FOR THE RADIO ENTHUSIAST . . .

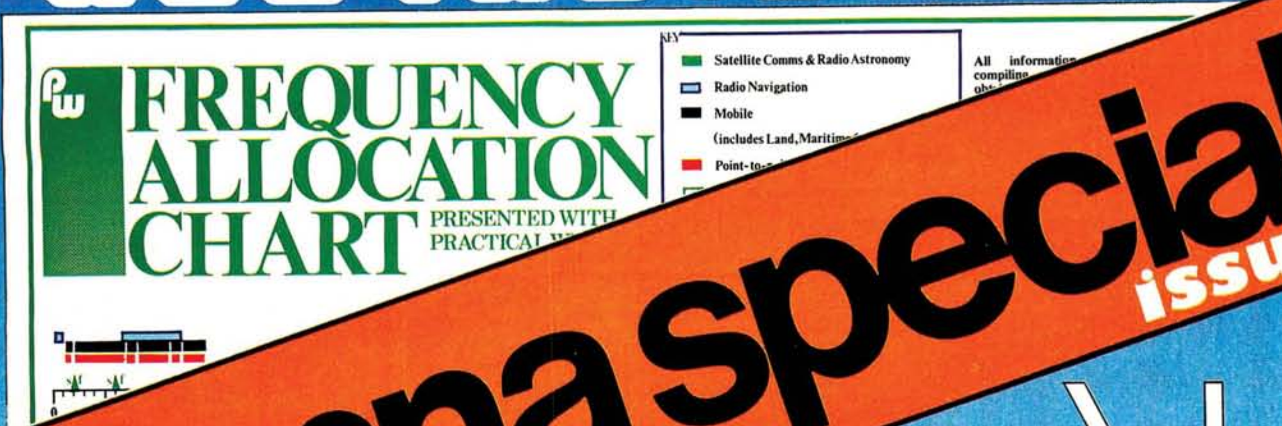
MARCH 1981

Practical Wireless

Australia $1.15
New Zealand $1.25
Malaysia $4.00

65p

FREE INSIDE



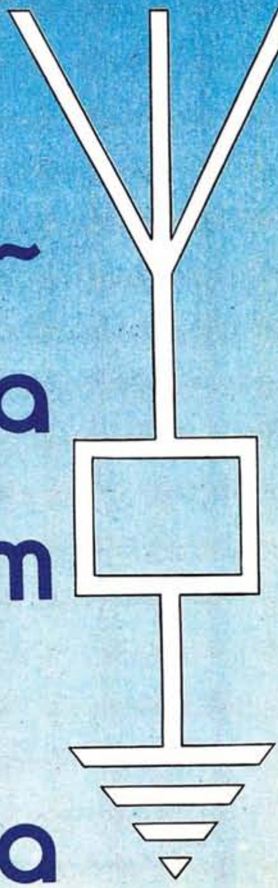
antenna special issue

featuring:~

Active Receiving Antenna

Delta Beams for 10 & 15m

Q Multiplier and Spiral Loop Antenna



FREQUENCY ALLOCATION CHART

PRESENTED WITH PRACTICAL WIRELESS MARCH 1981

KEY

- Satellite Comms & Radio Astronomy
- Radio Navigation
- Mobile (includes Land, Maritime & Aeronautical)
- Point-to-point services
- Broadcasting
- Amateur
- Standard frequency & Time signal
- Distress frequency

All information used in compiling this chart was obtained from *Revised Table of Frequency Allocations,* published by Her Majesty's Stationery Office.

New and revised allocations resulting from WARC '79 come into effect in January 1982, except for some bands where existing users must transfer to new allocations. For example, the new amateur bands at 18 and 24MHz will not be immediately available.

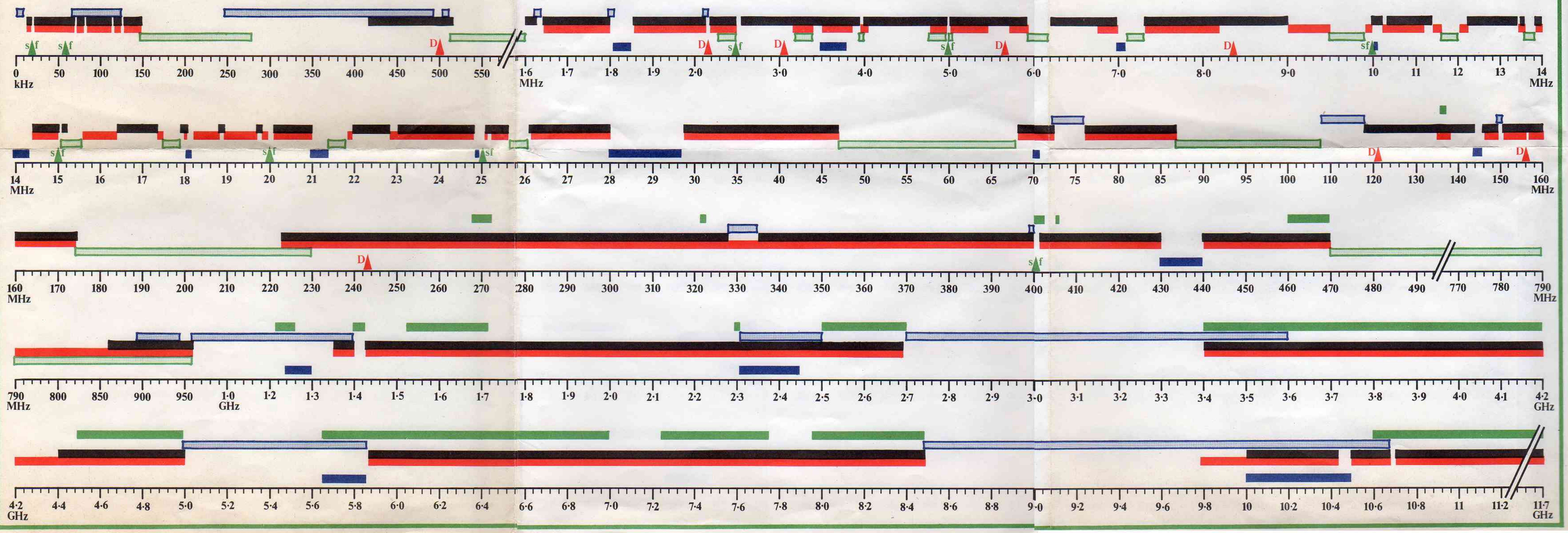
AMATEUR BANDS

Frequency limits	Band	Frequency limits	Band
1·81-1·85MHz	160m	430-440MHz	70cm
3·50-3·80MHz	80m	1·24-1·30GHz	23cm
7·00-7·10MHz	40m	2·30-2·45GHz	(13cm)
10·1-10·150MHz	30m*	5·65-5·85GHz	(5cm)
14·0-14·350MHz	20m	10·0-10·5GHz	3cm
18·068-18·168MHz	17m*	24-24·25GHz	(1cm)
21·0-21·450MHz	15m	47-47·20GHz	(0·6cm)*
24·89-24·990MHz	12m*	75·5-81·0GHz	(0·3cm)*
28·0-29·70MHz	10m	142-149GHz	(0·2cm)*
70·025-70·77MHz	4m	241-250GHz	(0·12cm)*
144-146MHz	2m		

*See new Frequency Allocation note.

BROADCAST BANDS

Frequency limits	Band	Frequency limits	Band
148·5-238·50kHz	2000-1053m (Long)	11·65-12·05MHz	25m
		13·60-13·80MHz	22m
526·5-1606·5kHz	571-187m (Medium)	15·10-15·60MHz	19m
		17·55-17·90MHz	16m
2·300-2498·0kHz	120m	21·45-21·85MHz	13m
3·200-3·40MHz	90m	25·67-26·10MHz	11m
3·950-4·00MHz	75m	47·00-68·00MHz	(4-6m)
4·750-5·06MHz	60m	87·50-108·0MHz	(3m)
5·950-6·20MHz	49m	174·0-230·0MHz	(1·5m)
7·100-7·30MHz	41m	470·0-960·0MHz	(30-60cm)
9·500-9·90MHz	31m	11·70-12·50GHz	(2·4-2·5cm)



AS REVIEWED THIS ISSUE
THE RM940 INFRA RED
SAFETY MICROPHONE
NOW IN STOCK £45

Bredhurst electronics

HIGH ST., HANDCROSS, W. SUSSEX 0444 400786

TRY OUR TELEPHONE SALES SERVICE

TRANSCEIVERS

ICOM FOR TWO METRES

IC 2E £159

inc. VAT & CARRIAGE

- Fully synthesized – covering 144-145.995 in 5KHz steps.
- 1.5W power output with 9V battery as supplied.
- Optional 6V or 12V packs for lower or higher power.
- BNC antenna output socket for helical or external antenna.
- Weight – only 450 grams, with supplied battery pack and helical.
- Send/battery indicator – indicates transmit until time for battery recharge.
- Duplex/Simplex switch – Hi/Low power switch.
- Optional external speaker microphone available now.
- Full 12 months guarantee for all rigs bought from Bredhurst Electronics.

H.F.

TRIO TS130V (New Model)	£404.00
TRIO TS130S (New Model)	£491.00
TRIO TS520SE (Still a Favourite)	£437.00
YAESU FT707	£499.00
YAESU FT101Z (New Bands)	£488.00
YAESU FT101ZD (New Bands)	£569.00
TRIO TS830S (The New One)	£639.00
ICOM IC720	£699.00
YAESU FT107M	£690.00

2.M. MOBILES

FDK Multi 700EX	£199.00
STANDARD C8800	£250.00
ICOM IC255E	£255.00
TRIO TR7800	£265.00

HANDHELDS

FDK PALM II	£99.00
ICOM IC2E	£159.00
FDK PALM IV	£159.00
TRIO TR2300	£166.00
AOR AR245A	£178.00
TRIO TR2400	£198.00
YAESU FT207R	£199.00

2.M. MULTIMODES

FDK MULTI 750E	£299.00
ICOM IC260E	£339.00
TRIO TR9000	£345.00
YAESU FT480R	£359.00
ICOM IC251E	£479.00

2M FM

25 Watts

FDK MULTI 700EX

The 700 EX is a mobile F.M. transceiver with built in speaker and comes complete with microphone, mobile mounting bracket and D.C. lead. Power output is variable between 1-25 watts on the front panel. Tuning is 25 kHz or 12·5 kHz steps from 144-146 MHz. Full repeater shifts are built-in including instant reverse repeater operation and also a scanning facility is included.

£199, inc. VAT free Delivery

RECEIVERS

H.F.

LOWE SRX30	£158.00
YAESU FRG7	£189.00
TRIO R1000	£285.00
YAESU FRG7700	£299.00

2.M. F.M.

SEARCH 9	£45.00
A.O.R. AR22	£83.00
FDK TM56B	£79.00
BEARCAT 220FB	£258.00

MARINE V.H.F.

SEARCH 9	£45.00
FDK TM56B	£79.00
BEARCAT 220FB	£258.00

£258 inc. VAT & Carriage

THE BEARCAT 220 FB

AS REVIEWED THIS ISSUE

YAESU FRG 7700 THE NEW RECEIVER

BASIC UNIT £299

FRG 7700M with Memory £389

Memory Unit Only £83.95

These prices include VAT & Carriage

AT LAST A POWER SUPPLY WITH

Overvoltage Crowbar Protection
Current Limit with Voltage Foldback
Thermal Overload Protection

AND IT'S MADE IN THE UK!

DRAE 13·8V Power supplies.

4 amp	**£27.95** (£1.50)
6 amp	**£44.95** (£2.00)
12 amp	**£69.00** (£2.00)
24 amp	**£92.00** (£3.00)

N.B. These are prices for Fully Protected British power supplies.

ACCESSORIES

MORSE EQUIPMENT	Carriage
HK 707 (Up/Down Key)	£10.50 (£0.50)
MK 704 (Squeeze Paddle)	£10.50 (£0.50)
EK 121 (Elbug)	£29.95 (£0.50)
EK 150 (Electronic Keyer)	£74.00 (£0.00)
POWER SUPPLIES	
13·8V 4 AMP	£22.95 (£1.00)
13·8V 5/6 AMP	£29.95 (£1.50)
YAESU FP4 4/6 AMP	£40.00 (£1.50)
PH 5000 5/7 AMP	£46.00 (£1.50)
YAESU FP12 12/16 AMP	£78.00 (£2.00)
TRIO PS30 15/20 AMP	£85.00 (£2.00)
YAESU FP707 15/30 AMP	£109.00 (£2.00)
DUMMY LOADS	
DL 20 30 WATT	£6.00 (£0.30)
T 100 100 WATT (500 MHz)	£24.00 (£0.30)
T 200 200 WATT (500 MHz)	£35.00 (£0.30)
PROBLEMS WITH T.V.I.	
YAESU Low Pass Filter FF501DX (1KW)	£19.95 (£0.75)
TRIO Low Pass Filter LF30A (1KW)	£18.40 (£0.75)
W&S HP3A High Pass Filter (TV down lead)	£3.50 (£0.25)
FERRITE RINGS	£0.45 (—)
HEADPHONES	
YAESU YH55	£10.35 (£0.50)
TRIO HS4	£10.35 (£0.50)
TRIO HS5	£21.85 (£0.50)
WORLD CLOCKS	
QTR 24	£18.40 (£0.60)
QTR 24D (QUARTZ)	£24.50 (£0.60)

MOBILE ANTENNAE (All with PL259 fitting)	Carriage
14 MHz 1/4 (20SE)	£13.80 (£1.50)
21 MHz 1/4 (15SE)	£11.50 (£1.50)
28 MHz 1/4 (10SE)	£11.50 (£1.50)
144 MHz 1/4 (0dB)	£1.50 (£0.50)
144 MHz 5/8 (3dB)	£8.50 (£1.50)
144 MHz 7/8 (4·5dB)	£13.00 (£1.50)
432 MHz 2×5/8 (5·5dB)	£11.50 (£1.00)
CABLE MOUNT	£3.50 (£0.50)
GUTTER CLIP	£3.15 (£0.50)
MAGNETIC MOUNT	£6.95 (£0.50)
BOOT LIP MOUNT	£3.50 (£0.50)
MICROWAVE MODULES	
MMC 144 MHz	£24.90 (—)
MMC 432 MHz	£29.90 (—)
MMC 432/144S 70cm CONVERTER	£29.90 (—)
MMT 144/28 2M TRANSVERTER	£99.00 (—)
MMT 432/285 70cm TRANSVERTER	£136.00 (—)
MMT 432/144R 70cm TRANSVERTER	£173.65 (—)
MML 144/25 2M 25W LINEAR	£59.00 (—)
MML 144/100 2M 100W LINEAR	£142.60 (—)
MML 144/40 2M 40W LINEAR	£77.00 (—)
MML 432/20 70cm 20W LINEAR	£77.00 (—)
MML 432/50 70cm 50W LINEAR	£119.00 (—)
MML 432/100 70cm 100W LINEAR	£228.65 (—)
MMD 50/500 500 MHz COUNTER	£69.00 (—)
MMA 28 10M PREAMP	£14.95 (—)
MMA 144V 2M RF Switched PREAMP	£34.90 (—)
MMF 144 2M FILTER	£9.90 (—)
MMF 432 70cm FILTER	£9.90 (—)

SWR POWER METERS	Carriage
YW-3 TWIN METER	£11.50 (£0.50)
TOYO T 435 (144-435 MHz)	£34.45 (£0.75)
DAIWA SW110A (1·8-150 MHz)	£35.00 (£0.75)
WELZ SP 200 (1·8-150 MHz)	£49.95 (£0.75)
WELZ SP 400 (130-500 MHz)	£49.95 (£0.75)
DAIWA CN 620A (1·8-150 MHz)	£52.80 (—)
WELZ SP 300 (1·8-500 MHz)	£69.95 (—)
DAIWA CN 630 (140-500 MHz)	£71.00 (—)
SAFETY MICROPHONES	
ADONIS MM 202S (CLIP ON)	£20.95 (£0.50)
ADONIS MM 202H (Head Band + Up/Down)	£29.00 (£0.50)
ADONIS MM 202 FU (Swan Neck + Up/Down)	£30.00 (0.50)
DAIWA RM 940 INFRA RED LINK	£45.00 (£0.50)
DESK MICROPHONES	
YAESU YD 148 (Dual Imp.)	£20.95 (£0.75)
TRIO MC 50 (Dual Imp.)	£24.15 (£0.75)
SHURE 444 (High Imp.)****	£25.00 (£0.75)
ADONIS AM 502 Compressor Mic.	£39.00 (£0.75)
ADONIS AM 802 Compressor Mic. (3 outputs)	£59.00 (£0.75)
A.T.U.'s	
KX2 (Listeners A.T.U.)	£29.95 (£0.75)
MFJ 901	£50.95 (£0.75)
TRIO AT 130	£72.00 (—)
YAESU FC 707	£74.00 (—)
TRIO AT 200	£82.00 (—)
DAIWA CNA 1001A (Automatic A.T.U.)	£129.00 (—)
TEST EQUIPMENT	
FX1 Wave Meter	£28.00 (£0.75)
TRIO DM 801 Dip Meter	£51.00 (£0.75)

Buy it with Access

MAIL ORDER – RETAIL CALLERS 9–5.30 PM.
HIGH ST., HANDCROSS, W. SUSSEX. 0444 400786

BARCLAYCARD VISA

TO ORDER ANY OF THE ABOVE ITEMS SIMPLY WRITE, ENCLOSING A CHEQUE OR PHONE YOUR CREDIT CARD NUMBER

EDITORIAL OFFICES
Practical Wireless
Westover House
West Quay Road
Poole, Dorset BH15 1JG
Poole 71191

Geoff Arnold G3GSR
Editor

Dick Ganderton C.Eng., MIERE,G8VFH
Assistant Editor

Peter Metalli
Art Editor

John Fell G8MCP
Technical Editor

Alan Martin G8ZPW
News & Production Editor

Elaine Howard
Technical Sub-Editor

Rob Mackie
Technical Artist

Keith Woodruff
Assistant Art Editor

Sylvia Barrett, Sharron Breeze
Secretarial

ADVERTISEMENT OFFICES
Practical Wireless
King's Reach Tower
Stamford Street
London SE1 9LS
Telex: 915748 MAGDIV-G

Dennis Brough
Advertisement Manager
01-261 6636

Roger Hall G8TNT (Sam)
Ad. Sales Executive
01-261 6807

Claire Gerrish
Secretary
01-261 6636

Colin R. Brown
Classified Advertisements
01-261 5762

Dave Kerindi
Make-up & Copy
01-261 6570

Practical Wireless

MARCH 1981 VOL. 57 NO. 3 ISSUE 888

contents

Free this month—*PW* Frequency Allocation Chart

THE SHIMIZU SS105S *80-10 metres ssb/cw transceiver*

This super new transceiver covers 80-10 metres, gives 10W out and is smaller than anything else we have seen so far. Ideal for transverter driving, the SS105S has FM transmit and receive options as well as excellent performance on SSB/CW for HF band use. The SS105S is supplied in semi kit form so as to keep down the price, but all the RF and mixer boards are ready built and aligned so no test equipment is required. All the cabinet work has been carried out so all you have to do is assemble the IF strip, xtal oscillator, and fit them to the completed chassis. Great idea and it brings back the flavour of home brew with the added advantage that the rig will work when you've finished it. For more info, just ask us or come along and see it. It's a great little rig.

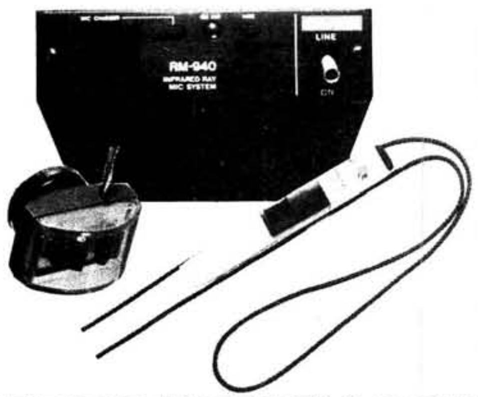
		NETT.	inc. VAT	CARR.
SS105S	80-10m solid state SSB/CW/FM transceiver. Semi kit form	**225.00**	**258.75**	4.50
SE-NB	Noise blanker kit	**6.75**	**7.76**	.50
SE-FMrx	RX FM discriminator kit	**15.00**	**17.25**	1.00
SE-FMtx	TX FM generator kit	**11.00**	**12.65**	1.00
SE-MK	RX marker kit	**9.60**	**11.04**	.50
0.5 CWF	500 Hz CW filter	**19.50**	**22.43**	.50
Optional band crystals		**3.00**	**3.45**	.25

AR 245 *2 metre hand held synthesized 144-146 5/1 watt.*

AR 240A *2 metre hand held synthesized 144-146 1½ watt.*

***AR 245 £178** inc. VAT.* ***AR 240A £158** inc. VAT.* *Carriage £1.50.*

INFRARED MOBILE MIKE SYSTEM



The Daiwa infrared mike system, comprising of a control box, sensor and infrared mike enables you to dispense with the hand mike and cable when operating in your car or shack. By using an infrared beam audio is transmitted from the mike to the sensor and then to the control box which activates the transmitter. To transmit, press the locking switch on the mike and talk. To receive, release the switch and your rig immediately returns to receive. When you have finished your contact return the mike to its slot in the control box and the mike nicad battery is maintained at full charge. For those of you who like fresh air and drive with all windows open there is a matching wind shield available at an additional 75p. So there we are, the latest in technology to bring safety to your mobile operation, the Daiwa infrared mike.

DAIWA INFRARED MIKE SYSTEM

£45.00 inc. VAT.
Carriage £1.50.

FREQUENCY COUNTER *Model HFC 55.*

The HFC55 is a sensibly priced, easy to use digital frequency meter covering 10 kHz-55 MHz in a single range. The bright 5 digit display gives a direct reading of frequency when the built in telescopic aerial is placed near a source of RF. The HFC operates from internal dry batteries and is housed in a strong metal case to withstand regular and continuous use.

***HFC55 Frequency Counter £36.50** inc. VAT. Carriage £1.50*

POWER SUPPLY UNITS

*the PP1305 4 amp 13.8 volts d.c. **£18.40** inc. VAT.*
*the PP137 7 amp 13.8 volts d.c. **£32.00** inc. VAT.*
*the PP1310 10 amp 13.8 volts d.c. **£49.50** inc. VAT.*
Carriage £2.00.

LOWE ELECTRONICS LTD

CHESTERFIELD ROAD, MATLOCK, DERBYSHIRE. Tel. 0629/2817.

TRIO *pacesetter in amateur radio*

TR-8400

70 centimetres is on the move.

The TR-8400 synthesized 70-cm UHF FM mobile transceiver covers 430-440 MHz in 25-kHz steps and includes five memories, automatic memory and band scan, UP/DOWN manual scan, and two VFOs.

TR-8400 FEATURES:

- Synthesized coverage of 430-440 MHz in 25-kHz steps.
- Five memories and memory backup terminal on rear panel.
- Two VFOs.
- Offset switch for ± 1.6 MHz transmit offset and simplex operation. Fifth memory allows any other offset by memorizing receive and transmit frequencies independently.
- Automatic scan of memories and of 430-440 MHz band (in 25-kHz steps). Locks on busy channel and resumes when signal disappears. HOLD or mic PTT button cancels scan.
- Up-down manual band scan in 25-kHz steps with UP/DOWN microphone supplied with TR-8400.
- Only 5¾ inches wide, 2 inches high and 7⅝ inches deep.
- TONE switch to activate 1750 Hz repeater access tone.
- Four-digit frequency display and S/RF bar meter. Other LEDs indicate BUSY, ON AIR, and REPEATER operation.
- HI/LOW (10 W-1 W) RF-output power switch.

TRIO TR-8400 £279 inc. VAT.
Securicor carriage £4.50.

R-1000

hear, there and everywhere easy tuning, digital display.

The R-1000 is an amazingly easy-to-operate, high-performance, communications receiver, covering 200 kHz to 30 MHz in 30 bands. This PLL synthesized receiver features a digital frequency display and analog dial, plus a quartz digital clock and timer.

R-1000 FEATURES:

- Covers 200 kHz to 30 MHz continuously.
- 30 bands, each 1 MHz wide.
- Five-digit frequency display with 1-kHz resolution and analog dial with precise gear dial mechanism.
- Built-in 12-hour quartz digital clock with timer to turn on radio for scheduled listening or control a recorder through remote terminal.
- Step attenuator to prevent overload.
- Three IF filters for optimum AM, SSB, CW. 12-kHz and 6-kHz (adaptable to 6-kHz and 2.7-kHz) for AM wide and narrow, and 2.7-kHz filter for high-quality SSB (USB and LSB) and CW reception.
- Effective noise blanker.
- Terminal for external tape recorder.
- Tone control.
- Built-in 4-inch speaker.
- Dimmer switch to control intensity of S-meter and other panel lights and digital display.
- Wire antenna terminals for 200 kHz to 2 MHz and 2 MHz to 30 MHz. Coax terminal for 2 MHz to 30 MHz.

R-1000 receiver £285.20 inc. VAT. **Matching speaker £26.45** inc. VAT.
Securicor carriage £4.50.

TR-7800 *the only 2 metre FM mobile transceiver.*

Frequency selection with the TR-7800 2-metre FM mobile transceiver is easier than ever. The rig incorporates new memory developments for repeater shift, priority, and scan.

TR-7800 FEATURES:

- 15 multifunction memory channels, selected with a rotary switch. M0 to M12 . . . memorize frequency and offset (± 600 kHz or simplex). M13 and 14 . . . memorize transmit and receive frequencies independently for non-standard offset.
- Internal backup for all memories, by installing four AA NiCd batteries (not supplied) in battery holder.
- Priority channel (memory "14") and priority alert.
- Covers 144-146 MHz, in 25-kHz or 5-kHz steps.
- Front-panel keyboard for selecting frequency, transmit offset, programming memories, and controlling scan.
- Automatic scan of entire band (5-kHz or 25-kHz steps) and memories.
- Manual scan of band and memories, with UP/DOWN microphone (standard).
- Repeater REVERSE switch.
- Selectable power output. 25 W (HI)/5 W (LOW).
- LED S/RF bar meter.
- TONE switch to activate 1750 kHz repeater access tone.

TRIO TR-7800 £268 inc. VAT.
Securicor carriage £4.50.

HEAD OFFICE AND SERVICE CENTRE
Chesterfield Road, Matlock, Derbys. Tel. 0629 2817 or 2430.
Open Tuesday-Friday 9-5.30, Saturday 9-5.00. Closed for lunch 12.30-1.30.
For all that's best in ham radio, contact us at Matlock.
For full catalogues send 48p in stamps with your address. Mark enquiry PW.

LE

POPULAR KITS AND PARTS

TRANSMITTER SURVEILLANCE
Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox—all electronic parts and circuit. **£2·30.**

RADIO MIKE
Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. **£6·90.**

SAFE BLOCK
Mains quick connector will save you valuable time. Features include quick spring connectors, heavy plastic case and auto on and off switch. Complete kit **£1.95.**

LIGHT CHASER
Gives a brilliant display—a psychedelic light show for discos, parties and pop groups. These have three modes of flashing, two chase-patterns and a strobe effect. Total output power 750 watts per channel. Complete kit. **Price £16.** Ready made up **£4 extra.**

FISH BITE INDICATOR enables anglers to set up several lines then sit down and read a book. As soon as one has a bite the loudspeakers emits a shrill note. Kit. **Price £4·90.**

6 WAVEBAND SHORTWAVE RADIO KIT
Bandspread covering 13·5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit. Includes case materials, six transistors, and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy, if you have an amplifier to connect it to on a pair of high resistance headphones. Price **£11·95.**

SHORT WAVE CRYSTAL RADIO
All the parts to make up the beginner's model. Price **£2·30.** Crystal earpiece **65p.** High resistance headphones (give best results) **£3·75.** Kit includes chassis and front but not case.

RADIO STETHOSCOPE
Easy to fault find—start at the aerial and work towards the speaker — when signal stops you have found the fault. **Complete kit £4·95.**

INTERRUPTED BEAM KIT
This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components—relay, photo transistor, resistors and caps etc. Circuit diagram but no case, Price **£2·30.**

OUR CAR STARTER AND CHARGER KIT has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250w mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. **Price £11·50** + £2·50 post.

G.P.O. HIGH GAIN AMP/SIGNAL TRACER. In case measuring only 5¼in × 3½in × 1½in is an extremely high gain (70DB) solid state amplifier designed for use as a signal tracer on GPO cables etc. With a radio it functions very well as a signal tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4½v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, cueing amp, etc. **An absolute bargain at only £1·85.** Suitable 80 ohm earpiece 69p.

VU METER
Edgewise mounting, through hole size 1¾" × ⅞" approx. These are 100 micro amp f.s.d. and fitted with internal 6 volt bulb for scale illumination, also have zero reset. The scale is not calibrated but has very modern appearance. Price **£2·88p.**

BALANCE METER
Edgewise mounting 100 UA centre zero. Price **£2·30p.**

1¾" SQUARE PANEL METER
Eagle full vision plastic front, 50 UA. Price **£4·60p** 1 mA Price **£4·03p.**

WATERPROOF HEATING WIRE
60 ohms per yard. This is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses—around water pipes, under grow boxes in gloves and socks. **23p** metre.

DIAL INDICATOR
As used in tool making and other precision measuring operations, the famous John Bull accurately shows differences of 0·1mm. A beautifully made precision instrument, price in most tool shops would be £12-£15. We have a fair quantity. Price **£9·20p.**

COMPONENT BOARD Ref. W0998.
This is a modern fibre glass board which contains a multitude of very useful parts, most important of which are: 35 assorted diodes and rectifiers including four 3 amp 400v types (made up in a bridge) 8 transistors type BC 107 and 2 type BFY 51 electrolytic condensers, SCR ref. 2N 5062 25 Ouf 100v DC and 100uf 25v DC and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at **£1·15.**

FRUIT MACHINE HEART. 4 wheels with all fruits, motorised and with solenoids for stopping the wheels with a little ingenuity you can defy your friends getting the "jackpot." **£9·95 + £4** carriage.

DESOLDERING PUMP
Ideal for removing components from computer boards as well as for service work generally. Price **£6·35.**

4-CORE FLEX CABLE
White pvc for telephone extensions, disco lights, etc. 10 metres **£2,** 100 metres **£15.** Other multicore cable in stock.

MUGGER DETERRENT
A high-note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. **£2·50** complete kit.

HUMIDITY SWITCH
American made by Honeywell. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive microswitch. Very sensitive breathing on it for instance will switch it on. Micro 3 amp at 250V a.c. Only **£1·15.**

MINI-MULTI TESTER

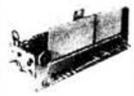
Deluxe pocket size precision moving coil instrument, jewelled bearings—2000 o.p.v. mirrored scale.
11 instant range measure:
DC volts 10, 50, 250, 1000.
AC volts 10, 50, 250, 1000.
DC amps 0-100 mA.
Continuity and resistance 0-1 meg ohms in two ranges. Complete with Test Prods and instruction book showing how to measure capacity and inductance as well.
Unbelievable value only **£6·75** + 50p post and insurance.

FREE Amps ranges kit to enable you to read DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini-tester and would like one, send **£2·50.**

SUPER HI-FI SPEAKER CABINETS.

Made for an expensive Hi-fi outfit—will suit any decor. Resonance free cut-outs for 8" woofer and 4" tweeter. The front material is carved Dacron, which is thick and does not need to be stuck in and the completed unit is most pleasing. Colour black. Supplied in pairs, price **£6·90** per pair (this is probably less than the original cost of one cabinet) carriage £3 the pair.

CHASSIS BARGAIN



3 wave band radio with stereo amplifier. Made for incorporation in a high-class radiogram, this has a quality of output which can only be described as superb. It is truly hi-fi. The chassis size is approximately 14". Push buttons select long, medium, short and gram. Control are balance, volume, treble and bass. Mains power supply. The output is 6 + 6 watts. Brand new and in perfect working order, offered at less than value of stereo amp alone, namely **£6·90.** Post £2·00.

MULLARD UNILEX

A mains-operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy-to-assemble modular form this should sell at about **£30**—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£16** including V.A.T. and postage.
FREE GIFT—Buy this month and you will receive a pair of **Goodman's** elliptical 8" × 5" speakers to match this amplifier.

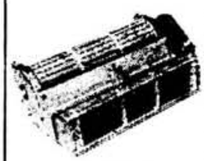
THIS MONTH'S SNIP

THERMOSTAT ASSORTMENT 10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc, or when fitted say in front of the element of a blower heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0-100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats would cost round about **£15·00**—however, you can have the parcel for **£2·50.**

WALL MOUNTING THERMOSTAT,

Danfoss, a handsome 2 tone this is intended for living rooms but is just as efficient in a greenhouse or store. It is suitable for normal air temperature range 32F-80F—price **£4·60.**

TANGENTIAL HEATER UNIT



3 KW Mode
£6-95
+ £1.50 P & P

A most efficient and quiet running blower-heater by Solatron—standard replacement in many famous name heaters—comprises mains induction motor—long turbo fan—split heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct into base of say kitchen unit. Price **£5·95,** post **£1·50.** Control switch to give 2kw, 1kw, cold blow or off available 60p extra. 3kw model **£6·95.** Control Switch **95p.**

3-CHANNEL SOUND TO LIGHT KIT

Complete kit of parts for a three-channel sound to light unit controlling over 2,000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for Disco work.
The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is **£14·95** in kit form or **£19·95** assembled and tested.

8 POWERFUL BATTERY MOTORS

For models, Meccanos, drills, remote control planes, boats, etc. **£2.**

TERMS: Cash with order—but orders under **£10** must add **50p** to offset packing, etc.
BULK ENQUIRIES INVITED. PHONE: 0444-54563.
ACCESS & BARCLAYCARD WELCOMED.

J. Bull [ELECTRICAL] Ltd.

(DEPT. PW3)
34-36 AMERICA LANE,
HAYWARDS HEATH SUSSEX.
RH16 3QU

IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

DUE TO THE HIGH & RISING PRICES OF FUEL many companies and probably many householders are looking around for ways of saving some of this cost. One Company bought a number of fans from us and fitted these on the ceiling of their workshops where the hot air tends to collect and they blow this hot air downwards. Another Company has bought fans from us to suck the exhaust from their oil fired central heaters through a zig zag of asbestos pipes, the asbestos pipes being in a separate chamber which becomes a hot air chamber, the hot air from this is blown through ducting to where ever it is needed. Basically, they have cut out the normal chimney and replaced this with one of our high power extractor fans. If you have any other good ideas on heat cost saving, let us know and we will pass it on to other readers.

EXTRACTOR FANS

Ex-Computer made by Woods of Colchester, ideal also as blower; central heating systems, fume extraction etc. Easy fixing through panel, very powerful 2,500 r.p.m. but quiet running. Choice of 2 sizes, 5" **£5·50,** 6" **£6·50;** post **£1** per fan.

PING PONG BALL BLOWER-UPPERS Have you got to organise a Christmas Party or Charity Fund-Raising Event? Then one always popular way is to have ping pong balls going up and down and being caught. We have some powerful blowers and these should be ideal for this, and of course for more serious purposes. They are 4 stage blowers, coupled to synchronised AC mains motors of approximately ¼ h.p. They have a terrific suction as well as a high velocity blow. Ex computers, price **£26·00.**

TWO MORE BLOWERS Both 'snail' type, one very small and compact and suitable for cooling projectors or other equipment. Impeller size 2" × 1", coupled to mains voltage induction motor, outlet size approximately 1½" × 1½". Price **£5·50** + 68p. The other is a larger **FLANGED BLOWER** for direct coupling to ducting, outlet size 3½" × 2½" + 1" flange, holed for easy fixing to trunking. Impeller size 5½" × 1¾". Powered by 1/12 h.p. mains motor. **£11·75.**

RECHARGEABLE SOLID GEL BATTERY 12v 5 AH new and unused made by or for Elpower Corporation of California. Dimensions, 6" long, 3¾" high and 2½" wide. Regular price of similar batteries, R.S. Components is **£26·00.** Limited quantity available at **£15·80.**

DUAL DIGITAL TIMER Short delay, left timer adjustable 0-2 secs, right timer 0-9·9 secs. Made by Techno Instruments Ltd., catalogue no. 010 18/1. We have very little information on these, but they are battery operated, to use you simply set the digital switches in the desired position, turning the rotary indicator to the chosen time. The lamp will light up when the right timer is in operation. Periodic or single action possible. This is a precision instrument 4¾" wide. 1½" high and 5½" deep. We understand that these cost over £60·00 from the Makers. limited quantity only at **£23·00.**

SOLID STATE VARIACS By Lewis and Holtzman Ltd—their "Elvar". 230-240v AC in and out. 10 amp model is cylindrical approximately 3½" diameter 4½" deep. Price **£13·80.** 5 amp model, again cylindrical, 2½" diameter, 4½" deep. Price **£9·20.**

E.H.T. UNITS One of our specialities has always been E.H.T. transformers, and we probably have bigger stocks than most of our contemporaries. It is surprising what uses these high voltages can be put to—killing flies and weeds, lighting central heating boilers, lifting paper, extracting dust, etc. etc. A new one this month is 14·5 KV. (dc) 0·5mA—made by ADVANCE ELECTRONICS—this unit is completely enclosed and has input and output sockets—size of the unit is approximately 6" × 3" × 3¾", price **£15·38** post £1.
To remind you of the E.H.T. Transformers we stock, here is a list:

3-4 KV	3 mA	ex equipment	**£2·90**
5 KV	5 mA	ex new equipment	**£7·15**
5 KV	5 mA	with outer casing and E.H.T. outlets	**£9·45**
8·5 KV	10 mA	totally enclosed with E.H.T. outlets	**£13·50**

LEDS are used increasingly and are now being recommended for nearly all indicators and for games and novelties. Due to a fortunate purchase, this month we are able to offer 10 red led's for **£1.** These are the small ones equivalent to the TIL 209. Bulk price **£60·00** per 1,000 + V.A.T.

FIG. 8. FLEX is always in demand, especially when doing the Christmas decorations. We are able to offer white Fig. 8 5 amp type on 50 metre roll for **£2·80,** ditto but dark grey with tracer lead, suitable for speaker extensions, 50 metres **£3·38.**

500 WATT MERCURY VAPOUR LAMP Mazda, ref. 90-5104 MAT/V blended. These give a really powerful light but, of course, have to be used with the correct control gear. We are expecting to get this control gear early in the New Year. Price of the lamp is **£3·38** + 38p. Post 50p.

ANTI FROST THERMOSTAT The normal refrigerator type thermostat, switches off as the temperature falls and so is not suitable for anti-frost devices. However, we have the *ice stat*—this switches on as the temperature falls and is set to switch on just above freezing point. It is a skeleton stat so would require boxing, but the price is modest at **£1·10.**

THIN CONNECTING WIRE 500 metre drums, 7 stranded copper core p.v.c. covered available in 10 different colours. Price **£7·15.**

OCTOBER/NOVEMBER CONSTRUCTOR'S SNIP. Here's a super bargain for you. 100 twist drills, regular tool shop price over £50, yours for only **£11·50.** With these you will be able to drill metal, wood, plastic etc from the tiniest holes in P.C.B. right up to about ¼". Don't miss this snip—send your order today.

SUPER BREAKDOWN PARCEL with free gift of a desoldering pump, perhaps the most useful break-down parcel we have ever offered. Consists of 50 nearly all different computer panels on which you will find: over 300 ICs, over 300 diodes, over 200 transistors and many hundred other parts, resistors, condensors, multi turn pots, rectifiers, SCR etc. etc. for only £8·50, which when you deduct the value of the desoldering pump, works out to just a little over 4p per panel, + **£1·27** VAT + £2 post (it's a big parcel).

TIME SWITCH BARGAIN Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with dials. Complete with knobs **£2·50.**

GMT ELECTRONICS

Freepost E Birmingham B19 1BR
021·233·2400

- ■ FREEPOST ON ORDERS
- ■ VAT INCLUSIVE PRICES
- ■ ADD 30p P&P
- ■ 24 HR PHONE ANSWERING SERVICE
- ● ACCESS
- ● VISA
- ● CASH
- ● CHEQUE

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

C·MOS (BUFFERED)

HEF4000	22	HEF4044	105	HEF4512	138
HEF4001	22	HEF4046	133	HEF4516	127
HEF4002	22	HEF4047	109	HEF4517	478
HEF4006	119	HEF4049	57	HEF4518	118
HEF4007	22	HEF4050	57	HEF4519	69
HEF4008	100	HEF4051	87	HEF4520	118
HEF4011	22	HEF4052	90	HEF4521	235
HEF4012	22	HEF4053	90	HEF4528	124
HEF4013	57	HEF4066	62	HEF4532	150
HEF4014	105	HEF4067	475	HEF4534	638
HEF4015	100	HEF4068	22	HEF4539	138
HEF4016	57	HEF4069	22	HEF4585	122
HEF4017	100	HEF4070	22	HEF4724	214
HEF4018	100	HEF4071	23	HEF40097	113
HEF4019	58	HEF4072	23	HEF40098	92
HEF4020	112	HEF4073	23	HEF40106	78
HEF4021	107	HEF4075	23	HEF40160	149
HEF4022	103	HEF4076	130	HEF40192	149
HEF4023	22	HEF4077	22		
HEF4024	78	HEF4078	23		
HEF4025	22	HEF4081	23		
HEF4026	244	HEF4082	23		
HEF4027	57	HEF4085	80		
HEF4028	89	HEF4086	80		
HEF4029	113	HEF4093	63		
HEF4030	58	HEF4094	219		
HEF4031	250	HEF4104	208		
HEF4035	138	HEF4502	114		
HEF4040	107	HEF4505	714		
HEF4041	94	HEF4508	230		
HEF4042	83	HEF4510	135		
HEF4043	100	HEF4511	157		

Voltage Regulators

LM309DA(K)	119
UA723CN	42
UA7805CU	78
UA7812CU	78
UA7815CU	78
UA7912CU	97
UA7915CU	97
UA78L05CS	38
UA78L12CS	38
UA78L15CS	38

LINEAR

CA3046	84
CA3080E	77
CA3130E	99
CA3140E	48
CA3189E	293
LM301AN	34
LM339N	78
LM380N	104
LM381AN	198
LM3900N	75
MC3403P	156
NE531	131
NE536T	259
NE555N	28
NE556N	66
NE566N	171
NE570N	485
NE571N	505
RC4136	146
TBA120S	88
TDA1022	713
TDA1034B	239
TL081CP	84
TL084CN	156
UA741CN	20
UA741CT	47

Zener Diodes

400mW C4V7-C33 BZY88/BZX79 + Voltage 9

SEMICONDUCTORS

IN914	5	BC182L	12
IN4001	5	BC184	11
IN4002	5	BC184L	12
IN4004	7	BC212	11
IN4007	9	BC212L	12
IN4148	4	BC214	11
IN5402	15	BC214L	12
2N2369	21	BC547	13
2N2646	46	BC548	11
2N2926G	13	BC549	12
2N3053	19	BC557	15
2N3054	55	BC558	15
2N3055	55	BCY70	15
2N3702	9	BCY71	15
2N3704	9	BD131	39
2N3705	10	BD132	39
2N3773	297	BD139	39
2N3819	22	BD140	39
2N3820	39	BFR90	333
2N3904	9	BFX85	29
2N5457	39	BFY50	17
2N5459	35	BFY51	17
40673	88	BRY39	50
BC107	14	BSX20	21
BC108	14	CL8960	2850
BC108C	18	TIP31	48
BC109	14	TIP32	54
BC109B	19	TIP41C	76
BC109C	20	TIP42C	78
BC148	10	TIP2955	75
BC158	10	TIP3055	60
BC177	17	TIS43	36

CAPACITORS

Electrolytic Axial Order Code
−10% to +50% Tol. Cap 018 + µF

µF \ V	16	25	40	63
1.0				9
1.5				9
2.2				9
3.3				9
4.7				9
6.8			9	10
10		8		10
15	8		9	11
22		8		13
33	8		9	
47		8	11	13
68	9			
100		9	13	
150	9	10		31
220	13		26	36
330			30	40
470		23	32	47
680	21	30	39	54
1000	26	30	59	
1500	35	39		
2200	42			

Polyester Radial Leads Order Code
Dipped Type, C280/352 Style — Cap 352
Moulded Type, 10.2mm Pitch — Cap 380
+ Value

µF	352	380	µF	352	380
.001		7	.1	7	9
.0015		7	.15	8	10
.0022	6	7	.22	9	11
.0033	6	7	.33	11	
.0047	6	7	.47	14	
.0068	6	7	.68	17	
.01	6	8	1.0	21	
.015	6	8	1.5	30	
.022	6	8	2.2	35	
.033	6	8			
.047	6	8			
.068	7	8			

Electrolytic Radial Leads Order Code
−10% to +50% Tol. Cap 034 + µF

µF \ V	10	16	25	35	40	50	63
.47							7
.68							7
1.0							7
1.5							7
2.2							7
3.3							7
4.7					7		8
6.8			7			8	9
10		7			8		9
15		7	8			9	11
22	7	8			9	11	
33		8	9		11		
47	8	9		11			
68		9	11				
100	9						
150	11						

D.I.L. Sockets

8 Pin Low Profile Socket Tin	12	DIL SKT 8
14 Pin Low Profile Socket Tin	14	DIL SKT 14
16 Pin Low Profile Socket Tin	16	DIL SKT 16

P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying 69

RESISTORS

		Order Code
Carbon Film, Fixed		
0.25W, E24 Values 1R0-10M, 5% Tol.	2 each	Res RD¼
100/100 (Mult 10/Value)		
0.5W, E12 Values 1R0-4M7, 10% Tol.	3 each	Res RD½ + Value
Metal Film, Fixed		
0.5W, E24 Values, 5R1-1M, 2% Tol.	8 each	Res MR30
2.5W, E12 Values, 10R-27K, 5% Tol.	18 each	Res PR52 + Value
Metal Glaze, Fixed		
0.5W, E24 Values, 1M-33M, 5% Tol.	18 each	Res VR37 + Value

		Order Code
Skeleton Presets, Miniature		
0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting	8	Min. Preset V
0.1W, E3 Values, 100R-1M, Lin. Horizontal Mount	8	Min. Preset H + Value
Skeleton Presets, Standard		
0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	11	Std. Preset V
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mount	11	Std. Preset H + Value
Potentiometer, Rotary		
0.5W, E3 Values, 1K-2M2 Lin	39	Ro Pot Lin
0.25W, E3 Values, 4K7-2M2 Log.	39	Ro Pot Log + Value
Potentiometer, Slider		
0.5W, E3 Values, 2K2-470K, Lin.	45	Sl Pot Lin
0.25W, E3 Values, 1K0 - 1M0 Log.	45	Sl Pot Log + Value

MAINS TRANSFORMERS — Order Code

Secondaries may be connected in series or parallel to give wide voltage range
Primaries 0-220, 240V

6VA — Clamp Type Construction 235 each
Approx. 18% Regulation F C 54, H36, W35

0-4.5V, 0-4.5V Secondaries — Trans 6VA
0-5V, 0-6V
0-12V, 0-12V
0-15V, 0-15V
0-20V, 0-20V

20VA — Clamp Type Construction 360 each
Approx. 16% Regulation F C 70, H48, W48

0-4.5V, 0-4.5V Secondaries — Trans 20VA
0-6V, 0-6V
0-12V, 0-12V
0-15V, 0-15V
0-17.5V, 0-17.5V
0-20V, 0-20V

Plastic Boxes — Boss Industrial Mouldings
Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
L112 W82 D31	99	Case BIM2003 OR
L150 W80 D50	131	Case BIM2005 OR
L190 W110 D60	223	Case BIM2006 OR

Plastic Boxes with Metal Lids
Recessed Top Box
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Gray

		Order Code
L85 W56 D29	112	Case BIM4003 OR
L111 W71 D42	150	Case BIM4004 OR
L161 W96 D53	208	Case BIM4005 OR

Diecast Boxes
Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

		Order Code
L113 W63 D31	124	Case BIM5003 NA
L152 W82 D50	218	Case BIM5005 NA
L192 W113 D61	334	Case BIM5006 NA

VERO ELECTRONICS PRODUCTS

95.25"x95.25" .1" pitch Veroboard	86	200-21073A
95.25"x63.5" .1" pitch Plain Board	54	200-21077L
Heat Sink 3.75°C/W 75mmx100mm	96	201-21093G
Keyboard Console *SPECIAL PRICE*	899	202-21389C
3.75"x5" .1" pitch Plain Board	135	200-21084E
Spot Face Cutter	107	203-21013A
Pin Insertion Tool for .040 type pin	147	203-21015F
DS Pins .040 (100)	44/Pack	200-21087G
SS Pins .040 (100)	44/Pack	200-21017B
Verowire Kit (1-pen, 2-wire, 25-comb)	454/Kit	200-21341D
Verowire Combs (25)	109/Pack	200-21339F
Verowire Wire (2)	109/Pack	200-21340G

SWITCHES

			Order Code
Miniature Toggle — Honeywell			
SPDT		67	SW 8A1011
SPDT	C/Off	81	SW 8A1021
SPDT	Double Bias To Centre	90	SW 8A1041
DPDT		99	SW 8A2011
DPDT	C/Off	111	SW 8A2021
Miniature Push — C & K			
SP	Push To Make, Momentary	62	SW 8531
SP	Push To Break, Momentary	62	SW 8533

GMT ELECTRONICS PROJECTS	KIT	BUILT UP
FREE-STANDING COMPLETE TELETEXT UNIT - FULL SPEC	£199-90	£275-00
TELETEXT DECODER BOARD + REMOTE HAND CONTROL	£135-90	£160-00
TELETEXT COMPATIBLE TUNER AND P.S.U.	£ 46-90	£ 57-00
TELETEXT COMPATIBLE PAL ENCODER + MODULATOR	£ 22-90	£ 35-00
F.E.T. OUTPUT 100W MONO POWER AMPLIFIER MODULE	£ 27-50	£ 35-00
X-BAND DOPPLER RADAR ALARM MODULE - MARK II	£ 35-90	£ 44-00
ONE AMP P.S.U. MODULE (SPECIFY 5 OR 12 VOLTS)	£ 7-50	£ 10-00
SIMULATED INERTIA MODEL TRAIN CONTROLLER	£ 22-50	£ 35-00
SIMULATED INERTIA SLOT RACER CONTROLLER	£ 27-50	£ 40-00
MODEL TRAIN STEAM SOUND SIMULATOR MODULE	£ N/A	£ 5-00

GMT ELECTRONICS, P.O. BOX 290, HAMPTON STREET, BIRMINGHAM B19 3JR

The larger Catalogue that means FREE POSTAGE IN U.K.
●
ADDITIONAL DISCOUNTS
●
KEEN PRICES
●
GUARANTEED SATISFACTION
●
GOOD STOCKS GOOD DELIVERY
●
We Pay Postage

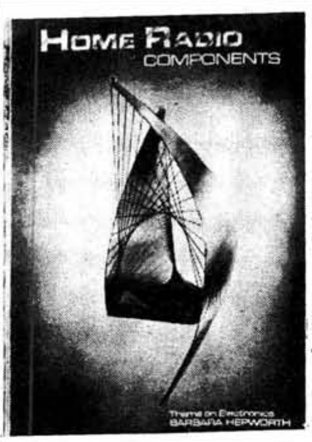
68 LARGER PAGES

Semi-Conductors • I.C.s • Opto-devices • Rs and Cs in great variety • Pots • Switches • Knobs • Accessories • Tools • Materials • Connectors

ELECTROVALUE

FREE FOR THE ASKING

ELECTROVALUE LTD. (PW2),
28 St. Jude's Road, Englefield Green, Egham, Surrey TW20 0HB. Phone: 33603 (London 87) STD 0784. Telex 264475.
NORTHERN (Personal Shoppers Only): 680 Burnage Lane, Burnage, Manchester M19 1NA. Phone (061) 432 4945.



START THE NEW YEAR WELL with a HOME RADIO CATALOGUE

- About 2,000 items clearly listed.
- Profusely illustrated throughout.
- Large A-4 size pages.
- Bargain list, order form and 2 coupons each worth 25p if used as directed, all supplied free.

Price £1, plus 50p for post, packing and insurance.

Send cheque or P.O. for £1.50

HOME RADIO Components LTD
Dept. PW, P.O. Box 92, 215 London Road, Mitcham, Surrey. 01-543 5659

OHIO SCIENTIFIC COMPUTERS. New series 2 Challenger C1P £259 + 15%. New series 2 disc version Challenger C1PMF £689 +15%. New Superboard 3 £159 + 15% VAT post free, with free power supply and modulator kit. Kits for use with old Superboard 2 (Add 15% VAT):- Guard band kit £8. 4K extra ram £16.95. Display expansion kit approx 30 lines × 54 characters £20. Case £27. Colour conversion board built £65. CEGMON improved monitor rom £29.50. Cassette recorder £16.
SINCLAIR PRODUCTS SC110. 10MHz Scope £145. PFM200 £51.95.
TV GAMES. AY-3-8600 + Kit £12.98. Stunt cycle chip + kit £20.95.
IC AUDIO AMPS with pcb. JC12 6W £2.50. JC20 10W £3.54.
BATTERY ELIMINATORS. 3-way type 6/7½/9V 300ma 9v £4.77, 9 + 9v £5.99. Car convertor 12v input, output 4½/6/7½/9v 800ma £3.04.
BATTERY ELIMINATOR KITS. 100ma radio types with press-studs 9v £1.64, 9 + 9v £2.30. Stabilized 8-way types 3/4½/6/7½/9/12/15/18v 100ma £3.12, 1Amp £8.10. Stabilized power kits 2-18v 100ma £3.12, 1-30v 1A £8.30, 1-30v 2A £14.82. 12v car convertor 6/7½/9v 1A £1.62.
T-DEC AND CSC BREADBOARDS s-dec £3.79, t-dec £4.59, exp4b £2.64, exp300
TRANSFORMERS. 6-0-6V 100ma 96p, 1½a £3.32. 0-0-9v 75ma 96p, 1a £3.08, 2a £4.93. 12-0-12v 100ma £1.20, 1a £3.70.
SHARP COMPUTERS

Add 15% VAT to these prices. Sharp MZ80K Computer with Basic tape and a free tape of approx 50 programes:- 20K version £438, 48K version £459. MZ80 I/O £83. MZ80P3 £499. MZ80FD £772. PC1211 £83. CE121 £12.
PRINTERS. Seikosha GP80 £250. Oki Microlone 80 £349. Free interface and word processor for Superboard 2 included. Add 15% VAT.

SWANLEY ELECTRONICS

Dept. PW, 32 Goldsel Rd., Swanley, Kent.

Post 40p extra. Prices include VAT unless stated. Official and overseas orders welcome. Lists 27p post free. Telephone Swanley 64851.

SUPERSOUND 13 HI-FI MONO AMPLIFIER

A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE **£18·40,** P. & P. £1·60.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp.). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 30 watts music power. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12¼in wide × 5in high × 7¼in deep.

Special price **£29·00** + £3·00 carriage and packing.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11¾" × 14 11/16" × 1 7/16" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.

Only **£9·20** each + p. & p. (one £1·20, two £1·50).

A brand new 22 transistor hi-fi stereo amplifier of superior design made by a well-known British manufacturer, for a now cancelled contract order. The unit is supplied new & tested on a printed circuit panel size approx. 6¾" × 4½" × 1½" h. using high grade discrete components. Brief specification: 15 watts r.m.s. per channel O/P into 8 ohms. (o/p stages fully protected against s/c) I/P 60mV. for *ceramic cartridge. Provision for tape i/p & o/p. Only requires the addition of a 40 volt @ 2 amp. power supply & the bass, treble, balance & vol. control. (standard types). FULL Circuit diagram & connection details supplied Price with edge connectors. Only **£9.00** + 80p p. & p.

IF ORDERED WITH AMPLIFIER:-

*2 stage pre-amp. For mag. cart. RIAA corrected **£2.50.** Mains transformer, rectifier, smoothing condenser **£4.00** + **£1.80** p. & p. Set of 4 pots. **£2.50** (while stocks last).

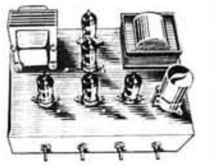
MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State FM AM Stereo Tuner. Covering M.W. A.M. 540-1605 KHz VHF/FM 88-108 MHz.

Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8½"w × 4"h × 9½"d approx.

LIMITED NUMBER ONLY at **£29·00** + £2·00 P. & P.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3·15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple intruction booklet **50p** + SAE (Free with parts). **All parts sold separately.** ONLY **£18·40,** P. & P. £2.00. Also available ready built and tested **£22·50,** P. & P. £2·00.

STEREO DECODER MK.II

SIZE 1½" × 2.5/16" × ½" ready built. Pre-aligned and tested for 10-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions supplied **£7·00** plus 25p P. & P. Stereo beacon light if required **40p** extra.

Mullard LP1159 RF IF module 470kHz **£2·50** + P. & P. 40p. Full specification and connection details supplied.

Pye VHF FM Tuner Head covering 88-108MHz 10·7 MHz I.F. output. 7·8V + earth. Supplied pre-aligned, with full circuit diagram with precision-geared F.M. gang and 323PF + 323PF A.M. Tuning gang only **£3·40** + P. & P. 60p.

STEREO MAGNETIC PRE-AMP. Sens. 3mV in for 100mV out. 15 to 35V neg. earth. Equ. ± 1dB from 20Hz to 20KHz. Input impedance 47K. Size 1⅝" × 2⅜" × ⅜" H. **£3·20** + 22p P. & P.

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response: ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω: Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.

Overall Size 12"w. × 8"d. × 2¾"h.

Fully detailed 8 page construction manual and parts list free with kit or send 50p plus large S.A.E.

AMPLIFIER KIT .. .. **£14·95** P. & P. £1·20

(Magnetic input components 33p extra)

POWER PACK KIT .. **£6·20** P. & P. £1·50

CABINET .. .. .. **£6·20** P. & P. £1·50

SPECIAL OFFER—only £25·80 if all 3 items ordered at one time plus £2·80 P. & P.

Full after sales service

Also avail. ready built and tested **£32·20,** P. & P. £2·80.

HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec. play socket are mounted on the printed circuit panel, size approx. 9½" × 2½" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only **£10·40** plus 90p P. & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at **£2·15** + 70p P. & P. if required. Full connection details supplied.

All prices and specifications correct at time of press and subject to alteration without notice.

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. SEND SAE WITH ALL ENQUIRIES.

HARVERSON SURPLUS CO. LTD. (Dept. P.W.) 170 MERTON HIGH ST., LONDON, S.W.19. Tel.: 01-540 3985

A few minutes from South Wimbledon Tube Station. Open 9.30–5.30 Mon. to Fri. 9.30–5 Sat. Closed Wed.

BARCLAYCARD WELCOME

PCB'S FOR PRACTICAL WIRELESS PROJECTS

Jan. 80.	Nimbus Radio Control Encoder	WR061	Price £2.28 30 pence p&p.
Jan. 80.	Nimbus Radio Control Rec.	WR064	Price £2.92 30 pence p&p.
Jan. 80.	A.F. Speech Processor	WR068	Price £2.28 30 pence p&p.
Jan. 80.	Wide Band Pre Amp.	WR067	Price £0.70 30 pence p&p.
Jan. 80.	Nimbus Radio Control T.X.	WR062	Price £2.26 30 pence p&p.
April 80.	Signal Generator	WR070	Price £2.71 30 pence p&p.
April 80.	P.W. Nimbus Relay	WR075	Price £0.55 30 pence p&p.
April 80.	P.W. Nimbus Modulator	WR074	Price £0.70 30 pence p&p.
April 80.	Nimbus Transceiver	WR073	Price £5.30 30 pence p&p.
May 80.	Hundred Second Photo Timer	WR078	Price £2.48 30 pence p&p.
June 80.	Audio Limiter Main Board	WK076	Price £2.00 30 pence p&p.
June 80.	Audio Limiter	WK077	Price £1.15 30 pence p&p.
June 80.	Audio Limiter RF Input Board	WR079	Price £1.30 30 pence p&p.
June 80.	VHF/UHF Repeater Timer Main	WR080	Price £1.90 30 pence p&p.
June 80.	P.W. Nimbus Base Station Adpt.	WR083	Price £2.60 30 pence p&p.
June 80.	Acoustic Flash Trigger	WRK84	Price £1.25 30 pence p&p.
Aug. 80.	Model Railway Controller	WR085	Price £2.17 30 pence p&p.
Sept. 80	Transceiver Power Unit	WR095	Price £0.62 30 pence p&p.
Sept. 80.	P.W. Nimbus Tonedurst/ Timer Module	WR096	Price £1.85 30 pence p&p.
Sept. 80.	Beginners 2m Converter	WAD634	Price £1.08 30 pence p&p.
Sept. 80.	P.W. Tamar Board 1	WR086	Price £0.80 30 pence p&p.
Sept. 80.	P.W. Tamar Board 2	WR087	Price £1.50 30 pence p&p.
Sept. 80.	P.W. Tamar Board 3	WR088	Price £1.71 30 pence p&p.
Sept. 80.	P.W. Tamar Board 4	WR089	Price £1.71 30 pence p&p.
Oct. 80.	P.W. Tamar Board 5	WR090	Price £3.70 30 pence p&p.
Oct. 80.	P.W. Tamar Board 6	WR091	Price £3.70 30 pence p&p.
Oct. 80.	P.W. Nimbus 7 Mains PSU/Charger	WR097	Price £0.80 30 pence p&p.
Oct. 80.	Direct Conversion Receiver	WR082	Price £1.40 30 pence p&p.
Nov. 80.	Linear Scale Resistance Meter	WAD641	Price 90p 30 pence p&p.
Nov. 80.	Model Radio Control Field Test Unit	WK100	Price 90p 30 pence p&p.
Nov. 80.	M.R.C.F. T.V.	WK101	Price 90p 30 pence p&p.
Nov. 80.	P.W. Helford	C4CLF	Price £2.24 30 pence p&p.
Nov. 80.	P.W. Sherborne Synth Boards	1-2	£8.95 per set 30 pence p&p.
Dec. 80.	P.W. Helford	WR0104	50p per set 30 pence p&p.
Dec. 80.	Bird Scarer	WR0101	94p per set 30 pence p&p.
Dec. 80.	Bird Scarer	WR0102	£1.05 per set 30 pence p&p.
Dec. 80.	Buffer Amp	WR0103	90p per set 30 pence p&p.

FULL RANGE OF RS COMPONENTS AVAILABLE

C. BOWES ELECTRONICS

252A Stockport Road, Cheadle Heath, Stockport, Cheshire SK3 0LX.

Tel: 061-428 4497

Please enclose cheque or postal order with order.

RST

VALVE MAIL ORDER CO.

Climax House

159 Fallsbrook Road, London SW16 6ED

SPECIAL EXPRESS MAIL ORDER SERVICE

	£p	EM87	1·50	PY81	0·84	6AN5	4·74	6Q7	2·20
AZ31	1·10	EN91	3·50	PY82	0·80	6ANBA	3·45	6SA7	1·45
CL33	2·00	EY51	1·75	PY83	0·70	6AQ5	0·96	6SC7	1·50
DY86/7	0·84	EY86	0·84	PY88	0·88	6AR5	1·98	6SJ7	1·60
DY802	0·84	EY88	1·75	PY500A	1·80	6AS6	4·98	6SK7	1·30
E88CC	3·36	EY500A	1·94	PY800	0·84	6AS7GA	6·75	6SL7GT	2·68
E180F	8·40	EZ80	0·84	PY801	0·84	6AT6	0·85	6SN7GT	1·60
E810F	14·47	EZ81	0·84	QQV02-6	12·56	6AU5GT	4·32	6SS7	1·80
EABC80	1·20	GY501	2·75	QQV03-10		6AU6	1·08	6SG7M	2·50
EB91	0·82	GZ32	1·25		5·80	6AW8A	3·39	6U8	0·80
EBF80	0·50	GZ33	4·00	QQV03-20A		6B7	1·50	6V6GT	1·60
EBF89	0·85	GZ34	2·50		17·50	6B8	1·75	6X4	1·20
EC91	7·56	GZ37	4·00	QQV06-40A		6BA6	1·00	6X5GT	0·85
ECC33	3·50	KT61	3·50		36·34	6BA7	5·12	7C5	2·95
ECC35	3·50	KT66	10·00	QV03-12	4·46	6BE6	1·08	7C6	2·25
ECC81	0·88	KT77	8·00	R18	4·25	6BH6	1·52	7S7	2·25
ECC82	0·72	KT88	12·00	R19	1·20	6BJ6	1·08	12AT6	1·20
ECC83	0·88	N78	9·00	SP41	6·00	6BN6	1·65	12AT7	0·88
ECC85	1·20	OA2	1·92	SP61	2·00	6BQ7A	3·72	12AU7	0·72
ECC88	1·90	OB2	2·55	U19	13·75	6BR7	4·00	12AX7	0·88
ECC91	8·93	OC3	1·92	U25	1·16	6BR8	1·75	12BA6	2·19
ECF80	1·08	OD3	1·92	U26	1·44	6BS7	4·00	12BE6	2·43
ECH35	2·00	PC86	1·40	U37	9·00	6BW6	4·00	12BY7	2·70
ECH42	1·15	PC88	1·40	UABC80	1·25	6BW7	1·52	12BY7A	2·70
ECH81	1·20	PC92	1·28	UBF89	1·20	6BZ6	2·37	12HG7	4·17
ECL80	1·00	PC97	1·20	UCH42	1·20	6C4	0·88	30FL1/2	1·12
ECL82	1·00	PC900	1·20	UCH81	2·32	6C6	1·75	30P4	1·20
ECL83	1·50	PCF80	1·00	UCL82	1·04	6CB6A	2·49	30P19	1·20
ECL86	1·20	PCF82	1·00	UCL83	1·44	6CD6GA	5·07	30PL13	1·80
EF37A	3·50	PCF86	1·60	UF89	1·44	6CH6	8·50	30PL14	1·68
EF39	2·75	PCF801	1·60	UL41	2·50	6CL6	3·72	75C1	2·35
EF41	2·00	PCF802	1·90	UL84	1·20	6CW4	7·68	85A2	2·39
EF42	2·00	PCF805	1·60	UY41	1·25	6D6	1·75	90C1	2·44
EF50	1·50	PCF808	1·60	UY85	1·04	6DQ5	5·94	150B2	3·02
EF54	5·00	PCH200	1·60	VR105/30	1·92	6EA8	2·94	150C2	1·92
EF55	2·50	PCL82	1·00	VR150/30	1·92	6EH5	1·85	150C4	2·39
EF80	0·80	PCL83	2·00	Z759	16·80	6F6	1·75	572B	27·50
EF86	1·52	PCL84	1·00	Z803U	7·90	6Gk6	2·67	805	20·00
EF91	1·80	PCL85	1·08	2D21	3·50	6H6	1·50	807	3·75
EF92	5·81	PCL86	1·08	3B28	16·80	6HS6	3·77	811A	15·93
EF183	0·80	PCL805	1·08	4CX250B		6J5	2·50	812A	15·88
EF184	0·84	PD500	3·60		27·50	6J6	3·50	813	74·67
EH90	1·40	PFL200	1·80	5R4GY	2·00	6J7	2·50	866A	8·85
EL32	1·50	PL36	1·20	5U4G	1·52	6JB6A	4·56	872A	18·67
EL33	3·50	PL81	1·20	5V4G	1·52	6JS6C	5·58	931A	14·76
EL34	2·20	PL82	1·20	5Y3GT	0·85	6K4N	1·25	2050	6·96
EL36	1·60	PL83	2·22	5Z3	1·50	6K6GT	1·30	5763	3·75
EL81	2·50	PL84	1·08	5Z4GT	1·50	6K7	1·50	5814A	3·72
EL84	1·00	PL504	1·40	6/3DL2	1·56	6K8	1·75	5842	12·09
EL86	2·50	PL508	1·80	6AB7	1·50	6KD6	6·36	6080	6·85
EL91	7·14	PL509	3·20	6AH6	4·71	6L6G	2·50	6146A	8·96
EL95	1·32	PL519	3·20	6AK5	3·60	6L6GC	2·50	6146B	7·06
EL360	8·50	PL802	2·96	6AL5	0·82	6L7	2·00	6883B	11·19
EM81	1·00	PY33	1·10	6AM6	1·80	6LQ6	6·72	6973	3·87
								7360	9·96
								7586	10·14
								7587	17·49

Open daily to callers: Mon-Fri 9 a.m.–5 p.m.
Valves, Tubes and Transistors Closed Saturday
Terms C.W.O. only · Tel. 01-677 2424-7.

Prices excluding VAT add 15% Quotations for any types not listed S.A.E. **Post and Packing 30p per order** **Telex 946708**

Prices correct when going to press

AND THERE'S MORE WHERE THIS CAME FROM

It's a long time since one of our adverts was presented in 'list' form - but simply because we do not try to squeeze this lot in every time doesn't mean that it's not available. Our new style price list (now some 40 pages long) includes all this and more, including quantity prices and a brief description. The kits, modules and specialized RF components - such as TOKO coils, filters etc. are covered in the general price list - so send now for a free copy (with an SAE please). Part 4 of the catalogue is due out now (incorporating a revised version of pt.1).

LINEAR ICs - NUMERIC LISTINGS

TBA120S	1.00	KB4413	1.95
L200	1.95	KB4417	1.80
U237B	1.28	TDA4420	2.25
U247B	1.28	KB4420B	1.09
U257B	1.28	KB4423	2.30
U267B	1.28	KB4424	1.65
LM301H	0.67	KB4431	1.95
LM301N	0.30	KB4432	1.95
LM308H	0.96	KB4433	1.52
LM308N	0.65	KB4436	2.53
LM339N	0.66	KB4437	1.75
LM348N	1.86	KB4438	2.22
LF351N	0.38	KB4441	1.35
LF353N	0.76	KB4445	1.29
LM374N	3.75	KB4446	2.75
LM380N-14	1.00	KB4448	1.65
LM380N-8	1.00	NE5044N	2.26
LM381N	1.81	NE5532N	1.85
ZN419CE	1.95	SD6000	3.75
NE544N	1.80	SL6270	2.03
NE555N	0.30	SL6310	2.03
NE556N	0.50	SL6600	3.75
NE560N	3.50	SL6640	2.75
NE562N	4.05	SL6690	3.20
NE564N	4.29	SL6700	2.35
NE565N	1.00	ICL8038CC	4.50
NE566N	1.60	MSL9362	1.75
NE570N	3.85	MSL9363	1.75
SL624	3.28	HA11211	1.95
TBA651	1.81	HA11223	2.15
uA709HC	0.64	HA11225	1.45
uA709PC	0.36	HA12002	1.45
uA710HC	0.65	HA12017	0.80
uA710PC	0.59	HA12402	1.95
uA741CH	0.66	HA12411	1.20
uA741CN	0.27	HA12412	1.55
uA747CN	0.70	LF13741	0.33
uA748CN	0.36	SN76660N	0.80
uA753	2.44		
uA758	2.35		
TBA810AS	1.09		
TBA820M	0.75		
TCA940E	1.80		
TDA1028	2.11		
TDA1029	2.11		
TDA1054	1.45		
TDA1062	1.95		
TDA1072	2.69		
TDA1074A	5.04		
TDA1083	1.95		
TDA1090	3.05		
HA1137	1.20		
HA1196	2.00		
HA1197	1.00		
TDA1220	1.40		
LM1303	0.99		
LM1307	1.55		
MC1310P	1.90		
MC1330	1.20		
MC1350	1.20		
HA1370	1.90		
HA1388	2.75		
TDA1490	1.86		
MC1496P	1.25		
SL1610P	1.60		
SL1611P	1.60		
SL1612P	1.60		
SL1613P	1.89		
SL1620P	2.17		
SL1621P	2.17		
SL1623P	2.24		
SL624C	3.28		
SL1625P	2.17		
SL1626P	2.44		
SL1630P	1.62		
SL1640P	1.89		
SL1641P	1.89		
TDA2002	1.25		
TDA2020	3.00		
ULN2242A	3.05		
ULN2283B	1.00		
CA3080E	0.70		
CA3089E	1.84		
CA3090AQ	3.35		
CA3123E	1.40		
CA3130E	0.80		
CA3130T	0.90		
CA3140E	0.46		
CA3189E	2.20		
MC3357P	2.35		
LM3900N	0.60		
LM3909N	0.68		
LM3914N	2.80		
LM3915N	2.80		
KB4400	0.80		
KB4406	0.60		
KB4412	1.95		

FREQUENCY DISPLAY & SYNTHESISER ICs

SAA1056	3.75
SAA1058	3.35
SAA1059	3.35
11C90DC	14.00
LM1232	19.00
LM1242	19.00
MSL2318	3.84
MSM5523	11.30
MSM5524	11.30
MSM5525	7.85
MSM5526	7.85
MSM5527	9.75
MSM55271	9.75
ICM7106CP	9.55
ICM7107CP	9.55
ICM7216B	19.25
ICM7217A	9.50
SP8629	3.85
SP8647	6.00
95H90PC	6.00
HD10551	2.45
HD44015	4.45
HD12009	6.00
HD44752	8.00

CMOS 4000 SERIES

4001	0.17	4043	0.85
4000	0.17	4044	0.80
4002	0.23	4046	1.30
4008	0.80	4047	0.99
4009	0.58	4049	0.52
4010B	0.58	4050	0.55
4011AE	0.20	4051	0.65
4011B	0.20	4052	0.65
4012	0.55	4053	0.65
4013	0.55	4063	1.09
4015	0.95	4066	0.56
4016	0.52	4068	0.25
4017	0.80	4069	0.20
4019	0.60	4070	0.20
4020B	0.93	4071	0.20
4021	0.82	4072	0.20
4022	0.90	4073	0.20
4023	0.17	4075	0.20
4024	0.76	4076	0.90
4025	0.17	4077	0.20
4026	1.80	4078	0.20
4028	0.72	4082	0.20
4029	1.00	4093	0.78
4030	0.58	4175	0.95
4035	1.20	4503	0.69
4040	0.83	4506	0.51
4042	0.85	4510	0.99
		4511	1.49
		4512	0.98
		4514	2.55
		4518	1.03
		4520	1.09
		4521	2.36
		4522	1.49
		4529	1.41
		4539	1.10
		4549	3.50
		4554	1.53
		4560	2.18
		4566	1.59
		4568	2.18
		4569	3.03
		4572	0.30
		4585	1.10

TTL N and LSN

		7443N	1.15	74LS112	0.38	74LS169	2.00		
		7444N	1.12	74LS113	0.38	74170N	2.30		
7400N	0.13	7445N	0.94	74LS114	0.38	74LS170	2.00		
74LS00	0.20	7446N	0.94	74118N	0.83	74LS174	1.20		
7401N	0.13	74LS47	0.89	74120N	1.15	74175N	0.87		
74LS01	0.20	7448N	0.56	74121N	0.42	74LS175	1.10		
7402N	0.14	74LS48	0.99	74122N	0.46	74176N	0.75		
74LS02	0.20	74LS49	0.99	74123N	0.73	74177N	0.78		
7403N	0.14	7451N	0.17	74LS124	1.75	74181N	1.65		
74LS03	0.20	74LS51	0.24	74125N	0.38	74LS181	3.50		
7404N	0.14	7453N	0.17	74LS125	0.44	74LS183	2.10		
74LS04	0.24	7454N	0.17	74126N	0.57	74184N	1.35		
7405N	0.18	74LS54	0.24	74LS126	0.44	74185N	1.34		
74LS05	0.26	74LS55	0.24	74128N	0.74	74LS190	0.92		
7406N	0.28	7460N	0.17	74132N	0.73	74192N	1.05		
7407N	0.38	74LS63	1.24	74LS132	0.78	74LS192	1.80		
7408N	0.17	7470N	0.28	74LS136	0.40	74193N	1.05		
74LS08	0.24	7472N	0.28	74LS138	0.60	74LS193	1.80		
7409N	0.17	7473N	0.32	74141N	0.56	74194N	1.05		
74LS09	0.24	74LS73	0.38	74142N	2.65	74196N	0.99		
7410N	0.15	7474N	0.27	74143N	3.12	74LS196	1.10		
74LS10	0.24	74LS74	0.28	74144N	3.12	74LS197	1.10		
7411N	0.20	7475N	0.38	74LS145	0.97	74198N	1.50		
74LS11	0.24	7476N	0.37	74147N	1.75	74199N	1.60		
7412N	0.17	74LS76	0.38	74148N	1.09	74LS247	0.93		
7413N	0.30	74LS78	0.38	74LS148	1.19	74LS257	1.08		
7414N	0.51	7480N	0.48	74150N	0.99	74LS260	1.53		
74LS15	0.24	7481N	0.86	74151N	0.55	74LS279	0.52		
7416N	0.30	7482N	0.69	74LS151	0.84	74LS283	1.20		
7417N	0.30	7485N	1.04	74153N	0.64	74LS293	0.95		
7420N	0.16	74LS85	0.99	74LS153	0.54	74LS365	0.49		
74LS20	0.24	74LS86	0.40	74154N	0.96	74LS366	0.49		
7421N	0.29	7489N	2.05	74155N	0.54	74LS367	0.43		
74LS21	0.24	7490N	0.33	74LS155	1.10	74LS368	0.49		
7423N	0.27	74LS90	0.90	74156N	0.80	74LS374	1.80		
7425N	0.27	7491N	0.76	74157N	0.67	74LS377	1.95		
7427N	0.27	74LS91	1.10	74LS157	0.55	74LS379	1.30		
74LS27	0.44	7492N	0.38	74LS158	0.60	74LS393	1.40		
7428N	0.35	74LS92	0.78	74159N	2.10				
74LS28	0.32	7493N	0.32	74160N	0.82				
7430N	0.17	74LS93	0.99	74LS160	1.30				
74LS30	0.24	7494N	0.78	74161N	0.92				
7432N	0.25	7495N	0.65	74LS161	0.78				
74LS32	0.24	74LS95	1.14	74LS162	1.30				
7437N	0.40	7496N	0.58	74163N	0.92				
7438N	0.33	74LS96	1.20	74LS163	0.78				
74LS38	0.24	7497N	1.85	74164N	1.04				
7440N	0.17	74LS107	0.38	74LS164	1.30				
74LS40	0.24	74109N	0.63	74165N	1.05				
7441N	0.74	74LS109	0.70	74LS165	1.04				
7442N	0.70	74110N	0.54	74167N	2.50				
74LS42	0.99	74111N	0.68						

VOLTAGE REGULATORS

78series	0.95
79series	1.00
78Mseries	0.65
78Lseries	0.35
79L05	0.85
78MGT2C	1.75
79MGT2C	1.75
723CN	0.65
L200	1.95
TDA1412	0.75
NE553N	1.25
LM317MP	1.48
LM337MP	1.48

MICROMARKET

8080A/2	7.50
8212	2.30
8214	3.50
8216	1.95
8224	3.50
8251	6.25
8255	5.40
6800P	7.50
6810	5.95
6820	7.45
6850	4.90
6852	4.85
MC2708	7.50
2114	6.50
4027	5.78
2102	1.70
2112	3.40
2513	7.54
HM4716	4.50
81LS97	1.25

VARICAP TUNING DIODES

BA102	0.30
BA121	0.30
ITT210	0.30
BB204B	0.36
BB105B	0.36
BB109	0.27
MVM125	1.05
BB212	1.95
KV1210	2.45
KV1211	1.75
KV1226	1.95
KV1225	2.75
KV1215	2.55
KV1225	2.75

SWITCHING AND PIN DIODES

SHOTTKY DIODES

1N6263	0.62
BA182	0.19
BA244	0.17
BA379	0.35
TDA1061	0.95

SIGNAL DIODES & RECTIFIERS

1N4148	0.06
1N4001	0.06
1N4002	0.07
1N5402	0.15
OA91	0.07
AA112	0.25
BRIDGES:	
1A/50V	0.35
6A/200V	0.75

TOKO COILS AND FILTERS SEE THE EXTENSIVE SECTION IN OUR NEW PRICE LISTS AND CATALOGUE

LF/HF FIXED INDUCTORS –FULL E12 RANGE

7BA series 1uH-1mH	0.16
8RB series 100uH-33mH	0.19
10RB series 33mH-120mH	0.33
10RBH series 120mH-1.5H	0.55
PIEZO SOUNDER PB2720	0.44

CRYSTAL FILTER PRODUCTS

10.7MHZ 2 POLE TYPES:	
10M15A 15KHZ BW	2.49
10.7MHZ 8 POLE TYPES:	
10M4B1 15kHz BW	14.50
H4402 7.5KHZ BW	15.50
10M22D 2.4KHZ SSB	17.20
HF FIRST FILTER:	
B34F8A 34.5MHz HF	32.00

RADIO CONTROL CRYSTALS

(No splits available)	
AM TX:-	
3rd OT 30pF HC25U	1.65
AM/FM RX:-	
3rd OT 30pF HC25U	1.65
FM TX :-	
Fund 20pF HC25U	1.85
Pairs FM	3.25
Pairs AM	3.10

CRYSTALS

32.768 kHz	2.70
100kHZ	3.85
455kHZ	5.00
1.0MHz	3.00
3.2768MHz	2.70
4.000MHz	2.00
4.19439MHz	2.30
6.5536MHz	2.10
10.0MHz	2.50
10.6985MHz	2.50
10.7015MHz	2.50
10.245MHz	2.50
10.7MHz	3.00
11.52MHz	2.50
100MHz	3.00

LEDs

5MM RED	0.12
3MM RED CLEAR	0.15
3MM RED	0.15
2.5 X 5MM RED	0.17
5MM GREEN	0.15
3MM GN CLEAR	0.16
3MM GREEN	0.16
2.5 X 5MM GN	0.20
5MM YELLOW	0.15
3MM YELLOW CL	0.16
3MM YELLOW	0.18
2.5 X 5MM YE	0.20
5MM ORANGERED	0.20
5MM ORA CL	0.29
3MM ORANGERED	0.19
2.5 X 5MM ORA	0.24
5MM INFRA RED	0.56
BPW41 IR DET	1.51
IR OPT CPLR	1.44
5MM CLIP	0.04

LCDs

3.5 digit	9.45
4 digit	8.95
5 digit	8.95

SCHOTTKY DIODE BAL MIXERS (SBL1=MD108)

SBL1 1-500MHz	4.25
SBL1-8 .1-200MHz	4.55
SBL1-X 10-1000MHZ	5.75
SRA1 .5-500MHz	8.45
SRA1-1 .1-500MHz	9.25
SRA1H .5-500MHz	13.35
SRA3 .025-200MHz	10.25

TRANSISTORS

AUDIO DEVICES

BC237	0.08
BC238	0.08
BC239	0.08
BC307	0.08
BC308	0.08
BC309	0.08
BC413	0.10
BC414	0.11
BC415	0.07
BC416	0.08
BC546	0.12
BC556	0.12
BC550	0.12
BC560	0.12
BC639	0.22
BC640	0.23
2SC1775	0.18
2SA872A	0.14
2SD666A	0.30
2SB646A	0.30
2SD668A	0.40
2SB648A	0.40
2SD760	0.45
2SB720	0.45
2SC2546	0.19
2SA1084	0.20
2SC2547	0.19
2SA1085	0.20

AUDIO POWER DEVICES

2SB753	2.34
2SB723	2.34
2SK133	3.00
2SJ 48	3.00
2SK134	3.10
2SK135	3.75
2SJ 50	3.75
BD535	0.52
BD536	0.52
BD377	0.33
BD378	0.33
BD165	0.30
BD166	0.31

SMALL SIGNAL RF DEVICES

BF194	0.18
BF195	0.18
BF224	0.22
BF241	0.18
BF274	0.18
BF440	0.21
BF441	0.21
BF362	0.49
BF395	0.18
BF479	0.66
BF679S	0.55
BFR91	1.33
BFW92	0.60
BFT95	0.99
BFY90	0.90
40238	0.85

RF POWER DEVICES

VN66AF	0.95
2N3866	0.85

SMALL SIGNAL RF FET/MOSFET

BF256	0.38
2SK55	0.28
2SK168	0.35
J310	0.69
J176	0.65
40823	0.65
40673	3SK51
3SK45	0.49
3SK51	0.54
3SK60	0.58
MEM680	0.75
BF961	0.70
BF960	1.24
3SK48	1.64

LCD Module

CM161. Miniature clock, 12/24 hr., alarm, day, date, backlight. All for......9.95

CAPACITORS
All 5mm or less spacing

CERAMIC 50v
2P2,3P3,4P7,6P8
8P2,10P,15P,18P..0.04
22P,27P,33P,47P
56P,68P,82P,100P.0.05
150P,220P,270P
330P,390P,470P...0.055
1N0,2N2,3N3,4N7..0.06
10N (0.01uF)....0.05
22N,47N..........0.06
100N,220N........0.09
MONOLITHIC CERAMIC
10N,100N.........0.16

FEEDTHRU
1N0 SOLDER IN....0.09

POLYESTER (SIEMENS)
10mm LEAD SPACING
10N,22N,33N......0.17
47N,68N,100N.....0.19
220N,470N........0.22
1uF..............0.29

POLYESTER (GENERAL)
10mm LEAD SPACING
10N,15N,22N,33N..0.06
47N,68N,100N.....0.08
220N.............0.11
20mm LEAD SPACING
220N,330N,470N...0.18

MYLAR
5mm LEAD SPACING
1N0,10N,22N,33N..0.08
100N.............0.09
20mm LEAD SPACING
220N,470N....... 0.17

POLYSTYRENE
10P,15P,18P,22P,
27P,47P,56P,68P..0.08
100P,180P,220P,
270P,330P,390P...0.09
470P,680P,820P...0.10
1N0,1N2,1N5,1N8..0.11
2N2,2N7,3N3,3N9..0.12
4N7,5N6,6N8,10N..0.13

TANTALUM BEAD CAPS
16v: 0.22,0.33,
0.68,1.0.........0.18
16v: 2.2,4.7,10..0.19
6v3: 22,47.......0.30
10v: 22,100......0.35

ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT)
(uF/voltage)
1/63,2.2/50,4.7/35
10/16,15/16,22/10
33/6.3...........0.08
22/16,33/10,
47/10............0.09
10/63,22/50,33/50,
47/16,100/16.....0.10
47/63,100/25,220/16
470/6.3..........0.12
100/63,470/16,
1000/10..........0.18
1000/16,470/63...0.23
1000/63,2200/16..0.30
3300/25..........0.69
1000/100.........0.88
10000/70.........3.00

AXIAL (HORIZ. MOUNT)
1/25,4.7/16,6.4/25
10/16............0.08
4.7/63,22/10,22/16
33/16............0.09
47/25,100/16.....0.10
100/25...........0.11
1000/16..........0.25
2200/16,1000/25..0.36
1000/35,4700/16..0.45
1000/50..........0.58

RESISTORS
0.25W, 5% E12 CARBON
1ohm-10M.........0.02
0.25W 1% E12 METAL FILM
1.1ohm-1M........0.05

HORIZ CARBON PRESETS
10mm TYPE
100ohms-2M5......0.12
HORIZ CERMET PRESETS
1k, 10k..........0.27

PRICES EXCLUDE VAT - PLEASE ADD 15%*
Postage 35p per order. CWO please. (*UK only)

CWO PLEASE : Commercial MA terms on application. Goods are offered subject to availability, prices subject to change - so please phone and check if in doubt.

Please send an SAE with all enquiries. Access/Barclaycard (min £5 please) Callers welcome

ambit INTERNATIONAL

200 North Service Road, Brentwood, Essex

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

CATALOGUES
2 & 3....60p ea
4...........75p
(4 inc. rev. of part 1)
ALL PARTS : ....£1.75......

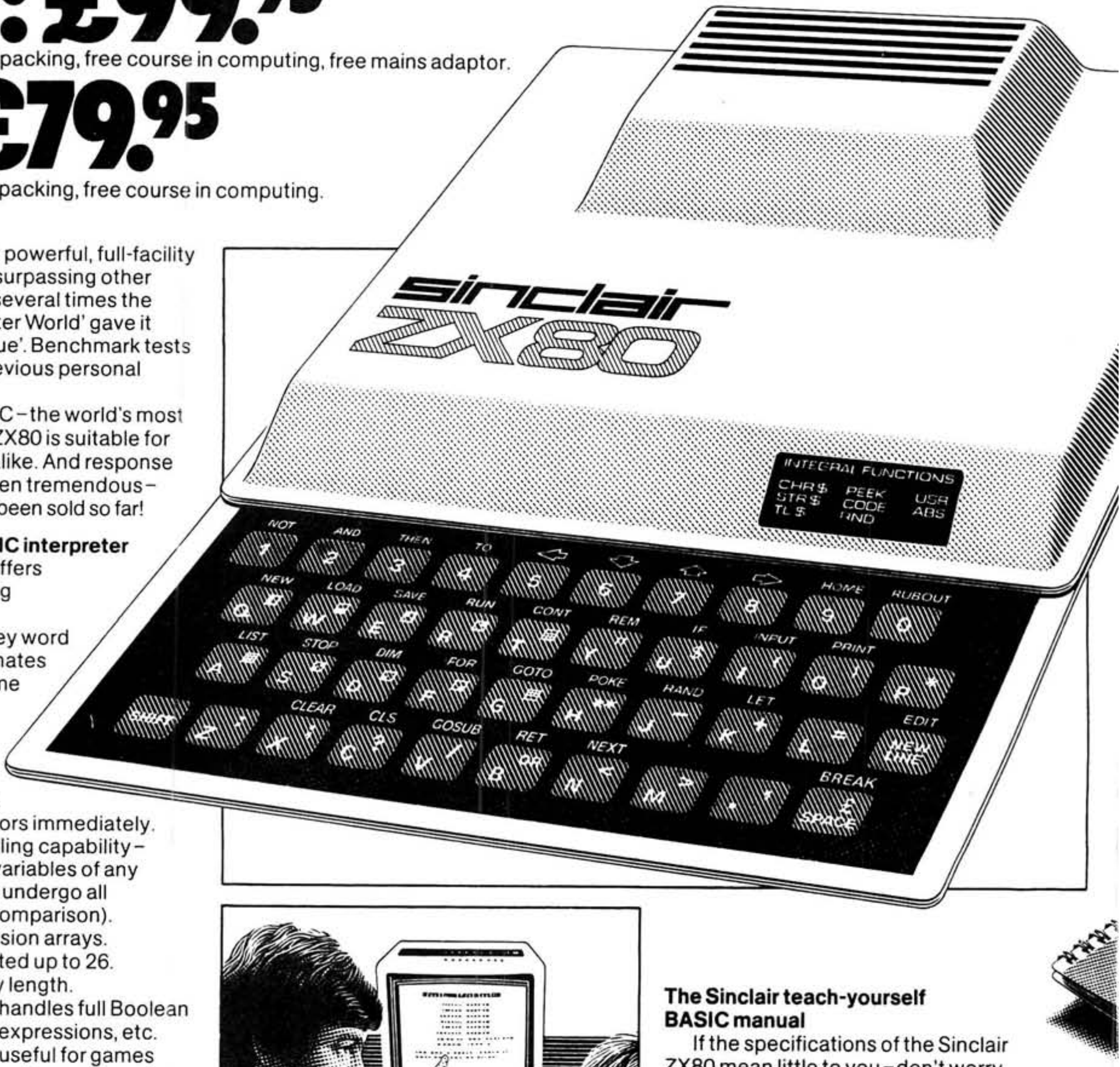
Why the Sinclair ZX80 is Britain's best-selling

Built: £99.95

Including VAT, post and packing, free course in computing, free mains adaptor.

Kit: £79.95

Including VAT, post and packing, free course in computing.



This is the ZX80. A really powerful, full-facility computer, matching or surpassing other personal computers at several times the price. 'Personal Computer World' gave it 5 stars for 'excellent value'. Benchmark tests say it's faster than all previous personal computers.

Programmed in BASIC – the world's most popular language – the ZX80 is suitable for beginners and experts alike. And response from enthusiasts has been tremendous – over 20,000 ZX80s have been sold so far!

Powerful ROM and BASIC interpreter

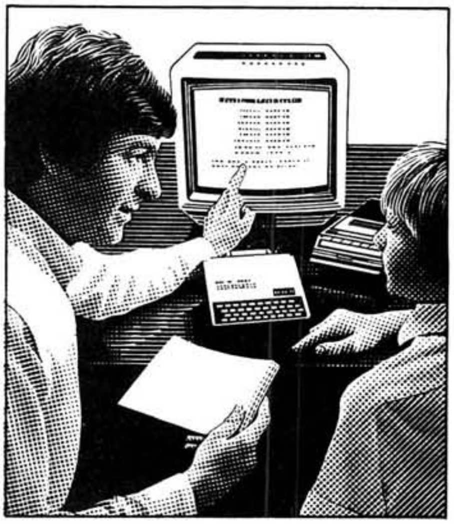
The 4K BASIC ROM offers remarkable programming advantages:

* Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.
* Unique syntax check. A cursor identifies errors immediately.
* Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison).
* Up to 26 single dimension arrays.
* FOR/NEXT loops nested up to 26.
* Variable names of any length.
* BASIC language also handles full Boolean arithmetic, condition expressions, etc.
* Randomise function, useful for games and secret codes, as well as more serious applications.
* Timer under program control.
* PEEK and POKE enable entry of machine code instructions.
* High-resolution graphics.
* Lines of unlimited length.

Unique RAM

The ZX80's 1K-BYTE RAM is the equivalent of up to 4K BYTES in a conventional computer – typically storing 100 lines of BASIC.

No other personal computer offers this unique combination of high capability and low price.



The ZX80 as a family learning aid. Children of 10 years and upwards are quick to understand the principles of computing – and enjoy their personal computer.

The Sinclair teach-yourself BASIC manual

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book (free with every ZX80). The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs.

Kit or built – it's up to you

In kit form, the ZX80 is pleasantly easy to assemble, using a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9V DC nominal unregulated. If not, see the coupon.

Both kit and built versions come complete with all necessary leads to connect to your TV (colour or black and white) and cassette recorder. Plug in and you're ready to go. (Built versions come with mains adaptor.)

personal computer.

Now available for the ZX80... New 16K-BYTE RAM pack

Massive add-on memory. Only £49.95.
The new 16K-BYTE RAM pack is a complete module designed to provide you – and your Sinclair ZX80 – with massive add-on memory. You can use it for those really long and complex programs – or as a personal database. (Yet it can cost as little as half the price of competitive add-on memory for other computers.)

For example, you could write an interactive or 'conversational' program to show people what your ZX80 can do. With 16K-BYTES of RAM, they could be talking to your computer for hours!

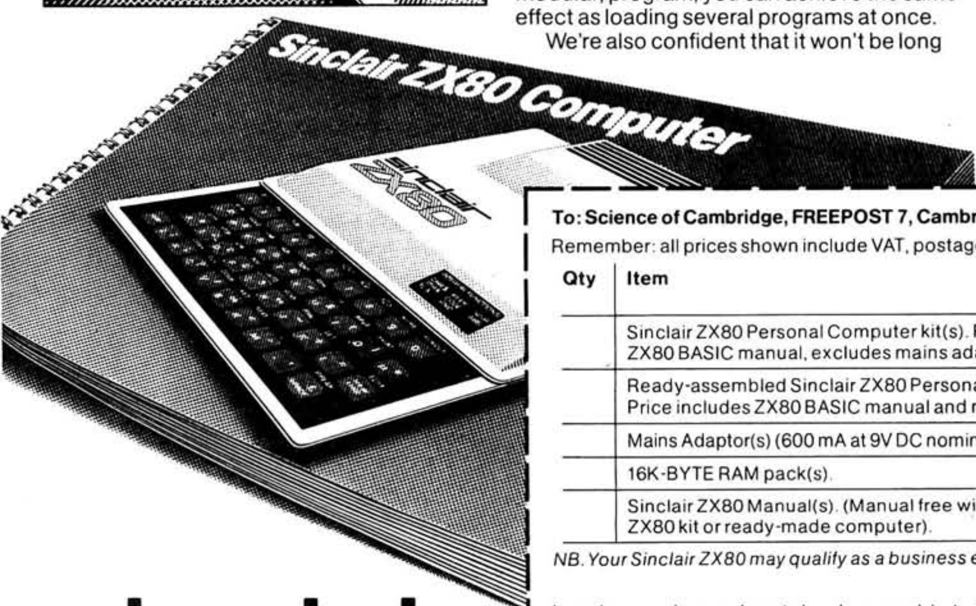
Or you can store a mass of data – perhaps in a fairly simple program – such as a name and address list, or a telephone directory.

And by linking a number of separate programs together into one giant, but modular, program, you can achieve the same effect as loading several programs at once.

We're also confident that it won't be long before you can buy cassette-based software using the full 16K-BYTE RAM. So keep an eye on the personal computer magazines – and brush up your chess perhaps!

The RAM pack simply plugs into the existing expansion port on the rear of the ZX80. No wires, no soldering. It's a matter of seconds and you don't need another power supply. You can only add one RAM pack to your ZX80 – but with 16K-BYTES who could want more!

How to order
Demand for the ZX80 exceeds all other personal computers put together! So use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.



To: Science of Cambridge, FREEPOST 7, Cambridge CB2 1YY.
Remember: all prices shown include VAT, postage and packing. No hidden extras. Please send me:

Qty	Item	Code	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	02	79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	01	99.95	
	Mains Adaptor(s) (600 mA at 9V DC nominal unregulated).	03	8.95	
	16K-BYTE RAM pack(s).	18	49.95	
	Sinclair ZX80 Manual(s). (Manual free with every ZX80 kit or ready-made computer).	06	5.00	

NB. Your Sinclair ZX80 may qualify as a business expense. **TOTAL: £**

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ ________
Please print
Name: Mr/Mrs/Miss ________
Address ________

FREEPOST – no stamp needed. PRW02

sinclair ZX80

Science of Cambridge Ltd.
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: 0223 311488.

comment...

Pot Pourri

AS THIS is being written, just before Christmas 1980, there is much discussion and argument among the ranks of the candidates for the latest RAE. The May exam went off quite quietly, but the December one seems to have stirred up a real hornets' nest. City & Guilds have already announced that one question is void, because the correct answer was not among the options offered. If disgruntled examinees are to be believed, there were more problems than that.

Last week two announcements of interest to radio enthusiasts were put out by the Home Office. One, concerning radio control and metal detector licensing, is reproduced in full elsewhere in this issue. The other, concerning Open Channel, effectively says you can have 928MHz now, without licensing restriction, but if you want a lower frequency band, to achieve longer range, this will have to be looked into at greater length. Or, as the more cynical put it, CB on Home Office terms or not at all (legally, anyway).

I don't believe some of the estimates of the number of illegal CB users in the UK, put out by its devotees. The highest I've heard is 1·5 million, but you only have to do a little arithmetic and keep your eyes open to realise this must be wrong. For example, there are perhaps 20 000 amateurs operating mobile in the UK. Even in London, I think that there are more "obviously amateur" antennas visible on cars than there are "obviously 27MHz CB" ones. If, for the sake of argument, you allow that perhaps only 50 per cent of CB rigs are used mobile, and that perhaps 90 per cent of mobile CB users successfully camouflage the fact, that would still put the number of CB rigs at under 400 000. Similar arguments can be put forward on the basis of the number of road vehicles registered in the UK.

My guess—and it is a guess—is around a third of a million. Still a large number, and undoubtedly growing, though more and more CBers are "going legit" as licensed radio amateurs. Have we reached the stage where 27MHz CB is here to stay, no matter what the Government does? I don't know, but maybe the long-awaited 35MHz allocation to radio-controlled model aircraft is a clue to Home Office thinking on this point. I think it's fairly obvious to everyone that there is no "ideal" frequency for CB, but my own feeling is that the proposed extremes of 27MHz and 928MHz are even less ideal than some of those bands between.

Geoff Arnold

services

QUERIES

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

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

PROJECT COST

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

CONSTRUCTION RATING

Each constructional project will in future be given a rating, to guide readers as to its complexity:

Beginner
A project that can be tackled by a beginner who is able to identify components and handle a soldering iron fairly competently. Generally this category will be used for simple projects, but sometimes for more complicated ones of wide appeal. In this case, construction and wiring will be dealt with in some detail.

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

Advanced
A project likely to appeal to an experienced constructor, and often requiring access to workshop facilities and test equipment for construction, testing and alignment. Constructional information will generally be limited to the more critical aspects of the project. Definitely not recommended for a beginner to tackle on his own.

SUBSCRIPTIONS

Subscriptions are available to both home and overseas addresses at £11.80 per annum, from **"Practical Wireless" Subscription Department, Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.** Airmail rates for overseas subscriptions can be quoted on request.

BACK NUMBERS AND BINDERS

Limited stocks of some recent issues of *PW* are available at 95p each, including post and packing to addresses at home and overseas.

Binders are available (Price £4.30 to UK addresses and overseas, including post and packing) each accommodating one volume of *PW*. Please state the year and volume number for which the binder is required.

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

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

NEWS NEWS NEWS

Licence Changes Confirmed

As mentioned in the "News" column on page 19 of the October 1980 issue, it was reported that the Home Secretary, Mr Whitelaw, proposed to introduce changes in the licence regulations for certain low-powered devices. The changes have been confirmed and will take effect from 1 January 1981.

Unfortunately, the announcement, issued 18 December 1980, came much too late for specialist publications like *Practical Wireless* to notify their readers of the changes, prior to the date of effect.

I am reproducing verbatim, the announcement which was headed "Exemption of Low Powered Devices from Licensing."

"From 1 January 1981 users of model control equipment and metal detectors/pipefinders will no longer need to be licensed under the Wireless Telegraphy Act 1948. This fulfils a commitment given by the Home Secretary on 14 July 1980. The Home Secretary said then that the proposal would "lead to less bureaucratic control and to greater freedom for individuals."

At the same time an additional frequency (35·005MHz to 35·205MHz) is to be made available for model aircraft control.

The licence fee for the use of model control equipment is £2·80 for a five year period. Just under 93 000 licences were in issue at the end of last year, and when the exempting regulations come into force, existing licences will be formally revoked. In exempting the equipment from licensing regulations, a simplified form of the existing conditions will be used, so that frequency and power output requirement will remain unchanged.

The licence fee for pipefinders and metal detector equipment is £1·40 for five years. The number of licences in issue at the end of 1979 was 150 000.

The Home Secretary has emphasised that exemption of metal detectors would not absolve users in any way from the need to obtain permission to enter, search and dig land and to keep off protected archaeological and other sites.

The equipment will no longer be subject to the type approval procedure, so the exempting regulations will set out the simple technical conditions that will have to be met in order to avoid interference to other radio users.

These conditions will be framed so as to cover all existing type approved equipment.

Technical Note

Metal Detector and Model Control Equipment are exempted from the requirement of a Licence subject to the following terms:

Metal Detectors

1. A metal detector shall be used only with emissions at a fundamental frequency within the frequency band 0Hz to 148·5kHz.
2. The strength of the electric field of emissions shall not exceed 3000 microvolts per metre measured at a distance of 6 metres.
3. The strength of the electric field of the spurious emissions produced by a metal detector shall not, insofar as those emissions are within the frequency band 148·5kHz to 6·5MHz exceed 100 microvolts per metre when measured at a distance of 6 metres.
4. The use of a metal detector shall not cause undue interference with any wireless telegraphy.

Model Control Equipment

Model control equipment shall be used only:

1. With emissions which are within the 26·96MHz to 27·28MHz band or the 458·5MHz to 459·5MHz band.
2. With a maximum mean power not exceeding 1·5 watts in the 26·96MHz to 27·28MHz band and 0·5 watts in the 458·5MHz to 459·5MHz band.

Notwithstanding these provisions model control equipment designed *solely* for the purpose of controlling the movement of a model aircraft may be used with emissions which are within the frequency band 35·005MHz to 35·205MHz and with a maximum mean power of 1·5 watts. This is an *additional* band not previously available.

The use of model control equipment shall not cause undue interference with any wireless telegraphy.

The use of model control equipment shall be subject to the condition that it is made available for inspection if so required by any person authorised for the purpose by the Secretary of State.

Home Office, 50 Queen Anne's Gate, London SW1H 9AT. Tel: 01-213 3030/4050/5050.

CB Decision Soon?

In the House of Commons on Thursday, 18 December 1980, the Home Secretary, Mr Whitelaw, replied to a question from Mr John Butcher (Coventry South-West) concerning the consultation document on Open Channel radio.

Mr Whitelaw said: "The responses to the consultation document fell into two categories. On the one hand there were a large number of individuals who wanted citizens' band radio at 27MHz to be legalised. On the other hand the electronics industry and institutions representing other interests such as broadcasting strongly advocated frequencies higher than 27MHz. It is clear that all these alternatives, other than 928MHz, would cause great interference to television and hi-fi equipment. I am therefore disposed to allocate frequencies to Open Channel radio in the neighbourhood of 930MHz for this purpose and I am considering whether it would be possible to exempt the facility from licensing if certain conditions are met. This should give British manufacturers an attractive opportunity to develop new products having the potential of a wider market through international standardisation.

The responses to the consultation document showed that there are many people who advocate a system, such as 27MHz, with a greater range than that which Open Channel on 930MHz would provide. I remain concerned about the likely interference to other users if a service operating at a much lower frequency were introduced, but I intend to continue consultations to examine this question further.

I shall announce final decisions on all these matters as soon as I can."

NEWS NEWS NEWS

Exhibition

The Northern Radio Societies Association will be holding their annual exhibition on Sunday, 29 March 1981, in the Lancaster Suite at Belle Vue Manchester, commencing at 1030hrs.

Following the success of last year's exhibition, at which over 5000 people attended, many more trade stands have been booked, including a number of companies in the home computer market.

Further details from: *The Secretary, Chris Marcroft G4JAG, 24 Lancaster Avenue, Ramsbottom, Bury, Greater Manchester BLO 9QA.*

New Catalogue

Maplin announce the availability of their 1981 catalogue.

The 320 page catalogue lists 5540 items (1022 new lines) and carries over 2000 photographs and line drawings.

Available from W. H. Smith, priced £1·00 or £1·25 by mail inland from: *Maplin Electronic Supplies Ltd., PO Box 3, Raleigh, Essex.*

On the Move

Tri-tronic Marketing Ltd., have moved to new premises, the move should enable the company to provide an even better service for its customers and also increase its product range.

The new premises are at: *9 Badby Leys, Rugby, Warwickshire CV22 5RB. Tel: (0788) 812895. Telex remains unaltered at 312137 manmar G.*

Following the success of last year's crease of personnel Transam, manufacturers of Triton personal computer systems, are moving to new premises.

Both Transam and TCL Software will be operating from their new address from 1 August 1980, the transfer from 12 Chapel Street having taken place during July. Transam can still be contacted on 01-402 8137, extra sales lines have been installed, they are 01-405 5240/2113. The telex number remains the same—444198.

The new premises are opposite the Ministry of Defence at: *59/61 Theobalds Road, London WC1.*

Amateur Radio in Hospital

After a recent spell in hospital, our well-known contributor Fred Judd G2BCX has provided the following notes for the possible benefit of other readers.

"Providing permission is obtained in advance, there is usually no objection to the use of amateur radio transmitting equipment by licensed operators during a spell in hospital. However, there are certain rules that must be observed, aside from obtaining permission in the first place. Small 2 metre equipment is the obvious choice except in cases where the stay in hospital may be for a very considerable time, e.g., in a hospital or home for the handicapped.

Permission for use of radio or indeed any electrical equipment should be obtained as far in advance as possible from the Unit Administrator and/or District Works Officer c/o the hospital concerned. This is important in hospitals where sensitive electronic equipment is in use, for example, operating theatre life support systems and in intensive care units, etc. It is vital that radiation, however low, cannot cause interference. Tests with respect to this are absolutely essential and hospital staff will normally be willing to co-operate.

It is also essential that any equipment connected directly to a mains socket (usually available at bedsides) meets electrical standard safety regulations. This aspect can be checked by an appropriate member of the hospital staff. Providing such equipment takes negligible power from the mains, e.g., a small charger unit for a portable battery-operated 2 metre hand-held or low-power mains operated TX/RX there may be no charge for the electricity consumed. Check on this.

The following conditions concerned with actual operation are recommended:

1. Use lowest transmitting power possible. Your hospital may not be too far from a repeater station.
2. Have regard for other patients by using an earphone for listening (or mic/earphone), and keeps voice level to a minimum when talking.
3. Close down immediately if asked to do so.

The writer is indebted to Senior Staff Members of the Norfolk and Norwich Hospital, Norwich, for guidance on the above."

EDXC 1981 Conference

The European DX Council will be holding their 15th annual conference between 22 and 25 May at Berne, Switzerland.

The cost of the conference will be 275 Swiss Francs, and application forms can be obtained from *EDXC, PO Box 4, St Ives, Huntingdon, Cambs PE17 4FE,* for the cost of return postage or one IRC. The closing date for applications is 27 February 1981.

Wavemeter

We understand that Packer Communications, manufacturers of the WM-2A Wavemeter announced in Production Lines in our November 1980 issue, plan to be back in operation by March, and will be showing their wares at amateur radio rallies during 1981.

New Service Dept.

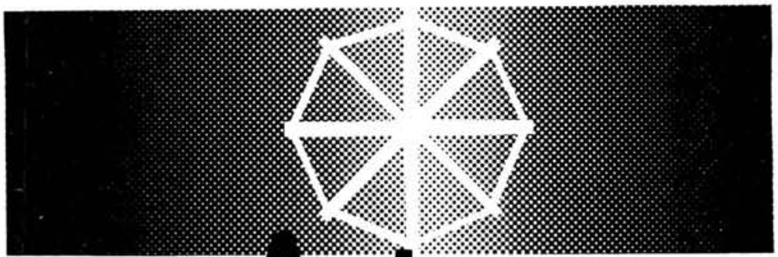
Leeds Amateur Radio have opened a new service and mail order department at *60 Green Road, Meanwood, Leeds LS6 4JP. Tel: Leeds (0532) 782224.* Their retail shop at *27 Cookridge Street, Leeds LS2 3AG. Tel: Leeds (0532) 452657 remains in operation.*

Can I Help You!

Are you the secretary, organiser or general dog's body of your local radio club or any other group whose functions may interest readers of *PW*. If so, let me know and I will endeavour to publicise your rally, get-together whatever, through this column. Remember though, we compile the magazine some time ahead of publication day (e.g. this note was written in December), so, the earlier I can have details, the better.

Alan Martin

Q Multiplier and Spiral Loop Antenna



G. S. MAYNARD

The loop antenna is an established part of receiving apparatus for m.w. DXers throughout the world. With tuned resonance and directional pick-up, it is possible to minimise both adjacent and co-channel interference, allowing optimum wanted signal resolution.

A study of loop parameters indicates that voltage output increases with area, number of turns and effective "Q" of the tuned circuit. However, since loop size is generally governed by convenience and the turns count is determined by tuning range, the "Q" of the circuit is the only parameter easily varied. It follows, therefore, that any increase in "Q" produced by an externally connected "Q"-multiplier not only makes the aerial more selective but creates useful signal voltage gain.

This article describes a simple remotely controlled "Q"-multiplier which increases signal gain by some 10dB to 20dB when used with existing aerials.

There are also notes on loop/multiplier performance with various sizes of antenna, details of a spiral loop for optimum reception and some general comment based upon experimental work.

Circuit Description

The "Q"-multiplier was designed specifically for loop aerials and satisfies the following requirements:

(a) it should clip onto a loop without any need for coupling windings,
(b) should not modify tuning range,
(c) must be capable of smooth operation throughout the m.w. band, and
(d) be remotely controlled yet isolated from supply cable r.f. to preserve loop directionality and null points.

The circuit is shown in Fig. 1.

The signal at A is fed to G1 of Tr1, a unity gain, self-biased, common source m.o.s.f.e.t. stage, and the inverted output developed across R1 directly coupled to Tr2. This is a common emitter amplifier which inverts the signal again and produces an output across L2. The voltage across L2 is in phase and amplified compared with the signal at A. A minute portion of this output is returned to terminal A as positive feedback, counteracting losses within the loop and creating signal gain.

Components R3, R4 and L1 filter the output of Tr2 and produce feedback for the low frequencies in the band while capacitance Cf is responsible for feedback at higher frequencies. Though Cf does not exist as an individual component it is shown in Fig. 2 to represent the small capacitance formed by two parallel copper Veroboard tracks. The values of Cf, R3, R4 and L2 are in balance for a loop capable of full m.w. coverage with a 365pF tuning capacitor and produce similar levels of gain throughout the band.

Power is fed down the twin flex used for signal coupling between loop and receiver. The entire amplifier is allowed to float isolated at r.f. by L3 and L4, thus maintaining the naturally balanced electromagnetic induction potentials across the tuning capacitor. C3 and C4 provide d.c. blocking at the loop and receiver.

The effective "Q" is controlled by overall amplifier gain and varied remotely by adjustment of supply current with potentiometer R6. Variation in "Q" from less than 100 to greater than 1000 is possible and R7 is included to centre the useful portion of rotation on R6.

When R6 is high and the amplifier current low Tr1 will conduct. However, Tr2 will be unable to produce r.f. gain until sufficient voltage is developed across R1 to overcome Vbe and the voltage drop across R5. This ensures that, even with low gain settings, Tr1 operates linearly and does not produce cross-modulation from powerful adjacent channel transmissions.

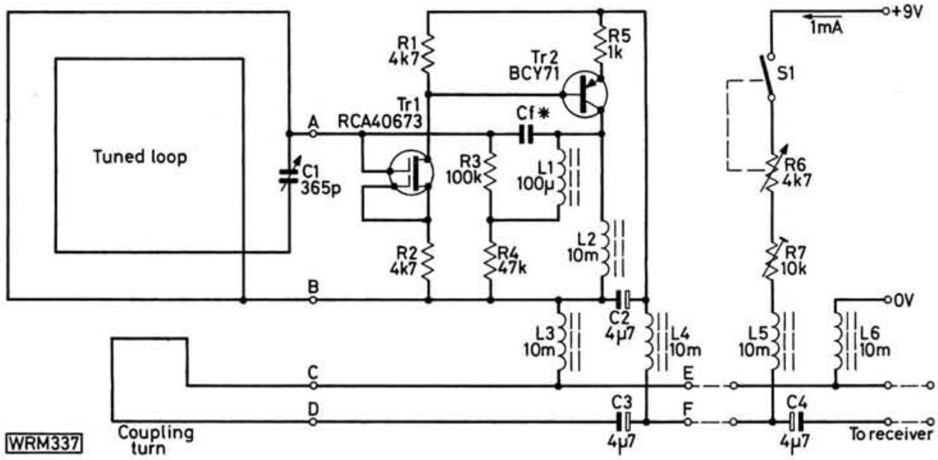
CONSTRUCTION RATING — **BEGINNER**

BUYING GUIDE

Constructors should have little difficulty in obtaining the components for this project. The local hardware shop should have the wood strips and Electrovalue Ltd. can supply all the remaining components

APPROXIMATE COST — **£20**

Fig. 1: Circuit diagram of the "Q"-multiplier



Construction and Testing

Construction is as simple as the circuit itself, using readily available components mounted on a 0·1in matrix copper stripboard. It is recommended that only the parts listed and the layout shown in Fig. 2 are used for this design, as any deviations may reduce operational efficiency.

Fig. 3 shows the strip cutting points and terminal pin positions on the Veroboard. When all cuts have been made, mount and solder the components taking care to correctly identify transistor and capacitor leads.

The potentiometers, battery source, receiver and twin flex connectors should be housed in a convenient box.

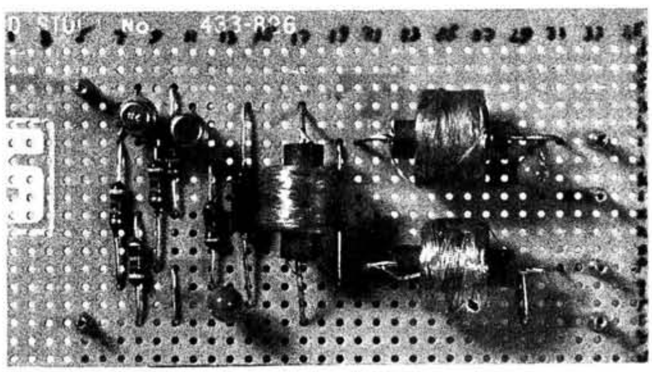
After construction and checking, a test with R6 and R7 at their mid-positions should show a current of around 1mA. If the current is less than 500μA or greater than 1·5mA you have a problem.

If the current drain is acceptable the presence of multiplier gain may be checked by connecting terminals A and B to an isolated m.w. ferrite rod, coil and tuning capacitor combination. Turn R6 and R7 to minimum resistance and note interference on a closely proportioned portable receiver as the combination is tuned. Whistles indicate correct operation and should cease as R6 and R7 are turned to maximum resistance.

Loop Connection

If the "Q"-multiplier works with a tuned ferrite aerial, then it will function with a loop. Components specified are suitable for use with medium size aerials ranging from 0·25m^2 to 5m^2, but slight changes will accommodate all m.w. coils.

Terminal B must be connected to a centre tap, plus or minus half a turn, made by baring the wire. Terminal A may be linked to the start or finish of a solenoid-wound loop, but when used with a spiral must be connected to the



This picture shows the main components of the "Q"-multiplier mounted on a piece of Veroboard. This unit is fitted to the centre of the spiral loop antenna together with the tuning circuit. Note that L5,6, C4, R6,7 and S1 are housed in a small plastics box near the receiver

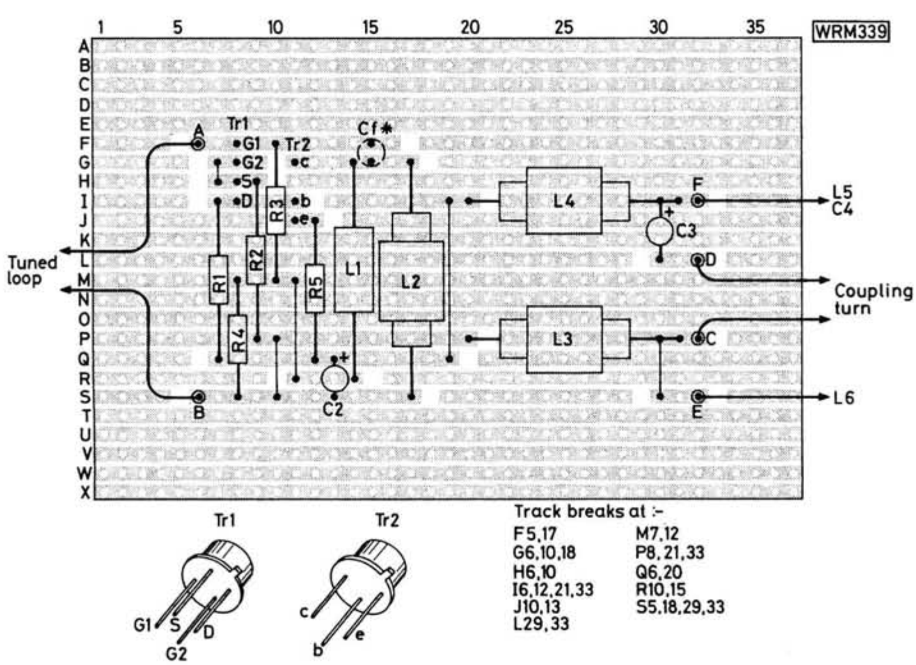


Fig. 2: Veroboard layout of the "Q"-multiplier circuit. Take great care to get the track breaks in exactly the specified positions

outer end so that the flux from the driven turns envelops the remainder.

For receiver coupling with all "Q"-multiplier driven loops, try a single turn 25cm square wound centrally to minimise tuned circuit damping and prevent r.f. stage overload by the amplified signal.

When used with coils or loops smaller than $0{\cdot}25m^2$, R3, R4 and L1 may have to be removed to smooth the transition between positive feedback and the onset of oscillation. Cf should then be adjusted at low frequencies to provide just enough feedback for oscillation.

With loops larger than $5m^2$ Cf may have to be increased, either by lengthening the Cf connected strips or by adding extra capacitance, say 1pF to 5pF. With very large loops try reducing R3 to 22kΩ.

The "Q"-multiplier peaks sensitivity not only to signal pick-up but to changes of both capacitance and inductance. Small variations have a large effect on voltage output and therefore the tuning drive should have a minimum 36:1 reduction gearing. The variable capacitor should be isolated either by cord drive or an insulated shaft and the loop winding must be well supported to prevent wire vibration and flutter.

Results

Having covered construction and detail, some notes from experimental work will illustrate the versatility and performance.

A small loop 25cm square of 20 turns of miniature 10 × 0·1mm insulated wire solenoid-wound over 5cm tuned over the m.w. band with a Jackson 365pF variable capacitor. The "Q"-multiplier produced a useful output similar to that of a standard seven turn 1m square loop.

This little antenna was certainly useful for desk top DX reception though since the width-to-depth ratio was only 5, signal nulls were very shallow. It would pull in Canada and the USA when the path was open but loop tuning and multiplier gain setting were critical.

Medium Size Loop

A medium size loop 1m square with 10 turns of 10 × 0·1mm wire spaced over 12·5cm tuned from 510kHz to 1640kHz with the 365pF capacitor and "Q"-multiplier connected. Width-to-depth ratio was a little better at 8, though still not good enough for good nulls. Signal output was however more satisfactory than that from an outdoor loop of two turns 2·5m × 7m with a parallel connected twin 365pF variable capacitor. It was possible to tune accurately with a 36:1 drive and adjust the bandwidth to suit each signal by varying the "Q"-multiplier gain.

The 2·5m × 7m aerial was of larger area than necessary to ensure that demodulated noise in a good receiver was predominantly background interference and not noise from the receiving system itself. This view was reinforced by observation of non-improvement in signal-to-noise ratio with loop "Q" increase. Again bandwidth could be varied with multiplier gain but the most startling feature here was loop field intensity.

This antenna was mounted on an outside wall, and with multiplier operation it was possible to tune into St John's, Newfoundland on many nights from 2300 GMT on a six-transistor clock radio in the house or garden within six feet of the loop plane.

One serious disadvantage of the outside loop however, was that the wire fluttered in the wind and eventually stretched. The flutter was apparent on the a.g.c. lines and audio when multiplier gain was set high for a narrow bandwidth.

These results led to a basic set of conclusions for optimum loop design. It should be of medium size and fitted with a "Q"-multiplier to ensure that received noise predominates receiving system noise. It should be mounted indoors and have a high width-to-depth ratio for good rotational nulls.

A Spiral Aerial

A simple to construct, eight turn, 1·5m diameter, octagonal spiral loop evolved from these conclusions and has become a trusted part of the author's DX system.

It is constructed from four 6ft pieces of finished 30mm × 6mm ramin hardwood which may be purchased from most good d.i.y. shops. Dimensions are not critical in case exact sizes cannot be found but the wood must be thin.

Cut three pieces 1·5m and one 1·7m long, and drill a 4mm hole in the middle of each. Pencil mark a line 74·5mm from the centre on both sides of every piece and then mark inwards at 10mm spacing for an eight turn

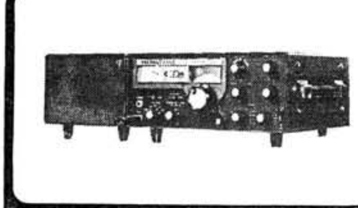
★ components

Resistors		
¼W 5%		
100Ω	1	R8
1kΩ	1	R5
4·7kΩ	2	R1,2
47kΩ	1	R4
100kΩ	1	R3
Potentiometers		
Preset		
10kΩ	1	R7
Linear with switch		
4·7kΩ	1	R6
Capacitors		
Tantalum bead		
4·7µF 35V	4	C2,3,4
Single gang variable		
365pF	1	C1 (see text)
Electrolytic		
4700µF 16V	1	C5
Inductors		
100µH (Sigma)	1	L1
10mH (Repanco)	5	L2,3,4,5,6
Semiconductors		
Transistors		
BCY71	1	Tr2
40673	1	Tr1

Miscellaneous
6:1 ball drives, Jackson 4511BD (3); 54mm dia. pulley; 6V cassette motor with pulley; 40m 10/0·1mm insulated wire; 2A Twin "8" cable; wood strips; Veroboard 0·1in matrix; knob; drawing pins; miniature d.p.d.t. centre-off toggle switch.

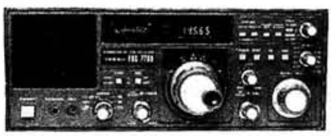
Whether you are: just starting, taking an R.A.E. course, just licensed, or an old timer, SMC has something for you. . . . And at our **LOWEST** ever prices.
Advertised **PRICES** on this page **INCLUDE VAT** at 15%, **INCLUDE SECURICOR** speedy delivery and **INCLUDE A TWO YEAR WARRANTY** (remember as Yaesu Musen UK distributors our guarantee is **FACTORY BACKED**).

We take **ACCESS AND BARCLAYCARD OVER THE PHONE**, offer attractive **HP** (including a **FREE FINANCE SCHEME** on many regular priced items) on application, and have branches and agents conveniently situated across the country plus the bigget mail order department right in Totton. Whatever your requirements SMC . . . your single stop service.



FT/FP200 £345

10-80m. SSB, CW, 180W PIP C/W FP200 AC PSU/speaker



FRG7700

- ★ 150kHz-30MHz no gaps
- ★ SSB-CW-AM and FM
- ★ Up-conversion no preselector
- ★ 12 channel memory option
- ★ Mains and 12 volts dc option
- ★ Clock/timer built-in

From 30MHz to 150KHz (lower at reduced spec.) in 1MHz bands. SSB, CW, AM, FM. On 10m and with a convertor the NBFM detector with squelch plus a noise blanker opens new horizons.
4 filters fitted as standard! SSB, 2·7KHz and FM 15KHz. For AM, 3 positions! Narrow 2·7KHz, Medium 6KHz and Wide 12KHz, with tone control, and switchable AGC.

No preselectors! Up conversion with a 48MHz crystal filtered IF plus dual PLL system provides automatic selection of the input bandpass filter direct from the band selector or memory.
The inbuilt quartz clock/programmable timer has battery back-up.
12 frequencies anywhere within the range may be stored by simply touching the M button, no preselector adjustment, no range switch adjustment. The memory is tunable by ± ıKHz and is kept alive year long by 3'AA' dry cells.

FRG7700 £309 FRG7700M £389

FT901DM £715

10-160m. SSB, CW, AM, FM, 6 bands (DE version £645 D version £655)

FT101ZD £515

10-160m. SSB, CW, AM, Digital 6 bands model. (Analogue version £445.)

FRG7 £199

0.5-30MHz General Coverage Receiver. 230V AC. 12V DC, + Battery pack. AM/SSB.

FRG7000 £259

0.25-30MHz General Coverage Receiver. 230V AC. AM/SSB Timer, digital. AM/SSB.

FT107M £625

160-10m + 2 Aux. SSB, CW, FSK, AM. Memory option. Deluxe 6 band model.

PRICES INCLUDE VAT @ 15% **FREE SECURICOR DELIVERY** **2 YEAR DISTRIBUTOR WARRANTY**

SOUTH MIDLANDS COMMUNICATIONS LIMITED

S. M. HOUSE, OSBORNE ROAD, TOTTON, SOUTHAMPTON, SO4 4DN, ENGLAND
Tel: Totton (0703) 867333, Telex: 477351 SMCOMM G, Telegram: "Aerial" Southampton

S.M.C. Agents
G3ZUL Stourbridge (03843) 5917
GM8GEC Edinburgh (031665) 2420
GI3WWY Tandragee (0762) 84056
GI3KDR Bangor (0247) 55162
GW3TMP Pontybodkin (035287) 846/324
GW8EBB Swansea (0792) 872525
GJ4ICD St. Saviour (0534) 26788

S.M.C. (Leeds) BRANCH
LEEDS,
Colin Thomas, G3PSM
257 Otley Road,
Leeds 16, Yorkshire.
Leeds (0532) 782326
9–5.30 Monday–Saturday

S.M.C. (Jack Tweedy) LTD
CHESTERFIELD,
Roger Baines, G3YBO
79 Chatsworth Road,
Chesterfield, Derbyshire
Chesterfield (0246) 34982
9–6: Tuesday–Saturday

S.M.C. (Jack Tweedy) LTD
WOODHALL-SPA,
Jack Tweedy, G3ZY
150 Horncastle Road,
Woodhall Spa, Lincolnshire
Woodhall Spa (0526) 52793
9–5: Tues–Sat (+ appointments)

winding. Bolt all pieces together using large washers on a 4mm bolt and open out to even spacing with the longest strip vertical for rotational mounting.

Winding starts at bottom vertical so a ninth pencil mark will be required here as an anchor point, also a single mark on each limb 150mm from the centre for the receiver coupling winding.

Starting at bottom vertical label each limb in clockwise rotation from A to H, then push drawing pins into pencil marks to a depth which will hook the winding wire as shown in Fig. 4.

Winding is from the inside outwards with 36m of insulated 10 × 0·1mm miniature stranded wire starting from the pin nearest the centre of limb A through B, C, etc. Make a single receiver coupling turn at 150mm radius then remove wire insulation close to the fifth pin on limb A for terminal B.

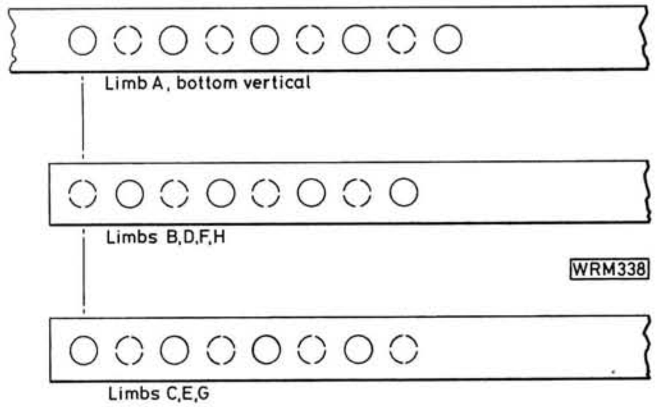


Fig. 3: The arrangement of pins at the ends of the wooden cross members of the spiral loop antenna

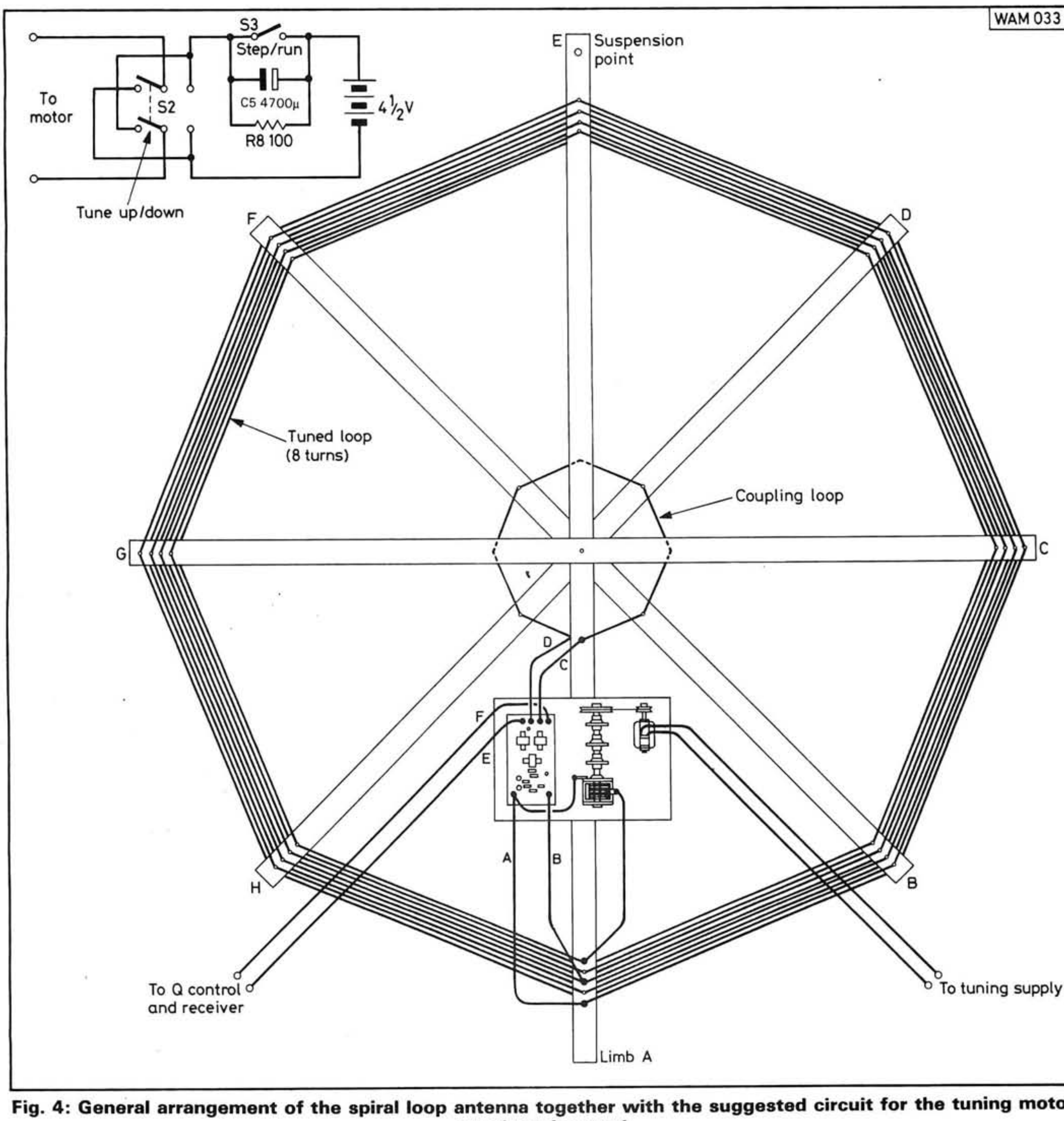


Fig. 4: General arrangement of the spiral loop antenna together with the suggested circuit for the tuning motor supply and control

"Q"-Multiplier Connection

When finished the antenna looks like a giant cobweb with its light, though reasonably rigid, construction. The author's prototypes weighed only 800g, yet were very efficient.

Tuning range with a Jackson 01–365pF (type 5250/1), is 510kHz to 1630kHz, with the "Q"-multiplier connected and because of the large diameter-to-depth ratio it produces remarkable 50dB signal nulls on the aerial axis.

With high multiplier gain, selectivity is so sharp that a 216:1 reduction tuning drive is necessary and the combination is capable of peaking on any desired portion of a modulated signal, such as the centre of a sideband less affected by interference.

Those interested in Top Band might like to try a six turn 1·5m spiral with components R3, R4 and L1 omitted from the multiplier.

Comment

"Q"-multiplier gain control with this design is very gradual and capable of reducing aerial bandwidth to well below 2kHz, before instability produces system oscillation. With careful use therefore narrow bandwidth will cause bassy, unreadable sound, warning of possible instability and, since optimum performance is obtained before audible loss of clarity, there should be no need to advance the gain further.

If oscillation is inadvertantly allowed the loop will receive approximately 100µW of r.f. and interference will be radiated. At distances up to 20m with coincidental tuning of the spiral loop there is a possibility of producing whistles on radios already receiving normal transmissions. However, tests with a sensitive portable indicate that interference would not be noticeable above background noises beyond a 50m radius, and, since the aerial will be tuned to stations not normally received the chances of an experienced operator being a nuisance to neighbours are minimum.

Motorised Tuning

For true remote operation it becomes necessary to motorise the tuning capacitor. The author has had success here with a standard 6V cassette motor and pulley mounted in a horizontal clip and driving a 54mm diameter drum at the end of the triple 6:1 ball drive reduction train. Power from a 4·5V bell battery switched and reversed with a centre-off level switch allows motor control in each direction. Tuning drive may be pulsed in 500Hz steps by series insertion of a 4700µF electrolytic capacitor paralleled with a 100Ω resistor so that coarse and fine tuning may be achieved using two switches. No extra interference suppression is required, but separate wiring should be used for the motor supply.

Feeder Cables

With existing loops there should be no reason to change feeder cable where good results have previously been obtained. The author prefers flat twin low impedance cables terminating in an earthed, centre tapped balanced input. At m.w. frequencies ordinary "Figure 8" flex is suitable, and runs of 20 metres along the ground produce no loss of DX capability when for example listening in the garden.

Cardioid Connection

So far there has been no mention of the cardioid connection where signal from a straight wire is externally mixed with that from a loop. When aerial voltages are equal, signal addition changes the loop sensitivity pattern from figure eight to heart-shaped with a single very deep null point. This connection is useful for cancellation of European signals when tuning American DX.

The key for cardioid connection with "Q"-multiplier operation lies in the statement "when voltages are equal", because equal voltages can only be obtained if the straight wire signal is tuned at a similar "Q" to the loop. A second "Q"-multiplier with wire aerial wave trap can balance signals and produce cardioid response, however, adjustment is critical and any differences in "Q" can cause sideband splatter.

The author has had little success in mixing signals because noise from the straight wire antenna at his QTH degrades loop output, though St John's, Newfoundland on 930kHz has been received free of any interference before closedown of Brussels on 927kHz.

This relatively compact spiral loop and multiplier combination should out-perform most other domestic antennas, and with its total construction price tag of about £20 should be within grasp of serious m.w. listeners.

Effective gain is created, resolution improved and weak signals are lifted above system noise, all conditions that aid reception and the logging of new DX. ●

a visit to...

Alan MARTIN G8ZPW

As mentioned in the News column of the October issue of *Practical Wireless*, members of the editorial staff attended the first "Radio Communications Day" at the Chalk Pits Museum at Amberley, West Sussex, on Sunday, 5 October 1980. They were the Editor Geoff Arnold, Technical Editor John Fell, Technical Sub Editor Elaine Howard, myself Alan Martin and well over 1000 other visitors.

The weather obliged and gave us a splendid sunny day. Upon arrival we were greeted by Ron Ham, a regular contributor to *PW,* who introduced us to many of the personalities manning the exhibits.

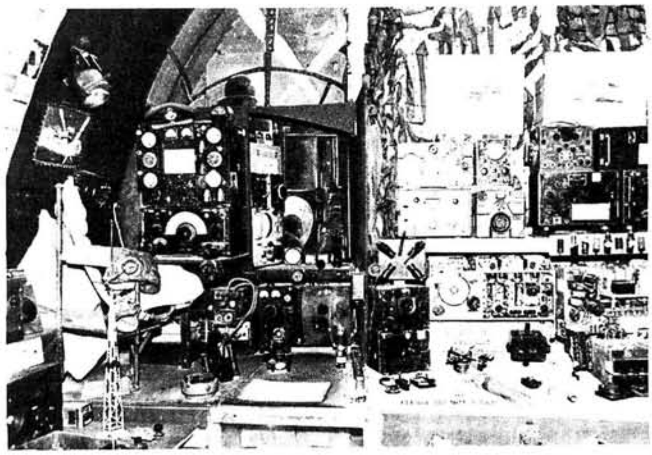
Our first stop was at an exhibit of microwave equipment belonging to "The Two Erns", Ernie Hoare G3RZD and Ernie Downer G8GKV, he's the chap leaning on the car in the photograph. Among the other exhibits in the White Cliff outside section were, Ralph Barrett who was demonstrating a selection of wartime radio equipment, including the famous No. 18 set, and an official Post Office interference van under the supervision of Bob Taylor. West Sussex RAYNET members, who recently assisted in the search for a little girl who was lost on the South Downs, ran a station whose aerials were kindly supplied by Robin Bellerby, an RSGB council member. Gerry Brownlow G3WMU, operated the h.f. station, and QSLs with many parts of the world were logged.

Part of the microwave equipment exhibit

An interesting display of Morse keys and ATC equipment was put on by about a dozen members of 2464 Squadron from Storrington, under the command of Flt/Lt John Keegan; they also ran the organiser's communications via the ATC's v.h.f. network.

Other exhibits were housed in two massive pantechnicons, kindly loaned by Gordon Luckings, the theatrical removers. Among the exhibits housed in the vehicles was a display of historical telephone equipment, compiled by Post Office engineers from the Smalldean exchange, a static display of modern repeater technology and demonstrations by the Sussex Repeater Group.

A trade display of the latest Swan (Astro) radio products was installed by David Willis, and Brighton and District Radio Society organised the v.h.f. station with an RTTY installation which was demonstrated by Alan Baker G4GNX, the society's president. Both the h.f. and v.h.f. stations operated under the special event callsign GB2CPM.



A view of some wartime equipment in the radio building

The museum's permanent radio building, run by Ron Ham and David Rudram, who was also in part responsible for the historical telephone exhibit, housed a magnificent collection of vintage telegraph and radio equipment, gramophones, components and accessories and a very popular collection of valuable wartime radio equipment, both German and British.

Finally, the Chichester Radio Club ran a bring-and-buy stall, and in the Museum shop Martin Shaw of Scan Computers demonstrated a PET mini-computer.

Chalk Pits Museum is situated in 36 acres of West Sussex countryside and has many other attractions to interest the whole family, including excavated lime burning kilns, steam engines, tool displays both agricultural and industrial, blacksmith's forge, brick drying shed, various railway exhibits, nature trail, collections of vintage household equipment and a reconstruction of the original owner's office. There is also a picnic area, free parking, good local pubs and tearooms.

The museum exhibits are restored and maintained by volunteers and it is the intention of the organisers that, where possible, the exhibits are displayed in a working situation. Development at the museum is continuous and new exhibits are being planned and worked on throughout the year.

I would like to offer our thanks, especially to Mrs Joan Ham, who made us very welcome and gave us a conducted tour around the museum, also to the many other people who were responsible for providing us with a most interesting and enjoyable day out. I, personally look forward to visiting Chalk Pits Museum again in 1981, when, following the success of the first Radio Communications Day, the museum organisers are planning two special radio days to be held in June and September. ●

NIMBUS

Modular 2m Transceiver System

16~Channel Scanner

(Part 10)

Michael TOOLEY BA G8CKT
&
David WHITFIELD MA MSc G8FTB

Complete constructional details were presented last month. In this concluding part the testing and alignment procedures are covered, together with user available modifications.

Initial Checks and Tests

The control logic is checked first and requires only a d.c. power supply and a multimeter for the purpose. Connect a 12 volt 1A variable power supply to SK3/SK4, with a meter in the positive line to measure the current consumption. Set the output voltage to minimum and switch on with S22. The voltage at the output of the +5 volt regulator should rise from 0 volts and stabilise at +5 volts as the supply voltage is raised to approximately +7 volts. The supply current should not exceed approximately 500mA at any time as the voltage at SK3/SK4 is raised to +12 volts; any significant departure from the values given should be investigated before proceeding any further. The off-board components and wiring should be examined first since the p.c.b.s have already been checked. In case of doubt, the current consumption of the logic boards may be remeasured and compared with the earlier values noting that a small amount of variation can be expected due to additional circuit loading, but no dramatic change.

The manual channel selection should now be checked. Set S22 to ON and S2 to MANUAL. The selected channel indicated by the l.e.d.s D2–D17, should correspond to the setting of the thumbwheel switch, S5. Using the push-buttons on the top and bottom of the switch, it should be possible to step backwards and forwards respectively, through all the 16 channels in turn. At all times, only one l.e.d. should be illuminated and it should correspond to the channel shown on the thumbwheel switch. The setting of the control switches other than S2/S5/S22 should have no effect on the channel selected. In the event of a discrepancy between the selected and displayed channel, a careful check should be made on the wiring between S5 and the channel selector p.c.b. and to the l.e.d.s.

The auto-channel selection logic is now checked by setting S2 to AUTO, S4 to SCAN, S3 to CONT, S1 to FAST, S22 to ON, and S6–S21 to ACTIVE. In this configuration, channels 0 to F should be selected cyclically at a rate of approximately two channels per second, indicated by the l.e.d.s. No change of selected channel may indicate that the switches S6–S21 have been installed upside down, and this should be checked first, before any other wiring is examined. Changing the setting of S1 to SLOW should reduce the rate of scanning to approximately one channel in two seconds.

With the scan operating correctly, the ACTIVE/IGNORE facility on each channel should be checked in turn, to ensure that each channel is skipped in the scan. It should then be possible to skip any number of channels in the scan; with all the switches set to IGNORE, the last ACTIVE channel should remain selected.

All ACTIVE/IGNORE switches should now be reset to ACTIVE to restore a full 16-channel scan. Changing S4 to HOLD should cause the scan to halt at the currently selected channel, but the scan should resume from this point when the SCAN position is re-selected.

Next S4 is set to HOLD and, by momentarily selecting the INC position, it should be possible to step to the following channel, irrespective of whether that channel is set to ACTIVE or IGNORE. Each subsequent switch movement to INC should cause the next sequential channel to be selected. In all cases, the next sequential channel from channel F is channel 0.

With the Autoscanner set up to scan, the channel change inhibit logic may be tested by applying +12V to SK1. Under these conditions the scan should halt until the potential is removed, when the scan should re-commence.

The signal strength meter and HOLD-ON-BUSY CHANNEL facilities are checked as follows: hold S23 set to the "REF" position and adjust R78 to give a half-scale indication, 2·5 on the signal strength meter. Set S23 to SIGNAL and check that D25 is not illuminated; if it is illuminated, check that the connections to the comparator (IC12) are wired correctly. Now connect a test signal to SK5 as shown in Fig. 22. As the potentiometer is varied over its range, the indication on the meter should vary from 0 to 5. When the reading is over 2·5, D25 should be illuminated. Below 2·5, D25 should be extinguished.

This completes the testing of the control logic. In the event of any problems, a careful check should always be made on the wiring associated with the area of the logic causing problems. If the Autoscanner cannot be changed from its switch-on state, suspicion must fall upon the timer i.c. in the first case, since none of the logic will operate correctly without the basic clock signals.

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

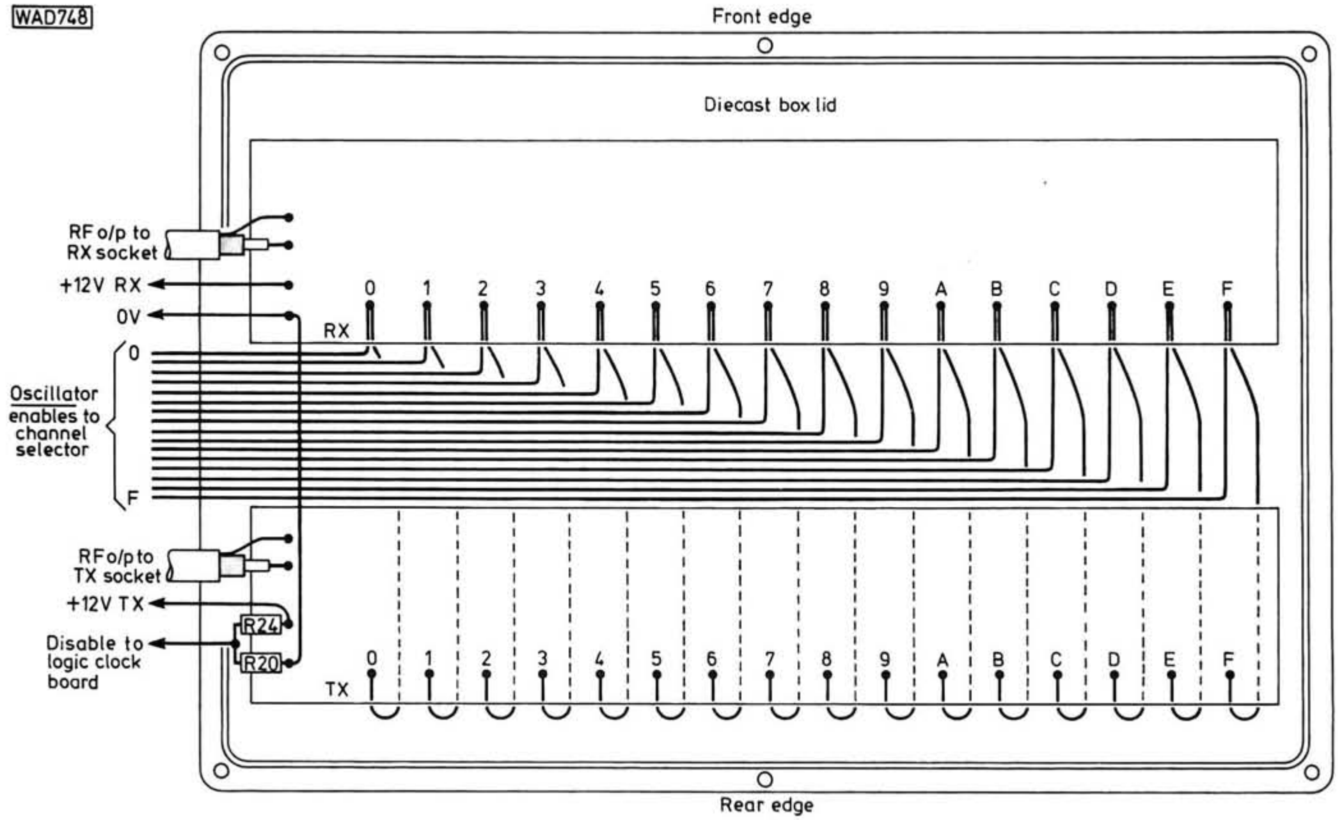
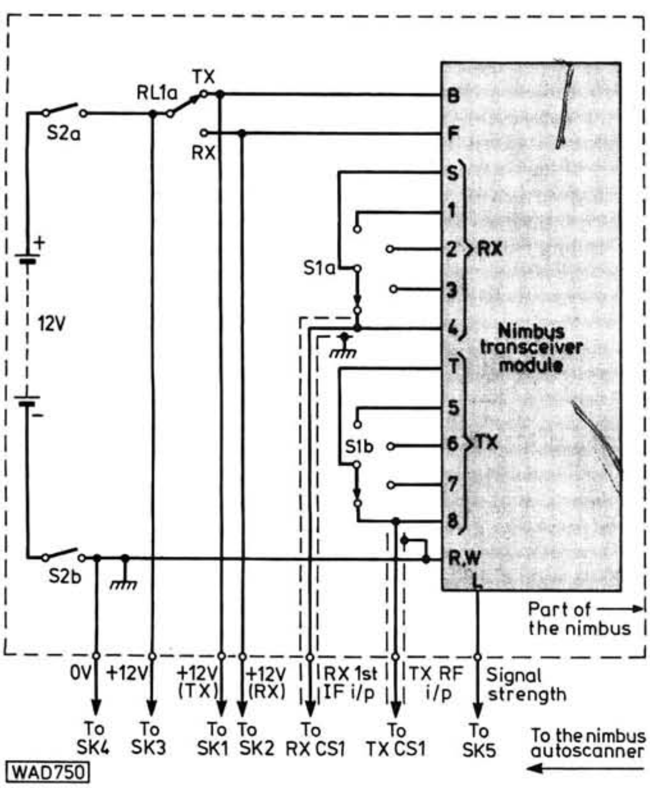


Fig. 19: Wiring layout for the two channel oscillator boards

Fig. 20: Connections to the Nimbus transceiver from the Autoscanner



The same test procedure is followed for the two oscillator banks, and each bank should be tested in turn. Power is applied to the control logic, via SK3 and SK4 and to the oscillator bank under test, via SK1 or SK2, as appropriate. The control logic is set to AUTO mode and HOLD sub-mode. Each channel should then be selected in turn using the INC sub-mode. As each channel is selected, the voltage on the collector of Trb, in the associated oscillator, should be measured. The expected value is approximately 8·8–8·9V (i.e., the Zener voltage minus $V_{ce(sat)}$ for Tra), and the non-selected oscillators should all have the collector of Trb at 0 volts.

Autoscanner Tx/Rx oscillator banks and control logic p.c.b.s

Full-size paper prints of these p.c.b.s are available from the Editorial Office at Poole. Price 45p including p&p to UK addresses.

Where suitable frequency measuring equipment is available, the oscillator for each channel may be adjusted, using Ce, to bring it onto the nominal channel frequency. Some types of transmitter crystals may require a small capacitor, typically 22pF, in parallel with Ca for adjustment.

Crystals

The crystals used in the *PW* Nimbus Autoscanner are the same as those used in the *PW* Nimbus transceiver. Most of the commonly available 18MHz transmit and 44MHz receive crystals intended for use in Japanese transceivers will operate quite satisfactorily in the Nimbus equipment. It is important to note that the crystals used in the transmitter are fundamental types (20pF or 30pF circuit loading), whilst those in the receiver are overtone types (series resonant). All crystals are HC25/U types.

All crystals are operated in the fundamental mode in the channel oscillators in the same configuration as used for the basic Nimbus transceiver. See November *PW* for details. Crystal frequencies are determined in the same manner as the following example calculations:

$$\text{Transmitter Crystal Frequency (MHz)} = \frac{\text{Signal Frequency (MHz)}}{8}$$

Example S20 = 145·500MHz

$$\text{Tx. Crystal Frequency} = \frac{145{\cdot}500\text{MHz}}{8} = 18{\cdot}1875\text{MHz}$$

$$\text{Receiver Crystal Frequency (MHz)} = \frac{\text{Signal Frequency (MHz)}-10{\cdot}7}{3}$$

Example S20 = 145·500 MHz

$$\text{Rx. Crystal Frequency} = \frac{145{\cdot}500-10{\cdot}7}{3} = 44{\cdot}9333\text{MHz}$$

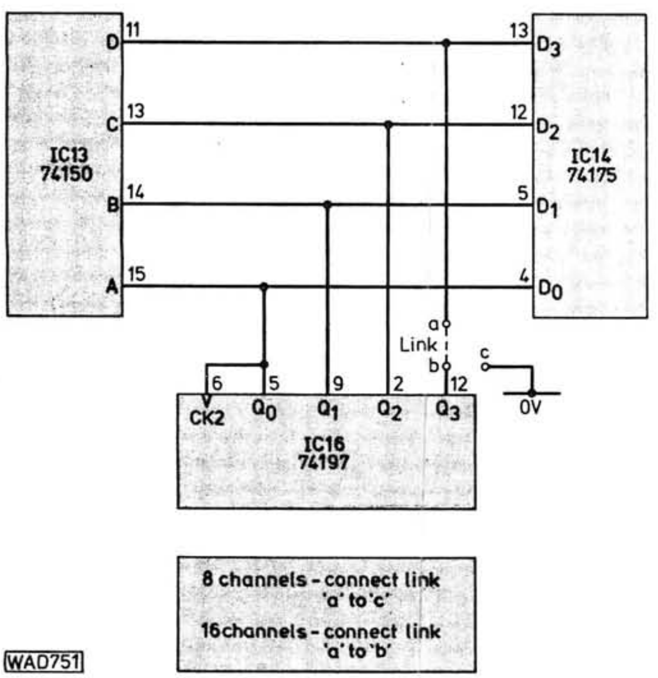


Fig. 21: Modifications to the channel selector logic to allow 8-channel operation. All other connections remain unchanged

Connection to the Nimbus

The link between the Autoscanner and the Nimbus transceiver consists of four power supply lines from SK1, 2, 3 and 4, the signal strength line from SK5, and two r.f. coaxial lines. Fig. 23 shows how these are interfaced to the Nimbus. The type and placement of the connectors fitted to the Nimbus is left to individual constructors.

In view of the relatively high current demand on the +12 volt line to the control logic, typically 500mA on SK3, users may wish to consider conserving the Nimbus battery supply by using an external supply connected directly to SK3. This would limit the increased battery drain to 30mA.

The coaxial links to the Rx and Tx oscillators are shown connected to the channel selector switch in position "4". This assumes that this position is unused, i.e., there is no crystal in either the transmitter or receiver crystal socket for this channel. In practice, any unused channel may be used or, alternatively, the Nimbus channel selector may be replaced by a 2p6w type, and the spare positions used for selecting the Autoscanner.

Modification for 8-Channel Operation

The 16 channels provided by the Autoscanner, in addition to the four already available on the Nimbus transceiver, should prove more than adequate for the requirements of most operators and/or their pockets. Indeed, in many cases this number may prove to be more than can be used, and a variation of the Autoscanner with only eight channels may be a useful alternative.

Figure 24 shows how the logic of the channel selector may be modified to cater for either eight channels (0 to 7) or 16 channels (0 to 9 and A to F). The addition of the link shown will require modification of the copper track layout such that IC13 pin 11 and IC14 pin 13 remain connected together, but no longer connect with IC16 pin 12. The changes involved are best made to the track area in the vicinity of IC16. Where only eight channels are required, the associated channel oscillators for channels 8, 9, A, B, C, D, E, F, the switches S14 to S21, and the l.e.d.s D10 to D17 may be omitted. If, for any reason, channels 8 to F are preferred to channels 0 to 7 in the 8-channel mode, this may be accomplished by replacing the wiring from pin "c" to ground by a 1kΩ resistor from pin "c" to +5 volts.

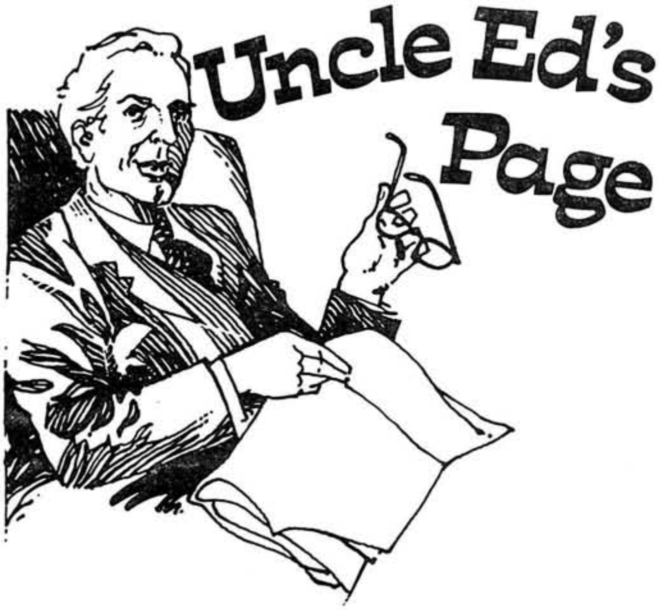
Expansion of the 8-channel unit to 16 channels is simply a matter of restoring the link to the "a-b" position and installing the necessary oscillators, switches and l.e.d.s.

Conclusion

The Autoscanner provides a whole range of extra facilities for the serious v.h.f. user, but one final feature deserves a mention in passing, and that is that it makes a superb "party piece". Set up without the Nimbus, and with only the control logic power applied, the scanning facilities have been known to keep newcomers, young and not-so-young alike, fascinated for hours at a time. ●

Correction

Point "a", S1 "FAST" in Fig. 4: Timing generator in Part 8, should connect to the junction of R1 and R2.



A monthly look at some aspect of the radio/electronics hobby that seems to bug the beginner, or occasionally a more advanced topic seen from an unusual angle.

SINGLE SIDEBAND (s.s.b.)

Look at any text-book dealing with modulation and you will be launched immediately into equations littered with trig functions. This is all very well for people who are mathematically minded, they can speak and understand the language, but not so for lesser mortals. I don't intend to get involved in much maths here, though hopefully when I've finished, the text-book explanations may mean a little more to you.

Before I can start on s.s.b., I shall need to explain one or two ideas which will be useful to you anyway, as you're interested in radio. The first idea is that there are two ways of looking at a radio signal. Most of you will probably have seen an oscilloscope displaying a sinewave (Fig. 1) or maybe even a modulated radio signal (Fig. 2). Both of these are showing a voltage varying with time, and are just electronic representations of graphs that might be drawn with paper and pencil, with voltage on what is called the "Y" axis (up and down the screen or graph), and time on the "X" axis (across the screen or graph). Time goes from left to right, so what is shown at the left-hand side happened before what happened at the right.

Such a display is said to be in the time domain, which is nothing to do with H. G. Wells or Doctor Who, but just a technical way of saying that you're looking at how a voltage varies with time.

If you have a special sort of oscilloscope display called a panoramic adaptor (rather expensive) or a spectrum analyser (terribly expensive) you can replace time on the "X" axis by frequency (Fig. 3). This is rather like tuning a radio receiver across a band and drawing a graph with a vertical line to indicate each station on the dial, with taller lines for stronger stations. The display is usually arranged so that frequency increases from left to right, and is said to be (you guessed it!) in the frequency domain.

The display of Fig. 3 is what you might see on a panoramic receiver tuned to a small portion of the medium-wave broadcast band early in the morning before programmes start. Stations (a) and (c) have just switched on their transmitters and are sending out their carrier waves only, but station (b) has added his tuning note—a constant audio tone. If you were to change the frequency sweep rate, you could expand station (b) to look at it more closely, as in Fig. 4, showing the carrier in the centre, and the two sidebands, one higher in frequency (called the upper sideband), and one lower in frequency (called the lower sideband). Strictly speaking, what are shown in Fig. 4 are side frequencies, rather than sidebands, because the station is sending out just a single tone, and not the band of frequencies which makes up speech or music. It's easier to start off by considering a single tone modulation, and I shall ignore the different name here to keep things simple.

What is shown in Figs. 2 and 4 could be time- and frequency-domain pictures of the same station, which is using double-sideband amplitude modulation (d.s.b. a.m.). Reception of such a signal can also be thought of in two ways.

In Fig. 2 we have a carrier-wave which is amplitude modulated by an audio tone, with the modulation envelope (or outline) corresponding to the shape of the tone. We can recover the shape of that envelope, using a circuit called (believe it or not) an envelope detector. See any text-book for a description of the classic diode detector circuit.

If, on the other hand, we look at Fig. 4, we can see that the signal is made up of energy at three frequencies: $f_c - f_m$, f_c, and $f_c + f_m$, where f_c means carrier frequency and f_m means modulation frequency. Thus for a station operating on a carrier frequency of 1000kHz (1MHz), with a tuning note of 1kHz, the sidebands would be on 999kHz and 1001kHz. If we receive this signal and feed it to a different type of detector, called a product detector, this will extract the difference between the carrier and the sidebands, which in each case is 1kHz, the original modulation signal frequency.

So, what I've described are not two different sets of circumstances, but two ways of looking at the same thing. The

continued on page 92 ▶▶▶

Fig 1

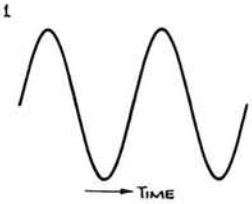


Fig 2

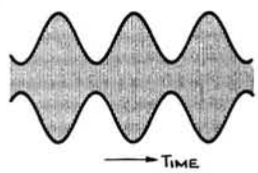


Fig 3

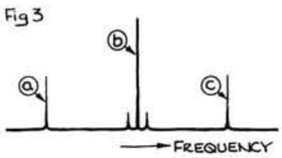


Fig 4

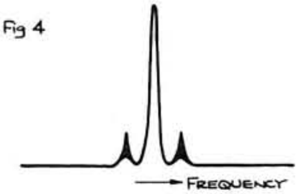
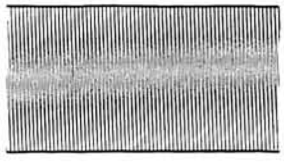


Fig 5



WRM341

AUDIO POWER AMPLIFIERS PART 2

M. J. DARBY

In the first part of this series, which is intended as an introduction to transformerless solid-state audio power amplifiers using bipolar transistors, we looked at the basic complementary-pair output stage and its biasing requirements.

Quasi-Complementary Circuit

Some years ago, high-power *pnp* silicon transistors were not readily available for the construction of a circuit such as that which is shown in Fig. 6, in which the two Darlington circuits are fully complementary. This resulted in the use of the so-called quasi-complementary type of output circuit shown in Fig. 9. It can be seen that both of the high power output transistors are *npn* types, but the driver transistors must be an *npn* and *pnp* complementary pair.

The quasi-complementary circuit can be used to provide high power outputs, but distortion is generally higher than that of the fully complementary circuit.

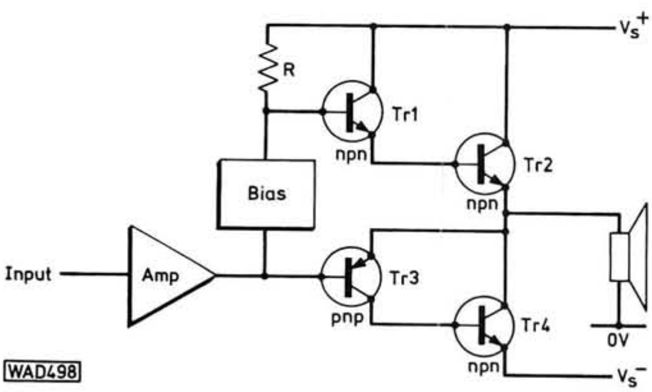


Fig. 9: The quasi-complementary output circuit

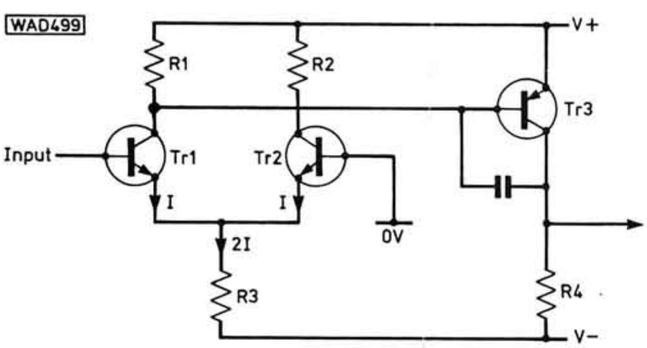


Fig. 10: The differential input stage arrangement

Although the quoted distortion of a quasi-complementary circuit may not seem excessively high (perhaps a few tenths of one per cent total harmonic distortion), some of these high-order odd harmonics are especially unpleasant to the ear. It has been suggested that the widespread use of quasi-complementary circuits a few years ago has resulted in the widely held belief that valve amplifiers produce a more pleasant sound than similar quality transistor amplifiers.

The main problem in quasi-complementary circuits is the difference in impedance at the base of Tr1 and the base of Tr3 in Fig. 9. We have already seen that a voltage of $2V_{BE}$ is required at the base of Tr1 with respect to the emitter of Tr2 to enable this Darlington pair to conduct. However, a voltage of only $-V_{BE}$ is required at the base of Tr3 relative to the collector of Tr4 to cause these transistors to conduct, since there is only one base-emitter junction between the base of Tr3 and the output.

It is this difference in impedance which causes the distortion of the quasi-complementary circuit. It cannot be eliminated by merely introducing an extra resistance, since the curvatures of the current/voltage characteristics of the Tr1 and Tr3 circuits are quite different. A diode introduced into the emitter circuit of Tr3 is said to produce some improvement, as this adds an extra *pn* junction. The distortion of a quasi-complementary circuit is most noticeable at low signal amplitudes; it can be reduced by negative feedback, but the amount of feedback one can use is limited by stability problems. Quasi-complementary circuits do not seem to be able to provide the very low distortion produced by the fully complementary circuits.

The Input Amplifier

The circuit of Fig. 6 shows an input amplifier followed by twin complementary Darlington pairs, but the negative feedback circuit has been omitted for simplicity. The Darlington pairs provide a high current gain, but not voltage gain; they are essentially emitter followers.

The input amplifier need not therefore provide more than about 10mA of output current in a typical circuit, but it must provide a fairly high voltage gain. The voltage gain of the whole amplifier is determined by the values of the components in the feedback network, but the voltage gain of the input amplifier should be much greater than the gain of the complete amplifier with feedback.

A differential input stage (or "long-tailed pair") is required in the input amplifier for the same reasons as in a conventional operational amplifier. A basic circuit employing a differential stage, Tr1, and Tr2, is shown in Fig. 10. This type of stage has the advantage over a single transistor stage that any change in the temperature of both transistors will not affect the output voltage.

The resistor R3 causes the total current in this part of the circuit to be almost equally divided between Tr1 and

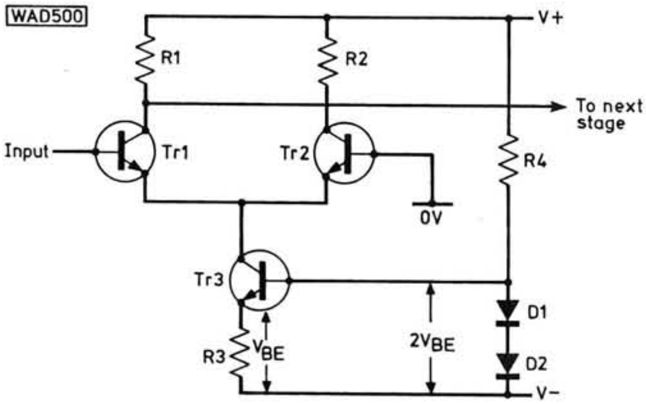


Fig. 11: A differential input stage with constant-current source for improved performance

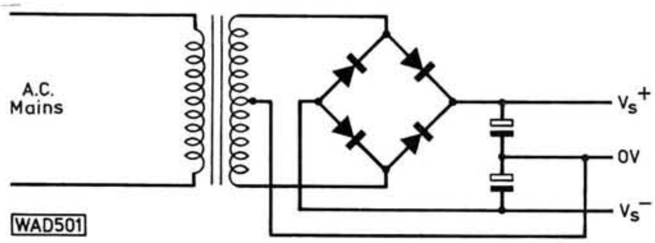


Fig. 12: A basic, unregulated, balanced power supply

Tr2. If the same signal is applied in the common mode to the bases of both of these transistors, little change in the output potential will occur, but a signal applied to only one base will produce a change of output.

An additional transistor Tr3 is shown in Fig. 10. The value of R1 should be chosen so that the voltage drop across this resistor will cause a moderately small collector current to pass in Tr3. Thus the voltage across R1 should be about 0·6V. In a practical amplifier circuit, the base of Tr2 is often not connected to ground, since it is convenient to return the negative feedback to this base.

An improved version of this circuit is shown in Fig. 11 in which Tr3, R3, D1, D2 and R4 form a constant current source which replaces the resistor R3 of Fig. 10. A small current flows through the resistor R4 (which has a fairly high value) and through the two diodes. The junction of R4 and D1 is therefore at a potential of $2V_{BE}$. There is a voltage drop of V_{BE} across the base-emitter junction of Tr3 and therefore the voltage across R3 is also V_{BE}. The current flowing through R3 and through Tr3 is thus $V_{BE}/R3$ and this current is equally divided between Tr1 and Tr2 when the input voltage is zero. This current remains almost constant as the supply voltage varies.

A further improvement in the thermal stability can be obtained by using a dual transistor for Tr1 and Tr2, so that both devices are always at the same temperature, or even an ultra-matched dual transistor with low temperature drift of the offset voltage. The use of such devices can greatly assist with the problem of keeping the output voltage of the amplifier mid-way between the two power supply line voltages.

Power Supplies

The power supply unit is a most important part of a high power amplifier and can greatly affect performance. Amplifiers designed to provide relatively moderate output power levels (typically up to about 30W mean) may use a conventional full-wave rectified power supply providing an unbalanced or asymmetrical output with the negative line grounded. They may employ either a transformer with a centre-tapped secondary and two rectifier diodes or an untapped winding with a diode bridge.

Amplifiers for power levels up to about 125W may use the circuit of Fig. 12 to provide a balanced or symmetrical supply with the advantages already discussed. A centre-tapped transformer winding is required in this circuit with a normal diode-bridge module or four discrete diodes; it may be considered as a pair of full-wave rectifiers providing outputs of opposite polarity.

In amplifiers designed to provide mean output levels of 200W or more, symmetrical stabilised supplies are almost always employed. A casual glance at Table 1 (in Part 1) may indicate that it would be easy to obtain an output of a few hundred watts; however, if the simple unstabilised supply of Fig. 12 is employed, the supply line voltage falls considerably when the high current is taken from the supply lines by the amplifier. If one has supply lines of ±45V under no-load conditions, this voltage may well fall to ±35V or less when a high current is drawn by the amplifier, with the result that the maximum power output is almost halved (for example, about 112W into a 4 ohm load instead of about 200W with ±45V supplies). Circuit design problems (such as transistor voltage ratings) normally make it very difficult to solve this problem merely by increasing the supply line voltages and a stabilised supply is required.

This is one of the main reasons why the cost of amplifiers increases rapidly as one passes through the 100W level up to 200W or more.

Complete Amplifier

The circuit of a typical complete amplifier is shown in block form in Fig. 13. It is essentially an operational amplifier which can supply a high current from its output and therefore appreciable power. The voltage gain at audio frequencies is equal to (R1 + R2)/R2 or approximately R1/R2 when R1 is much larger than R2.

The capacitor C1 in series with R2 prevents appreciable current at zero frequency from flowing through R2. Thus at zero frequency the impedance of (R2 + C1) is large and the overall amplifier gain is unity. Any input offset voltage is thus amplified only by unity and the output offset (output voltage at zero input voltage) is little different from the input offset voltage. If C1 is omitted and the lower end of R1 is directly connected to 0V (ground), any input offset is

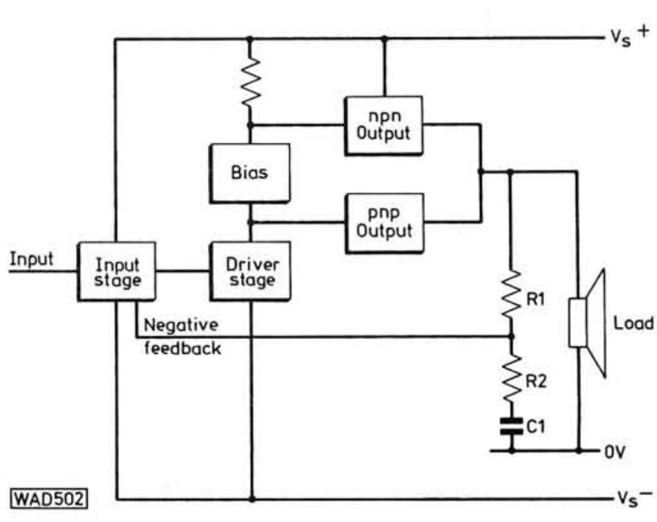


Fig. 13: Block diagram of a typical amplifier having a complementary output stage

multiplied by the full gain of the amplifier circuit and the output offset can be quite large.

Many variations of the basic circuit of Fig. 13 are possible and a few typical circuits will be discussed. The circuitry required for protecting the amplifier varies widely from one design to another, but a typical example will be given. Protection circuits for preventing damage when the output connections are shorted together range from fuses to the more rapidly-acting electronic circuits used in high-power circuits.

The circuits of Fig. 6 and Fig. 8 show Darlington circuits consisting of discrete transistors. However, it is normally preferable to use power Darlington devices which have the internal structures shown in Fig. 14. Apart from the Darlington transistors themselves, these integrated circuits contain the base-emitter resistors R1 and R2 which stabilise the operating current and the protective diode D1 which will short-out any pulses of incorrect polarity.

For simplicity these power Darlington devices will be shown in the circuits as single transistors. They have a high current gain, typically over 1000 at collector currents of some amps. In addition, they have a higher saturation voltage than single transistors.

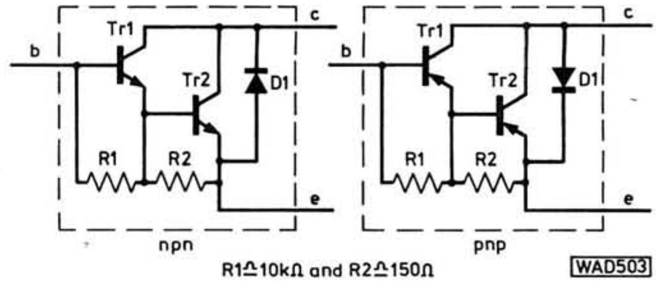


Fig. 14: Internal structures of *npn* and *pnp* power Darlington devices

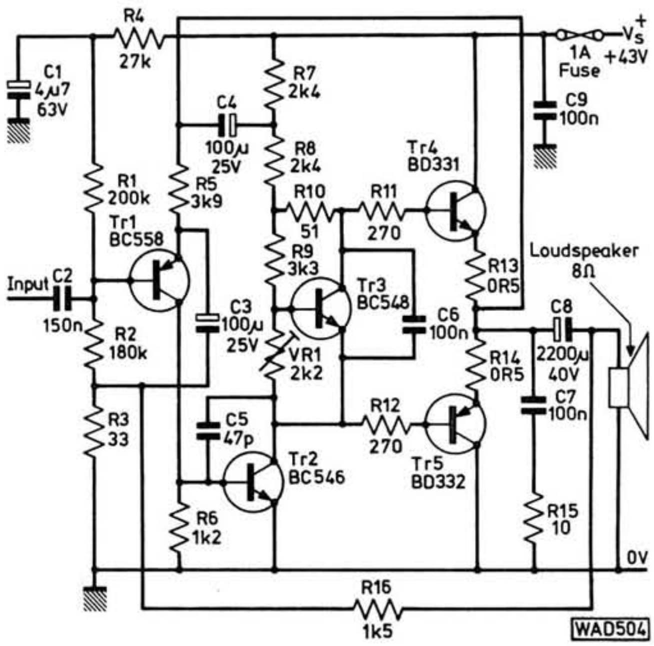


Fig. 15: A complete 20 watt amplifier circuit

20W Circuit

A circuit designed by the Mullard-Philips Company which will provide an output of 20W into an 8 ohm load using an asymmetrical 43V power supply is shown in Fig. 15. The circuit employs a single transistor input stage, Tr1 followed by the class A driver stage Tr2 and the V_{BE} multiplier bias circuit of Tr3. A pair of complementary power Darlington devices is used in the output circuit, each of the output devices being mounted on separate 6·4°C/W heatsinks which each consist of a 2mm thick aluminium sheet of $60cm^2$ area used vertically. The V_{BE} multiplier transistor Tr3 is mounted on the same heatsink as Tr4. The negative feedback loop from the output through R16 is returned to the base circuit of Tr1.

The collector current of Tr1 is nominally 0·5mA, a single transistor being adequate in this circuit, since any output offset voltage will be unable to drive a steady current through the output capacitor C8 into the loudspeaker. The transistor Tr2 operates at a current of about 4mA, whilst VR1 should be adjusted to produce a quiescent current of 20mA in the output devices. This current rises to about 710mA at the full nominal output power. The capacitor C5 prevents any tendency towards instability in the Tr2 circuit. The output emitter resistors R13 and R14 are required for thermal stability, whilst C7 and R15 form a Zobel network which prevents possible instability by presenting a load which is more nearly a pure resistance at high frequencies; in other words it compensates for the load inductance.

The input voltage for 20W output is about 375mV, whilst the input impedance is 180kΩ. Similar circuits have been designed for maximum mean output power levels at 10W and 15W.

Low Distortion Circuit

The circuit of a very versatile, low-distortion audio amplifier is shown in Fig. 16. It may be used with a supply of about ±22V to deliver over 30W into a 4 ohm load, with a supply of about ±28V to deliver a similar power level into an 8 ohm load, or with ±37V and a 16 ohm load. The distortion is especially low, about 0·015 per cent, but rises at frequencies above 10kHz.

The input coupling circuit shown dotted is required only if the input signal is not centred about the ground potential. The input signal is fed to a dual transistor differential stage for minimum offset voltage across the loudspeaker. The current passing through Tr1 is determined by the constant current source of Tr2, D1, D2 and R6 at about $V_{BE}/R4 = 0{\cdot}6/330$ or about 2mA. Thus about 1mA flows through R1 and a similar current through R2.

A similar constant current source is formed using Tr5, but the current through this transistor is set at about 4mA, since R10 is about half the value of R4. This sets the current passing through the Tr3 driver stage and through the multiplier stage of Tr4. The *pnp* driver stage of Tr3 requires a fairly high voltage device, the high frequency response being controlled by C3 for stability. The V_{BE} multiplier involves the diode D3 as well as the transistor Tr4. The potentiometer VR1 should be adjusted so that the quiescent current in the output Darlingtons is about 15–20mA.

The plastic encapsulated Darlington transistors Tr6 and Tr7 must be bolted to adequate heatsinks; the heatsink tab of Tr6 is at the potential of the positive supply line and that of Tr7 at the negative supply line potential, so a common heatsink cannot be used unless the devices are insulated from it. The more economical TIP140 and TIP145 complementary Darlingtons can be used for supply voltages not exceeding ±30V.

continued on page 49 ▶▶▶

MODS

IMPORTANT—The ideas presented here are suggestions only, and as they are untried by this magazine, we cannot accept responsibility for any resultant damage, however caused. Before alterations are attempted, care should be taken to ensure that any guarantee is not invalidated, and it should also be borne in mind that modifications usually have an adverse effect on resale prices. In cases where specialist skills or equipment are needed, most dealers will undertake the work for a reasonable fee.

Roger Hall G8TNT (Sam)

No. 4

To start this month's column on mods (modifications), I would like to pass on a tip from Cambridge Kits of Milton in Cambridge who have written in to say that anyone who has one of their Low Frequency Converters can modify the Antenna Tuning Unit to give extended coverage down to 15kHz by simply switching in a 33mH inductor in series with L3 for operation on 15–100kHz. Many thanks to Mr M. Mann, the Engineering Manager of Cambridge Kits, for the idea.

G4JSW, Harry of Great Bookham in Surrey, has a Trio TS-520 and he has found that when he uses it for long periods of listening the fan is unnecessary and although there is a switch to turn off the heaters, there isn't one for the fan. To overcome this, Harry has fitted a switch to the rear panel of his set, directly behind the front-panel phone socket, and wired it up as in Fig. 1, which shows the physical layout in the transmitter. The wiring of the switch as it relates to the circuit diagram in the manual is shown in Fig. 2.

To wire up the switch, the blue/white and blue wires should be cut at the points marked "x" and two new wires (shown by the dotted lines) connected as in Fig. 1.

With the switch in the OFF position it interrupts the 100V line from the main transformer to the fan, and the 12·6V line from the front-panel heater switch to the valve heaters. It is then possible to use the set as a receiver only, with the valve heaters and the fan turned off.

For transceive operation, both the rear-panel fan switch and the front-panel heater switch must be turned on before the transmitter can be used. It is not possible to turn on the heaters without turning on the fan, most useful for anyone as absent-minded as I am.

Harry has also told me about the Users International Radio Club that is organised by Robert A. Poherence, N8RT. The club publishes two newsletters, one for owners of Icom equipment and one for owners of Trio equipment, and they are both full of mods.

As Rob has given me permission to reprint tips from his newsletters, I would like to pass on this information which was originally supplied by Alan K. Lefcort WB3GPR/6, who wrote in to the newsletter to point out that some of the microphones sold by Tandy as replacement mikes for portable cassette tape-recorders are plug-to-plug compatible with the Trio TR-2400. The sub-miniature (2·5mm) plug normally used for the ON/OFF control of the cassette recorder will control the push-to-talk on the TR-2400, and the miniature (3·5mm) phone plug will provide the audio connection.

Alan goes on to say that the audio quality, though slightly lower than that of the built-in microphone, is still excellent with the Tandy microphone catalogue number 33-1034. Some other Tandy microphones such as 33-1031, 33-1039, 33-1040, and 33-1054 are also compatible, and are not too expensive.

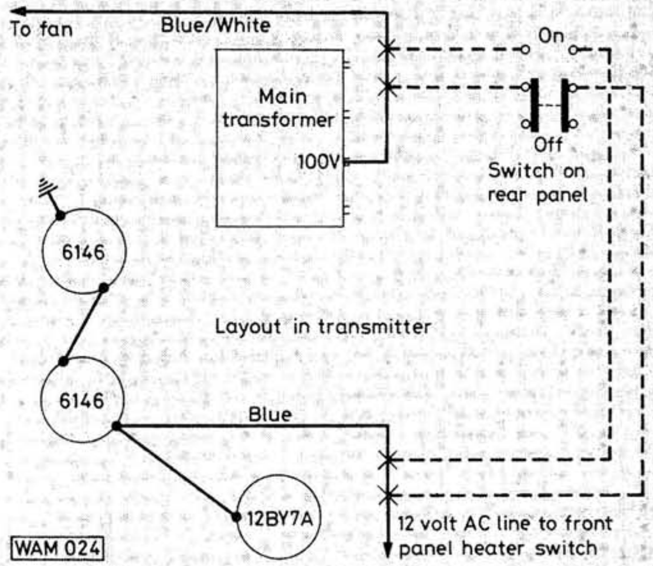
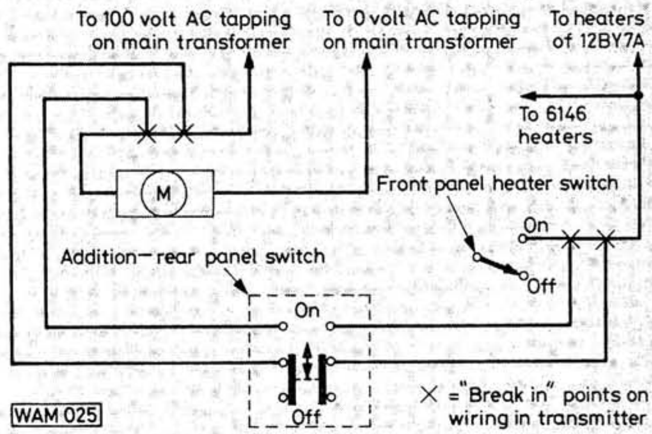


Fig. 1: ▲

Fig. 2: ▼



Wanted

I have received two requests for this month's "wanted" column, both for the Standard C-7800 70cm transceiver.

Is there anyone who knows a simple way of retaining the memories in this rig when it has been disconnected from the power supply? A small internal NiCad would probably be the answer, but as yet I have not found anyone who knows how to install it.

The other mod that has been requested for the C-7800 is for reverse repeater. Because of the construction of this rig, this mod will probably involve an extra crystal and a relay, and if anyone has carried out this mod I would appreciate hearing from them.

Can you help with either of the above mods? If you can, or if you have any other mods, hints or tips that you would like to see published, please write to: R. S. Hall, Practical Wireless, King's Reach Tower (Hatfield House), Stamford Street, London SE1 9LS.

73's
Sam G8TNT

PRODUCTION LINES

ALAN MARTIN G8ZPW

The Icom IC-451

Take Your Pick for 70cm

Over the past few weeks I have received, from four separate manufacturers, literature describing new equipment for use on the 70cm u.h.f. band, which makes me wonder if we are about to see an upsurge of activity on these under-used frequencies.

The **Yaesu** FT-404R is a 70cm f.m. hand-held transceiver, crystal controlled with six channel capability.

Other features include: 2·5W r.f. output (switchable); sensitivity 0·35µV for 20dB quieting; audio output 400mW at 10% t.h.d.; current consumption, receive 160mA (7mA squelched), transmit 900mA (high) 400mA (low). The unit is housed in an identical case to the FT-202R, its 2m predecessor and is supplied with helical antenna, NiCad battery pack; carrying case, costs in the region of £180 and is obtainable from: *Amateur Electronics UK, 508-516 Alum Rock Road, Birmingham 8. Tel: 021-327 1497/6313.*

Trio's TR-8400 70cm f.m. transceiver is extremely compact measuring only 147·5 × 51·5 × 193mm deep and is fully synthesised.

This full-featured rig covers 430–440MHz in 25kHz steps and includes five memories, memory scan, automatic band scan, manual Up /Down scan and two independent v.f.o.s.

Other features include: switchable r.f. power, 10W high, 1W low; multi-coloured, eight-segment S/RF l.e.d. bar meter and tone-burst switch. The receiver sensitivity is less than 0·4µV for 12dB SINAD and audio output is better than 2W (at 10% distortion into 8Ω load).

The VAT inclusive price of the TR-8400 is £279 plus £4.50 carriage and is obtainable from: *Lowe Electronics Ltd., Chesterfield Road, Matlock, Derbys. DE4 5LE. Tel: (0629) 2917/2430.*

Standard introduce a very versatile rig in their C-78 portable/mobile 70cm f.m. transceiver. Main features include: five memories; automatic scan of all the synthesised channels; manual Up/Down scan via the microphone; automatic calling channel selection; memory scan; busy/free/vacant scan switch; three-position simplex/repeater switch; battery save facility; MHz shift button and r.f. power output of 1W for portable operation.

An interesting feature of the complete mobile installation is the interconnecting mounting bracket, which provides direct plug-in power and signal connections. This facility also applies when the CP878 10W linear amplifier is employed. Altogether the three components provide a highly compact, easy-fit installation.

Individual, VAT inclusive prices are, C-78 u.h.f. transceiver £209.50, CP878 10W linear amplifier £65.00, mounting bracket £17.75 and carrying case £6.95. However, the complete installation can be obtained at a fully inclusive, special offer price of £289.00 from: *Lee Electronics Ltd., 400 Edgware Road, London W2. Tel: 01-723 5521.*

▲ The Standard C-78 and CP878

▼ The Trio TR-8400

Icom also announce the introduction of their IC-451, a 70cm multi-mode version of their respected IC-251 2m base station.

Manufactured to Icom's usual high standards, the IC-451 includes the following features: frequency coverage 430–440MHz; three memory channels, any inband frequency programmable; 7-digit luminescent display, 100Hz resolution frequency readout with power supply requirement of nominal 13·8V d.c. (4A max. on transmit) or 240V a.c. mains.

Transmitter output power is continuously variable over the range 1–10W in all modes and operating modes are s.s.b. (u.s.b./l.s.b.), c.w. and f.m. The receiving system for s.s.b. and c.w. consists of a double conversion superhet and for f.m. a triple conversion superhet system, sensitivity on s.s.b. and c.w. is less than 0·5µV for 10dB S+N/N and on f.m. less than 0·6µV for 20dB noise quieting, audio output power is more than 2W into 8Ω.

The IC-451 base station costs £579.00 which includes VAT and is available from: *Thanet Electronics Ltd., 143 Reculver Road, Beltinge, Herne Bay, Kent CT6 6PL. Tel: (02273) 63859.*

Bits and Pieces

The experienced constructor will know how useful his box of bits can be when getting the parts together for his latest experiment or project. Home Radio, to assist the beginner, have produced an instant box of bits which they call the Beginners Constructional Hamper.

The contents of the hamper include a capacitor pack, resistor pack, tuning capacitors, lamps and holders, coils, plugs and sockets, switches, l.e.d.s, loudspeaker, potentiometers, Veroboard, aluminium chassis kit and many other assorted items.

Home Radio estimate the retail value of the hamper to be £35.00, but offer it to *Practical Wireless* readers at £15.00, which includes VAT and p&p. The Beginners Constructional Hamper is obtainable from: *Home Radio (Components) Ltd., P.O. Box 92, 215 London Road, Mitcham, Surrey. Tel: 01-543 5659.*

MAIL ORDER

Photo Acoustics Ltd

MICRO COMMUNICATIONS DIVISION

BUDGET ACCOUNT

TR7800 £268

R1000 £285

TR9000 £345

TRIO

TS-180S 160-10m 200W transceiver **£679.65**
TS-130S 80-10m mobile 200W transceiver **£491.00**
TS-130V 80-10m mobile 20W transceiver **£404.00**
TS-830S 160-10m transceiver (includes new bands, various I.F. options, digital display, 2 × 6146 PA, plus many other features) **£639.52**
TS 770E 2m/70cm mullimode base station **£763.60**
TR 2300 2m handheld (80 channels) **£166.75**
TR 2400 2m synthesized handheld **£198.00**

Receivers
R 820 Simply the best amateur receiver **£690.00**
SRX 30 SSB/AM/CW 0-5-30Mhz **£158.00**
SR 9 144-146 or 156-162Mhz tuneable or xtal **£46.00**
AMR 217B Marine or amateur band 8 channel scanner – xtal **£120.75**
SL 1600 2m 16 channel scanner **£39.50**
FRG 7700 The latest from Yaesu **£389.00**
R 517 Air band portable-tuneable & xtal **£49.45**
SX 200 26-514Mhz scanner, AM and FM **£235.00**

ICOM

IC 2E 2m handheld-synthesized **£159.00**
IC 240 2m 10W mobile **£169.00**
IC 255E 2m 25W scanning mobile **£255.00**
IC 260E 2m Multimode mobile **£339.00**
IC 251E 2m Multimode base station **£479.00**
IC 215E Supplied with S20, 22, R0-9 **£149.00**
IC 402 70cm s.s.b. portable **£242.00**
IC 202s 2m s.s.b. portable **£169.00**
IC 720 0-1-30Mhz 100W transceiver, all bands, SSB/CW/Rtty/AM **£795.00**
IC 451E Latest 70cm multimode base station **£579.00**

All Icom accessories available
Aerials – J. Beams – Revco – Hokushin – G. Whip.
Power supplies – microphones – plugs – sockets – dummy loads – lightening arresters etc all available.

ACCESSORIES

RM 940 Infra Red remote mike **£45.00**
CN 1001A Automatic ATU and SWR **£129.45**
CN 620 Cross pointer SWR 1-8-150Mhz **£52.81**
CN 630 Cross pointer SWR 140-450Mhz **£71.00**
CN 650 Cross pointer SWR 1-2-2-5Ghz **£95.00**
T 3170L 3-5-150Mhz SWR **£12.94**
RW 151D Watt meter 0-150W, 0-500Mhz **£69.00**

Rotators
NS 200 VHF – UHF Beams **£29.50**
AR 40 For mini Beams **£59.80**
DR 7500X For 3 element HF Beams Preset controller **£98.04**
DR 7600X Up to 2 element 40m Beams Preset controller **£135.00**
Many other models available + 5 core-6 core cable UR43 – UR 67 – twin feeder.
Full range of MICROWAVE MODULES and S.E.M. products available.

COMPUTERS

New **CBM 8032** 80 column + 24k Rom **£1029.25**
New **CBM 8050** dual drive **£1029.25**
CBM 2001-8 8k, including cassette **£435.88**
CBM 3008 8k, Qwerty keyboard **£457.70**
CBM 3016 16k, Green screen **£569.25**
CBM 3032 32k, Green screen **£718.75**
CBM 3022 80 Column dot matrix printer **£440.45**
CBM 3040 Dual drive mini floppy **£718.75**
CZN Cassette deck **£56.98**
KIM 1 The ideal teaching aid **£106.95**
KIM 3B Ram Board **£110.40**
KIM 4S Mother Board **£74.75**
All P.E.T. leads and accessories and manuals available + full range of NASCOM and APPLE products.
VIDEO GENIE-EG 3003 Tandy level 2 compatable, with 16k Ram, integral cassette, boxed and ready to go, only **£333.00.**
Full range of consumables (disks, cassettes, labels, ribbons etc) available + Petsoft – Commodore – BSF – Monitor and everything from Space Invaders to a complete Business System. Also a large range of books in stock.

Please phone for quotation on any items not listed.
ALL PRICES INCLUDE VAT

PART EXCHANGE
Let us sell your rig for you – no commission charged if you purchase new rig from us.
Monday-Saturday 9.30am-5.30pm.

AUTHORISED ICOM DEALER

58 HIGH STREET, NEWPORT PAGNELL, BUCKS. ● TEL. 0908 610625

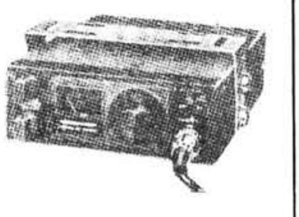
TRIO

GEMINI COMMUNICATIONS

YOUR SOMMERKAMP IMPORTER

1 Railway Road,
Blackburn, Lancs. Telephone: 51842.
(Telephone Evenings: Bolton 592929 G4GHE)

SOMMERKAMP TS280 FM
80 channels, 2 metre FM
Mobile Transceiver



Rapid channel change with illuminated read-out, 25KHz steps. Complete with mobile mount and microphone (which also incorporates a volume control). Two versions available – 50W output, switchable down to 2 watts at **£199,** and 10W output switchable down to 1 watt at **£159.** Can be used as base station with a Sommerkamp Power Supply.

SOMMERKAMP TS802
80 channel, 2 metre FM Hand-held Transceiver.

Fully synthesized, switchable reverse scan, digital readout, repeater shift, tone burst. 2 watts output switchable down to 0.2 watts. Price includes leather carry case, flexible aerial and a free battery charger – a bargain at **£129.** Set of Nicads **£10.** £2 post, packing and insurance.

SOMMERKAMP

FRG7 Receiver **£188**
FRG7700 Receiver, inc. 12 memories **£379**
FT277ZD HF Transceiver 160-10 metre ....
FT767 HF Mobile Transceiver 80-10 metre ....
FT480 2 metre Mobile Transceiver **£359**
FT227RAE 2 metre Mobile Transceiver **£255**
FT307CBM HF Transceiver 160-10 metre ....
FT902DM HF Transceiver 160-10 metre ....

We also stock genuine Sommerkamp accessories:
Power supplies, SWR bridges, power output meters etc.

SEND FOR DETAILS – LATEST PRICES
All prices include VAT. Barclaycard, Access, Part Exchanges etc.

NEOSID SMALL ORDERS
PO BOX 86
WELWYN GARDEN CITY
HERTS AL7 1AS

NEOSID

Come to the manufacturer for

INDUCTORS:–R.F. choke parts
inductor assemblies
suppression beads
ferrite toroids, rods, E cores

"HELFORD" COIL COMPONENTS – REF PW 30
Coil components, balun cores and beads as used in the current PW project.
PRICE £3.95 inc. p&p
New!!

The following PW kits are also still available:

"NIMBUS" COIL COMPONENTS – REF PW 10
Formers, cans, bases and beads plus winding wire and trimming tool.
PRICE **£6.65** inc. p&p

GENERAL INDUCTOR KIT – REF PW 20
Wide range of inductor parts for coils from LF to VHF, rods, choke cores, coil assemblies etc. and tech. data.
PRICE **£6.10** inc. p&p

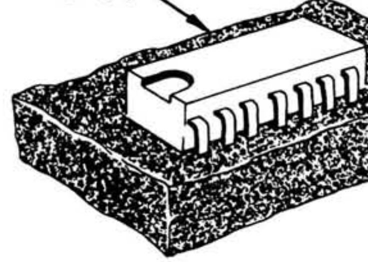
TRIMMING TOOL KIT – REF 650
Adjusters for I.F. coils & convergence coils including hexagonal types.
PRICE **£1.25** inc. p&p

Catalogue of standard parts available by return – send S.A.E.

Please supply .... PW30 KIT(S) AT **£3.95** inc. P&P
.... PW10 KIT(S) AT **£6.65** inc. P&P
.... PW20 KIT(S) AT **£6.10** inc. P&P
.... REF. 650 KIT(S) AT **£1.25** inc. P&P
I enclose PO/CHEQUE NO.......... FOR £..........
NAME ....
ADDRESS ....
....

NEOSID SMALL ORDERS **Brownfields, Welwyn Garden City, Herts AL7 1AS**

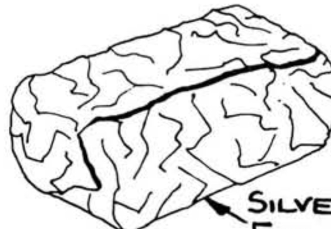
CONSTRUCTOR'S SKETCHBOOK



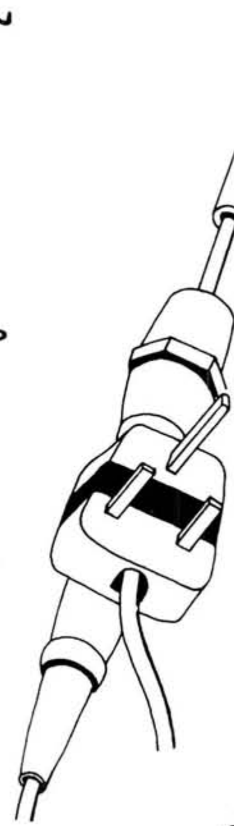
C.M.O.S. DEVICES.

STATIC ELECTRICITY KILLS C.M.O.S. DEVICES. WHEN YOU RECEIVE YOUR C.M.O.S. DEVICES THEY SHOULD BE PACKAGED IN SUCH A MANNER AS TO ENSURE THAT ALL PINS ARE SHORTED TOGETHER NEVER REMOVE THE DEVICES FROM THIS PACKAGING UNTIL YOU ARE READY TO INSERT THEM INTO THE CIRCUIT. RESIST THE TEMPTATION TO INSPECT THEM.

WHEN INSERTING C.M.O.S DEVICES INTO A CIRCUIT DO NOT TOUCH THE PINS.

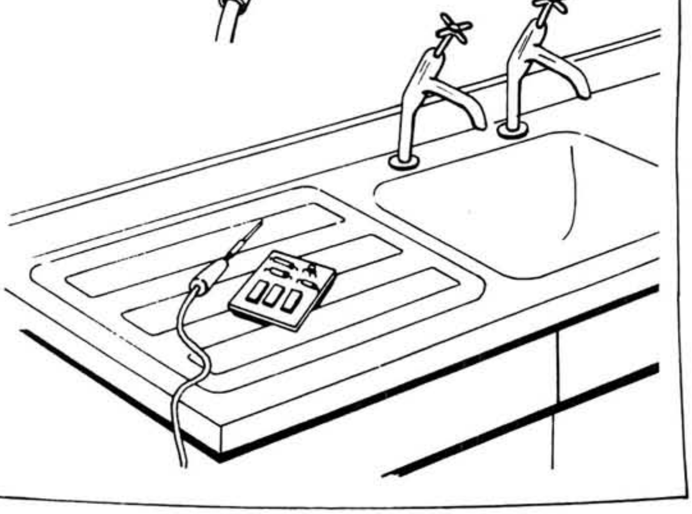


IF YOU CANNOT USE A SOCKET FOR THE i.c. AND HAVE TO SOLDER IT TO THE CIRCUIT BOARD YOU MUST ENSURE THAT THE SOLDERING IRON BIT IS PROPERLY EARTHED. EVEN BETTER - UNPLUG THE MAINS LEAD BEFORE USING THE IRON. A GOOD IDEA IS TO FASTEN THE MAINS PLUG TO THE IRON HANDLE AND SHORTEN THE MAINS LEAD TO SUIT. THE IRON IS PLUGGED INTO A MAINS SOCKET BUT MUST BE REMOVED TO BE USED.



ANOTHER USEFUL TIP IS TO WORK ON A STAINLESS STEEL DRAINING BOARD WHICH ACTS AS A GOOD EARTH. KEEP ONE HAND IN CONTACT WITH THE SINK TOP AT ALL TIMES, OR AT LEAST TOUCH IT FREQUENTLY. AVOID NYLON CLOTHES AND CARPETS, AND SHOES WITH SOLES OF 'MAN-MADE' MATERIALS - ALL CAN GENERATE STATIC ELECTRICITY.

WKM 124



PW HELFORD

Part 5

HF SSB TRANSCEIVER

Vic Goom G4AMW

The output specified for the *PW* Helford is 100W p.e.p. and this is achieved with a solid-state p.a. based on an application note by TRW Semiconductors.

The advantages claimed for this design are high efficiency, wide instantaneous bandwidth and small size. To achieve these TRW have designed a family of transistors able to tolerate a wide range of operating temperatures, bias conditions, load v.s.w.r. and overdrive conditions with the minimum of control circuitry.

The p.a. used in the *PW* Helford is remarkably small for its rated r.f. output, a feature that allows the *PW* Helford to be built into a reasonable size of case.

Circuit

The circuit of the amplifier is shown in Fig. 20. Two pairs of PT 9797 transistors are operated in push-pull and then combined in 0° hybrid transformers T501 and T508 to convert the nominal 50Ω source and load impedances to two 100Ω ports which are in phase. Any amplitude or phase unbalance causes power to be dumped into resistors R506 and R507.

The collector feed transformers T504 and T505 combine with the matching transformers to form a modified 180° hybrid combiner.

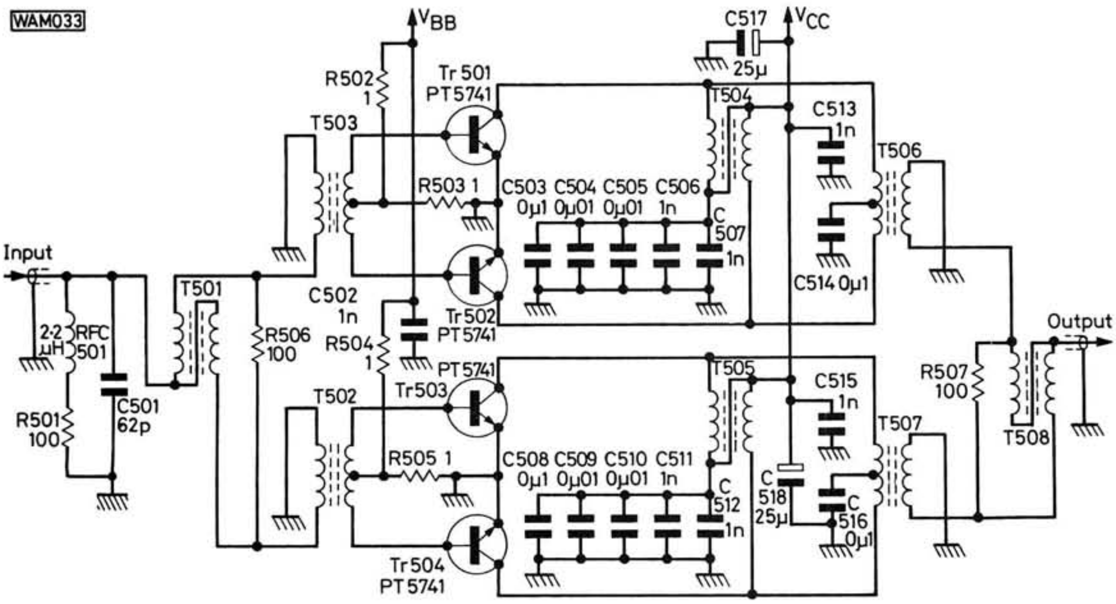


Fig. 20: Circuit diagram of the 100W p.a. used in the *PW* Helford

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

Transformer winding details

T501 T508	Twisted pair of pvc covered 7/0·2mm stranded wires twisted at about one twist per 5mm. End cheeks are not used. Six ferrite cores on each tube.
T502 T503	Secondary is one turn centre tapped consisting of two lengths of brass tube 4·8mm o.d. × 20·3mm long. Primary is 5T 18 s.w.g. enamelled copper wire. Three ferrite cores on each tube.
T504 T505	Twisted pair of pvc covered 7/0·2mm wire passed through the top pair of brass tubes of T506 and T507. Six ferrite cores on each tube.
T506 T507	As T502, T503 but brass tubes are 35mm long. Secondary 4T 18 s.w.g. enamelled copper wire. Six ferrite cores on each tube.

★ components

POWER AMPLIFIER

Resistors		
½W 5% carbon		
1Ω	4	R502,503,504,505
100Ω	2	R501,506
2W 5% carbon		
100Ω	1	R507
Capacitors		
Disc ceramic		
1nF	4	C506,507,511,512
10nF	4	C504,505,509,510
0·1μF	4	C503,508,514,516
Chip		
1nF	3	C502,513,515
Dipped mica		
62pF	1	C501
Electrolytic, axial leads		
25μ 25V	2	C517,518
Inductors		
Moulded choke		
2·2μH	1	RFC501
Semiconductors		
Transistors		
PT9797	4	Tr501,502,503,504

Miscellaneous

Brass tube 4·8mm dia. × 300mm long; Transformer end cheeks (4 sets); FB43/2401 ferrites 4·8mm i.d. × 9·7mm o.d. × 4·8mm long (84); p.c.b.; Heatsink (see text).

Any phase or amplitude differences that would otherwise exist at the collectors are now minimised by allowing the difference current to be by-passed to ground. The resulting currents in T506 and T507 are balanced and provide exceptional second harmonic rejection.

Construction

The construction of the p.a. is similar to the driver stage described in Part 4 and constructors are advised to keep a copy of that part in front of them during construction.

The amplifier is built on a double-sided p.c.b. (Fig. 22). It should be noted that this board has a complete ground plane on the side away from the components. The components are soldered onto the pads except where indicated in Fig. 22 that the lead should be taken through a hole in the board and soldered to the ground plane.

The transformers are constructed in the same manner as for the driver stage using the same type of p.c.b. end cheeks. Winding details are given in the table. The ferrite material used for the cores of the transformers has an initial permeability of 800 and remains above 200 at 30MHz.

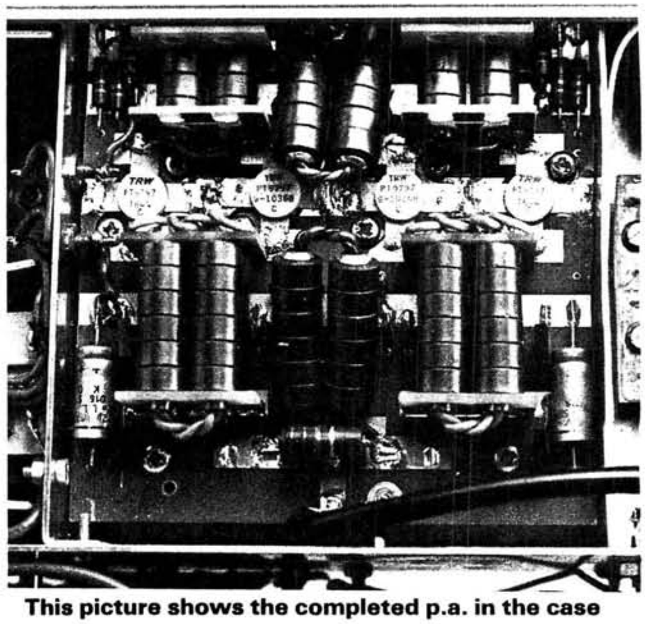
The heatsink is a larger version of that used for the driver stage. Care should be taken when mounting the transistors onto the p.c.b. and heatsink. The mounting details are the same as for the driver stage shown in Fig. 16 in Part 4.

Testing

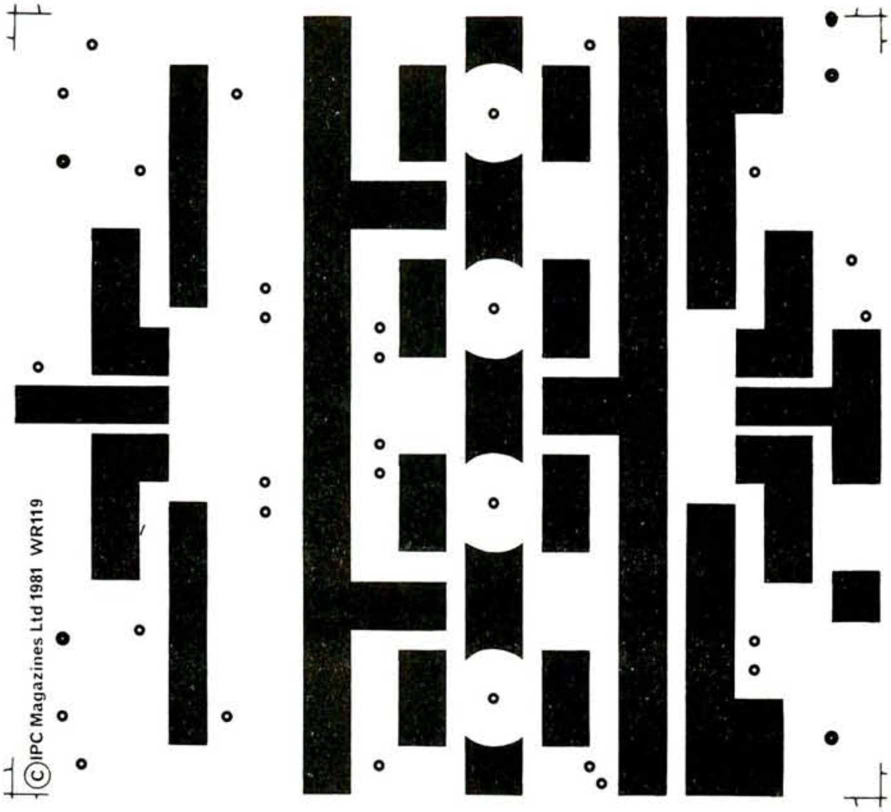
A nominal 12V d.c. supply capable of giving 16A is needed to operate the p.a. stage. With a 50Ω dummy load on the output the bias potential should be adjusted to give a quiescent current of 500mA. With full carrier insertion the current should rise to around 16A with 7A peaks under voice modulation.

Component Availability

The special toroids used for the transformers in both the driver and p.a. stages can be obtained from TMP Electronic Supplies, Britannia Stores, Leeswood, Nr Mold, Clwyd CH7 4RU. AJH Electronics (see adverts) stock the transistors used in the p.a. and driver stages.



This picture shows the completed p.a. in the case



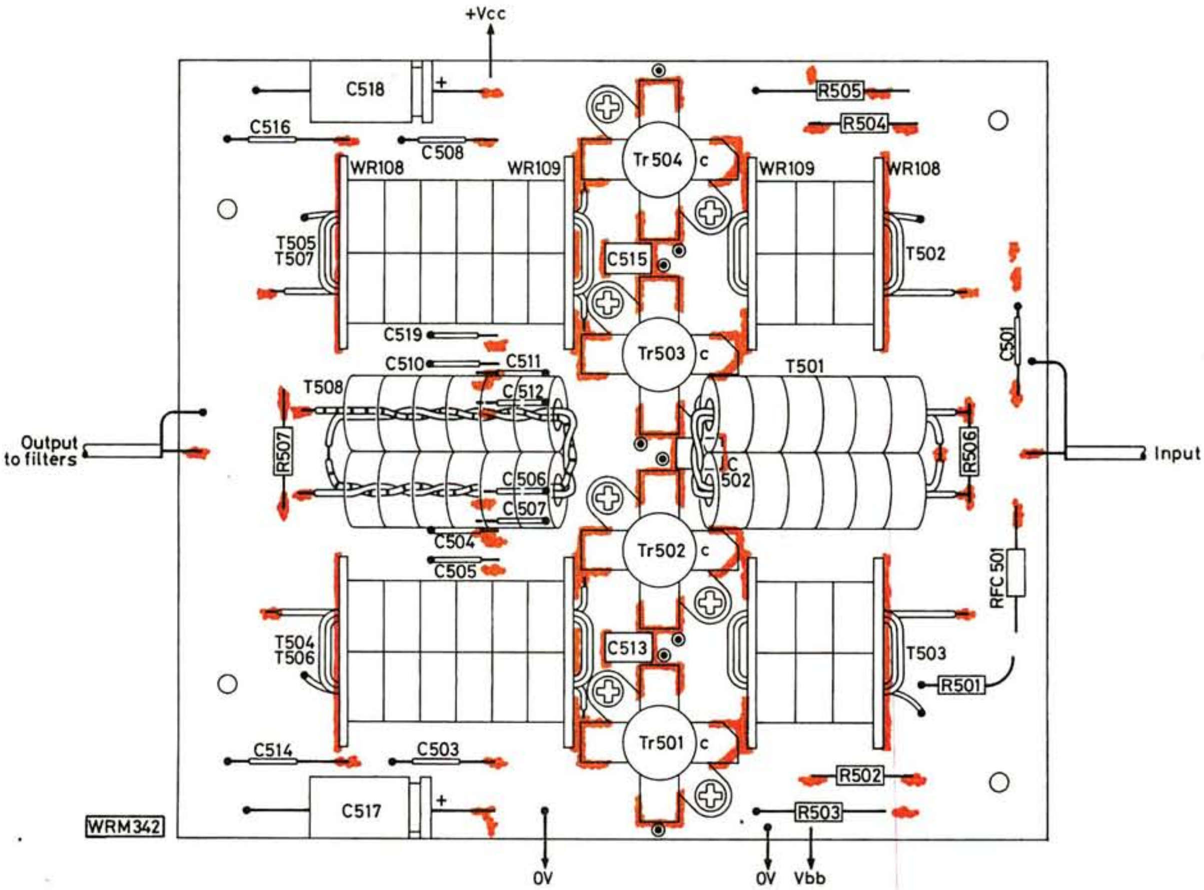


Fig. 22 (top): The copper track pattern of the 100W p.a. shown full size. This is the component side, the other side is a complete ground plane. Fig. 23 (above): The component placement drawing of the p.a. Note that there are eight links between the ground plane and the transistor emitter pads

Filters

In order to supress any odd-order harmonics suitable filters should be inserted between the output of the final p.a. and the antenna. The filter design chosen for the *PW* Helford is based on an elliptic function with the cut-off frequency chosen to give "poles" of attenuation at the harmonic frequencies.

The filters are constructed on simple single-sided p.c.b.s as shown in Fig. 26. Two of these boards are needed for the *PW* Helford as described here with another three filters to be fitted if the extra bands are to be added later on.

Table

L801	14T 18 s.w.g. on T50-10
L802	13T 18 s.w.g. on T50-10
L803	21T 18 s.w.g. on T68-2
L804	20T 18 s.w.g. on T68-2

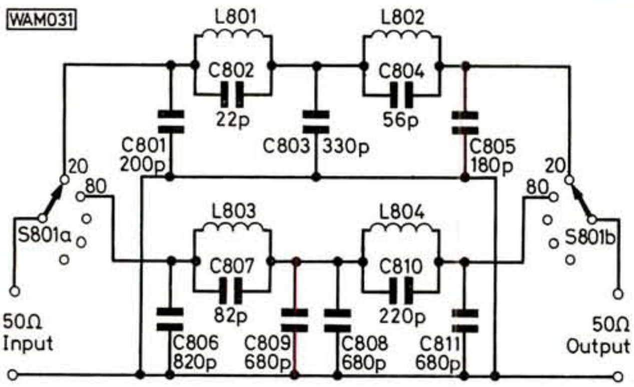


Fig. 23: Circuit diagram of the filters

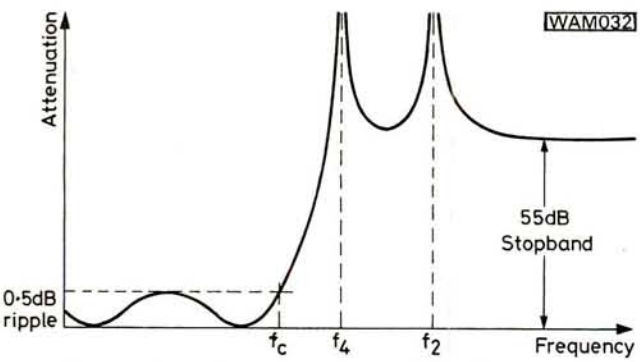


Fig. 24: The characteristics of the filter circuit

★ components

FILTERS

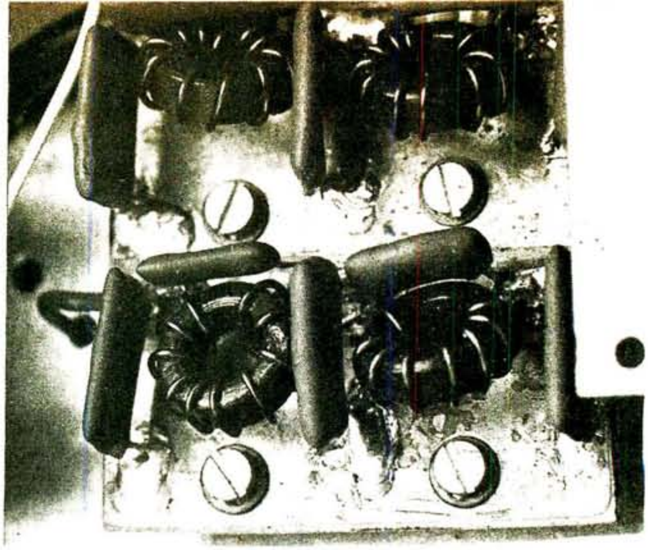
Capacitors

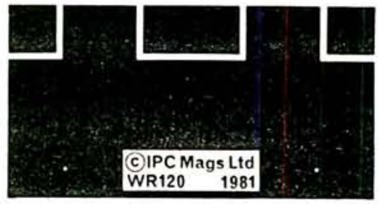
Silver Mica (350V d.c.)

22pF	1	C802
56pF	1	C804
82pF	1	C807
180pF	1	C805
200pF	1	C801
220pF	1	C810
330pF	1	C803
680pF	3	C808,809,811
820pF	1	C806

Miscellaneous

Toroids, Amadon T68-2 (2); Amadon T50-10 (2); p.c.b. (2).





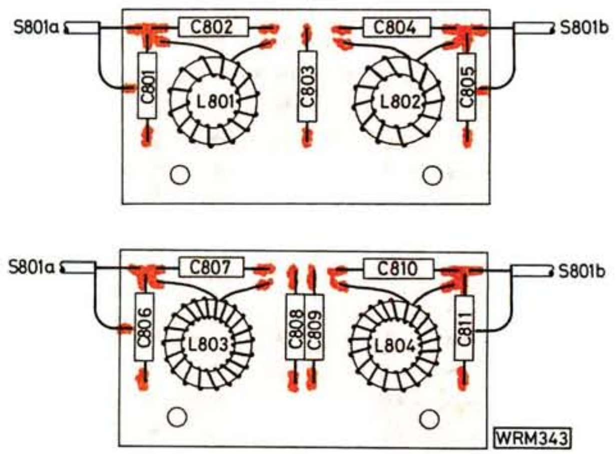


Fig. 25 (top): The copper track pattern of the filter boards shown full size. Fig. 26 (above): The component placement for the two filters

Corrections

In Part 1 C46 and C41 are shown the wrong way round on the p.c.b. layout (Fig. 4). Pins 3 and 4 of IC7 are shown transposed in the circuit diagram. The p.c.b. is correct.

PW Helford Builders' Net

The designer, Vic Goom G4AMW, has decided to start a net on 80m for builders and users of the *PW* Helford. The net will commence on 2 February at about 1930 on 3·72±QRM and will be run either by G4AMW or G3XPZ who will be prepared to answer queries and problems.

Part 6

The next instalment will deal with the power switching arrangements and the metalwork.

Echoes of the Past

Elaine HOWARD

The area in which our offices are now situated has played quite an important part in the early history of radio. Many of the early Marconi experiments were conducted around Poole and Bournemouth, and on the Isle of Wight.

The Needles Hotel

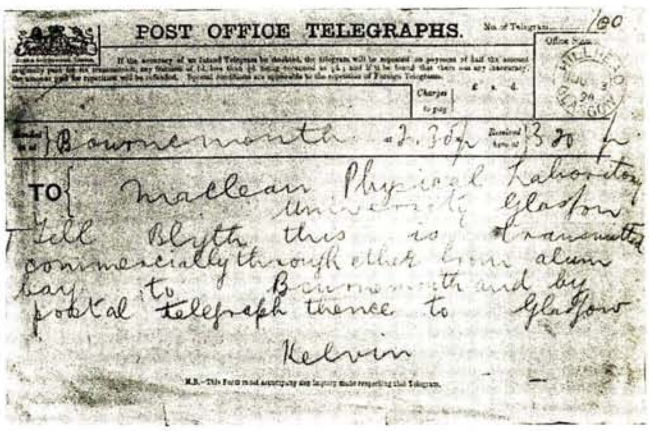
An experimental station was set up in the Needles Hotel on the Isle of Wight in November 1897. This was the first real permanent station and during the following months tests on ship-to-shore communications took place.

The ships were hired from the L & SW Railway company at Southampton, these were called *The Solent* and *The Mayflower*. These steamers sailed around Alum Bay, even during bad weather, and communications of up to 29km were achieved. It was also whilst at the Needles Hotel that communications with a station set up in the Madeira Hotel in Bournemouth were established.

Many distinguished people visited the Needles Hotel station and sent messages to friends at the Madeira Hotel, among them Lord and Lady Kelvin accompanied by Lord Tennyson.

Lord Kelvin sent messages to Dr MacLean in Glasgow, to Sir George Stokes in Cambridge, Lord Rayleigh and Mr Preece in London. These messages were sent by wireless to Bournemouth and then by land telegraph to their respective destinations.

Interior of the Marconi station, Isle of Wight



POST OFFICE TELEGRAPHS.

Bournemouth 2.30p Received here at 3.20p

TO Maclean Physical Laboratory University Glasgow

Tell Blyth this is transmitted commercially through ether from alum bay to Bournemouth and by postal telegraph thence to Glasgow

Kelvin

First paid wireless telegram sent by Lord Kelvin

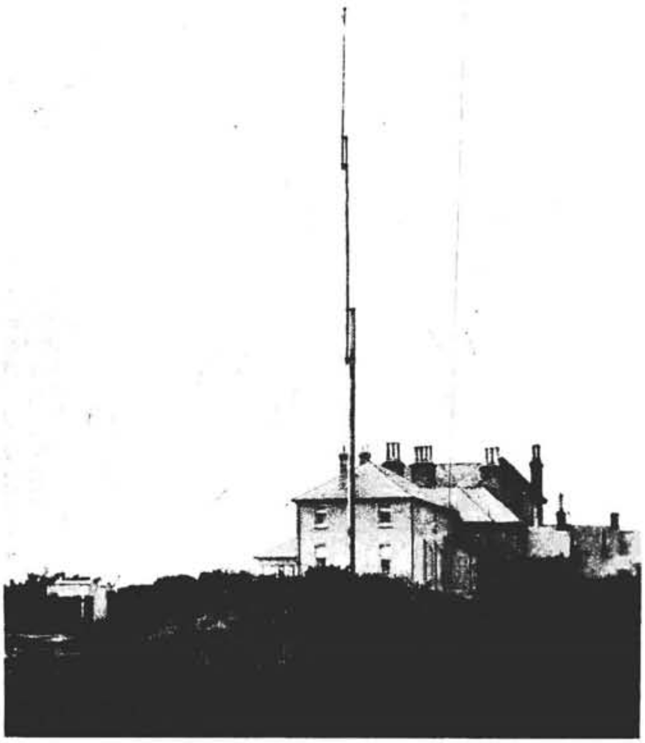
Lord Kelvin insisted on paying a shilling per message for the use of the Marconi system on all the messages he sent. Thus he established a claim for sending the first paid wireless telegram in the world. This illustrated its possibility as a commercial viability as well as his personal appreciation of the service.

Lord Tennyson sent his message to his nephew at Eton and it read as follows: "Sending you message by Marconi's ether telegraph Alum Bay to Bournemouth paid commercially thence by wire very sorry not to hear you speak your Thackery to-morrow. Tennyson."

The next day the Italian Ambassador and some of his staff visited the station to personally see the Marconi system. He sent a long telegram to the King of Italy's aide-de-camp via Bournemouth. This message was between 40 and 50 words long and was entirely in Italian. As this language was not understood by either of Marconi's operators, it could be called a coded transmission. Yet the message was received as perfectly as it was transmitted.

The Madeira Hotel

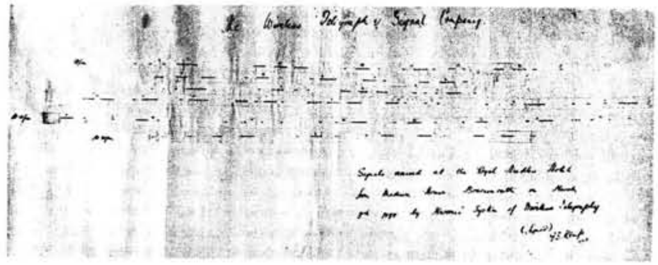
The station at the Madeira Hotel was 22km from the Needles and messages between the two stations began on 3 March 1898. In late September of that year there was some trouble with the Manager of the Madeira Hotel. There was a dispute about charges for the accommodation of the mast in the front garden of the hotel. This resulted in the apparatus being moved to the Haven Hotel in Poole, a distance of 30km from the Needles.



Exterior of the Haven Hotel showing Marconi's aerial mast. Acknowledgment to the Marconi Archival Collection for all photographs and information

The Haven Hotel

Although the location was changed the station continued as an important experimental station until its closure in 1926. The masts were erected on the water side of the hotel. In later years (1904) another lower mast was erected at the back of the hotel, then the first mast was re-erected on top making a complete mast 55m in height. This was dismantled in 1913 to allow builders to extend the hotel. Since then the hotel has been largely rebuilt, and to record the hotel's association with Marconi and his experiments, a plaque is on display in the hotel lounge.



Tape of signals received at the Royal Needles Hotel from Madeira House

Royal Telegrams

During the time that tests between the Needles Hotel and the Madeira Hotel were being conducted, more interest was aroused with the use of the system by the Royal Family. The Prince of Wales was convalescing on the Royal Yacht after injuring his knee, with Queen Victoria staying at Osborne House. The necessary equipment, to enable the Queen to hear news of the health of the Prince, was installed in Osborne House.

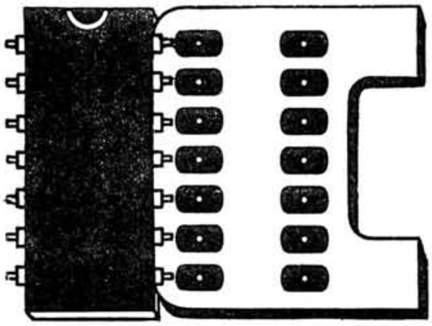
Perfect signals were said to have passed between the Royal Yacht *Osborne* and Osborne House during the 10 days that it was needed. Every morning the Queen received a report on the condition of the Prince. Numerous messages are said to have passed between various members of the Royal Family, the Duke of York was so interested that he paid several visits to the instrument room on board the *Osborne*.

The Prince expressed his high appreciation of Marconi's system and presented him with a souvenir in the form of a scarf pin, wishing him every success with his invention.

First Newsletter at Sea

Whilst Marconi was returning to England on the *SS St Paul,* he set up his equipment on board. At a distance of about 96km, he established contact with the Needles station and obtained several items of the latest news. These were immediately printed on board the ship in the form of a news-sheet and included items on the South African War.

It was sold for one dollar per copy, in aid of the Seamen's Fund and was the first news-sheet to be published at sea. Called the *Transatlantic Times Volume I No. 1,* it was dated 15 November 1898. ●



OF THE MONTH

Brian DANCE M.Sc

TL080 BIFET Op. Amps.

The 741 type of operational amplifier has proved to be a very widely used component which can satisfy many requirements, but many new types of operational amplifier are now available which offer a considerably improved performance. One parameter of the 741 that does not meet the requirement of designers is the very low input resistance, typically 2MΩ, and its requirement for greater input current, about 500nA, than is available in some circuits.

One technique for making operational amplifiers, having a very high input impedance and requiring low input current, involves the use of field effect transistors in the input stage. Hybrid devices were initially available in which a silicon chip containing the two f.e.t.s, for the input stage, were put in the same package as the operational amplifier chip. Unfortunately such devices proved very expensive to manufacture.

It was very difficult to incorporate f.e.t.s on the same chip as the operational amplifier, but now a wide range of BIFET devices, with input junction f.e.t.s, and BIMOS devices, with input MOSFETS, are available at very economical prices. We will now consider the Texas Instruments series of TL080 BIFET products, which have typical input resistances of 10^{12} ohm (one million MΩ) and typical input currents of 0·2nA

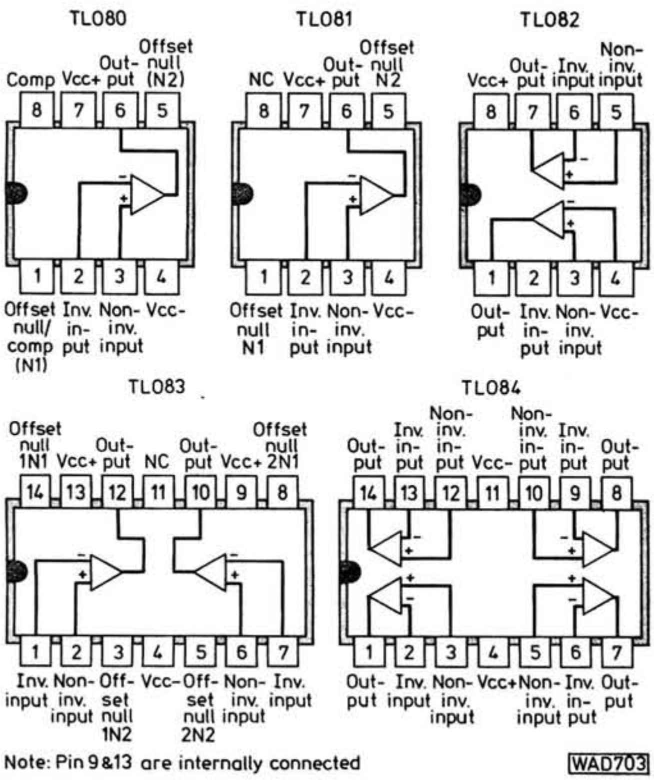


Fig. 1: TL080 series connections

The TL080 Series

The TL080 series of devices have been designed as general purpose operational amplifiers to replace such products as the 741 where a high input resistance, slew rate or other requirement is present. All of the devices in this series are of basically the same circuit type, but the individual devices differ in the following ways:

The TL080 is a single operational amplifier in an 8-pin dual-in-line package which requires external frequency compensation to render it stable. The TL081 is also a single operational amplifier in an 8-pin d.i.l. package, but is internally compensated. It has the same pin connections as the 741 and is perhaps the most widely used device of the series. Both the TL080 and the TL081 have offset nulling facilities. The TL082 contains two similar operational amplifiers in an 8-pin d.i.l. package. Internal frequency compensation is employed, but no offset nulling facilities are available owing to the limited number of pins per amplifier. The TL083 is also a dual amplifier, but as it is encapsulated in a 14-pin d.i.l. package, offset nulling facilities are provided. It is internally compensated, with connections equivalent to the 747.

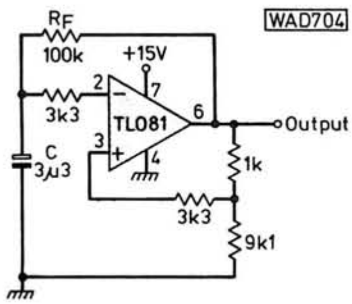


Fig. 2: Squarewave generator

The TL804 is a quad device with internal compensation in a 14-pin d.i.l. package, but again insufficient pins are available to provide nulling facilities for the four amplifier package. The connections are similar to the 324 devices.

Connections for all of these devices are shown in Fig. 1. Any of the amplifiers can be used in the circuit to be discussed, but an external frequency compensating capacitor must be used if the TL080 is used. Multi device circuit construction is simplified by the use of dual or quad packages, but in terms of cost price little benefit is obtained.

Parameters

Apart from the high input impedance of the TL080 family, it is interesting to note that the devices have a typical slew rate of 12V/μs, which is 24 times as great as the 0·5V/μs of a typical 741 device. The slew rate controls the speed at which the voltage at the output of the device can change. Thus one of the TL080 series of amplifiers can satisfactorily provide a large output, such as 5V peak-to-peak, at a much higher frequency than a typical 741 device.

The input offset voltage of the TL080 device is quoted as 15mV, although the somewhat more expensive TL080A series has a quoted value of 6mV. This voltage is the potential between the two inputs of the device required to produce zero output voltage when the amplifier is fed from balanced positive and negative power supply lines. The 741 has an input offset of 6mV, so the 741 is better than the TL080 devices in this respect and about as good as the TL080A series.

The gain of the TL080 series of devices falls to unity at a bandwidth of typically 3MHz, this being three times the value of a typical 741. Thus the TL080 can operate satisfactorily at high frequencies if the signal is small. In most other respects the TL080 devices are comparable with the figures quoted for the 741 devices. Each amplifier of the TL080 series consumes about 2·8mA and has short-circuit current limiting protection like the 741, so no damage to the device can result from accidental shorting of the output.

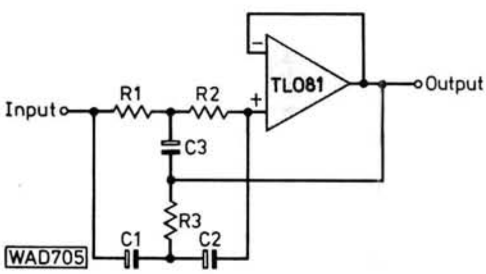


Fig. 3: High Q notch filter

Practical Circuits

The circuit of Fig. 2 shows a squarewave generator using a single positive supply of +15V. A lower power supply voltage can be used if a smaller output amplitude is satisfactory. The frequency of operation is equal to 1/2 (πRFC) or about 0·48Hz with the values shown.

The power supply connections to pins 4 and 7 are shown in this circuit, but are omitted in the following circuits for simplicity. When a dual or quad device is employed, only one set of power supply connections are required for all the devices in the package concerned.

The circuit of Fig. 3 shows a high Q notch filter which will greatly attenuate one selected frequency, whilst having a minimum effect on other frequencies. A twin T filter circuit is used in the input to this circuit, but it is important

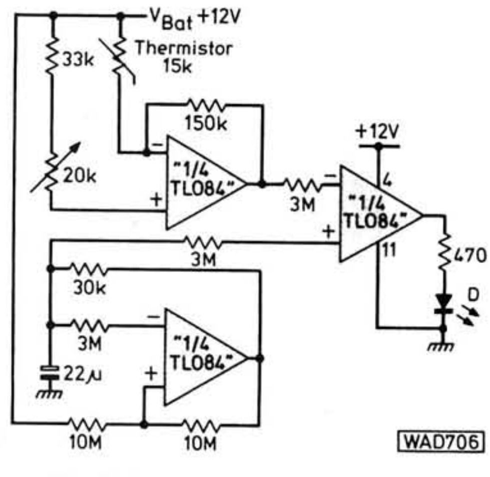


Fig. 4: Icy road warning indicator

to note that close tolerance resistors and capacitors are required—preferably 1 per cent to 2 per cent for optimum rejection. The component values should be selected so that R1 = R2 = 2R3 and C1 = C2 = 0·5C3, in which case the frequency of the rejection notch = 1/2πR1C1. If R1 is 1·5 MΩ and if C1 is 110pF, the rejection notch frequency will be 964Hz or nearly 1kHz.

One of the advantages of using a BIFET device in this type of notch filter is that the input resistors can have a very high value, because of the high input resistance of the device. For a given frequency the capacitors can thus have a relatively low value and low value close tolerance capacitors are far cheaper than high value close tolerance

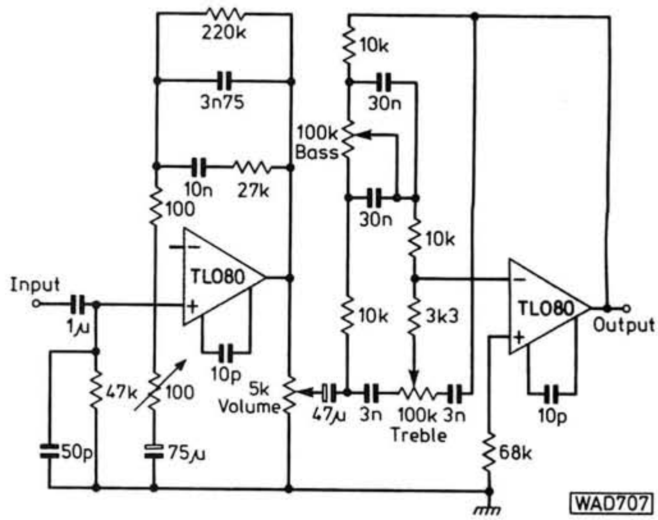


Fig. 5: Pre-amplifier with tone controls

components. This type of circuit can be used at quite low frequencies where a 741 would be unsuitable owing to the high value close tolerance capacitors needed.

The circuit of Fig. 4 shows an icy road warning detector using three of the four devices in a TL084 package. However, three separate TL081 devices would be equally satisfactory or one TL082 and one TL081. The thermistor must be placed in the region where temperature is to be measured and the variable resistor should be adjusted so that the light emitting diode just comes on when the temperature of the thermistor falls to freezing point.

An i.c. pre-amplifier circuit is shown in Fig. 5. The incoming signal is amplified by the first TL080 device which feeds the volume control. The signal tapped off from this volume control is fed into a circuit of the Baxandall type, containing independent treble and bass controls. A second

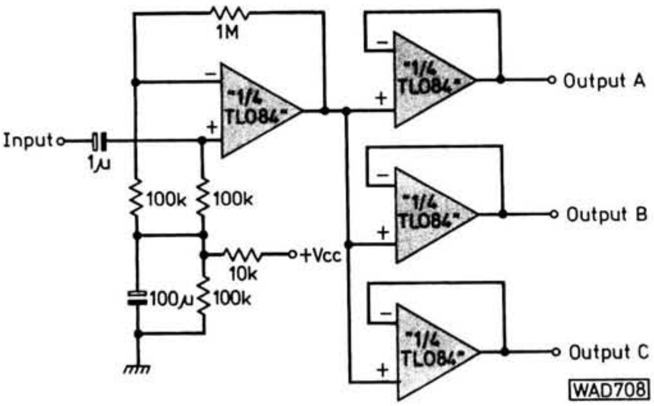


Fig. 6: Audio distribution amplifier

TL080 device is used as an output buffer amplifier. Note the use of 10pF compensating capacitors with each of the TL080 devices.

An audio distribution and isolation amplifier is shown in Fig. 6. A single TL084 is required or two TL082 devices or four TL080 units for this three-output circuit. The three output amplifiers employ 100 per cent feedback to provide unity gain, high input impedance, voltage follower circuits.

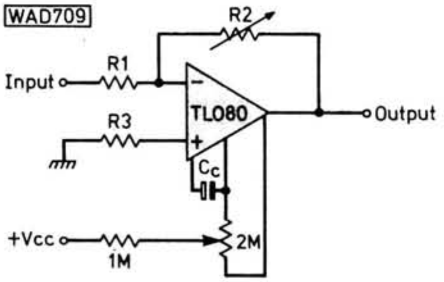


Fig. 7: A variable gain inverting amplifier

As a final example of a TL080 circuit, Fig. 7 shows a variable gain circuit. The gain is equal to R_2/R_1 and the 2MΩ potentiometer can be used to null the output voltage. The compensation capacitor C_c should not be less than $R1/(R1 + R2) = 30pF$. For optimum performance R3 should equal the value of R1 and R2 in parallel so that the input current in each input circuit is similar.

Availability

Devices in the TL080 range are currently available from advertisers including Watford Electronics. ●

AUDIO POWER AMPLIFIERS

▶▶▶ *continued from page 36*

The feedback circuit values shown will provide a gain of about 48, but the gain can be varied over a very wide range of values by adjusting R5. The gain is equal to $1 + R7/R5$. The capacitor C2 reduces the gain at high frequencies and improves stability.

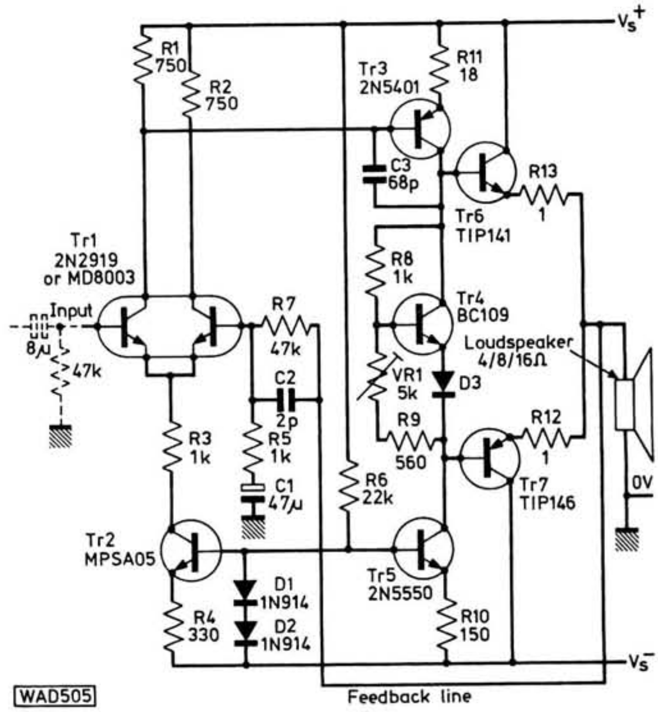


Fig. 16: Circuit of a low-distortion 30 watt amplifier

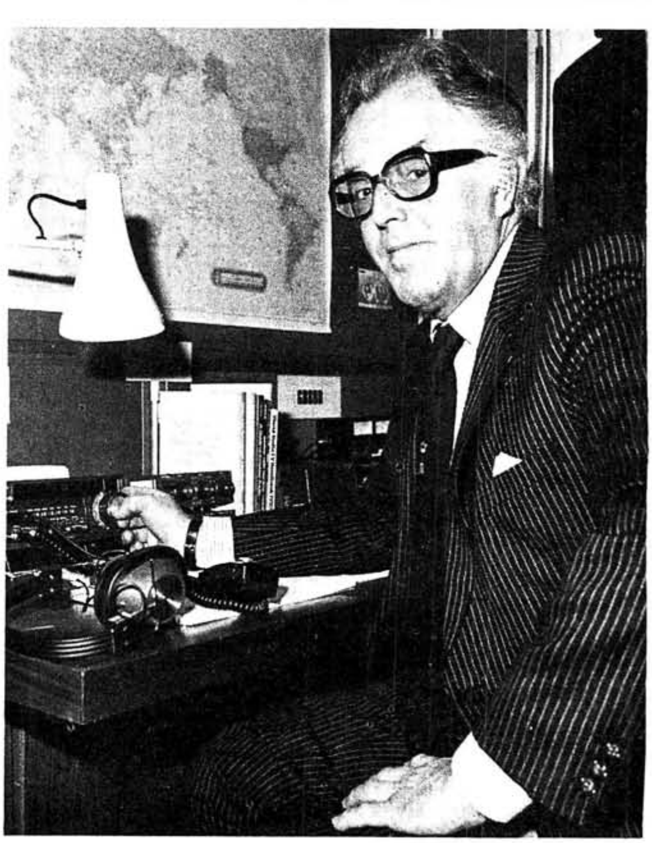
The writer has been using this type of circuit as an audio amplifier for some years and feels it provides an excellent performance. It can also be used for operation down to zero frequency (for example, for the operation of servo motors) if the input is directly coupled and if the lower end of R5 is directly connected to 0V (ground) with C1 omitted. However, if minimum offset voltage is required, it would be advisable to use an ultra-matched dual transistor (such as the Precision Monolithics MAT-01) for zero frequency operation, as this will minimise the offset voltage at the amplifier output.

In the third and final part of this series, we shall deal with audio drive i.c.s and some high-power amplifier circuits.

We apologise for the long delay in printing the second part of this series.

We can provide photocopies of Part 1 for any reader not having the September 1980 issue in which it appeared. Please send a large (220 × 110mm minimum) stamped addressed envelope, plus a cheque or postal order for 20p, made payable to IPC Magazines Limited.

PW at BREADBOARD 80



Brian Rix G2DQU on our stand on the opening day: (top) chatting to Editor Geoff Arnold G3GSR; (above) trying out the FT-707

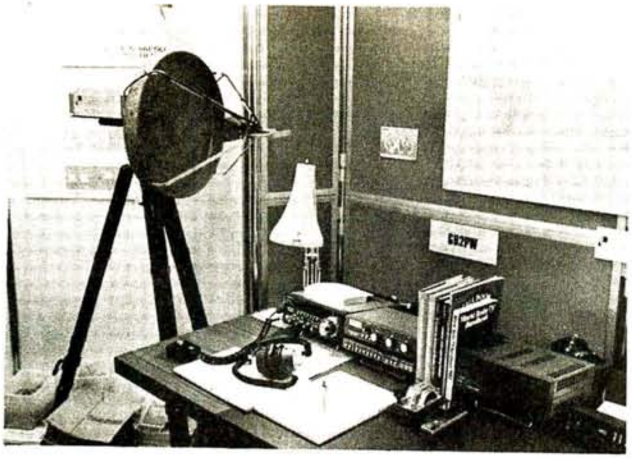
The third Breadboard exhibition, held at the Royal Horticultural Society's New Hall, London SW1, from 26–30 November 1980 proved very popular, attendance being just over 17 000, an increase of more than 50 per cent over 1979. Devotees of electronic pianos and organs, audio, computers, games and gadgets were all catered for, with plenty of kits and bits, and there were several stands offering "CB" accessories.

Most of the *Practical Wireless* stand was given over to a fully operational amateur radio station, and a total of 167 contacts were made during the five days of the show. The transceivers used were by Yaesu, kindly loaned by South Midlands Communications at Totton. The h.f. station was an FT-707, whilst on 2m and 70cm, we were running an FT-480R and an FT-720R respectively. Antennas were a trapped dipole and a discone, both mounted on the roof of the hall, around thirty metres high.

Each day, we had personalities from the field of amateur radio on the stand, operating the station and chatting to visitors about the hobby. On the opening day we were privileged to welcome Brian Rix G2DQU, and he was followed by Phil Ciotti G3XBZ (co-designer with Vic Goom G4AMW of the *PW* "Helford", which he operated from the stand), Mike Tooley G8CKT, Eric Dowdeswell G4AR, Robin Hewes G3TDR (all regular contributors to *PW*), and Graham Wood G3VPC and Nick Foot G8MCQ (both involved in running the Dorset 2m repeater GB3SC).

The *PW* demonstration stations, with Assistant Editor Dick Ganderton G8VFH operating GB8BB on 2 metres

Exhibitions always give us the welcome opportunity to talk to readers old and new, to show our constructional pro-



The h.f. station GB2PW, with our prototype microwave transceiver alongside it. The dustbin-lid antenna of the latter attracted a lot of attention from visitors to the exhibition

An introduction to amateur radio was provided by the RSGB display, and by a v.d.u. coupled to a Tono Theta 7000E Communications Computer (courtesy of Thanet Electronics)

jects, and to receive the bouquets and the brickbats about the magazine. At Breadboard we were also glad to chat to many people, young and old, about amateur radio, and to explain the ways it differs from CB. Quite a few were very surprised to find the scope offered in modes: c.w., voice, RTTY, TV, SSTV, etc.; in methods, including moonbounce and satellite; and in frequency bands from 160m to microwaves. Talking of microwaves, our prototype "dustbin-lid" system (to be published soon) proved quite a talking point on the stand, too.

As a tailpiece, I must tell you the story of a CB enthusiast who came to our stand asking if we had a receiver on which we could listen for his transceiver, producing a 3-channel hand-held from his pocket. We replied that our receiver was amateur bands only, and did not cover 27MHz, and in any case CB was not legal in the UK. He then said that this didn't apply to his set, which had three channels: 25MHz, 25·5MHz and 26MHz. The shop that sold it to him told him that "It was only 27MHz that was illegal; his set was not on 27MHz, therefore it was not illegal." He had just one problem—as he hadn't managed to contact anyone on it (hardly surprising), he wasn't sure whether it was working or not! It's amazing what some people will do to "turn a fast buck".

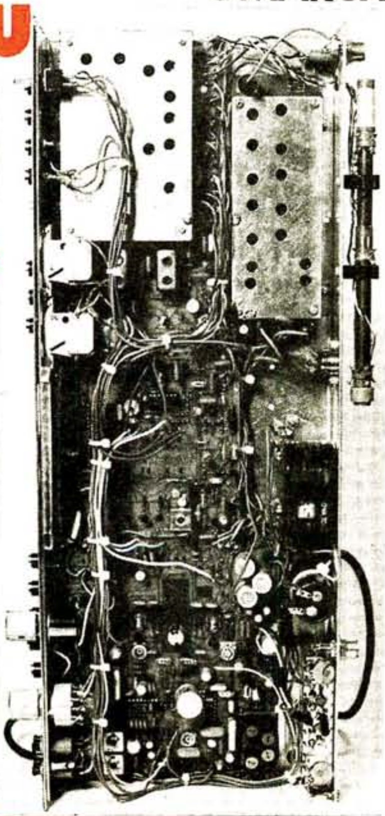
Next month in PW

ON SALE 6 MARCH

You've asked for it!

the PW 'WINTON' TUNER

A high-performance tuner to complement the famous PW "Winton" amplifier. Covering long, medium and short wavebands, plus Band II f.m. and Band IV/V TV sound. Digital frequency readout plus clock and timer



BOAT ENGINE HOURS COUNTER

A simple unit for logging hours run between overhauls on a boat's outboard motor

MOBILE SUPPRESSION TECHNIQUES

How to overcome interference from a vehicle's ignition system and accessories, affecting operation of amateur radio, PMR and in-car-entertainment equipment.

ACTIVE RECEIVING ANTENNA

Michael TOOLEY BA G8CKT
David WHITFIELD MA MSc G8FTB

Due to limitations of space (and money), few of us are able to indulge in the antenna system that we would really like. Yet most of us recognise that the antenna system is crucial in determining the overall performance of any receiving or transmitting station. Those with large gardens who are fortunate enough to be able to install full-size antennas (e.g., a half-wave dipole for 80m) are relatively few and far between. Even then the available antenna space may have to be used in favour of some bands rather than others. For those dwelling in flats or town-houses the problems are even worse. If h.f. antennas can be installed at all they have to be very much smaller than the ideal and may well have to be made as inconspicuous as possible.

The active antenna described has a physical length which is only a small fraction of the operating wavelength, yet exhibits many of the properties of a full-size dipole. Its desirable features may be summarised as follows:

(a) Comparable directivity and polar response to that of a full-size dipole.
(b) Appreciable gain over a random length wire antenna.
(c) High degree of electrical balance between elements.
(c) In-built balun for coaxial output.

The antenna may be used over a wide range of frequencies, typically from 60kHz to 30MHz, and its directional properties are essentially the same as its full-size counterpart. The antenna may thus be rotated to provide optimum reception in a particular direction or, alternatively, may be used to "null" interference from an unwanted signal on an adjacent channel. Furthermore, the depth and symmetry of the null makes the antenna ideally suited to direction finding applications.

The antenna consists of a helically-wound short dipole which has a nominal half-wavelength at approximately 50MHz. The physical length is actually that of a half wavelength at 70MHz, however the helical winding increases the inductance of the antenna in a distributed fashion and provides a further reduction in overall length. To preserve the electrical balance of the dipole a symmetrical high input impedance matching stage is incorporated and this feeds a two-stage wideband amplifier, which provides a voltage gain in excess of 20dB. Construction is straightforward and uses readily available components. Because of its small size, the active receiving antenna is ideally suited for indoor use and thus will prove to be invaluable to the s.w.l. who, due to space limitations, is unable to construct a full-size antenna.

What is an Active Antenna?

Active antennas would, at first sight, appear to be a relatively new concept. However this is, in some measure, due to the comparative lack of information on the topic. Indeed even the distinction between active and passive antennas would appear to be somewhat hazy. For the purpose of this article we shall define an active antenna as one in which amplifying devices are incorporated as an integral part of the antenna. This has the further implication that there should be an uninterrupted length of feeder from an active antenna to the receiver rather than the more usual antenna/pre-amplifier/receiver arrangement where a length of feeder links each component in the system to the next.

An active antenna designed for reception purposes will generally not be suitable for transmission, if for no other reason than it will not be capable of handling the level of r.f. power involved. Another consideration is the efficiency of the antenna system. This is vitally important in transmitting applications but very much less so in reception. Efficient free-space coupling is not essential for receiving antennas and hence very short antennas can be used despite their inherent inefficiency. What is important is the need to transfer as much power as possible from the antenna to the receiver without dissipating overmuch in the matching network. In other words, it is the matching that is important. Short antennas are capacitive and have a relatively high impedance. Effective matching can be achieved by the use of active devices connected in a voltage follower configuration, thus avoiding the losses normally associated with matching networks consisting of inductors, capacitors, transformers and the like.

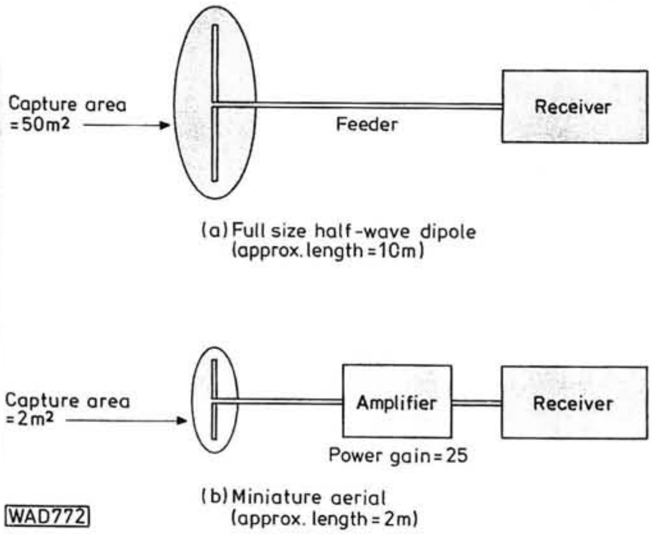


Fig. 1: Antenna systems with comparable performance at 15MHz

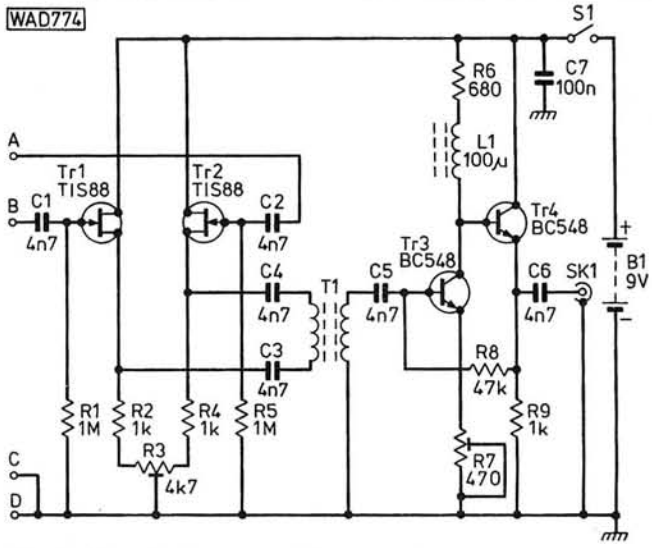


Fig. 3: Circuit diagram of the complete active antenna

Gain and Capture Area

A half-wave dipole captures energy from the area surrounding it. This capture area, which is somewhat greater than the physical area of the elements, is known as the equivalent aperture and effectively has an elliptical shape with the dipole aligned along its major axis. An antenna which is said to offer some "gain over a dipole" achieves this by having a correspondingly larger capture area. It therefore obtains more energy from an incident electromagnetic wave than would be acquired by a dipole. The capture area of a dipole is a function of frequency and is found by dividing the power delivered by the antenna into a matched load by the power per unit area available. It can be shown that:

$$\text{Capture area (half-wave dipole)} = 0{\cdot}131\lambda^2$$

since $\lambda = \frac{v}{f}$ (where $v = 300 \times 10^6$ m/s and f is in MHz)

$$\text{Capture area (half-wave dipole)} = \frac{0{\cdot}131 \times (300 \times 10^6)^2}{f^2}\ \text{m}^2$$

$$\text{or capture area (half-wave dipole)} = \frac{1{\cdot}179 \times 10^4}{f^2}\ \text{m}^2$$

This relationship shows that the capture area is inversely proportional to the square of the frequency. To put this into context, at 10MHz a half-wave dipole exhibits a capture area of approximately 118 square metres, whereas at 30MHz its capture area would only be some 13 square metres. It should also be noted that this applies only to an ideal antenna supported clear of any obstructions and several wavelengths above earth.

Short Antennas

For short antennas the capture area will, of course, be proportionally reduced. However the performance of a short dipole may be considerably improved by the incorporation of active devices to provide additional power gain. In this case, adequate arrangements must be made for matching the antenna over a wide range of frequencies. If this is not taken into account, losses due to mismatch will be appreciable and the overall performance will be somewhat dependent upon frequency. Two comparable systems are shown in Fig. 1, and assuming that the matching was perfect, they would both deliver the same signal power at the receiver input.

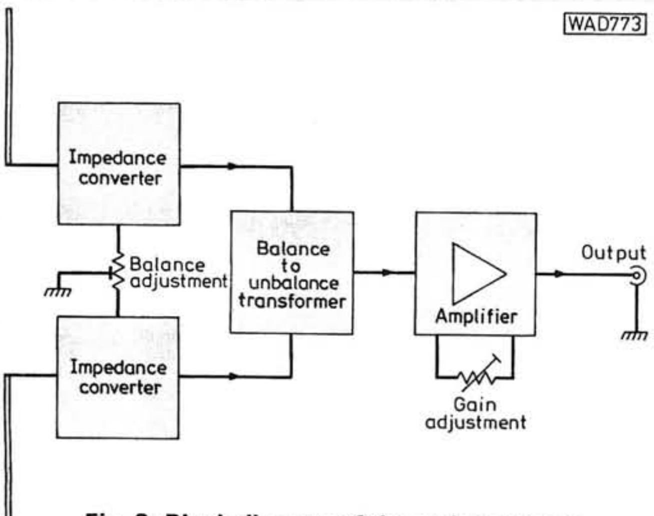


Fig. 2: Block diagram of the active antenna

Circuit Description

The simplified block schematic of the active antenna is shown in Fig. 2. Anti-phase signals from the antenna elements are connected to high-impedance, unity-gain matching stages. The outputs are combined in a balanced-to-unbalanced transformer (balun) and then fed to a wide-band amplifier. The complete circuit diagram is shown in Fig. 3. Transistors Tr1 and Tr2, connected as source followers, provide the input matching with R3, which sets the drain currents, acting as a balance control to compensate for variations in f.e.t. parameters and component values. Transistor Tr3 operates as a common emitter amplifier with peaking provided by L1 acting as part of the collector load. This inductor compensates for the stray capacitance at the collector and helps extend the h.f. performance of the amplifier. Emitter follower Tr4 provides matching to the relatively low impedance of the feeder which connects the active antenna to the receiver. Stabilisation of the bias is provided by R8, and the gain is preset by means of R7 which applies a measure of series current negative feedback.

Construction

The components for the matching and amplifying stages are assembled on a small single-sided p.c.b., the foil layout of which is shown in Fig. 4. In order to maintain performance at high frequencies constructors are strongly recommended to follow the p.c.b. layout. The components are located on the top of the p.c.b. as shown in Fig. 5. Note that, since space on the p.c.b. is rather limited, the use of miniature components is essential. The transformer T1 is wound on a small ferrite ring of mean diameter 10mm according to the data given in Fig. 6. The primary and secondary windings consist respectively of 16 and 10 turns of 32 s.w.g. enamelled copper wire, closewound on opposite sides of the ring. The completed p.c.b. should be carefully checked and then mounted on stand-off pillars inside the plastics box, as shown in Fig. 7.

Elements

The antenna elements are constructed as follows: Obtain a 2·143m (7ft) length of 20mm diameter plastics conduit from an electrical contractor. With the aid of a hacksaw cut this to exactly 2·083m and then mark the centre point. Using the hacksaw cut a V-shaped slot in the centre. (*n.b.,* take great care not to place any undue strain on either end of the conduit since this may cause weakening at the centre of the "V".) Obtain a 250mm length of 16mm diameter dowel. Wind 80 turns of 18 s.w.g. enamelled copper wire closewound (i.e., adjacent turns touching) on this former. The overall length of the completed winding should be approximately 114mm. Carefully draw the winding off the former into the conduit and gradually increase the pitch to about one turn per 25mm. The arrangement shown in Fig. 8 shows probably the best method of doing this, though constructors may prefer to develop their own technique. It is important that the pitch of the coil is kept as uniform as possible throughout the entire length of the conduit.

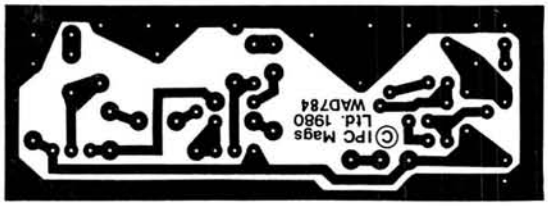
Cut holes in opposite ends of the plastics box. These should accommodate the conduit, which should be a fairly tight push-fit. Then slide the box onto the conduit and position it at the exact centre with the V-shaped slot uppermost. The conduit should be secured to the case with the aid of a suitable adhesive. Bend the ends of the helix over

CONSTRUCTION RATING Beginner

BUYING GUIDE

Readers should find little difficulty in obtaining the components for this project. The plastics conduit can be bought from electrical retailers while a look through the advertisements in this issue should provide sources for the remaining components.

APPROXIMATE COST £7



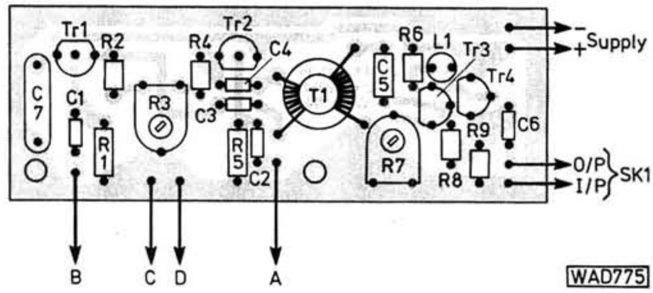


Fig. 4 (top): Full-size copper track pattern of the p.c.b. for the active antenna. Fig. 5 (above): The component placement diagram for the p.c.b. shown full size

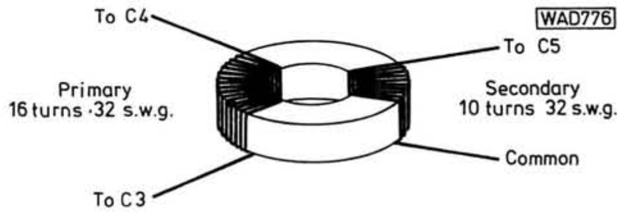


Fig. 6: Details of the toroidal coil. The windings should be secured with Denfix

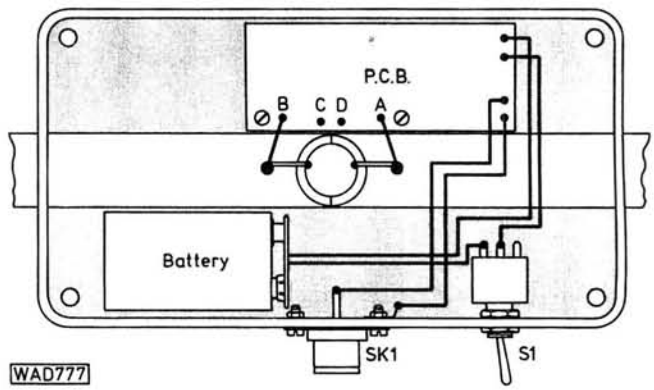
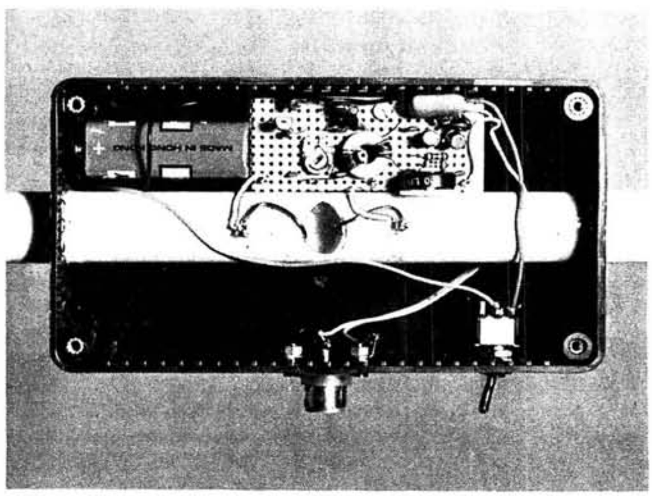


Fig. 7: Internal layout and wiring details. Note that C and D are not connected in this configuration



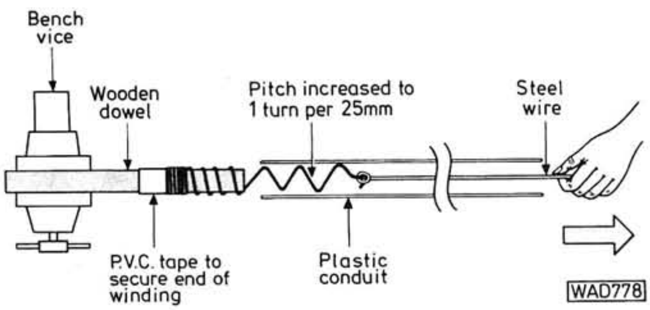


Fig. 8: Constructional method for the helical dipole elements

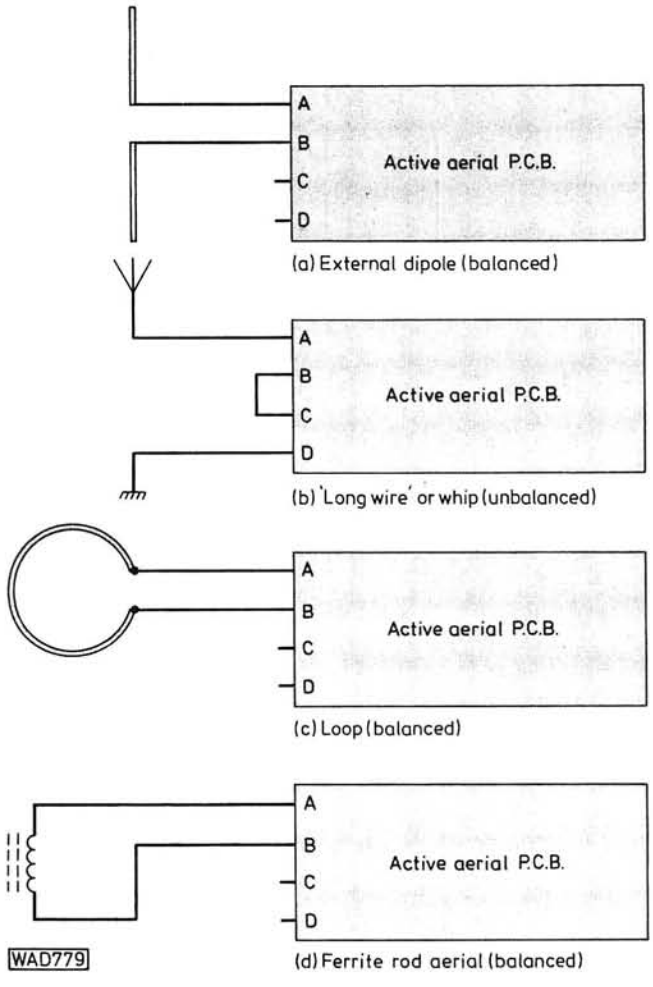


Fig. 9: Possible configurations of the active antenna

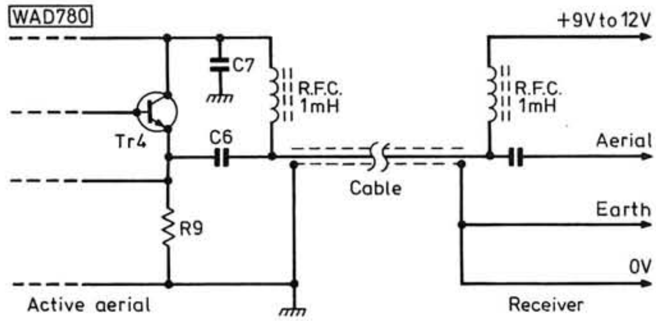


Fig. 10: Remote power feed to the active antenna

and secure them to the ends of the conduit using short lengths of pvc tape. Then, using the V-shaped hole for access, carefully cut the enamelled copper wire at the centre, bend and terminate it as shown in Fig. 7. The plastics conduit may be drilled to accommodate push-fit terminal pins, but do take care not to overheat the conduit when soldering the ends of the enamelled copper wire. Link the helical elements to the p.c.b. using short lengths of pvc-covered wire, and then connect the switch, battery connector and output socket, as shown in Fig. 7. The assembly is now complete and the active antenna is ready for initial checks and balancing.

Initial Checks and Adjustments

Connect a 9V PP3-size battery and insert a milliammeter to measure the supply current. Set R3 and R7 to mid-position and switch the supply on. The supply current should be in the range 12mA to 20mA. If this is not the case, carefully check the p.c.b. and associated wiring for errors. The output of the antenna should be connected to the receiver using a short length of coaxial cable. The impedance of this cable will normally be 50Ω but, if necessary, 75Ω cable may be used. Position the antenna horizontally and at some distance from the walls, ceiling and floor. Tune the receiver to a fairly weak signal in the range 1MHz to 2MHz. Observe the "S" meter indication and check that the signal is free from fading (QSB). Then vary the setting of the gain control, R7, and note the effect on the "S" meter. This should indicate an overall change of somewhat greater than 20dB. Adjust R7 to obtain a

★ components

Resistors		
¼W 5% Carbon		
680Ω	1	R6
1kΩ	3	R2,4,9
47kΩ	1	R8
1MΩ	2	R1,5
Potentiometers		
Linear preset		
470Ω	1	R7
4·7kΩ	1	R3
Semiconductors		
Transistors		
BC548	2	Tr3,4
TIS88	2	Tr1,2
Capacitors		
Polyester		
100nF	1	C7
Miniature Ceramic		
4·7nF	6	C1–6

Miscellaneous
100μH inductor; Miniature switch s.p.d.t.; Ferrite ring 9·53mm diameter T37-12 (Ambit); 9V battery; Plastics box, 150 × 80 × 50mm; Plastics conduit (Gilflex) 20mm o.d. (see text).

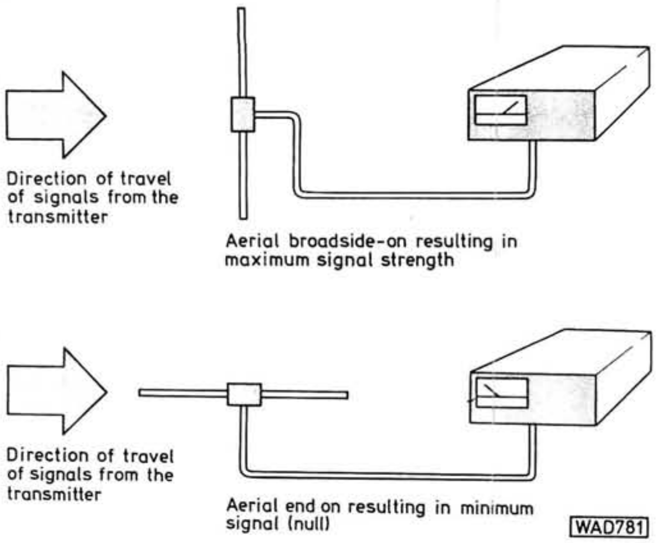


Fig. 11: Directional properties of the antenna

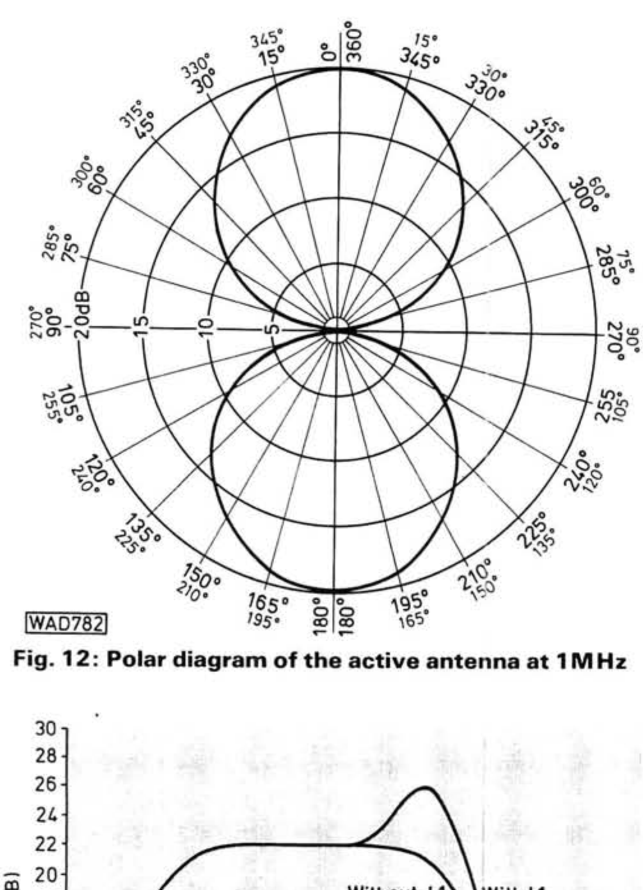


Fig. 12: Polar diagram of the active antenna at 1MHz

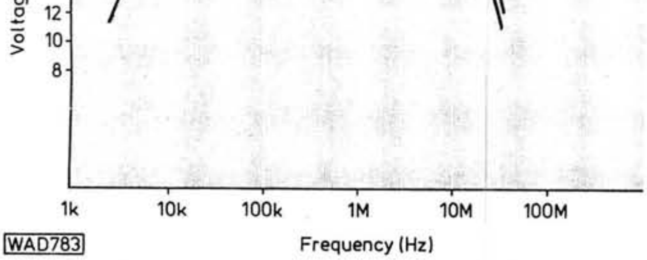


Fig. 13: Frequency response of the amplifier stage formed by Tr3 and Tr4

reading of "S-9". Connect a short jumper lead from *A* to *B*, thus shorting the elements together. The "S" meter indication should fall to a low value, typically "S-5" or lower. Carefully adjust R3 for minimum indication on the meter. If necessary turn up the r.f. gain control of the receiver so that the null is more noticeable. Leave R3 at this minimum setting and then remove the shorting link from the p.c.b. The antenna is now balanced and ready for use.

Using the Active Antenna

The directional properties of the antenna can be used in several ways:

(a) Interference rejection—The deep and fairly sharp nulls in the polar response (see Fig. 12) can be used to reject interference from co- or adjacent-channel signals. The antenna is simply rotated to minimise the effect of the interfering signal. In some cases it may be advantageous to slant the aerial for maximum rejection once the null has been found.
(b) Direction Finding—The null may be used to find the approximate bearing of a transmitter from the receiver.

The antenna is again rotated for minimum and the bearing read from a compass or protractor scale. In the null position the antenna will be pointing directly towards the transmitter. Note that, since there are two nulls, 180° apart, two possible bearings are obtained. It is, however, usually a fairly simple matter to exclude one of these from knowledge of the programme material. A typical accuracy of ±5° can easily be achieved by this method. Note that it is the null, rather than the peak, that is used because of its relative sharpness. Also, where a programme is broadcast synchronously from several transmitters at different locations on the same frequency, the nulls will be indistinct and the results will be meaningless.

Experiment

Constructors may wish to experiment with several other antenna configurations rather than the use of the dipole arrangement exclusively. Fig. 9 shows some possible schemes. The active antenna may, if desired, be powered remotely from the receiver. This will be found to be useful in cases where the antenna is mounted in a loft or similar inaccessible place. The circuit shown in Fig. 10 allows the supply to be fed along the centre conductor of the coaxial cable while the two radio frequency chokes provide a relatively high impedance at signal frequencies.

Caution

Finally, a word of caution concerning the setting of the gain control, R7. Very strong signals present at the input of a receiver can cause severe cross-modulation and blocking. Hence it is essential that minimum gain should be employed in the r.f. amplifier of the active antenna consistent with achieving acceptable signal strength. Constructors should avoid leaving the gain control set at maximum unless this is absolutely necessary in order to bring wanted signals out of the noise. In most applications R7 can be left set at about mid-position. In this case the gain will be a modest 10dB or so, and the risk of cross-modulation due to overloading the receiver will be considerably reduced. ●

designing with RM cores

J. B. DANCE M Sc

Most components are easy to specify, such as a certain type of transistor or integrated circuit, a resistor value and wattage or a capacitor value and working voltage, since other parameters are generally unimportant. When one requires an inductor of a specified value, perhaps with a given quality factor Q, specified at a certain frequency, more often than not one has to wind it oneself and is left with the task of selecting the best core material of suitable dimensions and of winding on the correct number of turns. Inductor design can be quite an imposing problem to the person who is not well versed in the theory.

The design of ferrite-cored coils for frequencies of up to about 1MHz can be greatly simplified by the use of the Mullard "RM" series of ferrite cores which are available as two parts together with coil formers, retaining clips to hold the two parts together and, if needed, an adjuster which can be screwed in to set the inductance at any required value in its adjustment range. One of the main advantages is that the inductance value is proportional to the square of the number of turns, so one can use the value quoted for the inductance of a core with a single turn coil to calculate the number of turns required for the value of inductance one needs.

Mullard manufacture 18 types of RM core in ferroxcube grade A13 which provide optimum performance at frequencies of up to 200kHz (the violet range) and another 10 types of RM core of ferroxcube grade A10 which provides optimum performance from 200kHz to 2MHz (the red range). We will consider only two of these types in detail which are readily available to the home constructor. One of these types is an RM6 core with a maximum dimension not exceeding 14·7mm and a height of 12·5mm and the other the larger RM10 core with a maximum dimension not exceeding 24·6mm and a height of 18·7mm. A cross-section through one of these cores, with its coil, is shown in Fig. 1 and the shape of the core alone in Fig. 2. The pins of the coil are positioned so that they will fit into standard 0·1 inch matrix board.

The RM6 core and the RM10 core have an inductance factor, A_L, of 250nH. This means that a single turn coil on this core will have an inductance of 250nH, whilst the approximate number of turns required to produce other values of inductance are shown in Table 1. Other values are easily calculated, since the formula for the number of turns required to make an inductance is:

$$N = \left(\frac{L \times 10^9}{250}\right)$$

where N = Number of turns
L = Inductance in henries

Winding

When winding the coil, the barrel and both flanges of the coil former should be suitably supported, since the former is quite fragile. If the diameter of the wire is less than 0·4mm, no attempt should be made to wind the coil in even layers, but a randomly wound coil, also known as scramble winding for obvious reasons, should be built up as neatly as possible. In the case of wire of diameter greater than 0·4mm, the wire should be wound in layers as far as possible so that the required amount of wire can be packed into the available space. Only the outer parts of the coil may be randomly wound.

If the wire diameter is less than 0·14mm, it is recommended that lead out wires, such as four strands of 0·125mm diameter wire, be used at each end of the coil for joining to the coil former pins. These lead out wires should be covered in a suitable insulating sleeve.

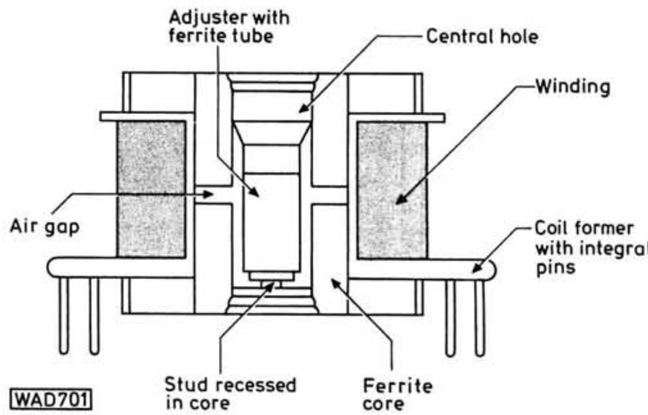


Fig. 1: Cross-section through a RM type core showing the coil winding and the adjuster

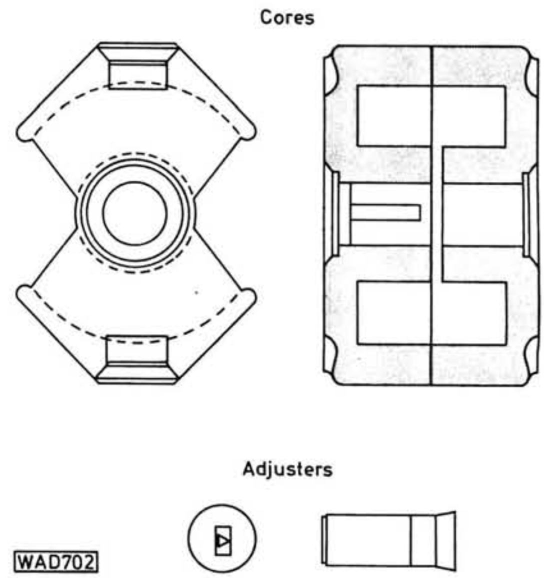
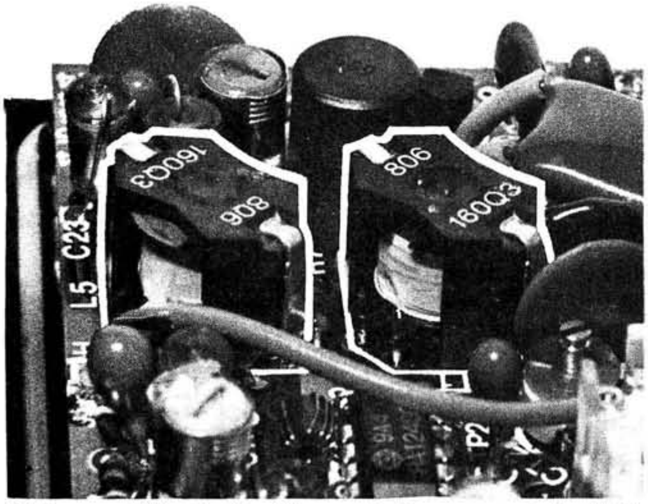


Fig. 2: The shape of the ferrite parts and the adjuster of the RM series



RM cores fitted to the Magnetic Components Lo-Kata digital radio compass

After the coil has been wound, the two halves of the ferrite core should be fitted into it and held by the retaining clips, which provide the required force for a stable assembly. The air gap between the two parts of the ferrite core reduces losses and stabilises the inductance value against any change in the magnetic permeability of the core with temperature and time.

The inductance factor of 250nH for a single turn coil has a 2 per cent tolerance and is the value applicable without any adjuster. When the adjuster is in the mid-position, the value of this factor is increased to about 267·5nH in the case of the RM6 coil under consideration and to about 274·3nH for the RM10 assembly with the adjuster in the mid-range position. Thus the overall adjustment possible is about 14 per cent for the RM6 and about 17 per cent for the RM10 unit. A setting accuracy of better than 0·02 per cent is obtainable in the inductance value.

Losses

At low frequencies the main cause of energy loss is the d.c. resistance of the winding. This can be minimised by the use of the maximum diameter of wire that can be accommodated on the coil former and by the use of the RM10 rather than the RM6 assembly, as there is more space in the RM10 for the coil wire which can therefore be of a larger diameter.

At the higher frequencies (above about 25kHz), the use of bunched conductors or Litz wire will reduce losses and produce a coil of higher Q factor if suitably wound, but for many purposes coils wound in enamelled copper wire will be satisfactory for use up to fairly high frequencies.

In the case of the RM6 coil, Q factors of over 100 can be obtained for the frequency range of 2·5kHz to 700kHz with Q values of over 400 between 20kHz and 50kHz for a 20mH inductor. The RM10 can be used to provide Q factors of over 100 in the frequency range 2kHz to 650kHz, the Q factor peaking at over 300 at 10kHz for a 100mH inductor. All of these values can be obtained using full windings of enamelled copper wire, but the use of bunched wires enables Q factors of 600 for a 1mH inductor at 100kHz to be obtained with the RM6 core and 800 for a 1mH inductor at 75kHz for the RM10 core.

Table 1 gives an approximate idea of the maximum diameter of enamelled copper wire which may be used with the RM6 and RM10 inductors to obtain the inductance quoted; however, much depends on the amount of care taken when winding and it is possible to place considerably more turns of the diameter of wire shown on the former if great care is taken during winding.

Table 1

Turns	Inductance (no adjuster)	Maximum wire diameter (mm)	
		RM6	RM10
1	0·25µH	1·60	1·60
2	1·00µH	1·60	1·60
5	6·25µH	1·06	1·60
10	25µH	1·02	1·60
15	56µH	0·75	1·30
20	100µH	0·71	1·25
25	156µH	0·63	1·12
30	225µH	0·55	1·00
40	400µH	0·50	0·90
50	625µH	0·45	0·80
60	900µH	0·40	0·71
80	1·6mH	0·35	0·63
100	2·5mH	0·31	0·55
120	3·6mH	0·28	0·50
150	5·6mH	0·25	0·45
180	8·1mH	0·22	0·40
200	10·0mH	0·22	0·35
225	12·6mH	0·20	0·35
250	15·6mH	0·19	0·35
275	18·9mH	0·18	0·33
300	22·5mH	0·17	0·31
350	30·6mH	0·16	0·30
400	40·0mH	0·15	0·28
450	50·6mH	0·14	0·25
500	62·5mH	0·11	0·24
600	90·0mH	0·10	0·22
700	122mH	0·10	0·20
800	160mH	0·10	0·19
900	202mH	0·09	0·18
1000	250mH	0·09	0·16
1200	360mH	0·08	0·14
1500	562mH	0·07	0·14
1800	810mH	0·06	0·12
2000	1·00 H	0·06	0·11
5000	6·25H	0·04	0·065
10 000	25H	0·025	0·045

Inductance values produced using either a RM6 or RM10 core with an inductance factor of 250nH. Approximate maximum wire diameters are shown for the two sizes of core for each inductance value.

Conclusion

The RM6 and RM10 cores are very suitable for a wide range of applications ranging from LC filters for audio and other applications to the inductors required for use in switching mode power supplies at currents of up to about 1·5A in the case of the RM10 core or up to about 0·4A in the case of the RM6 core, depending on circuit design. Full design data is given in the Mullard data book, but one must ensure that the flux density in the ferrite does not exceed 1 milli-Tesla for optimum results. It is better to use the larger RM10 core if the current flowing in the winding of the inductor will exceed 200mA, although this is not intended to be anything more than a very rough general guide, as the permissible current is inversely proportional to the number of turns.

Full information about the Mullard RM series of cores is available as *"Book 3, Part 4"* of the *"Mullard Technical Handbook"*.

The RM6 and RM10 ferrite cores, coil formers, retaining clips and adjusters are available from Mullard stockists, or from advertisers (such as C. Bowes Electronics) handling RS Components parts. ●

cheap & cheerful AMPLIFIER

J. A. BRETT

Most readers will from time to time need a simple audio amplifier for such applications as signal tracing in servicing, checking amplifier outputs and, as in the author's case, for providing an amplifier for junior's crystal receiver. The requirements for this amplifier are not critical, a sensitivity of about 50mV into around 100kΩ, and an output to drive a loudspeaker enough to be heard clearly is sufficient. About 10mW is surprisingly loud when the speaker is placed on the bench in front of the listener. As for junior and his using it with his crystal set, this is ideal as it does not disturb the rest of the house.

For convenience of use, a battery powered amplifier was decided on, the emphasis was to be on economy in the choice of components and running costs. The idea of a $1\frac{1}{2}$V single cell became a very interesting challenge. The HP7 size of battery is the ideal choice since if the amplifier is accidently left on and the battery flattened, replacement is not too expensive.

Circuit Design

Operation of a transistor at low voltages is quite satisfactory provided that sufficient voltage is made available to cause the required base current to flow. If one considers a popular, simple way of achieving a high gain by using a Darlington configuration difficulties soon emerge. Referring to the circuit shown in Fig. 1, consider the voltages indicated; to cause an output collector current to flow V_1 and V_2 will each need to be about 0·7V. This means that the input base will have to be biased to around 1·4V, therefore making the choice of resistors difficult for correct bias, and as soon as the battery voltage falls below this level, the circuit will not work.

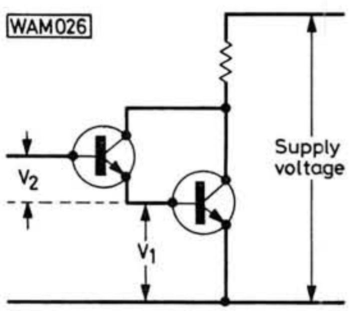


Fig. 1: Circuit diagram of a Transistor Darlington

The idea of direct connection of one transistor to the next is still, however, a desirable component-saving feature. To overcome this voltage problem the idea of connecting in cascade an *npn* and a *pnp* transistor proved to be the solution. This circuit makes use of the fact that the transistor will operate with very low collector-emitter voltages, so long as it is above the bottoming or saturation voltage of the device, this voltage being typically 0·1V. If one transistor is used, at this low collector-emitter voltage, to control the base current of the next transistor, then a voltage as low as 1V will be satisfactory for the supply rail.

In the final circuit this technique is carried out over three transistors giving an *npn-pnp-npn* arrangement, and Fig. 2 shows this final circuit. The input signal is coupled onto the base of the first transistor Tr1 by C1. The transistor then provides an amplified drive to the base of the second transistor Tr2. Similarly Tr2 amplifies the signal and controls the base of the output transistor Tr3.

With so much d.c. coupled gain, drift would be a problem if the standing current in Tr3 was governed only by the bias being set at the input due to the potential divider R2 and R3. By fitting a current sensing resistor R5, in the emitter circuit of Tr3, and decoupling the signal component with R4 and C2, a control voltage can be fed back to the input.

If, due to drift, the current starts to rise, a higher voltage drop will occur across R5. This change in voltage level is fed to the emitter of Tr1-causing the voltage on the emitter to rise with respect to the voltage set by the resistors R2 and R3 on the base of Tr1. The effect of this will be to reduce the base drive to Tr1 causing it to pass less current,

CONSTRUCTION RATING Beginner

BUYING GUIDE

Constructors of the Cheap and Cheerful Amplifier should have no difficulty obtaining the components for this project. The case size will depend on the dimensions of the loud speaker used, therefore no size or type number has been specified.

APPROXIMATE COST £4

this will also reduce the drive to Tr2 and hence the drive to Tr3—thus tending to reduce again the standing current in Tr3.

The circuit therefore tends to be self-stabilising against the effects of circuit-generated drift. The current in Tr3 is determined by the voltage set by the bias resistors R2 and R3 being compared with the decoupled voltage fed back from Tr3. To make the setting of this standing current in Tr3 simpler, one of the two resistors can be replaced by a skeleton potentiometer. It is far easier to adjust a potentiometer than solder in different values of R3.

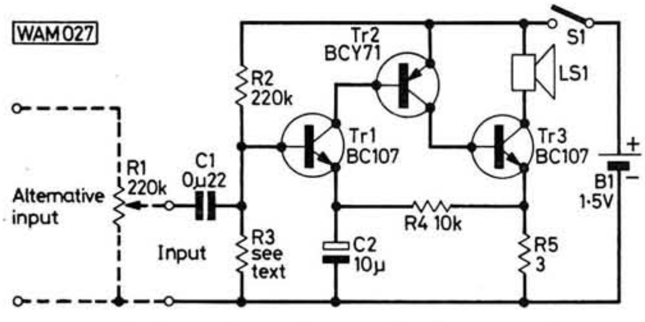


Fig. 2: Final circuit chosen for the amplifier

Construction

The circuit can be built on a piece of Veroboard, and to ensure there are no loops introduced into the circuit which might cause instability, the layout shown in Fig. 3 should be followed. The enclosure is not described in detail since this is fixed by the size and shape of the loudspeaker. The simplest construction is to make a shallow box to mount the loudspeaker and screw the circuit board and battery to the inside. The on/off switch and volume control, if needed, can be fitted through holes in the same face as the loudspeaker or in the side, whichever is the most convenient.

The pen torch cell is mounted in a Terry clip for mechanical support with electrical connection by bent angle brackets, or bent paper clips, screwed to the inside of the box.

★ components

Resistors		
½W 10%		
10kΩ	1	R4
220kΩ	1	R2
330kΩ	1	R3 (see text)
2½W wire wound		
3Ω	1	R5
Potentiometer		
220kΩ log	1	R1
Capacitors		
Polyester		
0·22µF	1	C1
Electrolytic 25V		
10µF	1	C2
Semiconductors		
Transistors		
BC107	2	Tr1,3
BCY71	1	Tr2
Miscellaneous		
3 to 15Ω Loudspeaker; s.p.s.t. switch; 1½V battery.		

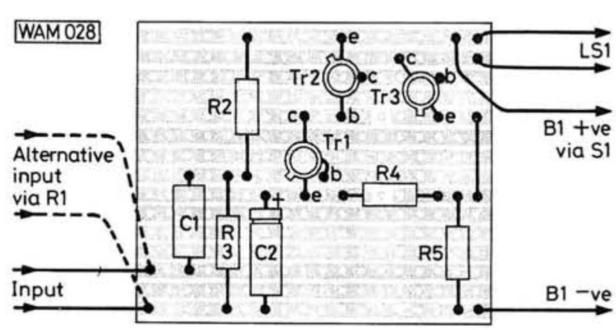
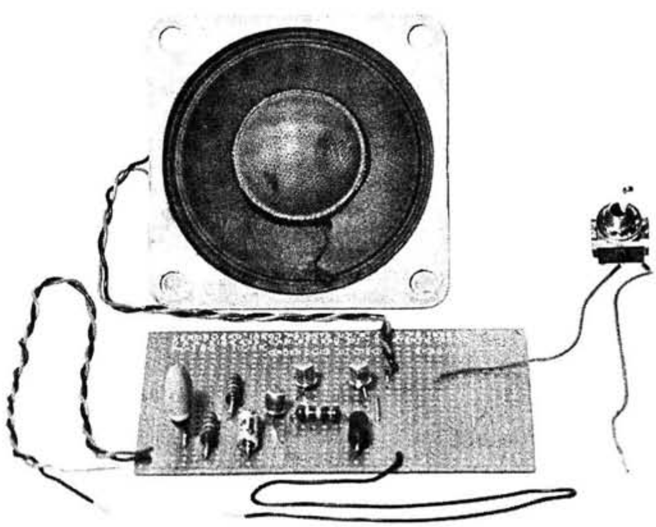


Fig. 3: Veroboard track and component layout diagram. Note the track breaks between Tr2/b and Tr3/e and under R4

Operation

When the amplifier is first switched on (with no input signal), the current in the output transistor must be set. The current is measured by connecting a milliammeter in series with the loudspeaker, or by measuring the voltage across R5 with a voltmeter. With this latter method the current in Tr3 is given by:

V across R5 × 1000mA/3



Photograph of the prototype

For a loudspeaker with an impedance of 3–5Ω, the current should be set to approximately 50mA. For higher impedance speakers up to 15Ω, a setting of about 30mA is used. The current is set by substituting different values of R3 in the range 100kΩ to 330kΩ, or by adjusting the potentiometer, if this has been fitted. Once the potentiometer is set it can be locked in position with a drop of molten wax.

An input signal can now be connected, if this is found to be too loud, or so large that it drives the amplifier into distortion, a volume control can be fitted in the input circuit as shown by the broken lines in Figs. 2 and 3.

The amplifier will work well as the battery runs down to about 1 volt, or until there is an undesirable loss in volume or increase in distortion. The HP7 battery has a capacity of some 400mAH at 30mA continuous discharge before 1 volt is reached. At least 13 hours operation can thus be expected, or 8 hours at the 50mA setting, but in practice with intermittent use the HP7 will give somewhat longer life. ●

DELTA BEAMS for 10&15m

F.C.SMITH GW2DDX

Selecting a beam for best results calls for careful thought, not least of which is cost. The Delta beams described in this article have been thoroughly tested and yielded excellent DX results, which will satisfy the most ardent DX chaser, be he licensed amateur or s.w.l.

Delta beams possess the following desirable points:

(1) A good low angle of radiation
(2) Good directivity
(3) Broad bandwidth
(4) Easy erection and not least, low cost.

The performance of the Delta 2-element beam equals that of a 3-element Yagi, at twice its height above ground. This has been corroborated by the writer whilst working DX stations in JA and VK, who have exchanged exactly the same signal strength reports, but whereas the DX stations' antennas were between twelve and fifteen metres above ground, the bottom leg of the Delta was only five-and-a-half metres above ground. The gain of the Delta should be 5·5dB to 6dB, dependant on reflector spacing. Let us look at the requirements for a good DX antenna.

A low vertical angle of the major lobe is paramount, if the antenna is to work DX consistently. The only factor controlling this angle is the height of the antenna above ground. The reader may well ask: "What is the best height to obtain this condition?" and the answer is that there is no best height, with the seasonal variation in propagation conditions throughout the year. For an all the year angle to work DX, between eight and fifteen degrees should be the most useful under all ionospheric conditions. This would require a 3-element Yagi to be over a wavelength high. With Yagi type parasitic beams it is essential to have the beam at least one half-wave above ground and preferably much higher for best results. With Quad and Delta loop beams, the height at which good DX results may be obtained can be considerably lower. The chief reason for this is that the two half-waves in the loop act in the same manner as a stacked array, with more power from the secondary lobes compressed into the lower primary lobe, enhancing the lower angle and forward gain. The writer has used three Quads in the last ten years and finds the 2-element Delta the better beam. The Delta has a broader bandwidth and improved directivity.

With the bottom leg of the Delta beam only five metres above ground level, a call to VK during most mornings brought a reply at once and this when conditions were not good. All districts of JA were worked over a period: Guam; KH6: ZL; the Solomon Islands; Papua, New Guinea (P29nbf) and to the north-west many W6 and W7s. All this with the writer's 150 watt Viceroy Tx, from a QTH at about 100ft a.s.l. and completely surrounded by buildings.

A word about directivity; the side lobes produced in the down wires of a Quad to some extent mask the directivity of this popular beam. The writer can give no factual premise for his belief that these side lobes are absent in the Delta, other than the difference in the configuration of the latter. The absence of these side lobes would account for the better directivity of the Delta over the Quad and having used Quads as mentioned, it is found that the beam heading of the loop is more definable, with the half-wave points of the horizontal pattern some degrees narrower than the Quad. It must, however, be emphasised that these observations are based purely on practical use of both these antenna types over a long period.

Of course, the 15m-band Delta can be interlaced, as with the Quad antenna, to include the 10m-band elements, making it a single beam for the 10m and 15m bands. It would then be advisable to feed each driven element separately to obtain a good feed point match, thus requiring two feed lines. In the writer's case, the 72Ω feed line from an antenna tuning unit gave a very good match to each single beam element, with a very low standing wave ratio. The a.t.u. needed no adjustment over half the band once set.

Construction

The first stage of construction is the assembly of the top boom member. This is fitted with insulator rings at each end to allow the element wire to pass through. The top boom is supported, as shown in Fig. 1, by a rope spreader and can be hauled into position at the head of the mast by a suitable pulley rope.

CONSTRUCTION RATING Intermediate

Materials required to construct the Delta Beam antennas should be available from hardware and d.i.y. shops. For transmitting use readers will have to be prepared to shop around for the transmitting type capacitors. For receiving only any air spaced capacitor can be used.

APPROXIMATE COST £12

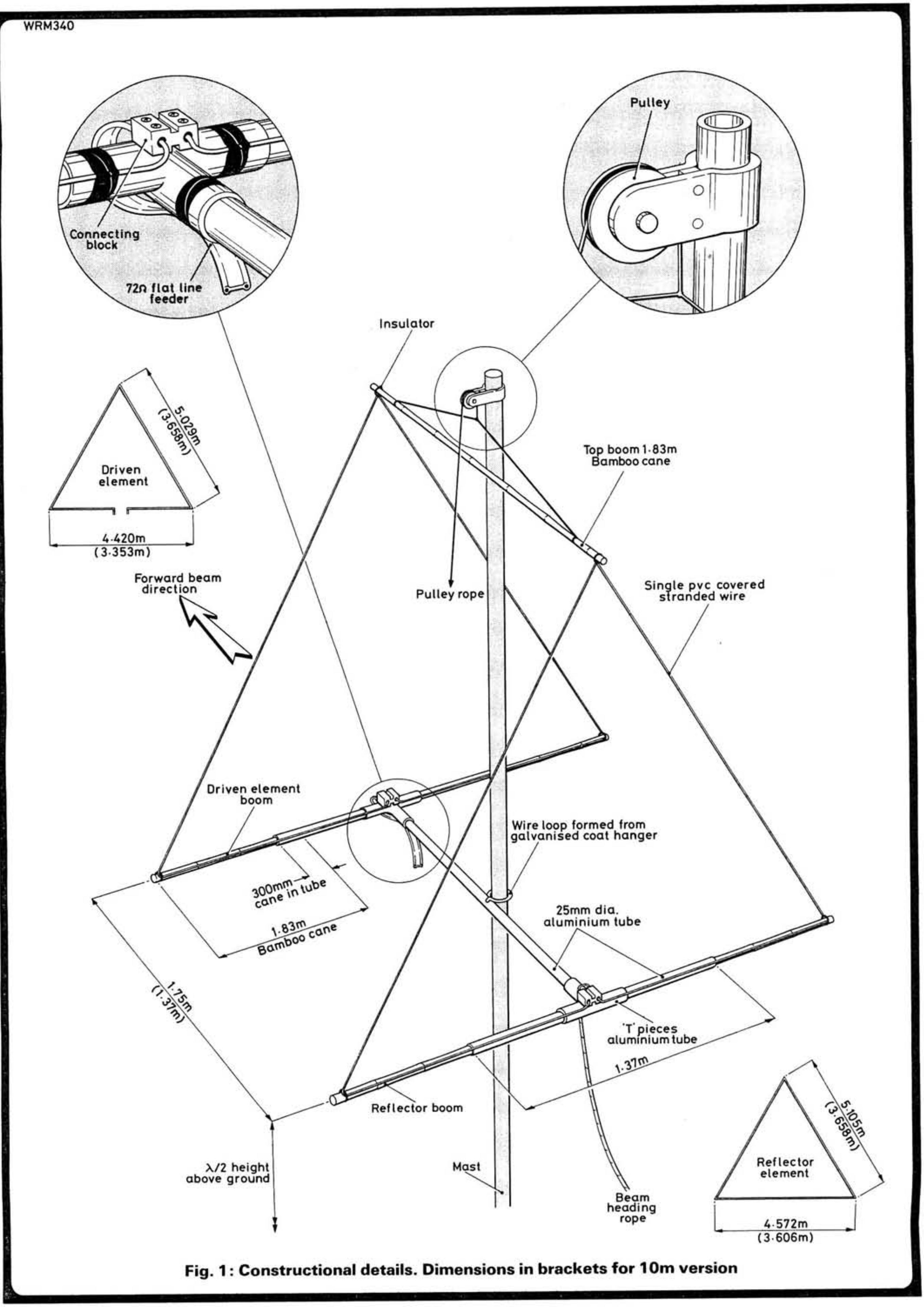


Fig. 1: Constructional details. Dimensions in brackets for 10m version

Next, the lower boom is constructed to the dimensions and layout given in Fig. 1. Originally, aluminium tubes were used but as an alternative, heavy wall plastic tubing could be substituted. Ensure the bamboo canes are a good fit inside the tubes, if not cross-pin to secure.

Having completed the boom sections, measure out the correct length of wire, for the required operating frequency, to form the driven element. This is then fed over the top boom insulator, down to the lower boom ends and through the curtain rings to terminate at an electrical connector block fixed at the centre point. The reflector element is prepared in the same manner with the principal difference being a link at the connector block to provide a "closed loop." As an alternative, the reflector may be soldered at its centre point but this method is less useful if it is wished to g.d.o. the reflector.

The 72Ω flat line feeder is terminated to the driven element connector block, with its length determined to suit individual station requirements. Before elevating the assembly fit the wire loop around the mast. This really does stabilise the beam when in the final position. Beam headings can be varied by attaching a rope to the lower boom centre point.

Antenna Tuning Unit

The a.t.u. shown in Fig. 2 consists of two 140pF wide spaced variable capacitors ganged together with an insulated shaft and in series with a six to eight turn coil, 75mm in diameter and 32mm long. A two turn link winding in the centre couples to the p.a. output.

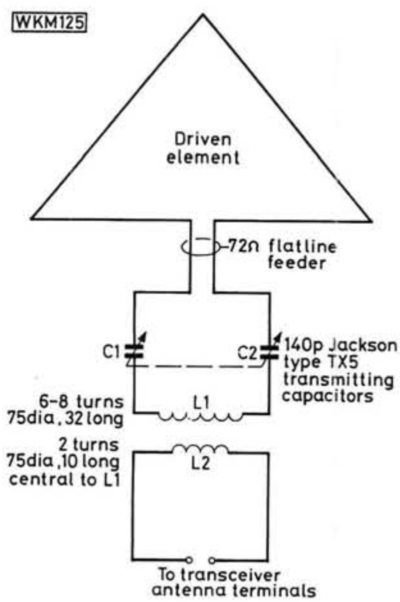


Fig. 2

Setting Up Procedure

A grid dip oscillator (g.d.o.) is used to set the antenna up. Tune the 15m-band beam to 21·3MHz and the 10m-band to 28·8MHz. The measurements given should prove to be very near the ideal. There is no need for adjustment of the reflector.

The beams are now tuned for forward gain. Tuning up is best done with the antenna between eight to ten metres above ground level and standing on a step ladder.

The beam can now have the feed line attached and be hoisted up on the mast. The ideal height for DX working, with the Delta, is at a half-wavelength above ground to the base of the beam. On the 15m-band this will be seven-and-a-half metres and on the 10m-band, five metres. ●

GAREX (G3ZV1)

RESISTOR KITS a top-selling line for many years. E12 series, 5% carbon film, 10Ω to 1M, 61 values, general purpose ratings ¼W or ½W (state which)
Starter pack 5 each value (305 pieces) **£3.10**
Standard pack 10 each value (610 pieces) **£5.55**
Mixed pack, 5 each ¼W + ½W (610 pieces) **£5.55**
Giant pack, 25 each value (1525 pieces) **£13.60**

NICAD RECHARGEABLES physically as dry cell: AA(U7) **£1.30;** C(U11) **£3.35;** PP3 **£5.55.** Any 5+: less 10%, any 10+: less 20%.

AMPLIFIER MODULE new, fully assembled 6W IC unit, 12V DC. Low impedance (4-8Ω) input and output for extn. speaker amplification, with circuit **£2.75**

CRYSTALS FOR 28.5MHz 3rd. overtone, suit most 'CB' rigs. 28.5MHz Tx and 28.045MHz Rx. HC18U **£4.60 per pair**

CRYSTAL FILTER 10.7MHz, 12½kHz channel spacing, ITT type 901C **£6.90**

CO-AXIAL CONNECTORS & ADAPTORS sae full list.

PL259 UHF plug with reducer **75p;** S0239 UHF socket, panel mtd. **60p;** 2 × **SO239** inline coupler **£1;** 2 × **PL259** inline coupler **£1.** Any 5+ connectors: less 10%

PYE CAMBRIDGE SPARES (our speciality, sae full list). Ex. equip., fully guaranteed. Rx RF board 68-88MHz **£5.95.** 10.7MHz I.F. **£3.65.** 2nd mixer 10.7MHz to 455kHz **£3.** 455kHz block filter 12½kHz **£9.40,** ditto 25kHz **£3.** 455kHz AM I.F. **£3.65.** Audio bd. **£1.95,** and many more. Vanguard & Westminster spares also.

MONITOR RECEIVERS
SX-200 VHF-UHF AM-FM SCANNER
Covers 26-88MHz, 108-180MHz and 380-514MHz, AM + FM, it scans, seeks, memorises and beats all the others. Sae full details.

HF-12 POCKET SIZE FM 12 channel xtal controlled. 4MHz bandwidth in range 130-174MHz. With nicad and charger **£57.95** Xtals extra, see below.

SOUNDAIR 008 PORTABLE FM SCANNER 8 channel xtal controlled 140-170MHz. With nicad and charger. **£59** Xtals extra.

SR-9 top-selling monitor: 2m FM with 144-146MHz full coverage VFO + 11 xtal controlled channels; ideal for fixed, /M, /P use. 12V DC operation **£47.50**
Marine band SR-9, 156-162MHz, same spec. and price.

CRYSTALS FOR NR-56, SR-9, SR-11, HF-12, SOUNDAIR, TM-56B All 2m channels from 0 (145.00) to 32 (145.80) incl. at **£2.46** (+**15p** post per order). Over 40 popular marine channels at **£2.85** (+**15p** post). Non-stock xtals made-to-order in 3 weeks at **£4.30** each. Sae list.

'SCAN-X' VHF/UHF BROADBAND FIXED STATION AERIAL £19.90 Ideal for SX-200 and other VHF/UHF receivers.

We also stock the:
KDK 2025 2m SYNTHESISED TRANSCEIVER Full band coverage 25 or 12½kHz steps/10 channel memory/scans memories or selected band portion/3W or 25W Tx/all the features you need at **£225**

YAESU FRG 7700 GENERAL COVERAGE RECEIVER 150kHz – 30MHz AM/USB/LSB/CW **and** FM **£309**

MAINS PSU British made by GAREX 12 volt 1 Amp regulated **£15.95**

MAIN DISTRIBUTOR OF REVCO AERIALS & SPECIAL PRODUCTS (trade enquiries welcome)

Access

PRICES INCLUDE UK POST & PACKING & 15% VAT.

GAREX ELECTRONICS
7 NORVIC ROAD, MARSWORTH, TRING, HERTS HP23 4LS.
Phone 0296 668684. Callers by appointment only.

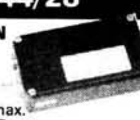
BARCLAYCARD VISA

MICROWAVE MODULES LTD

HAVE YOU BEEN CONVERTED?

Our wide range of high quality VHF & UHF frequency converters and preamplifiers will expand your existing equipment (YAESU FRG7, TRIO R1000, etc.), to provide coverage of the ever-popular VHF & UHF bands, at the least expense possible. No modifications to your equipment are necessary. Just put one of our converters in place of your existing aerial connection, connect a suitable aerial, a 12 volt DC supply – and that's all there is to it!!
DO YOURSELF AND YOUR RECEIVER A JUSTICE, BUY ONE OF OUR TOP QUALITY PRODUCTS – AND SEE WHAT YOU'VE BEEN MISSING!!

MMC 144/28



2 METRE DOWN TO 10 METRE CONVERTER
Gain: 30dB typ.
Noise figure: 2.5dB max.
Image rejection: 65dB typ.
Our "old faithful" will give you a 2 metre facility, immediately.
JUST £27.90 inc. VAT
(p+p 80p)

MMA 144V

2 METRE ULTRA LOW NOISE RF SWITCHED PREAMPLIFIER
This preamplifier is an essential addition for the serious operator.
Gain: 15dB typ.
Noise figure: 1.3dB max.
This unit is designed to be left in the aerial lead at all times, and will accept a through power of 100 watts.
£34.90 inc. VAT *(p+p 80p)*

MM 2000

RTTY TO TV CONVERTER
This *NEW* converter contains a terminal unit and a microprocessor controlled TV interface, and requires only an audio input from your FRG7, TRIO R1000, or similar, and a 12 volt DC supply, to enable a live display of "off-air" RTTY and ASCII signals on a domestic UHF standard TV set.

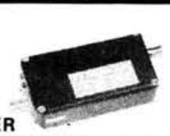
FEATURES INCLUDE:–
- ★ Complete terminal unit/TV interface
- ★ Automatic speed sensing
- ★ Microprocessor controlled
- ★ Will accept RTTY and amateur standard ASCII

ALL THIS FOR JUST £169
inc. VAT
(p + p £2.00)

MMC 70/28

4 METRE DOWN TO 10 METRE CONVERTER
Gain: 30dB typ.
Noise figure: 2.5dB max.
Image rejection: 65dB typ.
JUST £27.90 inc. VAT
(p+p 80p)

MMA 28

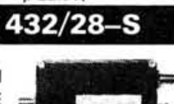


10 METRE LOW NOISE PREAMPLIFIER
Now that the winter months are nearing, and HF conditions will be better, hot up the performance of your 10 metre receiver with this low-noise preamp.
Gain: 20dB typ.
Noise figure: 1.8dB max.
£14.95 inc. VAT
(p+p 80p)

MMC 28/144

10 METRE DOWN TO 2 METRE CONVERTER
For those of you with an existing 2 metre receiver, here is a simple means of listening to the 10 metre band.
Gain: 15dB typ.
Noise figure: 1.8dB max.
£27.90 inc. VAT
(p+p 80p)

MMC 432/28–S



70 CM DOWN TO 10 METRE CONVERTER
(with dual range coverage)
This 70cm converter covers 432-434 MHz and 434-436 MHz in two switched ranges, both for an IF output of 28-30 MHz. This facility allows satellite and repeater coverage as well as the usual simplex mode.
Gain: 30dB typ. Noise figure: 3.0dB max.
Also available with an IF of 144-146 MHz – (MMC 432/144–S).
£34.90 inc. VAT
(p+p 80p)

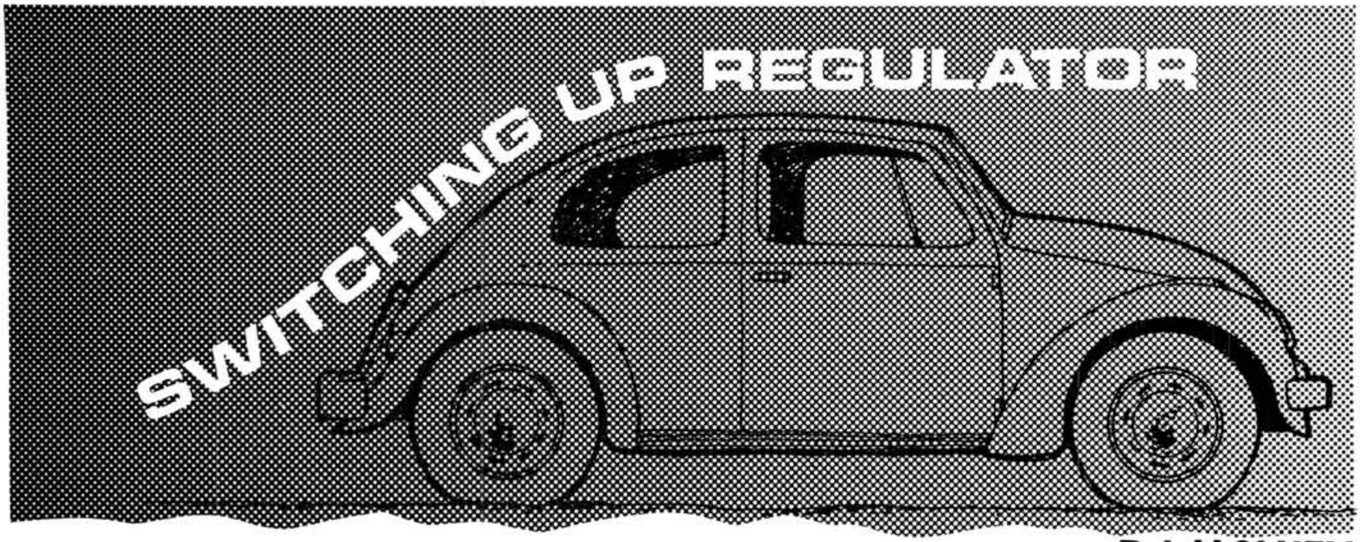
BARCLAYCARD AND ACCESS WELCOME

Buy it with Access · BARCLAYCARD VISA

MICROWAVE MODULES
BROOKFIELD DRIVE, AINTREE, LIVERPOOL L9 7AN, ENGLAND
Telephone: 051-523 4011 Telex 628608 MICRO G
Callers are welcome, please telephone first.

Your orders and enquiries will be dealt with both efficiently and courteously by our experienced sales dept. Monday-Friday, 9-12.30, 1-4.30 pm.

SWITCHING UP REGULATOR



D. L.H.SMITH

The circuit presented in this article has been developed to provide a source of 12V d.c. from vehicles equipped with 6V systems. By using the regulator "in-car" equipment requiring a 12V supply may be used in such vehicles without the necessity of converting the complete supply generation system.

Circuit Description

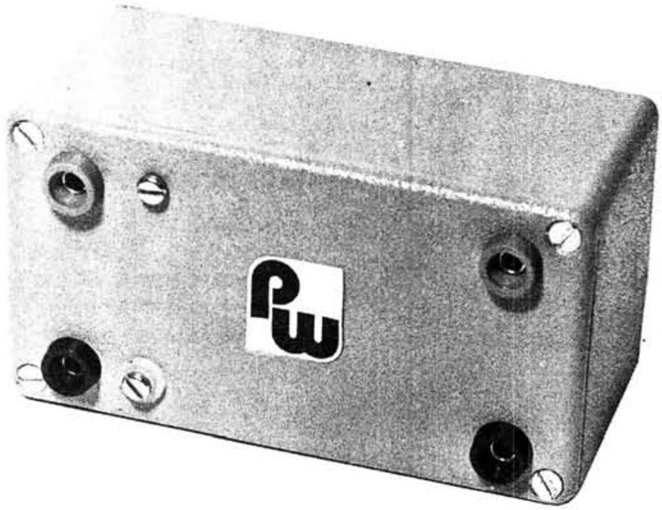
The circuit shown in Fig. 1 is a "switching-up" regulator. When IC1 turns Tr1 on, energy is stored in the inductor L1. Diode D1 prevents any current flowing to the output. When Tr1 is turned off, the energy flows from the inductor via D1, the commutation diode, into C4 developing a voltage across it. Resistors R1 and R2 provide voltage feedback to IC1. As more current is drawn from the output, so Tr1 is turned on and off more rapidly, up to the maximum frequency of about 25kHz, thus keeping the output voltage constant. Capacitors C1 and C5 are included to provide a degree of r.f. suppression. The 12V output is at an absolute maximum of 1·1A. Because of the high peak currents the commutation diode is a fast recovery type and the specified device or direct equivalent must be used.

CONSTRUCTION RATING **Beginner**

BUYING GUIDE

Constructors of this project should find the integrated circuit available from suppliers who usually stock Texas components. The box was a RS painted diecast box, these are available through advertisers in the magazine.

APPROXIMATE COST **£12**



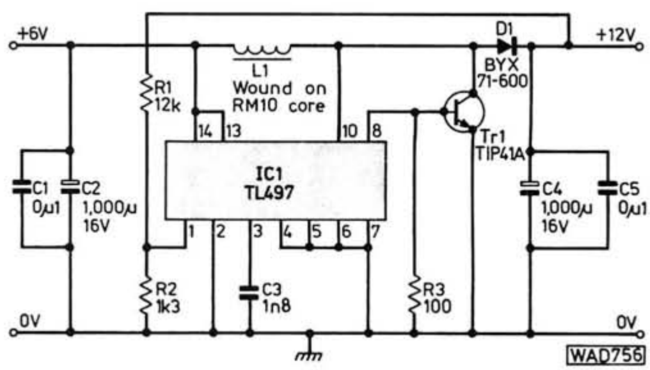
Construction

The prototype regulator, shown in the accompanying photographs, was built on a conventional 0·1in pitch Veroboard. No special handling techniques are required and normal constructional practices will suffice.

The inductor, L1, is made by winding 18 turns of 20 s.w.g. enamelled copper wire onto a Mullard RM10 series ferrite core. This winding should be in a neat single layer, retained with a small application of fast setting adhesive.

Transistor Tr1 and diode D1 should be mounted onto a suitable heatsink and electrically isolated by use of the

continued on page 69 ▶▶▶

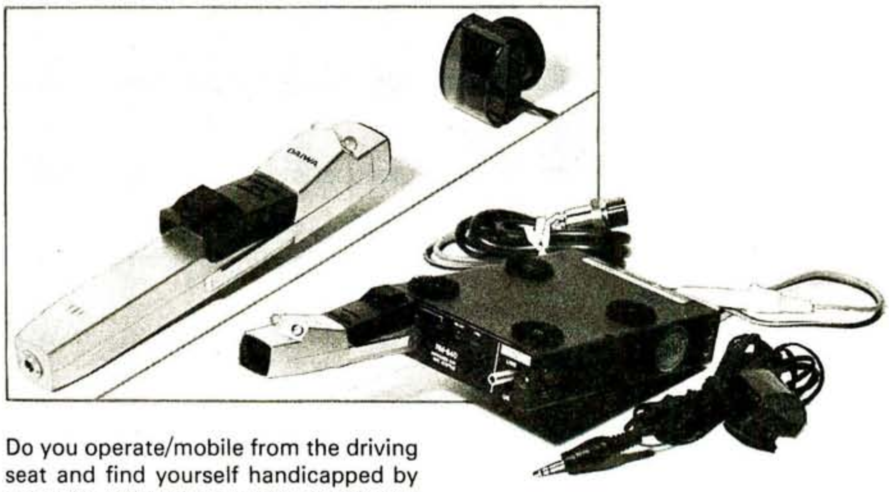


Circuit diagram of the Switching-up regulator

air test

USER REPORTS ON SETS AND SUNDRIES

DAIWA RM-940 Infra-red Mobile Mic. System



Do you operate/mobile from the driving seat and find yourself handicapped by normal hand-held microphones? If you don't, congratulations on your rare ability. For those of us wishing for the freedom to operate and drive with equal efficiency, the RM-940 Infra-red Mic. attempts to adjust the balance.

The system is based around an infra-red optical link which conveys speech modulation and p.t.t. line control functions between the remote microphone and associated receiver. Operation is conventional but arranged with the microphone hanging pendant-like on the operator's chest, approximately 100mm below mouth level. Depressing the latchable p.t.t. switch activates the self-contained NiCad powered infra-red transmitter, housed within the microphone body, allowing a beam of light to pass from the transmitter transducers to those of the receiver.

The receiver, which is powered from the 12V vehicle supply, is mounted in a convenient position along the dashboard with its optical sensor head prominently located near to the head lining and sun visor. When not in use, the microphone is inserted into a charging receptacle in the receiver front panel, providing continuous float charging of the internal battery. Indication of ON AIR state is given by a panel mounted red l.e.d. and the emission of a single "ping" from the internal piezo bleeper. To accommodate the various non-standardised wiring of microphone plugs, three separate versions of the RM-940 are available.

The review sample was connected to a Trio TR-7800 mobile transceiver and installed in a small estate car that placed the remote microphone within a metre of the optical sensor. In this location modulation response levels were found to be comparable with normal hand-held microphones. The RM-940 does not have provision for audio level adjustment, so variations in drive levels, if necessary, must be made in conjunction with the transceiver being used. Maximum response was obtained within a radius of one metre and increasing range rapidly reduced signal strength, until a full QSB fade out occurred! Provision is made for the addition of a second optical sensor to obtain a wider coverage or, as suggested in the application notes, to allow use of the system from the rear seats of the vehicle.

The RM-940 Mic. System costs £46.50 including VAT and carriage and is currently available from **Lowe Electronics Ltd., Chesterfield Road, Matlock, Derbyshire,** to whom go our thanks for the loan of the review unit.

Yaesu FRG-7700 Follow-up

When we reviewed the new Yaesu FRG-7700 communications receiver in our December 1980 issue, we commented adversely on the very large number of spurious signals which were present on the pre-production model which we had tested. By the time that the review appeared in print, production models of the receiver had arrived in the UK, and we have now been able to check one of these out.

Our latest tests showed the FRG-7700 to be very free of spurii, in fact, it is one of the best synthesised receivers we have tried from this point of view. Obviously, Yaesu have tackled this problem very effectively. The noise blanker on the production model also seemed a lot more efficient.

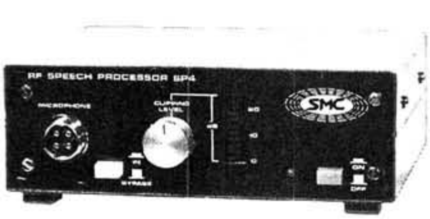
As mentioned in the original review, two antenna inputs are provided on the FRG-7700. For frequencies below 2MHz a 500Ω unbalanced input via a spring terminal is provided. For frequencies above 2MHz, the input is 50Ω unbalanced, via paralleled spring terminal and SO-239 (UHF) socket. Our latest tests showed that the FRG-7700 does not like having a directly-connected long-wire antenna above 2MHz. Such an antenna should be connected via an antenna tuning unit (always good practice anyway), or a matched 50Ω antenna used, otherwise problems can arise due to intermodulation of strong h.f. broadcast band signals. We understand that Yaesu now stress this particular point themselves. The other thing to remember is that the "medium wave" antenna must be disconnected when on h.f., otherwise similar difficulties can arise.

We are happy to be able to give the FRG-7700 a clean bill of health following our latest tests—just remember to watch the antenna systems you use.

We are grateful to **Amateur Radio Exchange** for the loan of the production model of the receiver, and to **South Midlands Communications** and **Amateur Electronics UK** for the provision of facilities and information.

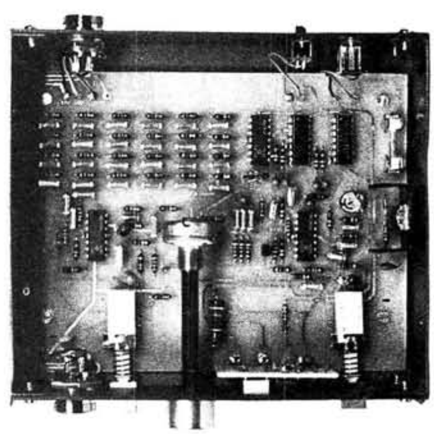
SMC SP4 RF Speech Processor

Designed and built in the UK, the SP4 Speech Processor is an aid for the serious amateur DX operator. Inserting this device between microphone and audio input socket on s.s.b. transmitters results in a substantial effective increase in "talk power".



Within the unit the applied audio input signal is converted to r.f. by mixing, filtered, clipped to remove excess bandwidth and subsequently processed to provide an audio output of constant level within the audio range. When applied to a transmitter the modulated r.f. signal is of a sustained average level and not dependant on the fluctuations in amplitude produced by the vocal tract of the operator. Received, processed speech, when correctly set up is not harsh but sounds "compressed", syllables holding to within close relative levels. Due to the increased average r.f. levels obtained from a transmitter when driven by a processed audio device, conventionally modulated transmitters would require additional r.f. amplification to produce equivalent received signal strength reports.

Operating tests of the SP4 were conducted in conjunction with the reviewer's ICOM 202–S 2m s.s.b. transceiver. A conventional "oriental" four pin mic. socket is fitted to the SP4 front panel, adjacent to the BYPASS push-button which allows "straight through" connection. Setting up is accomplished by the use of a monitor receiver or "captive" local and consists of adjusting the output level potentiometer, accessible from the rear panel, to a point just below that which creates discernible audio distortion, with the clipping level control set at maximum. The level control is then backed off to the setting that allows all the elements in the l.e.d. display to illuminate under peak modulation. In



use the display gives a continuous visual monitor of the clipping level.

The processor is provided complete with a 12V d.c. power supply which connects to the unit via rear mounted socket. Internal construction consists of a double-sided p.c.b. on which is mounted the audio processing components and the polyphase network for deriving s.s.b.

The SMC SP4 RF Speech Processor is available from **South Midlands Communications Ltd., S.M. House, Osborne Road, Totton, Southampton SO4 4DN.** Price £60 plus carriage and VAT.

SWITCHING UP REGULATOR

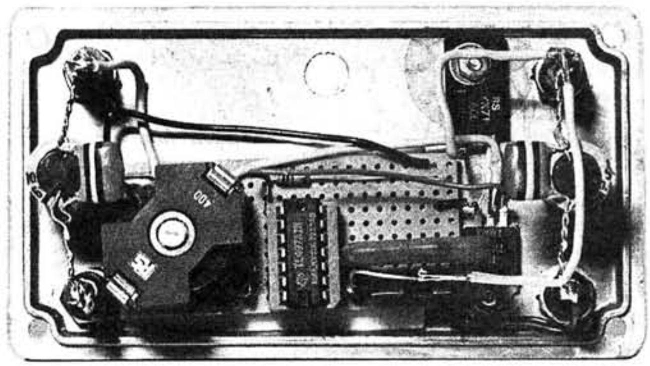
▶▶▶ *continued from page 66*

★ components

Resistors		
¼W 5% Carbon		
100Ω	1	R3
1·3kΩ	1	R2
12kΩ	1	R1
Semiconductors		
Integrated Circuits		
TL497	1	IC1
Transistors		
TIP41a	1	Tr1
Capacitors		
Silver Mica		
1800pF	1	C3
Polyester		
0·1μF	2	C1,5
Electrolytic, p.c.b. type		
1000μF 16V	2	C2,4

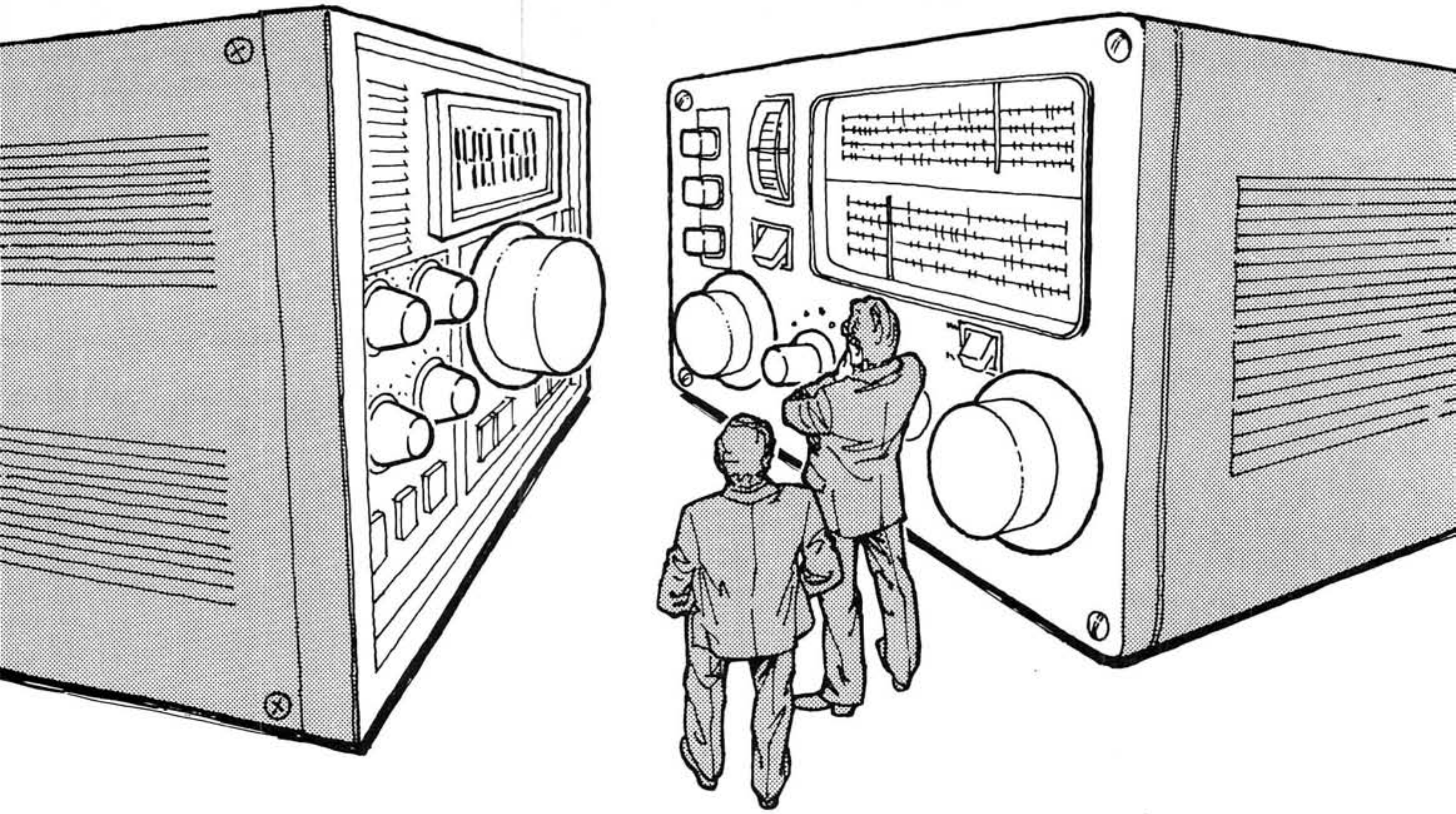
Miscellaneous
Ferrite core Mullard RM10; Diecast box 114 × 64 × 55mm; 4mm sockets red (2); black (2); Veroboard.

supplied mounting hardware kit. **Do not forget to use heatsink compound.** The enclosure used in the prototype was a diecast box and this is recommended for its heatsinking and screening abilities. By using 4mm terminals for input/output connections the whole circuit may be housed on the box lid.



Photograph of the prototype

Having completed construction and checked to verify the correct output voltage is present, with a 6V input, the unit may be installed in the vehicle. It is strongly recommended that "in-line" fuses are used in both input and output lines. If the device being supplied from the regulator is a radio it may be necessary to fit additional supply line suppression filtering. If this proves to be the case fitting a combination of "in-line" chokes and 0·1μF capacitors across the 12V output leads should reduce the breakthrough to an acceptable level. ●



PART 2

Peter CHADWICK G3RZP

UNDERSTANDING RECEIVER PARAMETERS

Part 1 of this article considered the major parameters of sensitivity, selectivity and spurious responses. In this concluding part remaining parameters and their specification are investigated.

Intermodulation Distortion

One of the most important of these parameters is intermodulation distortion (i.m.d.). This is a phenomenon, which in its simplest form involves only two signals that have been distorted such that it appears that the harmonics and fundamentals mix to produce spurious frequencies. In an s.s.b. transmitter, which is the simplest case to consider, the application of two signals produces related output frequencies. For example, if a s.s.b. transmitter is set up radiating a two-tone signal such that the tones are represented by radio frequencies of 7050kHz and 7051kHz, then intermodulation acts, just as if harmonics on 14 100kHz and 14 102kHz were mixed with these fundamental frequencies, to produce outputs of 14 102kHz–7050kHz and 14 100kHz–7051kHz. These resultant frequencies are 7052kHz and 7049kHz and because they are caused by the curve relating input and output of an amplifying stage having a cubic relationship, they are called third order products. The relative levels of this form of distortion can be seen in Fig. 4, as well as that of the higher order products, producing signals at 7048kHz and 7053kHz (fifth order products) and 7047kHz and 7054kHz (seventh order products). It may be asked: "What has this to do with receivers?" The answer is that if the mixer or r.f. amplifier stage suffers from this form of intermodulation, a wanted signal could be lost. For example, if a receiver was tuned to 7050kHz and strong signals existed at 7060kHz and 7070kHz, the third order intermodulation product on 7050kHz could well drown out the wanted signal. Furthermore, a strong signal on 7080kHz could produce fifth order intermodulation and so on. In fact, the result is that a lot of signals combine to produce a high noise level and the receiver appears noisy. It is only in recent years that intermodulation in receivers has been considered important and this realisation has been hastened by the introduction of solid-state receivers, the majority of which offer worse performance than the valve receivers they have replaced. It has been said that intermodulation distortion problems rarely occur in on-the-air use (*QST,* Nov 1979 pp 48–9), but this is an opinion with which the author definitely disagrees. For example, in the 1979 s.s.b. Field Day, it was very noticeable that the 21MHz band appeared to have weak carriers every 10kHz up the band and each carrier was accompanied by garbled modulation. This was high order i.m.d. occurring in the receiver front end.

Testing for i.m.d. is relatively simple. Two signal sources are suitably combined and the resultant signal fed to the receiver at a level that produces i.m.d. Normally, one of the sources is switched off and the receiver tuned to the frequency at which the measurement is to be made. The level is adjusted to some convenient point such as 1μV and the SINAD or signal-to-noise ratio measured and/or the audio output noted. The two generators are then set to frequencies that will ensure the i.m.d. product is on the frequency to which the receiver is tuned—e.g., at −10kHz and −20kHz from the tuned frequency. The level of the two generators is then increased until the output is equivalent to a 1μV input and the output level of the generators measured. Both generators need to have equal outputs for the measurements to be readily compared with other equipment, and the method of combining the generators has to be carefully considered if the measurement is not to be that of the generator's own i.m.d! Fig. 5 shows the test set-up used. In practice, measurements of this type are a little artificial, since there are not two but a multiplicity of signals present at the input of the receiver. It can be shown by comparison of input powers at the input of the r.f. amplifier and mixer stages, that quite accurate predictions of the noise level caused by i.m.d. can be made from the data generated by the two-signal test.

Dynamic Range

Intermodulation distortion measured in this way relates very well to the concept of Dynamic Range. Dynamic Range very frequently means all things to all men but can be usefully defined in one or two ways. The best definition relates to the Intermodulation Intercept Point—shown in Fig. 6. This point occurs because the power level of the i.m.d. product rises with increasing input level faster than the signal. For example, at an output level of 0dBm (0dB relative to 1mW in 50 ohms, or 223·6mV), the i.m.d. products might be −40dBm, corresponding to a 40dB i.m.d. ratio. If the input was raised by 10dB and the system was capable of handling the larger signals involved, the output would be 10dB higher, at 10dBm, with the 3rd order i.m.d. products 30dB higher, at −10dBm. The i.m.d. ratio would now be 20dB. So for every increase in signal level by 10dB, the i.m.d. ratio decreases by 20dB, and eventually, the i.m.d. power level would equal the wanted signal. In practice, the output signal would reach gain compression first and the wanted signals would not increase by 1dB for every 1dB of increase of input signal. Below the point where this occurs however, the ratios can be easily calculated and if for example the ratio for 0dBm input is 40dB, then for 20dBm it will be 0dB and the intercept point 20dBm.

The dynamic range of a receiver is the range of input signals over which i.m.d. products can be ignored, i.e., they are below the noise. So the higher the minimum detectable signal level is for any given intercept point, the smaller the dynamic range; see Fig. 7. A useful practical definition of dynamic range is two thirds of the difference in dB between noise floor and intercept point, but readers should be very careful of assuming that a statement of so many dB of dynamic range in an advert means that!

In practice, however, we have to make some assumptions and some simple calculations to decide what sort of figures we require for intermodulation performance and thus dynamic range. For example, on the 7MHz band at night, we are probably not going to usefully detect a signal of less than 1μV. This would probably give us a 10dB signal-to-noise ratio, at which point on s.s.b. the readability would be about 90 per cent. If we allow degradation of this signal-to-noise ratio by i.m.d. products to reach 7dB, the noise would be equal to the i.m.d. power, and both would be at −10dB on 1μV. Unwanted broadcast stations would be at levels of around S9 plus 40dB, which would probably be about 10mV to 15mV. 10mV is plus 80dBμV, so we are asking that the internal i.m.d. be −90dB on 10mV. 10mV is equal to −27dBm, so the i.m.d. is −90dB on −27dBm. At 0dBm, the i.m.d. power is three times larger, or −9dBm, corresponding to an intercept point of 4·5dBm. However, this takes account only of the two signals and the other power will cause a worsening of the noise floor. So an intercept point of around the 10dBm mark is probably the worst that can be tolerated for high performance receivers and very very few amateur receivers come anywhere near to this.

In practical terms, this results in weak signals at these levels not being heard and it is then that the addition of an aerial attenuator shows up to best advantage. In the previous example, insertion of a 3dB attenuator pad in the aerial lead would produce the same level of signal-to-noise but the i.m.d. products would have dropped by 9dB, so that the necessary intercept point would become around 0dBm.

From this, it may seem that a very good receiver would need input signals of about 10mV to 20mV to produce a third order i.m.d. product of about 1μV. This receiver should produce weak signals on 7MHz at night that can't be heard on other receivers and will also be very good for the h.f. broadcast DXer. Incidentally, the h.f. BC band DXer is in a somewhat worse case than the amateur, since the BC bands have the majority of their users on fixed channel spacings, so the i.m.d. products fall exactly on the other channels! Further the power levels are very much higher.

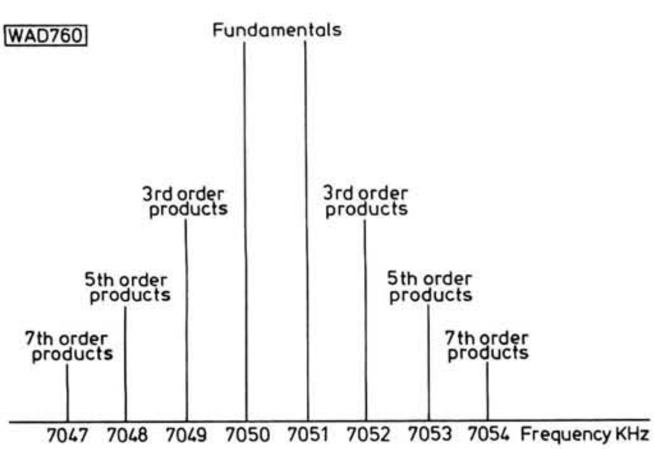


Fig. 4: Odd order Intermodulation Products on signals at 7050kHz and 7051kHz

Cross Modulation

Intermodulation distortion is a relatively simple concept to illustrate, and Figs. 4, 6 and 7 should have made this phenomenon fairly clear. Cross modulation is a related phenomenon and in its simplest form is the transfer of the modulation of one signal onto the carrier of another. It was first noticed in the early 1930s, when medium-wave broadcast stations began to proliferate and was generally cured by the substitution of a variable mu valve for the "straight" tetrodes or pentodes of those days. Like intermodulation, it is caused by non-linearity in the active devices and in the 1930s case, was caused by the valve being non-linear when driven by a big signal whilst being biased back to receive a fairly large wanted signal. Certain of the more naive textbooks of the '60s were of the opinion that cross modulation (c.m) disappeared with the advent of the variable-mu, remote cut off, pentode but unfortunately this is not so. Nevertheless, it is by no means so common as might be believed if one listens to the 80 metre band! Cross modulation is related to i.m.d. by a fairly complex

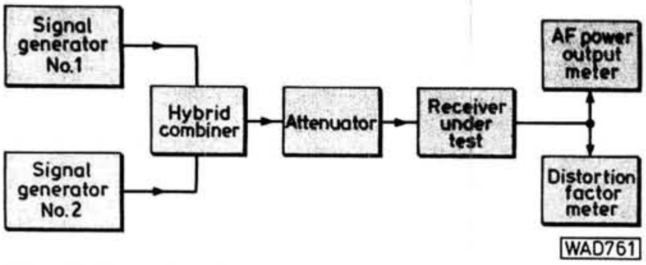


Fig. 5: Two signal test set-up. Note the attenuator—this ensures a good match for the combiner which otherwise will not function correctly. 14dB is a convenient value as most combiners lose 6dB, giving a total loss of 20dB

mathematical relationship, which shows that in general, i.m.d. products will be heard before c.m. products.

Discussion so far has centred around the odd order products and c.m. is related to third order distortion. Nevertheless, even order i.m.d. does exist, but often is not a great problem unless f.e.t.s are in use in the front end. Even order distortion results in strong signals mixing together to produce a spurious signal at the tuned frequency. For example, if a receiver is tuned to 7000kHz and strong signals at 4000kHz and 11000kHz appear, second order i.m.d. produces an interfering signal by direct mixing of the two. Field effect transistors are square-law devices, which makes their response immunity to c.m. and odd order i.m.d. very good, but does make them prone to even order problems. Usually, two or three tuned circuits of reasonable Q get round most of this problem, but wide-band, up-conversion receivers with no band-pass filters in the early stages can suffer quite badly from this phenomenon. However, if it can be arranged that a filter less than an octave wide can be inserted ahead of the receiver, the problem can usually be reduced to manageable proportions. This is the reason for the inclusion of the "sub-octave" filters in so many professional designs.

Blocking

Blocking tests normally manage to give pretty good answers. Blocking appears as a degradation in the output of a receiver when a fairly close in frequency signal is increased in level. Generally, the wanted signal output level suddenly drops and the 3dB blocking level occurs where the wanted signal has decreased by 3dB. Even the poorest of modern receivers seems to manage to stand around the 30mV or so mark before this happens and so blocking is not a great problem. Indeed, once the i.m.d. is right, reduction in blocking and cross modulation tend to follow naturally.

Reciprocal Mixing

The final major parameter is reciprocal mixing. This is handled best in a crystal-controlled valved receiver and worst by solid-state synthesised receivers and so deserves attention.

Fig. 8 shows the spectral plot of a superhet receiver. The wanted signal is mixed with local oscillator to produce the i.f. which "sits" within the filter passband. Signals outside the filter passband are rejected. Suppose however, that the mixer was fed with two local oscillator signals. Then the filter would pass two signals through into the i.f. chain and they could cause interference to each other.

Alternatively, suppose that the local oscillator was frequency modulated. Again, a number of signals would be heterodyned into the i.f. passband and if any of them are stronger than the wanted signal, it would of course drown out the wanted signal. Similarly, if the local oscillator is frequency modulated with noise, then signals and noise will be mixed into the i.f. passband. In practice, the spectrum of the local oscillator signals will be something like Fig. 6, and this results in strong signals adjacent to the wanted channel mixing noise into the i.f. passband, so that the effect is to widen the i.f. response at levels of say −60dB relative to the peak of the response. The higher the Q of the oscillator, the narrower is the noise bandwidth produced and the higher the power, the greater the signal-to-noise ratio, since there is a lower limit fixed by physics below which the noise cannot fall, as in the case of the absolute sensitivity. A valve operating with a crystal oscillator at high power is very good for reciprocal mixing.

Where a system is used with mixers producing the local oscillator frequency however, the noise level of each oscillator is added to the previous one and any "jitter" in synthesisers is similarly added. Amplifiers in phase-locked-loop systems likewise add noise which modulates the v.c.o., whilst v.c.o.s in synthesisers are frequently fairly low-Q, low-power devices. Wadley loop receivers are very bad in this respect, whilst single-conversion receivers, with valve oscillators running at high power, are quite good—AR88, HRO, CR100 users note!

Measurement of reciprocal mixing is difficult, however. This is because the signal generator used must have very low noise sidebands and very few generators are good enough for really high-performance receivers. The technique used is as follows: Signal generator 1 is set to the frequency at which the test is to be carried out, at a level of 1μV. The receiver is tuned to this frequency, and the SINAD or signal-to-noise ratio is noted. Generator 2 is set to an adjacent frequency and the output level increased until the SINAD or signal-to-noise ratio has decreased by 3dB. Typical spacings range from 50kHz to 10MHz, whilst the levels for the 3dB degradation range from 1mV for a very high-performance synthesised receiver from one manufacturer, to more than 300mV for a valved crystal controlled h.f. s.s.b. transceiver from the same firm. In practice, it is unlikely that levels of more than 80dB are re-

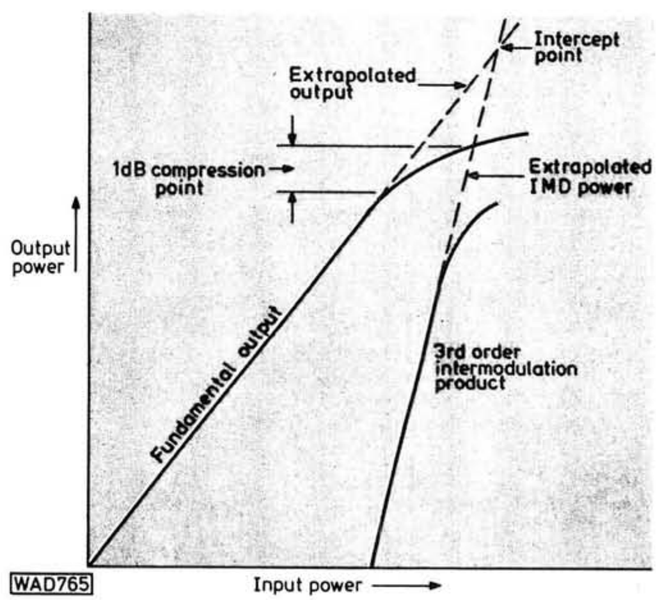
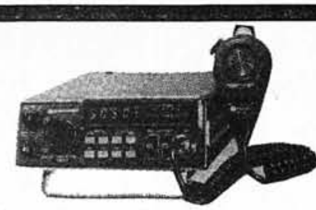


Fig. 6: Intercept and Compression points

THE LATEST 2M ALL-MODE MOBILE YAESU FT480R NOW IN STOCK



KDK 2025 2m SYNTHESIZED 25w TRANSCEIVER

- ★ Custom designed microprocessor control
- ★ 25kHz *and* 12.5kHz synthesizer steps!!
- ★ 'Instant QSY', 10 times rate button
- ★ 25 Watts of reliable RF output
- ★ Band scan between any 'easy set' limits
- ★ 10 write-in non-volatile memory channels
- ★ Memory scanning with hold facility
- ★ Standard ± 600kHz or any repeater split

New Low Price £225.00 inc. VAT

C8800 2m FM Mobile

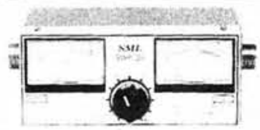
The C8800 is a matching unit to the C7800 with the same features covering the 2m band in 5 or 25kHz steps (this is switchable from the rear panel). S20 and S22 are pre-programmed and available at a touch of a button, the unit has a 3 position RF gain to attenuate strong signals such as repeaters. Provision is made for two repeater offsets (600kHz is fitted as standard) at **£252** inc. VAT.

SWR200B swr/power meter covering 3–200MHz 50/75 Ohm power range 3–30MHz, 20/200/2kW, VHF 2/20/200W **£40.20.**

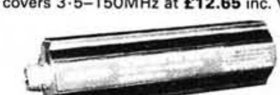
UH74 SWR & power meter switchable HF, 2m & 432MHz with remote heat at **£16.40** inc. VAT.

As EK-150 but with four memories each capable of storing 256 bits making a total of 1,024 bits. This can be recalled separately or in sequence for one long message. **£135** inc. VAT.

PX402 13·8V DC 3 amp continuous 4 amp max fully stabilized power supply with overload protection **£22.95** inc. VAT. P&P £2.00.
Also available:
PH5000, 5A continuous, 7A surge. **EP2500,** 25A continuous, 30A surge.



SWR25: This ever-popular twin SWR and Power meter covers 3·5–150MHz at **£12.65** inc. VAT. P&P 50p.



DL-30 Dummy load 25W DC-150 MHz **£6.35** inc. VAT. P&P 25p.
T-100 80W Dummy load DC-500 MHz **£24.10** inc. VAT. P&P 25p.
T-200 150W Dummy load DC-500 MHz **£35.60** inc. VAT. P&P 25p.

TERMS OF BUSINESS: Please note all above items **PRICE INCLUDES VAT.** Please send cheques or P.O's or quote Barclaycard or Access No. to: **B. BAMBER ELECTRONICS, 24 HOUR PHONE SERVICE (0353) 860185.** Callers welcome Tues, Sat. 9.00 am-5.30 pm.

Buy it with Access

B. BAMBER ELECTRONICS
5 STATION ROAD LITTLEPORT CAMBS CB6 1OE

BARCLAYCARD VISA

YAESU MUSEN – FRG-7700

A NEW BREAKTHROUGH IN RECEIVER TECHNOLOGY

YAESU

Yes indeed, the exciting new FRG-7700 GENERAL COVERAGE RECEIVER from YAESU MUSEN, the world's largest manufacturer of Amateur Radio equipment, will satisfy the demands of the most critical Short Wave Listener or Licensed Operator with it's superb performance and incredible specification – just consider the following condensed details:

Frequence coverage 150 KHz–29.999 MHz.

Modes **AM (fitted Narrow, Medium and Wide Filters).**
USB, LSB, CW and FM.
Memory option with twelve channels and automatic band selection.
CPU Digital Clock and Timer.
State-of-the-Art Noise Blanker.
FM Squelch Control.
Mains or Battery operation.
Digital and Analogue read-out.

Send today for full details of the new FRG-7700 or if you would like the full Yaesu catalogue as well 36 pence in stamps will bring you this together with our credit voucher for £3.60 – a 10 to 1 winning offer!

FRG-7700 **£309.** Memory unit **£83.95.** FRG-7700M (with fitted memory) **£389**

FULL DETAILS AND THE NEW LOW FACTORY PRICE LIST FROM
BRITAIN'S NO. 1 IMPORTER
EX-STOCK – INSTANT CREDIT – FREE SECURICOR DELIVERY

AMATEUR ELECTRONICS UK

Buy it with Access

508-516 ALUM ROCK ROAD 021-327 1497 6313
BIRMINGHAM 8 Telex 337045

G3FIK

quired, since few receivers have filters in the i.f. strip better than this. Where filters like the KVGXF9B, with a 90dB stopband, are used in home-brew receivers, it is not really worthwhile attempting to use this stopband unless the reciprocal mixing is as good as this. This means that the noise floor of the local oscillator signal needs to be 90dB plus the signal-to-noise ratio of the 1μV signal down at 4·6kHz away from the local oscillator. To measure this, signal generators of the calibre of the Hewlett Packard 8640B are required—and even then, it will not be easy! Thus it can be seen that the claims of one US manufacturer some years ago that their crystal filter went down to −120dB in the stopband produced some wry comments—especially as the local oscillator injection was pre-mixed! To make full use of this filter as far as adjacent channel signals were concerned, required the oscillator noise level to be better than that theoretically possible!

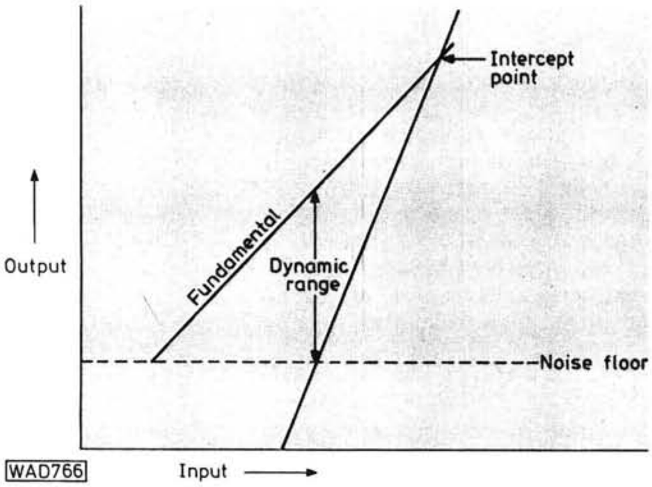


Fig. 7: Dynamic Range and Noise Floor

Spurious Radiation and Channel Intermodulation

A few other parameters are occasionally specified in professional receivers. These include radiation levels of the oscillator signals and the in-channel intermodulation distortion. Generally speaking, the radiation of oscillator signals from receivers does not cause many problems, although the HRO was well known for causing problems on Channel 1 TV when operating on the 14MHz bands. However, for military purposes, or when there are several receivers operating in proximity to each other, this parameter can be important.

In-channel intermodulation is generally required to be about 30dB or so down. However, most loudspeakers are incapable of effectively reproducing signals sufficiently cleanly to detect this, unless hi-fi speakers are used. As a result, this parameter is not as important as might be considered, but in any case, the resulting in-channel i.m.d. only affects the quality of the received signal and in many cases, the received signal-to-noise ratio is insufficient for any degradation of the signal to be observed. Nevertheless, it is uncommon to find an a.f. amplifier as bad as 30dB when operating within its linear range. More important in this respect is mains hum, which may not always be very obvious when using a small speaker, but can lead to operator fatigue for no apparent reason.

External Influences

This article has discussed the major parameters covering electrical design of a receiver. For many requirements, there are related mechanical parameters which are just as important—and these parameters are generally measured on a vibration table. Bump tests simulate the effects of collision or gunfire in mobile applications, but whilst presenting interesting mechanical design problems, they are not of much application to amateur equipment. (Unless the neighbours take a particularly robust view towards TVI!) Temperature tests are however, another matter. A receiver that offers either reduced or no performance at all, or excessive frequency drift with temperature is extremely annoying and in some cases may be completely useless.

Determination of the conditions to be measured are not quite as easy to decide upon however, as in pure electrical tests. Should drift be measured from cold switch-on, or should the equipment be allowed to warm up for an hour and then raised in temperature for the drift to be measured? The author's approach is to switch the equipment on and allow two minutes for stabilisation, and then measure the drift at five-minute intervals for an hour, but this is by no means an exhaustive test and does not really simulate the usual case of a cold shack warming up at the same time.

Supply voltage variations and their effects on performance are usually restricted to changes in frequency for minor (10 per cent) changes in supply voltage. Although regulators are almost universally used in equipments, valved receivers are particularly prone to long slow drifts because of the change in heater voltage. The main requirements for high immunity to supply voltage changes occurs in mobile use, but a shack at the bottom of the garden in conjunction with a full-power rig can have surprisingly detrimental results.

Finally, the rest of the receiver performance is likely to be subjective. Such things as the layout of the front panel, the size and feel of the controls and their placement on the front panel can have a great effect on how good the receiver is to operate. These can be best evaluated on a personal basis, but receiver performance as a whole cannot be measured in a few minutes. Certain shortcomings are easily recognised by the experienced operator and some of these shortcomings can be defined into correct areas by the design engineer, in either case, more than a five-minute test is required.

continued on page 92 ▶ ▶ ▶

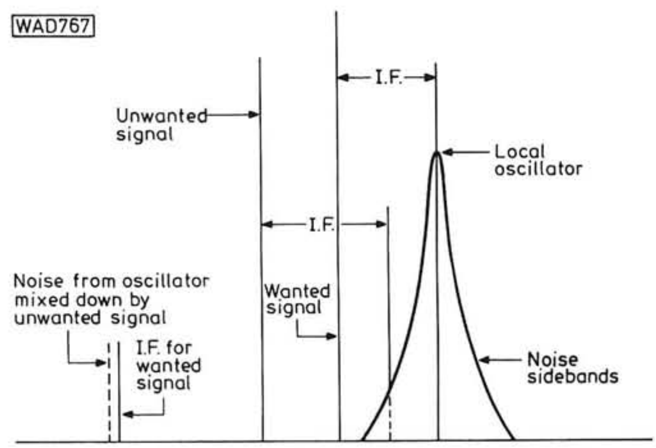
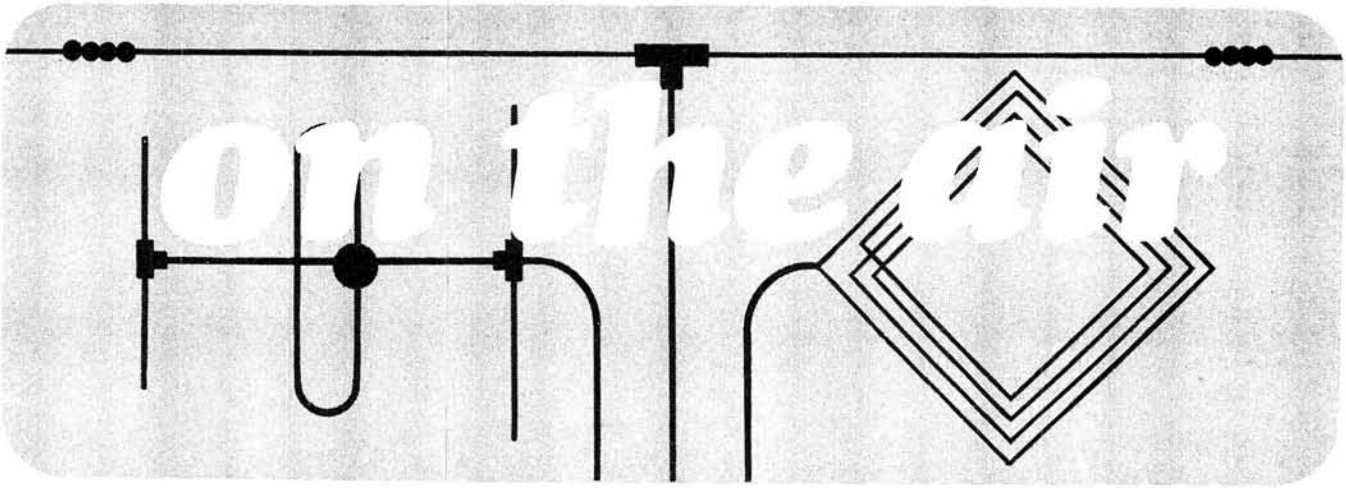


Fig. 8: Reciprocal Mixing: note the noise is phase modulated and so cannot be removed by limiting



Amateur Bands

by Eric Dowdeswell G4AR

Reports to: Eric Dowdeswell G4AR
Silver Firs, Leatherhead Road,
Ashtead, Surrey KT21 2TW.
Logs by bands in alphabetical order.

The chaos caused by the changeover in the American system of issuing amateur radio callsigns continues, with a steady flow of queries on calls that don't seem to appear in prefix lists and confusion when the announced location of an American station does not tie up with the prefix.

Although the new arrangement has been in force for over two years, anomalies will remain with us for a long time. Callsigns issued before March 1978 remain in use and, worst of all, licensees keep the new calls, which are governed by location, even when they move to another postal area, which should infer another callsign.

A full explanation of the new system can be found in the excellent *Amateur Radio Operating Manual* published by the RSGB for £4.96 including post and packing, or less 10 per cent for members.

My various comments on the CB situation have prompted some interesting replies both for and against the idea, with those in favour plumping for 27MHz, obviously, with many already being on the air and, in some cases, quoting their "callsigns"! Whether the Home Office will pay any regard to the fact that replies to its Green Paper will almost certainly be heavily in favour of 27MHz, since the writers are already active there, remains to be seen.

The present absence of any suitable 928MHz gear is not likely to stop CB being approved at this frequency. Our Far East friends will be able to come up with something pretty quickly once the HO has made up its mind. After all, the u.h.f. TV bands go up to almost 900MHz so there is nothing mysterious about the techniques required to produce suitable equipment for 928MHz.

As for the possible dangers to health at this frequency, this is just another of the microwave oven scares that has little substance in fact; the risk can be safely discounted. With many tens of thousands of people on 27MHz, and ridiculous figures up to half a million being quoted, it would be interesting to know if the Post Office has received many cases of interference from such equipment, one of the main claims of the anti-27MHz lobby. Personally, I doubt it very much.

Just for the record, my own objection to 27MHz CB is the abuse which would undoubtedly follow, as it has done everywhere else, by the use of high power amplifiers and extensive antenna systems, leading to the establishment of a "free" amateur band adjacent to our own 28MHz band.

General News

Some 200 readers wrote to me for a copy of the i.f. mods to the FRG-7 receiver devised by Tim Harrowell G3IMI. Now **Eric George** of Ashford, Co Wicklow, has told me that he has been able to get an LCF-2A 2·4kHz i.f. filter from Yaesu Musen (CPO Box 1500, Tokyo, Japan) for 2100 Yen (around £5), which is a direct replacement for the one in the set. A bank draft in Yen or US dollars is requested. A technical bulletin with filter fitting instructions should be requested at the same time.

Cheong Khee Chan, who wrote a month or so ago, has now settled in Darlington. Having passed the RAE he is now G5MUR, with the same privileges as a G8 seemingly until such time as he passes his code test. Activity is on 2m with a TR-2300 and "Slim Jim" antenna.

In Bury St Edmunds (Suffolk), **Russell Brown** has joined a local club and acquired a BC358 but is handicapped by the upper frequency limit of 18MHz. Russell has an OU degree in electronics but is looking forward to some real practical work and a licence very soon.

An appeal from **Roland Clark** P29RO (PO Box 42, Panguna, Bouganville, Papua New Guinea), for a manual on the old Eddystone S710 All World Six receiver or even a circuit diagram. All costs will be paid of course. **Jim McCrindle** (3 Warwickhill Place, Kilmarnock, Ayrshire KA1 2LR) would like some help and info on the B40 receiver, which is working but he feels is not really up to the mark in performance. An OAP, Jim has been reading *PW* for many years but only recently got around to investigating the amateur bands, with much pleasure.

A note from **Alan Taylor** of Stanford-le-Hope, Essex, tells me he is now the proud owner of callsign G4KJI having written to me in December 1978 asking "how do I get started in amateur radio"! He is now secretary of the Thurrock ARC meeting every Tuesday at 7.30pm on the top floor of Grays Park Hall, Orsett Road, Grays, Essex, with code tuition available. The rest of Alan's QTH is 11

We're giving away this soldering iron worth over £10.

Choose any of 10 selected kits from the Heathkit catalogue as your first order, and we'll give you a superb soldering iron worth over £10. Plus a 10% discount!

These kits have been specially designed with first-time kit builders in mind. So even if you've never built an electronic kit before you won't find it difficult. In fact, the simple to follow step-by-step instructions make it easy to build any Heathkit kit.

And with your special offer discount you can afford to see just how easy it is.

Full details of this FREE offer are available in the Heathkit 48 page catalogue. So send the coupon for your copy now.

To: Heath Electronics (UK) Limited, Dept. (PW3), Bristol Road, Gloucester, GL2 6EE.

Please send me a copy of the Heathkit catalogue. I enclose 25p in stamps.

Name ____________________

Address ____________________

NB: If you are already on the Heathkit mailing list you will automatically receive a copy of the latest Heathkit catalogue without having to use this coupon.

HEATHKIT HEATH Zenith

INTERESTED IN ELECTRONICS?
TRY A ZEDPACK!
COMPONENTS AT A PRICE EVERYONE CAN AFFORD

Z1 **300** mixed $\frac{1}{2}$ **and** $\frac{1}{4}$ **watt resistors** **£1.95**
Z2 **150** mixed **1 and 2 watt resistors** **£1.50**
Z3 **300** mixed **capacitors,** most types **£3.95**
Z4 **100** mixed **electrolytics** **£2.20**
Z5 **100** mixed **polystyrene caps** **£2.20**
Z6 **300** mixed **printed circuit components** **£1.95**
Z7 **300** mixed **printed circuit resistors** **£1.45**
Z9 **100** mixed miniature ceramic and **plate caps** **£1.20**
Z10 **25 assorted pots.** **£1.50**
Z11 **25** assorted **presets,** skeleton etc. **£1**
Z12 **20** assorted **vdr's** and **thermistors** **£1.20**
Z13 **1lb mixed hardware.** Nuts, bolts self-tappers, sleeving, etc. **£1.20**
Z14 **100** mixed, new and marked, full spec. **transistors.** Pack includes:– BC148, BF154, BF274, BC212L, BC238, BC183L, PBC108 and, or lots of similar types. **£4.95**
Z15 **100** mixed **diodes** including:– zener, power, bridge, signal, germanium, silicon etc. All full spec. **£4.95**
Z18 **20** assorted zeners, 1 watt and 400mw **£1.50**
Z20 10 assorted switches. Slide, push-button, multibank, miniature, reed etc. **£1.20**

TBA 800 Audio I.C. **80p ea. 3 for £2.**

Delux FIBREGLASS printed circuit etching kits.
Includes 100 sq. ins. of copperclad F/G board, 1lb ferric chloride, (made for U.S. Army to MIL. SPEC.), 1 dalo etch resist pen, abrasive cleaner, tweezers, etch resist dish and instructions. **OUR PRICE £5.95**
1lb of FeCl. **£2.25**
150 sq. ins. single sided board. **£2.20**
150 sq. ins. double sided board. **£3.30**
UHF, Transistors T.V. TUNER with slow motion drive, AE.skt. and leads. **£1.95**
100 Miniature **reed switches.** **£2.30**

MINIATURE MAINS TRANSFORMERS
Top quality. Split bobbin construction will give 4.5V-0-4.5V at 250MA. $1\frac{3}{4}'' \times 1\frac{1}{2}'' \times 1\frac{1}{2}''$, all sorts of uses. **ONLY £1. 3 for £2.50**

PP3 Battery Connectors 10 for 50p
Miniature Press to Make Switches, Red knob. **3 for 50p**
Subminiature S.P.C.O. Slide Switches. **6 for 50p.**
Miniature D.P.C.O. Slide Switches. **6 for 50p.**
Standard **2P, 3 Position** Slide Switch, **4 for 50p.**
4 × HP11 Battery Holders (2 × 2 Flat type) with leads. **2 for 50p.**
Assorted Fuse Holders including 20mm, P.C. Panel and chassis types. **Pack of 7 for 50p.**
3.5mm Jack Sockets, switched. **Enclosed type.** P.C. or panel mounting. With nuts and washers. **4 for 50p.**

R.C. SUPPRESSORS
250V. $1'' \times \frac{5}{8}'' \times \frac{1}{4}''$. Ideal for fluorescent light suppression, car, and relays. Also for snubber networks. **3 for £1**

ALTERNATOR RECTIFIERS
Make lovely **60 amp 150V** bridges. Ideal for **High Power Battery Chargers.** Type 4AFI. **Set of 4** (2 neg. case + 2 pos. case) **£2.**

Special Purchase enables us to offer **Mullard C280 Polyester Capacitors** (Liquorice Allsorts) at the unbeatable price of **£2 for 100 mixed.** These consist of factory clearance lots i.e. spillages, floor sweepings, cosmetic rejects etc. Also **Mullard miniature electrolytics 200 mixed £2.**

TELESCOPIC AERIALS
Chrome on brass, 9 section, 25" extended. Plugs into any 3.5mm jack socket. Ideal for S.W.R., metre, portable TV, etc. **ONLY £1**

BB105B VARICAP DIODES
20 for £1.50.

Professional quality **TV Plugs** (coax.) Diecast alloy body, **Silver Plated** solid brass centre pin, brass grubscrew for centre conductor. **50p ea, 5 for £2. Ideal for video's.**

UHF MODULATORS
Calibrated to **Channel 36** 625 line UHF. Housed in metal box, $2\frac{1}{2}'' \times 2'' \times \frac{1}{2}''$. Complete with **9 feet of coax lead** and **TV plug. 9V** operation, ideal for video games, computers etc. **£2.50 ea** with connection **Data.**

Vernitron FM4 10.7MHz ceramic filters **50p ea, 3 for £1.**

To: **"GEMINI ELECTRONIC COMPONENTS" DEPT PW**
"THE WAREHOUSE" SPEEDWELL ST. LONDON S.E.8.
Please Quote ZED Code. Where shown. Send Cheque* or Postal Order. Plus **60p** P&P.
*Schools etc. SEND OFFICIAL ORDER
ZED PACKS now available for **Callers** at 50 Deptford Broadway, London, S.E.8.

SIGNAL GENERATORS. Marconi TF144G bench sig gen 85Kc to 25Mc/s in 8 bands direct calibration, O/P var from 1 Uv to 1 volt by fine & coarse atten, int mod at 400c/s fitted RF level & Mod level meter, in case size 29×12×10" 240v I/P supplied tested with circ & inst book **£55.**

DOPLAR NAVIGATION T.S. Marconi bench test set three function unit comprising Meter unit with $3\frac{1}{2}''$ Sq 10-0-10 volt DC meter, selector swt etc, Scope unit with $1\frac{1}{2}''$ dia CRT P.7 trace with controls, focus, brill, X&Y shift, Timebase fine & coarse freq, Sync, Y amp Atten, Range & Speed section with 4 digit counter Ind lamps swts etc, also some servo motors tachos etc. Complete in neat case size 10×15×9" with front cover, note I/P 115v 400c/s the scope section can be used as a normal L.F scope, **£35.**

RANGE INDICATOR UNIT with 2" dia flat face CRT Blue short persistance trace electromagnetic deflection 6.3 heater 5Kv EHT complete with scan & focus coil ass, int EHT unit 115v 400c/s plus misc valves, transistors, trim pots etc in case size 8×4×15" **£12.** This unit & the Marconi unit can be operated from the MK.123 12v Invertors using the AC O/P.

RADIOSONDE UNITS normally dropped by parachute, contains sensors for Pressure, Temp, etc small drive motor the O/Ps from sensors are used to modulate a small 1 valve Tx unit (DC90 valve) supplied with valve Tx as new unused. Reqs. 3 volt batt. **£12.50.**

SMALL HF Tx & Rx UNITS Tx unit 2 to 8Mc/s crystal controlled with meter, 2x valves about 1 watt O/P CW only, **£6.50** Rx unit 2 to 8Mc/s in two bands 5 valves inc BFO direct cal O/P for HR phones **£15,** both units size 8×5×4" both req 135v HT & 1.5v DC with circs. Rx tunable.

HEADPHONES type DLR.5 low imp. can be used for sound powered intercom **£3.50** or two pairs for **£6** new boxed **£4.50** pair.

Above prices include Vat & Carriage, goods ex equipment unless stated new, 2×10p stamps for list 26.

A. H. SUPPLIES

122, Handsworth Road, Sheffield S9 4AE.
Phone 444278 (0742)

Kathleen Close if you are interested in the club.

A plea from **R. A. Weston** of 11 Darlingscote Road, Shipston-on-Stour, Warwickshire CV36 4DR, for a vibrator for his R109 receiver otherwise thought to be in good working order. I don't normally mention sets for sale in this column but feel I must make an exception for **G. Prosser** of 10 Lon Garnedd, The Woodlands, Abergele, Clwyd LL22 7EP, who, due to continuing ill-health, has to part with his almost new DX160, but being an OAP cannot afford to give it away. He must now concentrate on fresh air and an outdoor life but since his XYL is a keen birdwatcher, no problems there. Get well soon OM. Try a call to Abergele 825521 in the first place.

Some of the members of the St Helens & District ARC at a club Open Night, bringing amateur radio to the public's attention. Standing, left to right, are Paul G8PQD the club's Secretary, Pat G8XPJ, Mark G8YBV and Bill G8TIW. Below are Joe G3NNR (Chairman) and his wife Mavis G8XZT, Ed G4KRJ (son of Sec), with SWLs Malcolm and George. In spite of appearances Mavis is not trying to talk up the Satellit 2000!

DX Land

Geoff Watts, of prefix list fame, writes about the W6GO *Directory of QSL Managers* listing over 5000 managers and costing only £1 from Brian Russell BRS33915, 163 Halton Road, Runcorn, Cheshire WA7 5RJ.

From Stourbridge, W.Mids, **Peter Hawkes** comments on the chaos of the US callsigns as mentioned at the beginning of this piece, recommending the RSGB book as a good guide to the present position. He found TA1MB, but at the present time QSL cards should not be sent to any TA even if he would normally be considered legitimate. By this time Peter will be settled in Zimbabwe and contacting the local club and members. Last log showed 5N8BRC, 5H3FW (QSL DF4TA), C5ACA (QSL PO Box 553, Banjul), AP2ZR, HS1AMM and VK7FH on the 10m band, 8Q7KK (QSL K2FV), FH8OM, FK8AH, VP8QI (QSL G4CHD), VQ9RS (QSL N6BLN) and J3AH were on 20m, plus VP5RIT and VP9KD on 15m with VP2MCK on 80m who has home call of G2ACK.

First letter from **David Warr** BRS44127, aged 15, who uses a 9R59DS receiver and half-size G5RV aerial system and lives in Weymouth, Dorset. He looks at 40m in the mornings but the BC QRM at night defeats him. On that band he caught 8P6OR and PY5OGG, while 20m came up with 8P6IB with VP9AD, YC2BJR and Y58AF on15m. Dave asks about the location of the last one which is just another East German, I'm afraid. Best DX on 10m was VP1BEH and C5ACL.

Wandering off the 28MHz band **Bill Rendell** down in Feoch, Truro, Cornwall, was surprised at the DX he heard on the CB band! Bands have not been too bright according to Bill but nevertheless he came up with FM0FJE, VK2WC, 6Y5WS and 8P6OR on 40m, J3AH, J6LOU (QSL Box 93, Castries, St Lucia), VP8PP (Box 224, Port Stanley, Falkland Is), and VP8SB (QSL G3ZMF) all on 20m, and M1C and 5T5JD on 15m. For 10m it was VP2MW, XT2AT, 3B8RS and 8Q7KK (QSL K2FV). Oh, yes, receiver is the HRO.

David Whittaker in Harrogate, Yorks, fills me in on his gear there which is a Trio JR310 and Mosley TA32Jnr tribander, with a 20 metre wire for 40m and a 55 metre stretch for Top Band, both via a CL22 a.t.u. David has been an SWL for 20 years or so and has heard 333 countries of which he has the remarkable total of 328 confirmed! Latest log shows that 40m is pretty good, as evidenced from other logs, with David catching AP2KS, J73PP, HM1TR, FM7WS, XT2AW, FK8DH, T3LAA, ZL1AMO/C and HK0FBF. Incidentally, David's brother is G3IGW, probably best known to c.w. addicts for his DXing abilities.

In Knutsford, Cheshire, **Dave Coggins** has really got down to his code practice using an oscillator featured in *PW* of March '75, and has begun copying stuff on the bands. Dave copied lots of s.s.b. on 40m also, like FP8AB, JA6XMM, KG4WM, VP2MCK, VU2YK, 8P6OR, 8Q7KK and 9K2FO. Amazing reception on 80m was FR0FLO, 3790kHz to be precise, at 1600 GMT plus JA6BSM and JY7YJ at other times.

Sticking mainly to 20m **Mike Howard** near Oldham, Lancs, used his DX-160 to copy A35RD, FK8CR, FP0GBG, HK0EHM, KX6BB, TJ1AY, TT8SP, YS0BYR, ZD9GM, 5N0DOG, 5T5SA, 5W1CY and 6O0DX for an unusual one. Goodies on 15m included FB8XY (QSL DK2OC), VP5B (QSL N4KE), VQ9CI, 3D2AZ, 5U7AF, and 9Q5AH. 10m accounted for just CO1EG and ZE1CR. Mike's country total has now reached a fine 264 and going upwards steadily. Mike is another reader who would like to see some pictures adorning this column. Agreed, but they must be clear, black and white and informative!

Allan Stevens (Crowthorne, Berks) has been looking at 80m but was annoyed at not being able to get the full call of a J2O station found there. However, he did manage to copy EA8AK. Another head-scratcher, on 10m, was EC9BA, presumably a novice style station in Ceuta or Melilla, quite a rare spot although not far from home. Another heard was BY1AA but not much hope of it being OK, but, as I told Allan, count it or work it until it is proved to be phoney. All the signs are that we can expect some genuine activity from China before long and that is certainly going to be some pile-up! Allan has joined the RSGB and is very impressed with the journal *Radio Communication,* and rightly so.

Not much point in telling you that **Collin Frankland** was located in Hull as he will have moved QTH by now. He logged San Marino M1C, 9L1AP and ZE1CL on 15m for new countries with his 9R59DS and indoor dipoles, while SV0AW/9 proved exciting on 10m from Crete, with VP2MH holding forth on the DX net on 20m. **Basil Woodcock** in Leeds says the S8 queried recently is in the Transkei but does not have DXCC status as seemingly the proper ITU prefix should be S83. Another rare call logged was 4K1OC, from one of the USSR bases in the Antartic. Basil did not find much on 40m, which seems strange as everyone else has. I have suggested he get a long wire up plus a.t.u. for the l.f. bands to supplement his 10 and 20m dipoles which won't be much good there. In more detail Basil found FP0FSZ, HC1NP, HP1XKZ, PZ1AP, TU2HW and 5Z4GM on 28MHz, plus J28AI, KH6APS, SU1ER, 9X5NH and 4K1OC on 14MHz s.s.b.

One of our younger readers, 14-year-old **Mark Ryder,** near Oldham, Lancs, used his FRG-7 plus 20 and 40m dipoles to get PY0OD (QSL WA4MDS), T3AT (QSL G3XZF), TU2JD, VQ9TT (QSL KB5MZ), 5T5JD, 6W1CY and 9N1MM on 20m s.s.b., plus C6ABC and VP5PP on 15m. On 10m VP5WW, 3B8RS and 5T5CJ appeared. 40m produced a nice one in PY0AA (QSL PY7PO). On the l.f. bands 4X4VL showed on 80m and UK9AAN on Top Band. Another case it seems for a long wire for the l.f. bands?

Lovely to hear from old correspondents (in terms of writing to *PW)* young **John and Steven Goodier** of Marple, near Stockport. They were G8VHF and G8VHE respectively, and are now proud owners of G4KUC and G4KUB, having spent some months sweating over a hot tape machine but now feeling that it was all worth while. Gear is an FT-101Z plus vertical for 10, 15 and 20m, with a certain nervousness in getting going on c.w. actually on the air! Best wishes to you both and much DX in the future in addition to J3AK, YB0BJM, CT2DL and some Yanks worked already on 15m s.s.b. Heard on 20m were VP2MCK and 3D2GM, with a nice one, A3AS on Tonga on 15m c.w.

Studying for the RAE takes **Bob Heeley** (Mansfield) away from his FRG-7 and long wire, but it will pay off very soon I hope. He did manage to copy 8Q7KK on 3·5MHz, FC6FPH, J3AH, KH6AJ, TG4NX and ZF1SB on 14MHz, with C5ACG, HK0FKF, PZ1AP, 5N0DOG and 9J2KO on 28MHz.

Finally, for the certificate chasers, some notes from regular reader of *PW* **Fred Robertson-Mudie** VK1MM (PO Box E288, Canberra, ACT 2600, Australia) on the *VK1 Award* available to licensed amateurs and SWLs, designed to increase interest in the 300 or so VK1s. Logging/working 10 VK1s will be enough with log extracts as evidence plus five IRCs.

On to the Clubs

Much news from many clubs so details will have to be brief. Many club secs pleased with *PW* rave notices bringing in new members, always most welcome.

Manchester & District ARS. At Newton Heath Community Centre, 203 Droylsden Road, Manchester, at 7.15pm Wednesdays with active station on all bands. Try Mike Howard, previously mentioned, at 8 Silverdale Avenue, Chadderton, Oldham, Lancs OL9 9DL.

Maidstone ARC. Fridays at the YMCA Sports Centre, Melrose Close, Cripple Street, Loose, Maidstone, with excellent facilities not being fully used by any means, so new prospective members write to Chairman Graham Edy G4AXD, 29 Beech Road, East Malling, Maidstone, Kent ME19 6DH, or try 0732 841021. Club shack is open 24 hours a day with h.f. and v.h.f. gear for licensed members. Note March 27 when Ambit International make a presentation. Biennial mobile rally is on May 3.

Doncaster ARC. New QTH is in Royal Naval Association at North Bridge, Doncaster, Mondays and Thursdays, with club station G3UER plus code and project sessions. Contact: Bert Perryman G4KKJ, 15 Queen Mary Crescent, Kirk Sandall, Doncaster DN3 1JU.

Braintree ARS. First and third Mondays around 8pm at Braintree Community Centre, Victoria Street, Braintree. Prospective members will be happy to contact Janet Storey, 33 Redwood Close, Witham, Essex CM8 2PL.

Wakefield & District RS. Alternate Tuesdays (ugh!) in Room 2, Holmfield House, Denby Dale Road, Wakefield, but you can work it out from meeting on Feb 10 with PO documentary films and Feb 24 which is on-the-air and natter nite. On March 10 it's G4BLT demonstrating Teletext but try him for details of the club, at 1 Wavell Garth, Sandal Magna, Wakefield, or Wakefield 255515.

Army School of Electronic Engineering ARC. Situated in Arborfield, Berks, and my old regiment REME. So welcome to the column. Mixture of civilian and Army types with lots of gear for virtually all bands (G3IHH) and a 33 metre mast to hang the antennas on. Needless to say the workshop is very well equipped and lecture room facilities more than ample. Meetings each Tuesday 7.30pm but more precise details from John Northcott G8SZK, civvy rep of the club at 328 Nine Mile Ride, Wokingham, Berks, RG11 3NH.

Coventry ARS. Fridays 8pm at Baden Powell House, 121 St Nicholas Street, Radford, Coventry, with plenty of events to suit all tastes. Details of history of club welcome, from past members possibly, because it's the club's 50th birthday in 1982. More from John Beech G8SEQ, 14 Hollow Crescent, Radford, Coventry. Latest licensee at club is 14-year-old Richard G8ZJP.

Wirral & District ARC. Second and fourth Wed at 7.45pm at Dining Room, Concourse Sports Centre, West Kirby, with informal meetings other Weds. Feb 11 sees Microwave Modules holding forth on its products, while the 25th sees OT Dud Charman in his RSGB tape and slide lecture on antennas, not to be missed at any price. More from Ian Brooks, 28 Paignton Road, Wallasey, Merseyside L45 6TT, or 051-639 5666.

Wirral ARS. Not to be confused with the preceding mob! First and third Weds 7.45pm Sports Centre, Grange Road West, Birkenhead. Hon Sec G. O'Keeffe-Wilson G8VPF at 20 South Drive, Upton, will supply details of forthcoming meetings, etc., or ring 677 1531.

Midland ARS. June sees Golden Jubilee of club with new premises hopefully commissioned at 249a Broad Street before that date. Almost facing the local rep seemingly. For the moment go along to Room 110 or 118 at the University of Aston on the last-but-one Tuesday of the month for lectures, film nights and other hilarities. New club room and accommodation will really be something with a shack, lecture room and even a kitchen! Tom Brady G8GAZ 57 Green Lane, Great Barr, B'ham B43 5LE, will be pleased to tell you more. That is also 021-357 1924.

Aberdeen ARS. Fridays 7.30pm at 80 Guild Street, Aberdeen, next to Station Hotel and railway station. Try top floor at the right. Could hardly be more precise! Active programme of lectures, film shows and the like planned for 1981, with club station GM3BSQ on all bands. An unusual feature is p.c.b. service for members, from own artwork. Newcomers to licensed amateurs all equally welcome, says John Livingston GM4FDD at 95 Morningside Avenue, Aberdeen AB1 7NU.

Verulam ARC. Fourth Tuesday at 7.30pm at Charles Morris Memorial Hall, Tyttenhanger Green, Tyttenhanger, which is near to St Albans, Herts, with informal meetings at RAFA HQ, Victoria Street, St Albans, on second Tuesdays, at least until April. Hilary Claytonsmith G4JKS, 115 Marshallswick Lane, St Albans AL1 4UU, can fill you in.

Thornton Cleveleys ARS. First and third Weds at 7.45pm in St John's Ambulance Hall, Fleetwood Road, Thornton, which is next to the Gardeners' Arms, so no problems there! RAE classes plus slow on-the-air code from G3ZRZ. The 80 club members enjoy films, lectures, surplus gear sales and gear building projects. More from A. Parr G3IWP, 43 Argyle Road, Poulton-le-Fylde FY6

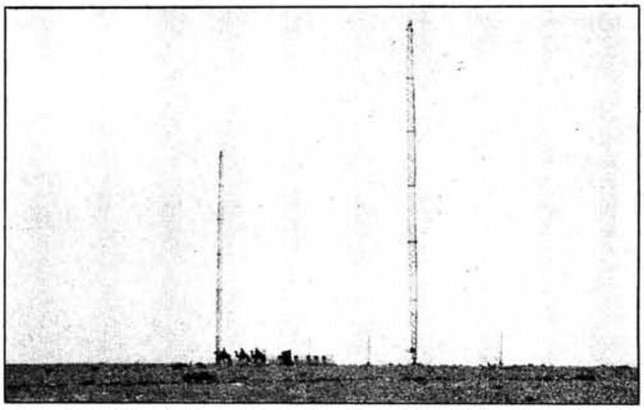
7EW, which is in Lancs I hasten to add.

Haverhill & District ARS. Meetings Fridays 8pm at Copse Hall Farm, Bumpstead Road, Haverhill, Suffolk, with coming events including code practice on Feb 6 and 20, AGM on the 13th, and surplus gear sale on the 27th but chairman "Woody" D. C. Woodhouse G3TWX, c/o 13 Gannet Close, Haverhill, Suffolk, will be glad to assist further with details.

Bournemouth RS. Just space to tell you that they meet at the Dolphin Hotel, Holdenhurst Road, Bournemouth, at 7.30pm, with a projects night on Feb 6 and a film show on thin film microcircuits and the manufacture of junction transistors on the 20th which can't be bad. Glad to see the old BRS Newsletter is back to its voluminous self with nine pages in the latest issue full of chat and interesting projects and ideas. G. T. Lloyd G8GTB at 4 Gorleston Road, Parkstone, Poole, Dorset, is the man to tell you more or try Parkstone 769317.

My sincere thanks to all those who sent greetings cards at Christmas, much appreciated and good wishes heartily reciprocated. Don't forget the deadline, the 15th of the month.

A QSL from Radio Americas



An unusual QSL card, from Radio Villa Cisneros EAJ202

Medium Wave Broadcast Band DX

by Charles Molloy G8BUS

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

While looking through my QSLs recently I came across a couple from "countries" that no longer exist. One was from Radio Americas located on Swan Island, which used to broadcast on 1157kHz in English and Spanish. Swan island is in the Caribbean about one third of the way from Honduras to Cuba, but the QSL was obtained by writing to a PO Box in Miami. Reception generally was good in Europe, since the signal was beamed towards Cuba which is in our direction. Radio Americas went off the air in 1968 and the island which is now called Isla de Cisnes has been part of Honduras since 1971.

The second QSL is from EAJ202 Villa Cisneros (998kHz) in what was once the Rio de Oro (Spanish Sahara) on the north-west coast of Africa. Villa Cisneros is now Dakhla in Mauretania. Without a tape-recorder, identification would not have been possible, as the station was not listed when I first heard it in January 1968. By replaying the identification several times "Veeya Seesnayros" came through, which led to an interesting QSL card showing radio masts, camels and sand.

Tape Recording and DXing

Villa Cisneros leads me into the use of a tape-recorder as an aid to DXing on the medium waves. There are a number of advantages in making a tape of your DX. You can replay a station identification if you are unsure of it. If two stations identify simultaneously on the same channel, which can occur with North Americans on the hour or half hour, then both may subsequently be identified if you "tune your ears" to each in turn on replay. It is worth having a tape-recorder for this use alone.

There are a number of less obvious advantages. If you hear a rare station and are really keen for a QSL then send them a taped report. A tape library can be interesting especially if it contains DX you were unable to QSL. I have a recording of an English broadcast from Biafra at the closing stages of the civil war in Nigeria where obviously no QSL was possible. With the aid of a time switch you can monitor a channel at an hour when you are unable, or unwilling, to be at the controls yourself. You can tape respond with other DXers and if there is a second recorder available you can insert some of your DX catches in the tape letter.

What Type of Recorder?

I still prefer my old reel-to-reel studio deck which has a pause control and a digital counter. The pause control enables you to stop recording during a fade if QRM appears, and to start up again instantly if something interesting appears. The type of recorder to use is really a matter of personal choice, but it is essential to have one with a counter so that you can make a note of its reading against time, while you are DXing.

Using the Recorder

The easiest way to make a recording is to place the microphone in front of the speaker, which is a practice universally frowned on. I can't think why you shouldn't record this way when DXing, unless the microphone is incorporated in the body of the recorder, which would be rather clumsy to use, or if there is a lot of background noise in your shack. A DX signal from a selective receiver will have restricted audio response so there is little point in treating it like hi-fi.

If the receiver has a tape socket, like my EB36, then all you have to do is to connect it to the recorder using a screened lead with the appropriate plug at each end. If you use phones instead of a loudspeaker then get hold of a suitable "Y" adaptor to plug into the phone socket. This will provide two outputs, one for phones and the other for tape.

If there is an extension loudspeaker socket then it can go to the low impedance input on the recorder. With some receivers you can even connect across the loudspeaker terminals using crocodile clips, but beware of short-circuits. The most effective method of connecting receiver to recorder is to connect a screened lead via a 0·1μF isolating capacitor to the receiver volume control, see Fig. 1, but do not attempt to do this with a mains-operated receiver unless you are very sure of what you are doing.

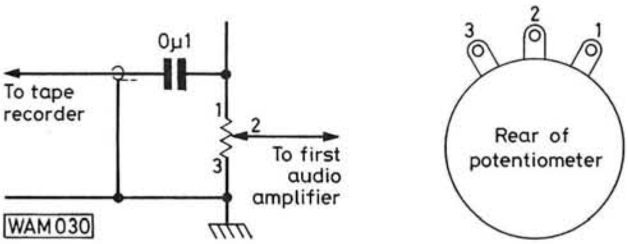


Fig. 1: Connections to a receiver volume control

North American DX

"What are the best North Americans to hear?" asks reader **Richard Benbough** of Billericay, who uses a Trio 9R59DS receiver with a "40 inch" m.w. loop antenna. His sole catch to date is CJYQ St John's in Newfoundland on 930kHz, which he picked up at 2330.

The easiest and the most consistent are, as you might expect, the nearest located in Newfoundland some 2600 miles from the UK. Although a few may be heard before midnight it is probably better for the newcomer to start at this hour as those Europeans that are going to close down will have done so and any DX from North America should have appeared.

Newfoundland can also be heard on 590kHz (VOCM) and on 640kHz (CBN) both in St John's and there is CKVO in Clareville on 710 and CBGY in Bonavista Bay on 750. There are others, but these four come in regularly in the UK along with CJYQ. Nova Scotia presents several possibilities such as CHER 950kHz in Sydney, CHNS 960 in Halifax, CKBW 1000 in Bridgewater and CKEC 1320kHz in New Glasgow. Mainland Canada is represented by CBM 940 in Montreal and CBA Moncton N.B. on 1070. All of these stations come in well in the UK.

Although further away, broadcasts from the eastern part of the United States are often heard. The most consistent are WOR in New York City on 710kHz (mixed with CKVO), WHDH Boston on 850, WNEW in NYC on 1130, WCAU Philadelphia on 1210, WTOP Washington DC on 1500, WITS Boston on 1510 and WQXR NYC on 1560kHz.

There is nothing regular or predictable about North American DX on the medium waves. Stations are absent one night and conspicuous the next. All North Americans suffer from slow cyclic fading which rather detracts from the entertainment value. Even a strong signal like CJYQ can be missed if you happen to drop on the frequency for a few moments during a fade.

Receivers

"It may interest your readers to learn that I have received Q Radio (CJYQ 930kHz) on 15 successive nights from November 7, on all except three, reception began before midnight," writes **Dr E. G. Duncan** from St Andrews. Bonavista Bay (CBGY 750) was identified on ten occasions. A home-brew receiver with MOSFET r.f. and mixer stages was used along with a 3m long antenna. "Only occasionally was it necessary to reach for the long wire and a.t.u."

Our reader goes on to say that tracking problems were avoided by using a twin-gang capacitor for the r.f. and mixer stages and a separate control for the local oscillator. The latter is linked to a digital display. This set locates CJYQ before his FRG-7, which he attributes to his use of a CFM2 455A i.f. filter. This was obtained from Ambit for 65p which he regards as one of the world's best bargains. A statement like that from north of the border cannot be ignored!

My much-modified R1155 had a panel trimmer across each section of the tuning capacitor in place of the normal "fixed" trimmers. Occasionally it was possible to peak up a weak station and I thoroughly enjoyed using the numerous controls, but lack of sensitivity is seldom a problem on the medium waves. It is good selectivity that is vital when DXing on this crowded band. Selectivity is achieved in the receiver i.f. stages, hence the value of the CFM2 filter.

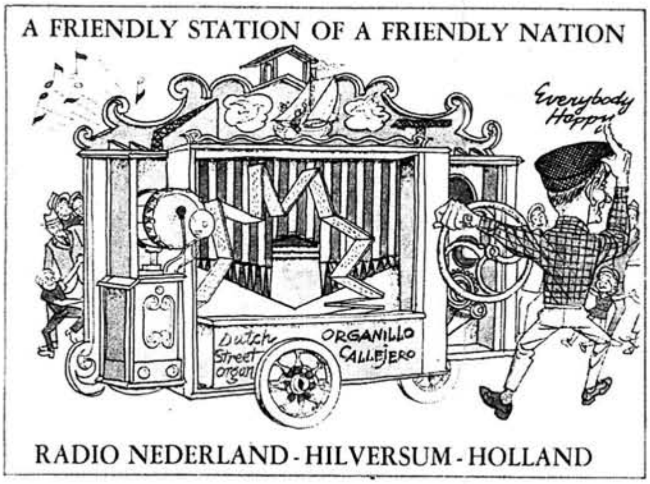
Receiver manufacturers now seem to realise that there is a demand for good selectivity as can be seen if you compare the "spec" of the new FRG-7700 with its predecessors.

Short Wave Broadcast Bands

by Charles Molloy G8BUS

Reports: as for medium wave DX, but please keep separate.

Judging by the number of letters received, the choice of a suitable s.w. receiver is a topic uppermost in the minds of many readers. The demand for information that would



Radio Nederland

help in making a choice is recognised in the December issue of *Voices* which contains a shopping list of radio receivers compiled by Jonathan Marks and Wim van Amstel, both of Radio Nederland. The list, which covers sets that have been seen by Radio Nederland, is split into four categories, each of which is defined in detail. These are: cheap portables, sets for the serious programme listener, semi-professional DX equipment, DX professional class. Basic information about individual receivers is given together with European prices in Pounds Sterling.

Voices

Further information about this international guide to radio, published in Helsinki, can be obtained by sending a s.a.e. to Box 27, Woodford Green, Essex or an IRC to Box 226, Helsinki 17, Finland. "*Voices* is in no way connected with the Finnish Broadcasting Company though we can confirm its existence" is their own explanation why those who have written to Radio Finland about *Voices* have received no reply.

DX Juke Box

This weekly programme for DXers, which is in English, is now presented by Jonathan Marks, who many will remember for his interesting and informative talks over Austrian Short Wave Panorama on Sundays. *DX Juke Box*, which is on the air at approximately 2045 on Thursdays, comes in well at my QTH at the moment on 15 220kHz in the 19 metre band, and on 17 695 on 16m. An up-to-date schedule from Radio Nederland can be obtained by writing to PO Box 222, Hilversum, Holland.

Relays

During the early days of radio you could pick up a programme from a distant country and be certain that the transmitter was indeed located in that country. This is not so today. Relay stations, which as the name suggests, retransmit programmes, are now in general use, making life rather difficult for the DXer who is never really sure what he is listening to.

There are a number of reasons why this situation has arisen. More reliable reception is obtained if you live within "single hop" distance of the transmitter. The maximum distance that can be covered by a single reflection from the ionosphere is about 4000km. If you hear a transmitter further away, then the radio waves must have been reflected from the ionosphere back to the earth's surface from which they are reflected back into the ionosphere for a second time before reaching your receiver. This is multi-hop reception and is, as might be expected, less reliable than single hop.

You can also be too near a country for reliable reception on the short waves after dark. If you live within the skip zone then it is only from a more distant relay that you can hope to hear, for example, Holland from my QTH after dark. When I listen to *DX Juke Box* on 15 220kHz at 2050 on a Thursday in winter I cannot be listening to a transmitter in Holland, since I am too near that country for reception on the 19m band at that time. In fact the transmitter is located at Radio Nederland's relay station at Bonaire in the Caribbean.

There is another reason why relays are popular. The path from the country of origin may not be open on any frequency at the peak listening hour. It is fairly easy to pick up Japan at breakfast time on the 13m, 16m and 19m bands but reception is difficult during the evening. A relay is required if R. Japan wants to reach an evening audience in Europe.

All this can be confusing to the DXer. "How do I know when I'm listening to a relay station?" asks reader **L. Harding.** Unfortunately there is no easy way to tell. Most transmitters will identify their location at the end of transmission but perhaps the best aid is the frequency list in the *World Radio and TV Handbook* which does refer to transmitter locations.

Monitors

Major broadcasters on the international bands are usually pleased to hear from their audience, especially when letters comment on the quality of the programmes and give details about the listener, his background and interests. Many letters though only contain a report on the quality of reception giving the SINPO rating of the signal, the listener not realising that this information is of limited value. Stations know they are reaching their audience, for part of the time at any rate.

What is really wanted is a day-by-day record of how the station is being received and this would include occasions when reception was difficult or impossible owing to poor propagation or interference. In order to obtain this information in a standard form, Monitors are appointed who, as the name suggests, listen regularly and provide the information the station wants.

Sometimes it is the DXer with his experience, skill and specialised equipment who is enlisted. I know of one who listens regularly to the Australian time signal station on 7·5MHz and 12MHz to obtain a continuous record of propagation. More often though it is the ordinary listener with his domestic set who can more accurately represent the view of the majority of listeners.

All this brings me to an invitation from HCJB The Voice of the Andes in Ecuador, to readers of *Practical Wireless*. Monitor Coordinator (UK) **Malcolm Cheesman** writes "We are at present looking for short-wave listeners to act as official monitors of our English language transmissions to the United Kingdom." Anyone interested should write to Malcolm at 34 Penchwintan Road, Bangor, Gwynedd, LL57 2UY.

DX Party Line

This is HCJB's programme for DXers which is on the air at 2130 on Mondays, Thursdays and Saturdays. According to the current schedule it can be heard on

21 480kHz in the 13m band, 17 790 on 16m, and 15 295 on 19m. The 19 metre transmission comes in best at my QTH at the time of writing, but as the days lengthen the higher frequencies should improve. No need to write to Ecuador unless you want a QSL. Copies of the schedule are obtainable from 63a Main Street, Bingley, W. Yorks, BD16 2H2 which is the HCJB UK office.

DX Heard

In response to my enquiry in the June issue about the Australian Domestic Service, **K. Lewis** of Pensilva in Cornwall reports hearing VLM4 in Brisbane on 4920kHz in the 60m band just after sunrise (0850) on November 28 with his DX160 and 27 metre long wire. The identification "This is the ABC" came at 0900. A rather good catch. Don't rely on VNG the Australian Time Signal station on 4·5MHz as a pointer as it does not come on the air until 0945 and signs off at 2130.

Radio New Zealand is reported by **G. R. Ellis** (Aylesbury) who picked it up between 0430 and 0620 with his SRX-30, a.t.u. and long wire. Our reader is looking for a handbook for an EC10 and I suggest sending an s.a.e. to Brooks, 5 Farrant House, Winstanley Road, London SW11 2EJ who supplies copies of handbooks and circuits for a large number of receivers. **Robert Long** of Eccles also runs an SRX-30 which he uses with a 9 metre long wire. He reports hearing India on 11 620kHz in the 25m band at 2215. Try this frequency at 2125 on the first and third Mondays of the month for *DX Circle* which is a new programme in English for DXers.

Mathew Phillips (Halstead Essex) is back at the controls of his HRO MX after a break of about a year. He reports hearing R. N. Brazil on 15 445 at 2310, and he mentions the two West German home service relays on the 49m band, Rias Berlin/Munich on 6005 and Suddeutscher Rundfunk 6030kHz, which come in well at his QTH during the day. The unidentified on 15 030 is probably Peking which broadcasts in a number of languages.

From Lossiemouth there is a report of DX heard by reader **W. B. Stewart** who uses a Panasonic DR28 with its own telescopic aerial. Sri Lanka was heard in English at 0100 on 15 425, Peking at 0120 on 15 030, Athens on 17 830 at 1245, Cairo with "Arabic by Radio" on 17 920 at 1255, India on 15 110 at 2340 and Japan at 2348 on 15 270, which goes to show that you can listen to the world on the short waves using quite a simple aerial.

Schedule from HCJB

VHF Bands

by Ron Ham BRS15744

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

I know it is extra work, but it really is worthwhile keeping separate records of such natural events as auroral displays seen, solar bursts heard, extremes of temperature and weather, rainfall, thunderstorms and the atmospheric pressure for later comparison with the DX entries in the shack log. Some daily newspapers publish a weather map with their report and a collection of these can prove very useful in the shack archives.

Solar

A few small bursts of solar radio noise and a slight noise storm were recorded by **Cmdr Henry Hatfield,** Sevenoaks, at 136MHz and by me at 143MHz on November 13. During the midday observation on the 14th we both recorded a large individual burst (Fig. 1), which lasted for seven minutes, followed by a few tiny bursts on the 15th and one of five minutes duration on the 18th. A few short-duration bursts were recorded on the 23rd and 27th, and December 3, 4, 12 and 14, and there were noise storms on November 28, and December 15 and 16. Faint auroral events on November 19 and 23 were reported by **John Branegan** GM4IHJ, Saline, Fife.

On December 16, Henry, using his spectrohelioscope, saw six sunspot groups and one, on the central meridian, was very active and may well have been responsible for the extensive aurora which manifested between about 1600 and 1915 on the 19th. During the latter part, when most of us were home from work, **Alan Baker** G4GNX, worked two DKs, two DLs, a DJ and a GM via tone-A c.w., and I counted 30 burbling signals from Continental broadcast stations between 45MHz and 73MHz. Alan said that the main aerial beam heading was N/NE and the signal from another local, G3WZT near Horsham, was exceptionally strong from the aurora. More news in our next issue. During the early hours of the 20th, the BBC World Service reported that an ionospheric disturbance was affecting their north American routes.

The 10m Band

The 10m band was full of DX almost daily from November 12 to December 15, during which time I heard some interesting QSOs. At 0902 on the 17th I received a strong signal from ZL2VO while he was working a PA0, at 1350 on the 22nd I received 59 signals from both sides of a QSO between OH8UI and VE3HL, and about the same time on the 25th I heard 59 signals from both SM5DFY and W9RG who were also congratulating each other on their very strong signals.

"The 10m band is wide open," writes **Harold Brodribb,** St Leonards-on-Sea, Sussex, who has been logging many stations from the USA and listening to those harmonics from lower frequency broadcast stations which often thunder in on several frequencies within the band. On November 17 and 22 he heard the news in French around 28·4MHz and German on 28·1MHz and 29·2MHz. During my regular listening times, early mornings and midday, I heard signals from JA on about 12 mornings during the period, VK on 10 and ZL on 5. Although the Russians were prominent during the early mornings, at midday I often heard strong signals from stations in eastern Europe. Russia and Scandinavia working equally strong stations in Canada and the USA. Around 1320 on the 30th I heard Canadian stations working each other and at 1836 (RSA local time) on December 1, **Alan Pretorius,** Bleskop, Republic of South Africa, heard a s.s.b. QSO between a station in Cleveland, Ohio and Farnborough, UK, on his Barlow Wadley XCR-30 portable receiver, using only its rod aerial. Alan has been bitten by the amateur radio bug and is making further enquiries into getting a transmitting licence.

Strong echoes were heard on signals from JA at 0815 on November 18 and on French and German signals at 0924 on the 19th, and apart from a QSO, with deep QSB, between a UB and a 9H1 the band was relatively quiet at 0845 on December 1, even the beacons A9XC and DL0IGI were only just audible. Around 0910 on November 27, I heard ZL3GF tell a G station that he always tunes for the beacons in Germany DL0IGI and the UK GB3SX in the same way that we do to see what the band conditions are like. During the 34 days between November 12 and December 15, I received signals from the International Beacon Project stations in Bahrain A9XC on 33 days, Bermuda VP9BA at midday on 25 days, Cyprus 5B4CY 29 days, Germany DL0IGI 33 days and DK0TE 25 days, Mauritius 3B8MS 13 days and the Norwegian beacon LA5TEN was 589 at 1308 on December 5. A report from **Ted Waring,** Bristol, shows similar beacon results to mine plus his afternoon observations of the beacons in Canada VE2TEN and Florida W4ESY. During the afternoon of December 11, Ted set himself a new record by logging eight beacon signals, from Sussex to Florida, at one time.

The 6m Band

"Since October 16 I have had a most interesting time on 6m crossband. The openings have been more marginal and usually less wide in area coverage compared with 1979, but there has been far more variety this year," writes John Branegan on December 8. During a 6-week period John worked 5B4AZ, EL2AV and VP2VGR for new countries, plus Ws 1, 2, 3, 4, 5, 8, 9, 0, VE1, VE2, KP4, and heard EL2F2, FY7THF, HI8DAF, EI6AS, ZB2VHF and VP9WB. His best DX was with K0GUV in Park Rapids, Minnesota. At 1238 on December 7, **Barry Ainsworth** G4GPW, Lancing, Sussex, heard the automatic keyer of VE1AVX at about 559 and some 10 minutes later it was 599. "Suddenly the band was full," said Barry who took advantage of the good conditions and worked VE1AVX, VE1ASJ, VO1JN and AF1T, heard signals from Ws 1, 2, 3, 4, 8, and VE1ASJ working crossband 6m to 4m with G4BPY. Between 0124 and 0139, Barry heard about five meteor pings per minute from GB3SIX at 539. I hope to hear more about this Barry.

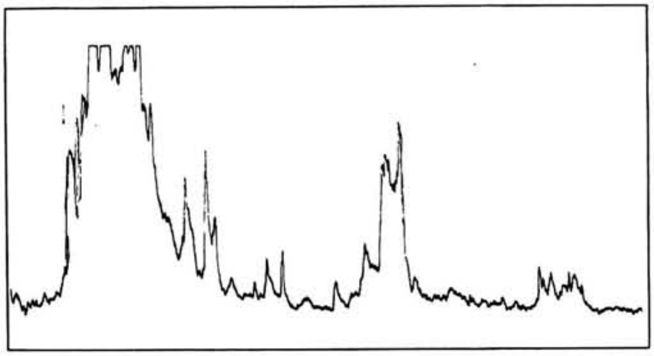


Fig. 1: A 12-minute period of solar activity recorded by the author at midday on 14 November 1980

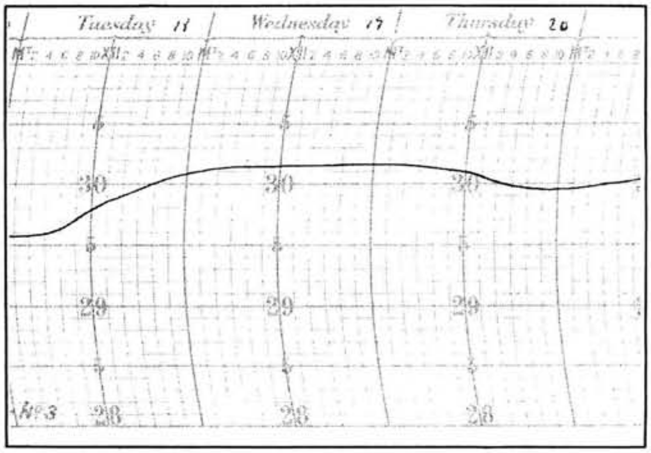


Fig. 2: The period of atmospheric pressure variations responsible for the tropospheric opening during the afternoon on November 20

RTTY

Alan Baker G4GNX, Newhaven, tells me that the use of RTTY on v.h.f. is rapidly growing in Sussex, and many such signals can be heard on the 2m calling channel 145·350MHz. Interest is also growing in Data transmission and the West Sussex Raynet are working on a system for RTTY and Data links. I will be pleased to hear from any of my readers who are active or interested in RTTY signals.

Tropospheric

"Thanks to my new 70cm aerial the Sutton Coldfield beacon, GB3SUT, is now always audible at 439," writes **George Grzebieniak,** RS41733, London. Just shows what a good aerial can do George. I have a simple dipole for 70cm and can only hear GB3SUT when the band is open as it was at 1400 on December 1 when, incidentally, the atmospheric pressure, measured at my QTH, 200ft a.s.l., reached an almost record high of 30·7in (1039mb). **Sam Faulkner** sent a cutting from the *Burton Daily Mail* stating that the AP at the end of November was 30·97in (1049mb) only 6mb short of the old British Isles record. Despite this high, which began at 2300 on November 28, rose sharply through the 29th to reach 30·7in by midnight on the 30th and fell rapidly to 30·1in (1019mb) by noon on December 2, the expected lift in v.h.f. conditions was disappointing. As far as I was concerned, the event was limited to hearing GW mobiles working through the Bristol Channel repeater, GB3BC R6.

For those who are interested in converting the atmospheric pressure readings from inches of mercury to millibars, I am told that 33·863mb equals one inch of mercury, therefore 30·0in would be 1015·89mb. Another rapid rise, from 29·6in (1002mb) began at 0800 on December 6, reaching 30·1in (1019mb) at 1200 on the 7th and 30·5in (1032mb) by noon on the 8th, where it stayed until noon on the 9th when the fall started. During the afternoon and evening of the 9th I heard GW mobiles working through GB3BC, an average 539 signal from GB3SUT on 70cm, and Continental broadcast signals in Band II. Between 2100 and 2215 on the 9th, **Simon Hamer,** Presteigne, Wales, heard classical and jazz music, an interview and a tribute to the late John Lennon from several French stations in Band II.

Pressure Measurement

L. R. Hutchings G8FOD, Solihull, asks about measuring the atmospheric pressure and recording trends. Well, obviously the best way is to use an instrument called a barograph which records the pressure on a weekly chart graduated in hours (Fig. 2). Another way is to make a monthly graph from readings taken twice daily, say noon and midnight, from a standard barometer, or if any readers are really keen, what about the Heathkit Weather Computer?

Visitor from the USA

I was delighted to have an eyeball QSO with one of our American readers, **Bill Potts** KA1ESH, when he was on holiday in the UK last November. Back home Bill uses a Drake TR7 and vertical dipole for 15m and 10m, mainly c.w., and on 2m, an all-mode Icom, a 200W linear and a crossed Yagi antenna. The 2m band in the States spreads from 144–148MHz and the main repeater activity is between 146MHz and 148MHz. Periodically Bill operates through the OSCAR satellite using mode A and for RTTY he has recently installed a Microlog ATR6800 computer.

News Items

Jonathan Read G8YMH, Alresford, Hants, is using a Storno Radiophone converted for the 2m simplex channels, S20, 21, 22 and 23, and the R5 repeater channel, and can be heard working through GB3SN. Jonathan is experimenting with various forms of aerial and no doubt getting a bit of advice from Dad who has held the call G3JIZ for 25 years.

Although **Richard Benbough** RS44194, Billericay, is mainly a medium-wave DXer he has been taking a keen interest in the 10m band with his 9R-59DS receiver and hopes to build a 2m converter so he can listen to the local nets.

At 1627 on November 17, VE1ASJ on 6m made a c.w. QSO averaging 229/339 with G4BPY on 4m for possibly the first 6/4m contact across the pond.

Lawrence Hatfield G8VJC, has installed a rotatable 6-element beam and a Slim Jim aerial at his home in Sevenoaks and is often heard on both the repeater and simplex channels.

TV

by Ron Ham BRS15744

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

Television enthusiasts often find that a TV set, although very good for the domestic use it was intended for, does require some modification before it is suitable for specialised DX purposes. Therefore, I must warn newcomers to DXTV that high voltages are employed inside television receivers, and they should not attempt any alterations without seeking expert advice.

Tropospheric

I received pictures from the IBA transmitter at Lichfield, Ch. 8, at midday on November 20 while the atmospheric pressure was falling (Fig. 2, *VHF Bands*), and under similar circumstances, at midday on December 1 and at 0918 on the 10th. In each case the tropospheric opening was short-lived and I only needed a dipole aerial to receive the signals. **Paul Farrugia,** Cardiff, using a GEC 2010 dual-standard set fitted with an ELC 2060 varicap tuner for Bands I to V, received a variety of pictures from the French u.h.f. television service during an opening between 1800 and 2330 on October 3 (Fig. 1). Around 1800 Paul saw the Philips PM5544 test card with TDF in the top box and TF1 in the bottom box, very soon he realised that the French picture was negative so he re-adjusted his modified receiver to correct this.

Sporadic-E

Short-lived Sporadic-E disturbances were seen by **Sam Faulkner**, Burton-on-Trent, during the early evenings of November 16 and 18. Between 1700 and 1800 on the 16th he watched a variety programme, news and sport from RAI, Italy on Ch. IA 53·75MHz and a picture he could not identify on Ch. E3 55·25MHz. From 1720 on the 18th Sam received signals, at excellent strength, from RTP Portugal and RTVE Spain on Ch. E3. "The RTP1 and RTVE test cards were often on the screen simultaneously before RTVE began its early evening children's programme," writes Sam. One of my Derby readers who is fascinated with Sporadic-E uses a Skantic TV receiver for his pictures and a Hallicrafters S36 communications receiver to tune through Band I. Readers who have these wartime receivers such as the Hallicrafters S27, S36 and 5-10 and the ex-RAF RL85 may find it well worth trying a masthead pre-amplifier which covers Bands I and II.

SSTV

"Although SSTV stations were seen from Ws 1, 2, 3, 4, 5, 8, 9, 0, HK3, IT9, OH, VE and ZS6 on 10m, the band seemed generally unstable for this mode from November 11 until quite recently." writes Sam Faulkner on December 8. Sam found good conditions on December 7 when he logged pictures from HK3DBQ, KA1KSG, K1DMU, KC4FM, OH2KM, OH5RM, OH5ZJ, five W stations and VE3KIF, and at 1300 he received a colour card (in mono) from ZS6BTD in Johannesburg while he was in

BI-AND SAVE SALE-81

DIODES

AA119	£0.06	IN34	£0.06
BA100	£0.08	IN60	£0.07
BA148	£0.13	IN4148	£0.05
BA173	£0.13	IN4002	£0.04
BAX13	£0.05	IN4003	£0.05
BAX16	£0.06	IN4004	£0.06
OA200	£0.06	IN4005	£0.07
OA202	£0.07	IN4006	£0.08
BY100	£0.18	IN4007	£0.09
BY126	£0.12	IN5400	£0.12
BY127	£0.14	IN5401	£0.13
OA47	£0.06	IN5402	£0.15
OA70	£0.06	IN5404	£0.15
OA79	£0.06	IN5406	£0.19
OA81	£0.08	IN5407	£0.23
OA90	£0.06	IN5408	£0.28
OA91	£0.06	IS44	£0.03
OA95	£0.06		

BC108 FALLOUTS

50 NPN BC107/108 SJ124 £1

Manufacturers out of spec on volts or gain or neither – Metal TO18 case – You test.

50 PNP BC177/178 SJ1244 £1

UJT's & FET's

UT46/TIS43	£0.18
BRY56	£0.25
2N4860	£0.40
2N4220	£0.30

Silicon Fast Switch
NPN – like 2N706/2N2369
You select by test!
O/No. SJ125. **50 for £1.00**

ASSORTED GERM. TRANS.

SJ135 20 Assorted Germanium Transistors – ALL New & Coded types include AC's – 2G's – GET's – ACY's etc. **£1.00**

FM TUNER

SJ141 FM Tuner (Front End) with AM twin gang capacitor 87-109MHZ 5-10 volts supply – data sheet supplied **£2.50**

AERIALS

FM Indoor Tape/Ribbon Aerial
O/No. 107. **40p each**
HI-FI CAR AERIAL
4-section fully retractable & locking **SPECIAL PRICE.**
O/No. 109. **£1.40 each**

IC SOCKET PACKS

SJ36	14	8 pin	SJ41	6	22 pin
SJ37	12	14 pin	SJ42	5	24 pin
SJ38	11	16 pin	SJ43	4	28 pin
SJ39	8	18 pin	SJ44	3	40 pin
SJ40	7	20 pin			

ALL AT ONLY £1.00 each

VOLTAGE REGULATORS

Case T0220

Positive		Negative	
uA7805	£0.65	uA7905	£0.70
uA7812	£0.65	uA7912	£0.70
uA7815	£0.65	uA7915	£0.70
uA7818	£0.65	uA7918	£0.70
uA7824	£0.65	uA7924	£0.70

AUDIO AMPLIFIER

5 watt Audio Amplifier Module.
Special Clearance Offer
O/No. AL20. **£2.50**

Special Introductory Offer

COMPUTER IC's
EPROM 2708 @ **£3.00**
EPROM 2516/2716 @ **£6.00**
D.RAMS 4116 @ **£2.25**

BI-PAK'S OPTO BARGAIN!

Valued at over £10 – Normal Retail

We offer you a pack of 25 Opto devices to include LED's large and small in Red, Green, Yellow and Clear. 7 segment Displays both Common Cathode and Common Anode PLUS bubble type displays – like DL-33. Photo Transistors – similar to OCP71 and Photo Detectors – like MEL11-12. This whole pack of 25 devices will cost you just . . .

£4.00!

and we guarantee your money back if you are not completely satisfied.

Full data etc included
O/No. SJ120.

GERM. TRANSISTORS

The last of the Germanium PNP – OC71-71-75 etc. Mullard Black/Glass Type – You test (5 could cost you that!)
O/No. SJ126. **50 pcs £1.00**

GERM. POWER TRANS.
AD149-OC26-AD140 **£0.50 each**
AD142-OC28-2N3614 **£0.65 each**

CAPACITOR PAKS

16201	18 electrolytics	4.7uF-10uF
16202	18 electrolytics	10uF-100uF
16203	18 electrolytics	100uF-680uF

All 3 at SPECIAL PRICE of £1.30

16160	24 ceramic caps	22pF-82pF
16161	24 ceramic caps	100pF-390pF
16162	24 ceramic caps	470pF-3300pF
16163	24 ceramic caps	4700pF-0.047pF

All 4 at SPECIAL PRICE of £1.80

SPECIAL OFFER LINEAR IC's

NE555	5 for **£0.90**
741P	5 for **£0.80**
NE556	5 for **£2.50**
LM380	5 for **£3.50**
72723 14 pin	5 for **£1.75**
CA3085	1 for **75p**

GENUINE MULLARD TRANSISTORS

AF116	£0.40	AC187	£0.20
AF118	£0.45	AC187K	£0.35
OC71	£0.12	AC188	£0.20
OC75	£0.25	ASZ17	£0.60
OC76	£0.30	BC148C	£0.07
OC79	£0.35	BC149C	£0.07
OC42	£0.18	BC157	£0.08
OC44	£0.20	BC159	£0.08
OC45	£0.18	OCP71	£0.30

RESISTOR PAKS

Order No.		
16213	60 ¼W	100ohm-820ohm
16214	60 ¼W	1K-8.2K
16215	60 ¼W	10K-82K
16216	60 ¼W	100K-820K
16217	40 ½W	100ohm-820ohm
16218	40 ½W	1K-8.2K
16219	40 ½W	10K-82K
16220	40 ½W	100K-820K

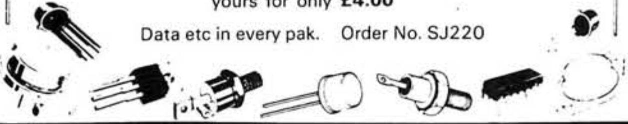
ANY 4 at SPECIAL PRICE of £1.80

Semiconductors from Around the World

100 A collection of Transistors, Diodes, Rectifiers, Bridges, IC's, SCR's, Triacs both Logic and Linear + Opto's all of which are current everyday usable devices. **100**

Guaranteed Value over £10 at Normal Retail Price yours for only **£4.00**

Data etc in every pak. Order No. SJ220



DISC CERAMIC CAP

100 Disc Ceramic Cap. Mixed values covering complete range 3PF-4,700PF.
SUPER VALUE
O/No. SJ121. **£1.00**

SPECIAL OFFER

MJ2955 (PNP Comp. to 2N3055) TO3	£0.75
ZN414	£0.75
ORP12	£0.50

SWITCHES

Push-to-make. 6mm panel mounting.
O/No. SJ131. **5 for £0.50**
Push-to-break as above.
O/No. SJ132. **4 for £0.50**
Silicon Heat Sink Compound 3mL in syringe **25p**
SJ134 Slide Switches Low voltage and mains types **12 for £1.00**

SEE OUR SPECIAL INCLUSIVE APRIL ANNOUNCEMENT

POPULAR CMOS

CD4001, CD4007, CD4011, CD4017, CD4081 – 1 of each normal price £1.80 for 5 – our price **£1.30**

SILICON TRANS.

SJ25 100 Silicon NPN transistors all perfect & coded – mixed types with data – equivalent sheet – no rejects **£2.50**
SJ26 100 Silicon PNP transistors all pefect & coded – mixed types and cases, data & equivalent sheet **£2.50**
SJ27 50 Assorted pieces of SCR's, diodes & rectifiers incl. stud types, all perfect – no rejects, fully coded – data incl. **£2.50**

PRECISION VOM MULTIMETER

20,000 ohms/volts DC. Complete with test leads & Instructions.
OUR SPECIAL OFFER PRICE £11.00 each.
O/No. 1323
Use your Barclay or Access Card!

L.E.D.

2nd Quality Paks

1507	10 Assorted colours & sizes	£0.65
S122	10.125 RED	£0.50
S123	10.2 RED	£0.50

LED CLIPS

1508/125	.125	5 for £0.10
1508/2	.2	5 for £0.12

PCB

O/NO: 1609 PCB Etch Resist Pen **£0.55**
SJ138 Paper PCB 5 pieces – approx 200 sq.ins. **£1.75**
SJ139 Glass Fibre PCB 5 pieces – approx 200 sq.ins. **£2.25**
SJ140 Mixed PCB single sided paper – single & double sided Glass Fibre – 5 pieces – approx 200 sq.ins. **£2.00**

TTL's

SJ28 20 TTL74 series gates – assorted 7401-7460 **£1.00**

Mixed DTL ALL New and Coded

930-9099 our mix 10 for **£1.00**
O/NO: SJ133

NPN TRANSISTORS

SJ68 30 ZTX300 type transistors NPN pre-formed for P/C Board colour coded Blue – all perfect. **£1.00**
SJ70 25 BC107 NPN TO106 case perfect transistors code Green Spot. **£1.00**
SJ71 25 BC177 PNP TO106 case perfect transistors code C1395. **£1.00**
SJ72 4 2N3055 silicon power NPN transistors TO3 **£1.00**

MISCELLANEOUS

SJ137 Assorted Cable Grips and Cabinet Feet 50 pieces for **£1.00**
SJ136 Nickel Cadnium rechargeable Cell 3500D-HP2 size **£2.50**
Calculator Chip Type: GOM2-C500 24 pin MOX with Data **£0.50**
2015 IC Insertion – Extraction Tool **£0.52**

CAPACITORS

SJ11 150 Caps. mixed types & values. **£0.50**
SJ12 60 Electrolitics all sorts mixed. **£0.50**
SJ13 40 Polyester/polystyrene capacitors mixed. **£0.50**
SJ14 50 C280 type capacitors mixed. **£1.00**
SJ15 Polystyrene Caps - 1, 160v **£0.50**
SJ16 40 Low volts electrolitics mixed values up to 10v. **£0.50**

RESISTORS

SJ1 200 Resistors mixed values. **£0.50**
SJ2 200 Carbon resistors ¼-½ watt preformed. **£0.50**
SJ3 100 ½ watt miniature resistors mixed values. **£0.50**
SJ4 60 ½ watt resistors mixed values **£0.50**
SJ5 50 1-2 watt resistors mixed pot values. **£0.50**
SJ7 30 2-10 watt wirewound resistors mixed. **£0.50**

POTENTIOMETERS

16173	15 Assorted Pots	£0.50
SJ54	20 Assorted Slider Pots	£1.00
SJ56	10 100 K Lin Slider Pots 40mm	£0.50
16186	25 Pre-sets Assorted	£0.50
SJ49	8 Dual gang carbon pots log and lin mixed values	£1.00
SJ50	20 Assorted slider knobs – chrome/black	£1.00

ODDMENTS

16170 50 metres asst. colours single strand wire. **£0.50**
16187 30 metres stranded wire mixed colours. **£0.50**
16178 5 Main slider switches assorted. **£0.50**
SJ76 1 Board containing 2×5-pin DIN sockets 180° & 2×2-pin DIN loud-speaker sockets. **£0.30**

TRANSFORMERS

MINIATURE MAINS Primary 240v

No.	Secondary	
2021	6v-0-6v 100mA	£0.75
2023	12v-0-12v 100mA	£0.95
2035	240v Primary 0-55v 2A Secondary	£5.50

CASSETTES

SUPER VALUE & A GREAT SAVING!!!
C120 Dindy Cassettes – Low noise – astounding value and sound.
O/No. SJ32. **10 for £3.50**

TRIACS

4A 400v TO-202 non-isolated TAG136D	£0.40
8A 400v TO-220 isolated TAG425	£0.60
Diac D32/BR100	£0.15
SCR C106D plastic case	£0.30

KNOBS

SJ62 5 15mm chrome knobs standard push fit. **£0.50**
SJ63 Instrument knob – black winged (29×20mm) with pointer. ¼" standard screw fit. **£0.15**
SJ64 Instrument knob – black/silver aluminium top (17×15mm). ¼" standard screw fit. **£0.12**

BI-PAK

Send your orders to: **Dept PW3, BI-PAK, PO BOX 6, WARE, HERTS.**
SHOP AT: 3 BALDOCK ST, WARE, HERTS.
TERMS: CASH WITH ORDER, SAME DAY DESPATCH, ACCESS, BARCLAYCARD ALSO ACCEPTED. TEL: (0920) 3182. GIRO 388 7006
ADD 15% VAT AND 50p PER ORDER POSTAGE AND PACKING.

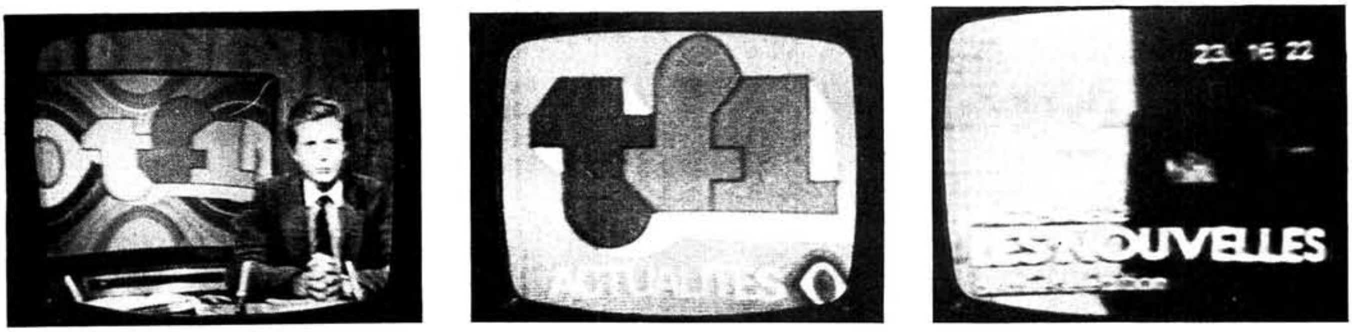


Fig. 1: Pictures received from French Television by Paul Farrugia in Cardiff on 3 October 1980. The first two are from TDF TF1, and the third is from Antenne 2

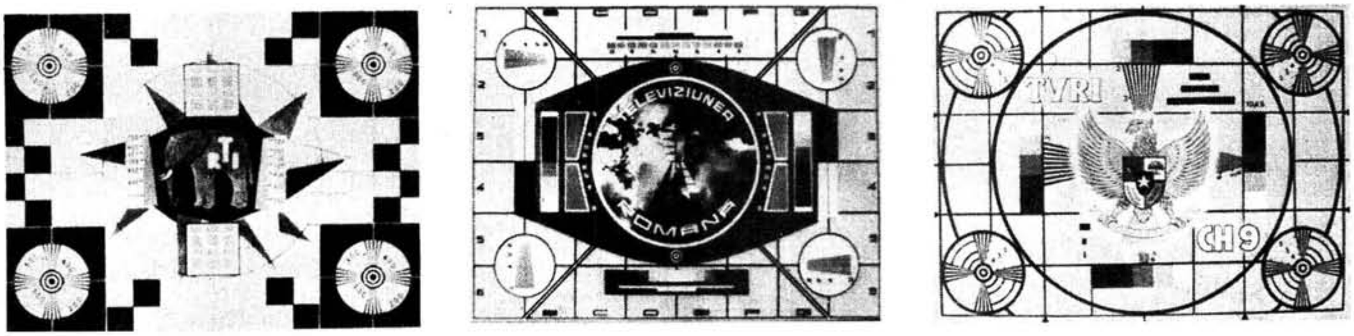
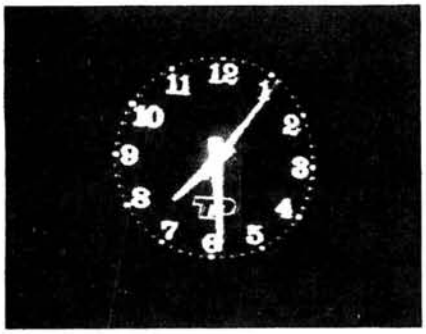


Fig. 2: Test cards from the Ivory Coast, from Rumania and from Indonesia



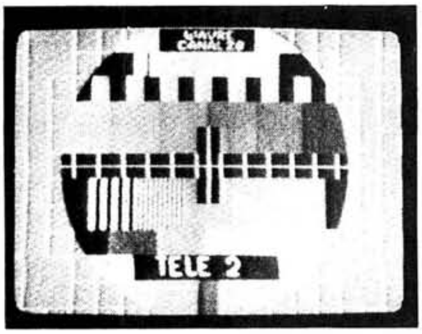


Fig. 3 (far left): A clock caption from Poland, received by Keith Hamer. Fig. 4 (left): A test card from Belgium, received by Garry Smith

The photographs in Fig. 2 are from *Guide to World-Wide Television Test Cards*

QSO with WA1ZMJ. Sam also received several very interesting pictures of the planet Saturn from W0TV and WB1CWD, who were transmitting SSTV pictures that they received from the laboratory monitoring the signals from the Voyager spacecraft.

Help Required

Can any of our overseas readers, especially in the African and Middle Eastern countries, send photographs of their local television test cards to Keith Hamer, 7 Epping Close, Mackworth Estate, Derby DE3 4HR, who, along with Garry Smith, is compiling further editions of their famous book *Guide to World-Wide Television Test Cards*. After seeing the three samples from Book 1, Fig. 2, I for one am certainly looking forward to Book 2. Both Garry and Keith are keen TVDXers and have each sent me a photograph, Figs. 3 and 4, giving an indication of their own work in this particular field.

Mods for Meteor Scatter

Sam Faulkner has two JVC3040 UKC receivers which have been in regular service for almost two Sporadic-E seasons and although like other sets, they have given good results in their standard form, the main problem for DX use is with signals on closely adjacent channels floating over each other. For example, Ch. E2 48·25MHz and Ch. R1 49·75MHz and sometimes the side splatter from Ch. B2 51·75MHz and Ch. B4 61·75MHz. These British signals often present a problem to TVDXers using Band I.

Sam has modified one of his sets by replacing the original tuner with one of the varicap tuner boxes, supplied by Hugh Cocks, which he has fed directly into the 3040's i.f. strip via a couple of Philips "G8" selectivity modules. By carefully adjusting each module for minimum adjacent channel QRM and tweaking up all around, a very narrow bandwidth has been obtained for vision only. "This modification has enabled me to tune for meteor scatter for the first time on Ch. R2 59·25MHz," writes Sam "an impossibility before due to our extremely strong local station on B4".

The tuner supplied by Hugh Cocks, Robertsbridge, Sussex, is mains-powered and housed in a smart aluminium case with controls for coarse and fine tuning, tuner gain and bandswitching. A 4in panel meter is incorporated in some models for accurate channel logging and the unit can tune from 40–90MHz in Bands I and II, 175–220MHz in Band III and the u.h.f. TV Channels 21–69. Hugh is also a TVDXer and told me on December 14 that he had seen evidence of pictures, via F2, on Ch. R1 on almost every day since October 9. Between 0830 and 0900 on December 9 he again received signals from Australian TV on Ch. 0 46·25MHz.

Band I

Like John Branegan up in Fife, and Sam Faulkner in the Midlands, I down in the south have also received multipath, smeary pictures on Ch. R1 arriving via the F2 region of the ionosphere. At 0915 on November 12, I saw what looked like a military gent being interviewed, and at 1035 on December 14 I picked out a multi-image figure conducting an orchestra. A typical event begins around 0830 when, on my R216 communications receiver, I hear the first weak synchronising pulses on Ch. R1. These gradually become stronger and by about 0900 my JVC 3060, in standard trim and working alongside the R216, begins to resolve a mixture of pictures which fluctuate in strength until about 1030.

At 0922 on December 3 there were long bursts of test card from Poland, which looked like a bit of Sporadic-E chucked in, but by 0940 there were multiple images of a single person on the screen which was most definitely F2, and at 0925 on the 5th there was a smeary mixture of unidentifiable programmes and test cards. It is a pity, but it is generally agreed that considerable patience is required before getting just a glimpse of an identifiable signal under F2 conditions.

UNCLE ED'S PAGE

▶▶▶ *continued from page 33*

carrier-wave of the transmitter is varied in amplitude (modulated) by the audio tone to produce the waveform of Fig. 2. In doing the modulation, sidebands above and below the carrier are produced (this is what that equation with the trig functions is trying to tell us). The waveform of Fig. 2 can also be thought of as due to the carrier and sidebands beating together, producing a pulsating signal. If you had a very, very selective receiver, so that you could tune to just the carrier, and reject the sidebands completely, you would hear nothing, and an oscilloscope connected to the input to the detector circuit would display a constant amplitude, unmodulated carrier-wave (Fig. 5). This is an extension of what happens when you try to listen to a music programme on a receiver with too narrow a bandwidth. The musical high notes are lost because the sidebands which carry them are cut before they reach the detector, and the original "brilliance" of the music is also lost. All the programme information, be it a tuning note, speech or music, is in the sidebands; the carrier carries no information.

"Then why," I hear you ask, "do we transmit the carrier at all?" Well, we don't actually have to, although doing away with it does cause some complications. Since both upper and lower sidebands contain the same information, we can do away with one of those too. All this is great for energy conservationists, and brings us on to the real subject of this article. Unfortunately, I've rabbited on so long setting the scene that I've run out of space for this month. So we'll get down to s.s.b. next time, when as they say, all will be revealed. (I hope!)

RECEIVER PARAMETERS

▶ ▶ ▶ *continued from page 75*

Summing Up

The author would rate as vital such parameters as those of selectivity, sensitivity, i.m.d. and drift, but unfortunately manufacturers often either omit figures altogether, or make meaningless statements. ("Hot ½μV sensitivity!")

To give some ideas of high-price performance, it is suggested that the following figures give some guide. A receiver meeting all of these figures will not be cheap, but a receiver costing £500 or more should meet the majority of them.

Sensitivity:	15dB SINAD for 1μV e.m.f. (0·5μV p.d., or −113dBm)
AF Output:	100mW for above input
Selectivity:	2·7kHz at −6dB; 5·4kHz at −60dB
Third Order i.m.d.:	Two signals 20kHz apart at 6mV e.m.f. (3mV p.d., or −37·5dBm) producing an i.m.d. product with a 6dB SINAD ratio (Intercept plus 5dBm) Dynamic range is thus 89dB
Ultimate SINAD:	40dB
Spurious Responses:	
Internal:	None greater than 6dB above noise
External:	−70dB
Reciprocal Mixing:	An unwanted signal 10kHz away from a wanted signal of 1μV e.m.f. should be at least 18mV e.m.f. to degrade the SINAD ratio by 3dB

Other figures, such as a.g.c., etc., are not so critical. The figures given should provide some sort of guide to the higher performance figures for h.f. receivers. There is some tendency for r.f. performance to be made subsidiary to digital readouts, microprocessor control, synthesisers and the whole gamut of modern electronic goodies. Although these can well be useful additions, the basic worth of a receiver is still measured by its r.f. capabilities, and no manner of added gimmicks of this sort will turn a bad r.f. performance into a good one.

Conclusion

Receivers are complex equipments when the highest performance is required; their performance cannot be solely determined on the air or on the laboratory bench, for both evaluations are required. Their shortcomings are often realised subjectively, and attempts to put a name to these from on-the-air use, lead to fallacies and inaccuracies, often compounded by a lack of knowledge of the actual operations inside the box.

It is hoped that this article will have removed some of the "black magic" surrounding receiver performance, and lead to a better understanding of the operation of the most important piece of equipment in the shack of both the transmitting amateur and the s.w.l. ●

The biggest name in solder worldwide

Products that help you make a better job of it.

Arax Multicore Solder.
Economy pack for general non-electrical use. Replaces solid wire and stick solder. (B.S. 219 Grade L). Econopak 200g reel of 3mm dia. Size 16A.
£4.14 per reel.

Toolbox Reels.
Multicore 5-core solder for general use. Suitable for electrical joints (B.S. 219 Grade G).
40/60 tin/lead. 1.6mm dia. Size 3. **£3.91 per reel.**

Savbit.
Multicore 5-core solder for radio, T.V. and similar work. Reduces copper erosion. Suitable for service engineers and manufacturers using small quantities of solder.
1.2mm dia. Size 12. **£3.91 per reel.**

Multicore Wick.
Multicore solder-wick for removing solder from virtually any joint.
1.7mm dia. Size AB10. **£1.38 per reel.**

Handy Dispensers		Per pack
PC115	for printed circuits.	£1.15
SV130	for radio and T.V. repairs.	£1.61
AR140	for non-electrical applications, except aluminium	£1:38
SS160	for stainless steel and silver jewellery.	£2.53
19A	for all electronic joints. non-corrosive.	96p
AL150	for aluminium.	£1.93
BCA16	solder cream for stainless steel, jewellery and household products (non-electrical).	£3.22
BCR10	solder cream for electronic and electrical use.	£1.38
BCA14	all purpose solder cream, non-electrical jointing and repairing.	£1.38

Tip Kleen.
Multicore Tip Kleen.
Soldering-iron tip wiping pad. Replaces wet sponges. (Should not be used above 350°C).
81p per pack.

Econopak.
Ersin Multicore 5-core solder. Contains non-corrosive flux for electrical applications.
1.2mm dia. 200g Econopak. Size 13A. **£4.14 per reel.**

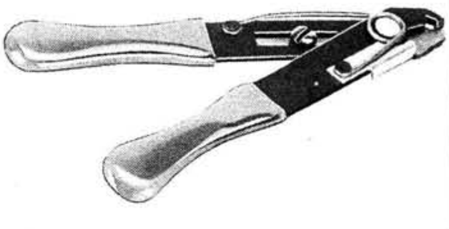
Metal Soldering.
Arax Multicore 4-acid-core solder for metal fabrication (not aluminium) and repairs.
40/60 tin/lead. 1.6mm dia. Size 11. **£3.91 per reel.**

T.V. and Radio Soldering.
Savbit Multicore for radio, T.V. and similar work. Reduces copper erosion.
1.2mm dia. Size 5.
90p per handy dispenser.

Econopak.
General purpose solder suitable for all electrical joints.
40/60 alloy. 1.2mm dia. Size 6. **58p per handy plastic dispenser.**

Aluminium Soldering.
Alu-Sol Multicore 4-core solder for soldering most types of aluminium. No extra flux needed.
1.6mm dia. Size 4. **£6.90 per reel.**

Soldering Flux Pastes.
Multicore soldering flux paste. Extra fast, non-corrosive, rosin-flux for electrical and general purpose soldering.
Rosin R.F.10. 35g net. **69p per pack.**
Multicore soldering flux paste for soft metals (except aluminium) and stainless steel. Non-electrical.
Arax A.F.14. 35g. **69p per pack.**



Wire Stripper and cutter.
Wire stripper and cutter with precision ground and hardened steel jaws. Adjustable to most wire sizes. With handle locking-catch and easy-grip plastic covered handles.
Ref: 9. **£2.69 per pair.**

Bib Hi-Fi Accessories Ltd., (Solder Division),
Kelsey House, Wood Lane End,
Hemel Hempstead, Hertfordshire HP2 4RQ.
Telephone: (0442) 61291.

All recommended retail prices shown are inclusive of VAT. If you have difficulty in obtaining any of these products send direct with 40p for postage and packing. For free colour brochure send S.A.E.

The range grows bigger... better...

New Profile Amplifiers - Two New Series

MOSFET

CHOOSE AN I.L.P MOSFET POWER AMP when it is advantageous to have a faster slew rate, lower distortion at higher frequencies, enhanced thermal stability, the ability to work with complex loads without difficulty and complete absence of cross-over distortion. I.L.P's exclusive encapsulation technique within fully adequate heatsinks has been taken a stage further with specially developed computer-verified 'New Profile' extrusions. These ensure optimum operating efficiency from our new MOSFETS, and are easier to mount. Connection is via five pins on the underside. **I.L.P MOSFETS ARE IDENTICAL IN PERFORMANCE TO THE COSTLIEST AMPLIFIERS IN THIS EXCITING NEW CATEGORY BUT ARE ONLY A FRACTION OF PRICES CHARGED ELSEWHERE.**

Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
MOS120	60W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£25.88 + £3.88
MOS200	120W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£33.46 + £5.02

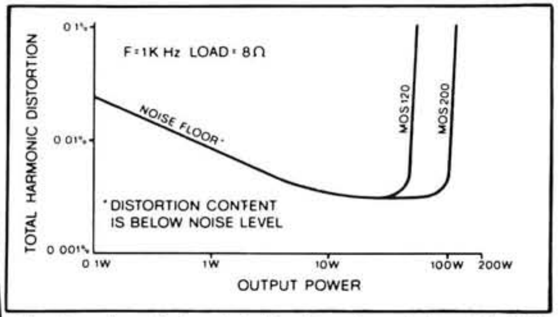
BIPOLAR

STANDARD O/P TRANSISTORS

CHOOSE AN I.L.P BIPOLAR POWER AMP where power and price are first consideration while maintaining optimum performance with hi-fi quality and wide choice of models. From domestic hi-fi to disco and P.A., for instrument amplification; there is an I.L.P Bipolar to fill the bill, and as with our new Mosfets, we have encapsulated Bipolars within our New Profile extrusions with their computer-verified thermal efficiency and improved mounting shoulders. Connections are simple, via five pins on the underside and with our newest pre-amps and power supply units, it becomes easier than ever to have a system layout housed the way you want it.

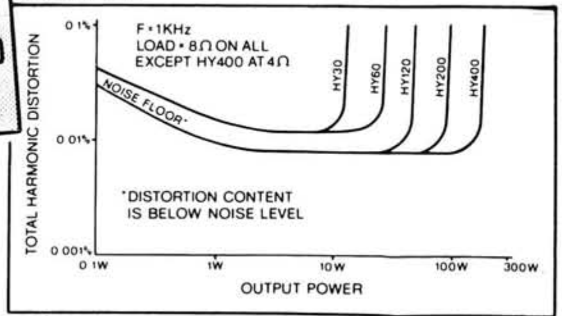
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
HY30	15W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£7.29 + £1.09
HY60	30W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£8.33 + £1.25
HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£17.48 + £2.62
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£21.21 + £3.18
HY400	240W into 4Ω	0.01%	15V/μs	5μs	100dB	£31.83 + £4.77

ILP POWER AMPS ARE ENCAPSULATED FOR THERMAL STABILITY AND LONGER LIFE



Load impedance both models 4Ω - ∞ Input sensitivity both models 500mV

Input impedance both models 100KΩ Frequency response both models 15Hz-100KHz – 3dB



Load impedance all models 4Ω - ∞ Input sensitivity all models 500mV

Input impedance all models 100KΩ Frequency response all models 15Hz-50KHz – 3dB

THE NEW PROFILE EXTRUSIONS

The introduction of standard heatsink extrusion for all I.L.P. power amplifiers achieves many advantages: – Research shows they provide optimum thermal dissipation and stability. Slotted shoulders allow easy mounting; standardisation enables us to keep our prices competitive. Surfaces are matt black, anodised for higher thermal conductivity. Extrusions vary in size according to module number.

BAKER SPEAKERS "STAR SOUND"

Post £1·50 ea.

GROUP 45–12 **£15**
12in. 45 watt
4, 8 or 16 ohms.

GROUP 75–12 **£22**
12in. 75W professional model. 4, 8 or 16 ohms
Response 30 — 16,000.
With aluminium presence dome.

DISCO 100/12 **£26**
12 in 100W model
8 or 16 ohm

DISCO 100–15 **£29**
15in. 100 watt
8 or 16 ohms.

AUDITORIUM 15
Bass woofer 15in. Special cone surround
Heavy duty cone. 60 watts. 20 to 8000 cps. **£35**

E.M.I. 13½ × 8in SPEAKER SALE!

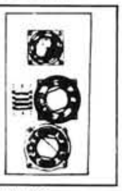
With tweeter. And crossover. 10W. State 3 or 8 ohm. *Illustrated* **£9·95** Post £1

15W model 8 ohms **£10·95** Post £1

GOODMANS 20 Watt Woofer
Size 12 × 10in. 4 ohms. Rubber cone surround. Hi-Fi Bass unit. **£8·50** Post £2

GOODMANS TWIN AXIOM 8
8 in. 15 ohm Hi-Fi Twin Cone Special unit 15 watts **£8·00** Post 95p

EMI MINI MODULE KIT 3-way Loudspeaker System, EMI 5in Bass, 5in Middle, 3in Tweeter, with 3-way Crossover and Ready Cut Baffle. 15 × 8¼in. Full assembly instructions supplied. Response = 60 to 20,000 cps 12 watt RMS. 8 ohm. £10 per kit. Postage £1.50.



R.C.S. LOUDSPEAKER BARGAINS

3 ohm. 6 × 4in. £1·50. 7 × 4in. £1·50. 8 × 5in. £3·00. 6½in. £3·00 8in. £3·50. 8in. £3·50. 12in. £4·50.
8 ohm. 2¾in. £1·50. 3in. £1·50. 5in. £1·50. 8in. £3·50. 12in. £4·50
16 ohm. 6 × 4in. £1·50. 5in. £1·50. 8in. £3·50. 12in. £4·50. 10 × 6in. £3·50. 25 ohm 3½in. 35 ohm 3in. £1·50.

LOW VOLTAGE ELECTROLYTICS

1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V **10p.**
500mF 12V **15p;** 25V **20p;** 50V **30p;**
1000mF 12V **20p;** 25V **35p;** 50V **50p;** 1200mF/76V **80p.**
2200mF 6V **25p;** 25V **42p;** 40V **60p;** 2000mF/100V **£1·20.**
2500mF 50V **70p;** 3000mF 25V **50p;** 50V **65p.**
3300mF 63V **£1·20;** 4700mF 63V **£1·20;** 2700mF/76V **£1.**
5000mF 35V **85p;** 50V **95p;** 5600mF 76V **£1·75.**

HIGH VOLTAGE ELECTROLYTICS

8/350V	**35p**	8+8/450V	**75p**	50+50/300V	**50p**
16/350V	**45p**	8+16/450V	**75p**	32+32+32/325V	**75p**
32/350V	**75p**	20+20/450V	**75p**	100+100/275V	**65p**
50/350V	**80p**	32+32/350V	**50p**	150+200/275V	**70p**
50/500V	**£1.20**	50+50/500V	**£1.80**	220/450V	**95p**

MANY OTHER ELECTROLYTICS IN STOCK

TRIMMERS 10pF, 30pF, 50pF, **5p.** 100pF, 150pF, **15p.**
CONDENSERS VARIOUS, 1pF to 0·01mF. **3p.**
PAPER 350V-0.1 **7p;** 0·5 **13p;** 1mF 150V **20p;** 2mF 150V **20p** 400V–0·001 to 0·05 **5p;** 0·1 **15p;** 0·25 **25p;** 0·47 **35p.**
MICRO SWITCH SINGLE POLE CHANGEOVER 20p.
SUB-MIN MICRO SWITCH. 25p. Single pole change over.
TWIN GANGS 120pF **50p;** 500pF **£1.**
GEARED TWIN GANGS 25pF **95p;** 365pF **£1;** 365 + 365 + 25 + 25pF **£1.**
NEON PANEL INDICATORS 250V. Red 1¼ × ⅜ **45p.**
ILLUMINATED ROCKER SWITCH. Single pole. Red **65p.**
RESISTORS. 10Ω to 10M. ¼W, ½W, 1W, 20% **2p;** 2W, **10p.**
HIGH STABILITY. ½W 2% 10 ohms to 1 meg., **8p.** Ditto 5%. Preferred values 10 ohms to 10 meg., **3p.**
ALUMINIUM CHASSIS 18 s.w.g. Undrilled, 4 sides, riveted corners; 6 × 4 × 2½in.—**£1·20;** 8 × 6 × 2½in.—**£1·50;** 10 × 7 × 2½in.—**£1·90;** 14 × 9 × 2½in.—**£2·50;** 16 × 6 × 2½in.—**£2·40;** 12 × 3 × 2½in.—**£1·50;** 12 × 8 × 2½in.—**£2·20;** 16 × 10 × 2½in.—**£2·70. ANGLE BRACKET** 6 × ¾ × ¾in.—**25p.**
ALUMINIUM PANELS 18 s.w.g. 12 × 12in.—**£1·30;** 14 × 9in.—**£1·20;** 6 × 4in.—**36p;** 12 × 8in.—**90p;** 10 × 7in.—**80p;** 8 × 6in.—**60p;** 14 × 3in.—**60p;** 12 × 5in.—**60p;** 16 × 10in.—**£1·40;** 16 × 6in.—**90p.**
BLACK PLASTIC construction box with brushed aluminium facia size 6¼ × 4¾ × 2" **£1·50.** Many other sizes.
BRIDGE RECTIFIER 200V PIV ½ amp **50p.** 2 amp **£1·00.** 4 amp **£1·50.** 8 amp **£2·50.**
TOGGLE SWITCHES SP **30p.** DPST **40p.** DPDT **50p.**
MANY OTHER TOGGLES IN STOCK. Please enquire.

BSR 172 BUDGET SINGLE PLAYER ideal for disco or small three-speed Hi-Fi system with stereo cartridge cueing device and bias compensator. **£20** Post £2

BSR STEREO CARTRIDGES SC7 medium SC8 High output **£2.** Sonotone 9TA-HC **£2·50.** V.100 Magnetic **£7.**
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt **15p.**
CASSETTE MOTOR. 6 volt **£1·00.**

MAINS TRANSFORMERS

Post 99p

6V, 500mA .... £2·00	6-0-6V 100mA .... £1·80
12V, 100mA .... £1·30	9-0-9V 50mA .... £1·50
12V, 750A .... £1·75	12V, 3 a, £3·50; 5 a £4·00
10-0-10V 2amp .... £3·00	10V, 30V, 40V, 2 amp .. £3·50
30V, 5 amp and 17V-0-17V, 2 amp .. £4·00	20V, 1 amp .... £3·00
0, 5, 8, 10, 16V, ½ amp .. £2·50	20V-0-20V, 1 amp .... £3·50
9V, 3 amp .... £3·50	2 of 18V, 6 amp, each £11·00
15–0–15V 2 amp ...... £3·00	12-0-12V, 2 amp ...... £3·50
30V, 2 amp .... £3·50	9V, ¼ amp .... £1·50
30V, 1½ amp .... £3·30	28V, 1 amp+28V 1 amp £5·00
20V, 40V, 60V, 1 amp .. £4·00	32-0-32V 6·5A .... £11·00

Radio Component Specialists
337, WHITEHORSE ROAD
CROYDON, SURREY, U.K. TEL: 01-684 1665.
Post 50p Minimum. Callers Welcome.
Access-Barclay-Visa. Lists 20p. Closed Wed.

H.A.C. SHORT-WAVE KITS

WORLD-WIDE RECEPTION

'H.A.C.' well known by amateur constructors for its Short Wave receivers, now offers a complete range of kits and accessories which have been up-dated to suit the novice and the expert.

£14·50 INCLUSIVE – the ever popular and easy to construct DX receiver Mark III; containing all genuine short wave components, drilled chassis, valve, accessories and full instructions.

AT LAST – a battery eliminator kit, which will last you a lifetime – for use in all H.A.C. valve receivers. H.T. batteries are now unobtainable, this will solve your problems for only £9·60.

T TWIN TRANSISTOR RECEIVER, selective, sensitive and with fantastic reception, yet needing only a single PP3 battery, at £17·50 this receiver is outstanding value, and will give you hours of interest and entertainment.

NEW – TRIPLE-T RECEIVER, a more advanced super three transistor receiver, loud, clear reception, value unequalled at bargain price of £24·00.

All orders despatched within 7 days. Send stamped and addressed envelope now for free descriptive catalogue of kits and accessories.

SORRY, NO CATALOGUES WITHOUT S.A.E.

"H.A.C." SHORT-WAVE PRODUCTS
P.O. Box No. 16, 10 Windmill Lane
Lewes Road, East Grinstead, West Sussex RH19 3SZ

MAINS INTERCOM

NO BATTERIES NO WIRES ONLY **£37.99** PER PAIR + VAT £5·70

The modern way of instant 2-way communications. Just plug into power socket. Ready to use. Crystal clear communications from room to room. Range ½-mile on the same mains phase. On/off switch. Volume control, with 'buzzer' call and light indicator. Useful as inter-office intercom, between office and warehouse, in surgery and in homes. P. & P. £1·85. Also F.M. 2 channel "touch" model **£55·95** + VAT £8·40 + P&P £1·95.

NEW AMERICAN TYPE CRADLE
TELEPHONE AMPLIFIER

£18.95 + VAT £2·85 + P & P £1·25

Latest transistorised Telephone Amplifier, with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume control, conversation recording, model at **£20·95** + VAT £3·15. P&P £1·25.

DOOR ENTRY SYSTEM

No house/business/surgery should be without a DOOR ENTRY SYSTEM in this day and age. The modern way to answer the door in safety to unwanted callers. Talk to the caller and admit him only if satisfied by pressing a remote control button which will open the door electronically. A boon for the invalid, the aged, and busy housewife. Supplied complete d.i.y. kit with one internal Telephone, outside Speaker panel, electric door lock release (for Yale type surface latch lock); mains power unit, cable (8-way) fo 50 and wiring diagram. Price **£59·95** + VAT £9·00 + P&P £1·95. Kit with two Telephone **£69·95** + VAT £10·50 + P&P £2·15

10-day price refund guarantee on all items

WEST LONDON DIRECT SUPPLIES (PW1)
169 KENSINGTON HIGH STREET, LONDON, W8

NICKEL CADMIUM BATTERIES

	AA (HP7) 0.5AHr	SUB 'C' 1.2AHr	'C' (HP11) 1.65AHr	'C' (HP11) 2.0AHr	'D' (HP2) 4.0AHr	PP3 0.1AHr
1–24	£0.85	£1.38	£1.69	£2.25	£2.97	£3.79
25–49	£0.82	£1.28	£1.58	£2.10	£2.77	
50–99	£0.80	£1.24	£1.52	£2.02	£2.67	
100 up	£0.70	£1.15	£1.41	£1.87	£2.47	

All cells are brand new full spec devices from reputable mnfrs. All Nickel Cadmium cells (except PP3) are supplied complete with solder tags and are **'VENTED' devices** suitable for fast charge.

CHARGERS – single or dual O/P to charge PP3, AA or SUB 'C' cells in 12-14 hrs (chargers will charge 'C' and 'D' cells but with longer charging time). Units supplied complete in plug top case with flying leads. Number of cells (10 max) in series and type **must** be specified for each required O/P when ordering.

SINGLE O/P CHARGER **£5.04**
DUAL O/P CHARGER **£5.72**

TRANSFORMERS – as used in chargers, 2 × 12 volt 0.25 amp secondarys 240v primary, tag connections **£1.57** each.

Data and charging circuits free with orders over £10 otherwise 30p post. P&P 10% if order less than £10, 5% if order over £10. Prices *DO NOT INCLUDE VAT* and this should be added to the total order.

Cheques, P.O.'s Mail Order to:–
SOLID STATE SECURITY,
Dept. (PW), Bradshaw Lane,
Parbold, Wigan, Lancs.
Telephone 02576-3018.

MARCO TRADING

LOW PROFILE I.C. SOCKETS

	1+	100+		1+	100+
6 pin	7p	**5.5p**	20 pin	16p	**14p**
8 pin	8p	**6p**	22 pin	18p	**16p**
14 pin	10p	**8.5p**	24 pin	20p	**18p**
16 pin	11p	**9.5p**	28 pin	28p	**20p**
18 pin	13p	**11.6p**	40 pin	32p	**31p**

TRANSFORMERS (ALL 240V Primary)

6-0-6	100ma	**£1.00**
6-0-6	250ma	**£1.60**
9-0-9	75ma	**£1.00**
12-0-12	50ma	**£1.00**
12-0-12	100ma	**£1.50**
9-0-9	1A	**£2.40**
12-0-12	1A	**£2.86**

Carbon film resistors ½W 5% low noise E12 series 2.2 ohm to 10M **2p each**

Special resistor pack 10 of each value 2.2 ohm to 2M2 730 resistors only **£6**

BRIDGE RECTIFIERS

1.5A		2.0A		6.0A		10.0A		25.0A	
50V	**36p**	50V	**38p**	50V	**70p**	50V	**£2.25**	50V	**£2.38**
100V	**38p**	100V	**43p**	100V	**73p**	100V	**£2.34**	100V	**£2.41**
200V	**41p**	200V	**44p**	200V	**76p**	200V	**£2.60**	200V	**2.51**
400V	**43p**	400V	**51p**	400V	**84p**	400V	**£2.79**	400V	**£3.20**
600V	**47p**	600V	**58p**	600V	**95p**	600V	**£3.54**	600V	**£4.75**
800V	**54p**	800V	**65p**						

Wholesale/Quantity prices available.

400mw Zener Diodes
2.7v, 3v, 3.3v, 3.6v, 3.9v, 4.3v, 4.7v, 5.1v, 5.6v, 6.2v, 6.8v, 7.5v, 8.2v, 9.1v, 10v, 11v, 12v, 13v, 13.5v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 36v, 39v, 43v, 47v, 51v, 56v, 62v.
PRICE: 8p each, **75p**/10. Any 100 for **£6.**
BA156 **9p.** BY126 **12p.** OA10 **35p.** BY127 **12p.** OA90 **10p.** OA91 **10p.** OA200 **5p.**

1 Watt Zener Diodes
3.3v, 3.6v, 3.9v, 4.3v, 4.7v, 5.1v, 5.6v, 6.2v, 6.8v, 7.5v, 8.2v, 9.1v, 10v, 11v, 12v, 13v, 13.5v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 36v, 39v, 43v, 47v, 51v, 56v, 62v, 68v, 75v, 82v, 91v, 100v, 110v, 120v, 130v, 150v, 160v, 180v, 200v. **PRICE: 15p** each. Any 100 **£12.50.**

WIREWOUND RESISTORS

2.5 Watt 5% Values: 0.22 ohm to 270 ohm	**Price: 18p each**
5 Watt 5% Values: 10 ohm to 12K	**Price: 21p each**
10 Watt 5% Values: 15 ohm to 25K	**Price: 24p each**
4 Watt 5% & 10% Values: 1 ohm to 10K (Flameproof)	**Price: 22p each**
7 Watt 5% & 10% Values: 0.47 ohm to 22K (Flameproof)	**Price: 24p each**
11 Watt 5% & 10% Values: 1 ohm to 22K (Flameproof)	**Price: 28p each**
17 Watt 5% & 10% Values: 1 ohm to 22K (Flameproof)	**Price: 35p each**

SPECIAL OFFER: METAL SLIDER POTENTIOMETERS
Length of track 60mm. 500 ohm LIN Mono **30p.** 50K LOG Stereo **40p.** 100K LIN Stereo **40p.** 1 Meg LOG Stereo **40p.** ALL PRICES INCLUDE FREE KNOBS TO FIT.

Send 20p for our latest catalogue. Please add 35p P+P to all orders. Please then add 15% VAT to total.
MARCO TRADING, Dept. PW5, The Old School, Edstaston, WEM, Shropshire, SY4 5RJ. Tel: (094 872) 464/465.

When replying to Classified Advertisements please ensure:

(A) That you have clearly stated your requirements.

(B) That you have enclosed the right remittance.

(C) That your name and address is written in block capitals, and

(D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

SMALL ADS

The prepaid rate for classified advertisements is 28 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £9.50 per single column centimetre (minimum 2·5 cms). All cheques, postal orders etc., to be made payable to Practical Wireless and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance should be sent to the Classified Advertisement Manager, Practical Wireless, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine.

Receivers and Components

TVDX. VHR-UHF CONVERTER (UPCONVERTER). Ideal way to start DX on band I using Uhf TV. £10 inc pp. Sae data. lists. H. Cocks, Cripps Corner, Robertsbridge, Sussex. Tel. 058083-317.

BRAND NEW COMPONENTS BY RETURN

HIGH STABILITY RESISTORS.
¼W Carbon Film E12 Series 1R-10M. (E24 2R-6M2)—**1p**
½W, ¼W & 1W Metal Film E12 Series 10R-2M2—**2p**
CAPACITORS.
MULLARD Min. Ceramic E12 100V 2% 1.8pf. to 47pf.—**3p**
2% 56pf. to 330pf.—**4p.** 10% 390pf. to 4700pf.—**4p**
Plate Ceramic 50V Wkg. Vertical Mounting.
E12 22pf. to 1000pf. & E6 1K5pf. to 47Kpf.—**2p**
Miniature Polyester 250V Wkg. Vertical Mounting.
.01, .015, .022, .033, .047 & 068 mfds.—**4p**
0.1—**5p.** 0.15 & 0.22—**6p.** 0.33 & 0.47—**8p**
0.68—**11p.** 1.0—**15p.** 1.5—**20p.** 2.2—**22p**

ELECTROLYTIC. Wire Ended (Mfds/Volts).

0.47/50	5p	22/25	6p	100/25	7p	470/25	11p
1.0/50	5p	22/50	6p	100/50	8p	470/40	16p
2.2/50	5p	47/16	6p	220/16	8p	1000/15	15p
4.7/50	5p	47/25	6p	220/25	8p	1000/25	18p
10/50	5p	47/50	6p	220/50	10p	1000/40	35p
22/16	6p	100/16	7p	470/16	11p	2200/16	20p

TANTALUM BEAD SUBMINIATURE ELECTROLYTICS.
0.1, 0.22, 0.47, 1.0, 2.2 @ 35V & 4.7 @ 6.3V—**14p**
4.7/16V & 25V—**15p.** 10/16 & 22/6—**20p.** 10/25—**29p**
10/35V, 22/16V, 47/6.3V, 68/3V & 100/3V—**30p**
15/25, 22/25, 47/10—**35p.** 47/16—**80p.** 220/16—**£1.20**
Polystyrene 63V Wkg. E12 Series Long Axial Wires.
10 pf. to 820 pf.—**3p.** 1000 pf. to 10,000pf.—**4p**

TRANSISTORS.

BC107/8/9	10p	BC182L	8p	BF197	10p
BC147/8/9	10p	BC184L	8p	BFY50/51/52	18p
BC157/8/9	10p	BC212L	8p	BFX88	25p
BC547C/8C/9C	7p	BCY70	15p	2N2926	7p
BC557C/8C/9C	7p	BF194	10p	2N3055	50p

8 Pin D.I.L. i.c's 741 Op/amp.—**18p.** 555 Timer—**24p**
Holders 8 pin—**9p.** 14 Pin—**12p.** 16 Pin—**14p.** 28 Pin—**25p**
40 Pin—**30p.**

DIODES (p.i.v./amps).

75/25mA	1N4148	2p	1250/1A	BY127	10p
100/1A	1N4002	4p	400/3A	1N5404	14p
800/1A	1N4006	6p	60/1.5A	S1M1	5p
1000/1A	1N4007	7p	30/150mA	AAY32	12p

ZENER DIODES.
E24 Series 3V3 to 33V 400mW—**8p.** 1W—**10p**
L.E.D.'s 3 mm. & 5 mm. Red—**10p.** Green, Yellow—**14p**
Grommets for 3 mm.—**1½p.** Holders for 5 mm.—**2p**
FUSES. 20 mm. Glass. 100mA to 5A. Q.B.—**3p.** A/S.—**5p**
VOLTAGE REGULATORS+. 5V, 8V, 12V, 15V 100mA.—**35p**
5V, 8V, 12V, 15V, 18V & 24V 0.5A—**60p.** 1A—**65p**
PRESET POTENTIOMETERS
50mW & ¼W 100R to 1MO.—**6p**

THE C. R. SUPPLY CO.
127, Chesterfield Road, Sheffield S8 0RN.
V.A.T. Inclusive Prices, Postage 15p
(FREE over £5.00)

PREWAR ONWARD VALVES, WIRELESS. SAE. Sole Electronics, 37 Stanley Street, Ormskirk, Lancs.

CRYSTALS MADE TO ORDER within 6 weeks. 4-105MHz. wire or pins. £3.90 each inclusive. HARTLEY CRYSTALS. Green Lane, Milford, Godalming, Surrey GU8 5BG.

CIRCUIT BOARDS FOR P.W. PROJECTS

Feb 78	Hythe Rx	£4.60	Sep 80	Nimbus Timeburst Mod	£1.80
Jan 80	Radio Control Encoder	£2.00	Sep 80	Transceiver Psu	£0.75
Jan 80	Radio Control Tx	£1.50	Sep 80	2M Converter	£1.30
Jan 80	Radio Control Rx	£1.50	Oct 80	Direct Conversion Rx	£1.50
Jan 80	Speech Processor	£1.60	Oct 80	Nimbus Psu Charger	£1.00
Jan 80	Wideband Amp	£0.70	Nov 80	Field Test Set (2 Boards)	£1.50
Feb 80	Servo Amp	£0.70	Nov 80	Linear R Meter	£0.70
Mar 80	Servo Controller	£0.90	Dec 80	Pippy Bird Scarer (2 Boards)	£1.95
Apr 80	Signal Generator	£2.60	Jan 81	PW Helford 5 Boards	£4.50
Apr 80	Nimbus Tx	£4.90	Jan 81	PW Twynham (2 Boards)	£3.90
Apr 80	Nimbus Modulator	£0.75			
May 80	100 S Timer	£1.30			
May 80	NBFM Demodulator	£0.75			
Sep 80	PW Tamar 6 Board	£12.00			

N.B. OUR PRICES INCLUDE VAT POSTAGE ETC.

H.T.E. (Electronics) P.C.B. Div Dept PW
50 Milnefield Avenue, Elgin, Moray. IV30 3EL

CLEARANCE PARCELS: Transistors, Resistors, Boards, Hardware. 10lbs only £5.80! 1,000 Resistors £4.25, 500 Capacitors £3.75, BC108, BC171, BC204, BC230, 2N5061, CV7497 Transistors, 10 70p, 100 £5.80. 2N 3055, 10 for £3.50. S.A.E. Lists: W.V.E. (1) 15 High Street, Lydney, Gloucestershire.

PACKER COMMUNICATIONS
Our popular VHF WAVEMETERS are again available!
Remember your licence conditions, you MUST have one to be legal.
WM-2 for 2m 130-300 MHz (includes the vital 288) £20.85
WM-7 for 70cm 400-900 MHz (the ONLY one we know) £23.65
WM-4 for 4m 65-150 MHz (includes PMR and airband) £21.55
Post and packing £1.15 per order
New!! anti-TVI/HiFi filters for amateur and CB
SAE or 20p stamps for details of all our products
BRIDGE END BARN, SOUTERGATE, CUMBRIA. LA17 7TW

BOURNEMOUTH/BOSCOMBE. Electronic components specialists for 33 years. Forresters (National Radio Supplies) late Holdenhurst Rd. now at 36, Ashley Rd., Boscombe. Tel. 302204. Closed Weds.

CRYSTALS Brand new high-precision. You benefit from very large stocks held for industrial supplies. All normal freq standards, baud rates, MPU, and all magazine projects inc: HC33/U: 1·0, 1·008, 2·5625 MHz, **£3·50.** 1·280 MHz, **£4·15.** HC18/U: 4·0, 5·0, 6·0, 7·0, 8·0, 9·0, 10·0, 10·7, MHz **£3·00.** 12·0, 15·0, 16·0, 18·0, 20·0, 6·9375, 38·6667, MHz, **£3·25.** Selected freqs stocked in Glider, Marine and 27 MHz bands. Any freq made to order in 6 weeks from **£3·90.**
FILTERS Your best source for 6 and 8 pole and monolithics for AM, CW, SSB, FM, on 455 kHz, 1·6, 9·0, 10·7, 21·4 MHz, etc.
Prices inc. VAT and UK post. SAE lists.
P. R. GOLLEDGE ELECTRONICS
G3EDW, Merriott, Somerset, TA16 5NS.
Tel: 0460 73718

WE SUPPLY most Vintage Radio components parts with a friendly service worldwide. British Vintage Radio Components. Co. 57, Weldon Park, Weldon, Nr. Corby, Northants. Tel. Corby 61875.

Southern Valve Co.,
2nd Floor, 6 Potters Road, New Barnet, Herts.
Tel: 01-440 8641 for current prices & availability, all popular valves stocked. **NO CALLERS,** SAE Lists. Cash with order. ! Same Day Postal Despatch. Telephone afternoons preferred.

Valves, Tubes, Aerials etc by LEADING-MAKERS. Send SAE Lists or Phone for current prices. Counter or MAIL ORDER. NO COD. Speedy Despatch assured. No order under £1.
Philip Bearman, 6 Potters Road, New Barnet, Herts.
Tel: 01-449 1934/5 (1934 Recording Machine).
Telephone for Shop Hours.

8 PAGE LIST FREE. Thousands of different items, all at cut price. Send SAE to PC Electronics, Thornhill, Romsey Road, Whiteparish, Salisbury.

BALLARD'S OF TUNBRIDGE WELLS have moved to 54 Grosvenor Road, no lists. S.A.E. all enquiries phone Tunbridge Wells 31803.

Aerials

COPPER AERIAL WIRE 14swg hard drawn 70' £3.50, 140' £7.00 inc VAT. Postage £1.75. T.M.P. Electronics, Supplies, Britannia Stores, Leeswood, Nr. Mold, N. Wales.

ANTI-TVI TRAP DIPOLES
1981 Range: Shortwave Listener Aerials
Indoor models **£14.50 & £27.50**
Outdoor models **£30.00 & £36.00**
Lists 10 × 8 in 17p SAE, Aerial Guide **50p**
Indoor and Invisible Aerials **£3.50**
Callers Welcome Tel: 03986-215
G2DYM, Uplowman, Tiverton, Devon.

TONNA (F9FT) AMATEUR ANTENNAS for 2m, 70cm. and 23cm bands, send 30p for full catalogue. Randam Electronics, (PW) 12 Conduit Road, Abingdon, Oxon OX14 1DB.

Books and Publications

FULL REPAIR data any named T.V. £5.50, with circuits, layouts, etc., £7. (AUSW) 76 Church Street, Larkhall, Lanarks ML9 1HE.

Build your own
P.A., GROUP & DISCO SPEAKERS
by R. F. C. Stephens
Save money with this practical guide. Plans for 17 different designs, line source, I.B., Horn and Reflex types, for 8"-18" drive units. **£3·95** post free ($8 overseas).

THE INFRA-BASS LOUDSPEAKER
by G. Holliman
(full constructional details for versions using 15", 12" and 10" drive units.) **£2·95** post free ($6 overseas)

THE DALESFORD SPEAKER BOOK
by R. F. C. Stephens
This book is a must for the keen home constructor. Latest technology DIY designs. Plans for I.B., and Reflex designs for 10-100 watts. Also unusual centre-bass system. **£2·20** post free ($5 overseas).

VAN KAREN PUBLISHING
5 SWAN STREET, WILMSLOW, CHESHIRE

WHY NOT START your own business rewinding electric motors. A genuine opportunity to success. LARGE PROFITS. You can't help but make money if you follow the easy, step by step, instructions in our fully illustrated manual showing how to rewind Electric Motors, Armatures and Field Coils as used in Vacuum Cleaners, Electric Drills and Power Tools. NO PREVIOUS KNOWLEDGE IS REQUIRED, as the manual covers in 13 chapters, where to obtain all the work you need, materials required, all instructions, rewind charts and how to take data etc. A gold mine of information. How to set up your home workshop and how to cost each job to your customer. £4.80 inclusive of P & P. UK. CWO to: Industrial Supplies, 102 Parrswood Road, Withington, Manchester 20. Dept. PW.

Record Accessories

STYLI, Cartridges for Music Centres, etc. FREE List no. 29 for S.A.E. includes Leads, Mikes, Phones etc. FELSTEAD ELECTRONICS (PW), Longley Lane, Gatley, Cheadle, Ches. SK8 4EE.

Wanted

ELECTRONIC COMPONENTS PURCHASED. All types considered – Must be new. Send detailed list – Offer by return – WALTONS, 55A Worcester Street, Wolverhampton.

WANTED. Sinclair Micromatic Miniature AM-Radio or similar micro-radio. 47, Wordsworth Crescent, Plymouth.

Service Sheets

G.T. **TECHNICAL INFORMATION SERVICE**
76 CHURCH ST., LARKHALL, LANARKS.

Any full size service sheet – still only £1 + s.a.e.

Thousands of different sheets & manuals in stock (many of these only obtainable from us)

Repair data your named T.V. £6 (with circuits £8)

Domestic Equipment Manual Vol. 1 £13.50 (updatings free for 1 year)

S.A.E. for free newsletter, price lists, any quotation, bargain offers, unique T.V. publications. 2 big catalogues listing thousands of service sheets and manuals with £4 worth of vouchers – special offer **£2** + large s.a.e.

Phone: 0698 883334 anytime. Callers 4–6 pm weekdays, Sat. after 10.

BELL'S TELEVISION SERVICES for Service Sheets on Radio, TV etc., £1.00 plus S.A.E. Colour TV Service Manuals on request, S.A.E. with enquiries to B.T.S., 190 Kings Road, Harrogate, N. Yorkshire. Tel. (0423) 55885.

30,000 SERVICE SHEETS IN STOCK
COLOUR MANUALS ALSO AVAILABLE

TV Monos, Radios **£1.25** – Tuners **£1.** – Tape Recorders, Record Players, Transistors from **£1.25** – Car Radios, Stereograms, Radiograms from **£1.25** – Except Colour TV Circuits from **£2.** – State, if circuit will do, if sheets are not in stock. All TV sheets are full length 24 x 12", not in Bits & Pieces. All other Data full lengths. Free Fault Finding Chart or TV Catalogue with order. Crossed P.O.s returned, if sheets not in stock. S.A.E. please.

C. CARANNA
71, Beaufort Park, London NW11 6BX
01-458 4882 (Mail Order)

SERVICE SHEETS, Radio, TV etc., 10,000 models. Catalogue 24p, plus S.A.E. with orders, enquiries. TELRAY, 154 Brook Street, Preston PR1 7HP.

SERVICE SHEETS from 50p and S.A.E. Catalogue 25p and S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex.

Courses

COURSES – RADIO AMATEURS EXAMINATION. City & Guilds. Pass this important examination and obtain your G8 licence, with an RRC Home Study Course. For details of this and other courses (GCE, professional examinations etc) write or phone – THE RAPID RESULTS COLLEGE, DEPT. JX1, Tuition House, London SW19 4DS. Tel: 01-947 7272 (Careers Advisory Service) or for prospectus requests ring 01-946 1102 (24hr Recordacall).

Educational

CAREERS in Marine Electronics, Courses commencing September and January. Further details, The Nautical College, Fleetwood FY7 8JS. Tel. 03917 79123.

Educational – Contd.

TECHNICAL TRAINING

Get the training you need to move up into a higher paid job. Take the first step now—write or phone ICS for details of ICS specialist homestudy courses on Radio, TV, Audio Eng. and Servicing, Electronics, Computers, also self-build radio kits. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. 277E Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

COLOUR TV SERVICING

Learn the techniques of servicing Colour TV sets through new homestudy course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Other courses for radio and audio servicing. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. 277E Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

CITY & GUILDS EXAMS

Study for success with ICS. An ICS homestudy course will ensure that you pass your C. & G. exams. Special courses for: Telecoms, Technicians, Electrical Installations, Radio, TV & Electronics Technicians, Radio Amateurs, Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. 277E Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

For Sale

NEW BACK ISSUES OF "PRACTICAL WIRELESS" available 90p each, post free. Cheque or uncrossed P.O. returned if not in stock. BELL'S TELEVISION SERVICE, 190 Kings Road, Harrogate, N. Yorks. Tel: (0423) 55885.

FLUKE DIGITAL MULTIMETER 8000A rechargeable battery, mains. AC/DC V/A/Ω ranges. £60. 061436-1392.

WARWICKSHIRE COUNTY COUNCIL
COUNTY ENGINEER'S DEPARTMENT

SALE OF USED MOBILE RADIO EQUIPMENT

The following Used Mobile Radio equipment is for sale by tender:–

(1) Base station complete.
(2) 42 transistorised mobile Trans/Receivers Lowband.
(3) 36 Valved mobile Trans/Receivers Lowband.
(4) Plus many other items.

Tender documents and appointment to view may be obtained from Mr. T. Inkester, County Engineer's Department, Warwickshire County Council, P.O. Box 50, Shire Hall, Warwick CV34 4RJ. (Telephone Warwick 43431, extension 2373) and tenders should be returned by not later than Monday 16th March 1981.

John W. M. Vallis, County Engineer, Shire Hall, Warwick.

GRUNDIG SATELLIT 3000 £220. Bearcat 220FB £160 new. Personal guarantee. Please write first. H. Woodman, Flat 3, 17, Halesworth Road, Lewisham, London SE13 7TJ.

FOR SALE. Drake Communications Receiver 530kHz/MHz coverage. As new. £120. Tel. (0749) 74969.

OLDISH TRANSCUR KW2000 ETC. or similar. Must work. For sale SRx30 £110. R. Leask, G4CEO, 27, Edward Road, Bedford.

UK AIRCRAFT FREQUENCIES LIST £1. UK Marine frequencies list £1. Including HF VHF PLH electronics. 20, Vallis Road, Frome, Somerset.

Miscellaneous

MORSE CODE TUITION AIDS

Cassette A: 1-12 w.p.m. for amateur radio examination.
Cassette B: 12-24 w.p.m. for professional examination preparation. Each Cassette are type C90.
Morse Key and Buzzer unit for sending practice.
Price each Cassette (including booklets) **£4·75.** Morse Key and Buzzer **£4·75.**
Prices include postage etc. Overseas Airmail £1·50 extra.

MHEL ELECTRONICS (Dept 2), 12 Longshore Way, Milton, Portsmouth PO4 8LS.

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Practical Wireless for .... insertions

I enclose Cheque/P.O. for £..................................

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Practical Wireless).

NAME...

ADDRESS...

....

Send to: Classified Advertisement Manager
PRACTICAL WIRELESS,
GMG, Classified Advertisement Dept., Rm. 2337,
King's Reach Tower, Stamford Street,
London SE1 9LS **Telephone 01-261 5846**

Rate
28p per word, minimum 12 words. Box No. **60p** extra.

LOSING DX?

RARE DX UNDER QRM? DIG it OUT with a Tunable Audio Notch Filter, between your receiver and speaker, BOOST your DX/QRM ratio, 40dB notch, **£10.90.**

TIME EXACT? MSF CLOCK is ALWAYS CORRECT – never gains or loses, self setting at switch-on, 8 digits show Date, Hours, Minutes and Seconds, auto GMT/BST and leap year, also parallel BCD output for computer and audio to record and show time on playback, receivers Rugby 60KHz atomic time signals, built-in antenna, 1000Km range, ABSOLUTE ACCURACY, **£54.80.**

V.L.F.? EXPLORE 10-150KHz, Receiver **£13.70.**

MISSING DX? Get SPOT-ON with a Crystal Calibrator, between your antenna and receiver, 1MHz, 100, 25KHz markers to vhf, bypassed when off, MORE DX, **£19.80.**

Each fun-to-build kit includes all parts, printed circuit, case, postage etc, money back assurance so GET yours NOW.

CAMBRIDGE KITS
45 (PQ) Old School Lane, Milton, Cambridge.

SUPERB INSTRUMENT CASES by Bazelli, manufactured from P.V.C. Faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low £1.05. Chassis punching facilities at very competitive prices. 400 models to choose from. Suppliers only to Industry and the Trade. BAZELLI, (Dept No. 25), St. Wilfrid's, Foundry Lane, Halton, Lancaster LA1 6LT.

GUITAR/PA/ MUSIC AMPLIFIERS

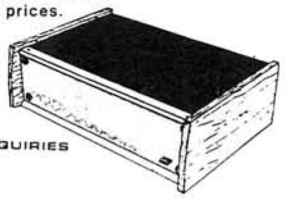
100 watt superb treble/bass overdrive. 12 months guarantee. Unbeatable at **£49;** 60 watt **£42;** 200 watt **£68;** 100 watt twin channel sep. treble/bass per channel **£62;** 60 watt **£52;** 200 watt **£78;** 100 watt four channel sep. treble/bass per channel **£75;** 200 watt **£98;** slaves 100 watt **£34;** 200 watt **£56;** fuzz boxes, great sound **£12.00;** bass fuzz **£12.90;** overdriver fuzz with treble and bass boosters **£22;** 100 watt combo superb sound overdrive, sturdy construction, castors, unbeatable **£98;** twin channel **£110;** bass combo **£112;** speakers 15in. 100 watt **£36;** 12in. 100 watt **£24;** 60 watt **£16;** microphone Shure Unidyne B **£25;** 3-Channel sound/light **£26.**

Send cheque or P.O. to:

WILLIAMSON AMPLIFICATION
62 Thorncliffe Avenue, Dukinfield, Cheshire.
Tel: 061-308 2064

If it's a case of making your project look good, then use one of ours.

Simply send a *S.A.E.* for Details and prices.



TRADE ENQUIRIES INVITED.

H. M. ELECTRONICS. P.W.
271a/275a Fulwood Road.
Broomhill
Sheffield S10 3BD

OUT NOW!! The 1981 Greenweld Components Catalogue, 60p Discount Vouchers, Reply Paid Envelope. Free Bargain List & Data Sheet. Only 75p. Greenweld, 443B, Millbrook Road, Southampton SO1 0HX.

LED DISPLAY FILTERS. Covers in red, green, blue neutral plastic. Cutting and precision machining service. Moon – 01-560-7519.

VALVES

Radio – T.V. – Industrial – Transmitting
Projector Lamps and Semiconductors

We Dispatch Valves to all parts of the world by return of post, Air or Sea mail, 4000 Types in stock, 1930 to 1976. Obsolete types a speciality. List 50p. Quotations S.A.E. Open to callers Monday to Saturday 9.30 to 5.00 closed Wednesday 1.00. We wish to purchase all types of new and boxed Valves, Projector Lamps and Semiconductors.

COX RADIO (SUSSEX) LTD.
Dept. P.W. The Parade, East Wittering, Sussex PO20 8BN
West Wittering 2023 (STD Code 024366)

EX GOVT BATTERIES HT AND LT. Send SAE for list. A. Messom, 22, Oakwood Close, Warsash, Southampton, Hants.

KEEP ONE HANDY IN THE WORKSHOP

The unique aerosol treatment for minor burns and scalds. From Boots and other Chemists.

PSYCHOTRONIC GENERATORS, gravity lazers, electrokinesis, electropotography, skinvision, SAE 4 × 9". Paralab, Downton, Wilts.

C.W.A.S. ALARM. Send now for the latest discount catalogue of Professional Burglar Alarm Equipment. C.W.A.S. Alarm, 11 Denbrook Walk, Bradford BD4 0QS, W. Yorks. Phone 0274 682674.

THE SCIENTIFIC WIRE COMPANY

PO Box 30, London E.4
Telephone 01 531 1568

ENAMELLED COPPER WIRE

SWG	1 lb	8 oz	4 oz	2 oz
8 to 29	2.76	1.50	0.80	0.60
30 to 34	3.20	1.80	0.90	0.70
35 to 39	3.40	2.00	1.10	0.80
40 to 43	4.75	2.60	2.00	1.42
44 to 47	8.37	5.32	3.19	2.50
48 to 49	15.96	9.58	6.38	3.69
SILVER PLATED COPPER WIRE				
14 to 30	6.50	3.75	2.20	1.40
TINNED COPPER WIRE				
14 to 30	3.85	2.36	1.34	0.90

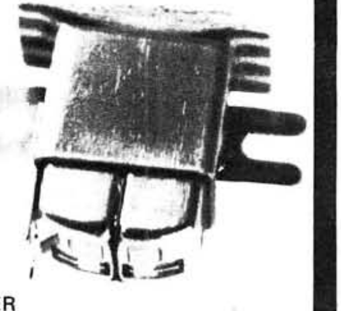
Prices include P&P, VAT and Wire Data.
Orders under £2 please add 20p. SAE for list.
Dealer enquiries welcome.

PLEASE MENTION
PRACTICAL WIRELESS
WHEN REPLYING TO ADVERTISEMENTS

MONOLITH

QUALITY REEL TO REEL & CASSETTE TAPE HEADS + MECHANISMS

YOUR EXTRA HEAD!



A NEW TAPE HEAD COULD TRANSFORM THE QUALITY OF YOUR TAPE RECORDER

MEET OUR NEW C42RPS18, THE HIGH PERFORMANCE STEREO HEAD WITH SEPARATE RECORD & PLAYBACK CHANNELS FOR IMPROVED DYNAMIC RANGE & RECORD MONITORING.

POPULAR UNIVERSAL CASSETTE TAPE HEADS

- B12-01 Mono Playback £1.89
- B12-02 Mono Record/Playback £4.02
- B24-01 Stereo Playback £3.30
- B24-02 Stereo Record/Plbk £6.66
- B24-07 Stereo R/P, (Dolby Stsm) £7.87
- C42RPH20 Stereo SENDUST R/P £9.28
- C42RP1ES01 Stereo combined R/P + Erase £10.93
- C42RPH04 Stereo GLASS FERRITE R/P £11.60
- C42RPS18 Stereo TWIN GAP R+P £25.21
- E12-09 Mono/stereo erase .... £ 1.85
- B22-02 Twin ½ track R/P .... £ 5.97
- C44RPH03 Quad ¼ track R/P £13.17
- C44RP2ES01 Quad ¼ track combined R/P + Erase £26.45
- C22ES02 Twin half track erase .... £ 4.72

SEND FOR OUR TAPE HEAD CATALOGUE 50p

MONOLITH

PLEASE ENCLOSE 30p P&P WITH ORDER

THE MONOLITH ELECTRONICS CO. LTD.
5/7 CHURCH ST., CREWKERNE, SOMERSET, ENGLAND. (0460) 74321

ALL PRICES INCLUDE VAT

SPECIAL OFFER SURPLUS STOCK TO CLEAR. BULK PURCHASE.

Qty.	Pence	Qty.	Pence	Qty.	Pence	Qty.	Pence
8 – 2114	1700	10 – AD162	250	5 – BU208	500	10 – 7473DC	180
8 – 4116	1800	10 – BC107	80	5 – C106D	130	10 – 7474	250
1 – 2708	320	10 – BC109	80	5 – DL704	300	5 – 7485	400
1 – 2716	550	10 – BD131	250	5 – DL707	600	10 – 7493	250
1 – 2114	250	10 – BD132	250	10 – LM380	650	5 – 7495	250
1 – 4116	250	10 – BD135	220	100 – NE555	1900	10 – 74107J	200
10 – 7805	500	10 – BD137	210	10 – OC29	800	5 – 74119	500
10 – 7812	500	10 – BD139	210	10 – OC35	900	5 – 74141	190
10 – 7815	500	10 – BF180	200	5 – R2540	600	5 – 74157	300
10 – 7905	450	10 – BF258	200	5 – TBA800	280	5 – 74175	250
10 – AC127	180	10 – BFY50	150	5 – TBA920	550	5 – 74180	350
10 – AC128	180	10 – BFY51	150	10 – TIP41	250	5 – 74182	350
10 – AD149	500	10 – BT106	650	5 – 7414	200	10 – 2N5061	100
10 – AD161	250	5 – BU205	400	5 – 7442	200		

MAIL ORDER ONLY

Please add 30p P&P and VAT at 15%. Govt. Colleges, etc. Orders accepted. Quotations given for large quantities.

SUNMIT ELECTRONICS
96 PEEL ROAD, WEMBLEY, MIDDLESEX, ENGLAND.
Tel. 01-908 1928.

TV SPARE PARTS & COMPONENTS

The Practical Wireless TV Sound Tuner. Still unsurpassed! Parts still available. Price List, copy of original article supplied on request. (cost of set of parts £28.40 incl. p/p & VAT)

Callers still welcome at shop premises.

MANOR SUPPLIES
(Tel. 01-794 8751)
172 WEST END LANE, LONDON NW6.
(near W. Hampstead Jubilee and British Rail Stations).

INDEX

Published on approximately the 7th of each month by IPC Magazines Limited, Westover House, West Quay Road, POOLE, Dorset BH15 1JG. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon and Gotch (Asia) Ltd.; South Africa—Central News Agency Ltd. Subscriptions INLAND and OVERSEAS £11·80 payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. PRACTICAL WIRELESS is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to V.A.T. and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

for only £255 INCL.

IC-255E An experts mobile choice

NOW WITH IMPROVED FRONT-END

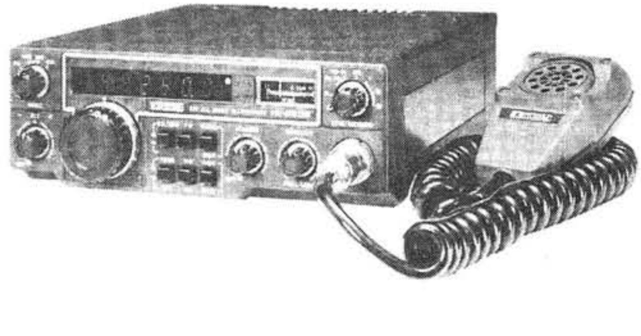
25 Watts – 5 Memories – Scanning – 600kHz
AND User Selectable Repeater Shift – Full Coverage in 5kHz or 25kHz Steps.

- Crystal controlled Tone Burst
- Full band coverage – extendable to 148MHz if required
- Four digit LED display
- 25 Watts output or 1W low power
- A superb receiver using grounded gate FET front end
- Scanning over a user programmable range
- Memory scan
- Stop on empty or busy channels
- Tuning in 25kHz or 5kHz steps
- 5 Memories – retained while the power is connected to the rig
- Built-in 600kHz Repeater Shift
- Alternative programmable shift
- Reverse Repeater facilities
- RIT (± 3kHz for those off channel stations)
- Scan control from the microphone (optional mic available)
- Good loud audio
- Optically coupled tuning between control knob and CPU
- Multiway 24 pin socket on back for touchpad, computer, or external control
- Rugged modular PA (Guaranteed of course!)
- Mobile mount which can be padlocked
- Up-down scanning microphone available

CAN YOU RESIST SUCH A TEMPTATION

Enjoy VHF mobile at it's best-IC-260E

The IC-260E offers such extras as full frequency read out, upper and lower sideband, and scanning as well as FM and CW. Thus, it makes an ideal base station, when used with a DC power supply, as well as a mobile. Now supplied with up-down scanning mic.



£339 INCL.

SEND FOR TECHNICAL DETAILS

AGENTS (PHONE FIRST – **All evenings and weekends only, except Burnley**)

Scotland	Jack GM8GEC (031-665-2420)	Midlands	Tony G8AVH (021-329 2305)
Wales	Tony GW3FKO (0874 2772)	North West	Gordon G3LEQ (Knutsford (0565) 4040)
Burnley	(0282 38481)		

Make it for a Song!

The New Maplin in Matinée

Amazing Value For Only **£299.95** + £99.50 for cabinet if required.

Easy to build. Latest technology -- means less cost, less components and 80% less wiring. Comparable with organs selling for up to £1,000.00. Two 49-note manuals. 13-note pedalboard. All organ voices on drawbars. Preset voices: Banjo, Accordion, Harpsichord, Piano, Percussion. Piano sustain Sustain on both manuals, and pedalboard. Electronic rotor, fast and slow. Vibrato and Delayed vibrato. Reverb. Manual and Auto-Wah. Glide (Hawaiian Guitar Sound). Single finger chording plus memory. 30 Rhythms! 8-instrument voicing. Major, Minor and Seventh chords. Unique walking bass lines with each rhythm. Unique countermelody line with each rhythm. Truly amazing value for money. Full construction details start in the March issue of Electronics & Music Maker on sale Feb. 14th.

The complete buyers' guide to electronic components. With over 300 pages, it's a comprehensive guide to electronic components with thousands of photographs and illustrations and page after page of invaluable data. Get a copy now — it's the one catalogue you can't afford to be without.

Post this coupon now for your copy of our 1981 catalogue price £1.
Please send me a copy of your 320 page catalogue. I enclose £1 (Plus 25p p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the UK send £1.68 or 12 International Reply Coupons.
I enclose £1.25.

Name ______________________

Address ______________________

____

PW381

MAPLIN

Maplin Electronic Supplies Ltd
All mail to P.O. Box 3, Rayleigh, Essex SS6 8LR
Telephone: Southend (0702) 554155. Sales (0702) 552911

Shops
159-161 King Street, Hammersmith, London W6. Telephone: (01) 748 0926
284 London Road, Westcliff-on-Sea, Essex. Telephone: Southend (0702) 554000
Both shops closed Mondays

Catalogue now on sale in all branches of WHSMITH Price £1.00