

FOR THE RADIO ENTHUSIAST...

Practical wireless

MARCH 1981

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65p

FREE INSIDE

**FREQUENCY
ALLOCATION
CHART**

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PRACTICAL

- Satellite Comms & Radio Astronomy
- Radio Navigation
- Mobile
- Point-to-point

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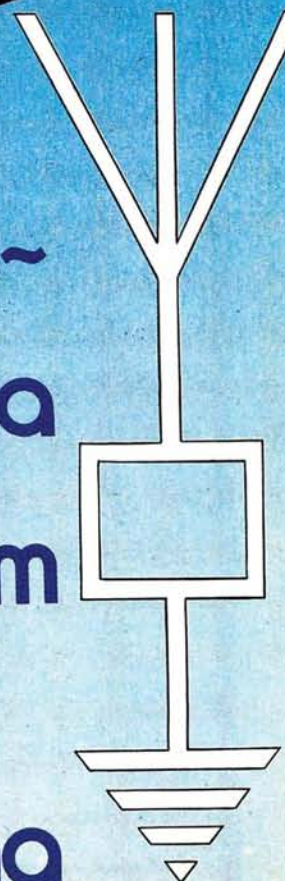
antenna special issue

featuring:~

Active Receiving Antenna

Delta Beams for 10 & 15m

Q Multiplier and Spiral
Loop Antenna



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

Bredhurst

electronics

HIGH ST., HANDCROSS, W. SUSSEX O444 400786

TRANSCEIVERS

TRY OUR TELEPHONE SALES SERVICE

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.

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YAESU FT101ZD (New Bands)	£569.00
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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.

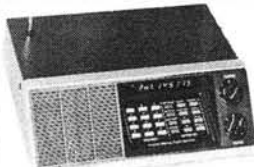
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free Delivery

RECEIVERS

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YAESU FRG7700	£299.00

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A.O.R. AR22	£83.00
FDK TM50B	£79.00
BEARCAT 220FB	£258.00

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SEARCH 9	£45.00
FDK TM50B	£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

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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	
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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.	
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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 (-)

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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)

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14 MHz 1/4 (20SE)	£13.80 (£1.50)
21 MHz 1/4 (1SSE)	£11.50 (£1.50)
28 MHz 1/4 (1SSE)	£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 2x5/8 (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 432/28S 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	£119.00 (-)
MML 432/50 70cm 50W LINEAR	£228.65 (-)
MMD 50/500 50 MHz COUNTER	£69.00 (-)
MMA 28 10M PREAMP	£14.95 (-)
MMA 144V 2M RF Switched PREAMP	£34.90 (-)
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MMF 432 70cm FILTER	£9.90 (-)

SWR POWER METERS	Carriage
YW 3 TWIN METER	£11.50 (£0.50)
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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 150	£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)



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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 blander kit	6.75	7.76	.50
SE-FMtx	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 1 1/2 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

TR-8400

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.

pacesetter in amateur radio

70 centimetres is on the move.



- * Up-down manual band scan in 25-kHz steps with UP/DOWN microphone supplied with TR-8400.
- * Only 5 $\frac{3}{4}$ inches wide, 2 inches high and 7 $\frac{5}{8}$ 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.

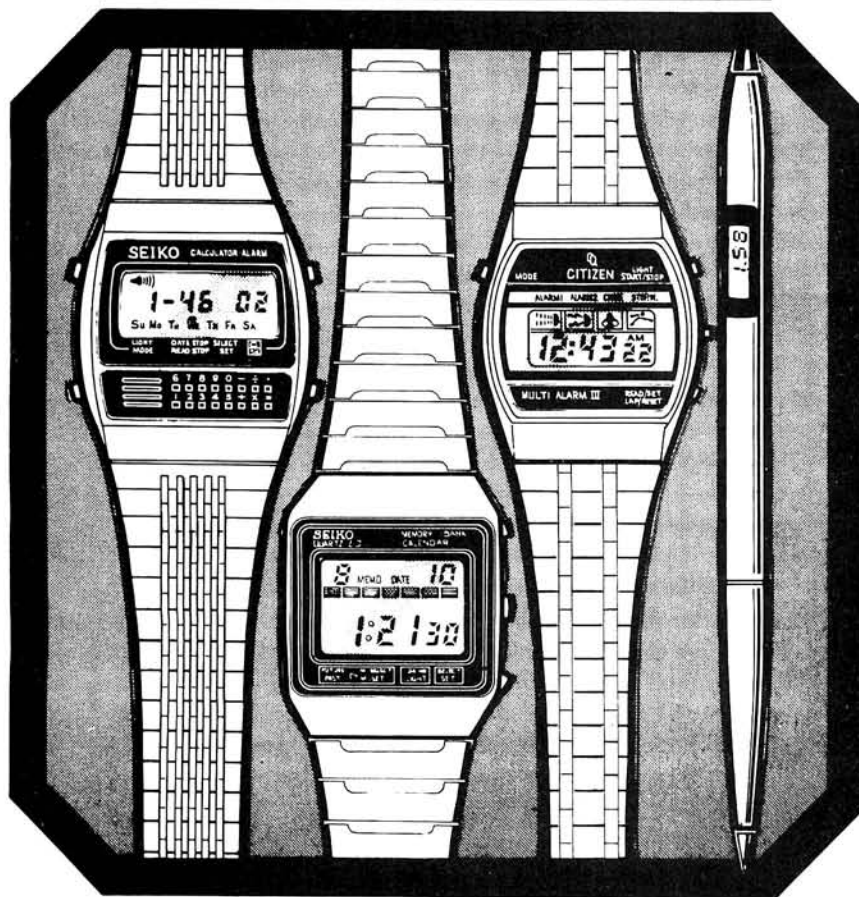
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SALE TIME



EXTRA SPECIAL OFFER QUARTZ WATCHES

AT 'GIVEAWAY' PRICES

SEIKO QUARTZ CALCULATOR/ALARM Only £47.95 + 85p p&p Continuous display of hours, minutes, seconds with day, alarm indicators. Optional display: month, date, AM/PM with day indicator. Calculator (16 key) performs arithmetic, percentage, constant and power calculations. 12 hour alarm with AM/PM indication, rings twice a second for 10 seconds, then four times a second for 10 seconds. Display flashes as battery life nears end. Back light. Water resistant. Adjustable stainless steel strap.

SEIKO QUARTZ MEMORY BANK CALENDAR Only £27.95 + 85p p&p Continuous display of hours, minutes, seconds, day, date; 12 hour or 24 hour cycle. Optional monthly calendar display of month, year and dates for designated month with Sunday dates flashing. (Any month Jan 1930 to Dec 2009). Memory bank stores up to 11 dates, displays 'MEMO' and flashes on designated dates. Display flashes as battery life nears end. Back light. Water resistant. Adjustable stainless steel strap.

CITIZEN QUARTZ MULTI-ALARM with timer, stopwatch facilities. Only £27.95 + 85p p&p Continuous display of hours, minutes, seconds with AM/PM indication. Optional display of month, date, day. 12 hour capacity timer, sounds alarm at end of countdown. Time signal chimes every hour on the hour. 12 hour capacity stopwatch. 12 hour alarm with AM/PM indication and spare alarm for added convenience. Indicator flashes as battery life nears end. Back light. Adjustable stainless steel strap. Available with black/white or black/grey face.

MITRAD PEN WATCH Only £10.15 + 85p p&p Elegant stainless steel ballpoint pen combined with a quartz precision timepiece. The five function LCD watch displays hours, minutes, seconds, month and date and has a computerised four year date memory. In presentation case with spare pen refill.

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- ☐ Citizen Multi-Alarm Watch(es) at £28.80 (inc p&p)
- ☐ Pen Watch(es) at £11 (inc p&p)

Total value of my order £

I enclose cheque/PO or debit my Access/Barclaycard

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CE 608	Power Amp	£20.09
CE 1004	Power Amp	£23.43
CE 1008	" "	£26.30
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CE 1708	" "	£33.48

CPS 1	Power Unit	£19.52
CPS 3	" "	£23.52
CPS 6	" "	£30.00

CPR 1	Pre Amp	£32.17
CPR 1S	" "	£42.52

SINCLAIR INSTRUMENTS

Digital Multimeter		
"	PDM35	£34.50
"	DM235	£52.50
"	DM350	£72.50
"	DM450	£99.00
Digital Frequency Meter		
"	PFM200	£49.80
Low Power Oscilloscope		
"	SC110	£139.00
TF200 Frequency Meter		£145.00
TGF 105 Pulse Generator		£85.00

NEW

LCD Multimeter	TM351	£99.00
LCD Multimeter	TM352	£49.95
Prescaler	TP600	£37.50

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HY30	£6.34
HY50	£7.24
HY120	£15.20
HY200	£18.44
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Pre Amplifiers

HY6	£5.60
HY66	£10.60

Power Supplies

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PSU60	£4.75
PSU70	£13.61
PSU180	£23.02

MULTIPLEX NICKEL CADMIUM CELLS

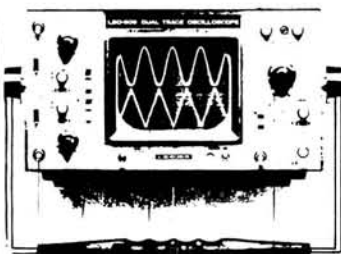
Type S101 (HP4)	£0.98
Type SubC (HP11)	£1.75
Type SubD (HP2)	£1.95
Frivo Chargers for above Penlight	
4: accommodates 1-4 size HP7	£5.50
Combibox FW611: accommodates	
HP7, HP11	£13.25

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EXCLUDING VAT.
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Presensitised PC Boards, Developer. U.V. units, Toyo miniature Fans 230v AC £9.95
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Flow/Speed Sensors for monitoring fuel consumption electronically in vehicles

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OSCILLOSCOPE**
With 20MHz DC bandwidth and 10 mv input sensitivity on a 5" screen this universal oscilloscope is suitable for a wide range of applications.

Send SAE for details of full range.

Marshall's 80/81 catalogue is now available by post, UK 75p post paid Europe 95p post paid: Rest of world £1.35 post paid.

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Mail Order Only or callers by appointment.
All prices include VAT but add 50p post & packing.

VHF RF. POWER TRANSISTORS:-

Type	Gain (db)	Output (watts)	Volts	Freq.	Price
2N6083	5.7	30w.	12	175MHz	£6.50
BLY87A	9	8	12	175	£4.00
SD1212-6	8.2	3	12	175	£2.50
BLW16A	10	1/2	12	175	£0.75
PT4236A	10	1 min.	12	175	£0.75
PT4555	8	25	12	80	£3.50
PT4556C	7	40	12	80	£4.50
2N5070	13	25(pep)	24	30	£5.00

MDA800 8 amp 50 volt bridge rectifier OK for 12v PSU etc. **65p.** 2 for **£1.15.**

DUAL-GATE MOSFETS 3N204 **£1.25**, 3SK51 (40673) **80p**, BFR84 **75p**.

FETs E5565 (2N3819) **30p**, TIS88A **40p**, BF256C **40p**, 2N4381 **40p**.

BIPOLARS:- BF576, pnp VHF RF amp. FT1200 MHz **20p**, 2N4957 pnp

VHF/UHF RF amp of only 33db = 1GHz **30p**, BF180 **30p**, BF166 VHF RF amp

25p, BF990 UHF RF amp **95p**, BF152 VHF mix/osc. **15p**.

RF SWITCHING DIODES for switching oscillators etc. BA143 (VHF) **20p**,

BA144 (UHF) **25p**.

AUDIO AMP IC. TBA1010 6 watt output adjustable to 9 watt, = 14 volt single-

line type & ideal for transceivers, receivers, record players, cassette players etc.

BARGAIN OFFER ONLY £1.35 two for **£2.40**. Supplied with data sheet showing

construction of stereo amp. full data sheet (19 pages) **20p**.

27-30 MHz RECEIVER PRE-AMP. Have you a tired or old receiver with poor

performance above 25MHz then one of our super pre-amps is what you want:- 50

ohm imp. in & out 25db gain with better than 1db nf. ready built on PCB 60mmx-

40mm, adjustable gain control, only **£8.00** or built into grey hammer finish die

cast box with BNC sockets **£12.50**.

10.7 MHz CRYSTAL FILTER for AM/FM 12 1/2 KHz channel spacing +3 1/2 KHz =

only new & unused small size 38mmx18mmx15mm 200 ohm imp. give away

PRICE ONLY £4.00 each two for **£7.00**.

10.7 MHz CRYSTAL FILTER for AM/FM 12 1/2 KHz channel spacing +3 1/2 KHz =

3db ITT type 024DE/923L. **£7.00** ea.

MOTOROLA CAR RADIO PCBs complete less vol. cont. tuner etc. with circuit

80p ea. four for **£3.00**.

CAR RADIO 470 KHz IF AMPS with stereo pre-amp IC, with circuit **65p**.

CAR RADIO/CASSETTE PLAYER stereo amps 5 watt/chan. with multitag

pot. matching amp to above IF amp board. Contains 2 TA7205P ICs, with circuit

£2.75.

BAG MIXED ELECTROLYTIC CAPACITORS 2.2mf - 1000Mfd 100 **£1.60**.

BAG OF MIXED RESISTORS 1/2 watt carbon film pre-formed type all with long

leads plus some 1/2 watt std types 250 for **£1.60**.

FEEDTHROUGH CAPACITORS 1000pF 500v solder in type 1 1/2" dia. 10 for **28p**.

FERRITE RINGS 12mm dia 10p ea. **FERRITE BEADS** FX1115 10 for **20p**.

PRICE LIST 15p STAMP - FREE WITH ORDER.

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VALVES		PL509	2.30	6080	4.20	BC213L	0.09	BU108	1.69
DY86	0.55	PL802	2.50	6146A	4.45	BC214	0.09	BU205	1.30
DY802	0.60	PY88	0.72	6146B	4.85	BC214L	0.09	BU208	1.39
E180F	5.65	PY500A	1.35	7025	1.50	BC237	0.09	BU208A	1.52
EAB380	0.56	PY801	0.60	7360	7.50	BC238	0.08	MJE340	0.40
EFB89	0.70	QV02-6	8.25	7591	2.35	BC307	0.09	OC71	0.22
ECC81	0.55	QV03-20A				BC327	0.10	R2008B	1.70
ECC82	0.55		12.25			BC337	0.10	R2010B	1.70
ECC83	0.60	QV06-40A				BC461	0.30	R2540	2.48
ECC85	0.60		13.95			BC478	0.20	TIP29	0.42
ECC88	0.65	QV03-12	3.25			AC126	0.22	TIP29C	0.42
ECC807	1.30	TB2 5/300				AC172	0.28	TIP30C	0.43
ECF80	0.65		42.00			AC178	0.28	TIP31C	0.42
ECF82	0.60	TY2-125A	30.00			AC176	0.22	TIP32C	0.42
ECH81	0.58	U19	11.95			AC141K	0.18	TIP41C	0.45
ECL82	0.58	UCH81	0.70			AC187	0.26	TIP42C	0.47
ECL83	1.13	ULC82	0.70			AC178K	0.28	TIP47	0.65
ECL86	0.74	UL84	0.78			AC188	0.22	TIP2955	0.84
EF80	0.48	UY85	0.70			BD131	0.30	TIP3055	0.60
EF86	0.70	Z759	9.00			AD161	0.39	TIS91	0.20
EF89	0.65	2D21	1.60			AD161/2	1.04	2N3054	0.59
EF91	1.22	4CX250B	21.75			AD162	0.39	2N3055	0.59
EF93	0.65	5R4GY	1.25			AF127	0.32	2N3702	0.12
EF94	0.65	5U4G	0.90			BF112	0.32	2N3703	0.12
EF95	0.78	6GK6	2.50			BF239	0.42	2N3704	0.12
EF183	0.56	6J6	0.65			BF107	0.10	2N3705	0.12
EF184	0.56	6JS6C	5.00			BF108	0.10	2N3706	0.12
EL34	1.54	6KD6	4.50			BF178	0.10	2N3708	0.12
EL84	0.60	6L6C	1.75			BF180C	0.30	2N5294	0.38
EM84	0.65	6LD20	0.60			BF183	0.29	2N5296	0.48
EZ80	0.48	6LQ6	6.50			BF140	0.31	2N5298	0.38
EZ81	0.56	6SN7GT	0.90			BC141	0.25		
GZ32	0.76	6V6GT	1.05			BC142	0.21		
GZ33	1.85	757	2.00			BF143	0.21	I.C.'s	
GZ34	2.00	12A7	0.98			BF147	0.09	MC1307	1.00
KT61	3.50	12AU7	0.60			BC148	0.09	MC1350	1.00
KT66	4.00	12AX7	0.65			BC149	0.09	MC1495	3.00
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KT88	6.00	12BE6	1.05			BC158	0.09	SN76013N	1.15
N78	0.90	12BH7	0.95			BC159	0.09	SN76013ND	
OA2	0.78	12HG7	3.50			BC160	0.28	SN76033N	1.35
PCF80	0.72	85A2	1.20			BC170B	0.10	SN76033N	1.35
PCF802	0.66	90C1	1.69			BC171	0.08	SN76131N	1.30
PCF808	1.48	807	1.09			BC172	0.09	SN76277N	1.05
PCL82	0.68	811A	9.00			BC173	0.10	SN76660N	0.60
PCL84	0.72	813	1.30			BC182	0.09	TA8618	1.20
PCL86	0.75	833A	47.85			BC183	0.09	TBA1205	0.70
PCL805	0.80	866A	2.50			BC184LA	0.09	TBA540	1.25
PFL200	1.13	2050A	3.90			CC212	0.09	TBA550Q	1.55
PL504	1.13	5763	3.20			CC211	0.09	TBA641-B11	
PL508	1.48	5814A	2.75			BC121	0.09		
						BU105	1.22		

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P&P 50p per order

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including vintage valves.

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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 £11-95.

LIGHT CHASER

Gives a brilliant display—a psychedelic light show for discos, parties and pop groups. There are three modes of flashing, two chase-patterns and a strobe effect. Total output power 750 watts per channel. Complete kit. Price £16. Ready made for £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 emit a shrill note. Kit. Price £4-90.

6 WAVEBAND SHORTWAVE RADIO KIT

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 (five 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 AM/SIGNAL TRACER. In case measuring only 5in x 3in x 1 1/2in 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 41v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, curing amp, etc. An absolute bargain at only £1-85. Suitable 80 ohm earpiece 69p.

VU METER

Edgewise mounting, through hole size 1 1/2" x 1/2" 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 £2-89p.

BALANCE METER

Edgewise mounting 100 U.A. centre zero. Price £2-30p.

1 1/2" SQUARE PANEL METER

Eagle full vision plastic front, 50 U.A. 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 capacitors, SCR ref. 2N 5062 25 Out 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 DETECTOR

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. Net £2-00.

MULLARD UNIST

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" x 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-90F—price £4-60.

TANGENTIAL HEATER UNIT

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 any kitchen unit. Price £5-95, post £1-50. Control switch to give 2kw, 1kw, cold blow or off available £60 extra. 3kw model £6-95. Control Switch 95p.

3 KW Mode
£6-95
+ £1.50 P & P



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 1/2" 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.

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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 1/2 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" x 1", coupled to mains voltage induction motor, outlet size approximately 1 1/2" x 1 1/2". Price £5-50 + 68p. The other is a larger **FLANGED BLOWER** for direct coupling to ducting, outlet size 3 1/2" x 2 1/2" + 1" flange, housed for easy fixing to trunking. Impeller size 5 1/2" x 1 1/2". Powered by 1/12 h.p. mains motor. £11-75.

RECHARGEABLE SOLID GEL BATTERY 12v 5 AH new and unused made by or for Elpor Corporation of California. Dimensions, 6" long, 3 1/2" high and 2 1/2" wide. Regular price of similar batteries. 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. 010 181. 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 4 1/2" wide, 1 1/2" high and 5 1/2" 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 3 1/2" diameter 4 1/2" deep. Price £13-80. 5 amp model, again cylindrical, 2 1/2" diameter, 4 1/2" 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 find, put to rest—killing flies and weeds, lifting central heating boilers, lifting paper, extracting dust, 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" x 3" x 3 1/2". 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 1". Don't miss this snip—send your order today.

SUPER BREAKDOWN PARCEL with free gift of a desoldering pump, perhaps the most useful breakdown 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, capacitors, 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.



Toroidal

TRANSFORMERS

IN A RANGE OF 75 TYPES

We use advanced winding technology to make our toroidal transformers. They have only half the weight and height of their laminated equivalents and are appreciably more efficient. Our toroids cost virtually the same as the older types which they are rapidly replacing. Induced hum is reduced by a factor of ten. Supplied with rigid mounting kit with centre bolt, steel and neoprene washers.

30VA 70mm dia. x 30mm
Weight 0.45 Kg **£4.71**
(+£1.00 p.p. + 0.86 VAT)

TYPE	SECONDARY RMS VOLTS	SECONDARY RMS CURRENT
1X010	6+6	2.50
1X011	9+9	1.66
1X012	12+12	1.25
1X013	15+15	1.00
1X014	18+18	0.83
1X015	22+22	0.68
1X016	25+25	0.60
1X017	30+30	0.50

50VA 80mm dia. x 35mm
Weight 0.9 Kg **£5.19**
(+£1.10 p.p. + 0.94 VAT)

TYPE	SECONDARY RMS VOLTS	SECONDARY RMS CURRENT
2X010	6+6	4.16
2X011	9+9	2.77
2X012	12+12	2.08
2X013	15+15	1.66
2X014	18+18	1.38
2X015	22+22	1.13
2X016	25+25	1.00
2X017	30+30	0.83
2X028	110	0.45
2X029	220	0.22
2X030	240	0.20

80VA 90mm dia. x 30mm
Weight 1 Kg **£5.76**
(+£1.20 p.p. + £1.04 VAT)

TYPE	SECONDARY RMS VOLTS	SECONDARY RMS CURRENT
3X010	6+6	6.64
3X011	9+9	4.44
3X012	12+12	3.33
3X013	15+15	2.66
3X014	18+18	2.22
3X015	22+22	1.81
3X016	25+25	1.60
3X017	30+30	1.33
3X028	110	0.72
3X029	220	0.36
3X030	240	0.33

120VA 90mm dia. x 40mm
Weight 1.2 Kg **£6.72**
(+£1.30 p.p. + £1.20 VAT)

TYPE	SECONDARY RMS VOLTS	SECONDARY RMS CURRENT
4X011	9+9	6.66
4X012	12+12	5.00
4X013	15+15	4.00
4X014	18+18	3.33
4X015	22+22	2.72
4X016	25+25	2.40
4X017	30+30	2.00
4X028	110	1.09
4X029	220	0.54
4X030	240	0.50

160VA 110mm dia. x 40mm
Weight 1.8 Kg **£8.88**
(+£1.40 p.p. + £1.54 VAT)

TYPE	SECONDARY RMS VOLTS	SECONDARY RMS CURRENT
5X012	12+12	6.66
5X013	15+15	5.33
5X014	18+18	4.44
5X015	22+22	3.63
5X016	25+25	3.20
5X017	30+30	2.66
5X018	35+35	2.28
5X028	110	1.45
5X029	220	0.72
5X030	240	0.66

225VA 110mm dia. x 45mm
Weight 2.2 Kg **£10.59**
(+£1.50 p.p. + £1.81 VAT)

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8X026	40+40	6.25
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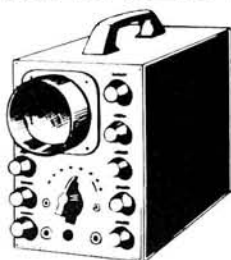
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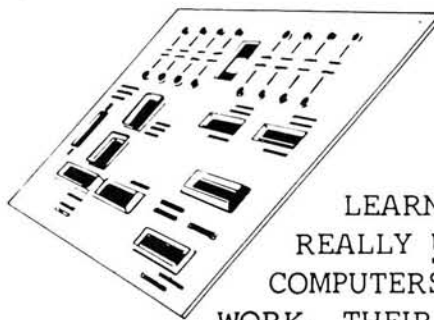
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HEF4040	107	HEF4097	714			UA7915CU	97	BC108F	20	TP42C	76
HEF4041	94	HEF4098	230			UA7915CS	38	BC148	10	TP285S	75
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2.2	16	9	9	9	9	9	9
3.3	16	9	9	9	9	9	9
4.7	16	9	9	9	9	9	9
6.8	16	9	9	9	9	9	9
10	16	9	9	9	9	9	9
15	16	9	9	9	9	9	9
22	16	9	9	9	9	9	9
33	16	9	9	9	9	9	9
47	16	9	9	9	9	9	9
68	16	9	9	9	9	9	9
100	16	9	9	9	9	9	9
150	16	9	9	9	9	9	9
220	16	9	9	9	9	9	9
330	16	9	9	9	9	9	9
470	16	9	9	9	9	9	9
680	16	9	9	9	9	9	9
1000	16	9	9	9	9	9	9
1500	16	9	9	9	9	9	9
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0.25W, E24 Values 10R-10M, 5% Tol.	2 each	Res RD%		0.1W, E3 Values, 100R-1M, Lin. Horizontal Mount				8			
		100/100 (Multi 10/Value)									
0.5W, E12 Values, 10R-4M7, 10% Tol.	3 each	Res RD%									
		Value									
Metal Film, Fixed						Skeleton Presets, Standard					
0.5W, E24 Values, 5R-1M, 2% Tol.	8 each	Res RD%		0.3W, E3 Values, 100R-1M, Lin. Vertical Mounting				11		Std. Preset V Std. Preset H	
2.5W, E12 Values, 10R-27K, 5% Tol.	18 each	Res RD%		0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mount				11		Value	
		Value									
Metal Glaze, Fixed						Potentiometer, Rotary					
0.5W, E24 Values, 1M-33M, 5% Tol.	16 each	Res RD%		0.5W, E3 Values, 1K-2M2 Log				39		Rd Pot Lin	
		Value		0.25W, V-Values, 4K7-2M2 Log				39		Rd Pot Log	
						Potentiometer, Slider					
				0.5W, E3 Values, 2K2-47K Lin				45		Sl Pot Lin	
0.5W, E24 Values, 1M-33M, 5% Tol.	16 each	Res RD%		0.25W, E3 Values, 1K0-1M0 Log				45		Sl Pot Log	
		Value									

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Spot Face Cutter	107	203-21013A		DPDT	C/DH	111	SW BA2021
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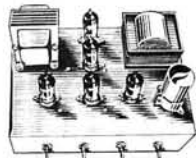
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200/240V Mains operated Solid State FM AM Stereo Tuner. Covering M.W. A.M. 540-1605 KHz VHF/FM 88-108 MHz. Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600mV r.m.s. into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8 1/2" \times 4" \times 9 1/2" approx. LIMITED NUMBER ONLY at £29.00 + £2.00 P. & P.

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SIZE 1 1/2" \times 2 5/16" \times 1 1/2" 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. \pm 1dB from 20Hz to 20KHz. Input impedance 47K. Size 1 1/2" \times 2 1/2" \times 1 1/2" H. £3.20 + 22p P. & P.

HARVERSON SUPER SOUND 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: \pm 3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω . Full power bandwidth: \pm 3dB 12-15,000 Hz. Bass boost approx. to \pm 12dB. Treble cut approx. to -10dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12" \times 8" \times 2 1/4". 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.

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

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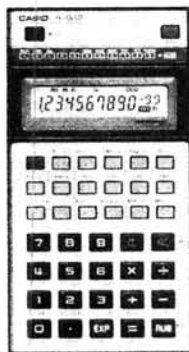
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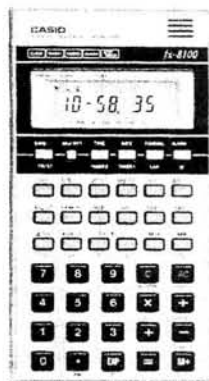
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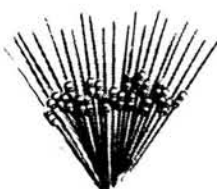
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160R	1k6	16k	160k
180R	1k8	18k	180k
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220R	2k2	22k	220k
240R	2k4	24k	240k
270R	2k7	27k	270k
300R	3k	30k	—
330R	3k3	33k	330k
360R	3k6	36k	—
390R	3k9	39k	—
430R	4k3	43k	—
470R	4k7	47k	470k
510R	5k1	51k	—
560R	5k6	56k	560k
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750R	7k5	75k	—
820R	8k2	82k	820k
910R	9k1	91k	1M

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10 Wardour St., London W1.

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).

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74LS153	0.54
74LS154	0.96
74LS155	0.54
74LS156	1.10
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BF241	0.18
BF274	0.18
BF440	0.21
BF441	0.21
BF362	0.49
BF395	0.18
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BF6795	0.55
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4038	0.85

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1000/63	0.30
3300/25	0.69
1000/100	0.88
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LCD Module

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

RESISTORS

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

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

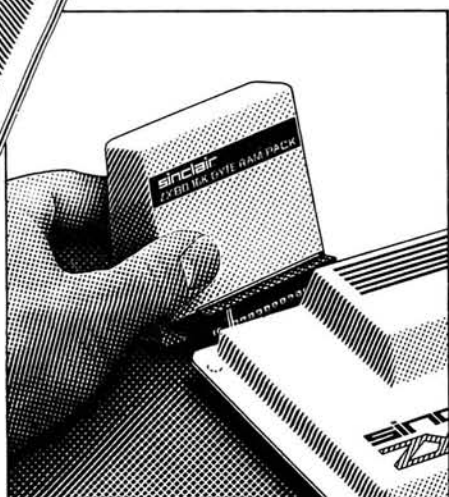
In kit form, the ZX80 is pleasantly easy to assemble, using a fine-tipped soldering iron. And you may already have a suitable mains adaptor—600 mA at 9V DC nominal unregulated. If not, see the coupon.

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.)

Practical Wireless, March 1981

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.

Practical Wireless, March 1981

NEW

PRACTICAL ELECTRONICS PROJECT 125 WATT POWER AMP KIT

SPECIFICATIONS

Max. Output power 125 watt RMS
Operating voltage (DC) 50-80 Max.
Loads 4-16 ohms
Frequency response Measured at 100 watts 25Hz-20kHz
Sensitivity for 100 watts 400mV @ 47K
Typical T.H.D. @ 50 watts 4 ohms load 0.1 %
Dimensions 205 x 90 and 190 x 36 mm

The P.E. power amp kit is a module for high power applications—disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, the

output stage uses four 115 watt transistors normally only two would be used, result, a high powered rugged unit. The PC Board is backprinted, etched and ready to drill for ease of construction, and the aluminium chassis is preformed and ready to use. supplied with all parts and circuit diagrams.

125 watt power amp kit

ACCESSORIES

Suitable L.S. coupling electrolytic

Suitable Mains Power Supply Unit

sufficient for one power amp

£9.50 plus £1.00 p&p

£1.00 plus 20p p&p

£7.50 plus £2.75 p&p



AS FEATURED IN
PRACTICAL ELECTRONICS
OCTOBER ISSUE

DIY STEREO BARGAIN PACKS FEATURING FAMOUS BUILT MULLARD PREAMP MODULES

MULLARD STEREO PREAMP MODULES AND TWO 12 WATT POWER AMP KITS.



In easy to build form
P.C.B.s backprinted, etched
and drilled ready to use.

BUILD A 12 WATTS PER CHANNEL STEREO AMPLIFIER ACCESSORIES AND L.S. KIT EXTRA (not available separately)

£6.00

DIY PACK 1 2 x power amp kits LP1182/ preamp module, suitable for ceramic and auxiliary inputs.

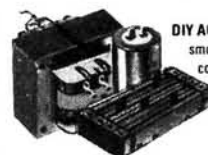
£6.00 plus £1.10 p&p

DIY PACK 2 2 x power amp kits LP1184 preamp module suitable for magnetic ceramic and auxiliary inputs.

£8.50 plus £1.15 p&p

DIY SPEAKER KIT Two 8" x 5" approx. 4 ohm bass.

£3.50 plus £1.70 p&p



DIY ACCESSORIES Mains transformer smoothing capacitor rectifier 4 slider controls, for base, treble and volume.

£3.00 plus £1.60 p&p

ACCESSORIES: Available only at time of purchase of Bargain Packs

12 + 12 WATT AMPLIFIER KIT

NOTE: for use with 4 to 8 ohms speakers.

With up-to-the-minute features. To complete you just supply screws, connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs—tape, speakers and headphones. By the press of a button it transforms into a 24 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus 2 power amplifier assembly kits and mains power supply. Also featured 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia panel with matching knobs. Easy to assemble teak simulate cabinet and ready made metal work. For further information instructions are available price 50p. Free with kit. Size 9 1/4" x 8 3/4" x 4" approx.

NOTE: for use with 4 to 8 ohms speakers.

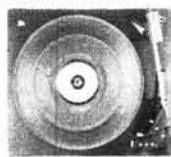
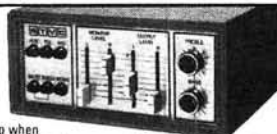
£13.95 plus £2.55 p&p

BSR chassis record deck with manual set down and return, complete with stereo ceramic cartridge

£8.50 plus £2.75 p&p when purchased with amplifier. Available separately **£10.50** plus £2.75 p&p.

8" SPEAKER KIT. 2 Philips 8" approx. speakers. **£4.75** per stereo pair plus £1.50 p&p when purchased with amplifier. Available separately **£6.75** plus £1.50 p&p.

STEREO MAGNETIC PRE-AMP CONVERSION KIT all components including P.C.B. to convert your ceramic input on the 12 + 12 amp to magnetic. **£2.00** when purchased with kit featured above. **£4.00** separately inc p&p.



BSR Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or disco use.

£12.25 OUR PRICE plus £2.75 p&p

PHILLIPS RECORD PLAYER DECK GC037

Size approx 15 1/2" x 12 1/4"



Hi Fi record player deck, 2 speed, damped cueing, auto shut-off, belt drive with floating sub chassis to minimise acoustic feedback. Complete with GP401 stereo magnetic cartridge—LIMITED STOCK. UNBEATABLE OFFER AT

£27.50 complete plus £2.75 p&p

OFFER! SAVE MONEY by purchasing 12 + 12 amp kit, BSR record deck and speaker kit together for only

£25.50 p&p £4.50.

PRACTICAL ELECTRONICS CAR RADIO KIT

£10.50

(Constructors pack 7)

plus £1.75 p&p



2 WAVE BAND MW LW

* Easy to build * 5 push button tuning

* Modern styling design * All new unused components

* 6 watt output * Ready etched & punched P.C.B.

* Incorporates suppression circuits * Now with tape input socket

All the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue. Features: Pre-set tuning with five push button options, black illuminated tuning scale, with matching rotary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia. The P.E. Traveller has a 6 watts output, neg ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The radio fits easily in or under dashboards. Complete with instructions.

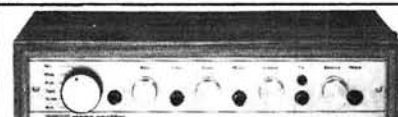
CONSTRUCTORS PACK 7A

Suitable stainless steel fully retractable locking aerial and speaker (approx. 6" x 4") is available as a kit complete **£1.95** per pack, p&p £1.00

Pack 7A may only be purchased at the same time as Pack 7

NOTE: Constructor's pack 7A sold complete with radio kit **£15.20** including p&p.

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30 + 30 WATT STEREO AMPLIFIER BUILT AND TESTED

Viscount IV unit in teak simulate cabinet silver finished rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30 + 30 watts. RMS 60 + 60 watts peak for use with 4 to 8 ohm speakers. Size 14 1/4" x 10" approx.

READY TO PLAY **£32.90** plus £3.30 p&p



323 EDGWARE ROAD, LONDON W2
21c HIGH STREET, ACTON W3 6NG

ACTON: Mail Order only. No callers
ALL PRICES INCLUDE VAT AT 15 %
All items subject to availability. Price correct at 1.2.81 and subject to change without notice.

For further information send for instructions
20p plus stamped addressed envelope.

NOTE: Persons under 16 years not served without parent's authorisation.

BARGAIN OFFER!!



ARISTON PICK UP

Ariston pick-up arm manufactured in Japan. Complete with headshell. Listed price over £30.00

£11.95 OUR PRICE plus £2.50 p&p

100 WATT MONO DISCO AMPLIFIER

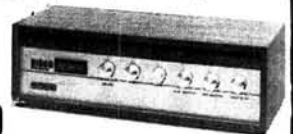
Brushed aluminium fascia and rotary controls. Size approx 14" x 4" x 10 1/4". Five vertical slide controls, master volume, tape level, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PRL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

£76.00 plus £4.00 p&p

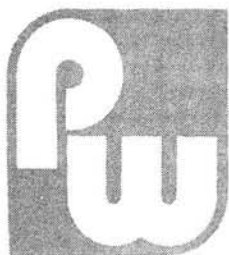
50 WATT MONO DISCO AMPLIFIER

Size approx 13 1/2" x 5 1/4" x 6 1/4". 50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

£30.60 plus £3.20 p&p



Personal Shoppers EDGWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am-5.30pm. Closed all day Thursday ACTON: Mail Order only. No callers GOODS DESPATCHED TO MAINLAND AND N. IRELAND ONLY



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.

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 regula-

tions 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."

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.*

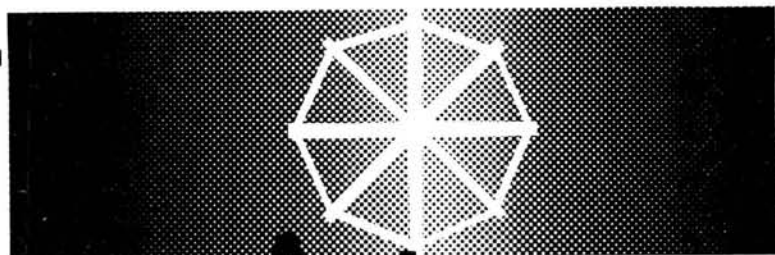
Can I Help You!

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

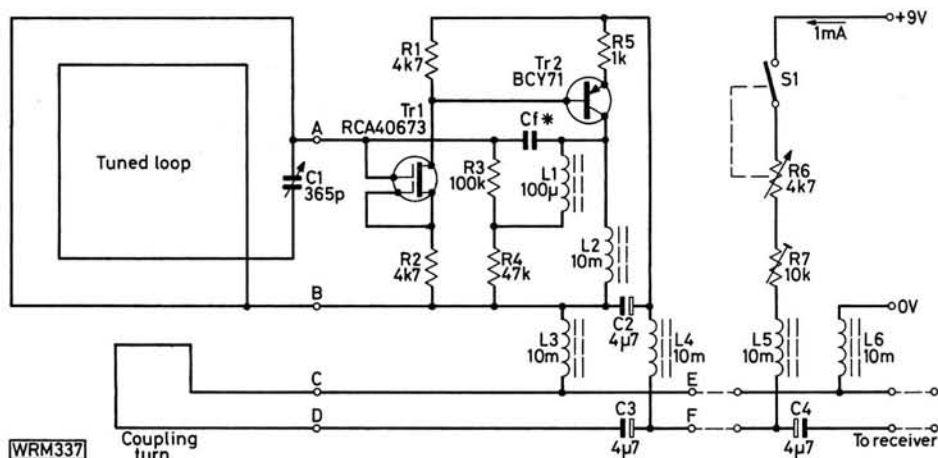
BUYING GUIDE

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.

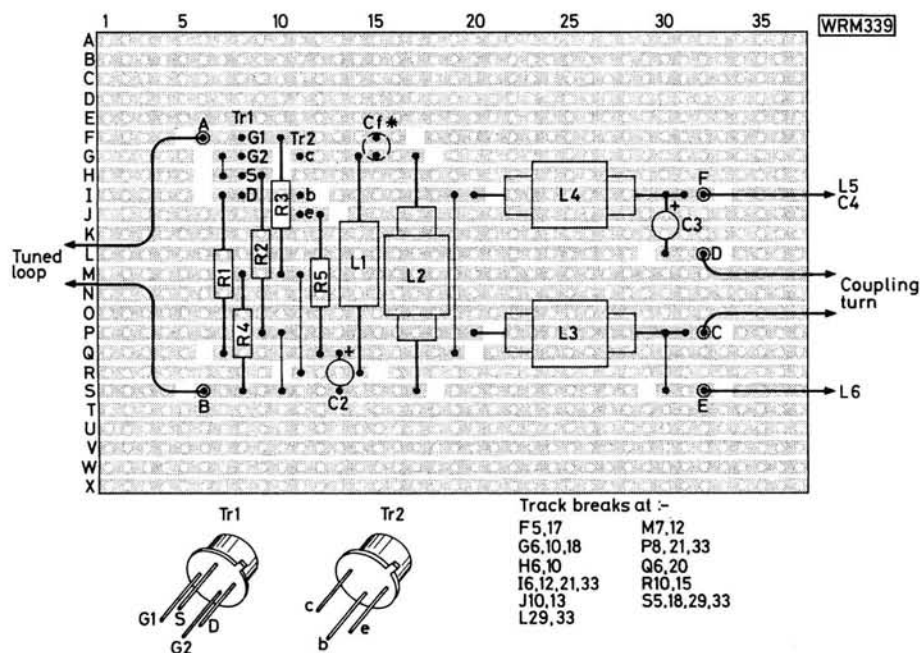
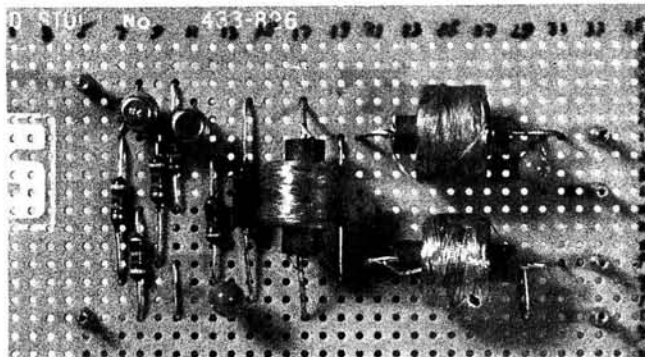
After construction and checking, a test with R6 and R7 at their mid-positions should show a current of around 1mA. If the current is less than 500µA or greater than 1.5mA you have a problem.

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 0.25m² to 5m², 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 0.25m², 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 5m² 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

$\frac{1}{4}$ W 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
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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.

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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 biggest 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

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.

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Whichever frequency you tune your receiver to, for PEAK PERFORMANCE on all frequencies you need good matching between your Receiver and Antenna to hear the best from it. If you plan to listen on the high frequency bands up to 30MHz then you know you can't have an antenna for every frequency! Or can you? – Well, not quite! BUT we can offer you MUCH IMPROVED PERFORMANCE from your receiver by using an antenna tuning unit, that will electrically change the length of your antenna to match the frequency you select – In other words – A MATCH AT ALL FREQUENCIES.

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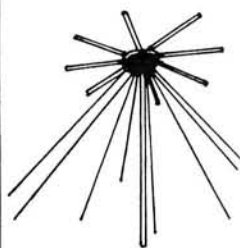
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winding. Bolt all pieces together using large washers on a 4mm bolt and open out to even spacing with the longest strip vertical for rotational mounting.

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 10×0.1 mm 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.

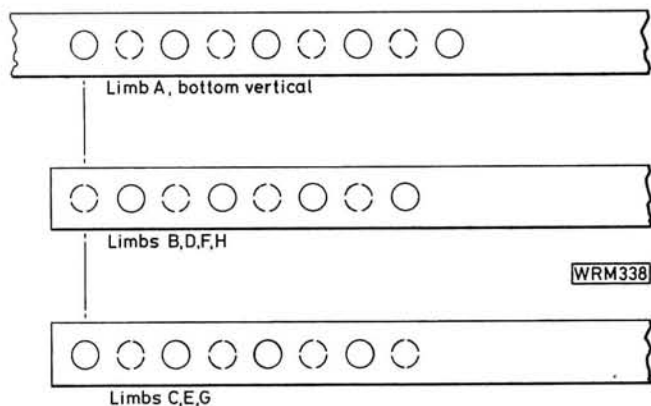


Fig. 3: The arrangement of pins at the ends of the wooden cross members of the spiral loop antenna

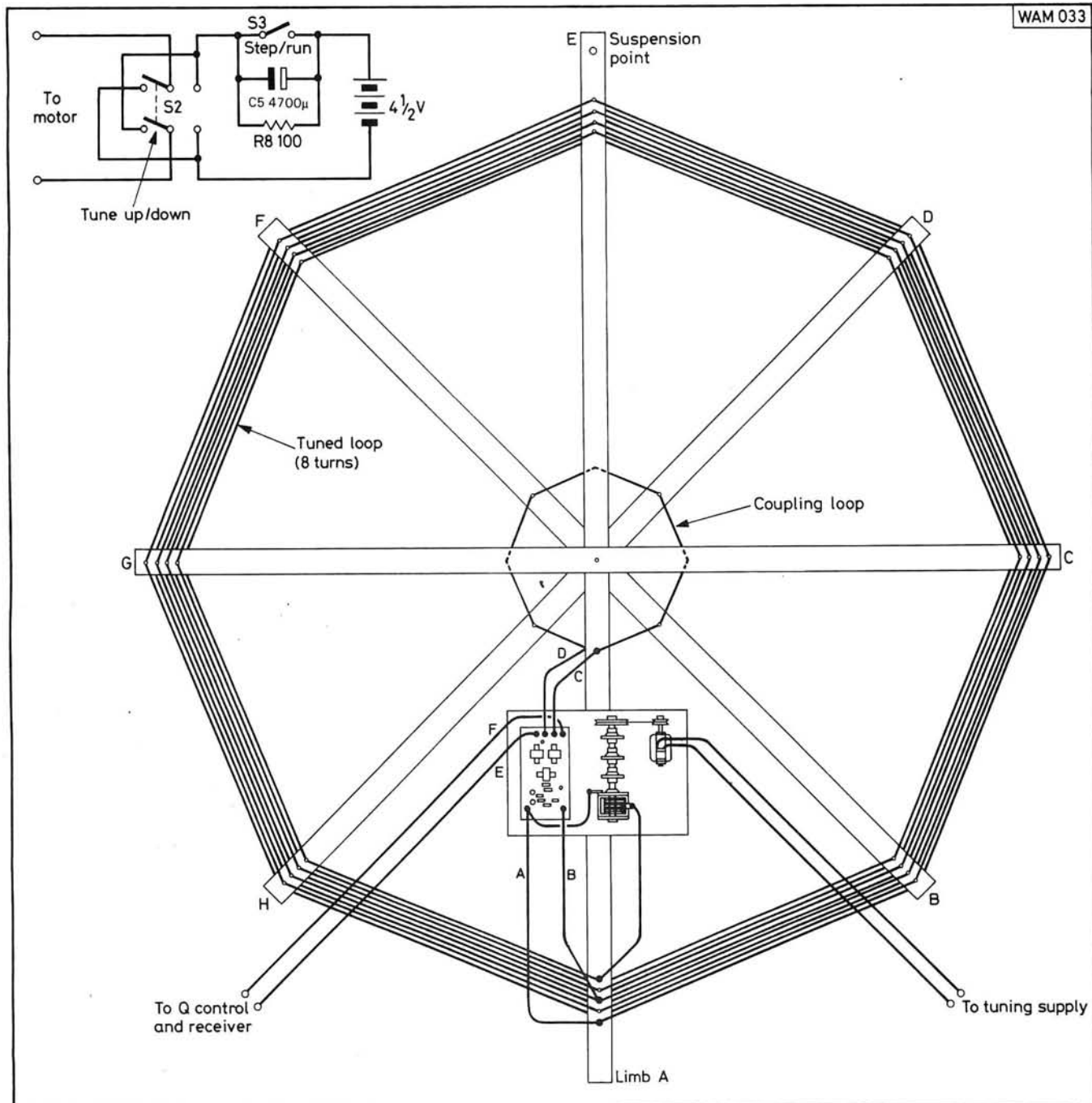


Fig. 4: General arrangement of the spiral loop antenna together with the suggested circuit for the tuning motor supply and control

"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 inadvertently 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.

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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 Ern's", 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.

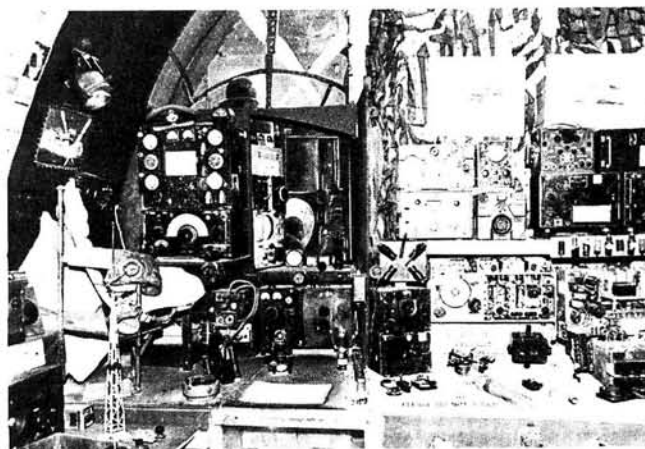


Part of the microwave equipment exhibit

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 pan-technicons, 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 Autoscan 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 Autoscan 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.



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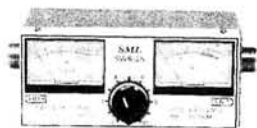
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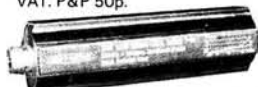


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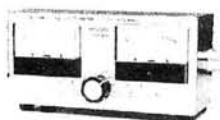
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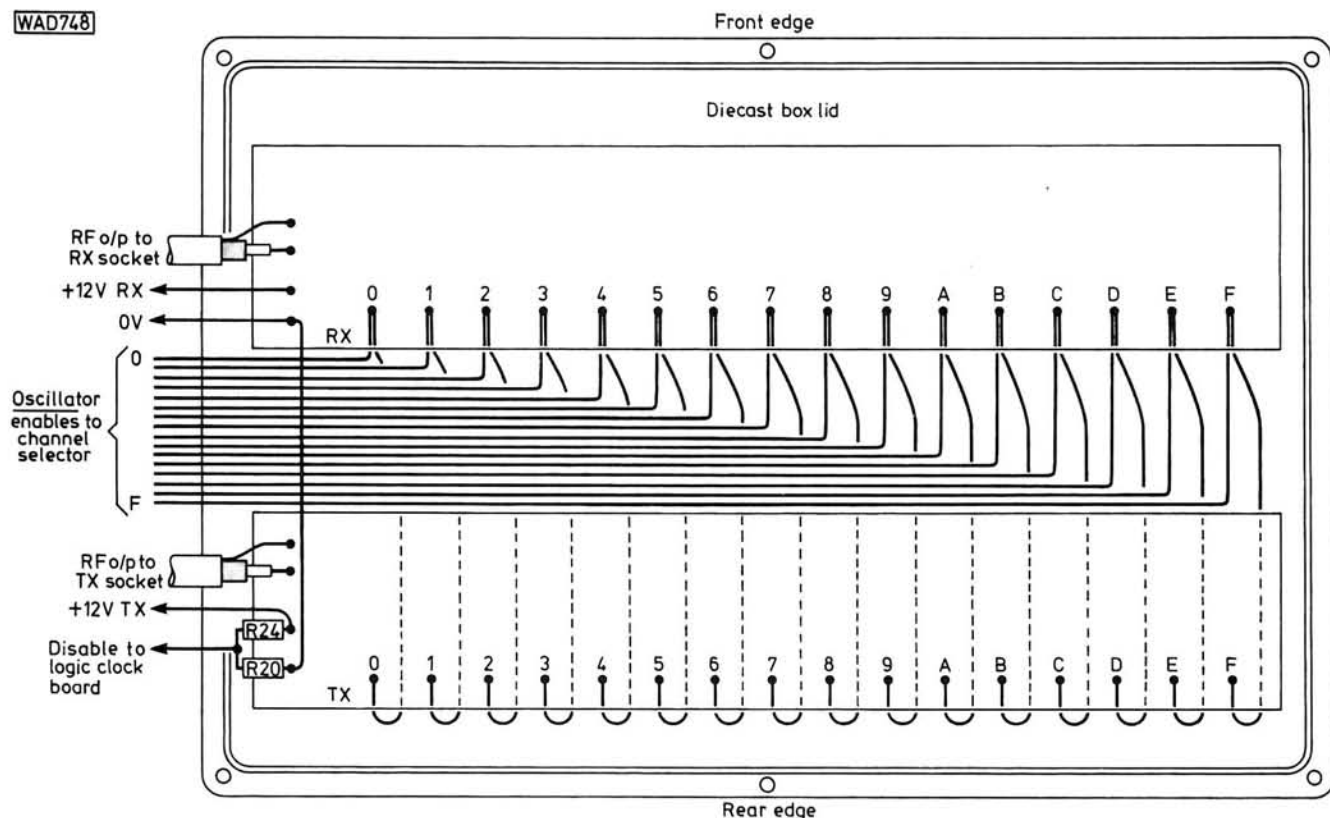
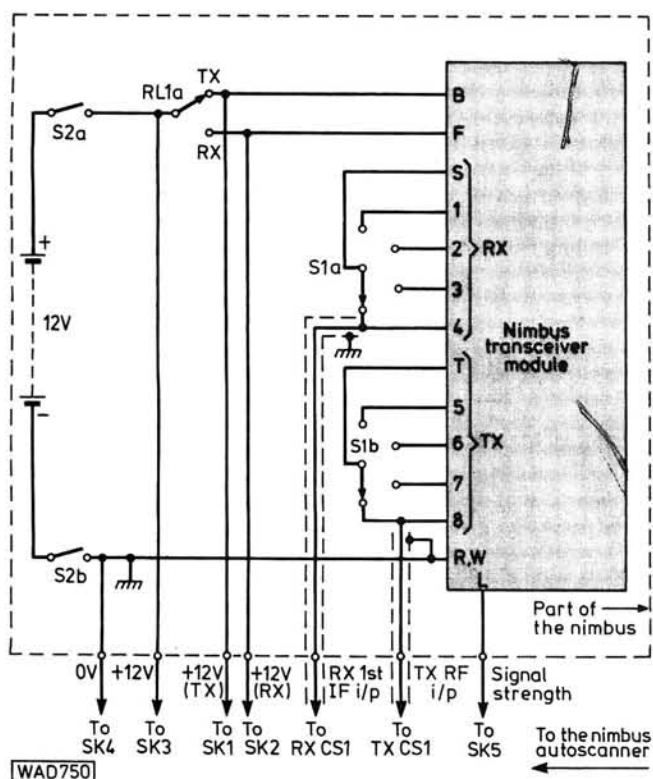


Fig. 19: Wiring layout for the two channel oscillator boards

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

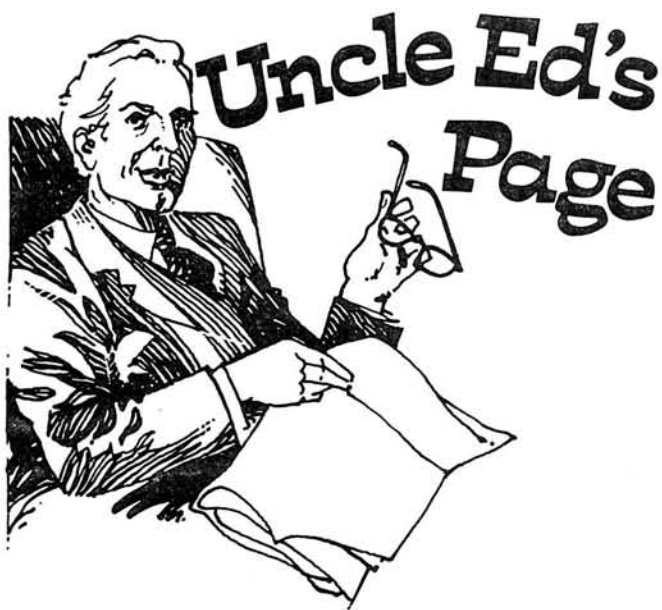


The same test procedure is followed for the two oscillator banks, and each bank should be tested in turn. Power is applied to the control logic, via SK3 and SK4 and to the oscillator bank under test, via SK1 or SK2, as appropriate. The control logic is set to AUTO mode and HOLD sub-mode. Each channel 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.

www.americanradiohistory.com



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

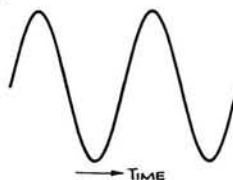


Fig 2

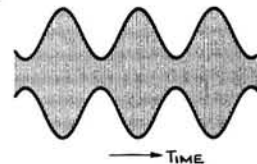


Fig 3

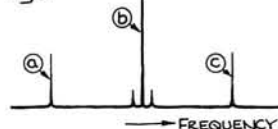


Fig 4

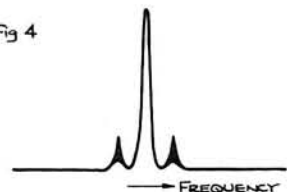
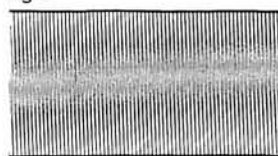


Fig 5



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 *nnp* types, but the driver transistors must be an *nnp* 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.

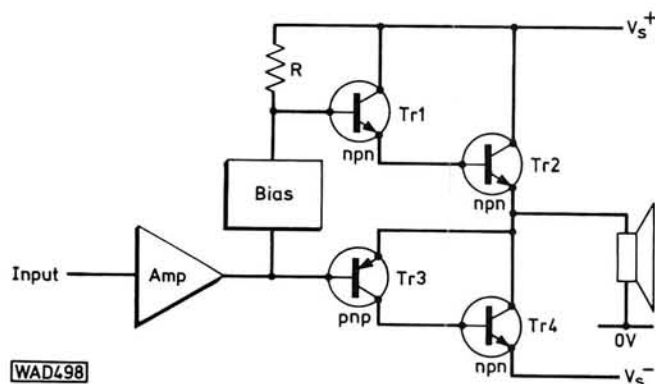


Fig. 9: The quasi-complementary output circuit

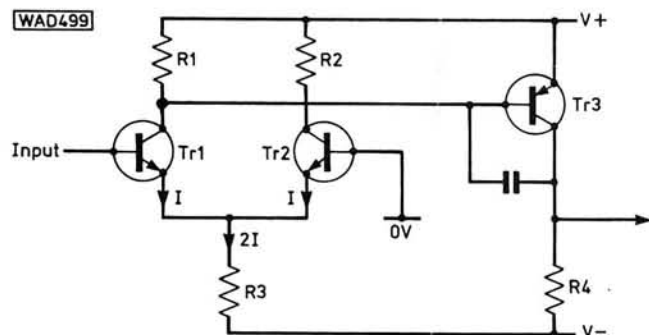


Fig. 10: The differential input stage arrangement

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

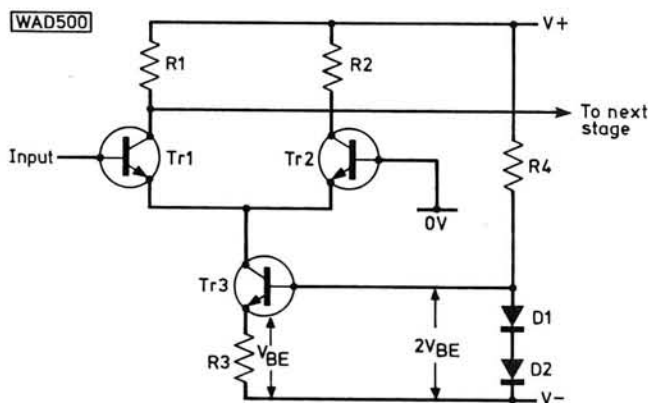


Fig. 11: A differential input stage with constant-current source for improved performance

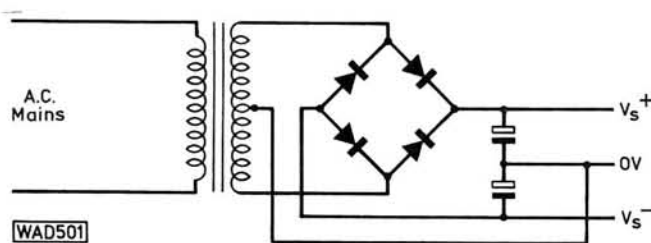


Fig. 12: A basic, unregulated, balanced power supply

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 $\pm 45V$ under no-load conditions, this voltage may well fall to $\pm 35V$ 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 $\pm 45V$ 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

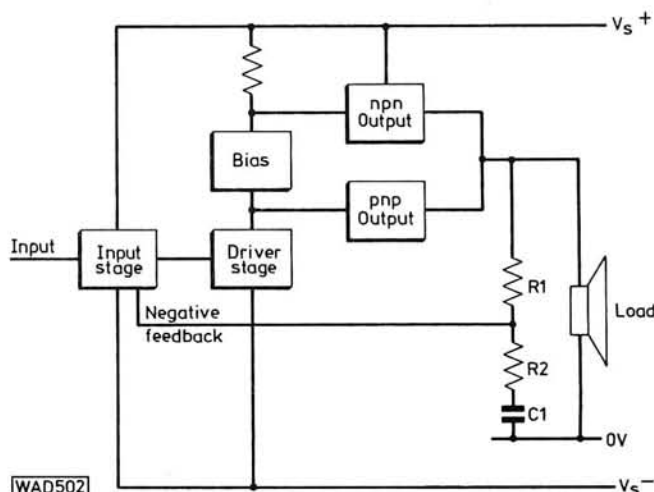


Fig. 13: Block diagram of a typical amplifier having a complementary output stage

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.

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 $180\text{k}\Omega$. 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 $\pm 22\text{V}$ to deliver over 30W into a 4 ohm load, with a supply of about $\pm 28\text{V}$ to deliver a similar power level into an 8 ohm load, or with $\pm 37\text{V}$ and a 16 ohm load. The distortion is especially low, about 0.015 per cent, but rises at frequencies above 10kHz.

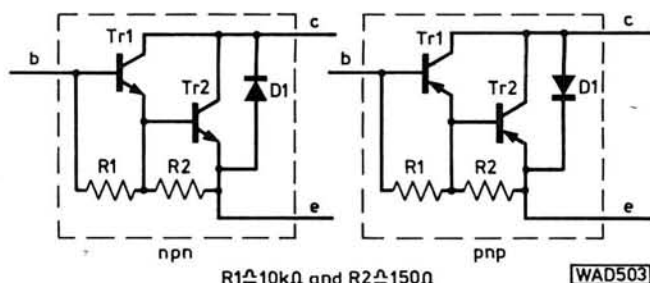


Fig. 14: Internal structures of npn and pnp power Darlington devices

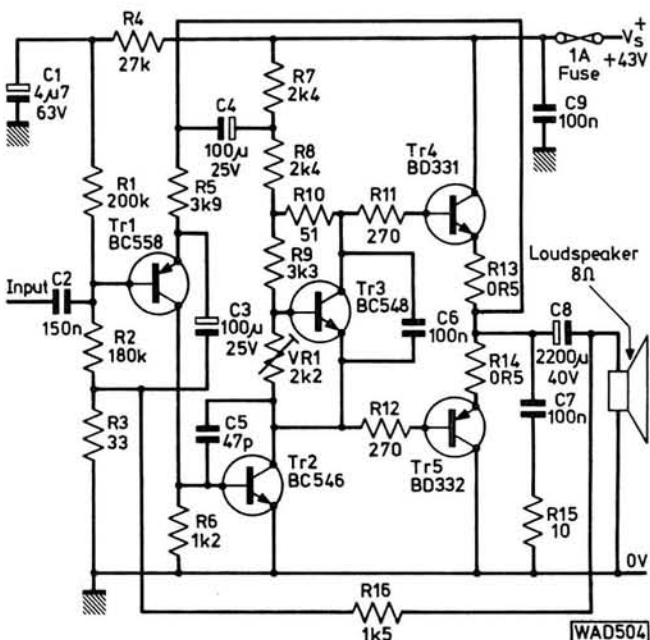


Fig. 15: A complete 20 watt amplifier circuit

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 $V_{BE}/R4 = 0.6/330$ 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 Darlington transistors 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 Darlington transistors can be used for supply voltages not exceeding $\pm 30\text{V}$.

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.

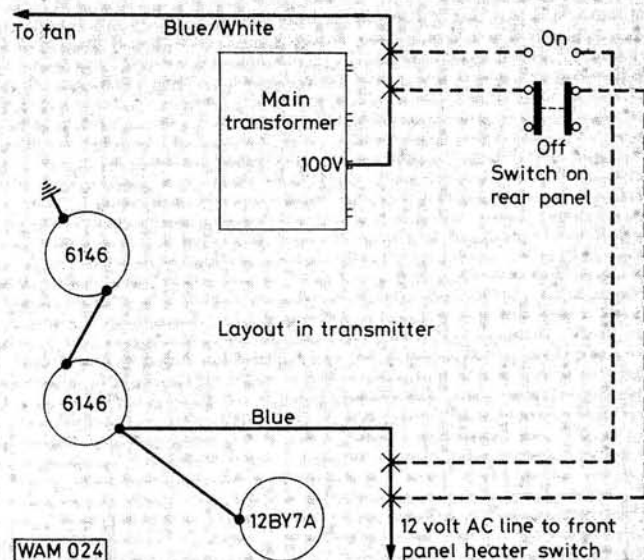
With the switch in the OFF position it interrupts the 100V line from the main transformer to the fan, and the 12.6V line from the front-panel heater switch to the valve heaters. It is then possible to use the set as a receiver only, with the valve heaters and the fan turned off.

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.

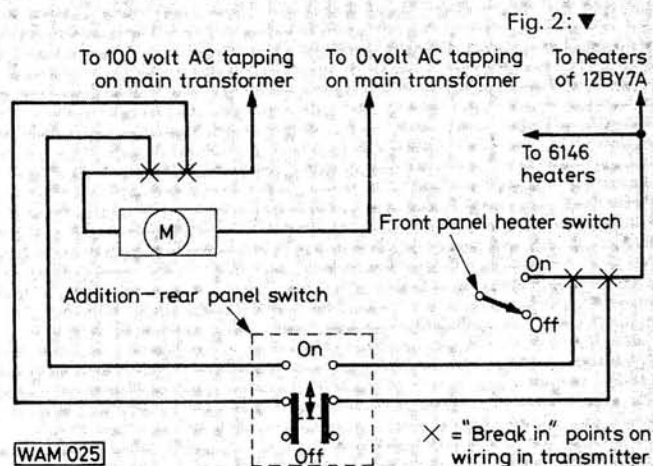
As Rob has given me permission to reprint tips from his newsletters, I would like to pass on this information which was originally supplied by Alan K. Lefcort WB3GPR/6, who wrote in to the newsletter to point out that some of the microphones sold by Tandy as replacement mikes for portable cassette tape-recorders 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.



WAM 024

Fig. 1: ▲



WAM 025

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

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 x 51.5 x 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 inter-connecting 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



The Icom IC-451

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, Vero-board, 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.**

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TR9000 £345

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TS-770E 2m/70cm multimode base station £763.60
TR-2300 2m handheld (80 channels) £166.75
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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/Rty/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 - lightning 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 £12.99
RW-151D Watt meter 0-150W, 0-500MHz £69.00
Rotators
NS-200 VHF - UHF Beams £29.50
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CONSTRUCTOR'S SKETCHBOOK

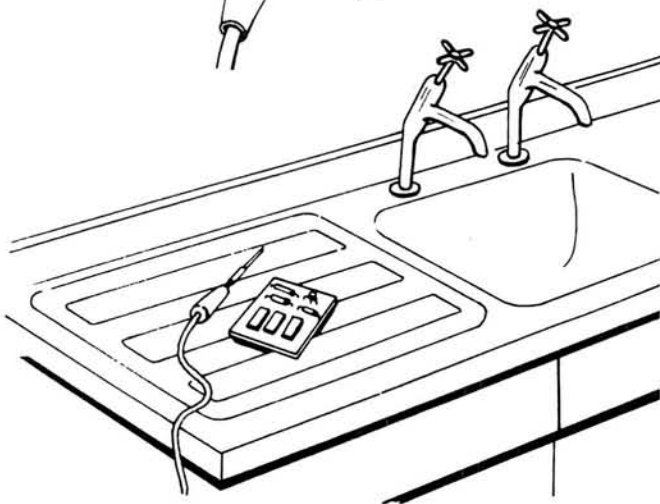
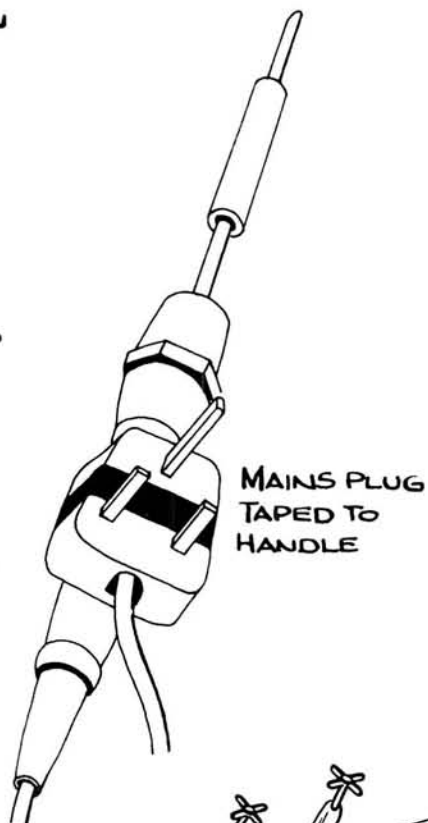
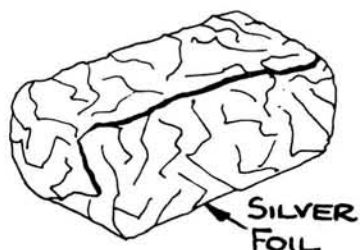
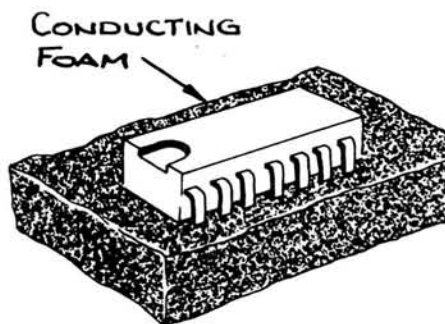
C.M.O.S. DEVICES.

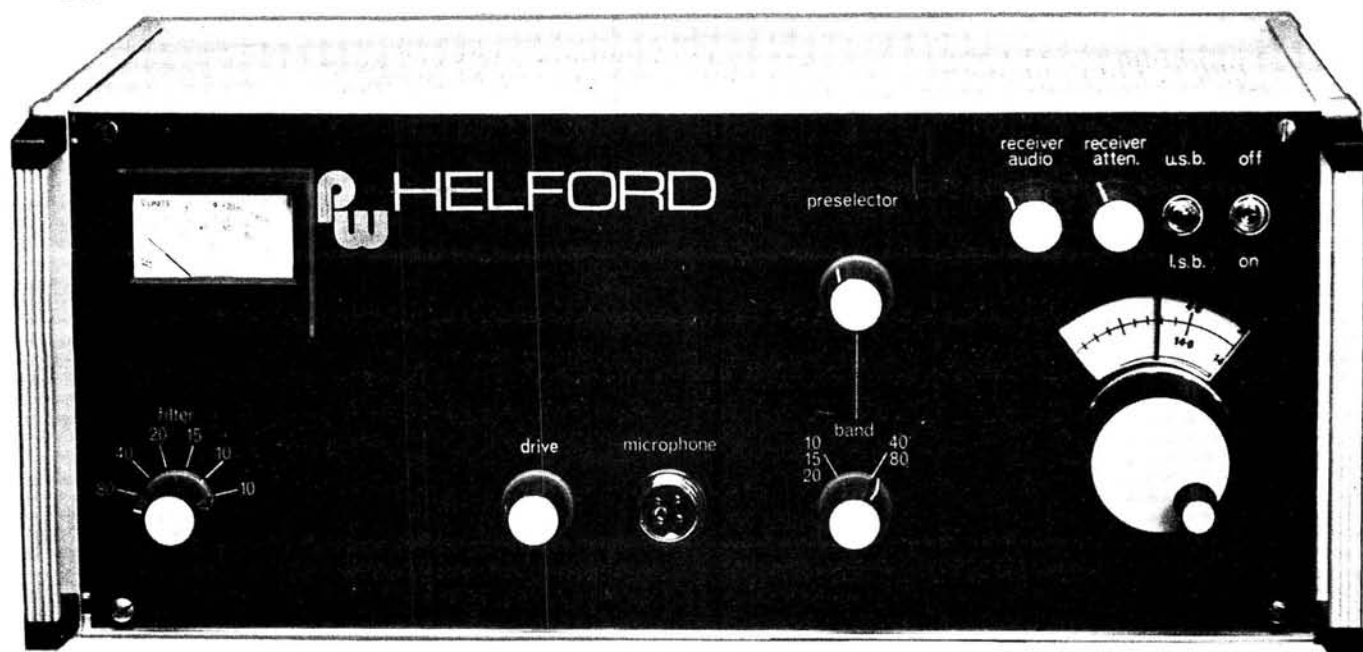
STATIC ELECTRICITY KILLS C.M.O.S. DEVICES. WHEN YOU RECEIVE YOUR C.M.O.S. DEVICES THEY SHOULD BE PACKAGED IN SUCH A MANNER AS TO ENSURE THAT ALL PINS ARE SHORTED TOGETHER. NEVER REMOVE THE DEVICES FROM THIS PACKAGING UNTIL YOU ARE READY TO INSERT THEM INTO THE CIRCUIT. RESIST THE TEMPTATION TO INSPECT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

WKM124





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.

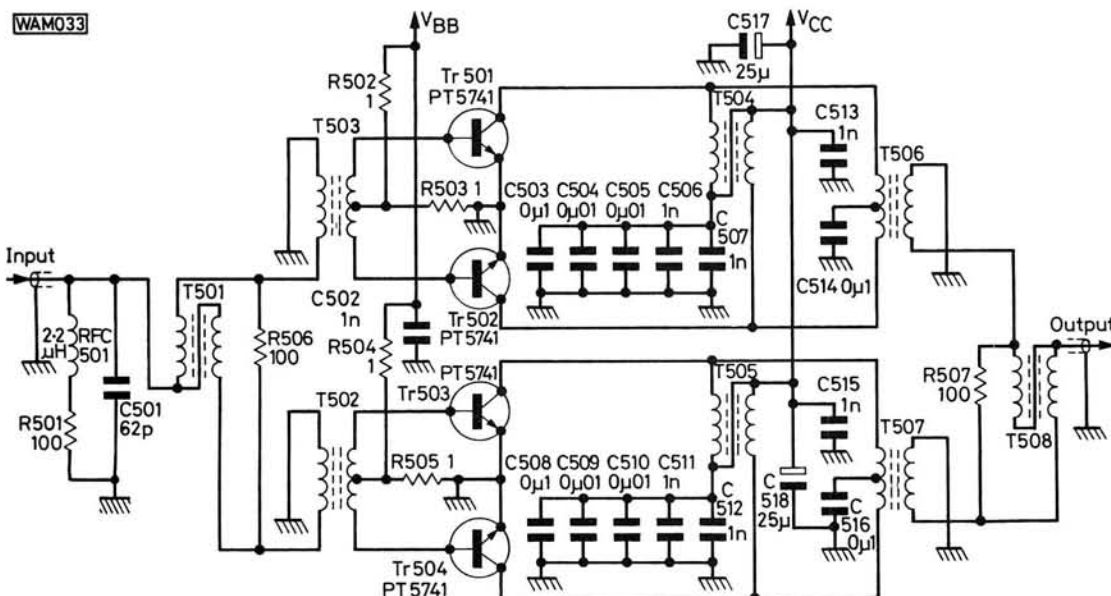


Fig. 20: Circuit diagram of the 100W p.a. used in the *PW Helford*

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. x 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

$\frac{1}{2}$ W 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. x 300mm long; Transformer end cheeks (4 sets); FB43/2401 ferrites 4.8mm i.d. x 9.7mm o.d. x 4.8mm long (84); p.c.b.; Heat-sink (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.

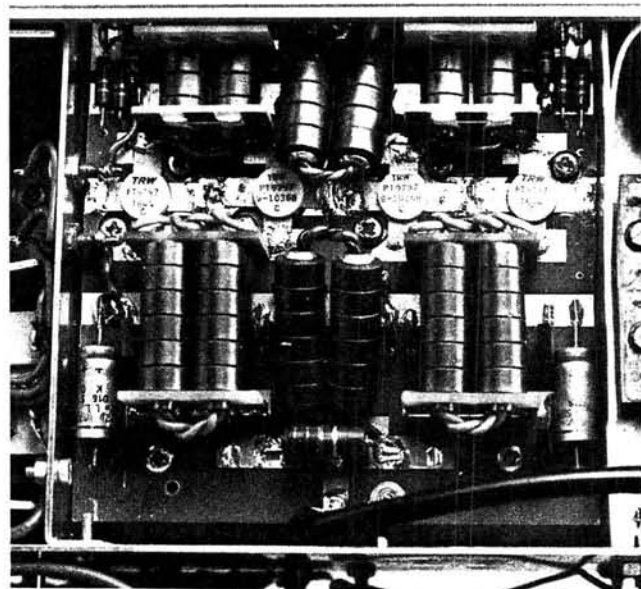
The heatsink is a larger version of that used for the driver stage. Care should be taken when mounting the transistors onto the p.c.b. and heatsink. The mounting details are the same as for the driver stage shown in Fig. 16 in Part 4.

Testing

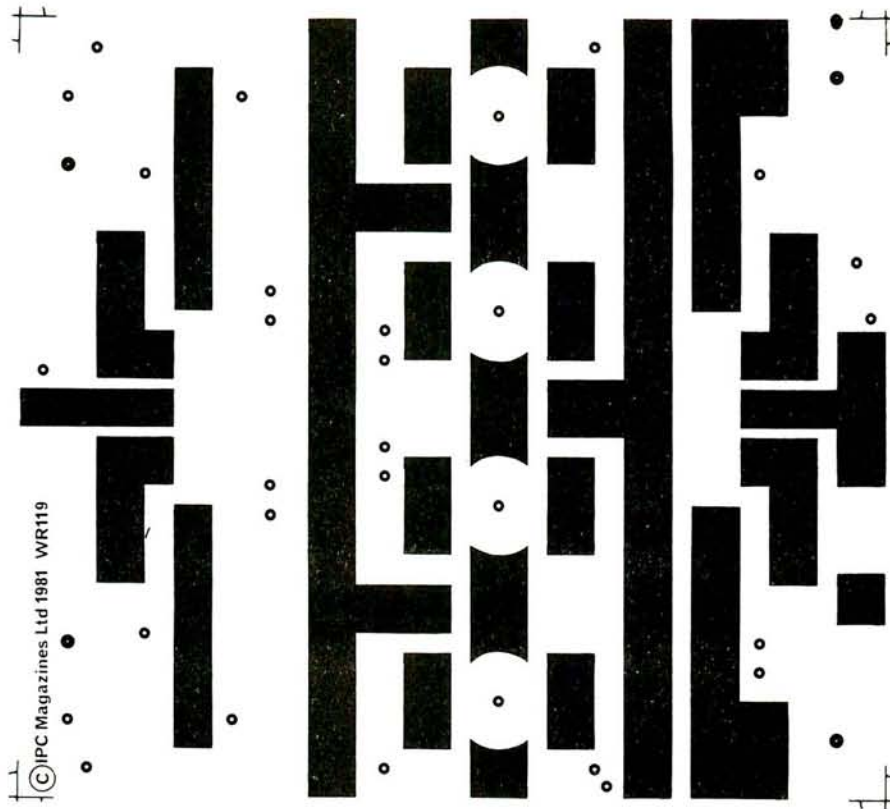
A nominal 12V d.c. supply capable of giving 16A is needed to operate the p.a. stage. With a 50Ω dummy load on the output the bias potential should be adjusted to give a quiescent current of 500mA. With full carrier insertion the current should rise to around 16A with 7A peaks under voice modulation.

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



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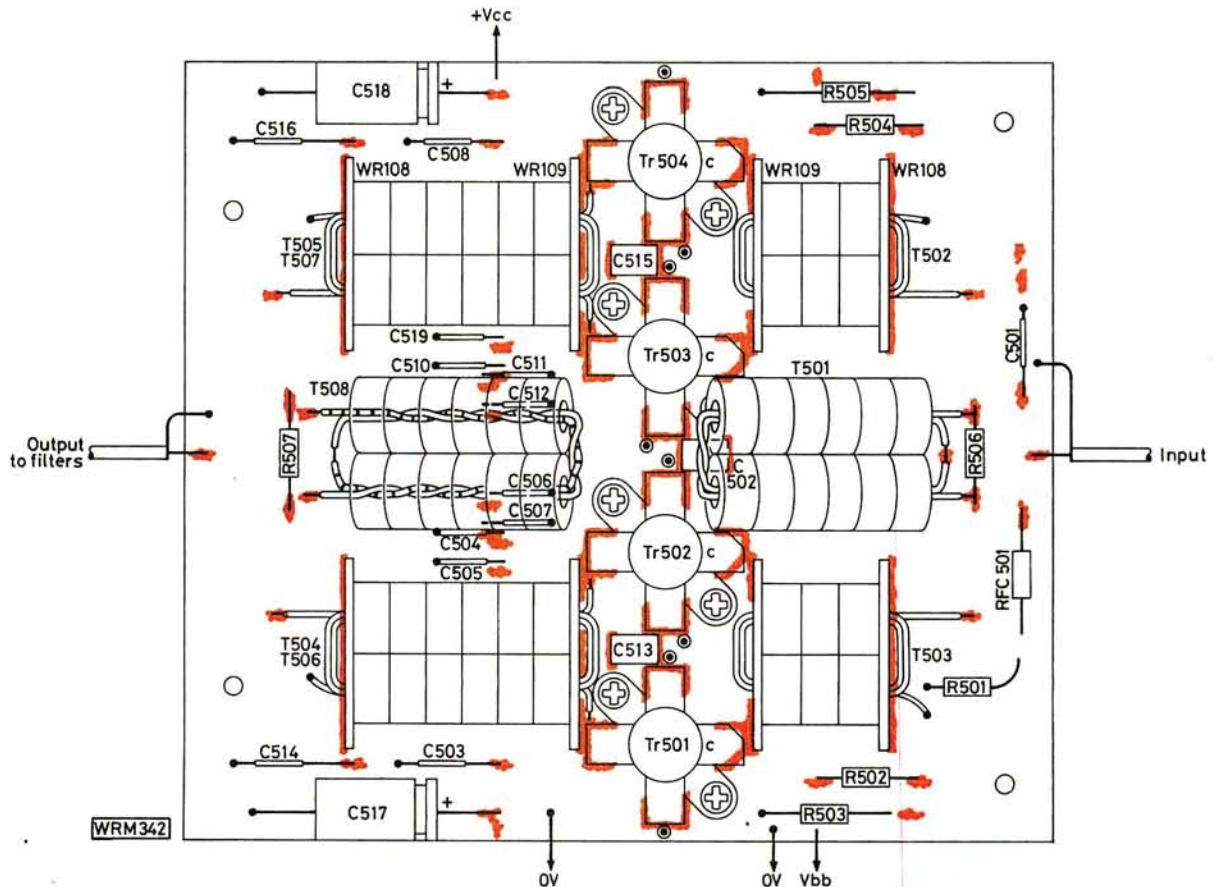


Fig. 22 (top): The copper track pattern of the 100W p.a. shown full size. This is the component side, the other side is a complete ground plane. **Fig. 23 (above):** The component placement drawing of the p.a. Note that there are eight links between the ground plane and the transistor emitter pads

Filters

In order to suppress 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

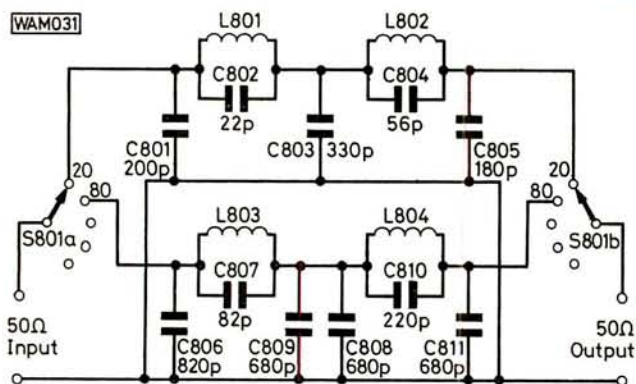


Fig. 23: Circuit diagram of the filters

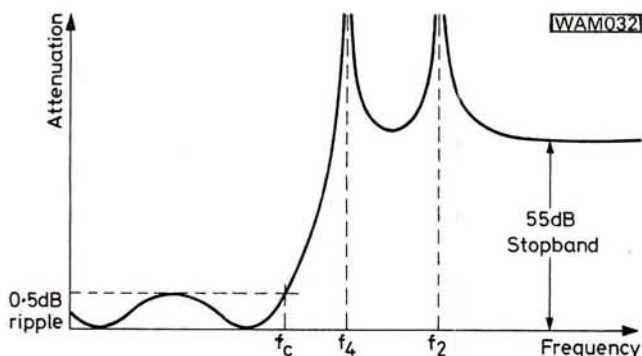


Fig. 24: The characteristics of the filter circuit

★ 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).

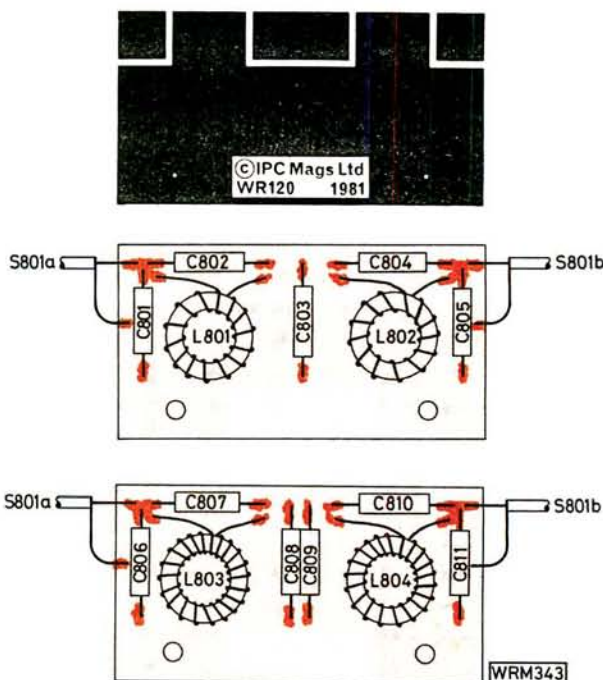
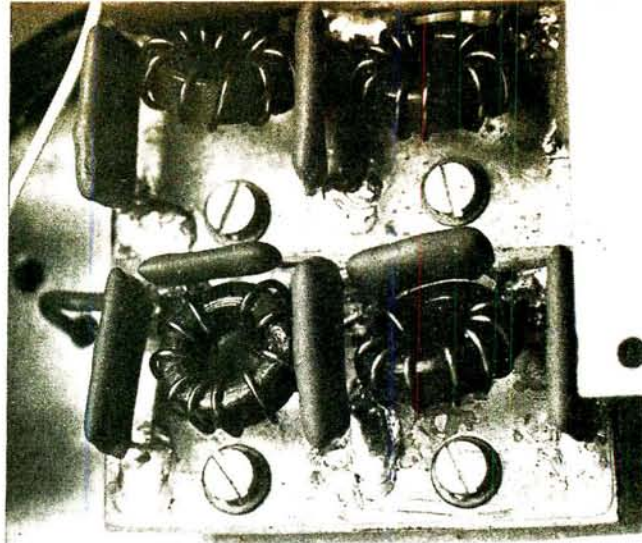


Fig. 25 (top): The copper track pattern of the filter boards shown full size. Fig. 26 (above): The component placement for the two filters

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

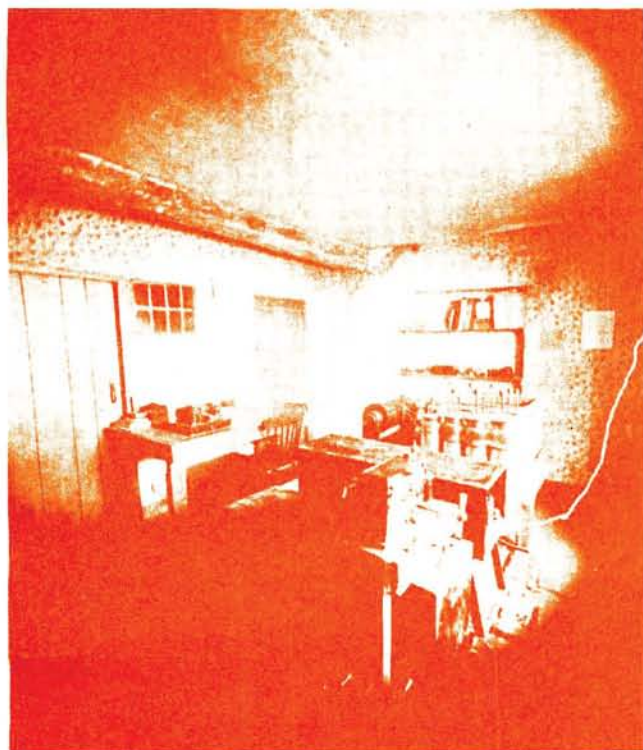
An experimental station was set up in the Needles Hotel on the Isle of Wight in November 1897. This was the first real permanent station and during the following months tests on ship-to-shore communications took place.

The ships were hired from the L & SW Railway company at Southampton, these were called *The Solent* and

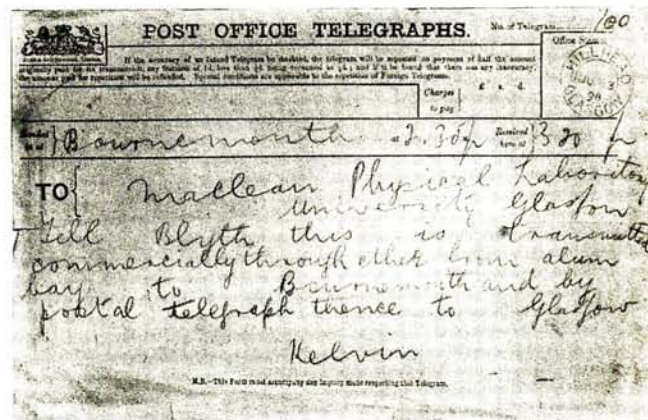
The Mayflower. These steamers sailed around Alum Bay, even during bad weather, and communications of up to 29km were achieved. It was also whilst at the Needles Hotel that communications with a station set up in the Madeira Hotel in Bournemouth were established.

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



First paid wireless telegram sent by Lord Kelvin

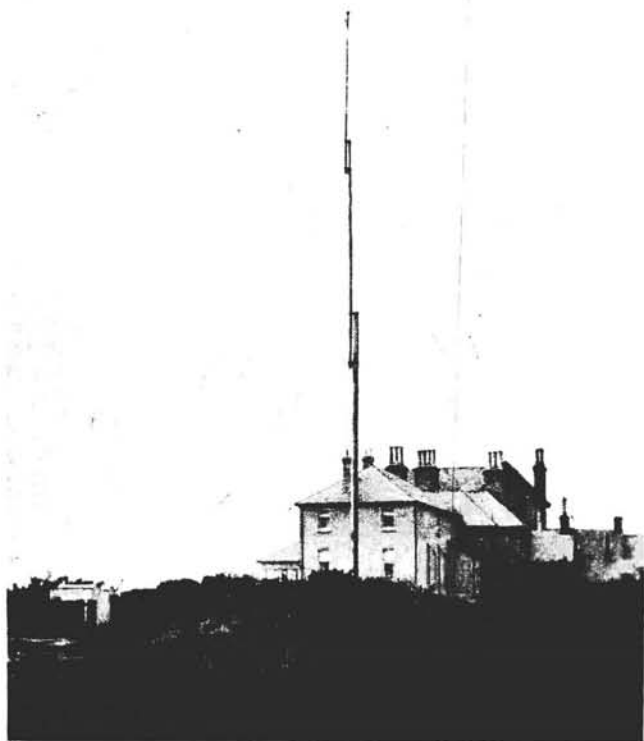
Lord Kelvin insisted on paying a shilling per message for the use of the Marconi system on all the messages he sent. Thus he established a claim for sending the first paid wireless telegram in the world. This illustrated its possibility as a commercial viability as well as his personal appreciation of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

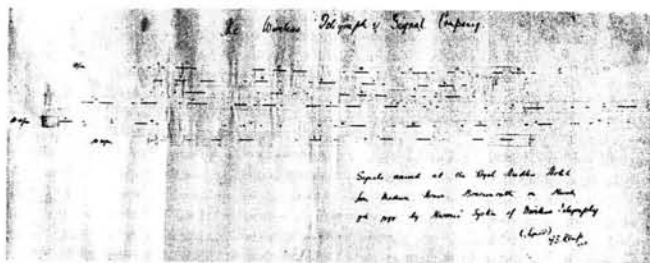
The station at the Madeira Hotel was 22km from the Needles and messages between the two stations began on 3 March 1898. In late September of that year there was some trouble with the Manager of the Madeira Hotel. There was a dispute about charges for the accommodation of the mast in the front garden 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*.

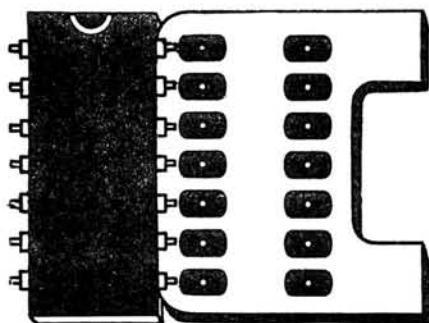
The Prince expressed his high appreciation of Marconi's system and presented him with a souvenir in the form of a scarf pin, wishing him every success with his invention.

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.

**PLEASE MENTION
PRACTICAL WIRELESS
WHEN REPLYING
TO ADVERTISEMENTS**



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 $2M\Omega$, 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 $M\Omega$) and typical input currents of $0.2nA$.

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.

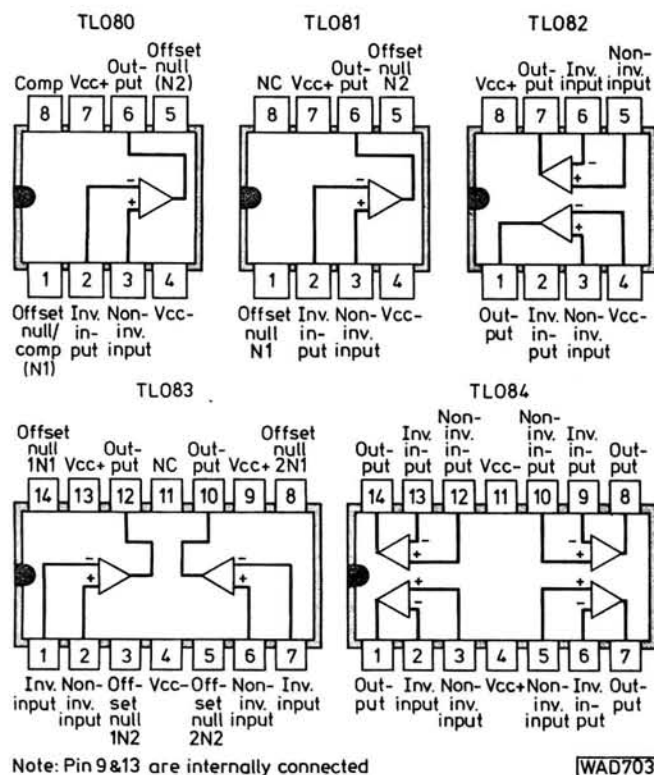


Fig. 1: TL080 series connections

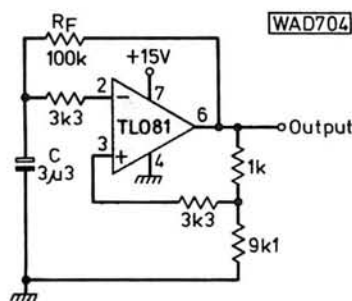


Fig. 2: Squarewave generator

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 $12\text{V}/\mu\text{s}$, which is 24 times as great as the $0.5\text{V}/\mu\text{s}$ 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.

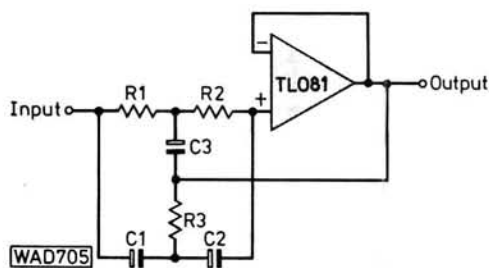


Fig. 3: High Q notch filter

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 $1/2(\pi R C)$ 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

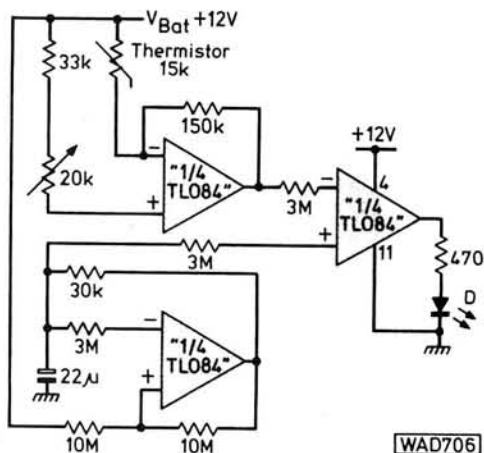


Fig. 4: Icy road warning indicator

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 = $1/2\pi R1C1$. 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

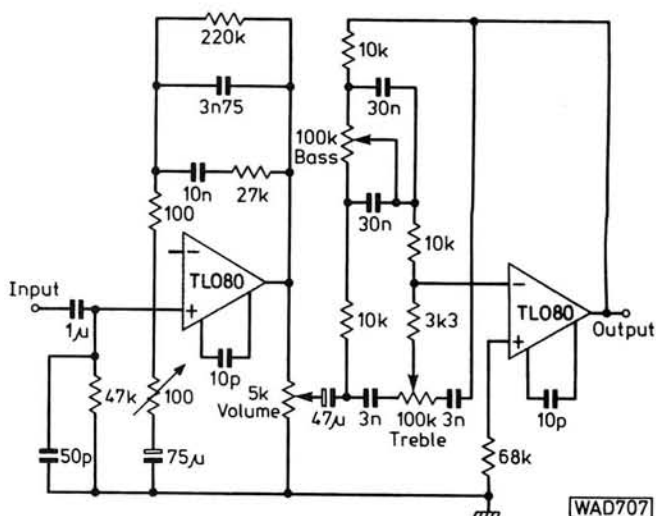


Fig. 5: Pre-amplifier with tone controls

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

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

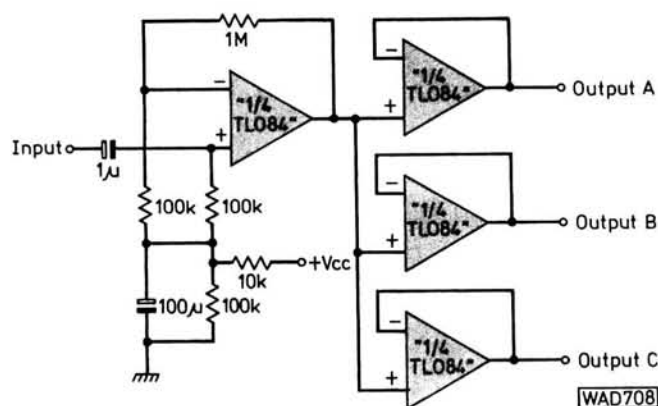


Fig. 6: Audio distribution amplifier

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.

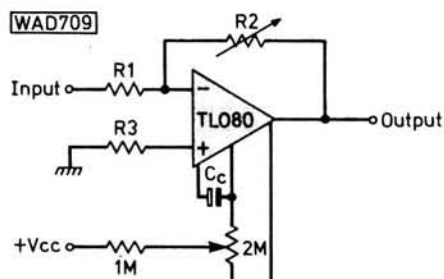


Fig. 7: A variable gain inverting amplifier

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 $2M\Omega$ potentiometer can be used to null the output voltage. The compensation capacitor C_c should not be less than $R_1/(R_1 + R_2) = 30pF$. For optimum performance R_3 should equal the value of R_1 and R_2 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.

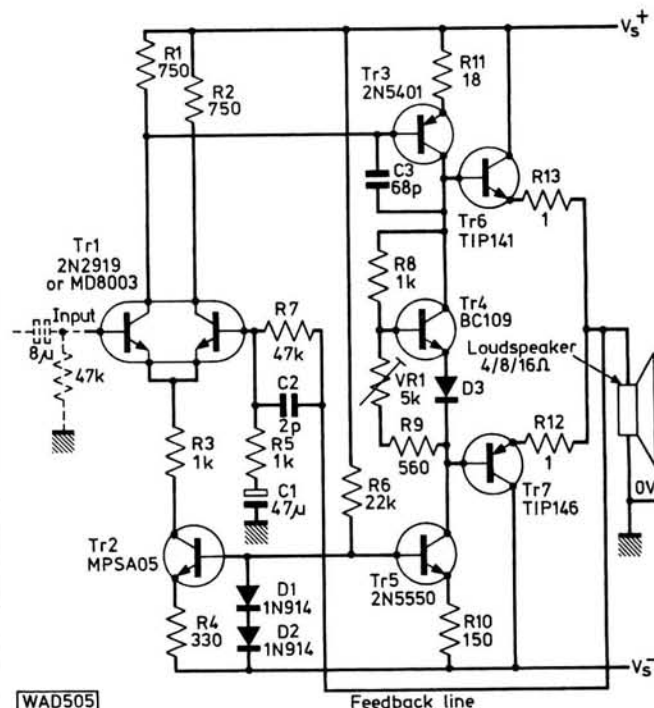


Fig. 16: Circuit of a low-distortion 30 watt amplifier

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.

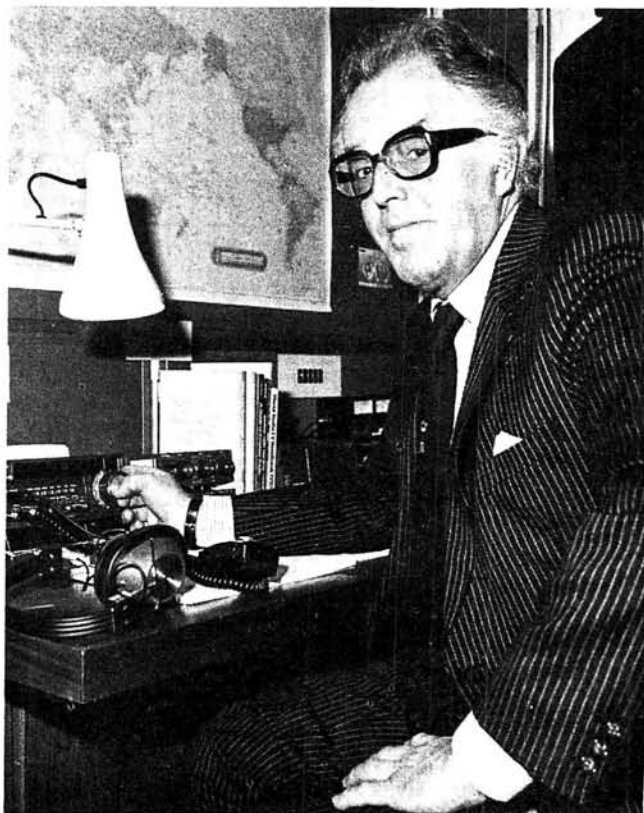
We can provide photocopies of Part 1 for any reader not having the September 1980 issue in which it appeared. Please send a large (220 x 110mm minimum) stamped addressed envelope, plus a cheque or postal order for 20p, made payable to IPC Magazines Limited.

PW at BREAD BOARD 80

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



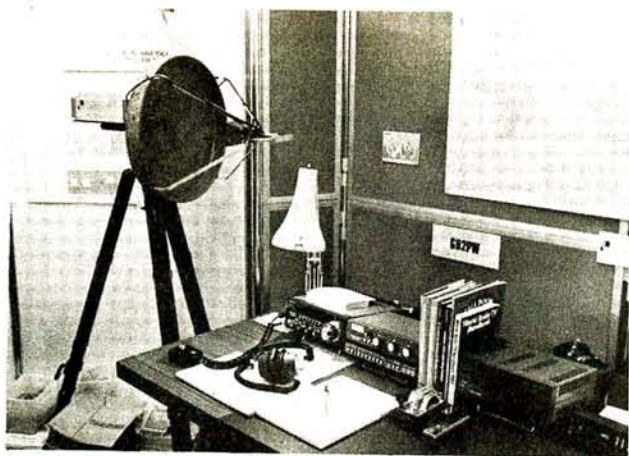
Brian Rix G2DQU on our stand on the opening day: (top) chatting to Editor Geoff Arnold G3GSR; (above) trying out the FT-707



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

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).

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

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



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)

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.

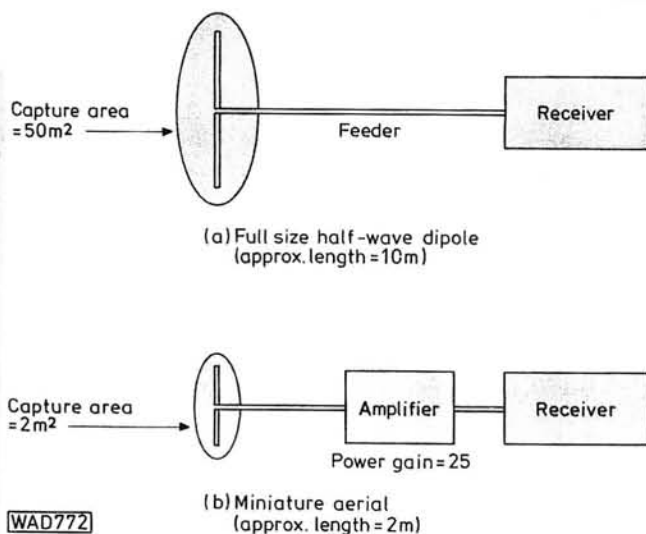


Fig. 1: Antenna systems with comparable performance at 15MHz

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:

$$\text{Capture area (half-wave dipole)} = 0.131\lambda^2$$

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

$$\text{Capture area (half-wave dipole)} = \frac{0.131 \times (300 \times 10^6)^2}{f^2} \text{ m}^2$$

$$\text{or capture area (half-wave dipole)} = \frac{1.179 \times 10^4}{f^2} \text{ m}^2$$

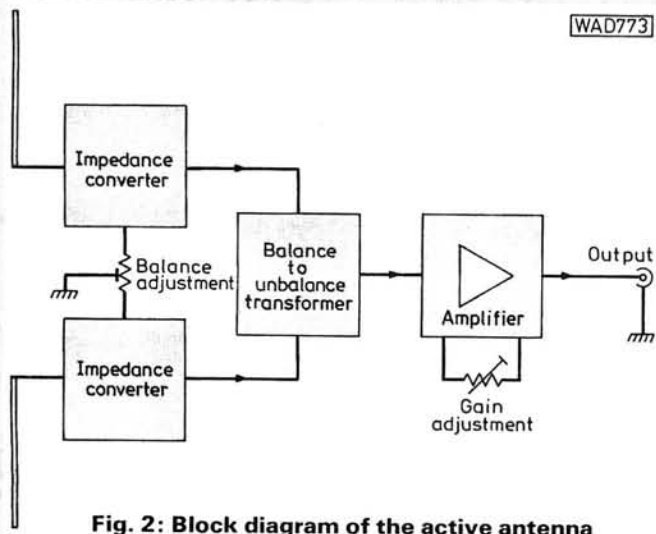


Fig. 2: Block diagram of the active antenna

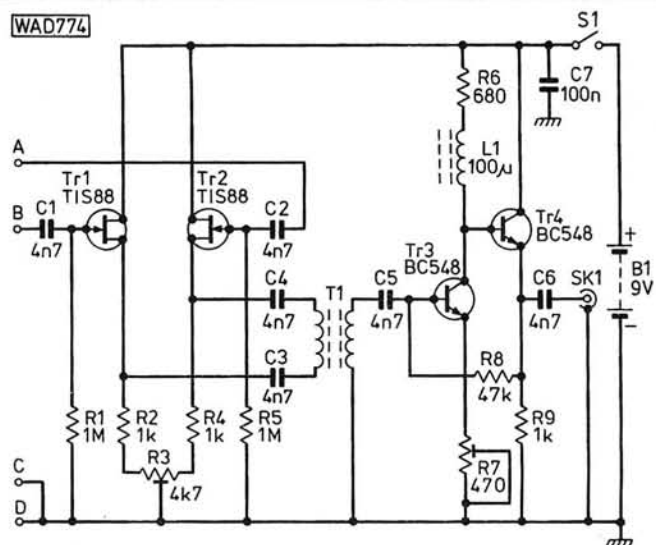


Fig. 3: Circuit diagram of the complete active antenna

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.

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

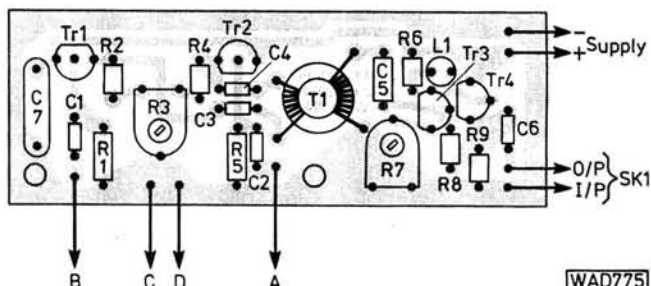
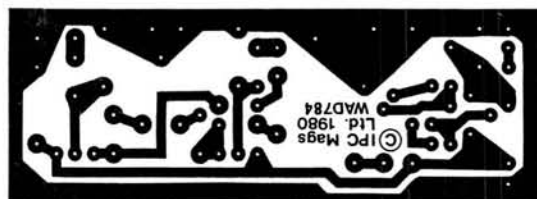


Fig. 4 (top): Full-size copper track pattern of the p.c.b. for the active antenna. Fig. 5 (above): The component placement diagram for the p.c.b. shown full size

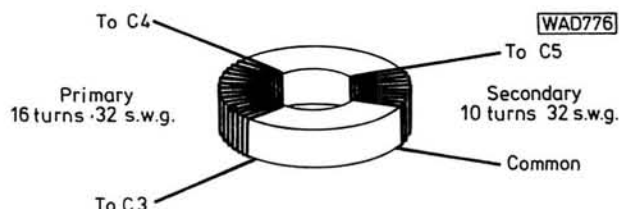


Fig. 6: Details of the toroidal coil. The windings should be secured with Denfix

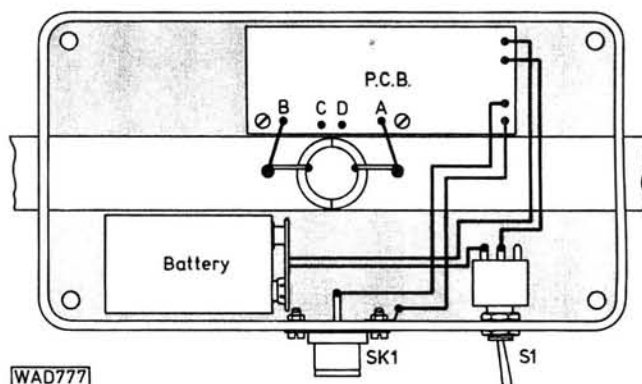
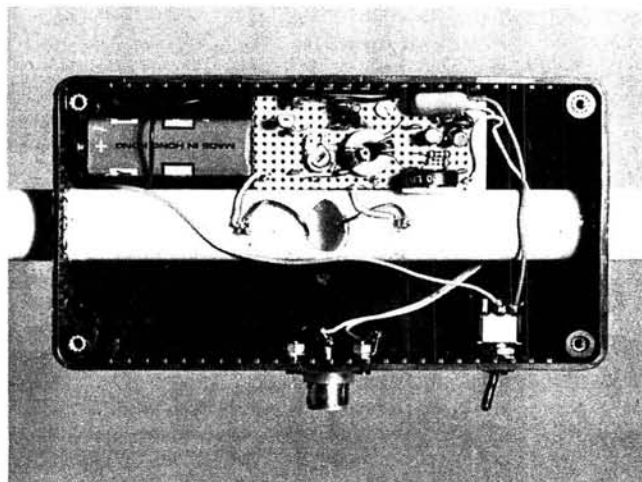


Fig. 7: Internal layout and wiring details. Note that C and D are not connected in this configuration



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

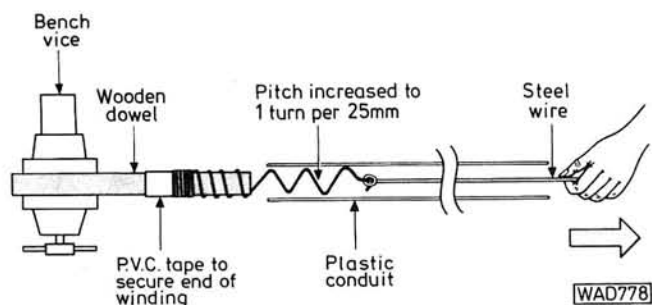


Fig. 8: Constructional method for the helical dipole elements

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

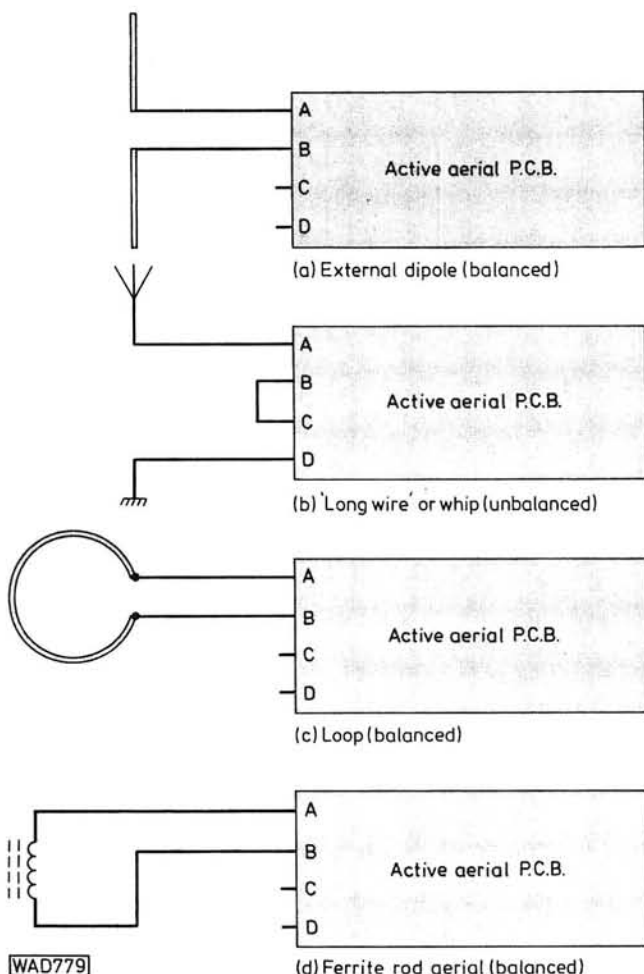


Fig. 9: Possible configurations of the active antenna

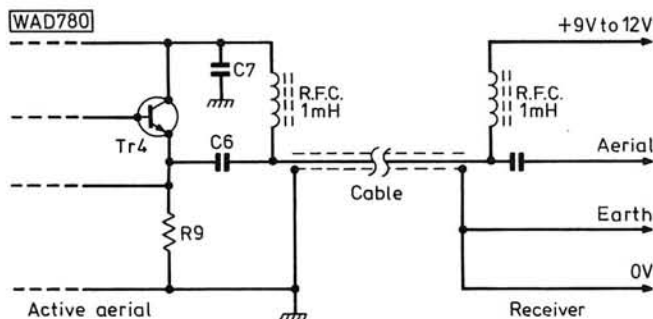


Fig. 10: Remote power feed to the active antenna

★ components

Resistors

$\frac{1}{4}$ W 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 x 80 x 50mm; Plastics conduit (Gilflex) 20mm o.d. (see text).

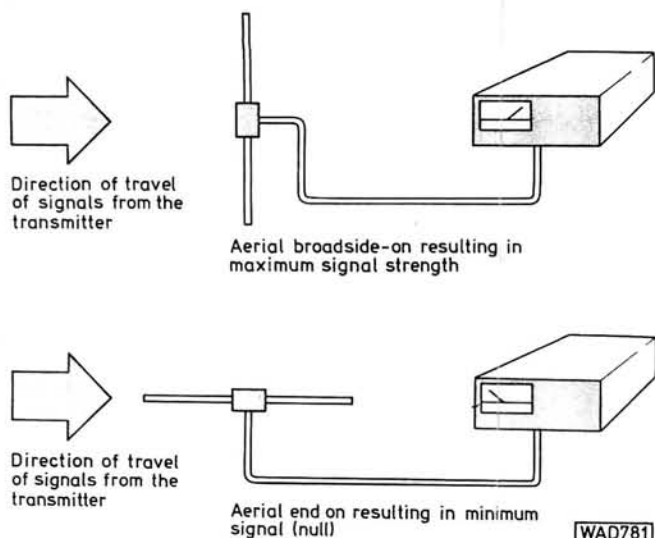


Fig. 11: Directional properties of the antenna

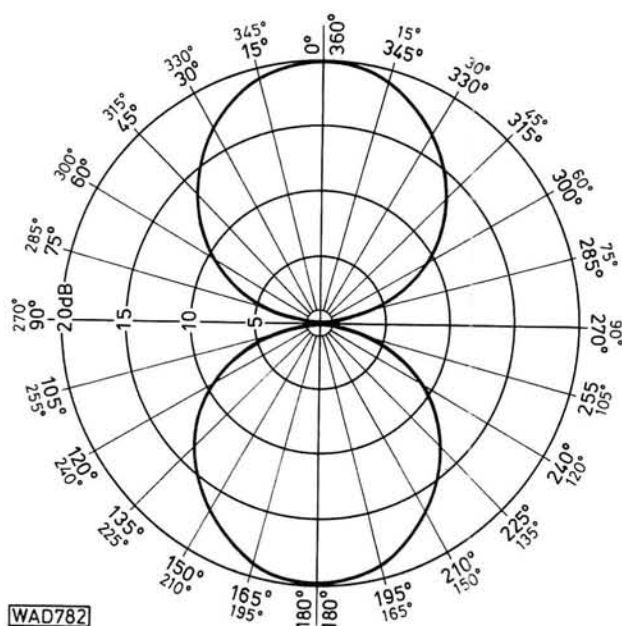


Fig. 12: Polar diagram of the active antenna at 1MHz

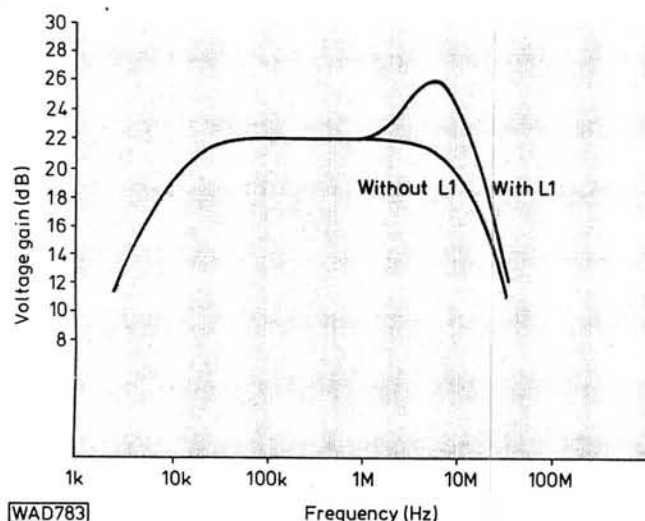


Fig. 13: Frequency response of the amplifier stage formed by Tr3 and Tr4

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 $\pm 5^\circ$ 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. ●

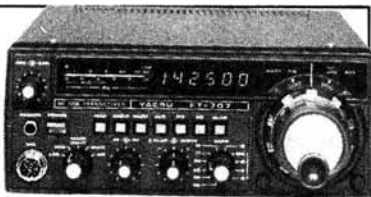
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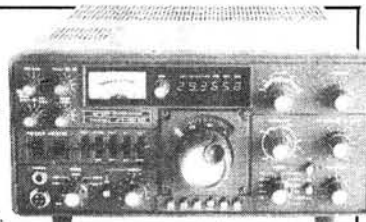
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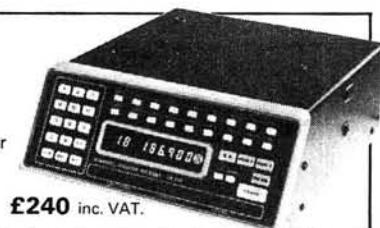


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designing with RM cores

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

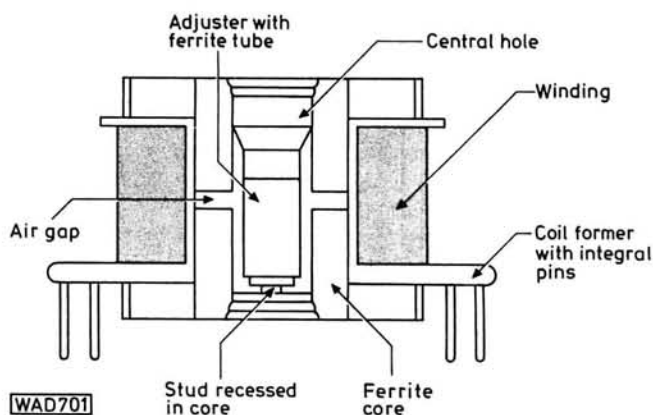


Fig. 1: Cross-section through a RM type core showing the coil winding and the adjuster

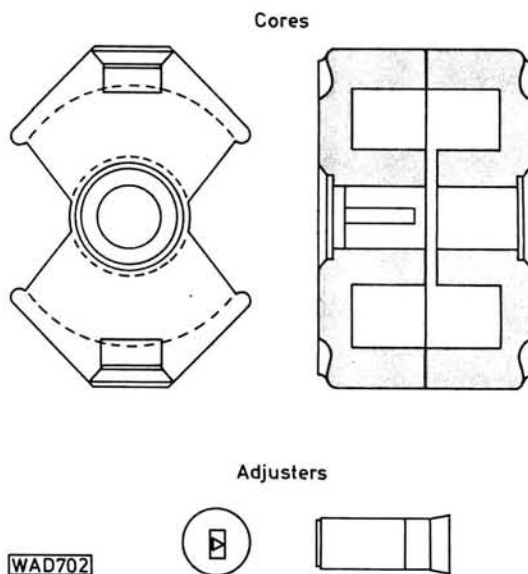
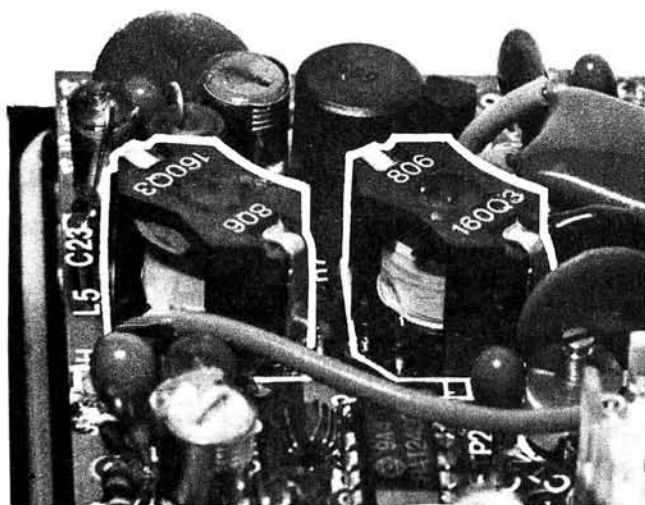


Fig. 2: The shape of the ferrite parts and the adjuster of the RM series

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.



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 100k Ω , 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 1½V single cell became a very interesting challenge. The HP7 size of battery is the ideal choice since if the amplifier is accidentally 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.

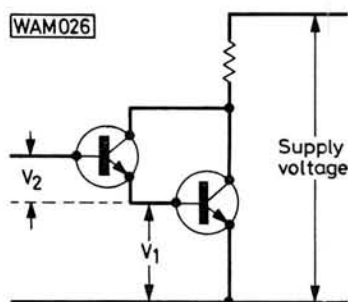


Fig. 1: Circuit diagram of a Transistor Darlington

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 *nnp* and a *pnnp* 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 *nnp-pnp-nnp* 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.

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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.

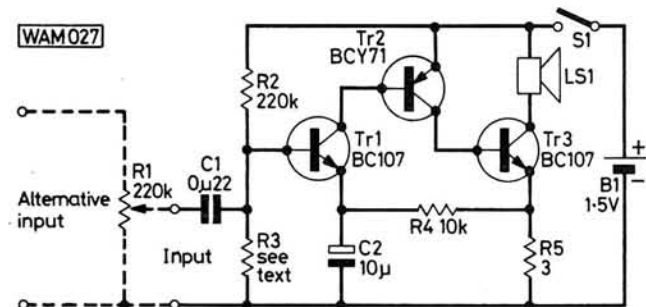


Fig. 2: Final circuit chosen for the amplifier

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

$\frac{1}{2}W$ 10%

10kΩ	1	R4
220kΩ	1	R2
330kΩ	1	R3 (see text)

$2\frac{1}{2}W$ 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; $1\frac{1}{2}V$ battery.

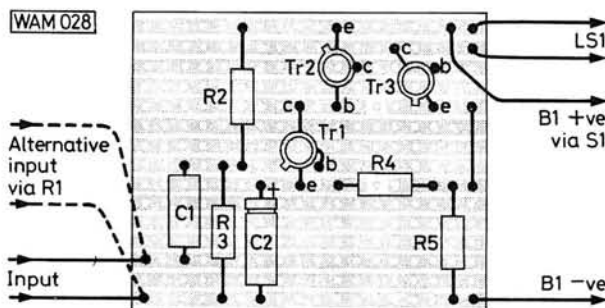
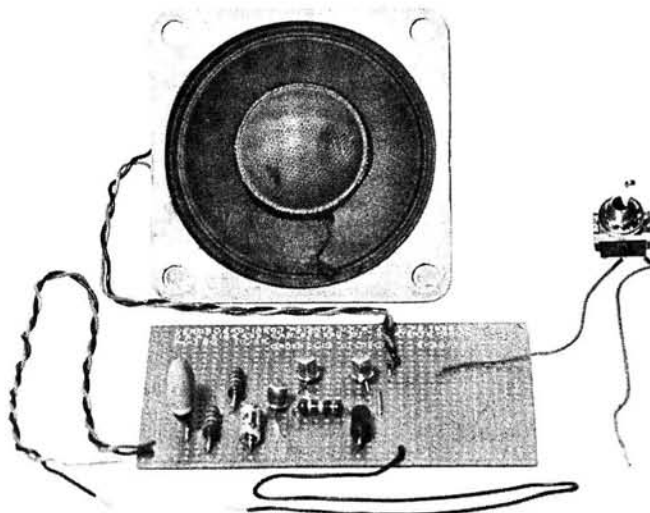


Fig. 3: Veroboard track and component layout diagram. Note the track breaks between Tr2/b and Tr3/e and under R4

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:

$$V \text{ across } R5 \times 1000\text{mA}/3$$



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

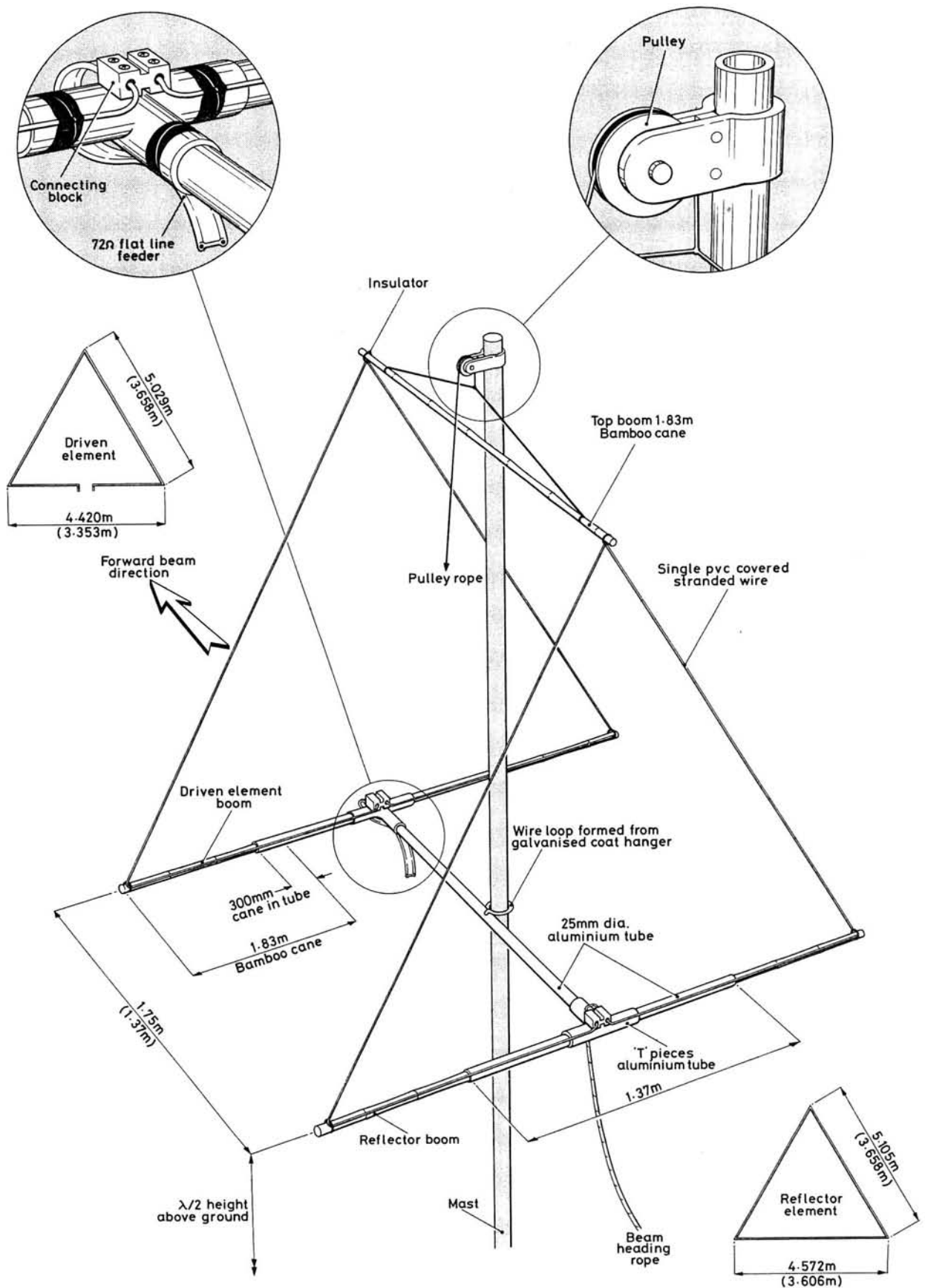


Fig. 1: Constructional details. Dimensions in brackets for 10m version

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.

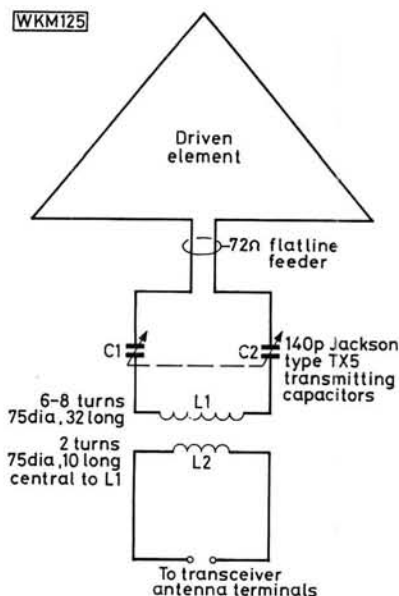


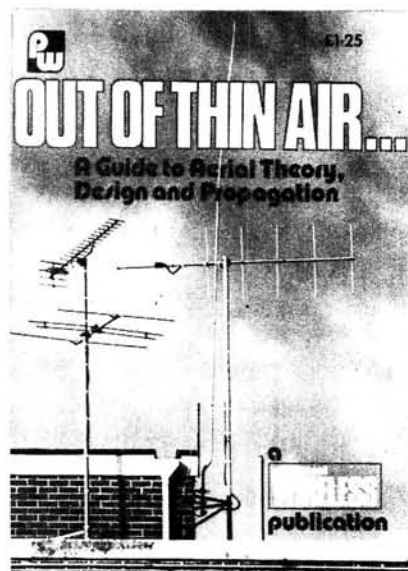
Fig. 2

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.



Aerials and aerial accessories are very definitely among the most popular topics covered in *Practical Wireless*. In response to requests from readers, we've reprinted a selection of articles from the past three years, plus two new features—one by Ron Ham on v.h.f. propagation, the other describing the "Ultra-Slim Jim", a new version of that most popular 2-metre aerial design by Fred Judd.

Out of Thin Air has 80 pages, 295 × 216mm, and is available from W. H. Smith price £1.25, or by post from Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF, price £1.50 including postage and packing to UK addresses, or £1.80 by surface mail overseas. Please ensure that your name and address are clearly legible.

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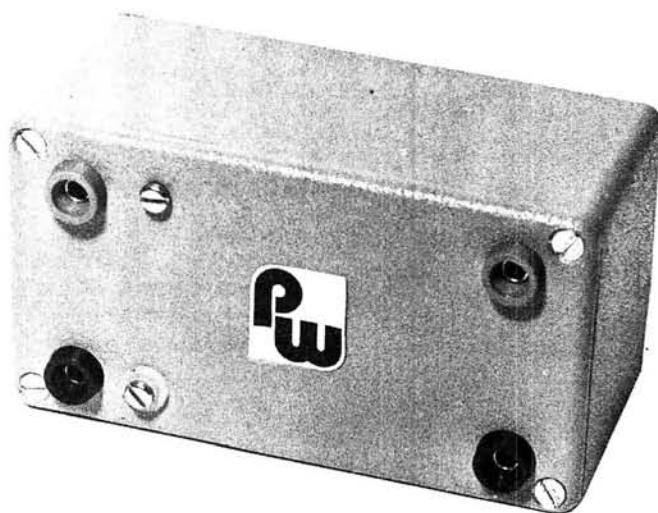
SWITCHING UP REGULATOR

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

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

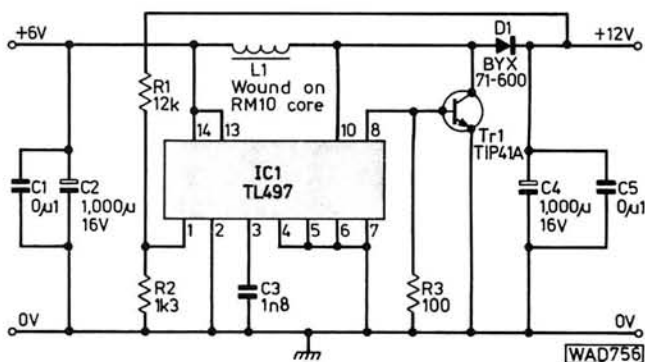
continued on page 69 ►►

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

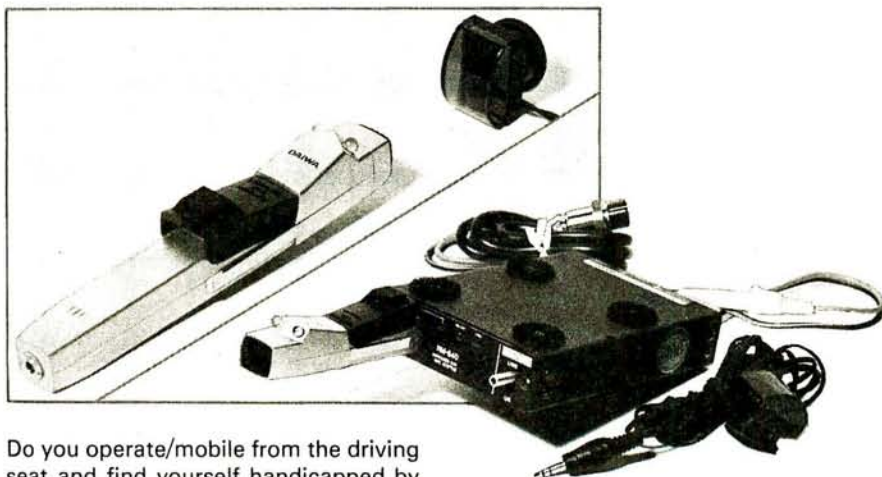


Circuit diagram of the Switching-up regulator

air test

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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. Indica-

tion 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 spurious, 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.

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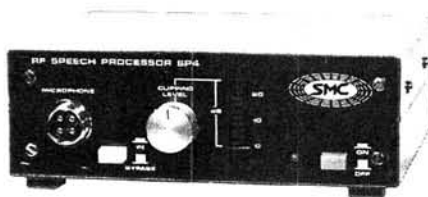
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SMC SP4 RF Speech Processor

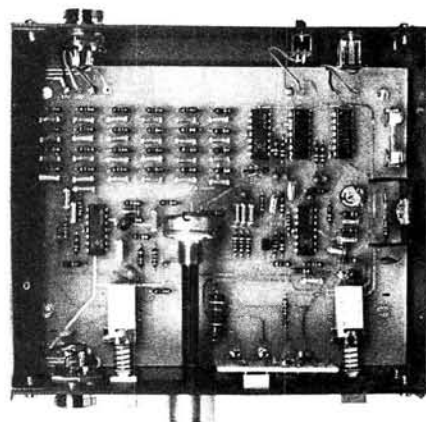
Designed and built in the UK, the SP4 Speech Processor is an aid for the serious amateur DX operator. Inserting this device between microphone and audio input socket on s.s.b. transmitters results in a substantial effective increase in "talk power".



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 i.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

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$\frac{1}{4}$ W 5% Carbon

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12kΩ	1	R1

Semiconductors

Integrated Circuits

TL497	1	IC1
-------	---	-----

Transistors

TIP41a	1	Tr1
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Capacitors

Silver Mica

1800pF	1	C3
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Polyester

0.1μF	2	C1,5
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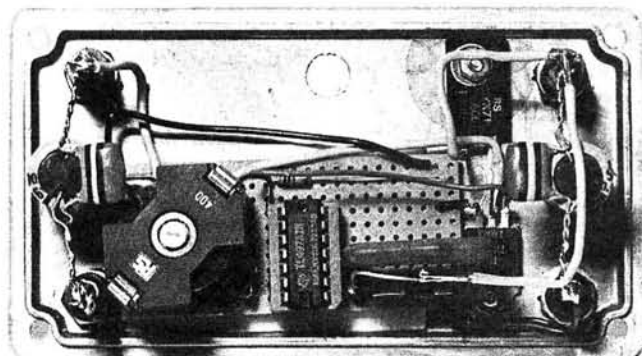
Electrolytic, p.c.b. type

1000μF 16V	2	C2,4
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Miscellaneous

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

supplied mounting hardware kit. **Do not forget to use heat-sink 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. ●

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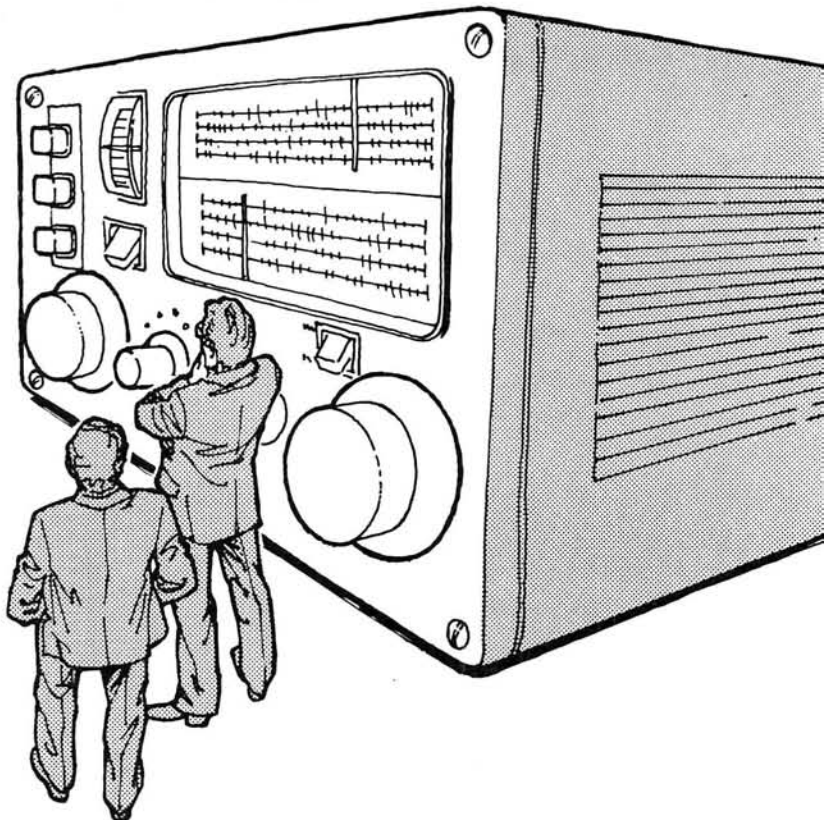
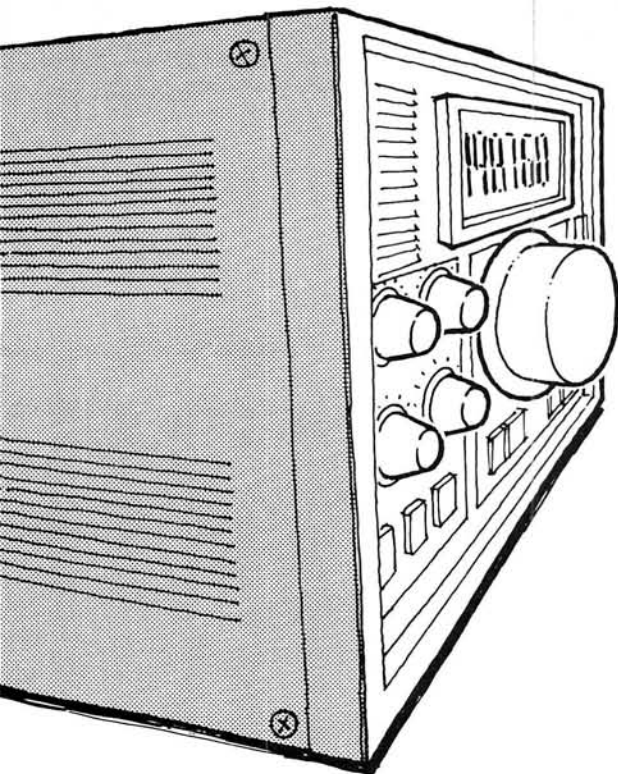


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PART 2

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 14100kHz and 14102kHz were mixed with these fundamental frequencies, to produce outputs of 14102kHz-7050kHz and 14100kHz-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 1 μ V 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 1 μ V. 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 1 μ V. Unwanted broadcast stations would be at levels of around S9 plus 40dB, which would probably be about 10mV to 15mV. 10mV is plus 80dB μ V, 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 1 μ V. 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.

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

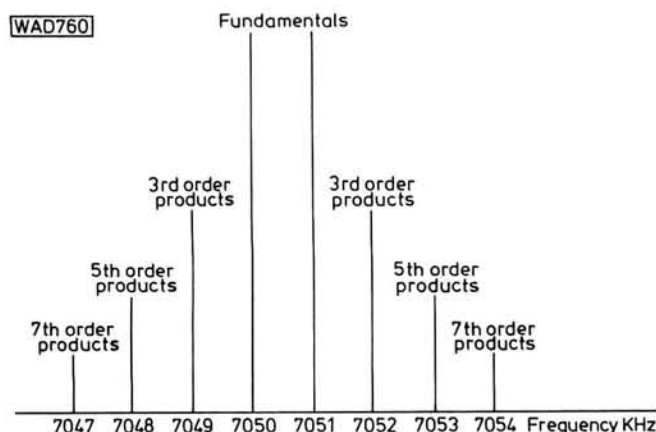


Fig. 4: Odd order Intermodulation Products on signals at 7050kHz and 7051kHz

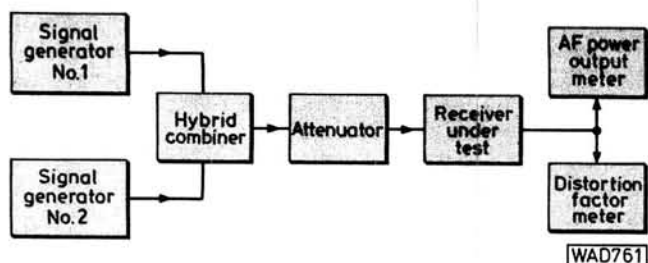


Fig. 5: Two signal test set-up. Note the attenuator—this ensures a good match for the combiner which otherwise will not function correctly. 14dB is a convenient value as most combiners lose 6dB, giving a total loss of 20dB

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-

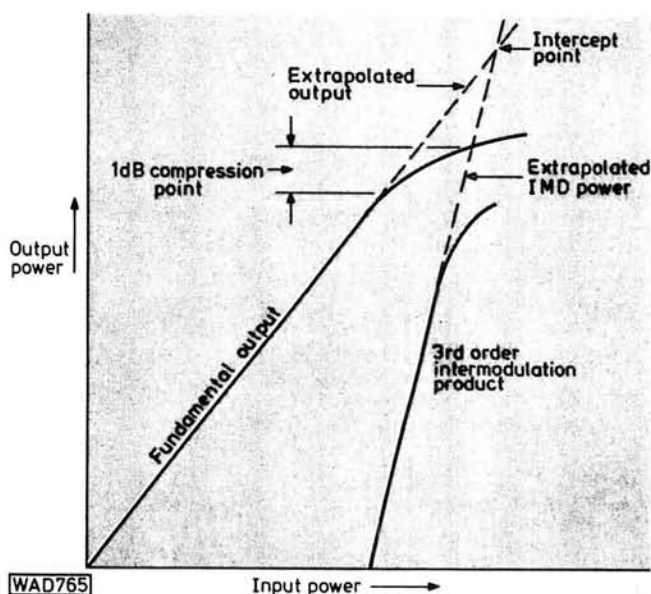
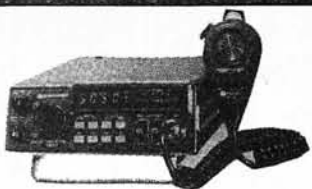


Fig. 6: Intercept and Compression points

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R4	4.0305	8.0611	12.0916	15.0000	18.1375	45.0000
R5	4.0312	8.0625	12.0937	15.0027	18.1406	45.0083
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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 $1\mu\text{V}$ 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!

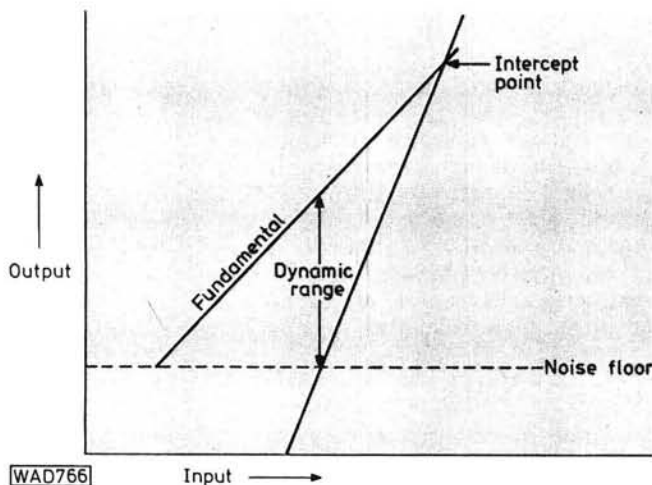


Fig. 7: Dynamic Range and Noise Floor

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 ▶▶▶

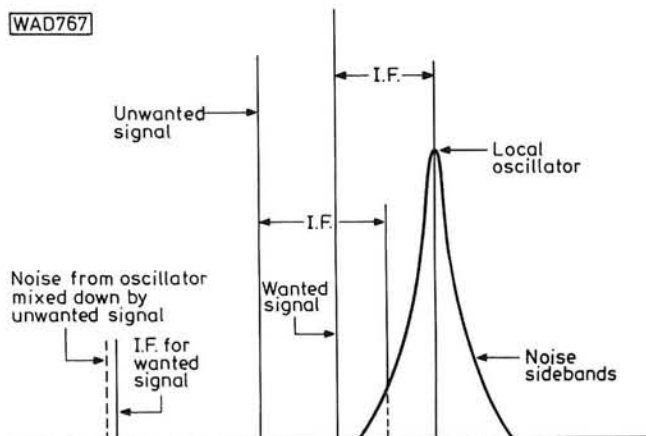


Fig. 8: Reciprocal Mixing: note the noise is phase modulated and so cannot be removed by limiting

on the air

Amateur Bands

by Eric Dowdeswell G4AR

Reports to: Eric Dowdeswell G4AR
Silver Firs, Leatherhead Road,
Ashted, 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, Bougainville, 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

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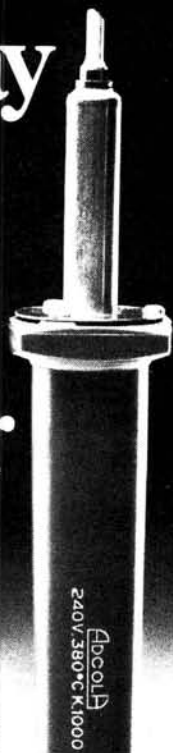
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A plea from **R. A. Weston** of 11 Darlingscote Road, Shipston-on-Stour, Warwickshire CV36 4DR, for a vibrator for his R109 receiver otherwise thought to be in good working order. I don't normally mention sets for sale in this column but feel I must 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.

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 on 15m. 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 tri-band, 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,



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!

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 Antarctic. 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, FC6FPF, 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 *VKI 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, Holmfild 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 Tele-text but try him for details of the club, at 1 Wavell Garth, Sandal Magna, Wakefield, or Wakefield 25515.

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 Claytonsmit 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

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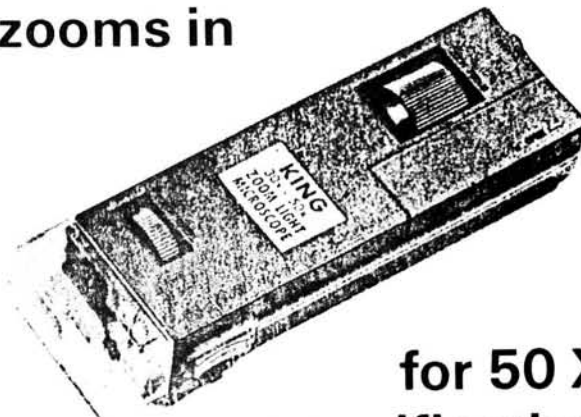
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7EW, which is in Lancs I hasten to add.

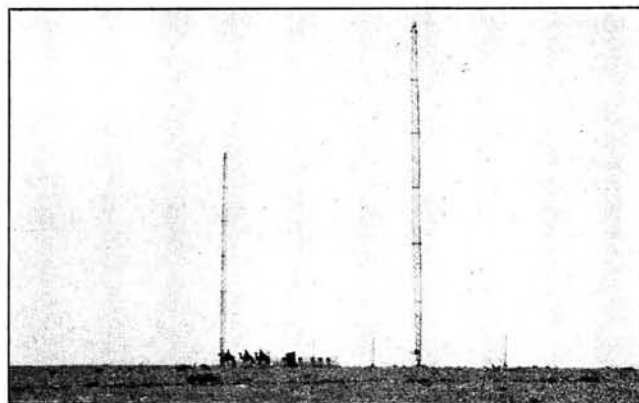
Haverhill & District ARS. Meetings Fridays 8pm at Copse Hall Farm, Bumpstead Road, Haverhill, Suffolk, with coming events including code practice on Feb 6 and 20, AGM on the 13th, and surplus gear sale on the 27th but chairman "Woody" D. C. Woodhouse G3TWX, c/o 13 Gannet Close, Haverhill, Suffolk, will be glad to assist further with details.

Bournemouth RS. Just space to tell you that they meet at the Dolphin Hotel, Holdenurst 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 Mauritania. 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.

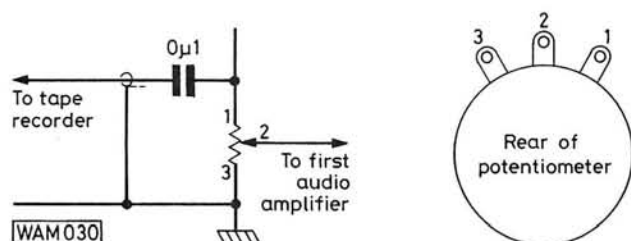


Fig. 1: Connections to a receiver volume control

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.

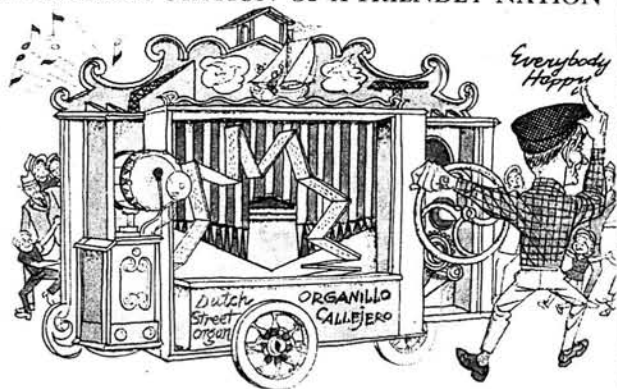
Short Wave Broadcast Bands

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

A FRIENDLY STATION OF A FRIENDLY NATION



RADIO NEDERLAND - HILVERSUM - HOLLAND

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 Penchwantan Road, Bangor, Gwynedd, LL57 2UY.

DX Party Line

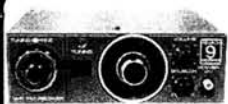
This is HCJB's programme for DXers which is on the air at 2130 on Mondays, Thursdays and Saturdays. According to the current schedule it can be heard on

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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 Sddeutscher Rundfunk 6030kHz, which come in well at his QTH dur-

ing 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.

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

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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 DLOIGI 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 DLOIGI 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 DLOIGI 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

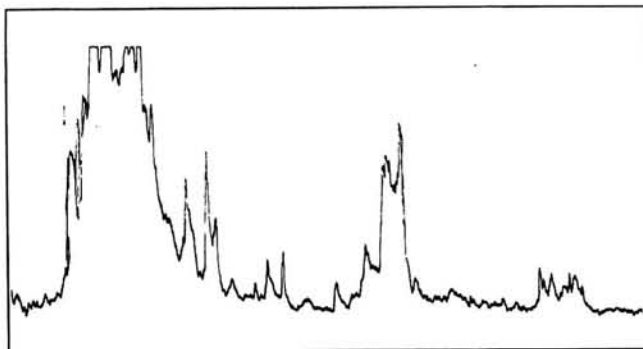


Fig. 1: A 12-minute period of solar activity recorded by the author at midday on 14 November 1980

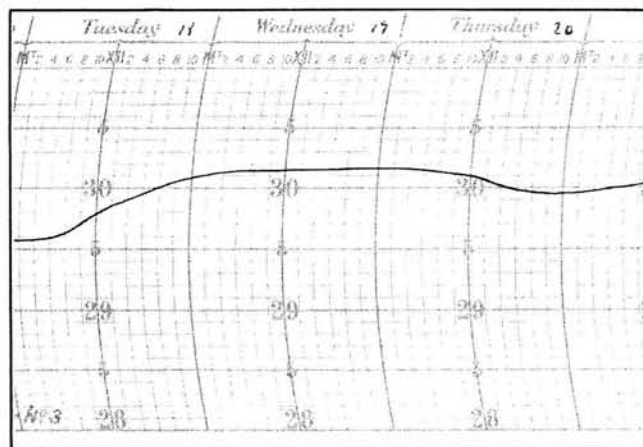


Fig. 2: The period of atmospheric pressure variations responsible for the tropospheric opening during the afternoon on November 20

meteor pings per minute from GB3SIX at 539. I hope to hear more about this Barry.

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. 1A 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 mast-head 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

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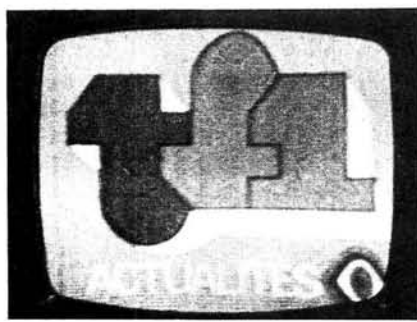


Fig. 1: Pictures received from French Television by Paul Farrugia in Cardiff on 3 October 1980. The first two are from TDF TF1, and the third is from Antenne 2

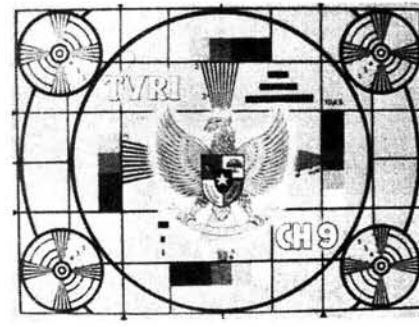
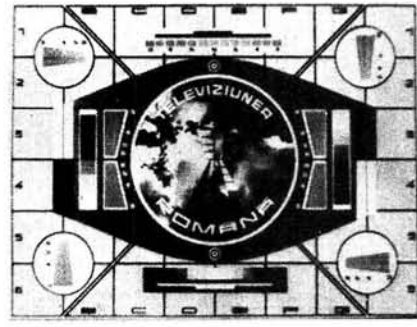
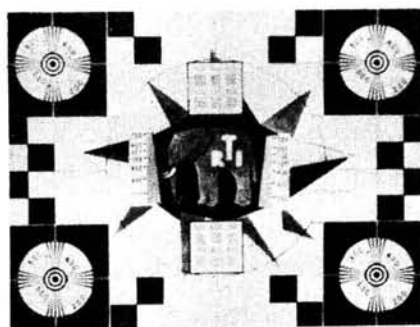


Fig. 2: Test cards from the Ivory Coast, from Rumania and from Indonesia

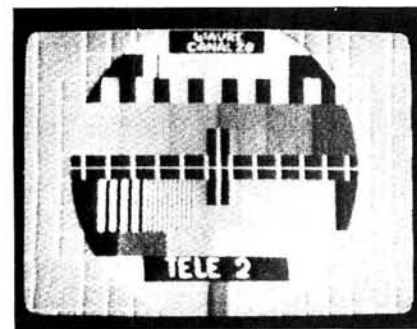


Fig. 3 (far left): A clock caption from Poland, received by Keith Hamer. **Fig. 4 (left):** A test card from Belgium, received by Garry Smith

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 rabbitied 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 $\frac{1}{2}\mu\text{V}$ 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 $1\mu\text{V}$ e.m.f. ($0.5\mu\text{V}$ 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 $1\mu\text{V}$ 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. ●



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New Profile Amplifiers - Two New Series

MOSFET

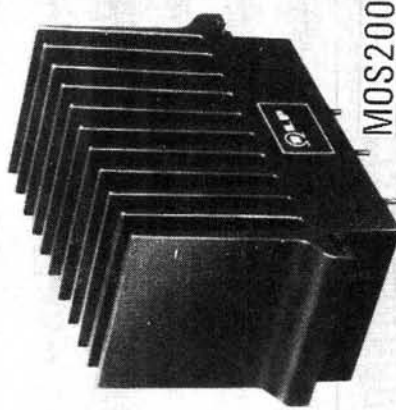
CHOOSE AN I.L.P. MOSFET POWER AMP when it is advantageous to have a faster slew rate, lower distortion at higher frequencies, enhanced thermal stability, the ability to work with complex loads without difficulty and complete absence of cross-over distortion. I.L.P.'s exclusive encapsulation technique 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

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

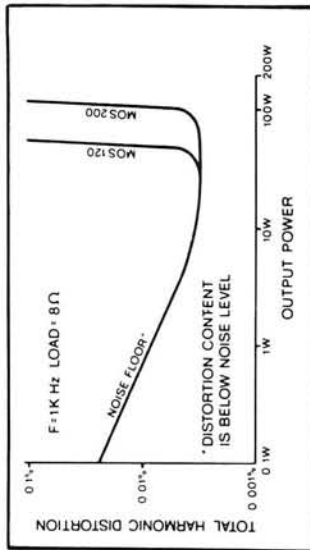


MOS200

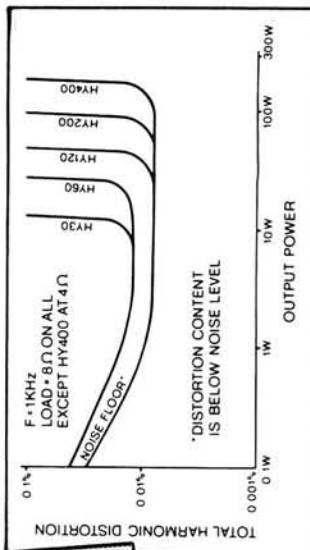


HY60

I.L.P. POWER AMPS ARE ENCAPSULATED FOR THERMAL STABILITY AND LONGER LIFE



Load impedance both models 4Ω-∞ Input sensitivity both models 500mV
Frequency response both models 15Hz-100KHz-3dB



Load impedance all models 4Ω-∞ Input impedance all models 100KΩ
Input sensitivity all models 500mV Frequency response all models 15Hz-50KHz-3dB



THE NEW PROFILE EXTRUSIONS

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HY6 (mono) and HY66 (stereo) are new to I.L.P.'s range of advanced audio modules. Their improved characteristics and styling ensure their being compatible with all I.L.P. power-amps both MOSFET and BIPOLAR, giving you chance to get the best possible reproduction from your equipment. HY6 and HY66 pre-amps are protected against short circuit and wrong polarity. Full assembly instructions are provided. Mounting boards are available as below.

Sizes - HY6 - 45 x 20 x 40 mm. HY66 - 90 x 20 x 40 mm. Active Tone Control circuits provide ± 12 dB cut and boost. Inputs Sensitivity - Mag. PU - 3mV; Mic - selectable 1-12mV; All others 100mV. Tape O/P - 100mV; Main O/P - 500mV; Frequency response - D.C. to 100KHz - 3dB.

HY6 mono £6.44 + 97p VAT Connectors included
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B6 Mounting Board for one HY6 78p + 12p VAT
B66 Mounting Board for one HY66 99p + 15p VAT

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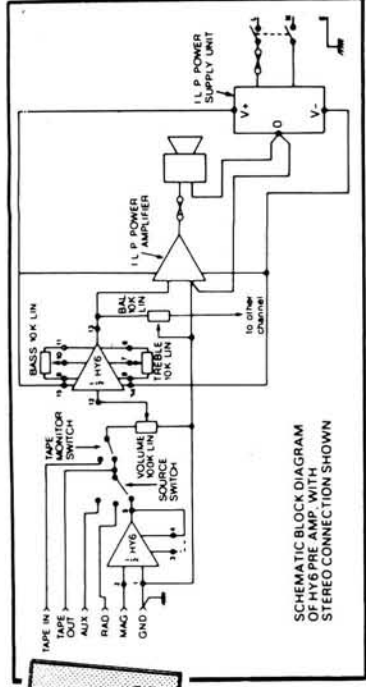
- PSU30 ± 15 V at 100mA to drive up to 12 x HY6 or 6 x HY66 £4.50 + 0.68p VAT
- THE FOLLOWING WILL ALSO DRIVE I.L.P. PRE-AMPS
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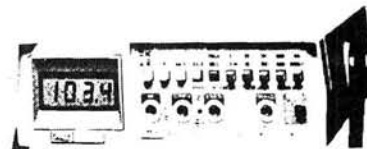
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Practical Wireless, March 1981

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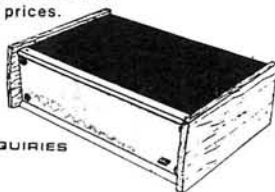
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B12-02 Mono Record/Playback.....	£2.02	C42RPS18 Stereo TWIN GAP R/P.....	£25.21
B24-01 Stereo Playback.....	£3.30	E12-09 Mono/stereo erase.....	£ 1.85
B24-02 Stereo Record/Playback.....	£6.66	B22-02 Twin 1/2 track R/P.....	£ 5.87
B24-07 Stereo R/P, (Delby Stem).....	£7.87	C44RPH03 Quad 1/4 track R/P.....	£13.17
C42RPH20 Stereo SENDUST R/P.....	£9.28	C44RPS01 Quad 1/4 track combined R/P + Erase.....	£26.45
C42RPS01 Stereo combined R/P + Erase.....	£10.93	C22ES02 Twin half track erase.....	£ 4.72

SEND FOR OUR TAPE HEAD CATALOGUE 50p

MONOLITH

THE MONOLITH ELECTRONICS CO. LTD.
5/7 CHURCH ST., CREWKERNE, SOMERSET, ENGLAND. (0450) 74321

PLEASE ENCLOSE 30p P&P WITH ORDER
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
10-7805	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.

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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)

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(near W. Hampstead Jubilee and British Rail Stations).

TRANSFORMERS +VAT 15%

30 VOLT RANGE (Split Sec)
Sec Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V or 15V-0-15V.

Ref.	30V 15V	Price	P & P
102	5	2.90	0.90
79	1	3.93	1.10
3	2	6.35	1.10
20	3	7.39	1.31
21	4	8.79	1.31
51	5	10.00	1.52
117	6	12.29	1.67
88	8	16.45	1.89
89	10	18.98	1.89
90	12	21.09	2.24
91	15	24.18	2.39
92	20	32.40	O.A.

50 VOLT RANGE (Split Sec)
Sec 50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 23, 30, 40 or 20V-0-20V or 25V-0-25V.

Ref.	50V 25V	Price	P & P
102	5	3.75	0.90
103	7	4.57	1.10
104	8	7.88	1.31
105	10	9.42	1.52
106	12	12.82	1.73
107	15	16.37	1.89
118	16	22.29	2.39
119	20	27.48	O.A.
109	12	32.88	O.A.

MAINS ISOLATORS (SCREENED)
0-120; 0-100-120V (120, 220, 240V) Sec 60-55-0-55-60 twice to give 55, 60, 110, 115, 120, 125, 175, 180, 220, 225, 230, 235, 240.

Ref.	VA	Price	P & P
*07	0.1	4.84	0.91
149	60	7.37	1.10
150	100	8.38	1.31
151	200	12.28	1.31
152	250	14.61	1.73
153	350	19.07	2.12
154	500	22.52	2.47
155	750	32.03	O.A.
156	1000	40.92	O.A.
157	1500	56.52	O.A.
158	2000	67.99	O.A.
159	3000	95.33	O.A.

*Pn 0-220-240V Sec 115 or 240V State sec. volts required

CASED AUTO TRANSFORMERS
240V cable in 115V USA flat pin outlet

VA	Price	Ref.
20	6.55	1.03
75	8.50	1.31
150	11.00	1.31
250	13.39	1.67
500	20.13	1.89
1K	30.67	2.65
1500VA	42.82	O.A.

voltages stated are on full load

Continuous Ratings

60 VOLT RANGE (Split Sec)
Pn 220/240V sec 0-24-30-40-48-60V. Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V or 30V-0-30V.

Ref.	60V 30V	Price	P & P
124	5	4.27	1.10
126	1	6.50	1.10
127	2	8.36	1.31
125	3	12.10	1.31
123	4	13.77	2.12
40	5	17.41	1.89
120	8	19.87	2.12
121	10	27.92	O.A.
122	12	32.51	O.A.
189	12	24	O.A.

12 OR 24V OR 12-0-12V
Pn 220 240 volts

Ref.	12V	24V	Price	P & P
113	0.5	0.25	2.42	0.52
211	1	0.5	2.90	0.90
71	2	1	3.86	0.90
115	2	10	15.37	2.39
85	0.5	2.5	6.16	1.10
70	6	3	6.99	1.10
108	8	4	8.16	1.31
72	10	5	8.93	1.31
116	12	6	9.89	1.52
117	16	8	11.79	1.52
118	20	10	15.37	2.39
187	30	15	19.72	2.39
226	60	30	40.41	O.A.

SCREENED MINIATURES

Ref.	mA	Volts	Price	P & P
238	200	3-0-3	2.83	0.63
212	1A	1A 0-0-6	3.14	0.90
13	100	0-9-9	2.35	0.44
235	300	0-9-9	2.19	0.44
207	500	0-9-9	3.05	0.85
208	1A	1A 0-9-9	3.88	0.90
236	200	0-15-0	2.19	0.44
214	300	0-20-0	3.08	0.90
221	700 (DC)	20-12-0-12-20	3.75	0.90
206	1A	1A 0-15-0-15-20	5.09	1.10
203	500, 500	0-15-27-0-15-27	4.39	1.10
204	1A, 1A	0-15-27-0-15-27	6.54	1.10
239	50	12-0-12	2.88	0.37

Send 20p stamps for Catalogue. Prices correct 1/12/80.

AUTO TRANSFORMERS
Voltages available: 105, 115, 190, 200, 210, 220, 230, 240, for step up and step down.

Ref.	VA	Price	P & P
113*	15	2.73	0.81
64	80	4.41	1.10
4	150	5.89	1.10
53	350	10.08	1.31
67	500	12.09	1.91
84	1000	20.64	2.39
93	1500	25.61	O.A.
95	2000	35.31	O.A.
73	3000	68.13	O.A.
80S	4000	84.55	O.A.
57S	5000	98.45	O.A.

*0.115, 220, 240.

END OF LINE OFFERS
B7-0-110-120-240V. Sec 20V 1A £1.80 P & P 66p

M616 - 0-240V. Screen 11 13-0-13 1A, 21 12V 150mA £1.50 60p

M708 - 6k to 30k matching trans. 5 watt £90 40p
M679 - 240V, 36V 1.6A £3.00 78p
M865 - 100V Line to 4 10V watts £1.90 60p

M1020 - 0-240V 12-0-12V = 50mA 75p 30p
M1126 - 120/240V: 9-0-9V = 1A £1.79 71p

15V RANGE 0-C Tap (7.5-0-7.5V)

Ref.	500mA	Price	P & P
171	1A	2.30	0.52
172	1A	3.26	0.90
173	2A	3.95	0.90
174	3A	4.13	0.99
175	4A	6.30	1.10

NEW RANGE TRANSFORMERS
2 windings 0-36V-48V/36V-0-36V 48V-0-48V 72V or 96V.

Amps	Ref.	Price	P & P
1	430	4.88	0.76
1	431	8.12	0.99
2	432	13.35	1.31
3	433	16.17	1.40
4	434	20.65	2.11
5	435	29.30	2.47
6	436	36.69	O.A.
8	437	40.03	O.A.

Split Bobbin Type
0-12-15-20-24-30V
Ref 009 1 Amp £2.98 P & P £1 10
Ref 010 2 Amp £4.62 P & P £1 10

OTHER ITEMS AVAILABLE

AVO TEST METERS

Model	Price
AVO 8 MK5. Latest Model	£106.40
AVO 71	£43.10
AVO 73	£58.60
AVO MM5 minor	£36.90
AVO Wee Megger	£87.00
AVO T1169 in circuit transfer tester	£45.00
AVO EM272 316K - Volts	£63.40
AVO DA116 Digital	£108.90
AVO BM7 Megger	£58.60
AVO Clamp Meter to 300A	£59.10

All Avo's Meggers and accessories available.
P & P £1.32 VAT 15%

EDUCATIONAL METERS (Moving Coil)
0-10A, 0-15V, 0-30V. Freestanding large scale easily read meters with top screw terminals for quick connections.
£4.50 P & P 66p + VAT. Size 75x78mm scale.

Antex Soldering Irons 15W & 25W £4.58
each. Safety Stand £1.75 P & P 52p each

P.W. Purbeck oscilloscope transformer 250-0-250: 6 3V: 12 9V £8.42 £1-04
(author approved)

Soldering Iron - 25W to BS spec. £1.75 P & P 30p + VAT
De-Solder Pumps - Spring loaded with quick action button release for one handed working.

Large £5-10 P & P 35p. Small £4-75 P & P 30p + VAT
Replacement tips Small 65p + VAT. Large 86p + VAT

Metal Oxide Resistors - 1/2W 5% £1.00 per 100.
390Ω/470Ω/510Ω/560Ω/820Ω/1K/1K1/1K2/1K6
1K8/2K/2K4/3K/16K/20K/22K/24K/47K/82K/100K
110K/120K/130K/150K/180K/220K/270K/300K
Use instead of Carbon Film (100's only) 30p P & P + VAT.

PANEL METERS

Size	Price	Ref.
43mm x 43mm	6.20	0.50A
0.50mA	5.95	0.500A
0.1mA	5.95	0.1mA
0.1mA	5.95	0.30A
0.1mA	5.95	0.30A
0.1mA	5.95	0.30A

MAINS ELIMINATORS
Plugs into 13A socket 3V = 100mA or 6, 9, 12V = 300mA £4.60. P & P 55p + VAT.

BRIDGE RECTIFIERS
100V 25A £2.86 500V 200V 2A £0.52 PM7A6 200V 4A £0.75 12A 400V 4A £0.98 12A 400V 6A £1.44 £3.75
P & P 17p + VAT

TTLs BY TEXAS				74LS192				74C157				LINEAR I.C.s				TRANSISTORS				TIP41C				DIODES			
7400	11p	7497	150p	74251	160p	74LS193	140p	74C160	155p	AY1-0212	600p	MC1496	100p	AC127/8	20p	BFY51/2	22p	TIP42A	70p	2N3866	90p	BY127	12p				
7401	12p	74100	130p	74252	250p	74LS194	140p	74C161	155p	AY1-1313	668p	MC3340	120p	AD149	40p	BFY56	33p	TIP42C	82p	2N3905/6	20p	OA47	9p				
7402	14p	74104	65p	74253	90p	74LS195	120p	74C162	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA81	15p				
7403	14p	74105	65p	74254	250p	74LS196	120p	74C163	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA85	15p				
7404	14p	74107	34p	74255	250p	74LS197	120p	74C164	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA90	9p				
7405	18p	74109	55p	74256	250p	74LS198	120p	74C165	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA91	9p				
7406	32p	74110	55p	74257	250p	74LS199	120p	74C166	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA95	9p				
7407	32p	74111	70p	74258	250p	74LS200	120p	74C167	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA200	9p				
7408	19p	74116	200p	74259	250p	74LS201	120p	74C168	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA202	10p				
7409	19p	74118	200p	74260	250p	74LS202	120p	74C169	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA203	10p				
7410	15p	74119	210p	74261	250p	74LS203	120p	74C170	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA204	10p				
7411	24p	74120	110p	74262	250p	74LS204	120p	74C171	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA205	10p				
7412	20p	74121	20p	74263	250p	74LS205	120p	74C172	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA206	10p				
7413	30p	74122	48p	74264	250p	74LS206	120p	74C173	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA207	10p				
7414	60p	74123	48p	74265	250p	74LS207	120p	74C174	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA208	10p				
7416	27p	74125	55p	74266	250p	74LS208	120p	74C175	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA209	10p				
7417	27p	74126	55p	74267	250p	74LS209	120p	74C176	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA210	10p				
7420	17p	74128	75p	74268	250p	74LS210	120p	74C177	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA211	10p				
7421	20p	74129	75p	74269	250p	74LS211	120p	74C178	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA212	10p				
7422	22p	74130	75p	74270	250p	74LS212	120p	74C179	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA213	10p				
7423	34p	74131	70p	74271	250p	74LS213	120p	74C180	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA214	10p				
7425	30p	74142	200p	74272	250p	74LS214	120p	74C181	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA215	10p				
7426	40p	74145	90p	74273	250p	74LS215	120p	74C182	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA216	10p				
7427	34p	74147	190p	74274	250p	74LS216	120p	74C183	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA217	10p				
7428	36p	74148	150p	74275	250p	74LS217	120p	74C184	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA218	10p				
7430	17p	74150	100p	74276	250p	74LS218	120p	74C185	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA219	10p				
7431	30p	74151	70p	74277	250p	74LS219	120p	74C186	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA220	10p				
7433	40p	74153	70p	74278	250p	74LS220	120p	74C187	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA221	10p				
7437	35p	74154	100p	74279	250p	74LS221	120p	74C188	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA222	10p				
7438	35p	74155	90p	74280	250p	74LS222	120p	74C189	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA223	10p				
7440	17p	74156	90p	74281	250p	74LS223	120p	74C190	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA224	10p				
7441	70p	74157	70p	74282	250p	74LS224	120p	74C191	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA225	10p				
7442A	60p	74159	190p	74283	250p	74LS225	120p	74C192	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA226	10p				
7443	112p	74160	100p	74284	250p	74LS226	120p	74C193	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA227	10p				
7444	112p	74161	100p	74285	250p	74LS227	120p	74C194	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA228	10p				
7445	100p	74162	100p	74286	250p	74LS228	120p	74C195	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA229	10p				
7445A	93p	74163	100p	74287	250p	74LS229	120p	74C196	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA230	10p				
7447A	70p	74164	100p	74288	250p	74LS230	120p	74C197	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA231	10p				
7448	80p	74165	130p	74289	250p	74LS231	120p	74C198	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA232	10p				
7450	17p	74166	100p	74290	250p	74LS232	120p	74C199	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA233	10p				
7451	17p	74167	200p	74291	250p	74LS233	120p	74C200	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA234	10p				
7453	17p	74170	240p	74292	250p	74LS234	120p	74C201	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA235	10p				
7454	17p	74172	720p	74293	250p	74LS235	120p	74C202	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA236	10p				
7460	17p	74173	120p	74294	250p	74LS236	120p	74C203	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA237	10p				
7470	36p	74174	93p	74295	250p	74LS237	120p	74C204	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA238	10p				
7472	30p	74175	85p	74296	250p	74LS238	120p	74C205	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA239	10p				
7474	34p	74176	85p	74297	250p	74LS239	120p	74C206	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA240	10p				
7474	30p	74177	90p	74298	250p	74LS240	120p	74C207	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA241	10p				
7475	30p	74178	160p	74299	250p	74LS241	120p	74C208	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA242	10p				
7476	35p	74180	90p	74300	250p	74LS242	120p	74C209	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA243	10p				
7480	50p	74181	200p	74301	250p	74LS243	120p	74C210	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA244	10p				
7481	100p	74182	150p	74302	250p	74LS244	120p	74C211	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA245	10p				
7482A	90p	74183	150p	74303	250p	74LS245	120p	74C212	155p	AY1-5050	212p	MC3350	120p	AD161/2	45p	BFY90	90p	TIP43C	82p	2N3905/6	20p	OA246	10p				
7483A	90p	74184	150p	74304	250p	74LS246	120p	74C213	155p	AY1-5050	212p	MC3350															

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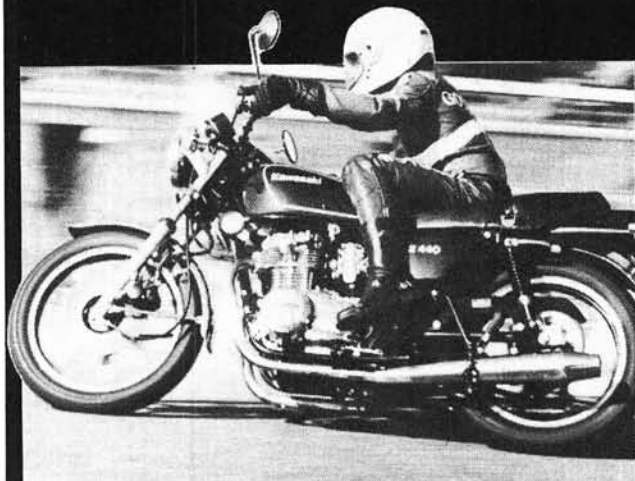
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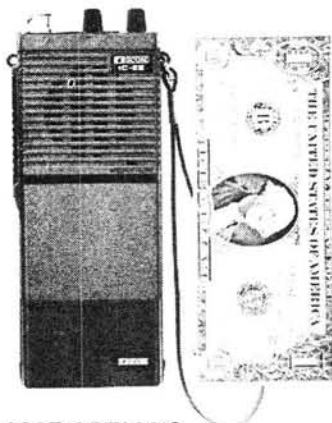
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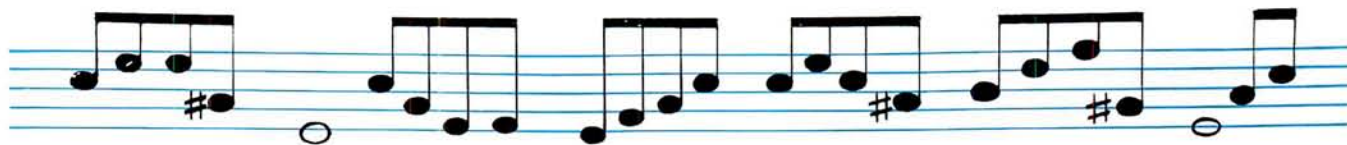
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