PRACTICAL

ELECTRONICS

NOVEMBER 1971 20p

P.E. SCORPIO

CAR IGNITION

SPECIAL AUDIO FEATURE

LOUDSPEAKER SYSTEMS

...DRIVE UNITS...ENCLOSURES...

The largest selection

NEW LOW PRICE TESTED S.C.R.'s

PIV	1A TO-5	3A TO-66	7A TO-66	10A	16A TO-48	30A TO-48
	£p	£p	£p	£p	£p	£p
50	0·23	0·25	0·47	0·50	0·53	1·15
100	0·25	0·33	0·53	0·58	0·63	1·40
200	0·35	0·37	0·57	0·61	0·75	1·60
400	0·43	0·47	0·67	0·75	0·93	1·75
600	0·53	0·57	0·77	0·97	1·25	—
800	0·63	0·70	0·90	1·20	1·50	4·00

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
	£p	£p	£p	£p	£p	£p	£p
50	0·04	0·05	0·05	0·07	0·14	0·21	0·47
100	0·04	0·06	0·05	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·23	0·34	0·45	1·85
800	0·10	0·17	0·13	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·15	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·33	0·57	0·75	—

TRIACS

VBOM	2A TO-1	6A TO-66	10A TO-88
	£p	£p	£p
100	0·50	0·63	1·00
200	0·70	0·90	1·25
400	0·90	1·00	1·60

LUCAS SILICON RECTIFIERS

35 amp. 400 P.I.V. Stud type. £1·10 each.

DIACS

FOR USE WITH TRIACS
BR100 . . . . 37p each

2A POTTED BRIDGE RECTIFIERS 200V 50p

UNIJUNCTION

UT46. Eqvt. 2N2646, Eqvt. TI843. BEN3000 27p each, 25–99 25p 100 UP 20p.

AD161 NPN AD162 PNP

MATCHED COMPLEMENTARY PAIRS OF GERM. POWER TRANSISTORS. For mains driven output stage of Amplifiers and Radio receivers. OUR LOWEST PRICE OF 63p *PER PAIR*

NPN SILICON PLANAR BC107/8/9, 10p each; 50–99, 9p; 100 up, 8p each; 1,000 off, 7p each. Fully tested and coded TO-18 case.

FREE

One 50p Pak of your own choice free with orders valued £4 or over.

2N3055 115 WATT SIL. POWER NPN OUR PRICE 63p EACH

AF239 PNP GERM. SIEMENS VHF TRANSISTORS. RF MIXER & OSC. UP TO 900 MHZ. USE AS REPLACEMENT FOR AF139-AF186 & 100's OF OTHER USES IN VHF. OUR SPECIAL LOW PRICE:—1-24 37p each, 25–99 34p each 100 + 30p each.

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-33V. 400mV (DO-7 Case) 13p ea. 1½W (Top-Hat) 18p ea. 10W (SO-10 Stud) 25p ea. All fully tested 5% tol. and marked. State voltage required.

FET'S

2N 3819 . . . . 35p
2N 3820 . . . . 93p
MPF105 . . . . 40p

BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed

Pak No.			EQVT
T1	8	2G371A	OC71
T2	8	2G374	OC75
T3	8	2G3744A	OC81D
T4	8	2G381A	OC81
T5	8	2G382T	OC82
T6	8	2G344A	OC44
T7	8	2G345A	OC45
T8	8	2G378	OC78
T9	8	2G399A	2N1302
T10	8	2G417	AF117

All 50p each pak

CADMIUM CELLS

ORP12 43p
ORP60, ORP61 40p each

PHOTO TRANS.

OCP71 Type. 43p

2N2060 NPN SIL. DUAL TRANS. CODE D1699 TEXAS. Our price 25p each.

SIL. G.P. DIODES

		£p
300mW	30 . .	0·50
40PIV (Min.)	100 . .	1·50
Sub-Min.	500 . .	5·00
Full Tested	1,000 . .	9·00

Ideal for Organ Builders.

120 VCB NIXIE DRIVER TRANSISTOR. Sim. BSX21 & C407, 2N1893 FULLY TESTED AND CODED ND120. 1-24 17p each. TO-5 N.P.N. 25 up 15p each.

D13D1 Silicon Unilateral switch 50p each. A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5p each. Any Qty.

EX-EQUIPMENT MULLARD

AF117 transistors. Large can 4 leads type. Leads cut short but still usable, real value at 15 for 50p.

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS

NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		£p
U1	120 Glass sub-min. general purpose germanium diodes	0·50
U2	60 Mixed germanium transistors AF/RF	0·50
U3	75 Germanium gold bonded diodes sim. OA5, OA47	0·50
U4	40 Germanium transistors like OC81, AC128	0·50
U5	60 200mA sub-min. Sil. diodes	0·50
U6	30 Silicon planar transistors NPN sim. BSY95A, 2N706	0·50
U7	16 Silicon rectifiers Top-Hat 750mA up to 1,000V	0·50
U8	50 Sil. planar diodes 250mA, OA/200/202	0·50
U9	20 Mixed volts 1 watt Zener diodes	0·50
U11	30 PNP silicon planar transistors TO-5 sim. 2N1132	0·50
U13	30 PNP-NPN sil. transistors OC200 & 28104	0·50
U14	150 Mixed silicon and germanium diodes	0·50
U15	25 NPN Silicon planar transistors TO-5 sim. 2N697	0·50
U16	10 3-Amp silicon rectifiers stud type up to 1000 PIV	0·50
U17	30 Germanium PNP AF transistors TO-5 like ACY 17-22	0·50
U18	8 6-Amp silicon rectifiers BYZ13 type up to 600 PIV	0·50
U19	25 Silicon NPN transistors like BC108	0·50
U20	12 1·5-Amp silicon rectifiers Top-Hat up to 1,000 PIV	0·50
U21	30 A.F. germanium alloy transistors 2G300 series & OC71	0·50
U23	30 Madt's like MAT series PNP transistors	0·50
U24	20 Germanium 1-Amp rectifiers GJM up to 300 PIV	0·50
U25	25 300Mc/s NPN silicon transistors 2N708, BSY27	0·50
U26	30 Fast switching silicon diodes like IN914 micro-min	0·50
U28	Experimenters' assortment of integrated circuits, untested. Gates, flip-flops, registers, etc., 8 assorted pieces	1·00
U29	10 1-Amp SCR's TO-5 can up to 600 PIV CRS1/25-600	1·00
U31	20 Sil. Planar NPN trans. low noise amp 2N3707	0·50
U32	25 Zener diodes 400mW D07 case mixed volts, 3–18	0·50
U33	15 Plastic case 1 amp silicon rectifiers IN4000 series	0·50
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 28302/4	0·50
U35	25 Sil. planar trans. PNP TO-18 2N2906	0·50
U36	25 Sil. planar NPN trans. TO-5 BFY50/51/52	0·50
U37	30 Sil. alloy trans. SO-2 PNP, OC200 28322	0·50
U38	20 Fast switching sil. trans. NPN, 400Mc/s 2N3011	0·50
U39	30 RF germ. PNP trans. 2N1303/5 TO-5	0·50
U40	10 Dual trans. 6 lead TO-5 2N2060	0·50
U41	25 RF germ. trans. TO-1 OC45 NKT72	0·50
U42	10 VHF germ. PNP trans. TO-1 NKT667 AF117	0·50

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

GENERAL PURPOSE GERM. PNP POWER TRANSISTORS

Coded GP100. BRAND NEW TO-3 CASE. POSS. REPLACEMENTS FOR:—OC25-28-29-30-35-36. NKT 401-403-404-405-406-430-451-452-453. TI3027-3028, 2N250A, 2N456A-457A-458A, 2N511 A & B. 2G220-222, ETC.
SPECIFICATION
VCBO 80V VCEO 50V IC 10A PT. 30 WATTS Hfe 30–170.

PRICE	1-24	25–99	100 up
	43p each	40p each	36p each

GENERAL PURPOSE SILICON NPN POWER TRANSISTORS

Coded GP300. BRAND NEW TO-3 CASE. POSSIBLE REPLACEMENT FOR:—2N3055, BDY20, BDY11.
SPECIFICATION
VCBO 100V, VCEO 60V, IC 15AMPS. PT. 115 WATTS. Hfe 20–100. FTI MHZ

PRICE	1-24	25–99	100 up
	55p each	50p each	47p each

JUMBO COMPONENT PAKS

MIXED ELECTRONIC COMPONENTS

Exceptionally good value (no rubbish)

Resistors, capacitors, pots, electrolytics and coils plus many other useful items. Approximately 3lbs in weight. Price incl. P. & P

£1·50 only

Plus our satisfaction or money back guarantee.

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8, BSY27/28/95A. All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p			
20	For	0·50	100	For	1·75
50	For	1·00	500	For	7·50
			1000	For	13·00

SILICON PHOTO TRANSISTOR. TO-18 Lens end. NPN Sim. to BP × 25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1-24	25-99	100 up
Price each	45p	40p	35p

RTL MICROLOGIC CIRCUITS

	Price each 1-24	25-99	100 up
Epoxy TO-5 case			
uL900 Buffer	35p	33p	27p
uL914 Dual 2i/p gate	35p	33p	27p
uL923 J-K flip-flop	50p	47p	45p

Data and Circuits Booklet for I.C's Price 7p.

NEW QUALITY TESTED PAKS

Pak	Description	Price £p
Q1	20 Red spot trans. PNP AF	0·50
Q2	16 White spot R.F. trans. PNP	0·50
Q3	4 OC77 type trans.	0·50
Q4	6 Matched trans. OC44/45/81/81D	0·50
Q5	4 OC75 transistors	0·50
Q6	4 OC72 transistors	0·50
Q7	4 AC128 trans. PNP high gain	0·50
Q8	4 AC126 trans. PNP	0·50
Q9	7 OC81 type trans.	0·50
Q10	7 OC71 type trans.	0·50
Q11	2 AC127/128 comp. pairs PNP/NPN	0·50
Q12	3 AF116 type trans.	0·50
Q13	3 AF117 type trans.	0·50
Q14	3 OC171 H.F. type trans.	0·50
Q15	5 2N2926 sil. epoxy trans.	0·50
Q16	2 GET880 low noise germ. trans.	0·50
Q17	3 NPN 1 ST141 & 2 ST140	0·50
Q18	4 Madt's 2 MAT 100 & 2 MAT 120	0·50
Q19	3 Madt's 2 MAT 101 & 1 MAT 121	0·50
Q20	4 OC44 germ. trans. A.F.	0·50
Q21	3 AC127 NPN germ. trans.	0·50
Q22	20 NKT trans. A.F. R.F. coded	0·50
Q23	10 OA202 sil. diodes sub-min.	0·50
Q24	8 OA81 diodes	0·50
Q25	6 IN914 sil. diodes 75PIV 75mA	0·50
Q26	8 OA95 germ. diodes sub-min. 1N69	0·50
Q27	2 10A 600PIV sil. rects. IS45R	0·50
Q28	2 Sil. power rects. BYZ13	0·50
Q29	4 Sil. trans. 2 × 2N696, 1 × 2N697, 1 × 2N698	0·50
Q30	7 Sil. switch trans. 2N706 NPN	0·50
Q31	6 Sil. switch trans. 2N708 NPN	0·50
Q32	3 PNP sil. trans. 2 × 2N1131, 1 × 2N1132	0·50
Q33	3 Sil. NPN trans. 2N1711	0·50
Q34	7 Sil. NPN trans. 2N2369, 500MHZ	0·50
Q35	3 Sil. PNP TO-5 2 × 2N2904 & 1 × 2905	0·50
Q36	7 2N3646 TO-18 plastic 300MHZ NPN	0·50
Q37	3 2N3053 NPN sil. trans.	0·50
Q38	7 PNP trans. 4×2N3703, 3×2N3702	0·50
Q39	7 NPN trans. 4×2N3704, 3×2N3705	0·50
Q40	7 NPN amp. 4×2N3707, 3×3N3708.	0·50
Q41	3 Plastic NPN TO-18 2N3904	0·50
Q42	6 NPN trans. 2N5172	0·50
Q43	7 BC107 NPN trans.	0·50
Q44	7 NPN trans. 4×BC108, 3×BC109	0·50
Q45	3 BC113 NPN TO-18 trans.	0·50
Q46	3 BC115 NPN TO-5 trans.	0·50
Q47	6 NPN high gain 3×BC167, 3×BC168	0·50
Q48	4 BCY70 NPN trans. TO-18	0·50
Q49	4 NPN trans. 2×BFY51, 2×BFY52	0·50
Q50	7 BSY28 NPN switch TO-18	0·50
Q51	7 BSY95A NPN trans. 300MHZ	0·50
Q52	8 BY100 type sil. rect.	1·00
Q53	25 Sil. & germ. trans. mixed all marked new	1·50

PRINTED CIRCUITS—EX-COMPUTER

Packed with semiconductors and components, 10 boards give a guaranteed 30 trans and 30 diodes. Our price 10 boards, 50p. Plus 10p P. & P. 100 Boards £3, P. & P. 30p.

NEW EDITION 1971

TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalents book for European, American and Japanese Transistors. Exclusive to BI-PAK 90p each.

GERM. POWER TRANS.

Type	Price each	Type	Price each
OC20	50p	OC29	40p
OC22	30p	OC35	33p
OC23	33p	OC36	40p
OC25	25p	AD140	40p
OC26	25p	AD142	40p
OC28	40p	AD149	43p

OUR STOCKS of individual devices are now too numerous to mention in this Advertisement. Send S.A.E. for our listing of over 1,000 **Semiconductors.** All available **Ex-Stock** at very competitive prices.

Dual-in-Line Low Profile Sockets
14 and 16 Lead Sockets for use with Dual-in-Line Integrated Circuits

Order No.	Price each 1-24	25-99	100 up
TSO 14 pin type	30p	27p	25p
TSO 16 pin type	35p	32p	30p

-the lowest prices!

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

DOWN AGAIN IN PRICE

Check our 74 Series List before you buy any I.C's. **Our prices are the lowest possible.** All devices ex-stock.
Full spec. guaranteed.

BI-PAK Order No.	Similar Types to:—Description	Price and qty. prices 1–24 £p	25–99 £p	100 up £p
BP00 = 7400	Quad 2-input NAND gate	0·15	0·14	0·12
BP01 = 7401	Quad 2-input pos. NAND gate (with open collector output)	0·15	0·14	0·12
BP02 = 7402	Quad 2-input pos. NOR gates	0·15	0·14	0·12
BP03 = 7403	Quad 2-input pos. NAND gates (with open collector output)	0·15	0·14	0·12
BP04 = 7404	Hex Inverters	0·15	0·14	0·12
BP05 = 7405	Hex Inverter (with open-collector output)	0·15	0·14	0·12
BP10 = 7410	Triple 3-input pos. NAND gates	0·15	0·14	0·12
BP13 = 7413	Dual 4-input Schmitt trigger	0·29	0·26	0·24
BP20 = 7420	Dual 4-input pos. NAND gates	0·15	0·14	0·12
BP30 = 7430	8-input pos. NAND gates	0·15	0·14	0·12
BP40 = 7440	Dual 4-input pos. NAND buffers	0·15	0·14	0·12
BP41 = 7441	BCD to decimal nixie driver	0·67	0·64	0·58
BP42 = 7442	BCD to decimal decoder (4–10 lines, 1 of 10)	0·67	0·64	0·58
BP46 = 7446	BCD-to-seven-segment decoder/driver	2·00	1·75	1·50
BP47 = 7447	BCD-seven-segment decoder/drivers (15V outputs)	0·97	0·94	0·88
BP48 = 7448	BCD-to-seven-segment decoder/driver	0·97	0·94	0·88
BP50 = 7450	Expandable dual 2-input and-or-invert	0·15	0·14	0·12
BP51 = 7451	Dual 2-wide 2-input and-or-invert gates	0·15	0·14	0·12
BP53 = 7453	Quad 2-input expandable and-or-invert	0·15	0·14	0·12
BP54 = 7454	4-wide 2-input and-or-invert gates	0·15	0·14	0·12
BP60 = 7460	Dual 4-input expander	0·15	0·14	0·12
BP70 = 7470	Single-phase J-K flip-flop	0·29	0·26	0·24
BP72 = 7472	Master slave J-K flip-flop	0·29	0·26	0·24
BP73 = 7473	Dual Master slave J-K flip-flop	0·37	0·35	0·32
BP74 = 7474	Dual D type flip-flop	0·37	0·35	0·32
BP75 = 7475	Quad latch	0·47	0·45	0·42
BP76 = 7476	Dual J-K with pre-set and clear	0·43	0·40	0·38
BP80 = 7480	Gated full adders	0·67	0·64	0·58
BP81 = 7481	16-bit read/write memory	0·97	0·94	0·88
BP82 = 7482	2-bit binary full adders	0·97	0·94	0·88
BP83 = 7483	Quad full adder	1·10	1·05	0·95
BP86 = 7486	Quad 2-input exclusive NOR gates	0·32	0·30	0·28
BP90 = 7490	BCD decade counter	0·67	0·64	0·58
BP91 = 7491	8-bit shift registers	0·87	0·84	0·78
BP92 = 7492	Divide-by-twelve counters	0·67	0·64	0·58
BP93 = 7493	4-bit binary counters	0·67	0·64	0·58
BP94 = 7494	Dual entry 4-bit shift register	0·77	0·74	0·68
BP95 = 7495	4-bit up-down shift register	0·77	0·74	0·68
BP96 = 7496	5-bit parallel in parallel out shift-register	0·77	0·74	0·68
BP100 = 74100	8-bit bistable latches	1·75	1·65	1·55
BP104 = 74104	Single J-K flip-flop equivalent 9000 series	0·97	9·94	0·88
BP105 = 74105	Single J-K flip flop equivalent 9001 series	0·97	0·94	0·88
BP107 = 74107	Dual Master slave flip-flops	0·40	0·38	0·36
BP110 = 74110	Gates master-slave flip-flops	0·55	0·53	0·50
BP111 = 74111	Dual data lock-out flip-flop	1·25	1·15	1·00
BP118 = 74118	Hex set-reset latches	1·00	0·95	0·90
BP119 = 74119	Hex set-reset latches. 24-pin	1·35	1·25	1·10
BP121 = 74121	Monostable multivibrators	0·67	0·64	0·58
BP141 = 74141	BCD-to-decimal decoder/driver	0·67	0·64	0·58
BP145 = 74145	BCD-to-decimal decoder/driver O/C	1·50	1·40	1·30
BP150 = 74150	16-bit data selector	1·80	1·70	1·60
BP151 = 74151	8-bit data selectors (with strobe)	1·00	0·95	0·90
BP153 = 74153	Dual 4-line-to-1-line data	1·20	1·10	0·95
BP154 = 74154	4- to 16-line decoder	1·80	1·70	1·60
BP155 = 74155	Dual 2- to 4-line decoder	1·40	1·30	1·20
BP156 = 74156	Dual 2- to 4-line decoder O/C	1·40	1·30	1·20
BP160 = 74160	Sync. decade counter	1·80	1·70	1·60
BP161 = 74161	Sync. 4-bit binary counter	1·80	1·70	1·60
BP190 = 74190	Sync. up-down BCD counter	3·50	3·25	3·00
BP191 = 74191	Sync. binary up-down counter (single clock line)	3·50	3·25	3·00
BP192 = 74192	Sync. up-down decade counter	2·10	1·95	1·75
BP193 = 74193	Sync. binary up-down counter (tow clock lines)	2·10	1·95	1·75
BP196 = 74196	Pre-setable 50MHz decade counter	1·80	1·70	1·60
BP197 = 74197	Pre-setable 50MHz binary counter	1·80	1·70	1·60
BP198 = 74198	8-bit parallel L-R shift register	5·50	5·00	4·00
BP199 = 74199	8-bit parallel access shift register	5·50	5·00	4·00

Devices may be mixed to qualify for quantity price. Larger quantities—prices on application (TTL 74 Series only).
Data is available for the above series of I.C's in booklet form. Price **13p.**

TTL INTEGRATED CIRCUITS

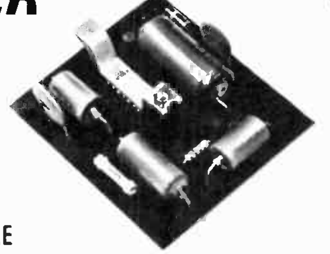
Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C's and experimental work.

PAK No.		PAK No.		PAK No.	
UIC00 = 12 × 7400N	50p	UIC42 = 5 × 7450N	50p	UIC80 = 5 × 7480N	50p
UIC01 = 12 × 7401N	50p	UIC50 = 12 × 7450N	50p	UIC82 = 5 × 7482N	50p
UIC02 = 12 × 7402N	50p	UIC51 = 12 × 7451N	50p	UIC83 = 5 × 7483N	50p
UIC03 = 12 × 7403N	50p	UIC60 = 12 × 7460N	50p	UIC86 = 5 × 7486N	50p
UIC04 = 12 × 7404N	50p	UIC70 = 8 × 7470N	50p	UIC90 = 5 × 7490N	50p
UIC05 = 12 × 7495N	50p	UIC72 = 8 × 7472N	50p	UIC92 = 5 × 7492N	50p
UIC10 = 12 × 7410N	50p	UIC73 = 8 × 7473N	50p	UIC93 = 5 × 7493N	50p
UIC20 = 12 × 7420N	50p	UIC74 = 8 × 7474N	50p	UIC94 = 5 × 7494N	50p
UIC40 = 12 × 7440N	50p	UIC75 = 8 × 7475N	50p	UIC95 = 5 × 7495N	50p
UIC41 = 5 × 7441AN	50p	UIC76 = 8 × 7476N	50p	UIC96 = 5 × 7496N	50p

UICX1 = 25 × Asst'd 74's £1·50

Paks cannot be split but 20 assorted pieces (our mix) is available as PAK UICX1
Every PAK carries out BI-PAK Satisfaction or money back GUARANTEE.

ANOTHER BI-PAK FIRST!



THE NEW **S.G.S.** EA 1000 AUDIO AMPLIFIER MODULE

*GUARANTEED NOT LESS THAN 3 WATTS RMS

Especially designed by S.G.S. incorporating their proven Linear I.C. Audio Amp. TA/621 providing unlimited applications for the enthusiast in the construction of radios, record players, Audio and Stereo units. Also ideal for intercom systems, monitoring applications and phone answering machines. OTHER USES: *portable applications where supply rails as low as 9V are of prime importance.*

- Sensitivity 40 mV for 1 watt VOLTAGE GAIN 40dB but can be varied up to 73dB for some applications.
- Signal to Noise Ratio 86dB.
- Frequency response better than 50 Hz to 25 KHz for −3dB.
- Normal supply Voltage 9-24V.
- Suitable for 8-16 OHM Loads.
- Overall Size 2″ × 3″ × ¾″.
- Typical Total Harmonic distortion at 1 watt less than 1%.

**Supply voltage (Vs) = 24V 15ohm load.*

Module Tested and Guaranteed

Quantity	1-9	10-25
Price each	£2·63	£2·28

Larger quantities quoted on request

Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

ROCK BOTTOM PRICES—CAN'T BE BEATEN!

LOGIC DTL 930 SERIES IC's

Type No.	Function	Price 1–24	25–99	100 up
BP930	Expandable dual 4-input NAND	12p	11p	10p
BP932	Expandable dual 4-input NAND buffer	13p	12p	11p
BP933	Dual 4-input expander	13p	12p	11p
BP935	Expandable Hex Inverter	13p	12p	11p
BP936	Hex Inverter	13p	12p	11p
BP944	Dual 4-input NAND expandable buffer without pull-up	13p	12p	11p
BP945	Master-slave JK or RS	25p	24p	22p
BP946	Quad, 2-input NAND	12p	11p	10p
BP948	Master-slave JK or RS	25p	24p	22p
BP951	Monostable	65p	60p	55p
BP962	Triple 3-input NAND	12p	11p	10p
BP9093	Dual Master-slave JK with separate clock	40p	38p	35p
BP9094	Dual Master-slave JK with separate clock	40p	38p	35p
BP9097	Dual Master-slave JK with Common Clock	40p	38p	35p
BP9099	Dual Master-slave JK Common Clock	40p	38p	35p

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

BRAND NEW LINEAR I.C's—FULL SPEC.

Type No.	Case	Leads	Description	Price 1–24	25–99	100 up
BP 201C—SL201C	TO-5	8	G.P. Amp	63p	53p	45p
BP 701C—SL701C	TO-5	8	OP Amp	63p	50p	45p
BP 702C—SL702C	TO-5	8	OP Amp Direct OP	63p	50p	45p
BP 702—72702	D.I.L.	14	G.P. OP Amp (Wide Band)	53p	45p	40p
BP 709 —72709	D.I.L.	14	High OP Amp	53p	45p	40p
BP 709P—μA709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP 711—μA711	TO-5	10	Dual comparator	58p	50p	45p
BP 741 —72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
μA 703C—μA703C	TO-5	6	R.F.-I.F. Amp	43p	35p	27p
TAA 263—	TO-72	4	A.F. Amp	70p	60p	55p
TAA 293—	TO-74	10	G.P. Amp	90p	75p	70p

All prices quoted in new pence *Giro No. 388-7006*
Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 7p. Overseas add extra for airmail.
Minimum order 50p. Cash with order please.

Guaranteed Satisfaction or Money Back

DISCOUNTS UP TO 60% ON BRANDED GOODS

ALL BRAND NEW
in manufacturer's sealed cartons.
GUARANTEED 12 MONTHS.

SONY · LEAK · SINCLAIR · TELETON · ARMSTRONG · THORENS · PHILIPS · K.E.F. · TEAC · ROGERS · PIONEER

TURNTABLES

Please add 75p for post and packing

*Garrard SP25 Mk. III	£10·45
*Garrard 2025TC with stereo cart.	£8·00
*Garrard 2025TC with Sonotone 9TAHC	£8·95
*Garrard 3000 with Sonotone 9TAHC	£10·25
*Garrard SL65B	£13·25
*Garrard AP76	£19·95
*Garrard SL72B	£24·00
*Garrard SL75B	£26·00
*Garrard SL95B	£35·50
Garrard 401	£27·00
*B.S.R. MP60	£10·75
Pioneer PL12AC	£36·00
Thorens TD125	£62·50
Thorens TD125AB	£98·50
Thorens 150ABII	£42·50
Goldring GL69/2	£21·00
Goldring GL69P2	£29·50
Goldring GL75	£29·00
Goldring GL75P	£36·50

** Items marked can be mounted in plinth and cover, ready wired for £4·50 extra plus 25p for post and packing*

AMPLIFIERS

Please add 50p for post and packing

Armstrong	521 (cased)	£41·95
Amstrad	8000	£17·70
Dulci 207		£15·95
Dulci 207M		£21·00
Europhon	10 + 10	£14·50
H.L. Audio 707		£17·75
Metrosound ST20		£24·75
Metrosound ST20E		£26·95
Philips	R580	£20·50
Pioneer	SA500	£41·50
Pioneer	SA700	£67·00
Pioneer	SA900	£94·50
Rogers Ravensbrook Chassis		£35·00
Rogers Ravensbrook Cased		£40·25
Rogers Ravensbourne Chassis		£44·50
Rogers Ravensbourne Cased		£48·00
Sansui AU101		£34·00
Sansui RA500		£38·00
Sansui AU222		£45·50
Sansui AU666		£75·00
Sinclair	2000 Mk. I	£21·00
Sinclair	2000 Mk. II	£22·50
Sinclair	3000	£32·50
Sinclair	PRO60/2 × Z30/PZ5	£15·75
Sinclair	PRO60/2 × Z30/PZ6	£17·75
Sinclair	PRO60/2 × Z50/PZ8/Trans.	£22·95
Sinclair	AFU	£4·70
Teleton	SAQ206B (New Product)	£20·50
Wharfedale		£49·75

TUNERS

Please add 50p for post and packing

Armstrong 523 AM/FM	£40·00
Armstrong 524 FM	£30·00
Dulci FMT7	£19·50
Dulci FMT7 Stereo	£27·00
Teleton GT101 MPLX	£30·00
Rogers Ravensbourne FET 2 Chassis	£45·50
Rogers Ravensbourne FET 2 Cased	£49·00
Rogers Ravensbrook FET 4 Chassis	£32·50
Rogers Ravensbrook FET 4 Cased	£36·50
Sinclair 2000	£18·75
Sinclair Pro 60	£19·75
Philips RH690 (New Product)	£34·50

All items listed available at the prices shown at the time of going to press

PICK-UP ARMS

Please add 35p for post and packing

SME 3009/S2	£23·75
SME 3012/S2	£25·25
Goldring L75	£9·50
Goldring L69	£7·50
Audio-Technica AT1005	£14·95

TUNER AMPLIFIERS

Please add 75p for post and packing

Armstrong 525 FM	£68·75
Armstrong 526 AM/FM	£78·75
Armstrong M8	£7·75
Teleton CR10T with speakers	£26·25
Teleton F2300 (new product)	£38·50
Teleton CR55	£87·00
Teleton TSF50	£51·75
Wharfedale 100–1	£103·00
Teleton TFS50LA	£60·00
Teleton 2100	£34·00
Sansui 200	£71·00
Goodmans Module 80	£73·00
Philips RH781	£53·00
Rogers Ravensbourne (cased)	£89·50
Rogers Ravensbourne (chassis)	£83·50

KIT RADIOS

Please add 25p for post and packing

Smallest radio in the world. 5 years' guarantee.

Sinclair Micromatic	£2·75
Sinclair Micromatic (ready assembled)	£3·25

Batteries 14p extra

SPEAKERS

Please add £1·25 for post and packing

(PRICE PER PAIR)

Wharfedale Denton		£29·75
Wharfedale Melton		£49·90
Wharfedale Triton		£45·75
Wharfedale S/Linton		£40·75
Wharfedale Denton II (New product)		£33·00
Wharfedale Super Linton II (New product)		£40·75
Keletron	KN500	£15·00
Keletron	KN700	£18·00
Keletron	KN123/3	£31·50
Keletron	KN1000	£27·50
Keletron	KN1500	£37·00
Keletron	KN2000	£41·50
K.E.F.		by letter
Celestion	Ditton 120	£35·50
Celestion	Ditton 15	£49·50
Celestion	Ditton 25	£101·00
Celestion	Ditton 10	£67·50
Ste-Ma	400	£34·00
Ste-Ma	300	£48·50
Ste-Ma Hi-Fi 4		£78·00
Ste-Ma Hi-Fi 115		£17·50
Ste-Ma Hi-Fi 3		£63·50
Goodmans Minster		£36·00
Goodmans Magister		£79·90
Goodmans Maxim		£30·00
Goodmans Mezzo		£48·90
Goodmans Magnum K2		£62·00
Richard Allan Minette		£27·00
Richard Allan Chaconne		£32·50
Richard Allan Pavane		£58·00
Sinclair Q16		£12·95

GLOBAL CONTRACT SERIES

Contract 8 3-way 7 watts R.M.S.	£16·00
Contract 6 3-way 5 watts R.M.S.	£10·75

SPEAKER KITS

Wharfedale Unit 3	£20·50
Wharfedale Unit 4	£27·00
Wharfedale Unit 5	£39·00
Richard Allan Twin Assembly	£16·00
Richard Allan Triple Assembly	£28·00
Richard Allan Super Triple Assembly	£33·00

PERSONAL CALLERS VERY WELCOME!

Come and browse through our multi 1,000 foot warehouse/showroom.

NO PARKING PROBLEM

CARTRIDGES

Please add 10p for post and packing

Goldring	G850	£3·75
Goldring	G800H	£4·50
Goldring	G800	£6·75
Goldring	G800E	£10·50
Goldring	G800SE	£15·25
Sonotone	9TAHC Diamond	£1·75
Shure	M3DM	£4·75
Shure	M44S/7/C	£7·00
Shure	M55E	£8·75
Shure	M75E	£13·50
Shure	V15 Type 2	£28·00
Shure	M44E	£8·00
Shure	M31E	£8·50
Shure	M32E	£8·00
Audio-Technica	AT66	£4·95
Audio-Technica	AT35	£14·25
SMC	101	£2·79
MC15		£4·50

TAPE DECKS & RECORDERS

Please add 75p for post and packing

Teleton FXB 510D	£44·75
Teleton TCR130	£22·90
Akai 1720L	£74·95
Akai X5000	£122·50
Akai 4000D	£66·50
Ferrograph 722	£196·00

COMPACT SYSTEMS

Please add 75p for post and packing

Teleton 2S60F	£52·00
Windsor	£41·50
Marconi Unit 4	£64·00
Fidelity Music Master	£37·00

8-TRACK CASSETTES

Teleton STP80D	£42·97

PLINTHS & COVERS

(as illustrated)

£3·20

plus 35p post and packing

Finished in real teak veneer with tinted dustcover. Ready to use (fully assembled). Suitable for Garrard SP25, 2025TC, 3000, AT60, 2000, 2500, 3500, 5100, 1025, SL65B.

Also for B.S.R. McDONALD MP60 and others

Plinths and Covers for AP76, AP75, SL72B, SL75, SL95B. £4·20 plus 35p post and packing.

Also finished in walnut to match Japanese equipment—no extra charge.

GLOBAL AUDIO DISCOUNT WAREHOUSES

Dept. (PE3) 174 Pentonville Road, London, N1. Telephone 01-278 1769

Or: 4 High View Parade, Redbridge Lane East, Woodford Avenue, Ilford, Essex. Tel: 01-550 1086.

2 minutes from KING'S CROSS, EUSTON & ST. PANCRAS on main road leading to the East and West Country

MAIL ORDERS: Order with confidence. Send Postal Order, Cheque, Money Order, Bank Draft, Giro or Cash by Registered Mail. **CALLERS:** Please note that cheques can only be accepted together with cheque cards (not Barclay Card).

SPECIAL PURCHASE !

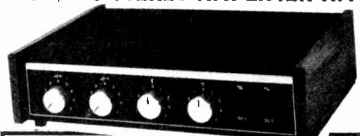
BRAND NEW FM MULTIPLEX STEREO DECODER UNITS. Manufactured by PHILIPS. Size 2" × 3½" × 1". All transistor 24V. at 6mA. Supplied pre-aligned with full circuit diagram and connection details. **£4** each. Post free.

FEW ONLY—LEAK MK I TRANSCRIPTION PICK-UP ARMS. Using the world famous gimbal pivot system. Complete but less pick-up head. **£2·50.** P. & P. 20p.

INPUT MATCHING TRANSFORMER. Beautifully made in heavy Mu-metal cylindrical case for minimum hum pick-up. Size 1¾" high × 1¼" dia. Ratio 150: 1 approx. Especially suitable for matching dynamic or ribbon mikes or pick-up from low to high impedance or vice versa. **75p** each. Post Free.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2¾" × 3" approx. **25p** pair. P. & P. 5p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



NEW IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD FOR EASY CONSTRUCTION

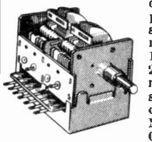
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output 14W r.m.s. per channel into 5 ohms. Frequency response ±3dB 12–30,000Hz. Sensitivity better than 80mV into 1MΩ. Full power bandwidth ±3dB 12–15,000Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35V at 1·0 amp. Overall size—12" wide × 8" deep × 2¾" high.
Fully detailed 7-page construction manual and parts list free with kit or send 18p plus large S.A.E.

PRICES AMPLIFIER KIT. **£10·50** P. & P. 15p.
POWER PACK KIT. **£3** P. & P. 30p.
CABINET. **£3** P. & P. 30p.

(Post Free if all units purchased at same time). Full after sales service. Also available ready built and tested, **£20·50.** Post Free.

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

SPECIAL PURCHASE OF MANUFACTURER'S SURPLUS! All Transistor F.M. tuner head with twin A.M. Gang incorporated. Beautifully engineered with precision geared reduction drive. F.M. R.F. Transistor, oscillator/Mixer and first I.F. stage (10.7 Mc/s output) with optional AFC connection. Built on printed circuit panel and fully screened. Extremely stable over range 88-108 Mc/s. Brand new and pre-aligned. Size 2½in H. × 1⅞in W. × 2¼in D. For 6V D.C. @ 2.8mA. A.M. Gang fitted with trimmers which can be connected to standard A.M. aerial and oscillator circuits if required. LIMITED NUMBER. Only **£2·25** post free. Connection details supplied.



HIGH GRADE COPPER LAMINATE BOARDS 8 × 6 × $\frac{1}{16}$in. FIVE for **50p.** P. & P. 13p.

TELESCOPIC AERIALS WITH SWIVEL JOINT. Can be angled and rotated in any direction. 6 section Lacquered Brass. Extends from 6in. to approx. 22½in. Maximum diameter ½in. **25p** each. P. & P. 5p.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations: 0-5-10-15-20-25-30-35-40-60V half wave at 1 amp or 10-0-10, 20-0-20, 30-0-30V, at 2 amps full wave. Size 3inL × 3½inW × 3inD. Price **£1·75.** P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240V. Sec. 9-0-9 at 500mA. **70p.** P. & P. 13p. Pri. 200/240V. Sec. 12-0-12 at 1 amp. **88p.** P. & P. 13p. Pri. 200/240V. Sec. 10-0-10 at 2 amp. **£1·38.** P. & P. 30p. Tapped Primary 200-220-240V. Sec. 21·5V at 500mA. **63p.** P. & P. 13p.

SPECIAL OFFER!!
HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½in high × 10½in wide × 5¾" deep. Fitted with E.M.I. Ceramic Magnet 13in × 8in bass unit, two H.F. tweeter units and crossover. Power handling 10W. Available 3, 8 or 15 ohm impedance.

Our Price £8·40 Carr. 65p.

CABINET AVAILABLE SEPARATELY **£4·50.** Carr. 60p.

Also available in 8 ohm with EMI 13in × 8in. bass speaker with parasitic tweeter. **£6·50.** Carr. 65p.

LOUDSPEAKER BARGAINS

3in 4 ohm **50p.** P. & P. 13p. 5in 3 ohm **80p,** P. & P. 15p. 7 × 4in 3 ohm **£1·05,** P. & P. 20p. 10 × 6in 3 or 15 ohm **£1·90,** P. & P. 30p. E.M.I. 8 × 5in 3 ohm with high flux magnet **£1·62.** P. & P. 20p. E.M.I. 13½ × 8in 3 ohm with high flux ceramic magnet **£2·10** (15 ohm **£2·25**). P. & P. 30p. E.M.I. 13 × 8in, 3 or 8 or 15 ohm with two inbuilt tweeters and crossover network **£4·20.** P. & P. 30p. E.M.I. 13" × 8" twin cone (parastatic tweeter) 8 ohm **£2·25.** P. & P. 30p.

BRAND NEW. 12in 15w H/D Speakers, 3 or 15 ohm. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£5·50.** Guitar models: 25w **£6·50.** 35w **£8·50.** P. & P. 38p each.

E.M.I. 3½in HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3, 8 or 15 ohm **98p** each. P. & P. 13p.

12in "RA" TWIN CONE LOUDSPEAKER
10 watts peak handling. 3 or 15 ohm, **£2·20.** P. & P. 30p. **35 ohm SPEAKERS 3".** ONLY **63p.** P. & P. 13p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Usually £1·75 yd., our price **75p** yd. length. P. & P. 15p (min. 1 yd.). S.A.E. for samples.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam ear-muffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15,000Hz. Matching impedance 8–16 ohms. PRICE **£2·95.** P. & P. 15p.

SINGLE HEADPHONE. With aluminium headband. Approx. 200 ohm. **25p.** P. & P. 8p.

CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity, **93p.** P. & P. 8p.

HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE **£1·05.** P. & P. 8p.

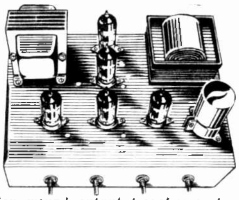
GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER. For P.U. Tape, Mike, Guitar, etc., and suitable for use with valve or transistor equipment. 9–18V. Battery or from H.T. line 200/300V. Frequency response 15Hz–25KHz. Gain 26dB. Solid encapsulation size 1¾ × 1¼ × ¾in. Brand new—complete with instructions. Price **88p.** P. & P. 13p.

BRAND NEW E.M.I. LIGHTWEIGHT PICK-UP ARM WITH ARM REST. Fitted mono t/o stylus and cartridge for LP/78, ONLY **£1.** P. & P. 8p.

QUALITY RECORD PLAYER AMPLIFIER MK II
A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. × 3d. × 6 h. Ready built and tested. PRICE **£3·75.** P. & P. 40p. ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit cabinet below. PRICE **£4·88.** P. & P. 50p.

DE LUXE QUALITY PORTABLE R/P CABINET MK II
Uncut motor board size 14½ × 12in., clearance 2 in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE **£3·98.** P. & P. 50p.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **13p** (Free with parts). **All parts sold separately.** ONLY **£7·97.** P. & P. 55p. Also available ready built and tested complete with std. input sockets, **£9·97.** P. & P. 55p.

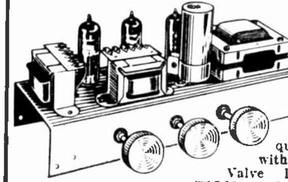
BRAND NEW TRANSISTOR BARGAINS. GET 15 (Matched pair) **75p;** V15/10p, **50p;** OC71 **25p;** OC76 **30p;** AF117 **18p;** 2G339 (NPN) **15p.**
Set of Mullard 6 transistors OC44, 2—OC45, AC128D, matched pair AC128 **£1·25;** ORP12 Cadmium Sulphide Cell **53p.** All post free.

SPECIAL PURCHASE !
SPEAKER CABINET FROM FAMOUS MAKER !

Beautifully made all-wooden construction cabinet with medium walnut finish front, gold anodised expanded aluminium grille and dark sides. Approx. size overall 11¾" high × 5" deep × 13¾" wide at base. Easily removable baffle cut out for 8" speaker. Fibre board back. Could accommodate amplifier or radio together with speaker. An expensively made cabinet at a give-away price.

LIMITED NUMBER ONLY £1·38 Post Free.

DE LUXE STEREO AMPLIFIER

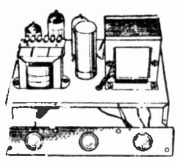


A.c. mains 200–240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11in. w × 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. Price **£8·92.** P. & P. 45p.

4-SPEED RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/A21 4-SPEED AUTOCHANGER. With latest mono compatible cartridge **£6·97.** Carr. 50p. With stereo cartridge **£7·97.** Carr. 50p.
SUITABLE PLINTH UNIT FOR ABOVE with rigid plastic cover. **£5·75** complete. P. & P. 50p.
LATEST GARRARD MODELS. All types available 1025, 2025, SP25, 3000, AT60, etc. S.A.E. for Latest Prices!
PLINTH UNITS cut out for Garrard Models 1025, 2025, 2000, 3000, 3500, etc. With rigid transparent plastic cover. Special design enables above models to be used with cover in position. Also suitable for housing AT60 and SP25. OUR PRICE **£5·75** complete. P. & P. 50p.

LATEST ACOS GP91/1SC Mono Compatible Cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·50.** P. & P. 8p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus. Diamond Stereo LP and Sapphire 78. ONLY **£2·50.** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£3.** P. & P. 10p.
LATEST RONETTE T/O Stereo Compatible Cartridge for EP/LP/Stereo/78. **£1·63.** P. & P. 10p.
LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono or stereo records on mono equipment. **£1·50.** P. & P. 10p.

3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4¾in. 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.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£3·98.** P. & P. 40p.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240V. Supplied absolutely Brand New, completely wired and tested with good quality output transformer. FEW ONLY.

OUR ROCK BOTTOM BARGAIN PRICE **£2·75** P. & P. 35p

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
A must for servicemen and home constructors. 1971 edition including many 1000's of British, U.S.A., European and Japanese transistors. ONLY **40p.** Post 5p.

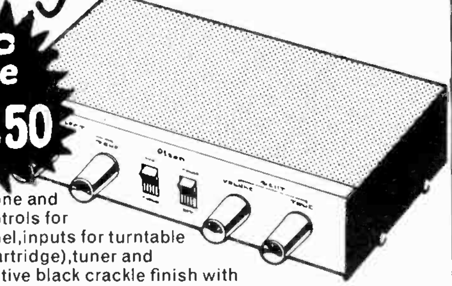
Open 9-5.30 Monday to Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station

HARVERSON SURPLUS CO. LTD.
170 HIGH ST., MERTON, LONDON, S.W.19 Tel. 01-540 3985
SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

JUST BEGINNING?

Then try out **8-Watt, 10-Transistor Stereo Amplifier R.137**



ROC price £10.50

Separate tone and volume controls for each channel,inputs for turntable (ceramic cartridge),tuner and tape.Attractive black crackle finish with brushed aluminium front.Frequency response:70-20,000 Hz ±3dB.Output: 4 watts per channel @ 8 ohms.Inputs:Phono 80mV; tuner/aux 80mV.

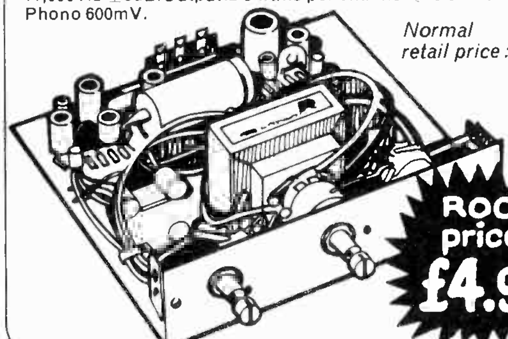
Normal retail price : £14·70

FIRST STEP TO STEREO!

5-Watt Transistor Stereo Amplifier Chassis R.123

Completely self-contained,fully transistorised,mains-powered (240vAC) amplifier,needing only cabinet and knobs.Ideal for adapting mono players to stereo.Frequency response:40-17,000 Hz ±3dB.Output:2·5 watts per channel @ 8 ohms.Input: Phono 600mV.

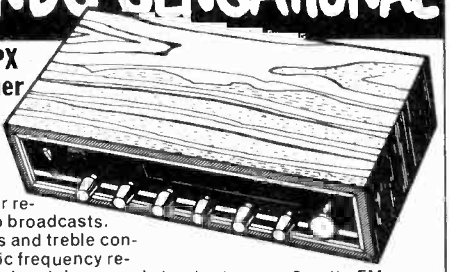
Normal retail price : £7·30



ROC price £4.95

SOUNDS SENSATIONAL

AM/FM/MPX Stereo Tuner Amplifier R.124



A top quality amplifier with facility for receiving stereo broadcasts. Separate bass and treble controls,automatic frequency response,stereo headphone socket,output power:8 watts.FM frequency range 88-108 M Hz;AM frequency range 535-1605 K Hz. Inputs for turntable (ceramic cartridge) and tape.Frequency response:50-10,000 Hz ±3dB.Output:4 watts per channel @ 8 ohms.Inputs:Phono 200mV,tape 100mV.FM:Sensitivity 20µV, stereo separation 26dB,image rejection 55dB.AM:Sensitivity 300µV.

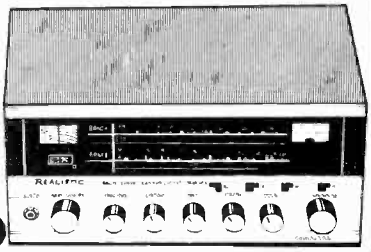
Normal retail price : £42·00 **ROC price: £29.95**

World wide reception

Professional Solid-state, Four-band Communications Receiver R.135

Fully transistorised with continuous coverage from 555K Hz to 30 M Hz in four bands (with illuminated bandspread for 160-10 metres).Incorporates internal speaker,automatic noise limiter, SSB/AM/CW switch,AVC switch,S Meter,Receive and Standby switch,external socket for headphone or speaker,bandspread control,BFO control,on/off/AF gain,band selector,antenna trimmer and RF gain.Runs off 240 v AC,batteries or any 12 v DC negative ground source.Frequency ranges (in mHz):Band A, 535-1·6;B,1·55-4·5;C,4·5-13;D,13-30.Sensitivity:0·5µV @ 30mHz. Bandspread:10-160 metres.

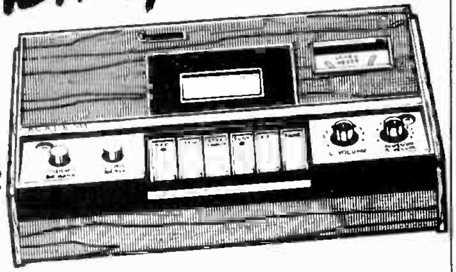
Normal retail price : £65·00



ROC price: £45.00

AMAZING OFFER!

Stereo Cassette Tape Unit R.142



Complete stereo record and playback unit with line and microphone inputs. Fitted with tape counter,separate pause control,recording level metres for each channel,pop-up cassette ejection.Supplied complete with two pencil microphones.Wow & flutter better than 0·3%, frequency response 100-10,000 Hz.Tape speed:1⅞ IPS,4·75 CMS.Rewind time: Better than 60 sec (C.60 cassette).

Normal retail price : £65·00

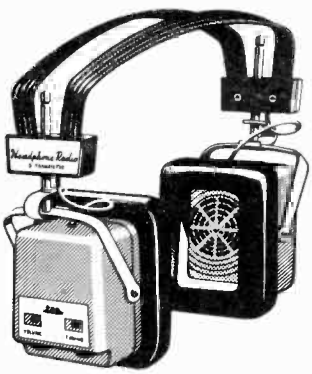
ROC Price £49.50

We don't want you to

Every piece of electronic or audio-equipment we sell is built to our specifications.It comes complete with a Guarantee.And it's tested before it leaves us.

We bend over backwards in our advertising to make sure everything we say is factually accurate. But,buying mail-order,even though you're buying from us,we accept you could still end up with a piece of equipment that's not exactly what you wanted.And we think that's unfair.

FANTASTIC BARGAIN



Headphone Radio R.143
For completely private listening without the distortion of the ordinary earphone adaptor. Battery operated; PP3. Fully transistorised. Frequency range: 535-1600 K Hz, Medium Wave Band. Maximum output: 300mW.

ROC price £6.90

Normal retail price: £9·40

STEREO headphones

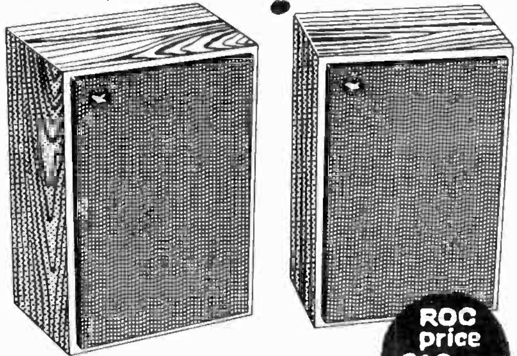
only £2.40

Stereo Headphones R.328

Light and comfortable, with a frequency response of 30-15,000 Hz for real listening pleasure. Complete with jack plug. Impedance 8-16 ohms.
Normal retail price: £2·95

2 for the price of one!

Matched Stereo Speakers R.446

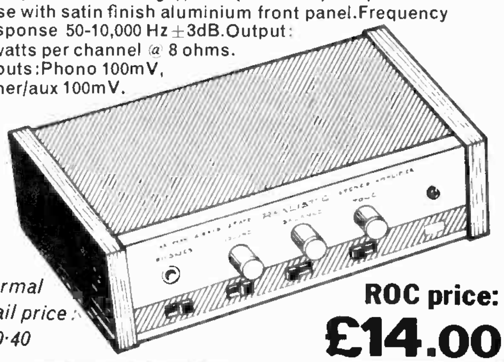


ROC price £16.40

Heavily lagged teak finish cabinets each with large dual cone base unit and separate tweeter. Power handling: 10 watts peak; frequency range: 40-18,000 Hz, impedance: 8 ohms. Size: 14 x 8¾ x 6¼.
Normal retail price: £19·60

Don't read this!

10-watt Transistor Stereo Amplifier R.136
Ganged volume, balance and tone controls. Inputs for turntable (ceramic cartridge), tuner (see R.134) or tape. Oiled walnut case with satin finish aluminium front panel. Frequency response 50-10,000 Hz $\pm$3dB. Output: 5 watts per channel @ 8 ohms. Inputs: Phono 100mV, tuner/aux 100mV.



Normal retail price: £20·40

ROC price: £14.00

The Perfect match!

AM/FM/MPX Stereo Tuner R.134

Matching unit to the R.136 amplifier. Covers AM and FM tuning bands with automatic stereo signal light. FM frequency range: 88-108mHz; AM frequency range: 535-1605kHz. FM: Sensitivity 5µV, stereo separation 25dB@1kHz, image rejection 50dB. AM: Sensitivity 250µV.
Normal retail price: £28·60

ROC price £22

pay for your mistakes

So we've got a proposition for you.
If you buy a piece of Roc equipment, and it's not quite what you expected, send it back within seven days, and as long as it's as good as new we'll give you your money back. O.K?

Return of post mail-order service; orders over £10 post free, (U.K. only) add 25p for p & p to orders under £10. HP terms available.

ROC ELECTRONICS LIMITED
193 B Edgware Road, London W2 1ET. *Phone: 01-723 6211.*
Callers at Shop welcome 9-6 Mon to Sat (Thurs 1pm)

G. F. MILWARD 369 Alum Rock Road, Birmingham B8 3DR. Tel. 021-327 2339

VEROBOARD

2½in × 1in × 0·15in **6p**	5in × 3¾in × 0·15in **28p**	3¾in × 3¾in × 0·1in **24p**
3¾in × 2½in × 0·15in **16p**	17in × 2½in × 0·15in **55p**	5in × 2½in × 0·1in **23p**
3¾in × 3¾in × 0·15in **20p**	17in × 3¾in × 0·15in **74p**	5in × 3¾in × 0·1in **28p**
5in × 2½in × 0·15in **20p**	3¾in × 2½in × 0·1in **21p**	

Spot Face Cutter **38p**. Pin Insert Tool **48p**. Terminal Pins (0·1 or 0·15) 36 for **18p**. Special Offer Pack consisting of 5 2½in × 1in boards and a Spot Face Cutter—**50p.**

RECORD PLAYER CARTRIDGES. Well below normal prices! G90 Magnetic Stereo Cartridges, Diamond Needle, 6mV output, **£4**. ACOS GP 67/2 (Mono, Crystal) **75p**. ACOS GP 91/3 (Compatible, Crystal) **£1**. ACOS GP 93/1 (Stereo, Crystal, Sapphire) **£1·25**. ACOS GP 93/1D (Stereo, Crystal, Diamond) **£1·63**. ACOS GP 94/1 (Stereo, Ceramic, Sapphire) **£1·50**. ACOS GP 94/1D (Stereo, Ceramic, Diamond) **£1·88**. ACOS GP 95/1 (Stereo, Crystal with two L.P./Stereo needles) **£1·25**.

TRANSISTORISED FLUORESCENT LIGHTS, 12 volt. All with reversed polarity protection. 8 watt type with reflector suitable for tents, etc. **£3**. Postage/Packing 25p. 15 watt type, batten fitting for caravans **£4**. Postage/Packing 25p. 13 watt type, batten with switch. 22in × 2in. × 1in **£5**. Postage/Packing 25p. THESE CAN BE SENT ON APPROVAL AGAINST FULL PAYMENT.

MULLARD POLYESTER CONDENSERS
1,000pF, 1,200pF, 1,500pF, 1,800pF, 2,200pF, **15p** per dozen (all 400V working). 0·15μF, 0·22μF, 0·27μF, **30p** per dozen (all 160V working). 25% discount for lots of 100 of any one type.

RESISTORS
¼ and ½ watt. Most values in stock. **50p** per 100. **10p** per dozen of any one value. WIRE WOUND MAINS DROPPERS. Hundreds of values from 0·7 ohm upwards. 1 watt to 50 watts. A large percentage of these are multi-tapped droppers for radio/television. Owing to the huge variety these can only be offered "assorted" at **50p** per dozen.

SILVER MICA/CERAMIC/POLYSTYRENE CONDENSERS
Large range in stock, 75p per 100 of any one value. 15p per dozen.
RECORDING TAPE BARGAIN! The very best British Made low-noise high-quality Tape! 5in Standard **38p**. Long-play **45p**. 5¾in Standard **45p**. Long-play **60p**. 7in Standard **60p**. Long-play **82p**. We are getting a fantastic number of repeat orders for this tape. Might we suggest that you order now whilst we still have a good stock at these low prices?

STOCKTAKING CLEARANCE! IMPOSSIBLE TO REPEAT!
We have huge numbers of components in quantities too small to advertise individually. In order to "clear the decks" we have made up parcels containing a mixture of carbon and wire-wound resistors, electrolytic and paper condensers, controls, transistors, diodes etc., for a tiny fraction of normal price. It is emphasised that these are mixed parcels only—contents cannot be stipulated! Sold only by weight.

Gross weight 2 lb. .. .. **£1** (postage 20p)
Gross weight 5 lb. .. .. **£2** (postage 30p)

Unrepeatable Offer ! ! ! !
Surplus VEROBOARDS, 3¾″ × 2½″ × ·15″
Only 10p each or £1·00 per dozen

TANTALUM CAPACITORS. COMPARE THE PRICE—ONLY 10p EACH ! ! ! !

Sub-miniature types			*Miniature types*					
0·047μF	50	volts	0·022μF	20	volts	5·6 μF	35	volts
0·056μF	50	volts	0·033μF	20	volts	8·2 μF	10	volts
0·07 μF	20	volts	0·047μF	20	volts	8·2 μF	35	volts
0·1 μF	20	volts	0·068μF	35	volts	15 μF	35	volts
0·1 μF	50	volts	0·12 μF	35	volts	18 μF	35	volts
0·18 μF	20	volts	0·15 μF	35	volts	22 μF	15	volts
0·33 μF	35	volts	0·22 μF	50	volts	27 μF	120	volts
0·47 μF	35	volts	0·47 μF	50	volts	56 μF	15	volts
0·68 μF	20	volts	0·68 μF	35	volts	56 μF	20	volts
1·0 μF	15	volts	0·68 μF	50	volts	150 μF	6	volts
2·2 μF	3	volts	1·0 μF	35	volts	*Standard*		
2·7 μF	15	volts	1·0 μF	75	volts	6·8 μF	50	volts
2·7 μF	35	volts	1·8 μF	20	volts	7·5 μF	20	volts
3·0 μF	12	volts	2·2 μF	20	volts	8·2 μF	150	volts
10·0 μF	1·5	volts	2·7 μF	50	volts	12 μF	35	volts
			3 μF	12	volts.	12 μF	50	volts
			3·3 μF	15	volts	39 μF	20	volts
			4 μF	20	volts	82 μF	20	volts
			4·7 μF	35	volts	150 μF	15	volts
			5·6 μF	6	volts	270 μF	6	volts

NEW ! NEW ! NEW ! NEW !

An aerosol spray providing a convenient means of producing any number of copies of a printed circuit both simply and quickly.
Method: Spray copper laminate board with light-sensitive spray. Cover with transparent film upon which circuit has been drawn. Expose to light. (No need to use ultra-violet.) Spray with developer, rinse and etch in normal manner.

Light sensitive aerosol spray **£1**
Developer spray **50p**

G. F. MILWARD, Drayton Bassett, Tamworth, Staffs. Postage (minimum) per order 15p.

Video Spray 90 cleans tape heads-in operation

A quick squirt of Video-spray 90 and your tape heads and gaps are rapidly cleaned. And you can use Video-spray 90 whilst the machine is in operation. It dissolves even hardened dirt by simultaneous physical and mechanical action.

99·8% pure. Video-spray 90 can be used safely with any video or sound recording machine. The spray doesn't attack plastics, is electrically non-conductive and is not inflammable.

Supplied in 2·5oz. and 6oz. cans
Available through your Retailer or direct from

Special Products Distributors Ltd.

81 Piccadilly, London, W1V 0HL. Tel: 01-629 9556

ERSIN Multicore 5 CORE SOLDER

for fast, easy, reliable soldering

Contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux required.

SAVBIT ALLOY ALSO REDUCES COPPER BIT WEAR.
Economically packed for general electrical and electronic soldering. 75 ft. 18 gauge on plastic reel. Recommended retail price 75p
Size 12

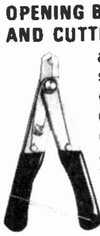
THIN GAUGE SOLDER, ESSENTIAL FOR soldering small components and thin wires. High tin content, low melting point, 60/40 alloy, 170 ft. 22 gauge on plastic reel. Recommended retail price 75p
Size 10

A RANGE OF SOLDERS IN HANDY DISPENSERS.

REF.	ALLOY	SWG	
19A	60/40	18	18p *
Size 5 (illustrated)	Savbit	18	18p *
15	60/40	22	22p *

*Recommended Price

INVALUABLE FOR STRIPPING FLEX, THE NEW AUTOMATIC OPENING BIB WIRE STRIPPER AND CUTTER, easily adjustable for all standard diameters. Plastic covered handles can also be used as wire cutter. Recommended retail price **50p**



From Electrical and Hardware shops. If unobtainable, write to: Multicore Solders Ltd., Hemel Hempstead, Herts.

28 watts, r.m.s. 40Hz to 40kHz ± 3dB

Viscount III Audio Suite complete £49

There are two stereo amplifiers—the R100 for ceramic cartridges, the R101 for magnetic and ceramic. Both incorporate FETs (FIELD EFFECT TRANSISTORS), just like top-priced units. FETs give you more of the signal you want, and almost none of the background hiss you don't. Both units have a jack socket to plug in headphones and there's a separate output for tape recorder. Filters (an unusual feature in this price range) and tone controls give a wide range of bass and treble adjustment which compensate for input deficiencies and domestic acoustic conditions.

PRICES SYSTEM 1

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

Available complete for only £52 + £3·50 P.&P.

SYSTEM 2

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

Available complete for £69 + £4 P.&P.

SYSTEM 3

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

Available complete for only £49 + £3·50 P.&P.

SPEAKERS Duo Type II
Size approx. 17in × 10¾in × 6¾in. Drive unit 13in × 8in with parasitic tweeter. Max. power 10W, 3 ohms. Simulated Teak cabinet. **£14 pair** + £2 P. & P.
Duo Type III Size approx. 23½in × 11½in × 9½in. Drive unit 13½in × 8¼in with H.F. speaker. Max. power 20W at 3 ohms. Frequency range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair** + £3 P. & P.

SPECIFICATION R100/101
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 × 9in × 3¾in.

R+TV

Radio and TV Components (Acton) Ltd. 21d High Street., Acton, London, W3 6NG
323 Edgware Road, London, W.2. Mail orders to Acton. Terms C.W.O. *All enquiries S.A.E.*

Goods not dispatched outside U.K.

See opposite page for addresses

BI-PRE-PAK LIMITED

FULLY TESTED AND MARKED

	£p		£p
AC107	0·15	OC170	0·23
AC126	0·13	OC171	0·23
AC127	0·17	OC200	0·25
AC128	0·13	OC201	0·25
AC176	0·25	2G301	0·13
ACY17	0·15	2G303	0·13
AF239	0·37	BC113	0·10
AF186	0·50	2N1302-3	0·20
AF139	0·37	2N1304-5	0·25
BC154	0·25	2N1306-7	0·30
BC171 = BC107	0·13	2N1308-9	0·35
BC172 = BC108	0·13	2N3819FET	0·45
BF194	0·15		
BF274	0·15	**Power Transistors**	
BFY50	0·20		
BSY25	0·57	OC20	0·50
BSY26	0·13	OC23	0·30
BSY27	0·13	OC25	0·25
BSY28	0·13	OC26	0·25
BSY29	0·13	OC28	0·30
BSY95A	0·15	OC35	0·25
OC41	0·13	OC36	0·37
OC44	0·13	AD149	0·30
OC45	0·13	AUY10	1·25
OC71	0·13	2S034	0·25
OC72	0·13	2N3055	0·63
OC73	0·17	**Diodes**	
OC81	0·13	AAY42	0·10
OC81D	0·13	OA9S	0·10
OC83	0·20	OA79	0·09
OC139	0·13	OA81	0·09
OC140	0·17	IN9114	0·07

FREE!

PACKS OF YOUR OWN CHOICE UP TO THE VALUE OF 50p WITH ORDERS OVER £4

CLEARANCE LINES

COLOUR T.V. LINE OUTPUT TRANSFORMERS. Designed to give 25KV when used with PL509 and PY500 valves. As removed from colour receivers at the factory. **NOW ONLY 50p each.** Post and Packing 25p.

1 Amp. Plastic Rectifiers. These are voltage, reverse polarity and other rejects from the BY127 range. Ideal for low voltage Power Units, etc. Price: £1 per 100.

	1–10	10–50	50+
BB105 Varicap Diodes	10	8	6
OC71 or 72 Fully tested Unmarked	5	5	4
Matched sets, 1-OC44 & 2–OC45's. Per Set	25	20	15
Matched Sets of OC45's 1st & 2nd IF	15	12	10
OA47 Gold Bonded Diodes, Marked & tested	3	3	2
1 Watt Zener Diodes 7 5, 24, 27, 30, 36, 43, Volts	5	4	3
10 Watt Zener Diodes 5·1, 8·2, 11, 13, 16, 24, 20, 100v.	20	17	15
Micro Switches, S/P, C/O.	25	20	15
1 Amp. Bridge Rect. 25v.	25	22	20
INTEGRATED CIRCUITS			
SL403D Audio Amp. 3 Watt	2·00	1·95	1·80
709C Linear Opp. Amp.	50	40	35
Gates Factory Marked & Tested by A.E.I.	25	22	20
J.K. Flip Flops Factory Marked & Tested, A.E.I.	40	35	30
PA234 1 Watt Audio Amp.	1·00	90	80
UL914 Dual 2 I/P Gate	40	35	30

NEW TESTED AND GUARANTEED PAKS

B2	4	Photo Cells, Sun Batteries. 0·3 to 0·5V, 0·5 to 2mA.	50p
B79	4	IN4007 Sil. Rec. diodes, 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, mixed types large and small	50p
B99	200	Mixed Capacitors. Postage 13p. Approx. quantity, counted by weight	50p
H4	250	Mixed Resistors. Postage 10p. Approx. quantity, counted by weight	50p
H7	40	Wirewound Resistors. Mixed types and values. Postage 8p	50p
H8	4	BY127 Sil. Recs. 1000 PIV. 1 amp. plastic	50p
H9	2	OCP71 Light Sensitive Photo Transistor	50p
H12	50	NKT155/259 Germ. diodes, brand new stock clearance	50p
H18	10	OC71/75 uncoded black glass type PNP Germ.	50p
H19	10	OC81/81D uncoded white glass type PNP Germ.	50p
H28	20	OC200/1/2/3 PNP Silicon uncoded TO-5 can	50p
H29	20	OA47 gold bonded diodes coded MCS2	50p

F.E.T. PRICE BREAKTHROUGH ! ! !

This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is also an excellent replacement for the 2N3819.

Data sheet supplied with device.

1-10 **30p** each, 10-50 **25p** each, 50+ **20p** each.

OUR VERY POPULAR 3p TRANSISTORS

FULLY TESTED & GUARANTEED

TYPE "A" PNP Silicon alloy, metal TO-5 can. 2S300 type, direct replacement for the OC200/203 range.

TYPE "B" PNP Silicon, plastic encapsulation, low voltage but good gain, these are of the 2N3702/3 and 2N4059/62 range.

TYPE "E" PNP Germanium AF or RF—please state on order. Fully marked and tested.

TYPE "F" NPN Silicon plastic encapsulation, low noise amplifier of the 2N3708, 9, 10, 11.

Make a Rev. Counter for your Car. The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car. **£1 each**

BULK BUYING CORNER

NPN/PNP Silicon Planar Transistors, mixed, untested, similar to 2N706/6A/8, BSY26-29, BSY95A, BCY70, etc. **£4·25** per 500; **£8** per 1,000.

Silicon Planar NPN Plastic Transistors, untested, similar to 2N3707-11, etc., **£4·25** per 500; **£8** per 1,000.

Silicon Planar Diodes, DO-7 Glass, similar to OA200/202, BAY31-36, **£4·50** per 1,000.

NPN/PNP Silicon Planar Transistors, Plastic TO-18, similar to BC113/4, BC153/4, BF153/160, etc., **£4·25** per 500; **£8** per 1,000.

OC44, OC55 Transistors fully marked and tested, 500+ at **8p** each; 1,000+ at **6p** each.

OC71 Transistors, fully marked and tested, 500+ at **6p** each; 1,000+ at **5p** each.

3823E Field effect Transistors. This is the 2N3823 in Plastic Case, 500+ **13p** each; 1,000+ **10p** each.

1 amp Miniature Plastic Diodes:
IN4001, 500+ **3p** each; 1,000+ **3p** each.
IN4004, 500+ at **5p** each, 1,000+ at **4p** each.
IN4006, 500+ at **6p** each, 1,000+ at **5p** each.
IN4007, 500+ at **8p** each, 1,000+ at **7p** each.

NEW UNMARKED UNTESTED PAKS

B66	150	Germanium Diodes Min. glass type	50p
B83	200	Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	50	Sil. Diodes sub. min. IN914 and IN916 types	50p
B88	50	Sil. Trans. NPN, PNP, equiv. to OC200/1, 2N706A, BSY95A, etc.	50p
B60	10	7 Watt Zener Diodes Mixed Voltages	50p
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	50p
H10	25	Mixed volts, 1½ watt Zeners. Top hat type	50p
H11	30	MAT Series "alloy" pnp Transistors	50p
H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
H16	8	Experimenters' Pak of Integrated Circuits. Data supplied	50p
H20	20	BY126/7 Type Silicon Rectifiers, 1 amp plastic. Mixed volts.	50p

FREE CATALOGUE AND LISTS for:—
TRANSISTORS, RECTIFIERS, DIODES, INTEGRATED CIRCUITS, FULL PRE-PAK LISTS & SUBSTITUTION CHART

MINIMUM ORDER 50p CASH WITH ORDER PLEASE. Add 10p post and packing per order. OVERSEAS ADD EXTRA FOR AIRMAIL.

8 RELAYS FOR £1

Various Contacts and Coil Resistances. No individual selection. Post and Packing 25p

FREE! A WRITTEN GUARANTEE WITH ALL OUR TESTED SEMICONDUCTORS

BI-PRE-PAK LTD DEPT. A. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX
TELEPHONE: SOUTHEND (0702) 46344

OSMABET LTD.

We make transformers amongst other things

MAINS TRANSFORMERS
Prim. 200/240V a.c. TX6, 425–0–425V, 500 Ma, 6·3V 6A CT, 6·3V 6A CT, 0·5–6·3V 3A, **£12·75**; **TX1**, 425–0–425V, 250Ma, 6·3V 4A CT, 6·3V 4A CT 0–5–6·3V, 3A, **£7·50**; TX2, 250–0–250V, 150mA, 6·3V4A CT, 0–5–6·3V, 3A, **£4·05**; TX5, 300–0–300V, 120mA, 6·3V 2A CT, 6·3V, 2A, 6·3V, 1A, **£4·05**; TX8, 250–0–250V, 65mA, 6·3V, 1·5A, **£2·10**; MT1, 200V, 30mA, 6·3V, 1A, **£1·20**; MT2, 230V, 45mA, 6·3V, 1·5A, **£1·50**; MT2A, 250V, 60mA, 6·3V, 2A, **£1·95**; MT3 Prim. 110/240V, Sec. 250V, 100mA, 6·3V, 2A, **£2·25**.

AUTO TRANSFORMERS
30 to 4000 watt ex stock, up to 1000 watt to order.

MULTIVOLT TRANSFORMERS
Prim. 200/240V a.c. OMT4/1. One tapped sec, 5–20–30–40–60V giving 5–10–15–20–25–30–40–45–55–60, 10–0–10, 20–0–20; 30–0–30V a.c., 1A, **£2·25**; OMT4/2 ditto, 2A, **£3·45**; OMT5/1 one tapped sec, 40–50–60–80–90–100–110V a.c., 1A, **£3·45**. Duo 12V 4A–12V 4A **£3·60**; Duo 0–10–20–25V 2A–0–10–20–25V 2A **£3·60**.

LOW VOLTAGE TRANSFORMERS
Prim. 200/240V a.c., 6·3V, 1·5A, **85p**; 3A, **£1·13**; 6A CT, **£1·80**; 12V, 1·5A, **£1·13**; 3A CT, **£1·80**; 6A CT, **£2·70**; 18V, 1·5A CT, **£1·80**; 24V, 1·5A CT, **£1·80**; 3A CT **£2·70**; 5A, **£3·75**; 8A, **£6**; 12A, **£9**; 40V, 3A CT, **£3·45**.

MIDGET RECTIFIER TRANSFORMERS
For FW rect., size 1¾ × 2 × 1½in, Prim. 200/240V a.c. output, PPT1 9–0–9V, 0·3A, PPT2 12–0–12V, 0·25A, PPT3 20–0–20V, 0·15A, **£1·20** each; ditto, size 2 × 2½ × 1¾in MTV1 9–0–9V, 1A, **98p**; MTV2 12–0–12V, 1A, MTV3 20–0–20V, 0·75A, **£1·20** each.

O/P TRANSFORMERS FOR POWER AMPLIFIERS
P.P. sec. tapped 3–7·5–15 ohms, A–A 6·6kΩ, 30W (KT66, etc.), **£4·05**; 50W, 3kΩ, A–A, **£6·75**; 100W, 3kΩ, A–A, EL34 (KT88, etc.), **£11·40** with and to 400W.

LOUDSPEAKERS, HI-FI, P.A., GUITAR, ETC.
New boxed famous makes, 25W, **£5·60**; 35W **£7·20**; 50W, **£9·45**; 100W, **£19·90**; E.M.I. 13½ × 8in, 10W, 3, 8 and 15 ohms, **£2·25**; fitted two tweeter Hi-Fi, 3, 8 and 15 ohms, **£4**; 3", 3 ohms; 3½", 3 or 15 ohms; 5", 3, 15 or 25 ohms, **90p**. 7" × 4", 3 ohms, **£1·10**.

TAPE RECORDER MOTORS
A variety of uses, Blowers, Fans, Models, etc.; new, 110V a.c., **30p** each or per pair **50p**, plus p. & p. 20p.

CONDENSERS
Paper, 0·01/2KV, **12½p**; 0·22/800V a.c. **25p**; 40/150V **25p**; 4/500V, **25p**. Electrolytics, 6000/15V, **10p**.

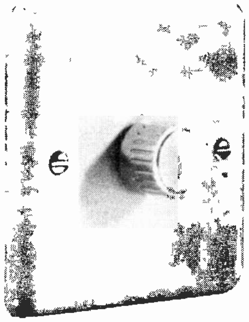
12V LT FLUORESCENT LIGHTING
Complete 8 watt 12 in fitting with tube, **£3·75**; 12V inverter for 20 watt tube, **£5·75**.

PRINTED CIRCUIT ETCHING KITS
Comprehensive factory pack, with all solutions, and equipment to make your own P.C. boards, instructions, **£1·25**. Carriage extra all orders

S.A.E. INQUIRIES-LISTS, MAIL ORDER ONLY

46 Kenilworth Road, Edgware, Middx. HA8 8YG
Tel. 01-958 9314

Vary the strength of your lighting with a DIMMASWITCH



The DIMMASWITCH is an attractive and efficient dimmer unit which fits in place of the normal light switch and is connected up in exactly the same way. The ivory mounting plate of the DIMMASWITCH matches modern electric fittings. Two models are available, with the bright chrome knob controlling up to 300 w or 600 w of all lights except fluorescents at mains voltages from 200-250 v, 50Hz. The DIMMASWITCH has built-in radio interference suppression:

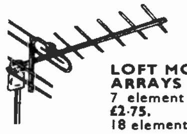
600 Watt **£3·20**. Kit Form **£2·70**
300 Watt— **£2·70**. Kit Form **£2·20**

All plus 10p post and packing.
Please send C.W.O. to:—

DEXTER & COMPANY
1 ULVER HOUSE, 19 KING STREET
CHESTER CH1 2AH Tel. 0244-25883
As supplied to H.M. Government Departments

U.H.F. TV AERIALS

SUITABLE FOR COLOUR & MONOCHROME RECEPTION



All U.H.F. aerials now fitted with tilting bracket and 4 element reflector.

LOFT MOUNTING ARRAYS
7 element **£2·25**. 11 element **£2·75**. 14 element **£3·25**. 18 element **£3·75**.

WALL MOUNTING c/w **WALL ARM AND BRACKET.** 7 element **£3·25**. 11 element **£3·75**. 14 element **£4·25**. 18 element **£4·75**.

CHIMNEY MOUNTING ARRAYS c/w **MAST AND LASHING KIT.** 7 element **£4**. 11 element **£4·50**. 14 element **£4·75**. 18 element **£5·25**.

MAST MOUNTING arrays only 7 element **£2·25**. 11 element **£2·75**. 14 element **£3·25**. 18 element **£3·75**. Complete assembly instructions with every aerial. LOW LOSS coaxial cable 9p yd.

KING TELEBOOSTERS from **£3·75**. LABGEAR all band V.H.F.—U.H.F.—F.M. radio mains operated pre-amps **£7·50**. State clearly channel number required on all orders. P. & P. on all aerials 50p accs. 15p. C.W.O. min. C.O.D. charge 25p.

BBC-ITV-FM AERIALS

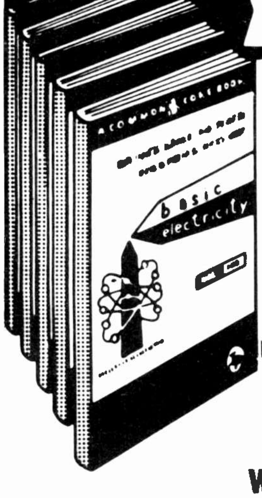
BBC (band I) Wall S/D **£2**. **LOFT** inverted 'T' **£1·25**. **EXTERNAL** 'H' array only **£3**. **ITV (band 3)** 5 element loft array **£2·50**. 7 element **£3**. **COMBINED BBC-ITV** loft 1+5 **£2·75**. 1 + 7 **£3·50**. **WALL AND CHIMNEY UNITS ALSO AVAILABLE.** Pre-amps from **£3·75**.

COMBINED U.H.F.-V.H.F. aerials 1+5+9 **£4**. 1+5+14 **£4·50**. 1+7+14 **£5**. **F.M. RADIO** loft S/D **£1**. 3 element **£3·25**. 4 element **£3·50**. Standard coaxial plugs 9p. Coaxial cable 5p yd. Outlet box 30p. P. & P. all aerials 50p, accs. 30p. C.W.O. min. C.O.D. charge 25p. Send 5p for fully illustrated lists.

CALLERS WELCOMED
OPEN ALL DAY SATURDAY

K.V.A. ELECTRONICS
40-41 Monarch Parade, London Rd.
Mitcham, Surrey
Telephone 01-648 4884

YOURS FREE FOR 7 DAYS



The 'New Picture-Book' way of learning
BASIC ELECTRICITY (5 VOLS.) ELECTRONICS (6 VOLS.)

You'll find it easy to learn with this outstandingly successful NEW PICTORIAL METHOD—the essential facts are explained in the simplest language, one at a time, and each is illustrated by an accurate, cartoon-type drawing. The books are based on the latest research into simplified learning techniques. This has proved that the PICTORIAL APPROACH to learning is the quickest and soundest way of gaining mastery over these subjects.

TO TRY IT, IS TO PROVE IT

The series will be of exceptional value in training mechanics and technicians in Electricity, Radio and Electronics.

WHAT READERS SAY

"HELPED ME TO UNDERSTAND"
"I am a qualified electrician. Your set of excellent books has helped me to understand matters in the field of electronics which I thought previously were above me. Indeed these books are well worth the money." *T.E.D., Abergavenny*

"MOST PERFECT BOOKS"
"I have decided to send you the full payment for the books you mailed to me, in my mind they are the most perfect books for any beginner to Electronics." *G.G., London, S.W.8*

"BEST BOOKS IN THIS COUNTRY"
"On going through these books I have found that they are the best books I have ever had in this country." *A.P.L., Norwich*

POST NOW FOR THIS OFFER!!

To The SELRAY BOOK CO., 60 HAYES HILL, HAYES, BROMLEY, KENT BR2 7HP

Please send me WITHOUT OBLIGATION TO PURCHASE, one of the above sets on 7 DAYS FREE TRIAL, I will either return set, carriage paid, in good condition within 7 days or send the following amounts. BASIC ELECTRICITY £4·50. Cash Price on Down Payment of £1 followed by 4 fortnightly payments of £1 each (Total £5). BASIC ELECTRONICS £5·40. Cash Price or Down Payment of £1 followed by 5 fortnightly payments of £1 each (Total £6). This offer applies to UNITED KINGDOM ONLY. Overseas customers cash with order, prices as above.

Tick Set required (*Only one set allowed on free trial*)

BASIC ELECTRICITY ☐ **BASIC ELECTRONICS** ☐

Prices include Postage and Packing.

Signature ....
(*If under 18 signature required of parent or guardian*)

NAME ....
BLOCK LETTERS
FULL POSTAL ADDRESS..
....

The truth about Tottenham Ct. Rd.

To any stereo bug Tottenham Court Road is a little like Mecca.

It's impossible to stay away.

The lure? A street of shiny shops. Full of fabulous Hi-Fi goodies. All of them with a price tag that implies strongly that they're really being given away. Stroll up from the Dominion to Warren Street Station.

And you'll get the feeling that this is the one street in the whole wide world

where you'll get a stereo bargain.

You want to know the truth? It ain't necessarily so.

Of course the prices are keen along the grimy mile. They have to be.

But Tottenham Court Road is by no means the only place where stereo is priced sensibly. If you want to buy good stereo—and I mean good stereo—without bankrupting yourself, all you have to do is visit your nearest Eagle dealer.

And there are lots of them.

Eagle

You probably already know the name

Eagle. Most people do. But assume for a moment you don't.

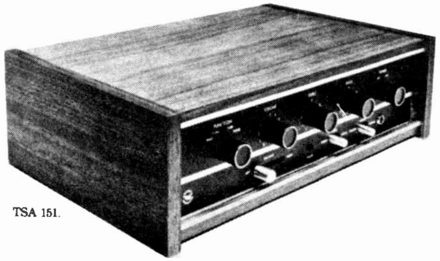
Eagle International are manufacturers and importers of over 400 lines of Audio and Hi-Fi equipment. (what we don't make, is made strictly to our specifications and usually our design).

The MD of the Company is Gerry Adler. That's me.

Eagle International has a company philosophy. We believe that no customer can be expected to buy a product for which no one takes responsibility. So I personally take responsibility for all the equipment we sell. We give everything a complete two-year no-nonsense guarantee. So if something ever does go wrong with anything with the Eagle name on it–I'm the one you hammer.

Amps

Amplifiers come at all prices. The main



TSA 151.

difference between them is power output. And signal to noise ratio. There are three new Eagle amplifiers.

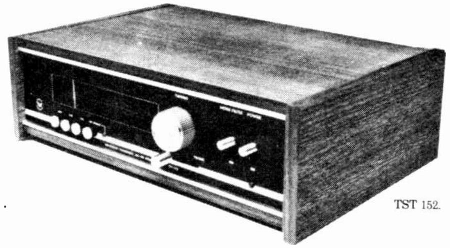
The TSA 149 is £26·00. It has a better than 25-18,000 Hz frequency range.

Its signal to noise ratio is in excess of a very healthy 50dB. Output power is 7 watts RMS per channel.

And it's perfect for rooms up to 16′ x 18′.

The TSA 150 is £29·60. Frequency range is 30-18,000 Hz. Signal to noise ratio is better than 50 dB. (there are amplifiers on the market with signal-to-noise ratios of less than 30 dB. And the most expensive amps don't give you much better than 70 dB.) Power output is 7.5 watts RMS per channel. Provision for main/remote speakers. And it performs beautifully in rooms up to 16′ x 18′.

Lastly comes the TSA 151. At £36.00 there's nothing else that gets near it on the market. Frequency range is a tremendous 20-34,000 Hz. (The average human ear can only



TST 152.

hear sound waves travelling between 25 and 16,000 cycles per second)

The extra power of the TSA 151 means really low distortion at the top and bottom ends. Signal to noise is a more than ample 54 dB. And there's a very hefty 15 watts RMS per channel power output.

Room size? Pretty well as big as you like.

And Tuners

We also have a splendid new stereo tuner. Called the TST 152. It costs just over £37.00. It receives AM, FM and stereo multiplex broadcasts. Has wide-ranged switched AFC. FET front-end. And it's designed to match the TSA 149 and 151 amplifiers.

Eagle as Furniture

If you buy a decent tuner or amp your wife is going to be living with it for a long, long time. So we've designed all our equipment not only to perform well but look good too.

The TSA 149, 150, and 151 and the TST 152 all have visually strong fascia and matching veneered teak cabinets.

So now you know that Tottenham Court Road isn't the only place in the world for good stereo equipment. I've written a book called 'Stereo—and how to avoid making an expensive mistake'. It's got specs of all our equipment—and a lot more besides. It's in full colour.

And it's free.

If you'd like a copy just fill in the coupon below, and I'll get one sent to you right away.

And remember—there's an Eagle International dealer near you.

And he's always happy to help in any way he can.

Gerry Adler

Please send me right away my free copy of 'Stereo—and how to avoid making an expensive mistake'.

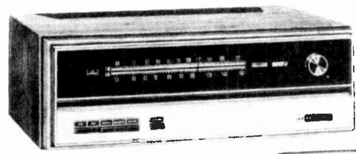
Name

Address

Eagle International

Precision Centre, Heather Park Drive, Wembley HAO 1SU. 01-903 0144

5

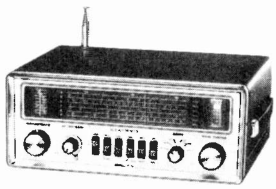


UBC-4
Battery Charger

TRENT
Speaker

The new HEATHKIT catalogue is now available ...FREE on request

MI-29
Fish Spotter



GR-78 Shortwave Receiver

GD-48 Metal
Locator

The new AR-2000 Tuner Amplifier

HEATHKIT

HEATH (Gloucester) LTD., GLOUCESTER GL2 6EE

Why not visit the Heathkit showrooms in London or Birmingham?
233 Tottenham Court Road
London
17-18 St. Martin's House
Birmingham

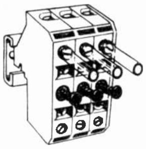
Please send me the free Heathkit Catalogue

Name ....

Address ....

.... 25/11

FLEX CONNECTOR



A quick way to connect equipment to the mains safely and firmly—L, N, and E, coded to new colour scheme; disconnection by plugs prevents accidental switching on; has sockets which allow insertion of meter without disconnection; cable inlets firmly hold one hair wire on up to four 7·029 cables. **85p** each.

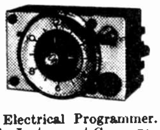
MULTI-SPEED MOTOR

Six speeds are available 500, 850 and 1,000 r.p.m. and 8,000, 12,000 and 15,500 r.p.m. Shaft is ¼ in diameter, 230/240V, its speed may be further controlled with the use of our Thyristor controller. A very powerful and useful motor size approx. 2 in dia. × 5 in long, mains 230/240V. Price **88p** plus 23p postage and insurance.

2 OCTAVE MINI ORGAN

As described in Practical Wireless, November. Send today for list of parts.

20 AMP ELECTRICAL PROGRAMMER



Learn in your sleep: Have Radio playing and kettle boiling as you awake — switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an Electrical Programmer. Made by the famous Smiths Instrument Company. This is essentially a 230/240V mains operated Clock and a 20A Switch, the switch-off time of which can be delayed up to 12 hours (continuously variable not stepped). Similarly the switch-on time can be delayed. This is a beautiful unit, size 5¼ in × 3¾ in × 2¼ in deep. Metal encased, glass fronted with chrome surround. Offered at **£2·40** plus 23p postage and insurance.

RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1 each or £11 per dozen. Specify 5, 10 or 15 amp—*simply fit in place of switch.*

BLANKET SWITCH

Double pole with neon let into side so luminous in dark. Ideal for dark room light or for use with waterproof element, new plastic case **30p** each. 3 heat model **40p**.

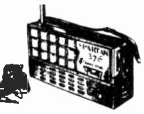
2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling, adjustable thermostat acts as auto control and safety cut-out. Complete kit **£3·75**. Post and ins. 38p.

COMPUTER TAPES

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide **£1·45** plus 33p post and insurance, with cassette. ¾in wide **£1·25** plus 30p post and insurance with cassette. ½in wide **£1** plus 25p post and insurance with cassette. Spare spools and cassettes—1in **£1**, ¾in **85p**, ½in **75p** each plus 20p post and insurance.

SPARTAN Portable RADIO



Long and medium wave 7 transistor, size 6 in × 4 in × 1½ in. With larger than usual speaker giving very good tone. Built-in ferrite aerial and telescopic aerial for distant stations. A real bargain complete with leather case, carry sling, earplug and case **£3·75** plus 25p post and ins.

PROTECT VALUABLE DEVICES

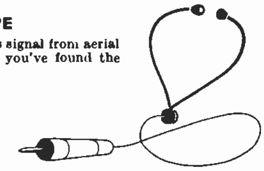
FROM THERMAL RUNAWAY OR OVER-HEATING:

Thyristors, rectifiers transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90 deg. to 190 deg. F. or with the dial removed range setting is between 80 to 800 deg. F. Price **50p.**

CAPACITOR DISCHARGE CAR IGNITION

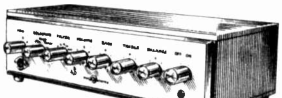
This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for improved and even more efficient version, price **£4·95** + 30p post. When ordering please state whether for positive or negative systems.

RADIO STETHOSCOPE



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 inc. 20p.

P.E. GEMINI



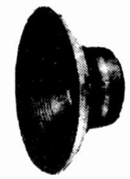
Dual purpose twin 30W stereo amplifier for exceptional performance. Complete kit of parts less case **£45** or reprint of data and parts list 55p.

STANDARD WAFER SWITCHES

Standard size 1¼ wafer—silver-plated 5-amp contact· standard ¼" spindle 2" long—with locking washer and nut·

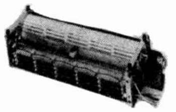
No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1.45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

THIS MONTH'S SNIP



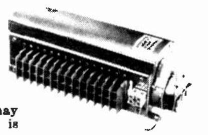
15 WATT 12in HI-FI SPEAKER. Is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 15W R.M.S.—Cone moulded fibre—Freq. response 30-10,000 c.p.s. specify 3 or 15 ohms. Chassis diam. 12 in—12¾ in over mounting lugs. Overall height 5½ in. A £10 speaker offered this month for **£3·75** plus 30p post and ins.

TANGENTIAL HEATER UNIT



This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. **£3·50.** 2kW Model as above except 2 kilowatts **£2·50.** Don't miss this. Control Switch **35p.** P. & P. 40p.

HONEYWELL PROGRAMMER



This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing. Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price **£5·75** plus 25p post and insurance. Don't miss this terrific bargain.

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect. first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPN matched pair. Regular price of parcel well over **£5.** Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 5/- upwards with circuits and technical data of each. Complete parcel only **£1** post paid. *DON'T MISS THIS TERRIFIC BARGAIN.*

DIGITAL COUNTER TIMER

Very stable and reliable crystal controlled circuit. Capable of work in excess of 15MHz. Construction simplified by use of 15 integrated circuits. Complete kit with case **£37·50**, or construction data and price list 30p.

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. **£2·50** plus 20p post and insurance.

DRILL CONTROLLER

NEW IKW 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.

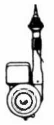
HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermister as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack **£5·50.**

P.E. CONSTRUCTIONAL PROJECTS

We can probably supply the components to build projects described in this issue and companion magazines. Send S.A.E. for list naming the project.

AUTO-ELECTRIC CAR AERIAL



with dashboard control switch—fully extendable to 40 in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. **£6** plus 250 post and insurance.

TOGGLE SWITCH

3 amp 250V, with fixing ring **7½p** each, **75p** doz.

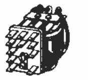
CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. **38p** each or 10 for **£3·42.**

ROCKER SWITCH

13A self-fixing into an oblong hole, size approximately 1in × ⅝in **6p** each, 10 for **54p.**

MAINS RELAY BARGAIN



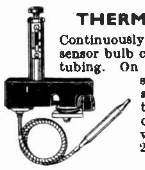
Special this month are some single, double and treble pole changeover relays. Contacts rated at 15A. Operating coil wound for 240V a.c. Good British make Unused. Size approx. 1½in × 1in. Open construction.

Single pole	**25p** each	10 for **£2·25**
Treble pole	**35p** each	10 for **£3·15**

BALANCED ARMATURE UNIT

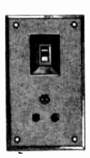
500 ohm, operates speaker or microphone, so useful in intercom or similar circuits. **6/6 each, £3·50 doz.**

THERMOSTAT



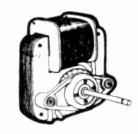
Continuously variable 30°-90°C. Has sensor bulb connected by 33 in of flexible tubing. On operation a 15 amp 250V switch is opened and in addition a plunger moves through approx. ⅛ in. This could be used to open valve on ventilator etc. **£1·50** plus 23p p. and ins.

5A 3-PIN SWITCHED SOCKETS



An excellent opportunity to make that bench dis board you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered switch sockets for only **50p** plus 18p post and insurance. (20 boxes post free.)

MAINS MOTOR



Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **50p.** Postage 15p for first one, then 5p for each one ordered.

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.

J. BULL (ELECTRICAL) LTD.

Dept. P.E. 7, Park Street, Croydon CRO IYD

VOL. 7 No. 11
November 1971

PRACTICAL ELECTRONICS

Editor F. E. BENNETT **Assistant Editor** M. A. COLWELL **Editorial Assistants** D. BARRINGTON G. GODBOLD M. KENWARD
Art Editor J. D. POUNTNEY **Technical Illustrators** J. A. HADLEY P. A. LOATES
Advertisement Manager D. W. B. TILLEARD

RETROSPECT AND PROSPECT

SEVEN years is a long time in electronics . . . PRACTICAL ELECTRONICS first appeared on the scene in mid October 1964. The very next day (!) Sir Alec Douglas-Home conceded victory to Mr. Harold Wilson. Shortly afterwards the Ministry of Technology was set up, intended by the incoming administration to be the symbol of a new technological era, and the British electronics industry received assurances of determined government backing in their battle with foreign competitors. At this time, valve manufacturers continued to face the future stoically despite the formidable progress of the transistor, but P.E. put its money on solid state from the word go.

Seven years on . . . the thermionic valve has all but conceded victory to the semi-conductor, and prepares to make its final stand in the high power region. On the other hand the transistor, after enjoying a few delightfully expansive years of near total sovereignity, is itself alerted to a serious threat from nearer home as that more recent offspring of solid state technology, the IC, makes its bid to take over the strategic small signal areas from its discrete brethen.

In the meanwhile . . . the government has changed once again and MinTech, child of that now demised white-hot technological revolution, is demolished and replaced by the no-nonsense, businesslike—if prosaic sounding—Department of Trade and Industry. Our semiconductor manufacturers, now "freed" after several years of cossetting at the taxpayers expense, bravely face the cold, hard outside world—as true exponents of private enterprise should—without a murmur (save perhaps, just a *little* one).

On the home constructor front developments proceed apace. It's an ill wind . . . IC manufacturers pour many thousands of their excess production onto the amateur market. Private designers and constructors get bigger ideas as the devices get smaller. Miniaturisation and yet expansion seems the order of the day.

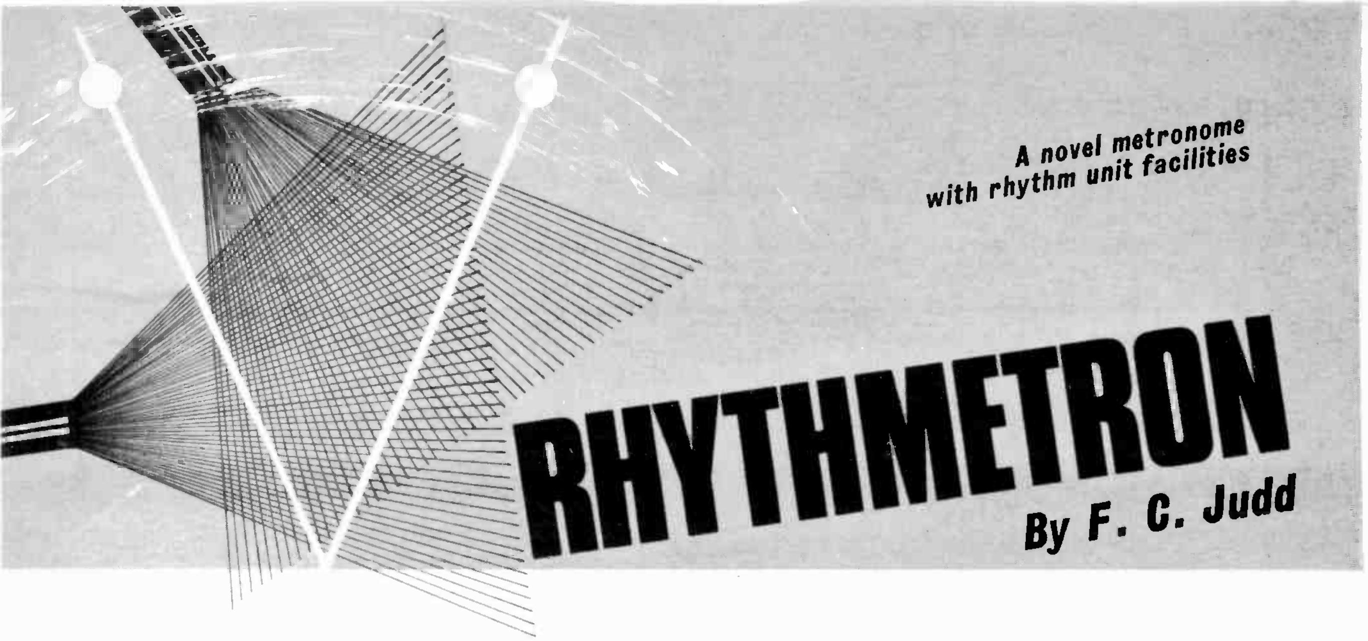
Today . . . the outlook is, indeed, promising. Yet how does one magazine such as ours cope with the inordinate demands arising from the increasing popularity of amateur electronics as a hobby? For, considering the various types of individuals already involved, or likely to become so any moment now, it is obvious that technical knowledge, practical skills, and areas of special interest and involvement range enormously.

continued on page 938

THIS MONTH

Our December issue will be published on Saturday, November 13.

Practical Electronics, Fleetway House, Farringdon St., London, E.C.4. Phone: *Editorial* 01-634 4452; *Advertisements* 01-634 4202



A novel metronome with rhythm unit facilities

RHYTHMETRON

By F. C. Judd

MANY circuits for simple electronic metronomes have been published but almost all of these have employed a multivibrator with one output coupled directly to a small high resistance loudspeaker. The resultant sound is a click, usually not very loud and bearing little resemblance to the more resonant beat produced by a mechanical metronome.

Unless an amplifier is included the loudness from a multivibrator and loudspeaker is not normally sufficient to make itself clearly audible above modern amplified musical instruments like the electronic organ or indeed above the sound produced by a small orchestra or choir.

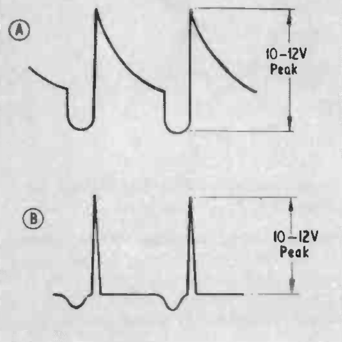
The signal output from the generator described in this article is more than sufficient to drive almost any amplifier but as the sound it produces has no bass content quite a loud sound will be obtained even with a 3W amplifier and relatively small speaker, certainly sufficient for practice with a domestic electronic organ or piano and probably enough for school music classes.

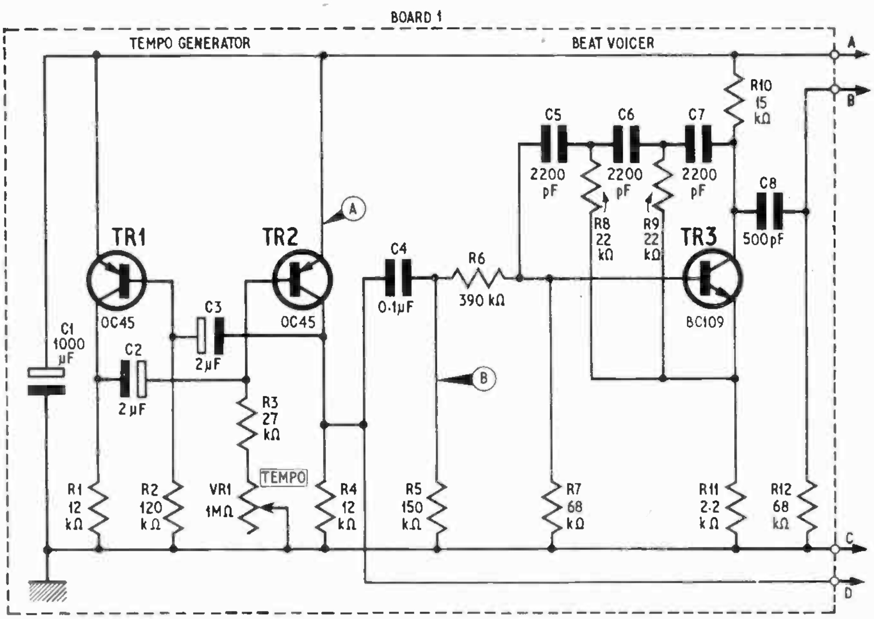
DRUM BRUSH RHYTHM

In addition to beat notes the generator will produce a steady drum brush effect with variable attack and decay so it also becomes a very simple rhythm unit. The tempo is continuously variable over the usual music range of about 40 to 250 beats per minute and to assist constructors a cut-out calibration scale is included with beats per minute marks and approximate settings for tempo variations between largo (very slow) and presto (very fast).

The generator does not produce accented beats as this requires complex counting circuitry but as the beats are steady it is quite easy to play against them in three-four, two-four or four-four time, or multiples, depending on the setting of the tempo control. As the drum brush attack and decay can be controlled, the "voicing" can be set to produce a fast attack and short decay for fast tempi and soft attack and slow decay for slow tempi such as the slow waltz.

TEMPO GENERATOR AND BEAT VOICER





THE CIRCUIT

The generator can be operated from batteries or a small mains power supply. It consumes only 2mA so it would run economically from two 9V batteries in series. The circuit given in Fig. 1 shows the complete generator with a battery supply. An alternative mains operated power unit is given in Fig. 2.

The first stage consists of a multivibrator. TR1 and TR2 are *pnp* transistors with emitters connected to the +18V rail. The tempo is controlled by VR1.

The output from TR2 collector provides a positive going pulse which is coupled via C4 to the "beat" voicer TR3. This transistor is an *npn* type and is connected as a phase shift oscillator biased to cut-off. The positive pulse from C4 instantly drives TR3 on but the short time constant provided by C4/R5 allows the pulse voltage to decay quickly. The output from TR3 is, therefore, a short but gradually decaying burst of oscillation of about 1,500Hz. The sound is a resonant tapping not unlike that of a clave and closely resembling the sound of a mechanical metronome.

THE DRUM BRUSH VOICER

The output from TR2 is also fed to R15 and the diode D2 which together with the attack/decay network VR2, R16, C11, C12 and VR3 provides a positive pulse with variable rise and decay time. This pulse, from C11, drives the drum brush amplifier TR4.

The white noise for the drum brush voicing is obtained from the special Zener diode D1. It must be emphasised that any "noisy" Zener may fail to produce the required amount of white noise which must be at least 50 to 100mV r.m.s. in level. The Z1J Zener diode specified will produce in excess of 100mV of noise and can be obtained from Semitron Limited, Cricklade, Wiltshire, price 40p including packing and postage.

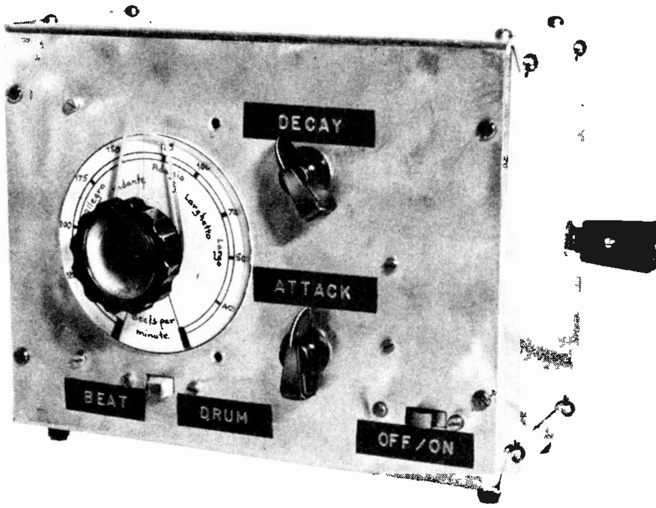
The outputs from the beat voicer (TR3) and the drum brush voicer (TR4) are taken to S1 which enables selection of either voice. The "mute" switch S3 is optional but it is a worthwhile addition as it will enable the user to leave the generator running but stop and start the signals as required.

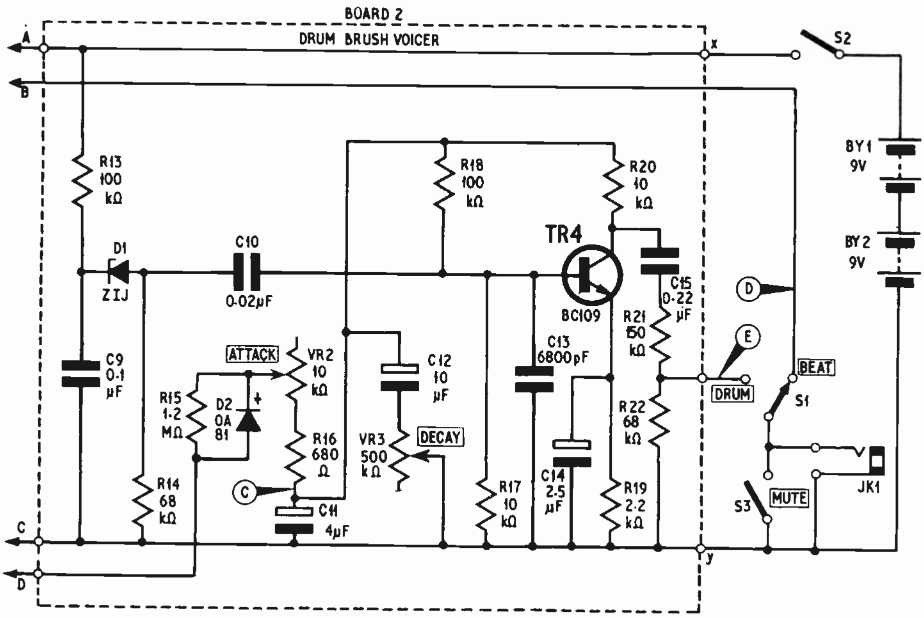
THE POWER SUPPLY

The alternative mains power supply of Fig. 2 requires a transformer with a secondary delivering between 12 and 18V. The current consumption required by the generator is small but the line voltage must be adjusted on load to 18V, hence the resistor R23 in the power supply may need to be larger depending on the transformer secondary voltage. If the transformer specified is used it can be mounted on a piece of Veroboard together with the rectifier and the reservoir capacitor C16 and R23 omitted as shown in Fig. 3. If two 9V batteries are used they can be retained within the generator case by suitable clips.

CONSTRUCTION

In the prototype the generator was constructed on two boards as shown in Figs. 4 and 5. Board 1





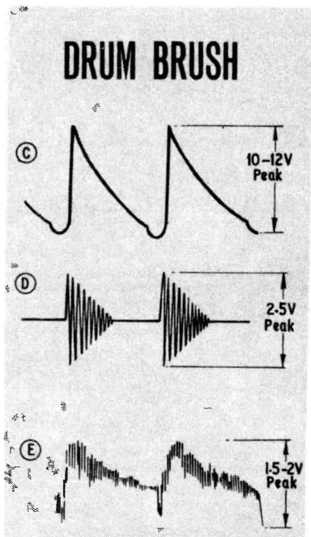


Fig. 1. Circuit diagram of the Rhythmetron

COMPONENTS . . .

Resistors

R1	12k Ω	R9	22k Ω	R17	10k Ω
R2	120k Ω	R10	15k Ω	R18	100k Ω
R3	27k Ω	R11	2·2k Ω	R19	2·2k Ω
R4	12k Ω	R12	68k Ω	R20	10k Ω
R5	150k Ω	R13	100k Ω	R21	150k Ω
R6	390k Ω	R14	68k Ω	R22	68k Ω
R7	68k Ω	R15	1·2M Ω	R23	470 Ω (see text)
R8	22k Ω	R16	680 Ω		

All 10% ½ watt carbon

Potentiometers

VR1 1M Ω log. carbon
VR2 10k Ω linear carbon
VR3 500k Ω linear carbon

Capacitors

C1	1,000μF elect. 25V	C9	0·1μF polyester
C2	2μF elect. 15V	C10	0·02μF polyester
C3	2μF elect. 15V	C11	4μF elect. 15V
C4	0·1μF polyester	C12	10μF elect. 15V
C5	2,200pF polystyrene	C13	6,800pF polystyrene
C6	2,200pF polystyrene	C14	2·5μF elect. 15V
C7	2,200pF polystyrene	C15	0·22μF polyester
C8	500pF polystyrene	C16	1,000μF elect. 25V

Transistors

TR1, TR2 NKT214 or OC45 (2 off)
TR3, TR4 BC109 (2 off)

Diodes

D1 ZIJ Zener (see text)
D2 OA81
D3–D6 Bridge rectifier LT119

Switches

S1 S.P.D.T. slide switch
S2 Single pole on/off switch
S3 Single pole on/off (see text)

Miscellaneous

T1 12–0–12V 50mA Eagle transformer type MR12
Universal chassis 8in × 6in × 4in.
BY1–BY2 9V batteries (2 off). JK1 Standard jack socket.

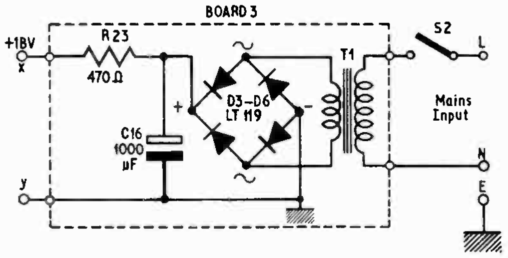


Fig. 2. Circuit diagram of the mains power supply unit

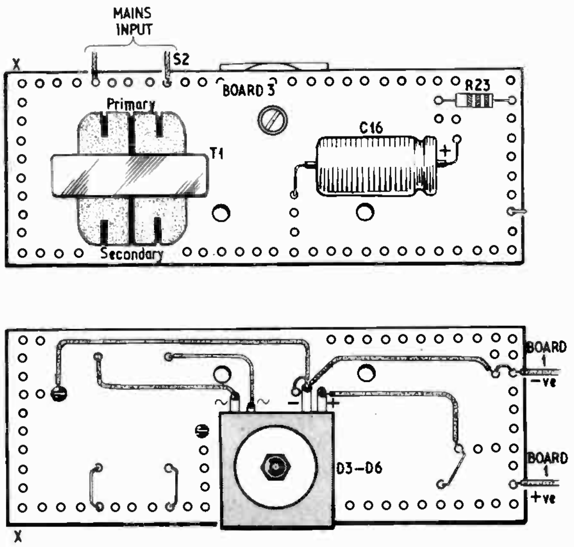


Fig. 3. Component assembly and wiring details for power supply board

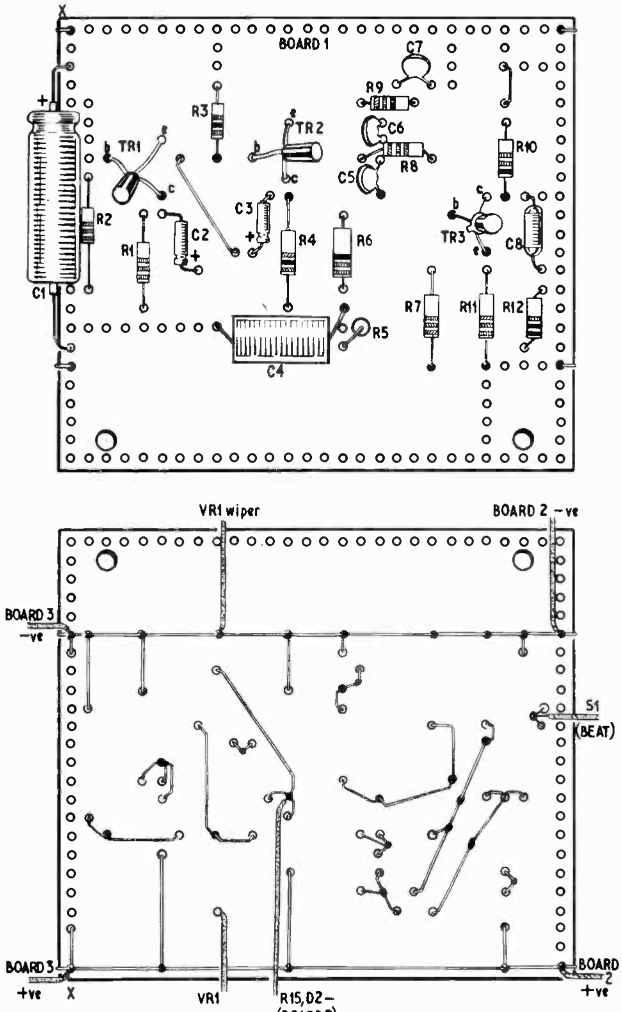
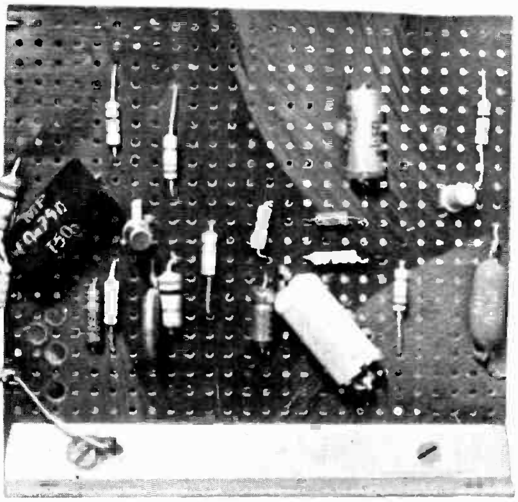


Fig. 4. Component assembly and wiring details for tempo generator and beat voicer circuits



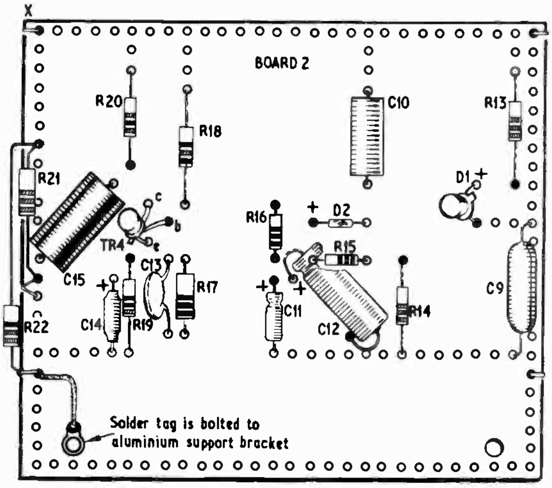
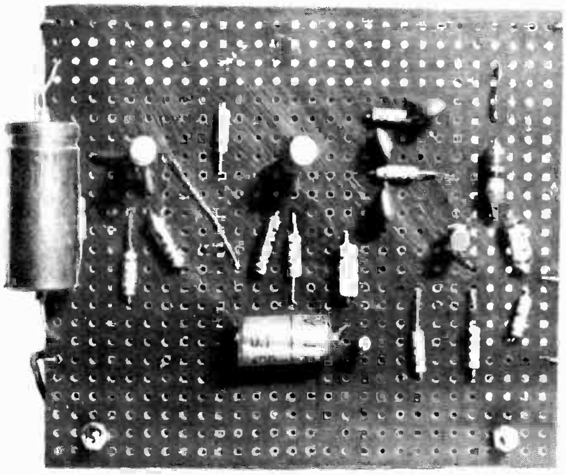
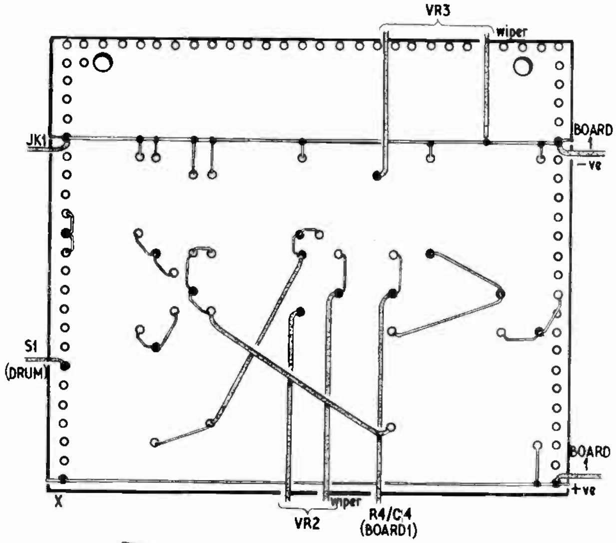


Fig. 5 (right). Component assembly and wiring details for drum brush voicer circuit





Tempo generator and beat voicer board

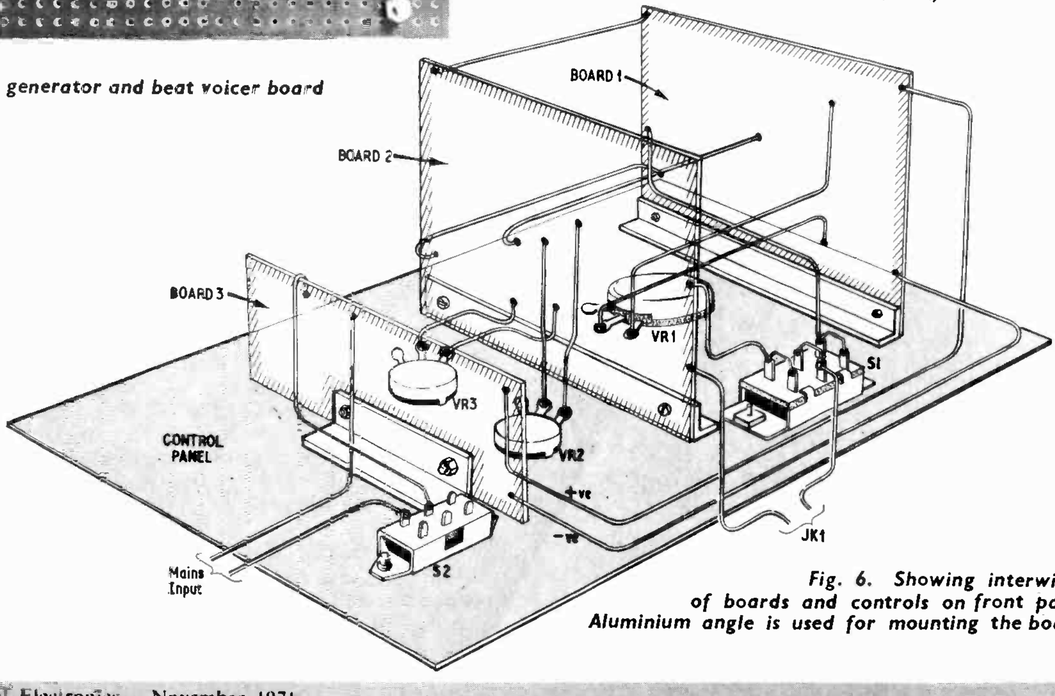
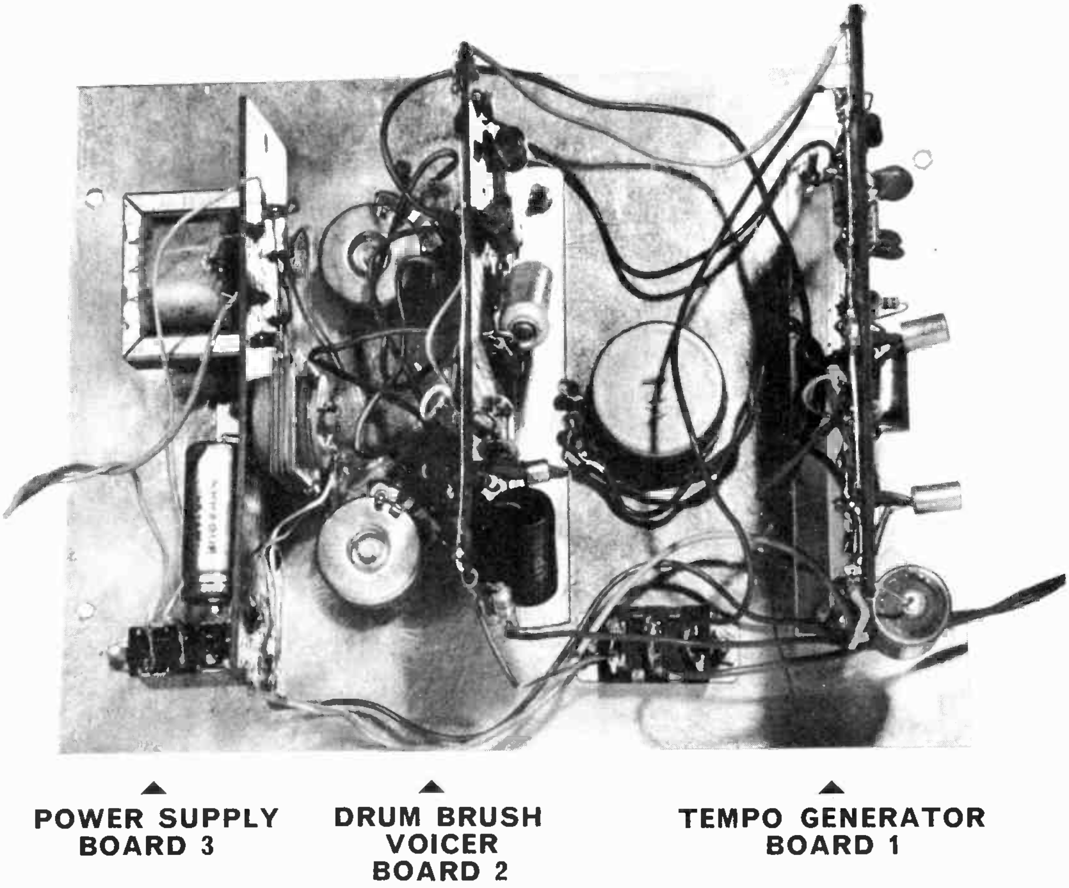


Fig. 6. Showing interwiring of boards and controls on front panel. Aluminium angle is used for mounting the boards



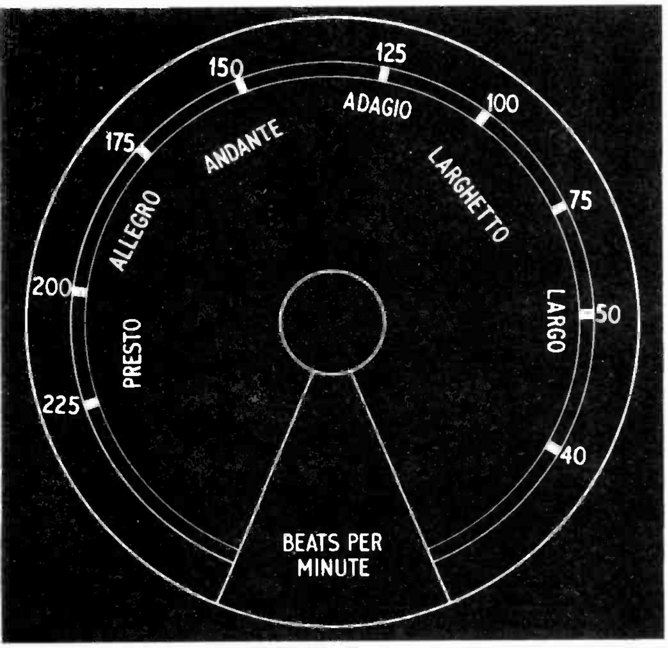


Fig. 7. Tempo calibration scale which can be cut out and pasted on the front panel

carries the multivibrator and beat voicer (TR3) and Board 2 contains the white noise generator and drum brush voicer (TR4).

The prototype was built into a case approximately 8in × 6in × 4in. Board interwiring and the layout of the front panel components is given in Fig. 6.

Note that VR1, which is a log potentiometer, is wired so that tempo increases with anti-clockwise rotation. This arrangement was found to provide a more linear calibration for the beats per minute scale. The scale is reproduced in Fig. 7 and can be cut out and used with the specified tempo potentiometer VR1.

OSCILLOGRAMS AND VOICE VARIATIONS

To check the correct circuit functioning the oscillograms in Fig. 1 should be found by monitoring at the letter reference points. Of course, depending on the time base speed of the oscilloscope used, there may be some departure from these shapes.

Some adjustment can be made to the voicing. For example, the pitch of the metronome beat can be raised or lowered slightly by slightly changing the value of R8.

The drum brush voicing can be made sharper by omitting C13 and connecting a 200pF mica capacitor between the collector and base of TR4. The variable controls VR2 and VR3 will provide a more than sufficient range of attack and decay requirements. ★

LOUDSPEAKERS

By
H. E. BARNES
(E.M.I. Sound Products Ltd.)

It is nearly 100 years since Bell demonstrated the first working telephone at Philadelphia. It was the culmination of many experiments with sound waves in search of a method by which deaf children might be taught to speak, and was the practical application of an idea by Charles G. Page in 1837 that electric current might carry sound.

The receiver used was a simple device enabling variations in electric current to produce magnetic attractions of related strength and frequency to a metal disc. The resulting piston-like vibrations of the disc modulated the air pressure between the disc and the ear of the person listening and produced intelligible sound, but it was necessary to place the earphone against the ear to hear the sounds clearly.

Further sound amplification was obtained by adding a megaphone-shaped horn to an appropriately modified earphone so that several people could hear the sound at the same time, and thus the earphone was turned into a loudspeaker. Alas, the sound it produced was far from a faithful reproduction of the original, and engineers were challenged with the task of improving the sound reproduced in order to satisfy the needs of the rapidly developing electric gramophone, talking pictures and wireless receiver.

MOVING COIL SPEAKERS

The horn speaker was gradually replaced by a reed-driven cone speaker which could be mounted inside the same cabinet that would contain the radio receiver or gramophone. Still the quality left much to be desired and the moving iron type of drive unit was eventually superseded by the moving coil system very similar to that being used today.

In its early stages the magnetism of the moving coil speaker was provided by a large coil energised by the h.t. current of the receiver amplifier. This was necessary because at that time permanent magnet material was not very efficient and proved too expensive for the popular speakers.

Advances in both magnet steel and later the development of ferrite ceramics has resulted in the replacement of the energised magnet by the now total use of permanent magnets. These are applied in two basic ways, the screened magnet system Fig. 1 and the unscreened magnet system Fig. 2.

The screened magnet type of loudspeaker is particularly useful in transistor portables and similar equipment, where the loudspeaker is in close proximity to components such as coils and aerials with ferrite cores, which would be affected in performance by stray magnetism. Fortunately, this problem does not exist with speakers housed in separate enclosures, so unscreened ceramic magnet systems are commonly used in these types with a saving in cost over equivalent steel magnet types.

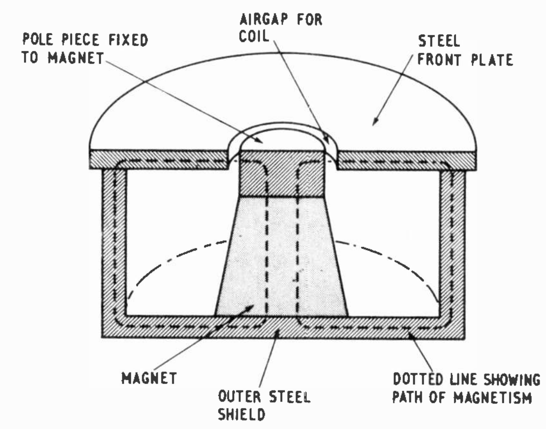


Fig. 1. Cutaway view of shielded magnet

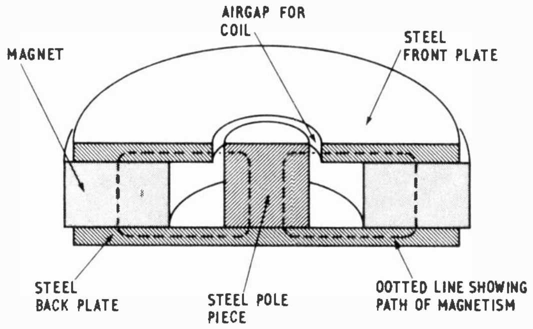


Fig. 2. Cutaway view of unshielded ceramic magnet

Advances in knowledge of electronic sound reproduction and manufacturing techniques, and a steady improvement in the characteristics of materials used has resulted in the modern speaker having improved frequency response, efficiency and power output. The most popular loudspeaker unit uses the moving coil system of drive and the explanations which follow apply to this particular type.

Before dealing with the technical details of units and completed loudspeaker systems in enclosures, a general appreciation might prove useful, particularly to newcomers to hi fi.

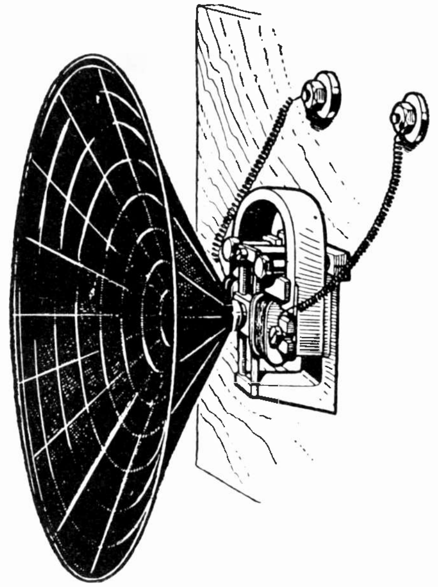
OPERATING PRINCIPLES

The diagram Fig. 3 shows the important details of a moving coil speaker unit. It consists of a rigid frame or chassis, the front edge of which has a flange for fixing the chassis to the baffle board of an enclosure. At the rear of the chassis is the magnet system, which generates magnetic field in a circular gap formed between the centre pole and the front plate of the system, this plate being firmly attached to the chassis.

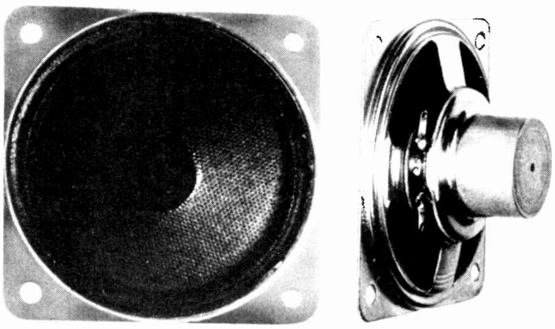
The diaphragm used to generate the sound waves is usually cone shaped, although it may be dome shaped in some high frequency speaker units. It is fixed at its outer edge to a flexible section of material which in turn is fixed to the flange of the chassis.

The inner portion of the cone or diaphragm is attached to a lightweight tube upon which a coil of copper or aluminium wire is wound. A circular flexible suspension diaphragm keeps the coil clear of the magnet system parts by centring the coil around the pole. The combination of the front and rear suspensions enables the cone and coil to move backwards and forwards under control.

The ends of the coil are attached to flexible connecting leads to which the amplifier is ultimately connected. The output signal from the audio amplifier comprises a complex series of alternating currents which pass through the speaker coil (or speech coil as it is also called), driving it and the cone to and fro in a similar complex series of vibrations.



An early direct radiator loudspeaker by Celestion



Popular small Plessey 3in loudspeaker frequently used as inexpensive tweeters or as pocket radio speakers

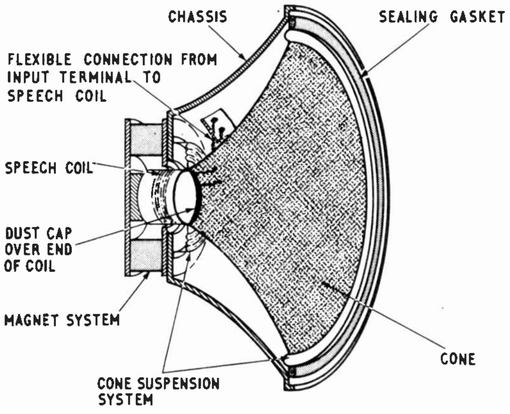


Fig. 3. Section through a moving coil loudspeaker

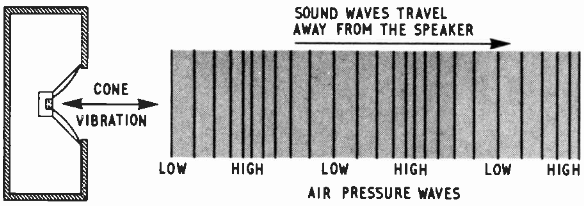


Fig. 4. How piston action of the cone creates sound pressure waves

Since the cone is in contact with air, its vibrations are transmitted in the form of pressure waves to the listeners' ears, Fig. 4. The type of sound one hears depends upon the nature of the pressure waves. The purpose of the whole audio reproducing system is ultimately to regenerate sounds of a loudness and quality as closely resembling the original as possible.

In the case of bass frequencies, the air is displaced at comparatively low speeds. To obtain the required loudness, a much greater amount of air has to be moved per cone movement than at higher frequencies. Without a baffle board around the speaker orifice, air movement at the front of the cone would interfere with that at the back. The neatest form of baffle is usually that shaped into a box and is most effective when it is a sealed box, so that no air movement from the front of the cone can interfere with that at the back of the cone.

FREQUENCY RESPONSE

Sounds audible to a good human ear range from approximately 30Hz to 20kHz and loudspeaker units can vary considerably in the way they produce this sound spectrum, mainly due to the characteristics of the materials used in speaker manufacture. Some units are designed primarily to reproduce their best at the bass end of the audible range, say, up to 500Hz. There are mid-range units designed to cover

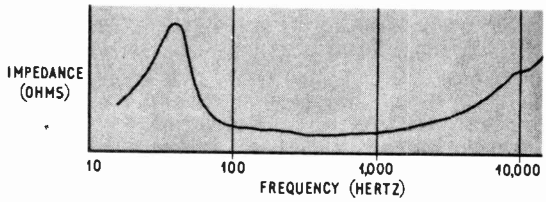


Fig. 5a. Impedance characteristic of a typical single speaker of wide range compared on the same scale with Fig. 5b below

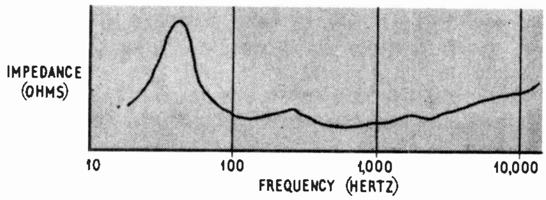


Fig. 5b. Impedance characteristic of a typical complete three-speaker system. Crossover frequencies are shown by the slight humps at approximately 250Hz and 2kHz

500Hz to 5kHz for example, and high frequency units complete the audio range from 5kHz to 20kHz. There are also units which cover wider frequency ranges in each classification. It is possible to have a loudspeaker with one unit which has a limited range from, say, 100Hz to 10kHz or two complementary types of unit, with a crossover frequency network, covering from, say, 50Hz to 15kHz. Three types of units, with two crossover frequency networks, could cover a wide range from, say, 40Hz to 20kHz.

The crossover frequency networks are usually specified by the manufacturer to suit the frequency responses of the individual speaker units. The frequency of crossover is chosen so that the response of one unit is cut as the next one is introduced to give a smooth overall response.

IMPEDANCE

The electrical resistance provided by the speech coil to the applied alternating drive current is the impedance, which is measured in ohms. Because it is the result of coil resistance and the effect of induced voltage in the coil when it vibrates, it is not constant in value over the frequency range of the speaker.

At the lower end of the frequency range of any particular unit, the moving system reaches a point of resonance where the amplitude of vibration is easily maintained for comparatively little input energy. This can produce a point of higher impedance than normal. Similarly, towards the upper end of the frequency range of the unit, the impedance can tend to rise (Fig. 5). The manufacturer generally quotes a nominal value which is usually 400Hz for a bass unit. This is not necessarily the lowest value but normally the difference is small enough to be ignored.

MAGNET STRENGTH

The performance of a speaker for sensitivity and overall frequency response depends a lot upon the power of the magnet system, because the current in the coil reacts with the magnetic field to produce the mechanical vibrations of the cone.

Speakers have various sizes of coil from about ½in up to 3in diameter depending upon their function in the system and the amount of acoustic power they have to produce. In general the larger the total lines of force (larger magnet), the more likely the speaker is to have a superior performance.

FUNDAMENTAL RESONANCE

All speaker units have a fundamental resonance. This is of particular importance in the case of the bass speakers because it has a direct bearing upon the bass response of the loudspeaker in an enclosure.

One should select a speaker unit whose bass resonance is as low as possible so that the final resonance in the enclosure is also kept low, otherwise the sound will lack bass quality.

The aim should be to produce a completed speaker with a bass resonance below 100Hz, and this can normally be achieved in infinite baffle enclosures with units which have a fundamental free air resonance of 35Hz or less.

EMI 215 system incorporating a 14in × 9in elliptical bass unit, two 5in mid-range units, a moulded chassis high frequency unit, and crossover network

EFFICIENCY

Efficiency is the relationship between electrical power input to the loudspeaker and its sound power output in equivalent units. For example, a 10 watt power input into a speaker having 10 per cent efficiency will result in one tenth of the input power leaving the speaker as acoustic power—in this case, 1 watt.

Loudspeaker manufacturers rarely quote efficiency figures but as a general rule a unit with a large magnet can have an efficiency of 5 per cent for an 8-inch round unit and about 10 per cent for a 12-inch round unit. Bear in mind, however, that this figure is for total radiated sound power from the unit. When it is fitted into an enclosure only about a half of this power is radiated; the other half is absorbed in the enclosure. The efficiency, therefore, of the complete speaker is half that of the unit in free air.

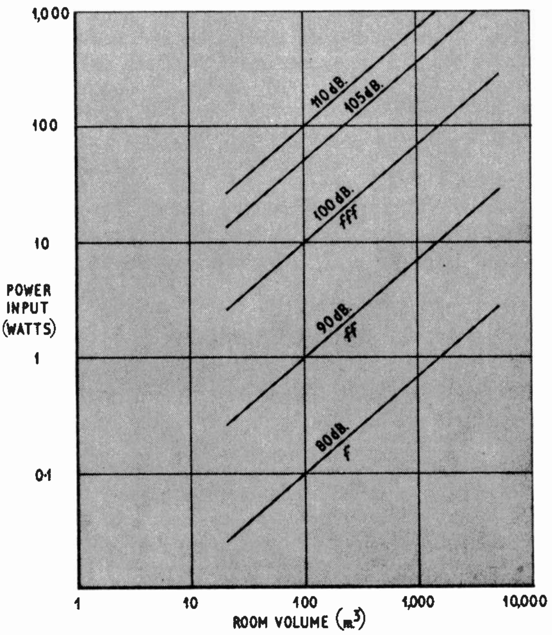


Fig. 6. Electrical input required for a speaker of 5 per cent efficiency related to room volume and sound intensity within

POWER RATING

The loudspeaker is usually rated in terms of the amplifier which can be used to drive it. If the amplifier is rated at 15 watts r.m.s. maximum at, say, 0·1 per cent total harmonic distortion at 4 ohms impedance, then the loudspeaker will need to have a nominal impedance of 4 ohms and a rating of 15 watts r.m.s. at least. It is not wise to use a loudspeaker with a lower watts rating than the amplifier (each channel in the case of stereo) otherwise the life of the speaker may be reduced.

Many studies have been made by acoustic engineers which have resulted in a relationship being established between power input to a speaker and the loudness of the sound it produces in an average furnished room of known dimensions. This is called acoustic intensity, which is the effect of air pressure waves at the point it is measured. Units are measured in decibels (dB) where 0dB represents the reference intensity level equivalent to 10^{-16} watts per square centimetre.

It has been established that an intensity level of
100dB is extremely loud *fff* in musical terms.
90dB is very loud, *ff* in musical terms.
80dB is loud, *f* in musical terms.

POWER DRIVE REQUIREMENT

The results of the studies have concluded with a mathematical relationship between room volume and acoustic intensity, so that if we know the efficiency of a loudspeaker we can obtain a close approximation to the input power required. For the data (Fig. 6), an efficiency of 5 per cent for the loudspeaker unit in free air is assumed. The reader can make proportional adjustment to suit. If he has a speaker with 10 per cent efficiency, the input power for a given loudness will be halved.

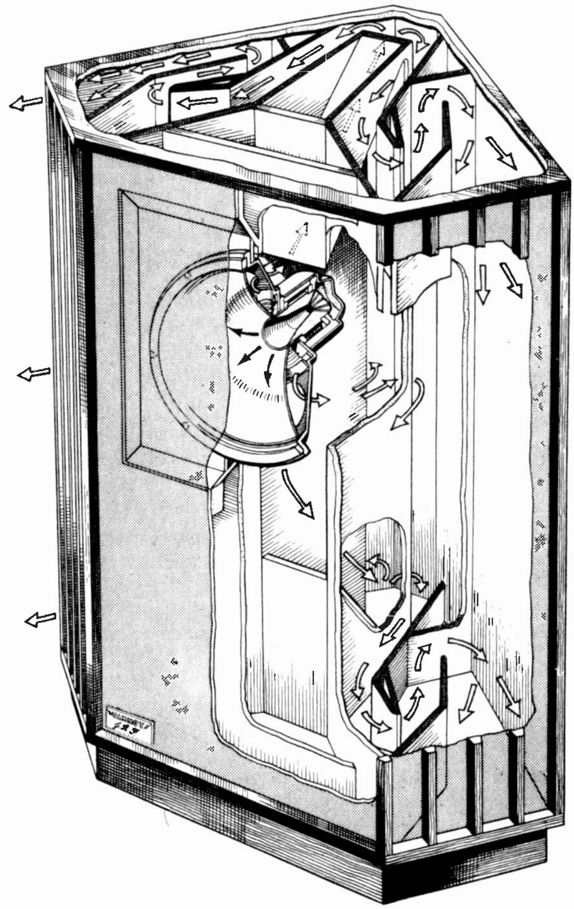
Remember that the data give the power requirements for one loudspeaker. When stereo is used, theoretically the total power required will be shared equally between the two speakers and amplifier channels. In practice a degree of uneven sound absorption occurs, and it is recommended that each channel is rated at 50 per cent more than the theoretical amount to avoid overload on either channel when the loudness of the channels is corrected by the balance control.

Taking an example, a room with a volume of 100 cubic metres will require a total input power of 10 watts to give a level of 100dB intensity. If you have a stereo system, each channel will then be rated at 7½ watts r.m.s. If you double the power available you will raise the maximum level to 103dB which does not look much on this scale, and the increase in loudness is just noticeable. Having attained this level of loudness it would cost more money to obtain any marked increase than would be worthwhile.

LOUDSPEAKER ENCLOSURES

If you intend to construct a loudspeaker enclosure with speaker units of your own choice it would be wisest to build an infinite baffle type, which is free from tuning problems. Vented cabinets can give low bass frequency response but unless one is prepared to experiment it is easy to spoil the quality of the bass response.

The principle of the infinite baffle enclosure is to seal the speaker units in a rigid walled box so



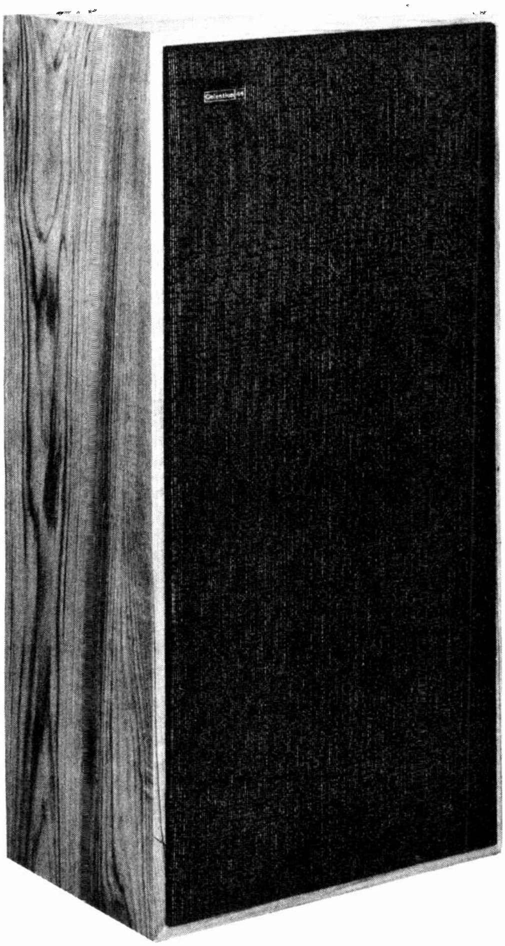
Cutaway view of a Tannoy folded horn enclosure used with a 15in dual concentric unit

Celestion

Loudspeakers for the Perfectionist

Proudly present the Fabulous

Celestion **DITTON 44** MONITOR



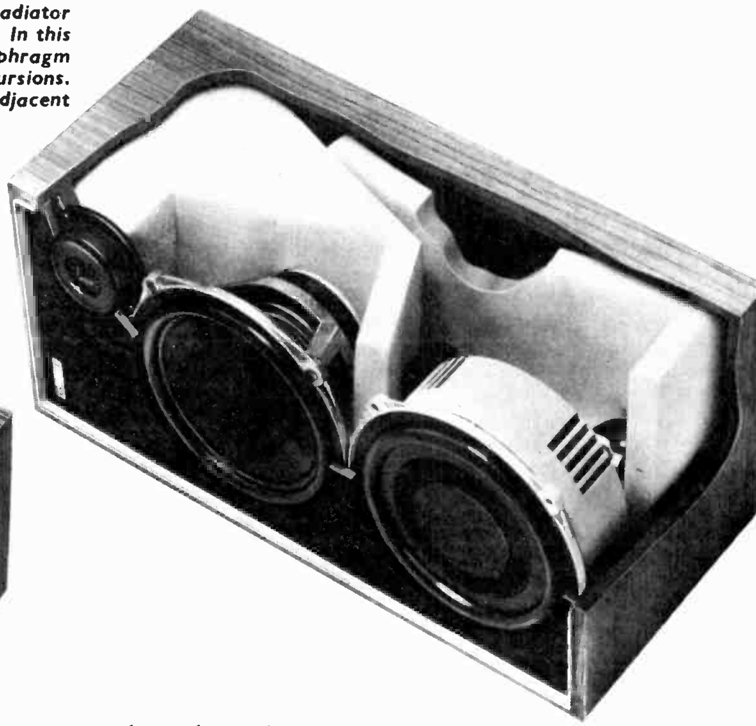
Dimensions:	30″ x $14\frac{1}{2}$″ x 10″
Max Input:	44 Watts (D45.500)
Response:	30 Hz to 30 KHz
Impedance:	4 to 8 ohms
Crossover:	500 & 5,000 Hz
Treble:	HF2,000 (pressure)
Mid:	MF Super 5″
Bass:	LF Long drive 12″
Finish:	Natural Teak
R.R.P.	£54.00 each

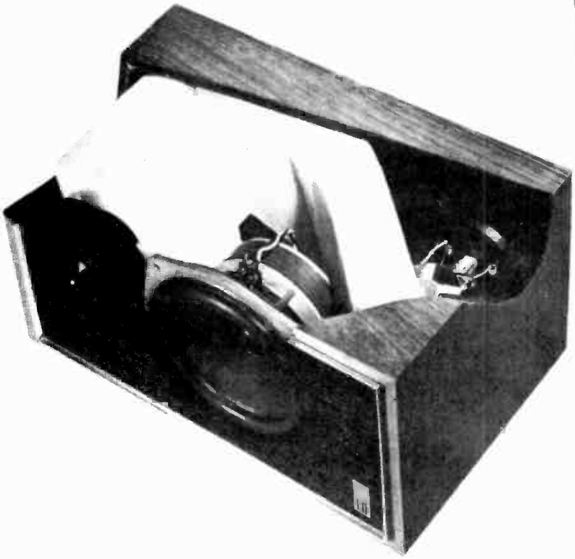
Plus full supporting cast!

Left to Right: Ditton 10 Mark II, Ditton 120, Ditton 15, Ditton 44, Ditton 25.

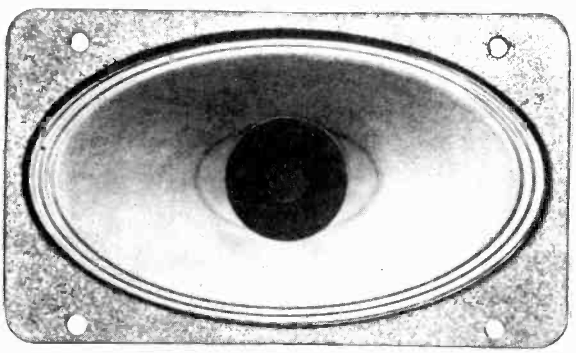
ROLA CELESTION LIMITED, DITTON WORKS, FOXHALL ROAD, IPSWICH, SUFFOLK, ENGLAND

A fairly recent innovation in extending bass response down to 30Hz is achieved by using an auxiliary bass radiator (right) of similar dimensions to the mid range unit. In this Celestion system (Ditton 15) the ABR is a rigid diaphragm with a linear air suspension capable of large excursions. It is pressure driven by the rear radiation from the adjacent 8in bass unit

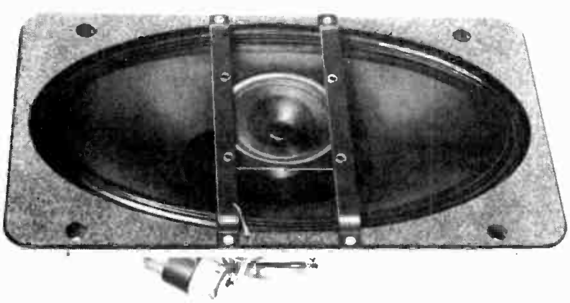




Very good results are obtained by padding a small enclosure with plastics foam as shown in this photograph of the Ditton 10. Notice the rolled neoprene suspension on the cone of the larger unit to give optimum excursion capability



Elliptical speaker ($13\frac{1}{2} \times 8\frac{1}{4}$in) with parasitic concentric tweeter—E.M.I. type 150



Elliptical speaker with coaxially mounted $3\frac{1}{4}$in h.f. unit and crossover unit—E.M.I. type 350

that the minimum of "rear-of-cone" radiation occurs to interfere with the "front-of-cone" radiation.

Loudspeaker manufacturers give guidance on enclosure volumes suitable for their units which will give the best results and they often quote examples of enclosure construction. As a general rule, the enclosure walls should be as rigid as possible, and internally lined with absorbent material such as glass wool or acoustic wadding, to prevent reflections of sound back through the speaker cone. All joints of the enclosure and points of entry should be sealed and care should be taken to make sure the speaker units are also sealed to the baffle board.

MULTI UNITS

Should your loudspeaker contain a combination of units, place the mid-frequency and high-frequency units off centre in unequal amounts to reduce effects of reflection from the enclosure edges. The mounting of the high frequency unit is usually quite critical and unless you have special equipment for response testing, it is difficult to obtain an optimum result. However, if you mount the unit on the front surface of the baffle board this will be better usually than if it is sunk in a tunnel of baffle board thickness (i.e. on the rear surface of the baffle board).

Make sure all leads are correctly connected and internal components are unable to produce buzzing sounds by vibrating. Keep them completely clear of the speaker units and clamp them firmly to adjacent surfaces, preferably with felt or foam rubber mounting cushions.

There is no mystery around the efficiency of loudspeaker systems; having understood basic principles and peculiarities in certain operating conditions, a great deal of common sense and help from published books will help the reader devise a system to suit his needs. ★

THIS last part shows how a "fire" is indicated and offers some ideas on how added "realism" can be effected by producing suitable battle sounds. Operational tactics are also given.

STAGE SEVEN—FIRE

One third of the positions of the Ledex switch will pass current to Panel D (Fig. 17). The leading edge of this current is shaped by the differentiator circuit C30, R120 and passed to a ten second timing circuit. One has already been given (Fig. 10) and here is another. The shaped pulse switches a bistable formed by TR25 and TR26. The result is a slow charge of C31. The trigger formed by TR27 and TR28 finally fires, switching the bistable off again. While the bistable was on it primed the lamp driver TR29 and TR30 and also delivered a charge to the magazine storage capacitors through D13 and R129.

In play, some of the damage indications will be accompanied by a fire indication. The player can do nothing about the fire but watch and wait. If he is lucky, the lamp will go out in ten seconds with nothing untoward happening. If he is unlucky, the charge on his magazine storage capacitor will reach the critical value and the magazine lamp will glow, putting him out of the game.

SOUND EFFECTS

Because of the belief that many constructors will want to add sound effects, the writer has spent some time experimenting with circuitry to do this. Various conclusions emerge. First, it would be annoying for sound to be emitted all the time. An on-off switch might serve, but the easiest method would be for sound to be emitted only during dialling. Secondly, hum and noise, oscillation and warble are not unacceptable in the war situation, if suitably filtered or chopped, so nothing elaborate is called for.

Taking off through a $0{\cdot}1\mu F$ capacitor at the point (f) indicated in Fig. 3 is satisfactory only at heavier calibre settings, when the sound is like a heavy machine gun. At lighter calibres a buzz is emitted, as would be expected from the higher frequency. Such noises are of course intermittent as the pulse contacts on the dial open and close and do give some indication of hits scored. Figure 18 is given for those who might like to experiment further.

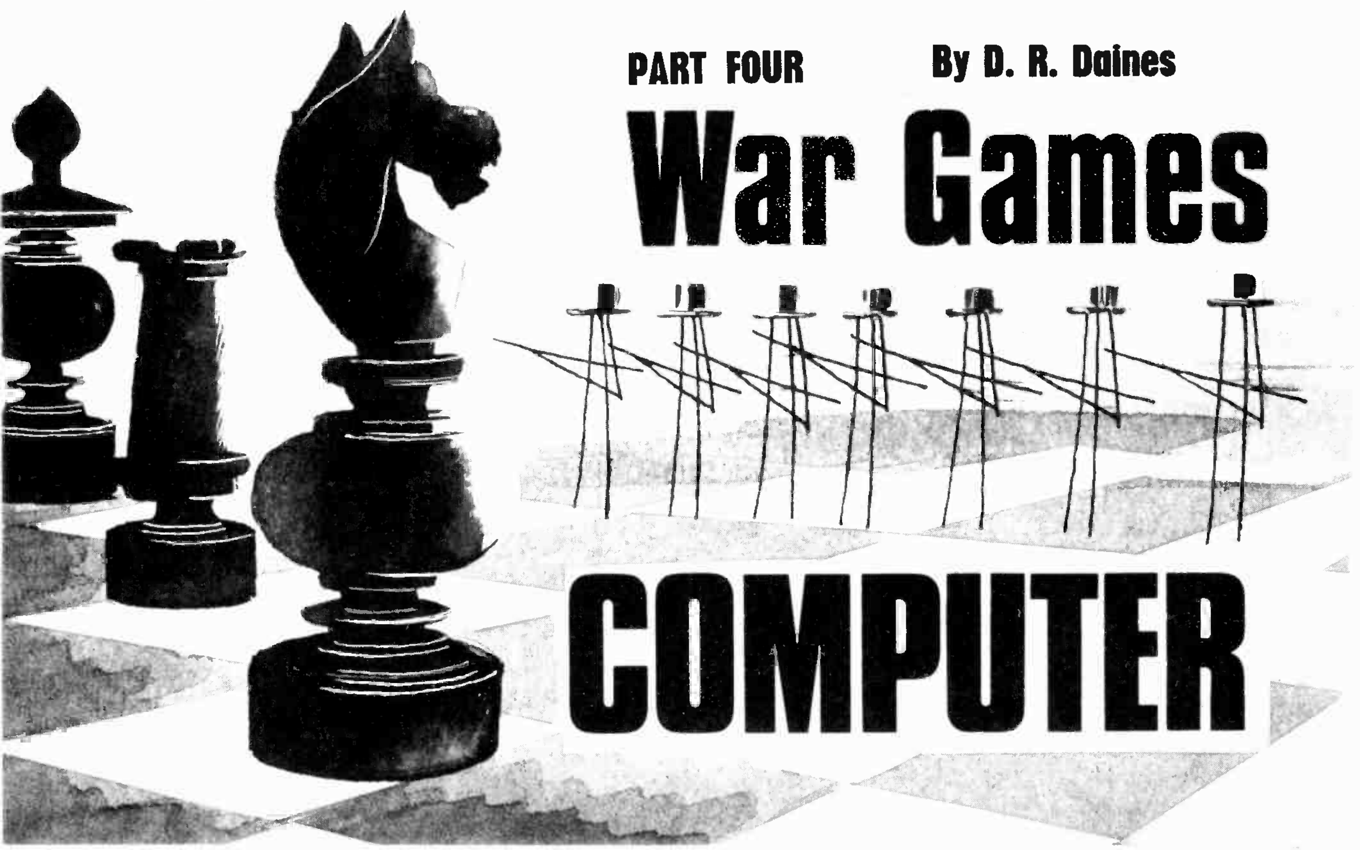
Taking off from point (k) (Fig. 12) gives an indication of damage pulses. As such it is useful, but again, not very realistic.

Examining the back of a telephone dial reveals a third pair of contacts that, like the ones that motivate the Ledex, close when dialling commences. If sound effects are desired the best method is a simple multivibrator giving good voltage swing and of appropriate frequency feeding directly into a permanent magnet loudspeaker and keyed from the dial (Fig. 19).

PLAYING TABLE

For a full treatment of the subject the reader is referred to any of the books on war games, particularly "Naval War Games" by Featherstone (Stanley Paul, London, 1969). Here we can give only a sufficient outline. The first requirement is a playing board as large as possible and preferably marked in inch squares. Several sheets of card would do, or even a roll of ceiling paper.

If desired, shallows, rocks, islands and coastlines are marked in. Minefields might also be "laid" by each side and their position not divulged to the opponent. A token for each ship is required, clearly numbered. Simple card shapes will suffice, although for many it could be the beginning of a collection of any of the excellent little models available.



PART FOUR

By D. R. Daines

War Games COMPUTER

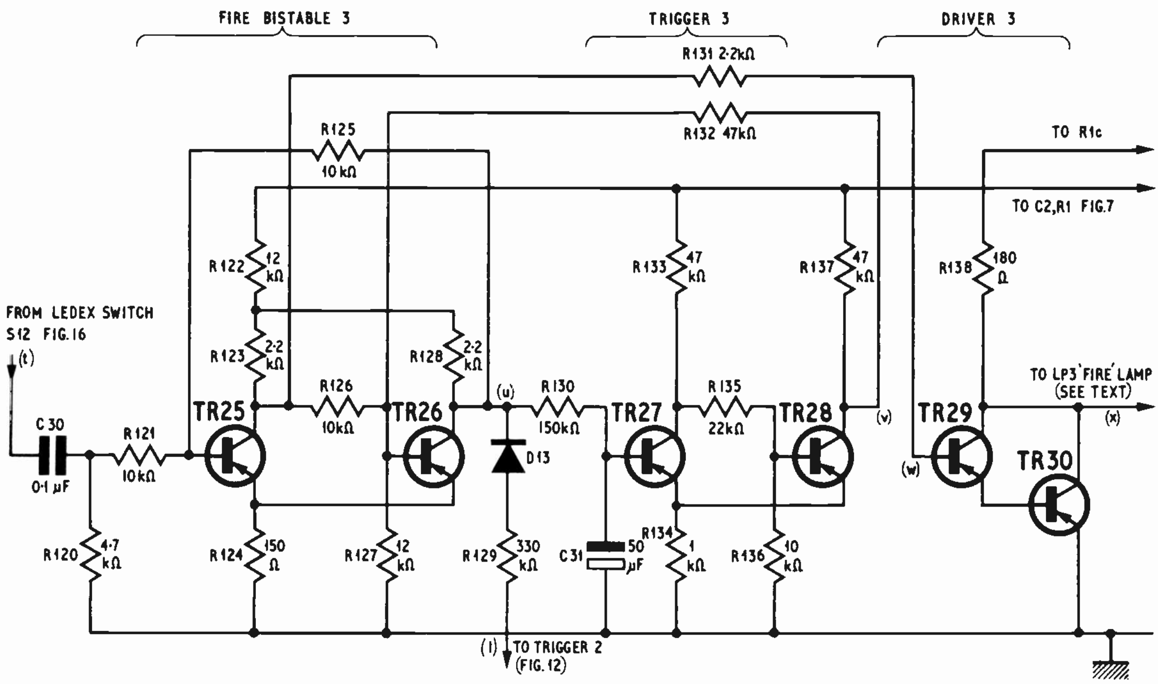


Fig. 17a. Fire indicating circuit on Panel "D"

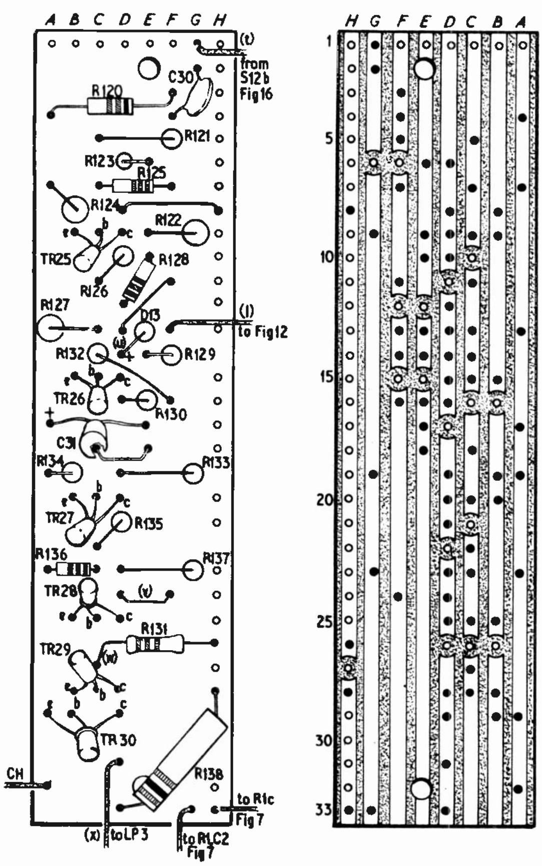


Fig. 17b. Layout of Panel D and cuts in the copper strips

COMPONENTS . . .

STAGE SEVEN (Panel "D" Fig. 17)

Resistors

R120 4·7kΩ
R121 10kΩ
R122 12kΩ
R123 2·2kΩ
R124 150Ω
R125 10kΩ
R126 10kΩ
R127 12kΩ
R128 2·2kΩ
R129 330kΩ
R130 150kΩ
R131 2·2kΩ
R132 47kΩ
R133 47kΩ
R134 1kΩ
R135 22kΩ
R136 10kΩ
R137 47kΩ
R138 180Ω 1W
All ±10%, ¼W carbon except R138

Capacitors

C30 0·1μF 125V
C31 50μF elect. 25V

Semiconductors

TR25 to TR30 OC71 or similar *pnp* germanium
D13 OA81 or any small germanium diode

Miscellaneous

Veroboard 0·15in matrix 5in × 1¼in with copper strips

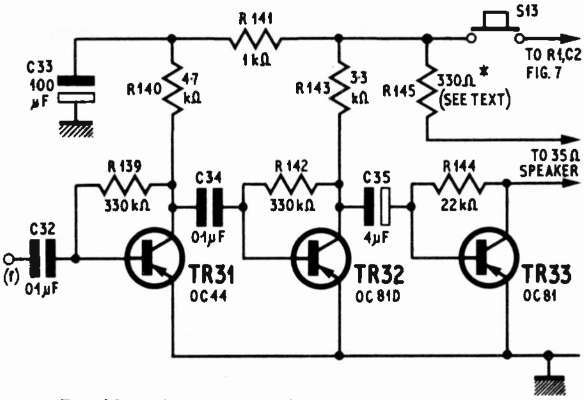


Fig. 18a. Experimental sound effects amplifier

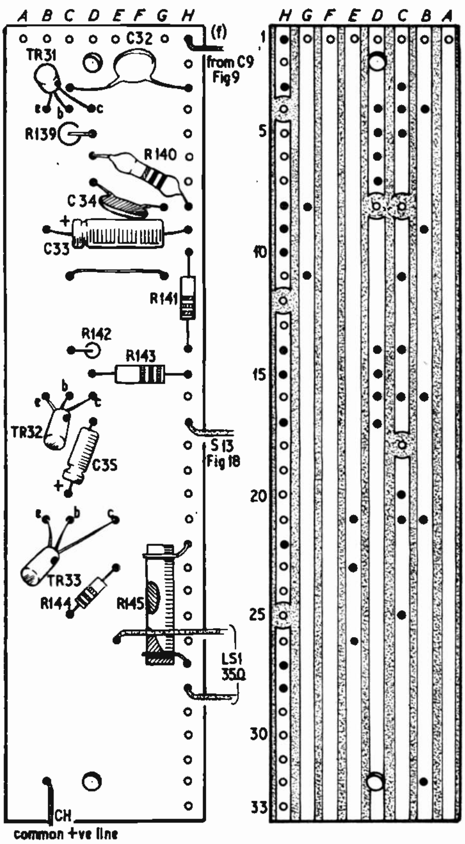


Fig. 18b. Layout of experimental amplifier boards and cuts in the copper strips

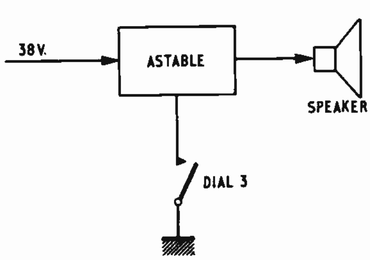


Fig. 19. Using an astable multivibrator switched into use by dial contact in the common chassis line

COMPONENTS . . .

STAGE EIGHT (Experimental sound effects amplifier)

Resistors
R139 330kΩ
R140 4·7Ω
R141 1kΩ
R142 330kΩ
R143 3·3kΩ
R144 22kΩ
R145 330Ω (for 35 ohm LS)

Capacitors
C32 0·1µF 125V
C33 100µF elect. 25V
C34 0·1µF 125V
C35 4µF elect. 25V

Semiconductors
TR31 OC44
TR32 OC81D
TR33 OC81

Miscellaneous
LS1 Small 35–40 ohm loudspeaker
Veroboard 0·15in matrix 5in × 1¼in with copper strips

Note: The lamps 6 and 7 should be "Double chance" and lamps 8 and 11 should be "Single chance", and not as indicated on page 816, October issue.

On page 810, half way through "STAGE FOUR—PANEL B", should read "Capacitor C11 blocks d.c. and leaves only pulses swinging about zero volts . . ."

SCORE CARDS

Finally a score card for each ship is needed upon which is marked full details of armament, torpedo tubes, aircraft carried and thickness of belt armour. Speed is also marked, scaled down to inches per move at full speed, and turning circle, expressed as a 45 degree turn every so many squares. Examples are given in Table 1.

On the reverse side of the card a sketch plan of the ship is made, clearly showing the position and sweep of all turrets and torpedo tubes. When the card is complete it may be covered with clear adhesive tape or sheet and used over and over for many years. Details as required may be obtained from any public library.

Table 1: NAVAL FLEET MANŒUVRABILITY

Size	Name	Speed (in/move)	Turning distance (for 45°)
Battleship	Vanguard	3in	4in
Carrier	Eagle	4in	3in
Cruiser	Essex	5in	3in
Destroyer	Ajax	7in	2in
Submarine	Neptune	surface 4in	2in
		submerged 2in	2in
M.T.B.	T107	8in	1in

When all is ready, tokens are placed on the board and play begins. Dice are rolled to determine the state of the sea and the visibility. The dice reading is transferred directly to the computer, and agreement reached as to how often this shall be done. Usually they are rolled for every ten moves. Both CANCEL switches are put in the cancel position and S11 (target number) slowly rotated all the way round, ensuring that all storage capacitors are completely discharged. A coin is tossed, the winner deciding whether to go first or last. Player A moves; player B moves; player A fires; player B fires. Damage is recorded and the coin tossed again. Play continues until one ship or the other is sunk.

USING THE COMPUTER

When either player fires, the computer is set up as follows:

Target number corresponds to the number of the token and so must be carefully chosen at the outset.

Target speed is a direct reading in inches and is the speed the vessel is actually supposed to be going (which might be less than its possible maximum).

Armour thickness is taken from the score card and is a direct transfer in inches, as indicated by the knob.

Target size: twelve types of ship are given and the nearest in size to the target is registered.

The *angle* subtended is the angle the target ship makes to the line of fire; 90 degrees is broadside on, while 180 degrees is bow or stern on; 45 degrees is provided as a halfway condition. There is no need to get a protractor out; simply set the control to the nearest position. Range is directly read in inches and is quickly counted along the inch squares.

Firing ship's speed is also the actual speed indicated by movement in inches.

Morale is determined by dice throw for each ship at the commencement of the game and goes up or down according to the fortunes of war. If damage is inflicted on the enemy, morale goes up one point; if damage is sustained it goes down one point.

Shell type is a conscious choice of HE or AP, while *calibre* is obtained from the score card.

The whole operation takes less time to do than to read about and when all controls have been quickly set, the number of guns is dialled. This is where the indication of sweep of turrets comes in, for not all turrets will be able to bear upon the target and if in doubt the score card is laid over the token and a straight-edge laid along the extremes of the arc.

Check that both CANCEL switches are off and dial the *number of guns* firing and able to bear. The result (if any) is immediately indicated in one or more lamps lighting up.

EFFECT OF DAMAGE

If the score card has been covered with clear plastics sheet, Chinagraph pencil may be used on it and wiped off after each game. The effect of damage is as follows:

Conning Tower. Cease firing all main armament for the number of turns determined by a throw of a dice.
Hull. Reduce speed by one-quarter.
Engine Room. Halt for the number of turns determined by a throw of dice.
Rudder. Proceed only in a circle for the number of turns determined by the throw of dice.
Aircraft or **Torpedo tube.** Opponent decides which he wants knocked out; you choose a particular one.
Sub-Armament. One-quarter of all sub-armament is knocked out.
Forward Turret. One forward turret of main armament is knocked out.
Rear Turret. One rear turret is knocked out.

When the appropriate notes and action are taken the CANCEL OTHERS switch is thrown, extinguishing the lamp. If preferred, double-pole push-buttons might be used instead of switches, thereby ensuring that they cannot accidentally be left in the cancel position.

If a fire is indicated, no action can be taken, but it will always be indicated in association with one of the above.

VARIATIONS

Some variations to the game have already been indicated and further variations are limited only by the imagination of the users. Players may have any number of ships under their command and if imagination lags there is always history to turn to. Try running a convoy through a pack of submarines to a particular port, or fight the battles of Jutland, Midway, Otranto, Coromandel or Falkland Islands over again.

MINES AND TORPEDOES

From the moment of firing a torpedo has a life of its own. A token with arrow showing direction is placed on the board and it must always follow a straight line course. In the first move it travels 6in, in its second move 5in, then 4in and then is assumed to be lost.

If it strikes a target, the computer is set for best conditions and a ten is dialled. The result is almost certainly indicated damage, but only damage below the water-line is accepted, i.e. engine room, hull, rudder, or magazine. All other damage is ignored; likewise with mines. If a ship enters a square in which is supposed to be a mine, the opponent produces his previously prepared note of mine positions. Damage is found by dialling under the same conditions and with the same provisos.

SUBMARINES

One side of the playing token could be painted black. If this is placed uppermost the submarine is deemed to be submerged. One move is required to submerge or to surface. While submergd she is considered undetectable although she may fire torpedoes. As for striking back at submarines, readers might like to devise their own rules.

FIGHTING OTHER BATTLES

As mentioned at the outset, the computer may be used for other wars and other periods, land as well as sea. Adaptation is simply accomplished by the use of card overlays that alter the readings of some controls and readout lamps.

The cards simply fit over the faces of the computer with the lamps shining through holes. In the case of the card altering the controls it will be necessary to remove the appropriate knob first. ★

NEW PCB SERVICE

All eyes will be on the Inter/Nepcon exhibition at Brighton this month (October 19-21). It certainly is the most successful specialised exhibition of recent years and attracts production engineers not only from British companies but also in substantial numbers from the Continent.

One of the regular exhibitors is Exacta Circuits Ltd. who, since starting up in 1962 with two men, has climbed up to be in the top three independent printed circuit board manufacturers in the country, specialising in high-quality plated-through-hole and multilayer boards. Having outgrown their old factory (a converted textile mill) in Galashiels, the company moved most of the production staff and equipment to a brand new purpose-built factory at Selkirk in August, leaving the Galashiels premises as a bulk store and small-run production unit.

Inter/Nepcon is the occasion chosen to launch Exactaplan, a new service to cut costs and speed delivery to the small man who wants quality boards by the hundred rather than the thousands. Alan Bruce, Exacta's technical director, told me during a sneak preview that Exactaplan, though appearing almost ridiculously simple and obvious, was quite a tough nut to crack. The idea is to mass produce a range of standard PCBs with a grid pattern already printed on them. From the range, the circuit designer need only select that nearest his needs and indicate which interconnections he desires.

In small batch production, the precision art work is quite a high proportion of the total cost. Exactaplan cuts artwork costs and saves time too.

Exactaplan is being launched with 12 different board sizes, two packaging densities (i.e. standard and fine line) and three types of connectors which together give a choice of 72 boards.

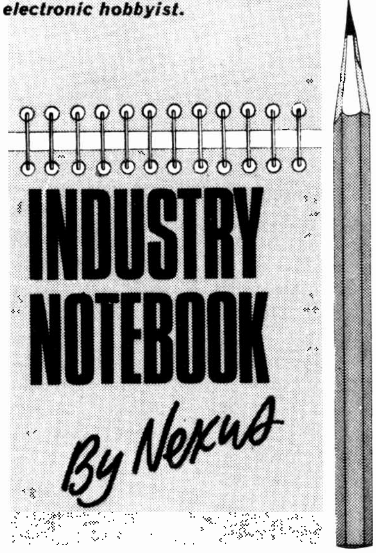
WHO WAS FIRST ?

The great excitement generated a few weeks ago by the almost simultaneous announcements from a number of power supply manufacturers of a breakthrough in "transformerless" solid-state power units brought a wry smile to the lips of Dennis Hendry, managing director of Weir Electronics. Weir had, in fact, been in production with similar units for many months but as they were part of a contract order for a special customer, the company was precluded from giving them any publicity.

Weir Electronics is one of the few companies that has thrived throughout the general recession in the capital goods electronics

OUR new feature INDUSTRY NOTEBOOK appears this month for the first time. Many P.E. readers work in the electronics industry and, indeed, are professional electronic engineers and technicians. Others, though perhaps professionally occupied in other ways will, we believe, also welcome news and views on the electronics industry.

Our regular contributor, Nexus, is close to the industry, both in its technical and commercial aspects. Month by month he will report and comment on significant events, on current trends, on how he sees the future and, where appropriate, how new developments may inspire the electronic hobbyist.



industry. Hendry told me Weir is making a profit of over £60,000 p.a. on capital employed of only £130,000. Some fat export contracts are helping enormously and negotiations are in hand for purchasing a production unit in Holland, which will become Weir's forward base for a drive into Europe.

The smaller companies like Weir, with their greater flexibility and faster response time in meeting changing markets are at least spared the present miseries of the giants.

WHIZZ-KID OF THE EAST

One of the most remarkable men in the industry has his base over a row of shops in Ealing Broadway, West London. When you enter his office you can't help seeing the magnificent wild boar's head on the wall, the many other souvenirs including a photo of your host shaking hands with Harold Wilson, a smoker's compendium in the form of a wooden model train from the Soviet Union, a fine leather case containing his shot-guns.

His name is Eddie Baizert and he is owner and managing director of a group of companies operating under the generic name Uni-Export. Baizert is now a British subject but was born in Norway and reached these shores via the Middle East. He is a linguist with fluent Russian and Czech and spends most of his time getting orders for British electronic equipment from the Eastern Bloc.

His favourite souvenir, framed and hanging by his desk, is the cheque for £500 with which he started in 1961. There was only himself and a secretary. Now he has a staff of 14 at Ealing and three people in his office in Prague. His first sale was a telephone answering unit worth £25. Today Uni-Export turns over £1 million a year.

He handles all the best names in British equipment, bears all the cost of advertising, exhibition stands and all the other incidentals involved in selling and if he doesn't sell he doesn't charge a bean. You can't be fairer than that—but, as he smilingly points out, Baizert always sells and gets his 15 percent commission.

To keep his eye on the international scene he likes to travel round the world twice a year and normally clocks up 100k miles in his E-Type Jaguar in Europe for good measure.

NC STILL STRUGGLING

The much-publicised Pre-production Scheme devised by the old Mintech to put numerically-controlled machine tools on the map in Britain cost the tax-payer £2 million and went off like a damp squib. The IRC had a go at rationalising the industry with a splendid investment of your money and mine. And yet with all the effort and all the cash that has gone in, the numerical control business is still as flat as a pancake.

My sympathy goes to Plessey Numerical Controls which now incorporates all the business and types of equipment (most of it non-compatible) handled by Ferranti and Airmec-AEI as well as the original Plessey product lines. The general recession in the engineering industry is the culprit and, as it turned out, PNC could not have been formed at a worse time.

Nevertheless, morale remains high at PNC headquarters at Poole, even though it is rock-bottom at what was to be the main production unit in Scotland, now threatened with closure. Sales may be slack but it has been a good opportunity to start rationalising the product line, identifying new marketing slots, and preparing for the expected up-turn next year.

MAIL ORDER DIVISION

distronic LTD

THE POWER HOUSE

28 BURNT MILL
ELIZABETH WAY
HARLOW ESSEX
HARLOW 32947

Why wait weeks ? — ALL OUR ORDERS DISPATCHED BY RETURN OF POST!

Transistors, Diodes and Integrated Circuits

A) DIODES & RECTIFIERS

1N4001	7p
1N4002	8p
1N4003	9p
1N4004	10p
1N4005	12p
1N4006	14p
1N4007	20p

Compare our prices

WO05	40p
WO1	45p
WO4	48p
WO6	50p

B) TRANSISTORS

2N696	15p
2N930	25p
2N930A	30p
2N1613	22p
2N1711	25p
2N2369	20p
2N2484	34p
2N2605	45p
2N2904	36p
2N2904A	41p
2N2905	46p
2N2905A	60p
2N3053	22p
2N3055	70p
2N3442	£2
2N3638	25p
2N3866	£1·50
2N4347	£1·50
2N4356	35p
40411	£2·50
AC138	15p
AC141	20p
AC141H	25p
AC142	15p
AC187K / AC188K Matched pr.	50p
AC191	15p
AC192	15p
AC193	20p
AC193K / AC194K Matched pr.	60p
AC194	20p
AD143	50p
AD262 / BD162 Matched pr.	90p
AD262	35p
AD263	40p
AF106	25p
AF109	35p
AF139	31p
AF166	20p
AF170	18p
AF172	18p
AF200	25p
AF201	30p
AF239	40p
AF239S	45p
AL102	60p
AL103	50p
AU103	£1
BC109	11p
BC113	20p
BC114	20p
BC115	25p
BC116A	30p
BC117	30p
BC125	20p
BC126	30p
BC132	20p
BC134	20p
BC137	30p
BC142	35p
BC143	40p
BC144	35p
BC145	30p
BC147	15p
BC148	11p
BC149	15p
BC153	30p
BC154	35p
BFX86	30p
BFX87	30p
BFX88	25p
BFY34	30p
BFY50	22p
BFY51	20p
BFY52	20p
ME0404-1	12p
ME0404-2	13p
ME1001	10p
ME1002	11p
ME2001	10p
ME2002	11p
ME3001	20p
ME3002	25p
ME4001	10p
ME4002	11p
ME6001	15p
ME6002	18p
ME8001	20p
ME8002	30p
ME8003	30p
ME9001	15p
ME9002	15p
MEL11	40p
MEL12	50p
MEU21	40p
MEU22	50p
OC25	37p
AU106	95p
AU107	70p
AU108	65p
AU110	£1
AU111	70p
AUY21A	60p
AUY22A	70p
AUY35	45p
AUY37	60p
BC107	11p
BC108	11p
BCY70	26p
BCY71	26p
BCY72	26p
BF152	25p
BF153	25p
BF158	25p
BF159	35p
BF160	28p
BF177	25p
BF178	35p
BF179C	40p

Please note minimum order 50p

Send 10p for price list or free with order

Component Discounts 10% on orders over £5

C) INTEGRATED CIRCUITS

709C (TO-99)	95p
709C (DIP)	95p
741C (TO-99)	£1·25
741C (DIP)	£1·25

2N3055 115 Watt 15 Amp	70p
2N3053 1 Amp TO-5	22p
BC107 Also BC108 and BC109	11p
AF239 UHF: 5 DB at 800 MHz	40p
WO1 1 Amp, 100 V Bridge Rectifier	45p
AD262 / BD162 PNP Matched NPN pair 10 Watts, AUDIO OUTPUT PAIR	90p
AD142 80 Volts, 10 Amp TO-3	50p
AU103 155 Volts, 10 Amp TO-3	£1
AU106 320 Volts, 10 Amps	95p
BC147/8/9 High gain LOCKFIT	15p
ME1001 45 Volt high gain	10p
40411 30 Amp, 150 Volts	£2·50
1N4001 1 Amp, 100 Volts	7p
BF179C 250 Volts TO-5	40p
BFY51/2	20p
2N3866 1 Watt output at 400MHz	£1·50
BC114 High gain: 200 at 1mA	20p
741C DIP or TO-99 High gain operational amp. S/C proof	£1·25

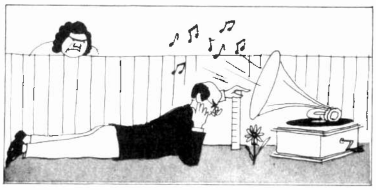
POSTAGE & PACKING PLEASE ADD 10p TO YOUR ORDER

SEND FOR BONUS VOUCHER* FREE WITH EVERY £1 ORDER

*Redeemable upon receipt of subsequent order value £5 or more, received before Dec. 31, 1971

Gerry Brown . . .

ON THE FRINGE



PLANTS AREN'T DEAF?

Since, to the delight of farmers, the effects of playing dance records while lightening milk-laden cows has improved both quality and yield, the scene seems to have switched from the, now tranquil, ruminant to attempts at inducing a similar effect in flora.

It was in India, in fact, that some years ago changes for the better were reported in rice plant yield following about an hour per day musical treatment of the cereal. Since then most experiments have been performed at ultrasonic frequencies with fair success. The reason for the effect is not fully understood, but in part appears due to an increase in the activity of various enzymes associated with the plants growth.

Since the original tests, experiments at audio frequencies have been resumed by two Canadian workers in Ottawa. They have employed at least four different frequencies for continuously irradiating wheatseeds during a period of time (termed vernalisation) when dampened seeds are deliberately reduced to a low temperature to cause early flowering.

Following several weeks of this treatment the seeds are allowed to germinate and the resulting seedlings permitted a period of eight weeks growth. Subsequent measurement of such things as height, weight, number and size of leaves, has revealed a dramatic improvement over normally treated varieties. It is reported that the most effective stimulation frequency is around 5kHz. This has produced in excess of 200 per cent yield over the plants used as controls.

Believe me, I've tried directing the output of my old record player at the wallflower patch, but alas, other than some raised eyebrows from already curious neighbours, no go. "Raindrops keep falling on my head" and the "Ooh ah" of the bicycling tune had a remarkable effect on the groundsel though!—Perhaps the term 'ear' of the wheat is meaningful after all!

TIME FOR A CHANGE

There can be but few professions that share the degree to which electronics serves industry; not only industry, but the professions too. Think for example, just how much electronics is now at the "beck and call" of the biological professions. Sure the biologies have given of themselves many times to mankind, however, what of *their* help to other sciences?

As a change wouldn't it be great if instead, say, of relying on electric motors and hydraulics for prime-movers we employed lumps of cultured muscle tissue! It is not difficult to see what an asset such a material would be, particularly if it could be electrically triggered into contraction or extension.

Apart from the very obvious advantages for the physically handicapped, who would naturally be given priority to use the special muscle, imagine how quiet an automobile would be with this kind of propulsion.

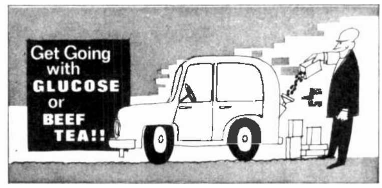
MUSCLE POWER

Perhaps thankfully, no one has yet been able to grow muscle tissue on the scale suggested by my reverie, although I recall hearing of someone who went part-way to achieving something rather similar. He found that if a thin strip of collagen (obtained from animal connective tissue and cartilage) is placed in a strong solution of lithium bromide it will slowly contract with a force greater than 1,000 times its own weight. If it is then washed in clean water it will regain, once more, its original form. This process can be repeated, as far as I can remember, ad infinitum.

Actual motors have been built which employ the principle, and generally comprise an endless collagen tape loop running around six pulleys, or so. The tape is first arranged to enter a small tank of lithium bromide solution and, by virtue of a ratchet mechanism, the subsequent contraction pulls more (un-treated) tape into the tank. Simultaneously, since the whole tape will be on-the-move, treated tape can be drawn through yet another tank containing clean water and so complete the cycle. Output drive is via one of the pulleys.

Just in case you reckon we might have got a perpetual motion device on our hands, and appear scheduled to make some vast fortune, let me dispel the euphoria straight away! The machine will run for several hours, I gather, but ultimately comes to a halt when the tanks become contaminated with one anothers contents.

One day, who knows, someone might invent a mechano-chemical motor which is as successful as its neuro-muscular counterpart. Picture, if you will, the economics of a motor running almost indefinitely on packets of glucose tablets and the occasional mug of beef tea!

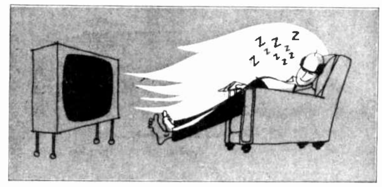


KEEPING A "BEAD" ON THE ADS

I thought it would only be a matter of time before TV advertisers (in the States, at least) dispensed with their "little old ladies" who diligently keep a daily check on the number of times an advert has been on the screen. A much more reliable, electronic, method of monitoring advertising has now come into being.

The ads are now tagged by a system which makes use of coded data, concealed from the public, and can be either added to an "off the picture" area of the raster, or inserted in the sound channel.

As an aid to advertisers, this holds little interest for me. However, it does of course imply that, because the code will accompany all advertising (eventually, no doubt, in this country as well) one only needs a "code present/absent detector" to automatically turn off vision and sound until programme material returns. The detector would, however, require a delayed "on period" because the code, unfortunately, only appears for a short time at the beginning and end of an ad. I just can't wait for this great new boon to reach the advertising industry!



P.E. SCORPIO CAR IGNITION

By D. S. GIBBS and I. M. SHAW (Ferranti Ltd)

In the past 40 years the performance of car engines has been improved enormously, but the ignition system has hardly changed at all and is becoming inadequate to supply the demands of today's high performance engines. The system described here overcomes the limitations of the conventional (Kettering) system and it is suitable for all types of car, although the improvement will be greatest on high performance models.

THE CONVENTIONAL SYSTEM

Fig. 1a shows the conventional system. When the contact breaker closes current flows in the primary of the coil, and rises exponentially at a rate determined by the inductance and resistance of the transformer primary. Typical values are 11mH and 3·5 ohms giving a time constant (L/R) of about 3ms (Fig. 1b). After 3ms the current would rise to about 63 per cent of its maximum value; after 6ms it would be 87 per cent; and after 9ms it would have risen to 95 per cent of its final value of 3·4 amps.

When the contact breaker points open the current is suddenly interrupted and a high voltage (about 300V) is generated across the primary. This is stepped up to about 15–20kV at the secondary, and an arc forms between the plug electrodes.

At low and medium engine speeds this works perfectly well but at high engine speeds the current in the coil does not have time to reach its full value. As an example, take a four cylinder engine going at 6,000 r.p.m. The engine needs two sparks per revolution which is 12,000 sparks/minute and the time between each spark is 5ms. Now the contact breaker points are open for 40 per cent of the time and closed for 60 per cent, so that at 6,000 r.p.m. the contact breaker points are closed for just 3ms. In this time the current in the coil primary can only reach 63 per cent of its low speed value, and if we take into account contact bounce and wear the figure is nearer 50 per cent. Nearly all modern four cylinder engines can reach 6,000 r.p.m., some can reach 7,000 or 8,000 r.p.m., and with a six cylinder engine the situation is still worse because this needs three sparks per revolution.

TRANSISTOR ASSISTED IGNITION

Many of the " bolt-on " electronic ignition systems consist of no more than a special high ratio coil switched by a high voltage transistor. The contact breaker is used to interrupt the base current of the transistor. These do give a higher kilovolt output at high r.p.m. and greatly reduced contact breaker wear but they require much more current, sometimes as much as 10–12A. This places a severe additional load on an already overburdened electrical system.

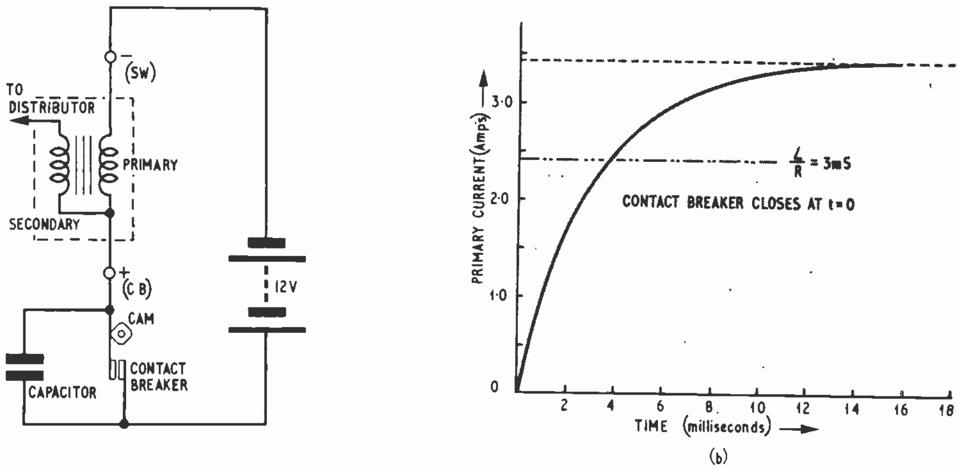
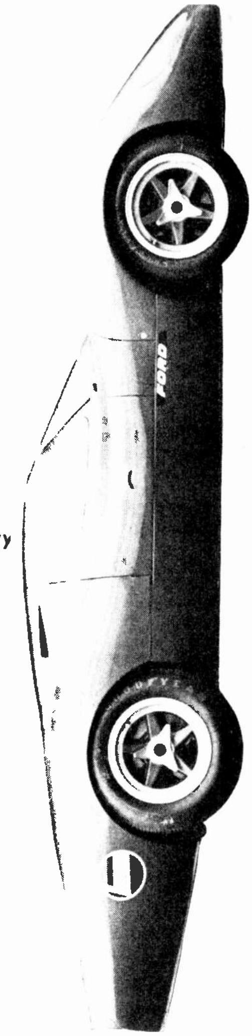


Fig. 1(a). The conventional ignition system. (b) graph of current rise with time in ignition coil primary



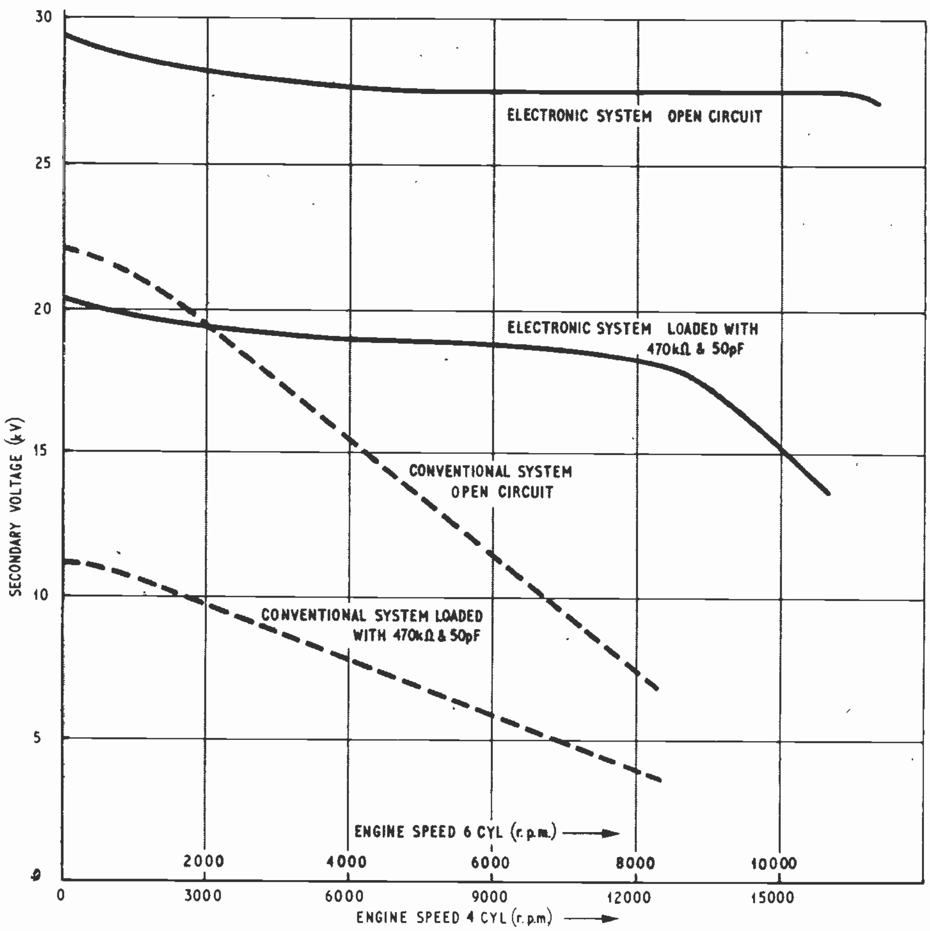
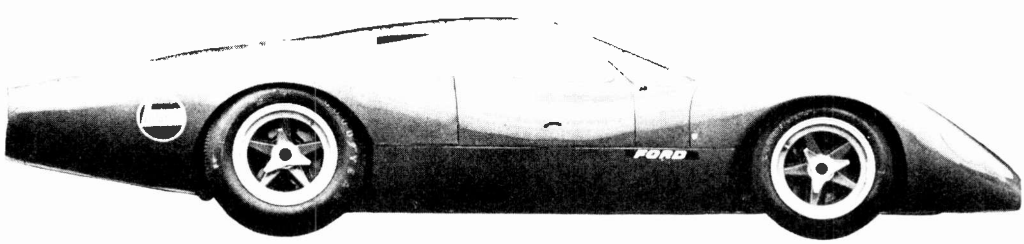
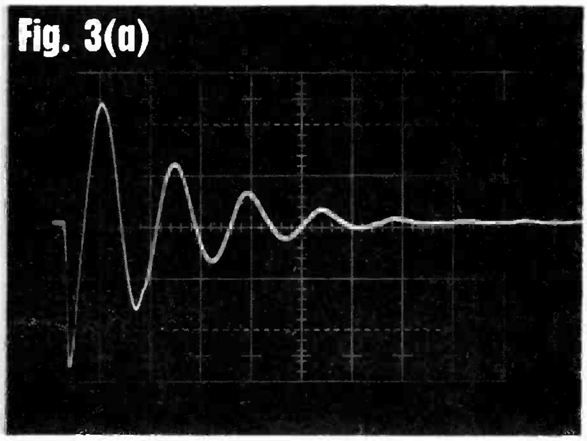
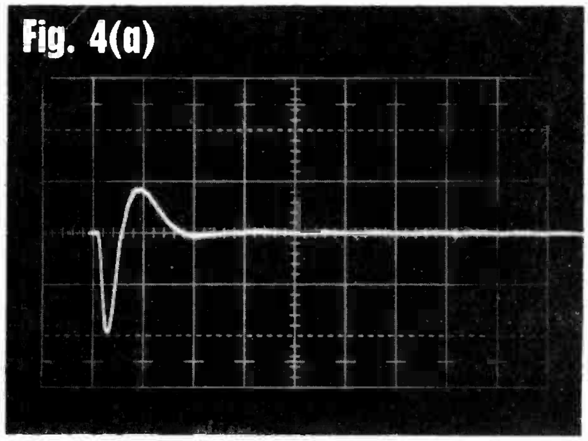


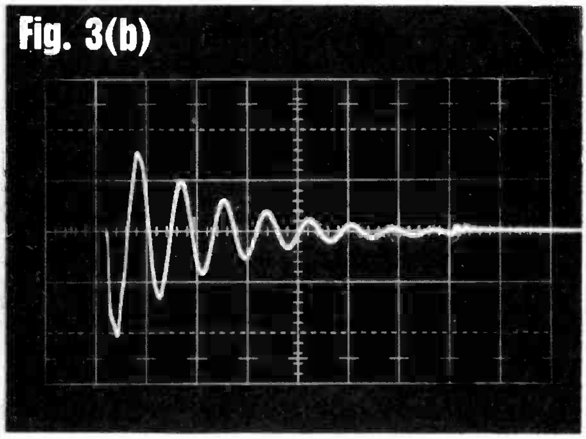
Fig. 2. Output voltage with engine speed for conventional and capacitor discharge systems

5 per cent more BHP









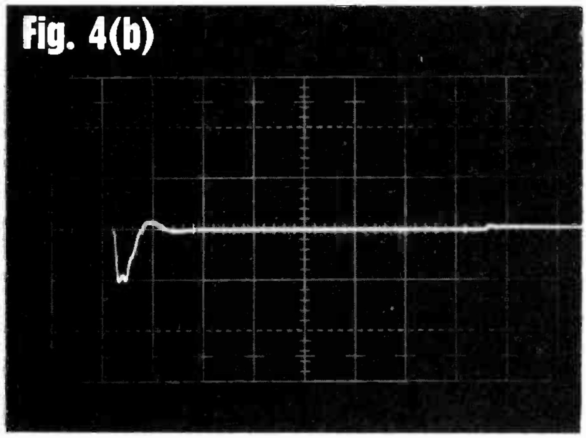


Fig. 3(a). Oscillogram of open circuit secondary voltage with electronic system. Vertical is 10kV/cm and horizontal 200μs/cm. (b) open circuit secondary voltage with conventional system. Vertical is 10kV/cm and horizontal 500μs/cm

Fig. 4(a). Output voltage of electronic system loaded with 470kΩ and 40pF. Vertical is 10kV/cm and horizontal 200μs/cm. (b) output voltage of conventional system loaded as before. Vertical is 10kV/cm and horizontal 500μs/cm

CAPACITOR DISCHARGE IGNITION

In the past few years another system has been gaining in popularity—the capacitor discharge system. In this system a transistor inverter is used to charge up a capacitor to about 400V. Energy is stored in the capacitor, and when the contact breaker opens, a silicon controlled rectifier is triggered and discharges the capacitor through the coil. This system has several important advantages:

1. The kilovolt output has a very fast rise time, typically 20–30μs as compared with 100μs for the conventional systems. This enables it to fire fouled plugs more easily and gives easier starting and smoother running when cold.
2. Low current drain. At low speeds it needs only about 1A, rising to 3–4A at very high speeds.
3. It will work with the ordinary ignition coil, a high ratio coil is not required, and in the unlikely event of failure the system can be put back to normal merely by reconnecting a few leads.

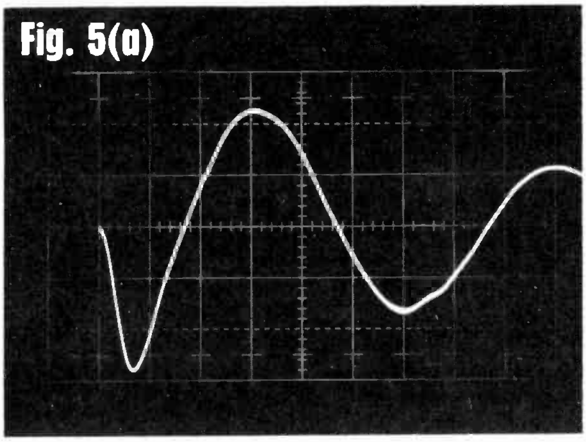
The circuit described here gives virtually constant output voltage over the whole speed range, to over 10,000 r.p.m. for a four cylinder engine and 7,000 r.p.m. for six cylinder. This gives improved combustion and more accurate timing. The greatly reduced contact breaker wear allows the engine to remain "in tune" and improves the petrol consumption and power, and the contact breaker will not need adjustment for about 20,000 miles.

PERFORMANCE

Figs. 2 to 6 compare the performance of the capacitor discharge and the conventional system. Fig. 2 shows how the output voltage of the electronic system remains almost constant, and is still high enough to produce a good spark even when heavily loaded with a parallel combination of 470 kilohms and 50 picofarads (simulating a badly fouled plug). The prototype actually operated up to the equivalent of 15,000 r.p.m. (four cylinder) although the circuit is only designed to work up to two thirds of this speed.

In Figs. 3 and 4 are shown the actual secondary voltage waveforms obtained. Fig. 5 shows the much faster rise time of the electronic system.

more miles per gallon



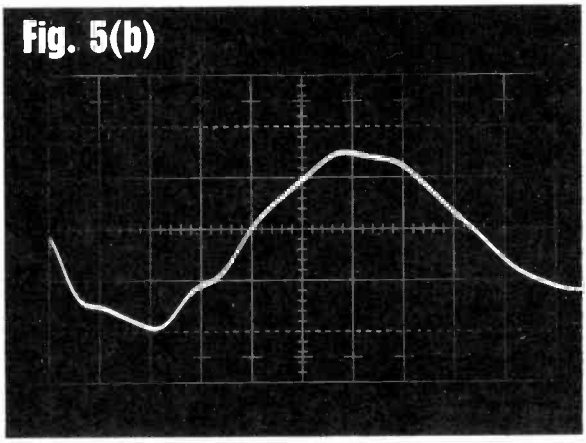
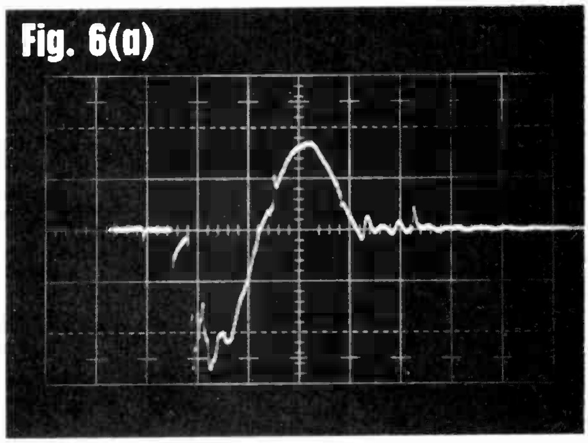


Fig. 5(a). Expansion of Fig. 3(a), showing rise time of electronic system. Vertical is 10kV/cm and horizontal 50μs/cm. (b) expansion of Fig. 3(b) showing rise time of conventional system. Vertical is 10kV/cm and horizontal 50μs/cm



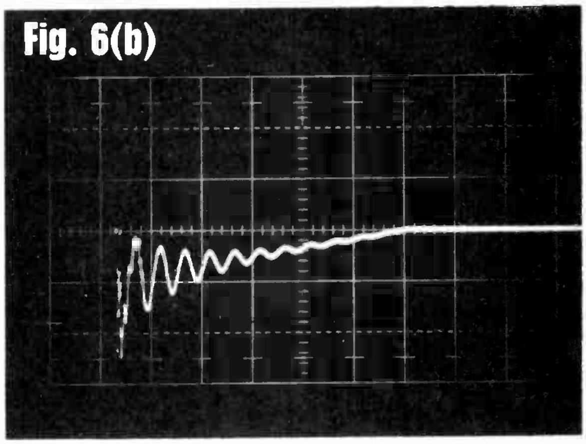


Fig. 6(a). Spark current produced by electronic system. Vertical is 100mA/cm and horizontal 50μs/cm. (b) spark current produced by the conventional system. Vertical is 50mA/cm and horizontal 200μs/cm

The spark current traces shown in Fig. 6 are particularly interesting. In the conventional system the spark current is unidirectional. This causes erosion of the sparking plug gaps due to deposition of metal from one electrode to the other.

In the electronic system not only is the spark much shorter—0·2ms as compared with 1ms for the conventional system—but it also has nearly equal positive and negative half cycles. This greatly reduces plug erosion and increases spark plug life.

CIRCUIT DESCRIPTION

The complete circuit diagram is shown in Fig. 7. Transistor TR1 is not required for positive earth use but it may be left in circuit if desired. This will enable the ignition unit to be used in cars of either polarity merely by altering a few connections. It is only suitable for 12V systems.

Assume that the circuit is wired for negative earth with tag 9 earthed and the contact breaker connected to tag 8.

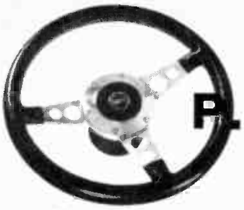
When the contact breaker closes TR1 is saturated and TR2 is cut off. When the contact breaker opens TR1 turns off and C1 is rapidly charged via R3. TR2 turns on and the positive pulse at its collector is differentiated by C2 and R11 and applied to the gate of SCR1 as a trigger pulse.

Transistors TR4 and TR5 with the ferrite core transformer T1 form a very efficient push-pull inverter, oscillating at about 2kHz. The 400V alternating output from the secondary is rectified by the bridge D3–D6 and charges the energy storage capacitors C6 and C7 in about 1·5ms (Fig. 8).

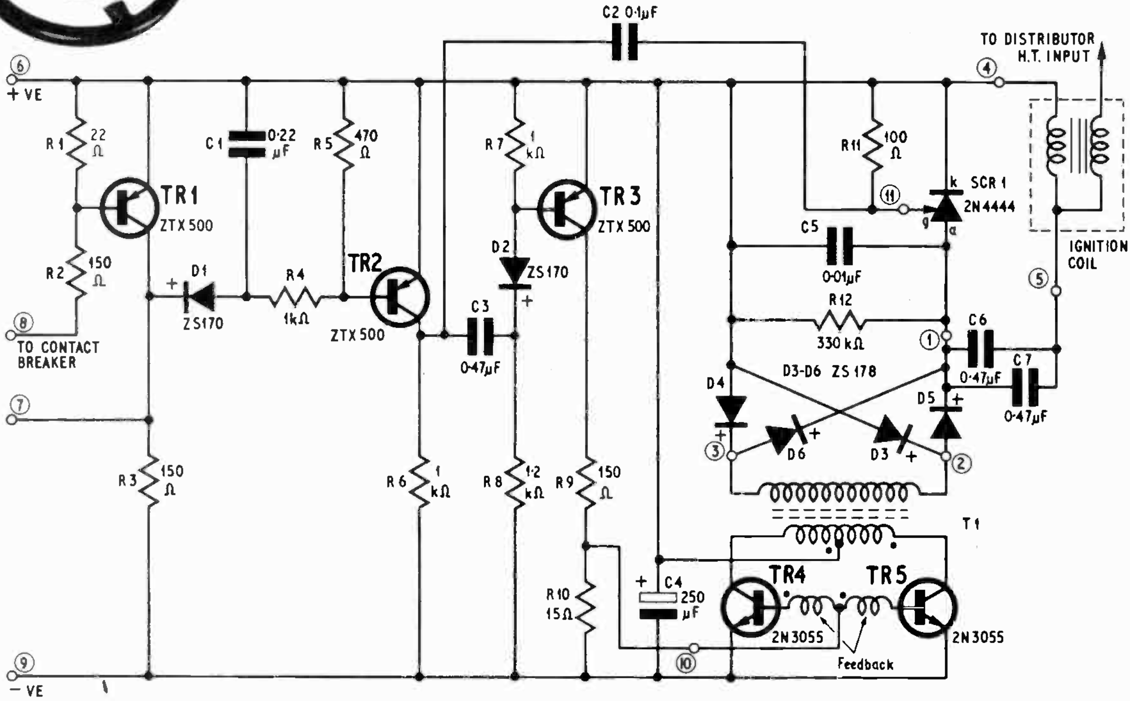
When fully charged the capacitors store 80 millijoules, which is about the same as the energy produced by the conventional system under ideal conditions.

When the thyristor is triggered C6 and C7 are switched directly across the coil so that the coil primary voltage instantaneously rises to minus 400V. The coil voltage then follows a cosine law whilst the coil current follows a sine law, the frequency being determined by the coil primary inductance in parallel with C6 and C7. See Figs. 9 and 10.

As the coil voltage reaches its positive peak the coil current passes through zero and the thyristor turns off. Then, as the coil voltage begins to fall, the diodes in the rectifier bridge become forward biased allowing the coil current to reverse. As the coil voltage reaches its second negative peak the current has again reached zero, but since the thyristor is now turned off the current cannot reverse again, and the remaining coil voltage is left on the storage capacitors C6 and C7. The capacitors then start to recharge for the next pulse.



P.E. SCORPIO IGNITION



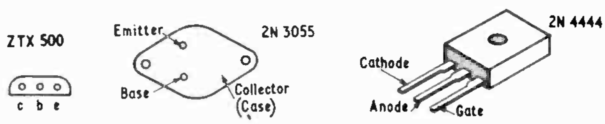


Fig. 7. Circuit diagram of the capacitor discharge system

COMPONENTS...

Resistors

R1	22 Ω	R7	1k Ω
R2	150 Ω 2W	R8	1·2k Ω
R3	150 Ω 2W	R9	150 Ω 2W
R4	1k Ω	R10	15 Ω 1W
R5	470 Ω	R11	100 Ω
R6	1k Ω	R12	330k Ω 1W

All ½W 10% carbon except where otherwise stated

Capacitors

C1 0·22µF 250V Mullard C280
C2 0·1µF 250V Mullard C280
C3 0·47µF 250V Mullard C280
C4 250µF 40V Mullard C437
C5 0·01µF 1,000V
C6 0·47µF 1,000V
C7 0·47µF 1,000V

Transistors

TR1–TR3 ZTX500 Ferranti (3 off)
TR4, TR5 2N3055 Ferranti (2 off)

Diodes and Thyristor

D1, D2 ZS170 or ZS270 Ferranti (2 off)
D3–D6 ZS178 or ZS278 Ferranti (4 off)
SCR1 2N4444

Transformer

T1—Two Mullard FX2243 ferrite cups with DT2206 former (see text). Ready wound transformer available from A.M.C. Electronics Ltd., 160 Drake Street, Rochdale, Lancs.

Miscellaneous

Eddystone diecast case 7¼in × 4½in × 2in
6-way 5A connector block, mica washers, screws, spacers, turret tags, 14/·0076 connecting wire, TO3 transistor covers
An etched printed-circuit board is available from A.M.C. Electronics Ltd. (see above)

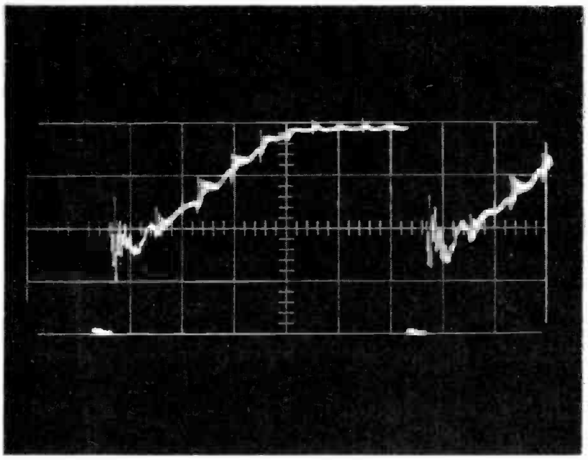


Fig. 8. Voltage on thyristor anode. Vertical is 100V/cm and horizontal 0·5μs/cm

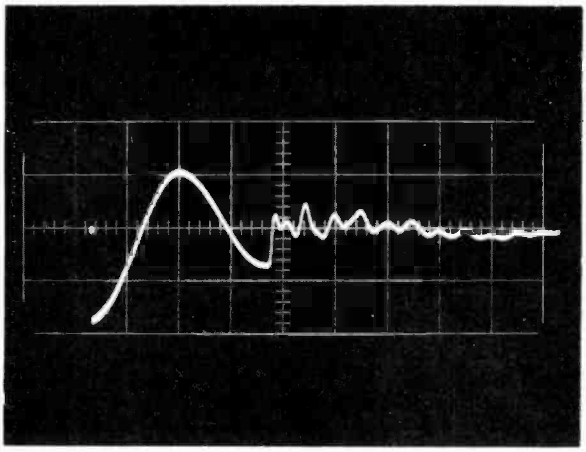


Fig. 9. Voltage across coil primary. Vertical is 200V/cm and horizontal 50μs/cm

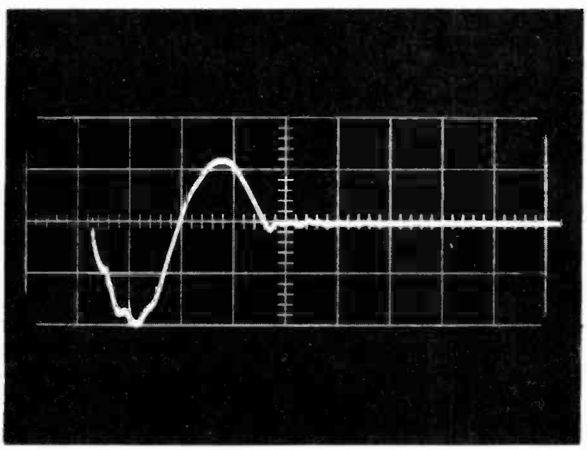
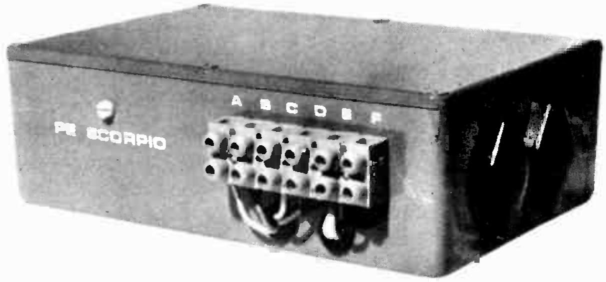


Fig. 10. Current in coil primary. Vertical is 5A/cm and horizontal 50μs/cm



The completed electronic ignition unit in a diecast box. Note the terminal block and power transistors with plastics covers

PREVENTING LATCH ON

When the thyristor turns on it places a short circuit across the rectifier bridge. This does not damage the inverter because the base drive to TR4 and TR5 disappears at the same time, but the inverter tends to produce a low amplitude oscillation at several hundred kilohertz. Normally the output current under these conditions will be insufficient to cause the thyristor to latch on, but to ensure reliable operation TR3 acts as a monostable which switches off the base bias to TR4 and TR5 for about 0·3ms after the thyristor fires. This stops the inverter completely so that there is no possibility of the thyristor latching on.

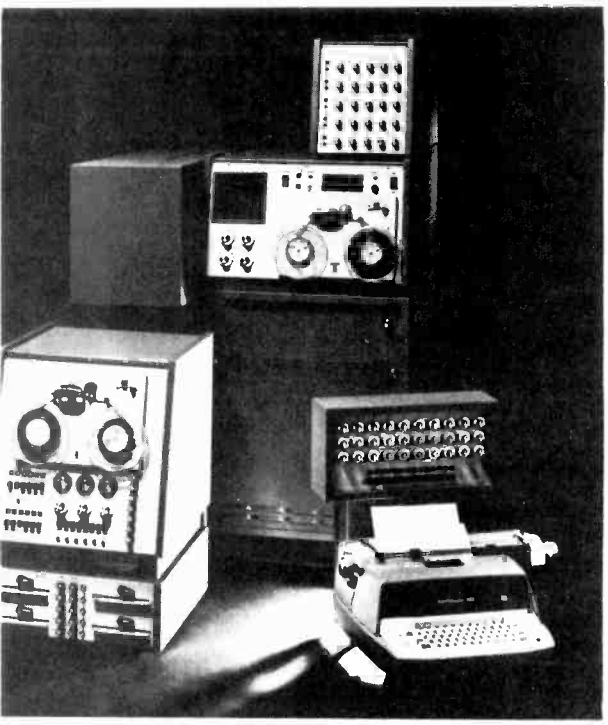
It is important to prevent the thyristor from triggering on spurious pulses produced by contact bounce when the contact breaker points close. In the circuit this is prevented by diode D1 and capacitor C1.

When the contact breaker closes, TR1 turns on and diode D1 is reversed biased. C1 then discharges slowly through R4 and R5, holding TR2 on for a further 0·3ms. Any spurious pulses arriving in this period cannot trigger the thyristor as TR2 is still saturated.

Further noise immunity is provided by C2 which takes about 0·3ms to discharge fully after TR2 turns off.

Next month: Complete constructional details for the ignition system will be given together with information on testing and installing the unit in the car.

all-weather starting and increased engine performance



Electronic Photo-typesetting using Magnetic Tape

THE photograph (left) shows an example of modern electronic phototypesetting equipment. The Alphatype is an American system allowing one operator to perform all the operations that standard metal casting machines perform, plus all of the hand make-up operations.

The heart of the Alphatype system is the "Multimix" recorder enabling any operator, after a minimum of training, to begin setting phototype. With the aid of sophisticated solid state electronics, type instructions fed in at the keyboard are relayed via magnetic tape to the "Multimix" print-out.

To set type in any of 10 alphabets the operator loads the recorder with magnetic tape and sets the dial to the proper unit measure for the desired pica width. Finally, he inserts the proper style cards for the 10 desired alphabets (5 type founts) in the recorder.

When a change of measure is required, he simply types the new information and the "Multimix" recorder holds it in memory until otherwise instructed. When keyboarding is complete, the operator removes the magnet tape with "hard copy" instructions and takes it to the print-out unit.

The magnetic tape is loaded into the Multimix print-out with the proper founts. At the push of a switch the print-out automatically begins to compose the job, changing founts as it reads the recorded instructions.

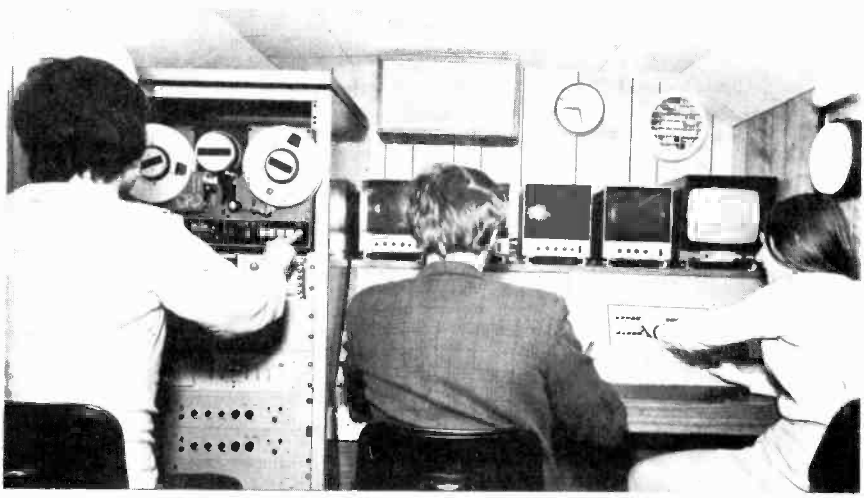
ELECTRONORAMA

University to use OB Television Recording Van

A MOBILE television unit equipped and staffed to produce material required by colleges of the University of Durham's Institute of Education has just completed its initial term's work and will begin its first full year of operation this autumn. Designed and constructed by the Video Systems Division of Bell & Howell, it is housed in a specially modified van.

The unit is to be operated by Durham's recently established educational television consortium, and will spend at least four days of every term at the disposal of lecturing staff.

To meet these and other production requirements, the unit is equipped with three Bell & Howell monochrome cameras. Two are of Plumbicon type and are fitted with 10:1 zoom lenses; the third, with fixed focus optics, is a back-up camera to be used by non-specialist assistants for establishing shots or whenever a third angle is needed.



It also has three video recorders: a 1in recorder with editing facilities; a 1in non-editing recorder; and a ½in machine, mainly to record material for colleges whose own VTR equipment is of the ½in type. In addition the van is fitted with effects and mixing equipment and a sync-pulse generator.

A

Laser Memory

THE development of a crystal that stores hologram images as atomic patterns that can be read out one by one by slow rotation in a laser beam, like photographic slides in a projector, is reported by RCA.

As the laser beam traverses the crystal part of it is diffracted (bent) to fall on a round mirror where it reconstructs any stored information in the crystal (left).

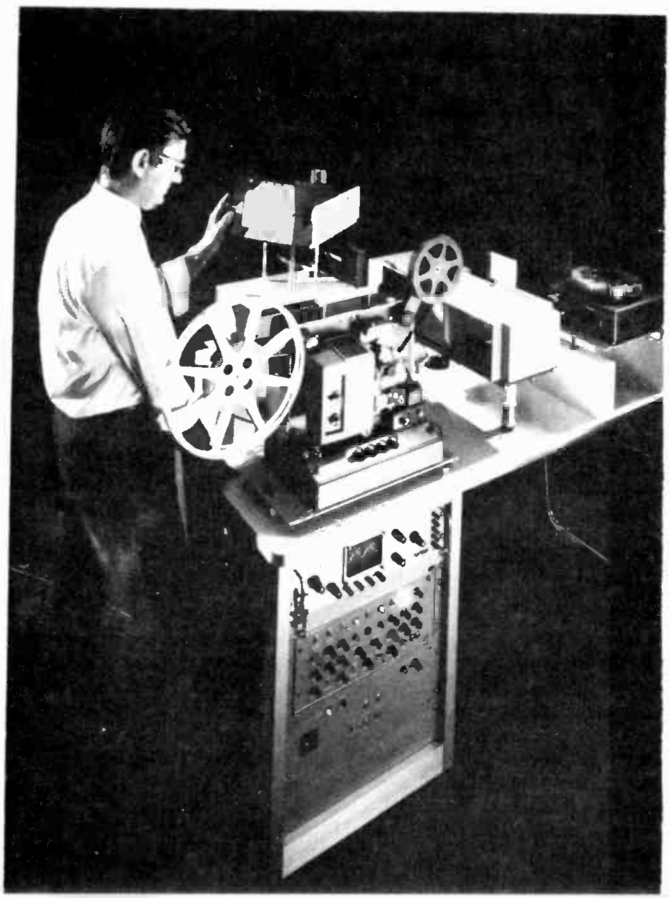
This new advance in holography may lead to a revolutionary document storage system in which files of statistics, architectural drawings, computer data, photographs, maps and other graphic materials are stored permanently in crystals the size of sugar cubes.

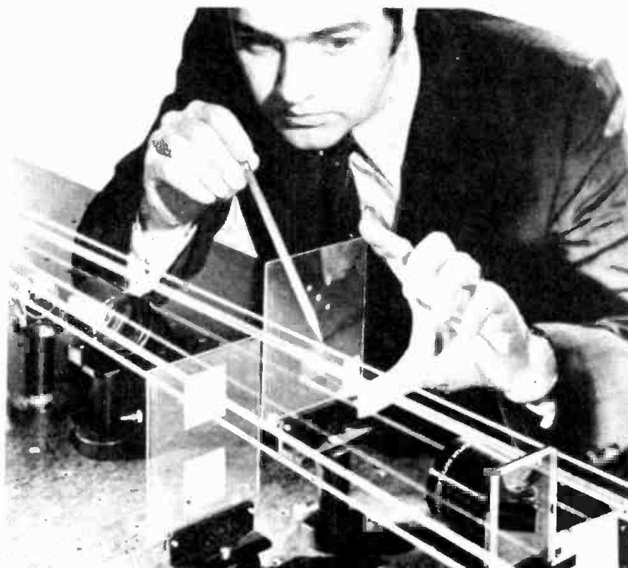
A novel computer memory which for the first time will make it possible for a million bits of data to be written, stored, read out repeatedly, or erased by laser light will be built by RCA for NASA, the American Space agency.

When completed next spring, the experimental, six-foot-long, telescope-shaped device will be the first full-cycle, all-optical memory ever built.

The experimental system is being built under a $193,000 NASA contract, with the Marshall Space Flight Center having overall technical direction. The system is expected to validate the optical memory concept and to establish a base for the possible development of units that could be installed in space stations, earth resources satellites and similar spacecraft that need to store and process extremely large volumes of data at high speed. The laboratory model is shown below.

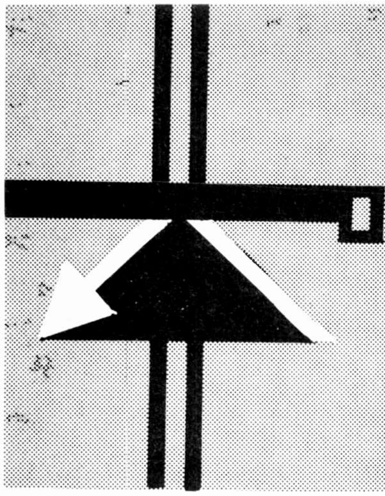
The optical memory appears suited for such applications because of its freedom from dependence on any sort of mechanical motion and its reliability. Such a memory, because it combines extremely large data storage with electronic access, could sometime in the 1980s replace the entire hierarchy of magnetic tapes, discs, drums and cores now used in modern computers.





Monochrome Telecine for Education Studios

A NEW monochrome telecine unit specially designed for professional closed-circuit television work has been introduced by EMI Electronics Ltd. Designated the type "416" the new EMI equipment enables material on 16mm film and 35mm slides to be used in the production of educational television programmes, and also provides captioning facilities.



Substitutes for ZENERS

By J. N. WATT

SINCE the behaviour of silicon semiconductor devices follows a common pattern, it will be found that the base emitter junction can be used as a conventional diode. Similarly, the base-emitter junction of a silicon planar *npn* transistor can be used as a low power Zener diode under certain operating conditions.

The reverse breakdown voltage of almost all silicon planar transistors usually lies somewhere between 7 and 10 volts. This is why the maximum reverse rating of such base-emitter junctions is quoted at 5 to 6 volts, since Zener breakdown is not normally required in the application to which it is subjected.

However, provided steps are taken to limit the power dissipated to around 100mW or so in the case of low power transistors, it will be found that the Zener voltage of any particular specimen remains remarkably constant.

ZENER VOLTAGES

The graph in Fig. 1a shows, by means of a histogram, the range of base-emitter Zener voltages measured on a batch of 30 unmarked *npn* silicon transistors at 5mA Zener current.

Although these transistors were unmarked, they were quoted as all being of a similar type.

It is reasonable to suppose that a batch of 30 guaranteed manufacturer's transistors would show a much closer spread—although it might be considered an advantage to have a range of Zener diodes so readily available in this way.

In point of fact, a measurement of a few new transistors, type BSY95a, did show a much tighter spread of base-emitter Zener breakdown voltage.

The graph A in Fig. 1b shows the voltage-current curve for one of the batch of 30 mentioned above.

The circuit configuration when using a transistor in this way is given in Fig. 2. Note that the emitter is made positive with respect to the base.

The value of R1 is chosen, after V_0 and I_L are known, by Ohms law, that is:

$$R_1 = \frac{V_R}{I_R} = \frac{V_{i(min)} - V_Z}{I_L + I_Z}$$

I_Z should be about 3mA for a small transistor used as a Zener.

Note that if the load current falls to zero by, for example, the load going open circuit, all the former load current will flow in the Zener and due allowance must be made for this.

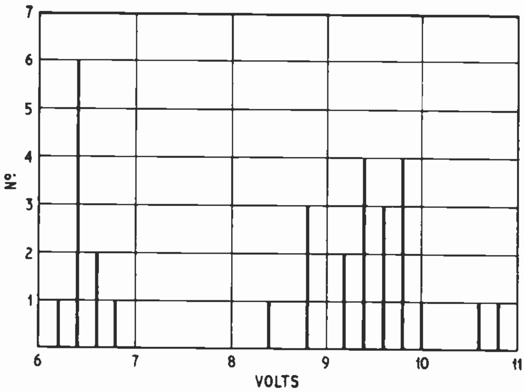


Fig. 1a. Range of base-emitter Zener voltages of a number of sample silicon transistors

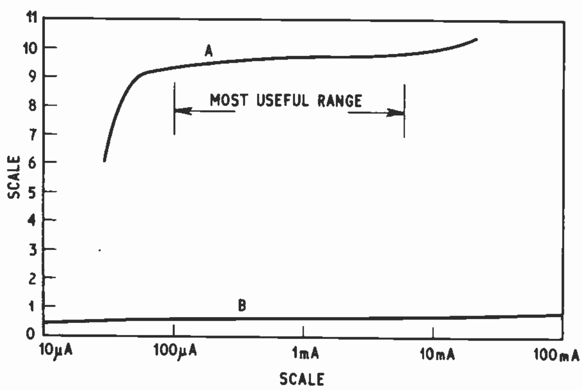


Fig. 1b. Voltage/current characteristic of one sample

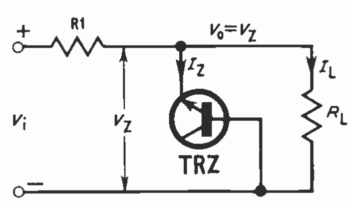


Fig. 2. Circuit used to measure the graph in Fig. 1b

The maximum dissipation in the Zener substitute should be restricted to about 100mW in the case of small 300mW transistors such as BC108; more powerful transistors, such as BCY51, can handle 300mW in this mode.

Details of how to regulate greater power levels follow later.

If, as in Fig. 3, the base-emitter junction is biased forward (as it would be in normal transistor use), then once again a closely controlled voltage is obtained, this time of around 600–700mV.

Fig. 4 shows on a histogram the range of such voltages measured on the same batch of 30 transistors mentioned earlier, again at a current of 5mA. Graph B in Fig. 1b gives the performance of one of these transistors used in this way at various base-emitter currents.

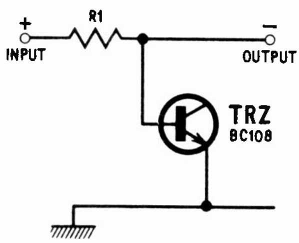


Fig. 3. Forward biased base-emitter junction

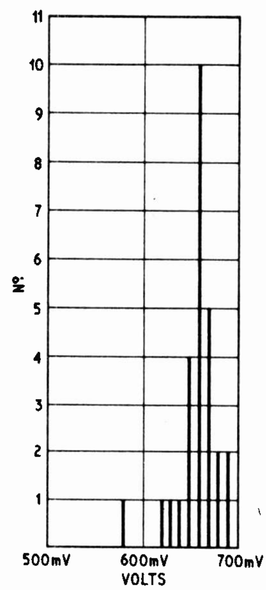


Fig. 4. Range of base-emitter forward voltages from the sample batch

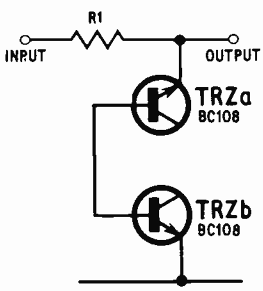


Fig. 5. Series transistors as Zener diodes for 9V supply

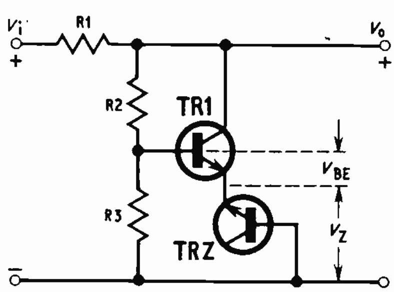


Fig. 6. Arranging higher output voltage by using a transistor

SERIES DIODES

It is possible, of course, to use Zener diodes in series, and the same applies to transistor substitutes. For example, Fig. 5 gives the set-up to provide 9 volts (8·4 + 0·6) from an unregulated supply.

Since the temperature coefficients of a base-emitter junction are of opposite sign, according to which polarity is connected, some measure of temperature compensation is obtained in this last circuit. This is useful in, say, motor car applications, where the voltage supply to instrumentation circuitry can thus be stabilised against battery fluctuations over a wide temperature range.

In view of the availability from a number of advertisers of *npn* silicon planar transistors at prices around 20 to 30 for 50p, it is well worthwhile to consider these devices for use as Zeners in regulated power supplies.

Even if more than one device is required for a single application, there could still be cost savings; this will allow the constructor to make use of some of the more sophisticated circuits which follow, at no greater expense. Thus, greater flexibility and improved performance are obtained.

Substitute Zeners can be employed in a variety of regulated supplies, and those given here are intended to be typical. Any component values quoted are not necessarily optimum, but do show the principles involved, while the simple design formulae given should allow experimenters to adapt circuits to their own requirements.

There is (naturally!) a disadvantage in the use of a transistor as a Zener diode, and that is the limited range of voltages available.

HIGHER OUTPUT

It is, however, easy to arrange for a higher output voltage, and the method used is shown in Fig. 6. (Although a transistor used as a Zener is shown, a conventional Zener diode can be used.)

The output voltage is

$$V_0 = \frac{R_3 + R_2}{R_3}(V_Z + V_{BE})$$

where V_{BE} is the base-emitter voltage of the transistor TR1. This voltage is effectively in series with the Zener voltage and must be included. With a silicon transistor used for TR1, V_{BE} will be about 0·6V; a germanium transistor will have a V_{BE} of about half this.

The maximum dissipation of the "amplified Zener", as this arrangement has been called, is that of the Zener plus the transistor TR1.

Typical values of R2 and R3 are 15kΩ and 3·3kΩ respectively; such values give a V_0 of 9V with a Zener of 6·8V.

Calculation of the value of R1 in Fig. 6 follows the procedure given for the simple Zener circuit.

It is not as straightforward to arrive at an output voltage lower than the Zener voltage, and although it can be done, it would be better to leave consideration of this point until somewhat later, when we come to consider series regulators.

MEASURING ZENER VOLTAGE

Before any transistor is used as a Zener it would be desirable to measure its Zener voltage, bearing in mind the likely variation in that voltage from sample to sample.

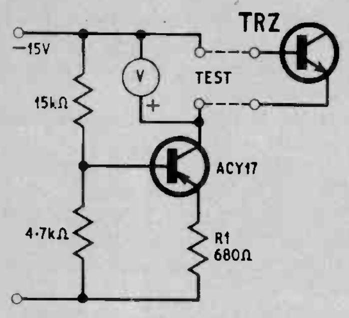


Fig. 7. Simple means of measuring Zener voltage

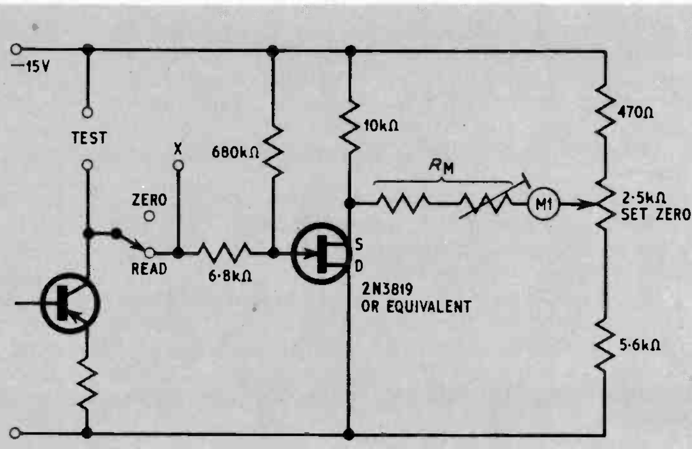


Fig. 8. F.E.T. Zener voltmeter for use with constant current tester. Values for R_M are as follows:
5·6kΩ fixed and 5kΩ preset for 1mA meter
10kΩ fixed and 10kΩ preset for 500μA meter
56kΩ fixed and 50kΩ preset for 100μA meter

A suitable arrangement for this measurement is given in Fig. 7. The voltage at the base is fixed by the two bias resistors and thus the emitter voltage is fixed too. Hence with a fixed value of emitter resistor a constant current will flow through the transistor when the collector circuit is completed.

If the substitute Zener is connected as shown, the constant current mentioned will flow through it and so a useful measurement can be made of its Zener voltage. This will be the more useful since various samples of Zeners will all automatically be tested at the same current.

The above reasoning naturally assumes that the supply voltage is high enough to develop the required voltage across the Zener and in addition provide voltage for the constant current transistor to function. A supply of about 30% greater than the highest Zener voltage likely to be measured should suffice.

In Fig. 7 the test current will be 5mA for the value of R1 shown. Lower values of R1 will give larger currents and vice versa, so permitting testing at other currents if desired.

In practical use, any low or medium power *pnp* transistor, such as ACY17, can be used. Remember that maximum dissipation will take place in the transistor with the lower values of Zener voltage, for it is then that most voltage appears across the transistor. Thus when measurements of the forward voltage drop of base-emitter junctions (about 600mV) are being made, almost all the supply voltage will appear across the transistor, so dissipating 75mW at a test current of 5mA. At higher test currents, some form of heat sink may be needed.

F.E.T. ZENER VOLTMETER

Measurement of the Zener voltage itself can be carried out with a high resistance testmeter on the appropriate voltage range. However, if testing of Zener diodes is to be done at low currents or if only a low resistance testmeter is available, then a simple f.e.t. voltmeter has several advantages, and a suitable circuit is shown in Fig. 8.

A popular type of f.e.t. is used. The set zero control is used to show zero volts on the meter with the switch in the "zero" position. The Zener under test is connected and the switch put to "read"; after the reading is taken, the switch should be returned to "zero" to prevent the meter reading the 15V supply voltage when the Zener is removed.

Values of external series resistance R_M are given in Fig 8 caption for some popular meter sensitivities. It is required to be adjustable to allow for various f.e.t. characteristics and meter resistances, and is quite easily set up.

First, switch to "zero" and adjust the set zero control for zero on the meter. With the "zero/read" switch still at "zero", connect the positive terminal of, say, a 6 volt battery to the point marked "X" in Fig. 8, with the battery negative to the tester negative rail. Monitor this battery voltage with a suitable test-meter (this can be of a low resistance type). Adjust R_M to give a suitable reading on the meter used; for example, with a 1mA meter aim for an indication of 0·6mA with 6 volts applied.

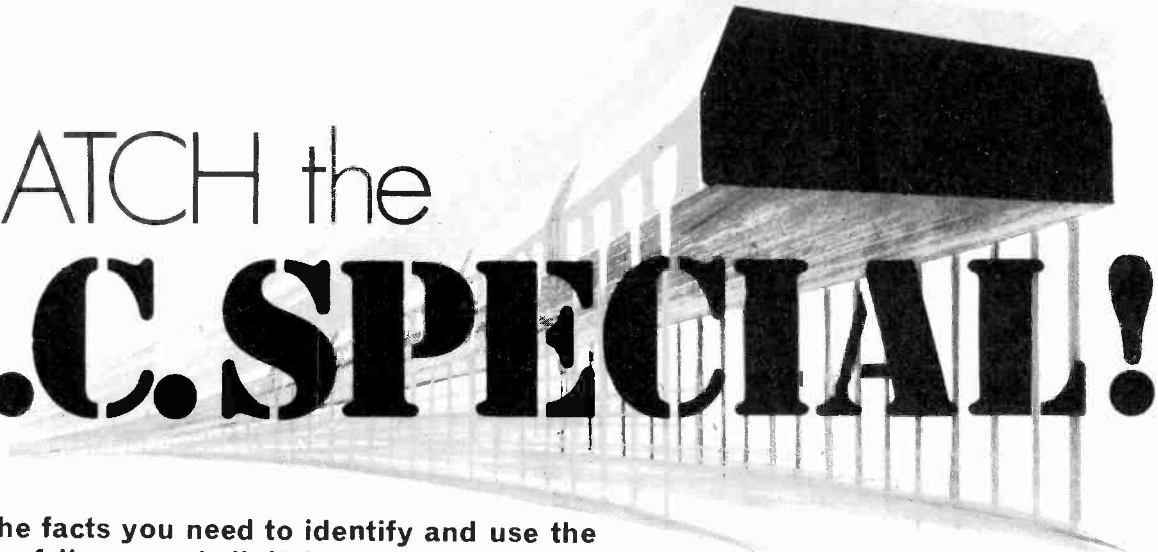
The advantages of this circuit are that a basic meter of low sensitivity can be utilised, and that Zener voltages can be measured at low currents. If a simple voltmeter circuit were used, it would have to be ensured that the current taken by the voltmeter was small compared with the test current, for otherwise the level of test current would vary as the current into the voltmeter varied. The f.e.t. voltmeter shown does not have this disadvantage even at test currents as low as 100μA.

ZENER REGULATORS

As mentioned earlier, the upper limit of power handling for a substitute Zener is reached at a few hundred milliwatts or so.

However, it is easy to arrange for greater levels to be regulated, and there are basically two ways of achieving this, using additional power handling transistors: as will be shown next month.

CATCH the I.C. SPECIAL!



Get the facts you need to identify and use the mass of linear and digital integrated circuits now available. Classified tables of data and applications information are given in the supplement in our December issue.

Integrated Circuit Survey

. . . follow up by trying out the constructional features:

Logical Radio Control

Integrated circuits are used to great advantage in coding and decoding proportional radio control functions for models. Wiring is simplified with printed circuit cards making control systems small enough for a wide range of models.

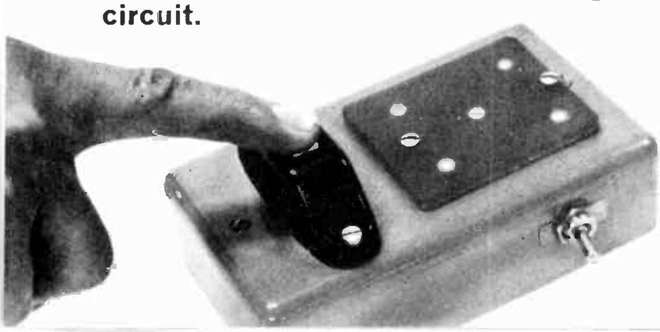
An Added Attraction

ELECTROLUMINESCENCE AND MATERIALS

This article explains the principles of light emitting semi-conductor materials in connection with modern means of communication.

Digital Dice

This small battery operated dice has a neat array of spots in conventional dice configuration, and is illuminated by pressing a button. The actual value shown is determined by random switching of a counter and gating circuit.



DECEMBER ISSUE ON SALE — NOVEMBER 13

PATENTS REVIEW...

"IDEAS" LIBRARY

For the electronics enthusiast there is a wealth of interesting ideas buried in the millions of patents kept in the library attached to the British Patent Office in Southampton Buildings, Chancery Lane. And the numbers are added to every week. It costs nothing to refer to anything kept there and it only costs 25p to buy a copy of any British patent specification. The only trouble is finding interesting needles in the haystack.

The idea behind this column is to pick out a few of those "needles" and in view of the massive numbers of specifications involved it seems sensible to concentrate only on those that are being newly published. So a few of those most likely to interest *Practical Electronics* readers will be mentioned in this series.

LEGAL ASPECT

On the legal side of things, remember that a patent serves two purposes. Firstly, it discloses to the public the details of what the patentees have been doing, and secondly—for a period of up to sixteen years while the patent is in force—it gives the patentee a monopoly on whatever is really new in his activities.

The scope of this monopoly is defined by the claims which are found at the end of the specification and so—in theory at least—you are liable to be sued if you do what the patentee is claiming. But in practice, of course, the average reader of *Practical Electronics* is likely to be far less bothered by the legal side of things than he might at first fear.

Quite apart from the question of whether what he is doing actually meets the requirements of the patent claims, and quite apart from the question of whether those claims are really valid (these are questions that only a chartered patent agent can advise you on) it is common sense that a reader playing about in his garden shed with a bit of one-off circuitry is unlikely to find himself sued by a multi-million pound electronics firm on the grounds that he has made up a version of a patented device or circuit.

But it could be very different if the same reader starts making up that circuit by the dozen and advertising them for sale.

So if anyone has ideas from this or any subsequent article, please use some common sense and if in doubt take professional advice from a chartered patent agent. Bear in mind that agents' time is not cheap to buy and so professional advice should only be sought where really necessary. The Editor cannot enter into any correspondence on the legal aspects of patent applications, inventions, or specifications.

One final point. A reasonable estimate would be that 90 per cent of everything disclosed in any patent specification is established knowledge anyway. Most patents need pages of background information to highlight the novel and inventive step—and of course those pages of background information are often of the most interest to the amateur constructor. If something described is old and known, it is assumed free for anyone to use.

SIMPLE SLIDE SYNC

THE Hungarian firm Elektroakusztikai Gyar have a new British Patent 1 230 040 which concerns a synchroniser for automatically operating a multitrack tape recorder and an electronically remote-controlled slide projector. To date a wide variety of control systems have been devised for ganging tape recorders and slide projectors so that a recorded commentary automatically controls slide change.

Recently some fairly sophisticated set-ups have emerged. For instance where a built-in synchroniser is used, the synchronising signal has been recorded and reproduced by means of an erase head. 50Hz signals are taken off the mains and fed to the erase head for recording onto a second track. On playback these signals are detected by the same erase head and used with amplification to operate the projector control relay. (Tape erasure may also be handled by erase head when fed by a d.c. voltage.) This all works well but problems arise when the tape recorder does not have a built-in synchroniser. So separate synchronisers have been marketed although for one reason or another their presence have tended to complicate the overall system in a manner which Elektroakusztikai Gyar maintain is unnecessary.

The Hungarians suggest solving the problem by using a separate synchroniser, but one which records the control signals on the tape from an amplifier with switchable positive feedback. By means of a capacitor this positive feedback converts the circuits used into an approximately assymetrical multivibrator so that the amplifier can handle the function of a code oscillator as well as its other routine functions (see Fig. 1).

The patent specification describes some convenient transistorised circuitry for positive

BP 1 230 040

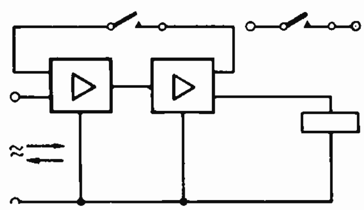


Fig. 1

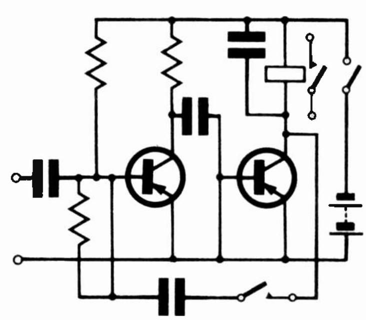
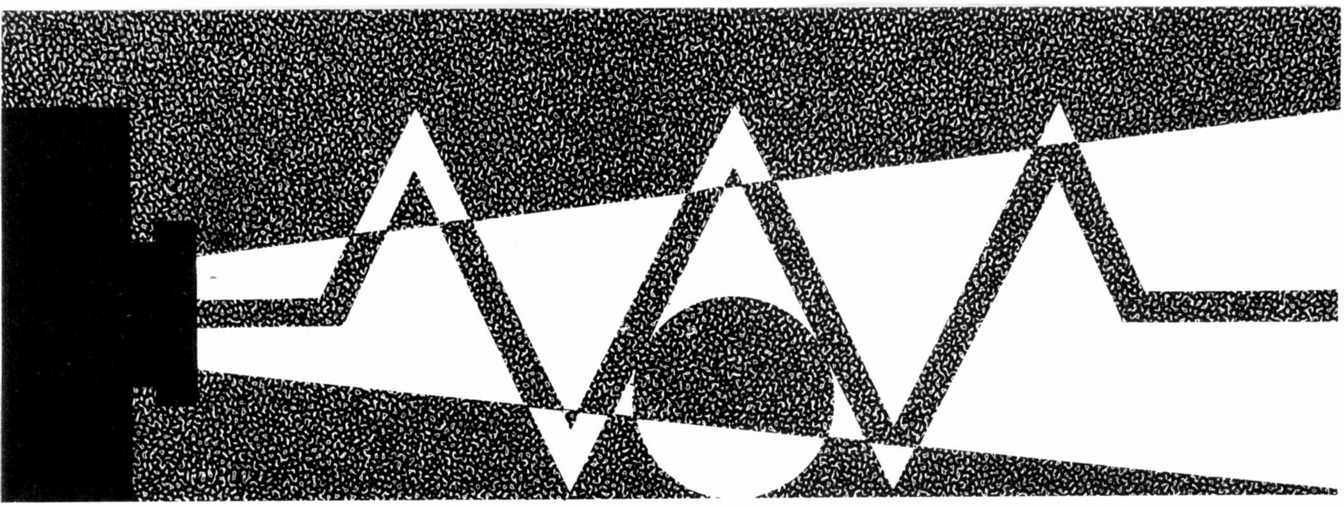


Fig. 2

feedback production—and most important of all—the circuitry looks fairly simple and thus should provide an equally fairly cheap system for "add-on" synchronisation. The feedback switch of course also provides for easy manual control of the projector. The detailed circuit without component values is in Fig. 2.



PROJECTOR LAMP PROTECTOR

By J. KAY

As an enthusiastic user of a 35mm still projector, the author has found that the cost of replacing blown bulbs can be rather high. It is common knowledge that a lamp's filament is more likely to fuse at the instant of switch-on than at any other time. The reason for this can be seen best by taking an example.

A 500 watt, 250 volt lamp in normal use carries a current of 2 amp. However, if the cold lamp's resistance is measured by an ohmmeter, it is found to be 4–5 ohms. By Ohm's Law this indicates that, at switch-on, the current carried will be 50 amps.

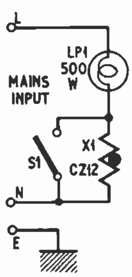


Fig. 1. Switch protection for the Projector lamp thermistor

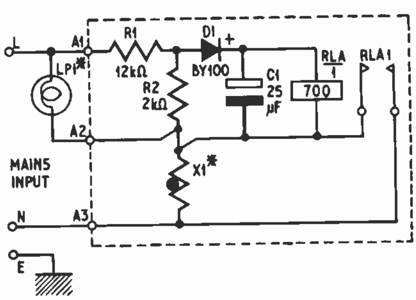


Fig. 2. Circuit diagram of the Automatic Projector Lamp Protector

It is, therefore, not very surprising that lamps will tend to fuse at switch-on.

SURGE LIMITING

In order to reduce this initial surge, thermistors are made which have cold resistance of about 120 ohms and hot resistances of approximately one ohm. If this 120 ohms and the lamp's 4–5 ohms are connected in series across the mains, the current at switch-on will be 2 amps.

As this current heats up the thermistor its initial resistance value will begin to fall and hence the current through it will rise. The temperature of the lamp's filament will also rise, and so will its resistance.

These two changes occurring at the same time tend to balance one another out and the current through the lamp and the thermistor remains at about 2 amps, or a little lower since the lamp heats up more rapidly than the thermistor.

THERMISTOR PROTECTION

If the thermistor is left in circuit, its effect on the lamp's brilliance will be negligible. However, the temperature of the thermistor may reach 200–250°C in free air and higher if enclosed.

At these temperatures the thermistor is rather fragile, and unless it is shorted out soon after switch-on, may easily break as a result of vibration. In addition any subsequent switch-on must be delayed by 10–15 minutes as it requires this period to cool down.

A manually operated switch, S1, connected in parallel with the thermistor as in Fig. 1, is apt to be overlooked and in consequence the life of the CZ12 is reduced.

RELAY SWITCHING

To overcome this problem, automatic switching using a relay was devised as in Fig. 2. Since initially most of the voltage appears across the thermistor there will be a delay period before the relay operates as R1 and R2 form a divider to provide a suitable voltage for the relay. As the line volts are alternating a rectifier D1 and smoothing capacitor are required.

The relay used in the prototype had a coil resistance of 700 ohms. With an operating voltage from 12–24 volts, a 2 kilohm resistor for R2 is suitable.

If other relays of similar operating requirements are available the value of this resistor should be tailored to provide contact pull-in after about six seconds.

COMPONENTS . . .

Resistors
R1 12kΩ 5W
R2 2kΩ 1W

Capacitor
C1 25μF elect. 50V

Thermistor
X1 CZ12 (Henry's Radio) (See text for type variants)

Diode
D1 BY100

Relay
RLA 2 pole, 2 way, 12–24V 700 ohm type 4189GD contact rating 2A (Henry's Radio)

Miscellaneous
Standard tag board, wire

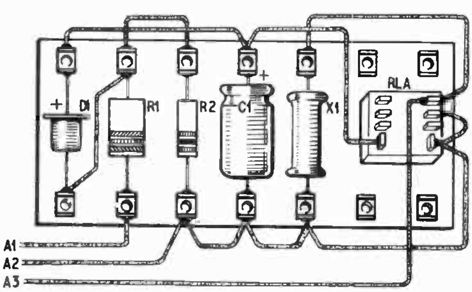


Fig. 3. Tag board assembly and wiring details for the Lamp Protector

CONSTRUCTION

The relay and associated components shown contained in the dashed box can be assembled on a piece of standard tag board as shown in Fig. 3. As wiring is not at all critical other layouts may be employed.

If lower voltage lamps are used, the thermistor type should be changed as follows. For lamps up to 150 W—CZ9A. And for lamps up to 300 W—CZ11. With these alternatives there is no need to change any of the relay circuit components values.

If the projector has a fan, it should be left connected to the mains and not included in the lamp control circuit. The tag board assembly should be clear of this if mounting in the projector is intended. ★

NEWS BRIEFS

Patents and the Patent Office

A most useful and informative booklet has just been published by The Patent Office, London. It describes the information retrieval services provided by the Patent Office ("the largest technical publisher in the country") and how to make use of them.

The booklet also deals briefly with applying for a patent, and the exploitation of a patent. And contains a list of publications available concerned with invention and patent literature.

The booklet is available free of charge from Sale Branch, The Patent Office, Orpington, Kent BR5 3RD.

Worldwide Communication

The North Staffordshire Polytechnic has recently improved its amateur radio station equipment and now has a rotating complex of beam aerials on top of a 60ft tower mounted on the roof at the polytechnic.

The new aerial system, the wide range communications equipment and the facilities at the adjacent electronics laboratory have made this station the most advanced installation of its type in the country. Signals from the station can be received, the Polytechnic say, anywhere in the world.

The equipment which includes three transmitters has been acquired over the past four years and some of it has been built or modified by students. Officially G3VZI —the station's call sign—is operated by North Staffordshire Polytechnic's Amateur Radio and Electronic Society.

Dimmer Switches

The Accessories Section of the Installation Equipment Division of BEAMA has recently extended its scope to cover dimmer switches for domestic and similar lighting circuits.

A technical panel has been set up in collaboration with the Appliance Control Section of BEAMA and other interested bodies, to produce a draft British Standard Specification covering dimmer switches.

A selection of readers' suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.
This is YOUR page and any idea published will be awarded payment according to its merit.

IC TEST JIG

BEING faced with the need to test and experiment with a variety of dual-in-line type i.c.s, and not wishing to part with the cost of an expensive commercial type "breadboard", I evolved the following extremely handy inexpensive test jig.

The complete unit can be built in under 30 minutes, costs less than 50 pence and consists of one 16-pin DIL i.c. socket, one small piece of 0·1 matrix Veroboard size 17 × 24 holes, and 16 Veropins.

The jig is constructed as shown in the photographs. The distance between the Veropins is great enough to allow connection of crocodile clips with minimum risk of short circuits.

It should be noted that the $+V_{CC}$ and earth connections for 14-pin DIL's are different and the necessary modification will have to be made to the board.

This system could be enlarged using a larger board and it could also be adapted for TO5 type i.c.s using the sockets and pin spreaders available from advertisers.

Jnr. Tech. Nekrews,
Royal Air Force,
BFPO 45.

LIFT-NOTE GENERATOR

THE circuit in Fig. 1 will produce tones in increasing frequencies until the highest one is reached. Then the cycle repeats again from the lowest frequency. The circuit consists of an astable multivibrator, a pump counter, and a tone generator.

The switching frequency of the astable is varied by the potentiometers VR1, VR2, and this frequency decides the speed at which the tone changes from one frequency to a higher one.

The voltage across transistor TR3 is used to control the pump counter. When this is conducting, only a low voltage is obtained across it. But when TR3 is cut off, this voltage increases considerably. A negative signal is then introduced to the base of TR4 and this turns TR4 on.

When TR4 is cut off a high resistance appears between its emitter and collector. C5 then charges through R6, C4 and D2. Depending on the value of C4, a fixed fraction of the supply voltage appears across C5.

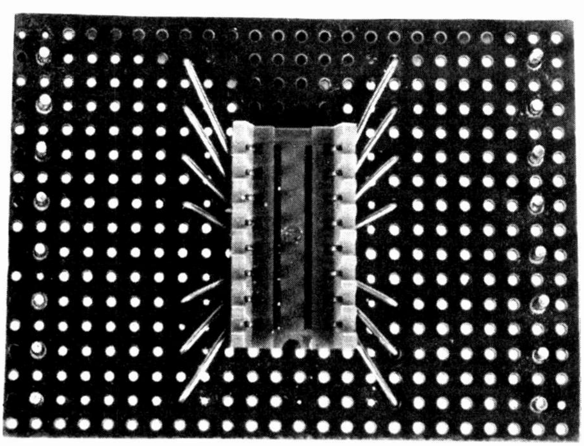
When TR4 turns on, resulting in a low resistance between collector and emitter, C4 discharges through TR4 and D1. Notice that capacitor C5 is prevented from discharging quickly via D2.

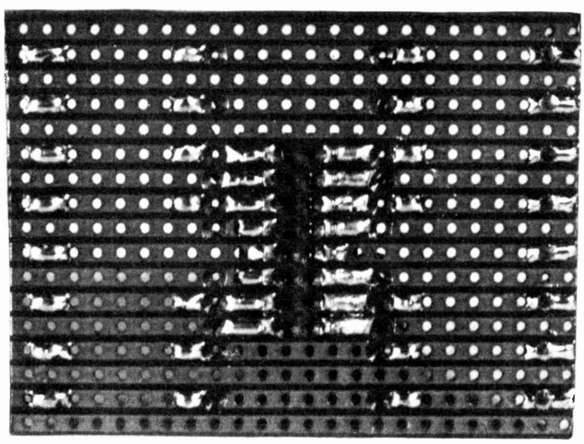
Next time TR4 is cut off C5 charges a little more, and so on. In this way the emitter voltage of the unijunction transistor TR5, after some pulses, gets high enough to fire TR5. Capacitor C2 then discharges, and the process starts all over again.

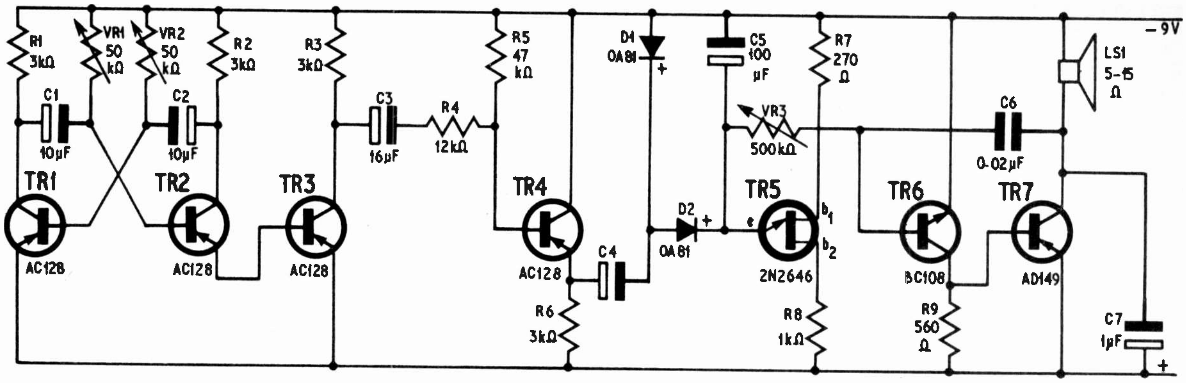
This staircase voltage is further fed to the tone generator unit. This is simply a direct coupled amplifier stage with a regenerative feedback causing oscillation. The oscillation frequency depends on the base bias of TR6 taken from TR5 emitter via VR3. The base bias must not be too high and is adjusted by VR3, beginning with its maximum value and slowly reducing it until the tones are heard.

The circuit has many application possibilities, one being doorbell alarm. It is wise to mount the three units on separate boards, because all the units can be used separately.

Renny Skagestad,
Norway.







CONVERSION TO 24 HOUR CLOCK SYSTEM

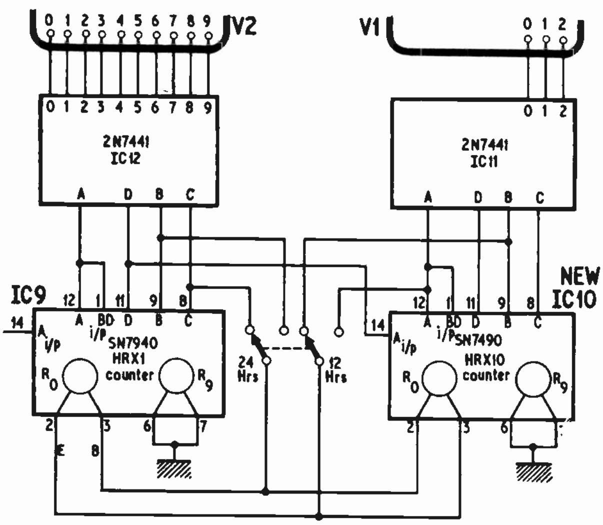
With regard to your Digital Clock, here are one or two modifications that your readers may be interested in.

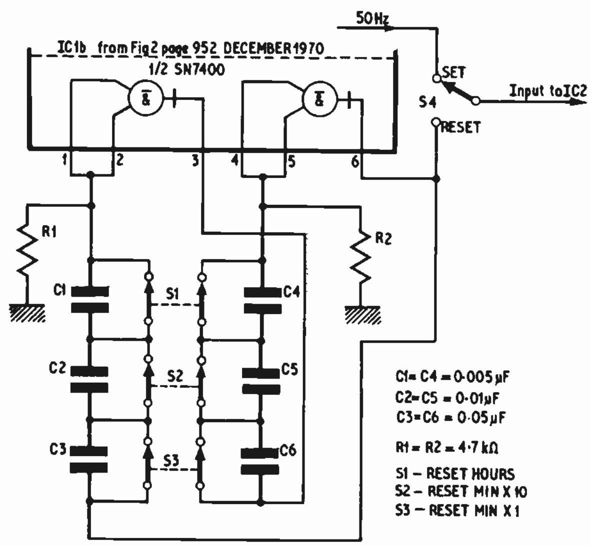
The first enables the Clock to be converted to read a 12 or 24 hours cycle when the alarm system is not being incorporated. As shown in Fig. 1, the counter for HOURS × 10 is made on SN7490, and the mode of the clock is changed by switching the inputs to RESET ZERO gates of the HOURS × 1 and HOURS × 10 counters.

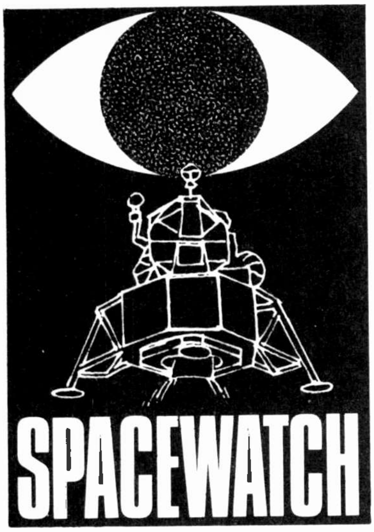
Because the clock is to read both 12 and 24 hours, the HOURS × 10 Nixie is connected to the HOURS × 10 decoder. The clock, therefore, reads at the recycle times 11.58-11.59-00.00-00.01 and so on, in the 12 hour mode and 23.58-23.59-00.00-00.01 in the 24 hour mode which means in the 12 hour mode the clock never reads 12.00 hours.

The second modification concerns the RESET facilities. The circuit shown in Fig. 2 enables the clock to be reset in faster time; also the clock can be held at a particular time in order that it can be accurately set up. As can be seen, the circuit makes IC6 and S1 redundant, but introduces more discrete components at four switches. The second half of IC1 (IC1b) is used as a three-frequency multivibrator, the individual frequences being switched by S1, S2 and S3 in Fig. 1. With all three in the closed position, the circuit does not oscillate, and therefore, when S4 is in the RESET position, the clock receives no input pulses. With S4 in this position, and S1 open the multivibrator oscillates at a frequency that charges the HOURS counter approximately once per second. With S2 open and S1 and S3 closed, the MINUTES × 10 counter changes approximately once per second. S3 performs the same function for the MINUTES × 1 counter. This results in the clock being completely recycled in 55 seconds in the hour mode and 25 seconds in the 12 hour mode.

K. D. Brown,
Southend-on-Sea.







BY FRANK W. HYDE

GLOBAL WEATHER STUDY

With the launching of the French satellite *EOLE* a new step forward has been made in the expansion of meteorological studies. Satellites in the service of man are beginning to reap the harvest of space technology spin-off. It is interesting that the French have chosen a name which means " God of the Winds."

The satellite will gather data from as many as 500 free ranging meteorological balloons. The existing systems which have been so outstandingly successful in the case of the *Nimbus* satellites, gather mainly data from the higher levels, though some balloon interrogation is carried out.

Both *Nimbus 3* and *4* which carried the interrogation, recording and location system was able to show its efficiency in tracking balloons, aircraft and other types of instrumental platforms.

The Omega position location equipment which was installed in the geostationary satellites *ATS 1* and *ATS 3* tracked balloons and buoys successfully.

The doppler system installed in *EOLE* is superior to the others in that they cannot cope with the same number of balloons. This satellite will take over in an area where expensive rocket methods have been used, namely the 30 to 60km levels in the atmosphere.

The *EOLE* satellite weighs about 160lbs and was designed, under the direction of Professor P. Morel from the University of Paris, at the Centre Nationale D'Etudes Spaciales. It will occupy a 560 mile orbit with a 50 degree inclination to the equator. The orbital period is 103 minutes and the satellite will have a pattern of interrogation which will continue day and night.

The data will be stored until the satellite passes over a tracking station which will command the telemetry at 136MHz to release its store. The experiment is expected to last some 6 months.

The lifetime of the balloons used will vary from one to 5 months. These will be released by researches in the southern hemisphere at the rate of three a day from each of the stations at Mendoza, Neuquen and Lago Fagano.

The balloons, which are twelve feet in diameter, will drift at an altitude of 12,000 metres. Each balloon will carry a payload of instruments in a 32ft long string which will consist of temperature and pressure sensors, together with batteries and solar cells. These will serve the receiver operating at 464·4864MHz and the 4 watt transmitter which will radiate on 401·71796MHz.

It is expected that the satellite system will be able to locate a balloon to within 3km.

ATLANTIC AIRLANE CONTROL

In August an agreement was made between the United States government and ESRO (European Space Research Organisation). Ten countries are represented in ESRO and the agreement arranged through the FAA (Federal Aviation Administration) of America may well end the hazards that exist in the aircraft lanes.

At the present time the minimum separation limits are 2,000ft vertical, 120 nautical miles horizontal and 15 minutes in longitude. At any one moment the accuracy of the known position is not better than ten miles. Using satellite methods the position could be known to half a mile.

In view of the amount of interference that can occur in the normal aircraft communication bands it is expected that the aircraft communication will be shifted to the L band (390 to 1550MHz). It has been tentatively suggested that the specification might follow this form: world wide coverage; accuracy 0·5 Nautical miles deviation to allow separation to be reduced to 30 nautical miles horizontal; 1,000ft vertical; and 5 minutes longitudinal.

VIKING MISSION

Some rather disturbing conditions are forecast as a possibility in the Martian atmosphere when the *Viking* spacecraft attempts the landing on Mars in five years time.

Cornell University has been making a study of the possibilities of high winds over the surface. It is difficult to forecast exactly what will happen for the meteorology can only be known from indirect methods.

The terrestrial experience does not help very much for the atmosphere on Mars is tenuous and a key factor is the height of the atmosphere and mountain range height. On Mars the scale height is comparable with height of the mountain ranges over a distance of perhaps a hundred miles. The scale height (the point at which the pressure of the atmosphere falls by half) may have the changes of as much as ten miles in height and therefore be very much dependent on the topography.

Carl Sagan and Peter Gierasch have derived solutions to the problems of thermal winds and predict speeds of up to 250 mile per hour in some regions. This will dictate to a great extent where the spacecraft could safely land.

For certain technical reasons the landings have to be made within a limited equatorial belt and there are forbidden areas within these limits where the winds will be too high. Thus it means that regions of great scientific interest will not be suitable for a landing. One of these is the Hellas region.

The lowland flats will be the best choice for landings, but it would appear that the value of the scientific work will be reduced.

Last year there were a number of yellow clouds detected and these may well be dust swept up by very large gale force winds. Some of these lasted for several weeks.

It seems that there are new techniques to be perfected for the later manned landing and that the astronauts who visit will have new techniques to learn.

ASTEROIDS MAY HAVE MAGNETOSPHERES

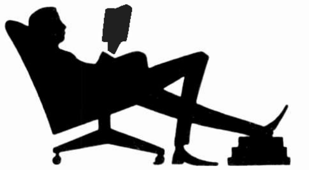
During the grand tour of the planets which is to be made in the late 70's the spacecraft used will traverse the asteroid belt. This lies between the orbits of Mars and Jupiter.

There are many hundreds of these minor planets and it may well be that the probes will pass in the vicinity of one of the larger ones. If this should be so then there may be effects on the instruments carried, particularly the magnetometers.

It is known that none of the asteroids have an atmosphere but it is possible that they have a magnetosphere. The magnetosphere is the zone of magnetic influence round a body which acts as a barrier to penetration by the fast charged particles in the solar wind.

It appears that the solar system has a small residual magnetic field and therefore an asteroid could have a low surface magnetism. If this magnetism were as low as one thousandth of that of the earth then a magnetosphere could exist.

The magnetosphere extends a considerable distance from the body it encloses (the tail of the Earth's magnetosphere extends as far as the Moon) so that a wide pass could yield some data.



BOOK REVIEWS

CHARACTER RECOGNITION 1971

Published by the British Computer Society
212 pages, 8¼in × 5¾in. Price £2

THIS is an up-dated version of the handbook originally published in 1967. It is intended to assist the layman in his comprehension of character recognition; particularly those who may wish to discuss the techniques and possibilities with manufacturers of reading machines.

Physical and optical properties of paper, printing methods, the design of alphabetic and numeric characters and symbols that are suitable for automatic reading by machines are described. Optical mark reading (OMR); magnetic ink character recognition (MICR); and optical character recognition (OCR) techniques are all explained and the text is well illustrated with excellent diagrams. The variety of electronic systems employed in OCR is impressive: after the mechanical scanner (Nipkow disc), come laser-beam, flying-spot, Vidicon, and photocell matrix scanners. This portion of the book offers a good, concise technical introduction to the subject for the general reader.

Proprietary equipment and services are reviewed in the final chapter. This will be most valuable to potential buyers or users of such commercial equipment.

F.E.B.

MICROWAVE SEMICONDUCTOR DEVICES

By H. V. Shurmer, PhD, CEng, FIEE.
Published by Pitman Publishing.
223 pages, 8¼in × 6in. Price £2·25

THIS is one of an Electronic Engineering Series of monographs written at a level ranging from undergraduate to postgraduate and professional standard. It is therefore, a specialist's book. It deals with certain types of semiconductor devices which are employed in the rather rarified regions of the frequency spectrum remote and foreign to most laymen, but where much professional activity is taking place involving radar, telemetry, and instrumentation applications, for industrial and defence requirements.

A brief outline of the history of origin, or development of the particular device is given at the commencement of each chapter. The theory of operation is treated concisely, but in some depth with extensive recourse to mathematical proof, the level (as stated by the author) being suitable for students on an engineering degree course. It goes without saying that the usefulness of this authoritative work will extend even further, to others with serious interest in this rather specialised area of electronics.

The scope of the book is best indicated by listing the devices described (each having one chapter): Point-contact, varactor, Schottky-barrier, tunnel, backward, *pin*, Gunn effect, and avalanche diodes, transistors, and finally, integrated circuits, an area still in its infancy—in microwave terms—but holding out interesting possibilities for the future.

F.E.B.

TRANSISTOR CIRCUIT DESIGN TABLES

By David S. Taylor, M.A. (Oxon), Ph.D.
Published by The Butterworth Group
120 pages, 9in × 6in. Price £2·80

WHEN first seeing the title of this book, then reading the publisher's blurb on the jacket, one would naturally expect to find a great deal of information on the various basic transistor building block circuits. The Preface goes on to tell us how the material is a direct reprint from data derived from computer calculations. Discrepancies, we are told, may be as high as +20 to −30 per cent of the indicated values due to variations in transistor characteristics.

I used these tables in a test case, in which only one line of figures was required. It can be concluded that the value of the book as a whole is minimal since a great deal of the data given is seldom likely to be used. It is like choosing one or two ties from a shop full of ties of different kinds. The designer is rarely likely to require more than basic information on circuit values for only a couple of supply parameters.

One must credit the author with the effort involved in collecting all this data, but for the price of the book I personally do not consider this a "value-for-money" buy. If, however, the designer requires to use this information, a quick peep at the book in a library will be a great help to him.

Probably the most useful chapter is that on Schmitt trigger circuits, but capacitor and inductor reactances are more easily assimilated from nomograms or abacs. Parallel and series resistor and capacitor calculations involve basic arithmetic and excellent approximations can be achieved by mental calculation.

The other three chapters on common emitter amplifier stages (restricted to somewhat outdated RC coupling) and multivibrators are useful and relevant to the title.

M.A.C.

COLOUR TELEVISION THEORY

By G. Hutson
Published by McGraw-Hill Ltd
326 pages, 10in × 7½in. Price £3·85

THIS is a very well prepared textbook on colour television engineering embracing both the PAL and NTSC systems, but with the emphasis on PAL. As is the wont of most textbooks, this is particularly aimed at those students who are preparing for examinations which include colour television principles, particularly those offered by the City and Guilds of London Institute and the Radio Trades Examination Board.

The fact that the use of mathematics is small will no doubt induce lay readers with a working knowledge of monochrome television principles, to invest in this, for not only is it an excellent tutor but a valuable reference.

Commencing with chapters on the physics of light and colour television signals, the book goes on to analyse the various receiver sections that makes reception possible.

The book is very well illustrated with a 14-page index that makes reference a very easy business.

G.G.

Our nearest neighbour the Andomeda Nebula. It resembles our own galaxy and has enabled astronomers to make a more accurate model of our galaxy. It is about 200,000 light years in diameter and is about 2,200,000 light years distant from our galaxy. Its number is M31 and is one of the nebulæ that is visible to the naked eye on a clear night and easily seen through modest binoculars.

RADIO ASTRONOMY TECHNIQUES

BY F. W. HYDE · PART 6

In this part the various pieces of equipment from the aerial system to the recorder will be brought together to form the radio telescope. The setting up of the receiving system will be covered in some detail, much of which may be familiar to some readers. However, this is a very necessary step for the newcomer and those more experienced can go straight to the setting up in their own way.

In order to check each stage certain test equipment is desirable. One test unit which would be of great help is a signal generator of good standard. If this is not available then the next best thing is to make up a noise generator and use this to provide a setting-up signal. This presupposes that some means will be available to set the correct frequencies which are to be used. The nominal operating frequency of this telescope has been set at 137MHz. It is essential therefore that both the pre-amplifier and the converter are centred on this frequency.

NOISE GENERATOR

A suitable noise generator may be made up quite simply and a diagram of a suggested circuit is shown in Fig. 6.1. It is possible to purchase noise generators on the surplus market at reasonable prices and they have the advantage of being calibrated. However, the simple one that is described will serve the purpose very well.

For the sake of making an alternative available that is within the ability of the constructor, a valve diode circuit is shown in Fig. 6.2. It must be pointed out that in the case of the valve diode its life is limited and that if this unit is made up, the time in use at maximum noise should be kept to a minimum.

Either of these noise generators can be used to measure the noise factor of a receiver or amplifier, although this is not the purpose in this case. It will be used in order to ensure that each unit in the chain of apparatus is operating under optimum conditions.

LOW RESISTANCE RECORDER

Certain alternative methods of recording have been given, so the order of setting up will vary slightly accordingly.

Taking the simplest of the arrangements, that of connecting a low resistance recorder directly to the output transformer of the receiver final stage, the procedure will be as follows.

Switch on the converter and the communications receiver and let them warm up for about 20min. Connect the recorder in parallel with the loudspeaker. Disconnect the output from the converter to the receiver.

Set all gain controls at maximum while watching the pen on the recorder. If this goes to full scale before the controls are at maximum, reduce the a.f. gain control progressively while increasing the r.f. control. If the a.f. control is at a point less than 50 per cent of its travel then reduce the r.f. control till the a.f. gain can be set at the halfway point.

The loudspeaker may now be disconnected after reducing the pen position to half scale by the con-

Build yourself a TRANSISTOR RADIO

NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT

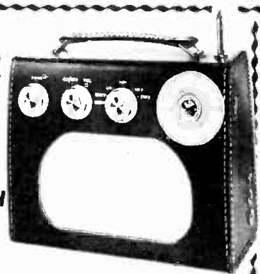
10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND, VHF AND LOCAL STATIONS AND AIRCRAFT BAND.

Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. Switched earpiece socket complete with earpiece. 10 transistors plus 3 diodes. 7in × 4in speaker. Air spaced ganged tuning condenser with VHF section. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in × 7in × 4in.

Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

TOTAL BUILDING COSTS **£8·50** P.P. & INS. 50p (OVERSEAS P. & P. £1)

ROAMER EIGHT Mk. I

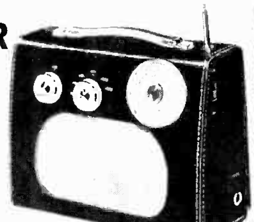


NOW WITH SWITCHED TONE CONTROL

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. 7in × 4in 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 9in × 7in × 4in approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts).

TOTAL BUILDING COSTS **£6·98** P. P. & INS. 41p (OVERSEAS P. & P. £1)

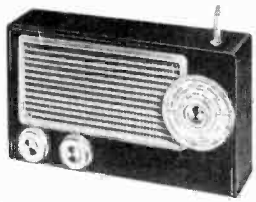
ROAMER SEVEN Mk. IV



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. 7in × 4in P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9in × 7in × 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 **£5·98** P. P. & INS. 41p (OVERSEAS P. & P. £1)

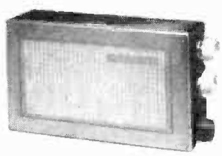
ROAMER SIX



6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, TRAWLER BAND PLUS AN EXTRA MW 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 9in × 5½in × 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 **£3·98** P. P. & INS. 26p (OVERSEAS P. & P. £1)

POCKET FIVE



3 TUNABLE WAVEBANDS: MW, LW, TRAWLER BAND WITH EXTENDED MW 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 5½in × 1¼in × 3½in. 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 **£2·23** P. P. & INS. 21p (OVERSEAS P. & P. 63p)

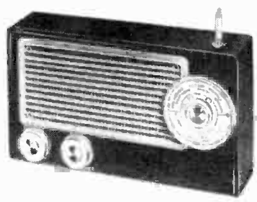
TRANSONA FIVE

NOW WITH 3in SPEAKER

3 TUNABLE WAVE BANDS: MW, LW AND TRAWLER BAND. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone 3in moving coil speaker. Attractive case with red speaker grille. Size 6½in × 4½in × 1½in. 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 **£2·50** P. P. & INS. 22p (OVERSEAS P. & P. 63p)

TRANS EIGHT



6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, SW3 AND TRAWLER BAND. Sensitive ferrite rod aerial for MW and LW. 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 9in × 5½in × 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 **£4·48** P. P. & INS. 31p (OVERSEAS P. & P. £1)

NEW! "EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT. Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: 4″ × 2½″ Speaker: Terminal Strip: Ferrite Rod Aerial: 3 Plugs and Sockets: Battery Clips: 4 Tag Boards Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ½in Knobs.

Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.

ALL PARTS INCLUDING CASE AND PLANS **£5·50** P. P. & INS. 31p (OVERSEAS P. & P. £1)

FULL AFTER SALES SERVICE

★ Callers side entrance Barratts Shoe Shop

★ Open 10-1, 2.30-4.30 Monday-Friday, 9-12 Saturday

RADIO EXCHANGE LTD

61 HIGH STREET, BEDFORD. Tel. 0234 52367

I enclose £ .... please send items marked

ROAMER TEN	☐	ROAMER SEVEN	☐
ROAMER EIGHT	☐	TRANS EIGHT	☐
TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for ....

Name ....

Address ....

.... P.E. 35

trols on the receiver. If the sensitivity available is such that the loudspeaker needs to be in parallel all the time, then to avoid causing disturbance by the continual hiss of the speaker, a simple muting arrangement of switching in a dummy load resistor in place of the loudspeaker can be used.

The case of high receiver noise level has been covered so far. The other case, that of the quiet receiver, which incidentally is the more desirable, a different technique is required. If the recorder does not respond to full scale with the a.f. control at the halfway mark and the r.f. gain at maximum, then a short piece of wire connected to the aerial input socket of the receiver should give sufficient noise to enable the sequence to be followed.

OTHER TYPES OF RECORDER

Having dealt with the simplest form of recorder connection, the alternative arrangements discussed in the previous article for connection to the receiver output stage will now be covered. In the case of the special winding on the output transformer, this will accommodate a high resistance order. The sequence of the setting up procedure will be identical with that for the low resistance recorder.

Where the potentiometer system in the output stage is used there will be the additional control which sets the recorder level, whether this be high or low resistance coil. The same conditions apply, that is to say the r.f. and a.f. controls are set as previously described, with the additional advantage of varying the sensitivity of the recorder.

In both these cases the muting of the loudspeaker using the switching network will apply.

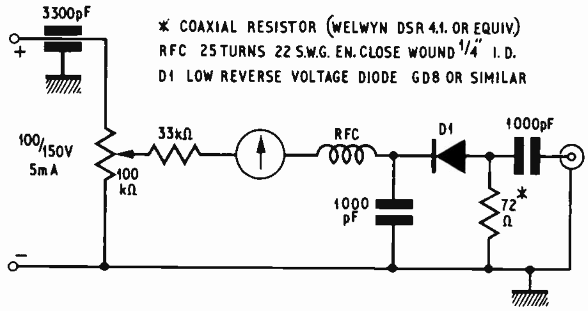


Fig. 6.1. A simple noise generator using a solid state diode. In raising the noise level by increasing the voltage it will be noticed that the noise increases and then passes through a decreased level finally rising again. As this generator is being used for testing only, any convenient noise point may be used

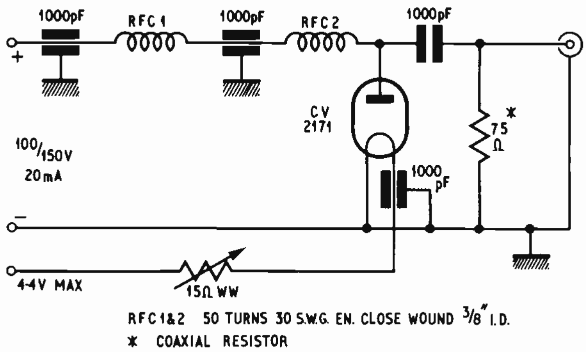


Fig. 6.2. An alternative noise generator circuit, using a valve diode. Care should be exercised when using this type of circuit because the life of the diode is not much in excess of 500 hours. For that reason it should be used at the lowest level consistent with the test being made

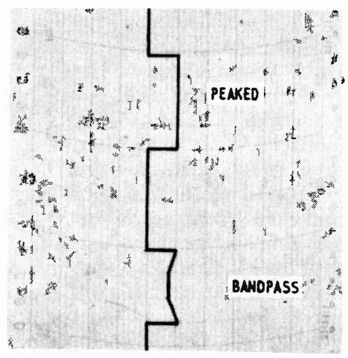


Fig. 6.3. A receiver tuning test recorded on the chart for reference purposes

USING D.C. AMPLIFIERS

When d.c. amplifiers are employed, a similar procedure so far as the setting up of the receiver is concerned will be followed, but before connecting the recorder in the circuit the d.c. amplifier will need to be balanced as follows.

In place of the recorder insert a milliammeter. Set this at the 10mA range to begin with. The pointer should be set at midscale by adjusting the controls and the meter brought to the lower current settings until the halfscale reading is the same as that for the recorder. In general this will be 0·5mA since most recorders will be of the 0–1·0mA full-scale type.

Having set up the d.c. amplifier, it may be connected into the receiver and checked before replacing the meter with the pen recorder. Again the same sort of procedure will be followed. In the case of the rather more complicated amplifier a greater sensitivity will be available, so this needs to be taken into account.

ADDING IN THE CONVERTER

The next step is to connect the converter to the receiver and to reduce the r.f. gain until the recorder is at the same level as in the first setting-up using the receiver alone. A check can be made at this point to see if the receiver has been set to the correct i.f. frequency. It is assumed that the converter has been checked for its mid-point frequency of 137MHz.

With no aerial connection to the converter, the tuning of the receiver can be adjusted slightly to each side of the i.f. frequency to see if the noise level falls equally. If the wideband system of the receiver's own i.f. transformers shows two humps a visual and audio adjustment will perhaps be necessary. The correct tuning will be for the receiver tuning to be set midway between humps. This will show a slight rise of the pen level on each side of the datum. Let this fact be borne in mind for all subsequent checks. A note made on the test chart showing all three points would be useful. See Fig. 6.3.

ADDING THE PRE-AMPLIFIER

The pre-amplifier (without the aerial connected) is now linked with the converter. There will be a rise in the noise level and the first adjustment will be made to the receiver r.f. gain control so that once again the recorder pen is at its datum.

If there is so much gain in noise that additional reduction is required at the a.f. gain control, it may well be that the inherent noise of the amplifier is too high. In order to check this connect the aerial to the pre-amplifier. If there is a rise in noise then all is well. If there is no detectable difference then the internal noise of the system is too high.

Before opening up the pre-amplifier make the following recheck. Set the controls so that the pen recorder has a tracing which is clearly one of varying noise. Feed in the noise generator at the aerial input of the pre-amplifier—which should be brought into the vicinity of the other apparatus. Set an optimum noise level with the noise generator "on". Note the reading and then disconnect the generator. Note the fall in noise level and if this is substantial it will establish that the system is all right but that somewhere there is an overload condition arising. This may be because the a.g.c. circuit is over sensitive.

It is better that there should be no a.g.c. applied when the system is used as a telescope. It may be necessary to interpose between the amplifier and the converter some form of attenuator, or it may be that this is needed between the converter and the receiver. This will have to be a matter of empirical investigation.

In the other case, where no change of level is noted when the noise generator is used, then the units must each be checked for noise level. For this purpose, of course, the noise generator can be used. No doubt some form of audio amplifier with a diode detector will be available and this can be used to check the noise level of the pre-amplifier.

INTO PRACTICE

Having set up the system and checked its operation, a note should be made of the positions of all controls. As the time constants at the recorder sections are long it might appear that the whole system is not working. To check this (in the case of recorders being connected directly to the output stages) a pair of phones or the loudspeaker kept in operation for final setting up will indicate the sensitivity of the system.

The reason for using the long time constants is to remove the high level random noise peaks of short duration and also the modulated transmissions which might appear from time to time. To appreciate this perhaps a few words of explanation are required.

The noise that is received by the aerial is randomly distributed but contains in its spectrum some coherent noise from extra terrestrial sources. Over a period of time the random noise will tend to cancel itself out but the coherent noise will over the period of time show a level which is higher than the purely random noise. To this is added the random noise of the aerial itself and that of the system to which it is connected.

Using a long time constant, the coherent noise tends to assume a noticeable level because the purely random noise cancels itself over the period of integration. In the case of this telescope, 4 seconds and 8 seconds approximately have been chosen as integration times. This will be satisfactory for most purposes and for the early stages of this project.

MONITORING ARTIFICIAL SATELLITES

When using the telescope for the monitoring of artificial satellites, there will be no need to change the time constant on the recorder unless the details of the telemetry are required. The automatic picture satellites (APT) used for meteorology will register a signal on the chart, but if actual picture reception is contemplated then the receiver will be quite different. A picture receiver needs to be a frequency modulated unit and a crystal controlled oscillator is essential.

Everything is now ready for the first observations. Each of the three positions of the telescope will require a change of altitude. To ensure that the same position is located each time, it is a good idea to make or buy a protractor. This can be fitted to the end of the reflector and with a suitable plumb bob the exact position repeated at each change.

If the telescope is to be used for satellite tracking then it is best to turn the aerial upwards so that the aperture points to the zenith. Most satellite passes will then be recorded, though any that are low, near the horizon, and cross on short arcs may not be detected.

TYPES OF SOLAR BURSTS

In the previous article some elementary information regarding the sun was given so that some elements of the observations would become clearer. A brief description will now be given of the types of solar bursts that may be recorded during the observations. The types of burst are classified by numbers, each group having some special characteristic. The *centres of activity* are the disturbed regions and to give a basis of understanding the schematic diagram in Fig. 6.4 should be borne in mind.

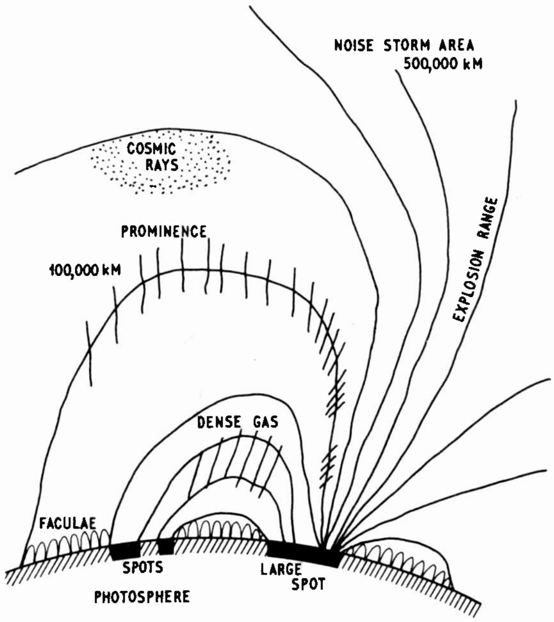


Fig. 6.4. Solar bursts. Diagram of a centre of radio activity on the sun

ATTRACTIVE DISCOUNTS!

ELECTROVALUE

Electronic Component Specialists

EVERYTHING BRAND NEW TO SPEC • LARGE STOCKS • NO SURPLUS

BARGAINS IN NEW SEMI-CONDUCTORS

MANY AT NEW REDUCED PRICES · ALL POWER TYPES WITH FREE INSULATING SETS

40361	55p	2N2905	44p	2N4291	15p	BC148	9p	BFX87	29p
40362	68p	2N2905A	47p	2N4292	15p	BC149	10p	BFX88	26p
2N696	17p	2N2924	20p	AC107	46p	BC153	19p	BFY50	23p
2N697	18p	2N2925	22p	AC126	20p	BC154	20p	BFY51	20p
2N706	12p	2N2926	11p	AC127	20p	BC157	12p	BFY52	23p
2N930	29p	2N3053	27p	AC128	20p	BC158	11p	BSX20	16p
2N1131	29p	2N3055	60p	AC153K	22p	BC159	12p	C407	17p
2N1132	29p	2N3702	13p	AC176	16p	BC167	11p	MC140	25p
2N1302	19p	2N3703	13p	ACY20	20p	BC168	10p	MPS6531	35p
2N1303	19p	2N3704	13p	ACY22	16p	BC169	11p	MPS6534	30p
2N1304	26p	2N3705	13p	AD140	63p	BC177	14p	NKT211	25p
2N1305	26p	2N3706	13p	AD142	50p	BC178	13p	NKT212	25p
2N1306	33p	2N3707	13p	AD149	58p	BC179	14p	NKT214	23p
2N1307	33p	2N3708	10p	AD161	33p	BC182L	11p	NKT274	18p
2N1308	36p	2N3709	11p	AD162	36p	BC183L	10p	NKT403	65p
2N1309	36p	2N3710	13p	AF114	24p	BC184L	11p	NKT405	79p
2N1613	23p	2N3711	13p	AF115	24p	BC212L	16p	OC71	38p
2N1711	26p	2N3819	23p	AF117	22p	BC213L	16p	OC81	25p
2N1893	54p	2N3904	35p	AF124	24p	BC214L	16p	OC81D	25p
2N2147	95p	2N3906	35p	AF127	22p	BCY70	18p	ZTX300	14p
2N2218	34p	2N4058	13p	AF139	33p	BCY71	33p	ZTX301	16p
2N2218A	44p	2N4059	10p	AF239	36p	BCY72	15p	ZTX302	22p
2N2219	38p	2N4060	11p	ASY26	27p	BF115	23p	ZTX303	22p
2N2219A	53p	2N4061	11p	ASY28	27p	BF167	18p	ZTX304	27p
2N2270	62p	2N4062	12p	BC107	12p	BF173	19p	ZTX500	18p
2N2369A	19p	2N4124	18p	BC108	11p	BF194	14p	ZTX501	21p
2N2483	35p	2N4126	27p	BC109	12p	BF195	15p	ZTX502	25p
2N2484	42p	2N4284	15p	BC125	15p	BFX29	31p	ZTX503	22p
2N2646	47p	2N4286	15p	BC126	22p	BFX84	25p	ZTX504	52p
2N2904A	42p	2N4289	15p	BC147	10p	BFX85	52p		

RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9 (see note below)	10 to 99	100 up
C	1/20W	5%	82Ω–220KΩ	E12	9	8	7
C	1/8W	5%	4·7Ω–470KΩ	E24	1	0·8	0·7
C	1/4W	10%	4·7Ω–10MΩ	E12	1	0·8	0·7
C	1/2W	5%	4·7Ω–10MΩ	E24	1·2	1	0·9
C	1W	10%	4·7Ω–10MΩ	E12	2·5	2	1·9
MO	1/2W	2%	10Ω–1MΩ	E24	4	3·5	3
WW	1W	10% ± 1/20Ω	0·22Ω–3·9Ω	E12	7	7	6
WW	3W	5%	12Ω–10KΩ	E12	7	7	6
WW	7W	5%	12Ω–10KΩ	E12	9	9	8

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

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions on total value of resistor order.)

Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

ZENER DIODES 5% full range E24 values: 400mW: 2·7V to 30V, **15p each**; 1W: 6·8V to 82V, **27p each**; 1·5W: 4·7V to 75V, **60p each.**
Clip to increase 1·5W rating to 3 watts (type 266F), **4p.**

CARBON TRACK POTENTIOMETERS, long spindles. Double wiper ensures minimum noise level.
Single gang linear 100Ω to 2·2MΩ, **12p**; Single gang log, 4·7KΩ to 2·2MΩ, **12p; Dual gang** linear 4·7KΩ to 2·2MΩ, **42p**; Dual gang log, 4·7KΩ to 2·2MΩ, **42p**; Log/antilog, 10K, 47K, 1MΩ only **42p**; Dual antilog, 10K only, **42p.** Any type with ½A D.P. mains switch, **12p** extra.
Only decades of 10, 22 and **47** available in ranges quoted.

CARBON SKELETON PRE-SETS
Small high quality, type PR, linear only: 100Ω, 220Ω, 470Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 4M7, 10MΩ. Vertical or horizontal mounting, **5p each.**

COLVERN 3 watt Wire-wound Potentiometers. 10Ω, 15Ω, 25Ω, 50Ω, 100Ω, 150Ω 250Ω, 500Ω, 1K, 1·5K, 2·5K, 5K, 10K, 15K, 25K, 50K, **32p each.**

Handbook of transistor equivalent and substitutes, 40p. (Postage 3p if ordered alone).

MULLARD polyester C280 series
250V 20%: 0·01, 0·022, 0·033, 0·047 **3p each**; 0·068, 0·1, **4p each**; 0·15, **4p**; 0·22, **5p.** 10%: 0·33, **7p**; 0·47, **8p**; 0·68, **11p**; 1μF, **14p**; 1·5μF, **21p**; 2·2μF, **24p.**

MULLARD SUB-MIN. ELECTROLYTICS
C246 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; 5/64; 6·4/6·4; 6·4/25; 8/4; 8/40; 10/2·5; 10/16; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/4; 32/10; 32/40; 32/64; 40/16; 40/2·5; 50/6·4; 50/25; 50/40; 64/4; 64/10; 80/2 5; 80/16; 80/25; 100/6·4; 125/4; 125/10; 125/16; 160/2·5; 200/6·4; 200/10; 250/4; 320/2·5; 320/6·4; 400/4; 500/2·5.

LARGE CAPACITORS
High ripple current types: 1000/25, **28p**; 1000/50, **41p**; 1000/100, **82p**; 2000/25, **37p**; 2000/50, **57p**; 2000/100, **£1·44**; 2500/64, **77p**; 2500/70, **98p**; 5000/25, **62p**; 5000/50, **£1·10**; 5000/100, **£2·91**; 10000/50, **£2·40.**

● ● ● COMPONENT DISCOUNTS
10% on orders for components for £5 or more.
15% on orders for components for £15 or more.
(No discount on nett items.)

POSTAGE AND PACKING
Free on orders over £2. Please add 10p if orders under £2.
Overseas orders welcome: carriage and insurance charged at cost. *Prices subject to alteration without notice.*
U.S.A. CUSTOMERS
U.S.A. orders charged at special prices as advertised by ELECTROVALUE AMERICA, P.O. Box 27, Swarthmore, PA 19081.

Appointed distributors for
SIEMENS (U.K.) LTD.
Appointed stockists
NEWMARKET TRANSISTORS
RADIOHM POTENTIOMETERS

SAVE £6·25 ON THE NEW ENGLEFIELD 840 AMPLIFIER

This latest Peak Sound high fidelity amplifier incorporates many strikingly original features including facility for adding in stereo FM tuner. Superb performance characteristics and luxurious styling. Electrovalue choice of simulated soft leather covering in black, blue, red or dark green. As now advertised at £49·50. Our price, nett **£38·75**

MAINLINE AMPLIFIER KITS
70W. power amplifier, **£12·60** nett.

30 WATT BAILEY AMPLIFIER PARTS

Transistors and PCB for one channel **£6·46**
Capacitors, resistors (metal oxide), and transistors, one channel. **£8·41.**
Complete unregulated power supply pack, **£4·75**
Suitable heatsink 10DN 400C, **55p**

SIEMENS TTL INTEGRATED CIRCUITS

We stock a large range of all Siemens types for a very wide range of applications. For details, see our latest catalogue.

S-DeC RANGE
S-DeC, **£1·44**; DeCSTOR, **£2·88**; 5 DeC 4-pack, **£5·10**; T-DeC, **£2·88**; μ DeC A, **£3·18**; μ DeC B, **£5·94.**
Accessory prices increased by approx. 20% (pp. 51-53 in our catalogue). Guide prices unchanged.

INDICATOR LAMPS
NEON chrome bezel, round red NR/R, **24p**; chrome bezel, round amber NR/A, **24p**; chrome bezel, round clear NR/C, **24p.** Neon, square red type LS5C/R, **18p**; amber type LS5C/A, **18p**; clear type LS5C/C, **18p.** All above are for 240V mains operation. **Filament types:** 6V, 0·04A square red type LS5C/R-6V, **30p**; 6V, 0·04A amber type LS5C/A-6V, **30p**; 6V 0·04A clear type LS5C/C-6V, **30p**; 6V 0·04A green type LS5C/G-6V, **30p**; 12V 0·04A LS5C/R-12V, **34p**; 34V 0·04A LS5C/R-28V, **45p.**

SIEMENS 5% TOLERANCE POLYCARBONATE CAPACITORS

250V up to 0·1mF: 100V 0·1mF and above
0·01, 0·012, 0·015, 0·018, 0·022, 0·027 .. .. **5p**
0·033, 0·039, 0·047, 0·056, 0·068, 0·082, 0·1, 0·12, 0·15, 0·18, 0·22 .. .. **6p**
0·27, **7p**; 0·33, **9p**; 0·39, **9p**; 0·47, **10p**; 0·56, **13p**; 0·68, **15p.**

DIN CONNECTORS

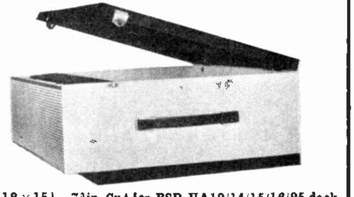
		plug	*socket*
Loudspeaker ..	2-pole	12p	10p
Audio	3-pole	13p	10p
Audio	4-pole	14p	12p
Audio	5-pole 180deg.	15p	12p
Audio	5-pole 240deg.	15p	12p
Audio	6-pole	15p	13p

HAD YOUR COPY YET? ELECTROVALUE 1971 CATALOGUE

64 pages plus covers. Thousands of items plus classified information and illustrations.
Post free **10p**

ELECTROVALUE DEPT. P.E.1171, 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY
Hours: 9-5.30, 1.0 p.m. Saturdays. *Phone: Egham 5533 (STD 0784-3) Telex 264475*

PHILIPS PORTABLE PLAYER CABINET



Size 18 × 15½ 7¾in. Cut for BSR UA12/14/15/16/25 deck. Amplifier space 14 × 5 × 3½in. Satin aluminium front grille. Really smart appearance. Black/White. Chrome fittings. **£4** Post 25p

BSR C.109 SUPERSLIM STEREO & MONO

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13½ 11¼in. Above motor board 3¼in. below motor board 2½in.

with STEREO and MONO XTAL **£7·75** Post 25p.

GARRARD SINGLE PLAY TA Mk II Stereo/Mono £10. GARRARD PLAYERS with Sonotone 9TA Cartridges. Stereo Diamond and Mono Sapphire. SP25 Mk II £15. Model 3500 Stereo and Mono Autochanger £14. Post 25p.

RECORD PLAYER PORTABLE CABINET **£3·75** With space for R.C.S. Amplifiers and most modern autochangers. Two-tone rexine covered. Post 25p.

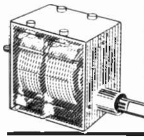
RCS DE-LUXE 3 WATT AMPLIFIER. Ready made tested. 2-stage with triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer. Knobs, loudspeaker, valves ECL82, EZ80. Response 50-12,000 cps. Sensitivity 200mV. Post 25p. **£4**

R.C.S. TEAKWOOD BASE. Ready cut out for mounting (state player make and model). **£2·75**

R.C.S. PLASTIC COVERS FOR ABOVE BASE. Durable tinted plastic, attractive appearance. **£2·75**

EMI PICK-UP ARM. With mono xtal and stylus £1·25. HI-FI PICK UP CARTRIDGES. Diamond Stereo/Mono 9TA £2·50; GP94 £2·50; GP93 £2·00; Mono GP91 £1·50; GC8 £1·25; ACOS L.P. only 50p.

AM — FM/VHF TUNING GANG



Super quality small size 1½ × 1½ × 1¼in. plus spindle 1½ × ¼in. 365 + 365 pF with 25 + 25 pF. British made. Geared slow motion drive 6 : 1. Plastic dust cover. 6BA tapped front fixing. Cast aluminium frame.

50p POST FREE

WEYRAD P50 — TRANSISTOR COILS

RA2W Ferrite Aerial	65p	Spare Cores	3p
Osc. P50/1AC	30p	Driver Trans. LFDT4	50p
I.F. P50/2CC 470 kc/s	33p	Printed Circuit, PCA1	50p
3rd I.F. P50/3CC	33p	J.B. Tuning Gang	65p
P51/1 or P51/2	33p	Weyrad Booklet	10p
P50/3V	33p	OPT1	55p

Mullard Ferrite Rod 8 × ⅜in. 20p. 6 × ¼in. 25p.

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p.

80ohm Coax 4p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2. FRINGE LOW LOSS Ideal 625 and colour **10p** yd

WIRE-WOUND 3-WATT POTS. Small type with small knob. Values 10 Ω to 30 K., Carbon 30 K to 2 meg. **25p**

WIRE-WOUND 3-WATT STANDARD SIZE POTS. LONG SPINDLE 10 OHMS to 100 K. **40p**

VEROBOARD 0·15 MATRIX

2½ × 5in. 19p. 2½ × 3¾in. 16p. 3¾ × 3¾in. 19p. 3¾ × 5in. 26p. EDGE CONNECTORS 16 way 25p; 24 way 38p. PINS 36 per packet 17p. FACE CUTTERS 38p. S.R.B.P. Board 0·15 MATRIX 2½in. wide 3p per 1in., 3¾in. wide 4p per 1in.; 5in. wide 5p per 1in. (up to 17in.). S.R.B.P. undrilled 1/16 in. Board 10 × 8in. 15p.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2in. sides 7 × 4in. 45p; 9 × 7in. 50p; 11 × 7in. 70p; 13 × 9in. 75p; 14 × 11in. 80p; 15 × 14in. 85p; 11 × 3in. 50p. ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 8p; 8 × 6in. 15p; 10 × 7in. 17p; 12 × 8in. 23p; 14 × 9in. 27p; 12 × 12in. 32p.

1½inch DIAMETER WAVECHANGE SWITCHES. 25p. 2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 25p each. 1 p.1 2-way, or 4 p. 2-way, or 4 p. 3-way 25p. TOGGLE SWITCHES, sp. 14p; dp. 18p; dp. dt. 23p.

"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

200/250 v. A.C. Leaflet S.A.E.

£2·35 Post 15p

R.C.S. STABILISED POWER PACK KIT

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. **£2** Post Free

GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

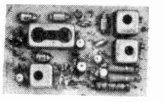
for Mike, Tape, P.U., Guitar, etc.

Battery 9-12v. or H.T. line 200-300v. D.C. operation. Size 1¾" × 1½" × ½". Response 25 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions supplied. Brand new. Guaranteed. Details S.A.E. **90p** Post 10p

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	16+16/500V	55p
4/350V	14p	500/25V	20p	50+50/350V	35p
8/450V	14p	1000/25V	35p	60+100/350V	58p
16/450V	15p	1000/50V	47p	32+32/250V	18p
32/450V	20p	8+8/450V	18p	32+32/450V	33p
25/25V	10p	8+16/450V	20p	350+50/325V	50p
50/50V	10p	16+16/450V	25p	32+32+32/350V	43p
100/25V	10p	32+32/350V	25p	100+50+50/350V	48p

SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p; 500, 1000mF 12V 18p; 2000mF 25V 35p. CERAMIC, 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p. PAPER 350V-0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p. 500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p. SILVER MICA. Close tolerance 1%. 2·2-500pF 8p; 560-2,200pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mfd 30p each. TWIN GANG. "0-0" 208pF + 176pF, 65p; Slow motion drive 365pF + 365pF with 25pF + 25pF, 50p; 500pF slow motion, standard 45p; small 3-gang 500 pF £1·10. SHORT WAVE SINGLE. 25pF, 50pF, 55p. CHROME TELESCOPIC AERIALS 23in. Swivel base 20p. TUNING. Solid dielectric. 100pF, 500pF, 35p each. TRIMMERS. Compression 30, 50, 70pF, 5p; 100pF, 150pF, 8p; 250pF, 10p; 600pF, 750pF, 10p; 1250pF, 10p. SILICON REC. 40–LUCAS 2DS500 Bridge 70v. 5 amp £1. RECTIFIERS CONTACT COOLED half wave 60mA 38p; 85mA 48p. SILICON BYZ13 30p; BY100 30p; BY127 30p. Full wave Bridge Rectifiers 75mA 50p; 150mA 98p. EX-GOVT. RECTIFIERS 250V 200mA 30p. NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p. RESISTORS. ¼ w., ½ w., 1 w., 20% 1p; 2 w. 5p. HIGH STABILITY. ½ w. 2% 10 ohms to 1 meg., 10p. Ditto 5%. Preferred values 10 ohms to 10 meg., 4p. WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p.

PHILIPS TRANSISTOR FM STEREO MULTIPLEX DECODER



As used in LEAK Troughline Tuner. Brand New. Pre-aligned with 9 semiconductors. 24V d.c. at 6mA. Complete with circuit and connection details. 3½ × 2 × 1 in. **£4** Post Free

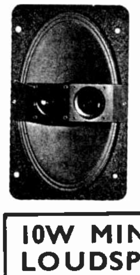
MAINS TRANSFORMERS

All post 25p each

250-0-250 80 mA. 6.3 v. 4 amp.	£1·40
250-0-250 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a. or 5 v. 2 a.	£2
350-0-350 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a. or 5 v. 2 a.	£2
300-0-300 v. 120 mA., 6.3 v. 4 a. C.T.; 6.3 v. 2 a.	£2·50
MINIATURE 200 v. 20 mA., 6.3 v. 1 a. 2½ × 2½ × 2in.	75p
MIDGET 220 v. 45 mA., 6.3 v. 2 a. 2½ × 2½ × 2in.	90p
P.E. AURORA TRANS. 12 + 12v., 500mA	£1·50
MINI-MAINS 20v. 100mA. 1½ × 1⅜ × 1⅜in.	50p
HEATER TRANS. 6.3 v. 3a.	60p
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp.	80p

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp., 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £2
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £2
2 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £3
AUTO TRANSFORMERS. 115v to 230v or 230v to 115v. Input/Output, 150w. £2; 500w. £5; 1000w. £12
CHARGER TRANSFORMERS. Input 200/250v. for 6 or 12v., 1½ amp., £1·20; 2 amp £1·50; 4 amp. £2
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. 1½ amp. 40p; 2 amp. 55p; 4 amp. 85p.
All Transformers Postage 25p each

E.M.I. 13½ × 8in. LOUDSPEAKERS



With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£4** Post 15p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·25** Post 15p

Recommended Teak Cabinet Size 16 × 10 × 9in. Post 25p. **£5**

10W MINI-MODULE £3·25 LOUDSPEAKER KIT

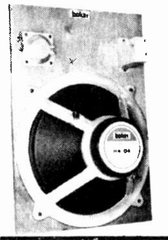
Post 25p

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 15 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16½ × 10½ × 6in. Modern design, dark grey Tygan covered baffle. **£5** Post 25p

ALL MODELS "BAKER SPEAKERS" IN STOCK

BAKER 12in MAJOR £9



30-14,500 c.p.s., 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. State 3 or 8 or 15 ohm. Post Free.

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11·50**

BAKER "BIG-SOUND" SPEAKERS

'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£7** 3 or 8 or 15 ohm	12 inch 35 watt **£9** 3 or 8 or 15 ohm	15 inch 50 watt **£19** 8 or 15 ohm

TEAK HI-FI SPEAKER CABINETS. Fluted wood front.

For 12in. round Loudspeaker	£9 Post 25p
For 13 × 8in. Loudspeaker	£5 Post 25p
For 10 × 6in. Loudspeaker	£4 Post 25p

LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft

GOODMANS HI-FI 6in. WOOFER

8 ohm, 10 watt. Large ceramic magnet. 30–12,000 cps. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4**

ELAC CONE TWEETER —LATEST DESIGN

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 watt. 3 ohm or 15 ohm models. **£1·90** Post 10p

Horn Tweeters 2-16Kc/s, 10W 8 ohm or 15 ohm £1·50. De Luxe Horn Tweeters 2-18 Kc/s, 15W, 8 ohm £3. TWO-WAY 3,000 c.p.s. CROSSOVERS 3 or 8 or 15 ohm 95p. SPECIAL OFFER! 80 ohm, 2¾in. dia.; 35 ohm, 2in.; 3 in. 25 ohm, 2½in. dia.; 3in. dia.; 6 × 4in.; 8 × 5in. 15 ohm, 3½in. dia.; 7 × 4in.; 8 × 5in. 8 ohm, 6 × 4in.; 3 ohm, 2½in. 3in. 5in. 5 × 3in. 7 × 4in. **£1** EACH TYPE. LOUDSPEAKERS P.M. 3 OHMS. 6½in. £1·10; 8 × 5in. £1·25; 8 × 2½in. 90p; 8in. £1·75; 10 × 6in. £1·90. 5in. WOOFER. 8 w. max. 20-10,000 cps. 8 or 15 ohm £1·80. ELAC 8 in. De Luxe Ceramic 3 ohm or 15 ohm £2·50. RICHARD ALLAN TWIN CONE LOUDSPEAKERS 8in. dia. 4 watt; 10in. dia. 5 watt; 12 in. dia. 6 watt, 3 or 8 or 15 ohm models £1·95 each. Post 15p. OUTPUT TRANS. EL84, etc. 25p. MIKE TRANS. 50:1 25p. SPEAKER COVERING MATERIALS. Samples Large S.A.E. GOODMANS OUTPUT TRANSFORMER 5 watt push pull for valves EL84, etc., 3, 8 and 15 ohms 85p. Post 20p.

BAKER 100 WATT ALL PURPOSE POWER AMPLIFIER

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

ALL EAGLE PRODUCTS

SUPPLIED AT LOWEST PRICES. ILLUSTRATED EAGLE CATALOGUE 20p. Post free

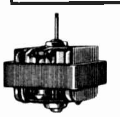
BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **£4**

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

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. 9 volt, Printed Circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4 inch **£10**
BARGAIN FM TUNER as above, Chassis only, less cabinet. **£7·50**

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 15p. DIN PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS, 5p; CERAMIC 8p; CANS 5p.



E.M.I. TAPE MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA Spindle 0·187 × 0·75in. Size 3½ × 2½ × 2½in. (illustrated). Post 15p. **£1·25**

BALFOUR GRAM. MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 50mA. Spindle ⅛ × 3/20. Size. 2½ × 2½ × 1½in. Post 15p **85p**

Minimum Post and Packing 15p. RETURN OF POST DESPATCH. HI-FI STOCKISTS. CUSTOMERS FREE CAR PARK. CALLERS WELCOME

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, CROYDON

Open 9-6 p.m. (Wednesdays 9-1 p.m., Saturdays 9-5 p.m.)

List 5p. Written guarantee with every purchase. (*Export: Remit cash and extra postage.*) Buses 133, 68 pass door. S.R. Stn. Selhurst. Tel. 01-684-1665

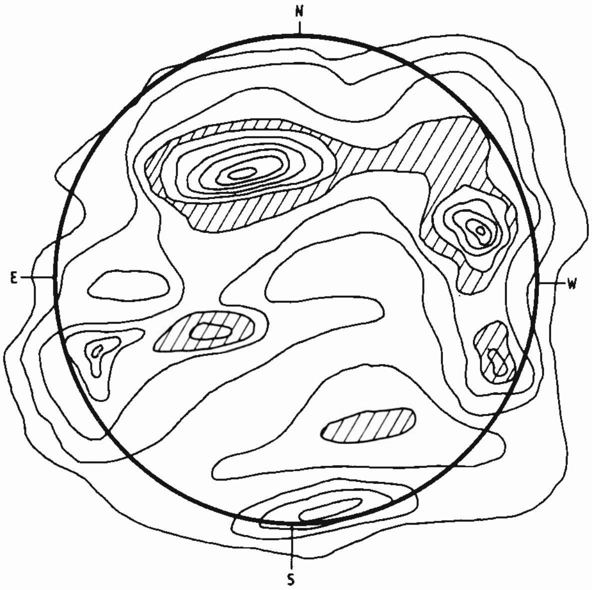


Fig. 6.5. Active ("radio") sun, showing concentration of high level activity

A *centre of activity* is visually observed as a sunspot. However the activity begins before the appearance of the actual spot and also continues after. During this time many changes of radio activity are observed. A magnetic field develops and it is as though a giant magnet lies beneath the surface of the photosphere. Where the field protrudes through the chromosphere, the gas is made to glow and the hydrodynamic waves travel up the magnetic lines and produce bright streaks known as faculæ. The corona is also heated. It is after this phase that the actual sunspots appear.

The sunspots appear dark against the surface because they are at a slightly lower temperature. They are an indication of where the greatest magnetic concentration crosses the photosphere. Above the spots there is great activity. A great intensity of gas clouds occur high up in the corona: these are the prominences and are supported in their positions by the magnetic field.

During the time of the spot the major activity often results in flares. Although the flare is only an increase of intensity of line emission, the results are extensive. A terrific explosion may result with far reaching effects. A vast cloud of gas is ejected and drags the magnetic field with it. The gas and the magnetic field reach the earth about a day or so after, causing magnetic storms and aurora. A picture diagram of the radio sun is shown in Fig. 6.5.

Type I bursts do not follow closely after a flare but are nevertheless very important because the effect of such a burst lasts for a whole day. They are only found in the metre wave part of the spectrum, mostly between 100 and 150MHz. During such a storm there appear short bursts of great intensity that last only a few seconds. The trace that appears on the long time constant will not normally register these. They need a much higher recorder speed.

Type II bursts usually appear with very intense outbursts and are often associated with and follow **Type III** bursts. These are both the result of special

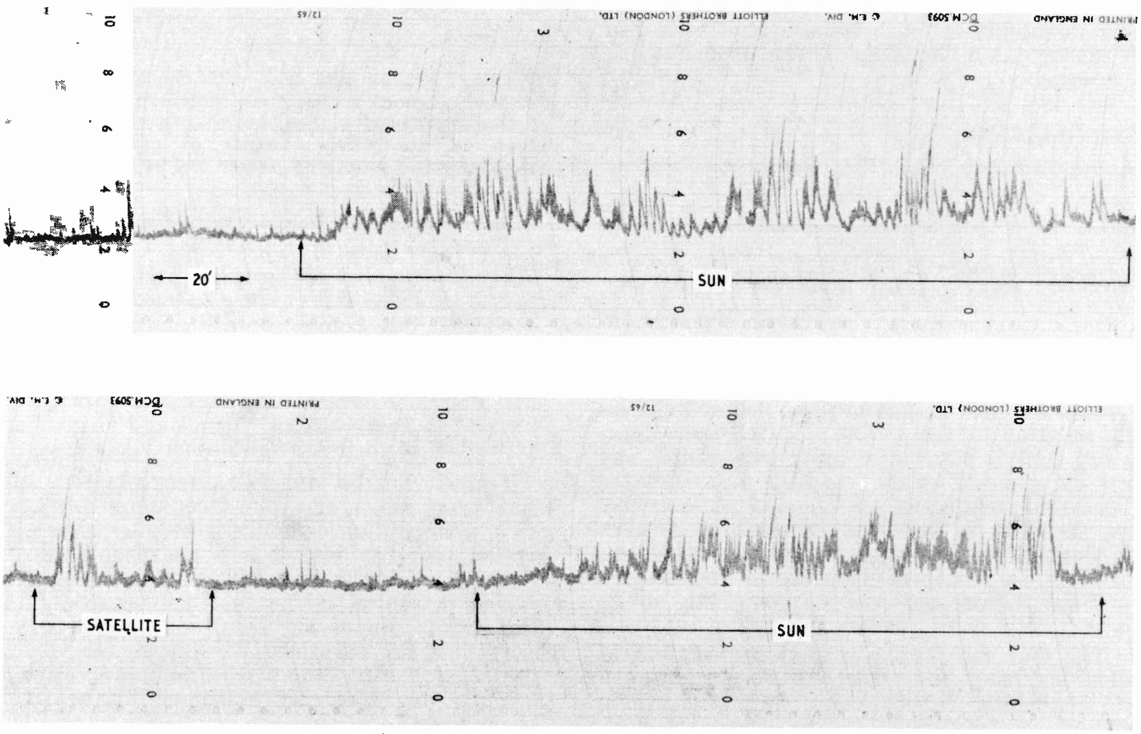


Fig. 6.6a, b. Recordings of the sun. Two examples of noise storms with random bursts and showing varying amplitude due to Faraday rotation

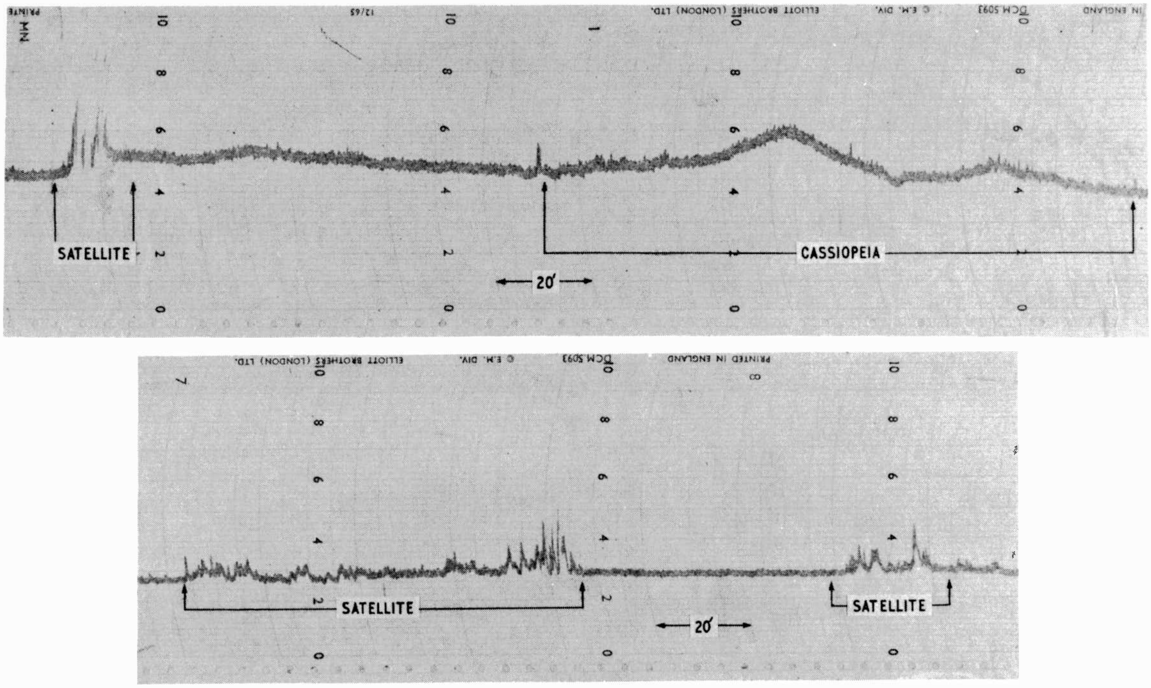


Fig. 6.7a Pen recording of a satellite and Cassiopeia. b Recording of two satellite passes

and fast moving disturbances in the corona resulting in the bunching of electrons.

Type IV bursts have a broad spectrum and show a high temperature. They follow after **Type II** bursts and seem to be a continuum.

Not so much is known about **Type V** bursts, but they may be similar in nature. Usually this activity is more noticeable at much higher frequencies and much remains to be done before the phenomena is fully understood.

OBSERVATIONS

It is now time to make the observations, and to help in recognising the results, the pen recordings in Figs. 6.6 and 6.7 are given as a guide.

It would be a good plan to do a three- or four-days run in the noon period so that the observer becomes familiar with the appearance of the charts. Having found that the results are satisfactory, the full observations may then be undertaken.

The next article will deal with the extension of the simple telescope to form an interferometer. Details of the additional equipment that is required will be given so that the benefits of greatly increased sensitivity and resolving power can be obtained.

RETROSPECT AND PROSPECT

continued from page 889

After careful thought we have decided upon a solution. We are convinced there are many people who would like just to dabble without becoming too deeply involved in the subject. At the same time, there are endless possibilties using only simple and modest circuits for creating gadgets and items of real practical worth in all manner of everyday affairs. Designs for such gadgets ought to be even more widely disseminated than they are at present; and of course presented in a form to suit the person with limited experience. Also, the novice needs particular consideration and help.

We feel that such needs warrant the creation of an additional magazine—independent, yet having a certain association with PRACTICAL ELECTRONICS. So a new popular magazine, entitled *Everyday Electronics,* is due to make its bow next week. Our new companion will augment the service that PRACTICAL ELECTRONICS already provides, and will, we trust, encourage many more people to make their very first entry into this exciting branch of technology. And in a practical purposive manner, of course.

When our readers have examined a copy of this new magazine, we are sure they will wish to recommend it to many of their friends and acquaintances, as well as to their sons and other younger relatives.

Truly it can be said that electronics is a subject with many facets, and each facet seems to be taking on a different or certainly a broader countenance as the years go by. It is a challenging task, but PRACTICAL ELECTRONICS will continue to cover this expansive subject in the best manner to suit those tens of thousands of keen and serious devotees electronics has attracted. We like to feel that many of these followers were first introduced to electronics through this magazine, sometime during the last seven years.

The prospect looks good—and exciting.

F.E.B.

Readout—
A SELECTION FROM OUR POSTBAG

Correspondents wishing to have a reply must enclose a stamped addressed envelope. We regret we are unable to guarantee a reply on matters not relating to articles published in the magazine. Technical queries cannot be dealt with on the telephone.

Trial by Fury

Sir—For unmentionable years I being of almost sound mind have read P.E., in fact I have that many that my wife gave me an ultimatum, either my P.E.'s go or she does. I might add that I miss her.

Now the thing that's worrying me is "why"?

Why is it that no matter how you plan a circuit, the transistors almost inevitably end up with the tails all but tied in a granny knot.

Why when one buys a packet of assorted resistors or capacitors after ten years you still have them around. Why is it that your transistor collection, considered by friends to be so well planned an assortment, never contains the ones you want for a new circuit you fancy.

Why is it that, no matter where you put the soldering iron, the smell of burning sleeve or flesh is ever present. Why is it that the wife never appreciates the new gadget you've built even though you have offered to pay for a new tablecloth (it's only a small hole).

Why is it that even if you've successfully built a multi-frequency astable-bistable double switched stereophonic thingumy with a.g.c. at all levels, the main topic of conversation with visiting friends is the Browns' new baby.

Why is it that friends consider your life should be spent repairing Japanese transistor radios, you spend three hours taking it out of the case, two hours finding a substitute transistor, another four hours putting back the guts and the run is usually ten fags and the remark that he thought it was only the battery.

Is it worth it, or should I give it all up? By the way, do you publish a book on Practical Knitting?

R. G. Taylor,
Birmingham.

Any offers!

Sir—I wonder if any reader or designer can help with the following project.

I am chairman of the Grimsby Group Hospitals Sports and Social Club, and since music and electronics are my hobbies, I am usually responsible for playing, organising music and purchasing or making amplifiers.

The sports club was founded just after the N.H.S. was formed and is run on a subscription basis; assets are obviously very limited.

During the past twenty years, rooms that used to be available for activities, in the local hospitals, have been swallowed up for other essential purposes. However, some twelve months ago we were given a disused old ward block. With our capital and voluntary labour from members, we have altered this building to our requirements, having used almost all our money.

Certain members have donated different items (e.g. piano, psychedelic lighting, etc). I have supplied a tape recorder, built a sound system and even installed my electronic organ.

We are, however, very much in need of an auto-rhythm unit, but find these far too expensive for us to purchase. I have constructed drum units for contact (pedal) sounding for the organ—these work well. However, although I know that auto-rhythm units must be driven by pulses from a binary ring counter logic I cannot devise one myself.

I wonder if any of your readers can help with this project. Other items of less importance, e.g. echo, would be useful.

E. C. Darnell,
Waltham, Grimsby.

How about it!

Sir—I would like to say a few words, through your magazine, aimed at manufacturers and suppliers.

Now that D.I.N. connectors are becoming more popular and standard on most equipment nowadays, how about making 5-core cable readily available, and 4-core individually screened cable at least available, if not readily available.

A few words also, to other users.

How about creating a demand for these cables by using them whenever you make up D.I.N. leads. It's cheaper in the long run, instead of making up dozens of different, single twin-core leads.

R. Williams,
St. Albans.

Sparking power unit!

Sir—Your Editorial on electronics in motor cars was timely and enthusiastic, without being at all "Beyond the Fringe"—no disrespect to Gerry Brown!

But the most telling point was "even the magic of electronics cannot save the internal combustion engine from ultimate extinction." I have for many years championed the cause of electric cars, and have urged the British car companies to do something. Only amateurs (as in radio's early days) appear to be doing anything.

Ten years ago, we were well ahead, and I made a forecast then that the first commercial electric car would be Japanese or European or American. How can we expect an electric car from this country when the designers haven't yet heard of electronics?

Readers of P.E. must surely wince at a power unit which needs oil, petrol, sparks, air, water and grease pumped to it in sequence, all to drive four captive cannonballs, which drive a bent piece of metal, which turns a cog, which . . .

Over the years I have written to practically every newspaper and magazine trying to promote an Electric Car Rally, but with no takers.

E. A. Wadsworth,
Scarborough.

BACK NUMBERS

We regret that back numbers of Practical Electronics can no longer be supplied. We are conscious that many readers frequently require reference to past projects and in order to go some way toward helping them we are prepared to devote a limited amount of editorial space to announcements of readers' requirements. We will try to publish these (without a guaranteed date) free of charge on the following conditions:

1. The announcement must be restricted to issues of Practical Electronics only that are required.
2. Any communication regarding any announcement should be addressed to the advertiser and not to this office.
3. The Editor cannot enter into correspondence on matters relating to back numbers, nor can he accept any money, postal orders, cheques or postal reply coupons in connection with any sale of back numbers of Practical Electronics.
4. Advertisers should send full name, permanent address and *dates* of issues required to the Editor, Practical Electronics, Fleetway House, Farringdon Street, London EC4A 4AD.

Finally, it is worth remembering that several public libraries hold copies of Practical Electronics and indexes for reference. Better still, make sure of getting a copy in future by placing a regular order with your newsagent now.

BEST BUY IN TTL!!

SIEMENS QUALITY PLUS BARGAIN PRICES PLUS LST SERVICE

A full design range of high quality TTL available from LST your Officially Appointed Siemens Distributors

Part No.	Description	Equal to	1-24	25-99	100 up
FLH					
101	Quadruple 2-input NAND gate	7400	20p	16p	14p
111	Triple 3-input NAND gate	7410	20p	16p	14p
121	Dual 4-input NAND gate	7420	20p	16p	14p
131	8-input NAND gate	7430	20p	16p	14p
141	Dual 4-input NAND buffer	7440	24p	20p	17p
151	Expandable dual 2-wide 2-input AND-OR-INVERT gate	7450	20p	16p	14p
161	Dual 2-wide 2-input AND-OR-INVERT gate	7451	20p	16p	14p
171	Expandable 4-wide 2-input AND-OR-INVERT gate	7453	20p	16p	14p
181	4-wide 2-input AND-OR-INVERT gate	7454	20p	16p	14p
191	Quadruple 2-input NOR gate	7402	20p	16p	14p
201	Quadruple 2-input NAND gate with open collector output	7401	20p	16p	14p
211	Hex inverter	7404	25p	21p	18p
221	Gated full adder	7480	67p	56p	48p
231	2-bit binary full-adder	7482	87p	73p	62p
241	Four-bit binary full adder	7483	£1·32	£1·16	£1·00
FLH					
271	Hex inverter with open collector output	7405	25p	21p	18p
281	BCD to decimal decoder TTL output	7442	£1·16	94p	81p
291	Quadruple 2-input NAND gate with open collector output	7403	20p	16p	14p
341	Quadruple 2-input exclusive-OR element	7486	33p	27p	23p
351	Schmitt Trigger	7413	35p	29p	25p
361	Excess 3 to decimal decoder	7443	£1·45	£1·20	£1·08
371	Excess 3 gray to decimal decoder	7444	£1·45	£1·20	£1·08
381	Quad 2-input positive AND gate Totem pole output	7408	25p	21p	18p
391	Quad 2-input positive AND gate open collector	7409	25p	21p	18p
FLY					
101	Dual 4-input expander	7460	20p	16p	14p
FLJ					
101	J-K flip flop	7470	45p	37p	32p
111	J-K master-slave flip-flop	7472	32p	27p	23p
121	Dual J-K master-slave flip-flop	7473	45p	40p	35p
131	Dual J-K master-slave flip-flop with preset and clear	7476	45p	40p	36p
FLJ					
141	Dual D-type edge triggered flip-flop	7474	46p	38p	33p
151	Quad bistable latch	7475	45p	40p	37p
161	Decade counter	7490	80p	67p	57p
171	Divide-by-12 counter	7492	85p	71p	61p
181	4-bit binary counter	7493	80p	67p	57p
191	4-bit shift register	7495	87p	72p	62p
201	Synchronous up down 4-bit decade counter with one line mode control	74190	£1·80	£1·48	£1·27
211	Synchronous up down 4-bit binary counter with one line mode control	74191	£1·80	£1·48	£1·27
221	8-bit shift register	7491A	£1·28	£1·07	92p
231	4-bit shift register	7494	£1·13	94p	81p
241	Synchronous up down 4-bit decade counter	74192	£1·74	£1·45	£1·25
251	As above—binary counter	74193	£1·74	£1·45	£1·25
261	5-bit shift register	7496	£1·48	£1·22	£1·05
271	Dual J-K master-slave, flip-flop with preset and clear	74107	52p	43p	36p
301	Dual quadruple bistable latch	74100	£1·64	£1·37	£1·17
FLK					
101	Monostable multi-vibrator	74121	48p	40p	34p
FLL					
101	BCD to decimal decoder and nixie driver	74141	£1·22	£1·02	87p

TYPES MAY BE MIXED TO QUALIFY FOR PRICE BREAKS

DATA BOOKLET 20p

CONTRACT ORDER PRICES AND BULK QUANTITY PRICES QUOTED ON REQUEST

ALL STOCKS ADVERTISED LAST MONTH STILL AVAILABLE

FREE NO GIMMICKS !! FREE

Our catalogue is Free

postage appreciated (5p)

NEW PRODUCT!!

(Siemens Tantalum Bead Capacitors)

Mfd.	Voltage	Mfd.	Voltage
·1	35	2·2	16
·22	35	4·7	16
·47	35	10	16
1	35	15	16
2·2	35	22	16
4·7	35	33	10
6·8	25	10	6·3
10	25	22	6·3
15	20	47	6·3
		100	3

Epoxy encapsulated miniature sinter Tantalum Electrolytics—polarized Size example : 10mfd 16v 4·5 × 7·5 mm.

All one price: **12p** each; 25 pieces 1 type **10p** each.

BZY88 SERIES ZENERS 400mW 5%

All voltages available 3·3 to 33 Volt

25+ **12p** 100+ **10p**
500+ **9p** 1000+ **8p**

SPECIAL OFFER IN4000 SERIES 1 AMP RECTIFIERS

	p.i.v.	1-49	50+	100+
IN4001	50	·070	·060	·050
IN4002	100	·070	·065	·060
IN4003	200	·090	·085	·070
IN4004	400	·100	·090	·080
IN4005	600	·120	·100	·090
IN4006	800	·140	·130	·110
IN4007	1000	·190	·150	·120

	p.i.v	500+	1000+
IN4001	50	·045	·040
IN4002	100	·055	·045
IN4003	200	·060	·050
IN4004	400	·070	·060
IN4005	600	·075	·070
IN4006	800	·100	·085
IN4007	1000	·110	·100

Should any item be out of stock we reserve the right to supply at higher voltage rated item at no extra charge.

TERMS: Cash with order please. Postage: 10p inland, 25p Europe. Elsewhere — send plenty — will refund excess. All goods carry manufacturers' warranty. Counter Sales—Same Address.

Mullard Metallised Polyester 250v. C280 series

Mfd.	
0·01	3p
0·015	3p
0·022	3p
0·033	3p
0·047	4p
0·068	4p
0·1	4p
0·15	5p
0·22	5p
0·33	7p
0·47	8p
0·68	11p
1·0	14p
1·5	20p
2·2	24p

Mullard Electrolytic C437 series

Mfd.	Volt. Wkg.	
250	16	9p
400	16	12p
640	16	15p
1,000	16	18p
160	25	9p
250	25	12p
400	25	15p
640	25	18p
100	40	9p
160	40	12p
250	40	15p
400	40	18p

Mullard Sub-Miniature Ceramic Plate C333 series

63 volt working. Range 1·8pf to 220pf (usual pref. values).

Packs of 6 (any values) .. **15p**

CAPACITORS—Mullard Miniature Electrolytic C426 series

Mfd.	Volt Wkg.	
2·5	16	8p
10	16	6p
20	16	6p
40	16	6p
80	16	6p
1·6	25	8p
6·4	25	6p
12·5	25	6p
25	25	6p
50	25	6p
80	25	6p
1	40	8p
4	40	6p
8	40	6p
16	40	6p
32	40	6p
50	40	6p

ENCAPSULATED BRIDGES

Type No.	Current Rms.	Volts.	
W005	1 Amp	50	50p
W06	1 Amp	600	65p

LINEAR AND DIGITAL ICs

R.C.A.

CA3004	£1·80
CA3005	£1·20
CA3011	75p
CA3013	£1·05
CA3014	£1·25
CA3018	85p
CA3020	£1·30
CA3028A	75p
CA3035	£1·25
CA3043	£1·40
CA3044	£1·20
CA3046	75p
CA3047	£1·40
CA3048	£2·05
CA3049	£1·60
CA3052	£1·65
CA3090Q	£3·46

BARGAIN OP-AMPS!!

LM709C (DIL high gain op-amp) 60p

LM741CN (equiv. SN72741P) 95p

Fairchild

	1-11	12-24	25+
μL900	40p	35p	32p
μL914	40p	35p	32p
μL923	53p	50p	47p

Devices may be mixed to qualify for quantity price.

G.E. (U.S.A.)

PA230	Pre-amp	£1·10
PA234	1 watt Amp	£1·00
PA237	2 watt Amp	£1·87
PA246	5 watt Amp	£2·63
PA424	Zero Volt Switch	£2·45

MISCELLANEOUS

SL403D Plessey New Design .. £2·12

Mullard

TAA263	Linear Amp.	75p
TAA293	Gen. Purp. Amp	£1·00
TAA310	Record/Playback Amp	£1·50
TAA320	MOS LF Amp	65p
TAD100	IC Receiver	£1·97
TAD110	AM/FM Receiver	£1·97

PHASE LOCKED LOOP £5·98

LST break the price barrier on this fantastic device. M565 Phase locked loop IC now ex stock—data **10p.**

TRIACS

2N5756	2·5A (RMS) 400 PIV TO-5 Mod.	95p
40486	6 Amp (RMS) 400 PIV TO-5 Mod.	£1·20
40430	6 Amp (RMS) 400 PIV TO-66	£1·01
40432	6 Amp (RMS at 75° Amb.) 400 PIV* TO-5 Mod.	£1·50
40512	2·2 Amp (RMS at 25° Amb.) 400 PIV*	£1·45
40576	15A (RMS) 400 PIV TO-66	£1·70

*These types have integral triggering

BARGAIN TRIAC OFFER

40533 RCA 400V 2·5 AMP **60p**

THYRISTORS

CR1/051C	1 Amp 50 PIV TO-5	40p
CR1/401C	1 Amp 400 PIV TO-5	50p
2N3525	5 Amp 400 PIV TO-66	£1·09
40739	10 Amp 400 PIV Stud Mtg.	£1·65

ULTRASONIC TRANSDUCERS

Operate at 40 kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 transducers can transmit and receive.

FREE: With each pair our complete transmitter and receiver circuit.

PRICE .. £5·90

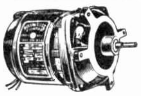
(Sold only in pairs)

LST ELECTRONIC COMPONENTS LTD

Mail Order Dept.: (PE) 7 Coptfold Road, Brentwood, Essex

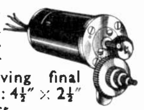
Industrial Sales Dept.: Tel.: Brentwood 226470/1 Telex 99443

BODINE TYPE N.C.I. GEARED MOTOR



(Type 1) 71 r.p.m. Torque 10lb. inch. **Reversible.** 1/70th h.p., 50 cycle, 0·38 amp. (Type 2) 28 r.p.m. Torque 20lb. inch. **Reversible.** 1/80th h.p., 50 cycle, 0·28 amp. "As new" condition. Input voltage of motor 115V a.c. Supplied complete with transformer for **230/240V a.c. input.** Price, either type **£3·15** plus 35p P. & P. or less transformer **£2·13** plus 27p P. & P.

12 VOLT DC MOTOR



Powerful 1 amp. REVERSIBLE motor. Speed 3,750 RPM complete with external gear train (removable) giving final speed of 125 RPM. Size: 4½" × 2¼" dia. Price **95p** inc. post.

230V/240V COMPACT SYNCHRONOUS GEARED MOTORS

Manufactured by either Sangamo, Haydon or Smith. Built-in gearbox.
1 rev. per hour. Clockwise rotation.
1 rev. per hour. Anti-clockwise rotation.
2 revs. per hour. Clockwise rotation.
3 revs. per hour. Anti-clockwise rotation.
60 revs. per hour. 1 r.p.m. Clockwise.
Fraction of makers' price. All at **75p** incl. P.&P

MICRO SWITCH

5 amp. c/o contacts. Fitted with removable push button assembly. Ex. P.O. 20 for **£1** inc. post. (Min. order 20)

MINIATURE LEVEL METER

Approximately 300 micro amp basic, as fitted to Tape Recorders, etc. Strip type dual coloured dial. **50p** + 8p P. & P.

ELECTRONIC ORGAN KIT

Easy to build, Solid State. Two full octave (less sharps and flats). Fitted hardwood case. Powered by two penlite 1½V batteries. Complete set of parts including speaker, etc., together with full instructions and 10 tunes. Price **£3·00**. P. & P. 22p.

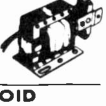
50 in 1 ELECTRONIC PROJECT KIT

50 easy to build Projects. No soldering, no special tools required. The kit includes Speaker, Meter, Relay, Transformer, plus a host of other components and a 56-page instruction leaflet. Some examples of the 50 possible Projects are: Sound Level Meter, 2 Transistor Radio, Amplifier, etc. Price **£7·75**. P. & P. 30p.

CRYSTAL RADIO KIT

Complete set of parts, including: Crystal Diode, Ferrite Aerial, Drilled Chassis, and Personal Ear Piece. No soldering, easy to build, full step by step instructions. **£1·75** inc. post.

230v AC SOLENOID



Extremely powerful with approx. 14lb. pull, 1" travel. Fitted with mounting feet. Size: 4" long, 2¾" wide, 3" high. £2·00 incl. P. & P.

230-250V SOLENOID

Mfg. by Westool, approx. 1½lb pull (similar in appearance to above illustration). Size of feet 1¼" × 1⅛". Price **85p** incl. Post.

VENNER Electric Time Switch

200/250V Ex. GPO. Tested. Manually set 2 on, 2 off every 24h. Override switch: 10A £2·75, 15A £3·25, 20A £3·75. P. & P. 20p. Also available with solar dial ON dusk, OFF dawn. Price as above.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0-260V.

All Types (and Spares) from ½ to 50 amp from stock.

SHROUDED TYPE

1 amp, £5·50 P. & P. 40p **2·5 amp, £6·75** P. & P. 40p
5 amp, £9·75 P. & P. 55p
10 amp, £18·50. **20 amp, £37·00.**
15 amp, £25·00. **25 amp, £49·00.**
37·5 amp, £72·00. **50 amp, £92·00.**
All plus £1·00 carr. where not specified.

OPEN TYPE (Panel Mounting) ½ amp, **£3·93.** 1 amp, **£5·50.** 2½ amp, **£6·63.** Carr. 40p on open types.

Superior Quality Precision Made NEW POWER RHEOSTATS

100 WATT. 1 ohm, 10A; **5 ohm,** 4·7A; **10 ohm,** 3A; **25 ohm,** 2A; **50 ohm,** 1·4A; **100 ohm,** 1A; **250 ohm,** 0·7A; **500 ohm,** 0·45A; **1 kΩ,** 280 mA; **1·5 kΩ,** 230 mA; **2·5 kΩ,** 2A; **5kΩ,** 140 mA. Diameter 3⅛in Shaft length ⅝in, dia. ¼in. All at **£1·50** each. P. & P. 5p.
50 WATT. 1/5/10/25/50/100/250/500/1/1·5/2·5/5kΩ. **All at £1·12 each.** P. & P. 11p.
25 WATT. 10/25/50/100/250/500/1/1·5/2·5/3·5/5kΩ. **All at 78p each.** P. & P. 15p.

STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.

EXPERIMENTERS' ECONOMY KIT
Speed adjustable 1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions **£6·30** plus 25p P. & P.

NEW INDUSTRIAL KIT
Ideally suitable for schools, laboratories, etc. Roller tin printed circuit. New trigger coil, plastic thyristor. Speed adjustable 1–80 f.p.s. Price **£10·50.** P. & P. 50p.

HY-LYGHT STROBE MK III
This strobe has been designed and produced for use in large rooms, halls and the photographic field, and utilizes a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Speed adjustable 0–30 f.p.s. Light output approx. 4 joules. **£12·00.** P. & P. 50p.
SPECIALLY DESIGNED, FULLY VENTILATED METAL CASE. Including reflector. **£4·00** P. & P. 45p. Post paid with kit.

AND NOW!
THE 'SUPER' HY-LYGHT KIT

Approx. four times the light output of our well proven Hy-Lyght strobe. Incorporating:
- Heavy duty power supply.
- Variable speed from 1–23 flash per sec.
- Fantastic Octal based tube with massive electrodes.
- Reactor control circuit producing an intense white light.

The brilliant light output of the "SUPER" HY-LYGHT gives fabulous effects with colour filters.
Never before a Strobe Kit with so HIGH an output at so LOW a price. ONLY **£20** plus 75p P. & P.
ATTRACTIVE, ROBUST, FULLY VENTILATED METAL CASE specially designed for the Super Hy-Lyght Kit Including reflector. **£7·00** P. & P. 45p.
7-inch POLISHED REFLECTOR
Ideally suited for above Strobe kits. Price **53p.** P. & P. 13p or post paid with kits.

RELAYS SIEMENS, PLESSEY, Etc.
MINIATURE RELAYS · COMPETITIVE PRICES

1	2	3	4	1	2	3.	4
45	6–9	2 HD M	**50p**	700	15–35	2 c/o HD	**73p***
185	6–12	4 c/o	**73p***	700	16–24	6M	**63p***
230	9–12	4 c/o	**78p***	1,250	24–36	4 c/o	**63p***
280	9–12	2 c/o	**73p***	2,500	36–45	6M	**63p***
600	18–32	4 c/o	**78p***	2,400	30–48	4 c/o	**50p**
700	16–24	4M 2B	**63p***	5,800	40–70	4 c/o	**63p***
700	16–24	4 c/o	**78p***	9,000	40–70	2 c/o	**50p***
700	12–24	2 c/o	**63p***	15k	85–110	6M	**50p***

(1) Coil ohms; (2) Working d.c. volts; (3) Contacts; (4) Price (HD) Heavy Duty. All Post Paid. *Including Base.

MAINS RELAY
230V a.c. coil 3 c/o. 10 amp a.c. contacts, **50p** plus 8p P. & P.

ALARM BELL

Manufactured by GENTS. 6 inch bell 3/6 volt D.C. operation. As NEW. ONLY **£1·50** P. & P 45p.

SERVICE TRADING CO

All Mail Orders—Also Callers—Ample Parking Space
Dept. P.E. 57 BRIDGMAN ROAD, LONDON W4 5BB
Phone 01-995 1560 SHOWROOM NOW OPEN MON.-FRI.

Personal callers only. Open Sat.
9 LITTLE NEWPORT ST.
LONDON WC2H 7JJ 01-437 0576

Professional receivers, supplied to Govt. Depts., Industry, Laboratories, Radio and TV Authorities, etc.

BUY DIRECT AT PRICES 15% BELOW RETAIL VALUES

THE NEW **** JULIETTE MPR 3065

is a high quality COMMUNICATIONS RECEIVER

(replaces NA 5018A)
Recommended Price
£42

£37·80

(Cash only) plus 62p P. & P. Complete with standard batteries and earpiece. BFO (optional extra) add £1·75.
IT NOT ONLY RECEIVES Aircraft, Shipping (VHF and SW), Taxis, Ambulances, Fire Service, TV Sound, Hams, Gas and Electric Boards, Public Services and many other radio telephone mobiles—BUT ALSO Classical Music, Pop and all that Jazz.
The **MPR 3065** is a communications receiver and entertainment source in one neat, transistorised, portable package. Features a colour coded illuminated tuning dial and band selector, AFC, squelch, BFO (optional extra), large speaker, Ext. Aerial Socket. Works off mains or batteries. Size: 10¼in × 7¼in × 4in. 22 Transistors/Diodes.
FREQUENCIES: Medium Wave, 540-1,600Kcs.; **Marine,** 1·6-4·6Mcs.; **FM/VHF,** 88-108Mcs.; **Aircraft,** 108-136Mcs. (Military, Civil and Ground control); **High VHF/PB,** 146-176Mcs. (Commercial and Industrial RT mobiles).

MODEL MPR 3016 6 BAND

SAME BANDS AND FREQUENCIES AS MODEL MPR 3065 *PLUS* ADDED FEATURE OF SW 5·0-12·0Mcs. (with Fine Tuner). Batts. and Earpiece incl. *Plus 62½p P. & P.* Styled in elegant black case with luxury Chrome trim, soft padded speaker grille, die-cast sides and walnut insert. Size 8¾in × 11in × 3¾in. Wt. 5lb approx.
Enclose 5d stamp for reply. Trade supplied

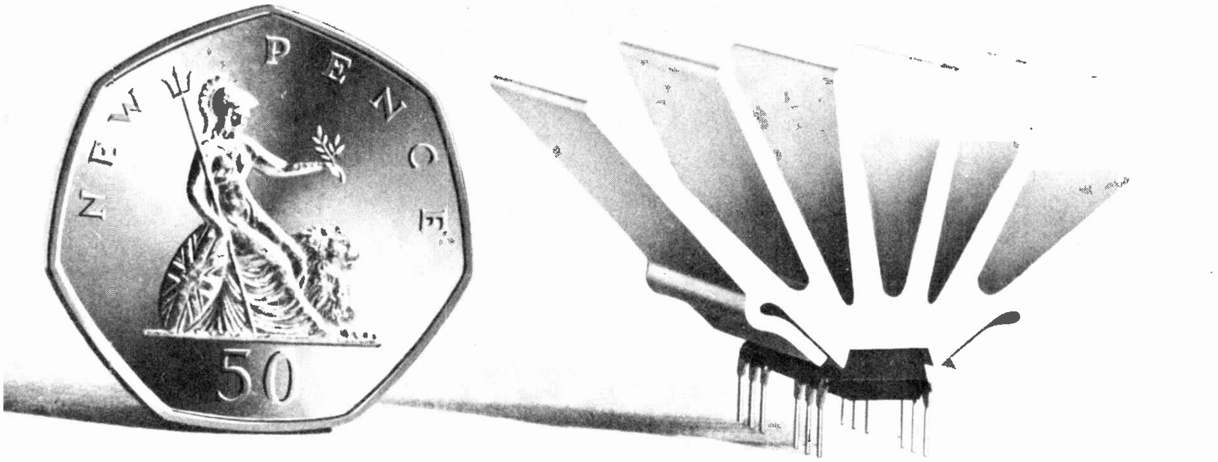
NEW!
FROM "LAFAYETTE"

4 Band TV Sound Battery Portable with PB Mobile Band (146–176MHz).
TV sound channels 2–13, VHF/FM local and national radios, PSB RT mobiles. Our Price **£27·95** Plus 50p P. & P. complete with batteries, earpiece, circ. diagram, AC adaptor socket; external aerial socket.

STOCKTON PARTNERS (Dept. "PE")
Importers and Distributors
Brighowgate, Grimsby, Lincs.
Tel. 0472 64196/58815

new

Super IC-12



High fidelity Monolithic Integrated Circuit Amplifier

Two years ago Sinclair Radionics announced the World's first monolithic integrated circuit Hi-Fi amplifier, the IC.10. Now we are delighted to be able to introduce its successor, the Super IC.12. This 22 transistor unit has all the virtues of the original IC.10 plus the following advantages:

1. Higher power.
2. Fewer external components.
3. Lower quiescent consumption.
4. Compatible with Project 60 modules.
5. Specially designed built-in heat sink. No other heat sink needed.
6. Full output into 3, 4, 5 or 8 ohms.
7. Works on any voltage from 6 to 28 volts without adjustment.
8. NEW 22 transistor circuit.

Output power 6 watts RMS continuous (12 watts peak).

Frequency Response 5 Hz to 100KHz ± 1 dB.

Total Harmonic Distortion Less than 1%. (Typical 0.1%) at all output powers and all frequencies in the audio band.

Load Impedance 3 to 15 ohms.

Power Gain 90dB (1,000,000,000 times) after feedback.

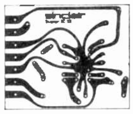
Supply Voltage 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

Size 22 x 45 x 28 mm including pins and heat sink.

Input Impedance 250 Kohms nominal.

Quiescent current 8mA at 28 volts.

With the addition of only a very few external resistors and capacitors the Super IC.12 makes a complete high fidelity audio amplifier suitable for use with pick-up, F.M. tuner etc. Alternatively, for more elaborate systems, modules in the Project-60 range such as the Stereo 60 and A.F.U. may be added. The comprehensive manual supplied with each unit gives full circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include car radios, oscillators etc. The very low quiescent consumption makes the Super IC.12 ideal for battery operation.



Price, inc. **FREE** printed circuit board for mounting.

£2.98 Post free

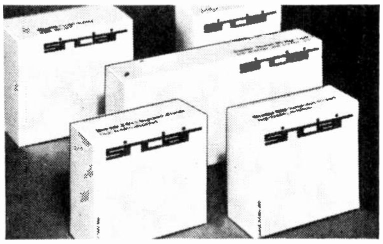
SINCLAIR GENERAL GUARANTEE
Should you not be completely satisfield with your purchase when you receive it from us, return the goods without delay and your money will be refunded in full, including cost of return postage, at once and without question. Full service facilities are available to all Sinclair customers.

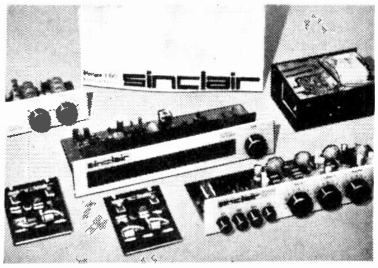
Sinclair Radionics Ltd, London Rd, St. Ives
Huntingdonshire PE17 4HJ
Telephone St Ives (048 06) 4311

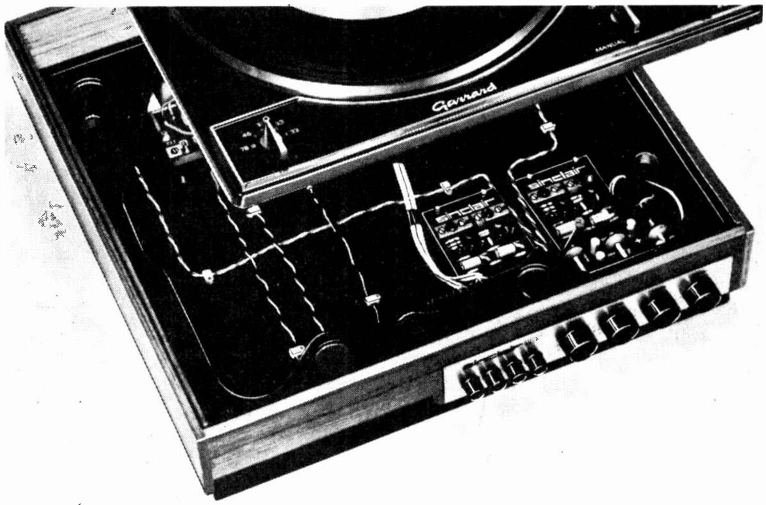
sinclair

Sinclair Project 60

The World's leading range of high fidelity modules







New!

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**

All you need for a superb 30 watt high fidelity stereo amplifier.

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**

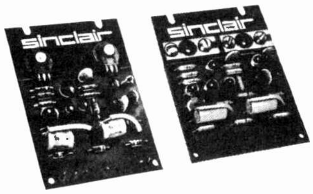
F.M. Stereo Tuner **(£25)** & A.F.U. Filter Unit **(£5.98)** may be added as required.

Sinclair Radionics Limited, London Road, St. Ives, Huntingdonshire PE17 4HJ. Tel: St. Ives (048 06) 4311

sinclair

from a simple amplifier to a complete stereo tuner amplifier with Project 60 modules

Z.30 & Z.50 power amplifiers



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 full output 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.

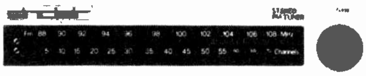
For speakers from 3 to 15 ohms impedance.

Size: 14 x 80 x 57 mm.

Z.30
Built, tested and guaranteed with circuits and instructions manual. **£4.48**

Z.50
Built, tested and guaranteed with circuits and instructions manual. **£5.48**

Project 60 Stereo F.M. Tuner



First in the world to use the phase lock loop principle

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. Good reception is possible in difficult areas, and often a few inches of wire are enough for an aerial. 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 any other high fidelity system.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 2µV for 30dB quieting: 7µV for lock-in over full deviation. **Squelch level:** 20µV. **A.F.C. range:** ±200 KHz. **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:** Power on/tuning/stereo. **Size:** 93 x 40 x 207 mm.

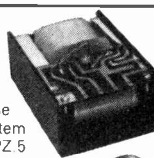
Built and tested. Post free. **£25**

Stereo 60 Pre-amp/control unit

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 + 15 to —15dB at 10 KHz: BASS + 15 to —15dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.
Built tested and guaranteed. **£9.98**

Power Supply Units



PZ.5

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.8

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**

A.F.U. High & Low Pass Filter Unit

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.
Built tested and guaranteed. **£5.98**

The Sinclair 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.

To: SINCLAIR RADIONICS LTD LONDON ROAD ST. IVES HUNTINGDONSHIRE PE17 4HJ

Please send	Name
	Address
I enclose cash/cheque/money order.	P.E. 1171

Sinclair Q16/Micromatic

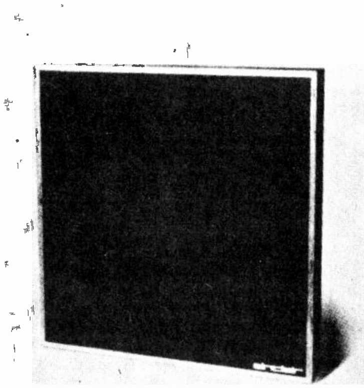
Q16 High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies without loss.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.
Loading: up to 14 watts RMS.
Input Impedance: 8 ohms.
Frequency response: From 60 to 16,000 Hz. confirmed by independently plotted B and K curve.
Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension for excellent transient response.
Size and styling: $9\frac{3}{4}$ in. square on face x $4\frac{3}{4}$ in. deep with neat pedestal base. Black all over cellular foam front with natural solid teak surround.
Price £8.98.



Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver brilliantly designed to provide remarkable standards of selectivity, power and quality for its size. Powerful AGC counteracts fading from distant stations: bandspread at higher frequencies makes reception of Radio 1 easy. The plug-in magnetic earpiece provided, matches the Micromatic's output to give wonderful standards of reproduction. Everything including the special ferrite rod aerial and batteries is contained within the minute attractively designed case. Whether you build a Micromatic kit or buy this amazing receiver ready built and tested, you will find it as easy to take with you as your wrist watch, and dependable under the severest listening conditions.

Specifications:

Size: 36 x 33 x 13 mm (1.8 x 1.3 x 0.5 in.)
Weight: including batteries, 28.4 gm (1 oz.)
Case: Black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies (550 to 1,600 KHz).
Earpiece: Magnetic type.
On/off switching: By inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and solder **£2.48.**
Ready built, tested and guaranteed, with earpiece **£2.98.**
Two Mallory Mercury batteries type RM675 required from radio shops, chemists, etc.

To: SINCLAIR RADIONICS LTD LONDON ROAD ST. IVES HUNTINGDONSHIRE PE17 4HJ

Please send ________	Name ________
________	Address ________
________	________
for which I enclose cash/cheque/money order	P.E. 11 71

Sinclair Radionics Ltd., London Rd, St. Ives
Huntingdonshire PE17 4HJ.
Telephone St. Ives (048 06) 4311

sinclair

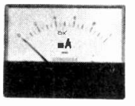
SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.
● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS

TYPE SW. 100
100 x 80 mm



		500µA	£3·12½
		1mA	£2·97½
		20V d.c. ...	£2·97½
		50V d.c. ...	£2·97½
		300V d.c.	£2·97½
50µA	£3·47½	1A d.c. ..	£2·97½
50-0-50µA	£3·37½	5A d.c. ..	£2·97½
100µA	£3·37½	300V a.c.	£2·97½
100-0-100µA	£3·25	VU Meter	£3·75

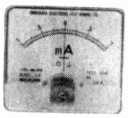
BAKELITE PANEL METERS

TYPE S-80
80 mm square fronts

50µA	£3·12½		
50-0-50µA	£2·97½		
100µA ...	£2·97½		
100-0-100µA	£2·87½		
500µA	£2·62½		
1mA	£2·47½	1A d.c. ..	£2·47½
20V d.c. ..	£2·47½	5A d.c. ..	£2·47½
50V d.c. ..	£2·47½	300V a.c.	£2·62½
300V d.c.	£2·47½	VU Meter	£3·37½

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4¼in × 4¼in fronts.



		50mA	£2·60
		100mA	£2·60
		500mA ..	£2·60
		1A........	£2·60
		5A........	£2·60
		15A	£2·60
		30A	£2·60
		20V d.c. ..	£2·60
		50V d.c. ..	£2·60
		150V d.c.	£2·60
50µA	£3·60	300V d.c.	£2·60
50-0-50µA	£3·10	15V a.c. ..	£2·60
100µA	£3·10	300V a.c.	£2·60
100-0-100µA	£3·10	S Meter	
200µA ..	£2·87½	1mA ..	£2·87½
500µA	£2·75	VU Meter	£3·60
500-0-500µA	£2·60	1A a.c.* ..	£2·60
1mA	£2·60	5A a.c.* ..	£2·60
1-0-1mA ..	£2·60	10A a.c.*	£2·60
5mA	£2·60	20A a.c.*	£2·60
10mA	£2·60	30A a.c.*	£2·60

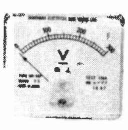
Type MR.52P. 2½in square fronts.

50µA	£3·10	20V d.c. ..	£2·00
50-0-50µA	£2·60	50V d.c. ..	£2·00
100µA	£2·60	300V d.c.	£2·00
100-0-100µA	£2·37½	15V a.c. ..	£2·00
500µA	£2·25	300V a.c.	£2·00
1mA	£2·00	S Meter	
5mA	£2·00	1mA ..	£2·10
10mA	£2·00	VU Meter	£3·10
50mA	£2·00	1A a.c.* ..	£2·00
100mA ..	£2·00	5A a.c.* ..	£2·00
500mA ..	£2·00		
1A........	£2·00	10A a.c.*	£2·00
5A	£2·00	20A a.c.*	£2·00
10V d.c. ..	£2·00	30A a.c.*	£2·00

Type MR.65P. 3¼in × 3¼in fronts.

50µA	£3·37½	20V d.c. ..	£2·10
50-0-50µA	£2·75	50V d.c. ..	£2·10
100µA	£2·75	150V d.c.	£2·10
100-0-100µA	£2·60	300V d.c.	£2·10
200µA	£2·60	15V a.c. ..	£2·10
500µA	£2·37½	50V a.c. ..	£2·10
500-0-500µA	£2·10	150V a.c.	£2·10
1mA	£2·10	300V a.c.	£2·10
5mA	£2·10	500V a.c.	£2·10
10mA	£2·10	S Meter	
50mA	£2·10	1mA ..	£2·37½
100mA ..	£2·10	VU meter	£3·37½
500mA ..	£2·10	50mA a.c.*	£2·10
1A........	£2·10	100mA a.c.*	£2·10
5A........	£2·10	200mA a.c.*	£2·10
10A	£2·10	500mA a.c.*	£2·10
15A	£2·10	1A a.c.* ..	£2·10
20A	£2·10	5A a.c.* ..	£2·10
30A	£2·10	10A a.c.*	£2·10
50A	£2·37½	20A a.c.*	£2·10
5V d.c. ..	£2·10	30A a.c.*	£2·10
10V d.c. ..	£2·10		

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



		150mA ..	£1·37½
		200mA ..	£1·37½
		300mA ..	£1·37½
		500mA ..	£1·37½
		750mA ..	£1·37½
		1A	£1·37½
		2A........	£1·37½
		5A........	£1·37½
		10A	£1·37½
		3V d.c. ..	£1·37½
		10V d.c. ..	£1·37½
50µA	£2·00	15V d.c. ..	£1·37½
50-0-50µA	£1·87½	20V d.c. ..	£1·37½
100µA	£1·87½	100V d.c.	£1·37½
100-0-100µA	£1·75	150V d.c.	£1·37½
200µA	£1·75	300V d.c.	£1·37½
500µA	£1·50	500V d.c.	£1·37½
500-0-500µA	£1·37½	750V d.c.	£1·37½
1mA	£1·37½	15V a.c. ..	£1·37½
1-0-1mA ..	£1·37½	50V a.c. ..	£1·37½
2mA	£1·37½	150V a.c.	£1·37½
5mA	£1·37½	300V a.c.	£1·37½
10mA	£1·37½	500V a.c.	£1·37½
20mA	£1·37½	S Meter	
50mA	£1·37½	1mA ..	£1·60
100mA ..	£1·37½	VU meter	£2·10

Type MR.45P. 2in square fronts.

50µA	£2·25	10V d.c. ..	£1·50
50-0-50µA	£2·10	20V d.c. ..	£1·50
100µA	£2·10	50V d.c. ..	£1·50
100-0-100µA	£1·87½	300V d.c.	£1·50
200µA	£1·87½	15V a.c. ..	£1·50
500µA	£1·60	300V a.c.	£1·50
500-0-500µA	£1·50	S Meter	
1mA	£1·50	1mA ..	£1·87½
5mA	£1·50	VU Meter	£2·25
10mA	£1·50	1A a.c.* ..	£1·50
50mA	£1·50	5A a.c.* ..	£1·50
100mA ..	£1·50	10A a.c.*	£1·50
500mA ..	£1·50	20A a.c.*	£1·50
1A........	£1·50	30A a.c.*	£1·50
5A........	£1·50		

"SEW" BAKELITE PANEL METERS

Type MR.65 3¼in square fronts.

		500mA ..	£1·75
		1A	£1·75
		5A	£1·75
		15A	£1·75
		30A	£1·75
		50A	£1·75
		5V d.c. ..	£1·75
		10V d.c. ..	£1·75
		20V d.c. ..	£1·75
		50V d.c. ..	£1·75
		150V d.c.	£1·75
		300V d.c.	£1·75
25µA	£3·50	30V a.c.*	£1·75
50µA	£2·37½	50V a.c.*	£1·75
50-0-50µA	£2·25	150V a.c.*	£1·75
100µA	£2·25	300V a.c.*	£1·75
100-0-100µA	£2·25	500mA a.c.*	£1·75
500µA	£2·10	1A a.c.* ..	£1·75
1mA	£1·75	5A a.c.* ..	£1·75
1-0-1mA ..	£1·75	10A a.c.*	£1·75
5mA	£1·75	20A a.c.*	£1·75
10mA	£1·75	30A a.c.*	£1·75
50mA	£1·75	50A a.c.*	£1·75
100mA ..	£1·75	VU meter	£3·10

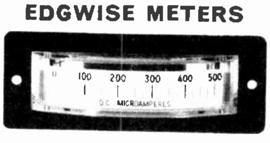
*** MOVING IRON — ALL OTHERS MOVING COIL**
Please add postage

"SEW" EDUCATIONAL METERS

Type ED.107. Size overall 100mm × 90mm × 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50µA......	£4·50	20V d.c. ..	£3·97
100µA......	£4·25	50V d.c. ..	£3·97
1mA......	£3·97	300V d.c. ..	£3·97
50-0-50µA	£4·25	Dual range	
1-0-1mA ..	£3·97	500mA/5Ad.c.	£4·25
1A d.c.....	£3·97	5V/50V d.c.	£4·25
5A d.c.....	£3·97		
10V d.c. ..	£3·97		

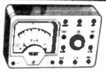
EDGEWISE METERS



PE.70 3 17/32in × 1 15/32in × 2¼in deep.

50µA	£3·00	500µA	£2·60
50-0-50µA	£2·87½	1mA......	£2·37½
100µA ...	£12·87½	300V a.c.	£2·37½
100-0-100µA	£2·75	VU meter..	£3·25
200µA	£2·75		

MULTIMETERS for EVERY purpose!



TECH PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000V a.c. and d.c. 0/1/100/500mA. d.c. 0/100K. £1·97½. P. & P. 12½p.

MODEL TE-200. 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V d.c. 0/10/50/250/1,000V a.c. 0/50µA/250MA. 0/60K/6 meg. −20 to +62dB. £3·75. P. & P. 15p.

MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30µA/3/30/300mA. 0/16K/160K/1·6M/16 meg. £5·50. P. & P. 15p.

MODEL TE12. 20,000 O.P.V. 0/0·6/30/120/600, 1,200 / 3,000 / 6,000V d.c. 1/6/30/120/600/1,200V a.c. 0 / 60µA / 6 / 60 / 600MA/ 0 / 6K / 600K / 6meg./60. Megohm 50PF. 2 MFD £5·97½. P. & P. 17½p.

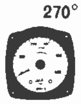
MODEL PL436. 20k Ω / Volt d.c. 8k Ω/Volt a.c. Mirror scale. 0·6/3/12/30/120/600V d.c. 3/30/120/600V a.c. 50/600µA/60/600mA. 10/100K/1 Meg/10 meg Ω. −20 to +46dB. £6·97½. P. & P. 12½p.

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

TMK MODEL TW-20CB. Features Resettable Overload Button. Sensitivity: 20K Ω/Volt d.c. 5K Ω/Volt a.c. D.c. volts: 0-0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 0-2·5, 10, 50, 250, 1,000V. D.c. currents: 0-0·05, 0·5, 5, 50, 500mA. Resistance: 0-5K, 50K, 0-500K, 5 meg. Decibels: −20 to +52dB. £11·50. P. & P. 17½p.

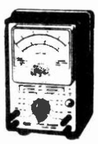
TMK LAB TESTER. 100,000 O.P.V. 6½in scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt a.c. D.c. volts: 0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 3, 10, 50, 250, 500, 1,000V. D.c. current: 10, 100µA, 10, 100, 500mA, 2·5, 10A. Resistance: 1K, 10K, 100K, 10 meg, 100 meg. Decibels: −10 to +49dB. Plastic case with carrying handle, size 7½in × 6¼in × 3¼in. £18·90. P. & P. 25p.

270° WIDE ANGLE 1mA METERS



MW1-6 60mm square £3·97½. MW1-8 80mm square £4·97½. P. & P. extra.

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER



10 meg. input 10 ranges: ·01 / ·003 / ·1 / ·3 / 1 / 3 / 10 / 30 / 100 / 300V. R.M.S. 4c/s.-1·2Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V a.c. £17·50. Carr. 25p.

TE-65 VALVE VOLTMETER

High quality instrument with 28 ranges. D.c. volts 1·5-1,500V. A.c. volts 1·5-1,500V. Resistance up to 1,000 megohms. 220/240V a.c. operation. Complete with probe and instructions. £17·50. P. & P. 30p. Additional Probes available: R.F. £2·12½. H.V. £2·50.

HONOR. TE.10A. 20k Ω/Volt 5/25/50/250/500/2,500V d.c. 10/50/100/500/1,000V a.c. 0/50µA/2·5mA 250mA d.c. 0/6K/6 meg. ohm. −20 to +22dB. 10-0, 100 mfd. 0-100-0·1 mfd. £3·47½. P. & P. 15p.

MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/0·6/3/15/60/300/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30µA / 6mA / 60mA / 300mA/600mA. 0/8K/80K/800K/8 meg. −20 to +63dB. £5·97½. P. & P. 15p.

TMK MODEL MD.120. Mirror scale. 20k Ω/volt d.c., 10k Ω/volt a.c. 30/60/300/600/3,000V d.c. 6/120/1,200V a.c. Current 0–60µA/0–12/0–300mA. 0–60k Ω/0–6M Ω −20 to +63dB. £4·62½. P. & P. 15p.

MODEL TE-90. 50,000 O.P.V. Mirror scale, overload protection. 003/13/60/300/600/1,200V d.c. 0/6/30/120/300/1,200V d.c. 0·03/6/60/600mA. d.c. 16K/160K/1·6/16 meg. −20 to +63dB. £7·50. P. & P. 15p.

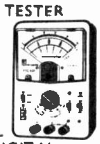
SKYWOOD SW-500

50 K Ω/Volt. Mirror scale DC Volts 0.6/3/12/30/300/600. AC Volts 3/30/300/600. DC Current 20uA/6/60/600mA. Resistance 10K/100 K/1Meg/10 Meg. Decibels −20 to +57dB. £7·50. P. & P. 15p.

MODEL AS-100D. 100K Ω/Volt. 5in, mirror scale. Built-in meter protection 0/3/12/60/120/300/600/1,200V d.c. 0/6/30/120/300/600V a.c. 0/10µA/6/60/300mA/12A. 0/2K/200K/2M/200M. −20 to +17dB. £12·50. P. & P. 17½p.

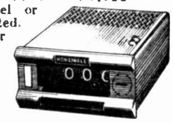
TE-900 20,000 Ω/VOLT GIANT MULTIMETER. Mirror scale and overload protection. 6in full view meter. 2 colour scale. 0/2·5 / 10 / 250 / 1,000 / 5,000V a.c. 0/25/12·5/10/50/250/1,000/5,000V d.c. 0/50µA/110/100/500mA/10A d.c. 02K/200K/20 meg. ohm. £15. P. & P. 25p.

FTC-401 TRANSISTOR TESTER



Full capabilities for measuring A, B and ICO, *npn* or *pnp*. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. £6·97½. P. & P. 15p.

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 a.c. and d.c. volt, current and ohms with optional plug-in cards.

Specification:—
Accuracy: ± 0·2. ± 1 digit.
Resolution: 1mV.
No. of digits: 3 plus fourth overrange digit.
Overrange: 100% (up to 1·999)
Input impedance: 1000 Meg ohm.
Measuring cycle: ½ 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: 5¼in. × 2 13/16in. × 8 3/16in
AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE
£49·97½ Carr. 50p

G. W. SMITH & CO (RADIO) LTD.
Also see next two pages

SEMI-CONDUCTORS/VALVES

ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors

2G301	20p
2G302	19p
2G303	20p
2G306	30p
2G308	30p
2G309	30p
2G371	15p
2G374	20p
2G381	22p
2N388A	49p
2N404	20p
2N696	15p
2N697	15p
2N698	25p
2N699	42p
2N706	9p
2N706A	11p
2N708	15p
2N709	45p
2N718	25p
2N718A	30p
2N726	25p
2N727	25p
2N914	17p
2N916	17p
2N918	30p
2N929	22p
2N930	24p
2N937	52p
2N1090	22p
2N1091	22p
2N1131	25p
2N1132	25p
2N1302	17p
2N1303	17p
2N1304	22p
2N1305	22p
2N1306	24p
2N1307	24p
2N1308	25p
2N1309	24p
2N1507	17p
2N1613	21p
2N1631	35p
2N1632	30p
2N1637	30p
2N1638	27p
2N1639	27p
2N1701	110p
2N1711	24p
2N1889	32p
2N1893	37p
2N2147	72p
2N2160	57p
2N2193	40p
2N2193A	42p
2N2194	27p
2N2194A	30p
2N2217	27p
2N2218	20p
2N2219	20p
2N2220	25p
2N2221	25p
2N2222	20p
2N2222A	25p
2N2297	30p
2N2368	15p
2N2369	17p
2N2369A	17p
2N2410	42p
2N2483	27p
2N2484	32p
2N2539	22p
2N2540	22p
2N2613	27p
2N2614	30p
2N2646	47p
2N2711	25p
2N2712	25p
2N2713	27p
2N2714	30p
2N2904	20p
2N2904A	25p
2N2905	25p
2N2905A	30p
2N2906	20p
2N2906A	25p
2N2907	23p
2N2923	15p
2N2924	15p
2N2925	15p
2N2926G	12p
2N2926O	12p
2N2926Y	12p
2N3011	24p
2N3014	25p
2N3053	22p
2N3054	49p
2N3055	72p
2N3133	25p
2N3134	30p
2N3135	25p
2N3136	25p
2N3390	25p
2N3391	20p
2N3391A	30p
2N3392	17p
2N3393	15p
2N3394	15p
2N3402	22p
2N3403	22p
2N3404	32p
2N3405	45p
2N3414	22p
2N3415	22p
2N3416	27p
2N3417	37p
2N3439	130p
2N3440	97p
2N3564	17p
2N3565	15p
2N3566	22p
2N3568	25p
2N3569	25p
2N3570	125
2N3572	97p
2N3605	27p
2N3606	27p
2N3607	22p
2N3638	18p
2N3638A	20p
2N3641	18p
2N3642	18p
2N3643	20p
2N3644	25p
2N3645	25p
2N3691	15p
2N3692	18p
2N3693	15p
2N3694	18p
2N3702	10p
2N3703	10p
2N3704	12p
2N3705	10p
2N3706	10p
2N3707	12p
2N3708	8p
2N3709	10p
2N3710	10p
2N3711	10p
2N3713	187p
2N3714	200p
2N3715	222p
2N3716	290p
2N3773	240p
2N3791	275p
2N3819	34p
2N3820	57p
2N3823	75p
2N3854	27p
2N3854A	27p
2N3855	27p
2N3855A	30p
2N3856	30p
2N3856A	35p
2N3858	25p
2N3858A	30p
2N3859	27p
2N3859A	32p
2N3860	30p
2N3866	150p
2N3877	40p
2N3877A	40p
2N3900	37p
2N3900A	40p
2N3901	97p
2N3903	25p
2N3904	25p
2N3905	30p
2N3906	30p
2N4058	15p
2N4059	10p
2N4060	12p
2N4061	12p
2N4062	12p
2N4244	47p
2N4248	15p
2N4249	15p
2N4250	18p
2N4254	42p
2N4255	42p
2M4284	17p
2N4285	17p
2N4286	17p
2N4287	17p
2N4288	15p
2N4289	15p
2N4290	15p
2N4291	15p
2N4292	15p
2N4294	17p
2N4303	47p
2N4964	15p
2N4965	18p
2N5027	52p
2N5028	57p
2N5029	47p
2N5030	42p
2N5172	18p
2N5174	52p
2N5175	52p
2N5176	45p
2N5232A	30p
2N5245	45p
2N5246	42p
2N5249	67p
2N5265	325p
2N5305	37p
2N5306	40p
2N5307	37p
2N5308	37p
2N5309	62p
2N5310	42p
2N5354	27p
2N5355	27p
2N5356	32p
2N5365	47p
2N5366	32p
2N5367	57p
2N5457	34p
2N5458	35p
2N5459	48p
2S102	25p
2S103	25p
2S104	25p
2S301	47p
2S302	47p
2S303	57p
2S304	72p
2S501	32p
2S502	35p
2S503	27p
3N83	40p
3N128	70p
3N140	77p
3N141	72p
3N142	55p
3N143	67p
3N152	87p
40050	55p
40250	50p
40251	32p
40309	32p
40310	45p
40311	35p
40312	47p
40314	37p
40315	37p
40316	47p
40317	37p
40319	55p
40320	47p
40323	32p
40324	47p
40326	37p
40329	30p
40344	27p
40347	57p
40348	52p
40360	42p
40361	47p
40362	55p
40370	82p
40406	57p
40407	40p
40408	52p
40409	55p
40410	62p
40412	50p
40467A	57p
40468A	35p
40528	72p
40600	57p
40603	50p
AC107	30p
AC126	20p
AC127	24p
AC128	20p
AC151	18p
AC152	22p
AC154	22p
AC176	22p
AC187	25p
AC188	27p
ACY17	27p
ACY18	24p
ACY19	20p
ACY20	20p
ACY21	20p
ACY22	15p
ACY28	17p
ACY39	47p
ACY40	14p
ACY41	25p
ACY44	40p
AD140	47p
AD149	47p
AD150	62p
AD161	35p
AD162	35p
AF109	45p
AF114	25p
AF115	25p
AF116	25p
AF117	20p
AF118	44p
AF121	30p
AF124	22p
AF125	19p
AF126	18p
AF127	16p
AF139	28p
AF178	42p
AF179	45p
AF180	50p
AF181	47p
AF186	39p
AF239	30p
AF279	47p
AF280	47p
AFZ11	32p
ASY26	25p
ASY27	31p
ASY28	24p
ASY29	27p
ASY50	25p
ASY51	32p
ASY54	25p
ASY67	45p
ASY86	32p
ASZ21	37p
AUY10	150p
BC107	10p
BC108	10p
BC109	10p
BC113	10p
BC114	15p
BC115	15p
BC116	15p
BC118	15p
BC119	35p
BC121	20p
BC122	20p
BC125	15p
BC126	25p
BC134	15p
BC135	15p
BC136	15p
BC137	15p
BC138	37p
BC140	35p
BC141	35p
BC147	15p
BC148	11p
BC149	15p
BC152	17p
BC153	35p
BC154	35p
BC157	15p
BC158	15p
BC159	15p
BC160	35p
BC167	15p
BC168B	14p
BC168C	15p
BC169B	14p
BC169C	15p
BC170	12p
BC171	15p
BC172	15p
BC175	22p
BC177	22p
BC178	20p
BC179	22p
BC182	10p
BC182L	10p
BC183	10p
BC183L	10p
BC184	15p
BC184L	12p
BC186	25p
BC187	27p
BC212L	12p
BC213L	12p
BC214L	15p
BCY10	27p
BCY30	24p
BCY31	30p
BCY32	50p
BCY33	20p
BCY34	25p
BCY38	30p
BCY39	60p
BCY40	50p
BCY41	15p
BCY42	15p
BCY43	22p
BCY54	32p
BCY58	22p
BCY59	22p
BCY60	97p
BCY70	15p
BCY71	20p
BCY72	15p
BCY78	30p
BCY79	30p
BCZ10	27p
BCZ11	40p
BD112	30p
BD116	112p
BD121	65p
BD123	80p
BD124	75p
BD131	75p
BD132	85p
BDY10	125p
BDY20	105p
BDY61	125p
BDY62	100p
BF115	25p
BF117	47p
BF152	28p
BF154	38p
BF158	28p
BF159	57p
BF163	35p
BF167	25p
BF170	33p
BF173	25p
BF177	25p
BF178	25p
BF179	30p
BF180	35p
BF181	35p
BF182	30p
BF184	20p
BF185	20p
BF194	17p
BF195	15p
BF196	15p
BF197	15p
BF198	42p
BF200	35p
BF224	20p
BF225	20p
BF237	22p
BF238	22p
BF244	32p
BFW61	47p
BFW87	25p
BFW88	23p
BFW89	20p
BFW90	22p
BFW91	20p
BFX12	22p
BFX13	22p
BFX29	25p
BFX30	25p
BFX37	30p
BFX44	37p
BFX68	67p
BFX84	25p
BFX85	32p
BFX86	25p
BFX87	25p
BFX88	20p
BFX89	65p
BFX93A	70p
BFY11	42p
BFY18	25p
BFY19	25p
BFY21	42p
BFY24	45p
BFY29	40p
BFY30	40p
BFY41	50p
BFY43	62p
BFY50	22p
BFY51	20p
BFY52	22p
BFY53	17p
BFY56A	57p
BFY76	42p
BFY77	57p
BFY90	65p
BSX19	17p
BSX20	17p
BSX21	20p
BSX26	45p
BSX27	47p
BSX28	32p
BSX60	82p
BSX61	62p
BSX76	15p
BSX77	20p
BSX78	25p
BSY24	15p
BSY25	15p
BSY26	17p
BSY27	17p
BSY28	17p
BSY29	17p
BSY32	25p
BSY36	25p
BSY37	25p
BSY38	20p
BSY39	22p
BSY43	50p
BSY51	32p
BSY52	32p
BSY53	37p
BSY54	40p
BSY56	80p
BSY79	45p
BSY90	57p
BSY95A	12p
C424	15p
C450	15p
GET102	30p
GET113	20p
GET114	15p
GET118	20p
GET120	25p
GET873	12p
GET880	30p
GET887	15p
GET889	22p
GET890	22p
GET896	22p
GET897	22p
GET898	22p
MAT100	25p
MAT101	30p
MAT120	25p
MAT121	30p
MJ400	107p
MJ420	112p
MJ421	112p
MJ430	102p
MJ440	95p
MJ480	97p
MJ481	125p
MJ490	100p
MJ491	137p
MJE340	62p
MJE370	65p
MJE371	87p
MJE520	87p
MJE521	87p
MPF102	42p
MPF103	35p
MPF104	37p
MPF105	37p
MPS3638	32p
NKT124	42p
NKT125	27p
NKT126	27p
NKT128	27p
NKT135	27p
NKT137	32p
NKT210	30p
NKT211	30p
NKT212	30p
NKT213	30p
NKT214	22p
NKT215	22p
NKT216	37p
NKT217	40p
NKT219	30p
NKT223	27p
NKT224	22p
NKT225	22p
NKT229	30p
NKT237	35p
NKT238	25p
NKT240	27p
NKT241	27p
NKT242	20p
NKT243	62p
NKT244	17p
NKT245	20p
NKT261	26p
NKT262	30p
NKT264	20p
NKT271	20p
NKT262	20p
NKT274	20p
NKT275	20p
NKT278	25p
NKT281	27p
NKT401	87p
NKT402	80p
NKT403	75p
NKT404	62p
NKT405	75p
NKT406	62p
NKT451	62p
NKT452	62p
NKT453	47p
NKT713	20p
NKT717	42p
NKT734	27p
NKT736	35p
NKT773	25p
NKT781	30p
OC16	50p
OC19	37p
OC20	75p
OC22	50p
OC23	60p
OC24	60p
OC25	37p
OC26	25p
OC28	60p
OC29	60p
OC35	50p
OC36	60p
OC41	22p
OC42	25p
OC44	17p
OC45	12p
OC46	15p
OC70	12p
OC71	12p
OC72	12p
OC73	30p
OC74	30p
OC75	22p
OC76	22p
OC77	30p
OC78	20p
OC81	20p
OC81D	20p
OC82	25p
OC82D	15p
OC83	25p
OC84	25p
OC159	25p
OC140	32p
OC170	25p
OC171	30p
OC200	40p
OC201	60p
OC202	75p
OC203	40p
OC204	40p
OC205	75p
OC206	90p
OC207	75p
OCP71	42p
ORP12	50p
ORP60	40p
ORP61	42p
P346A	22p
ST140	15p
ST141	20p
TIS34	62p
TIS43	40p
TIS44	12p
TIS45	12p
TIS46	12p
TIS47	12p
TIS48	12p
TIS49	12p
TIS50	17p
TIS51	12p
TIS52	12p
TIS53	22p
XB112	11p
XC141	35p
ZTX107	14p
ZTX108	11p
ZTX109	17p
ZTX300	11p
ZTX301	17p
ZTX302	18p
ZTX303	18p
ZTX304	25p
ZTX500	16p
ZTX501	16p
ZTX502	20p
ZTX503	17p
ZTX504	40p
ZTX531	28p

Integrated Circuits

CA3000	180p
CA3005	117p
CA3007	262p
CA3011	75p
CA3012	88p
CA3013	105p
CA3014	124p
CA3018	84p
CA3018A	110p
CA3019	84p
CA3020	126p
CA3020A	160p
CA3021	156p
CA3022	130p
CA3023	126p
CA3026	100p
CA3028A	74p
CA3028B	105p
CA3029	87p
CA3029A	165p
CA3030	137p
CA3035	122p
CA3036	72p
CA3039	82p
CA3041	109p
CA3042	109p
CA3043	137p
CA3044	120p
CA3045	122p
CA3046	81p
CA3047	137p
CA3048	204p
CA3049	160p
CA3050	186p
CA3051	184p
CA3052	165p
CA3053	46p
CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
FCH101	85p
FCH111	105p
FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH161	50p
FCH171	105p
FCH181	105p
FCH191	105p
FCH201	130p
FCH211	130p
FCH221	130p
FCH231	150p
FCJ101	160p
FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	280p
FCY101	102p
FJH101	25p
FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
IC10	250p
IC12	250p
L900	40p
L914	40p
L923	40p
MC724P	66p
MC780P	247p
MC788P	82p
MC790P	124p
MC792P	66p
MC799P	66p
MC1303L	262p
MC1304P	275p
MC1305P	386p
MC838P	549p
MC1435P	345p
MC1552G	461p
MC1709CG	94p
MFC4000P	112p
PA222	437p
PA230	100p
PA234	100p
PA237	186p
PA246	245p
PA424	235p
PA264	447p
PA265	497p
SL403A	187p
SL702C	147p
SN7400	23p
SN7401	23p
SN7402	23p
SN7403	23p
SN7404	23p
SN7405	23p
SN7406	80p
SN7408	23p
SN7409	23p
SN7410	23p
SN7411	23p
SN7413	35p
SN7420	23p
SN7430	23p
SN7440	23p
SN7441AN	87p
SN7442	87p
SN7446	125p
SN7447	110p
SN7448	100p
SN7450	23p
SN7451	23p
SN7453	23p
SN7454	23p
SN7460	23p
SN7472	35p
SN7473	43p
SN7474	43p
SN7475	47p
SN7476	45p
SN7483	87p
SN7486	50p
SN7490	100p
SN7492	87p
SN7493	87p
SN7495	87p
SN7496	87p
SN74107	43p
SN74153	140p
SN74154	220p
SN74160	180p
SN74161	180p
SN74164	220p
SN74165	225p
SN74192	225p
SN74193	225p
TAA241	162p
TAA242	425p
TAA243	150p
TAA263	75p
TAA293	97p
TAA300	175p
TAA310	125p
TAA320	72p
TAA350	175p
TAA435	147p
TAA521	132p
TAA522	360p
TAA530	495p
TAA811	445p
TAB101	97p
TAD100	150p
TAD110	197p
UA702A	280p
UA702C	77p
UA703C	137p
UA709C	125p
UA710C	125p
UA716	187p
UA723C	162p
UA730C	160p
UA741C	87p

BRIDGE RECTIFIERS PLASTIC ENCAPSULATED

		50 PIV 4A	60p
		100 PIV 4A	70p
		200 PIV 4A	75p
		400 PIV 4A	80p
600 PIV 1A	50p	50 PIV 6A	62p
50 PIV 2A	55p	100 PIV 6A	75p
100 PIV 2A	60p	200 PIV 6A	85p
200 PIV 2A	67p	400 PIV 6A	£1·10
400 PIV 2A	80p		

SILICON RECTIFIERS MINIATURE WIRE ENDED PLASTIC

	IN SERIES 1 AMP	PL SERIES 1·5 AMP	CL SERIES 3 AMP
4001 50PIV	08p	10p	19p
4002 100PIV	09p	11p	20p
4003 200PIV	10p	12p	22p
4004 400PIV	10p	12p	25p
4005 600PIV	12p	15p	26p
4006 800PIV	15p	17p	27p
4007 1000PIV	20p	20p	30p

50+ less 15% 100+ less 20%

SILICON RECTIFIERS STUD MOUNTING

	6A	10A	17·5A	35A
100PIV	—	45p	50p	£1·22
200PIV	25p	50p	55p	£1·42
400PIV	30p	55p	62p	£1·77
600PIV	32p	60p	72p	£2·12
800PIV	35p	75p	87p	£2·47
1000PIV	40p	85p	£1·05	£2·77

50+ less 15% 100+ less 20%

ZENER DIODES

400MW	1·5 WATT	10 WATT
3·3-33 V	2·4—100	3·9—100V
15p each	20p each	25p each

25+ less 15% 100+ less 20%

TRANSISTOR DISCOUNTS: 12 + 10%; 25 + 15%; 100+20% any one type Postage on all Semi-Conductors 7p extra.
S.A.E. FOR FULL LISTS.

VALVES

OA2	38p
OB2	45p
OZ4	30p
IL4	20p
IR5	35p
IS5	25p
IT4	25p
IU4	27p
IU5	50p
2D21	35p
3Q4	40p
3S4	35p
3V4	45p
5R4	60p
5U4	33p
5V4	42p
5Y3	32p
5Z4G	40p
6/30L2	75p
6AC7	25p
6AG7	40p
6AK5	30p
6AK6	57p
6AL5	20p
6AM6	33p
6AQ5	35p
6AS6	37p
6AT6	30p
6AU6	25p
6AV6	30p
6BA6	25p
6BE6	30p
6BH6	45p
6BJ6	45p
6BQ7A	40p
6BR7	85p
6BR8	65p
6BW6	85p
6BW7	70p
6BZ6	35p
6C4	33p
6CD6	£1·15
6CL6	60p
6CW4	63p
6F1	62p
6F6G	30p
6F13	38p
6F14	65p
6F15	65p
6F18	45p
6F23	80p
6H6	20p
6J4	50p
6J5	20p
6J5GT	30p
6J6	20p
6J7	45p
6K8G	35p
6L6GT	45p
6LD20	40p
6Q7	40p
6SA7	40p
6SG7	35p
6SJ7	40p
6SK7	35p
6SL7	35p
6SN7	35p
6SQ7	40p
6U4	60p
6V6G	25p
6V6GT	32p
6X4	30p
6X5G	30p
6X5GT	27p
10C2	50p
10F1	90p
10P13	55p
10P14	£1·10
12AT6	30p
12AT7	30p
12AU7	30p
12AX7	30p
12AV6	33p
12BA6	35p
12BE6	35p
12BH7	40p
19AQ5	35p
20D1	45p
20F2	75p
20L1	£1·10
20P1	50p
20P3	60p
20P4	£1·10
20P5	£1·20
25L6	45p
25Z4	30p
25Z5	42p
25Z6	65
30C15	80p
30C17	85p
30C18	75p
30F5	85p
30FL1	70p
30FL12	92p
30FL14	75p
30L15	85p
30L17	80p
30P12	80p
30P19	80p
30PL1	70p
30PL13	93p
30PL14	80p
35L6	50p
35W4	30p
35Z4	30p
35Z5	40p
50B5	45p
50C5	40p
80	50p
85A2	45p
807	50p
1625	50p
5763	70p
6146	£1·50
AZ31	50p
CY31	35p
DAF91	25p
DAF96	42p
DF91	25p
DF96	42p
DK91	35p
DK92	50p
DK96	42p
DL92	35p
DL94	45p
DL96	42p
DM70	32p
DY86	33p
DY87	35p
E88CC	65p
E180F	95p
EABC80	35p
EAF42	55p
EB91	20p
EBC41	55p
EBC81	30p
EBF80	40p
EBF83	40p
EBF89	32p
EBL21	60p
EC86	60p
EC88	60p
ECC40	60p
ECC84	30p
ECC85	60p
ECC88	40p
ECF80	35p
ECF82	35p
ECF86	65p
ECH21	57p
ECH35	60p
ECH42	70p
ECH81	30p
ECH83	40p
ECL80	40p
ECL82	35p
ECL83	65p
ECL86	40p
EF37A	60p
EF39	40p
EF40	50p
EF41	65p
EF42	70p
EF80	25p
EF85	30p
EF86	35p
EF89	28p
EF91	33p
EF92	40p
EF183	30p
EF184	35p
EH90	40p
EL34	50p
EL33	£1·25
EL41	55p
EL42	58p
EL81	55p
EL84	25p
EL85	43p
EL91	32p
EL95	35p
EM80	40p
EM81	50p
EM84	35p
EM85	£1·00
EM87	43p
EY51	40p
EY86	40p
EY87	42p
EZ40	45p
EZ41	45p
EZ80	25p
EZ81	28p
GZ32	48p
GZ34	60p
KT66	£2·05
KT88	£2·00
MU14	60p
PABC80	40p
PC86	60p
PC88	60p
PC97	45p
PC900	48p
PCC84	40p
PCC85	40p
PCC88	55p
PCC89	50p
PCC189	55p
PCF80	30p
PCF82	34p
PCF84	50p
PCF86	60p
PCF800	80p
PCF801	50p
PCF802	50p
PCF805	75p
PCF806	70p
PCF808	75p
PCL82	35p
PCL83	65p
PCL84	45p
PCL85	40p
PCL86	45p
PFL200	70p
PL36	55p
PL81	50p
PL82	45p
PL83	45p
PL84	40p
PL500	75p
PL504	80p
PY32	55p
PY33	63p
PY80	35p
PY81	30p
PY82	30p
PY83	38p
PY88	40p
PY800	50p
PY801	50p
U25	75p
U26	75p
U50	32p
U52	33p
U191	75p
U281	40p
U282	40p
U301	40p
U801	£1·00
UABC80	35p
UAF42	55p
UBC41	50p
UBC81	40p
UBF80	40p
UBF89	35p
UCC84	49p
UCC85	40p
UCF80	55p
UCH21	60p
UCH42	70p
UCH81	35p
UCL82	35p
UCL83	60p
UF41	60p
UF80	35p
UF85	40p
UF89	35p
UL41	65p
UL84	30p
UY41	45p
UY85	30p
VR105/30	38p
VR150/30	35p

Add 12p in £ for postage

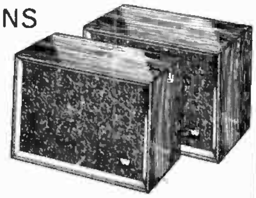
DIODES & RECTIFIERS

1N34A	10p	BA154	12p	GJ7M	37p
1N194	7p	BAX13	12p	OA5	17p
1N916	7p	BAX16	7p	OA6	12p
AA119	7p	BAY31	7p	OA10	22p
AA129	10p	BAY38	17p	OA9	10p
AAZ13	10p	BY100	15p	OA47	7p
AAZ15	12p	BY103	22p	OA70	7p
BA100	15p	BY122	37p	OA73	10p
BA102	22p	BY124	15p	OA79	9p
BA110	32p	BY126	15p	OA81	7p
BA111	27p	BY127	17p	OA85	7p
BA112	70p	BY164	57p	OA90	7p
BA115	7p	BY210	35p	OA91	7p
BA141	32p	BYZ11	32p	OA95	7p
BA142	32p	BYZ12	30p	OA200	7p
BA144	15p	BYZ13	25p	OA202	10p
BA145	20p	BYZ16	40p	OA210	17p

← See previous page ● G. W. SMITH & CO. (RADIO) LTD. ● See opposite page →

SUPER SPEAKER BARGAINS

WHARFEDALE DENTONS



A compact system sold in matched pairs for a perfectly balanced stereo system. Each Denton contains an 8in bass unit with 3in pressure unit, coupled by a Wharfedale crossover network. Rated input: 15 watts maximum. Frequencyresponse: 65–17,000Hz. Impedance: 4/8 ohms. Cabinet 9¾in × 14in × 8¾in. Available in oiled teak finish and are small enough to blend in with most surroundings.

Post 50p

LIST PRICE £39·90 LASKY'S PRICE **£27·00**

WHARFEDALE TRITONS

A new and exciting addition to the Wharfedale range, this three-speaker system will satisfy the most ardent Hi-Fi enthusiast. Shelf or floor standing—hand finished in oiled teak. Frequency response: 55–22,000Hz. C.A.B. Dome pressure unit. Bass unit 8in. Mid-range unit 5in. Treble unit 2in. Impedance: 8 ohms. Size: 21¾in × 9¾in × 9in.

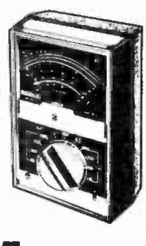
LIST PRICE £59·90

LASKY'S PRICE **£36·00**

Post 50p

EXCLUSIVE TM-1

MODEL TM-1 MINI-TESTER



The first of Lasky's new-look top value meters, the TM-1 is a really tiny pocket multimeter providing "big" meter accuracy and performance. Precision movement calibrated to 3in of full scale. Click stop range selection switch. Beautifully designed and made impact resistant black case with white and metallic red/green figuring. Ohms zero adjustment.

Size Only
3½in × 2¼in × 1¼in

- DC/V: 0–10–50–250–1,000 at 1k OPV
- AC/V: 0–10–50–250–1,000 at 1k OPV
- DC CURRENT: 0–1mA, 100mA
- Resistance: 0–150k
- Decibels: −10dB to 22dB
- Complete with test leads, battery and instructions

LASKY'S PRICE **£1·95** POST 13p

TM-5 5K ohms/V POCKET MULTIMETER

Another new look pocket multimeter from Lasky's providing top quality and value. The "slimline" impact resistant case, size 4¾in × 2¾in × 1¼in, fitted with extra large 2¼in square meter. Readability is superior on all low ranges; making this an excellent instrument for servicing transistorised equipment. Recessed click stop selection switch. Ohms zero adjustment. Buff finish with crystal clear meter cover.

- DC/V: 3–15–150–300–1,200 at 5k OPV
- AC/V: 6–30–300–600 at 2·5k/OPV
- DC Current 0–300μA, 0–300mA
- Resistance: 0–10k/ohms, 0–1M/ohm
- Decibels: −10dB to +16dB
- Complete with test leads, battery and instructions.

LASKY'S PRICE **£2·95** POST 13p

LASKY'S NEW "LOW NOISE" CASSETTES FROM the U.S.A.

Model	Singles	5	10	20
C.60	32p	£1·52	£2·96	£5·60
C.90	50p	£2·37	£4·62	£8·75
C.120	69p	£3·28	£6·38	£10·85

Post Each 5p. 5–20p. 10–25p. 20–50p.

TRIO KA.2002 PACKAGE DEAL TOP VALUE

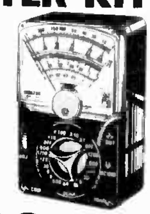
TRIO KA.2002	£39·50
Pair Wharfedale Dentons	£39·90
BSR MP60	£15·20
LASKY BASE & COVER	£4·75
AD76K CARTRIDGE	£4·35
Total list price	£103·70

PACKAGE PRICE £79·50

Carriage in U.K. £2·00

ADD £9 if Wharfedale TRITONS are preferred to Dentons

TMK MODEL 200 METER KIT



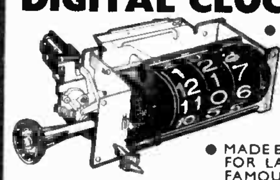
TMK offer the unique opportunity of building a really first-class precision multimeter at a worthwhile saving in cost. The cabinets are supplied with the meter scale and movement mounted in position. The highest quality components and 1% tolerance resistors are used throughout. Supplied complete with full constructional circuit and operating instructions.

Specification
20,000 P.O.V. Multimeter. Features 24 measurement ranges with mirror scale accuracy. DC/V and current: 2%. A.c.:V: 3%. Resistance 3%. Special 0–6V DC range for transistor circuit measurements.

ONLY

LASKY'S PRICE **£4·60** POST 13p

DIGITAL CLOCK SCOOP



- SHOCK AND VIBRATION PROOF
- 12-HOUR ALARM
- AUTO "SLEEP" SWITCH
- HOURS, MINUTES AND SECONDS READ-OFF
- FORWARD AND BACKWARD TIME ADJUSTMENT
- SILENT OPERATION SYNCHRONOUS MOTOR
- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
- MAINS OPERATION
- BUILT-IN ALARM BUZZER

EXCLUSIVELY FROM LASKY'S in chassis form for you to mount in any housing. The clock measures 4¾W × 1¾H × 3¾D (overall from front of drum to back of switch). SPEC.: 210/240V AC, 50Hz operation; switch rating 250V, 3A. Complete with instructions.

HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS

LASKY'S PRICE **£6·50** POST 18p

SPECIAL QUOTATIONS FOR QUANTITIES

TRIO HS.1 HS.2. STEREO HEADPHONE BARGAINS

Models HS.1 and HS.2. Both these sets by TRIO offer really superb stereo reproduction in a lightweight, fully adjustable headset designed for optimum comfort. Listening fatigue is unknown with TRIO headphones. Brief spec. both models: Input imp. 8 nominal (matching 4 to 8): max. input 0·5W: frequency response 20–19kHz: output sensitivity at 1mW input; HS.1 118dB, HS.2 111dB: weight 0·661lbs. Identical in appearance—both models are finished in ivory with contrasting foam-filled ear pads and head band.

HS.1. List Price £8·40. Lasky's Price **£5**

HS.2. List Price £6·75. Lasky's Price **£4**

Post 18p

Lasky's Radio Limited

Branches

207 EDGWARE ROAD, LONDON, W.2 Tel: 01-723 3271

33 TOTTENHAM CT. RD., LONDON, W.1 Tel: 01-636 2605
Open all day, 9 a.m.-6 p.m. Monday to Saturday

152/3 FLEET STREET, LONDON, E.C.4 Tel: 01-353 2833
Open all day Thursday, early closing 1 p.m. Saturday

The Home of High Fidelity

42-45 TOTTENHAM CT. RD., LONDON, W.1 Tel: 01-580 2573
Open all day, 9 a.m.-6 p.m. Monday to Saturday

NEW CITY BRANCH *NOW OPEN*

109 FLEET STREET, LONDON, E.C.4 Tel: 01-353 5812
Open all day Thursday, early closing 1 p.m. Saturday

LASKY'S RADIO LTD. OVER 38 YEARS ESTABLISHED

ALL MAIL ORDERS AND CORRESPONDENCE TO: 3-15 CAVELL ST. TOWER HAMLETS, LONDON, E.1 Tel.: 01-790 4821

Practical Electronics Classified Advertisements

RATES: 7½p per word (minimum 12 words). Box No. 7½p extra. Advertisements must be prepaid and addressed to Classified Advertisement Manager, " Practical Electronics" IPC MAGAZINES LTD., Fleetway House, Farringdon Street, London EC4A 4AD

MISCELLANEOUS

PSYCHEDELIC LUMINOPHONICS

Or is this just another way of referring to FANTASY? Either way, our Projects 24 and 1014 probably come within this category—THINK OF THE FUN YOU WOULD HAVE WITH SOMETHING LIKE THIS AT A PARTY! There are MANY OTHER UNUSUAL PROJECTS TOO—how about an ELECTRONIC STETHOSCOPE for LISTENING THROUGH WALLS, etc., or a TRANSMITTER/RECEIVER that doesn't use RF, SO LICENCE WORRIES ARE OVER! Then there's another project for a "LEARNING" MACHINE—imagine one of these in YOUR BACKROOM; YOUR FRIENDS WOULD BE AMAZED! If REALLY UNUSUAL projects interest you, then WE'VE GOT WHAT YOU WANT. In a few days from now YOU COULD BE IN THE "SCIENCE-FICTION" WORLD OF "BOFFIN"!

DON'T PUT IT OFF! SEND 15p for your list—NOW

BOFFIN PROJECTS
4 CUNLIFFE RD., STONELEIGH, EWELL, SURREY
Designs by GERRY BROWN and JOHN SALMON and presented on TV

SYNTHESISER MODULES

Send S.A.E. for details of voltage-controlled modules for synthesiser construction to:

D.E.W. Ltd.
254 Ringwood Road, Ferndown, Dorset

TOP MANUFACTURERS' PRODUCTS AT TRADE PRICES ! ! !

ADCOLA SOLDERING IRONS AND ACCESSORIES: 60/40 SOLDER
ELECTROSIL RESISTORS: TR4, TR5, TR6, TR8, C5
T.M.C. RELAYS, PUSH BUTTON KEYS AND LEVER KEYS
B.I.C.C. P.V.C. EQUIPMENT WIRE—ALL COLOURS

Send large s.a.e. for price lists

SPEEDY COMPONENTS SUPPLY LTD.
High Street · Handcross
Haywards Heath · Sussex RH17 6BW
Handcross 671/2
CALLERS WELCOME

TOP TRANSISTORS

Brand New and Individually Tested Transistors supplied unmarked, but packed separately for indentification and guaranteed to be within their correct specification or money refunded. All at 9p. each or

Any 25 transistors for only £1·90

ACY22	BFY51	OC72	2N3702
BC108	BFY52	OC202	2N3703
BC109	BSY27	ZTX300	2N3705
BC168	OC45	2N706	2N3706
BC169	OC71	2N2926	2N3708

Money back guarantee. P. & P. 10p.

J. M. KING (P)
17 Buckridge, Portpool Lane, London, E.C.1

RECORD T.V. SOUND using our loudspeaker isolating transformer. Provides safe connection to recorder. Instructions included, **70p** + 10p P. & P. CROWBOROUGH ELECTRONICS (P.E.), Eridge Road, Crowborough, Sussex.

MISCELLANEOUS *(continued)*

12 VOLT FLUORESCENT LIGHTS

Beat Power Cuts, 12 ins 8 watt Tube, ideal for Caravan, Tent, Emergency Lighting, etc. Fully Transistorised, Low Battery Drain. With ON/OFF Switch and 12V Socket to run other Lights or 12V Equipment.

Unbeatable at **£3·30**
or in kit form **£2·90** post paid

SALOP ELECTRONICS
23 Wyle Cop
Shrewsbury, Shropshire

Callers welcome
S.A.E. for lists

NEW! VHF AIRCRAFT BAND CONVERTER

Today's skies are full of exciting crosstalk as aircraft from giant jets to small private planes jostle to take off and land. Now you can eavesdrop on their tense conversation with this remarkable **ready-to-use, fully-transist. batt. converter.** Place it 1" away from any std. medium-wave radio (even tiny portable!) **for crystal-clear reception on aircraft communications. Money back guarantee.**

ONLY **£3·60** +15p P&P

MARKTYME (MAIL ORDER) LTD
Dept. PE4
Willesden Lane
London, N.W.6
01-624 4633

DO-IT-YOURSELF . . . . we stock a large range of audio and electronic components at very competitive prices, e.g.: Chassis speakers, cross-over networks, hi-fi speaker kits, (Wharfedale and Peerless), BAF sound absorbent, speaker grille fabrics, inductors, resistors, electrolytics (reversible and polarised), transistors, etc. Send for FREE list. (2 × 3p stamps for fabric samples). Mail order ONLY. No callers please.

AUDIOSCAN
Dept. P.E.11
4, PRINCES SQUARE, HARROGATE, YORKS.

NO NEED TO WORRY ABOUT A TRANSMITTING LICENCE

because this GPO approved transmitter/receiver kit does not use R.F. and you can get one easily. Your transmissions will be virtually SECRET since they won't be heard by conventional means. Actually it's TWO KITS IN ONE because you get all the printed-circuit boards and components for both the transmitter AND receiver. You're going to find this project REALLY FUN-TO-BUILD with the EASY-TO-FOLLOW instructions. An extremely flexible design with quite an AMAZING RANGE—has obvious applications for SCHOOL PROJECTS, LANGUAGE LABORATORIES, SCOUT CAMPS, etc.

GET YOURS ! SEND £5·20 NOW

TO: 'BOFFIN PROJECTS'
DEPT. KE2010
4 CUNLIFFE ROAD
STONELEIGH, EWELL, SURREY

MISCELLANEOUS *(continued)*

LIGHTWEIGHT TREASURE-PROBE

Look for BURIED COINS, silver, gold and metal relics PROFESSIONALLY with the BOFFIN solid-state TREASURE-PROBE. An extremely EASY-TO-BUILD Kit that REALLY *DOES* WORK! SIMPLE-TO-FOLLOW INSTRUCTIONS. It comes to your doorstep with maximum copper PRINTED-CIRCUIT BOARD plus ALL ELECTRONIC COMPONENTS including search-coil and ear-phone. Think of the fun you'll have BEACH-COMBING with the sensitive TREASURE-PROBE, and the expectancy of hearing its LOUD 'BEEP' tell you " YOU'RE ON TO SOMETHING".

GET YOUR TREASURE-PROBE!
SEND £6·95 NOW!

BOFFIN PROJECTS
4 CUNLIFFE ROAD, STONELEIGH
EWELL, SURREY
Designed by GERRY BROWN and JOHN SALMON and presented on TV

PROFESSIONAL CONTROL PANELS *with* FASCIA KIT

MAKE YOUR OWN PANELS IN PERMANENT, ANODISED, SELF-ADHESIVE ALUMINIUM. NO SPECIAL EQUIPMENT NEEDED. EASY TO FOLLOW INSTRUCTIONS. CHOICE OF SILVER ON BLACK, RED, BLUE, GREEN.

TRIAL KIT £1·28 Carr. Paid
No. 1 KIT £1·88 Carr. Paid
No. 2 KIT £2·39 Carr. Paid

M.P.E. Ltd., BRIDGE ST., CLAY CROSS, DERBYS.

BUILD IT in a DEWBOX quality cabinet 2in × 2½in × any length. DEW LTD., Ringwood Road, Ferndown, Dorset. S.A.E. for leaflet. Write now—right now.

AARVAK ELECTRONICS. 3-channel sound-light converters, **£17.** Strobes, **£16.** Rainbow Strobes, **£96.** 74 Bedford Avenue, Barnet, Herts. 01-449 1268.

HARDWARE FOR CONSTRUCTORS. Screws, nuts, brackets, spacers, etc. S.A.E. list. R. A. MARSH, 29 Shelbourne Road, Stratford-on-Avon, Warwicks.

CLEARING LABORATORY, scopes, V.T.V.M's, V.O.M's, H.S. recorders, transcription turntables, electronic testmeters, calibration units, P.S.U.'s, pulse generators, D.C. null-potentiometers, bridges, spectrum analysers, voltage regulators, sig-gens, M/C relays, components, etc. Lower Beeding 236.

JOHN SAYS . . .

RING MODULATOR by Dewtron is professional, transformerless, 5-transistor, has adjustable F1/F2 rejection. Module **£7.** Unit **£8·90. WAA-WAA** Pedal kit of all parts, including all mechanics and instructions ONLY **£2·45. AUTO RHYTHM** from Dewtron modules. Simple unit for waltz, fox-trot, etc. Costs **£16·55** in modules. **SYNTHESISER MODULES** and other miracles! Send 15p for illustrated list. **D.E.W. LTD., 254 Ringwood Road, Ferndown, Dorset**

FASCIA PANELS, hi-fi equipment, etc., etched aluminium to individual specifications, S.A.E. details. R. MARSH, 29 Shelbourne Road, Stratford on Avon, Warwicks.

OFFERS INVITED. Practical Electronics, back issues July 1965–November 1968. 42 Abbott Road, Alfreton, Derbys.

RECEIVERS AND COMPONENTS

RECEIVERS AND COMPONENTS *(continued)*

RECEIVERS AND COMPONENTS *(continued)*

RECEIVERS AND COMPONENTS

(continued)

CHROMASONIC electronics

supply only brand new guaranteed goods

LOW NOISE HI-STABS

¼ watt 5% all E24 values 3 for **2p** plus p. & p. **6p.** for up to 50 resistors + **1p** for each additional 50.

INTEGRATED CIRCUITS

PA234	**87p**	MFC4000P	**70p**	μA709C	**50p**
PA237	**£1·57**	MFC4010P	**75p**	μA710	**50p**
PA246	**£1·60**	TAA700	**£2**	μA741C	**75p**

TRANSISTORS & DIODES

AC187/88	**30p**	BC147	**15p**	2N3708/9/10/11	**12p**
AD161 }	**63p**	BC148	**12p**	2N3055	**70p**
AD162 }	pair	BC149	**15p**	2N2926 O/Y	**15p**
BC107	**12p**	2N3702/3	**12p**	2N1711	**25p**
BC108	**11p**	2N3704	**17p**	OA81/90/91	**7p**
BC109	**12p**	2N3705/6/7	**15p**	BZY88	**15p**

F.M. STEREO I.F. STRIP **£3·50** + p. & p. 25p
F.M. FRONT END **£5·00** + p. & p. 25p
F.M. STEREO DECODER **£5·25** + p. & p. 25p

100μF 16V 4p each

Mullard C431 series capacitors:
500μF 40V **28p** 2000μF 25V **42p** 4000μF 25V **63p**
1250μF 25V **36p** 2500μF 40V **63p** 4000μF 40V **77p**
1250μF 40V **42p** 2500μF 64V **77p** also
C426 (**6p**), C437, C280, C333, S. MICA & polystyrene

CARBON TRACK POTS, Single gang Log or Lin **12p** Dual gang Log or Lin **40p**, Mains Sw. **12p** extra. SKELETON PRESETS, Vert. or Horiz. 0·1W **5p.** 0·25W **7p.** Mains Transformer Sec. 250V 25mA + 6·3V 1·2A **£1·90.**

FREE CATALOGUE p. & p. 3p

P. & P. on all orders other than resistors 6p.
56 FORTIS GREEN ROAD, LONDON N10 3HN

COMPUTER PANELS. 5-BC108 diodes, **15p**, post 5p, **4—50p**, post 10p. **AMERICAN PANELS** total at least 30 transistors, first-grade components, details provided, **3—55p**, post 10p. **ASSORTED PANELS 6—£1**, post 15p, no midget boards, plenty of components at least 60 transistors. List of boards sent on receipt of S.A.E. **LA2 POT CORES**, 20 in all box with 20 1% capacitors. **£1·50**, post 27p. Singles **18p** c.p. New and boxed **30p** c.p. **COMPUTER RELAYS DPDT**, 700 ohm coil, weigh ¼oz, carry 2 amp, **60p** c.p. Same weigh 1½oz silver-contacts, **35p** c.p. **ORP12** on panel ex equipt. **35p** c.p. **WIRE ENDED NEONS** bank of 20, **50p**, post 7p. **COPPER CLAD PAXOLIN** single sided, 8 × 5, **10p**, post 5p each. 10½ × 8, **20p**, 13 × 11½, **30p**, post 8p each. **RESETTABLE COUNTER** 5 Figure 18/22V. **£1·75**, post 10p. **POWER TRANSISTOR** BD112. NPN Silicon 15W, 3A 80V, **40p** c.p.
ELECTROLYTICS 5,000 MFD 25V, **40p** c.p.
POLYSTYRENE CAPACITORS 125V, 150, 180, 220, 330, 390, 560, 680, 820, 1,200, 1,500, 1,800, 2,200, 2,700, 3,300, 3,900, 5,600, 6,800, 8,200, 0·01, 0·012, 0·015, **15p** dozen, post 10p.
ASSORTED COMPONENTS. 7lb, **£1·25** c.p.
ASSORTED COMPUTER PANELS. 2lb, **£1·25** c.p.

J.W.B. RADIO
75 HAYFIELD ROAD, SALFORD 6, LANCS.
MAIL ORDER ONLY

PRINTED CIRCUIT BOARDS for P.E. PROJECTS

All boards drilled and roller tinned complete with layout drawing.

EXAMPLES

Marine Tachometer (May 1970) **25p** ea. Musical Stave (May 1970) **40p** ea.
Waa-Waa pedal Vol. 4 No. 7 **14p** ea. Audio Sig. Gen. (Sine and Square on one board) Vol. 5 No. 10 **42½p** ea.
S.A.E. for List. Now available from:- HENRY'S RADIO LTD., Edgware Road, London, W.2
P.H. ELECTRONICS, Industrial Estate, Sandwich, Kent. Tel. 2517

NEW THIS MONTH

MULTI-PURPOSE PRINTED WIRING BOARD

NIPPIBOARD

Type 'A' for making amplifiers, car gadgets, electronic music circuits, alarms, oscillators, in fact almost any electronic circuit using up to four transistors. NIPPIBOARD is a new design with grid references for quick component location and costs only **15p** (plus **4p** postage and packing). CASH WITH ORDER ONLY. IDEAL FOR SCHOOL PROJECTS.
SPECIAL OFFER (closes November 30, 1971) TWO NIPPIBOARDS for **25p**; FOUR for **40p** (add **5p** p. and p.). Trade enquiries welcome.
NEW SL403D short circuit proof 3W amplifier **£1·99** plus 9p postage and packing. C.W.O

Dept. NB/E11, NIP Electronics
P.O. Box 11, St. Albans, Herts.

5kΩ P.C. POTS, 3p; 100 solder tags, **12½p;** ZTX300, **3p.** Lists S.A.E. 1 Newton Street, Ulverston, Lancs.

C-CORE TRANSFORMER KITS

Consisting of:—

CLAMPS, WINDING BOBBIN, TWO C-CORES AND BANDS

Rating	Price	P. & P.
5 VA	**35p**	5p
10 VA	**40p**	10p
15 VA	**50p**	15p
25 VA	**60p**	20p
50 VA	**90p**	25p
100 VA	**£1·50**	35p
500 VA	**£2**	40p

Transformers made to specification.

Inquiries invited for other sizes, also toroids, E-cores, transformers for other frequencies, and enamelled copper wire.

Design advice given F.o.C.

Supplied by:—
Trankit Electrical
192 Silvertonhill Avenue
Hamilton ML3 7PF

DRY REED INSERTS

Overall length 1.85" (Body length 1.1"), Diameter 0.14" to switch up to 500 mA at up to 250v D.C. Gold clad contacts. **62½p** per doz.; **£3·75** per 100; **£27·50** per 1,000; **£250** per 10,000. All carriage paid.

G.W.M. RADIO LTD.
40/42 Portland Road, Worthing, Sussex 0903 34897

MICROCIRCUITS
SN76013 (like IC12) **£1·50**; 709 **36p**; 741 **36p**; PA230 **91p**; PA234 **86p**; PA237 **£1·55**; SL402A **£1·75**; SL702C **40p**; TTL GATES **19p**; FLIPFLOPS **42p.**
TRANSISTORS
2N3055 **54p**; BC107B **9p**; BC108C **9p**; BC109C **9p**; BCY70 **16p**; BFX86 **15p**; ME0402 **21p**; ME0411 **20p**; ME0412 **20p**; ME0413 **15p**; ME1002 **11p**; ME4101 **11p**; ME4102 **12p**; ME6101 **15p**; ME6102 **19p**; ME8001 **17p**; MP8111 **35p**; MP8112 **45p.**
1 AMP RECTIFIERS
50V **3p**; 100V **4p**; 200V **5p**; 400V **6p**; Bridges: 50V **30p**; 100V **31p**; 400V **33p.**
3 AMP RECTIFIERS: 400V **12p.**
PRINTED CIRCUIT RESIST PEN 80p.

JEF ELECTRONICS (PE11)
York House, 12 York Drive, Grappenhall
Warrington

Mail Order Only. C.W.O. P. & P. 7p per order. Overseas 50p. Money back if not satisfied. List free on application.

P. E. AURORA. Complete sets of electronic components for assembly on Vero board. We also have specially designed printed circuit cards for a combined controller/filter system readily available. (S.A.E. for lists).

OPTELMEC LTD.
1, 2 & 3 Nelson Works
Back Road, SIDCUP, Kent

BRAND NEW COMPONENTS BY RETURN. Electrolytics 15 or 25V 1, 2, 5, 10 mfds—**3½p**, 25, 50—**4p.** 100—**5p.** Mylar Film 100V, 0·001, 0·002, 0·005, 0·01, 0·02—**2p**; 0·04. 0·05—**2½p**; 0·068, 0·1—**3p.** Mullard miniature carbon film resistors third watt E.12 series 1Ω–10MΩ, 8 for **5p**, insured postage **8p.** The C.R. SUPPLY CO., 127 Chesterfield Rd., Sheffield, S8 0RN.

COMPONENTS. Carbon film resistors (E24) range 0·5 watt 5% at **1½p** each. Mullard C426 series Electrolytic Capacitors, 10/16, 20/16, 40/16, 80/16, 125/16, all at **6p** each. Minimum order **5p** plus 10%. P. P. FREEMANTLE, 18 Pennine Road, Southampton.

LADDERS

VARNISHED TIMBER LADDERS from manufacturer, LOWEST PRICES anywhere: 15½ft ext., **£6·20**; 17ft extd., **£6·50**; 20ft extd., **£7**; 21½ft extd., **£7·75**; 24½ft extd., **£8·90**; 29ft extd., **£10·25**; 31½ft triple extd., **£12·25**; 36ft. triple extd., **£16.** Carr. 80p. Free Lists. Also Aluminium Ext. and Loft Ladders. Callers welcome. Dept. PEE, HOME SALES, Baldwin Road, Stourport, Worcs. Phone: 02-993 2574. Placing order on C.O.D.

Arbour Electronics Limited
Manufacturing Contractors

15 WATT AMPLIFIER

- ★ 15W R.M.S. into 15 ohms load
- ★ 20 to 20 KHz
- ★ Input 312 Mv
- ★ 50V DC power
- ★ All Silicon Transistors
- ★ Distortion less than 0·1%
- ★ With output capacitor
- ★ Wired and tested

£6·90
POST FREE U.K.

Power supply for one or two amps **£5·40**

Full details of matching pre-amp for use as a Hi-Fi Stereo amplifier supplied on request.

10-14 HALL RD., HEYBRIDGE
MALDON, ESSEX TEL.: MAL 4755

TELERADIO SPECIAL PRODUCTS

How to build a Digital radio control System.
2-5 Channels **75p** 2 Channel **50p**
How to build a Digital Clock **65p**
How to build a Mullard Stereo Pre-Amplifier **50p**
How to build a W/World (Linsley-Hood) Hi-Fi Amp. **75p** Also Texas & Bailey Hi-Fi amplifiers
LISTS FREE SEND S.A.E.

TELERADIO ELECTRONICS
325-7 Lower Fore Street, Edmonton London, N.9 01-807 3719

BATTERY ELIMINATORS

The ideal way of running your TRANSISTOR RADIO, RECORD PLAYER, TAPE RECORDER, AMPLIFIER, etc. Types available: 6v, 9v, 12v, 18v (single output) £2 each. P. & P. 15p. 9v + 9v; 6v + 6v; or 4½v + 4½v (two separate outputs) **£2.50** each. P. & P. 15p. Please state output required. All the above units are completely isolated from mains by double wound transformer ensuring 100% safety.

R.C.S. PRODUCTS (RADIO) LTD.
(Dept. P.E.), 31 Oliver Road, London, E.17

If you have difficulty in obtaining

PRACTICAL ELECTRONICS

Please place a regular order with your newsagent or send 1 year's subscription (£2·65) to Subscription Department, Practical Electronics, Fleetway House, Farringdon Street, London, E.C.4.

RST

VALVE MAIL ORDER CO.

BLACKWOOD HALL
16a WELLFIELD ROAD, LONDON SW16 2BS
SPECIAL EXPRESS MAIL ORDER SERVICE

Express postage 1p per transistor, over ten post free

	£p		£p		£p		£p		£p
1N21	0·17	AC127	0·25	BF173	0·30	GJ4M	0·38	OC43	0·40
1N23	0·20	AC128	0·20	BF181	0·35	GJ5M	0·25	OC44	0·17
1N85	0·88	AC187	0·25	BF184	0·20	GJ7M	0·37	OC44M	0·17
1N253	0·50	AC188	0·25	BF185	0·20	HG1005	0·50	OC45	0·12
1N256	0·50	ACY17	0·30	BF194	0·17	HS100A	0·20	OC45M	0·18
1N645	0·25	ACY18	0·25	BF195	0·15	MAT100	0·25	OC46	0·27
1N725A	0·20	ACY19	0·25	BF196	0·15	MAT101	0·30	OC57	0·60
1N914	0·07	ACY20	0·20	BF197	0·15	MAT120	0·25	OC58	0·60
1N4007	0·20	ACY21	0·20	BFS61	0·28	MAT121	0·30	OC59	0·65
1S021	0·20	ACY22	0·10	BFS98	0·28	MJE520	0·87	OC66	0·50
1S113	0·15	ACY27	0·25	BFX12	0·20	MJE2955	1·37	OC70	0·12
1S130	0·13	ACY28	0·17	BFX13	0·25	MJE3055	0·87	OC71	0·12
1S131	0·13	ACY39	0·50	BFX29	0·25	NKT128	0·35	OC72	0·20
1S202	0·23	ACY40	0·15	BFX30	0·25	NKT129	0·30	OC73	0·30
2G240	1·98	ACY41	0·15	BFX35	0·98	NKT211	0·25	OC74	0·30
2G301	0·20	ACY44	0·25	BFX63	0·50	NKT213	0·25	OC75	0·25
2G302	0·22	AD140	0·50	BFX84	0·25	NKT214	0·15	OC76	0·25
2G306	0·30	AD149	0·50	BFX85	0·25	NKT216	0·37	OC77	0·40
2G371	0·22	AD161	0·37	BFX86	0·25	NKT217	0·35	OC78	0·20
2G381	0·25	AD162	0·37	BFX87	0·20	NKT218	0·40	OC79	0·22
2G414	0·30	AF106	0·30	BFX88	0·25	NKT219	0·33	OC81	0·20
2G417	0·22	AF114	0·25	BFY10	1·00	NKT222	0·20	OC81D	0·20
2N214	0·43	AF115	0·25	BFY11	1·25	NKT224	0·22	OC81M	0·20
2N247	0·25	AF116	0·25	BFY17	0·25	NKT251	0·24	OC81DM	0·18
2N250	0·50	AF117	0·25	BYF18	0·25	NKT271	0·25	OC81Z	0·40
2N404	0·20	AF118	0·62	BFY19	0·25	NKT272	0·25	OC82	0·25
2N697	0·15	AF119	0·20	BFY24	0·45	NKT273	0·15	OC82D	0·20
2N698	0·40	AF124	0·25	BFY44	1·00	NKT274	0·20	OC83	0·25
2N706	0·10	AF125	0·20	BFY50	0·22	NKT275	0·25	OC84	0·25
2N706A	0·12	AF126	0·17	BFY51	0·20	NKT277	0·20	OC114	0·38
2N708	0·15	AF127	0·17	BFY52	0·22	NKT278	0·25	OC122	0·60
2N709	0·63	AF139	0·30	BFY53	0·17	NKT301	0·40	OC123	0·65
2N711	0·37	AF178	0·55	BFY64	0·42	NKT304	0·75	OC139	0·25
2N987	0·53	AF179	0·45	BFY90	0·65	NKT403	0·75	OC140	0·35
2N1090	0·30	AF180	0·52	BSX27	0·50	NKT404	0·55	OC141	0·60
2N1091	0·32	AF181	0·42	BSX60	0·93	NKT678	0·30	OC169	0·20
2N1131	0·25	AF186	0·40	BSX76	0·15	NKT713	0·25	OC170	0·25
2N1132	0·25	AFY19	1·13	BSY26	0·16	NKT773	0·25	OC171	0·30
2N1302	0·18	AFZ11	0·60	BSY27	0·17	NKT777	0·38	OC200	0·40
2N1303	0·23	AFZ12	1·00	BSY51	0·50	O78B	0·38	OC201	0·70
2N1304	0·25	ASY26	0·25	BSY95A	0·12	OA5	0·20	OC202	0·80
2N1305	0·22	ASY27	0·32	BSY95	0·12	OA6	0·12	OC203	0·40
2N1306	0·25	ASY28	0·25	BT102/500R		OA47	0·10	OC204	0·40
2N1307	0·25	ASY29	0·30		0·75	OA70	0·10	OC205	0·75
2N1308	0·25	ASY36	0·25	BTY42	0·92	OA71	0·10	OC206	0·90
2N1309	0·25	ASY50	0·17	BTY79/100R		OA73	0·10	OC207	0·90
2N1420	0·93	ASY51	0·40		0·75	OA74	0·10	OC460	0·20
2N1507	0·28	ASY53	0·20	BTY79/400R		OA79	0·10	OC470	0·30
2N1526	0·38	ASY55	0·20		1·25	OA81	0·08	OCP71	0·97
2N1909	2·25	ASY62	0·25	BY100	0·15	OA85	0·12	ORP12	0·50
2N2147	0·75	ASY86	0·33	BY126	0·15	OA86	0·15	ORP60	0·40
2N2148	0·60	ASZ21	0·42	BY127	0·17	OA90	0·08	ORP61	0·42
2N2160	0·60	ASZ23	0·75	BY182	0·65	OA91	0·07	S19T	0·30
2N2218	0·20	AUY10	0·98	BY213	0·25	OA95	0·07	SAC40	0·25
2N2219	0·20	AU101	1·50	BYZ10	0·35	OA200	0·07	SFT308	0·38
2N2287	1·08	BC107	0·10	BYZ11	0·32	OA202	0·10	ST722	0·38
2N2297	0·20	BC108	0·10	BYZ12	0·30	OA210	0·25	ST7231	0·63
2N2369A	0·15	BC109	0·10	BYZ13	0·25	OA211	0·30	SX68	0·20
2N2613	0·28	BC113	0·15	BYZ15	1·00	OAZ200	0·55	SX631	0·30
2N2646	0·45	BC115	0·20	BYZ16	0·62	OAZ201	0·50	SX635	0·40
2N2712	0·25	BC116	0·25	BYZ88C3V3		OAZ202	0·40	SX640	0·50
2N2784	0·50	BC116A	0·30		0·15	OAZ203	0·42	SX641	0·55
2N2846	0·75	BC118	0·25	C111	0·65	OAZ204	0·30	SX642	0·60
2N2848	0·42	BC121	0·20	CRS1/05	0·25	OAZ205	0·42	SX644	0·75
2N2904	0·20	BC122	0·20	CRS1/40	0·17	OAZ206	0·42	SX645	0·75
2N2904A	0·33	BC125	0·68	CS4B	2·50	OAZ207	0·47	V15/30P	0·50
2N2906	0·20	BC126	0·65	CS10B	3·13	OAZ208	0·32	V30/201P	0·75
2N2907	0·23	BC140	0·55	DD000	0·15	OAZ209	0·33	V60/201	0·75
2N2924	0·23	BC147	0·15	DD003	0·15	OAZ210	0·32	V60/201P	0·38
2N2925	0·15	BC148	0·12	DD006	0·18	OAZ211	0·32	XA101	0·10
2N2926	0·10	BC149	0·20	DD007	0·40	OAZ222	0·45	XA102	0·18
2N3054	0·50	BC157	0·15	DD008	0·38	OAZ223	0·45	XA151	0·15
2N3055	0·75	BC158	0·12	GD3	0·33	OAZ224	0·45	XA152	0·15
2N3702	0·10	BC160	0·63	GD4	0·05	OAZ241	0·22	XA161	0·25
2N3705	0·10	BC169	0·12	GD5	0·33	OAZ242	0·23	XA162	0·25
2N3706	0·23	BCY31	0·30	GD8	0·25	OAZ244	0·23	XB101	0·43
2N3707	0·12	BCY32	0·55	GD12	0·05	OAZ246	0·23	XB102	0·10
2N3709	0·13	BCY33	0·25	GET102	0·30	OAZ290	0·38	XB103	0·25
2N3710	0·13	BCY34	0·30	GET103	0·22	OC16	0·50	XB113	0·12
2N3711	0·10	BCY38	0·40	GET113	0·20	OC16T	0·38	XB121	0·43
2N3819	0·35	BCY39	1·00	GET114	0·15	OC19	0·37	ZR24	0·63
2N3820	0·60	BCY40	0·50	GET115	0·45	OC20	0·98	ZS170	0·10
2N3823	0·75	BCY42	0·25	GET116	0·50	OC22	0·50	ZS271	0·18
2N5027	0·53	BCY70	0·15	GET120	0·25	OC23	0·60	ZT21	0·25
2N5088	0·33	BCY71	0·20	GET872	0·30	OC24	0·60	ZT43	0·25
2S005	1·00	BCZ10	0·35	GET875	0·25	OC25	0·37	ZTX107	0·15
2S301	0·50	BCZ11	0·50	GET880	0·37	OC26	0·25	ZTX108	0·12
2S304	0·75	BD121	0·65	GET881	0·25	OC28	0·60	ZTX300	0·12
2S501	0·32	BD123	0·80	GET882	0·25	OC29	0·60	ZTX304	0·25
2S703	0·62	BD124	0·75	GET885	0·25	OC30	0·40	ZTX500	0·16
AA129	0·20	BDY11	1·62	GEX44	0·08	OC35	0·50	ZTX503	0·17
AAZ12	0·30	BF115	0·25	GEX45/1	0·07	OC36	0·60	ZTX531	0·25
AAZ13	0·12	BF117	0·50	GEX941	0·15	OC41	0·25		
AC107	0·37	BF167	0·25	GJ3M	0·25	OC42	0·30		
AC126	0·20								

SEMI-CONDUCTOR SET FOR
P. E. GEMINI AMPLIFIER £12·95

SEND S.A.E. FOR LIST OF 3,000 TYPES
VALVES, TUBES AND TRANSISTORS

Open daily to callers: Mon.-Sat. 9 a.m.-5 p.m.
Closed Sat. 1.30 p.m.-2.30 p.m.

Terms C.W.O. only | Tel. 01-769 0199/1649

THE LATEST AND THE GREATEST TO DATE...

NEW PRACTICAL MOTORIST ANNUAL 1972

128-page guide to car maintenance, A to Z of motoring terms, fault finding, overhaul, improvements, renovation/preservation, electrics, leisure, accessories, data sheets and handy hints in an attractive four-colour cover!
Be sure to get your copy as soon as possible.

ON SALE WEDNESDAY, 20th October, PRICE 25p

P.E. GEMINI

Pre-amplifier P.C.B.	£1·95
Main Amplifier P.C.B.	£1·45
Power Supply P.C.B.	60p
Pre-amplifier Semiconductors	£1·75
Main Amplifier Semiconductors	£7·25
Power Supply Semiconductors	£2·50
Packing and Postage on all orders	15p

All Semiconductors available separately. *S.A.E. for list*

DAVIAN ELECTRONICS
P.O. BOX 38 OLDHAM LANCS

BAKER 15in. AUDITORIUM

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home.

Maximum Power	35 watts
Bass Resonance	35 c.p.s.
Flux Density	15,000 gauss
Voice coil impedance	8 or 15 ohms models
Useful response	20-14,000 c.p.s.
Nett weight	15 lbs.

£19 POST FREE

GUITAR MODEL "GROUP 50" 50 watt £19
Latest catalogue 5p with enclosure plans

Baker Reproducers Ltd
Bensham Manor Road Passage, Thornton Heath, Surrey. 01-684-1665

Published approximately on the 15th of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd.; Rhodesia and Zambia—Kingstons Ltd.; East Africa—Stationery and Office Supplies Ltd. Subscription Rate (including postage): For one year to any part of the world £2·65 (£2.13.0.).
Practical Electronics is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.