronomical Association. Ron is the auroral co-ordinator for the BAA and has also contributed an interesting, five page article, entitled *The Aurora 1985* in the same issue.

On November 12, 13, 15, 21, 23, 24, 25, 26 and 30, Ron observed active areas on the sun's disc. He received reports of visual aurora from observers in Finland for the nights of 3/4 and 4/5, Moray Firth on 11/12 and Orkney on 23/24 and 26/27. The magnetometer used by Karl Lewis (Saltash), was generally unsettled on November 27 and 28, very unsettled for periods on days 9, 12, 13 and 24 and reaching storm levels from 1600 to 2200 on the 2nd, 1600–2300 on the 3rd, 1615–1715 on the 13th and 0900–1500 on the 24th.

"Owen Pearson, operating a jamjar magnetometer in Edinburgh, reported a magnetic surge during the evening of the 23rd," said Ron.

"The monthly mean sunspot number for November was 40.9 with peaks of 100 and 123 on the 22nd and 23rd and the lowest was 21 on the 14th," wrote **Neil Clarke G0CAS** from Ferrybridge. His computer printout, Fig. 1, shows that the solar flux units for the month ranged between 91 on the 10th and 121 on the 22nd.

It is interesting to note that **Dave Coggins** (Knutsford) heard auroral tones on many signals between 3 and 23MHz at 1950 on the 23rd. "Lots of broadcast stations had that familiar very rapid QSB on them," said Dave.

Cmdr Henry Hatfield (Sevenoaks) located sunspots and filaments on the days listed in Fig. 5 and recorded solar radio noise, at 136MHz, on November 29 as well as December 4, 5 and 14 plus large individual bursts of noise, lasting from 4 to 10 minutes, on December 1, 6, 18 and 20

Propagation Beacons

First, my thanks are due to **Chris van den Berg**, (The Hague), Dave Coggins, Henry Hatfield, **Don Hodgkinson G0EZL** (Hanworth), **Bill Kelly** (Belfast), **Greg Lovelock G3III** (Shipston-on-Stour), **Ted Owen** (Maldon) and **Fred Pallant G3RNM** (Storrington) for their 28MHz logs. From these logs I compiled the chart of international beacon signals, heard over an area ranging from Holland to Northern Ireland as well as many other parts of the UK between November 26 and December 25, Fig. 2.

Dave, who had a good haul of South-African beacons this time, logged GB3RAL via meteor scatter during the evenings of November 19 and December 14. He uses an Icom R71 receiver with a 2-element beam for 28MHz.

"It's been an interesting period on the beacon front, with eight new beacons, KA1YE/B (28.286MHz), OH2TEN (28.253MHz), VE2HOT/B (28.301MHz),

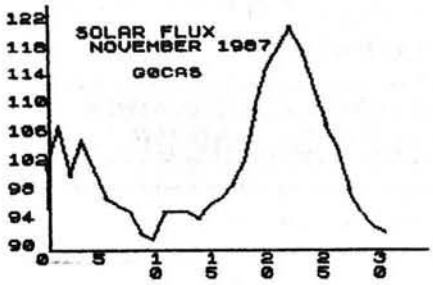


Fig. 1

VE3TEN (28.175MHz), W2NZH/B (28.289MHz), W9UXO/B (28.225MHz), WB4JHS/B (28.252MHz) and WB8UPN/BCN (28.295MHz), being identified since my last report. The Norwegian beacon, LA5TEN, seems to have re-emerged again," wrote Don on December 23.

Greg Lovelock and Ted Owen added KB4UPI/B (28.266) to the newcomers list and Fred Pallant heard the Bermuda beacon, VP9BA, on 3 of the days listed in Fig. 2.

Chris reports hearing a Canadian beacon, VE2MO, (28.300MHz) from Montreal on November 25. Ted Owen kept an ear on 10.1MHz and logged signals from a German beacon, DK0WCY, on December 1, 2, 3, 4, 7, 10, 11 and 21.

Tropospheric

The slightly rounded atmospheric pressure readings, taken at noon and midnight from the Short and Mason barograph, Fig. 4, installed at my QTH, covering the period November 26 to December 25, are shown in Fig. 3. In order to economise on chart,

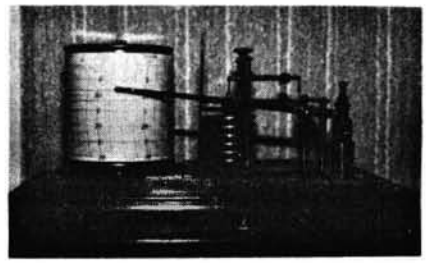


Fig. 4

which is currently around £10 for a year's supply, I usually make one chart last two weeks. The upper trace (second week) in Fig. 4, is above 30.0in where v.h.f. enthusiasts like to see it and the far right of the lower trace (first week) indicates where a climb to high pressure began.

In Maldon, Ted Owen's barometer recorded highs of 1034mb (30.55in) on November 30 and December 1 and 22 and lows of 1002mb (29.6in) on December 16 and 1007mb (29.75in) on November 26 and December 18.

934MHz

The December News Letter of the Personal Radio Club of Great Britain contains some information and copies of correspondence between the DTI and their President James Finch about the possible introduction, in the early 1990s, of a Short Range Radio service in the 933–935MHz region. This newsletter also has a frequency guide for such a service and references to suitable equipment and the future of the present 934MHz band. Readers wanting to know more about the PRCGB, should

Fig. 2

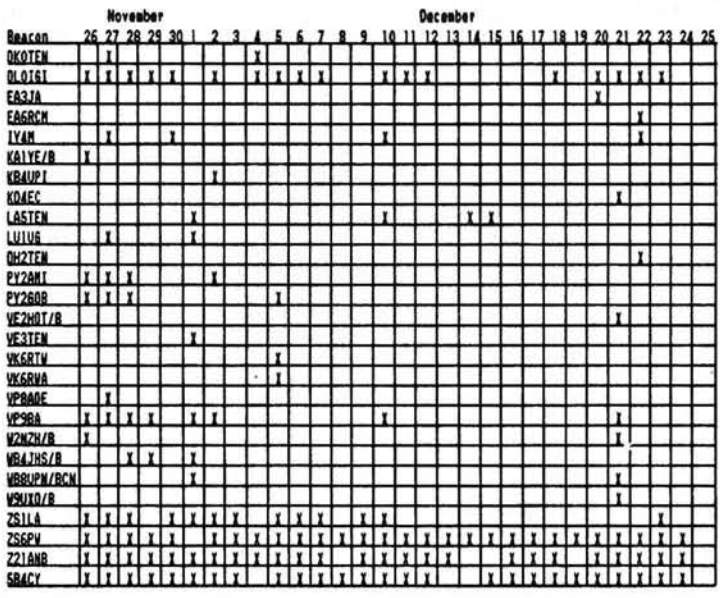
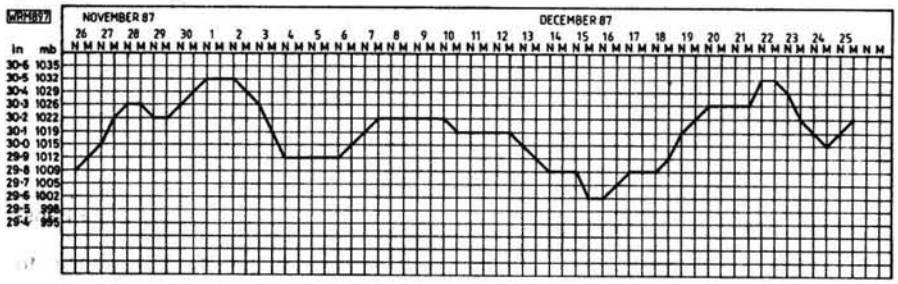


Fig. 3



Date	Time	Spots	Groups	Filaments	Remarks
27/11	1045	2	1?	11	Poor Seeing
28/11	1117	0	0	15	Good Seeing
8/12	1102	6	1	12	
9/12	1152	5	1	13	
10/12	1110	6	1	15	

Fig. 5: **Observations from Sevenoaks from Cdr A.R. Hatfield**

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

send an s.a.e. to James, at 41 Twyford Avenue, Shirley, Southampton SO1 5NZ.

"At 2100 on December 4, Ralph Rowlet GR-587 (Upper Caldecote) contacted a station in Birmingham and at 2120 on the 7th he made a "scratchy" contact in the Blackwall area of London," wrote **John Raleigh** from Bedford. John, secretary of The Four County 32cm Club, said the atmospheric pressure during each contact was 1013mb (29.95in) and 1025mb (30.25in) respectively.

Broadcast Round-up

Peter Shore

Conditions for listening were very variable at the beginning of the New Year, with stations from south east Asia booming in on some days, yet hardly anything audible, including the ubiquitous Soviet signals, on others. However, much has been happening on the bands, with a present for Poles on New Year's Day, when jamming of broadcasts in Polish from the BBC, Voice of America and Radio Free Europe ended. This move had been expected for some time, perhaps in view of Prime Minister Margaret Thatcher's visit to Poland later this year, but is nonetheless welcome, particularly as it means less unnecessary noise on the bands. The jamming transmitters, which were in the Soviet Union, continue to be used against Russian and Soviet regional language broadcasts from Radio Liberty, the American-financed sister organisaiton to RFE, and the Russian Services of Deutsche Welle and Israel Radio.

Jamming also affected Radio Netherlands during the early part of December, when its broadcasts to the Caribbean in the morning and evening were interfered with by the Surinam government. This isn't the first time that this has occurred —in April 1986, a single-tone jammer was put on the air from Paramaribo at the prime of Radio Netherland's broadcasts to the area, joined by a second noise jammer on another frequency. This continued until 27 March 1987 when it ceased. The latest jamming operation lasted from 7 to 9 December. Surinam was a Dutch colony until the 1970s.

On January 2, test transmissions from Radio Exterior de Espana began from facilities of Radio Beijing under an agreement signed late last year. Details of the REE transmissions are in the News section. Reciprocal broadcasts by Beijing over Spanish Foreign Radio transmitters had not been traced at the time of writing, although details of broadcasts from the Mali relay of Beijing which appeared in last month's column, have now been confirmed.

Radio Australia launched a new schedule on January 1, and with it a new DX and media show, lasting almost half-an-hour. Details of all the new timings and programmes also in the News section later.

KYOI, the station operated by the Christian Science Monitor in Saipan, was due to change its format on January 4 from its soft rock output to more mellow music, with WCSN news casts beamed by digital satellite link from the Boston headquarters. At weekends, religious programmes known as the Herald of Christian Science (heard on WCSN broadcasts on Sundays) are to be broadcast. Plans are also well advanced to build another transmitter at the KYOI site, with a steerable antenna array. Back in the USA, a site at Cyprus Creek, South Carolina has been bought and will have two 500kW transmitters to be used for broadcasts to Canada and the United States, as well as Central and South America.

Meanwhile, the Voice of America and the National Broadcasting Service of Thailand have reached agreement to build one 250kW and six 500kW transmitters in Thailand in the next five years. Radio Thailand's External Service will have exclusive use of the lower powered transmitter, and will be able to broadcast 12 hours a day on one of the 500kW transmitters. Radio Thailand currently has an External Service operating on 9.655MHz with 50kW and 11.905MHz with 100kW.

The Soviet Union suffered problems in the week prior to the Reagan-Gorbachev summit when a transponder on the satellite feeding European versions of the Moscow Central Television failed without warning. Radio programmes were also affected, and radio transmitters in European parts of the Soviet Union had no programme feeds for some time on the morning of the transponder failure.

Europe

Note: all times are UTC (GMT)

Austria has inaugurated a listeners' telephone Open Line, which on Thursday evenings may be used to leave DX tips for the German service DX programme. The number is +43 222 82913636. The English *Austrian Shortwave Panorama* may be heard on Sundays at 0900 on 6.155, 11.915 and 15.415MHz, with an evening repeat to Europe at 1805 on 5.945, 6.155, 11.825 and 12.015MHz.

Radio Berlin International has resumed transmissions on the medium wave frequency of 1.359MHz, starting at 1800 with the Danish transmission. English is carried to Europe on this channel at 1915 and on shortwave on 6.115 and 6.08MHz, whilst the 2300 English bulletin is also heard on medium wave as well as 7.295 and 6.115MHz.

Following a reorganisation of some domestic channels, the East German Youth Radio programme, DT-64, is audible between 0400 and 1800 on 657kHz.

Deutsche Welle is using relay facilities of other broadcasters to fill in the gap left by the closure of the Trincomalee relay station on Sri Lanka. Radio Bras in Brazil has been carrying tests, and Radio Veritas Asia carries a Chinese programme between 1230 and 1320 on 9.69MHz. This is not in parallel with the main Chinese programme from Cologne at the same time, as the transmitter site does not have satellite facilities, so the programme is sent by satellite earlier in the day to a receiving station on another part of the island, and taken by courier to the transmitter for broadcast.

The Voice of Greece transmission to North America at 1500, which includes, Mondays to Saturdays, news in English at 1540, has changed frequency from 9.855 to 9.905MHz. An English news cast is also carried in the programme at 1900 on 11.645, 9.425 and 7.43MHz.

Radio Bucharest's programme at 1300 in English is now carried on 17.72, 15.405, 11.94 and 9.69MHz.

Radio Exterior de Espana's relay via Radio Beijing which was mentioned in the introduction can be heard in Europe, albeit weakly, at 1000 on 7.165MHz, although the broadcast scheduled for 1100 on 11.87MHz is unheard in Europe as Radio Moscow uses this channel for a relay of National Radio of Laos in French between 1100 and 1130, followed by a Radio Moscow service.

Swiss Radio international has become the latest user of the 13MHz band. Their foray into this uncharted territory is from 1500 on 13.685MHz, including an English transmission at 1530, in parallel with 21.685, 17.83, 15.43 and 9.885MHz.

The 2300 English service of the Voice of Turkey has moved from 9.56 to 9.445MHz, also on 17.76, 7.16 and 7.135MHz.

Radio Lubljana, one of the varied language services relayed by Radio Yugoslavia has added 5.92MHz for its 2120 English cast. The sequence of language programmes commences at 2000, also heard on 9.62 and 7.24MHz. Lubljana also carries Slovenian programmes.

Radio Kiev's English language programme to Europe at 1900 is heard on 7.17, 6.165, 6.09 and 6.01MHz. A German service at 1700 has the additional frequency of 5.905MHz.

North, Central and South America

Radio Havana Cuba is heard with English to Europe as per:
0000–0200 on 6.09MHz
0200–0300 on 6.115 and 6.09MHz
0300–0400 on 6.14, 6.115 and 6.09MHz
0400–0600 on 6.14 [to 0450], 6.115, 6.09, 6.035 and 5.965MHz
1700–1800 on 9.76MHz
1830–2000 on 9.67MHz
2200–2300 on 6.165MHz

KUSW, the new North American station has been heard with extremely weak signals in the UK at 1600 on 15.225MHz, and from 1900 on 17.715MHz. Radio Surinam via Radiobras is heard in Dutch and English at 1700 on 17.838MHz.

Middle East

Iran's Voice of the Islamic Republic of Iran has been behaving rather oddly of late, with some external services not appearing as and when they are scheduled. The English service, booked to appear at

1130, should be heard on 11.79 and 3.778MHz, whilst the 1330 programme is scheduled for 9.575MHz.

Syria's Radio Damascus is currently announcing 11.625MHz which is unheard here in the UK, although the service is audible on 9.43MHz at 2005. This frequency is probably on the air from 1800.

Africa

The Republic of Cameroon has been noted at 0500 on 4.85MHz with English news.

Radiodiffusion Nationale Tchadienne has been noted on 4.904 and 4.919MHz at around 2000.

Ghana's Domestic Service GBC-1 has been heard at 0525 on 3.366MHz with English identification.

Mali, now benefiting from the refurbishment of its transmitters by the People's Republic of China, is clearly audible in the UK during the day on 9.635MHz (try from 1000), and in the evening, from 1645 on 11.96, 9.635 and 7.285MHz and from 1800 on 4.783 and 4.835MHz.

Asia and the Pacific

Radio Afghanistan has added 9.635MHz to its transmissions between 1730 and 2000 for Europe, including the half-hour segment in English at 1900.

Radio Australia introduced a new schedule on January 1, and its new DX and media programme, *Communicator,* can be heard on Sundays at 0230, 0730, 1230, 1730 and 2030. A ten-minute bulletin of world news, followed, by three minutes of Australian news is now heard at 0100, and every two hours thereafter, with the 30 minute *International Report* programme heard at 0000 and every two hours after that. Mike Bird's propagation report is daily except Sunday at 0425, 0827, 1225, 1627 and 2027. *Window on Australia,* looking in on people and places all over the nation is Monday to Friday at 0113, 0713, 1313, 1513 and 2313. Frequencies recommended by the station for the UK are 0700–0900 on 17.715 and 15.395, 0700–1030 on 9.655 and 1530–2030 on 7.205 and 6.035, although 9.58 has been audible past 1200 at the start of the New Year.

China's Central People's Broadcasting Station 2 has been noted in the afternoon carrying an English language course at 1430 on Wednesdays on 11.74, 11.63, 10.26, 9.39, 9.02, 7.77, 6.89, 5.163 and 5.095MHz.

Radio Ulan Bator is reported to have been heard with English to Europe at 1940 on 11.87 and 9.645MHz. The programme lasts until 2015.

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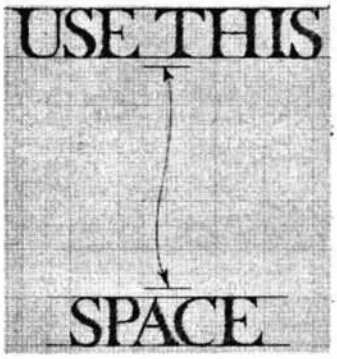

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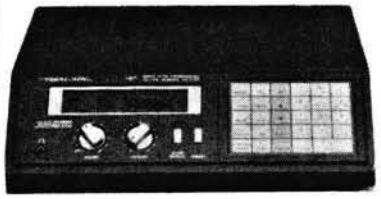

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