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Practical Wireless
THE RADIO MAGAZINE
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FC757AT	Automatic A.T.U.	POA	
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IC 4E	70cm Handheld	199.00	(—)
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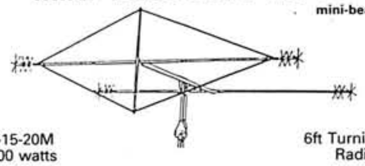

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		£	c&p
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FL2	Multi-mode Audio Filter	89.70	(—)
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AD370	Outdoor Active Antenna	64.40	(—)
AD270	Indoor Active Antenna	47.15	(—)
MK	Keyboard Morse Sender	137.42	(—)
Codecall	Selective Calling Device	33.92	(—)
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ANF	Auto notch filler (Audio)	67.85	(—)
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MMT70/28	4M Transverter for HF Rig	119.95	(—)
MMT70/144	4M Transverter for 2M Rig	119.95	(—)
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MMC144/28	2M Converter to HF Rig	29.90	(—)
MMC432/28S	70cm Converter to HF Rig	37.90	(—)
MMC432/144S	70cm Converter to 2M Rig	37.90	(—)
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TONO 550	299.00	(—)
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ROTATORS

Hirschman	RO250 VHF Rotor	45.00	(2.00)
9502B	Colorotor (Med. VHF)	56.95	(2.00)
EMR400	Alinco	89.95	(2.50)
KR400RC	Kenpro – inc lower clamps	125.00	(2.50)
KR600RC	Kenpro – inc lower clamps	175.00	(3.00)

MORSE EQUIPMENT

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MK704	Squeeze Paddle	11.95	(0.75)
HK703	Deluxe Key	25.70	(1.20)
EK150	Electronic Keyer	87.00	(—)

TEST EQUIPMENT

Drae VHF Wavemeter 130-450MHz	27.50	(—)
DM81 Trio Dip Meter	71.00	(0.75)
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FOR THE Radio ENTHUSIAST ...

Practical Wireless

DECEMBER 1983 VOL. 59 NO. 12 ISSUE 921

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in glasgow,

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in darlington,

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in london,

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The performance of the AR2001 sets new standards. Gone are the complaints of "deaf" receivers. The AR2001 has typical sensitivity of 0.2 microvolts for 12dB SINAD on FM (N) **across the entire 25 – 550MHz range.**

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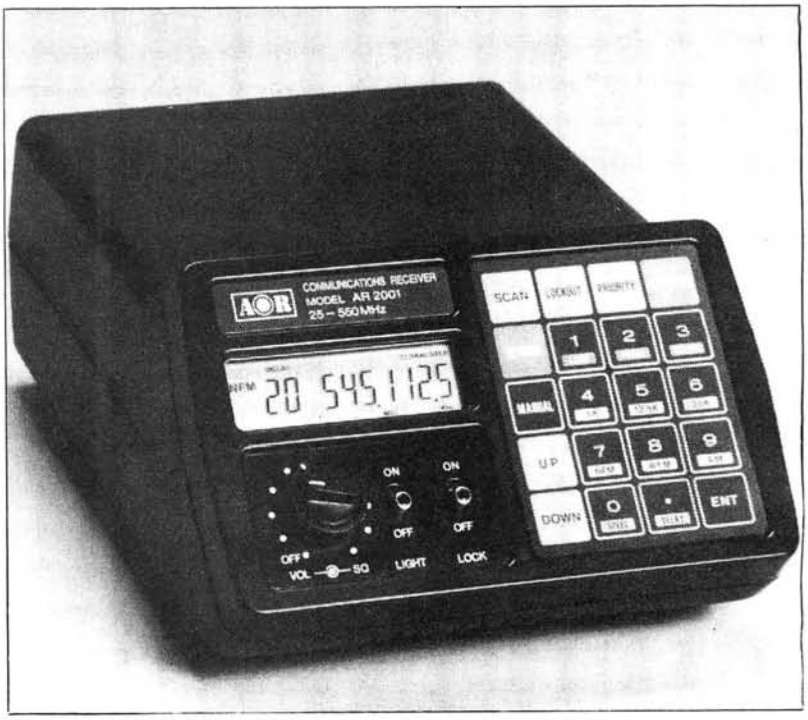

receiver coverage continuous from 25 to 550 MHz.

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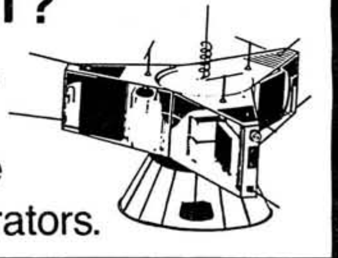

FT-726R

TRANSCEIVERS

FT726R	Transceiver c/w 2M	£675.00
430/726	70CM Module	£230.00
SAT726	Full duplex module	£90.00
FT780R*	70CM All mode 10W	£289.00
FT480R	2M All mode 10W	£399.00
FT790R	70CM All mode 1W	£299.00
FT290R	2M All mode 2.5W	£249.00

* Special Low price offer, 1.6 MHz shift version **£299**

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MML432/50	70CM 10W to 50W	£129.95
MML432/100	70CM 10W to 100W	£245.00
MML1296/10W	23CM 1W to 10W	T.B.A.

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H100	50 Metres	£39.00
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LDF4/50	Andrews heliax p/m	£3.58

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FTV107R	Transvertor c/w 2M	£89.00
FTV901R	Transvertor c/w 2M	£139.00
432TV	70CM Module for above	£214.65
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MMC432/28	Convertor 70CM down to 10M	£37.90
MMC432/144S	Convertor 70CM down to 2M	£37.90
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SBLA144E	2M Mosfet masthead preamp	£79.90
SLNA145SB	FT290R Preamp	£27.40
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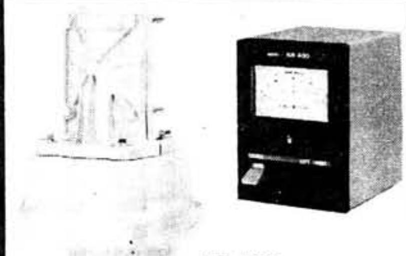
TLNA432U	Unswitched (432S)	£29.00
GLNA432U	70CM Gasfet unswitched	T.B.A.

MML-432/100

Carriage is free except where indicated



KR-400

ROTATORS

KR400	Meter controllor	£97.75 *
KR400RC	Round controller	£114.94
KR600RC	Round controller	£163.30
AR40	CDE	£90.85
CD45	Meter controllor	£136.85
HAMIV	Meter controllor	£258.75
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* Rotators could be used with a home computer for automatic tracking of satellite.

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Carriage on antennas Each **£2.50**

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REMEMBER

Only authorised Yaesu dealers have direct contact with the factory in Japan, and only if you buy your radio from an authorised dealer can you be assured of spares and service back up. So **BEWARE** of grey importers who offer sets a few pounds cheaper, they may not be around if your set goes wrong!!

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SMC NEW LOW YAESU PRICES

FT-980

FT ONE	Transceiver General Coverage	£1395.00
KEYT901	Curtis Keyer	£26.85
DCT1	DC Power Cable	£9.60
RAMT1	Non volatile memory board	£13.05
FMUT1	FM unit	£39.85
XF8.9KCN	300 Hz CW filter	£17.25
XF8.9KC	600 Hz CW filter	£17.25
XF8.9KA	6 KHz AM filter	£17.25
XF10.7KC	800 Hz CW filter	£11.90
FT980	Transceiver General Coverage Rx Amateur Tx	£1150.00
SP980	External speaker	£54.80
SP980P	External speaker phone patch	£69.75
FT102	Transceiver 9 band multimode	£685.00
SP102	Speaker with audio filter	£49.05
SP102P	Speaker and phone patch	£69.00
FV102DM	Synthesized scanning VFO	£230.00
FC102	Antenna coupler 1.2KW PEP	£200.00
AMFMUT102	AM/FM unit option	£46.00
FAS14R	4 Way antenna selector	£39.10
XF82GA	6 KHz AM filter	£18.80
XF82HSN	1.8 KHz Narrow SSB filter	£18.80
XF82HC	600 Hz CW filter	£18.80
XF82HCN	300 Hz CW filter narrow	£18.80
XF455C	500 Hz CW filter	£44.85
XF455CN	270 Hz CW filter narrow	£44.85
FT77	Transceiver 9 band mobile multimode	£459.00
FT77S	Transceiver 9 band mobile 10 watts	£399.00
MRKT77	Calibration marker unit option	£9.60
FMUT77	FM Board option	£25.30
FP700	External power supply/speaker	£110.00
FC700	Antenna tuner	£85.00
XF8.9KC	600 Hz CW filter	£17.25
FT757GX	Amateur bands TX General RX	£625.00
FP757GX	Switch mode PSU	£135.00
FC757AT	Automatic Antenna Tuner	£210.00
FT902DM	Transceiver 9 band, multimode	£885.00
FT902DE	902DM less invertor, memory & FM	£790.00
FT902D	902DM less invertor, memory & keyer	£800.00
FMU901	FM Module	£28.00
KEYT901	Curtis Keyer	£26.85
MEMT901	Memory Unit	£87.90
DCT901	Invertor (from 12VDC)	£46.75
XF89GF	12 KHz crystal filter FM	£26.05
FTV901R	Transvertor c/w 2M	£139.00
50TV	6m transvertor module	£79.75
70TV	4m transvertor module	£84.70
144TV	2m transvertor module	£109.65
430TV	70cms transvertor module	£214.65

XF8.9HC	CW Filter 600Hz	£26.05
XF8.9HCN	CW Filter 300Hz	£26.05
XF8.9GA	AM Filter 6KHz	£26.05
FL2100Z	Linear Amplifier 1200 W + (PIP)	£475.00
FT707	Transceiver 100W 10-80M (8 bands)	£499.00
FT707FM	FT707 with SMC's FM unit fitted	£549.00
FP707	Mains power supply/speaker	£110.00
FV707DM	Digital VFO	£170.00
FC707	Antenna Tuner	£85.00
FTV707R	Transvertor c/w 2M	£99.00
FRB707	Relay switching box	£15.35

FT-726R

FT726R(2)	Multimode multiband c/w 2M	£675.00
FT726R	Main frame only	£550.00
50/726	6m module	£170.00
21/24/28	HF module for 15m, 12m and 10m	£180.00
144/726	2m module	£135.00
430/726	70cm module	£230.00
SAT726	Full duplex module	£90.00
XF455MC	600Hz CW filter	£39.85
FT230R	Transceiver 2m FM 25W	£239.00
FT730R	Transceiver 70cm FM 10W	£259.00
FT690R	Transceiver 6m 2.5W multimode	£239.00
FT290R	Transceiver 2m 2.5W multimode	£249.00
FT790R	Transceiver 70cm 1W multimode	£299.00
SMC2.2C	Nicad cell, 2.2 A/hr 'C' size	£2.70
SMC8C	Slow charger (220mA)	£8.80
MMB11	Mobile mount	£24.90
CSC1A	Soft carrying case	£3.85
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FL2010	Linear amplifier 2m 10W	£59.00
FL7010	Linear amplifier 70cm	£91.00
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FT480R	Multimode transceiver 2m	£399.00
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FT780R1.6	FT780R c/w 1.6 MHz shift	£299.00
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SC1	Station console	£138.00
FL2050	Linear amplifier 50W	£115.00
FT720RV	Transceivers 2m 10W FM	£199.00
FT720RVH	Transceivers 2m 25W FM	£209.00
FT720RU	Transceiver 70cms 10W FM	£229.00
FT720R	Control head	£100.00
720RV	Deck only 2m 10W	£100.00
720RVH	Deck only 2m 25W	£110.00
720RU	Deck only 70cms 10W	£130.00
S72	Switching box	£39.00
E72S	Cable, 2m long	£10.00
E72L	Cable, 4m long	£15.00

Prices include VAT & Carriage

FT-290R

FT280R	Transceiver Handheld 2.5 2m	£199.00
FT708R	Transceiver Handheld 1W 70cms	£209.00
FNB2	Nicad Battery Pack	£19.95
FBA2	Battery pack sleeve (fits FNB2)	£3.05
FBA3	Charging sleeve (for FT207 acc)	£5.35
NC9C	Slow charger	£8.00
NC7C	Base Master	£30.65
NC8C	Quick charge and PSU	£50.60
MMB10	Mobile bracket	£6.90
FRG7700	Receiver 0.15-3.0 MHz AM/CW/SSB/FM	£335.00
FRG7700M	Receiver c/w 12 channel memory	£389.00
DCRG7700	DC modification kit	£1.15
MEMG7700	Memory option	£98.90
FRT7700	Antenna tuner/switch	£42.55
FRA7700	Active antenna	£38.70
FF5	Low pass filter 500 KHz	£9.95
FRV7700A	Convertor 118-130, 130-140, 140-150 MHz	£78.95
FRV7700B	Convertor 118-130, 140-150, 50-59 MHz	£84.70
FRV7700C	Convertor 140-150, 150-160, 160-170 MHz	£74.75
FRV7700D	Convertor 118-130, 140-150, 70-80 MHz	£80.90
FRV7700E	Convertor 140-150, 150-160, 118-130 MHz	£83.95
FRV7700F	Convertor 150-160, 160-170, 118-130 MHz	£83.95
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FSP2	Mobile speaker 4 ohms	£11.15
YH55	Headphones padded low z	£9.95
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YH1	Lightweight mobile headset/boom mic	£13.80
SB1	PTT switch box for FT208/FT708	£14.95
SB2	PTT switch box for FT290/FT790	£12.65
SB3	PTT switch box for FT202	£13.80
FP4	12V power supply 4 amps	£44.45
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FF501DX	Low pass filter	£25.70
YP150Z	Terminated Wattmeter 5-30-150W FSD	£92.00

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FTV107R TRANSVERTER c/w 2m	£89.00	FV101DM VFO	SOLD OUT
FTV901R TRANSVERTER c/w 2m	£139.00	FV901DM VFO	SOLD OUT
FTV707R TRANSVERTER c/w 2m	£99.00	FT227R	£149.00
DMS 107 DMS UNIT for FT107	£69.00	FP107 PSU	£79.00

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Something new to celebrate! IC-745 HF Transceiver £759.

What's the celebration about?
The IC-745...a new all band HF transceiver with SSB, AM, CW, RTTY and an FM option.. plus, a 100KHz – 30MHz general coverage receiver.
And...the IC-745 has a combination of features found on no other transceiver at such an incredibly low price. See the IC-745 at our shop and showroom at Herne Bay or contact your local authorised ICOM dealer for more information.

IC-R70, HF Receiver, £499.

The R-70 covers all modes (when the FM option is included), and uses 2 CPU-driven VFO's for split frequency working, and has 3 IF frequencies: 70MHz, 9MHz and 455KHz, and a dynamic range of 100dB. It has a built-in mains supply.

NEW! IC-271, £569. VHF Multimode Base station

Icom have made improvements to the IC-251 and brought it up to date.
Power can be adjusted up to 25W on all modes SSB, CW and FM. Squelch works on all modes and a listen-input facility has been added for Repeater work. RIT shift is shown on the display.
Options include a switchable front end pre-amp.
Speech synthesizer announcing displayed frequency.
22 Channel memory extension - with scan facilities.
10 Hz tuning facility. SM5 desk mic
Internal chopper PSU, Why not call us for further details?

NEW! IC-120, 1296 MHz FM £419.

Thinking of 1296? Then Icom IC-120 could be the answer.
Now you can have the sophistication of today's technology on this up and coming band-all built into a unit the same size as the IC-25E, very compact...

Thanet ICOM

IC-751, £969. HF Transceiver

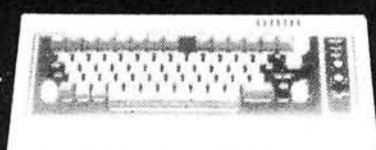
Think about the IC-740,
One of the most popular amateur bands transceivers, make a few improvements such as adding 36 memory channels, doing away with mechanical bandswitching and then add full HF receive capabillity (0.1-30 MHz) which is even an improvement on the famous R70 and you get a pretty good idea of what the IC-751 is like. It is fully compatible with Icom Auto units such as the AT-500 and IC-2KL and a further option for computer control can be added. There is also a digital speech synthesizer option which will be ideal for blind operators For power supplies you have the option of the IC-PS740 (which fits inside) or the PS-15/PS20 range for external use.

RTTY, Morse & ASCII

Shortwave listeners and amateurs are able to take more interest in other modes of transmission than speech with the latest range of decoders and senders available. As well as amateur transmissions, there is an abundance of news and other interesting broadcasts which can be read using these space-age devices.

Some models in our range are the Tono 550, 9000E and the Telereader CWR-670, CWR-685E and CWR-610E. There is now available a professional version of the Tono 9000E, the PRO-1, which has a built-in scrambler. The Telereader CWR-670 is also available with a built-in VDU which can include a 40 column printer.

TONO 9000E Sender/Decoder £669.



CWR-610E, Decoder £189.

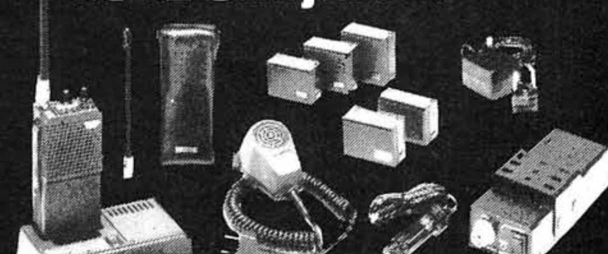
As U.K. importers of the renowned TONO and TELEREADER products, we can offer you a wide range, from a simple morse and RTTY reader which can be plugged into your TV., to a complete send and receive system with memories and built-in displays, or outputs for high-definition VDU.

As well as stocking the complete ICOM range of equipment suitable for European use, we also sell Yaesu, Jaybeam, Datong, Welz, G-Whip, Western, TAL, Bearcat, Versatower and RSGB publications from our shop and showroom at the address below.

IC-290D, VHF, £433. Multimode Mobile

The recently introduced IC-290H has proved so popular that we have decided to concentrate on this (25W) model 2m multimode. With its bright green display, 5 memories, scan facilities on either memories or the whole band, tone-call button on the microphone and instant listen input for repeaters, this little box really is a beauty. The 70cm version, the IC-490E has similar features (although the output is only 10W in this case).

IC-2E, VHF/FM, £179. IC-4E UHF, £199.



Nearly everybody has an IC2E – the most popular amateur transceiver in the world – there is also the 70 cm version which is every bit as good and takes the same accessories.

IC-25H/25E, £329/£369. VHF, FM Mobiles

The FM mobile choice has to be the Icom IC-25E. It is so small yet boasts a powerful 25 Watt voice and a sensitive receiver. The new 25H now avalable has a green display and 45 Watts output. There are five easily programmable memories, and facilities for changing the repeater shift from the default value of 600kHz.

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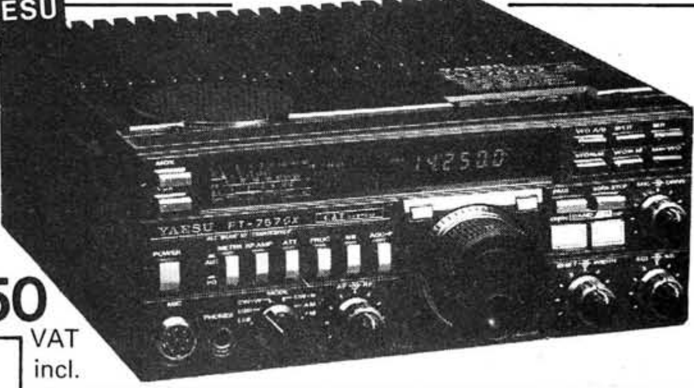
FT-757GX The latest all-mode HF rig from YAESU



How do they do it? - To get so much in so small a package - Just look at the features.

- **All-mode operation SSB, CW, AM and FM are included as standard features. ● Full CW break-in. ● Dual VFO plus eight memories. ● Programmable memory scanning.**
- **600 Hz CW filter fitted. ● Iambic keyer with dot-dash memory.**
- **IF shift and width filters. ● TX coverage 160 thru 10 metres.**
- **High performance general coverage RX 500 KHz - 29.999 MHz.**

All this for around **£650** VAT incl.

Optional P.S.U.'s FP-757 (plinth type) FP-700.

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Not just a mobile rig - with matching PSU and ATU this makes a first class budget station.

FT-77 - New low price **£459** VAT incl.
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SPECIAL OFFER

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FT-480R 2 metre multi-mode

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With memory £**389** VAT incl.
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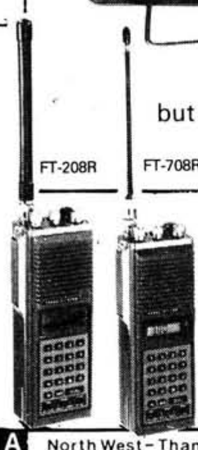

FT-208R 2 metre FM hand-held

The finest hand-held bar none at under £200. £**199** VAT incl.

FT-708R 70cm FM hand-held

New low price of £**209** VAT incl.

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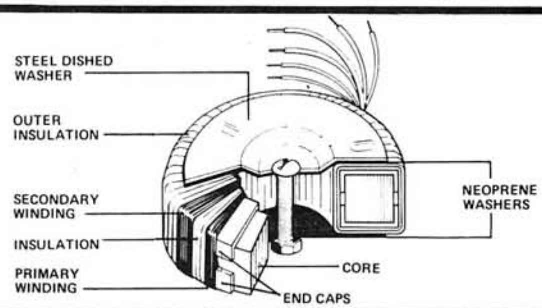

15 VA 62 x 34mm 0.35Kg Regulation 19%

SERIES No	SECONDARY Volts	RMS Current
0x010	6+6	1 25
0x011	9+9	0 83
0x012	12+12	0 63
0x013	15+15	0 50
0x014	18+18	0 42
0x015	22+22	0 34
0x016	25+25	0 30
0x017	30+30	0 25

(encased in ABS plastic)

30 VA 70 x 30mm 0.45Kg Regulation 18%

1x010	6+6	2 50
1x011	9+9	1 66
1x012	12+12	1 25
1x013	15+15	1 00
1x014	18+18	0 83
1x015	22+22	0 68
1x016	25+25	0 60
1x017	30+30	0 50

50 VA 80 x 35mm 0.9Kg Regulation 13%

2x010	6+6	4 16
2x011	9+9	2 77
2x012	12+12	2 08
2x013	15+15	1 66
2x014	18+18	1 38
2x015	22+22	1 13
2x016	25+25	1 00
2x017	30+30	0 83
2x028	110	0 45
2x029	220	0 22
2x030	240	0 20

80 VA 90 x 30mm 1Kg Regulation 12%

3x010	6+6	6 64
3x011	9+9	4 44
3x012	12+12	3 33
3x013	15+15	2 66
3x014	18+18	2 22
3x015	22+22	1 81
3x016	25+25	1 60
3x017	30+30	1 33
3x028	110	0 72
3x029	220	0 36
3x030	240	0 33

120 VA 90 x 40mm 1.2Kg Regulation 11%

4x010	6+6	10 00
4x011	9+9	6 66
4x012	12+12	5 00
4x013	15+15	4 00
4x014	18+18	3 33
4x015	22+22	2 72
4x016	25+25	2 40
4x017	30+30	2 00
4x018	35+35	1 71
4x028	110	1 09
4x029	220	0 54
4x030	240	0 50

160 VA 110 x 40mm 1.8Kg Regulation 8%

5x011	9+9	8 89
5x012	12+12	6 66
5x013	15+15	5 33
5x014	18+18	4 44
5x015	22+22	3 63
5x016	25+25	3 20
5x017	30+30	2 66
5x018	35+35	2 28
5x026	40+40	2 00
5x028	110	1 45
5x029	220	0 72
5x030	240	0 66

225 VA 110 x 45mm 2.2Kg Regulation 7%

6x012	12+12	9 38
6x013	15+15	7 50
6x014	18+18	6 25
6x015	22+22	5 11
6x016	25+25	4 50
6x017	30+30	3 75
6x018	35+35	3 21
6x026	40+40	2 81
6x025	45+45	2 50
6x033	50+50	2 25
6x028	110	2 04
6x029	220	1 02
6x030	240	0 93

300 VA 110 x 50mm 2.6Kg Regulation 6%

7x013	15+15	10 00
7x014	18+18	8 33
7x015	22+22	6 82
7x016	25+25	6 00
7x017	30+30	5 00
7x018	35+35	4 28
7x026	40+40	3 75
7x025	45+45	3 33
7x033	50+50	3 00
7x028	110	2 72
7x029	220	1 36
7x030	240	1 25

500 VA 140 x 60mm 4Kg Regulation 4%

8x016	25+25	10 00
8x017	30+30	8 33
8x018	35+35	7 14
8x026	40+40	6 25
8x025	45+45	5 55
8x033	50+50	5 00
8x042	55+55	4 54
8x028	110	4 54
8x029	220	2 27
8x030	240	2 08

625 VA 140 x 75mm 5Kg Regulation 4%

9x017	30+30	10 41
9x018	35+35	8 92
9x026	40+40	7 81
9x025	45+45	6 94
9x033	50+50	6 25
9x042	55+55	5 68
9x028	110	5 68
9x029	220	2 84
9x030	240	2 60

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For 220V primary (Europe) insert "1" in place of "X" in type number.
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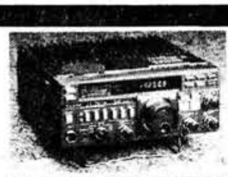

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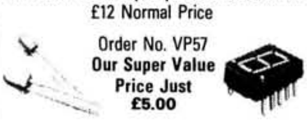

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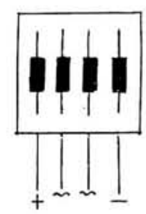

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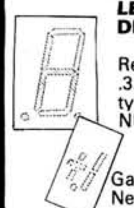

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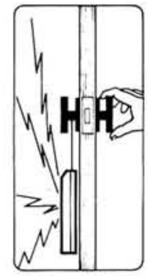

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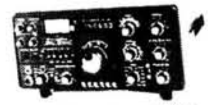

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PW Comment

New Modes

THIS MONTH we do something we've not done in *PW* for a very long time: reprint an article from another magazine. We always like to feature material that's new, or at least updated or revised, but just once in a while an article that's been published elsewhere catches our eye. The piece in question is *Amateur Packet Radio*, which appeared earlier this year in the American publication *Ham Radio*. You may already have seen the series in *HR*, which circulates quite widely outside the USA. If so, our apologies. We felt that this article, which so clearly introduces a fascinating new communications mode, deserved a bigger audience.

★ ★ ★ ★ ★ ★

Two other modes which will be affecting us all in years to come are satellite and cable broadcasting. If the cost of receiving antennas and converters for satellite TV and sound can continue to fall in the way they seem to be doing now, this could become an attractive way of getting high-quality programme reception, especially in less densely populated areas. In the cities, cable will probably have the edge because of the problems in putting up antennas with a clear view of the satellite on blocks of flats, town houses, etc., or anywhere the skyline is cluttered. Let's hope the cable system installation will be properly done, so that there's not too much r.f. leakage either into or from the system, causing interference headaches for both cable and radio users.

Though satellite and cable broadcasting are technically elegant systems, capable of providing much better quality pictures and sound than many people are forced to put up with now, I do have doubts about how attractive a choice of up to forty TV programmes will be to the viewer, especially if a costly subscription has to be paid. If cable TV had become generally available before domestic video recorders hit the market in profusion things might have been different. Now, with sales of v.c.r.s in the UK more than doubling every year since 1979 and passing the two million mark for 1982, so many people have got used to having the programme they want, at the time that they want, that I fear that they're not going to give such a welcome to cable TV.

To my mind, the need to fill the UK's four TV channels with visual entertainment for so many hours each day is really taking a toll in the quality of programmes. Yes, there are still some outstandingly good ones, but too often it seems that an idea which might have made a brilliant single programme is milked to the extreme to produce several weekly doses of mediocrity.

And on the operating side, am I alone in feeling that on TV live outside broadcasts, where professionalism counts the most, we are seeing more and more fuzzy focusing, or cutting to cameras which the cameraman is still panning or zooming—not intentionally for artistic effect, but accidentally because someone made a mistake?

If there are so many problems in providing four channels of TV, where is all the material and manpower to come from to create forty? It's a brave man who invests his money in cable TV.

Geoff Arnold

PW 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.

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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.

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Address

Post Code

Occupation Age Phone No. (Home) (Work)

I/We hereby apply to insure the equipment detailed below

BLOCK LETTERS

	Manufacturer's Name	Model	Serial No.	Description of equipment to be insured e.g. Base station; Mobile; CB; etc.	VALUE £
1					
2					
3	Antennas (Aerials), s.w.r. meters, etc.				

Please continue list of equipment on a separate sheet if necessary **TOTAL SUM TO INSURE £**

DECLARATION: I/We hereby declare that: 1. The sums insured represent the full replacement value of the equipment. 2. I/We have not* had insurance cancelled, declined, restricted, or other terms imposed in any way other than the normal Policy terms. 3. This proposal shall be the basis of the contract and that the contract will be on the Underwriters normal terms and conditions for All Risks and Legal Costs/Expenses cover unless otherwise agreed. 4. I/We have not* sustained any loss or damage to any radio communications equipment or been involved in litigation relating to use of radio equipment during the past three years, whether insured or not. 5. All the above statements made in connection with this proposal are true and no material information has been withheld. 6. I/We understand no liability shall attach until this proposal shall have been accepted by Laymond's and the premium paid in full and a Certificate issued.

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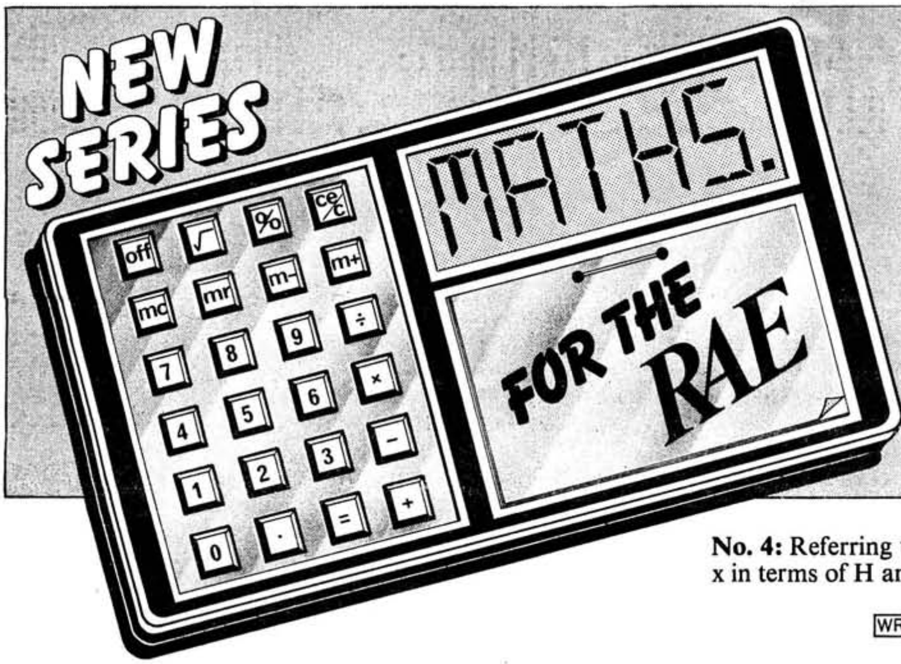


Part 1 by Roger Lancaster

The mathematical skills required to secure a pass in the Radio Amateur's Examination could be described as minimal. However, what may be regarded as minimal by someone with a recent "O" level in mathematics may not seem nearly so minimal to another who never "got on" with maths at school, or one who has had nothing to do with maths (apart from income tax and VAT) since leaving school forty years ago, or perhaps a young enthusiast still working his way through secondary school.

Not that Maths "O" level standard is required—far from it. A fundamental grasp of certain specific topics is all that is necessary.

Quite apart from the mathematical ability required to answer questions in the examination itself, the candidate will require some knowledge of graphs, trigonometry and simple equations in order to understand the technical descriptions given by a lecturer on a course or by an author in a textbook. The lecturer will not be allotted time to spend on the very basic mathematical concepts and the author of the textbook will certainly assume such a mathematical background.

So, it would be wise for anyone contemplating an attempt at the examination to be sure of the maths before paying out money to enrol on a course or to begin private study. Even after acquiring a licence, the enthusiast will want to read technical books and articles which will call for at least this same basic level of mathematical understanding.

Do you fall into this category of enthusiast requiring a more solid mathematical base? Try the following little self-test. If you can answer these without any trouble then you need read no further, but if not then you will hopefully benefit from continuing.

No. 1: Given that:

$$f = \frac{1}{2\pi\sqrt{LC}}$$

write down the formula expressing C in terms of f and L, in the form C = . . .

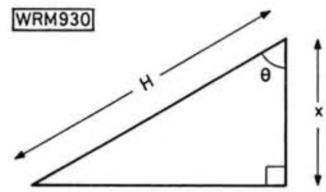
No. 2: Given that:

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

write down the formula expressing R_1 in terms of R_t, R_2 and R_3 in the form $R_1 = \ldots$

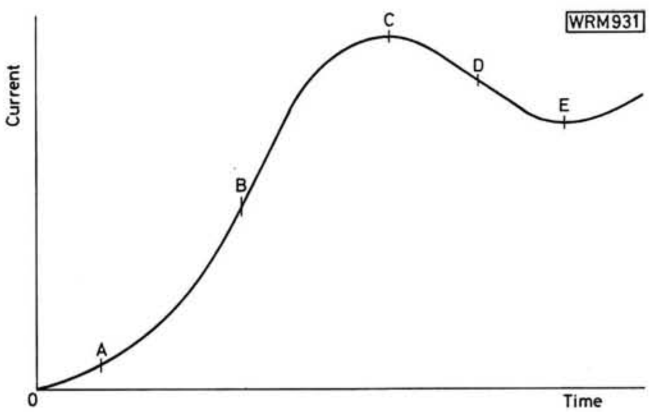
No. 3: Given that $y = a^x$, express x in terms of y and a in the form x = . . .

No. 4: Referring to Fig. 1.1, write down the expression for x in terms of H and θ in the form x = . . .



No. 5: Referring to Fig. 1.2, which points on the graph are points of:

i) maximum current
ii) maximum rate of change of current
iii) zero rate of change of current



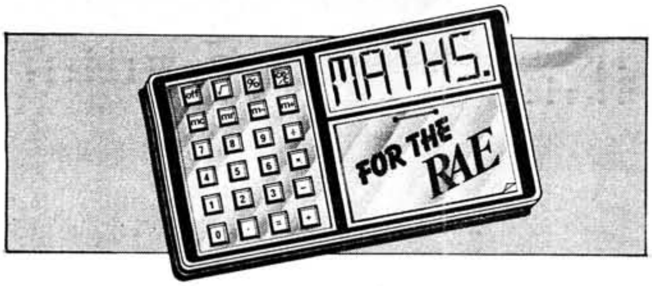
No. 6: Sketch the graph of y = 15 cos θ for values of θ between 0 and 4 radians

(Answers are at the end of this article).

Transposition of Formulae

The accurate manipulation of formulae is often a stumbling block in the early part of a technical student's progress, yet it is absolutely vital to master this thoroughly and quickly if advancement is to be made.

What technical people are inclined to call formulae are in reality simple equations—in technical subjects a formula will often have several variables (i.e. letters representing any number) but nevertheless they are related by a form of simple equation, an example being the f, L and C of question No. 1 in the self-test.



An equation can be compared with simple balance type weighing scales, where we place an unknown weight on side A and known weights on side B. Between the two sides, the balance arm is pivoted at its centre. When the scales are balanced we know that the weight on side A is equal to the known weight on side B.

The two sides of an equation are analagous to the two sides of the scales, the equals sign being the equivalent of the pivot. The equation is **always** balanced, but in number rather than weight. Any expression containing an equals sign, the two sides of which are not numerically the same is not an equation but a false statement.

For example, $6x = 8x - 2x$ is an equation, but $10y = 5y + 6y$ is a false statement. Note: The unknowns, or variable, x and y, can be any number, but x will always be the **same** number throughout a single equation, as will y.

We can maintain the scales balanced only by doing **precisely the same** (weight-wise) to both sides. Within this limitation, however, we can do anything we like to the weights on the two sides and the scales will remain balanced. Similarly, we can perform any numerical operation (e.g. add or subtract a number, multiply or divide by a number, raise to a power, take a root, take a logarithm etc.—virtually anything you can do to a number on a pocket calculator) to both sides of an equation without altering its truth provided we do **precisely the same** (number-wise) to the expressions on both sides of the equals sign.

All this may seem glaringly obvious, yet failure to obey this fundamental rule is very common among students—not because they forget the rule or are unaware of it, but because they become more and more unsure about whether they are indeed performing precisely the same numerical operation on both sides of the equation as the equations themselves become more and more intricate.

With technical formulae, we usually want to rearrange the equation so that we have a single variable (say x) on one side and an expression involving all the other variables (say a, b and c) on the other side. This is sometimes called "making x the subject of the formula" or alternatively "expressing x in terms of a, b and c".

Suppose we have the equation:

$$2a + 3x = 4b - 5c - 7x,$$

and we want to make x the subject of the formula. The first step is to get all the terms involving x to one side and all the other terms to the other side. To get rid of the a s from the left-hand side we must subtract two of them, so we must do the same to the right-hand side, i.e.

$$3x = 4b - 5c - 7x - 2a.$$

To get rid of the x s from the right-hand side we must add seven of them and do the same to the left-hand side, i.e.

$$3x + 7x = 4b - 5c - 2a.$$

Now we can add the "like" terms (those containing the same variable)—and **only** the like terms—to simplify the formula to:

$$x = \frac{4b - 5c - 2a}{10}$$

Note that the **whole** of the right-hand side has been divided by ten.

It should soon become obvious that you can move added or subtracted terms from one side of the equation to the other provided you **change their signs.** So we could have gone straight from

$2a + 3x = 4b - 5c - 7x$ to $3x + 7x = 4b - 5c - 2a$.

But note that we must not break up individual terms (groups of numbers or letters purely multiplied together) in this operation. Similarly with terms such as $3/y$ or $x/4$: these are also multiple terms, since $3/y$ is 3 times $1/y$ and $x/4$ is x times $1/4$.

Another example: to make x the subject of the formula:

$$\frac{x}{3} + \frac{a}{2} = \frac{b}{6} + 4c$$

First this becomes:

$$\frac{x}{3} = \frac{b}{6} + 4c - \frac{a}{2}$$

then multiplying both sides by 3,

$$x = 3\left(\frac{b}{6} + 4c - \frac{a}{2}\right)$$

In the first step, $a/2$ was subtracted from both sides and in the second step both sides were multiplied by 3.

Note, however, that the **whole** of the right-hand side must be multiplied by 3. The statement:

$$x = \frac{3b}{6} + 4c - \frac{a}{2}$$

would be wrong but,

$$x = \frac{b}{2} + 12c - \frac{3a}{2}$$

would be correct since **every** term on the right-hand side has been multiplied (individually, here) by three. Care must be taken in a case like:

$$5x = 3b + \frac{3x + 5}{4a}$$

where x is to be made the subject. We cannot go from here to

$$5x - 3x = 3b + \frac{5}{4a}$$

because the 3x on the right-hand side is only part of the term $\frac{3x + 5}{4a}$ and we can only transfer **whole terms** in the manner previously described. The best way to tackle this one would be to write the awkward term as two separate ones: both the 3x part and the +5 are divided by 4a, so we can rewrite the term as

$$\frac{3x}{4a} + \frac{5}{4a}$$

The equation then becomes:

$$5x = 3b + \frac{3x}{4a} + \frac{5}{4a}$$

and we can transfer the whole x term from right to left, giving

$$5x - \frac{3x}{4a} = 3b + \frac{5}{4a}$$

This brings us to another problem: how do we get x on its own on the left-hand side? Since we have only terms involving x on the left, x is a **common factor** (i.e. it divides into each term without leaving a remainder) to them all and we can rewrite the left-hand side as

$$x\left(5 - \frac{3}{4a}\right)$$

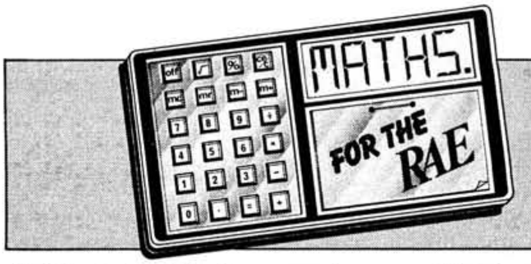
if you multiply both terms inside the bracket by the common factor outside the bracket you will see that we have not changed the numerical value of the left-hand side so we need do nothing to the right-hand side.

Now all we have to do is divide both sides by the expression in the brackets, to leave

$$x = \frac{3b + \frac{5}{4a}}{\left(5 - \frac{3}{4a}\right)}$$

and we have done what we set out to do.

You may be familiar with the term "cross-multiplying", an operation which is a neat rule-of-thumb for either



dividing both sides by a number or multiplying both sides by a number. The rule is that we can change over **factors** from one side to the other provided we move them diagonally from denominator (beneath the fraction bar) on one side to numerator (above the fraction bar) on the other, or vice versa.

The simplest example is:

$$\frac{a}{b}=\frac{x}{y}$$

All these letters are **factors,** that is they are either purely multiplied by or purely divided by the remainder of their side of the equation, with no added or subtracted terms on either side. The letter a can be moved to the right-hand side provided it becomes part of the denominator of the right-hand side, i.e.:

$$\frac{1}{b}=\frac{x}{ay}$$

(Note that dividing a number by itself leaves 1 or, to put it another way, the factors of a are a and 1). The letter y could be moved to the left-hand side provided it becomes part of the numerator on the left-hand side, i.e.:

$$\frac{ay}{b}=x$$

It then becomes easy to make any of the letters in this example the subject of the formula. Doing each in turn, we can get:

$a=\frac{bx}{y}$ $\quad\frac{ay}{x}=b\ (\text{so } b=\frac{ay}{x})$ $\quad\frac{ay}{b}=x\ (\text{so } x=\frac{ay}{b})$

and $y=\frac{xb}{a}$

A variation on the cross-multiplying rule is to **invert** both sides of the equation. The original example here is suitable and it can become:

$$\frac{b}{a}=\frac{y}{x}$$

Mistakes are made when students try to cross-multiply letters or numbers which are not factors of the whole of their side. For example, suppose we want to make x the subject of the formula $2ax + b = 3$. We cannot cross-multiply the a or the 2 straight away because as the equation stands they are not factors of the left-hand side. First we must move the b to the right-hand side (and change its sign, of course) to give $2ax = 3 - b$. Now the a and the 2 are both factors of the left-hand side and we can cross-multiply them to give us

$$x=\frac{3-b}{2a}$$

Notice that the $3 - b$ of the right-hand side has been regarded as a single number, and hence a factor. Sometimes it helps to keep expressions like inside brackets when we must treat them as a factor. So,

$$x=\frac{(3-b)}{2a}$$

Writing it like this we are less likely to be tempted to try and cross-multiply the 3 or the −b alone. This would be wrong because they are not factors of the right-hand side, but we could cross-multiply the (3−b) as a whole, because this is a factor and we could have

$$\frac{x}{(3-b)}=\frac{1}{2a}\quad\text{if we wished.}$$

We have to be equally careful when we invert both sides: the whole of each side must be treated as a single fraction.

For example, take the equation:

$$\frac{a}{b}=\frac{x}{y}+\frac{3}{4}$$

We cannot say

$$\frac{b}{a}=\frac{y}{x}+\frac{4}{3}$$

because the right-hand side is not a single fraction. Instead, to invert this, we must say

$$\frac{b}{a}=\frac{1}{\left(\frac{x}{y}+\frac{3}{4}\right)}$$

Alternatively, we could convert the right-hand side into a single fraction by adding the fractions in the usual way: the denominator of the sum is the lowest common multiple (the smallest number that each will divide into) of the denominators (4 and y), which is 4y; y divides into this 4 times, so multiply x by 4 to give the first term in the numerator; 4 divides into the denominator y times, so multiply 3 by y to give the second term in the numerator. The result is that the equation becomes

$$\frac{a}{b}=\frac{4x+3y}{4y}$$

and we can now invert it to give

$$\frac{b}{a}=\frac{4y}{4x+3y}$$

This should explain the choice of answers to question No. 2 of the self-test.

Similar rules apply to cancelling: we can cancel only factors, and furthermore these must be factors of the same term, or fraction. Take the equation:

$$x=\frac{b}{3a}+\frac{2c}{b+2}-\frac{cd}{3c}$$

We cannot cancel b s because they belong to different terms. We cannot cancel 2 s because while the 2 in the numerator is a factor the 2 in the denominator is not, it is added to the b. We can cancel the c s in the last term, however, because they are both factors of the same term.

Next month we will look further into this subject of transposition of formulae and also at the interpretation of graphs.

Answers to Self-Test

No. 1: $C=\frac{1}{4\pi^2f^2L}$

No. 2: $R_1=\frac{R_tR_2R_3}{R_2R_3-R_tR_3-R_tR_2}$

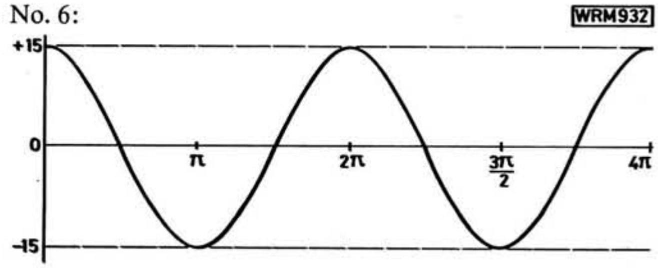
or $R_1=\frac{1}{\frac{1}{R_t}-\frac{1}{R_2}-\frac{1}{R_3}}$

No. 3: $x=\frac{\log y}{\log a}$

No. 4: $x = H\cos\theta$

No. 5: i) C, ii) B, iii) C and E

No. 6:



SWITCHES—2

Before I talk some more about the multi-gang type of push-button switch, let's look at the simpler single push-button.

The action of a push-button switch can be basically one of two types. First there's the sort where the contact arrangement changes its state when you push the button in, keeps its new state whilst you hold the button in, but reverts to its original state when you let the button out again. In the jargon, this is known as a **momentary action** switch. Taking the simplest switch with a single set of contacts, these could be **normally open,** where the contacts close whilst the button is pushed (also known, for obvious reasons, as a **push-to-make** switch), or they could be **normally closed,** where the contacts open when the button is pushed (that's a **push-to-break**). Both of these are single-pole, single-throw (s.p.s.t.) types. Or it could have changeover contacts (s.p.d.t.) and then usually takes the form of the four-terminal type shown in Fig. 4 last month, rather than the three-terminal type. Switches with more than one contact set are available.

The second sort has what you might call a mechanical memory built in, so that when you push the button in, it changes its contact state and it keeps that new state when you let the button go. This sort is called a **latching, sequential action** or **alternate action** push-button switch.

In a latching push-button switch, it doesn't necessarily mean that the button itself latches in. It can be just the contact mechanism that latches, with the button always returning to the same position. Then, of course, you can't tell what state the switch is in just by looking at it, and it would be a nonsense to try to specify it as a normally open (abbreviated to **n.o.**) or a normally closed (**n.c.**) type. This sort of switch is sometimes called a **push on/push off** when it's a simple single-throw type—you push it once and the contacts close, push it again and they open.

Both these sorts of simple push-button switch are available with q.m.b. or s.m.b. actions.

Multiple Push-buttons

When I talk about multiple push-buttons, I mean the sort where you have a row of switch units mounted on a single frame, very often linked together mechanically so that they are interlocked—push one button in and the one that was pressed in before pops out.

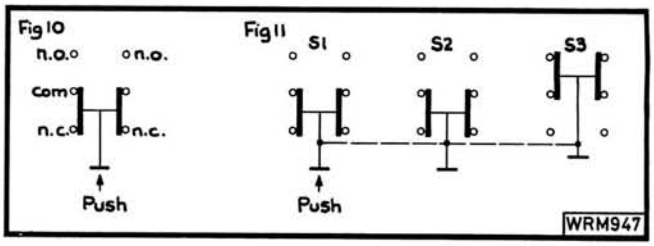
As I mentioned last month, the contact arrangement in these switches is very like that in the slide switch, see Fig. 10 where the fine lines show mechanical links. The contact sets come in pairs, so that you get these switches in 2-pole, 4-pole, 6-pole, 8-pole or even 10-pole versions.

If a number of switches are mounted side-by-side on a frame and interlocked (Fig. 11), only one switch will be in at a time. If I press the button of S1; it will latch in and S3 will pop out. S2 will stay unchanged. Looked at together, S1, S2 and S3 form a 6-pole changeover switch with quite a complicated set of possible relationships between the pairs of contacts.

Arrangements like this are handy for changing wavebands, selecting inputs, etc. When compared with a rotary switch performing the same job, the push-button can be changed from, say, input 1 to input 4 without having to go through inputs 2 and 3 on the way, and possibly getting a burst of unwanted programmes. In some applications this can be quite an advantage, but the push-button switch takes up more room than a rotary, unless there are only a few positions.

When designing around a multiple push-button switch assembly, you must remember that it is possibe to get all the buttons out (or sometimes in) at one time by gentle manipulation. So it's no good having a circuit which will go up in smoke if every button is either in or out at the same time!

Each of these switches on its own is a s.m.b. type, but when interlocked with other switches on a single frame, they become slow operate/quick release, because the operate action depends on the speed of movement of your finger, but the release action is produced by the spring-loaded interlock mechanism. Not all the switches on one frame have to be interlocked. You can mix momentary-action or individual latching switches with the interlocked ones on the same frame. Special q.m.b. switches suitable for a.c. mains control are available and can again be mounted on the same frame.



These multiple push-button switches can have either solder-tag connections for hard-wiring or solder-pins for p.c.b. mounting, or sometimes one on the top of the switch and the other below. The p.c.b. pin arrangement is usually designed to suit a 0·1in grid, but not always—if in doubt, check it.

Rotary Wafer Switches

Wafer switches consist of three main parts (Fig. 12): the **shaft,** which at the front of the switch becomes the **spindle** (what the knob fits on to); the **switch mechanism,** which by means of some assembly of springs, levers, balls or rollers holds the shaft at the correct angle of rotation (the jargon for the mechanism is a **detent,** because it detains the shaft at the appropriate place); and one or more **wafers,** which are the bits that do the actual circuit switching.

The angle that you turn the shaft through from one switch position to the next is called the **indexing angle.** The most common is 30°, which gives a maximum of 12 switch positions (360/30 = 12). Others you might come across give 20, 24 and more recently 40 positions (for 40-channel CB transceivers). I leave you to work out the indexing angles for those!

With some mechanisms you can turn the shaft round and round (a help in preventing damage through vandalism), but most have end-stops which prevent you turning beyond the number of contact positions available on the wafer. Often there's one fixed stop and one adjustable stop which can be located to limit movement between anything from the full 12 positions (for our 30° indexing switch) down to just 2 positions. On the simplest switches, both stops may be fixed. The only other thing to say about the switch mechanism is to tell you about the mounting face (Fig. 12). This is the front surface of the mechanism which bears against the panel on which the switch is mounted. The reason I mention it is that when a switch catalogue talks about spindle length, it's generally length **f.m.f.,** meaning **from mounting face,** and not just the length of spindle protruding from the threaded mounting bush. The same term is used for potentiometers, by the way.

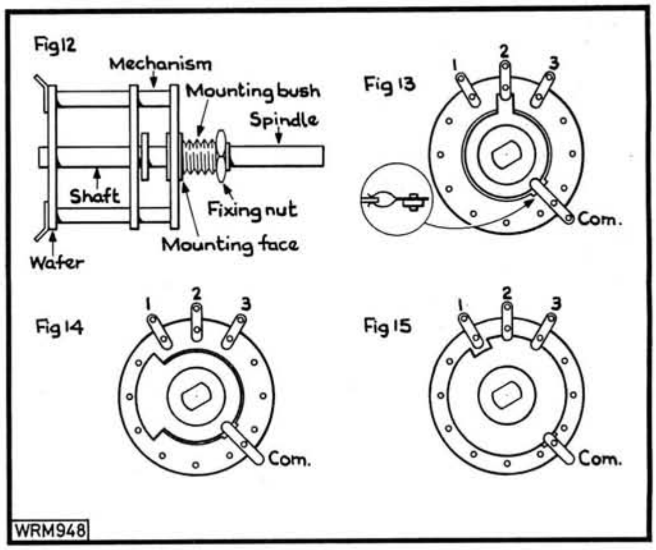
When we come to the wafer part of the switch, the world is your oyster, as the saying goes. Switch suppliers produce the most amazing combinations of circuit operations to special order for equipment manufacturers. To keep it simple, I'll confine myself to the 30° indexing variety and the basic variations from which more complex switches are built up.

Wafers can be single- or double-sided though there are limits to the double-sided ones, because of the space available for putting rivets through the fixed part of the wafer, called the **stator.** A single-sided wafer could be single-pole, twelve-way (1-p. 12-w.) or 2-p. 6-w., or 3-p. 4-w., or 4-p. 3-w., or 6-p. 2-w. If you wanted a single-pole, three-way switch you have the option of using part of any of the first four varieties of wafer on that list.

A 1-p. 3-w. wafer is shown in Fig. 13. The shaded ring is the **moving contact** or **wiper** (mounted on the part of the wafer that turns, called the **rotor**) which is connected at all times via contact springs to the tag marked **com,** meaning **common,** sometimes also marked **w,** meaning **wiper.** The projecting tongue on the wiper ring is connected to tag 2 as shown in the drawing, and could be moved to connect to either tag 1 or tag 3.

So far, I've been talking about a switch where, as the tongue on the wiper moves from one fixed contact to the next, one circuit is broken before the next one is made. This is known, believe it or not, as a **break-before-make** switch, abbreviated to **b-m.** If the wiper tongue is a little wider, the new circuit will be made before the last one is broken, and for a brief time the two fixed contacts will be shorted together (and connected to the common, of course). This is—you've guessed it—a **make-before-break** switch, abbreviated **m-b.** Obviously there are circuits where you must use a b-m switch, because contact 1 must never be connected to contact 2, etc., even momentarily. Otherwise, bang! Similarly, there are circuits where the com connection must never be left "floating" or disconnected from one or other of the fixed contacts, even momentarily—changing shunts in an ammeter is a typical example. Incidentally, a 12-way wafer with m-b contacts will sometimes have a maximum of 11 ways, because there isn't enough space to get the com tag between two of the fixed contacts, and it has to take one of the fixed contact positions instead. Similarly, 2-p. 6-w. may have to be limited to 2-p. 5-w. in a m-b version.

If you make the wiper tongue even wider, it becomes a **shorting-segment** (Fig. 14). With this switch you could move from the off position shown to connect com to 1, or 1 and 2, or 1 and 2 and 3. This would mean that one wafer could do a job which might otherwise require three wafers. The switch knob might be labelled "OFF—LOW—MEDIUM—HIGH" to control heat, light or sound volume.



Make the wiper tongue wider still, until it reaches the point where at any time all the fixed contacts except one are linked together and to the com contact, and you have what is called a **shorting-ring** switch (Fig. 15). What use is such an animal? Well, in the days when a communications receiver might have had ten or more sets of high-Q r.f. coils for as many frequency bands, each waiting to be selected and tuned by a section of a ganged tuning capacitor, the unused coils could resonate with stray capacitance in some other band, causing very odd results around certain parts of the dial. The solution adopted was to switch the coils with a double-sided wafer, one side being a conventional 1-p. 10-w. or whatever, and the other side a shorting ring switch. The corresponding fixed contacts of the two sides were linked directly together. By this arrangement, the "live" side of the wanted coil was connected to its tuning capacitor and the associated amplifier, whilst all the other coils were shorted out by linking the com connection of the shorting-ring side to earth or chassis, and the "earthy" sides of all the coils. A shorted coil is firmly damped and cannot resonate to cause problems. Nowadays, with the adoption of diode-switching and broad-band, fixed-tune filters in communications receiver front ends, the problem doesn't occur, but the principle can still be useful on occasions: in testing multi-core cables for short-circuits between one conductor and all the others, for example.

In talking about switch wafers, I've been thinking mainly about the old-fashioned sort with contacts rivetted onto paxolin stators. Now you are more likely to come across wafers moulded from plastics of one sort or another, with the contacts included in the moulding. Rotors are often made of polythene to increase the leakage resistance between the contact ring and the shaft. If you're making up a switch from one of the "kit" types available and it has rotors made of polythene or similar soft material, be gentle in pushing the wafers onto the shaft. It is possible to distort the rotor so that the contacts on the stator no longer line up properly, or even to push the rotor clean out of the middle of the stator.

Rotary switches of the wafer type are all s.m.b. As with multiple push-button switches, special q.m.b. units for a.c. mains operation are made. On rotary switches these mount on the end of the shaft, *behind all the* other ordinary wafers.

TO BE CONTINUED

News

AMSAT OSCAR-10

OSCAR-10, the latest AMSAT space vehicle, is now fully operational, following activation for general use of the mode B transponder and beacons on 6 August, and is providing exceedingly effective communications coverage between most parts of the Earth during its nominal 11·6 hour elliptical orbits.

Considering the enormous demand for use of the transponder, it is essential that **all** users comply with the bandplan and take careful note of the information from AMSAT control, printed below.

Full details of the bandplan for the mode L transponder will be published when verified by AMSAT.

OSCAR-10 Bandplan—mode B

Designated use	Uplink (MHz)	Downlink (MHz)	
Engineering beacon	—	145·987	
SSC H1	435·025	145·975	
SSC H2	435·035	145·965	
s.s.b. only	435·038	145·962	Upper ▲
Mixed s.s.b./c.w.	435·080	145·920	Transponder bandwidth
c.w. only	435·120	145·880	
	435·162	145·838	▼ Lower
SSC L2	435·165	145·835	
SSC L1	435·175	145·825	
General beacon	—	145·810	

Key: SSC—special service channels; L1—data communications; L2—RTTY/c.w. bulletins; H1—s.s.b. bulletins; H2—scientific programs/auxiliary bulletin frequency. **Notes:** SSCs should be used only by prior arrangement. Bulletin channels are used by National and Regional AMSAT organisations for regular news bulletins.

The following message block, in the form of an appeal, was sent by Dr Karl Meinzer DJ4ZC, from the European Control Centre, and transmitted via OSCAR-10:

"Telemetry of transponder a.g.c. shows values between −15 and −22dB during most of the time. In other words, if most stations would reduce their power at least tenfold, nothing would change other than that weaker stations would get louder. Please spread the word. 73's Karl."

Additionally, AMSAT explain: When high power stations transmit, the transponder receiver's a.g.c. cuts in and reduces gain **for the entire passband.** The gain reduction has been seen at −22dB and this has the effect that the lower powered stations disappear from the passband. So, take note of the strength of your own downlink signal, and if you are significantly louder than the typical 100 watt 10–13dB uplink antenna stations, then you are causing a problem for everyone!

The power required will also change as the spacecraft range alters around its orbit and the antenna orientation changes relative to the ground station, so periodic checks of your own downlink signal are necessary to keep them to the beacon levels.

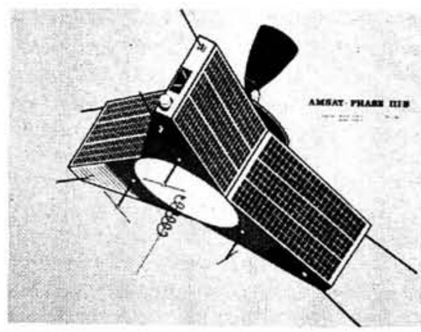
In order to demonstrate the effects of reducing high signal levels, a QRP day has been incorporated in the OSCAR-10 schedule. This is on Mondays, UTC, and a **maximum e.i.r.p.** level of 100W will be allowed on these days; this is a maximum, and lower e.i.r.p. levels between 50 and 100W should be perfectly sufficient. At no time should signals relayed by the transponder be at a greater level than the general beacon output. It cannot be overstressed that all stations must adhere to these recommendations in order that the full potential of the spacecraft's unattenuated inherent sensitivity can be realised.

Unlike previous OSCARs, uplink transmissions to OSCAR-10 require use of l.s.b., which is received by ground stations monitoring the downlink, as u.s.b. Raising the uplink frequency results in a lowering of the downlink frequency, which apart from requiring a slight mental adjustment on the part of the station operator, does result in a 50 per cent reduction of doppler frequency shift.

Mode L Transponder: The mode L transponder was first activated for $1\frac{1}{2}$ hours $\pm$ of apogee on 21 September (i.e. 1830 to 2130 approximately). The general beacon signals on 436·020MHz were very strong in the UK, even on very simple antenna systems. AMSAT-UK secretary, Ron Broadbent G3AAJ, was easily able to hear the beacon on a fixed elevation, standard TV type horizontal antenna with an estimated gain of 3dBi!

At the same time, Trevor G4GPQ, using an az/el tracking array, obtained full quieting p.s.k. telemetry, in fact the signals were stronger than any he has ever obtained from previous satellite vehicles. Ron also copied c.w. from the mode L transponder, but these signals were found to be some 25dB below beacon stength due, it is thought, to a fault on the antenna changeover relay or to a software failure. Work continues to clear this problem and for the time being the mode L transponder will continue to be operational on schedule Wednesdays, but will also be switched on at odd times for experimental work.

AMSAT Control (DJ4ZC) have requested that all mode L transmissions for the time being are kept within 436·500 and 436·000MHz.



An artist's impression of OSCAR-10

New UOSAT (UOSAT-B)

As a result of a withdrawal by another satellite user, NASA have advised the University of Surrey that they can have a launch during February 1984 of a second UOSAT package to be codenamed UOSAT-B. To achieve this target date will require (once again) a tremendous effort on the part of the UOS and AMSAT groups. It is understood that UOSAT-B will carry less separate experiments but will include an experimenal Packet System transponder.

More on pages 31 & 63

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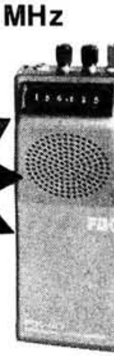
JUST ARRIVED! "Super Snooper" RX40 Professional VHF monitor. FM 141–180 MHz

The RX40 is a new, highly sophisticated VHF monitor, packed into a remarkably small space. Built to professional standards, this unit will surely find application both commercially and for the enthusiast. It covers all VHF FM frequencies from 141.00 to 180mHz in 2.5kHz steps. This makes it suitable for all current channel spacings. Its comprehensive ranges include police, fire, ambulance, amateurs, marine, radio telephone, etc., etc. High sensitivity and complete portability enables the unit to be slipped into ones pocket and used as a "go anywhere" monitor. Frequency selection is by professional, thumbwheel selectors and power is via an internal ni-cad battery pack that provides up to 10 hours operation from a single charge (AC mains charger included). A detachable antenna is provided for. The built-in speaker provides good, clear audio with the facility of also using an earpiece and a squelch control enables the receiver to be muted when no signals are present.

PRICE SLASHED THIS MONTH ~~£149~~ £119



TRIO			
TW4000	FM dual band mobile trans. 2m/70cm	469.00	2.50
TS930S	160–10m trans./gen. cov. receiver	1,216.00	5.00
AT930	Aut. ATU 80–10m ham bands	141.75	2.50
TS430S	HF trans. 160–10m/gen. cov. receiver	736.00	5.00
PS430	Mains PSU. built-in cooling fan	112.75	5.00
SP430	Matching speaker for TS430S	29.50	1.50
MB430	Mobile Mount bracket for TS430S	11.25	1.50
FM430	FM option unit for TS430S	34.50	1.00
TS830S	160–10m trans. with new bands	697.75	5.00
VFO230	VFO with mem and digital readout	243.75	5.00
AT230	All band ATU & power meter.	135.75	5.00
SP230	Ex. speaker with switched filters	41.25	2.00
YK88C	500Hz CW filter for TS430S	31.75	0.75
YK88CN	270Hz CW filter for TS430S	37.25	0.75
YG445CN	250Hz CW filter SPECIAL PRICE!	39.00	0.75
TS530S	160–10m trans. with new bands	595.00	5.00
AT130	100w aerial tuner – new bands	93.00	1.75
TL922	160–10m 2kw linear. 3–500Z tubes inc	724.50	5.00
MC50	Deluxe dual impedance desk mic.	30.75	1.75
MC60A	Deluxe desk mic. with built in pre-amp	55.25	2.00
MC35S	Fist mic. 50K impedance	14.75	1.25
MC30S	Fist mic. 500ohm impedance	14.75	1.25
MC40S	Up/down mic. for TR900/7800 etc.	14.75	1.25
MC42S	Up/down hand mic. for TS930S	15.25	1.25
LF30A	HF low pass filter, 1kw rating	21.25	1.25
TS780	2m/70cm all mode transceiver	795.00	5.00
TR9130	2m multi mode mobile/fixed station	433.50	2.50
TR7800	2m FM syn. mobile/fixed station 25w	257.50	2.50
TR7930	2m FM trans. with large LCD display	305.25	2.50
TR2300	2m FM syn. portable trans.	152.00	2.50
VB2300	10w amplifier for TR2300	65.75	1.50
TR2500	2m FM syn. handheld	232.50	2.50
VB2530	30w amplifier for TR2300	69.75	2.00
SMC25	Speaker/microphone	16.00	1.00
TR3500	70cm handheld trans. to match 2500	250.75	2.50
TR9500	70cm syn. mulitmode mobile fixed.	399.00	5.00
R600	Syn. Gen. Cov. receiver 150kHz–30mHz	257.00	5.00
R1000	Syn. 200kHz–30mHz receiver	297.00	5.00
R2000	Gen. Cov. Receiver	398.75	5.00
VC10	VHF unit for R2000. 118mHz–174mH	113.00	1.50
HC10	Digital station world time clock	67.50	1.50
YAESU			
FT757GX	Gen. Cov. HF transc.	t.b.a.	
FT980	New Gen. Cov. HF transc.	1,150.00	5.00
SP980	Matching speaker	54.80	2.00
FC902	9 band atu SWR/PWR meter.	135.00	5.00
SP901	External speaker for 901 and 101	31.00	2.00
FT101ZDFM	9 band HF transc. SSB-CW-FM	665.00	5.00
FAN	Cooling fan for above	14.20	1.50
FT102	9 band HF transceiver	685.00	5.00
FC102	9 band matching atu	200.00	5.00
SP102	External speaker plus AF filtering	49.05	2.00
FM/AM	Unit for above	46.00	1.00
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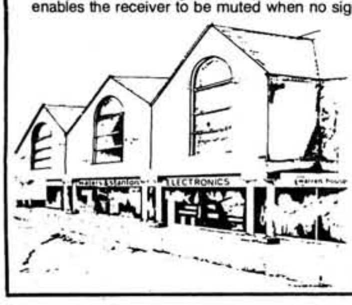
FC700	ATU for FT77	85.00	2.00
FL2100Z	160–10m linear amplifier	475.00	5.00
FT290R	2m multimode portable $2\frac{1}{2}$ watts	249.00	2.50
FT790R	70cm multimode portable	299.00	2.50
NC/WSE	2.2amp hour ni-cad pack for 290/790	22.00	2.00
NC11C	230v AC charger for 290/790	9.20	1.00
CSC1A	Soft carrying case for 290/790	3.85	0.75
MMB11	Mobile mount for 290/790	24.90	1.75
FL2010	Linear amp for 290R 2 watts o/p	59.00	2.00
FT208	2m FM synthesised handheld 1 watt	199.00	2.00
FT708	70cm FM synthesised handheld $2\frac{1}{2}$ watts	209.00	2.00
NC9C	slow charger	8.05	1.00
PA3	Battery eliminator/charger 12v DC	14.20	0.75
FT230R	2m 25 watt FM mobile transceiver	239.00	2.50
FT730R	70cms 10 watt FM mobile transciever	259.00	2.50
FT726R	3 band all mode base station	699.00	5.00
430T726	70cms module	230.00	2.50
50T726	6 metre module	170.00	2.50
SAT726	Full duplex cross band unit	90.00	2.00
FRG7700	0.2–30mHz gen. cov. rec. digital display	335.00	5.00
FRG7700M	As above but fitted memory unit	399.00	5.00
MEMGR7700	Memory module option for above	98.90	1.50
FRT7700	Antenna tuner unit for above	42.55	1.50
FRA7700	Active Antenna	38.70	2.00
VHF converters for FRG7700. Prices start from		74.00	1.50
YH55	Padded 8ohm head phones	10.50	1.00



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These products have been specifically designed for the many low power multimode 2 metre transceivers, and have a switchable input for either 1 or 3 watt levels.
The MML144/30-LS provides 30 watts RF output power, whilst the MML144/100-LS will provide 100 watts. Both units require 13.8V DC and include an ultra low-noise receive preamp (3SK88), which can be controlled from the front panel.
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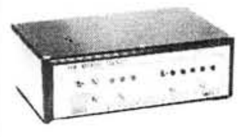
MML144/30-LS



MMS 1

MMT432/144-R

MMS1 £115 (P&P £3) — MMS2 £169 (P&P £3)

MMS1 – The Morsetalker An ideal morse tutor, which sends random morse code in the range 2-20 w.p.m., and provides speech talkback of the morse so that the pupil may check his/her ability.
Letters and numbers can be selected and the alphabet is formatted in 4 sections to aid learning. Group lengths of 1, 5 and 50 characters can be selected, and the facility to send continuous morse without speech talkback is included.
A 12 volt DC supply is all that is needed and the unit can be used in a vehicle from the standard battery.

MMS2 – Advanced Morse Space Trainer This unit is based on the MMS1, and boasts the same basic features, witn the following additions:—
1. The pupil may key in his/her own morse code. In this way, sending proficiency can be perfected.
2. An uprated speed range: 6-32 w.p.m.

MML432/50 £129.95 (P&P £3.50) — MML432/100 £245 (P&P £4.50)

These amplifiers are compatible with any 10 watt 70 cm multimode equipment, and can be supplied for ATV use at no extra charge.
The MML432/50 provides 50 watts RF output power whilst the MML432/100 will provide 100 watts.
Both units require a 13.8v DC supply and include an RF vox circuit, thus making operation simple. (The MML432/50 also includes a low-noise receive preamplifier).
Current drain is 8 amps for the 50 watt version and 18 amps for the 100 watt.

MMT432/28-S £159.95 (P&P £3) — MMT432/144-R £184 (P&P £3)

MMT432/28-S This transverter provides coverage of 432-436 MHz in two ranges, switch selectable, and is compatible with any 10 metre transceiver having a low-level output. (5-500mW).
The unit produces an output power of 10 watts and incorporates a low-noise receive converter, which together provide high performance in all respects.

MMT432/144-R Similar to the unit above, this transverter is compatible with 2 metre multimode transceivers, and incoporates a repeater shift of 1.6 MHz.
An attenuator is supplied to allow use with transceivers having an output power of 10 watts nominal. (An alternative attenuator allowing other levels is available to order).

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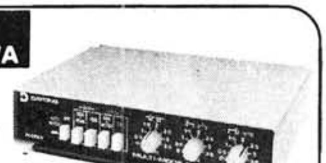
AUDIO FILTERS
MODELS FL2, FL3, FL2/A



Model FL3 represents the ultimate in audio filters for SSB and CW.
Connected in series with the loudspeaker, it gives variable extra selectivity better than a whole bank of expensive crystal filters. In addition it contains an automatic notch filter which can remove a "tuner-upper" all by itself.
Model FL2 is exactly the same but without the auto-notch. Any existing or new FL2 can be up-graded to an FL3 by adding Model FL2/A conversion kit, which is a stand-alone auto-notch unit. Datong filters frequently allow continued copy when otherwise a QSO would have to be abandoned.
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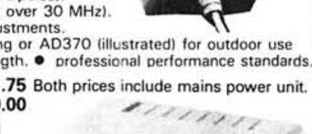

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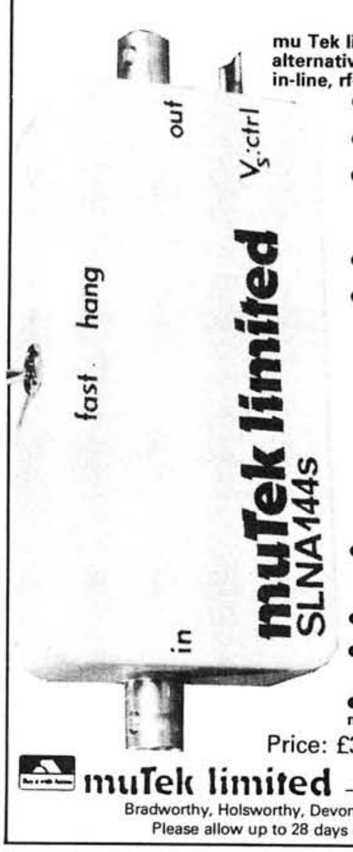

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AIR TEST

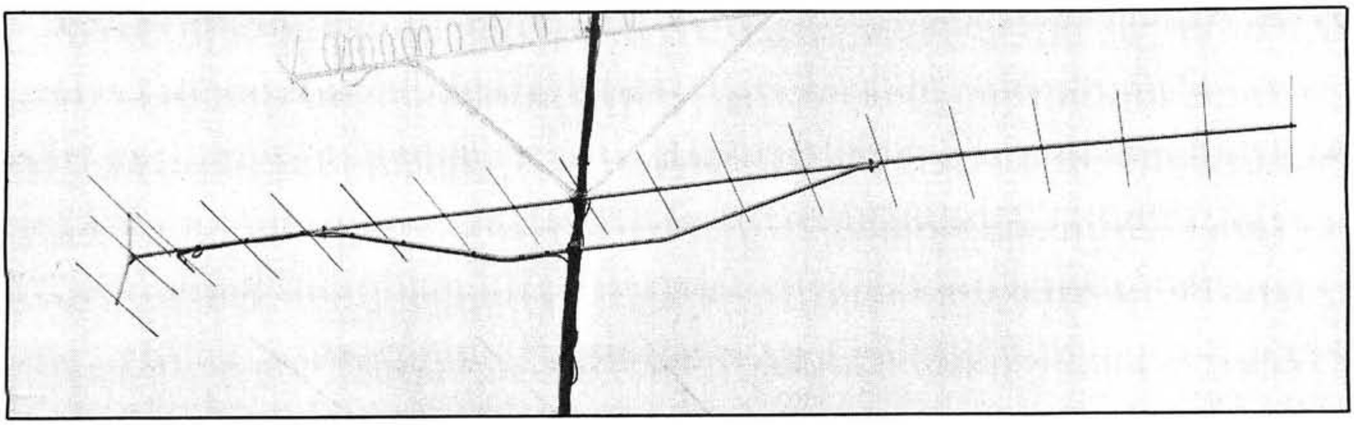
USER REPORTS ON SETS AND SUNDRIES

METALFAYRE 144-19T NBS LONG YAGI

During the early 1950's a research program was undertaken by Peter Viezbicke of the US National Bureau of Standards (NBS) with the specific aim of obtaining design information to realise optimum performance Yagi antennas. Until J Reisert W1JR was persuaded to publish an article in a 1977 edition of *Ham Radio* the results of this massive 9 man-year investigation lay largely undiscovered by the amateur population.

Since this time the NBS data has been used to produce Yagi antennas with applications stretching across the r.f. spectrum from h.f. to the low microwave regions.

The MET range of antennas has been designed to rigidly comply with the NBS data and in the case of the 144-19T results in a long Yagi with a quoted gain of 14·2dBd for a boom length of 6·57m. The director elements are all of constant pitch but progressively reduce in length.



From the constructional point of view NBS concluded that either good insulation or good contact between individual elements is required and for sustained performance all materials used should be homogeneous. MET have approached these requirements by incorporating high tensile through boom clamping (Fig. 1) using all-aluminium components. The alloys used, HE9 for the boom and HE30 for the elements, provide both anti-corrosive and structural advantages—problems normally encountered with dissimilar metals (electrolytic corrosion etc) are therefore eliminated. All 19 elements (15 directors, 1 driven and 3 on the triagonal reflector) are formed from solid aluminium rods, the directors/reflectors being 5mm in diameter and the driven 6mm.

The antenna is supplied in "knock-down" form and requires the use of spanners and a screwdriver to assemble. All elements are fitted with numbered collars which correspond with locations listed in the four page assembly instructions. The boom, which is made from 19mm square hollow section tube, comes in four sections which are spigot jointed using an extruded section insert and secured by adjacent M8 through-boom element clamp.

With an antenna such as this it is essential to provide external support bracing for the boom—without this the boom section would need to be exceedingly rigid/massive with corresponding weight penalty, ruling out the possibility of stacked arrays. Once again 19mm square section tube is used in this case, with both the main boom and support (3·1m long) being provided with elevation adjustable swivel clamps. The clamps will permit connections to masts of up to 50mm diameter and 20 degrees of elevation (a good feature for the Sporadic E and low elevation satellite user) and are produced from cadmium plated mild steel.

A gamma matching network is provided to allow user adjustment of the driven element to obtain optimum v.s.w.r. indications. This arrangement consists of a tubular capacitive element fed from a boom mounted silver plated N type socket with a movable clamp clip tapping the rod element. Once again the manufacturers have considered the long term stability of this part of the antenna and have ensured material compatibility together with a supply of sealant and rubber shroud for the capacitance element connection.

Once assembly is completed (single-handed approximately two hours) the antenna must be tuned for either a specific portion of the band or optimised for general coverage. In practice an indicated v.s.w.r. of 1·2:1 was obtained over the c.w./s.s.b. end of the band with a slight rise to approximately 1·4:1 at the other extreme—all quite acceptable and consistent with expected results/measurement accuracy (a v.s.w.r. of 1·3:1 would for example result in a radiated power loss of two per cent).

The actual setting up is performed by mounting the assembled and terminated antenna onto a short pole clear of

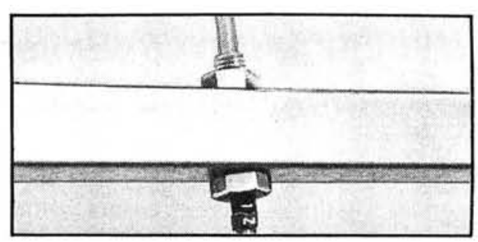


Fig. 1: The MET 144-19T Yagi uses a through-boom element layout. The 5mm solid aluminium elements are crimp-locked into M8 high tensile aluminium setscrews

any other surrounding metallic objects—in this case on a Western Electronics Ultimast, luffed over at 35 degrees. By means of trial and measurement, adjustment of the tapping clip and final trimming by alteration of the capacitor, the driven element is matched. Subsequent installation at operating height should not noticeably degrade the matching. As a final note on the subject of setting up the antenna it is more or less essential to have assistance when handling the assembled antenna—6·57m of antenna is a lot of metalwork and trying to remove the odd bend created whilst manoeuvring around the back lawn can be quite tedious!

In terms of performance the 144-19T produces results consistent with the NBS data predictions and has allowed this reviewer the chance of some very fair DX even through the often well below average conditions during the summer of 1983. Contacts have been made with most parts of the UK, including GM on several occasions whilst using well under 100W of s.s.b. The manufacturer's polar response plot indicates a −3dB beamwidth of approximately 34 degrees and this is certainly borne out by practical investigation. Furthermore the front to back ratio obtained was the highest yet found for a single Yagi—proving the effectiveness of the triagonal reflector assembly. The actual f-b ratio obtained on test amounted to 22dB with minimal sidelobe response in evidence, and forward gain in close agreement with the quoted figure.

In conclusion then if you are looking for high gain coupled with good directivity the MET 144-19T Yagi must be a leading contender in its field. I understand that several contest groups are already using stacked/bayed arrays based on this particular design and that the UOSAT control station at the University of Surrey have purchased crossed Yagis from the same design series—must stop this name dropping. (However, if you want me to review an e.m.e. array . . .)

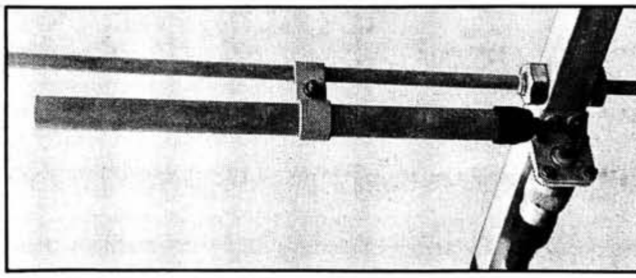


Fig. 2: A view of the gamma matching network. Correct matching is obtained by adjustment of the clip and rotation of the tubular capacitive element

My thanks go to **Metalfayre, 12 Kingsdown Road, St Margarets at Cliffe, Dover CT15 6AZ, telephone 0304 853021,** for the supply of the review antenna.

The current UK price of the MET 144-19T is £56.17 including VAT and delivery.

John M. Fell

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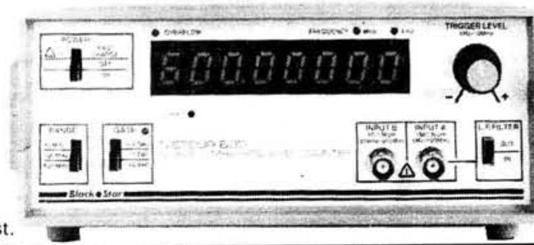

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News

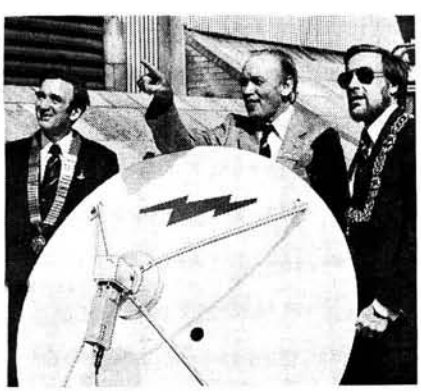
Scottish Amateur Radio Convention

Cardonald College, Glasgow, was the venue for the successful 1983 Scottish Amateur Radio Convention. A wide variety of trade stands—including several from the "deep south" of England—an interesting lecture programme coupled with demonstrations of many aspects of radio lured amateurs from far and wide.

The convention was opened by the Lord Provost of Glasgow, Michael Kelly, who has an interest in amateur radio having apparently passed the RAE several years ago.

Practical Wireless made the 1000 mile round trip to show our readers north of the border that they are just as important as those south of Potters Bar.

Our picture shows the *PW* stand with (L to R) G8VFH Assistant Editor, GM3EDZ Tom Hughes the convention organiser, Peggy G8VFH's XYL and the Lord Provost of Glasgow. Photo by Alan J Dinnick. The second picture is of one of the microwave dishes on display by Andrew Antennas with (L to R) D. Baptiste CBE President of RSGB, Tom Hughes and the Lord Provost. Photo by Ronald M Cowan GM4SRL.



PW Availability

It has come to our notice recently that many readers throughout the UK are experiencing some difficulty in obtaining their copy of *Practical Wireless.*

We have, therefore, set up a scheme to rectify the problem and invite readers, who have had trouble obtaining a copy, to assist by providing us with the following information: your name and address; date you were unable to obtain a copy; name and address of newsagents; have you placed a regular order? If so, do you collect or is it delivered?

Also, please include any other details you think may help. Many thanks.

GB3TW AGM

The 1983 AGM of the repeater group who manage GB3TW, the Tyne and Wear 144MHz repeater, will be held on 23 November at 8.00pm, in the radio room at the Great Lumley Community Centre, Great Lumley.

All will be most welcome and further information is available from: *The Secretary, Mr B. Laverick G4PFE. Tel: Durham (0385) 45914.*

UK-USA Special Event

A special event station in Massachusetts USA, using the callsign WA1NPO, will be in operation on Thanksgiving Day, Thursday 24 November, from a site overlooking a replica of the *Mayflower* at Plimoth Plantation, which is a living-history museum depicting life as it was in the early days of America's history.

On the UK side of the Atlantic, a complementary station, GB2PRC, will be operated by the Plymouth Radio Club from Plymouth Hoe in Devon, the port from which the original *Mayflower* sailed for New England in 1620.

WA1NPO will be operational on the following frequencies:

20 metres: 14·180 or 14·255MHz from 1300 to 1600 GMT, and 14·355MHz from 1600 to 2000 GMT.
15 metres: 21·260MHz from 1300 to 1430 GMT, and 21·385MHz from 1730 to 2000 GMT.

Contacts with any UK station will be welcomed and an attractive certificate featuring the *Mayflower,* suitable for framing, is available for confirmed contacts with WA1NPO.

Further details are available from: *Peter Jackson G3ADV, 32 Brown Avenue, Parkfield, Nantwich, Cheshire CW5 7DH. Tel: (0270) 627149.*

50MHz Feedback

The following report is based on extracts of correspondence regarding 50MHz experiments.

During June this year our colleague Roger Bunney of *Television* magazine DXTV fame wrote to the RRD regarding the current experimental 50MHz licences in the UK and further developments thereof.

Whilst pointing out the historical use of 50MHz by radio amateurs the letter highlighted the current level of Band I TV occupancy throughout Europe and the potential expansion of such services. Specifically noted was the introduction of the new French 625 line (4th channel) service, with four channels allocated in Band I together with likely problems due to tropo and Sporadic-E anomalous propagation. It was suggested that minimal interference would be encountered if the RRD were to allocate spectrum for UK amateurs in the range 56–58MHz. (In the USA their lowest channel ch. A2 occurs at 55·25MHz thus posing no interference problems).

In their response dated 4 August 1983 the DTI acknowledged the need for consideration of the "potential impact on TV reception in other European countries before finalising any future use of part of Band I by radio amateurs".

They also stated that "there is a requirement to adopt an amateur band to 'match' the USA norm, if in fact such is feasible without adversely affecting broadcasting services".

The letter concludes with a further comment that no reports of interference to continental TV have been reported and "the fact that transmissions (of the 40 licensees) are limited to outside of Band I channel 2 broadcasting hours in great measure mitigates against interference possibilities . . ."

Latest Update: During our latest conversation with Mr P. N. McDonald, spokesman for the DTI, he confirmed that in respect of the preliminary recommendations made by the "Merriman Report" regarding re-use of Band I TV, that position has not changed.

In reiterating the interim report he said: "Where planning permits". . . it is recommended that an allocation to the amateur service be made. As of 28 September 1983 "planning is just starting" and in Mr McDonald's words we (amateurs) should "wait and see".

He also said that work on the licence schedule revisions was now nearly complete and, subject to final discussions with the RSGB, hoped they would be soon. Class B c.w./crossband revisions in 1984?

A ROCK~BOTTOM STAR

By G. P. Stancey G3MCK

A casual reader of some current radio magazines could easily be left with the impression that a pre-requisite of becoming a radio amateur is to be either a boffin or a millionaire. The objective of this article is to demonstrate that this is not the case.

The approach to be described is probably not the only route to getting on the air in a cheap and easy manner and may not meet everybody's requirements. However, a lot of fun and experience can be gained by starting with a single band crystal controlled c.w. transmitter of moderate power. To those who wince at the words c.w. and are about to turn quickly to something more interesting, remember, you have to pass the Morse test to hold a full licence. Hence, having done the really hard part, i.e. reaching 12 w.p.m., why not try and use your new-found skill? Honestly, once you have reached 12 w.p.m., the hardest part is over. Performance improves with practice, and better performance brings more pleasure, which in turn encourages more practice . . .

Whilst it is not essential to start with a single band crystal controlled transmitter, such a device represents about the lowest level of complexity. The band to use is a matter of personal choice, but as my most recent experience is with 3·5MHz (80 metres), operation on this band will be assumed for the rest of this article.

One further assumption is that the reader has an RAE level of knowledge and possesses a good reference book, such as the *Radio Communication Handbook.* Indeed. how anybody can consider following amateur radio, let alone take the RAE, without that book is beyond my comprehension.

The Receiver

This is a difficult area to discuss. The amount of money that could be spent is virtually unlimited, and operator skills can do so much to overcome the deficiencies of a poor receiver.

Rolling your own is feasible, but probably if you are capable of doing that you will not need this article to encourage you to get on the air. However, if you are thinking of buying a first receiver or replacing an existing one, stop and think—in terms of price/performance the classic receivers of yesterday still take a lot of beating on the l.f. bands. Such receivers as the AR88, HRO, CR100 may be unsuitable on account of their size or weight but, if they are up to something like the manufacturer's specification, they can certainly deliver the goods. Refinements like digital readout may be missing, but the really important features such as bandspread, c.w. selectivity, freedom from cross modulation, etc., are there. In short, don't dispose of the old clunker unless you are really convinced that the new one will do its job better.

The Transmitter

As previously stated single band crystal control involves minimum complexity. Realistically for rigs of moderate power, i.e. 25–50 watts, this points to the well trodden route of the crystal oscillator/power amplifier (c.o.p.a.). There is little to be gained with equipment of this sort in going over 50 watts input. For example, raising the power to 150 watts will only increase the received signal at the other end by 5dB or about one "S" point. At low *signal* strengths that "S" point can be useful, but for all other circumstances it just makes a loud signal into a louder one. At powers of less than 25 watts the going seems to become disproportionately harder and as the cost of building a 10 watt rig is not much different from that of building a 25 watt one, there is merit in going for the higher power. Yes, I know that there are some good 2 watt signals on the band, but they have v.f.o.s (variable frequency oscillators) to chase contacts and may well have excellent antennas.

As for actual circuits, the handbooks are full of basic oscillator and p.a. circuits, and it really is just a matter of selecting two of them and bolting them together. For less adventurous souls, detailed circuits appear in the older ARRL handbooks and *QSTs* under the title of novice rigs.

The HRO-60. A late model in a famous series of receivers *Photo courtesy of RSGB*

One major problem with home built equipment is the possible need for expensive test-gear to get it to work. If you have access to, or own, such equipment, lucky you. However, for lesser mortals, like myself, this can be the stumbling block with home brewing. Happily a transmitter of the sort referred to above can be de-bugged with nothing more complex than a simple d.c. voltmeter, consisting of a micro-ammeter and a few series resistors. It may surprise many newcomers that not too many years ago multiband high power rigs were successfully made using no other test equipment. Times and fashions change but the basic laws of nature remain the same—if grandad could do it why can't you?

With home brewing you are not faced with the problem of repeating the item and can use components which are to hand. Exploit this advantage to the full. For example, a wide range of valves are suitable for the p.a. ranging from, say, the 6L6 to the 6146. Yes, for running 35 watts at

A ROCK~BOTTOM STAR

3·5MHz the 6L6 is quite adequate and will give much the same efficiency as the 6146, which is much more expensive and somewhat fragile electrically. However, the kingpin for this use must be the 807 which, short of hitting it with a hammer, seems to be virtually indestructible!

If you don't have suitable items in your junk box, watch the small adverts in *Radio Communication* or try asking round your local club. My club holds junk/surplus sales every so often at which old fashioned goodies like 807s are virtually given away.

Antennas

These can be a problem for any band, but in general the problem gets worse the lower the frequency. If you have plenty of real estate and/or convenient trees, the handbooks are full of information which it is only a matter of following. However, those who live in spec-built suburbia take heart. I had happy operation from a house with a 10m rear garden and 6m at the front by using an inverted Vee dipole. The apex of this antenna was supported by a 1·2m pole on the gable, and one leg passed over the roof to the front garden. Needless to say, the array was very asymmetric—and had bent ends—but it worked.

I make no excuse for plugging the inverted Vee dipole as it is such a practical antenna. It needs only one support, which is at the point of maximum weight, and is very tolerant of the way you treat its ends. For reasonable efficiency it is desirable to have the centre half in the clear, the ends just being used to load the system to resonance; see Fig. 1.

An early array of mine used loading coils 10·5m from the centre, and end tuning sections 3m long. This system worked well, but when it was replaced by a full sized inverted Vee dipole, which was drastically bent to fit in the space available, I did not notice any change in performance and the newer antenna was easier to construct and make weatherproof.

Both of these antennas were directly fed with coaxial cable following the principle that anything placed between the transmitter and the antenna is a potential attenuator and this includes baluns. The purists may blanch at the thought of feeding a balanced system with an unbalanced line and I do have sympathy for that view. However, my antennas were so asymmetric there was no way that they could be considered as being balanced loads. Any line currents that the balun would have removed would doubtless have reappeared due to induction from the antenna.

It is currently my opinion that, unless an antenna can be erected in something like textbook manner, whether or not to use a balun is questionable. However, if you feel happier using a balun by all means do, you know your local conditions better than I do. It is well to remember that the first reference to baluns for h.f. dipoles did not appear in the amateur press until circa 1960 and people had QSOs and worked DX before then!

A few constructional comments about the inverted Vee dipole may be helpful. A bent dipole does not resonate at the same frequency as a dipole in the clear. There are two solutions to this problem. The first is to trim the dipole to resonance by either a grid-dip oscillator (g.d.o.) coupled via a two or three turn link to the coaxial cable at the transmitter end, or for minimum s.w.r. as shown by an s.w.r. indicator. In fact a full-blown s.w.r. indicator is not required, as all that you are interested in is to trim for minimum reflected power.

The second method is to make no attempt to trim the antenna to resonance, but to use it as it is with standing waves and all! This suggestion may cause consternation in the ranks of those who have been led to believe that standing waves are incredibly evil. However, before writing the author off as an idiot, just consider the circumstances. It is true that a high s.w.r. will increase line losses, but at 3·5MHz this is hardly of any consequence, as the following examples show:–

Cable type	RG58U	RG8U
Line loss for 30m feeder	0·68 dB	0·30 dB
Extra line loss due to 4:1 s.w.r.	0·60 dB	0·42 dB

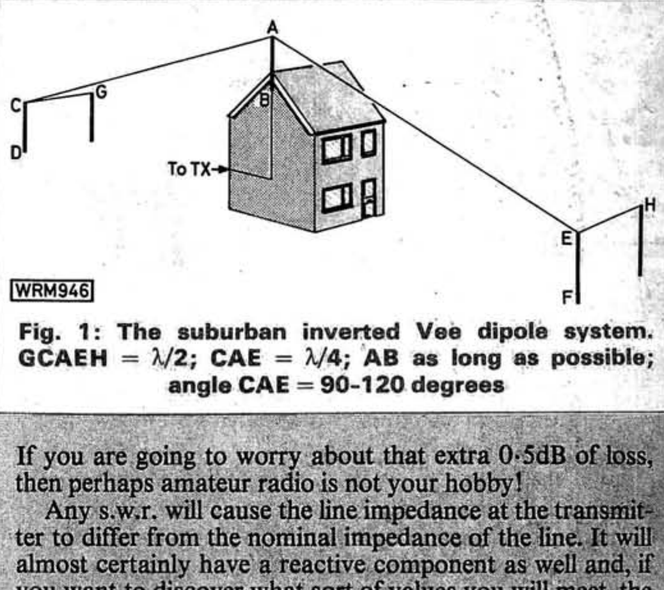


Fig. 1: The suburban inverted Vee dipole system. GCAEH = $\lambda/2$; CAE = $\lambda/4$; AB as long as possible; angle CAE = 90-120 degrees

If you are going to worry about that extra 0·5dB of loss, then perhaps amateur radio is not your hobby!

Any s.w.r. will cause the line impedance at the transmitter to differ from the nominal impedance of the line. It will almost certainly have a reactive component as well and, if you want to discover what sort of values you will meet, the use of Smith Charts becomes necessary, as well as explanatory articles on their use. This input impedance may make it impossible to load satisfactorily a p.a. which has a *pi*-network designed for 50/75 ohms. However, this problem can easily be solved by using a simple *L*-network between the transmitter and the line or by tweaking the *pi*-network components. Again here is another beauty about home construction, you can even design your transmitter to suit your own antenna/feeder combination.

But, won't a high s.w.r. damage the p.a.? With the 807 never!

From the previous comments on s.w.r., you may well have deduced that the impedance of the line used to feed the dipole is not too important. However, if you do have to

T TO AMATEUR RADIO

buy some coaxial cable, 50 ohm does give a better match than 75 ohm, and there is no point in needlessly going for a high s.w.r.

Final point, if you have say 9m of 50 ohm coaxial cable and 12m of 75 ohm coaxial feeder, can you join them to give a 21m feeder? Yes, your s.w.r. will be most interesting, but the system should be capable of being loaded.

Connections and Control

The major components of an amateur station—transmitter, receiver and antenna—all need connecting together to work as an integrated system. The pukka way of doing this is by coaxial relays and normal relays and it is a good idea to make a suitable relay control system as it will be needed for future projects, but such sophistication is not necessary to get going. The double-pole double-throw (d.p.d.t.) toggle switch can be satisfactorily used to provide single switch change over as shown in Fig. 2. An even simpler solution is to use separate antennas for the receiver and transmitter and, with power levels of less than 50 watts and a valve receiver, it may not be necessary to protect the receiver input. I found this system quite satisfactory with an HRO and 15m of wire for the antenna, but felt it prudent to short the antenna to ground, whilst transmitting, with a small relay.

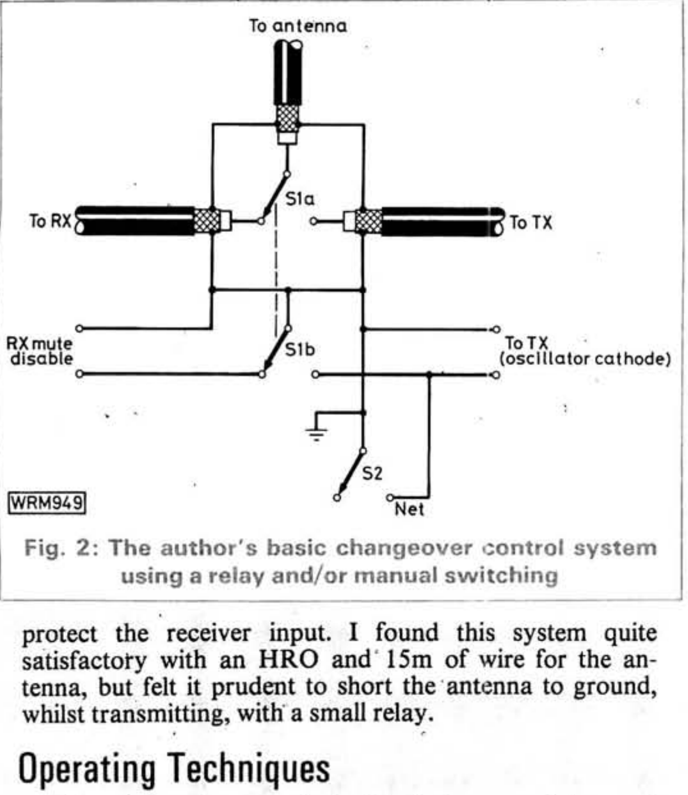


Fig. 2: The author's basic changeover control system using a relay and/or manual switching

Operating Techniques

This section does not deal with the *basic* techniques of operating, which can be found in any handbook, but with the slight variations that are necessary when working crystal controlled in today's environment.

A first point to be considered is how many crystals do you need? Well, the minimum is obviously one, and after that the more the merrier—or is it? In practice two or three crystals are quite enough, provided that they are on good frequencies, i.e. not too close to commercial stations. If one of your crystals is on a commercial's frequency then, apart from lumping it, the only other possibilities are to move its frequency by etching, grinding or loading. I will say no more about these techniques because if you know what they are you can either do them or know to leave well alone.

Crystals (rocks) can be bought from suppliers who advertise in these pages. However, they are often a little expensive and unnecessarily good as they are made to close frequency tolerances which are not likely to be relevant to someone who wants a crystal say of *about* 3560kHz. I acquired my crystals by careful shopping at junk shops, from the small ads and radio rallies. One possible cheap source is to use a colour TV time base crystal of 3579kHz for one of your channels.

Now back to operating. First of all let's consider a band on which you have a clear channel and nobody is near it calling CQ. Then the only thing to do is to call CQ just as anybody else would. At the end of the call listen plus/minus 2kHz for replies. This will allow for transceivers that don't send and receive on the same frequency, netting mistakes when using separates, forgetting that the r.i.t. (receiver incremental tuning) is on, and me calling off frequency on one of my rocks. I imagine that everybody has their own view of what constitutes a clear channel, which is coloured by their operating ability and their receiver. Mine is that provided nobody is closer than 300Hz then you have a clear channel. You think that's too near? Well, if my 1938 HRO will cope with that spacing and your 1983 DX-inhaler won't, reread the earlier paragraph on the virtues of older receivers.

The other likely circumstance is to find somebody calling CQ on or near your frequency. First check to see that nobody is using your frequency, then if all is clear give him a call. How near is a good question. I feel that it is pointless calling the other man if he is more than 2kHz away as today's custom is not to tune for calls. Whether you will get an answer is a matter of luck and depends on the other man's equipment, e.g. whether he is using broad or narrow selectivity, which sideband he is listening on, and how close you are to him.

If all channels are occupied then sit back, listen, practise your c.w. receiving and wait until the QSO finishes and call one of them, preferably the one who "owns" the frequency.

Surprising though it may seem, you can enjoy contest working, where you have a choice of two techniques. The first is to establish yourself on a frequency and wait for replies to your CQ/QRZ calls. The other is to go up the band from crystal to crystal, waiting and working whoever is on that frequency before going to the next one. Usually on returning to the first crystal you will find somebody else on it and can start the procedure again. Neither of these techniques is likely to enable you to win a contest, but at least you can join in the fun.

To send Morse you need a key. These days Morse keys come in varying degrees of complexity and price levels. However, it is worth remembering that for years the humble straight key has been the standard professional device. Indeed, many handbooks recommend acquiring proficiency on the straight key before attempting to use any bug key. In fact it is questionable whether there is any need to use other than the straight key for speeds of less than 20 w.p.m. This is not meant to decry the use of el-bugs, which can be fascinating projects to design and infuriating beasts to master. It is worth remembering that the Morse test will be conducted using a straight key.

Finale

The $64,000 question must be, what results can I get with such a simple set-up? Well, that depends so much on you and your site that it is impossible to answer. As a guide I find that I can work the usual daylight ranges of 160–320km and round Europe after dark. I do not keep unsocial hours and don't try for the exotic stuff, so perhaps you will do much better than me in terms of DX. Whether you will have any more fun, who knows?

Those who have manfully read so far may well be saying, what's new, where are the circuits, this is very vague, it appears that almost anything goes. Right, that's it. Almost any of the older techniques will give good results, if only you are prepared to try them. So blow fashion, have a go, and I am sure you will not be disappointed.

Final Finale

This is not a state of the art article but merely an encouragement to get on the air. The article assumes activity on 3·5MHz c.w. and many of the cut corners, e.g. s.w.r. and antenna resonance, would be inappropriate on say the 14MHz (20m) band, but once on the air you will be able to steadily expand and improve your station whilst having fun and gaining experience. It may be tempting to jump right into radio with a "glossy" set-up and work 300 countries in the first year, but there is a lot of merit in leaving something for next year. Remember Alexander the Great, who conquered the known world at the age of 31 and died at the age of 33!

Acknowledgements

It takes two to make a QSO and I would like to thank all my friends who answer my off frequency calls and give me hours of pleasure. Now they know a bit more about what goes on behind the call, I hope they will still call me. ●

References

(1) *The Smith Chart,* L A Moxon, *Radio Communication* January 1978

(2) *The Radio Amateurs' Handbook,* pp 248, 542, 567 ARRL 1961

(3) *The Radio Amateurs' Handbook,* pp 131, 132 ARRL 1954

ANTENNAS PART 11

F.C. JUDD G2BCX

Part 10 of this series dealt with the general requirements for an antenna range and other conditions for carrying out gain measurements and plotting radiation patterns of antennas operating at 70MHz and higher e.g., 144, 432 and 1296MHz. Broad outlines only were given with regard to actual gain measurement.

Gain by Comparison

Whichever type of reference antenna is used, accurate impedance matching with the measuring equipment is most important. If for instance, the now more or less standard impedance of 50 ohms is adopted for measuring equipment and probably most of the antennas likely to be tested, then the normal 72 ohm impedance of a λ/2 antenna used for reference will need to be transformed. It will also be necessary to balance the feed connection as well to prevent r.f. flowing on the outer of the cable which could cause errors in measurement.

However, using a λ/2 as a reference the *power gain* will be related by:

$$Gp = \frac{W1}{W2} = \left(\frac{V1}{V2}\right)^2$$

Where W1 = Signal power received with the antenna under test.
W2 = Signal power received with the λ/2 reference antenna.
V1 = Signal voltage received with the antenna under test.
V2 = Signal voltage received with the λ/2 reference antenna.

Measurements may therefore be made with a direct reading power meter or with a calibrated voltmeter—the latter being the more usual method.

The gain in dBd from *power* ratios (W1/W2) can be obtained from $10Log_{10}$ W1/W2 or, with voltage ratios from $20Log_{10}$ (V1/V2). For example a power ratio of 20 gives a gain of Log_{10} 20 = 13dBd. The *voltage* ratio for the same gain would be 4·467 which gives $20Log_{10}$ 4·467 = 13dBd. For gain over an isotropic radiator add 2·15dB.

Gain by comparison measurements should be made with both antennas in a location where the wave from the signal source antenna is substantially a plane-wave and of constant amplitude over the effective aperture area of the antenna under test as outlined in Part 10.

A conventional arrangement for measuring gain by comparison, as described, is illustrated in Fig. 11.1. Both antennas must be properly matched and function with a v.s.w.r. as near to 1 : 1 as possible. The cable feed to each must have the same amount of natural attenuation. If one cable has more, or less attenuation than the other or, if one of the antennas has some finite v.s.w.r., then the gain measurement will be in error.

On the assumption that a λ/2 antenna has no loss of its own accord *its power gain* over a lossless isotropic radiator will be 1·64. The gain of the λ/2 over the isotropic is therefore $10Log_{10}$ 1·64 = 2·148dB, usually rounded up to 2·15 as given earlier. As in Fig. 11.1 the antenna under test and the reference antenna may be mounted near to each other (but not too near) and the comparison made by switching the detector/indicator from one to the other. This will be assumed to provide a voltage read-out. Note that the distance between the signal source antenna and the antenna under test (including the reference antenna) is Rd as in Fig. 11.1 and determined by the procedures given in Part 10.

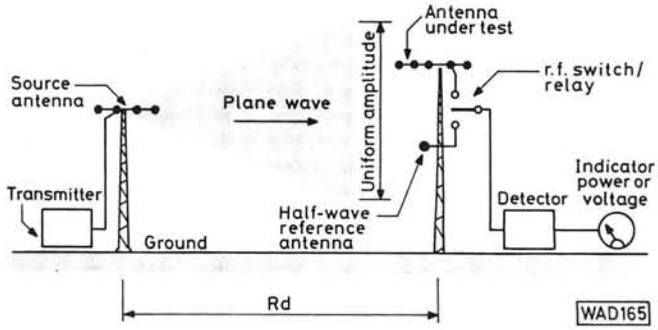


Fig. 11.1: Test range set up for plotting gain by comparison with a standard gain antenna or a reference λ/2 dipole. The distance Rd is as per the information given in Part 10. See text for special requirements

An Alternative Method

An alternative measuring method is to adjust the level of signal at the detector/indicator by means of an attenuator directly calibrated in decibels (dB) so that the level of the received signal can be set to obtain the same reading for each antenna. The signal from the reference antenna is set by the attenuator to provide a meter reading which is noted and used as the 0dB reference. The attenuator/detector/meter is now connected to the antenna under test and assuming it has gain over the reference antenna of course, the amount of attenuation is increased until the meter once again indicates the 0dB reference mark or reading. The amount of attenuation is read off in dB and will also provide the gain of the antenna under test over the reference antenna i.e., gain over a dipole expressed as dBd. The arrangement is illustrated in Fig. 11.2.

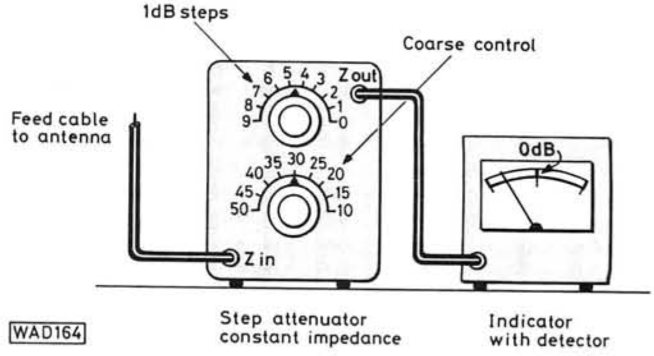


Fig. 11.2: The arrangement using a calibrated attenuator (0·5 or 1dB steps) with a total range sufficient to cover the highest antenna gain likely to be covered

It is usual to employ special attenuators that switch in 0·5 or 1dB steps and with a total range of attenuation to cover the highest anticipated antenna gain. Such instruments are however very expensive unless they can be obtained in good condition secondhand. They must have constant input and output impedance that will directly match with the feed cables to the antennas and to the detector/meter unit.

A cheaper but perhaps not so accurate method is a calibrated (in dB) potentiometer incorporated in a d.c. amplifier following the detector. Accuracy in this case will depend on how accurately the instrument can be calibrated in the first place. Incidentally, if the reference antenna is mounted too close to the antenna under test, measurements may be affected by mutual coupling. The only way of avoiding this is to substitute one antenna for the other but using the same feed cable for connection between antenna and measuring instrumentation.

Measurement of Radiation Patterns—Polar Co-ordinates

For plotting radiation patterns it is usual to have the antenna being tested operating in the receive mode, just as for gain measurement and with aperture r.f. illumination as described in Part 10. The signal source transmitting antenna is fixed and the antenna under test has to be rotated through 360 degrees. Indication of signal strength may be obtained by a detector/meter system and readings are taken every few degrees and through the whole 360 degrees as illustrated in Fig. 11.3. Since the antenna must be turned by hand this method is very tedious and time consuming. Needless to say the rotating antenna mast must be equipped with a bearing scale and pointer.

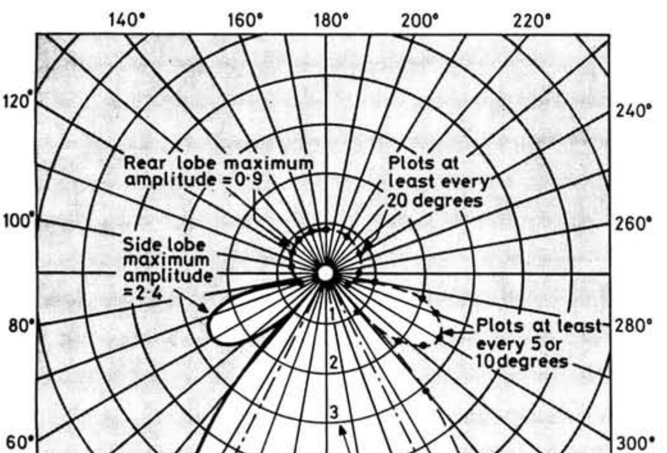


Fig. 11.3: Plotting a radiation pattern (as described in text). Information such as beamwidth and lobe amplitudes as well as approximate gain can be obtained from a carefully plotted radiation pattern

An alternative but less time consuming, although more expensive arrangement, is to have automatic rotation synchronized with a polar chart pen recorder that will provide a direct read-out in polar co-ordinates, or with a long persistance c.r.t. display similar to that described in *PW* August 1979. A linear pen chart recorder run at a speed relative to the rotational speed of the antenna can also be used as will be described later.

Interpretation of Polar Patterns

With beam antennas it is usual to make two radiation pattern tests, one with the antenna horizontal and one in the vertical mode which not only provides a three dimensional aspect of the radiation but also allows the gain to be estimated with a fair degree of accuracy. Other information can also be obtained such as minor lobe amplitude, symmetry of the pattern as a whole, the antenna beamwidth and front to back ratio i.e., ratio of forward radiation amplitude compared with that from the rear of the antenna.

Examination of Fig. 11.3 will show how the pattern is plotted (by the hand turning method) from a series of readings taken every five degrees or so. Because of the close proximity of the divisions near the centre of the polar graph paper, readings for small side and rear lobes might only be possible every 10 or 20 degrees. The centre scale, 1–10 represents relative signal level in terms of voltage with 10 as the set reading for maximum forward gain.

Several items of information can be obtained from a polar pattern. In the first instance the half power point (−3dB) is 0·707 of the amplitude of maximum forward radiation. From this the beamwidth can be determined which in the example in Fig. 11.3 is 52 degrees. The amplitude of the side lobes is 2·4V and of the rear lobe 0·9V. The side lobes are therefore 20Log_{10} 2·4/10 or 12·39dB down with respect to maximum forward radiation, whilst the rear lobe is 20Log_{10} 0·9/10 or 20·9dB down.

This kind of performance would be considered quite reasonable but we can also obtain a fairly good estimate of the gain of this antenna with respect to a $\lambda/2$ dipole from knowing the *beam area in square degrees at the −3dB (half power) point*. The example gives the beamwidth as 52 degrees with the antennna in the horizontal mode. If we assume the beamwidth to be the same for the vertical mode the antenna gain would be 10Log_{10} 32027/Beam area in square degrees, in this case 10Log_{10} 32027/52 × 52 or 10·73dBd. However the beamwidth for the vertical mode is not always the same as for the horizontal mode and is usually wider. The lower portion of the above equation would then be "horizontal beamwidth degrees × vertical beamwidth degrees", giving the area of the beam in square degrees.

Radiation Patterns—Cartesian Co-ordinate

With this method the signal from the antenna being tested is plotted automatically on a linear pen chart recorder, a sample of which is shown in Fig. 11.4. The same information can be obtained from this as from a polar read-out. The point for maximum forward radiation is 8, which may be a voltage so all other levels down to zero are also in voltages.

The half power point gives a beamwidth of 36 degrees and although the main and side lobes are fairly symmetrical, the side lobe amplitudes are unequal. Again assuming the beamwidth to be the same for both horizontal and vertical modes, the gain of the antenna would be in the region of 13·9dBd. However the amplitudes of the side lobes and rear lobe are too high for the overall performance to be considered as good.

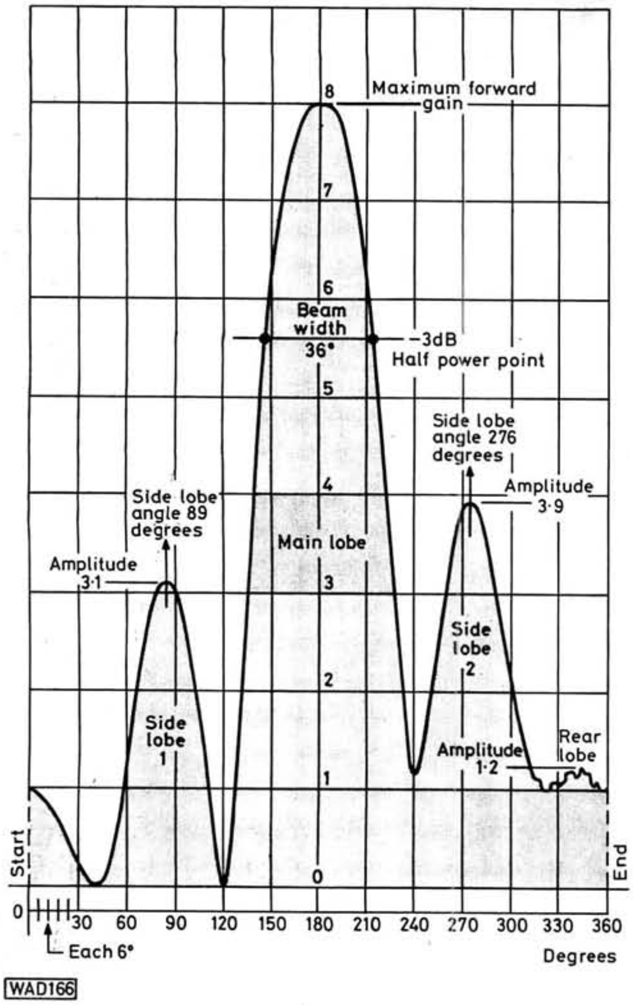


Fig. 11.4: Antenna radiation pattern in Cartesian co-ordinate form. This gives the same information as would be obtained from a polar co-ordinate plot. See text for further explanation

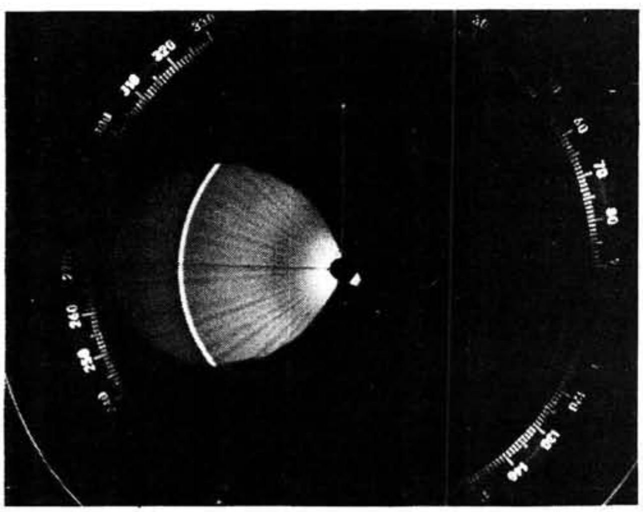


Fig. 11.5: Scale model antenna systems are frequently used for measurement and in conjunction with antenna design. This photograph shows radiation pattern of typical small beam antenna as displayed automatically on a c.r.t. screen. The bright line across pattern is a 3dB down marker

Radiation Patterns with Scale Model Antennas

This subject has been dealt with extensively in previous issues of *PW* but for the benefit of new readers scale models of antennas operating at much higher than the normal frequency are commonly used for investigation into antenna performance and in connection with actual design.

An example of the radiation pattern of a small beam antenna as displayed automatically on a long persistence c.r.t. screen with a rotating time base synchronised with the rotation of the antenna, is shown in Fig. 11.5. The bright marker line indicates the −3dB point and reveals a beamwidth of 62 degrees. There are no side lobes and the rear lobe is too small to be of any consequence. Since the pattern and therefore the beamwidth is the same for operation in the vertical mode, the gain of the antenna is approximately 9·2dBd. Further details concerned with the use of scale model antennas are included in *Out of Thin Air* published by IPC Magazines Ltd.

This concludes the current series on Antennas. Look for the h.f. and v.h.f./u.h.f. antenna specials starting next month

New Books

THE STORY OF RADIO — 1. How Radio Began
By W. M. Dalton. Published by Adam Hilger Ltd.
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ISBN 0 85274 241 X

The story is taken up to the First World War, when things had a temporary halt put on them. The author talks about the properties of amber and the ancient Greeks, experiments with magnets, Galvaries twitching frog's legs, telegraphy without wires and so on.

THE STORY OF RADIO — 2. Everyone an Amateur
By W. M. Dalton. Published by Adam Hilger Ltd.
157 pages, 145 × 210mm. Price £6.00
ISBN 0 85274 307 6

This second book continues the story after WW-I and takes up with the developments brought home by ex-servicemen, and leads onto the enthusiasm for radio brought about almost entirely by amateurs. The author pays tribute to the devoted amateur pioneer in the radio field, and recounts the start of the BBC and how things have never looked back.

THE STORY OF RADIO — 3. The World Starts to Listen
By W. M. Dalton. Published by Adam Hilger Ltd.
154 pages, 145 × 210 mm. Price £6.00
ISBN 0 85274 308 4

In the third part of his series the author continues his step-by-step story of the development of radio.

The BBC had now become a corporation, and the quality of broadcasts had improved. The start of telephones, talking films and television are the subjects for his final chapter.

THE HANDBOOK OF ANTENNA DESIGN—Volume 2
Published by Peter Peregrinus Ltd.
on behalf of the IEE
945 pages, 151 × 228 mm. Price £52.00
ISBN: 0–906048–87–7

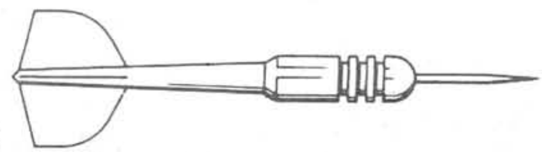
This book is one of the IEE Electromagnetic Waves Series, and is intended to deal with the principles and applications of antenna design with particular emphasis on more recent developments. A list of the chapter headings gives a good idea of the subjects covered: Linear Arrays; Planar Arrays; Conformal Arrays; Circular Arrays; Array Signal Processing; Radomes; VLF, LF and MF Antennas; High Frequency Antennas; VHF and UHF Antennas; Coaxial Transmission Lines and Components.

The treatment level varies from a more superficial summary for well-established topics, to an in-depth mathematical analysis for newer developments, but in each case supported with plenty of practical information.

At a price of £52.00 (or £86.00 for Volumes 1 and 2 together) this book is obviously beyond the pocket of most amateur enthusiasts, which is a pity because there is a lot of information that will be of interest to students and experimenters among them.

Price Changes

Please remember that all prices quoted in *Practical Wireless* are subject to fluctuation after each issue has gone to press. You are advised to check both price and availability with suppliers before ordering goods.



PW DART QRP TOP BAND TRANSMITTER

by Rev G.C. Dobbs G3RJV & Colin Turner G3VTT PART 2

Following on from the general description and details of the v.f.o./mixer board given in Part 1 this concluding part covers the remaining two boards and setting-up details.

The layout for the Amplifier/Changeover Board is shown in Fig. 3. The audio gain control, R23, is mounted on the back of the case because once set it rarely requires readjustment. The whole amplifier is very simple and can be tested with a pair of headphones on the output when it is built. The same board carries the changeover circuitry including the voltage source for unbalancing the mixer for c.w. operation.

The changeover relay is a small 12 volt double-pole-changeover type. As there are several suitable types all with differing conections a space has been left on top of the p.c.b. to stick the relay by its casing with glue or

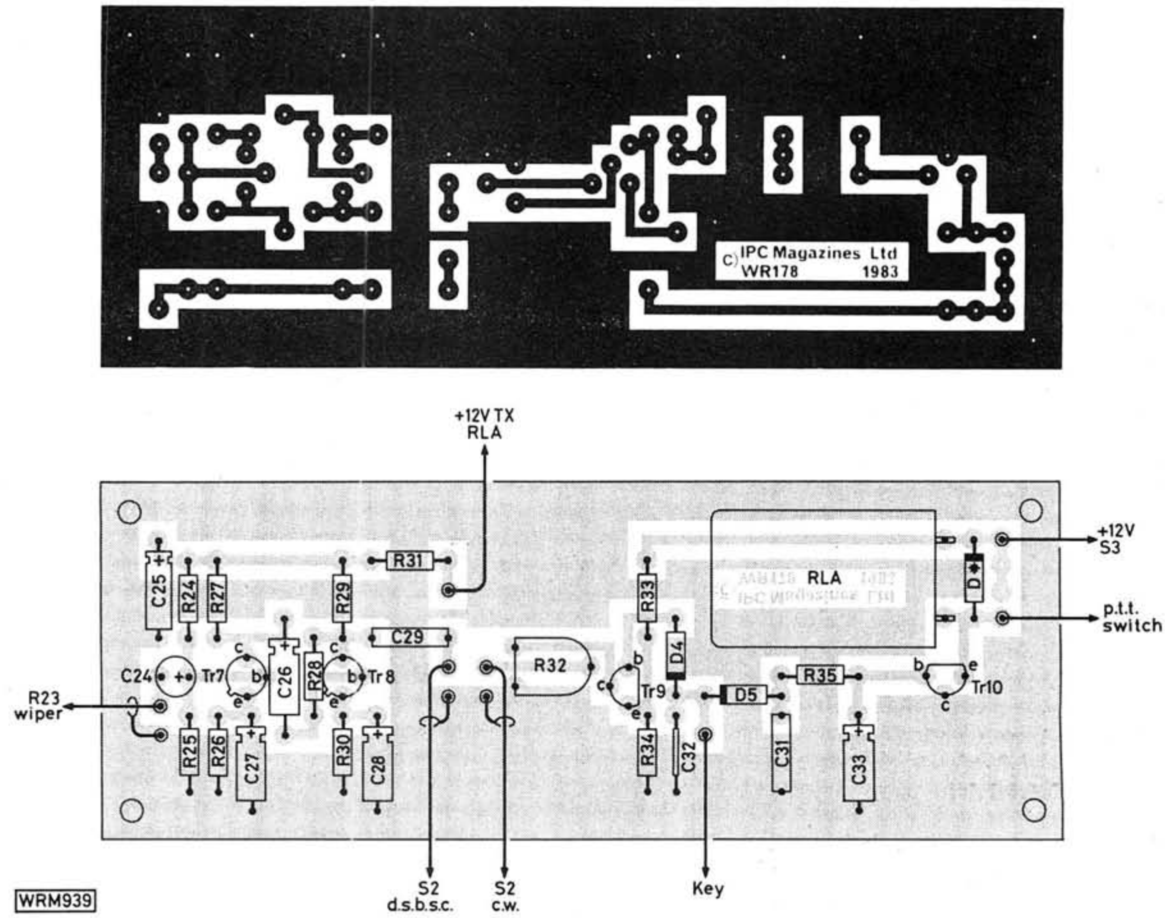


Fig. 3: Full size p.c.b. track pattern and component placement details of the combined audio processing/changeover board. D* is a 1N4001 and is provided to block back e.m.f. generated by RLA

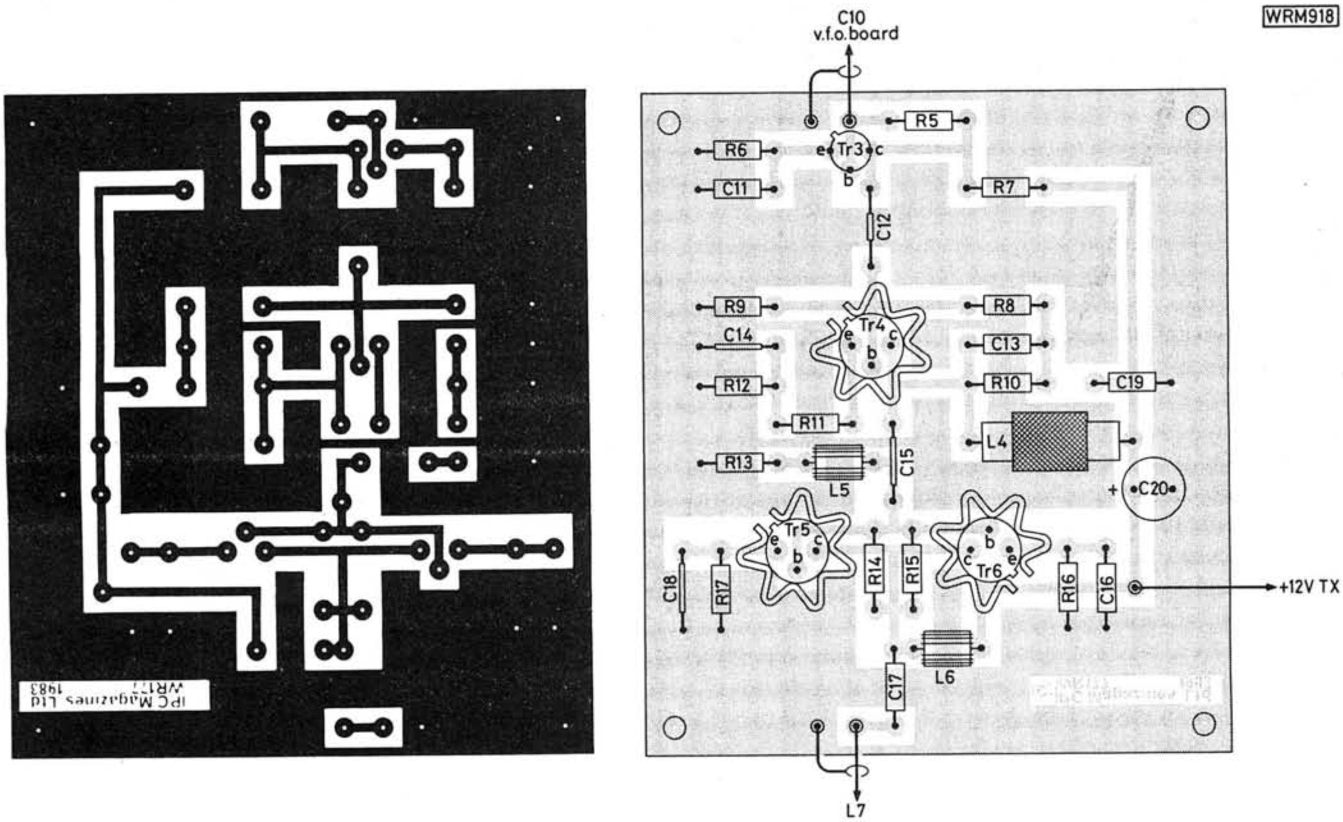


Fig. 4: Component placement and p.c.b. track pattern details of the p.a. stage, shown full size

Blutack. The changeover circuit provides the required supplies on transmit and receive for the various sections of the circuit as well as switching the antenna input between the transmitter output and a socket which leads to the receiver. The signal leads should be screened cable.

This board when built can be tested in conjunction with the v.f.o./Mixer module by connecting a receiver to the output of C10. Monitoring the signal on headphones, it should be possible to obtain d.s.b.s.c. signals with S2 in the d.s.b.s.c. position, and then in the c.w. position increase *the* voltage output from R32 until a c.w. signal can be keyed. Check the action of the changeover. The relay should hold in between words at the normal c.w. keying speed of the operator. If the action is too fast C33 may be increased to hold RLA1 on longer in keying spaces.

The p.a. Board, shown in Fig. 4 is simple to build although the spacing around the two output transistors is a little tight when the star type heatsinks are added to the transistors. The driver stage, Tr4, also requires a small star type heatsink. Inductors L5 and L6 are both homemade from ferrite beads with 8 turns of 32 s.w.g. enamelled wire. Care must be taken in winding these chokes to avoid scraping the enamel off the wire. The winding is a bit of a tight fit but in the past I have got 12 turns onto a ferrite bead with care, so 8 turns should be no real problem. Capacitor C21 is a front panel control and the prototype had L7 mounted on the side of the back set of vanes of this capacitor. Inductor L7, which is wound on a T68-2 toroid comprising identical 10 turn 28 s.w.g. link windings (a) and (c) wound over the 28 s.w.g. 50 turn resonant section (b), can be attached to a piece of plastic board; the prototype used a matrix board called "Perfboard" which is like Veroboard without the copper tracks. Capacitor C21 is any reasonable sized two-gang 365pF variable capacitor with both gangs wired in parallel. Screened leads take the signal to and from the C21/L7 circuitry.

The whole of the circuit of the resistive s.w.r. bridge is contained on the back of the switch, S1, and the panel meter, M1. The layout of the components on the back of the switch with some spare contacts used for interconnection tags is shown in Fig. 5. Resistor R22 is soldered directly onto the back of the meter. The prototype uses a miniature edgewise meter of some 200μA full scale deflection but almost any moving coil meter with a full scale deflection of 1mA or less can be used. Screened leads are

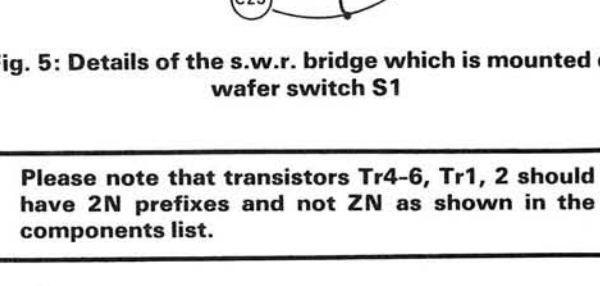


Fig. 5: Details of the s.w.r. bridge which is mounted on wafer switch S1

Please note that transistors Tr4-6, Tr1, 2 should have 2N prefixes and not ZN as shown in the components list.

Readers who intend to operate the *PW* Dart should be in possession of the appropriate licence issued by the Department of Trade and Industry to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Department of Trade & Industry, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

used in the connection to and from the s.w.r. bridge. This bridge is a very compact and useful little circuit which I have used on a whole variety of QRP transmitters.

Receive Offset

The v.f.o. is left running the whole time to aid stability. The prototype v.f.o. was very stable after the usual movement caused by junction warm up in an f.e.t. oscillator. This means that if the transmitter is switched on to receive there could be some v.f.o. present on the received signal due to leakage through the mixer. In the prototype this was of such low order as to present no problem. If it is a problem the easiest way to deal with it is to offset the frequency of the v.f.o. during receive. This takes the v.f.o. out of the passband of the receiver so that no signal from the v.f.o. is heard on receive. A suitable circuit for this is shown in Fig. 6. A capacitor and a diode form a capacitive circuit across the v.f.o. tuned circuit. On receive 12 volts is applied to this circuit and the capacitance shift should take

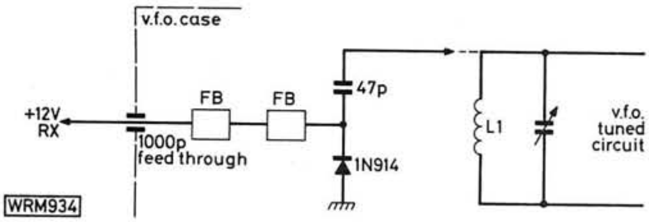


Fig. 6: Circuit details of the optional receive offset circuit which if fitted must be mounted within the v.f.o. housing in close proximity to the main tuned circuit

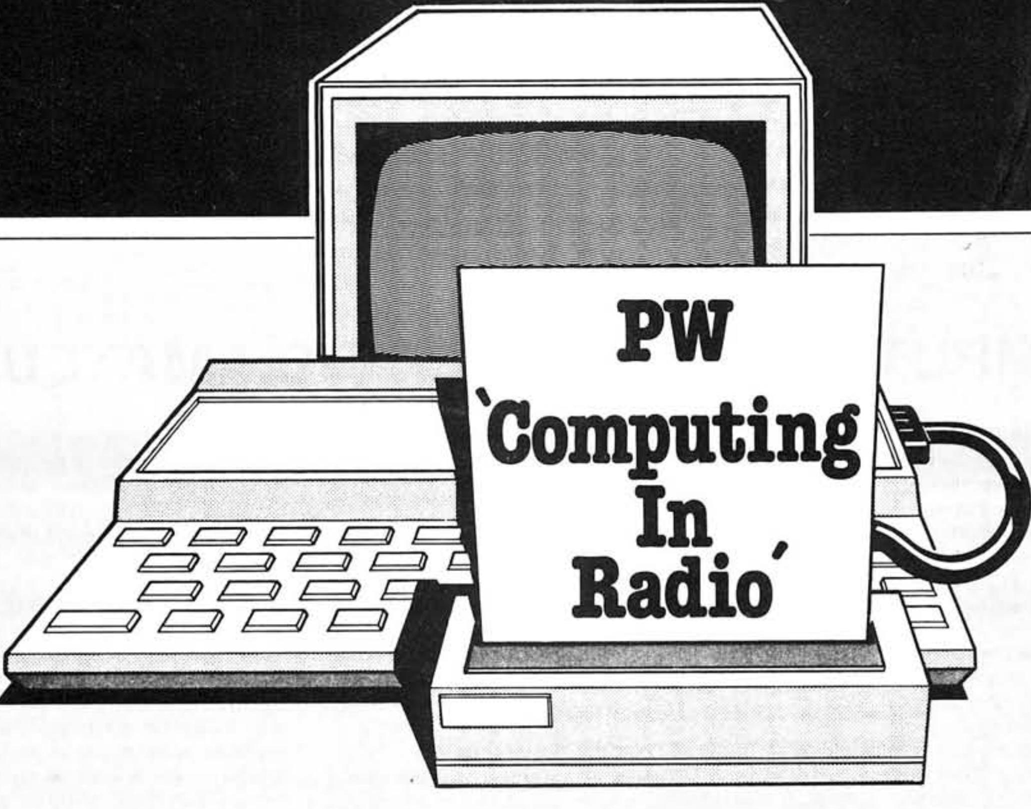
the v.f.o. out of the passband of the receiver. The values shown should do the job but the capacitor may require some adjustment in value to suit individual versions of the v.f.o. This capacitor should be a silver mica type and the additional circuitry added to the v.f.o. must be solid and directly wired to maintain stability.

Transmitter Netting

If the v.f.o. leakage through the mixer is small—as it should be—then it is difficult to net the transmitter without putting it on to transmit. This is undesirable as some means of locating the transmitter frequency on the receiver, without transmitting, is required to avoid one being a nuisance to other operators. This is quite simple to do by putting S2 into the c.w. mode and pressing the press to talk (p.t.t.) switch on the microphone. This switches on the p.a. without allowing a full signal to reach the output giving plenty of signal to locate the frequency of the transmitter.

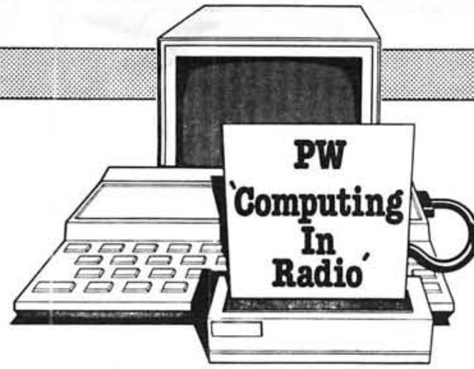
The *PW* Dart transmitter represents about the simplest way to put a phone signal onto an amateur band. The tuning-up procedure is simple using the three positions of S1. Resistor R23 should be set to give just enough injection to the mixer to produce a reasonable carrier signal on key down. Reports on the air suggest that most people with s.s.b. transceivers or good receivers think that it is a single sideband suppressed carrier signal. Not bad for a few cheap and standard components. ●

1) *SPRAT, Journal of the G-QRP Club* (Autumn 1981), c/o G3RJV, 17 Aspen Drive, Chelmsley Wood, Birmingham, B37 7QX.



CONTENTS

The programs described in this special feature together with several other useful radio-related programs are available on cassette for the Spectrum and ZX81 computers. **See page 86 for details**



COMPUTING AND THE RADIO AMATEUR

In the twelve months since the publication of our first computing supplement the radio amateur seems to have taken to using a home computer in the shack to perform a wide variety of tasks. Without doubt this trend has been fuelled by the rapidly falling price of the Sinclair ZX81 to a point where it is being considered by many as not a computer but another "component" to be built into some project or other.

The competition in the low-cost colour computer market following the introduction of several competitors to the Sinclair Spectrum has also helped the trend. Many radio amateurs will have a ZX81 lurking in a shack drawer as a direct result of a member of the family upgrading to a faster and more sophisticated model. The ZX81 is however a powerful machine and in this supplement we will be looking at a low-cost replacement ROM which changes the ZX81 into a fast, powerful multi-tasking computer.

During the year we have also learned a lot about what you, our readers, want in respect of computer software. We have decided to stick to software and hardware for those computers which we know are popular with radio enthusiasts. Computer experts amongst our readers will probably laugh at the choice, in their eyes they are classed as toys. However they are very powerful toys and can perform a very wide range of computer tasks at a much lower outlay than "proper" computers. In fact, so seriously do we at *Practical Wireless* take computers as a useful shack tool that we are installing in the Editorial offices a wide variety of models covering those that we know are most popular with readers.

In this special supplement we are again presenting a selection of programs which the radio enthusiast should find useful. The listings given are for the ZX81 or Spectrum but there is no difficult translation involved to allow them to run on any other machine using BASIC. In fact we have already produced the tapes for these programs for both the ZX81 and Spectrum computers and we intend to produce tapes for other popular machines.

The cassette produced for the ZX81 with the programs from the December 1982 *Computing Supplement* have proved very popular and are now available for the Spectrum. Details elsewhere in these pages.

What does the next year hold for the radio enthusiast so far as computers are concerned? Without a doubt we will see the price of the basic black and white computer such as the ZX81 fall even lower, making it even more attractive as a straightforward "component". More sophisticated software will become available to allow the amateur to perform routine tasks as well as using modes of transmission and reception which up to now have been the prerogative of either those with a super-flexible credit card or a tolerant XYL who will put up with mechanical noises and smells.

At *Practical Wireless* we will continue to grow with this aspect of the hobby, but not at the expense of radio. The computer so far as we are concerned is just another tool to be used, not an end in itself.

The BBC Model B home computer is popular with radio amateurs and represents the top end of the market

ZX81 FORTH ROM OFFER COUPON

ZX81 FORTH

The Sinclair ZX81 computer is reckoned by the "Experts" to be nothing more than a "toy". However, it does offer fantastic value for money and fitted with a better keyboard, of which there is a wide choice, it is really remarkably powerful.

Now David Husband, G8HJT, has come up with a replacement EPROM which simply takes the place of the Sinclair PROM and changes the ZX81 from the slow BASIC machine into a sleek greyhound running a version of fig-FORTH with multi-tasking.

The ready-programmed EPROM is simply plugged into the ZX81 board after removing the Sinclair ROM chip. Some boards apparently have the chip soldered in place and it is recommended that a socket is used to make chip changing easier. Solder Wick will help in the removal of the original chip. For those who are unsure of their soldering ability David Husband can supply a ready converted ZX81 to order.

So what advantages have you gained by changing from the Sinclair BASIC to ZX81-FORTH? Well, for those unfamiliar with FORTH as a computer language it bears no resemblance to BASIC. It is in fact getting on towards machine code and as a result is capable of running very fast indeed. As an example a 3000 DO LOOP in ZX81-FORTH takes only four seconds compared with around five minutes for ZX81-BASIC. If you run the FORTH in AUTO then it only takes just under one second. So ZX81-FORTH is some 300 times faster than ZX81-BASIC.

FORTH is certainly more difficult to learn than BASIC but it is possible to retain the Sinclair ROM chip and by suitable switching change from ZX81-BASIC to ZX81-FORTH, so keeping the machine for use with those games and other software which you already have.

ZX81-FORTH matches, where possible, the fig-FORTH commands although it is not fig-FORTH. Also ZX81-FORTH contains some non-standard words to allow it to perform multi-tasking.

The workings of ZX81-FORTH is fully described in the manual which accompanies the EPROM. Although this manual is comprehensive in terms of describing ZX81-FORTH and what it can do, it does assume that you can already program to some extent in FORTH. David Husband does recommend a suitable book to get you going and this is *"The Complete FORTH"* by Alan Winfield.

The presentation of the screen, or rather screens, is different to the conventional ZX81. There are, in fact, two sets of screens in ZX81-FORTH. The first one is a conventional display taking up the whole screen while the second set is a split screen. This has two screen areas divided by a horizontal black band. The upper screen is the edit area in which the program is written, modified and corrected before it is moved into the bottom part of the screen to be compiled. the horizontal black divider is actually a form of "scratch pad" and it is possible to transfer or write areas of text into the pad before putting it back into the edit screen as required. This facility is useful when writing programs as it simplifies the writing of FORTH words. Changing between formats is very simple.

ZX81-FORTH is unusual in that it allows the user to task programs. This puts your modified ZX81 computer in the forefront of computing.

Tasking is the act of scheduling a program to execute at some time in the future. Any program can be scheduled in a task and you can run up to ten tasks simultaneously in the background before the system slows down so much as to make the editing of new programs useless.

If desired, ZX81-FORTH will allow up to 63 tasks to be performed by the computer. This is the exciting area for the radio enthusiast as now he can run a RTTY program, monitor several channels for messages while the computer looks after the central heating and burglar alarms. Not only that, but his logbook and filing system can be run, together with calculations of distance and bearing or QTH locator as needed.

Practical Wireless will be publishing programs and other supporting information for ZX81-FORTH in the future and to allow readers to get in at the ground floor we have negotiated a special price for the programmed EPROM direct from David Husband. Also the book *"The Complete FORTH"* is available from David Husband with the EPROM at £6·95 extra. Details of how to order are given in the box below.

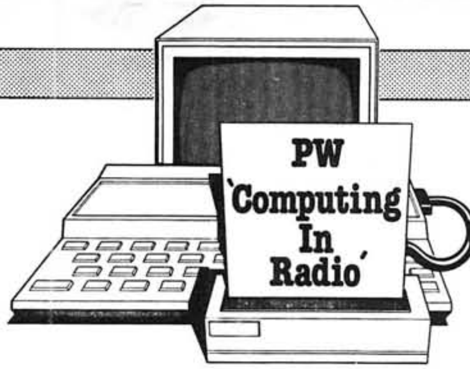
ZX81-FORTH offers the radio amateur many advantages and modifying your existing ZX81 to run ZX81-FORTH is the cheapest way of getting going in FORTH.

ZX81-FORTH EPROM is available from **David Husband, 2 Gorleston Road, Branksome, Poole, BH12 1NW,** price £22.50 inc. post, with the special offer coupon (£29.00 normal price).

ZX81 FORTH ROM OFFER

To obtain your ZX81 FORTH ROM at the special price, send your name and address together with £22·50 and the coupon opposite direct to **David Husband, 2 Gorleston Road, Branksome, Poole BH12 1NW.** Please allow 28 days for delivery. This offer closes on 31 January 1984.

by J T Beaumont G3NGD



ANTENNAS AND FEEDERS USING THE ZX81

This program, written for the ZX81, will calculate the impedance of either a coaxial cable or a parallel feeder. The program can also be used to calculate the resonant length of an aerial, and a wavelength to frequency and vice versa conversion can also be performed.

The graphics are stored in a pair of strings T$ and R$. This method was used to provide instant "call-up" and display when requested, and also to save a large number of PRINT AT positions having to be entered into the program.

The graphics are drawn and stored in lines 145Ø to 166Ø, and these lines are deleted from the listing when the strings T$ and R$ have been completed.

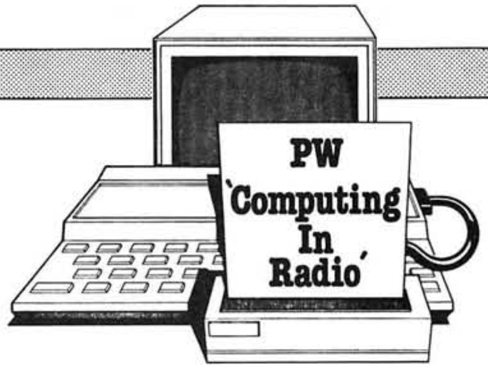
When the complete program listing has been entered into the computer type GOTO 145Ø, the screen will appear blank for a few seconds. The computer is in FAST MODE at this time and the strings T$ and R$ are being formed. The program will "self-run" to the title and then to the "Menu".

The strings T$ and R$ can be checked by inputting "A" or "B" at this point. (Prompt line 2ØØ). If all appears well, DELETE lines 145Ø to 166Ø inclusive.

Do not type RUN or CLEAR from now on.

To save the program on tape enter GOTO

```
10 CLS
20 PRINT "***ANTENNAS AND FEEDERS G3NGD***"
30 PRINT
40 PRINT "SELECT YOUR PROGRAM"
50 PRINT
60 PRINT "INPUT LETTER TO CALCULATE:"
70 PRINT "------------------------"
80 PRINT
90 PRINT "A= IMPEDANCE OF COAX CABLE"
100 PRINT
110 PRINT "B= IMPEDANCE OF TWIN FEEDER"
120 PRINT
130 PRINT "C= FREQUENCY TO WAVELENGTH"
140 PRINT
150 PRINT "D= WAVELENGTH TO FREQUENCY"
160 PRINT
170 PRINT "E=ANTENNA LENGTH"
180 PRINT AT 18,1;"DO NOT PRESS ""RUN"" OR ""CLEAR"""
190 PRINT AT 19,1;"------------------------------"
200 LET A$=INKEY$
210 IF A$="A" THEN GOTO 280
220 IF A$="B" THEN GOTO 610
230 IF A$="C" THEN GOTO 850
240 IF A$="D" THEN GOTO 1000
250 IF A$="E" THEN GOTO 1230
260 IF A$="F" THEN GOTO 1440
270 GOTO 200
280 CLS
290 PRINT T$
300 PRINT AT 0,0;"TO CALC. FEEDER LINE IMPEDANCE"
310 PRINT AT 17,4;"CIRCULAR COAXIAL CABLE"
320 PRINT AT 3,17;"----------"
330 PRINT AT 14,17;"----------"
340 PRINT AT 7,21;"INPUT OUTER"
350 PRINT AT 9,23;"DIA.MM"
360 INPUT D
370 PRINT AT 7,21;"  OUTER =
"
380 PRINT AT 9,23;D;"MM    "
390 PRINT AT 7,2;"------- ---"
400 PRINT AT 11,2;"------------
"
410 PRINT AT 8,0;"INPUT INNER"
420 PRINT AT 9,1;"DIA.MM"
430 INPUT X
440 PRINT AT 8,0;"INNER =      "
450 PRINT AT 9,1;X;" MM  "
460 PRINT AT 16,0;"INPUT DIELECTRIC AIR=1. POLY=2.3"
470 INPUT K
480 PRINT AT 18,0;"THE DIELECTRIC CONSTANT ""K"" = ";K;"    "
490 IF A$="B" THEN GOTO 740
500 LET Y=D/X
510 LET Z=138*(LN Y/LN 10)
520 LET Z=Z/SQR K
530 LET Z=INT (Z*10+.5)/10
540 PRINT AT 20,0;"IMPEDANCE OF COAX = ";Z;" OHMS"
550 PAUSE 100
560 PRINT AT 21,8;"MORE? YES/NO
"
570 LET Y$=INKEY$
580 IF Y$="Y" THEN GOTO 280
590 IF Y$="N" THEN GOTO 10
600 GOTO 570
610 CLS
620 PRINT AT 0,0;"TO CALC. FEEDER LINE IMPEDANCE"
630 PRINT R$
640 PRINT AT 16,0;"PARALLEL LINE ( TWIN FEEDER )"
650 PRINT AT 4,8;"<---INPUT MM--->"
660 INPUT D
670 PRINT AT 4,9;"----";D;" MM---"
680 PRINT AT 13,5;"<-X->"
690 PRINT AT 14,3;"INPUT DIA ""X"" IN MM."
700 INPUT X
710 PRINT AT 14,3;"
"
720 PRINT AT 14,6;X;"MM"
730 GOTO 460
740 LET Y=2*D/X
750 LET Z=276*(LN Y/LN 10)
760 LET Z=Z/SQR K
770 LET Z=INT (Z*10+.5)/10
780 PRINT AT 20,0;"IMPEDANCE OF TWIN = ";Z;" OHMS"
790 PAUSE 100
800 PRINT AT 21,8;"MORE? YES/NO
"
810 LET Y$=INKEY$
820 IF Y$="Y" THEN GOTO 610
830 IF Y$="N" THEN GOTO 10
840 GOTO 810
850 CLS
860 PRINT AT 2,4;"FREQUENCY TO WAVELENGTH"
870 PRINT AT 8,7;"INPUT FREQ MHZ."
880 INPUT F
890 PRINT AT 8,7;"FREQ = ";F;" MHZ   "
900 LET W=300/F
910 PRINT AT 15,3;F;" MHZ = ";W;" METRES"
920 LET G=W*100
930 LET G=INT (G*10+.5)/10
940 IF F>200 THEN PRINT AT 18,1
```



1670 and the program will "self-run". When the program lists the "Menu" input "F". (Note: this is not shown on the Menu). The program will GOTO 1440 and SAVE "ANTS + FEEDS". On completion of the SAVE routine the program will return to listing.

Coaxial Cable

This section is listed between lines 280 and 600. The prompt requests the 'outer diameter' size of the Coaxial cable in millimetres, followed by the 'inner diameter'. When the dielectric constant is input (i.e. Air = 1 Polythene 2·3) the impedance is calculated and displayed on the screen.

Frequency To Wavelength

This section is listed between lines 850 and 990. Frequency inputted in Megahertz is converted to Wavelength.

Wavelength To Frequency

This section is listed between lines 1000 and 1220. The input can be in either Metres or Centimetres. The frequency is converted to either Megahertz or Gigahertz.

Antenna Length

The final program "To calculate Antenna Length" is listed between lines 1230 and 1420. On inputting the Resonant Frequency and the number of half wavelengths required, the program calculates the antenna length in both imperial and metric lengths.

This program should be of use to those interested in antenna design and construction. How often have we wished to have known what impedance that odd length of coaxial cable in the junk box was?

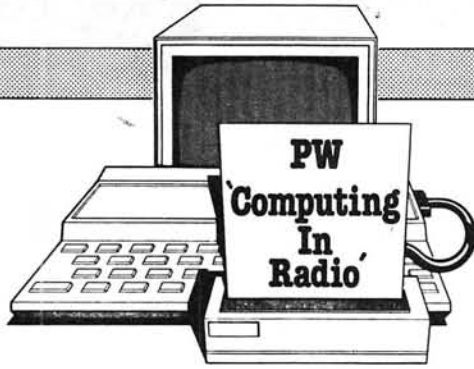
Twin Parallel Feeder

This section is listed between lines 610 and 840. The prompt requests the distance between the parallel conductors in millimetres, followed by the diameter of the conductor itself. On inputting the dielectric constant, the impedance is calculated and displayed.

If the program ever returns to listing: GOTO 10 will return you to the "Menu". **Remember: Do not type "RUN" or "CLEAR" or you will have to re-load from tape.**

```
;"WHICH EQUALS ";G;" CENTIMETRES"
 950 PRINT AT 21,8;"MORE? YES/NO"
 960 LET Y$=INKEY$
 970 IF Y$="Y" THEN GOTO 850
 980 IF Y$="N" THEN GOTO 10
 990 GOTO 960
1000 CLS
1010 PRINT "CALC. WAVELENGTH TO FREQUENCY"
1020 PRINT AT 15,5;"ENTER (M) OR (CM)"
1030 LET C$=INKEY$
1040 IF C$="M" THEN PRINT AT 15,5;"INPUT METRES      "
1050 IF C$="C" THEN GOTO 1100
1055 IF C$<>"M" THEN GOTO 1030
1060 INPUT N
1070 LET F=300/N
1080 PRINT AT 15,5;N;" METRES = ";F;" MHZ"
1090 GOTO 1180
1100 PRINT AT 15,5;"INPUT CENTIMETRES  "
1110 INPUT P
1120 LET O=P/100
1130 LET F=300/O
1140 PRINT AT 15,5;P;" CM. = ";F;" MHZ"
1150 IF F>999 THEN LET G=F/1000
1160 IF F>999 THEN LET G=INT (G*100+.5)/100
1170 IF F>999 THEN PRINT AT 18,2;"WHICH EQUALS ";G;" GIGA-HERTZ"
1180 PRINT AT 21,6;"MORE? YES/NO"
1190 LET Y$=INKEY$
1200 IF Y$="Y" THEN GOTO 1000
1210 IF Y$="N" THEN GOTO 10
1220 GOTO 1190
1230 CLS
1240 PRINT "TO CALCULATE ANTENNA LENGTH"
1250 PRINT AT 5,2;"HOW MANY HALF-WAVES?"
1260 INPUT H
1270 PRINT AT 5,2;"ANTENNA IS ";H;" HALF-WAVES LONG"
1280 PRINT AT 10,2;"INPUT RESONANT FREQ IN MHZ."
1290 IF H=1 THEN PRINT AT 5,0;"ANTENNA IS ";H;" HALF - WAVE LONG  "
1300 INPUT F
1310 PRINT AT 10,2;"RESONANT FREQUENCY = ";F;" MHZ."
1320 LET L=492*(H-.05)/F
1330 PRINT AT 15,0;"WIRE LENGTH IS ";L;" FEET "
1340 LET C=L*.3048
1350 LET C=INT (C*1000+.5)/1000
1360 PRINT AT 18,3;"OR ";C;" METRES IN LENGTH"
1370 PAUSE 100
1380 PRINT AT 21,8;"MORE? YES/NO"
1390 LET Y$=INKEY$
1400 IF Y$="Y" THEN GOTO 1230
1410 IF Y$="N" THEN GOTO 10
1420 GOTO 1380
1430 CLS
1440 SAVE "ANTS+FEEDS"
1450 FAST
1460 FOR K=0 TO 2*PI STEP PI/10
1470 PLOT 15+4*COS K,25+4*SIN K
1480 PLOT 47+4*COS K,25+4*SIN K
1490 NEXT K
1500 DIM R$(550)
1510 FOR L=7 TO 15
1520 FOR M=6 TO 27
1530 LET R$(M+32*L)=CHR$ PEEK (PEEK 16396+256*PEEK 16397+M+33*L)
1540 NEXT M
1550 NEXT L
1560 CLS
1570 FOR K=0 TO 2*PI STEP PI/10
1580 PLOT 30+10*COS K,25+10*SIN K
1590 PLOT 30+3*COS K,25+3*SIN K
1600 NEXT K
1610 DIM T$(470)
1620 FOR L=4 TO 14
1630 FOR M=11 TO 21
1640 LET T$(M+32*L)=CHR$ PEEK (PEEK 16396+256*PEEK 16397+M+33*L)
1650 NEXT M
1660 NEXT L
1670 CLS
1680 PRINT "   ▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
1690 FOR J=1 TO 18
1700 PRINT TAB 3;"▒";
1710 PRINT TAB 25;"▒"
1720 NEXT J
1730 PRINT "   ▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
1740 PRINT AT 3,5;"*AMATEUR RADIO"
1750 PRINT AT 5,10;"CALCULATIONS*"
1760 PRINT AT 7,12;"BY:"
1770 PRINT AT 9,5;"J.T.BEAUMONT.-G3NGD"
1780 PRINT AT 12,10;"ANTENNAS"
1790 PRINT AT 14,12;"AND"
1800 PRINT AT 16,10;"FEEDERS"
1810 PAUSE 1000
1820 CLS
1830 SLOW
1840 GOTO 10
```

by J T Beaumont G3NGD



CALCULATING THE RESONANT FREQUENCY OF A TUNED CIRCUIT USING THE ZX81

This simple program for the ZX81 described below, will calculate the resonant frequency of a tuned circuit from known values of inductance and capacitance, or calculate the value of an inductor or a capacitor in order to resonate a tuned circuit at a required frequency — useful when designing oscillators and traps.

The program is based on the formula:

$$F = 1/2\pi\sqrt{LC}$$

which works for both series and parallel resonant circuits.

Using the Program

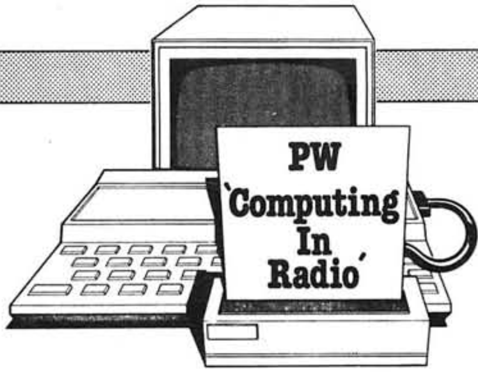
RUN the program and in response to the input prompts, type in the data. The program is self-explanatory asking you to input appropriate data.

An inductance of 250µH is to be connected in parallel with a variable capacitor of maximum value 160pF and minimum value 40pF. What is the tuning range of the circuit? Use the program to find out.

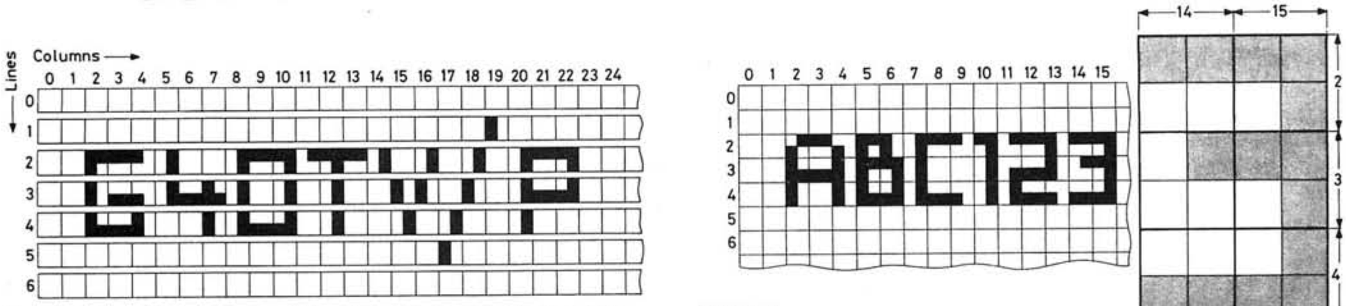
In addition to using the program for designing series-resonant circuits (acceptor circuits) and parallel tuned circuits (rejector circuits), it should be an asset to students studying for the RAE when checking their answers to calculations.

```
   5 REM **TO START PRESS "RUN"*
  10 PRINT "TO DESIGN A TUNED CI
RCUIT G3NGD "
  12 PRINT
  13 PRINT
  20 PRINT "DO YOU WANT TO CALCU
LATE            THE INDUCTANCE?  (YE
S/NO)"
  21 INPUT A$
  22 PRINT
  23 IF A$="YES" THEN GOTO 49
  24 PRINT "DO YOU WANT TO CALCU
LATE            THE CAPACITANCE? (Y
ES/NO)"
  25 INPUT B$
  26 IF B$="YES" THEN GOTO 1000
  27 PRINT
  28 PRINT "DO YOU WANT TO CALCU
LATE            THE FREQUENCY? (YES
/NO)"
  34 INPUT C$
  35 IF C$="YES" THEN GOTO 2000
  40 CLS
  48 IF C$="NO" THEN GOTO 20
  49 CLS
  50 PRINT """TO CALCULATE THE I
NDUCTANCE IN MICRO HENRIES"""
  51 PRINT
  80 PRINT "INPUT FREQUENCY ""IN
 MHZ."""
 100 INPUT F
 120 PRINT "FREQ IS ";F;" MHZ."
 132 LET F=F*10**6
 133 LET F=F**2
 135 PRINT
 140 PRINT "INPUT VALUE OF CAPAC
ITANCE IN PF ";
 150 INPUT C
 160 PRINT "CAPACITANCE IS ";C;"
 PF."
 180 LET C=C*10**-12
 200 LET A=4*(PI**2)
 250 LET X=A*F*C
 260 LET L=1/X
 270 PRINT
 290 PRINT
 295 LET Z=L*10**6
 296 LET Z=INT (Z*10+.5)/10
 297 IF Z<=0 THEN GOTO 1480
 298 PRINT "INDUCTANCE IS: ";Z;"
  MICRO-HENRY"
 320 GOTO 3160
1000 CLS
1012 PRINT
1020 PRINT """TO CALCULATE THE C
APACITANCE"""
1025 PRINT
1030 PRINT "INPUT FREQUENCY ""IN
 MHZ."""
1100 INPUT F
1120 PRINT "FREQ IS ";F;" MHZ."
1132 LET F=F*10**6
1133 LET F=F**2
1135 PRINT
1140 PRINT "INPUT VALUE OF INDUC
TANCE IN UH ";
1150 INPUT L
1160 PRINT "INDUCTANCE IS ";L;"
UH."
1180 LET L=L*10**-6
1200 LET A=4*(PI**2)
1250 LET X=A*F*L
1260 LET C=1/X
1270 PRINT
1295 LET Z=C*10**6
1400 PRINT
1410 LET Z=C*10**12
1450 LET Z=INT (Z*10+.5)/10
1480 IF Z<=0 THEN PRINT AT 15,8;
"YOU HAVE SILLY VALUES"
1485 IF Z<=0 THEN GOTO 3160
1500 PRINT "CAPACITANCE IS: ";Z;
"  PF"
1600 GOTO 3160
2000 CLS
2050 PRINT "TO CALCULATE THE FRE
QUENCY OF A TUNED CIRCUIT"
2052 PRINT
2060 PRINT "INPUT VALUE OF CAPAC
ITOR PF."
2065 INPUT C
2075 PRINT "CAPACITANCE ";C;"PF.
"
2080 LET C=C*10**-12
2088 PRINT
2090 PRINT "INPUT INDUCTANCE IN
MICRO HENRY"
2100 INPUT L
2200 PRINT "INDUCTANCE ";L;" UH.
"
2300 LET L=L*10**-6
2400 LET A=4*(PI**2)
2500 LET X=C*L*A
2600 LET Z=1/X
2700 LET F=SQR Z
2725 LET F=F/10**6
2730 LET F=INT (F*1000+.5)/1000
2750 PRINT
2800 PRINT "TUNED CIRCUIT FREQ:
";F;" MHZ"
3160 PRINT AT 18,2;"""TO RETURN
TO START"" ""PRESS X"""
3165 PRINT AT 20,7;"THEN NEWLINE
."
3170 INPUT X$
3175 IF X$="X" THEN CLS
3180 GOTO 20
```

by D. Green G4OTV



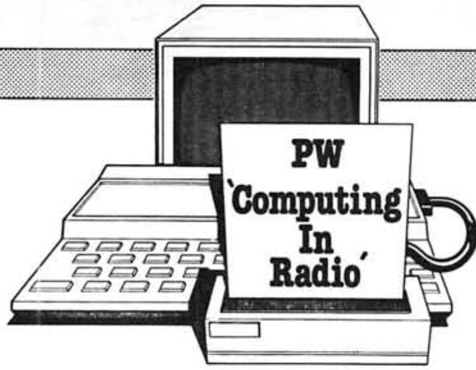
QSL CARD PRINTER FOR SPECTRUM



How to "dissect" your own callsign for entering into the program.

```
    5 CLS
    6 PRINT "G4DTV QSL Card Print
er"
    7 PRINT
   10 PRINT "Enter location (16 c
haracters)"
   20 INPUT a$
   30 PRINT "Enter location conti
nued (16)"
   40 INPUT b$
   45 PRINT "Date ? (9)"
   50 INPUT e$
   60 PRINT "Band in MHz.?(4)"
   70 INPUT f$
   60 PRINT "Mode ? (3)"
   90 INPUT g$
  100 PRINT "Rig ? (9)"
  110 INPUT i$
  120 PRINT "Antenna ? (10)"
  130 INPUT j$
  140 PRINT "Power ? (3)"
  150 INPUT k$
  155 CLS
  156 PRINT "G4OTV QSL Card print
er"
  157 PRINT
  160 PRINT "Callsign of station
?(11)"
  170 INPUT c$
  160 PRINT "Time of QSO ?(4)"
  190 INPUT d$
  200 PRINT "RST ?(3)"
  205 INPUT h$
  210 PRINT "Name of operator wor
ked ? (8)"
  215 INPUT l$
  220 PRINT "Input ""B"" to QSL v
ia buro,                ""D"" for di
rect"
  225 INPUT u$
  227 IF u$="B" THEN LET u$="via
buro"
  230 IF u$="D" THEN LET u$="dire
ct"
  240 PRINT "OM or YL ?"
  250 INPUT m$
  255 CLS
  260 PRINT AT 1,20;"[illegible]"
  270 PRINT AT 2,2;"[illegible]
[illegible]"
  280 PRINT AT 3,2;"[illegible]
[illegible]"
  290 PRINT AT 4,2;"[illegible]
[illegible]"
  295 PRINT AT 5,16;"[illegible]"
  300 PRINT AT 7,1;"Operated from
";a$
  310 PRINT AT 8,16;b$
  320 PRINT AT 10,1;"Confirming Q
SO with ";c$
  330 PRINT AT 12,1;"At ";d$
  340 PRINT AT 12,9;"GMT on ";e$
  350 PRINT AT 12,26;"using "
  360 PRINT AT 13,1;"the ";f$
  370 PRINT AT 13,9;"MHz band in
";g$
  380 PRINT AT 13,25;"mode"
  390 PRINT AT 15,1;"UR RST ";h$
  400 PRINT AT 15,11;", Rig hr is
";i$
  410 PRINT AT 16,1;"Antenna-";j$
  420 PRINT AT 16,22;"Power ";k$;
"W"
  430 PRINT AT 18,1;"VI MNI TNX F
ER FB QSO ";l$
  440 PRINT AT 19,1;"Pse QSL ";u$
  450 IF m$="OM" THEN PRINT AT 20
,24;"73"
  460 IF m$="YL" THEN PRINT AT 20
,24;"88"
  470 PRINT AT 20,27;" Dave"
  476 INPUT q$
  460 IF q$="" THEN GO TO 900
  485 CLS
  490 PRINT AT 3,5;"G4OTV QSL Car
d Printer"
  500 PRINT AT 5,2;"Please select
 from this list"
  510 PRINT AT 8,3;"1 to enter al
l information"
  520 PRINT AT 10,3;"2 to enter Q
SO info. only"
  530 PRINT AT 12,3;"3 to termina
te processing"
  536 INPUT r$
  540 IF r$="1" THEN GO TO 5
  550 IF r$="2" THEN GO TO 155
  560 IF r$="3" THEN CLS
  561 PRINT : PRINT "  Glad to ha
ve been of service"
  570 PRINT
  590 PRINT "73 de Dave (G4OTV)"
  600 STOP
  900 COPY
  910 GO TO 485
 1000 SAVE "QSL CARDS" LINE 5
```

by J T Beaumont G3NGD



WINDING SINGLE LAYER COILS USING THE ZX81

This program was written as a follow-up to the program "Calculating the Resonant Frequency of a Tuned Circuit Using the ZX81". It was decided that having calculated the inductance required to make a tuned circuit, the next logical step was to calculate the number of turns of wire to wind on the former.

The computer program listed here will calculate the number of turns required to wind either an "Air-spaced" or a "Dust-cored" coil. It should be noted that the variation in inductance using "Dust-iron" or "Brass" cores depends on the winding length and the core composition, and there is no exact correction factor. As a rough guide, a "Dust-iron" core will give a maximum inductance of twice the "Coreless" inductance and a "Brass" core a minimum inductance of about 0·8 times the "Coreless" inductance.

Using the Program

RUN the program and a list of wire gauge options will appear on the screen. Having decided on the gauge of wire, the coil diameter has to be entered in millimetres. At line 4Ø81 an input prompt asks if a "dust-slug" is to be used. This "slug" is assumed to be three-quarters of the way into the coil and the program adjusts accordingly.

Finally, on inputting the inductance required, the number of turns are calculated and displayed on the screen.

Practical Example

Designing an antenna "Trap" coil

A parallel circuit comprising a coil and a 50pF capacitor is required to resonate at 3·7MHz. If the coil is to be wound on a 38·1mm diameter former using 20 s.w.g. enamelled copper wire, calculate the number of turns.

From resonant frequency program based on the formula $F=1/2\pi\sqrt{LC}$ the inductance was calculated to 37μH. When this value was input to this program the answer was 37·2 turns.

This program should be of value to amateur radio enthusiasts who enjoy building their own equipment. This program could be added to the resonant frequency of a tuned circuit program and the cassette tape *PW Radio Programs–4* features the combined programs.

Rewriting Programs

The programs listed in this Special Feature can be easily rewritten for either Spectrum or ZX81 computers since no machine code is involved. The Radio Range program for Spectrum uses a PLOT and DRAW routine. For the ZX81 this becomes:—

12Ø FOR A = Ø TO 1*PI STEP PI/5Ø
13Ø PLOT 3Ø + 3Ø * COS A, 1Ø + 2Ø * SIN A
14Ø NEXT A
15Ø SLOW

Translation into other BASIC dialects should not prove difficult to perform, only the graphic presentation should need really thinking about.

```
4000 PRINT "WIND A SINGLE LAYER
COIL G3NGD"
4001 PRINT
4005 PRINT "12 SWG","28 SWG","14
 SWG","30 SWG","16 SWG","32 SWG"
,"18 SWG","34 SWG","20 SWG","36
SWG","22 SWG","38 SWG","24 SWG",
"40 SWG","26 SWG","42 SWG"
4008 PRINT AT 11,5;"ENTER WIRE S
IZE"
4009 LET N=0
4010 INPUT S$
4035 IF S$="10" THEN LET N=7.48
4036 IF S$="12" THEN LET N=9.09
4037 IF S$="14" THEN LET N=11.78
4038 IF S$="16" THEN LET N=14.8
4039 IF S$="18" THEN LET N=19.7
4040 IF S$="20" THEN LET N=26
4041 IF S$="22" THEN LET N=33
4042 IF S$="24" THEN LET N=41.5
4043 IF S$="26" THEN LET N=50.3
4044 IF S$="28" THEN LET N=61
4045 IF S$="30" THEN LET N=72.5
4046 IF S$="32" THEN LET N=82.6
4047 IF S$="34" THEN LET N=96.2
4048 IF S$="36" THEN LET N=116.3
4049 IF S$="38" THEN LET N=144.9
4050 IF S$="40" THEN LET N=178.6
4051 IF S$="42" THEN LET N=212
4052 IF N=0 THEN GOTO 4010
4056 PRINT AT 11,5;"WIRE SIZE =
";S$;" SWG"
4060 PRINT AT 13,5;"ENTER COIL D
IAMETER = MM"
```

```
4069 PRINT AT 14,0;"▄▀"
4070 PRINT AT 15,0;"█▄▄▄▄▄▄▄"
4071 PRINT
4073 PRINT "▄▄▄▄▄▄▄"
4074 PRINT "█"
4077 INPUT R
4078 LET P=R*.03937
4079 LET P=P/2
4080 PRINT AT 13,5;"THE COIL DIA
METER = ";R;" MM"
4081 PRINT AT 16,2;"HAS COIL A D
UST-SLUG?  YES/NO"
4082 INPUT B$
4083 IF B$="YES" THEN PRINT AT 1
6,2;"**** THE COIL IS ""SLUG- TU
NED"""
4084 IF B$="YES" THEN GOTO 4087
4086 PRINT AT 16,2;"----------AI
R SPACED----------"
4093 PRINT AT 18,8;"INPUT MICROH
ENRYS = ";
4094 INPUT J
4095 IF B$="NO" THEN LET H=J
4097 IF B$="YES" THEN LET H=J/1.
5
4098 PRINT AT 18,8;"INDUCTANCE =
 ";J;" UH.    "
4100 LET W=(H*5)/(P**2*N)
4120 LET E=(.36*(N**2*P**3)/H)+1
4130 LET G=(SQR E)+1
4140 LET W=W*G
4145 LET W=INT (W*10+.5)/10
4150 PRINT AT 21,0;"WIND ";W;" T
URNS OF ENAM WIRE"
```

REVIEW—G3WHO RTTY PROGRAM

I think Peter is the sort of chap who would probably renew his *RAMTOP* subscription at the end of the year whatever I said about his RTTY program so you needn't think I'm creeping when I say that it's good: it's very good. I've been using it with the *RAMTOP* KTU terminal unit for a couple of months now and, in its present form, I can find little about it that I would like changed. Earlier versions of the program lacked one or two refinements now included and it's hard to see what more Peter can do to bring about further substantial improvement.

The program is currently available on tape or disc. Peter has deliberately made the program easy to copy so that one's own "customised" version can easily be kept. Various alterations might be made to the original by an individual user. Each function key, for example, can call a pre-programmed message, switch between TX and RX and so on. The owner's callsign can be programmed in and called by a single symbol in the text. When these adjustments have been made to the BASIC part of the program, the user will want to record the result for use and he'll probably want to put away a security copy.

When the program is running, the screen is split into two halves by a horizontal line. Received text appears above the line and text for transmission can be prepared below the line. The 80 column mode allows plenty of space and is not too difficult to read on an ordinary black-and-white portable television. Special characters can be typed into the text to force new lines, to print the current clock time (initiated by the user after loading the program), to send a c.w. identification and so on. Two volatile memories can also be recalled in this way. "Volatile" simply means that up to 12 characters can be stored in each and changed easily; this is in contrast to the pre-programmed messages. One obvious use is for storing the callsign of the other station in the current QSO. This can be "captured" from the received text on the screen and stored in memory 1 by holding down the <CTRL> key and pressing <D>. Another control code opens up the memory for the direct entry of a string. Others clear each half of the screen, toggle between 50 and 45.45 baud or between TX and RX and so on.

My copy of the program is set up so that a complete CQ text, my name and QTH details and my working conditions are each available at the touch of a function key. My F8 clears the TX screen and sets up a carriage return and a few RYs ready for transmitting together with anything else I can get typed in before the other end stops sending. His message, of course, is still appearing at the top of the screen while I'm trying to fill the bottom. I can then sit back until it's time to press the TX key (my F9). I can then continue typing in the end of my message while the first part is being sent. The transmitted audio tones are generated inside the computer itself.

I know there are other programs available which I've not had the chance to use and so I'm not going to make any claims for Peter's program over against the merits of those. All I know is that I like it and have had lots of successful RTTY contacts using it with the *RAMTOP* KTU interface.

If you've got a BBC B then you could do a lot worse than build the KTU and send off for a copy of this program. I reckon it's good value.

Available from **Dr. P. J. Harris (G3WHO), 10 Appleby Close, Great Alne, Alcester, Warks, B49 6HJ** price £7·50 on cassette or £9·50 on disc incl. p&p.

This review, by G4NWH, is reprinted, with permission, from the September issue of *RAMTOP*.

RAMTOP Newsletter

One of the most useful publications for the radio amateur with a computer is *RAMTOP*. Available on subscription this is an interesting newsletter packed full of useful programs and information. Produced by Wellingborough School, *RAMTOP*, edited by G4NWH, is issued quarterly in January, April, July and September, and contains program listings, circuit diagrams and ideas for adapting a wide range of microcomputers for Amateur Radio users. As *RAMTOP* is a member of the Sinclair Amateur Radio Users Group no material specific to Sinclair computers is published. However this does not mean that *RAMTOP* is of no interest to Sinclair owners.

RAMTOP costs £4·50 *per year from* **Wellingborough School, Wellingborough, Northamptonshire NN8 2BX.**

Note that £4·50 sent now will give you the three issues so far published plus the January 84 issue. All subscriptions are renewable after the January 84 issue.

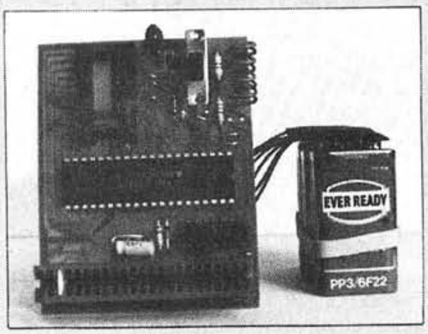
EPROM PROGRAMMER FOR ZX81

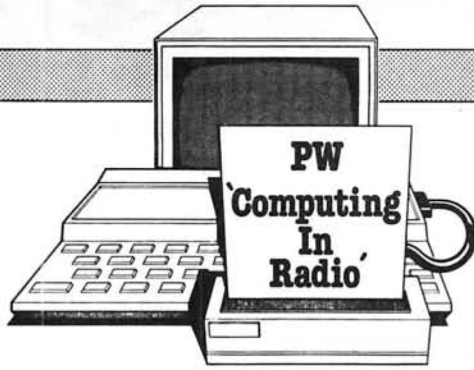
The PROMER-81 is a low cost ZX81 EPROM programmer for 2516, 2532, 2716, 2732 now available from Cambridge Microelectronics. At a price of £19.95 + VAT it should persuade users to put their programs in EPROM. Pricing tables, toolkits, educational and scientific programs, assemblers, text editors etc., can be instantly and reliably called up from ROM readers like the ROM-81 and DREAM-81, also from the same company.

All the standard programmer functions of CHECK, SPECIFY, READ, PROGRAM and VERIFY are provided. The control program contains various safety features e.g., a check on Vpp status before executing a task. User Notes give easily understood guidance on procedure, and the additional routines necessary for blowing EPROMs to work with the ZX81.

Four PP3 batteries are required, to provide a regulated programming voltage. The control program is supplied on tape. The menu driven program with on-screen prompts is designed to make it easy for the newcomer. PROMER-81 comes assembled and tested, with an extension connector at the rear.

Cambridge Microelectronics Ltd., 1 Milton Road, Cambridge CB4 1UY. Tel: 0223 314814.





SIMPLE OUTPUT PORT FOR ZX81

Before a computer can be used to perform real tasks rather than just play games or carry out simple calculations it needs some means of actuating other devices.

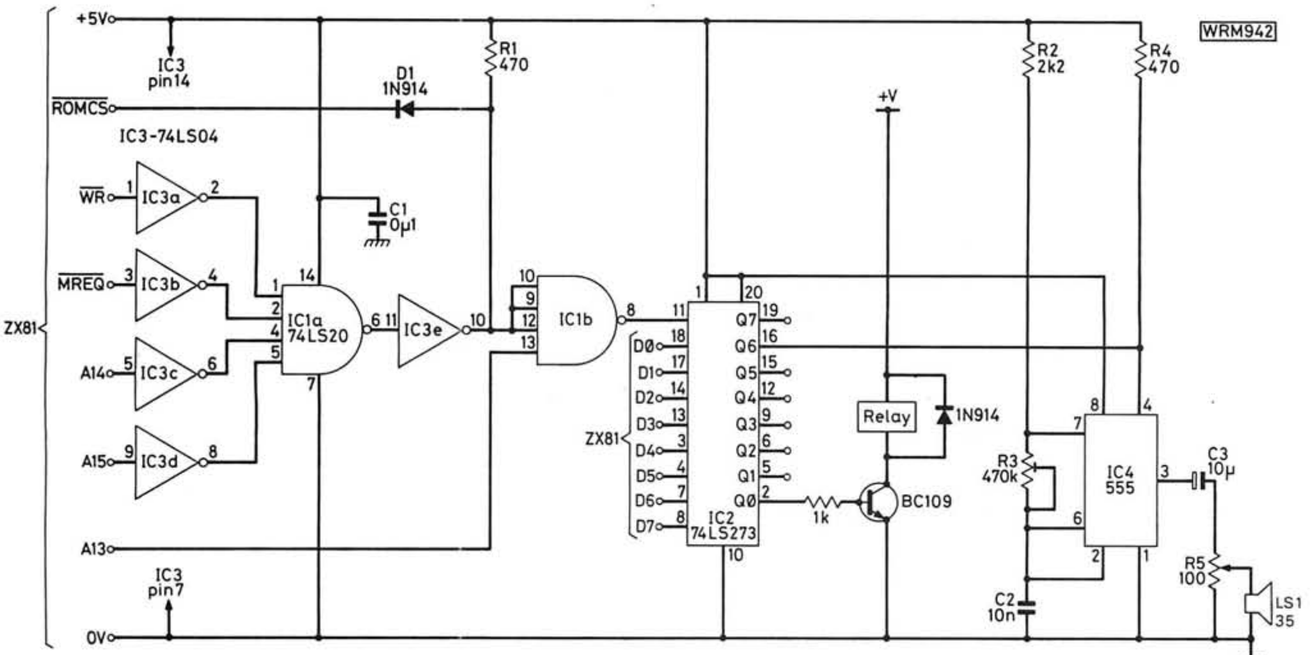
The circuit shown in Fig. 1 is based on the output port designed for use with the *PW Structured Morse Learning Course*. The port in fact has eight output terminals only one of which can be at logic level 1 (+5V) at any given time. By POKEing different values into the appropriate address you can determine which terminal is energised and hence turn on and off anything which can be attached to the terminals.

The circuit shows two such devices. The Morse practice oscillator is attached to pin 16 (Q6) and is switched on when Q6 goes high and off when it goes low. The transistor switched relay is connected to QØ (pin 2) and the relay is energised when QØ goes high. Note that the relay supply can be any positive voltage (e.g. 12V) and the relay would be chosen to suit this voltage.

The relay contacts could be used to drive a motor or switch an electrical load on and off at the command of the computer program. An example would be to switch the antenna rotator on and off as determined by the satellite tracking program on *PW Radio Programs — 1* "ORBITS".

A subroutine would need to be written to POKE 8192,16 if the antenna azimuth needed altering and POKE 8192,Ø to stop the rotator when it had achieved the correct position. Obviously some form of positional feedback would be required and this would need to be input into a suitable input port.

POKE 8192,	IC2 pin at logic 1	
Ø	All outputs low	
1	19	Q7
2	16	Q6
4	15	Q5
8	12	Q4
16	2	QØ
32	5	Q1
64	6	Q2
128	9	Q3



Note. Memotech 16K RAM packs. Set switches 1 and 3 DOWN, 2 and 4 UP.

EPROM READER FOR ZX81

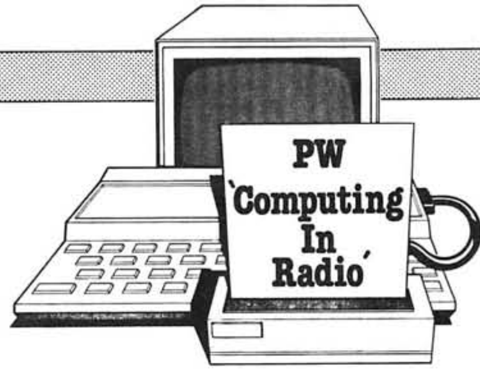
The ROM-81 is a memory expansion unit for the ZX81 personal computer which enables the user to read useful routines and commonly used information, stored in u.v. Erasable, Programmable Read Only Memory (EPROM). The unit is supplied without EPROMs as these are normally programmed and provided by the user.

Two 24-pin sockets allow either 2716 or 2732 EPROMs to be used. They can provide up to 8Kbytes of memory in 2K increments. The sockets are decoded to lie between 8K and 16K in the ZX81 memory map, which is just below the BASIC area. Separate 2K and 4K decoding is link selectable to make it possible to vacate locations occupied by other peripheral cards.

The most popular EPROMs have a maximum access time of 450 ns, which is too slow for the ZX81. A special "Wait State" circuit in the ROM-81 automatically requests the c.p.u. in the ZX81 to wait until data has been read. "Wait States" do very slightly decrease the speed of operation of the computer and affect precise calculations of delay loops. The key device has therefore been socketed. Removing it will prevent implementation of "Wait States".

ROM-81 comes in a black plastic case with a screwed down cover for quick accessibility without vulnerability. It plugs on to the ZX81 with an adaptor at the rear of the box for further expansions. It is supplied with easy to follow User Notes which give the programs for data retrieval.

Price is £14.95 plus VAT from **Cambridge Microelectronics Ltd., 1 Milton Road, Cambridge, CB4 1UY. Tel: 0223 314814.**



G4BMK DRAGON MORSE TUTOR PROGRAM

This program contains all the features you need for learning both to read Morse up to any speed you like, and also to send good Morse via a "squeeze" keyer.

Being written entirely in Assembler (machine code) the program contains more sophisticated facilities than those found on most Morse tutor programs. It will operate at up to 99 w.p.m.—faster than any BASIC program can manage.

Audio tones are produced via the TV loudspeaker, and also appear on the Dragon cassette output for taping or transmission.

Learning the Morse alphabet is made simple by introducing letters gradually in the order of their ease of learning. You can build up at your own rate until the whole alphabet is mastered. 36 five-letter random groups of the selected letters are sent at the speed of your choice.

The program includes a library of over 250 words which can be produced in random sequence, and which have been carefully chosen to reduce guessing, and also to include many common c.w. word abbreviations which you will encounter on the h.f. amateur bands.

Number groups, and mixed letters/numbers/punctuation groups can also be generated.

Learning Morse by "pattern recognition" is encouraged by allowing you to request extra gaps between letters, whilst the letters themselves are sent at a minimum speed for correct overall sound.

The program includes a send practice facility which simulates the electronics of an iambic "squeeze" keyer. This can be activated either directly from the Dragon keyboard, or via your own paddle connected to the joystick sockets. Thus you can become a proficient sender before buying an expensive electronic keyer. The program decodes the Morse that you send, showing the letters on the TV screen. You will soon find that good spacing is encouraged. Procedural symbols such as $\overline{AR}$ and $\overline{CT}$ are also decoded.

The program is supplied on a high quality audio cassette tape for easy loading into your Dragon-32 computer.

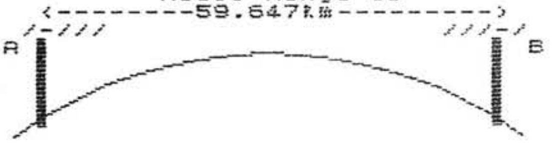
The software can also be provided on an EPROM as an addition to the G4BMK RTTY cartridge or to the G4BMK CW QSO cartridge.

Prices are cassette tape £8.50, cartridge upgrade £12.00 incl. post from **M. J. Kerry, 22 Grosvenor Road, Seaford, East Sussex BN25 2BS. Tel: 0323 893378.**

Please supply your callsign or other identification with your order.

SPECTRUM — RADIO RANGE by G3NGD

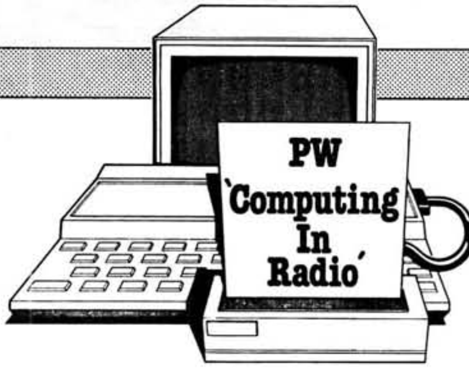
```
Radio Range-Height Calculations
             by G3NGD
   © 1983 IPC Magazines Ltd

         Radio Range is
  <--------59.647km---------->
 /-///                   ///-/
A                              B
```



```
Antenna A height= 100m asl

Antenna B height= 20m asl

Line of sight 51.656km

      More Yes/No?
```

```
  25 CLS
  30 PRINT "Radio Range-Height C
alculations"
  31 PRINT "             by G3NGD
"
  32 PRINT "   © 1983 IPC Magazi
nes Ltd"
  40 PRINT AT 6,1;"/-///
                   ///-/"
  50 PRINT AT 7,0;"A █
                   █ B"
  60 PRINT AT 8,2;"█
                   █"
  70 PRINT AT 7,2;"█
                   █"
  80 PRINT AT 9,2;"█
                   █"
  90 PRINT AT 10,2;"█
                   █"
 [illegible] PRINT AT 11,2;"█
                   █"
 [illegible] PLOT 237,75: DRAW -232,0,.4
*PI
 160 PRINT AT 5,12;"Horizon"
 170 PRINT AT 15,0;"Input height
 of Antenna A              "
 180 PRINT AT 17,1;"in metres ab
ove sea level"
 190 INPUT F
 200 PRINT AT 15,0;"Antenna A he
ight= ";F;"m asl          "
 210 LET D=SQR (F*12.74)
 220 PRINT AT 5,2;"<------------
--------------->"
 230 PRINT AT 17,1;"Input height
 of Antenna B asl"
 240 INPUT H
 250 PRINT AT 17,0;"Antenna B he
ight= ";H;"m asl          "
 260 LET J=SQR (H*12.74)
 270 LET K=D+J
 280 LET K=INT (K*1000+.5)/1000
 290 LET S=SQR (16.986666*F)
 300 LET T=SQR (16.986666*H)
 310 LET L=S+T
 320 PRINT AT 4,9;"Radio Range i
s"
 330 LET L=INT (L*1000+.5)/1000
 340 PRINT AT 5,11;L;"km"
 350 PRINT AT 19,0;"Line of sigh
t ";K;"km"
 360 PRINT AT 21,6;"More Yes/No?
"
 370 LET Y$=INKEY$
 380 IF Y$="Y" THEN CLS : GO TO
20
 400 IF Y$="N" THEN STOP
 410 GO TO 360
4000 SAVE "RANGE" LINE 25
```

by J T Beaumont G3NGD



DESIGNING METERS USING A SPECTRUM

Now is the time to convert that "surplus milliammeter" in the "junk box" into a useful multimeter. Today, instruments can be costly items and young electronics enthusiasts tend to purchase the cheapest instrument, usually with a low sensitivity.

The complete program enables the value of "Shunts" and "Multipliers" to be calculated using a ZX81 computer, and will enable a milliammeter to be converted to read either as a Voltmeter or as an Ammeter. The connections and shunt or multiplier values are shown as the program "runs". Only the ammeter section of the program is reproduced here. The complete program is available on *PW Radio Programs—4 cassette.*

When the program has been entered it should be SAVED on tape; the instruction being GOTO 14ØØ. On completion the program will "self-run" and go to line 1Ø.

The prompt at line 12Ø will ask if the basic milliammeter is calibrated in Amperes, Milliamperes or Microamperes, line 16Ø being to ensure validity of data.

The program to extend the range of an ammeter is contained in lines 28Ø–64Ø. Input the internal resistance of the movement at line 41Ø and then the "full scale deflection current" (f.s.d.) as requested.

At line 53Ø the "new current" required is input in amperes. (Note: to extend the range in milliamperes: 1mA = 0·001A). The value of both the shunt resistance and its power rating is then displayed. ENTER will start the program again.

```
   5 GO TO 1430
  10 PRINT "to extend the range of a meter"
  20 PRINT
  30 PRINT "Is instrument f.s.d. in :"
  40 PRINT
  50 PRINT "   a. ""amperes (A)"""""
  60 PRINT
  70 PRINT "   b. ""milliamperes (mA)"""""
  80 PRINT
  90 PRINT "   c. ""microamperes (uA)""   "
 100 PRINT AT 18,3;"Select letter then ENTER."
 110 LET a=0
 120 INPUT s$
 130 IF s$="a" THEN LET a=1
 140 IF s$="b" THEN LET a=1e-3
 150 IF s$="c" THEN LET a=1e-6
 160 IF a=0 THEN GO TO 110
 170 CLS
 280 PRINT " EXTEND THE RANGE OF AN AMMETER "
 285 PRINT AT 2,14;" moving"
 286 PRINT AT 3,14;"  coil "
 287 PRINT AT 4,14;"movement  "
 290 PRINT AT 5,15;"▄▄▄▄▄▄▄▄"
 300 PRINT AT 6,15;"█      █"
 310 PRINT AT 7,15;"█      █"
 320 PRINT AT 8,6;"--->-----█ █-->--"
 330 PRINT AT 9,6;":         █ █   :"
 340 PRINT AT 10,6;":          █ █   :"
 350 PRINT AT 11,6;":          ▀▀▀ ▀▀▀   :"
 355 PRINT AT 13,6;":                :"
 360 PRINT AT 14,6;":           shunt      :"
 370 PRINT AT 15,6;":          ▀▀▀ ▀▀▀   :"
 380 PRINT AT 16,6;"-------->--█ █-->---"
 390 PRINT AT 17,16;"▀▀▀▀▀▀▀"
 395 PRINT AT 12,1;"->---.            :-->--"
 400 PRINT AT 20,1;"Input resistance of movement  "
 410 INPUT R
 420 PRINT AT 8,16;R;"R"
 430 IF S$="a" THEN LET a$="A"
 435 IF S$="b" THEN LET a$="mA"
 440 IF S$="c" THEN LET a$="uA"
 450 PRINT AT 6,11;a$
 460 PRINT AT 20,1;"How many """;a$;""" is the f.s.d.?     "
 470 INPUT C
 480 PRINT AT 8,10;C;a$
 520 PRINT AT 20,1;"Input new f.s.d. in amperes    "
 530 INPUT N
 540 PRINT AT 12,0;N;"A->"
 550 LET S=N-(A*C)
 560 PRINT AT 16,8;S;"A"
 570 LET V=R*C*A
 580 LET X=V/S
 590 LET X=INT (X*10000+.5)/10000
 600 PRINT AT 20,1;"Shunt resistance = ";X;" ohms     "
 610 LET W=S↑2*X
 620 LET W=INT (W*100+.5)/100
 630 PRINT AT 21,1;"Wattage of shunt = ";W;"W"
 640 PAUSE 1000
 650 CLS
 660 CLEAR
 670 GO TO 10
1410 CLS
1420 SAVE "METERS" LINE 1425
1425 CLS
1430 PRINT "   ##########################"
1440 FOR J=1 TO 18
1450 PRINT TAB 3;"#";
1460 PRINT TAB 28;"#"
1470 NEXT J
1480 PRINT "   ##########################"
1490 PRINT AT 3,0;"         TO EXTEND THE RANGE         "
1510 PRINT AT 4,0;"   OF A VOLTMETER OR AN AMMETER      "
1520 PRINT AT 9,11;"written by"
1530 PRINT AT 11,7;"J.T.BEAUMONT - G3NGD"
1535 PRINT AT 15,5;"©1983 IPC Magazines Ltd"
1537 PRINT AT 13,5;"for PRACTICAL WIRELESS"
1540 PAUSE 1000
1550 CLS
1560 GO TO 10
1565 RUN 1430
```

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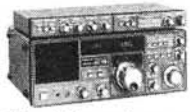

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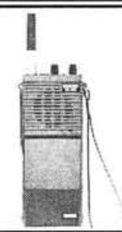

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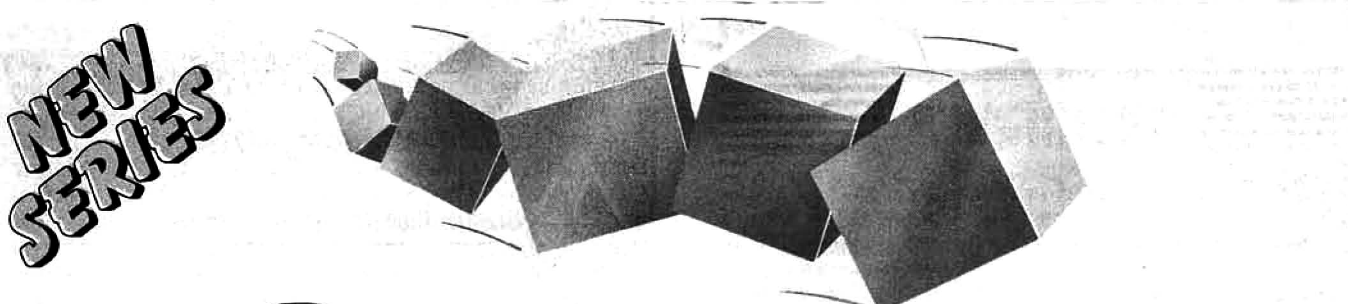

PACKET RADIO

by Margaret Morrison KV7D and Dan Morrison KV7B
Part 1

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Imagine sitting down in front of your station for an evening. You get out your 144MHz f.m. transceiver, attach it to a cable coming from a 200 × 200 × 76mm "black box" connected to your data terminal. After turning everything on and initiating a short dialogue between the terminal and the box, you enter a friend's callsign. After a short pause you see:

***CONNECTED to (callsign)

on your terminal. From this point on, everything you type appears on your friend's terminal, and everything he types appears on yours. Your friend could be within simplex range, or within voice repeater distance, or accessible only via a series of linking stations. In fact, you might need a satellite link to talk to your friend!

He asks, "Would you like a copy of my latest program for playing, 'Escape The Maze'?"

"Sure," you reply, "only my compiler can't handle your gigantic programs. Why don't you just send me a dump of the machine language (binary) program?"

"No problem. Let me know when you're ready," he sends back.

You go over to your home computer, power it up, load your communications program, connect it to the box instead of the terminal, and type, "OK, let 'er rip."

Then you start your file-loading program and wait. Soon, binary data begins arriving from your friend at slightly less than 120 bytes of data per second. You sit back relaxed, knowing that even though the QSO is being held under noisy conditions, with occasional QRM breaking through, you won't receive a single bit incorrectly.

After the program has been stored away, you resume your conversation. It is almost boringly error-free, and with the speaker disconnected from your radio you don't even hear the QSO, which is being periodically interrupted by the automatic identification of both stations in c.w. Later on you try out the new program and, sure enough, find you've received the whole thing perfectly.

Does this sound like magic? It shouldn't—it's happening right now with packet radio.

Packet radio promises to open new worlds of communications undreamed of just a few years ago by making possible the rapid transfer of digital information over great distances—with a virtual guarantee of integrity down to the last bit. This is tremendously attractive. Not only can traffic be exchanged between hams equipped with data terminals, but just as easily between a ham and a computer, or between two computers.

Let's look first at what a packet is and then at the history of packet communications and the kind of hardware and software packet radio requires. We will use the two most familiar systems to serve as examples, although others are in use as well. These two are the VADCG (Vancouver Amateur Digital Communications Group) system and the TAPR (Tucson Amateur Packet Radio) system.

What is a Packet?

Packet radio is a relatively new form of digital communications. It has some characteristics in common with older forms, such as ASCII and RTTY, now both familiar to the Amateur community. In all of these modes information is coded in binary form, that is, as a series of *1*s and *0*s. The information is translated into an audio signal consisting of alternations between two tones, and the audio signal then used to modulate an r.f. signal to produce an f.s.k. (frequency shift keying) or a.f.s.k. (audio frequency shift keying) transmission.

In an ASCII or RTTY system, the transmission typically consists of a sequence of individual characters separated by periods of unmodulated carrier transmission. In order for the receiving station to interpret the characters correctly, extra transitions are added at the beginning and end of each character (start and stop bits). Depending on reception conditions, anywhere from all the information to virtually none of it may be received correctly; what's not received correctly may be garbled or missed completely.

A packet consists of binary data (which might be ASCII, Baudot, or some other code), and the modulation techniques may be essentially the same as for conventional ASCII or RTTY, although the exact interpretation of the tones may be different. The VADCG and TAPR TNCs produce a.f.s.k. but more sophisticated schemes are being developed. (The TNC, or terminal node controller, is the "black box" referred to in the introduction to this article. It is a complete microcomputer-based communications system with a good-sized memory, 30 kilobytes in the case of the TAPR TNC. It does all the work involved in sending and receiving packets).

In a packet, the individual characters, or bytes, are run together with no space at all between. This eliminates the need for both the start and stop bits as well as the dead time between characters. The result is much more efficient information transfer. The analogue of start and stop bits are sent only for the beginning and end of the packet, and the transmitter is keyed only while information is actually being sent.

Extra information is inserted into each packet that enables the receiving station to determine automatically whether the packet was received without error. Thus every correctly received transmission is acknowledged. The sending station can keep retransmitting its information until it is assured that it has got through. Other features of the packet which facilitate this "handshaking" are described later.

History of Packet Radio

Packet switching is a technology that was developed to tie computer users into a network which could extend over a wide area. It has been used for many years over common carrier lines, both commercially and by government. The first large-scale packet network in North America was ARPANET, set up in 1969 by Bolt Beranek and Newman, Inc., for the Defense Advanced Research Projects Agency. This network introduced packet switching, in which each message sent is broken up into small packets and each is switched to its destination over the quickest communications path available at that instant. Data interconnections are typically 50 kilobit-per-second wideband lines, and the packets are passed from node to node until they arrive at their destination. Typical end-to-end times are 250 milliseconds, and receipt of data is acknowledged.

Other networks around the world soon began operation, and today there are many government and commercial computer networks, such as TYMNET and TELENET, which allow users all over the country to access thousands of computers remotely.[1]

Packet radio experiments began in the 1970s. One of the largest packet radio systems, based at the University of Hawaii and known as the ALOHANET, linked together a number of computers and users, and also provided access into ARPANET and satellite links.[2] Other systems were developed for the purpose of providing distributed automatic digital communications for remote sensing stations.

Packet switching networks (both wire and radio based) generally use one of two methods for routing packets from the originating station, through intermediaries, to the destination. In one system used by TYMNET and others, a central controller determines the optimum path for a particular pair of stations on the basis of the stations present in the network at any time. In the other system, the network itself is intelligent and determines the routing between stations. This is the system that was pioneered by ARPANET.

North American Amateurs first entered the picture in Canada, where, beginning in 1978, the Department of Communications encouraged the use of packet radio by permitting Amateur packet transmissions and by giving exclusive use of 221 to 223MHz and 433 to 434MHz to packet and digital transmissions. Taking advantage of this ruling, VADCG, a group of Vancouver, British Columbia, designed the first well known Amateur packet radio TNC, and soon TNCs became widely distributed.[3] Their use in the US followed a rule by the FCC making such ASCII transmissions legal in March of 1980. Finally, in October of 1982, the FCC revised Part 97.69, lifting many restrictions on digital communications and advanced data transmission. Today many experimenters using the VADCG TNC, the TAPR TNC, and home-brew systems are hard at work, developing this new mode of communications.

Anatomy of a Packet

The basic element in packet radio is the frame—a string of bits with a specific format. The bits are presented to the transmitter on a modulator output line. In the case of the TAPR and VADCG TNCs, the modulation system uses 1200Hz and 2200Hz tones and coherent (phase-continuous) f.s.k., with a data rate of up to 1200 bits per second; it is compatible with the Bell 202 standard modem. Other modulation systems being developed for Amateur use include minimum shift keying (m.s.k.), and various forms of phase shift keying (p.s.k.). These schemes, which are more efficient than ordinary f.s.k., are useful for long-haul traffic, especially via satellite.[4]

The f.s.k. signal is related to the bit stream according to specific digital encoding rules. The most commonly used system is non-return to zero inverted (NRZI) encoding. In this system, a transition from one tone to the other is interpreted as a *0*, whereas no transition during the bit period is a *1*. Such a method is used because, according to the rules by which the frame is constructed, a transition is guaranteed at least once in every five bit periods. This is needed to keep the receiving station in "sync" with the incoming data.

The actual structure of the frame varies from one packet radio system to another. The structure makes possible, among other things, the delivery of the message to the proper recipient and a system for ensuring data integrity. The most frequently encountered format for frames is known as HDLC, or High Level Data Link Control. Each HDLC frame consists of six fields, as shown in Fig. 1.

FLAG 1	ADDR	CONTROL	DATA	FCS	FLAG 2

Fig. 1

In order of transmission, FLAG1 is first. It is at least eight bits long, consisting of the bit pattern *01111110*. This particular combination is unique to FLAG1 and FLAG2, and appears nowhere else in the frame. Part of the transmitting station's job is to alter the message content of the frame to prevent this combination from appearing elsewhere (a process known as bit-stuffing). This alteration is, of course, undone by the receiving station. FLAG1 (which may be repeated several times before the rest of the frame is sent) says, "Get ready! Here comes a frame!"

The ADDR (address) field varies among the various packet radio systems developed in the Amateur community. HDLC requires only that it be at least one byte long. It typically contains the source address, and may contain the destination address and perhaps routing information. The address field contains the information which permits delivery of the packet.

The CONTROL field also varies among systems. The length of this field specified by HDLC is one or two bytes. The information contained in this field typically includes acknowledgment information for previous packets successfully received; an indication that the sender would like to begin talking (connect) to the destination station; a request to terminate the conversation (disconnect); or other "supervisory" functions, such as requests to stop transmitting or to resume transmitting (referred to as flow control).

The DATA field consists of zero or more bytes of information (zero in the case of simple acknowledgments, for example). They may be in any bit pattern—ASCII characters, part of a binary program, you name it. (The FCC, however, would like you to have available enough information so they can decipher your data!) The HDLC standard requires that when five consecutive *1*s appear a *0* be inserted. This is the bit-stuffing mentioned above. It prevents data from being mistaken for flags, and also ensures frequent tone transitions if NRZI encoding is used. Upon reception, these extra *0*s are discarded. Typically, the maximum data length is 128 to 256 bytes.

The last item in the frame prior to the ending flag bits is the FCS, or frame check sequence, an extremely important two-byte number computed by the transmitting station based on all the bits in the frame following FLAG1. If the frame is received in garbled condition it is extremely unlikely that it would be garbled in such a way as to produce the same FCS. The FCS is separately computed by the receiving station and, if both numbers agree, there is virtual certainty that the frame was received as sent.

Finally, the frame ends with another byte of flag field, thus indicating to the receiving station that the previous two bytes were indeed the FCS.

Protocols

What we have described is not yet truly packet radio. It could be called "frame radio", the exchange of frames of information. The protocol, in addition to specifying the structure of the frame, determines the contents of the ADDRESS, CONTROL, and possibly the DATA fields. It also determines action to be taken in various situations. For example, just exactly what should be done if the first, second, and fourth frames received in a single transmission check out, but the third does not? Or, what should be done if the other station suddenly stops responding? The list of "what-ifs" increases rapidly as other users join the frequency.

The interchange of packets results in communications between the participating stations on more than one level. The ISO, International Standards Organisation, has defined a model network structure consisting of seven "layers". The first three, levels 1, 2, and 3, are concerned with communications and are the ones of interest to us. Each consists of a set of related tasks which would ordinarily be handled by correspondingly related processes (electrical or software). The ISO layer structure does not define the specific protocol to be followed to accomplish the tasks of any level, and the operation of each level should be independent of how lower-level tasks are performed.[5]

Furthermore, each layer is "transparent" to the levels above it. This means, for example, that information used to direct actions by a level 3 process is treated as data by the level 2 process. A packet is structured like an onion. Each process peels off the applicable control information before passing the remainder to the next higher level.

The bottom layer is called the physical layer. It is concerned with such things as modulation and transmission techniques, signalling the beginning and end of packets, bit-stuffing, and maintaining synchronisation with the incoming data stream. The second level, or data link layer, defines the use made of the address, control, and FCS fields of the packet. Level 2 is responsible for setting up and maintaining a connection or data link with the other station. This includes verifying data integrity, acknowledging receipt of intact frames, retransmitting unacknowledged frames, and performing various link control functions. The third level, the network layer, defines routing the functions and inter-network communication. Level 3 is concerned with setting up and maintaining routing tables for communication between stations which are not in direct contact. Amateur packet radio has implemented some level 3 functions but not all.

An additional set of rules, a collision avoidance protocol, is necessary for packet radio but not for communications over wires. Since stations cannot receive at the same time as they are transmitting, "collisions" occur when two or more stations transmit simultaneously. A scheme for avoiding repeated collisions must ensure different retransmission times after an initial transmission has failed. If all stations can hear each other, as is the case when all transmissions are made on the same frequency and all stations are close together, all that is needed is to impose a short random wait time for stations retransmitting a packet. If a central controller (or a satellite) transmits on one frequency and listens for all other transmissions on another frequency, a more elaborate scheme is required.

The HDLC frame structure described above is imposed on levels 1 and 2 of all protocols implemented so far for Amateur packet radio, and both the VADCG and TAPR TNCs use l.s.i. (large scale integration) chips that perform many of the level 1 and 2 tasks. The two most widely used protocols, VADCG and AX.25, are thus functionally equivalent on level 1 and quite similar on level 2.[6,7] AX.25 is modelled on X.25, a standard developed by the Consultative Committee for International Telegraph and Telephone (CCITT) of the ITU.[8] AX.25 was put forward by a group of Amateurs at the AMSAT packet conference in October of 1982. AX.25 specifies the address as containing Amateur callsigns of both the sending and receiving stations, with optional routing information in the form of the callsigns of stations requested to relay, or digipeat, the packet. The VADCG address field contains a numeric address of the sending station only; packets setting up the connection contain callsign information in the data field. Relay by an unspecified digipeater can be requested. The control functions implemented in AX.25 are summarised in Table 1. Most control functions can be performed by a packet which also transmits data. Fewer level 2 control functions are specified in the VADCG protocol.

Implementation

If you have a home computer, you are probably wondering where you can get a packet radio program for it. You may even be thinking about writing one yourself. The only hitch here is that you need more than a program. At a minimum, you need some hardware to enable the computer to control the radio push-to-talk line, put signals into the microphone input, and interpret signals on the speaker output. Specialised hardware, such as an HDLC controller, is very desirable. This hardware must be able to generate interrupt requests to the computer. The program itself should take care of the input and output require-

TABLE 1. LEVEL 2 CONTROL FUNCTIONS

RR	Receive ready: acknowledge receipt of information frames by specifying the sequence number of the last packet received.
RNR	Receive not ready: request to stop sending (receive buffers full).
REJ	Request retransmission of missed frames after receipt of a frame number larger than expected.
DM	Disconnected mode: response to a packet other than a connect request.
SABM	Set asynchronous balanced mode. This is a connect request.
DISC	Disconnect request.
UA	Unsequenced acknowledgment: sent in response to a connect or disconnect request.
FRMR	Reports an abnormal condition; that is, receipt of a packet with an undefined or invalid control byte.

ments of both the radio and the terminal through interrupt processing. You can't afford to miss part of an incoming packet because you got busy parsing a line from the terminal! This means that the program probably has to be written at least partly in assembly language. Interpreted languages, such as BASIC, are commonly used on small computers, but they are neither fast enough nor versatile enough for real-time programming of this kind. These obstacles are not insurmountable, and in fact many hams have been successfully running packet radio programs on various home computers.

There are disadvantages with this approach, however. These programs are not very portable: they work on a specific computer with a specific operating system, and depend on the specific configuration of the hardware "extras". The programming has to be separately done for each different type of computer. Modifying a protocol would be a major undertaking involving reprogramming many computers. Furthermore, many hams who don't own computers or who don't want to get involved in a programming project are interested in packet radio. After all, an RTTY terminal unit or a c.w. keyboard need not be connected to a computer. This is why most Amateurs involved in packet radio are using a terminal node controller. The TAPR and VADCG TNCs have standard terminal interface connections, and provisions for versatile radio interfaces. The ROM memory chips can be programmed with software implementing a standard packet radio protocol, and, once such software is written, it can be easily transferred to any similar TNC. Since the TNC is basically a dedicated microprocessor, the demands of radio communications do not interfere with a resident operating system.

Packet Radio—Communications of the Future

Hams all over North America are now involved in sending packet radio messages across town on v.h.f. or u.h.f. bands. Digipeater relays and ordinary voice repeaters make it possible to communicate over distances of 100 miles or more. Packet radio mailboxes and bulletin boards are on the air in several areas. Interest is growing rapidly in this newest mode of communications. With more experimentally inclined packeteers joining the ranks, exciting developments will be forthcoming. The emphasis for the future will be on long-distance communications and inter-network linking protocols. Experimental h.f. packet communication has been done on 28MHz. Inter-network communications through u.h.f. and microwave linking stations using high data rate modulation techniques are envisaged. The digital special communications channel on the AMSAT Phase III-B satellite will see use by packet radio stations. Groups are working on protocol standards for this application and on L-band amplifiers to allow inexpensive access to this satellite mode. Possibly the most ambitious project in the works is a packet radio satellite with a store-and-forward mailbox as well as direct relay capability.

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Tucson Amateur Packet Radio Corporation Packet System Beta Test (1983). This manual contains information on AX.25, VADCG protocol modulation, and HDLC.

Part Two will continue with a detailed description of the TAPR terminal node controller; it will provide a clearly defined set of interface requirements and point out pitfalls to be avoided in making reliable radio connections.

Did You Know...

That 80 years ago, American ships used a sewing-machine needle to detect wireless signals?

In the early days of radio communication, various methods were employed to rectify wireless waves. Marconi had originally used a Branly coherer; during the Russo-Japanese war of 1904/5, in which wireless was used extensively, the fashionable rectifying device was the battery-operated electrolytic detector—a mixture of lead shavings, water, glycerine and metal filings in which were set two electrodes less than a millimetre apart. As early as 1874 Ferdinand Braun, of Strasbourg, discovered that a crystal of certain materials, with a fine wire or needle-point resting lightly against it, had the property of rectifying alternating currents. This was the basis of the widely used "crystal detector", though such a detector did have the disadvantage of being difficult to set correctly, and its setting could easily be broken by the slightest vibration. A popular version of the crystal detector, especially on American ships, consisted of an ordinary sewing-machine needle held in contact between two pieces of aluminium by a strong spring. Crystal detectors, in the form of miniature diodes, are in use at the present day.

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2N4440	6.50	SD 1135	8.42	MRF 245	30.10
2N5016	6.72	SD 1136	11.80	MRF 247	34.00
2N5090	16.80	SD 1143	8.50	MRF 260	5.00
2N5109	2.01	SD 1219	11.40	MRF 261	7.00
2N5179	0.86	SD 1229FL	7.80	MRF 262	10.40
2N5485	0.62	SD 1272	10.20	MRF 264	11.00
2N5486	0.66	SD 1272FL	10.20	MRF 314	25.06
2N5589	4.70	SD 1407	22.50	MRF 401	10.84
2N5590	6.85	SD 1410	19.68	MRF 406	11.83
2N5591	8.90	SD 1412	27.18	MRF 421	31.57
2N5635	5.20	SD 1416	30.00	MRF 422	35.52
2N5636	9.70	SD 1418	26.22	MRF 449A	14.00
2N5637	11.25	SD 1428	23.00	MRF 450A	11.40
2N5641	5.35	SD 1429	13.98	MRF453	15.30
2N5642	7.90	SD 1444	3.00	MRF454A	18.80
2N5643	13.00	SD 1488	26.25	MRF 455	13.80
2N5913	2.10	2SC730	3.84	MRF 460	15.78
2N5944	6.90	2SC1165	5.88	MRF 464	31.57
2N5945	8.95	2SC1177	16.14	MRF 472	2.50
2N5946	11.40	2SC1306	1.44	MRF 475	2.40
2N6080	5.10	2SC1307	2.34	MRF 476	1.71
2N6081	6.75	2SC1678	1.44	MRF 477	10.70
2N6082	8.45	2SC1946A	18.54	MRF 515	2.70
2N6083	8.75	2SC1947	9.24	MRF 604	1.60
2N6084	11.70	2SC1970	2.76	MRF 607	2.20
2N6094	5.00	2SC1971	7.50	MRF 629	4.10
2N6095	6.90	2SC1972	10.32	MRF 646	26.24
2N6096	8.40	2SC2237	15.00	MRF 648	35.14
2N6097	13.30	2SC2538	1.62	MRF 901	2.58

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EC91	8.65	6BA8A	3.40
ECC81	1.19	6BH6	2.55
ECC82	1.19	6BQ7A	3.45
ECC83	1.19	6BR8A	3.50
ECC88	2.30	6B26	2.50
ECC91	3.75	6CB6A	2.30
ECH81	2.50	6CD6GA	4.65
EF86	1.35	6CL6	3.40
EL34	2.68	6CW4	6.85
EL84	1.00	6DK6	2.65
KT77	6.80	6DQ5	5.50
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/6939	15.75	6JS6C	5.00
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/6360	9.50	6KD6	5.60
QQVO3-20A		6LQ6	6.00
/6252	63.00	65N7GTB	2.75
QQVO6-40A		6080	11.00
/5894	45.00	6146A	8.00
QVO3-12		6146B	8.00
/5763	5.80	6159B	18.00
UCL 82	1.60	6201	6.30
2D21	2.85	6360	6.00
3B28	14.95	6550A	6.70
4CX250B	37.10	6688	9.80
4CX350A	69.50	6689	12.24
5U4GB	2.50	6883B	7.70
5670	3.40	6973	3.85
5726	2.40	7360	9.50
5763	4.05	7551	5.90
5814A	3.50	7558	9.50
5842	11.20	7591A	3.80
5965	3.25	7868	3.95
6AH6	4.75	811A	14.75
6AK5	3.55	812A	18.55
6AK6	2.00	813A	60.00
6AN5	4.40	866A	15.00
6AN8A	3.20	872A	15.65
6AQ5A	2.15	8298A	4.90
6AS6	5.10	8417	5.80
6ASTG	6.45	931A	18.20
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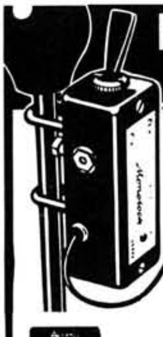

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M·O·R·S·E K·E·Y·E·R

by A. P. Cooper

Morse keyers need not be tremendously complicated or expensive to construct.

The circuit shown in Fig. 1 has been designed to provide a dot to dash ratio of one to three, with variable speed control provided by dual gang potentiometer R2.

Construction of the keyer is non-critical and can be based on a p.c.b. or the Veroboard layout shown. Unused pins of the 74LS221 integrated circuit IC1 may be left open circuit. The low current "bleeper" is directly driven from the dual monostable i.c. but do observe the correct polarity when connecting up.

A paddle arrangement was constructed using an ordinary flexible nail file allowing "side-swipe" action to operate the s.p.c.o. configuration obtained. The switch poles consisted of Veropins soldered into the circuit board on either side of the paddle arm. It is recommended that for maximum reliability gold plated pins are used. ●

★ components

Resistors
¼W 5% carbon film
4·7kΩ 2 R1,4

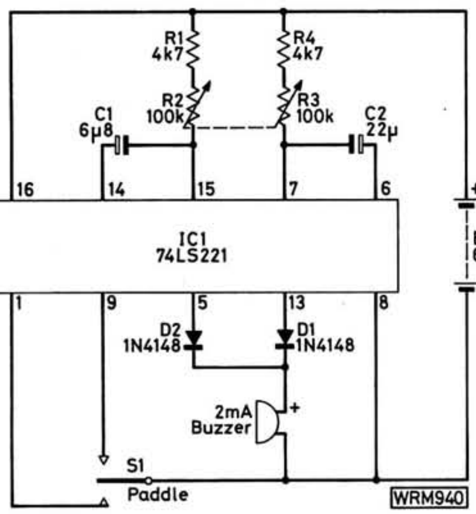
Ganged potentiometer ¼ inch spindle
100kΩ (Lin) 1 R2,3

Capacitors
Tantalum bead
6·8μF 1 C1
22μF 1 C2

Semiconductors
Integrated circuits
74LS221 1 IC1

Diodes
1N4148 2 D1,2

Miscellaneous
16 pin d.i.l. socket; p.c.b.; buzzer; paddle materials (see text).



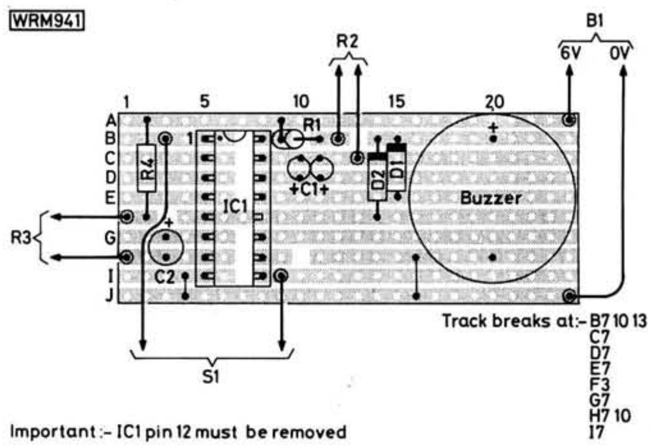


Fig. 1 (above): Circuit diagram of the simple Morse keyer with the full size Veroboard component placement (right). The circuit will function quite happily with non-Schottky versions of IC1, with only a slight increase in current consumption

News

RAIBC AGM

The Annual General Meeting of the RAIBC for the year ended 31 March, 1983 was held at the Flight Refuelling Amateur Radio Society Mobile Rally at Wimborne, Dorset on Sunday, 21 August, 1983.

The Club had another successful year best measured perhaps by the acquisition of 40 class A licences and 55 class B licences by members. There were 217 new members and 36 new representatives. Additional equipment on loan to members included three transceivers and seventeen receivers.

In thanking the Committee for their help during the year, the Chairman, Mr. W. N. Craig G6JJ paid special tribute to the Secretary/Editor, Mrs. F. E. Woolley G3LWY and congratulated her on being elected an Honorary vice-President of the RSGB in recognition of her work on behalf of the RAIBC.

The Chairman also referred to the essential part played by the representatives in furthering the aim of the RAIBC which is to help members to enjoy the hobby of Amateur Radio. As well as assisting with the installation of equipment and keeping it serviceable, many representatives were keeping in more regular contact with their members and helping them to feel that they really belonged to the Club—a situation much welcomed by the members.

The meeting passed a vote of thanks to Flight Refuelling A.R.S. for providing the venue for the AGM.

Enquiries or offers of help should be made to: *The Hon. Secretary, Mrs. Frances Woolley G3LWY, 9 Rannoch Court, Adelaide Road, Surbiton, Surrey KT6 4TE.*

REMINISCENCES 3

Stan KEELEY

I was a proud bloke indeed when, having left school in 1932, I got a job, dismantled my humble two-valver, and sat down at the controls of my Hallicrafters Skybuddy S19—the complete DXer.

In comparison with the space age DX receivers of the 80s the Skybuddy was a very pedestrian affair—a 6K8 mixer, 6L7 i.f. amplifier and b.f.o., 6Q7 second detector and audio, and a 6K6 output pentode feeding the speaker or phones.

But it had three wavebands covering from the top of the medium waves continuously down to 16 metres (17·5MHz), a magnificent stainless steel dial marked directly in frequencies and—even for these days—a fantastic 2400 degree bandspread on a separate dial. Prosaic indeed, you may think. But in the relatively QRM-free days of the Thirties such a set performed very well indeed.

There were, of course, plenty of other higher-performance receivers for those who had money to lash out. The Sky Champion, for instance, had a tuned r.f. stage and went all the way down to 40MHz, and this all for £15. The Super Skyrider at £10-or-so more was a very posh affair with a crystal filter.

Something tells me that hundreds of old-timers are going to write in and remind me of their venerable National HROs, their Eddystones and Hammarlunds. Great names of the old days, but far beyond the reach of someone getting 17s. 6d. a week on permanent night work . . .

With the assistance of the *ARRL Handbook,* the "bible" of the American radio enthusiast, I built myself a 6K7 regenerative preselector, which hopped up the selectivity and the image rejection no end. And at this same time I discovered the delights of medium-wave DXing.

In the Thirties people knew what time to switch off and go to bed. At 2300hrs—or at the latest, midnight, stations all over Europe bade their listeners goodnight, played their national anthem and pulled the big switch. The 24-hour station was unknown.

The entire medium-wave was wide open for transatlantic DX, and on a good night revealed delights untold.

There were, of course, the big 50kW boys such as WGY Schenectady (what a magic name!), WBZ Boston and WLW Cincinnati who came in quite regularly, and at quite good programme value. But I and many others for the first time discovered that throughout the medium-wave there were dozens of US stations sharing the same frequency, and all neatly spaced 10kHz apart from 550 down to 1600kHz. And much the same went for Canadians and Latin Americans too.

From about 1200kHz down was the home of the little fellers—some of about one kW or so, serving small communities. And providing that one was prepared to "sit" on one of those channels all sorts of rarities emerged.

The beauty of it all was that so many of these little stations were tickled pink that they could be heard at all across "The Pond", and were more than willing—nay, quite anxious—to QSL, even without return postage. And all this happened with hardly a vestige of European QRM. Ah, halcyon days!

That old Skybuddy still rests out in the shed awaiting a rebuild, after doing yeoman service in my office for news bulletins until my retirement. I must get around to it one day . . .

QSL cards from WBZ Boston, WGY Schenectady and WLW Cincinnati—although from a much later date (circa 1960s) show the sort of cards the stations would send to listeners

Those happy experiences were mirrored for me by reader Harold Buggins, of Witney, Oxon, who wrote me to say that he still has a Skybuddy which he bought 25 years ago. And it's still going, though it needs an overhaul.

He writes: "I started getting interested in DXing when my parents bought an Ekco RX which had ten push-button station selectors. This was in 1938 when I was the tender age of 16.

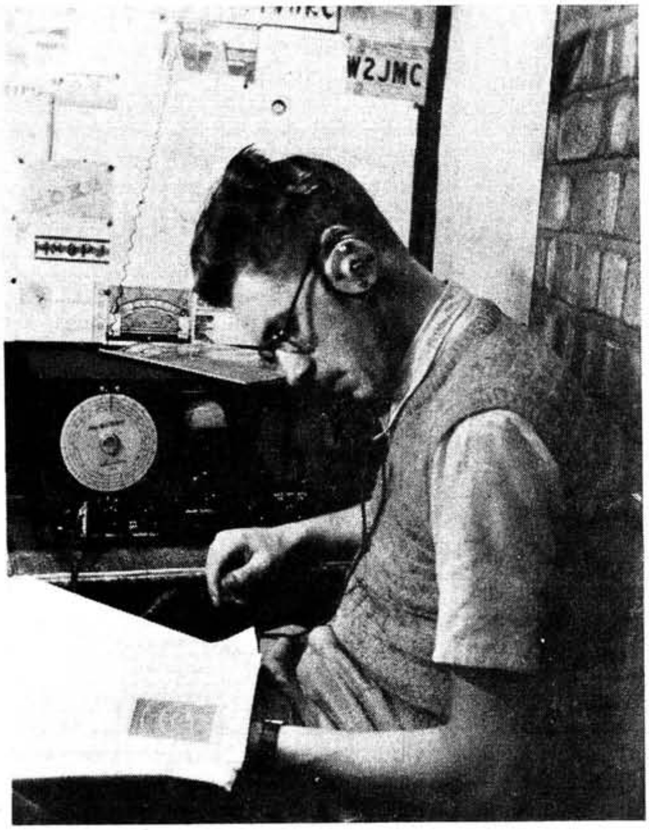
"I was fascinated to hear W3XL, WGEO and all those other Ws coming through.

"Then came VK2ME (Australia), JZJ (Japan), XGOX (China)—and without all the noise one has to put up with today.

"My DXing activities came to a halt when I was called up for the Army in 1942. I did dig up a QSL from HP5J in Panama one evening on a 48 set when I was sitting in a cave in Cassino, Italy.

"On return to Civvy Street I purchased an R1155, and later on a BC348. I logged and QSLed just about 100 countries over the next few years."

Harold adds: "What interested me so much was the fact that I also won a lb. of coffee beans from TGWA in Guatemala City, Costa Rica in '38—it was a special DX programme that used to go out at 0600 on a Sunday morning once a month. I still have the card.



The author—shown here with the Sky Buddy receiver. The receiver hasn't changed much over the years, but the author has aged a little since this photograph

"Another QSL that I particularly value is one from MTCY in Hsinking, Manchukuo, a country that disappeared a long time ago."

Harold's DX from this wartime Italian cave naturally leads us to the fact that from 1939 most of us had to eschew DXing on the airwaves before doing a bit of DXing in person!

Every barrack room in Britain, of course, had its obligatory radio set—and eventually, it seems to me, they all ended up permanently tuned to AFN Munich.

These radios were a monument to British ruggedness. They stood on a shelf permanently switched on for 24 hours a day, broadcasting crackle during daylight until AFN faded in at nightfall.

They were no doubt, in fine fettle when they were first put on those shelves. But as the days and weeks went by they were "adjusted" and "serviced" in the good old reliable British manner.

At the first sign of some idiosyncrasy someone would hurl a boot at it—which, by some magic, almost unfailingly worked. But cabinets splintered away bit by bit, and eventually we were entertained by the chassis and speaker still working faithfully away. Still, in my recollection, belting out AFN . . .

For those of us who got posted out to the "wide open spaces" it really did become a matter of "practical wireless".

Our own little mobile mob, marooned in the monsoons and mosquitoes of South East Asia, had no means of extracting information from Blighty at all, though we were carting round and servicing hundreds of thousands of pounds'-worth of radar equipment.

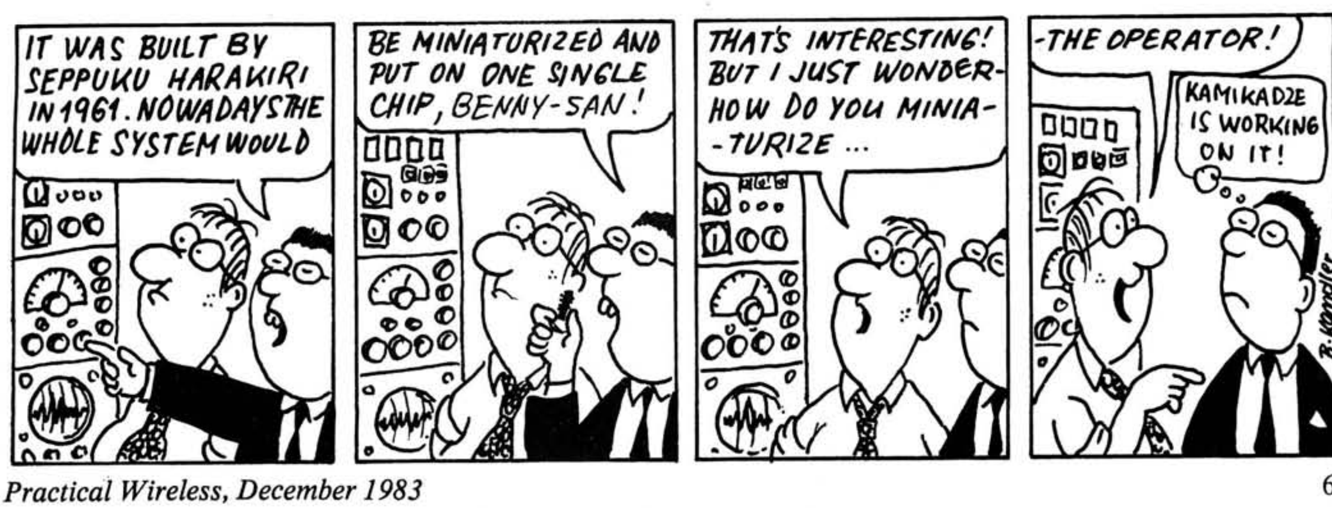
Our first effort to keep contact with home, I recall, was with an electric guitar amplifier we had built with purloined radar spares before we left Britain. It was back to the one-valver of hallowed memory again.

We wound coils from odd bits of wire on even odder formers, scrounged a resistor here and a condenser there from unserviceable radio equipment. And eventually the "bum-bum-bum" V-sign of the BBC crept into our earphones. A lead into the guitar amp input and we were part of the rest of the world again.

We sat there in the middle of the jungle clustered round the amp, powered . . . by a giant Lister generator pumping out enough watts to run a radar TX and RX and a mobile workshop as well!

Later we were lucky enough to "win" a proper commercial receiver with a shortwave band, but it was never as exciting as those first days with our Fred Karno set-up, desperately searching unknown wavebands for news of home.

Benny



Transceiver Selection

a systematic approach

by G. Y. Loades G3VPD

Any newly qualified A licensee will have looked forward in eager anticipation to the day when he, or she, can fire-up on the h.f. bands and explore new territories, which until then, had been forbidden under B licensee rules.

Prior to the event a lot of thought will have been given to what transceiver to buy and whether it ought to be new or secondhand. It soon becomes apparent that the question of choice is not easy to make. The past decade has shown an increase in design sophistication, which shows no sign of abating. Consequently, the problem of judging each new development on its merits, for all the models available, can turn out to be a tedious and confusing task. One has only to sit down with a handful of catalogues before confusion sets in under the welter of data.

To overcome this problem the following procedure is proposed which is adapted for amateur use from the more usual industrial applications. The advantage of using this method of selection, compared with a haphazard approach, is that it enforces a systematic appraisal of the various transceiver specifications.

To begin with it is necessary to decide what are the most required features in a transceiver. The answer to this question is very much an individual one and depends on the operating interests, e.g. h.f., c.w., contests, mobile/portable operating, DX hunting and so on.

The new transceivers currently on the market may well satisfy your requirements, but more likely than not, you will be paying for additional sophistication in a transceiver, which some people would be prepared to do without, and pay less as a result.

Consequently, when judging a transceiver's worth, it is a useful aid to apply a weighting factor, biased in favour of those points considered best to serve operating interests, but at the expense of others which may be peripheral and not absolutely essential.

Referring to Fig. 1, the left-hand column lists those features considered to be important in the eyes of the individual operator. The list given is intended as an example only and is not intended to be exhaustive, or the best. Those with a higher level of understanding will be able to create a list which reflects a greater appreciation of the technicalities and thereby, will be able to make a more discerning judgement.

The weighting factor is applied to each feature, signifying the degree of importance according to individual preference and judgement. A maximum value of 10 is awarded, and more than one feature may have the same value of weight factor, if it is felt that they have equal merit. This list of features may be as large as necessary and need not be in order of priority. It is not a league table.

Now, working horizontally across the table for each transceiver being considered, points are awarded for each listed feature. The maximum value of these points is awarded against that transceiver which best meets the feature, bearing in mind individual operating interests. As before, more than one transceiver can have the same number of points if it is felt they equally meet the particular feature. Repeat the procedure until all the features and points awarded are made for all the transceivers. The general layout for doing this is shown in Fig. 1.

The next step is to establish the merit marks for each transceiver. This is easily done by multiplying the weighting factor for a given feature with the points awarded for each transceiver. This product is then entered in the merit mark column. The sum of the merit marks for each transceiver forms the basis for comparison. The transceiver with the highest merit mark represents the best individual choice.

The above procedure is a lot easier to carry out than describe, but obviously the results obtained will give a more accurate appraisal having followed a systematic approach.

There is also no reason why the above procedure should not be applied to secondhand as well as new equipment, or perhaps more interestingly, a mixture of both. For example, comparing transceivers no longer in production with those currently on offer helps clarify the value of those extra facilities incorporated in more up-to-date transceivers.

It is quite possible to meet operating interests by buying a secondhand rig no longer in production, re-valving and re-aligning to the original specification, rather than paying for unwanted sophistication, and so save a considerable sum. To this end the above method should prove helpful in making a choice of transceiver. ●

Fig. 1 WRM927

Transceiver features	Weighting factor	TCVR 'A' Points awarded	TCVR 'A' Merit mark	TCVR 'B' Points awarded	TCVR 'B' Merit mark	TCVR 'C' Points awarded	TCVR 'C' Merit mark	TCVR 'D' Points awarded	TCVR 'D' Merit mark	TCVR 'E' Points awarded	TCVR 'E' Merit mark
Sensitivity	10	5	10x5=50	5	10x5=50	3	10x3=30	4	10x4=40	5	10x5=50
Valve or s.s. p.a.	8	3	8x3=24	5	8x5=40	2	8x2=16	1	8	4	32
Price	7	1	7	3	21	5	35	4	28	2	14
Selectivity	10	2	20	3	30	5	50	4	40	5	50
Nº of modes	5	3	15	4	20	5	25	3	15	4	20
Nº of bands	6	5	30	4	24	4	24	5	30	4	24
Broad-band p.a.	8	3	24	5	40	5	40	4	32	3	24
S/N ratio	9	5	45	2	18	4	36	3	27	5	45
Speech proc.	5	3	15	5	25	5	25	3	15	3	15
Total merit mark		230		268		281		235		274	

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.

From time to time in these columns I have advocated that suitable licensed amateurs in radio clubs should be permitted to certify that a prospective applicant for an amateur radio licence has had sufficient training under proper supervision to enable him or her to go on the air with confidence and a knowledge of the correct procedures.

In a letter **Rex Black** VK2YA (Wagga Wagga, NSW) points out that back in 1960 he submitted a scheme, which was eventually approved, to the Wireless Institute of Australia (equivalent of our RSGB) for a Youth Radio Scheme following suggestions from a number of teachers in State schools that also ran amateur radio clubs. Five certificates of proficiency were awarded, from elementary to advanced, the advanced level enabling the student to tackle the government AR examination with every hope of success.

There are also certificates for telephony and telegraphy proficiency obtained by actual on-the-air experience under qualified instructors. Eventually more than 50 clubs were participating in the scheme. Following on from this Rex Black chaired an investigation committee aimed at introducing a novice licence and after **18 years** such a licence was approved by the government, faced at that time by "hordes of unlicensed and aggressive CB pirates", who thought it saw a way out of the CB problem. However it seems that although the novice facility was very successful the CB menace remained although it now seems to be on the decline as in many other countries.

In practice members of radio clubs of all ages participate in the training scheme with real old timers getting their Youth Radio Scheme awards! Surely it is not beyond hope that the RSGB could introduce such a scheme in the UK, perhaps sponsoring a novice licence if this is thought necessary. With the transfer of AR matters from the Home Office to the Department of Trade and Industry there would now seem to be a real possibility of advancement in this field.

The Government's Youth Opportunities Scheme appears to be offering courses to C & G standards in basic electronics thus providing an opportunity to those who seek to obtain an amateur licence in due course.

On a more technical plane, I have been dismayed of late at articles appearing in our field, and aimed at the newcomer, that advocate the use of external wire antennas with what I would call general purpose s.w. receivers that normally employ a telescopic antenna on the s.w. bands. The anticipated better results never materialise as the wanted stations seem to be covered in more interference than before. Unless a receiver is fitted with a terminal specifically intended for use with an external antenna it is unwise to try such a modification.

The transistors on the input are likely to be basic types which overload very easily on strong signals causing these signals to cross-modulate the weaker ones giving the impression of interference when in fact it may not exist. This is due to the non-linear operation of the input circuits and is a deficiency in the set's design, often in the pursuit of cheapness. On the s.w. broadcast bands the interfering signal may not even be audible being well removed, in terms of frequency, from the frequency to which the receiver is tuned, but nevertheless the signal will still cause non-linear operation of the input devices and cross-modulation.

The only answer to the problem in practice is to **reduce** the input signal levels with an attenuator so that cross-modulation does not occur and although the wanted signal may now be much weaker there is every chance that it will now be readable, which is the primary object of the exercise.

In General

The Surrey Police Radio Society has sent in details of the All-Surrey Award which appears to be confined to licensed amateurs only. A pity as I'm sure s.w.l.s would also like to have a go at obtaining the award which is in four classes for UK ops and two classes for DX stations. Usual object, to work a number of Surrey amateurs with extra points for working Surrey Police Force stations GB4SPF, GB8SPF and G4SPF. Looking at the certificate itself it does cover "worked/heard" requirements so perhaps the rules need amending! Anyway, more details from award manager Richard Hook G8LVB, Ops Room, Surrey Police HQ, Mount Brown, Sandy Lane, Guildford, Sy, or on G'ford 571212 Ext 243.

How is this for courage and determination? Chris Moore is now G6WCB up in Walsall Wood, W. Mids after contacting his local club and getting some of the members to visit him regularly and coach him for the RAE. He managed a credit in each part of the paper at the first attempt. He says that just because he is confined to a wheelchair it doesn't drop his IQ by a factor of 100! For the moment he is on 144MHz with an Icom 245E but says he is going to press on to finer things, like the Morse code test. Murphy's Law crept in when, being left-handed, he lost the use of his left hand and arm. If you are wondering what he used to communicate with me, it was an electronic printer which must be a godsend to Chris.

Anyone engaged at all seriously in listening to the h.f. bands will benefit from the network of eight beacon stations that has been established around the world during this World Communications Year, on 14100kHz, providing an excellent guide to propagation conditions for 24 hours a day. The eight stations are KH6O/B, W6WX/B, 4U1UN/B, CT3B, OH2B, 4X6TU/B, ZS6DN/B and JA1IGY. Unfortunately, so far there is no coverage of the South American or Australasian areas in the network which has been organised by the North California DX Foundation. It is to be hoped that the network can be continued on a more permanent basis after 1983. Listeners in particular could make a great contribution to propagation studies by keeping records of reception of the various beacons, preferably over a long period.

On the DX Bands

Chris Burger ZS6BCR writes from Pretoria to make some comments on the l.f. bands down his way, finding GI3OQR the strongest signal on both 7 and 3·5MHz. On the former band Chris has a ground plane antenna and a dipole for 3·5MHz although a 16m g.p. is on the stocks, linked to a good radial earth system for this band. His rig is an FT-707 running around 100W and he concentrates on c.w. operation.

In Cork, Eire, **John Buckley** has dumped his dipole in favour of a full-sized G5RV antenna feeding his Trio QR666 receiver via an a.t.u. He also uses a Texas TI99/4A computer for his station logging system. Like several other readers John has found 21MHz to be the best for DX at the moment. Catches on 3·5MHz included OX7T, VK6LK and ZD7BW while on 14MHz it ran to TA1BO, VP8ANT (QSL PO Box 146, Cambridge), 5N9GM (QSL 18XIU), 9N1MM (QSL N7EB) passing on to 21MHz and C21RK (PO Box 139, Rep of Nauru), C53EK (QSL PO Box 569, Banjul, The Gambia), FG0HYJ/FS7 (QSL to VE2EWS), HL5BGB (QSL DJ9NB),

J6LHY (QSL KE1A), KP2AF, KG4DX, TL8TX, TR8DX, V2AN (QSL WB8SSR), YC2DNT, S79MC, 5W1DZ, 9V1VP and 9Y4BA.

John Lambert is BRS54067 up in Palmers Green, London N13 with a keen interest in RTTY reception via a TS130V and 40m-long antenna plus CWR610 printer. Catches on 14MHz have included OH0TTY, VK3BH, FR0FLO, 9M2DW, VK3ACA, CT2AK, EA9JZ and YJ3CDN plus 9H1GD also on 14 but s.s.b. ran to VK6AAF, VP2MO and VK9ZB.

A thin report from **Goff Curtis** of S. Harrow, Middx is blamed on holidays as well as on bad conditions but he still logged FG7AM working G3OLU/SV5, FM7CD, PZ1DV and YS1GMV and 9N1LP all on c.w., 21MHz, with 6W8LM and 8Q7BT on Malé Island using s.s.b. On 14MHz s.s.b. brought only YB0AV, and 9V0VM who wants cards via WB0TEC. Good catch on 7MHz c.w. was DF3GX/VP2 who said QSL to home QTH. Goff uses an R600 with 6m-long horizontal or vertical wires to an a.t.u.

Using his FRG-7 and a 20m-long wire **John Desmond** in Cork, Eire, found 21MHz about the best band, as did so many others, and logged ZK2JS, YJ8TT, T3ODB (W.Kiribati), 9Y4BA and J37AH, plus KG4DX who says he'll be active from there for the next 18 months or so. On 14MHz John found FG0HYJ/FS7, J6LCV, V2AN, D44BC, V3IZ, KG4DX and PJ4CR while 7MHz gave up KP4DEX/V2A, CE1FNZ and EA5CTX/HB0. Lastly, but by no means least, some good catches on 3·5, around 3·8MHz to be more precise, with JY9CZ, PT7KW and rare CE0ZAD on Juan Fernandez Island.

In Knutsford, Cheshire, regular **Dave Coggins** has added 50MHz elements to his 28MHz quad and managed to copy the 5B4CY beacon. His FRG-7700 plus a.t.u. and 25m-long wire brought in FY7KRU, J37AJ, VP8QD, ZD8DX and 3X4EX in Guinea (QSL N4CID) on 28MHz. Goodies on 21MHz included HH2JR, HR3JJR, OX3KM and TR8DX while 14MHz produced UA0ZDD on Kamchatka, VP8ANT, and famous VR6TC on Pitcairn. A look at our 10MHz allocation found JA6SW, VK2PA and W8EGB on c.w.

More information on the goings on on the new WARC bands would be very welcome for this column, and a good chance to practise the code.

With much the same outfit as Dave Coggins, **Viv Doidge** in Callington, Cornwall, also did well on 3·8MHz with CE3DNP, VP8ANT, VS6DO, VX1FG (otherwise VO1) and ZS4PB while 7MHz came up with CP8GB, OA4ASY, VK6HD, VP8AEN at Faraday Base, and ZL4IG. On to 14MHz and KG6RN, KH6AT, VS5PP (Box 1200, BSB, Brunei) and 8Q7AC (Box 0207, Naifarde Island, Maldives). Again, 21MHz did well with A2ER, FG7CO, HP1HBT, SU1ER, S79MC, VQ9DF, YI1BGD, 9L1DR and 9V0OK.

Chesham & District ARS scored a hat trick this year when these three charming ladies each passed the RAE with credits in both papers. Left to right, Linda Alldridge G6ZWG (XYL of club secretary G6LKS), Liz Cabban G6ETU (XYL of club chairman G4OST) and Debbie Orgill G6WYU (XYL of member G6LBG) *G6LKS*

Jim Willett with his FRG-7700 + FRT-7700 a.t.u. and long wire up in Grimsby has neglected the DX of late in favour of swotting for the RAE, and quite right, too! However he managed to get in a solid 24 hours of logging for the Grimsby ARS in the h.f. s.s.b. contest. Good one on 3·8MHz was ZF2HE on the Caymans, with ZL2AAG, 7X5AB and 3D2DM on Fiji, all on 7MHz.

A full-wave delta loop fed at one bottom corner is being tried out by **David Price** of Wellington, Somerset, on the 14MHz band with some good results. Otherwise it's dipoles. The FRG-7 pulled in VS5DD and VE1BDW on 3·8MHz, then 8J1RL in Antarctica, 9V1VG and YB0BZZ on 14MHz, followed by AA2Z, H5AE in Botswana, JR6SVR on Okinawa, 9X5SL (QSL DL8DF), and XZ9B in Burma with cards to JA8IXM, on 21MHz.

A late report from **Goff Curtis** of S. Harrow comments on JT1AO, thought to be in Ulan Bator, who appeared on 7002kHz c.w. around 1930Z with the inevitable pile-ups.

It's back to school for **Dave Shapiro** ARS 53844 of Prestwich, Manchester, so DXing cut accordingly on his Realistic DX200 with a.t.u., fed from a 20m-long wire. Some problems with the receiver have not helped, either. However the quality of the DX helps to make up for these glitches, like CE0ZAD, FM7WS, VK6LK, and ZL2BCG on 3·8MHz s.s.b., followed by VK2WC, ZL3BH and TR8CR on 7MHz. 14MHz seemed to be the favourite band with FG7JM, HH2JR, J28DM, J39BS, J6LT, KL7BCS, VP5WJR, VP8LP, V2AO (PO Box 126, St Johns, Antigua), ZD8SS, ZK2RS, 9N1MM, C53EK, D44BC, FR0FLO, H5AE, KC6IN, P29NSF, VQ9JD, YJ8TT and 5W1DZ. Don't really know what he's grumbling about!

Club Time Again

Abergavenny & Nevill Hall ARC GW4GFL After a turn in the chair Ffestin Jones GW3SSY becomes sec again and is back with the news. The RAE course is designed to accept newcomers at any time *while the club itself* is an approved RAE exam centre. The club foregathers every Thursday above the Male Ward 2, Pen-y-Fal Hospital, A'gavenny, with code classes beforehand. New project is to take an old valved receiver and to convert it into a decent communications receiver. Diary note: annual Christmas dinner on December 9, that's a Friday. More from SSY at 2 Dalwyn Houses, Llanover Road, Blaenavon, Gwent or buzz (0495) 791617.

Acton, Brentford & Chiswick ARC G3IIU At the Tuesday, November 15 meeting the subject for discussion will be "Members Holiday Activities" which ought to prove interesting. It's at the Chiswick Town Hall, High Street, Chiswick, London W4 at 7.30 but W. G. Dyer G3GEH is your man for more info, at 188 Gunnersbury Avenue, Acton, London W3.

Ayr AR Group This group meets at the Community Leisure Centre, 24 Wellington Square, Ayr, Scotland, at 7.30 on "alternate" Fridays which is November 4 (too late!) and the 18th when GM4CUB will be expounding on the early days of radio. So will tell you of the chat on December 2 by GM4CXM on how to work the DX on 144MHz. Try Dr R. D. Harkness GM3THI at the Centre or on Alloway 42313 for latest info.

Bath & District ARC G4TMH This rapidly expanding group meets at the Englishcombe Inn, E'combe Lane, Bath, on "alternate" Wednesdays but as to which Weds that is you'll have to contact PRO Trevor Whitehead G6HRX, 14 Arundel Road, Bennett's Lane, Bath, or ring Bath 319150. All electronic interests are catered for, reflected in the widely varying nature of recent lectures and demonstrations.

Brighton & District ARS Dates for November are Wednesday 16 when it's video night and the 30th when the AGM takes place, with the Christmas Party on Wednesday December 14. Meeting time is 7.30 at the Marmion Road YMCA with Morse code classes held at the same spot on Mondays. Contact Wendy Firmager, 26 Brownleaf Road, Brighton.

Bury RS Postponed from September, Norman Kendrick G3CSG will give his talk on the Japanese equivalent of the Morse code on Tuesday November 8 at 8, at the Mosses Community Centre, Cecil Street, Bury, where gatherings take place every Tuesday, the second in the month being main meeting time. Wine and cheese will follow the AGM on December 13 so I suppose that is some compensation. If you've already got a 1984 diary enter the Bury RS Ham Feast at the club QTH on Sunday February 5, starting at 11am. All interested to contact sec Brian Tyldsley G4TBT, 4 Colne Road, Burnley, or B'ley 24254 for further information.

Buxton ARS Second and fourth Tuesdays at the Egerton Hotel, 36 St Johns Road, Buxton, Derbys, at 8. Principal event for November is the AGM on the 8th while the 22nd is devoted to a natter nite. More from Derek Carson G4IHO, 28 Harris Road, Harpur Hill, Buxton, Derbys otherwise Buxton 5006.

Cambridge & District ARC G2XV Fridays, 7.30, the Visual Aids Room on the ground floor of the Coleridge Community College, Radegund Road, off Coleridge Road, Cambridge. Dave Wilcock G2FKS says that on Novembr 11 there will be a film show with informal meeting on the 18th which will in-

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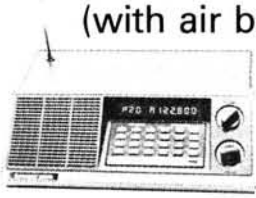

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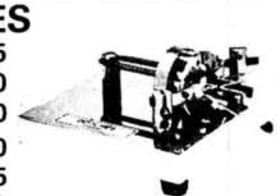

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BC140	0.31
BC141	0.25
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BC143	0.24
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BC149	0.09
BC157	0.12
BC158	0.09
BC159	0.09
BC160	0.28

BC170B	0.15
BC171	0.09
BC172	0.10
BC173B	0.10
BC182	0.10
BC183	0.10
BC184LA	0.09
BC212	0.09
BC212L	0.09
BC213	0.09
BC213L	0.09
BC237	0.10
BC238	0.09
BC307	0.09
BC327	0.10
BC461	0.35
BC478	0.20
BC547	0.10
BC548	0.10
BC549A	0.08
BC557	0.08
BC558	0.10
BD131	0.32
BD132	0.35
BD133	0.40
BD135	0.30
BD136	0.30
BD137	0.32
BD138	0.30
BD139	0.32
BD140	0.30
BF179	0.34
BF180	0.29
BF183	0.29
BF194	0.11
BF196	0.11
BF197	0.11
BF198	0.16

BF199	0.14
BF200	0.40
BF258	0.28
BF259	0.28
BF336	0.34
BFX29	0.30
BFX84	0.26
BFX85	0.32
BFX86	0.30
BFX88	0.25
BFY50	0.21
BFY51	0.21
BFY52	0.25
BFY90	0.77
BT106	1.49
BT108	1.89
BT116	1.20
BU105	1.22
BU108	1.69
BU124	1.00
BU126	1.60
BU205	1.30
BU208	1.39
BU208A	1.52
BU326A	1.42
MRF450	12.50
MRF450A	12.50
MRF453	17.50
MRF454	23.50
MRF475	2.50
MRF477	10.00
OC71	0.40
R2008B	1.70
R2010B	1.70
R2540	2.48
TIP29	0.40
TIP29C	0.42
TIP30C	0.43
TIP31C	0.42

TIP32C	0.42
TIP41C	0.45
TIP42C	0.47
TIP47	0.65
TIP146	2.75
TIP2955	0.80
TIP3055	0.55
TIS91	0.20
2N3054	0.59
2N3055	0.52
2N3702	0.12
2N3704	0.12
2N3705	0.12
2N3708	0.12
2N3773	1.95
2N5294	0.42
2N5296	0.48
2N5496	0.65
2SA715	0.95
2SC495	0.80
2SC496	0.80
2SC1096	0.80
2SC1173	1.15
2SC1306	1.00
2SC1307	1.50
2SC1449	0.80
2SC1678	1.25
2SC1945	2.10
2SC1953	0.95
2SC1957	0.80
2SC1969	1.95
2SC2028	1.15
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clude a code class and on-the-air activity with club station G2XV. Ray Flavell talks on propagation on the 25th. Keep time for the club's Christmas "do" on December 2 at the Madingley Village Hall. Dave hangs out at 6 Lyles Road, Cottenham, Cambridge or try (0954) 50597, and is the club's PRO.

Cheltenham AR Association G5BK First and third Fridays in the Stanton Room, Charlton Kings Library, Cheltenham is what I deduce from club mag *CARA News* and suggest G4LIL QTHR for further information on club dates and events.

Chichester & District ARC Sporadic E propagation as it affects DXTV is the subject for Ron Ham on Thursday November 17, the club meeting in the Green Room, Fernleigh Centre, 40 North Street, C'chester at 7.30, on first Tuesdays and third Thursdays. In addition there is a club net on S11 on 144MHz Wednesdays at 7pm. From club newsletter it seems that an RAE course has already started at the Bognor Adult Education Centre while a Morse code course is due to start there on January 17 next. Sec of club is T. M. Allen G4ETU, 2 Hillside, West Stoke, Chichester, Sussex or buzz West Ashling 463.

Cray Valley ARS G6UW If you worked or heard GJ6UW special station in the CQ WW SSB contest cards are obtainable from G3ZAY POB 146, Cambridge. The Bob Treacher talk in November has been cancelled but by this time an alternative feature should have been arranged. It's first and third Thursdays at 8, at the Christchurch Hall, Eltham High Street. It's C. Henderson G4FAM, 18 Faversham Road, Beckenham, Kent.

Darlington & District ARS It's every Friday for this new group, in the Hurworth Community Centre in the south of Darlington, at 7.30. Several interesting lectures are lined up for the coming months according to sec C. Webb G4NYJ, 34 Cleveland Terrace, D'ton (D'ton 467271) plus code and RAE courses now under way run by G3UTI and G3GUV. The club station should also be active by this time.

East Kent RS G3LTY G6EKR The Cabin Youth Centre, Kings Road, Herne Bay, Kent, at 8 on the first and third Thursdays. Earliest date in which you could be interested is a visit to the Richborough power station on December 1 with the annual cheese and wine party plus grand Christmas Draw on December 22, not to be missed. On to January 5 and a natter nite and Morse code class. Contact sec Stuart Alexander G6LZG, 66 Down Road, Canterbury, Kent.

Edgware & District RS G3ASR G8ERS It's the second and fourth Thursdays at 8, at 145 Orange Hill Road, Burnt Oak, Edgware, Middx with a club net on 1·875MHz Mondays at 10pm. Club station G3ASR continues to offer slow Morse on the air, "Top Band and Two", plus classes at the club. No current info on November gatherings but December 8 will see a junk sale in full swing. More from PRO David Wilkins G4JLU, 802 Kenton Lane, Harrow Weald, Middx.

Flight Refuelling ARS G4RFR G6SFR Sundays at 7.30 is the unusual but very successful meeting time for this go-ahead group, at the Sports & Social Club, Merley, Wimborne, Dorset. C. Harris, FR Safety Officer, deals with health and safety at work, on November 6, some of which may hopefully filter through to safety in the shack. On the 13th Bob Fuller G8CEZ runs a slide show and talks on Turkey and the Middle East while on the 20th Nick Foot G8MCQ handles Technical Matters. On the 27th it's AGM time again, and a chance to try democracy, says sec Mike Owen G8VFY, "Hamden", 3 Canford View Drive, Canford Bottom, Wimborne also known as (0202) 882271.

Fylde ARS Unusual venue for a club, the Kite Club at Blackpool Airport, first and third Tuesdays at 7.45. Informal meetings in November but the Christmas festivities break out on Tuesday December 6. Given sufficient interest there are Morse code classes preceding the main meetings. Programme sec is H. Fenton G8GG, 5 Cromer Road, St Annes, Lytham St Annes, Lancs.

Greater Peterborough ARC Revised programme shows a talk by G3NRW on satellite working on Thursday, November 24. Meetings on the fourth Thursday at Southfields Junior School, Stanground, Peterborough at 7.30pm. Otherwise there is a GPARS net on 21·2MHz at 8 on Monday evenings. Prospective, licensed and s.w.l.s all equally welcome, says sec Frank Brisley G4NRJ, 27 Lady Lodge Drive, Orton Longueville, Peterborough.

Lincoln SW Club G5FZ G6COL The City Engineers Club, Central Depot, Waterside South, Lincoln is the rendezvous, Wednesdays, says Pam Rose G4STO, who can be reached c/o the club QTH. Nov 9 is antenna time, directed by G8CTG, with RAE/c.w. instruction activity on the 16th, 30th and December 7. On Nov 23 it's activity night on the air from the club stations. Diary note is the Christmas Social evening on December 14.

Mid-Sussex ARS G3ZMS Second and fourth Thursdays at the Marle Place Adult Education Centre, Leylands Road, Burgess Hill, W. Sx but note extra meeting on November 10 with visit to the police HQ and ops room at Lewes with numbers attending severely limited. A week later it's a talk on the use of computers in amateur radio. Be there at 7.30 for a 7.45 start. Only contact noted is Jack Booker G3JMB, 8 Barrowfield, Cuckfield, Haywards Heath, or HH 413889.

Nene Valley RC G4NWZ G6GWZ Lecture on November 9 is by G4ODI discussing Wheatstone's greatest invention, with the club rig on the air on the 16th plus a bit of nattering. Professor Jones G8TTF addresses the club on radio communications on the 23rd and the month finishes with a buffet and social evening on the 30th. From which you may have gathered the club meets every Wednesday with lectures and at the Dolben Arms, Finedon which is near Wellingborough, and transmitting activities from the First St Mary's Scout Hall nearby. Note that December 7 is the closing date for the club's constructional contest. Potential members and visitors should contact Lionel Parker G4PLJ, 128 Northampton Road, Wellingborough.

Norfolk ARC G4ARN G6NRC The Crome Centre, Telegraph Lane East, Norwich at 7.45pm on Wednesdays, with a special date on November 16 when it's Open Night and a special welcome awaits new members. Not forgetting the 30th, a "bring your YL/XYL" occasion, and a chance to show where you get to every Wednesday evening. Peter Forster G3VWQ, 12 Thor Road, Thorpe-St-Andrew, Norwich is also on N'wich 37709.

North Bristol ARC G4GCT Club now has a newsletter together with programme of events for well into next year. Well done, that committee! Meetings every Friday at 7 at the Self-Help Enterprise, 7 Braemar Crescent, Northville, Bristol, with a current membership of no less than 140 excluding juniors under 14 who do not pay subs but are very welcome nonetheless. Bill G4FMH and Phil G3ZJH run code classes, the latter having 100 per cent success in recent tests. November 11 is junk sale time, with a chat from G4TRN on operating f.m. on 28MHz on the 25th. Your contact is Ted Bidmead G4EUV, 4 Pine Grove, Northville, Bristol.

North Wakefield RC At the Carr Gate Working Mens Club, every Thursday at 8, with special event being the junk sale on November 17 at 7.15pm when a pie and peas supper will be available. So says Steve Thompson G4RCH, 3 Harlington Court, Morley also known as (0532) 536633.

Perth & District AR Group The club's own room is located at the Perth City Sports & Social Club, Leonards Street, Perth, Scotland, and meets Tuesdays from 8.30, with Wednesdays devoted to code classes. Computer and allied electronic interests are catered for as well as AR. Sec is R. H. Barnes GM6ESY, Pittendynie Cottages, Moneydie, near Luncarty, Perth, also (073882) 575.

Plymouth RC New meeting spot is the Penlee Secondary School, Somerset Place, Stoke, Plymouth, on "alternate" Mondays at 7.30 so it's a slide or maybe a video show courtesy RSGB on November 14 and a DF hunt on the 28th. December dates are a Christmas quiz on the 12th and social on the 17th, a Saturday. Publicity is handled by Mike Newcombe G4FJZ, PO Box 46, Plymouth.

Radio Society of Harrow Chris Friel G4AUF, 17 Clitheroe Avenue, Rayners Lane, Harrow, Middx, says the club meets Fridays at 8pm at the Harrow Arts Centre, High Road, Harrow Weald, with next important event being the annual dinner on November 11 at the Grimsdyke Hotel, Old Redding. The 18th is an informal plus practical construction evening with a talk on computer-aided design (c.a.d.) likely to be very popular on the 25th. Make a note of the junk sale on December 9. According to club mag *QZZ* membership has now soared past the 150 mark.

Ripon & District ARS From sec Peter Fautley G6CUG I learn that the club meets on Thursdays at 7 starting with Morse and RAE classes, then on to the coffee with the evening's main event at 8pm. All this at the St John Ambulance Hall, Ripon. Peter is available on (0845) 24945.

Salop ARS G3SRT HQ is the Albert Hotel, Smithfield Road, Minsterley, Shropshire, at 8 on Thursdays. Info on current meetings from sec D. Goddard G3UQH, 4 Gravels Bank, Minsterley, Shropshire.

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 and Social Club, White Moss Road, S'dale.

Spen Valley ARS G3SVC Thursdays at 8, at the Old Bank Working Men's Club, Mirfield, a venue that has turned out to be a great success, apparently, with membership now up to 50. On November 10 equipment alignment is the subject for G4EZV, with G6WEF expounding on the "Madcap fringes of amateur radio". Whatever can he mean? That's on November 24. Make a note of G4OTL dealing with video recorders on December 8, bound to be a big draw. Hon sec for info is Ian Jones G4MLW, 54 Milton Road, Liversedge, Heckmondwike, W. Yorks.

Stevenage & District ARS G3SAD G8SAD Change of meeting to first, second and third Tuesdays with the second being devoted to constructional matters, at TS Andromeda, Fairlands Valley Park, Shephall View, Stevenage, Herts at 8 and code classes beforehand at 7.15. Principal event in November is a talk on navigational satellites on the 15th and for more info listen to the Sunday net at 7pm on 145·250MHz. It's Cliff Barber G4BGP, 13 The Sycamores, Baldock, Herts otherwise (0462) 893736.

Stockton & District AR Group Every Monday at 8, the Oxbridge Hotel, Stockton-on-Tees, where a study class for the RAE is already in full swing. Anyone with an interest in AR or associated fields is most welcome, says John Walker G6NRY, 7 Widdrington Court, Stockton-on-Tees, Cleveland.

Wimbledon & District RS All welcome at the St John Ambulance HQ, 124 Kingston

Road, London SW19, on the second and fourth Fridays with attractions like a talk on basic computing techniques with particular application to AR by G6TDI on November 11 plus a Rediffusion film on cable TV on the 25th. You should contact Geoff Mellett G4MVS, 26 Paget Avenue, Sutton, Sy, for more info on the club's activities, also reachable on 01-644 8249.

Winchester ARC Meets on third Saturdays starting at 7.30 at the Scout Log Cabin, Stockbridge Road, W'chester, with a demonstration of amateur equipment promised by Wood & Douglas on November 19. The Christmas social evening is scheduled for Saturday December 17. Club nets are two in number, at 8.30pm Wednesdays on 145·250MHz and Sunday mornings at 9am on 3660kHz plus or minus the QRM. Seems to be a singularly unfortunate time and frequency considering the GB2RS broadcasts at the same time for the south on a nearby frequency. Hon sec of club is Brian Epps G3SHQ, to be found on Twyford 713003.

Wirral ARS G3NWR Reminder of the new venue, the Guide Hut, Westbourne Road, West Kirby, to be visited on the first and third Wednesdays at 7.45 for an 8pm start. Slow Morse code programme run by G4MIA is on the air most evenings on 144·725MHz around 7.30, with speeds to suit everyone. Details of events to come in November from Cedric Cawthorne G4KPY, 40 Westbourne Road, West Kirby direct or via 625 7311.

With the spate of club AGMs at this time of the year I look forward to receiving club programmes for some months ahead from the new committees. Such information makes life a lot easier for club secretaries and for myself when compiling this feature. Remember that I need at least six weeks' notice of events if they are to appear in the appropriate issue of *PW*. Even earlier notification is desirable for events that take place in the first few days of a month. General copy deadline is the 15th of the month direct to me and not *PW* offices.

MEDIUM WAVE BROADCAST BAND DX

by Charles Molloy G8BUS

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

"I use an FRG-7 plus medium wave loop, also a long wire. I have not had much success on m.w.—please could you tell me how I can get better reception" writes **Glenn Hocking** from Redruth in Cornwall. Although our reader has not been too specific I know what he means. Tune round the main short wave bands at any time of the day or night and they are full of signals. Not so on the medium waves though.

Medium Wave DXing

There is nothing wrong with Glenn's equipment. An FRG-7 with loop is a very good set-up for m.w. DXing but you have to listen for the DX at the right time. During the day you will only hear stations within a hundred miles or so. This is the ground-wave reception. After dark the band is alive with signals which reach the receiver after being reflected and returned to earth by the ionosphere. The trouble is that there are too many high power semi-local stations operating on the band in Europe which masks the DX we want to hear. There are two courses open to the DXer. He can stay up late, after midnight, when some Europeans have closed down for the night, or he can investigate gaps between strong signals.

The "interesting channels" starting with 927kHz and 747kHz and continuing with 918kHz this month are good places for the beginner, for this is where he will get the feel of m.w. DXing and learn to control his gear, especially the loop. Fading is another factor to take into account. DX on the medium waves nearly always suffers from slow cyclic fading, the cycle lasting for two or three minutes. Even the strongest signal can dip to inaudibility for a short period. Sometimes this is advantageous as it enables weaker signals on the same frequency to be heard. The DXer who tunes quickly over the band is unlikely to hear much. Persistence and patience are required to be successful. Investigate weak signals and wait to see if they will peak up.

Interesting Channels

Last month we had a look at 927kHz and what might be heard after the Belgian station on this frequency signs off for the night at 2230 (later on a Monday). Now we move down 9kHz to the adjacent channel at 918kHz. This may be rather close to BBC Radio 2 on 909kHz in some locations so it can be a test of receiver selectivity. I can listen quite comfortably on 918 with my Vega 204 portable.

918kHz

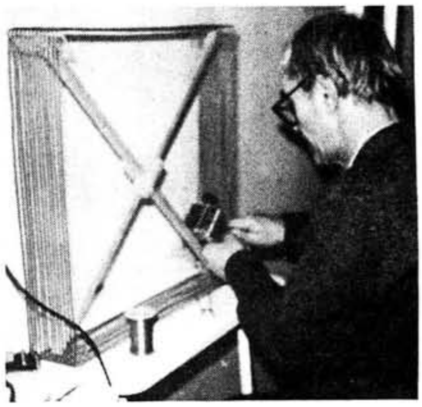
Two stations of moderate strength occupy this frequency. They are Radio Ljubljana located in Slovenia in Northern Yugoslavia and Radio Intercontinental Madrid in Spain. The two are easily separated with a loop or simply by rotating the receiver if it is a portable. R. Ljubljana is on the air all night, some of the programming being in Italian. The address of the station is Tavcarjeva 17, 61000 Ljubljana, Yugoslavia.

Radio Intercontinental has the callsign EAJ29 which is used when the station signs off, often at midnight. The address for a QSL is Modesto Lafuento 42, Madrid, Spain. There is a third, weaker occupant of 918 which is located in the USSR. I have heard it after 0200 using a loop to null out R. Ljubljana. Although I have not identified this broadcaster it is probably located at Mezem near Arkangel.

920kHz

When conditions to North America are good it is worth moving up 2kHz to the Region 2 channel 920kHz. It is easy to check if the path across the Atlantic is open, listen on 930kHz for CJYQ in St John's, Newfoundland.

CJCH in Halifax, Nova Scotia is the station most likely to be heard on 920kHz. It is commercially operated, carries advertising and uses its callsign frequently for identification as is the practice with broadcasters in Canada and the United States. CJCH, although weaker than CJYQ, is often logged in the UK. The address for a reception report in 2885 Robbie St, Halifax, Nova Scotia B3J 2Z4, Canada.



The Medium Wave Loop Antenna

"I am puzzled by the Medium Wave Loop. Please would you tell me about it; what its advantages are against a long (or short) wire antenna," writes **Philip Hodgson** from Uffington in Lincolnshire.

The loop is a tunable directional antenna based on the frame antenna used in the early days of wireless. The standard DXers' loop consists of 7 turns of wire wound in the shape of a square of 1 metre side. This is the main winding which is joined to a variable capacitor of approx 500pF which is the tuning control. An additional single turn collects the signal, by induction from the main winding, and leads it off to the receiver. This is the coupling winding. When you point the loop towards a station, pick-up is at a maximum. When the loop is broadside-on to a station then pick-up is at a minimum. Constructional details and an explanation of the principles involved are given in my article in *Out of Thin Air* which is currently available from the Post Sales Department of IPC Magazines Ltd.

How do you use a loop? Tune in a station on the medium waves with your receiver. Peak it up with the loop's tuning control. Rotate the loop for optimum reception. If two stations are being heard simultaneously and they lie in different directions from the receiving location then it is possible to listen to each station in turn by rotating the loop which will null-out each station separately as it comes broadside-on to the loop.

The loop will pick up less signal than a good outdoor antenna. It will also pick up less static. It is largely immune to man-made electrical noise and can therefore be used inside the house close to the receiver where it is under the control of the DXer. One drawback is that a loop cannot be used with a receiver that already has an internal antenna of its own. This includes practically all portables and table receivers. If you attempt to use a loop with a portable then the portable will continue to pick up a station via its own antenna even though the station is being nulled out by the loop. The overall effect is no null and the advantages gained by using a loop are lost.

More Direction Finding

If you hear a weak station, too weak to resolve, then switch on the b.f.o. and try to null the heterodyne note out with your loop. If you are successful then the direction indicated by the loop should help to identify the station. I have often checked CJYQ on 930kHz this way before the QRM on 927 goes off. Searching for weak carriers and trying to identify them, apart from being an interesting diversion, can lead to rare DX. It can also give an indication whether a particular path is likely to open up later in the night. It is possible to take this procedure a stage further. Sometimes when listening to a strong station you may be aware of a weak companion. It gives itself away by the beat on the "S" meter. Although the two stations are nominally on the same channel they will differ by a few Hz and this difference shows up as a beat. By rotating your loop it may be possible to null out the beat! You are really nulling out the weak station whose direction can be indicated by the loop.

It is an advantage when using a loop for direction finding to use a differential matching amplifier to counter Antenna (Vertical) Effect which can introduce errors.

Readers' Letters

A Panasonic RF3100 is in use by reader **Ron Wyres** who reports a novel method of joining an external antenna to this set. An a.t.u. is used. The external antenna and an earth are connected to the a.t.u. The output from the a.t.u. is clipped onto the telescopic antenna which is retracted, and the earth is joined to the receiver's antenna socket. Ron can now peak up a station using the a.t.u. The advantage of this method is that there is selectivity in the coupling device which should reduce overloading.

SHORT WAVE BROADCAST BANDS *by Charles Molloy G8BUS*

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

A number of readers have written to me recently asking for information about the external digital frequency readout unit used at my QTH. The advantages of being able to read, from a calculator-type display, the frequency you are tuned to are obvious. Tuning scales, dial cords, crystal calibrators, etc., will soon belong to the past. What about the gear, transistor and valved, currently in use by many DXers? It is possible to fit an external readout unit to some receivers though there can be problems. To date I have modified three sets, a DX150A, DX160 and BRT400 so that my Honest Frequency Counter FC5M with 455kHz offset (obtained from Lowe Electronics) can be plugged into a coaxial socket fitted at the rear.

External Digital Readout

The "front end" of a single conversion superhet is shown in Fig. 1. At first sight it would seem that all we have to do is to measure the frequency of the incoming signal but it is not feasible to do this. The poor digital frequency meter (d.f.m.) would be dizzy trying to deal with weak signals, strong ones and QRM and of course there would be nothing to measure while tuning between stations. What we do is to join up the receiver's local oscillator, which will differ from the incoming signal by the value of the intermediate frequency (i.f.). This is 455kHz with many single-conversion superhets. The local oscillator is usually but not invariably tuned to a frequency 455kHz higher than the incoming signal, so our d.f.m. must subtract 455 from the frequency being measured before it is displayed. A d.f.m. that does this will have an offset of 455kHz.

The modification to the receiver is shown in Fig. 2. A buffer (isolating) amplifier is used (there is a circuit of a buffer amp on page 49 of the October *PW*). Its high impedance input is tapped across the local oscillator while the low impedance output goes to a coaxial socket at the rear of the set, or if you prefer it, direct to the d.f.m. It is as simple as that, or is it?

Problems

I ran into two snags. With the DX-150A and DX160 the frequency displayed for the highest frequency band was 910kHz too low. On this band the local oscillator was tuned to a frequency 455kHz lower than the incoming signal. There is nothing you can do unless you are prepared to realign the set so that the local oscillator is 455kHz higher than the incoming signal. I did this with both sets and it spoiled the scale shape for this band.

The second problem is with the l.e.d. display which generates interference (r.f.i.) right across the long, medium and short wave bands. It can be reduced by keeping the d.f.m., its leads and power supply well away from the r.f. side of the receiver.

It is possible to do without a buffer amp provided the d.f.m. is sensitive enough. A low-value silver mica capacitor is used instead. Tune to the lowest frequency covered by the receiver and use the lowest value capacitor that will give a stable reading on the d.f.m.

Fig. 1

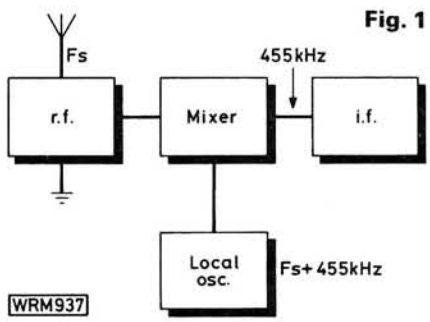
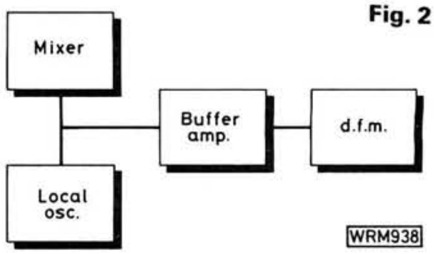


Fig. 2



The disadvantages of this method are that you are taking energy away from the local oscillator. This may have a detrimental effect on receiver performance and could detune the l.o. at the h.f. end of the set's range. It also provides a path for r.f.i. from the display to feed into the receiver.

My d.f.m. cost £42 some three years ago so clearly it is not worth fitting one to a low-priced set. Portables generally are difficult to modify. There is a special d.f.m. available for the FRG-7 which uses the Wadley Loop principle. If you have a double-conversion set then you need a d.f.m. with an offset equal to the first i.f. If this is unobtainable then all you can do is to measure the l.o. without offset and use a pocket calculator to add on the i.f., which makes the whole exercise of doubtful value. Sets like the Hammarlund HQ180 present a real problem. It has an i.f. of 455kHz up to 7·85MHz and 3·035MHz above that. It should be possible to produce a d.f.m. that can be programmed easily to any offset. Perhaps someone has already done this. Finally, if you are thinking of purchasing a new set then if at all possible, get one with digital readout.

Sunspots and Solar Noise

DXers who are interested in Radio Propagation will welcome the return of the monthly sunspot number from the Zurich Observatory which is now broadcast on the second Saturday of the month by the *Swiss Shortwave Merry-go-round* programme. It is on the air at 1105, 1320, 1535, 1820 and 2130 all in UTC (GMT) on 3·985MHz, 6·165MHz and 9·535MHz. Choose the one that comes in best at your QTH. The current figure is given plus a forecast for the coming months.

Why are we so interested in sunspots? The sunspot number is a measure of solar activity. It is radiation from the sun that maintains the ionosphere which is responsible for long distance reception on the short waves so indirectly the SS number is an indicator of short wave reception conditions.

The Solar Flux broadcast by the WWV is another method of doing the same thing. The SF is the radio noise from the sun measured at a frequency of 2·7GHz (2700MHz). It is often more convenient to measure the SF than to count sunspots. The ionospheric information from WWV at 18 minutes after the hour can be obtained at any time by dialling the US Dept of Commerce at Boulder, Colorado. The number, for those who missed the October issue, is 010-1-303-497-3235. It is a recorded message taking only a few seconds. As a matter of interest you can also dial the transmitter at Fort Collins on 010-1-303-499-7111 and monitor what is actually going out over the air at any moment.

Travellers' Sets

A steady trickle of letters from readers going abroad who would like to keep in touch with events at home via the BBC Overseas Service asks for information about a small-sized pocket receiver with good s.w. coverage. A recent search in radio shops uncovered the Sony ICR 4800 which would indeed fit in the pocket and has five s.w. bands. Has anyone used this or any similar sized set while abroad? Performance, ease of tuning, battery consumption and availability are the points of interest. I would like to compile a list of such sets before next year's holiday season.

Readers' Letters

Disabled reader **J. R. Sadley** reports hearing Radio Bras (Brasil) in English on 15·125MHz beamed to Europe at 1800. Welcome aboard OM, hope to hear from you again. "Can you let me have the address of KNLS in Alaska" writes **Stephen Blanchflower.** Try Box 473, Anchor Point, Alaska 99556, USA.

VHF BANDS *by Ron Ham BRS15744*

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

The installation of a repeater in the north, two radio exhibitions in the south, new ILR stations heard in several parts of the UK, and a late August tropospheric opening, are just some of the goodies in my post-bag this month.

Solar

Using his optical equipment in Bristol, **Ted Waring,** observed 6 sunspots on August 22, 10 on the 27th, 6 on September 1 and 23 on the 5th. Ted also saw a streak of bright faculae on the 29th. "Not many spots visible," writes Ted—which is no doubt the reason why the radio noise reported by **Cmdr Henry Hatfield,** Sevenoaks, was limited to a burst lasting about 2 minutes at 197MHz and 15 minutes at 136MHz around 1420 on September 15. I recorded a few small bursts during my mid-day observations at 143MHz on the 6th and 13th.

The 50 and 70MHz Bands

During a late season sporadic-E opening, I counted 18 very strong f.m. signals from east-European broadcast stations, operating between 66 and 73MHz, at 1820 on September 6, and 36 such stations at 0825 on the 7th. "I have been listening on 50MHz late at night and early morning," writes **Dave Coggins,** Knutsford, who adds, "It is a most interesting band and so far I have logged 17 of the 40 permit holders". Dave has installed a 2-band quad antenna about 6m a.g.l. for the 28 and 50MHz bands. "The quad has made an enormous improvement in my loggings so far on 50MHz". Although his best DX is the Cyprus beacon 5B4CY, he can receive GB3SIX almost daily and logged the Gibraltar beacon ZB2VHF on August 19 and 21. Between August 19 and September 7, Dave heard G3COJ, 'LTF, 'PWK, 'TCU, 'USF and 'ZIG, G4HUP, G6XM, GW3LDH and 'MHW, GW4HXD and 'ILL/A and GM3ZBE—all using c.w. and G3OHH, 'PWK, 'NOX, 'USF and 'ZIG on s.s.b. A good report, Dave, let's hope the band really opens up again this winter.

The 28MHz Band

Between 1930 and 2000 on August 21, **Fred Pallant** G3RNM, a near neighbour of mine, heard signals from EA and LU and during the evening of the 31st he logged stations in EA, CT1, HP1, I and LU. On the 28th, **Peter Lincoln,** Aldershot, found an opening to Africa during the afternoon and heard 9Y4RD/P/SV a United Nations station in the Sinai desert, plus ZS6GF, 9J2FC and J28EB. Dave Coggins has been busy listening on 28MHz and logged very good signals from LU and

9J2JB on August 20, the Mediterranean area on the 21st, CE6 and PY on the 27th, Spain on the 29th, LU, Ws 2, 3, 5, 8 and HC1 on the 30th, and South America on the 31st. On September 4 Dave did very well when he received signals from A82, CE, CX, HR2, LU, PY, SM, TG9, VE1 and 2, Ws 1, 2, 3 and 9, XE1, ZS and 8P6, and VJ4RS, a YL crossing the Atlantic in a small boat and her QTH at the time of logging was Caribbean. Between 1330 and 1337 on August 31, **Stan Williams** G3LQI, Lancing, had a 559-both-ways QSO with a Chinese station BY1PK. Also **Peter Prosser** GJ4TVZ, St. Helier, using a Yaesu FT-102 and a 5-band vertical ground-plane antenna worked KA3IOL in Pennsylvania and K5MRU, south Texas, around 2300 on September 4 and 4X6FR at 1322 on the 7th. **Norman Hyde** G2AIH, Epsom Downs, heard most European countries and reported on September 8 that the DX he logged was limited to PY and VP8. Fred Pallant heard signals from South America on the 10th and 11th, J28EB on the 15th and **Norman Jennings,** Rye, logged CX3TI, 5H3DM and J28DX during the month prior to the 14th.

28MHz Beacons

"Has anyone else heard 'DE W3VD/BCN FM 19 APL' on approximately 28·295MHz"? asks **John Coulter,** Winchester, who logged it at 1930 on August 19. From Belfast, **Bill Kelly** writes, "Only consistent beacon on 28 during August was our old friend DL0IGI". It certainly looks that way from our beacon chart, Fig. 1, Bill. "On September 3, I heard I2JRY in beacon mode for a few minutes and the Ottawa signal, VE3TEN, on the 4th, was the strongest I've heard it since 1980", writes Ted Waring. Henry Hatfield found the signal from the Cyprus beacon 5B4CY very strong at 1840 on August 20. Dave Coggins heard the beacons in Canada VE2TEN on September 4 and 5 and South Africa ZS6DN on the 3rd, and the rest of his log, along with those of John Coulter, Henry Hatfield, Norman Hyde, Bill Kelly, **Edward Owen,** Ted Waring and I, provided the information to make up the list of beacons heard between August 21 and September 20.

Tropospheric

The atmospheric pressure, measured at my QTH with a Short and Mason Barograph, stood at 30·0in (1015mb) on August 22, it then rose to a peak around 30·4 (1029) on the 27th and 28th. There is little doubt that the gradual fall to 29·8 (1009), by mid-day on September 1, was responsible for the late August tropospheric opening. By 0200 on the 3rd the pressure was down to 29·6 (1002) and then swung rapidly up to 30·2 (1022) by noon on the 4th and 5th, only to fall slowly back to 29·5 (998) by midday on the 10th. Around 0100 on the 11th the pressure began to rise a little but it remained below 30·0, with a low of 29·4 (995) on the 16th, until 2100 on the 19th, when it crossed the 30·0 line on an upward trend.

Between 2100 and midnight on August 25, **Simon Hamer,** New Radnor, using a Daiwa Search 9 receiver and HB9CV antenna, heard signals through the 144MHz repeaters in Aylesbury GB3VA R4 and Barkway GB3PI R6. Between the 28th and 30th, **John Cooper** G8NGO, Cowfold, worked several Dutch and German stations as well as 2 OZs and 6 SMs and while in QSO with LA6VBA, he heard a GJ calling CQ off the back of his beam "August 29 and 30 were good for tropospheric propagation on 144MHz", writes **Susan Beech** GM4SGB, Dollar. She worked 4 G6/Ps in southern England and a French station on the 29th and a GJ and F6 on the 30th giving her the Channel Islands as a new country and Devon, East-Sussex and Jersey as new counties. Sue enjoyed the IARU VHF contest on September 3 and 4 when she worked a G4 in the south giving her a new locator square ZK, and during the Perseids meteor shower she heard signals from stations in Italy, Spain and W. Germany.

Scottish Repeaters

Many thousands of radio amateurs and s.w.l.s get a great deal of enjoyment from the v.h.f./u.h.f. repeater network and believe me, without the voluntary efforts of the dedicated people involved with the repeater groups throughout the UK, there would be no repeaters for us to use. Bruce McCartney GM4BDJ is secretary of the Scottish Borders Repeater Group who are responsible for the Berwick-upon-Tweed GB3BT R2 and Scottish Borders GB3SB R0 repeaters. He tells me that the antenna system for GB3BT, a folded dipole for the transmitter and a colinear for the receiver, is mounted on a farm silo, Fig. 2. The equipment for 'BT, set up by John GM8LRI, Ken GM4EZJ and Ian G3HDT, is housed in a cabinet in a farm building at the foot of the silo, Fig. 3. Ken and John are seen again in Fig. 4 installing the 2-element transmitter antenna for 'SB, beamed towards Galashiels, from a site near Duns, to reduce overlap with 'BT. The group recently acquired three helical filters, Fig. 5, to give about 55dB attenuation of transmitter signals at the receiver. "These filters have given 'SB a much better performance and there is virtually no desense", writes Bruce, who says that the receiver antenna for 'SB is about 10m a.g.l. and for the transmitter about 5m a.g.l. on a site some 330m a.s.l. Our congratulations and thanks to Bruce and his colleagues on a fine effort; and don't forget, readers, I am always pleased to hear from other repeater groups who I feel sure have a similar story to tell.

Band II

Since August 29, the ILR station Southern Sound has been punching a good signal around Sussex on 103·4MHz and DX reports should go to Radio House, Franklin Road, Portslade, Sussex. **John Parry** G4AKX, Northwich, tells me that Signal Radio is on regular transmission on 104·3MHz (top of the band station for the UK) and the address for reports is Studio 257, Stoke Road, Stoke-on-Trent ST4 2SR. **Dave Mayhew,** Yapton, keeps a look-out above 100MHz and reports hearing Southern Sound, Signal Radio, GB Radio Gwent, RBL, and unidentified Dutch and French broadcast stations. Both Signal Radio and Southern Sound have been mentioned in the reports I received from **Michael Bennett,** Slough, **Harold Brodribb,** St. Leonards-on-Sea, **Adrian Butcher,** Washington, **Steve Green, Ian Kelly,** Reading, Simon Hamer and **Michael Welch,** London.

Harold Brodribb logged 20 French stations in Band II on August 25, 18 on the 27th, 13 on the 30th and 11 plus BBC Radio Devon on the 31st. During this late August opening, Adrian Butcher heard a very strong French station around 98MHz, and **Richard Hunt,** Tadcaster, received excellent signals from France-Cultur, Capital Radio, LBC in London and Chiltern Radio in Luton.

At 0730 on August 25, Steve Green heard the BFBS news from Bielefeld on 101·5MHz. Michael Welch listened to the *Stuart and Gyn* programme on BBC radio WM on the 26th coming live from Birmingham airport, and in reply to his signal report Michael received a QSL card, sticker and photographs of both

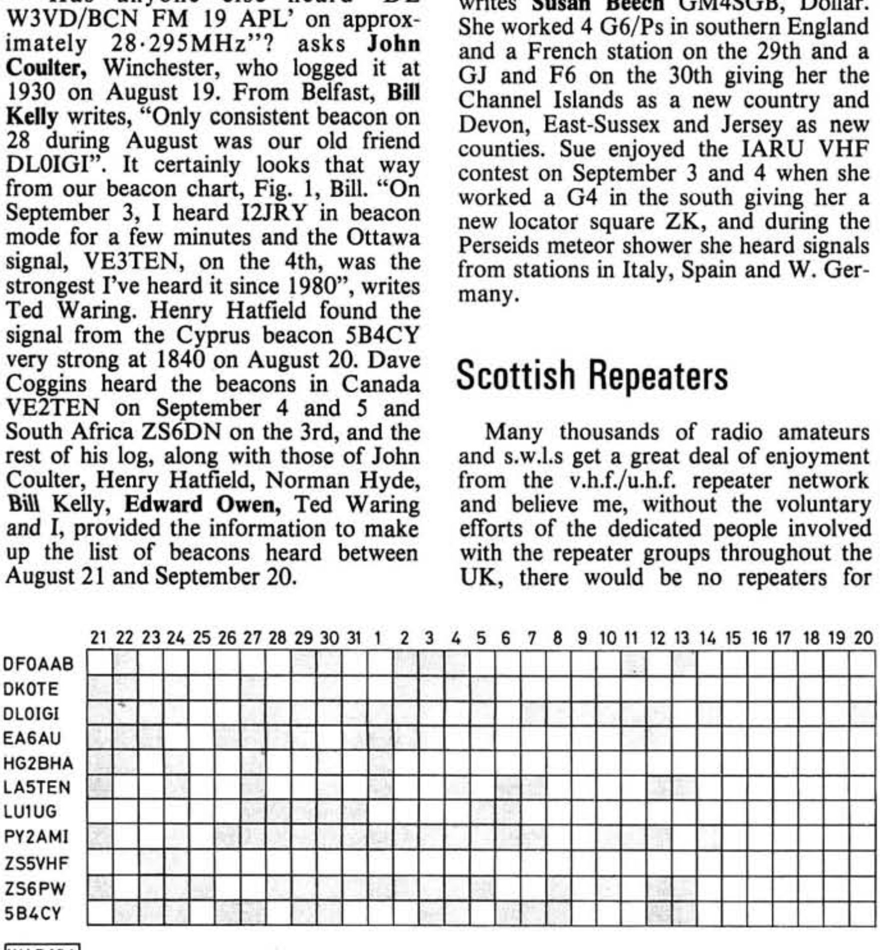


Fig. 1: Distribution of beacon signals

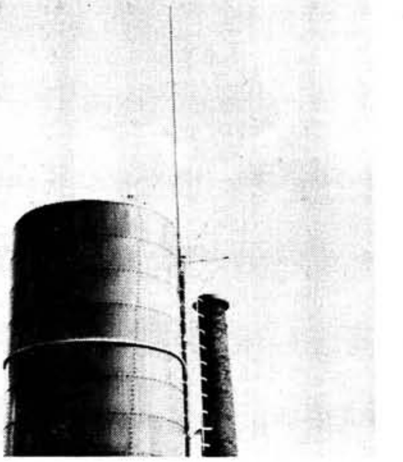


Fig. 2: Antenna system for GB3BT

Fig. 3: (L to R) GM8LRI, GM4EZJ and GM3HDT installing the repeater equipment

presenters. Michael also received strong signals from the ILR station Hereward Radio, and French and Spanish signals were reported by Mike Bennett during the period. On September 5, Simon Hamer heard BBC Radio York from Tacolneston and while the pressure was falling on the 8th, Harold Brodribb logged 22 French stations, including six editions of the programme *Musique*.

My thanks to **John Parry** for telling me that the American forces in Spain have several f.m. stations in operation and says that reception reports should go to US Air Force, Torrejone Air Base, near Madrid, and adds that the United States Armed Forces Radio and TV Service have a network in Italy which he thinks is referred to as the Southern Europe Broadcasting Service.

Ian Kelly heard ILR Essex Radio and GB Radio on August 27, French stations from Caen and Sarrebourg and on the 29th he logged France-Inter from Le Mans, Radio Bologne Littoral from Bologne, WLS from Kortrijk in Belgium, and ILR Saxon Radio from Bury St. Edmunds. By monitoring the signals of the ILR stations Chiltern and Wyvern and BBC Radio Oxford, at his QTH in Solihull, **Roger Wallis** can soon tell if a tropospheric opening is brewing up.

Fig. 4: GM4EZJ and GM8LRI adjusting the antenna for GB3SB

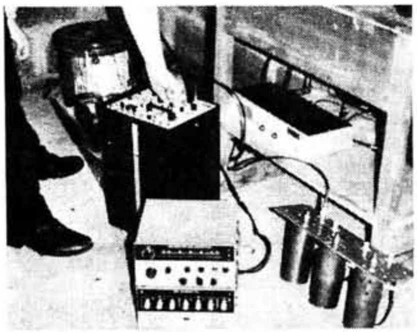


Fig. 5: The equipment and helical filters for GB3SB

RTTY

Peter Lincoln BRS42979, Aldershot, has added a Tono Theta 550 c.w./RTTY unit to his station and is very pleased with its performance, and like myself found the auto noise circuit very good for stopping all the rubbish that is printed when no signals are present. "RTTY has been fairly good this month with signals from Europe and the USA on most days as well as from the Far East, including many from Indonesia and Japan", writes Peter. During that month, Peter added 3 new countries, C5CL, KD7P/KHZ and W6HTH/KH6, to his score and also logged A4XRS and A4XJQ from Oman and says that 5B4CV is operating as 5B0CV for World Communications Year.

Between August 19 and September 12, Norman Jennings, Rye, with minimal time spent at his receiver, copied RTTY signals from 70 countries, including 3 new ones for him, CX, XE and TG9, 34 Europeans, the best being HB0LJX and OH0TTY, and a number of South Americans. During a similar period, I copied RTTY signals from 17 countries, CT, DK, DL, EA, F, I, IT9, KP4, LZ, QE, OH, ON, UA, VE, VK, W and Y8 on 14MHz and 7 countries, CT, DU, OE, ON, PY, VE and W on 21MHz. At 0209 on September 11 I copied the ARRL news from W1AW on 14MHz, around 14·090MHz and recommend this to readers.

Vintage Wireless Day

Although wind and rain reduced the attendance at the Vintage Wireless Day, held at the Chalk Pits Museum, Amberley, Sussex, on September 18, we were delighted to welcome Irene and David, the widow and son of the late Gerald Marcuse G2NM, Len Newnham G6NZ and Geoff Stone G3FZL, both past presidents of the RSGB and many 'old timers' who heard QSOs through our special station GB2NM commemorating the work of Gerald Marcuse, past president of RSGB, pioneer of Empire Broadcasting and founder member of RAOTA. As organiser, I would like to thank all the radio amateurs and enthusiasts who supported the event, our exhibitors Ralph Barrett, Les Sawford and family, members of the Chichester, Surrey and Worthing Amateur Radio Clubs and Sussex Raynets, Chris Pearce with his Humber WW2 radio truck and Bob Warner for his military exhibits, members of the British Vintage Wireless Society and the British DX Club, our stewards Adrian Butcher, David Ford, Fred Pallant and Ron Weller and the Brownlow family for looking after and organising the museum shack.

Contests

The Swale Amateur Radio Club G4SRC have organised two open contests, with low power sections, for RSGB members to take place on 144MHz between 1000 and 1800GMT on January 22 and on 432MHz between 1400 and 1800GMT on the 29th, 1984. The low power means 25 watts and below for 144MHz and 10 watts and below for 432MHz. The scoring is one point per contact and 10 points for working the club station and the final score is the number of points multiplied by the number of postal counties. Countries, other than the UK, will count as extra counties and the contest exchange shall consist of callsign, RS(T) report, serial number starting from 001 and the postal county. Duplicates must be marked.

The overall winner of each contest will receive a cup to keep and certificates will be given to the winners of the low power sections and to runners-up. Logs must be postmarked on or before 15 days from the date of the contest and sent to Brian Hancock G4NPM, Leahurst, Augustine Road, Minster, Sheerness ME12 2NB, and include a declaration that the entrant is an RSGB member and has operated in

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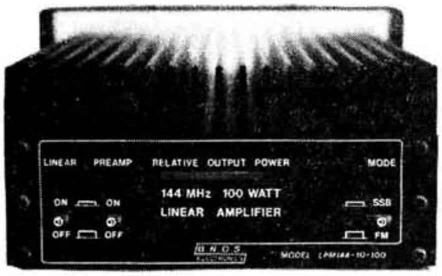

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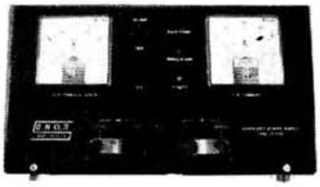

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accordance with licence conditions and a statement of the transmitter power used. Good luck to all competitors, and don't forget the RSGB are holding their 144MHz fixed station contest on December 4.

Tail Piece

Among nearly 50 exhibits at the Rotary Club's Hobbies and Leisure exhibition in Worthing's Assembly Hall on September 17 was an amateur station and display by the Worthing and District Amateur Radio Club, which proved to be very popular with the visitors. During the event two ZL stations were among the 50 QSOs made, as well as a station in Florida worked at mid-day via the Russian RS8 satellite and the Worthing TV group showed the public pictures taken by one of their cameras in the balcony.

Can anyone help Nigel Wood with a circuit or general information on a Selmar valve type electronic organ? If so, please give Nigel a ring on Midhurst, Sussex, 2126.

Nicholas Quinn, Lancing, is an active member of the British DX Club and the Worthing and District Amateur Radio Club and uses Sony 2001 and Trio R-1000 receivers and long wire antenna for broadcast listening and operates with his call G6TIS on the 144MHz band. During his 4 years as a BCL he has more than 100 countries confirmed and has an impressive book of QSL cards to prove it. He is particularly pleased with the signals he received from the Voice of Malaysia and Radio Free Granada. Nick tells me that the BDXC has about 250 members and readers wishing to join should contact the secretary, Donald McKinlay, 55 Boundary Road, Worthing, Sussex.

TELEVISION *by Ron Ham BRS15744*

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

Although the 1983 sporadic-E season ended in late August, we still have a few minor events, plus F2 and tropospheric openings, to watch out for during the months ahead. Don't forget, I am always pleased to hear from readers about Amateur Television and associated cameras and equipment, contests, events, SSTV and television receivers and recorders from both home and overseas.

Sporadic-E

Between August 19 and 27, **Alan** and **Julie Taylor**, Coventry, logged test cards from Italy, Russia and Yugoslavia in Band I. I received the test card ORF FS 1 from Austria on the 21st, the Norwegian NRK clock at 0804 on the 25th showing 0904, followed by a programme schedule and YL announcer. At 1832 on September 6 and 0825 on the 7th, outside of the sporadic-E season, I watched news programmes from the USSR on Ch. R1 with the familiar captions BPEMR, HOBOCTON and TB CCCP, male and female presenters and followed by their analogue clock showing 4 hours ahead of GMT. While **Harold Brodribb**, St Leonards-on-Sea, reported seeing the Italian RAI-1 test card on August 16 and the Norge GAMLEM and MELHUS test cards, with their digital clocks, on the 18th, **Mike Bennett**, Slough, saw the programme *It's a Knockout* from an unknown station on Ch. E2 on the 21st.

"The sporadic-E season now seems to be over", writes **Brian Renforth,** Torquay, on September 2, who received the last pictures by this means of propagation on August 28. Brian has installed a new antenna system, Fig. 1, comprising a 103-element beam for u.h.f., 3-element for Band I and a 5-element for Band III, all mounted on a Hirschmann/Stolle rotator. Among the many logos and test cards Brian received during the season was RUV Iceland, Fig. 2, and he asks if any reader has any idea of the origin or meaning of the caption Celebrouh under the motif of a sailing ship, which he saw around Ch. E4 at 0830 on July 20. **Walter Haller**, stationed in the UK with the American forces, uses a Plustron TVRC 7D and 3-element beam for Band I, received pictures from Hungary and Spain, Fig. 3, during the evening of August 17. **Len Eastman** G8UUE, Bristol, using a JVC CX610GB and mast-head pre-amplifier, stores his DX on a video tape and kindly sent a selection of pictures, he received in July, of people familiar to the TVDXer like the Russian YL presenter, Fig. 4, three characters from Poland, Figs. 5, 6 and 7. The Russian sport presenter, Fig. 8 and the digital clock on the Norge Steigen test card, Fig. 9, were logged by **Steve Green**, and the Norwegian NRK analogue clock, Fig. 10 and an entertainer, Fig. 11, seen on Russian television, were received by Len Eastman.

"My Plustron TVR5D has certainly 'earned its corn', as the saying goes, during the last few months and as far as I am concerned it must be one of the best buys I have made regarding electronic equipment" writes **Eric Weaver**, Redditch, who, having logged stations from Europe, Scandinavia and the USSR during his first few months of TVDXing adds, "It's all been so much simpler than I anticipated", so much so that Eric plans to include a Vega 402 in his station, which at present has a Yaesu FRG-7700 communications receiver and a Fidelity 14in colour TV. At 1900 on September 3, **Simon Hamer**, New Radnor, saw a studio contest from the USSR on Ch. R1 with captions that looked like MOANH and OHBCNKH with cartoon violins and at 2005 on the 5th he watched a film from Italy on Ch. IA 53·75MHz.

Tropospheric

Steve Green, Malvern, is pleased with the performance of his Vega 402D and during the tropo opening on August 26, 27th and 30th, he received pictures from Denmark, Fig. 12, received on another set back in June, Holland and Sweden in Band III and watched *West Side Story* from the German station ZDF on u.h.f. Ch. 35. At 0804 on the 25th, I received test cards from Holland PTT NED1 on Ch. E5 and German WDR1 on Ch. E11. At 2230, **Alan Taylor** received a strong test card from DR Denmark, like Fig. 12 and I logged it again on Chs. E5, E7 and E10 early in the mornings of the 29th and 30th.

"It's great to see TDF normally instead of a jumbled-up negative mess", writes Brian Renforth, who spent all of a recent Sunday in his workshop modifying his KB VC52 chassis for the French television system which has a negative-going picture and uses 819 lines compared with most other systems of 625 lines.

"Absolutely spectacular pictures from Germany and Holland on August 26, when my lad and I were able to 'Page the Televerket' on Ch. 31 (NED 1) and Ch. 37 (ZDF) from 0800 to 0845 without a single parity error!" writes **Roger Wallis** from Solihull.

Amateur Television

"We certainly need to keep the 432MHz band in use otherwise it may go the same way as in Belgium!" writes Len Eastman, one of the pioneers of television in Bristol. Good thinking Len, do you remember how the advent of the G8-plus-3 callsigns almost certainly saved the band back in the late 1960s?

Len tells me that G3NXU, G4BVK, G6RQP, G6TSE, G8GLQ, G8KGH, G8RFD, himself G8UUE, G8VPG, G8WAX, G8XXG, G8XZG and G8ZQF are among the many amateur TV stations active in the Bristol area and that a number of these are planning to build equipment for 1296MHz. They have also applied for a TV repeater licence for Bath because, like Bristol, it is a rather hilly part of the country.

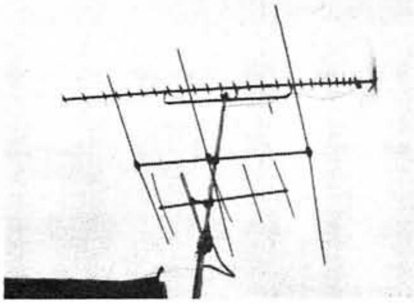

Fig. 1: Brian Renforth's new antennas

Fig. 2: Icelandic caption *Brian Renforth*

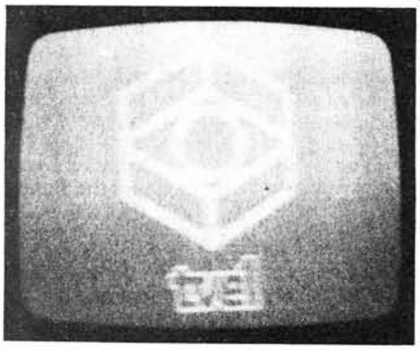

Fig. 3: Spanish TV logo *Walter Haller*

Fig. 4: Russian presenter, with digital clock *Len Eastman*

Fig. 5: Familiar face from Poland *Len Eastman*

Fig. 6: Polish news presenter—note the dt caption *Len Eastman*

Fig. 7 Received from Poland *Len Eastman*

Fig. 8: Russian sport *Steve Green*

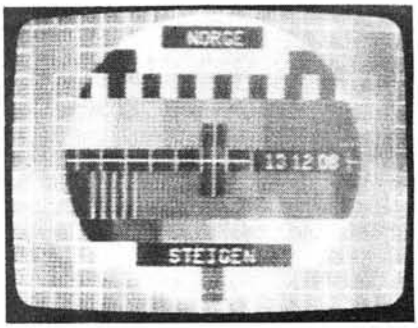

Fig. 9: Digital clock on Norge test card *Steve Green*

Fig. 10: Norwegian clock *Len Eastman*

Fig. 11: Entertainer received from the USSR *Len Eastman*

Fig. 12: Band III signals *Steve Green*

SSTV

Although **Peter Lincoln**, Aldershot, copied several German and Italian SSTV stations during the month preceding September 7, his best DX was EA8AHK whose picture is seen in Fig. 13 and LA4R, Fig. 14, who confirmed Peter's report with a QSL card.

Beginner's Guide to Television

Television enthusiasts should not be put off by the word Beginner, because in my view, the 6th edition of Gordon King's book, *Beginner's Guide to Television* (Newnes Technical Books ISBN 0 408 01215 3), revised by Eugene Trundle, is a first-class work hitting the right level for the early student of the subject and is a good refresher for the seasoned engineer.

Personally, I like the way that the meat of this complex subject, from the camera through the many circuits which make up the transmission and reception of pictures, is put in a nutshell and without doubt is easy for the TV buff to understand.

For the enthusiast who just uses equipment, the sections on Data Transmission, Closed Circuit TV and Video Recording should be of great interest and the Bands IV and V DXer may well find the pages devoted to antennas and propagation and the use of a test card to adjust receivers, of great value. To sum up I would say that this book is good value at £4.35 (soft cover) and is an important key to the better understanding of more specific technical literature.

Fig. 13: EA8AHK *Peter Lincoln*

Fig. 14: SSTV from Norway *Peter Lincoln*

Station Reports

Further to the use of the word Tagesthemen, which I mentioned in our October issue, came two replies, the first from **John Coulter**, Winchester, who said "Tagesthemen means 'topics of the day' " and the second from **Richard Hunt**, Tadcaster, who explains. "The 'FIRST PROGRAMME' of German TV, ARD has three news bulletins nightly. The first two, usually about 1615 and 2000CET respectively, are titled 'Tagesschau' and the third bulletin, around 2230CET, is titled 'Tagesthemen' and lasts about half an hour with more in-depth coverage than the other two which last some 15 minutes". Richard also told me that British TV programming times are more rigid than German, so the times he quotes may vary, by design, up to three-quarters of an hour per day. My thanks to John and Richard for their trouble, such information is valuable to many readers.

"I noticed a strange phenomenon in 1982", writes Major Rana Roy, Bikaner, India, "Whenever it was bright, sunny and hot, I received TVDX signals, but when it rained there were no signals. However, the same was not true this year". An interesting observation Rana, no doubt you will do another comparison next year and let us know the result.

Can anyone help television specialist Ron Weller with a manual or any information for a 1950s Telequipment Serviscope, if so, drop him a line at 203, Tarring Road, Worthing, Sussex.

Swap Spot

Have Alba, model CB H2, 40-channel hand held f.m. CB transceiver. Would exchange for a Sinclair ZX81. Tel: 021-356 6454 (Birmingham). *T431*

Have Yaesu FRG-7700M receiver, memories version, c.w., matching tuner, v.h.f. converter model E and active antenna unit, all as new. Would exchange for modern radio/music centre or video recorder to equivalent value. Details in writing please. B. Kenneford, 2 Mill Lane, Shoreham-by-Sea, W. Sussex BN4 5AB. *T436*

Have ZX Spectrum computer 48K. Would exchange for 144MHz 10W in 100W out amplifier with r.f. switched pre-amp—must be working. Tel: Bristol 550596, ask for G6MHB or leave message and telephone number. *T437*

Have electric bass guitar, with case, leads etc. Also Tandy four channel 144MHz scanner. Would exchange for MMT432/28 transverter, 144MHz linear + p.s.u. (10W input) or MMK1296/144 receive converter/pre-amp, w.h.y. A.G. Robson GM8YIK, 38 Glebe Park, Duns, Berwickshire. *T453*

Have Nato R-444 v.h.f. search receiver with tuning units 36MHz–12GHz, spectrum analyser, Marconi RCI bridge, 35mm film viewdata, RTTY converter using an oscilloscope, signal generators covering 10Hz–4GHz. Would exchange all for receiver 500kHz–30MHz. Bob Wright, 249 Sandy Lane, Hindley, Wigan, Lancs. Tel: 55948. *T455*

Have Datong D70 Morse tutor. Would exchange for 144MHz linear 10W input or Fairing for Yamaha 250cc motorcycle. G8XCL (NOT QTHR) Tel: Lydd (Kent) 20954. *T462*

Have FRV-7700B converter to work with FRG-7700 or any general coverage receiver. Covers 118–135MHz, airband, 50MHz band and 140–150MHz. Would exchange for 432 or 1296MHz TV transmitter or w.h.y. Tel: 0942 601216 evenings (Leigh). *T471*

Have Skyleader 35MHz f.m. radio control outfit plus 3 model engine kits, also Super 8 sound projector, two cameras, one Super 8 and one Standard 8. Would exchange for Kenwood TR2500 or similar 144MHz handheld with NiCads and charger. Tel: 074 570 469 (Clwyd) evenings only. *T480*

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.

Setting up a station?

* TRIO *

Trio have just introduced some wonderful new models. There's the TW 4000A, the two-in-one mobile. It combines 70cms and 2m in one box. There are far too many features to describe here so why not come in and try it for yourself?

For those who would prefer to have two separate radios, how about the new super slim mobiles – the TM 201A and the TM 401A. Both are attractively styled with a host of features that would make a trip to see them well worth the effort.

We have these models in stock and would be more than pleased to demonstrate them to you.

Trio have also just introduced a superb new range of accessories. We can now supply Trio SWR bridges, power meters, mobile microphones, headphones, microphone adaptors etc. etc. The entire range has the Trio stamp of quality.

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Two Decades of DXing

by Roger Bunney

In musing through the pages of *Practical Wireless* the thought arises that with the advances in communications technology how easy everything is these days!

The modern "black box" bought-in Far Eastern technology is now perhaps spawning a new breed of radio enthusiast, that of the operator rather than the amateur who can design, construct and repair his equipment. There are few I suspect that could actually repair an SX200N who currently operate them, such is progress in these modern synthesised times—yet mass production can give us a 40-channel, digital-readout, 4 watt transceiver for under £25, perhaps half the cost of the actual components!

My first experiences of DXing were in the early 1960s using a 5-valve superhet costing £3.19s.6d. The Short Wave bands were less congested without the multi-hundred kilowatt broadcasters—the simple superhet with no r.f. amplifier stage and two i.f. stages was quite sufficient to produce DX of such a remarkable nature to discard the Duke and Co. superhet in favour of a 13gn. Govt. Surplus PCR3 s.w. receiver from Relda Radio. This magnificent beast looked like a real communications receiver (although I suspect it was made for enhanced Forces entertainment purposes), black crackle case and handles! The Relda Radio offering was their de-luxe version with a built-in mains p.s.u. With the tuned r.f. amplifier stage results improved considerably and with increasing confidence the receiver was carefully modified, following details in *Practical Wireless* around 1961.

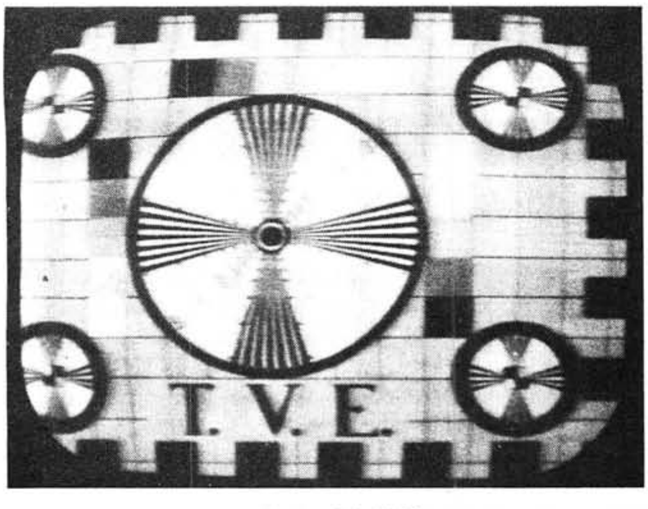

Fig. 1. An example of a mid-1960s monoscope test pattern, TVE (Spain), off-air DX. TVE is Ch. E2 Madrid

Medium wave DXing was also tried for one winter but the physical stamina required to sustain prolonged nights in mid-winter for West Coast Stateside transmitters, when one has to earn the proverbial crust the next (or same day), was such that the following winter I went upmarket to the s.w. bands again!

Over the next decade there followed a succession of receivers: TCS12, Heathkit RG1, Eddystone 840c, EC10mk2, 680, 680x, 940, Murphy B40, CR100 and currently (and occasionally used) a Lowe SRX30D. Of these I look back with fondness on the PCR3 and with pride on the 940, the latter a magnificent example of British engineering.

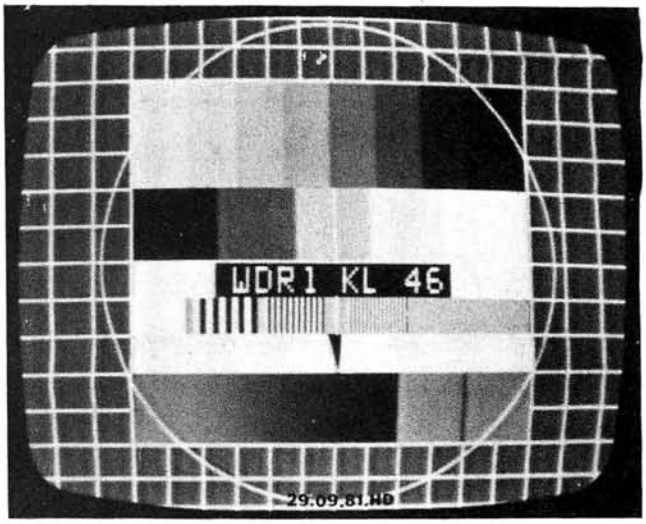

Fig. 2. A WDR (West Germany) example of early 1980s electronic generated test pattern

Today I can tune the SRX30D to a given frequency, switch on and if the transmitter is in operation one hears it. With the digital version so much more accurate tuning is brought to the operator, an accuracy that 10 years ago was unheard of in domestic equipment. Tuning to a specific frequency in "those days" often meant reference to perhaps a known frequency broadcast against a logging scale—then tuning "up a bit", aided possibly by a crystal calibrator. The wide scale units such as the AR88D obviously were easier, particularly if the alignment was spot on.

Radio equipment in earlier days seemed to look "right", an amateur transmitting station would comprise racks of equipment, meters, knobs and so forth, glowing valves—can there be the same character in modern Japanese, compressed, miniaturised, digitalised, fragile knobbed equipment—all that glows are l.e.d.s!

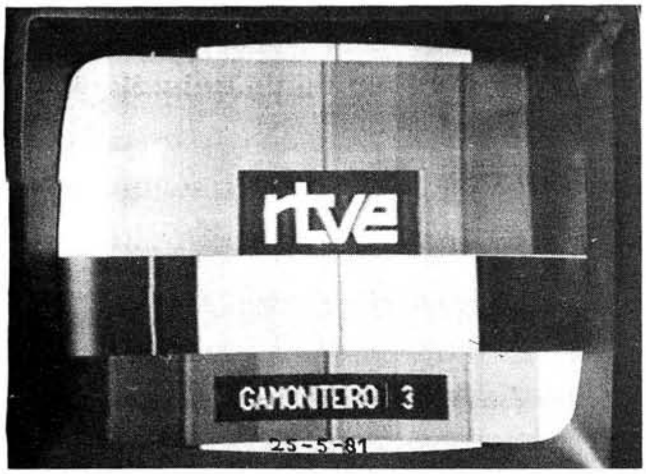

Fig. 3. RTVE (Spain), an example of early 1980s electronic generated test pattern

In 1962/3 I became active with TVDX in addition to my s.w.l. activities. Unlike the present time it was impossible to obtain an "export" TV receiver and so recourse was made to standard 405-line equipment with modifications made to run at 625 lines (difficult with harmonic tuned l.o.p.t.s with reasonable efficiency) and to switch between positive and negative going video. Fortunately working at the time with DER TV Rental confidence with television chassis ensured a high level of modification and also retained efficiency.

As with s.w. radio the early days of TVDX were an adventure. Little was known of other European countries' test cards or programmes, and there was much closer liaison between enthusiasts in resolving problems and technical difficulties. Test cards too differed between countries, those were the days of monoscope card generation unlike the electronically generated standard cards (such as the Philips 5544) of today. With the proliferation of Continental channels in Band I (thoughts of Sporadic-E openings!) so turret tuners were sought with additional "biscuits"—their coils adjusted to get "in between" UK channels.

Perhaps the biggest breakthrough in the last decade has been the varicap tuner which has eased DXing problems considerably, allowing a continuous sweep throughout the appropriate bands. Currently, for example, there can be purchased a MOSFET varicap tuner covering all TV bands and most in between—for the unusual channels. Antenna technology has advanced with the u.h.f. TV expansion—wideband high gain u.h.f. antennas can now easily be purchased and low-noise, high-gain head amplifiers (commercial types in mass production now reach down to 1·8dB maximum noise figure) have extended u.h.f. horizons out to 500km in regular Tropospheric scatter situations.

We can now look forward to an accelerating technology in the next decade with (in the communications field) improved facilities at lower component count and cost. The next few years will see 12GHz satellite communication as an everyday domestic utility. The microprocessor will undoubtedly become more micro with greater facilities and the humble TV serving as the household v.d.u. centre.

Fig. 5. The mid-1980s will see this type of antenna adorning the skyline or gardens of the UK

Broadcasting will extend its hours gradually but the advent of the DBS (direct broadcasting satellite) and its influence on national broadcasting (and perhaps international reception) may result in the current national terrestrial network taking on a much more regional bias. The search for alternative power sources will gather momentum, already there is a medium power a.m. transmitter solely operational from a field full of solar cells in the USA. Fuel conservation could well become the motivation for the next two decades.

Whatever else occurs there should still be plenty to occupy the DX enthusiasts for a long time to come. ●

Fig. 4. Advances into microwave/satellite reception, the Moscow 1st Chain at 4GHz via Gorizont received on home-constructed equipment in Northern UK

the things people say

Mobile stations working the talk-in station at the Woburn Rally

1st mobile: "I would like to warn all mobiles that there is a wallaby loose near the main entrance."

2nd mobile: "Is it a wallaby or a kangaroo?"

3rd mobile: "Log it as a VK mobile!"

heard by J. Glanville G3TZG

Have you heard any (printable) comments, funny peculiar or funny ha-ha? If so, why not send them in to our Editorial offices at Poole. We will pay for every one published.

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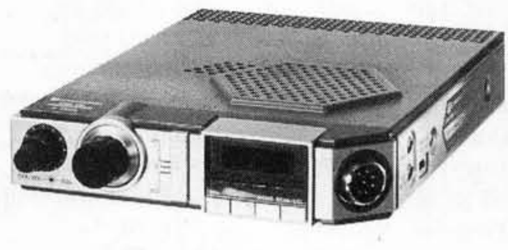

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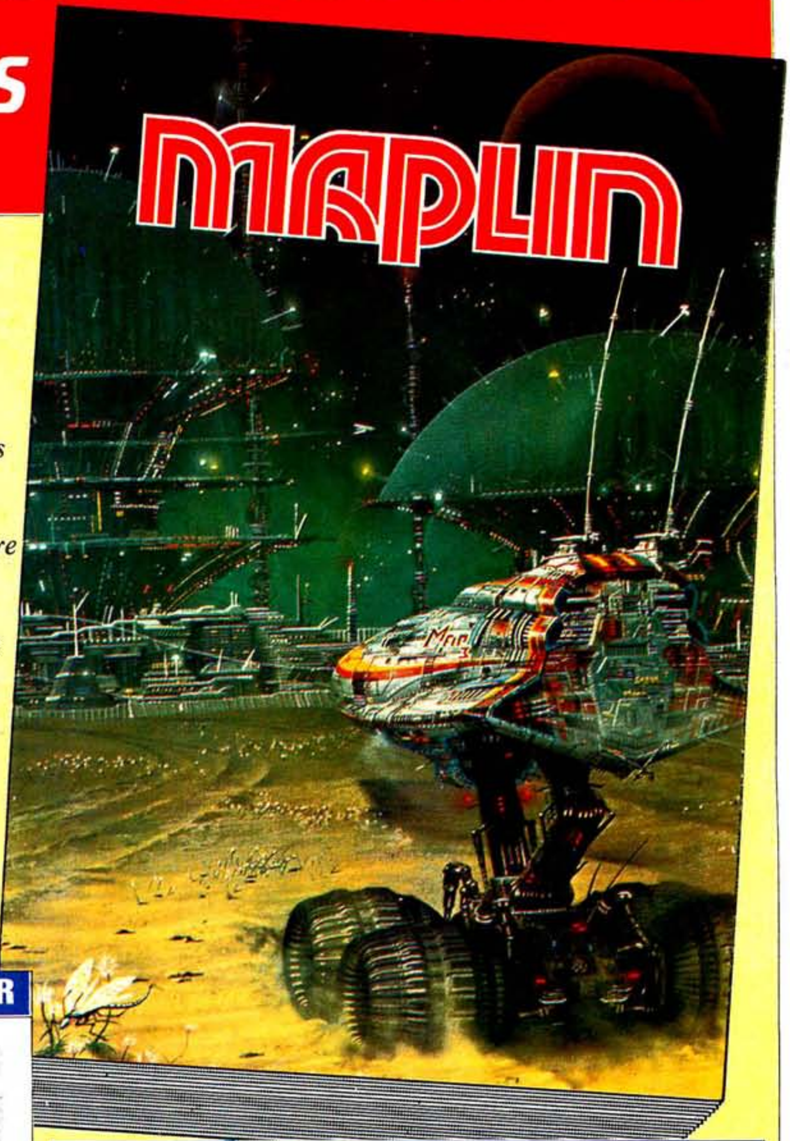

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