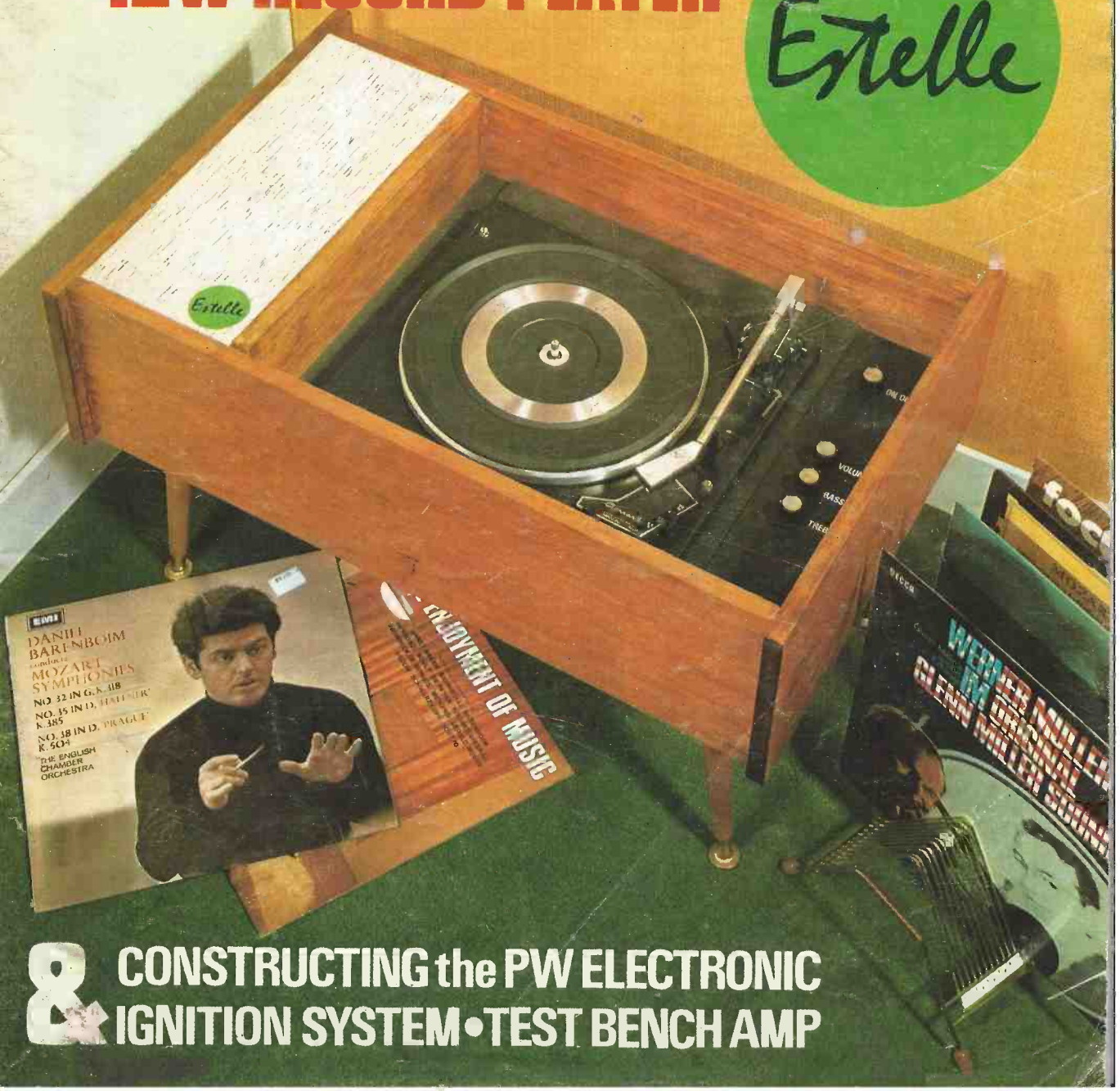
PRACTICAL WIRELESS

JUNE 1972

20p

12W RECORD PLAYER

Estelle



& CONSTRUCTING the PW ELECTRONIC IGNITION SYSTEM • TEST BENCH AMP

RSC HIGH-FIDELITY STEREO PACKAGE OFFERS

Four fully wired units ready to 'plug in'.

★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
★ GARRARD SP25 MK III Turntable on Plinth with cover
★ GOLDRING G850 Magnetic cartridge with diamond stylus
★ PAIR OF STANWAY II Speaker Units

Special Total Price **£87·75** Carr. £1·50

Terms: Deposit £12·75 and 9 monthly payments £9·37 (Total £97·08).

★ Super 30 Amplifier (15 + 15 watt) in veneered housing
★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
★ Goldring Magnetic P.U. Cartridge.
★ Pair of Stanway II speaker units.

Special Total Price **£99·75** Carr. £1·50

Terms: Deposit £14·75 and 9 monthly payments £10·52 (Total £110·33).

ATTRACTIVE TEAK OR AFRORMOSIA VENEERED CABINETS AND PLINTHS

Send S.A.E. for coloured brochure showing other money saving offers.

Matching as recommended for optimum performance. Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.

★ TA12 AMPLIFIER 6·5 + 6·5 watt in veneered housing
★ GARRARD SP25 MK III Player unit on Plinth
★ GOLDRING CS90 Ceramic P.U Cartridge with diamond stylus
★ PAIR OF DORCHESTER Loudspeaker Units

Special Total Price **£59**

Or Deposit £9 and 9 monthly payments £6·25 (Total £65·25). Carr. £1·25

Trans. Plastic Cover £3·15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. £1·25 **£51·75**

Or Deposit £8 and 9 monthly payments £5·58 (Total £58·22)

Trans. Plastic cover £3·15 extra.

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

★ **Moderate size only 25×14×10in.**
★ **Response 30-20,000 c.p.s. Impedance 15 ohms**

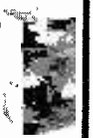
COMPLETE KIT Carr. 65p **£23**

★ **Performance comparable with units costing considerably more.**

Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8×5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4·60 and 9 monthly payments £2·47 (Total £26·83).

DEMONSTRATIONS AT ALL BRANCHES

HIGH FIDELITY LOUDSPEAKER UNITS



Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

DORCHESTER (Illustrated) Size 16×11×9in. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13×8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£9·45** Carr. 40p.

STANWAY II Size 20×10¾×9¾in. approx. Rating 10 watts. Inc. 13×8in. speaker with highly flexible cone surround, long throw voice coil and 10,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. See 'package offers' for illustration **£17·85**

R.S.C. TA12 MKIII 6·5+6·5 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL

Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. −2dB ★ Harmonic Distortion 0·3% at 1,000 c.p.s. Hum and Noise −70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & Knobs.

COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. £15.50 Carr. 40p. **Factory built with 12 mths. guarantee £19·50**

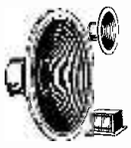
Deposit £3 and 9 mthly pymts £2·15 (Total £22·35). Or in Teak veneer housing Dep. £3 & 9 mthly payments £2·55 (Total £25·95). Send S.A.E. for leaflet. **£23**

Individual Ganged Controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 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 P.U. or Tape/Radio. For loudspeaker output impedances of 3 to 15 ohms. For standard 200–250v. A.C. mains operation. Attractive Black and Silver finished metal facia plate and matching control knobs.

COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11·50** Carr. 40p

Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated **£14·99** or dep. **£2·20** and 9 monthly payments **£1·70** (Total **£17·50**).

AUDIOTRINE HI-FI SPEAKER SYSTEMS



Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. £5·95 Carr. 30p

OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER £6·95 Carr. 35p

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. All sizes approx. Carr. 35p. per enclosure.

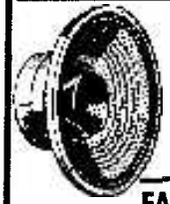
JE8 Size 16×11×9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**

SE8 For optimum performance with any 8in. Hi-Fi speaker. Size 22×15×9in Ported. **£6·47**

SE10 For outstanding results with 10in. Hi-Fi spkr. Size 24×15×10in. P'td. **£6·74**

SE12 For exclnt prfmcne with 12in Hi-Fi speaker and Tweeter. Size 25×16×10½in. **£7·87**

AUDIOTRINE HIGH FIDELITY SPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround. "D" 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	£2·88	HF120D	12″	15W	£4·75
HF102D	10″	10W	£3·40	HF126	12″	15W	£5·50
HF120	12″	15W	£4·25	HF126D	12″	15W	£5·90

R.S.C. BATTERY/MAINS CONVERSION UNITS

TYPE BM1. An all-dry battery eliminator. Size 5¼×4¼×2in. approx. Completely replaces batteries supplying 1·5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available.

COMPLETE KIT WITH DIAGRAM **£3·25** ASSEMBLED READY FOR USE **£3·75**

FANE 807 HIGH FIDELITY 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 3 or 8-15 Ω. STATE WHEN ORDERING **£3·85**

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

200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. 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 Output rating I.H.F.M. Fully enclosed enamelled case, 9¼×2¾×5¼in. Attractive brushed silver finish facia plate 10¼×3¼in. and matching knobs.

Complete kit of parts with full wiring diagrams and instructions. £7·50 Carr 40p

OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £9·75

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

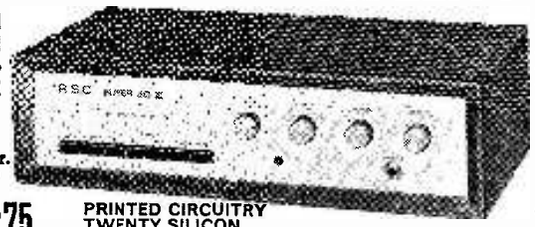
A COMPLETELY NEW DESIGN FURTHER IMPROVED IN BOTH APPEARANCE and PERFORMANCE. REPRESENTING VALUE FAR HIGHER THAN THE PRICES SUGGEST.

Only high grade components by leading manufacturers:

COMPLETE KIT OF PARTS Carr. 65p **£25**

Or **FACTORY BUILT** with 12 months guarantee. Dep. £5·75 and 9 monthly payments £3·50 (Total £37·25.) **£33·75**

Or **FACTORY BUILT** in cabinet as illustrated. Dep. £7 and 9 monthly payments £3·99 (Total £42·91) **£38·75**



PRINTED CIRCUITRY
TWENTY SILICON TRANSISTORS.
FOUR DIODES,
FOUR RECTIFIERS

★ **SATIN SILVER METAL FACIA** with black lettering. Black edged knobs with bright silver centres.
★ **PUSH-BUTTON SELECTOR SWITCHING**
★ **NEON INDICATOR**
★ **JACK SOCKET FOR HEADPHONES**
★ **CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE CERAMIC or MAGNETIC, REGARDLESS OF PRICE. WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.**

OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.
HUM & NOISE −75dB Min. Vol. −65dB Full Vol. **HARMONIC DISTORTION**
FREQUENCY RESPONSE: −3dB 7Hz to 70kHz 0·1% at 1000 Hz 10 Watts
TREBLE CONTROL: +16dB to −12dB at 14kHz
BASS CONTROL: +17dB to −16dB at 40Hz **CROSS TALK** −58dB
SENSITIVITIES: Disc Mag. 2·5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

TECHNICAL DETAILS (Applying to each channel where appropriate)
CONTROLS: PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono L (5) Mono R (6) SPEAKER DIS. (7) Mains on/off. Bass, Treble and Balance. Plus Ceramic Mag P.U. Switch.

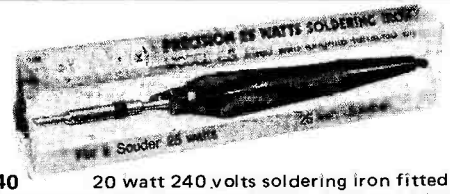
CN.240/2 Miniature soldering iron 15 watt 240 volts, fitted with nickel plated 3/32" bit and packed in transparent display box. Also available for 220 volts. **Price £1.70**

CN.240 Miniature soldering iron 15 watt 240 volts, fitted with iron coated 3/32" bit. Up to 18 interchangeable spare bits obtainable. This iron can also be supplied for 220, 110, 50 or 24 volts. **Price £1.70**

G.240 Miniature soldering iron 18 watt 240 volts extensively used by H.M. Forces. Suitable for high speed soldering and fitted with iron coated 3/32" bit. Also available for 220 volts. Spare bits 1/8", 3/16" and ¼" are obtainable. **Price £1.83.**

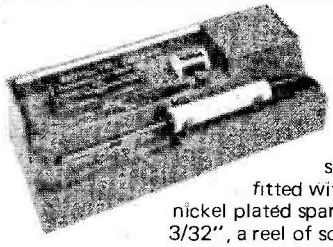
CCN.240 New model 15 watt 240 volts miniature soldering iron with ceramic shaft to ensure perfect insulation (4,000 v A.C.). Will solder live transistors in perfect safety; fitted with 3/32" iron coated bit. Spare bits 1/8" 3/16" and ¼" available. Can also be supplied for 220 volts. **Price £1.80**

CCN.240/7 The same soldering iron fitted with our new 7-star high efficiency bit for very high speed soldering The triple-coated bits are iron, nickel and chromium plated. **Price £1.95**



E.240 20 watt 240 volts soldering iron fitted with ¼" iron coated bit. Spare bits 3/32", 1/8" and 3/16" available. Can also be supplied for 220 and 110 volts. **Price £1.80.**

ES.240 25 watt 240 volts soldering iron fitted with 1/8" iron coated bit. Spare bits 3/32", 3/16" and ¼" available. Can also be supplied for 220 and 110 volts. **Price £1.83**



SK.1 SOLDERING KIT

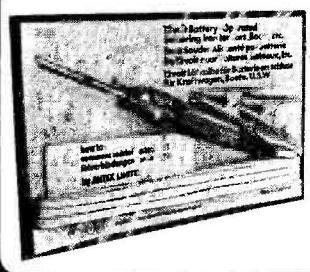
The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

Price £2.75

SK. 2 SOLDERING KIT

This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder"

Price £2.40.



MES. 12

A battery operated 12 volts 25 watt soldering iron complete with 15' lead, two crocodile clips for connection to car battery and a booklet "How to Solder" packed in a strong plastic wallet.

Price £1.95.

sign here to answer all your soldering problems

I enclose cheque/P.O./Cash (Giro No. 2581000)

Name _____

Address _____

PW6

☐ Please send the Antex colour catalogue.

Please send the following:

_____

_____

_____

A N T E X

from electrical, radio or car accessory shops or from **Antex Ltd., Freepost** (no stamp required) **Plymouth PL1 1BR** Telephone 0752 67377/8

All prices in pounds and new pence

VALVES

		6BA6	25	6J6	20	7C5	£1·13	12SR7	40	37	40	DAF91	30	EBL31	£1·50	EL41	60	N108	£1·50	PL508	90	UABC80	40
		6BE6	30	6J7M	45	7C6	75	14H7	50	42	50	DAF96	45	EC90	33	EL42	65	OA2	38	PL509	£1·10	UAF42	55
		6BH6	75	6J7G	30	7D5	60	19AQ5	50	50B5	50	DCC90	£1·35	EC81	35	EL84	25	OC3	38	PL802	95	UBC41	50
1A7GT	45	6BJ6	50	6J7GT	45	7H7	50	20D1	50	50C5	50	DF33	55	EC82	30	EL95	35	OZ4	40	PX4	£2·50	UBC81	40
1CP31	£7·00	6BQ7A	45	6K6GT	60	7R7	75	20P2	70	50CD6G	£1·20	DF70	45	EC83	30	ELL80	£1·00	PC86	60	PX25	£2·50	UBF80	40
1D5	50	6BR7	90	6K7M	35	7S7	£2·25	20L1	£1·10	50L6GT	55	DF91	30	EC84	30	EM80	45	PC88	60	PY33	63	UBF89	35
1H5	50	6BR8	70	6K7G	35	7Y4	65	20P4	£1·10	75	50	DF92	20	EC85	40	EM81	60	PC97	50	PY81	30	UCC84	43
IN5GT	55	6BS7	£1·30	6K7GT	35	9BW6	60	20P5	£1·20	78	45	DF96	45	EC88	40	EM84	35	PC84	40	PY82	35	UCC85	40
IR5	40	6BW6	85	6K8M	60	10C2	63	25A6	35	80	55	DH3-91	£7·00	ECH21	63	EY51	40	PCC89	55	PY83	38	UCF80	55
1S4	30	6BW7	80	6K8G	40	10F1	75	25L6GT	50	85A2	50	DH77	35	ECH35	£1·00	EY86	40	PCC189	55	PY500	£1·00	UCH42	70
1S5	30	6C4	33	6K8GT	50	10F9	90	25Y5	65	150B2	60	DK32	45	ECH42	75	EZ35	40	PCF80	30	PY800	40	UCH81	40
1T4	30	6C5G	35	6K25	75	10P9	60	25Z4	30	150C4	60	DK91	40	ECH81	30	EZ40	50	PCF82	35	PY801	50	UCL82	35
3A4	40	6C6	25	6L6G	50	10F18	50	25Z5GT	55	801	60	DK92	55	ECH83	45	EZ41	50	PCF84	60	R2	75	UCL83	60
3Q4	50	6CD6G	£1·25	6L18	45	10LD11	65	25Z6	65	807	50	DK96	50	ECL80	45	EZ80	27	PCF86	60	R19	50	UF41	60
3Q5	50	6CH6	60	6Q7G	40	10P13	60	30C1	30	813FSA	£3·75	DL66	£1·25	ECL82	35	EZ81	29	PCF801	50	S130	£1·75	UF89	40
3S4	35	6CW4	65	6Q7GT	43	11E3	£4·00	30C15	80	866A	75	DL92	35	ECL83	70	GY501	80	PCF802	50	SP4	50	UL41	65
3V4	48	6D6	35	6S7M	40	12AT6	30	30C17	90	954	60	DL93	40	ECL86	40	GZ30	40	PCF805	80	SP41	60	UL84	40
5R4GY	75	6E5	60	6S7M	75	12AT7	35	30C18	80	1625	55	DL94	48	ECLL800		GZ32	48	PCF806	70	SP61	75	UM80	30
5U4G	35	6F1	70	6S7M	40	12AU6	35	30F5	85	4022AR	£5·50	DL95	50		£1·65	GZ34	60	PCF808	85	STV280/80		UY6	£1·05
5V4G	45	6F5G	90	6SH7M	40	12AU7	30	30FL1	75	5763	70	DL96	45	EF9	75	HN309	£1·50	PCL82	35		£10·00	UY7	£1·05
5Y3GT	40	6F6G	35	6SJ7GT	30	12AX7	30	30FL12	£1·20	7193	30	DM70	45	EF37A	£1·20	KT36	£1·00	PCL83	65	SU25	£1·00	UY8	£1·05
5Z4G	40	6F8G	50	6SK7GT	40	12BA6	40	30FL14	85	7475	50	DY86	33	EF39	50	KT61	£1·25	PCL84	45	SU2150	75	UY9	50
6/30L2	80	6F11	40	6S7GT	35	12BE6	40	30L15	85	A61	48	DY87	33	EF41	65	KT66	£2·05	PCL85	40	T41	£1·00	UY21	50
6A7	75	6F13	45	6SN7GT	35	12C8GT	35	30L17	80	ATP4	45	E88CC	65	EF50	25	KT81	£1·75	PCL86	45	TDD4	60	UY41	48
6A8G	40	6F14	70	6SQ7GT	40	12E1	£1·80	30P4	£1·12	ATP5	60	EA50	20	EF80	25	KT81(7C5)		PD500	£1·30	U10	75	UY85	40
6AK5	35	6F23	85	6T4GT	65	12J5GT	30	30P12	80	ATP7	60	EABC80	35	EF85	35		£1·13	PEN A4	£1·00	U14	75	VMP4G	85
		6F24	75	6U5G	40	12J7GT	50	30P19	85	AC2	£4·00	EAF42	55	EF86	30	KT88	£2·00	PEN B4	£1·00	U19	£3·00	VP4B	£1·25
6AM5	35	6F25	£1·00	6V6M	60	12K7GT	40	30PL1	75	AC5	75	EB91	20	EF89	28	KTW61	£1·00	PEN45	75	U25	80	VR105/30	38
6AM6	33	6F28	65	6V6G	30	12K8GT	50	30PL13	93	AZ1	55	EBC33	50	EF91	33	KTZ41	50	PEN46	40	U26	80	VR150/30	35
6AQ5	38	6F32	25	6V6GT	40	12Q7GT	40	30PL14	90	AZ31	55	EBC41	55	EF92	35	ML4	88	PL36	55	U78	35	VU111	75
6AS7G	85	6G6	25	6X4	35	12SA7GT	50	35A5	75	CBL31	£1·00	EBC90	35	EF98	75	ML6	40	PL81	50	U191	75	VU120	£1·00
6AT6	35	6H6	23	6X5G	40	12SG7	35	35L6	50	CCH35	75	EBF80	40	EF183	30	MSP4	50	PL82	45	U251	80	VU129	£1·00
6AU6	25	6J5M	50	6X5GT	40	12SH7	35	35W4	35	CL33	£1·30	EBF83	40	EF184	35	MU14	75	PL83	45	U301	63	VU133	75
6B4G	£1·00	6J5G	20	7B6	70	12SJ7	40	35Z3	70	CY30	63	EBF89	30	EL32	50			PL84	40	U403	60	VU139	75
6B8G	25	6J56T	30	7B7	50	12SK7	50	35Z4GT	60	CY31	43	EBL1	£1·00	EL33	£1·25	MX40	63	PL500	80	U404	60	VU150/20	38
								35Z5	50	DAC32	50	EBL21	60	EL34	50	N78	£1·50	PL504	80	U801	£1·18	VU160	35
																						VU178	75
																						VU179	75
																						VU189	75
																						VU201	75

Transistors

		2N2218	20	2N3819	35	AD149	50	BC169C	15	GET882	25	NKT223	33	OAZ201	50	OC35	50	OC81D	20	Z8170	10
		2N2219	20	2N4289	15	AD161	37	BFS98	28	GJ7M	37	NKT251	24	OAZ207	47	OC44	17	OC82	25	Z8178 P on A	
		2N2369A	15	AAZ12	30	AF115	25	BFY50	22	KS100A	20	NKT713	25	OAZ210	32	OC45	12	OC82D	20	ZTX107	15
1N914	07	2N697	15	2N2444	£1·91	AC126	20	BFY51	20	MJE520	87	OA70	10	OAZ222	45	OC57	60	OC84	25	ZTX108	12
1S113	25	2N706	10	2N2646	45	AC127	25	BFY90	25	BY100	15	MJE2955		OA71	10	OAZ224	45	OC58	60	OC170	25	ZTX300	12
1S202	23	2N1132	25	2N2904	20	AC128	20	BC107	10	BZY88	15		£1·37	OA81	08	OAZ241	22	OC59	65	OC171	30	ZTX304	25
2G302	22	2N1305	22	2N2926	10	ACY20	20	BC108	10	CBS1-40	47	MJE3055	87	OA85	12	OAZ242	23	OC71	12	OC200	40	ZTX500	16
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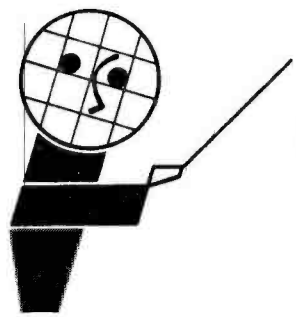

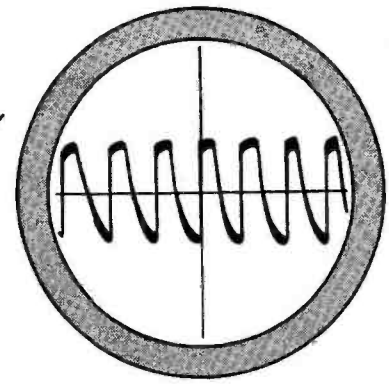

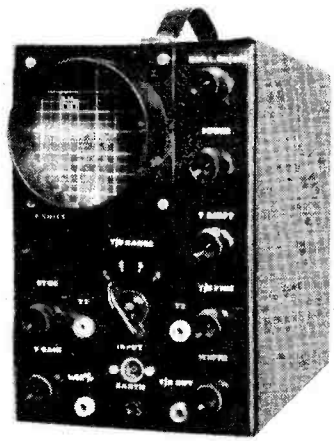

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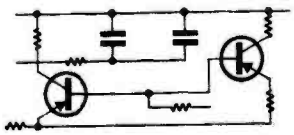

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BP90 = SN7490	0·67	0·64	0·58
BP91 = SN7491AN	0·87	0·84	0·78
BP92 = SN7492	0·67	0·64	0·58
BP93 = SN7493	0·67	0·64	0·58
BP94 = SN7494	0·77	0·74	0·68
BP95 = SN7495	0·77	0·74	0·68
BP96 = SN7496	0·77	0·74	0·68
BP100 = SN74100	1·75	1·65	1·55
BP104 = SN74104	0·97	0·94	0·88
BP105 = SN74105	0·97	0·94	0·88
BP107 = SN74107	0·40	0·38	0·36
BP110 = SN74110	0·55	0·53	0·50
BP111 = SN74111	1·25	1·15	1·00
BP115 = SN74118	1·00	0·95	0·90
BP119 = SN74119	1·35	1·25	1·10
BP121 = SN74121	0·67	0·64	0·58
BP141 = SN74141	0·67	0·64	0·58
BP145 = SN74145	1·50	1·40	1·30
BP150 = SN74150	1·80	1·70	1·60
BP151 = SN74151	1·00	0·95	0·90
BP153 = SN74153	1·20	1·10	0·95
BP154 = SN74154	1·80	1·70	1·60
BP155 = SN74155	1·40	1·30	1·20
BP156 = SN74156	1·40	1·30	1·20
BP160 = SN74160	1·80	1·70	1·60
BP161 = SN74161	1·80	1·70	1·60
BP164 = SN74164	2·00	1·90	1·80
BP165 = SN74165	2·00	1·90	1·80
BP181 = SN74181	2·75	2·60	2·40
BP182 = SN74182	0·97	0·94	0·88
BP190 = SN74190	3·50	3·25	3·00
BP191 = SN74191	3·50	3·25	3·00
BP192 = SN74192	2·10	1·95	1·75
BP193 = SN74193	2·10	1·95	1·75
BP195 = SN74195	1·10	1·05	0·95
BP196 = SN74196	1·80	1·70	1·60
BP197 = SN74197	1·80	1·70	1·60
BP198 = SN74198	5·50	5·00	4·00
BP199 = SN74199	5·50	5·00	4·00

PRICE-MIX. Devices may be mixed to qualify for quantity prices.
PRICES for quantities in excess of 500 pieces mixed, on application.
Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock. WARE 3442.

LINEAR I.C's—FULL SPEC.

Type No.	Price 1–24	25–99	100 up
BP 201C—SL201C	63p	53p	45p
BP701C—SL701C	63p	50p	45p
BP 702C—SL702C	63p	50p	45p
BP 702—72702	53p	45p	40p
BP709—72709	53p	45p	40p
BP 709P—μA709C	53p	45p	40p
BP 710—72710	53p	45p	40p
BP 711—μA711	53p	50p	45p
BP 741—72741	75p	60p	50p
μA703C—μA703C	43p	34p	27p
TAA 263—	70p	60p	55p
TAA 293—	90p	75p	70p
TAA 350	170p	158p	150p

S.G.S. EA1000 2·63

ROCK BOTTOM PRICES
LOGIC DTL 930 Series I.C's

Type No.	Price 1–24	25–99	100 up
BP930	12p	11p	10p
BP932	13p	12p	11p
BP933	13p	12p	11p
BP935	13p	12p	11p
BP936	13p	12p	11p
BP944	13p	12p	11p
BP945	25p	24p	22p
BP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP9093	40p	38p	35p
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

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

NUMERICAL INDICATOR TUBES

MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1·70	£1·55	£1·90

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

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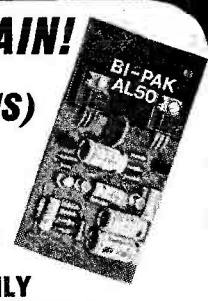
THE AL50



★ Frequency Response 15Hz to 100,000—1dB.

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★ Distortion—better than ·1% at 1KHz.

★ Signal to noise ratio 80dB.

ONLY £3.25p each

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★ Overall size 63mm × 105mm × 13mm.

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FULLY BUILT — TESTED — GUARANTEED.

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AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (rms) per channel, simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5amps at 35volts. Size: 63mm × 105mm × 30mm.

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STABILISED POWER MODULE SPM80 £2·95

TRANSFORMER BMT80 £1·95 p. & p. 25p.

SPECIAL COMPLETE KIT COMPRISING 2, AL50's, 1, SPM80 & 1, BMT80 ONLY £11 FREE p. & p.

DTL & TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C's and experimental work.

Pak No.		Pak No.	
UIC930 = 12 × μA 930 ..	50p	UIC948 = 8 × μA 948 ..	50p
UIC932 = 12 × μA 932 ..	50p	UIC951 = 5 × μA 951 ..	50p
UIC933 = 12 × μA 9o3 ..	50p	UIC961 = 12 × μA 961 ..	50p
UIC935 = 12 × μA 935 ..	50p	UIC9093 = 5 × μA 9093 ..	50p
UIC936 = 12 × μA 936 ..	50p	UIC9094 = 5 × μA 9094 ..	50p
UIC944 = 12 × μA 944 ..	50p	UIC9097 = 5 × μA 9097 ..	50p
UIC945 = 8 × μA 945 ..	50p	UIC9099 = 5 × μA 9099 ..	50p
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Packs cannot be split but 25 Assorted Pieces (our mix) is available as Pack UICX9 Data Booklet available for the BP930 Series, PRICE 13p

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UIC01 = 12 × 7401N	50p	UIC47 = 5 × 7447N	50p	UIC82 = 5 × 7482N	50p
UIC02 = 12 × 7402N	50p	UIC48 = 5 × 7448N	50p	UIC83 = 5 × 7483N	50p
UIC03 = 12 × 7303N	50p	UIC50 = 12 × 7450N	50p	UIC86 = 5 × 7486N	50p
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UIC10 = 12 × 7410N	50p	UIC54 = 12 × 7454N	50p	UIC92 = 5 × 7492N	50p
UIC13 = 8 × 7413N	50p	UIC60 = 12 × 7460N	50p	UIC93 = 5 × 7493N	50p
UIC20 = 12 × 7420N	50p	UIC70 = 8 × 7470N	50p	UIC94 = 5 × 7494N	50p
UIC40 = 12 × 7440N	50p	UIC72 = 8 × 7472N	50p	UIC95 = 5 × 7495N	50p
UIC41 = 5 × 7441AN	50p	UIC73 = 8 × 7473N	50p	UIC96 = 5 × 7496N	50p
UIC42 = 5 × 7442N	50p	UIC74 = 8 × 7474N	50p	UIC121 = 5 × 74121N	50p
UIC43 = 5 × 7443N	50p	UIC75 = 8 × 7475N	50p	UICX1 = 25 × Asst'd 74's	£1·50
UIC44 = 5 × 7444N	50p	UIC76 = 8 × 7476N	50p		
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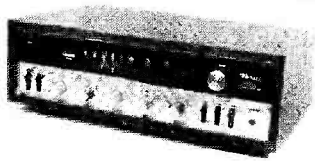

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Garrard 401	£28·95
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Sansui 1050C	£62·00

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TK 141	£47·00
TK 146	£52·00
TK 248	£120·00
TK 3200	£100·00
SV 85	£100·00
RT 100	£140·00
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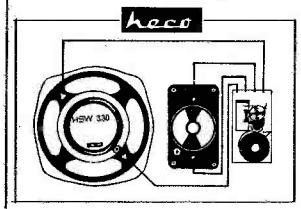

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Baffle Unit
Freq. Response 45–25,000Hz
Power Handling 30 watts RMS
Retail £20·22
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ERSIN Multicore 5 CORE SOLDER

for fast, easy reliable soldering

Ersin Multicore Solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required.

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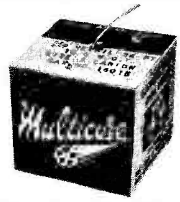

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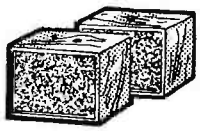
FANTASTIC! WHARFEDALE BARGAINS

SAVE £8.90 ON DENTON 2



Sold in matched pairs. Each Denton contains an 8in. bass unit with 3in. pressure unit, coupled by a Wharfedale crossover network. Rated input: 18 watts maximum. Frequency response: 65-17,000 Hz. Impedance: 4/8 ohms. Cabinet 9¾in. x 14in. x 8¼in.

List Price C&P £2·00
£39·90 Per Pair
LASKY'S PRICE £31·00

	List Price	Lasky's Price	C&P
LINTON 2 Pair	£49·90	£38·75	£2
TRITON 3 Pair	£65·00	£51·50	£2
MELTON 2 each	£35·00	£25·50	£1
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UNIT 3 each	£12·50	£9·50	50p
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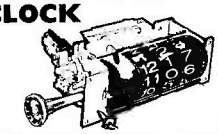

EXCLUSIVELY FROM LASKYS
The lock measures 4¾ W x 1¾ H x 3¾ D (overall from front of drum to back of switch). SPEC.: 210/240V a.c. 50Hz operation; switch rating 250V, 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS COMPLETE WITH KNOBS. FEATURES: ● MAINS OPERATION ● 12-HOUR ALARM ● AUTO "SLEEP" SWITCH ● HOURS, MINUTES AND SECONDS READ-OFF ● FORWARD AND BACKWARD TIME ADJUSTMENT ● SILENT OPERATION ● SHOCK AND VIBRATION PROOF ● BUILT IN ALARM BUZZER**

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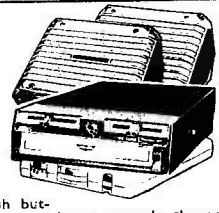
BSR TD8S

8 TRACK STEREO CARTRIDGE PLAYER
The unit is switched on and off by the insertion of the cartridge; The TD8S is suitable for use with most modern stereo amplifiers and delivers a pre-amp output of 125mW. Power requirements: 210/250V AC, 50Hz. Frequency response: 50Hz-10KHz. 4 pole dynamically balanced synchronous motor maintains unwavering speed accuracy - independent of mains fluctuations. Compact in size the TD8S is housed in black and woodgrain plastic cabinet. Size: 8½(W) x 3¾(H) x 10¼ (D) in.

List Price £24·20 **LASKYS PRICE £17·95** C&P 35p

BELTEX 8 TRACK



Stereo car Player
Accepts all standard pre-recorded 8 track stereo cartridges and other features include automatic head cleaner, channel select and channel repeat push buttons, slider type volume and tone controls, channel balance control. Tech spec. max output 10W (5 watts per channel), frequency response 50Hz-10kHz. Output imp. 4 ohms. size 4¾(W) x 1⅛(H) x 6¼(D) in. Operates on 12V DC negative earth systems. Beautifully styled with black ivory and chrome trim finish.

BELTEK C5700 complete with mounting brackets and 8-track pre-recorded demonstration cartridge
£19·75 C&P 25p each

BELTEK C5700 8 track player complete with pair SP24 speakers
£24·95

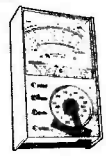
Beltek SP24 speakers are available perfectly matching the C5700 in performance and finish specially designed for optimum performance in heavily damped car interior. Size: 7¼in(W) x 6in(D) x 4⅜in. rear, 2¼in front (H). Comp with connecting leads.
£5·95 Pair C&P 25p

TM-1 TEST METER

1000 ohms/volt
Lasky's new look top value TM-1 is a really tiny pocket multimeter providing "big" meter accuracy and performance. Precision movement calibrated to +3% of full scale. Click stop range selection switch. Beautifully designed and made impact resistant black case with white and metalic red/green figuring. Ohms zero adjustment. 1000's IN USE. SIZE ONLY 2⅞x3⅛x1⅜ ● DC/V: 0–10–50–250–1000 at 1K/ohms/V. ● AC/V: 0–10–50–250–1000 at 1K/ohms/V. ● DC Current: 0–1mA, 100mA. ● Resistance: 0–150K ohms. ● Decibels: –10 + 22dB. ● Complete with test leads.

LASKYS PRICE £1.85 C.&P. 15p

TM-5 TEST METER



5000 ohms/volt
Another pocket multimeter from Lasky's. The "slimline" impact resistant case–size 4¾in x 2¼in x 1¾in fitted with extra large 2¾in square meter. Readability is superior on all low ranges, making this an excellent instrument for servicing transistorised equipment. Zero ohms adjustment. Buff finish with crystal clear meter cover. ● DC/V: 3–15–150–300–1,200 at 5K ohms/V. ● AC/V: 6–30–300–600 at 2·5K/ohms/V. ● DC Current: 0–300μA, 0–300mA. ● Resistance: 0–10K/ohms, 0–1M/ohms. ● Decibels: –10dB to 16dB. ● Complete with test leads, battery and instructions

LASKYS PRICE £2.55 C.&.P 35p

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High precision low-mass counter-balanced pick-up arm, heavy balanced turntable, simple to operate controls, viscous cueing device, slide in cartridge carrier, 4 pole motor.

LASKYS PRICE £10.95 C.&.P. 50p

BSR McDONALD UNITS & PACKAGES
A. Chassis only. **B.** Complete with Lasky's plinth and cover. **C.** Complete with Lasky's plinth. **D.** Comp. wired on BSR plinth with cover. **E.** As D plus AD76K carridge.

MODEL	A	B	C	D	E
MP.60	10·95	15·50	18·50	18·75	22·00
HT.70	15·90	19·90	23·50	23·75	27·00
610	14·50	18·75	23·00	22·25	25·50
510	12·10	16·50	18·85	20·00	22·85
310	9·75	14·00	16·50	17·25	20·25
MP.60 TPD2 Styrene base				17·50	21·00

210 Complete with plinth, cover & BSR cartridge £9·95

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A new two waveband all transistor car radio that covers full medium and long wavebands with slide switch wave change. Large easy to grip controls. Illuminated dial with "easy to read" lining scale. Externally adjustable aerial trimmer ensures maximum output. Powerful output stage gives perfect reproduction through either one or two speakers. Operates on all 12 volt D.C. system. Negative or positive earth. Standard size 6¼in (W) x 4¼in (D) x 2in (H). Black with chrome trim. Complete with speaker, baffle, leads, mounting brackets and instructions. Fully guaranteed. Complete with speaker, baffle & mounting bracket.

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STEREO 30 PLUS amplifier (cased)
List Price £62·50 **LASKY'S PRICE £45·00** C & P £1·00

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List Price £75·00 **LASKY'S PRICE £55·00** C & P £1·00

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List £69·50 **Lasky's Price £47·50** C & P £1·50

CAR RADIOS FROM PHILIPS

MODEL RN 214/15

RN214 is a triumph of micro-miniaturisation. So compact and light, mounted on its spindles only, it needs no real support. The RN214 can be fixed quickly and easily. **Spec:** Power supply: 13 volt D.C. negative earth operation only. Power output: 5 watts. Wave ranges: Medium wave: 185m-586m (1622-512kHz). Long wave: 1030m-2000m (290-150 kHz). Intermediate frequency: 470kHz. Size: 7in x 1·6in x 3·6in. **EN8893/05 general purpose mounting kit with loudspeaker £2·70 extra.**

List Price £19·25 **LASKYS PRICE £15·50** C.&P. 25p

Model RN 314/15

The RN314 gives you big sound because of the high sensitivity from the tuned RF stage. Due to its compact size it can be mounted without any rear support. Spec: power supply: 12V DC neg earth only. Power output: 5 watts RMS. Wave ranges: Medium 185m-586m (1622-512kHz): Long 1030m-2000m (290–150kHz). Intermediate frequency: 470kHz. Size: 7in x 1·6in x 3·6in. **EN8893/05 general purpose mounting kit with loudspeaker £2·70 extra.**

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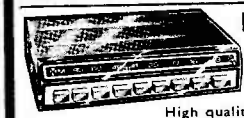

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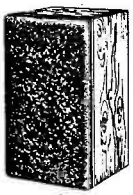

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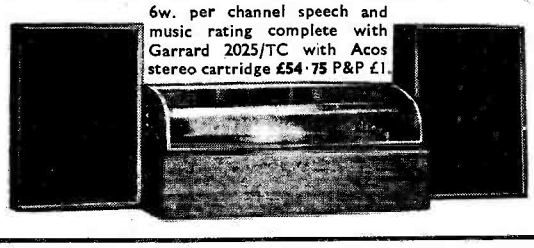

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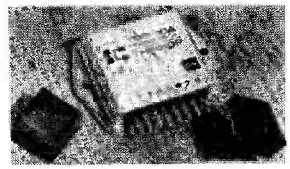

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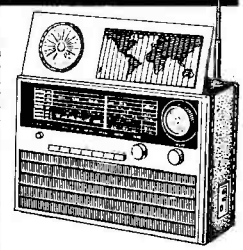

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100-0-100μA	£3·35	1 amp. D.C.	£3·10
500μA	£3·20	5 amp D.C.	£3·10
1mA	£3·10	300V. A.C.	£3·10
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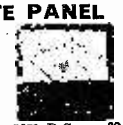

50μA	£3·20	50V. D.C.	£2·60
50-0-50μA	£3·10	300V. D.C.	£2·60
100μA	£3·10	1 amp. D.C.	£2·60
100-0-100μA	£3·00	5 amp. D.C.	£2·60
500μA	£2·75	300V. A.C.	£2·60
1mA	£2·60	VU Meter	£3·37
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Type MR.85P. 4¼in. × 4¾in. fronts.

50μA	£3·60	50mA	£2·80
50-0-50μA	£3·10	100mA	£2·80
100μA	£3·10	500mA	£2·80
100-0-100μA	£3·00	1 amp.	£2·80
200μA	£3·00	5 amp.	£2·80
500μA	£2·90	15 amp.	£2·80
500-0-500μA	£2·80	30 amp.	£2·90
1mA	£2·80	20V. D.C.	£2·80
1-0-1mA	£2·80	50V. D.C.	£2·80
5mA	£2·80	150V. D.C.	£2·80
10mA	£2·80	300V. D.C.	£2·80
		15V. A.C.	£2·80
		300V. A.C.	£2·80
		S Meter 1mA	£2·87
		VU Meter	£3·60
		1 amp. A.C.*	£2·80
		5 amp. A.C.*	£2·80
		10 amp. A.C.*	£2·80
		20 amp. A.C.*	£2·80
		30 amp. A.C.*	£2·80

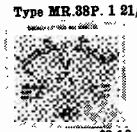
Type MR.52P. 2¼in. square fronts.

50μA	£3·10	10V. D.C.	£2·00
50-0-50μA	£2·60	20V. D.C.	£2·00
100μA	£2·60	50V. D.C.	£2·00
100-0-100μA	£2·50	300V. D.C.	£2·00
500μA	£2·30	15V. A.C.	£2·10
1mA	£2·00	300V. A.C.	£2·10
5mA	£2·00	S Meter 1mA	£2·10
10mA	£2·00	VU Meter	£3·20
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3¼in. × 3¼in. fronts.

50μA	£3·37	10V. D.C.	£2·20
50-0-50μA	£2·75	20V. D.C.	£2·20
100μA	£2·75	50V. D.C.	£2·20
100-0-100μA	£2·65	150V. D.C.	£2·20
200μA	£2·65	300V. D.C.	£2·20
500μA	£2·40	15V. A.C.	£2·30
500-0-500μA	£2·20	50V. A.C.	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	S Meter 1mA	£2·37
100mA	£2·20	VU Meter	£3·37
500mA	£2·20	50mA A.C.*	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.	£2·20	500mA A.C.*	£2·20
15 amp.	£2·20	1 amp. A.C.*	£2·20
20 amp.	£2·20	5 amp. A.C.*	£2·20
30 amp.	£2·30	10 amp. A.C.*	£2·20
50 amp.	£2·50	20 amp. A.C.*	£2·20
5V. D.C.	£2·20	30 amp. A.C.*	£2·20

Type MR.38P. 1 21/32in. square fronts.



50μA	£2·10	200mA	£1·60
50-0-50μA	£1·90	300mA	£1·60
100μA	£1·90	500mA	£1·60
100-0-100μA	£1·75	750mA	£1·60
200μA	£1·75	1 amp.	£1·60
500μA	£1·65	2 amp.	£1·60
500-0-500μA	£1·60	5 amp.	£1·60
1mA	£1·60	10 amp.	£1·60
1-0-1mA	£1·60	3V. D.C.	£1·60
2mA	£1·60	10V. D.C.	£1·60
5mA	£1·80	15V. D.C.	£1·60
10mA	£1·60	20V. D.C.	£1·60
20mA	£1·60	100V. D.C.	£1·60
50mA	£1·60	150V. D.C.	£1·60
100mA	£1·60	300V. D.C.	£1·60
150mA	£1·60	500V. D.C.	£1·60
		750V. D.C.	£1·60
		15V. A.C.	£1·70
		50V. A.C.	£1·70
		150V. A.C.	£1·70
		300V. A.C.	£1·70
		500V. A.C.	£1·70
		S Meter 1mA	£1·70
		VU Meter	£2·10

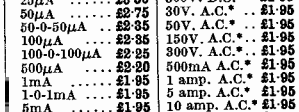
Type MR.45P. 2in. square fronts.

50μA	£2·25	5 amp.	£1·70
50-0-50μA	£2·10	10V. D.C.	£1·50
100μA	£2·10	20V. D.C.	£1·50
100-0-100μA	£1·87	50V. D.C.	£1·50
200μA	£1·87	300V. D.C.	£1·50
500μA	£1·75	15V. A.C.	£1·80
500-0-500μA	£1·70	300V. A.C.	£1·80
1mA	£1·70	S Meter 1mA	£1·85
5mA	£1·70	VU Meter	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
500mA	£1·70	20 amp. A.C.*	£1·70
1 amp.	£1·70	30 amp. A.C.*	£1·70

"SEW" BAKELITE PANEL METER

Type MR.65. 3¼in. square fronts.

25μA	£3·50	1 amp.	£1·95
50μA	£2·75	2 amp.	£1·95
50-0-50μA	£2·35	5 amp.	£1·95
100μA	£2·35	15 amp.	£1·95
100-0-100μA	£2·25	30 amp.	£1·95
500μA	£2·20	50 amp.	£1·95
1mA	£1·95	5V. D.C.	£1·95
1-0-1mA	£1·95	10V. D.C.	£1·95
5mA	£1·95	20V. D.C.	£1·95
10mA	£1·95	50V. D.C.	£1·95
50mA	£1·95	150V. D.C.	£1·95
100mA	£1·95	300V. D.C.	£1·95
500mA	£1·95	30V. A.C.*	£1·95
		50V. A.C.*	£1·95
		150V. A.C.*	£1·95
		300V. A.C.*	£1·95
		500mA A.C.*	£1·95
		1 amp. A.C.*	£1·95
		5 amp. A.C.*	£1·95
		10 amp. A.C.*	£1·95
		20 amp. A.C.*	£1·95
		30 amp. A.C.	£1·95
		50 amp. A.C.	£1·95
		VU Meter	£3·10



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Type PE.70. 3 17/32in. × 1 15/32in. × 2¾in. deep

50μA	£3·10	500μA	£2·75
50-0-50μA	£3·00	1mA	£2·45
100μA	£3·00	300V. A.C.	£2·45
100-0-100μA	£2·90	VU Meter	£3·40
200μA	£2·90		

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1-0-1mA	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c.	£4·65
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Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. £17·50. Carr. 37½p.

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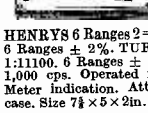
TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 megΩ 6 Ranges ±1% L.1 μ H - 111 HENRYS 6 Ranges 2 = %C.10pF ±1110mFd 6 Ranges ± 2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7⅛ × 5 × 2in. £20. P. & P. 25p

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Built in gearbox. All brand new and boxed. 60 RPM CW; 30 RPH CW; 2R/HR ACW; 2R/HR CW; 8R/DAY CW; 10 RPM CW; 20R/HR ACW.
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HIOKI MODEL 720X

20,000 O.P.V. Overload protection 5/25/100/500/1000 VDC. 10/50/250/1000 VAC. 50uA/250mA. 20K/2 meg ohm. −5 to + 62db. £4·97. P. & P. 15p.

ModelS-100TRMULTIMETER/TRANSISTOR TESTER.

100,000o.p.v. mirror scale/overload protection. 0/·12/·6/3/12/30/120/600 VDC. 0/6/30/120/600 VAC. 0/12/600μA/12/300mA/12 AMP DC. 0/10 K/1MEG/100MEG. −20to+50 db. 0·01–2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. £13·50. P/P 25p.

MODEL 500 30,000 O.P.V with overload protection mirror scale 0/·5/2·5/10/25/100/250/500/1,000v. D.C 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω. £8·87½. Post paid.

HT100B4 MULTI-METER

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Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/1000v A.C. DC Current 100 wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE £5·97 P. & P. 25p.

TO-3 PORTABLE OSCILLOSCOPE

3in. tube, Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1·5cps –800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. £40·00. Carr. 50p.

HONEYWELL DIGITAL VOLTMETER VT.100

Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ±0·2, ±1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5⅛in. × 2 13/16in. × 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. £49·97½. Carr. 50p.

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2N697	15p	2N3607	22p	3N140	77p	BC140	35p	BFX89	62p	NKT262	30p
2N698	25p	2N3638	18p	3N141	72p	BC141	35p	BFX93A	70p	NKT264	20p
2N699	30p	2N3638A	20p	3N142	55p	BC147	10p	BFY11	42p	NKT271	20p
2N706	10p	2N3641	18p	3N143	67p	BC148	10p	BFY18	25p	NKT262	20p
2N706A	12p	2N3642	18p	3N152	87p	BC149	12p	BFY19	25p	NKT274	20p
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2N914	17p	2N3694	18p	40312	47p	BC160	35p	BFY50	20p	NKT404	55p
2N916	17p	2N3702	10p	40314	37p	BC167	11p	BFY51	20p	NKT405	75p
2N918	30p	2N3703	10p	40315	37p	BC168B	10p	BFY52	20p	NKT406	62p
2N929	22p	2N3704	11p	40316	47p	BC168C	11p	BFY53	15p	NKT451	62p
2N930	20p	2N3705	10p	40317	37p	BC169B	11p	BFY56A	57p	NKT452	62p
2N987	40p	2N3706	9p	40319	55p	BC169C	12p	BFY76	42p	NKT453	47p
2N1090	22p	2N3707	11p	40320	47p	BC170	12p	BFY77	57p	NKT713	20p
2N1091	22p	2N3708	7p	40323	32p	BC171	15p	BFY90	65p	NKT717	42p
2N1131	25p	2N3709	9p	40324	47p	BC172	15p	BSX19	17p	NKT734	27p
2N1132	25p	2N3710	9p	40326	37p	BC175	22p	BSX20	15p	NKT736	35p
2N1302	17p	2N3711	12p	40329	30p	BC177	20p	BSX21	20p	NKT773	25p
2N1303	17p	2N3713	187p	40344	27p	BC178	20p	BSX26	45p	NKT781	30p
2N1304	22p	2N3714	200p	40347	57p	BC179	20p	BSX27	47p	OC16	50p
2N1305	22p	2N3715	123p	40348	52p	BC182	10p	BSX28	82p	OC19	37p
2N1306	25p	2N3716	130p	40360	40p	BC182L	10p	BSX60	82p	OC20	75p
2N1307	25p	2N3773	240p	40361	40p	BC183	9p	BSX61	62p	OC22	50p
2N1308	25p	2N3791	206p	40362	50p	BC183L	9p	BSX76	15p	OC23	60p
2N1309	25p	2N3819	34p	40370	32p	BC184	11p	BSX77	20p	OC24	60p
2N1507	17p	2N3820	55p	40406	57p	BC184L	11p	BSX78	25p	OC25	40p
2N1613	20p	2N3823	50p	40407	40p	BC186	25p	BSY24	15p	OC26	25p
2N1631	35p	2N3854	27p	40408	52p	BC187	27p	BSY25	15p	OC28	60p
2N1632	30p	2N3854A	27p	40409	55p	BC212L	12p	BSY26	17p	OC29	60p
2N1637	30p	2N3855	27p	40410	62p	BC213L	12p	BSY27	15p	OC35	50p
2N1638	27p	2N3855A	30p	40412	50p	BC214L	15p	BSY28	17p	OC36	60p
2N1639	27p	2N3856	30p	40467A	57p	BCY10	27p	BSY29	17p	OC41	22p
2N1701	162p	2N3856A	35p	40468A	35p	BCY30	27p	BSY32	25p	OC42	25p
2N1711	24p	2N3858	25p	40528	72p	BCY31	30p	BSY36	25p	OC44	15p
2N1889	32p	2N3858A	30p	40600	57p	BCY32	50p	BSY37	25p	OC45	12p
2N1893	37p	2N3859	27p	40603	50p	BCY33	25p	BSY38	20p	OC46	15p
2N2147	72p	2N3859A	32p	AC107	30p	BCY34	30p	BSY39	22p	OC70	15p
2N2160	57p	2N3860	30p	AC126	20p	BCY38	40p	BSY43	50p	OC71	12p
2N2193	40p	2N3866	150p	AC127	24p	BCY39	60p	BSY51	32p	OC72	12p
2N2193A	42p	2N3877	40p	AC128	20p	BCY40	50p	BSY52	32p	OC73	30p
2N2194	27p	2N3877A	40p	AC151	18p	BCY41	15p	BSY53	37p	OC74	30p
2N2194A	30p	2N3900	37p	AC152	22p	BCY42	15p	BSY54	40p	OC75	22p
2N2217	25p	2N3900A	40p	AC154	22p	BCY43	15p	BSY56	90p	OC76	22p
2N2218	20p	2N3901	97p	AC176	20p	BCY54	32p	BSY79	45p	OC77	30p
2N2219	20p	2N3903	20p	AC187	25p	BCY58	22p	BSY90	57p	OC78	20p
2N2220	25p	2N3904	25p	AC188	25p	BCY59	22p	BSY95A	12p	OC81	20p
2N2221	25p	2N3905	80p	ACY17	27p	BCY60	97p	C424	15p	OC81D	20p
2N2222	20p	2N3906	25p	ACY18	24p	BCY70	15p	C450	15p	OC82	25p
2N2222A	25p	2N4058	12p	ACY19	24p	BCY71	20p	GET102	30p	OC82D	15p
2N2297	30p	2N4059	10p	ACY20	20p	BCY72	15p	GET113	20p	OC83	25p
2N2368	15p	2N4060	12p	ACY21	20p	BCY78	30p	GET114	20p	OC84	25p
2N2369	15p	2N4061	12p	ACY22	10p	BCY79	30p	GET118	20p	OC139	25p
2N2369A	15p	2N4062	12p	ACY28	17p	BCZ10	27p	GET120	25p	OC140	32p
2N2410	42p	2N4244	47p	ACY39	47p	BCZ11	40p	GET873	12p	OC170	25p
2N2483	27p	2N4248	15p	ACY40	20p	BD112	50p	GET880	80p	OC171	30p
2N2484	32p	2N4249	15p	ACY41	15p	BD116	112p	GET887	20p	OC200	40p
2N2539	22p	2N4250	18p	ACY44	25p	BD121	65p	GET889	22p	OC201	60p
2N2540	22p	2N4254	42p	AD140	47p	BD123	80p	GET890	22p	OC202	75p
2N2613	35p	2N4255	42p	AD149	47p	BD124	60p	GET896	22p	OC203	40p
2N2614	30p	2M4284	17p	AD150	62p	BD131	75p	GET897	22p	OC204	40p
2N2646	40p	2N4285	17p	AD161	35p	BD132	80p	GET898	22p	OC205	75p
2N2711	25p	2N4286	17p	AD162	35p	BDY10	125p	MAT100	25p	OC206	95p
2N2712	25p	2N4287	17p	AF109	45p	BDY20	105p	MAT101	25p	OC207	75p
2N2713	27p	2N4288	15p	AF114	25p	BDY61	125p	MAT120	25p	OCP71	42p
2N2714	30p	2N4289	17p	AF115	25p	BDY62	100p	MAT121	25p	ORP12	50p
2N2904	20p	2N4290	12p	AF116	25p	BF115	25p	MJ400	107p	ORP60	40p
2N2904A	25p	2N4291	15p	AF117	20p	BF117	47p	MJ420	80p	ORP61	42p
2N2905	25p	2N4292	15p	AF118	60p	BF152	28p	MJ421	80p	P346A	22p
2N2905A	20p	2N4294	17p	AF121	30p	BF154	20p	MJ430	102p	ST140	15p
2N2906	20p	2N4303	47p	AF124	22p	BF158	15p	MJ440	95p	ST141	20p
2N2906A	25p	2N4964	15p	AF125	19p	BF159	35p	MJ480	97p	TIS34	62p
2N2907	23p	2N4965	18p	AF126	19p	BF163	35p	MJ481	125p	TIS43	40p
2N2923	15p	2N5027	52p	AF127	16p	BF167	18p	MJ490	100p	TIS44	10p
2N2924	15p	2N5028	57p	AF139	28p	BF170	33p	MJ491	137p	TIS45	27p
2N2925	15p	2N5029	47p	AF178	42p	BF173	19p	MJE340	50p	TIS46	11p
2N2926G	10p	2N5030	42p	AF179	45p	BF177	30p	MJE370	80p	TIS47	11p
2N2926O	10p	2N5172	12p	AF180	50p	BF178	25p	MJE371	80p	TIS48	12p
2N2926Y	10p	2N5174	52p	AF181	40p	BF179	30p	MJE520	60p	TIS49	12p
2N3011	20p	2N5175	52p	AF186	39p	BF180	35p	MJE521	70p	TIS50	12p
2N3014	32p	2N5176	45p	AF239	80p	BF181	32p	MPF102	42p	TIS51	10p
2N3053	18p	2N5232A	30p	AF279	47p	BF182	30p	MPF103	35p	TIS52	11p
2N3054	46p	2N5245	45p	AF280	47p	BF184	20p	MPF104	37p	TIS53	22p
2N3055	60p	2N5246	42p	AFZ11	32p	BF185	20p	MPF105	37p	XB112	12p
2N3133	30p	2N5249	67p	ASY26	25p	BF194	15p	MPS3638	32p	XC141	35p
2N3134	15p	2N5265	325p	ASY27	30p	BF195	15p	NKT124	42p	ZTX107	15p
2N3135	25p	2N5305	37p	ASY28	24p	BF196	15p	NKT125	27p	ZTX108	12p
2N3136	25p	2N5306	40p	ASY29	27p	BF197	15p	NKT126	27p	ZTX109	15p
2N3390	25p	2N5307	37p	ASY50	25p	BF198	15p	NKT128	27p	ZTX300	12p
2N3391	20p	2N5308	37p	ASY51	32p	BF200	35p	NKT135	27p	ZTX301	15p
2N3391A	30p	2N5309	62p	ASY54	25p	BF224	14p	NKT137	32p	ZTX302	20p
2N3392	17p	2N5310	42p	ASY67	45p	BF225	19p	NKT210	30p	ZTX303	20p
2N3393	15p	2N5354	27p	ASY86	32p	BF237	22p	NKT211	30p	ZTX304	25p
2N3394	15p	2N5355	27p	ASZ21	51p	BF238	22p	NKT212	80p	ZTX500	15p
2N3402	22p	2N5356	32p	AUY10	150p	BF244	23p	NKT213	30p	ZTX501	15p
2N3403	22p	2N5365	47p	BC107	10p	BFW61	47p	NKT214	20p	ZTX502	20p
2N3404	32p	2N5366	32p	BC108	10p	BFW87	25p	NKT215	22p	ZTX503	17p
2N3405	45p	2N5367	57p	BC109	10p	BFW88	23p	NKT216	35p	ZTX504	40p
2N3414	22p	2N5457	30p	BC113	10p	BFW89	20p	NKT217	40p	ZTX531	25p

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CA3028A	74p	FJJ141	125p	SN7476	45p
CA3028B	105p	FJJ181	75p	SN7483	87p
CA3029	87p	FJJ191	65p	SN7486	33p
CA3029A	165p	FJJ211	125p	SN7490	87p
CA3030	137p	FJJ251	125p	SN7492	87p
CA3035	122p	FJL101	125p	SN7493	87p
CA3036	72p	FJY101	25p	SN7495	87p
CA3039	82p	IC10	250p	SN7496	87p
CA3041	109p	IC12	250p	SN74107	52p
CA3042	109p	L900	40p	SN74153	135p
CA3043	137p	L914	40p	SN74154	200p
CA3044	120p	L923	40p	SN74160	180p
CA3045	122p	LM380	122p	SN74161	260p
CA3046	81p	MC724P	60p	SN74164	220p
CA3047	137p	MC780P	247p	SN74165	225p
CA3048	204p	MC788P	146p	SN74192	175p
CA3049	160p	MC790P	124p	SN74193	175p
CA3050	185p	MC792P	66p	TAA241	162p
CA3051	134p	MC799P	66p	TAA242	425p
CA3052	165p	MC1303L	200p	TAA243	150p
CA3053	46p	MC1304P	225p	TAA263	75p
CA3054	109p	MC1305P	386p	TAA293	97p
CA3055	240p	MC838P	549p	TAA300	175p
CA3059	165p	MC1435P	345p	TAA310	125p
CA3064	120p	MC1552G	461p	TAA320	72p
FCH101	85p	MC1709CG	94p	TAA350	175p
FCH111	105p	MFC4000P	55p	TAA435	147p
FCH121	105p	PA222	260p	TAA521	132p
FCH131	50p	PA230	140p	TAA522	360p
FCH141	105p	PA234	92p	TAA530	495p
FCH151	105p	PA237	210p	TAA811	445p
FCH171	105p	PA246	150p	TAB101	97p
FCH181	105p	PA424	235p	TAD100	150p
FCH191	105p	PA264	190p	TAD110	150p
FCH201	130p	PA265	200p	SL403D	15 p
FCH211	180p	SN7400	20p	SL702C	147p
FCH221	180p	SN7401	20p	UA702A	280p
FCH231	150p	SN7402	20p	UA702C	77p
FCJ101	160p	SN7403	20p	UA703C	137p
FCJ111	150p	SN7404	20p	UA709C	45p
FCJ121	275p	SN7405	20p	UA710C	125p
FCJ131	275p	SN7406	80p	UA716	187p
FCJ141	525p	SN7408	20p	UA723C	100p
FCJ201	100p	SN7409	20p	UA730C	160p
FCJ211	275p	SN7410	20p	UA741C	80p
FCK101	430p	SN7411	23p		
FCL101	230p	SN7413	30p		
FCY101	102p	SN7420	20p		
FJH101	25p				

BRIDGE RECTIFIERS PLASTIC ENCAPSULATED

600 PIV 1A	50p	50 PIV 4A	40p
50 PIV 2A	45p	100 PIV 4A	50p
100 PIV 2A	50p	200 PIV 4A	55p
200 PIV 2A	55p	400 PIV 4A	65p
400 PIV 2A	60p	600 PIV 4A	70p
		50 PIV 6A	45p
		100 PIV 6A	55p
		200 PIV 6A	65p
		400 PIV 6A	75p
		600 PIV 6A	85p

SILICON RECTIFIERS MINIATURE WIRE ENDED PLASTIC

SERIES	IN 1 AMP	PL 1·5 AMP	CL 3 AMP
4001 50PIV	7p	8p	19p
4002 100PIV	7p	9p	20p
4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	26p
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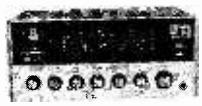

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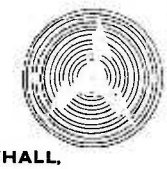

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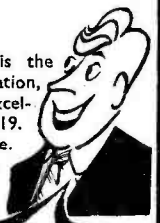

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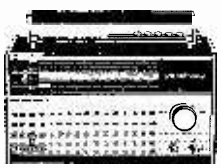

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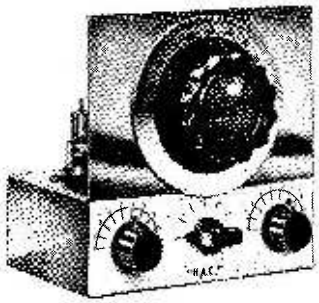

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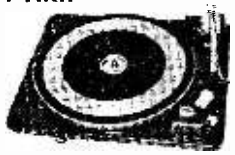

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8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns, Hi-Fi Enclosures Systems, etc. **£4**

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The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watts. 3 ohm or 15 ohm models. **£1·90** Post 10p.

SPEAKER COVERING MATERIALS. Samples Large S.A.E.
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SPECIAL OFFER! 80 ohm 2½in.; 2¾in.; 35 ohm, 2in.; 3in 25 ohm, 2½in. dia.; 3in dia.; 6 × 4in.; 8 × 5in. 15 ohm, 3½in. dia.; 6 × 4in.; 7 × 4in.; 3 ohm. 2¾in. 3in. 5 × 3in. **£1** EACH TYPE
LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in. £1·25; 6½in. £1·50; 8 × 5in. £1·60; 8 × 2½in. £1·50 8 in. £1·75; 10 × 6in. £1·90.
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. dia. 4 watt; 10in. dia. 5 watt; 12in. dia. 6 watt 3 or 8 or 15 ohm models £2.00 each. Post 15p.
VALVE OUTPUT TRANS. 25p; **MIKE TRANS.** 50:1 25p. **5 WATT MULTI-RATIO,** 3, 8 and 15 ohms 80p.

BAKER 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

4 inputs speech and music. Mixing facilities. Response 10-30,000 cps. Matches all loudspeakers. A.C. 200/250V. Separate Treble and Bass controls. Guaranteed. Details S.A.E. **£39** Post Free

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BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **£4·50**

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **STEREO VERSION OF ABOVE 24·50.** **£3·50**

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BARGAIN FM TUNER as above less cabinet **£8·85**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3·50**

COAXIAL PLUG 6p. **PANEL SOCKETS** 6p. **LINE** 18p. **OUTLET BOXES, SURFACE OR FLUSH** 25p. **BALANCED TWIN FEEDERS** 5p yd. 80 ohms or 300 ohms. **JACK SOCKET** Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p. **JACK PLUGS** Std. Chrome 15p; 3·5mm Chrome 14p. **DIN SOCKETS** Chassis 3-pin 10p; 5-pin 10p. **DIN SOCKETS** Lead 3-pin 18p; 5-pin 25p. **DIN PLUGS** 3-pin 18p; 5-pin 25p. **VALVE HOLDERS,** 5p; **CERAMIC** 8p; **CANS** 5p.

E.M.I. 13½ × 8in. LOUDSPEAKERS

With twin tweeters and crossover. 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4·25** Post 15p

With flared tweeter cone and ceramic magnet. 10 watts. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·75** Post 15p

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The Specification sounds fine the System sounds great

Viscount 111 Audio Suite complete £49

14 + 14W per channel 40Hz to 40kHz ± 3dB Total distortion at 10 watts at 1kHz —0·1%.

This is real value for money! We have designed 3 systems and the heart of them all is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. It is available in 2 versions — R100 for ceramic cartridges, and R101 for magnetic and ceramic. FET's (Field effect transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range of bass and treble adjustment.

For all systems we have chosen the famous Garrard SP25 Mk. III deck which comes complete with teak finished plinth and perspex cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

PRICES

SYSTEM 1

Viscount III R101 amplifier	£22·00+90p p&p
2 x Duo Type II speakers	£14·00+£2 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23·00+£1·50 p&p
Total	£59·00

Available complete for only £52+£3·50 p&p

SYSTEM 2

Viscount R101 amplifier	£22·00+90p p&p
2 x Duo Type III speakers	£32·00+£3 p&p
Garrard SP25 Mk. III with MAG. cartridge, plinth and cover	£23·00+£1·50 p&p
Total	£77·00

Available complete for only £69+£4 p&p

SYSTEM 3

Viscount III Amplifier R100	£17·00+90p p&p
2 x Duo Type II speakers, pair	£14·00+£2 p&p
Garrard SP25 Mk. III with CER. diamond cartridge, plinth and cover	£21·00+£1·50 p&p
Total	£52·00

Available complete for only £49+£3·50 p&p

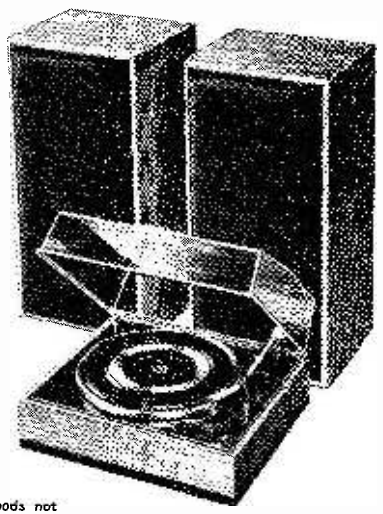
SPEAKERS Duo Type II

Size approx. 17" x 10¾" x 6¾". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts, 3 ohms. Simulated Teak cabinet.
£14 pair+£2 p&p.

Duo Type III. Size approx. 23½" x 11½" x 9½". Drive unit 13½" x 8¼" with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair**+£3 p&p.

SPECIFICATION R101

14 watts per channel into 3 to 4 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) R101—P.U.1 and radio—65dB. P.U.2 —58dB. **R100** same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than —35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13¾" x 9" x 3¾".



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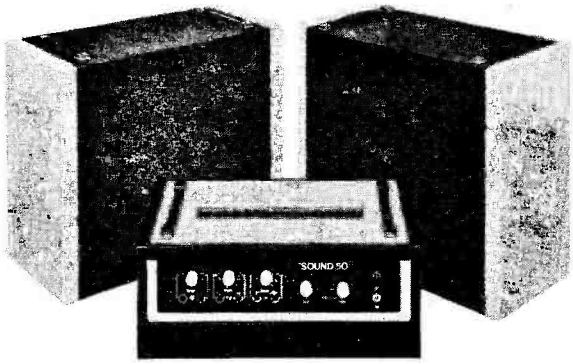
SOUND 50

50 WATT AMPLIFIER & SPEAKER SYSTEM



The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

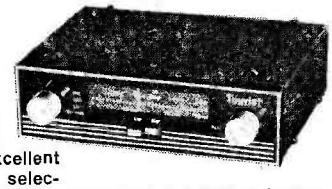
Output Power: 45 watts R.M.S. (Sine wave drive). **Frequency response:** —3dB points 30Hz at 18KHz. **Total distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB.
Speaker Impedance: 3, 8 or 15 ohms. **Bass Control Range:** ± 13dB at 60Hz. **Treble Control Range:** ± 12dB at 10KHz. **Inputs:** 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.
To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.
SPEAKERS! Size 20" × 20" × 10" incorporating 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM Sound 50 amp and 2 speakers **£50** Plus £6 P. & P.

or available separately. Amplifier **£28.50** plus £1.50 P. & P.
Speakers **£12.50** each plus £2.25 P. & P.

TOURIST MK3 CAR RADIO

ALL TRANSISTOR



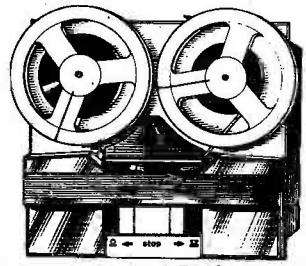
Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4½in deep.

SET OF PARTS

£6.30 plus P. & P. 50p.

Circuit diagram 13p. Free with parts Speaker, baffle and fixing kit **£1·25** extra plus 25p. p. & p. Postage free when ordered with parts.

CONTINENTAL 4 TRACK, 3 SPEED TAPE DECK

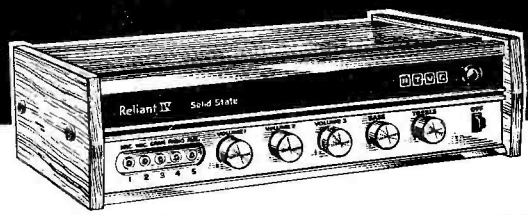


with high impedance heads

R.C. 74 tape deck. Three speeds—7½, 3¾ and 1⅞ ips. 4-track record/playback head. Plus 4-track erase head. Positive pressure pad system. Takes any tape spool up to and including 7". The R.C. 74 is driven by a powerful 200/250V 50-cycle A.C. motor. A heavy, accurately balanced, flywheel brings wow and flutter levels down to approx. 0.3% total at 3¾ and 7½ ips. Fast rewind in both directions.
Controls couldn't be simpler! Just five push buttons that interlock to cut out accidental tape damage. Efficient servo-action type braking. Easy drop-in tape loading.
The R.C. 74 comes with an attractive moulded deck cover, which has positions for tone and volume controls. The unit is built into a rigid die-cast frame, and overall size of the whole unit is 12¾ × 11¾ × 6 inches. Every single deck fully tested before dispatch. Spools not supplied.

£15·00. Plus 75p P. & P.

RELIANT mk. IV



Provides a high standard of sound reproduction, with full mixing facilities. Its versatility makes it suitable for: Discotheque, P.A., Home Entertainment Applications, etc.

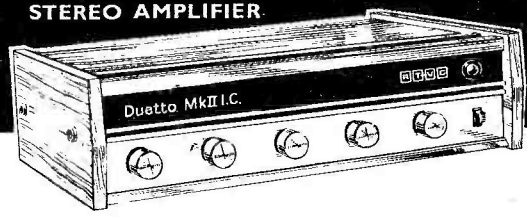
- ★ **Five Electronically Mixed Inputs**
- ★ **Three Individual Mixing Controls**
- ★ **Separate base and treble controls common to all five inputs**
- ★ **Mixer employing F.E.T. (Field Effect Transistor)**
- ★ **Solid State Circuitry** ★ **Attractive Styling**

£9.50 plus P. & P. 60p.

INPUTS:—1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram. Tuner, Monitor, Organ, etc.). All 250mV sensitivity.
CONTROLS:—3 Volume controls. Bass control range : 13db @ 60Hz. Treble control range ±12db @ 15KHz. Separate ON/OFF Switch. Neon Indicator.
POWER OUTPUT:—12 Watts R.M.S. into 3 to 4 ohms speaker
SIGNAL/NOISE:—Better than —60db on Inputs 3, 4 and 5 & —50db on 1 & 2
SUPPLY:—220 - 250 AC Mains. **SIZE:**—12½" x 6" x 3½"

DUETTO mk. II I.C.

STEREO AMPLIFIER



Sophisticated styling combined with up-to-date electronics means Hi-Fi. This is what the Duetto Mk.II offers at a realistic price. Mullard built stereo pre-amplifier/tone control module and the highly efficient I.C. monolithic power chips ensure: reliability, very low distortion at all power levels, correct operation in all ambient temperatures, full power over the audio spectrum etc.

Inputs : P.U. 150mV. @ 2·2 Meg (for cer. cartridge)
Auxiliary 100mV. @ 1 Meg (for radio, tape etc.)
Outputs : 5 watts rms per channel into 8–15Ω speakers.
Switched stereo headphone socket with power correction.
Controls : Mono/stereo switch, selector switch, treble, bass, volume, balance and on/off switch. Neon indicator.
Tone Controls : Treble ±14db @ 15KHz
Bass ±14db @ 60Hz
Power Bandwidth : ±2db 20Hz–25KHz Size 12½" × 6" × 3½"

£10.50 plus P. & P. 60p

RTVC

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Goldring G800
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Teleton SAQ206B	£20·50
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Please add 75p P. & P.	
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6F23	·68	807	·45	ECH84	·36	N78	·87	PY32	·55	W77	·43
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6J7G	·24	B349	·65	ECL82	·31	PC86	·47	PY81	·25	**Transistors**	
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6X4	·23	DF91	·16	EF89	·26	PCC88	·40	R20	·56	AF118	·48
6X5GT	·28	DF96	·36	EF91	·13	PCC89	·45	U25	·64	AF125	·17
10P13	·58	DH77	·20	EF92	·30	PCC189	·48	U26	·56	AF127	·17
12AH8	2·95	DK32	·33	EF98	·65	PCF805	·56	U47	·64	OC26	·25
12AT7	·17	DK91	·28	EF183	·28	PCF80	·28	U49	·56	OC44	·12
12AU7	·20	DK92	·50	EF184	·31	PCF82	·33	U52	·31	OC45	·12
12AX7	·22	DK96	·45	EH90	·35	PCF86	·48	U78	·24	OC71	·12
19BG6G	·80	DL35	·40	EL33	·55	PCF800	·58	U191	·59	OC72	·12
20F2	·87	DL92	·26	EL34	·45	PCF801	·28	U193	·42	OC75	·12
20P3	·77	DL94	·47	EL41	·54	PCF802	·40	U251	·64	OC81	·12
20P4	·92	DL96	·38	EL84	·23	PCF805	·61	U301	·38	OC81D	·12
25L6GT	·19	DY86	·24	EL90	·26	PCF806	·56	U329	·66	OC82	·12
25U4GT	·57	DY87	·24	EL95	·33	PCF808	·68	U801	·80	OC82D	·12
										OC170	·28

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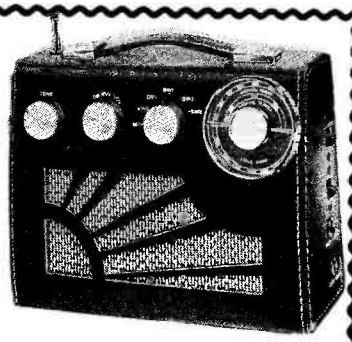
10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS AND AIRCRAFT BAND



Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome 7 section Telescopic Aerial, for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 8" × 2½" Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and easy build plans **30p** (FREE with parts).

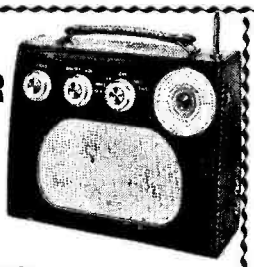
Total building cost

£8·50

P. P. & Ins. 50p

(Overseas P. & P. £1)

ROAMER EIGHT Mk I



NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 8" × 2½" Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans **25p** (FREE with parts).

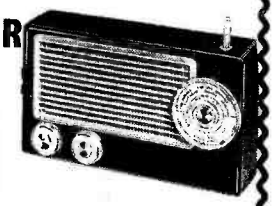
Total building cost (Overseas P. & P. £1) **£6·98** P. P. & Ins. 41p.

ROAMER SEVEN MK IV

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, including Micro-Alloy R.F. Transistors. 8" × 2½" speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans **15p** (FREE with parts). Earpiece with plug and switched socket for private listening, **30p** extra.

Total building costs (Overseas P. & P. £1) **£5·98** P. P.& Ins. 41p.

ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening **30p** extra.

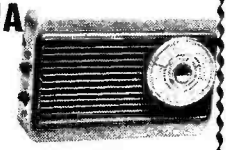
Total building costs (Overseas P. & P. £1) **£3·98** P. P. & Ins. 26p

POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5¼ × 1½ × 3¼in. Easy build plans and parts price list **10p** (FREE with parts). Earpiece with plug and switched socket for private listening **30p** extra.

Total building costs (Overseas P. & P. 63p) **£2·23** P. P. & Ins. 21p

TRANSONA FIVE

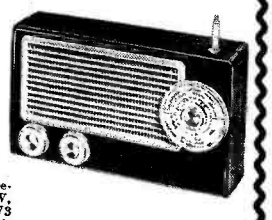


5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6¼ × 4½ × 1¼in. Easy build plans and parts price list **10p** (FREE with parts). Earpiece with plug and switched socket for private listening **30p** extra.

Total building costs (Overseas P. & P. 63p) **£2·50** P. P. & Ins. 22p

TRANS EIGHT



8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans **25p** (FREE with parts). Earpiece with plug and switched socket for private listening **30p** extra.

Total building costs (Overseas P. & P. £1) **£4·48** P. P. & Ins. 31p

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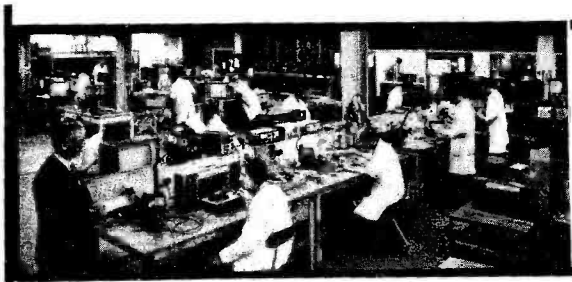

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STEREO AMPLIFIERS	Rec. Retail Price	Comet Price
ALBA UA 700	37·93	24·95
ALPHA 212 By Highgate	37·75	25·95
AMSTRAD Stereo 8000 Mk 2	27·95	14·95
AMSTRAD I.C. 2000	42·85	27·50
ARMSTRONG 521	59·00	44·95
DULCI 207	26·00	16·50
DULCI 207M	32·00	19·50
FERROGRAPH F307 Mk. II (cased)	64·00	46·95
FERROGRAPH F307 MII (Metal case)	60·00	42·95
GOODMANS Maxamp	54·00	34·95
LEAK Delta 30 (cased)	65·00	48·25
LEAK Delta 70 (cased)	79·50	58·95
METROSOUND ST20E	39·50	24·95
METROSOUND ST60	70·00	46·25
PHILIPS RH 591	79·00	53·95
PHILIPS RH 590	52·00	35·50
PHILIPS RH 580	29·00	19·95
PIONEER SA500A	58·78	39·95
PIONEER SA600	89·60	58·95
PIONEER SA800	119·85	75·95
PIONEER SA900	133·83	90·95
PIONEER SA1000	147·83	95·95
PIONEER QL600 Quadraphonic con.	94·43	65·55
PIONEER Reverberation 202W	51·05	34·95
RANK Rotel 210	34·90	24·95
RANK Rotel 310	47·50	32·95
RANK Rotel 610	74·50	49·50
ROGERS Ravensbourne	64·50	45·50
ROGERS Ravensbourne (cased)	69·50	49·50
ROGERS Ravensbrook Mk. II	50·50	35·95
ROGERS Ravensbrook (cased) Mk.II	55·50	39·95
SINCLAIR 2000	35·00	24·25
SINCLAIR Project 60/2 x Z30/PZ5	23·90	15·95
SINCLAIR PROJECT 60/2 x Z50/PZ8/trans	34·86	21·95
SINCLAIR PROJECT 605	29·95	20·25
SINCLAIR AFU	5·98	4·25
SINCLAIR Neoteric	61·95	42·93
SINCLAIR 3000	45·00	29·50
TELETON SAQ 205	33·00	19·50
TELETON 307	33·00	20·95
WHARFEDALE Linton Amplifier	60·00	42·95
TELETON GA202 15 watt RMS P.Chan.	Spec Price	28·50

All take both ceramic and magnetic cartridges.

TUNERS		
*ARMSTRONG 523 AM/FM	52·68	39·50
*ARMSTRONG 524 FM	40·97	30·95
ARMSTRONG M8 Decoder	9·50	6·95
*DULCI FMT.7 FM	24·43	17·50
DULCI FMT.7S Stereo	32·89	24·50
GOODMANS Stereomax	75·74	46·95
LEAK Delta FM	73·00	53·95
LEAK Delta AM/FM	87·00	65·95
PHILIPS RH 690	44·15	33·50
PHILIPS RH 691	83·40	67·25
PIONEER TX500 AM/FM	70·93	52·50
PIONEER TX600 AM/FM	100·37	77·95
RANK ROTEL 320	53·38	38·50
ROGERS Ravensbourne chassis	57·95	42·50
ROGERS Ravensbourne in teak case	62·63	47·25
ROGERS Ravensbrook chassis	42·14	31·25
ROGERS Ravensbrook (cased)	48·00	35·25
SINCLAIR 2000	45·00	33·50
SINCLAIR 3000	45·00	34·25
SINCLAIR Project 60 tuner (stereo)	25·00	19·95

All above Tuners are complete with MPX Stereo Decoder except where starred.

TUNER/AMPLIFIERS		
AKAI AA 8500	228·34	169·95
AKAI 6600	145·26	105·50
AKAI 6300	125·83	92·50
AKAI 6200	97·09	72·50
ARENA 2600	111·30	59·95
ARMSTRONG M8 Decoder	9·50	6·95
ARMSTRONG 525	90·14	67·95
ARMSTRONG 526	102·72	77·50
GOODMANS Module 80, 35w. RMS	89·02	67·75
GOODMANS Module 80 Compact	160·38	125·95
GOODMANS Module 110 FM/MW/LW/SW 100W RMS	131·22	104·95
LEAK Delta 75	160·00	127·95
MIDLAND 19/542	49·56	36·75
PHILIPS RH 790	134·00	74·95
PIONEER SX770 AM/FM	135·80	104·95
PIONEER SX440 AM/FM	101·60	79·95
ROGERS Ravensbrook Chassis	96·57	77·95
ROGERS Ravensbrook (cased)	105·35	82·95
ROTEL RX150	67·93	51·95
TANDBERG 1171 MPX	103·03	84·95
TANDBERG TR200 MPX	96·23	79·95
TELETON F2000	51·50	27·25
TELETON CR55	125·26	68·50
TELETON R8000 AM/FM	42·16	21·95

All the above Tuners and Tuner/Amplifiers take both ceramic and magnetic cartridges except Teleton F2000, 8000 which take ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

CARTRIDGES	Rec. Retail Price	Comet Price
AUDIO TECHNICA AT66	6·47	4·20
GOLDRING G850	6·10	3·45
GOLDRING G800	12·21	5·80
GOLDRING G300E	17·67	9·70
GOLDRING G800 Super E	24·41	14·40
*GOLDRING CS90 Stereo	4·88	4·20
*GOLDRING CS91/E	7·33	6·20
EMPIRE 1000ZE/X	59·12	45·95
EMPIRE 999VE/X	42·14	33·25
EMPIRE 999TE/X	24·58	19·50
EMPIRE 999SE/X	19·90	15·60
EMPIRE 999E/X	15·57	11·70
EMPIRE 909E/X	12·12	9·40
EMPIRE 90EE/X	9·37	7·15
ORBIT Magnetic NM 22	SpecPrice	2·85
ORTOFON M15E	27·60	22·95
SHURE M3DM	6·10	4·20
SHURE M31E	11·63	8·50
SHURE M32E	10·73	7·85
SHURE M32-3	9·84	7·65
SHURE M44-5	8·30	5·65
SHURE M44-G	8·30	5·65
SHURE M44-7	7·90	5·40
SHURE M-44G	7·90	5·40
SHURE M44E	8·60	5·80
SHURE M55E	9·70	6·60
SHURE M75G	14·70	9·70
SHURE M75-6	13·60	8·25
SHURE M75EJ	15·40	10·50
SHURE M75E	19·00	12·70
SHURE M75E/95G	20·80	14·60
SHURE V15-11	39·40	26·95
SONOTONE 9TAHC Diam/Saph.	3·75	1·95

Starred cartridges above are ceramic. All others are magnetic.

PICKUP ARMS		
GOLDRING Lenco 75	13·51	9·30
GOLDRING Lenco L69	9·77	6·40
SME 3009 with S2 Shell	32·34	24·50
SME 3012 with S2 Shell	34·44	26·50

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The following Turntables are complete with base, plinth, perspex cover and cartridge. Fully wired and ready for use. All at special prices.

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GARRARD SP25 Mk III with Shure M.44/7 Special Price £20·50

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GARRARD AP76 with Goldring G800 Special Price £29·90

GARRARD AP76 with Shure M55E Special Price £32·95

GARRARD AP76 with Shure M75EJ Special Price £34·95

GARRARD 2025 with Sonotone 9TAHC Special Price £13·90

GOLDRING 705/P with G850 £26·00 £10·95

GOLDRING GL75 with G800 Special Price £39·95

THORENS 150 AB complete with TX11 cover Shure M55E cartridge £60·46 £47·95

GARRARD SP25 Mk III	16·17	10·25
GARRARD SL65 B	20·93	13·95
GARRARD SL95 B	49·21	32·75
GARRARD 401	39·04	27·50
GARRARD SL72 B	32·60	22·95
GARRARD Zero 100A	57·42	39·95
GARRARD Zero 100S	52·83	38·95
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GARRARD 40B	13·63	10·95

	Rec. Retail Price	Comet Price
GARRARD AP76	28·44	19·50
GOLDRING GL69 Mk.II	26·86	18·50
GOLDRING GL69P Mk. II	35·23	25·25
GOLDRING GL75	39·06	28·25
GOLDRING GL75P	47·43	35·25
GOLDRING Covers for 69P and 72P	4·36	3·75
Cover for 75P Deluxe	4·88	3·95
GOLDRING C99—plinth and cover for G99	10·75	9·75
GOLDRING G99	27·90	19·50
GOLDRING G101P/C	27·90	22·50
GOLDRING GL72 Chassis	27·90	20·95
GOLDRING GL72P	36·27	29·25
GOLDRING GL85	61·03	46·50
GOLDRING GL85P	70·80	54·75
LEAK Delta	67·50	54·75
McDONALD MP60	14·80	10·25
McDONALD 610	18·79	14·50
McDONALD HT70	20·68	15·25
McDONALD HT70 inc. plinth & cov.	29·89	22·50
Base and Cover for MP60 and 610	Spec Price	3·95
PHILIPS 202 Electronic	64·65	51·75
PHILIPS 308 transcription unit complete with base and cover	36·55	28·25
PIONEER PL12AC with base & cover	47·15	36·25
THORENS TX25 cover	8·26	6·60
THORENS TD125	73·78	58·25
THORENS TD125AB	112·14	91·95
THORENS TD150 Mk. II	33·64	28·25
THORENS TD150A Mk. II	43·09	33·50
THORENS TD150AB Mk. II	46·63	38·25
THORENS TX11 Cover	4·13	3·75
WHARFEDALE Linton with base and cover and Shure M44/7 cart.	34·50	27·25

SPEAKERS		
AMSTRAD 138 (pair) 13"×8" twin cone teak	26·00	15·95
AKAI SW 155	59·50	39·95
B & W Model 70	159·50	111·95
B & W DM2	62·50	51·95
B & W DM3	63·00	47·95
B. & W DM1 (pair)	75·20	59·95
CELESTION COUNTY	23·97	19·50
CELESTION Ditton 120 (pair)	56·40	42·95
CELESTION Ditton 15	37·60	26·50
CELESTION Ditton 25	65·00	44·95
CELESTION Ditton 44	54·00	39·95
CELESTION Ditton 66	99·00	74·95
GOODMANS Minister (pair)	46·86	36·95
GOODMANS Havant (pair)	54·42	42·95
GOODMANS Magister	65·63	41·95
GOODMANS Double Maxim	32·07	25·25
GOODMANS Mezzo 3	35·70	23·95
GOODMANS Magnum K2	46·20	30·95
GOODMANS Dimension 8	72·44	49·95
GOODMANS DIN 20NT kit	12·19	9·70
KELETRON KN400 2-speaker System (pair)	15·86	12·50
KN600 3-speaker System (pair)	26·46	17·50
KN800 3-speaker System	15·90	10·25
KN1100 4-speaker System	20·40	13·95
KN1600 3-speaker System	25·20	15·95
KN2100 3-speaker System	30·60	20·45
LEAK 150 (pair)	49·00	37·00
LEAK 250 (pair)	63·00	46·50
LEAK 600	49·50	34·50
METROSOUND HFS 103 (pair)	29·21	23·50
METROSOUND 202	21·50	15·25
METROSOUND Duplex 15	32·00	23·95
METROSOUND Duplex 25	52·00	36·95
PHILIPS RH 411 (pair)	20·60	16·10
PHILIPS RH 402 (pair)	44·70	27·20
PHILIPS 406	34·00	28·20
SINCLAIR Q16	8·98	6·95
STE-MA 450	25·00	16·95
TANDBERG TAN 7	27·22	23·40
TANDBERG Tan 11 (pair)	36·94	31·20
TANDBERG Tan 12 teak (pair)	48·82	43·83
TANDBERG Tan 25 teak (pair)	66·08	56·50
TANDBERG Tan 50 teak	65·00	49·95

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Denton Mark II (pair)	39·00	29·50
Linton Mark II (pair)	49·00	37·50
Melton Mark II	35·00	24·45
Dovedale 3 Mark I I	45·00	30·50
Rosedale	65·00	44·95
Triton (III) (pair)	63·00	50·95
Unit 3 Speaker Kit	12·00	9·25
Unit 4 Speaker Kit	18·00	11·95
Unit 5 Speaker Kit	26·00	17·50
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GOODMANS Twin-Axiom 8	8·65	7·10
GOODMANS Twin Axiom 10	9·58	7·75
GOODMANS Axiom 401	17·68	12·25
GOODMANS Audiom 8P	5·20	4·15
GOODMANS Audiom 10P	5·67	4·70
GOODMANS Audiom 12P	13·00	9·90
GOODMANS Audiom 15P	21·00	15·75
GOODMANS Audiom 18P	35·70	25·95
GOODMANS Axiom 100 40 watts din	12·00	9·50
GOODMANS ARU 172	4·50	3·20
GOODMANS Axent 100	6·90	4·90
GOODMANS Midax 650	13·59	9·30
GOODMANS Attenuator	3·73	2·70
GOODMANS Crossover Network XO/950	7·77	5·25
WHARFEDALE 8in.Bronze/RS/DD	4·50	3·40
WHARFEDALE Super 8/RS/DD	8·00	6·60
WHARFEDALE Super 10/RS/DD	13·00	11·00
WHARFEDALE WMT1 Matching Transformer	0·84	0·70
HI-FI STEREO SYSTEMS COMPLETE		
ALBA UA552	47·75	34·65
AMSTRAD Stereo 1000	48·00	33·95
DANSETTE Consort Stereo	34·43	24·95
DECCA Sound 813	Special Price	53·95
DECCA Sound 614	Special Price	57·95
DECCA Sound 1204	Special Price	76·95
DECCA Compact 3	Special Price	102·35
DECCA 403	Special Price	47·75
ELIZABETHAN LZ101	58·33	41·85
FERGUSON 3450 with Radio	70·45	52·95
FERGUSON 3451 with Radio	96·80	76·95
FIDELITY UA2 Music Master	44·50	33·95
FIDELITY UA1 Music Master with Radio	107·00	78·95
FIDELITY stereo nine	38·50	24·95
GOODMANS Module 80 compact system FM/35 watts. RMS (Less L/S)	165·00	125·75
HMV 2404/5/6 with Radio	194·40	159·00
HMV 2451	115·95	89·95
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HMV 2450 with Stereo Radio	130·60	103·00
KB1025 with 657 speakers	49·50	37·95
MURPHY 902 Studio 1, AM/VHF Radio	86·84	65·95
MARCONI 4452	73·95	56·50
PHILCO FORD M1500	97·96	66·75
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PYE black box unit stereo 1022	90·93	68·25
RIGONDA party time	27·50	21·95
STEEPLETONE stereo system	41·75	31·95
TELETON STP 8 track stereo system	57·50	38·95
ULTRA 6026	36·10	29·95
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AKAI 4000D 4-track stereo deck	93·65	60·45
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BUSH Discassette DC70	20·62	16·55
BUSH TP 66 Batt./Mains Cassette Recorder	28·18	21·95
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EKCO 350 Battery/Mains Cassette VHF/MW Radio	37·42	28·75
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FERGUSON 3248 4-track	53·75	39·95
FERGUSON 3252 4-track	100·52	74·95
FERGUSON 3253	43·55	31·95
FERGUSON 3258 4-track	72·40	53·95
FERGUSON 3262	30·15	23·95
FERROGRAPH 702 2-track tape deck	224·43	170·65
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GRUNDIG TK 141 4-track	62·10	45·75
GRUNDIG TK 146 4-track Auto	66·95	49·95
GRUNDIG TK 147 4-track Auto	93·05	71·95
GRUNDIG C410 Cassette recorder	42·50	32·95
PHILIPS R.R. 392 MW/VHF Radio and Cassette Recorder	49·95	36·55
PHILIPS 2204 cassette, battery/mains	29·10	22·90
PHILIPS 2202 cassette	49·95	36·55
PHILIPS 3302 cassette	20·35	15·95
PHILIPS 4307 4-track	48·65	34·95
PHILIPS 4308 De luxe 4-track	56·85	41·45
PHILIPS 4404 4-track stereo recorder	89·25	65·95
PHILIPS 4407 4-track stereo recorder	108·50	81·85
PHILIPS 4500 4-track stereo tape deck	124·30	91·65
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PYE 9109 cassette	20·37	18·45
PYE 9116 Stereo cassette	66·10	60·95
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TANDBERG 1841 4-track stereo tape deck	66·09	48·75
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TANDBERG 4041X 4-track stereo	174·00	135·50
TANDBERG 6041X 4-track stereo	188·00	145·25
TANDBERG 6021X twin track stereo	188·00	145·25
TELETON TC110 cassette battery/mains	26·76	18·50
TELETON TRC 130 cassette with VHF/AM radio battery/mains	41·32	28·00
WHARFEDALE Dolby DC9 cassette stereo tape deck	107·50	87·75
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The Amtron range of products will shortly be available in the U.K. and a sole agent is required to handle distribution. These are just four examples from their extensive range of equipment.

UK 450

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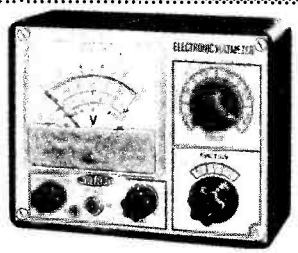
Variable frequency signal generator for T.V. alignment; both frequency and amplitude can be modulated.
Output voltage 100mV - Frequency range: 34 to 50 MHz - Attenuator: Continuous variation - Amplitude modulation: at 1 kHz depth 30%. Can be operated on 120, 160, 220 and 240V A.C. Power Supplies.

UK 470

CRYSTAL CALIBRATOR MARKER GENERATOR

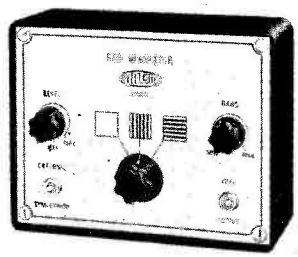
When a sweep signal is applied to a circuit the curves obtained on an oscilloscope are easier to analyse if they have the precise frequency reference. The UK740 marker generator provides an answer to this problem.
Ratings and characteristics; Radio frequency output voltage; 100mV Output frequency: 27·5 to 47 MHz fundamental 55 to 94 MHz second harmonic: 84 to 140 MHz third harmonic: 140 to 345 MHz fifth harmonic.
Attenuator: continuous variation - Amplitude modulation: internal 1000 Hz with possibility of cutting out the external one by UK 495 - Crystal calibrator - Output frequency: 5·5 MHz - Output voltage at 5·5 MHz: 100mV - Power: 9V battery - Transistors used: 2 x AF106—AC128.



UK 475

ELECTRONIC VOLTMETER

Using FET transistors which give better stability than the conventional valve instrument. Can be used with a 9V battery.
Ratings and Characteristics - Continuous voltage range: from 20mV to 300V D.C. Bandwidth 20 Hz to 1 MHz



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BAR GENERATOR

The UK 495 can be used for setting up TV sets without the help of the broadcast test pattern.
Vertical bars: variable from 8 to 16; duration: 0·5 μs approx. - Horizontal bars: variable from 7 to 13; duration 200 μs approx. - Line synchronism: repetition rate 64 μs (15625 Hz); duration: 5 μs approx. Frame synchronism: repetition rate: 20 ms (50 Hz), duration: 600 μs approx. - Power: 9V D.C.

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PRACTICAL WIRELESS

VOL 48 NO 2
Issue 784

JUNE 1972

All the Winners!

BY a unanimous decision, the panel of judges, comprising the Editor and editorial staff of P.W., selected as the winner of the Project Autumn competition the following article:

1. **Digital Frequency Counter/Timer,** by J. Thornton-Lawrence (September-December 1971).

Congratulations are therefore due to author John Thornton-Lawrence for the design, construction and preparation of his most successful project since he started writing for us. Apart from the opinion of the judges, the Digital Frequency Counter/Timer has enjoyed a great success with readers, as confirmed by correspondence. John will soon be travelling to London to officially receive the Designer's Trophy and we hope that he has cleared a prominent space on the sideboard to display the cup!

The selection of runners-up was more difficult. There were twelve nominations to be considered and placed in order of merit. In the event, these were the articles selected:

2. **Linear Ohmmeter,** J. N. Watt (Sept. 71)
3. **Quality Hi-fi System,** C. R. Bradley (Feb.-April 72)
4. **Gate Dip Oscillator,** B. Wood (February 72)
5. **Cube Radio,** R. F. Graham (March 72)
6. **Modular Audio Mixing System,** F. C. Judd (Oct.-Dec. 71)

While congratulating the runners-up, we must also offer our sympathy to the several authors who very nearly squeezed into the final list—some by a very narrow margin.

As mentioned last month, and detailed elsewhere in this issue, our next writer's competition is restricted to those who have never written for P.W. before. This should provide a keen incentive to readers who have hitherto felt that the opposition might be too strong!

We will, of course, continue to publish articles by our established authors, but they will not be eligible for the competition itself. In this way, if we achieve nothing else, it will be seen that the pages of P.W. are open to anyone producing the right kind of material. A study of the winning articles in the last competition will be helpful in assessing chances and will also show that a long and complex article is not necessarily the route to a prize. And for new writers who need a little guidance on preparing articles for publication, some handy notes are available from this office on request. Now it is up to you!

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

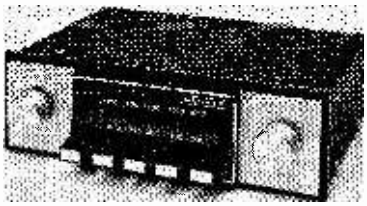
CONSTRUCTIONAL

OTHER FEATURES

JULY ISSUE WILL BE PUBLISHED ON JUNE 2nd

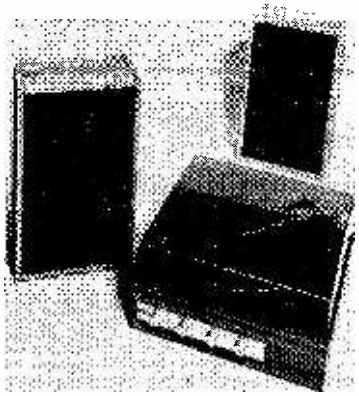
NEWS... NEWS... NEWS...

Push-button wonder



It's a "wonder" because it's a push-button car radio in kit form retailing for only £7! Step-by-step assembly instructions are provided with the kit, and the manufacturers, Radio & TV Components Limited, maintain that anyone with a little experience in wielding a soldering iron can complete the unit in an evening—or if you go to bed very early, two evenings! An integrated circuit and a printed circuit board simplify construction and cut down the number of components to be soldered. The "Tourist" car radio, as it has been called, features five push buttons which can be tuned to four preset medium wave stations. The fifth button is for use on long wave. Spun aluminium knobs are used and the tuning scale is illuminated.

Permeability tuning is employed and r.f. sensitivity is said to be better than 15μV at 1MHz. Power output into an 8Ω speaker is better than 2·5W. The i.f. module and the tuner are pre-aligned and

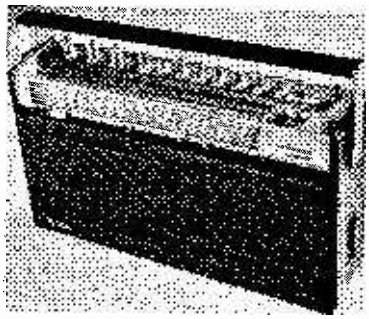


the kit is suitable for 12V positive or negative operation.

Also announced by Radio & TV Components is the £25 stereo system designated Unisound 505. This comprises pre-assembled units which can be wired together in about an hour by means of a screwdriver (no soldering iron being needed). Basically the units used in this system are the Mullard Unilex modules modified by the addition of ATES integrated circuits on the amplifier output stages to provide increased output. The turntable supplied is a Garrard 2025 TC and speakers are dual cone 13×in. elipticals in kit form, manufactured by EMI.

Further information on both of these units may be obtained from *Radio & TV Components, (Acton) Limited, 21 High Street, Acton, London, W.3.*

Saba radio



One receiver in the new Saba range is the Transeuropa Automatic G Radio mains/battery/car portable radio. Waveband ranges are: f.m. 87·5MHz-104MHz, SW1 6·8MHz-18·9MHz, SW2 15MHz-15·5MHz, SW3 5·9MHz-6·23MHz, SW4 2·8MHz-7·5MHz, MW1 510kHz-1220kHz, MW2 1180kHz-1630kHz, LW 150kHz-300kHz.

Twelve transistors are used and the f.m. tuner employs two transistors and vari-cap diode tuning. There are common i.f. stages for a.m. and f.m.: 460kHz 10·7MHz.

A five transistor audio amplifier provides 3·6W and 6W when operating from 12V car battery. There are 2×5 Ohm speakers—7 & $2\frac{1}{2}$in.—the $2\frac{1}{2}$in. speaker is switchable. Treble and base controls are provided amongst many other features. Recommended retail price is £55. U.K. Distributors are *Lampitt Electronics Limited, Manchester.*

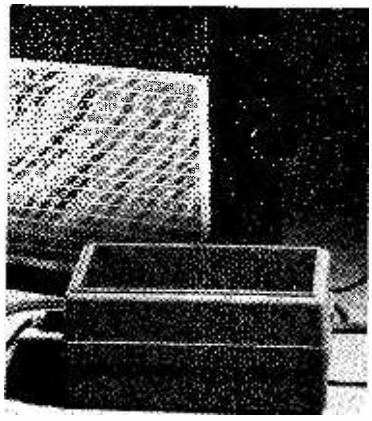
Burnt fingers

We mentioned it once before, and we're mentioning it again because it's useful stuff. Burneze, priced at 39p, is an aerosol preparation which gives instant relief to minor burns. Available through all branches of Boots and most good chemists, it should have a place in every workshop, or home first aid kit, ready for instant action the moment you grab hold of the wrong end of the soldering iron!

Hacker power

The VP408 is a fully-stabilized power unit designed to plug into the mains electricity supply and give a d.c. output adjustable from 6 to 18 volts.

Selection of the voltage required by the equipment to be operated is very simple. Set flush in the underside of the unit is a circular control which may readily be turned by a small screwdriver until the pointer on the control is in line with the voltage indicated on the scale.



The VP408 is intended primarily as an alternative to batteries as the power source for Hacker portable radios, but its wide range of stabilized voltages makes it an ideal power source for portable radios generally, some cassette tape recorders and other equipment requiring low voltage d.c. current within the capabilities of the unit. The VP408 costs £6·90p. *Hacker Radio Limited, Norreys Drive, Cox Green, Maidenhead, Berks.*

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

Record rack

The record rack shown on the front cover was kindly loaned to us by *Civil Service Stores, Strand, London.*

TEAC amplifier

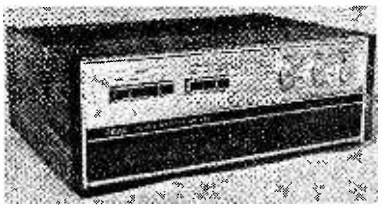
Acoustico Enterprises Ltd., inform us that they now have stocks of Teac equipment and in the picture we show the Teac Amplifier type AS-200S, retailing at £170·48. This is an all silicon transistor stereo amplifier having a rated power of 60W per channel ±0·5dB into a 4Ω load or 50W per channel ±0·5dB in an 8Ω load. Harmonic distortion is under 0·5%, rated output, under 0·1%, 30W output and under 0·1% 100mW. Frequency response is 20-80,000kHz +0dB −1dB and power bandwidth is 20-30,000Hz. Input impedance is 25kΩ or more and sensitivity is 0·7V for rated output.

Elimination of capacitance from the output circuit plus the very stable dual p.s.u. results in an 'unprecedented' flat frequency response which is very noticeable in the low frequency ranges.

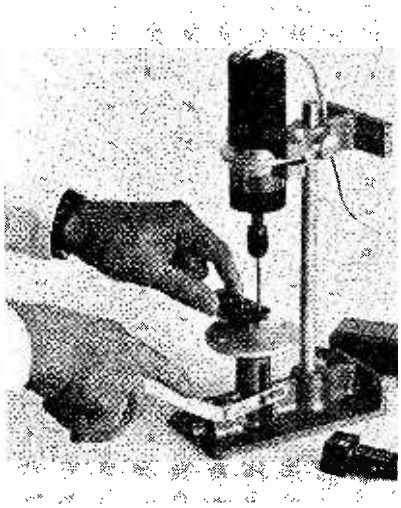
A precision 3dB step selection tone control is employed to eliminate any tonal imbalance between channels.

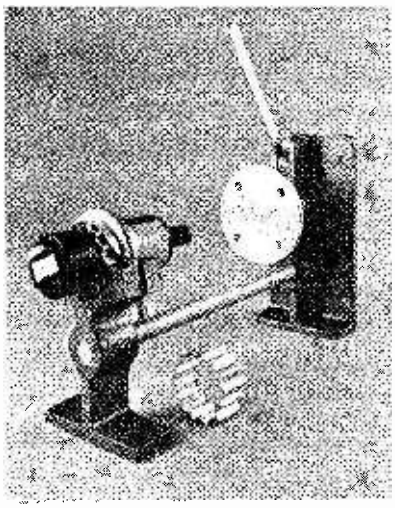
So that the speakers are protected from surge voltage when the unit is first switched on, Teac have included a muting circuit that prevents any current flow to the speakers until the unit has stabilized—usually 3-4 seconds after switch-on.

A matching and very smart looking a.m./f.m. stereo tuner designated AT-200S is also available from Acoustico for £220·41. For further information on Teac equipment contact *Acoustico Enterprises Ltd., 6-8 Union Street, Kingston Upon Thames, Surrey.*



Drills for printed circuit boards





Last October we gave details of two miniature electric drills, made by Expo (Drills) Ltd., which have proven very useful indeed to constructors faced with the problem of drilling a multitude of small holes in circuit boards. The Reliant, and its big brother the Titan Super, are intended to run from a 12V battery or a mains rectifier unit. Now a drillstand-cum-lathe bed is available capable of accommodating either drill. The drill is attached to the stand by a fixed clamp, the work table rising up to the drill by means of a small hand lever against a spring action.

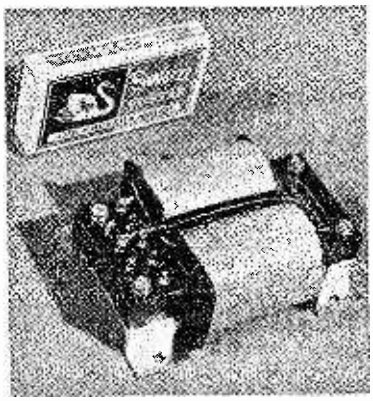
Holes are provided in the stand body to enable it to be screwed down to a bench or to a moveable wooden base. The stand can also be screwed down with the drill and main post horizontal when it may be used as a simple lathe bed for polishing, grinding or cutting. Apart from standard twist drills various cutters, burrs and saws are available as accessories. All these can be accommodated in a set of three collets with a maximum capacity of $\frac{1}{8}$in. A three jaw chuck of unique design is expected to be available in the near future. Details from *Expo Ltd., 62 Neal Street, London, W.C.2.*

Texan transformers

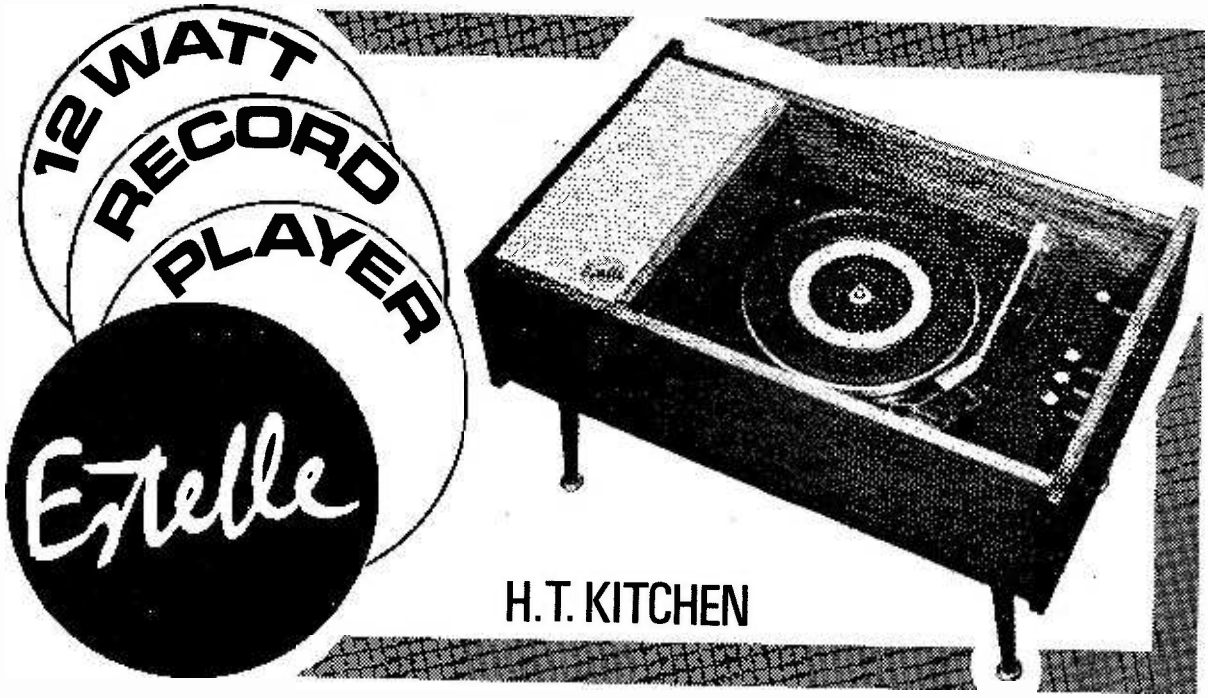
Gardners Transformers Limited announce a new range of low-profile transformers which are designed to overcome the transformer problems associated with the modern tendency towards slimmer electronic equipment.

Use of a Solo Series Transformer (Gardners Type SL 20) in the "Texan" stereo-amplifier designed by Richard Mann, of Texas Instruments, enabled the designer to achieve a remarkably compact design.

Further details of the new SOLO Series (Drawing A.3869) are readily available to industrial users, while a separate Advance Technical Data Sheet (AT.23) describing the Texan 20W transformer will gladly be forwarded upon request to *Gardners Transformers Limited, Christchurch, Hampshire, BH23 3PN.*



12 WATT RECORD PLAYER



THIS is a project that really got out of hand! Originally I had an old Garrard 4HF turntable that had seen better days and the intention was to put it in a home-made cabinet with a simple mono amplifier and hand it over to my daughter Estelle for her birthday. Her chief criterion of quality is the level obtainable, "the louder the better"!

In the end a second hand Garrard SP25 deck was fitted carrying a ceramic cartridge of unknown history. The "simple" amplifier finished up with ten transistors and at least "mid-fi" performance. The relatively small eliptical speaker in the cabinet has become more of a monitor speaker, the amplifier output being taken to a larger external speaker better able to handle the amplifier output of 12W r.m.s.

THE PREAMPLIFIER

A pre-amplifier performs two basic functions. It must raise the usually low voltages fed into it to a level suitable for feeding the power amplifier, and it must be capable of altering the frequency response of the signals passing through it to fulfil two essential requirements. First, to equalise or com-

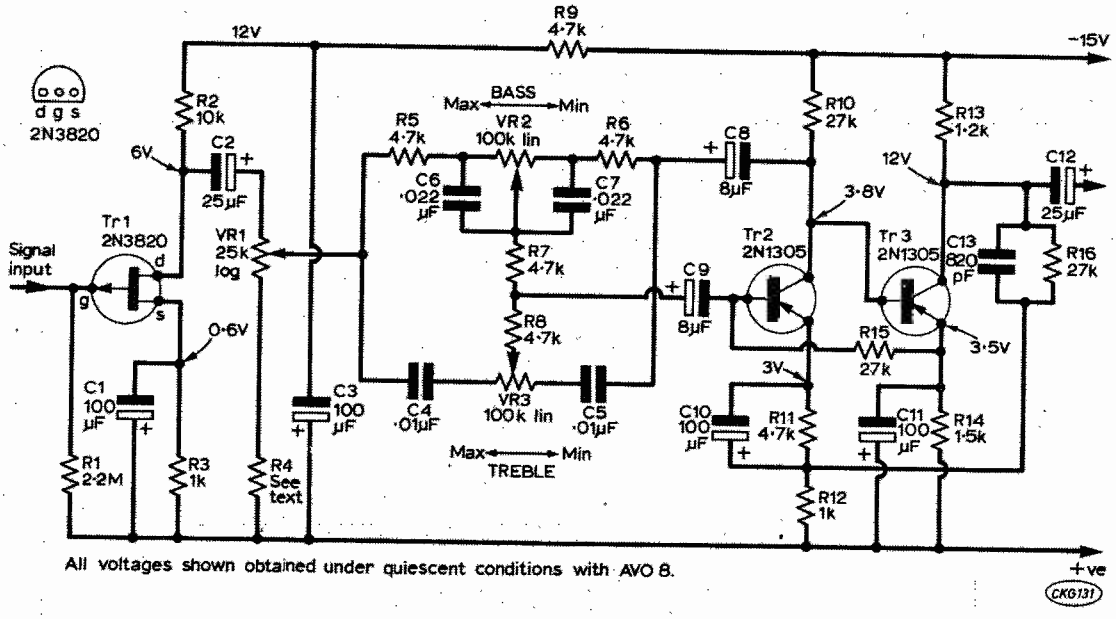


Fig. 1: The circuit of the preamplifier and tone control sections.

pensate the frequency dependent characteristics of the cartridge so that the output from the pre-amp is substantially "flat". This is achieved by providing the pre-amp with a response that is the reverse of the cartridge. Secondly, to provide a variable frequency response so that the flat response can be altered at will. Paradoxical perhaps, but a necessary requirement nevertheless.

The first requirement is a fixed frequency response to the RIAA standard. The second requirement is to provide a variable frequency response, the limits of which follow long established practice. The paradox referred to earlier is a necessary one, for the flat ideal response may result in a sound output from the loudspeaker that is aurally totally unacceptable. The variable frequency response that results from the use of correctly designed tone controls allows the user to modify the response so that a more pleasing sound can be obtained from the loudspeaker, even though a graph of the same response may well depart, perhaps greatly, from the theoretically "correct" flat line response.

Fig. 1. shows the circuit of the pre-amp used in the present design. Considering the various ways possible of loading a ceramic cartridge to provide the required correction, the simplest is by working it into a high resistance, typically 2MΩ, and this is the value of the gate resistor of the f.e.t. used as the input device. R2 is the drain load, the drain current of 600μA being set by the source resistor R3, which is decoupled to a.f. by C1. The low drain current assists in maintaining a low noise level in Tr1, an essential requirement, since the following stages will amplify this noise as well as the wanted signal.

Tr1 feeds the volume control VR1 at the earthy end of which is a low value resistor, R4, allowing a low level signal from the loudspeaker whilst a record is being played with the volume control at minimum. This is purely a safety measure, intended to forestall the user from turning the volume right down when, for example, answering the telephone, and then forgetting all about the record player. The value of R4 is best found experimentally.

The output of the volume control feeds the tone controls which are of the well known and highly regarded Baxandall configuration. A further stage of amplification follows the tone controls before the signal is ready to be passed on to the power amplifier. The degree of amplification required is quite modest but nevertheless two transistors are allotted to this task. The configuration of Tr2 and Tr3 however, allows the overall gain (of the two) to be closely controlled, and is therefore far superior to a single transistor. Direct coupling from Tr2 collector to Tr3 base goes a long way towards eliminating low frequency phase shifts which can occasionally prove troublesome.

Base bias for Tr2 is derived from the emitter of Tr3, improving d.c. stability. Feedback from Tr3 collector to the junction of R11, R12, and C10, controls the a.c. gain and is dependent on the ratio of R16 to R12. Thus, if R16 is, for example, 20kΩ and R12 is 1kΩ, the gain will be 20 times. We can therefore control the gain within wide limits simply by varying the ratio of R12 and R16. This is a most useful facility. Since the output of ceramic cartridges can vary from around 30mV for a better class cartridge, to around a volt for the cheaper "crystal" type, it is clearly useful to be able to vary the gain somewhere in the amplifier to compensate. If this is done, then the gain can be individually "tailored", assuming the cartridge type remains unaltered, so that full output is only available with the volume control fully advanced.

A further advantage of the two transistor circuit is the ability to "tailor" the a.c. feedback such that it becomes frequency selective. This can be effected by

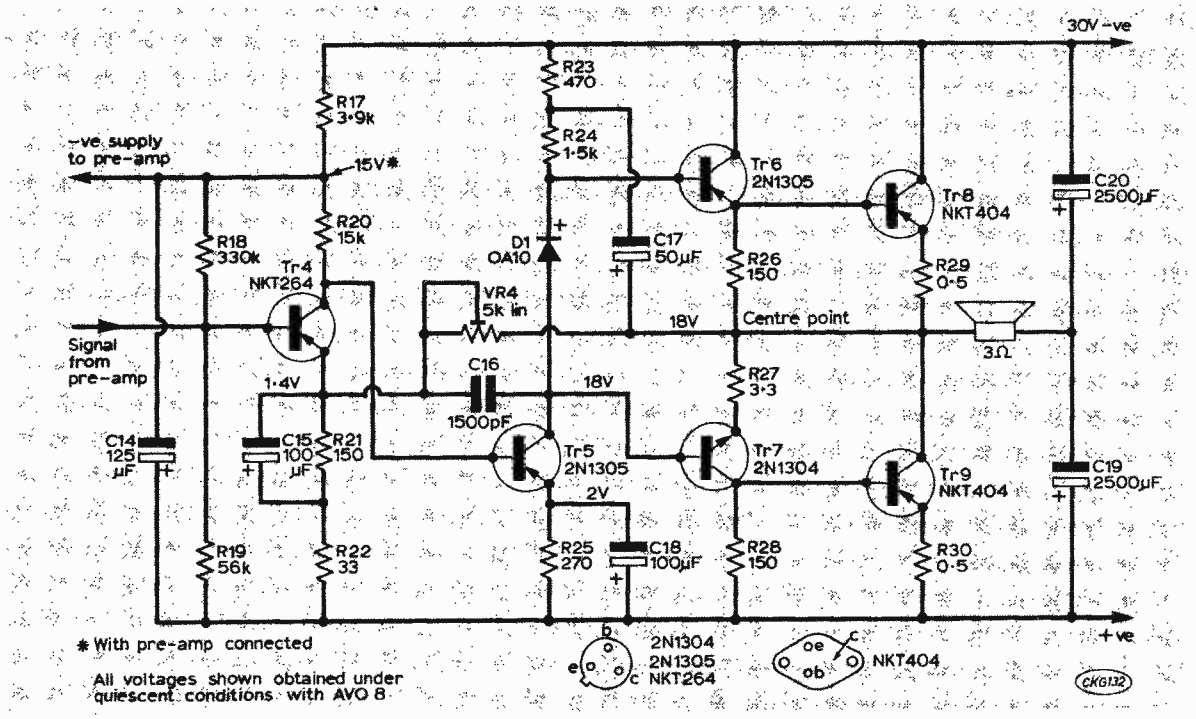


Fig. 2: The circuit of the main amplifier.

shunting R16 with a capacitor, C13. The higher the capacity of C13, the lower the frequency at which it becomes effective. C13 can be selected by purely subjective means, using a cut and try approach in conjunction with listening tests.

THE POWER AMPLIFIER

The circuit of the power amplifier, shown in Fig. 2., is entirely conventional, based upon well established and proven techniques. Several versions, both 3Ω and 15Ω output impedance, having been built and all having performed faultlessly.

Tr4, the input transistor, is a simple voltage amplifying stage with base bias provided by the potential divider R18 and R19. The collector of Tr4 is directly coupled to the base of Tr5. Feedback from the centre point of the amplifier to Tr4 emitter, via VR4, establishes the d.c. working conditions throughout the whole amplifier. Since transistors and other components are subject to manufacturing "spreads", it is necessary to include VR4 to compensate for deviations in the working conditions caused by these "spreads". VR4 is the only component used in setting up the power amplifier.

From Tr5 the signal passes to the bases of an n.p.n.-p.n.p. pair of transistors, Tr6 and Tr7. Diode D1 assists in maintaining correct bias levels. At this junction an emphatic warning must be sounded, if partially or irretrievably damaged transistors are not to be the order of the day. D1 is part of the bias network for the output transistors, *and must be correctly wired into circuit. Suspect or "surplus" diodes must not be used in this application.* Failure to observe these requirements may result in trouble.

Capacitor C16 introduces a degree of high frequency attenuation, in order to protect the output transistors from high level, high frequency, long duration, signals. The h.f. response of the germanium transistors used is very limited, and an excessive continuous h.f. signal can destroy them by overheating the junctions. Under what may be termed normal conditions, these problems should not arise; however, readers possessing a.f. signal generators will no doubt wish to carry out appropriate tests, and then there is a very real danger of an increased mortality rate among power transistors if due care is not exercised.

Cross-over distortion, caused as the output transistors alternately conduct and cut off, can sound most unpleasant if remedial procedures are not taken. The standard remedy is to apply a small forward bias to the output transistors. Emitter resistors R29 and R30 perform this function in the present design.

★ components list

Resistors

R1	2·2MΩ	R12	1kΩ	R23	470Ω
R2	10kΩ	R13	1·2kΩ	R24	1·5kΩ
R3	1kΩ	R14	1·5kΩ	R25	270Ω
R4	see text	R15	27kΩ	R26	150Ω
R5	4·7kΩ	R16	27kΩ	R27	3·3Ω
R6	4·7kΩ	R17	3·9kΩ	R28	150Ω
R7	4·7kΩ	R18	330kΩ	R29	0·5Ω 10% WW
R8	4·7kΩ	R19	56kΩ	R30	0·5Ω 10% WW
R9	4·7kΩ	R20	15kΩ	R31	390Ω 5% 1W
R10	27kΩ	R21	150Ω		
R11	4·7kΩ	R22	33Ω		

All ½W 5% carbon film except as noted.

VR1 25kΩ log. VR3 100kΩ lin.
VR2 100kΩ lin. VR4 5kΩ skeleton pre-set

Capacitors

C1	100μF 15VW	C13	820pF polystyrene
C2	25μF 15VW	C14	125μF 15VW
C3	100μF 15VW	C15	100μF 15VW
C4	0·01μF	C16	1500pF polystyrene
C5	0·01μF	C17	50μF 15VW
C6	0·022μF	C18	100μF 15VW
C7	0·022μF	C19	2500μF 25VW
C8	8μF 15VW	C20	2500μF 25VW
C9	8μF 15VW	C21	1500μF 60VW
C10	100μF 15VW	C22	8μF 15VW
C11	100μF 15VW	C23	1000μF 60VW
C12	25μF 15VW	C24	0·1μF 500V

Note: C21 and C23 must have an a.c. ripple rating of 1A for mono or 2A for stereo.

Semiconductors

Tr1	2N3820	Tr5	2N1305	Tr9	NKT404
Tr2	2N1305	Tr6	2N1305	Tr10	NKT404
Tr3	2N1305	Tr7	2N1304	D1	OA10
Tr4	NKT264	Tr8	NKT404	D2	ZL30 30V 1·5W
		D3 to 6	1N4004		

Miscellaneous

T1, mains transformer 240V/30V 750mA (mono). Fuses and holders (2). S1a-b, 2 pole rotary on-off. Knobs etc. PC board 7 x 3 in. Veroboard 0·1in. Matrix 4½ x 3 in. Speaker 7 x 4 in. eliptical 3Ω.

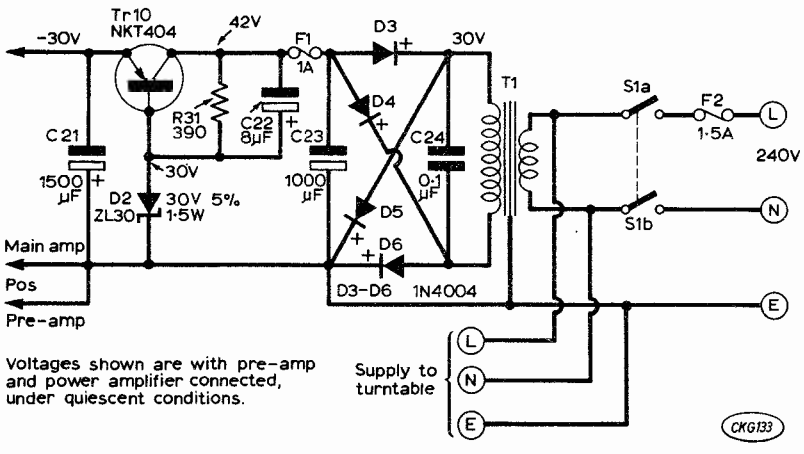


Fig. 3 : The power supply circuit.

To reduce the loading on the pre-driver stage, it is customary to increase the input resistance of the driver stage. This is effected by means of a "boot-strap" capacitor, C17 in the amplifier.

A disconcerting, though normally harmless effect found on some power amplifiers, is a loud "plop" when the amplifier is first switched on. The loudspeaker is here fed from a single output capacitor of some 2000μF from the centre point, and the

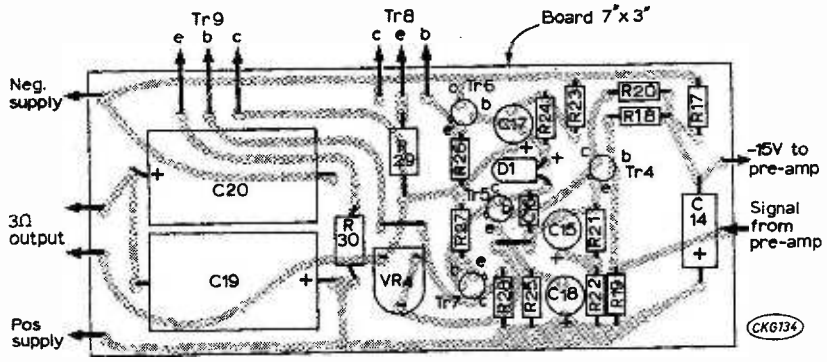


Fig. 4: The circuit board for the main amplifier viewed from the component side.

"plop" is caused by the capacitor charging up to half the supply potential via the "upper" output transistor and the loudspeaker, which are effectively in series.

In the present design this effect is greatly minimised by the use of two output capacitors in series, with the loudspeaker connected from the centre point to the junction of the capacitors. We now effectively have a bridge circuit, in which Tr8 and Tr9 form one side and C19 and C20 form the other. Initial surge currents now tend to flow more symmetrically and steadier nerves should result.

A further important advantage of the symmetrical output configuration, perhaps outweighing the plop reducing properties, is that supply ripple voltages will also flow symmetrically, resulting in a reduced hum level from the 'speaker, not that the hum level requires much reduction!

THE POWER SUPPLY

The amplifier was originally designed for a 15Ω output, as one of a stereo pair. The mains transformer was therefore bought with a 30V secondary to provide a rectified supply, at the quiescent current rating, of 42V. Since the present amplifier requires a supply of 30V, a series transistor in the power supply drops the surplus 12V.

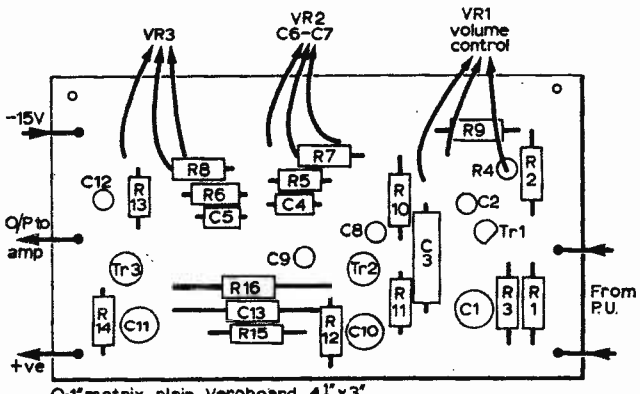
The secondary of the mains transformer feeds a bridge rectifier comprising diodes D3 to D6, Fig. 3. Capacitor C24 is a bypass capacitor, intended to reduce overvoltage spikes and mains-borne noise. C23 is the reservoir capacitor. Tr10 is the series regulating transistor, the base of which is held a constant 30V by the zener diode D2.

CONSTRUCTION

The power amplifier, as already mentioned, was originally conceived as one of a stereo pair, the two amplifiers being laid out on one sheet of copper clad laminate as a mirror image pair. For this application, the sheet was split in half, shown from the component side in Fig. 4. The pre-amp was, to save time, built on a piece of 0·1in. matrix plain Veroboard, shown in Fig. 5. together with its mounting bracket.

Clearly, there is no reason why both units should not be built upon the same type of board either separately, as here, or in an integrated form. The power amplifier is not unduly critical of layout, but the straight line type of construction is undoubtedly best. The pre-amp carries and "processes" some quite low level signals, and if the signal-to-noise ratio and hum level are not to suffer, care in layout must be exercised.

The power supply is integrated to the extent of having all its components mounted on and around the mains transformer. A piece of $\frac{1}{16}$in. aluminium 5×2in. is bolted to one end of the mains transformer, but spaced from it by $\frac{1}{2}$in. by means of $\frac{3}{4}$in. 4BA bolts. In the centre of this panel is



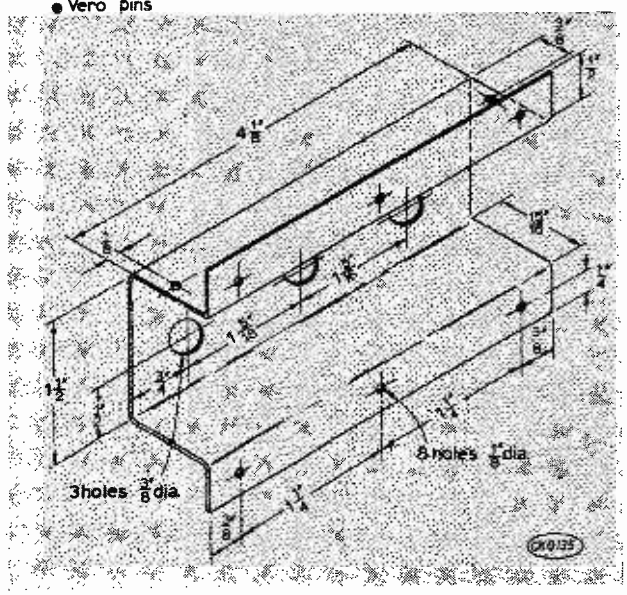


Fig. 5: The component layout and mounting bracket for the preamplifier.

mounted Tr10 with an insulating mica washer. D2, R31 and C22 are grouped round the pins of Tr10. The ends of the aluminium panel protrude either side of the mains transformer body, and carry C21 and C23, one at each end.

The end of the transformer, remote from the power transistor heat sink, Fig. 6, carries a small panel of s.r.b.p. on to which are mounted eight tags.

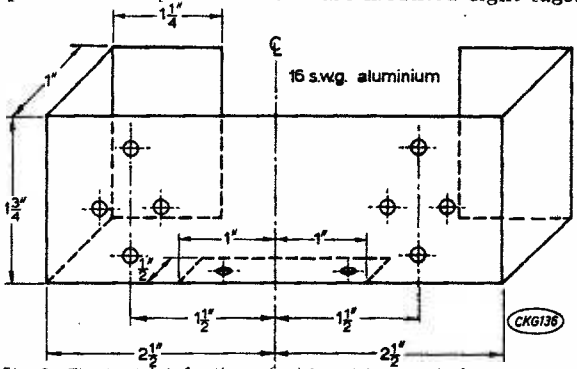


Fig. 6: The heatsink for the output transistors made from 16 s.w.g. aluminium.

Diodes D3 to D6 are soldered to these turret tags, the interconnections being on the reverse side. Since the current demands are heavy (relatively speaking) wire of a suitably heavy gauge must be used such as 14/·01in.

COMPONENTS

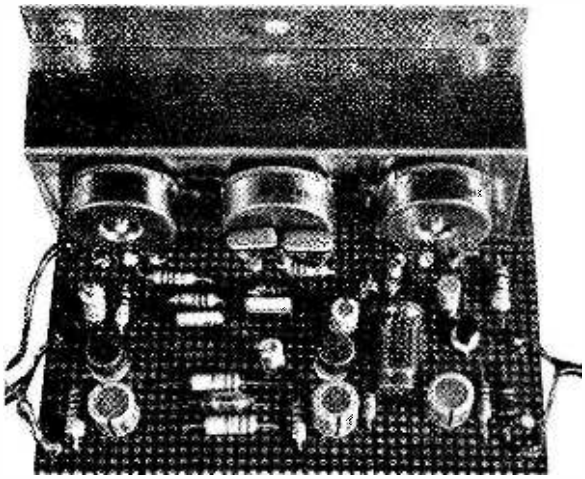
It must be borne in mind that the power amplifier and the latter two transistors of the pre-amp are directly coupled; any faulty transistors, or transistors well outside the published specifications, can lead to fault conditions developing. At best these conditions will prevent correct operation of the equipment; at worst they will cause the destruction of the power transistors. The "cure" is to buy only new transistors from a reputable supplier.

With the exception of R29, R30, and R31, all the resistors used are 5% $\frac{1}{2}$W carbon film types since these are now freely and inexpensively available from many suppliers. The use of these resistors makes subsequent fault finding very much easier, should the need arise, since any deviation from correct operation can almost certainly be attributed to the semiconductors whose manufacturing "spreads" are so much wider than those of the resistors.

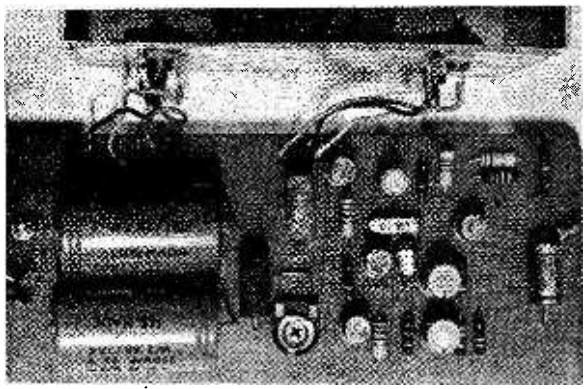
The mains transformer, as already explained, was purchased with a 30V secondary. If the expense of the simple series stabiliser is unacceptable, then the conventional power supply (transformer—rectifier—capacitor) can be used. Under these conditions, the transformer should be rated at 18 to 20V at 800mA for a single amplifier, or at 1·5A for a stereo pair. Since smoothing is now dependent upon C23 alone, it should be increased in value to 2000μF or 2500μF. An anti-surge resistor of about 1Ω should be interposed between the rectifiers and C23.

When the amplifier is delivering its full rated power, transistors Tr8, Tr9. and Tr10 get very hot under sustained drive conditions, and adequately rated heat sinks are necessary. Under normal conditions, when music is being reproduced at a reasonable level, through speakers of average efficiency, the heat generated is very much less, and smaller heat sinks can be used, providing an adequate air flow is ensured.

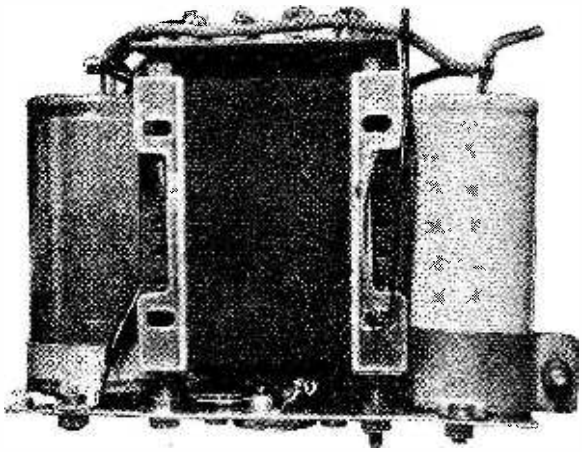
When the various units are completed, they must be thoroughly checked over; wiring errors, shorting wires, etc., can be disastrous, so time spent in careful checking is time well spent.



A view of preamplifier.



The main amplifier. The wires to the output transistors can be seen at the top.



The power supply.

The first item to be checked can be the power supply. Assuming a series stabiliser is used with a transformer having a 30V secondary, the voltages should agree closely with those shown in Fig. 3.

Having allowed C21 ample time to discharge completely, the power amplifier can be connected to the power supply. A fairly high wattage resistor of some 10 to 20Ω should be connected in series with the negative line to limit the maximum current that can be drawn in the event of the power amplifier having a fault condition. Power can now be applied.

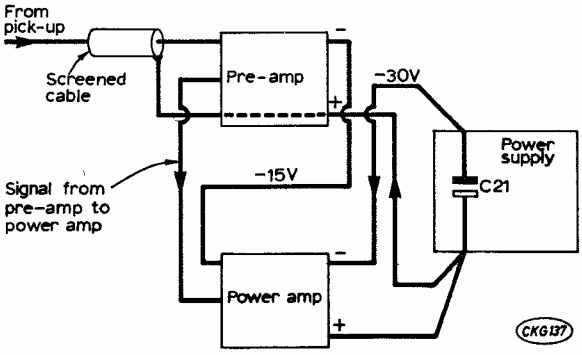


Fig. 7: The interconnection of the individual sections.

An accurate voltmeter should be connected to the centre point and VR4 adjusted to provide a centre-point voltage of approximately 18V. The remaining voltages can also be checked and should agree with those shown in Fig. 2. If voltages differ considerably from those shown, or if the centrepoint cannot be set to 18V, then a semiconductor is the most likely cause, and the easiest course of action is to remove them all from circuit and have them checked on a reliable tester. It is no good pressing on in the hope that the fault will "go away". It won't, it will remain or get worse. If all appears to be well, the series resistor can now be removed.

The centre point voltage, under quiescent conditions, is set to exceed half the supply voltage by a small margin, so that at maximum drive the centre

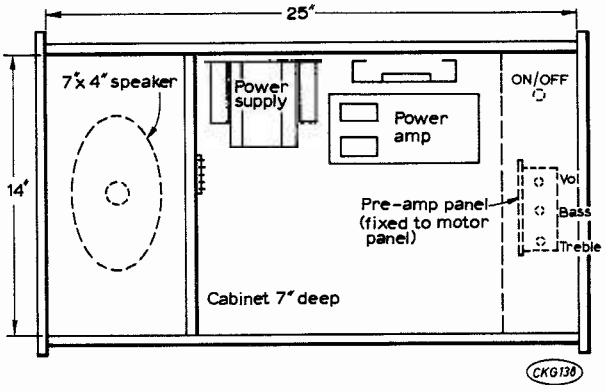


Fig. 8: The general layout employed in the prototype.

point falls to exactly half the supply voltage. Limiting, under conditions of excess drive, will therefore be symmetrical.

If an audio oscillator and oscilloscope are available, VR4 can be set even more accurately. A 1kHz signal is injected into the base of Tr4, and the oscilloscope is connected from the centrepoint to earth. The input from the generator is increased to the point where limiting becomes visible on the oscilloscope. VR4 is then adjusted until the limiting become symmetrical, i.e. positive and negative peaks are evenly clipped. Since VR4 has an effect upon the overall gain of the amplifier, the input signal may require altering to compensate.

As explained earlier, the output transistors are liable to be damaged, or even completely destroyed if indiscriminate high power testing is indulged in. For this reason, sine wave testing at full power *must not be attempted beyond 1 or 2kHz.* High frequency testing can be attempted, but at greatly reduced power outputs. Even then, a series ammeter should be used to continuously monitor the current consumption. If this is done at a carefully chosen output then it will become apparent that I^2R as a function of *actual power output,* and I^2R as a function of *power consumed,* are two very different quantities, the power consumed being, of course, greater than the power output, *the difference increasing with an increase in frequency.*

When the power amplifier has been satisfactorily set up, attention can be turned to the pre-amp. Again, an audio oscillator and oscilloscope are invaluable. A voltage at 1kHz., equal to the peak output of the cartridge to be used, is fed into the input of the pre-amp and R16 is selected such that, with the volume control fully advanced, the output waveform from the power amplifier just starts to limit. This will ensure that distortion due to overloading cannot occur, even at maximum output.

CONNECTING UP

AC currents of over $\frac{1}{2}$A flow through the output stages under maximum drive conditions and incorrect earthing can result in instability or the formation of hum loops. Some thought to interconnections must therefore be given, the circuit of Fig. 7 having been found satisfactory. The pickup lead should only be earthed at the pre-amp, the other end being left disconnected. The turntable should be earthed separately to the main earth.On the prototype, a separate mains on-off switch is used, sited well away from pre-amp to preclude any possibility of mains induced hum. This switches the mains to the player as well as to the amplifier power supply.

Although the amplifier has been described as a mono or single channel unit, reference has occasionally been made to stereo operation. This is, of course, quite possible. All that is required is a doubling up of everything, with a revised physical layout. Separate heat sinks should be used for the two power amplifiers, and if continual high power operation is envisaged, these should be of the commercially produced extruded type.

The power supply will require revision, since a single NKT404 will probably be overrun. Its maximum collector dissipation in the present application is in the region of 8W and this will be doubled for stereo. The easiest course, if a regulator is desired, is to replace the NKT404 with a 2N3055 in the positive side, and to turn the power supply circuit "up side down". The 2N3055 must be mounted on an extruded heat sink to dissipate the heat generated safely, this being mounted in a position where an adequate air flow is possible. ■

MODIFICATIONS TO THE TRANSISTORISED OSCILLOSCOPE

FEBRUARY-MARCH 1972

SINCE publication of the constructional details of the Transistorised Oscilloscope in the February and March editions of *Practical Wireless*, many readers have written in to say that they have had difficulty in obtaining the VCR 139A cathode ray tube. When the unit was first designed, stocks of this tube appeared to be adequate to meet the anticipated demand, but the response to the article has been very much greater than expected and consequently the VCR 139A has become a very rare specimen! In reply to readers' requests several alternative tubes have been tried but, to date, only two which are readily available in quantity have proved to be satisfactory—the surplus 2A P1 and the Mullard DG 7-5.

The 2A P1 can be used as a direct electrical replacement with only one circuit modification (change R12) but suffers from two mechanical disadvantages:

1. The tube face is only 2in. diameter rather than $2\frac{3}{4}$in. of VCR 139A.
2. Some versions are slightly too long to be accommodated into the original chassis design. Early versions of the tube are just over 10in. long and will require extensive modificaion to the metalwork before they can be used. The later, and fortunately much more common version, is $7\frac{1}{2}$in. long and fits perfectly well into the cradle as designed.

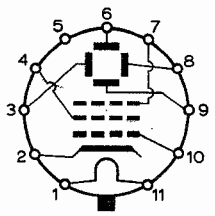
The pin connections for the 2A P1 are shown in Fig. 1 together with the corresponding connections for the VCR 139A. The only electrical modification is the changing of R12 (Fig. 5 page 887 of February issue) which should now be 10Ω 5 watt.

The Mullard DG 7-5 is listed by its makers (Philips of Eindhoven) as being obsolete, but, on checking with wholesalers, it still seems to be very widely stocked throughout the country and should be available to special order from any good component retailer. This tube works very well in the revised circuit and gives, if anything, a slightly brighter and better focussed trace than the VCR 139A.

The modified display unit is shown in Fig. 2 and this should be compared with the original circuit (Fig. 5—page 887). As will be seen the main change to the original circuit is the provision of a negative supply for the tube grid. This supply is required because the heater and the cathode of the DG 7-5 are internally connected, so that instead of being able to take the grid to chassis and running the cathode at a positive potential with respect to the chassis, we are obliged to hold the cathode at chassis potential and make the grid negative. The additional components required for this modification are prefixed with the figure 4 in the revised circuit diagram.

The major points concerning construction and testing are unaffected by this modification and the few additional components are easily accommodated on the tag-strips mounted on the back panel.

DN 0669



Tube 2AP1
Base USM11

	2AP1	VCR139A
Heater	1,11	3,4
Cathode	2	1
Grid	10	2
Focus electrode	4	5
Anode	7	9
X plates	3,8	8,10
Y plates	9,6	7,11

Fig. 1: Pins connections of the 2AP1.

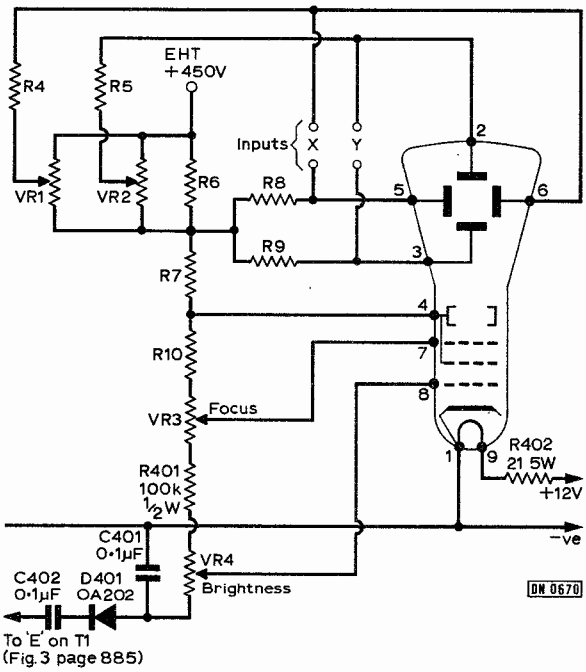


Fig. 2: Circuit changes when using the DG 7-5 tube.

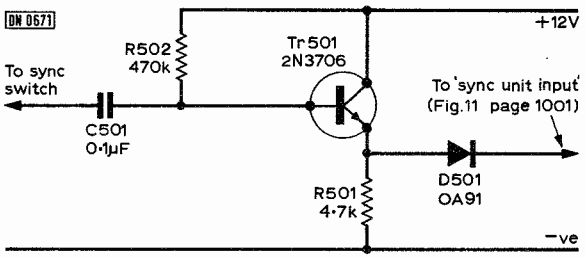
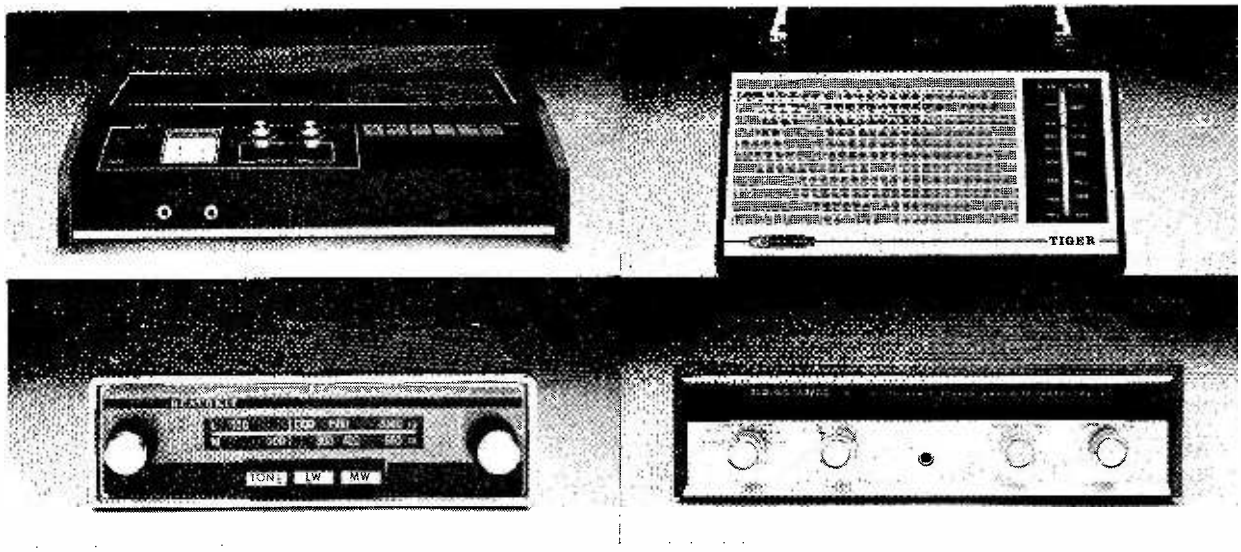


Fig. 3: Modification of the sync circuit.

Many readers have expressed a preference for a more conventional synchronisation circuit than the gated system used in the prototype. The most obvious method is to feed negative going pulses into B_2 of Tr9 (Fig. 11 page 1001) but unfortunately this seems to have a rather distressing effect on linearity. A simple and effective circuit is shown in Fig. 3—the only disadvantage being a lack of sensitivity to very fast pulses. ■



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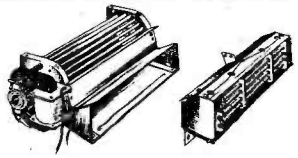

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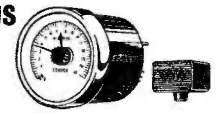

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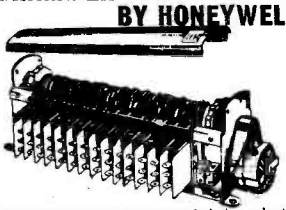

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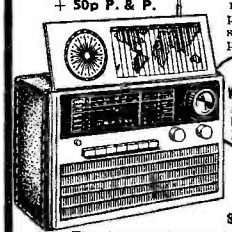

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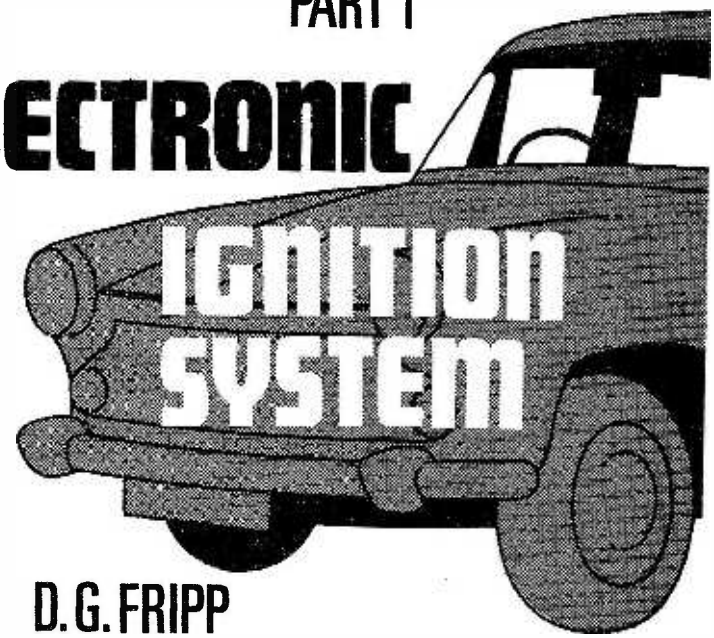
constructing THE PW ELECTRONIC IGNITION SYSTEM

PART 1



Last June we published a short article on the PW Electronic Ignition System little realising the tremendous interest it would arouse. Thousands of these units have been built but many readers wrote in saying "I've got all the parts, what do I do next?" Here is all the information they could possibly need, based on the experiences of a reader.

D. G. FRIPP

THE advantages of an electronic ignition system are now quite well known, and of the various systems available perhaps the "capacitor discharge" system is the most widely popular. This constructional article deals with such a system and follows closely the circuitry as described under this heading in the June 1971 issue in which most of the advantages were fully explained with the exception of one fact of paramount importance to the constructor; as this system uses the contact breaker as already fitted to the car, it in no way alters the timing; thus in the unlikely event of a component failure, a quick rearrangement of the connecting leads taking less than thirty seconds enables the car ignition to be returned to normal and the journey resumed.

Unlike many other systems employing specialised components which are not always readily available even from agents without some delay, this system with its inherent safety factor of easy reversion has much to commend it, as no doubt anyone who has been stranded by an ignition fault would hasten to agree.

SOME ADVANTAGES

Some not quite so obvious advantages not previously mentioned may be of interest to would be constructors, not least of which is the fact that owing to the more powerful spark delivered to the plugs by this electronic ignition unit—this may vary from 20 per cent to 40 per cent depending on the coil used—the firing of the petrol-air mixture is ensured, thus a slightly weaker mixture can often be used to enhance the economy already achieved by this form of ignition due to more complete combustion. This of course means that as up to 25 per cent more of the fuel used is burnt in the engine, where it develops more power, there is a correspondingly significant decrease in the pollution emission in the form of unburnt exhaust gases. In these days of a growing awareness of the desirability of reducing the amount of pollution, as is typified by the lowering of the limits of exhaust emission which must be complied with for the importation of cars into the U.S.A. in the near future, it would seem that the future of electronic ignition may well be assured if only from this one important aspect.

Another advantage of this type of ignition is that because of the faster rise time (as against conventional inductive systems) there is much less time for the current to leak away through any leakage paths which may exist on any of the insulated parts of the ignition components such as plug insulators, leads, distributor cap, rotor arm, and coil h.t. stack, also any conductive deposits which may have accumulated on the plug firing points. Thus plug fouling is virtually eliminated and therefore the heat range grading can be ignored. From this it can be

seen that a vehicle using this electronic ignition unit, which is driven under widely varying conditions, should not exhibit any plug trouble even if it were prone to with normal ignition, assuming plugs of reasonable condition.

Largely because of the reasons just mentioned at least one well known plug manufacturer has developed a plug specifically for use with electronic ignition. This plug has an annular gap, which has the effect of greatly increasing the mass of the outer electrode, so its erosion should be slower. It should be realised that the effect of a high energy spark is likely to cause more erosion of the electrodes—especially the outer—although this seems to be offset to some degree by using wider gaps as is advocated later in this article, and is probably nullified by the fact that this high energy spark is of much shorter duration—approximately one fifth of a conventional system—and contains nearly equal positive and negative half cycles so that metal migration of the plug firing electrodes should be very much less.

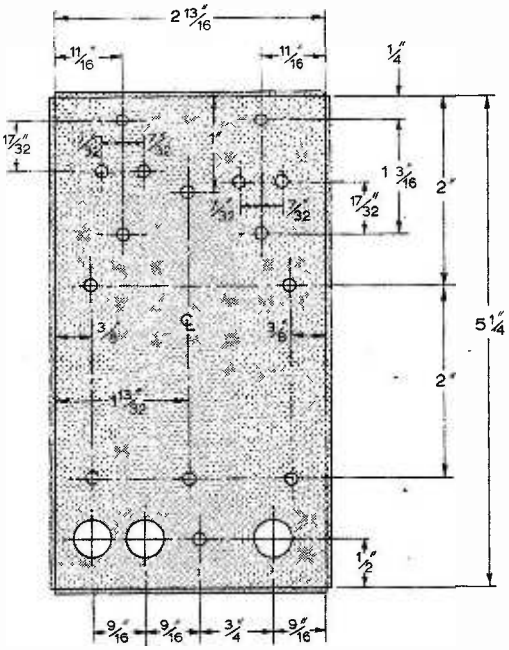
Certainly these conditions would appear to prolong spark plug life, and this is borne out by one such car fitted with new plugs when one of these ignition units was installed, as careful examination of the plugs over 5,000 miles later showed no observable deterioration of the firing electrodes.

From this it can be seen that the normal plugs as quoted by the car manufacturer can be used with confidence, provided that they are in reasonable condition and the gaps are reset.

POLARITY

The unit as shown is the one as used for positive earth supply, but the method of construction and the placing of components is identical for the negative earth type except for the transistor types and the polarity of the associated diodes as has been explained in the original article. The actual connections from the unit to the coil and contact breaker remain the same in both models as the polarity of the pulse fed to the ignition coil is identical.

When wiring in the unit see that the pulse feed from the discharge capacitor is connected to that terminal on the coil marked positive, as this terminal should correspond to the single end of the primary winding whilst the terminal marked negative should be the end of the primary winding which is common with the earthy end of the secondary on a correctly marked coil.



18 s.w.g. aluminium
Small holes 4 BA clearance. Large holes 3/8" dia.
View looking into box lid
CKG072

Fig. 1 Drilling details for the lid of the box on which all the components are mounted.

★ components list

Resistors
R1 82Ω 3W wirewound
R2 1kΩ ¼W
R3 1kΩ ¼W
R4 82Ω 3W wirewound
R5 1kΩ ¼W
R6 8·2kΩ ¼W
R7 39Ω 5W wirewound
R8 2·2 MΩ ¼W

Capacitors
C1 0·47μF 600V
C2 0·22μF 250V

Semiconductors
Tr1, Tr2 2N3055 Positive earth system
2N3614 Negative earth system
D1, 2, 4, 5 1N4001 D3 4 x BY100 or 1N4006
ZD1, ZD2 BZY94C30 SCR TAG1/500 or TAG1/600 (see text)
Semiconductors available from Jermyn Industries, Sevenoaks, Kent

Transformer
T1 Type P1/6 Available from Magtor Ltd., 68 Dale Street, Manchester (£1·50 inc. p/p.)

Miscellaneous
Aluminium box and lid (Type AB7), see text. Tag strips ⅜in. spacing, 8 way with earthing tag each end, 2 way with one earth tag, 3 way with centre earth tag (R.S. Components Ltd.). 4 right angle male push-on connectors (Lucar type).

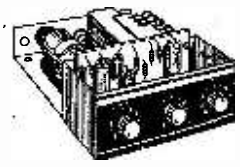
CONSTRUCTION

This unit has been designed to be as compact as possible without undue cramping of the specified components, but there is little room to spare; high voltage points are adequately spaced and their positions relative to other components considered so the constructor is urged to follow the layout as closely as possible.

Having made a box and lid to the required dimensions, Fig. 1 or purchased a ready made one the lid is marked out to the dimensions given in Fig. 1 and all the holes drilled. Extra holes may be required in the box and lid if extra self tapping screws will be needed to hold the unit together when the box is mounted in the car owing to the possible inaccessibility of the one screw top and bottom provided on the ready made box.

At this stage it is prudent to ascertain the mounting position of the unit and the method to be adopted. Pan head self-tapping screws straight through the back of the box, or alternatively small pieces of aluminium angle may be affixed to the sides of the box to secure fixing points. Whichever

SUPERSOUND 13 HI-FI MONO AMPLIFIER



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PRICE £10·50. P. & P. 25p.

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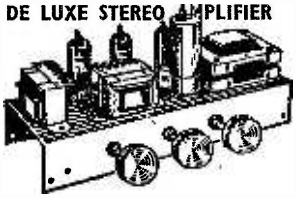

A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum.

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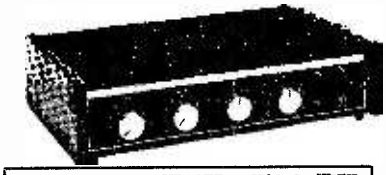

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Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi Fi Discotheque use, etc.

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Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4¾" 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 **£4·75.** P. & P. 35p.
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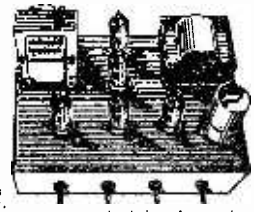

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way is used, remember that any metal protrusions in the shape of screw or rivet heads must be shallow and positioned only in close proximity to earthed parts of the circuit, and also that the unit relies on its mounting for earth return operation which keeps the number of leads to a minimum and the reversionary facility less confusing.

The three heat sink fins, having been made to the sizes given in Fig. 2, are then mounted by means of $^3/_8$" × 4BA screws as is also the transformer (five leads toward transistors), the two-way tag strip, the three-way centre earth leg tag strip and the discharge capacitor clip which is made from a piece of thin scrap aluminium. The eight-way tag strip is not mounted at this stage as it is more easily fitted after the tag panel.

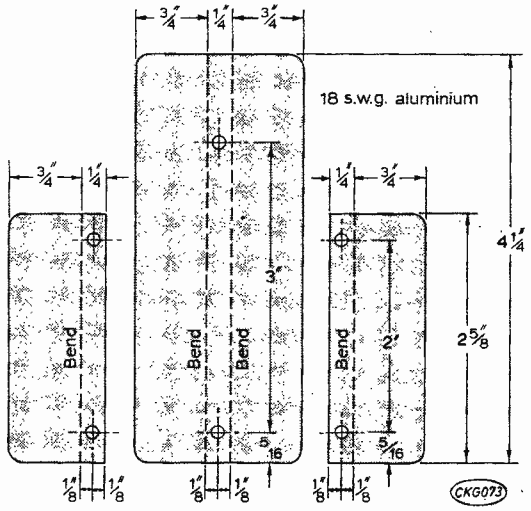


Fig. 2. These three heat sink fins are fitted to the lid of the box.

When mounting the heat sink fins and the transformer it is a sound idea to give those sides which come in contact with the chassis a smear of silicone grease to ensure thermal conductivity. Likewise the transistors when they are mounted.

To obtain a professional finish to the unit now is the time to give it a few coats of matt black paint after masking the transistor mounting positions with two small pieces of masking tape or something similar cut to the required shape using the actual transistors as templates. One of the popular aerosols is ideal for this job and the results are well worth the small effort involved, not only as regards the final appearance of the unit but this process effectively assists the even dissipation of heat besides preventing corrosion.

The paxolin strips and washers are next prepared as in Fig. 3 and assembled to form the tag panel in the manner indicated not forgetting to include a soldering tag under the nuts of connectors marked coil +, −, and CB and the earth tag of the eight-way tag strip under the nut of the remaining connector marked IG/SW., the nut on that side of the transformer being removed to take the other earth tag of the eight-way tag strip which should have the adjacent tag completely removed as reference to Fig. 4 makes clear.

The two transistors of the type required for the particular polarity unit being constructed should next be mounted (with silicone grease on mating surfaces) and also the thyristor heat sink by soldering the doubled over tag in the position indicated in Fig. 4. This heat sink may either be made from thin springy brass or copper 0·020" thick to the dimensions given in Fig. 5 or it can be formed from a commercial heat sink as supplied for OC81 type transistors as was done in the prototype. It serves as a convenient anchorage for the s.c.r. as well as providing a safety factor which, although not absolutely necessary, is an added precaution.

Wiring can now be begun and is largely achieved with the wire ends of the components. The long wire from the discharge capacitor should be well insulated with plastic sleeving and dressed as in Fig. 4. Careful checks especially on the polarity of the various diodes and the use of a heat sink is strongly recommended whilst soldering operations are in progress.

With regard to the components around the transistors, which were soldered into circuit so as to preclude any intermittent contacts which might occur with spring contacts on transistor holders (imagine an ignition fault impairing performance whilst overtaking), it may be found advantageous to solder the components together one by one so that the final connection to the appropriate transistor pin consists of only one wire end which simplifies construction, replacement of transistors should this ever be necessary, or if the unit is ever altered to the opposite polarity working.

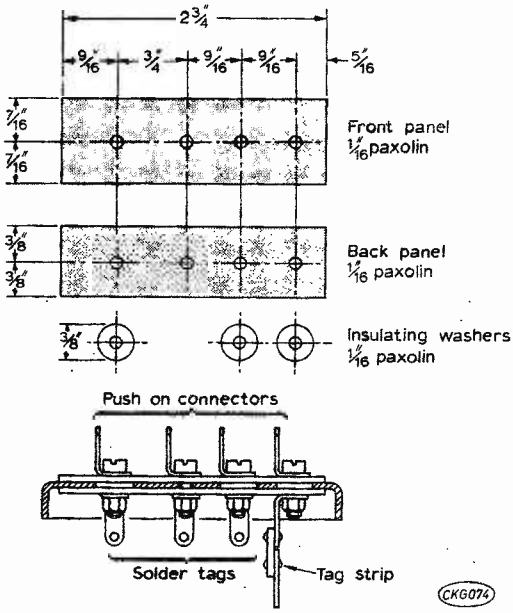


Fig. 3. Assembly details of tag panel.

The next few paragraphs may be ignored by the competent constructor, but are included for those who prefer to work from a step by step outline.

NOTE: The following instructions refer to a unit with a **positive** earthed vehicle. They also apply to the construction of a unit for negative earth use if the reference to polarities of D1, D2, D4, ZD1, ZD2 are reversed, D5 is not required, and of course TR1 and TR2 are of the type specified in the components list. The gate and cathode connections are also reversed for the negative earth unit.

Start by terminating the two black wires of the transformer to the third and fourth tag of the eight-way tag strip (counting earth tags and removed tag from transformer towards IG/SW connector) followed by blue transformer lead and one side of R1 to right tag, and yellow transformer lead and one side of R4 to left tag of three-way strip on transistor side of transformer.

Connect one side of R2, R3 and positive side of ZD1, ZD2 to the central earth tag of the same three-way strip; join free end of R2 to free end of R1 fairly close to R1 body in a T form thus leaving the wire from R1 full length, then using this tee technique again join the positive end of D1 to the R1 wire, the end of this R1 wire is now formed into a small loop to fit on the Base pin of Tr1. By using this method there is only one connection to be made to Tr1 base pin with the advantages already mentioned.

Repeat this process with R3, R4, and D2 to Base pin of Tr2. Connect the free end of D1 (negative) to the free end of ZD1 (negative) and also green lead of T1 using same T method, again forming small loop on the ultimate wire of these junctions for connection to emitter pin of Tr1.

Repeat with D2, ZD2, red transformer lead and emitter pin of Tr2. The four BY100 which form bridge rectifier D3 are next wired in position, Fig. 4. by joining two negative wires of two BY100's together and to the earth tag on strip held by T1 bolt, one positive going to tag 3 where black T1

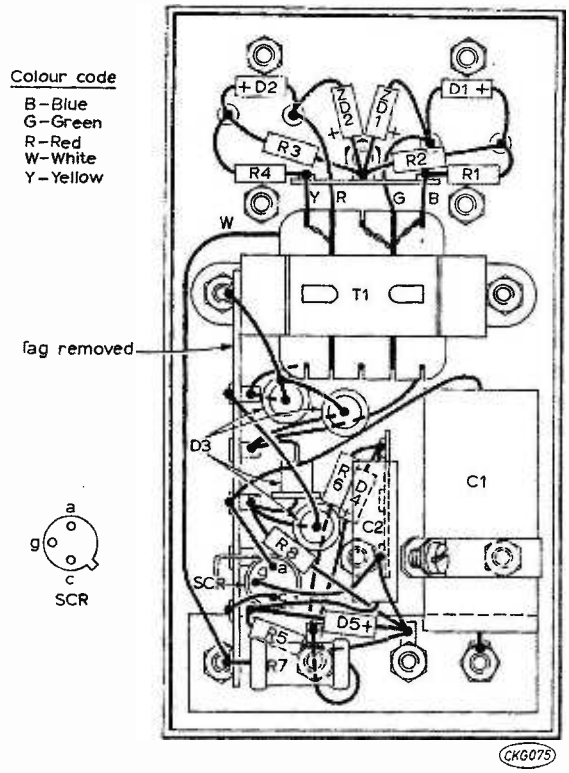
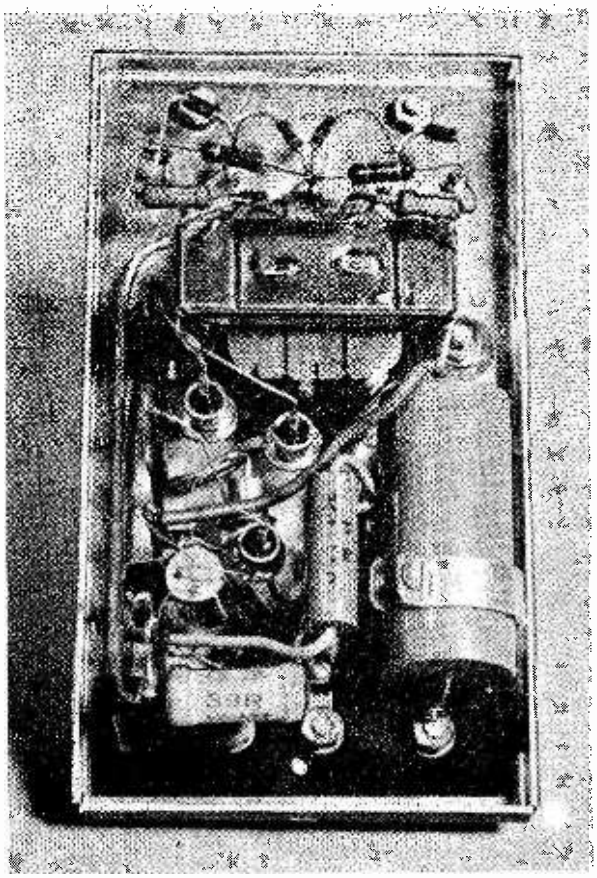


Fig. 4. Complete wiring diagram for a **positive** *earth unit which may be compared with the photograph, below left.*



lead joins. The other positive goes to tag 4 where the other black T1 lead has been soldered and from this point is connected the negative of the third BY100. Its positive wire goes to tag 5 as also does the positive of the fourth BY100 together with one side of R8. The negative of the fourth BY100 is returned to tag 3, upper half of tag. Use the lower half of tags for all previous connections except the earth one.

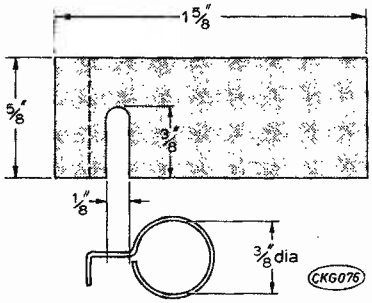


Fig. 5. Heat sink for the SCR made from springy brass or copper.

The two-way tag strip should now be mounted by means of the central heat sink fin fixing bolt and a short piece of wire soldered from the unit tag marked Coil negative to the earth tag on the two-way strip, in the form of a bus bar. Several earth joints can then be comfortably accommodated the first of which is the free end of R8.

To the lower half of tag 7 solder one end of R5 and the negative end of D5, the other end of R5 and the positive end of D5 are then earthed at the bus bar.

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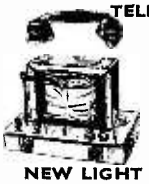

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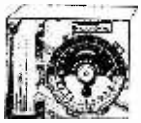

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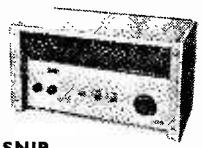

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Note: 2415 is a floor mounting 3 phase unit.

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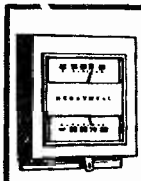

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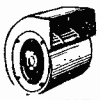

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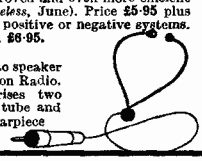

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **£2**—twin stethoset instead of earpiece **75p** extra—post and ins. 20p.

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Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **£1·25**, 12v. car model also available same price. Jug heater **£1·50** (mains only)

MAINS OPERATED SOLENOIDS

Model TT2—small but powerful 1" pull—approx. size 1½ × 1½ × 1¼" **60p**.
Model 400/1¼" pull. Size 2¾ × 2 × 1⅝" **75p**.
Model TT10 1¼" pull. Size 3 × 2½ × 2¼" **£1·80** plus 20p post and ins.

MAINS RELAY BARGAIN

Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V. A.C. Good British Make. Unused. Size approx. 1¼" × 1". Open construction.
Single pole **25p** each 10 for **£2·25**
Double pole **35p** each 10 for **£3·15**

DRILL CONTROLLER *NEW 1KW MODEL*

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1·50** plus 13p post and insurance. Made up model also available. **£2·25** plus 13p post & p.

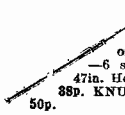
SLIDE SWITCHES

Slide Switch. 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in × ¾in rated 250V lamp. **6p** each. 10 for **54p**, 100 for **£5·10**, 500 for **£24**. Ditto as above but for printed circuit **5p** each 10 for **45p**, 100 for **£4·25**. **Sub Miniature Slide Switch.** DPDT 19mm (¾in approx.) between fixing centres. **12p.** each or 10 for **£1·08**.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in dia. by ¼in thick. Rated at 500 MW, wire ended. **43p** with circuit. Also ORP12 light cell **45p**.

TELESCOPIC AERIAL



for portable, car radio or transmitter. Chrome plated—6 sections. extends from 7½ to 47in. Hole in botton for 6B.A. screw, **38p**. KNUCKLED MODEL FOR F.M. **50p**.

0-8 AMMETER

2in square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price **43p** each. 10 for **£3·90**.

EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft. per hour Suitable for kitchen, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5½" casing with 5½" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets. **£2** plus 36p post and ins.

DIGITAL CLOCK

As featured this issue, send for parts list.

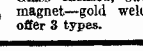
MICRO SWITCH

5A changeover contacts. **9p** each. **£1** doz. 15 amp Model **10p** each or **£1·05** doz.

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 **20p** each **£1·80** for ten, your assortment.

REED SWITCHES



Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types.

Where postage is not stated then orders over £5 are post free. Below £5 add 20p Semiconductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

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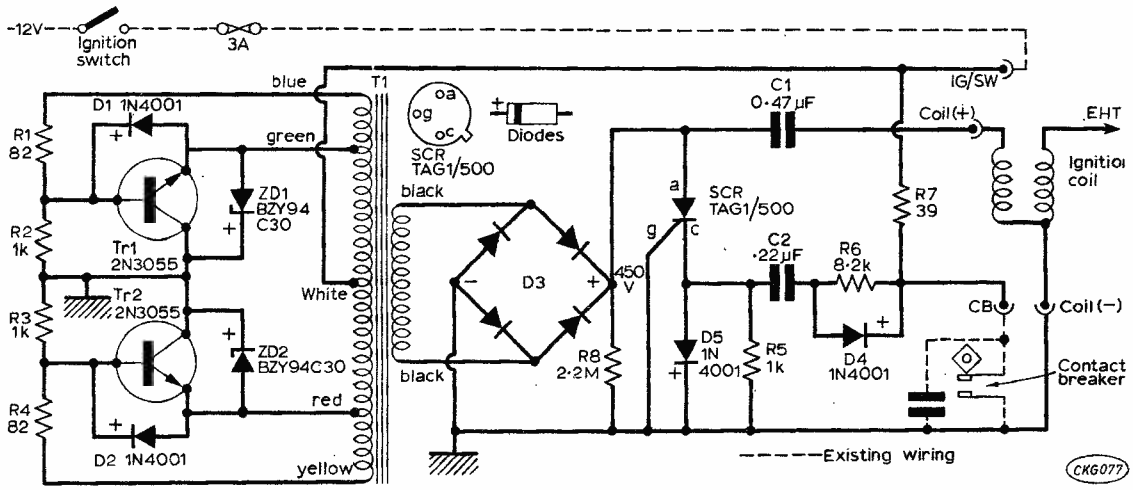


Only minor amendments have been made to the original circuit. This one is for **POSITIVE** *earth vehicles.*

One end of R6, the negative end of D4, and one end of C2 are soldered to the free tag on the two-way strip; the free end of R6 and the positive end of D4 are then connected to the unit tag marked CB as is also one side of R7, the other side of R7 and the white T1 lead solder to the earth tag 8 which is unit tag marked IG/SW.

The free end of C2 connects to lower half of tag 7 on eight-way strip.

Capacitor C1 fixing clamp should now be fixed in position and C1 secured by means of the clamping bolt—not forgetting to use a small piece of aluminium as a crush guard. One end of C1 connects to unit tag marked coil positive and the other end covered with good quality plastic sleeving and dressed as in Fig. 4 and connected to tag 5 on eight-way strip.

The thyristor heat sink is then fixed by bending both upper and lower portions of tag 6 (on eight-way strip) in such a manner as to form an almost complete wrap around the strip, the slot in the heat sink is then pushed down centrally over this wrap and soldered in position as shown in Fig. 4.

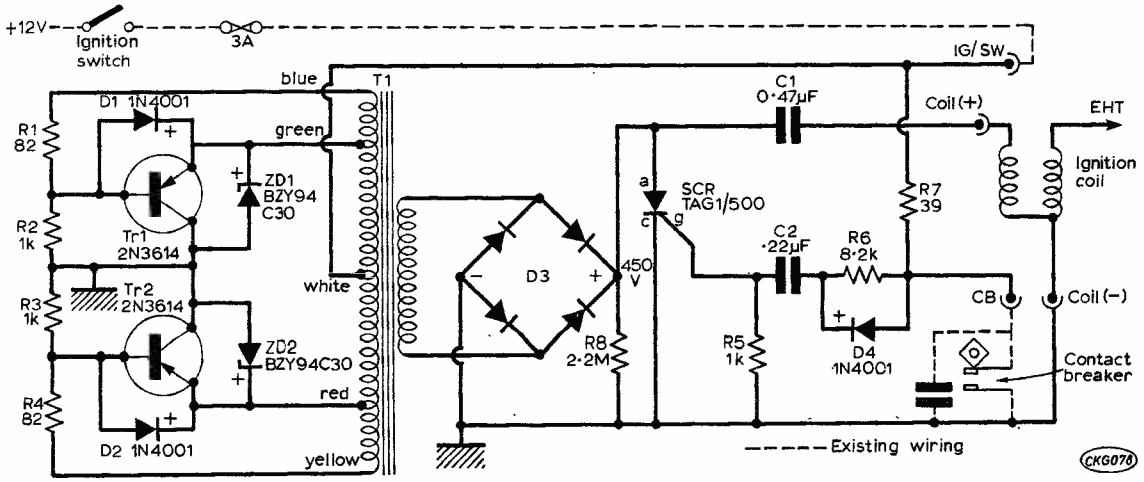
The last component to be fitted is the thyristor SCR and reference to Fig. 4. clearly shows how this is connected, namely anode to tag 5 cathode to tag 7 on eight-way strip whilst the gate is connected to the earth bus bar adjacent to unit tag marked Coil negative.

The TAG 1/500 has proved eminently suitable for use with most ignition coils as fitted to British cars and far superior to those s.c.r.'s obtained from other sources, in freedom from breakdown, but some foreign-made ignition coils require the TAG 1/600 to be used owing to the primary inductance generating excessive oscillatory peaks. However, this subject is too extensive to go into in this article and the foregoing remarks can be taken as a reliable guide.

TESTING

When the unit is complete it should be tested by applying the car battery to connectors IG/SW and −ve (IG/SW to live feed and −ve to that pole of the battery which is earthed on the particular car and unit) when a whistle should be heard indicating that the oscillator section is working. The voltage

This circuit is for **NEGATIVE** *earth vehicles. Certain diode polarities are reversed as well as the gate and cathode connections to the SCR. Diode D5 is omitted.*



across the bridge rectifier is then measured and should be approximately 450V, this reading may increase to approximately 480V when the connections to the ignition coil are made but it depends on coil characteristics.

Assuming these initial tests to be satisfactory the unit is then fixed to the car in a suitable place, all connections checked, and the unit is ready for use.

CONNECTING UP

The connections of the ignition unit to the vehicle are quite simple but are given here in full for guidance of any constructor who may be doubtful.

After mounting the unit (preferably on side of wing or bulkhead so as to keep leads from the unit to the ignition coil as short as practicable) remove the existing ignition switch to ignition coil wire—that is the thin lead which does *not* go to the contact breaker—and connect to unit tag marked IG/SW (see notes in text about ballast resistor if cold start coil is fitted).

Remove the thin lead from the ignition coil which connects to the contact breaker, and connect this lead to unit tag marked 'CB'.

Two short extra leads are now required and are connected one lead from unit tag marked 'coil negative' to ignition coil terminal marked 'negative,' the other lead goes from unit tag marked 'coil positive' to ignition coil terminal marked 'positive.' These connections are identical for both negative and positive earthed vehicles.

For coils marked SW and CB, this corresponds to positive and negative respectively—see circuit diagram.

Should the reversionary facility be required—due to component fault, although this should not occur if the recommended components are used—simply remove the two short leads connecting the unit tags marked 'coil positive' and 'negative' to the ignition coil positive and negative.

Remove the lead from the unit tag marked CB and connect it to the ignition coil terminal which is the same polarity as that terminal of the battery which is earthed to the chassis.

The remaining lead which is left on the unit tag marked IG/SW is removed and connected to the remaining free terminal on the ignition coil.

PLUGS

It is recommended that the sparking plug gaps be reset to around 0·050″ instead of the usual gap which is about 0·025″, as the higher resistance load thus presented enables the greater output available from the electronic ignition unit to be used to the fullest advantage.

The prototype of this unit is in use on the writer's car and has proved a worthwhile accessory.

NEXT MONTH Part 2 reviews the various types of ignition coil available today and how they can be used with the PW Electronic Ignition System plus information on using your tachometer with this unit. Finally, a discussion of the various advantages of the PW unit as obtained in actual road tests.

Practical Wireless Designer's Trophy 1972

To encourage new authors, entries for the 1972 Trophy will be restricted to readers who have not previously had an article published in PW. This leaves the field wide open for those wanting to try their hand at writing technical constructional articles. Contestants will not be in competition with well-known authors, only with other newcomers, so the cup can only be won by a new writer. **It Could Be You.**

TURN YOUR CONSTRUCTIONAL PROJECT INTO CASH—AND MAYBE WIN THE CUP!

RULES

1. The winning entry will be chosen by a panel of judges from among articles published in issues of PW dated September 1972 to August 1973 inclusive. The Editor's decision on all matters arising will be final.
2. The winner of the competition will receive and retain outright the PW Designer's Trophy 1972. Other prizes will be awarded to the best runners-up. Articles will be paid for shortly after publication.
3. The competition is open only to authors who have not previously had any work published in PW.
4. Articles submitted for the competition should conform to the general style of material published in PW and must describe the operation and construction of a piece of radio, audio or test equipment that has been designed and built by the author.
5. Articles should, preferably, be typed using double spacing, leaving wide margins, on one side only of each sheet. Circuit diagrams and any other drawings must be separate and numbered to agree with the text. Author's roughs must be clear enough to permit re-drawing. Components list must also be separate and laid out to the standard PW format.
6. Photographs of the equipment are desirable and should be in black and white, sharp and clear. Photographs may be identified by sticking a label on the reverse instead of writing on the back of the photograph itself.
7. Components used in the design must be readily available from retail sources.
8. Articles should be sent to the Editor, Practical Wireless, Old Fleetway House, Farringdon Street, London, E.C.4. Authors will be advised as soon as possible of the acceptance or rejection of their articles. Equipment, the subject of an article, must not be sent to the Editor until advised to do so.
9. Employees and staff of PW are not eligible for entry to this competition.

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TAKE 20

JULIAN ANDERSON

A series of simple transistor projects, each using less than twenty components and costing less than one pound to build.

No. 37
BURGLAR ALARM

MAGAZINES such as *Practical Wireless* require a continual supply of new ideas and new articles in order to attract readers; this is not always easy as new and original projects are rare. There is one field however which seems to have been almost ignored—that of burglar and security alarms. A few have been published but I can only recall three in the past ten years.

This is all the more extraordinary when one considers how useful (and how simple) a burglar alarm can be. Admittedly the electronics side is only the tip of the iceberg as the hard part is the fitting and wiring of the alarm circuit rather than the construction of the alarm itself. This can present problems but some guides will be given.

The circuit of the alarm itself is shown in Fig. 1. This is a simple, but reliable audio oscillator whose output is fed to a loudspeaker. The alarm circuit wire is shown as a shorting link between the base and emitter of Tr1; this cuts off the transistor. This link will, of course, be very long; it may be up to 100 yards but even so its resistance will not be more than a few ohms assuming that reasonable quality wire is used. This will have virtually no effect on the circuit and may, for our purposes, be considered as a dead short.

When this link is broken Tr1 will be biased by R1 and when conducting this will in turn provide bias for Tr2 causing a considerable current to be passed through the primary of the transistor output transformer T1 and so to the speaker. However the inclusion of C1 causes this current to appear as a series of pulses and this sounds like an audio note in the speaker.

When the alarm circuit is closed the only current passing will be that through R1 plus the tiny leakage currents through the transistors. This will be below 20μA in total and this sort of current can be taken from a battery almost indefinitely; it will decay of old age before running down.

Note that the output of the speaker, while being more than sufficient to scare off a burglar, is not all that high and so an efficient speaker should be used. This excludes the use of miniature types and the larger the diameter, the greater will be the output.

The construction of this circuit should present few problems but a suggested layout on a small tagboard is shown in Fig. 2.

The alarm circuit comprises a single wire running between the doors and windows to be protected. The contacts can take many forms. Microswitches can be used, most of these have changeover contacts and so can be arranged to break the circuit when a window or door is opened. A springy metal can also be used to make the contacts. All of the switches must be in series of course so that if any one of them is opened the alarm will sound.

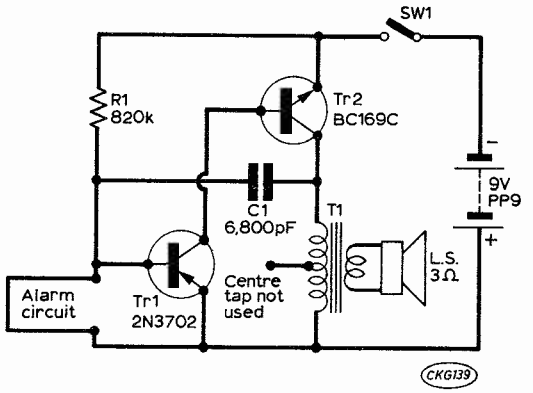


Fig. 1: The circuit of the Take 20 Burglar Alarm.

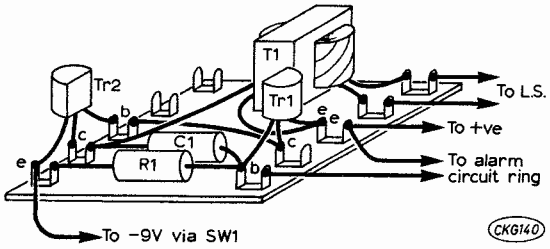


Fig. 2: A suggested component layout on tagboard.

R1	820kΩ, ⅛W, 5%	1p
C1	6,800pF, polystyrene	4p
Tr1	2N3702	13p
Tr2	BC169C	11p
T1	Transistor output transformer (Eagle Type LT700 or similar)	20p
LS	3Ω loudspeaker (ex-TV type)	15p
SW1	On-off switch	5p
	Tagboard	11p
		80p

Prices are those recently advertised in Practical Wireless and may have changed. No allowance is made for minimum order costs or for postage and packing and these should be checked carefully before ordering.

In addition to acting as a burglar alarm, this arrangement will also provide a rapid check to ensure that all the necessary windows and doors are shut. It is also a fail-safe circuit; any faults in the circuit will cause the alarm to sound.

Although battery operation is perfectly satisfactory if the battery is replaced regularly, it is far better to operate this circuit from a mains power supply. In the long run this will be cheaper and more reliable. ■

* IN NEXT MONTH'S PRACTICAL WIRELESS

AUDIO Test TRIO

Either of these audio signal generators plus the calibrated switched attenuator will enable the constructor to carry out accurate performance tests and measurements on audio equipment. Output amplitude is stabilised using an FET rather than the usual power-consuming thermistor, permitting operation with self-contained batteries. The series starts with a full description of the more sophisticated, full-facility, sine/square-wave version.

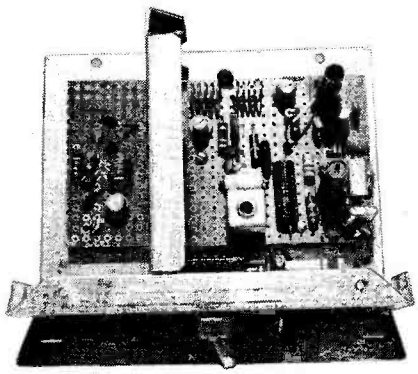
DON'T MISS YOUR COPY!

* PLUS MANY OTHER CONSTRUCTIONAL ARTICLES AND ALL THE REGULAR FEATURES

DX'ERS AUDIO AID

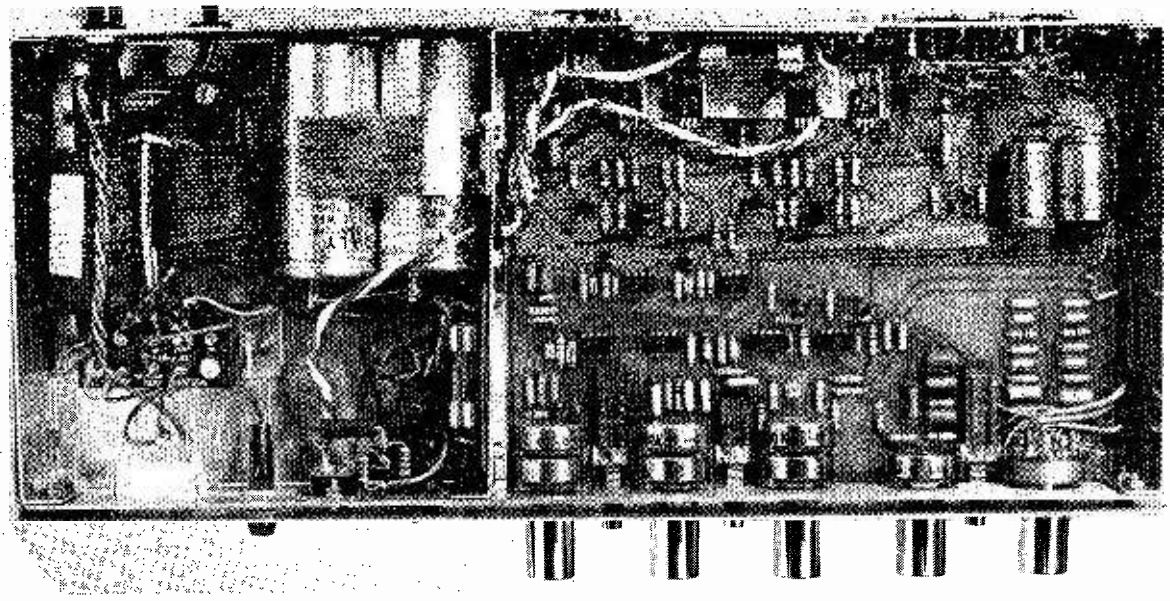
This unit will greatly improve the intelligibility of weak DX signals—by filtering the a.f. rather than working at r.f. It incorporates a highly efficient adjustable noise limiter together with an audio filter which will virtually eliminate heterodynes, whatever the strength.

2 METRE F.E.T. CONVERTER



This simple 4-transistor crystal controlled converter permits reception of the entire 2 metre amateur band (144-146MHz) on any receiver capable of covering from 4 to 6MHz. A suitable choice of crystal frequency allows direct frequency read-out on 2 metres from the calibration on the main receiver.

ALL IN THE JULY ISSUE ON SALE 2nd JUNE



The complete Texan amplifier. The power supply section is to the left of the dividing screen.

approximately 1kΩ. However it seems a pity to lose the rumble filter especially as ceramic cartridges are more likely to be used with the sort of turntables which require a rumble filter most.

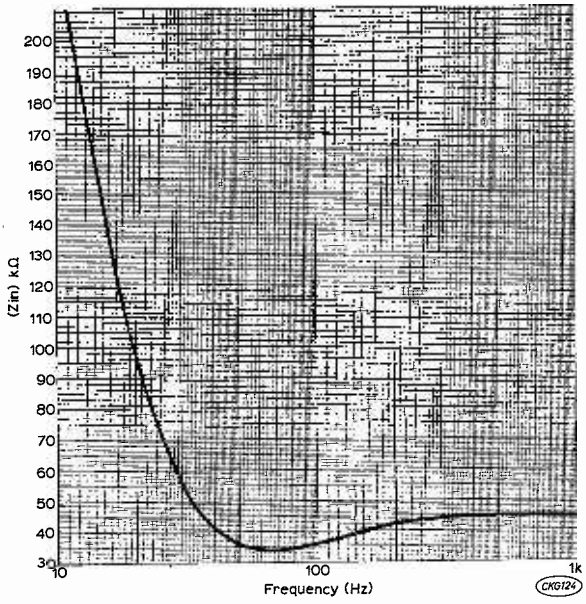
Therefore, the best approach is to use a low impedance loading circuit on the ceramic cartridge such as shown in Fig. 15. This will give a characteristic which approximates to the velocity characteristic of a magnetic cartridge and the output level will also be similar so that the amplifier can be used without modification to its feedback components. This circuit allows some variation of the shunt capacitor to improve the linearity of the response and some manufacturers will quote the circuit values which give the best "magnetic" characteristic from their particular cartridge. If this approach is adopted the constructor can wire the attenuator quite neatly across the pins of the DIN pickup socket.

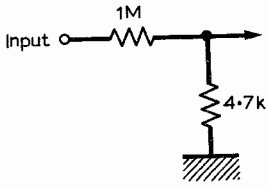
Input Impedance

In the specification the input impedance of the amplifier is quoted as 47kΩ at 1kHz. This nominal figure is modified when the rumble filter is inserted in circuit partly due to the shunting effect of R1 and partly to the series reactance of C1 and C2. This will not normally have any effect on a magnetic pickup cartridge but it may have some loading effect if a ceramic/magnetic conversion network is used so the variation of input impedance is plotted in Fig. 16.

Auxiliary

The *Texan* was originally designed to give an equalized output directly from a tape head without external amplifiers. For this reason the circuit shows R8, R9 and C9 and the printed circuit board is laid out to take these components. However, the present





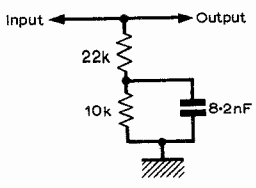


Fig. 14: (far left) Equalisation circuitry for high output crystal/ceramic pickup cartridges.

Fig. 15: (left) Equalisation circuitry for low output crystal/ceramic cartridges.

Fig. 16: (above) Variation of input impedance with frequency (rumble filter in).

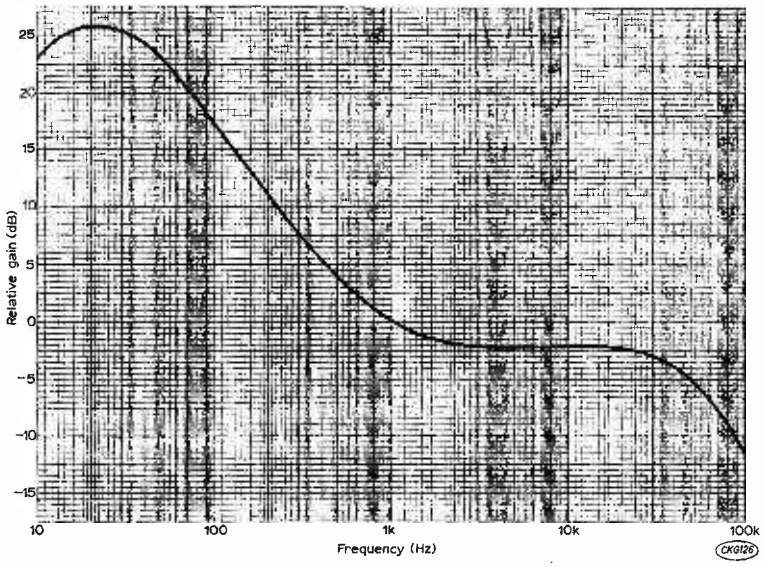


Fig. 17: Tape replay characteristic (direct from head).

day tendency is for a separate tape unit, having internal amplifiers. If it is intended to use such a unit, R8 and C9 should be omitted and R9 reduced to approximately 1·2kΩ giving a flat characteristic and sensitivity similar to that of the radio position.

Nevertheless I feel that many home constructors may be interested in a tape head facility so the following table gives the appropriate values for a few of the standard replay characteristics.

TABLE 1

	R8	R9	C9	Standard time constants
D.I.N. 1⅞ ips	33kΩ	390kΩ	3·9nF	1590μS 120μS
D.I.N. 3¾ ips	33kΩ	820kΩ	3·9nF	3180μS 120μS
D.I.N. 7½ ips	22kΩ	—	3·3nF	— 70μS
N.A.B. 7½ ips	15kΩ	1 MΩ	3·3nF	3180μS 50μS
N.A.B. 3¾ ips	27kΩ	1 MΩ	3·3nF	3180μS 90μS
N.A.B. 1⅞ ips	As for 3¾ ips N.A.B.			

The overall response of the amplifier when using components for DIN $3^3/_4$ i.p.s. is shown in Fig. 17. The sensitivity of the amplifier with this characteristic was 1mV approx. Once more the very high loop gain of the operational amplifier is valuable for producing the large amount of bass boost which is required.

Performance

A number of facts and figures have already been quoted regarding the performance of the *Texan* so that distortion is the main topic left for discussion.

Apart from the money the other good thing about writing an article is the opportunity it gives for liberating a few proverbial bees from one's bonnet. My personal "bee" is concerned with the vicious circle of "specmanship" which sets Hi-Fi designers chasing each others' tails (or should it be "tales"). Now I am all in favour of pickups which track, noise reduction systems for tape recorders, f.m. broadcasting and electrostatic loudspeakers—on the whole I am sure that they are worth the money. But I cannot see much point in paying more and more for better and better amplifiers when they are already too good for the transducers coupled to them. When the most experienced ears can barely detect 0·1% distortion on pure tones why spend money struggling for 0·01%, especially when all transducers and recording media introduce about 2 or 3% in themselves. This is a generalisation, of course, and it is always easy to find a specific flaw in such an argument. However, I feel the basic principle is good. Namely, consider the system as a whole and don't spend a lot more money unless you are going to hear the difference. With that said, here are a few more figures:

TABLE 2

Load	Fundamental frequency	Power output (watts)	Harmonic output (dB) 2nd	3rd	4th	T.H.D. %
15Ω	1kHz	15	76	67	—	0·047
		10	74	80	86	0·023
		5	74	80	80	0·024
		0·5	71	77	80	0·033
		0·05	59	61	62	0·164
	10kHz	15	51	48	80	0·488
		10	54	53	70	0·302
		5	56	57	64	0·221
		0·5	57	57	67	0·205
		0·05	61	70	75	0·096
8Ω	1kHz	25	63	61	69	0·114
		20	65	63	—	0·09
		15	66	65	—	0·075
		5	69	75	—	0·04
		0·5	75	75	—	0·025
		0·05	65	68	69	0·077
	10kHz	25	50	43	63	0·779
		20	52	46	69	0·562
		15	54	50	70	0·375
		5	60	56	65	0·196
		0·5	60	77	—	0·101
		0·05	60	—	—	0·10
4Ω	1kHz	25	61	50	75	0·329
		20	63	50	—	0·324
		15	65	52	—	0·257
		10	67	55	90	0·183
		5	68	61	81	0·098
		0·5	66	70	71	0·066
		0·05	55	58	59	0·245

Distortion: Harmonic distortion was measured using a Radford Low Distortion Oscillator and a Hewlett Packard 3590A Wave Analyzer with a 3593A Sweeper.

This measurement technique is far more accurate and gives more useful information due to the subjective nature of harmonic distortion. The harmonics

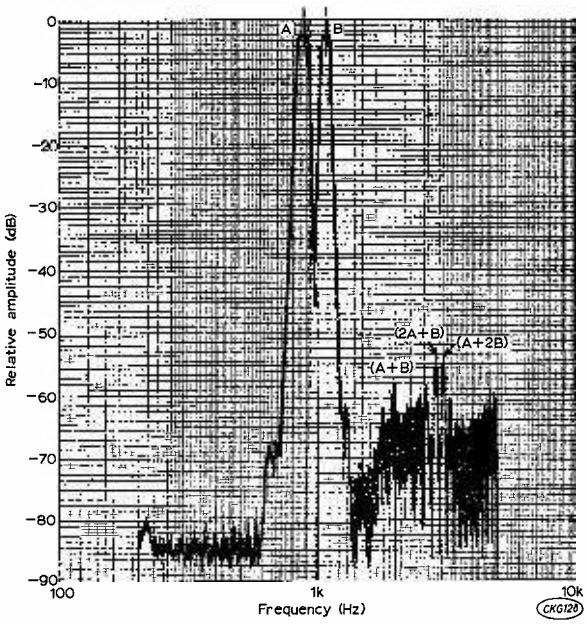


Fig. 18: Wave analysis for input frequencies of 900Hz and 1·1kHz.

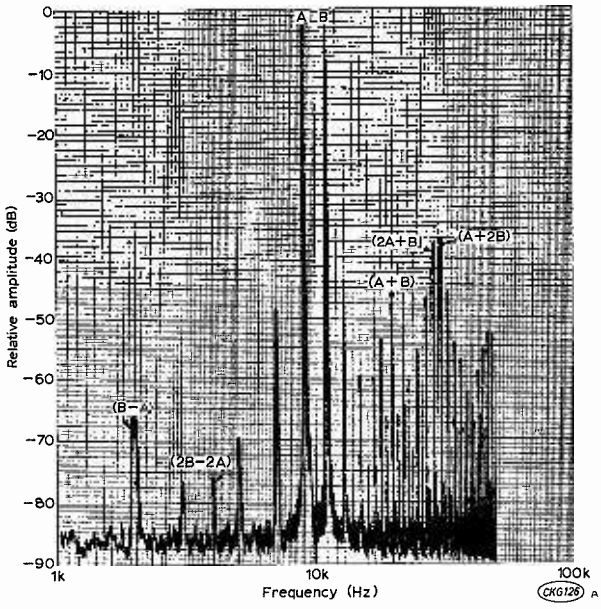


Fig. 19: Wave analysis for input frequencies of 9kHz and 11kHz

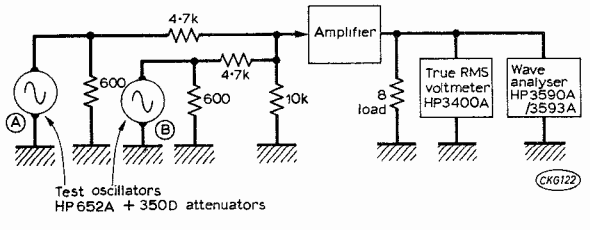


Fig. 20: Test set-up that was used for measurements of intermodulation products (I.P.).

are therefore tabulated in some detail in Table 2 along with total harmonic distortion figures. So you pays your money and you takes your choice. The harmonics are quoted in dB below the fundamental. The total harmonic figures are given as a percentage and calculated from

$$\text{T.H.D.} = \sqrt{V_2^2 + V_3^2 + V_4^2} \ldots .$$

where V_2, V_3, V_4 etc are the percentage values of the harmonic components.

It can be seen that the percentage T.H.D. does not leap up at the levels where crossover distortion would be apparent so the amplifier has a good clean sound.

The *Texan* is primarily designed to work into 15Ω or 8Ω speakers but, for interest, some distortion figures are also quoted for 4Ω loads.

All the measurements were made on the complete amplifiers so they include any distortion due to the preamplifier.

Intermodulation Distortion

The intermodulation products (I.P.) in an amplifier's output result from non linearity of the transfer characteristic which causes multiplication of the components of a complex input waveform so that a spectrum of sum and difference frequencies may be produced across the entire amplifier bandwidth. Thus with only two sinusoidal inputs with frequencies A and B we may get I.P.'s at frequencies of A+B, A−B, 2A+B, 2A−B, A+2B, A−2B etc. If the spectrum is analyzed there will also be components at 2A, 2B, 3A, 3B which are due to harmonic distortion in the signal source and those harmonics produce their own I.P.s resulting in the general mish-mash shown in Figs. 18 and 19.

However, after a bit of mental arithmetic, it is fairly easy to sort out the I.P.s which really count. The total intermodulation distortion is calculated from:

$$\text{I.D.} = \frac{\sqrt{IP_1^2 + IP_2^2 + IP_3^2}}{A+B} \times 100\%$$

where I.P., etc are the amplitudes of the intermodulation products A and B are the amplitudes of the input waveforms.

Therefore any I.P. which is 10 to 20dB below the major I.P. in level can virtually be ignored.

The method of measurement was as follows: With the apparatus shown in Fig. 20, oscillator A was temporarily disconnected and the level from oscillator B was adjusted to give 12·6 volts across the 8Ω load (ie 20 watts). The B attenuator was then set back 3dB. This procedure was repeated for oscillator A alone. The two inputs were then mixed together and the output checked on the true r.m.s. meter to ensure that the power was still 20 watts.

The input frequencies were 900Hz and 1·1kHz in one case (Fig. 18) and 9kHz and 11kHz in the other case (Fig. 19). The analyzer was set to sweep from 200Hz to 5kHz for the low frequency test and from 2kHz to 50kHz for the higher frequency test with an analyzer bandwidth of 100Hz in each case.

Fig. 18 shows that with inputs 900Hz and 1·1kHz the predominant I.P.s occur at 2kHz (A+B), 2·9kHz (2A+B) and 3·1kHz (A+2B). These components give a percentage I.D. of 0·19% approximately.

At the higher frequencies it is easier to pick out I.P.s due to the amplifier and again it can be seen

from Fig. 19 that the dominant components are at 20kHz, 29kHz and 31kHz. The difference frequency I.P.s are also clearly seen at 2kHz (B−A), 4kHz (2B−2A) etc but they are insignificant compared with the sum products so that an I.D. figure of 1·0% is obtained.

These distortions may seem rather high but the method of measurement was rather unkind since the *peak* voltage for the combined waveform is $\sqrt{2}$ times greater than the *peak* voltage for a pure sine input due to the beating of the two waves. The peak output voltage is thus 25·2 volts giving a peak power of 80 watts instead of 40 watts.

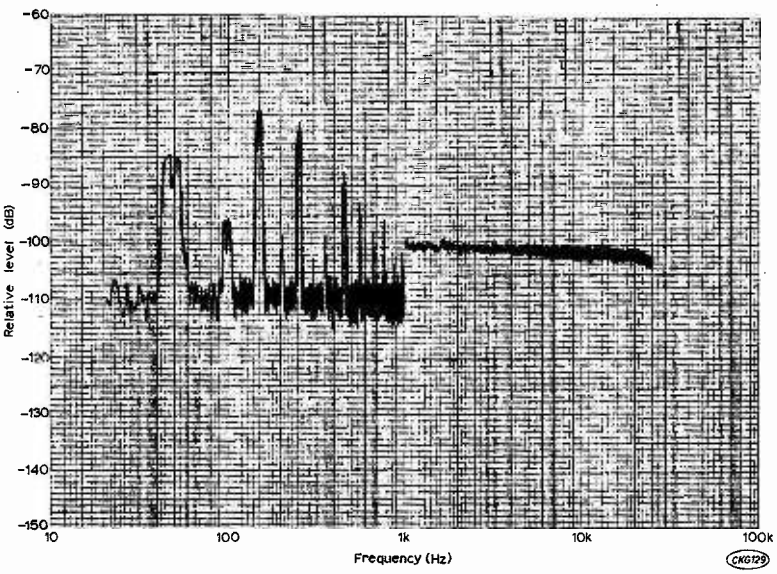


Fig. 21: Noise v. frequency.

Noise and Crosstalk

The wave analyzer which was used for the distortion measurements is also a very valuable instrument for measuring noise and crosstalk. It gives more accurate and meaningful results and since one has only to insert the graph paper and push the button it appeals to my lazy nature.

The noise versus frequency plot shown in Fig. 21 was made with the *Texan* switched to the radio input and the volume control turned up to nearly maximum so that the input sensitivity was exactly 30mV. The input was then grounded via 600Ω and the wave analyzer was connected across the amplifier output.

Between 20Hz and 1kHz an analyzer bandwidth of 10Hz was used, necessitating an automatic sweep rate of 1Hz/Sec. To avoid spending six hours or so completing the plot to 25kHz, the bandwidth was increased to 100Hz after 1kHz. This allowed the sweep rate to be increased to 10Hz/Sec.

The ordinate scaling of the graph is relative to the full output voltage (12·6V) and it can be seen that between 20Hz and 1kHz the mean level is approximately −110dB. Above 1kHz the level jumps by 10dB since noise is proportional to $\sqrt{\text{Bandwidth}}$

$$\left(\text{and } 20 \log_{10} \frac{100}{10} = 10\text{dB}\right)$$

However, the absolute noise/root cycle is still the same, about 38μV/$\sqrt{}$Hz. To get a full bandwidth signal/noise ratio we must add 33dB to the plotted level:

$$\left(\text{i.e. } 20 \log_{10} \frac{20\text{kHz}}{10\text{Hz}}\right) \text{ giving a figure of 77dB.}$$

The wave analyzer allows the hum components to be measured separately since peaks are obvious at 50Hz and particularly at the odd harmonics of 50Hz indicating that they originate in the power supply. Adding these components together gives a separate figure of 75dB for the signal/hum ratio.

More subjectively I have found that for normal listening in domestic surroundings one has to put an ear fairly close to the loudspeaker to decide if the amplifier is switched on or not and that is really the acid test.

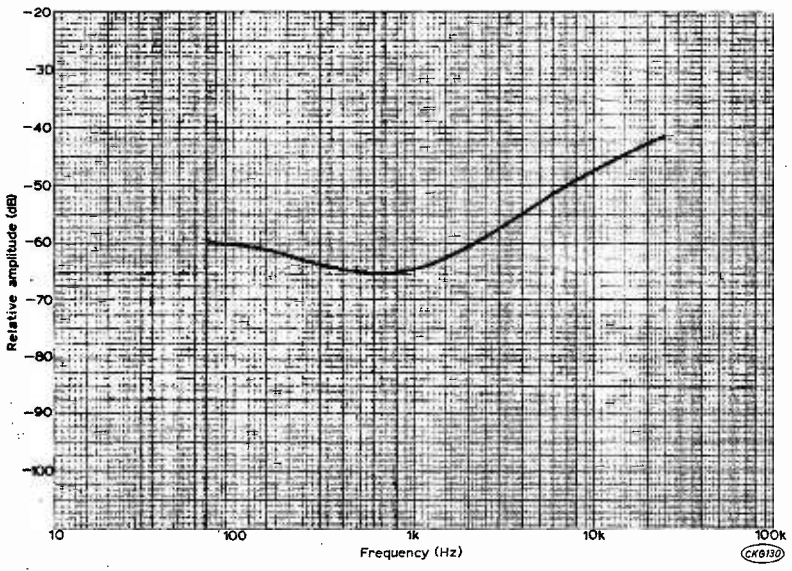


Fig. 22: Interchannel crosstalk v. frequency.

To measure crosstalk versus frequency the b.f.o. output of the wave analyzer was used to provide a 30mV input to one channel of the amplifier. The input of the other channel was grounded via 600Ω and the balance control was set to its mid-way position. The volume control was adjusted to give 20 watts into one load so that any extra coupling via the power supply would be included. The analyzer input was then connected to the output of the other channel. A continuous sweep was made between

60Hz and 25kHz at a bandwidth of 100Hz. The ordinates of the plot are again relative to full output voltage giving an inter-channel crosstalk figure of −65dB at 1kHz and −48dB at 10kHz. The crosstalk figures quoted in the specification were measured with an r.m.s. voltmeter at full bandwidth—hence the difference of 14dB at 1kHz. This shows the merit of using a selective voltmeter at low signal levels if other spurious signals are likely to be present. At 10kHz the crosstalk becomes the predominant signal so that the specification figure is not in error at this frequency.

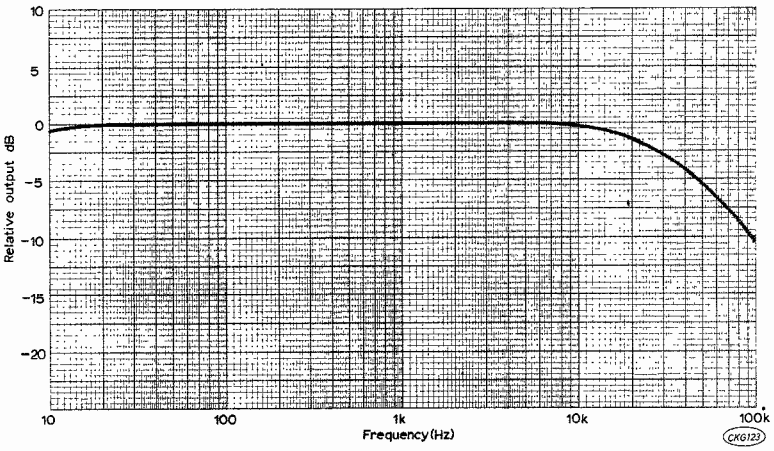


Fig. 23: Power response (20W into 8Ω resistive load).

Power response

The frequency response of the *Texan* was plotted with the selector switch in the flat radio position and with the input and gain adjusted to give a power output of 20 watts at 1kHz into an 8Ω resistive load. The response is almost identical to the low level response shown in Fig. 5 (part 1). This indicates that the gain of the amplifier is still determined by the passive feedback components in the circuit and is not effected by changes in the parameters of the transistors in the power stage. The phase advance capacitor C18 produces a smooth roll-off outside the audio band to eliminate r.f. signals from the output which could cause intermodulation problems with stereo multiplex decoders, tape oscillators and so-forth. In response to numerous enquiries, readers are reminded that all components for the *Texan*—including drilled fibre glass p.c. board, drilled and punched metalwork, finished front panel, will be available from Henry's Radio Limited.

Kits will also contain pre-formed wire packs to facilitate assembly and complete hardwear—in fact everything will be included even down to the last nut and bolt.

A slimline version of the teak sleeve—slimmer than the type shown in the photographs will be available during July/August.

Henry's Radio Limited are the sole U.K. distributors for the *"TEXAN"*, to the trade and retail outlets.

TO BE CONTINUED

MOBILE RALLY DIARY

May 7— Spalding "Tulip Time" at picnic site, Surfleet, 4 miles north of Spalding on the A16 Spalding - Boston road. Talk - in stations will be G3VPR/P on top band (1980kHz). Something for all the family. Free admittance.

May 21— Northern Mobile Rally, at Moore Grange School, Parkstone Avenue, off Ring Road, West Park, Leeds. Refreshments will be available. Further details from D. Binns, G3MGI, 80 Gipton Wood Road, Leeds 8, Yorkshire.

May 28— Chiltern Mobile Rally, organized by the Chiltern Amateur Radio Club, and held in the grounds of Sir Francis Dashwood, at West Wycombe, near High Wycombe, on the same day as an annual steam rally. Talk-in on 160m and 2m. Further details from: P. Perkins, G3OUV, Loakes House, Loakes Park, High Wycombe, Bucks. High Wycombe (0494) 21612.

May 28— Hull & District Amateur Radio Society held in grounds of the East Riding College of Education, Bishops Burton, on the A.1079 York to Beverley. Further information from L. D. Colley, G3AGX, Micasa, Ferry Road. Wawne, Hull, Yorkshire.

June 11— Third Elvaston Castle, Elvaston Castle Countryside Park, Nr. Derby.

June 18— Anglian Mobile Rally, at the Suffolk Show Ground, Ipswich. Further details from D. W. Thomas, G3ZLN, The Old Peoples Home, 9 Burlington Road, Ipswich, Suffolk.

June 25— Bristol City & County RSGB Group, at Longleat, Warminster, Wilts.

June 25— West of England Mobile Rally, at Longleat, near Warminster, Wiltshire. Information from D. Iles, G3COP, 23 Dryleaze Road, Stapleton, Bristol.

July 2— South Shields & District Amateur Radio Club.

July 9— Cornish Mobile Rally, organized by the Cornish Radio Amateur Club, will be held at the Truro Rugby Football Ground. Talk-in stations will be operational on 1·875kHz a.m. and 2m a.m.

July 16— Upton-on-Severn Mobile Rally organised by the Worcester & District Amateur Radio Club. Further information from B. A. Jones, G8ASO, 12 Woodside Road, Larkill, Worcester.

August 6— Woburn Abbey Rally.

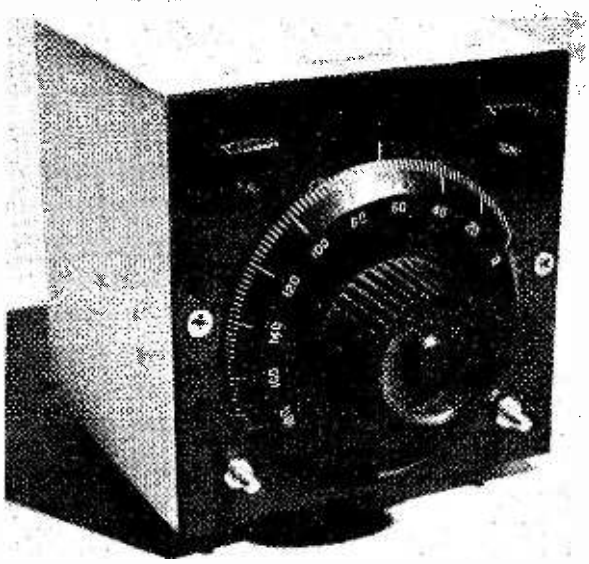
August 13— Torbay Amateur Radio Society Mobile Rally at Newton Abbot Rugby Ground.

August 13— Annual Derby Mobile Rally at Rykneld Schools. Details from T. Darn, G3FGY, 1, Sandham Lane, Ripley, Derby.

August 20— Saltash & District Amateur Radio Club Rally at Saltash Grammar School, with side-shows etc. Ample free parking on site. Details from: 1 Aldridge, G4AJU, 302 St. Peter's Road, Manadon, Plymouth, Devon, PL5 3DU.

August 26-27— Stratford-on-Avon Radio Club Mobile Rally at the National Agricultural Centre, Kenilworth, Warwickshire. Hq. of the Royal Agricultural Society of England. Further details M. J. W. Webb, G3OOQ, 14 Townsend Road, Tiddington, Stratford-on-Avon, Warwickshire. Or ring Stratford-on-Avon 5973.

MW/IF



WOBBULATOR

A.J.BIRKINSHAW

A WOBBULATOR is a signal generating oscillator which is frequency modulated by the sawtooth timebase sweep of an oscilloscope. The band of frequency swept is designed to cover the pass band of tuned radio frequency coupled circuits such as the intermediate frequency transformers of a superhet receiver.

THE REQUIREMENT

The response curve of an i.f. amplifier may be plotted by gradually shifting the frequency of a calibrated signal generator of constant amplitude applied to the amplifier input and recording the detector output voltage relative to input frequency as in Fig. 1.

We could use a pen recorder to trace output voltage on a moving paper chart if there were a mechanical linkage from chart drive to the tuning control of the oscillator with linear rotation relative to frequency.

One would plot many graphs before deciding which give the best or required performance and as preset controls on i.f. transformers are not designed to give an indication of electromechanical value and in some instances a certain amount of hysteresis between electrical and mechanical value may exist, the process of resetting may become somewhat tedious.

Most of us have at some time or other taken the easy way out and tuned for maximum aural response which is reasonably effective under the circumstances because we do not have the manufacturers resources in the way of special equipment designed to set-up a particular model.

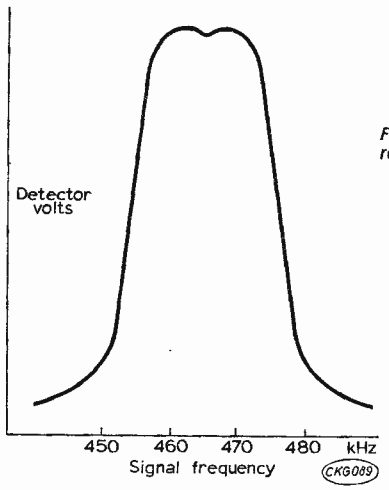


Fig. 1: A typical response of an i.f. amplifier.

However, because radio receivers depend largely on their i.f. response curves for the quality of reproduction, both bandwidth and amplitude have to be considered. We are in deeper trouble if we have just substituted a transformer of higher Q where maximum amplitude may lead to instability. So we require to see the behaviour of the circuit during adjustment.

We can display the band-pass response on an oscilloscope screen during alignment operations if we automatically sweep the signal in synchronism with the 'scope's time base using the detector output voltage for vertical deflection of the trace, Fig. 2.

Sweep may be obtained if the time base voltage controls the reactance of the oscillatory circuit of the signal generator to swing its resonant frequency a known amount equally above and below a mean value, the mean being the dial frequency setting of the generator.

Frequency modulated signal generators which, with the aid of a cathode ray oscilloscope, were designed for the visual examination of band-pass response curves and the alignment and testing of radio receivers have used various methods to obtain the required sweep as technology advanced. First the motor driven condenser, then the Miller reactance valve and nowadays we have the much

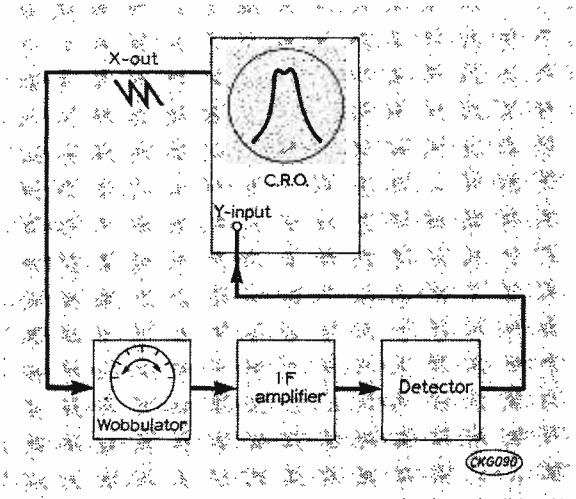


Fig. 2: The arrangement used for displaying the curve shown in Fig. 1.

simpler semiconductor diode whose reverse bias capacitance varies with voltage.

The author is indebted to D. Bollen who described, in the January 1970 issue of *Practical Wireless*, how the common silicon power rectifier shows useful varactor properties. The author has found by experiment that we may dispense with the bias battery for the oscillator application.

For amateur receiver projects the wobbulator to be described will repay its simple cost even if the oscilloscope required as an accessory has to be borrowed. Its output is 100 to 370mV peak to peak over the tuning range of 370kHz to 1·2MHz which covers normal intermediate and medium-wave frequencies.

The minimum requirements of the oscilloscope are moderate, a vertical sensitivity of 0·1 to 1V per centimeter and a time base speed range covering 10mS to 1mS per centimeter being all that is required.

THE CIRCUIT

A single OC44 germanium PNP transistor is used in a circuit configuration popularly employed as a common base oscillator found as part of self-oscillating mixers in medium-wave superhet transistor radios. The emitter resistor is smaller in value than usually employed to allow for greater r.f. output.

The diode requires a negative reverse bias which is not apparent by first examination of the circuit diagram shown in Fig. 3. The bias is provided by rectification of oscillatory power developed across R4 and R5.

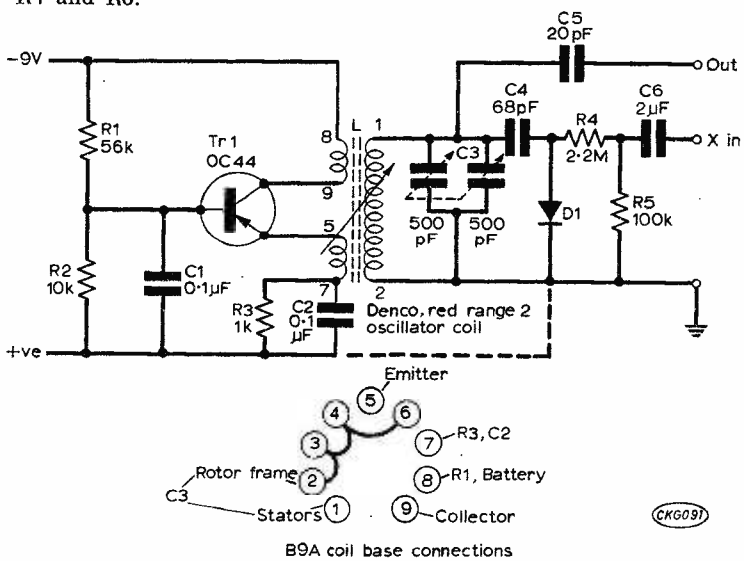


Fig. 3: The circuit of the m.w./i.f. wobbulator.

The X input in a sawtooth waveform is applied via C6 to preserve the waveshape. Sawtooth amplitude should be in the region of 20V peak to peak which is required to swing the diode capacitance and thereby frequency modulate the oscillator.

A lead via a 20pF capacitor connects to the signal input of the receiver being examined. A screened lead from the detector load connects to the Y input of the oscilloscope in use (screening is essential to avoid instability).

With the Denco coil specified, a twin gang 500pf tuning capacitor connected in parallel covers the range depicted in Fig. 4. A twin 365pF unit may be substituted with an acceptable shift of frequency coverage.

★ components list

Resistors
R1 56kΩ
R2 10kΩ
R3 1kΩ
R4 2·2MΩ
R5 100kΩ
All ¼W, 10% types

Capacitors
C1 0·1μF
C2 0·1μF
C3 500+500pF variable
C4 68pF
C5 20pF
C6 2μF 250V polyester

Semiconductors
Tr1 OC44
D1 Silicon diode BY127, FST3/4 AF etc.

Miscellaneous
L1, Oscillator coil, Denco red, Range 2; Veroboard; B9A valve holder

CALIBRATION

The dial can be an engraved knob marked every two degrees from 0 to 180°, an alternative is to use a small protractor and pointer knob. With the case removed, connect the battery and place near a broadcast receiver tuned to the medium wave-band. Select a programme of known frequency and rotate the wobbulator tuning control to obtain a beat whistle. Check with the calibration graph shown in Fig. 4 and adjust the core of the coil to obtain a similar calibration.

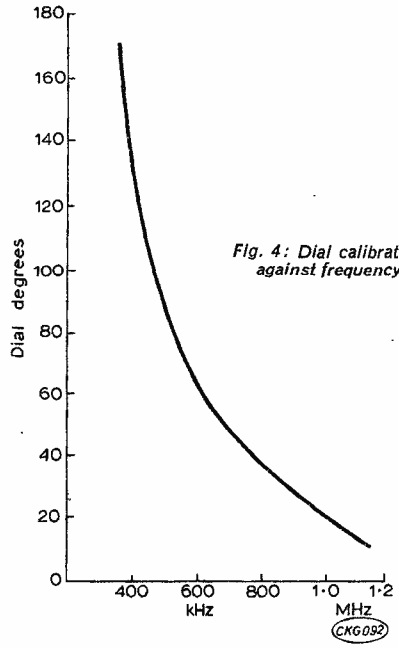
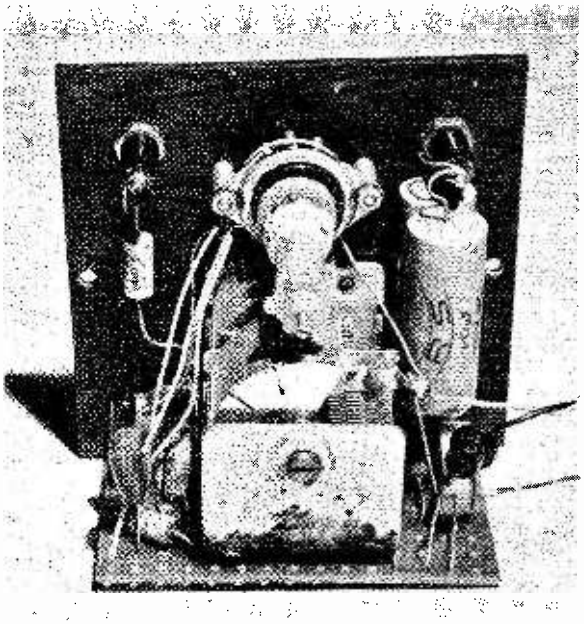


Fig. 4: Dial calibration against frequency

Construction should present no problems and the layout adopted by the author may be seen from the photographs. The Denco coil is best mounted on a B9A valveholder, this will avoid the necessity of soldering directly to the pins.

The simple wobbulator project can be put to further use by the addition of an audio modulating

oscillator operating at about 440Hz. We do not of course require modulation when using the wobbulator but there are many occasions where a modulated oscillator with reasonably pure sine wave characteristics is an asset, having successfully



An internal view of the prototype.

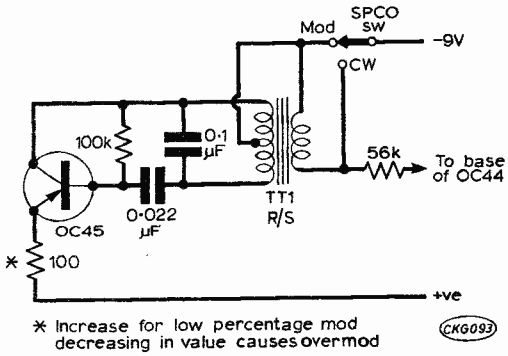


Fig. 5: A simple modulator circuit which may be added.

aligned our receiver i.f. stages we may prefer to adjust the signal r.f. stages and also to note the aural response through the amplifiers driving the loudspeaker. A tunable modulated oscillator enables us to do this, conversion is a simple matter for if we do not apply a sawtooth input, the r.f. oscillator provides c.w. output which may be base modulated by a single transistor oscillator as shown in Fig. 5.

The additional stage may be constructed on a small piece of Veroboard, this and a single pole changeover switch may easily be accommodated in the space at the rear of the cabinet.

Modulation depth may be adjusted by altering the value of the 100Ω emitter resistor but the value given is a reasonable compromise to allow sufficient tolerance in the performance of the component parts. Reducing the value gives overmodulation and poor waveform, increasing the value decreases modulation amplitude but provides a sine wave without distortion. ■

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

On the bottle

Like your four correspondents of March '72 "Letters" I, too, was bottle-fed on valves. However, they should try to recapture the spirit of adventure and voyage into the New World of electronics. More than 50 years ago valves were also unreliable (and costly) remember? but we persevered until better days came along. Now transistors and other solid state devices have opened the door very widely indeed. Transistors unreliable? Not any more when properly used and treated. A transistor radio designed and built in 1958 by the writer is still working 100 per cent without any breakdowns. Blame the faults on designers and manufacturers of commercially made equipment built to a price-profit formula: to the lack of a new kind of servicing expertise which many persons cannot be bothered to acquire. The craze for making equipment for ordinary purposes smaller and yet smaller, added to the profit motive regardless, one must expect shoddy goods. No, Valvers, the day of the bottles—good as they were and blessed their memory—is gone forever. Space travel, satellite communications, etc, would not have been possible without solid state devices—nor would there have been any moon walk on television. Greatest boon of all is possibly the contributions these devices have made to Medical electronics.—**A. V. Nash,** *(London, S.W.12).*

N.Z. prices

I have just read a letter in your magazine, from K. B. Moore, dated December, 1971, and I feel I must point out that the prices for the items listed are as follows: BC109 transistor—$0·84c (42np) not $1·85c. BC169C transistor—$1·10c (55np) not $2·25c. 5μF 12V capacitor—·14c (7np) not ·20c. 1·5M resistor—·05c (2½np) not ·10c. If Mr. Moore was actually charged the prices he mentions, I would suggest that next time he buys components, he shops around first.

As you will see from the corrected list, semiconductors are about 4 to 5 times their cost in the U.K., but passive components are very similar in price. The major reason for the difference is that the N.Z. Government places a rather large import duty and sales tax on all semi-conductors.—**A. R. Millar,** *(Auckland 10, New Zealand).*

Fight Back

As a human being, I am open to susceptance, and it is with great reluctance that I resist a tirade against "bottles," induced by the first four letters in your March issue. However, as an unbiased electronics enthusiast it would be wrong to omit to mention that valves have their uses. Indeed, only a fool would suggest using transistors in the output stages of a high power radio transmitter, for example. But semiconductor devices also have a place. Who, for instance, would even consider building a computer of valves, or even of discrete components?

In his letter in the March issue Mr. Martin gives no evidence against transistors, nor any in support of valves; it would be interesting to know the reasons for his electronic reactionism! By comparison, Mr Freeby gives difficulty of servicing as his reason for preferring valves. He mentions "transistor radios which almost fall to pieces when you try to service them," but this is the fault of their physical construction, not the transistors therein. However, he does conclude "or blow up half a dozen transistors when searching for one faulty one", and *this* 'fault' can be cured by practise on the serviceman's part.

"Valves are best for starting people off on electronics," writes Mr. Watton, but here I must beg to differ, for the following reasons:

(i) Transistors are *very* cheap—those used by beginners that is, which can be obtained for less than 1p each (the transistors, not the beginners!)

(ii) There is no risk of electric shock or of burns in beginner's transistors circuits.

(iii) The electrical fragility of transistors encourages care on the part of the constructor, surely an important part of electronics.

Finally, Mr. Wode's only argument seems to be the average size of loudspeakers in transistor radio sets gviing poor tone. I am sure we all agree that large loudspeakers are essential for good quality sound, but where do transistors come in? Admittedly, transistors are electrically fragile, and a transistor class B amplifier needs careful design, for it to be successful, but the fact that all the audio amplifiers I know of on the market today are transistor amplifiers, prove that, in this field at least, transistors are supreme!—**R. D. Broome,** *(Warwickshire).*

U.S.A. — 1940

Further to your Leader in the March issue, your younger readers may be interested to know that prior to 1940, reception of U.S.A. stations in the S.W. Bands was so good that the London evening newspapers used to print the radio programmes of Boston, New York, Schenectady etc. in addition to B.B.C.—**G. Snewin,** *(London, E.17).*

Quality speakers

British beaches may soon have no sand judging by the number of people who seem to be building the Quality Hi-Fi speakers! But here's a useful bit of information which may help readers.

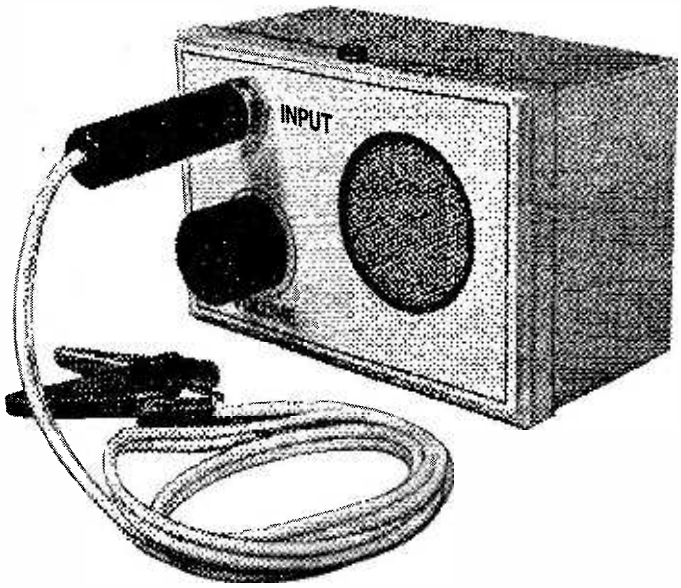
The SI-1020A hybrid amplifier specified for the system has been discontinued but may be replaced by the SI-1025A which is for all practical purposes identical in performance and mounting. The plinth specification is unchanged. Amplifers available from Photain Controls Ltd., Randalls Road, Leatherhead. Tel. 2776.—**Caleb Bradley,** *(Essex).*

Company policy

I couldn't agree more with the many views on poor workmanship and bad after-sales service that have been published in *Practical Wireless.* It's about time that high standards of the above were adopted as company policy to ensure value for money.—**Ian Vine,** *(Middlesex).*

test bench amp

E. BUCKLAND



ANYONE who has more than a passing interest in the construction of radio and electronic projects will have acquired a fair number of items of test gear. A multimeter is essential but an r.f. and a.f. signal generator will also be found very useful. These items, plus others which will be required for one's own particular field of interest, are used mainly to test and trouble-shoot finished or partially finished equipment.

One of the most useful items in the author's opinion, however, is none of the above but a simple straightforward audio amplifier; this is rarely considered as an item of test gear. This is surprising when one considers how useful it can be.

A high proportion of the projects published in this magazine are fitted with an amplifier as the final stage; a quick check shows that 30 of the last 36 projects featured on the cover of *P.W.* either used an audio amplifier or were designed to feed one. This gives a rough indication of how often a test bench amplifier could be used for checking that either the early stages of such a project are operating properly or even that an amplifier is working correctly. The circuit shown here can equally well be used as a signal tracer at audio frequencies.

To be of maximum use such an amplifier has to meet certain requirements. Portability was considered important and so the circuit is battery operated. Small size was also high on the list of priorities as this will mean less shelf space and will make it easy to carry around in a brief case for instance. It had to be of reasonable quality, at least good enough to be able to distinguish between correct and incorrect operation of the equipment to which it is coupled. High input impedance and high sensitivity are also desirable features for such a circuit. The output level is of less importance as long as it is to be used mainly as a monitor. The output is in the order of 200mW but small speakers are not very efficient and this output is less than it sounds. Even so, this compares favourably with the output from normal small transistor radios using the same type of battery and has been found to be more than adequate for the intended purpose. In fact many of the design features were controlled by the use of a PP3 battery. This is used to meet the requirements of portability and small physical size. The permissible current drain from this battery limits the output to the level mentioned above.

All the components used are widely available and the cost of this project is not high—certainly not over £2 in total.

THE CIRCUIT

The circuit of the Test Bench Amplifier is shown in Fig. 1. The input is applied directly across the volume control VR1 which is rather higher in value than one would normally encounter in a circuit of this type. This high value has the advantage here of presenting a high impedance input at low volume control settings—this approaches 500kΩ, though this is somewhat reduced for high volume settings where

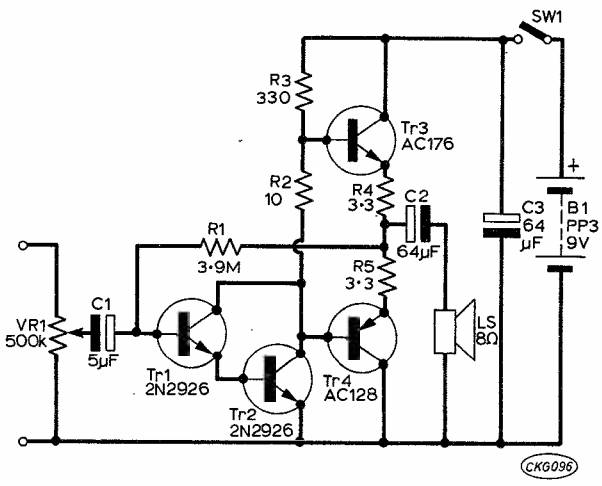


Fig. 1: The complete circuit of the Test Bench Amplifier.

the input impedance of the first transistor is in parallel with the volume control.

The slider connects to the base of the first transistor via the d.c. blocking capacitor C1. Tr1 and Tr2 are connected as a Darlington Pair, a configuration which gives very high gains and also a higher input impedance than a conventional common-emitter amplifier would present.

This stage drives the output pair Tr3 and Tr4. These are conventionally connected as a complementary output pair; one is an NPN and the other a PNP with the bases connected together by R2, a 10Ω resistor. This is necessary to provide a small bias to avoid cross-over distortion.

When Tr2 is conducting heavily (when it is driven on by a positive swing in the signal), Tr4 is driven into conduction. When Tr2 approaches cut-off (due to a negative going swing) the voltage at the base of Tr3 rises (R3 providing the bias) and it conducts. This explanation is far from complete but descriptions of the operation of this type of output stage are described more completely from time to time in other articles.

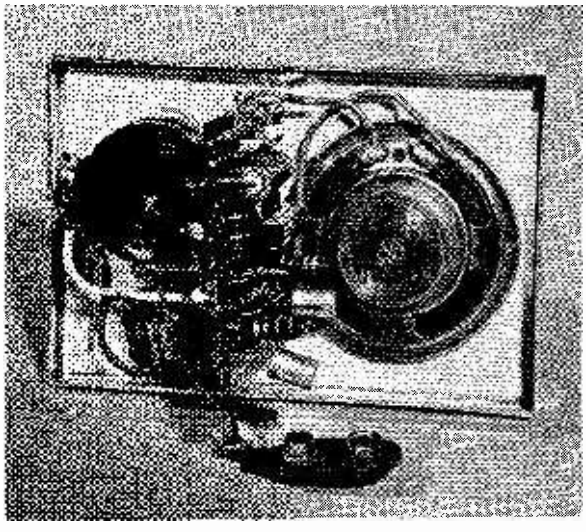
Note that Tr3 and Tr4 must be a matched pair of transistors but are not otherwise critical. Any similar complementary pair of germanium transistors can be substituted without any circuit modifications.

The bias for the Darlington Pair is provided by R1 which also introduces both a.c. and d.c. feedback. If difficulty is experienced in making the circuit work, a slight change in this value may be helpful. However four prototypes have been built of this circuit and this value has proved satisfactory in each case.

The low value of C2 certainly reduces the bass response but this makes very little difference in practice—miniature loudspeakers are not normally renowned for their good bass response; there seems little point in providing a signal which cannot be handled by the speaker. This smaller value than one would normally find has the added advantage that it is physically small.

CONSTRUCTION

The majority of the components are mounted on a small piece of Veroboard, 0·15in matrix, 13 x 11 holes. One end is left free of components to leave room for a small mounting bracket. The components layout is shown in Fig. 2. The copper conducting



An internal view of the prototype.

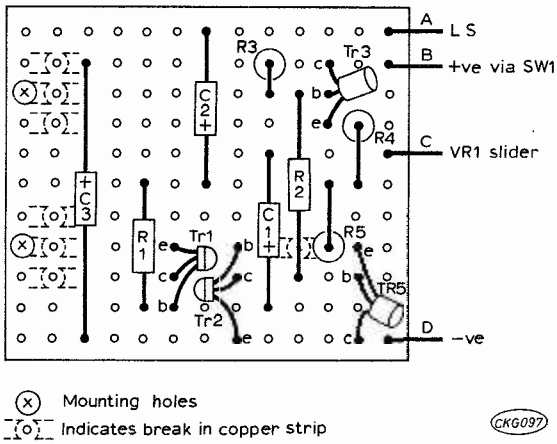


Fig. 2: The component layout on Veroboard.

★ components list

Resistors
R1 3·9MΩ
R2 10Ω
R3 330Ω
R4 3·3Ω
R5 3·3Ω
All ¼W, 10% types
VR1 500kΩ log. pot. with switch

Capacitors
C1 5μF 10V
C2 64μF 10V
C3 64μF 10V

Transistors
Tr1 2N2926
Tr2 2N2926
Tr3 AC176†
Tr4 AC128†
† Matched Pair.
Any "colour" of 2N2926 transistor may be used for Tr1 and Tr2.

Miscellaneous
L.S. Miniature 8Ω loudspeaker
B1 PP3 battery, 9V
Battery clip; Veroboard 0·15in. matrix, 13 x 11 holes; metal or plastic case—see text; Jack plug and socket; Crocodile clips.

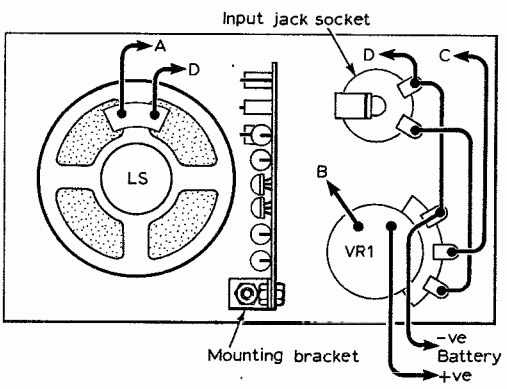


Fig. 3: The wiring details. The wires marked A to D connect to the appropriate points on the circuit board.

strip has to be cut away around the mounting holes for obvious reasons but other than this only one additional break is needed.

Due to the low output and the protection afforded the output pair by R4 and R5, heatsinks are not really necessary on Tr3 and Tr4 when operating from the specified battery.

The circuit can be fitted into almost any small case. The author originally built his into a plastic case but this was dropped several times and eventually broke. For this reason it was replaced by a small metal case which proved much more satisfactory. The one used in the prototype was 4 x $2\frac{1}{2}$ x 2in. fitted with a lid; this is available by mail order from Henry's Radio.

The lid carries the components and a wiring diagram for the final connections is shown in Fig. 3. Of course, any convenient case can be used. The loudspeaker is glued to the face; this method of fixing has been found to be very simple and quite strong enough.

The input to the amplifier is through a jack socket and two wires from the associated jack plug can be fitted with croc clips for rapid connection to any circuit. A band of tape was wound around one of these wires to identify the "earthy" connection.

Proper distortion and frequency response figures have not been taken from this circuit but the amplifier introduces no noticeable distortion and the frequency response has proved to be quite adequate for the designated purpose. ■

BOOKS WANTED

...Mullard Circuits for Audio Amplifiers. Second Edn. 1962.—George W. Saunders.

...Any volumes 3 to 10 "Wireless World", RSGB T & R Bulletin, July 1933 (with covers), RSGB 1928 Annual Log Book. "History of Radio Telegraphy & Telephony", Blake, 1927.—Allan Herridge, G31DG, 96 George Street, Basingstoke, Hants.

...Oscilloscope equipment circuits by Easterling buy or borrow.—F. Cosgrove, Rowan Chalet, Lower Road, Postcombe, Oxford, OX9 7DU.

..."Simple Radio Circuits" by A. T. Collins.—J. Wheelton, 41 Chorley Road, Burntwood, Walsall, Staffs.

...Young Schoolboy requires a second-hand copy of the Radio Communication Handbook about £1? Phone Harpenden 5910.—Huw Hallybone, 78 Sauncey Avenue, Harpenden, Herts.

INFORMATION AVAILABLE

...I have in my possession an Italian Magazine dated the Year 1959 called "Bolletino Tecnico Jeloso", it also has English Translation of contents. I would be pleased to send to any reader who may have a need for it, if they send S.A.E. 12" x 4". It has full diagrams, of circuits and components, for the following: TRANS: 9,212-TR, TRANS: 9,222-TR, REC: 9,209-R.—R. Peel, 57 Tangmere Drive, Castle Vale, Birmingham, 35.

EXCHANGE

...P.E. April, 70 to Nov. 70 & March 71 to Dec. 71. Also P.T. Jan. 71 to Oct. 71. 27 issues. All good condition. Would exchange all these for Vol. 43 & 44 P.W.—G. J. David, 32 Trebeferad, Llantwit Major, Glam.

...I have the Aug. 1966 edition of P.W. twice so am willing to exchange one copy for any interesting bit of electronic junk.—L. Cook, 7 Plum Tree Close, Eccleston Park, Prescot, Lancs., L35 7JT.

..."Swap, buy or sell P.W. back issues. Large quantity for disposal. S.A.E. for lists."—R. Forsbert, 123 Harestone Hill, Caterham, Surrey, CR3 6DL.

...June 1968, July and Aug. 1968 issues of P.E.—S. Tucker, 8 Hawkswell Gardens, Oxford, OX2 7EX.

...May 1971 issue of P.W.—C. H. Cheah, 17 Hargrave Road, Archway, London, N19 5SH.

...Aug. 1968 P.W. or photocopy of Portable Keyless Organ.—G. E. Dutton, Buckith-Vine-Inn, Burscough Street, Ormskirk, L39 2EG, Lancs.

...P.W. Volume 45 (May 69–April 70), P.W. Volume 47 No. 7 (Nov. 71), P.E. Volume 5 (Jan. 69–Dec. 69 inc.).—M. Ridger, 25 Broomfield Crescent, Leeds, LS6 3DD.

...P.W. for Jan. 1971 with Part 1 of the Stereo Tape Recorder.—R. W. Andrews, 7 Bracken Grove, Wellington, Salop.

...The issue of P.W. containing the circuits, operating info. for the electric organ published circa 1964.—A. J. L. Brown, 9 Ruilion Road, Penicuik, Midlothian.

...The blueprint for the P.W. 35W Guitar Amplifier.—P. Winkley, 96 Leopold Avenue, Handsworth Wood, Birmingham, 20.

...July 1971 issue and any 1969 issues of P.W.—N. A. Dent, Middle House, Lockner Holt, Chilworth, Guildford, Surrey.

CHARLES MOLLOY

THE Medium Wave Column

TOMMY CROSBIE who lives in Broseley, Cheshire writes "I do not think a communications receiver is necessary for a beginner. I only use a domestic receiver (removed from an old radiogram) though some modifications must be made." He then describes how he traced the a.g.c. line and connected it to chassis via a switch. When the switch is operated the a.v.c. is off and the receiver is ready for DXing. Stations heard by Tommy on his modified receiver and MW loop include RNE Tenerife, Canary Islands on 620kHz; Godhavn, Greenland 650kHz; PJB TransWorld Radio, Bonaire 800kHz; EFJ57 Tenerife 890kHz; WINS New York 1010kHz; WBMJ San Juan, Puerto Rico 1190kHz; Radio Afghanistan, Kabul 1280kHz; PJD St Maartin, Netherlands Antilles 1295kHz (this station often broadcasts in English).

DXers will find it an advantage to switch-off the a.v.c. when operating on the medium waves. Two or more stations can often be heard simultaneously on a channel and the slight difference in frequency between them gives rise to a beat. If the a.v.c. is switched on, then the receiver gain will follow this beat, giving rise to an unpleasant flutter which makes reception difficult. The writer invariably has the a.v.c. switched on, then the receiver gain will follow this while the receiver gain is adjusted with the r.f. gain control.

Paul Swain, while on a visit to Tudweilog on the coast of Wales, used his Sanyo 7 transistor portable between 0003hrs and 0330hrs GMT on the 12th February to log CBN St John's, Newfoundland 640kHz; WOR New York 710kHz; CJON St John's 930kHz; WINS New York 1010kHz; WNEW New York 1130kHz; WWVA Wheeling, West Virginia 1170kHz; WHAM Rochester, New York 1180kHz; WOWO Fort Wayne, Indiana 1190kHz; WCAU Philadelphia, 1210kHz; WTOP Washington, D.C. 1500kHz; WMEX Boston 1510kHz; WKBW Buffalo, N.Y. 1520kHz.

Richard Coyle of Glasgow sends a log heard on a Lafayette KT340 and an antenna of 200ft of wire wound round the loft in a triangular coil. R. Caracas, Venezuala 750kHz; WHDH Boston 850kHz; WCBS New York 880kHz; CBM Montreal 940kHz; R. Sutatenza, Colombia 960kHz; WBZ Boston 1030kHz; WHN New York 1050kHz; Radio Globo, Rio 1180kHz; R. Tupi, Rio 1280kHz.

A new high power outlet at Bissau, Portuguese Guinea has appeared on 1070kHz. According to a QSL received by the writer it is on the air daily until 0100hrs GMT and has been heard as a strong signal with deep fading, after 2300hrs. The address for reception reports (which may be in English) is Emissora da Guine Portuguesa, Caixa Postal 191, Bissau, Portuguese Guinea.

Send logs and information about the Medium Waves to the writer at 132 Segars Lane, Southport, PR8 3JG.

Electronotes...

S. GINSBERG

THINGS are hotting up in the television field. Hitachi have launched a 20in. colour tube with 110° deflection angle and with a 29mm neck. The Japanese market version of the tube will have a black matrix but because of Zenith patents the one for Europe will not. Hitachi have plans to follow this tube up with smaller versions in 18in. and 16in. One interesting thing about the Hitachi tubes is a change in the approach to avoid a form of distortion.

A problem with many 110° tubes is that the static convergence at the edges of the tube is upset because of the large convergence angle near the edges of the tube. The electrons passing through the aperture in the shadowmask do not land accurately on the corners of an equilateral triangle and thus colour purity is degraded. While some people might claim that corrective action during tube manufacture tends to eliminate this defect, Hitachi claims that these remedies are inadequate.

Hitachi are fabricating tubes to match this electron distortion rather than trying to correct the placing of the electron beam itself. The resultant tube permits components such as those used with 90° tubes to be used rather than require special deflection coils and special components.

Back to computers. Memories are very much in the news but perhaps the most interesting one is not a semiconductor memory nor a magnetic core. It is a ferroelectric one which, if researchers are right, will pack some 10^{13} bits of information. The idea came originally from holograms. These are three-dimensional images. It was reasoned that perhaps information could be stored in three dimensions, one layer behind the other. Now comes the idea that this could be done with ferroelectric materials and the suggestion is for one called barium titanate which has been doped with impurities. The doping causes the individual crystals to become photosensitive besides being transparent. Thus they could be used to record the interference waves from a holographic image. They could easily be "read out" by using a beam of light and they can also be erased and new information "written" in. So it looks like another twist in the memories stakes with a serious competitor for the memory elements; semiconductor, hologram, plated wire, magnetic core etc.

RCA are recorded as having done some work on ferroelectric crystals but this method used a great deal of heat (some 300°C required for erasure) and there were few problems. The newer method just announced, using barium titanate, uses only an electric filed for erasure and thus looks promising. Experiments, incidentally, are taking place in France.

practically wireless commentary by HENRY

No. 90
Nothing if not Informative

SHATTERED, not a little disabused, Henry sits hunched in the corner of his workshop trying to work out where he went wrong.

No, it is not another classic case of diagnosing power supply, regulator and control circuit malfunction when the heat-fuse in the mains transformer had parted. Not a mere inability to restring a dial drive cord that goes twice round the town hall and back between tuning gang and pointer pulley. Not even, not *especially*, another case of reading *nano* for *micro* or *milli* for *Meg*.

Worse than that, Henry has been accused by a close colleague —nay, a collaborator—of being too literary, not factual enough. 'People pick up *PW*,' he says, 'to be informed, not to be led through the pages of the dictionary.'

Oh dear—I plead guilt. Mea culpa, and all that. Verbal diarrhoea has afflicted your scribe.

There—you see? Put into plainsong, the foregoing should read: Henry talks too much, and to little effect.

'Tis true, 'tis true. Which is why Henry, in this lazy month between Spring and Summer, wants to acquaint you with a few of the facts he has stumbled upon during a recent browse through the trade and enthusiast magazines.

Large frightening sparks.

In the April 1972 issue of *Studio Sound* there are two equipment reviews. First is of a Crown DC 300 amplifier, imported from Indiana, U.S.A. A cool 600 watts into 4 ohms, is all. Or, to be a little more realistic, 150W RMS per channel into 8 ohms. The reviewer, P. A. Lomas, had little to say about it except that it 'exceeded specification' for every test made. And, believe me, those specifications are very impressive, as one would expect for a bit of hardware costing £360.

What interests Henry more is the methods he used to determine how good this amplifier really was. . . . Harmonic distortion of 0·008% at 500Hz, Crosstalk at 10kHz, 95dB below full output, and noise at −113dB, forsooth!

He does report—and Henry applauds the touch of humanity —'Short circuit tests merely produced large frightening sparks, pitted screwdrivers and a shaking hand.'

But the accompanying review was rich. It dealt with the Edison Phonograph, and could have been better if a perfectly straight-faced approach had been maintained. Instead, we read such specifications as:—Wow and Flutter: dependent on alcohol level in blood of operator. (The Phonograph is a cylindrical-scan tinfoil clad machine operated by a hand crank, or hadn't you guessed?)

In fact, the review goes into nice detail about the construction, with diagrams, and nowhere does T. T. Wittering mention April 1. If David Kirk, the Editor of *Studio Sound*, intends to continue with the April Fool insert, as Radio-Electronics used to do (still does?), T. T. W. will have to get together with Henry Scruggs or George Izzard O'Veering and write about the Super-Crown.

On second thoughts, he need only quote from some specifications as boldly published by the makers of system audio equipment. And if he wants more power, what about the Marantz at 250 watts, or the Phase Linear, 750 watts?

The 'ultimate' Hi-Fi system.

Power alone isn't everything, as any owner of an earache generator can tell you. But it does seem to be the tendency for makers of powerful amplifiers to make, also, equipment that performs to the highest standards.

Bert Whyte's piece in the February *Audio* talks about Joe Audiophile, in his seventh heaven because his Aunt Nelly remembered him in her will. He purchases the 'ultimate' hi-fi system, super megawatt amplifiers, preamps with a plethora of controls, which can be corrective or creative, digital readout tuner—naturally, Joe's system is quadrophonic — and ultra-wide range speakers with low frequency response down in the subbasement.

Developing his theme, Bert describes that Joe's aim is to listen to his 15 ips copies of classical masters. 'The first faint susurations (sic) of Ravel's "Daphnis and Chloe" are heard from the speakers . . . *molto pianissimo* . . . and Joe is in a transport of delight.' no tape hiss —but then—WHUMP! RUMBLE'

Joe has been the victim of monitoring techniques. The discs made from those master tapes have been 'rolled off rapidly' below 60Hz.

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2N3055	NPN	High power	50p
2N3702	PNP	Low power	10p
2N3704	NPN	Low power	10p
AC126	Ger. PNP	Small sig./driver	23p
AC128	PNP	Low power	20p
AC176	NPN	Low power	16p
AD149	PNP	High power	58p
*AD161	NPN	Med. power	33p
*AD162	PNP	Med. power	36p
BC108	Sil. NPN	Small signal	11p
BC109	NPN	Low noise	12p
BC168	NPN	Small signal	10p
BC169	NPN	Low noise	11p
BF194	NPN	RF amp.	14p
BFY51	NPN	Med. current	20p
OA90	Ger. diode	RF detector	6p
OA91	,, ,,	General	5p
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*Matched pair AD161/AD162			60p

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C	1/8W	5%	4·7-470K	E24	1	0·8	0·7
C	1/4W	10%	4·7-10M	E12	1	0·8	0·7
C	1/2W	5%	4·7-10M	E24	1·2	1	0·9
C	1W	5%	4·7-10M	E12	2·5	2	1·9
MO	1/2W	2%	10-1M	E24	4	3	2 nett
WW	1W	10% +1/20 Ω	0·22-3·9	E12	7	7	6
WW	3W	5%	10Ω-10K	E12	7	7	6
WW	7W	5%	10Ω-10K	E12	9	9	8

Codes: C = carbon film high stability low noise
MO = metal oxide Electrosil TR5 ultra low noise
WW = wire wound Plessey

Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades. E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 72, 91 and their decades. Prices *are in pence each for same ohmic value and power rating. NOT mixed values. (Ignore fractions of* 1p *on total value of resistor order).*

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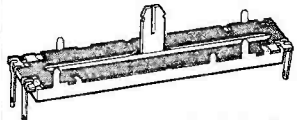

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FLH371	(7444)	1·45	FLJ301	(74100)	1·64
FLH151	(7450)	20p	FLJ281	(74104)	43p
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FLH181	(7454)	20p	FLJ201	(74190)	1·80
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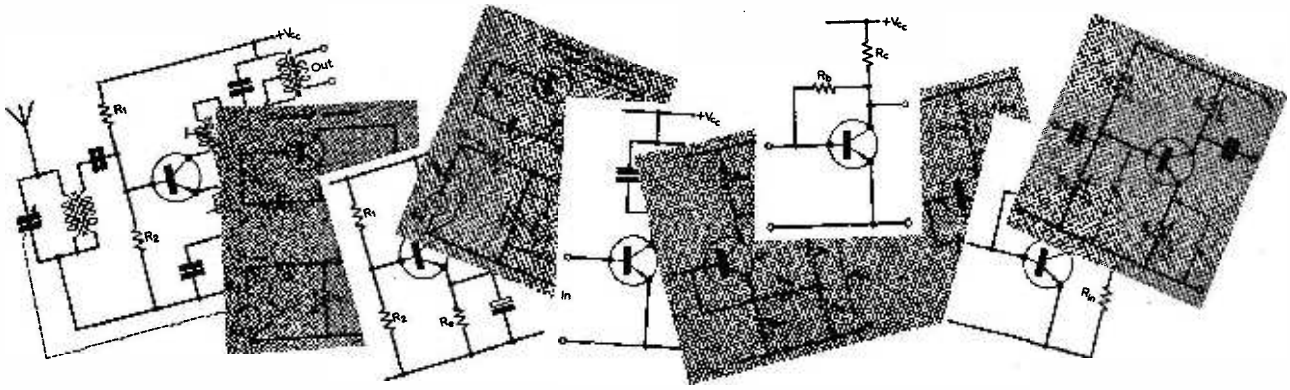

TRANSISTOR CIRCUITRY for beginners

PART 8

H.W. HELLYER & MICHAEL HOLLIER

Buffer links

It has become obvious in recent months, from the polite noises made over the editorial hot-line, and correspondence we have received, that our chosen method of dealing with simple transistor circuitry meets with some approval.

Simplicity can be deceptive. This month, for instance, we have chosen as our subject a single-transistor collector-follower circuit. One transistor, a few components, a little bit of board, and a few moments of your time. But if we were to cover, fully, all the parameters affecting the calculated performance of this 'simple' circuit, half the adverts would be squeezed out of *PW*. More important, such an approach would frighten off the beginner—and he's the chap at whom this series was aimed, remember?

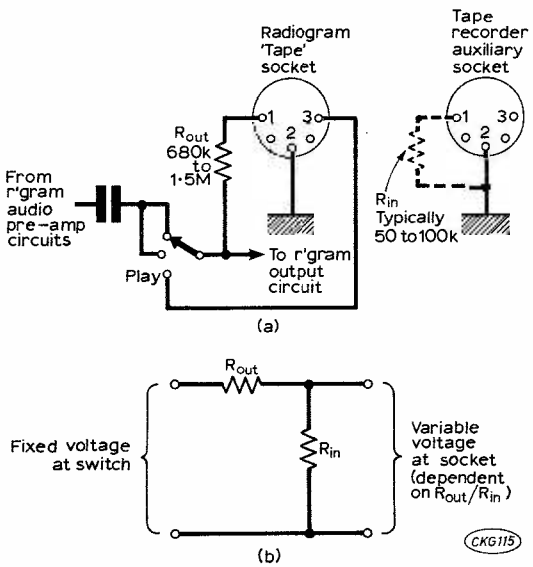

Fig. 39. (a) A single channel of a typical radiogram 'tape' outlet showing the presence of R_{out} which affects the matching. (b) is the equivalent of (a).

The buffer-link can be used between two pieces of equipment when discrepancies of impedance and voltage are such that gain as well as matching is needed. A typical example is the case of the tape recorder connected to the 'Tape' outlet of a radio-gramophone. Quite often, specifications make it appear that the simple connecting lead will do the job adequately. The significant point omitted from those specifications (or, at best, skated over), is that the impedance of the load drastically affects the available signal voltage from the radiogram. A glance at Fig. 39 shows why this should be.

To prevent the load (i.e., the tape recorder) from robbing the main equipment of some signal voltage and to save the extra cost of a properly designed feed stage, such as we have already described, a fairly high resistor is used to connect the signal take-off point to the socket.

If a direct connection is now made to the socket, the relatively low impedance of the tape recorder will not affect the performance of the radiogram. But, and it's a big but, a potential devider is now formed, with the smaller resistance section being the tape recorder, so the available voltage is reduced in proportion to the two resistors.

If there is not enough voltage available, we are not going to be able to make a decent recording. No amount of ingenuity with external resistive networks will produce sufficient modulation. What we need is a little amplifier between the radiogram and the tape recorder. We need, in fact, a buffer to prevent interaction of one upon the other and a link to join their circuits together—a buffer-link.

Simple circuit

Emitter-follower circuits make excellent buffers, but do not allow us to obtain any voltage improvement. A two-stage circuit would do the trick, maybe; like the Darlington Pair of Part 6; or even more elaborate circuitry, like the single-double device of Part 7. Here, we can obtain the gain we require and make a suitable match with the very simple circuit of Fig. 40.

This is the single-transistor collector follower stage. If you have read Part 5, page 913, it should

not be necessary for me to explain those terms. Such a stage has a medium impedance input, certainly lower than the emitter follower we previously discussed, but still not too low for our purpose. It has a fairly high output impedance, but again, not too high for our purpose. Component changes can modify the performance to suit our requirements, as we shall show. Voltage gain is quite reasonable, and the signal inverts 180° between input and output. All these are conditions that we want.

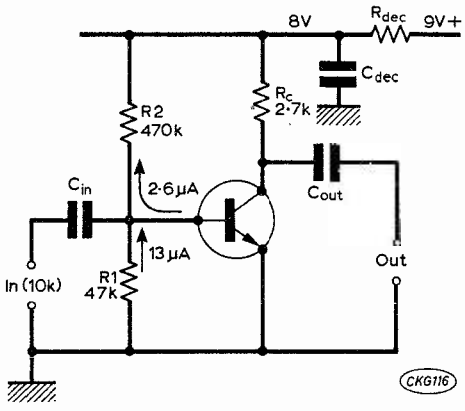

Fig. 40. Basic buffer-link circuit. Essentially a collector-follower the emitter is taken directly to the negative line.

R1 and R2 form the potential divider to give us base bias, just as we have seen in previous months. R_c is the collector load resistor, and this time, our a.c. signal is developed across this load. The emitter in our first example is taken directly to chassis.

The input signal to the base is coupled by C_{in}, with C_{out} performing its coupling function at the other end of the stage, taking the signal to the input of the tape recorder.

Recap

Recapping a little: previous dealings with the emitter follower and Darlington circuits have taught us that the output signal is a little less than the signal voltage fed in to the circuit. In technical terms, the gain is less than unity. This time, we have acquired a bit of gain, and the price we pay is an input impedance lower than before, and an output impedance higher than before. In addition, we now have a phase inversion, which the emitter follower did not have. A signal at the input of the stage is inverted, i.e., receives a phase change of 180°. If the input signal is positive-going, the output signal will be negative-going. This doesn't much matter to us in our present application, but can be quite important for some applications.

On the subject of impedance, the terms high, low and medium are, of course, only relative. Impedance is the resistance to an a.c. signal, usually at a specified frequency. Where no frequency is specified, as in the case of an amplifier, it is assumed that the impedance is constant over the frequency range of interest: example, 20Hz to 20kHz. A reference frequency of 1kHz is generally assumed, except in the case of microphones and loudspeakers, when 400Hz is more often employed. In general, an a.c. resistance of 1kΩ and below would be called low, up to 100kΩ would be medium and above 100kΩ referred to as 'high impedance'.

Circuit details

We should begin with some modest requirements, bearing in mind that a wide variation of performance can be expected with certain circuit changes. Battery supply—again 9 volts, allowing for 1 volt being dropped across the decoupling resistor, so the stage supply V_{cc} is 8V. The collector current we shall choose is 1mA. And with these simple starters we can choose a transistor.

Our choice is determined by the need more for low noise than high gain, although it is nice to have both. So, to get the best of both worlds, back to old faithful, BC109. Referring to Figs 41 and 42, we can work out the more detailed figures.

The transistor will be operating at a collector current of 1mA, and the voltage between collector and emitter, V_{CE}, will be about 5 volts. (Refer to previous articles in this series for reasons for these quoted figures—an expansion of the argument). From Fig. 41, we can see that the a.c. current gain, h_{fe}, can be determined at somewhere around 450. Similarly, from Fig. 42, we find that the d.c. current gain, h_{FE}, is around 380.

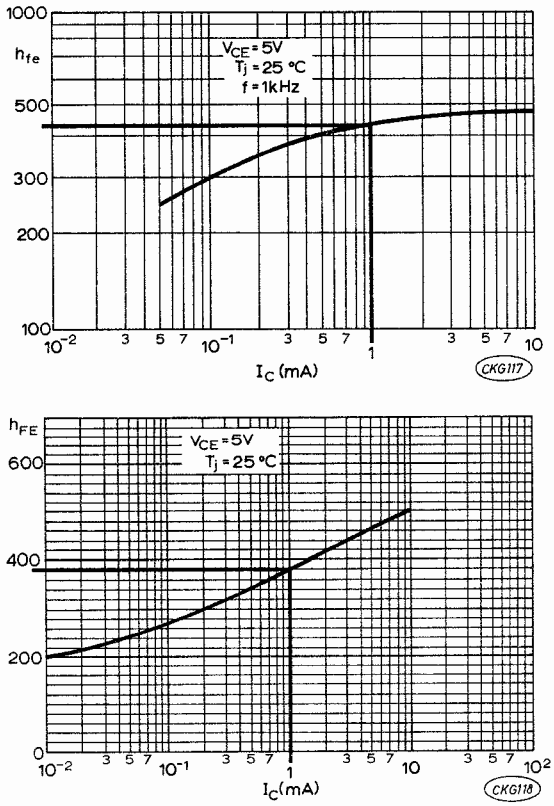

Fig. 41. (top) Graph to determine h_{fe}, the a.c. current gain. Fig. 42 (bottom) is the graph to find the d.c. current gain h_{FE}.

The base current of the transistor is determined by the formula:

$$I_b = \frac{I_c}{h_{FE}}$$

We have determined h_{FE} and the I_c we chose, for best conditions and easy working, to be 1mA. Putting these figures in the above formula, we arrive at the conclusion $I_b = 2{\cdot}6\ \mu A$.

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AC187	25p	BF155	35p	OC42	40p	2N2218	20p
AC188	25p	BF156	25p	OC43	50p	2N2218A	25p
ACY17	30p	BF158	15p	OC44	15p	2N2219	20p
ACY18	25p	BF159	35p	OC45	12p	2N2219A	25p
ACY19	25p	BF180	35p	OC70	12p	2N2220	25p
ACY20	20p	BF181	35p	OC71	12p	2N2221	20p
ACY21	20p	BF182	35p	OC72	20p	2N2221A	25p
ACY22	10p	BF184	15p	OC75	25p	2N2222	20p
ACY39	55p	BF185	15p	OC76	25p	2N2222A	25p
ACY40	20p	BF196	15p	OC77	40p	2N2369	15p
ACY41	15p	BF197	15p	OC81	20p	2N2369A	15p
ACY44	25p	BFX13	25p	OC81D	20p	2N2646	40p
AD140	50p	BFX29	25p	OC81Z	40p	2N2904	20p
AD149	50p	BFX30	25p	OC83	25p	2N2904A	25p
AD161	35p	BFX84	25p	OC84	25p	2N2905	25p
AD162	35p	BFX85	30p	OC139	25p	2N2905A	25p
AF114	25p	BFX86	25p	OC140	40p	2N2906	20p
AF115	25p	BFX87	25p	OC141	60p	2N2906A	25p
AF116	25p	BFX88	20p	OC170	25p	2N3011	20p
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BAY38	15p	GET113	25p	VR525	35p	2N3905	25p
BC107	10p	GET114	20p	WO1	30p	2N3906	25p
BC108	10p	GET115	50p	WO6	45p	2N4058	12p
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Referring again to our previous arguments, we say that the current flowing in the base bias chain, R1 and R2, should be about five times the base current of the transistor. In our circuit, we have the emitter taken directly to the negative line, and we know that the base-emitter voltage of a silicon transistor is normally 0·6V. So we can calculate the value of R1, since the voltage across it must be 0·6V and the current through it five times the base current of 2·6μA. If we do our sums correctly, the answer will be:

$$R1 = \frac{0{\cdot}6V}{5 \times I_b (2{\cdot}6\mu A)} = \frac{0{\cdot}6 \times 10^6}{13} = 46{,}154\Omega.$$

The nearest preferred value in the 5% range will be 47kΩ.

The voltage across R2 will be the supply voltage, 8 volts, minus the base voltage of 0·6V=7·4V. The current will be six times I_b, that is the current in R1 plus the original base current. So:

$$R2 = \frac{V_{cc} - V_b}{6 \times I_b} = \frac{8 - 0{\cdot}6}{15{\cdot}6 \times 10^{-6}} = \frac{74 \times 10^6}{156} = 474{,}359\Omega.$$

The nearest preferred value is 470kΩ.

Input resistance

We have talked before about input resistance and our own experiences in trying to match equipment, about which manufacturers have given inadequate information, show that this is a difficult field. 'Fings ain't always wot they seem ter be!'

The input resistance of the transistor (looking into its base and ignoring R1 and R2) is h_{ie}. Fig. 43 shows that Mullard graph for the BC109, idealised for the conditions under which we are using the transistor—that is, with unnecessary information omitted. We have done this here, at Michael's insistence, because, to the layman, there is nothing more confusing than a graph filled with curves and references he is not called upon to use.

Here, we have indicated that the h_{ie} is a little over 10kΩ. If we had no graph, we should have to calculate:

$$h_{ie} = r_e \times h_{fe} \text{ where } r_e = \frac{25\Omega}{I_c\,(mA)}$$

so $h_{ie} = \frac{25}{1} \times 450$ or 11·25kΩ, which is reasonably near the plotted figure in this case.

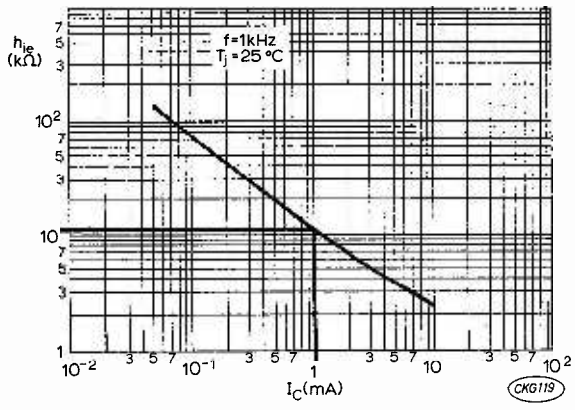

Fig. 43. This graph will give the input resistance, h_{ie}, of the transistor.

The input resistance of the **stage,** and not just the h_{ie}, is the latter shunted by the parallel combination of R1 and R2. This is as far as a.c. is concerned. (In parallel, because to a.c. signals, by reason of the low impedance of C_{dec}, the top of R2 is effectively connected to the bottom of R1.)

So we calculate for h_{ie}, R1 and R2 in parallel, arriving at:

$$\frac{1}{11k\Omega} + \frac{1}{47k\Omega} + \frac{1}{470k\Omega} = 8{\cdot}7k\Omega \text{ approx.}$$

If there are to be 5 volts between collector and emitter, then we must have a voltage drop across R_c of 8−5 ($V_{CC} - V_{CE}$). This works out to 3 volts and if the collector current is chosen to be 1mA, the resistance of the load R_c:

$$\frac{3 \text{ volts}}{1mA} = \frac{3{,}000}{1}$$

The nearest preferred value to a 3kΩ resistor we shall get in the 5% range is 2·7kΩ. That's near enough.

Gain

Stage voltage gain (A_v) is equal to R_c divided by the emitter resistance. In this case we are concerned with the **effective internal** emitter resistance, r_e, which you will remember, caused some confusion earlier, and is calculated from the formula:

$$r_e = \frac{25}{I_c\,(mA)} = 25\Omega.$$

The stage gain, A_v, becomes:

$$\frac{R_c}{r_e} = \frac{2{,}700}{25} = 108$$

We made some comment on the principle of selecting transistors so this may be the place to underline the importance of parameter variations on the validity of some associated calculations. In this case, if I_c changes, so does r_e. We chose our collector current and took a 'typical' H_{FE} from the graph. But collector current (actual) depends on base current and actual h_{FE}. So if the selected transistor has an h_{FE} that differs, I_C will differ, r_e will be affected and the stage gain may be quite different from that calculated. Hard world, isn't it?

Adding an external R_e

In the previous case, that of Fig. 40, we had the emitter firmly strapped to 'earth' so the emitter voltage was the same as the negative supply line. What happens to the stage and its performance if we now insert a resistance in this emitter, in the position R_e of Figs 44 (a and b)?

Quite simply, the stage gain is altered and at the same time the input resistance, R_{IN}, is increased.

Basing our calculations on some of the factors we have already, we can choose a convenient value of resistor for R_e and work out what differences it will make. First, V_{cc} is 8V; I_c, 1mA; R_c, 2·7kΩ and our R_e will be, let us say 47Ω. Then $V_e = I_e \times R_e = 1mA \times 47$ ohms = 0·047V.

The emitter current is the collector current plus base current, or $I_e = I_c + I_b$. Since the base current of the transistor (2·6μA) is very small in comparison with the collector current of 1mA, it is convenient to ignore it, satisfied that there will be only a negligible amount of error. So we can say, effectively,

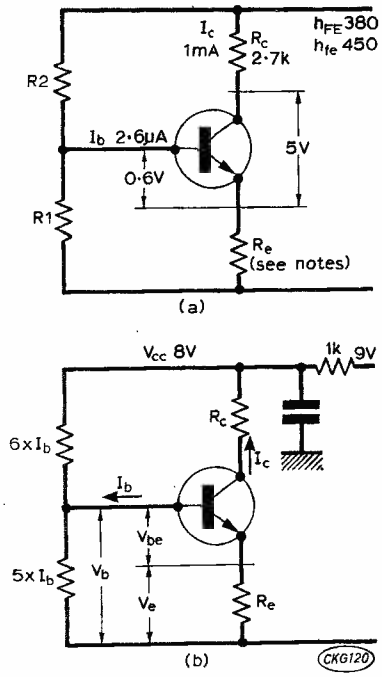

Fig. 44. (a) Theoretical collector follower circuit, showing voltage and current distribution. (b) shows the symbolic representation with R1 and R2 values indicated relative to I_b.

$V_b = V_e + V_{be}$ (Note:—the base-emitter voltage of a silicon transistor, when it is forward biased, as in normal operation, is about 0·6V). Thus, $V_b = 0{\cdot}047 + 0{\cdot}6 = 0{\cdot}65$V, which is also the voltage across R1.

$$R1 = \frac{V_b}{5\times I_b} = \frac{0{\cdot}65}{5\times 2{\cdot}6\times 10^{-6}} = 50\text{k}\Omega, \text{ approx.}$$

To the nearest preferred value in the 5% range, we can choose 47kΩ.

$$R2 = \frac{V_{cc}-V_b}{6\times I_b} = \frac{8-0{\cdot}65}{15{\cdot}6\times 10^{-6}} = 471{\cdot}154\text{k}\Omega$$

Again, we choose the nearest preferred value, and settle for 470kΩ in the 5% range.

Having added R_e, we now have to take account of its presence in the voltage gain formula, A_v:

$$\frac{R_c}{(R_e+r_e)} = \frac{2{,}700}{47+25} = 37{\cdot}5$$

Input impedance

We were content to deal with h_{ie} previously, the input resistance (impedance) of the transistor, looking into the base with R1 and R2 ignored. Now that we have added R_e, we must allow for it in calculating the input impedance, and we shall be dealing with R_{in}:

$R_{in} = (R_e + r_e)(h_{fe}+1) = (47+25)(450+1) = 32{\cdot}472\text{k}\Omega$

The shunting effect of R1 and R2 has to be considered again, as far as a.c. is concerned, so the stage input resistance R_{IN} is calculated as before:

$$\frac{1}{R_{IN}} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R_{in}} = \frac{1}{47\text{k}\Omega} + \frac{1}{470\text{k}\Omega} + \frac{1}{32\text{k}\Omega}$$

$= 18{\cdot}3\text{k}\Omega$, approx.

Negative feedback enters into matters at this point. We have not fitted any bypass capacitor across the emitter resistor. This has allowed series negative feedback to take place, and the gain of the stage is reduced by the negative feedback. As it effectively changes the value of $R_e + r_e$, the stage input resistance is also affected. This feature is widely used in transistor circuitry, where negative feedback is employed to set the stage gain, alter the input impedance, improve the frequency response and reduce harmonic distortion.

To demonstrate the differences that are obtained when R_e is inserted, and then altered, the accompanying table has been prepared. Calculations which back these figures are based on the foregoing formulae, as worked out for an R_e of 47Ω, which we have used. We are assuming a V_{cc} of 8V, and R_c of 2·7kΩ, using a BC109 transistor. We have taken the figures calculated and measured for no R_e and for four different resistive values.

R_e Ω	0	47	100	220	470
Output impedance	<2·7k	2·7k	2·7k	2·7k	2·7k
R1 (kΩ)	47	47	47	56	82
R2 (kΩ)	470	470	470	470	390
R_{IN} (kΩ) measured	8·6	19·5	26	36·3	52
R_{IN} (kΩ) calculated	8·7	18·3	25	34·3	52
A_v (voltage gain) measured	120	35	19	10·5	5·4
A_v calculated	108	37·5	21·6	11	5·74

Table indicating the changes in the circuit characteristics with different values of R_e.

Finally, a paragraph on coupling and decoupling. We have already stated that R_{dec} is dropping 1V and we know that the approximate current through it will be 1mA so from this we can calculate its value,

$$R_{dec} = \frac{1\text{V}}{1\text{mA}} = 1\text{k}\Omega$$

We can take it that the decoupling capacitor, C_{dec} is as before, that is 100μF. C_{out} is similar, at 10μF and C_{in} will vary with the stage input resistance for optimum value. Using the rule-of-thumb method, 1μF into 100kΩ, and applying this to measured values of R_{IN}, we can see that this will vary from a mere 0·1μF (actual value 0·086μF) to greater than 0·5μF.

TO BE CONTINUED

BRAND NEW GUARANTEED

SEMICONDUCTORS & COMPONENTS

SOLE AGENTS FOR SOLID STATES DEVICES INC., (U.S.A.), IN U.K.

RETURN OF POST SERVICE

TRANSISTORS

2G301	20p	2N3404	32½p	40310	45p	BC212L	18p	BSX28	32½p	NKT281	27½p
2G302	20p	2N3405	45p	40311	35p	BCY30	27½p	BSX60	32½p	NKT401	87½p
2G303	20p	2N3414	22½p	40312	47½p	BCY31	30p	BSX61	62½p	NKT402	90p
2G306	42½p	2N3415	22½p	40314	37½p	BCY32	50p	BSX76	22½p	NKT403	75p
2G308	30p	2N3416	37½p	40320	47½p	BCY33	25p	BSX77	27½p	NKT404	62½p
2G309	30p	2N3417	37½p	40323	32½p	BCY34	30p	BSX78	27½p	NKT405	75p
2G371	15p	2N3570	£1·25	40324	47½p	BCY38	40p	BSY10	27½p	NKT406	62½p
2G374	20p	2N3572	97½p	40326	37½p	BCY39	60p	BSY11	27½p	NKT451	62½p
2G381	22½p	2N3605	27½p	40329	30p	BCY40	50p	BSY24	15p	NKT452	62½p
2N404	22½p	2N3606	27½p	40344	27½p	BCY42	15p	BSY25	15p	NKT453	47½p
2N696	20p	2N3607	22½p	40347	57½p	BCY43	15p	BSX26	17½p	NKT603F	32½p
2N697	17p	2N3702	11p	40348	52½p	BCY54	32½p	BSY27	17½p	NKT613F	32½p
2N698	25p	2N3703	10p	40360	42½p	BCY58	22½p	BSX28	17½p	NKF674F	30p
2N706	12½p	2N3704	11p	40361	47½p	BCY59	22½p	BSY29	17½p	NKT677F	30p
2N705A	12½p	2N3705	10p	40362	57½p	BCY60	97½p	BSY32	25p	NKT713	25p
2N708	15p	2N3706	09p	40370	32½p	BCY70	20p	BSY36	25p	NKT781	30p
2N709	62½p	2N3707	11p	40406	57½p	BCY71	25p	BSY37	25p	NKT10419	30p
2N718	25p	2N3708	07p	40407	40p	BCY72	17½p	BSY38	22½p	NKT10439	
2N726	30p	2N3709	09p	40408	52½p	BCZ10	27½p	BSY39	22½p		37½p
2N727	30p	2N3710	09p	40410	62½p	BCZ11	42½p	BSY40	32½p	NKT10519	
2N914	17½p	2N3711	12p	40467A	57½p	BD116	£1·12½	BSY51	32½p		32½p
2N916	17½p	2N3715	£1·25	40468A	35p	BD121	65p	BSY52	32½p	NKT20329	
2N918	30p	2N3716	£1·30	40600	57½p	BD123	82½p	BSY53	37½p		47½p
2N929	22½p	2N3791	£2·06	AC107	30p	BD124	60p	BSY54	40p	NKT20339	
2N930	27½p	2N3819	35p	AC126	20p	BD131	75p	BSY56	90p		37½p
2N1090	22½p	2N3823	97½p	AC127	25p	BD132	85p	BSY78	47½p	NKT80111	
2N1091	22½p	2N3854	27½p	AC128	20p	BDY10	£1·37½	BSY79	45p		77½p
2N1131	25p	2N3854A	27½p	AC154	22½p	BDY11	£1·62½	BSY82	52½p	NKT80112	
2N1132	25p	2N3855	27½p	AC176	25p	BDY17	£1·50	BSY90	57½p		97½p
2N1302	17½p	2N3855A	30p	AC187	62½p	BDY18	£1·75	BSY95A	12½p	NKT80113	
2N1303	17½p	2N3856	30p	AC188	37½p	BDY19	£1·97½	BSW41	42½p		£1·12
2N1304	22½p	2N3856A	35p	ACY17	27½p	BDY20	£1·12½	BSW70	27½p	NKT80211	
2N1305	22½p	2N3858	25p	ACY18	25p	BDY38	97½p	C111	75½p		92½p
2N1306	25p	2N3858A	30p	ACY19	25p	BDY60	£1·25	C424	27p	NKT80212	
2N1307	25p	2N3859	27½p	ACY20	25p	BDY61	£1·25	C425	55p		92½p
2N1308	30p	2N3859A	32½p	ACY21	25p	BDY62	£1·00	C426	40p	NKT80213	
2N1309	30p	2N3860	30p	ACY22	20p	BF115	25p	C428	37½p		92½p
2N1507	17½p	2N3866	£1·50	ACY28	20p	BF117	47½p	C744	30p	NKT80214	
2N1613	25p	2N3877	40p	ACY40	20p	BF163	37½p	D16P1	37½p		92½p
2N1631	35p	2N3877A	40p	ACY41	25p	BF167	18p	D16P2	40p	NKT80215	
2N1632	30p	2N3900	37½p	ACY44	40p	BF173	19p	D16P3	37½p		92½p
2N1638	27½p	2N3900A	40p	AD140	52½p	BF177	30p	D16P4	40p	NKT80216	
2N1639	97½p	2N3901	97½p	AD149	57½p	BF178	30p	GET102	30p		92½p
2N1671B	£1·00	2N3903	35p	AD150	62½p	BF179	30p	GET113	20p	OC20	75p
2N1711	25p	2N3904	35p	AD161	37½p	BF180	35p	GET114	20p	OC22	50p
2N1889	32½p	2N3905	37½p	AD162	37½p	BF181	32½p	GET118	20p	OC23	60p
2N1893	37½p	2N3096	37½p	AF106	42½p	BF184	25p	GET119	20p	OC24	60p
2N2147	82½p	2N4058	17½p	AF114	25p	BF185	42½p	GET120	52½p	OC25	50p
2N2148	57½p	2N4059	10p	AF115	25p	BF194	17½p	GET873	12½p	OC26	27½p
2N2160	57½p	2N4060	12½p	AF116	25p	BF195	15p	GET880	30p	OC28	62½p
2N2193	40p	2N4061	12½p	AF117	25p	BF196	42½p	GET887	20p	OC29	62½p
2N2193A	42½p	2N4062	12½p	AF118	62½p	BF197	42½p	GET889	22½p	OC35	50p
2N2194A	30p	2N4244	47½p	AF119	20p	BF198	42½p	GET890	22½p	OC36	62½p
2N2217	27½p	2N4285	17½p	AF124	22½p	BF200	52½p	GET896	22½p	OC41	22½p
2N2218	23p	2N4286	17½p	AF125	20p	BF224	14p	GET897	22½p	OC42	25p
2N2219	23p	2N4287	17½p	AF126	20p	BF225	19p	GET898	22½p	OC44	20p
2N2220	25p	2N4288	17½p	AF127	17½p	BF237	23p	MJ400	£1·07½	OC45	12½p
2N2221	25p	2N4289	17½p	AF138	37½p	BF238	23p	MJ420	£1·12½	OC46	15p
2N2222	30p	2N4290	17½p	AF178	42½p	BF244	23p	MJ421	£1·12½	OC70	15p
2N2270	47½p	2N4291	17½p	AF179	72½p	BFW61	47½p	MJ430	£1·02½	OC71	12½p
2N2297	30p	2N4292	12½p	AF180	52½p	BFX12	22½p	MJ440	95p	OC72	12½p
2N2368	17½p	2N4303	47½p	AF181	42½p	BFX13	22½p	MJ480	97½p	OC74	32½p
2N2369	17½p	2N5027	52½p	AF239	42½p	BFX29	30p	MJ481	£1·25	OC75	22½p
2N2369A	17½p	2N5028	57½p	AF279	47½p	BFX30	30p	MJ490	£1·00	OC76	22½p
2N2410	42½p	2N5029	47½p	AF280	62½p	BFX42	37½p	MJ491	£1·37½	OC77	30p
2N2483	27½p	2N5030	42½p	AF281	32½p	BFX44	37½p	MJ1800	£2·17½	OC81	20p
2N2484	32½p	2N5172	12½p	ASY26	25p	BFX68	67½p	MJE340	82½p	OC81D	22½p
2N2539	22½p	2N5174	52½p	ASY27	37½p	BFX84	25p	MJE520	60p	OC83	25p
2N2540	22½p	2N5175	52½p	ASY28	27½p	BFX85	33½p	MJE521	72p	OC84	25p
2N2613	35p	2N5176	45p	ASY29	27½p	BFX86	25p	MPF102	42½p	OC139	32½p
2N2614	30p	2N5232A	30p	ASY36	25p	BFX87	27½p	MPF103	37½p	OC140	32½p
2N2646	52½p	2N5245	45p	ASY50	25p	BFX88	25p	MPF104	37½p	OC170	30p
2N2696	32½p	2N5246	42½p	ASY51	32½p	BFX89	62½p	MPF105	37½p	OC171	30p
2N2711	25p	2N5249	67½p	ASY54	25p	BFX93A	70p	MPS3638	32½p	OC200	40p
2N2712	25p	2N5265	£3·25	ASY86	32½p	BFY10	32½p	NKT0013	47½p	OC201	60p
2N2713	27½p	2N5266	£2·75	AU103	£1·25	BFY11	42½p	NKT124	42½p	OC202	75p
2N2714	30p	2N5267	£2·62½	ASZ21	42½p	BFY17	22½p	NKT125	27½p	OC203	42½p
2N2865	62½p	2N5305	37½p	BC107	10p	BFY18	32½p	NKT126	27½p	OC204	42½p
2N2904	30p	2N5306	40p	BC108	10p	BFY19	32½p	NKT128	27½p	OC205	90p
2N2904A	32½p	2N5307	37½p	BC109	10p	BFY20	£1·60	NKT135	27½p	OC207	75p
2N2905	37½p	2N5308	37½p	BC113	15p	BFY21	42½p	NKT137	32½p	OCP71	42½p
2N2905A	40p	2N5309	62½p	BC115	15p	BFY24	45p	NKT210	30p	ORP12	50p
2N2906	25p	2N5310	42½p	BC116A	15p	BFY25	25p	NKT211	30p	ORP61	50p
2N2906A	27½p	2N5354	27½p	BC118	10p	BFY26	20p	NKT212	30p	P346A	224p
2N2907	30p	2N5355	27½p	BC121	20p	BFY29	50p	NKT213	30p	TIS34	62½p
2N2923	15p	2N5356	32½p	BC122	20p	BFY30	50p	NKT214	22½p	TIS43	27p
2N2924	15p	2N5365	47½p	BC125	20p	BFY41	50p	NKT215	22½p	TIS44	10p
2N2925	15p	2N5366	32½p	BC126	20p	BFY42	62½p	NKT216	32½p	TIS45	10p
2N2926		2N5367	57½p	BC140	37½p	BFY50	22½p	NKT217	42½p	TIS46	11p
Green	14p	2N5457	37½p	BC147	10p	BFY51	20p	NKT219	30p	TIS47	11p
Yellow	12½p	2S005	75p	BC148	10p	BFY52	22p	NKT223	27½p	TIS48	12½p
Orange	12½p	2S020	£2·00	BC149	12p	BFY53	17½p	NKT224	25p	TIS49	12½p
2N3011	30p	2S102	50p	BC152	17½p	BFY56A	57½p	NKT225	22½p	TIS50	17½p
2N3014	32½p	2S103	25p	BC157	20p	BFY75	30p	NKT229	30p	TIS51	12½p
2N3053	18p	2S104	25p	BC158	11p	BFY76	42½p	NKT237	35p	TIS52	12½p
2N3054	46p	2S501	32½p	BC159	12p	BFY77	57½p	NKT238	25p	TIS53	22½p
2N3055	62p	2S502	35p	BC160	62½p	BFY90	67½p	NKT240	27½p	TIS80	22½p
2N3133	30p	2S503	27½p	BC167	11p	BFW58	27½p	NKT241	27½p	TIS81	25p
2N3134	30p	3N83	40p	BC168B	10p	BFW39	25p	NKT242	20p	TIS82	27½p
2N3135	25p	3N128	70p	BC168C	11p	BFW60	25p	NKT243	62½p	TIP29A	50p
2N3136	25p	3N140	77½p	BC169B	11p	BPX25	£1·35	NKT244	17½p	TIP30A	60p
2N3390	25p	3N141	72½p	BC169C	12p	BPX29	£1·80	NKT245	20p	TIP31A	62½p
2N3391	20p	3N142	55p	BC170	12½p	BPY10	£1·45	NKT261	20p	TIP32A	75p
2N3391A	30p	3N143	67½p	BC171	15p	BRY39	37½p	NKT262	30p	TIP33A	
2N3392	17½p	3N152	87½p	BC172	15p	BSX19	17½p	NKT264	20p		£1·02½p
2N3393	15p	R.C.A.	52½p	BC175	22½p	BSX20	17½p	NKT271	20p	TIP34A	£2·05
2N3394	15p	40050	55p	BC182	10p	BSX21	37½p	NKT272	20p	TIP35A	£2·90
2N3402	22½p	40251	32½p	BC183	09p	BSX26	45p	NKT274	20p	TIP36A	£3·68
2N3403	22½p	40309	32½p	BC184	11p	BSX27	47½p	NKT275	20p		

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SN7401	0·20	0·18	SN7437	0·64	0·06	SN7473	0·43	0·41
SN7402	0·20	0·18	SN7438	0·64	0·60	SN7474	0·43	0·41
SN7403	0·20	0·18	SN7440	0·23	0·21	SN7475	0·45	0·44
SN7405	0·20	0·18	SN7441AN	0·87	0·83	SN7476	0·45	0·44
SN7406	0·80	0·75	SN7442	0·85	0·81	SN7480	0·70	0·65
SN7407	0·80	0·75	SN7443	2·88	2·70	SN7481	1·40	1·38
SN7408	0·20	0·18	SN7444	2·86	2·70	SN7482	0·87	0·82
SN7409	0·20	0·18	SN7445	2·50	2·40	SN7483	0·87	0·82
SN7410	0·20	0·18	SN7446	1·00	0·95	SN7484	2·00	1·85
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SN7412	0·48	0·46	SN7448	1·00	0·95	SN7486	0·33	0·30
SN7413	0·40	0·38	SN7449	1·00	0·95	SN7490	0·87	0·84
SN7420	0·20	0·18	SN7450	0·20	0·18	SN7491AN	1·21	1·10
SN7423	0·51	0·47	SN7451	0·20	0·18	SN7492	0·87	0·84
SN7427	0·48	0·45	SN7453	0·20	0·18	SN7493	0·87	0·84
SN7428	0·80	0·75	SN7454	0·20	0·18	SN7494	0·87	0·84
SN7430	0·23	0·15	SN7460	0·20	0·18	SN7495	0·87	0·84
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C425 range axial lead — **6p each**

Values: (μF/V); 0·64/64; 1/40; 1·6/25; 2·5/16: 2·5/64; 4/10; 4/40; 6·4/6·4; 6·4/25; 8/40; 10/16; 10/64; 12·5/25: 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/10; 32/40; 40/16; 50/6·4; 50/25; 50/40; 64/10; 80/2·5; 80/16; 80/25; 100/6·4; 125/10; 125/16; 200/10.

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	8p	9p	10p	11p	12p	15p	20p	—
3A	15p	17p	20p	22½p	25p	27p	30p	35p
6A	—	—	25p	30p	32½p	35p	—	—
10A	—	52½p	57½p	65p	77½p	86½p	97½p	£1·25
15A	—	57½p	62½p	77½p	90p	97½p	£1·20	£1·57½
35A	—	80p	90p	£1·00	£1·25	£1·50	£2·50	—

1 amp and 3 amp are plastic encapsulation.

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IN34A	10p	AA119	7p	BAX16	12½p	FST3/4	22½p
IN914	7p	AA129	15p	BAY18	17½p	OA5	17p
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IN4007	20p	AAZ15	12p	BAY38	25p	OA9	10p
IS44	7p	AAZ17	10p	BY100	15p	OA47	8p
IS113	15p	BA100	15p	BY103	22p	OA70	7p
IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA82	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	22p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
IS923	12p	BA145	17p	BYZ11	32p	OA200	7p
IS940	5p	BA154	12p	BYZ12	30p	OA202	10p
		BAX13	5p	BYZ13	25p	TIV307	50p

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MINITRON 3015F 7-SEGMENT INDICATOR (16 PIN DIL) £2·00
May be driven by SN7447

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	0.15 Matrix	0.1 Matrix
2½ × 3⅞in	17p	23p
2½ × 5in	25p	25p
3⅞ × 3⅞in	25p	25p
3⅞ × 5in	30p	29p
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Pin insertion Tools (·1 and ·15 matrix) at 55p.

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(As published in P.E. Nov. '71). Complete kit £10·00 P. & P. 50p.

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¼ watt 5%, 1p. ¼W, 1W & 2W
½ watt 5%, 1p E12 Series
½ watt 5%, 1½p
½ watt 2%, M/O 4p
1 watt 10%, 2½p ¼W & ½W
2 watt 10%, 6p E24 Series.

BRIDGE RECTIFIERS

A.	PIV		A.	PIV	
1	100	37p	4	50	60p
1·4	140	57p	4	100	70p
2	50	32p	4	400	90p
2	200	41p	6	50	82p
2	400	46p	6	200	80p
			6	400	£1·10

MULLARD C280 M/FOIL CAPACITORS

0·01, 0·022, 0·033, 0·047 3p each
0·068, 0·10 .. .. 4p each
0·15, 0·22, 0·33 .. .. 5p each
0·47 .. .. .. 9p
0·68 .. .. .. 11p
1μF 14p
1·5μF 21p
2·2μF 25p

WIRE-WOUND RESISTORS

2·5 watt 5% (up to 270 ohms only), 7p
5 watt 5% (up to 8·2k Ω only), 9p
10 watt 5% (up to 26k Ω only), 10p

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MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

THE first reporter this month is **Hugh Cocks** of Mayfield in Sussex who has a Unica UNR-30 receiver and a 70 foot long-wire. Hugh sent in a special log of South American stations as follows:

9515 *R. Roquete, Pinto, Brazil* at 2200.
9530 *R. Calendario, Venezuela* at 2230.
9595 *R. Cultura de Bahia, Brazil* at 2130.
9620 *R. Novo de Julho, Brazil* at 2150.
9635 *R. Aparecida, Brazil* at 2225.
9665 *R. Nac. Brasilia, Brazil* at 2230.
9705 *R. Maua, Brazil* at 2100.
11720 *R. Nac. Brasilia, Brazil* at 2100.
11785 *R. Guaiba, Brazil* at 2058.
11795 *R. Nac. Rio, Brazil* at 2100.
11805 *R. Globo, Brazil* at 2100.
11865 *R. Cl. de Pernambuco, Brazil* at 2100.
11875 *R. Soc. de Bahia, Brazil* at 2100.
11915 *R. TV. Gaucha, Brazil* at 2115.
11925 *R. Bandeirantes, Brazil* at 2200.
11950 *R. Min. Educaco, Brazil* at 2130.
15105 *R. Rural Brasileira, Brazil* at 2200.
15145 *R. Jornal do Comercio, Brazil* at 2150.
15155 *R. Dif. de Sao Paulo, Brazil* at 2200.
15190 *R. Inconfidencia, Brazil* at 2230.
15415 *R. Cl. Ribeirao, Brazil* at 2130.

Ian Howes of Lowestoft used a TV antenna with his R209 Mk. 2 receiver to log the following very interesting stations:

4500 *Urumchi, China* with music at 0010.
4665 *Pathet Lao, Laos* in Laotion at 1545.
4790 *R. Ondas Portenas Venezuela* at 0010.
4800 *AIR, Hyderabad, India* at 1545.
4840 *AIR, Bombay, India* at 1510.
4965 *R. Santa Fe, Colombia* news at 0000.
9680 *VLH/R9 ABC, Melbourne, Australia* at 1100.
11875 *R. Dif. Nacional, Nicaragua* at 0000.
11880 *R. Splendid, Argentina* in Spanish at 0045.

Peter Herman of New South Wales, Australia has an equipment line-up which includes a Trio 9R-59DS receiver, a 9MHz. dipole, a 15MHz. dipole, and a Hitachi SCT-115OR 3-band radio/cassette with a telescopic and 12 foot long-wire antenna. Peter's log included:

3322 *R. Bougainville, N. Guin.* at 1143.
4820 *R. Gambia* at 1800.
6145 *AIR, India* at 1540.
7100 *R. Budapest, Hungary* at 1630.
7235 *All India Radio* at 1500.
7285 *R. Berlin International* at 1730.
7290 *R. Kuwait* at 1630.
11920 *R. Abidjan, Ivory Coast* at 1830.

D. A. Hairon of St. Clement, Jersey has sent in another report using the usual equipment, this time he has heard:

9570 *ABC, Australia* in English at 1015.
9625 *Israel B.C.* in English at 2130.
11730 *R. Nederland, Bonaire* at 0525.
11760 *R. Habana, Cuba,* sign off at 0200.
11815 *TWR, Bonaire* in English at 0045.
11860 *BBC, Ascension Is.* relay at 0815.
11875 *R. Nacional, Nicaragua,* Spanish at 0130.
15160 *R. Ankara* in Arabic at 0530.
15532 *R. Bangldesh* in English at 1245.
17855 *NHK, Japan* in English at 0900.
21605 *R. Kuwait* in Arabic at 1100.

Alastair Nimmo is only eleven years old but this extract from his log, using a Meridian 10 transistor portable and 100 foot long-wire shows distinct promise:

5960 *HCJB, Quito, Ecuador,* English at 0830.
6040 *VOA, Rhodes relay* at 2100.
9515 *R. Ankara* in English at 2200.
9525 *RSA, South Africa* in English at 2215.
9530 *AIR, Delhi* in English at 1900.
9530 *VOA, Monrovia* relay, English at 2230.

In order to mention as many reporters as possible I will end this article with a few short extracts from the many received:

Richard Coyle, Glasgow, Lafayette KT340:
4965 *R. Santa Fe, Colombia* at 0550.
4970 *R. Rumbos, Venezuela* at 0345.
4990 *R. Barquisimeto, Venezuela* at 0400.
5038 *R. Bangui, Ident.* in French at 0500.
5075 *R. Sutatenza, Colombia* at 0100.

Adrian Pell, Wareham, Dorset:
12025 *Voice of Vietnam,* English at 2015.
15165 *Danish Radio* in Danish at 1400.
15295 *TWR, Bonaire* in Norwegian at 2145.
15370 *VOA, Greenville* in French at 2200.

Ian Newbold, Birmingham, R209 Mk. 2, 95 foot aerial:
3340 *R. El Mar, Equador* at 2000.
4550 *R. Nacional, Colombia* at 2005.
9735 *NHK, Japan* in Japanese at 2018.
15170 *ELWA, Liberia* in French at 2007.

Fred Wall, E.17, PR155, 20 foot long-wire:
3380 *R. Malawi* in English at 1800.
9510 *R. Barquisimeto, Venezuela* at 2350.
9520 *R. New Zealand* in English at 0900.
11930 *Windward Is. B.S.* cricket at 2120.

Philip Sokell, Barnsley, Romer 10, telescopic antenna:
6125 *VOA* noted at 1610.
6185 *Radio Australia* at 2045.
7215 *Radio Cairo, Egypt* at 0254.
7230 *Radio Kiev, Ukraine* at 0045.

Reports should arrive by the 15th of the month and be addressed to me at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex.

ON THE

SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

IN theory, it should have been a very good month for keen listeners since almost every log sent in was for bands which were at either end of the r.f. spectrum. Quite a few queries in the post bag, many asking questions which would require a text book, blackboard and a couple of years at evening classes to answer. Many people who have queries have a very simple way out—join the nearest radio club. You can ask a question and get an immediate answer. There is nearly always someone at the club who specialises in an area where your question is aimed at. If one person doesn't know the full answer, then it is virtually certain that someone else will.

Join the R.S.G.B., too. This organisation will give you all the help you need, and will also tell you the name and address of the secretary of your nearest radio club. The Society also publishes a number of "booklets" especially for the radio enthusiast and some are aimed specifically at the beginner.

Having joined a club, you will get a chance to visit other people's 'stations' and see gear which, at present, is only a number, like PR40 or R107. Better still, you can have a twiddle with the gear and make up your own mind as to whether a particular piece of equipment is very good or just mediocre.

So you don't hear any DX in spite of all those lovely logs you read in *Practical Wireless*? One way to latch on to some DX is to listen for a DX net which has European stations either in it or even running it. Listen for a good European station calling a DX station. Once you have found the right frequency it is highly probable that other stations will come up also calling the DX station. Eighty metres is a common hunting ground for this type of DX net.

Combined efforts of the **Ipswich** and **Colchester** clubs will result in the Anglian Mobile rally to be held at Ipswich on June 18. Talk-in stations on 160, 80, 4 and 2 metres. Colchester club also runs slow morse practice sessions. Anyone in the area might like to drop to Hon. Sec. a line at 26 Pondfield Road, Colchester, Essex. See you at the rally?

An appeal from **Sam Elsdon** for Amateur stations to use "standard" phonetics. I agree. Only way seems to be to make an accepted phonetic alphabet compulsory and written into all Amateur licences throughout the world. Sam has just finished off the CQ2 v.h.f. receiver which appeared in the September edition of *Practical Wireless* back in 1969. He runs a CR70A and PR40 plus a 310ft end-fed. A listen on eighty metres s.s.b. raised: DJ9NW, PJ4AQ, W5ILR/TF, XE1CV, 9H1D. Log for 20 metres reads: BY4AP, EA3AKE, FG7TC, IS1KLO, VE3MR, VK2AVA, VK3OEL, VK5OB, VO4HW, ZS5KY, 4X4DK, 7X2PK, 7X3ORU.

Kevin Lamb has seen thirteen summers pass and resides at Ashford. Gear consists of a two-valve homebrew receiver, a.t.u. (also homebrew) and a 50ft end-fed. Goodies heard on topband include: HB9CM, OK1FT, OK1MAC, OL1APC, 4U1ITU. Twenty metres using an R107 (that's cheating) raised: CX2XA, EA8GZ, EA8DI, HK5ASM, PY7AZQ, VK3ALL, VK4NB, VK4UC, VK5FH, VK6HE, VP9GK, ZL1HD, ZL3AH, ZL3AR, ZL3HA. Kevin asks about some four metre activity. This is a band which the Amateur could so easily lose unless there is a lot more activity. If the two metre addicts would come down, the G8 plus threes take the trouble to learn c.w., and the h.f. DX types go up another band, we might just save it—or is it worth the effort?

One hundred and thirty-two feet of wire stretching into the sunset but anchored to the aerial terminal of an R107 is a feature at a house in Melbourne Road, Chester. **Mike Purcell** loiters thereabouts and heard the following on 3·5MHz s.s.b.: CR4BS, CT1UN, HB9LQS, VE1QM, VP2LAT, VO1CU, WB0FFG/TF, W1AA, 4X4UF.

Another CQ2 v.h.f. receiver builder is **David Lawley** (Gravesend). He has heard a fair number of Amateur two-metre stations already but although he is only ten miles from the beacon station GB3VHF, he can't hear it at all. (V-e-r-y interesting.) Ten metres is the band which has brought a lot of stations in for David using the School Radio Society's B40 plus 500ft long, long, long wire. Log reads: JA8GWA, JR1INC, OD5HI, PZ1DV, VE3DOR, VE7HC, VU2JM, K1BCD, hoards of W stations, ZC4BJ, 4X4GH, 4X4HK, 9X5MS all mostly on s.s.b.

Down on topband, David reports signals from: EI9J, GM3YOR, GW3UCB, GW3UPK, GW4AHN/A, HB9CM, HB9NL, OL1AOH, OL5ANJ, PA0PN. These were all on c.w. but PA0PN is on most Sunday mornings on s.s.b.

Eighty-three W stations start off the eight metre log of **Richard Coyle** (Glasgow). Additional appearances from: VE1ANZ, VE2WA, VE3GCS, VE3VE, ZL3GS, 6W8DY.

Fifty-nine W stations in the ten-metre log from an unknown listener at Henrietta Street, Girvan in Ayrshire. OK, don't sign your name, but I know you've got a CR70A and a ten-metre dipole. Incidentally, it is surprising how many logs don't get in because no receiver is mentioned, or the aerial hasn't been divulged or the whole list is not in alphabetical order. (Hint! hint!!)

John Guy (Wimborne), B40C, 70ft end-fed, 28MHz, mode unspecified: CR4BS, CR611, ET3USA, FL8MM, HC2GG/P, KP4DHD, VS6DO, YV1AMX, YV3SZ, 7Q7BC, 8R1G.

More news from **John Stevenson** (Woking) about his d.c. (direct conversion) receiver. A number of mods have given a large increase in sensitivity. Log for 14MHz s.s.b. reads: CT1BZ, HR1RS, HV3SI, KP4BSA, PY1CAD, PY2YRS, PY4AS, VK2NN, VK2RV, VQ9R, ZL1BE, 3A2CP, 4X4BL, 4X4NJ, 4Z4TV, 9H1CZ.

Happenings for the merry month of May include: 6-7, 432MHz contest; 21, 2 metres contest. June: 3-4, National Field Day; 10-11, 4 metre contest.

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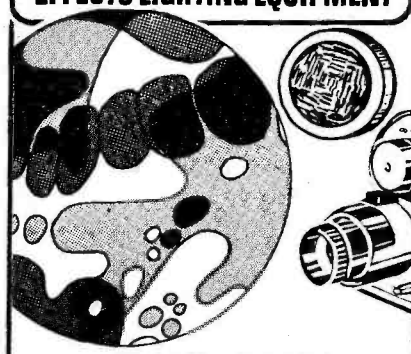

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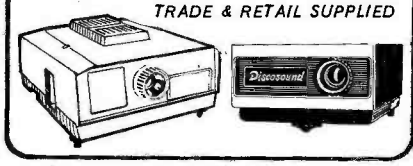

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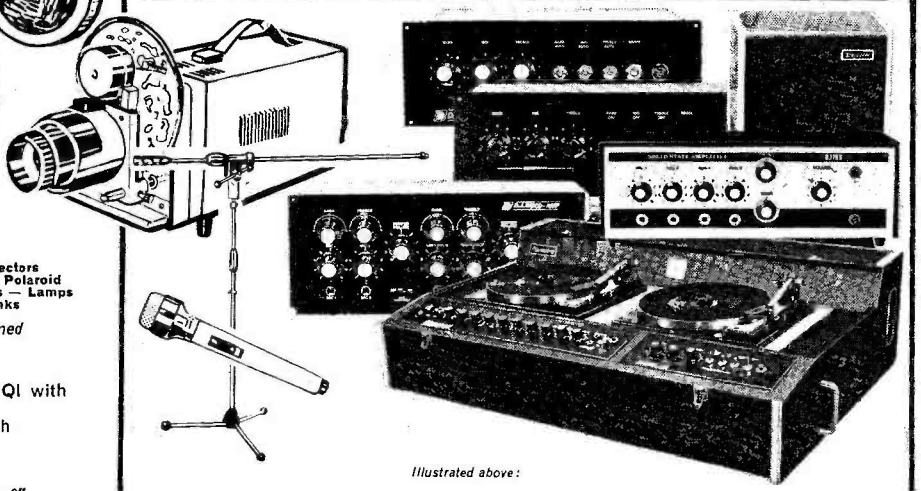

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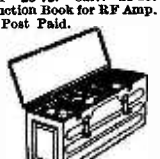

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20-0-20	30 mA	MT 211 CS*†	£0·91	8p
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0-8-9×2	500 mA×2	MT 207 CT*†	£1·46	19p
0-15-20×2	500 mA×2	MT 205 AT*‡	£2·12	29p
0-15-27×2	500 mA×2	MT 203 AT*	£2·45	29p
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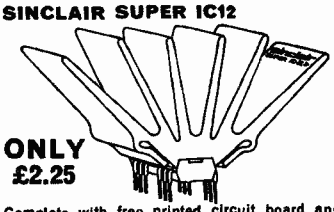

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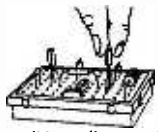

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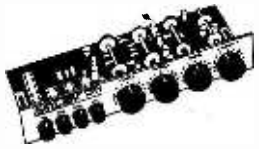

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I.C. OF THE MONTH

L.A.J. IRELAND

Number 30 — RCA CA3090Q Stereo Decoder

IN AUGUST 1970 this column reported on the introduction of a stereo decoder i.c., the Motorola type MC1303. In the interval this unit has proved very successful and certain commercial concerns are marketing decoder units based on this device. However, technology does not stand still; it was recognised that the elimination of the set of coils required in a standard stereo decoder would facilitate the assembly of units on a commercial basis.

Successful decoding demands the selection of the 19kHz pilot tone from the audio signal developed by the discriminator stage of the f.m. tuner, followed by the reconstruction of the 38kHz carrier by frequency doubling without degrading the phase relationship with the pilot tone. Replacement of the carrier into the 38kHz sideband permits demodulation of the "difference" signal; the audio components of the discriminator output provide the "sum" signal.

The final stage in decoding is the reconstruction of the separate right and left channels from the "sum" and "difference" signals supplied. To reduce noise in the subcarrier (38kHz) regeneration process, it is desirable that sharply tuned circuits be used to reduce the bandwidth about 19kHz when determining the pilot tone. This however, is in conflict with the requirement of phase coherence, since then slight detuning can introduce significant phase shift. Remembering that a channel separation of at least 20dB is the minimum acceptable in a stereo decoder and that less than 10° of phase shift in each of the three inductors alone can cause a reduction in channel separation approaching this figure, the care necessary in designing and aligning the coils can be estimated, even with a sound basic system such as the MC1303.

At this point it may be recalled that the introduc-

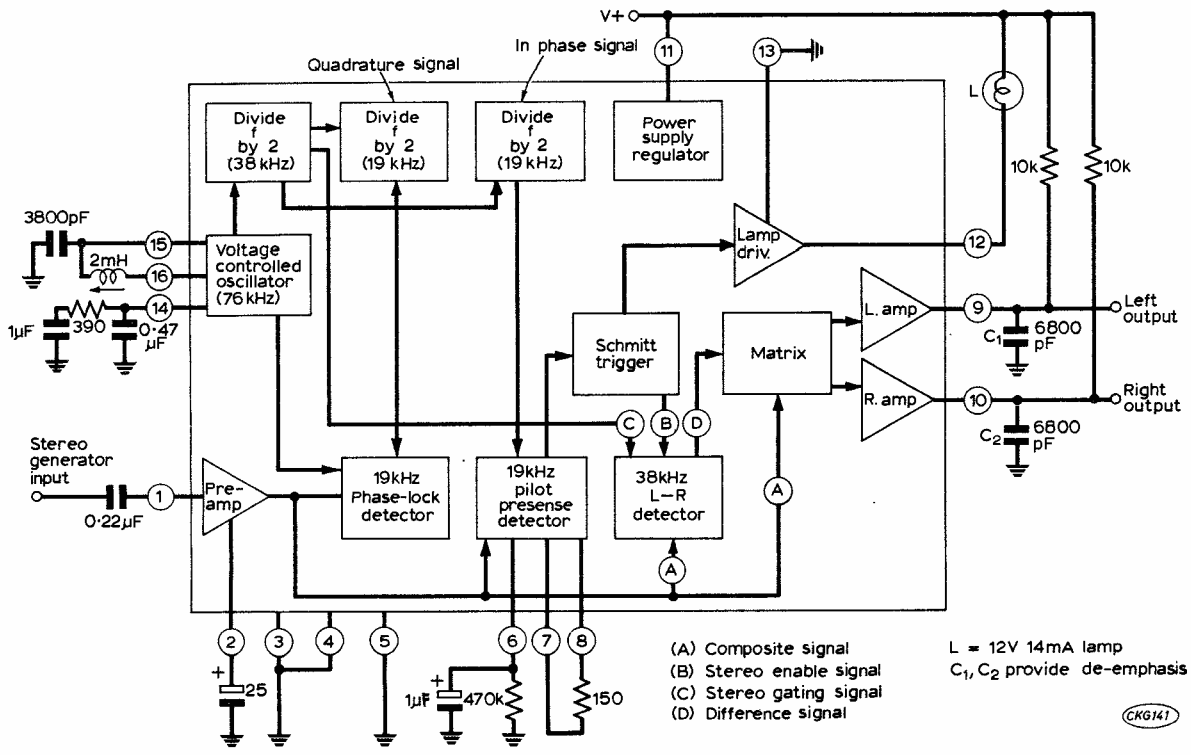


Fig. 1: The R.C.A. type CA3090Q phase-locked loop i.c. stereo decoder block diagram and applications circuit. In domestic tuner systems the f.m. discriminator is applied across the 0·22 μF capacitor.

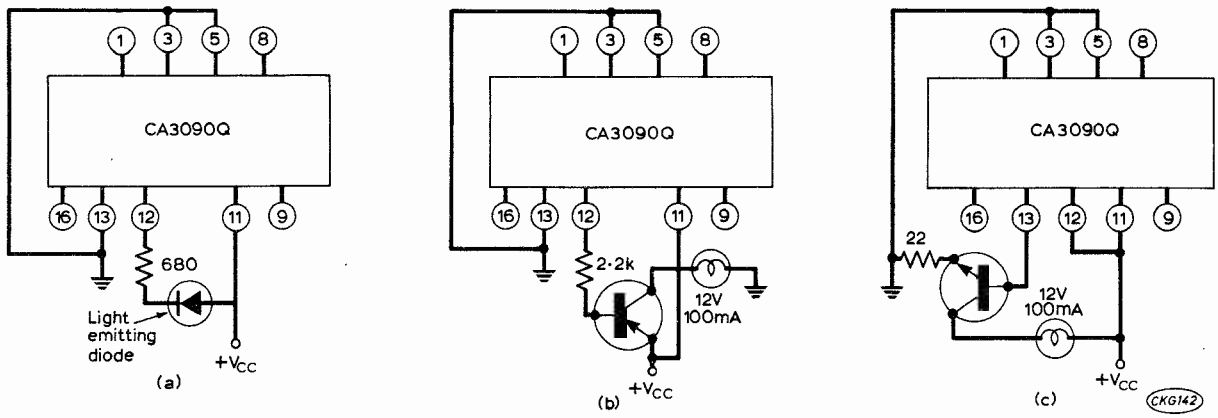


Fig. 2: Various methods of light indication (a) using a light emitting diode (b) PNP lamp driver (c) NPN lamp driver.

tion of monolithic silicon technology has opened an alternative route to the operation of tuned circuits, capable of eliminating to a great extent the requirements for precision LC circuits. It is, of course, the phase-locked loop circuit, first dealt with in "I.C. of the Month" in July 1971. Here, a local oscillator, whose operating frequency can be shifted by a limited amount by the application of an external voltage bias, drives a phase comparison circuit. The other input to the comparator is the external reference signal. The comparator output, a measure of frequency and phase separation of the local and the reference signal, feeds back to the local oscillator as an error voltage, correcting the local oscillator frequency.

The phase-locked loop i.c. considered last July was the Signetics NE561B system, suitable as an a.m./f.m. demodulator. This month exactly the same circuit concept is applied to the stereo decoder problem in the new R.C.A. Type CA3090Q. It is perhaps unnecessary to point out that by a phase-lock method, the problem of phase-shift degradation of channel separation is clearly avoided, and the need for design compromise between subcarrier circuit bandwidth and signal/noise ratio circumvented.

In the CA3090Q the loop local oscillator operates at a centre frequency of 76kHz and is followed by bistable frequency dividers, producing the 38kHz subcarrier at first division and 19kHz, the pilot tone frequency, at the second division. The frequency and phase comparison operation is carried out at 19kHz by reference to the received pilot tone, and the d.c. error voltage fed back to the local oscillator to maintain phase lock. Unlike the Signetics unit, the voltage controlled local oscillator of the CA3090Q is an LC oscillator, but the coil for this circuit is the only inductor required in the whole stereo decoder system, and even then alignment is non-critical. In point of fact, a 4kHz shift in local oscillator free-running frequency requires a correction voltage representing some 10° **total** subcarrier phase shift; the 40dB. channel separation figure then achieved is highly satisfactory, Fig. 1.

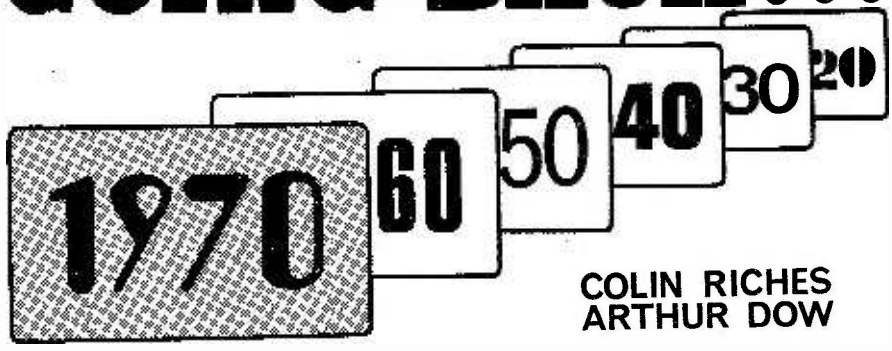
Signals at 19kHz are derived from the local oscillator by division independently for the phase comparator already mentioned and for a stereo signal presence detector circuit. When the pilot tone exceeds a preset value, corresponding to an f.m. detector output (i.e. the "composite" stereo signal comprising a.f. "sum" signal, 19kHz pilot tone and 38kHz suppressed carrier "difference" signal) of 40 mV, a Schmitt trigger operates, switching the i.c. into stereo mode, with demodulation of the 38kHz signal and matrixing for channel separation, together with a suitable stereo reception signal. External indication of stereo operation is therefore directly available in a dial light, with the attractive possibility that this may be an l.e.d. solid state indicator, rather than a mere bulb, Fig. 2. A manual override to the automatic mono/stereo switching operation may be incorporated; the control voltage to secure this function is applied at pin 4 (shown earthed in Fig. 1).

The circuit incorporates an internal voltage regulator, a feature widely accepted in complex function i.c.'s since it eliminates the need for external decoupling of power supply lines, a decoupling which could well be ineffective anyway due to internal "crosstalk" on the chip. Further, in a complex circuit, the availability of pins for external connections is often a limiting factor, and economically more significant in production than a few extra transistors on the chip, which require consideration once and for all only at the design stage. The effectiveness of the internal regulation is indicated by the capability of the unit to function over a power supply voltage range of 10 to 16 volts.

Design of the actual decoder can be based on Fig. 1, which shows the actual circuit for a phase locked loop automatic stereo decoder with function indicator lamp. The coil is a 2mH unit, and may be wound on an adjustable pot core. The complexity of the unit can be judged by the fact that it has 128 transistors! Clearly an itemised analysis of circuit function would not find a place in this note, so Fig. 1 also provides a block diagram to assist the constructor who wishes to study the system more fully. For the majority of readers, though, it will be sufficient that in this i.c. there is available a first-rate stereo decoder which is simple to apply even if highly sophisticated in design.

The unit is supplied in a 16-pin quad-in-line plastic package, i.e. differing from the d.i.p. package in that alternate pins are displaced to provide four lines each of four pins. This facilitates the design and construction of suitable p.c. boards; it is recommended that an earth strip be left down the centre of the i.c., screening contacts on one side of the i.c. from those on the other. However, no difficulty should be experienced, even by the relative newcomer to construction, in achieving success with this unit. ■

GOING BACK...

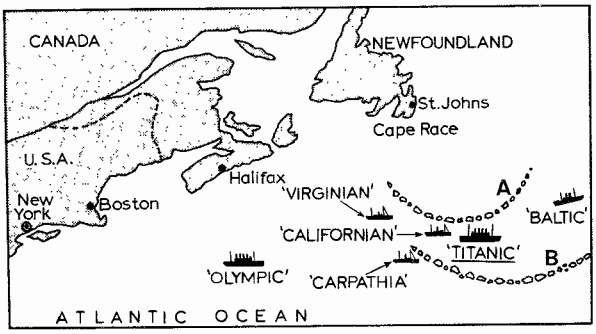


COLIN RICHES
ARTHUR DOW

TITANIC DISASTER - PART 2

Mr. Cyril Evans, examined by the Solicitor-General at the Court of Enquiry on the disaster, stated that he was the sole Marconi operator in the *Californian*. At 5.35 p.m. New York time, or 7.30 ship's time, he received a message from the steamship *Antillian* that an hour before she had seen three large icebergs to the southward. A little later he heard from the *Titanic* and offered her the report about the ice, and she replied, "All right, I heard the same thing from the *Antillian*". At 9.5 New York time, or 11 o'clock ship's time, the captain directed him to tell the *Titanic* that the *Californian* was stopped and surrounded by ice. He sent the message to the *Titanic* and got the reply, "Keep out." That was because the *Titanic* was at that moment in communication with Cape Race, and his message had caused an interruption. The *Titanic*, however, must have heard what he had said about the ice, because his signals were much stronger than the Cape Race signals. He next heard the *Titanic* say to Cape Race, "Sorry, please repeat". The messages from the *Titanic* to Cape Race were private messages from the passengers.

Mr. John Durrant, Marconi operator of the *Mount Temple*, was another witness. In reply to the Solicitor-General, he stated that the range of his wireless installation was 150 miles by day and 200 miles by night. On the evening of Saturday, April 13th—the day before the foundering of the *Titanic*—he got an official message from the captain of the *Mount Temple* that ice had been seen. This was the only message he received in regard to ice before the wreck.



Map showing the approximate positions of the Titanic and other ships.

The witness then proceeded to give from his log-book the various calls he heard sent by the *Titanic* and the replies to them by ships which they reached.

The first thing he heard of the *Titanic* was at 11 minutes past 12 o'clock (ship's time) on Sunday night, when he got the message "C.Q.D." from the *Titanic*, giving her position, and adding, "Come at once. Struck berg. Advise captain." He told his captain at once. After the lapse of ten minutes he had the entry, "*Titanic* still calling C.Q.D.", that she was asked by the *Carpathia* what was wrong, and replied, "Struck iceberg. Come to our position," which was given. At 12.26 a.m. he made the entry—"*Titanic* still calling C.Q.D." At this time the *Mount Temple* had altered her course, and was speeding to the assistance of the *Titanic*. This had been done about 15 minutes after getting the first signal. At 12.34 he heard the *Frankfurt* answering the *Titanic* and the *Titanic* giving her position to the *Frankfurt*. The *Titanic* asked, "Are you coming to our assistance?" The *Frankfurt* said, "What is the matter with you?" and the *Titanic* answered, "Have struck an iceberg. Sinking. Come to our help. Tell captain." The *Frankfurt* then said, "O.K. Will tell bridge at once", and the *Titanic* replied, "O.K. Yes. Quick." At 12.42 he heard the *Titanic calling "S.O.S."*

At a quarter to 1 o'clock he heard the *Titanic* sending out both calls. She then got into touch with the *Caronia*, and next with the *Virginian*.

The Solicitor-General then asked if Mr. Durrant had broken in and talked to the *Titanic* would he

H. T. Cottam, wireless operator on board the "Carpathia".

have interrupted her messages to other ships? Yes, I never said a word after I got her position. The first rule in wireless telegraphy is "Never Interfere".

The witness, continuing the narrative from his log-book, said the *Titanic* called the *Olympic* at 12.43 a.m. The *Olympic* replied at 1.06 a.m. and got the message, "Get your boats ready. Going down fast by the head." At 1.11 the *Frankfurt* sent a message to the *Titanic*, "Our captain will go for you". At 1.13 he heard the *Titanic* working the *Baltic*.

The witness said the *Titanic* answered the *Olympic*, "We are putting the women off in the boats". At 1.29 the *Titanic* sent out a general call. "C.Q.D. Engine-room flooded". The *Titanic* also informed the *Olympic* that the sea was clear and calm. At 1.31 he heard the *Frankfurt* say to the *Titanic*, "Are there any boats round you already?" and to this the *Titanic* made no reply. At 1.33 he heard the *Olympic* send a message to the *Titanic* asking whether the *Titanic* was steering south to meet the *Olympic* and the reply of the *Titanic* was simply the code word for "Received". That was the last message that he heard from the *Titanic*. The messages from the *Titanic* did not get fainter towards the end. When the messages ceased, he thought the flooding of the engine-room had put the wireless out of condition. Most ships, including his own, carried storage batteries for use when power could not be obtained from the dynamos, and the wireless apparatus could be changed from the dynamos to the storage batteries in a minute: but the range of a wireless using storage batteries would be less than that of a wireless using dynamos.

At 1.41 a.m. he heard the *Frankfurt* and the Russian ship, the *Birma*, calling the *Titanic* and there was no reply. At 1.56 the *Olympic*, the *Frankfurt*, and the *Baltic* called, and again there was no answer from the *Titanic*. At 2.11 the *Birma* informed the *Frankfurt* that she was 70 miles from the *Titanic*. At 2.36 he made the entry, "All quiet now. The *Titanic* has not spoken since 1.33." At 3.11 he heard the *Carpathia* say, "If you are there, we are firing rockets." At 3.26 the *Carpathia* again called the *Titanic*. At 3.44 the *Birma* told the *Frankfurt* that he thought he heard the *Titanic* and calling her, said, "Steaming full speed to you. Shall arrive 6 in the morning. Hope you are safe. We are only 50 miles away." At 3.46 he heard the *Carpathia* calling again. At 4.40 he made the entry. "All quiet. We are stopped away. Pack ice." At 5.11 the *Californian* called "C.Q.", and he answered telling her that the *Titanic* had struck an iceberg and sunk, and he gave her the position. At 5.26 he heard the *Californian* speaking to the *Frankfurt*, and she replied to the same effect. His last entry was, "8 a.m. Heard from *Carpathia* that she had rescued 20 boatloads".

Mr. John Durrant, operator on the "Mount Temple".

P.M.G. Comments

The Right Honourable Herbert Samuel, M.P., Postmaster-General, referring to the disaster at the dinner of the London Chamber of Commerce on April 18th, 1912, said:

"Those who had been saved had been saved through one man, Mr. Marconi, whose wonderful invention was proving not only of infinite social and commercial value, but of the highest humanitarian values as well." He had seen it stated that in the United States of America the efficiency of the wireless telegraphy service had been impaired by lack of regulation. He did not know whether that was well founded or not, but as Postmaster-General he could assure them that such disturbance was impossible here. Parliament had given the Postmaster-General a complete control over the use of wireless telegraphy, and no one could operate or establish a station without the Postmaster-General's licence, which was only very sparingly given, and for purposes of experiment and research and under such conditions which precluded disturbance of commercial or humanitarian messages. Round the coast, in charge of his department, there was a girdle of wireless stations which were in constant communication with the telegraphic services of the country and with the life-saving stations. No fewer than 400 liners had been equipped with wireless apparatus, including a certain number of cargo vessels. All the operators on these ships were required to hold a Post Office Certificate of Efficiency, and to answer immediately any signals of distress, and under conditions which, as far as possible, precluded interference with one another.

David Sarnoff

David Sarnoff was on duty at the Marconi Wireless Telegraph Co. of America station at Saisconset on Nantucket Island. On the night of April 14, 1912, he picked up the messages that told of *Titanic's* distress signals and he stayed on duty continuously for 72 hours so that he could relay messages from the rescue ship to the rest of the world.

Brig. General David Sarnoff, born in a small village near Minsk in Russia, in 1891, and former Chairman of the Board of R.C.A. passed away on December 12th, 1971.

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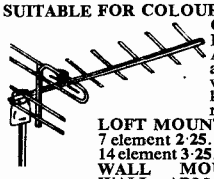

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★100 watts continuous sine wave output into 8 ohms.
★4 high impedance inputs, allowing mixing facilities for all types of equipment to match any signal.
Input 1 250mV } Suitable for crystal or ceramic
Input 2 100mV } cartridge radio tuner, etc. Input impedance 500K.
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Input 4 5mV } Input impedance 100K.
★Separate volume controls on each input.
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★Short and open circuit protection on output stage
★Standard 240V–120V mains operation.
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50 WATT ALL-PURPOSE AMPLIFIER

★50 watts continuous sine wave output into 8–15 ohms.
★One dual input high gain channel with individual volume control, matches any mic, guitar, etc. Sensitivity 5mV into 500K.
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Find buried treasure with this READY BUILT & TESTED
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ONLY **£4·95**

FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. Signals exact location by "beep" pitch increasing as you near buried metallic objects. *So sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND!** GIVES CLEAR SIGNAL ON ONE COIN! **£4·95** + 30p carr. etc. (High quality Danish Stethoscope headphones **£2·75** extra if required.) **EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.**

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This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC.** *Extremely sensitive, will signal presence of certain objects buried several feet below ground* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody rom nine years of age upwards,* with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2·85** + 25p p. & p. (Sectional handle as illustrated 95p extra). Parts available separately. Made up looks worth £15!

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CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design — the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering.

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Amazing Radio Construction set! Become a radio expert for **£2·45.** A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all you need. Presentation box **45p extra** as illus. (if required) (parts available separately) no soldering necessary. **Send £2·45** + 20p p. & p.

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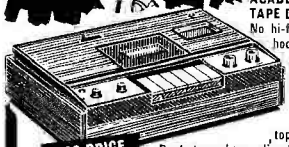
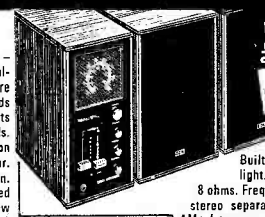


ACADEMY STEREO CASSETTE TAPE DECK. MODEL CS-2000D

No hi-fi system is complete without one – hook it up to any ROC or other good quality amplifier, and the results are fantastic! The CS-2000D records and plays back. A big feature is its easy-to-use piano-key controls. Easy-to-get-at mic inputs are on top: line inputs and outputs at the rear. Dual-channel recording level meter. Pop-up cassette ejection. Stereo/Mono button. Tape counter. Pause control. Tape speed 1⅞ ips (4·75 cms). Frequency response 100–10,000 Hz. Wow and flutter better than 0·3%. Rewind time better than 60 sec with C60 cassette. Engineered throughout to the highest electrical and mechanical standards. Size 18" wide, 4½" high and 8" deep. Walnut cabinet with satin aluminium trims.

ROC PRICE £42.00
Including two pencil microphones and all connecting leads
Normal Price £65·00



ROC PRICE £70.99
Including connecting leads
Normal Price £115·00

REALISTIC HI-FI 36-WATT STEREO CONCERTMASTER FM-AM RECEIVER SYSTEM. MODEL 12-694

Brilliantly designed tuner/amplifier with two matching speakers. All three units in beautifully finished walnut cabinets with smart aluminium vertical trims. The tuning dial is fronted by unique black glass. Figures light up behind it in green when the unit is on. Separate easy-to-operate Left and Right volume controls. Microswitch for on/off. Programme selector. Separate bass and treble controls. Headphone socket on front panel for easy access. Single tuning knob for FM and AM. Built-in aerials, facilities for external FM aerial. Illuminated dial. Stereo broadcast indicator light. Each speaker has 6½" bass and 3" treble units. Output: 9 watts r.m.s. per channel into 8 ohms. Frequency response: 30 to 20,000 Hz. FM: frequency range 80-108 MHz, sensitivity 2·5µV, stereo separation 30dB, image rejection 40db. AM: frequency range 530-1605 kHz, sensitivity 100µV. Sizes: speakers 8" wide, 12" high and 9¾" deep; receiver 6" wide, 12" high and 9¾" deep. And their sophisticated appearance matches the excellence of the specification.

REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500

A superb hi-fi amplifier with all the features you've ever wanted – for under £46·00. Saving over £10·00 on the normal retail value. Up-to-the-minute slider controls for bass and treble. Separate volume and balance controls. Headphone socket on front panel. Push-button input controls – magnetic phono (high/low) tuner, aux, mono, monitor. Loudness push-button control for perfect sound at low output levels. Left and right push-button on/off switches for speakers. Noise filtering and tape monitoring facilities. Two auxiliary AC outlets. Frequency response 20-20,000 Hz ± 1 db at full power. 15 watts rms per channel. Walnut cabinet with satin aluminium trims. Inputs: phono 2·5mV and 5mV RIAA: tuner/aux 250mV. Hum and noise: phono – 50db; tuner/aux – 65db. How's that for a specification! Size 14½" wide, 3½" high, 10½" deep.

ROC PRICE £35.20
Normal Price £55·50

ROC PRICE £59.55
Normal Price £95·00

8-TRACK STEREO CARTRIDGE TAPE DECK MODEL RP-1000ST

The popular Lear-Jet type recording unit is the heart of the fantastic RP-1000ST, which has full record and playback facilities. Automatic track change with manual override. Press to start button. Stereo headphone and Left and Right Mic sockets on front panel. Dual recording level meter, and Left and Right volume controls. Built-in pre-amp. Tape speed 3¾ ips (9·5 cms). Frequency response: playback 30-10,000 Hz; recording/playback 30-8,000 Hz. Line output: fully variable 0-500mV. The RP-1000ST incorporates all the features you'd expect in a top quality Cartridge Tape Deck. Size 16" wide, 4" high, 9" deep. Cabinet in walnut. Including connecting leads

ROC PRICE £27.25
Normal Price £39·95 each.

25-WATT 3-WAY CRYSLER 'LIVING AUDIO' SPEAKER CE-5b

This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units an 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r.m.s into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10½" × 7½" × 8¾". Exactly right for matching the most modern decor.

OLSON RA-310 AM/FM/MPX STEREO TUNER

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as it's good looking design! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10·00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz; AM: 525-1605 kHz. FM Sensitivities: FM, 3µV; AM, 250µV. Stereo separation 30dB at 1kHz, image rejection 60dB. Size: 11⅞" wide, 4" high, 7½" deep.

ROC PRICE £31.20
Normal Price £50·00

ROC PRICE £27.55
Normal Price £42·

PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16

This is one of the lowest priced stero tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received – that's the time to switch to 'Stereo'! The SSA-16 has all the facilities you'd expect to find on tuners costing twice as much – separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz, AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4½" high, 6" deep.

ROC PRICE £31.20
Normal Price £49·00

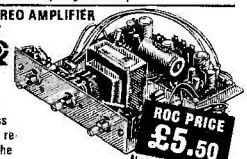
8-TRACK HOME STEREO CARTRIDGE PLAYER MODEL E1

With this unit, you can play any standard 8-track cartridge on the market – at a fraction of the normal retail value! It gives you a total of 5 watts of power, to feed into two 8-ohm speakers. The frequency response is 50 to 10,000 Hz, giving you a fine tonal quality that can't be bettered at anything near this price. The E1 has separate tone, balance and volume controls, giving you complete freedom to select the sound you want to hear. Tape speed is 3¾ ips, and wow and flutter are both less than 0·3%. Size: 11½" wide, 5" high, 11" deep.

REALISTIC SA-100B 6-WATT STEREO AMPLIFIER

Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide × 3" high × 5¾" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/tuner and power on/off slide switches. The ends are oiled walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

ROC PRICE £12.45
Normal Price £21·00



ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317

This exclusive ROC Stereo Chassis is completely self-contained, and it costs £2·25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5½" wide, 1¾" high and 6¾" deep. It contains its own mains power supply, and has a ganged tone control and separate volume controls for each channel. Specification: frequency response 40-17,000 Hz ± 3dB; output 3·5 watts music power per channel into 8 ohms; input, phono, 600mV; signal-to-noise ratio better than 45dB.

ROC PRICE £5.50
Normal Price £7·75

REALISTIC TM-100 AM/FM/MPX STEREO TUNER

Here's another unit that gives you fabulous value in miniature! Designed specifically to match the Realistic SA-100B in both appearance, size and performance, the TM-100 is superb value-for-money. It gives you the full FM and AM ranges – FM, 88-108 MHz; AM, 535-1605 kHz. Sensitivities FM 5µV; AM 250µV. Image rejection 50dB.

ROC PRICE £17.55
Normal Price £28·60

ROC PRICE £17.80
Normal Price £25·00 per pair.

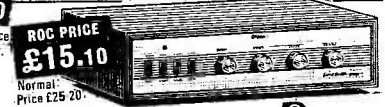
R.446 3-WAY MATCHEO SPEAKERS

These will do justice to your amplifier – and to your pocket. At only £17·80 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 16 watts rms (8 watts rms each). Each loudspeaker contains a large dual cone base unit, plus a separate tweeter. Frequency range: 40 to 19,000 Hz. Size 14" high, 9" wide, 6½" deep.

OLSON AM-395 40-WATT STEREO AMPLIFIER

An ideal unit for your new stereo separate system. It is more than £10·00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3·0mV RIAA, crystal phono 100mV; tape 160mV; tuner 160mV. Size 11⅞" wide, 4" high, 7½" deep. The specification reads well – sounds even better!

ROC PRICE £24.10
Normal Price £39·60



ROC PRICE £15.10
Normal Price £25·20

OLSON AM-372 16-WATT, STEREO AMPLIFIER

Here's a really good amplifier at a really down-to-earth price – nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you – reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r.m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12½" wide, 3½" high, 7½" deep.

OLSON AM-357 4-WATT STEREO AMPLIFIER

Here's marvellous value for someone just starting to set themselves up in audio! At only £9·00 you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminum front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 70-20,000 Hz ± 3dB. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV; tuner/aux 80mV. Size 8" wide, 2⅞" high, 4½" wide.

ROC PRICE £9.00
Normal Price £14·70

units at lowest prices?"...

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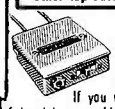
Every item shown here is the best of its kind within its price range. Buy them separately or at the same time as the other top-value audio products listed.

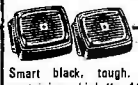
R.328 STEREO HEADPHONE If you're starting in hi-fi, and you discover the need for a pair of really good stereo headphones, The R.328 is ideal, at a price you can afford. They have padded ear cushions, a 6-foot cord and jack plug. Frequency range 30-15,000 Hz. Impedance 8 ohms per channel. **ROC PRICE £2·95**

EAGLE SE-30 STEREO HEADPHONE This model is for the more discriminating listener. For a start the frequency range extends from 30 to 16,000 Hz. And you can adjust the volume of each earpiece independently. There's also a mono/stereo switch. For maximum comfort, the ear cushions are covered in soft leathers. **ROC PRICE £7·05**



R.186 STEREO HEADPHONE JUNCTION BOX If you want easy, fingertip control of headphones *and* loudspeakers, here's the ideal solution to the problem. All you do is connect it to your speakers and amplifier, plug in your headphones - and you're ready to take over! At the flick of a slide switch, you can have headphones alone, or speakers alone, or both together. Input: suitable for use with amplifiers rated up to 20 watts. Size: 2¾"×3⅛"×1⅞". **ROC PRICE £1·50**

TEC HR-007 HEADPHONE RADIO When you want to listen to the radio all by yourself. Then this will solve the problem. Separate volume and tuning controls with easy-to-use knobs. Frequency range is 535 to 1605 kHz medium wave band. Maximum output is 300 mW. Normal Price £9·45 **ROC PRICE £5·80**



R.151 STEREO CAR SPEAKERS Smart black, tough, plastic cases, each containing a high flux 110mm diameter speaker unit. Just what you need to go with the CS.8 Cartridge Player or any other car stereo system. Fitted with over three yards of connecting cable. Dimensions: 6½"×5¾"×3⅛". Impedance: 8 ohms per speaker. Rating: 5 watts max per speaker. **ROC PRICE £3·72**

EAGLE 8-TRACK CAR STEREO PLAYER. CS.8 Drive to the sound of music – with this fabulous 8-Track Cartridge Player. It gives you superb tone and power to fill the car with stereo sound. Ideal for use with R.151 or R.152 speakers. Complete with all mounting accessories. For negative earth electrical systems only. Output: 2·5 watts per channel. Frequency range: 70-10,000 Hz. Wow and flutter: less than 0·3%. Tape speed: 3·5 cm/sec. Channel selector: automatic with manual over-ride. Mounting dimensions: 5¾"×5½"×2½" **ROC PRICE £27·20**

R.152 STEREO CAR SPEAKERS These sloping front speakers match the CS.8 Cartridge Player or any other car stereo system. Fitted with high flux 110mm diameter speaker unit, and over three yards of connecting cable. Dimensions: 6½"×6¾"×3⅜". Impedance: 8 ohms per speaker. Rating: 5 watts max. per speaker. **ROC PRICE £4·96**

EAGLE LC.05 STEREO MAGNETIC CARTRIDGE For fabulous reproduction at a very low price, you'll find it hard to beat. 0·7 mil diamond stylus. Output: 6mV per channel. Frequency range: 30-18,000 Hz. Channel balance: ±1·5dB. Channel separation: 20dB. Recommended stylus pressure: 2-4 grams. Compliance: 9×10·6 cm/dyne. **ROC PRICE £4·75**

"WATTS" RECORD CLEANERS The original "Dust Bug" Automatic Record Cleaner keeps your records clean as they play. **£1·20** Watts Disc Preener. Keeps new records like new – for perfect record reproduction. **35p**

EAGLE LC.07 STEREO MOVING-MAGNET CARTRIDGE Here's your opportunity to own a transcription cartridge for the price of a ceramic! Is specially designed to match top quality tone arms, and to get the very best from your hi-fi amplifier. 0·7 mil diamond stylus. Output: 7mV per channel. Frequency range: 20-21,000 Hz. Channel balance: ±1dB. Channel separation: 28dB. Compliance: 12×10·6 cm/dyne. **ROC PRICE £6·37**

R.307 TRANSISTORIZED STEREO PRE-AMPLIFIER Now your amplifier that could only reproduce ceramic or crystal pick-up cartridges, can accept signals from moving-magnet cartridges! The R.307 steps up signals from between 5-20mV to 200-800 mV. Input: 5-20mV. Equalisation: RIAA. Output: 200-800mV flat. Frequency range: 20-22,000 Hz. Dimensions: 3¾"×1¾"×2⅞". Supply: 240 VAC. **ROC PRICE £4·92**

R.088 MATCHED STEREO LOUDSPEAKERS Here's real value in stereo speakers! Each unit comes complete with 10-foot lead and phono plug, and look really smart. Power handling per speaker: 4 watts rms, 8 watts peak. Frequency range: 40-16,000 Hz. Flux density: 8,500 gauss. Impedance: 8 ohms. Dimensions: 9" high, 5½" wide, 4¾" deep. Finish: oiled walnut. **ROC PRICE £9·50 pair**

15-FOOT STEREO HEADPHONE EXTENSION CORD R.362 Fitted with heavy duty 3-circuit stereo plug at one end and a matching stereo socket at the other. **ROC PRICE £1·30**

STEREO HEADPHONE "Y" ADAPTOR R.361 Enables you to use two sets of stereo headphones from a single socket. Fitted with male plug and two female sockets. **ROC PRICE £1·30**

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A-3000 36-WATT SOLID STATE STEREO AMPLIFIER The A-3000 looks as good as it sounds! Giving you a big performance this superb audio amplifier has a full range of facilities on the front and rear panels. On the front – all the controls you're ever likely to need plus a headphone socket. On the rear – signal inputs, speaker outputs and a line fuse for circuit protection. Specifications: 18 watts rms per channel into 8 ohms. Frequency response 20-35,000 Hz (± 2db) Inputs Magnetic, Ceramic, Tuner, Tape, Aux. Tape Play. Size: 345mm × 300mm × 130mm. Normal Price £30·70. **ROC PRICE £28·00**

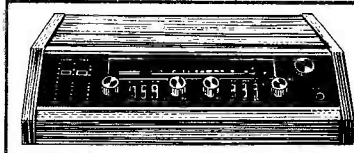
SAQ-501 50-WATT SOLID STATE STEREO AMPLIFIER A really powerful unit with all the facilities you need for home entertainment – inputs for magnetic cartridge, tape, radio tuner and auxiliary. Controls for bass, treble, balance and volume. Headphone socket on the front panel for easy access. Loudness switch. Rumble and scratch filters. Specifications: 25 watts rms per channel into 8 ohms. Inputs Magnetic, Tuner, Tape/Aux. Tape play. Frequency response 20-20,000 Hz (± 1db). Size: 333mm × 102mm × 285mm. Normal Price £33·60. **ROC PRICE £26·40**

A - 5000 60 - WATT SOLID STATE STEREO AMPLIFIER With the A-5000, you're in the big-sound class – 30 watts rms per channel into 8 ohms! The circuit is all-silicon-transistor, giving you top quality sound and a mere 0·2% distortion at 25 watts output. And optimum stereo input balance is derived from the use of an IC (integrated circuit). There's no need to worry about overload or short-circuiting the output – the A-5000 has built-in protection. Specifications: 30 watts rms per channel into 8 ohms. Frequency response 15-40,000 Hz (± 2db) Inputs Magnetic, Tuner, Tape/Aux, Tape Play. Normal Price £43·40. **ROC PRICE £34·00**

R-200 20-WATT AM/FM/MPX STEREO TUNER AMPLIFIER What more could a hi-fi enthusiast want! The R-200 gives you top quality reproduction of both AM and FM programmes, including all the stereo broadcasts now available on FM. And you have built-in facilities for recording your favourite programmes on an external tape recorder. The front panel is carefully designed, with the latest slider controls for bass, treble, volume and balance. Alongside the dial are a meter for accurate tuning and a stereo indicator lamp that automatically lights up when you're tuned in to a stereo signal. Dozens of other brilliant facilities including main and remote speaker terminals. Specifications: 10 watts rms per channel into 8 ohms. Frequency response: 25-40,000 Hz (± 2db) Inputs: Magnetic, Ceramic, Tape, Aux. Tape Play. Size: 398mm × 267mm × 106mm. Normal Price. £50·00. **ROC PRICE £42·00**

R-150 12-WATT AM/FM/MPX STEREO TUNER AMPLIFIER You couldn't get better value-for-money in Stereo Tuner Amplifiers anywhere! Just look at all the facilities the R-150 gives you – bass, treble, balance, volume, switchable AFC for drift-less reception on FM, socket for headphones on the front panel. A tuning meter. Stereo indicator. Tape output, so that you can record your favourite programmes. To name but a few. AM section covers the medium waveband – 535-1605 kHz, and the FM band 88-108 MHz. Specifications: 6 watts rms per channel into 8 ohms. Frequency response: 40-20,000 Hz (± 2db) Inputs: Magnetic, Ceramic, Aux. Size: 107mm × 385mm × 263mm. Normal Price £38·30. **ROC PRICE £29·90**

D-4008 STEREO CASSETTE DECK Precision engineered for trouble-free performance, this Stereo Cassette Deck has a fantastic range of facilities, making it a real value-for-money unit. Left and right level meters for recording, the latest slider controls for record level, switchable playback noise filter, aux/mic switch, mic input sockets, piano-key controls for record, rewind, play, fast-forward, and stop/eject. Index counter with reset button. Specifications: Frequency response: 35-12,000 Hz. Wow and flutter less than 0·25%. Inputs: Mike, Aux. Din Socket. Size: 345mm × 300mm × 100mm. Normal Price £39·50 **ROC PRICE £34·00**



MR-15 AM/FM/MPX STEREO TUNER AMPLIFIER Here's a beautifully styled AM/FM Stereo Tuner Amplifier. Featuring FET (Field Effect Transistor) front end FM tuner, and dual-channel IC equalizer for perfect balance, the MR-15 incorporates professional style vertical sliding controls for bass and treble. All the input/output facilities you need. Covers FM 88-108 MHz, AM 535-1605 kHz. Output 16 watts rms per channel into 8 ohms. Inputs Magnetic, Tape, Aux, Tape Play. Size: 467mm × 458mm × 130mm. Normal Price £67·60. **ROC PRICE £54·00**

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EBC41	52p	EL42	58p	PCL83	65p
ECC81	30p	EL84	25p	PCL84	42p
EBF80	42p	EL85	43p	PCL85	42p
EBF83	42p	EL86	40p	PCL86	42p
EBF89	30p	EL90	35p	PFL200	66p
ECC81	30p	EL95	35p	PL36	53p
ECC82	28p	EL500	85p	PL81	50p
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CARTRIDGES. All with standard fittings and stylii. Stereo-compatible Mono GP91/SC **£1·10**; STEREO GP93 **£1·40**; Stereo Ceramic GP94 **£1·95**. (All at 6p each.) Comparatives shown in List, with more types incl. Sonotone 9TAHC, Stereo Ceramic Diamond **£1·97½** (6p) **DIAMOND STYLII:** single tip types: Acos GP37, GP59, GP65/67, GP71, BSR TC8/LP/ST; COLLARO O. P and DC284, GARRARD GC2, GC8, GCS10,GCE12, RONETTE BF40, O, P. and T. PHILIPS 3501 (3060, 3066, 3302, 3304), 3010/12/13/16, SONOTONE 19T/20T ALL AT **40p** each (6p). SAPPHIRE **17½p** (6p). Double-tip turn-over types (78 sap. on other side). For ACOS GP73, GP91 (for cartridges GP93, GP94 etc.) GP91SC (for stereo-compat. types) GP104 BSR ST4 (ST3, ST5), ST9, (ST8). ST12/14/15. SONOTONE 8TA, 9TA, 9TAHC. PHILIPS 3306 (3310, 3224, 3228/22, GP280). GARRARD GCM21, 22, GCS23, GKS25 and 26, GCM21T and 22T, GKM24T, GCS23†, GKS25TS, & 26T, GCM31, GC36, GCS35, GCS38, KS40A, KS41B ETC. ALL AT **75p** (6p). SAPPHIRE **35p** (6p). **DOUBLE DIAMOND STYLII:** (Same dia. tip each side: no 78) All types **£1·50** (6p). SAPPHIRE DOUBLE ST/LP, TIPPED **40p** (6p). **PICK-UP WIRE:** Super thin twin flex screened, sheathed, **6p** per yard (Up to 6 yds., 6p over charges paid).

MICROPHONES: CRYSTAL: LAPEL 1½″, chip/hand, lead 3·5mm jack plug **32½p** (7½p). CM20 Cream Plastic hand **52½p**; "STICK" 60 **£1·02**; CM70 "PLANET" Metal, tapered, with neck cord, adaptor for stand **£1·47½**; "MIC 91" hand/desk **81p**; "MIC 45" Curved metal hand grip **£1·00**. ALL with leads (all 9p). MICROPHONE INSERTS: 0·9″ **27½p** (Up to 6 for 6p). DYNAMIC: 209 Cardioid Ball. 50K/600Ω built-in volume control, on/off switch, special 20ft. lead, the best value anywhere at **£6·30**; UD130, uni-dir. mesh ball 50K/600Ω jack plug, cable, adaptor, **£4·80**: DM160, omni-dir. Ball mesh. 50K, cable adaptor jack plug **£3·87½** 27½p each). **SPEAKERS.** Very popular 12″ ROUND, fitted tweeter, 3 or 15 ohms (state which) **£1·87½** (27½p)—or pair for stereo **£4·25**, charges paid. **SMALL** 2½″ 3Ω or 8Ω, (state which) **37½p** (6p). More speakers in List. **HEADPHONES:** High resistance 2000Ω adjustable: **92½p** (10½p). **EARPIECES.** With lead and min. 2·5mm or 3·5mm (state which) jack plug, MAGNETIC **9p.** CRYSTAL (3·5mm plug only) **24p** (Up to 3 for 6p any type). **SOLDERING IRON.** Slim, modern, British high speed. 8½″, all parts replaceable, highest quality fully guaranteed **£1·17½** (10p). **TRANSFORMERS:** Sub-min 11×11×12mm, OUTPUT (3Ω for OC72, etc.) **14p** or DRIVER **15p** (Up to 12 for 6p). **CONNECTING WIRE.** Packs of 5 coils, each coil 5 yds. asstd. cols. SOLID CORE **14p.** FLEXIBLE or SUPER THIN for transistor wiring, etc. either **16p** (Any pack 8p), **RETRACTABLE FLEXIBLE LEADS.** (CURLIES): With phono plug, each end, 6ft **23p.** 12ft **39p.** With phono plug/phono socket other end 6ft. **25p.** 12ft. **42½p** (6p lead any type). **VIBRATORS.** 12v/4 pin non-synch 121HD4, 2½″ ex. pins, **27½p.** SAME but 3½″ ex pins, USA, **20p.** 12v/7 pin, synch. (128R7) 2½″ ex pins, **62½p** (6½p any type). **TRANSISTORS,** etc. AC/126 **12½p,** AF115 **20p,** AF116 **15p,** AF117 **20p,** OA5 **10p,** OA10 **10p,** OA81 **10p,** OC44 **14p,** OC45, OC71, OC72, OC75, OC81D, OC82D, all at **12½p** each, OC81 **15p.** OC170 **20p,** OC171 **12½p,** BY100/800 piv **14p.** Many more incl. power types thyristors, etc. in List **(6p** up to 12). **MAINS NEONS,** fly leads **10p. NEON SCREWDRIVER** (pocket tester) **17½p (6p** either). **MAINS BATTERY ELIMINATOR.** Input 240v-AC. Output 3, 4½, 6, 7½, 9 and 12 volt D.C. by switch selector. On/off switch, pilot lamp, leads, plug, plug to suit most cassette recorders. **£3·75** (25p).

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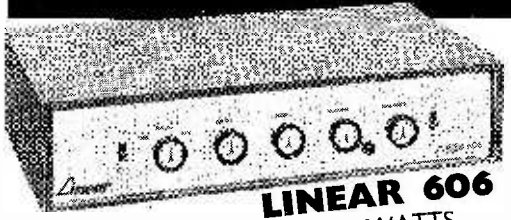

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6+6 WATTS

0-200-230-250v. 50 Hz A.C. mains operation. Inputs for magnetic or Ceramic Pickup, Tape or Radio Tuner.

Recommended Retail Price

£22·50

TECHNICAL DETAILS

Bass Control ± 12 dB at 40 Hz.

Treble Control ± 12 dB at 14 KHz.

Sensitivities Mag. P.U. 3·5 m.v. into 47K ohm R.I.A.A. Ceramic P.U. 35 m.v. into 100K ohm. Tape Amp. 100 m.v. into 100K. Radio Tuner 400 m.v. into 400K ohm.

Crosstalk 53 dB.

Hum and Noise—75 dB min. vol.—65 dB max. vol.

Total Harmonic Distortion 0·1% at 1watt into 15 ohms.

Output (per channel) 6·5 watts I.H.F.M.

★ Individual Bass and Treble Controls.
★ Frequency Response ± 1½ dB 20 Hz to 65 KHz.
★ Outputs for Speaker impedances between 3 and 15 ohms.
★ Stereo/Mono Switch.
★ Input Selector Switch.
★ Solid State Circuitry.
★ Attractive silver finished metal facia and matching control knobs.

LINEAR 505

5+5 WATTS

Recommended Retail Price

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0-200-250v. 50 Hz A.C. mains operation

★ A modestly priced solid state unit.
★ The Silver Facia with black lettering enhanced by matching control knobs, provides a high standard of appearance.
★ Suitable for crystal or ceramic Gram. Pick-up cartridges, and Radio input.
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★ A selector switch permits instantaneous selection of Gram. or Radio.
★ Speaker impedances between 3 and 15 ohms are suitable.

TECHNICAL DETAILS

Frequency Range 20 Hz to 20 KHz

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Treble Control ± 14 dB. at 14 KHz.

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ECC81	10p	PL81	17p	20D1	10p
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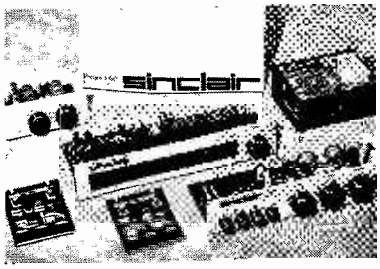

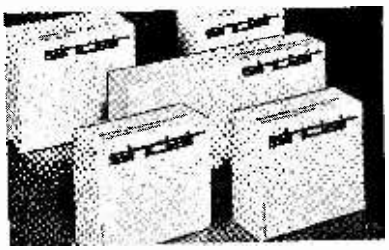

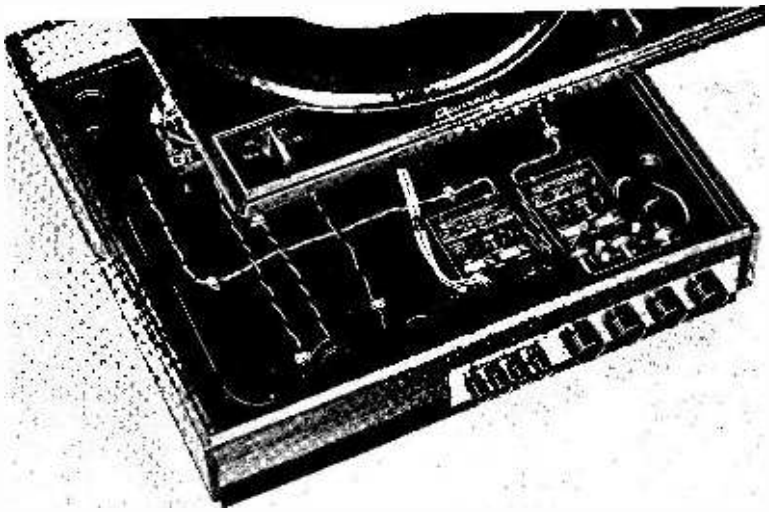

Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.
Performance characteristics are so good they hold their own with any other available system irrespective of price or size.
Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

Typical Project 60 applications

System	The Units to use	together with	Cost of Units
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control etc.	**£9.45**
20+20 W. stereo amplifier for most needs	**2 x Z.30s, Stereo 60, PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
20+20 W. stereo amplifier with high performance spkrs.	**2 x Z.30s, Stereo 60, PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
40+40 W. R.M.S. de-luxe stereo amplifier	**2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. Filter Unit **(£5.98)** may be added as required.

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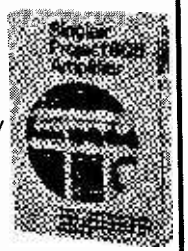
Project 605

The easy way to buy and build **Project 60**



Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

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Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 7μV for lock-in over full deviation. **Squelch level:** 20μV. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10 Hz – 15 KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC.
Indicators: Stereo on ; tuning. **Size:** 93 x 40 x 207mm.

Stereo 60 Pre-amp/control unit

Built, tested and guaranteed. **£9.98**

Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A curve ±1dB :20 to 25,000 Hz. Ceramic p.u. – up to 3mV : Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE + 12 to —12dB at 10 KHz : BASS + 12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

A.F.U. High & Low Pass Filter Unit

Built tested and guaranteed. **£5.98**

For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (—3dB) variable from 28KHz to 5KHz. L.F. cut-off (—3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply) 0.02% at rated output. **Size:** 66 x 40 x 90 mm.

Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual. **Z.30 £4.48** **Z.50 £5.48**

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).***

Power Outputs
Z.30 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms using 50 volts.
Frequency response: 30 to 300,000Hz ±1dB.
Distortion: 0.02% into 8 ohms.
Signal to noise ratio: better than 70dB unweighted.
Input sensitivity: 250mV into 100 Kohms (for 15w into 8Ω)
For speakers from 3 to 15 ohms impedance.
Size: 14 x 80 x 57 mm.

Power Supply Units

Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ.5 *30 volts unstabilised* **£4.98**
PZ.6 *35 volts stabilised* **£7.98**
PZ.8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ.8 *mains transformer* **£5.98**

Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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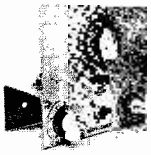

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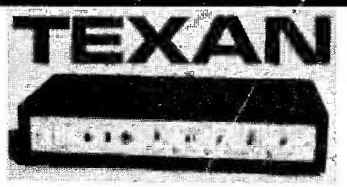

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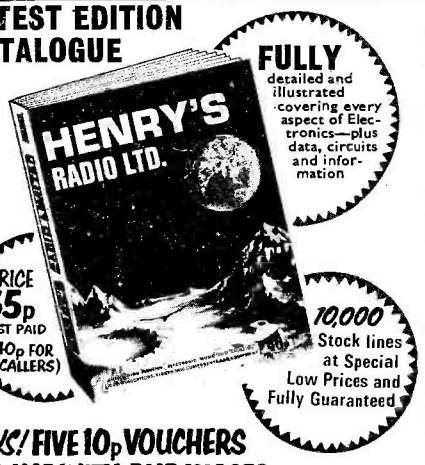

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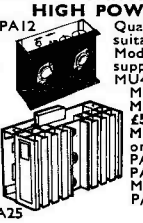

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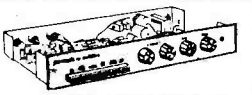

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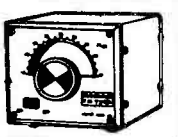

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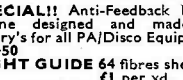

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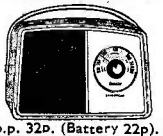

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