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Practical Wireless

THE RADIO MAGAZINE

VHF/UHF ANTENNA SPECIAL

Going Circular

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Practical Wireless

FOR THE Radio ENTHUSIAST . . .

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for the HF man, the TS 430S

£736.00 inc vat carriage £6.00

A new HF transceiver, taking into account the outstanding performance of the previous Trio rigs you could be forgiven for thinking that it would be impossible for them to improve on existing models and specifications. Alternatively of course, you might be of the opinion that engineers with the talents as displayed by the designers of such rigs as the TS830S, TS130V and TR2500 etc. would have no trouble in pushing forward the frontiers of transceiver technology s we know it today.

The new HF transceiver from Trio is the TS430S. Those who have seen it and the fortunate ones who have used it on the air are all agreed that here we have a major advance for the enthusiastic operator on todays busy bands. Not only does the transceiver have full amateur band coverage from 160 to 10 metres (including the three new bands) but it also incorporates a general coverage receiver (150 kHz to 30 MHz). The new transceivers features are many; USB, LSB, CW, and AM with FM available (optional FM430 board), compact size 270mm wide/96mm high/275mm deep, continuous tuning over the entire frequency range, two separate VFO's and an up/down scan mode using the optional MC42S microphone. Eight memories, each of which can be used as a separate VFO are provided and frequency scan is programable between the two frequencies held in memory channels six and seven. Not only does the memory remember frequency but also the mode of operation, thus short wave DX and Broadcast stations can be stored alongside a SSB net channel and complete sense made as the frequencies are scanned. The by now normal Trio features are all included, IF shift, notch filter, speech processor and narrow/wide filter selection on CW, SSB and AM modes.

The TS430S, Trio's rig for todays operator.

and now RTTY, ASCII and CW using TELEREADER equipment.

I must confess that I was extremely sceptical regarding RTTY and the equipment already on the market. To realise that we were to market the Telereader range did not fill me with enthusiasm. That was the situation before Saturday 22nd October.

Being the devoted company man that you all know, I decided to upset my tidy shack, remove the TRIO TS700S and put in its place a TELEREADER CWR 685E complete with matching keyboard. The rig was taken home and connected to my shack power supply. After much study of the most comprehensive manual that I have seen, I made the necessary connections to the TS780. I must quickly point out that to connect any of the TELEREADER equipment to either a receiver or transceiver is simple. In the case of the top of the range CWR685E, three connections are required. These are, audio in from the external speaker socket of the TS780, transmit signal from the TELEREADER to the TS780 front panel microphone socket and finally a PTT line which again uses the front panel microphone socket. Simple!

Having previously studied the two metre band plan I tuned the transceiver to 145.300, the RTTY afsk calling frequency (audio frequency shift keying) and waited. At this point I must confess I thought about half an hour would be enough, and then I could restore the TS700S to its rightful position. However, before 5 minutes had elapsed the TS780 burst into life but there was nothing on the screen. I quickly changed the baud rate, no success. Getting technical now! The information was arriving but I was still getting nowhere.

To speed up matters I decided to throw caution to the wind and transmit, pressed control key + A and began to type. Result: nothing! the TELEREADER appeared to work but not properly, when I stopped typing no tone could be heard.

I must now mention G8FCQ who was the operator I was trying to copy. A more helpful chap I have yet to meet and quickly he put me right. Soon the CWR685E was idling away to itself and typing began. My problem was simple. TELEREADER have designed a beautiful machine, the 33 control commands put the keyboard in control of all functions and make operating a pleasure, but you have to know the commands. Not all of them but the basic ones. For example control key + key A pressed together change the rig from receive to transmit, control key + key Y + key – establishes the idle mode and control key + key W sets the page on the monitor so that the five memories can be prewritten.

Why have memories and what is meant by "page"? Until you have experienced RTTY you will have no concept of the different and refreshing style of operating. By splitting the screen into two, you can receive at the top of the screen and at the same time be typing your reply at the bottom. When the other station has concluded his over and sends you "DE G8FCQ KKK" then you can quickly go to transmit (control key + A as you have already instructed the equipment to be in idle mode). The CWR685E begins transmitting what you have already typed at full speed. Soon you are caught up and from then on progress is at your typing speed which in my case is slow, hence the thoughtful inclusion by TELEREADER of memory. The memories are written prior to going on the air or loaded from tape storage and can be up to 5 blocks of information. For example; a CQ call complete with callsign, a response to someone else's call, a description of the station and in the final memory "73 DE G8GIY, THANKS FOR A FINE CONTACT BI BI". Having mastered the memories then you can prepare a sequence transmission. Again for example; memory 0 three times, station identification followed by a DE G8GIY KKK and, now for the sophistication, you can pre-instruct the TELEREADER to return to receive. Real armchair operation, key in control + key A and sit back to await a call. All the normal test transmissions are included and, don't forget, the rig also has ASCII and CW.

I must confess that I have used neither the CW or ASCII modes. My attention has been held by the number of contacts I have had on RTTY. Having said that, one RTTY contact has requested that I stand by with ASCII whilst he moves his terminal into the shack. I await his call.

It is most important that I convey the TELEREADER'S ability to receive under the most difficult conditions, the "fine" control on the front panel adjusts the tuning frequency of the space filter relative to a fixed mark frequency. So if the station you are trying to copy is not perfectly set up re. mark and space then you can make the necessary corrections yourself. This attention to detail is applied to all aspects of TELEREADER equipment and one doesn't have to use the equipment for long before concluding that a skilled electronic design team has been this way before.

You may have discerned my enthusiasm, I've thrown my microphone away!, after all, on that first weekend I worked on the TELEREADER, ON7XT, perhaps not the best DX but good enough for a beginner.

CWR685E RX/TX Unit	**£730.99 inc vat**
CWR610E RX Only	**£175.00 inc vat**

LOWE IN LONDON, Open monday to saturday, six days a week
lower sales floor, Hepworths, Pentonville Rd, London. telephone 01.837.6702
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TR9130 TWO METRE ALL MODE TRANSCEIVER

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

TR9130 .... **£433.32 inc vat.**

TS780 DUAL BAND BASE STATION TRANSCEIVER

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

TS780 .... **£795.00 inc vat.**

TR7930 TWO METRE FM MOBILE TRANSCEIVER

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

TR7930 .... **£305.21 inc vat.**

R2000 GENERAL COVERAGE RECEIVER

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

R2000 .... **£398.82 inc vat.**

TS930S HF TRANSCEIVER WITH GENERAL COVERAGE RECEIVE FACILITIES

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

TS930S .... **£1150.00 inc vat.**

TR2500/TR3500 HANDHELD TRANSCEIVERS

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

TR2500 .... **£232.53 inc vat.**
TR3500 .... **£250.70 inc vat.**

TS530SP HF AMATEUR BAND TRANSCEIVER

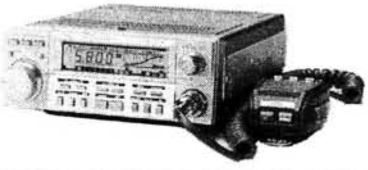
Only TRIO could improve on the unimprovable. The TS530S transceiver of such excellent pedigree now has a notch filter. What was said about the earlier TS520 series applies to the new TS530SP, a rig without frills and yet providing the enthusiastic amateur with all the necessary facilities for reliable world wide communication.

TS530SP .... **£638.00 inc vat.**

TW4000A DUAL BAND FM TRANSCEIVER

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

TW4000A .... **£469.00 inc vat.**



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FT-980

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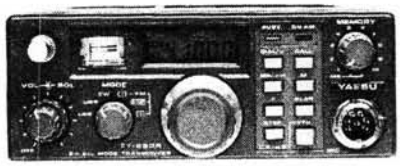
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FRG7700

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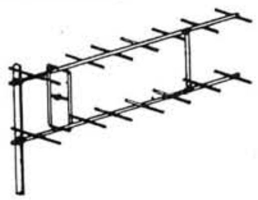
Q6/2M	Quad 6 element	10.9dBd	£39.10	£2.50
Q8/2M	Quel 8 element	11.9dBd	£44.85	£2.50
D5/2M	Yagi 5 over 5 slot	10dBd	£25.30	£2.50
D8/2M	Yagi 8 over 8 slot	11.1dBd	£34.50	£2.50
5XY/2M	Yagi 5 ele crossed	7.8dBd	£28.17	£2.50
8XY/2M	Yagi 8 ele crossed	9.5dBd	£35.65	£2.50
10XY/2M	Yagi 10 ele crossed		£46.00	£2.50
PMH2/C	Harness cir polarisation		£9.77	£1.50
PMH2/2M	Harness 2-way 144MHz		£12.65	£1.50
PMH4/2M	Harness 4-way 144MHz		£28.75	£1.50
C8/70	Colinear Omni Vertical	6.1dBd	£62.10	£2.50
D8/70	Yagi 8 over 8 slot	12.3dBd	£25.87	£2.50
PBM18/70	18 ele Parabeam	13.5dBd	£32.20	£2.50
PBM24/70	24 ele Parabeam	15.1dBd	£42.55	£2.50
LW24/70	Yagi 24 element	14.8dBd	£27.02	£2.50
MBM28/70	28 ele Multibeam	11.5dBd	£21.27	£2.50
MBM48/70	48 ele Multibeam	14.0dBd	£35.65	£2.50
MBM88/70	88 ele Multibeam	16.3dBd	£48.87	£2.50
8XY/70	Yagi 8 ele crossed	10dBd	£42.55	£2.50
12XY/70	Yagi 12 ele crossed	12dBd	£52.90	£2.50
PMH2/70	Harness 2-way		£10.35	£1.50
PMH4/70	Harness 4-way		£22.42	£1.80
CR2/23CM	Corner reflector	13.5dBd	£40.25	£2.50
PMH2/23CM	Harness 2-way		£31.05	£1.50



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SMCVHFL	Discone 65-520MHz Rx only 5.0'	£15.70	£2.50
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SMCGP144W	Colinear 2M Multi ⅝ wave 6.5dB¼ 10.2'	£27.60	£2.50
SMCGP2M	⅝ wave c/w ground plane 3.4dB¼ 4.6'	£18.00	£2.50
SMCSQ144	2M Swiss Quad for vertical mounting	£57.60	£2.50
SMCGP432X	Colinear 70cm 3 × ⅝ wave 6.8dB¼ 5.6'	£29.90	£2.50
SMC7Q2V	Colinear 2.8dB¼ 2M, 5.7dB¼ 70cm 3.6'	£29.90	£2.50
SMC2HB6	6M HB9CV 2 Driven elements	£19.95	£2.50
SMCHS770	144/432 Duplexer 50W 30dB isolation	£15.35	£1.50

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14AVQ/WB	Vertical 10, 15, 20, 40 18.0'H	£64.40	£2.75
18AVT/WB	Vertical 10, 15, 20, 40, 80M 25.0'H	£113.85	£2.75
14RMQ	Roof mounting Kit 12AVQ 14AVQ & 18AVT	£38.52	£2.75
18V	Vertical 10, 15, 20, 40, 80M 19.0'H	£36.22	£2.75
103BA	3 Ele Yagi 10 metres 17.0'LE 8.0'B	£67.85	£3.50
105BA	5 Ele Yagi 10 metres 18.5'LE 24.0'B	£155.25	£3.95
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TH3MK3	3 Ele Yagi 10-15-20M 27.0'LE 14.0'B	£274.85	£5.30
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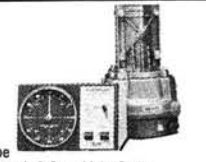
TH7DXX	"Thunderbird" 7 Ele 31.0'LE 20'TR	£511.75	£8.75
HYQUAD	2 Ele Quad 10, 15, 20M 13.5'TR 8.0'B	£354.20	£6.00



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MML432/50	70cm 10W in 50W out	£129.95	FOC
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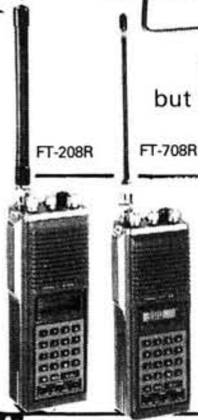

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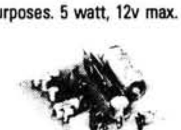

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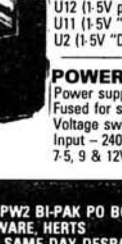

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UNIT TYPE	AR21	AR71
Description	VHF FM Receiver	UHF FM Receiver
Frequency Range	130-180 MHz	400-500 MHz
Number of Channels Available	2 (6ch also available)	2 (6ch also available)
Sensitivity	0.25μV P.D. for 20dB Sinad	
Selectivity	>80dB at ±25kHz	
Input Impedence	50 ohm	50 ohm
Audio Output Power	3 watts into 4 ohms	
Squelch Range	0.2-1.0μV	0.2-1.0μV
Supply Voltage	12.5 volts (11v min, 15.6v max)	
Current Consumption	50-600mA dependent on audio level	
Dimensions	135 × 123 × 26mm	

UNIT TYPE	AT25	AT75
Description	VHF FM Transmitter	UHF FM Transmitter
Frequency Range	130-180MHz	400-500MHz
Power Output	4 watts (normal) 0.5 watts (reduced)	2 watts (normal) 0.5 watts (reduced)
Output Impedence	50 ohm	50 ohm
Supply Voltage	12.5 volts (11v min, 15.6v max.)	
Current Consumption	0.8 amps for 4w output 0.5 amps for 1w output	0.6 amps for 2w output 0.4 amps for 0.5w output
Dimensions	135 × 102 × 26mm	

UNIT TYPE	PRICE (exc. VAT)
AR21 VHF FM Receiver	£149
AR71 UHF FM Receiver	£177
AT25 VHF FM Transmitter	£84
AT75 UHF FM Transmitter	£110

The above items carry a 12 month guarantee, and we normally carry good stocks to ensure the minimum of delivery delays. If you have a requirement, or would be interested in quantity discounts, please contact our sales department.

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ICOM ICR70 GENERAL COVERAGE RECEIVER

Our ads have said it all year "SILKY SMOOTH APPEARANCE WITH THE SILKY SMOOTH PERFORMANCE". What we did not mention was THE SILKY SMOOTH PRICE. . . . We are still not going to but call 01-422 9585 and you will have yourself a merry christmas for sure at a price you will not refuse. Other receivers available FRG7700, KENWOOD 2000. Call for quote.

THE FM MOBILES

There are many on the market these days and it must be difficult for the buyer to make a decision. . . . DON'T LET IT WORRY YOU for we have exactly the same problem. . . . We've searched the specs, tested the performance and analysed the reliability and our findings are simple . . . THEY ARE ALL GOOD . . . some have this and some have that, some are black, some are grey but they all have one thing in common . . . VALUE FOR MONEY. If you like it and it suits you then it's the one for you. . . . It leaves only one problem . . . THE PRICE. Our Welsh friends are forever repeating our original copy "HELPING WHERE IT HURTS". We haven't changed, we're still easing the pain. . . . Call 01-422 9585 and stop hurting.

YAESU FT980 GENERAL COVERAGE TRANSCEIVER

Yaesu said the FT1 was an adventure in electronics and we agreed. The FT980 is something quite different . . . IT'S AN ACCOMPLISHMENT IN ELECTRONICS providing the operator with a brilliantly designed transceiver with a wealth of features. Every feature has been carefully designed in to ensure the operator has MAXIMUM BENEFIT without gimmicks while allowing INCREDIBLE EASE OF OPERATION. We'd need more than this page to do justice to the FT980 so we suggest you call in and try it for yourself or call 01-422 *9585 for a beautifully* illustrated leaflet with a full description. . . . Yes it is expensive . . . the best usually is unless a way can be found to ease the pain . . . AMCOMM ARE EXPERTS AT THAT . . . TRY US.

HEIL HQ 200

What's missing in most amateur radio transmissions? Articulation! The ability to clearly understand each syllable when spoken. Look at the specification of your equipment, does it mention audio articulation or audio frequency response and their distortion levels? We know you won't find it but we'll tell you what to expect. If you have a good audio section it should be fairly flat in response — no big peaks or nulls — and have less than 0.2% distortion. More often than not the microphone is the culprit having an inability to match the audio of the transceiver or your voice. You've heard it on the air "this is Mic one, this is Mic two, this is Mic three" etc. Something is missing, you've paid plenty for the microphone but you are not getting what you expected. What is missing is EQUALISATION, the introduction of active filter circuits in place of passive devices which are capable of giving ± 15 to 20dB of cut and boost at precise frequencies that are easily selected and completely variable. The EQ 200 microphone equaliser is all this and more. Full details are available by calling 01-422 9585, price is £49.95, please state transceiver make when ordering. DON'T FORGET BY ALL MEANS BE HEARD BUT BE HEARD AS YOU REALLY ARE WITH A HEIL EQUIALISER

YAESU 757GX GENERAL COVERAGE TRANSCEIVER

The requests for leaflets of this unit has been incredible. Most of you have the information you need to make a decision, however there is one question left to ask, CAN MR. YAESU PRODUCE ENOUGH TO MEET THE DEMAND? . . . The competition are already in a state of depression . . . read on . . . this is the complete HF rig and includes as standard FULL BREAK IN, CW FILTER, KEYER, MARKER, IF/WIDTH SHIFT, NOISE BLANKER, SWITCHABLE AGC and RF PRE AMP. . . . It also has AM and FM fitted. General coverage 150hz-29.999MHz plus TWIN VFO's. . . . Call 01-422 9585 if you need more information and WE'LL GUARANTEE YOU A GOOD START TO 1984.

THE HANDHELDS

As we said last month "It's been a great year for the handhelds, especially the Yaesu FT208R, they are all extremely versatile BUT THE 208 HAS THE EDGE. Did you see the reviews? They certainly told you a lot . . . WHAT THEY DID'NT TELL YOU WAS HOW TO OPERATE YOUR HF RIG FROM THE 208, from the garden, from the car, even the bath if your are willing to chance it. How? Call us and we'll tell you, we'll even send you the information, so if Father Xmas didn't open his bag for you don't worry, IT'S NOT TOO LATE, Call 01-422 9585 and see what's left in his sack.

AMTECH 300B ANTENNA COUPLER

BRITISH MADE and MADE TO LAST . . . thousands in use throughout the world and priced to suit your pocket. Rated at 300 watts P.E.P. this coupler is suitable for coaxial fed antennas or random wires . . . just compare the price with anything else available and you'll understand why users say it's SUPER VALUE . . . at £49:95 including carriage. It really is our STAR BUY. . . . **Call 01-422 9585 for fast delivery.**

ROTORS

HIRSCHMANN 250. . . . There is no better buy on the market than this. . . . A lightweight Rotor suitable for most VHF antennas. . . . It's yours for £45 . . . Carr and ins. £1:50.

SKYKING SU4000. . . . An outstanding Rotor for large VHF arrays or light HF beams. . . . A delightful illuminated compass readout. . . . NICE ONE AT £85:00 CARR & INS. £1:50.

SKYKING 2000 . . . A super little rotor ideal for the smaller VHF array, already in use at G5VS and doing a grand job, he is delighted and so will you be at the performance and PRICE £39.95 . . . CAN YOU BELIEVE IT? Add £1.25 carriage and you will, we'll have it off to you at once.

YAESU FT726R 2m/70cms/SAT

WHERE YOU ONE OF THE LUCKY ONES ON XMAS MORNING?

If not don't despair, Yaesu are working very hard to keep them coming, like you and the reviewers they know a good thing when they see and hear it. We said it was THE RIG OF THE YEAR 1983, we believe that in twelve months from now we'll be saying the same. If you are buying the number is 01-422 9585, if you are dreaming the number is still the same and we'll be pleased to send you a leaflet to drool over.

YAESU FT102 9 BAND TRANSCEIVER

This transceiver has been on special offer at various emporiums and you probably think it's on the hit list to be discontinued . . . NOT SO says the horses mouth . . . simply an overstock situation which has nearly rectified itself . . . We believe it won't be too long before THE PRICE RISES to a more sensible level . . . so if you are dithering keep the delay to a minimum and CASH IN on the opportunity of a lifetime . . . call us now on 01-422 985 for a SUPER PRICE while current stock lasts.

THE ICOM NEW ONES

ICOM have been busy little boys this year. . . . THREE NEW ONES all announced at the same time . . . IC751 GENERAL COVERAGE TRANSCEIVER . . . IC745 ALSO A GENERAL COVERAGE TRANSCEIVER. . . . The differences are shown in the full illustrated literature which is yours for a phone call. . . . Replacing the IC251E is the NEW IC271, it looks the part and our first buyers are saying it certainly lives up to the high standards everybody has come to expect from ICOM. . . . 01-422 9585 FOR SUPER PRICE AND SUPER SERVICE.

UNION ELEC. WORLD TIME GLOBE

INSTANT TIME AT HOME AND ABROAD . . . simply turn the globe to the required country and it displays a red FLASHING LIGHT on that country. . . . Beneath, IT DISPLAYS THE TIME IN THE UK AND THE COUNTRY OF YOUR CHOICE. . . . Long life of batteries guaranteed by automatic switch off after 30 seconds . . . a beautiful and practical addition to the shack at any time . . . £47:50 post paid. . . . Call now 01-422 9585 FOR FAST DELIVERY.

YAESU FT290RB 2m ALL MODE TRANSCEIVER

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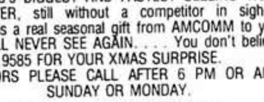
COMPETITORS PLEASE CALL AFTER 6 PM OR ANYTIME SUNDAY OR MONDAY.



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Amcomm

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Comment

"Black-Box" Syndrome

THE ARGUMENT about whether the "black box" operator is a real radio amateur or not is one that often crops up over the air, or where two or more amateur licensees are gathered together, and in letters to the *PW* editorial offices.

Certainly the whole character of amateur radio has changed in the past thirty years. After WWII, there were warehouses stacked out with "war surplus" radio and electronic equipment, and the radio shops of Lisle Street and Tottenham Court Road were like Aladdin's caves for the enthusiast. Units that were of no immediate use were bought and stripped down to the last nut and bolt to fill the obligatory junk-boxes—the printed circuit board hadn't been invented then and all the resistors and capacitors had nice long leads, so they could be easily used to build something new.

By the late 1960s the sheer cost of warehouse space meant that much of the remaining war-surplus stock was simply sold off for scrap, and life began to get harder for the home constructor. As the commercial use of radio and electronics grew, availability of redundant and surplus gear did help a little, but the shift in technology, the p.c.b. and the equipment manufacturers' liking for "special" custom components made amateur re-use more and more difficult.

At the same time, enterprising oriental manufacturers were latching on to the spin-off of the space programme—integrated circuits meant that highly sophisticated equipment could be built into a small cabinet at a price that could be afforded by enough enthusiasts to make it worth going into production, and the "black box" was born.

Today, hardly a single receiver or transceiver on the enthusiast market lacks a microprocessor, though some of its applications are a little doubtful in value. The love of gimmicks, pretty lights and modern styling which has spread from the hi-fi market means that amateur radio for many enthusiasts has become a "consumer" hobby, with all or most equipment bought ready made.

The constructor seems to be the victim of a vicious circle that has developed over the supply of components, particularly of the "radio" variety. The popularity of ready made equipment means the demand for components has fallen, or so stockists tell us. Therefore many stockists no longer deal in radio components, and the aspiring constructor finds it more and more difficult to find all the bits for his latest project. Result: disheartened, he gives up and goes out and buys a "black box".

But is the "black box" operator a real amateur? I'm sure that argument will rage for ever, but it is worth remembering that the international Radio Regulations define the Amateur Service as: "A radiocommunication service for the purpose of self-training, intercommunication and technical investigation carried out by amateurs . . .", a phrase which seems to cover quite a wide variety of activities.

Geoff Arnold

Services

QUERIES

While we will always try to assist readers in difficulties with a *Practical Wireless* project, we cannot offer advice on modifications to our designs, nor on commercial radio, TV or electronic equipment. Please address your letters to the **Editor, "Practical Wireless", Westover House, West Quay Road, Poole, Dorset BH15 1JG,** giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

Components for our projects are usually available from advertisers. For more difficult items, a source will be suggested in the "Buying Guide" box included in each constructional article.

PROJECT COST

The approximate cost quoted in each constructional article includes the box or case used for the prototype. For some projects the type of case may be critical; if so this will be mentioned in the Buying Guide.

INSURANCE

Turn to the following page for details of the PW Radio Users Insurance Scheme, exclusive to our readers.

CONSTRUCTION RATING

Each constructional project will in future be 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. Generally this category will be used for simple projects, but sometimes for more complicated ones of wide appeal. In this case, construction and wiring will be dealt with in some detail.

Intermediate

A project likely to appeal to a wide range of constructors, and requiring only basic test equipment to complete any tests and adjustments. A fair degree of experience in building electronic or radio projects is assumed.

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. Constructional information will generally be limited to the more critical aspects of the project. Definitely not recommended for a beginner to tackle on his own.

SUBSCRIPTIONS

Subscriptions are available at £13 per annum to UK addresses and £14 overseas, from **"Practical Wireless" Subscription Department, Room 2816, King's Reach Tower, Stamford Street, London SE1 9LS.** Airmail rates for overseas subscriptions can be quoted on request.

BACK NUMBERS AND BINDERS

Limited stocks of some recent issues of *PW* are available at £1 each, including post and packing to addresses at home and overseas.

Binders are available (Price £5.50 to UK addresses, £5.75 overseas, including post and packing) each accommodating one volume of *PW.* Please state the year and volume number for which the binder is required.

Send your orders to **Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.** All prices include VAT where appropriate.

Please make cheques, postal orders, etc., payable to IPC Magazines Limited.

Radio Signals Probe Aurora

The glow of an aurora may be beautiful, but it accompanies electrical and magnetic disturbances which can disrupt communications throughout the world and which can cause havoc with compasses, telephone and telegraph lines, electric power lines, radar and satellite-borne computers. In an attempt to gain a better understanding of these phenomena, scientists in America are using one of the most powerful radio transmitters of its kind in the world to probe the effects of the aurora on radio signals and to find out more about this large-scale natural phenomenon.

Alfred Y. Wong, Professor of Physics and Director of the Surmac Plasma Physics Laboratory of the University of California in Los Angeles, says that this research may possibly enable worldwide communications to be improved and lead to a better understanding of the environment surrounding the earth, the other planets and the stars. Professor Wong leads the High Power Auroral Stimulation (HIPAS) research project near Fairbanks, Alaska together with Juan G. Roederer, Professor of Physics and Director of the University of Alaska's Geophysical Institute.

They will work on the aurora borealis in northern latitudes, but a similar phenomenon, the aurora australis, is found in southern latitudes. Auroras are most frequently found as shimmering curtains of blue, green or red light which stretch across the entire sky around the north and south poles. As time passes throughout the night, the intensity and shape of the lights vary dramatically. During the past two years the aurora borealis or northern lights have been especially impressive and are being seen farther south as a result of the increased large solar flare activity.

The aurorae will blaze into view when highly energetic charged particles become trapped in the earth's magnetic field. These charged particles are dumped into the atmosphere where they collide with molecules and atoms which emit the colourful radiation we see as an aurora.

Wong has said that "A comprehensive study of the auroral storms will open the possibility of channelling their frantic energy into useful purposes, such as the improvement of worldwide communication. This kind of study will also probably lead to more accurate prediction of the storms".

The study being made by the teams from the University of California in collaboration with the University of Alaska differs in a number of ways from other work on the aurorae, most of the earlier efforts having involved passive observations from the ground, from satellites and from rockets. In the HIPAS work the aurora is being actively probed with bursts of radio waves which are observed and measured as they bounce off the auroral region of the upper atmosphere. Yet the power sent into the ionosphere during these tests is less than the power of an average radio station, according to Professor Wong.

The project is being funded by the US Office of Naval Research.

BD

Components Fair

Pontefract & District Amateur Radio Society G3FYQ will be holding their fourth annual Components Fair on Sunday 18 March 1984, at the Carleton Community Centre, Pontefract, between 11.00am (10.30am for the disabled) and 4.30pm.

The event will be based on the mobile radio rally with particular emphasis, via the trade stands, being given to the home constructor. There will also be a bring & buy stall, RSGB bookstall, refreshments and licensed bar, plus talk-in on S22.

For further information contact: *A. Mason G4TGU, tel: (0532) 871484 or N. Whittingham G4ISU, tel: (0977) 792784.*

Reg Ward & Co. Ltd.

Would readers please note that one of the telephone numbers in the above company's advertisement on page 23 of the January 1984 issue was incorrect. The second number quoted should have read 34918. We apologise both to Reg Ward and any of his customers who may have been inconvenienced.

Repeater News

The latest batch of proposals to go to the DTI on 1 January 1984 included the Jersey 144MHz unit GB3GJ to be on R2. This particular batch is quite small due to lack of documentation; however, many proposals are in the pipeline for future submissions. As a guide only, requests for re-siting an existing repeater are currently taking approximately eight months to be cleared by the authorities.

Catalogue

Amtronics, the Tonbridge based amateur radio specialists, celebrated their first birthday in October 1983 with the publication of an anniversary catalogue.

The firm are appointed dealers for an impressive list of manufacturers which include FDK, Azden, Icom, Totsuko, MET, Fortop, Bnos, Welz, Jaybeam, Tono, Adonis, Kempro, Diamond, Amtron (kits) and Yaesu.

To obtain a copy of their current catalogue, send a large s.a.e. to: *Amtronics (Tonbridge) G4SYV, 8 Tollgate Buildings, Hadlow Road, Tonbridge, Kent. Tel: (0732) 361850.*

EDXC Club List

The European DX Council recently released the first edition of its Club List which contains information about all the Council's member and observer clubs, including details of their publications, membership fees, meetings, any specialisation and other useful material.

To be revised annually in the springtime, *The EDXC Club List* is primarily intended for shortwave listeners thinking about joining a club and wanting detailed information on the choice available to them in Europe.

Costing only 50p or three i.r.c.s, *The EDXC Club List* is available from: *European DX Council, PO Box 4, St Ives, Huntingdon, Cambs. PE17 4FE.*

Can I Help You!

Are you the secretary, organiser or general dog's body of your local radio club or any other group whose functions may interest readers of *PW*? If so, let me know and I will endeavour to publicise your rally, get-together whatever, through this column.

News

Television & Radio 1984

The expanding range of public services is the theme of *Television & Radio 1984,* the Independent Broadcasting Authority's handbook, which was published on Friday 18 November 1983.

The handbook offers a detailed and informative guide to Independent Broadcasting, and comprises 224 pages with over 400 illustrations, many in colour.

Obtainable from booksellers and newsagents at £3.90, or direct from the distributors for £5.00, which includes p&p: *Independent Television Publications Ltd., Circulation Department, Whippendell Road, Watford, Herts.*

Morse Code Classes

A beginners' 10 week Morse code course will be held at Brooklands Technical College, Heath Road, Weybridge, Surrey, commencing on Thursday 9 February 1984 between 6.30 and 8.00pm. Enrolment will take place on Thursday 2 February between 6.30 and 7.00pm. For further details contact: *Chris Roberts G4EVA, Course Tutor, at the Department of Technology, Brooklands Technical College. Tel: (0932) 53300, extension 246.*

A Morse class intended specifically for intermediate students who already possess the ability to read approximately 8 w.p.m. will commence on Tuesday 10 January 1984 between 7.30 and 9.30pm at *Beckenham Adult Education Centre, 28 Beckenham Road, Beckenham, Kent. Tel: 01-650 1383.* The Tutors will be Peter Grant and Steve Palmer.

New Owners

Would readers, especially those who own a copy of Out of Thin Air, note that Amtest, a recommended supplier in the "Receiver Add-on Accessories" article, have been taken over by D. J. Stanton (Radio).

The new owners will deal, on a mail order basis, with any service, general enquiries and supply of Amtest equipment, from the following address: *73 St. Georges Lane, Worcester WR1 1QX.*

Satellite News

Further to our brief News mention in the December 1983 issue concerning a second UOSAT series experimental satellite, we have been advised by AMSAT-UK that a formal agreement to launch the satellite has been reached between the University of Surrey and NASA.

During its construction phase the new package will be known as UOSAT-B, and subject to its successful launch on 1 March 1984, will presumably be known as OSCAR-11.

In providing this launch facility, NASA's contribution towards this ongoing scientific research has saved the project the commercial cost of a launch which would normally have run to eight figures.

OSCAR-10: The cause of problems encountered by users of the Mode L (1269/432MHz) transponder have been attributed to contamination on the contacts of an r.f. switching relay, resulting in a 20dB reduction in performance. Following repeated corrective "toggling" commands from the ground control station, the attenuation figure has been reduced to some 10dB below the design performance.

AMSAT-UK should, by the time this issue is published, have commenced weekly news bulletins, transmitted via OSCAR-10, based on GB2RS broadcast information. Exact times of these transmissions, covering a three month period, are obtainable from AMSAT-UK.

Insurance

Readers who are interested in applying to the *PW Radio Users Insurance Scheme* are advised to use the coupon published on page 18 of last month's issue.

Please Note!

A number of our advertisers have asked us to advise readers that the price of imported products are likely to change from month to month.

The reason behind these changes is fluctuating international exchange rates. So, readers are therefore advised that they would do well to check prices with suppliers prior to sending off orders.

FUSES selection & use

Part 1 **by E. A. Rule**

In modern electronics, fuses play a very important role which is frequently misunderstood, with the result that expensive equipment is often not protected fully, and this can result in expensive repair bills. The history of fuses is as old as the use of electricity and probably goes back to the time of the first short circuit! At first, fuses were simple open-wire affairs but around 1890 Edison enclosed the wire into a lamp base to make the first enclosed fuse. By 1904 the Underwriters Laboratories had introduced specifications covering fuse size and ratings to meet the safety standards of the period. In 1927 Littelfuse started making the first of their range of low amperage fuses for the budding electronics industry. Since that time many new types of fuses have appeared on the market, some with very special characteristics for particular types of protection, and today the choice is extremely large. In this article it is proposed to take a look at the more common types encountered by the home constructor and to show how by selecting the correct type for any particular circuit, better protection can be provided and the risk of expensive repair bills reduced.

Purpose of a Fuse

A fuse is a device which is introduced into an electrical circuit to prevent excessive current flowing under fault conditions. On overload the wire forming the fuse element will heat up and melt (or blow) and interrupt the current flow, preventing damage from excessive current to the remaining circuits. It is the electrical equivalent of a "safety valve".

The characteristic of most importance to the home constructor is the current rating and, regretfully, this rating is often misunderstood. The current rating of a fuse is established by the manufacturer after a series of tests under controlled conditions. This enables the manufacturer to publish a set of specifications for his product which design engineers can use to decide which is the correct type of fuse for a particular circuit. In order to understand the current rating of a given fuse it is important to know the conditions under which this rating was achieved. There are three main groups of fuses, viz. slow-blow (or anti-surge), normal quick acting, and very fast acting. There is also a fourth type known as time delay fuses. Each of these types will protect a circuit from excessive continuous current, but act very differently under surge or short time conditions. The fitting of the wrong type could mean no protection at all is being provided, or fuses that keep "blowing" for no apparent reason.

Let us now take a detailed look at each type. The blowing time in seconds plotted against percentage overload for the three main types of fuse mentioned above is shown in Fig. 1.1. It can be seen that up to 100 per cent overload there is very little difference between the three types. But if we take a current overload of say 500 per cent we can see that the fast acting fuse blows in 0·001 seconds (a millisecond) and the slow-blow in about 2 seconds with the normal acting fuse at about 0·01 seconds. Quite a considerable difference between the three types. In fact the ratios (taking our normal acting fuse as the reference) work out at one tenth of the time for our fast acting fuse and 200 times longer for our slow-blow type! A very big difference indeed and more than enough to decide the fate of expensive semiconductors under fault conditions.

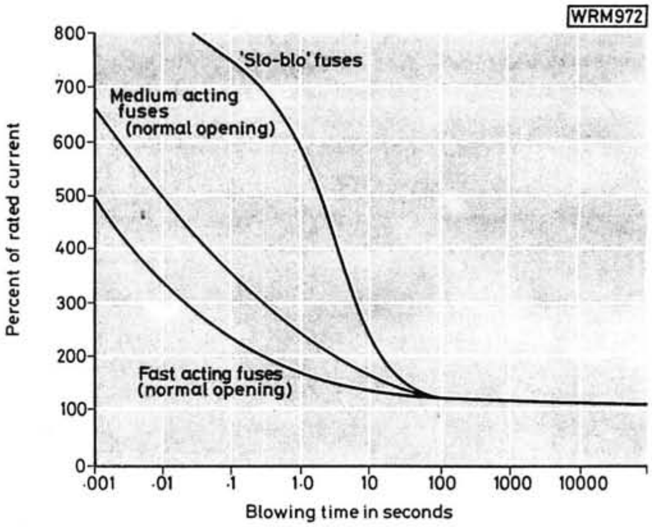


Fig. 1.1: Chart showing the relation of percent of rated current to blowing time

If we now look at Fig. 1.2, we can see how the temperature also has an effect on the current rating. As the ambient temperature becomes lower the amount of current required to "blow" a fuse becomes higher and this can make a considerable difference to the blowing times under surge conditions. In fact taking our slow-blow and normal fuses we can see that the two curves actually cross over at low temperatures. This could require a change of ratings for low and high temperature operation. Although this curve applies to the continuous current rating the overload performance may also be affected. When deciding on a suitable fuse under extreme temperature conditions it is important to carry out a series of tests with simulated faults to check the actual results in practice. However this is unlikely to affect the home constructor as most domestic equipment is operated at or around 20°C with possible lower temperatures of 0°C (cold room on a frosty morning), so the "normal" manufacturer's rating can be used for all practical conditions, but it is as well to know that the current rating may be different at extremes of temperature.

Ah, you may be thinking, let's use a fast acting fuse all the time and be safe. Regretfully this is not practical as many circuits have a high surge current when first switching on, or switching to change operating conditions.

A typical power supply circuit consisting of a mains transformer with a bridge rectifier and smoothing capacitor is shown in Fig. 1.3. A load resistor is also

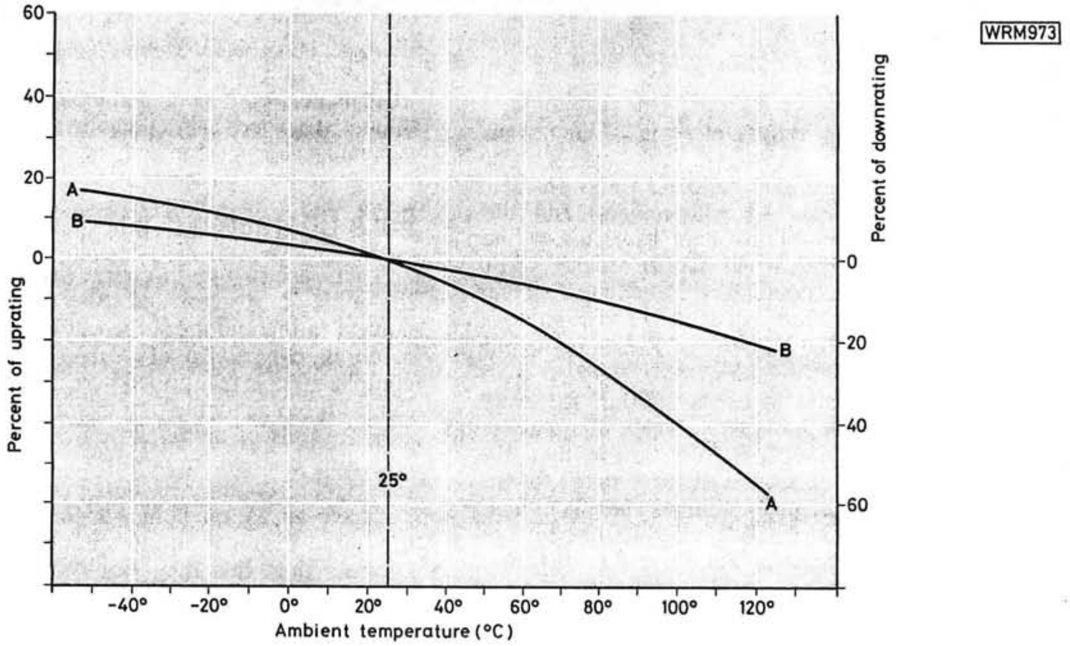


Fig. 1.2: Chart showing effect of ambient temperature on current carrying capacity

shown to provide a steady working current. Fuses are shown in three different places (although in practice only one fuse may be fitted) to show how the type of fuse required depends on its position in the circuit. Assuming a 240 volt a.c. input and say an output of 12 volts at 8 amps d.c. we can consider what types of fuse are required. When the switch is made (or closed) there will be a very high surge current into the primary of the transformer and if the making of the switch just "happened" to be at the time that the sinewave input was at its peak, we could be applying $\sqrt{2} \times 240$ volts across a few ohms (the d.c. resistance of the primary). A typical 100VA mains transformer would have a d.c. resistance of say 20 ohms. This could result in an initial surge current of 17 amps. We know that our output from the power supply is 12 volts at 8 amps, i.e. 96 watts, assuming losses bring this up to 100 watts our continuous current at the primary would be 0·416 amps. So for continuous use we require a fuse which will handle, say, 0·5 amps, but it must also handle a switch-on surge of up to 17 amps for about 2·5 milliseconds (the peak of a 50Hz cycle).

Looking at Fig. 1.1 we can see that a slow-blow type of fuse will handle surges of up to 800 per cent for around 0·01 seconds (10 milliseconds). So taking our maximum peak surge current as our worst case we need a fuse that will handle a surge of 17 amps for at least 2·5 milliseconds. So 17 divided by 8 equals 2·1 amps and a fuse rating of 2·5 amps continuous should prove satisfactory. In the event of a fault condition this fuse rating would blow after around 1 minute with an overload current of 5 amps or so. It is important that this level of current is reached under fault conditions and tests should be made to establish this fact. Normally a fuse in the primary of a transformer will protect the transformer and bridge rectifier from, say, a short-circuit smoothing capacitor.

However, there may be conditions where a fuse in this position will not provide protection. For example, suppose our mains transformer has windings with a high d.c. resistance. If the primary winding had a resistance of 75 ohms, then a short across the secondary circuit could only increase the primary current to a maximum of 340 divided by 75, or 4·5 amps, and in certain circumstances this may not "blow" the fuse before the transformer burns out. Mind you, in the example shown such a transformer would also result in very poor regulation at the output. A paradox, but it is more difficult to correctly fuse a poorly designed circuit than a well designed one simply because the current under fault conditions isn't high enough!

Coming now to our second fuse (FS2) position (in series with the bridge rectifier), although we still have a surge of current, at switch-on the actual conditions are different to our first example. Before switching on the smoothing capacitor is in a discharged state and therefore acts like a short circuit across the output of the bridge rectifier. When we switch on a large current will flow into the capacitor and start to charge it up and as it does so the level of current will fall as the voltage across the capacitor rises. We are concerned here with three levels of current, the normal load current, the initial surge current, and the likely fault current.

We know that our output is 12 volts d.c. and this is the result of the capacitor charging up to the peaks of the rectified input from the bridge. As upon switching on the capacitor is discharged we are only concerned with the maximum voltage from the transformer via the bridge applied to a discharged capacitor (effectively a short circuit). The r.m.s. output from the transformer is around 8·5 volts plus, say, 1 volt to allow for the voltage drop across the rectifier at full load, a total of 9·5 volts. No circuit is perfect and there will be a small resistance in the connecting leads and in the internal connections of the capacitor, as well as the resistance of the transformer secondary (we will ignore the primary resistance for our example).

Let us assume that the secondary winding has a resistance of 0·2 ohms and that all the other resistance in the circuit equals 0·1 ohm. This makes a total of 0·3 ohms

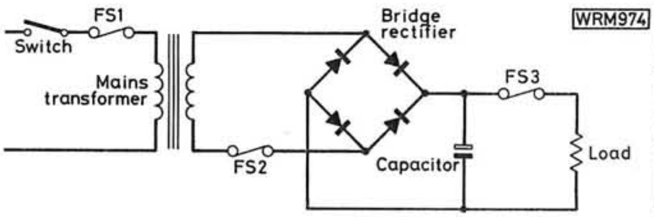


Fig. 1.3: A typical power supply circuit

in series with the current flow into the capacitor at the time of switching on, so our $\sqrt{2} \times 9{\cdot}5$ volts is looking into 0·3 ohms for the first fraction of a second and this will produce a surge current of 44·8 amps! Our fuse must be able to handle this surge without "blowing". Our normal maximum load current we know is 8 amps and we also know that a slow-blow fuse will handle an 800 per cent overload for 0·01 seconds (10 milliseconds) and this would seem to be suitable for use here if we use a fuse rated at 10 amps because this will handle a surge of 80 amps. But, we now have to contend with the time constant of the capacitor circuit and this will depend on the value of capacitor used and also the amount of resistance in the circuit.

A rough rule of thumb is to use a 1000µF for every amp of load current so the most likely value of capacitor in practice would be 10 000µF. We know that the resistance is equal to 0·3 ohms and the time taken for the current to drop to 33 per cent of its initial value is $C \times R$. Therefore our time constant is 0·01 farad × 0·3 ohms, or 0·003 seconds (3 milliseconds). Our slow-blow fuse will handle up to around 80 amps for 10 milliseconds, so in this example would be suitable to use. If a larger value of capacitor was in use or the circuit resistance was lower (or both) then the same fuse may no longer be suitable. For example, if the resistance was as low as 0·1 ohm our surge current would peak at 134 amps which would blow the fuse. Likewise a capacitor of 50 000µF and a resistance of 0·3 ohms would give a time constant of 15 milliseconds and again the fuse could blow.

Of course all this is very over-simplified as all the factors mentioned will interact with each other and make actual calculation almost impossible, but the example serves to show the general picture of what is happening and why a slow-blow type of fuse is required.

Coming now to our third position FS3 (in the output), we may have an unknown factor present and that is, do we know the type of load likely to be presented to the circuit? If it is a capacitive load then we have to apply the same method of deciding on a fuse as a surge may occur. However, if it is a resistive load we only have to consider the load current and a fuse with a rating just above the current flowing, and a normal or fast-acting fuse could be used. A fuse in this positon will only protect the power supply in the event of external faults, it will not give any protection for internal faults. A well-designed power supply would be fitted with fuses in all three positions. By now the reader should be aware that fusing is not the simple thing that so many people think it is; a fuse is a complicated device and must be chosen with consideration of all the factors in a particular situation.

Let us now consider the construction of a typical cartridge fuse. First it has to have a body or barrel and this is normally made of glass or ceramic material. The barrel will have some form of termination at each end, usually brass or copper which has been plated to prevent corrosion. The fuse element will be connected between the two end terminations and enclosed within the barrel, it will consist of a single wire in the case of a quick acting fuse, or may be one or more wires arranged in a specific way for delay and anti-surge types. Sometimes a filler is used to modify the action of the fuse and this may be sand or quartz powder. This filler will absorb the energy of the arc when the current is interrupted.

Fuses are of course marked in some way as to type and ratings, normally on one or both of the end caps and in addition there may be an indication of one of the many standards that the particular fuse complies with, e.g. BS, SEMKO, etc. The size of fuse may vary but there are a number of standard sizes and the most common are the Continental Standard which is 20mm long by 5mm diameter and the British plug top standard of 1in by $\frac{1}{4}$in diameter. The other common size used in British equipment is the $1\frac{1}{4}$in by $\frac{1}{4}$in diameter. Many other sizes are available ranging from 5mm long to over 200mm and of course there are a number of other styles available for special purposes.

Fuse Characteristics

There are two main characteristics which will concern the home constructor and these are maximum continuous current rating and the surge rating of slow-blow types. The rupturing capacity of a fuse may also be important and for completeness is mentioned here. A high rupturing capacity (h.r.c.) fuse is capable of interrupting currents in the order of thousands of amperes. It would have a ceramic body and also contain an arc-quenching medium. Non-h.r.c. fuses (more common in home constructed equipment) do not have an arc-quenching medium and are only suitable for surge currents up to about 50 amps. With higher currents than this they would be very likely to explode when they blow.

Fusing Speed

A **quick-acting fuse** is designed to react both to short and long term overload conditions. They are very robust in construction and will withstand shocks and vibration. But they do tend to have a higher resistance and the voltage drop caused by this may be a problem in some applications. This higher resistance also means that more heat is produced and this must be effectively dissipated.

Time delay fuses will react to long term overload currents but will withstand transient surges without harm; several types are available. For example, one type has what looks like a spring inside the barrel and these will stand up to surges of around ten times the normal rating for 75 milliseconds. Another type has a "blob" in the middle of the fuse element and this type has a reduced surge capacity, typically ten times rated current but only for 25 milliseconds. Time delay types have a very low resistance and can be used in enclosed places as there is little self-generated heat but they are only available in the lower current ratings. Both the "spring" and the "blob" type are time delay fuses.

So far we have only mentioned the current rating of fuses, but they also have a maximum voltage rating. This voltage rating has no effect on the current rating but is important nevertheless. When a fuse "blows" an arc is developed between the two ends of the broken fuse element and if the voltage across these ends is high enough, the arc will be maintained and the current ***will not be*** interrupted. This condition could result in considerable damage to the equipment. Arcs are readily produced in high voltage circuits or where inductive loads are being used and in these conditions the voltage rating of a fuse must not be exceeded. Fuses can be used at their current rating at all voltage levels up to their maximum. When it is known for certain that although the circuit has a high voltage present the power available is limited, it is possible to use a fuse at a higher voltage than that for which it is rated. This is common practice in domestic electronic equipment and quite safe. But if in doubt, keep within the voltage ratings given by the manufacturers.

In the next part we will look at the factors to consider when selecting the best fuse for a circuit. We will also look at the markings of Continental fuses.

EXTERNAL BFO FOR 7MHz

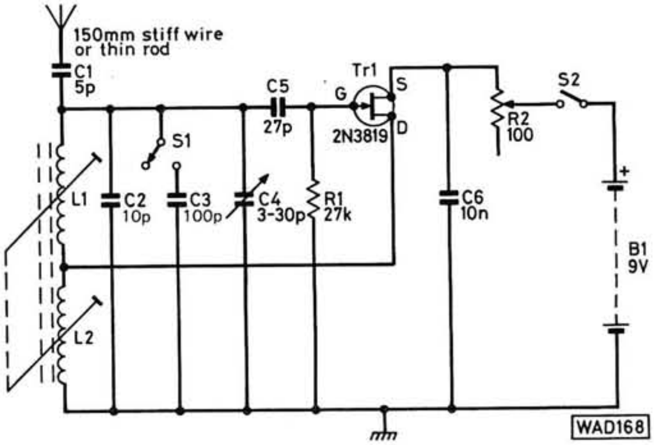
E. Vaughan

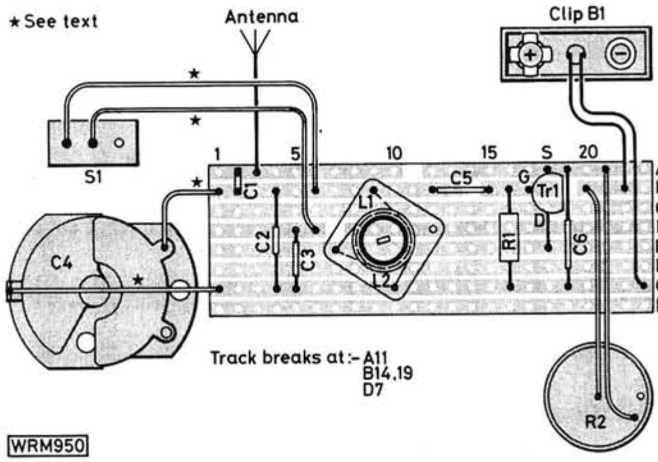
An ordinary all-wave band a.m. receiver may not have a beat frequency oscillator (b.f.o.) available and therefore cannot resolve single sideband (s.s.b.) signals correctly. By using an external v.f.o. (variable frequency oscillator) in conjunction with the receiver the resolution of s.s.b. is possible.

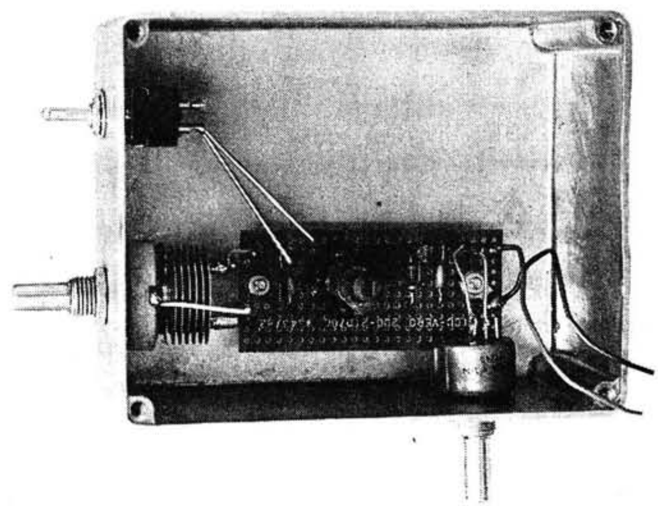
This circuit involves no modifications to the main receiver or wires connecting the two units together. The external v.f.o. should just be placed on top of the main receiver, or close-by, depending on the results. This method of "carrier-injection" was often used in the early days for resolving s.s.b., and is proving useful again.

Operation

The main tuning on the receiver should be used to find an s.s.b. signal. This should be easily recognisable as the recovered audio is garbled and incomprehensible. Then use C4 on the v.f.o. unit as a coarse tune and the s.s.b. should become a little clearer. Resistor R2 allows fine frequency control and can be used to resolve the signal into clear speech.







★ components

Resistors
⅛W 5% Carbon Film

27kΩ	1	R1

Cermet Potentiometer

100Ω	1	R2

Capacitors
Sub-miniature Plate Ceramic

4.7pF	1	C1
10pF	1	C2

Silvered Mica

27pF	1	C5
100pF	1	C3

Disc Ceramic

10nF	1	C6

Jacksons C804 airspaced variable

30pF	1	C4

Miscellaneous
2N3819 (1); s.p.s.t. switch (2); 28 s.w.g. wire; 7·1mm diameter coil former; 6mm diameter ferrite core; knob (2) 114 × 64 × 55mm diecast box; 9V battery.

continued on page 36 ▶▶▶

Practical Yagi Design

By Dave Powis G4HUP

This article offers a practical approach to the design of Yagi type parasitic antennas, its main advantage being that it provides an answer to the age-old constructors' problem—you can never find exactly the same materials as the design specifies! The method proposed is not just a way of altering existing designs to suit the available materials, it is a complete design system.

No originality whatsoever is claimed by the author for the information contained in this article. The hard work of research and evaluation of results has been performed by others (see references) and published in the USA. The author's experiences with this design approach, however, have led him to believe that this information is worth a much wider audience on this side of the Atlantic. It is from this aspect that the information is presented in the hope that it will encourage more amateurs and s.w.l.s to have a go at making their own antennas.

Initially the design information itself will be presented, with a worked example. This will be followed up by a practical design, with full design and construction details.

Research into Antenna Design

In the early 1950s (yes, that long ago!) the American National Bureau of Standards (NBS) instituted a program of research into the factors affecting the design of the Yagi antenna. Although this work was completed the results were not published for many years; the first time it was published in amateur circles was in 1977, in an article in *Ham Radio*[1], by W1JR. This article gave the salient features of the research, and presented several practical designs. The designs to be presented here have been derived from the design information published, and are not repetitions of W1JR's work.

Basis of Yagi Design

There are many parameters which can be varied in the design of Yagi antennas. The boom length, element spacing and director length (constant or tapered) are just a few. Using computer techniques it is possible to optimise all variables, and hopefully produce the "best" design—see DL6WU's excellent articles in *VHF Communications*[2]. The complexities of this technique are way beyond the facilities of the average amateur, and it is for him (wherever he is!) that this article is written.

By restricting certain of the variables at the outset of the design procedure, the production of repeatable, practical designs is well within the capabilities of the amateur, especially when aided by the approach given here. A full treatment of the subject is neither given nor intended—anyone interested in this should attempt to obtain a copy of the full NBS report[3], and the *Ham Radio* article[1]. However, sufficient information is given here to enable the reader to make full use of the NBS data.

The NBS Design Data

The design information arrived at by the NBS depends on accepting a *fixed* element spacing along the boom. Having accepted this limitation, the NBS data provides tabulated information, Table 1, of the parasitic element lengths, spacing and overall gain for six different antennas.

All of the information is given in fractional wavelength form, and is "normalised" for an element diameter of $0{\cdot}0085\lambda$. As in all practical situations, $0{\cdot}0085\lambda$ diameter elements are probably the one size you can't get, but don't worry, you can adjust the lengths to suit what you can get.

Various diameters of metal boom can also be allowed for by applying correction factors—this means that you can design your antenna to suit both the element *and* boom materials available. It is this fact that makes the NBS design data so powerful. A constant problem with trying to repeat other published designs is making sure that you have used the same materials as the original.

Table 1

	1	2	3	4	5	6
Antenna Length	0·4	0·8	1·2	2·2	3·2	4·2
Reflector Length	0·482	0·482	0·482	0·482	0·482	0·475
Director 1	0·442	0·428	0·428	0·432	0·428	0·424
Director 2		0·424	0·420	0·415	0·420	0·424
Director 3		0·428	0·420	0·407	0·407	0·420
Director 4			0·428	0·398	0·398	0·407
Director 5				0·390	0·394	0·403
Director 6				0·390	0·390	0·398
Director 7				0·390	0·386	0·394
Director 8				0·390	0·386	0·390
Director 9				0·398	0·386	0·390
Director 10				0·407	0·386	0·390
Director 11					0·386	0·390
Director 12					0·386	0·390
Director 13					0·386	0·390
Director 14					0·386	
Director 15					0·386	
Director Spacing	0·2	0·2	0·25	0·2	0·2	0·308
Gain dBd	7·1	9·2	10·2	12·25	13·4	14·2
Design Curve	A	C	C	B	C	D

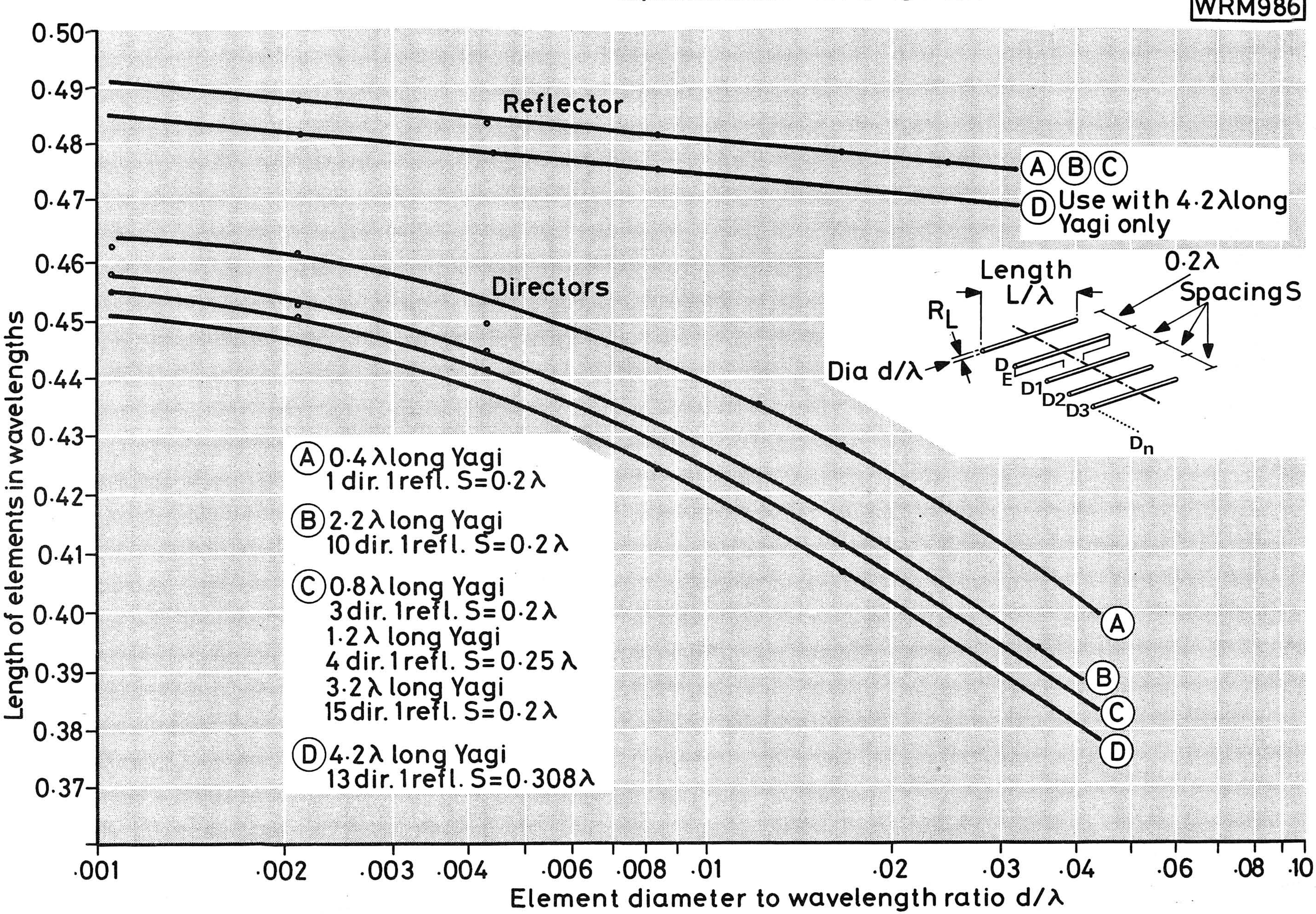
Optimised parasitic element lengths. All lengths are expressed in terms of λ. Reflector spaced 0·2λ behind dipole, element diameter 0·0085λ (reproduced from *Ham Radio*, August 1977)

Using the Design Data

Rather than get involved in a long discussion about the finer points of the design data, we will go through the paper exercise of designing an antenna, dealing with any points as they arise.

The heart of the information is the design graph of Fig. 1. As you will see from this graph there are six lines plotted in two families. The upper family of two lines deals with the reflector design, and the lower four curves handle the director design.

Fig. 1: Yagi design graph showing the relationship between element diameter to wavelength ratio (d/λ) and element length for different antennas
Reproduced from *Ham Radio*, August 1977



Example of Yagi Design

First of all, let's assume that we have director material of $0 \cdot 0085\lambda$ diameter available—it's convenient to do so, and we can examine the effect of other diameters later. Also, let's settle initially for a relatively small antenna—a 5-element beam, with a boom length of $0 \cdot 8\lambda$, and a gain of 9·2dB relative to a $\lambda/2$ dipole.

The information for this is to be found in column 2 of Table 1. From it we can read off several details directly:

a) the reflector length is $0 \cdot 482\lambda$

b) The three directors are:
   D1 $0 \cdot 428\lambda$
   D2 $0 \cdot 424\lambda$
   D3 $0 \cdot 428\lambda$

c) the spacing between the reflector and the dipole is $0 \cdot 2\lambda$

d) the spacing between the directors is $0 \cdot 2\lambda$

With this information we can now draw our "ideal" antenna, as shown in Fig. 2, with the dimensions in fractional wavelength form, as we have made no reference to the working frequency.

There are two dimensions that we still need in order to end up with a viable design. We need to know the dipole length, and we have made no decision yet on the boom diameter.

The Driven Element

The length of the driven element, or in this case the dipole, is not critical, and in fact the length can be varied to obtain the required matching conditions. A reasonable starting value for the dipole length, as recommended by the NBS data, is: Dipole length $= 0 \cdot 466\lambda$ or in practical terms:

$$L = \frac{5500}{f} \text{ inches or}$$

$$L = \frac{139700}{f} \text{ mm}$$

where L = length
and f = frequency in MHz

Boom Diameter

The diameter of the supporting boom is a compromise—it must be substantial enough to fulfil its task as a support, yet ideally should be small enough for its effects on the tuning of the antenna elements to be ignored. This is not always possible to achieve, and another of the benefits of the NBS data is that a graph, Fig. 3, is available to help you determine the change in element length required to compensate for the effect of the boom.

Note that this chart only applies to elements mounted onto or through a conductive (i.e. metal) boom. If the elements are stood-off from a metal boom then the effect of boom diameter can be ignored. It is worth mentioning at this point that the NBS research did examine the effect of using different boom materials, including wood and plastic. The outcome of their investigations was that a good insulation between elements or a good contact between elements produced a good antenna. However, a good insulation is much more difficult to maintain than a good contact. Wood, in particular, was found to be a bad boom material, as it was very susceptible to changes in humidity. This caused changes in the gain and directivity of the antenna, to the extent that repeatability was virtually non-existent despite various protective coatings that were used to combat this.

Designing a Real Antenna

OK, so that's the easy bit done—we can now design an antenna provided materials are available to our exact specification. Now let's look at the real world, where we must accept the materials we can get.

We will repeat the "ideal" exercise, but this time we will specify a frequency, and turn our antenna into a realisable practical design. We have already obtained the starting information about element lengths and spacings, and must now apply the necessary factors to compensate for the materials we intend to use.

It is at this point that we must be specific about frequency, as we need to know about our materials in terms of fractional wavelength. For the sake of this example, let's assume that we are designing this antenna for the *144MHz* (2m) band, and we will design for 145MHz, the band centre.

$$\text{The wavelength is: } \frac{2998}{145} = 2 \cdot 0676\text{m}$$

Selecting Suitable Materials

Without getting involved in calculations of mechanical forces, the sizing of materials for antenna construction is largely empirical. Booms must be sufficient to support the elements without too much droop, and the elements must be strong enough to support their own weight plus that of the occasional starling or wood pigeon! It must also be remembered that the diameter of the elements affects the bandwidth of the antenna. Whilst this is not generally going to be a problem for amateur band coverage, it should be borne in mind particularly when designing 50MHz and 430MHz antennas if coverage of the entire allocation *is* required—i.e. 50–54MHz or 430–440MHz. The smaller the element diameter, the narrower the bandwidth of the antenna, although this can be overcome to some extent by making the dipole and possibly the reflector larger in diameter than the other elements.

For our particular example 12·5mm diameter tube is suitable as the element material, and 25mm tube is readily available for the boom. Converting these figures into fractional wavelength terms we find that the element diameter is:

$$\frac{12 \cdot 5}{2068} = 0 \cdot 006\lambda$$

and that the boom diameter is:

$$\frac{25}{2068} = 0 \cdot 012\lambda$$

Adjusting the Dimensions

We can now use the graph of Fig. 1 to derive the necessary changes to the "ideal" element lengths extracted from Table 1. The bottom line of Table 1 indicates that for the design we have chosen we must use design curve C of Fig. 1.

Find $0 \cdot 006\lambda$ on the X (horizontal) axis of Fig. 1, and carefully draw a line vertically from that point. This gives our reference point for working out the new element lengths.

Dealing with the reflector first; the length obtained from Table 1 was $0 \cdot 482\lambda$ for $0 \cdot 0085\lambda$ element diameter. Our line, at $0 \cdot 006\lambda$, intersects the reflector curve C at $0 \cdot 483\lambda$, so this is our new reflector length.

Now for the directors. You will find that the $0 \cdot 0085\lambda$ element diameter line crosses director curve C at $0 \cdot 428\lambda$, which is the value given in Table 1. The line we have drawn, at $0 \cdot 006\lambda$, crosses director curve C at $0 \cdot 436\lambda$, WRM987

Table 2

Element	From Table 1	Compensated for Diameter
Reflector	0·482λ	0·483λ
Director 1	0·428λ	0·436λ
Director 2	0·424λ	0·432λ
Director 3	0·428λ	0·436λ

Element lengths compensated for diameter

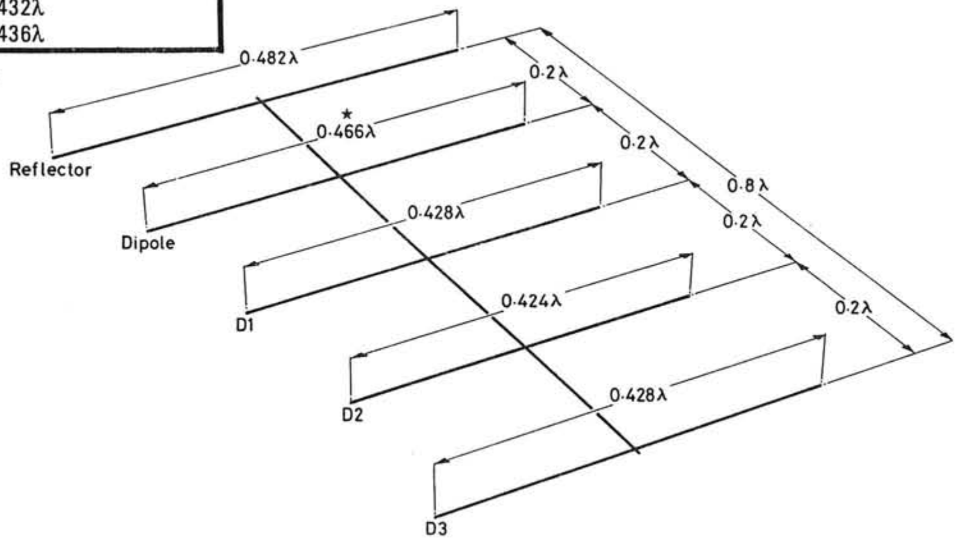
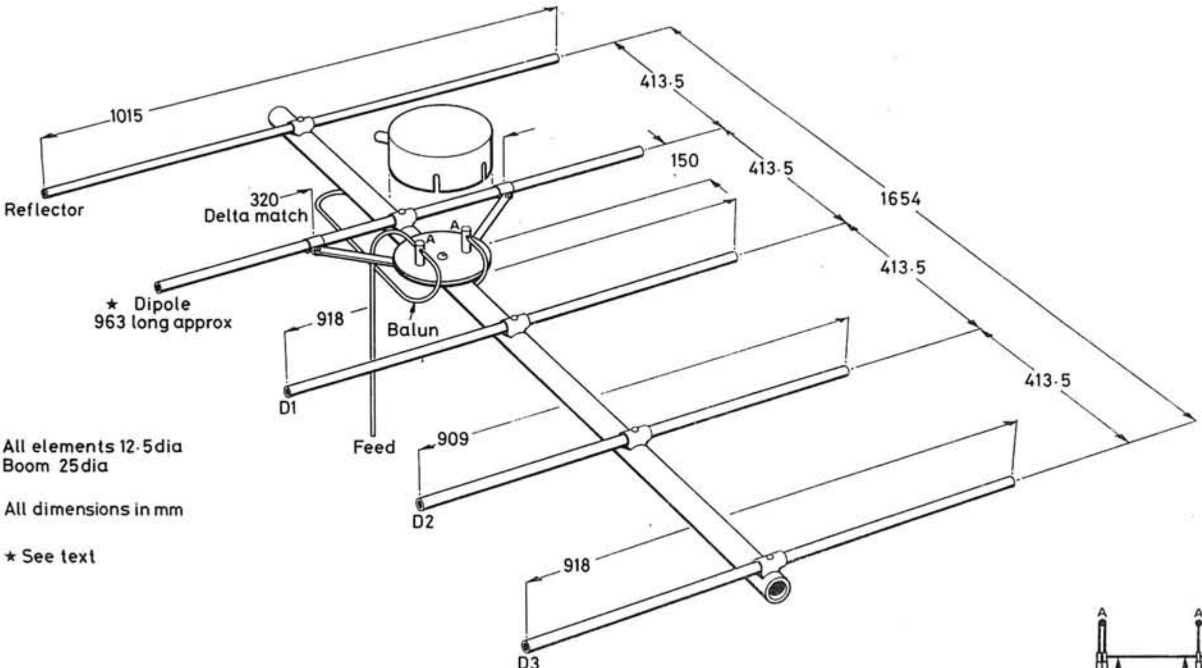


Fig. 2 (Above): 5-element Yagi design—"ideal" case with (Below) a "practical" 5-element 144MHz Yagi with associated Delta matching arrangement and coaxial balun to provide 50Ω input impedance



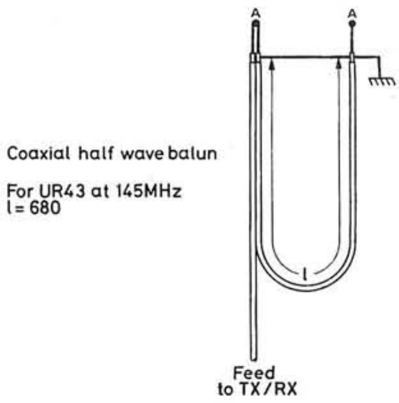


Table 3

Element	From Table 2	+ Boom Factor	Actual Length
Reflector	0·483λ	0·491λ	1015mm
Director 1	0·436λ	0·444λ	918mm
Director 2	0·432λ	0·440λ	909mm
Director 3	0·436λ	0·444λ	918mm

Element lengths with boom correction factor. Element spacing 413·5mm

which is substantially longer.

To derive the lengths of the remaining directors you will need a pair of dividers. Set one point of the dividers on the intersection of the 0·0085λ vertical line and director curve C. Set the other point to the place at which curve C crosses the horizontal 0·424λ element length line. Now transfer this value to our new reference, the 0·006λ vertical. You should find that this gives an element length of 0·432λ.

We are now able to tabulate the dimensions for the new, practical antenna, in terms of wavelength. Table 2 shows the original lengths, extracted from Table 1, and the compensated element lengths derived via Fig. 1.

Allowing for the Boom

All that remains now is to add the compensating factor for the boom diameter. We have already established that our boom diameter is 0·012λ, so by referring to Fig. 3 we can obtain the correction factor.

Following the 0·012λ vertical on Fig. 3, it crosses the curve at a horizontal value of 0·008λ. Therefore each element of our antenna must be lengthened by 0·008λ to allow for the boom diameter. Table 3 shows the fully compensated element lengths, and for the first time, the actual lengths in mm.

Adding the Driven Element

We now have a full design for the parasitic part of the Yagi antenna. All that remains is to add the driven element. Referring back to the paragraph on the driven element, a good starting point is 0·466λ.

It is not necessary to apply the correction factors to the driven element, as we may need to adjust its length to alter the match anyway. Converting 0·466λ into real terms gives us a length of 963mm for the dipole, and we can now draw the complete "practical" antenna, with dimensions, as shown in Fig. 2.

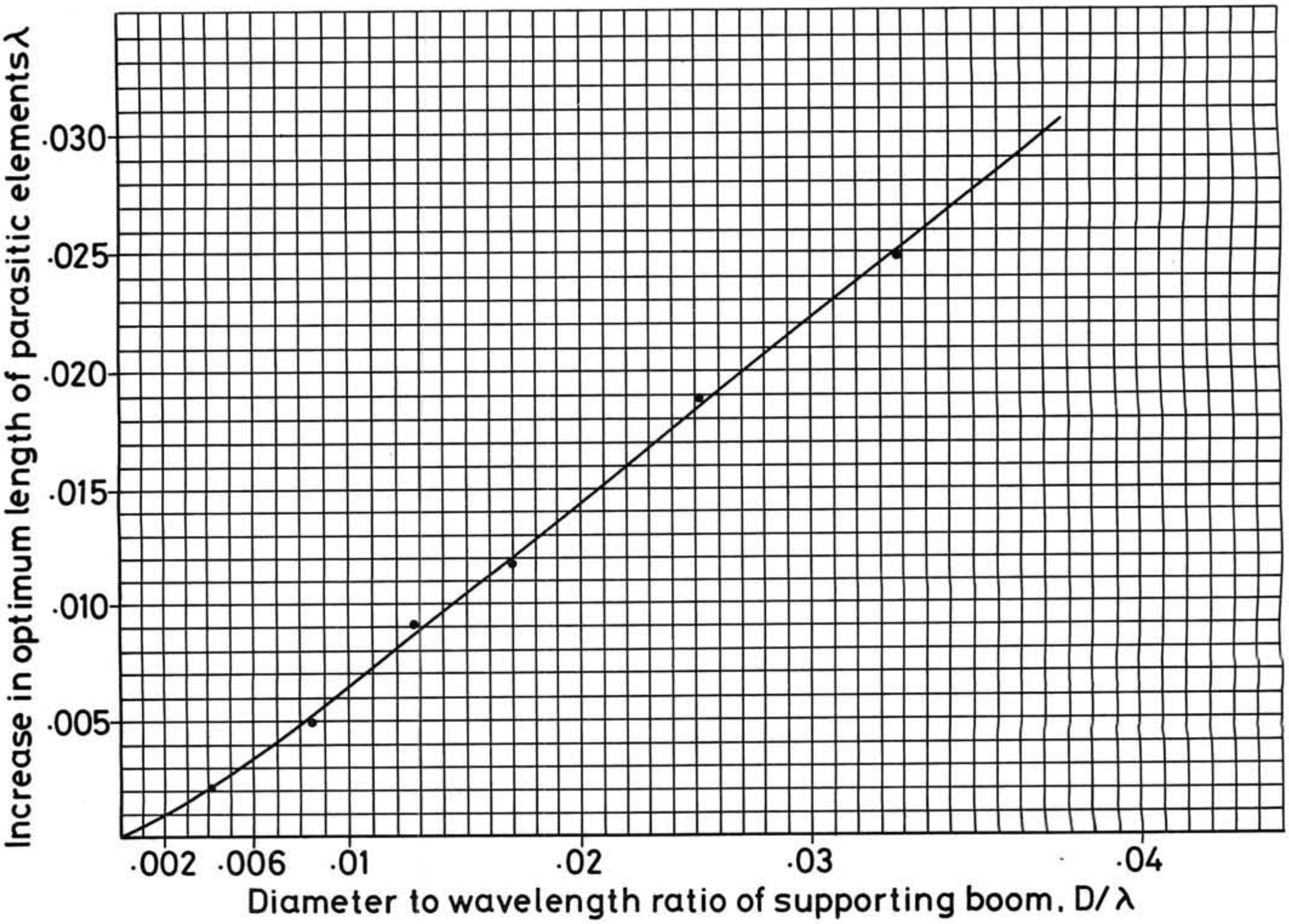
Feeding the Antenna

So far we have made no mention of actually connecting a feeder to this antenna! The dipole may be of either single or folded dipole construction, but a single dipole is probably easier to adjust for matching conditions. If a single dipole is chosen, the feed options are the Delta match, Beta match or Gamma match. The author has found the Delta match to be very satisfactory, and a suggested set of dimensions for 144MHz band use is given in Fig. 2. These have not been tried, but as with the dipole itself they are not very critical.

The Delta match will present an impedance of around 200Ω, and this can be matched to the unbalanced 50Ω of your feeder very conveniently by using a 4:1 halfwave coaxial balun.

Fig. 3: Graph showing the effect of a supporting metal boom on the length of the parasitic elements
Reproduced from *Ham Radio,* August 1977

WRM988



Folded Dipole

If you wish to use a folded dipole, connect the coaxial cable to the dipole by using a coaxial balun, as shown in Fig. 2, to step up the impedance from 50Ω to around 200Ω and to give unbalanced to balanced conversion.

Although the folded dipole is difficult to adjust in length (without making a whole family of dipoles) there are other methods which have been used successfully by the author to match Yagi antennas.

Practical Matching

One of these methods is to build the antenna, but not to fix the dipole to the boom. Set the antenna up, in the clear, beaming at the sky. Slide the dipole between the reflector and the first director, looking for the point that gives the best match. Make sure that there is an electrical contact between the dipole and the boom whilst you are doing this. Fix the dipole at the position that gives the best match.

The other method, which can only be recommended where the match is fairly close anyway, is to bend the reflector ends towards or away from the dipole. This can cause the antenna to look slightly odd, but it does work. The author has found this approach to be particularly useful for matching arrays of antennas.

For any matching operations the use of lower power (i.e. return loss type) measurement techniques is to be recommended. Using the station TX to provide the drive for an s.w.r. measurement is not really satisfactory for two reasons. In the first instance you are exposing yourself to r.f. power. This may only be of the order of a few watts, but the exposure can be for a considerable length of time when you are experimenting, and in spite of various reassurances and statements about safe power levels, we don't really understand the full effects of r.f. exposure. Secondly, you may be experimenting for some time, and if you are using the s.w.r. approach you will be radiating signal. Apart from the annoying distraction of having to find the microphone and identify yourself every 15 minutes (!), the presence of a carrier for long periods may well cause annoyance to other band users.

Antenna Construction

Antenna construction is a relatively straightforward task. Measure all dimensions carefully before cutting or drilling, and if you have designed the antenna check and double-check your figures.

When preparing the boom there are two precautions well worth taking. First, make yourself a jig of some sort to ensure that all the holes you are going to drill will end up in line. There is nothing more annoying than to have taken great care over getting the spacing right, only to discover that you have just produced a boom for some sort of circularly polarised device!

The second point concerns the measurements on the boom. Choose a reference point—the reflector mounting position for instance, and make *all* measurements from that point. That is, measure from the reflector to the dipole position and mark. Then measure from the reflector to the 1st director and mark, etc. This method minimises any errors. The danger with measuring from each element to the next is that any errors *accumulate* along the boom.

Whilst we are talking about errors, it is as well to consider tolerances. The degree of inaccuracy that is acceptable is normally taken to be $0{\cdot}001\lambda$. Convert this into a measurement for the frequency you are working at, and try to make sure that all of your work is to at least this accuracy.

The most difficult part for the "garden shed antenna manufacturer" is making a reasonably professional job—mounting the elements to the boom so that they can't twist round, and housing the balun and dipole feed in a secure and waterproof manner. A range of suitable plastic mouldings for a variety of standard boom and element sizes are available from: G. Bellis & Co., Sturgess Street, Stoke-on-Trent, Staffs. An s.a.e. with your requirements will bring you the details.

Other Designs

Subsequent articles will detail the design and construction of two 430MHz band antennas—a 12-element design for rear mounting, and a lightweight, high-performance 15-element design.

Conclusions

The author has already used this design information to produce a number of practical antennas at frequencies between 50 and 1300MHz, for both amateur and commercial applications. The results have been surprisingly consistent and it is for this reason that the NBS Yagi Design Data is worth a wider audience.

Acknowledgements are due to those who did all the hard work: to P. Viezbickie, who did the research at NBS, and to J. Reisert, W1JR, and D. Hilliard, W0PW and W0EYE, who all persuaded him to publish the information. It is unfortunate that it took so many years for this valuable piece of work to reach the amateur! ●

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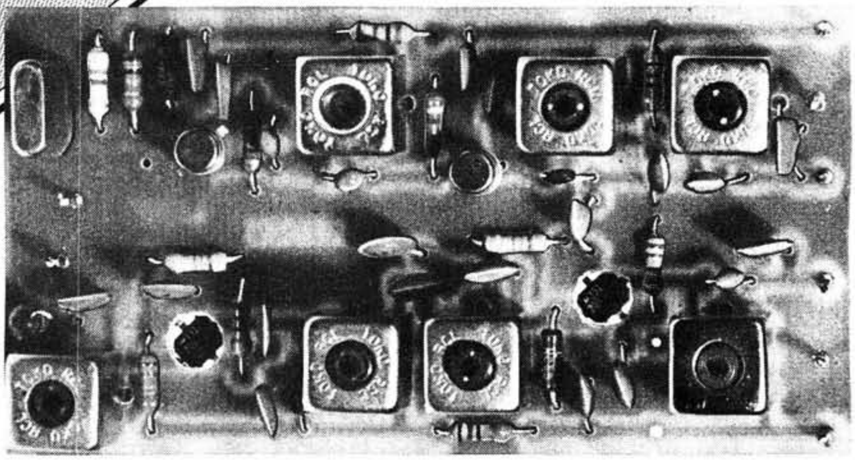
2. G. Hoch, DL6WU, *Yagi Antennas, VHF Communications 9,* 3/1977; and *More Gain with Yagi Antennas, VHF Communications 9,* 4/1977.
3. P. Viezbickie, *Yagi Antenna Design,* NBS Technical Note 688, US Department of Commerce, Washington D.C., December 1976.

This is a special station
. . . with apologies to W5LFL

PW REVIEW



SPECTRUM COMMUNICATIONS RC6-2 50MHz Receive Converter

During the late spring and summer months of 1983 I have kept watch on events occurring at 50MHz, principally with the aid of a constructional kit converter supplied by Spectrum Communications of Dorchester.

The RC6-2 converter provides an ideal means of reception of this "potential" UK amateur band for those already in possession of a 144MHz (2m) multimode receiver. Operation consists of connecting the converter input to a suitable antenna, in my case a South West Aerial Systems 3-element Yagi, the output to the antenna socket of the 144MHz equipment (used as a tunable i.f. stage) and 12V d.c. at 20mA. The resulting combination allows continuous coverage of the range 50–52MHz in all modes available on the 144MHz equipment.

Design-wise the RC6-2 features the familiar format of tuned input/r.f. amplifier, using an MPF131 dual gate MOSFET, feeding a further MOSFET mixer via a two-stage bandpass filter. To obtain the required frequency conversion a local oscillator is used based on a 31·333MHz crystal, the supply for which is Zener stabilised. This oscillator output is tripled to 96MHz and subsequently filtered before being passed to the mixer stage. A separate oscillator output at 1V p-p (into 300Ω) is provided for use in conjunction with transverter type systems.

The mixer output passes to the output terminal of the converter via an adjustable i.f. matching section.

Construction of the kit did not produce any great problems, the only slight "hiccup" concerning the correct orientation of the two MOSFET packages which are of plastic rectangular construction. Subsequent assembly instructions, provided with all kits, will incorporate elaborated details for those not blessed with a comprehensive semiconductor data book!

Construction time amounted to approximately $2\frac{1}{2}$ hours including a careful inspection of the assembled single-sided p.c.b. The assembly instructions also include a circuit diagram and details of any "odd" component markings (where applicable) together with details of the alignment procedure. Alignment requires an ordinary d.c. voltmeter to verify the voltage present across the MOSFET source resistors (0·5V) and a suitable hexagonal key for adjusting the inductor cores. **Do not** attempt to use a screwdriver blade or similar tool—I did and it took not a short length of time to obtain spares from the UK stockist. (Spares are now available direct from Spectrum). In fact, due to the closed magnetic structure of the inductor cores, it is quite feasible to use a standard metallic hexagonal key—without any discernible shift in settings.

A 50MHz signal source, preferably with a means of attenuation, is also useful during the setting-up operation. The 96MHz oscillator frequency can be roughly verified by listening to the carrier on a domestic band II v.h.f. receiver and finally trimmed against a known 50MHz source (beacons etc).

The completed p.c.b. was mounted inside a standard 110 × 60 × 30mm diecast aluminium box (not supplied with basic kit), r.f. being coupled in and out through BNC sockets and the d.c. feed de-coupled via a feedthrough capacitor. This form of housing proved to be effective in eliminating any local oscillator leakage or interstage breakthrough.

In operation the converter has been used in conjunction with several 144MHz transceivers including a Standard C-58 and latterly the Yaesu FT-726R—in all cases performing well. Laboratory tests on the kit indicate worst case spurious outputs occurring at 157MHz (−58dBm) and 126MHz (−56dBm). Sensitivity was very good with input signals as low as −127dBm being detectable; an input at −93dBm produced a corresponding 144MHz i.f. output at −70dBm.

The bandwidth of the converter is adjustable and in practice can either be peaked for a specific section of the 2MHz wide band or optimised for general coverage. If peaked to 50MHz (c.w./beacons) the response at 52MHz drops by approximately 14dB. Overall performance is constant to within 1dB over a voltage input range of 10 to 15V d.c.

During the review period several of the 40 UK 50MHz stations were observed including stations in G/GW/GU/GJ using s.s.b. and c.w. Also, signals were obtained by meteor scatter "pings" from GB3SIX on Anglesey and ZB2VHF, the Gibraltar beacon. This latter device on occasions during the summer was strong enough to be detectable for long periods without much need for the antenna!

Whatever transpires with respect to further general use of 50MHz in the UK this band is more than capable of providing a wealth of interest to both the licensed amateur and s.w.l. and with its very apparent duality of characteristics (h.f./v.h.f.) demands greater attention.

Our thanks for the review, sample RC6-2 converter, go to **Spectrum Communications, Unit B6, Marabout Industrial Estate, Dorchester, Dorset. Telephone: 0305 62250.**

The current price of the kit is £14.30 and if required is available ready built in a box at £27.30 including VAT.

JOHN M. FELL

The Origin Of Radar

by F. C. Judd **Part 1**

Communication by "electromagnetic waves" is not exactly new. For the past millions of years many living species have made use of visible light waves as well as the non-visible e.g. ultra-violet and infra-red, high in the frequency spectrum of electromagnetic waves generated by nature. Much lower in the spectrum and discovered (not invented) by man are what were originally called **wireless waves** now commonly used by man in addition to his many other established methods of communication. Radar is simply a development that utilises wireless waves and therefore was not an invention either. Its origin dates back only about 50 years. Again nature has first claim at least to the basic principle of radar since certain animals evolved thousands of years ago with forms of audible and inaudible (to us) sound radar. However we cannot really exclude the development of wireless because the fairly rapid progress of its own technology after about 1900 had considerable bearing on its adaptation for radar.

Evolution—Wireless

We could perhaps begin at about the time of Queen Elizabeth the First when great interest was being shown in electricity and magnetism although the experiments with these phenomena were largely regarded as something of a novelty.

From this time it took some 300 years of slow stimulation by the discoveries of well-known scientists such as Maxwell, Faraday, Ampere, Ohm and many others to establish the various and important principles on which **wireless** was founded. Principles such as electromagnetic induction, the generation of alternating current, the relationship between voltage, current and resistance, etc. The application of **wireless waves** as an invisible medium that was to change the whole concept of communication between people of the world is generally attributed to Guglielmo Marconi and a full and detailed account of his work given in a book called *A History of the Marconi Company*[1] makes very interesting reading. As far as wireless is concerned what might be termed as the "breakthrough" could well have occurred in 1888 when Heinrich Hertz announced what he called **the generation of an outspreading force** or, in modern parlance, the radiation of radio waves. If these waves had been detected at a distance then the centenary of wireless could be due in 1988. Or should we wait for G. Marconi who applied for the world's first patent in wireless telegraphy in 1896 (centenary 1996). On the other hand it is recorded that a patent was taken out in 1872 by an American, Mahlon Loomis, in connection with wireless transmission and reception. With the aid of two kite antennas flown from adjacent mountain tops he claims to have transmitted signals from one to the other.

Wireless Echoes

Until the work carried out by Kennelly and Heaviside between 1905 and the 1920s, little was known about the nature of the ionised layers high above the earth's surface which today we take for granted as the medium that enables round-the-world radio transmission and reception to be accomplished. Before this time it was realised that although "wireless waves" followed the curvature of the earth's surface, they did so only for relatively short distances and yet some other medium seemed to exist that was allowing wireless communication over very long distances; more than half way round the world in fact.

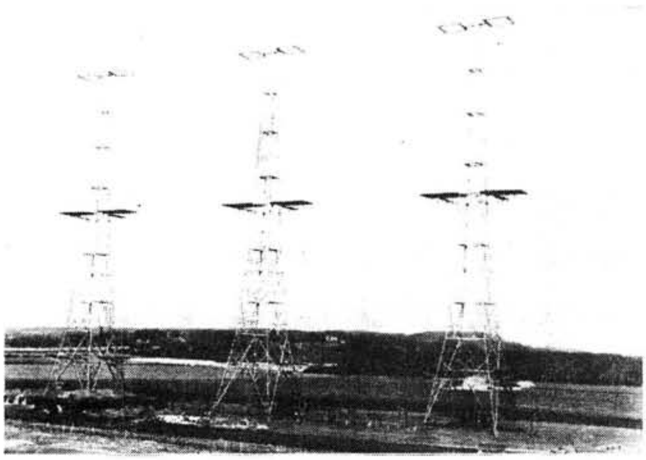
Work in connection with ionospheric layers by Kennelly and Heaviside was taken a stage further by Professor E.V. Appleton who established the F layer and its height and also employed **pulsed wireless transmission** for his investigations. By measuring the time taken for echoes of the pulses reflected from a layer back to earth its height could be determined with a considerable degree of accuracy.[2] It was this technique that came to be widely used in virtually all World War II radar applications and still is in radar systems of today.

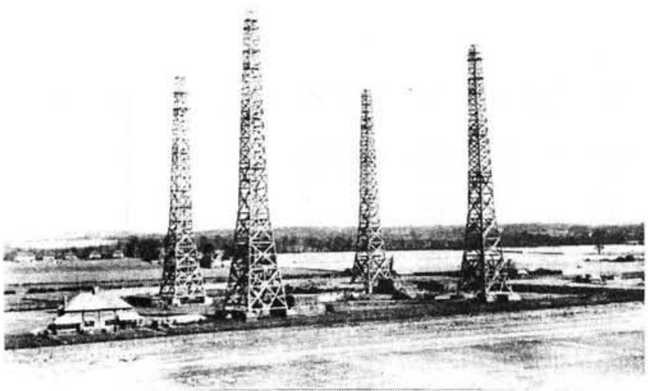
It is interesting to note that a few years after the discoveries in connection with the ionosphere, a Japanese Professor named Hidesugu Yagi published an important paper concerned with the transmission and reception of wireless waves using highly directional antennas thus making it possible for the first time to concentrate transmitted waves into a narrow beam.

Valves, CRTs and Antennas

Without valves and the cathode ray tube (c.r.t.) or oscillograph the detection of aircraft, etc., by wireless would not have been possible, at least not in the form we know today as "radar". In 1904 Dr. J.A. Fleming had developed the thermionic diode and although this was first used as detector or rectifier of wireless waves it was some time later that a "grid" was introduced by Dr. Lee de Forest (circa 1906/7). Later improvements on the valve enabled it to be used as an amplifier or generator (oscillator) at both audio and wireless frequencies well up into the high megahertz region.

The cathode ray tube eventually used for radio location displays stemmed from those employed for television and/or instrument oscilloscopes with either electrostatic or magnetic systems for producing the time trace (X deflection) and echo signals (Y deflection). Echo signals were also displayed by trace brightening (grid modulation). In some cases cathode ray tubes were used which had a special screen coating to provide a "long persistence effect", i.e. retention of the displayed trace, and Y deflected signals or grid





East coast CH transmitter towers (top)

East coast CH receiver towers (above)

By courtesy of the RAF Museum, Hendon

modulated signals. The latter applied specifically to p.p.i. or **plan position indicator** displays which are commonly used in most modern radar systems.[3]

Only one important requirement remained: suitable antenna systems. Fortunately sufficient was known about the function of antennas even by the 1930s to design high-gain fixed arrays and rotating directional beam systems that would prove suitable for what was soon to become known as "radio location". Many of the antennas used for the earlier experimental and the wartime operational stations were provided and erected by the Marconi Company. The photographs give some idea of the enormous size of the transmitting and receiving antennas that were employed for all operational fixed location CH (Chain Home) stations.

It now only required an appointed establishment and personnel to put this potential new aid to the air defence of Great Britain into being.

The Beginning of Radar

The use of pulsed "wireless" transmission as a means of obtaining wireless echoes from a remote target was first made in 1931 although only a very short range was achieved but, surprisingly for that period, the frequency used was 600MHz (500mm wavelength). At the time very little interest was shown in this attempt even though the idea had been considered long before this. For example, in 1900 Tesla *thought*, that wireless waves might be used for detecting moving objects and in 1904 a German engineer named Hullsmeyer patented a primitive form of "radar" but this was found to have no real practical value. In 1916 G. Marconi and his assistant C.S. Franklin found that during some experimental work using a wavelength of about 2 metres, the transmitted signals were reflected from objects in the path of the radiated wave. Although Marconi talked of this work and concluded that a form of "wireless detection" (radar?) seemed possible, he did not pursue the idea.[1]

However, by the 1930s the combining of all the known technology of wireless as well as the pulse transmission technique had created the means of developing equipment for the detection of moving aircraft, hostile or otherwise, beyond the coastlines of the British Isles, as well as ships at a distance on the high seas. In 1935 and with the anticipation of a second world war in a very few years a committee was formed for The Scientific Survey of Air Defence.[4] The first outcome of this was that Robert Watson-Watt, formerly Superintendent of the Radio Research Laboratory at Slough, was briefed by the committee to look into the feasibility of producing some kind of **wireless death ray with either the idea of stopping aircraft engines or killing the pilots!** The reply to this by Watson-Watt was, as one might guess, somewhat negative and instead he produced a paper dealing with **detection of aircraft at range by the use of wireless waves**. A practical test using a BBC transmitter at Daventry and carried out in February 1935 proved conclusively that this was possible. The experiment included the use of a cathode ray oscilloscope as a visual indicator.

Orfordness and Bawdsey

A site suitable for R. Watson-Watt and his selected team of scientists and engineers to carry out further experimental work was found on a strip of land on the East Suffolk coastline at Orfordness and it was here that the development of what was then called "radio location" or RDF (radio direction finding) took place. Many different applications evolved by the system itself later became known as RADAR, a term of American origin derived from **RA**dio **D**etection **A**nd **R**anging and which has been used ever since. It will be used in the remainder of this article.

The preliminary work at Orfordness proved encouraging and on 15 June 1935 an aircraft was successfully followed by radar to a distance of 27km. By July of that year a range of 65km had been attained and later 160km with a positional accuracy to within 3 or 5km paved the way for the production and setting up of a chain of coastal radar stations. However, within a matter of months the Orfordness establishment was becoming too small owing to the vast amount of development taking place and the extra staff that had been acquired to cope with this. Larger premises were urgently needed and eventually Bawdsey Manor with its large and secluded grounds became the chosen home for Watson-Watt and his team. It too was in Suffolk, still on the coast and not too far from Felixstowe.

Bawdsey Research Station as it became known created a place in history for itself not only by developing the first coastal radar station designs but also many other radar devices including airborne systems. By 1939 a chain of fully operational coastal radar stations known as CH (Chain Home) had been installed at strategic positions along the coast between Ventnor on the Isle of Wight and the Firth of Tay. One of these stations was at West Beckham in North Norfolk where the author first became acquainted with the then "top secret" means of detecting the approach and position of hostile aircraft. British fighter aircraft could be directed to advantageous positions instead of aimlessly patrolling the skies on the offchance of spotting the enemy planes. It has been said that without these early warning radar stations and the unique and complex RAF plotting system used in conjunction with radar, the Battle of Britain might well have been lost.[5] By the end of 1940 no less than 22 CH and 28 CHL radar stations were in full operation as the map in Fig. 1.1 shows. Note: CHL or Chain Home Low stations employed special rotating directional antenna systems and operated at v.h.f. at about 200MHz. They were used for detection of low flying aircraft that might not have been located by the larger CH stations which operated in the frequency band approximately 26 to 30MHz. In an original specification the CH band coverage was 20 to 55MHz although the first experimental transmitters and receivers used a frequency of 6MHz which stemmed from the work carried out on ionospheric layer sounding. At first the average transmitted pulse power for CH stations was 200kW although later this was increased to 600 to 800kW depending on the frequency used. At one time a power of 1·7 megawatts was attained but difficulty was found in providing an antenna to handle this. Power levels of this order were not used operationally.[6]

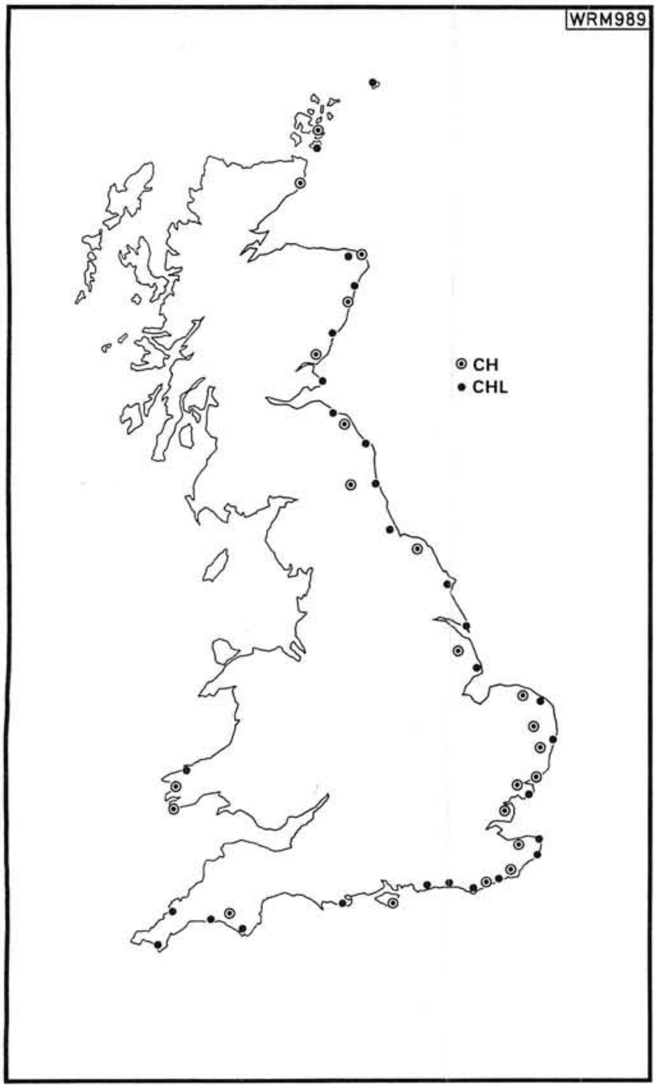


Fig. 1.1: The locations of CH and CHL radar stations operated by RAF 60 Group that had been installed and were fully operational by the end of 1940

References

1. *A History of the Marconi Company* by W.J. Baker. Methuen Co. Ltd. 1970. This book covers the whole history of wireless from a period long before the work begun by Marconi. Then comes the Marconi era and all the developments that stemmed from this including equipment for both world wars, wireless communication and radar. The final section deals with the early days of broadcasting and television. A book that every radio enthusiast will find worth reading.

2. *The Timing of Wireless Echoes* by Prof. E.V. Appleton. *Wireless World.* 7 January 1931 and 14 January 1931. Various methods used for determining the height of wireless wave reflection from the sky (the ionosphere).

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EXTERNAL BFO

▶▶▶ *continued from page 25*

Construction

Capacitor C2 is in circuit on both the 7MHz and 3·5MHz bands, but for 3·5MHz band operation S1 must be used to introduce C3 into circuit. Leads starred on the layout must be as short and rigid as possible.

Coil L1 consists of 60 turns close wound using 28 s.w.g. wire and L2 is 5 turns overwound on the bottom end of L1—also close wound using 28 s.w.g. wire. The former used in the prototype was of 7·1mm diameter and will accept a 6mm ferrite core.

To minimise hand-capacitance de-tuning effects the assembled v.f.o. board was mounted into a diecast box, which also housed the 9V battery.

Setting-up

The communications receiver should be tuned to the centre of the 3·5MHz band. Capacitor C3 should be switched into circuit and C2 should be set with the vanes half meshed. Slowly introduce the slug of L1 into the holder until the carrier produced by the v.f.o. is at zero beat with the receiver.

Now set the receiver to the top end of the band and verify that C2 will allow the v.f.o. to oscillate at this frequency. The procedure is repeated for the bottom end of the band.

With the component values chosen a generous band overlap should result.

When switched to the 7MHz position the tuning slug should not be altered as C2 should once again provide sufficient adjustment for the whole of the band. ●

SPARE A THOUGHT FOR YOUR RECTIFIER by R.T. IRISH

Most power supplies contain two distinct parts, (i) the transformer, rectifiers and smoothing capacitor(s) and (ii) the regulator circuit—as shown in Fig. 1. The action of the regulator is to reduce the potential at its input terminals to the desired output voltage (normally 12 volts for amateur equipment). This reduction has to be achieved irrespective of the ripple or other voltage variations at its input. Since this is a "cutting-down" effect, in order to work correctly the input voltage must be greater than 12 volts for all parts of the cycle. If the regulator supplies a constant load, then the current it passes will also be constant.

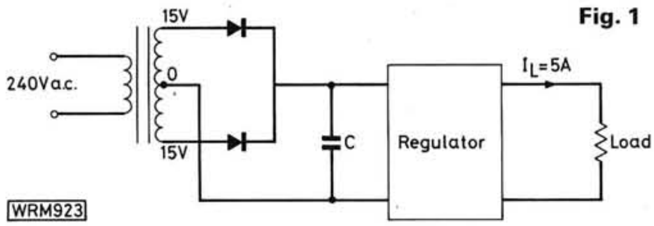


Fig. 1

Let us now look at the transformer, rectifiers and smoothing part of the supply. Assuming full-wave rectification, as shown in Fig. 1, then if the capacitor (C) was not present a series of consecutive half sine waves would appear at the regulator's input. However, the action of this capacitor is that it charges up to the peak value of the rectified sine waves through the rectifiers and discharges, relatively slowly, through the regulator and thus the load. During this latter part of the cycle the voltage across the capacitor falls linearly at a rate of I/C volts/second. When this linear decay is interrupted by the next rising half sine wave, the current is subsequently governed by the characteristics of the rising half sine wave. The value of this current is C × dV/dt and this can be surprisingly large. The current passing through the conducting rectifier is now the capacitor's charging current **plus** the load current.

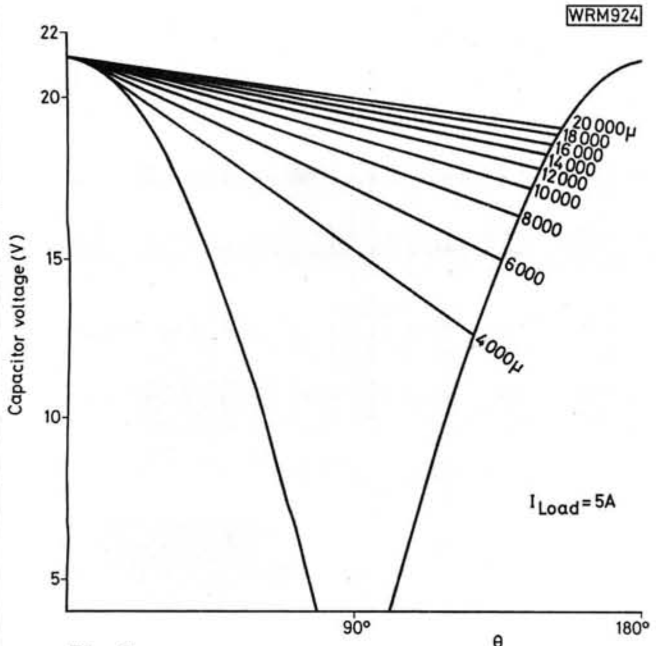


Fig. 2

Going back to our 12 volt supply, and assuming it to contain (typically) a 15–0–15 volt transformer and to supply a load current of 5 amps, the rate of fall of the voltage across the capacitor is 5/C volts/second. This is shown in Fig. 2 for a range of values of the smoothing capacitor, from 4000μF to 20 000μF. The associated peak capacitor charging current has been found from the intercept of the decay with the next rising half sine wave and is shown in Fig. 3. As may be seen here, for a 5 amp load current and a typical smoothing capacitor value of 10 000μF, the maximum charging current is 38·5 amps and the maximum current in the rectifiers is 43·5 amps!

It is important therefore that the rectifiers should be chosen so that these high peak currents are within their ratings—or smoke may be expected!

The high peak-to-average current ratio in this form of circuit has long been underestimated by p.s.u. constructors and has frequently been the cause of disappointment in the reliability of such supplies. The appreciation of the high peak currents to which the rectifiers are subjected enables appropriate diodes to be selected. In conjunction with this, Fig. 3 indicates the wisdom of reducing the value of the smoothing capacitor as much as possible—consistent with maintaining the voltage at the input to the regulator at least one volt higher than the desired output voltage at all parts of the cycle.

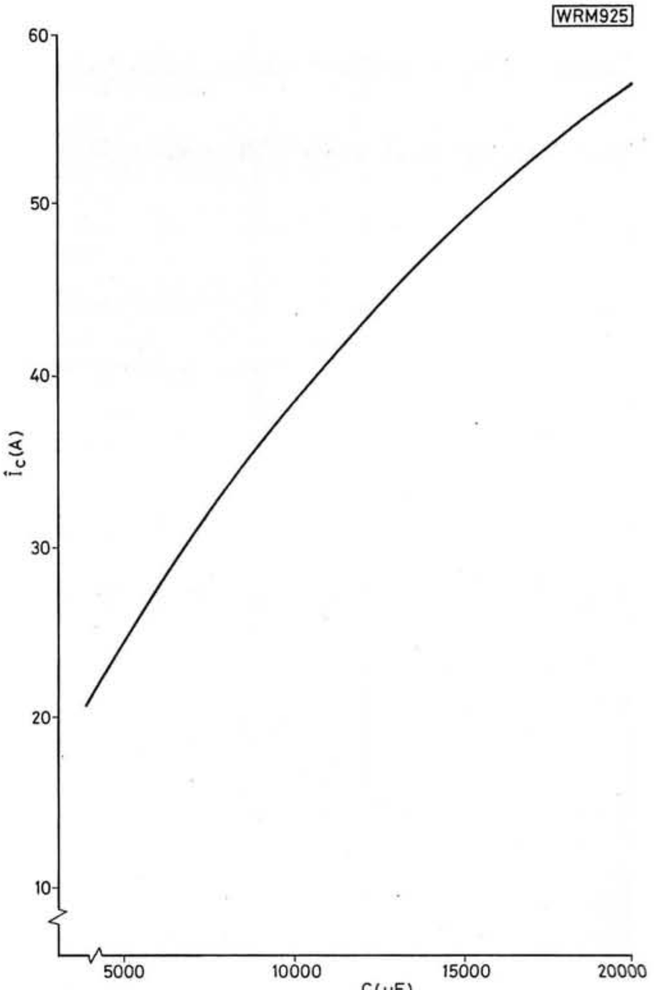


Fig. 3

Going Circular

By David J. Silvester G4TJG

Radio amateurs will be familiar with linear polarisation obtained with a dipole, $\lambda/4$ whip, or Yagi antenna. A transmitting dipole antenna and part of the wave fronts produced by the current flowing in the antenna elements is shown in Fig. 1(a). These wave fronts are in fact spherical and expand outwards at the velocity of light. If we could stand at point "b" in Fig. 1(a) and look at the waves we would find that they are made of two fields, one electrical and one magnetic at right angles to each other and also at right angles to the direction of travel, Fig. 1(b). The two fields constantly change in magnitude and reverse direction every half cycle, and these varying fields would induce an r.f. current in a receiving antenna placed at "b". The electrical field produced by the antenna is in the same plane as the elements and the polarisation of the antenna is regarded as the direction of the electrical field, i.e. vertical in this case. Consequently the receiving antenna would have to have its elements placed vertically for the maximum signal to be received.

The choice of polarisation at v.h.f./u.h.f. is based on the fact that whilst horizontal polarisation will give a signal which is subject to lower attenuation over long distance, it is much simpler for mobile working to use a vertical whip antenna. Consequently almost everyone follows along and installs a vertical antenna for f.m./mobile use and a horizontal Yagi for s.s.b./DX work. The situation is, however, not that simple and when v.h.f. signals are reflected, or pass through obstructions such as trees or built up areas, not only is the signal attenuated but its polarisation can be changed considerably. Frequently the signal from a long-distance repeater can be stronger on a horizontally polarised antenna than on a vertical antenna.

Space communications require circular polarisation as it is impossible to keep any antenna on the spacecraft at a fixed orientation to the earth's surface, and the signal from it would increase and decrease as the spacecraft rotated. The logical alternative is to "spin" the radio wave so that the rotational speed of the spacecraft will not affect the signal strength. This is circular polarisation.

Returning to Fig. 1(b), a circularly polarised signal would appear to rotate the two fields at the frequency in use, i.e. at v.h.f., 144 million complete revolutions per second; the field strength in this case will not vary. A dipole receiving antenna would still have an r.f. current induced in it by a circularly polarised signal, as the apparent field strength in any one direction will vary exactly as would the field strength produced by a linearly polarised signal. The signal induced would be 3dB below that produced when using two linearly polarised antennas providing there has been no alteration of the polarisation between transmission and reception.

So what are the advantages for use at ground level? We noted that when working between a circularly polarised and a linearly polarised antenna we immediately have a 3dB loss over a perfectly set up system using two linearly polarised antennas. Yet the linear system could result in 20–25dB losses due to polarisation changes, whilst the circular/linear system can never lose more than 3dB. If both stations are using circular polarisation then the path will induce little loss due to polarisation changes. Those amateurs in poor radio locations especially in built up areas will find that circular polarisation improves the situation considerably.

Having decided to try circular polarisation how do we achieve it? The simplest and most obvious way is to use a helical antenna, and a number of reference books will give details of construction. But the problem with a helix is whether to choose a clockwise or anti-clockwise spiral and hence right- or left-hand polarisation.

Many stations will already have crossed Yagi antennas

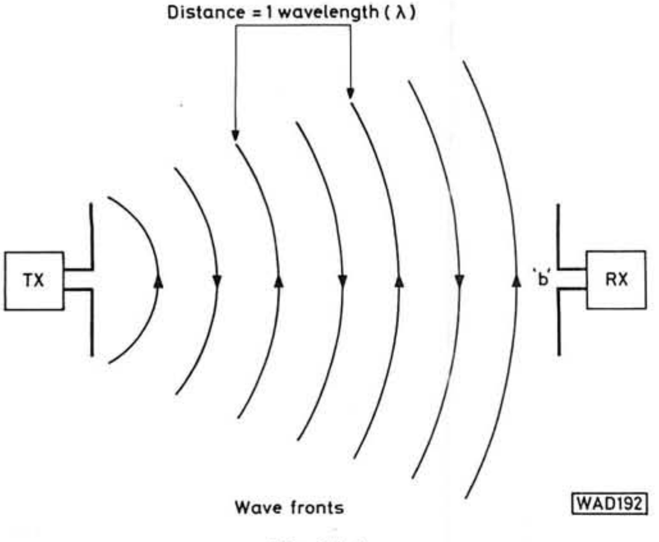


Fig. 1(a)

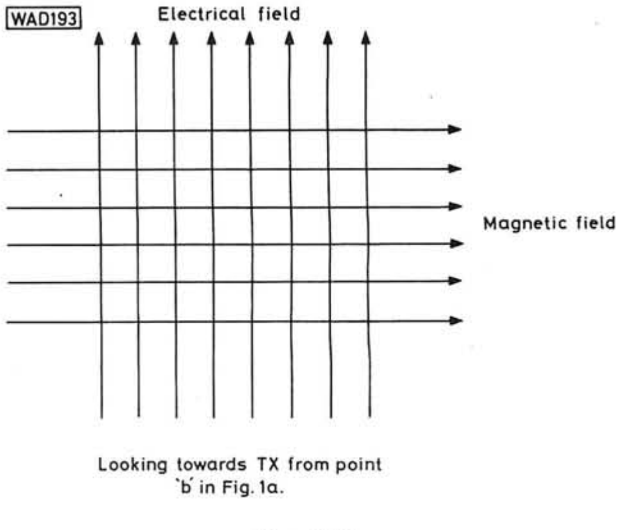


Fig. 1(b)

as these are available commercially, but few people will be using these for circular polarisation. These crossed antennas only require that two signals, one of which has a 90° phase lag, are connected to the horizontal and vertical radiators. Depending on which radiator receives the delayed signal the crossed Yagi can give right- or left-hand polarisation. Now if the horizontal and vertical elements are in phase or 180° out of phase then slant polarisation of 45° and 135° respectively is obtained.

The switching unit proposed will provide horizontal, vertical, left-hand and right-hand circular and 45° and 135° slant polarisations irrespective of whether the antenna is set up as an "X" or "+". Many amateurs will need to convince themselves about the advantages of circular polarisation and may already have a crossed Yagi set up in the "+" configuration. In this case the stub mast above the rotator will need to be of fibreglass as an aluminium pole will upset the radiation pattern.

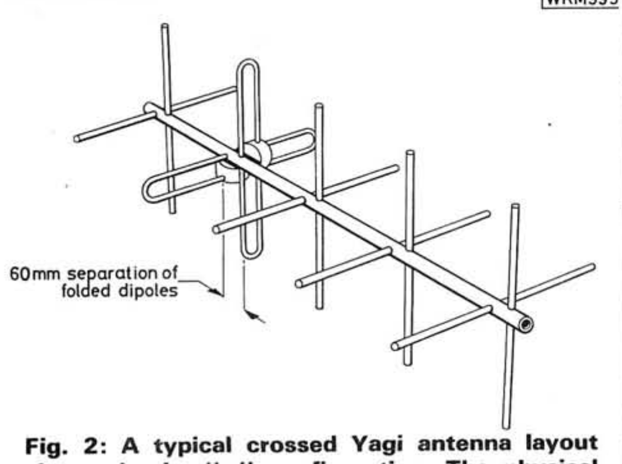


Fig. 2: A typical crossed Yagi antenna layout shown in the "+" configuration. The physical offset between the two independent driven elements must be removed by electrically delaying the signal received by the forward (vertical) radiator.

Feeders

The switching unit will provide all the necessary signal delays for the system provided that the electrical length of the feeders between the antennas and switch unit is identical. Referring to Fig. 2, the horizontal folded dipole can be seen to be offset to the rear of the antenna compared to the vertical dipole. In the author's commercial antenna the distance between the horizontal and vertical dipoles is 60mm, and allowance for this offset must be made.

The velocity of a radio wave in 50 ohm solid dielectric coaxial cable is 66 per cent of that in free space.

To correct this offset we must ensure that the coaxial cable to the rear (horizontal) radiator is shorter electrically by 60mm, i.e. a physical shortening of the cable by 40mm (60 × 0·66). The two coaxial cables must in all other respects be identical, and the more care taken to achieve this, the more pure the various polarisations will be.

Switching Unit Considerations

To produce circular polarisation we need to delay or advance the signal to the horizontal dipole by $\lambda/4$ compared to the vertical, depending on whether we require right- or left-hand polarisation respectively. This can be achieved by using a $\lambda/4$ section of coaxial cable placed into one of the feeders, or more easily by using a $\lambda/4$ section in one line and a $\lambda/2$ section in the other which can be shorted out when necessary.

Slant polarisation requires the horizontal and vertical dipoles to be fed in phase for 45° slant or 180° out of phase for 135° slant.

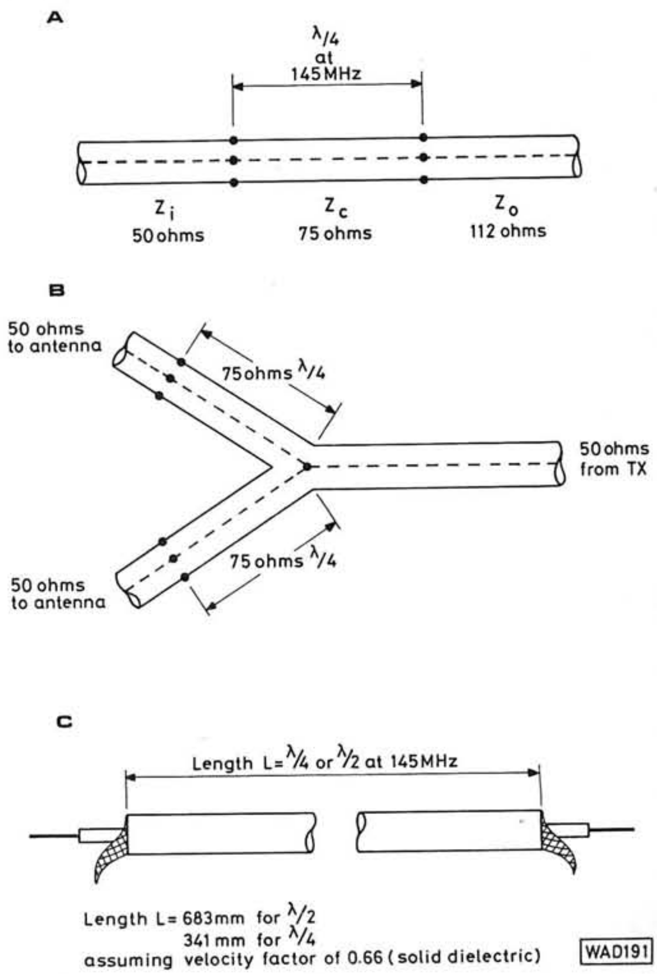


Fig. 3: Details of the impedance transformer and matching arrangement used in the control box, together with cutting details

The more difficult problem is to split one 50 ohm feed from the transceiver into two 50 ohm feeds to the antenna. Looking at Fig. 3(a), if a section of coaxial cable which is λ/4 at the frequency in use, and having a characteristic impedance of Zc ohms, is joined to a feed cable of Zi ohms, then the impedance required for the output cable can be found from the formula:

$$Zo = \frac{Zc^2}{Zi}$$

Using the values of commonly available coaxial cables and letting Zc = 75 ohms and Zi = 50 ohms, then Zo becomes 112 ohms.

Looking at Fig. 3(b), we could now join the two 112 ohm points together and this will form a good match to the 50 ohm coaxial input.

Considering the arrangement of the switching, although the author would agree that coaxial switches should be used, the design costs would be prohibitive. Consequently other types of switch were considered and it was finally decided to use wafer switches. This design of switch is capable of use at 300V a.c. and with a contact current rating, **but NOT switching capability,** of 5A. The power limit is therefore 1250 watts BUT only at 50Hz. Since the author only wished to switch the 10 watt output from a transverter it was felt that the switch would be capable of handling this power easily at the frequencies involved. The switch should take the legal limit of 100 watts mean, but this has not been tried yet. The only other item to consider is the length of the coaxial cables required to give λ/4 and λ/2 lines. Allowing, as before, for a velocity factor of 0·66 the length of the lines becomes 341 and 683mm respectively. A method of measuring the lengths is shown in Fig. 3(c). The completed design with switching for horizontal, vertical, both circular, and two slant polarisations is shown in Fig. 4.

Because the antenna may be set up in six possible ways

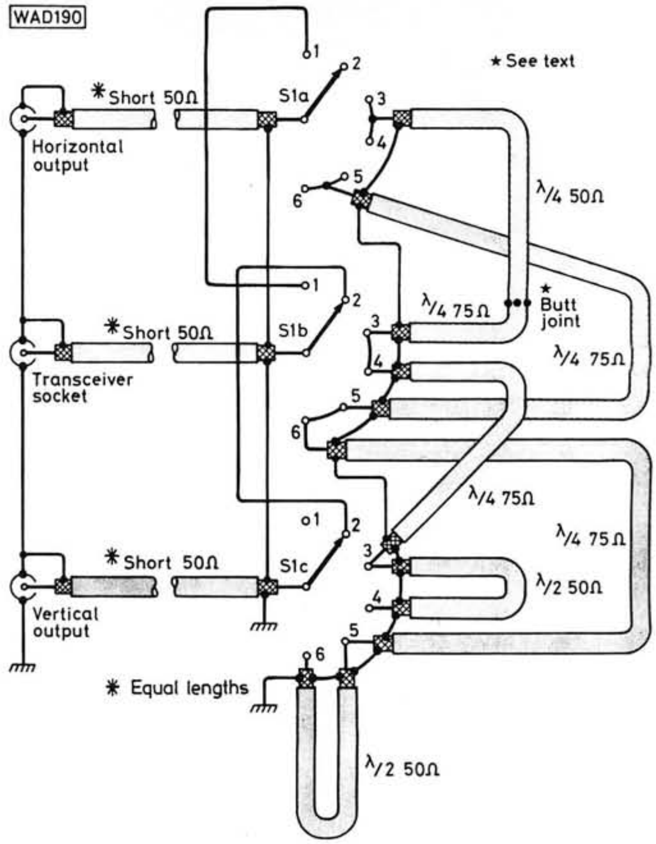


Fig. 4: Polarisation control box arrangement. The switch used in the prototype was obtained from Maplin and consists of their Maka switch (FH46A) and wafers (FH47B). Surplus switch contacts should be removed. A 186 × 106 × 56mm diecast aluminium box will house the assembly. UR43 or UR76 can be used for the 50Ω lines and UR70 for the 75Ω sections

depending upon its mechanical design and the way it is mounted on the mast, these various possibilities must be related to the six switch positions. Table 1 shows the relationship of the outputs from the unit for the switch positions 1 to 6.

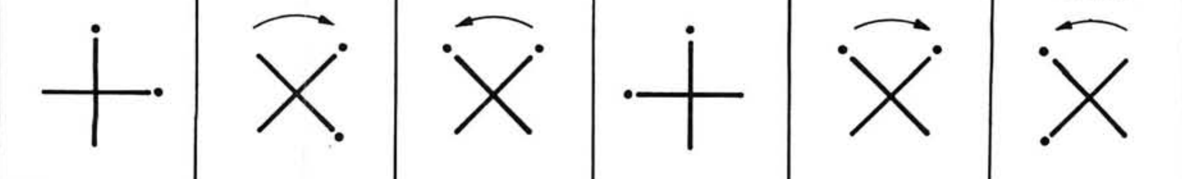
The antenna should be rotated until the vertical dipole connected to the centre core of the coaxial feeder is uppermost. The feeder to the horizontal dipole may now be found to be connected to either the right-hand or left-hand side of the vertical. Table 2 shows the polarisations obtained with the above antenna connections and also the

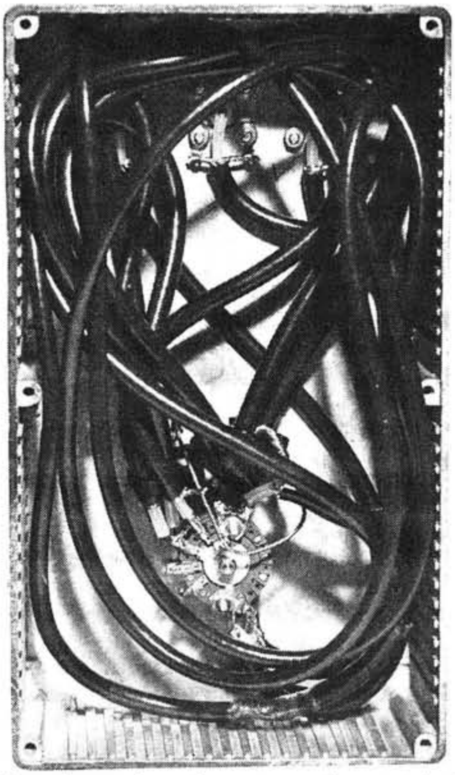
TABLE 1

Switch Position	Phase Relationship	
	Vertical Output	Horizontal Output
1	No Output	0°
2	0°	No Output
3	0°	+90°
4	+90°	0°
5	0°	0°
6	+180°	0°

TABLE 2

Switch Position	I	II	III	IV	V	VI
1	Horizontal	135° slant	45° slant	Horizontal	135° slant	45° slant
2	Vertical	45° slant	135° slant	Vertical	45° slant	135° slant
3	R.H. Circular	R.H. Circular	R.H. Circular	L.H. Circular	L.H. Circular	L.H. Circular
4	L.H. Circular	L.H. Circular	L.H. Circular	R.H. Circular	R.H. Circular	R.H. Circular
5	45° slant	Horizontal	Vertical	135° slant	Vertical	*Horizontal*
6	135° slant	Vertical	Horizontal	45° slant	Horizontal	Vertical





polarisation given when the antenna is rotated either 45° clockwise or anti-clockwise. In all cases the view is from the rear of the antenna. The constructor will have to allocate the polarisations to the switch positions depending on the antenna configuration.

Construction

The construction of this item is extremely easy provided care is taken over the measurement of the coaxial cable lengths. First mark out the case to accept the switch and three coaxial sockets, and drill the necessary holes. The box may now be painted if required. Install the sockets, fitting a tag washer onto one of the screws holding each of the sockets in place.

Assemble the switch with the three wafers using spacers to separate the layers. Ensure that the indexing pin allows the switch to have only six positions, then mount the switch in the box. Identify the tags on the switch layers corresponding to the positions 1 to 6, and the centre contact. Any surplus wafer contacts should be removed.

Cut the seven pieces of coaxial cable to the dimensions required, using Fig. 3(c) as a guide to the measurement, and leave sufficient insulation on the inner core so that the screen will not touch any of the switch tags. Cut three **equal** lengths of 50 ohm coaxial cable, as short as possible, and connect these to the centre contacts of S1a, S1b, and S1c and to the horizontal, input, and vertical sockets respectively. The screens of these pieces of coaxial cable are connected to tag washers at the socket end and a further common tag washer mounted on the switch assembly studding.

One piece of 75 ohm coaxial cable of 341mm and a 341mm piece of 50 ohm will need to be butt jointed giving the overall length of 683mm. This will necessitate the shortening of one end of each, soldering the centre cores together, insulating and then remaking the screen.

The centre cores of the measured cables can be connected to the switch as shown in Fig. 4. All of the coaxial screens on each switch i.e. S1a may now be connected together and are then, using a short piece of 18 s.w.g. wire, connected to a solder tag washer on the switch studding. Finally connect S1a position 1 to S1b position 1; S1b position 2 to S1c position 2; position 3 to position 4 and position 5 to position 6 on both S1a and S1b, as shown.

Testing

Having completed the switching unit it is advisable to make a few tests with a multimeter before connecting to the transceiver. Measure the resistance between the centre pin of each socket and the box, with the switch in each of its positions. The resistance should be infinitely high in all switch positions. Now measure the resistance between the centre contact of the input socket, and that of the output sockets. The result should be low resistance in five of the six positions and high only when; in position 1, vertical output is measured and; in position 2 when horizontal output is measured.

Now connect the unit to the crossed Yagi antenna or, if available, to two dummy loads, and to the transceiver via a s.w.r. bridge. The more care that has been taken with construction the lower will be the s.w.r. in all switch positions. The s.w.r. should be below 1·05:1 even allowing for the type of switch chosen, but anything over 2:1 should be regarded as evidence of a construction fault.

In Use

After going to all this trouble, how well does the unit work in practice? With any DX signals, the signal level is higher and fluctuations of signal strength, especially from mobiles, decreases significantly. Interestingly it is not only DX signals that are improved; the circular polarisation switch positions always seem to give an increase in signal strength of about half an "S" point, over that from the horizontal or vertical antenna. This gain appears to extend up to S9+40dB but the cause is as yet unknown. ●

Uncle Ed

SWITCHES—3

In this final part of my series on switches, I want to look first at the variety of types designed to be mounted direct on printed circuit boards.

Over the years, equipment manufacturers have chased switch designers to produce a wafer switch which could be connected directly into a p.c.b., to do away with the expensive hours of wiring needed to connect a big wafer switch to the board by conventional means. The first solution was to make the stator into a little p.c.b. with all the connections brought to one edge, so that it might be attached to the main p.c.b. like a little "daughter-board". These have been improved over the years and are currently available, though not so easy to come by as the conventional type. A more recent development, prompted again by equipment manufacturers in their search for a switch which would fit more easily into modern slimline or low-profile equipment, is a wafer switch which no longer bears any visual resemblance to the conventional type. Instead, each "wafer" is a box about 10 × 10 × 30mm with the shaft passing through the centre of one of the long faces, and again designed for direct p.c.b. mounting.

Slide switches for p.c.b. mounting are available in a range of sizes and ratings, but are basically similar to the traditional panel-mounted type.

One of the latest additions to the family is the d.i.l. switch, which comes in a package little larger than an i.c., and has its terminals arranged in two lines like an i.c., hence the description d.i.l. (dual-in-line). You can find anything from a single s.p.d.t. to ten s.p.s.t. switches in one package, other types offer 1-p. 8-w. or 4-p. 2-w., either ganged or individually switched. Operation is by tiny knobs (very slim fingers needed here), by tiny levers, or by slotted pads suitable for a mini-screwdriver tip.

For data entry in computers, etc., keyboards are often made up of special momentary-action push-button switches mounted direct on a p.c.b.

Popular for setting operating frequency in hand-held monitors and transceivers is the edge-switch. These are operated either by a thumbwheel for each digit, or by a pair of push-buttons, one to count up and the other down. Several contact arrangements are available: a simple decade switch, 1-p. 10-w.; a binary-coded decimal (b.c.d.) switch, giving b.c.d. output and its complement for digits 0–9; a 16-position hexadecimal coded output 0–9 plus A to F.

There are several other switch types widely used in industry which the hobbyist may come across occasionally. I'll mention a few briefly, so that you'll know what the names mean. First, the microswitch—this is a special switch, biased to one position by a spring and designed for mechanical operation by a cam, by a door or a push-rod, etc. Most have a single change-over contact so that they can be used as normally open or normally closed, as required, and have a small push-button, a lever or a roller actuator according to the particular application.

A point to remember about mechanically-operated switches. A safety switch on an equipment door must be arranged so that the contacts make to complete the power circuit when the door is shut, and break under the action of the spring to cut the power off when the door is opened. That means that though we want the contacts to be closed under normal conditions (door shut), the switch would have to be wired up in the normally-open mode. On the other hand, if the switch was intended to turn a light ON when the door was left open, as a warning perhaps, then we'd want the contacts to be open under normal conditions, but the switch would have to be wired up in the normally-closed mode. Confused? Well, just remember that shutting the door operates the switch, but opening the door releases it to its normal or resting state. The same sort of argument applies to any mechanically-operated switch—you simply have to work out what you want the switch to do.

Next, the key-switch. Some confusion here, too, this time because there are two quite different sorts of switch known sometimes as a key-switch. One type (example shown in the photograph) is used on telephone switchboards and can have two or three positions with up to four changeover contact sets on each side of a three-position switch. The centre position of the operating lever is the "rest" position, and if the lever is moved it may either stay where it's put (called a "locking" action) or spring back when it's let go (called a "non-locking" action). A three-position switch may be locking one side and non-locking the other. Contact arrangements can be complicated, including make-before-break sets, and are best understood by watching the contacts whilst operating the switch. The key-switch is very useful in audio or control circuits, for example, to switch different receiver outputs to a loudspeaker, an RTTY decoder, an audio filter. This sort of key-switch is also known as a lever-key switch, or sometimes just a lever-switch.

The other sort of key-switch is a security switch, one that's got a cylinder lock on it so that it can only be operated by someone with the right key. It's also known as a key-operated switch.

Ratings

Because of the need to avoid prolonged arcing, switch contact ratings, especially in slow-make-and-break switches, are often reduced when operating in d.c. circuits. A few examples will show what to expect:

"15A" Toggle switch (s.m.b.) 15A at 250V a.c./10A at 24V d.c.

Slide switch (p.c.b. mounting) 300mA at 125V a.c. or 24V d.c.

Min. toggle (silver contacts) 6A at 250V a.c. or 28V d.c.

Larger switches will often cope with the same current on a.c. or d.c., for example:

"3A" Toggle switch (q.m.b.) 3A at 250V a.c./d.c., increasing to 6A at 125V a.c./d.c.

Beware that many of the modern miniature and sub-miniature switches have maximum working voltages of 100V or 125V and are not suitable for a.c. mains operation. Look for the ratings stamped on the switch body.

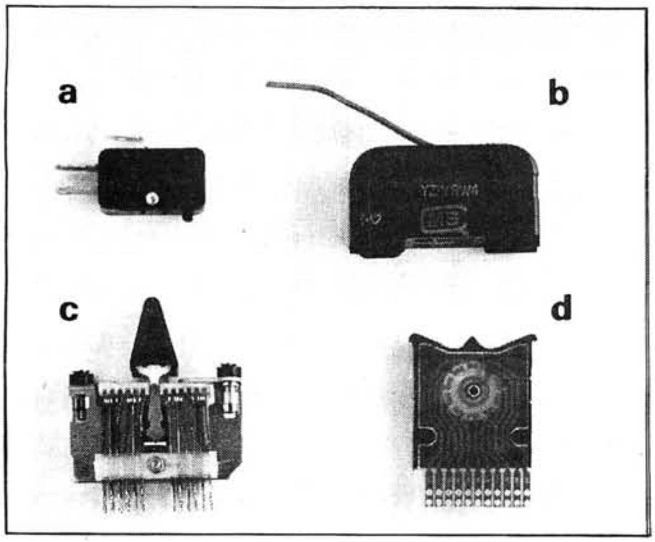


Fig. 11: (a) Button-actuator miniature microswitch. (b) Lever-actuator, heavy-duty microswitch. (c) Lever switch. (d) Thumbwheel edge switch

If you are switching low-level signals at audio or radio frequencies, contact resistance can be important, as I mentioned in Part 1. A typical value is around 20mΩ (0·02Ω). Not very often quoted is insulation resistance across open contacts. This depends on the material the switch is made of, and can be important in very high impedance circuits, around f.e.t.s for example. You can look for at least a megohm, and some of the highest figures are for the tiny d.i.l. switches, an almost unbelievable 100GΩ; that's 100 000 megohms!

At r.f., the capacitance across open contacts can be a problem, as anyone who has ever tried to switch receiver antennas will know. Very few manufacturers quote values, in fact the only figure I've found in current catalogues is for one of the multiple push-button switches I talked about in Part 2, and that's 5pF.

To round off this series,a list of abbreviations likely to be found in switch descriptions.

TABLE

b-m	break before make (contacts)
c. or com.	common (contact)
c.o.	change-over (contacts)
d.p.	double-pole
d.t.	double-throw
f.m.f.	from mounting face (see Part 2)
form A	normally open (contacts)
form C	change-over (contacts)
l.	locking (action)
m-b	make before break (contacts)
n.c.	normally closed (contacts)
n.l.	non-locking (action)
n.o.	normally open (contacts)
q.m.b.	quick-make-and-break
s.m.b.	slow-make-and-break
s.p.	single-pole
s.t.	single-throw
w.	wiper (contact)

AUTHORISED YAESU

ICOM

AMATEUR RADI

★INSTANT HP FACILITIES ★ACCESS ★BARCLAYCARD ★FREE FINANCE ★MAIL OR

YAESU

0010	FT1	Gen Cov HF t'ceiver	PHONE
0020	Key T901	Curtis keyer for above	26.85
0030	DCT1	DC power cable	9.60
0040	RAMT1	Non-volatile mem board	13.05
0050	FMUT1	FM unit	34.90
0060	XF8.9KCN	300Hz CW filter	39.85
0070	XF8.9KC	600Hz CW filter	17.25
0080	XF8.9KA	6kHz AM filter	17.25
0090	XF10.7KC	CW filter	11.90
0100	FT980	Gen cov HF t'ceiver	PHONE
0110	SP980	Matching speaker	54.80
0130	FT102	9 band HF transceiver	PHONE
0140	FC102	9 band matching atu	225.00
0150	FV102DM	Remote vfo for above	250.00
0160	SP102	External speaker	49.05
0240	FM AM	Unit for above	46.00
1341	MH1B8	Scanning hand mic.	13.80
0390	FT77	8 band 100 watt t'ceiver	PHONE
0450	Marker unit		9.60
0460	FM Unit		25.30
0410	FP700	PSU for FT77	110.00
0420	FC700	ATU for FT77	99.00
1449	FL2100Z	160-10m linear amp	459.00
0810	FT290R	2m Multimode portable	239.00
0840	FT790R	70cm Multimode Portable	289.00
0860	NC11C	FT290/790 AC charger	9.20
0880	CSC1A	FT290/790 carrying case	3.85
0870	MMB11	FT290/790 Mob mount	24.90
0900	FL2010	290R Linear amplifier	59.00
0700	FT208R	2m FM handheld 2½W	189.00
0710	FT708R	70cm FM handheld 1W	209.00
0750	NC9C	Slow charger	8.05
0720	FWB2	Spare Ni-cad battery pack	19.95
0740	FBA3	Charging sleeve	5.35
0760	NC7C	Base master charger	30.65
0770	NC8C	Base master quick charger	50.60
0780	PA3	Charger 12v DC	14.20
0800	MMB10	Mobile mounting bracket	6.90
1000	FT230R	2m 25W FM mob t'ceiver	255.00
1010	FT730R	70cms 10W FM mob t'ceiver	PHONE
1020	FT726R	3 band all mode base station	PHONE
1030	430T726	70cms module	230.00
1050	50T726	6 metre module	170.00
1051	HFT726R	HF module	180.00
1060	SAT726	Full duplex x/band unit	90.00
1090	FRG7700	0.2-30mHz gen cov rec	PHONE
1100	FRG7700M	7700 with memory unit	PHONE
1110	MEMGR7700	Memory module	98.90
1120	DCRG7700	DC modification kit	2.95
1130	FRT7700	Antenna tuner unit	42.55
1201	FRA7700	Active Antenna	38.70
1140	FF5	Low pass filter	9.95
1150	FRV7700A	118-130, 130-140, 140-150mHz	78.95
1160	FRV7700B	118-130, 140-150, 50-59mHz	84.70
1170	FRV7700C	140-150, 150-160, 160-170mHz	74.75
1180	FRV7700D	118-130, 140-150, 70-80mHz	80.90
1190	FRV7700E	118-130, 140-150, 150-160mHz	83.95
1200	FRV7700F	118-130, 150-160, 170-180mHz	83.95
0490	FT757GX	Multi Mode Gen Cov.	PHONE

ICOM

2005	IC751	*NEW * 100W H.F.	969.00
2008	IC745	*NEW * 100W H.F.	769.00
2010	IC740	100w HF trans 12v DC	PHONE
2020	PSU(Int.)	230v AC power supply	134.00
2030	FM(EX242)	FM module for above	26.00
2040	KEYER(EX243)	Keyer module for above	36.00
2100	IC730	100w HF trans 12v DC	695.00
2120	FL30	SSB pass band filter	29.00
2190	IC720A	100w HF trans plus gen. cov.	PHONE
2200	PS15	230v p.s.u. for HF t'ceivers	119.00
2210	PS20	230v chopper type unit	155.00
2150	FL45	500Hz filter for 740/730	39.00
2050	FL44	2.4kHz SSB filter	65.00
2220	FL32	CW narrow filter for 720	34.00
2230	FL34	AM filter for 720	29.00
2150	EX202	LDA unit for 730	13.50
2160	EX203	CW audio filter for 730	14.00
2170	EX205	TRV unit for 730	11.50
2240	B10	Memory back up for 720	5.75
2290	IC2KL	500W solid state linear	915.00
2300	IC2KL PSU	Matching 230v AC PSU	256.00
2310	AT100	100 watt HF Auto ATU	249.00
2320	AT500	500 watt HF Auto ATU	349.00
2340	CF1	Cooling fan	20.50
2350	SP3	Matching ext speaker	39.00
2360	HP1	Communication phones	25.00
2370	SM5	Base microphone	29.00
2250	IC-R70	Comms rec 230v AC	PHONE
2260	FM unit	Plug in module	30.00
2270	FL63	CW narrow filter	32.50
2050	FL44	Xtal filter	65.00
2410	IC290H	Multimode 2m 12v DC	433.00
2430	BU1	Back up supply	20.00
2440	IC471	Multimode 70cm	689.00

ICOM CONT.

2450	IC490	Multimode 70cm 12v DC	459.00
2480	IC2E	2m synth h'held 1.5w	159.00
2490	IC4E	70cm synth h'held 1.5w	189.00
2760	MMB2	Mobile mounting bracket	t.b.a.
2770	MMB5	Mobile mounting bracket	12.50
2810	MMB9	Mobile mounting bracket	12.50
2840	MMB12	Mobile mounting bracket	11.50
2850	HM3	4 pin hand mic.	12.50
2870	HM7	8 pin hand mic.	12.50
2890	HM9	L/S mic for IC2E/4E	15.00
2900	HM10	Up/down scan mic.	20.00
2950	SM2	4 pin desk mic.	29.00
2960	SM5	8 pin desk mic.	29.00
2970	SP3	External loudspeaker	39.00
2520	LCX3	Cases for IC2E/4E	4.25
2570	BC25	Standard mains charger	5.75
2590	BC30	Base hod type charger	49.00
2610	BP2	Low voltage pack	30.00
2620	BP3	Standard pack	23.00
2630	BP4	Empty battery box (AA cells)	6.95
2640	BP5	High power battery pack	44.00
2650	CP1	Charger lead for 12V supply	4.49
2660	DC1	12v Regulator pack	11.99

TRIO/KENWOOD

1450	TS930S	160-10m t'ceiver with gen cov	1095.00
1460	AT930	Automatic ATU 80-10m	141.75
1470	SP930	External speaker unit	59.00
1490	YK88A-1	6kHz AM filter	33.25
1500	YK88C-1	500Hz CW filter	33.25
1510	YG455C-1	500Hz CW filter	77.50
1520	YG455CN-1	270Hz CW filter	91.75
1530	TS430S	160-10m with gen cov rec	736.00
1540	PS430	Mains PSU for TS430S	112.75
1550	SP430	Speaker for TS430S	29.50
1570	FM430	FM option unit TS430S	34.50
1580	YK88C	500Hz CW filter	31.75
1590	YK88CN	270Hz CW filter	37.25
1600	YK88SN	1.8kHz SSB filter	32.50
1850	TL922	160-10m 2kw linear	724.50
1870	MC60 N4	Desk microphone	51.50
1880	MC60 S6	Desk mic with up/down	53.50
1890	MC60A	Desk mic with pre-amp	55.25
1900	MC35S	Fist mic 50K imp	14.75
1910	MC30S	Fist microphone 500ohm imp	14.75
1920	MC40S	Up/down mic for TR9000/7800	14.75
1930	MC42S	Up/down mic (TS930S)	15.25
1940	LF30A	LF low pass filter	21.25
1950	TS780	2m/70cm all mode t'ceiver	785.00
1980	TR9130	2m multi mode mobile	433.50
1934	TW4000	FM transceiver 2m/70cm	425.00
1680	TR2500	2m FM synth handheld	219.00
1700	ST2	Base stand and charger	51.75
1710	SC4	Soft case and belt hook	13.75
1720	MS1	Mob stand and power unit	31.75
1730	SMC25	Speaker/microphone	16.00
1750	LH2	Deluxe leather case	24.00
1770	DC25	Power supply from 12V	16.00
1780	TR3500	70cm handheld trans.	225.00
1790	TR9500	70cm multimode mob	395.00
1800	R600	Gen cov rec 150kHz-30MHz	239.00
1820	R2000	Gen cov rec	389.00
1821	HC10	World time clock	62.00

DATONG

3880	PC1	Gen cov convertor	137.40
3870	VLF	Very low frequency convertor	29.90
3670	ANF	Freq agile audio filter	67.85
3660	FL2	Multi-mode audio filter	89.70
3650	FL3	Auto filter for receivers	129.00
3700	ASP/B	r.f. speech clipper for Trio	82.80
3700	ASP/A	r.f. speech clipper for Yaesu	82.80
3710	D75	Manual RF speech clipper	56.35
3740	D70	Morse Tutor	56.35
3750	MK	Keyboard morse sender	137.40
3910	RFA	RF switched pre-amp	33.90
3800	AD270	Active dipole indoor	47.15
3820	AD370	Active dipole outdoor	64.40
3810	AD270-MPU	As above with mains p.s.u.	51.75
3830	AD370-MPU	As above with mains p.s.u.	69.00
3980	MPU	Mains power unit	6.90
3730	RFC/M	RF speech clipper module	29.90
3920	PTS1	Tone squelch unit	46.00
3640	SRB2	Auto Woodpecker blanker	86.25

MICROWAVE MODULES RANGE

3130	MML28/100-S	10m 100W lin/preamp	129.95
3140	MML70/50	4m 50 watt lin/preamp	85.00
3150	MML70/100-S	4m 100W lin/preamp	139.95
3160	MML144/30LS	2m 30W linear amp	69.95
3170	MML144/50S	2m 50W lin/preamp	85.00
3180	MML144/100-S	2m 100W lin/preamp	139.95
3190	MML144/100LS	2m 100W (1 or 3W i/p)	159.95
3200	MML432/30L	70cm 30W lin/preamp	99.00
3210	MML432/50	70cm 50W lin/preamp	109.95
3220	MML432/100	70cm 100 watt linear	228.65
3250	MMC435/51	70cm ATV con, VHF out	37.90
3260	MMC435/600	70cm ATV con, UHF out	27.90
3270	MTV435	70cm ATV 20W t'mitter	149.00
3290	MM1000KB	Converter with keyboard	99.95
3300	MM2001	RTTY to TV converter	189.00
3320	MM4001KB	RTTY term with keyboard	299.00
3330	MMS1	The MORSETALKER	115.00
3340	MMS2	Advanced morse trainer	169.00
3350	MMT28/144	10m linear transverter	109.95
3360	MMT70/28	4m linear transverter	119.95
3370	MMT70/144	4m linear transverter	119.95
3380	MMT144/28	2m linear transverter	109.95
3390	MMT432/28-S	70cm linear transverter	159.95
3400	MMT432/144-R	70 cm linear transverter	184.00
3410	MMT1296/144	23cm linear transverter	184.00
3425	MMC27/MW	27MHz to med wave conv	19.95
3430	MMC28/144	10m to 2m up conv	29.90
3440	MMC50/28	6m to 10m down conv	29.90
3450	MMC70/28	4m to 10m down conv	29.90
3460	MMC70/28LO	4m to 10m down conv	32.90
3470	MMC144/28	2m to 10m down conv	29.90
3480	MMC144/28LO	2m to 10m down conv	32.90
3490	MMC432/28-S	70cm to 10m down conv	37.90
3500	MMC432/144-S	70cm to 2m down conv	37.90
3510	MMC1296/28	23cm to 10m down conv	34.90
3520	MMK1296/144	23cm to 2m down conv	69.95
3530	MMK1691/137.5	1691mHz Meteosat conv	129.95
3540	MMA28	10m low noise preamp	16.95
3550	MMA144V	2m RF switched preamp	34.90
3560	MMA1296	23cm low noise preamp	34.90
3570	MMd050/500	500MHz digital freq meter	75.00
3580	MMd600P	600mHz-10 prescaler	29.90
3590	MMDP1	Freq counter amp/probe	14.90
3620	MMS384	384mHz freq source	29.90
3630	MMR15/10	15dB, 10W attenuator	11.90

AZDEN

4060	PCS4000	2mFM transceiver 25W	229.00
4130	MEX55	Mobile boom safety mic	28.50

FDK

5779	M.750XX	2m FM/SSB/CW 10W t'ceiver	315.00
5782	EXP.430	M.750 70cm transverter	249.00
5772	KP100	AC/DC Electronic Keyer	69.00
5780	ATC720	Synth air monitor 110-138MHz	159.00
5781	RX40	Synth FM mon 140-180MHz	149.00

MUTEK LTD

5850	SLNA 50s	50MHz low noise switched preamplifier using BF981	37.10
5860	SLNA 70s	70MHz low noise switched preamplifier using BF981	37.10
5870	SLNA 70u	70MHz low noise unswitched preamplifier using BF981	22.40
5880	SLNA 70ub	Unboxed version of SLNA 70u	13.70
5890	SLNA 144s	144MHz low noise switched preamplifier using BF981 (0.9dB noise figure)	37.10
5900	SLNA 144u	144MHz low noise unswitched preamplifier using BF981	22.40
5910	SLNA 144ub	Unboxed version of SLNA 144u	13.70
5920	SLNA 145sb	Transceiver optimised preamplifier with antenna c/o switching using BF981. Intended for the FT290R, but has many other applications!	27.40
5930	GFBA 144e	Ultra-high performance environmentally housed switched gasfet preamplifier using advanced negative feedback circuitry for superb dynamic performance. Supplied with ATCS 144s controller	129.90
5940	TLNA 432s	Very high performance bipolar transistor switched preamplifier for 430-440MHz using BFQ69 for 1.4dBnf and 0dBm input intercept performance	74.90
5950	TLNA 432u	Unswitched boxed variant of TLNA 432s	29.00
5960	TLNA 432ub	Unboxed TLNA 432u	20.40
5970	GLNA 432u	Series 432 MHz gasfet unswitched preamplifiers	PHONE
5980	BLNA 432ub	Sub-miniature 1.3dBnf BFQ69 preamplifier	13.70

MUTEK LTD CONT.

5990	BLNA 1296ub	Noise matched N… lna
6000	RPCB 144ub	Complete replace… for the FT221 and…
6010	RPCB 251ub	Complete repla… for the IC211 and…
6020	HDRA 95u-1	1.5dBnf/8.5dB ga… range 88-108MH…
6030	HDRA 95u-2	11.5dB gain varia…
6040	BBBA 500u	20-500MHz broad… dynamic range…
6050	BBBA 860u	250-860MHz bro… amplifier
6060	XBPF 700ub	Microstripline ba…
6070	PPSU 012	12V (nominal) m… HDRA95 & BBBA…
6080	CISA 001	'UHF'(f) to BNC(…
6090	ATCS 144s	Transmit receive… sequence and cc…

WRAASE ELECTRONIC

SLOW SCAN EQUIPMENT

4720	SC140	SSTV receive
4730	SC160	SSTV tranceiv…
4740	SC442A	SSTV TX/RX
4775	SC-1	SSTV + FAX…
4750	FG422A	Light pen
4760	KB422A	Keyboard
4780	Prince	12" green disp…

SCANNING RECEIVERS

5573	Sony ICF7600D Digital receiver
5574	Power supply mains, for abov…
5580	Bearcat BC100 synthesised h/h…
5610	Bearcat BC2020FB AM/FM VH…
5650	Jil SX200N AM/FM VHF/UHF
5651	Jil SX400 26-510MHz AM/FM
5659	Gemscan Synthesised VHF/UH…
5641	AOR2001 Synth. 26-520 AM/F…
5770	Fairmate AS32320 AM/FM VH… airband
5760	Corona CD6000 AM airband re…
5781	FDK RX40 pocket synthesised… 180MHz
5780	FDK ATC720 pocket synthesise… receiver

VHF/UHF AMPLIFIERS

TONO PRODUCTS

5340	2M-50W	40W linear fo…
5350	2M-100W	90W linear fo…
5360	MR-150W	140W linear…
5370	MR-250W	210W linear…
5380	MR28	100W linear…
5390	4M60	50W linear fo…

TOKYO HY-POWER LABS INC

5670	HC-150	3.5MHz to 30…
5680	HC2000	1.8MHz to 30…
5690	HL-82V	2M linear am… includes Mo…
5700	HL-160V	2M linear am… includes J.Fe… I/P
5709	HL-45U	70cm linear… 50W O/P
5711	HL90U	70cm linear… O/P *NEW*

ALINCO ELECTRONICS

5720	ELH230E	2M linear mi… P small
5730	ELH710	70cm linear… 3W I/P
5740	ELH730	As above but…
5741	ELH230D	As ELH230 b… (switched)
5742	ELH250D	2M linear 50… pre-amp (swi…

See full range of BNOS and Micro…

DAVETREND LTD

4670	VHF/W	Wavemeter 1…
4680	4APSU	4 amp 13.8V…
4690	6APSU	6 amp 13.8V…
4700	12APSU	12 amp 13.8V…
4710	24APSU	24 amp 13.8V…
4711	MT1	Morse tutor…

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E64535 1.3GHz	26.90
ment front-end FT225	71.00
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dband low noise	22.60
ndpass tvi filter	2.95
ins psu for 860	6.90
) coaxial adaptor	1.60
changeover ntroller	22.60

S

oard	179.00
board	299.00
- colour	695.00
X/RX	795.00
	40.25
	149.00
ay vdu	119.00

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NEW	169.00
	6.00
eld VHF/UHF	345.00
/UHF	258.75
	299.00
	P.O.A.
F scanner *NEW*	259.00
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F/UHF + military	149.00
ceiver, digital	99.00
receiver 140-	119.00
d airband	149.00

S

2 metres	69.00
2 metres	129.00
metres	169.00
r 2 metres	325.00
r 10 metres	65.00
70cms	159.00
Hz ATU. 150W	62.50
Hz ATU. 2Kw	276.55
min 80W O/P t preamp	144.50
min 160W O/P preamp 3 or 10W	242.40
p 10W I/P 40-	115.00
p 10W I/P 100W	259.00
30W O/P 1/3W I/	49.00
np 10W O/P-1/	59.00
30W O/P with pre-amp	59.95
O/P 1/3W I/P hed)	99.00

vave Module amplifiers!

0-450MHz	27.50
su prot.	30.75
su prot.	49.00
psu prot.	74.00
psu prot.	105.00
th mains psu	49.00

EET

LLOWS

MORSE KEYS

HI-MOUND KEYS

5430	HK702	Up/down on marble	26.94
5440	HK704	Up/down super deluxe	17.65
5450	HK705	Up/down deluxe	13.80
5460	HK706	Up/down economy	14.60
5461	HK707	Up/down popular	13.75
5470	HK708	Basic unit up/down	13.26
5480	MK704	Squeeze keyer manipulator	12.65
5490	MK705	As 0548 with metal base	21.28
5501		Ex-ministry No. 8 key, original packing	4.95

Bencher Products

5220	BY1	Keyer paddle (black base)	37.95
5230	BY2	Keyer paddle (chome base)	48.30
5240	BY3	Keyer paddle (gold plated)	92.00
5250	ZA1A	Balun 3.5-30MHz for dipoles	15.00
5260	ZA2A	Balun 14-30MHz for beam antennas	17.25

RTTY/CW READERS

Tasco Products

5400	CWR685E	Tele reader – RTTY/CW/ASCII	769.00
5410	CWR670	Tele reader – as above, RX only	349.00
5420	CWR610E	Tele reader – as above, basic unit	159.00

Tono Products

5270	9000E	CW/RTTY/ASCII/Editor/lite pen, term L	669.00
5280	550E	CW/RTTY/ASCII/Terminal RX	299.00
5290	350	CW/RTTY/ASCII/Terminal RX only	259.00
5300	CRT120G	VDU 12 inch green screen – mains power	125.00
5310	CRT1200G	VDU 12 inch for 80 columns	136.00
5320	HC800	Line printer centronics	449.00
5330	SK7	Plug adaptors for printers	8.50

ICS Electronics

4900	AMT-1	Amtor RX/TX	275.00

BNOS ELECTRONICS

5800	12/6A	Power supply 13.8V 6 amp, fully protected	48.30
5810	12/12A	Power supply 13.8V 12 amp, fully protected	86.40
5820	12/24A	Power supply 13.8V 25 amp, fully protected	125.45
5830	12/40A	Power supply 13.8V 40 amp, fully protected	225.40
5831	L144/1/100	1 watt input linear	138.00
5832	L144/3/100	3 watt input linear	138.00
5833	L144/10/100	10 watt input linear	115.00
5834	LPM144/1/100	1 watt input linear/preamp	172.50
5835	LPM144/3/100	3 watt input linear/preamp	172.50
5836	LPM144/10/100	10 watt input linear/preamp	149.50
5837	L144/25/160	25 watt input linear	155.00
5838	LPM144/25/160	25 watt input linear/preamp	189.50
5839	L144/10/180	10 watt input linear	178.00
5840	LPM144/10/180	25 watt input linear/preamp	212.50

TONNA ANTENNAS F9FT

	L(M)	W(kg)	
50MHz			
6100 5 element	3.5	3.2	34.30
144MHz			
6103 4 element	0.87	0.5	14.95
6110 9 ele fixed	3.3	1.9	17.71
6120 9 ele portable	3.3	1.7	20.00
6130 9 ele crossed	3.5	2.0	32.43
6140 13 ele portable	4.5	2.5	31.05
6150 17 ele fixed	6.60	4.5	37.66
435MHz			
6190 19 element	3.2	1.1	20.70
6189 19 ele crossed	3.3	1.8	34.27
6200 21 element	4.6	2.6	29.62
6210 21 element ATV	4.6	2.6	29.67
144/435HMz			
Oscar Special			
6160 9 & 19 element	3.3	2.0	4.27
1,250MHz or 1,296MHz			
6213 23 element	1.8	0.9	25.90
6214 4 × 23 ele antennas – power splitter – stacking frame			140.00

Full range of J Beam, T.E.T. and Yaesu antennas available!

WELZ

4980	SP200	1.8-160MHz PWR/SWR	69.95
4990	SP300	1.8-500MHz PWR/SWR	97.00
5000	SP400	130-500MHz PWR/SWR	69.95
5010	SP600	1.8-500MHz PWR/SWR	97.00
5040	SP10X	1.8-150MHz PWR/SWR	24.45
5020	SP15M	1.8-160MHz PWR/SWR	35.00
5030	SP45M	130-470MHz PWR/SWR	51.00
5050	SP250	1.8-60MHz PWR/SWR	49.50
5060	SP350	1.8-500MHz PWR/SWR	59.95
5080	AC38	3.5-30MHz ATU 400w PEP	65.00
5160	TP05X	50-500MHz 0-5W meter	13.95
5131	CA35A	Static protector	10.75
5132	CA23N	Static protector	12.60
5090	CT15A	15/50W dummy load PL259	7.95
5100	CT15N	15/20W dummy load N plug	13.95
5110	CT150	150/400W dummy load	35.50
5120	CT300	300/1kW dummy load	49.50
5130	CT03N	3W dummy load 1.3gHz	30.00
5140	CH20A	2 way coax switch SO239	17.95
5150	CH20N	2 way coax switch N socket	31.95
5133	DF72C	144/430MHz duplexer	18.95

WELZ DIAMOND AERIALS

7800	RH2B	2m ¼ wave whip BNC	8.95
7810	RG200B	2m half wave whip BNC	18.95
7820	RH702B	70cm 2 × 5/8 whip BNC	16.00
7830	M285	2m 5/8th mobile PL259	8.50
7840	M287	2m 7/8th mobile	14.95
7850	EL770E	Dual band 2m/70cm mobile	18.95
7860	B285	2m 5/8th base with radials	14.95
7870	GH22	2m 2 × 5/8th base	27.95
7880	GH72	70cm 2 × 5/8th base	27.50
7890	DP100S	80-10m mobile system 100w	79.95
7960	GLS	Gutter mount with 4m cable	8.95
7970	GLP	SO239 vehicle mount	2.75
7980	SPM	Heavy duty magnetic base	12.95
7990	TRB	Heavy duty trunk lip mount	11.50
8000	LOR	14" elevated ground plane	18.50
8010	LBR	Heavy duty base spring	10.50
8020	BDS	Bumper mounting strap	9.50
8030	BSB	As LBR with ball adjustment	8.50
8040	EL80	Base loaded whip 3.5MHz	37.00
8050	EL40	Base loaded whip 7MHz	32.50
8060	CP3	6-10-15 vertical with G.P.	69.00
8070	CP4	10-40m vertical with G.P.	89.00
8080	CP5	10-80m vertical with G.P.	115.00
8090	KB101	10-40m 1kw vertical	55.00
8100	KB105	10-80m 1kw vertical	79.50

SUN ANTENNAS

9900	KG209SE2	7/8 + cap hat 2M	13.95
9910	KG309SE2	5/8 + cap hat 2M	9.95
9915	KG366	5/8 standard 2M	7.95
9920	KG144GP	3 × 5/8 base colin 2M	26.95
9925	KG110G	Gutter mount	2.95

NEW RANGE – OSKER BLOCK

9950	SWR300	VSWR + power meter 3.5-30MHz 2KW		59.95
9955	SWRWV3	Economy version of SWR300, add required inserts		29.95
9960	SWR145	VSWR + power meter 144-155MHz 250W		27.95
9965	SPC6A	Insert for 300/WV3 0-2W/0-20W 50MHz		15.95
9970	SPC6B	Insert for 300/WV3 0-20W/0-200W 50MHz		15.95
9975	SPC2A	Insert for 300/WV3 0-2W/0-200W 144MHz		15.95
9980	SPC2B	Insert for 300/WV3 0-20W/0-200W 144MHz		15.95
9985	SPC07A	Insert for 300/WV3 0-2W/0-20W 432MHz		15.95
9990	**SWR300** + choice of 3 inserts		**Special price**	84.95
9995	**SWRWV3** + choice of 3 inserts		**Special price**	59.95

THIS MONTH'S SPECIALS

- 9680 Confidential Frequency list. Latest edition — 10.95
- 10100 Noda Tushin 427H RMS/PEP 1.8-150MHz power meter — 74.95
- Full range of WPO communication kits in stock — PHONE
- Many second hand items refurbished by us are now available Typical examples: FRG 7700 from £239.00; FT290R from £185.00; 2M amplifiers from £29.00

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DUAL POWER SUPPLY

Designing a power supply suitable for use as a general purpose bench unit poses a number of problems not found when designing for use in a specific item of equipment. For example, what voltage and current does one provide? Whatever is decided it will be found to be wrong at some time, either not enough amps or the voltage is wrong.

While talking to a number of people it was found that the most common requirements would be met by a variable supply giving 0 to 50V at currents up to 1A. This was the specification decided on for the "*PW* Bridport" power supply. The supply was made even more versatile by making it a dual unit, giving up to 100V by series connection, and also by providing a constant current mode which may be preset between the limits of 100mA and 1A. With certain precautions it is also possible to operate the two sections in parallel and obtain 0 to 50V at up to 2A and this is dealt with in the section on operation.

Circuit

Fig. 1.1 shows a block diagram of the basic power supply which uses an LM317 regulator. The 40V unregulated supply across capacitor "C" is applied to the regulator input and the output voltage is controlled by potentiometer "R_v". However, as the LM317 can only be used up to a maximum of 40V, the voltage across the device must not exceed this figure or failure will result. To enable voltages in excess of this to be handled, certain precautions must be taken. Fig. 1.2 shows the basic circuit used in the "*PW* Bridport" power supply. The addition of the transistor and Zener diode limits the voltage across the regulator to not more than the Zener voltage at all times.

For example, assume the output is shorted. The Zener is then connected between the negative terminal and the base of the transistor; if this Zener is rated at, say, 15V the maximum voltage on the base will be 15V and that at the emitter a little lower. Thus the voltage across the i.c. is limited to a maximum of 15V—well inside its maximum rating of 40V, even though the unregulated supply is much higher. The excess voltage is developed across the transistor, which must of course be suitable for the task.

The complete circuit diagram is shown in Fig. 1.3. The a.c. mains is fed to both T1 and T2 via the mains switch S1 and fuse FS1. The output from T1 is fed to the four silicon diodes used as a bridge rectifier and the resultant

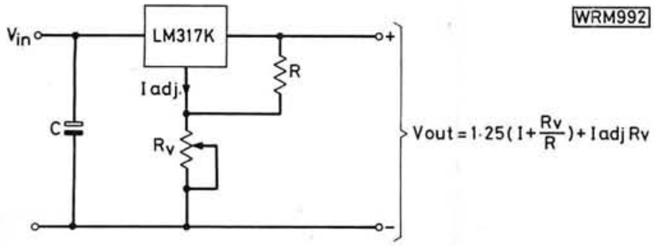


Fig. 1.1: Block diagram of the basic regulated power supply

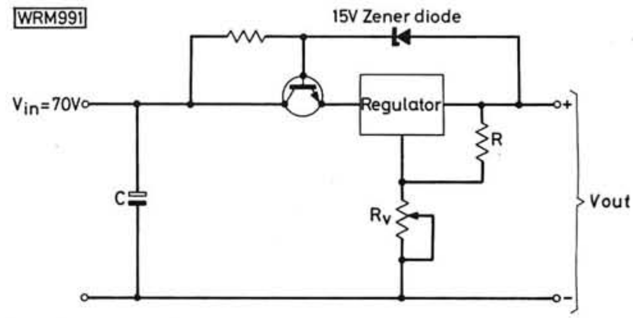


Fig. 1.2: The basic regulator circuit used in the *PW* Bridport

d.c. appears across C1. This unregulated voltage (approx. 78V) is fed to the collectors of Tr1 and Tr2. Transistor Tr1 provides the current drive for Tr2 and it also has two Zener diodes connected to its base. D7 is rated at 15V and has its other end connected to the output of IC1. The other Zener D6, rated at 56V, connects to the negative rail and prevents the base, and therefore the output voltage, of Tr2 rising above this value. This is important when in the constant current mode and will be dealt with later.

The output from the emitter of Tr2 is fed to the input of the regulator IC1. The switches are shown set for constant voltage so we shall deal with this mode first. The actual output voltage obtained from the 317K depends on the values of R4 and R9, assuming for the moment that the bottom end of R9 is connected to the common rail, the output voltage is found from:

$$V_{out} = 1{\cdot}25\left(1 + \frac{R9}{R4}\right) + (I_{adj.}\, R9)$$

($I_{adj.}$ is typically 50μA for the 317K so for R9 = 5kΩ, $I_{adj.}$ R9 is 0·25V). It can be seen from this that if R9 is zero ohms the output voltage will be 1·25V and not zero. For this reason R9 is not returned to the common line but to a separate supply providing −2·7V via R8. By adjusting the value of R8 while R9 is at zero ohms we can offset the 1·25V and obtain zero volts at the output of IC1 when R9 is at zero ohms.

This enables the output voltage to be controlled from the maximum down to zero. An important point as a standing voltage of 1·25V could cause problems with some semiconductor circuits when switching on for the very first time; much better to start at zero volts and bring up the supply slowly.

The required negative voltage is provided from T2 and uses a half wave rectifier circuit D5 and C3 to provide the d.c. Resistor R2 and D8 (a 2·7V Zener) stabilise the final voltage before it is applied to the control circuit of IC1. Note that both transformers have two separate secondary windings, this is because there must not be any direct connection between the two sections of the dual power supply, the circuits must be isolated one from another. For the same reason, both circuits are isolated from chassis.

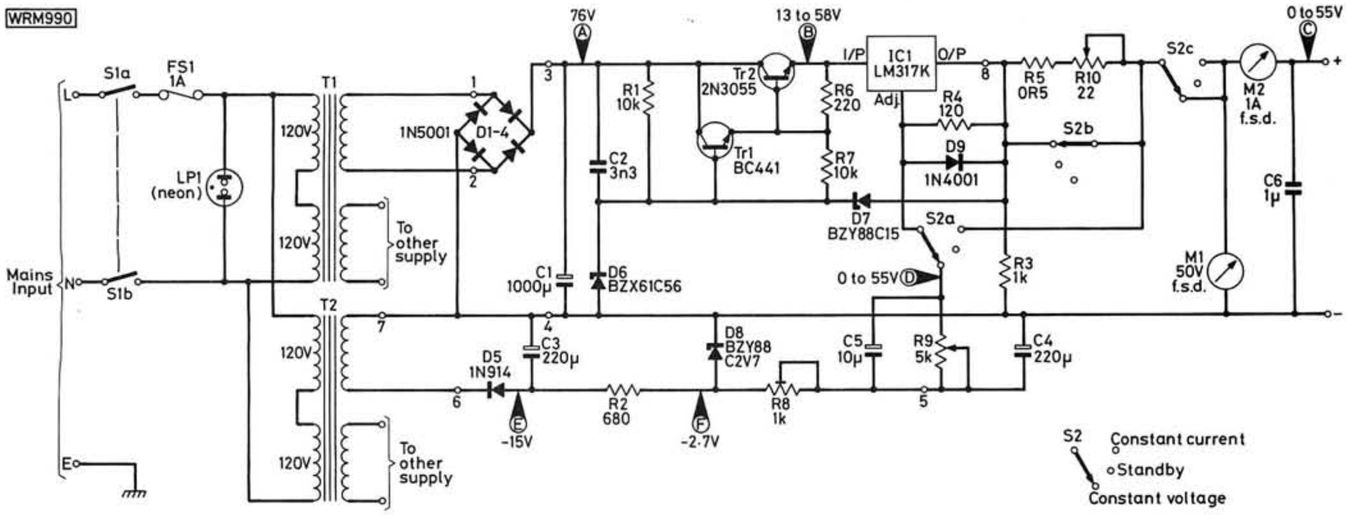


Fig. 1.3: Complete circuit diagram of the *PW* Bridport dual regulated power supply. Note that only one supply is shown, the other being identical with the component references indicated by the addition of 100 (e.g. R104 etc)

The regulated output from IC1 then passes to the output terminal via the meter M2 (0–1A), with meter M1 (0–50V) between output and the common line. This output is also via switches S2b, c of course, and as shown they are in the correct positions for a constant voltage supply. We say "constant", although it can be varied, because it remains constant at whatever voltage it is set to.

In the position shown, S2b shorts out R10 and R5 and S2a selects R9. The centre position of these switches is a standby position and the output terminals are disconnected from the positive rail. The reason for having a standby position is so that when the power supply is connected to an external experimental circuit it can be switched off without any delays or voltage surges. If it was switched off by the mains switch the main supply rail will take longer to "collapse" than the low voltage negative supply, and this causes the output voltage to increase by about 4V before falling to zero. This surge could spell disaster to certain types of semiconductor circuits as, for example, if the output had been set to 5V for checking a digital circuit, switching off at the mains will cause a surge to about 9V which could "blow" digital i.c.s. An optional modification to overcome this problem will be described in Part 2. **Always use the standby "off" position for "instant" zero volts or current.**

In the third position of switch S2 the circuit is set for constant current. In this mode the potentiometer R10 is in series with the output and R9 is disconnected, the regulator control pin is connected to the output after R10 and this sets the i.c. into its constant current mode. The maximum current available can be adjusted to between 100mA and 1A depending on the setting of R10. The approx. current is calculated from:

$$I_{out} = \frac{1 \cdot 25}{(R10 + R5)}$$

All potentiometers have a certain terminal resistance called "hop on" or "hop off" resistance. When the wiper reaches the end of the track there will be a certain resistance left in circuit and this will depend on the design of the potentiometer. With the components specified this is quoted as 2 ohms maximum. In most cases it will be found to be much lower than this but its actual value is important as it sets the current limit maximum value. For example, if it is 2 ohms, $I_{out} = 1 \cdot 25/2 = 0 \cdot 625$A and this would be the maximum available current in the constant current mode. In the prototype the value was found to be less than 1 ohm, which would give 1·25A and is too high, so an extra resistance R5 was added so that with R10 set for maximum current (minimum R) the current was limited to 1A. Wire-wound potentiometers are **not** suitable as the resistance tends to change in small "steps" and continuous adjustment is impossible. The Cermet type appear to be the most suitable.

The point is that should you find that you cannot get a current as high as 1A you may need to try another potentiometer with a lower terminal resistance. If, on the other hand, the current is higher than 1A it is easy to add a small value series resistance between R10 and the output of the regulator. Unfortunately, it is not possible to use a parallel resistance to reduce the terminal resistance of the potentiometer as this would prevent the current limit being set to a low value.

Resistor R3 (1kΩ 2·5W) provides a small continuous current drain at the output of the i.c. Without this resistor fitted the output voltage would not be stabilised at very low currents. Diode D9 prevents the capacitor C5 discharging through the i.c. if the output is shorted, C5 reduces the ripple and noise present and should not be omitted. Capacitors C2 and C6 prevent high-frequency instability. (Note that C6 is a polyester type and not an electrolytic.) The circuit as shown, providing it is used with the specified heat sinks, will withstand short circuit conditions for a considerable period and may be used at full ratings

BUYING GUIDE

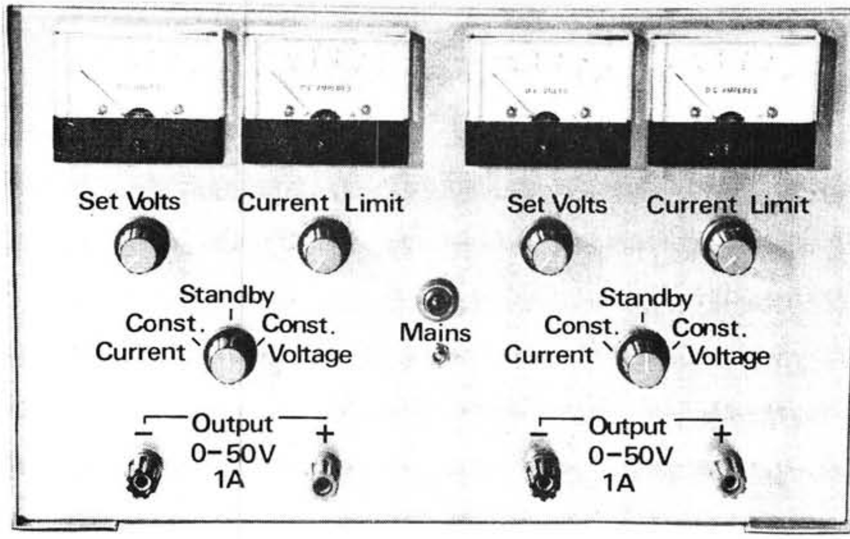
There should be no difficulty in obtaining components for this project. The sheet metal for the case should be available from your local aluminium stockholder (see *Yellow Pages*) or from K. Whiston, New Mills, Stockport SK12 4PT (Send for a copy of *The Whiston Cat).*

Approximate Cost

£80

Construction Rating

INTERMEDIATE



(50V at 1A) continuously without damage, although under extreme conditions the heat sinks will run very hot, about 65°C with an ambient temperature of 20°C. The heat sinks specified should be used; do not be tempted to use smaller types. The thermal resistance is about 1°C/W when mounted on the chassis.

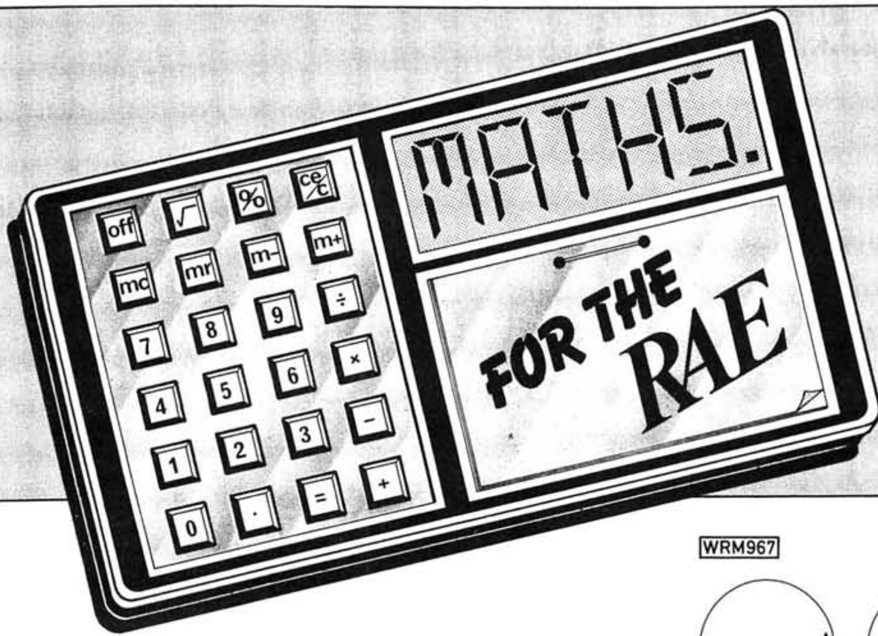
Note that under short circuit output conditions in the constant voltage mode the current is limited to around 2·25A. Although the current meter will be "hard over" no damage will be caused with the specified meters. The mains fuse, rated at 1A, must be of the anti-surge type.

In the constant current mode the output voltage is not stabilised and normally could rise to the full unregulated voltage. To prevent this a Zener diode, D6 (56V), is fitted and this "clamps" the voltage to a safe level. The actual voltage present at the output will depend on the load resistance but will be correctly indicated on the voltmeter (M1). As around 56V will be present with no load connected, this meter will be "hard over" until the output is loaded (i.e., trying to indicate 56V on a 50V scale!) One important point, R4 must be close to the regulator i.c. as shown or voltage stabilising will be impaired. Part 2 will start construction of the project.

★ components

Resistors		
¼W 5% Carbon film		
120Ω	2	R4,104
220Ω	2	R6,106
680Ω	2	R2,102
0·5Ω	2	R5,105 (see text)
10kΩ	4	R1,7,101,107
2·5W Wire-wound		
1kΩ	2	R3,103
Potentiometers		
Min. horizontal preset		
1kΩ	2	R8,108
Cermet 2W ¼inch spindle		
22Ω (lin)	2	R10,110
5kΩ (lin)	2	R9,109
Capacitors		
Polystyrene		
3·3nF	2	C2,102
Polyester		
1µF	2	C6,106
Electrolytic p.c.b. mounting		
10µF 63V	2	C5,105
220µF 16V	4	C3,4,103,104
Electrolytic, single-ended		
1000µF 100V 1·3A min. ripple current	2	C1,101
Semiconductors		
Diodes		
1N914	2	D5,105
1N4001	2	D9,109
1N5401	8	D1–4, 101–104
BZX61C56	2	D6,106
BZY88C2V7	2	D8,108
BZY88C15	2	D7,107
Transistors		
BC441	2	Tr1,101
2N3055	2	Tr2,102
Integrated circuits		
LM317K	2	IC1,101
Transformers		
240V primary		
50 + 50V, 100VA (RS 207–324)	1	T1/101
9V + 9V, 6VA (RS 208–096)	1	T2/102
Switches		
Rotary		
3p.3w.	2	S2,102
Toggle		
Double pole mains	1	S1

Miscellaneous
Panel meter 0–50V (2), 0–1A (2); Mains neon indicator (1); Fuse holder, 20mm chassis mounting (1); Knobs (6); Terminals, Red (2), Black (2); Heat sink 1·1°C/W (RS 401–807) (2), 50°C/W (RS 401–508) (2); Materials for case (see text).



Part 3 by Roger Lancaster

In this final part of the series we will be looking at graphs of sine and cosine functions.

The circle in Fig. 3.1 represents a wheel, the hub of which is at O. Point A on the circumference is the equivalent of a tyre valve. B is the point at axle height directly above or below A. Let the radius of the wheel be one metre; therefore OA will be one metre, as also will the height of O from the ground, and all lengths will be expressed in metres. The angle OA makes with the horizontal, measured with respect to the line OH, is represented by θ (theta). We will say AB is positive when A is higher than O and negative when A is lower than O; also OB is positive when B is to the right of O and negative when B is to the left of O.

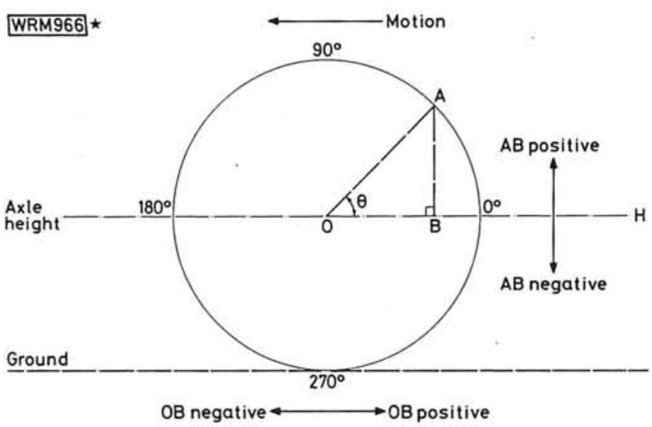


Fig. 3.1

As the wheel moves in the direction shown, A rotates anticlockwise. As it does so, AB increases to a maximum of one metre while at the same time OB reduces to zero, Fig. 3.2(i) to (iii). Then AB reduces to zero while OB increases negatively to minus one metre, Fig. 3.2(iv) and (v). Then AB increases negatively to minus one metre while OB returns to zero, Fig. 3.2(vi) and (vii). Finally, to complete one rotation, AB returns to zero as OB increases to one metre, Fig. 3.2(viii) and (i). Only a few instants during one complete rotation are shown in Fig. 3.2.

The following points should be noted from Fig. 3.2:

a) θ passes through all angles from 0° to 360° (0 to 2π radians) in one rotation. A radian is the angle subtended at

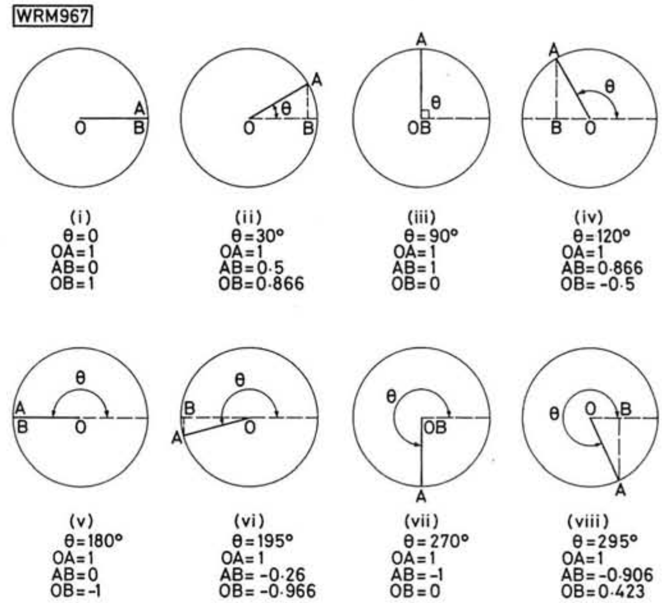


Fig. 3.2

the centre of a circle by an arc whose length is equal to the circle radius, as shown in Fig. 3.3. Since the circumference of a circle is 2π times its radius, there will be 2π times one radian in the 360° of one rotation. So 2π radians is one complete rotation, π radians is half (180°), $\pi/2$ radians is a quarter (90°), and so on. The word "radian" is often dropped, so that if no units are quoted, then radian measure is assumed.

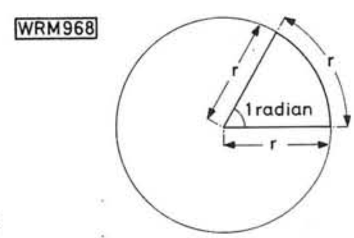


Fig. 3.3

b) OA is always one metre in length.

c) The length of AB changes rapidly around angles of 0° and 180° (π) but changes gradually around angles of 90° ($\pi/2$) and 270° ($3\pi/2$). In other words, the length of AB is not directly proportional to θ (see Part 2).

d) The length of OB changes gradually around angles of 0° and 180° (π) but rapidly around angles of 90° ($\pi/2$) and 270° ($3\pi/2$). Again, OB is not directly proportional to the angle.

In order to see exactly how the length of AB varies with θ we can plot a graph, with the values of these two variables forming the axes of the graph (see Part 2). If the shape is to be right, we must plot many more values of AB than those in Fig. 3.2, say one for every ten degrees. Each of the plotted points will show the length of AB at one instant, and these are therefore called **instantaneous values.** The result of joining all these instantaneous values with a smooth curve would be as shown in Fig. 3.4.

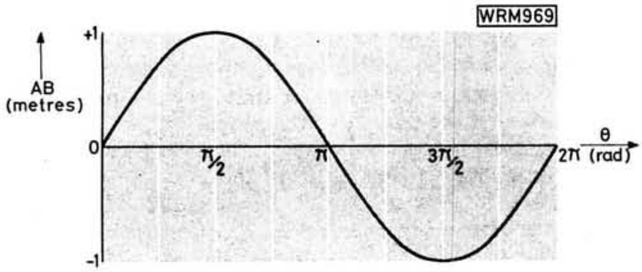


Fig. 3.4

The curve is called the **sine curve**, because the **sine** of an angle is the ratio of the length of the side opposite the angle in a right-angled triangle to the length of the hypotenuse (the longest side). In our example, the sine of θ (written $\sin\theta$) is therefore equal to AB/OA and from this

$AB = OA.\sin\theta = 1.\sin\theta = \sin\theta$

So our graph turns out to be the general graph of the sine of an angle, plotted against the angle itself, and therefore shows how the sine of the angle varies with the angle itself. This is a special case, where the maximum value reached by AB is one. In the general case, where the maximum value is, say, x, the value of AB at angle θ would be given by the expression

$AB = x.\sin\theta$

Many things, both in nature and technology, behave in this **sinusoidal** manner. The alternator, the rotating machine which generates electricity, produces a voltage which varies in this way, the most common example being the voltage which form our domestic mains supply. The output voltage of most oscillators also varies like this.

The graph as drawn in Fig. 3.4 shows one **cycle** of this **sine wave.** If the wheel continued to rotate, the whole cycle would repeat over and over again. The number of such cycles taking place every second is called the **frequency** (symbol f), expressed in hertz (Hz), one cycle per second being one hertz. The **angular velocity**, the rate at which the angle changes with time, expressed in radians per second, is given the symbol ω (omega) and is equal to $2\pi f$. The time for one cycle is called the period (symbol T), and therefore $T = 1/f$ seconds.

The horizontal axis of Fig. 3.4 could be graded in time rather than angle, assuming a constant angular velocity. In this case π (radians) would be replaced by $1/2f$ (seconds), 2π by $1/f$ etc. However, such time axes are often graded in terms of

$$\frac{\text{angle in radians}}{\text{angular velocity}}$$

so that π (radians) would be replaced by π/ω (seconds), 2π by $2\pi/\omega$ etc. Remember $\omega = 2\pi f$, so

$$\frac{2\pi}{\omega} = \frac{2\pi}{2\pi f} = \frac{1}{f}$$

which is the expression for period previously quoted.

Also, angular velocity × time = angle

$$\frac{\text{radians}}{\text{sec}} \times \text{sec} = \text{radians}$$

so ωt or $2\pi ft$ is the angle corresponding to any time t seconds after zero. The general expression for a sine wave is therefore often written as $x.\sin\omega t$.

Two cycles of the domestic mains (alternating current) supply voltage are shown in Fig. 3.5. The frequency (in the UK) is 50Hz, so the period is $1/50 = 0{\cdot}02$ second, or 20 milliseconds (ms), a millisecond being one thousandth of a second. The expression describing the wave is therefore $339{\cdot}4 \sin\omega t$, or $339{\cdot}4 \sin(100\pi t)$.

The **peak value** of a sine wave is the maximum positive value of the variable represented by the vertical axis. In Fig. 3.4 the peak value is one metre (OA), in Fig. 3.5 the peak value is 339·4 volts. The **peak-to-peak value** is double the peak value, i.e. two metres for Fig. 3.4 and 678·8 volts for Fig. 3.5.

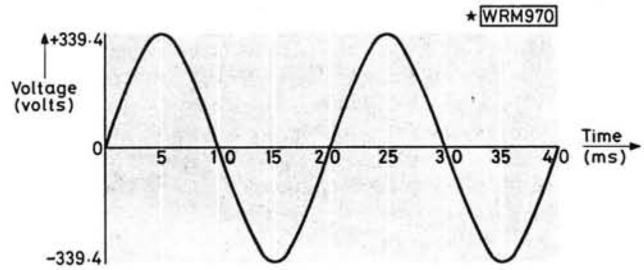


Fig. 3.5

These two amplitudes are not always quoted when describing the magnitude of a sine wave, however. In electrical applications in particular, it is the **root-mean-square (r.m.s.) value** which is most often quoted. The heating effect produced by an electric fire when connected to the mains supply of Fig. 3.5 would be the same as if the fire were connected to a constant (direct current) supply of **240 volts.** This r.m.s. value, which is always 0·707 times the peak value of a sine wave, is more apt for electrical purposes because it gives a better idea of what the a.c. can do in terms of electrical work.

Plotting values of OB as θ increases from 0 to 2 results in the graph of Fig. 3.6. This is a **cosine wave**. The cosine of an angle is defined as the ratio of the length of the side adjacent (to that angle in a right-angled triangle) to the length of the hypotenuse. The cosine of θ ($\cos\theta$) in all the diagrams of Figs. 3.1 and 3.2 is

$$\frac{OB}{OA} = \frac{OB}{1} = OB$$

Since Fig. 3.6 shows how OB varies with the size of θ, the graph is of $\cos\theta$. The graph is still loosely called sinusoidal as it is exactly the same **shape** as the sine graph, it has merely been shifted along the horizontal axis by $\pi/2$. The general expression for this graph is $x.\cos\theta$ or $x.\cos\omega t$, x being the peak value.

If you study the graphs of Figs. 3.4 and 3.6 closely, you will see that AB passes through exactly the same values as OB but 90° later. For example, OB falls from +1 to 0 between angles of 0 and $\pi/2$ and AB does exactly the same thing between $\pi/2$ and π, i.e. 90° later; OB falls from 0 to −1 between $\pi/2$ and π and AB does exactly the same thing between π and $3\pi/2$, again 90° later. The frequency of the two waves is the same, so AB always follows OB 90° behind.

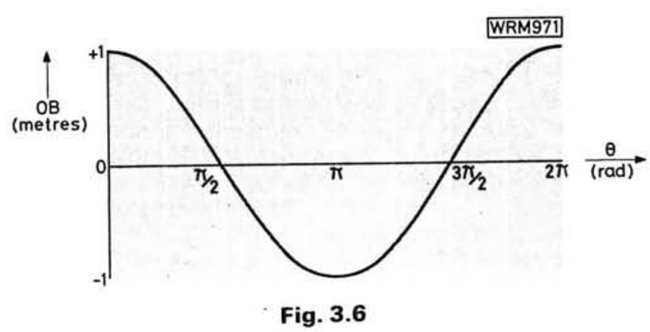


Fig. 3.6

Because AB and OB reach their maxima and minima at different times, they are said to be **out of phase.** In fact, there is a **phase difference** between them of $\pi/2$ or 90°. The **phase angle** is 90°, or $\pi/2$. Because OB is always ahead of AB by this phase angle, OB is said to lead AB (by 90° in this case). Alternatively, AB lags OB (by 90°).

It could be argued that AB leads OB by 270° ($3\pi/2$) because, for instance, AB rises from 0 to +1 between 0 and $\pi/2$ while OB does the same thing between $3\pi/2$ and 2π, i.e. 270° later. However, the accepted standard is that the smallest angle between the two variables is taken to be the phase angle and it is this which decides which variable leads.

Another way of describing the rotation of the tyre valve is by **vector,** which is drawn in one direction, as in Fig. 3.7, but because the frequency is quoted it is implied that the vector rotates at a constant angular velocity (anti-clockwise is the accepted standard). The length of the vector is the **peak value** of the sine wave representing the same rotation, in our example one metre.

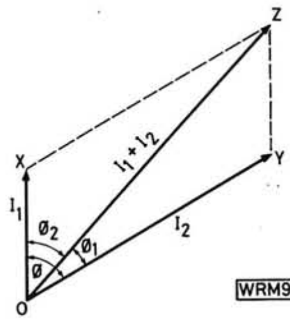
In electrical work, very often two or more variables are changing in a sinusoidal manner and at the same frequency. For example, the voltage across component A in a circuit may be varying sinusoidally at the same frequency as the supply to the circuit and at the same time the voltage across component B in the same circuit may be varying sinusoidally at the same frequency as the supply but out of phase with the voltage across component A. Because there is only one frequency the phase difference remains constant. The two voltages could be represented by a **phasor diagram,** as shown in Fig. 3.8. The lengths show the peak value of each voltage while $\emptyset$ (phi) is the phase angle between them. The directions in which the two phasors are drawn is immaterial as long as they are separated by $\emptyset$; they rotate together at the same speed and the diagram merely shows the situation frozen at one instant in time. Only the lengths (amplitudes) of the voltages and the phase angle between them are important in a phasor diagram. These phasor diagrams are very useful because they can show the relative amplitudes and phases of several voltages and/or currents at a glance.

Often, such currents or voltages which are out of phase with each other must be added together. Suppose two such currents, I_1 and I_2 join together at a point in a circuit, as shown in Fig. 3.9, to form the current $I_1 + I_2$. In a d.c. circuit this is straightforward and the two currents are simply added. But if the currents are a.c. and varying sinusoidally it is not necessarily so easy.

If I_1 and I_2 were at the same frequency but with a phase difference between them we cannot simply add their peak values together because they will pass through their maxima (and minima) at different times. In a case like this we must take the **phasor sum.** The two currents in a phasor diagram are shown in Fig. 3.10; it also shows how the phasor sum is obtained by **completing the parallelogram.** A line parallel to OX and equal in length to I_1 is drawn from Y (to Z). Another line parallel to OY is drawn from X, equal in length to I_2, i.e. from X to Z. The diagonal (OZ) is the **phasor sum** of I_1 and I_2 and it is this current which will flow after the two currents have joined together. You will see that it is a bigger current than I_1 or I_2 but not as big as if I_1 was simply tacked on to the end of I_2.

A case where the phasor sum of two currents is smaller than either of the individual currents is shown in Fig. 3.11. This happens when the phase angle approaches π. In fact, if the two phasors were exactly π apart, their "sum" would be the **difference** between them, and they are said to be in anti-phase.

Sometimes we need to perform the opposite operation on a phasor, that is to resolve a single phasor into two component parts.



WRM982 ◄ **Fig. 3.10**

WRM983

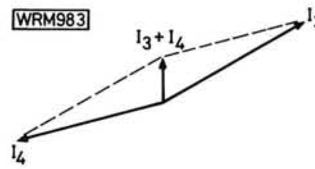


Fig. 3.11 ▲

Two phasors, a voltage V_S and a current I, with a phase angle between them of $\emptyset$, are shown in Fig. 3.12. We may know, from a knowledge of the action of the circuit, that V_S is actually the phasor sum of two voltages, V_R (in phase with I) and V_L (leading I by 90°). We can find the amplitudes of these components by drawing a perpendicular line from the end of V_S onto the current phasor as shown.

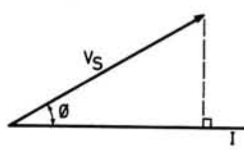
The full phasor diagram for this is shown in Fig. 3.13. The amplitudes of the two components can be calculated by simple trigonometry:

$$\sin \emptyset = \frac{\text{side opposite to } \emptyset}{\text{hypotenuse}} = \frac{V_L}{V_S}$$

therefore, $V_L = V_S.\sin \emptyset$

$$\cos \emptyset = \frac{\text{side adjacent to } \emptyset}{\text{hypotenuse}} = \frac{V_R}{V_S}$$

therefore, $V_R = V_S.\cos \emptyset$



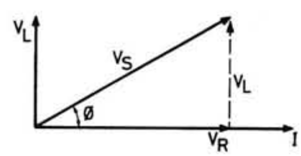


Fig. 3.12 WRM984 WRM985 **Fig. 3.13**

WRM979

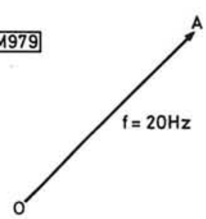
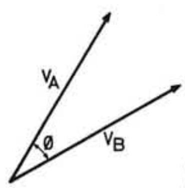


Fig. 3.7 ▲



WRM980

Fig. 3.8 ▲

WRM981

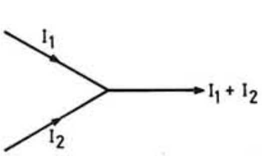


Fig. 3.9 ►

Conclusion

If you have followed these three articles you should now have the necessary mathematical background to embark on a course leading to the Radio Amateurs Examination. There is still a lot to learn—you will have to apply this knowledge to the technical theory which forms part of the syllabus—but at least you should now be able to follow the explanations given by lecturers and authors of textbooks.

Enjoy your course, and good luck in the examination. ●

Products

Portable Power

Oldham Batteries, internationally respected suppliers of a huge range of British-made quality automotive and industrial traction batteries, can now offer a comprehensive series of sealed lead acid maintenance-free batteries.

Called the "Carefree" range, they provide a variety of outputs and physical sizes covering from 6V 1·1Ah to a 12V 100Ah unit.

The introduction of these batteries represent the result of close collaboration between Oldham and Eagle-Pilcher Industries, an American company who developed and supplied high technology batteries for use on Apollo rockets and the moon buggy.

All "Carefree" rechargeables are constructed with individual cell covers providing protection against intercell electrical leakage, additionally, a second outer cover is installed that serves as a protector against accidental corrosive leakage.

Perhaps the most revolutionary

feature of these batteries is the use of calcium as the hardening agent in the lead-acid grid, rather than antimony which has the effect of eventually "poisoning" the battery by depositing itself onto the active material of the negative plate.

Probably the unit of particular interest to the radio amateur is the 12V 6Ah model that can be supplied complete with a built-on carrying handle terminated with a car-type cigar lighter socket.

Utilising this simple type of connector, not only can the battery be recharged from the car whilst driving, but should provide sufficient power to run a typical hand-held transceiver for a weekend. When not in use, the battery may be recharged from a standard home charger—observing the charge rate and battery capacity—or may be float charged continuously.

The 12V 6Ah battery mentioned is housed in a moulded case constructed of high impact polystyrene, measures only 155 × 61 × 100mm (excluding handle), weighs 2·155kg and is priced at £14·00, plus VAT and carriage.

For further details, contact: *Carefree Sales, Oldham Batteries Ltd., Denton, Manchester M34 3AT. Tel: 061-336 2431.*

New Products from SMC

South Midland Communications Ltd. inform me of two new items they have added to their range of products.

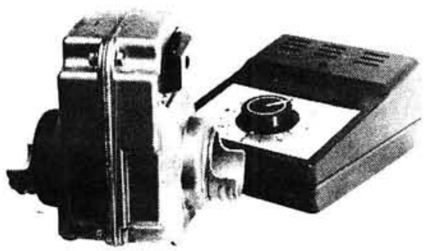
First, the MS-8400, a microprocessor controlled v.h.f./u.h.f. scanning receiver.

The frequency range is covered in four frequency blocks described as Low v.h.f. (68·000–88·000MHz), Mid v.h.f. (108·000–136·000MHz), High v.h.f. (136·005–174·000MHz) and u.h.f. (360·000–512·000MHz). Selectable scanning steps 5, 10, 12·5 and 25kHz on v.h.f. and 10, 12·5 and 25kHz on u.h.f.

Main features of the MS-8400 include: 40 programmable memory channels (memory backup is provided by a 9V PP3 battery); selectable a.m. or f.m. modes; scan rate of

approximately 18 channels per second with a two second scan delay and four second priority sampling time. Selectivity is better than −60dB @ ±25kHz with audio output at 1·2W through a 100 × 63mm elliptical loudspeaker, a telescopic antenna is fitted and an external antenna socket is provided. Power requirements are 12–16V d.c. at 600mA.

The MS-8400, which measures 190 × 250 × 85mm, weighs 1·7kg, costs £249 inclusive of VAT and is supplied carriage free.



Second, is the FU-200 antenna rotator and control unit, designed specifically for domestic TV and lightweight u.h.f./v.h.f. antennas—typically an 8 element v.h.f. Yagi.

The control unit is a.c. mains powered, which transforms the operating supply for the rotator to 22V a.c. at 1·5A.

With a 360° rotation angle, achieved in 60 seconds, the rotator is suitable for mounting on a mast of between 38 and 50mm diameter. The rotating extension may similarly be of 38 to 50mm diameter material.

Housed in a weather-proof metal casing, the FU-200 costs £49 which includes VAT and once again carriage is free.

For further details contact: *South Midland Communications Ltd., S.M. House, Rumbridge Street, Totton, Southampton SO4 4DP. Tel: (0703) 867333.*

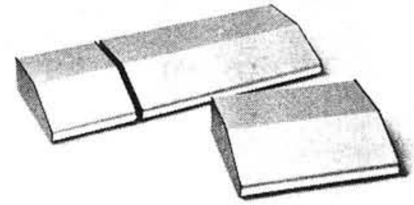
New Desk-top Cases

West Hyde Developments Ltd. has recently introduced a new range of lightweight cases primarily intended for desk-top applications such as intercoms and controls.

The Empress case is attractively styled with smooth contours, and is manufactured from 2mm thick aluminium and has a natural anodised finish with black side cheeks.

Four different sizes comprise the range, all with a common profile, and every case is supplied complete with self-adhesive feet, ex-stock.

For further information and prices contact: *West Hyde Developments Ltd., Unit 9, Park Street Industrial Estate, Aylesbury, Bucks. HP20 1ET. Tel: (0296) 20441.*



Products

New Receivers from Sharp

Two new receivers, designed for travellers, that may appeal to radio enthusiasts, have recently been launched by Sharp Electronics (UK) Ltd.

Entitled FV–310GB and FV–610GB, both models employ dual-conversion superheterodyne circuitry and offer coverage of the v.h.f. f.m., long, medium and seven shortwave bands.

On/off and band select switches are located on the right-hand edge of the receiver, below a rotary tuning knob, whilst slider controls on the front of the set cover volume, tone and select for the seven shortwave bands.

Powered by five 1·5V HP–7 cells, the FV–310GB has an 8cm loudspeaker and the maximum power output is 1300mW. Weighing 650g, the set measures overall 210 × 135 × 42mm deep and comes complete with carrying case, shortwave handbook and batteries.

The model FV–610GB has the same output, speaker, and overall dimensions. However, it is slightly heavier at 700g, which is accounted for by the inclusion of extra microprocessor controlled circuitry that provides the following functions: frequency counter, clock, alarm with snooze facility and programme timer, all selectable and displayed on an l.c.d. readout.

The VAT inclusive prices are, around £76 for the FV–310GB and around £109 for the FV–610GB.

Sharp Electronics (UK) Ltd., Sharp House, Thorp Road, Manchester M10 9BE. Tel: 061-205 2333.

Data Books

Readers may be interested in a book offer made available recently through component distributors United Components Ltd.

Available ex-stock are the following hardback books and catalogues, all containing a wealth of useful design information in addition to device specification and applications:

Plessey Semiconductors

- Linear (Integrated Circuit) Handbook—202 pages £1.50
- Telecomms Integrated Circuit Handbook—194 pages £1.20
- Consumer Integrated Circuit Handbook—220 pages £1.50
- High Speed Data Processing Integrated Circuits Handbook—104 pages £1.20
- SP8000 Series High Speed Dividers Integrated Circuit Handbook—188 pages £1.50

General Instrument

- Catalogue of Optoelectronic Products 1983—420 pages £2.50

Siliconix

- Small Signal FET Design Catalogue Nov 1982—286 pages £2.10
- MOSPOWER Design Catalogue (including RF) Jan '83—370 pages £2.50

All prices include post and packing in the UK. Further details or orders to: *United Components Ltd. Unit 5, Wye Estate, London Road, High Wycombe, Bucks, HP11 1LH. Tel: (0494) 444712.*

Audio Monitor

A recently introduced unit from Weston Developments allows 4 to 8Ω headphones, both mono and stereo types that are terminated with 6mm jack plugs, to be connected to the audio output of all receivers that are fitted with a 3·5mm jack socket.

In addition to two 6mm jack sockets, for mono and stereo, a 3·5mm external loudspeaker socket is provided which incorporates a resistive load to protect the receiver's output stage, should the loudspeaker plug be inadvertently pulled out.

Entitled the AMU–1, the unit is constructed in a matt black semi-flexible ABS box and costs £5.50, which includes VAT and p&p.

The AMU–1 is obtainable from: *Weston Developments, 33 Cherville Street, Romsey, Hants. SO5 8FB.*

If you please

Please mention this column when applying to manufacturers or suppliers featured on these pages.

48K ZX Spectrum RTTY Program

Scarab Systems announce that a new cassette program has been added to their range of computer software designed particularly for radio amateur users. It is a new version of their SP-RTTY program and has been written specifically for the 48K ZX Spectrum home computer.

Main features of the program include: type ahead buffer that will hold well over 1K of characters; split-screen facility which allows an answer to be compiled whilst in receive mode; seven memories of up to 255 characters with memory allocation marker; Morse ident can be sent (the callsign may be entered into the memory); real time clock not only displayed but transmittable; red transmit text, green receive text and letter/figure shift. Additionally, the program allows one memory to be called up from within another.

This updated version is only compatible with the 48K ZX Spectrum; however, the 16K ZX Spectrum version remains available. Both programs cost £7·50, which includes VAT and p&p.

Purchasers of the original SP-RTTY program may return their original cassette, as proof of purchase, and Scarab Systems will replace it with an updated version.

In addition to a 48K ZX Spectrum and the SP-RTTY program, the system requires an interface board and a terminal unit. Scarab can supply the program and interface p.c.b. for £17·50; program, p.c.b. and components for £29·10 or the program with the interface board ready-built for £37·50.

Further information including details of a terminal unit from: *Scarab Systems, 39 Stafford Street, Gillingham, Kent ME7 5EN. Tel: (0634) 570441.*

Parchments For Metre-Wave People

by Jack Hum G5UM

It is a typical morning's mail for the RSGB's VHF Awards Manager. There comes a letter from a "young married" who is awaiting her new transmitting licence and wishes to know what v.h.f. and u.h.f. awards will be available to her when she gets it. There is another from an experienced short-wave listener in the West Midlands who after many years has taken the plunge, passed the Radio Amateur's Examination and at his moment of writing was "in expecto" the magic piece of paper that gave him his new callsign. He too in his letter of that morning asks for information about the UK metre-wave awards system.

A third letter comes from a transmitting amateur in the Greater London area who had already submitted a claim for a 144MHz award but had forgotten to include a QSL card for his own county. His letter of that morning had the needfull QSL in with it to bring his claim up to date: all was well for the issue of his parchment.

A fourth letter in that morning's delivery was from northern Germany. It came from a microwave enthusiast who had achieved spectacular success in covering long distances on the 1·3GHz (23cm) and 2·4GHz (13cm) bands—and he sent QSL cards by way of proof, many of them confirming contacts with British microwave operators.

And apropos microwaves there was another letter from an enthusiast of this genre who requested the despatch to him of the RSGB microwave claim form only. He made no request for claim forms for the lower v.h.f./u.h.f. bands and was clearly a specialist in "the upper regions".

To top up all of the foregoing—yes, all by the same mail delivery—there came a pro forma from one of the RSGB v.h.f. contest adjudicators instructing the VHF Awards Manager to prepare winners' certificates for despatch to several winners and runners-up in recent national metre-wave transmitting contests.

The Early Days

So much for a cross-section of activity in the office (it is a converted conservatory at the rear of the G5UM ménage) whence the metre-wave certificates are issued.

"But 'twas not ever thus . . ." Only in the last twenty years has interest in the certification of metre-wave prowess proliferated to the level it sustains today. Indeed, the national society's *Four Metres and Down* scheme came of age only last year, having been introduced in 1961.

Before then the bias in British amateur radio communication was decidedly towards "the h.f. bands". The big swing to the metre-waves began to accelerate in the Fifties when a number of v.h.f. enthusiasts having been elected to the national society's governing body were able to extol the merits of the world above 30MHz where at that time few had explored. Among other things they were able to initiate the concept of a v.h.f. national field day by way of a complement to the h.f. bands national field day which had been so popular since it started in 1933. They were also influential in suggesting that skill in operating in the then fairly difficult v.h.f./u.h.f. spectrum should be recognised by appropriate certification.

And that spectrum **was** difficult. Those were the years (in the mid-fifties) when transistors to operate in it were unknown to the generality of radio amateurs; when valves as generators and amplifiers were persuaded to work on ever higher frequencies; and when virtually everything in the radio room was home-built—except, of course, for such magnificent pieces of electronic architecture as the HRO or BC348 or Eddystone receivers that were pressed into service to function as tunable i.f. strips into which the (valve) converters of the day were fed.

It was into this background that the *Four Metres and Down* awards were introduced. These awards required operators to show proof of having made contact with a certain number of counties and countries. Practical commonsense governed this stipulation: to communicate beyond one's own county in those distant days when amateurs were opening up the metre-wavelengths was a laudable target. As for the opportunity to work into countries abroad, this came into the category of "rare accidents"; but as the years passed and more was learned about the peculiarities of v.h.f. propagation it became clear that certain manifestations of nature could be exploited to extend normally expected ranges.

By intelligent use of auroral and tropospheric openings—to mention but two of these manifestations—

operators began gradually to build up their tally of countries worked to enable them to apply for the coveted *Four Metres and Down* certificate.

To indicate the difficulties of the earlier days and the sparse population of the v.h.f./u.h.f. (with the "v.h.f. only" B licensee still many years ahead) one need only state, that in the first ten years of operation of the *Four Metres and Down* awards system 211 certificates for 144MHz prowess (the Standard Transmitting Award) were issued. In the next ten years up to 1981 more than double that number were mailed to successful applicants.

On "the next band up", meaning the 432MHz (70cm) band, fewer than 60 certificates were won in the first ten years, but almost another 90 in the next ten years, boosted by then, of course, by the advent of the B licensee.

Four Bands—Seventeen Classes

And now, having referred to two of the bands on which *FMD* certificates may be won, it is time to round out the rest of the story.

The *Four Metres and Down* parchment is available as a consequence of operations on the 70MHz (4m), 144MHz (2m), 432MHz (70cm) and 1296MHz (23cm) bands as follows:

70MHz—all contacts verified
Standard Transmitting—3 countries and 30 counties
Senior Transmitting—3 countries and 60 counties

144MHz—all contacts verified
Standard Transmitting—9 countries and 40 counties
Senior Transmitting—15 countries and 60 counties

432MHz—all contacts verified
Standard Transmitting—3 countries and 20 counties
Senior Transmitting—9 countries and 40 counties

1296MHz—all contacts verified
Standard Transmitting—3 countries and 20 counties
Senior Transmitting—6 countries and 40 counties

The dedicated metre-wave listener, too, is catered for: Standard Receiving and Senior Receiving Awards exist in respect of the four bands listed above and with the same countries/counties requirements.

All claims for an *FMD* certificate must be fully supported by QSL cards. All contacts must have been made after 1 January 1961, in respect of the old UK counties, or after 1 January 1975, in respect of the new UK counties, Scotland revisions counting as from 1 January 1976.

It is worth stressing that because every amateur transmitting licence embodies within itself four variants—namely: Home, Portable, Mobile or Alternative Address—it is possible for an operator to claim a certificate for each of them, so long as he can get the QSLs in for each variant, home and away! Categories cannot be mixed for the self-evident reason that each of them represents a different station, e.g. G5UM is quite a separate and distinct station from G5UM/P or G5UM/M.

The percipient reader having totted up the number of classes for which a *Four Metres and Down* Certificate may be won may be inclined to ask: "Your sub-heading above says seventeen classes . . . I can only count sixteen. What is the seventeenth?"

The seventeenth is indeed the most difficult of all to attain. Known as The Supreme Award it requires the applicant to show proof of having won three Senior Awards or two Senior Awards plus one 1296MHz Standard. Of the 1400+ *FMD* parchments issued in the last 21 years only 41 are Supremes.

For the Microwaves

The significant increase in microwave activity during the last decade or more is recognised by a series of *Four Metres and Down Microwave Awards* operated on a rather different basis from the well-known countries and counties concept.

A certificate may be claimed for the first contact to be made on any of the bands shown below beyond the following distances:

1·3GHz beyond 600km
2·3GHz beyond 500km
3·4GHz beyond 400km
5·6GHz beyond 300km
10GHz beyond 150km
24GHz beyond 150km

Microwave Special Awards are also issued for 3 countries and 20 counties worked on any of the above bands—a not inconsiderable feat.

Once again, verification by QSL must be proved to the RSGB VHF/UHF Awards Manager. Many microwave operators aver that securing the needful QSL as a result of gigahertz operation is often easier than amassing the QSLs required to turn in a claim on the "lower v.h.f.s". Why? Because all microwave operators know the problem from first hand, and in consequence are always ready to QSL.

Then There are the Squares . . .

Four years ago the national society instituted an entirely new metre-wave certificate called the *4-2-70 Squares Award*. It was intended to cater for the growing numbers of operators keen to put their signals into the various QTH squares into which the continent of Europe (and the rest of the world, for that matter) is divided up.

This award has similarities to *Four Metres and Down* in so far that claimants are required to contact a certain number of countries on the metre-wave bands: to these they add not counties as in *FMD* but QTH squares.

Readers with a v.h.f. bent will know that the QTH square concept visualises a vertical line running along the Greenwich Meridian, in other words, along nought degrees. "The alphabet runs eastwards . . ." and from nought degrees to two degrees east you are in an "A" square. From two degrees to four degrees you are in a "B" square, and so on. The system is fully described in various textbooks that deal with the metre-wave scene[1].

To transmit to the remoter squares of Europe is regarded as a considerable challenge by many, to the extent that the Squares Award has been issued to the tune of more than 200 parchments within its comparatively brief life.

Typically, an aspirant for the *4-2-70 Squares Award* upon seeing the QSL cards being steadily amassed would make sure he (and, increasingly these days, she) had the appropriate claim form ready to hand to fill in when cards for 10 countries and 40 squares worked on 144MHz had come in. The form is obtainable from the RSGB's VHF Awards Manager. Upon it the claimant lists countries and squares in alphabetical order and despatches it to the VHF Awards Manager, complete with some form of proof of membership of the national society (these awards, being operated by the RSGB, naturally require membership of RSGB on the part of claimants).

Finding the claim to be "A-okay" the VHF Awards Manager prepares a certificate and affixes to it a sticker for the category claimed, as follows:

70MHz—all contacts verified

4 countries and 20 squares to earn the initial certificate bearing the 4 + 20 sticker; then—

6 countries and 25 squares; a successful claim in this category earns a 6 + 25 sticker to affix over the original one on the certificate;

8 countries and 30 squares: same again, an 8 + 30 sticker being earned to replace the one that was there before;

10 countries and 35 squares (quite difficult, this one): proof of contact with 10 + 35 earns the appropriate sticker.

Where the 144MHz band is concerned—and by reason of its high population density this has become easily the most popular Squares Award to tackle—the classes are:

144MHz—all contacts verified

10 countries and 40 squares worked brings the initial certificate with the 10 + 40 sticker on it. Next—

15 plus 60 squares earns a 15 + 60 sticker to place over the basic 10 + 40 one; so to—

18 plus 80 squares: same procedure;

20 plus 100 squares, another sticker; then to the rarefied heights of—

20 countries plus 125 squares; and—

20 countries plus 150 squares; and even more rarefied—

20 countries and 175 squares; then the two top flights of—

30 countries and 200 squares (another sticker if you are perspicacious enough), and so to—

35 countries plus 250 squares (and it has been done). Proceeding now to "the next band up" the classes on 432MHz are:

432MHz—all contacts verified

6 countries and 30 squares for the initial parchment; then—

10 countries plus 40 squares for "the next sticker up"; and—

13 countries plus 50 squares for a further sticker;

15 countries and 60 squares sticker;

15 countries and 70 squares sticker; and—

15 countries and 80 squares confirmed for the "top sticker".

Just as in the *FMD* competition stations are eligible for awards in the four categories of Home, Stroke P, Stroke M and Stroke A. All contacts must be supported by QSL cards—or photocopies of QSL cards if the originals are regarded as too precious to commit to the post to the VHF Awards Manager.

Contacts must have been made since 31 December 1978. And as has been said above, proof of RSGB membership is required (usually a wrapper from the Society's journal bearing the claimant's name and address).

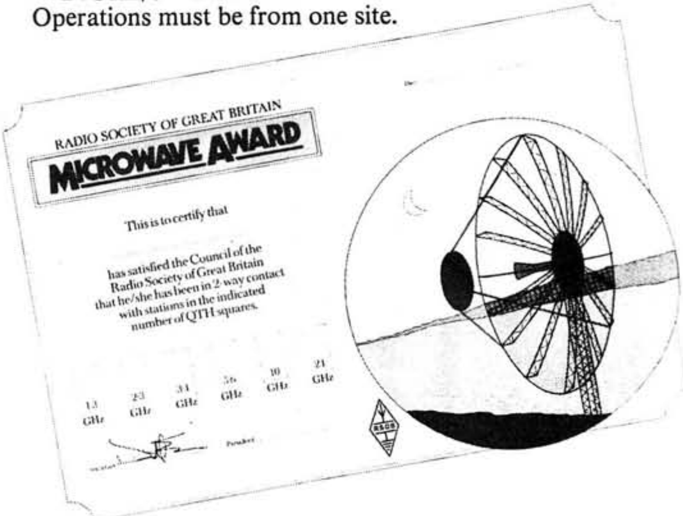
Again as with *FMD* metre-wave listeners can participate in the same 70MHz, 144MHz and 432MHz categories listed before.

Microwave Squares Awards

A certificate of rather larger size than the *4-2-70* one comes to successful participants seeking squares in the microwave spectrum—maybe recognising that as this area presents particular difficulties, prowess in it should be recognised by a larger than usual parchment!

As may be seen from the illustration of the *Microwave Award* there are spaces for each of the allocated microwave bands into which are affixed the relevant stickers that record the operator's success in these bands. The categories are:

1·3GHz/5—requires two-way contact with five QTH locator squares;
1·3GHz/10—with 10 QTH locator squares;
1·3GHz/15—with 15 squares;
1·3GHz/20—with 20 squares;
and in steps of 5 up to 50;
2·3GHz/5—with 5 locator squares again in steps of 5 up to 50;
3·4GHz/5—with 5 locator squares and then et seq;
5·7GHz/5—as before;
10GHz/5—as before;
24GHz/5—as before.
Operations must be from one site.



To Conclude . . .

Experience down the years has shown that the existence of awards such as those described stimulates activity on all v.h.f., u.h.f. and microwave bands and induces a healthy sense of competition that can do nothing but good to the furtherance of communication on frequencies which two decades ago were still in the realms of the esoteric. ●

[1] Details can be found in the RSGB Operating Manual.

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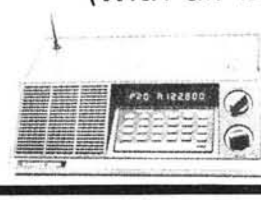

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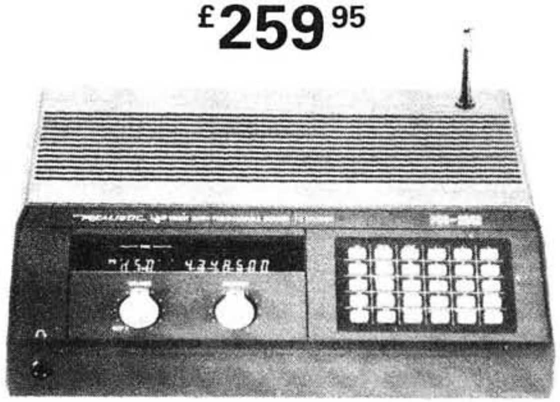

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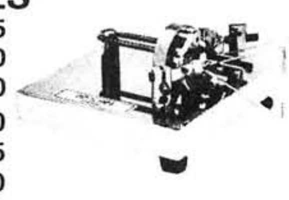

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Have complete set, sixty, Kensitas silk flower cigarette cards in original album. Also several hand-painted magic lantern slides. Would exchange for amateur bands receiver/transceiver. N. Goldstraw. 5 Wantage Road, Great Shefford, Newbury, Bucks. *T874*

Have Pye PF1 pocketphone RX/TX on u.h.f. RB6, complete with batteries and spares. Also have Pye night call unit which has built in audio amplifier and charger, plus three PF1 receivers only. Would exchange for Burndept 470 handheld, cash adjustment. Tel: 0302 835280 (Doncaster). *T875*

Have BSA C15 motorcycle (1965) original and running. Would exchange for FT-480R or similar 144MHz multimode or f.m. 144MHz rig plus extras. Write or call S. Asher. 20 Stuart Road, Market Harborough, Leics LE16 9PQ. *T876*

Have York JCB863 and Maxcom 20E f.m. CB transceivers both v.g.c. Also s.w.r./power meter, 5 amp power supply, antenna matcher, two mobile antennas and much cable etc. Would exchange for two professional long-range walkie-talkies. Andrew Ferry. Tel: 01-402 6818. *T881*

Have 10-element crossed Yagi, AR88D rack receiver, HRO receiver, coils and power unit. Would exchange for HB9CV, CB transceiver, 144MHz s.w.r. meter (100W). GW8XAN. Tel: Newtown Llantwit 201694. *T881*

Have ZX81 plus 16K RAM, many programs for "ham" user plus games. Would exchange for desk mic Trio preferable with up/down switches or HF5 vertical with radial kit. Tel: 061-480 1933 (Stockport). *T909*

Have Trio 9R59DS h.f. receiver 550kHz-30MHz bandspread tuning on all amateur bands, a.m., c.w., s.s.b., a.f. gain, b.f.o. etc. Excellent condition. Would exchange for good oscilloscope, ZX81 with 16K or w.h.y. Tel: Landrake 540 (Cornwall). *T910*

Have Bearcat 220 with lowband (32-50MHz) a.m. Would exchange for 220FB with 60-80MHz band, possible cash adjustment. Baker, 10 Ormston Street, Cramlington, Northumberland. *T912*

Have car speaker and vintage radio. Would exchange for transceiver 40km radio range and communications/short wave radio. Amery House, Milton Ernest, Bedford. Tel: 02302 2438. *T913*

Have Chinon CE-4S electronic camera with flash gun, auto winder and gadget bag. Would exchange for FT200, KW2000B, etc. John. Tel: 091 4162606 (Washington, Tyne and Wear). *T914*

Have 4·8m pigeon loft raised on legs with stage, 3 sections, open door trapping, one section complete with widowhood nest boxes. Would exchange for FT200, any h.f. gear or 144MHz transceiver. John. Tel: Wigan 491179. *T918*

Have Braun communications receiver (T1000CD) mains, battery, f.m., a.m., eight s.w. bands 1·6-29·5MHz, m.w., l.w., b.f.o. and tape socket. Would exchange for FRG-7700. Tel: North Shields 578828. *T919*

Have Icom 1050, fully modified to 28MHz f.m. Includes repeater, sensitivity and selectivity mods, plus 25W p.a. Would exchange for FRG-7700 memory unit. O. Gunnill. Tel: Warrington 65000 (day) or Helsby 3923 (evenings). *T921*

Have Citroen Dyane R reg car only 3900 miles in very good condition, 11 months MOT, 6 months tax, very dependable and economical car 50 m.p.g. Would exchange for complete amateur radio station. Geoff. Tel: 0484 653549 (Huddersfield). *T944*

Have 22in Pye colour TV with stand, nice condition with plenty of spares. Would exchange for Hallicrafters SX28 or AR88 or similar. Tel: West Drayton 441031. *T945*

Have Petri t.t.l. 35mm camera with auto Pentacon telephoto lens 135mm F2.8 and 2X converter together with Sharp 7in reel stereo recorder, all good condition. Would exchange for 144MHz portable rig. Tel: 061 969 1065 (Sale). *T950*

Have 1155RX, collectors item in good working order. Modified for 220V and for 1·8MHz band and marine frequency. Would exchange for 144MHz RX or RX/TX or anything considered. G. W. Reed, 96 Wootton Road, King's Lynn, Norfolk. Tel: 0553 63428. *T967*

Have two CB rigs, plus Tandy TRC1001 handheld, frequency counter, power pack, dipole, plus lots of other accessories. Would exchange for FRG-7700 or similar. A. Burton. 100 Carden Hill, Hollingbury, Brighton BN1 8DB. *T971*

Have Sony TC377 reel-to-reel tape recorder, stereo. Plus twenty 7in × 550m top quality boxed tapes on reels, plus extras. Would exchange for any two Yaesu FRV converters or w.h.y. Interested party must collect. Tel: Deal, Kent 68284. *T977*

Have 6-channel radio control MRC 766 series, 12 servos Superfly, 4 engines Retracts and chargers. Would exchange for ZX Spectrum or Commodore plus hardware. Write to R. Wallace, 44 Kilmein Avenue, Patna, Ayrshire KA6 7PE. Tel: 531421. *T982*

Have Vic 20 (unexpanded), tape player, power supply, all leads, joystick, Choplifter and River Rescue cartridges, Arcadia, Tornado and Gridrunner tapes plus basic learning kit. Four months old. Would exchange for FRG-7700 or Trio R1000. Keith Skidmore. 239 Alfreton Road, Blackwell, Derbys. Tel: Ripley 812653. *T985*

Have Hartley CT-436 double-beam oscilloscope, 6MHz bandwidth. Would exchange for Sphinx 1·8MHz, 3·5MHz, 14MHz s.s.b. transmitter. Norman Birkett G3EKX. Tel: 0872 862575 (Truro). *T991*

PW "SWAP SPOT"

Got a camera, want a receiver? Got a v.h.f. rig, want some h.f. gear to go with your new G4? In fact, have you got anything to trade radio-wise?

If so, why not advertise it FREE in our new feature SWAP SPOT. Send details, including what equipment you're looking for, to "SWAP SPOT", *Practical Wireless,* Westover House, West Quay Road, Poole, Dorset BH15 1JG, for inclusion in the first available issue of the magazine.

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

Swap Spot

Have Regentone AW66 domestic radio in clean condition and working well (1946 vintage), also Bush DAC90 (faulty). Would exchange both for Eddystone 740/750 or BC348, not necessarily working, or w.h.y. Tel: Tewkesbury (0684) 297205. *T998*

Have American Super 8, 5X zoom cine and a zoom dual projector. Also have MX2 144MHz s.s.b. handheld. Would exchange for 934MHz or "ham" gear. John G8BXO. 3 Westpark, South Molton, Devon. Tel: 07695 3382 (evenings). *U003*

Have Grundig video, working, with two tapes. Also have Honda 250cc Dream (1977). Would exchange for h.f. transceiver or FRG-7700 plus memories, or 432MHz gear. M. Hilton. Tel: Harpenden 64349. *U004*

Have Boley instrument lathe complete. Would exchange for KW107 a.t.u. and/or Datong Morse Tutor, w.h.y. Keith. Tel: 0278 663265 (North Petherton, Somerset). *U005*

Have Bearcat 220FB plus Para back-pak 257·2MHz-277·8MHz in six channels. Also have 8 × 8 slot-fed Jaybeam plus Kenpro rotator. Would exchange for colour video camera or 144MHz handheld rig. Tel: 0504 882600 after 6pm. (Strabane, Co. Tyrone). *U012*

Have Yaesu FRG-7 (narrow filter fitted) and AX-1 antenna/ receiver switching unit. Would exchange for home computer (not Sinclair). Geoff Mersereau, Crucible Theatre, Sheffield S1 1PA. Tel: 0742 760621. *U023*

Have Chrysler 12·9h.p. twin cylinder outboard engine, electric start model with fuel tank. Would exchange for h.f. transceiver. Tel: High Wycombe 29868. *U035*

Have Sony ICF6800W general coverage receiver f.m., m.w., 29 s.w. bands, s.s.b., c.w., frequency counter, digital readout l.c.d. Brand new and unused, value £220. Would exchange for Revox tape recorder. Tel: 0494 30065 (High Wycombe). *U047*

Have Bearcat 220 scanner with 32-50MHz coverage. Would exchange for similar with 72-88MHz coverage with cash adjustment. Tel: 0273 516801 (Newhaven). *U063*

Have NEC communications receiver (1·8–30MHz) in as-new condition. Would exchange for small metal turning lathe or motorised bench drill or camera. A. V. Clark. Tel: 0707 54535 (Potters Bar). *U075*

Have all-valve transmitter with own power supply and amplifier plus Marconi CR150 Mk 3 receiver in working order—with some spare valves. Would exchange for transistor receiver. Will consider anything interesting or reasonable offer. Tel: 01-698 2488, ask for Dave. *U097*

Have the entire content of Rift Valley Cichlid Fish House, many 1·5m tanks—value £2000. Would exchange for transceiver, a.t.u., p.s.u., anything considered. Also have KW transceiver separates. Would part exchange for transceiver, only h.f. equipment. Cash adjustment as necessary. Tel: 0293 515711 (Crawley). *U102*

Have Amstrad tuner amplifier model EX222 and two matched speakers. Would exchange for good general coverage receiver. A. G. Potter, 37 Wykeham Hill, Wembley, Middx. *U112*

Have Uniden 100CB 7 amp p.s.u., Wotpole, cable, power/s.w.r. meter (boxed) also WT2 40 channel hand-held (boxed). Would exchange all items for h.f. receiver R600, FRG-7 w.h.y. "Swapper" collects. Tel: 0438 350310 (Stevenage). *U129*

Have Pentax Spotmatic F 35mm s.l.r. with Vivitar 285 zoom flashgun. Would exchange for 144MHz hand-held transceiver. George G1BDM. Tel: 0229 63284 (Barrow-in-Furness, Cumbria). *U139*

Have Class D wavemeter, etc. (stamps for lists: lamps, valves, projectors). Would exchange for rotator, 3D items, w.h.y. 25 Glenmore Road, Birkenhead. Tel: 051-638 3552 (evenings). *U140*

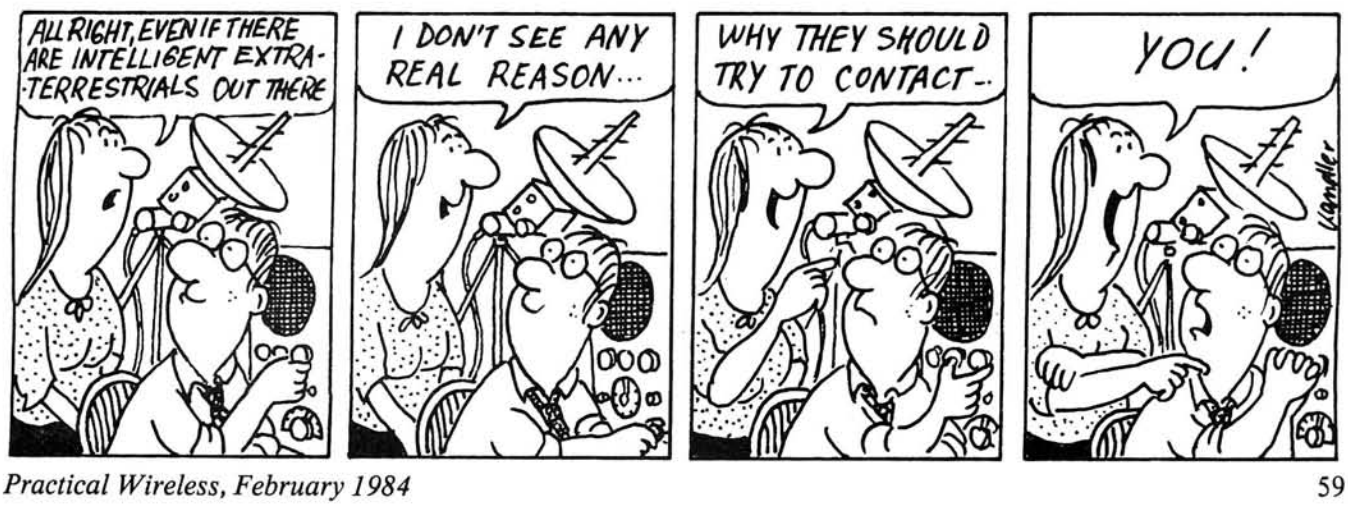
Have 10 × 50. 23oz binoculars by Karl Hartman, worth over £100. Superb condition with genuine leather case. Would exchange for 8/10dB 144MHz beam with rotator in clean working order please with mast fittings. O. Gunnill. Tel: Helsby 3923 (evenings) or Warrington 65000 (weekdays). *U148*

Have bodybuilding weights, bench, bars etc. Also have drawing board (A0 size) with stand. Would exchange for h.f. transceiver with cash adjustment if necessary. Tel: Heckmondwike 409310. *U149*

Have 144MHz f.m. portable transceiver with multi-charger and eight NiCad packs. Would exchange for Sinclair Spectrum or Morsetalker—Microwave Modules. w.h.y. Tel: Sedgley 78792 (anytime). *U164*

Have B40 receiver. Would exchange for a.t.u. for FRG-7 or digital readout or both. Also info for c.w. decoder on ZX81—receiver only, in layman's language please. Tel: 0205 60132 (Boston, Lincs). *U176*

Benny



Microwave Dish Construction

By John Tye G4BYW

The recent interest in satellite TV reception together with amateur developments at 1·3GHz and above has revived interest in high-gain directional antennas. Details of parabolic dish construction employed by the author are presented here in the hope that such information will encourage other brave souls onto the "untapped acres" above 430MHz.

A parabolic dish, when accurately formed, has the ability to focus at an infinite distance energy fed to it from an antenna feed-source located at the focal point. When used for reception purposes incident energy is concentrated at the focal point. The dish in itself is not frequency-conscious—operating frequency is determined by the form and geometry of the feed structure.

In order to determine the relevant dimensions for dish construction it is first necessary to consider the physical size, which will in turn determine the gain and beamwidth of the antenna. An indication of power gain against diameter is shown in Fig. 1, together with the half-power (3dB) beamwidth for a properly fed system. It is common practice to assume an efficiency of approximately 50 per cent.

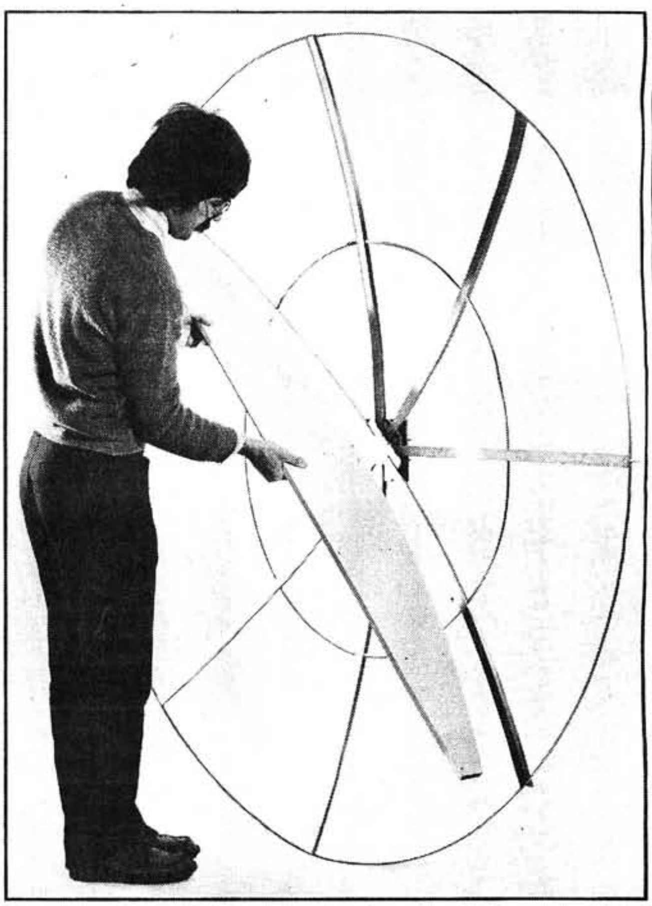
From the details of Fig. 1 it will become apparent that, for a given size dish, the gain increases in proportion to the frequency of operation and conversely the beamwidth reduces as the gain is increased. Practical limitations are imposed by the requirements of pointing accuracy, difficult to maintain under high windage conditions, and the dimension tolerances of the surface profile. Once again, as the frequency of operation is increased so deviations from the true form incur increasing losses and reduction in efficiency as a result of diffusion of the beam energy. As a general rule, surface deviations should be kept to within $\lambda/8$, preferably better, providing such deviations are confined to distances across the surface of less than a wavelength at the operating frequency. It must be further appreciated that the supporting structure of the dish must be of sufficient rigidity to retain the reflecting surface in its true position, whilst at the same time allowing practical construction and mounting.

The basic parabolic geometry is shown in Fig. 3 and the formula relating the focal length (f) to diameter (D) is used to derive the co-ordinates for construction. Table 1 provides details for curve plotting a dish of 2 metres in diameter which has been successfully used by the author since 1970 for both the 1·3GHz (23cm) and 2·3GHz (13cm) amateur bands. This dish has a focal length to diameter (f/D) ratio of 0·6, which for amateur applications has been found to be optimum and will allow several types of feed system to be employed.

The co-ordinates are marked out on a full-size wooden template (Fig. 2), which should be rigid enough to survive subsequent handling. Care at this stage will ultimately determine the efficiency of the completed antenna. When marked out, double-check your measurements and when satisfied cut and smooth the parabolic curve profile.

Constructional details are shown in Fig. 4. Probably the most difficult part of the procedure concerns the bending of the ribs. Whilst aluminium Tee bar has a very good strength to weight ratio and would appear to be hard to bend, it is possible, with some "grunting and groaning", to produce the desired curved form. The author has found that the best technique consists initially of cutting a square hole of appropriate size through a length of 50 × 38mm hardwood. This is then clamped in a substantial bench vice and the Tee bar inserted through the hole. The parabolic curve is then obtained by carefully applying a downward force on the aluminium, working outwards from the centre point, Fig. 5.

It will be useful to transfer pencil marks from the curve template onto the ribs and bend at these points—25mm spacing results in a smooth curve without any noticeable "kinking" of the section. It is vital to repeatedly check the bent material against the profile template—small individual bends can rapidly produce an impressive "boomerang" in over-enthusiastic hands!



The 2m parabolic dish being checked for profile accuracy before final mesh cladding

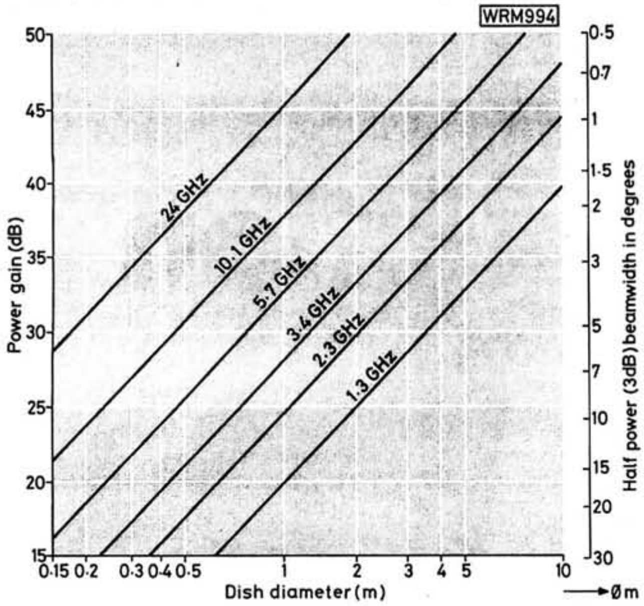


Fig. 1: Graph relating the available gain from a parabolic dish to amateur bands, based on an efficiency of approximately 50 per cent

TABLE 1

Y (mm)	X (mm)	Y (mm)	X (mm)	Y (mm)	X (mm)	Y (mm)	X (mm)
25	0	275	17	525	63	775	138
50	0·5	300	21	550	69	800	147
75	1·5	325	24	575	76	825	156
100	2·5	350	28	600	82	850	165
125	3·5	375	32	625	89	875	175
150	5	400	37	650	97	900	186
175	7	425	41	675	104	925	196
200	9	450	46	700	112	950	207
225	12	475	52	725	120	975	218
250	14	500	57	750	129	1000	229

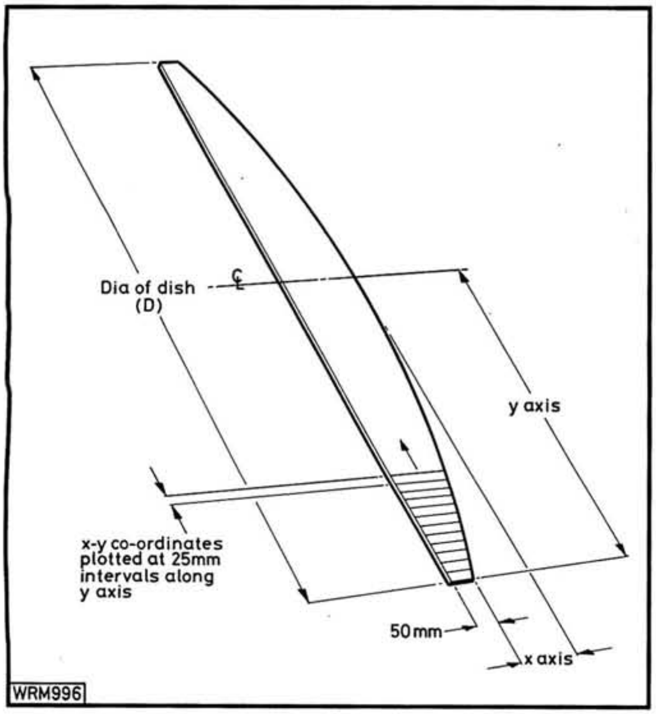


Fig. 2: The profile template arrangement. Melamine faced 12mm Chipboard is ideal for this job, being easy to mark and cut to shape

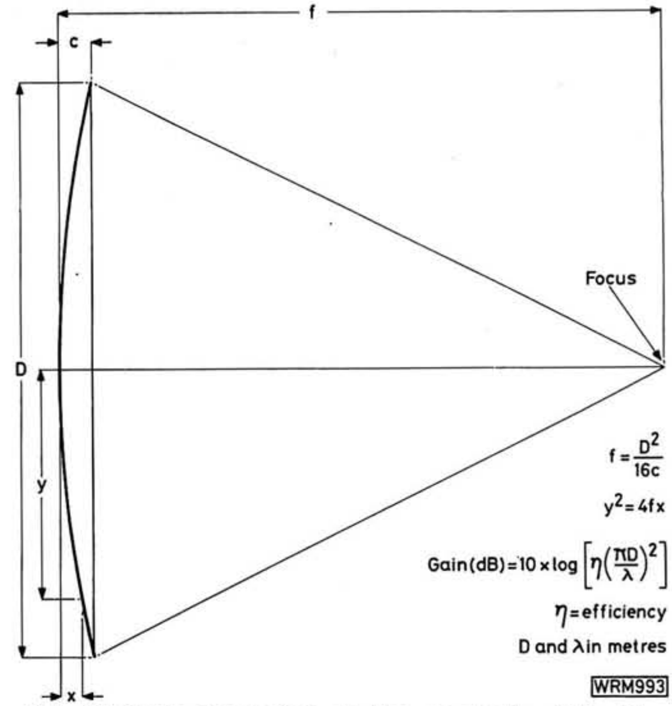


Fig. 3: Basic geometry of the parabolic dish. The formulae shown are used to determine the required parameters

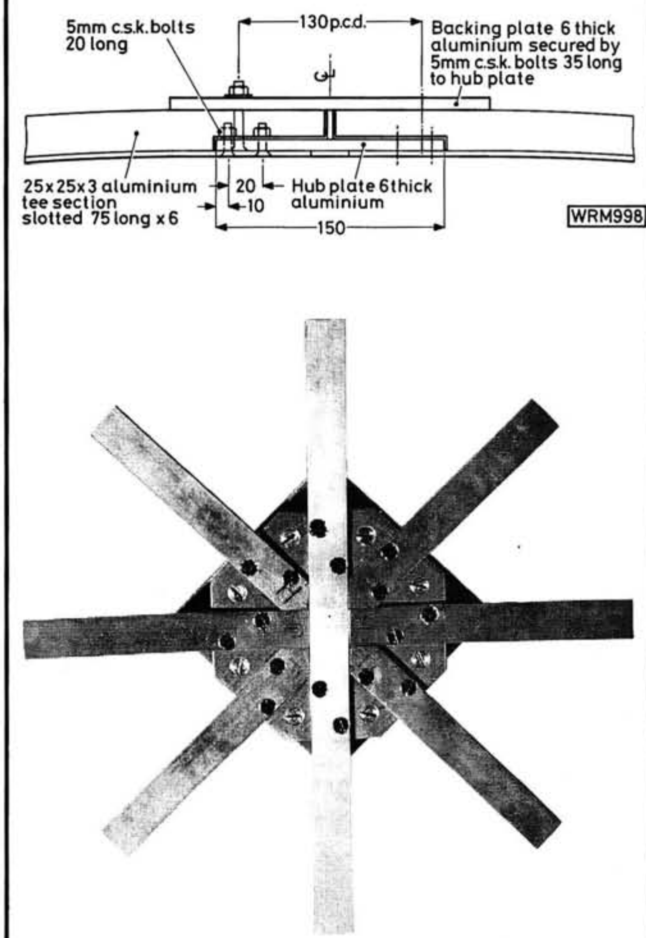


Fig. 4: Constructional details of the rib structure and central hub of the author's 2 metre diameter dish, a version of which has been in use since 1970

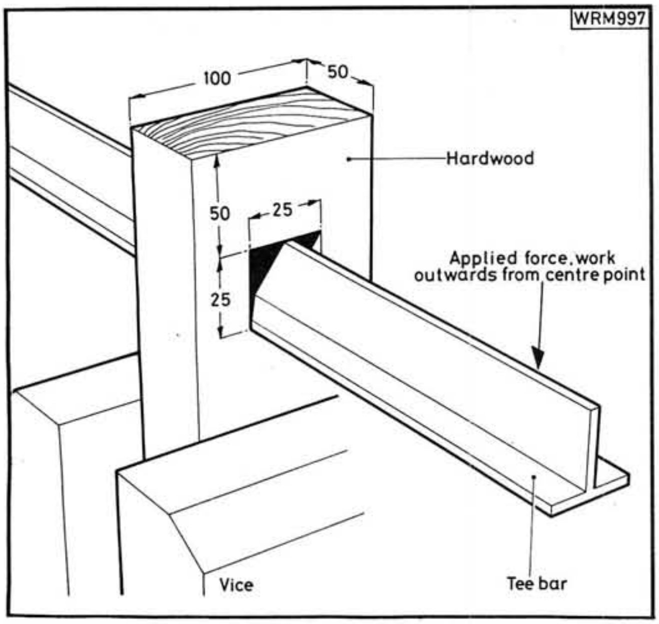


Fig. 5: The method used by the author to form the parabolic ribs. With care and patience this technique will yield a smooth curve free of kinks

When all four "full-section" ribs have been produced and checked for profile accuracy they should be prepared in accordance with the constructional drawing details. At each stage of assembly check the structure for parabolic alignment, correcting as necessary. For a 2m diameter dish two concentric rings of 6mm aluminium rod will provide sufficient support for the dish face material. These can be formed by hand around a suitable former, allowing for material ductility by using a reduced diameter former.

The material used for the face of the antenna will once again be determined by the frequency of operation and practical constraints. At 1·3GHz "half inch" galvanised chicken wire mesh is quite suitable and reasonably cheap—no pun intended! As a general guide the maximum dimension of the mesh perforation should not exceed $\lambda/10$ in order to finish up with a performance within 1dB of a solid sheet facing. The selected material is initially stitched together with galvanised wire before being laid over the rib structure. Always allow a minimum overlap of 20mm at any mesh joints—efficiency will improve slightly, when using a linear feed, if these joints run parallel to the plane of polarisation. A series of small holes can be drilled through the ribs to allow loops of retaining wire to pass through the mesh, being wired directly to the radial rings and folded over at the rim.

The completed dish can be mounted on a suitable mast using exhaust clamp type brackets. As mentioned previously, the frequency of operation will be determined by the feed arrangement and with a parabola having an f/D of 0·6 there are several options including dipoles and waveguide horns. Close attention must be given to the mounting arrangements for all types of feed. If there is any relative movement between the feed and dish during operation efficiency will suffer. If it is not possible to mount a tripod support system onto the antenna rib system without face distortion it is recommended that a support structure using the main mast and separate cross-boom be employed.

Further details of amateur feed assemblies and dish construction are contained in the *VHF/UHF Manual* published by the RSGB. ●

on the air

AMATEUR BANDS *by Eric Dowdeswell G4AR*

Reports to: Eric Dowdeswell G4AR, c/o 60 Blakes Lane, New Malden, Surrey KT3 6NX.
Logs by bands in alphabetical order.

Do you get a lot of noise on your receiver that can't be explained away by local interference? Possibly particularly bad on the lower frequency bands. Then check to see if there is a d.c. path to earth or chassis from your antenna which will by-pass static charges on the antenna wire, frequently bad in the summer months. If there is no d.c. path then quite high voltages can build up on the wire inducing a very high noise level in the receiver. The circuit of Fig. 1 shows an antenna with an a.t.u. which should have the r.f. choke added, as shown, to provide the d.c. path.

Many receivers have A1, A2 and Earth terminals at the rear. If a dipole is used with twisted or flat twin feeder going to A1 and A2, then A2, usually, should also be connected to the earth terminal, otherwise the antenna and feeder are floating and static charges will build up. Charles Molloy mentioned ways of reducing noise in receivers with particular regard to good earth connections in *SW Broadcast Bands* in the November 1983 *PW*.

Transceivers generally use the final stage of the transmitter as the input stage on receive, Fig. 2, with a blocking capacitor to remove the high voltage from the tuned circuits but which also removes a d.c. path to earth for static build-up. A good all-band transmitting type r.f. choke can be connected across the coaxial output socket to provide the necessary path.

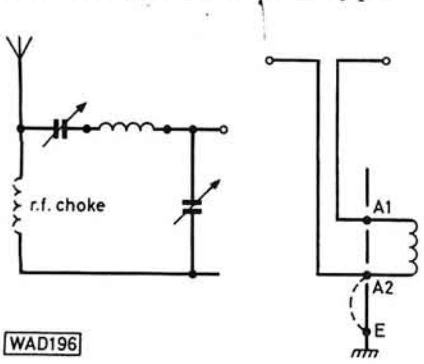


Fig. 1: Circuit of a typical a.t.u. with an r.f. choke added to give a d.c. path to earth for static charges. Right, a dipole connected to receiver input terminals may not have a d.c. path to earth so it is important that one side of the feeder is connected to earth as shown. If coaxial feeder is used this would be the outer shield or braid

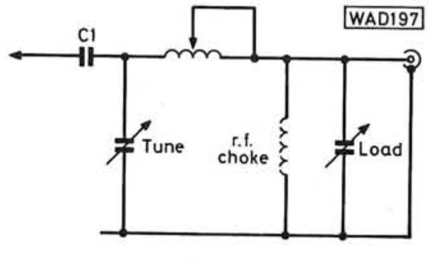


Fig. 2: Simplified output stage of a transceiver with r.f. choke added to offset blocking effect of capacitor C1 and give d.c. path to earth

General

A letter from **Jack Swiney** VK6JS says that owing to pressure of work he is no longer able to run the VK CW QRPP Club which became defunct as from October last. He has also had to resign as secretary of the World QRP Federation, replaced temporarily by Colin Turner G3VTT whose QTH is "Hurley", Weavering Street, Maidstone, Kent, to whom all WQF correspondence should now be sent. Jack asks me to offer his humble apologies to all concerned for any inconvenience.

The **Cheshunt & District ARC (G4ECT and G6CRC)** is making its contribution to the World Communications Year by building and supplying a 10W beacon to be located in Freetown, Sierra Leone, the shack of the Sierra Leone ARS at a height of 460m a.s.l. The frequency of 28·2725MHz has already been allocated to the beacon. Most of the p.c.b.s required are already built and in the process of being tested. It is hoped that the beacon will be operational by April next to coincide with the IARU Region 1 meeting in Sicily. The callsign will be 9L1FTN.

Matthew Probert, writing from Haslemere in Surrey, wishes to point out that contrary to popular opinion among licensed amateurs s.w.l.s are not bods who have failed the RAE, nor are they lacking necessarily in the ability or patience to sit the exam. Apart from himself Matthew thinks that there are many others who do not have the desire to transmit but that does not make them less knowledgeable in the art of radio communication. Basically, Matthew is asking that s.w.l.s should not be treated like "second-class citizens" and that s.w.l.ing be considered an art and skill in itself. He complains, too, of DX not using the correct phonetic alphabet but how do you get that over to some distant op whose knowledge of English is confined to AR phrases? It might be better if we put our own house in order first before we criticise others.

The traditional "junk sale" or more politely the sale of "surplus equipment" has always been a source of income to many clubs but I wonder if it is as regular a feature of club activities as it should be. A few notes culled from the **Wirral ARS** newsletter *News & Views* might be of help to organisers of such events. It should be held regularly every three months with only paid-up club members offering goods for sale with only members or properly invited guests of members being allowed to bid. Lists of goods for sale are proposed with not more than 12 lots per list. Ten per cent of the proceeds go to the club funds which is not a difficult operation if the bidding is made in an orderly fashion and selling prices noted.

Reserve prices on goods are acceptable but members should ensure that any unsold items are taken away at the end of the sale. If random selling and buying is allowed then the club has to rely upon the honesty of members to recover its share of the proceedings.

There has been a big increase in AR activity on the 28MHz band in recent times partly due to the f.m. repeater network in the United States and some readers have asked for more information on the subject. The ARRL plan is to allow AR satellites between 29·300 and 29·500MHz with repeater inputs between 29·520 and 29·580MHz and outputs from 29·620 and 29·680MHz. The common calling channel is on 29·600MHz. It is now possible to buy converted CB rigs to cover these channels for £50 or even less and information on carrying out these conversions on certain CB rigs has been published. Quite simple antennas and the 4W output of these rigs will enable worldwide contacts to be made under suitable conditions.

The calling frequency of 29·600MHz is now widely used both for local and DX working. Bowing to the inevitable, many transceiver manufacturers are now adding a 28MHz band f.m. facility to their rigs or offering it as an optional module. This single channel will soon become hopelessly overloaded and so one can expect other channels either side of 29·600MHz to become the norm. It is to be hoped that the RSGB and the ARRL and other interested national radio societies will agree on a band plan before chaos reigns.

An exciting event at the **Bury Radio Society** recently was a practical demonstration by **David Cadman G8UVE** of working through the Oscar 10 amateur satellite using comparatively simple battery operated equipment into Yagi antennas elevated to 40 degrees. A station in Belgium was worked quite satisfactorily. A Sinclair Spectrum was used to predict the position of the satellite and the frequency shift that occurred.

DX time

I really must start with the excellent logs received from our regular **Dave Coggins** up in Knutsford, Cheshire, particularly on Top Band where he has a quarter-wave wire end-fed from an a.t.u. to his FRG-7700. During the CQ Worldwide SSB contest he logged EA6NB, four EA8's, EA9EU, HZ1AB, JY9RF, NP4A, RA9FGS, SV1RK, SV1DT and SV8CS plus TI1C, T77C, UA9SJL, UK9CAA, UK9CAE, 4X4NJ, 4X6DK, 5B4EP, 5N8ARY and 7X5AB plus W1, 2, 3, 4, 8 and 9. VK3HD was heard but Dave was not happy that he had made a full identification and has not counted it. On 28MHz it was D44BS, YC3CEV (Box 187 Surabaya) YS1OD (Box 1300 San Salvador) and 3B9FK. Only DX of note heard on c.w. on 24MHz was VU2LO. Logged on 7MHz were TG9VT, VK6VU at 2140Z via short path, and VP2KM. DX on 28MHz is caught using a quad with two elements at about 6m high. Let no reader write in to me and say that Top Band is always dead!

Harry Anderson G4PDT (Edgware, Middx) is one of the rapidly growing number of QRP enthusiasts and records a recent QSO on c.w. on 28MHz with W2BA when Harry was using a homebrew rig (courtesy G4TPM) with just one watt of r.f. output into a trapped dipole. If I ask if anyone can beat that I shall probably be inundated with replies as I know that worldwide contacts are quite frequent when using powers down to the milliwatt range. However Harry hopes that putting such QSOs on record will inspire others to get away from the curse of the black box and to work the DX with rigs made with one's own fair hands!

In reply to my request for some c.w. logs for a change I had a nice one from **Tom Neal BRS85157** who resides in Ashington, Northumberland, with his FRG-7 and a temporary 3m-long wire. On 28MHz he found CE3WD, CX4ML, LU4FDM, PS7BE and TZ6FI with 21MHz coming up with HP1AW, lots of JAs, J73D, KP4GJ, KV4P, PT2CWR, PZ1DV, ZP0BB, 3D6AK, 6W8CC and 9J2LL. On to 14MHz and CO2ST, FG7CO, FM7WD, HH2VP, HL1CX, HZ1HZ, VK7GK, VP9DR, VU2BK and V2AW. Country chasers may well find new ones on c.w. that seldom appear on the bands using s.s.b.

A welcome for new correspondent **Marcus Walden** of Harrogate, North Yorks, who is 15 and started a year ago with the BC bands soon emigrating to the AR bands which he finds a much greater challenge. He has covered all the usual bands on his DX302 fed from a 20m-long wire antenna. Why does everyone, almost, studiously ignore our new bands? Plenty of code practice available there, too. Marcus is wondering at what times he ought to listen for 3·5MHz band DX, particularly N. America and Australasia. Early evenings for the VK/Asia area and almost any time during the hours of darkness for the States and America generally. However at this time of the year at these latitudes DX is around much earlier during daylight hours with Scandinavian stations able to work DX throughout the 24 hours. So don't think that they are kidding if you hear them working DX not audible to you. I would suggest to Marcus that he makes an a.t.u. to make the most of his antenna on the l.f. bands. All s.s.b. it was CN2AQ and HB0P on 3·8MHz or so, with T77V the best heard on 7MHz. The BH0 heard on several bands can be QSL'ed via F6FQK. Up to 14MHz and JY7RZ (QSL Box 2353 Amman), KL7LF, LX0WCY, T77V, YB0WR (QSL Box 4602 Djakata), YI0BIF (QSL Box 5864 Baghdad), ZD9BV via W4FRU. 3V8PS, 5B4HG (QSL Box 375 Larnaca + two IRCs), 6Y5MJ, 9H1GT. SV5TH of Box 282, Rhodes was an unusual one, plus 3V8AS and 5B4BD of Box 4096 Nicosia. Finally on to 28MHz and VP9KD, 5B0JR and 6W8CK with cards to DL1HH.

Another comparative newcomer to the column is **Denis Norton** (London W6) who runs an FRDX500 plus a.t.u., 20m-long wire antenna plus half-wave vertical for 28MHz. He would like to know a bit more about propagation so I suggest the RSGB's *Guide to Amateur Radio* as a start with their *Radio Communications* handbooks if greater depth of coverage is required. A good one for Denis on 3·8MHz was OA7YX, plus 5B0JE of Box 1733 Limassol. A funny on 14MHz was CI3GCO in Ontario seemingly celebrating the 100th anniversary of the Royal Canadian Regiment, then RW9A (USSR), 4V2C in Port Au Prince, Haiti and cards to NQ4I, 3X4EX (QSL to N4CID) and 4N74 otherwise Yugoslavia. Of interest on 21MHz was SP0AWL using just 1W, and ZS4JAM, 5N8BRC and another funny in 4Z0DX. Then C53EK, YB0ARA, 5B4IT (Box 4872 Nicosia). 5Z4DE and 9J2JN on 28MHz end this interesting log.

The CQ WW SSB contest also helped **Dave Shapiro** of Prestwich, Manchester to some more countries on Top Band where his total is now 39. A 20m-long wire antenna plus a dipole for 28MHz feeds a DX-200 and a.t.u. bringing in stuff like EA6FO, EA8QL, FC9UC, HB0BOE, HZ1AB, KN3O, OH0BH, UA9CBO, UK2GAB, VE1DXA, 4X4NJ and the lovely 5N8ARY for a fine finish on 1·8MHz, yes Top Band! On to 3·8MHz or thereabouts and HB0P, FM7WS, JA6XMM, JY8RF, TI1C, lots of UA's, VO1FG, VP2VDM, YV3AZC and 4X6DK. A good start on 7MHz was JT1AO and then FM7CD, PJ2FR, TU2NW, VK6LK, VP2KF, VP9AD and 6Y5IC. Best on 14MHz was TR8JD, VP2VDH, VP8ANT, VU2DK, YI1BGD, 4S7PVR and 9Y4W with 21MHz providing J28DS, J37AM, KP2AD US Virgin Is, PJ7A, VP2MR, ZD7BW and 4D1AU from DU-land, says Dave.

Considering that it was only a club event the Cray Valley's 13th SWL Contest attracted 38 entries from around the world. In the c.w. section **John Goodrick BRS44395** was top with 86866 points with **Brian Coyne G-SWL** in second spot with 79834. In the telephony section for solo ops was **Jean-Jacques Yerganian ONL-383** of Belgium was tops with 164206 points leaving **Martin Parry BRS52543** second with 157398 points (Why don't we hear from you OM?). Other logs came from as far apart as GW and VK4, GW and JA, plus OE, PA0, W and EI. Only entry in the multi-op 'phone division was the VK Bravo Romeo Group with 6930 points. A complete list of entrants can be got from Owen Cross G4DFI, 28 Garden Avenue, Bexleyheath, Kent, for an s.a.e.

With the seemingly endless issue of new country prefixes by the ITU it is imperative that the DXer be aware of the excellent prefix list available from Geoff Watts, 62 Belmore Road, Norwich NR7 0PU for 75p, or was. Apart from prefixes it lists the DXCC status of countries, the CQ and ITU zone numbers and the very complicated USSR "oblasts" together with a mass of relevant information indispensible to the listener or licensed amateur interested in DX.

Club Time

In order to assist club secretaries and PROs to get copy to me in good time for the appropriate issue of *PW* I have appended a list of cover dates and deadlines which should help to remove some of the confusion that exists at the moment. It should be particularly useful to newly-elected secretaries and those concerned with publishing club activities.

Acton, Brentford & Chiswick ARC G3IIU Meeting at the Chiswick Town Hall, High Road, Chiswick, London W4, at 7.30 on Tuesday, January 17 for the club's AGM which is a particularly good time for potential members and a visitors to get along and meet the gang with a warm welcome promised for all. Club sec is W. G. Dyer G3GEH, 188 Gunnersbury Avenue, Acton, London W3.

Banbury ARS Last Thursday of the month in St Paul's Church Hall, Warwick Road, B'bury, with general mixture of film shows, lectures and demonstrations of amateur gear and junk sales. Visits to places of interest to

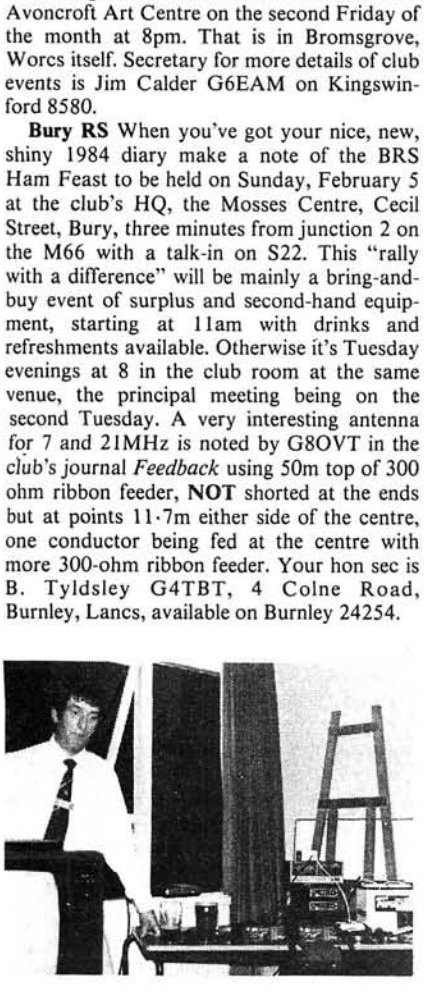
members are another common feature, plus DF hunts on Top Band and 144MHz bands. Try John Burrell G8OZH, 6 Blenheim Croft, Brackley, Northants.

Biggin Hill ARC AGM at 8pm in the Biggin Hill Memorial Library, Church Road, Biggin Hill, otherwise meetings at the St Mark's Church Hall just along the same road seemingly, at 8.30, and make a note of the demo of 10GHz equipment on February 21. Try Ian Mitchell G4NSD, 37b The Grove, Biggin Hill, Westerham, Kent, for the latest club dates.

Brighton & District RS To remind you of the new venue for the club at the Seven Furlong Bar of the Brighton Racecourse, at the northerly end of the grandstand. The site could hardly be better, accommodating mobile rallies amid almost limitless parking. Details of current meetings from sec Nigel Hewitt G8-JFT, 36 Princes Terrace, Kemptown, Brighton, Sussex.

Bromsgrove & District ARC G3VGG The Avoncroft Art Centre on the second Friday of the month at 8pm. That is in Bromsgrove, Worcs itself. Secretary for more details of club events is Jim Calder G6EAM on Kingswinford 8580.

Bury RS When you've got your nice, new, shiny 1984 diary make a note of the BRS Ham Feast to be held on Sunday, February 5 at the club's HQ, the Mosses Centre, Cecil Street, Bury, three minutes from junction 2 on the M66 with a talk-in on S22. This "rally with a difference" will be mainly a bring-and-buy event of surplus and second-hand equipment, starting at 11am with drinks and refreshments available. Otherwise it's Tuesday evenings at 8 in the club room at the same venue, the principal meeting being on the second Tuesday. A very interesting antenna for 7 and 21MHz is noted by G8OVT in the club's journal *Feedback* using 50m top of 300 ohm ribbon feeder, **NOT** shorted at the ends but at points 11·7m either side of the centre, one conductor being fed at the centre with more 300-ohm ribbon feeder. Your hon sec is B. Tyldsley G4TBT, 4 Colne Road, Burnley, Lancs, available on Burnley 24254.



David Cadman G8UVE explains the battery powered equipment he uses to work through satellite Oscar 10 at a demonstration to the Bury Radio Society. The rigs involved are an FT-790, FT-290 Microwave Modules amplifiers and simple Yagi antennas plus a Sinclair Spectrum for prediction purposes

Photo courtesy G3VNQ/G4OAC

Cheltenham AR Association G5BK All I can glean from a recent copy of *CARA News* is that the club meets at the Stanton Room, Charlton Kings Library, C'ham, and that the meeting on January 6 will deal with getting going on the 1296MHz band and that January 20 is a natter night. Seems the sec is "Gill" and she can be found on C'ham 525162.

Chesham & District ARS Regulars and visitors meet at the Stable Loft, Bury Farm, Pednor Road, Chesham, at 8pm every Wednesday, says sec John Alldridge G4UXA (was G6LKS) of 15 Whichcote Gardens, Chesham, Bucks (C'ham 786935). The recently instituted constructional evening has gone like a bomb with almost half the participants coming from the ladies' side of the membership. Let this be a source of inspiration to other clubs who may be looking for new ideas to boost club activity.

Weekly construction evenings for beginners to the ancient art of homebrewing are now under way at the Chesham & District ARS with Ann Webber, left, and Shirley Hesketh G4HES taking a good look at their p.c.b. to check for dodgy soldered joints

Photo courtesy of J. Alldridge G4UXA

Cheshunt & District ARC G4ECT G6CRC The Church Room, Church Lane, Wormley, Herts every Wednesday at 8. January 11 features a show of slides of the club's past activities, organised by G4SXF and on the 25th G8MQT will offer an introduction to military radio equipment. Details of the club's contribution to the WCY is given under the "General" heading. Roger Frisby G4OAA, 2 Westfield Road, Hoddesdon, Herts, is the hon sec, with (0992) 464795 as an alternative.

Civil Service ARS Meets at lunch time first and third Mondays at the CS Recreation Centre, Monck Street, London SW1, which is just off Horseferry Road. By this time a club station could be on the air. You can monitor the club's activities on 144·575MHz f.m. on Tuesdays at 7.30pm or on 3·760MHz s.s.b. also on Tuesdays at 8pm. Further info from hon sec George Costin G4GFU on 01-632 6444.

College of Technology, Belfast, ARS GI2BX Open to members of staff or the student body with an interest in AR, whether licensed or s.w.l. Club station GI2BX is on the air most lunch times on both 144MHz and the h.f. bands. Talks on the various aspects of AR will be open to the general public. At the moment the club is looking for speakers on the subjects of h.f. antennas and computers in AR work. Liaise with James Barr, 121 Kitchener Street, Belfast BT12 6LF or at the college on B'fast 227244 extension 243.

Crawley ARC Meetings at the Trinity Church Hall, Ifield, Crawley or at members' homes more informally. Projected outside visits include the Air Traffic Control Centre at nearby Gatwick and the American Airlines Simulator Training Centre also at Gatwick. Now contact D. L. Hill G4IQM, 14 The Garrones, Worth, Crawley, W. Sussex or on Crawley 882641 for up to date information.

Darlington & District ARS Recently resurrected from the ashes as it were, the club now gathers at the Hurworth Community Centre at 7.30 every Friday. That spot is just to the south of Darlington. Current activity includes classes for the RAE and the Morse code run by G3UTI and G3GUV but C. Webb G4NYJ, 34 Cleveland Terrace, Darlington will fill in the gaps for you. You can also try D'ton 467271.

Dudley ARC G4DAR Sec Mrs C. Wilding G4SQP, 92 Ravenhill Drive, Codsall, Wolverhampton, W. Mids (Codsall 5636) says that the club meets second and fourth Tuesdays at 7.45 at the Central Library, D'ley, with the manager of the Classic Cinema, B'ham, describing how a successful cinema should be run, on January 24. And you won't want to miss Joe Jacobs holding forth on TV o.b.s between 1950 and 1980, on February 28.

East Kent RS G3LTY G6EKR The Cabin Youth Centre, King's Road, Herne Bay, at 8 on the first and third Thursdays with January likely to prove very popular when the Kent Constabulary Crime Prevention Officer will hold forth on the subject and also deal with the marking of AR equipment. Now is the time to tell you also of the mammoth junk sale promised for February 2 because the next issue of *PW* will be too late. Anyone in the least bit interested in AR is very welcome to any meeting, says sec Stuart Alexander G6LZG, 66 Downs Road, Canterbury, Kent.

Edgware & District RS G3ASR Second and fourth Thursdays at 8 at 145 Orange Hill Road, Burnt Oak, Edgware, Middx, with notice of the club's AGM on January 12, the meeting on the 19th being informal. A feature of the club's activities are the slow Morse transmissions on Top Band and 144MHz from G3ASR linked to code classes at meetings. Your contact man is Howard Drury G4HMD, 11 Batchworth Lane, Northwood, Middx or N'wood 22776.

Fareham RC A busy month for the club, meeting Wednesdays at the Portchester Community Centre, in Room 12 at 7.30, with the AGM on January 25. Previously, on the 18th G8GNB will have Power Distribution as his subject while on the 11th it is a natter nite cum on-the-air sessions. It's Brian Davey G4ITG, 31 Somervell Drive, Fareham, Hants, also 234904.

Farnborough & District RS Second and fourth Wednesdays at 8, the Railway Enthusiasts Club, 103 Hawley Lane, Farnborough, Hants. For just 35p you can get a copy of the society's souvenir issue of its annual magazine which covers all the past year's successes and achievements plus accounts and just about everything concerning the club's multi-farious activities. Otherwise all I can tell you is that the hon sec is Ivor Ireland G4BJQ QTHR.

Flight Refuelling ARS G4RFR G6SFR. On Sunday January 8 it's Use of Computers by Dorset Police with Nick's Rambles a week later. On January 22 Part 1 of Fault Finding is by G8YCA with Part 2 (Theory and Practice) on the 29th. More from sec. Mike Owen G8VFY on Wimborne 882271.

Fylde ARS I hope you were able to get along to the AGM on January 3 but if not there is an informal club meeting on the 17th. First and third Tuesdays at 7.45, at the Kite Club, Blackpool Airport with code classes beforehand. Note that on February 7 John Parkinson G6DNK will deal with Public Service Radio. Programme sec is H. Fenton G8GG, 5 Cromer Road, St Annes, Lytham St Annes, Lancs.

Greater Peterborough ARC G4EHW All meetings at the Southfields Junior School, Stanground, P'boro, at 7.30 generally on the fourth Thursday. Make special note of the AGM on January 26. During the past year meetings have been dedicated occasionally to such as s.w. listeners, satellite working, transceivers (home brew) and antennas. Frank Brisley G4NRJ, 27 Lady Lodge Drive, Orton Longueville, Peterborough is the source of further club info.

Guildford & District RS G6GS Meeting spot is the GMES HQ Building, Stoke Park, Guildford, Surrey, second and fourth Fridays at 7.30 for a prompt 8pm start. Lewis Bright G4BHQ is the hon sec at 4 Dagley Farm Park, Shalford Common, Guildford, alternatively G'ford 576375 at any time.

Ipswich RC G4IRC GB2IRC A very early reminder of the annual East Suffolk Wireless Revival event to be held on the Bank Holiday Sunday, May 27, at the usual venue near to the Suffolk Show Ground in Ipswich. The club itself meets on the second and last Wednesdays at 8, in the club room of the Rose & Crown, 77 Norwich Road, Ipswich. It is worth noting that the room is detached from the public bars and thus juniors are particularly welcome at the meetings, while Morse classes are available on the other Wednesdays. Backed by extensive advertising the club magazine *QUA* for September last featured articles on an end-of-over pip tone unit, test equipment, AMSAT's Oscar 10, workshop hints and tips, and a Morse decoder program in Pascal for the computer buffs, all edited by Alan Owen G4HMF. More from sec Jack Tootill G4IFF, 76 Fircroft Road, Ipswich, Suffolk, alternatively try (0473) 44047.

Midland ARS Meets at 294A Broad Street, Birmingham, with January 17 having nuclear power as its theme. That's a Tuesday, the third in the month and every month, but Monday night is constructional project time, a new idea with plenty of support already. I'm not surprised! It is also intended to revitalise the local RAYNET group very shortly. City developments may mean the loss of the present premises so news of possible alternatives would be welcome. Club president Tom Brady G8GAZ is still the post boy, as he likes to call himself, so contact him at 57 Green Lane, Great Barr, Birmingham B43 for further info or try 021-357 1924.

Mid-Sussex ARS G3ZMS It's 7.30 for a 7.45 start at the Marle Place Adult Education Centre, Leylands Road, Burgess Hill, W.Sx with January 12 devoted to a talk on basic test equipment while the 26th is AGM time. Colin Campbell G4TDN can help with more club info on Burgess Hill 41830.

Mid-Warwickshire ARS Sec Carol Finnis G4TIL says the club meets first and third Tuesdays at 61 Emscote Road, Warwick, with the usual warm welcome being extended to visitors. Some very interesting lectures and demos seem to be in the pipeline for '84 so contact Carol at 37 Stowe Drive, Southam, Warks, or ring (092681) 4765.

North Bristol ARC G4GCT There will be a sale of surplus equipment at the club on January 13 and the AGM follows on the 27th. Meetings every Friday in fact at the Self-Help Enterprise, 7 Braemar Crescent, Northville, Bristol at 7pm, with usual light refreshments available, provided by the ladies. Further info from sec Ted Bidmead G4EUV, 4 Pine Grove, Northville, Bristol 7.

Plymouth RC Seems the change of venue given in the December issue is already out of date with the latest info giving the Hyde Park Junior School, Hyde Park Road, Mutley, P'mouth, as the new spot. I'm also told that the new PRO is Ian Harley G6BJJ, 4 Havelock Terr., Stoke, Plymouth.

Radio Amateur Invalid and Blind Club RAIBC The club is particularly delighted to learn that its Secretary/Editor Francis Woolley G3LWY has been made an honorary Vice-President of the RSGB in recognition of her work for the RAIBC. During the year members obtained over 40 "A" licences and 55 in the "B" category with the membership increasing by some 217. Equipment loaned to the club included three transceivers and 17 receivers so if anyone has such gear in excess of requirements they will know what to do with it! Francis can be reached at 9 Rannoch Court, Adelaide Road, Surbiton, Surrey.

Radio Club of Thanet G2IC The club continues to meet at the Grosvenor Club, Grosvenor Place, Margate, at 8 on the second and fourth Tuesdays with January 10 set aside for a talk by G8SBS on satellite working with the 24th devoted to computers. Club president Ian Gane G4NEF, 17 Penshurst Road, Ramsgate, Kent sends me the info and is on (0873) 54154 but the sec is K. Lown G4PTE QTHR or 32198.

Rhyl & District ARC GW4ARC GW1ARC First and third Mondays at the 1st Rhyl Scouts Hut, Tynewydd Road, Rhyl at 7.30, details of forthcoming season's events not yet to hand from sec GW4PFC, 67 Ashley Court, St Asaph, Clwyd.

Skelmersdale & District ARC George Rogers G6OMN, 113 Foxfold, Fosters Green, S'dale, Lancs says the club meets every Thursday at 7.45 at the Dunlop Sports & Social Club, White Moss Road, S'dale, and that he will be very glad to fill in the details of current club activity on request.

Smiths Industries RS G4MEN Normal venue is the Club House, Newlands, Bishops Cleeve, but be warned that this may change for the meeting on Thursday, January 12, and thereafter every other Thursday. So better get on to sec Roger Hawkins G8UJG, Smiths Industries Radio Society, Sports & Social Club, A.D.S. Co, Evesham Road, Bishops Cleeve, Cheltenham, Glos. Don't forget that the club has initiated a net around 3·735MHz s.s.b. when the club is in session hoping that other clubs will do likewise and thus increase the interaction between clubs.

South Bristol ARC Formed in September to fulfil the needs of the AR community on the south side of the city the club meets at the Whitchurch Folkhouse, East Dundry Road, Whitchurch, Bristol every Tuesday at 7.30. RAE and Morse code classes are well attended by the 40 or so members already recruited, but limitations of space may restrict the total to 75 in due course. A club callsign is envisaged very soon. On January 10 G4OPQ will lecture on and demonstrate the art of c.w. operating, with the 17th concentrating on 144MHz matters. The 24th sees a lecture on home brew equipment, concluding the Jan events on the 31st with a 432MHz night. Warning of a bring-and-buy plus dealer's evening on February 7. All enquiries to Len Baker G4RZY (QTHR as G6HNU) on (0272) 834282.

Southdown ARS G3WQK Its HQ is the Chaseley Home for Disabled Ex-Servicemen at Southcliff, Eastbourne, Sx, meeting on the first Monday at 7.30 for an 8pm start. Sec is T. Rawlance G4MVN, 18 Royal Sussex Crescent, E'bourne. Unfortunately the otherwise interesting newsletter does not give any info on forthcoming events.

South East Kent (YMCA) ARC G3YMD G8YMD At the Dover YMCA, Godwynehurst, Leybourne Road, Dover, with RAE coaching on Mondays at 8, code classes on Tuesdays also at 8, and main club evening on Wednesdays at 7.30pm. Club nets include 3·745MHz and 144·395MHz at 11am and 144·525MHz at 9pm, all on Sundays. Details of the club and its activities from Alan Moore G3VSU, 42 Nursery Lane, Whitfield, Dover, Kent or buzz Dover 822738.

Southend & District RS Think this is the first mention in this column of this club which meets at the Council Offices, Rayleigh, Essex, which I gather is opposite the church, at 7.30 every Friday. A wide variety in the programme of events is promised to suit all AR interests and visitors will be particularly welcome. No hon sec or PRO here but a Liaison Officer no less in the form of John Weston G6XBM, 67 Victoria Road, Rayleigh, Essex who can also be reached on R'leigh 742128.

South Essex ARS The latest issue of the club magazine *EARS* carries articles on building a 12m tilt-over mast, computer comment, a noise bridge for 1·6 to 30MHz, a medium wave column plus s.w. and h.f. bands feature, and a history of radio by editor Dave Pritchard G4GVO, who, with his editorial colleagues is to be congratulated on an excellent, well-produced magazine. It already has a wide circulation but more subscriptions would be welcome, which, at £6 for 10 issues a year has just got to be good value for money. The club now boasts a membership of around 140. New sec *is Ralph Burtonshaw* G4UYG but as I don't have his QTH you had better stick to editor Dave at 55 Walker Drive, Leigh-on-Sea, Essex.

Stevenage & District ARS The first, second and third Tuesdays starting with code practice at 7.15 with main meeting getting under way at 8. All at the TS Andromeda, Fairlands Valley Park, Shephall View, Stevenage, Herts, with January 10 being a constructors' evening as is every second Tuesday. It's a Grand Auction of surplus gear on the 17th so take along the gear and plenty of money! The club net is held on Sundays at 7pm on 145·250MHz f.m. PRO is Trevor Tugwell G8KMV, 11 The Dell, Stevenage, Herts.

Torbay ARS G3NJA G8NJA Every Friday with a constructional evening on the last Saturday of the month, all at Bath Lane at the rear of 94 Belgrave Road, Torquay. Club nets on the 3·5MHz band operate on Wednesdays and Saturdays. Tony Rider G6GLP, 7 Kingston Close, Kingskerswell, S. Devon is sec and wife Margaret is dishing out the tickets for the club's annual dinner in March. Both available on (08047) 5130.

Vale of White Horse ARS G4VWH/G6VWH meets at 7.30 p.m. on the first and third Tuesdays of the month at the Social Club, Milton Trading Estate, near Abingdon, Oxfordshire. On January 3 Roy Church G3KJC will be showing the club how to get started on h.f. QRP, and on February 7 Alan Simpson G3UMF will be talking about Fast-Scan Amateur TV. Further details from club secretary Ian White G3SEK on Abingdon 31559.

Wimbledon & District RS Natter nights and Morse code practice alternate with lectures, film shows and demonstrations on the second and last Fridays of the month at the St John Ambulance HQ, 124 Kingston Road, London SW19, starting at 8. On January 27 club sec Geoff Mellett G4MVS will deal with basic radio theory and he can be contacted at 26 Paget Avenue, Sutton, Surrey, for general info on the club, or ring 01-644 8249.

Wirral ARS G3NWR At the Guide Hut, Westbourne Road, West Kirby, first and third Wednesdays at 7.45. January 18 is a film night on satellite communications and note February 1 with an insight into microprocessors offered by G3YGL. Code practice is available from G4MIA on 144·725MHz at 7.30pm on most evenings with a range of speeds. More info from sec Cedric Cawthorne G4KPY, 40 Westbourne Road, West Kirby, Wirral or buzz 625 7311.

Worcester & District ARC It could be the Oddfellows Club or the Old Pheasant Inn, both are in New Street, Worcester at 8pm, on the second and fourth Mondays. On January 9 it's at the former venue with a discussion evening, while the 23rd is informal at the latter. So that you won't miss it make a note of D. Fry G4JSZ talking on calculations for the radio amateur on February 6 at the O'fellows Club. Hon sec is Alasdair Lindsay G4NRD, 11 Durcott Road, Evesham, Worcs.

Yeovil ARC G3CMH G6YEO Every Thursday at 7.30, the Recreation Centre, Chilton Grove, Yeovil, Somerset, and hopefully you may get along to the meeting on January 5 when G3MYM will discuss his conclusions on chordal hop propagation (How about an article for *PW*?), with the same speaker dealing with "Your amateur radio career" on the 12th. On the 19th G3GC covers the wide-ranging subject of semaphore to satellites while the 26th is a general natter nite. More from John Howard G4EVI, 127 Goldcroft, Yeovil or buzz (0935) 75920.

The following list of copy deadlines can be extended quite easily into the remainder of 1984. Remember that all material and copy for this feature should be sent to me direct and not to *PW*.

Issue	Copy deadline	For events in
Mar '84	Dec 15 '83	Feb '84
April	January 15	March
May	February 15	April
June	March 15	May
July	April 15	June

Just to recap, *PW* is published around the first Friday of the month with a cover date of the following month. Club events occurring in the first few days of a month should be notified to me in time for the **previous** issue to that shown above, or they will not be covered.

MEDIUM WAVE BROADCAST BAND DX

by Charles Molloy G8BUS

Reports to: Charles Molloy G8BUS, 132 Segars Lane, Southport PR8 3JG.

"I bought a f.m.-m.w. tuner a couple of weeks ago and it will just not perform as I expected with a conventional loop antenna writes reader **George McCandless.** This letter raises two matters of interest to anyone who wants to try his hand at DXing on the medium waves.

The first point concerns the loop antenna. A loop will not work properly if it is connected to a receiver that has an antenna of its own. If George's tuner has an internal ferrite rod antenna for the medium waves and many do, then a loop will not work if it is joined to this set. It is easy to check if a receiver has an internal antenna. Tune round the band without using an external antenna. If you hear a number of stations then there must be an internal antenna.

Why doesn't the loop function properly? The principle advantage of a loop antenna is its two nulls—directions of little or no pick up. These are used by rotating the loop, to null out interference (QRM). If you null out a station with the loop then the receiver will still pick up signal from that station via the internal antenna. The internal antenna masks the loop's null and gives the impression that the loop is not working.

Hi-fi and DXing

The second point concerns hi-fi tuners which, as the name suggests are designed to provide high quality audio. In order to do this they must have a wide bandwidth and consequently poor selectivity. Moreover they need not be particularly sensitive as they will be used to receive strong signals from a local station.

For DXing the position is reversed. The DXer will want a receiver with good selectivity so that he can separate stations that are close to one another. He will also want a sensitive receiver that will resolve weak signals. In short, DXing and hi-fi are incompatible. Although it is possible to design a receiver that could be switched from hi-fi to DXing, such a set would be expensive and probably there would be little demand for it. Such sets may exist but they are not generally available so you need two receivers if your interests cover both hi-fi and DXing.

Loops and Portables

Reader **David Murphy** of Newcastle-upon-Tyne has followed up my suggestion of placing a portable receiver inside a m.w. loop antenna without making any connection between the two. "I can confirm startling results from that. The results have produced stations that were just not there when the ferrite rod in the set was used by itself."

For the benefit of those who missed it, my suggestion was to place the portable on a shelf fitted at the centre of the loop. There is no connection between loop and receiver and the loop need not have a coupling winding if you are making one especially for use with a portable. How does the signal travel from the loop to the receiver. Well, since the signal picked up by the loop has nowhere to go, it is reradiated, to be picked up directly. This is one of the few occasions where you get something for nothing and it really does work.

The null of the loop and the null of the ferrite rod should point in the same direction, which can be found by trial and error. The null of a ferrite rod antenna is along the length of the rod i.e. you point the rod at the station you want to suppress. The null of a loop is at right angles to the windings. If the ferrite rod lies along the longest side of the receiver then the set will have to be mounted at right angles to the plane of the windings of the loop.

Sticker from Radio Mediterranee International which is on 173kHz, 612kHz and 1233kHz sent in by Shoyab Patel

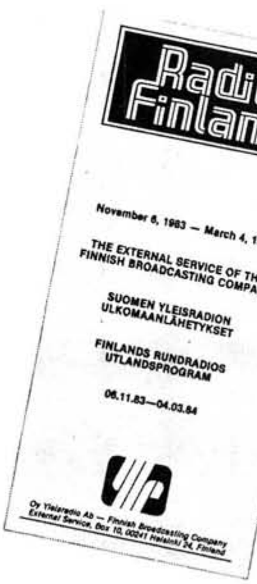
Tune in a station on the receiver. Rotate the loop's tuning control to peak up the signal. Rotate receiver and loop together to reduce interference from an unwanted station.

There are two advantages to be had from using a loop and portable in this way. You will now be able to null out QRM with the loop, which you could not do if you connected the loop directly to the receiver. You will also be able to pick up weaker stations that were inaudible when using the portable on its own. Why not connect a long (random) wire antenna to the portable in order to give a boost to a weak station? If you do, then you may overload the receiver with strong signals from all over the band to produce spurious responses, cross modulation etc. A loop is a selective device. It will peak up a station on the frequency to which it is tuned. It will not do this to stations on other parts of the band.

Loop Antenna Experiments

David goes on to say that he first aligned his portable onto the transmitter for maximum signal strength and then offset the alignment of the loop outside, by a few degrees. Even greater signal strength was obtained this way. This result is surprising as normally the direction of maximum reception for a loop is rather blunt and ill-defined. It is for this reason that a d.f. bearing is always taken with a null. It is much sharper.

Finally, David contructed a half size loop which he placed inside the main loop. The half size loop was then connected to an Icom R-70 communications receiver. "I tuned into Canadian m.w. with first the larger loop and then the smaller loop inside the larger—the improved signal when using the smaller as well as the larger loop was remarkable". David asks if the smaller loop was acting as a director. I doubt it. A director or reflector, to be effective has to be separated from the main part of the antenna by a significant fraction of a wavelength, a quarter of a wavelength in theory, in practice usually about 0·2λ. At 1MHz in the middle of the band, the wavelength is 300 metres! None the less, David's experiments are worth following up. One disadvantage of a loop is that the pickup is less than most outdoor (random wire) antennas and the use of two loops coupled in this way might be a way of counteracting this.


Radio Finland

November 6, 1983 — March 4, 1984

THE EXTERNAL SERVICE OF THE FINNISH BROADCASTING COMPANY

SUOMEN YLEISRADION ULKOMAANLÄHETYKSET

FINLANDS RUNDRADIOS UTLANDSPROGRAM

06.11.83—04.03.84

Oy Yleisradio Ab — Finnish Broadcasting Company External Service, Box 10, 00241 Helsinki 24, Finland

Schedule from Radio Finland

Interesting Channels

Have you heard Africa on the medium wave? It isn't too hard if you know where to look and even an ordinary portable will pull in a few stations from this continent.

The French network of Radio Algiers is a strong signal on 891kHz. Locate BBC Radio Wales on 882kHz and tune up-band by one channel. There is a low power outlet at Hulsberg in Holland on this channel but it is easily suppressed with a loop or simply by rotating the set, at my QTH. This station closes down at 2300, if you have any trouble with it. There are two other occupants of 891 that are of interest. Ujgorod in Ukraine comes in well as we approach midnight while Antalya in Turkey is best heard at sign-on time at 0300.

The Arabic Service of Radio Algiers is on 981kHz, a frequency it shares with Sweden, but the latter is usually off the air by 2300, which is just as well as it is none too easy to separate the two with a loop or ferrite rod. Look for the BBC low power stations on 990kHz and tune down one channel. Once Sweden has gone off you may be able to hear a third station on 981kHz. Null out Algiers and you will be listening to Megara, probably with a programme of Greek music. This station is owned by Yened, which is the Greek Armed Forces network. The address for a QSL is 135 Messogion Street, Athens.

Radio Finland

Usually it is to the short waves that we go if we want to hear an international service but one exception is Finland where, owing to the geographical location, it can be heard well on the medium and longwaves. Listen at 2030 on 558kHz, 963kHz on m.w. and on 254kHz on the longwaves. On Saturday there is a two hour programme on 963 and 254 at 2200. In some parts of the country reception may be difficult owing to interference that has recently appeared on this channel.

Programmes from Radio Finland are varied, Finnish music, talks about life in Finland, a magazine programme covering art, music and sport, a mailbag programme. Details can be found in the station schedule which is available free of charge from Oy Yleisradio Ab, External Service, Box 10,00241, Helsinki 24, Finland. R. Finland does not QSL but it will issue a listener card in return for a Programme Report.

SHORT WAVE BROADCAST BANDS *by Charles Molloy G8BUS*

Reports: as for Medium Wave DX, but please keep separate.

Following on from last month when we had a look at broadcasting in the English language from Latin America, we will now move northwards where the situation is very different. Canada and the United States are a prolific source of entertainment and interest to the English speaking listener. High power transmitters beamed to Europe dominate the higher frequencies during the evening, especially 15MHz (19m), at a time of day when the path to the Far East has closed down and there is little interference.

Voice of Malaysia sent in by Christopher Williams

United States

The government owned Voice of America beams its programmes to Europe from 1100 to 2200 UTC daily. Three transmitter sites in the US and eleven in other parts of the world are in use, not all to Europe though. Listen from 1700 onwards on 6·04, 9·46, 11·76, 15·58, 17·785 and 21·48MHz. The VOA publishes the bi-monthly *Voice Magazine*. It is free of charge to listeners and can be had by writing to the VOA, PO Box 400, Washington, DC20044, USA.

The letters AFRTS stand for American Forces Radio & TV Service which augments the many AFN (American Forces Network) stations on v.h.f. and the medium waves. AFRTS beams to Europe from 1100 to 0100 on 15·43MHz and usually comes in well during the evening. Programmes are mainly news and sports, relayed from domestic stations in the USA. The address for a QSL card is AFRTS, 1016

North McCadden Place, Los Angeles, Calif 90038, USA.

The letters WYFS make up the callsign of Family Radio which can be picked up on 11·675MHz from 1800 to 2000 and on 15·44 from 2000–2200. The address of this gospel station is 290 Hegenberger Road, Oakland, Calif 94621, USA.

WRNO in New Orleans which is a recent arrival on the s.w. bands, is commercially operated. It doesn't seem to have found a permanent home yet but at the time of writing was on 17·755MHz and 15·42MHz between 1800 and 2300 and on 11·855 after 2300. There is a DX programme presented by Glen Hauser on Sundays at 2330. Station address is PO Box 1000, New Orleans LA 70181, USA.

WINB, which is run by the World International Broadcasters is on the air to Europe from 1600 to 2200 on 17·73 from 2000 to 2245 on 15·185 and from 2245 to 2345 on 15·145. Reports should go to PO Box 88, Red Lion, PA 17356, USA.

Canada

Radio Canada International (RCI) broadcasts to Europe from Monday to Friday for half an hour at 1900 and 2000 and on Saturdays and Sundays for one hour at 1900. The Sunday transmission includes *SWL Digest*. Listen on 11·905, 15·235, 17·875. A programme for Canadians abroad is on the air Monday to Friday at 2200. It includes features from the domestic service such as *The World at Six* and *As it Happens*. Listen on 9·76, 11·96, 15·235.

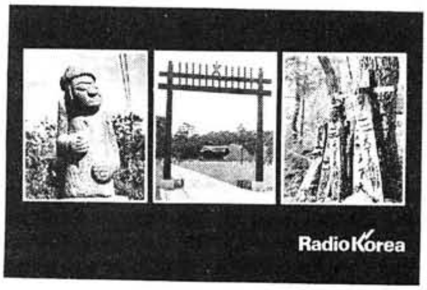
RCI only QSLs once a year with a do-it-yourself card which comes along with their programme schedule. This is obtainable from RCI, PO Box 6000, Montreal, Canada, H3C 3A8.

North American DX

In Canada the shortwaves are also used for domestic broadcasting and some of these transmissions can be picked up in Europe. The CBC (Canadian Broadcasting Corporation) Northern Service from Montreal is on 9·625MHz and 11·720MHz until 2330 and on 6·065 and 6·195 (49m band) during the night. Programming is in the English, French, Indian (North American) and Eskimo languages. The address is CBC Northern Service, PO Box 6000, Montreal.

It is the low power relays of domestic station on the 6MHz (49m) band that provide the real challenge to the DXers. Two logged recently in Europe are CHNX in Halifax Nova Scotia with 500 watts on 6·13MHz which relays the m.w. outlet CHNS (960kHz) and CKZN in St John's Newfoundland with 1kW on 6·16MHz which relays CBN (640kHz). Worth searching for are CFVP the Voice of the Prairies in Calgary with 100 watts on 6·03MHz relaying CFCN (1060kHz) and CFCX in Montreal with 1kW on 6·07MHz relaying CFRB (1010kHz). Those who think there is no longer any DX to be found on the international broadcast bands should try for the 10 watt relay of CKWX (1130kHz) in Vancouver on 6·08MHz which has been picked up in many parts of the world.

Voice of Free China sent in by Christopher Williams

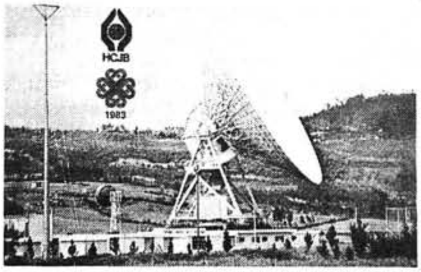


Radio Korea sent in by Christopher Williams

Callsigns

"Can you please tell me the full names for the following abbreviations, KYOI in Saipan, ELWA in Liberia, WRNO in New Orleans, WYFR in Okeechobee in the USA, RAE in Argentina," asks **Stephen Blanchflower.** Only one of them is an abbreviation. RAE stands for Radio Argentina Exterior. All the others are callsigns. At one time, broadcasting stations used callsigns just like other users of the air waves but this has largely died out. In Canada and the United States domestic stations are allocated and are obliged to use callsigns as this is probably the only feasible method of identification owing to the very large number of stations. The practice has extended into the short waves, though "official" stations such as the Voice of America and RCI no longer follow it. KYOI is in American controlled Marianas, the address for a QSL being Box 795, Saipan, CM96950, Marianas Islands.

Call letters in the USA start with the letter W if the station is located east of the Mississippi river and with K if located to the west. Canada uses the prefix C e.g. CHNX on 6·13MHz. The letters selected by domestic broadcasters are often appropriate to the station or its location. WNEW for example is in New York City. At one time WSUN and WFUN could be found in Florida and KOLD in Alaska. According to a report in the *Chicago Sun Times* quoted in *DX Monitor* early last year, WTCO-FM on 92·7MHz located in surburban Arlington Heights, won a 4 month battle to change its call letters to WSEX. No details of station format were revealed!



HCJB sent in by Shoyab Patel

European DX Council

A letter from Michael Murray, who is Secretary General of the EDXC draws attention to the second edition of their *QSL Survey* which is currently available for 50p in the UK and 75p or 3 IRCs elsewhere, which is the same as for the EDXC Club List mentioned last month. A new edition of the *Country Land List* is being prepared and should be available in the near future.

"Would any of your readers be interested in the fact that we have IRCs for sale at 25 pence each, minimum quantity 20," continued Michael. These are I should think IRCs sent to the EDXC from abroad. IRCs have become something of an international currency among DXers, being an easy way of paying moderate amounts for club publications and subscriptions as well as for the normal use with a reception report.

Readers' Letters

"I wonder if you can tell me where I can buy traps for the Broadcast Bands i.e. 21MHz/17MHz/15MHz/11MHz," asks **William Lee**, who is referring to trapped dipole antennas. These use inductors and capacitors in sealed units as part of the antenna to make it resonate at chosen frequencies. Can anyone help?

"Regarding Philip Hodgson's problem with Qatar Radio," writes **Bill Pentland** from Dairsie in Fife, "on reporting to this station I monitored the fluctuations in modulation, signal strength, QRM, QRN on a a two minute basis." Bill submitted this information, together with the station identification to Qatar, with positive results. He received a QSL card, programme schedule and map of the state of Qatar in return. You deserve full marks for originality Bill, this is the most unusual reception report I have encountered.

"I own a DX302 communications receiver," reports **Marcus Walden** from Harrogate, who goes on to say: "Recent additions to my set-up are a random wire around the attic and a homebrew antenna tuning unit. The design for the a.t.u. was obtained from Radio Netherland's publication *Give Your Antenna Some Air.*" This is available free of charge. The address to write to is PO Box 222, 1200JG Hilversum, Holland. Marcus has picked up an unidentified station in English on 3·250MHz which is probably Radio 5 in RSA.

Two final items. Greenland is back on 3·999MHz. I haven't logged it myself yet but it is worth looking for. Radio Free Grenada is now Radio Spice Island.

VHF BANDS *by Ron Ham BRS15744*

Reports to: Ron Ham BRS15744, Faraday, Greyfriars, Storrington, West Sussex RH20 4HE.

As high atmospheric pressure hotted up the v.h.f. bands and more sporadic-E, RTTY and DX on 28MHz occurred, we all had plenty to get excited about during the month of activity that we are now chewing over.

Solar

Although the sun was very quiet between October 20 and November 15, **Cmdr Henry Hatfield,** Sevenoaks, using his spectrohelioscope saw a double sunspot and one faint single spot on the 19th, one faint spot on the 23rd, five filaments and a few quiescent prominences on the south east limb, on the 28th. **Ted Waring,** Bristol, observed the sun while it was low in the sky and counted 4 sunspots on the 19th, only 2 on the 24th and 8 on November 10th. As far as radio noise is concerned I recorded a few tiny and random bursts at 143MHz, during my midday observations on October 31 and November 2, 5, 8 and 9th.

The 28MHz Band

Congratulations to **Peter Lewis,** Ivybridge, who passed his Morse test in September and now, with his new call G4VFG and an FT-77, a.t.u. and a variety of wire antennas is active on the h.f. bands and very pleased with the results. During a spell on 28MHz on October 16, 21 and 23, Peter worked stations with the prefixes PY2, PY5, VE3, VP2, VP8, VP9, WD2, UA6, ZS6 and 8P6. That was certainly a good score to open your 28MHz innings with Peter. I also found the band wide open on the 23rd, with many UAs on both c.w. and s.s.b. early in the morning.

I logged Russian stations, mainly in the mornings, almost daily between October 20 and November 15, with signals from Canada and the USA coming up on several days from noon onwards, but my best for the period was to hear the enthusiastic voice of Sheri VK4VMB, in Cairns, working G4AYC and a Russian station about 0930 on the 28th. There seemed to be a lift toward south America early on the 25th, because at 0905 I heard (or should I say read on the screen) a PY6 working into Germany on the key and **Bill Kelly,** Belfast, logged LU9CR at 1115. "It was interesting to note the changes of lift conditions on the higher h.f. bands," said Bill who spends a fair bit of time at his receiver and adds, "Some days the big lift was in the far south and a good scattering of LUs and PYs were heard, even one from Antarctica".

During the early evening of November 7 and 8, **Fred Pallant** G3RNM, Storrington, logged signals from Italy, Sweden and the USA. In his report for the month, **Peter Lincoln,** BRS42979, Aldershot, writes "I found 28MHz opening up very well to north America, Oceania, Africa and Asia".

28MHz Beacons

It's good to see the beacon list, Fig. 1, getting longer and some old friends like the Bahrain beacon A92C, heard by **John Coulter,** Winchester and Ted Waring, appearing again and, what I call the sporadic-E beacons DF0AAB, DK0TE, HG2BHA and LA5TEN still popping up periodically. Short duration beacons, KA4RHZ and W2NZH/BCN were logged by Bill Kelly, EA7AML by **Ted Owen** and Ted Waring and W3VD/BCN by John Coulter. Ted Owen also heard signals from the Australian beacon VK6RTW on October 24, 25 and 26th.

Unfortunately, I have no report this time from Norman Hyde G2AIH who had a spell in hospital, so the list of beacons heard, Fig. 1, for the period October 20 to November 15, is compiled from the logs of John Coulter, Henry Hatfield, Bill Kelly, Ted Owen, Ted Waring and I. Look forward to seeing your log in the list next time Norman.

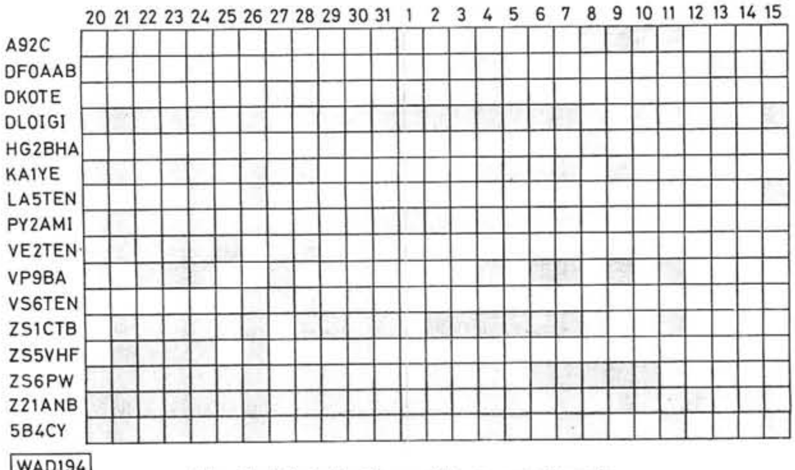


Fig. 1: Distribution of beacon signals

Sporadic-E

Although the 1983 sporadic-E season "ended" in August, more events lasting several hours occurred, mainly in the mornings, toward the end of October and in early November. At midday on October 28, I counted 33 very strong signals from east-European f.m. broadcast stations operating between 66 and 73MHz and 17 around the same time on November 4. **Harold Brodribb,** using an ex-military RL85 v.h.f. communications receiver and a temporary dipole antenna laying horizontally across furniture near the set and facing roughly east, logged 23 such stations at 1030 on the 2nd. "Some were exceedingly loud and by 1145 they had all gone", said Harold. During the events on the 28th and the 4th, signals of 589 from the German beacons DL0IGI and DK0TE were telling me that the prevailing disturbances were reaching the 28MHz band.

Tropospheric

The atmospheric pressure, measured at my QTH, began rising from 30·1in (1019mb) at 1000 on October 19 and although it peaked at 30·6 (1036) around noon on the 22nd, by 1600 it was falling again Fig. 2, giving us those very good tropospheric conditions on the 23rd. The pressure levelled at 30·3 (1026) at 2100 on the 23rd, rose again to almost 30·5 (1032) by 0400 on the 25th, gradually fell to 30·1 by 2000 on the 27th, gently climbed again to 30·4 (1029) by noon on the 29th, fell a little, then averaged around 30·3 (1026) until midday on November 3 when it began to hover between 30·0 and 30·1, still keeping v.h.f. conditions above average with a few short lifts, until the 14th.

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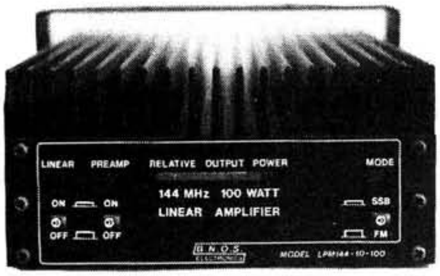

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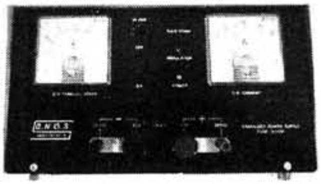

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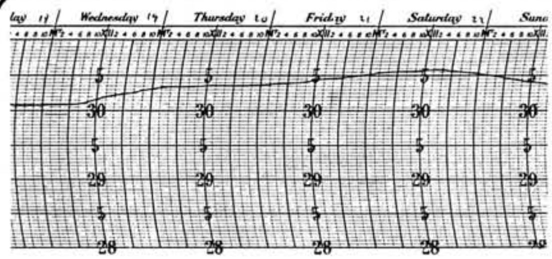

Fig. 2: The author's barograph chart for October 18 to 23, showing a typical trace during a lift

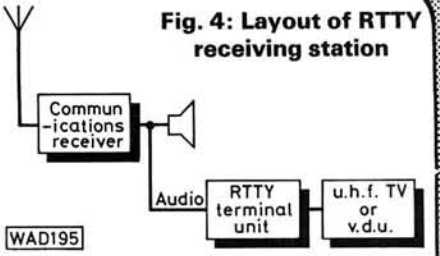

Fig. 4: Layout of RTTY receiving station

At 0138 on the 22nd, I heard a GW checking access through the 144MHz repeater at Swindon, GB3WH R2, while using a vertical dipole, 12m a.g.l. to feed my SX200N scan receiver and I guessed that there was a good lift on the way. The repeater channels were wide open on the 23rd, when, around 0830 I received strong signals from both PA0BNL/M near Rotterdam and G3IUE, Penzance, in QSO via a repeater on R8, also RAIBC member G1AIE, Brentford, making his first continental QSO with F1HKZ via R1 and G1BDL working his second continental station, PD0CFW, on R0.

Around midnight on the 22nd, **Simon Hamer,** New Radnor, heard a German station working through R2 and during the evening of the 25th, he heard signals via the French repeater FZ2THF on R6 and a Belgian operator saying that the "time-out" on the repeater was turned off so that maximum use could be made of it during the lift. At 1950 on the 23rd, I heard ON1ALX work a G6 via a 144MHz repeater on R4 and around midnight, several GWs were active on R0. During the period October 21 to 26, Peter Lewis G4VFG, worked stations in EA, F, *DL*, ON and PA, on 144MHz using his FT-77, Microwave Modules transverter, 100W linear and a ZL12 beam and says that friends of his in Torbay worked HB9s, OZs and a Russian.

In a short time around 2000 on the 26th, I heard PD0HJC, near Amsterdam, work G6ANI/M via the Wells repeater GB3WR on R0 and G6ZSC, Crediton, make his first Dutch QSO. Signals from a PE1 working G6ODV via a repeater on R4 and GW6VRN in QSO with G1AAV/P, via R2, were pounding in.

Band II

"It has been fastastic" writes **John Berridge,** Cardiff, who, between 0400 and 0900 on October 21 heard several French stations, so strong that they were blotting out local signals around 100MHz. Between 2215 and 2317 on the 24th he heard classical piano and orchestral music from France and a variety of programmes from very strong Dutch stations. Your remark adequately sums up the feelings of most of us about these good conditions John. I first noticed the lift at 1450 on the 21st, when I tried my Plustron, TVR5D, while portable near Harting in West Sussex and heard very strong French signals between 97 and 100MHz. "The French networks were very strong here with lots of them in stereo" writes **Denis**

Fig. 3: RTTY QSL card received by A. Moulder

Parkes, Brighton, on October 24. Denis also logged signals from Belgian stations between 95 and 100MHz, BBC Radio Devon, in stereo on 97·5MHz and says that BBC Radio Sussex started on the 22nd on 95·3 and 103·1MHz and readers who would like a car sticker can get one by sending an s.a.e. to Radio Sussex, Marlborough Place, Brighton.

From Wales on the 23rd, Simon Hamer heard the programme *About Sussex* from Radio Sussex on 103·1MHz, ILR Southern Sound on 103·4MHz and signals from France TDF-Inter from Paris and Belgium RTBF-2 from Liege. Between 2200 and midnight on the 25th, Simon heard *The World Tonight* from BFBS at Bielefeld, jazz music from the German stations NDR-2 from Aurich and SDR-1 from Heidelberg and signals from Belgium BRT-2 Schoten, East Germany DDR-2 Brocken and Holland NOS-1 Smilde.

On the 23rd, **Tim Anderson,** Stroud, using a Sharp Tuner and indoor dipole antenna heard BBC Radios Devon, Plymouth and Sussex, ILR County Sound and Signal Radio along with 7 French and 2 Dutch broadcast stations. Between 0200 and 0300 on the 23rd, **Raymond O'Connor,** Dublin, using a Sony ICF-2001 receiver and a 2-element antenna heard the German station Saarlandischer Rundfunk's identity at the end of their news programme. On the 25th Ray heard France-Cultur from Brest, Caen and Rouen, France-Inter from Bourges, Caen, Lille and Rouen, France-Musique from Bourges and Chartres and BBC Radio Devon. While the high atmospheric pressure system sat to the south of the UK, Harold Brodribb, St Leonards-on-Sea, counted 9 French stations in Band II on October 31, 8 on November 2, 12 plus BBC Radio Devon on the 3rd, Radios Cymru and Devon on the 5th and 18 French stations at 1015 on the 7th. From a site near Ardingly, Sussex, at 1311 on October 26, I counted 12 French stations between 88

Fig. 5: QSL from BRT—II received by Albert Moulder

and 105MHz just using my TVR5D with its own rod antenna.

"Early in 1983 I purchased a p.c. board from G3LIV to make an RTTY interface. The components to build this were easily obtainable and little difficulty occurred in construction. Alignment, although straightforward, required the use of an oscilloscope and an accurately calibrated variable frequency signal generator," writes **Albert Moulder** G8VBQ, Rainham. Having completed the interface, he loaded his BBC micro computer with the G3WHO programme, connected up a v.d.u. and a short-wave receiver, tuned to 14MHz and copied a QSO between stations in Hungary, Fig. 3 and the USA. "A BBC micro opens up a new world of communications", writes Albert, who also logged an RTTY QSO between G6OQJ and G6TKI on 144MHz.

Congratulations to Colin Desborough G3NNG, Andre Bourbon ON7CB, G4IVV/A and members of the Worthing and District Amateur Radio Club (G3WOR/P), on being the leaders and runners up of the single and multi-operators sections, respectively, of the BARTG Autumn 144MHz RTTY Contest. The s.w.l. section was won by Frans van Oostenbrugge NL4483 and the Ealing Challenge Cups will be awarded to the winners for their respective achievements. "Almost all the contestants commented on the poor conditions and in addition many of the portable stations had adverse weather to contend with as well", writes Ted Double G8CDW, BARTG's contests and awards manager.

From the Cape, Republic of South Africa, RTTY enthusiast **K. C. Easom** tells me that he has now mastered the numerous buttons on his Tono Theta 550 terminal unit which he uses with an FRG-7 receiver, tuneable notch filter supplied in kit form by Cambridge Kits and an FRA7700 a.t.u. His FRG-7 has been updated with a digital readout.

The advent of machines like the MM4001, Telereader and Tono, and the

RTTY programmes for a variety of computers has made it considerably easier for the s.w.l. to enjoy yet another aspect of amateur radio. There is plenty of activity on the h.f. bands, especially if one sticks at it, now with only a casual glance each day between October 20 and November 15, I copied RTTY signals from stations in 17 countries: DL, EA, F, HA, HB9, I, IT9, LA, OE, OH, OZ, SM, SP, UA, YO, YU and 3V8 on 14MHz; 13; DL, EA, G, HB9, I, LX, LZ, UK, VE, W, Y39, 3V8 and 9H1 on 21MHz and 3: CT1, KA1 and W on 28MHz.

R. E. Axford G4LHV tells me that his firm Scarab Systems have produced a new version of SP-RTTY written for the 48K Sinclair Spectrum computer incorporating split-screen facilities (see *Products* pages).

Like many keen s.w.l.s, **Philip Davies,** Merthyr Tydfil, who uses an FRG-7, would like to know more about receiving RTTY signals. Briefly Philip, having selected one of the range of RTTY terminal units on the market and connected it between the audio output of your receiver and some form of video display, Fig. 4, I suggest that you tune around 14·090MHz, in the 14MHz band, and tune in a RTTY signal which sounds like chattering high speed Morse code. Your terminal unit should be set to 45·5 baud, the speed of most amateur traffic, and the RTTY signal you have tuned must appear correctly on the input indicator of the terminal unit. **You must refer to the manufacturers instructions for tuning information before you connect the three units together** and/or **talk to your dealer** who will normally give you helpful friendly and technical advice. Once you know your gear and get the hang of tuning it correctly, especially the normal and reverse modes, a complete new field of amateur radio will open up before your eyes.

During the month October 12 to November 11, **Norman Jennings,** Rye, copied RTTY signals from 47 different countries including 24 Europeans, 5N23ECA (a special one day prefix on the 13th) and J28DQ and 3V8AS, probably the first RTTY stations in Djibouti and Tunisia respectively. Four new ones this time brings Norman's countries total to 118 and he tells me that SP9BCH and UT5RP are using 50 baud. That's interesting Norman, I copied an Italian station using 50 baud on November 1, no doubt we will hear more about this move and the reasons behind it.

"I have copied RTTY signals from most of Europe and north America and I was pleased to copy VK7HV on 14MHz, this being the first Tasmanian station I have logged in this mode", reports Peter Lincoln for the month preceding November 14. Peter also copied 3V8AS on 21MHz and ARRL news on 28MHz and says "they (ARRL) are now transmitting in Murray Code, ASCII and AMTOR".

Tailpiece

Mark Amos, Portsmouth, is keen to become a radio amateur and is very pleased with the advice, help and encouragement he received from local amateurs G4JXO and G6APD and members of their amateur radio club when he was invited to one of their meetings.

Congratulations to Peter Lincoln on reaching the magic 50 countries confirmed on RTTY and he has applied to the British Amateur Radio Teleprinter Group (BARTG) for the endorsement to add to his Quarter Century Award. Roll on the ton Peter.

During September, Albert Moulder received a strong signal, in full stereo from Belgium on 98·6MHz, but the language appeared to be Dutch. Albert phoned the Belgian Embassy and a very pleasant receptionist told him that it was Flemish and also which of their stations it came from. Her efforts were a great help to Albert who wonders if other listeners have approached an embassy for information. The QSL card from BRT II confirming his report can be seen in Fig. 5.

TELEVISION by Ron Ham BRS15744

Reports: as for VHF Bands, but please keep separate.

Amateur television pictures from France, an upsurge of late Autumn sporadic-E, more tropo openings, new DXers reporting for the first time, news from India, a 405-line enthusiast and a new publication are among the goodies in this month's report.

Amateur Television

"On October 26, a superb lift on 432MHz brought amateur television pictures from F3YX, 30km south east of Paris, and F1EDM, Le Havre, into England and two Bristol stations worked F3YX with P4 and P5 results", writes **Len Eastman** G8UUE, Bristol. He adds, "I believe stations as far north as Birmingham also worked F3YX". Later this French station played back the signals he received from the two Bristolians, Ken Stevens G4BVK and Chris Short G8GLQ, "with very little loss", said Len. Pictures were also received in the Bristol area, approximately 450km, by Shaun O'Sullivan G8VPG, Roger Worth G8ZQF and Len who video recorded Figs. 1, 2 and 3 and plans to show tapes of ATV and sporadic-E DXTV pictures at a winter meeting of the North Bristol Radio Club.

During the good conditions on October 23, one of my regular contributors, **Simon Hamer,** New Radnor, received his first ATV pictures from G4IMO in Rochford while he was in QSO with G6IKO and the signal was "virtually noiseless", said Simon.

Tropospheric

"Trops good here recently with BRT, NOS and a number of West German stations in good colour on u.h.f." writes **Keith Hamer** on October 31. "This last week was the best period of tropospheric propagation I have known in 8 months of DXing", writes **Raymond O'Connor,** Dublin, on the same day that Keith sent his letter. "The 26th was a most exceptional day as regards u.h.f. reception, I was very surprised to receive a test card, PTT NED 2, on Ch. 27, as I have never received continental u.h.f. signals before", says Ray and adds, "The Dutch station came and went until 2000, sometimes giving very good colour reception". Like all types of openings, tropos are full of surprises Ray, that's what makes TVDXing fun. Ray also received negative pictures from France TDF on Chs. 21, 25, 27 and 31 and BBC and IBA pictures from Crystal Palace, Ridge Hill, Rowridge, Sandy Heath and Sutton Coldfield.

Philip Heaney, Norwich, a keen s.w.l. and studying for the RAE, has taken up TVDXing with a Vega 402 receiver and was very thrilled on the very day he purchased and installed a Triax Bowtie grid antenna in his loft there was a tropo lift into Europe. On October 22 and 23, he received test cards from Belgium, Denmark, Holland and Germany in Band III and pictures from Central TV, LWT, Thames TV and Germany's ZDF on the u.h.f. band. Philip is very pleased with the performance of his Vega and delighted at 2315 on the 26th to be able to watch the programme *Newsnight* from Ireland's RTE 2 on Ch. E10. Earlier on the 26th, while using my Plustron TVR5D in its portable mode, I received a test card from Belgium RTBF-2 on Ch. E11 and several negative pictures, from French stations, strong enough to identify TDF and FR3 between Chs. 21 and 69. "At 2350 on October 22, on BRT-1, Egem, I watched *Niews* presented by Martene Tanghe, with news about Cruise missiles and Britain's Neil Kinnock MP speaking with Flemish sub-titles on the screen", writes Simon Hamer who, earlier in the evening and until midday on the 23rd, received pictures from Belgium, France, East and West Germany and Holland in both the v.h.f. and u.h.f. bands and logged such captions as ARD-WDR-1, BRT TV1, DDR-2, NOS JOURNAL, Fig. 9, NOS TV1, RTBF-1, TDF and ZDF. At 0920 on the 23rd, Simon watched a Laurel and Hardy film and a programme about the German Autumn countryside on ZDF and at 1245, a concert from *Festival Flanderseen* on BRT TV-1. "This is by

Fig. 1

Fig. 2

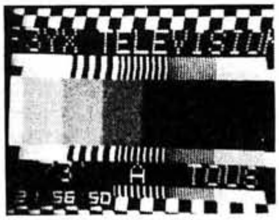

Fig. 3

Fig. 4

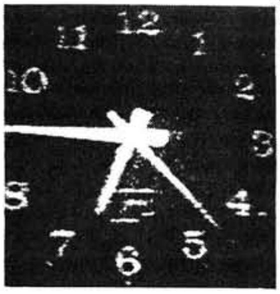

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

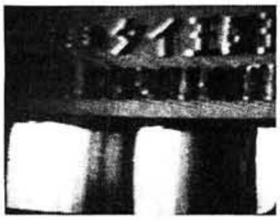

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

far the best tropo DXing I have ever had", said *Simon*, having analysed his log for the period and found that he had received signals from transmitters in Belgium at Egem, Liege, Schoten and Wavre, East Germany at Brocken, France on seven u.h.f. channels, Holland at Arnhem, Goes, Lopik, Markelo, Roermond, Smilde and Wieringermeer and West Germany at Langenberg, Rhon, Teutoburgerwald and some others unidentifiable. What a super effort Simon, beat that (until next time, hi).

At 0930 on the 23rd, **Mike Bennett,** Slough, received PTT NED-1 test card on Chs. E4 and 6, using only a Band I dipole to feed his set.

"During the evening of October 29, I watched Irish TV and a German station in Band III", writes **Alan Taylor,** Coventry and around the same time on November 7, **Fraser Lees** logged pictures from Belgium, Holland and West Germany. Early on October 23rd, I received test cards in colour from PTT NED 1, PTT-NL, on Chs. E4 and 5 respectively, the programme caption *Samstag*, a background *Sa* followed by *ARD* and letters *So* and programme schedule on Chs. E9 and 11. Around 0900 on the 26th and 27th, I logged test cards from RTBF-1 on Chs. E8 and 11 and at 1735 on the 26th, while the u.h.f. channels were badly disturbed, I found a variety of programmes from the continent in Band III on Chs. 3, 4, 6, 10 and 11.

Up in Sheffield on October 26, **Tony Palfreyman** received pictures from Belgian, Dutch and German ZDF television on their appropriate channels, 37, 39, 45, 46 and 53 and the u.h.f. pictures from the same countries again on November 11.

Sporadic-E

"There has been a sudden upsurge in sporadic-E activity", writes Keith Hamer, Derby, who received pictures from Italy RAI and Rumania TVR in Band I during late October. "I have been DXing for about 4 weeks", writes **Ian Davidson,** Johnstown, on October 22 and in that short time he received pictures in Band I from Czechoslovakia, Italy, Norway, Poland and Yugoslavia and adds, "Roll on the TVDX season". Ian uses a Grundig 14in colour set which covers Bands I and III and u.h.f. and a Vega 402E and Z4DA wideband pre-amplifier. Between 1754 and 1850 on the 21st, Ian received pictures from Poland, Fig. 4. A real good start Ian, I can tell from your letter that you will enjoy DXTV like the rest of us do. During sporadic-E disturbances on October 28 and November 4, I logged test cards from Czechoslovakia, Germany, Poland, Switzerland and the USSR and saw parts of a film about building workers and a Russian news programme with the Hobocтн caption and male presenter, on Chs. R1 49·75MHz and R2 59·25MHz. At midday on the 28th, Raymond O'Connor received colour pictures from Italy RAI on Ch. Ia 53·75MHz, Hungary MTV on Ch. R1 and Switzerland SRG on Ch. E2 48·25MHz. Around the same time on the 31st Ray received very strong test cards from Austria ORF on Ch. E2 and Czechoslovakia CST on Ch. R1. Around 1130 on the 31st, Len Eastman watched pictures from the USSR on Ch. R2 and at 0915 on November 1 he received pictures from Italy, Russia and Spain, Figs. 5 and 6. Early the following day, Len again found strong signals from Italy and Russia and comments "some of these events were as good as anything seen during the summer". Len also sent a couple of the pictures he received from Spain, Figs. 7 and 8, in July 1983, to prove his point. Both Alan Taylor, Coventry and I saw Sweden's TV1 test card on Chs. E2 and E4 between 0800 and 0930 on the 24th and their clock, one hour ahead of GMT, at 0757 and 0815. At 0840, Mike Bennett, Slough, received a test card from Switzerland PTT-SRG1, for the first time. Early on the 26th, I received a strong test card scribed Saarlandischer Rundfunk on Ch. E2 and at 0858 the ARD ZDF caption appeared with their clock showing 0958, followed by their news at 0900 and bursts of test card from Norway NRK. During the mid-morning of November 2, **Harold Brodribb,** St Leonards-on-Sea, received test cards in Band I from Italy and Yugoslavia and although pictures on other channels in the band were flickering in and out he managed to identify costume dancing and a pianist in costume and comments "an unusual haul for early November". At midday on the 4th, Fraser Lees G6JIO, Ringmer, received pictures from Portugal RTP and Spain on Ch. E2 and East Germany, Poland and the USSR on Chs. R1 and 2. Around 1320, Fraser saw the Russian news with a YL presenter and their digital clock showing 1625. At 1000 on the 8th Fraser received signals from Italy, Hungary's MTV clock caption and a programme about tractors from the USSR. Russian pictures on Chs. R1 and 2 were also reported by **Tony Palfreyman** on October 28.

SSTV

Congratulations to **Richard Thurlow**, March, who on November 11 celebrated the 45th anniversary of his callsign G3WW. Between October 14 and November 12, he had 2-way QSOs with new stations to him on SSTV, DL5MBF, HB9AOF, K6AEZ, VE3NAW, WB4DBB, W3XM and YU2OH. William Wells, Jnr, W4CVS, chairman of the board of directors of the International Visual Communications Association in Texas, has made Richard a complimentary member from October 25 and their quarterly magazine *Vision*, covering plenty of ATV and SSTV, first published in October 1983, does look interesting. More about that next time. During the month prior to November 14, **Peter Lincoln** received SSTV pictures from the South African station ZS6BTD and several stations in the USA.

Peter received a QSL card confirming his report from Michel Luttenschlaguer DJ0GF, Friedrichshafen, who said in his reply that he was pleased to see his SSTV pictures, that Peter received, published in our June issue.

"G4NJI collected his Volker Wrasse latest SC-1 scan converter, the first into the UK, from the ARRA exhibition in Doncaster and I visited his QTH in Rotherham and was very impressed with his equipment", writes Richard, who, along with Keith Andreang G4GZN, Catford, collected their SC-1s from Amateur Radio Exchange and, naturally, all three plus John Stace G3CCH, Scunthorpe, were soon swapping colour SSTV pictures.

Station Reports

Early in Sept 1983, **Major Rana Roy,** moved QTH from Amritsar, Punjab, to Bikaner, Rajasthan, a semi-desert area. Rana installed his antenna on the 15th and until the 29th he could only receive a Pakistani TV station on Chs. 8 and 10 in Band III. At 1530 on the 29th Rana received a south east Asian station, with multiple images, typical of F2 reflection, on Ch. 3 in Band I. "The same signals cleared at 1600 and up to 1715 there was a cartoon story in a south east Asian language which I could not identify and after every ten minutes there were adverts for Coca Cola, Horlicks, Mazda Cars and others which I could not make out", writes Rana. On October 19 he sorted out captions at 1805 and 1900, Figs. 10 and 11 respectively, and a news reader at 1905, Fig. 12, from the multiple images on Ch. 3. At 1600 on August 8, Rana, at his former QTH, received a caption from the USSR on Ch. R2, Fig. 13, followed by a sports programme for about 45 minutes and for about 10 minutes at 1805 on the 10th he watched Russian television news, Fig. 14.

HS Publications, run by that famous pair of TVDXers, Keith Hamer and Garry Smith, have introduced a bimonthly journal, *Teleradio News*, which is full of interesting and useful gen for both the radio and television enthusiast. The issue published in October has 16 pages containing news from home and overseas, subscribers' logs and pictures, letters and adverts (the latter, incidentally, are free to subscribers). Readers interested can get a sample copy for 75p (or 6 IRCs) post paid, by writing to their Editorial and Sales office at 7 Epping Close, Derby, DE3 4HR. Subscription for 6 issues is £4.50 for UK and worldwide by surface post, or £7 worldwide via air mail.

At his QTH in Stroud, totally surrounded by hills which are less than a mile away, except to the south west, **Tim Anderson** has two Plustron TVR5Ds, a Hugh Cocks tuner plus U800 modules connected to a National Panasonic mono receiver for 625-line DXTV and an old Ferguson 405-line portable which is proving the test of time. "Having recently got the 405 in good working order, I hope to receive as many 'B' channels as possible before they switch off", writes Tim, who has already logged signals from transmitters at Thrumster and Rosemarkie in Scotland, and Divis and Londonderry in Northern Ireland on Chs. B1 and B2 respectively. On October 22 and 25, Tim added North Hessary Tor B2, Croydon and Stockland Hill B9, Chillerton Down B11 and Caradon Hill B12. Tim has also added a Triax RB20 active antenna to his station. Is anyone else trying this, if so do let me know and remember time is short for 405.

Swap Spot

Have Sinclair "Microvision" TV with mains adapter, 12V leads, onboard batteries, viewing hood, telescopic antenna, normal antenna adapter, carrying case and strap. Also have a Microwave Modules 144MHz converter. Would exchange for a U11000 active antenna, Joy Stick + Joy Match, a.t.u. 24 Sally Ward Drive, Walsall WS9 9JZ. *T769*

Have complete Sharp CCTV surveillance system: three small cameras, 9in monitor, switch unit, long cable harnesses, etc. Intercom available at each camera. Would exchange for Pentax ME Super plus 50mm 1·4M plus good flash or w.h.y. Clive G4CZR. Tel: 0233 44063 (Ashford, Kent). *T770*

Have Uniden 100 CB, 7 amp p.s.u., Wotpole, s.w.r./power meter and cable. Also 40-channel WT2 handheld CB, as new in boxes. Would exchange for Yaesu FRG-7 or Trio R600 receivers, w.h.y. Tel: Stevenage 350310. *T781*

Have two Cossor oscilloscopes models 1035 and 1049 Mk 3A double beam. Complete with manual, circuit diagrams, spare c.r.t. and valves. Would exchange for Eddystone 640 or similar type receiver, w.h.y. Jim McMichan, 83 Haymarket Terrace, Edinburgh. *T795*

Have complete stereo disco consisting of Citronic Thames, 2 × 15in bins, 2 × micro cabs, pinspots + stands, projector + effects, 2 × ropes, 2 × light controllers, records. Value £2000+. Would exchange for h.f., v.h.f., u.h.f. gear (may split). Dave G6MMG. Tel: 051 430 9167 (Merseyside). *T808*

Have 50+ valves, many unused. Also have 6 Dekatrons, relays, motor-driven micro switch, two electric blowers, etc. Would exchange for a 20/22in transistor colour TV (working). Write first please. Mr F. J. Hunt, 45 Ashmead Road, Maybush, Southampton SO1 6DJ. *T809*

Have selection of British stamps from Victoria to Elizabeth. Many high values, including "Sea-Horses" catalogued at £200+. Would exchange for any h.f. or v.h.f. receiver or transmitter, test gear, w.h.y. Barry Harper, 141 Friar Park Road, Wednesbury, West Midlands. *T810*

Have Avo 8 MkV, nine months old, with matching carrying case—perfect order. Would exchange for Sinclair Spectrum, Vic 20, 144MHz rig, general coverage receiver, IC2E, mobile h.f. rig, air conditioning unit. Adjustments can be made for difference of value. Jake. 1 Gordon Road, Edmonton, London N9 0LX. *T851*

Have large Canadian 52 set, a.t.u. fitted with coaxial sockets each end. Also have 19 set variometer a.t.u. Would exchange for mains transformer 300-0-300V at 100mA or near, or pair headphones-mic suitable for 19 set. Callers only. Heslop, 75 Alder Park, Brandon, Durham DH7 8TJ. *T857*

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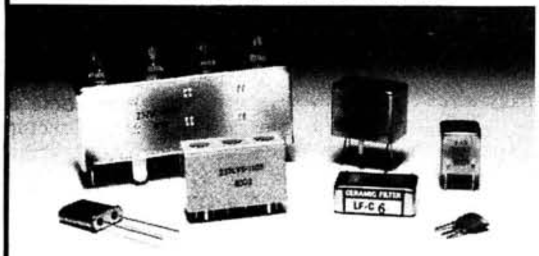

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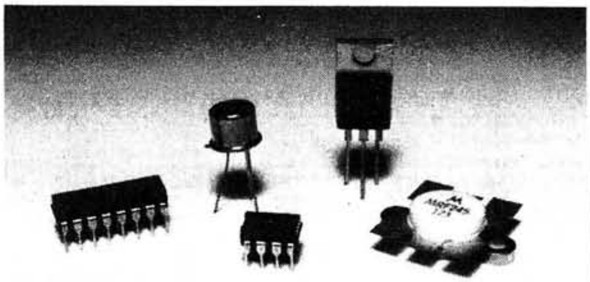

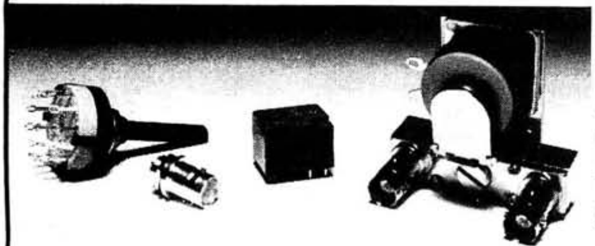

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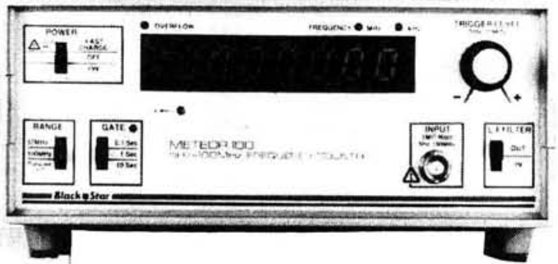

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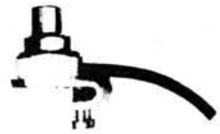

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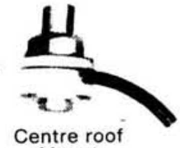

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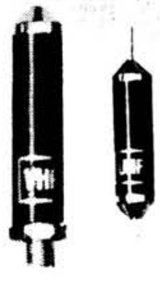

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Many more send for list.

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Solder in feedthrough capacitors 1000pf 500vw	**50p per 10**
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 2/84

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MMB10	Mobile Bracket	6.90	(0.75)
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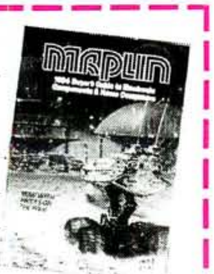

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