

PRACTICAL WIRELESS

JANUARY
1975

25p

P
W

MODEL CONTROL by RADIO

PART 1



ALSO:

LOW FREQUENCY AND MARINE RECEIVER

PRE-PUBLICATION BOOK OFFER: details inside

CONCLUDING SECTION of PW BUYERS' GUIDE 74/5

NEW EDU-KIT MAJOR

Completely Solderless Electronic Construction Kit
Build these projects without soldering iron or solder

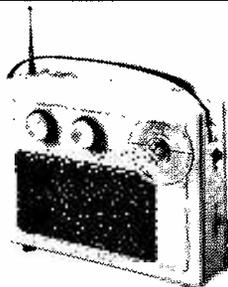
- ★ 4 Transistor Earpiece Radio.
- ★ Signal Tracer.
- ★ Signal Injector.
- ★ Transistor Tester NPN-PNP.
- ★ 4 Transistor Push Pull Amplifier.
- ★ 5 Transistor Push Pull Amplifier.
- ★ 7 Transistor Loudspeaker Radio MW/LW.
- ★ 5 Transistor Short Wave Radio.
- ★ Electronic Metronome.
- ★ Electronic Noise Generator.
- ★ Batteryless Crystal Radio.
- ★ One Transistor Radio.
- ★ 2 Transistor Regenerative Radio.
- ★ 3 Transistor Regenerative Radio.
- ★ Audible Continuity Tester.
- ★ Sensitive Pre-Amplifier.

Total Building Costs
£7.23 P P & Ins. 44p
(Overseas P & P £1.85)
(+ 8% VAT 57p)

Components Include: 24 Resistors • 21 Capacitors • 10 Transistors • 3 1/4" Loudspeaker • Earpiece • Mica Baseboard • 3 12-way connectors • 2 Volume controls • 2 Slider Switches • 1 Tuning Condenser • 3 Knobs • Ready Wound MW/LW/SW Coils • Ferrite Rod • 6 1/2 yards of wire • 1 Yard of sleeving etc. • Parts Price List and Plans 50p. (Free with parts).

NEW ROAMER NINE

WITH V.H.F. INCLUDING AIRCRAFT

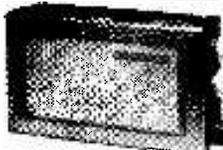


Nine Transistors, 9 Tuneable wavebands as Roamer Ten. Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors, 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9 1/4" x 7" x 2 1/2" approx. Parts Price List and Plans 40p (Free with parts).

Total Building Costs **£6.95** P P & Ins. 44p
(Overseas P & P £1.85)
(+ 8% VAT 55p)

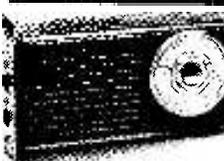
POCKET FIVE

NOW WITH 3" LOUD-SPEAKER



3 Tuneable wavebands, M.W. L.W. and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5 1/4" x 1 3/4" x 3 1/4" approx. Plans and Parts Price List 20p (Free with parts).

Total Building Costs **£2.50** P P & Ins. 26p
(Overseas P & P £1.25)
(+8% VAT 20p)



TRANSONA FIVE NOW WITH 3" LOUDSPEAKER

Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List 20p (Free with parts).

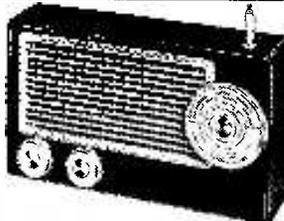
Total Building Costs **£2.75** P P & Ins. 26p
(Overseas P & P £1.25)
(+8% VAT 21p)

TRANS EIGHT

8 TRANSISTORS and 3 DIODES

6 Tuneable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/4 x 2 1/2 in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans 35p (FREE with parts).

Total building costs **£4.48** P P & Ins. 33p
(Overseas P & P £1.25)
(+ 8% VAT 36p)



ROAMER SIX

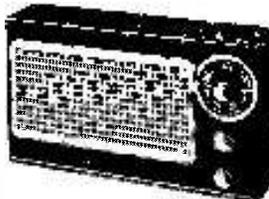
CASE AND LOOKS AS TRANS-EIGHT

6 Tuneable Wavebands: MW, LW, SW1, SW2, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/4 x 2 1/2 in. approx. Plans and parts price list 35p (FREE with parts).

Total building costs **£3.98** P P & Ins. 31p
(Overseas P & P £1.85)
(+ 8% VAT 32p)

NEW Everyday Series

Build this exciting New series of designs



E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4 1/2 volt Battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3" loudspeaker. Attractive case with red speaker grille. Size 9" x 5 1/4" x 2 1/2" approx. Parts Price List and Plans 20p. Free with parts.

Total Building Costs **£2.95** P P & Ins. 30p
(Overseas P & P £1.25)
(+ 8% VAT 23p)

E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans 30p. Free with parts.

Total Building Costs **£3.60** P P & Ins. 30p
(Overseas P & P £1.25)
(+ 8% VAT 29p)

E.V.7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. Parts Price List and Easy Build Plans 35p. Free with parts. Overseas P & P £1.05.

Total Building Costs **£4.08** P P & Ins. 31p
(Overseas P & P £1.85)
(+ 8% VAT 32p)

ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL

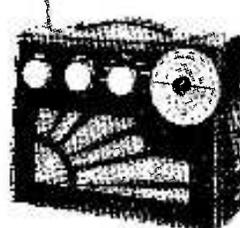


7 Tuneable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Chrome plated Telescopic aerial can be angled and rotated for peak short wave listening. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt ferrite magnet loudspeaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4 in. approx. Easy to follow instructions and diagrams. Parts price list and plans 50p (FREE with parts).

Total building costs **£6.98** P P & Ins. 47p
(Overseas P & P £1.85)
(+ 8% VAT 56p)

ROAMER TEN

WITH VHF INCLUDING AIRCRAFT



10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeakers. 9 Tuneable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band.

Built in Ferrite Rod Aerial for MW/LW. Chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Controls. Attractive Case in black with silver blocking. Size 9" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and plans 50p (FREE with parts).

Total building costs **£8.50** P P & Ins. 52p
(Overseas P & P £1.85)
(+ 8% VAT 68p)

"EDU-KIT"



Build Radios, Amplifiers, etc., from easy stage diagrams.

Five units including master unit to construct.

Components include:

Tuning Condenser: 2 Volume Controls: 2 Slider Switches; Fine Tone 3" Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors; 4 Diodes: Resistors: Capacitors: Three 1" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.

Parts price list and plans 40p (FREE with parts).
Total building costs **£5.50** P P & Ins. 33p
(Overseas P & P £1.85)
(+ 8% VAT 44p)

RADIO EXCHANGE LTD

★ Callers side entrance "Lavelis" shop.
★ Open 10-1, 2.30-4.30, Mon.-Fri. 9-12 Sat.

To RADIO EXCHANGE CO., 61a HIGH STREET, BEDFORD, MK40 1SA
Tel.: 0234 52887. Reg. No. 788372.

I enclose £..... for

Name

Address

(Dept. PW1.)

PRACTICAL WIRELESS

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JANUARY 1975

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BACK NUMBERS

We regret that we are unable to supply back numbers of Practical Wireless. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of Practical Wireless and Television only can be published in our CQ Column.

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We regret that we cannot answer technical queries by telephone nor can we provide information or advice on manufacturers' products other than that given in the magazine. We will endeavour to assist readers who have queries relating to articles published but we cannot offer advice on modifications to our published designs. All correspondents expecting a reply should enclose a stamped addressed envelope.

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SPECIAL PRE-PUBLICATION BOOK OFFER—Page 832
BUYERS' GUIDE to Radio and Electronic Components—FINAL PART

HUGE DISCOUNTS

ON LEADING BRAND HI-FI ALL RSC PRICES INCLUDE VAT LOW DEPOSIT CREDIT TERMS

Full labour and material guarantees for 12 months

	List Price	RSC Price
WHARFEDALE DENTON	£42.31 Pr.	£29.95
WHARFEDALE LINTON	£52.39 Pr.	£38.95
LEAK 250 SPEAKERS	£65.48 Pr.	£42.00
LINEAR 202 AMPLIFIER	£39.23	£24.95
ROTEL RT222 AM/FM Tuner	£50.57	£38.95
ROTEL RT322	£73.16	£53.50
ROTEL RX150 A Tuner/Amp	£77.09	£54.95
LEAK 2000 Tuner/Amp	£165.70	£134.95
Wharfedale Denton Tun/Amp	£93.28	£59.95
RANK 150a Stereo System	£137.35	£79.95

Also Shure Cartridges, Basf Tape, Koss H/Phones, etc.
Prices of above correct at Nov 12 1974

AKAI TAPE UNITS

Model	Rec. Price	£
GXC 36D	£110.72	£72.50
GXC 38	£147.19	£105.95
GXC 38D	£137.38	£97.95
GXC 46D	£157.59	£109.95
GXC 40T	£186.09	£135.95
GXC 75D	£199.90	£142.95

GXC 510D Rec. price £189.90 £135.95

Model	Price	£
GXR 82D	£122.65	£89.95
4000 DS	£130.12	£94.95
4000 DB (Dolby)	£196.27	£139.95
1721 L	£118.58	£84.95
CR 81D	£98.10	£69.95
CS33D	£105.81	£75.95

GOLDRING GL72 T/Table & G800 £29.95 (Approx. value £46) Carr. 75p
GOLDRING GL75 T/Table & G800 £34.95 (Approx. value £65) Carr. 85p
PIONEER PL12D T/Table on plinth & cover £41.75 List £61.90
BSR TD8S 8 track player. Special price £14.95
T/TABLES with MAGNETIC CARTRIDGE/PLINTH & COVER
GARRARD SP25 MK IV with G850 Special Price £19.95 (Carr. £1)
McDONALD MP60 with G800 or G850 ,, ,, £19.95 (Carr. £1)
RANK BD2000 Rec. Price £67.27 £48.95 (Carr. £1)

FANE HI-FI LOUDSPEAKERS AT APPROXIMATELY HALF-PRICE

UNREPEATABLE OFFER BRAND NEW BOXED FULLY GUARANTEED for High-Fidelity NOT Group Disco use
 Available by Mail Order only due to small quantities of some models. SAE for leaflets. Please state impedance required where not ind.

Model	Price	Model	Price	Model	Price	Model	Price	Model	Price	Model	Price	Model	Price
505	£2.78	807T 3Ω	£2.25	121/10	£3.17	138/10LR	£2.50	138/15TLR	£4.96	122/10TLR	£6.36	122/14ALR	£9.52
506	£2.61	1001	£4.37	121/10T	£3.37	138/10TLR	£2.63	101/10A	£4.27	122/12	£6.75	122/17	£10.26
507	£1.08	1002	£4.19	121/11	£3.58	138/11	£3.55	101/14	£6.04	122/12A	£7.08	122/17A	£10.59
801	£3.93	1005	£3.85	121/11T	£3.78	138/11LR	£3.87	101/14A	£6.74	122/12D	£6.88	122/17T	£10.50
802T	£3.89	1008	£3.50	121/15	£4.61	138/13	£3.88	122/10	£5.16	122/12T	£7.08	122/17LE	£10.98
802T	£3.82	1008	£2.93	121/16LR	£5.33	138/13LR	£4.15	122/10A	£5.49	122/14	£8.47	122/17ALR	£11.31
805	£3.25	1001LR	£5.09	138/10	£2.18	138/15	£4.51	122/10LR	£6.08	122/14A	£8.80	152/10	£9.26
806	£2.56	1005LR	£4.37	138/10T	£2.81	138/15LR	£4.83	122/10T	£5.49	122/14LR	£9.19	152/12	£10.84

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

Controls: Bass, Treble, Vol. and Bal. 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for Crystal P.U. or Tape/Radio. For speaker output impedances of 3 - 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs. COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS £12.95 Carr. Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £16.95 or dep. £2.12 and 8 monthly payments £2.12 (Total £19.08).



HI-FI SPEAKER ENCLOSURES

Teak veneer Carr. 50p. Sizes approx. per enc.
MEB 13 x 9 1/2 x 6 1/2 in. £3.95
JEB 16 x 11 x 9 in. £5.95 } Both cut for 8in. speaker
SE10 25 x 16 x 9 in. Cut for 10in. and Tweeter £8.95
SE12 25 x 16 x 9 in. Cut for 12in. and Tweeter £8.95



AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 11,000 Gauss 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. £6.95 Carr. 45p
 OR SENIOR 15 WATT INCLUDING £8.95 Carr. 50p
HF123 13,000 GAUSS SPEAKER

R.S.C. TA6 6 Watt HI-FI AMPLIFIER

200-250v. AC mains operated. Response 30-20,000 c.p.s. -2dB. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 8-15 ohm spkrs. Max. sensitivity 5mV. O/P rating I.H.F.M. Enclosed enamelled case 9 1/2 x 2 1/2 x 5 1/2 in. Silver finish fascia 10 1/2 x 3 1/2 in. Complete kit, wiring diagrams and instructions. £7.95 Carr. 40p. FACTORY BUILT £10.95



R.S.C. TA12 MKIII 6.5+6.5 WATT STEREO AMPLIFIER

Fully Transistorised. Hi-Fi/O/P of 6.5 watts per channel. Optimum performance with any crystal or ceramic P.U. Cartridge, Radio Tuner, Tape Rec. etc. Input Sel. Switch, Bass, Treble, Vol. & Bal. Controls. COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS £12.95 Carr. 40p. Or in Teak Dep. £2.50 & 8 mthly pymts 12 mths guarantee £16.61 Veneer housing £19.55 £2.50 (Total £22.50)



AUDIO FIDELITY FRI SPEAKER KIT

Response 30Hz-15KHz. Rating 15 watts in sealed cabinet. Imp. 8-15 ohms. 8" Bass Unit with P.V.C. Cone surround for ultra low resonance. Pressure Tweeter. Printed Circuit. Inductive/Capacitive Cross-over. Damping Material, Screws, Terminal Panels. £10.95

SPECIAL OFFER £14.99 Pair Carr. 50p each. Carr. Free.

AUDIOTRINE HIGH FIDELITY SPEAKERS

Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" or "T" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. PLEASE STATE CHOICE. Exceptional performance at low cost.

HF80ST 8" 10W	£3.55	HF180D 12" 15W	£6.50
HF102D 10" 10W	£3.50	HF180 12" 15W	£7.95
HF120 12" 15W	£5.95	HF180D 12" 15W	£8.50

AUDIO FIDELITY MODEL 80 HI-FI SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high tone response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 8-15Ω. £4.50 ea. £7.98 pr.

MODEL 83 8" 15w. with Parasitic Tweeter. £5.99 ea. £10.95 pr. Response 25 Hz to 15 KHz. Gauss 13,000 Imp 8-15Ω.



HI-FI 8" x 5" 7 watt LOUDSPEAKERS

with parasitic Tweeter 8 ohm imp. Post and Packing 20p

£1.25

R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET Only high grade components by leading manufacturers

- * Push Button Selector Switching
 - * Jack Socket for Headphones
 - * Neon Indicator
 - * Satin Silver Finish Metal Fascia
 - * Solid State Circuitry
 - * Twenty Silicon Transistors
 - * Four Diodes, Four Rectifiers
- Send S.A.E. for full descriptive leaflet.

For Magnetic or Ceramic Pick-Ups regardless of Price. Output (per channel) 15 watts RMS into 8Ω. Frequency Response 7 Hz to 70 KHz ± 1 1/2 dB.



COMPLETE KIT (less cabinet). Carr. 70p. Cabinet if req. £4.90 extra. Assembled unit in cabinet £42.50

£22.50

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

★ Moderate size only 25 x 14 x 10in. approx.
 ★ Response 30-20,000 c.p.s. Impedance 15 ohms
 Performance comparable with COMPLETE KIT units at twice the cost

£25.95 Carr. 75p

Deposit £4.71 and 8 monthly payments £2.12 (Total £29.87) Consists of (1) 12in. 15w Bass unit with cast chassis. Roll rubber cone surround for ultra low resonance. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range speaker. (4) Dome Pressure Tweeter. (5) Quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions.



R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS

Model	Price
MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 x 2 1/2 in.	
250v., 60mA, 6.3v. 2a	£1.50
250-0-250v., 60mA 6.3v 2a	£1.60
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250v. 60mA, 6.3v. 2a., 0-5-6.3v. 2a.	£2.25
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	£3.75
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	£3.75
300-0-300v. 130mA, 6.3v. 4a. c.t., 6.3v. 1a.	£4.50
For Mullard 510 Amplifier	£4.50
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	£3.75
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	£4.50
425-0-425v. 200mA, 6.3v. 4a., c.t., 5v. 3a.	£8.50
425-0-425v. 200mA, 6.3v. 4a., twice 5v. 3a.	£8.70
450-0-450v. 250mA, 6.3v. 4a., c.t., 5v. 3a.	£9.00

FULLY GUARANTEED. Impregnated and Interleaved where necessary. Primaries 200-250v. 50/s. Screened

Model	Price
CHARGER TRANSFORMERS 0-9-15v. 1 1/2a. £1.75, 2 1/2a. £1.95, 3a. £2.00, 4a. £2.45, 5a. £2.75, 6a. £3.00	
AUTO (Step Up/Step Down) TRANSFORMERS 0-110/120v. 200-250v. 50-80 watts £2.50, 150 watts, £4.50 250 watts £5.50; 500 watts £8.50	
OUTPUT TRANSFORMERS	
Std. Pentode 5000-3Ω or 7000-3Ω	88p
Push-Full 8 watts EL84 to 3Ω or 15Ω	£1.45
Push-Full 10 watts 6V6, 3-5-8-15Ω	£2.25
Push-Full EL84 to 3 or 15Ω 10-12 watts	£2.25
Push-Full Ultra Linear for Mullard 510, etc.	£3.75
Push-Full 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15Ω	£3.20
Push-Full 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15Ω	£5.50

SELENIUM RECTIFIERS

F. W. (Bridged) All 6/12v. D.C. output. Max. A.C. input 18v.
 1a, 38p. 2a, 49p.
 3a, 65p. 4a, 81p.
 6a, 97p.
 L.F. CHOKES
 150mA, 7-10H, 250
 10H, 200 Ω 95p;
 60mA, 10H, 400
 Ω 95p.

RSC 100watt DISCO SYSTEM

50 WATT SPEAKER **50 WATT SPEAKER**

TWIN TURNTABLE WITH PRE-AMP and POWER AMPLIFIER

HEADPHONES MICROPHONE

Complete with lid

AT FANTASTIC LOW PRICES!

Units listed below
 (a) DISCOMASTER TWIN TURNTABLE CONSOLE with integral 100W amplifier
 (b) PAIR OF HI-FI HEADPHONES
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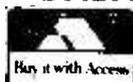
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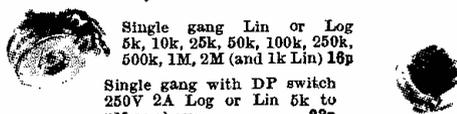
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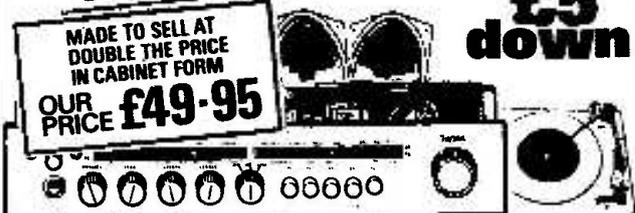
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**£5
down**

*Stereo Tuner Amplifier chassis with AM/FM radio covering long medium short and Stereo FM wavebands. Separate Base and Treble controls. Power output 7 watts R.M.S. per channel (frequency response 25-20,000 Hz) Tape record and playback facilities. Dimensions 18" x 8 1/2" x 3 1/4". The very latest BSR automatic record deck with cue and pause control. Two matching elliptical speaker units.

Order early limited stocks available cash price £49.95. Credit Sale £5.00 deposit 9 monthly payments of £5.75 (Total Credit price £56.75). P. & P. £2.50. Send £7.50 today.

Chassis only available for cash at £35.00.

Full 12 months Guarantee.

CALLERS WELCOME.

Stereo headphones supplied with every order.

LEWIS radio

WS 1/75 100 CHASE SIDE SOUTHGATE
LONDON N14 5PL. Telephones: 01-882-1644

16 CHERRY LANE
BRISTOL BS1 3NG

THE RADIO SHOP

TELEPHONE
0272-421196



TRIACS



1.6 AMP PLASTIC TAB		6.5 AMP ISOLATED TAB		10 AMP ISOLATED TAB	
NAS0161W 100V	.27	NAS0651W 100V	.46	NAS1001W 100V	.63
NAS0161X 100V	.26	NAS0651X 100V	.44	NAS1001X 100V	.60
NAS0162W 200V	.30	NAS0652W 200V	.58	NAS1002W 200V	.78
NAS0162X 200V	.28	NAS0652X 200V	.56	NAS1002X 200V	.74
NAS0164W 400V	.40	NAS0654W 400V	.84	NAS1004W 400V	1.09
NAS0164X 400V	.38	NAS0654X 400V	.80	NAS1004X 400V	1.04
NAS0166W 600V	.55	NAS0656W 600V	1.05	NAS1006W 600V	1.34
NAS0166X 600V	.52	NAS0656X 600V	1.00	NAS1006X 600V	1.28
3 AMP "CLIPPED TAB"		8.5 AMP ISOLATED TAB		16 AMP ISOLATED METAL	
NAS0301W 100V	.30	NAS0851W 100V	.50	NAS1601W 100V	.90
NAS0301X 100V	.28	NAS0851X 100V	.52	NAS1601X 100V	.82
NAS0302W 200V	.36	NAS0852W 200V	.67	NAS1602W 200V	.95
NAS0302X 200V	.34	NAS0852X 200V	.64	NAS1602X 200V	.88
NAS0304W 400V	.52	NAS0854W 400V	.97	NAS1604W 400V	1.40
NAS0304X 400V	.50	NAS0854X 400V	.92	NAS1604X 400V	1.32
NAS0306W 600V	.70	NAS0856W 600V	1.20	NAS1606W 600V	1.85
NAS0306X 600V	.66	NAS0856X 600V	1.14	NAS1606X 600V	1.75

Devices with Internal Trigger have "W" suffix. "X" denotes Standard Triac.



THYRISTORS



1.6 AMP MIN. T05		4 AMP ISOLATED TAB		6 AMP ISOLATED TAB	
NAS006P 50PIV	.25	NAS106P 50PIV	.26	NAS206P 50PIV	.37
NAS006Q 100PIV	.28	NAS106Q 100PIV	.30	NAS206Q 100PIV	.42
NAS006R 200PIV	.31	NAS106R 200PIV	.36	NAS206R 100PIV	.50
NAS006S 400PIV	.40	NAS106S 400PIV	.57	NAS206S 100PIV	.77
NAS006T 600PIV	.52	NAS106S 400PIV	.57	NAS206S 100PIV	.77
8 AMP ISOLATED TAB		16 AMP ISOLATED TAB			
NAS306P 50PIV	.41	NAS806P 50PIV	.50		
NAS306Q 100PIV	.47	NAS806Q 100PIV	.58		
NAS306R 200PIV	.59	NAS806R 200PIV	.73		
NAS306S 400PIV	.85	NAS806S 400PIV	1.15		

Quantity prices on application, S.A.E.

ME 55 Integrated circuit timer 8 pin dill only 62p.
MULTITURN POTENTIOMETERS EX. EQUIPMENT RELCON 1k + or - % good condition 25p.
2 1/2 in 75 ohms or 40 ohm miniature speaker 45p each.

Please add 8% VAT to all listed prices. Postage & packing 15p per order. Send 13p for latest catalogue. Callers welcome.

Crescent Quality Components

BARGAIN CAPACITOR 2,200MFD at 63v. DC w/kg.
Size = 2" x 1 1/2" diameter. Tag ended. All new and unused. Our price 35p.

STEREO/MONO HEADPHONE VOLUME CONTROL BOX



Plug stereo phones into this control box and you then incorporate a right and left hand volume control and a stereo/monoswitch. Complete with stereo jack plug and 2m cable. A bargain at £1.

TWO WAY STEREO ADAPTOR

Stereo Jack plug to two stereo free sockets, complete with 110mm cable. For connecting two stereo inputs into one.

A bargain at 65p.



LIGHT EMITTING DIODES

Til 209 (Red) With Clip 22p each
Til 209 (Green) With Clip 35p each
Til 209 (Yellow) With Clip 90p each
Med 500 T092 Type 16p each

LED READOUTS

Litronix
DL707 3 Character 14 Pin Dtl. £2.00
DL701 as above but ± 1 £2.00
DL747 6 Character £2.62

Minitron

3015 7 Segment 16 Pin Dtl £1.18
3015G as above but ± 1 £1.18

Clock Chip

CT7001 MOS/LSI Digital Clock/Calendar Chip Plus full Circuits and Information leaflet £8.95
Circuits and Information Sheet 15p
Lit 704 Led Display for above £1.35
Or 4 for £5.25

WAFER SWITCHES

1 Pole 12 Way
2 Pole 2 Way
2 Pole 3 Way
2 Pole 4 Way
2 Pole 6 Way
2 Pole 4 Way
4 Pole 3 Way
22p each



POTENTIOMETERS

All types 1" and less diameter
Singles
5K Log or 5K
10K Lin Less 10K
25K Switch 25K
50K 15p each 50K
100K 100K
250K Double 250K
500K Pole 500K
1M Switch 1M
2M 30p each 2M

PRE SETS

Sub Miniature Skeleton Type 0-1 Watt Horizontal Mounting 100, 250 and 500 ohm, 1k, 2.5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, and 1M ohm 6p each

MAINS TRANSFORMERS

Open Type Double Wound Continuously Rated, two hole fixing clamp with colour coded flying leads, varnish impregnated. Approx. size: 1 1/2" x 1 1/2" x 1 1/2" high
Fixing centres: 2 5/32"
TR1 20-0-20v 100 m/a
TR2 12-0-12 v 100 m/a All
TR3 9-0-9 v 100 m/a 240 Volt
TR4 6-0-6 v 100 m/a Primary
TR5 3-0-3 v 100 m/a
Our Price £1.23 each

200/250v MAINS RELAY

Heavy duty contacts 2-500 ohm coil. All new and unused D.P.D.T. mains relays 50p, Carr. Free. Special quantity £40 per 100 off.

MINIATURE RELAYS

Brand new range of British made Relays. Size 1 1/2" x 1" x 1/2". All two changeovers with 250v 1.5A contacts and suitable for fitting on 1m Veroboard.

Type	Volts	Current	Ohms	All
27/A	12v	17M/A	700	
21/A	12v	28M/A	430	£1.30
12/A	6v	33M/A	185	each

DOUGLAS TRANSFORMERS

All types are standard 240 volt primary. MT 102 ct. 0 = 19 = 25 = 33 = 40 = 50 at 500M/A

Model	Price
MT237cs 20-0-20 at 150M/A	£2.00 each
MT241cs 20-0-20 at 30M/A	£1.25
MT240cs 15-0-15 at 30M/A	£1.05
MT239cs 12-0-12 at 50M/A	£1.05
MT238cs 3-0-3 at 200M/A	£1.05

POWER PACKS

PP1 Switched 3 - 6 - 7 1/2 - 9 volt 400M/A Transistor and Zener Stabilised On/Off Switch and Polarity Reversal Switch, in a black metal case £5.25 each.
PP2 Switched 6 - 7 1/2 - 9 volt Battery Eliminator. Approx. size 2 1/2" x 2 1/2" x 3 1/2". Ideal for cassette recorders £2.75 each (philips type £3.00).
PP3 Car converter. From 12v Pos. or Neg. to = 6 - 7 1/2 - 9 volt. Easy to fit and transistor regulated £2.50 each



VEROBOARD

Size	Price	Plain	Price
2 1/2" x 3 1/2"	32p	15	15p
2 1/2" x 5"	34p	34p	18p
3 1/2" x 3 1/2"	34p	34p	
3 1/2" x 5"	39p	45p	
17" x 2 1/2"	1.06p	77p	60p
17" x 3 1/2"	1.45p	1.16p	75p
17" x 5"	1.85p		1.10p

Pin insertion tool 72p
Spot face cutter 52p
Pkt. 36 pins (state 1 or 15) 25p

LOUDSPEAKERS

Model	Price
2 1/2" 8 ohm	50p
2 1/2" 40 ohm	50p
2 1/2" 80 ohm	50p
5" 8 ohm ceramic	£1.25
6 1/2" 8 ohm dual cone ceramic	£2.50
10" 8 ohm dual cone ceramic	£3.75
7" x 4" 8 ohm ceramic	£1.60
8" x 5" 8 ohm Permanent Magnet	£1.60



***EMI 13" x 8" 450 Kit**

3 - 8 - 15 ohm £4.10

*EMI 13" x 8" 350 Kit 8 ohm £7.50

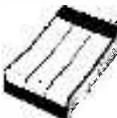
FANE ULTRA HIGH POWER LOUDSPEAKERS

Model	Price
*Pop 25/2 30 watt 150 ohm 12"	£8.29
*Pop 55 60 watt 8/15 ohm 12"	£14.50
*Pop 50 50 watt 15 ohm 12"	£11.99
*Pop 60 60 watt 8/15 ohm 15"	£15.70
*Pop 100 100 watt 8/15 ohm 18"	£28.70

* Carr. on L/S over 13 x 8 and 12" 50p per L/S.

MAINS KEYNECTOR

Keynector connects any Electrical Equipment to the mains supply in seconds. Ideal for beach, garage demonstrations, etc. Multi connections can be made (max. load 13A fused). £3.25p.



ALUMINIUM BOXES

Metal project boxes give your work a professional finish

Model	L	W	H	Price
AB7	2 1/2"	5 1/2"	1 1/2"	54p
AB8	4"	4"	1 1/2"	63p
AB9	4"	2 1/2"	1 1/2"	54p
AB10	4"	5 1/2"	1 1/2"	63p
AB11	4"	2 1/2"	2"	54p
AB12	3"	2"	1"	45p
AB13	6"	4"	2"	69p
AB14	7"	5"	2 1/2"	84p
AB15	8"	6"	3"	99p
AB16	10"	7"	3"	£1.35
AB17	10"	4 1/2"	3"	£1.02
AB18	12"	5"	3"	£1.20
AB19	12"	8"	3"	£1.50

ABS PLASTIC BOXES

Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.

1005 = 105mm x 73mm x 45mm = 51p
1006 = 150mm x 75mm x 47mm = 66p
1007 = 184mm x 124mm x 60mm = 96p
1021 = 106mm x 74mm x 45mm (sloping front) = 50p

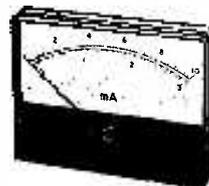
BARGAIN BOARDS

Components galore for the experimenter Ex Computer boards with Resistors, Capacitors and useful Transistors—at least 4 transistors per board. Five boards £1.00.

CLEAR PLASTIC PANEL METERS

Size 59mm x 46mm x 35mm these meters require a 38mm hole for mounting.

ME6	= 0 to 50 micro amp Full Scale
ME7	= 0 to 100 micro amp Full Scale
ME8	= 0 to 500 micro amp Full Scale
ME9	= 0 to 1 m/a Full Scale
ME10	= 0 to 5 m/a Full Scale
ME11	= 0 to 10 m/a Full Scale
ME12	= 0 to 50 m/a Full Scale
ME13	= 0 to 100 m/a Full Scale
ME14	= 0 to 500 m/a Full Scale
ME15	= 0 to 1 amp Full Scale
ME16	= 0 to 50 volts A.C. Scale
ME17	= 0 to 300 volts A.C. Full Scale
ME18	= "S" Meter
ME19	= "VU" Meter



OUR PRICE £3.00

Q-MAX SHEET METAL PUNCHES

The easiest and quickest way of punching holes in sheet metal (up to 1.625mm Mild Steel)

Model	Price	Key
DECON DALO 38PC	68p	"T" 6p
ETCH RESIST PEN	75p	
The Decon Dalco 33PC is a unique instrument for the professional and amateur electronics engineer, enabling him to prepare in minutes a perfect printed circuit board	83p	"A" 6p
OUR PRICE 80p	83p	
ADD LUXURY TO YOUR CAR with a motor driven car aerial	83p	
SPEC: ★ 5 section	88p	
★ extended length 100cm	88p	
★ Length under fender 40cm	90p	"B" 10p
★ Cable length 120cm	90p	
Supplied complete with fixing bracket and control switch	98p	"C" 13p
OUR PRICE 80p	98p	
1 1/2" SQUARE PUNCH complete with key	£1.03	
1 1/2" SQUARE PUNCH complete with key	£1.05	"B" 10p
1 1/2" SQUARE PUNCH complete with key	£1.10	
1 1/2" SQUARE PUNCH complete with key	£1.25	"B" 10p
1 1/2" SQUARE PUNCH complete with key	£1.43	
1 1/2" SQUARE PUNCH complete with key	£1.50	"B" 10p
1 1/2" SQUARE PUNCH complete with key	£2.05	
1 1/2" SQUARE PUNCH complete with key	£2.30	"B" 10p
1 1/2" SQUARE PUNCH complete with key	£4.10	
1 1/2" SQUARE PUNCH complete with key	£5.25	"B" 10p
1 1/2" SQUARE PUNCH complete with key	£8.10	

1" SQUARE PUNCH complete with key £2.10

STOP PRESS

BHA0002	15 watt Amp Module	£2.50
NE555	Timer I.C.	78p
MC1310P	Stereo Decoder I.C.	£2.00
7805	Regulator	£1.49
TIP 29A		55p
TIP 30A		63p
BC107		10p
BC 108		10p
BC109		10p



I.C. SOCKETS

D.L.L.	
8 pin	
14 pin	14p
16 pin	

BARGAIN TRANSFORMERS

12-0-12 volt 500m/a
240 volt primary transformer bargain. approx size = 60mm x 40mm x 50mm fixing centres = 75mm
Our Price = £1.20.

18 volt 500m/a
240 volt tapped 120 volt with screen. approx size = 60mm x 40mm x 50mm fixing centres = 75mm
Our Price = £1.00.

BARGAIN BOX

Loud buzzer mounted in a metal box complete with two U2 battery size holder. Designed and can be used as a fire alarm but is ideal as a door or Morse code practice buzzer. Approx. size = 2 1/2" x 6 1/2" x 1 1/2".
OUR PRICE—50p.

U.K. POSTAGE 15p UNLESS OTHERWISE STATED

V.A.T. Please add 8% to all Totals

CRESCENT RADIO LTD.

All mail to 11 MAYES ROAD, WOOD GREEN, LONDON N22 6TL
Phone: 01-888 3206

Callers Welcome at 15 Mayes Road & 13 South Mall, Edmonton N9.

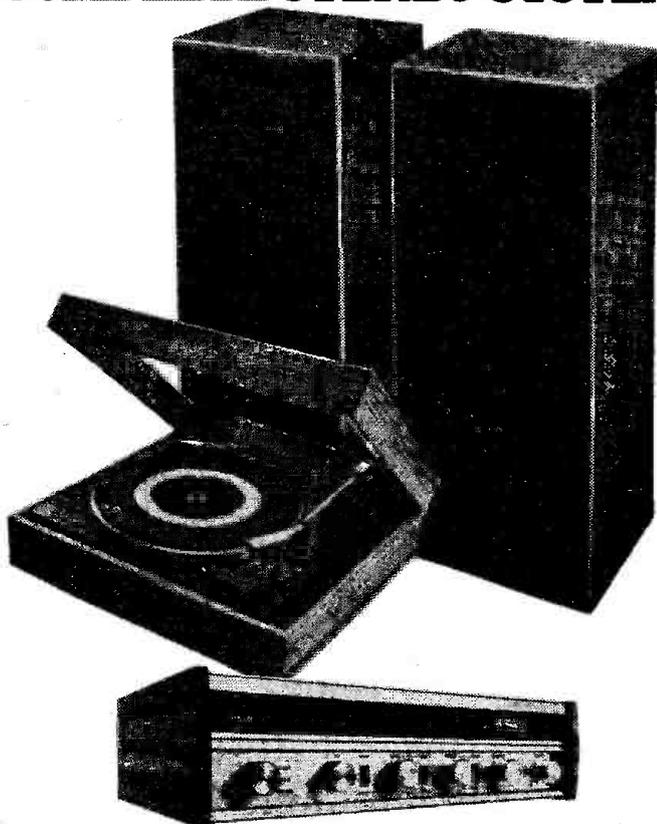
If you construct You should own one.

CRESCENT CATALOGUE
Price 20p.

R T V C

FOR AUDIO AT A BUDGET

COMPLETE STEREO SYSTEM System 1. £51-00



40 Watt Amplifier. Viscount III - R102 now 20 watts per channel.
System 1 includes:
Viscount III amplifier - volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.
Specification
 20 watts per channel into 8 ohms. Total distortion @ 10W @ 1kHz 0-1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K, equalised within ± 1 dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics:* Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.) -58dB. Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13 $\frac{1}{2}$ " x 9" x 3 $\frac{1}{2}$ ".
Garrard SP 25 Mk III deck with magnetic cartridge, de luxe plinth and hinged cover.
Two Duo Type II matched speakers - Enclosure size approx. 17 $\frac{1}{2}$ " x 10 $\frac{3}{4}$ " x 6" in simulated teak. Drive unit 13" x 8" with parasitic tweeter, 10 watts handling.

Complete System £51-00

System 2. £69-00

Viscount III amplifier (As System 1)
Garrard SP 25 Mk III deck (As System 1)
Two Duo Type III matched speakers - Enclosure size approx. 127" x 13" x 11 $\frac{1}{2}$ "
 Finished in teak veneer. Drive units 13" x 8" bass driver, and two 3" (approx.) tweeters. 20 watts R.M.S., 8 ohms frequency range - 20 Hz to 18,000 Hz.

Complete System £69-00

PRICES: SYSTEM 1

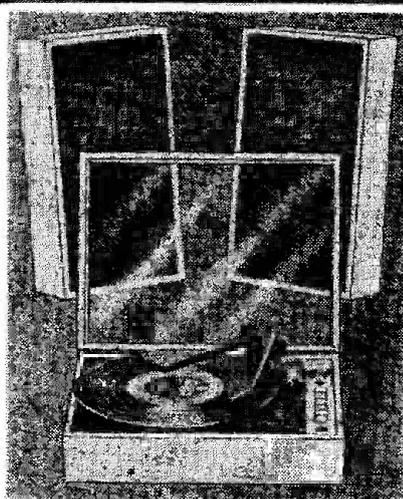
Viscount III R102 amplifier	£24.20 + £1 p & p
2 Duo Type II speakers	£14.00 + £2.20 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p
total:	£59.20

Available complete for only: **£51-00**
 + £3.50 p & p

PRICES: SYSTEM 2

Viscount III R102 amplifier	£24.20 + £1 p & p
2 Duo Type III speakers	£39.00 + £4.00 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p
total:	£84.20

Available complete for only: **£69-00**
 + £4.00 p & p



STEREO 21 * QUALITY SOUND FOR LESS THAN £20-00

Stereo 21, easy to assemble audio system kit. No soldering required. The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth.

Includes: - BSR 3 speed deck, automatic, manual facilities together with stereo cartridge, Two speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.
Specifications: For the technically minded: -
 Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel. Output impedance 8-15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs - radio, tape, etc., and outputs for taping discs. **Overall Dimensions.** Speakers approx. 15 $\frac{1}{2}$ " x 8" x 4". Complete deck and cover in closed position approx. 15 $\frac{1}{2}$ " x 12" x 6".
Complete only £19.55 + £1.60 p & p. Extras if required. Optional Diamond Stylus £1.37.
 Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance, **£3.85.**



BUILD YOUR OWN * STEREO AMPLIFIER

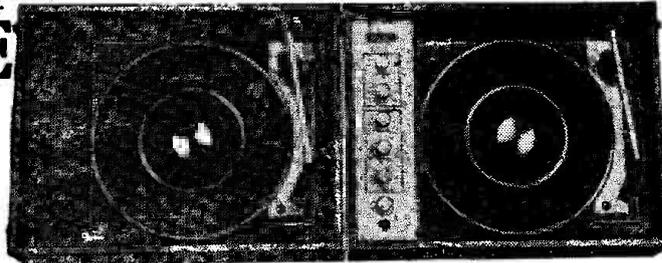
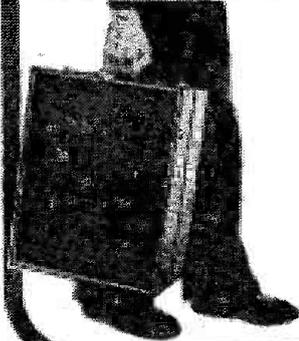
For the man who wants to design his own stereo - here's your chance to start, with Unisound - pre-amp, power amplifier and control panel. No soldering - just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only. **£7-64 + 55p. p & p**

8 TRACK HOME CARTRIDGE PLAYER *



Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21. Technical specification Mains input, 240V, Output sensitivity 125mV. Comparable unit sold elsewhere at £24.00 approx. **Yours for only £11.95 + 90p p & p.**

PORTABLE DISCO CONSOLE



INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables.

Two B.S.R. single play professional series decks, fitted with crystal cartridges. The turntables are designed and precision engineered. They combine clean modern styling with superb reproduction. Their many special features include square section aluminium tonearms, (high precision low mass design fully counterbalanced, with calibrated stylus pressure control for perfect tracking), and conveniently grouped easy to read linear controls. The turntables have viscous cueing devices which allows the tonearms to be placed or lifted at any point on the record. The two lightweight cartridge shells have slide-in-holders to facilitate easy inspection of needles and cartridges.

TECHNICAL SPECIFICATION:

Pre-amp - Output - 200mV.
 Auxiliary inputs - 200mV and 750mV into 1 meg.
 Mic input - 6mV into 100K. 240 volt operation.
Turntables capacity - 7", 10" or 12" records.
Rumble, wow and flutter -
 Rumble Better than -35dB. Wow Better than 0.2%.
 Flutter Better than 0.06% (Gaumont kalee meter).
Finish - Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.
Console size -
 Unit Closed - 17 3/4" x 13 3/4" x 8 3/4" (approx.)
 Unit Open - 35 3/4" x 13 3/4" x 4 3/4" (approx.)

This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.

The unit is finished in black PVC with contrasting simulated teak edging diamond spun control knobs with matching control panel.

Yours for only £45.00 + £3.50 P. & P.

EMI SPEAKERS AT FANTASTIC REDUCTIONS



20 WATT SPEAKER SYSTEM *
 System consists of a 13" x 8" (approx) elliptical woofer unit with a 8" x 5" (approx.) mid range unit incorporating parasitic tweeter and crossover components.

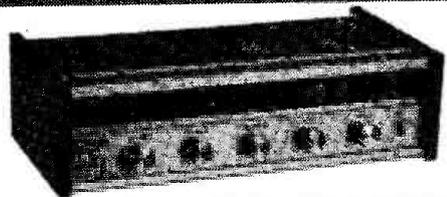
Technical Specification:
Bass Unit
 Flux density-100 K. speech coil-1 1/2", Cone. Triple laminated paper with P.V.C. surround.
Mid Range Unit
 Flux density-33K. speech coil-1" with parasitic tweeter.
Power Handling
 20 watts R.M.S., impedance - 8 ohms, frequency response - 20 Hz to 18,000 Hz.

OUR PRICE
£6.60. Complete
 + 90p p & p.



15" 14A/780 BASS UNIT
 Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 39 Hz. Flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3" voice coil.

Recommended retail price £40.80.
OUR PRICE £18.70
 + £1.50 p & p.

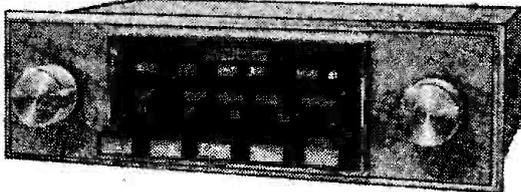


DISCO AMPLIFIER *

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.
Outputs 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).
Inputs *4 electrically mixed inputs. *3 individual mixing controls.
 *Separate bass and treble controls common to all 4 inputs.
 *Mixer employing F.E.T. (Field Effect Transistors) *Solid State circuitry.
 *Attractive styling.

INPUT SENSITIVITIES -Input - 1.) Crystal mic, guitar or moving coil mic, 2 and 10mV. (Selector switch for desired sensitivity).
 -Inputs - 2), 3), 4). Medium output equipment - ceramic cartridge, tuner, tape recorder, organs, etc. - all 250mV sensitivity. AC Mains, 240V operation. Size approx: 12 1/2" x 6" x 3 1/2". **£15.00 + 60p. p & p**

PUSH BUTTON CAR RADIO KIT * The Tourist II



NO SOLDERING REQUIRED!

NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board. **£7.70 + 55p p & p**

Technical specification: (1) **Output** 4 watts R.M.S. output. For 12 volt operation on negative or positive earth. (2) **Integrated circuit** output stage, pre-built three stage IF Module. **Controls** volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands.
 Size chassis 7" wide, 2" high and 4 3/4" deep approx

Speaker including baffle and fixing strip **£1.65+23p.p&p.**

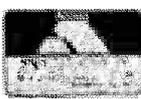
Car Aerial Recommended - fully retractable **£1.37+20p.p & p**

The Tourist I Kit For the experienced constructor If you can solder on a printed circuit board you can build this model.

Same technical specification as Tourist II **Price £6.60 + 55p p & p.**



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EB91	0-64	EF86	1-16	PC998	0-64	PL802	1-40		
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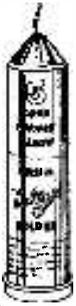
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CBL31	1-40	EF85	0-45	OB2	0-45	6J5G	0-55	6J5G	0-80
CL33	1-50	EF86	0-45	OC3	0-65	6J6	0-55	6J6	0-85
CY31	0-60	EF89	0-35	PC88	0-65	6J7G	0-85	6J7G	0-80
DAF91	0-40	EF91	0-40	PC97	0-55	6J7M	0-85	6J7M	0-85
DAF96	0-60	EF92	0-50	PC900	0-55	6K6GT	0-80	6K6GT	0-80
DCC90	1-35	EF95	0-45	PC884	0-45	6K7G	0-85	6K7G	0-85
DF91	0-40	EF98	0-80	PC888	0-62	6K7M	0-85	6K7M	0-85
DF96	0-60	EF183	0-40	PC889	0-55	6K8G	0-45	6K8G	0-45
DK91	0-50	EF184	0-40	PC890	0-55	6K8M	0-70	6K8M	0-70
DK92	1-00	EL32	0-60	PC891	0-40	6K9S	1-00	6K9S	1-00
DK96	0-75	EL33	2-00	PC892	0-42	6L6G	0-55	6L6G	0-55
DL92	0-50	EL34	0-70	PC893	0-65	6Q7G	0-40	6Q7G	0-40
DL94	0-48	EL36	0-60	PC894	0-60	6Q7M	0-60	6Q7M	0-60
DL96	0-55	EL37	2-50	PC895	0-55	6R7G	0-80	6R7G	0-80
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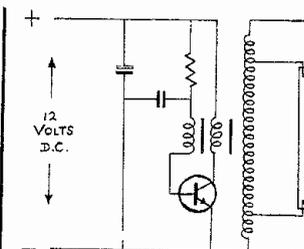
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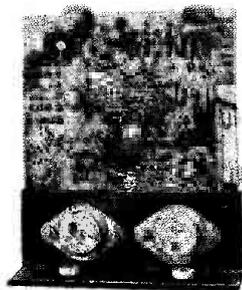
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50W RMS 25-65V
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100W RMS 45-70V
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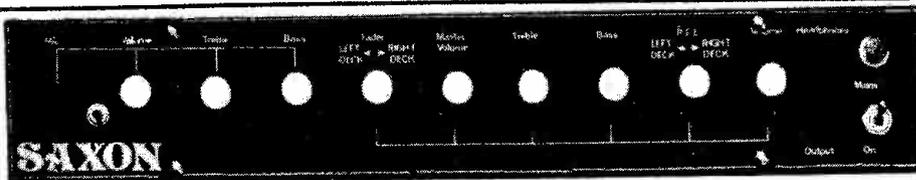
N.B. PS70 is not suitable for the SA50

120 watt module complete with built-in supply—extra heavy duty £22.50 Carr. 60p

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Carr. 30p

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Carr. 20p

Thousands sold of this extremely popular mono version. A mic input may be fitted using the VA30 (see below). Low consumption from a 9V battery. Features the same high standards of reproduction as the Stereo version. Controls: H/phone select, vol, Left deck vol, Right deck vol, bass, treble, master vol. Size 12½in x 3in x 2in deep.



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Only SAXON can supply such incredible value for money. This unit features 3kW power handling, full-wave control, bass, middle, treble AND master controls. Twin loudspeaker jacks for "through" connections. It may be used free standing or will panel mount next to either of the above. Also features unique CUT-BACK circuitry for extra wide range response. Size 12in x 3in x 2½in deep. Professional standards at a price you can afford!



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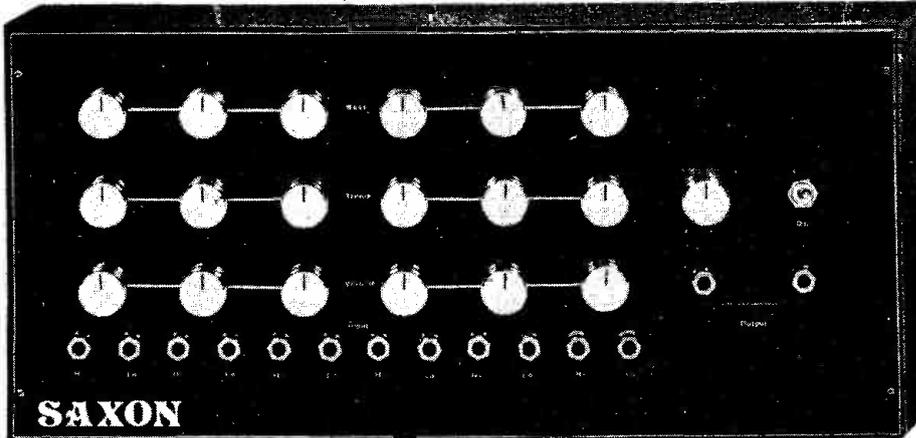
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M6HL

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Featuring multiples of our VA30 module, the M4HL and M6HL fulfil the requirements of all clubs, groups, etc. where a high quality mixer is required. Each channel has one high and one low impedance input, plus volume, treble and bass controls. Input impedances may, if required, be easily changed. The M4HL has four channels, and one output, and the M6HL six channels (12 inputs) and a master control and two outputs. Either unit may be used free-standing or panel mounted. These mixers will feed all types of amplifier. Recommended for their versatility and high performance, and excellent value for money.



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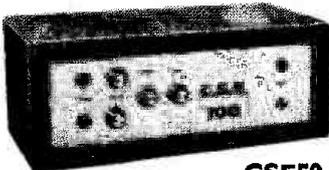
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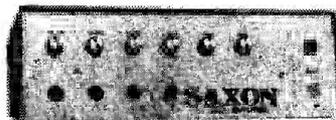
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100W of speech and music—Two separately controlled inputs. Wide range bass and treble controls. Sturdy and attractive vinyl case. Twin outputs. Ideal for groups, discos, etc. Fully tested and guaranteed. 50W version identical in appearance.



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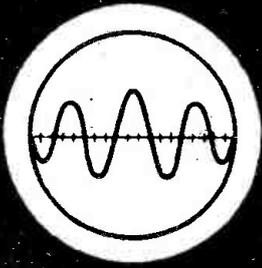
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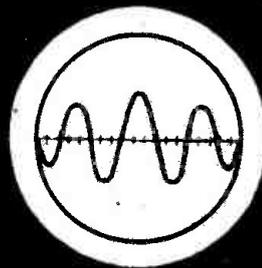
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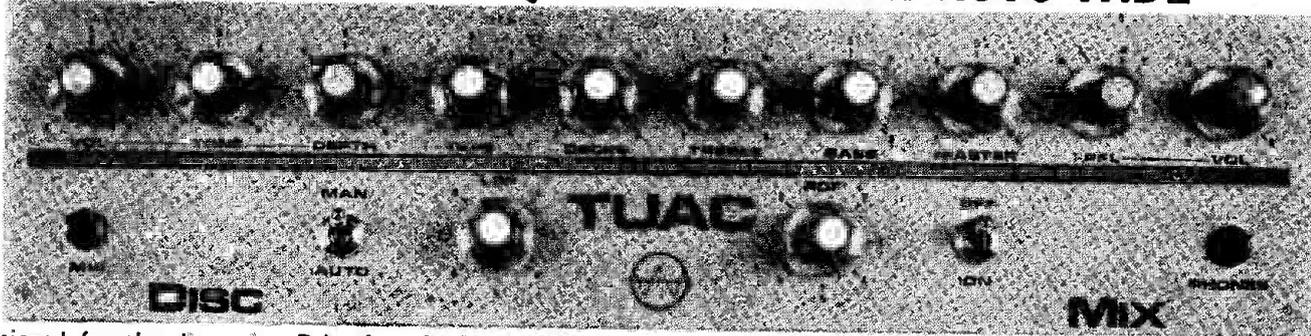


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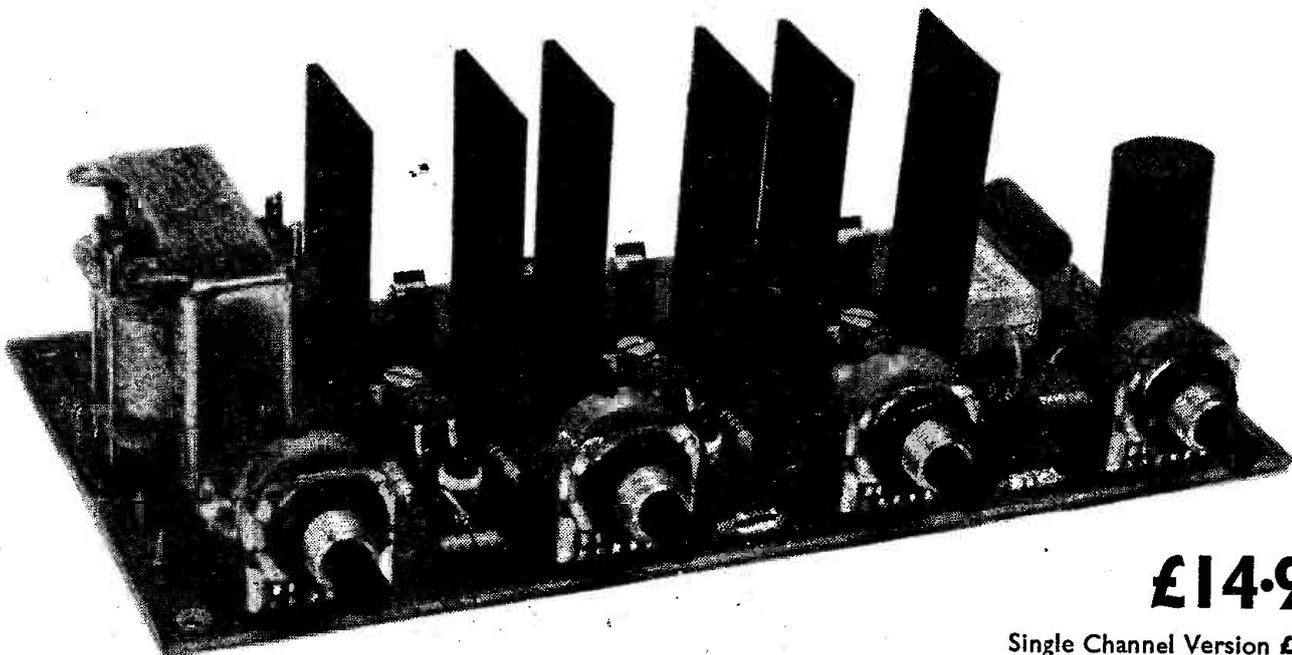
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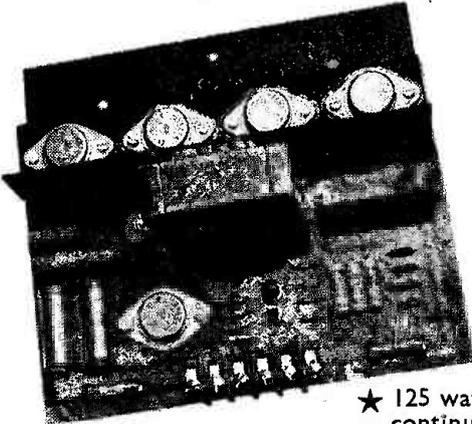


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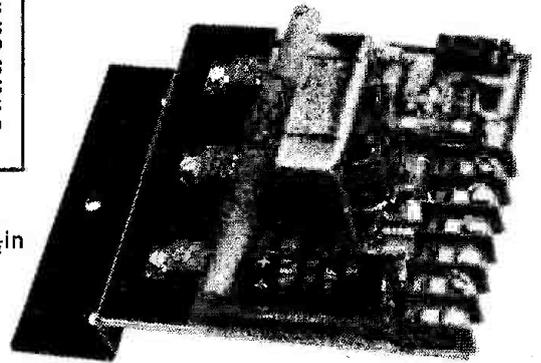
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- ★ 4 R.C.A. 150 watt 15 amp output transistors



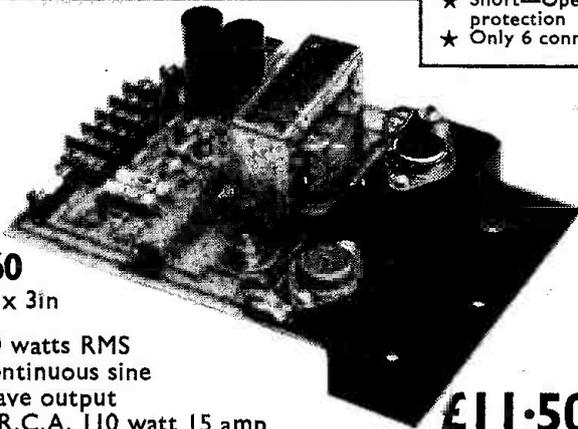
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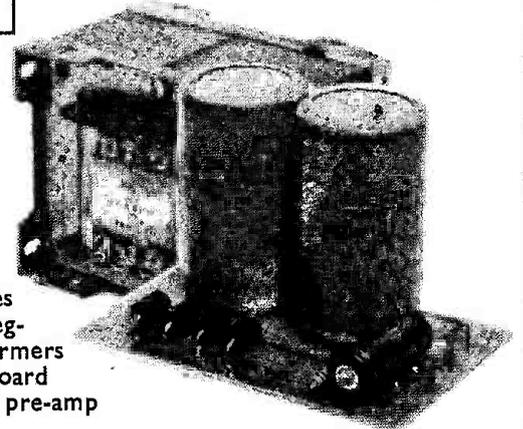
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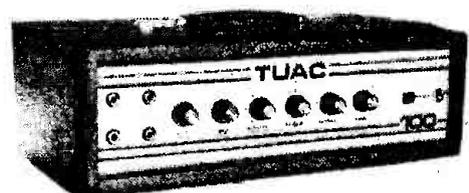
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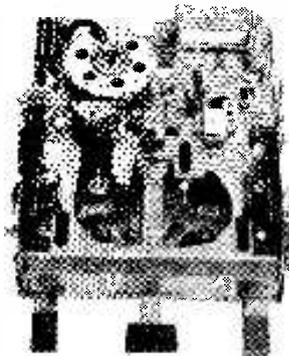
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Accredited by C.A.C.C. Member of A.B.C.C.

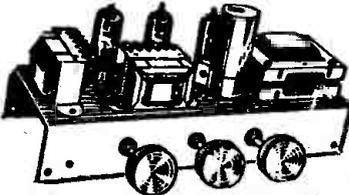
BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz-30KHz \pm 3dB. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7 1/2" deep. AC 200/250V. PRICE £13.50. P. & P. 50p.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up: 2 x ECL86 Triode Pentodes, 1 x EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11" w x 4" d. Overall height including valves 5". Ready built & tested to a high standard. £10.75. P.&P. 50p.

POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7.5v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" x 3 1/2" x 2 1/2". Suitable for Metal Rectifiers, Tape Recorders, Amplifiers etc. etc. Ready built and tested. PRICE £5.20 P. & P. 35p.

VYNAIR & BEXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £1.20 yd. length. P. & P. 15p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide x 3in. deep x 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer. £4.20 P. & P. 40p BARGAIN PRICE

FEW ONLY!

High grade mains transformer with grain orientated lamination. Primary 200/240 Secondary 18.5 volts at 0.6 amps and 4.6 volts at 0.3 amps. Size 2" h x 2 3/4" w x 2" d overall. £1.35 plus 25p P. & P.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long x 3 1/2in. wide x 3in. deep. Price £2.60 P. & P. 40p.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9-0-9 at 500 mA. £1.20. P. & P. 25p. Pri. 200/240v. Sec. 12-0-12 at 1 amp. £1.40. P. & P. 26p. Pri. 200/240v. Sec. 10-0-10 at 2 amp. £2.00. P. & P. 35p.

HI-GRADE COPPER LAMINATE BOARDS 8" x 6", Five for 70p plus 30p P. & P.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz-25KHz. Gain 26dB. Solid encapsulation size 1 1/2" x 1 1/2" x 1/2". Brand new complete with instructions. Price 1.20p. P. & P. 15p.

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY 40p. Post 5p.

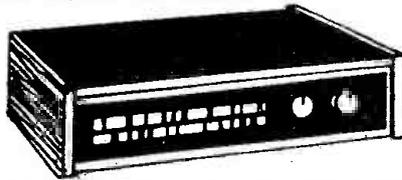
3 Reference Encyclopedias for Electronic Engineers and Designers, covering between them transistor characteristics, diode and transistor equivalents. Many thousands of up to date European types listed.

Diode Equivalents, 80p; Transistor Equivalents, 90p; Transistor Characteristics, £1.15; POST FREE All three together, £2.60

NEW ISSUE

Thyristor, Triac, Diac etc. encyclopedias 95p, Post Free 8 pole 3 way 2 bank low loss Yaxley type switches 1 1/2" sections. Standard spindle. 2 switches 64p + 10p P. & P.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER



Enjoy fabulous stereo radio at this fabulous low introductory price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-gain, low noise IF stages. Automatic frequency control to "lock-on" station and prevent drift. IC stereo decoder for maximum stereo separation. I.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12" wide x 8" deep by 2 1/2" high. Supplied ready built, fully tested and fully guaranteed (not available in kit form). Price £23.00 Post and Packing 50p.

STEREO-DECODER

SIZE 2" x 3" x 1 1/2" ready built. Pre-aligned and tested. Sens. 20-560 mV for 9-16V 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 (inclusive of hints and tips) supplied. £5.00 plus 10p. P. & P. Stereo beacon light if required 40p extra.



SPECIAL BARGAIN OFFER!

Limited number of BSR C123 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge. Brand new. ONLY £8.00 + p. & P. 60p.

LATEST Hi Sensitivity Uni-directional slim-line condenser microphone as used by many professionals. Very low acoustic feedback. Available hi impedance or low impedance. State which required. £13.50 plus 25p P. & P

LATEST ACOS GP91/LSC mono compatible cartridge with 1/0 stylus for LP/EP/78. Universal mounting bracket. £1.46. P. & P. 15p.

SONOTONE STAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. ONLY £2.27 P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £2.76. P. & P. 15p.

LATEST T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. £1.60 P. & P. 15p. **LATEST T/O MONO COMPATIBLE CARTRIDGE** for playing EP/LP/78 mono or stereo records on mono equipment. Only £1.47. P. & P. 15p.

QUALITY RECORD PLAYER AMPLIFIER MK. II

A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide x 3in. deep x 6in. high. Ready built and tested. PRICE £5.50. P. & P. 50p. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £6.70. P. & P. 60p.

HI-FI LOUSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16" high x 10 1/2" wide x 6" deep. Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, two H.F. tweeter units and crossover. Maximum power handling 10 watts. Available 3 or 8 or 15 ohms impedance.

OUR PRICE £9.50 Carr. 90p
Cabinet Available Separately £5.00, Carr. 90p
Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter £8.00, Carr. 90p.

LOUSPEAKER BARGAINS

5in. 3 ohm £1.25. P. & P. 15p. 7 x 4in. 3 ohm £1.40. P. & P. 20p. 10 x 6in. 3 or 15 ohm £2.10. P. & P. 30p. E.M.I. 8 x 5in. 3 ohm with high flux magnet £1.70. P. & P. 20p. E.M.I. 13 1/2 x 8in. with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm £3.50; P. & P. 30p. E.M.I. 13 x 8in. 3, 8 or 15 ohm with two inbuilt tweeters and crossover network £4.65. P. & P. 30p. E.M.I. tweeter. Approx. 3 1/2". Available 3 or 8 or 15 ohms, £1.25 + 20p. p. & p.

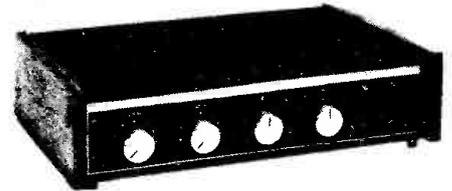
BRAND NEW Bakers Loudspeakers at substantial discounts. 12in. 15w. H/D Speakers, 3, 8 or 15 ohms. State which. Current production by well-known British maker. Now with HiFiux ceramic ferrobar magnet assembly £7.50. Guitar models: 26w £7.50. 35w, £7.50. P.&P. 45p.

12in. "RA" TWIN CONE LOUSPEAKER. 10 watts peak handling. 3 or 8 or 15 ohm (state which) £3.00. P. & P. 30p.

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

Size 11 1/2" x 14 1/2" x 1 1/2" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20KHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only £6.80 each. P. & P. 34p.

HARVERSONIC 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. Integrated 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 -16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12" w. x 8" d. x 2 1/2" h.

Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

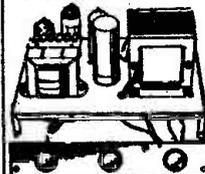
AMPLIFIER KIT £12.96 P. & P. 30p
(Magnetic input components 33p extra)
POWER PACK KIT £4.32 P. & P. 40p
CABINET £4.32 P. & P. 40p

(Post Free if all units purchased at same time)

Full after sales service

Also available ready built and tested £28.08. Post Free.

Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc. and will then provide mixing and fading facilities for medium powered Hi-Fi Discosque use, etc.



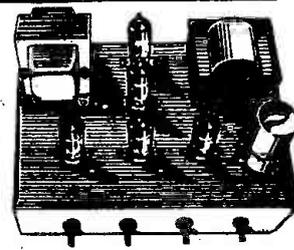
3-VALVE AUDIO AMPLIFIER HA34 MK II

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2" w. x 4 1/2" d. x 4 1/2" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4 1/2 watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £8.50. P. & P. 45p.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc £5.50 P. & P. 45p.

10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 8-15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 15p + SAE (Free with parts) All parts sold separately. ONLY £10.25 P. & P. 60p. Also available ready built and tested £14.00 P. & P. 70p.



HI-FI STEREO HEADPHONES

Adjustable headband with comfortable Hexifoam ear-muffs. Wired and fitted with standard stereo 3in jack plug. Frequency response 30-15,000Hz. Matching impedance 8-16 ohms. Easily converted for Mono. PRICE £3.50. P. & P. 25p.

PRICES INCLUDE VAT

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

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A few minutes from South Wimbledon Tube Station.

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SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES



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Educational & Government Departments
ALL PRICES INCLUDE VAT AT 8%

SPECIAL RESISTOR KITS (Prices include post & packing)

10E12 1/2W KIT: 10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%), £3.58 net
10E12 1W KIT: 10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%), £3.77 net
25E12 1/2W KIT: 25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%), £8.19 net
25E12 1W KIT: 25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%), £8.28 net
5E12 1/2W KIT: 5 of each E12 value, 10 ohms—1M, a total of 305 (METAL FILM 5%), £2.80 net
Due to current world shortages, resistor kits may contain some wattage and value substitutions.

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. Mounting: 0.01µF, 0.015µF, 0.022µF, 0.033µF, 0.047µF, 3 1/2p, 0.068µF, 0.1µF, 4 1/2p, 0.15µF, 4 1/2p, 0.22µF, 5 1/2p, 0.33µF, 8p, 0.47µF, 9p, 0.68µF, 12p 1µF, 15p, 1.5µF, 23p, 2.2µF, 26p.

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0.001µF, 0.0015µF, 0.0022µF, 0.0033µF, 0.0047µF, 2 1/2p, 0.0068µF, 0.01µF, 0.015µF, 0.022µF, 0.033µF, 3 1/2p, 0.047µF, 0.068µF, 0.1µF, 4 1/2p, 0.15µF, 6 1/2p, 0.22µF, 8p, 0.33µF, 12p, 0.47µF, 14p.

160V: 0.01µF, 0.015µF, 0.022µF, 0.033µF, 0.047µF, 0.068µF, 3 1/2p, 0.1µF, 4 1/2p, 0.15µF, 5p, 0.22µF, 5 1/2p, 0.33µF, 6 1/2p, 0.47µF, 8p, 0.68µF, 12p, 1µF, 14p.

MINIATURE CERAMIC FLAT CAPACITORS

50V: (pF) 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1K, 1K5, 2K2, 3K3, 4K7, 6K8, (µF) 0.01, 0.015, 0.022, 0.033, 0.047, 2 1/2p, each, 0.1-30V, 5p.

POLYSTYRENE CAPACITORS 160V 5%

(pF) 10, 15, 22, 33, 47, 68, 100, 150, 220, 330, 470, 680, 1000, 1500, 2200, 3300, 4700, 6800, 10,000, 4 1/2p.

RESISTORS

CF—High Stab Carbon Film, 5% MF—High Stab Metal Film, 5%.

W. Type	Range	1-99	100-499	500-999	1000+	Size mm
CF	22-1M	1	0.75	0.60	0.55	2.4x7.5
CF	22-2M2	1	0.75	0.60	0.55	3.9x10.5
CF	22-1M	1	0.75	0.60	0.55	5.5x16
MF	10-2M7	2	1.54	1.32	1.1	3x7
MF	10-2M2	2	1.43	1.21	0.99	4.2x10.8
1 MF	10-10M	3	1.98	1.81	1.65	6.6x13
2 MF	10-10M	4.5	3.52	3.08	2.75	8x17.5

For value mixing prices, please refer to our catalogue. (price in pence each).
VALUES AVAILABLE—E12 Series only. (Net prices above 100.)

PRESET SKELETON POTENTIOMETERS

MINIATURE 0.25W Vertical or horizontal 6p each 1K, 2K2, 4K7, 10K, etc. up to 1M Ω
SUB-MIN 0.05W Vertical, 100 Ω to 220K Ω 5p each.

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CATALOGUE No. 3 20p

Miniature Mullard Electrolytics

1.0µF 63V	6 1/2p	68µF 16V	6 1/2p
1.5µF 63V	6 1/2p	68µF 63V	12p
2.2µF 63V	6 1/2p	100µF 10V	6 1/2p
3.3µF 63V	6 1/2p	100µF 25V	6 1/2p
4.0µF 40V	6 1/2p	100µF 63V	14p
4.7µF 63V	6 1/2p	150µF 16V	6 1/2p
6.8µF 63V	6 1/2p	150µF 63V	15p
8.0µF 40V	6 1/2p	220µF 6.4V	6 1/2p
10µF 16V	6 1/2p	220µF 10V	6 1/2p
10µF 25V	6 1/2p	220µF 16V	8p
10µF 63V	6 1/2p	220µF 63V	21p
15µF 16V	6 1/2p	330µF 16V	12p
15µF 63V	6 1/2p	330µF 63V	25p
15µF 40V	6 1/2p	470µF 6.4V	9p
22µF 25V	6 1/2p	470µF 40V	20p
22µF 63V	6 1/2p	680µF 16V	15p
33µF 10V	6 1/2p	680µF 40V	25p
33µF 16V	6 1/2p	1000µF 16V	20p
33µF 40V	6 1/2p	1000µF 25V	25p
33µF 63V	6 1/2p	1500µF 4V	15p
47µF 10V	6 1/2p	1500µF 16V	25p
47µF 25V	6 1/2p	2200µF 10V	25p
47µF 63V	8p	3300µF 6.4V	26p

VEROBOARD 0.1 0.15

2 1/2 x 5"	36p	36p
2 1/2 x 3 1/2"	33p	25p
3 1/2 x 5"	42p	46p
3 1/2 x 3 1/2"	36p	36p
2 1/2 x 1"	9p	9p
2 1/2 x 5" (Plain)	—	19p
2 1/2 x 3 1/2" (Plain)	—	16p
5 x 3 1/2" (Plain)	—	29p
Insertion tool	73p	73p
Track Cutter	56p	56p
Pins, Pkt. 25	22p	22p

TRANSISTORS

AC127	16 1/2p	BC212L	12p
AC128	22p	BC213L	12p
BC107	11p	BC214L	18p
BC108	12p	OC44	18p
BC109	13p	OC71	13p
BC148	12p	OC81	16p
BC149	12p	OC170	23p
BC182L	12p	TIS43	33p
BC183L	12p	2N2926	11p
BC184L	13p	2N3702	11p

POTENTIOMETERS

Carbon Track 5K Ω to 2M Ω, log or lin (and 1K lin). Single, 16 1/2p Dual Gang 46p. Log single with switch 26p. Slider Pots. 10K, 100K, 500K, semi log 30mm, 34p, 45mm, 47p, 60mm, 55p.

DIODES

IN4001	6 1/2p	DIN 2 Pin	12p
IN4002	7 1/2p	3 Pin	13p
IN4003	9p	5 Pin 180°	16p
IN4004	90p	Std. Jack	20p
IN4005	12p	2.5mm jack	13p
IN4006	14p	Phono	6p
IN914	7p	SOCKETS	
IN916	7p	DIN 2 Pin	10p
BA100	10p	3 Pin	10p
OA5	42p	5 Pin 180°	12p
OA47	9p	Std. Jack	15p
OA81	11p	2.5mm Jack	13p
OA200	8p	Phono	6p

Integrated Circuits

µA709C	49p
µA741C	50p
µA723C	98p
ZN414	£1.30

PLUGS

DIN 2 Pin	12p
3 Pin	13p
5 Pin 180°	16p
Std. Jack	20p
2.5mm jack	13p
Phono	6p

SOCKETS

DIN 2 Pin	10p
3 Pin	10p
5 Pin 180°	12p
Std. Jack	15p
2.5mm Jack	13p
Phono	6p

ELECTROLYTIC CAPACITORS. Tubular & Large Cans

(µF/V): 1/25, 2/25, 4/25, 4.7/10, 5/25, 8/25, 10/10, 10/50, 16/25, 22/63, 25/25, 25/50, 32/25, 50/25, 100/10, 100/25, 6 1/2p, 50/50, 8p, 100/50, 200/25, 11p, 250/50, 18p, 500/10, 11p, 500/25, 15p, 500/50, 18p, 1000/10, 15p, 1000/25, 22p, 1000/50, 40p, 2000/10, 20p, 1000/100, 88p, 2000/25, 30p, 2000/100, 93p, 2500/25, 38p, 2500/50, 61p, 5000/25, 65p, 5000/50, £1.08.

HI-VOLT: 4/350, 14p, 8/350, 19p, 100/100 20p, 16/350, 22p, 16/450, 23p, 32/350, 33p, 50/250, 20p, 100/250, 30p.

METALLISED PAPER CAPACITORS

250V: 0.05µF, 0.1µF, 6p, 0.25, 6p, 0.5µF, 7 1/2p, 1µF, 9p, 500V: 0.025, 0.05, 6p, 0.1, 6p, 0.25, 7 1/2p, 0.5, 9p, 1000V: 0.01, 11p, 0.022, 13p, 0.047, 0.1, 15p, 0.22, 23p, 0.47, 34p.

Screened Wire, Metre

Twin Screened Wire, Metre	12p
Stereo Screened Wire, Metre	12p
Connecting Wire, All colours, Metre	21p
Neon Bulb, 90V Wire Ended	5 for 24p
Panel Neon, 240V Red, Amber, Clear	20p

ZENER DIODES

Low cost 400mW Tol ±7%
All values E24 series 3V-30V
1-24 25-99 100-499 1000—
9p 7 1/2p 6 1/2p 5 1/2p

MULTIMETER U4323

22 Ranges plus AF/IF Oscillator 20,000Ω/Volt.
Vdc—0.5—1000V in 7 ranges
Vac—2.5—1000V in 6 ranges
Idc—0.05—500mA in 5 ranges
Resistance—5Ω—1MΩ in 4 ranges.
Accuracy—5% of F.S.D.
OSCILLATOR—1 KHz and 465 KHz (A, M.) at approx. 1 Volt.
Size—160 x 97 x 40mm.
Supplied complete with carrying case, test leads and battery.
PRICE £8.30 net p & p 25p.

MULTIMETER U4341

27 Ranges plus Transistor Tester, 16,700Ω/Volt. Overload protected.
Vdc—0.3—900V in 8 ranges.
Vac—1.5—750V in 6 ranges.
Idc—0.06—600mA in 5 ranges.
Iac—0.3—300mA in 4 ranges.
Resistance—2KΩ—2MΩ in 4 ranges.
Accuracy—dc—2 1/2%, ac—4% of F.S.D.
hfe—10—350 in 2 ranges.
Size—115 x 215 x 90mm.
Complete with steel carrying case, test leads, and battery.
PRICE £11.30 net p & p 30p.

MULTIMETER U4324

34 Ranges. High sensitivity, 20,000Ω/Volt. Overload protected.
Vdc—0.6—1200V in 9 ranges.
Vac—3—900V in 8 ranges.
Idc—0.06—3A in 6 ranges.
Iac—0.3—3A in 5 ranges.
Resistance—25Ω—5MΩ in 5 ranges.
Accuracy—dc and R—2 1/2% of F.S.D. ac and db—1% of F.S.D.
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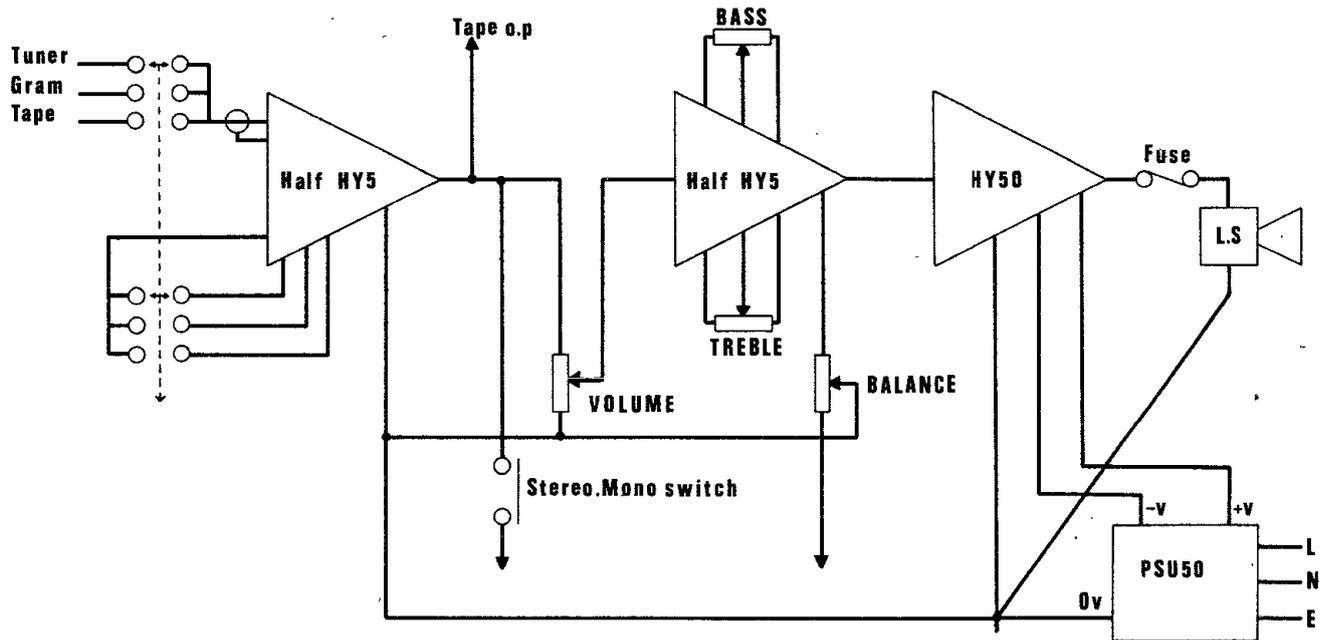
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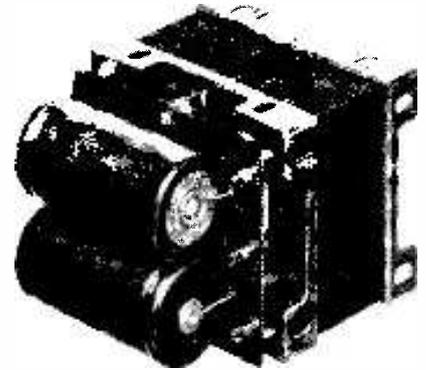
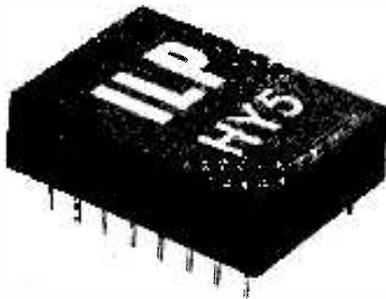


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Inputs: Magnetic Pick-up 3mV RIAA; Ceramic Pick-up 30mV; Microphone 10mV; Tuner 100mV; Auxillary 3-100mV; input/impedance 47kΩ at 1kHz. **Outputs:** Tape 100mV; Main output 0db (0.775V RMS). **Active Tone Controls:** Treble ± 12db at 10kHz; Bass ± 12db at 10kHz; Bass ± 12db at 100Hz. **Distortion:** 0.5% at 1kHz. **Signal/Noise Ratio:** 68db. **Overload Capability:** 40db on most sensitive input. **Supply Voltage:** ± 16-25V.

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TECHNICAL SPECIFICATION

Output Power: 25W RMS into 8kΩ. **Load Impedance:** 4-16Ω. **Input Sensitivity** 0db (0.775V RMS). **Input Impedance:** 47kΩ. **Distortion:** Less than 0.1% at 25W typically 0.05%. **Signal/Noise Ratio:** Better than 75db. **Frequency Response:** 10Hz-50kHz ± 3db. **Supply Voltage:** ± 25V. **Size:** 105 x 50 x 25mm.

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TECHNICAL SPECIFICATIONS

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AC107	0.22	AD162	0.39	BC149	0.13	BD124	0.76	BF181	0.33	MAT121	0.22	2G306	0.44	2N2160	0.66	2N2055	0.55	2N4059	0.11
AC113	0.20	AD161 &		BC150	0.20	BD131	0.55	BF182	0.44	MJE2955	0.95	2G308	0.39	2N2192	0.39	2N3391	0.16	2N1060	0.13
AC115	0.22	AD162(MP)	75	BC151	0.22	BD132	0.66	BF183	0.44	MJE3055	0.62	2G309	0.39	2N2193	0.39	2N3391A	0.18	2N4061	0.13
AC117K	0.22	ADT140		BC152	0.19	BD133	0.72	BF184	0.28	MJE3440	0.55	2G339	0.22	2N2194	0.39	2N3392	0.16	2N4062	0.13
AC122	0.18	AF114	0.27	BC153	0.31	BD135	0.44	BF185	0.33	MPP102	0.46	2G339A	0.18	2N2217	0.24	2N3393	0.16	2N4284	0.10
AC125	0.19	AF115	0.27	BC154	0.33	BD136	0.44	BF187	0.30	MPP104	0.41	2G344	0.20	2N2218	0.22	2N3394	0.16	2N4285	0.10
AC126	0.19	AF116	0.27	BC157	0.20	BD137	0.50	BF188	0.44	OC19	0.39	2G345	0.18	2N2219	0.22	2N3395	0.19	2N4286	0.10
AC127	0.20	AF117	0.27	BC158	0.13	BD138	0.55	BF194	0.13	OC20	0.70	2G371	0.18	2N2220	0.22	2N3402	0.28	2N4287	0.19
AC128	0.20	AF118	0.27	BC159	0.13	BD139	0.61	BF195	0.13	OC21	0.54	2G371B	0.13	2N2221	0.22	2N3403	0.23	2N4288	0.10
AC132	0.16	AF124	0.33	BC160	0.50	BD140	0.66	BF196	0.16	OC22	0.52	2G373	0.19	2N2222	0.22	2N3404	0.21	2N4289	0.19
AC134	0.16	AF125	0.33	BC161	0.55	BD155	0.88	BF197	0.16	OC23	0.54	2G374	0.19	2N2368	0.19	2N3405	0.46	2N4290	0.19
AC137	0.16	AF126	0.31	BC167	0.13	BD175	0.66	BF200	0.50	OC24	0.62	2G377	0.33	2N2369	0.16	2N3414	0.17	2N4291	0.10
AC141	0.20	AF127	0.31	BC168	0.13	BD176	0.66	BF222	£1.05	OC25	0.42	2G378	0.18	2N2369A	0.16	2N3415	0.17	2N4292	0.19
AC141K	0.32	AF129	0.33	BC169	0.13	BD177	0.72	BF257	0.50	OC26	0.32	2G381	0.18	2N2411	0.27	2N3416	0.21	2N4293	0.19
AC142	0.20	AF178	0.55	BC170	0.13	BD178	0.72	BF258	0.66	OC28	0.55	2G382	0.18	2N2412	0.27	2N3417	0.21	2N4294	0.19
AC142K	0.20	AF179	0.55	BC171	0.16	BD179	0.77	BF259	0.94	OC29	0.55	2G401	0.33	2N2646	0.52	2N3525	0.83	2N5294	0.60
AC151	0.17	AF180	0.55	BC172	0.16	BD180	0.77	BF262	0.61	OC35	0.46	2G414	0.33	2N2711	0.23	2N3614	0.74	2N5457	0.35
AC154	0.22	AF181	0.55	BC173	0.16	BD185	0.72	BF263	0.61	OC36	0.55	2G417	0.33	2N2712	0.23	2N3615	0.82	2N5458	0.35
AC155	0.22	AF186	0.55	BC174	0.16	BD186	0.72	BF270	0.39	OC41	0.22	2N388	0.39	2N2714	0.23	2N3616	0.82	2N5459	0.44
AC156	0.22	AF239	0.41	BC175	0.24	BD187	0.77	BF271	0.39	OC42	0.27	2N388A	0.61	2N2904	0.19	2N3646	0.62	2N6221	0.75
AC157	0.27	AL102	0.72	BC177	0.21	BD188	0.77	BF272	0.88	OC44	0.17	2N404	0.22	2N2904A	0.23	2N3702	0.13	28301	0.55
AC165	0.22	AL103	0.72	BC178	0.21	BD189	0.83	BF273	0.39	OC45	0.14	2N404A	0.31	2N2905	0.23	2N3703	0.13	28302A	0.46
AC166	0.22	ASY26	0.28	BC179	0.21	BD190	0.83	BF274	0.39	OC70	0.11	2N524	0.46	2N2905A	0.23	2N3704	0.14	28302	0.46
AC167	0.22	ASY27	0.28	BC180	0.27	BD195	0.94	BF275	0.39	OC71	0.11	2N527	0.46	2N2906	0.17	2N3705	0.13	28303	0.61
AC168	0.27	ASY28	0.28	BC181	0.27	BD198	0.94	BF276	0.39	OC72	0.16	2N598	0.46	2N2906A	0.20	2N3706	0.13	28304	0.77
AC169	0.16	ASY29	0.28	BC182	0.16	BD197	0.99	BF284	0.34	OC74	0.16	2N599	0.50	2N2907	0.22	2N3707	0.14	28305	0.86
AC176	0.22	ASY50	0.28	BC182L	0.16	BD198	0.99	BF285	0.33	OC75	9.17	2N696	0.14	2N2907A	0.24	2N3708	0.09	28306	0.86
AC177	0.27	ASY51	0.28	BC183	0.16	BD199	£1.05	BF286	0.24	OC76	0.17	2N697	0.15	2N2923	0.16	2N3709	0.10	28307	0.86
AC178	0.31	ASY52	0.28	BC183L	0.16	BD200	£1.05	BF287	0.27	OC77	0.28	2N698	0.27	2N2924	0.16	2N3710	0.10	28321	0.62
AC179	0.31	ASY54	0.28	BC184	0.22	BD205	0.88	BF288	0.24	OC81	0.17	2N699	0.39	2N2925	0.16	2N3711	0.10	28322	0.46
AC180	0.22	ASY56	0.28	BC184L	0.22	BD206	0.88	BF289	0.24	OC81D	0.17	2N706	0.09	2N2926(G)	14	2N3819	0.31	28322A	0.46
AC180K	0.32	ASY56	0.28	BC186	0.31	BD207	£1.05	BF290	0.22	OC82	0.17	2N706A	0.10	2N2926(Y)	12	2N3820	0.55	28325	0.62
AC181	0.22	ASY57	0.28	BC187	0.31	BD208	£1.05	BF291	0.22	OC82D	0.17	2N708	0.13	2N2926(O)	11	2N3821	0.39	28324	0.77
AC181K	0.32	ASY58	0.28	BC207	0.12	BDY20	£1.10	BFY53	0.19	OC83	0.22	2N711	0.33	2N2926(R)	11	2N3823	0.31	28325	0.77
AC187	0.24	ASY73	0.28	BC208	0.12	BF115	0.27	BSX19	0.17	OC139	0.22	2N717	0.39	2N2926(B)	11	2N3903	0.31	28326	0.77
AC187K	0.24	ASZ21	0.44	BC209	0.13	BF117	0.50	BSX20	0.17	OC140	0.22	2N718	0.27	2N3010	0.77	2N3904	0.33	28327	0.77
AC188	0.24	BC107	0.14	BC212L	0.14	BF118	0.77	BSY25	0.17	OC169	0.25	2N718A	0.55	2N3011	0.16	2N3905	0.31	28701	0.44
AC188K	0.25	BC108	0.15	BC213L	0.14	BF119	0.77	BSY26	0.17	OC170	0.25	2N726	0.31	2N3063	0.19	2N3906	0.30	40361	0.46
AOY17	0.28	BC109	0.14	BC214L	0.18	BF121	0.50	BSY27	0.17	OC171	0.28	2N727	0.31	2N3064	0.51	2N4058	0.13	40362	0.50
ACY18	0.22	BC113	0.11	BC225	0.28	BF123	0.55	BSY28	0.17	OC200	0.28	2N743	0.22						
ACY19	0.22	BC114	0.17	BC226	0.28	BF125	0.55	BSY29	0.17	OC201	0.31	2N744	0.22						
ACY20	0.22	BC115	0.17	BC301	0.30	BF127	0.55	BSY30	0.20	OC202	0.31	2N914	0.16						
ACY21	0.22	BC116	0.17	BC302	0.27	BF152	0.61	BSY39	0.20	OC203	0.28	2N918	0.33	AA119	0.09	BY128	0.17	OA10	0.15
ACY22	0.18	BC117	0.20	BC303	0.35	BF153	0.50	BSY40	0.31	OC204	0.28	2N929	0.23	AA120	0.09	BY130	0.16	OA47	0.08
ACY27	0.20	BC118	0.11	BC304	0.40	BF154	0.50	BSY41	0.31	OC205	0.39	2N930	0.23	AA129	0.09	BY133	0.23	OA70	0.08
ACY28	0.21	BC119	0.33	BC440	0.34	BF155	0.77	BSY95	0.14	OC309	0.44	2N1131	0.22	AA130	0.10	BY164	0.55	OA79	0.08
ACY29	0.39	BC120	0.88	BC460	0.40	BF156	0.53	BSY95A	0.14	OC309	0.44	2N1132	0.24	AAZ13	0.11	BYX38/300-46	0A81	0.08	
ACY30	0.31	BC125	0.13	BCY30	0.27	BF157	0.61	Bu105	£2.20	ORP12	0.48	2N1302	0.16	BA100	0.11	BYZ10	0.39	OA85	0.10
ACY31	0.31	BC126	0.20	BCY31	0.29	BF158	0.61	C111E	0.55	ORP60	0.44	2N1303	0.16	BA116	0.23	BYZ11	0.33	OA90	0.07
ACY34	0.23	BC132	0.13	BCY32	0.23	BF159	0.66	C400	0.55	ORP61	0.44	2N1304	0.19	BA126	0.24	BYZ12	0.33	OA91	0.07
ACY35	0.23	BC134	0.20	BCY33	0.24	BF160	0.44	C407	0.28	P20	0.55	2N1305	0.19	BA148	0.16	BYZ13	0.23	OA95	0.08
ACY36	0.19	BC136	0.13	BCY34	0.24	BF162	0.44	C424	0.28	P346A	0.28	2N1306	0.23	BA154	0.13	BYZ16	0.44	OA200	0.07
ACY40	0.19	BC138	0.17	BCY70	0.16	BF163	0.44	C425	0.55	P397	0.46	2N1307	0.23	BA155	0.16	BYZ17	0.39	OA202	0.08
ACY41	0.20	BC137	0.17	BCY71	0.22	BF164	0.44	C426	0.39	RT140	0.14	2N1308	0.26	BA156	0.15	BYZ18	0.39	SD10	0.06
ACY44	0.39	BC139	0.44	BCY72	0.16	BF165	0.44	C428	0.22	RT141	0.19	2N1309	0.26	BA173	0.16	BYZ19	0.31	SD19	0.06
AD130	0.42	BC140	0.33	BCZ10	0.22	BF167	0.24	C441	0.83	TIS43	0.34	2N1613	0.22	BY100	0.17	CG62	1N34	0.08	
AD140	0.53	BC141	0.33	BCZ11	0.23	BF173	0.24	C442	0.39	UT46	0.30	2N1711	0.23	BY101	0.13	(OA91 Eq)-0.06	1N34A	0.08	
AD142	0.53	BC142	0.33	BCZ12	0.23	BF176	0.39	C444	0.38	ZN414	£1.20	2N1889	0.35	BY105	0.19	CG651-	1N914	0.08	
AD143	0.42	BC143	0.33	BD115	0.68	BF177	0.39	C450	0.24			2N1890	0.50	BY114	0.13	(OA70-79)-0.07	1N916	0.06	
AD149	0.55	BC145	0.50	BD116	0.68	BF178	0.33	CAT100	0.21			2G3802	0.21	BY124	0.18	OA5	0.39	1N4148	0.06
AD161	0.39	BC147	0.11	BD121	0.66	BF179	0.33	CAT101	0.22			2G3803	0.21	BY126	0.16	OA5 short	18021	0.11	
		BC148	0.11	BD123	0.72	BF180	0.33	MAT120	0.22			2G3804	0.27	BY127	0.17	leads	0.23	18951	0.07

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AA130	0.10	BY164	0.55	OA79	0.08		
AAZ13	0.11	BYX38/300-46	0A81	0.08			
BA100	0.11	BYZ10	0.39	OA85	0.10		
BA116	0.23	BYZ11	0.33	OA90	0.07		
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Q23	10 OA 202 Silicon diodes sub-min.	0.55
Q24	8 OA 81 diodes	0.55
Q25	15 IN914 Silicon diodes 75 PIV 75mA	0.55
Q26	8 OA95 Germanium diodes sub-min IN69	0.55
Q27	2 10A PIV Silicon rectifiers 18425E	0.55
Q28	2 Silicon power rectifiers BYZ 13	0.55
Q29	4 Silicon transistors 2 x 2N698, 1 x 2N697, 1 x 2N698	0.55
Q30	7 Silicon switch transistors 2N706 NPN	0.55
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Q32	3 PNP Silicon transistors 2 x 2N1131, 1 x 2N1132	0.55
Q33	3 Silicon NPN transistors 2N1711	0.55
Q34	7 Silicon NPN transistors 2N2369, 500MHz (code P397)	0.55
Q35	3 Silicon PNP TO-5. 2 x 2N2904 & 1 x 2N2905	0.55
Q36	7 2N3646 TO-18 plastic 300 MHz NPN	0.55
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UIC42	=5 x 7442	0.55	UIC81	=5 x 7481	0.55	UIC199	=5 x 74199	0.55
UIC43	=5 x 7443	0.55	UIC82	=5 x 7482	0.55			
UIC44	=5 x 7444	0.55	UIC83	=5 x 7483	0.55			
UIC45	=5 x 7445	0.55	UIC86	=5 x 7486	0.55			

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U 5	60 200mA Sub-Min. Silicon Diodes	0.55
U 6	30 Sil. Planar Trans. NPN like BSY95A, 2N706	0.55
U 7	16 Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0.55
U 8	50 Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0.55
U 9	20 Mixed Voltages, 1 Watt Zener Diodes	0.55
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U20	12 1.5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0.55
U21	30 AF. Germanium Alloy Transistors 2G300 Series & OC71	0.55
U23	MADT's like MHz Series PNP Transistors	0.55
U24	20 Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0.55
U25	25 300 MHz NPN Silicon Transistors 2N708, BSY27	0.55
U26	30 Fast Switching Silicon Diodes like IN914 Micro-Min.	0.55
U29	10 1 Amp SCR's TO-5 can, up to 600 PIV CR81/25-600	1.10
U32	25 Zener Diodes 400mW DO-7 case 3-18 volts mixed	0.55
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U34	30 Silicon PNP Alloy Trans. TO-5 BCY26 2S302/4	0.55
U35	25 Silicon Planar Transistors PNP TO-18 2N2906	0.55
U36	Silicon Planar NPN Transistors TO-5 BFY50/51/52	0.55
U37	30 Silicon Alloy Transistors 80-2 PNP OC200, 2S322	0.55
U38	20 Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0.55
U39	30 R.F. Germ. PNP Transistors 2N1303/5 TO-5	0.55
U40	10 Dual Transistors 5 lead TO-5 2N2060	0.55
U43	25 Sil. Trans. Plastic TO-18 A.F. BC113/114	0.55
U44	20 Sil. Trans. Plastic TO-5 BC115/116	0.55
U45	7 3A SCR. TO86 up to 600PIV	1.10
U46	20 Unijunction transistors similar to TIS43	0.55
U47	10 TO220AB plastic triacs 50V 5A	£1.10
U48	9 NPN Sil. power transistors like 2N3055	£1.10
U49	12 NPN Sil. plastic power trans. 60W like 2N5294/5296	£1.10

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

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100	0-05	0-07	1N4002	0-06	0-10	0-17	0-23	0-75
200	0-06	0-10	1N4003	0-07	0-12	0-22	0-25	1-00
400	0-08	0-15	1N4004	0-08	0-15	0-20	0-28	1-25
600	0-09	0-17	1N4005	0-10	0-18	0-26	0-35	1-90
800	0-12	0-19	1N4006	0-11	0-20	0-28	0-35	2-10
1000	0-14	0-20	1N4007	0-12	0-25	0-48	0-65	2-50
1200	—	0-25	—	0-30	0-58	0-75	3-00	—

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100	0-28	0-37	0-52	0-52	0-55	0-64	0-70	1-84
200	0-39	0-41	0-64	0-64	0-83	0-83	1-76	—
400	0-48	0-52	0-82	0-82	0-74	0-83	1-03	1-93
600	0-59	0-63	0-75	0-75	0-85	1-07	1-38	—
800	0-70	0-77	0-88	0-88	0-99	1-32	1-65	4-40

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THINGS TO COME

WITH the year of 1974 almost behind us—what of 1975? During 1974 Practical Wireless introduced to the constructor the first build-it-yourself TV tennis game and now it is universally known as P.W. Tele-Tennnis.

The popularity of this design has been immense, and to those readers who visited our stand at the recent International Audio Festival & Fair especially to see P.W. Tele-Tennis in operation, we trust that you all got your chance to have a go—despite the queues. Interest was high, especially with regard to our new range of constructional projects that were on display and that we have especially commissioned for the New Year. To start 1975 off, we are featuring in the January issue of Practical Wireless Part 1 of a constructional series on model control by radio. A radio controlled boat—using the system to be described—was on display on our stand at the Audio Fair.

A new version of the popular Texan Amplifier was also on display. This was of Swedish origin and the manufacturers expect to introduce the kit to the U.K. market during 1975. Known as the Texan U66, it had in addition to numerous extra features, a push button FM tuner! We shall be giving brief details of this interesting design in our February issue.

Author, Richard Mann of Texas Instruments Limited, designer of the original P.W. Texan amplifier is currently engaged in updating and uprating the original design. This amplifier was especially designed for Practical Wireless magazine by Richard Mann in 1972. Full constructional details on this Mk II version will be published in Practical Wireless during 1975.

The February issue of Practical Wireless features the P.W. Ascot Stereo Cassette Deck. Especially designed for home hi-fi systems, it utilises a Goldring tape transport mechanism and also includes dynamic noise reduction. Start building the P.W. Ascot with the February issue.

Our March issue will feature Part 1 of the P.W. Easy-Build Electronic Organ—for use with home hi-fi systems. For those readers who require further details of these unique P.W. constructional projects and do not want to miss other new and exciting P.W. constructional designs that will be appearing in 1975 we recommend that you order P.W. on a regular basis.

To our many readers
wherever you may be—
the Editor and staff of
PRACTICAL WIRELESS
wish you all
seasonal greetings
and a prosperous 1975.

Do not miss out—place a regular order with your local newsagent or alternatively write to our Subscription department, details are given on page 777.

LIONEL E. HOWES—Editor.

NEWS...

'Look ahead' Radar

LARGE modern tankers may have little time to spare for manoeuvre in a potentially dangerous situation. A fully automatic radar system can speed up the work of the watch officer and provide those extra vital seconds. With this in mind, four new Shell tankers are getting the Predictor system of anti-collision radar. Predictor was developed by Marconi Marine with co-operation from Shell International Marine.

When the equipment is fitted to the new tankers Limnea, Liparus and Lancella (all 300,000 tonners) and the liquified natural gas carrier Genota, 15 Shell tankers will be carrying Predictor radar.

Predictor was the first commercial radar system which released the navigating officer from the task of manually assessing other ships' movements. As its name implies, it enabled him to 'see ahead'. Predictor gives the navigating officer an accurate prediction of the effect a contemplated change of course or speed by his ship would have on the entire radar scene, before he actually takes any such action.

Predictor was also the first system to provide fully automatic plotting of all targets visible on the radar screen. It shows up all above-surface objects—ships, coastlines or buoys—in its area. Simply by pressing a switch, and without the need for any prior action or calculation, the tracks of all fixed and moving objects are plotted continuously. The Predictor presents them either in relative motion—relative, that is, to the radar-carrying ship in its present position—or true motion. The plot is updated every 10 seconds, but situations up to 18 minutes previously can be shown.

When the Predictor system was originally being developed, Marconi approached members of Marine Operational Services division in Shell International Marine. They were sufficiently impressed with the Predictor approach to suggest that when a prototype model was available it should be tested on a Shell tanker.

Practical Wireless Tele-Tennis on BBC's "Nationwide" programme



MIKE HUGHES, the author of *P.W. Tele-Tennis*, was recently interviewed on BBC's "Nationwide" programme.

It was suggested by the interviewer, pretty Suzanne Hall, that all the equipment one required for playing our armchair tennis game was a soldering iron and a pair of slippers!

It was stated on the programme that most of the 12,000 television tennis games are situated in pubs and clubs but the *Practical Wireless* design was the only do-it-yourself game available for the home constructor.

Mike Hughes explained to viewers that the *P.W. Tele-Tennis* had been designed with the home constructor in mind and that it employed integrated circuits and printed circuit boards. The aver-

age constructor could build it providing he had some ability to carry out the soldering and follow a circuit layout.

When asked how the Tele-Tennis worked in relation to an ordinary television set, Mike Hughes explained that at the back of the Tele-Tennis case, there was a socket, just like the aerial socket on the back of a TV receiver. All that was needed was a length of cable like TV aerial downlead cable with a standard co-axial plug each end. One end plugged into the game and the other end plugged into the TV aerial socket. The game was then connected to the mains and switched on. The next move was then to tune the TV to a spare channel just as if one were tuning in a normal television programme.

Suzanne Hall asked if the unit could be adapted to play other games and Mike Hughes replied, "Yes, in fact the basic game we are looking at here is very fundamental. It can be turned into a football or basket-ball game but I must admit some of them stretch the imagination a little."

Mike then played a few games of Tele-Tennis with Suzanne Hall and explained to viewers that he was not the real expert. The Tele-Tennis 'champ' was his seven-year-old son, Andrew.

Admitting defeat, Suzanne concluded the interview and admitted she was not quite quick enough on the trigger. She told Mike Hughes that she would have to have a lot more practice before she could win a game of Tele-Tennis.

Mullard Data Book

A NEW feature of the 1974/75 edition of the Mullard Data Book is brief data on radio, audio and TV modules and TV assemblies.

The traditional formula has been changed slightly to show ICs separately. The full ranges of valves, TV picture tubes, semiconductors, capacitors, resistors and other components for entertainment applications are fully covered.

As before, different coloured papers are used for each of the main products sections, i.e. blue for semiconductors and ICs;

orange for valves and TV picture tubes; green for capacitors, resistors, modules and assemblies.

Copies may be obtained from local booksellers or *Technical Press Limited, Freeland, Oxford OX7 2AP.* for 40p.

IBA Journal

THE Independent Broadcasting Authority has launched a new quarterly journal of opinion with the object, as the foreword describes, "Of presenting the opportunity to provide frank accounts of the problems the Authority must face and the

elements which go into deciding its policies and plans".

The journal is also to give a wide range of people, as well as those engaged in broadcasting, a chance to present their own views about the many opinions expressed in it or to raise any fresh issues for examination in future editions.

The first issue contains articles on "Impartiality in Broadcasting", "Future pattern of the ILR", "Television Coverage", "Role of Television in Science Education."

For further information, contact the *Editor, Independent Broadcasting, IBA, 70 Brompton Road, London, SW3 1EY.*

low frequency & marine receiver

PART
1

CHARLES HEATH

MANY receivers provide no tuning coverage over the frequency range of about 300kHz to 550kHz, this being the "gap" between the long wave band of approximately 150-300kHz, and the medium wave band extending from about 550kHz to 1,500kHz. Such receivers usually have an intermediate frequency of around 470kHz, which lies between these LW and MW bands.

By adopting an IF of 1.6MHz it is possible to arrange tuning to give continuous coverage, thereby including the 600m or 500kHz shipping band, as well as other signals using adjacent frequencies. The receiver described here does in fact have three bands, with continuous coverage from 150kHz to 5MHz (except for a small gap at the 1.6MHz IF). These ranges therefore include ship and shore; 1.8-2.0MHz and 3.5-3.8MHz amateur bands; 2.5MHz standard frequency transmissions; other signals in these ranges, as well as the usual medium and long wave bands.

Ranges are selected with a bandswitch, and are approximately as follows:

Range 1.	150-470kHz.	2000-640m.
Range 2.	470-1500kHz.	640-200m.
Range 3.	1.55-5.0MHz.	190-60m.

The receiver will operate with AM (amplitude modulation), CW (Morse) and SSB (single sideband) signals, which will be found in the broadcast, amateur, and other bands covered.

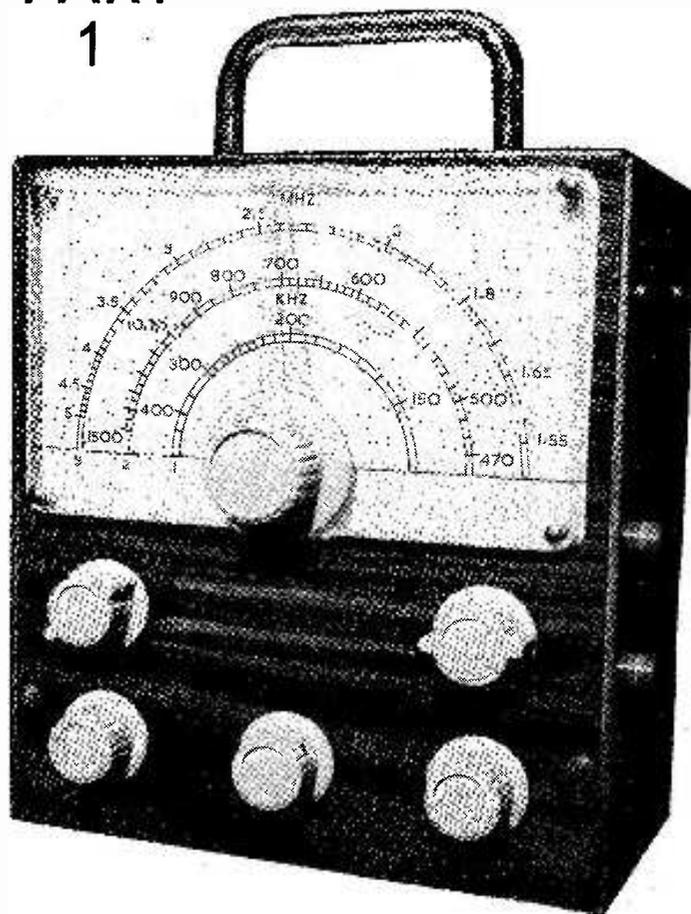
Circuitry is confined to three boards; mixer, oscillator and IF sections, BFO unit, and 3-stage audio amplifier.

MIXER AND OSCILLATOR

Fig. 1 shows this part of the circuit. S1 and S2 select the aerial coils L1, L2 or L3 as required. S3 and S4 are the remaining sections of the 3-way switch, and select oscillator coils L4, L5 or L6, each with its own padder capacitor, C7, C8 or C9.

The $2 \times 500\text{pF}$ tuning capacitor VC1/2 is operated by a dual ratio ball drive. As a panel trimmer TC1 is provided, with a fixed capacitor, C10, in the oscillator section, individual trimmers for each coil are not necessary. Even if individual trimmers were fitted for each range, changes to the aerial might upset alignment, while the use of TC1 does make sure this circuit can be peaked up at any frequency.

Tr1 is gate-protected, with signals at gate 1, oscillator injection at gate 2, and the drain circuit running to the first IF transformer.



IF AMPLIFIER

This is on the same board, using the circuit in Fig. 2, and operates at 1.6MHz. IFT1 and IFT2 are double tuned, and IFT3 is single tuned. These IFT's are pre-set by the manufacturer, the cores of which should not be adjusted except for final alignment after construction is completed.

Automatic gain control is applied to Tr3 through R12 and R7 in the usual way, while VR1 constitutes the audio gain or volume control.

R9 can be 560 ohms. However, the actual gain of Tr3 and Tr4 may vary quite widely. If gain is high, instability arises, and whistles accompany all signals. It is then necessary to increase R9 in value. On the other hand, where gain is low, R9 can be of lower value, or might in some cases be omitted completely. R9 therefore is not critical, but efficiency is at a maximum when the value here is the lowest which prevents instability. There is probably no point in having available more than three or four possible values, such as 100, 330, 560 ohm, and perhaps 1k Ω .

BFO UNIT

The beat frequency oscillator is constructed on a separate board, using the circuit in Fig. 3. (If this section is omitted, the receiver is suitable for reception of AM only, from 150kHz to 5MHz.)

The BFO operates at 1.6MHz, and is set to this frequency by rotating the core of L7, with VC4 half

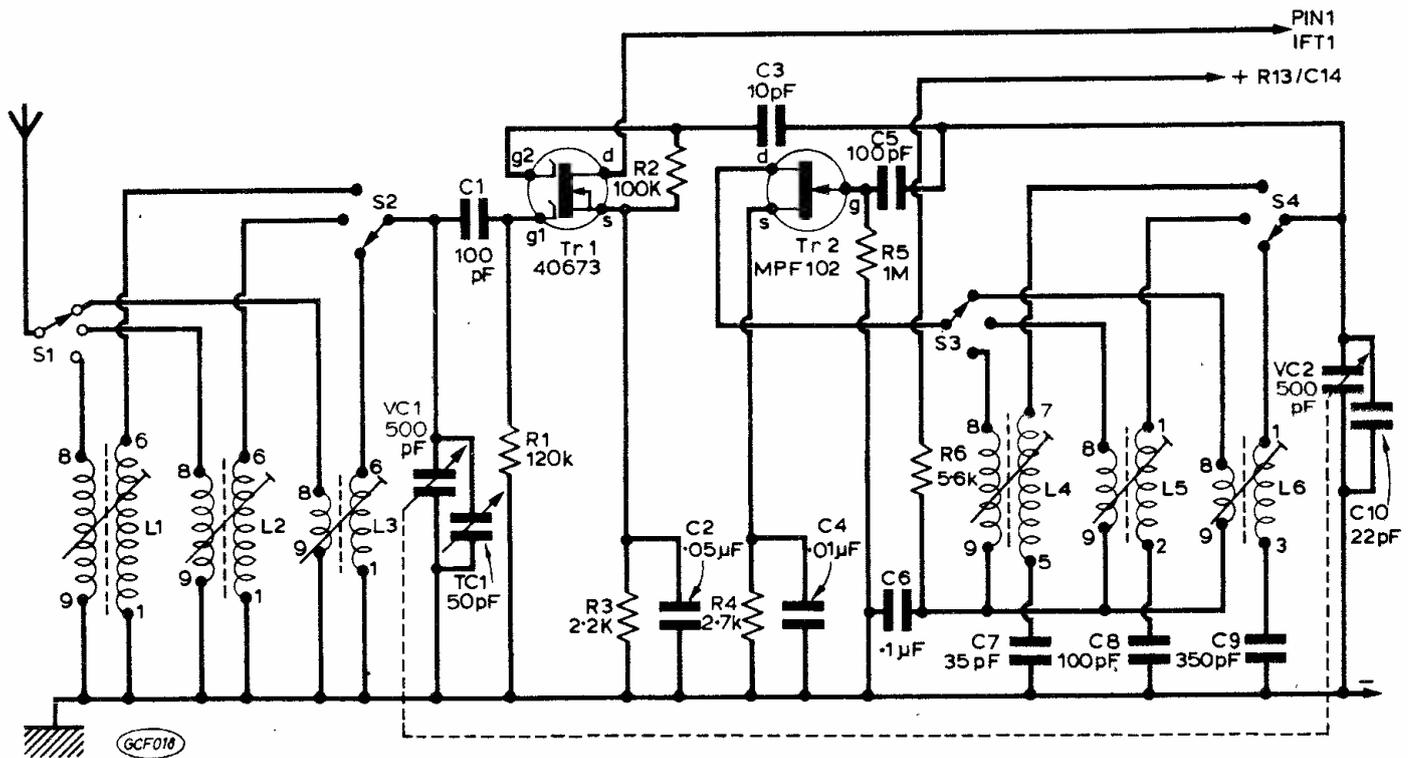


Fig. 1: Circuit of the mixer and oscillator stages of the Marine receiver. For simplicity the remaining stages are shown as separate diagrams. Band switches S1 to S4 are ganged.

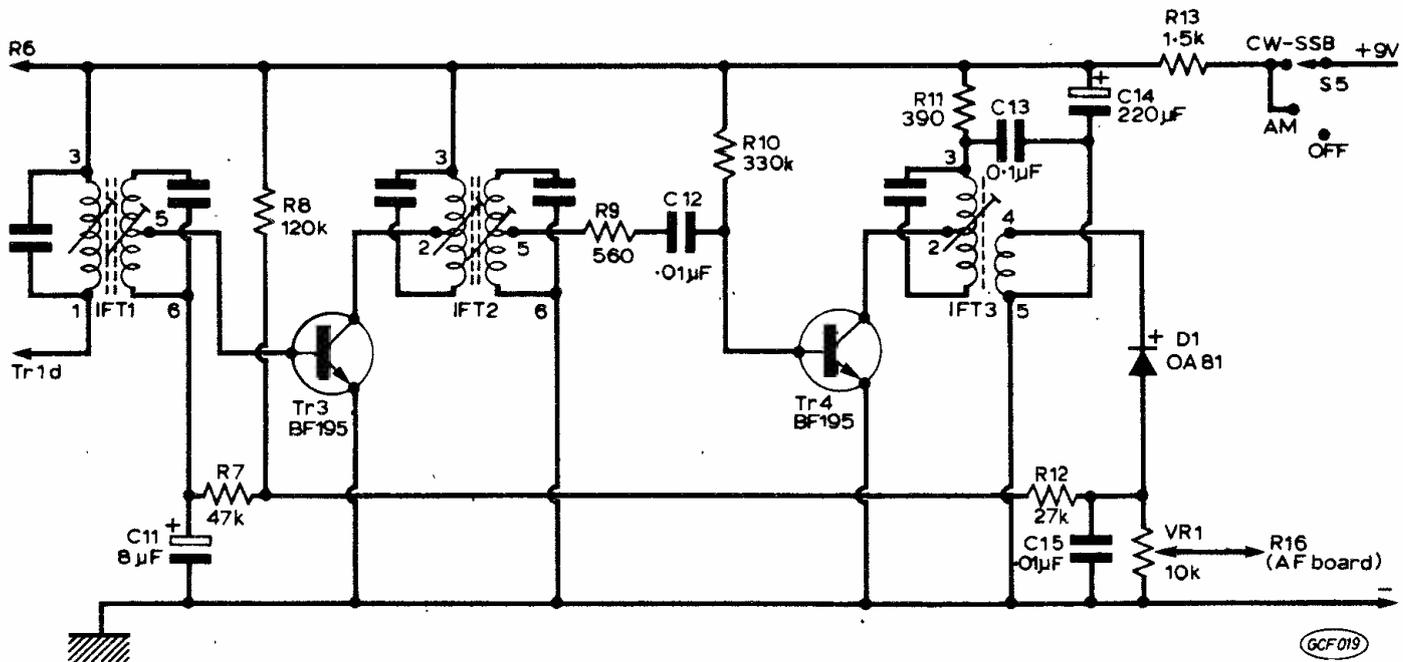


Fig. 2: The IF amplifier, circuit shown here, is built on a common circuit board with the mixer/oscillator.

closed. The frequency can then be shifted either side the IF by turning VC4. This allows an audible beat frequency to be obtained for CW reception, or allows the reception of SSB signals by adjusting the oscillator to the frequency of the suppressed carrier.

S5 (Fig. 4) and S6 has three positions, these being "Off," "AM" and "CW-SSB" reception. Tr5 operates in the last position only. The large capacitor C19 prevents frequency modulation at voice frequency by smoothing out the fluctuating current demand on the battery made by the output stage, at other than

low-volume levels.

AUDIO AMPLIFIER

This has three stages and is constructed on its own board (Figs. 4 and 9). Tr6 is a pre-amplifier, followed by the driver Tr7, and push-pull output stage Tr8/9. Quiescent current is pre-set by the adjustable resistor VR2, which gives good gain and volume, depending upon operating conditions and transistors used. It is preferable that Tr8/9 are a matched pair. Many other transistors of comparable type will be suitable as driver and for output purposes.

★ components list

Resistors

R1 120k Ω
 R2 100k Ω
 R3 2.2k Ω
 R4 2.7k Ω
 R5 1M Ω
 R6 5.6k Ω
 R7 47k Ω
 R8 120k Ω
 R9 560 Ω
 R10 330k Ω
 R11 390 Ω
 R12 27k Ω
 R13 1.5k Ω
 VR1 10k Ω log potentiometer

Capacitors

C1 100pF
 C2 0.05 μ F
 C3 10pF
 C4 0.01 μ F
 C5 100pF Silver Mica
 C6 0.1 μ F
 C7 35pF 1% Silver Mica
 C8 100pF 1% Silver Mica
 C9 350pF 1% Silver Mica
 C10 22pF SM
 C11 8 μ F 6.4V electrolytic
 C12 0.01 μ F
 C13 0.1 μ F
 C14 220 μ F 10V electrolytic
 C15 0.01 μ F
 VC1/VC2 Polar 2 x 500pF gang with feet. (Home Radio)
 TC1 50pF Jackson C804

Inductors

L1 Blue, Range 1
 L2 Blue, Range 2
 L3 Blue, Range 3
 L4 White, Range 1
 L5 White, Range 2
 L6 White, Range 3
 All miniature, valve type (Denco)

Semiconductors

Tr1 40673
 Tr2 MPF102
 Tr3 BF195
 Tr4 BF195
 D1 OA90

Miscellaneous

IFT1/2 (Denco IFT18/1-6), IFT3 (Denco IFT17),
 Veroboard (0.15in. matrix,) 3½ x 4in., Switch (S1-S4)
 4-pole 3-way rotary.

BFO BOARD

Resistors

R14 270k Ω
 R15 5.6k Ω

Capacitors

C16 180pF
 C17 330pF Silver Mica
 C18 5000pF
 C19 220 μ F 10V electrolytic
 VC4 15pF Jackson C804

Inductors

L7 55 turns 32swg enamelled wire on 7/16 in.
 diameter cored former.

Semiconductors

Tr5 BC107

Miscellaneous

Veroboard (0.15in matrix) 2½ x 2½in., Switch (S5-S6)
 2-pole 3-way rotary.

AUDIO BOARD

Resistors

R16 1k Ω
 R17 2.2M Ω
 R18 10k Ω
 R19 2.2k Ω
 R20 12k Ω
 R21 47k Ω
 R22 680 Ω
 R23 10k Ω
 R24 10k Ω
 R25 4.7 Ω
 All resistors 5% ¼W
 VR2 250 Ω miniature pre-set potentiometer

Capacitors

C20 0.5 μ F
 C21 100 μ F 10V electrolytic
 C22 8 μ F 6.4V electrolytic
 C23 100 μ F 10V electrolytic
 C24 100 μ F 6.4V electrolytic

Semiconductors

Tr6 BC107
 Tr7 AC128
 Tr8 AC128 } matched pair
 Tr9 AC128 }

Miscellaneous

T1 (Home Radio TR64), T2 (Home Radio TR65A),
 Veroboard (0.15in. matrix) 4½ x 2in.

CABINET ETC.

8 x 7 x 4in. universal chassis box with extra 7 x 4in.
 flanged side and 7 x 8in. flat plate.
 DL6 dual-ratio drive (Home Radio, Mitcham). Knobs,
 rubber or plastic feet, insulated sockets, bolts and
 tags etc. Battery PP9, with terminal clips.

MIXER/OSC./IF BOARD

These stages are assembled on plain Veroboard, approximately 3½ x 4in in size, and perforated with holes on a 0.15in matrix. It would be possible to use plain unperforated 1/16in thick paxolin sheet, drilling this in advance for resistors and other items.

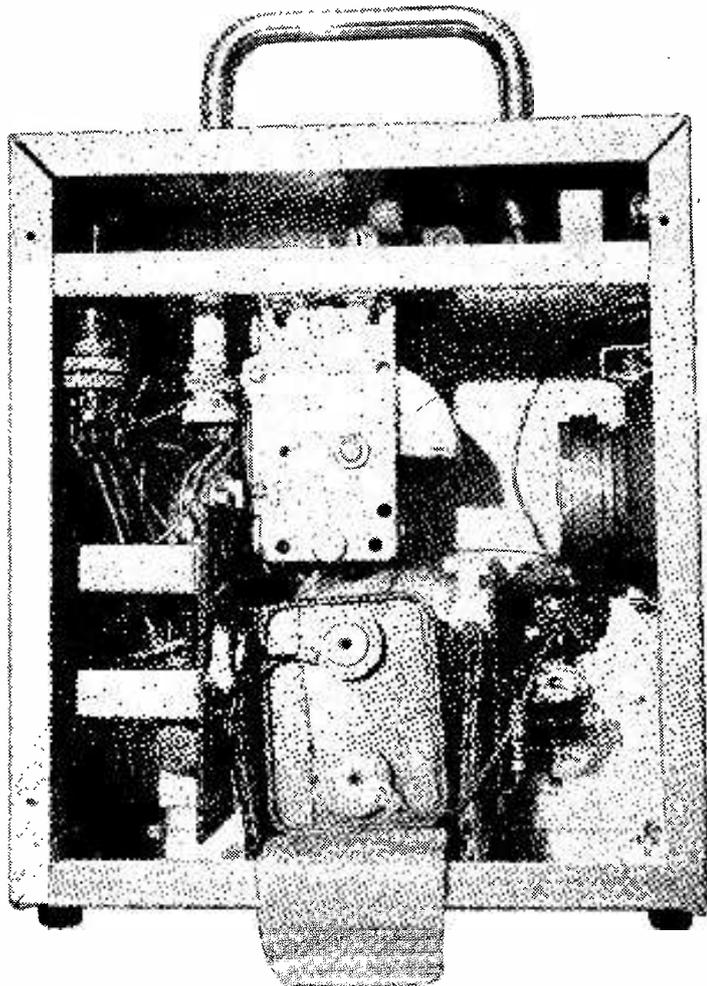
Holes are drilled so that the IFT pins come as in Fig. 6. Central holes to reach the cores are necessary under IFT1 and IFT2.

A metal bracket approximately 3 x 1¼in with a 5/8in flange is drilled for the switch and TC1 (Fig. 5), and bolted to the insulated board. (A piece cut from a flanged universal chassis member is ideal here.) Components can then be fitted as in Fig. 5, taking care to observe the polarity of C11, C14 and D1.

When starting the construction, it will be found that the easiest method is to fit a few items at a time, then turn the board over, and solder connections as in Fig. 6. In some places 24swg or similar connecting

wire will be necessary. Place sleeving on any leads which may touch other wires or joints.

It can be a little confusing to check the leads of Tr1 and Tr2 when these are fitted. This can be overcome by using short pieces of coloured sleeving and referring to Fig. 6. For example Tr1, blue can be used for g1, green for g2, orange for d, and s can be left bare. Tr2 on the other hand can have blue for g, orange for d, and leave s bare.



Inside the Marine receiver with the audio board across the top, the mixer/oscillator board at the left and BFO board to the right.

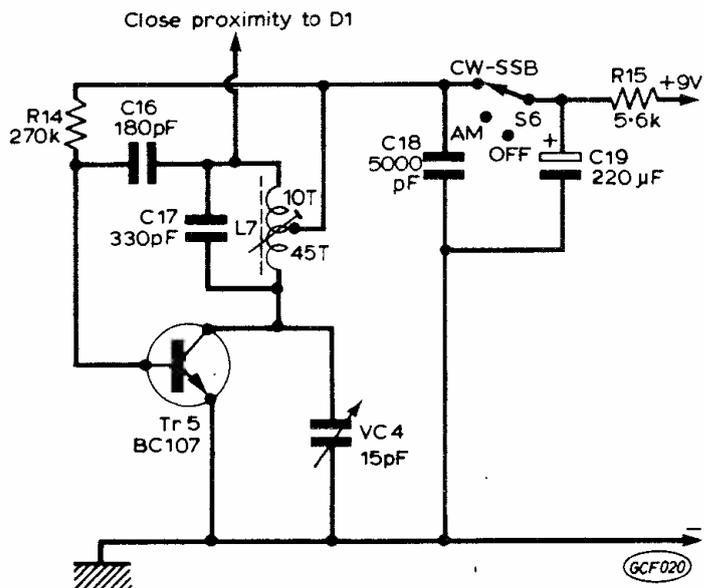


Fig. 3: Circuit of the BFO unit. Below, view of the receiver with casework removed.

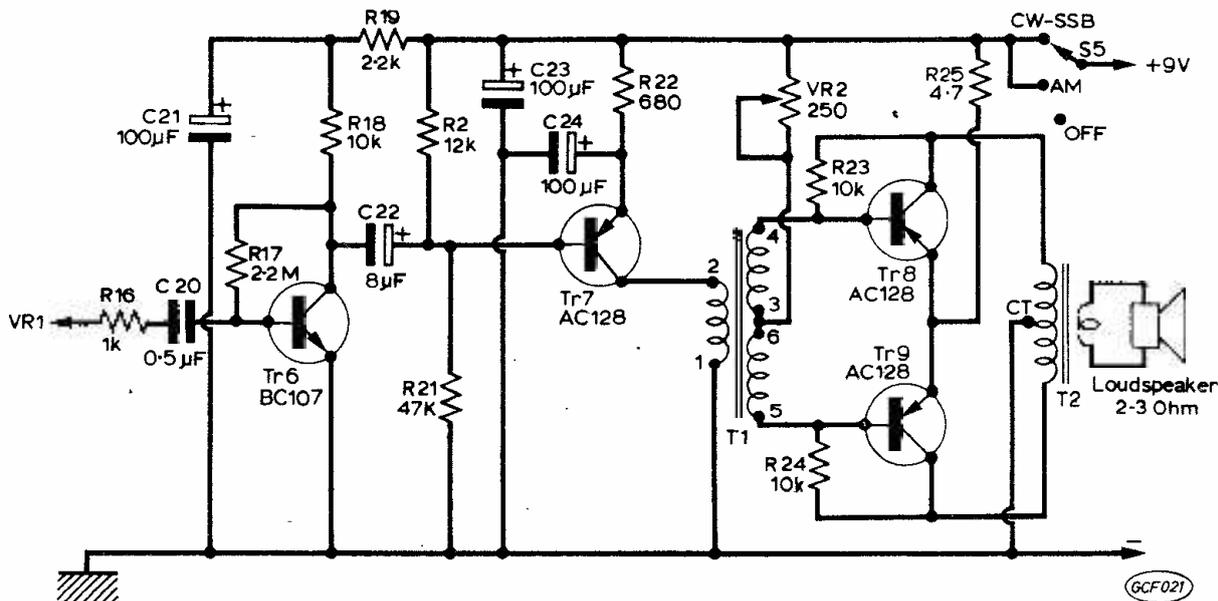
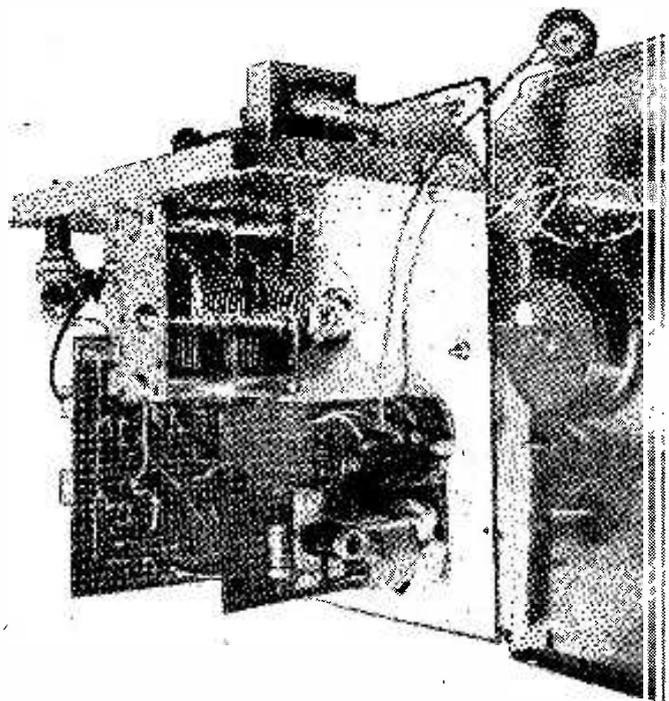
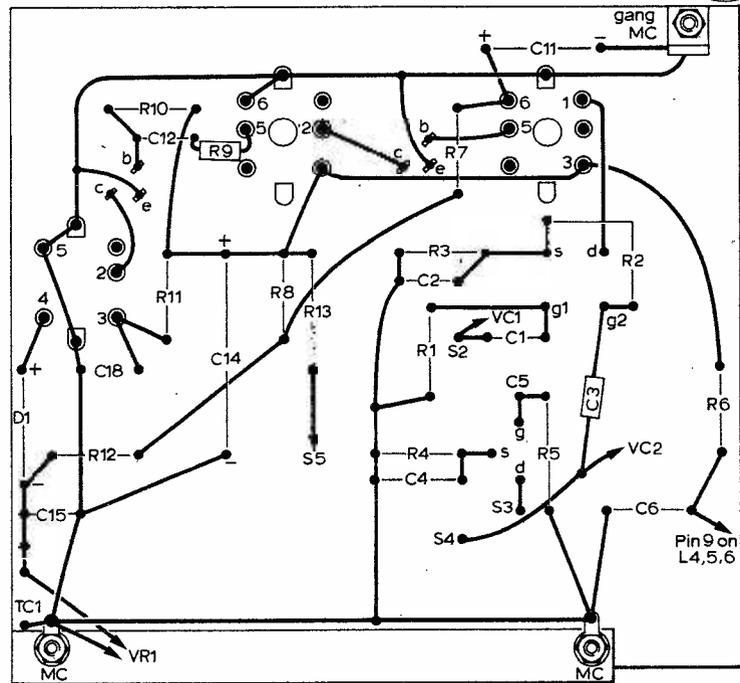
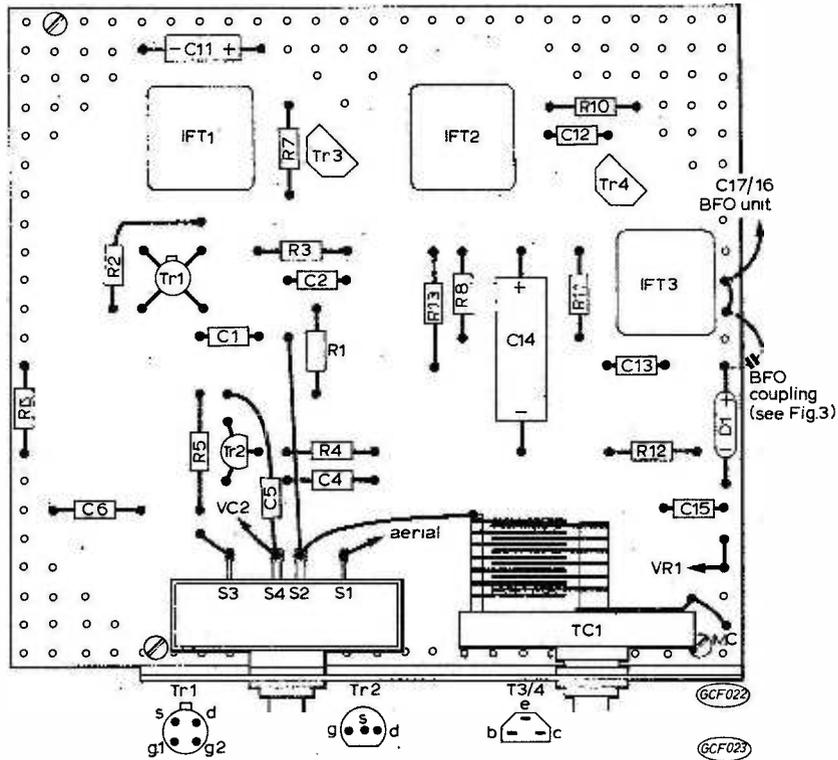


Fig. 4: The final circuit is of the audio amplifier. The speaker is fitted over a suitable aperture in the side of the case.



Figs. 5 and 6: Component layout and wiring of the combined mixer/oscillator and IF amplifier board.

R9 is soldered directly to pin 5 of IFT2, enabling it to be changed easily if this proves necessary. Flying leads are provided from D1 and C15 to go to the volume control and chassis return (Fig. 6). Connections also rundown through the board to go to VC1 and VC2 and to L4, L5 and L6. The switch and TC1 are now fitted, but the bush nuts of these are later used to hold the assembly to the front of the case.

BFO UNIT

Prepare another metal bracket as already described, and bolt Veroboard approximately $2\frac{3}{4} \times 2\frac{3}{4}$ in to this, as in Fig. 7. The nuts holding VC4 and the switch will eventually secure this unit to the panel, as with the earlier board.

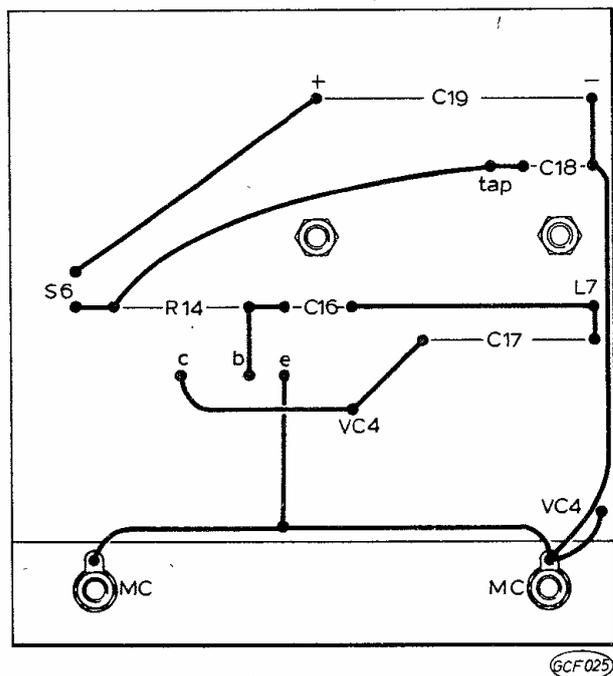
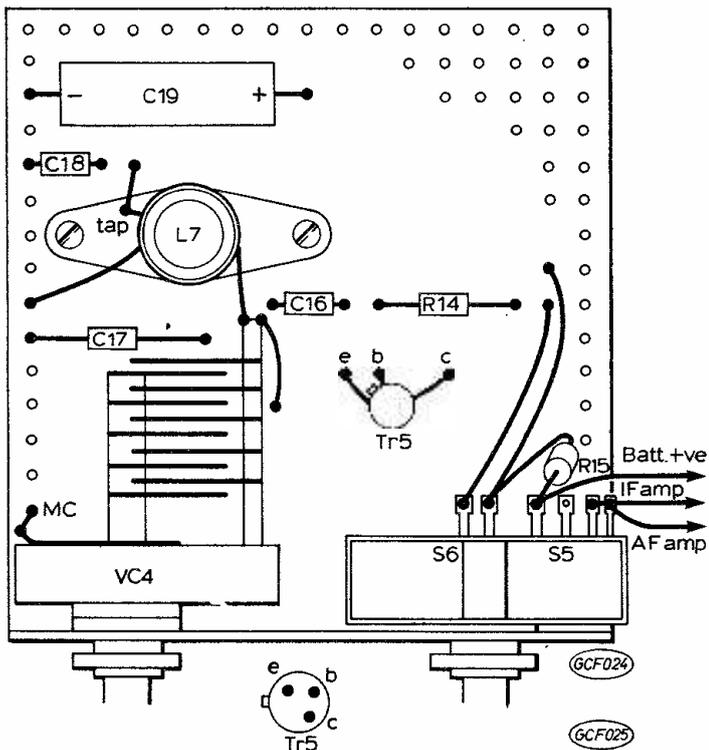


Fig. 7: above and Fig. 8, right, show both sides of the circuit board for the BFO unit.

L7 has 55 turns of 32swg enamelled wire, close wound on a 7/16in diameter former with adjustable core. Begin at the bottom of the former, leaving an end to reach to VC4 as in Fig. 7. Wind 45 turns, scrape the wire, and form a loop or tapping. Continue winding for another 10 turns, and take the wire down through the board to C17.

Wire switch S5/S6 as follows:

- (1) Off.
- (2) Battery positive to IF and AF amplifiers.
- (3) Battery positive to IF and AF amplifiers, and BFO Unit via R15 and C19 and S6.

Fig. 8 shows the underside of the BFO unit board. As mentioned, normal AM reception is obtained without this in use, so it can be built and added later if preferred.

PART 2 NEXT MONTH ON ALIGNMENT AND TESTING

Pw at the audio fair

In the picture below, visitors to the Audio Fair gather round our stand to watch Tele-Tennis on the JVC "Videosphere".

The Top-right photograph shows a typical crowd round the stand. It was like this every day of the exhibition.

(Bottom right) Two visitors play Tele-Tennis while two pretty P.W. readers study some Data Cards.



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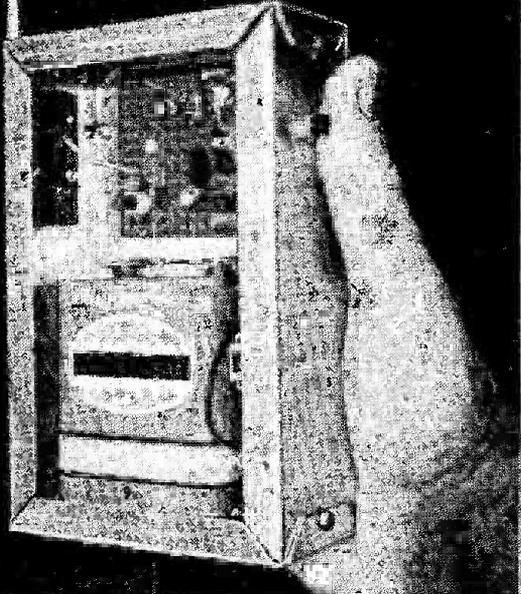
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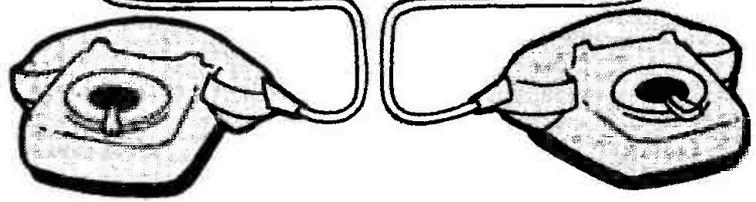
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PRODUCTION LINES

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EMITAPE X1000

EMITAPE X1000 a new ultra dynamic ferric oxide cassette—has been introduced by EMI Tape Ltd., at the recommended retail price of 99p for a C.60 (excluding VAT).

Having satisfied itself of the tape's characteristics under laboratory conditions EMI Tape adopted the move of proving the tape in the way that hi-fi enthusiasts will judge it—by its sound reproduction qualities under user conditions.

To this end a programme of comparative listening tests was mounted over a three-month period. Under the adjudication of Mr. Denys Killick, who is publisher and editor of Hi-Fi Trade Journal as well as being audio editor of Cassettes and Cartridges, these tests set out to determine whether leading musicians and others representing the many sectors of music today—from the classics to pop—could discriminate in 'blind' tests between X1000 and expensive chrome formulations.

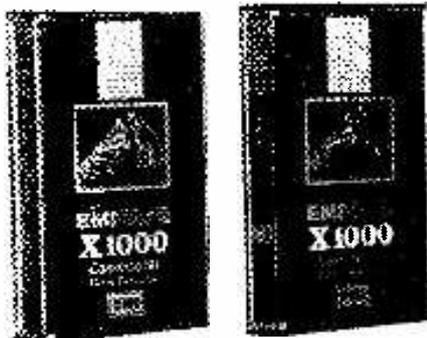
To ensure absolute impartiality in the tests, the performance of the Tandberg cassette decks used was checked to specification by Tandberg engineers and the recorders sealed by Denys Killick.

Music was recorded onto standard production cassettes—both X1000 and chrome—from EMI master tapes at Abbey Road under the scrutiny of Denys Killick and two senior audio engineers from AIR London, the biggest independent studios in London.

Later, at a series of listening tests the cassettes were played back—under supervision—to the musicians who made the original recordings ranging from the L.S.O. to the Spinners folk group.

In every case the participants were asked to record their opinions on a questionnaire and subsequent analysis of these shows clearly that even the trained ear has difficulty in discerning any difference between X1000 and the expensive chrome cassettes used in the tests.

Mr. Ted Naef, managing director



of EMI Tape Ltd., commented "We began our research from the belief that what really matters to an audio enthusiast is the quality of sound he gets from his chosen medium, related to the cost of the product. Our new cassette which gives as pleasing a reproduction as expensive chrome dioxide cassettes is considerably cheaper to buy. In addition X1000 is a much less abrasive tape, and there is no need for a special bias switch on the recording machine. It will without doubt improve the performance of many cassette tape recorders."

The main technical improvements in X1000 are:

- 1) An increase of 3-4dB in the 8-15kHz frequency range, compared to low noise tapes such as EMITAPE Hi-dynamic, giving a more realistic treble resulting in a brighter, more sharply defined sound.
- 2) Superior overload characteristics ensuring low distortion at high recording levels.
- 3) A wider dynamic range is obtained due to the tape's increased magnetic remanence, which results in less tape hiss.
- 4) When used with comparably high quality audio equipment, the tape exhibits a usable frequency response extending from 25Hz to 15kHz, giving a smooth clear bass coupled with crisp treble performance.
- 5) The improved high frequency response ensures a low level of intermodulation distortion providing a cleaner recording.

Further details may be obtained from EMI Electronics and Industrial, Blyth Road, Hayes, Middlesex.

PEAK READING V.U. METER.

Partridge Electronics announce the release of a special V.U. meter system which registers true peak programme levels. This is achieved by the use of a professional grade Bach-Simpson meter with special electronic circuitry, which responds to both positive and negative peaks. It also has an attack and decay time normally only associated with PPMs; and does not suffer from zero drift; is independent of normal voltage fluctuations and therefore requires no setting up. 0dB reading is equivalent to 6 on a standard PPM meter. Operates from a 24 volt positive supply, and only consumes 4mA. This unit fills the gap left between the shortcomings of the conventional V.U. system and high cost PPM units. It will market at £8.32 plus VAT. Partridge Electronics, 21-25, Hart Road, Benfleet, Essex, England. SS7 3PB.

BEYER PHONES

Beyer Dynamic, the West Germany based manufacturer of microphones, headsets and audio equipment, has produced a new headphone, type DT 302.

The DT 302 is a very lightweight headset. This is achieved by the design of the headband, which allows simple adjustment of the ear pieces up or down. These are protected by foam plastic pads eliminating any interference from "local noise", at the same time being exceptionally comfortable to the wearer. Three metres of lightweight cable complete the DT 302

Frequency response is quoted as 20-20,000Hz. Impedance: 2×600 ohms (can be connected directly to either high or low impedance outputs). Rated Power is approx. $7mW=7, IV$ for 600 ohms. The price of this headset is £7.83 plus V.A.T. Beyer Dynamic (GB) Limited, 1 Clair Road, Haywards Heath Sussex.



IN CIRCUIT TESTER

Daystrom-Schlumberger have just released an in-circuit tester designated Type 670. It is aimed at those engineers and constructors who need to take voltage, current and resistance measurements in solid-state circuitry.

With the 670, it is simply a question of connecting the two probes across the current carrying conductor then reading off the value of the current.

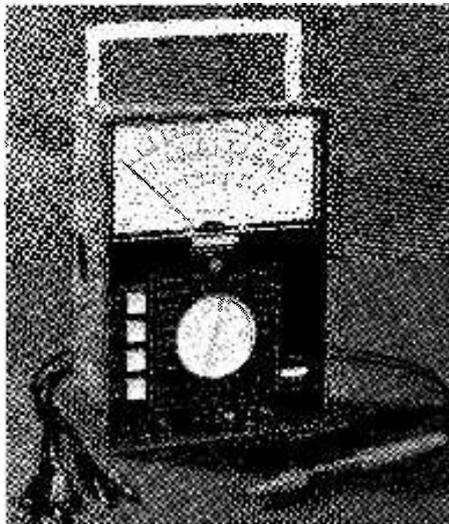
To provide this measurement facility—claimed by the manufacturers to be unique for an instrument in its price range—the 670 uses a pair of two-terminal concentric probes. Capable of contacting circuit board rails 0.015in. apart, these specially-designed probes can be snapped together for fixed spacing, or detached for separate use.

One contact in each probe senses the voltage drop across the current-carrying conductor under test. A differential amplifier senses this and generates a bucking current until the voltage drop is balanced. The bucking current is therefore proportional to the circuit current, which is read directly on the meter.

In addition to the "in-circuit" current measuring capability, the FET multi-meter offers eight voltage ranges and fourteen resistance ranges. Seven of the resistance ranges use low-power techniques—max 85mV—for testing semiconductors. Conventional current measurements can

be made with the standard probes also supplied with the "670".

The 670 is priced at £132. The kelvin clip probes for "in-circuit" current measurements in solid wire conductors are an optional extra. *Daystrom Schlumberger, Gloucester.*



VIDOR POWER PLUS

Vidor have introduced the Power Plus line of batteries to extend their range.

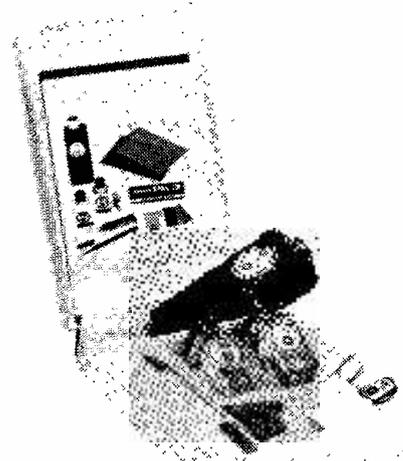
The Power Plus line comprises six alkaline manganese and five mercury types.

A four-page colour leaflet describing the new batteries is available from: *Crompton—Parkinson Ltd., Vidor Division, 50-52 Marefair, Northampton, NNI 1NY.*

PRINTED CIRCUIT KIT

This printed circuit kit from Eagle International of Wembley, Middlesex contains all the items necessary to reproduce a printed circuit to exact individual requirements. Designated the PK3 it is supplied in a durable case complete with comprehensive instructions.

The contents of the kit include: polishing powder, etch resist, etching liquid, resist remover, flux, copper clad phenolic circuit boards, stencil knife, spatula and etching tray. Recommended retail price of the PK3 is £2.86 excluding VAT. *Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU.*



BATTERY FLUORESCENT

The Electronics Design Associates' 12V fluorescent lighting kit comes complete with printed circuit board, transformer, ready-drilled metalwork, tube end-caps, components, 8W tube, nuts, bolts etc.

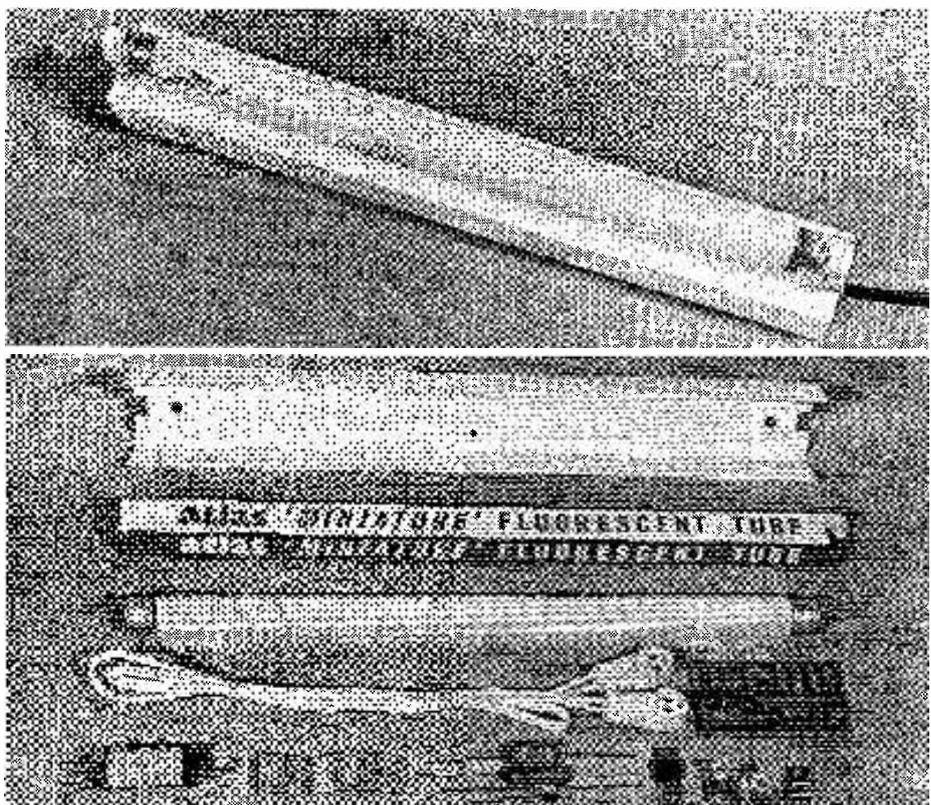
The unit, which only takes about half-an-hour to build up, draws about 0.6A from the battery.

Full instructions for building are supplied with every kit and construction is simplicity itself—all you need to know is how to wield a soldering iron!

At the price of £3.19, which includes post and packing, this kit represents very good value for money and would make a good investment particularly at the time of the year we are often threatened with power cuts.

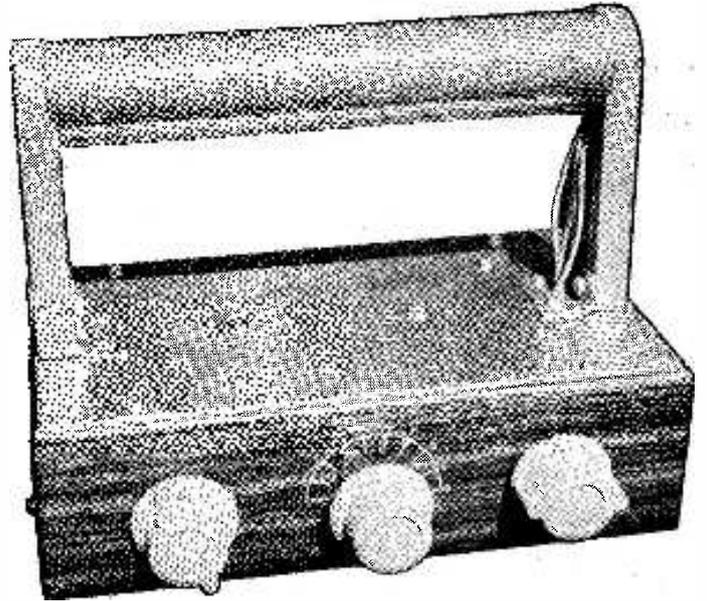
If you want to order a diffuser to give a really professional finish, there is an extra charge of 59p including VAT (12p post and packing if ordered separately).

The kit is available from *Electronics Design Associates, 82 Bath Street, Walsall, WS1 3DE.*



The built unit and a kit of parts.

An Active Aerial



THOUGH this unit is particularly intended for use with the Low Frequency & Marine 3-Band receiver described elsewhere in this issue, it can be employed with other receivers of suitable type, covering tuning long, medium and short wave bands up to 5MHz. It allows such a receiver to be operated without the use of an outdoor or extended wire aerial. The additional tuned circuit also considerably reduces second channel interference.

CIRCUIT

This is shown in Fig. 1, and uses a 3-band ferrite aerial. For LW coverage, S1, is at L, and L1, L2 and L3 are in series, tuned by VC1. L4 and L5 are the base coupling windings for Tr1. For MW reception, S1b shorts the LW coil L3. With the specified ferrite aerial, no switching of the base circuit is necessary for the change to this band. For SW reception, L2, L3 and L5 are shorted, leaving L1 and L4 in use. L6 wound on L1, and L7 situated between L2 and L3 allow an external aerial to be coupled, if wanted.

Transistor Tr1 provides RF amplification; its gain is controlled by VR1. This is necessary to avoid overloading the receiver input. The transistor can be adjusted to be nearly regenerative, giving best sensitivity.

In the 3-band receiver mentioned, the bandwidth selects one of the three aerial coil primaries. This winding is present from Aerial to Earth sockets of the receiver, as in Fig. 1, and forms the collector load for Tr1, and also provides its DC return.

The active aerial unit is constructed in a screened box, except for the ferrite aerial, which is protected by an external insulated tube. The receiver described is also screened, and this prevents unwanted coupling between aerial and Tr1 collector inductors, which would cause feedback.

CIRCUIT BOARD

This is approximately 2½ x 1½in, Fig. 2. Two tags are first secured with ½in 6BA bolts, for the points MC. The resistors and capacitors can then be inserted, and connected as shown, keeping the leads against the board. R3 must be mounted close to the base of Tr1. If wished, R5 can be modified to suit the actual gain of Tr1, though 1.2kΩ is generally satisfactory.

continued on page 813

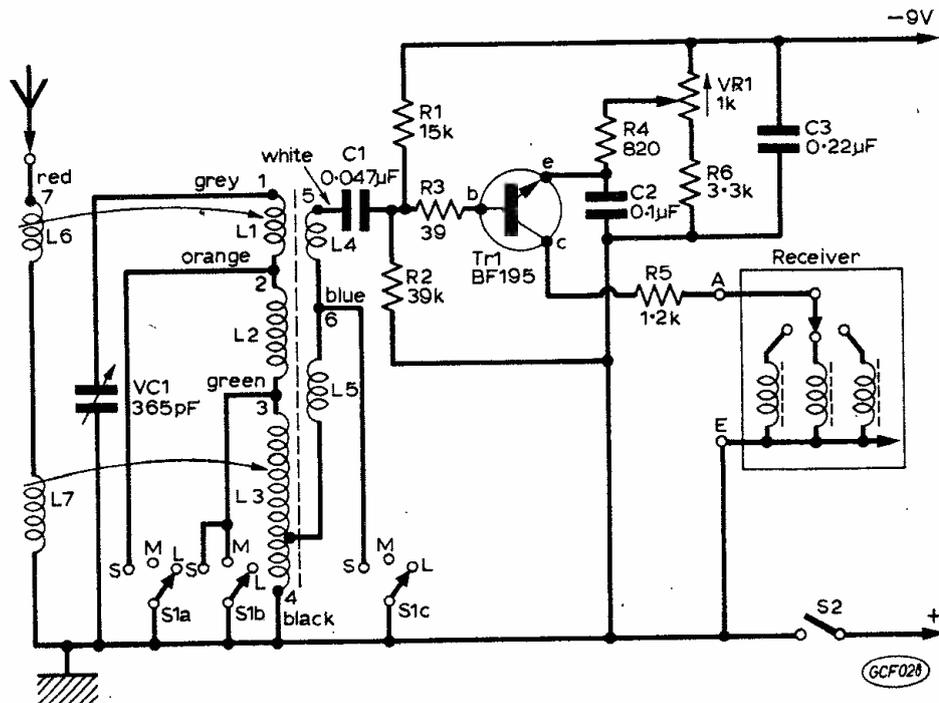
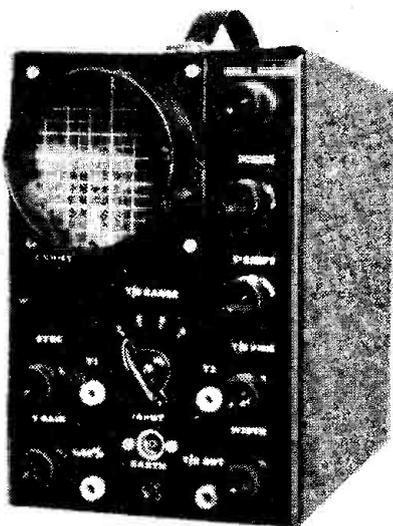
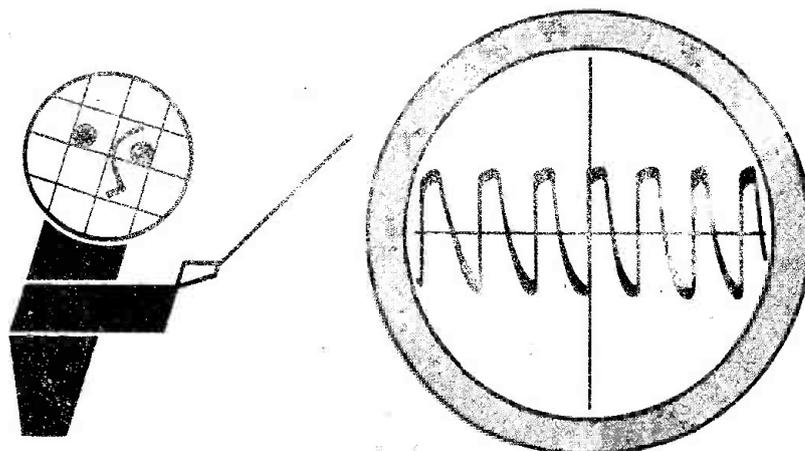


Fig. 1: Circuit of the Active Aerial. It is essential that there is a DC path between the aerial and earth terminals on the receiver being fed by the Active Aerial.

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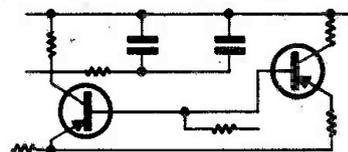
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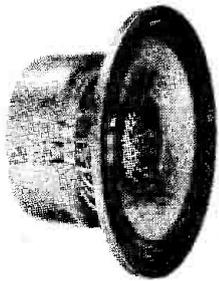
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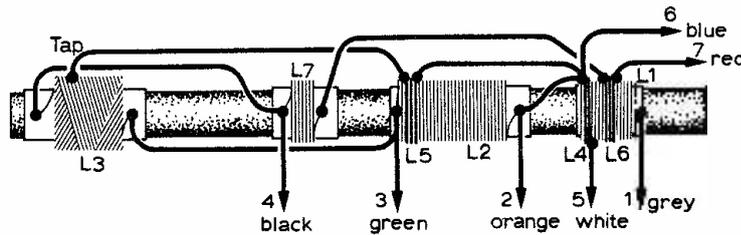
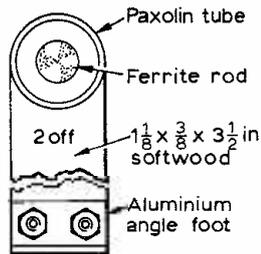
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SURPLECTRONICS

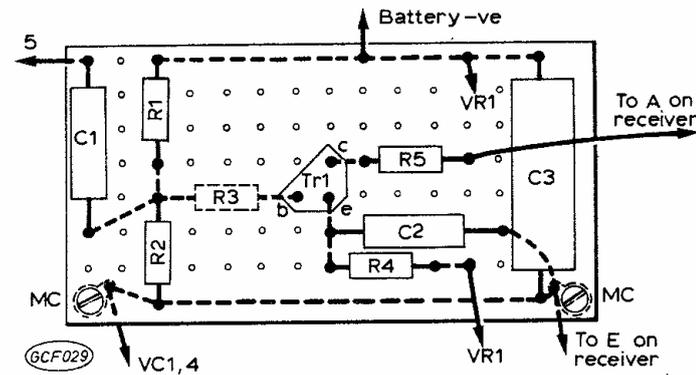
216 LEAGRAVE ROAD, LUTON, LU3 1JD, BEDS.



L2, L3, L5 see component list
 L1 28t
 L4 2t
 L6 3t
 L7 25t
 All 32 s.w.g. enamelled

GCF030

Fig. 3: above, gives details of the additional windings required on the ferrite rod aerial.
 Fig. 2: below, shows the component layout of the small circuit board.



AN ACTIVE AERIAL—continued from page 810

Flying leads are left from the MC line for 4 and VC1. Battery positive and R6 circuits are connected to the chassis. R4 is connected to VR1 wiper, and VR1 outer tag to negative. The board is mounted as in Fig. 4, with extra nuts on each bolt to give a 3/8in space between board and metal chassis.

FERRITE AERIAL

The rod may be either 5in or 6in long, and is 3/8in in diameter. The 1in paxolin tube should be the same length as the rod.

Two supports are made, each of 3/8in wood, about 1 1/8in wide and 3 1/2in high overall. First drill a 3/8in diameter hole to a depth of about 1/8in, as in Fig. 3, to support the end of the rod. A 1in diameter channel is then cut to the same depth, to take the paxolin tube. This is most easily done with an adjustable tank cutter.

Two brackets are cut from aluminium angle and drilled to allow the supports to be mounted vertically, at such a distance apart as to take the rod and tube.

All leads will pass down the right hand support, and a hole is drilled through chassis and bracket here. The wooden support (or one end of the paxolin

tube) is notched to leave space for the leads. The whole aerial is wired and tested before the tube is placed over it. This can be done by loosening the left hand support.

A tag strip which will provide seven connecting points for the leads (including MC) is bolted under the chassis, as in Fig. 4. These can also be identified by using thin coloured sleeving, as shown.

Details of the aerial, which is a standard component with four additional windings, can be seen from Figs. 1 and 3. Connections must be so made that all turns are in the same direction, beginning at 1, going to junction of L1 and L2 at 2, and on through L3 to point 4. L4, L5 and L3 are also in the same phase, as are L6 and L7.

This is most easily arranged by fitting L2 first, with the base winding L5 towards the centre of the rod. Now identify the ends of L3, either by examination, or by testing with a meter—the resistance from 3 to the tapping will be much higher than the resistance from 4 to the tapping. Place L3 as shown in Fig. 3.

Wind L7—25 turns of 32swg enamelled wire—on a strip of paper or thin card. L5 can then be connected to the tap on L3. L2 and L3 can also be connected together, and a green lead taken down to tag 3 on the strip. L7 and L3 are also joined, and a black lead is taken down to tag 4.

Next wind L1 in the same direction as L2. L1 has 28 turns of 32swg enamelled wire, side by side on thin card. Cover L1 with paper or tape, and wind on L4, comprising two turns, as in Fig. 3. Note that L4,

★ components list

Resistors All resistors 1/4W ± 5%

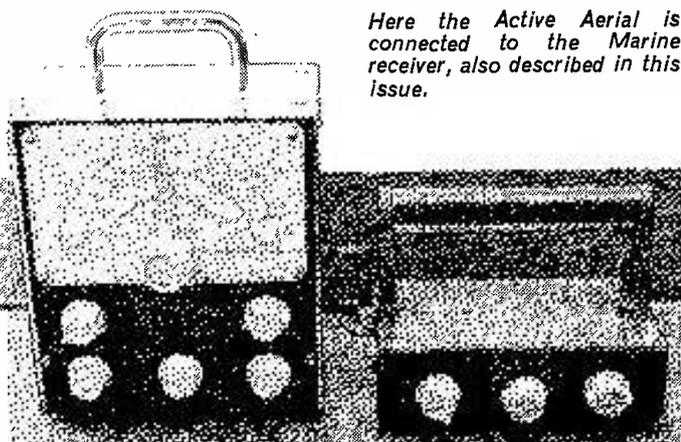
R1 15kΩ
 R2 39kΩ
 R3 39Ω
 R4 820Ω
 R5 1.2kΩ
 R6 3.3kΩ
 VR1 1kΩ linear pot with switch

Capacitors

C1 0.047μF
 C2 0.1μF
 C3 0.22μF
 VC1 Jackson 365pF single, reduction drive optional

Miscellaneous

L2, L3, L5, Denco MW/LW ferrite rod aerial
 L1, L4, L6, L7, see text
 Tr1 BF195
 S1, 3-pole 3-way rotary switch. S2 ganged with VR1.
 1in. dia. paxolin tube (see text).
 Universal chassis 7 x 4 x 2in. and extra 7 x 4in. flat plate. Plain Veroboard, 0.15 matrix. Rubber feet, Tag strip, Knobs, battery clips, insulated sockets.



Here the Active Aerial is connected to the Marine receiver, also described in this issue.

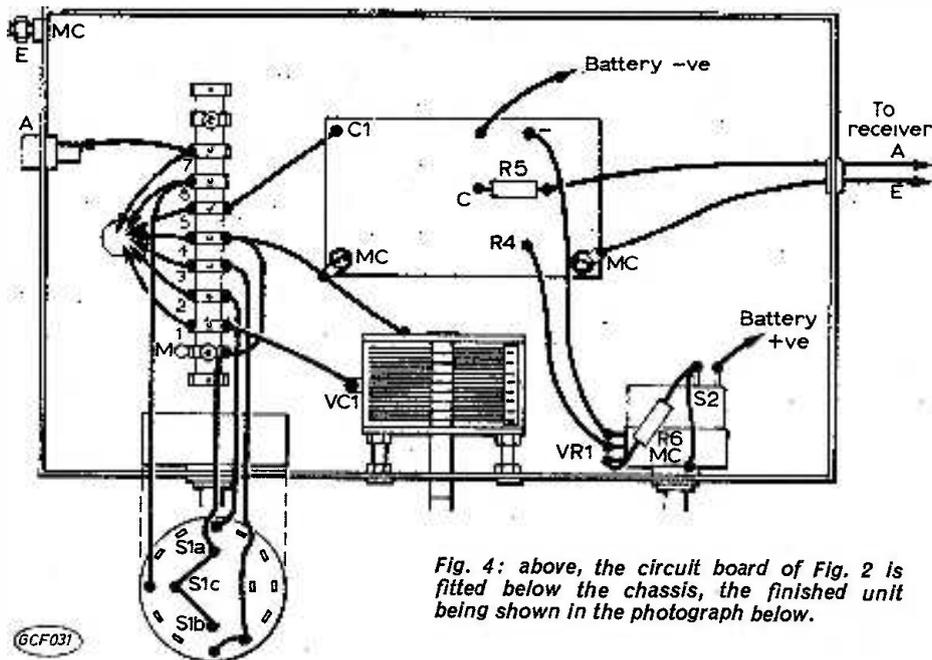
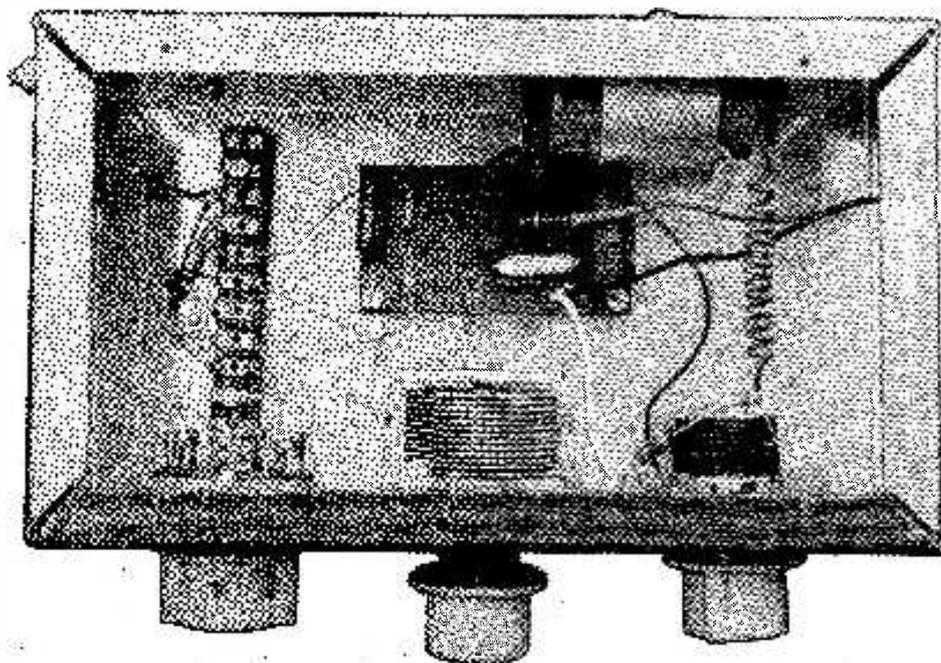


Fig. 4: above, the circuit board of Fig. 2 is fitted below the chassis, the finished unit being shown in the photograph below.

GCF031



is in the same direction as L5. Add three turns for L6, as in Fig. 3, in the same sense as L7. Thin insulated wires may be soldered on for connections or the leads themselves may be run through sleeving, and taken to the appropriate tags.

It is possible to modify band coverage in the usual way, by sliding the windings on the rod. However, as this circuit is individually tuned by VC1, and does not have to gang with another tuned circuit, this is not essential.

If the wires are kept against the support, and run down to the tags as the aerial is prepared, the paxolin tube can be fitted over the finished aerial with little disturbance.

ASSEMBLY

This can be seen in Fig. 4. VC1 is secured with three 4BA bolts, which may have washers, spacers or extra nuts, as they must not project inside the capacitor. A reduction drive is not essential, but eases tuning.

The battery is held with a clip inside the case. No external connections are required except to plug the output and chassis return leads into the Aerial and Earth sockets of the receiver. The active aerial unit is placed to the right of the receiver mentioned, and a short output (Aerial) lead is possible, so that no screening is necessary for this connection. Tuning scale markings are not essential, as tuning is readily peaked for best reception.

USE WITH RECEIVER

In most cases VR1 is not advanced for maximum gain, as this is likely to cause overloading. When receiving SSB or CW signals it is generally essential to turn the RF gain VR1 back, while advancing the receiver AF gain control, in order that the relative strengths of the received signal and BFO will allow proper resolution. If not, SSB cannot be received, or will sound like severely over-modulated AM.

The receiver aerial trimmer is peaked for best reception for each band, as with an extended aerial in use. The ferrite rod aerial and additional tuned circuit will considerably reduce second channel signal interference.

At some time of day and in some conditions a receiver with a high, extended outdoor aerial will pick up untunable noise at a high level. A similar pick-up of external noise can be encountered with the active aerial unit, and in these circumstances does not indicate any fault in the latter.

If the unit is to be employed with any receiver other than that described, the receiver must have an aerial coupling winding, as in Fig. 1, for Tr1 collector circuit. A receiver with a low impedance input such as 75Ω is not very suitable.

Due to the addition of L1, MW coverage is changed from that obtained by L2 alone. With L2 unmodified, and the coils situated approximately as in Fig. 3, coverage is 140-360kHz, 300-1150kHz, and 1.65-5.0MHz for the three bands. If it is wished to modify this, 22 turns can be removed from the outer end of L2 (junction with L1). Coverage is then 140-350kHz, 350-1500kHz, and 1.2-5.0MHz, which is convenient for the 3-Band receiver mentioned.

Signal pick-up is influenced to some extent by the bearing of the ferrite rod, and by the proximity of large areas of metal, as with a portable receiver. With construction and values as shown, regeneration to the point where oscillation arises is not obtained on all frequencies, but interference-free reception of many signals should be obtained.



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1250	1250	0-50 micro A.	0-100 micro A.	0-500 micro A.	0-1 mA	0-5 mA	0-10 mA	0-50 mA	0-100 mA	0-500 mA	0-1 AMP	0-2 AMP	0-25 Volt	0-50 Volt	0-300 Volt	"g" Meter	VU Meter
1400	730	200	200	200	200	200	6	0.5	0.5	0.5	0.5	0.5	15K	50K	300K	200	5250

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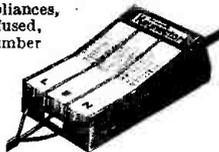
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100	150	8.22	0.80	4.80	0.52
200	151	10.20	0.80	7.40	0.52
250	152	11.68	0.80	8.88	0.65
350	153	14.10	0.80	10.80	0.80
500	154	15.68	0.80	12.38	1.00
750	155	24.63	1.00	18.72	1.20
1000	156	32.19	1.00	26.50	1.20
1500	157	38.18	1.00	30.34	O.A.
2000	158	45.20	2.40	34.68	O.A.
3000	159	66.50	2.40	53.35	O.A.

12 & 24 Volts Prim. 200-240V.

Amps	Ref. No.	Price £	Post £
0.3	0-15	2.42	1.34
0.5	0-25	1.11	1.38
1	0-5	2.13	1.58
2	1	7.1	2.09
4	2	18	2.58
6	3	70	3.80
8	4	108	4.20
10	5	72	4.80
12	6	116	5.01
16	8	17	6.22
20	10	115	9.47
30	15	187	11.95
40	20	232	13.28
50	30	226	15.30

30 Volts

Prim. 200-240V. Sec. 12, 15, 20, 24, 30V.

Amps	Ref. No.	Price £	Post £
0.5	112	1.72	0.22
1	79	2.21	0.38
2	3	3.25	0.38
3	20	4.10	0.42
4	21	4.69	0.52
5	51	5.80	0.52
6	117	6.50	0.52
8	88	8.50	0.67
10	89	8.97	0.67

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150	4	5.80	0.15	3.98	0.39
200	65	6.40	0.15	4.50	0.40
300	66	7.27	0.15	5.28	0.52
500	67	9.99	0.15	8.29	0.67
750	83	12.58	0.75	9.78	0.82
1000	84	15.70	0.75	12.40	0.82
1500	93	19.88	0.75	16.58	1.50
2000	95	30.10	1.44	22.05	1.50
3000	73	43.58	1.90	32.00	1.90

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Prim. 200-240V. Sec. 19, 25, 38, 40, 50V.

Amps	Ref. No.	Price £	Post £
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1	103	3.00	0.38
2	104	4.57	0.42
3	105	5.20	0.52
4	106	6.89	0.52
6	107	11.17	0.67
8	118	14.19	0.97
10	119	15.47	0.97

60 Volts

Prim. 230-240V. Sec. 24, 30, 40, 48, 60V.

Amps	Ref. No.	Price £	Post £
0.5	124	2.08	0.38
1	126	2.96	0.38
2	127	4.63	0.42
3	125	6.84	0.52
4	123	7.94	0.67
5	40	8.88	0.67
6	120	10.15	0.82
8	121	13.58	1.00
10	122	18.15	1.00
12	189	16.00	1.10

MINIATURE AND EQUIPMENT

Prim. 240V with screen.

Sec. 1 Volts	Sec. 2 Volts	Milliamps	Ref. No.	Price £	Post £
3-0-3	—	200	238	1.22	0.10
0-6	0-6	500	234	1.30	0.10
0-6	0-6	1000	1000	1.93	0.22
0-9	—	100	12	1.23	0.10
0-9	0-9	330	235	1.43	0.10
0-9	0-9	500	207	1.75	0.22
0-9	0-9	1000	208	2.80	0.30
15-0-15	—	40	240	1.23	0.10
0-15	0-15	200	236	1.30	0.10
20-0-20	—	30	241	1.23	0.10
0-20	0-20	150	150	2.37	0.10
0-15-20	0-15-20	500	500	2.47	0.38
0-20	0-20	300	300	2.14	0.22
0-20	—	3500	NO SCREEN	1116	3.00
0-12-0-12-20	—	700 (D/C)	—	221	2.31
0-15-20	0-15-20	1000	1000	2.06	0.38
0-15-27	0-15-27	500	500	2.73	0.38
0-15-27	0-15-27	1000	1000	2.04	3.52

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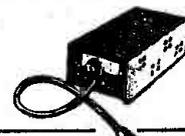
One Amp	Two Amp	Four Amp	Six Amp
50 P.I.V. 25p	50 P.I.V. 35p	100 P.I.V. 55p	50 P.I.V. 65p
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200 P.I.V. 28p	200 P.I.V. 45p	400 P.I.V. 65p	200 P.I.V. 80p
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PART TWO

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MOTOR CONTROL

The motor control board contains circuits for two basic functions, motor speed regulation and automatic stopping of the machine at the end of a cassette.

We shall deal first with the motor speed control. It will be seen from the circuit diagram (Fig. 2) that the motor is fed from the nominal 12V supply line via transistor Tr52 and resistors R55, R56 and R58. The base current for Tr52 is formed by the collector current of Tr51, the sensing transistor.

When power is supplied to the system, by inserting a cassette, a potential of just under two volts appears at the junction of resistors R53 and R54. This potential is applied, via diode D51, to the base of Tr51, so turning this transistor on. Collector current flowing in Tr51 provides the base current to turn Tr52 on and the resultant current flows into the motor via R55 and R56 in parallel. The motor starts to turn and diodes D52 and D53 conduct, so clamping the emitter of Tr51 at a fixed voltage negative with respect to the positive side of the motor.

This action results in the emitter of Tr51 moving positive, but the base also moves positive since the

collector of Tr52 is connected to Tr51 base via network R51, VR51 and R52. As a consequence, D51 becomes reverse-biased, so disconnecting the starting circuit, R53, R54 from Tr51 base. The emitter-base bias on Tr51 is now a function of the voltage developed across R55 and R56, since the top end of these resistors feeds the base circuit, while the bottom end is clamped to the emitter of Tr51 via D52 and D53.

If the motor load increases, so does its current drain. As a result, the voltage drop across R55 and R56 increases, so increasing the forward bias on Tr51. The increase in Tr51 collector current increases the flow of current in Tr52, so applying more power to the motor to compensate for its increase in load. If the load decreases, the process operates in reverse. Likewise, changes in the supply voltage are accommodated since the only reference required is the measure of current through the resistors in series with the motor, and the apparent DC resistance of Tr52 is adjusted accordingly.

The running speed of the motor is set by VR51 which varies the preset forward bias applied to Tr51. R58 provides a bleed current through the motor in the starting condition and also shunts Tr52, reducing its dissipation.

* Hamilton Electronics Ltd.

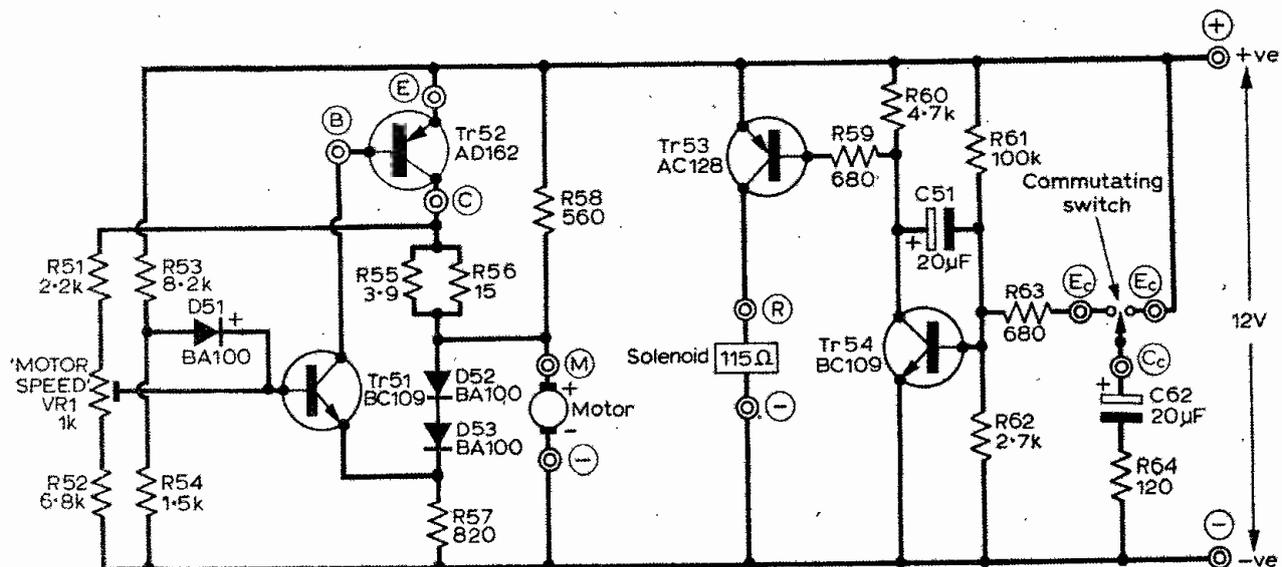
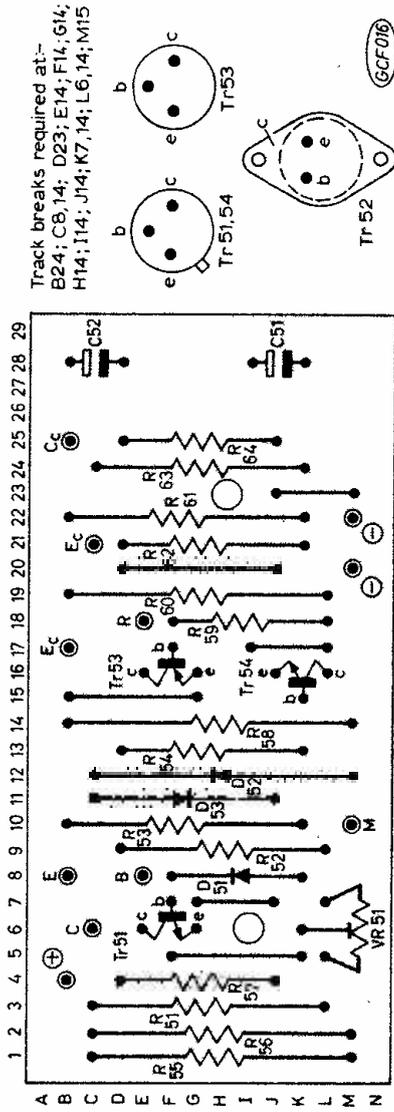


Fig. 2: Circuit of the motor control board. The motor, solenoid and commutating switch are part of the cassette mechanism.

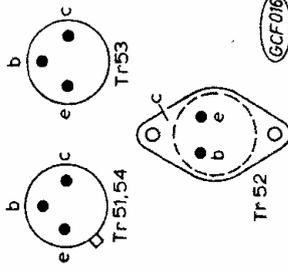
NOTES:

1. The Motor Speed control should be labelled VR51.
2. Capacitor C62 should be labelled C52.

88 **Fig. 3: Layout for the motor control board, using 0.1 in pitch Veroboard**
3 x 1.4 in.

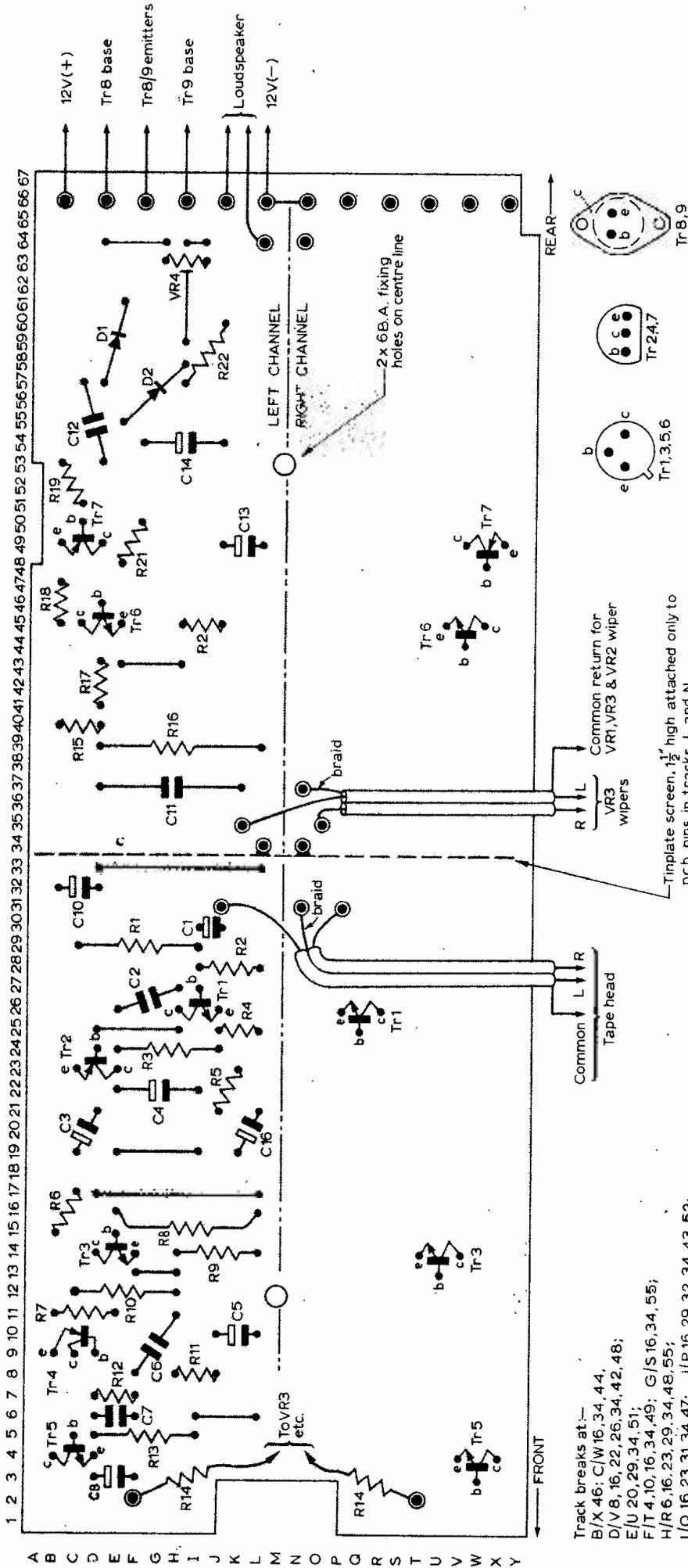


Track breaks required at:-
B24; C8,14; D23; E14; F14; G14;
H14; I14; J14; K7,14; L6,14; M15



Both these boards are viewed from the component side.

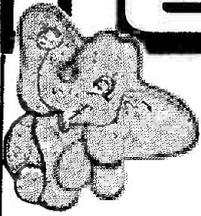
Fig. 4: Layout for the amplifier board built on 0.1 in. pitch Veroboard
6.75 x 2.5 in. The lower half of the board (Right channel) is a mirror image of the upper half except for the transistors shown, which are reversed for ease of assembly.



Track breaks at:-
B/X 46; C/W 16, 34, 44,
D/V 8, 16, 22, 26, 34, 42, 48;
E/U 20, 29, 34, 51;
F/T 4, 10, 16, 34, 49; G/S 16, 34, 55;
H/R 6, 16, 23, 29, 34, 48, 55;
I/Q 16, 23, 31, 34, 47; J/P 16, 29, 32, 34, 43, 52;
K/O 7, 16, 25, 34, 38;

Henry's

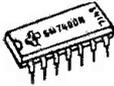
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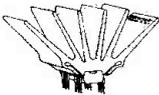
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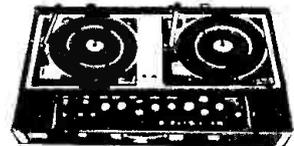


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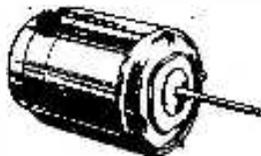
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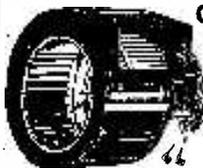
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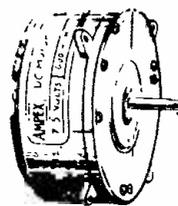
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AUTO STOP

Now we come to the autostop mechanism. When the cassette is pushed in, it will only hold in provided the solenoid is energised, to operate the latch. The solenoid is controlled by transistor Tr53. Attached to the cassette feed-spool hub is a commutating switch, below the deck, which constantly switches a common contact between the others provided the hub is rotating.

When power is applied to the circuit by inserting a cassette, capacitor C51 charges via R60, R59 and the base circuits of both Tr53 and Tr54. The resultant collector current in Tr53 energises the solenoid to hold the latch. The flow of collector current in Tr54 reduces the charging voltage applied to C51, so forming a "Miller integrator" circuit linearising the charging of the capacitor. Under these circumstances C51 would eventually become fully charged, and the current would stop flowing, so de-energising the solenoid and releasing the latch. However, this process is not allowed to complete.

LATCHING

As soon as the cassette is inserted, the motor starts to move the tape, and the commutating switch commences operation. C52 is alternately charged from the 12V supply, and discharged via R63 into the base of Tr54. The process is integrated by C51 so that a constant hold-in current flows through the solenoid. R64 is included to prevent excessive charging current in C52, with the attendant risk of contact wear and electrical interference.

When the cassette comes to the end, the feed hub stops rotating, and with it the commutating switch. As a result, no current pulses are fed into the base of Tr54, and C51 reaches its point of maximum charge. Current flow in the transistors then ceases, so de-energising the solenoid. The latch drops out releasing the deck mechanism and the cassette is ejected.

Obviously, any attempt to re-insert the cassette without turning it over will be fruitless, since the commutating switch will be inoperative and the cassette will be promptly ejected again.

CONSTRUCTION

Construction can commence with the two circuit boards. The motor control board, Fig 3, is quite straightforward but take care to cut the tracks in the correct places. When completed, the board is mounted on the rear panel of the cassette mechanism in the position shown in the photographs. Nylon nuts and bolts should be used to avoid shorting or earthing any of the tracks.

The rear panel also acts as the heatsink for Tr52 and is supplied already punched with the necessary pattern of holes. An insulating mounting kit must be used for this transistor.

The amplifier board carries the two channels side by side, one being a mirror image of the other apart from five of the transistors. These are turned around to make mounting easier. See Fig. 4.

Note that the amplifier starts in the middle of the panel and moves towards the controls. The signal is then conveyed via screened cables to the other half of the board, where it progresses towards the output transistors at the rear of the unit. Because of this layout it is essential, if feedback is to be avoided, to place a screen across the middle of the board, as shown in the diagram. This screen is a piece of thin tinfoil, soldered to two tags in the negative rails at the centre of the board. It should not touch any other metalwork.

The main earthing is via the deck mechanism; nylon fixing bolts are used to secure the amplifier board to the case. This method of earthing at one point avoids feedback loops which can affect both the stability of the equipment and its immunity to interference. It also eases the conversion to positive earth working.

When constructing the boards, it is wisest to cut the tracks in the appropriate places first, using the lists provided. Then, as you fit the components, check against the circuit diagram that the actual circuit you are making follows it precisely. Any apparent deviations should be checked, and will probably reveal incorrect positioning of components or incorrect cutting of the copper strips.

Next month we will conclude with details of the metalwork required plus final assembly and testing.

THE THIRD MIDLAND Amateur Radio & Electronics Exhibition

THE Third Midland Amateur Radio and Electronics Exhibition was held at the Granby Halls, Leicester on October 31st and November 1st and 2nd 1974. It was organised for the Amateur Radio Retailers' Association by T. Darn, G3FGY and L. J. Hellier, G3TED.

The following manufacturers, retailers and organisations were represented: Radio Society of Great Britain; D. P. Hobbs, Luton; Amateur Radio Bulk Buying Group; J. & A. Tweedy, Chesterfield; Home Office (Posts & Telegraphs); Homer & Whitbread, Crayford; Taurus Electrical, Loughborough; British Amateur Teleprinter Group; Stephen James, Liverpool; LMB Speakers, Loughborough; M & B Components, Leeds; Eley Electronics; International Short Wave League; Baginton Electronics; Datong Electronics; Doram, Leeds; Burns Electronics; Garex Electronics; Radio Shack Ltd.; Lowe Electronics; John Birkett; Amateur Radio Shop; Bamber Electronics; Western Electronics; RAIBC; D. Tilcock; Richard White; Bennison, Kings Lynn; Amateur Electronics; Microwave Modules; Isherwood Electronic; Telford Communication; Heath, Gloucester.

The "DX" station and talk-in station were operating under the call GB3ARE.

During the Exhibition hours the following programmes were scheduled for showing in the film theatre: Cough and You'll Deafen thousands; The History of the B.B.C.; Television Camera Tube; The Electroners; Semi-Conductor Physics; Television Carrier Wave; Its The Tube that makes the Colour; Something Big in Micro-Circuits; A Planned Environment.

From all reports, the exhibition was a huge success—it was very well organised!



MODEL CON

PART 1-THE R

This receiver is intended for use with the 27MHz model control transmitter to be described next month, but it may also be used in conjunction with any transmitter giving a tone modulated carrier. Though a superhet receiver has a less simple circuit than the super-regenerative receivers which are often used for model control, it does have some advantages. One of these is the additional selectivity obtained so that, if more than one model is in use, it is unlikely that control will be taken over accidentally by another person whose transmitter is near, as may happen with an unselective receiver.

The crystal controlled oscillator of the receiver also gives a high degree of reliability and frequency stability so that the receiver is unlikely to need regular adjustment. The receiver operation is not influenced by changes to the aerial, which can be critical with super-regenerative circuits.

RECEIVER CIRCUIT

The circuit shown in Fig. 1 employs five transistors and one IC. The aerial tuned circuit L1C2 is coupled through C1. The length of aerial used naturally influences the maximum range obtainable and can generally be some 12in. to 18in. or so. There is no critical or exact length which must be fitted.

Coil L2 couples signals to the base of the mixer Tr1 while Tr2 is the crystal controlled oscillator, coupled to Tr1 by C4. There is a difference of 455kHz between this oscillator and the frequency of the transmitter. Mixing in Tr1 thus provides a 455kHz output feeding the intermediate frequency transformer IFT1. IFT1 and IFT2 form a compact but quite selective IF filter and signals pass to pin 2 of IC1 providing IF amplification, automatic gain control and demodulation, the resultant audio tone being obtained at pin 1. Tr3 an audio amplifier after which the audio tone is coupled to Tr4 by the driver transformer T1.

When no tone is present Tr5 base is negative via R10 and no collector current passes. When the tone

TAKE NOTE!

The use of radio for controlling a model is permitted only under the authority of a licence issued by the Home Office. This authorises the use of A1, A2, F1 and F2 emissions in the frequency band 26.96 to 27.28 MHz with a maximum effective radiated power of 1.5 watts and in the band 458.5 to 459.5 MHz with a maximum effective radiated power of 0.5 watt. The licence authorises the use of the apparatus anywhere in the UK and is valid for five years. Applications for the licence should be sent to:—Home Office (Radio Regulatory Division), Waterloo Bridge House, Waterloo Road, London SE1 8UA together with the fee of £1.50 **NO EXAMINATION IS REQUIRED.**

CONTROL BY RADIO

RECEIVER

F. G. RAYER

G3OGR

present Tr4 conducts when its base is driven positive by T1 and these pulses are smoothed by C12. Tr5 base bias now results in collector current which operates the relay. The relay switches the circuit to magnetic or similar devices which in turn control steering or other functions in the model.

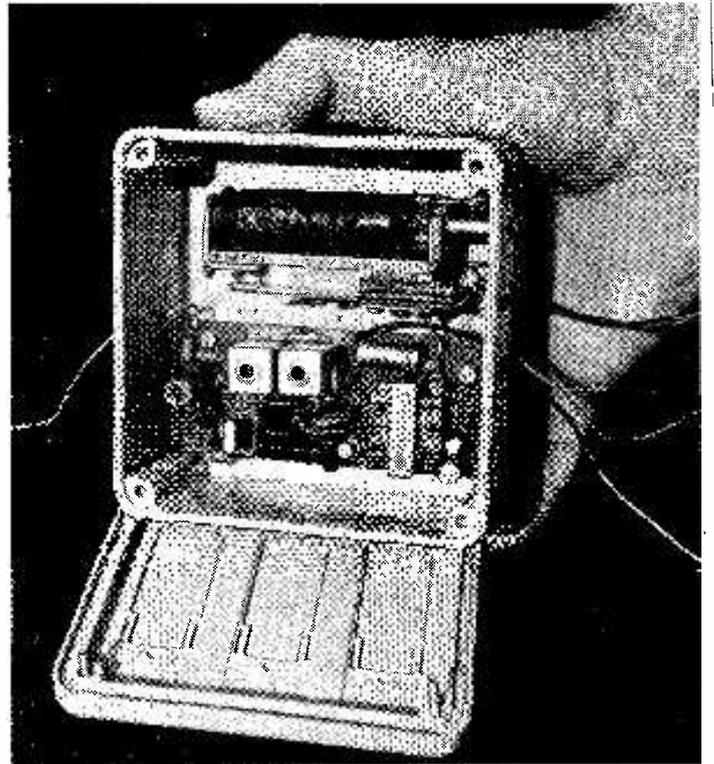
Current drain of the whole circuit is small and it is intended for use with any 4.5 volt or 3-cell battery.

CRYSTAL FREQUENCY

With a 27.005MHz crystal in the transmitter the receiver crystal is 27.460kHz, giving a difference, or IF, of 455kHz. There is no need to use these specific frequencies which are quoted as an example. Model control crystals are available for various channels, some being colour coded. If the equipment is being used by itself, remote from other model control transmitters, any channel may be used. But if other persons are operating model control equipment nearby each transmitter should use a separate channel to avoid interference. If a change in frequency is ever found necessary both transmitter and receiver crystals have to be pulled out and replaced by a pair for the new working frequency.

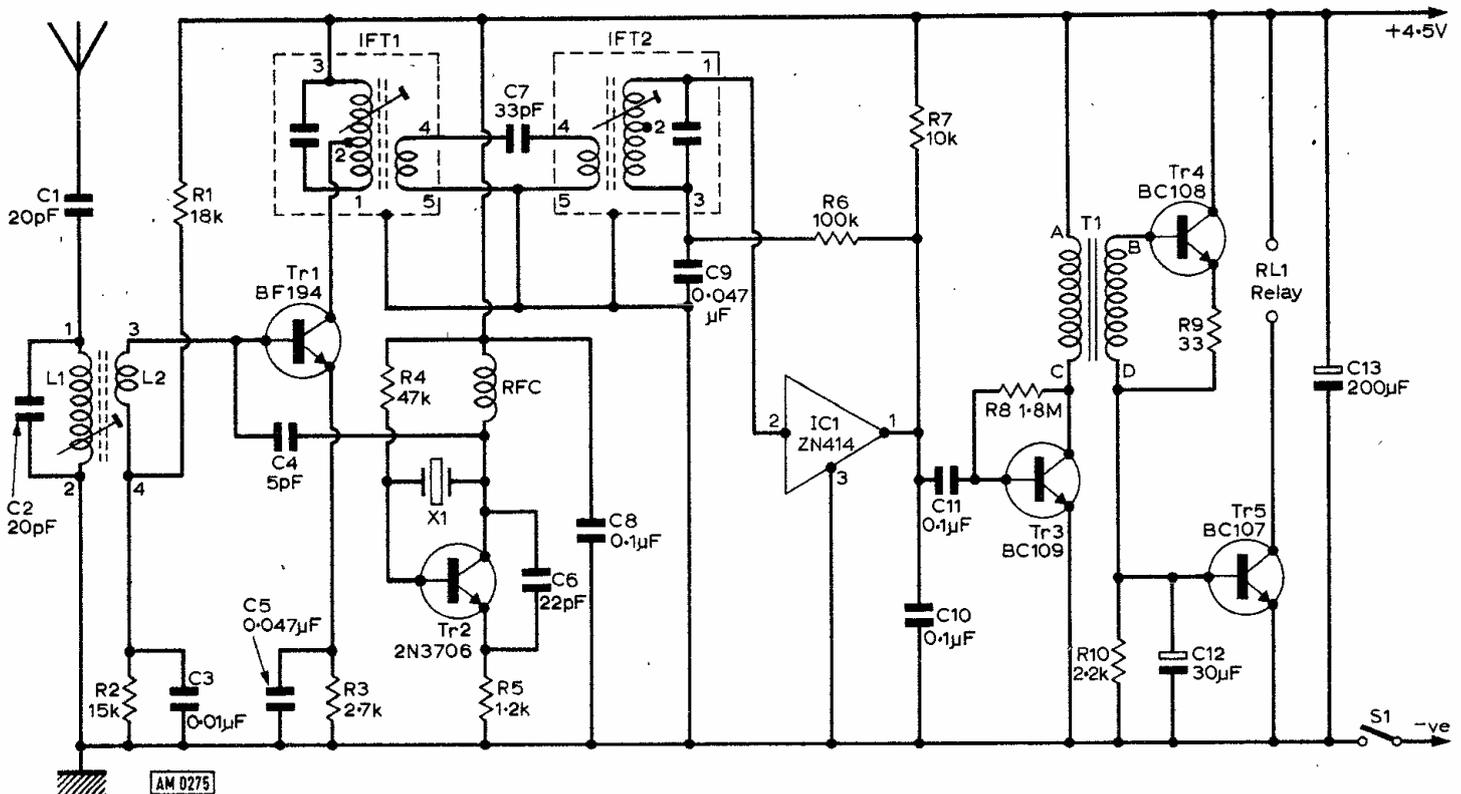
CIRCUIT BOARD

This board measures about 3⁵/₈ x 1⁵/₈in. without the relay but may be extended to permit a small relay to be mounted on it near Tr5, but the relay can just



▲ The finished receiver board mounted in a protective plastic box together with the relay. The battery switch and battery are mounted externally.

▼ Fig. 1: Circuit diagram of the crystal controlled receiver.



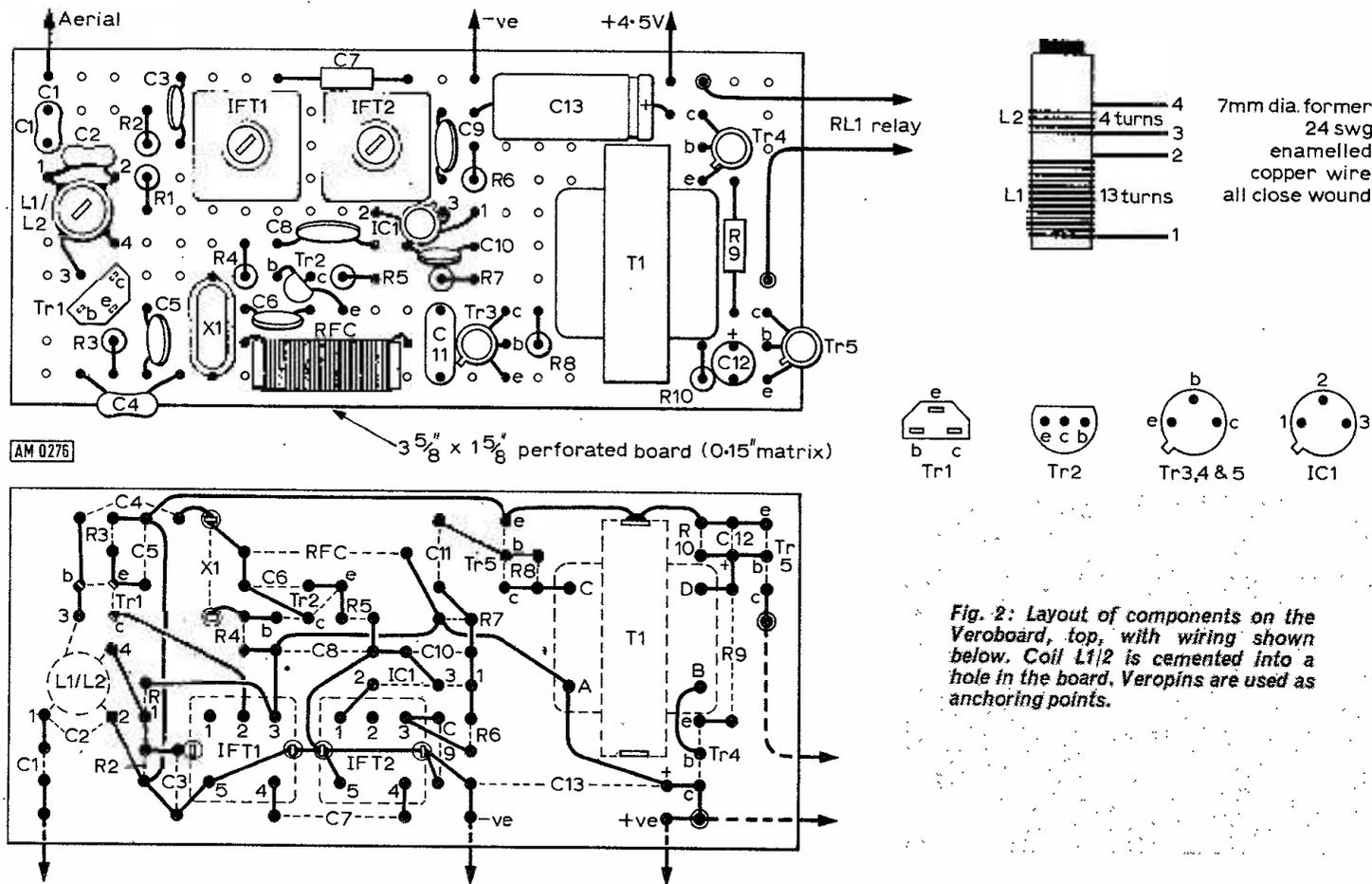


Fig. 2: Layout of components on the Veroboard, top, with wiring shown below. Coil L1/2 is cemented into a hole in the board. Veropins are used as anchoring points.

as well be separated from the receiver. Both sides of the circuit board are shown in Fig. 2. Holes are drilled for the pins and screening can tags of IFT1 and IFT2, for T1 and the crystal holder before fitting any items. The coil L1/L2 is a push fit in a hole and is cemented in place. A flying lead is left for the aerial connection and leads for battery positive and battery negative. The on-off switch S1 is placed in an easily reached position on the model. Two leads are soldered to Veropins which run to the relay.

The RF choke has 46 turns of 32SWG enamelled copper wire, close wound on a 1/4in diameter former about 3/4in long cut from insulated rod (some potentiometers have an insulated shaft which is suitable). A small hole is drilled near each end of the rod, the wire is taken through one hole and the choke wound then the wire is cut and passed through the other hole. Adhesive at the ends holds the choke to the board. The whole winding should not be covered with adhesive or any other protection.

In most places the wire ends of components are long enough to reach connecting points. Elsewhere, 22SWG wire can be used. Sleeving is necessary on leads which cross other wires or run near joints. Tr1 has tags which pass directly through the circuit board holes. The leads of the other transistors and IC1 are arranged as shown. Leads 1 and 2 of IC1 must be well separated as in Fig. 2.

The can tags of the IFT's are connected to the negative line as is the core of T1. The secondary centre tap of T1 is not used.

TESTING

The receiver is adjusted by setting the cores of L1, IFT1 and IFT2 and is best done with the aid of a multi-range meter. Set the meter to 100mA range

and clip it to the relay pins, with a resistor of about 100 ohms or so in series with one lead (the resistor is essential). Meter positive is taken to the positive pin. With the receiver switched on, current should be almost zero.

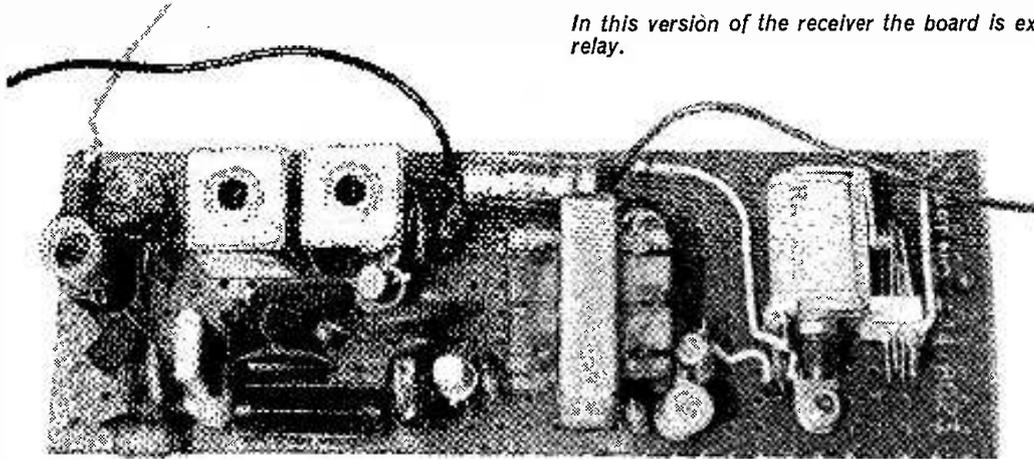
The transmitter (Part 2) is then switched on and the cores of IFT1 and IFT2 are rotated for maximum meter reading. To avoid overloading the transmitter aerial should not be extended and no aerial need be present on the receiver. A correctly shaped tool, such as that available from the IFT makers, should be used to adjust the cores, as a steel blade is unsuitable and wedge-shaped tools may split the cores so that they cannot be rotated. It may be helpful to have someone take the transmitter a short distance away so that the relay current shown by the meter only rises to 15 to 20mA or so. The core of L1 is also peaked for best results. In the absence of a transmitter a signal generator will suffice.

When the IFT's have been set they need no further adjustment. But when changing or connecting the aerial some small re-adjustment of L1 core may be needed.

AERIALS

A vertical or slightly sloping aerial will not appear out of place on many models. It can be the small telescopic receiver-type of aerial or a rod or stout wire which can be inserted in an insulated socket. A self-supporting vertical wire should have a loop formed on the top so that it is not a hazard to face or eyes. The length of the aerial will depend on the size of the model and the maximum range wanted. For close ranges the aerial can be short which would be useful for a small model boat controlled over a limited distance.

In this version of the receiver the board is extended to take a small relay.



RECEIVER PROTECTION

In a model boat there may well be moisture, spray or oil so the receiver can be protected by fitting it into an insulated box with a tight lid, with aerial, relay and battery leads emerging through small holes.

A check on operation and range should always be made after any changes to the equipment. If loss of control may result in the model not being recovered, a careful watch should be kept on the condition of all batteries. These may appear adequate after an interval of rest, but may soon lose voltage when delivering current, if in poor condition.

RELAY

Provided the relay opens and closes reliably when the transmitter is keyed, at the range wanted, it will probably need no further attention. However, as range is increased, the rise in current decreases. The maximum range which can be obtained thus depends on the relay sensitivity, as well as other adjustments. For example, if the relay requires

35mA to close, operation will be satisfactory where this or a higher current is obtained, but will become unreliable and cease when current falls below 35mA. So if the relay were set to close at 25mA instead, control would still be obtained at an increased range.

The simplest way to check the operation of the relay, if necessary, is to connect the relay, a 2k Ω or similar wire-wound potentiometer and a 9V battery in series, with the meter on 100mA range also in circuit. Begin with the full resistance and on reducing this note at what current the relay closes. Some relays have an adjusting spring and can be set to very close limits. With others, careful bending of the contact springs or a flat spring will be needed.

Both a miniature model control relay, with a coil having a resistance of 35 ohms and a larger surplus type relay were found suitable. The small relay originally required 60mA but was re-adjusted to pull in at 25mA and this easily gave control at 100 yards. The larger relay was capable of more sensitive adjustment. A miniature relay is more appropriate for a model having limited space. In general, a relay of moderately high resistance, such as 100 to 250 ohms, will be more sensitive than relays of under 100 ohms but the greater coil resistance naturally reduces maximum current. If wanted, an extra battery could be added in series with the relay so that the additional voltage is available for Tr5 only, but this was not needed with relays of the type mentioned.

Where the relay may switch circuits carrying appreciable power it is necessary to watch that the relay contacts are suitable or they will rapidly deteriorate and become pitted or stick together. A small relay can control the circuit to a small actuator or motor but it is not suitable for controlling directly speed models where a propulsion motor may consume several amperes. Where the receiver relay is unsuitable for the current required, it should control a relieving relay of more robust type, which will in turn switch the circuit required.

With a 100 ohm relay and 4.5V battery supply, current through the relay cannot exceed 45mA. Using this receiver at ground level, with a 20in aerial and the hand-held 5-transistor tone transmitter described in Part 2 a current change of about 40mA was maintained up to a distance of 100 yards. This easily gives strong, reliable operation of the relay. With no tone radiated, the receiver draws approximately 3mA which is a very light load for even small cells.

PART 2 NEXT MONTH DEALS WITH THE TRANSMITTER CONTROL UNIT.

★ components list

Resistors

R1	18k Ω	R6	100k Ω
R2	15k Ω	R7	10k Ω
R3	2.7k Ω	R8	1.8M Ω
R4	47k Ω	R9	33 Ω
R5	1.2k Ω	R10	2.2k Ω

All $\frac{1}{2}$ or $\frac{1}{4}$ W 5%

Capacitors

C1	20pF SM	C8	0.1 μ F
C2	20pF SM	C9	0.047 μ F
C3	0.01 μ F	C10	0.1 μ F
C4	5pF SM	C11	0.1 μ F
C5	0.047 μ F	C12	30 μ F 6V
C6	22pF SM	C13	200 μ F 6V
C7	33pF SM		

Semiconductors

Tr1	BF194	Tr4	BC108
Tr2	2N3706	Tr5	BC107
Tr3	BC109	IC1	ZN414

Miscellaneous

IFT1/2 (Denco IFT13). Pair of crystals, Type HC6U, see text (Henry's) and crystal holders. Transformer T1 (Home Radio TR64). S1, slide switch, on-off. Waterproof box to suit. Plain Veroboard $3\frac{5}{8}$ x $1\frac{5}{8}$ in. 0.15in matrix. Former 7mm dia. and core.

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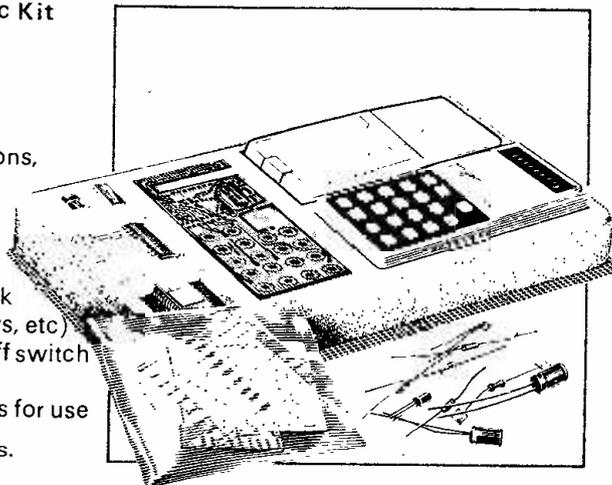
All parts are supplied — all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our Service Department will back you throughout if you've any queries or problems.

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Components for Scientific Kit (illustrated)

1. Coil
2. LSI chip
3. Interface chips
4. Case mouldings, with buttons, windows and light-up display in position
5. Printed circuit board
6. Keyboard panel
7. Electronic components pack (diodes, resistors, capacitors, etc)
8. Battery assembly and on/off switch
9. Soft carrying wallet
10. Comprehensive instructions for use

Assembly time is about 3 hours.



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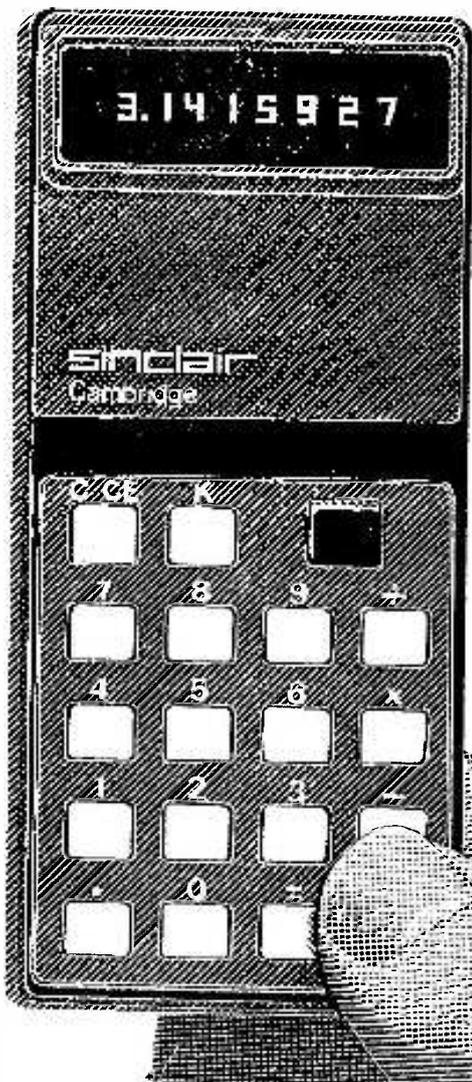
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*Delete as required.

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Name _____

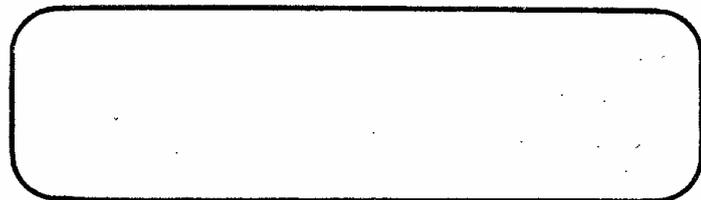
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by **Eric Dowdeswell G4AR**

JUST back from a couple of weeks of sunshine in SV-land, to be greeted by a nice pile-up of logs. Personally, I prefer a pile-up on 20m, especially if I am the focal point! All letters and logs will have been answered by the time this appears in print. I normally try to answer mail within a day or so of receipt but I have to have a break some time!

Eric Carling (Lymington, Hants) expresses surprise at the lack of logs for 10m especially since his Yaesu FR50B has rounded up 113 countries for him on that band this year. All round signals from a quarter wave vertical feed a Hamgear PMIA pre-selector. **Andrew Darragh** (Nr. Wetherby, Yorks) apologises for the absence of a log this month. He's been busy rewiring his AR88 and promises better things henceforth. Just so long as you haven't deserted us OM!

Paul Barker BRS 34898 (Sunderland) volunteered to provide some photos taken off his SSTV monitor but until I can persuade the Editor to give me some more space I am afraid it is not possible to include photographs. But, I can promise that there will not be any pics of any Fred Bloggs and a desk full of commercial equipment! Paul will be glad to assist those interested in SSTV. Also had a very interesting letter from MK Products, 5 Lancashire Drive, Belmont, Durham (alias G3LIV and G3RDI) who can provide PC boards for homebrew SSTV equipment, such as used by Paul Barker, and promise info and help to interested readers.

Lately 15m has been a happy hunting ground for **Bernard Hughes** BRS 25901 and his FR500SDX, logging 36 JA's in a couple of days. His comprehensive logging system shows a band/countries total of 533 countries on SSB from 10 to 160m so far this year with an all-time total of 1,048. Not to be outdone by Paul Barker and his SSTV antics, **Peter Roughley** (Warrington, Lancs) weighs in with a long list of RTTY call signs copied on 14.1 MHz in just a couple of days. His modest gear, fed from a 60ft wire or 21ft whip aerial is a BC312 with a Racal IF unit "grafted on as a Q5-er" feeding a homebrew terminal unit and 7B printer.

Michael Green A8088 (Northwich, Cheshire) bemoans his folk's colour TV timebase QRM and appeals for suggestions on suppressing same. Try shorting the aerial input to the chassis and see

how much is coming through the mains OM. Fit a mains suppressor if necessary, or try earthing your gear to a separate point such as an earth rod, after disconnecting the mains earth. All my own gear is earthed to an extensive buried radial system, used for 160m, and I get no QRM from a colour set situated about 15ft away. **Max France** (Warrington, Lancs) found that a 20ft vertical plus ATU produced better signals from the DX than separate dipoles for 10, 15 and 20m. Generally will OM, if one can tolerate the lack of horizontal discrimination such as a dipole will provide when placed end-on to the Euro QRM! **Tim Charles** (Colchester, Essex) has been braving our English summer and getting up at 0400 to check on 80m, usually finding ZL's at the top end. He is not too happy at a certain G-net station relaying VK and ZL's from 20 or 40m on to 80m giving the impression of a two-way QSO on 80m!

Kind letters from **Leonard Page** (Kilmarnock), **Malcolm Nesland** (Blyth) and **Bill Major** (Keighley) with hints on curing the hum on Yaesu 9R59 series of receivers, mentioned recently in this column. All amount to fitting an attenuator to the output and then turning up the audio gain. Try 100 and 10 ohm resistors in series across the output, the 100 ohm going to the live side and connect the phones to the junction of the resistors and earth. **Bill Urquhart** (Sutherland) repositioned the output transformer but got more joy replacing the 2kΩ resistor in the power supply circuit with a 10H choke. **Len Allard** (Leigh-on-Sea) wrote direct to Japan, to the makers, who suggested additional smoothing capacitors but again little improvement resulted. On my own 9R59DS I spent a week-end making some 25 mods to improve the overall performance, some taken from past articles in Radio Constructor, so it looks as if a separate article on the subject is now called for!

Alan Rae (Glasgow) has also taken the advice of your OT and provided himself with a 60ft vertical plus ATU for his CR100 and "it proved very effective especially on 80m" enabling Alan to log his first ZL's on the band.

Log extracts

Alan Rae:—80m VK2VQ VK4NE ZL2AR ZL3ACW ZL4BX 20m EA8TR TU2EF 3A2CP VE6JL/P.

Tim Charles:—80m VK2ALK ZL2BFT ZL3GX ZL4AA ZL4FB 40m BU3OS ST2RE ZL1AOP 20m AP9VHE XE6OMB YS2RL.

Max France:—80m FL8DJ ZD3R 6W8FP 9M2CJ 20m VK9YV VP8NS XP1AA 7P8AQ 15m KX6NQ 5N2ESH 10m CR6UE ZE4JW 3B8CV.

Michael Green:—40m HK4DHR 20m 7SL2AO



TU2DO.

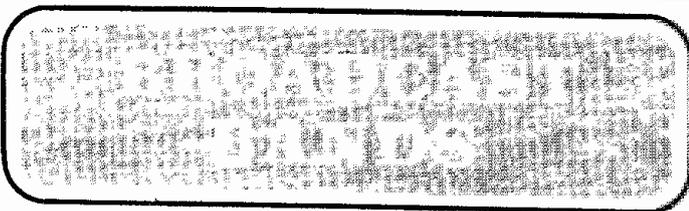
Peter Roughly:—20m ALL RTTY DAILS DJ0CP DL2BR EA3OT EA8FF F5WG F9IB G3AWA G8FC HA5KDQ HZ1SH IIPXC I3BA IC8SMY SM0ASW TF3IRA VE7BDQ VK3KF W3KV 3A2GX.

Bernard Hughes:—20m KL7HRP VK5YH ZLIPZ ZD3R 3D2AZ (Fiji) 15m A35AF JG1MVA JR1YFD JE1MLK.

Paul Barker:—20m DUINRS FM7AQ TJ1AF TU2DO ZB2CJ (QSL G3ATU) KL7GDX JR1VMC 15m VQ9BP/D 7P8AY 10m A4XFE (Oman) HZ1KE 3B8CV.

Eric Carling:—10m VU2DK EA9FA VQ9BP/D (Desroches Is) 9Y4SH HC1CW FY7YM 5U7BA FH8CJ 7Q7DW CT2AK ZS3AW KC4AAC 9J2DT PAOIWH/S21 (Bangladesh) JY9GR VP8HZ.

CW stations in bold, remainder SSB. Please note that logs should be in alphabetical order for every band.



MEDIUM WAVE BROADCASTS

by Charles Molloy

RODNEY ARMSTRONG who lives at Ashby-Cum-Fenby, near Grimsby refers to the October issue of PW and the reception of the Yorkshire TV sound on the medium waves by **E. Jenkinson** of Sheffield. Rodney has had similar reception which he has traced to re-radiation from his domestic TV receiver. He can also receive BBC1 sound on the 49m band when his TV is switched to that programme. Reception was on a Sony 7R33L portable connected to a 50ft longwire antenna.

Timothy James reports again from Southampton. With his Fidelity RAD 16 he has pulled-in BBC local stations at Medway on 1034kHz (290m); London on 1457kHz (206m); Brighton on 1484kHz (202m); Oxford, also on 1484kHz; Bristol on 1546kHz (194m) and the BBC1 relay at Bournemouth on 1484kHz; the IBA outlets, Capital Radio on 557kHz and London Broadcasting on 719kHz. Europeans heard include AFN Frankfurt on 872kHz; Cluj, Romania on 1151kHz; Radio Sweden 1178kHz; Radio Prague 1268kHz and Radio Norway 1578kHz (this station has an English programme at midnight on a Sunday and there is a DX programme on the first Sunday/Monday of the month at 0020hrs GMT).

Paul Slinger refers to Radio City, the new Independent Local Radio outlet in Liverpool which is now on the air for twenty-four hours a day. The frequency is 1546kHz (194m) and the transmitter has a power of 1200 watts.

Brendon McNamee (Portrush, N. Ireland) reports that the low power relays at Dublin and Cork, both

of which transmit on 1250kHz have been experimenting recently with individual local programmes during the daytime.

Long distance reception on the medium waves is at its best during the winter months when a path of darkness exists for part of the day between the UK and the American continent to the west and to large parts of Asia to the east. Ideally, a communications receiver and medium wave loop aerial are the tools used by the MW DXer, but complicated equipment is unnecessary on this band. A domestic radio connected to an outdoor aerial will pull-in some DX and when conditions are favourable for reception of this area, will certainly receive a few of the stronger North American outlets.

DX from the west begins about 2330hrs when the path starts to open and a number of Europeans have closed down for the night. Canadians appear first. Listen for CJON in St. John's, Newfoundland on 930kHz; CBN also in St. John's on 640kHz; CHER in Sydney, Nova Scotia on 950kHz and CBA in Moncton, New Brunswick on 1070kHz. High power outlets on the east coast of the United States appear by midnight. Search for WNBC in New York City on 660kHz; WOR also in NYC in 710kHz; WINS in NYC on 1010kHz; WBZ in Boston on 1030kHz and WNEW in NYC on 1030kHz. Latin Americans to look for are Radio Jornal, Rio de Janeiro on 940kHz; Radio Belgrano, Buenos Aires on 950kHz; Radio Margarita, Venezuela on 1020kHz; Radio el Mundo, Buenos Aires on 1070kHz and Radio Tupi, Rio de Janeiro on 1280kHz. DX from North and South America reaches a peak between 0100hrs and 0200hrs GMT but it continues throughout the night until it gradually becomes swamped by Europeans opening up again for the next days broadcasting.

SHORT WAVE BROADCASTS

by Derek Bell

THE main topic of conversation among the short wave enthusiasts over the past few weeks has been the heavy storms that have reached us from the sun, dosing the ionosphere with radiation. This spectacular solar hiccup produced very far reaching effects that ruined many an evening's listening on the short wave frequencies.

The main disturbance was centered round the 14, 15, 16, of September with a visible aurora in Finland on the evening of the 15th. The outbreak started to bite on the Sunday the 15th at 1430, and by nightfall the 80 metre band went out completely. The BBC North Atlantic path also went out, along with most of the hope of amateurs engaged in contests. On Thursday, September 19th, another smaller disturbance was registered, and between them these two sent the sound of frying bacon and assorted grunts and groans down the spectrum to remarkably low frequencies, still it's an ill wind, I suppose our VHF colleagues enjoyed the fun.

To move on to the latest QSL news, Radio Canada is sending out a multi-coloured card depicting the world cycling championships 1974. This is a nice example of the graphic designer's skill, a pity it is unsigned and thus robs the artist of his due credit. Meanwhile, "Down Under" Radio Australia is accepting reports that are sent to its London office at **54 Portland Place, London W1**, they are still "clocking" between 60 and 90 days for a reply though. One of the most original "QSLs" that I have heard of comes



from Radio Baghdad, I have it on good authority that a certain collector received through the post (would you believe) two pounds of Dates!! Another QSLer has had the three volume biography of Kim Il Sung, from the Lebanon, he thinks that it came via the Radio Fyongyang mailing list.

While on the subject of the broadcasting stations, we must welcome Radio Israel to the ranks of those that put out a DX show, they have one due to start shortly hosted by one **Ben Dolphin** who I am told is an amateur and who hopes that his listeners will send him technical questions. Radio Israel also announce that they are to start a transmission to Australia and South East Asia at 1030 on their usual frequencies these are on the air with short gaps for twenty four hours a day, and the tuning signal is a national hymn on trumpets and drums with the spoken announcement "Kanshidurei Yisrael Mi-Yerusalayim" in Hebrew.

One final station to look at is Radio Finland who recently resumed their English Transmissions to North America at 0300-0330 with a 100kW on 9585 dropping their 2300 to 2330 transmission.

Turning now to postbag, letters are sparse this month due to the changeover. However, I have beside me a missive from **Trevor Bland** who resides at Lea in Lincolnshire. He operates a Teleton TF182 FB and the pick of his loggings are as follows:—

- 9545 Radio Ghana at 2115 in English
 - 11880 Voice of Turkey at 0005 in English
 - 15265 Radio Afghanistan at 1145 in English
- His aerial is a built-in telescopic five feet long assisted by a seventy-five foot-long external wire.

Mr. J. A. Martin (sorry about the formality but I have no more information) of Staines in Middlesex also tells us of his catches on his Codar CR70A, he runs a hundred foot aerial in the loft among the spiders and this picks out of the ether such goodies as:—

- 15270 Voice of Nigeria at 0600 in English
 - 15012 Radio Hanoi at 1800 in English
- To be awake at 0600 and DXing show that we have a dedication to our hobby equalled only by such people as fisherman, mountain climbers, or ardent PW readers!

Well folks that brings this month to a close so it only remains for me to wish you all good DX and long may your long-wires prove truly fruitful!

BROADCAST BANDS

Short Wave and VHF reports by the 15th of the month to **Derek Bell** c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

Medium Wave Logs to **Charles Molloy**, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS

Logs covering any amateur band/s in band/ alphabetical order by the middle of the month to **Eric Dowdeswell G4AR**, Silver Firs, Leatherhead Road, Ashted, Surrey, KT21 2TW.

points arising...

'TELE-TENNIS'

We have heard from several readers of problems in setting up Board A. Symptoms are the display of two or more "courts" side by side on the television screen.

A cure may generally be effected by increasing the value of R4 to 2.7k Ω , though it may be necessary to change VR2 to 25k Ω to be sure of coping with timing spreads in IC2.

'EPSOM' SHORT WAVE RECEIVER

The following points should be noted in conjunction with Fig. 13 in the October, 1974 issue.

1. The various coils and IF transformers are all wound with 28swg enamelled copper wire.
2. Winding L9 is a straight 40 turns—no centre tap.

'SANDOWN' F.M. TUNER

From experience gained in constructing several more tuners to this design, the authors have recommended a number of minor modifications to ensure consistent performance.

1. With certain samples of Tr102 and Tr103, spurious oscillations occur in the mixer stage at about 400MHz. These may be cured by inserting a ferrite bead between C110 and the junction of R107, R108, and Tr102 g2. If C110 is stood on end, the bead can be threaded onto the longer lead.
2. To reduce the effect of hum pickup in the oscillator tuned circuit, increase C118 to 0.1 μ F and insert a 100k Ω resistor, R118, between the junction of R111 and C118 and the tuning line (H). No modification to the pcb is necessary as R118 can replace the wire link beside C118.
3. The decoupling capacitor C227 on pin 11 of IC202 should be changed to a 22 μ F tantalum bead type.
4. If stronger a.f.c. action is required, R217 may be increased in value up to a maximum of 47k Ω .
5. Some mains transformers, although of the rating specified in the components list, may be incapable of driving scale lamps as shown in Fig. 3.

If the resistance of the secondary winding is too high, the voltage drop due to the lamp load will cause the supply to IC301 to fall below the level required for satisfactory operation. The ripple on the stabilised 13V line will increase and cause hum on the audio output.

For those constructors requiring the dial lamps, the solution is to use a transformer of a higher current rating or a slightly higher secondary voltage. If the voltage at pins 11 and 12 of IC301 exceeds 19V, a resistor of about 10 Ω should be inserted in the line to these pins to restore it to that level.

TAKE 20

DAVID ANDREWS

No. 67 BASIC WOBBULATOR

A series of simple transistor projects, using not more than twenty components.

ALTHOUGH we call this month's project a Wobbulator it is in fact a voltage controlled r.f. oscillator and as such might prove a valuable experimental circuit for many applications. Its most obvious application is as an aid to circuit alignment and we have designed it to operate from about 400kHz to just over 1MHz. Basically it consists of a conventional Hartley oscillator centred around Tr2, Fig. 1.

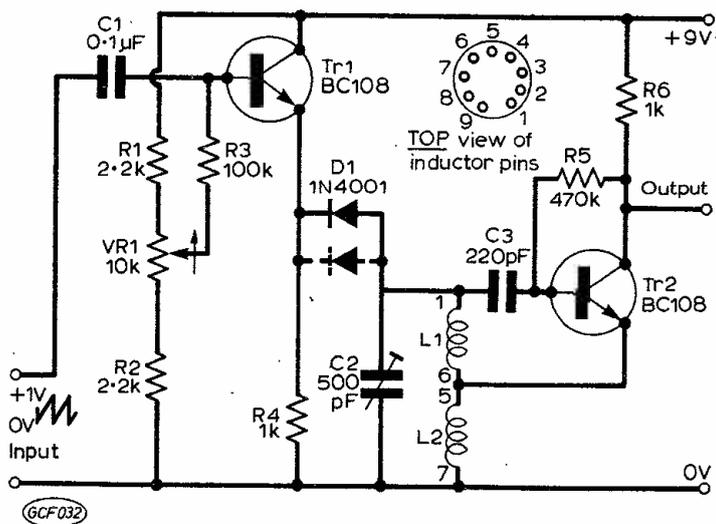


Fig. 1: Circuit for the Basic Wobbulator.

The coil used was one of the Denco Maxi-Q transistor aerial coils (Blue type) range 2T to give the desired frequency range. This is tuned by means of C2 and gives good coverage of the medium wave band as well as conventional intermediate frequencies. A high level is available at the output at quite a low impedance, nevertheless the oscillator is liable to "pulling" if too high a capacitive load is applied to the output. In most applications it will be found desirable to attenuate the signal by means of a suitable RC network—alternatively the output can be very loosely coupled to receivers under test (the output being taken "close" to the circuit in question without physical connection).

Higher frequencies

The prototype has only been tried with the above coil in the frequency range mentioned but there is no reason why it should not work at higher frequencies with different coils—provided the transistor has sufficient gain and circuit parasitics do not present problems. Should the gain of the transistor fall off at higher frequencies feedback coupling can be increased by increasing the value for C3. Excessive feedback will distort the output waveform as clipping sets in so do not make C3 larger than necessary for satisfactory oscillation.

"Wobbling"

To obtain "Wobbling" control of the frequency we must arrange to frequency modulate the oscillator with a control signal. In most applications this signal will be a sawtooth waveform extracted from the time base circuits of the test oscilloscope. The voltage control part of the circuit is around Tr1. The d.c. level at Tr1 emitter is set by VR1 and the sawtooth sweep is superimposed upon this. The voltage from Tr1 is used to control the shunt capacitance in the tuned circuit of the r.f. oscillator stage by means of D1. This diode is acting as a cheap substitute for a varactor diode and works extremely well. The principle of operation depends on the parasitic capacitance of the diode's depletion layer. When a diode is reverse biased very little current flows through it because of the layer between the p and n regions—known as the depletion layer—which is temporarily devoid of charge carriers. The depletion layer thus acts as a dielectric and the junction acts as a capacitor the value of which depends on the area of the junction and the width of this depletion layer. To get significant capacity we are using a large area junction—as found in a power rectifier—this gives capacity in the order of tens of picofarads.

★ components list

R1	2.2kΩ	} ¼W ± 10%	VR1	10kΩ linear
R2	2.2kΩ		C1	0.1µF (polyester)
R3	100kΩ		C2	500pF trimmer
R4	1kΩ		C3	220pF (see text)
R5	470kΩ		D1	1N4001
R6	1kΩ		Tr1 and Tr2	BC108

L1 and L2 Denco Maxi-Q aerial coil (Blue) range 2T B9A valve base (pc mounting).

The diode's capacity is varied by altering the width of the depletion layer. The greater the reverse bias on a diode the wider the depletion layer and hence the lower the junction capacity. Conversely as the bias on the diode is shifted in a forward direction the capacitance increases as the depletion layer gets narrower up to the point when the depletion layer disappears altogether and the diode is then said to be conducting in the forward direction.

Our circuit shows this diode as D1 and, of course, its polarity is very important. The polarity is such that it is always reverse biased by signal levels at the emitter of Tr1 and if these voltages vary, the internal capacity of the diode will change. The higher the voltage from Tr1 (in a positive direction) the more the diode is reverse biased and hence the

lower its capacitance and vice versa. Although it is not obvious from the diagram, this variable capacitance diode is acting in parallel with the main tuning capacitor C2 and hence input signal voltages will alter the frequency of the r.f. oscillator. For a wider range of control (together with a general increase in shunt capacity) you can put two or more similar diodes in parallel—this is shown by the dotted lines in both the schematic drawing and the layout.

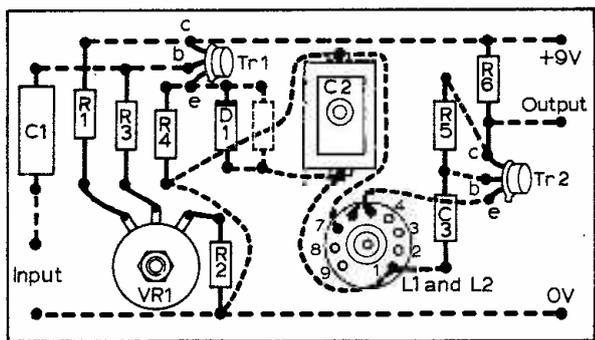


Fig. 2: Layout of Wobblator on plain Veroboard with components mounted on pins or tags. Dotted lines indicate wiring below the board. A B9A valve-holder may be used to take L1/L2, especially if different bands are contemplated.

The basic frequency of oscillation is set by C2 and this can be modified by the d.c. level at Tr1 emitter which is itself set by VR1. The degree of voltage control (as a percentage of the basic frequency) depends on the relative values of D1 and C2. At high frequencies (when C2 is at a low value) there will be a wider range of control than at low frequencies. In extreme cases the percentage variation is from about 100% to almost zero so some experimentation is needed. Of course, the voltage control is NOT linear with the output frequency over wide ranges—nevertheless it can be considered linear for a few percent modulation. R1 and R2 are present to prevent Tr1 being biased in extreme directions so that the input signal will always have some effect but it should be remembered that an excessive input signal could push Tr1 into an extreme conduction state if VR1 is set at either extreme.

As the title implies, this is a very basic circuit and although we cannot guarantee its quantitative accuracy it could prove very useful as a simple qualitative aid. Other applications could include experimental circuits involving phase locked loops and possibly self-tracking local oscillators for constant frequency reception of c.w. morse signals. **PW**

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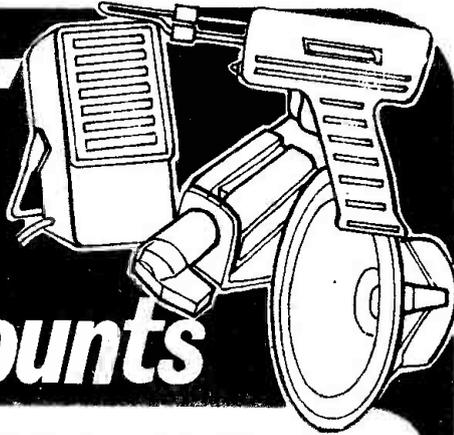
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AD140 67p	BC179 24p	BFY51 19p	ME8002 21p	OC83 24p	2N3705 11p		7400 20p	7486 7486	
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AD143 52p	BC183 11p	BFY64 39p	ME9001 17p	TIP29a 54p	2N3707 11p		7402 20p	7490 7490	
AD149 65p	BC184 12p	BFY90 \$1.15	ME9002 18p	TIP30a 64p	2N3707 11p		7403 20p	7492 7492	
AD161 46p	BC212 13p	BY100 17p	ME9003 16p	TIP31a 77p	2N3708 10p	Silicon	7404 21p	7493 7493	
AD162 44p	BC213 15p	BY127 17p	ME9002 19p	TIP32a 88p	2N3709 11p	Rectifiers	7405 21p	7494 7494	
AD161 } M/P	BC214 15p	BFZ10 39p	ME9002 18p	TIP33a \$1.13	2N3710 11p	IN4001 7p	7406 21p	7495 7495	
AD162 } 95p	BC257 15p	BFZ11 38p	ME9002 18p	TIP34a \$1.86p	2N3711 11p	IN4002 7p	7407 21p	7496 7496	
AF114 20p	BC258 13p	BFZ12 38p	ME8112 38p	TIP35a \$2.19p	2N3712 11p	IN4003 8p	7408 26p	7497 7497	
AF115 20p	BC259 15p	BY213 28p	MP8113 49p	TIP36a \$4.07p	2N3719 20p	IN4004 9p	7409 26p	7498 7498	
AF116 20p	BC267 14p	C407 19p	MP8113 49p	TIP41a 88p	2N3819 27p	IN4005 10p	7410 26p	7499 7499	
AF117 20p	BC268 13p	MA8001 30p	NKT211 29p	TIP42a \$1.10p	2N2926 11p	IN4006 11p	7411 26p	7500 7500	
AF124 29p	BC269 14p	MA8002 40p	NKT212 29p	TIP2955 \$1.05p	2N3904 17p	IN4007 13p	7412 40p	7501 7501	
AF125 29p	BC270 15p	MA8003 40p	NKT213 29p	TIP3054 55p	2N3906 17p	PL4001 8p	7413 38p	7502 7502	
AF126 29p	BC271 15p	MA8003 40p	NKT214 27p	TIP3055 66p	2N4036 57p	PL4002 10p	7414 44p	7503 7503	
AF127 29p	BC272 25p	ME0402 24p	NKT217 58p	TIS43 27p	2N4058 13p	PL4003 11p	7415 44p	7504 7504	
AF139 62p	BC297 26p	ME0404 19p	NKT261 25p	V763 38p	2N4059 13p	PL4004 12p	7416 44p	7505 7505	
AF239 66p	BC298 24p	ME0404/1 19p	NKT271 21p	IN33a 11p	2N4060 13p	PL4005 14p	7417 44p	7506 7506	
AFY79 73p	BC300 41p	ME0404/2 19p	NKT274 21p	IN914 8p	2N4061 13p	PL4006 17p	7418 44p	7507 7507	
ASY26 39p	BC301 40p	ME0411 22p	NKT405 75p	IN916 9p	2N4062 12p	PL4007 22p	7419 44p	7508 7508	
ASY27 50p	BC302 36p	ME0412 21p	NKT405 75p	IN4148 5p	2N5172 11p	IN5400 18p	7420 45p	7509 7509	
ASY28 39p	BC303 48p	ME0413 18p	NKT603F 41p	IN4149 5p	4N5192 85p	IN5401 20p	7421 45p	7510 7510	
ASY29 42p	BC304 39p	ME0414 19p	NKT613F 38p	1544 5p	40361 45p	IN5402 21p	7422 60p	7511 7511	
BA111 32p	BC41 89p	ME0462 23p	NKT674F 33p	2N696 23p	40362 45p	IN5403 23p	7423 60p	7512 7512	
BA115 10p	BC461 45p	ME0463 23p	NKT677 30p	2N706 12p	40363 45p	IN5405 28p	7424 60p	7513 7513	
					40364 45p	IN5406 26p	7425 60p	7514 7514	
					40365 45p		7426 60p	7515 7515	
					40366 45p		7427 45p	7516 7516	
					40367 45p		7428 79p	7517 7517	
					40368 45p		7429 20p	7518 7518	
					40369 45p		7430 20p	7519 7519	
					40370 45p		7431 45p	7520 7520	
					40371 45p		7432 45p	7521 7521	
					40372 45p		7433 79p	7522 7522	

Resistors

1/2 watt 5% carbon 3-9 ohms to 10 meg	1p
1/2 watt 5% carbon " " " "	1p
1/2 watt 2% m/o 10 ohms to 1 meg	41p
1 watt 5% carbon 5-6 ohms to 10 meg	3p
3 watt wirewound 1 ohm to 6K8 ohms	10p
5 watt wirewound " " " "	12p
10 watt wirewound " " " "	18p

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Tantalum Bead

Solid tantalum capacitors Tol ±20%.

All values 20p each.

MF/voltage: -1/35, -22/35, -33/35, -47/35, 1/35, 2-2/35, 4-7/35, 10/6-3, 10/16, 10/25, 22/16, 47/6-3, 100/3.

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C290 SERIES
400V: 0-001µF, 0-0015, 0-0022, 0-0033, 0-0047 3p. 0-0068, 0-01, 0-015, 0-022, 0-033 31p. 0-047, 0-068, 0-1 41p. 0.15 61p. 0.22 81p. 0-33 12p. 0p47 141p.

180V: 0-01µF, 0-015, 0-022, 0-033, 0-047, 0-068 31p. 0-1 41p. 0-15 4p. 0-1 41p. 0-15, 0-22 51p. 0-33 7p. 0-47 91p. 0-68 12p. 1µF 141p. 1-5µF 22p. 2-2µF 24p.

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24 x 5	31p	31p	Spot face cutter	57p
34 x 31	31p	31p	Pkt 50 Pins	22p
34 x 5	35p	35p		
17 x 31	24p	74p		
17 x 31	41-32	41-13		
17 x 5 Plain	41-10			

Electrolytic Capacitors

4 VOLT	10 VOLT	25 VOLT	40 VOLT
47µF 61p	220µF 8p	47µF 61p	470µF 18p
100µF 61p	330µF 10p	100µF 8p	680µF 25p
200µF 61p	470µF 10p	150µF 8p	1000µF 25p
320µF 61p	1000µF 11p	220µF 10p	2200µF 44p
1000µF 18p	1500µF 20p	470µF 13p	
4700µF 23p	2200µF 24p	680µF 20p	
		1000µF 22p	
		2200µF 35p	
		5000µF 68p	
6.3 VOLT	16 VOLT		63 VOLT
33µF 61p	15µF 61p		1µF 61p
68µF 61p	33µF 61p		2-2µF 61p
150µF 61p	150µF 61p		4-7µF 61p
470µF 11p	150µF 8p		6-8µF 61p
680µF 18p	220µF 9p		10µF 61p
1500µF 18p	680µF 17p		22µF 61p
2200µF 18p	1000µF 17p		68µF 10p
3300µF 26p	1500µF 25p		100µF 11p
	2000µF 43p		150µF 18p
10 VOLT	25 VOLT		220µF
22µF 61p	10µF 61p		470µF 26p
47µF 61p	22µF 61p		1000µF 44p

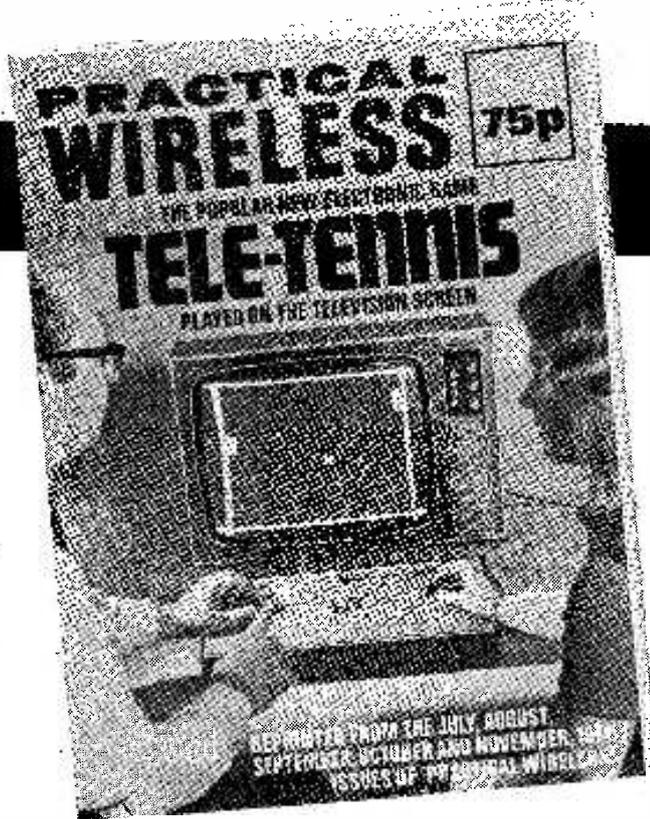
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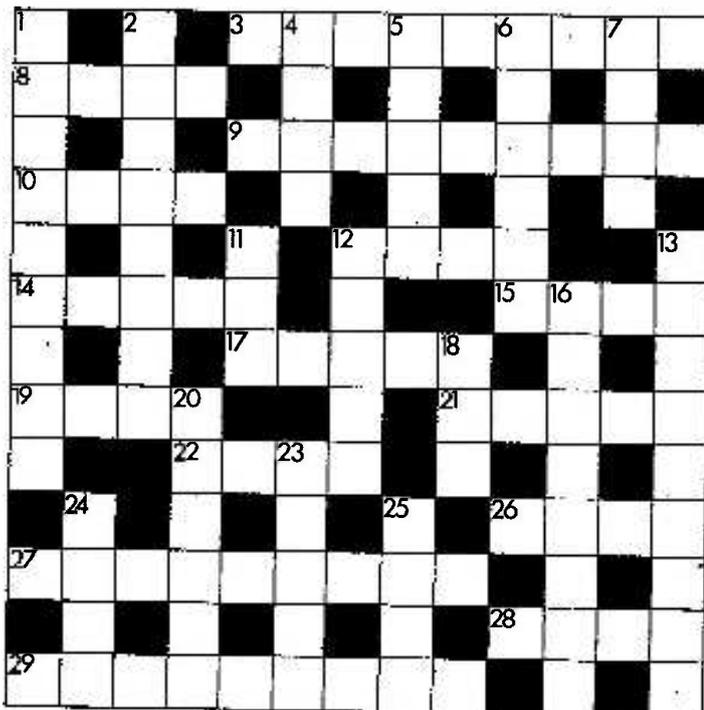
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ACROSS

- 3 It shows the power of a circuit! (9)
- 8 Call-sign of an outside broadcaster (4)
- 9 Record twister in sound reproduction! (9)
- 10 Need a rectifier for perfect garden reception?(4)
- 12 If re-echoing within, it's unstable (4)
- 14 Sound level in a sporting arena (5)
- 15 Press-button control of breeding (4)
- 17 A call for cats-whisker enthusiasts? (5)
- 19 The heart of electro-magnetism (4)
- 21 Decay in earthing technique (5)
- 22 Circuitous safety device (4)
- 26 Scots resort to bandwidth induction (4)
- 27 Electrical manufacturer may be dynamic (9)
- 28 An insulator from the mainland (4)
- 29 The frequency with which it transposes! (9)

DOWN

- 1 It starts strongly but weakens (5, 4)
- 2 It reveals current pressure in receiver design (8)
- 4 A strange connection made by Lily! (4)
- 5 A fine selector of wavelengths! (5)
- 6 Uses the by-pass technique (6)
- 7 Girl central to model laser design? (4)
- 11 Electrical unit from the old German (3)
- 12 Picturesque type of aerial (5)
- 13 I nosed about around Meg for an early phonograph(6, 3)
- 16 Aim be set to adapt oscilloscope system? (8)
- 18 Low howls with someone unknown inside? (3)
- 20 Result of cultivated distortion is a fact! (6)
- 23 Band that's not cold-shouldered (5)
- 24 Ferrite terminals cause a celebration (4)
- 25 Eastern European electrode? (4)

FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH

HOTLINES

ON RECENT DEVELOPMENTS

TV WALLPAPER

Printed circuit boards are all very well in saving the amount of wiring which needs to be done by hand, but the idea has now been taken a step further. A laminate company is offering for sale printed circuit boards which have a resistive layer beneath the copper layer. The idea is that one first etches away all the copper not required leaving only the desired connection pattern on the board surfaces. This exposes the layer of resistive material which the copper etchant does not affect. The required resistor pattern is then selected by printing using a negative and photoresist just as in normal PCB processing. The board is then etched in a solution which dissolves the unwanted resistive layer and bingo, resistive networks etc can be printed down and connected via the copper connection pattern. One company recently exhibited some tiny resistive patterns connected in this way. The patterns had small holes drilled through the PCB. The idea was that one simply pushed a transistor into the holes and the active device, together with the resistors already connected up, formed the well-known Schmitt trigger circuit. I wonder what else can be printed down onto the PCB? Perhaps in the end, the circuitry for television sets will be printed rather like wallpaper.

MEDICAL HELP

One of the most distressing ailments of our time is cancer. A British doctor, with the aid of electronics, is trying to do something about it. One way to check for cancer is to "tag" tumor antibodies in the patient and then measure the quantity. The "tagged" antibodies react with the patient's cells and give an indication of any cancer which might be lurking. Trouble is that all this takes time. The new method employs a mini-computer and allows some seven times the amount of samples per day to be processed when compared to other methods less automated. There's even a print out system which keeps the physician informed as to just how the test is going.

DEATH RAY

Readers may remember my commenting on a cigar-sized laser which was capable of putting out some very high power. I hear now that a nuclear-pumped laser has just arrived on the scene which would appear (at least in theory) to be capable of arc welding a missile to the nearest cloud. Experiments so far have been confined to using a helium-xenon gas laser which is excited by a neutron pulse from a reactor. Because of the military applications possible with this device, information is sketchy. However, it seems that the "death ray" is here and that metal could be melted and destroyed at quite vast distances.

MAGNETIC BUBBLES

Magnetic bubbles are back in the news. These are tiny bubbles which can be magnetised and passed along a chain thus forming a kind of memory which could be used in computer applications. These bubbles are only tiny—around 5 micrometers. "Too big," say Bell Laboratories who aren't known for telling fibs. Bell think that a single solitary micrometer is quite big enough. The effect will be to give greater packing density and lower power consumption. Well worth watching, these bubbles. Bell produced a bubble device about 12 to 14 months ago which took the form of a 100-bit shift register. Now they have succeeded in building an 8,000 bit array onto a 40 × 40 mil chip. How's that for progress in just over a year! If you really want to get technical about it, the film which contains these tiny bubbles in the latest device is composed of a gadolinium-cobalt-molybdenum alloy which in turn has been sputtered onto a glass substrate. Looks like future electronics engineers will need a degree in chemistry too.

Before you get all excited about the bubbles for memories, don't forget that charge coupled devices are bubbling along; an 8 million-bit memory was the highest count I last heard of—but then that was a month or two ago! Another interesting comparative newcomer is the

Josephson effect device. These are almost unbelievable if all the tales are true. To date they are claiming switching speeds in million-millionths of a second and power consumptions of meagre microwatts. Already these devices have been mentioned in applications for amplifications at 300GHz.

WELL 'ORGANISED'

Electronic organ enthusiasts will be pleased at the sound of the new SAH 200. It's an integrated circuit which can produce the top 13 notes of an electronic organ. Previously this task took three of the company's ICs. The device needs a single supply of 22V and is based on MOS technology. It comes in a 16-pin dual in-line package.

I.C. A CAR!

Motoring enthusiasts may like to know of a different IC; this time it's designated SAK 140 and it is intended for engine rev counters. It converts input pulses from the engine contact breaker into output current pulses of constant width and amplitude. I hope to give greater details next month if the circuitry (which is extremely simple) arrives in time.

DIGITAL TUNING

A parting thought. Your hi fi amplifier may be digitally tuned and controlled in future. Some ICs on the market require only a variable d.c. applied to be able to control such things as frequency response. One application given by the manufacturers shows an active bandpass filter whose response is controlled by a simple d.c. signal. Other examples include channel selection from a number of separate inputs. One advantage is that the d.c. control signal is not prone to interference in the same way that an a.c. control signal would be.

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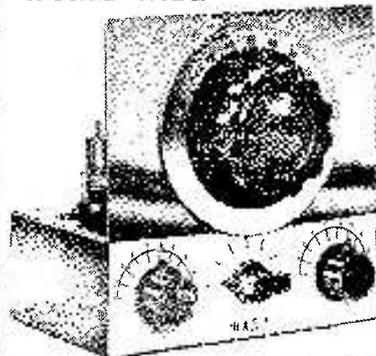
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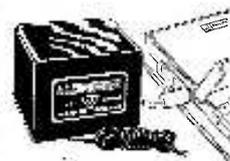
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PART 14—PHASE SHIFT CIRCUITS (cont)

THERE are innumerable applications of positive feedback and it would be impossible to give examples of all of them. Nevertheless following on from last month's experiments we felt it would be logical to continue with two other types of circuit which rely on phase shift and can be used in conjunction with feedback to make oscillators. At the same time we hope to show that positive feedback, alone, is not sufficient for oscillation to take place—there must always be a loop gain greater than unity.

We have selected two important circuits to describe this month; the **Wien Bridge** and the **Twin-T** or **Bridged-T network**.

Fig. 99 shows the basic circuit of a **Wien Bridge**. Basically it is a top cut and bottom cut filter rolled into one. Although it needs a lot of mathematics to prove it one can consider it as a circuit that will attenuate low frequencies and high frequencies to a great extent but will not have such a dramatic attenuation effect on middle frequencies. The response curve showing what the output voltage would be for different frequencies of input voltage is shown in Fig. 100.

The frequency of maximum output is called the *resonant frequency* and if the values of components in the bridge circuit follow the rule that $R_1=R_2$ and $C_1=C_2$ the output voltage at the resonant frequency is always one third of the input voltage

$$V_{out} = \frac{V_{in}}{3}$$

For all other frequencies the output voltage is considerably lower than the input.

Provided the two resistors and capacitors are of equal value there is a simple formula that relates the resonant frequency to these components

$$f(\text{resonance}) = \frac{1}{2\pi \times R \times C}$$

where R is in ohms, C in farads and f is in hertz.

Clearly, one could use this circuit as a passive filter of the "band pass" variety by inserting it between two stages of an amplifier—rather like the simple top and bottom cut filters described in an earlier part.

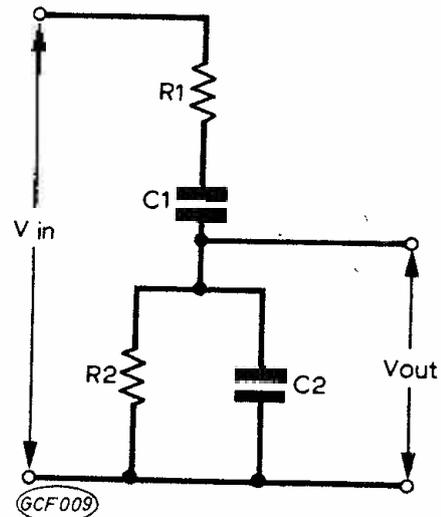


Fig. 99: Basic circuit of a Wien Bridge. Usually $R_1=R_2$ and $C_1=C_2$.

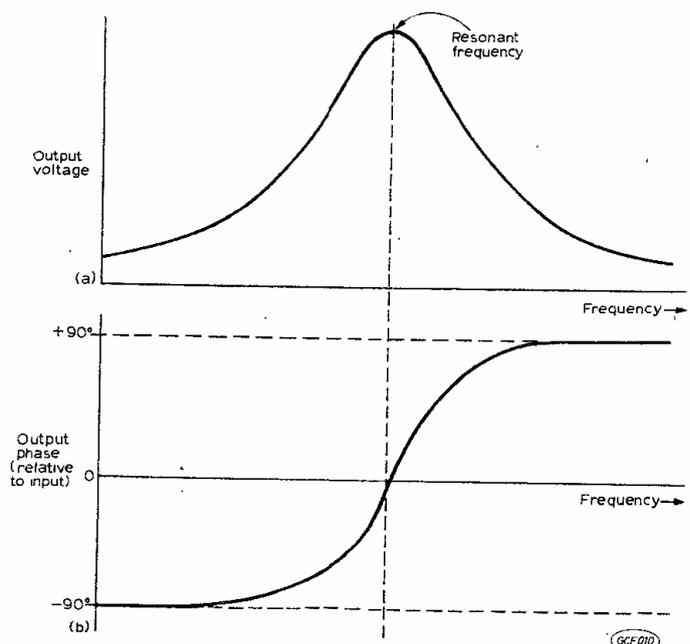


Fig. 100: top, shows that the output from a Wien Bridge is maximum at a particular frequency (resonance), below, indicates that there is no difference in phase between input and output at the resonant frequency.

The Q , or *quality factor* of such a filter is not very great so consequently it could not be used for accurate frequency selection.

When dealing with complex filters of this type one must not overlook what happens to the *phase* of the signal as it is processed by the circuit. In practice one can draw two curves to describe a filter's characteristics; the amplitude/passband characteristic that we have just described, also the relative phase of the output signal with respect to the phase of the input at different frequencies. Such a phase plot is shown in Fig. 100.

It should be noticed that for all frequencies below the resonant frequency the output lags behind the input by up to 90° in the extreme case, but above the resonant frequency the output has changed through zero phase to a leading condition and in the extreme this can be $+90^\circ$. This means that at resonance the output signal is *exactly* in phase with the input—in other words the network offers zero phase shift at resonance.

We can make use of this effect to produce a very versatile oscillator, the basic block diagram of which is shown in Fig. 101. We have already established

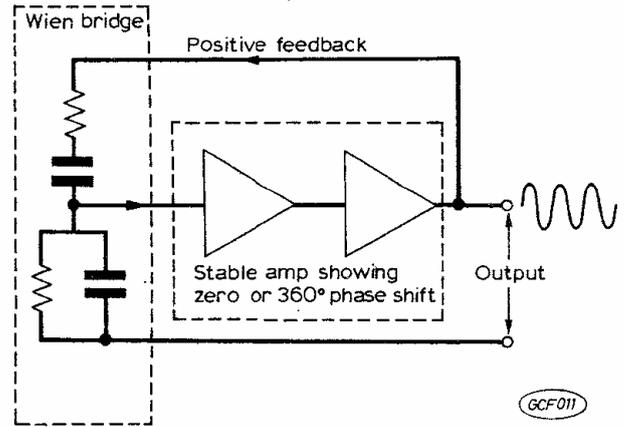
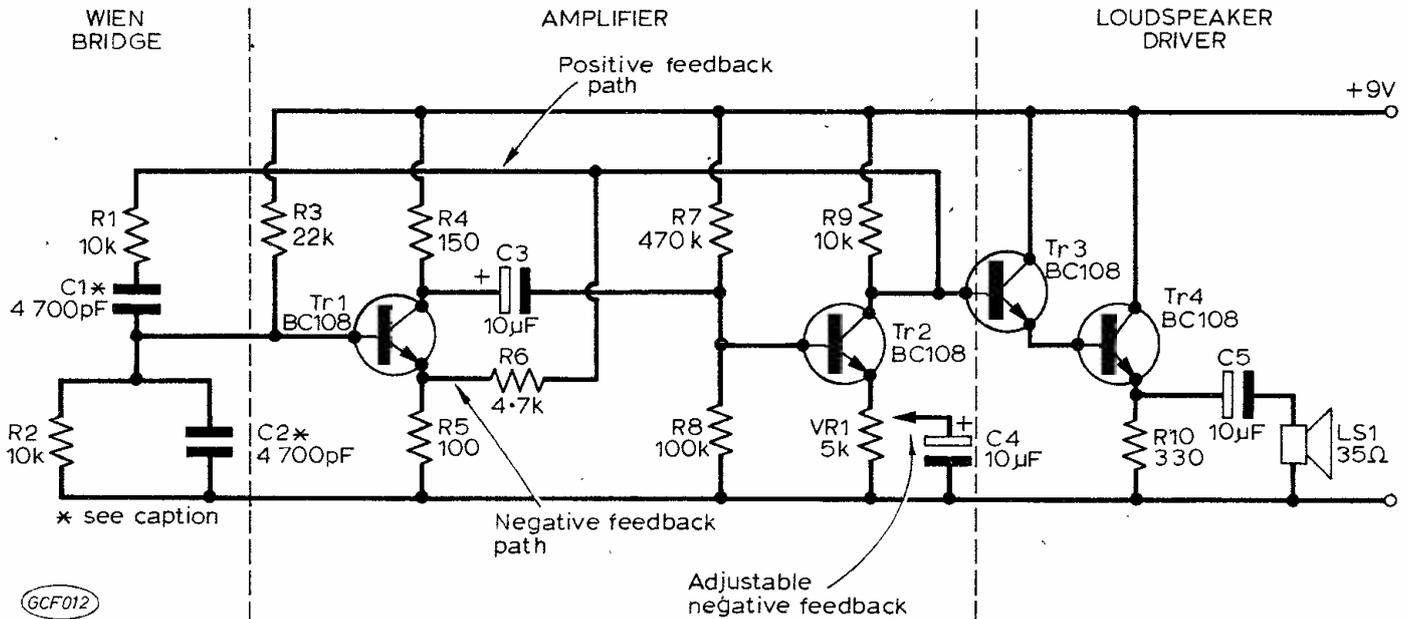


Fig. 101 : When connected into the feedback path of an amplifier having zero overall phase shift the Wien Bridge offers a simple way of making a sine wave oscillator.

that a two stage grounded emitter amplifier has an overall phase shift of 360° (which is the same as zero). Thus, if the output was connected back to the input we would have a condition for positive feedback.

continued on page 843



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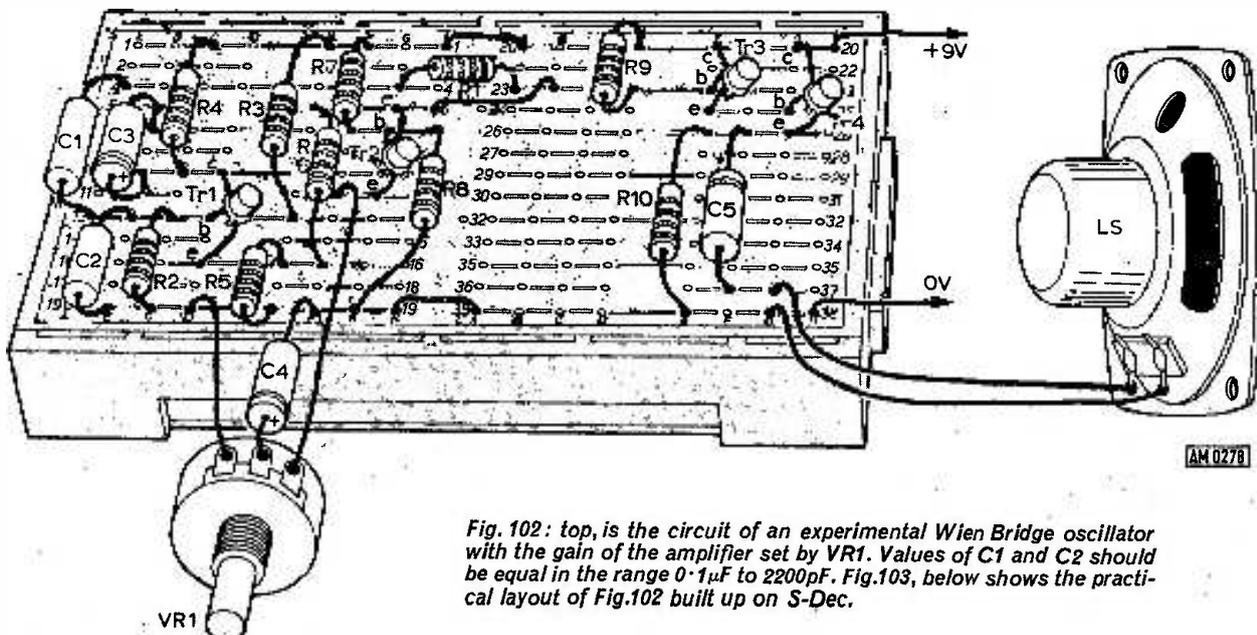


Fig. 102: top, is the circuit of an experimental Wien Bridge oscillator with the gain of the amplifier set by VR1. Values of C1 and C2 should be equal in the range $0.1\mu\text{F}$ to $2200\mu\text{F}$. Fig.103, below shows the practical layout of Fig.102 built up on S-Dec.

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151	200	8 0	12.1 x 9.3 x 10.2	7.39 53
152	250	13 12	12.1 x 11.8 x 10.2	8.93 73
153	350	15 0	14.0 x 10.8 x 11.8	10.80 73
154	500	19 8	14.0 x 13.4 x 11.8	12.41 91
155	750	29 0	17.2 x 14.0 x 14.0	18.65 *
156	1000	38 0	17.2 x 16.6 x 14.0	26.50 *
157	1500	46 0	21.6 x 13.4 x 18.1	30.23 *
158	2000	60 0	21.6 x 15.3 x 18.1	33.70 *

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4	150	3 4	8.9 x 7.7 x 7.7	0-115-200-220-240	3.75 45
66	300	6 4	9.9 x 9.6 x 8.6	"	5.29 53
67	500	12 8	12.1 x 11.2 x 10.2	"	8.02 67
84	1000	19 8	14.0 x 13.4 x 14.3	"	12.44 91
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18	4 2	2 12	8.3 x 7.7 x 7.0	0-12V at 2A x2	2.60 38
70	6 3	3 8	8.9 x 8.0 x 7.7	0-12V at 3A x2	3.75 45
108	8 4	5 8	9.9 x 8.9 x 8.6	0-12V at 4A x2	4.15 45
72	10 5	6 4	9.9 x 9.6 x 8.6	0-12V at 5A x2	4.67 53
116	12 6	6 12	9.9 x 10.2 x 8.6	0-12V at 5A x2	5.02 53
17	16 8	8 12	12.1 x 9.9 x 10.2	0-12V at 8A x2	6.62 60
115	20 10	11 8	14.0 x 9.6 x 11.8	0-12V at 10A x2	9.45 73
187	30 15	15 8	14.0 x 12.1 x 11.8	0-12V at 15A x2	12.29 85
226	60 30	32 0	17.2 x 15.3 x 14.0	0-12V at 30A x2	15.30 *

30 VOLT RANGE

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79	1.0	2 4	7.0 x 6.7 x 6.1	"	2.18 38
3	2.0	3 4	8.9 x 7.7 x 7.7	"	3.18 38
20	3.0	4 8	9.9 x 8.3 x 8.6	"	4.12 45
21	4.0	6 4	9.9 x 9.6 x 8.6	"	4.67 53
51	5.0	6 12	12.1 x 8.6 x 10.2	"	5.83 53
117	6.0	8 0	12.1 x 9.3 x 10.2	"	6.51 60
88	8.0	12 0	12.1 x 11.8 x 10.2	"	9.00 67
89	10.0	13 12	14.0 x 10.2 x 11.8	"	8.97 73

50 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	P & P £ p
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103	1.0	2 12	8.3 x 7.4 x 7.0	"	3.08 38
104	2.0	5 8	9.9 x 8.9 x 8.6	"	4.26 45
105	3.0	6 12	9.9 x 10.2 x 8.6	"	5.28 53
106	4.0	10 0	12.1 x 10.5 x 10.2	"	6.91 67
107	6.0	12 0	14.0 x 10.2 x 11.8	"	11.00 67
118	8.0	18 0	14.0 x 12.7 x 11.8	"	11.80 85
119	10.0	25 0	17.2 x 12.7 x 14.0	"	15.45 *

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126	1.0	3 4	8.9 x 7.7 x 7.7	"	3.10 38
127	2.0	6 4	9.9 x 9.6 x 8.6	"	4.62 45
125	3.0	8 12	12.1 x 9.9 x 10.2	"	6.84 60
123	4.0	13 12	12.1 x 11.8 x 10.2	"	7.96 67
40	5.0	12 00	14.0 x 10.2 x 11.8	"	8.87 73
120	6.0	15 8	14.0 x 12.1 x 11.8	"	10.27 85
121	8.0	25 00	14.0 x 14.7 x 11.8	"	13.64 *
122	10.0	25 0	17.2 x 12.7 x 14.0	"	15.93 *
189	12.0	29 00	17.2 x 14.0 x 14.0	"	18.16 *

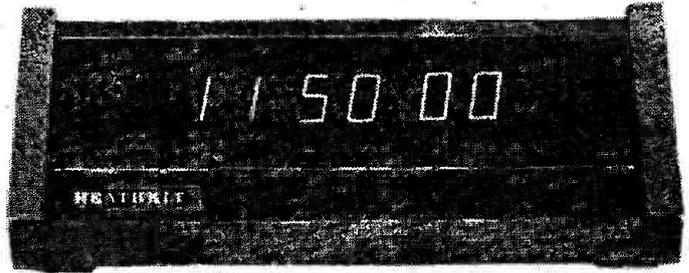
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13	100	4	3.9x2.6x2.9	9-0-9	1.28 13
235	330,330	4	4.8x2.9x3.5	0.9-0-9	1.42 19
207	500, 500	1 00	6.1x5.4x4.8	0-8.9-0-8.9	1.75 30
208	1A, 1A	1 12	7.0x6.4x6.1	0-8.9-0-8.9	3.00 38
236	200, 200	4	4.8x2.9x3.5	0-15-0-15	1.30 19
214	300, 300	1 4	6.1x5.8x4.8	0-20-0-20	1.76 30
221	700 (D.C.)	1 8	7.0x6.1x6.1	20-12-0-12-20	1.98 38
206	1A, 1A	2 12	8.3x7.7x7.0	0-15-20, 0-15-20	3.15 38
203	500, 500	2 4	8.3x7.0x7.0	0-15-27, 0-15-27	2.73 38
204	1A, 1A	3 4	8.9x7.7x7.7	0-15-27, 0-15-27	3.50 38

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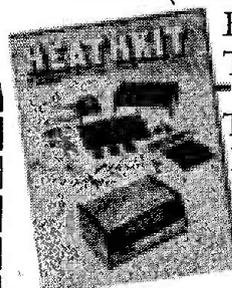
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MO	1/2	10-1M	4	3.3	2.3 nett
WW	1	0.22-3.9Ω	11	10	8 nett
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Tolerances:

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22	—	—	8p	—	8p	8p	10p	13p
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1,000	11p	13p	10p	17p	20p	25p	41p	—
2,200	15p	18p	13p	23p	26p	37p	—	—
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EXPERIMENTAL WORKSHOP—contd. from page 840

If we insert our Wien Bridge network in this feedback loop the bridge will alter the phase relationship of all frequencies *except* for the resonant frequency of the bridge in question; thus we would only obtain positive feedback at the resonant frequency.

The feedback signal is attenuated to one third of the output level, as we have just explained hence to obtain oscillation the gain of the two stage amplifier should be three. Although there is no problem in obtaining a low gain like this there are problems in maintaining its stability particularly as we are forced into using two stages to get the necessary phase response. Consequently our experimental circuit shown in Fig. 102 looks a little complex as we have built in two stages of *negative feedback* to fix and adjust the gain at this low level.

R6 in conjunction with R5 provide one negative feedback path which is fixed and VR1 allows a variable degree of feedback for experimental purposes. In practical production circuits a thermistor might be used instead of R6 to control the overall gain automatically.

If the gain diverges considerably from the desired value two things can happen. If it is too low the circuit will not oscillate, and if too high the output waveform at the collector of Tr2 might suffer from clipping. You should be able to experience this effect with the following experiment.

Make up the circuit of Fig. 102 complete with loudspeaker driver stage. Set the wiper of VR1 to the bottom end of its track. Depending on the components you have used the chances are that the circuit will not oscillate because we have excessive negative feedback around Tr2.

Increase the gain of the amplifier by reducing this negative feedback (advance the wiper of VR1) and the circuit should oscillate nicely. If you increase the gain too much you should hear the onset of clipping by a sudden change in tone of the signal from the loudspeaker.

You will find that there is a certain degree of sluggishness in getting oscillations started and they might build up in amplitude over a second or two which is caused by the high degree of negative feedback.

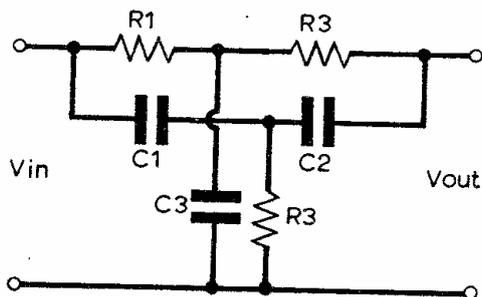


Fig. 104: Basic circuit of a 'Twin-T' or 'Bridged-T' filter. Normally the circuit is symmetrical with $R1=R2$ and $C1=C2$. $R3$ should equal $\frac{1}{2}R1$ and $C3$ should be $2 \times C1$.

A big advantage of this type of oscillator (compared with the phase shift type described last month) is that you only need change the values of two components in the frequency determining network (the bridge) to alter frequency and the range of adjustment is very large. In theory one can change the values of $C1$ and $C2$ or $R1$ and $R2$. However, in our experimental circuit you are limited to playing with different values for the capacitors only because $R2$ forms part of the potential divider biasing for Tr3

and changing its value would modify the gain levels of the amplifier. Nevertheless try substituting different pairs of values for $C1$ and $C2$ in the range $2,200\text{pF}$ to $0.1\mu\text{F}$.

This circuit is widely used by audio oscillator manufacturers for test instruments; for what it does it is a very simple circuit and is often used in amateur projects.

Whereas the Wein Bridge is a pass filter at resonance the **Bridge-T filter**, shown in Fig. 104 gives a high degree of attenuation at its resonant frequency. The onset of resonance is very sharp and this circuit is often used as a *notch* filter when a particular frequency needs to be removed from a series without significant influence on the amplitudes of neighbouring frequencies.

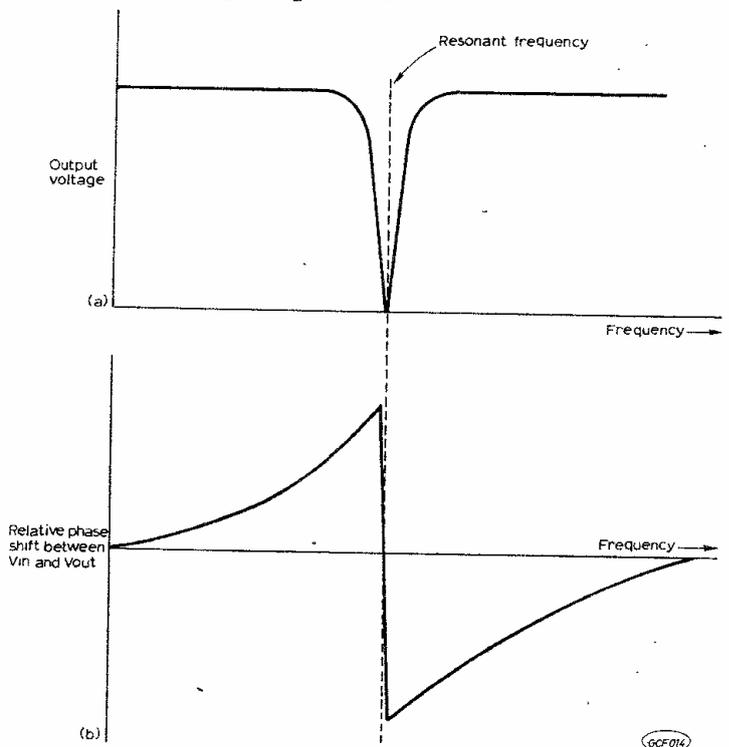


Fig. 105: top, output voltage at different frequencies for a fixed amplitude input signal. Below, at the resonant frequency 180° phase shift occurs.

The relationship between the component values is slightly more complex than the previous filter and although there is an unlimited variety of values one can use the Bridged-T is usually represented in its symmetrical form. This means that $R1$ should equal $R2$ and $R3$ should be half the value of $R1$. At the same time $C1$ should equal $C2$ and $C3$ should be twice the value of $C1$. Provided this relationship is maintained the resonant frequency is given by

$$f = \frac{1}{2\pi \times C_1 \times R_1}$$

where C_1 is in farads, R_1 in ohms and f in hertz.

The *phase* response of the filter is somewhat more complex. At the resonant frequency there is a sudden 180° phase shift between input and output. Depending on which side of the resonance frequency one looks one can say that the output is 180° out of phase with the input or it is in phase with the input. However, at the resonant frequency the theoretical output from the filter is zero, Fig. 105.

We can use this filter in the *negative* feedback loop of an amplifier (Tr1 of Fig. 106). Because of the rather strange phase response we shall get negative

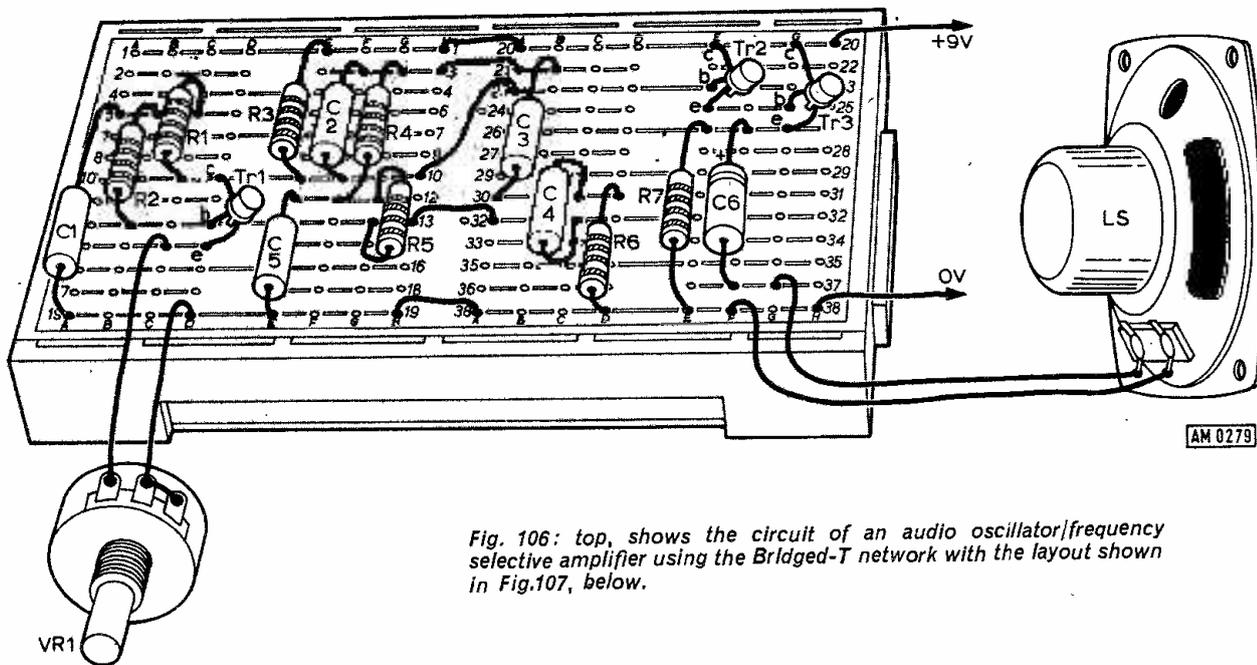
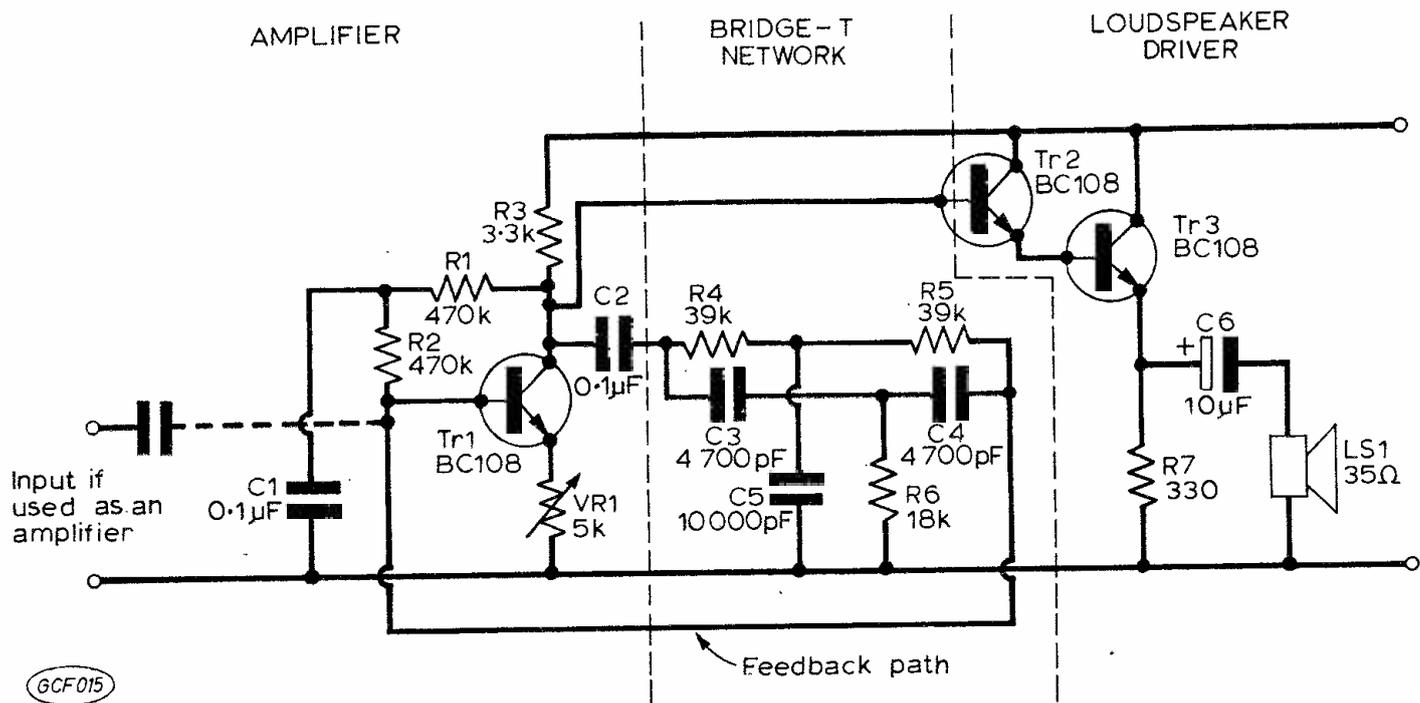


Fig. 106: top, shows the circuit of an audio oscillator/frequency selective amplifier using the Bridged-T network with the layout shown in Fig.107, below.

feedback on one side of resonance and positive feedback on the other side. By careful adjustment of the amplifier's gain we can get the circuit to oscillate at a frequency just slightly one side of resonance, by reducing the gain a little we have a complex balance between negative feedback on the one hand and positive feedback on the other. Thus it is possible to make a frequency selective amplifier that has a maximum gain (because of the zero negative feedback signal at resonance) at the resonant "notch".

This is very useful in many special applications and is frequently used by amateurs to make Waa-Waa effects with guitars and organs particularly if it is possible to sweep the resonant frequency by adjusting one of the components in the feedback circuit (usually R6).

You can experiment with the circuit as an oscillator or a frequency selective amplifier by suitable adjustment of VR1. Notice (as for the Wien Bridge)

that reducing VR1 too much (increasing gain) causes *clipping* and, in this case shifts the frequency further away from the notch.

As an amplifier connect the output of a crystal cartridge (through an attenuator if necessary) to the base of Tr1 through a 0.1µF capacitor and substitute a variable 50Ω potentiometer for R6.

By advancing the gain of the amplifier to just below the oscillating point you can deliberately make a *ringing amplifier*; i.e. a circuit that will respond to a pulse input and give a decaying train of sinewaves out. This effect is commonly used to produce electronic percussion effects to simulate drums or bells. You can stimulate such a ring by momentarily shorting the junction of R1 and R2 to the +9V rail. Altering the values of R4, R5, R6, C3, C4 and C5 will produce different sound effects.

Next month: Radio frequency oscillators.

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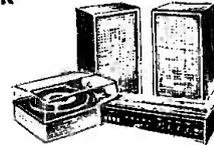
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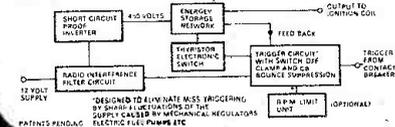
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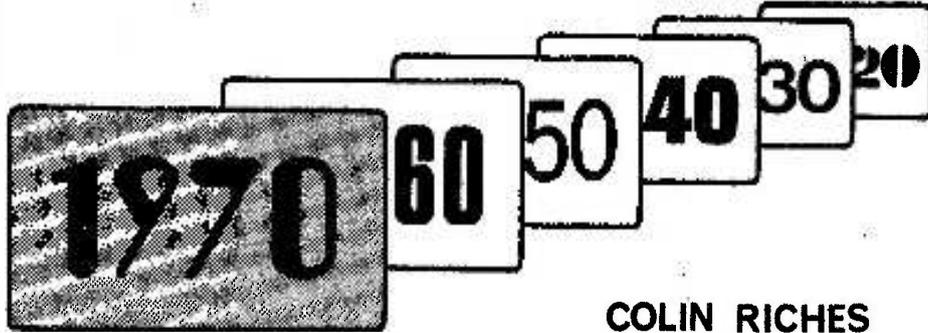
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GOING BACK...



COLIN RICHES

MR. A. Midgley from Northwood Middlesex has been kind enough to let me have some information on an Ediswan "One-Der" receiver his father once owned.

This set employed an ES 220 valve which was described as the "outcome of prolonged research and experiment". In 1925 it cost 22s. 6d.

Hints for obtaining maximum efficiency from the "One-Der" were as follows:

The "ONE-DER" Receiver, owing to the system of amplification employed, is capable of giving the purest reception at present obtainable, and in order

that this may not be marred by any faults, in or about the installation, the following hints are given:—

AERIAL.—Upon the efficiency of the aerial and earth system depends the amount of energy collected and supplied to the set, and every effort should be made to see that the aerial is as good as it is possible to obtain under the circumstances.

The aerial should be as large and as high as possible, and the lead-in wire from the aerial to the point of entry into the house should be clear of walls or buildings. If it must run parallel or side by side with a wall or any other obstruction, it should be kept at least two feet away, this may be achieved by propping it out. Good insulation of the aerial is absolutely essential, and where bare wire is employed the porcelain or other insulators used for its suspension should be periodically cleaned, particularly in large towns where smoke is prevalent. The aerial wire itself should be of the stranded variety known as 7/22, and each strand should be insulated from the other by a coating of enamel. This type of wire can be obtained at most dealers. This insulation, however, is not good enough to render the use of porcelain insulators unnecessary. This wire is usually sold in lengths of 100 feet, and where possible, erection should commence at the free end and the wire should be brought right to the AERIAL terminal on the set without being broken, so as to avoid making a joint.

EARTH.—Too much attention cannot be paid to the earth connection. The lead from the Receiver to earth should be as short as possible, and the cable should be at least as heavy as that employed for the aerial, or preferably heavier.

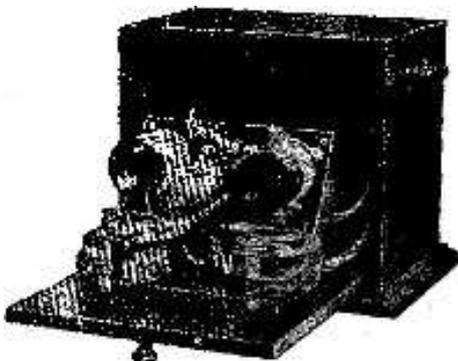


The Ediswan "One-Der" speaker (£2.10s in 1925).

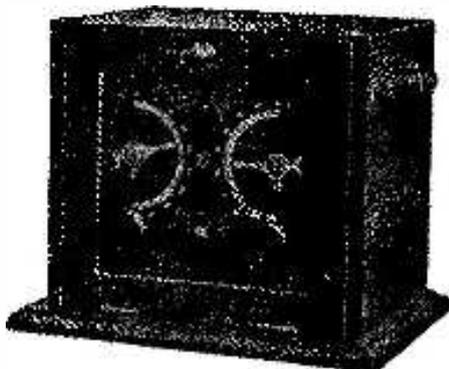
There is nothing better than what is known as cab tyre, which is insulated with a thick external sheath of rubber.

In most cases we expect that the connection will be made to the water system, and this is quite good provided connection can be made to a "rising main." On no account should connection be made to the hot water system as the joints which are inevitable in all such systems are usually packed with non-conducting material, and the fact that such pipes are usually made of iron, makes this method most unsatisfactory. Always endeavour to connect to a lead pipe. First scrape the lead perfectly clean and screw on the clean place some clip arrangement, many satisfactory types of which are obtainable at wireless dealers, and when this is clipped in position, it is a good plan to cover the joint made with tallow or Vaseline as this to some extent, will prevent the oxidation of the newly-cleaned lead and will ensure a good electrical joint.

LOW TENSION ACCUMULATOR—The L.T. accumulator which is the source from which the current for heating the filament is drawn, as a rule gives very little trouble beyond the need for re-charging when it is run down. It does, however, require careful charging, and the owner is advised to take the accumulator for re-charging to a reliable electrician who will



Interior view of the "One-Der."



Front panel of the receiver.

not overcharge it and so shorten its life. Accumulators which have glass for their outer container are always to be preferred before those in celluloid containers. The terminals of the accumulator should be kept clean and occasionally covered with Vaseline, and any connection made to the terminals of the accumulator should be screwed down tightly.

HIGH TENSION SUPPLY—The high-tension supply to most wireless sets is probably obtained from dry batteries, and it is essential that these should be of reliable make, otherwise the discharge may be somewhat intermittent, or noisy. Batteries of inferior manufacture often give rise to noises not unlike atmospherics, and for this reason high-tension batteries bearing a reputable name should always be purchased. As the "ONE-DER" Valve requires only a very small anode current, even when working a loudspeaker at full strength (it takes only 1-1½ milliamperes, which is probably less than any other valve available), a very small high-tension battery therefore is all that is needed, but it must consist of sufficient units to give 120 volts.

GRID BIAS.—It will be noted that the high-tension batteries

used include tapplings for Grid Bias at the negative (−) end, so that if this type of battery is used there is no need to employ a separate Grid Bias battery.

Place valve in holder, the two legs which are close together being put to the sockets which are similarly spaced. The others will be found to fit.

The coils are placed so that the one having the most winding and which has four inside tapplings is put on the left-hand side, while the one with the lesser winding and only two connections is placed on the right-hand side. Both coils have four pins, but in the case of one coil there are only two of these pins which have wire connections, the other two being left blank—this is visible on looking down inside the coil. The coil is placed on the right hand side working from the front of the set. To switch "on" or "off" pull out, or push in respectively, the small knob on lower front of set. The filament voltage required by this valve being 2 volts no filament rheostat is needed, as the filament is correctly dimensioned for this voltage.

Tuning is effected by means of the two larger knobs. As a general rule start with both

pointers at zero and advance each equally. It will be found that the two indicators will be at approximately the same positions on the scales. If any difference it will be found that the right-hand one is slightly higher up the scale than the one on the left-hand. Tuning is rather critical and this is purposely made so in order that powerful nearby stations can be eliminated without the use of a wave-trap. Continue to turn until the station wave or "mush" is heard, when a forward and backward final adjustment of both condensers will enable the station to be tuned in correctly. Should the set be inclined to oscillate even when the right-hand pointer is at zero, a reduction of voltage on the Green wire will always prevent this."

When new, the Ediswan "ONE-DER" Single Valve Receiver complete with valve, one pair of coils, H.T. and L.T. leads, and including all royalties, cost £5 10s. Daventry Coils were 10s. 6d. per pair. The Ediswan "ONE-DER" Loudspeaker (full size model) cost £2 10s., the Ediswan "Loten" Accumulator, XLG 282 was 10s. 6d. Ediswan 60 volt. High-tension Dry Batteries (two required), with tapplings for Grid Bias, were 10s.

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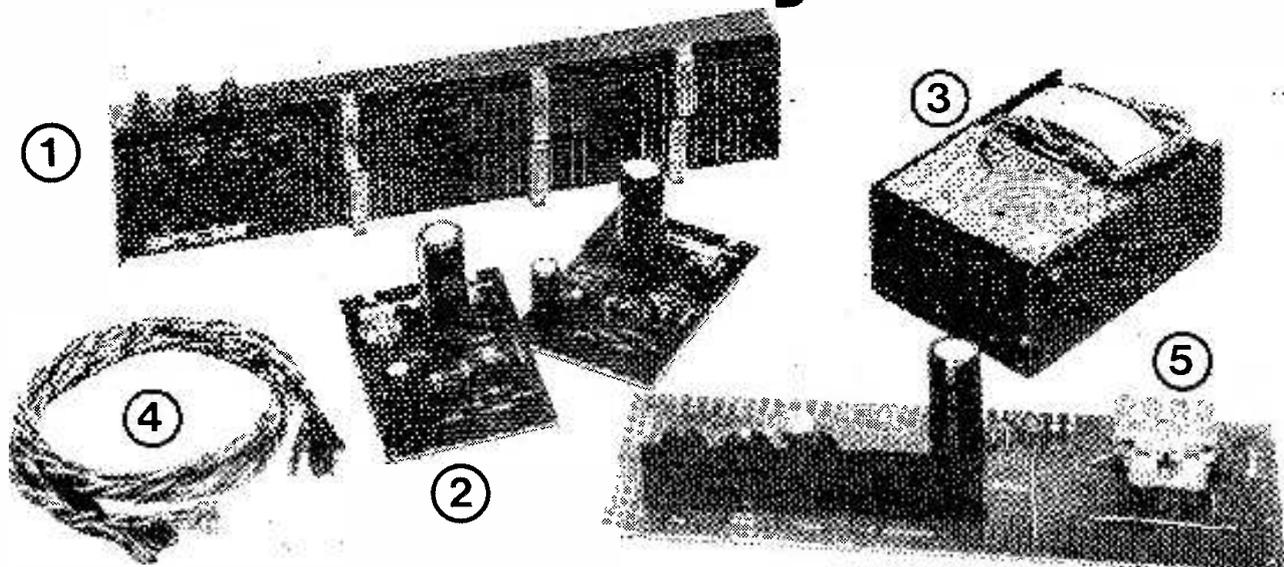
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BC147	12p	BFY44	50p	OA5	20p	TIP29B	58p	2N1303	16p	2N4061	12p	2N4061	12p	2N4061	12p
BC148	12p	BFY51	25p	OA7	10p	TIP30B	66p	2N1304	25p	2N4126	17p	2N4126	17p	2N4126	17p
BC149	12p	BFY52	25p	OA70	12p	TIP31B	70p	2N1305	25p	2N4286	15p	2N4286	15p	2N4286	15p
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CRS1/05	40p	TR1A1	40p	TR1A2	40p	TR1A3	40p	TR1A4	40p	TR1A5	40p	TR1A6	40p	TR1A7	40p	TR1A8	40p	TR1A9	40p	TR1A10	40p	TR1A11	40p	TR1A12	40p	TR1A13	40p	TR1A14	40p	TR1A15	40p	TR1A16	40p	TR1A17	40p	TR1A18	40p	TR1A19	40p	TR1A20	40p	TR1A21	40p	TR1A22	40p	TR1A23	40p	TR1A24	40p	TR1A25	40p	TR1A26	40p	TR1A27	40p	TR1A28	40p	TR1A29	40p	TR1A30	40p	TR1A31	40p	TR1A32	40p	TR1A33	40p	TR1A34	40p	TR1A35	40p	TR1A36	40p	TR1A37	40p	TR1A38	40p	TR1A39	40p	TR1A40	40p	TR1A41	40p	TR1A42	40p	TR1A43	40p	TR1A44	40p	TR1A45	40p	TR1A46	40p	TR1A47	40p	TR1A48	40p	TR1A49	40p	TR1A50	40p	TR1A51	40p	TR1A52	40p	TR1A53	40p	TR1A54	40p	TR1A55	40p	TR1A56	40p	TR1A57	40p	TR1A58	40p	TR1A59	40p	TR1A60	40p	TR1A61	40p	TR1A62	40p	TR1A63	40p	TR1A64	40p	TR1A65	40p	TR1A66	40p	TR1A67	40p	TR1A68	40p	TR1A69	40p	TR1A70	40p	TR1A71	40p	TR1A72	40p	TR1A73	40p	TR1A74	40p	TR1A75	40p	TR1A76	40p	TR1A77	40p	TR1A78	40p	TR1A79	40p	TR1A80	40p	TR1A81	40p	TR1A82	40p	TR1A83	40p	TR1A84	40p	TR1A85	40p	TR1A86	40p	TR1A87	40p	TR1A88	40p	TR1A89	40p	TR1A90	40p	TR1A91	40p	TR1A92	40p	TR1A93	40p	TR1A94	40p	TR1A95	40p	TR1A96	40p	TR1A97	40p	TR1A98	40p	TR1A99	40p	TR1A100	40p	TR1A101	40p	TR1A102	40p	TR1A103	40p	TR1A104	40p	TR1A105	40p	TR1A106	40p	TR1A107	40p	TR1A108	40p	TR1A109	40p	TR1A110	40p	TR1A111	40p	TR1A112	40p	TR1A113	40p	TR1A114	40p	TR1A115	40p	TR1A116	40p	TR1A117	40p	TR1A118	40p	TR1A119	40p	TR1A120	40p	TR1A121	40p	TR1A122	40p	TR1A123	40p	TR1A124	40p	TR1A125	40p	TR1A126	40p	TR1A127	40p	TR1A128	40p	TR1A129	40p	TR1A130	40p	TR1A131	40p	TR1A132	40p	TR1A133	40p	TR1A134	40p	TR1A135	40p	TR1A136	40p	TR1A137	40p	TR1A138	40p	TR1A139	40p	TR1A140	40p	TR1A141	40p	TR1A142	40p	TR1A143	40p	TR1A144	40p	TR1A145	40p	TR1A146	40p	TR1A147	40p	TR1A148	40p	TR1A149	40p	TR1A150	40p	TR1A151	40p	TR1A152	40p	TR1A153	40p	TR1A154	40p	TR1A155	40p	TR1A156	40p	TR1A157	40p	TR1A158	40p	TR1A159	40p	TR1A160	40p	TR1A161	40p	TR1A162	40p	TR1A163	40p	TR1A164	40p	TR1A165	40p	TR1A166	40p	TR1A167	40p	TR1A168	40p	TR1A169	40p	TR1A170	40p	TR1A171	40p	TR1A172	40p	TR1A173	40p	TR1A174	40p	TR1A175	40p	TR1A176	40p	TR1A177	40p	TR1A178	40p	TR1A179	40p	TR1A180	40p	TR1A181	40p	TR1A182	40p	TR1A183	40p	TR1A184	40p	TR1A185	40p	TR1A186	40p	TR1A187	40p	TR1A188	40p	TR1A189	40p	TR1A190	40p	TR1A191	40p	TR1A192	40p	TR1A193	40p	TR1A194	40p	TR1A195	40p	TR1A196	40p	TR1A197	40p	TR1A198	40p	TR1A199	40p	TR1A200	40p	TR1A201	40p	TR1A202	40p	TR1A203	40p	TR1A204	40p	TR1A205	40p	TR1A206	40p	TR1A207	40p	TR1A208	40p	TR1A209	40p	TR1A210	40p	TR1A211	40p	TR1A212	40p	TR1A213	40p	TR1A214	40p	TR1A215	40p	TR1A216	40p	TR1A217	40p	TR1A218	40p	TR1A219	40p	TR1A220	40p	TR1A221	40p	TR1A222	40p	TR1A223	40p	TR1A224	40p	TR1A225	40p	TR1A226	40p	TR1A227	40p	TR1A228	40p	TR1A229	40p	TR1A230	40p	TR1A231	40p	TR1A232	40p	TR1A233	40p	TR1A234	40p	TR1A235	40p	TR1A236	40p	TR1A237	40p	TR1A238	40p	TR1A239	40p	TR1A240	40p	TR1A241	40p	TR1A242	40p	TR1A243	40p	TR1A244	40p	TR1A245	40p	TR1A246	40p	TR1A247	40p	TR1A248	40p	TR1A249	40p	TR1A250	40p	TR1A251	40p	TR1A252	40p	TR1A253	40p	TR1A254	40p	TR1A255	40p	TR1A256	40p	TR1A257	40p	TR1A258	40p	TR1A259	40p	TR1A260	40p	TR1A261	40p	TR1A262	40p	TR1A263
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Forward with Project 80 into



Everything you want in one pack to build the world's most advanced modular hi-fi WITHOUT SOLDERING

- 1 Stereo 80 Control Unit
For mag. and ceramic cartridges, radio and tape.
- 2 Project 80 power amplifiers
Two Z.40s to give 8/8 watts R.M.S. output per channel.
- 3 Power supply unit
One PZ.5.
- 4 Connecting wires
All wires plus nuts, bolts, screws etc.
- 5 Project 805 Masterlink
For input and output connections.
- 6 Mains switch block and instructions manual (not illustrated).

This is Project 80 made even easier to build

You have seen how the marvellously compact Project 80 modules (only 2" high x 3" deep) are so adaptable and easy to install. Now, with Project 805, this wonderful system is made easier still to put together. In this, you have not only all the Project 80 modules in one pack for building an 8/8 watt R.M.S. hi-fi amplifier — there is also a loom of colour coded wires cut to length and tagged for clipping on so that you don't even have to solder! Input and output connections go via the 805 Masterlink panel. With the explicit stage-by-stage large 32 page instructions manual included, it becomes easy for anyone, no matter how inexperienced to install an ultra-modern assembly so advanced in appearance and design that it sets brand new concepts in domestic hi-fi — and of course, you can convert to quadraphony just whenever you wish by adding 805SQ. Only Sinclair know-how and manufacturing facilities could hope to bring you such quality and versatility.

TAGGED WIRES CUT TO LENGTH · NO SOLDERING

Project 805

the complete ready-to-build hi-fi
STEREO AMPLIFIER

Project 805 comprises a Stereo 80 Pre-amp/Control Unit with input for both magnetic and ceramic cartridges, radio, tape; separate bass and treble cut/lift, and volume controls 2 x Z.40 power amplifiers, PZ.5 power unit, 805 Masterlink, wire loom, instructions manual, etc down to nuts, bolts and washers.

£39.95

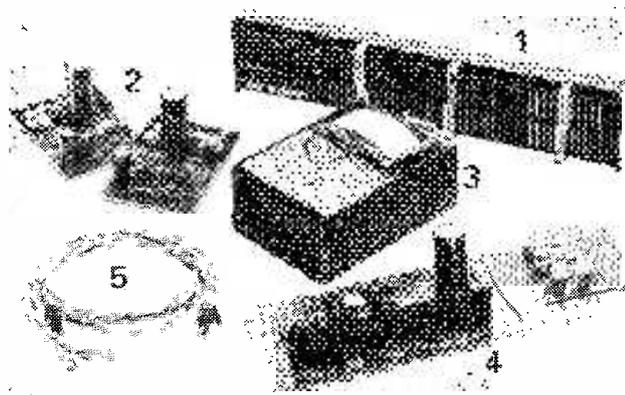
+£3.20 VAT (R.R.P.)



SINCLAIR RADIONICS LTD
London Rd, St Ives, Huntingdon PE17 4HJ
Telephone St. Ives (0480) 64646

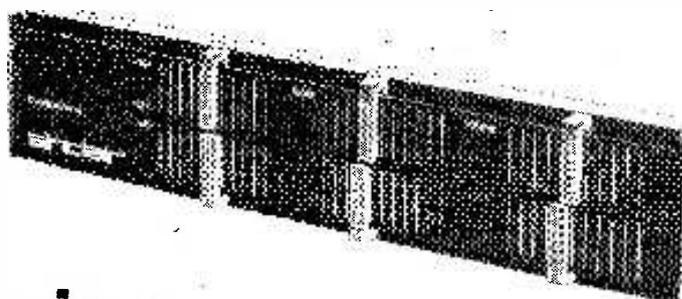
sinclair

true quadraphonics... *NOW!*



1. Project 80SQ decoder with controls.
2. Two Z 40 power amplifiers.
3. PZ.5 power pack
4. Project 80Q Masterlink unit.
5. Wire loom, with clip-on tags – NO SOLDERING!
6. (Not illustrated) Instructions manual, nuts bolts, washers, etc.

The most effective and economical way to enjoy this spectacular breakthrough in hi-fi listening

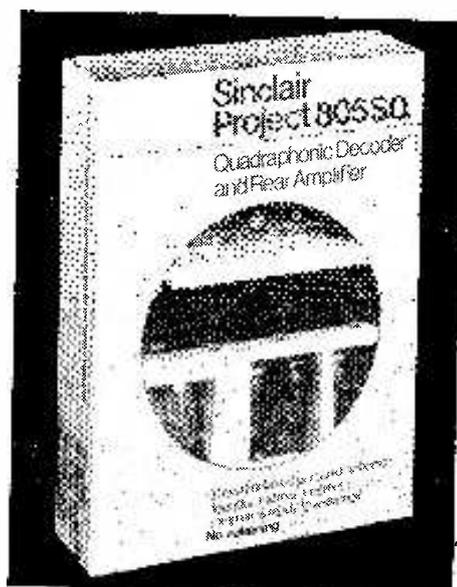


Project 80SQ Decoder
(available separately)
£18.95 + £1.52 VAT

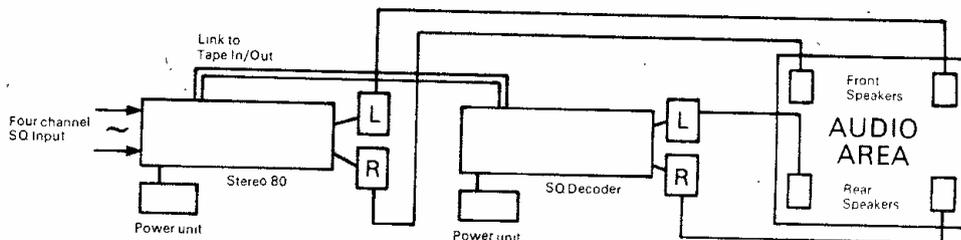
Add a fourth dimension to your stereo sound

It's so simple to convert to quadraphonics when you already have Project 80, or are about to start with Project 805. Project 805SQ is a complete add-on system at the heart of which is the Project 80SQ decoder. It uses the CBS.SQ matrix principle, by now the widest used method of containing four sound channels within the groove of the record. Project 805SQ includes two power amplifiers, power supply unit, connecting wire loom, 805Q Masterlink, switch block and instructions manual. The 80SQ decoder (also obtainable separately) has independent tone and volume slider controls on the two rear channels for matching true four channel sound to domestic environment. Project 805SQ is money saving too since you do not have to scrap existing Project 80 equipment to enjoy the newest and most exciting form of home listening in the entire history of sound, and your Project 80 quadraphonic assembly is compatible with stereo and mono records.

- Frequency response · 3db 15 Hz-25kHz
- Rated output 100mV
- S/N ratio 58dB
- Distortion 0.1%
- Power requirements 22-35 volts
- Phase shift network 90° ± 10°, 100 Hz-10kHz
- Adaptable to discrete (CD4) use



Project 805SQ



The output from any good stereo cartridge feeds into Stereo 80 and passes via the tape outlet to the 80SQ decoder. Here the signal is separated into its constituent 4 channels, those for the front being accepted by the Stereo 80, those for the rear going from the decoder to the two additional power amplifiers and speakers.

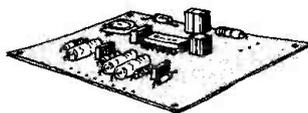
£44.95

+£3.60 VAT (R.R.P.)

Guarantee If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair Appointed Stockists also offer this guarantee. Should any defect arise in normal use within 2 years, we will service it without charge. For damage arising from mis-use a nominal charge will be made.

All Project 50 modules, Project 805 and Project 805SQ are obtainable from your local Sinclair stockist or direct, post free, in case of difficulty

BI-PRE-PAK Audio Bargains



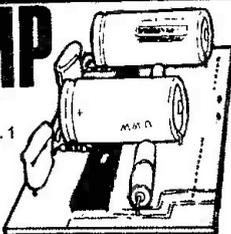
**STEREO
DECODER
£4.50**

incl. P. & P.

Ready-built unit, ready for connection to the IF stages of existing FM Radio or Tuner. The very latest 2nd Generation coil less integrated circuit design, operating on this phase locked loop system, offering even better stereo separation. Only owing to our bulk buying capacity are we able to offer this at the old price. LED stereo indicator lights available. **RED** at 25p. **GREEN** at 40p.

3 W.R.M.S. I.C. AMP
only **£1.50**

Incl. P. & P.
Order Code I.C.A.1

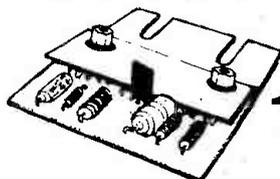


on P.C. Board with all components
or 2 on one board for £2.60

Order Code I.C.A.1/S

These amps. are supplied with a free booklet
on connecting up, specifications and easy to
build projects using the I.C.A.1

5W & 10W AMPS



5W ONLY £1.80
10W ONLY £2.26

inc. P. & P.

These matchbox size amplifiers have an exceptionally good tone and quality for the price. They are only 2½" x 1½". The 5W amp will run from a 12V car battery making it very suitable for portable voice reinforcement such as public functions. Two amplifiers are ideal for stereo. Complete connection details and treble, bass, volume and balance control circuit diagrams are supplied with each unit. Discounts are available for quantity orders. More details on request. **Cheapest in the UK. Built and tested.**

Now available for 5 & 10W AMPS

Pre-assembled printed circuit boards 2" x 3" available in stereo only, will fit 15 edge connector.

Stereo Pre-Amp 1 (Pre 1). This unit is for use with low gain crystal or ceramic pick-up cartridges. **£1.10**

Stereo Pre-Amp 2 (Pre 2). This unit is for use with magnetic pick-up cartridges. **£1.55**

Stereo Tone Control (STC). This unit is an active tone control board and when used with the right potentiometers will give bass and treble boost and cut. **£1.10**

Instruction leaflet supplied with all units. Post and packing included in prices. Add VAT at current rate.

I enclose £..... for..... Decoders/.....
3W Amps/..... 5W Amps/..... 10W Amps/.....
Stereo Pre-Amps 1 Stereo Pre-Amps 2
Stereo Tone Controls
(Please insert quantities and delete those not applicable)
Name
Address

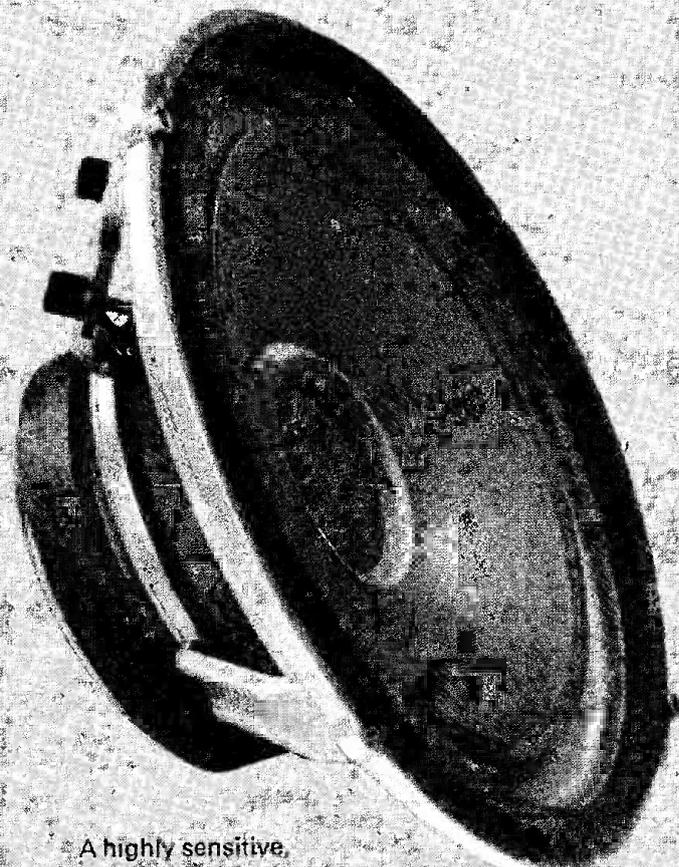
BI-PRE-PAK

Dept. D, 222/224 West Road,
Westcliffe-on-Sea, Essex SS0 9DF
Telephone: Southend (0702) 46344

Co. Regn. No. 820919

Guest Speaker

The Castle 8. RS. DD.



A highly sensitive, full range eight inch unit designed for use in the recommended cabinet, or one of similar dimension.

Suitable for use with good quality stereo installations, tape recorders, car radios, public address and background music systems, it has a frequency range of 50 to 20,000kHz - the lower limit variable with increases in cabinet volume. Recommended retail price is £9.00 excluding VAT

Aluminium Voice Coil

High-Flux 14,000 Oersteds Ceramic Magnet

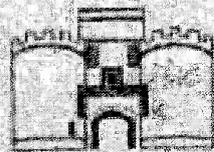
Roll Surround

Double-Diaphragm

8" Die-Cast Chassis

8 ohms Impedance

15 Watt DIN Power Handling



**Castle
Acoustics Limited**

Park Mill, Shortbank Road,
Skipton, Yorks. Tel: Skipton 5333.

CHROMASONIC electronics

Dept. 1
56, Fortis Green Road, London, N10 3HN.
telephone: 01-883 3705

RESISTORS

The standard ranges of Resistors stocked are either E12 or E24 and the values are all in multiples of ten times the decade shown below. The E12 items are only those in bold type. The E24 items are both those in bold and light type.

10	18	33	56
11	20	36	62
12	22	39	68
13	24	43	75
15	27	47	82
16	30	51	91

CARBON FILM $\frac{1}{4}$ watt $\pm 5\%$ tol. 2p ea.
E12 Series 10 Ω to 330K Ω

CARBON FILM $\frac{1}{2}$ watt $\pm 5\%$ tol. 13p ea.
E24 Series 10 Ω to 10M Ω

'CERMET' THICK FILM $\frac{1}{2}$ watt $\pm 2\%$ tol. 8p ea.
E12 series 56 Ω to 150K Ω

METAL OXIDE FILM $\frac{1}{2}$ watt $\pm 2\%$ tol. 43p ea.
E12 series 10 Ω to 1M Ω

CARBON COMPOSITION $\frac{1}{2}$ watt 43p ea.
2.2 ; 2.7 ; 3.3 ; 3.9 ; 4.7 ; ± 0.5 tol.
5.6 ; 6.8 ; 8.2 $\pm 10\%$ tol.

CARBON COMPOSITION 1 watt 53p ea.
2.2 ; 2.7 ; 3.3 ; 3.9 ; 4.7 ; ± 0.5 tol.
5.6 ; 6.8 ; 8.2 $\pm 10\%$ tol.

CARBON FILM 1 watt $\pm 5\%$ tol. 33p ea.
E12 series 10 Ω to 10M Ω

CARBON FILM 2 watt $\pm 5\%$ tol. 63p ea.
E12 series 10 Ω to 10M Ω

WIREWOUND 2 $\frac{1}{2}$ watt $\pm 5\%$ tol. 0.22 to 0.47 Ω 153p
E12 series $\pm 10\%$ 1 to 270 Ω 13p

WIRE WOUND 5 WATT 13p ea.

1	25	250	1.5K
1	30	270	1.8K
1	39	300	2K
2	50	330	2.2K
2	60	350	2.5K
3	68	400	2.7K
3	75	470	3K
4	82	500	3.3K
5	100	560	3.5K
5	125	600	3.9K
6	133	680	4.7K
8	150	750	5K
10	180	820	5.6K
15	200	1K	6.8K
21	220	1.2K	8.2K

WIRE WOUND 10 watt 14p ea.
All the values shown in bold in the 5 watt range

WIRE WOUND 10 watt $\pm 5\%$ tol. 20p ea.
10K ; 15K ; 20K ; 25K

WIRE WOUND 15 watt 133p ea.
All the values from 10 Ω upward shown in bold in the 5 watt range.

POTENTIOMETERS



5K 250K Log or Lin Less Switch (and 1K Lin) 14p
10K 500K Log or Lin with Switch 26p
25K 1 Meg Dual Less Switch 46p
50K 2 Meg Log only 57p
100K 10K Log + 10K Antilog Less Switch

Sliders

10K Single 33p
25K
50K DUAL 55p
100K

Presets

Vertical or Horizontal

1 Watt 53p .25 Watt 7p

100 1K 10K 100K 1Meg
250 2.5 25K 250K 2.5 Meg
500 5K 50K 500K 5Meg

Cermets

100 2.5K 25K 250K
500 5K 50K 500K
1K 10K 100K 1Meg

CAPACITORS

Ceramic Plate
Mullard C333 Series 63 Volts Wkg.

all at 53p each

+0.25pf	1.8 pf	$\pm 2\%$ 12 pf	$\pm 2\%$ 68 pf
2.2 pf	15 pf	82 pf	
3.3 pf	18 pf	100 pf	
3.9 pf	22 pf	120 pf	
4.7 pf	27 pf	150 pf	
5.6 pf	33 pf	180 pf	
6.8 pf	39 pf	220 pf	
8.2 pf	47 pf	270 pf	
10 pf	56 pf	330 pf	

Mullard 630 series 40 volts $\pm 10\%$ tol.
629 series 100 volts

all at 53p each

390 pf	1000 pf	3300 pf
470 pf	1200 pf	3900 pf
560 pf	1500 pf	4700 pf
680 pf	1800 pf	* 10 nf
820 pf	2200 pf	* 22 nf
	2700 pf	

Erie Monolithic Ceramic 30 Volts Wkg.

27 nf 11p; 47 nf 13p; 100 nf 17p

Low Voltage Disc Ceramics

all at 53p each

0.01 uF	18v	0.1 uF	30v
0.022 uF	18v	0.22 uF	6v
0.047 uF	18v	0.47 uF	3v

Mylar Film 100 Volts Wkg.

1000 pf	23p	0.05 uF	33p
2000 pf	23p	0.068uF	5p
5000 pf	23p	0.1 uF	5p
0.01 uF	33p	0.2 uF	63p
0.02 uF	33p	0.47 uF	7p
0.04 uF	33p		

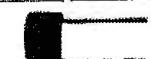
VDR's &

Thermistors



CZ1 17p
CZ4 18p
CZ13A 18p
CZ19 18p
E298CDA258 13p
E298EDA258 13p
E298EDA260 13p
E298EDA262 13p
E298EDA265 13p
E298EDP268 13p
E298Z205 13p
E298Z206 13p
E299DDP336 14p
E299DDP338 14p
E299DDP342 14p
E299DDP348 14p
G116 E1.21
G123 E1.21
R53 E1.49
R54 E1.61
VA1005 16p
VA1026 16p
VA1033 16p
VA1034 16p
VA1039 16p
VA1040 16p
VA1053 16p
VA1055S 16p
VA1056S 16p
VA1066S 17p
VA1057S 19p
VA1067S 19p
VA1077 21p
VA1098 31p
VA1104 31p
VA1107 29p

CAPACITORS



Silvered Mica 350V.
Tol. $\pm 0.5\%$ 11p each
2.2 pf 18pf 30pf
3.3 pf 20pf 33pf
5 pf 22pf 39pf
10 pf 25pf 47pf
Tol. $\pm 1\%$ 11p each
50pf 82pf 150pf
56pf 100pf 180pf
66pf 120pf 220pf
73pf
250pf 330pf 560pf
270pf 390pf 680pf
300pf 470pf 820pf
300pf
1000 pf 1500pf 220p
1800pf
2700pf 3600pf 5000pf
4700pf
6800pf 8200pf 10000pf

Mixed Dielectric 600 Volts Wkg.
0.01 uF 8p ; 0.1 uF 9 p
0.022 uF 8p ; 0.22 uF 173p
0.033 uF 8p ; 0.47 uF 263p
0.047 uF 8p ; 1 uF 363p
0.068 uF 9p ;

Mixed Dielectric 1000 Volts Wkg.
1000 pf 63p ; 0.022 uF 11p
2200 pf 63p ; 0.047 uF 13p
3300 pf 7p ; 0.1 uF 13p
4700 pf 7p ; 0.22 uF 243p
0.01 uF 10p ; 0.47 33p

Solid Tantalum Beads
all at 163p
0.1 uF 35v ; 10 uF 6.3v
0.22 uF 35v ; 10 uF 16v
0.47 uF 35v ; 10 uF 25v
1.0 uF 35v ; 22 uF 16v
2.2 uF 35v ; 47 uF 6.3v
4.7 uF 35v ; 100 uF 3v

Feed-through Ceramics
1000 pf 350v 6p

Disc Ceramics 750 Volts Wkg.
all at 53p each
470 pf; 1000 pf; 5000 pf; 0.01 uF

Tubular H1-K Ceramics 750 Volts Wkg.
1000 pf 53p ; 3000 pf 53p
1500 pf 53p ; 5000 pf 53p
2000 pf 53p ; 0.01 uF 53p

Pulse Ceramics all at 10p each
12 kv D.C. Wkg 8kv D.C.
10pf 120pf 200pf
22pf 140pf 220pf
68pf 150pf 250pf
82pf 100pf 270pf
100pf 200pf 300pf

VAT INCLUSIVE PRICES AT 8% OVERSEAS CUSTOMERS DEDUCT $\frac{2}{27}$ VAT INVOICES ON REQUEST P&P On U.K. Orders 15p. Overseas Orders at Cost

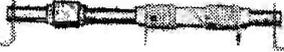
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56, Fortis Green Road, London, N10 3HN.
telephone: 01-883 3705

INDUCTORS

Denco Maxi-Q Coils

Ferrite Rod Aerials



FRA1 Long & Medium Wave band (300pf) 80p
FRA2 Long & Medium " (500pf) 80p

Tuning Coils in two series:

Range

1	150 khz	to	400 khz
2	515 khz	to	1.545 Mhz
3	1.67 Mhz	to	5.3 Mhz
4	5 Mhz	to	15 Mhz
5	10.5 Mhz	to	31.5 Mhz
6	30 Mhz	to	50 Mhz *
7	45 Mhz	to	78 Mhz *

* 50 pf tuning, all others based on 300 pf.

Series A Transistor - 48p each

Only available in ranges 1 to 5 inc.
4 Coils complete each range:

Blue	-	Aerial Coil
Yellow	-	R.F. Interstage
Red	-	Osc. Coil for 465 khz I.F.
White	-	Osc. Coil for 1.6 Mhz I.F.

give range number, letter 'T' and colour.

Series B Dual Purpose Coils 48p each

For FET or Valve Circuits
All ranges available
5 Coils complete each range:

Blue	-	Aerial
Yellow	-	Interstage R.F.
Green	-	R.F. plus reaction
Red	-	Osc. Coil for 465 khz I.F.
White	-	Osc. Coil for 1.6 Mhz I.F.

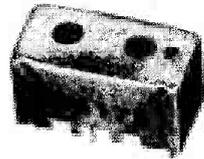
(Note use Red instead of White for ranges 6 & 7).

Chokes



We stock from 1 μH to 19 mH
Check levels & prices when ordering

TUNING CONDENSERS

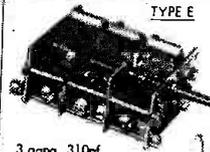


Tuned Block Filter incorporating a Ceramic element. Pre-aligned to 470 Khz. 3db bandwidth 5KHz. Zin 100K. Zout 100K.

LP1175 £1.46

I.F. Transformers

I.F.T 13	465 khz 1st & 2nd d/tuned	65p
I.F.T 14	465 khz final single tuned	65p
I.F.T 15	10.7 Mhz d/tuned	65p
I.F.T 16	1.6 Mhz 1st & 2nd d/tuned	65p
I.F.T 17	1.6 Mhz Final d/tuned	65p
I.F.T 18	465 khz or 1.6 Mhz d/tuned	75p



3 gang 310pf

£3.99

TYPE CB04



5pf 80p

10pf 80p

15pf 80p

25pf 80p

50pf 80p

60pf 94p

75pf 94p

100pf 99p



TYPE OO



208 + 176 pf with screen & trimmers

£1.48

DILECON



100pf 69p

300pf 69p

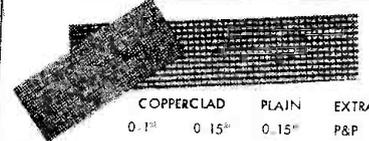
500pf 69p



365 pf 83p

365 x 365 pf £1.30

VEROBOARD



	COPPERCLAD	PLAIN	EXTRA
0.1"	0.15"	0.15"	P&P
21" x 11"	7p	7p	-
21" x 31"	26p	21p	12p
21" x 5"	30p	25p	13p
31" x 31"	30p	25p	-
31" x 5"	34p	34p	25p
17" x 21"	90p	69p	45p
17" x 31"	£1.21	75p	57p
17" x 5"	-	-	99p

D.I.P. Breadboard 4.15" x 6.15" £1.40
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Pin Insertion Tool (State .1" or .15") 63p
Spot Face Cutter 51p
Terminal Pins in Pkts. of 50 (State .1" or .15") 22p

Details of I.C.'s; Rectifiers; Diodes; Bridges; Passive Components; LED's; Clocks; Triacs etc. can be seen on other pages and/or issues of Wireless World; Practical Wireless; and Practical Electronics.

Electrolytics

UF	4V	6.3V	10V	16V	25V	40V	63V	100V	160V	450V
1										
1.5							63p		83p	15p
2.2							63p		83p	
3.3							63p		83p	
4.7							63p		83p	17p(40F)
6.8							63p	63p	83p	
8							63p	63p	83p	21p
10							63p	63p	83p	
15							63p	63p	83p	
22							63p	63p	83p	24p(160F)
33							63p	63p	83p	
47							63p	63p	83p	
68							63p	63p	83p	
100							63p	63p	83p	
150							63p	63p	83p	
220							63p	63p	83p	
330							63p	63p	83p	
470							63p	63p	83p	
680							63p	63p	83p	
1000							63p	63p	83p	
1500							63p	63p	83p	
2200							63p	63p	83p	
3300							63p	63p	83p	
4700							63p	63p	83p	
6800							63p	63p	83p	

DIODES

AA119	10p	BY103	22p	0A91	8p
AA120	10p	BY105	16p	0A200	11p
AA129	10p	BY126	16p	0A202	12p
BA100	10p	BY127	16p	ZS120	8p
BA102	27p	BY133	23p	ZS140	8p
BA110	44p	BY164	54p	ZS141	25p
BA115	19p	BY176	£1.62	ZS142	42p
BA144	20p	BY182	£1.62	ZS170	32p
BA145	22p	BY250	25p	ZS270	11p
BA148	22p	BZX70	27p	ZS271	16p
BA154	20p	Series		ZS278	36p
BA155	15p	BZY88	11p	IN914	8p
BA156	16p	Series		IN916	10p
BAX16	10p	0A47	11p	IN4009	7p
BB104	45p	0A79	10p	IN4148	5p
BB1CSB	41p	0A81	8p	IN4448	9p
BY100	16p	0A85	10p	IZS Series	18p
		0A90	8p		

TRANSISTORS

AC107	16p	BC213L	13p	D13V	52p	ZTX301	13p	2N3707	12p
AC126	13p	BC214L	13p	D40N3	59p	ZTX302	17p	2N3708	10p
AC127	13p	BC268	15p	MJ480	93p	ZTX303	14p	2N3709	10p
AC128	13p	BC407	16p	MJ481	£1.18	ZTX304	21p	2N3710	11p
AC176	15p	BCY70	17p	MJ490	£1.01	ZTX311	10p	2N3711	11p
AC187	22p	BCY71	22p	MJ491	£1.42	ZTX312	22p	2N3791	£2.55
AC187K	20p	BCY72	17p	MJ900	£1.42	ZTX341	22p	2N3792	£2.00
AC188	22p	BD115	73p	MJ1000	£1.22	ZTX384	18p	2N3791	£2.55
AC188K	25p	BD123	89p	MJ2955	£1.88	ZTX500	12p	2N3819	27p
ACY17	39p	BD124	80p	MJ3055	£1.21	ZTX501	13p	2N3821	81p
ACY17	38p	BD131	44p	MJ4000	£1.46	ZTX502	17p	2N3823	99p
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AD140	48p	BD131ZPR	£1.17	MJE340	45p	ZTX504	42p	2N3904	19p
AD149	48p	BD135	41p	MJE350	97p	ZTX531	22p	2N3905	25p
AD161	37p	BD136	43p	MJE2955	£1.20	ZTX550	17p	2N4056	13p
AD162	38p	BD201	£1.95	MPE102	72p	2N697	16p	2N4059	19p
AD161/62MP	74p	BD202	£1.46	MPE103	27p	2N706	13p	2N4062	16p
AF114	17p	BF109	74p	MPE104	40p	2N708	16p	2N4289	19p
AF115	17p	BF115	25p	MPE105	44p	2N914	24p	2N4441	85p
AF116	17p	BF160	25p	MPE106	49p	2N930	23p	2N4442	£1.04
AF117	17p	BF167	24p	MPE111	22p	2N1303	20p	2N4443	£1.42
AF118	54p	BF173	24p	MPSU06	63p	2N1304	20p	2N4444	£2.06
AF124	32p	BF178	28p	MPSU06	77p	2N1305	24p	2N4871	59p
AF139	34p	BF179	32p	MPSU56	77p	2N1305	24p	2N4901	£1.41
AF172	25p	BF180	32p	OC28	49p	2N1306	24p	2N5067	£1.07
AF239	40p	BF181	32p	OC35	49p	2N1307	27p	2N5129	16p
ASV26	32p	BF184	27p	OC36	49p	2N1308	34p	2N5172	11p
BC107	11p	BF185	27p	OC44	14p	2N1309	34p	2N5171	77p
BC108	11p	BF194	15p	OC45	14p	2N1711	20p	2N5194	91p
BC109	12p	BF195	17p	OC72	14p	2N1718	£4.37	2N5295	52p
BC117	22p	BF196	16p	OC72	14p	2N1893	52p	2N5447	16p
BC147	10p	BF197	16p	OC75	15p	2N2218	22p	2N5449	16p
BC148	10p	BF200	31p	OC76	27p	2N2219	38p	2N5457	46p
BC149	10p	BF244B	27p	OC81	14p	2N2646	54p	2N5458	43p
BC157	13p	BF262	25p	OC83	25p	2N2894	97p	2N5459	43p
BC158	12p	BF263	25p	OC170	27p	2N2904	32p	2N5485	52p
BC159	14p	BF272	£1.19	OC171	32p	2N2905	30p	2N5777	48p
BC167	17p			OC P71	£1.54	2N2924	16p	2N6068	44p
BC168B	11p	BF597	23p	ORP12	65p	2N2925	18p	2N6069	51p
CC169	12p	BF598	20p	TIP29	53p	2N2926G	10p	2N6070	57p
BC171	20p	BFW10	65p	TIP31	67p	2N3053	51p	2N6071	62p
BC172	17p	BFX 29	41p	TIP31A	67p	2N3054	50p	2N6072	67p
BC177	22p	BFX88	26p	TIP32A	79p	2N3055	51p	2N6075	£1.46
BC178	22p	BFY50	22p	TIP41A	36p	2N3375	£3.56	2N6076	16p
BC179	24p	BFY51	22p	TIP42A	36p	2N3442	£1.19	2N6111	54p
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BC183L	12p	BR100	42p	TIS88A	36p	2N3638	20p	2N6420	99p
BC184L	12p	BRY39	43p	TIS91	32p	2N3702	13p	3N141	87p
BC187	27p	BSX20	18p	ZTX107	10p	2N3703	12p	3N153	87p
BC204	14p	BSX21	22p	ZTX108	10p	2N3704	13p	40321	54p
BC209	14p	BSY95A	14p	ZTX109	15p	2N3705	12p	40330	£1.39
BC212L	12p	BU105/02	£1.95	ZTX300	12p	2N3706	14p	40673	55p

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15V	TBA625C £1.03	1037T1 (MVR15V) £1.45	L131 £1.39	TDA1415 97p

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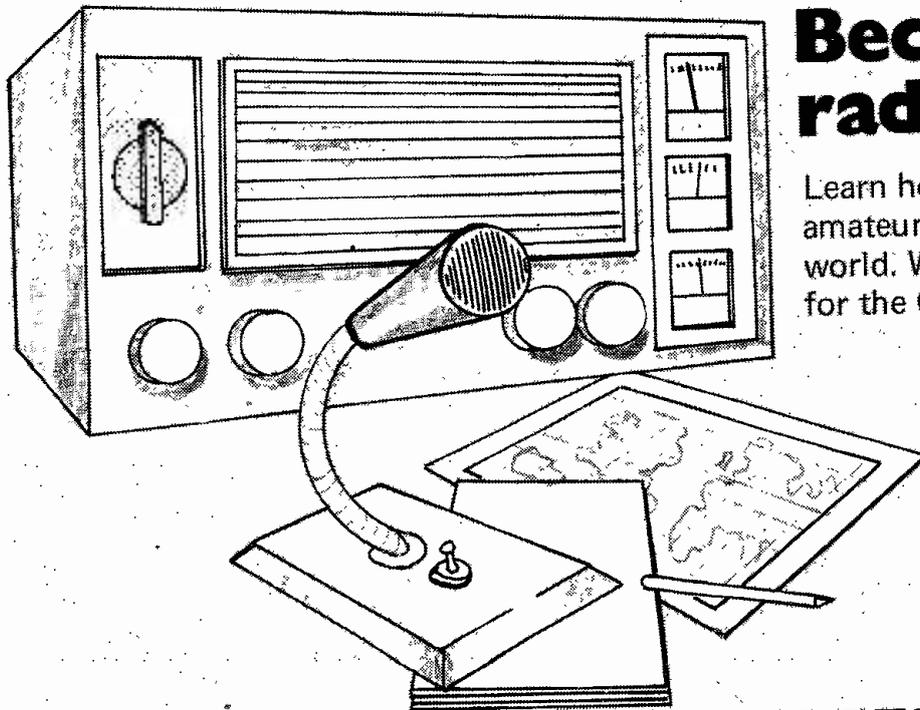
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Two full size loudspeakers 13 1/2 x 10 x 3in. Player unit clips to loudspeakers making it extremely compact. Overall size only 13 1/2 x 10 x 8in. 3 watts per channel, plays all records 33 rpm, 45 rpm. Separate volume & tone controls. 240V AC mains.



Attractive Teak finish Weight 13lbs. Bargain Price £25 85p carriage

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Single pole two-way. Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights, etc. Variable knob Turn on or off at full or intermediate settings. Makers last list price £4.50. Brand new and fully guaranteed. Fully insulated. **OUR PRICE £1.95 Post 25p**



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Primary 0-110-240V. Secondary 0-240V. 3A. 720W. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. **OUR PRICE £12** Carr. Famous make. (Value £19) 95p Can be used as 800W auto transformers 240-110V. IDEAL FOR COLOUR T.V. OR GARDEN TOOLS.

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16/450V 25p	1000/25V .. 25p	32+32/450V .. 60p
32/450V 35p	1000/50V .. 47p	32+32+32/350V 65p
32/500V 50p	8+8/450V .. 22p	32+32+32/450V 85p
25/25V .. 10p	8+16/450V 25p	900/350V .. 95p
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1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF. 15V. 10p. 500mF. 12V. 15p; 25V. 20p; 50V. 30p. 1000mF. 12V. 20p; 25V. 35p; 50V. 47p; 100V. 70p. 2000mF. 6V. 25p; 25V. 42p; 50V. 57p. 2500mF. 50V. 62p; 8000mF. 25V. 47p; 50V. 65p. 5000mF. 6V. 25p; 12V. 42p; 25V. 75p; 85V. 85p; 50V. 95p.

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LOUDSPEAKER CABINET WADDING 18in. wide, 20p ft

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OB2	.40	6BA6	.28	6L7	.50	12Q7GT	.45	35Z4GT	.70	DY87/6	.35	ECL82	.34	HY88	.40	PCH200	.80	UBF80	.40	Transistors	AF117	.21	BYZ13	.28	
OZ4	.47	6BC8	.60	6L18	.55	12SC7	.50	35Z5GT	.75	DY802	.35	ECL83	.70	HY91	.58	PCL82	.38	UBF89	.40	& Diodes	AF121	.33	FSY11A	.25	
1A3	.45	6BE6	.35	6L19	2.00	12BG7	.40	42	-.50	E800C	2.20	ECL84	.60	RZ40	.50	PCL83	.50	UBL21	.77	AF124	-.28	FSY41A	-.25		
1A8GT	.50	6BH6	.60	6LD20	.75	12BH7	.35	43	1.00	E80F	1.40	ECL85	.60	RZ41	.55	PCL84	.45	UC92	.45	2N404	-.20	AF125	-.19	OA9	-.14
1A9GT	.65	6B16	.55	6N7GT	.60	12BJ7	.44	50B5	-.85	E83F	1.30	ECL86	.40	RZ80	.28	PCL86	.47	UCC84	.75	2N966	-.58	AF126	-.20	OA10	-.47
1H6GT	.60	6BQ7A	.55	6Q7G	.50	128Q7	-.68	50C5	-.60	E88CC	.75	ECL87	.50	RZ81	.29	PCL805	.55	UCC85	-.45	2N1756	-.55	AF180	-.53	OA47	-.11
1L4	.28	6BR8	1.50	6Q7(M)	.55	14H7	-.55	50EH5	-.75	E180F	1.00	ECL88	.40	RZ82	.30	PEN45	.80	UCF80	.70	2N2147	-.94	AF186	-.61	OA70	-.17
1N6GT	.65	6BT7	1.40	6R7G	.60	14S7	-.80	50L6GT	.65	E182CC1	.25	ECL89	.40	RZ83	.25	PEN45DD	-.80	UGH21	2.00	2N2297	-.25	BA115	-.15	OA73	-.17
1R5	.45	6BW6	.70	6R7M	.75	19AQ5	.50	58A2	-.60	E1145	.52	ECL90	.40	RZ84	.20	PEN46	.50	UGH81	.40	2N3053	-.36	BA129	-.14	OA81	-.10
1S4	.83	6BW7	.70	6R7A	.44	19G8	6.00	58A3	-.60	EA50	.27	ECL91	.40	RZ85	.20	PEN45DD	2.00	UCL82	.38	2N3121	2.75	BA180	-.11	OA85	-.09
1U4	.60	6BZ6	.48	6SC7GT	.33	20D4	2.00	90AG	2.50	EA76	1.00	ECL92	.40	RZ86	.20	HABC80	.60	UCL83	.55	2N3703	-.21	BA163	-.17	OA90	-.14
1U5	.75	6C4	.35	6SG7	.44	20P2	.75	90C1	.75	EABC80	.38	ECL93	1.00	RZ87	.60	H123	.60	UF41	.70	2N3709	-.22	BC107	-.14	OA91	-.10
2D21	.45	6C5A	.50	6SH7	.44	20L1	1.10	90C2	2.40	EAC91	.75	ECL94	.40	RZ88	.60	H123DD	.75	UF42	.70	AA119	-.17	BC108	-.14	OA95	-.10
2KX	.55	6C6	.40	6SJ7	.55	20P3	-.80	150B2	.75	EAF42	.75	ECL95	.40	RZ89	.60	H220	.60	UF80	.35	AA120	-.17	BC109	-.11	OA200	-.10
2X2	.60	6C9	1.00	6SK7GT	.44	20P4	1.00	215SG	.50	EAF801	.75	ECL96	.40	RZ90	.60	H220DD	.75	UF85	.44	AA129	-.17	BC113	-.28	OA202	-.11
3A4	.50	6CD8G	1.25	6TK7GT	.45	20P5	1.30	807	.59	EA50	.25	ECL97	.40	RZ91	.60	H220DD	.75	UF86	1.00	AAZ13	-.20	BC115	-.17	OC44	-.11
3D6	.40	6CG8A	.75	6TV8G	.17	25A6G	.60	4032X	6.00	EB91	-.20	ECL98	.40	RZ92	.60	H220DD	.75	UF87	.44	AA129	-.17	BC116	-.28	OC45	-.18
3Q4	.40	6CL6	.65	6V6GT	.45	25Y6G	.70	8057	1.00	EBB31	.25	ECL99	.40	RZ93	.60	H220DD	.75	UF88	.44	AA129	-.17	BC117	-.28	OC46	-.17
3Q5GT	.55	6CL8A	.80	6X4	.40	25Y6G	.70	8060	1.00	EBF80	.29	ECL100	.40	RZ94	.60	H220DD	.75	UF89	.40	AC107	-.17	BC118	-.28	OC46	-.17
3S4	.40	6CM7	.75	6XBGT	.45	25Z6G	.70	7193	-.58	EBF89	.32	ECL101	.40	RZ95	.60	H220DD	.75	UF90	.40	AC113	-.28	BC118	-.28	OC46	-.17
3V4	.70	6CU5	.75	7B6	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL102	.40	RZ96	.60	H220DD	.75	UF91	.40	AC126	-.14	BCY10	-.50	OC70	-.14
4CB6	.55	6CW4	1.00	7B7	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL103	.40	RZ97	.60	H220DD	.75	UF92	.40	AC127	-.19	BCY12	-.55	OC71	-.18
5CG8	.55	6DE7	.75	7H7	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL104	.40	RZ98	.60	H220DD	.75	UF93	.40	AC128	-.22	BCY33	-.22	OC72	-.19
5R4GY	.80	6DE6A	.75	7H7	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL105	.40	RZ99	.60	H220DD	.75	UF94	.40	AC129	-.22	BCY34	-.22	OC74	-.25
5U4G	.40	6EW6	.75	7Y4	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL106	.40	RZ100	.60	H220DD	.75	UF95	.40	AC132	-.22	BCY38	-.25	OC75	-.12
5V4G	.50	6E5	1.00	7Z4	.80	25Z6G	.70	7193	-.58	EBF89	.32	ECL107	.40	RZ101	.60	H220DD	.75	UF96	.40	AC132	-.22	BCY38	-.25	OC76	-.17
5Y3GT	.45	6F1	.75	9D7	.85	25Z6G	.70	7193	-.58	EBF89	.32	ECL108	.40	RZ102	.60	H220DD	.75	UF97	.40	AC132	-.22	BCY38	-.25	OC77	-.80
5Z3	.75	6F6G	.50	10C2	.85	25Z6G	.70	7193	-.58	EBF89	.32	ECL109	.40	RZ103	.60	H220DD	.75	UF98	.40	AC132	-.22	BCY38	-.25	OC78	-.17
5Z4G	.45	6F13	.70	10D87	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL110	.40	RZ104	.60	H220DD	.75	UF99	.40	AC132	-.22	BCY38	-.25	OC78	-.17
5Z4GT	.45	6F14	.75	10F1	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL111	.40	RZ105	.60	H220DD	.75	UF100	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6J30L2	.80	6F18	.55	10F18	.85	25Z6G	.70	7193	-.58	EBF89	.32	ECL112	.40	RZ106	.60	H220DD	.75	UF101	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6A8G	1.25	6F23	.85	10D118	.70	25Z6G	.70	7193	-.58	EBF89	.32	ECL113	.40	RZ107	.60	H220DD	.75	UF102	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6A07	.49	6F24	.85	10D117	.70	25Z6G	.70	7193	-.58	EBF89	.32	ECL114	.40	RZ108	.60	H220DD	.75	UF103	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6A65	.87	6F25	1.00	10P13	.75	25Z6G	.70	7193	-.58	EBF89	.32	ECL115	.40	RZ109	.60	H220DD	.75	UF104	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6A86	.60	6F28	.87	10P14	2.00	25Z6G	.70	7193	-.58	EBF89	.32	ECL116	.40	RZ110	.60	H220DD	.75	UF105	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AJ5	.65	6F32	.50	12A6	1.00	25Z6G	.70	7193	-.58	EBF89	.32	ECL117	.40	RZ111	.60	H220DD	.75	UF106	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AK5	.40	6G6G	.60	12AC6	.70	25Z6G	.70	7193	-.58	EBF89	.32	ECL118	.40	RZ112	.60	H220DD	.75	UF107	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AK6	.60	6GH8A	.75	12AD6	.65	25Z6G	.70	7193	-.58	EBF89	.32	ECL119	.40	RZ113	.60	H220DD	.75	UF108	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AM8A	.55	6GK5	.65	12AE6	.65	25Z6G	.70	7193	-.58	EBF89	.32	ECL120	.40	RZ114	.60	H220DD	.75	UF109	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AN8	.70	6GU7	.75	12AT6	.40	25Z6G	.70	7193	-.58	EBF89	.32	ECL121	.40	RZ115	.60	H220DD	.75	UF110	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AQ5	.45	6H6GT	.25	12AU6	.45	25Z6G	.70	7193	-.58	EBF89	.32	ECL122	.40	RZ116	.60	H220DD	.75	UF111	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AR5	.60	6J5GT	.45	12AV6	.50	25Z6G	.70	7193	-.58	EBF89	.32	ECL123	.40	RZ117	.60	H220DD	.75	UF112	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6A87	1.00	6J6	.30	12BA6	.45	25Z6G	.70	7193	-.58	EBF89	.32	ECL124	.40	RZ118	.60	H220DD	.75	UF113	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AT6	.45	6J7G	.30	12BB6	.50	25Z6G	.70	7193	-.58	EBF89	.32	ECL125	.40	RZ119	.60	H220DD	.75	UF114	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AU6	.80	6J8A	.75	12BH7	.50	25Z6G	.70	7193	-.58	EBF89	.32	ECL126	.40	RZ120	.60	H220DD	.75	UF115	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AV6	.45	6K7G	.30	12E1	8.00	25Z6G	.70	7193	-.58	EBF89	.32	ECL127	.40	RZ121	.60	H220DD	.75	UF116	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AW8A	.95	6K8G	.45	12J7GT	.60	25Z6G	.70	7193	-.58	EBF89	.32	ECL128	.40	RZ122	.60	H220DD	.75	UF117	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6AXA	.75	6L1	2.00	12K5	1.00	25Z6G	.70	7193	-.58	EBF89	.32	ECL129	.40	RZ123	.60	H220DD	.75	UF118	.40	AC132	-.22	BCY38	-.25	OC78	-.17
6B8G	.80	6L6GT	.58	12K7GT	.50	25Z6G	.70	7193	-.58	EBF89	.32	ECL130	.40	RZ124	.60	H220DD	.75	UF119	.40	AC132	-.22	BCY38	-.25	OC78	-.17

RECORD PLAYBACK HEADS (TRUVOX)

Individual prices of these are:
2 track record playback heads 55p each.
4 track record playback heads 80p each.
Erase heads are also available separately—
2 track 40p—4 track 65p.

NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts. 9p each, 10 for 74p. Plastic pushrod suitable for operating. 7p each, 10 for 68p.

1 R.P.M. MOTOR+GEAR BOX

Made by the famous Chamberlain & Hookham Ltd. These could be made to drive clock or similar. Really robust reliable unit. Price £1.25 each.

AUTO-ELECTRICAL CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £6.95 plus 25p post and insurance.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v, 9v, 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only £1.50.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—
3 pole, 3 way—4 pole, 3 way—2
pole, 4 way—3 pole, 4 way—2 pole
6 way—1 pole, 12 way. All at 30p
each.

MULTI-SPEED MOTOR.

Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000, 12,000 and 15,500 r.p.m. Shaft is 1/4 in. diameter and approximately 1 in. long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. x 5 in. long. Price £1.00 plus 25p postage and insurance.

SLIDE SWITCHES

Slide switch. 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in x 1/4in rated 250V lamp. 10p each. 10 for 90p. Ditto as above but for printed circuit 8p each 10 for 72p. Sub Miniature Slide Switch. DPDT 19mm (1in approx.) between fixing centres. 20p each or 10 for £1.80. SP Change over spring return 250V 1 amp. 15p.

ISA ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2.30 + 20p p. & p. or with glass front, chrome bezel, £1.00 extra.

BALANCED ARMATURE UNIT

500 ohm, operates as speaker or microphone, so useful in intercom or similar circuits, 37p each.

12 VOLT 1 1/2 AMP. POWER PACK

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mF smoothing. Price £2.50 plus 20p post & packing.

Heavy Duty Mains Power Pack. Output voltage adjustable from 15-40V in steps—maximum load 250W—that is from 6 amp at 40V to 15 amp at 15V. This really is a high power heavy duty unit with dozens of workshop uses. Output voltage adjustment is very quick—simply interchange push on leads. Silicon rectifiers and smoothing by 3,000mF. Price £6.95 plus £1.00 post.

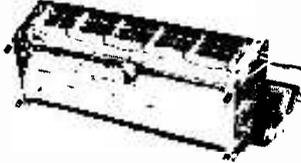
PC BOARD MARKER

Valve action fibre tipped marking pen filled with black etch resist—It's easy with this to make a perfect PC board, just draw straight on to the copper—allow 15 minutes to dry, then immerse in ferric chloride or other etchant on removal the circuit stands in high relief, 99p.

HONEYWELL PROGRAMMER

This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs. per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £20 each. Special snip price £7.50 plus 25p post and insurance. Don't miss this terrific bargain.

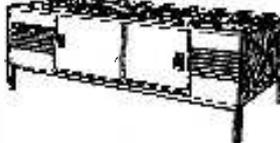
TANGENTIAL HEATER UNIT



This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters. Comprises motor, impeller, 2kW, element allowing switching 1, 2kW, and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch, £2.75. Don't miss this. Control Switch, 44p. P. & P. 40p.

STEREO RADIO CABINET

Long, Low and Modern. Teak veneered with sliding front and tapered legs. Speaker spaces each end. Size approx. 4ft. 2in x 15in x 15in. Probably cost over £20 to make. Our Price £8.10 each.



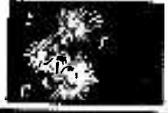
TWENTYLITE

Fluorescent lighting units with polyester choke and finished white enamel, 40 ins. model. Ideal kitchen, bedroom, hallway, porch, lift, etc., with tube. Assembled ready to install. Price £2.20 + 40p p. & p.



—THIS MONTH'S SNIP— SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450w) Unit in Box all ready to work. £7.95 plus 95p VAT and postage.



HORSTMANN 24-HOUR TIME SWITCH

With 6 position programmer. When fitted to hot water systems this could programme as follows—

Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

Suitable of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact there is no limit to the versatility of this Programmer. Mains operated. Size 3in. x 3in. x 2in. deep. Price £4.35 as illustrated but less case.



SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19.25-31.39 & 49 metre bands—Kit contains chassis front panel and all the parts. £1.25—crystal earphone 50p.



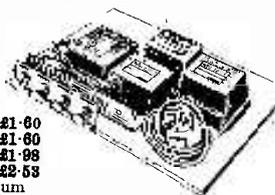
MULLARD UNILEX STEREO SYSTEM

There is no doubt that it is a good system, we believe that for the money it is without comparison. We demonstrate gladly at our Tamworth Road depot. Prices of the individual items for this—

1 Unilex Amplifier	Ref. EP.9000	£1.60
1 Unilex Amplifier	Ref. EP.9000	£1.60
1 Unilex Pre-Amp	Ref. EP.9001	£1.98
1 Unilex Power Unit	Ref. EP.9002	£2.53
1 Control panel kit with spun aluminium faced knobs		£3.30

Or the complete outfit—£11.30 post paid. Pair of 15 ohm speakers made by Goodmans are also available if required, price £3.80 the pair. No extra postage if ordered with the above, otherwise add 25p.

SPECIAL PRICES TO COLLEGES AND INSTITUTION ENGINEERING: THIS KIT IN THEIR CURRICULUM.



SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc.
24in x 18in £1.90
13in x 0in £1.50



HORSTMANN "TIME AND SET" SWITCH

(A 30 amp Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Two models 15 amp £2.18, 30 amp £3.35. P. & P. 25p each.



TERMS:—

ADD 8% V.A.T.

Send postage where quoted—other items, post free if order for these items is £6.00, otherwise add 30p.

AM/FM TUNER

Unit made by the American GEC company, 8 transistor, all-wired ready to work. Complete with tuner condenser, needs only scale and pointer. Tunes AM range 540 to 1620 KHz, FM range 88 to 108 MHz. Switches for on-off and AFC. Output for MXP or direct. Special snip price £5 plus 30p post. Three or more post free.

7 WATT STEREO AMPLIFIER

Again by the American GEC company. This has exceptionally good tone quality. Is complete with pre-amp and treble base, volume and balance controls. Also has mains smoothing circuit and rectifiers so requires only mains transformer. Output for 15 ohm speakers. Inputs for tuner, pick-up, mike, etc. Special snip price £6 plus 30p post. Three or more post free.

COMPLETE SYSTEM

AM/FM and MPX Tuner
Decoder and stereo amplifier. Specifications of tuner and amplifier are approximately as given above. This is ready built and tested system complete with scale and pointer, ready to install into suitable cabinet. (Our big stereo cabinet should be ideal for this.) Limited quantity, £15 each.

AMPLIFIER PANELS



Very nice looking, polished black pressspan with firing holes, 6 phono sockets and changeover slide switch and is printed as sketch. Price is 30p.

BATTERY CHARGERS

Famous Atlas in metal case with meter, output leads terminated by crocodile clips. For 6 or 12v charging simply by changing plug on front panel. Ready built new and still in maker's original packing. Two models: 1 1/2 amp £1.99 and 3-4 amp £2.95. Please add 40p postage for one and 75p postage for two.



ELECTRIC MOTORS

7 powerful battery motors as used in racing cars and power models. Output and types vary to make them suitable for hundreds of different projects—tools, toys, models, etc. All brand new reversible and for 10 to 12v. Bats., wiring diagrams included. Post and VAT 30p.

FREE Details of how to make miniature power station.

NEW ITEMS THIS MONTH

Car Cassette Power Kit. With a stabilised output of 6v, 9v or 12v. The kit comprises transistors, zener diode, resistors and condensers. Price £2.10. Suitable plastic case 40p extra.

Black Light as used in discotheques and for stage effects, etc. Virtually no white light appears until the rays impinge on luminous paint or white shirts, etc. We offer 12" 8w tubes complete with starter, choke, lamp holders and starter holder. Price £2.75 + 30p post. Tubes only £2 + 30p post. **3 KV Rectifiers.** For replacements in colour TVs or for experimenting with really high voltage for doublers and triplers, etc. Famous maker. 45p each. Quantity prices available.

Meters. All flush mounting with chrome-plated surround. 0-2 amp 40p. 0-3 amp 45p. 0-4 amp 55p. 0-10 amp 95p.

Rectifiers. All 24v full wave (bridge) with cooling fins. 1 1/2 amp 25p. 3-4 amp 85p. 5-7 amp £1.25. **15 way Screen Cable.** Suitable for equipment wiring, multi-way telephone installations, etc. Each core has seven strands copper, PVC insulated and colour coded differently from every other core. These are then laid together encased first by a metal screen and then grey PVC. Price 30p metre or 10 metres £2.50.

Touch Switch. This switch suitable for up to 10 amps mains voltage. Stands up approximately 1/2" rather like a joy stick and no matter which direction it is pushed, it makes contact. Base size approximately 2 1/4" x 2". Price 25p each.

Light Switch. Automatically switches on lights at dusk and off at dawn. Can also be used where light and dark is a convenient way to stop and start an operation. Requires only a pair of wires to the normal switch. In bakelite box normal switch plate size. 1 amp model £2.95.

J. BULL (ELECTRICAL) LTD.

(Dept. PW), 102/3 Tamworth Road, CROYDON CRO IXX

PE SCORPIO Mk2 ignition system kit new from ELECTRO SPARES

* 6 OR 12 VOLT
* + VE AND - VE GROUND

Here's the new, improved version of the original PE Scorpio Electronic Ignition System—with a big plus over all the other kits—the PE Scorpio Kit is designed for both positive and negative ground automotive electrical systems. Not just +ve ground. Nor just -ve ground. But both! So if you change cars, you can be almost certain that you can change over your PE Scorpio Mk. 2 as well. Containing all the components you need, this Electro Spares PE Scorpio Mk. 2 Kit is simply built, using our easy-to-follow instructions. Each component is a branded unit by a reputable manufacturer and carries the manufacturer's guarantee. Ready drilled for fast assembly. Quickly fitted to any car. When your PE Scorpio Mk. 2 is installed, you instantly benefit from all these PE Scorpio Mk. 2 advantages.

- ★ Easier starting from cold
- ★ Firing even with wet or oiled-up plugs
- ★ Smoother running at high speed
- ★ Fuel saving
- ★ More power from your engine
- ★ Longer spark plug life
- ★ No more contact-breaker burn

Electro Spares prices:

De luxe Kit only £11.50 inc. VAT and p & p.
Ready Made Unit £14.75 inc. VAT and p & p.
State 6V or 12V system.

Send SAE now for details and free list.

FM VARICAP STEREO TUNER

As featured in the May 1973 issue of 'Practical Electronics'. Superb Hi-Fi tuner Kit now available from Electro Spares. Including cabinet and all components - pre-set Mullard modules for R.F. and I.F. circuits. Motorola I.C. Phase Lock Loop Decoder for perfect stereo reception. No alignment needed. Guaranteed first time results - or send it back, and we'll return it in perfect order (for a nominal handling charge). Electro Spares price only £28.50 inc. VAT and p & p.

'GEMINI' STEREO AMPLIFIER

A superb unit with a guaranteed output of 30 watts RMS per channel into 8 ohms. Full power THD is a mere 0.02%, and frequency response is -3 dB from 20 Hz to 100 kHz into 8 or 15 ohms. Electro Spares have already sold 100s and 100s of these Kits. Get yours now! Depending on your choice of certain components, the price can vary from £50 to £60 inc. VAT and p & p.

- ★ All components as specified by original authors, and sold separately if you wish.
- ★ Full constructional data book with specification graphs, fault finding guides, etc. 55p plus 4p postage.
- ★ Price List only. Please send S.A.E. (preferably 9 x 4 minimum) for full details.

ELECTRO SPARES

The Component Centre of the North
288 ECCLESALL RD., SHEFFIELD S11 8PE (C)
Tel: Sheffield (0742) 668888

Marshall's

A. Marshall & Son (London) Limited Dept. PW
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& 85 West Regent Street Glasgow G22 QD Tel: 041-332 4133

Everything you need is in our new catalogue available now price 20p

Trade and export enquiries welcome

PW TELE TENNIS

As featured in PRACTICAL WIRELESS July - November 1974.
Also on BBC Nationwide and in the Daily Mail October 2nd 1974.

This exciting new game is now available in kit form. Due to popular demand we are now able to offer a fantastic saving on list prices. Ideal game for whole family. No need to modify your TV set, just plugs in to aerial socket. Parts list as follows:

A Resistor Pack	...	...	...	...	...	£1.00	p.p.	20p
B Potentiometer Pack	...	...	...	...	...	£1.25	p.p.	20p
C Capacitor Pack	...	...	...	...	...	£3.10	p.p.	20p
D Semiconductor Pack	...	...	...	...	...	£14.50	p.p.	20p
E IC Sockets	...	...	...	...	...	£4.00	p.p.	20p
F Transformer	...	...	...	...	...	£1.15	p.p.	25p
G PCB's	...	...	...	...	...	£7.50	p.p.	20p
H Switches	...	...	...	...	...	£4.50	p.p.	20p
I UHF Modulator Kit...	...	...	...	...	...	£7.20	p.p.	20p

Special Prices—complete kit (excluding case) £42.00 p.p. 50p Sections A-F incl. £23.50 plus 30p. Assembly instructions with complete kit or 75p on request.

SN7400	16p	SN7420	16p	SN7453	16p	SN7491	£1.10
SN7401	16p	SN7423	37p	SN7454	16p	SN7492	75p
SN7401A	38p	SN7425	37p	SN7460	16p	SN7493	65p
SN7402	16p	SN7427	45p	SN7470	30p	SN7494	85p
SN7403	16p	SN7430	16p	SN7472	38p	SN7495	80p
SN7404	24p	SN7432	45p	SN7473	44p	SN7496	£1.00
SN7405	24p	SN7437	35p	SN7474	48p	SN74100	£2.16
SN7406	45p	SN7438	35p	SN7475	59p	SN74107	43p
SN7407	45p	SN7440	16p	SN7476	45p	SN74118	£1.00
SN7408	25p	SN7441	85p	SN7480	75p	SN74119	£1.92
SN7409	33p	SN7442	85p	SN7481	£1.25	SN74121	57p
SN7410	16p	SN7445	£1.59	SN7482	87p	SN74122	80p
SN7411	25p	SN7446	£2.00	SN7483	£1.20	SN74123	72p
SN7412	28p	SN7447	£1.30	SN7484	95p	SN74141	£1.00
SN7413	50p	SN7448	£1.50	SN7485	£1.58	SN74150	£1.44
SN7416	45p	SN7450	16p	SN7486	45p	SN74190	£1.95
SN7417	30p	SN7451	16p	SN7490	65p		

OUR NEW GLASGOW SHOP IS NOW OPEN

Prices correct at August 1974, but all exclusive of V.A.T.
Post and Package 20p postage and package charges

Popular Semi-conductors

2N696	22p	2N3707	13p	AD142	59p	BC309	10p	LM709	
2N697	16p	2N3708	70p	AD143	45p	BC237	21p	TO 99	48p
2N698	40p	2N3715	£1.50	AD161	45p	BC238	17p	8DIL	38p
2N699	45p	2N3716	£1.80	AD162	45p	BCY70	19p	14DIL	40p
2N1302	19p	2N3771	£2.20	AD161	pr	BCY71	22p	LM723C	90p
2N1303	19p	2N3772	£1.80	AD162	£1.05	BCY72	13p	LM741	
2N1304	24p	2N3773	£2.65	AF109R	40p	BD123	32p	TO 99	40p
2N1305	24p	2N3819	37p	AF115	24p	BD131	40p	8DIL	40p
2N1306	24p	2N3820	38p	AF124	30p	BD132	50p	14DIL	38p
2N1307	22p	2N3823	£1.42	AF125	30p	BD135	42p	LM747	£1.00
2N1308	25p	2N3904	27p	AF126	28p	BD136	49p	LM7805	£2.00
2N1309	36p	2N3905	24p	AF127	28p	BD137	55p	MC1310	£2.92
2N1671	£1.44	2N4036	63p	AF139	39p	BD138	63p	MJ480	90p
2N1671A	£1.54	2N4037	42p	AF178	55p	BD139	71p	MJ481	£1.14
2N1671B	£1.72	2N4126	20p	AF179	65p	BD140	87p	MJ490	98p
2N1671C	£4.32	2N4289	34p	AF180	58p	BF115	25p	MJ491	£1.38
2N2102	50p	2N4921	73p	AF239	51p	BF116	23p	MJE340	45p
2N2147	78p	2N4922	84p	AF240	72p	BF117	43p	MJE2955	£1.12
2N2148	94p	2N4923	83p	AF279	54p	BF154	16p	MJE3055	68p
2N2160	60p	2N5190	92p	AF280	54p	BF163	32p	NE555V	70p
2N2218A	22p	2N5191	95p	BC107	16p	BF180	35p	OC28	76p
2N2219	24p	2N5192	£1.24	BC108	15p	BF181	34p	OC71	20p
2N2219A	26p	2N5195	£1.46	BC109	19p	BF184	30p	OC72	25p
2N2221	18p	2N5245	43p	BC147	12p	BF194	12p	SC35D	£1.68
2N2221A	21p	2N5457	49p	BC148	13p	BF195	12p	SC36D	£1.46
2N2222	20p	2N5458	45p	BC149	12p	BF196	13p	SC40D	£1.89
2N2222A	25p	2N5459	49p	BC167B	13p	BF197	15p	SC41D	£1.32
2N2646	55p	40361	48p	BC168B	13p	BF198	15p	SC45D	£1.89
2N2904	22p	40362	50p	BC168C	11p	BF200	40p	SC46D	£1.96
2N2904A	24p	40363	88p	BC169B	13p	BF237	22p	SC50D	£2.60
2N2905	24p	40406	44p	BC169C	13p	BF238	22p	SC51D	£2.39
2N2905A	26p	40407	33p	BC182	12p	BFX29	30p	SL414A	£1.80
2N2906	19p	40408	50p	BC182L	12p	BFX30	27p	TAA263	£1.00
2N2906A	21p	40409	52p	BC183	09p	BFX84	24p	TBA800	£1.50
2N2907	22p	40410	52p	BC183L	09p	BFX85	30p	TBA810	£1.50
2N2907A	24p	40411	£2.25	BC184	11p	BFX87	28p	TP29A	49p
2N2926	11p	40602	46p	BC184L	11p	BFX88	25p	TP30A	58p
2N3053	25p	40604	56p	BC212K	10p	BFX89	45p	TP31A	62p
2N3054	60p	40669	£1.00	BC212L	16p	BFY19	62p	TP328	74p
2N3055	75p	AC117	20p	BC214L	21p	BFY51	23p	TP33A	£1.01
2N3441	97p	AC126	20p	BC237	09p	BFY52	21p	TP34A	£1.51
2N3442	£1.69	AC127	20p	BC238	09p	BFY90	75p	TP35A	£2.90
2N3415	10p	AC128	20p	BC239	09p	BRY39	48p	TP36A	£3.70
2N3416	15p	AC151V	25p	BC257	09p	CI060	65p	TP41A	79p
2N3417	21p	AC152V	17p	BC258	09p	CA3020A	1.80	TP42A	90p
2N3702	11p	AC153K	25p	BC259	13p	CA3046	70p	TP2995	93p
2N3703	12p	AC176	18p	BC300	£2.12	CA3048	£2.11	TP3055	60p
2N3704	14p	AC176K	25p	BC301	34p	CA3089E	1.96	ZTX300	13p
2N3705	12p	AC187K	23p	BC307	10p	CA3090E	£4.23	ZTX302	20p
2N3706	9p	AC188K	34p	BC308	09p	LM301A	46p	ZTX500	15p

BRITAIN'S FASTEST SERVICE!



A SELECTION FROM OUR COMPREHENSIVE CATALOGUE

ALL ITEMS ARE BRAND NEW AND FULLY GUARANTEED

AA119 7p	BD131/132 56p	MJ802/MJ4502 £7-65	ZTX302 24p	2N6027 (D13T1) 58p
AC107 68p	BDY20 96p	MJ900 £1-88	ZTX303 15p	3N128 74p
AC126 25p	BF115 30p	MJ1000 £1-50	ZTX304 30p	3N140 92p
AC128 22p	BF167 25p	MJ4502 £4-00	ZTX314 18p	3N141 82p
AC128/AC176 51p	BF180 50p	MLM309K £2-08	ZTX320 40p	3N152 92p
AC151 26p	BF194 18p	MPP102 49p	ZTX500 20p	741/T05 50p
AC152 40p	BF195 18p	MPP103 (2N5457) 45p	ZTX501 22p	741/18DIL 34p
AC153 42p	BF196 18p	MPP104 (2N5458) 61p	ZTX502 25p	747/14DIL 85p
AC176 29p	BF200 46p	MPP105 (2N5459) 78p	ZTX503 20p	748/T05 41p
AC153/176K 71p	BF254 17p	NE555V 45p	ZTX504 60p	3015F £1-40
AC187K 40p	BF255 17p	NKT0033 92p	1N914 4p	3015G £2-00
AC188K 36p	BF259 39p	NKT211 32p	1N4001 4p	7400 24p
AC187/188K 76p	BFX84 34p	NKT212 32p	1N4002 4p	7401 24p
ACY17 41p	BFX85 41p	NKT271 22p	1N4003 5p	7402 24p
ACY18 28p	BFX86 35p	NKT272 22p	1N4004 7p	7403 24p
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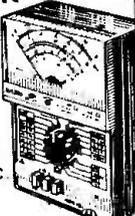
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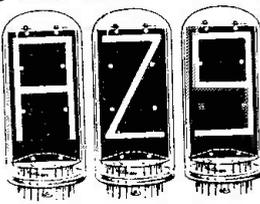
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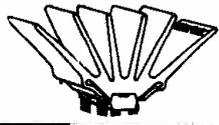
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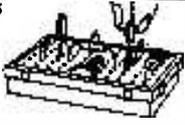
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- Pye/Echo D/S (as used in olympic and Europa chassis) £3.50
- (State whether cable or micro switch optional S/S)
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- Decca DRI £3

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- Convergence S/S £2 & D/S £4
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- RGB boards £2
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- S/F boards £1.45
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BCY39 99p	OC74 28p	2N1304 24p	40407 32p	7474 37p	74198 270p
BCY40 80p	OC81 12p	2N1305 24p		7475 35p	74198 270p
				7476 37p	74199 270p

LINEAR IC'S	DIODES	BRIDGE RECTIFIERS	TRIACS
MC1304P 169p	AA120 10p	400V 3A 85p	400V 3A 120p
MC1310P 275p	BY100 18p	(Plastic Case)	500V 6A 120p
MC1710CG 60p	BY164 35p	1A 50V 20p	500V 6A 150p
729C DIL/TO99 35p	BY211 25p	1A 400V 23p	400V 10A 145p
742C DIL/TO99 75p	NE562 FM Syn 35p	1A 600V 25p	500V 10A 180p
741C 8pin DIL 32p	PA263 150p	OA5 39p	
" 14pin DIL/TO99 38p	PA263 445p	OA9 9p	
747C 14pin DIL 80p	SL403D 150p	OA79 10p	
748C 8pin DIL 40p	SL414A 165p	OA81 8p	
ML91 1p	TAD100 AM 150p	OA85 10p	
7805 (TO3) 1.60	TBA800 5W AUD. 135p	OA90 6p	
CA3018 72p	ZN414 115p	OA91 6p	
CA3020 140p		OA200 6p	
CA3035 135p		OA201 6p	
CA3036 90p		PL4001 6p	
CA3046 70p		PL4004 8p	
CA3048 210p		PL4007 12p	
CA3050 135p		IN914 5p	
CA3075 150p		1N4001/2 5p	
CA3081 150p		1N4003 6p	
CA3089E 195p		1N4004/5 6p	
CA3099Q 345p		1N4006/7 7p	
LM300 TO99 170p		1N4148 5p	
LM304 TO99 170p			
LM305 TO99 170p			
MC724P 50p			
MC1303L 130p			

POLYESTER CAPACITORS: Axial lead type. (Values are in μ F).
400V: 0.001, 0.0012, 0.0015, 0.0018, 0.0022, 0.0033, 0.0047, 0.0068, 0.01, 0.015, 0.022, 3p; 0.047, 0.068, 0.1, 4p; 0.15, 0.22, 7p; 0.33, 10p; 0.47, 13p; 100V: 0.1, 0.15, 4p; 0.22, 5p; 0.33, 6p; 0.47, 9p; 0.68, 10p; 1.0, 13p. 250V: 0.22, 6p; 0.33, 8p; 0.47, 9p; 0.68, 12p; 0.47, 9p; 2.2, 18p.
RADIAL LEAD P.C. TYPE (Values are in μ F).
250V: 0.01, 0.015, 0.022, 3p; 0.033, 0.047, 0.068, 3.3p; 0.1, 4p; 0.15, 4p; 0.22, 0.33, 5p; 0.47, 7p; 0.68, 10p; 1.0, 11p; 1.8, 20p; 2.2, 22p.

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μ F).
63V: 1.0, 1.5, 2.2, 3.3, 4.7, 6.8, 10, 15, 20, 22, 47, 68, 8p each, 100, 12p. 40V: 100, 6p. 30V: 350, 35p. 25V: 68, 6p; 150, 6p; 220, 11p; 470, 13p. 25V: 680, 18p; 1000, 24p; 2200, 34p; 3000, 39p. 16V: 40, 125, 250, 6p. 10V: 1000, 1500, 16p. 10V: 4, 100, 5p; 640, 10p; 1000, 14p; 2200, 18p.

CERAMIC CAPACITORS
50V d.c. Plaquette body 25mm leads.
Range: 5pf-10,000pf price 2p each.
0.015 μ F, 0.022 μ F, 0.033 μ F, 0.047 μ F 3p

MYLAR FILM CAPACITORS
100V: 0.001 μ F, 0.002 μ F, 0.005 μ F, 0.01 μ F
0.02 μ F, 0.04 μ F, 0.05 μ F 3p. 0.1 μ F, 0.2 μ F.
50V, 0.47 μ F 6p.

POTENTIOMETERS (AB) Carbon
Track, 0.25W Log & 0.5W Linear values
1K Ω -2M Ω single gang 14p
5K Ω -2M Ω single gang D/P switch 28p
2K Ω -2M Ω dual gang stereo 42p

PRESET POTENTIOMETERS
0.25V: 100 Ω -1M Ω Horizontal 6p
1K-1M Ω Vertical 6p
0.1W: 50 Ω -1M Ω Vertical 4p

SLIDER POTENTIOMETERS
0.25W log and linear values
5K Ω -500K Ω single gang 35p
10K-500Kohm Dual gang 50p
KNOBs for above Black or Silvered 8p

RESISTORS High Stability Low noise
Pr. Type Tol. Range Val. 1-49 50+
1W C 5% 2.2 Ω -10M E24 1p 8p
1W C 5% 2.2 Ω -10M E12 1p 8p
1W C 5% 2.2 Ω -10M E12 2.5p 2p
4W WW 10% 1 Ω -100 Ω E12 8p —

	JACK PLUGS & SOCKETS			
	Screened chrome	Plastic Body	Open metal	Moulded with break contacts
2.5mm	10p	8p	8p	
3.5mm	14p	8p	8p	
Standard mono	17p	13p	13p	17p
Standard stereo	30p	18p	15p	2.5

	PLUGS	SKCTS.	CPLRS.	DIL SOCKETS
DIN	12p	8p	15p	8 Pin 14p
2 Pin-6 Pin				14 Pin 15p
				16 Pin 16p
CO-AXIAL (TV)	10p	8p	15p (f.f.)	CAR AERIAL PLUGS 10p
PHONO assorted colours	6p	5p (sgl.) 7p (dbl.) 10p (trpl.)	8p	CHOKES (RFC) 15p each
BANANA	6p	5p		

SWITCHES
TOGGLE: SPST 18p
DPDT 22p
SLIDE: 1A DP 250V 19p
1/2A DP 250V 9p
PUSH BUTTON: Miniature push to make or break nonlocking 15p
ROCKER (white): 5A 250V SP changeover 25p
centre off
ROTARY WAFER: 1 pole/12 way, 2p/6w, 2p/2w, 2p/4w, 3p/3w, 3p/4w, 4p/2w, 4p/3w, 24p

TRANSFORMERS
Primary 220V-240V
6.0-6 (miniature) 100mA 90p
9.0-9 " 100mA 90p
12.0-12 " 100mA 90p
18.0-18 also 24V 100mA 90p
24.0-24 " 500mA 220p
30-24-20-15-12-0 1A 230p
9-0 2A 110p
8-0 2A 110p
5-0 2A 110p

LAMP HOLDERS/LAMPS
LES HOLDERS Dome top, Red, Blue, Green/Yellow/White, 3/4" hole 14p
Les Bulbs 6v and 12v 6p
MES Holder, Heavy duty, round top Red, requires 3/4" hole 25p
NEON, 240V RES round top 3/4" hole 25p
NEON, As above but with 1/2" square RED top 25p
NEON, As above but with 1/2" square green top 25p

ALUM. BOXES
2.2x5.4x1.1" 45p
4x4x1.1" 45p
4x2.2x1.1" 45p
4x2.2x2.2" 48p
3x2x1" 38p
7x5x2.2" 78p
3x1x1" 8p
10x7x3" 99p
10x4x3" 118p
10x4x3" 99p
12x5x3" 120p
12x8x3" 150p

VEROBOARD
Pitch 0.1 0.15 0.15 (copper clad) (plain)
2.2x3.3" 30p 32p 32p
2.2x5" 32p 32p 32p
3.2x5" 38p 38p 38p
2.2x1.7" 98p 75p 55p
3.2x1.7" 130p 105p 78p
4.2x1.7" 173p 105p 105p
Pkt of 36 pins 20p
Spot face cutter 49p
Pin Insertion tool 68p

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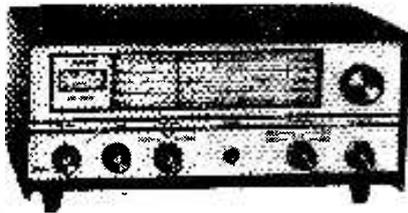
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The CODAR CR70A is an outstanding general coverage communication receiver, ideal for the keen S.W.L. It tunes from 540 metres medium through to 10 metres with no gaps. Covers shipping, coastguard and distress frequencies, all six amateur bands 160-10 metres, International broadcast, Met. stations etc. etc. giving world-wide reception. Exclusive features include Air-spaced CODAR-COIL Hi-"Q" Aerial input, illuminated Meter and Slide Rule Scale, Two Speed vernier tuning. Switched B.F.O. for CW/SSB signals. Separate output for Tape recorder. Ready to plug in to 200/240 volts A.C. it only needs your aerial and a 2/3 ohm loudspeaker to bring the world to your finger tips. 12 months full guarantee.

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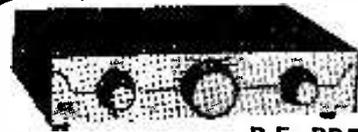
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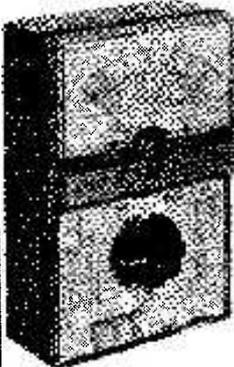
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AC/DC MULTIMETER TYPE U4324



33 ranges up to
3 Amps AC/DC;
1200V DC, 900V
AC, 500kΩ, +12
db.

Sensitivity:
20kΩ/V DC;
4kΩ/V AC

Accuracy:
±2.5% DC;
±4% AC

Movement is protected by silicon diodes.

Dimensions 167×98×63 mm. Weight: 1.5lb.

PRICE: complete with test leads, instruction manual and fibre-board storage case £9.25. Packing & carr. £0.50.

MULTIMETER TYPE U4323

Sensitivity: 20,000Ω/V.



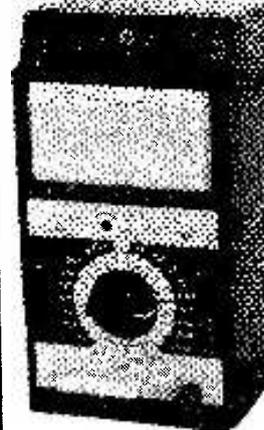
7 D.C. Voltage ranges 0.5-1000V
6 A.C. Voltage ranges 2.5-1000V
5 D.C. Current ranges 0.05-500mA

4 Resistance ranges 1kΩ-1mΩ
Built-in oscillator providing AF output of 1kHz and I.F. output of 465kHz with an amplitude of 1 volt minimum.

Dimensions: 140×87×40 mm. Weight 0.5kg

PRICE complete with leads and plastic storage case £7.70. Packing & postage £0.50

AC/DC MULTIMETER TYPE U4313



39 ranges:
600μA to 1.5A
AC
60μA to 1.5A DC
75mV to 600V
DC

1.5V to 600V AC
1MΩ, 0.5μF, 12db

Accuracy: 1.5%
DC; 2.5% AC

Sensitivity: 20k
Ω/V DC; 2kΩ/V
AC

Mirror scale 86mm long.

Dimensions: 115×215×90 mm, Weight 3.3lb.

PRICE, complete with test leads, service manual and steel carrying case £12.50. Packing & carriage £0.50.

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	£1.80	EF91	45p	PC889	50p	SCI/400	£3.00
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AC 20	BC 108	CRS 1/40	OC 35	1N 32A	2N 3731
AC 28	BC 118	CRS 3/10	OC 36	1N 38A	2N 3819
AC 39	BC 119	CRS 3/20	OC 42	1N 43	2N 4038
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AD 162	BC 172	GET 115	OC 78	1N 4148	2N 5285
ADZ 11	BC 172A	GET 116	OC 78	3N 128	3N 128
ADZ 12	BC 212A	GEX 46	OC 78D	3N 154	3N 154
AF 114	BCY 31	NKT 222	OC 81	3N 159	3N 159
AF 115	BCY 33	OA 5	OC 82	2N 918	2S 803
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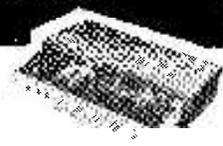
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