

PRACTICAL

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NOVEMBER 1971

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### ADCOLA L.646

for Factory Bench Line Assembly

A precision instrument—supplied with standard 3/16" (4.75 mm) diameter, detachable copper chisel-face bit\*. Standard temp. 360°C at 23 watts. Special temps. from 250°C—410°C.

PRICE  
**£1.85**

#### \*Additional Stock Bits (illustrated) available

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- B 38**  $\frac{1}{8}$ " — 3.2 mm CHISEL FACE
- B 14**  $\frac{3}{16}$ " — 2.4 mm CHISEL FACE
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- B 42 LL**  $\frac{1}{4}$ " — 4.75 mm CHISEL FACE
- B 38 LL**  $\frac{1}{8}$ " — 3.2 mm CHISEL FACE
- B 14 LL**  $\frac{3}{16}$ " — 2.4 mm CHISEL FACE
- B 44 LL**  $\frac{1}{4}$ " — 4.75 mm SCREWDRIVER FACE



Don't take chances. We don't. All our ADCOLA Soldering Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get consistent good service... reliability... from our famous thermally controlled ADCOLA Element and the tough steel construction of this ideal production tool.

\* Write for price list and catalogue



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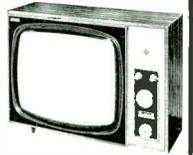
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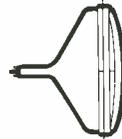


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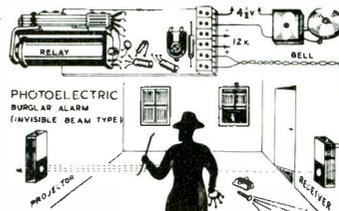
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PHOTOELECTRIC KIT  
£2.60

Postage and Pack. 15p (U.K.)  
Commonwealth:  
SURFACE MAIL 25p  
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Australia, New Zealand,  
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Also Essential Data Circuits  
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10 Advanced Designs

### INVISIBLE BEAM OPTICAL KIT

Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photo-cell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.

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CONTENTS: As above. Twice the range of standard kit. Larger Lenses, Filter, etc. Price £1.85. Postage and Pack. 15p (U.K.). Commonwealth: Surface Mail 20p; Air Mail £1.15.

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CONTENTS: Infra-Red Sensitive Phototransistor, 3 Transistors, Chassis, Plastic Case, Resistors, Screws, etc. Full Size Plans, Instructions, Data Sheet "10 Advanced Photoelectric Designs". Price £1.25. Postage and Pack. 10p (U.K.). Commonwealth 20p; Airmail 50p.

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CONTENTS: 2 Lenses, Infra-red Filter, Lampholder, Bracket, Plans, etc. Everything (except plywood) to build 1 miniature invisible beam projector and photo-cell receiver for use with Junior Photoelectric Kit.

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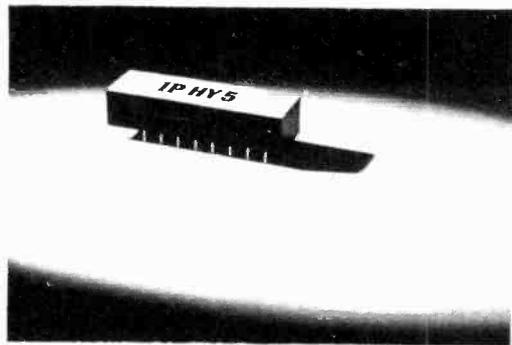
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# I.L.P. (Electronics) Ltd



## HY40 IS POWER AMP PERFECTION

Lets face it — an immediate success, the HY40 is here to stay.

HY40 means Hybrid Power, power neatly locked away inside an Integrated Circuit. Power the modern way, simply mount only five additional components on a printed circuit board (all of which are supplied with the HY40). Power not only for Hi-Fi, power for Groups, for public address, for industry, power for all.

### HY40 is HI-FI POWER ILP are POWER PROUD

In addition to the P.C. board and manual supplied with the HY40 we now include the five remaining components, at minimal cost, needed to complete the assembly of a High Performance Power Amplifier.

By merely combining two HY40s with a Stereo Preamplifier (2 x HY5) and simple Power Supply (PSU45), premium quality stereo may be obtained for a very modest outlay.

The free manual supplied with the HY40 gives clear, easy build instructions for Power Supply; volume, bass, treble and balance controls, together with inputs for Ceramic and Magnetic Pick-ups, Tape, Tuner and Auxiliary functions.

Internally the HY40 is based on conventional and proven circuit techniques developed over recent years.



**OUTPUT POWER** British Rating 40 WATTS PEAK, 20 watts RMS continuous.

**LOAD IMPEDANCE** 4—16 ohms

**INPUT IMPEDANCE** 22Kohms at 1KHz.

**INPUT SENSITIVITY** 300 mV for maximum output.

**VOLTAGE GAIN** 30db at 1KHz.

**FREQUENCY RESPONSE** 5Hz-60KHz  $\pm$  1db.

**TOTAL DISTORTION** less than 1% (typical 0.1%) at all output powers.

**SUPPLY VOLTAGE**  $\pm$  22.5 volts D.C.

**SUPPLY CURRENT** 0.8 amps maximum.

**PRICE:** including comprehensive manual, P.C. Board and FIVE EXTRA COMPONENTS:

MONO £4.40 STEREO £8.80 all post free.

### A WORLDS FIRST TO JOIN THE WORLDS BEST

The HY5 is a unique and revolutionary concept in High-Fidelity pre-amplifiers. Thanks to the latest techniques, all feedback and equalization networks are, for the first time, combined into an integrated pre-amplifier circuit.

Simply by adding volume, treble, bass potentiometers and only three stabilizing capacitors, which are supplied, your HY5 is complete and ready for use.

The HY5 provides equalization for almost every conceivable input. This years developments in equalization technique enables precise correction for both output voltage and frequency response for any crystal or ceramic cartridge. Yet another feature of the HY5 is its inbuilt stabilization circuit, allowing it to be run off any unregulated power amplifier supply.

The HY5 contains a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo preamplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY40 and PSU45 forms a completely integrated system.

#### INPUTS

Magnetic Pick-up (within  $\pm$ 1db RIAA curve) 2mV.  
Tape Replay (external components to suit head). 4mV.  
Microphone (flat) 10mV.  
Ceramic Pick-up (equalized and compensatable) 20—2000mV variable.  
Tuner (flat) 250mV.  
Auxiliary 1 250mV.  
Auxiliary 2 2—20mV.

#### OUTPUTS

Main Pre-amp output 500mV.  
Direct tape output 120mV.

#### ACTIVE TONE CONTROLS

Treble  $\pm$ 12db.  
Bass  $\pm$ 12db.

#### INTERNAL STABILIZATION

Enables the HY5 to share an unregulated supply with the Power Amplifier.

#### SUPPLY VOLTAGE

15—25 volt.

#### SUPPLY CURRENT

20mA approx.

#### OVERLOAD CAPABILITY

better than 30db on most sensitive input infinite on tuner and auxl.

#### OUTPUT NOISE VOLTAGE

0.5mV.

#### PRICE

Mono £3.60 Stereo £7.20

### POWER SUPPLY PSU45



The PSU45 is specifically designed to supply, simultaneously, your HY40 (in mono or stereo format) and one or two HY5s.

Spec.

PSU45  $\pm$  22.5 volts, 2 amps simultaneously.

PRICE: £4.50 including Postage and Packing

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# The largest selection

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

PIV	1A	3A	7A	10A	16A	30A
	TO-5	TO-66	TO-66		TO-48	TO-48
50	0-23	0-25	0-47	0-50	0-88	1-15
100	0-23	0-33	0-53	0-58	0-83	1-40
200	0-25	0-37	0-57	0-61	0-78	1-60
400	0-43	0-47	0-67	0-75	0-93	1-75
600	0-53	0-57	0-77	0-87	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
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	0-48	0-83	2-50
1200	0-11	0-33	—	0-33	0-57	0-75	—

**TRIACS**

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

**LUCAS SILICON RECTIFIERS**  
33 amp. 400 P.I.V. Stud type. \$1.10 each.

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

**2A POTTED BRIDGE RECTIFIERS 200V 50p**

**UNIJUNCTION**  
UT46. Eqt. 2N2646, Eqt. T1843. BEN3000 27p each, 25-99 25p 100 UP 20p.

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**ADI62 PNP**

**MATCHED COMPLEMENTARY PAIRS OF GERM. POWER TRANSISTORS.**  
For mains driven output stage of Amplifiers and Radio receivers. **OUR LOWEST PRICE OF 68p PER PAIR**

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300mW 30 . . . 1-50  
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Full Tested 1,000 . . . 9-00  
Ideal for Organ Builders.

**D18D1 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.

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

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**SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS**

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.	Description	2p
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. B8Y95A, 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, B8Y27	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 CR81/25-600	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. 80-2 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.

**NEW QUALITY TESTED PAKS**

Pak	Description	Price
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 OC71 H.F. type trans.	0-50
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Q19	3 Madt's 2 MAT 101 & 1 MAT 121	0-50
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Q21	4 AC128 NPN germ. trans.	0-50
Q22	20 NKT trans. A.F. R.F. coded	0-50
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Q24	8 OA81 diodes	0-50
Q25	6 IN914 sil. diodes 751PV 75mA	0-50
Q26	8 OA95 germ. diodes sub-min. IN69	0-50
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Q28	2 Sil. post rect. BYZ13	0-50
Q29	4 Sil. trans. 2 x 2N696, 1 x 2N697, 1 x 2N698	0-50
Q30	7 Sil. switch trans. 2N708 NPN	0-50
Q31	6 Sil. switch trans. 2N708 NPN	0-50
Q32	3 PNP sil. trans. 2 x 2N1131, 1 x 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 x 2N2904 & 1 x 2905	0-50
Q36	7 2N3646 TO-18 plastic 300MHZ NPN	0-50
Q37	3 2N3059 NPN sil. trans.	0-50
Q38	7 PNP trans. 4 x 2N3703, 3 x 2N3702	0-50
Q39	7 NPN trans. 4 x 2N3704, 3 x 2N3705	0-50
Q40	7 NPN amp. 4 x 2N3707, 3 x 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	1 NPN trans. 4 x BC108, 3 x 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 x BC167, 3 x BC168	0-50
Q48	4 BCY70 NPN trans. TO-18	0-50
Q49	4 NPN trans. 2 x BFY51, 2 x BFY52	0-50
Q50	7 B8Y26 NPN switch TO-18	0-50
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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.

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Coded GP100. BRAND NEW TO-3 CASE. POSS. REPLACEMENT FOR:—OC25-28, 29, 30, 33-36, NKT 401-403, 404-406, 430-431, 432-433, T13027-3028, 2N250A, 2N456A-457A-458A, 2N511 A & B. 2G220-222, ETC.  
SPECIFICATION  
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Qty. 1-24 25-99 100 up  
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Epoxy TO-5 case 1-24 25-99 100 up  
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uL914 Dual 2/p 35p 33p 27p  
uL923 J-K flip-flop 80p 47p 45p  
Data and Circuits Booklet for I.C's Price 7p.

**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  
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Plus our satisfaction or money back guarantee.

**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	38p
OC23	33p	OC36	40p
OC25	25p	AD140	40p
OC26	25p	AD142	40p
OC28	40p	AD149	48p

**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.	1-24	25-99	100 up
T80 14 pin type	30p	27p	25p
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# -the lowest prices!

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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	25-99	100 up
BP00 = 7400	Quad 2-input NAND gate	0p	0p	0p
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	0-28	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)	0-87	0-84	0-58
BP46 = 7446	BCD-to-seven-segment decoder/driver	2-00	1-75	1-50
BP47 = 7447	BCD-to-seven-segment decoder/driver (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	0-28	0-24
BP72 = 7472	Master slave J-K flip-flop	0-29	0-28	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	0-42	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	0-67	0-64	0-58
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	3-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	0-94	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 selector	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 (two clock lines)	2-10	1-95	1-75
BP196 = 74196	Pre-settable 50MHz decade counter	1-80	1-70	1-60
BP197 = 74197	Pre-settable 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.

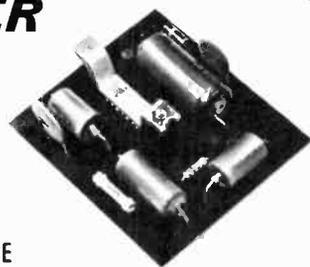
### TTL INTEGRATED CIRCUITS

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 x 7400N 50p	UIC42 = 5 x 7450N 50p	UIC80 = 5 x 7480N 50p
UIC01 = 12 x 7401N 50p	UIC43 = 5 x 7451N 50p	UIC81 = 5 x 7481N 50p
UIC02 = 12 x 7402N 50p	UIC44 = 5 x 7452N 50p	UIC82 = 5 x 7482N 50p
UIC03 = 12 x 7403N 50p	UIC45 = 5 x 7453N 50p	UIC83 = 5 x 7483N 50p
UIC04 = 12 x 7404N 50p	UIC46 = 5 x 7454N 50p	UIC84 = 5 x 7484N 50p
UIC05 = 12 x 7405N 50p	UIC47 = 5 x 7455N 50p	UIC85 = 5 x 7485N 50p
UIC10 = 12 x 7410N 50p	UIC70 = 8 x 7470N 50p	UIC90 = 5 x 7490N 50p
UIC11 = 12 x 7411N 50p	UIC71 = 8 x 7471N 50p	UIC91 = 5 x 7491N 50p
UIC12 = 12 x 7412N 50p	UIC72 = 8 x 7472N 50p	UIC92 = 5 x 7492N 50p
UIC13 = 12 x 7413N 50p	UIC73 = 8 x 7473N 50p	UIC93 = 5 x 7493N 50p
UIC14 = 12 x 7414N 50p	UIC74 = 8 x 7474N 50p	UIC94 = 5 x 7494N 50p
UIC15 = 12 x 7415N 50p	UIC75 = 8 x 7475N 50p	UIC95 = 5 x 7495N 50p
UIC16 = 12 x 7416N 50p	UIC76 = 8 x 7476N 50p	UIC96 = 5 x 7496N 50p
UIC17 = 12 x 7417N 50p	UIC77 = 8 x 7477N 50p	
UIC18 = 12 x 7418N 50p	UIC78 = 8 x 7478N 50p	
UIC19 = 12 x 7419N 50p	UIC79 = 8 x 7479N 50p	
UIC20 = 12 x 7420N 50p	UIC80 = 8 x 7480N 50p	
UIC21 = 12 x 7421N 50p	UIC81 = 8 x 7481N 50p	
UIC22 = 12 x 7422N 50p	UIC82 = 8 x 7482N 50p	
UIC23 = 12 x 7423N 50p	UIC83 = 8 x 7483N 50p	
UIC24 = 12 x 7424N 50p	UIC84 = 8 x 7484N 50p	
UIC25 = 12 x 7425N 50p	UIC85 = 8 x 7485N 50p	
UIC26 = 12 x 7426N 50p	UIC86 = 8 x 7486N 50p	
UIC27 = 12 x 7427N 50p	UIC87 = 8 x 7487N 50p	
UIC28 = 12 x 7428N 50p	UIC88 = 8 x 7488N 50p	
UIC29 = 12 x 7429N 50p	UIC89 = 8 x 7489N 50p	
UIC30 = 12 x 7430N 50p	UIC90 = 8 x 7490N 50p	
UIC31 = 12 x 7431N 50p	UIC91 = 8 x 7491N 50p	
UIC32 = 12 x 7432N 50p	UIC92 = 8 x 7492N 50p	
UIC33 = 12 x 7433N 50p	UIC93 = 8 x 7493N 50p	
UIC34 = 12 x 7434N 50p	UIC94 = 8 x 7494N 50p	
UIC35 = 12 x 7435N 50p	UIC95 = 8 x 7495N 50p	
UIC36 = 12 x 7436N 50p	UIC96 = 8 x 7496N 50p	
UIC37 = 12 x 7437N 50p	UIC97 = 8 x 7497N 50p	
UIC38 = 12 x 7438N 50p	UIC98 = 8 x 7498N 50p	
UIC39 = 12 x 7439N 50p	UIC99 = 8 x 7499N 50p	
UIC40 = 12 x 7440N 50p	UIC100 = 8 x 7500N 50p	
UIC41 = 5 x 7441AN 50p	UIC101 = 25 x Aest'd 74's £1.50	

Pake 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.

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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.
- Overall Size 2" x 3" x 1/2".
- Typical Total Harmonic distortion at 1 watt less than 1%.
- 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.
- 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	100 up	Price	100 up
BP930	Expandable dual 4-input NAND	12p	11p	12p	11p
BP932	Expandable dual 4-input NAND buffer	12p	12p	12p	11p
BP933	Dual 4-input expander	13p	12p	13p	11p
BP935	Expandable Hex Inverter	13p	12p	13p	11p
BP936	Hex Inverter	13p	12p	13p	11p
BP944	Dual 4-input NAND expandable buffer without pull-up	13p	12p	13p	11p
BP945	Master-slave JK or RS	25p	24p	25p	22p
BP946	Quad 2-input NAND	12p	11p	12p	10p
BP948	Master-slave JK or RS	25p	24p	25p	22p
BP951	Monostable	65p	60p	65p	55p
BP962	Triple 3-input NAND	12p	11p	12p	10p
BP9693	Dual Master-slave JK with separate clock	40p	38p	40p	35p
BP9694	Dual Master-slave JK with separate clock	40p	38p	40p	35p
BP9697	Dual Master-slave JK with Common Clock	40p	38p	40p	35p
BP9699	Dual Master-slave JK Common Clock	40p	38p	40p	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
BP 201C—8L201C	TO-5	8	G.P. Amp	1-24 25-99 100 up
BP 701C—8L701C	TO-5	8	OP Amp	68p 58p 45p
BP 702C—8L702C	TO-5	8	OP Amp Direct OP	63p 50p 45p
BP 702—72702	D.I.L.	14	G.P. OP Amp (Wide Band)	63p 45p 40p
BP 709—72709	D.I.L.	14	High OP Amp	53p 45p 40p
BP 709P—7A709C	TO-5	8	High Gain OP Amp	53p 45p 40p
BP 711—7A711	TO-5	10	Dual comparator	58p 50p 45p
BP 741—72741	D.I.L.	14	High Gain OP Amp (Protect)	75p 60p 50p
7A 703C—7A703C	TO-5	6	R.F.—F. Amp	48p 35p 27p
TAA 263—	TO-72	4	A.F. Amp	70p 60p 55p
TAA 293—	TO-74	10	G.P. Amp	90p 75p 70p

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A completely new style 100W amplifier especially designed for the D.J. who expects his equipment to look and sound really good, and still keep a moderate price:  
10-30,000Hz response.  
All loudspeaker systems suitable.  
Full output into 4 ohm.

All silicon transistors. F.E.T. at front end. Real value at **£42** plus £1 P. & P. and Insurance.

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8 ohm impedance, complete with plug and 5ft lead. A very comfortable phone set. Listen to stereo without noise interrupting the pleasure. Wonderful value. **£2.50** plus 10p P. & P.



### MINI LOUSPEAKERS

2 1/2in 8 ohm - 38p | 2 1/2in 25 ohm - 38p  
3in 8 ohm - 40p | 2 1/2in 75 ohm - 38p  
Plus 3p P. & P. on each Speaker

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5 transistor amplifier complete with volume control, is suitable for 9V d.c. and a.c. supplies. Will give about 1W at 8 ohm output.

With high IMP input this amplifier will work as a record player, baby alarm, etc., amplifier.



**EMI LOUSPEAKER 450**  
10W 13in x 8in ± two 2 1/2in tweeters and cross-over. All wired and ready for use. This ever-popular 450 in 3-8-15 ohm imp.  
**£3.50** plus 38p P. & P. each.



### PSYCHEDELIC LIGHT CONTROL UNIT



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Two teak finish shelves on a black frame (overall size: 28in x 26in x 12in). Ideal for hi fi equipment: amplifiers, speaker cabinets, etc. The perfect answer for housing unit audio and equipment. This unit is wall mounting.  
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1,000 Ω per phone ... **80p** TTC  
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An Audio Amplifier designed around the T7A021 Linear I.C.—  
Supply Voltage ... 9-24V  
Speaker Imp. ... 8-16 ohm  
Frequency ... 50Hz-25kHz  
Overall Size ... 2in x 3in x 1in  
Ideal Amplifier for radios, record players, stereo units, etc.  
Full technical data and diagrams with each module. All guaranteed and a bargain at



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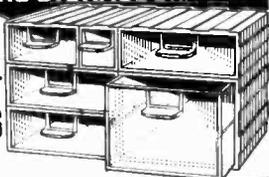


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Shure V15 Type 2	£28.00
Shure M44E	£8.00
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Finished in real teak veneer with tinted dustcover. Ready to use (fully assembled). Suitable for Garrard SP25, 2025TC, 3000, AT60, 2000, 2500, 3500, 5100, 1025, SL65B.

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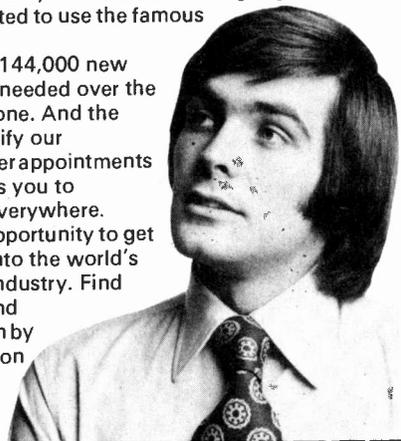
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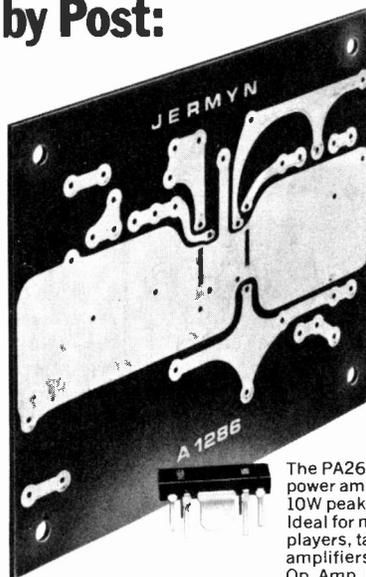
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For all petrol engines—cars, boats, etc. Guaranteed for 5 yrs.



Complete Installation Kit for 12-volt vehicles £12.95 + 35p P. & P. State earth polarity of vehicle POSITIVE or NEGATIVE earth. Unit Construction Kit also available for the radio electronics constructor £9.95 + 35p P. & P. The construction kit includes instructions and all components for wiring as positive or negative earth, and is complete with the stove enamelled steel case and aluminium base. All components are available separately.

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## SPECIAL PURCHASE!

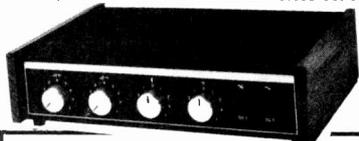
**BRAND NEW FM MULTIPLEX STEREO DECODER UNITS.** Manufactured by PHILIPS. Size 2" x 2 1/2" x 1 1/2". All transistor 24V at 6mA. Supplied pre-aligned with full circuit diagram and connection details. £4 each. Post free.

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

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## 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**

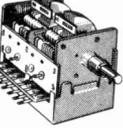
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors through 8 silicon diodes in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal 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  $\pm 3dB$  12-30,000Hz. Sensitivity better than 80mV into 1M  $\Omega$ . Full power bandwidth  $\pm 3dB$  12-15,000Hz. Bass boost approx. to  $\pm 12dB$ . Treble cut approx. to  $\pm 6dB$ . Negative feedback 15dB over main amp. Power requirements 35V at 1.0 amp. Overall size—12" wide x 8" deep x 2 1/2" high. Fully detailed 7-page construction manual and parts list free with kit or send 18p plus large S.A.E.

**PRICES AMPLIFIER KIT. £1-50 P. & P. 15p. POWER PACK KIT. £3 P. & P. 30p. CABINET. £2 P. & P. 20p.**

(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 Discosque 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 network. Fully enclosed, built on printed circuit panel and fully screened. Extremely stable over range 88-108 Mc/s. Brand new and pre-aligned. Size 2 1/2" H. x 1 1/2" W. x 2 1/2" D. For 6V D.C. @ 25mA. 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** 8x6x1/4 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. 22 1/2in. Maximum diameter 1/4 in. 25p each. P. & P. 5p.

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## SPECIAL OFFER!! HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16 1/2in high x 10 1/2in wide x 5 1/2" deep. Fitted with E.M.I. Ceramic Magnet 13in x 8in bass unit, two Hi-Fi tweeter units and crossover. Power handling 10W. Available 3, 8 or 15 ohm impedance.

**Our Price £8-40** Carr. 65p.  
**CABINET AVAILABLE SEPARATELY**

Also available in 8 ohm with EMI 13in x 8in. bass speaker with parasitic tweeter. £8-50. Carr. 65p.

### LOUDSPEAKER BARGAINS

3in 4 ohm 50p. P. & P. 13p. 5in 3 ohm 80p. P. & P. 15p. 7 x 4in 3 ohm £1-05. P. & P. 20p. 10 x 6in 3 or 15 ohm £1-90. P. & P. 30p. E.M.I. 8 x 5in 3 ohm with high flux magnet £1-82. P. & P. 20p. E.M.I. 13 1/2 x 8in 3 ohm with high flux ceramic magnet £2-10 (15 ohm £2-25). P. & P. 30p. E.M.I. 13 x 8in 3 or 8 or 15 ohm with two inbuilt tweeters and crossover network £4-20. P. & P. 30p. E.M.I. 13" x 8" twin cone (parasitic tweeter) 13 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.

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**12in "RA" TWIN CONE LOUDSPEAKER** 10 watts peak handling. 3 or 15 ohm. £2-80. P. & P. 30p. 35 ohm SPEAKERS 3". ONLY 68p. P. & P. 13p.

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Adjustable headband with comfortable flexifoam ear-muffs. Wired and fitted with standard stereo 3in jack plug. Frequency response 30-15,000Hz. Matching impedance 8-16 ohms. PRICE £2-95. P. & P. 15p.

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For P.U. Tape, Mike, Guitar, etc., and suitable for use with valve or transistor equipment. 9 x 15V. Battery or from I.E.T. line 200/300V. Frequency response 15Hz-25KHz. Gain 20dB. Solid encapsulation size 1 1/4 x 1 1/4 x 1/2 in. Brand new—complete with instructions. Price 88p. P. & P. 13p.

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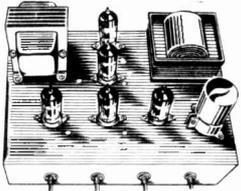
### QUALITY RECORD PLAYER AMPLIFIER MK II

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 7 1/2in. x 8 1/2in. 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 14 1/2 x 12 1/2 in., clearance 2 1/2 in. below, 5 1/2 in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 x 15 x 8 in. 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 3-15p 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 E280 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; V15/10V, 50p; OC71 25p; OC76 30p; AF117 18p; 2G389 (NFN) 15p.** Set of Mullard 6 transistors OC44, 2-OC45, AC128B, matched pair AC128 £1-25; ORP12 Cadmium Sulphide Cell 58p. All post free.

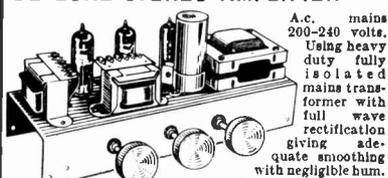
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### SPEAKER CABINET FROM FAMOUS MAKER!

Beautifully made all-wooden construction cabinet with medium walnut finish front, solid anodised expanded aluminium grille and dark sides. Approx. size overall 11 1/2" high x 5" deep x 13 1/2" 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.**

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A.c. mains 200-240 volts. Using heavy duty fully diode rectified mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up—2 x ECL82 Triode Pentodes. 1 x E280 as rectifier. Two dual potentiometers provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono) into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 1 1/2 in. x 4 1/2 in. x Overall height including valves 5 in. Ready built and tested to a high standard. Price £8-92. P. & P. 45p.

### 4-SPEED RECORD PLAYER BARGAINS

**Main models.** All brand new in manufacturer's packing. **LATEST B.S.R. C109/A21 4-SPEED AUTOCHANGER.** With latest mono compatible cartridge £8-97. Carr. 60p. With stereo cartridge £7-97. Carr. 60p.

**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. 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 GP91/18C Mono Compatible Cartridge** with 10 stylus for LP/EP/78. Universal mounting bracket. £1-50. P. & P. 8p.

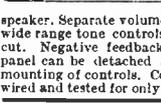
**SONOTONE STANC COMPATIBLE STEREO CARTRIDGE T/O stylus.** Diamond Stereo LP and Sapphire 78. ONLY £2-50. P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3. P. & P. 10p.

**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 7 1/2 in. x 4 1/2 in. x 4 1/2 in. h. Incorporates ECC83, EL84, E280 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4 1/2 watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £4-75. P. & P. 30p.



**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 valve. Impedance 3 ohms. Output approx. 3-5 watts. Volume and tone controls. Chassis size only 7 1/2 in. wide x 3 1/2 in. deep x 6 1/2 in. high overall. A.C. mains 200/240V. Supplied absolutely Brand New, completely wired and tested with good quality output transformer. FEW ONLY.

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# 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  $\pm$  3dB. Output: 4 watts per channel @ 8 ohms. Inputs: Phono 80mV; tuner/aux 80mV.

Normal retail price: £14.70

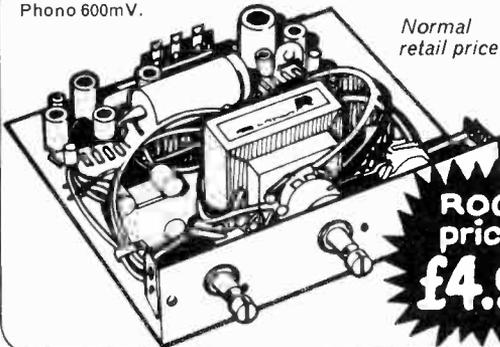


# FIRST STEP TO STEREO!

**5-Watt Transistor Stereo Amplifier Chassis R.123**

Completely self-contained, fully transistorised, mains-powered (240v AC) amplifier, needing only cabinet and knobs. Ideal for adapting mono players to stereo. Frequency response: 40-17,000 Hz  $\pm$  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 MHz; AM frequency range 535-1605 KHz. Inputs for turntable (ceramic cartridge) and tape. Frequency response: 50-10,000 Hz  $\pm$  3dB. Output: 4 watts per channel @ 8 ohms. Inputs: Phono 200mV, tape 100mV. FM: Sensitivity 20 $\mu$ V, stereo separation 26dB, image rejection 55dB. AM: Sensitivity 300 $\mu$ V.

Normal retail price: £42.00

**ROC price: £29.95**



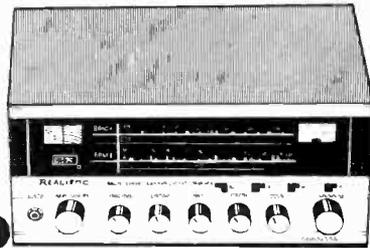
# World wide reception

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

Fully transistorised with continuous coverage from 555K Hz to 30 MHz 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: 0.5 $\mu$ V @ 30MHz. Bandspread: 10-160 metres.

Normal retail price:  
£65.00

**ROC price:**  
**£45.00**

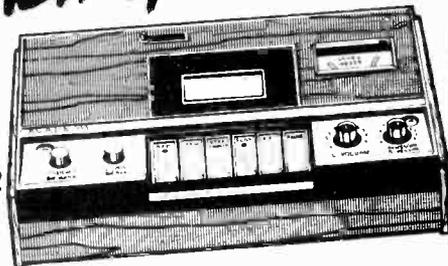


# AMAZING OFFER!

**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: 1 $\frac{1}{2}$  IPS, 4.75 CMS. Rewind time: Better than 60 sec. (C.60 cassette).  
Normal retail price: £65.00

**ROC price**  
**£49.50**

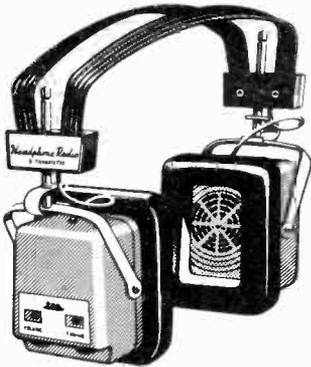


# We don't want you to

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

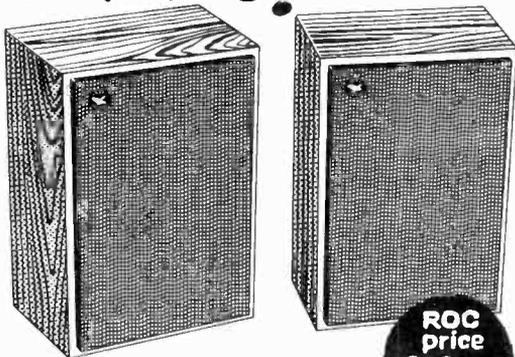


**Headphone Radio R.143**  
 For completely private listening without the distortion of the ordinary earphone adaptor. Battery operated; PP3. Fully transistorised. Frequency range: 535-1600 K Hz, Medium Wave Band. Maximum output: 300mW.

**ROC price**  
**£6.90**

Normal retail price: £9.40

**2 for the price of one!** **Matched Stereo Speakers R.446**



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 8½ x 6½.

**ROC price**  
**£16.40**

Normal retail price: £19.60

## 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)

# STEREO headphones

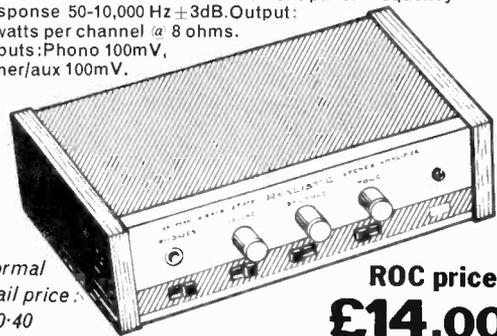
*only*  
**£2.40**



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

# 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 ± 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!



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**

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

## VEROBOARD

2 1/2in x 1in x 0.15in 6p 5in x 3 1/2in x 0.15in 28p 3 1/2in x 3 1/2in x 0.1in 24p  
 3 1/2in x 2 1/2in x 0.15in 16p 17in x 2 1/2in x 0.15in 55p 5in x 2 1/2in x 0.1in 23p  
 3 1/2in x 3 1/2in x 0.15in 20p 17in x 3 1/2in x 0.15in 74p 5in x 3 1/2in x 0.1in 28p  
 5in x 2 1/2in x 0.15in 20p 3 1/2in x 2 1/2in x 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 2 1/2in x 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 x 2in, x 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**  
 1/2 and 3/4 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. 5 1/2in 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, 3 1/2" x 2 1/2" x .15"**  
**Only 10p each or £1.00 per dozen**

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

Sub-miniature types	Miniature types	5.6 µF	35 volts
0.047µF 50 volts	0.022µF 20 volts	8.2 µF	10 volts
0.056µF 50 volts	0.033µF 20 volts	8.2 µF	35 volts
0.07 µF 20 volts	0.047µF 20 volts	15 µF	35 volts
0.1 µF 20 volts	0.068µF 35 volts	18 µF	35 volts
0.1 µF 50 volts	0.12 µF 35 volts	22 µF	15 volts
0.18 µF 20 volts	0.15 µF 35 volts	27 µF	120 volts
0.33 µF 35 volts	0.22 µF 50 volts	56 µF	15 volts
0.47 µF 35 volts	0.47 µF 50 volts	56 µF	20 volts
0.68 µF 20 volts	0.68 µF 35 volts	150 µF	6 volts
1.0 µF 15 volts	0.68 µF 50 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	15 µF	39 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



## 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

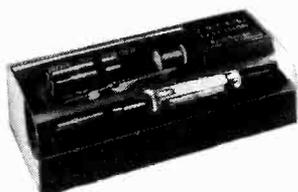


### INVALUABLE FOR STRIPPING FLEX, THE NEW AUTOMATIC OPENING BIB WIRE STRIPPER AND CUTTER, easily adjustable for all standard diameters. Plastic covered handles can also be used as wire cutter. Recommended retail price 50p



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

# cut out this coupon and answer your soldering problems



## SK1 SOLDERING KIT

In rigid plastic "tool box" containing Model CN - 15 watts - 240 volts miniature iron fitted  $\frac{1}{16}$ " bit. Spare bits  $\frac{5}{32}$ " and  $\frac{3}{32}$ ". Reel of resin-cored solder, heat sink, cleaning pad, stand and booklet "How to Solder".

£2.75



## SK2 SOLDERING KIT

In polystyrene pack, containing 15 watt miniature soldering iron, 240 volts fitted with  $\frac{3}{16}$ " bit, 2 spare bits  $\frac{5}{32}$ " and  $\frac{3}{32}$ ". Coil of resin-cored solder, heat sink, 1A fuse and booklet "How to Solder".

£2.40



Model CN 240/2  
- 15 watts  
- 240 volts

Fitted with nickel plated  $\frac{3}{32}$ " bit and packed in handy transparent box.

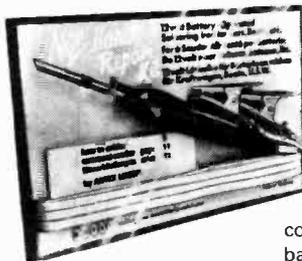
£1.70



ES240 D 25 watt  
soldering iron

In transparent display pack, fitted with long life iron-coated bit  $\frac{1}{8}$ " diam. In interchangeable spare bits  $\frac{3}{32}$ ",  $\frac{1}{16}$ ",  $\frac{1}{4}$ " (extra) available. Improved design to ensure strong and reliable high speed iron. Heats up in 2 minutes.

£1.83



M.E.S.  
Battery-operated  
12 volt  
soldering iron

Complete with 15 ft (4.50m) lead, 2 heavy gauge clips for instant

connection to car battery and a guide 'How to Solder'. Packed in strong plastic wallet.

£1.95



from electrical and radio shops or by Free Post (No stamp required) from ANTEX Ltd. FREE POST PLYMOUTH, PL1 1BR  
Tel: (0752) 67377/8

Please send the ANTEX colour catalogue.

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

Please send the following:

NAME .....

ADDRESS .....

PE11

# 28watts, r.m.s. 40Hz to 40kHz $\pm$ 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 x Duo Type II speakers	£14+£2	P.&P.
Garrard SP25 Mk. III with MAG. cartridge, plinth and cover	£23+£1.50	P.&P.
<b>Total</b>	<b>£59</b>	

Available complete for only **£52+£3.50**  
P.&P.

### SYSTEM 2

Viscount III R101 amplifier	£22+90p	P.&P.
2 x Duo Type III speakers	£32+£3	P.&P.
Garrard SP25 Mk. III with MAG. cartridge, plinth and cover	£23+£1.50	P.&P.
<b>Total</b>	<b>£77</b>	

Available complete for **£69+£4** P.&P.

### SYSTEM 3

Viscount III R100 Amplifier	£17+90p	P.&P.
2 x Duo Type II speakers	£14+£2	P.&P.
Garrard SP25 Mk. III with CER. diamond cartridge, plinth and cover	£21+£1.50	P.&P.
<b>Total</b>	<b>£52</b>	

Available complete for only **£49+£3.50**  
P.&P.

### SPEAKERS Duo Type II

Size approx. 17in x 10½in x 6½in. Drive unit 13in x 8in with parasitic tweeter. Max. power 10W, 3 ohms. Simulated Teak cabinet. **£14 pair + £2 P. & P.**

Duo Type III Size approx. 23½in x 11½in x 9½in. Drive unit 13½in x 8½in 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  $\pm$ 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. 13½ x 9in x 3½in.

# 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.

# VALVES

**SAME DAY SERVICE  
NEW! TESTED! GUARANTEED!**

**SETS** 1R5, 1R5, 1T4, 3B4, 3V4, DAF91, DF91, DK91, DL92, DL94.  
Set of 4 for £1.02, DAF96, DF96, DK96, DL96, 4 for £1.48.

1R5	-28	30C1	-28	DY87	-25	EL500	-62	PCL82	-38	UA6C80	-32
1R5	-22	30C15	-58	DY802	-35	EM80	-41	PCL83	-58	UAF42	-61
1T4	-16	30C17	-79	EABC80	-32	EM81	-41	PCL84	-84	URC41	-62
3B4	-26	30C18	-61	EAF42	-50	EM84	-32	PCL85	-40	UCF80	-34
3V4	-37	30F5	-70	EB41	-40	EM87	-38	PCL86	-40	UCF89	-32
5U4G	-26	30FL1	-61	EB91	-11	ET51	-38	PCL88	-65	UC884	-33
5V4G	-35	30FL12	-70	EBC33	-40	ET86	-29	PCL800	-75	UC885	-35
5Y3GT	-26	30FL14	-68	EBC41	-54	EZ40	-43	PEN44	-77	UCF80	-33
5Z4G	-35	30L1	-29	EBC90	-22	EZ41	-43	PEN36C	-70	UCI42	-62
6J0L2	-56	30L15	-59	EBF80	-32	EZ80	-22	PFL200	-58	UCH81	-32
6AL5	-11	30L17	-71	EBF89	-29	EZ81	-23	PL36	-49	UCI82	-34
6AM6	-13	30P4	-65	ECC81	-17	EZ30	-35	PL81	-45	UCL83	-65
6AQ5	-22	30P12	-72	ECC82	-20	EZ32	-40	PL81A	-49	UF41	-66
6AT6	-20	30P19	-65	ECC83	-35	EZ34	-48	PL82	-33	UF89	-30
6AU6	-20	30P11	-63	ECC85	-28	KT41	-77	PL83	-33	UL41	-67
6BA6	-20	30P113	-75	ECC904	-56	KT61	-55	PL84	-30	UL44	£1.00
6BE6	-21	30P114	-65	ECC90	-27	KT66	-78	PL500	-64	UL44	-38
6BJ6	-41	30P115	-90	ECC92	-26	LN319	-63	PL504	-64	UM84	-22
6BW7	-52	35L6GT	-45	ECH33	-30	LN329	-72	PM84	-35	UY41	-42
6CD6G	£1.07	35W4	-25	ECH42	-61	LN339	-63	PX25	£1.00	UY85	-28
6F14	-32	35ZAGT	-25	EC8H1	-29	NT8	-87	PY32	-55	VP45	-77
6P23	-68	807	-45	ECH83	-40	P61	-45	PY35	-55	Z77	-22
6P25	-57	6063	-62	ECH84	-36	PABC80	-34	PY81	-27	Transistors	
6K7G	-12	AC/VP2	-77	ECL80	-30	PC86	-47	PY82	-25	AC107	-17
6K8G	-17	B349	-65	ECL82	-31	PC88	-47	PY83	-28	AC127	-18
807G	-27	B729	-62	ECL86	-36	PC96	-42	PY88	-33	AD140	-37
6SN7GT	-30	6X135	-67	EP39	-31	PC97	-33	PY800	-34	AF118	-20
6V6G	-23	CV31	-30	EP41	-30	PC900	-38	PY801	-34	AF118	-20
6V6GT	-31	DAF91	-22	EP80	-23	PC84	-29	R19	-30	AF117	-20
6X4	-28	DAF96	-36	EP85	-28	PC85	-27	R20	-58	AF118	-48
6X5GT	-28	DF33	-38	EP86	-31	PC88	-42	U25	-65	AF125	-17
7B7	-33	DF91	-18	EP89	-28	PC89	-48	U26	-58	AF127	-17
10P13	-58	DF95	-38	EP91	-13	PCC189	-48	U47	-85	OC26	-25
12AT7	-17	DH77	-20	EP98	-65	PCC805	-56	U49	-58	OC44	-12
12AU6	-20	DK32	-33	EP183	-28	PCF80	-28	U50	-28	OC45	-12
12AU7	-20	DK91	-28	EP184	-31	PCF82	-31	U52	-31	OC71	-12
12AX7	-22	DK92	-38	EP190	-37	PCF86	-45	U78	-24	OC72	-12
19B6GG	-87	DK96	-38	EL33	-55	PCF800	-58	U191	-59	OC75	-12
30F2	-67	DL55	-40	EL34	-43	PCF801	-30	U193	-42	OC81	-12
30F3	-80	DL92	-28	EL41	-54	PCF802	-44	U251	-88	OC81D	-12
30P1	-62	DL94	-37	EL44	-23	PCF805	-61	U301	-66	OC82	-12
25L6GT	-20	DL96	-38	EL90	-22	PCF829	-28	U309	-66	OC82D	-12
25U4GT	-47	DY86	-25	EL95	-33	PCF808	-68	U801	-98	OC170	-22

## READERS RADIO

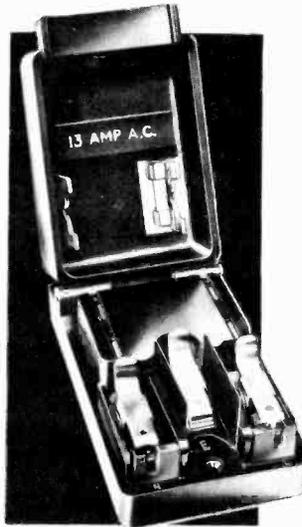
85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. Tel. 01-550 7441.

Postage on 1 valve 5p, on 2 or more valves 3p per valve extra. Any parcel insured against damage in transit 3p extra.

# SAFELOC

## of robust construction

Safe, quick and secure it connects 2-core and 3-core bare-ended flexible leads to the mains (A.C. only).



The concept was pioneered by Rendar, and introduced to the market 13 years ago.

Safeloc saves time. No need to fit a plug for tests. No danger, as no current can pass with the lid open.

Invaluable for testing and demonstrations in industry and shops, the work bench and the home.

Ask for Safeloc at your local stockist - or you can order it direct from the manufacturer.

If ordering by post, send cash with order.

PRICE £2.60+10p P.&P. EACH

Special bulk order wholesale and industrial rates on application



# RENDAR®

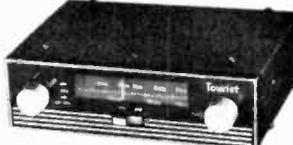
Rendar Instruments Ltd., Victoria Road, Burgess Hill, Sussex. Tel. Burgess Hill 2642

# TOURIST

## MARK 3 CAR RADIO

### ALL TRANSISTOR

Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4 1/2in deep.



### SET OF PARTS

£6.30 Plus P. & P. 50p

Speaker postage free when ordered with parts

Circuit diagram 13p, plus with parts Speaker, baffle and fixing kit £1.25 extra plus P. & P. 25p

# SOUND 50

## 50 WATT AMPLIFIER & SPEAKER SYSTEM

Output Power: 45 watts R.M.S. (Sine wave drive). Frequency response: -3dB points 30Hz at 18KHz. Total distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Speaker Impedance: 3, 8 or 15 ohms. Bass Control Range: ±13dB at 60Hz. Treble Control Range: ±12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.

To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power. SPEAKERS: Size 20in x 20in x 10in incorporating 12in heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM £50 Plus P. & P. or available separately Amplifier: £28.50 plus £1.50 P. & P. Speaker: £12.50 each plus £2.25 P. & P.

# RELIANT MK. IV

The Reliant Mk.IV provides a high standard of sound reproduction, with full mixing facilities. It's versatility makes it suitable for: Discotheque, P.A., Home Entertainment Applications, etc.

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

### SPECIFICATIONS

1. Crystal Mic. or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV. Inputs 3, 4 and 5 are suitable for a wide range of medium output equipment (Gram, Tuner, Monitor, Organ, etc.). All 250mV sensitivity.

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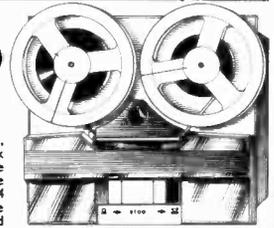
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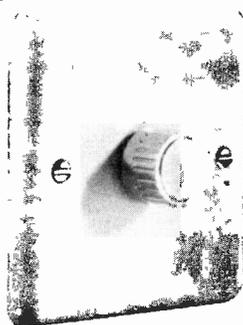
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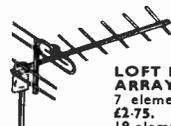
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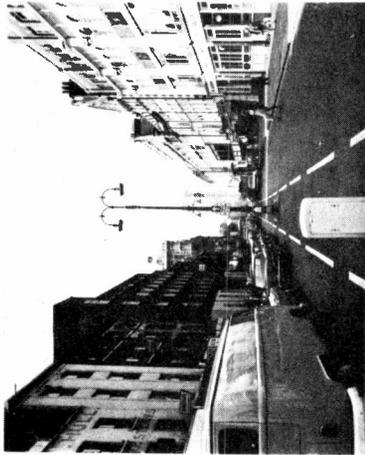
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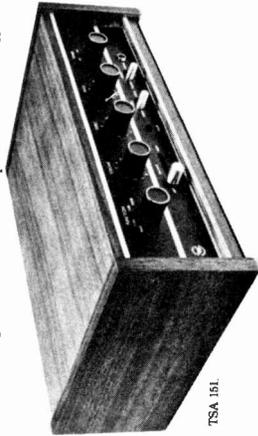
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Eagle International has a company philosophy. We believe that no customer can be expected to buy a product for which no one takes responsibility. So I personally take responsibility for all the equipment we sell. We give everything a complete two-year 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

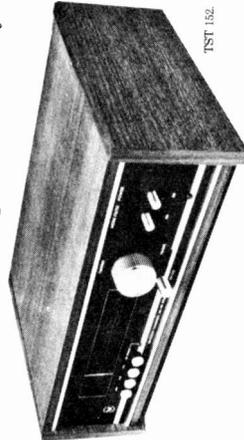
difference between them is power output. And signal to noise ratio. There are three new Eagle amplifiers.

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.

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/remoie 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. FFT front-end. And it's designed to match the TSA 149 and 151 amplifiers.

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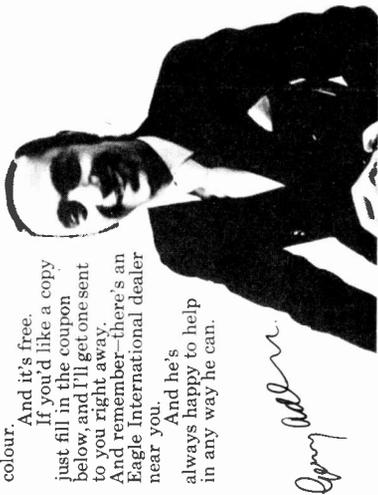
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*Gerry Adler*

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SN7407	0-20 0-18	SN7494	0-87 0-84
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SN7409	0-20 0-18	SN7496	0-87 0-84
SN7410	0-20 0-18	SN7497	0-87 0-84
SN7411	0-20 0-18	SN74100	1-65 1-58
SN7412	0-48 0-46	SN74104	1-52 1-40
SN7413	0-40 0-38	SN74105	1-52 1-40
SN7416	0-84 0-78	SN74107	0-52 0-49
SN7417	0-84 0-78	SN74110	0-80 0-75
SN7420	0-20 0-18	SN74111	1-57 1-45
SN7423	0-51 0-47	SN74118	1-80 1-25
SN7425	0-48 0-45	SN74119	1-60 1-50
SN7427	0-48 0-45	SN74121	0-50 0-47
SN7428	0-80 0-75	SN74122	1-44 1-35
SN7430	0-23 0-15	SN74123	2-85 2-70
SN7432	0-48 0-42	SN74145	1-80 1-70
SN7433	0-80 0-75	SN74150	3-52 3-40

FAIRCHILD (RTL)		1-5 6-11 12+
Part No.	Price	£p
L900	40p	37p
L914	40p	37p
L923	40p	37p

LINEAR		1-11 12-24 25-99
Op. Amps.	Price	£p
L702A TO5	2-90	2-70
L702C TO5	0-77	0-72
L703C TO5	0-62	0-57
L709A TO5	1-25	1-20
L709C TO5	0-47	0-42
L709C DIL	0-45	0-40
L710C TO5	0-47	0-42
L710C DIL	0-45	0-40
L711C TO5	0-49	0-44
L711C DIL	0-45	0-40
L716 TO5	1-87	1-75
L723C TO5	0-90	0-85
L741C TO5	0-80	0-75
L741C DIL	0-79	0-75
LM741CN DIL	0-75	0-65
SN72709P DIL	0-40	0-35

MULLARD PLESSEY		SL403D
Part No.	Price	£p
FJH101	0-87	SL611C 1-70
FJH121	0-87	SL701C 1-45
FJH141	0-87	SL702C 1-25
FJH161	0-87	DATA SHEETS 17p
FJH171	0-9A	
FJH221	0-87	
FJJ101	1-87	
FJJ121	1-87	
FJJ141	3-12	
FJJ191	1-87	
FJL261	3-12	
FKY101	2-25	
FKY101	0-80	

TOSHIBA		TH9013P
Part No.	Price	£p
TH9013P	£4.57	
20 WATT AMP		
TH9014P	£1.50	
PRE-AMP		
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MULLARD DTL		MULLARD LINEAR
Part No.	Price	Price
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FCH121	1-05	FCJ111 1-55
FCH201	1-32	FCJ201 1-80
FCH201	1-50	FCJ211 2-75
FCJ101	1-62	FCJ201 1-80
FCJ111	1-55	FCJ211 2-75
FCJ201	1-80	FCJ201 1-80
FCJ211	2-75	FCY101 1-05
FCY101	1-05	

GENERAL ELECTRIC		PA222
Part No.	Price	£p
PA222	2-60	PA230 1-40
PA230	1-40	PA234 0-90
PA234	0-90	PA237 2-10
PA237	2-10	PA239 2-10
PA239	2-10	PA246 1-60
PA246	1-60	PA264 1-90
PA264	1-90	PA265 2-00
PA265	2-00	PA424 2-05
PA424	2-05	PA436 1-90
PA436	1-90	PA494 2-05
PA494	2-05	

SGS		AA661B
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AA661B	£1.92	TAA700 £3.50
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TTL LOGICS		1-11 12-24	1-11 12-24
Part No.	Price	£p	£p
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SN7401	0-20 0-18	SN7404	0-20 0-18
SN7402	0-20 0-18	SN7405	0-20 0-18

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EA 1000	£2.63	

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CA3001V1	2-69	2.40	CA3036	0-73	0.65
CA3002	1-80	1.60	CA3037	1-65	1.47
CA3002V1	1-80	1.60	CA3037A	2-53	2.25
CA3004	1-80	1.60	CA3038	2-53	2.25
CA3005	1-17	1.05	CA3038A	3-40	3.03
CA3006	2-80	2.50	CA3039	0-84	0.75
CA3007	2-63	2.34	CA3040	2-40	2.14
CA3008	1-80	1.60	CA3041	1-09	0.97
CA3008A	2-96	2.64	CA3042	1-09	0.97
CA3010	1-87	1.23	CA3043	1-37	1.28
CA3010A	2-53	2.25	CA3044	1-20	1.07
CA3011	0-74	0.65	CA3044V1	1-20	1.07
CA3011PRE	CA3045	1-28	1.09		
	0-74	0.65	CA3046	0-69	0.60
CA3012	0-89	0.79	CA3047	1-37	1.28
CA3012V1	0-89	0.79	CA3047A	2-53	2.25
CA3013	1-05	0.94	CA3048	2-94	2.81
CA3014	1-24	1.10	CA3049	1-64	1.45
CA3014V1	1-24	1.10	CA3050	1-84	1.64
CA3015	2-09	1.86	CA3051	1-84	1.20
CA3015A	3-40	3.03	CA3052	1-65	1.47
CA3016	2-46	2.19	CA3053	0-86	0.41
CA3016A	3-75	3.33	CA3054	1-82	1.61
CA3018	0-84	0.75	CA3055	1-69	1.51
CA3018A	1-10	0.99	CA3056	1-20	1.07
CA3019	0-84	0.75	CA3056A	3-19	2.85
CA3020	1-26	1.13	CA3059	1-65	1.46
CA3020A	1-60	1.42	CA3060	4-61	4.27
CA3021	1-56	1.39	CA3062	2-53	2.27
CA3021V1	1-56	1.39	CA3064	1-20	1.07
CA3022	1-30	1.16	CA3065	1-20	1.07
CA3023	1-26	1.13	CA3066	2-11	1.68
CA3026	1-00	0.90	CA3067	2-18	1.94
CA3026PRE	CA3068	2-48	2.16		
	1-00	0.90	CA3070	1-70	1.51
CA3028A	0-74	0.65	CA3071	1-62	1.44
CA3028B	1-05	0.94	CA3072	1-66	1.48
CA3029	0-87	0.77	CA3073	1-18	1.00
CA3029A	1-65	1.47	CA3076	1-30	1.16
CA3030	1-37	1.23	CA3078	3-19	2.85
CA3030A	2-53	2.25	CA3080	0-79	0.70
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2G371	15p	2N3672	371p	40326	371p	BCY30	271p	BSX28	321p	NKT246	271p
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2G381	221p	2N3606	271p	40344	371p	BCY32	50p	BSX61	821p	NKT252	30p
2N404	221p	2N3607	221p	40347	371p	BCY33	25p	BSX76	221p	NKT264	20p
2N696	20p	2N3702	11p	40348	521p	BCY34	30p	BSX77	271p	NKT271	20p
2N697	20p	2N3703	10p	40360	421p	BCY38	40p	BSX78	271p	NKT272	20p
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2N706A	121p	2N3706	9p	40370	371p	BCY42	15p	BSY11	271p	NKT281	271p
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2N726	20p	2N3710	9p	40410	621p	BCY69	221p	BSY26	171p	NKT404	621p
2N727	20p	2N3711	12p	40410	621p	BCY69	971p	BSY27	171p	NKT405	621p
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2N918	30p	2N3719	42-06	40600	571p	BCY72	171p	BSY32	25p	NKT452	621p
2N929	221p	2N3819	35p	40673	85p	BCZ10	271p	BSY36	25p	NKT453	471p
2N930	271p	2N3823	971p	AC107	30p	BCZ11	421p	BSY37	25p	NKT453F	321p
2N1090	221p	2N3854	271p	AC126	20p	BD116	11-25	BSY38	221p	NKT613F	321p
2N1091	221p	2N3854A	271p	AC127	25p	BD121	65p	BSY39	221p	NKT674F	30p
2N1092	221p	2N3855	271p	AC128	25p	BD123	821p	BSY40	321p	NKT677F	30p
2N1132	221p	2N3855A	271p	AC154	25p	BD124	60p	BSY61	321p	NKT713	25p
2N1302	171p	2N3856	30p	AC176	85p	BD131	60p	BSY62	321p	NKT781	30p
2N1303	221p	2N3856A	35p	AC187	621p	BD132	85p	BSY63	371p	NKT10419	30p
2N1304	221p	2N3858	20p	AC188	371p	BDY10	11-25	BSY64	40p	NKT10439	371p
2N1305	221p	2N3858A	30p	ACY17	271p	BDY11	11-25	BSY66	90p	NKT10519	321p
2N1306	25p	2N3859	271p	ACY18	25p	BDY17	11-25	BSY78	471p	NKT20320	471p
2N1307	20p	2N3860	321p	ACY19	25p	BDY18	11-25	BSY79	45p	NKT20339	371p
2N1308	30p	2N3861	30p	ACY20	25p	BDY19	11-25	BSY82	521p	NKT80111	771p
2N1309	30p	2N3866	11-25	ACY21	25p	BDY20	11-25	BSY89	571p	NKT80112	971p
2N1507	171p	2N3877	40p	ACY28	20p	BDY38	971p	BSY95A	121p	NKT80113	971p
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2N1638	271p	2N3903	35p	AD140	581p	BF163	371p	C744	30p	NKT80216	921p
2N1671B	30p	2N3904	35p	AD149	571p	BF173	19p	D1P1	321p	OC20	75p
2N1711	25p	2N3905	371p	AD159	621p	BF178	30p	D1P2	30p	OC22	50p
2N1889	321p	2N3906	371p	AD160	621p	BF179	30p	D1P3	371p	OC23	60p
2N1893	371p	2N4058	171p	AD162	371p	BF180	35p	D1P4	40p	OC24	60p
2N1947	321p	2N4059	10p	AF106	421p	BF180	35p	OC25	50p	OC40	20p
2N1948	20p	2N4060	121p	AF114	25p	BF180	35p	OC26	271p	OC44	20p
2N1960	371p	2N4061	121p	AF114	25p	BF180	35p	OC28	621p	OC45	15p
2N1963	40p	2N4062	121p	AF116	25p	BF184	25p	OC29	621p	OC46	15p
2N1964	421p	2N4244	471p	AF116	25p	BF185	421p	OC35	20p	OC47	321p
2N1994A	30p	2N4285	171p	AF117	25p	BF194	171p	OC36	20p	OC48	321p
2N2217	271p	2N4286	171p	AF118	621p	BF195	15p	OC37	20p	OC49	321p
2N2218	221p	2N4287	171p	AF119	20p	BF196	421p	OC41	20p	OC50	321p
2N2219	221p	2N4288	171p	AF124	221p	BF197	421p	OC42	20p	OC51	321p
2N2220	221p	2N4289	171p	AF125	20p	BF198	421p	OC43	20p	OC52	321p
2N2221	25p	2N4290	171p	AF126	20p	BF200	521p	OC44	20p	OC53	321p
2N2222	30p	2N4291	171p	AF130	171p	BF224	14p	OC45	15p	OC54	15p
2N2287	11-071	2N4292	121p	AF139	171p	BF225	19p	OC55	15p	OC56	15p
2N2297	30p	2N4303	471p	AF178	421p	BF237	23p	OC71	121p	OC72	121p
2N2366	171p	2N5027	521p	AF179	721p	BF238	23p	OC73	121p	OC74	321p
2N2368	171p	2N5028	571p	AF180	521p	BF244	29p	OC75	221p	OC76	221p
2N2369A	171p	2N5029	571p	AF181	421p	BF244	29p	OC77	20p	OC78	20p
2N2410	421p	2N5030	421p	AF181	421p	BFW58	271p	OC81	20p	OC82	20p
2N2483	271p	2N5172	121p	AF239	421p	BFW69	25p	OC83	25p	OC84	25p
2N2484	321p	2N5174	521p	AF279	471p	BFW60	25p	OC85	25p	OC86	25p
2N2638	221p	2N5175	521p	AF280	621p	BFX11	471p	OC87	20p	OC88	20p
2N2640	221p	2N5176	45p	AF271	30p	BFX12	221p	OC89	20p	OC91	20p
2N2613	35p	2N5235	30p	AY27	371p	BFX13	221p	OC92	20p	OC93	20p
2N2614	30p	2N5243	45p	AY27	371p	BFX30	30p	OC94	20p	OC95	20p
2N2646	521p	2N5246	421p	AY28	271p	BFX30	30p	OC96	20p	OC97	20p
2N2696	321p	2N5249	671p	AY29	271p	BFX43	371p	OC98	20p	OC99	20p
2N2711	25p	2N5265	32-25	AY36	25p	BFX44	371p	OC100	20p	OC101	20p
2N2712	25p	2N5266	22-75	AY36	25p	BFX68	671p	OC102	20p	OC103	20p
2N2713	271p	2N5267	22-62	AY51	321p	BFX84	25p	OC104	20p	OC105	20p
2N2714	30p	2N5305	35p	AY51	321p	BFX85	321p	OC106	20p	OC107	20p
2N2865	621p	2N5306	40p	AY54	25p	BFX86	271p	OC108	20p	OC109	20p
2N2904	30p	2N5307	371p	AY86	321p	BFX87	271p	OC110	20p	OC111	20p
2N2904A	321p	2N5308	371p	AZ21	421p	BFX88	621p	OC112	20p	OC113	20p
2N2905	371p	2N5309	621p	AU103	11-25	BFX89	621p	OC114	20p	OC115	20p
2N2906	40p	2N5310	421p	BC107	10p	BFX93A	70p	OC116	20p	OC117	20p
2N2906A	25p	2N5354	271p	BC108	10p	BFY10	421p	OC118	20p	OC119	20p
2N2907	30p	2N5355	271p	BC109	10p	BFY11	421p	OC120	20p	OC121	20p
2N2923	15p	2N5365	371p	BC113	15p	BFY18	221p	OC122	20p	OC123	20p
2N2924	15p	2N5366	321p	BC115	15p	BFY19	221p	OC124	20p	OC125	20p
2N2925	15p	2N5367	371p	BC116A	15p	BFY20	221p	OC126	20p	OC127	20p
2N2926	15p	2N5457	371p	BC118	10p	BFY21	221p	OC128	20p	OC129	20p
.. Green	14p	2N5905	771p	BC121	90p	BFY24	40p	OC130	20p	OC131	20p
.. Yellow	12p	2N8020	42	BC122	90p	BFY25	25p	OC132	20p	OC133	20p
.. Orange	12p	2N8102	90p	BC125	20p	BFY26	20p	OC134	20p	OC135	20p
2N3011	30p	2N8103	25p	BC126	20p	BFY29	50p	OC136	20p	OC137	20p
2N3014	321p	2N8104	25p	BC140	371p	BFY30	50p	OC138	20p	OC139	20p
2N3015	18p	2N8501	321p	BC147	10p	BFY43	621p	OC140	20p	OC141	20p
2N3054	48p	2N8502	35p	BC148	10p	BFY50	621p	OC142	20p	OC143	20p
2N3055	62p	2N8503	371p	BC149	18p	BFY51	25p	OC144	20p	OC145	20p
2N3133	30p	2N8128	70p	BC152	171p	BFY52	25p	OC146	20p	OC147	20p
2N3134	30p	2N8139	11-27	BC157	11p	BFY53	12p	OC148	20p	OC149	20p
2N3135	25p	2N8140	771p	BC158	12p	BFY55A	571p	OC150	20p	OC151	20p
2N3136	25p	2N8141	721p	BC159	12p	BFY56	30p	OC152	20p	OC153	20p
2N3390	25p	2N8142	65p	BC160	621p	BFY75	421p	OC154	20p	OC155	20p
2N3391	30p	2N8143	671p	BC167	11p	BFY77	671p	OC156	20p	OC157	20p
2N3391A	30p	2N8152	871p	BC168B	11p	BFY90	671p	OC158	20p	OC159	20p
2N3392	171p	R.C.A.—		BC168C	11p	BFX25	11-25	OC160	20p	OC161	20p
2N3393	15p	40050	55p	BC169C	11p	BFX29	11-25	OC162	20p	OC163	20p
2N3394	15p	40244	55p	BC169C	11p	BPY10	11-25	OC164	20p	OC165	20p
2N340											

## FIND BURIED TREASURE! TREASURE LOCATOR TRANSISTORISED

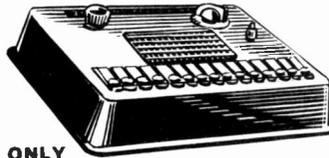
**NOW IT'S HERE AT LAST**, after experimenting for four and a half months with a multitude of different circuits and carrying out actual field tests with prototypes, our design team have come up with this real winner. This fully portable transistorised metal locator detects and tracks down buried metal objects—It signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, LOOT COINS, JEWELLERY, KEYS, WAR SOUVENIRS, ARCHAEOLOGICAL PIECES, METALLIC ORE, NUGGETS, ETC., ETC.** Outdoors or indoors. *Extremely sensitive, will signal presence of certain objects buried several feet below ground!* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards,* with the wonderfully clear, easy to follow, step-by-step, fully illustrated instructions—it really is as easy as ABC.



ONLY £2-37 (47/6)

transistorised—no valves. Uses standard PP3 battery. No soldering necessary. Size of detector head 13 1/2" x 10" x 2 1/2". Great demand expected at this remarkably low price—ORDER WHILE PRESENT STOCKS LAST. All parts including case, nuts, screws, wire, simple instructions, etc., etc. ONLY £2-37 (47/6) + 27p (5/6) p. & p. (Sectional handle as illustrated 75p (15/-) extra.) Parts available separately. Made up looks worth £161

## REAL WORKING ELECTRONIC ORGAN

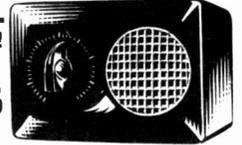


ONLY £2-75 (55/-)

Anyone from nine years upwards can build it easily in one short evening following the fully illustrated, step-by-step, simply worded instructions. **BIG DEMAND ANTICIPATED FOR THIS UNIQUE INSTRUMENT** at our low, low building price. ONLY £2-75 (55/-) + 25p (4/6) p. & p. for all parts, including case, loudspeaker, transistors, condensers, resistors, knobs, transformer, volume control, wire, nuts, screws, simple (but full) instructions, etc., etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

## GET A GOOD NIGHT'S SLEEP—EVERY NIGHT! INGENIOUS ELECTRONIC SLEEP INDUCER

only £2-75 (55/-)



**CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT?** Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sounds gradually become less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. *No soldering necessary.* Works off standard batteries—extremely economical. Size only 3" x 4 1/2" x 1 1/2"—take it anywhere. All parts including case, loudspeaker, components, nuts, wire, screws, etc., etc. **THERE WILL BE A GREAT DEMAND FOR THIS UNIQUE NEW DESIGN—SEND NOW £2-75 + 25p (55/- + 5/-) p. & p.** (Parts available separately.)

## SHORTWAVE TRANSISTOR RADIO Can be built in one evening



ONLY £2-25 (45/-)

At last! After trying countless circuits searching for easy build, work first-time short waves. Giving advanced world-wide performance, we chose this "Sky Roma". Anyone from 9 years up can follow the step-by-step, easy-as-ABC, fully illustrated instructions. (We built ten prototypes and every one worked first time, no soldering necessary. 76 stations logged on rod aerial in 30 mins.—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Transistorised (no valves). Size only 3" x 4 1/2" x 1 1/2". As tremendous demand anticipated price held to only £2-25 (45/-) + 17p (3/6) p. & p. for all parts incl. cabinet, screw, instructions, etc.) (Parts available separately.)

## BUILD 5 RADIO AND ELECTRONIC PROJECTS

TOTAL BUILDING PRICE £1-97 (39/6)

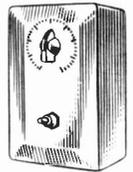


Amazing Radio Construction set! Become a radio expert for £1-97 (39/6). A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc., all you need. Presentation Box 37p (7/6) extra as illus. (if required) (extra parts available separately) no soldering necessary. Send only £1-97 (39/6) + 25p (4/6) p. & p.

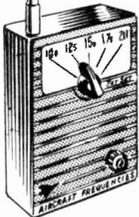
## SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON

**CUTS OUT NOISE POLLUTION—SOOTHS YOUR NERVES!** Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator based on avalanche operated transistors. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops—a well-known type of pink noise. *A group of Dentists have experimented on patients with this pink noise—NO ANESTHETICS WERE USED!* The noise ostensibly created a most definite reaction on these patients' nervous systems—the results that their pain systems were blocked. **IF YOU WORK IN NOISE OR DISTRACTING SURREOUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron.** Once used you will never want to be without it—use this amazing pink noise generator whenever you feel uneasy, can't relax or wish to concentrate. **TAKE IT ANYWHERE,** pocket sized. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. *No soldering necessary.* All parts including case, a pair of crystal phones, components, Nuts, Screws, Wire, etc., etc. no soldering. Send only £2-25 + 25p (45/- + 5/-) p. & p. (Parts available separately.)

only £2-25 (45/-)



## EAVESDROP ON THE EXCITING WORLD OF AIRCRAFT COMMUNICATIONS—JUST OUT V.H.F. AIRCRAFT BAND CONVERTER



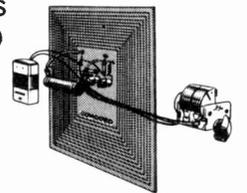
ONLY £2-37 (47/6)

Plus P. & P. 25p

Many thousands of v.h.f. Aircraft Band Converters now selling in U.S.A. *Listen in to AIRLINES, PRIVATE PLANES, JETPLANES. Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower. Hear for yourself the distinguished voices hiding messages on talk-downs.* Use with them have to take nerve ripling decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK ETC., ETC. CLEAR AS A BELL. This fantastic fully transistorised instrument can be built by anyone nine to ninety in under two hours. (Our design team built four—everyone worked first time.) *No knowledge of radio or electronics required.* No soldering necessary. Fully illustrated simply worded instructions take you step-by-step. Uses standard PP3 battery. Size only 4 1/2" x 3" x 1 1/2". All you do is extend rod aerial, place close to any ordinary medium-wave radio (even tiny portables) **NO CONNECTIONS WHATSOEVER NEEDED.** Use indoors or outdoors. **THERE WILL BE ENORMOUS DEMAND FOR THIS NEW DESIGN. SEND NOW ONLY £2-37 (47/6) + 25p (4/6) p. & p.** for all parts, including case, nuts, screws, wire, etc., etc. (parts available separately.)

## FIND BURIED TREASURE WITH THIS READY BUILT & TESTED Treasure Locator Module

Only £4-95 (99/-)



**BRAND NEW FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. Ready built and tested—just plug in a PP3 battery and 'phones and it's working.** Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, wood, dirt, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, WATCHES, JEWELLERY, NUGGETS, METALLIC ORE, HISTORICAL RELICS, BURIED PIPES, KEYS, NAIL-IN-TREES, ETC., ETC.** Signals exact location by "beep" pitch increasing as you near buried metallic objects. **PRINTED CIRCUIT SEARCH COIL so stable and sensitive it will detect certain objects buried SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIL!** *You could even use for your holidays with two or three days electricity on a stable and sensitive it will detect certain objects buried SEVERAL FEET BELOW GROUND!* **GIVES CLEAR SIGNAL ON ONE COIL!** *You could even use for your holidays with two or three days electricity on a stable and sensitive it will detect certain objects buried SEVERAL FEET BELOW GROUND!* Unclaimed treasure now exceeds the combined wealth of all nations. **ORDER NOW WHILE PRESENT STOCKS LAST—TREMENDOUS DEMAND EXPECTED AT THIS REMARKABLY LOW PRICE. DEMONSTRATIONS DAILY. ORDERS DESPATCHED IN STRICT ROTATION. SEND NOW £4-95 + 30p cart. (99/- + 6/-), etc.** (High quality Danish Stethoscope headphones £2-75 (55/-) extra if required.)

EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.

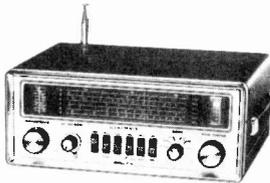
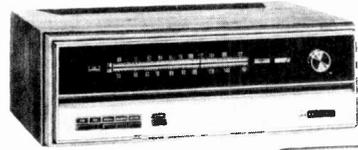
**CONCORD ELECTRONICS LTD (Dept. PE24)** 8 Westbourne Grove, London W.2. (Nr. Bayswater & Queensway Tubes. 1 minute ABC Cinema) Callers Welcome 9 a.m.-6 p.m. inc. Saturday



**UBC-4  
Battery Charger**



**TRENT  
Speaker**



**GR-78 Shortwave Receiver**

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



**MI-29  
Fish Spotter**



**GD-48 Metal  
Locator**



**The new AR-2000 Tuner Amplifier**



**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

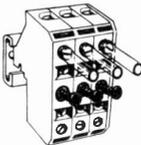
Name .....

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 up to four 7-029 cables. 85p each.



## MULTI-SPEED MOTOR

Six speeds are available 500, 800 and 1,000 r.p.m. and 8,000, 12,000 and 15,500 r.p.m. Shaft is 1/2 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. x 5 in long, mains 230/240V. Price 85p plus 25p postage and insurance.

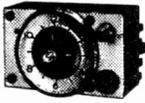


## 2 OCTAVE MINI ORGAN

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 5 1/2 in x 3 1/2 in x 2 1/2 in deep. Metal encased, glass fronted with chrome surround. Offered at 22-40 plus 25p postage and insurance.



## RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckon your time at 1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only 1/2 each or 11p per dozen. Specify 3, 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.



## 2 1/2 kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2 1/2 kW), switch down for half heat (1 1/2 kW), switch central blower cold for summer cooling, adjustable thermostat acts as auto control and safety cut-out. Complete kit 23-75. Post and ins. 38p.

## COMPUTER TAPES

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1 in wide 41-45 plus 33p post and insurance, with cassette. 1 in wide 41-25 plus 30p post and insurance with cassette. 1/2 in wide 41 plus 25p post and insurance with cassette. Spare spools and cassettes—1 in 41, 1 in 85p, 1/2 in 75p each plus 20p post and insurance.



## SPARTAN Portable RADIO

Long and medium wave 7 transistor, size 6 in x 4 in x 1 1/2 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 22-75 plus 25p post and ins.



## PROTECT VALUABLE DEVICES FROM THERMAL RUSSIA 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.



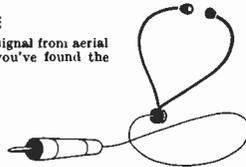
## CAPACITOR DISCHARGE CAR IGNITION

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 24-95 + 30p post. When ordering please state whether for positive or negative systems.



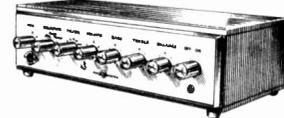
## RADIO STETHOSCOPE

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. 22—twin stetho-est 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 245 or reprint of data and parts list 55p.



## STANDARD WAFER SWITCHES

Standard size 1 1/2 wafer—silver-plated 5-amp contact—standard 1" spindle 2" long—with locking washer and nut

No. of Poles	2	3	4	5	6	8	9	10	12
1 pole	40p								
2 poles	40p								
3 poles	40p								
4 poles	40p								
5 poles	40p								
6 poles	40p								
7 poles	70p								
8 poles	70p								
9 poles	70p								
10 poles	70p								
11 poles	70p								
12 poles	70p								

## 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—12 1/2 in over mounting lugs. Overall height 5 1/2 in. A 210 speaker offered this month for 23-75 plus 30p post and ins.



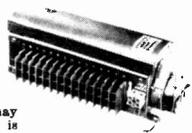
## TANGENTIAL HEATER UNIT

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. 23-50. 2kW Model as above except 2 kilowatts 22-50. Don't miss this. Control Switch 85p. 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 110 each. Special snip price 26-75 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 at 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 25. 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 21 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 23-50, or construction data and price list 30p.



## TREASURE TRACER

Complete Kit (except wooden battery) to make the metal detector as the circuit in Practical Wireless August issue. 22-50 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. 11-50 plus 13p post and insurance. Made up model also available, 22-25 plus 13p post & p.



## HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermistor as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack 22-50.

## 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. 26 plus 25p post and insurance.



## TOGGLE SWITCH

3 amp 250V, with fixing ring 7p each, 75p doz.

## CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. 85p each or 10 for 22-42.



## ROCKER SWITCH

13A self-fixing into an oblong hole, size approximately 1 1/2 in x 1 in 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. 1 1/2 in x 1 in. Open

Single pole	25p each	10 for 22-25
Treble pole	35p each	10 for 22-15



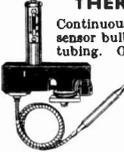
## BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in bedroom or similar circuits. 6/6 each, 22-50 doz.



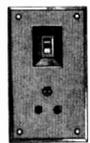
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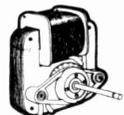
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## RETROSPECT AND PROSPECT

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 sovereignty, 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 brethren.

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*

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

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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.

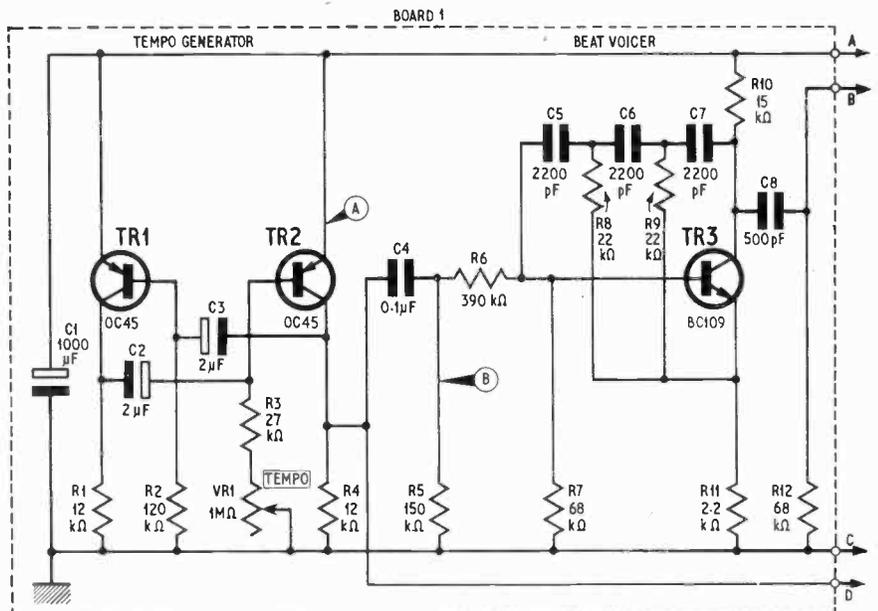
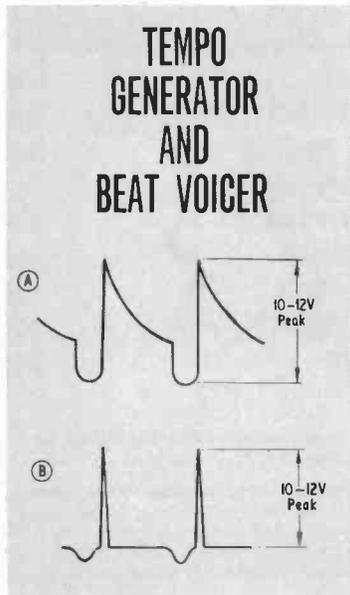
Unless an amplifier is included the loudness from a multivibrator and loudspeaker is not normally sufficient to make itself clearly audible above modern amplified musical instruments like the electronic organ or indeed above the sound produced by a small orchestra or choir.

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.



## 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

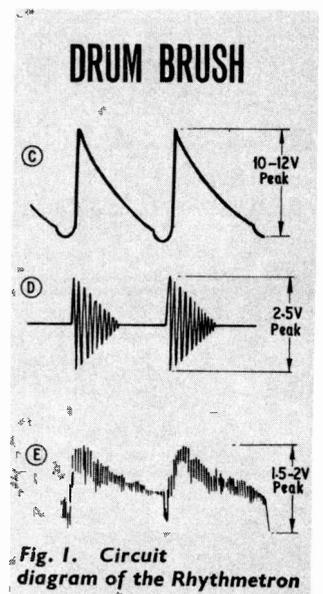
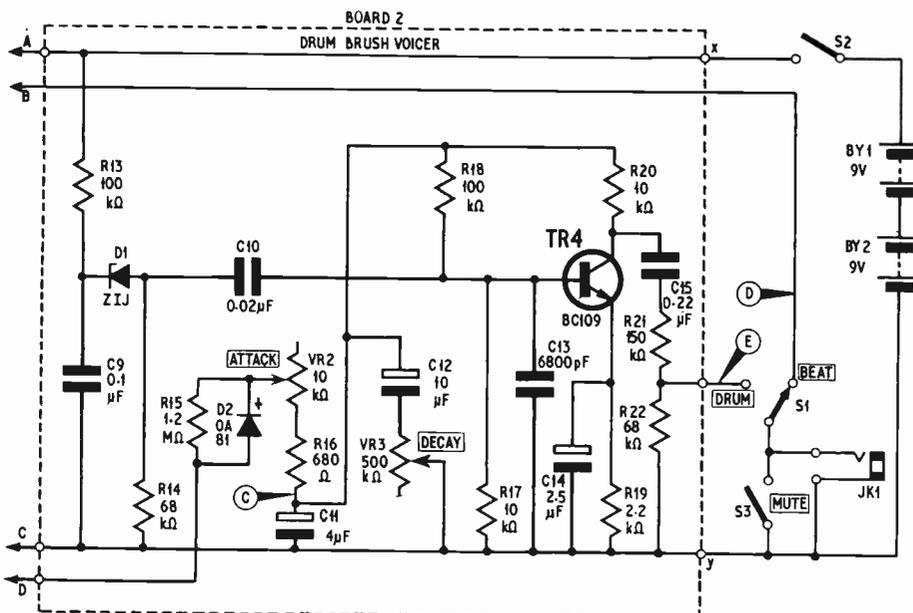
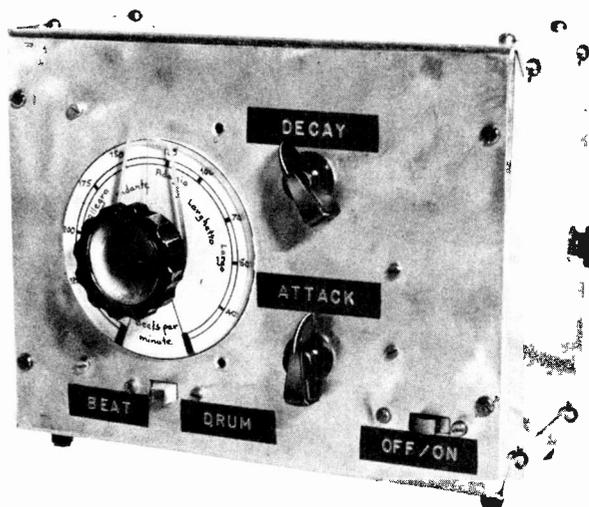


Fig. 1. Circuit diagram of the Rhythmetron

# COMPONENTS . . .

## Resistors

R1 12k $\Omega$	R9 22k $\Omega$	R17 10k $\Omega$
R2 120k $\Omega$	R10 15k $\Omega$	R18 100k $\Omega$
R3 27k $\Omega$	R11 2.2k $\Omega$	R19 2.2k $\Omega$
R4 12k $\Omega$	R12 68k $\Omega$	R20 10k $\Omega$
R5 150k $\Omega$	R13 100k $\Omega$	R21 150k $\Omega$
R6 390k $\Omega$	R14 68k $\Omega$	R22 68k $\Omega$
R7 68k $\Omega$	R15 1.2M $\Omega$	R23 470 $\Omega$ (see text)
R8 22k $\Omega$	R16 680 $\Omega$	

All 10%  $\frac{1}{2}$  watt carbon

## Potentiometers

VR1 1M $\Omega$ log. carbon	VR3 500k $\Omega$ linear carbon
VR2 10k $\Omega$ linear carbon	

## Capacitors

C1 1,000 $\mu$ F elect. 25V	C9 0.1 $\mu$ F polyester
C2 2 $\mu$ F elect. 15V	C10 0.02 $\mu$ F polyester
C3 2 $\mu$ F elect. 15V	C11 4 $\mu$ F elect. 15V
C4 0.1 $\mu$ F polyester	C12 10 $\mu$ F elect. 15V
C5 2,200pF polystyrene	C13 6,800pF polystyrene
C6 2,200pF polystyrene	C14 2.5 $\mu$ F elect. 15V
C7 2,200pF polystyrene	C15 0.22 $\mu$ F polyester
C8 500pF polystyrene	C16 1,000 $\mu$ F 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 LTI19

## 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  $\times$  6in  $\times$  4in.  
BY1-BY2 9V batteries (2 off). JK1 Standard jack socket.

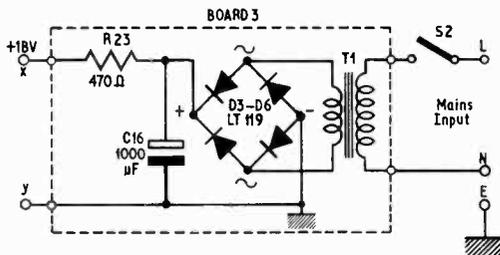


Fig. 2. Circuit diagram of the mains power supply unit

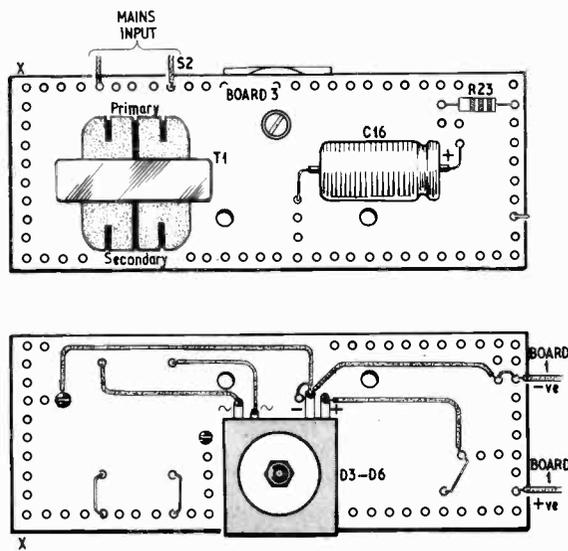


Fig. 3. Component assembly and wiring details for power supply board

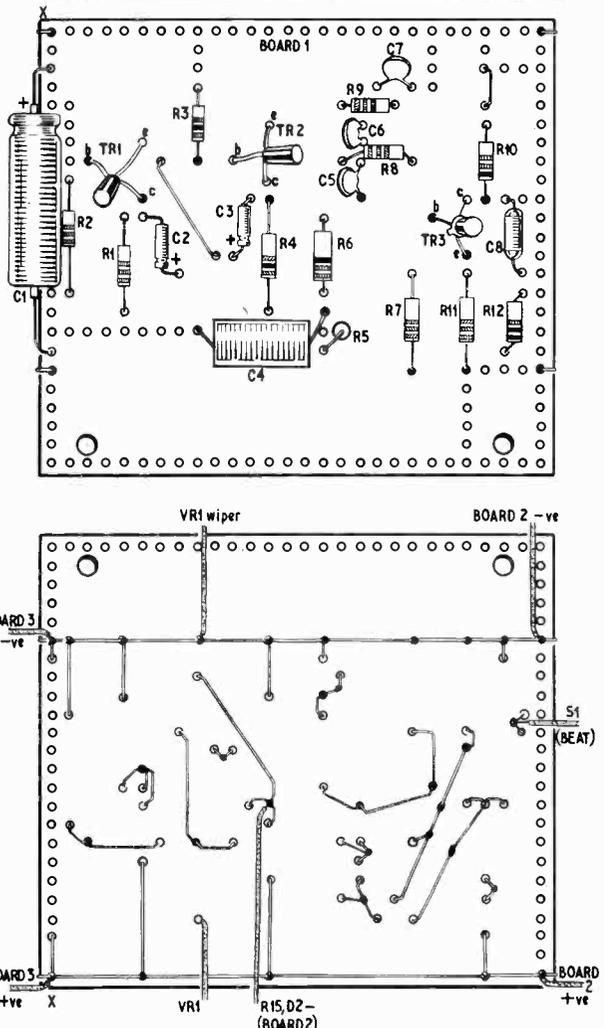


Fig. 4. Component assembly and wiring details for tempo generator and beat voicer circuits

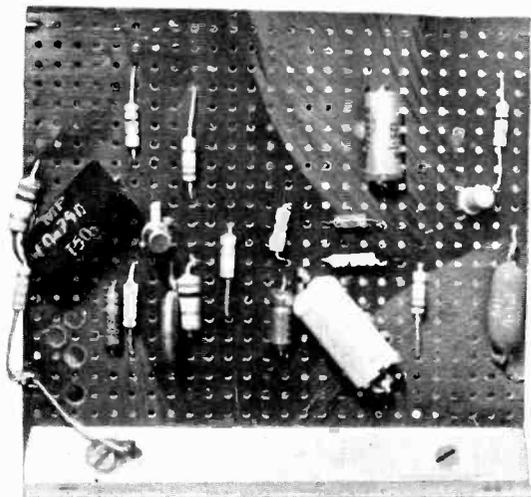
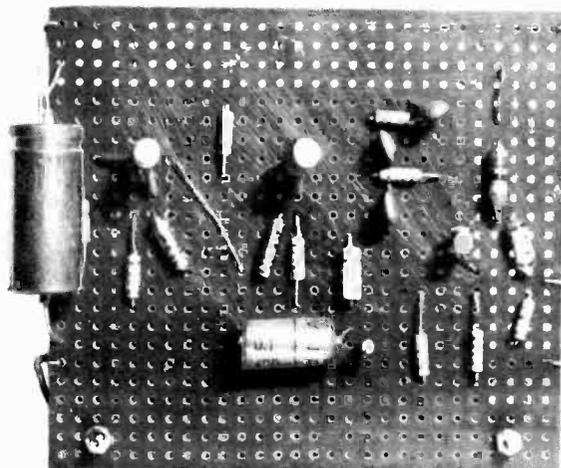
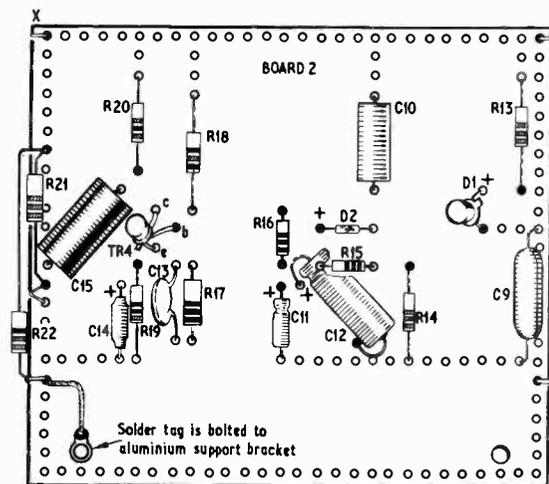


Fig. 5 (right). Component assembly and wiring details for drum brush voicer circuit



Tempo generator and beat voicer board

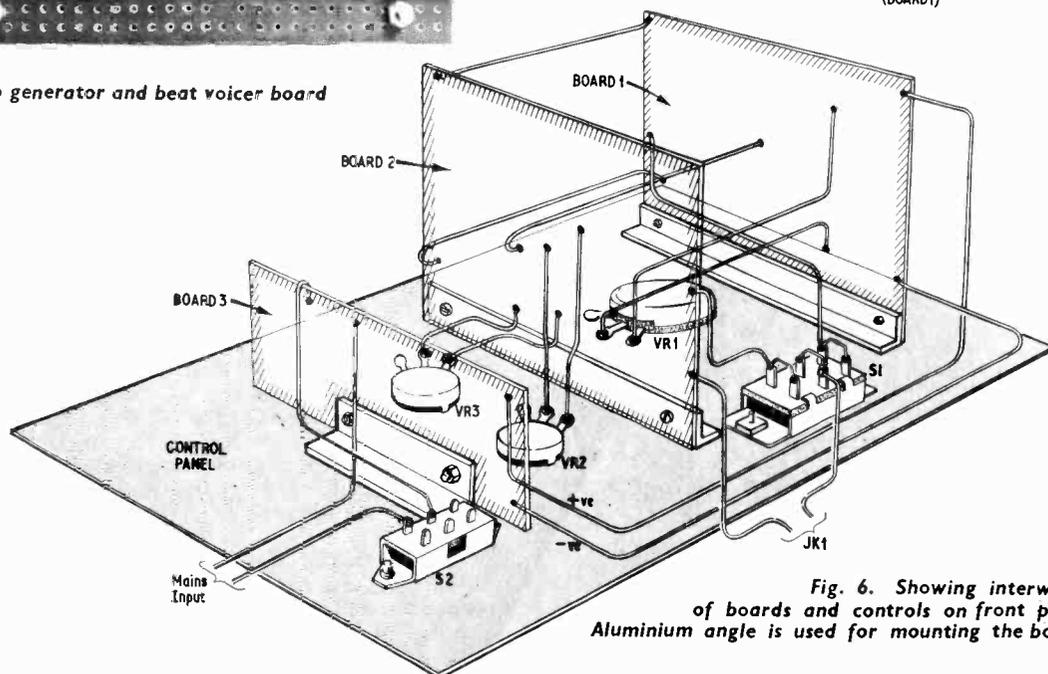
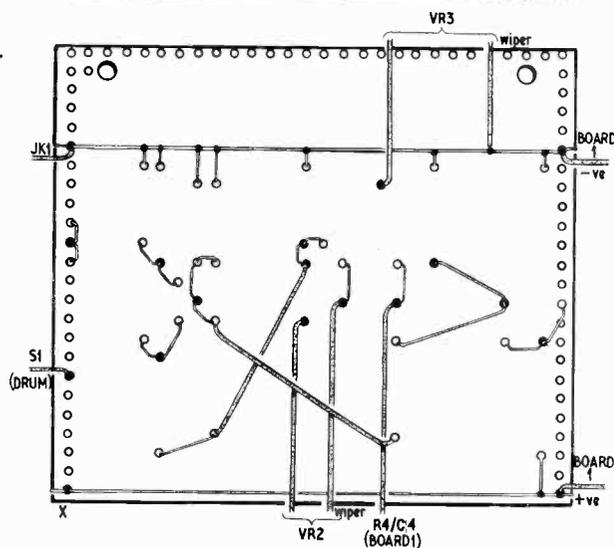
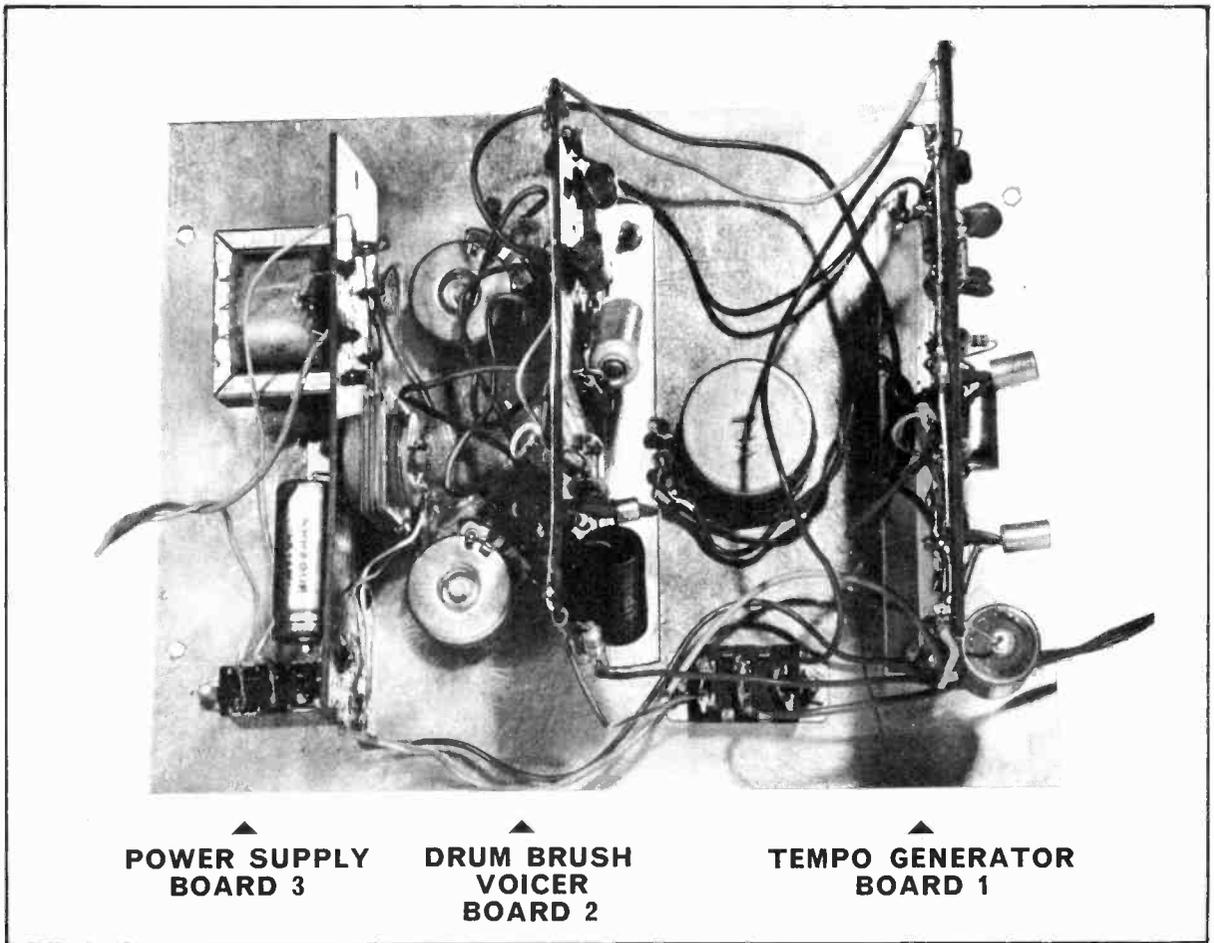


Fig. 6. Showing interwiring of boards and controls on front panel. Aluminium angle is used for mounting the boards



POWER SUPPLY BOARD 3

DRUM BRUSH VOICER BOARD 2

TEMPO GENERATOR BOARD 1

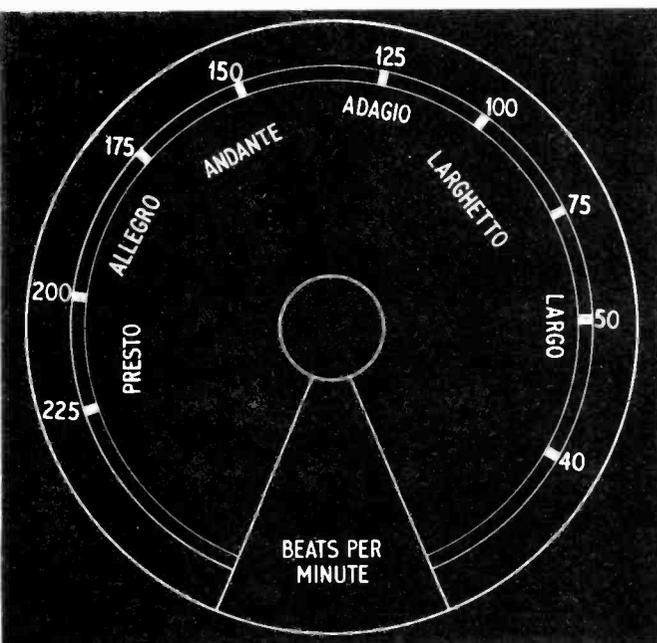


Fig. 7. Tempo calibration scale which can be cut out and pasted on the front panel

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. ★

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

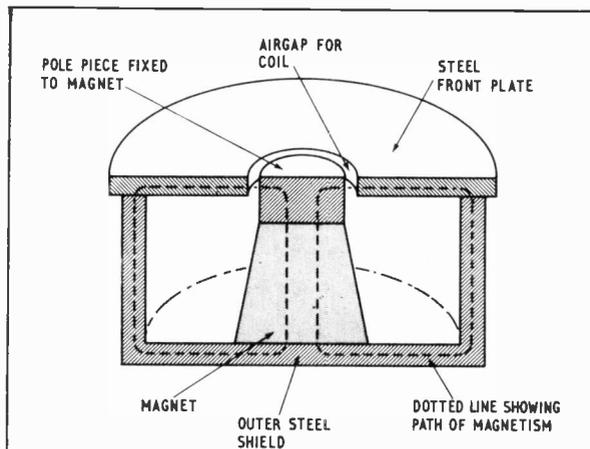


Fig. 1. Cutaway view of shielded magnet

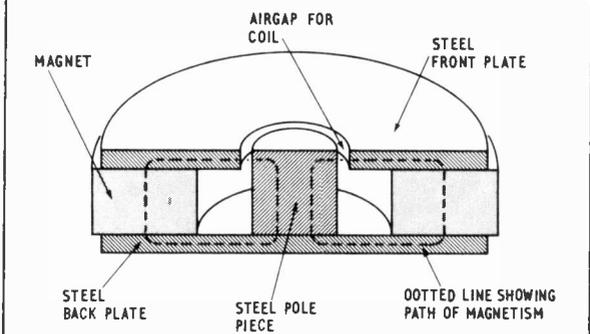


Fig. 2. Cutaway view of unshielded ceramic magnet

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 unshielded ceramic magnet systems are commonly used in these types with a saving in cost over equivalent steel magnet types.

Advances in knowledge of electronic sound reproduction and manufacturing techniques, and a steady improvement in the characteristics of materials used

# LOUDSPEAKERS

By  
**H. E. BARNES**

(E.M.I. Sound Products Ltd.)

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.

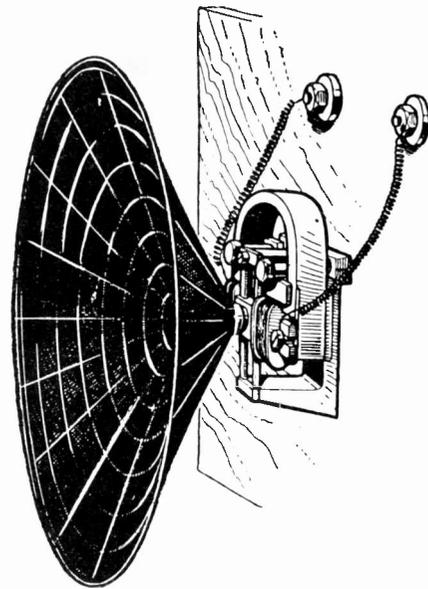
### OPERATING PRINCIPLES

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.

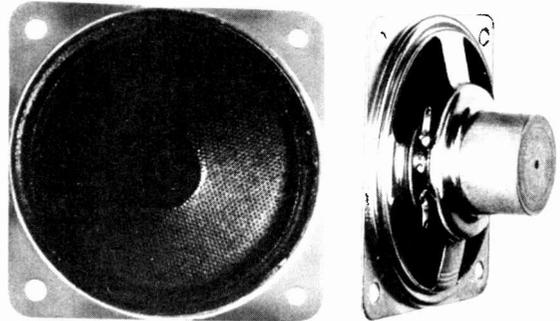
The diaphragm used to generate the sound waves is usually cone shaped, although it may be dome shaped in some high frequency speaker units. It is fixed at its outer edge to a flexible section of material which in turn is fixed to the flange of the chassis.

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



An early direct radiator loudspeaker by Celestion



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

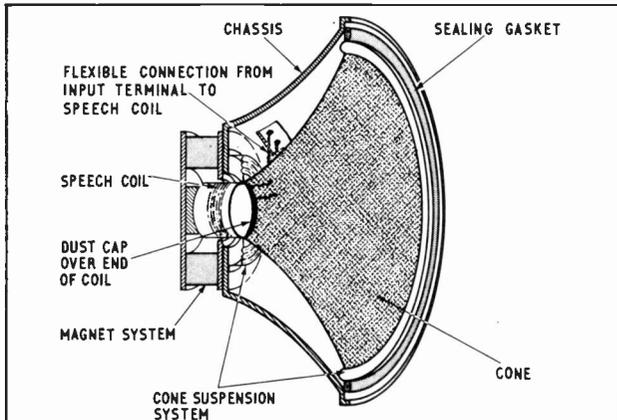


Fig. 3. Section through a moving coil loudspeaker

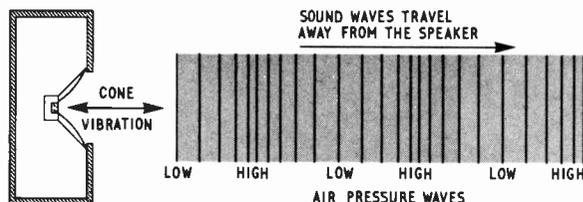


Fig. 4. How piston action of the cone creates sound pressure waves

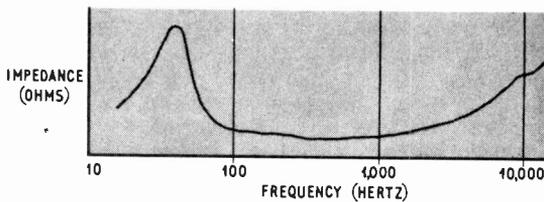
as it is also called), driving it and the cone to and fro in a similar complex series of vibrations.

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.

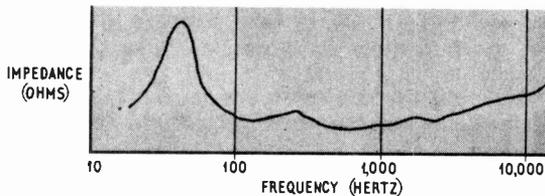
In the case of bass frequencies, the air is displaced at comparatively low speeds. To obtain the required loudness, a much greater amount of air has to be moved per cone movement than at higher frequencies. Without a baffle board around the speaker orifice, air movement at the front of the cone would 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  $\frac{1}{2}$ in 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 x 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.

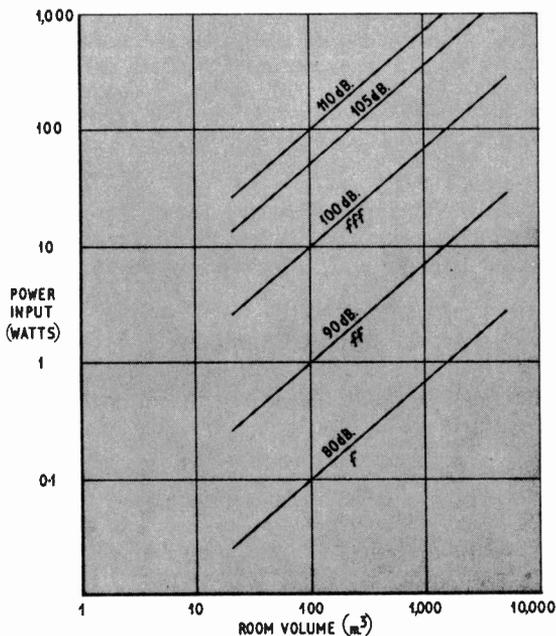


Fig. 6. Electrical input required for a speaker of 5 per cent efficiency related to room volume and sound intensity within

## 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  $7\frac{1}{2}$  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

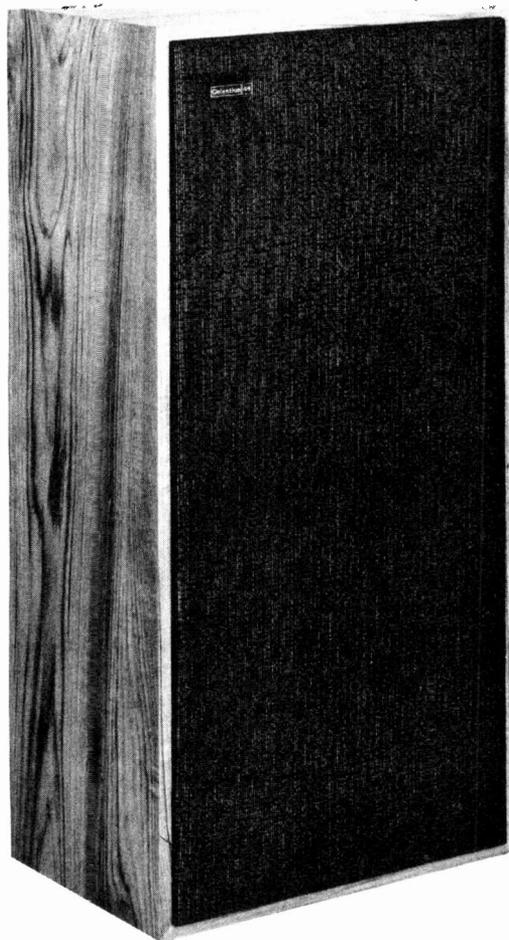


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R.R.P.	£54.00 each

*Plus full  
supporting  
cast!*

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



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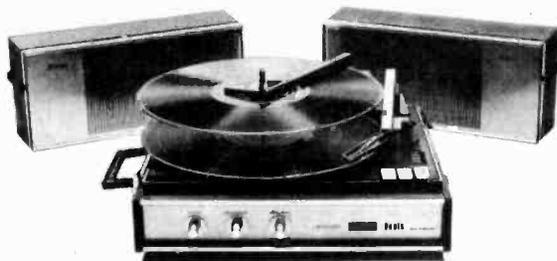
Midnight is a time for listening. Let the music be as late and as loud as you like; with headphones, it disturbs no one. Let the headphones be A.K.G. and you will find the quality staggeringly good. Made by a company whose professional microphones are known throughout the world and much used in this country, A.K.G. stereo headphones reflect the same fine quality of design and meticulous manufacture. They are just about as good as anything you can buy at any price. Go to the dealer displaying the A.K.G. Superhead and hear for yourself, without obligation. Shown here, Model K.60 R.R.P. £15.00

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Brought to you for your listening enjoyment from the

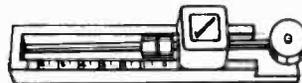
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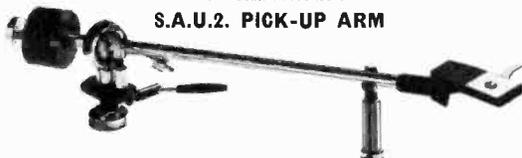
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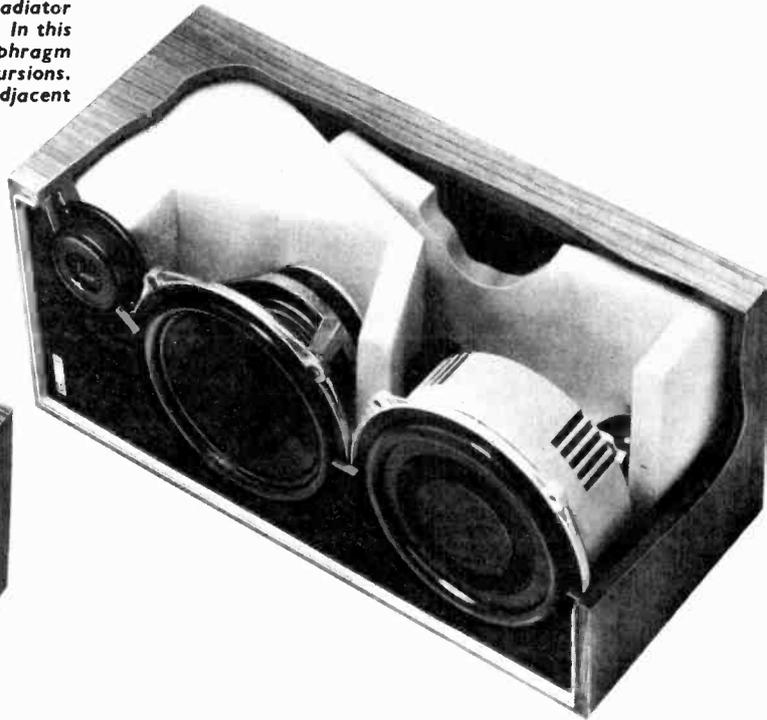
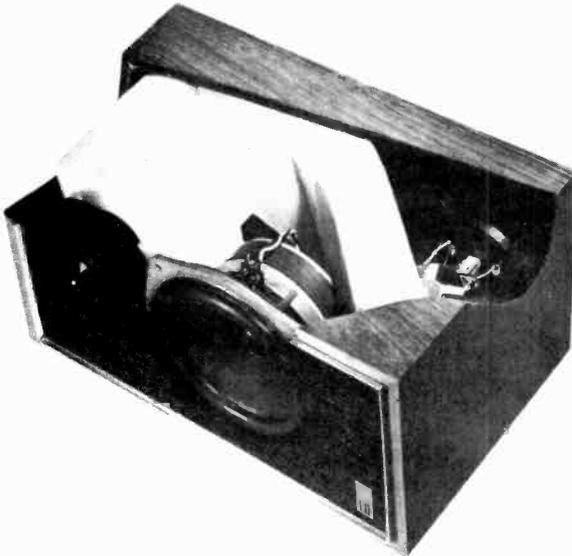
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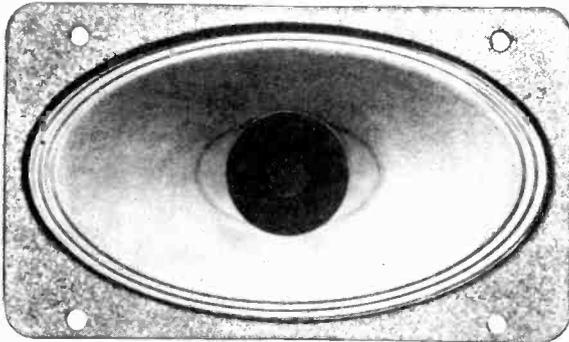
**A. R. SUGDEN & CO. (Engineers) Ltd.**

Market Street, Brighouse HD6 1DX, Yorkshire. Telephone 2142

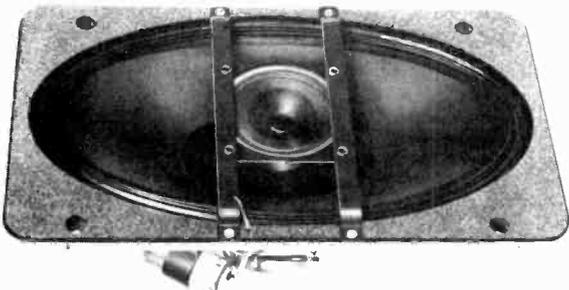
A fairly recent innovation in extending bass response down to 30Hz is achieved by using an auxiliary bass radiator (right) of similar dimensions to the mid range unit. In this Celestion system (Ditton 15) the ABR is a rigid diaphragm with a linear air suspension capable of large excursions. It is pressure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



**T**HIS 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  $0.1\mu\text{F}$  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

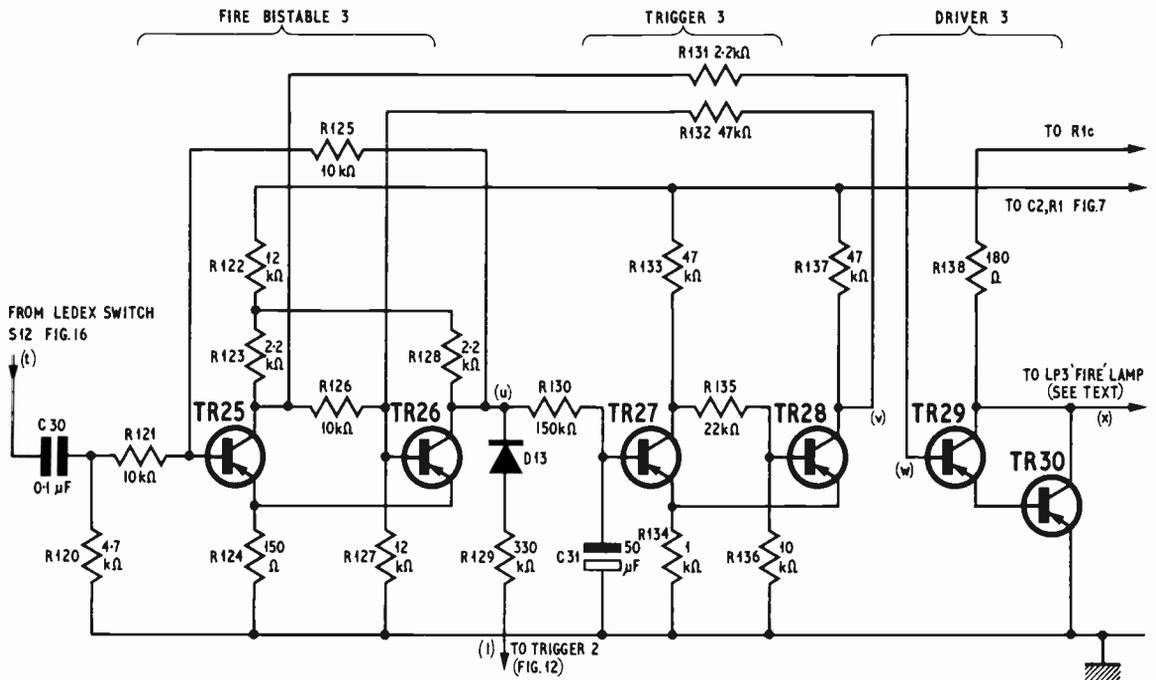


Fig. 17a. Fire indicating circuit on Panel "D"

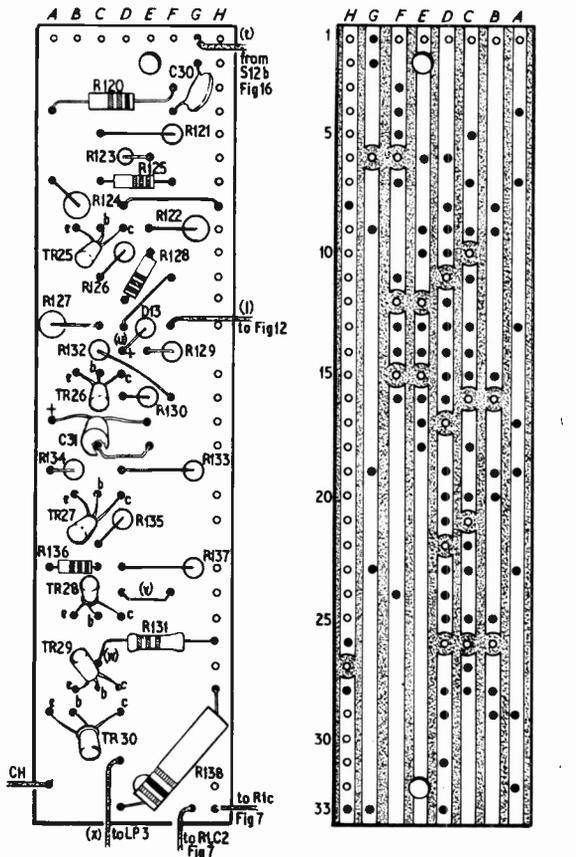


Fig. 17b. Layout of Panel D and cuts in the copper strips

## COMPONENTS . . .

### STAGE SEVEN (Panel "D" Fig. 17)

#### Resistors

R 120	4.7k $\Omega$
R 121	10k $\Omega$
R 122	12k $\Omega$
R 123	2.2k $\Omega$
R 124	150 $\Omega$
R 125	10k $\Omega$
R 126	10k $\Omega$
R 127	12k $\Omega$
R 128	2.2k $\Omega$
R 129	330k $\Omega$
R 130	150k $\Omega$
R 131	2.2k $\Omega$
R 132	47k $\Omega$
R 133	47k $\Omega$
R 134	1k $\Omega$
R 135	22k $\Omega$
R 136	10k $\Omega$
R 137	47k $\Omega$
R 138	180 $\Omega$ 1W

All  $\pm 10\%$ ,  $\frac{1}{4}$ W carbon except R138

#### Capacitors

C30	0.1 $\mu$ F 125V
C31	50 $\mu$ F elect. 25V

#### Semiconductors

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

#### Miscellaneous

Veroboard 0.15in matrix 5in  $\times$  1 $\frac{1}{4}$ in with copper strips

# COMPONENTS . . .

## STAGE EIGHT (Experimental sound effects amplifier)

### Resistors

- R139 330k $\Omega$
- R140 4.7 $\Omega$
- R141 1k $\Omega$
- R142 330k $\Omega$
- R143 3.3k $\Omega$
- R144 22k $\Omega$
- R145 330 $\Omega$  (for 35 ohm LS)

### Capacitors

- C32 0.1 $\mu$ F 125V
- C33 100 $\mu$ F elect. 25V
- C34 0.1 $\mu$ F 125V
- C35 4 $\mu$ F elect. 25V

### Semiconductors

- TR31 OC44
- TR32 OC81D
- TR33 OC81

### Miscellaneous

- LS1 Small 35-40 ohm loudspeaker
- Veroboard 0.15in matrix 5in  $\times$  1.5in 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 MANŒVRABILITY

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	2in
		submerged	2in
M.T.B.	T107	8in	1in

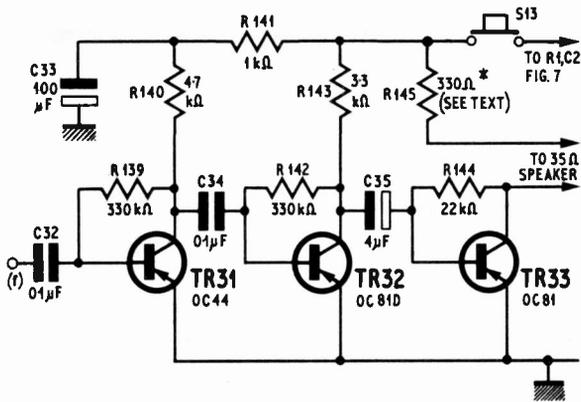


Fig. 18a. Experimental sound effects amplifier

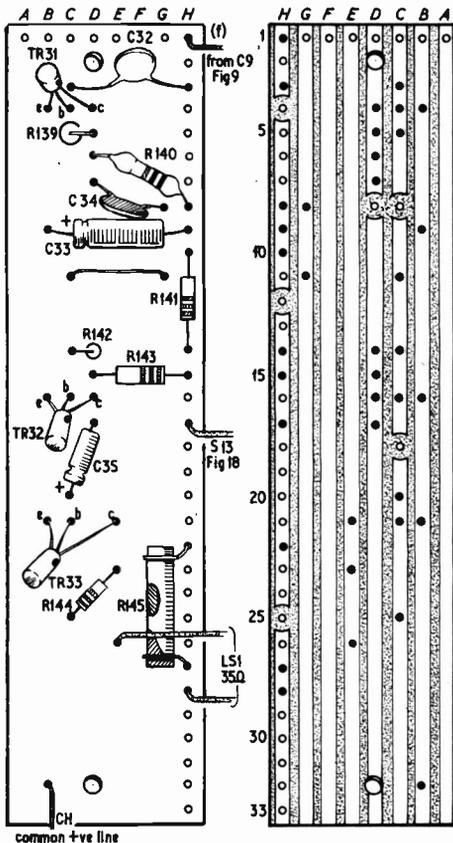


Fig. 18b. Layout of experimental amplifier boards and cuts in the copper strips

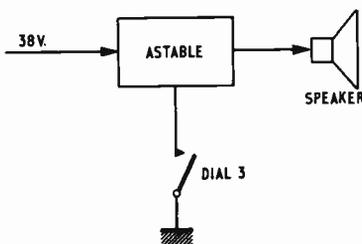


Fig. 19. Using an astable multivibrator switched into use by dial contact in the common chassis line

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 submerged 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.

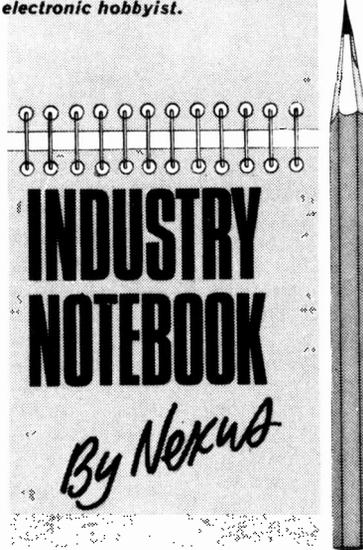
## WHO WAS FIRST ?

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

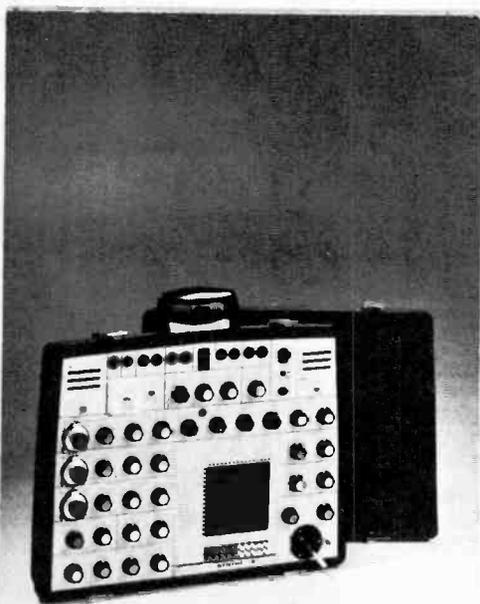
The much-publicised Pre-production Scheme devised by the old Mintech to put numerically-controlled machine tools on the map in Britain cost the tax-payer £2 million and went off like a damp squib. The IRC had a go at rationalising the industry with a splendid investment of your money and mine. And yet 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.



## there is a VCS3 inside this briefcase



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**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**

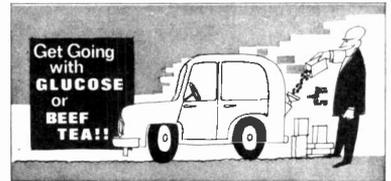
Perhaps thankfully, no one has yet been able to grow muscle tissue on the scale suggested by my reverie, although I recall hearing of someone who went part-way to achieving something rather similar. He found that if a thin strip of collagen (obtained from animal connective tissue and cartilage) is placed 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 another's 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!

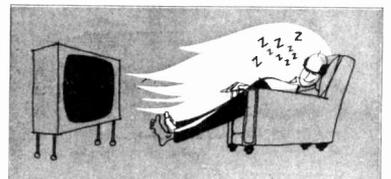


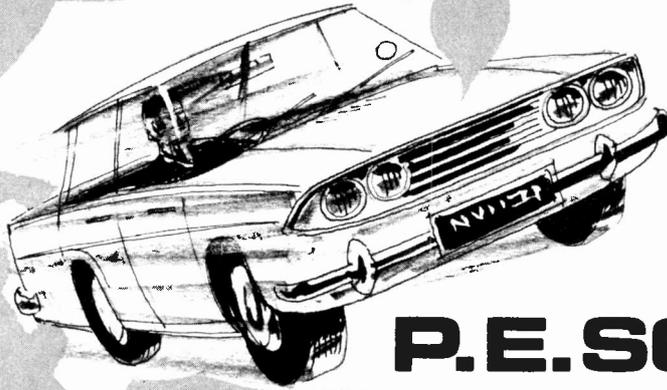
**KEEPING A "BEAD" ON THE ADS**

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.

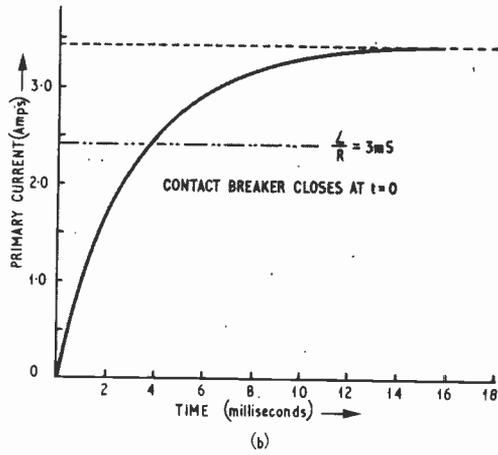
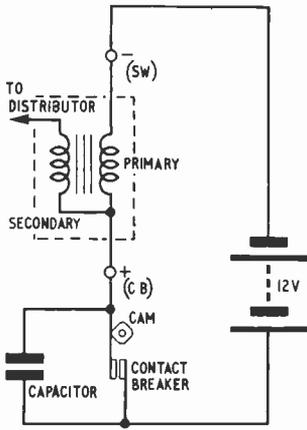


Fig. 1(a). The conventional ignition system. (b) graph of current rise with time in ignition coil primary

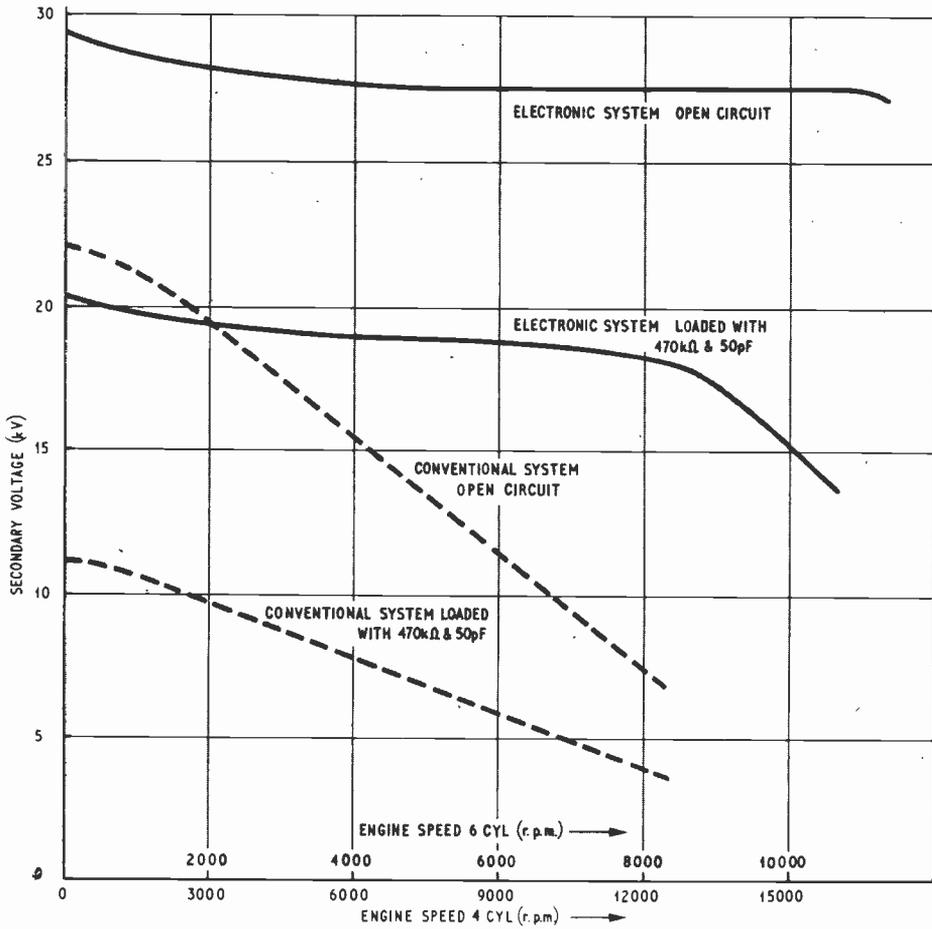
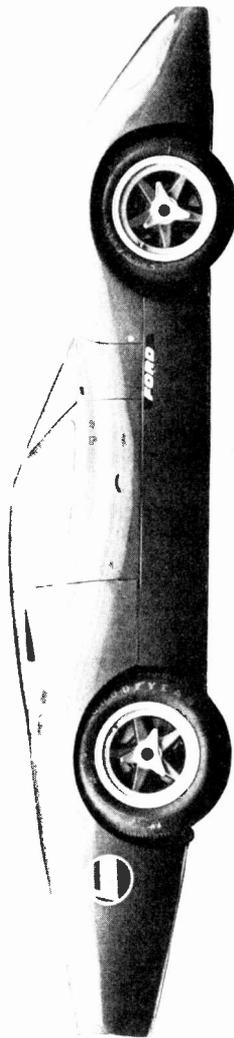
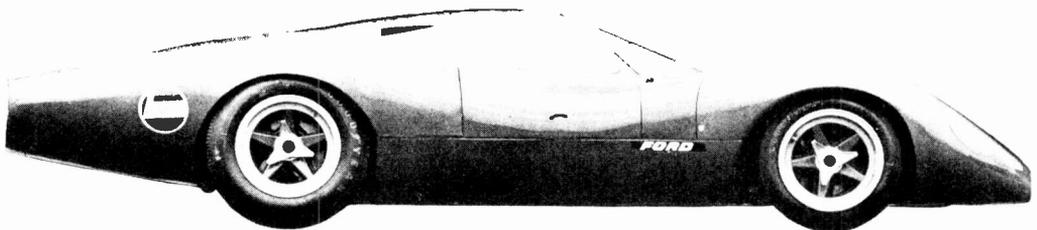
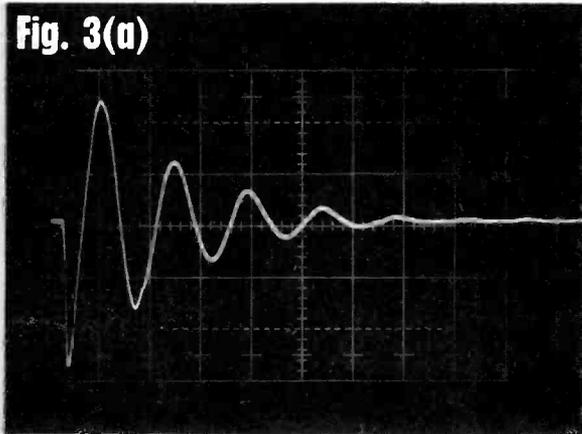
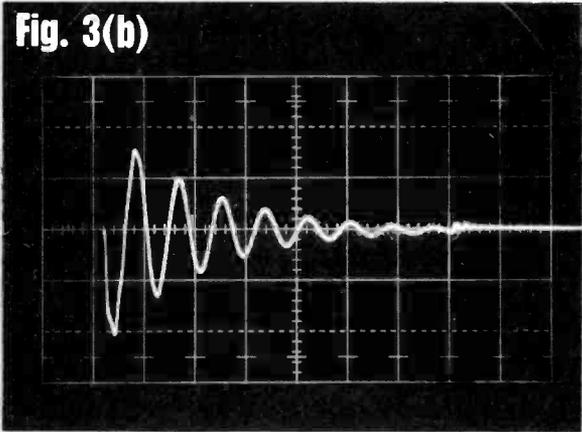


Fig. 2. Output voltage with engine speed for conventional and capacitor discharge systems



5 per cent more BHP



**Fig. 3(a)****Fig. 3(b)**

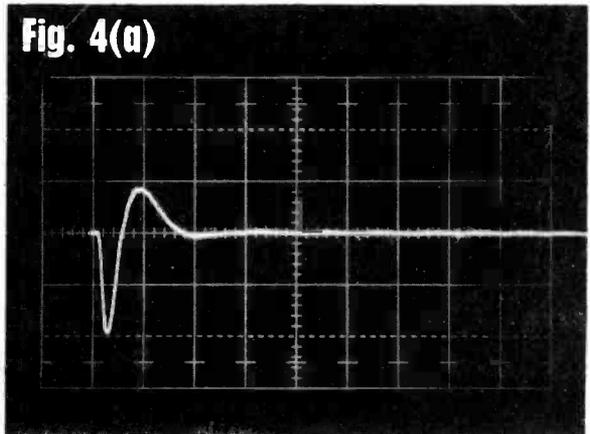
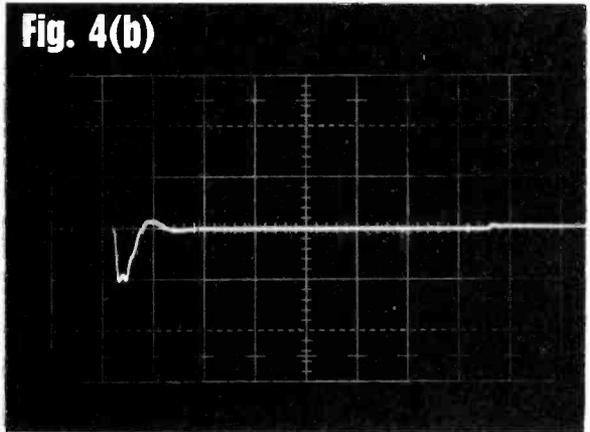
**Fig. 3(a).** Oscilloscope of open circuit secondary voltage with electronic system. Vertical is 10kV/cm and horizontal 200 $\mu$ s/cm. (b) open circuit secondary voltage with conventional system. Vertical is 10kV/cm and horizontal 500 $\mu$ s/cm

### 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 20–30 $\mu$ s as compared with 100 $\mu$ s 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,

**Fig. 4(a)****Fig. 4(b)**

**Fig. 4(a).** Output voltage of electronic system loaded with 470k $\Omega$  and 40pF. Vertical is 10kV/cm and horizontal 200 $\mu$ s/cm. (b) output voltage of conventional system loaded as before. Vertical is 10kV/cm and horizontal 500 $\mu$ s/cm

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.

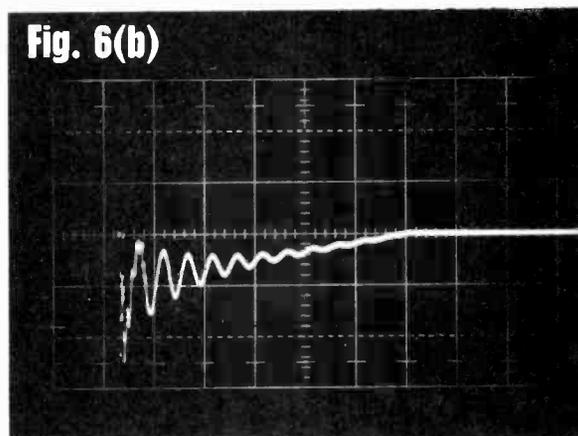
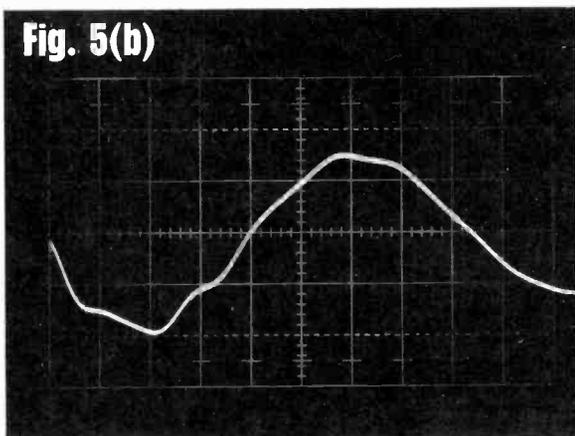
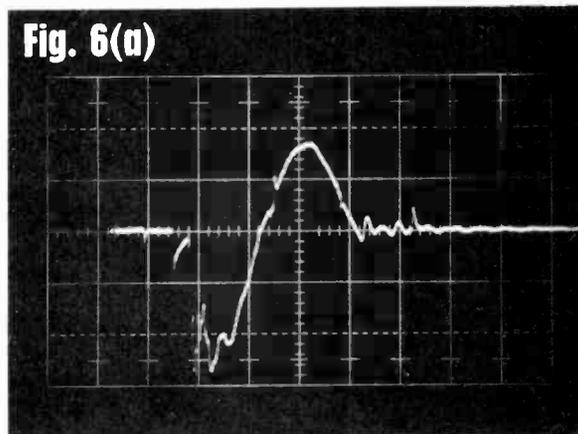
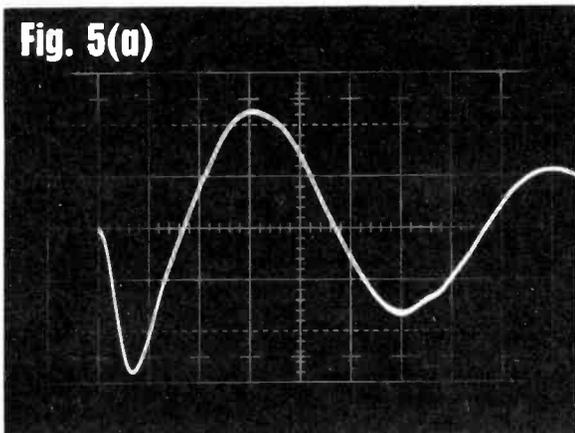
### PERFORMANCE

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 20µs/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

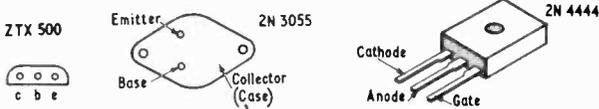
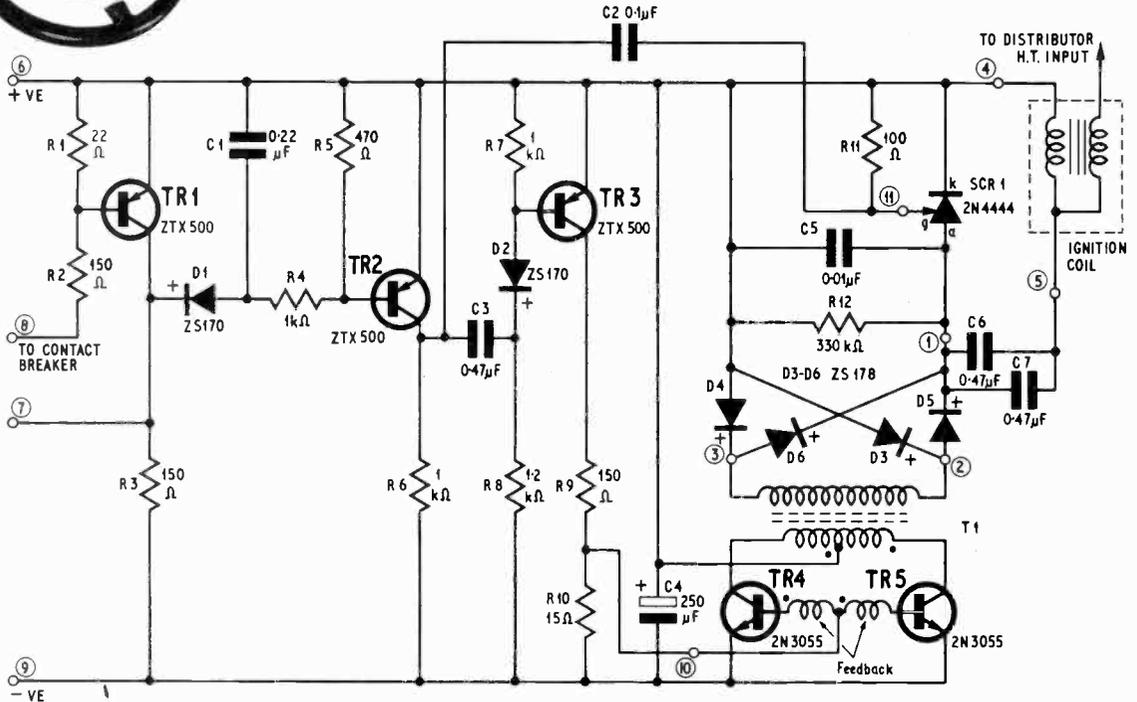


Fig. 7. Circuit diagram of the capacitor discharge system

## COMPONENTS...

### Resistors

R1 22 $\Omega$	R7 1k $\Omega$
R2 150 $\Omega$ 2W	R8 1.2k $\Omega$
R3 150 $\Omega$ 2W	R9 150 $\Omega$ 2W
R4 1k $\Omega$	R10 15 $\Omega$ 1W
R5 470 $\Omega$	R11 100 $\Omega$
R6 1k $\Omega$	R12 330k $\Omega$ 1W
All $\frac{1}{2}$ W 10% carbon except where otherwise stated	

### Capacitors

C1 0.22 $\mu$ F 250V	Mullard C280
C2 0.1 $\mu$ F 250V	Mullard C280
C3 0.47 $\mu$ F 250V	Mullard C280
C4 250 $\mu$ F 40V	Mullard C437
C5 0.01 $\mu$ F 1,000V	
C6 0.47 $\mu$ F 1,000V	
C7 0.47 $\mu$ F 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  $7\frac{1}{2}$ in  $\times$   $4\frac{1}{2}$ in  $\times$  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)



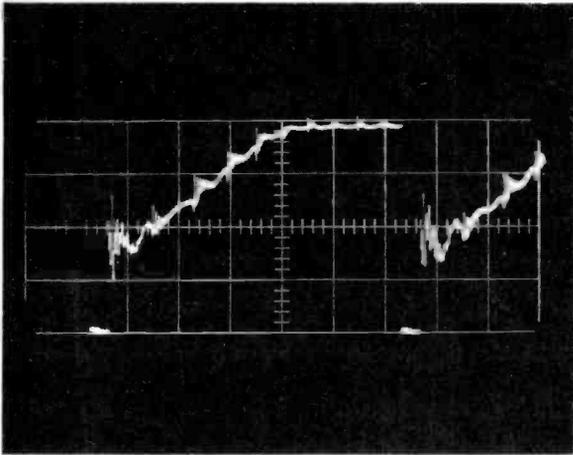


Fig. 8. Voltage on thyristor anode. Vertical is 100V/cm and horizontal 0.5 $\mu$ s/cm

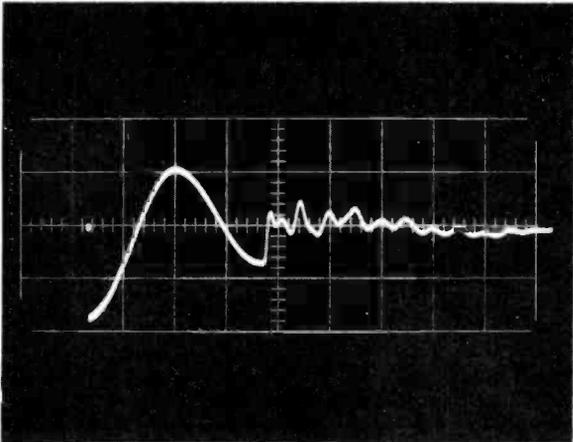


Fig. 9. Voltage across coil primary. Vertical is 200V/cm and horizontal 50 $\mu$ s/cm

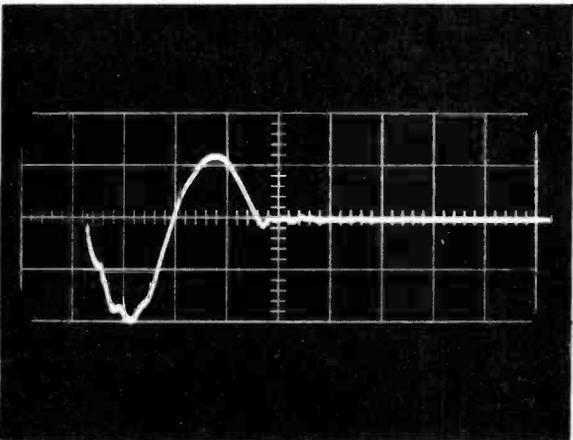
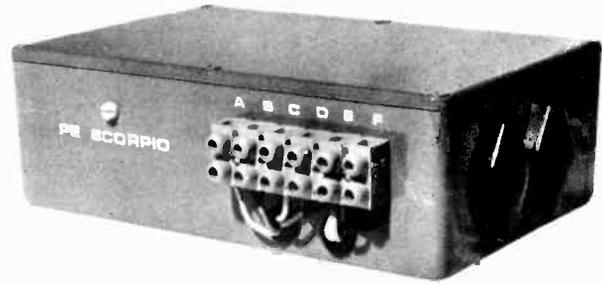


Fig. 10. Current in coil primary. Vertical is 5A/cm and horizontal 50 $\mu$ s/cm



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.

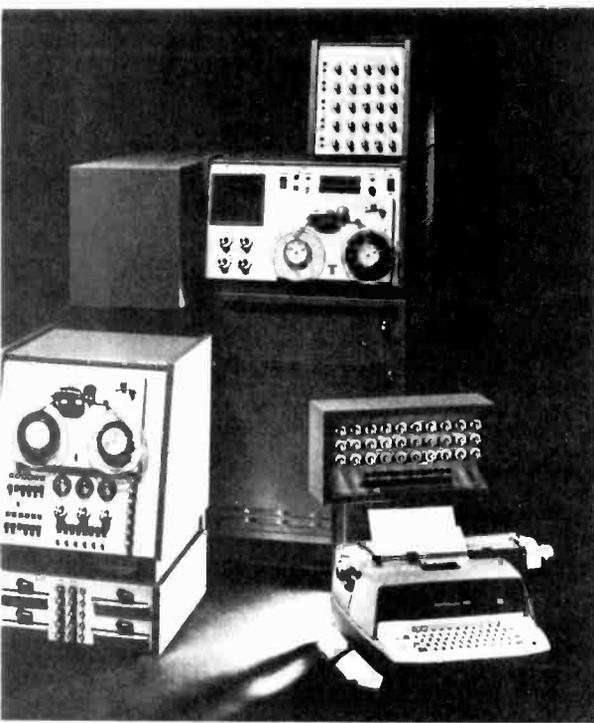
When the contact breaker closes, TR1 turns on and diode D1 is reversed biased. C1 then discharges slowly through R4 and R5, holding TR2 on for a further 0.3ms. Any spurious pulses arriving in this period cannot trigger the thyristor as TR2 is still saturated.

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.

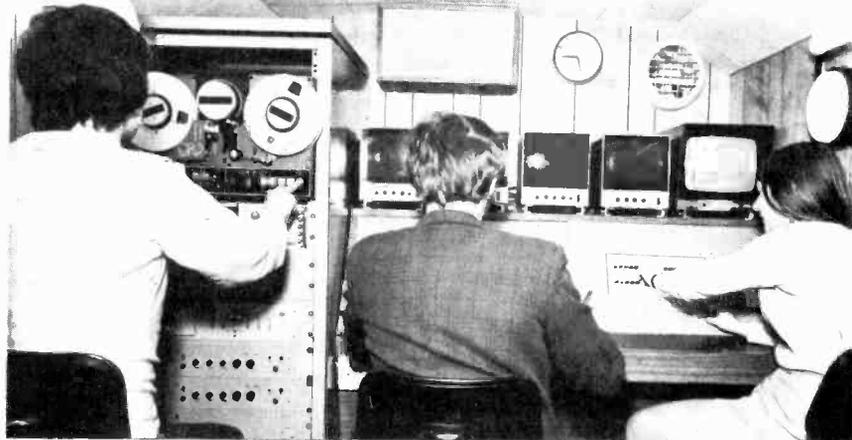
# ELECTRONORAM

## 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 1/2in machine, mainly to record material for colleges whose own VTR equipment is of the 1/2in type. In addition the van is fitted with effects and mixing equipment and a sync-pulse generator.





## Laser Memory

**T**HE 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).

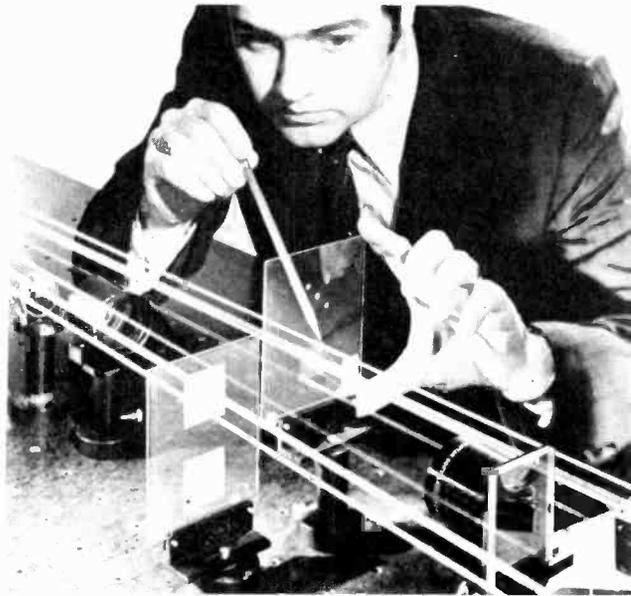
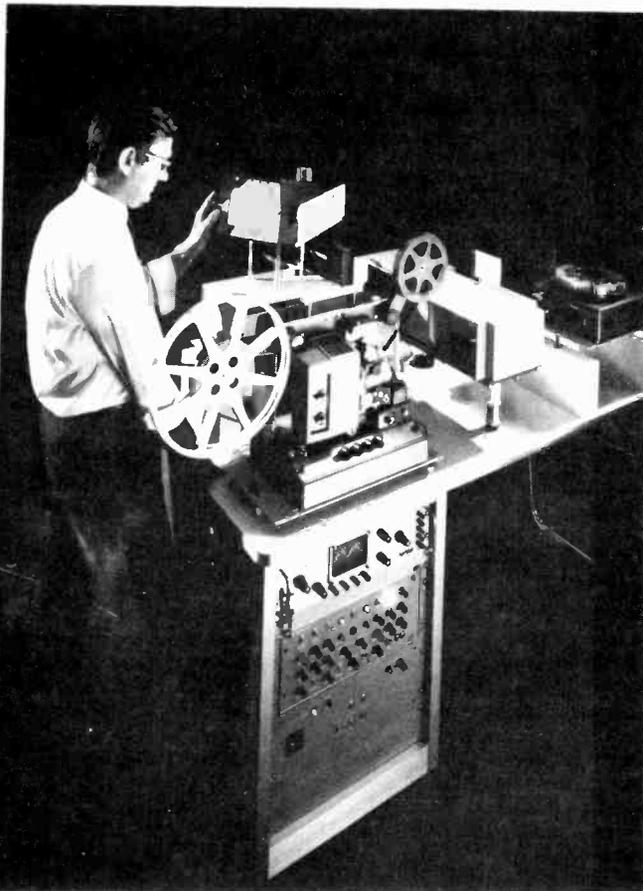
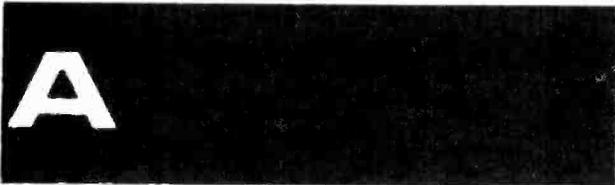
This new advance in holography may lead to a revolutionary document storage system in which files of statistics, architectural drawings, computer data, photographs, maps and other graphic materials are stored permanently in crystals the size of sugar cubes.

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.

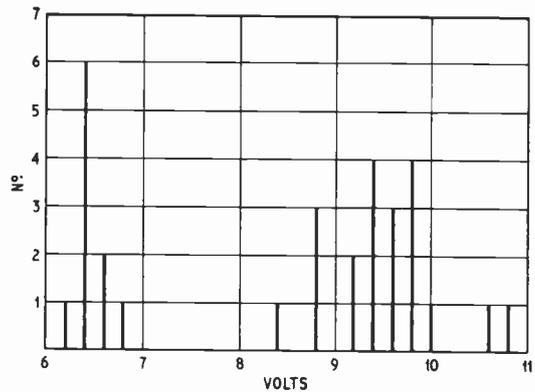


Fig. 1a. Range of base-emitter Zener voltages of a number of sample silicon transistors

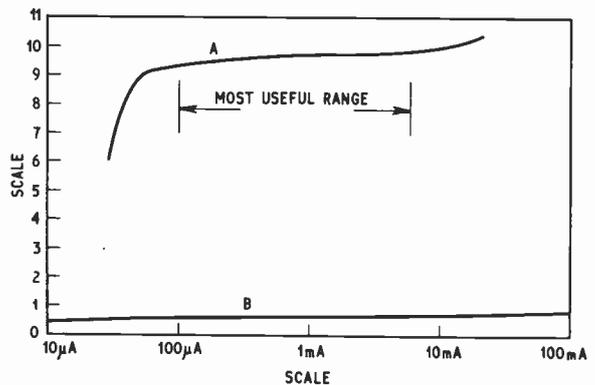


Fig. 1b. Voltage/current characteristic of one sample

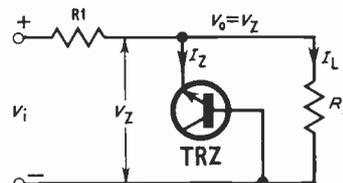


Fig. 2. Circuit used to measure the graph in Fig. 1b

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.

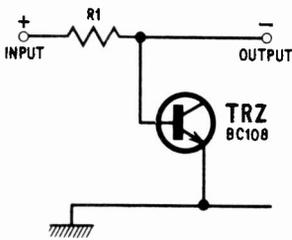


Fig. 3. Forward biased base-emitter junction

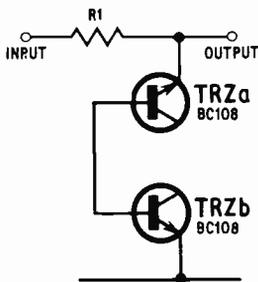


Fig. 5. Series transistors as Zener diodes for 9V supply

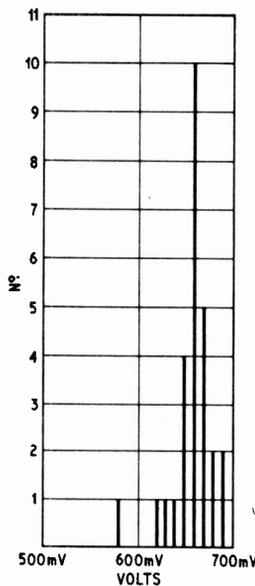


Fig. 4. Range of base-emitter forward voltages from the sample batch

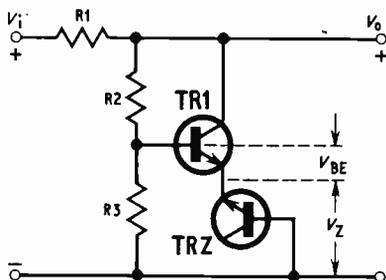


Fig. 6. Arranging higher output voltage by using a transistor

## 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

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

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 15k $\Omega$  and 3.3k $\Omega$  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.

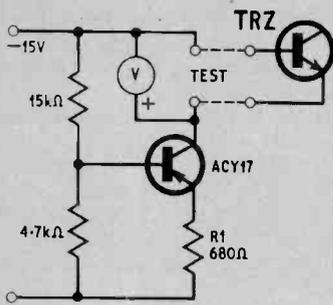


Fig. 7. Simple means of measuring Zener voltage

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.

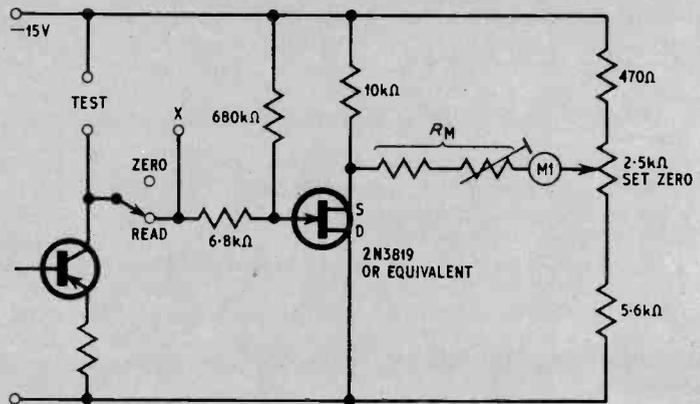


Fig. 8. F.E.T. Zener voltmeter for use with constant current tester. Values for  $R_M$  are as follows: 5.6kΩ fixed and 5kΩ preset for 1mA meter; 10kΩ fixed and 10kΩ preset for 500μA meter; 56kΩ fixed and 50kΩ preset for 100μA meter

A 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.

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*This article explains the principles of light emitting semiconductor materials in connection with modern means of communication.*

**DECEMBER ISSUE**

**ON SALE — NOVEMBER 13**

## "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

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

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

# PATENTS REVIEW...

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

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

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

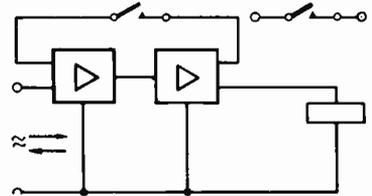


Fig. 1

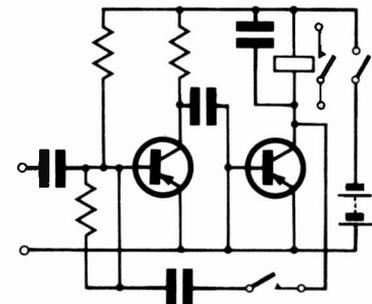
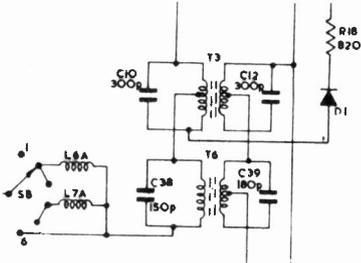


Fig. 2

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.

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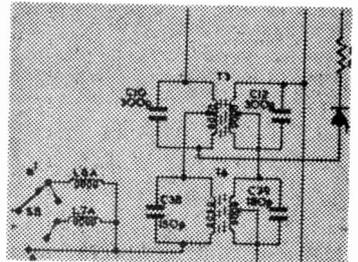
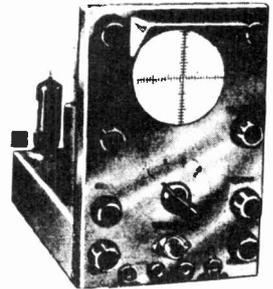
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# PROJECTOR LAMP PROTECTOR

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.

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

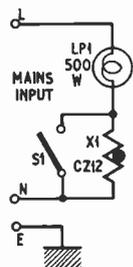


Fig. 1. Switch protection for the Projector lamp thermistor

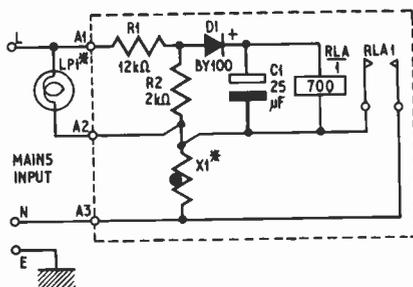


Fig. 2. Circuit diagram of the Automatic Projector Lamp Protector

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 12k $\Omega$  5W  
R2 2k $\Omega$  1W

### Capacitor

C1 25 $\mu$ F 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

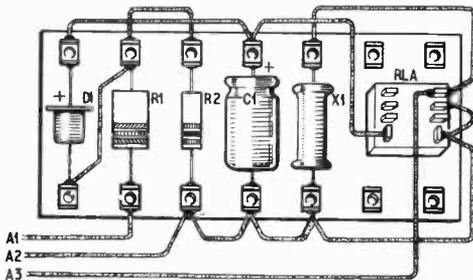


Fig. 3. Tag board assembly and wiring details for the Lamp Protector

## 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 G3VZ1—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.

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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.

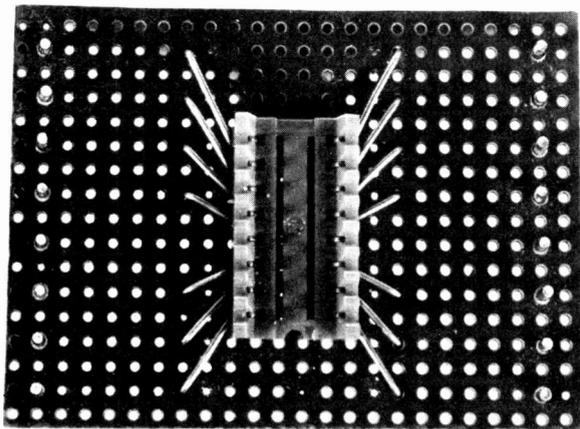
The complete unit can be built in under 30 minutes, costs less than 50 pence and consists of one 16-pin DIL i.c. socket, one small piece of 0.1 matrix Veroboard size 17 × 24 holes, and 16 Veropins.

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.

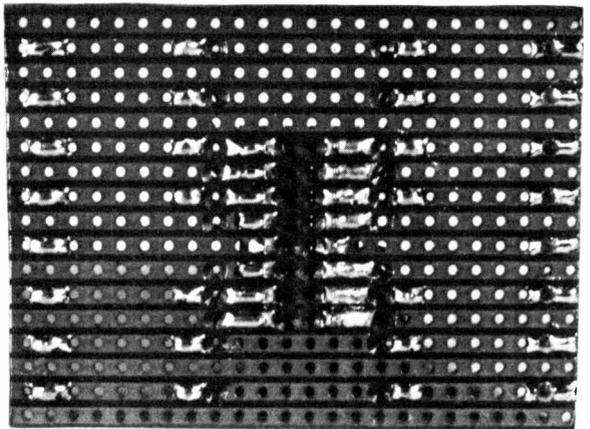
When TR4 turns on, resulting in a low resistance between collector and emitter, C4 discharges through TR4 and D1. Notice that capacitor C5 is prevented from discharging quickly via D2.

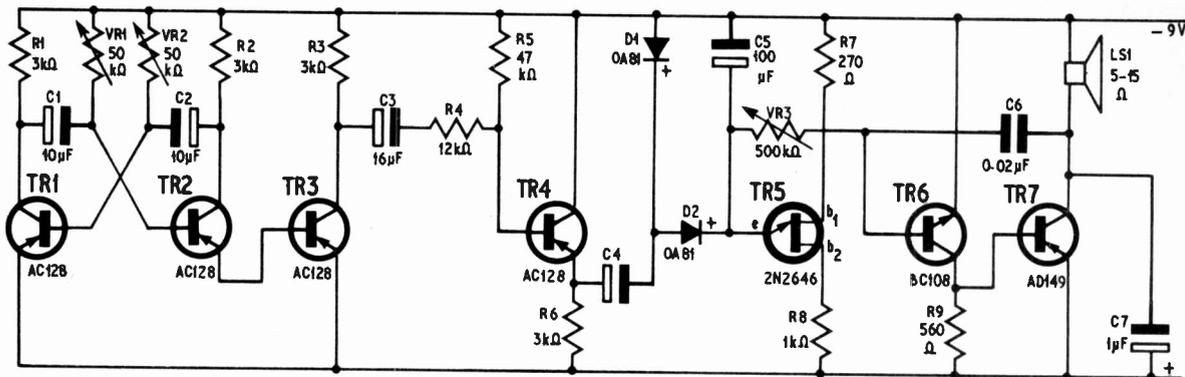
Next time TR4 is cut off C5 charges a little more, and so on. In this way the emitter voltage of the unijunction transistor TR5, after some pulses, gets high enough to fire TR5. Capacitor C2 then discharges, and the process starts all over again.

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

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

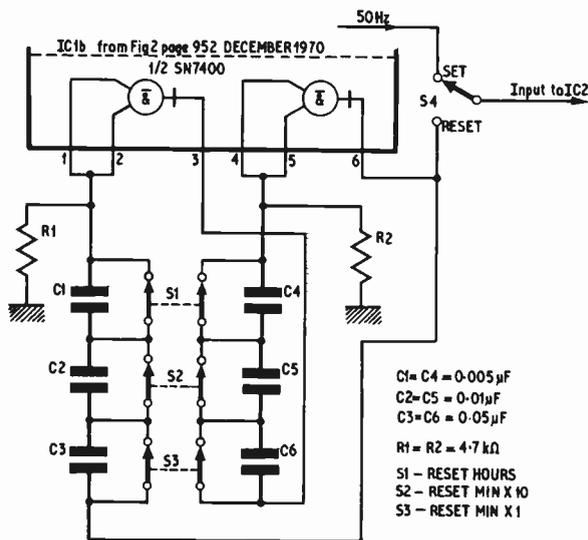
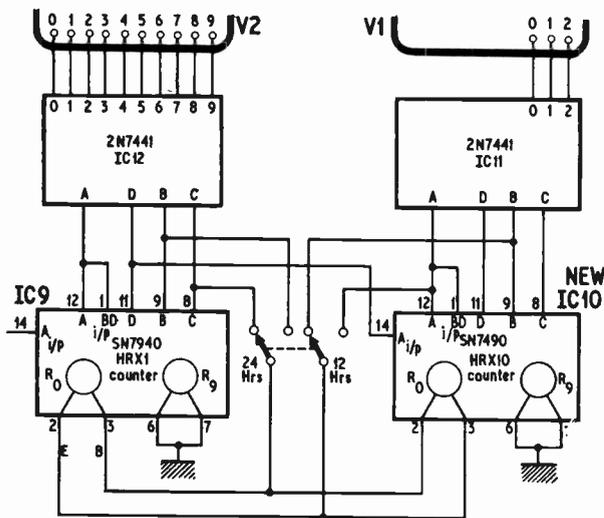
The first enables the Clock to be converted to read a 12 or 24 hours cycle when the alarm system is not being incorporated. As shown in Fig. 1, the counter for HOURS  $\times$  10 is made on SN7490, and the mode of the clock is changed by switching the inputs to RESET ZERO gates of the HOURS  $\times$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

Because the clock is to read both 12 and 24 hours, the HOURS  $\times$  10 Nixie is connected to the HOURS  $\times$  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 frequencies 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  $\times$  10 counter changes approximately once per second. S3 performs the same function for the MINUTES  $\times$  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.



- C1 = C4 = 0.005  $\mu$ F
- C2 = C5 = 0.01  $\mu$ F
- C3 = C6 = 0.05  $\mu$ F
- R1 = R2 = 4.7 k $\Omega$
- S1 - RESET HOURS
- S2 - RESET MIN  $\times$  10
- S3 - RESET MIN  $\times$  1



## 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 researchers 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.

## ASTERIODS 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, 8½ in × 5½ in. 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, 8½ in × 6 in. 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, 9 in × 6 in. 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, 10 in × 7½ in. 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 Andromeda 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 nebulae 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.

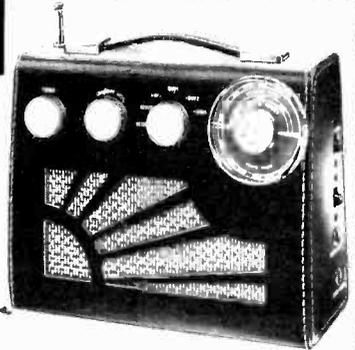
Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. Switched earpiece socket complete with earpiece. 10 transistors plus 3 diodes. 7in x 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 x 7in x 4in.

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

TOTAL BUILDING COSTS

**£8-50**

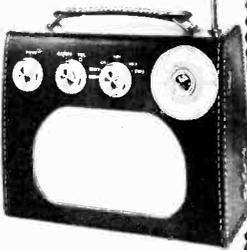
P.P. & INS. 50p  
(OVERSEAS P. & P. £1)



### ROAMER EIGHT

Mk. I

NOW WITH SWITCHED TONE CONTROL

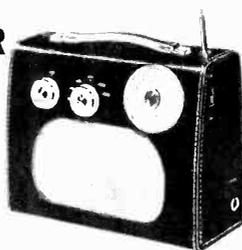


7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Retractable chrome plated telescopic aerial for short waves. Push-pull output using 600mW transistors. Car aerial and tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 7in x 4in speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shadle with gold blocking. Size 9in x 7in x 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

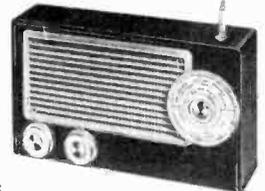


7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Extra

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 x 4in P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9in x 7in x 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

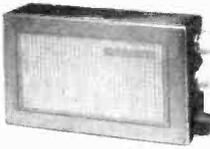


6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, TRAWLER

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 x 5 1/2in x 2 1/2in 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 5 1/2in x 1 1/2in x 3/4in. 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

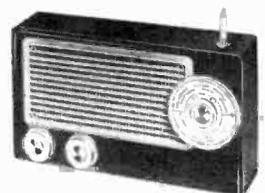


NOW WITH 3in SPEAKER

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 6 1/2in x 4 1/2in x 1 1/2in. 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 x 5 1/2in x 2 1/2in 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)



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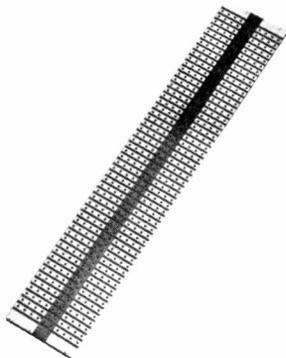
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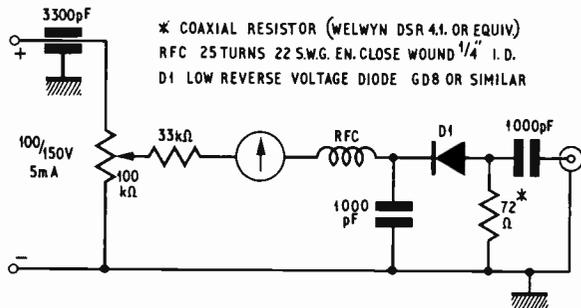
trots on the receiver. If the sensitivity available is such that the loudspeaker needs to be in parallel all the time, then to avoid causing disturbance by the continual hiss of the speaker, a simple muting arrangement of switching in a dummy load resistor in place of the loudspeaker can be used.

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.

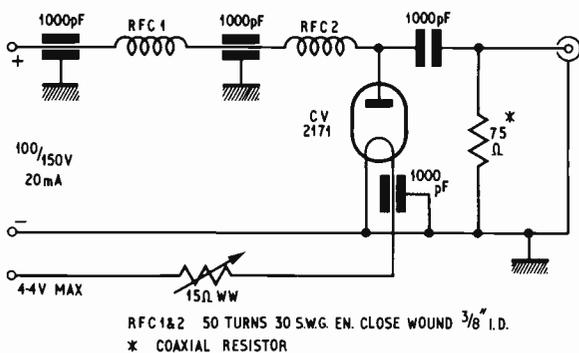
## OTHER TYPES OF RECORDER

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.

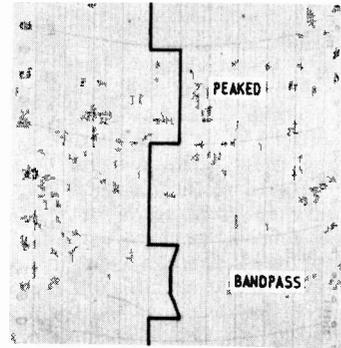
Where the potentiometer system in the output stage is used there will be the additional control which sets the recorder level, whether this be high or low resistance coil. The same conditions apply,



**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

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.

## 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.

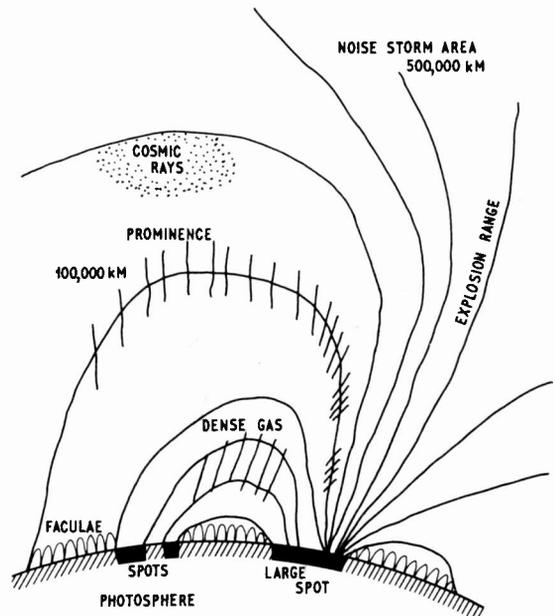


Fig. 6.4. Solar bursts. Diagram of a centre of radio activity on the sun

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2N1131	29p	2N3052	60p	AC153K	22p	BC159	12p	C407	17p
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2N1302	19p	2N3703	13p	AC176	16p	BC168	10p	MP56531	35p
2N1303	19p	2N3704	13p	AC176	16p	BC169	11p	MP56534	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	29p	2N3708	13p	AD161	33p	BC182L	11p	NKT274	18p
2N1308	36p	2N3709	13p	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	35p
2N1893	54p	2N3904	35p	AF124	24p	BC214L	16p	OC81D	25p
2N2147	95p	2N3906	35p	AF127	22p	BCY70	18p	ZTX300	14p
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2N2219A	53p	2N4061	11p	AS228	27p	BF173	19p	ZTX304	27p
2N2270	62p	2N4062	12p	BC107	12p	BF174	19p	ZTX500	21p
2N2369A	19p	2N4124	18p	BC108	11p	BF194	14p	ZTX502	25p
2N2483	35p	2N4126	27p	BC109	12p	BF195	15p	ZTX503	22p
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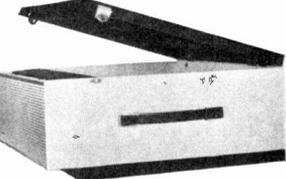
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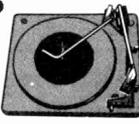
### PHILIPS PORTABLE PLAYER CABINET



Size 18 x 15 1/2 x 7 1/2 in. Cut for BSR UA12/14/15/16/25 deck. Amplifier space 14 x 5 x 3 1/2 in. Satin aluminium front grille. Really smart appearance. £4 Post 25p  
Black/White. Chrome fittings.

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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 13 x 11 1/2 in. Above motor board 3 1/2 in. below motor board 2 1/2 in.



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RECORD PLAYER PORTABLE CABINET £3.75 With space for R.C.S. Amplifiers and most modern autochangers. Two-tone rexine covered. Post 25p.

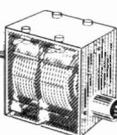
RCS-DE-LUXE 3 WATT AMPLIFIER. Ready made tested. 2-stage with triode pentode valve, 3 wats output. Tone and volume controls. Isolated mains transformer. Knobs, loudspeaker, valves ECL82, EZ80. Response 50-12,000 cps. Sensitivity 200mV. Post 25p. £4

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BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1.40; 60 yd. £2. FRINGE/LOW LOSS 10 p. Ideal 825 and colour yd

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Small type with all knob. Values 10 to 30 K. 25p

### WIRE-WOUND 3-WATT STANDARD SIZE POTS.

LONG SPINDLE 10 OHMS to 100 K. 40p

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BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2in. sides 7 x 4in. 45p; 8 x 7in. 50p; 11 x 7in. 70p; 13 x 9in. 75p; 14 x 11in. 80p; 15 x 14in. 85p; 11 x 3in. 50p. ALUMINIUM PANELS 18 s.w.g. 6 in. wide 3p per lin.; 8 x 6in. 15p; 10 x 7in. 17p; 12 x 8in. 23p; 14 x 9in. 27p; 12 x 12in. 32p.

1 1/2 inch 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.

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£2.35 Post 15p. A.C. Leadite S.A.E.

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All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/250V 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. £2 Post Free Details S.A.E.

### 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 1 1/2 x 1 1/2 x 1 1/2 in. Response c.p.s. to 25 Kc/s, 28 db gain. For use with valve or transistor equipment. Full instructions supplied. Brand new. 90p Post Guaranteed. Details S.A.E.

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  
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18/450V . . . 15p 1000/50V . . . 47p 32 + 32/250V . . . 18p  
32/450V . . . 20p 8 + 8/450V . . . 18p 32 + 32/450V . . . 38p  
25/25V . . . 10p 8 + 16/450V . . . 35p 16 + 50/325V . . . 50p  
50/50V . . . 10p 16 + 16/450V . . . 25p 32 + 32 + 32/350V . . . 48p  
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 14V; 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% . . . 2-2-500V 8p; 560-2,200mF 10p; 7,700-5,600pF 20p 500pF-0.01, mid 33p each.  
TWIN GANG. "0-0" 208pF + 178pF, 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 50, 70, 100, 150, 200, 300, 500, 1000pF, 150pF, 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; 35mA 48p. SILICON BYZ13 30p; BY100 30p; EY127 30p. Full wave Bridge Rectifiers 75mA 50p; 150mA 98p. RECTIFIERS CONTACT COOLED 300mA 30p; 500mA 30p. NEON PANE INDICATORS 250V AC/DC Red or Amber 20p. RESISTORS. 1/4 w. 1/2 w. 1 w., 20% 1p; 2 w. 5p. HIGH STABILITY. 1 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; 2 1/2 watt, 1 ohm to 8-20hms 10p.

### PHILIPS TRANSISTOR FM STEREO MULTIPLEX DECODER

As used in LEAK Troughline Tuner. Brand New. Pre-aligned with 9 semiconductor. 24V d.c. at 6mA. Complete with connection details. £4 Post Free 1 1/2 x 2 1/2 in.

### MAINS TRANSFORMERS

All post 25p each  
250-0-250 80 mA. 8.3 v. 4 amp. . . . . £1.40  
250-0-250 80 mA. 6.3 v. 3.5 a. 8.3 v. 1 a. or 5 v. 2 a. . . . . £2  
350-0-350 80 mA. 8.3 v. 3.5 a. 8.3 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. 2 1/2 x 2 1/2 in. . . . . 75p  
MIDGET 220 v. 45 mA. 6.3 v. 2 a. 2 1/2 x 2 1/2 in. . . . . 90p  
P.E. AURORA TRANS. 12 + 12v. 600mA . . . . . £1.50  
MINI-MAINS 20v. 100mA. 1 1/2 x 1 1/2 x 1 1/2 in. . . . . 50p  
HEATER TRANS. 6.3 v. 2 a. 100v. . . . . 60p  
Ditto tapped etc. 1.4, 2, 3, 4, 5, 6.3 v. 1 1/2 amp. . . . . 80p  
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp., 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, 30, 36, 40, 48, 60, 72 1 amp., 6, 8, 10, 12, 16, 20, 24, 30, 36, 40, 48, 60, 72 2 amp., 6, 8, 10, 12, 16, 20, 24, 30, 36, 40, 48, 60, 72 AUTO TRANSFORMERS. 115v to 230v or 230v to 115v. Input/Output 50w. £2. 500w. £4. 1000w. £12. CHARGER TRANSFORMERS. Input 200/250V. For 6 or 12v., 1 1/2 amp., £1.20; 2 amp. £1.50; 4 amp. £2. FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. 1 1/2 amp. 40p; 2 amp. 55p; 4 amp. 85p. All Transformers Postage 25p each

### E.M.I. 13 1/2 x 8 in. LOUSPEAKERS

With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. £4 Post 15p As illustrated.  
With fired tweeter cone and ceramic magnet. 10 watt. Bass re. 45 cps. Flux 10,000 gauss. £2.25 Post 15p State 3 or 8 or 15 ohm.  
Recommended Teak Cabinet Size 16 x 10 x 9 in. Post 25p. £5

### 10W MINI-MODULE £3.25 LOUSPEAKER KIT

Post 25p Triple speaker system combining on ready cut baffle. 1 in. chipboard 15 in. x 8 in. Separate Bass, Middle and Treble loudspeakers and crossover controller. The heavy duty 5 in. Bass Woofer 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 20-18,000 cps. Full instructions for 3 or 15 ohms. TEAK VENEERED BOOKSHELF ENCLOSURE. 16 1/2 x 10 1/2 x 6 in. 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 Maxwell. Bass resonance 40 Hz. R.F.C. 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' 12 inch £7 'Group 35' 12 inch £9 'Group 50' 15 inch £19  
2 1/2 watt 35 watt 50 watt  
3 or 8 or 15 ohm 3 or 8 or 15 ohm 8 or 15 ohm

TEAK HI-FI SPEAKER CABINETS. Fluted wood front. For 12in. round Loudspeaker . . . . . £9 Post 25p For 13 x 8in. Loudspeaker . . . . . £5 Post 25p For 16 x 8in. Loudspeaker . . . . . £4 Post 25p LOUSPEAKER 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 3 1/2 x 3 1/2 in. deep. Rating 10 watt, 3 ohm or 15 ohm models. £1.90 Post 10p

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OUTPUT TRANS. EL84, etc. 25p. MIKE TRANS. 50 1 1/2 25p. SPEAKER COVERING MATERIALS. Samples Large S.A.E. GOODMANS OUTPUT TRANSFORMERS 5 watt pull for valves EL84, etc., 3, 8 and 15 ohms 85p. Post 20p.

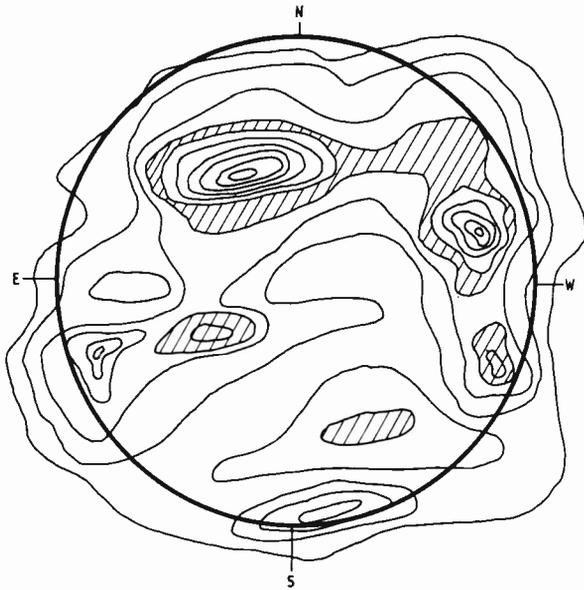
### BAKER 100 WATT ALL PURPOSE POWER AMPLIFIER

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 Superbet. Ferrite aerial. 9 volt. £4  
BARGAIN 4 CHANNEL TRANSISTOR MIXER. Add musical highlights and cross effects to recordings. With 4 Microphone, recorder, 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 x 5 x 4 inch BARGAIN FM TUNER as above. £7.50 Chassis only, less cabinet.  
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. 8 ohms or 300 ohms. JACK SOCKET 84d. open-circuit 14p, closed circuit 22p; Chrome Lead Socket 45p. Phono Plug 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 8-pin 18p; 5-pin 15p; DIN PLUGS 3-pin 10p; 5-pin 25p. VALVE HOLDERS, 5p; CERAMIC 8p; CANS 5p.  
E.M.I. TAPE MOTORS. 150v. or 240v. AC 1,200 r.p.m. 4 pole 132mA Spindle 0.187 x 0.75in. Size 3 1/2 x 1 1/2 x 2 1/2 in. (Illustrated). Post 15p. £1.25  
BALFOUR GRAM. MOTORS. 120v. or 240v. AC, 1,200 r.p.m. 4 pole 56mA. Spindle 1/2 x 3/80. Size. 85p 2 1/2 x 2 1/2 x 1 1/2 in. Post 15p



**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 pro-

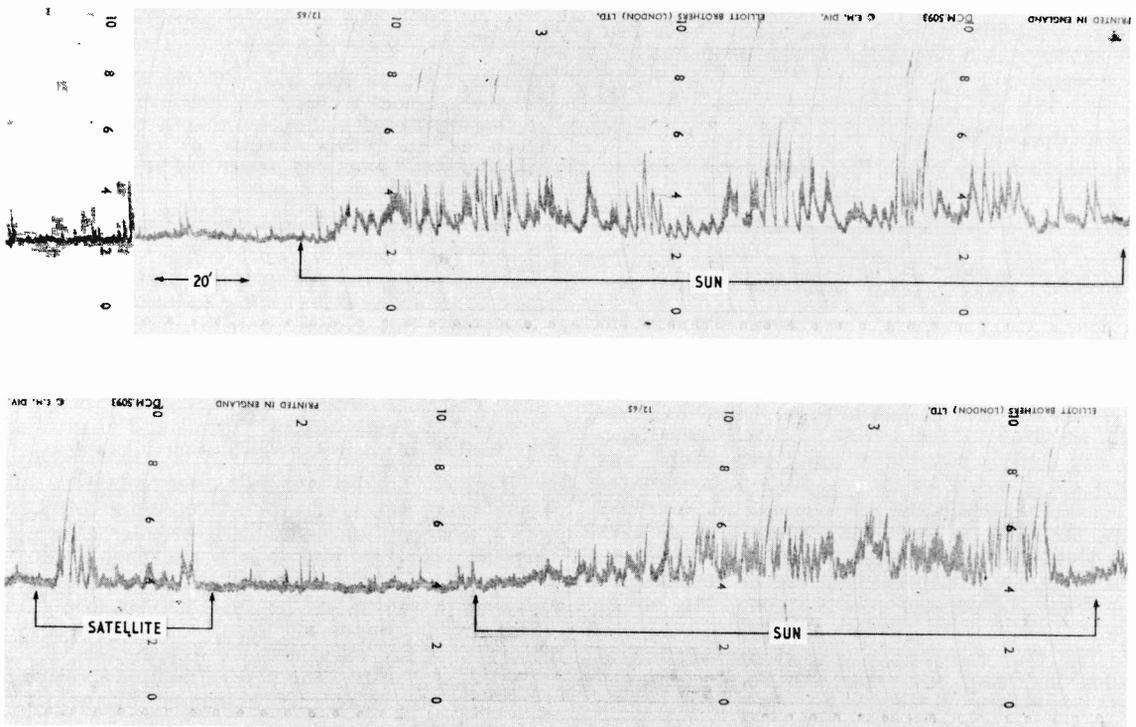
trudes through the chromosphere, the gas is made to glow and the hydrodynamic waves travel up the magnetic lines and produce bright streaks known as faculae. The corona is also heated. It is after this phase that the actual sunspots appear.

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**

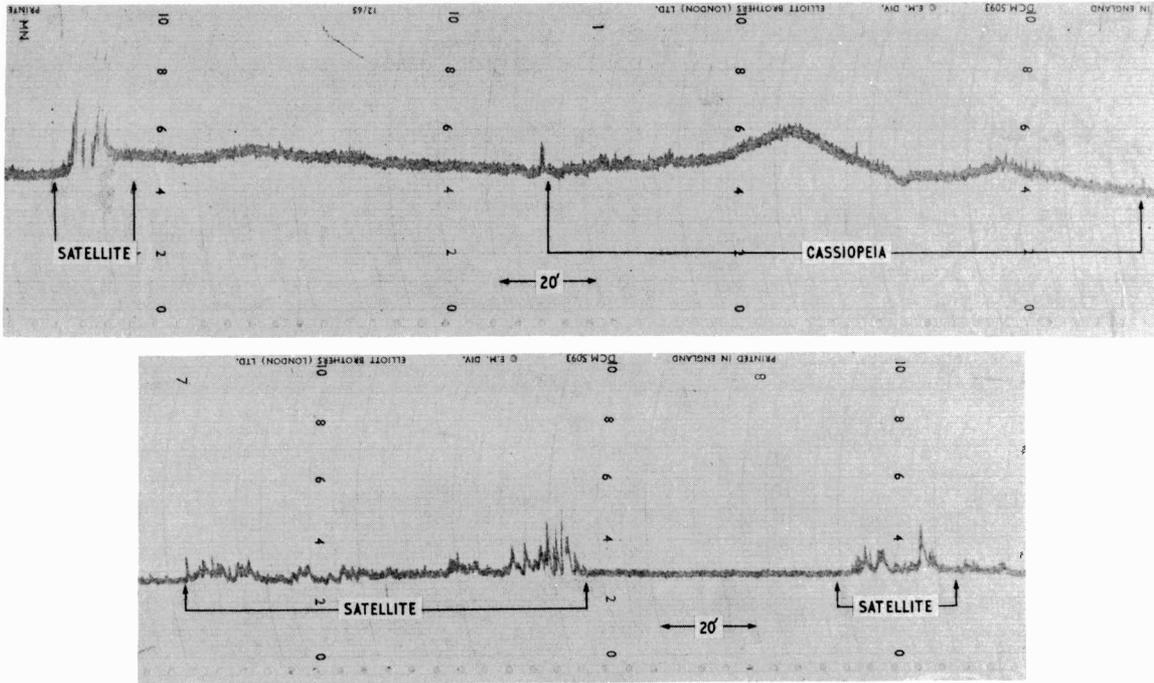


Fig. 6.7a Pen recording of a satellite and Cassiopeia. b Recording of two satellite passes

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 possibilities 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.

# BUDGET HIGH-FIDELITY STEREO SYSTEMS



**PREMIER STEREO SYSTEM "ONE"** consists of an all transistor stereo amplifier, Garrard 2025 T/C auto manual record player unit fitted stereo mono ceramic cartridge with diamond stylus and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. 2500 amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner, also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector, Power on/off. Solid teak cabinet with aluminium front panel. Size: 12 1/2 in X 4 1/2 in X 3 1/2 in high (Amplifier available separately if required £14.95, Carr. 40p).

**ONLY £40-95**  
carr. £1.75

**PREMIER STEREO SYSTEM "TWO"**, as above but with Garrard SP25 Mk III—ONLY £47. Carr. £1.75.

**ONLY £57-75**  
carr. £1.75

**PREMIER STEREO SYSTEM "THREE"**. This consists of Klinger KC903 stereo amplifier giving 6 watts rms per channel with Bass, Treble, Volume and Balance Controls. Inputs for Magnetic and ceramic pick-up, tuner, tape in and out, Stereo headphone socket. Garrard SP25 Mk III in teak finish plinth with cover and fitted Sonotone 9TAHCD diamond stereo cartridge. A pair of HMF Speakers size 16 1/2 in X 10 1/2 in X 9 in and fitted EM1 units complete the matching system.

**ALL SYSTEMS SUPPLIED WITH FREE LEADS AND PLUGS**

## PREMIER HI-FI OFFERS!

- Amstrad 8000 Stereo Amplifier (List £25.95) **£16.75**
- Philips 58C Stereo Amplifier (List £29.00) **£21.00**
- Rogers Ravensbrook 11 Stereo Amplifier in teak case (List £52.50) **£39.50**
- Rogers Ravensbourne Stereo Amplifier in teak case (List £64) **£49.00**

**NOW AVAILABLE AGAIN!!**  
MODEL SAQ203 Stereo Amplifier—Return of this popular model. 1000's have been sold. **£19.50**  
NOW AT NEW LOW PRICE

- Metrosound ST20 Stereo Amplifier in teak case (List £36) **£24.50**
- Goldring GL75 less cartridge (List £41.61) **£29.00**
- Garrard SP25 111 less cartridge **£11.90**
- Garrard SP25 111 with Goldring G800 cartridge (List £28.35) **£18.40**
- Garrard AF76 less cartridge **£19.50**

Garrard 3500 with Sonotone 9TAHCD stereo cartridge (List £15.50) **£9.97**

Garrard 2025 T/C with Sonotone 9TAHC Diamond Cartridge **£8.97**

Garrard 2025 T/C with Sonotone 9TAHC Diamond Cartridge ready wired in teak plinth with cover **£14.00**

Carriage and Insurance 50p extra any item.

## SP25 Mk III SPECIAL!



Garrard SP25 Mk. III Single Record Player. Fitted AT66 Magnetic Stereo Cartridge as available Complete in Teak Plinth with Rigid Perspex Cover.

Total list Price over £29.

**PREMIER PRICE £19.90**  
P. & P. 50p



## HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2 1/2 in speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft lead and stereo jack plug.

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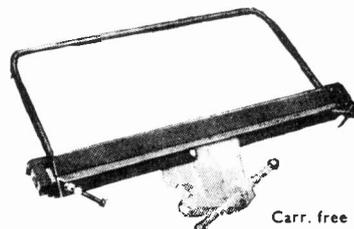
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# Readout —

## 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 thingummy 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.



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Lift lid once stays open. Lift twice catch releases and allows lid to close. Closed length 7 1/2 in, open length 10 1/2 in. Finished dull plating brand new. 4 for £1. Post free.

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Similar principle to above closed length 1 1/2 in, open length 5 1/2 in. Finished dull plating brand new. 5 for £1. Post free.

### NEW MICROSWITCHES—HONEYWELL

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Sensitivity: 166-6 Ohms/Volt, 333-3 Ohms/Volt when divided by two button is pressed on both a.c. and d.c. ranges.  
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Due to demand it may not always be possible to supply a particular model, and a different type to that ordered may be dispatched. These models are electrically identical.

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Side Reading	38m/m Lead	(Amber)	
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XN3A	6m/m Lead	(Clear)	
XN11/F	38m/m Lead	(Red)	
XN23/FA	38m/m Lead	(Amber)	
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AC197	20p	C4V3	15p	NKT80213	75p	2N696	15p
AC198	20p	C4V7	15p	NKT80214	75p	2N697	17p
AC200	19p	CSV1	15p	NKT80216	75p	2N698	30p
AC221	19p	CSV6	15p	OA10	25p	2N706	10p
AC222	19p	C6V2	15p	OA5	20p	2N706A	12p
AC240	15p	C6V8	15p	OA10	25p	2N708	16p
AD140	15p	C7V5	15p	OA7	8p	2N711	37p
AD149	57p	C8V2	15p	OA73	8p	2N711A	37p
AD161	37p	C9V1	15p	OA79	8p	2N911	50p
AD162	37p	C10	15p	OA81	8p	2N914	20p
AF106	24p	C11	15p	OA85	8p	2N918	42p
AF114	25p	C12	15p	OA89	8p	2N1090	30p
AF115	25p	C13	15p	OA91	8p	2N1091	33p
AF116	25p	C15	15p	OA95	8p	2N1131	30p
AF117	25p	C18	15p	OA200	10p	2N1132	30p
AF118	44p	C20	15p	OA202	10p	2N1302	20p
AF124	25p	C22	15p	OC19	37p	2N1303	20p
AF126	17p	C24	15p	OC20	97p	2N1305	25p
AF139	33p	C27	15p	OC22	47p	2N1306	30p
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BFY52	16p	NKT613F	30p	IN60	20p	40673	20p
BFY53	16p	NKT674F	30p	IN64	20p		
BFY90	67p	NKT675F	28p	IN82A	47p		
BSX19	16p	NKT676F	28p	IN914	7p		
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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	Part No.	Description	Equal to	1-24	25-99	100 up	Part No.	Description	Equal to	1-24	25-99	100 up
FLH 101	Quad 2-input NAND gate	7400	20p	16p	14p	271	Hex inverter with open collector output	7405	25p	21p	18p	FLJ 141	Dual D-type edge triggered flip-flop	7474	46p	38p	33p
111	Triple 3-input NAND gate	7410	20p	16p	14p	281	BCD to decimal decoder TTL	7442	£1.16	94p	81p	151	Quad bistable latch	7475	45p	40p	37p
121	Dual 4-input NAND gate	7420	20p	16p	14p	291	Quadruple 2-input NAND gate with open collector output	7403	20p	16p	14p	161	Decade counter	7490	80p	67p	57p
131	8-input NAND gate	7430	20p	16p	14p	341	Quadruple 2-input exclusive-OR element	7486	33p	27p	23p	171	Divide-by-12 counter	7492	85p	71p	61p
141	Dual 4-input NAND buffer	7440	24p	20p	17p	351	Schmitt Trigger	7413	35p	29p	25p	181	4-bit binary counter	7493	80p	67p	57p
151	Expandable dual 2-wide 2-input AND-OR-INVERT gate	7450	20p	16p	14p	361	Excess 3 to decimal decoder	7443	£1.45	£1.20	£1.08	191	4-bit shift register	7495	87p	72p	62p
161	Dual 2-wide 2-input AND-OR-INVERT gate	7451	20p	16p	14p	371	Excess 3 gray to decimal decoder	7444	£1.45	£1.20	£1.08	201	Synchronous up down 4-bit decade counter with one line mode control	74190	£1.80	£1.48	£1.27
171	Expandable 4-wide 2-input AND-OR-INVERT gate	7453	20p	16p	14p	381	Quad 2-input positive AND gate Totem pole output	7408	25p	21p	18p	211	Synchronous up down 4-bit binary counter with one line mode control	74191	£1.80	£1.48	£1.27
181	4-wide 2-input AND-OR-INVERT gate	7454	20p	16p	14p	391	Quad 2-input positive AND gate open collector	7409	25p	21p	18p	221	8-bit shift register	7491A	£1.28	£1.07	92p
191	Quadruple 2-input NOR gate	7402	20p	16p	14p	FLY 101	Dual 4-input expander	7460	20p	16p	14p	231	4-bit shift register	7494	£1.13	94p	81p
201	Quadruple 2-input NAND gate with open collector output	7401	20p	16p	14p	FLJ 101	J-K flip flop	7470	45p	37p	32p	241	Synchronous up down 4-bit decade counter	74192	£1.74	£1.45	£1.25
211	Hex inverter	7404	25p	21p	18p	111	J-K master-slave flip-flop	7472	32p	27p	23p	251	As above—binary counter	74193	£1.74	£1.45	£1.25
221	Gated full adder	7480	67p	56p	48p	121	Dual J-K master-slave flip-flop	7473	45p	40p	35p	261	5-bit shift register	74194	£1.74	£1.45	£1.25
231	2-bit binary full-adder	7482	87p	73p	62p	131	Dual J-K master-slave flip-flop with preset and clear	7476	45p	40p	36p	271	Dual J-K master-slave flip-flop with preset and clear	74107	52p	43p	36p
241	Four-bit binary full adder	7483	£1.32	£1.16	£1.00							301	Dual quadruple bistable latch	74100	£1.64	£1.37	£1.17

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

**F NO GIMMICKS !! F**  
**R Our catalogue is Free R**  
**E postage appreciated (5p) E**

### 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
22	35	22	16
47	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 x 7.5 mm.  
All one price: 12p each; 25 pieces  
1 type 10p each.

### BZY88 SERIES ZENERS 400mW

5%  
All voltages available  
33 to 33 Volt

25+	12p	100+	10p
500+	9p	1000+	8p

### SPECIAL OFFER IN 4000 SERIES 1 AMP RECTIFIERS

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	150	150	120

p.v. 50+ 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 C280 series

Mfd.	Volt. Wkg.	9p
0.01	16	3p
0.015	16	3p
0.022	16	3p
0.033	16	3p
0.047	16	4p
0.068	16	4p
0.1	16	4p
0.15	16	5p
0.22	16	5p
0.33	16	7p
0.47	16	8p
0.68	16	10p
1.0	16	11p
1.5	16	14p
2.2	16	24p

### Mullard Electrolytic C437 series

Mfd.	Volt. Wkg.	9p
250	16	12p
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 18pf to 220pf (usual pref. values).  
Packs of 6 (any values) 15p

### CAPACITORS—Mullard Miniature Electrolytic C426 series

Mfd.	Volt. Wkg.	8p
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
50	25	6p
25	25	6p
80	25	6p
1	40	8p
4	40	8p
8	40	6p
16	40	6p
32	40	6p
50	40	6p

### ENCAPSULATED BRIDGES

Type No.	Current	Rms. Volts.	50p
W005	1 Amp	50	50p
W06	1 Amp	600	65p

### R.C.A.

CA3004	£1.80
CA3005	£1.20
CA3011	75p
CA3013	£1.05
CA3014	£1.25
CA3018	85p
CA3020	£1.30
CA3028A	£1.70
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 60p  
(DIL high gain op-amp)  
LM741CN 95p  
(equiv. SN72741P)

### LINEAR AND DIGITAL ICs

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
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**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. M1655 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

\*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 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: 4 1/2" x 2 1/2" 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. 3 revs. per hour. Clockwise rotation. 3 revs. per hour. Anti-clockwise rotation. 60 revs. per hour. 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 1.5V 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, 2 1/2" wide, 3" high. £2.00 incl. P. & P.



### 230-250V SOLENOID

Mfg. by Westool, approx. 1 1/2lb pull (similar in appearance to above illustration). Size of feet 1 1/2" x 1 1/2". 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 1/2 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 amps, £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.



2.5 AMP

#### OPEN TYPE (Panel Mounting) 1/2 amp, £3.93.

1 amp, £5.50. 2 1/2 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 k ohm, 280 mA; 1.5 k ohm, 230 mA; 2.5 k ohm, 2A; 5 k ohm, 1.40 mA. Diameter 3 1/2 in. Shaft length 1/2 in. dia. 1/8 in. All at £1.50 each. P. & P. 5p. 50 WATT. 1/5/10/25/50/100/250/500/1/1.5/2/5/5k ohm. All at £1.12 each. P. & P. 11p. 25 WATT. 10/25/50/100/250/500/1/1.5/2/5/3/5/5k ohm. 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-LYGT 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. **SPECIALY DESIGNED, FULLY VENTILATED METAL CASE.** Including reflector. £4.00 P. & P. 45p. Post paid with kit.

### AND NOW! THE 'SUPER' HY-LYGT 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-LYGT 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.



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: 10 1/2 in x 7 in x 4 in. 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 62p P. & P. Styled in elegant black case with luxury Chrome trim, soft padded speaker grille, die-cast sides and walnut insert. Size 8 1/2 in x 11 in x 3 1/2 in. 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

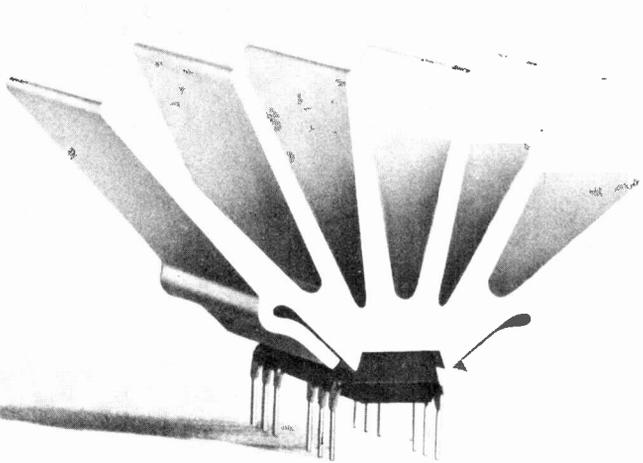
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# new

## 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  $\pm$  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.

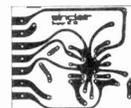
**Supply Voltage** 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

**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

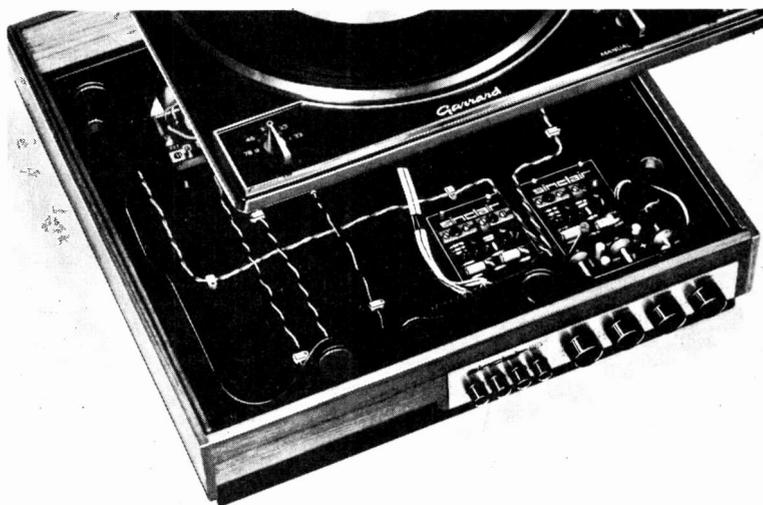
Should you not be completely satisfied with your purchase when you receive it from us, return the goods without delay and your money will be refunded in full, including cost of return postage, at once and without question. Full service facilities are available to all Sinclair customers.

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 PZ.5, two Z.30'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.

Sinclair Radionics Limited, London Road,  
St. Ives, Huntingdonshire PE17 4HJ.  
Tel: St. Ives (048 06) 4311

**sinclair**

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.

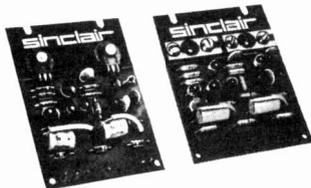
### Typical Project 60 applications

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 trsfmr	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.

# 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  $\pm 1$ dB.

**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*

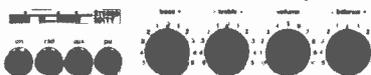
The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an 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:** 2 $\mu$ V for 30dB quieting; 7 $\mu$ V for lock-in over full deviation. **Squelch level:** 20 $\mu$ V. **A.F.C. range:**  $\pm 200$  KHz. **Signal to noise ratio:** > 65dB. **Audio frequency response:** 10 Hz – 15 KHz ( $\pm 1$ dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2 $\mu$ V. **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  $\pm 1$ dB; 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 207 mm.

Built, tested and guaranteed.

**£9.98**

## Power Supply Units

Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

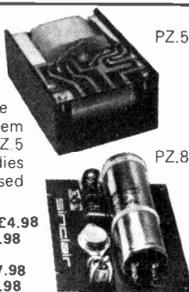
**PZ.5** 30 volts un stabilised **£4.98**

**PZ.6** 35 volts stabilised **£7.98**

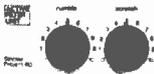
**PZ.7** 45 volts stabilised

(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.

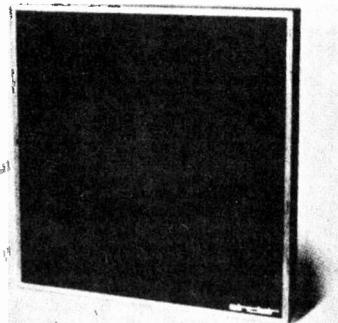
**Input Impedance:** 8 ohms.

**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 $\frac{1}{2}$  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. 1171

Sinclair Radionics Ltd., London Rd, St. Ives  
Huntingdonshire PE17 4HJ.  
Telephone St. Ives (048 06) 4311

**sinclair**

# YATES ELECTRONICS

(FLITWICK) LTD.

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KEMPSTON HARDWICK,  
BEDFORD

C.W.O. PLEASE. POST AND PACKING,  
PLEASE ADD 10p TO ORDERS UNDER £2.  
Catalogue which contains data sheets for most of the  
components listed will be sent free on request.  
5p stamp appreciated.  
10% DISCOUNT TO ALL CALLERS ON SATURDAYS

## RESISTORS

½W Iskra high stability carbon film—very low noise—capless construction.  
¼W Mullard CR25 carbon film—very small body size 7.5 x 2.5mm. 4W  
Erie wire wound.

Power watts	Tolerance	Range	Values available	Price
½	5%	4.7Ω-2.2MΩ	E24	1-99
½	10%	3.3MΩ-10MΩ	E12	1-0p
½	10%	1Ω-3.9Ω	E12	1-0p
½	5%	4.7Ω-1MΩ	E12	1-0p
½	10%	1Ω-10Ω	E12	1-0p
4				6p
				5.5p

Quantity price applies for any selection. Ignore fractions on total order.

## DEVELOPMENT PACK

0.5 watt 5% Iskra resistors 5 off each value 4.7Ω to 1MΩ.  
E12 pack 325 resistors £2.40. E24 pack 650 resistors £4.70.

## POTENTIOMETERS

Carbon track 5kΩ to 2MΩ, log or linear (log ½W, lin ¼W).  
Single, 12p. Dual gang (stereo), 40p. Single D.P. switch 24p.

## SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C.  
mounting (0.1 matrix).  
Sub-miniature 0.1W, 5p each. Miniature 0.25W, 6p each.

## SEMICONDUCTORS

AC126	12p	BFY52	22p	OC81	12p	2N3055	72p
AC127	12p	BSY56	30p	OC82	12p	2N3702	15p
AC128	12p	BSX21	25p	ORP12	48p	2N3703	14p
AD140	40p	BY124	7½p	IN4001	7½p	2N3704	17½p
AF115	20p	BYZ10	20p	IN4002	10p	2N3705	15p
AF117	20p	BYZ13	20p	IN4003	12p	2N3706	18p
BC107	10p	OA85	7p	IN4004	11p	2N3707	18p
BC108	10p	OA91	5p	IN4005	13p	2N3708	10p
BC109	10p	OA202	7p	IN4006	13p	2N3709	11p
BFY50	22p	OC71	12p	IN4007	13p	2N3710	12p
BFY51	22p	OC72	12p	2N2926	11p	2N3711	14p

## ZENER DIODES

400mW 5% 3.3V to 30V, 15p.

## ROTARY SWITCHES

2P2W, 1P12W, 2P6W, 3P4W,  
4P3W, 23p.

## BRUSHED ALUMINIUM PANELS

12in x 6in = 25p; 12in x 2½in = 10p; 9in x 2in = 7p.

## MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0.001μF, 0.0015μF, 0.0022μF, 0.0033μF, 0.0047μF, 2½p. 0.0068μF, 0.01μF,  
0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 0.1μF, 4p. 0.15μF, 6p. 0.22μF, 7½p.  
0.33μF, 11p. 0.47μF, 13p.  
160V: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 3p. 0.1μF 3½p. 0.15μF 4½p.  
0.22μF, 5p. 0.33μF, 6p. 0.47μF, 7½p. 0.68μF, 11p. 1.0μF, 13p.

## MULLARD POLYESTER CAPACITORS C283 SERIES

250V P.C. mounting: 0.01μF, 0.015μF, 0.022μF, 3p. 0.033μF, 0.047μF, 0.068μF,  
3½p. 0.1μF, 4p. 0.15μF, 0.22μF, 5p. 0.33μF, 6½p. 0.47μF, 8½p. 0.68μF, 11p. 1.0μF, 13p.  
15μF, 20p. 2.2μF, 24p.

## MYLAR FILM CAPACITORS 100V

0.001μF, 0.002μF, 0.005μF, 0.01μF, 0.02μF,  
2½p. 0.04μF, 0.05μF, 0.068μF, 0.1μF, 3½p.

## CERAMIC DISC CAPACITORS

100pF to 10,000pF, 2p each.

## CAPACITOR DEVELOPMENT PACK

Selection of 100 ceramic and polyester capacitors, 100pF to 1.0μF, £2.90.

## ELECTROLYTIC CAPACITORS—MULLARD C426 SERIES

(μF/V): 10/2.5, 40/2.5, 80/2.5, 160/2.5, 320/2.5, 500/2.5, 8/4, 32/4, 64/4, 125/4, 250/4,  
400/4, 6.4/6.4, 25/6.4, 50/6.4, 100/6.4, 200/6.4, 320/6.4, 4/10, 16/10, 32/10, 64/10, 125/10,  
200/10, 2.5/16, 10/16, 20/16, 40/16, 80/16, 125/16, 1.6/25, 6.4/25, 12.5/25, 25/25, 50/25,  
80/25, 1/40, 4/40, 8/40, 16/40, 32/40, 50/40, 0.64/64, 2.5/64, 5/64, 10/64, 20/64, 32/64.

## ELECTROLYTIC CAPACITORS Miniature P.C. mounting

(μF/V): 10/12, 50/12, 100/12, 200/12, 5/25, 10/25, 25/25, 100/25.

5p each.

## VEROBOARD

2½ x 3½	22p	0.15	16p
2½ x 5	24p	0.15	24p
3½ x 3½	24p	0.15	24p
3½ x 5	27p	0.15	27p
17 x 2½	75p	0.15	57½p
17 x 3½	100p	0.15	75p
17 x 5 (plain)	75p	0.15	75p
17 x 3½ (plain)	—	0.15	52½p
17 x 2½ (plain)	—	0.15	37½p
2½ x 5 (plain)	—	0.15	17½p
2½ x 3½ (plain)	—	0.15	15p
Pin insertion tool	47½p		47½p
Spot face cutter	37½p		37½p
Pkt. 50 pins	20p		20p

## PLUGS AND SOCKETS

Standard screened	18p	2.5mm insulated	8p
Standard insulated	12p	3.5mm insulated	8p
Stereo screened	35p	3.5mm screened	13p
Standard socket	15p	2.5mm socket	8p
Stereo socket	18p	3.5mm socket	8p

## D.I.N. PLUGS AND SOCKETS

2 pin, 3 pin, 5 pin (180°), 5 pin (240°), 6 pin  
Plug 12p. Socket 8p.

## BATTERY ELIMINATOR

£1.50  
9V mains power supply. Same size as PP9 battery.

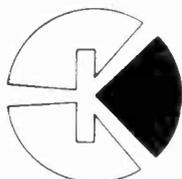
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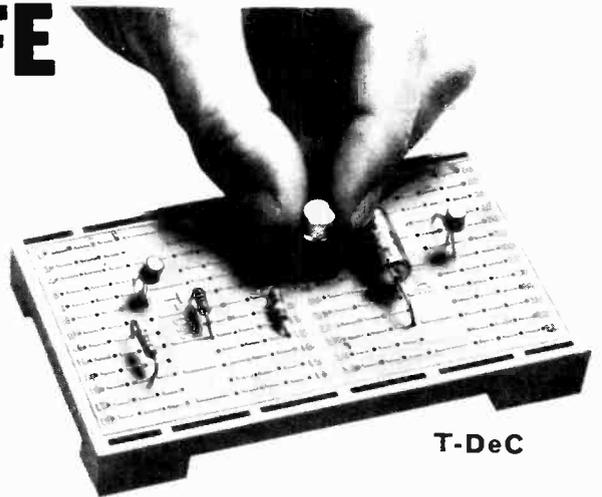
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34 Arkwright Road, Astmoor Industrial Estate, Runcorn, Cheshire  
Tel.: Runcorn 65041



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.....DeCSTOR Pack .....4-DeC Pack

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2N404	20p	BC107	12p	BY213	25p
2N696	15p	BC108	12p	BY215	20p
2N697	15p	BC109	12p	GET880	37p
2N706	10p	BC113	15p	MAT100	25p
2N706A	12p	BC114	25p	MAT101	30p
2N850	25p	BC115	20p	MAT102	30p
2N1131	25p	BC116	25p	MAT121	30p
2N1132	25p	BC116A	30p	MJ2801	41.37
2N1302	20p	BC118	25p	MJ2901	25.25
2N1303	20p	BC119	35p	MJE370	97p
2N1304	25p	BC134	25p	MJE520	87p
2N1305	25p	BC135	20p	MJE2955	
2N1306	25p	BC136	22p		
2N1307	25p	BC137	25p	MJE305	587p
2N1308	25p	BC138	25p	MPP102	42p
2N1309	25p	BC147	17p	MPP103	35p
2N1613	22p	BC148	12p	MPP104	37p
2N1711	25p	BC149	20p	MPP105	40p
2N2147	75p	BC154	37p	NK7217	40p
2N2160	60p	BC157	20p	NK7272	25p
2N2218	20p	BC165	17p	NKT403	75p
2N2219	20p	BC159	20p	NKT404	82p
2N2222	20p	BC169C	15p	OA5	20p
2N2222A25p		BC177	25p	OA9	10p
2N2369	20p	BC178	25p	OA10	25p
2N2344	35p	BC179	27p	OA47	10p
2N2944	50p	BC183	12p	OA79	10p
2N2904	20p	BC183L	12p	OA79	10p
2N2904A25p		BC184L	15p	OA81	10p
2N2905	25p	BC212	12p	OA85	12p
2N2906	20p	BCY30	25p	OA90	10p
2N2906A25p		BCY31	30p	OA91	7p
2N2907	23p	BCY32	50p	OA91	7p
2N2926	10p	BCY33	45p	OA200	7p
2N3011	25p	BCY34	30p	OA202	10p
2N3053	20p	BCY38	40p	OC16	50p
2N3054	50p	BCY39	85p	OC20	97p
2N3055	75p	BCY40	50p	OC22	50p
2N3625		BCY58	25p	OC23	50p
2N3701	1.10	BCY59	25p	OC24	60p
2N3703	10p	BCY70	20p	OC25	37p
2N3704	15p	BCY71	20p	OC26	25p
2N3705	15p	BCY72	30p	OC28	60p
2N3707	15p	BCY78	30p	OC29	60p
2N3709	10p	BCZ10	35p	OC33	50p
2N3710	10p	BD101	45p	OC36	60p
2N3819	35p	BD112	50p	OC41	25p
2N3820	60p	BD121	65p	OC42	30p
2N4053	15p	BD123	60p	OC43	40p
2N4061	15p	BD124	75p	OC44	17p
2N4547	35p	BD125	50p	OC45	15p
2N4548	37p	BD131	75p	OC71	15p
2N4549	50p	BD132	45p	OC72	25p
2N8301	50p	BD153	82p	OC72	25p
2N8302	50p	BD156	57p	OC73	30p
2N8303	60p	BDY1021	25p	OC74	30p
2N8304	75p	BDY1121	82p	OC75	25p
40290	50p	BDY1721	50p	OC75	25p
40361	50p	BDY1821	75p	OC76	45p
40362	50p	BDY1921	75p	OC81	25p
AA30	10p	BDY6121	25p	OC82	25p
AA30	10p	BDY621	20p	OC83	25p
AA31	12p	BF115	25p	OC84	25p
AA317	10p	BF122	30p	OC139	25p
AC107	37p	BF134	40p	OC140	37p
AC126	25p	BF135	30p	OC141	62p
AC127	25p	BF159	80p	OC170	25p
AC128	25p	BF167	25p	OC171	30p
AC176	25p	BF170	35p	OC200	40p
AC187	30p	BF173	30p	OC201	70p
AC188	30p	BF177	40p	OC292	80p
ACY17	30p	BF178	25p	OC293	40p
ACY18	25p	BF192	40p	OC294	40p
ACY19	25p	BF193	35p	OC295	75p
ACY20	20p	BF181	35p	OC296	90p
ACY21	20p	BF182	30p	OC297	90p
ACY22	10p	BF184	20p	OC297	90p
ACY23	60p	BF185	20p	ORP12	50p
ACY24	15p	BF194	17p	ORP16	40p
AD140	20p	BF195	15p	ORP61	42p
AD149	20p	BF196	15p	TIP29A	50p
AD161	37p	BF197	15p	TIP30A	60p
AD162	37p	BF200	37p	TIP31A	62p
AF114	25p	BF274	37p	TIP32A	75p
AF116	25p	BFX13	25p	TIP33A	
AF118	25p	BFX30	35p	TIP34A	1.10
AF117	25p	BFX30	35p	TIP34A	1.10
AF118	62p	BFX37	32p	TIP34A	1.10
AF124	25p	BFX84	25p	TIP34A	1.10
AF125	20p	BFX85	35p	TIP34A	1.10
AF126	17p	BFX86	25p	TIP34A	1.10
AF127	17p	BFX87	25p	TIP34A	1.10
AF139	30p	BFX88	25p	TIP34A	1.10
AF178	47p	BFY18	30p	TIP34A	1.10
AF179	65p	BFY50	22p	TIP34A	1.10
AF180	52p	BFY51	20p	TIP34A	1.10
AF181	42p	BFY52	22p	TIP34A	1.10
AF186	40p	BFY63	17p	TIP34A	1.10
AF239	40p	BSX20	65p	TIP34A	1.10
AS928	35p	BSX20	65p	TIP34A	1.10
AS928	35p	BSX21	20p	TIP34A	1.10
AS928	35p	BSX76	15p	TIP34A	1.10
AS928	35p	BSY05	15p	TIP34A	1.10
AS927	47p	BSY96	15p	TIP34A	1.10
AS927	47p	BY100	15p	TIP34A	1.10
BA115	7p	BY106	15p	TIP34A	1.10
BA164	10p	BY127	20p	TIP34A	1.10
BA113	6p	BY182	86p	TIP34A	1.10
BA116	7p	BY210	40p	TIP34A	1.10
BA117	7p	BY211	35p	TIP34A	1.10
BA118	7p	BY212	30p	TIP34A	1.10

# HENRY'S LOW COST INTEGRATED CIRCUITS

WE OFFER FROM STOCK AN EXCLUSIVE RANGE OF BRAND NEW CERAMIC FULL SPECIFICATION LOW COST TTL 7400 RANGE BY I.T.T., TEXAS, FAIRCHILD

Part No.	Ceramic	Description	1-24	25-99	100	250+
7400	Quad	2-input NAND Gate	20p	18p	15p	13p
7401	Quad	2-input Positive NAND Gate (with open collector output)	20p	18p	15p	13p
7402	Quad	2-input Positive NOR Gates	20p	18p	15p	13p
7403	Quad	2-input Positive NAND Gates (with open collector output)	20p	18p	15p	13p
7404	Hex	Inverters with open collector	20p	18p	15p	13p
7410	Triple	3-input Positive NAND Gates	20p	18p	15p	13p
7413	Dual	4-input Schmitt Trigger	35p	32p	29p	25p
7420	Dual	4-input Positive NAND Gates	20p	18p	15p	13p
7430	8-input	Positive NAND Gates	20p	18p	15p	13p
7440	Dual	4-input Positive NAND Buffers	20p	18p	15p	13p
7441	BCD	to decimal decade driver	87p	77p	66p	60p
7442	BCD	to decimal decoder (4-10 lines, 1 of 10)	87p	77p	66p	60p
7447	BCD	Seven-Segment Decoder/Drivers (15-V Outputs)	1.10	1.25	1.15	1.00
7450	Expandable	dual 2-input AND-OR-INVERT	20p	18p	15p	13p
7451	Dual	2-wide 2-input AND-OR-INVERT GATES	20p	18p	15p	13p
7453	Quad	2-input Expandable AND-OR-INVERT	20p	18p	15p	13p
7454	4-wide	2-input AND-OR-INVERT Gates	20p	18p	15p	13p
7459	Dual	4-input Expander	35p	32p	29p	25p
7470	Single	phase J-K Flip-Flop	35p	32p	29p	25p
7472	Master-slave	J-K Flip-Flop	35p	32p	29p	25p
7473	Dual	Master-slave J-K Flip-Flop	43p	40p	37p	33p
7474	Dual	O type Flip-Flop	43p	40p	37p	33p
7475	Quad	latch	47p	45p	43p	40p
7476	Dual	J-K with pre-set and clear	47p	45p	43p	40p
7477	Dual	J-K with pre-set and clear	47p	45p	43p	40p
7481	16-bit	read/write memory	1.35	1.25	1.15	1.00
7482	2-bit	Binary Full Adders	1.10	1.20	1.10	85p
7483	Quad	Full Adder	87p	77p	67p	60p
7484	8-bit	Shift Registers	80p	70p	60p	50p
7485	8-bit	Shift Registers	87p	77p	67p	60p
7486	8-bit	Shift Registers	1.21	1.10	1.00	75p
7487	Divide-by-Two	Counters	87p	77p	67p	60p
7488	4-bit	Binary Counters	87p	77p	67p	60p
7494	Dual	entry 4-bit shift register	87p	77p	67p	60p
7495	4-bit	up-down shift register	87p	77p	67p	60p
7496	5-bit	Parallel in parallel out Shift Register	87p	77p	67p	60p
74100	8-bit	Bistable Latches	1.75	1.85	1.65	1.35
74118	Hex	Set-Reset Latches	1.30	1.20	1.10	85p
74121	Monostable	Multivibrators	87p	77p	67p	60p
74141	BCD	to-Decimal Decoder/Driver	87p	77p	67p	60p
74145	BCD	to-Decimal Decoder/Drivers	1.80	1.70	1.60	1.50
74151	8-bit	Data Selectors (with Strobes)	1.40	1.30	1.20	1.05
74153	Dual	4-Line-to-1-Line Data Selectors/Multiplexers	1.40	1.30	1.20	1.05
74191	Binary	Counter reversible	1.20	1.10	1.00	85p

Devices may be mixed to qualify for quantity price.   
Data not available for above series in booklet form, price 10p. (Ref. No. 30).   
Larger quantity prices Extn. 4. Dual In-line 14 Pin Socket 30p each 16 Pin 35p each.

## SILICON RECTIFIERS

1 AMP MINIATURE WIRE ENDED PLASTIC RECTIFIERS	Type	P.I.V.	1-49	50+	100+	500+	1000+
IN4001	50p	8p	7p	6p	5p	4p	
IN4002	100p	8p	7p	5p	4p		
IN4003	200p	10p	9p	7p	6p	5p	
IN4004	400p	10p	9p	8p	7p	6p	
IN4005	600p	12p	10p	9p	7p	7p	
IN4006	800p	15p	14p	12p	11p	9p	
IN4007	1000p	20p	18p	13p	12p	10p	

1.5 AMP MINIATURE WIRE ENDED PLASTIC RECTIFIERS	Type	P.I.V.	1-49	50+	100+	500+	1000+
PL4001	50p	10p	9p	8p	7p	6p	
PL4002	100p	11p	10p	9p	8p	7p	
PL4003	200p	12p	11p	10p	9p	8p	
PL4004	400p	12p	11p	10p	9p	8p	
PL4005	600p	15p	13p	11p	10p	9p	
PL4006	800p	17p	15p	13p	12p	10p	
PL4007	1000p	20p	17p	15p	13p	11p	

3 AMP PLASTIC WIRE ENDED RECTIFIERS	Type	P.I.V.	1-49	50+	100+	500+	1000+
PL7001	50p	20p	18p	17p	16p	14p	
PL7002	100p	20p	18p	17p	15p	13p	
PL7003	200p	22p	20p	19p	18p	16p	
PL7004	400p	25p	23p	21p	20p	18p	
PL7005	600p	28p	24p	23p	22p	20p	
PL7006	800p	27p	25p	24p	23p	21p	
PL7007	1000p	30p	28p	26p	24p	22p	

POTTED BRIDGE RECTIFIERS (SILICON) SIZE i x i x i ins.	Type	P.I.V.	rent	1-49	50+	100+	500+	1000+
2002	200	2	70p	65p	60p	55p		
4002	400	2	80p	75p	70p	65p		
1004	1000	4	70p	65p	60p	55p		
2004	2000	4	75p	70p	65p	60p		
4004	4000	4	80p	75p	70p	65p		
6002	6000	6	80p	75p	70p	65p		
6004	6000	6	80p	75p	70p	65p		
1006	10000	6	80p	75p	70p	65p		
2006	20000	6	80p	75p	70p	65p		
4006	40000	6	80p	75p	70p	65p		
6006	60000	6	80p	75p	70p	65p		

## INTEGRATED CIRCUITS

# 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	... \$3-12
1mA	... \$3-27
20V d.c.	... \$3-27
50V d.c.	... \$3-27
300V d.c.	... \$3-27
50μA	... \$3-47
50-0-50μA	... \$3-37
100μA	... \$3-37
100-0-100μA	... \$3-25

**TYPE S-80**  
80 mm square fronts

50μA	... \$3-12
100-0-50μA	... \$3-27
500μA	... \$3-27
100-0-100μA	... \$3-27
500μA	... \$2-02
1mA	... \$2-47
20V d.c.	... \$2-47
50V d.c.	... \$2-47
300V d.c.	... \$2-47

1A d.c. ... \$2-47  
5A d.c. ... \$2-47  
300V a.c. ... \$2-62  
VU Meter ... \$3-37

### "SEW" CLEAR PLASTIC METERS

**Type MR.85P. 4 1/4 in. 4 1/4 in. 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
300V d.c.	... \$2-60
15V a.c.*	... \$2-60
100mA	... \$2-10
100-0-100μA	... \$2-60
200μA	... \$2-75
500-0-500μA	... \$2-60
1mA	... \$2-60
1-0-1mA	... \$2-60
5mA	... \$2-60
10mA	... \$2-60

**Type MR.85P. 1 21/32 in. square fronts.**

50μA	... \$2-00
50-0-50μA	... \$2-87
100-0-100μA	... \$1-75
200μA	... \$1-75
500μA	... \$1-50
500-0-500μA	... \$1-37
1mA	... \$1-37
1-0-1mA	... \$1-37
2mA	... \$1-37
5mA	... \$1-37
10mA	... \$1-37
20mA	... \$1-37
50mA	... \$1-37
100mA	... \$1-37

150mA ... \$1-37  
200mA ... \$1-37  
300mA ... \$1-37  
500mA ... \$1-37  
750mA ... \$1-37  
1A ... \$1-37  
2A ... \$1-37  
5A ... \$1-37  
10V d.c. ... \$1-37  
15V d.c. ... \$1-37  
20V d.c. ... \$1-37  
100V d.c. ... \$1-37  
150V d.c. ... \$1-37  
300V d.c. ... \$1-37  
500V d.c. ... \$1-37  
750V d.c. ... \$1-37  
15V a.c.\* ... \$1-37  
50V a.c.\* ... \$1-37  
150V a.c.\* ... \$1-37  
300V a.c.\* ... \$1-37  
500V a.c.\* ... \$1-37  
S Meter ... \$1-37  
1mA ... \$1-60  
VU meter ... \$2-10

**Type MR.52P. 2 1/4 in. square fronts.**

50μA	... \$3-60
50-0-50μA	... \$3-10
100-0-100μA	... \$3-10
200μA	... \$2-87
500μA	... \$2-75
500-0-500μA	... \$2-60
1mA	... \$2-60
1-0-1mA	... \$2-60
5mA	... \$2-60
10mA	... \$2-60

**Type MR.52P. 3 1/4 in. 3 1/4 in. fronts.**

50μA	... \$3-10
50-0-50μA	... \$2-60
100μA	... \$2-60
100-0-100μA	... \$2-37
500μA	... \$2-25
1mA	... \$2-00
5mA	... \$2-00
10mA	... \$2-00
50mA	... \$2-00
100mA	... \$2-00
500mA	... \$2-00
1A	... \$2-00
5A	... \$2-00
10V d.c.	... \$2-00

20V d.c. ... \$2-00  
50V d.c. ... \$2-00  
300V d.c. ... \$2-00  
15V a.c.\* ... \$2-00  
300V a.c. ... \$2-00  
S Meter ... \$2-00  
1mA ... \$2-10  
VU Meter ... \$2-10  
50mA a.c.\* ... \$2-10  
100mA a.c.\* ... \$2-10  
5A ... \$2-10  
10A ... \$2-10  
15A ... \$2-10  
20A ... \$2-10  
30A ... \$2-10  
50A ... \$2-10  
5V d.c. ... \$2-10  
10V d.c. ... \$2-10

### "SEW" BAKELITE PANEL METERS

**Type MR.85 3 1/4 in. square fronts.**

50μA	... \$2-25
50-0-50μA	... \$2-10
100μA	... \$2-10
100-0-100μA	... \$1-87
200μA	... \$1-87
500μA	... \$1-60
500-0-500μA	... \$1-50
1mA	... \$1-50
5mA	... \$1-50
10mA	... \$1-50
50mA	... \$1-50
100mA	... \$1-50
500mA	... \$1-50
1A	... \$1-50
5A	... \$1-50

10V d.c. ... \$1-50  
10V a.c.\* ... \$1-50  
50 a.c.\* ... \$1-50  
100 a.c.\* ... \$1-50  
200 a.c.\* ... \$1-50  
500 a.c.\* ... \$1-50  
1A a.c.\* ... \$1-50  
5A a.c.\* ... \$1-50  
10A a.c.\* ... \$1-50  
20A a.c.\* ... \$1-50  
30A a.c.\* ... \$1-50

**\* MOVING IRON — ALL OTHERS MOVING COIL**  
Please add postage

### "SEW" EDUCATIONAL METERS

**Type ED.107. Size overall 100mm x 90mm x 108mm.**  
A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The easily accessible to working. Available in the following ranges:

50μA	... \$4-50
100μA	... \$4-25
1mA	... \$3-97
50-0-50μA	... \$4-25
1-0-1mA	... \$3-97
1A d.c.	... \$3-97
5A d.c.	... \$3-97
10V d.c.	... \$3-97

20V d.c. ... \$3-97  
50V d.c. ... \$3-97  
300V d.c. ... \$3-97  
Dual range  
500mA/5A d.c. \$4-25  
5V/50V d.c. \$4-25

### EDGWISE METERS

**PE.70 3 17/32 in. 1 15/32 in. 2 1/4 in. deep.**

50μA	... \$3-00
50-0-50μA	... \$2-87
100μA	... \$12-87
100-0-100μA	... \$2-75
200μA	... \$2-75

500μA ... \$2-60  
1mA ... \$2-37  
10mA ... \$2-37  
300V a.c. ... \$2-37  
VU meter ... \$2-85

meter movement is demonstrate internal in the following ranges:

50μA	... \$4-50
100μA	... \$4-25
1mA	... \$3-97
50-0-50μA	... \$4-25
1-0-1mA	... \$3-97
1A d.c.	... \$3-97
5A d.c.	... \$3-97
10V d.c.	... \$3-97

20V d.c. ... \$3-97  
50V d.c. ... \$3-97  
300V d.c. ... \$3-97  
Dual range  
500mA/5A d.c. \$4-25  
5V/50V d.c. \$4-25

# MULTIMETERS for EVERY purpose!

**TECH PT-34. 1,000**  
O.P.V. 0/10/50/250/600/1,000V a.c. and d.c. 0/1/100/500mA.  
d.c. 0/100K, \$1-97; P. & P. 12p.

**MODEL TE-800. 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. 0/50/1A/250MA 0/60K/6 meg. ohm. -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. 15P. P. & P. 15p.

**MODEL TE12. 20,000**  
O.P.V. 0/0-6/30/120/600. 1/200/3,000 6,000V a.c. 1/6/30/120/600/1,200V a.c. 0/60μA/6/60/600MA/0/6K/600K/6meg./60. Megohm 50PF. 2 MFD \$5-97. P. & P. 17p.

**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. 50/600/1/60/600MA. 10/100K/1Meg/10 meg. Ω. -20 to +46dB. \$6-97. P. & P. 12p.

**MODEL 500. 30,000**  
O.P.V. with overload protection, mirror scale 0/5/25/100/250/500/1,000V d.c. 0/2-5/10/25/100/250/500/1,000V a.c. 0/50μA/5/50/500 mA. 12 amp. 0/60K/6 Meg./60 Meg. Ω. \$3-87. 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. 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. 17p.

**TMK LAB TESTER.**  
100,000 O.P.V. 6 1/4 in. scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt d.c. D.c. volts: 0-5, 2.5, 10, 50, 250, 1,000V. D.c. current: 3, 10, 50, 250, 500, 1,000V. 2.5, 10A. Resistance: 1K, 10K, 100K, 10 meg, 100 meg. Decibels: -10 to +49dB. Plastic case with carrying handle, size 7 1/4 in x 6 1/4 in x 3 1/4 in. \$18-90. P. & P. 25p.

**270° WIDE ANGLE**  
**1mA METERS**  
MW1-6 60mm square \$3-97. MW1-8 80mm square \$4-97. P. & P. extra.

**T.E.40 HIGH SENSITIVITY A.C. VOLTMETER**  
10 meg. input. 19 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. 230/240V a.c. operation. Complete with probe and instructions. Operation 230V a.c. \$17-50. Carr. 25p.

**HONOR TE.10A. 20k Ω**  
Volt 5/25/50/250/500/2,500V d.c. 0/10/50/100/500 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. \$3-47. 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. \$5-97. 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 20-50μA/0-12/0-300mA. 0-60k Ω/0-6M Ω. -20 to +63dB. \$4-62. 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 a.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/10/60/300mA. 12A. 0/2K/200K/2M/200M. -20 to +17dB. \$12-50. P. & P. 17p.

**TE-900 30,000 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. 0/2K/200K/110/100/600mA/10A d.c. 0-2K/0-60 meg. ohm. \$15. P. & P. 25p.

**FTC-401 TRANSISTOR TESTER**  
Full capabilities for measuring A, B and IC,  $n_{pn}$  or  $pnp$ . Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. \$8-97. 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: 1/2 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 cycle. Overall size: 3 1/4 in. x 2 1/8 in. x 8 3/16 in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE \$49-97 Carr. 50p

**G. W. SMITH & CO (RADIO) LTD.**  
Also see next two pages

# SEMI-CONDUCTOR DEVICES VALVES

ALL DEVICES BRAND NEW AND FULLY GUARANTEED

2G301	20p	2N3415	22p	2N5408	35p	BC114	15p	BFW90	22p	NKT219	30p
2G302	19p	2N3417	37p	2N5409	45p	BC115	15p	BFW91	20p	NKT223	27p
2G303	20p	2N3439	130p	2N5410	25p	BC116	15p	BFX12	22p	NKT224	22p
2G306	30p	2N3440	97p	2N5411	25p	BC119	35p	BFX29	25p	NKT229	30p
2G308	30p	2N3564	17p	2N5412	47p	BC121	20p	BFX30	25p	NKT237	35p
2G309	30p	2N3565	15p	2N5413	47p	BC122	20p	BFX37	30p	NKT238	25p
2G311	30p	2N3566	22p	2N5414	52p	BC141	35p	BFX240	27p	NKT240	27p
2G312	30p	2N3568	25p	2N5415	72p	BC126	25p	BFX68	67p	NKT241	27p
2G314	30p	2N3569	25p	2N5416	72p	BC126	25p	BFX68	67p	NKT241	27p
2G318	22p	2N3570	125p	2N5417	35p	BC134	15p	BFX84	25p	NKT242	20p
2N388A	49p	2N3572	97p	2N5418	35p	BC135	15p	BFX85	32p	NKT243	62p
2N404	20p	2N3605	27p	2N5419	27p	BC136	15p	BFX86	25p	NKT244	17p
2N696	15p	2N3606	27p	2N5420	70p	BC137	15p	BFX87	25p	NKT245	50p
2N697	15p	2N3607	22p	2N5421	70p	BC138	37p	BFX88	20p	NKT261	25p
2N698	25p	2N3608	18p	2N5422	72p	BC140	35p	BFX92A	20p	NKT262	30p
2N699	42p	2N3638A	18p	2N5423	72p	BC141	35p	BFX93	70p	NKT262	30p
2N706	9p	2N3641	18p	2N5424	67p	BC148	15p	BFY11	40p	NKT271	10p
2N706A	11p	2N3642	18p	2N5425	67p	BC149	15p	BFY18	25p	NKT262	10p
2N708	15p	2N3643	20p	2N5426	55p	BC152	17p	BFY21	42p	NKT275	20p
2N709	45p	2N3644	25p	2N5427	60p	BC153	35p	BFY24	45p	NKT278	25p
2N718	25p	2N3645	25p	2N5428	32p	BC154	35p	BFY29	40p	NKT281	27p
2N718A	30p	2N3646	25p	2N5429	32p	BC155	15p	BFY30	20p	NKT282	27p
2N726	25p	2N3647	18p	2N5430	42p	BC158	15p	BFY41	50p	NKT402	90p
2N727	25p	2N3648	15p	2N5431	35p	BC159	15p	BFY43	62p	NKT403	75p
2N914	17p	2N3694	18p	2N5432	47p	BC160	35p	BFY50	22p	NKT404	62p
2N916	17p	2N3702	10p	2N5433	37p	BC167	15p	BFY51	20p	NKT405	75p
2N918	30p	2N3703	10p	2N5434	37p	BC168B	14p	BFY52	20p	NKT406	62p
2N929	22p	2N3704	12p	2N5435	47p	BC168C	15p	BFY53	17p	NKT407	62p
2N933	24p	2N3705	10p	2N5436	37p	BC169B	14p	BFY56A	37p	NKT452	62p
2N937	52p	2N3706	10p	2N5437	72p	BC149C	35p	BFX76	42p	NKT453	30p
2N1090	22p	2N3707	12p	2N5438	47p	BC170	12p	BFY77	57p	NKT713	20p
2N1091	22p	2N3708	8p	2N5439	32p	BC171	15p	BFY90	65p	NKT717	42p
2N1131	25p	2N3709	10p	2N5440	47p	BC172	15p	BX819	17p	NKT734	27p
2N1132	25p	2N3710	10p	2N5441	47p	BC175	22p	BX820	17p	NKT736	35p
2N1302	17p	2N3711	10p	2N5442	30p	BC177	22p	BX821	20p	NKT773	25p
2N1303	17p	2N3712	10p	2N5443	47p	BC178	22p	BX822	20p	NKT774	31p
2N1304	22p	2N3713	20p	2N5444	47p	BC179	22p	BX827	47p	OC16	50p
2N1305	22p	2N3714	22p	2N5445	42p	BC182	12p	BX828	32p	OC19	37p
2N1306	24p	2N3716	20p	2N5446	42p	BC182L	10p	BX860	82p	OC20	75p
2N1307	24p	2N3717	20p	2N5447	47p	BC183	10p	BX861	62p	OC22	50p
2N1308	25p	2N3721	20p	2N5448	55p	BC183L	10p	BX876	15p	OC23	60p
2N1309	24p	2N3819	14p	2N5449	35p	BC184	15p	BX877	20p	OC24	60p
2N1307	17p	2N3820	14p	2N5450	35p	BC185	15p	BX878	25p	OC26	45p
2N1613	37p	2N3823	14p	2N5451	40p	BC186	25p	BX894	15p	OC26	25p
2N1631	35p	2N3854	27p	2N5452	52p	BC187	27p	BSY26	15p	OC28	60p
2N1632	30p	2N3854A	27p	2N5453	52p	BC212L	12p	BSY26	17p	OC29	60p
2N1637	30p	2N3855	27p	2N5454	62p	BC213L	12p	BSY27	17p	OC35	50p
2N1638	27p	2N3855A	30p	2N5455	60p	BC214L	15p	BSY28	17p	OC36	60p
2N1639	27p	2N3856	30p	2N5456	60p	BCY10	17p	BSY29	27p	OC41	22p
2N1701	110p	2N3857	40p	2N5457	32p	BCY30	25p	BSY32	22p	OC42	25p
2N1711	84p	2N3858	22p	2N5458	72p	BCY31	30p	BSY36	25p	OC44	17p
2N1889	32p	2N3858A	30p	2N5459	60p	BCY32	50p	BSY37	25p	OC45	15p
2N1893	37p	2N3859	27p	2N5460	57p	BCY33	20p	BSY38	20p	OC46	15p
2N2147	72p	2N3859A	32p	2N5461	57p	BCY34	25p	BSY39	22p	OC70	15p
2N2160	57p	2N3860	30p	2N5462	50p	BCY38	20p	BSY43	50p	OC71	12p
2N2193	40p	2N3866	16p	2N5463	24p	BCY39	60p	BSY51	32p	OC72	25p
2N2193A	40p	2N3867	40p	2N5464	32p	BCY40	32p	BSY52	32p	OC73	30p
2N2194	27p	2N3877A	40p	2N5465	15p	BCY41	15p	BSY53	37p	OC74	30p
2N2194A	30p	2N3900	30p	2N5466	22p	BCY42	15p	BSY54	40p	OC75	25p
2N2217	27p	2N3900A	40p	2N5467	22p	BCY43	15p	BSY56	90p	OC76	25p
2N2218	20p	2N3901	97p	2N5468	22p	BCY44	32p	BSY79	45p	OC77	30p
2N2219	20p	2N3902	25p	2N5469	22p	BCY58	22p	BSY90	57p	OC78	20p
2N2220	25p	2N3904	25p	2N5470	22p	BCY59	22p	BSY95A	15p	OC81	20p
2N2221	25p	2N3905	25p	2N5471	22p	BCY60	22p	BSY96	15p	OC81D	20p
2N2222	20p	2N3906	30p	2N5472	18p	BCY70	15p	C450	15p	OC82	25p
2N2222A	20p	2N4058	15p	2N5473	24p	BCY71	20p	GET102	30p	OC82D	15p
2N2297	30p	2N4059	10p	2N5474	15p	BCY72	15p	GET113	20p	OC83	25p
2N2368	15p	2N4060	12p	2N5475	20p	BCY78	30p	GET114	15p	OC84	25p
2N2369	17p	2N4061	12p	2N5476	20p	BCY79	30p	GET118	20p	OC159	25p
2N2369A	17p	2N4062	12p	2N5477	20p	BCY80	25p	GET120	25p	OC160	25p
2N2410	42p	2N4248	15p	2N5478	47p	BCZ11	40p	GET873	12p	OC170	25p
2N2483	27p	2N4248	15p	2N5479	14p	BD112	50p	GET880	30p	OC171	30p
2N2484	24p	2N4249	15p	2N5480	25p	BD116	112p	GET887	15p	OC200	40p
2N2539	22p	2N4250	18p	2N5481	40p	BD121	65p	GET889	22p	OC201	60p
2N2540	22p	2N4251	47p	2N5482	47p	BD123	65p	GET890	22p	OC202	75p
2N2613	27p	2N4252	45p	2N5483	47p	BD124	75p	GET892	22p	OC203	40p
2N2614	30p	2N4253	45p	2N5484	47p	BD131	75p	GET893	22p	OC204	40p
2N2646	30p	2N4285	17p	2N5485	35p	BD132	85p	GET898	22p	OC205	75p
2N2711	25p	2N4286	17p	2N5486	35p	BDY10	125p	MAT100	25p	OC206	90p
2N2712	25p	2N4287	17p	2N5487	45p	BDY20	105p	MAT101	30p	OC207	75p
2N2713	27p	2N4288	15p	2N5488	14p	BDY61	125p	MAT120	25p	OC271	42p
2N2714	30p	2N4289	15p	2N5489	25p	BDY62	100p	MAT121	30p	ORP12	50p
2N2904	30p	2N4290	15p	2N5490	15p	BF115	25p	MJ400	107p	ORP60	40p
2N2904A	35p	2N4291	15p	2N5491	15p	BF117	47p	MJ420	115p	ORP61	42p
2N2905	25p	2N4292	15p	2N5492	47p	BF121	47p	MJ421	115p	P346A	15p
2N2905A	25p	2N4293	15p	2N5493	47p	BF122	47p	MJ430	102p	ST140	15p
2N2906	20p	2N4303	47p	2N5494	22p	BF128	22p	MJ440	95p	ST141	20p
2N2906A	25p	2N4304	47p	2N5495	19p	BF129	57p	MJ450	95p	TR18A	62p
2N2907	23p	2N4305	47p	2N5496	16p	BF136	35p	MJ481	125p	TR184	40p
2N2923	15p	2N5027	52p	2N5497	16p	BF137	25p	MJ490	100p	TR185	40p
2N2924	15p	2N5028	47p	2N5498	16p	BF138	25p	MJ491	137p	TR186	12p
2N2925	15p	2N5029	47p	2N5499	16p	BF139	30p	MJ530	65p	TR186	12p
2N2926G	12p	2N5030	42p	2N5500	45p	BF177	30p	MJ530	65p	TR187	12p
2N2926L	12p	2N5172	42p	2N5501	45p	BF178	25p	MJ537	77p	TR188	12p
2N2926Y	12p	2N5174	42p	2N5502	45p	BF179	25p	MJ520	87p	TR189	12p
2N3011	24p	2N5175	42p	2N5503	45p	BF180	35p	MJ521	77p	TR190	12p
2N3014	25p	2N5176	42p	2N5504	45p	BF181	35p	MJ522	77p	TR191	12p
2N3052A	25p	2N5223A	30p	2N5505	47p	BF182	30p	MJ523	77p	TR192	12p
2N3054	25p	2N5245	45p	2N5506	47p	BF184	20p	MJ524	77p	TR193	12p
2N3055	72p	2N5246	45p	2N5507	47p	BF185	20p	MJ525	77p	TR194	12p
2N3133	20p	2N5249	67p	2N5508	47p	BF186	20p	MJ526	77p	TR195	12p
2N3134	20p	2N5250	67p	2N5509	47p	BF187	20p	MJ527	77p	TR196	12p
2N3135	20p	2N5251	67p	2N5510	47p	BF188	20p	MJ528	77p	TR197	12p
2N3136	20p	2N5252	67p	2N5511	47p	BF189	20p	MJ529	77p	TR198	12p
2N3137	20p	2N5253	67p	2N5512	47p	BF190	20p	MJ530	77p	TR199	12p
2N3138	20p	2N5254	67p	2N5513	47p	BF191	20p	MJ531	77p	TR200	

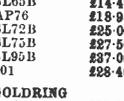
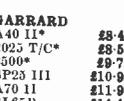
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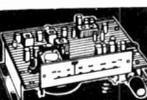
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ACI77	20p	ASY27	30p	BCI71	13p	BF154	35p	BSY26	15p	OC44	15p	2G377	17p	2N2193	30p	2N3391	17p	2N5172	12p	
ACI87	30p	ASY28	25p	BCI72	13p	BF157	25p	BSY27	15p	OC45	12p	2G377	17p	2N2217	20p	2N3392	17p	2N5172	12p	
ACI88	30p	ASY29	25p	BCI73	13p	BF158	25p	BSY28	15p	OC45	12p	2G377	17p	2N2218	25p	2N3393	15p	2N5172	12p	
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ACI733	18p	BCI09	11p	BCI84L	13p	BF180	30p	C425	40p	OC84	20p	2N697	15p	2N2416	50p	2N3420	37p	2N5172	12p	
ACI734	30p	BCI13	25p	BCI86	27p	BF181	30p	C426	30p	OC139	15p	2N698	24p	2N2417	50p	2N3421	37p	2N5172	12p	
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ADI140	40p	BCI17	35p	BCI89	11p	BF185	30p	C444	37p	OC200	27p	IN709	45p	2N2421	50p	2N3425	37p	2N5172	12p	
ADI142	40p	BCI18	25p	BCI212L	11p	BF188	30p	C450	17p	OC201	27p	IN709	45p	2N2422	50p	2N3426	37p	2N5172	12p	
ADI149	43p	BCI19	45p	BCI213L	11p	BF194	23p	C720	12p	OC202	27p	IN711	40p	2N2423	50p	2N3427	37p	2N5172	12p	
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ADI162	35p	BCI26	35p	BCI214L	12p	BF196	30p	C740	25p	OC204	25p	IN718	24p	2N2425	50p	2N3429	37p	2N5172	12p	
ADI161/1	162(MP)	63p	BCI34	30p	BCI226	35p	BF200	45p	C744	17p	OC205	35p	IN718A	50p	2N2426	50p	2N3430	37p	2N5172	12p
ADT140	50p	BCI35	30p	BCI317	12p	BF222	80p	C760	17p	P346A	17p	IN727	27p	2N2427	50p	2N3431	37p	2N5172	12p	
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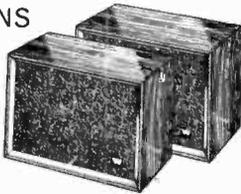
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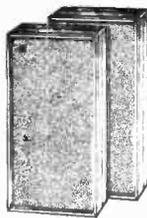


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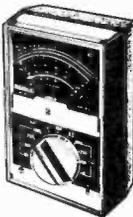
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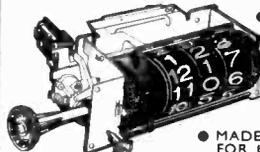


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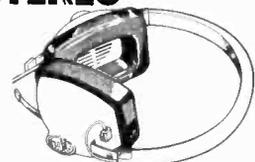
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2N3707	0-12	BCY32	0-55	GD8	0-25	0A2290	0-38
2N3709	0-13	BCY33	0-25	GET102	0-05	0C16	0-50
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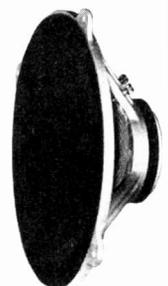
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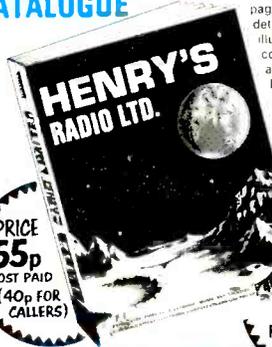
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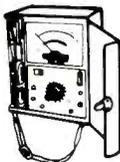
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