PRACTICAL WIRELESS

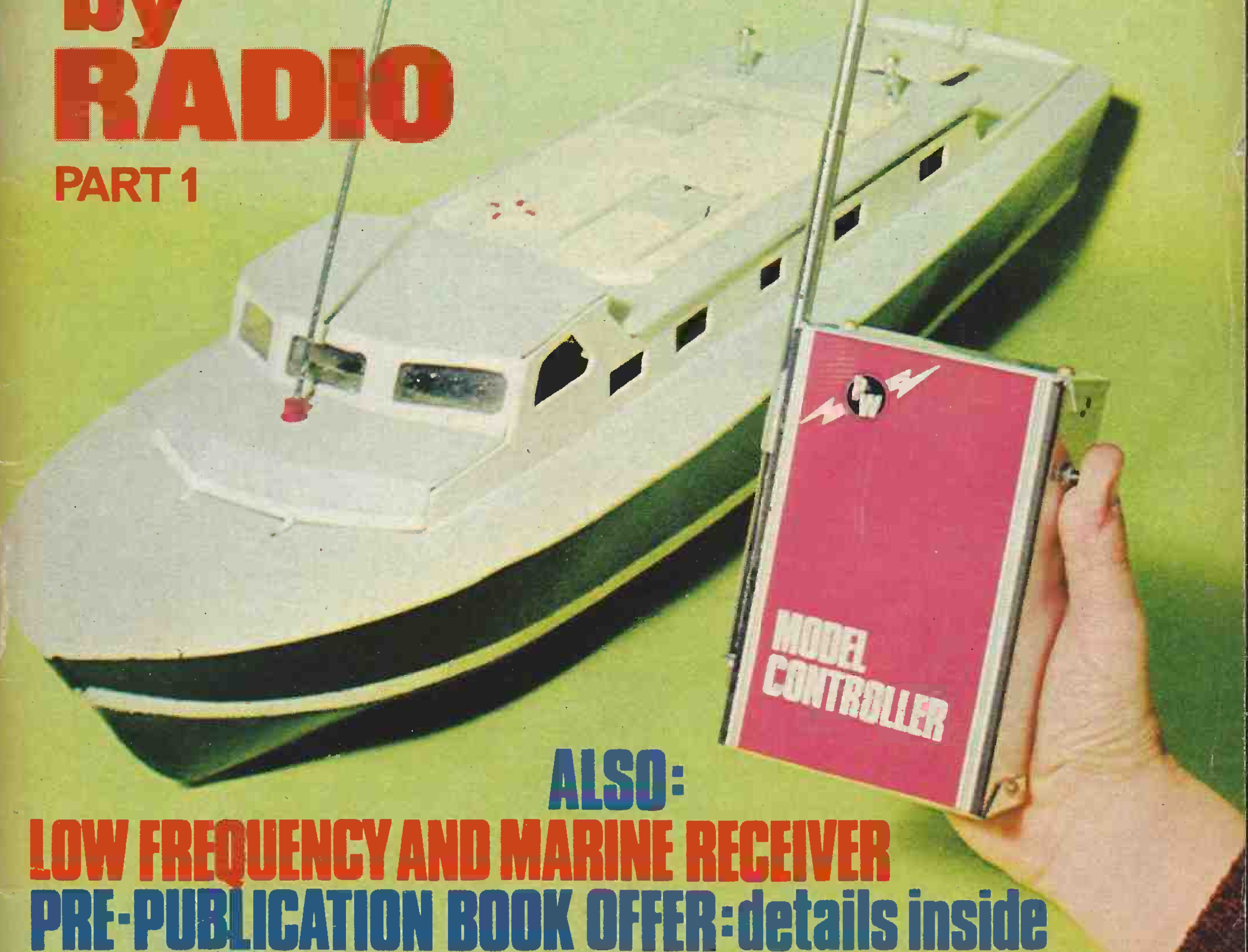
JANUARY 1975

25p

PW

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

PRACTICAL WIRELESS

VOL. 50 NO. 9
ISSUE 815
JANUARY 1975

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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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.

NEWS & COMMENT

CONSTRUCTIONAL

OTHER FEATURES

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
All £1 carr.

	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	£189·90	£135·95
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)

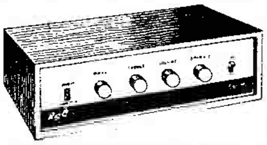
FANE HI-FI LOUDSPEAKERS AT APPROXIMATELY HALF-PRICE

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	Model	Price
505	£2·73	807T 3 Ω	£2·25	121/10	£3·17	138/10LR	£2·50	138/15TLR	£4·96	122/10TLR	£6·36	122/14ALR	£9·52	152/12A	£11·88
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	152/14	£12·49
507	£1·08	1002	£4·19	121/11	£3·58	138/11	£3·55	101/14	£6·64	122/12A	£7·08	122/17A	£10·59	152/17	£14·96
801	£3·93	1005	£3·65	121/11T	£3·78	138/11LR	£3·87	101/14A	£6·74	122/12D	£6·88	122/17T	£10·59	153	£17·48
802	£3·69	1006	£3·50	121/15	£4·61	138/13	£3·88	122/10	£5·16	122/12T	£7·08	122/17LR	£10·98		
802T	£3·82	1008	£2·93	121/15LR	£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	£6·03	122/14A	£8·80	152/10	£9·26		
806	£2·56	1005LR	£4·37	138/10T	£2·31	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

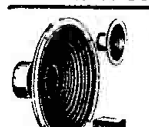


Controls: Bass, Treble, Vol. and Bal. 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for Crystal P.U. or Tape/Radio. For speaker output impedances of 3 — 15 ohms. For standard 200-250v. A.C. mains operation. 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. 40p
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. Sizes approx. Carr. 50p. per enc.

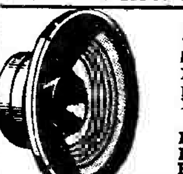
ME8 13 × 9½ × 6½in. £3·95 } Both cut for 8in. speaker
JE8 16 × 11 × 9in. £5·95 }
SE10 25 × 16 × 9in. Cut for 10in. and Tweeter £8·95
SE12 25 × 16 × 9in. Cut for 12in. and Tweeter £8·95

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 HF123 13,000 GAUSS SPEAKER **£8·95** Carr. 50p

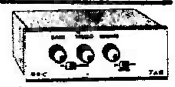
AUDIOTRINE HIGH FIDELITY SPEAKERS



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.

HF808T	8"	10W	£2·55	HF120D	12"	15W	£6·50
HF102D	10"	10W	£3·50	HF126	12"	15W	£7·95
HF120	12"	15W	£5·95	HF126D	12"	15W	£8·50

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 3–15 ohm spkrs. Max. sensitivity 5mV. O/P rating I.H.F.M. Enclosed enamelled case 9½ × 2¾ × 5¼in. Silver finish facia 10¾ × 3¼in. Complete kit, wiring diagrams and instructions. **£7·95** Carr. 40p. FACTORY BUILT **£10·95**

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 note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 8-15 Ω. £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 8–15 Ω.

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.
Factory built with 12 mths guarantee **£16·61** Or in Teak Veneer housing **£19·55** Dep. £2·50 & 8 mthly pymts £2·50 (Total £22·50).

HI-FI 8" x 5" 7 watt LOUDSPEAKERS **£1·25**
with parasitic Tweeter 8 ohm imp. Post and Packing 20p

AUDIO FIDELITY FR1 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** each. Carr. Free.
SPECIAL OFFER **£14·99** Pair Carr. 50p

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 ± 1½ dB.

COMPLETE KIT (less cabinet). Carr. 70p. Cabinet if req. £4·90 extra. **£22·50**
Assembled unit in cabinet £42·50

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

★ Moderate size only 25 × 14 × 10in. approx.
★ Response 30-20,000 c.p.s. Impedance 15 ohms
Performance comparable with units at twice the cost
COMPLETE KIT **£25·95** Carr. 75p
Deposit £4·71 and 8 monthly payments £3·12 (Total £29·67)
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
FULLY GUARANTEED. Impregnated and Interleaved where necessary. Primaries 200-250v. 50c/s. Screened

MIDGET CLAMPED TYPE 2½ × 2¾ × 2¼in.
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.
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

TOP SHROUDED DROP-THRO' TYPE
250-0-250v. 70mA, 6·3v. 2a., 0-5-6 3v. 2a. £2·25
250-0-250v. 100mA, 6·3v. 3·5a. .... £2·50
250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a. .. £2·75
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a. £2·75
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.
Suitable 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

FILAMENT or TRANSISTOR POWER PACK
Types 6·3v. 1·5a. 92p; 6·3v. 2a. 95p; 6·3v. 3a. £1·45p; 6·3v. 6a. £2 25; 12v. 1a. 95p; 12v. 3a. or 24v. 1·5a £2·25; 0-9-18v 1½a £1·95; 0-12-25-42v 2a £2·75.

CHARGER TRANSFORMERS 0-9-15v. 1½a. £1·75, 2½a. £1·95; 3a. £2·00; 5a. £2·45; 6a. £2·75; 8a. £3·00

AUTO (Step UP/step DOWN) TRANSFORMERS
0-110/120v. 200-230-250v. 50-80 watts £2·50, 150 watts, £4·50 250 watts £5·50; 500 watts £8·50

OUTPUT TRANSFORMERS
Std. Pentode 5000-3 Ω or 7000-3 Ω .. 96p
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω .. £1·45
Push-Pull 10 watts 6V6, 3-5-8-15 Ω .. £2·25
Push-Pull EL84 to 3 or 15 Ω 10-12 watts .. £2·25
Push-Pull Ultra Linear for Mullard 510, etc. £3·75
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω .... £3·20
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω £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 Ω £1·10; 100mA, 10H, 200 Ω 95p; 60mA, 10H, 400 Ω 35p.

RSC 100watt DISCO SYSTEM

AT FANTASTIC LOW PRICES!

Units listed below
(a) DISCOMASTER TWIN TURNTABLE CONSOLE with integral 100W amplifier
(b) PAIR OF HI-FI HEAD-PHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to h'phone)
(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets Size approx. 18" × 18" × 8"
(a) (b) (c) & (d) Carr. £3·00 **£149·95**

DEP. £19·95 & 19 fortnightly. payments of £7·87 (Total £169·48).

STEREO VERSION OF ABOVE SYSTEM Carr. £3·50 Or DEP £29·95 and 18 fortnightly pymts. £11·11 (Total £229·93) **£199.95**

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 or BSR MP60 type turntables and Sonotone or Acos Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid, see illustration on left. Or Dep. £9·00 and 18 fortnightly pymts. £4·22 (Total £84·96) **£75·00** Carr. £1·50

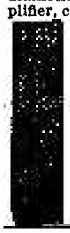
TD2S STEREO VERSION of above Car. £1·60 Terms. Dep. £15·00 and 18 fortnightly payments £6·51 (Total £132·18) **£115·00**

DISCOMASTER TWIN TURNTABLE POWER CONSOLE £99·95

Carr. £2·50

Garrard SP25 or McDonald MP60 turntables. Sonotone or Acos cartridges with diamond styli. Facilities as TDI Console but with built-in 100 watt Power Amplifier, complete with lid. Or Deposit £11·48 and 18 fortnightly payments £5·74 (Total £114·80)

STEREO DISCOMASTER **£145** or DEP. £20 and 18 fortnightly pymts £8·15 (Total £166·70). Carr. £3



R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair

TYPE C132 30-40 WATTS Fitted two exceptionally efficient, low feedback howl characteristic high flux 13" x 8" 20 watt speakers. Terms: Dep. £3·95 and 8 m'thly payments £2·67 (Total £25·31) Carr. 65p. **£19·95**

TYPE C3/70 70 WATTS. Fitted three 12" 25 watt Highly sensitive high flux speakers with high power voice coils. Size approx. 54" × 14" × 11". Dep. £5·11 & 8 mthly pymts. £5·11 (Total £45·99) Carr. 85p **£39·95**

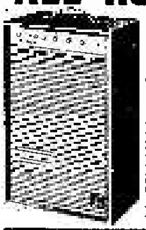
FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE High flux ceramic magnets. ALL CARRIAGE FREE.

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt	15" 60 Watt	12" 50 Watt
14,000 gauss 8/15Ω	14,000 gauss 8/15Ω	13,000 gauss 15Ω **£12·95**
£29·95	**£16·95**	Terms for pairs Dep £3·90 & 8 mthly pymts £3·16 Total £29·18
Dep: £3·80 and 8 mthly payments £3·80 (Total £34·20)	Dep. £2·17 and 8 monthly payments. £2·17 (Total £19·53)	PAIR SUITABLE ALL PURPOSES

FOR BASS GUITAR, ELECT. ORGAN, ETC.

ALL RSC PRICES INCLUDE VAT



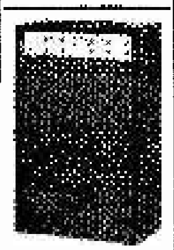
INTEREST on Credit Purchases REFUNDED settled in 3 months

MINSTREL 8W GUITAR AMP.

Incorporating Tremolo and 13" × 8" or 10" Speaker. Output 8 watts R.M.S. Continuous. 3 Jack Inputs for Microphone and Instrument. Mains Neon Controls: Volume, Tone, Tremolo Speed Tremolo Intensity. Terms: Deposit £4·40 and 8 monthly payments £2·67 (Total £25·76) Carr. free **£19·95**

FANE CRESCENDO SPEAKERS

FULL RANGE AVAILABLE AT ALL BRANCHES



FAL MAESTRO

COMBINED 30W AMP. AND 12" SPEAKER **£43·74** Carr. Free

For Lead Guitar, Mic, Gram, Radio, Tape (Not for use with Bass instruments) Inc. 3 inputs and 2 vol controls plus Treble & Bass, TREMOLO with associated controls. Attractively finished in black with silver-finished fascia. Compact size Fitted carrying handle. Deposit £5·59 and 8 mthly payments £5·59 (Total £50·31)

RSC 'PHANTOM 50' Rating 50 watts. 3 inputs, 2 vol. controls. Bass, Treble, Presence **£49·95** Carr. £1·50
Terms: Deposit £6·39 & 8 mthly. pymts. £6·39 (Total £57·51).

'POP' 25/2 12" 30W.

Dual cone. 15 ohm Imp. (Not for Bass Guitar use) **£8·95**

PH50 HIGH POWER TWEETER

Rating 50 Watt with 4 to 6 mfd filter. Imp 8 Ω **£5·95**

GROUP EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK. III AMPLIFIER £43·95
PR. FANE POP 25/2 30W L/SPEAKERS £17·90
£61·85
Terms: Deposit £7·35 and 8 monthly payments of £7·35 (Total £66·15)
PACKAGE PRICE **£56·95** carr. £1·10

F.A.L. PHASE 50 MK.III AMPLIFIER £43·95
PR. FANE POP 50 L/SPEAKERS £25·90
£69·85
Terms: Deposit £22·00 and 12 monthly payments of £4·20 (Total £72·40)
PACKAGE PRICE **£63·95** carr. £1·10

F.A.L. PHASE 50 AMPLIFIER £43·95
PAIR L12/25G SPKRS (in Cabinets) £25·90
£69·85
Terms: Deposit £22·00 and 12 monthly payments £4·20 (Total £72·40)
PACKAGE PRICE **£63·95** carr. £2·00

HIGH QUALITY LOUDSPEAKER UNITS

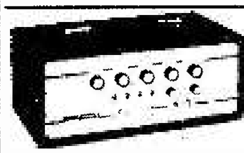
ALL TWO TONE VYNIDE AND VYNAIR FINISH

L12/2 50 WATT Fitted pair of 12" 30 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£39·95**
Or deposit £4·47 and 8 monthly payts. of £4·47. Total £40·23

L12/25G 12" 25 WATT 13,000 lines 15 ohms Terms for Pairs. Dep £3·32 & 8 mthly pymts £3·32 (Total £29·88) **£12·95** Carr. 55p.

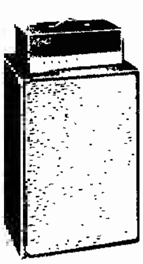
L12/10 10-15 Watt Veneered cabinet 12" unit 8-15 ohm. Approx. 14" × 14" × 9". Carr. 65p. Terms for Pairs. Dep. £2·05 & 8 mthly pymts £2·05 (Total £18·45). **£7·95**

FAL PHASE 50 Mk. III AMPLIFIER 50 WATT



Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective Circuitry against serious output overloading. Output for Speaker/s 8 to 15 ohms. Size 17" × 7" × 7½". 200–250v. A.C. mains. Output 50 watts music rating. Or deposit £5·75 & 8 monthly payments £5·75. Total £51·75. Carr. Free **£43·95**

REGENT 50X 50 WATT AMP.



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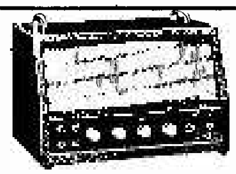

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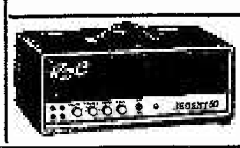

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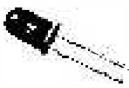

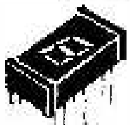

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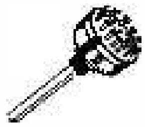

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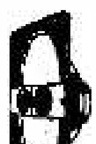

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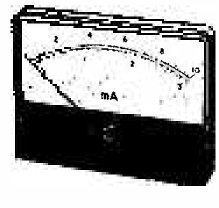

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ME11 = 0 to 10 m/a Full Scale
ME12 = 0 to 50 m/a Full Scale
ME13 = 0 to 100 m/a Full Scale
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⅞″	**98p**	Key "B" **10p**
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BC 108		**10p**
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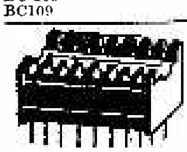

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8 pin
14 pin **14p**
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approx size =60mm x 40mm x 50mm
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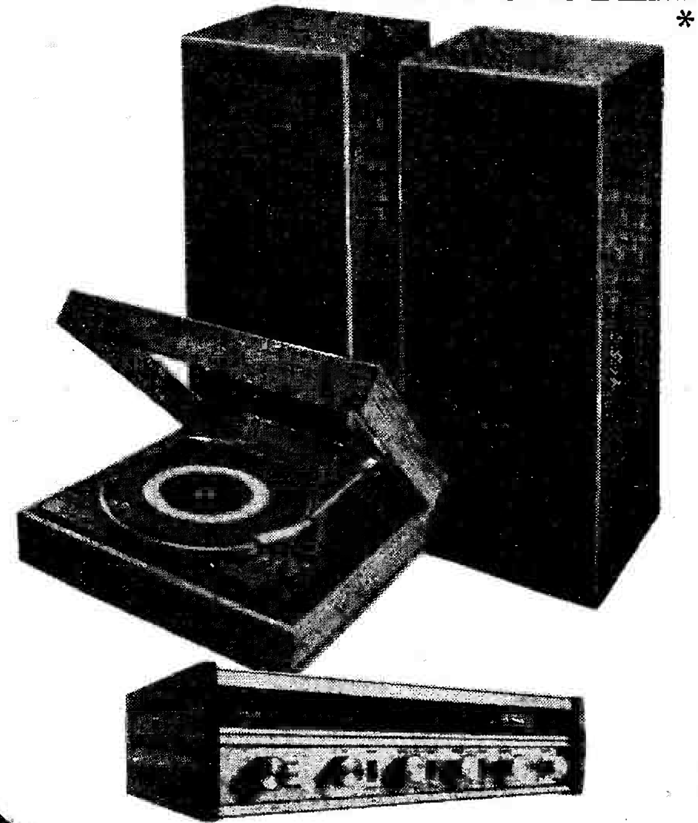

System 1. £51·00

40 Watt Amplifier. Viscount III – R102 now 20 watts per channel.
System I 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 ±1dB 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. 13¾" × 9" × 3¾".
Garrard SP 25 Mk III deck with magnetic cartridge, de luxe plinth and hinged cover.
Two Duo Type II matched speakers – Enclosure size approx. 17½" × 10¾" × 6" in simulated teak. Drive unit 13" × 8" with parasitic tweeter. 10 watts handling.

Complete System £51·00

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Viscount III amplifier (As System I)
Garrard SP 25 Mk III deck (As System I)
Two Duo Type III matched speakers – Enclosure size approx. 27" x 13" x 11½"
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	
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2 Duo Type II speakers	£14.00 + £2.20 p & p
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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. 15½" × 8" × 4". Complete deck and cover in closed position approx. 15½" × 12" × 6".
Complete only **£19.55 + £1.60 p & p. Extras if required.** Optional Diamond Styli **£1.37.**
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance, **£3.85.**

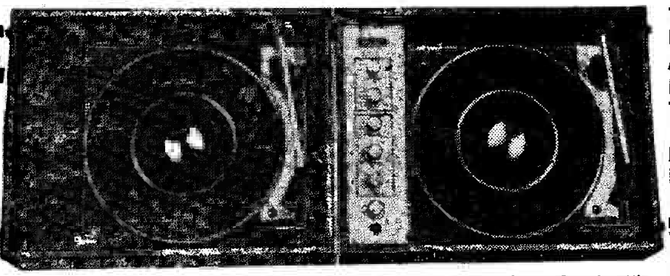
BUILD YOUR OWN * STEREO AMPLIFIER

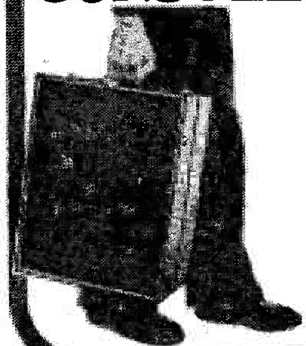
For the man who wants to design his own stereo — here's your chance to start, with Unisound — pre-amp, power amplifier and control panel. No soldering — just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic 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 eleswhere 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 – $17\frac{3}{4}" \times 13\frac{3}{4}" \times 8\frac{3}{4}"$ (approx.)
Unit Open – $35\frac{3}{4}" \times 13\frac{3}{4}" \times 4\frac{3}{4}"$ (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.

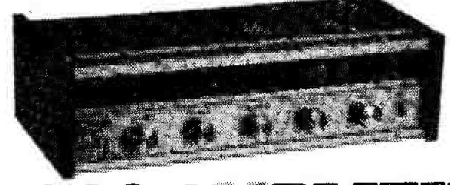
EMI SPEAKERS AT FANTASTIC REDUCTIONS

20 WATT SPEAKER SYSTEM *
System consists of a 13" × 8" (approx) eliptical woofer unit with a 8" × 5" (approx.) mid range unit incorporating parasitic tweeter and crossover components.
Technical Specification:
Bass Unit
Flux density–100 K, speech coil–$1\frac{1}{2}"$,
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 30 Hz. flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3" voice coil.

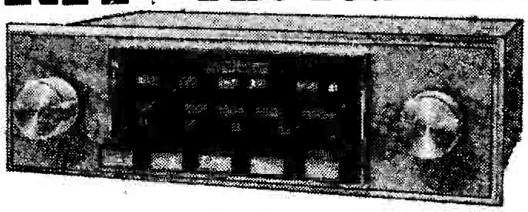
Recommended retail price £40·80.
OUR PRICE £18·70 + £1·50 p & p



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: $12\frac{1}{2}" \times 6" \times 3\frac{1}{2}"$. **£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 4¾" 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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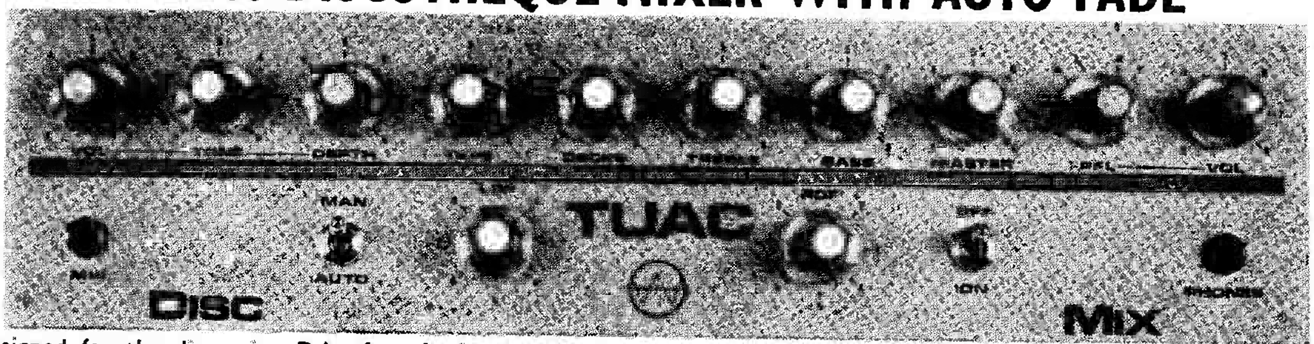
163 MITCHAM RD · LONDON SW17 9PG 01·672 3137/9080

TUAC DISCOTHEQUE MIXER WITH AUTO FADE



Designed for the discerning D.J. of professional standard Offering a vast variety of functions. Controls; Mic Vol; Tone, over-ride depth; auto/Manual Sw; Tape Vol; L & R Deck Faders; Deck Volume; Treble and Bass; H. Phon Vol Selector; Master Vol On/Off Sw. Max output 1V RMS.

Specification: Deck Inputs—50mV into 1mΩ; Deck Tone Controls—Treble +20 – 10dB at 12kHz. Bass +22 – 15dB at 40Hz; Mic input—200 ohms upwards. 2mV into 10kΩ; Mic Tone Control—Total Variation Treble 15dB. Total Variation Bass 10dB; Tape input —30mV into 47kΩ; Power Requirements—30–45 volts at 100mA.

£26·50

PANEL SIZE
18 × 4½ in.
DEPTH 3in.

HOW TO ORDER BY POST

Make cheques/P.O.'s payable to TUAC LTD (P.W.). OR QUOTE ACCESS/BARCLAYCARD No. and post to TUAC LTD (P.W.). 163, MITCHAM ROAD, LONDON S.W.17 9PG.

We accept Phone orders against ACCESS/Barclay Card Holders. Phone. 672-3137.

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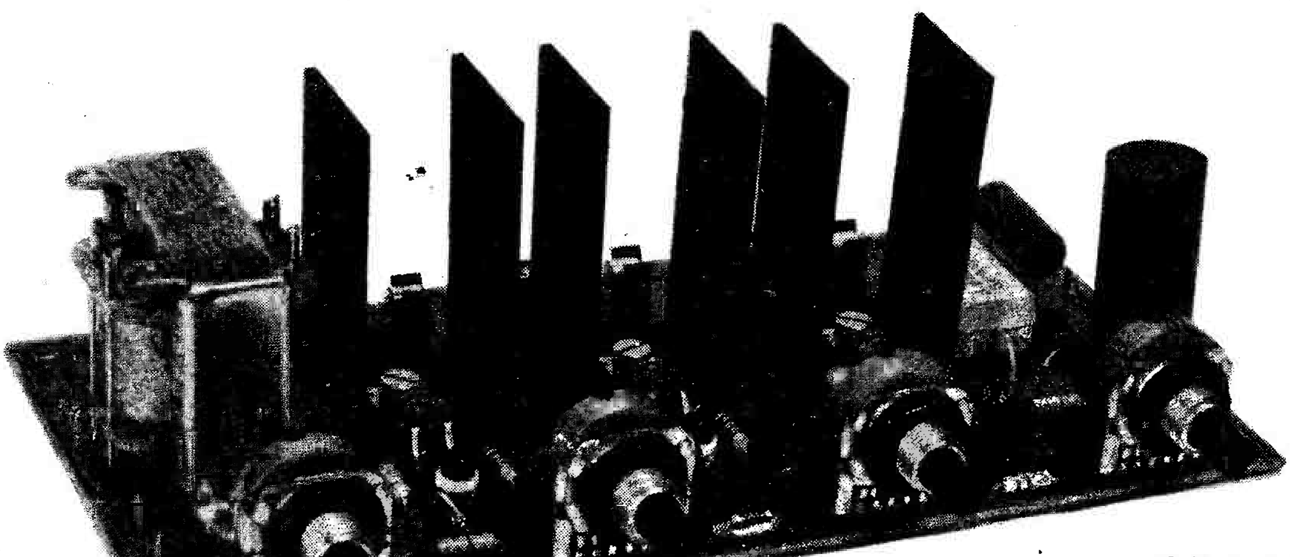
- R.C.A. 8 Amp Triacs
- 1000W per channel
- Each channel fully suppressed and fused
- Master control to operate from 1W to 100W
- Full wave control—12 easy connections



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Single Channel Version **£6·60**

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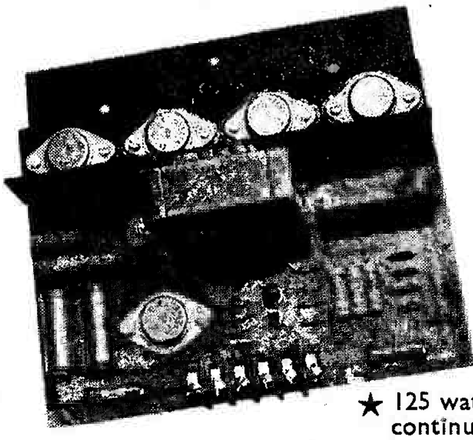
NEW TUAC POWER MODULES offering more power and quality than ever before.



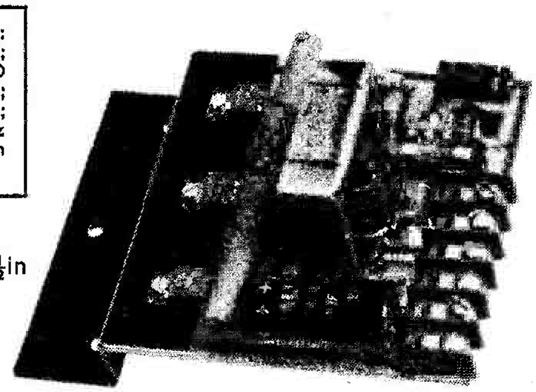
Specification on all power modules: All output power ratings ± 0·5dB; Output impedance 8-15 ohms; THD at full power 2% typically 1%; Input sensitivity 60mV into 10kΩ; Frequency response 20Hz–20kHz ±2dB; Hum and noise better than —70dB.

TP125
7 x 6½ x 3in

£17·00

★ 125 watts RMS continuous sine wave output

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

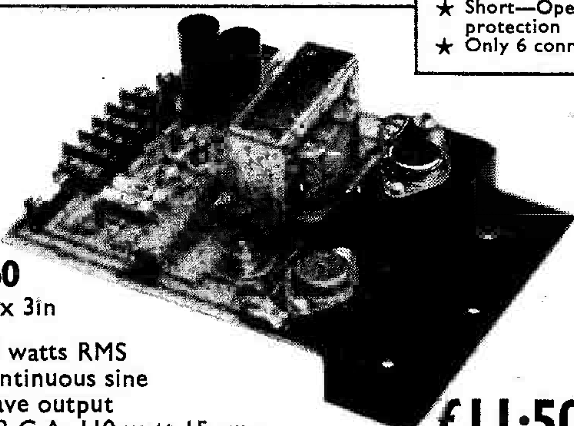


TL30
4 x 5¼ x 2½in

£9·30

★ 30 watts RMS continuous sine wave output
★ 2 R.C.A. 40 watt output transistor

★ Rugged layer wound driver transformer.
★ Short—Open—and Thermal overload protection
★ Only 6 connections



TL60
5 x 5 x 3in

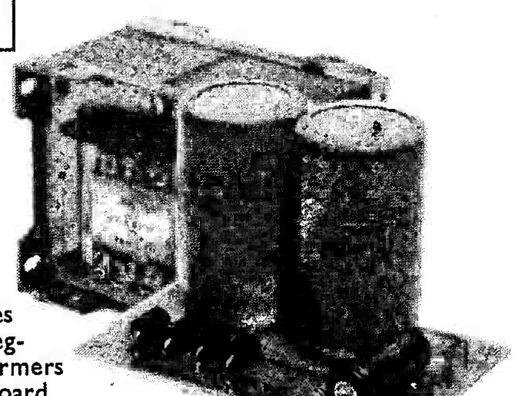
★ 60 watts RMS continuous sine wave output
★ 2 R.C.A. 110 watt 15 amp transistors

£11·50

TL100
5 x 5 x 3in

★ 100 watts R.M.S. continuous sine wave output
★ 2 R.C.A. 150 watt 15 amp transistors

£13·20



Power supplies vacuum impregnated Transformers with supply board incorporating pre-amp supply:

PS 125	± 50 volts for one TP125	**£11·50**
PS 100	± 45 volts for one TL100	**£10·50**
PS 60	± 40 volts for one TL60	**£9·30**
PS 30	± 50 volts for one TL30	**£6·85**
PSU 2	for supplying disco mixer	**£4·65**

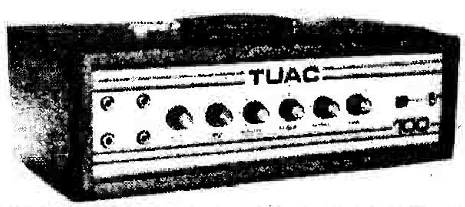
TUAC HIGH POWER AMPLIFICATION—ALL PURPOSE AMPLIFIER

built to high standards, and built to last
Suitable for Disco, PA, Guitar, 4 inputs, 2 volume controls. Master volume, treble, middle and bass controls. Rugged circuit, rugged leathercloth covered case, short and open circuit protection. Tone control specification as VAO8 pre-amp. **FULLY FUSED**

50 WATT RMS SINE WAVE **£43·00**
100 WATT RMS SINE WAVE **£64·50**

Also available

100 WATT SLAVE AMPLIFIER
Spec as above. **£48·50.**



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How to order the cassette unit for your Kempton or Ascot player.

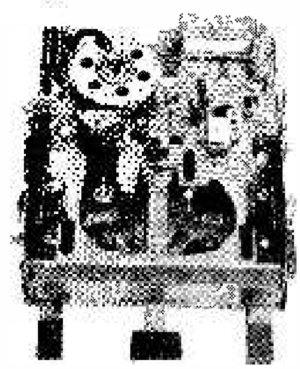
As a reader of Practical Wireless, you can get the cassette mechanism for your car stereo player direct from Goldring.

The units for both the PW Kempton and Ascot are made by Lenco and based on the famous STARR design, with wow and flutter reduced to 0.3% max.

All you have to do is send the coupon to us, with a cheque or PO made out to Goldring Ltd. Be sure to state which unit you need. For the Kempton, it's Lenco FFR at £18.90; for the Ascot, it's Lenco CRV at £19.98. Prices include packing, carriage and VAT.

The units are also available from selected distributors.

Lenco FFR for the Kempton. Robust and precision engineered, it's widely used in industry and by Europe's largest car stereo manufacturer.



Lenco CRV for the Ascot. A record/replay unit made to hi-fi standards. Features include dynamic noise limiting, auto-stop and cassette ejection.

To: Goldring Ltd, 10 Bayford Street, Hackney, London E8 3SE.

Please send me: Lenco FFR at £18.90

Lenco CRV at £19.98

I enclose PO, cheque for £ ______

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PC ETCHING KIT
Contains 100 sq ins copper laminate board DALO etch resist pen, 1lb Ferric Chloride, etching dish, abrasive cleaner, and instructions, all for only £3·30.

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500 assorted resistors **£1·35**, 2500 **£5**
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3W TAPE AMPLIFIERS
Polished wooden cabinet 14 × 13 × 9″ containing a sensitive (20μV) 4 valve amplifier with tone and volume controls. 3 watts output to the 7 × 4″ 3Ω loudspeaker. Also a non-standard tape deck. Supplied in good working condition with circuit. Standard mains operation **£4·50**. Suitable cassette **£1·10**. Spare head **33p**. Tape (ex-computer) **57p**. Amplifier Chassis only, complete & tested (2×ECC83, EL84, EZ80) and speaker **£3**. With circuit.

VERSATILE POWER SUPPLY
Contains mains transformer, 2 amp thermal cut-out and bridge rectifier in neat plastic case. Will give 1·7-10·5V output with 2 extra capacitors (provided). Supplied complete with data sheet. Only **£1·20**.

STABILIZED POWER UNITS
Made by WEIR Electronics. Mains input, output +26, +15, +6, 0, —6V. All fully stabilized. (Uses 8 2N3055, and 20 other transistors. **£16**.

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Anhydrous technical quality to Mil-Spec in 1lb double sealed packs. 1lb **80p**, 3lb **£1·60**, 10lb **£4·45**, 100lb **£33**

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Contained in steel case 5¾ × 5 × 3¾″ are 2 GET116 transistors on heat sinks, 3 pot cores, 2 30V zeners, 4 audio transformers, 1% R's & C's. With circuit diagram **£1**.

7 lb BARGAIN PARCELS
Hundreds of new components—Pots, resistors, capacitors, switches + PC boards with transistors & diodes. Also loads of odds & ends. Contents always changing as new stocks arrive Amazing value at **£2·30**.

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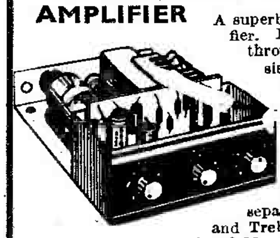
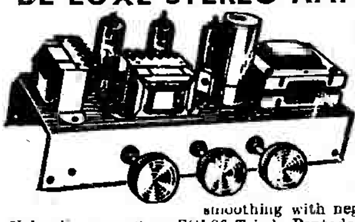
BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

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 ± 3dB. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel. Input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £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 × ECL86 Triode Pentodes. 1 × 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 300m/v 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 × 4"d. Overall height including valves 5". Ready built & tested to a high standard. £10·75. P.&P. 50p.

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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 × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer. P. & P. 40p BARGAIN PRICE **£4·20**

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 × 2½" w × 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 × 3½in. wide × 3in. deep. Price £2·60 P. & P. 40p.

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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 1¾" × 1¼" × ¾". Brand new complete with instructions. Price 1·20p. P. & P. 15p.

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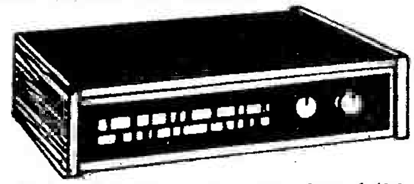
8 pole 3 way 2 bank low loss Yaxley type switches 1¼" sections. Standard spindle. 2 switches 64p + 10p P. & P.

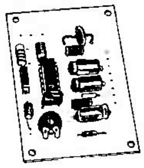
HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER



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 × 8" deep by 2¾" 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" × 3" × ½" 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 GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. £1·46, P. & P. 15p.

SONOTONE 9TAHC 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 × 3in. deep × 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.

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Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16" high × 10½" wide × 6" deep. Fitted with E.M.I. Ceramic Magnet 13" × 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" × 8" bass speaker with parasitic tweeter £8·00, Carr. 90p.

LOUDSPEAKER BARGAINS

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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 Hiflux ceramic ferrobar magnet assembly £7·50. Guitar models: 25w £7·50, 35w, £7·50, P.&P. 45p.

12in. "RA" TWIN CONE LOUDSPEAKER. 10 watts peak handling. 3 or 8 or 15 ohm (state which) £3·00, P. & P. 36p.

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Size 11¾" × 14⅜" × 1¼" 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 £6·60 each. P. & P. 34p.

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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 ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp. Overall Size 12"w. × 8"d. × 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

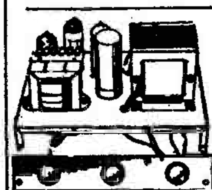
AMPLIFIER KIT	£12·96	P. & P. 30p
(Magnetic input components 33p extra)		
POWER PACK KIT	£4·32	P. & P. 40p
CABINET	£4·32	P. & P. 40p

(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 Discotheque use, etc.

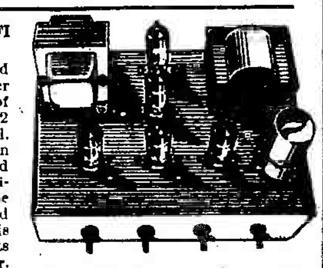
3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4½"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 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £6·50. 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 3-15 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.

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¼	CF	22–2M2	1	0·75	0·60	0·55	3·9x10·5
½	CF	22–1M	1	0·75	0·60	0·55	5·5x16
⅛	MF	10–2M7	2	1·54	1·32	1·1	3x7
½	MF	10–2M2	2	1·43	1·21	0·99	4·2x10·8
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MINIATURE 0·25W Vertical or horizontal 6p each 1K, 2K2, 4K7, 10K, etc, up to 1M Ω
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6·8μF 63V	6½p	150μF 63V	15p
8·0μF 40V	6½p	220μF 6·4V	6½p
10μF 16V	6½p	220μF 10V	6½p
10μF 25V	6½p	220μF 16V	8p
10μF 63V	6½p	220μF 63V	21p
15μF 16V	6½p	330μF 16V	12p
15μF 63V	6½p	330μF 63V	25p
16μF 40V	6½p	470μF 6·4	9p
22μF 25V	6½p	470μF 40V	20p
22μF 63V	6½p	680μF 16V	15p
32μF 10V	6½p	680μF 40V	25p
33μF 16V	6½p	1000μF 16V	20p
33μF 40V	6½p	1000μF 25V	25p
32μF 63V	6½p	1500μF 6·4V	15p
47μF 10V	6½p	1500μF 16V	25p
47μF 25V	6½p	2200μF 10V	25p
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22 Ranges plus AF/IF Oscillator 20,000Ω/Volt.
Vdc—0·5—1000V in 7 ranges
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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.
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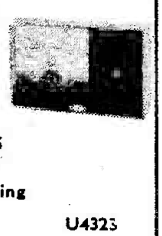
U4323

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—2½%. ac—4% of F.S.D.
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Complete with steel carrying case, test leads, and battery.
PRICE £11·30 net p & p 30p.


U4341

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34 Ranges. High sensitivity.
20,000Ω/Volt. Overload protected.
Vdc—0·6—1200V in 9 ranges.
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Size—167 x 98 x 63mm.
Supplied complete with storage case, test leads, spare diode, and battery.
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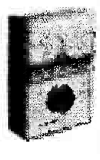
U4324

MULTIMETER U4313
33 ranges. Knife edge with mirror scale.
20,000Ω/Volt. High accuracy. mVdc—75mV.
Vdc—1·5—600V in 9 ranges.
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Idc—60—120 microamps in 2
Idc—0·6—1500mA in 6 ranges.
Iac—0·6—1500mA in 6 ranges.
Resistance—1KΩ—1MΩ in 4 ranges.
db scale—10 to + 12db.
Accuracy—dc—1½%. ac—2½%
Size—115 x 215 x 90mm.
Complete with steel carrying case, test leads, and battery.
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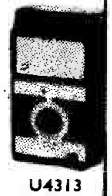
U4313

S-DeC

S-DeC	£2·14
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AC125	0·19
AC126	0·19
AC127	0·20
AC128	0·20
AC132	0·16
AC134	0·16
AC137	0·16
AC141	0·20
AC141K	0·32
AC142	0·20
AC142K	0·28
AC151	0·17
AC154	0·22
AC155	0·22
AC156	0·22
AC157	0·27
AC165	0·22
AC166	0·22
AC167	0·22
AC168	0·27
AC169	0·16
AC176	0·22
AC177	0·27
AC178	0·31
AC179	0·31
AC180	0·22
AC180K	0·32
AC181	0·22
AC181K	0·32
AC187	0·24
AC187K	0·25
AC188	0·24
AC188K	0·25
ACY17	0·28
ACY18	0·22
ACY19	0·22
ACY20	0·22
ACY21	0·22
ACY22	0·18
ACY27	0·20
ACY28	0·21
ACY29	0·39
ACY30	0·31
ACY31	0·31
ACY34	0·23
ACY35	0·23
ACY36	0·31
ACY40	0·19
ACY41	0·20
ACY44	0·39
AD130	0·42
AD140	0·53
AD142	0·53
AD143	0·42
AD149	0·55
AD161	0·39

Type	Price
AD162	0·39
AD161 & AD162(MP)	75
ADT140	0·55
AF114	0·27
AF115	0·27
AF116	0·27
AF117	0·27
AF118	0·39
AF124	0·33
AF125	0·33
AF126	0·31
AF127	0·31
AF139	0·33
AF178	0·55
AF179	0·55
AF180	0·55
AF181	0·55
AF186	0·55
AF239	0·41
AL102	0·72
AL103	0·72
ASY26	0·28
ASY27	0·33
ASY28	0·28
ASY29	0·28
ASY50	0·28
ASY51	0·28
ASY52	0·28
ASY54	0·28
ASY55	0·28
ASY56	0·28
ASY57	0·28
ASY58	0·28
ASY73	0·28
ASZ21	0·44
BC107	0·14
BC108	0·14
BC109	0·15
BC113	0·11
BC114	0·17
BC115	0·17
BC116	0·17
BC117	0·20
BC118	0·11
BC119	0·33
BC120	0·88
BC125	0·13
BC126	0·20
BC132	0·13
BC134	0·20
BC135	0·13
BC136	0·17
BC137	0·17
BC139	0·44
BC140	0·33
BC141	0·33
BC142	0·33
BC143	0·33
BC145	0·50
BC147	0·11
BC148	0·11

Type	Price
BC149	0·13
BC150	0·20
BC151	0·22
BC152	0·19
BC153	0·31
BC154	0·33
BC157	0·20
BC158	0·13
BC159	0·13
BC160	0·50
BC161	0·55
BC167	0·13
BC168	0·13
BC169	0·13
BC170	0·13
BC171	0·16
BC172	0·16
BC173	0·16
BC174	0·16
BC175	0·24
BC177	0·21
BC178	0·21
BC179	0·21
BC180	0·27
BC181	0·27
BC182	0·16
BC182L	0·16
BC183	0·16
BC183L	0·16
BC184	0·22
BC184L	0·22
BC186	0·31
BC187	0·31
BC207	0·12
BC208	0·12
BC209	0·13
BC212L	0·14
BC213L	0·14
BC214L	0·18
BC225	0·28
BC226	0·39
BC301	0·30
BC302	0·27
BC303	0·35
BC304	0·40
BC440	0·34
BC460	0·40
BCY30	0·27
BCY31	0·29
BCY32	0·33
BCY33	0·24
BCY34	0·28
BCY70	0·16
BCY71	0·22
BCY72	0·16
BCZ10	0·22
BCZ11	0·28
BCZ12	0·28
BD115	0·68
BD116	0·88
BD121	0·66
BD123	0·72

Type	Price
BD124	0·76
BD131	0·55
BD132	0·66
BD133	0·72
BD135	0·44
BD136	0·44
BD137	0·50
BD138	0·55
BD139	0·61
BD140	0·66
BD155	0·88
BD175	0·66
BD176	0·66
BD177	0·72
BD178	0·72
BD179	0·77
BD180	0·77
BD185	0·72
BD186	0·72
BD187	0·77
BD188	0·77
BD189	0·83
BD190	0·83
BD195	0·94
BD196	0·94
BD197	0·99
BD198	0·99
BD199	£1·05
BD200	£1·05
BD205	0·88
BD206	0·88
BD207	£1·05
BD208	£1·05
BDY20	£1·10
BF115	0·27
BF117	0·50
BF118	0·77
BF119	0·77
BF121	0·50
BF123	0·55
BF125	0·50
BF127	0·55
BF152	0·61
BF153	0·50
BF154	0·50
BF155	0·77
BF156	0·53
BF157	0·61
BF158	0·61
BF159	0·66
BF160	0·44
BF162	0·44
BF163	0·44
BF164	0·44
BF165	0·44
BF167	0·24
BF173	0·24
BF176	0·39
BF177	0·39
BF178	0·33
BF179	0·33
BF180	0·33

Type	Price
BF181	0·33
BF182	0·44
BF183	0·44
BF184	0·28
BF185	0·33
BF187	0·30
BF188	0·44
BF194	0·13
BF195	0·13
BF196	0·16
BF197	0·16
BF200	0·50
BF222	£1·05
BF257	0·50
BF258	0·66
BF259	0·94
BF262	0·61
BF263	0·61
BF270	0·39
BF271	0·33
BF272	0·88
BF273	0·39
BF274	0·39
BFW10	0·66
BFX29	0·30
BFX84	0·24
BFX85	0·33
BFX86	0·24
BFX87	0·27
BFX88	0·24
BFY50	0·22
BFY51	0·22
BFY52	0·22
BFY53	0·19
BSX19	0·17
BSX20	0·17
BSY25	0·17
BSY26	0·17
BSY27	0·17
BSY28	0·17
BSY29	0·17
BSY38	0·20
BSY39	0·20
BSY40	0·31
BSY41	0·31
BSY95	0·14
BSY95A	0·14
Bu105	£2·20
C111E	0·55
C400	0·33
C407	0·28
C424	0·28
C425	0·55
C426	0·39
C428	0·22
C441	0·33
C442	0·33
C444	0·39
C450	0·24
MAT100	0·21
MAT101	0·22
MAT120	0·21

Type	Price
MAT121	0·22
MJE2955	0·95
MJE3055	0·62
MJE3440	0·55
MPF102	0·46
MPF104	0·41
MPF105	0·41
OC19	0·39
OC20	0·70
OC22	0·52
OC23	0·54
OC24	0·62
OC25	0·42
OC26	0·32
OC28	0·55
OC29	0·55
OC35	0·46
OC36	0·55
OC41	0·22
OC42	0·27
OC44	0·17
OC45	0·14
OC70	0·11
OC71	0·11
OC72	0·16
OC74	0·16
OC75	0·17
OC76	0·17
OC77	0·28
OC81	0·17
OC81D	0·17
OC82	0·17
OC82D	0·17
OC83	0·22
OC139	0·22
OC140	0·22
OC169	0·28
OC170	0·28
OC171	0·28
OC200	0·28
OC201	0·31
OC202	0·31
OC203	0·28
OC204	0·28
OC205	0·39
OC309	0·44
OCP71	0·48
ORP12	0·48
ORP60	0·44
ORP61	0·44
P20	0·55
P346A	0·22
P397	0·46
ST140	0·14
ST141	0·19
TIS43	0·34
UT46	0·30
ZN414	£1·20
2G301	0·21
2G302	0·21
2G303	0·21
2G304	0·27

Type	Price
2G306	0·44
2G308	0·39
2G309	0·39
2G339	0·22
2G339A	0·18
2G344	0·20
2G345	0·18
2G371	0·18
2G371B	0·18
2G373	0·19
2G374	0·19
2G377	0·33
2G378	0·18
2G381	0·18
2G382	0·18
2G401	0·33
2G414	0·33
2G417	0·28
2N388	0·39
2N388A	0·61
2N404	0·22
2N404A	0·31
2N524	0·46
2N527	0·54
2N598	0·46
2N599	0·50
2N696	0·14
2N697	0·15
2N698	0·27
2N699	0·50
2N706	0·09
2N706A	0·10
2N708	0·13
2N711	0·33
2N717	0·39
2N718	0·27
2N718A	0·55
2N726	0·31
2N727	0·31
2N743	0·22
2N744	0·22
2N914	0·16
2N918	0·33
2N929	0·23
2N930	0·23
2N1131	0·22
2N1132	0·24
2N1302	0·16
2N1303	0·16
2N1304	0·19
2N1305	0·19
2N1306	0·23
2N1307	0·23
2N1308	0·26
SN1309	0·26
2N1613	0·22
2N1711	0·23
2N1889	0·35
2N1890	0·50
2N1893	0·41
2N2147	0·79
2N2148	0·63

Type	Price
2N2160	0·66
2N2192	0·39
2N2193	0·39
2N2194	0·39
2N2217	0·24
2N2218	0·22
2N2219	0·22
2N2220	0·24
2N2221	0·22
2N2222	0·22
2N2368	0·19
2N2369	0·16
2N2369A	0·16
2N2411	0·27
2N2412	0·27
2N2646	0·52
2N2711	0·23
2N2712	0·23
2N2714	0·23
2N2904	0·19
2N2904A	0·23
2N2905	0·23
2N2905A	0·23
2N2906	0·17
2N2906A	0·20
2N2907	0·22
2N2907A	0·24
2N2923	0·16
2N2924	0·16
2N2925	0·16
2N2926(G)	14
2N2926(Y)	12
2N2926(O)	11
2N2926(R)	11
2N2926(B)	11
2N3010	0·77
2N3011	0·16
2N3053	0·19
2N3054	0·51

Type	Price
2N3055	0·55
2N3391	0·16
2N3391A	0·18
2N3392	0·16
2N3393	0·16
2N3394	0·16
2N3395	0·19
2N3402	0·23
2N3403	0·23
2N3404	0·31
2N3405	0·46
2N3414	0·17
2N3415	0·17
2N3416	0·31
2N3417	0·31
2N3525	0·83
2N3614	0·74
2N3615	0·82
2N3616	0·82
2N3646	0·10
2N3702	0·13
2N3703	0·13
2N3704	0·14
2N3705	0·13
2N3706	0·13
2N3707	0·14
2N3708	0·09
2N3709	0·10
2N3710	0·10
2N3711	0·10
2N3819	0·31
2N3820	0·55
2N3821	0·39
2N3823	0·31
2N3903	0·31
2N3904	0·33
2N3905	0·31
2N3906	0·30
2N4058	0·13

Type	Price
2N4059	0·11
2N1060	0·13
2N4061	0·13
2N4062	0·13
2N4284	0·19
2N4285	0·19
2N4286	0·19
2N4287	0·19
2N4288	0·19
2N4289	0·19
2N4290	0·19
2N4291	0·19
2N4292	0·19
2N4293	0·19
2N5172	0·13
2N5294	0·60
2N5457	0·35
2N5458	0·35
2N5459	0·44
2N6221	0·75
2S301	0·55
2S302A	0·46
2S302	0·46
2S303	0·61
2S304	0·77
2S305	0·86
2S306	0·86
2S307	0·86
2S321	0·62
2S322	0·46
2S322A	0·46
2S323	0·62
2S324	0·77
2S325	0·77
2S326	0·77
2S327	0·77
2S701	0·46
40361	0·44
40362	0·50

DIODES AND RECTIFIERS

Type	Price	Type	Price	Type	Price
AA119	0·09	BY128	0·17	OA10	0·15
AA120	0·09	BY130	0·18	OA47	0·08
AA129	0·09	BY133	0·23	OA70	0·08
AAY30	0·10	BY164	0·55	OA79	0·08
AAZ13	0·11	BYX38/300	0·46	OA81	0·08
BA100	0·11	BYZ10	0·39	OA85	0·10
BA116	0·23	BYZ11	0·33	OA90	0·07
BA126	0·24	BYZ12	0·33	OA91	0·07
BA148	0·16	BYZ13	0·23	OA95	0·08
BA154	0·13	BYZ16	0·44	OA200	0·07
BA155	0·16	BYZ17	0·39	OA202	0·08
BA156	0·15	BYZ18	0·39	SD10	0·06
BA173	0·16	BYZ19	0·31	SD19	0·06
BY100	0·17	CG62		1N34	0·08
BY101	0·13	(OA91 Eq)	0·06	1N34A	0·08
BY105	0·19	CG651—		1N914	0·06
BY114	0·13	(OA70-79)	0·07	1N916	0·06
BY124	0·13	OA5	0·39	1N4148	0·06
BY126	0·16	OA5 short		IS021	0·11
BY127	0·17	leads	0·23	IS951	0·07

LINEAR I.C's—FULL SPEC.

Type No.	Price 1	25	100+
72702	50p	48p	45p
72709	35p	33p	30p
72709P	33p	31p	29p
72710	45p	43p	40p
72741	40p	38p	35p
72741C	45p	43p	40p
72741P	38p	36p	34p
72748P	38p	36p	34p
SL201C	59p	45p	40p
SL701C	50p	45p	40p
SL702C	50p	45p	40p
TAA263	80p	70p	60p
TAA293	£1·00	95p	90p
TAA350A	£1·85	£1·80	£1·70
μA703C	28p	26p	24p
μA709C	35p	33p	30p
μA711	45p	43p	40p
TBA800	£1·50	—	—

NUMERICAL INDICATOR TUBES

CD66	£1·87
GR116	£1·70
3015F Minitron	£1·50
MAN 3M. L.E.D. 7-segment 0·127"	£1·90

All indicators 0·9 + Decimal point. All side viewing. Full data for all types available on request.

ZN414 .. .. .. £1·20 each
I.C. Radio Rec. incl. full cir. data.

DTL 930 SERIES LOGIC I.C's

Type	Price 1	25	100+
BP930	15p	14p	13p
BP932	16p	15p	14p
BP933	16p	15p	14p
BP935	16p	15p	14p
BP936	16p	15p	14p
BP944	16p	15p	14p
BP945	30p	28p	25p
BP946	15p	14p	13p
BP948	30p	28p	25p
BP951	70p	65p	60p
BP962	15p	14p	13p
BP9093	45p	43p	40p
BP9094	45p	43p	40p
BP9097	45p	43p	40p
BP9099	45p	43p	40p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

VOLTAGE REGULATORS

TO.3 Plastic 1·5 Amps

μA.7805/L129	5V (Equiv. to MVR5V)	£1·76
μA.7812/L130	12V (Equiv. to MVR12V)	£1·76
μA.7815/L131	15V (Equiv. to MVR15V)	£1·76

TRIPLE 66-bit DYNAMIC SHIFT REGISTER EDSR 3166

Comprises three 66-bit 2 0 dynamic shift registers with independent inputs and outputs. TTL compatibility and buffered clock lines to reduce the capacitive load presented at the clock pins. A boot-strapped buffer ensures a full logic swing at the output.
£2·50 each

DUAL-IN-LINE SOCKETS.

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C's. TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	33p	30p	27p
TSO 16 „ „	38p	35p	32p
LOW COST No.			
BPS 14	16p	14p	12p
BPS 16	17p	15p	13p
BPS 8 spin type	15p	13p	11p

ALL PRICES INCLUDE VAT.

74 Series T.T.L. I.C's

BI-PAK STILL LOWEST IN PRICE. FULL SPECIFICATION GUARANTEED. ALL FAMOUS MANUFACTURERS

Type	Quantities 1 £ p	25 £ p	100+ £ p
7400	0·18	0·17	0·16
7401	0·18	0·17	0·16
7402	0·18	0·17	0·16
7403	0·18	0·17	0·16
7404	0·18	0·17	0·16
7405	0·18	0·17	0·16
7406	0·39	0·34	0·31
7407	0·39	0·34	0·31
7408	0·25	0·24	0·23
7409	0·25	0·24	0·23
7410	0·18	0·17	0·16
7411	0·28	0·27	0·26
7412	0·30	0·29	0·28
7413	0·32	0·31	0·30
7416	0·40	0·39	0·38
7417	0·40	0·39	0·38
7420	0·18	0·17	0·16
7422	0·30	0·29	0·28
7423	0·40	0·39	0·38
7425	0·40	0·39	0·38
7426	0·40	0·38	0·36
7427	0·40	0·38	0·36
7428	0·45	0·42	0·40
7430	0·18	0·17	0·16
7432	0·40	0·38	0·36
7433	0·42	0·40	0·38
7437	0·45	0·42	0·40
7438	0·45	0·42	0·40
7440	0·18	0·17	0·16
7441	0·74	0·71	0·64
7442	0·74	0·71	0·64
7443	1·20	1·15	1·10
7444	1·20	1·15	1·10
7445	1·98	1·95	1·90
7446	1·20	1·15	1·10
7447	1·10	1·07	1·05

Type	Quantities 1 £ p	25 £ p	100+ £ p
7448	1·10	1·07	1·05
7450	0·18	0·17	0·16
7451	0·18	0·17	0·16
7453	0·18	0·17	0·16
7454	0·18	0·17	0·16
7460	0·18	0·17	0·16
7470	0·32	0·29	0·27
7472	0·32	0·29	0·27
7473	0·41	0·39	0·35
7474	0·41	0·39	0·35
7475	0·60	0·58	0·56
7476	0·44	0·43	0·42
7480	0·74	0·71	0·64
7481	1·30	1·25	1·20
7482	0·90	0·85	0·80
7483	1·20	1·15	1·05
7484	1·10	1·05	1·00
7485	2·00	1·90	1·80
7486	0·35	0·34	0·33
7489	4·00	3·75	3·50
7490	0·74	0·71	0·64
7491	1·10	1·05	1·00
7492	0·74	0·71	0·64
7493	0·74	0·71	0·64
7494	0·85	0·82	0·75
7495	0·85	0·82	0·75
7496	0·96	0·93	0·86
74100	1·50	1·45	1·40
74104	0·70	0·68	0·66
74105	0·70	0·68	0·66
74107	0·44	0·42	0·40
74110	0·60	0·55	0·50
74111	0·95	0·92	0·90
74118	1·10	1·05	1·00
74119	1·50	1·40	1·30
74121	0·50	0·48	0·45

Type	Quantities 1 £ p	25 £ p	100+ £ p
74122	0·88	0·86	0·84
74123	1·58	1·54	1·50
74141	0·85	0·82	0·79
74145	1·58	1·54	1·50
74150	2·50	2·40	2·30
74151	1·10	1·05	1·00
74153	1·20	1·10	1·00
74154	1·98	1·90	1·75
74155	1·20	1·15	1·10
74156	1·20	1·15	1·10
74157	1·20	1·15	1·10
74160	1·73	1·70	1·65
74161	1·73	1·70	1·65
74162	1·73	1·70	1·65
74163	1·73	1·70	1·65
74164	2·20	2·10	2·00
74165	2·20	2·10	2·00
74166	2·35	2·30	2·25
74174	2·00	1·95	1·90
74175	1·40	1·35	1·30
74176	1·60	1·55	1·50
74177	1·60	1·55	1·50
74180	1·60	1·55	1·50
74181	5·00	4·50	4·00
74182	1·50	1·45	1·40
74184	2·40	2·30	2·20
74190	2·15	2·10	2·00
74191	2·15	2·10	2·00
74192	2·15	2·10	2·00
74193	2·15	2·10	2·00
74194	1·90	1·80	1·70
74195	1·60	1·50	1·40
74196	1·73	1·70	1·65
74197	1·73	1·70	1·65
74198	3·45	3·35	3·20
74199	3·10	3·00	2·90

Devices may be mixed to qualify for quantity price. (TTL 74 series only) data is available for the above series of I.C.'s in booklet form. Price 35p.

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ND 120 NIXIE DRIVER TRANSISTOR.
Suitable replacement for BSX 21, C 407, 2N 1893 120veb.

1	25	100+
0·19	0·17	0·16

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 6p each. Any Qty.

GP 100 TO3 METAL CASE GERMANIUM
Vebo = 80V. Vceo = 50V. I.C. = 10 amps. Ptot = 30W. hfe = 30–170. Replaces the majority of Germanium power transistors in the OC, AD and NKT range.

1	25	100+
0·47	0·44	0·40

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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. TO66 up to 600PIV	1·10
U46	20	Unijunction transistors similar to TIS43	0·55
U47	10	TO220AB plastic triacs 50V 6A	£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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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	0·30	0·38	1·35
600	0·09	0·17	1N4005	0·10	0·18	0·36	0·45	1·90
800	0·12	0·19	1N4006	0·11	0·20	0·38	0·55	2·10
1000	0·14	0·30	1N4007	0·12	0·25	0·48	0·65	2·50
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UIC20	= 12 × 7420	0·55	UIC73	= 8 × 7473	0·55	UIC141	= 5 × 74141	0·55
UIC30	= 12 × 7430	0·55	UIC74	= 8 × 7474	0·55	UIC151	= 5 × 74151	0·55
UIC40	= 12 × 7440	0·55	UIC76	= 8 × 7476	0·55	UIC154	= 5 × 74154	0·55
UIC41	= 5 × 7441	0·55	UIC80	= 5 × 7480	0·55	UIC193	= 5 × 74193	0·55
UIC42	= 5 × 7442	0·55	UIC81	= 5 × 7481	0·55	UIC199	= 5 × 74199	0·55
UIC43	= 5 × 7443	0·55	UIC82	= 5 × 7482	0·55			
UIC44	= 5 × 7444	0·55	UIC83	= 5 × 7483	0·55	UICXI	= 25 Assorted 74's	£1·65
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100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0·63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
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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-Tennis.

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.

NEWS... NEWS... NEWS...

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 average 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.

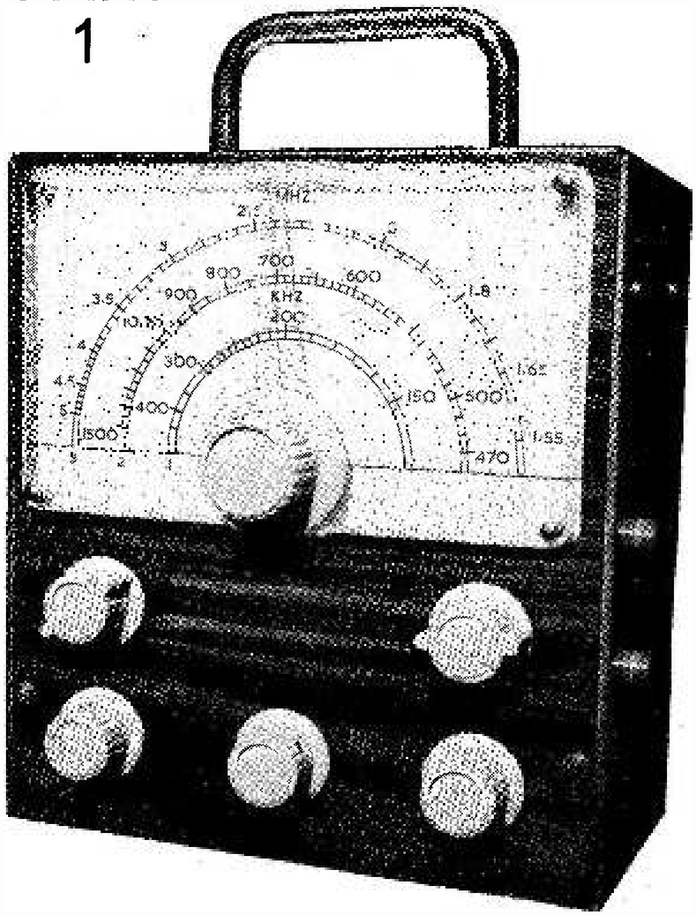
The first issue contains articles on "Impartiality in Broadcasting". "Future pattern of the ILR", "Television Coverage", "Role of Television in Science Education."

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 2×500pF 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 1kΩ.

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

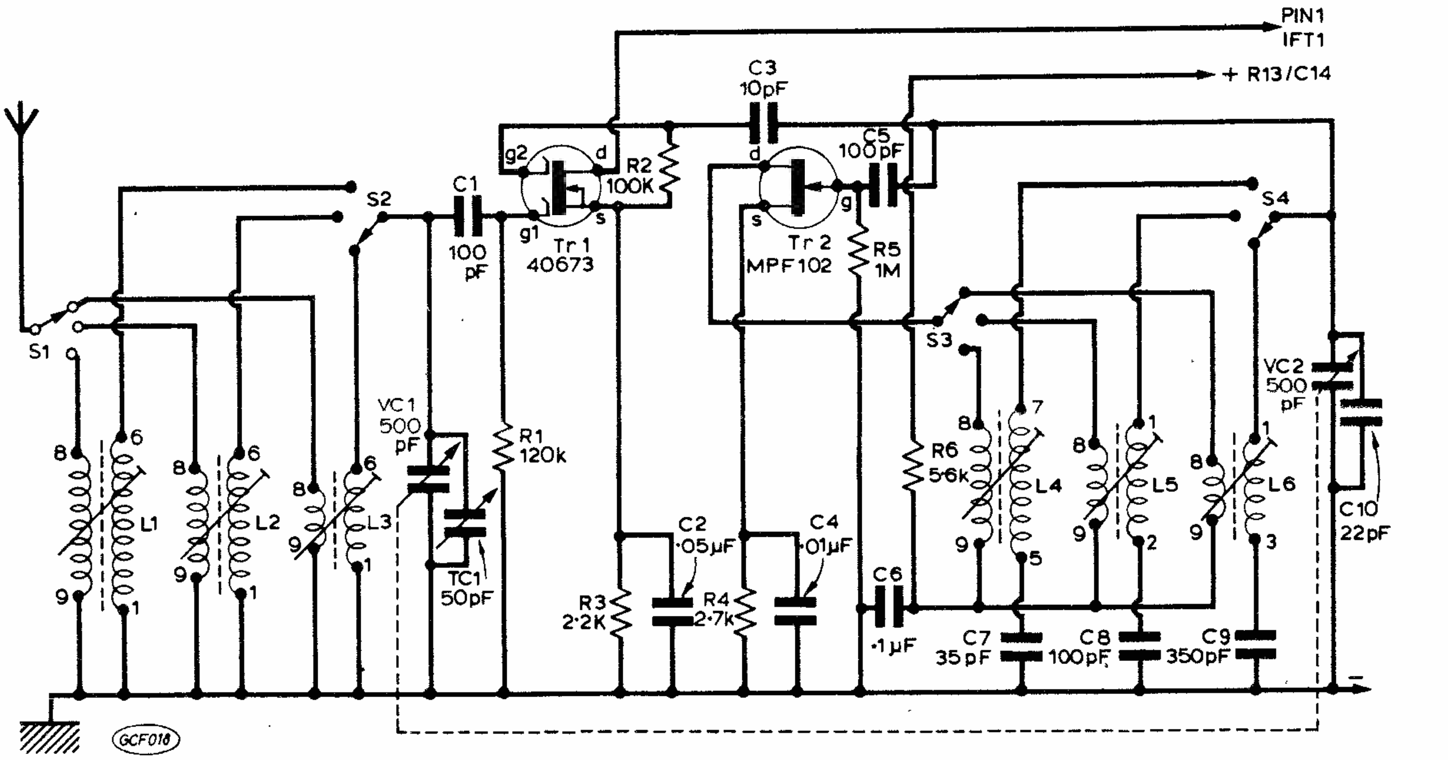


Fig. 1: Circuit of the mixer and oscillator stages of the Marine receiver. For simplicity the remaining stages are shown as separate diagrams. Band switches S1 to S4 are ganged.

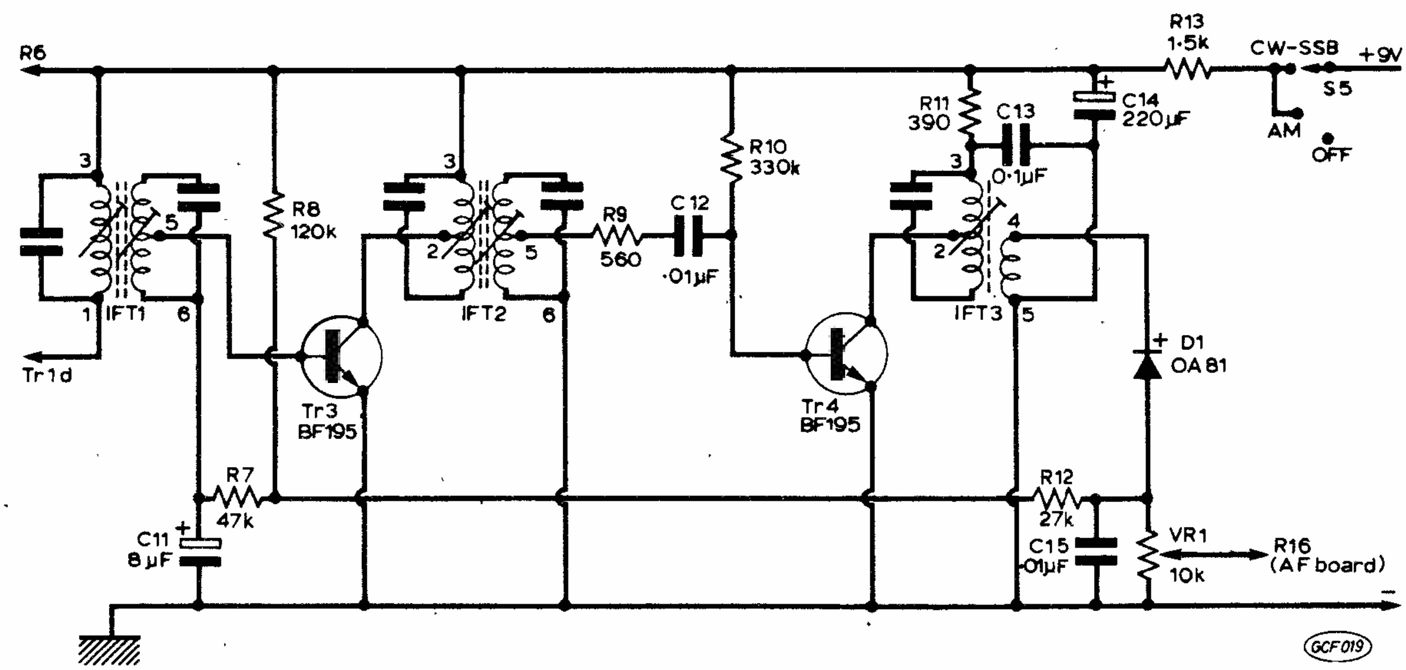


Fig. 2: The IF amplifier, circuit shown here, is built on a common circuit board with the mixer/oscillator.

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 120kΩ
R2 100kΩ
R3 2·2kΩ
R4 2·7kΩ
R5 1MΩ
R6 5·6kΩ
R7 47kΩ
R8 120kΩ
R9 560Ω
R10 330kΩ
R11 390Ω
R12 27kΩ
R13 1·5kΩ
VR1 10kΩ log potentiometer

Capacitors
C1 100pF
C2 0·05μF
C3 10pF
C4 0·01μF
C5 100pF Silver Mica
C6 0·1μF
C7 35pF 1% Silver Mica
C8 100pF 1% Silver Mica
C9 350pF 1% Silver Mica
C10 22pF SM
C11 8μF 6·4V electrolytic
C12 0·01μF
C13 0·1μF
C14 220μF 10V eletrolytic
C15 0·01μF
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 270kΩ
R15 5·6kΩ

Capacitors
C16 180pF
C17 330pF Silver Mica
C18 5000pF
C19 220μF 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) 2¾ x 2¾in., Switch (S5-S6) 2-pole 3-way rotary.

AUDIO BOARD
Resistors
R16 1kΩ
R17 2·2MΩ
R18 10kΩ
R19 2·2kΩ
R20 12kΩ
R21 47kΩ
R22 680Ω
R23 10kΩ
R24 10kΩ
R25 4·7Ω
All resistors 5% ¼W
VR2 250Ω miniature pre-set potentiometer

Capacitors
C20 0·5μF
C21 100μF 10V electrolytic
C22 8μF 6·4V electrolytic
C23 100μF 10V electrolytic
C24 100μF 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

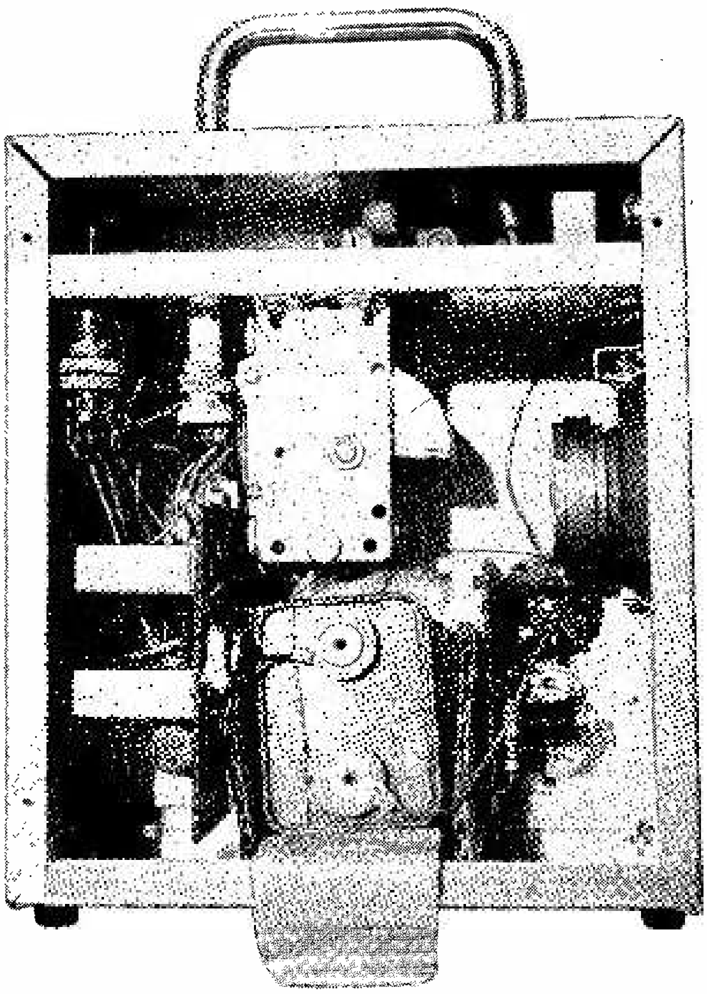
These stages are assembled on plain Veroboard, approximately 3½ x 4in in size, and perforated with holes on a 0·15in matrix. It would be possible to use plain unperforated 1/16in thick paxolin sheet, drilling this in advance for resistors and other items.

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 ⅜in 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.

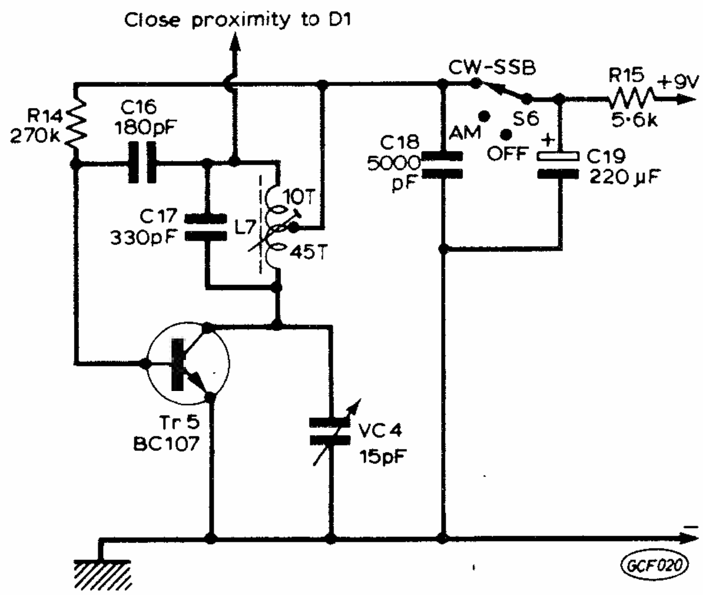
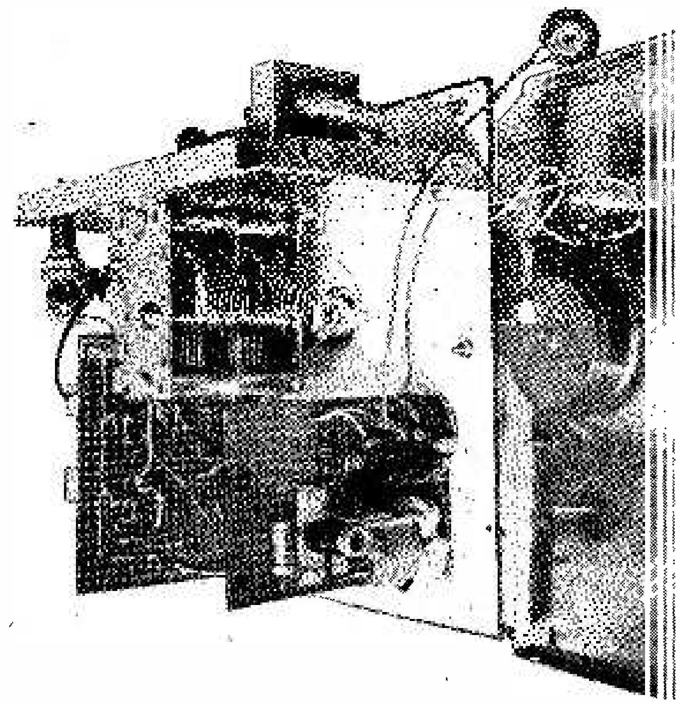


Fig. 3: Circuit of the BFO unit. Below, view of the receiver with casework removed.



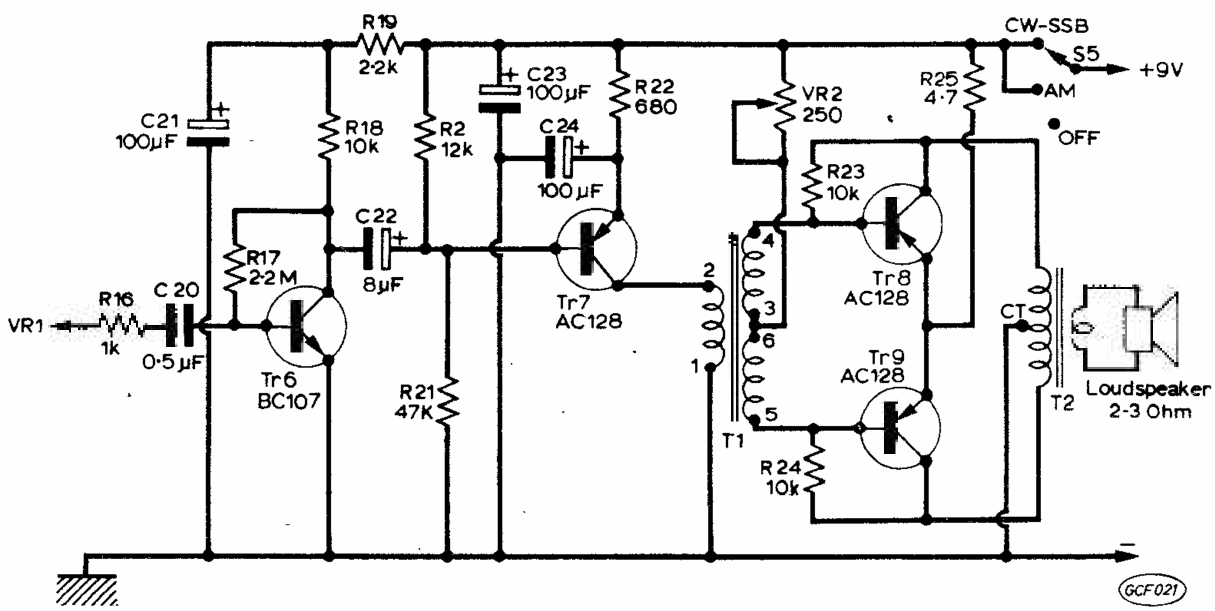
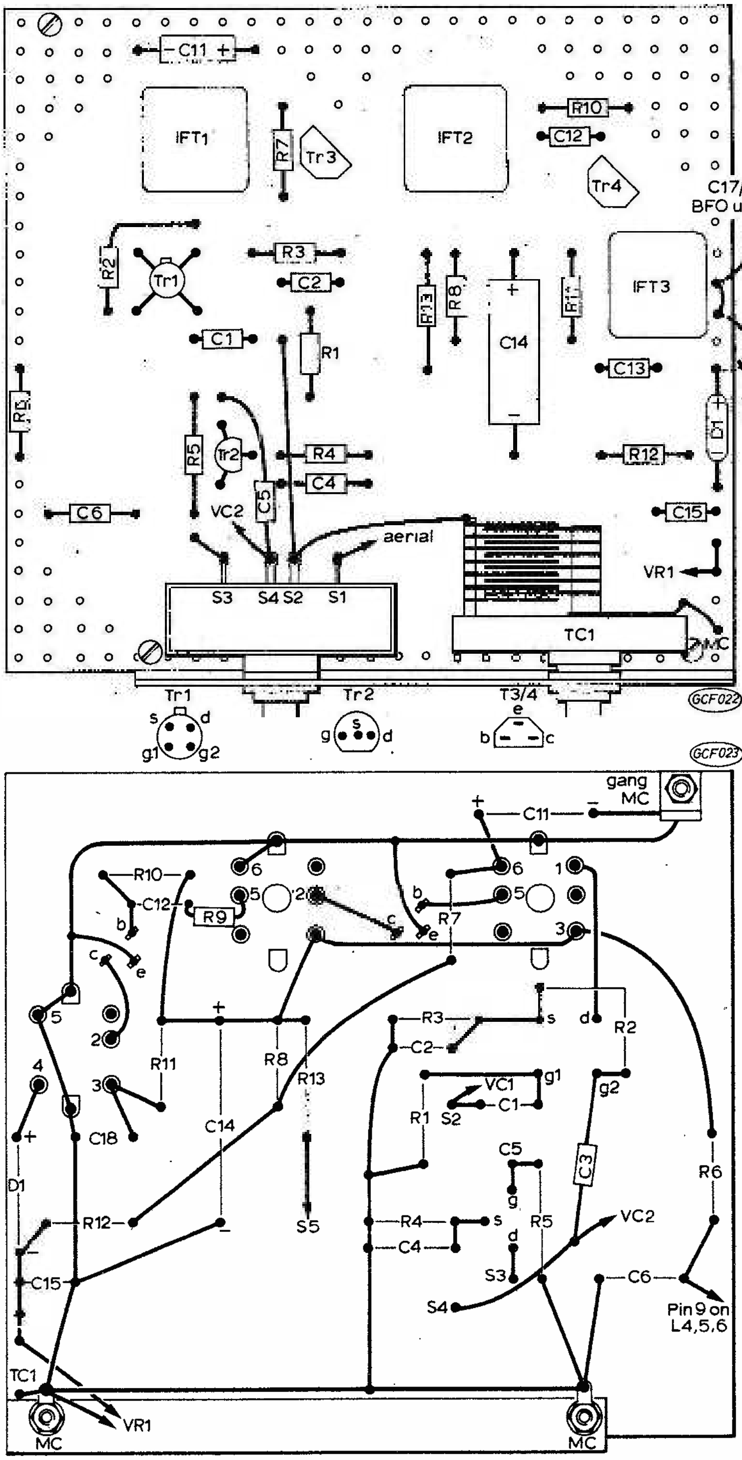


Fig. 4: The final circuit is of the audio amplifier. The speaker is fitted over a suitable aperture in the side of the case.

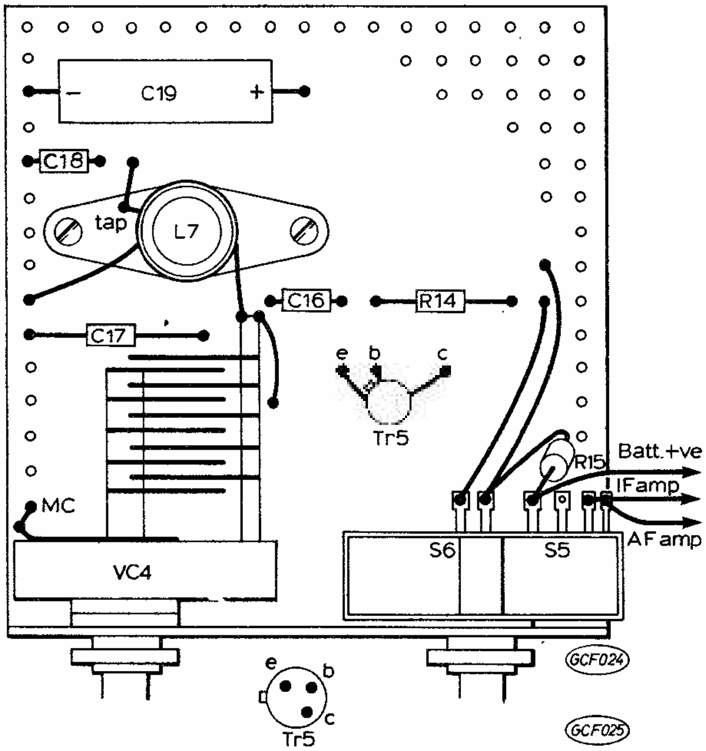


Figs. 5 and 6: Component layout and wiring of the combined mixer/oscillator and IF amplifier board.

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.



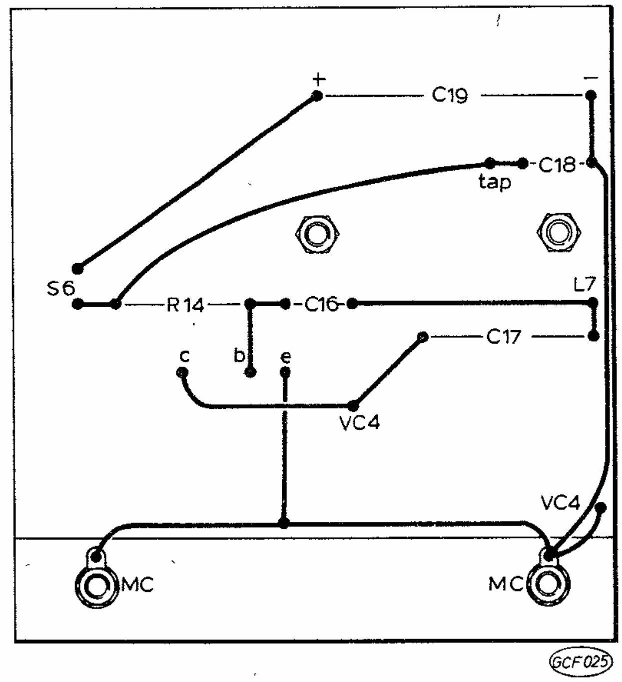


Fig. 7: above and Fig. 8, right, show both sides of the circuit board for the BFO unit.

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.

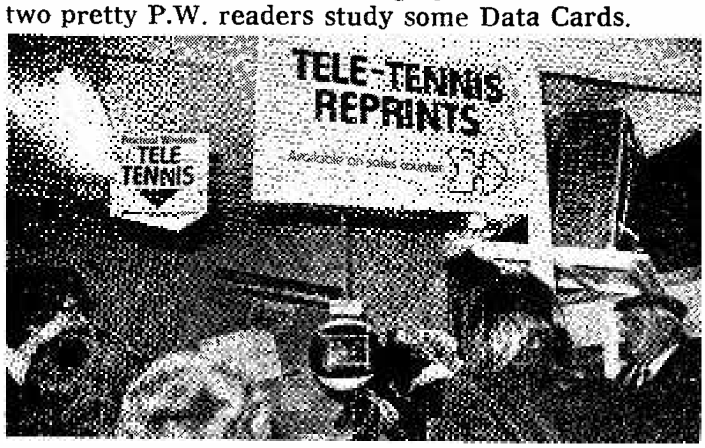
PART 2 NEXT MONTH ON ALIGNMENT AND TESTING

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.



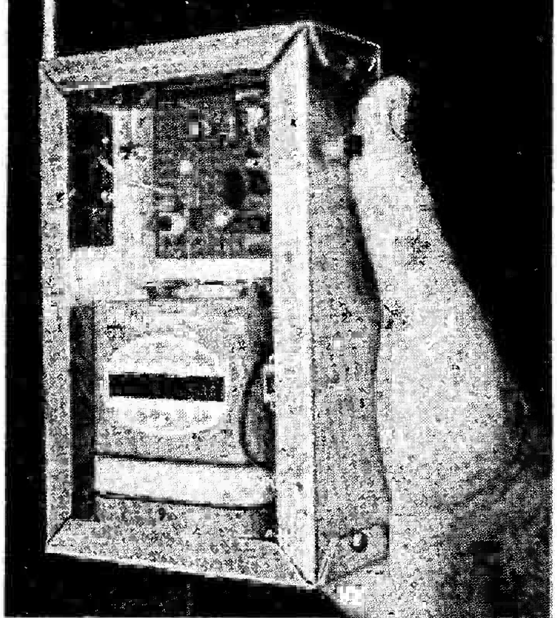
complete your HI-FI system... with our

PW 'ASCOT' STEREO CASSETTE DECK

IN NEXT MONTH'S PRACTICAL WIRELESS

A stereo cassette deck designed especially for the home constructor, using the Goldring-Lenco CRV front-loading tape transport mechanism. Features include dynamic noise reduction circuitry, inputs for microphones and radio, and a pre-monitor facility which allows the sound levels to be set before recording commences. Separate record and replay amplifiers and electronic switching greatly reduce mechanical complexity.

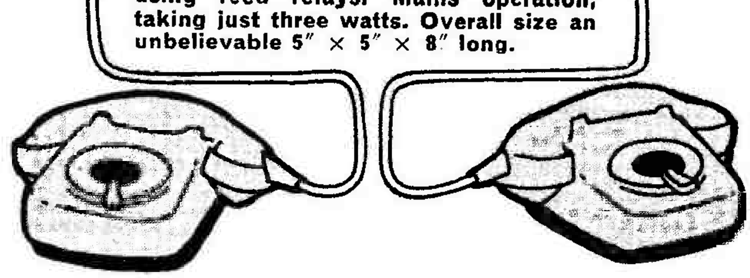
RADIO CONTROL SERIES—PART 2 The TRANSMITTER



ON SALE IN JANUARY

HOME TELEPHONE EXCHANGE

Completely silent . . . except for the bell! A single PCB provides facilities for up to nine subscribers. Solid state switching using reed relays. Mains operation, taking just three watts. Overall size an unbelievable 5″ × 5″ × 8″ long.



SC7

PRODUCTION LINES

colin riches

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 questionaire 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.

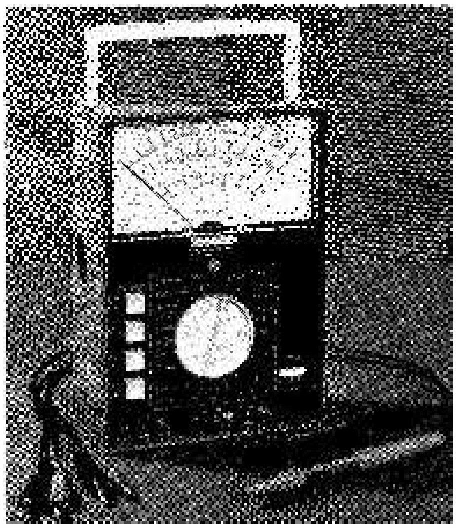
With the 670, it is simply a question of connecting the two probes across the current carrying conductor then reading off the value of the current.

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 multimeter 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.

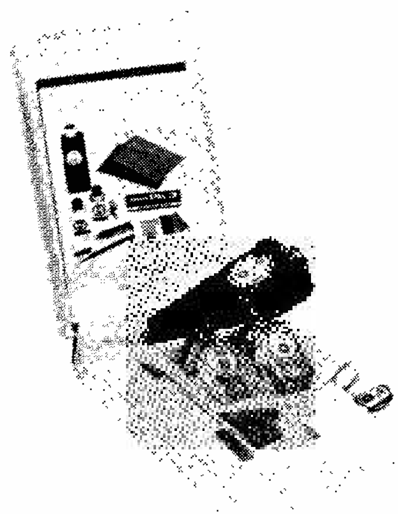
The Power Plus line comprises six alkaline manganese and five mercury types.

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

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.

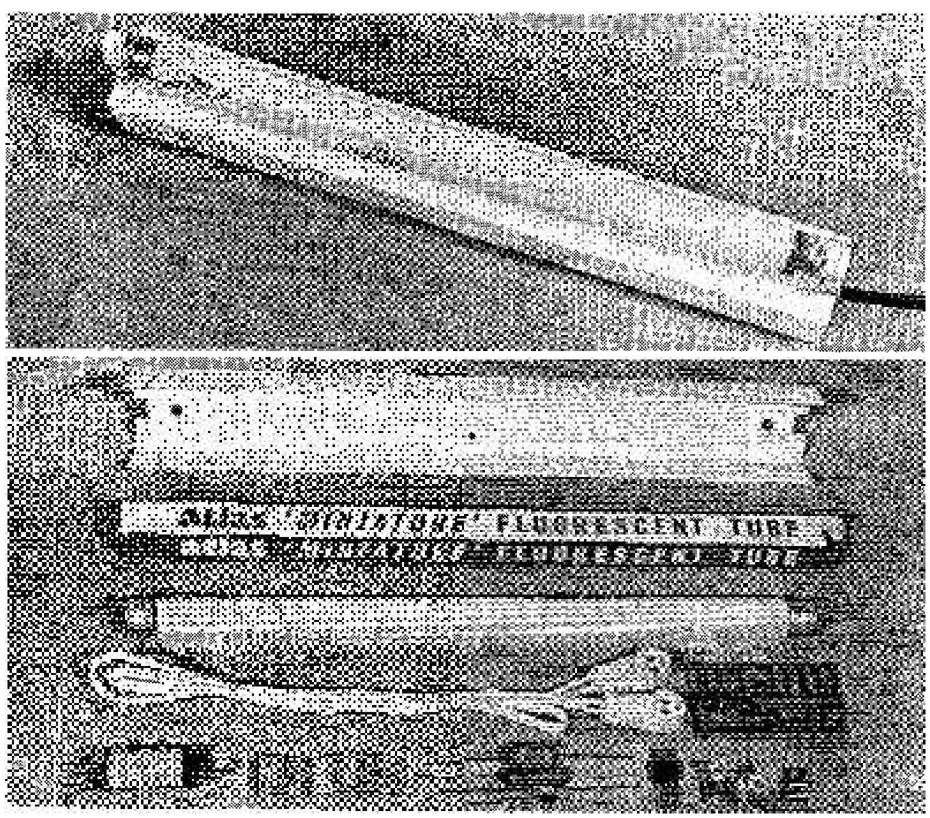
The unit, which only takes about half-an-hour to build up, draws about 0·6A from the battery.

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.*

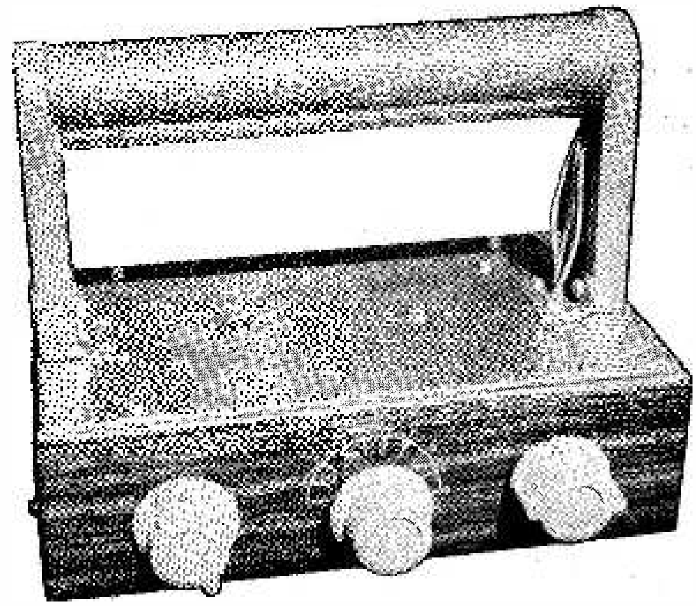


The built unit and a kit of parts.

CHARLES HEATH

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

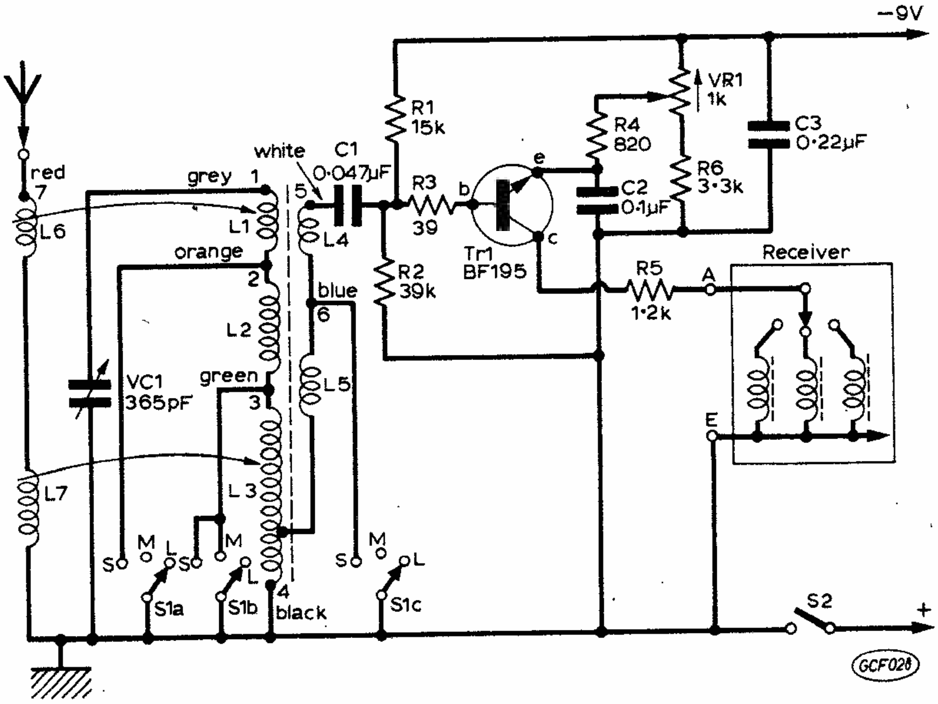
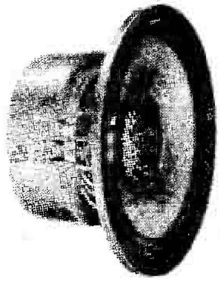


Fig. 1: Circuit of the Active Aerial. It is essential that there is a DC path between the aerial and earth terminals on the receiver being fed by the Active Aerial.



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Coral 6½"d/cone roll surr. 8 ohm	£2·50
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EMI 13 x 8 150 d/c 3, 8 or 15 ohm	£2·50
EMI 13 x 8 450 t/tw 3, 8 or 15 ohm	£3·75
EMI 13 x 8 type 350 8 or 15 ohm	£8·25
EMI 13 x 8 20 watt base	£6·60
EMI 6½" 93850 4 or 8 ohm	£3·00
EMI 5" 98132CP 8 ohm	£2·50
EMI 8 x 5 d/cone, roll surr 10 watt	£2·50
EMI 2½" tweeter 97492AT	·65
Eagle DT33 30 watt tweeter	£5·45
Eagle HT15 horn tweeter	£3·80
Eagle CT5 cone tweeter	£1·75
Eagle CT10 tweeter 8 or 16 ohm	£2·55
Eagle MHT10 horn tweeter	£3·80
Eagle crossover CN23, CN28, CN216	£1·50
Eagle FR4	£5·30
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Elac 9 x 5, 59RM109 15 ohm, 59RM114 8 ohm	£2·80
Elac 6½" 6RM171 d/c roll surr.	£3·50
Elac 6½" 6RM220 d/cone	£2·65
Elac 4" tweeter TW4	£1·21
Elac 10" d/cone 10RM239 8 ohm	£2·65
Elac 8" 8CS175 3 ohm	£2·50
Fane Pop 15 watt 12"	£4·80
Fane Pop 25/2 25 watt 12"	£6·95
Fane Pop 40 watt 10"	£8·50
Fane Pop 50 watt 12"	£11·00
Fane Pop 55 12" 60 watt	£12·50
Fane Pop 60 watt 15"	£13·00
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Fane Crescendo 12A 100 watt 12"	£29·00
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Fane Crescendo 15" 100 watt	£36·00
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Fane 801T 8" d/c roll surr.	£7·00
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Goodmans 12P-G 8 or 15 ohm	£15·75
Goodmans Audiomax 12AX 100 watt	£37·50
Goodmans Audiomax 15AX	£40·00
Goodmans 15P 8 or 15 ohm	£21·00
Goodmans 18P 8 or 15 ohm	£36·00
Goodmans Midax 750	£16·00
Goodmans Axent 100 tweeter	£7·25
Goodmans Audiom 100 12"	£12·00
Goodmans Axiom 401 12"	£17·25
Goodmans Twinaxiom 8	£8·25
Goodmans Twinaxiom 10	£9·00
Kef T27	£5·25
Kef T15	£6·00
Kef B110	£7·25
Kef B200	£8·25
Kef B139	£14·25
Kef DN8	£2·00
Kef DN12	£4·95
Kef DN13	£3·30
STC4001G super tweeter	£6·19
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2½" 64 ohm, 70mm 80 ohm, 70mm 8 ohm	·65
2½" 75 ohm	·50
7" x 4" 3 or 8 ohm	£1·40
8" x 5" 3 or 8 ohm	£1·50
10" x 6" 3, 8 or 15 ohm	£2·30

SPEAKER KITS

Baker Major Module	each £10·75
Fane Mode One	each £9·90
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Helme XLK 25	pair £22·00
Helme XLK 30	pair £14·95
Helme XLK 50	pair £39·95
Keffit 2	each £24·75
Keffit 3	each £36·75
Richard Allan Twinkit	each £8·95
Richard Allan Triple 8	each £13·75
Richard Allan Triple	each £19·95
Richard Allan Super Triple	each £23·75
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Wharfedale Glendale 3 kit	pair £34·50
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Eagle PA range in stock—ask for catalogue.

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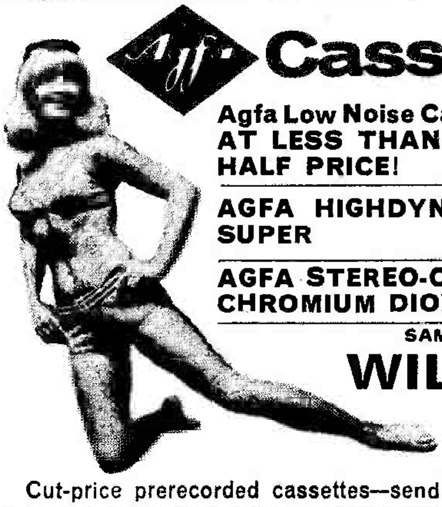
ALL PRICES QUOTED INCLUDE VAT.

WILMSLOW AUDIO (Dept. PW)

Loudspeakers: Swan Works, Bank Square, Wilmslow, Cheshire. SK9 1HF
Discount Radio, PA, Hi-Fi: 10 Swan St. Wilmslow

Send stamp for free booklet "Choosing a Speaker"



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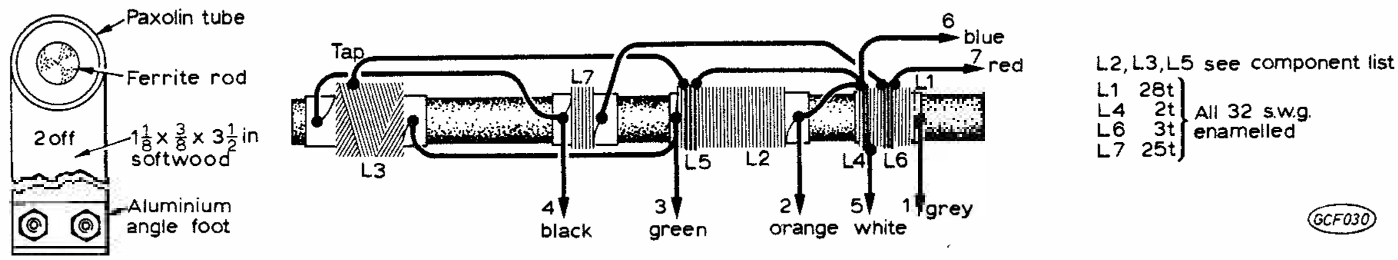
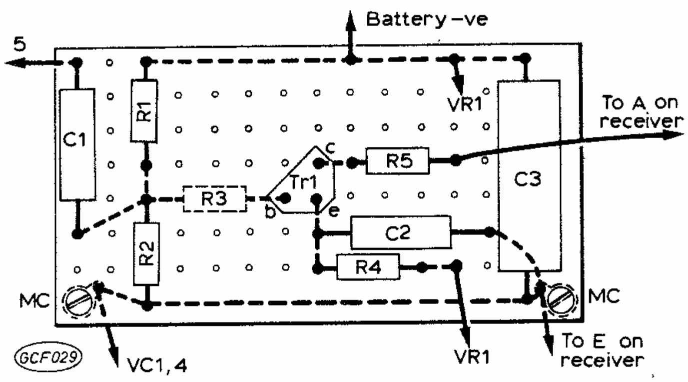


Fig. 3: above, gives details of the additional windings required on the ferrite rod aerial.
Fig. 2: below, shows the component layout of the small circuit board.



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 $\frac{3}{8}$in space between board and metal chassis.

FERRITE AERIAL

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

Two supports are made, each of $\frac{3}{8}$in wood, about $1\frac{1}{8}$in wide and $3\frac{1}{2}$in high overall. First drill a $\frac{3}{8}$in diameter hole to a depth of about $\frac{1}{8}$in. 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.

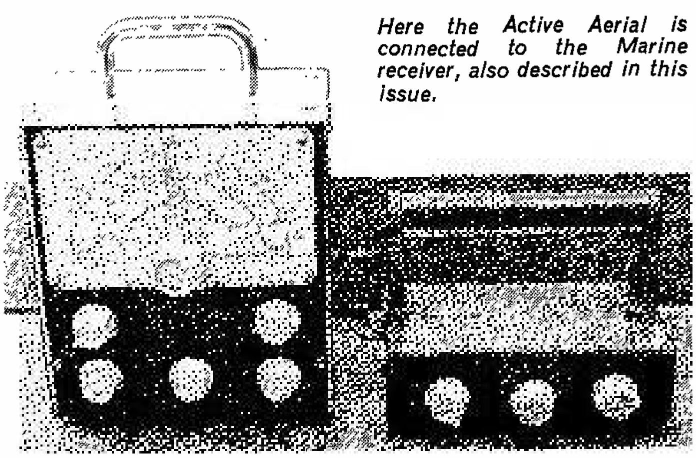
A tag strip which will provide seven connecting points for the leads (including MC) is bolted under the chassis, as in Fig. 4. These can also be identified by using thin coloured sleeving, as shown.

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



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

★ components list

Resistors All resistors ¼W ± 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.

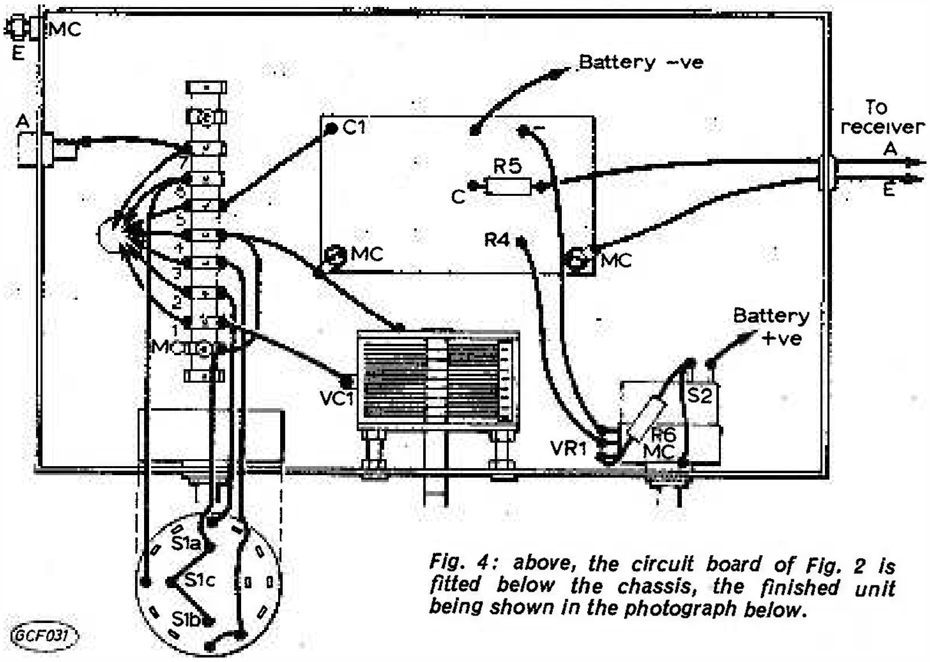
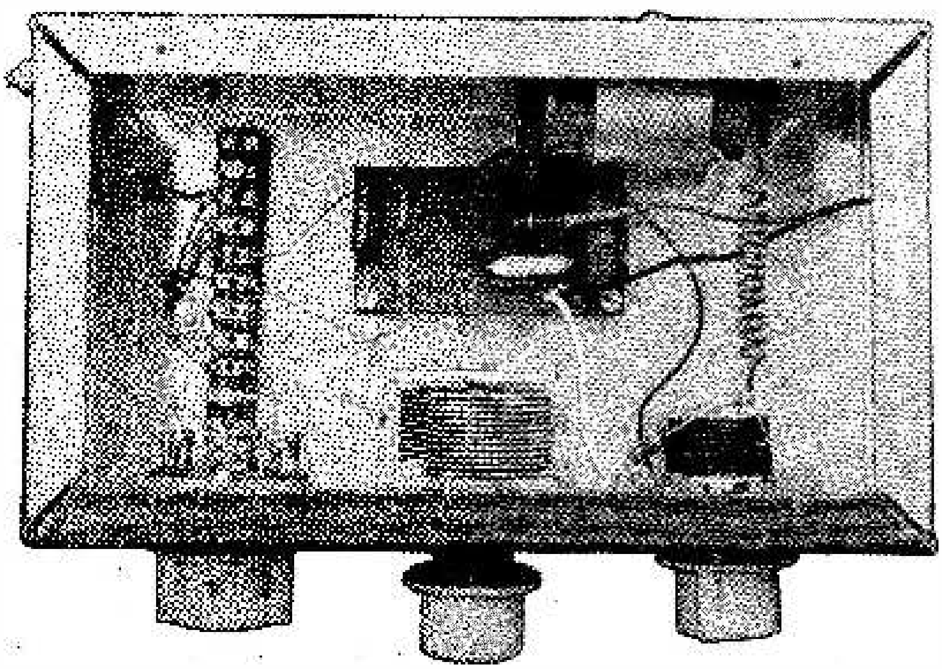


Fig. 4: above, the circuit board of Fig. 2 is fitted below the chassis, the finished unit being shown in the photograph below.



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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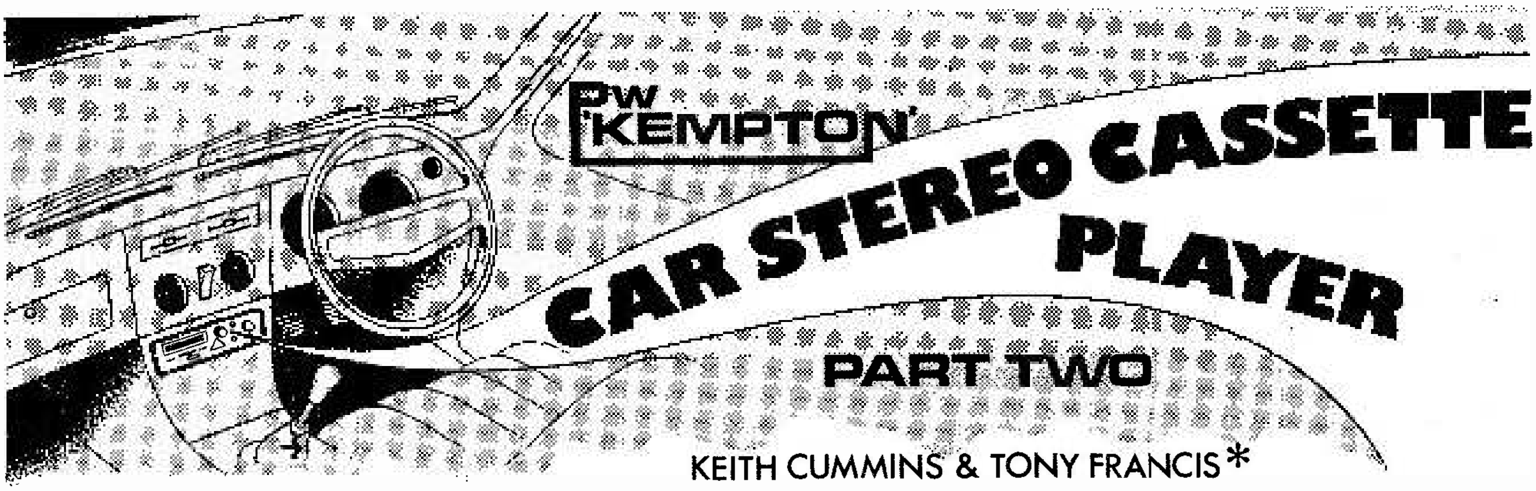


MOTOR CONTROL

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.*

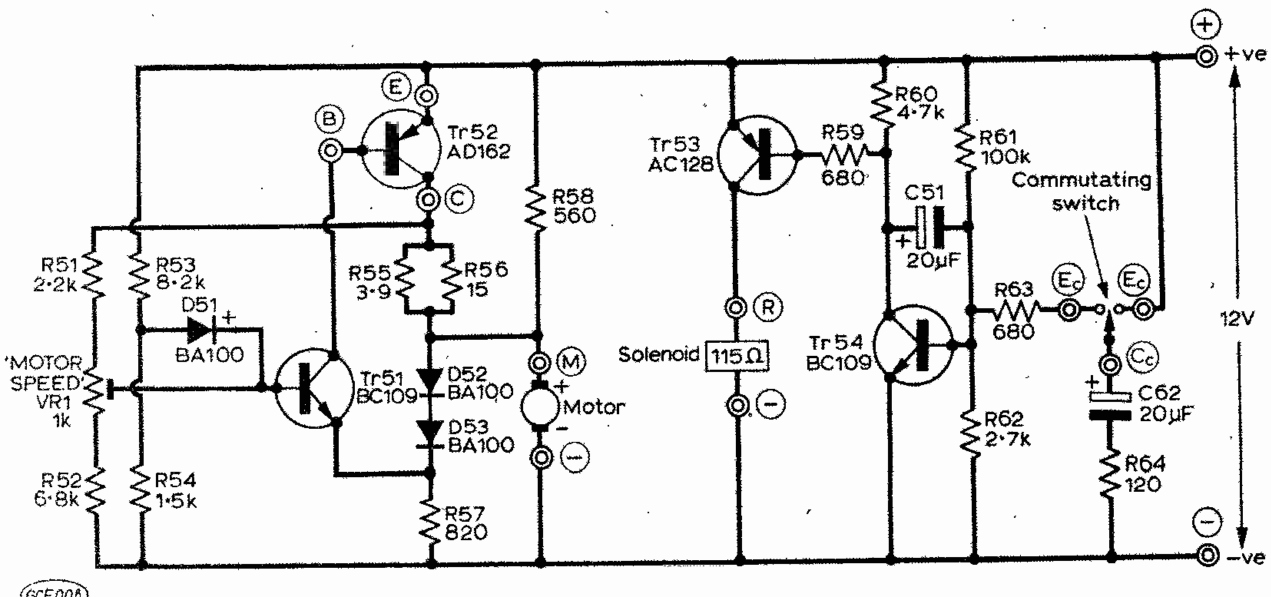
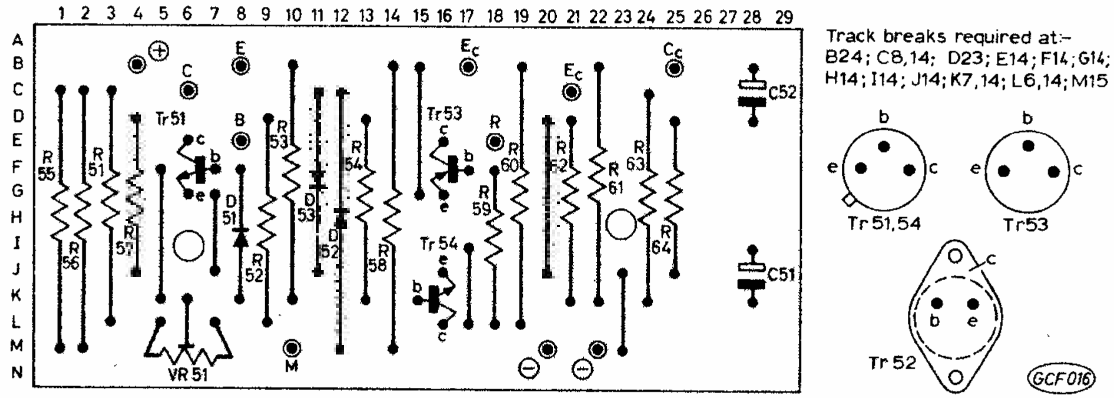


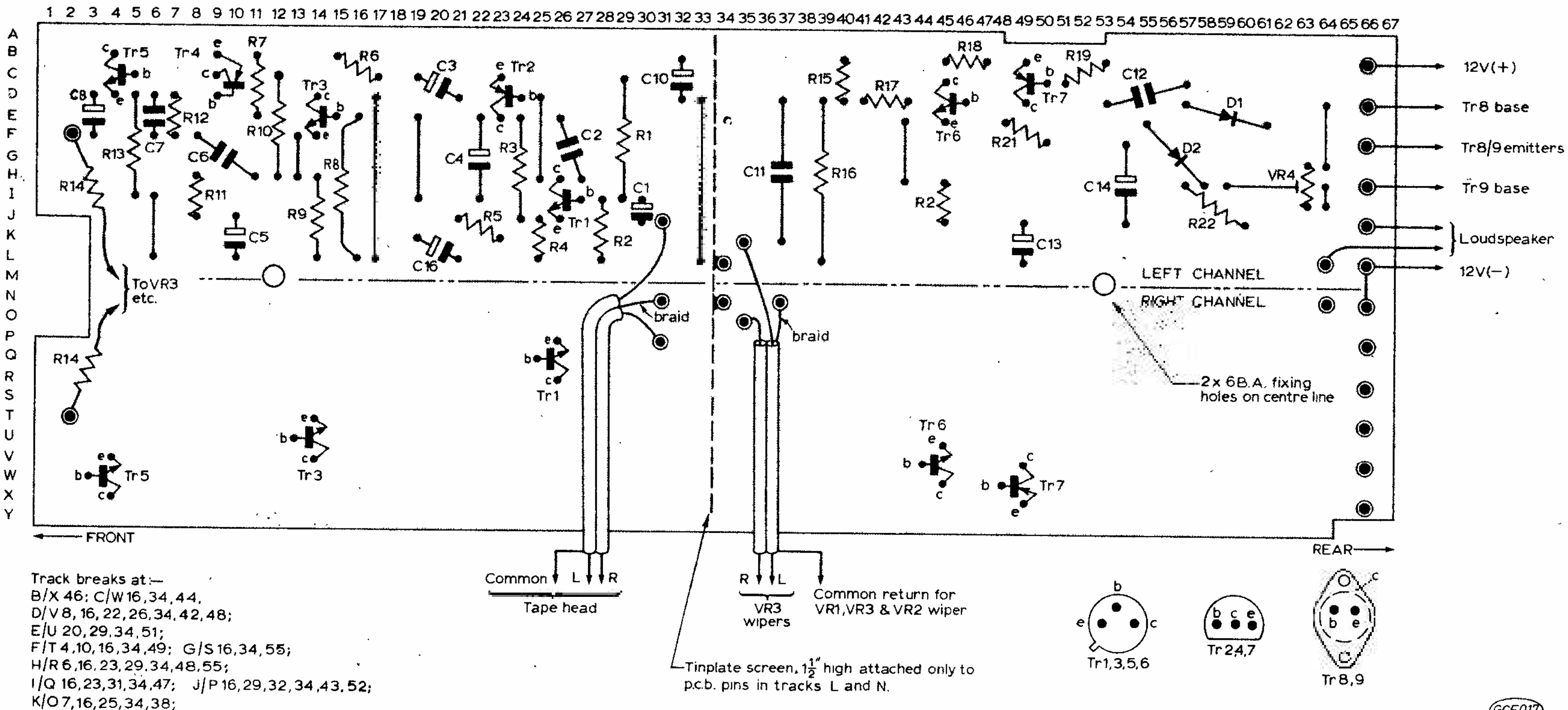
Fig. 2: Circuit of the motor control board. The motor, solenoid and commutating switch are part of the cassette mechanism.
NOTES:
1. The Motor Speed control should be labelled VR51.
2. Capacitor C62 should be labelled C52.

Fig. 3: Layout for the motor control board, using 0·1 in pitch Veroboard 3 x 1·4 in.

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.





—continued on page 821

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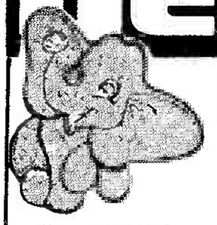

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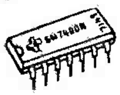

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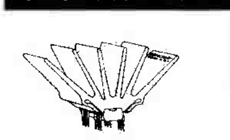

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BCY71	0·22	OC83	0·27	2N3886	0·72
BCY72	0·12	OC140	1·14	2N3903	0·15
BD124	0·65	OC170	0·30	2N4002	0·14
BD131	0·42	OC200	0·54	2N4126	0·15
BF115	0·20	OC202	0·90	2N4871	0·34
BF180	0·36	OCP71	1·20	2N5457	0·30
BF194	0·10	ORP12	0·60	2S303	0·60
BFX13	0·26	ORP60	0·55	40550	0·54
BFX34	0·70	P346A	0·18	40361	0·45
BFX88	0·24	TIL209	0·20	40362	0·40
BFX50	0·21	TIP29A	0·49	40408	0·50
BFX51	0·20	TIP30A	0·57	40486	0·85
BFX64	0·36	TIP31A	0·61	40636	1·00
BFX90	0·31	TIP41A	0·74	40430	0·85

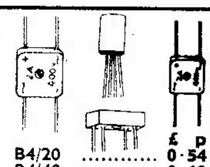
SILICON CONTROLLED RECTIFIERS

	£ p
TO5 1 Amp	
CRS1/05AF	0·42
CRS1/10AF	0·48
CRS1/20AF	0·52
CRS1/40AF	0·60
CRS1/60AF	0·78
TO48 3 Amp	
CRS3/025AF	0·36
CRS3/10AF	0·48
CRS3/20AF	0·54
CRS3/40AF	0·65
CRS3/60AF	0·80
TO48 7 Amp	
CRS7/400	0·84
CRS7/600	1·14
TO48 18 Amp	
CRS16/100	0·78
CRS16/200	0·85
CRS16/400	0·96

TRIACS

	£ p
3 Amp	
SC35A	0·85
SC35B	0·91
SC35D	0·99
SC35E	1·30
6 Amp	
SC40A	0·88
SC40B	0·97
SC40D	1·20
SC40E	1·50
10 Amp	
SC45A	1·09
SC45B	1·12
SC45D	1·50
SC45E	1·65
15 Amp	
SC50A	1·46
SC50B	1·57
SC50D	1·80
SC50E	2·00
Also	
40430	0·85
40669	0·90
40486	0·85

BRIDGE SILICON RECTIFIERS



	£ p
¼ Amp	
B025/025	0·14
B025/05	0·16
1 Amp	
B1/05	0·20
B1/10	0·21
B1/20	0·24
B1/60	0·25
B1/100	0·30
2 Amp	
B2/05	0·30
B2/10	0·35
B2/20	0·40
B2/40	0·44
B2/60	0·45
B2/100	0·55
4 Amp	
B4/05	0·45
B4/10	0·48

	£ p
B4/20	0·54
B4/40	0·60
B4/60	0·70
B4/80	0·90
6 Amp	
B6/05	0·50
B6/10	0·58
B6/20	0·68
B6/40	0·75
B6/60	0·87
1 Amp Tubular	
W005	0·27
W01	0·29
W02	0·30
W06	0·33

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U4324, 20k/V with case	£9·25
U435, 20k/V with steel case	£8·75
U4313, 20k/V with steel case	£12·50
U4317, 20k/V with case	£16·50
U4341, 33k/V + transistor tester steel case	£10·50
U4323, 20k/V plus 1KHZ OSC with case	£7·70
ITI-2, 20k/V slim type	£5·95
THL33D (L33DX) 2k/V Robust	£7·50
TP53N, 20k/V (Case £2·00)	£8·25
TP10S 2K/V	£6·25
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TW50K 50K/V	£11·25
EP10KN 10K/V	£9·95
AF105 50k/V Deluxe (case £1·90)	£12·50
S100TR 100k/V Plus trans. tester	£22·50

GENERAL TEST EQUIPMENT

(† carr/pack 50p. *c/p 30p unless stated)

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680R Multi-tester **£18·50**

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Electronic volt.	£18·00
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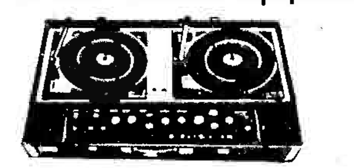
Gauss meter	£11·95
Signal injector	£5·95
Phase Sequence	£5·95
EHT Probe	£5·95
Shunts 25/50/10A	£4·50
†3100 IMA Stripchart recorder	£44·00
†TE40 AC Multi voltmeter	£19·75
†TE15 Grid dip meter 440KHZ-28MHZ	£19·95
†TE65 28 Range valve voltmeter	£22·50
†Tk20D RF Generator 120-KHZ 500MHz	£18·95
†Tk22D AF Gen 20HZ-200KHZ	£19·95
*HM350 In circuit transistor tester	£19·50
*C3025 Deluxe meter 1–300 MHZ	£6·95
*TT145 Compact transistor tester	£14·75
†G3-36 R/C osc. 20HZ-200KHZ	£19·75
*C3042 SWR Meter	£5·75
*SE350A Deluxe signal tracer	£12·95
*SE400 Mini-lab all in one tester	£15·50
C1-5 Scope 500,000KHZ (carr.£1)	£43·00
*C30435 CH F/A meter 1-300MHZ	£5·75
Resistance sub box } Post, etc. 20p	£2·40
Capacitor } Post, etc. 20p	£2·10
2 amp var. transformers (carr. £1)	£6·55
Radio activity counter 0–10 (carr. £1)	£9·97

Mains unit for above (carr. 50p) **£3·75**

PA-DISCO-LIGHTING Equipment



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'KEMPTON' —*continued from page* 818.

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 tinplate, 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.

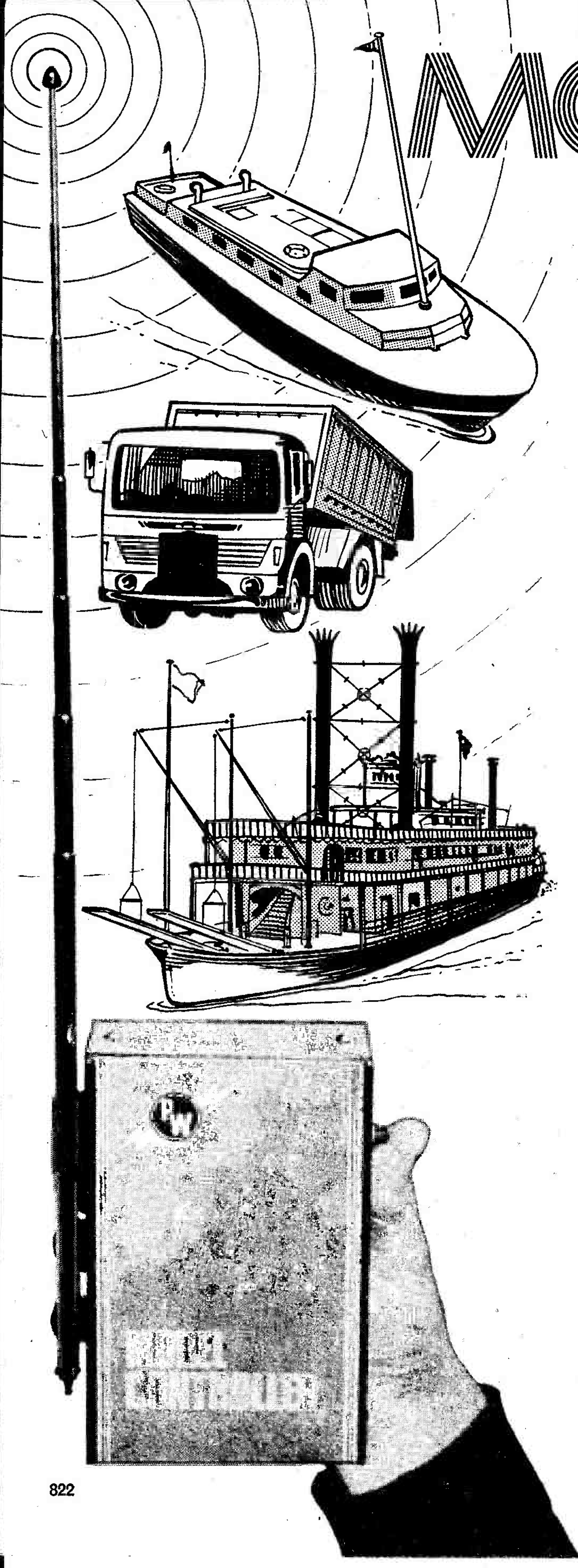
The "DX" station and talk-in station were operating under the call GB3ARE.

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 Electroneers; 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 from 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

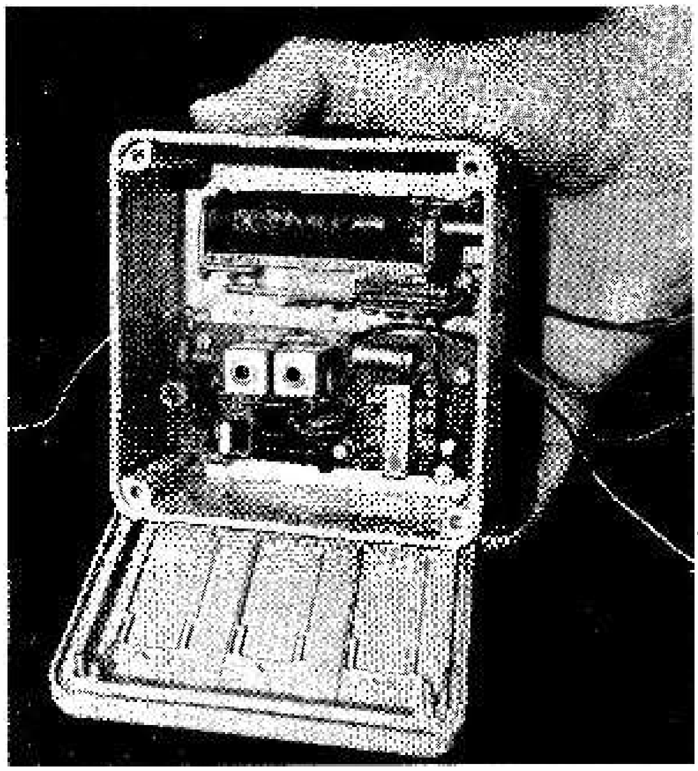
TAKE NOTE!

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.

NTROL BY RADIO

ECEIVER

F. G. RAYER G3OGR



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

is 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.

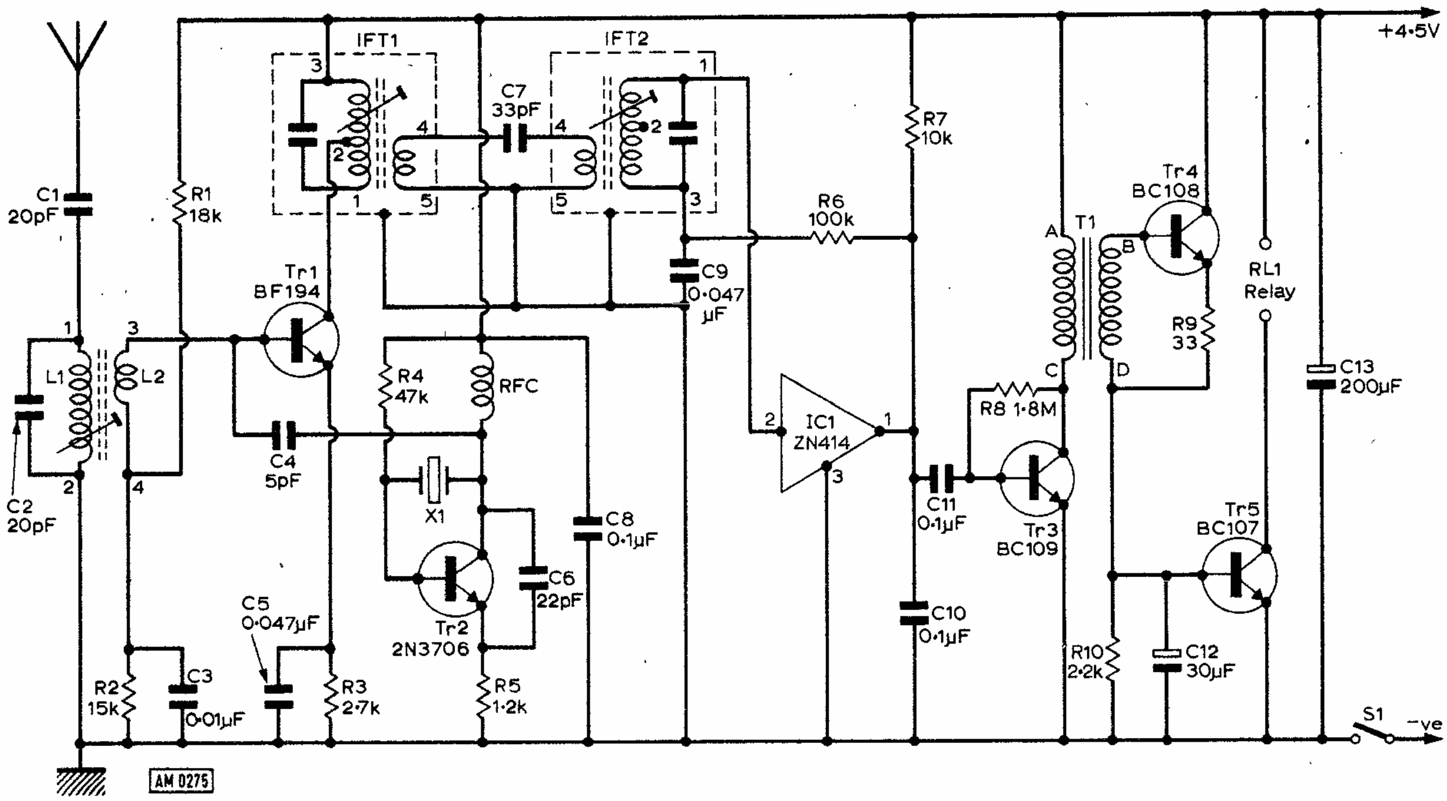
CRYSTAL FREQUENCY

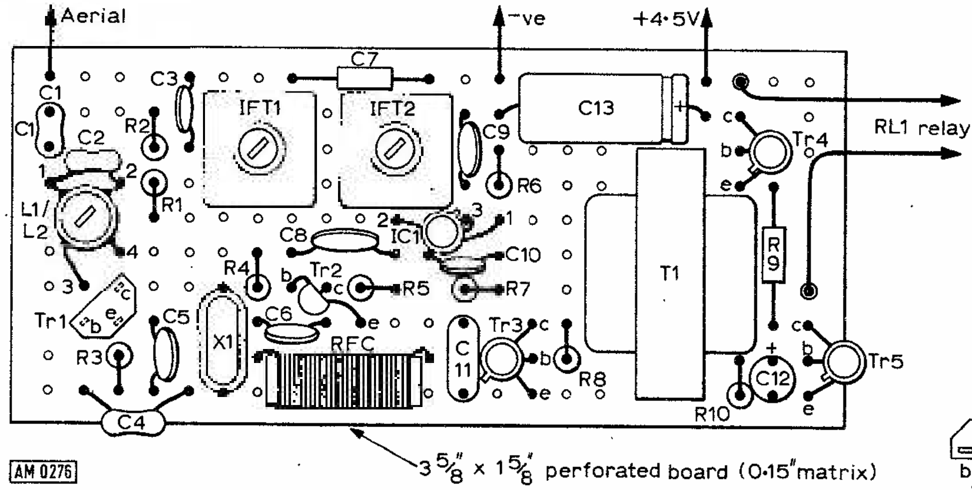
With a 27·005MHz crystal in the transmitter the receiver crystal is 27·460kHz, giving a difference, or IF, of 455kHz. There is no need to use these specific frequencies which are quoted as an example. Model control crystals are available for various channels, some being colour coded. If the equipment 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.

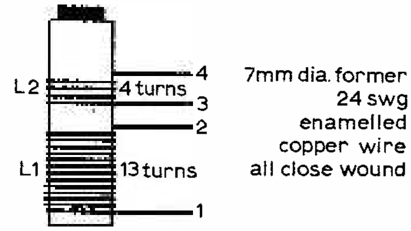
CIRCUIT BOARD

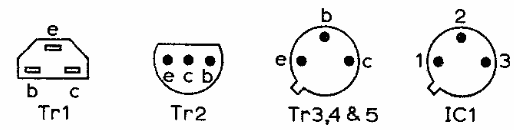
This board measures about $3\frac{5}{8}$ x $1\frac{5}{8}$in. without the relay but may be extended to permit a small relay to be mounted on it near Tr5, but the relay can just

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









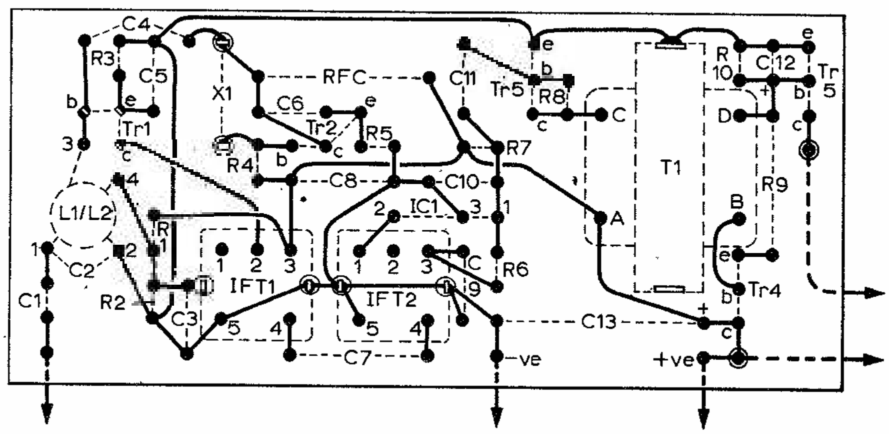


Fig. 2: Layout of components on the Veroboard, top, with wiring shown below. Coil L1/2 is cemented into a hole in the board. Veropins are used as anchoring points.

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 $\frac{1}{4}$in diameter former about $\frac{3}{4}$in 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

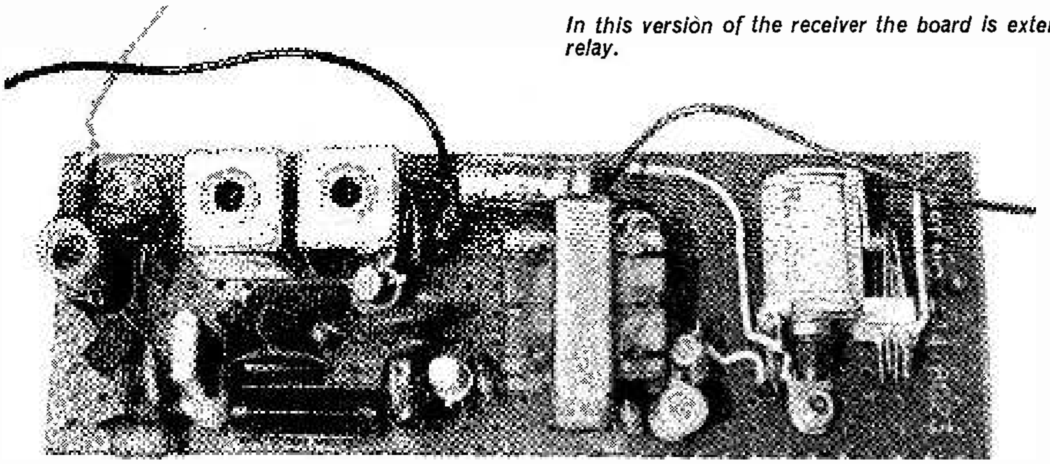
The receiver is adjusted by setting the cores of L1, IFT1 and IFT2 and is best done with the aid of a multi-range meter. Set the meter to 100mA range and clip it to the relay pins, with a resistor of about 100 ohms or so in series with one lead (the resistor is essential). Meter positive is taken to 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 2kΩ 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	18kΩ	R6	100kΩ
R2	15kΩ	R7	10kΩ
R3	2·7kΩ	R8	1·8MΩ
R4	47kΩ	R9	33Ω
R5	1·2kΩ	R10	2·2kΩ

All ⅓ or ¼W 5%

Capacitors

C1	20pF SM	C8	0·1μF
C2	20pF SM	C9	0·047μF
C3	0·01μF	C10	0·1μF
C4	5pF SM	C11	0·1μF
C5	0·047μF	C12	30μF 6V
C6	22pF SM	C13	200μF 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 (Henrys) and crystal holders. Transformer T1 (Home Radio TR64). S1, slide switch, on–off. Waterproof box to suit. Plain Veroboard 3⅝ x 1⅝in. 0·15in matrix. Former 7mm dia. and core.

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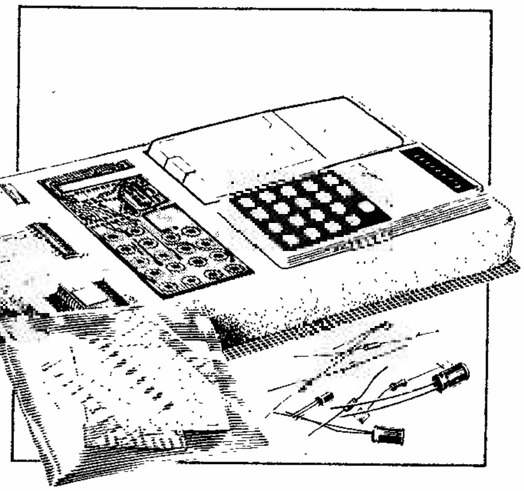
Components for Scientific Kit (illustrated)

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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● **Scientific notation** Display shows 5-digit mantissa, 2-digit exponent, both signable.

● **200-decade range** 10^{-99} to 10^{+99}.

● **Reverse Polish logic** Post-fixed operators allow chain calculations of unlimited length – eliminate need for an = button.

● **25-hour battery life** 4 AAA manganese alkaline batteries (e.g. MN2400) give 25 hours continuous use. Complete independence from external power.

● **Genuinely pocketable** 4 1/3" x 2" x 11/16". Weight 4 oz. Attractively styled in grey, blue and white.

ON THE AIR

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 PMIIA preselector. **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

ON THE AIR

TU2DO.

Peter Roughly:—20m ALL RTTY DA1LS DJ0CP DL2BR EA3OT EA8FF F5WG F9IB G3AWA G8FC HA5KDQ HZ1SH I1PXC I3BA IC8SMY SM0ASW TF3IRA VE7BDQ VK3KF W3KV 3A2GX.

Bernard Hughes:—20m KL7HRP VK5YH ZL1PZ ZD3R 3D2AZ (Fiji) **15m** A35AF JG1MVA JR1YFD JE1MLK.

Paul Barker:—20m DU1NRS 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 Bournmouth 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, Venezuala 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

ON THE AIR

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 Pyongyang 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, Ashtead, 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 2·7kΩ, though it may be necessary to change VR2 to 25kΩ 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 0·1μF and insert a 100kΩ 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 22μF tantalum bead type.
4. If stronger a.f.c. action is required, R217 may be increased in value up to a maximum of 47kΩ.
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 10Ω should be inserted in the line to these pins to restore it to that level. PW

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.

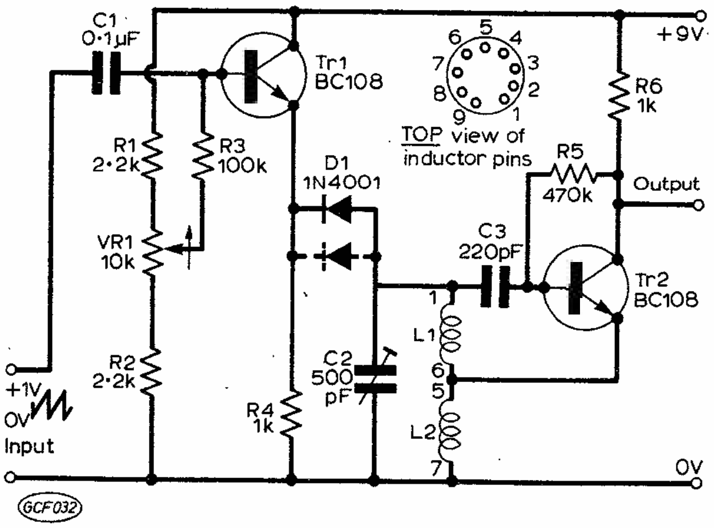


Fig. 1: Circuit for the Basic Wobbulator.

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 capacitative 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.

"Wobbulating"

To obtain "Wobbulator" 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 varacter 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.

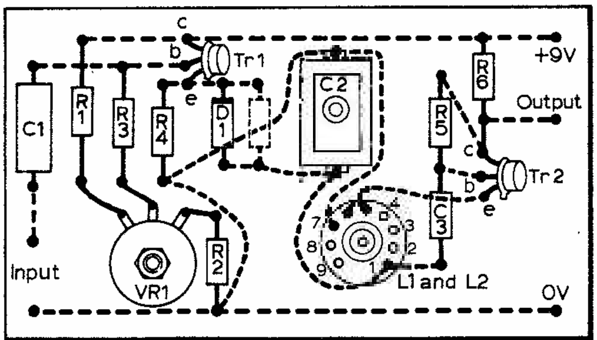
★ components list

R1	2·2kΩ	$\frac{1}{4}$W ± 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.



CKG033

Fig. 2: Layout of Wobbulator 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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AC142	22p
AC142k	29p
AC151	23p
AC152	23p
AC153k	39p
AC153k }	M/P
AC176k }	82p
AC176k	42p
AC176	24p
AC187	22p
AC187k	28p
AC188	22p
AC188k	28p
ACY17	36p
ACY18	22p
ACY19	26p
ACY20	23p
ACY21	24p
ACY22	19p
AD140	67p
AD142	59p
AD143	52p
AD149	65p
AD161	46p
AD162	44p
AD161 }	M/P
AD162 }	95p
AF114	20p
AF115	20p
AF116	20p
AF117	20p
AF124	29p
AF125	29p
AF126	29p
AF127	29p
AF139	62p
AF239	66p
AF279	73p
ASY26	39p
ASY27	50p
ASY28	39p
ASY29	42p
BA111	82p
BA115	10p

BA145	24p
BA154	14p
BA156	18p
BAX16	8p
BC107	14p
BC108	14p
BC109	14p
BC113	18p
BC114	19p
BC115	19p
BC117	26p
BC125	17p
BC126	17p
BC135	19p
BC137	19p
BC140	35p
BC147	12p
BC148	11p
BC149	13p
BC157	17p
BC158	16p
BC159	16p
BC167	13p
BC168	13p
BC169	13p
BC177	23p
BC178	21p
BC179	24p
BC182	12p
BC183	11p
BC184	12p
BC212	13p
BC213	15p
BC214	15p
BC257	15p
BC258	18p
BC259	15p
BC267	14p
BC268	13p
BC269	14p
BC270	15p
BC271	24p
BC272	25p
BC297	26p
BC298	24p
BC300	41p
BC301	40p
BC302	36p
BC303	49p
BC304	39p
BC441	39p
BC461	45p

BCY30	58p
BCY31	69p
BCY70	17p
BCY71	27p
BCY72	14p
BD124	1·30
BD131	52p
BD132	57p
BD131 }	M/P
BD132 }	£1·18
BDY20	91p
BF167	25p
BF173	28p
BF177	27p
BF178	34p
BF179	38p
BF194	16p
BF195	16p
BF244	27p
BF254	16p
BFX29	34p
BFX84	25p
BFX85	32p
BFX86	25p
BFX87	27p
BFX88	25p
BFY50	23p
BFY51	19p
BFY52	23p
BFY64	39p
BFY90	£1·15
BY100	17p
BY127	17p
BFZ10	39p
BFZ11	38p
BFZ12	38p
BY213	28p
C407	19p
MA8001	36p
MA8002	40p
MA8003	40p
MEO401	23p
ME0402	24p
ME0404	19p
ME0404/1	19p
ME0404/2	19p
ME0411	22p
ME0412	21p
ME0413	19p
ME0414	19p
ME0462	28p
ME0463	23p

ME04075	34p
ME0491	23p
ME0492	23p
ME0493	21p
ME1001	16p
ME1002	17p
ME1075	19p
ME1100	20p
ME1120	20p
ME2001	15p
ME2002	16p
ME3001	21p
ME3002	26p
ME3011	21p
ME4001	16p
ME4002	17p
ME4003	19p
ME4101	16p
ME4102	17p
ME4103	16p
ME4104	16p
ME6001	18p
ME6002	19p
ME6003	17p
ME6101	19p
ME6102	20p
ME8001	19p
ME8002	21p
ME8003	23p
ME9001	19p
ME9002	18p
ME9003	16p
ME9021	19p
ME9002	18p
MP8111	38p
ME8112	38p
MP8113	49p
NKT211	29p
NKT212	29p
NKT213	29p
NKT214	27p
NKT217	58p
NKT261	25p
NKT271	21p
NKT274	21p
NKT403	77p
NKT404	72p
NKT405	95p
NKT603F	41p
NKT613F	38p
NKT674F	33p
NKT677	30p

NKT713	34p
NKT773	30p
OA5(GH5001)	19p
OA10	24p
OA47	9p
OA90	6p
OA91	6p
OA95 (HG1005	7p
OA200	9p
OA202	9p
OA19	55p
OC25	45p
OC28	65p
OC29	69p
OC35	59p
OC36	65p
OC41	20p
OC44	20p
OC45	20p
OC70	23p
OC71	18p
OC72	18p
OC75	24p
OC81	28p
OC81D	25p
OC83	24p
OC84	28p
TIP29a	54p
TIP30a	64p
TIP31a	77p
TIP32a	88p
TIP33a	£1·18p
TIP34a	£1·66p
TIP35a	£3·19p
TIP36a	£4·07p
TIP41a	88p
TIP42a	£1·10p
TIP2955	£1·05p
TIP3054	55p
TIP3055	66p
TIS43	27p
V763	33p
IN33a	11p
IN914	8p
IN916	9p
IN4148	5p
IN4149	8p
1544	9p
2N696	22p
2N706	12p

2N930	22p
2N1131	26p
2N3132	26p
2N302	30p
2N1303	30p
2N1304	33p
2N1305	38p
2N1306	47p
2N1307	47p
2N1308	53p
2N1309	56p
2N1613	24p
2N1711	25p
2N2218	33p
2N2218a	48p
2N2219	42p
2N2219a	58p
2N2484	46p
2N2646	51p
2N2904	25p
2N2904a	30p
2N2905a	38p
2N3053	23p
2N3055	49p
2N3702	12p
2N3703	11p
2N3704	12p
2N3705	11p
2N3706	11p
2N3707	11p
2N3708	10p
2N3709	11p
2N3710	11p
2N3711	11p
2N3794	20p
2N3819	27p
2N2926	11p
2N3904	17p
2N3906	17p
2N4036	57p
2N4058	13p
2N4059	13p
2N4060	18p
2N4061	18p
2N4062	12p
2N5172	11p
4N5192	89p
40361	48p
40362	46p
40636	69p

Thermistors

VA1066S	15p
VA1055S	15p
VA1056	15p
VA1067	16p
VA1039	14p
VA1040	14p
VA1077	15p
VA1100	14p

Bridge Rectifiers

1 amp	
50v	38p
200v	43p
400v	46p
2 amp	
50v	49p
100v	56p
400v	67p
5 amp	
50v	£1·89
200v	£1·98
400v	£2·25
10 amp	
50v	£2·45
100v	£2·51
400v	£2·95

Silicon Rectifiers

IN4001	7p
IN4002	7p
IN4003	8p
IN4004	9p
IN4005	10p
IN4006	11p
IN4007	13p
PL4001	9p
PL4002	10p
PL4003	11p
PL4004	12p
PL4005	14p
PL4006	17p
PL4007	22p
IN5400	18p
IN5401	20p
IN5402	21p
IN5404	23p
IN5405	26p
IN5406	26p
IN5407	28p
IN5408	34p

400mW Zener Diodes
3·3v to 33v 12p

Thyristors

1 amp	
50v	30p
100v	32p
200v	37
400v	46p
3 amp	
50v	36p
100v	40p
200v	44p
400v	59p
5 amp	
100v	54p
200v	60p

Triacs

2 amp	
400v	70p
6 amp	
400v	90p
10 amp	
400v	£1·30

7400	20p
7401	20p
7402	20p
7403	20p
7404	21p
7405	21p
7406	44p
7407	44p
7408	26p
7409	26p
7410	20p
7411	36p
7412	40p
7413	38p
7416	49p
7417	44p
7420	20p
7422	60p
7423	60p
7425	45p
7426	45p
7427	48p
7428	79p
7430	20p
7432	45p
7433	79p
7437	77p
7738	77p
7440	20p
7441	81p
7442	81p
7443	£1·40
7444	£1·57
7445	£2·31
7446	£1·61
7447	£1·58
7448	£1·98
7450	20p
7451	20p
7453	20p
7454	20p
7460	20p
7470	36p
7472	36p
7473	49p
7474	49p
7475	65p
7476	55p
7480	98p
7481	£1·47
7482	£1·10
7483	£1·33
7484	£1·22
7485	£3·25
7486	49p
7489	£4·95
7490	82p
7492	84p
7493	82p
7494	£1·04
7494	£1·04
7495	£1·14
7496	£1·25
74100	£2·05
74104	£1·28
74105	£1·28
74107	48p
74110	67p
74111	£1·62
74118	£1·80
74119	£1·74
74121	57p
74122	£1·60
74123	£3·15
74141	£1·20
74145	£1·65
74150	£3·30
74151	£1·81
74143	£1·42
74154	£2·20
74155	£1·75
74156	£1·75
74157	£1·84
74160	£2·18
74161	£2·18
74162	£4·84
74163	£4·84
74164	£3·73
74165	£3·73
74166	£4·28
74174	£3·78
74175	£2·94
74177	£2·75
74180	£2·70
74181	£6·49
74182	£2·16
74184	£3·69
74190	£3·08
74191	£2·80
74192	£2·53
74193	£2·53
74194	£3·87
74195	£2·42
74196	£2·78
74197	£2·78
74198	£6·65
74199	£6·65

IC's

307 8 Pin DIL	69p
709c DIL	38p
709c T099	38p
723c DIL	99p
723c T099	£1·10
741c DIL	39p
741c 8 Pin DIL	38p
741c T099	38p
747c DIL	94p
748c DIL	54p

DIL Sockets

8 Pin	20p
14 Pin	32p
16 Pin	39p

All Prices incl. of V.A.T.

Resistors

¼ watt 5% carbon 3·9 ohms to 10 meg	1p
½ watt 5% carbon " " "	1p
¼ watt 2% m/o 10 ohms to 1 meg	4½p
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 " " "	13p

Volume Controls
Potentiometers
Carbon track 1k to 2meg
Log or Linear

Single	14½p
Dual Gang Stereo	48p
Single type with D.P. Switch	32p

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All values 100 ohms to 5 meg ohms
·1 watt 6p each
·25 watt 7p each

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8mm neon indicators
Red or Amber 26p each
at 6v, 12v, 28v, 110v or 230 volt.

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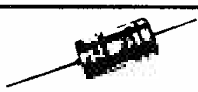
Solid tantalum capacitors Tol ±20%.
All values **20p** each.
MF/voltage: ·1/35, ·22/35, ·33/35, ·47/35, 1/35, 2·2/35, 4·7/35, 10/6·3, 10/16, 10/25, 22/16, 47/6·3, 100/3.

Veroboard

	·1	·15
2½ × 3¾	26p	22p
2½ × 5	31p	31p
3¾ × 3¾	31p	31p
3¾ × 5	35p	35p
17 × 2½	93p	74p
17 × 3¾	£1·32	£1·18
17 × 5 Plain		£1·10
Pin insertion tool	68p	68p
Spot face cutter	57p	57p
Pkt 50 Pins	22p	22p

Electrolytic Capacitors



4 VOLT		10 VOLT		25 VOLT		40 VOLT	
47µF	6½p	220µF	8p	47µF	6½p	470µF	19p
100µF	6½p	330µF	10p	100µF	8p	680µF	25p
200µF	6½p	470µF	10p	150µF	8p	1000µF	25p
320µF	6½p	1000µF	11p	220µF	10p	2200µF	44p
1000µF	13p	1500µF	20p	470µF	13p		
4700µF	29p	2200µF	24p	680µF	20p		

6·3 VOLT		16 VOLT		25 VOLT		63 VOLT	
33µF	6½p	15µF	6½p	1000µF	22p	1µF	6½p
68µF	6½p	33µF	6½p	2200µF	39p	2·2µF	6½p
150µF	6½p	150µF	6½p	5000µF	68p	4·7µF	6½p
470µF	11p	150µF	8p			6·8µF	6½p
680µF	18p	220µF	9p			10µF	6½p
1500µF	18p	680µF	17p			22µF	6½p
2200µF	18p	1000µF	17p			68µF	10p
3300µF	26p	1500µF	25p			100µF	11p
		2000µF	43p			150µF	18p

10 VOLT		25 VOLT		40 VOLT		63 VOLT	
				6·8µF	6½p		
				15µF	6½p		
				33µF	6½p		
				47µF	6½p	220µF	22p
22µF	6½p			68µF	10p	330µF	22p
47µF	6½p	10µF	6½p	100µF	9p	470µF	26p
100µF	6½p	22µF	6½p	220µF	11p	1000µF	44p

Ceramics
Miniature Ceramics 50v DC.
All values 1·8pF ot 10,000pF **8p** each.

Mullards Polyester Capacitors
C280 SERIES
250V P.C. mounting: 0·1µF, 0·015, 0·022 **3½p.** 0·033, 0·047, 0·068 **4p.** 0·1 **4½p.** 0·15, 0·22 **5½p.** 0·33 **7p.** 0·47 **9½p.** 0·68 **12p.** 1µF **14p.** 1·5µF **22p.** 2·2µF **27p.**
C296 SERIES
400V: 0·001µF, 0·0015, 0·0022, 0·0033, 0·0047 **3p.** 0·0068, 0·01, 0·015, 0·022, 0·033 **3½p.** 0·047, 0·068, 0·1 **4½p.** 0.15 **6½p.** 0.22 **8½p.** 0·33 **12p.** 0p47 **14½p.**
160V: 0·01µF. 0·015, 0·022, 0·033, 0·047, 0·068 **3½p.** 0·1 **4p.** 0·15 **4p.** 0·1 **4½p.** 0·15, 0·22 **5½p.** 0·33 **7p.** 0·47 **9½p** 0·68 **12p.** 1µF **14½p.** 1·5µF **22p.** 2·2µF **24p.**

£1 BARGAIN PACKS

- £1 10 Silicon *npn* power transistors (2N3055), tested/unmarked.
- £1 30 Plastic FET's unmarked/untested. Similar to 2N3819.
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- £1 20 TO18 transistors *pnp* like BC178, BC179, etc., untested/unmarked.
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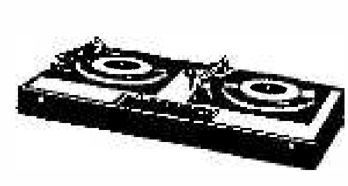
- £1 10 General purpose, fully tested FET's.

COMPLETE 100watt DISCO SYSTEM £194·95 inc. V.A.T.



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★ **NO DEPOSIT** terms available £10·63 monthly over two years.

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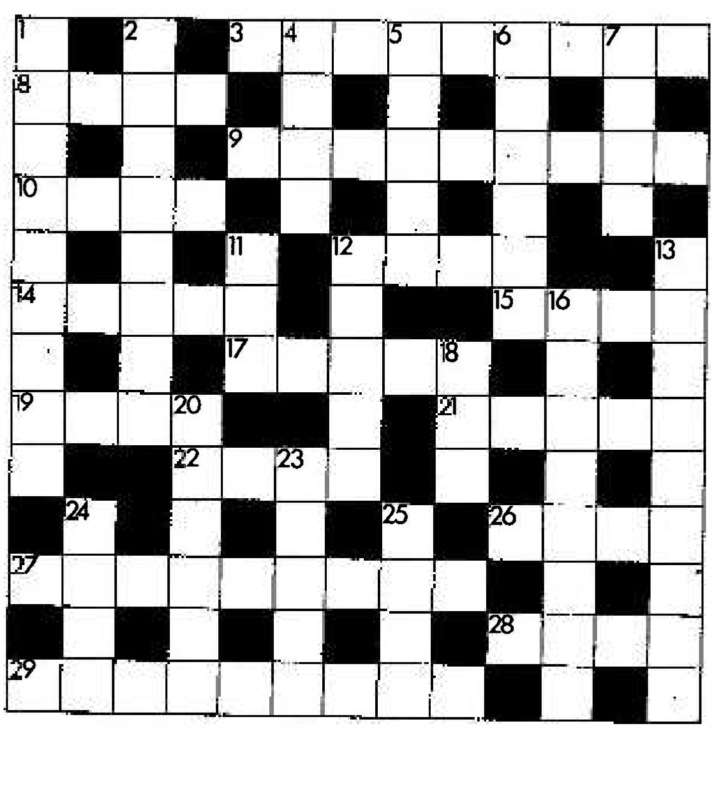
PW TECHNICROSS PUZZLE No.8



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 bandwith 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 restive 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 minicomputer 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!

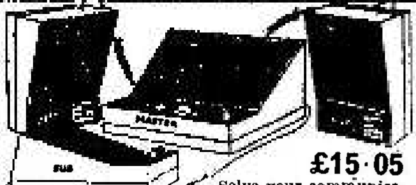
Motoring enthusiasts may like to know of a different IC; this time it's designated SAK 140 and it is intended for engine rev counters. It converts input pulses from the engine contact breaker into output current pulses of constant width and amplitude. I hope to give greater details next month if the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

Ginsberg

4-STATION INTERCOM



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Solve your communication problems with this **4-Station Transistor Intercom** system (**1 master** and **3 Subs**), in robust plastic cabinets for desk or wall mounting. Call/talk/listen from **Master to Subs** and **Subs to Master**. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 50p

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Sim. to above but for 8 x TO3 5 x 8 x 1⅛ **70p** (27p)

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5,000μ 35v	**40p** (12p)
20A 100 piv Si recs.	4 for **£1** (12p)
3A 100 piv Si recs	4 for **50p** (8p)
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250 mixed capacitors	**60p** (11p)
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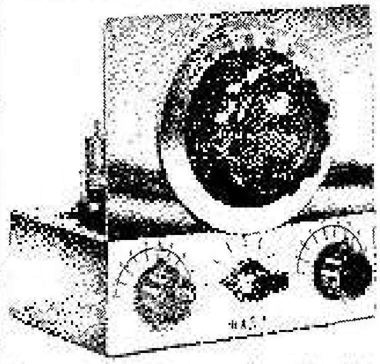

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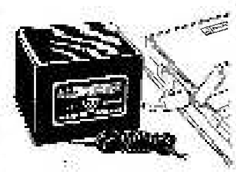

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EXPERIMENTAL WORKSHOP

M. J. HUGHES
M.A., C.Eng., MIERE.

LEARNING BY PRACTICAL PROJECT STEPS

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 R1=R2 and C1=C2 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.

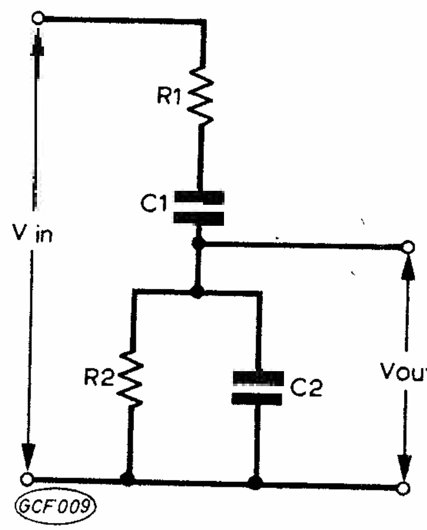


Fig. 99: Basic circuit of a Wien Bridge. Usually R1=R2 and C1=C2.

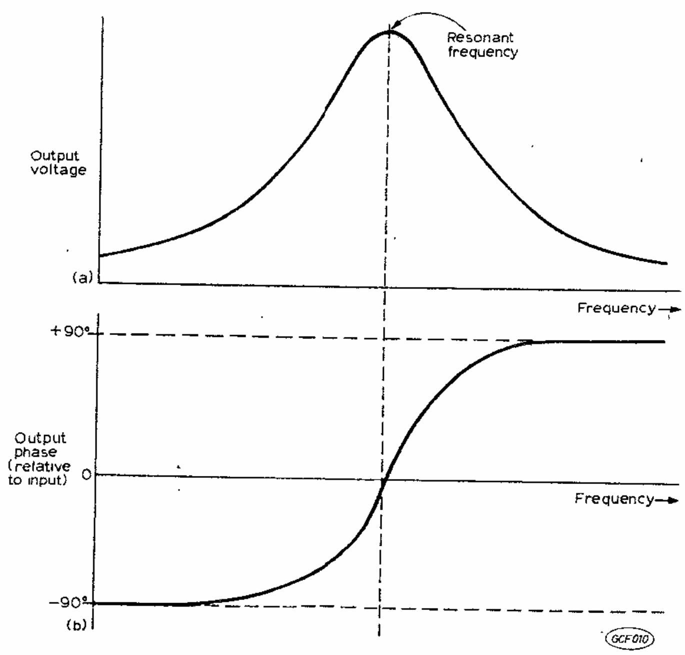


Fig. 100: top, shows that the output from a Wien Bridge is maximum at a particular frequency (resonance), below, indicates that there is no difference in phase between input and output at the resonant frequency.

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°. 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 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.

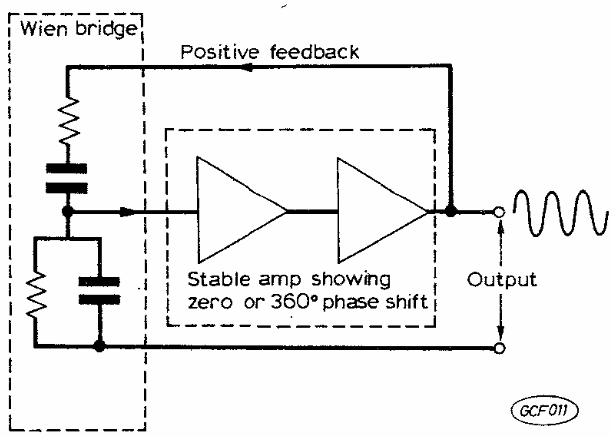
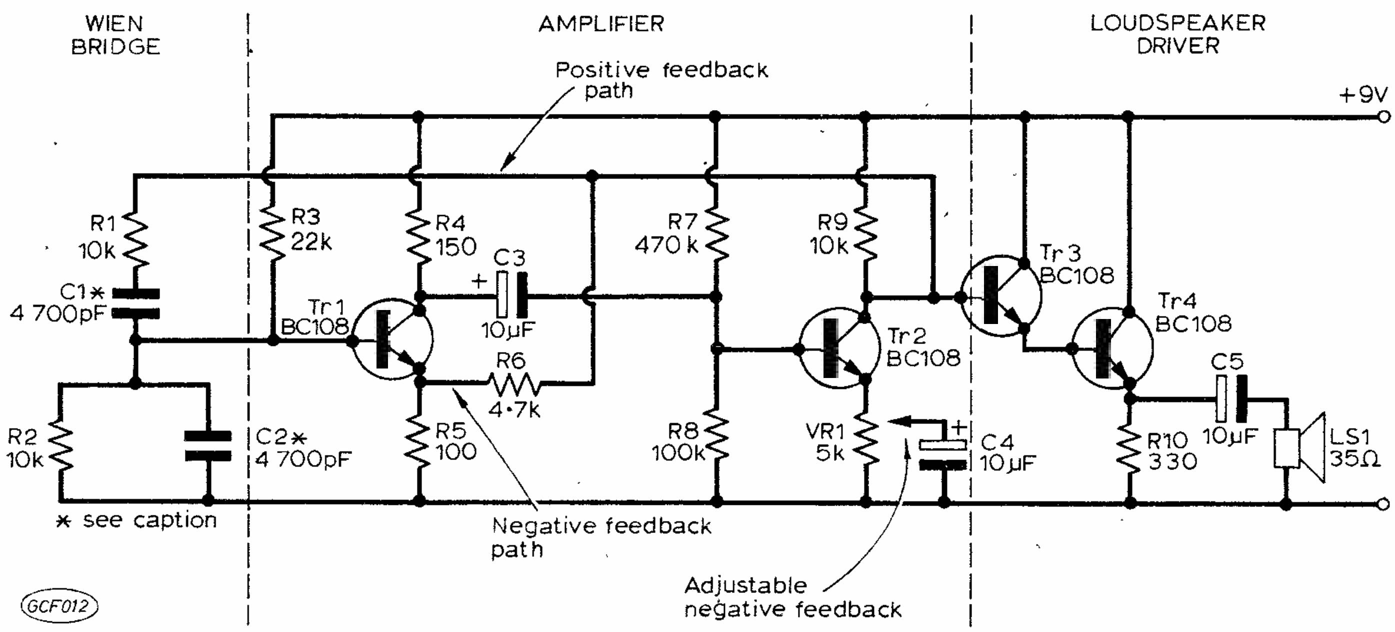


Fig. 101: When connected into the feedback path of an amplifier having zero overall phase shift the Wien Bridge offers a simple way of making a sine wave oscillator.

continued on page 843



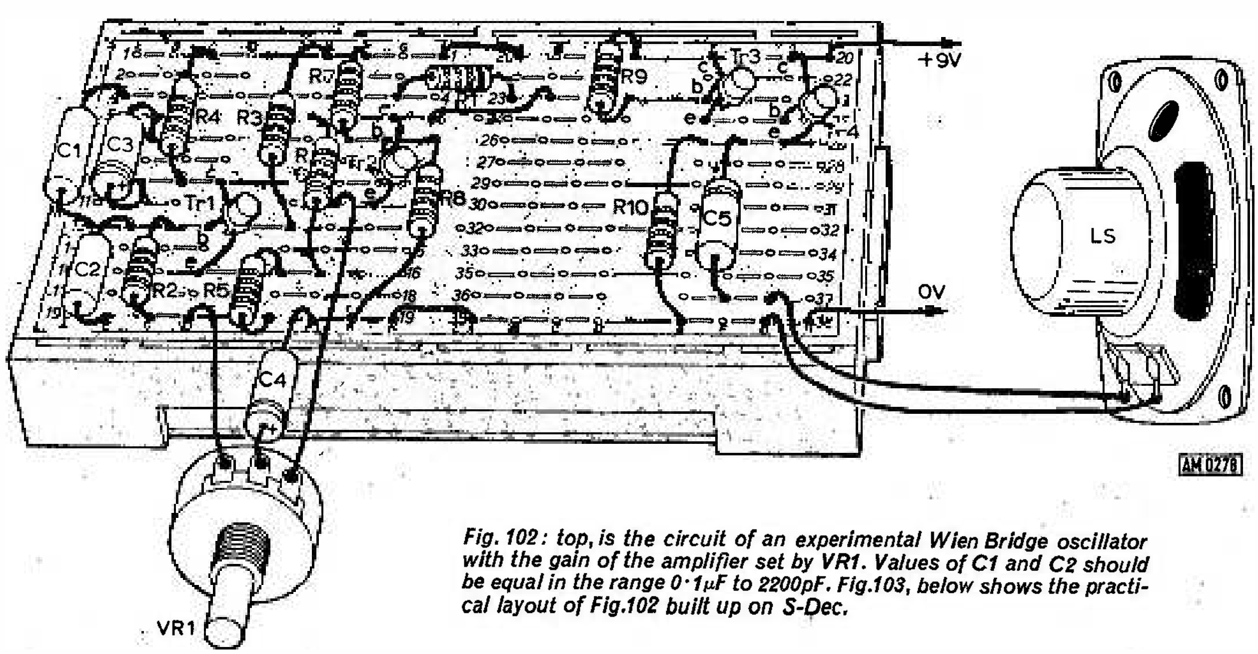


Fig. 102: top, is the circuit of an experimental Wien Bridge oscillator with the gain of the amplifier set by VR1. Values of C1 and C2 should be equal in the range 0·1μF to 2200pF. Fig.103, below shows the practical layout of Fig.102 built up on S-Dec.

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.

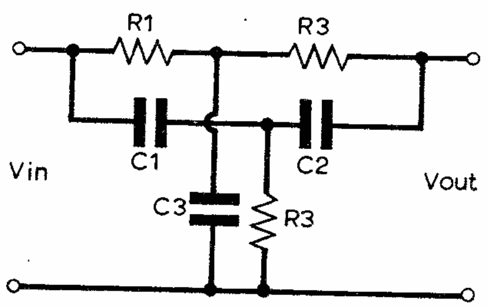


Fig. 104: Basic circuit of a 'Twin-T' or 'Bridged-T' filter. Normally the circuit is symmetrical with R1=R2 and C1=C2. R3 should equal ½R1 and C3 should be 2 x C1.

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 q levels of the amplifier. Nevertheless try substi different pairs of values for C1 and C2 in the ra 2,200pF to 0·1µF.

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.

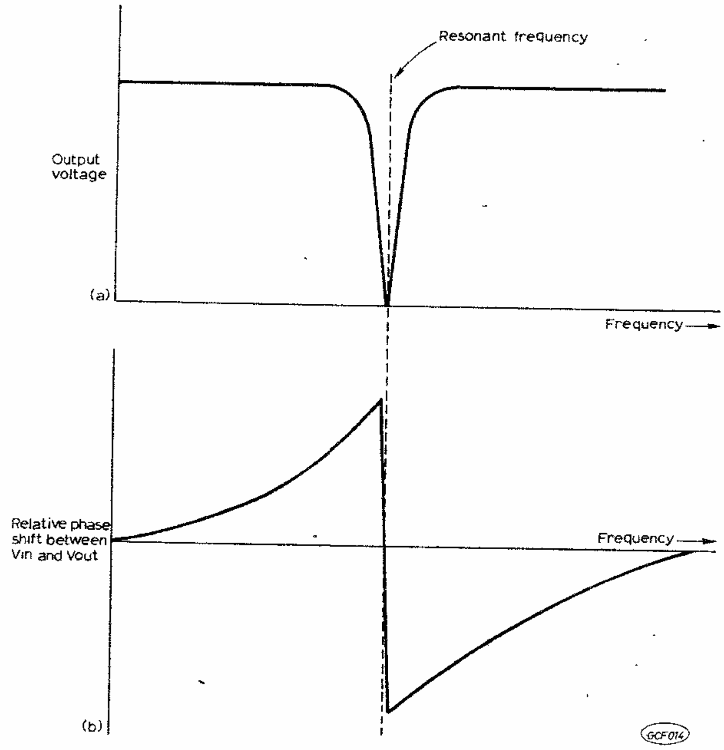


Fig. 105: top, output voltage at different frequencies for a fixed amplitude input signal. Below, at the resonant frequency 180° phase shift occurs.

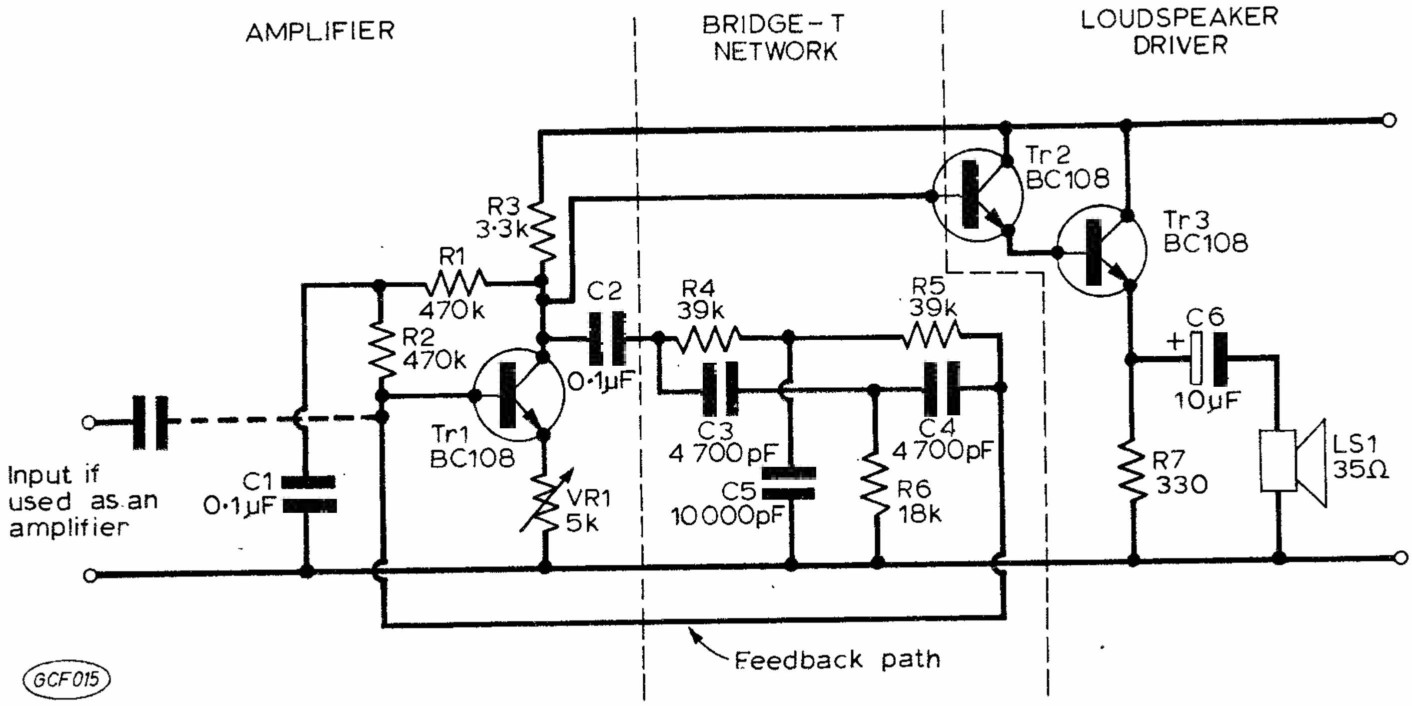
The relationship between the component values is slightly more complex than the previous filter and although there is an unlimited variety of values one can use the Bridged-T is usually represented in its symmetrical form. This means that R1 should equal R2 and R3 should be half the value of R1. At the 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



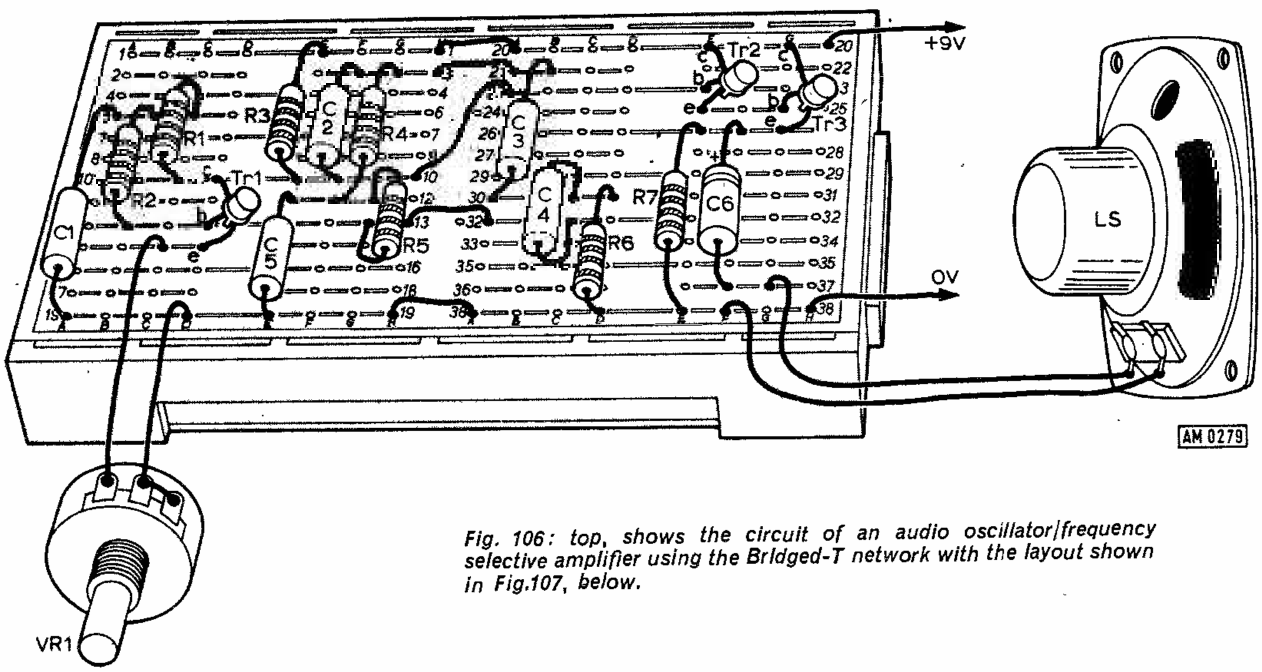


Fig. 106: top, shows the circuit of an audio oscillator/frequency selective amplifier using the Bridged-T network with the layout shown in Fig.107, below.

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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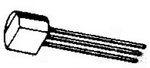

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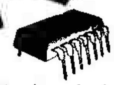

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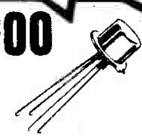

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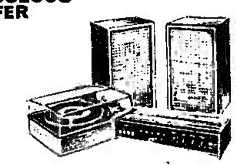

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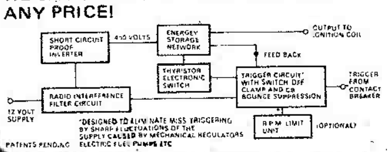

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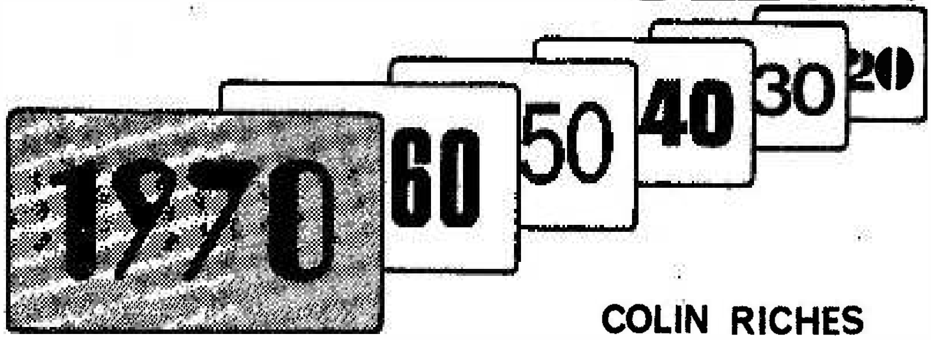


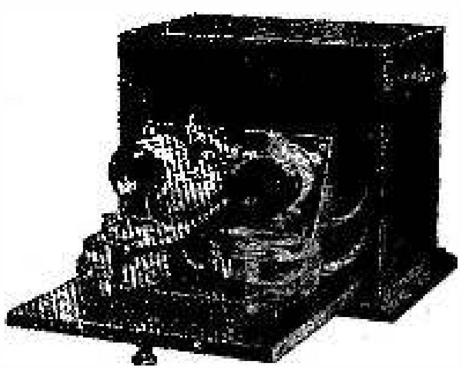
COLIN RICHES

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.

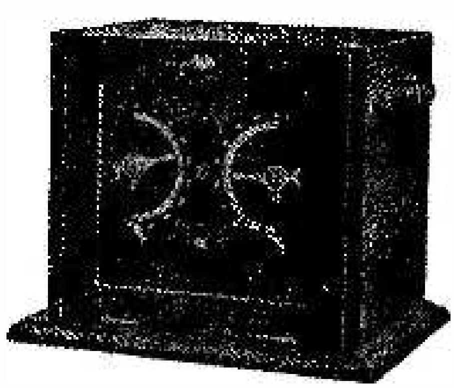
This set employed an ES 220 valve which was described as the "outcome of prolonged research and experiment". In c1925 it cost 22s. 6d.

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:—



Interior view of the "One-Der."

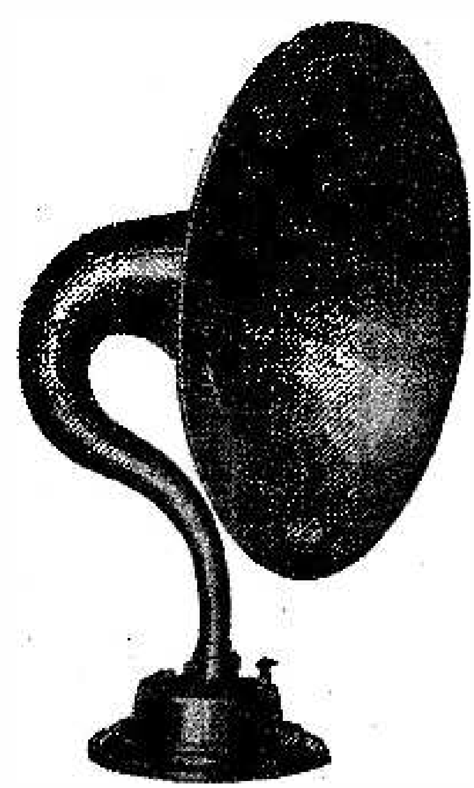


Front panel of the receiver.

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 oxidisation 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 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 tappings 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 tappings 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 tappings for Grid Bias, were 10s.

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DD5	Electret Paging Microphone, on table stand with gooseneck and switch, 600 ohms	£14·00
DD6	Lavalier Microphone with Windshield, Lavalier Cord. 6 metres Cable. 600 ohms/50kΩ	£11·20
DM18HL	Dual Impedance Dynamic Microphone with desk stand 600 ohms/50kΩ	£10·50
DM73	Omni Directional Dynamic Microphone with desk stand. 6 metres Cable and Plug 50kΩ	£10·00
DM81	Remote Dynamic Microphone Cassette type with Plugs 200 ohms	£1·80
DM82	Remote Cassette Cardioid Microphone with Plugs 200 ohms	£2·40
DM94	Omni Directional Dynamic Microphone with Slide on Windshield and Switch 50kΩ	£9·50
DM614	Pencil Type Dynamic Microphone with Cable Lavalier Cord and Base 50kΩ	£3·20
PROM5	Lavalier Capacitor Microphone with Tie Clip 5·8 metres Cable. 600 ohms	£16·00
PROM10	Omni Directional Capacitor Microphone with 6 metres Cable 600 ohms	£30·00
PROM20	Uni-Directional Capacitor Microphone with 6 metres Cable. 600 ohms	£32·00
PROM25	Capacitor Boom Arm Microphone with Arm two Windshields. Cable 600 ohms	£34·60
UD50HL	Cardioid Dual Impedance Microphone with Switch. 6 metres Cable and Plug 600 ohms/50kΩ	£12·00
200C	Slim Line Crystal Microphone with Switch. Cable and Connector	£3·80

TWEETERS

PRICES INC. VAT

CT5	Cone Tweeter Freq 3000–15000Hz Crossover freq 3000Hz Imp 8 ohms Suitable for systems up to 10 watts RMS	£1·98
CT10/8	Pressure Unit Type Tweeter Freq 1500–16000Hz Crossover freq 3000Hz Imp 8 ohms Suitable for systems up to 20 watts RMS	£2·60
CT10/16	As above but 16 ohms	£2·60
DT33	Dome Tweeter Freq. 2000–18000Hz Crossover freq 3000Hz Imp 8 ohms. Suitable for systems up to 40 watts	£5·70
FF27	Dome Tweeter Freq 2000–20000Hz Crossover freq 3000Hz Imp. 8 ohms Suitable for systems up to 30 watts RMS	£6 80
FF28	Horn Tweeter Freq 3000–20000Hz Crossover freq 3000Hz Imp 8 ohms Suitable for systems up to 20 watts RMS	£8·20
HT15	Horn Tweeter Freq 2000–18000Hz Crossover freq 3000Hz Imp 16 ohms Suitable for systems up to 30 watts RMS	£4·00
HT21	Horn Tweeter. Freq 2500–20000Hz Crossover freq 3000Hz Imp 8 ohms Suitable for systems up to 40 watts RMS	£6·20
MHT10	Horn Tweeter Freq 2000–18000Hz Crossover freq 3000Hz Imp 8 ohms Suitable for systems up to 30 watts RMS	£4·00

CROSSOVERS

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CN23	2 Way Crossover Network. Imp 3 ohms Crossover 3000Hz Suitable up to 15 watts RMS	£1·70
FF5	3 Way Crossover Network Imp 8 ohms Crossover freqs 1000 and 5000Hz Suitable up to 25 watts RMS	£3·30
FF30	3 Way Crossover Network Imp 8 ohms Crossover freqs 1000 and 5000Hz Suitable up to 25 watts RMS	£9 20
SN75	2 Way Crossover Network Imp 8 ohms Crossover 3000Hz Suitable for systems up to 15 watts RMS	£4·60

CASSETTES

PRICES INC VAT

	C60	C90	C120
BASF LH	88p	£1·21	£1·78
MEMOREX			
MROX2 Oxide	99p	£1·32	£1·76
CROX2	£1·47	£1·91	—
PHILIPS	85p	£1·19	£1·75

QTY Discounts 12–10%, 24–15%, 36–20%, 60–25%

SPEAKER CLOTH
Available in Black or Green: Approx width 54in £1·75 yd.

HEADPHONES
Type H-202 Features Mono/stereo switch. Volume controls on each channel Freq response 20–20 000Hz Impedance 4–16 ohms £4·50.

TEAK VENEERED SPEAKER CABINETS

	Size	
For 8 × 5in Speaker	9½ × 13½ × 5¾	£3·50
8in - Tweeter	7¾ × 11¾ × 5½	£5·00
13 × 8in	10½ × 17 × 6	£5·75
13 × 8in + Tweeter	12 × 18½ × 8¾	£7·50
12in. - Tweeter	15¾ × 18 × 8¾	£9·00

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Robust units suitable for most PA/Disco uses

5 watt 2 inputs. Vol. Treble Bass Controls	£12·50
15 watt 4 inputs. Vol. Treble Bass Controls	£24·50
30 watt 4 inputs. Vol. Treble. Bass Controls	£29·50
50 watt 4 inputs. Vol. Treble. Bass Controls	£38·25
150 watt 4 inputs with separate vol. controls plus master vol. treble. bass	£75·90
500 watt 4 inputs each with independent vol. treble and bass controls plus overall master vol. control	£124·50

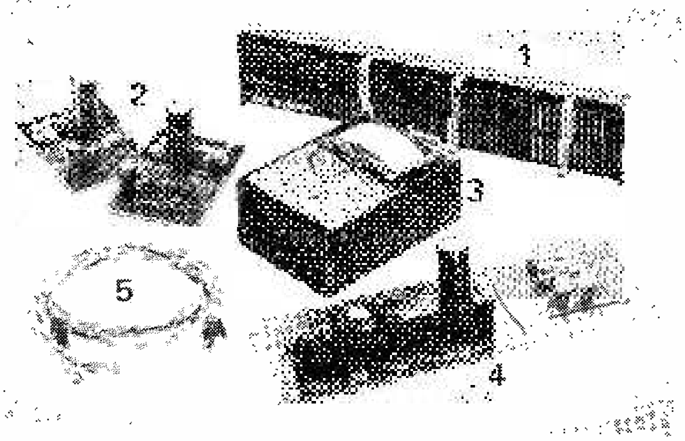
MICROPHONE MIXERS

PRICES INC VAT

FF1	4 Channel Mono Mixer and Preamplifier with individual slide controls Battery operated	£26·00
FF10	7 Channel Stereo Mixer and Preamplifier with individual slide controls Battery operated	£34·00
FF11	Stereo Frequency Controller and Preamplifier uses five slide controls Battery operated	£34·00

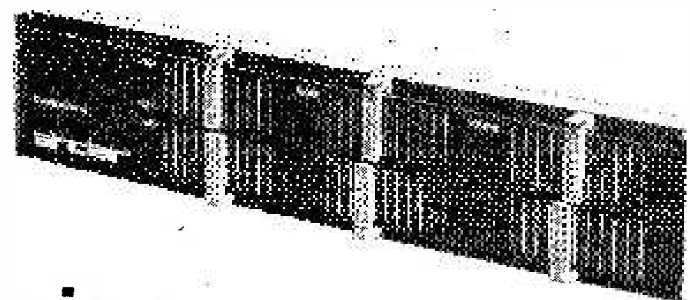
All mail order and enquiries to 270 Acton Lane Tel. 01-994 6275

true quadraphonics... NOW!



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

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.



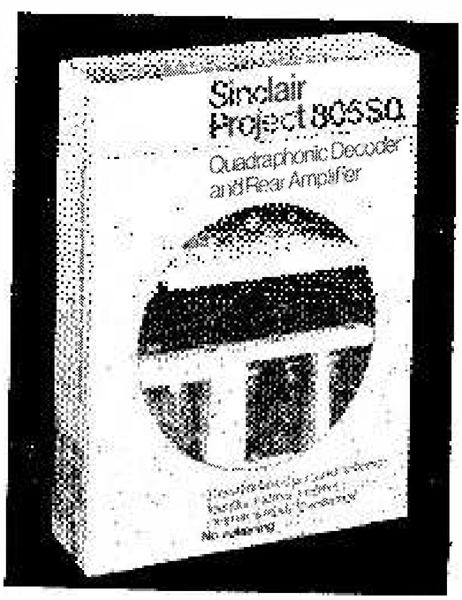
Project 80SQ Decoder (available separately)

£18·95 + £1·52 VAT

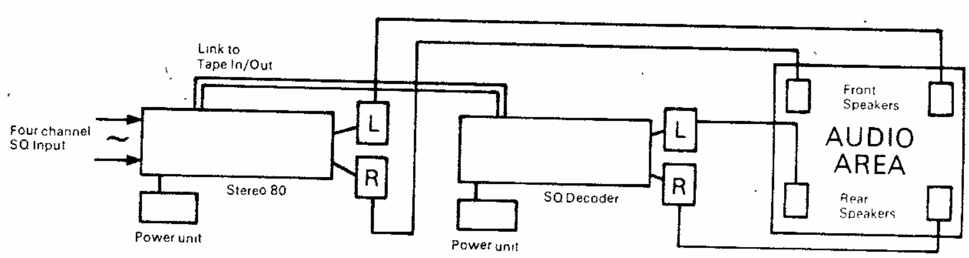
Add a fourth dimension to your stereo sound

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 Master-link, 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 quad-raphonic 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

CHROMASONIC electronics

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56, Fortis Green Road, London. N10 3HN.
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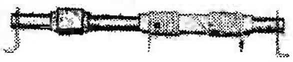
INDUCTORS

Denco Maxi-Q Coils

Ferrite Rod Aerials



FRA1 Long & Medium Wave band (300pf) 86p
FRA2 Long & Medium " (500pf) 86p

Tuning Coils in two series:

Range				
1	150 khz	to	400 khz	
2	515 khz	to	1.545 Mh3	
3	1.67 Mhz	to	5.3 Mh3	
4	5 Mhz	to	15 Mh3	
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.

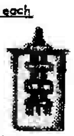
Series A Transistor - 48p each

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:

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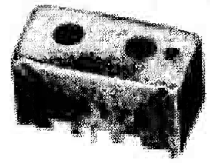
White - Osc. Coil for 1.6 Mhz I.F.

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

Chokes

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



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

LP1175 £1.46

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3 gang 310pf
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TYPE OO

208 + 176 pf with screen & trimmers
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83p
Slow Motion Drive Ratio 6:1 Ref: 4511

TYPE C804

5pf	80p
10pf	80p
15pf	80p
20pf	83p
25pf	80p
50pf	83p
60pf	94p
75pf	94p
100pf	99p

TYPE O

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2½" x 5"	30p	25p	13p	-
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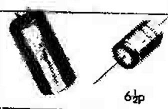
Details of I.C.'s; Rectifiers; Diodes; Bridges; Passive Components; LED's; Clocks; Triacs etc. can be seen on other pages and/or issues of Wireless World; Practical Wireless; and Practical Electronics.

Electrolytics



µF	4V	6.3V	10V	16V	25V	40V	63V	100V	160V	450V
1							6½p		8½p	15p
1.5							6½p			
2.2							6½p		8½p	
3.3							6½p			
4.7							6½p		8½p	17p(4uF)
6.8						6½p	6½p	8½p		
8										
10					6½p		6½p	8½p		21p
15				6½p		6½p	6½p			
22			6½p		6½p		6½p	11p		24p(16uF)
33		6½p		6½p		6½p				
47	6½p		6½p	6½p	6½p	6½p	8p			33p(32uF)
68		6½p		6½p			11p			25p(50uF)
100	6½p		6½p		6½p	8p	14p	25p		350V
150		6½p		6½p	8p	11p	14p			
220	6½p		6½p	8p	11p	14p	19p	31p		
330	6½p		8p	11p			25p	44p		
470		8p	11p		14p	20p	26p	47p		
680		10p		14p	20p	25p		59p		
1000	13p		14p	19p	22p	25p	44p	79p		
1500		18p	19p	25p						
2200		18p	24p		39p	44p	79p	149p		
3300		26p								
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ACY17	38½p	BD131	44p	MJ4000	£1.46½	ZTX502	17p	2N3903	16½p
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BC107	11p	BF185	27½p	OC44	14p	2N1309	34½p	2N5191	77p
BC108	11p	BF194	15p	OC45	14p	2N1711	26p	2N5194	91p
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BC148	10p	BF200	31½p	OC76	27p	2N2219	38½p	2N5457	46½p
BC149	10p	BF244B	27p	OC81	14p	2N2646	54p	2N5458	43½p
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BC171	20p	BFW10	65p	TIP31	67p	2N3053	19p	2N6071	62p
BC172	17½p	BFX29	41½p	TIP31A	67p	2N3054	50½p	2N6073	67p
BC177	22p	BFX88	26p	TIP32A	79½p	2N3055	51½p	2N6075	£1.46½
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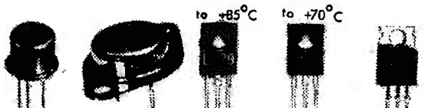

	100mA (TO-39)	500mA * (TO-3)	500mA * (SOT-32) -20°C to +85°C	500mA * (SOT-32) 0°C to +70°C	1A (TO-220)
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*600mA; 500mA and 450mA respectively.

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BCD encoded digital switch Reading 0 to 9. Suitable for digital clock alarm setting DVM input scaling etc.

1 to 9. £1.49 each.

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V	800mA		4A		8A	
30v	MCR102	32p	106Y	39p		
50v			106F	46p		
60v	MCR103	44p			2N4441	87p
100v	MCR104	49p	106A	48p		
200v	MCR120	51p	106B	53p	2N4442	£1.06
400v			106D	67p	2N4443	£1.45
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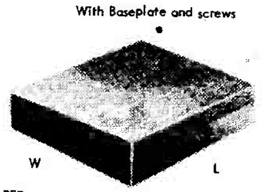
ALUMINIUM BOXES

With Baseplate and screws



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AB9	4"	2¾"	1½"	45p	15p
AB10	4"	5¼"	1½"	51p	15p
AB11	4"	2½"	2"	45p	15p
AB12	3"	2"	1"	38p	15p
AB13	6"	4"	2"	61p	17p
AB14	7"	5"	2½"	73p	17p
AB15	8"	6"	3"	92p	17p
AB16	10"	7"	3"	£1.05	20p
AB17	10"	4½"	3"	92p	25p
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OVERSEAS CUSTOMERS DEDUCT 2/27
VAT INVOICES ON REQUEST.
P&P On U.K. Orders min. 15p.. Overseas Orders at Cost

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

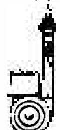
Double Leaf Contact. Very slight pressure closes both contacts. 9p each, 10 for 74p Plastic pushrod suitable for operating. 7p each, 10 for 63p.

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.

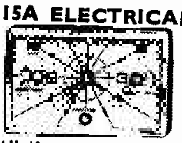
MULTI-SPEED MOTOR.

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 ¼ 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. × 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 × ⅜in 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 (⅜in approx.) between fixing centres. 20p each or 10 for £1·90. SP Change over spring return 250v 1 amp. 15p.

15A 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 1½ AMP. POWER PACK

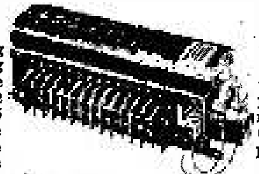
This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mF smoothing. Price £2·50 plus 20p post & packing.

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 cloride or other etchant on removal the circuit stands in high relief, 99p.

HONEYWELL PROGRAMMER



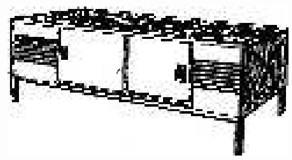
This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated 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.

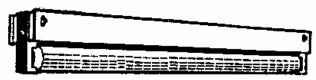
STEREO RADIO CABINET

Long, Low and Modern. Teak veneered with sliding front and tapered legs. Speaker spaces each end. Size approx. 4ft. 2in × 15in × 15in. Probably cost over £20 to make. Our Price £8·10 each.



TWENTYLITE

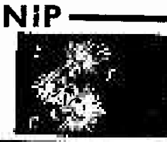
Fluorescent lighting units with polyester choke and finished white enamel, 40 ins. model. Ideal kitchen, bedroom, hallway, porch, lift, etc., with tube. Assembled ready to install. Price £2·20 + 40p p. & p.



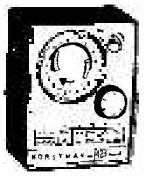
THIS MONTH'S SNIP

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:—

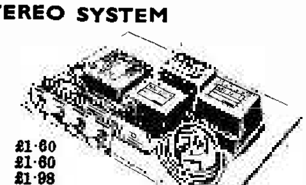
Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

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. × 3in. × 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



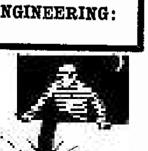
There is no doubt that it is a good system, we believe that for the money it is without comparison. We demonstrate gladly at our Tamworth Road depot. Prices of the individual items for this:—

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 £3·30 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 × 18in £1·90
13in × 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.

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.

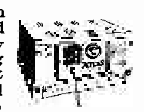
COMPLETE SYSTEM AM/FM and MPX Tuner

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.

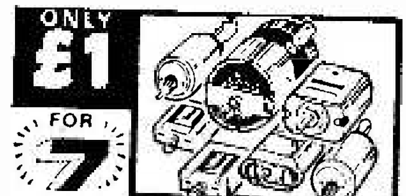
AMPLIFIER PANELS

Very nice looking, polished black presspahn with fixing 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: 1½ 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.

8 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 65p: 0–10 amp 95p.

Rectifiers. All 24v full wave (bridge) with cooling fins. 1½–2 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 ½" rather like a joy stick and no matter which direction it is pushed, it makes contact. Base size approximately 2¼" × 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.

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.

J. BULL (ELECTRICAL) LTD.

(Dept. PW), 102/3 Tamworth Road,
CROYDON CR0 1XX

BRITAIN'S FASTEST SERVICE!

A SELECTION FROM OUR COMPREHENSIVE CATALOGUE

ALL ITEMS ARE BRAND NEW AND FULLY GUARANTEED

AA119	7p
AC107	68p
AC126	25p
AC128	22p
AC128/AC176	51p
AC151	26p
AC152	40p
AC153	42p
AC176	29p
AC153/176K	71p
AC187K	40p
AC188K	36p
AC187/188K	76p
ACY17	41p
ACY18	28p
ACY19	32p
ACY20	26p
ACY21	30p
ACY22	10p
AD140	80p
AD149	70p
AD161	64p
AD162	64p
AD161/162	£1·28
AF106	40p
AF114	46p
AF115	40p
AF116	58p
AF117	40p
AF124	38p
AF125	38p
AF126	39p
AF139	64p
AF186	30p
AF239	69p
AF279	74p
ASY26	70p
ASY27	72p
BA138	35p
BB103	27p
BB104	50p
BB105	37p
BC107	16p
BC107/BC177	46p
BC108	14p
BC108/BC178	49p
BC109	16p
BC109/BC179	44p
BC109C	18p
BC140	52p
BC147	16p
BC148	16p
BC149	16p
BC157	17p
BC158	15p
BC159	17p
BC147/157	33p
BC148/158	31p
BC149/159	33p
BC167	15p
BC168	14p
BC169	14p
BC169C	15p
BC177	30p
BC178	35p
BC179	28p
BC182	15p
BC182L	15p
BC183	14p
BC183L	14p
BC184	16p
BC184L	13p
BC212	19p
BC212L	19p
BC238	14p
BC238/308	28p
BC257	16p
BC258	15p
BC259	16p
BC307	17p
BC308	14p
BCY70	22p
BCY71	33p
BCY72	19p
BD241A	54p
BD242A	60p
BD243A	72p
BD244A	78p
BD124	£1·00
BD131	24p
BD132	32p

BD131/132	56p
BDY20	96p
BF115	30p
BF167	29p
BF180	50p
BF194	18p
BF195	18p
BF196	18p
BF200	46p
BF254	17p
BF255	17p
BFX29	39p
BFX84	34p
BFX85	41p
BFX86	35p
BFX87	33p
BFX88	30p
BFY50	33p
BFY51	30p
BFY52	31p
BFY53	28p
BFY90	£1·35
BPX29	£1·62
BR100	22p
BRY39	66p
BSX19	26p
BSX20	25p
BSY27	27p
BSY95A	12p
BT106	£1·26
BTY79/400R	£2·52
BY100	20p
BY127	12p
BZY88C3V3 to BZY88C30V	10p
BZX61C7V5 to BZX61C30V	28p
BZY93C9V1	80p
BZY93C12V	80p
BZY93C15V	80p
BZY93C18V	80p
CA3005	£1·35
CA3011	83p
CA3013	£1·17
CA3014	£1·37
CA3018	72p
CA3018A	83p
CA3020	£1·39
CA3028A	79p
CA3035	£1·37
CA3043	£1·57
CA3046	70p
CA3048	£2·11
CA3052	£1·62
CA3053	47p
CA3065	£1·28
CA3088E	£1·24
CA3089E	£1·94
CA3090AQ	£4·20
CA3123E	£1·40
CR1/051C	65p
CR1401C	86p
CZ6	17p
D10 (NTGD10)	50p
IR2160	82p
IRC20	60p
JA424	£2·08
LD30A	29p
MC1303L	£1·59
MC1305P	£1·99
MC1307P	£1·38
MC1310P	£2·80
MC1330P	88p
MC1352P	90p
MC1466L	£3·50
MC1468L	£2·41
MC4024P	£1·84
MC4044P	£1·84
MFC4000B	50p
MFC6030	£1·21
MFC6040	£1·15
MFC8010	£1·44
MFC8040	£1·24
MFC9020	£1·56
MJE371	94p
MJE520	70p
MJE521	82p
MJE2955	£1·49
MJE3055	87p
MJ480	£1·15
MJ481	£1·45
MJ491	£1·84
MJ802	£3·65

MJ802/MJ4502	£7·65
MJ900	£1·88
MJ1000	£1·50
MJ4502	£4·00
MLM309K	£2·08
MPF102	49p
MPF103 (2N5457)	45p
MPF104 (2N5458)	61p
MPF105 (2N5459)	45p
NE555V	78p
NKT0033	92p
NKT211	32p
NKT212	32p
NKT271	22p
NKT274	22p
NKT275	29p
NKT279A	36p
NKT281	22p
NKT401	88p
NKT402	96p
NKT403	82p
NKT404	78p
NKT405	£1·00
NKT406	79p
NTGD10	50p
OA10 (NTGD10)	50p
OA47	10p
OA79	6p
OA90	6p
OA91	6p
OA95	9p
OA200	8p
OA202	8p
OC25	72p
OC28	87p
OC29	88p
OC35	78p
OC36	78p
OC41	57p
OC44	20p
OC45	20p
OC71	20p
OC72	20p
OC75	20p
OC76	46p
OC77	62p
OC81	32p
OC81D	29p
OC83	32p
OC84	32p
OC170	44p
OC171	47p
OCP71M	42p
ORP12	50p
PM7A2	£1·98
PM7A6	£2·62
PN70	13p
PN71	13p
PN107	9p
PN108	9p
PN109	9p
PN3819 (2N3819)	24p
SL103A	54p
SL403A (Rectifier)	71p
SL803A	94p
ST2	22p
T2700D	£1·01
T2800D	90p
T2800M	£1·33
TAD100	£1·97
TAD110	£1·97
TBA810S	£1·32
TIL112	£2·00
TIL209	30p
TIS43	36p
TR1	22p
VA1039	15p
VA1040	15p
VA1066s	15p
VA1077	17p
W005	25p
W01	26p
W02	26p
W04	27p
W06	32p
W08	40p
ZTX107	14p
ZTX108	11p
ZTX300	19p

ZTX302	24p
ZTX303	15p
ZTX304	30p
ZTX314	18p
ZTX320	40p
ZTX500	20p
ZTX501	22p
ZTX502	25p
ZTX503	20p
ZTX504	60p
1N914	4p
1N3754	18p
1N4001	4p
1N4002	4p
1N4003	5p
1N4004	7p
1N4005	7p
1N4006	8p
1N4007	9p
1N4148	4p
1N5400	16p
1N5404	22p
1N5408	33p
1S44	4p
1S920	10p
2N404	58p
2N697	26p
2N706	25p
2N706A	27p
2N708	20p
2N914	25p
2N918	54p
2N930	25p
2N1303	61p
2N1305	65p
2N1307	69p
2N1309	73p
2N1613	26p
2N1711	30p
2N1893	46p
2N2218	34p
2N2218A	48p
2N2219	43p
2N2219A	50p
2N2368	26p
2N2369	23p
2N2369A	25p
2N2484	48p
2N2646	58p
2N2904	32p
2N2904A	35p
2N2905	38p
2N2905A	40p
2N2924	23p
2N2925	27p
2N2926	10p
2N3053	30p
2N3054	60p
2N3055	65p
2N3228	88p
2N3391A	40p
2N3525	£1·04
2N3702	14p
2N3703	14p
2N3704	14p
2N3705	14p
2N3706	14p
2N3707	14p
2N3708	14p
2N3709	14p
2N3710	14p
2N3711	14p
2N3773	£3·20
2N3819	35p
2N3866	82p
2N3904	20p
2N3906	24p
2N4058	15p
2N4060	16p
2N4061	16p
2N4062	16p
2N4441	70p
2N4444	£2·20
2N4871	48p
2N4990	54p
2N4991	46p
2N5245	68p
2N5457 (MPF103)	45p
2N5458 (MPF104)	61p
2N5459 (MPF105)	45p
2N5756	£1·00
2N5777	54p

2N6027 (D13T1)	58p
3N128	74p
3N140	92p
3N141	82p
3N152	92p
741/T05	50p
741/8DIL	34p
747/14DIL	85p
748/T05	41p
3015F	£1·40
3015G	£2·00
7400	24p
7401	24p
7402	24p
7403	24p
7404	30p
7405	30p
7408	30p
7409	30p
7410	24p
7413	36p
7420	24p
7425	36p
7430	24p
7440	29p
7442	£1·39
7443	£1·74
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7445	£2·47
7446	£1·74
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7450	24p
7451	24p
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7454	24p
7460	24p
7470	54p
7472	36p
7473	54p
7474	55p
7475	54p
7476	54p
7480	80p
7482	£1·04
7483	£1·58
7486	39p
7490	84p
7491A	£1·54
7492	£1·02
7493	90p
7494	£1·36
7495	96p
7496	£1·78
74100	£1·97
74107	62p
74121	51p
74141	£1·20
74150	£4·02
74151	£1·32
74153	£1·62
74154	£2·40
74155	£1·86
74156	£1·86
74190	£2·16
74191	£2·16
74192	£2·09
74193	£2·09
74196	£1·80
74197	£1·80
40250	58p
40310	56p
40312	56p
40360	40p
40361	38p
40362	40p
40406	44p
40407	34p
40408	50p
40409	52p
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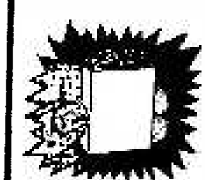

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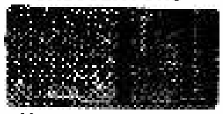

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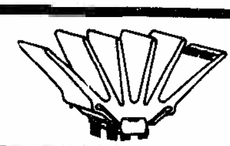

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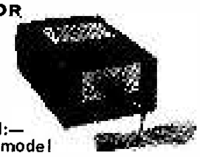

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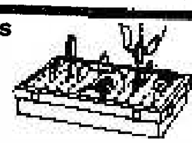

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