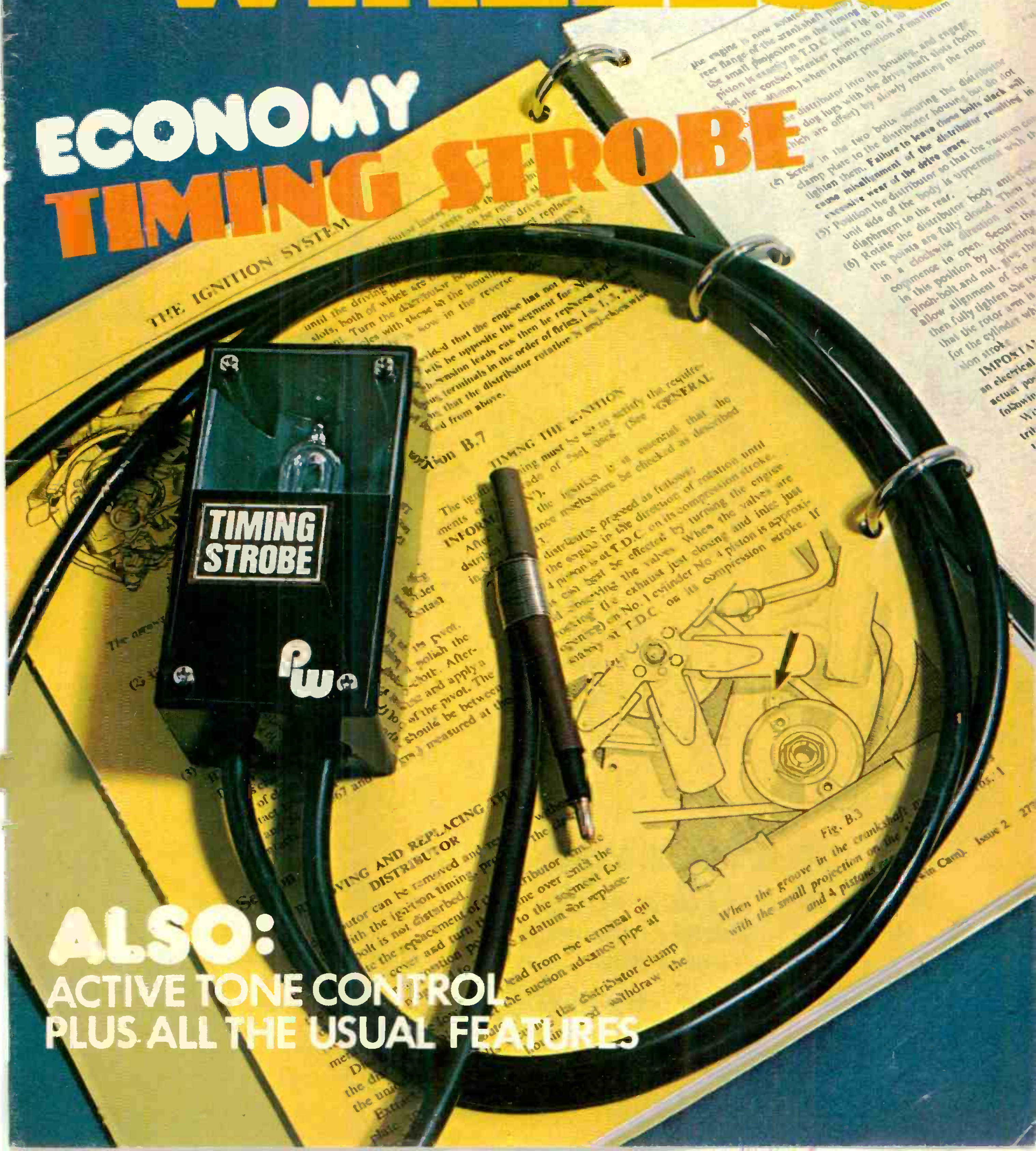
FEB 1978

45p

practical WIRELESS

ECONOMY TIMING STROBE



ALSO:

ACTIVE TONE CONTROL

PLUS ALL THE USUAL FEATURES

Practical Wireless

ISSUE 852

FEBRUARY 1978 · VOLUME 53 · NUMBER 10

BRITAIN'S LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH15 1JG

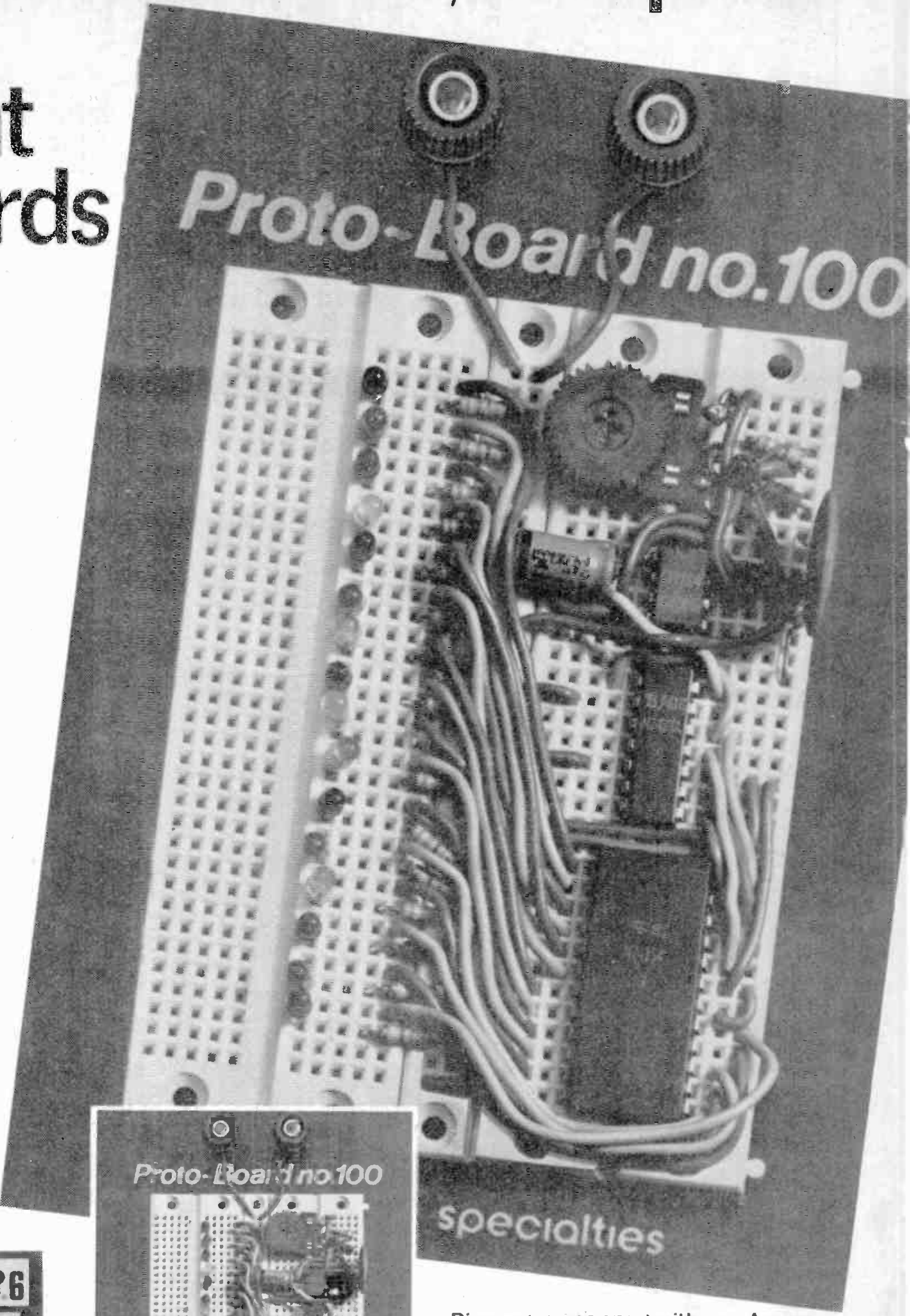
News and Views

For our Constructors

General Interest

Medium Wave Tuner/Amplifier, trailered last month, has been delayed. We hope to feature it in a forthcoming issue

The most economical, compact and convenient breadboards on the market!



They are the PROTO-BOARD* PB-6 and PB-100 solderless breadboard kits.

Buy them, and you are only minutes away from the first circuit.

Contacts are made from non-corrosive nickel-silver alloy, and are reliable for more than 10,000 insertions.

Contact resistance is a mere 0.4 mΩ, insertion force is typically 3 ozs per lead, and interterminal capacitance is typically less than 5 pF.

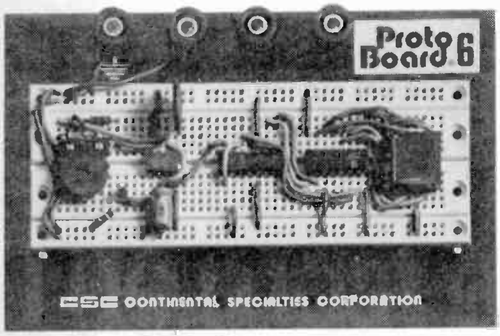
The kits are a must for experimental and development work in digital, audio, RF, video and beyond.

Resistors, capacitors, transistors, DIP's, LED's, transformers, pots, jumpers and any other component with leads between 0.015" and 0.032" will fit the contacts.

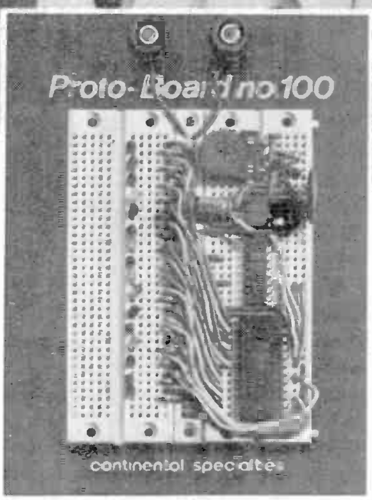
You can run circuits well beyond the recommended ambient operating temperature (100°C) if you wish, because the plastic used in the PROTO-BOARD is rated to over 200°C.

The kits come complete with instruction manual, assembly hardware, binding posts, non-scratch feet and the appropriate number of preassembled sockets and bus strips.

The sooner you order, the sooner you'll have that first circuit operating.



THE PB-6. 630 SOLDERLESS CONTACTS. TAKES UP TO SIX 14-PIN DIP'S OR EQUIVALENT IN LARGER AND SMALLER IC'S. FOUR 5-WAY BINDING POSTS. 6" x 4".
ONLY COSTS £10.47.



THE PB-100. 760 SOLDERLESS CONTACTS. TAKES UP TO TEN 14-PIN DIP'S. OR EQUIVALENT IN LARGER AND SMALLER IC'S. TWO 5-WAY BINDING POSTS. 6" x 4.5"
ONLY COSTS £13.50.

Ring us (01-890 0782) with your Access, Barclaycard or American Express number and your order will be in the post that night.
Alternatively, send a cheque, or postal order (don't send credit cards!) and it still only takes a few days.
Otherwise ask for our complete catalogue.
Our prices include VAT (8%) and postage.
All prices and specifications correct at the time of going to press.

CONTINENTAL SPECIALTIES CORPORATION

CSC

CONTINENTAL SPECIALTIES CORPORATION (UK) LTD., SPUR ROAD, NORTH FELTHAM TRADING ESTATE, FELTHAM, MIDDLESEX TW14 0TJ. TELEPHONE: 01-890 0782.
REG IN LONDON: 1303780 VAT NO: 224 8074 71 *TRADE MARK APPLIED FOR ©CSC (UK) LTD 1977. DEALER ENQUIRIES WELCOME. TELEX: 8813669 CSCLTD.

TRANSISTORS:

AC107	30p
AC117	32p
AC126	32p
AC127	32p
AC128	28p
AC128K	32p
AC141	22p
AC141K	44p
AC142	26p
AC142K	44p
AC153K	38p
AC154	20p
AC176	35p
AC178	44p
AC179	44p
AC187	32p
AC187K	42p
AC188	37p
AC188K	42p
AC193K	41p
AC194K	41p
ACY17	54p
AD140	84p
AD142	81p
AD143	83p
AD149	68p
AD161	58p
AD162	58p
AF114	32p
AF115	32p
AF116	32p
AF117	32p
AF118	60p
AF121	53p
AF124	36p
AF125	36p
AF126	36p
AF127	39p
AF139	45p
AF178	64p
AF179	74p
AF180	75p
AF181	75p
AF186	38p
AF239	45p
AF279	80p
ASY67	£1·30
AU110	£1·75
AU113	£1·45
BC107	12p
BC107A	14p
BC107B	14p
BC108	12p
BC108A	14p
BC108B	14p
BC108C	14p
BC109	12p
BC109A	14p
BC109B	14p
BC109C	15p
BC113	15p
BC114	15p
BC115	18p
BC116	19p
BC117	19p
BC118	19p
BC119	29p
BC125	18p
BC126	19p
BC132	20p
BC134	19p
BC135	18p
BC136	19p
BC137	19p
BC138	23p*
BC139	34p
BC140	32p
BC142	34p
BC143	34p
BC147	10p*
BC147A	11p*
BC147B	12p*
BC148	10p*
BC148B	11p*
BC149	10p*
BC149B	11p*
BC149C	12p*
BC152	22p*
BC153	16p*
BC154	15p*
BC157	12p*
BC157A	13p*
BC158	12p*
BC158B	13p*
BC159	12p*
BC159B	13p*
BC159C	14p*
BC161	50p
BC167B	14p*
BC168A	14p*
BC168B	14p*
BC169B	20p*
BC169C	23p*
BC170	14p*
BC170B	15p*
BC170C	16p*
BC171	14p*
BC171A	15p*
BC171B	15p*
BC172	12p*
BC172B	14p*
BC172C	16p*
BC173	16p*
BC173B	18p*
BC176	18p
BC177	18p
BC177A	19p
BC178	20p
BC178A	21p
BC178B	21p
BC179	23p
BC179A	24p
BC179B	24p
BC182	12p*
BC182B	13p*
BC182L	14p*
BC183	12p*
BC183B	13p*
BC183L	13p*
BC183LB	14p*
BC184	13p*
BC184L	14p*
BC184LB	15p*
BC186	23p
BC187	26p
BC204	16p*
BC208	16p*
BC212	13p*
BC212L	14p*
BC212LA	15p*
BC213	13p*
BC213L	14p*
BC214	13p*
BC214B	14p*
BC214L	15p*
BC237B	16p*
BC238	17p*
BC239	18p*
BC252C	21p*
BC253C	23p*
BC258A	22p*
BC261A	25p
BC261B	25p
BC262A	20p
BC263B	23p
BC267	25p
BC267C	26p
BC268A	12p
BC268C	14p
BC294	35p
BC301	30p
BC303	33p
BC304	40p
BC307A	15p*
BC307B	15p*
BC308A	16p*
BC309	17p*
BC313	42p*
BC323	82p
BC328	17p*
BC337	15p*
BC338	15p*
BC347A	18p
BC377	21p
BC384	18p*
BC440	28p
BC460	38p
BC547	12p*
BC548	12p*
BC558A	13p*
BCY31	65p
BCY38	85p
BCY42	25p
BCY70	18p
BCY71	23p
BCY72	18p
BCZ11	£1·11
BD115	61p
BD116	67p
BD123	87p
BD124P	87p
BD131	41p
BD132	41p
BD133	54p
BD135	38p
BD136	38p
BD137	40p
BD138	48p
BD139	44p
BD140	58p
BD145	75p
BD163	85p
BD182	98p
BD183	£1·03
BD184	£1·25
BD187	59p
BD232	85p*
BD234	58p
BD253	£2·35
BDX18	£2·35
BDX32	£2·35
BDY11	85p
BDY20	£1·05
BF115	42p
BF117	65p
BF120	75p
BF121	36p
BF123	38p
BF125	36p
BF127	38p
BF152	25p
BF153	36p
BF158	17p
BF159	25p
BF160	25p
BF161	25p
BF164	25p
BF166	35p
BF167	36p
BF173	27p
BF177	30p
BF178	42p
BF179	33p
BF180	33p
BF181	33p
BF182	38p
BF183	40p
BF184	28p
BF185	28p
BF186	42p
BF194	12p*
BF194A	13p*
BF195	12p*
BF195C	14p*
BF196	15p*
BF197	15p*
BF198	15p*
BF199	20p*
BF200	38p*
BF224J	25p*
BF224	35p*
BF240	20p*
BF241	18p*
BF254	38p*
BF255	29p*
BF257	40p
BF258	34p
BF259	44p
BF262	40p*
BF263	40p*
BF273	14p*
BF336	37p
BF337	35p
BF458	58p
BF459	52p
BF596	22p*
BF597	22p*
BFR39	27p*
BFR41	27p*
BFT41	45p
BFT43	40p
BFW10	65p
BFW11	75p
BFX84	29p
BFX85	29p
BFX86	31p
BFX87	31p
BFX88	29p
BFY50	22p
BFY51	22p
BFY52	22p
BFY53	34p
BFY72	51p
BFY77	22p
BFY90	£1·10
BR101	41p
BRC4443	£1·46
BRY39	40p
BRY56	38p*
BSX19	30p
BSX20	25p
BSX76	33p
BSY38	18p
BSY39	18p
BSY52	55p
BT106	£1·50
BU105	£1·60
BU108	£2·20
BU126	£1·94
BU204	£2·30
BU205	£2·10
BU206	£2·30
BU208	£2·65
C1129	9p
GET872	15p
GET881	15p
GET882	15p
ME6001	20p*
ME6002	20p*
ME8001	25p*
MJ2955	£1·40
MJE340	66p
MJE370	62p
MJE520	54p
MJE521	90p
MJE2955	£1·40
MJE3000	£2·10
MJE3055	97p
MPU131	35p*
OC41	75p
OC42	75p
OC44	40p
OC45	40p
OC70	40p
OC71	45p
OC72	45p
OC75	45p
OC77	88p
OC81D	50p
ORP12	£1·10
R2008B	£1·95
R2010B	£1·95
TIP29	54p
TIP31A	55p
TIP32A	57p
TIP33	96p
TIP34	96p
TIP41A	76p
TIP42A	79p
TIP3055	£1·15
TIS43	38p
TIS90	25p*
TIS91	26p*
2N705	40p
2N2646	75p
2N2696	£1·20
2N2904A	36p
2N2905A	36p
2N2906	22p
2N2907A	59p
2N2926G	17p*
2N29260	17p*
2N2926Y	17p*
2N3053	42p
2N3054	97p
2N3055	65p
2N3702	17p*
2N3703	17p*
2N3704	17p*
2N3705	17p*
2N3706	17p*
2N3707	17p*
2N3709	17p*
2N3819	42p
2S321	75p
RCA40530	95p
RCA40654	79p

INTEGRATED CIRCUITS:

7400	17p
7401	17p
7402	17p
7403	17p
7404	22p
7405	24p
7409	25p
7410	20p
7412	21p
7413	40p
7414	75p
7420	20p
7430	20p
7438	40p
7440	20p
7441	90p
7442	80p
7445	£1·20
7447A	90p
7450	20p
7453	20p
7460	22p
7470	39p
7473	36p
7474	36p
7475	52p
7476	43p
7482	80p
7490	68p
7492	65p
7493	51p
7496	90p
74121	43p
74122	52p
74141	90p
74154	£1·75
74175	£1·10
74190	£1·70
74192	£1·70
74196	£1·20
SN76001N	£1·57*
SN76003N	£2·45
SN76013N	£1·70
SN76013ND	£1·55
SN76023N	£1·65
SN76023ND	£1·55
SN76033N	£2·40
SN76226DN	£1·53
SN76227N	£1·23
SN76660	£1·15*
SN76666	£1·31*
TAA263	£1·10*
TAA550G	55p
TAA570	£2·02
TAA611B	£2·75*
TBA540Q	£2·20*
TBA550Q	£3·35*
TBA560CQ	£3·35*
TBA570Q	£1·35*
TBA641 (B11)	£2·60*
TBA720Q	£2·15*
TBA750	£1·97*
TBA800	£1·32*
TBA810AS	£1·42*
TCA270Q	£2·80*
NE555	61p*
NE556	£1·25
741 (8 pin DIL)	38p*
758	85p
ZN414	£1·65

DIL SOCKETS:

8 Pin DIL:

1+	20p
10+	19p
50+	17p
100+	15p

14 Pin DIL:

1+	22p
10+	21p
50+	18p
100+	16p

16 Pin DIL:

1+	24p
10+	23p
50+	19p
100+	17p

DIODES:

BA145	18p
BA148	18p
BA155	18p
BA156	15p
BAX13	8p
BAX16	9p
BB110B	50p
BR100	28p
BY126	15p
BY127	16p
OA10	35p
OA47	11p
OA81	15p
OA90	7p
OA91	7p
OA95	9p
OA200	8p
OA202	10p
TIL209 (0·125" Led/Red)	25p
TIL211 (0·125" Led/Green)	44p
1N4001 1A 50V	6p
1N4002 1A 100V	6½p
1N4003 1A 200V	7p
1N4004 1A 400V	7½p
1N4005 1A 600V	8p
1N4006 1A 800V	9p
1N4007 1A 1000V	10p
1N4009	7p
1N4148	6p
1N5401	16p
1N5402	17p
1N5404	18p
1N5406	20p
1N5408	22p
1N914	7p
1N916	8p
1S44	7p
1S920	7p
1S921	10p

ZENER DIODES:

400mW + − 5% 3V-33V 10p each: 10/95p

1W 3V3-200V 18p each: 10/£1·75

0·1W SUBMINIATURE SKELETON PRESETS:

(Vertical or Horizontal)

100 ohm to 1M—7p* each: 50 for £3·00*. 100 for £5·00*

RESISTORS—High stability, low noise carbon film 5% ⅓W at 40°C, ⅓W at 70°C. E12 series only—from 2·2Ω to 2·2MΩ. All at 2p* each, 15p* for 10 of any one value, 95p* for 100 of any one value. SPECIAL PACK: 10 of each value 2·2Ω & 2·2MΩ (730 resistors) £6·50*.

WIREWOUND RESISTORS:

5% Tol.

2·5W (0·22R-22R)—14p: 5W (10R-12K)—16p: 10W (0·47R-10K) —18p.

TANTALUM BEAD CAPACITORS:

0·1, 0·15, 0·22, 0·33, 0·47, 0·68, 1·0μF at 25/35V—10p*; 1·5μF/35V —11p*; 2·2μF/35V—12p*; 3·3μF/35V—13p*; 4·7μF/35V—15p*; 6·8μF/35V—17p*; 10μF/25V—17p*; 10μF/35V—21p*; 15μF/20V; 22μF/15V; 33μF/10V; 47μF/6·3V at 21p*; 68μF/3V—17p*; 100μF/3V —21p*.

ELECTROLYTICS:

Axial or Radial Leads: (values in μF)

16V—1, 2·2, 3·3, 4·7, 6·8, 10, 15, 22, 33—8½p*: 47, 68, 100, 150—12½p*: 220—15p*: 330, 470—20p*: 680, 1000—27p*: 1500—35p*: 2200—43p*.

25V—1, 2·2, 3·3, 4·7, 6·8, 10, 15, 22—8½p*: 33, 47, 68, 100—12½p*: 150—15p*: 220—20p*: 330, 470—27p*: 680, 1000—35p*: 1500, 2200—43p*.

35/40V—1, 2·2, 3·3, 4·7, 6·8—8½p*: 10, 15, 22, 33, 47, 68, 100—12½p*: 150—20p*: 220—27p*: 330, 470, 680—35p*: 1000, 1500—43p*: 2200—85p*.

63V—1, 2·2, 3·3, 4·7, 6·8—8½p*: 10, 15—12½p*: 22, 33, 47—15p*: 68, 100—27p*: 150, 220—35p*: 330, 470, 1000—43p*.

PRECISION POLY-CARBONATE CAPACITORS

All High Stability—extremely Low Leakage

440V A.C. RANGE

Value (μF)	Dimensions (mm) L	D	Price each
0·1	27	12·7	£1·34
0·15	27	12·7	£1·52
0·22	33	16	£1·66
0·25	33	16	£1·78
0·33	33	16	£1·92
0·47	33	19	£2·08
0·5	33	19	£2·24
0·68	50·8	22	£2·48
1·0	50·8	22	£2·64
1·5	50·8	25·4	£3·14
2·0	50·8	25·4	£3·74

63V D.C. RANGE

Value μF	±1%	±2%	±5%
0·01–0·2	£1·80	£1·22	88p
0·22–0·47	£1·82	£1·24	90p
0·68	£2·06	£1·38	£1·00
1·0	£2·26	£1·52	£1·08
1·5	£2·50	£1·68	£1·20
2·2	£2·80	£1·94	£1·42
3·3	£3·42	£2·30	£1·84
4·7	£4·00	£2·72	£2·24
6·8	£4·88	£3·36	£2·66
10	£6·94	£4·68	£3·56
15	£9·92	£6·48	£4·96
22	£13·32	£9·98	£6·80

Send s.a.e. for free detailed lists of additional stock items, plugs and sockets, fuses, discs, polyester capacitors, bridge rectifiers high voltage electrolytics. Wholesale price lists available to bona fide companies. ADD 8% VAT TO ALL ITEMS EXCEPT THOSE MARKED WITH * WHICH ARE 12½%. PLEASE ADD 25p Post and Packing to all orders. Export add cost of air/sea mail.

MARCO TRADING

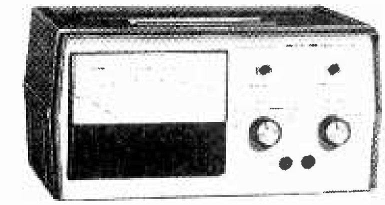
(Dept. W2)

The Old School, Edstaston, Wem, Shropshire SY4 5RJ

Tel: Whixall 464 (STD: 094-872)

(props. Minicost Trading Ltd.)

Over 200 kits in the free Heathkit Catalogue



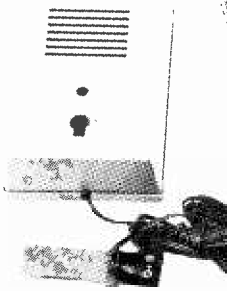
NEW 4 Function Solid State Multimeter – One of a whole range of test equipment

NEW Digital Clock – with repeater alarm

Car Intrusion Alarm – Gives a distinctive 'yelping' sound-signal the moment your car is tampered with

Freezer Alarm – Gives audible signal if freezer temperature rises to 6 C for any reason

NEW Electronic Chess Game



Right now, there's a brand new edition of the Heathkit Catalogue – packed with hundreds of practical and fascinating items which you can build yourself.

Send for your copy now!

To Heath (Gloucester) Ltd.
Department PW-28
Bristol Road, Gloucester, GL2 6EE.
Please send a copy of the Heathkit Catalogue.
I enclose 11p in stamps to cover postage only.

Name ___________

Address ___________

Soldering iron offer FREE

When you receive your catalogue you'll get details of this free offer worth approximately £4.75.

HEATH Schlumberger

The world's biggest producers of electronic kits.

ACCESS AND BARCLAYCARD WELCOMED

There are Heathkit Electronics Centres at 233 Tottenham Court Road, London (01-636 7349) and at Bristol Road, Gloucester (Gloucester 29451).

AUDIO MODULES—ALL REDUCED! TRANSISTOR PRICES SLASHED! MANY PAKS 33% OFF

BI-PAK GREAT SPACE

WE NEED THE SPACE

THYRISTORS

No. THY1A/50	1 Amp.	50 volt	TO5	18p
No. THY1A/400	1 Amp.	400 volt	TO5	32p
No. THY3A/50	3 Amp.	50 volt	TO64	25p
No. THY3A/200	3 Amp.	200 volt	TO64	32p
No. THY3A/400	3 Amp.	400 volt	TO64	40p
No. THY5A/50	5 Amp.	50 volt	TO66	25p
No. THY5A/400	5 Amp.	400 volt	TO66	40p
No. THY5A/600	5 Amp.	600 volt	TO66	50p
No. C106/4	6 Amp.	400 volt	TO220	42p

TRIAC

S84 8 Amp. 400 volt TO220 Plastic **80p**
(Non Isolated Tab)

DIACS

BR100 **15p**
D32 **15p**

SWITCHES

No. 16178 5 x Mains Slide Switches **40p•**
No. S17 5 x Miniature Slide Switches **40p•**
No. S18 4 x Standard Slide Switches **40p•**
No. S19 4 x Miniature Push to Make single hole mounting **40p•**
No. S20 3 x Miniature Push to Break single hole mounting **40p•**
No. S21 Push button Switch Pak 4 x Assorted types multi bank and singles Latching and non-Latching **£1.00•**

CAPACITOR PAKS

16201 18 Electrolytics 4.7μF – 10μF
16202 18 Electrolytics 10μF – 100μF
16203 18 Electrolytics 100μF – 680μF
All 3 at SPECIAL PRICE of £1.20•
16160 24 Ceramic Caps 22pF – 82pF
16161 24 Ceramic Caps 100pF – 390pF
16162 24 Ceramic Caps 470pF – 3300
16163 21 Ceramic Caps 4700pF – 0.047μF
All 4 at SPECIAL PRICE of £1.60

RESISTOR PAKS

Order No.
16213 60 ¼W. 100 ohm – 820 ohm
16214 60 ¼W. 1K – 8.2K
16215 60 ¼W. 10K – 82K
16216 60 ¼W. 100K – 820K
All 4 at SPECIAL PRICE of £1.60•
16217 40 ½W. 100 ohm – 820 ohm
16218 40 ½W. 1W – 8.2K
16219 40 ½W. 1K – 8.2K
16220 40 ½W. 100K – 820K
All 4 at SPECIAL PRICE of £1.60•

TRANSISTOR *FALL-OUT* PACK, GERM, SILICON, POWER, NPN, PNP. ALL MIXED. YOURS TO SORT AND TEST.

Approx. 500 Pieces.
Order No. S23
£1.25 per pack.

VOLTAGE REGULATORS

Positive

No. MVR7805	μA7805	TO220	85p
No. MVR7812	μA7812	TO220	85p
No. MVR7815	μA7815	TO220	85p
No. MVR7818	μA7818	TO220	85p
No. MVR7824	μA7824	TO220	85p

Negative

No. MVR7905	μA7905	TO220	£1.10
No. MVR7912	μA7912	TO220	£1.10
No. MVR7915	μA7915	TO220	£1.10
No. MVR7918	μA7918	TO220	£1.10
No. MVR7924	μA7924	TO220	£1.10

μA723C TO99 **38p** 72723 14 pin Dil **38p**
LM309K TO3 **£1.20**

MICROPHONES

DYNAMIC DUAL IMPEDANCE UNI DIRECTIONAL CARDIOID MICROPHONE
Impedance 600 ohms and 50K. Response 50-14,000 Hz. Sensitivity 54db at 50K.
Size 1½" Dia x 6¼" Long
Order No. 1328 **£7.50•**

DYNAMIC CASSETTE MIC

Fitted with On/Off switch. 1 metre of tough lead with floating 2.5 and 3.5 mm plugs.
Impedance 200 ohms Sensitivity 90db
Frequency 90-10,000 Hz.
Size 20mm Dia. x 120mm Long
Order No. 1326 **£1.15•**

LOGIC PROBE

A pocket size instrument capable of detecting T.T.L., D.T.L. Flip Flop and other pulse circuits. It is easy to use and operates from the 5V. D.C. supply of the circuit under test. The logic levels are indicated by 2 red LED's one for High and the other for Low. There is also a green LED for the Pulse Mode of the unit.
No. S59 **Our Special Price £16.95.**

TRANSISTORS

BRAND NEW – FULLY GUARANTEED

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	25p	BC177	12p	BF194	•9p	TIP32A	34p	2N1613	15p
AC126	14p	BC178	12p	BF195	•9p	TIP32B	35p	2N1711	15p
AC127	16p	BC179	12p	BF196	•12p	TIP32C	36p	2N1893	28p
AC128	16p	BC182	•9p	BF197	•12p	TIP41A	34p	2N2218	15p
AC128K	24p	BC182L	•9p	BF200	25p	TIP41B	35p	2N2218A	18p
AC176	16p	BC183	•9p	BFX29	22p	TIP41C	36p	2N2219	15p
AC176K	24p	BC183L	•9p	BFX84	18p	TIP42A	36p	2N2219A	18p
AC187	16p	BC184	•9p	BFY50	12p	TIP42B	37p	2N2221	15p
AC187K	26p	BC184L	•9p	BFY51	12p	TIP42C	38p	2N2221A	16p
AC188	16p	BC212	•10p	BFY52	12p	TIP2955	65p	2N2222	15p
AC188K	26p	BC212L	•10p			TIP3055	42p	2N2222A	16p
AD161/		BC213	•10p	MPSA05	•22p	ZTX107	•6p	2N2369	10p
162 MP	80p	BC213L	•10p	MPSA06	•22p	ZTX108	•6p	2N2904	14p
AF139	30p	BC214	•10p	MPSA55	•22p	ZTX109	•7p	2N2904A	15p
AF239	30p	BC214L	•10p	MPSA56	•22p	ZTX300	•7p	2N2905	14p
BC107	6p	BC251	•10p	OC44	12p	ZTX301	•7p	2N2905A	15p
BC108	6p	BCY70	12p	OC45	12p	ZTX302	•9p	2N2906	12p
BC109	6p	BCY71	12p	OC71	9p	ZTX500	•8p	2N2906A	14p
BC118	•10p	BCY72	12p	OC72	12p	ZTX501	•10p	2N2907	12p
BC147	•8p	BD115	40p	OC75	10p	ZTX502	•12p	2N2907A	13p
BC148	•8p	BD131	•35p	OC81	14p	2N696	10p	2N2926G	•8p
BC149	•8p	BD132	•37p			2N697	10p	2N2926Y	•7p
BC154	•16p	BF115	17p	TIP29A	35p	2N706	7p	2N3053	12p
BC157	•9p	BF167	19p	TIP29B	36p	2N706A	8p	2N3055	35p
BC158	•9p	BF173	20p	TIP29C	38p	2N708	8p	2N3702	•7p
BC159	•9p	BF180	25p	TIP30A	36p	2N1302	12p	2N3703	•7p
BC169C	•10p	BF181	25p	TIP30B	37p	2N1303	15p	2N3704	•6p
BC170	6p	BF182	25p	TIP30C	38p	2N1304	15p	2N3903	•11p
BC171	•6p	BF183	25p	TIP31A	32p	2N1307	18p	2N3904	•11p
BC172	•6p	BF184	25p	TIP31B	33p	2N1308	22p	2N3905	•11p
BC173	7p	BF185	25p	TIP31C	34p	2N1309	22p	2N3906	•11p

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA119	5p	BAX16/		BYZ16	30p	OA85	7p	IS44	3p
AAZ13	4p	OA202	5p	BYZ17	28p	OA90	6p		
BA100	6p			BYZ18	28p	OA91	7p	IN5400	10p
BA115	5p	BY100	15p	BYZ19	28p	OA95	7p	IN5401	11p
BA144	5p	BY127	•10p					IN5402	12p
BA148	10p	BYZ10	32p	OA47	5p	IN34	5p	IN5404	13p
BA173	10p	BYZ11	32p	OA70	5p	IN60	6p	IN5406	16p
BAX13/		BYZ12	32p	OA79	7p	IN914	4p	IN5407	17p
OA200	5p	BYZ13	30p	OA81	7p	IN4148	4p	IN5408	19p

LINEAR I.C.'s

TBA800	12 pin QIL	•75p	UA711C TO99	25p	UA748 TO99		28p
TBA810	12 pin QIL	•£1.00	UA703 TO99 (Plastic)	20p	72558 (Dual 748) TO99		45p
TBA820	14 pin QIL	•80p	741P 8 pin DIL	18p	MC1310P 14 pin DIL		•£1.25
LM380	14 pin DIL	•80p	72741 14 pin DIL	20p	76115 14 pin QIL		•£1.25
LM381	14 pin DIL	•£1.35	UA741C TO99	20p	NE555 8 pin DIL		32p
72709	14 pin DIL	28p	72747 14 pin DIL	55p	NE556 14 pin DIL		60p
UA709	TO99	28p	748P 8 pin DIL	28p	SL414A 10 pin		•£1.80

NEW CONSIGNMENT ZN 414 RADIO CHIP 75p•

OPTOELECTRONICS

Displays
No 1510 707 LED Display **70p** each
No 1511 747 LED Display **£1.50** each
No. S53 DL33 Triple 7 Segment LED Display Character height 11 Common Cathode 12 pin DIL **30p** each

LED's
No. S51 Red TIL209 (5 x .125") **50p**
No. S52 Red FLV117 (5 x .2") **50p**
No. 1502 Green .125" **18p** each
No. 1505 Green .2" **18p** each
No. 1503 Yellow .125" **18p** each
No. 1506 Yellow .2" **18p** each
No. S82 Clear .2" (illuminating red) **12p**

2nd QUALITY LED PAKS
No. 1507 10 x LED's Assorted **75p**

LED CLIPS
No 1508/.125 .125 5 for **12p**
No. 1508/.2 .2 5 for **15p**

SPECIAL REDUCTIONS
No 1514 NORP 12 **45p** each
No S76 OCP71 5 for **£1.00**
No S83 5, NIXIE Tubes ITT 5870 ST (including Data) **£2.00**
No S77 Neon Indicator Lamps 230V A.C State Colour (Red, Amber and Green) **25p** each

D.I.Y. PRINTED CIRCUIT KIT

Contains 6 pieces of copper laminate board, box of etchant powder, measure, tweezers, marker pen, high quality pump drill, Stanley knife and blades and 6 in metal rule.
Full easy to follow instructions.
Order No. S64 **Sale Price £5.50**

P.C.B. BOARDS

S61 8 pieces 8" x 3¼" (approx.) single sided paper **50p**
S62 4 pieces 8" x 3¼" (approx.) single sided fibreglass **50p**
S63 3 pieces 7" x 3¼" (approx.) double sided fibreglass **50p**

ETCH RESIST PENS

Order No. 1609 **50p each**

SOLDER

5m of 18 sw Multi-core Solder.
Order No. S60 **50p**

I.C. INSERTION EXTRACTION TOOL

Order No. 2015 **30p**

MAMMOTH I.C. PAK

Approx 200 Pieces Assorted fall-out integrated circuits, including Logic, 74 series Linear, Audio and D T L Many coded devices, but some unmarked – you to identify
Order No 16223 **£1.00**

POWER SUPPLY STABILIZER BOARD

Unused ex-equipment stabilizer board. Input 30V D C Output 20V Complete with circuit diagram.
Order No. S81 **£1.25**

P.O. RELAYS

S85 – 2 Off Post Office relays **40p**

BATTERY HOLDERS

to take 6 x HP7's
Order No. 202 **10p each**

EX. G.P.O. MICROSWITCHES

Order No. S51 4 for **50p**

CABLE CLIPS

S84 – 50 2.5mm round single pin fixing **30p**

SPECIAL OFFER!

UNTESTED SEMICONDUCTOR PAKS

Code No's shown below are given as a guide to the type of device. The devices themselves are normally unmarked.

No. 16130	100 Germ. Gold bonded diodes like OA47	40p
No. 16131	150 Germ. Point contact diodes like OA70/81	40p
No 16132	100 200mA Sil. diodes like OA200	40p
No. 16133	150 75mA Sil. Fast switching diode like IN4148	40p
No. 16134	50 750mA Sil. top hat Rects.	40p
No. 16135	20 3 amp Sil. stud Rect.	40p
No. 16136	50 400mw Zeners D.O.7 case	40p
No 16137	30 NPN Plastic trans. like BC107/8	40p•
No 16138	30 PNP Plastic trans. like BC177/8	40p•
No 16139	25 NPN trans. like 2N697/2N1711 TO39	40p
No. 16140	25 PNP trans. like 2N2905 TO39	40p
No. 16141	30 NPN trans. like 2N706 TO18	40p
No. 16143	30 NPN Plastic trans. like 2N3906	40p•
No 16144	30 PNP Plastic trans like 2N3905	40p•
No 16145	30 PNP Germ. trans. like OC71	40p
No. 16147	10 NPN to 3 Power trans. like 2N3055	80p

I.C. SOCKET PAKS

No. S66 11 x 8 pin DIL Sockets **£1.00**
No S67 10 x 14 pin DIL Sockets **£1.00**
No S68 9 x 16 pin DIL Sockets **£1.00**
No S69 4 x 24 pin DIL Sockets **£1.00**
No S70 3 x 28 pin DIL Sockets **£1.00**

TRANSISTOR SOCKETS

No S71 15 x TO18 Sockets **£1.00**
No S72 10 x TO5 Sockets **£1.00**

MOUNTING PADS

No S73 50 Mixed Transistor Pads TO18 and TO5 **40p**

TRANSISTOR HEATSINK PAK

20 Assorted types, TO1, TO5, TO18, TO92
Our Mix
Order No. S75 **60p**

TRANSISTOR INSULATING KITS

Mica washers and bushes assorted types i.e. TO220, TO66, TO3 etc. Approx. 100 pieces. (Approx. 40 sets)
Order No. S74 **50p**

DARLINGTON POWER TRANSISTORS

70 watt 8 amp NPN and PNP in plastic case 199 High Voltage (Typ 80V). High gain. 10 pieces 5 NPN and 5 PNP Data Sheet supplied.
Order No S78 **£1.00 per Pak**

MATCHED PAIRS OF PNP GERMANIUM MED. POWER TRANS

2 amp 750mW

	VCE	VCB	HFE	
NKT301	40	60	30-100	35p per pair
NKT302	40	60	50-150	35p per pair
NKT303	20	30	30-100	25p per pair
NKT304	20	30	50-150	25p per pair

ZENER PAKS

No S55 20 mixed values 400mW Zener diodes 3-10V **£1.00**
No S56 20 mixed values 400mW Zener diodes 11-33V **£1.00**
No S57 10 mixed values 1W Zener diodes 3-10V **£1.00**
No S58 10 mixed values 1W Zener diodes 11-33V **£1.00**

UNIJUNCTION TRANSISTORS

UT46 TIS43 **20p**

FET's

2N3819 **15p** 2N5458 **18p**

2 AMP. BRIDGE RECTIFIERS

Metal Stud Mounting
No. S45 50V (KBS 005) **28p**
No. S46 100V (KBS 01) **30p**
No. S47 200V (KBS 02) **34p**

10 AMP. BRIDGE RECTIFIERS 200V ON HEATSINK –
SPECIAL CLEARANCE ORDER NO. S22 – £1.00
SILICON RECTIFIERS G.E. 1 Amp.

SIMILAR IN4000 SERIES
No. S41 25 Like IN4001 (1A 50V) **60p**
No. S42 20 Like IN4002 (1A/100V) **60p**
No. S43 18 Like IN4003 (1A/200V) **60p**
No. S44 15 Like IN4004 (1A/400V) **60p**

DON'T MISS OUR SPECIAL CASSETTE OFFER! LOOK AT OUR BOOKS

SAVING SALE BI-PAK

YOU MAKE THE SAVING!

OPT FOR OPTOELECTRONICS! PRINTED CIRCUIT KITS, BOARDS & PENS.

SILICON RECTIFIERS – ½ AMP. G.E.

No. S48	40 x 50V	60p
No. S49	30 x 200V	60p
No. S50	20 x 700V	60p

G.E. HIGH VOLTAGE SILICON RECTIFIERS

GR559 10mA 14KV (14,000)	20p each
GA432 1 AMP. 2 KV (2,000)	20p each
FD2.5 2.5 KV Voltage Doubler	20p each

POTENTIOMETERS

Slider 40mm TRAVEL

Order No.			
16191	6 x 470 Ohm	LIN Single	40p*
S24	6 x 1 K	LIN Single	40p*
S25	6 x 5 K	LIN Single	40p*
16192	6 x 10 K	LIN Single	40p*
S26	6 x 10 K	LOG Single	40p*
16193	6 x 22 K	LIN Single	40p*
16195	6 x 47 K	LOG Single	40p*
16194	6 x 47 K	LIN Single	40p*
S27	6 x 100 K	LIN Single	40p*
S28	6 x 100 K	LOG Single	40p*
S29	6 x 500 K	LOG Single	40p*

Slider 60mm TRAVEL

S30	6 x 2.5 K	LOG Single	40p*
S31	6 x 10 K	LIN Single	40p*
S32	6 x 50 K	LIN Single	40p*
S33	6 x 250 K	LOG Single	40p*
S34	4 x 5 K	LOG Dual	40p*
S35	4 x 10 K	LIN Dual	40p*
S36	4 x 100 K	LOG Dual	40p*
S37	4 x 1.3 MEG	LOG Dual	40p*

S38 MIXED SLIDER POTS – VARIOUS VALUES AND SIZES – OUR MIX ONLY £1.00*

S39 6 x CHROME SLIDER KNOBS 40p*

WIREWOUND

A range of wirewound single gang pots. with linear tracks of 1 watt rating.

Order No.	Value	Order No	Value
1891	10 ohms	1894	100 ohms
1893	47 ohms	1895	220 ohms
1896	470 ohms	1898	2K2
1897	1K	1899	4K7

NOW 35p* each

16173	15 Rotary Potentiometers. Assorted values and types.	40p*
16186	25 Pre-sets Assorted Values and types	40p*

SALE PRICE 40p

MULTI-TURN PRE-SETS

S40 3 x 100 K LIN **ONLY 50P***

AUDIO PLUG AND SOCKET PAKS

Order No.		
S1	5 x 3.5 mm Plastic Jack Plugs	40p*
S2	5 x 2.5 mm Plastic Jack Plugs	40p*
S3	4 x Std. Plastic Jack Plugs	50p*
S4	2 x Stereo Jack Plugs	30p*
S5	5 x 5 Pin 180° DIN Plugs	50p*
S6	8 x 2 Pin Loudspeaker Plugs	50p*
S7	6 x Phono Plugs Plastic	50p*
S8	5 x 3.5 mm Chassis Sockets (Switched)	25p*
S9	5 x 2.5 mm Chassis Sockets (Switched)	25p*
S10	4 x Metal Std. Chassis Switched Jack Sockets	50p*
S11	2 x Stereo Jack Sockets with instruction leaflet for H/Phone connection.	50p*
S12	5 x 5 Pin 180° DIN Chassis Sockets	40p*
S13	8 x 2 Pin DIN Chassis Sockets	50p*
S14	6 x Single Phono Sockets	40p*

AUDIO LEADS

Order No		
117	A.C. Mains connecting lead for cassette recorders and radios Telefunken type	45p*
118	5 pin DIN headphone plug to stereo socket	78p*
119	2 x 2 pin plug to inline stereo socket for headphones	60p*
123	20 ft. of coiled guitar lead	£1.15*
124	3 pin to 3 pin DIN plug	50p*
125	Audio lead 5 pin DIN plug to 5 pin DIN plug	50p*
126	Audio lead 5 pin DIN plug to tinned open ends	50p*
127	Audio lead 5 pin DIN plug to 4 phono plugs	90p*
129	Audio lead 5 pin plug to 5 pin DIN plug – Mirror Image	70p*
130	5 metre lead 2 pin DIN plug to 2 pin DIN inline socket	45p*
132	10 metre lead 2 pin DIN plug	65p*

HEAVY GAUGE BLACK PLASTIC BOX

With aluminium lid and fixing screws. Size 6¼" x 3¼" x 2"
Order No. S16 **Only 75p**

74 SERIES TTL ICs

TYPE	QUANTITY 1 £p	100 £p	TYPE	QUANTITY 1 £p	100 £p	TYPE	QUANTITY 1 £p	100 £p
7400	0.09	0.08	7448	0.70	0.68	74122	0.45	0.42
7401	0.11	0.10	7450	0.12	0.10	74123	0.65	0.62
7402	0.11	0.10	7451	0.12	0.10	74141	0.68	0.65
7403	0.11	0.10	7453	0.12	0.10	74145	0.75	0.72
7404	0.11	0.10	7454	0.12	0.10	74150	1.10	1.05
7405	0.11	0.10	7460	0.12	0.10	74151	0.65	0.60
7406	0.28	0.25	7470	0.24	0.23	74153	0.70	0.68
7407	0.28	0.25	7472	0.20	0.19	74154	1.20	1.10
7408	0.12	0.11	7473	0.26	0.22	74155	0.70	0.68
7409	0.12	0.11	7474	0.24	0.23	74156	0.70	0.68
7410	0.09	0.08	7475	0.44	0.40	74157	0.70	0.68
7411	0.22	0.20	7476	0.26	0.25	74160	0.95	0.85
7412	0.22	0.20	7480	0.45	0.42	74161	0.95	0.85
7413	0.26	0.25	7481	0.90	0.88	74162	0.95	0.85
7416	0.28	0.25	7482	0.75	0.73	74163	0.95	0.85
7417	0.26	0.25	7483	0.88	0.82	74164	1.20	1.10
7420	0.11	0.10	7484	0.85	0.80	74165	1.20	1.10
7422	0.19	0.18	7485	1.10	1.00	74166	1.20	1.10
7423	0.21	0.20	7486	0.28	0.26	74174	1.10	1.00
7425	0.25	0.23	7489	2.70	2.50	74175	0.85	0.82
7426	0.25	0.23	7490	0.38	0.32	74176	1.10	1.00
7427	0.25	0.23	7491	0.65	0.62	74177	1.10	1.00
7428	0.36	0.34	7492	0.43	0.35	74180	1.10	1.00
7430	0.12	0.10	7493	0.38	0.35	74181	1.90	1.80
7432	0.20	0.19	7494	0.70	0.68	74182	0.80	0.73
7433	0.38	0.36	7495	0.60	0.58	74184	1.50	1.40
7437	0.26	0.25	7496	0.70	0.68	74190	1.40	1.30
7438	0.26	0.25	74100	0.95	0.90	74191	1.40	1.30
7440	0.12	0.10	74104	0.40	0.35	74192	1.10	1.00
7441	0.60	0.57	74105	0.30	0.25	74193	1.05	1.00
7442	0.80	0.70	74107	0.30	0.25	74194	1.05	1.00
7443	0.95	0.90	74110	0.48	0.45	74195	0.80	0.75
7444	0.95	0.90	74111	0.75	0.72	74196	0.90	0.85
7445	0.80	0.75	74118	0.85	0.82	74197	0.90	0.85
7446	0.80	0.75	74119	1.30	1.20	74198	1.90	1.80
7447	0.70	0.68	74121	0.28	0.26	74199	1.80	1.70

Devices may be mixed to qualify for quantity price. Data is available for the above series of ICs in booklet form **price 35p.**

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.14	CD4018	£0.85	CD4035	£1.40	CD4056	£1.15
CD4001	£0.16	CD4019	£0.45	CD4037	£0.78	CD4069	£0.32
CD4002	£0.16	CD4020	£0.95	CD4040	£0.78	CD4070	£0.32
CD4006	£0.80	CD4021	£0.85	CD4041	£0.68	CD4071	£0.20
CD4007	£0.17	CD4022	£0.80	CD4042	£0.68	CD4072	£0.20
CD4008	£0.80	CD4023	£0.18	CD4043	£0.78	CD4081	£0.20
CD4009	£0.50	CD4024	£0.64	CD4044	£0.78	CD4082	£0.20
CD4010	£0.50	CD4025	£0.18	CD4045	£1.15	CD4510	£1.10
CD4011	£0.18	CD4026	£1.85	CD4046	£0.95	CD4511	£1.25
CD4012	£0.17	CD4027	£0.48	CD4047	£0.75	CD4516	£1.10
CD4013	£0.42	CD4028	£0.80	CD4049	£0.46	CD4518	£1.10
CD4015	£0.80	CD4029	£0.95	CD4050	£0.46	CD4520	£1.10
CD4016	£0.42	CD4030	£0.46	CD4054	£0.95		
CD4017	£0.80	CD4031	£1.80	CD4055	£1.60		

AUDIO MODULE SALE

Type	Description	Normal Price	Sale Price
AL30A	10W RMS Power Amp	~~£3.65*~~	£2.95*
AL60	25W RMS Power Amp	~~£4.35*~~	£3.55*
AL80	35W RMS Power Amp	~~£6.95~~	£5.95
AL250	125 W RMS Power Amp	~~£15.95~~	£14.45
SPM80	35V Power Supply	~~£3.75*~~	£3.10*
PS12	20-30V Power Supply for AL30A	~~£1.30*~~	£1.15*
PA12	Stereo Pre-Amp for AL30A	~~£6.70*~~	£5.95*
PA100	Stereo Pre-Amp for AL60/AL80	~~£13.75*~~	£12.45*
S450	Stereo F.M. Tuner	~~£20.45*~~	£18.65*
MPA30	Magnetic-Ceramic Pre-Amp	~~£2.85*~~	£2.55*
Stereo 30	Complete Audio Chassis 7W + 7W RMS	~~£16.25*~~	£14.95*

LOOK & LISTEN
GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER MODULE

The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12db, Max. Voltage handling 2 V RMS, T.H.D., 0.5%, input impedance 100 K, output impedance less than 10 K. Frequency response 20 Hz-20 KHz (3db). The nine gain controls are centred at 50, 100, 200, 400, 800, 1600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders. (Not supplied with the module). See Paks S31 and 16192.

ONLY £19.50

SG30 Power supply board for GE100 15-0-15 Volt **£4.50**

SEND SAE FOR TECHNICAL DATA ON ANY OF THE AUDIO MODULES.

SPECIAL OFFER!
COMPONENT PAKS

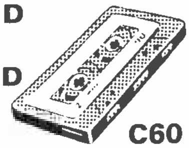
Order No.	Quantity	
16164	200 approx. Resistors mixed values. (Count by weight)	40p*
16165	150 approx. Capacitors mixed values. (Count by weight)	40p*
16167	80 ¼W Resistors mixed values	40p*
16168	5 pieces Assorted Ferrite rods	40p*
16169	2 pieces Tuning gangs MW/LW	40p*
16170	50 metres Single strand wire assorted wire	40p
16171	10 Reed switches	40p*
16172	3 Micro switches	40p*
16176	20 Assorted electrolytics Trans types	40p*
16177	1 pack Assorted hardware nuts/bolts etc.	40p
16179	20 Assorted tag strips and panels	40p
16180	15 Assorted control knobs	40p*
16184	15 Assorted Fuses 100mA – 5 amp	40p
16188	60 ½W resistors mixed values	40p*
16187	30 metres stranded wire assorted colours	40p

½ PRICE BARGAIN!

£4 worth (Min. Value)

of Electronic Project Books, Technical, Semi-conductor Data and Equivs – Books of Assorted Titles. **OUR CLEARANCE PRICE**
Order No. S80 **£2 per bundle**

SUPER SOUND SAVING METROSOUND LOW NOISE CASSETTES



C60

Order No. S53 **10 for £2.50***

BIB GROOVE CLEAN

Model 60. Chrome Finish Plastic
Order No. 829 **£1.40***

HOT OFFER

ANTEX SOLDERING IRONS

Order No. 1931 X25 25 watt. LOW LEAKAGE
Usually ~~£3.40~~ SALE PRICE £2.95
PLUS FREE Heatshunt

1948 Model C 15 watt General purpose
Usually ~~£3.40~~ SALE PRICE £2.95
PLUS FREE Heatshunt

1939 ST3 Soldering Iron Stand suitable for either Iron. **£1.20**

NEW Siren Alarm Module

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer break-down, and other security purposes.
Order No. S15 **£3.50**

AVDEL BOND

Cyanocrylate adhesive bonds – plastic, rubber, transistors, components in seconds.
Order No. 143 **55p per 2 gm. phial**

ORDERING

Please word your orders exactly as printed, not forgetting to include our part number.

VAT

Add 12½% to prices marked*
Add 8% to others excepting those marked †. These are zero.

BI-PAK

Dept. PW2, P.O. Box 6, Ware, Herts
COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

FOR RELIABLE JOINTS—ANTEX IRONS!

EDITOR
Geoffrey C. Arnold
ASSISTANT EDITOR
Dick Ganderton, C. Eng., MIERE
ART EDITOR
Peter Metalli
TECHNICAL EDITOR
Ted Parratt, BA
NEWS & PRODUCTION EDITOR
Alan Martin
TECHNICAL SUB-EDITOR
Peter Preston
TECHNICAL ARTIST
Rob Mackie
SECRETARIAL
Sylvia Barrett
Lynda Goddard
EDITORIAL OFFICES
Westover House, West Quay Road, POOLE, Dorset BH15 1JG
Telephone: Poole 71191

ADVERTISING MANAGER
01-261 5000 Roy Smith
CLASSIFIED ADVERTISING
01-261 5762 Colin R. Brown
ADVERTISING OFFICES
King's Reach Tower, Stamford Street, London SE1 9LS

BINDERS

Binders, for either the old or the new format, are £2·85 and Indexes are 45p (Inc VAT) and can be obtained from the Post Sales Department, IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF. Remittances with overseas orders for binders should include 60p to cover despatch and postage.

BACK NUMBERS

We are very glad to announce the re-establishment of a PW Back Numbers Service for our readers. In future back numbers dated from June 1977 only will be available from our Post Sales Department for 65p, which includes postage and packing. Cheques and Postal Orders should be made payable to IPC Magazines Ltd.
Send your orders to:- Post Sales Department, IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

A Time of Change

THOSE among our readers who notice such things will have realised that there are quite a number of new names among the staff of *PRACTICAL WIRELESS*, as listed on this page. When it was announced earlier this year that some of the Practical group of magazines were to move to Poole, there were several staff members who, for various personal reasons, felt unable to make the move away from London.

To those we have left behind, we say a farewell, and thank them for all that they have done for the magazine in the past. Some were comparative newcomers, others had been familiar names for many years. Some will, we hope, continue to make a contribution to *PW*, and so for them the break will not be complete.

We bid a welcome to our new staff, who bring with them in-depth knowledge of several fields which are, we know, of great interest to you, our readers. We plan to make use of this knowledge for your future interest and enlightenment.

With all these changes, including a new occupant for the editor's chair, you will probably be wondering what the future pattern of the magazine will be. Well, there will undoubtedly be some changes, but we hope not to frighten away our established readers! As our title would imply, we shall continue to give regular attention to wireless or radio—call it what you will—in its various applications, but will not neglect the ever-popular fields of hi-fi, disco equipment, musical instruments, nor the requirements of the electronics hobbyist. We hope you'll like the mix!

Geoffrey C. Arnold

PLEASE NOTE

We do not operate a Technical Query Service except on matters concerning constructional articles published in PW. We do not supply service sheets or information on commercial radios, TV's or electronic equipment.
All queries must be accompanied by a stamped self-addressed envelope otherwise a reply cannot be guaranteed.

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

Mini Monitor

Shown for the first time at Video-Tradex, the Sinclair picture monitors MON 1A and MON 1A/S are derived from the well-proven Microvision.

Special interfacing provides for standard level international signals. The model at the exhibition operates on the CCIR format but, as with the Microvision receiver, Sinclair will be able to adapt the device to 525-lines 60 fields.

Model MON 1A is cased, uses integral, rechargeable NiCad batteries and is supplied with a power unit. In addition to its normal function, it could well find application as a view-finder.

The MON 1A/S is supplied less case and cells, but is otherwise likened to the MON 1A. It is principally aimed at OEMs and systems engineers.

Both monitors in their CCIR form accept a standard, composite input of 0·7 volts video/0·3 volts sync, which is terminated by 75 ohms.

Connection is via a BNC socket.

Each unit is unconditionally guaranteed by the manufacturer for 1 year from date of purchase; should any unit fail within this time, the Company will repair or replace it free of charge. For details of price apply to:
Sinclair Radionics Ltd., London Road, St. Ives, Huntingdon, Cambridgeshire.

More Chips!

Texas Instruments have recently announced details of several new devices The TL505 is an analog-to-digital converter IC, and is designed for use with microprocessors similar to the Texas TMS1000 series. Both the TL505 and the TMS1000 are designed to operate from a single 7 to 15 volt supply, making them ideal for battery operation. Other features are three-digit (0·1%) accuracy, on-chip reference voltage, auto-zero, and high impedance MOS inputs. Unfortunately, prices are only quoted for 100 piece batches—in this case £2·29 each chip.

Also announced, and in roughly the same operating area, is a 5 volt regulator, with, it is claimed, greatly improved accuracy. Designated TL7805AC it is credited with an output current capability of 1·5 amps, with internal current limiting and thermal shutdown, thus providing reasonable immunity to overload. This device is priced at £1·12 each item, per batch of 100.

Finally, two new series of BIFET op. amps have emerged. These are the TL061 series, comprising three low-power op. amps, and the TL071 series with four low-noise audio op. amps. These are monolithic IC op. amps using high impedance junction field-effect transistors and bipolar transistors in a single chip. The TL061 device features a 3·5V per second slew rate, and the TL071 is quoted with a harmonic distortion of 0·01% typically, and a low noise level of 18 nanovolt per root Hertz. Both series feature a very high input impedance, and wide unity gain bandwidths, allowing significantly higher gain at higher frequencies than the 741 series. Both the TL061 and the TL071 are available in 8 pin plastic and ceramic dual-in-line packages. No prices are to hand for these, but details may be obtained, as with the rest of the devices reviewed, from:
Texas Instruments, Linear Circuits Department, Manton Lane, Bedford.

Video Recording at South London Tech.

A short course of nine special lectures on monochrome and colour video recording techniques, systems and applications of magnetic tape and cassette recorders for closed circuit television and broadcasting will be held in the Lecture Hall on consecutive Tuesday evenings from 6.30 to 8.30pm, commencing 17 January 1978. Slides will be shown and demonstrations will be given.

This course is intended for radio and television technicians and engineers, and for video recording enthusiasts. A basic knowledge of radio and television will be assumed. The course will be conducted by specialists from industrial organisations. The course fee is £6 and early enrolment is advised.

For details apply to:
A. A. Rowlands, South London Technical College, Knights Hill, London SE27 2JR. Tel: 01 670 4488.

Get in quick

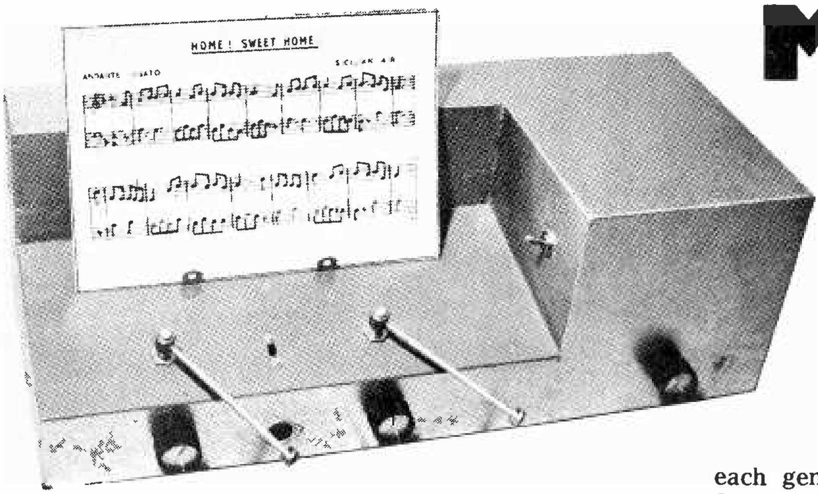
Have you got the latest Technomatic catalogue? If you haven't, read on.

The catalogue contains their latest price list, also a special offer list for the new year.

Technomatic specialise in the semi-conductor field, supplying only first grade, current date code, quality devices, produced by major manufacturers. They are concentrating their efforts on providing a comprehensive service for all your semiconductor requirements. We are assured the components offered are not surplus, but are their regular stock items and are fully guaranteed.

The special offer list is normally valid until 21 January 1978, however, if you mention *Practical Wireless* with your order, Technomatic have kindly agreed to extend the closing date until 10 February 1978.

The catalogue and special offer lists are available, free of charge, if you send a SAE (6in × 9in) from
Technomatic Ltd., 54, Sandhurst Road, London NW9 9LR. Tel: 01-204 4333.



MULTIVIB 'MUSICO'

R.H. LONGDEN

The Theremin was a novel electronic instrument in which radio frequencies were combined to produce an audible beat. It had infinitely-variable pitch, obtained by hand capacitance, but would not meet present-day radiation suppression requirements. A similar result however is even more readily obtained by using a variable frequency multivibrator.

Most musical instruments can be divided into two classes. In one, the pitch is found by the skill of the performer: in the other, the note is pre-tuned and is selected by the performer from the available range. The Multivib "Musico" can be used in either way: as an instrument in which the frequency is selected by the movement of projecting arms or tillers, or with a plug-in keyboard, tuned for two octaves.

Two note generators are used, so that separate left and right-hand tones are available. The whole instrument, especially with the two tiller controls, is extremely straightforward and has an IC audio amplifier which further simplifies building. It is operated from a dry battery. Separate bass (left hand) and treble (right hand) output controls are fitted, in addition to a volume control. There is also a jack outlet, either to permit the use of a bigger speaker, or to allow personal practice with a headset.

Note Generator

As each generator is variable, only two are required, and the circuit, **Fig. 1** is duplicated for the second unit. The frequency is controlled by the resistance connected to point 3, which is in series with R2. The output from C3 goes to the level control so that

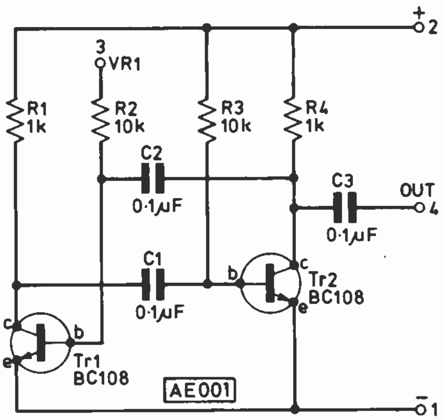


Fig. 1: The Tone Generator circuit diagram.

each generator is able to cover the same range of frequencies; with the two tillers in use, both may be operated at any point within the range available. Therefore both could be on bass or treble frequencies, if desired. This is particularly useful for sound effects.

When the keyboard is added, one generator is tuned for the octave below Middle C, the other running upwards from here, in order to obtain consecutive notation. The left hand is then confined to notes below Middle C, the right hand playing Middle C and higher notes.

Tag-Boards

Each board is made as in **Fig. 2**. Other forms of wiring could be employed, but this is a method needing no preparation, and taking very little time. Low voltage disc ceramic capacitors are used, and the components are not critical.

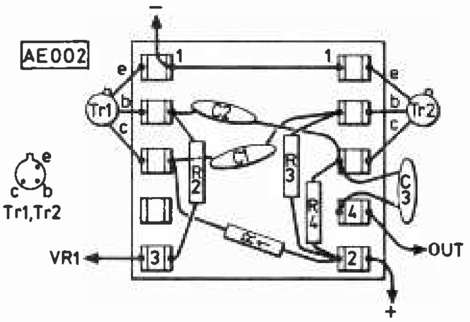


Fig. 2: Wiring the Tone Generator board.

The complete circuit

The full circuit (excluding the change-over switch and keyboard socket) is shown in **Fig. 3**. Each board has its own output control VR2, and VR2B, coupled to the common volume control VR3 by resistors R5 and R5B. VR2 and VR2B allow adjustment of the relative power of bass or treble.

The AF amplifier is available as a circuit board for the TBA800, having input, output, and battery connecting foils. Details of the amplifier are given later. It requires relatively few components and can provide a good audio output without heavy drain on the battery. A 16 ohm speaker can be used with some reduction in audio power. A jack breaks the speaker circuit, the audio signal then being available through tip and sleeve of the plug. Capacitor C4 is necessary to maintain stable operation. None of the component values in Fig. 3 was found to be critical.

It was not found necessary to screen the amplifier input or any other circuits. As all the potentiometers are mounted on wood, it is essential to connect the mounting bush and metal case of VR3 by wire to its negative tag. If a metal enclosure were used, this would not, of course, be necessary.

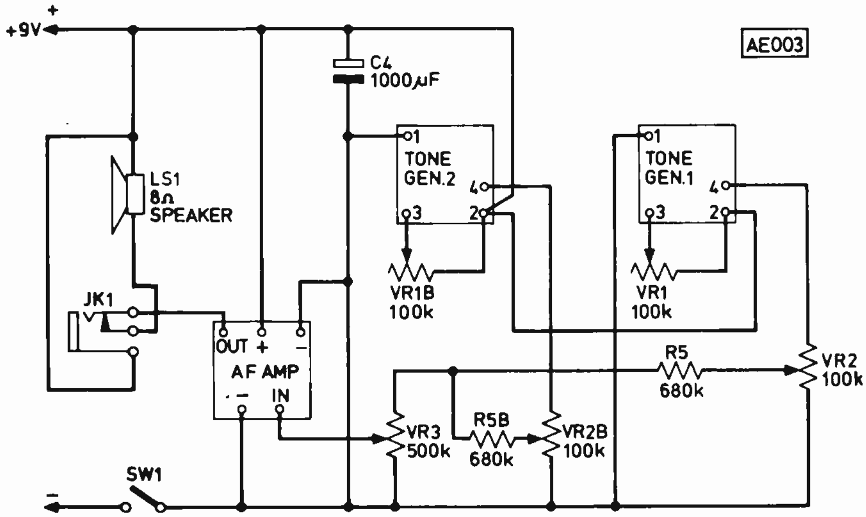


Fig. 3: Complete circuit diagram of the "Musico."

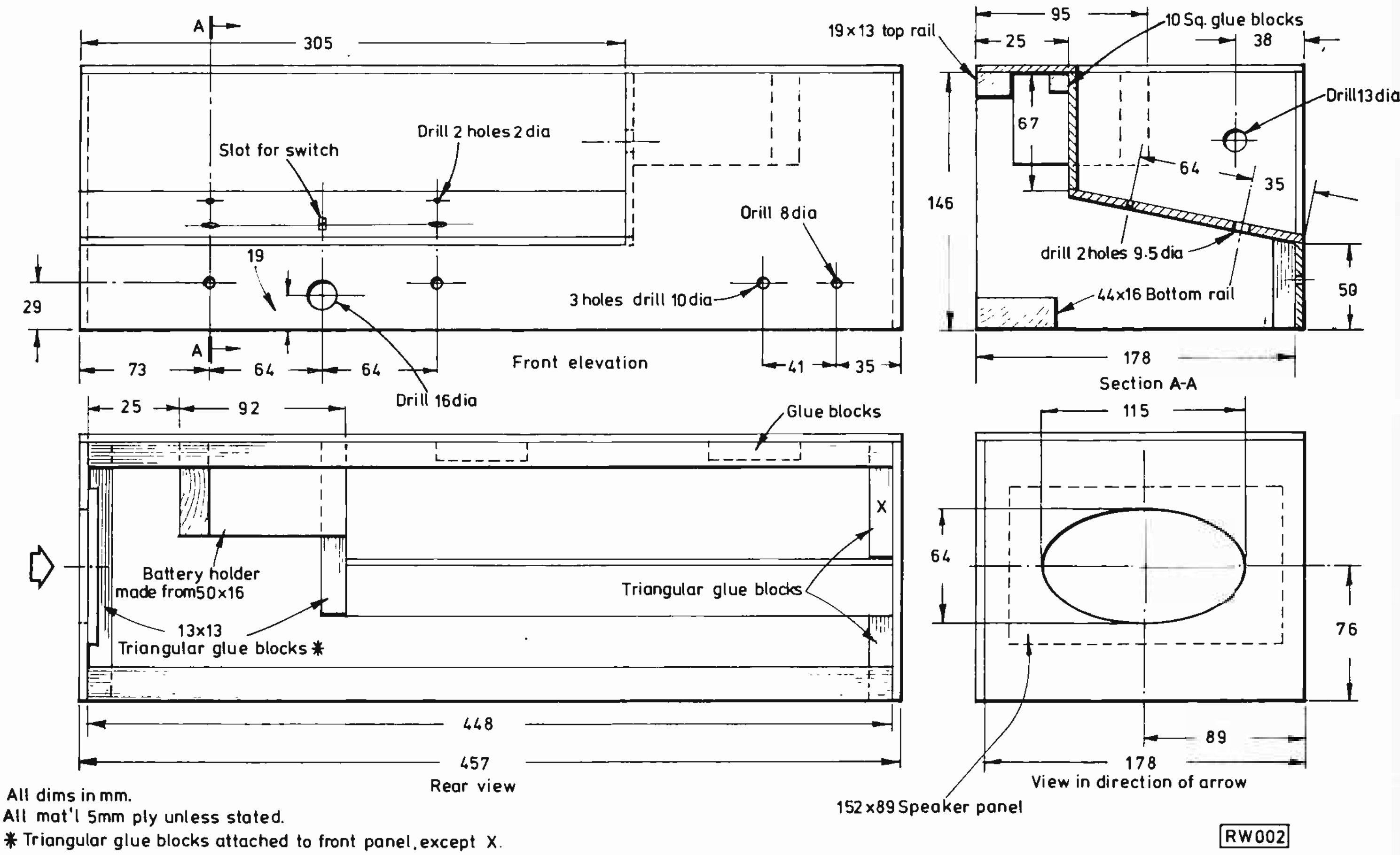
Case

The case (**Fig. 4**) has a low section for the pitch controls, and a higher part to accommodate the speaker and battery. It would be feasible to construct the equipment in a shallow, inverted box, if the speaker were separate or mounted flat. Assembly of the case is with panel pins and adhesive, with wooden fillets to strengthen the whole. Allow for overlap where necessary, though the actual finished dimensions are not important.

The lower part of the case allows a simple music stand to be provided. This consists of two strips pivoted on brackets, so that they can be folded down out of the way, or raised to support the music.

The battery fits in the higher part of the case, in a box glued in position, with a metal strip which can be moved aside to remove the battery.

Fig. 4: Constructional details of the "Musico" case.



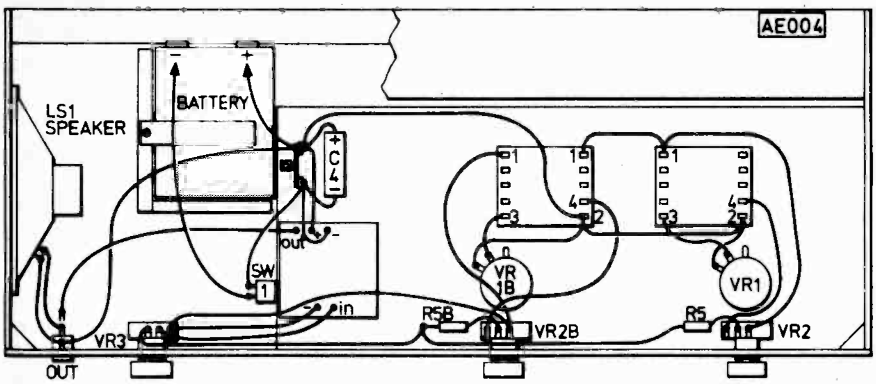


Fig. 5: Wiring diagram of the complete unit.

Underside wiring

The wiring is shown in **Fig. 5**. It is convenient to use red wire for positive and black for negative circuits. The boards are held clear of the wood by spare nuts or washers on the screws which hold them in place. A tag strip supports C4 and provides connecting points for positive and negative circuits. If these are wired as shown, loops which could cause instability will be avoided. VR3 could quite well have an on-off switch, if preferred.

Amplifier

For ease of building, it has been assumed that a ready-made printed circuit board, with IC, would be used, and a circuit for this item is shown in **Fig. 6**. It was found necessary to use quite a large decoupling capacitor (positive to negative) to avoid motor-boating and other troubles at some frequencies. If alternative audio amplifiers are used, they should have a fairly high input resistance and sufficient gain to avoid the need for a pre-amplifier.

The TBA800 can give a little over 1 watt with a 9V supply, and does not require a heat sink for this power. Higher outputs are possible with increased voltage, but a heat sink will then be needed.

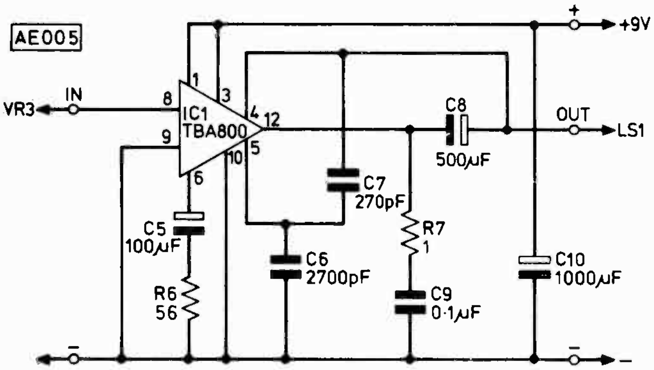


Fig. 6: Circuit diagram of the amplifier.

Tillers

The tillers were made by sawing a 6·3mm (¼in) brass coupler in two, thus obtaining collars which can be fitted to the potentiometer spindles. Each can be fitted to the potentiometer spindles. Each projecting arm was about 100mm (4in) long, with a small knob fitted at the end. They were made from Meccano rods, threaded 4BA at one end, with a collar the other end. Threading would not be needed with 4BA rods. This method of making the tillers is easy, but alternatives of wood, metal or plastic could be used.

Playing

Check that both oscillators work by adjusting VR2 and VR2B. Fit the tillers so that both notes are the same, with the knobs directly forward; a rise in pitch is obtained by moving the knobs to the right, and a fall in pitch to the left. It should be easy to find the positions which result in the notes being in unison

★ components

Tone Generator

Resistors

R1	1kΩ	R4	10kΩ
R2	10kΩ	R5	680kΩ
R3	10kΩ	All 5% ¼W	
VR1	100kΩlin	VR2	100kΩlog

Capacitors

C1, C2, C3 0·1µF 18V ceramic

Transistors

Tr1, Tr2 BC108

Miscellaneous

Tagboard 4-way

Note—All the above are duplicated for the second generator.

Amplifier, etc.

Resistors

R6	56Ω	R7	1Ω
VR3	500kΩlog		

Capacitors

C4	1000µF 10V elect.	C8	500µF 10V elect
C5	100µF 10V elect	C9	0·1µF
C6	2700pF	C10	1000µF 10V elect
C7	270pF		

Integrated Circuit

IC1 TBA800

Miscellaneous

LS1 5 × 3in elliptical, 8Ω

SW1 SPST

JK1 Switched jack

Printed circuit board for TBA800 (obtainable from J. R. Hartley, 78b High Street, Bridgnorth, Salop.)

Knobs. Battery Clips. Materials for case and tillers (see text)

Keyboard

Resistors

VR4-VR29 100kΩ min. horizontal pre-sets (26 off)

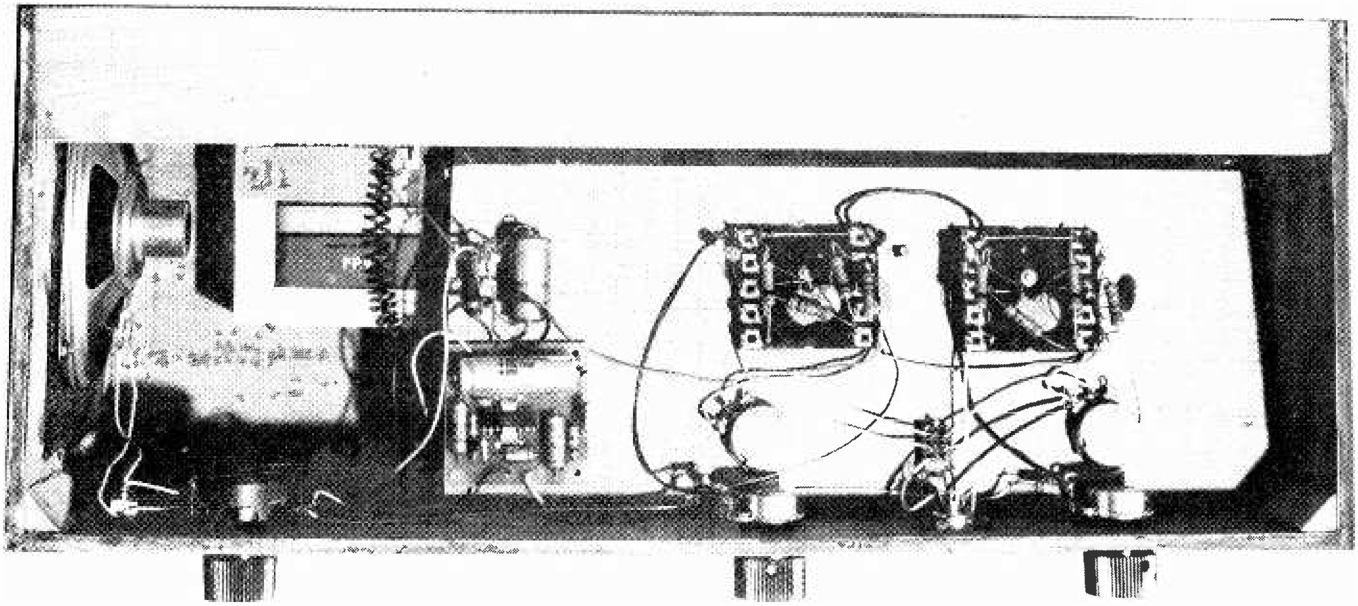
Miscellaneous

Materials for case and keyboard

and octaves. The manipulation to best advantage needs some practice.

Warbling and similar odd background effects are readily produced, the general effect being similar to that heard from a musical saw. Vibrato effects are achieved by fluttering one or both tillers slightly with the fingers. There is separate volume control of rising or falling tones.

between VR1 and VR1B. In one position, this connects VR1 and VR1B as before; in the other position the keyboard resistors are connected instead. All the keys are connected together and return to point 2 on the oscillator boards. When any key is depressed, it touches a screw underneath it. Pre-set potentiometers VR4 to VR29 are divided into two sections, wired for left and right hands. A 3-way plug allows



Plug-in Keyboard

It will be seen that if a pre-set resistor for each required frequency is substituted for VR1 and VR1B, the notes would be obtained by switching the appropriate resistance values into circuit. A simple means of doing this is to use the well-known type of stylus keyboard, where the circuit is completed by touching a metal point on a conductive area representing the note. The keyboard shown in **Fig. 7** is not of this type, but has metal keys or switches which are pressed to complete the contact, as this is easier to manipulate rapidly.

A 2-pole 2-way slide switch is fitted on the board the keyboard to be disconnected for carrying or when it is not needed.

It was decided to use Meccano strips for the keys, as these are of a convenient width and strength, and do not need drilling. Metal strips could of course be cut for this purpose. They are 114mm ($4\frac{1}{2}$in) long for the sharps and flats, and 140mm ($5\frac{1}{2}$in) long for the naturals. They could each have a wooden finger piece screwed on, but this was not done with the keyboard shown, and would have to be completed before fitting the keys. Finger contact with the metal has no effect on the pitch because all keys are joined electrically. The construction of the keyboard should be clear from **Fig. 8.**

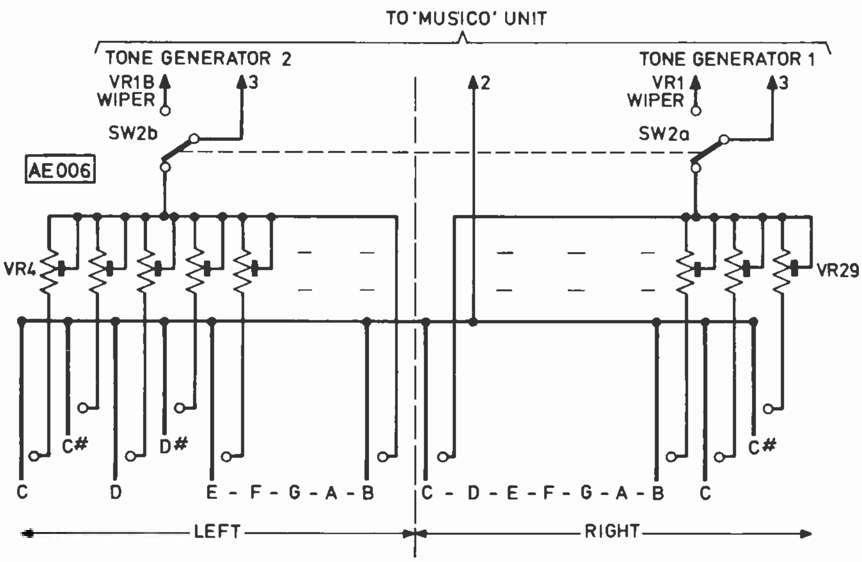


Fig. 7: Circuit diagram of the add-on keyboard.

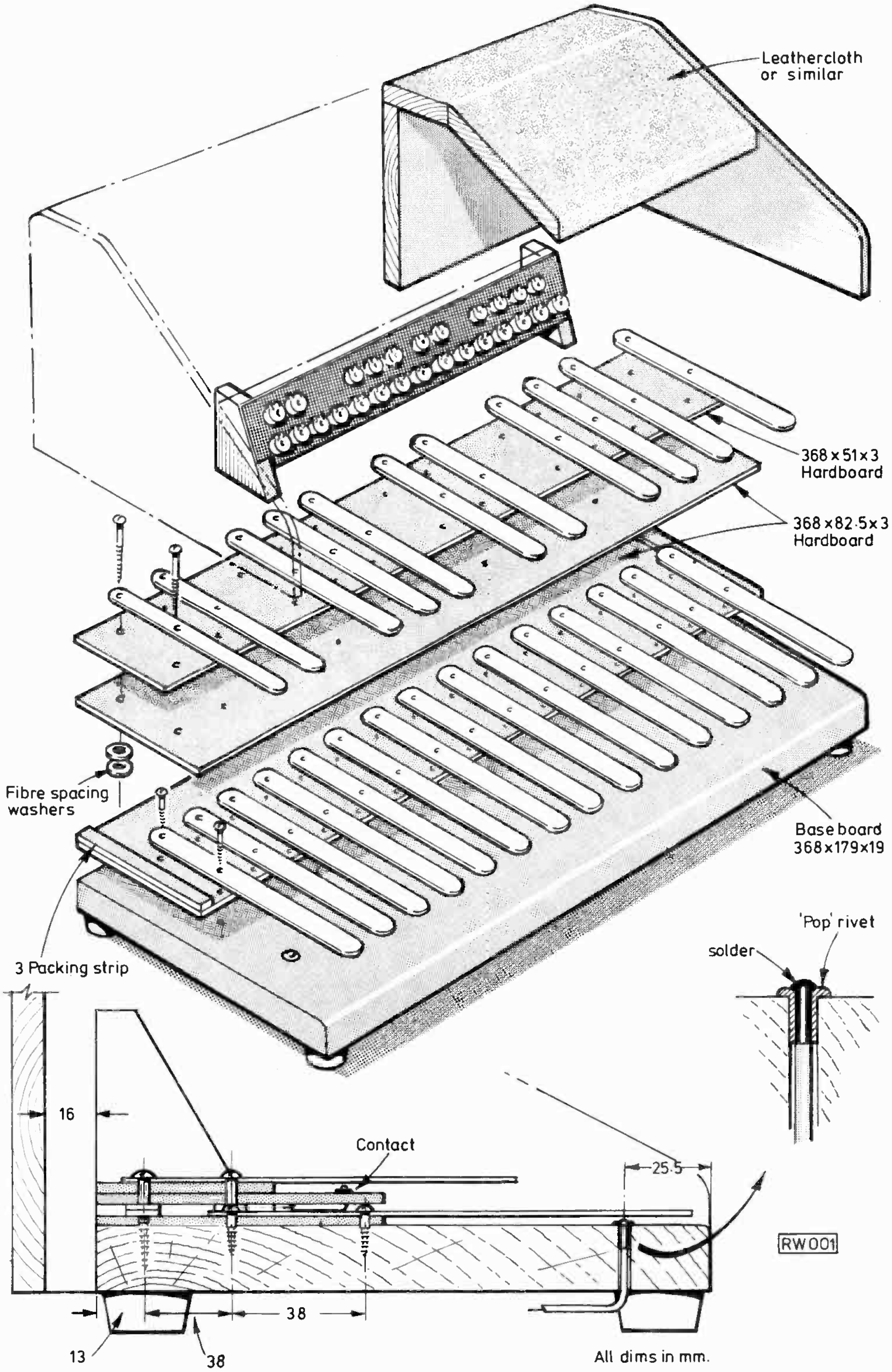
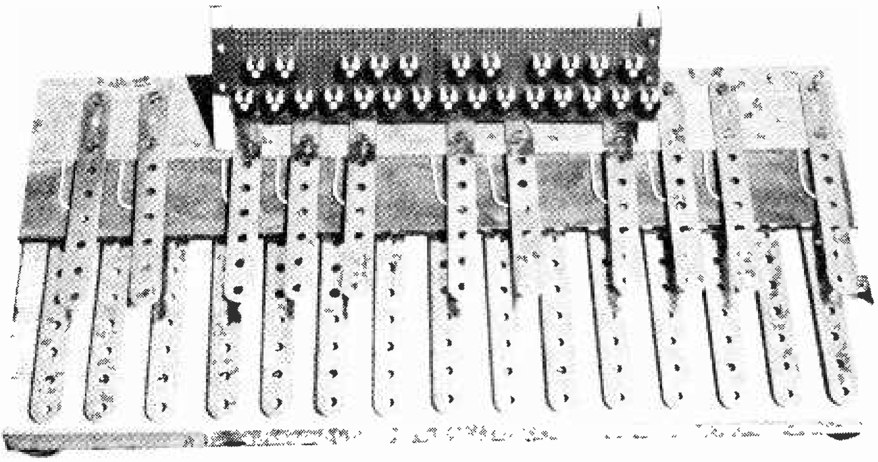


Fig. 8: An exploded view of the keyboard unit, showing constructional details and dimensions.

Pre-set Assembly

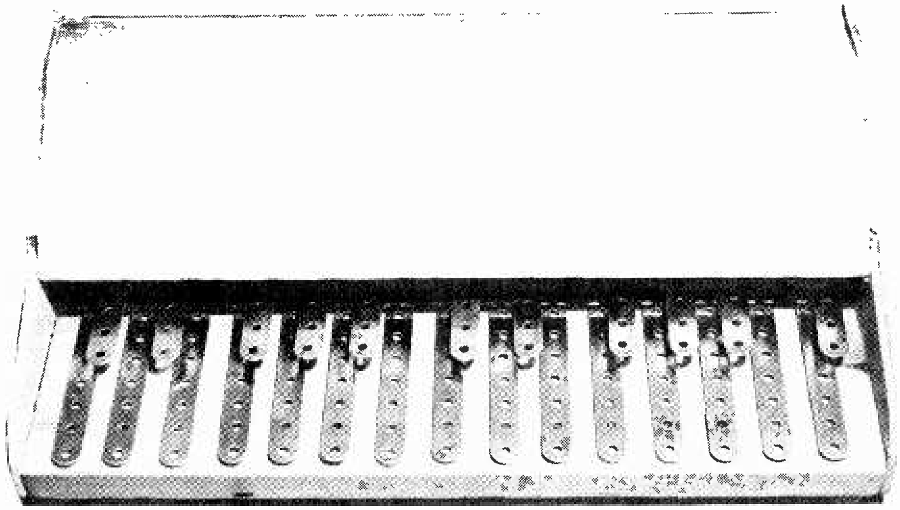
The pre-set potentiometers were fitted to a piece of 0·1in matrix perforated board 197 x 45mm ($7\frac{3}{4}$ x $1\frac{3}{4}$in). The board is supported on two triangular pieces of wood, so that the pots are easily reached when soldering the leads. They are in two rows, the higher of these being set in pairs and threes to match the sharp and flat keys, for ease of identification.

All the potentiometers are wired into two groups (**Fig. 7**) for left and right hands. The wires from the keys are then brought up the back one by one, cut to length, and soldered to the correct potentiometer. A 3-core lead is prepared and used for left-hand, right-hand, and common key return circuits.



An internal view of the keyboard, showing the keys and the mounting board for the pre-set potentiometers.

The assembled keyboard unit.



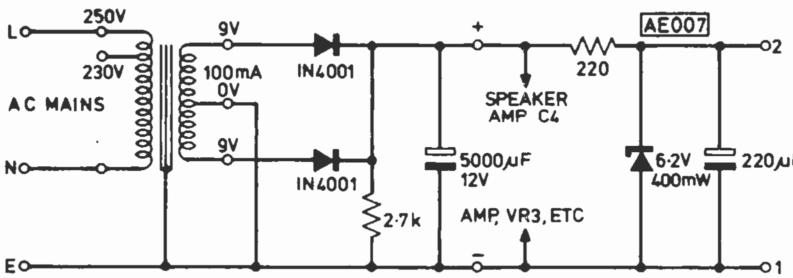


Fig. 9: Circuit diagram of a suitable mains power supply.

Tuning

The potentiometers should be connected so that the resistance in circuit increases, key by key, from right to left. Some rough adjustment can be given to the pots by clipping a meter to the board to measure resistance and depressing each key in turn. The resistance should increase note by note, and could be about 10k ohms for upper C, 25k for middle C, and 60k for lower C (exact values depend on other components). Such an adjustment will give some sort of progressive scale, with which to begin tuning.

A piano or other musical instrument should be available, so that each potentiometer can be adjusted to bring the note into tune. A good musician's ear is by no means necessary for this, as the adjustment is only to bring the pitch to that of a known note.

A tool with a fairly large handle, or fixed crossbar, permits quite critical adjustment. It would also be possible to use combinations of fixed and variable resistors for the notes, or pre-sets of lower values for the higher notes.

With the tillers only in use, no tuning is of course required, frequency depending on the operator's ear. "Microtonal" music or similar sound effects are also then possible.

Mains Power Pack

Frequency does not depend too critically on battery voltage, but changes in tone from this source can be largely avoided by adding a Zener diode to stabilise the supply to the oscillators. A simple mains pack can be added, either assembled in a box to replace the battery, or fixed in the space available in the instrument.

The mains power pack circuit and connections for the diode are shown in **Fig. 9**. A 3-core mains lead should be used to provide earthing, and the plug fitted with a 2A fuse. In the interests of safety, mains connections should be made on insulated blocks, or should be enclosed so that they cannot be touched.

The series resistor, diode and capacitor are supported by the adjacent tag board. A battery may still be used with the diode added. ●

OF THE MONTH 66

Brian DANCE M.Sc

THOMSON-CSF PROXIMITY DETECTOR

Proximity detectors are circuits which detect the presence of a piece of metal when it is brought close to a certain part of the circuit—often a coil. When the metal is brought into close proximity with the coil, the output voltage from the circuit changes. Proximity detectors may be used to measure the rate of rotation of a shaft, the rate of pulsing of the output being proportional to the speed of rotation of the shaft. They may, for example, be employed in a car rev counter, in which case a piece of metal connected to the cam shaft produces a pulse each time it passes the coil of the proximity detector. Alternatively, a proximity detector fitted to the propeller shaft or to one of the wheels of a vehicle can be used as an electronic speedometer. Another application in motor vehicles is the generation of the timing pulses for an electronic ignition system.

However, the use of proximity detectors is by no means confined to motor vehicle applications. They are very useful on industrial production lines for counting objects which may vary in size from a small piece of metal to a road vehicle. Indeed, they can be used in almost any application in which a piece of metal moves or in which the movement of any object can be converted into the movement of a small piece of metal.

The ESM 1601

The ESM 1601 is a new monolithic device manufactured by Thomson-CSF which can be connected to a small tuned circuit. The coil of this circuit is wound on a special ferrite cup core and when a piece of metal is brought up to the open face of this cup core, a large change in the output voltage occurs. The metal need not actually touch the cup core; the circuit operates when the metal is a few mm from the face of the core.

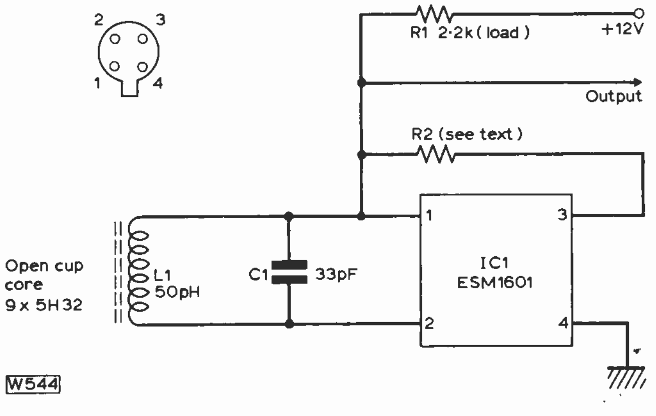


Fig. 1: Circuit of the ESM 1601 Proximity Detector.

The ESM 1601 is encapsulated in a small TO72 metal transistor type package, the leadout of which is shown. The device requires only a very simple circuit as in **Fig. 1.** Although the IC will not be damaged if the power supply is accidentally connected with the wrong polarity, it is important to note that the use of the load resistor R1 is essential and that the device will normally be destroyed if the power supply is directly applied to the package.

Operation

The natural resonant frequency of the tuned circuit L1/C1 should be within the range 500kHz to 6MHz; it is, of course, equal to $\frac{1}{2\pi\sqrt{(L1.C1)}}$. The values shown have been chosen to provide a natural resonant frequency of about 3·9MHz. The ferrite cup core used for L1 is shown in **Fig. 2**, but more details about it will be given shortly.

When no metal is near the coil, the circuit oscillates at the frequency of the tuned circuit. The output voltage is "low" when oscillation is taking place, the output being typically +1·55V at 25°C. The minimum output voltage during oscillation is 1·2V at 125°C and the maximum 2V at −40°C.

If a piece of metal is moved close to the face of the ferrite cup core (as shown in Fig. 2), Foucault or eddy currents flow in the metal. Power is absorbed from the tuned circuit since the currents generate a small amount of heat in the metal through which they flow. When the amount of power absorbed causes the amplitude of the oscillation to fall below a certain critical level, the output voltage rises very suddenly to a value of between +5·7V and +6·9V. The rise and fall times of the output voltage are typically 8μs and 5μs with maximum values of 25μs and 15μs respectively. The circuit returns to its former state with the output voltage "low" when the metal is removed from the coil face.

Cup core and coil

The miniature ferrite cup core recommended for use with the ESM 1601 is only 9mm in diameter and 3mm in depth; it is manufactured by Thomson-CSF under the type number 9 x 5H32 and has a small hole at its centre for mounting purposes. The manufacturers recommend that the coil should consists of 50 turns of stranded *(Litzendraht)* wire comprising 5 strands which each have a diameter of 0·06mm. Unfortunately the writer did not have any of this wire available and it is unlikely that many readers will be able to obtain it easily.

However, it was found easy to make a coil using 50 turns of single silk covered enamelled copper wire of diameter 0·15mm (38 SWG). A small resistor was selected which had a body diameter approximately the same as the internal diameter of the coil to be wound. About 20 turns of the wire were wound on the resistor, the width of the coil being suitable for fitting into the cup core. The 20 turns were fixed in position by applying a solution of polystyrene in amyl acetate before another 10 turns were added. These were fixed with the same cement before another 10 turns were added followed by further cement and the final 10 turns to make the total of 50 turns. Before the polystyrene cement had completely set, the coil was gently pushed off the resistor into the recommended ferrite cup core. A reasonably neat coil can be made in this way.

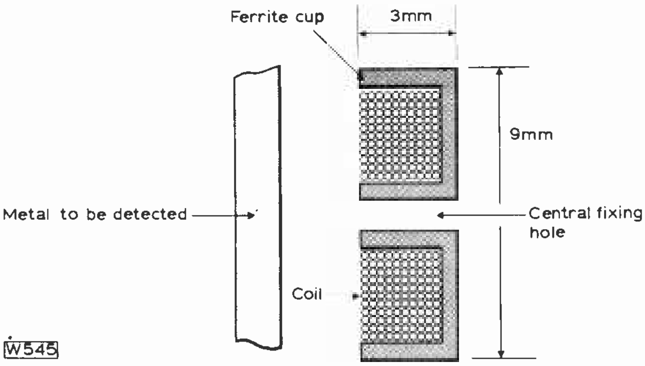


Fig. 2: Rough sketch of the ferrite cup core.

Value of R2

The value of the resistor R2 controls the amount of feedback; if R2 is small the circuit is more likely to oscillate than if it is large. The data sheet suggests that R2 can have a value of 47 kilohms when the recommended stranded wire is used for the coil L1. However, it was found that no oscillation occurred with the single wire coil when R2 had this value, but the circuit worked well when the value of R2 was reduced to about 8·2 kilohms. The additional losses in the coil using single wire necessitate the use of more feedback to maintain oscillation and this extra feedback is obtained by reducing the value of R2.

Load resistor

The value of the load resistor must limit the current to the device to the maximum permissible value of 20mA, but must not be so high that the current is less than 0·6mA. In addition, the maximum power dissipation (325mW at 25°C) must not be exceeded. The value shown is suitable for almost all applications, but is not at all critical. The minimum supply voltage is 8V.

In many applications, the output voltage may be used to deflect a small meter, but it can also be used to feed complex logic circuits. The maximum switching speed is 10kHz.

The ESM 1601 is available at 98p (including VAT) plus 20p for packing and postage from Phoenix Electronics Ltd., 46 Osborne Rd., Southsea, Hants PO5 3LT. Phoenix also supply the recommended cup core 9 x 5H32 price 75p including VAT. ●

THE 5 METRE STORY part 1

Ron HAM BRS 15744

The object of this article is to pay tribute to the many radio enthusiasts, both licensed amateurs and SWLs, who pioneered the five metre band from 1930 until September 1 1939 when the amateur radio licences in the UK were withdrawn. Many of those 5m operators are still active today, and will, no doubt, add their personal "tit bits" to this story through the letters page of this journal.

To prepare this article, the author has gathered information from the *T & R Bulletin* (then, monthly journal of the RSGB), and other contemporary documents, and by personal contact with people who were "there at the time".

"Ultra High Frequency"

When the words "Ultra High Frequency" (UHF) are used today we automatically think of radio wavelengths shorter than one metre, but, in those pre-1940 days, UHF meant the 56 and 112Mc/s bands. In fact, Chapter 12 of the *first* edition of the Amateur Radio Handbook, published by the RSGB in 1939, is entitled *Ultra High Frequencies* and is devoted to the 5 and 2½m bands. In the circumstances we'll continue to use 'Mc/s'!

To really appreciate this story the reader must clear his mind of today's technology and accept the fact that the 5m band, 46 years ago, was an unexplored part of the radio frequency spectrum. Try to think as those early pioneers did. Is it really possible to work DX on such a band? Could a circuit oscillate around 56 million times per second? What about propagation, and what effect would the earth's atmosphere have on such a high frequency radio signal?

Try Anything

The past seventy years have shown us that as radio advanced from using wavelengths of 3000 metres to micro-wavelengths of three centimetres and less, radio amateurs have been prominent among the leading experimenters. Anything that was thought to be impossible, you can be sure that somewhere an individual radio enthusiast had tried it out, had a little success, and reported his progress to others. Soon, a group of them would be trying to master the problem, with the technical press just itching to report their activities through the columns of their magazines.

Apart from the experimental aspect, 56Mc/s operation had certain advantages over the HF bands, mainly because it was very suitable for short distance working (across town), thus avoiding the congestion of the lower frequencies, and also because the aerials were smaller and required much less space. Converts to 'five' were delighted to find a band almost free of atmospherics, except for local thunder storms, although they soon found out that interference came from the ignition systems of the ever growing number of motor vehicles, and it was unfortunate for a 5m enthusiast who lived near a busy cross-road! We often forget that in the early thirties, the aeroplane, motor car, photography etc were growing side by side with radio communication, and each had its own band of enthusiasts.

When the author asked one 5m experimenter if he had any pictures of his early activity, he replied, "We could not afford photography as well as radio in those days". This remark was not surprising when one refers to the adverts in those early radio magazines e.g. in 1930:—a 0-100 mA meter £2.2.6, a quartz crystal £1, an output transformer £1.2.6, a tuning capacitor 15s, valves around 30s, a 10kΩ wire-wound pot 7s 6d and 'grid leaks' at more than 2s each!

Transmitting Licences

During his researches, the author was puzzled by a paragraph in the *T & R Bulletin* (p 411) March 1937 headed 'Special 56Mc/s Permits', and it read as follows:— "Members holding 56Mc/s permits are reminded that they may apply for permission to operate portable 56Mc/s stations from Good Friday until the end of September without additional fee. An assurance however must be given that frequency stabilised apparatus will be used. Applications must reach Headquarters not later than March 20."

Did this really mean that one could only operate portable in the summer months? Surely the authorities were aware of the fact that radio enthusiasts wanted to operate at any time and almost anywhere if need be! The author telephoned Miss Constance Hall G8LY who, as well as being a 5m pioneer herself, is a mine of information on amateur radio matters. Fortunately, Constance had preserved her pre-war licence documents and instantly made them available for this article. On October 5 1937 Constance received a letter from the GPO authorising her to use a transmitter in the 5m band.

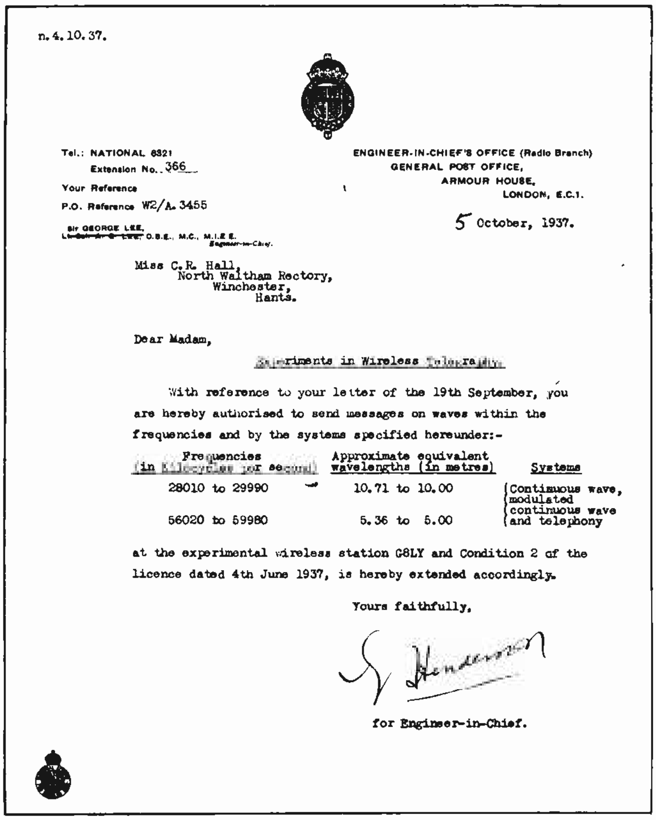
Like many of the other 5m enthusiasts Constance wanted to operate from a portable location, so, via the RSGB, she duly applied for permission to do so, but oh!, what restrictions! In a letter dated 15 April 1939, Constance was authorised to install and use an experimental wireless station, in the open air, on Saturdays and Sundays until the end of September 1939, but limited to a 10 mile radius of her home.

Only a Few

According to L. A. Moxon G6XN, writing in November 1930, there were less than a dozen active amateurs working on 56Mc/s in this country and very few in other parts of the world. One of these amateurs was G2DT who, in 1929, was the first 5m station in the UK to receive signals from a distance of over 100 miles.

Many SWLs played an important role in the development of the 5m band and one of these was Ted Williams (later G2XC) who, in 1932 joined the RSGB as a listening member. He was invited by the Society's Town Representative, Leonard Newnham G6NZ, to visit him. Len was firing everyone with enthusiasm for the 5m band and he transmitted every Sunday morning using a self-excited rig, while the listening stations all had super-regenerative portable receivers.

Ted built himself such a receiver and took it along to Len's station in Southsea to make sure that it was working "in the band". He returned to his own location, perched in the back seat of a friend's car, with earphones on, and using an odd length of wire as an aerial. He heard G6NZ's transmissions for a few hundred yards and then nothing until the car reached the top of Portsdown Hill (near Portsmouth) about $4\frac{1}{2}$ miles from G6NZ, and then nothing again when the car went down the other side of the hill.



n. 4. 10. 37.

Tel.: NATIONAL 6321
Extension No. 366
Your Reference
P.O. Reference W2/A. 3455

Sir GEORGE LEE, ~~Lt-Col. Sir G. LEE,~~ O.B.E., M.C., M.I.E.E.
Engineer-in-Chief.

ENGINEER-IN-CHIEF'S OFFICE (Radio Branch)
GENERAL POST OFFICE,
ARMOUR HOUSE,
LONDON, E.C.1.

5 October, 1937.

Miss C.R. Hall,
North Waltham Rectory,
Winchester,
Hants.

Dear Madam,

Experiments in Wireless Telegraphy.

With reference to your letter of the 19th September, you are hereby authorised to send messages on waves within the frequencies and by the systems specified hereunder:-

Frequencies (in Kilocycles per second)	Approximate equivalent wavelengths (in metres)	Systems
28010 to 29990	10.71 to 10.00	Continuous wave, modulated continuous wave and telephony
56020 to 59980	5.36 to 5.00	

at the experimental wireless station G8LY and Condition 2 of the licence dated 4th June 1937, is hereby extended accordingly.

Yours faithfully,

G. Henderson

for Engineer-in-Chief.

A facsimile of the GPO letter authorising Miss Constance Hall to operate a transmitter in the 5 metre band.

Line of Sight

A few Sundays later Ted drove along the length of the ridge of the hill so that he could plot G6NZ's signal strength at various points. No one believed then that reception over anything other than "line-of-sight" was possible. Ted's outing was typical of the contribution made by the listeners, many of whom held transmitting licences. The important thing at this point was that the amateur concerned had built a working "UHF" receiver and was prepared to go almost anywhere to use it.

At the Crystal Palace

In May 1933 G6HP, G6NF and G6QB humped a variety of radio equipment to the top of the North Tower of Crystal Palace for the famous 56Mc/s tests. Their transmitter used two B12's in the usual push-pull oscillator circuit while the modulator used two 211-E's in parallel. The microphone was fed directly into the grid through a high-ratio modulation transformer with no further amplification. Their transmitter power was about 10 watts, and the aerial a $2\frac{1}{2}$m length of copper petrol piping hanging from a stand-off insulator on the end of a pole which poked out, fishing-rod fashion, from the gallery of the tower.

The two receivers, both super-regens, were fed from independent LT and HT supplies so that they could be used together from opposite sides of the tower. This proved to be very useful and some interesting results were obtained. All the gear was tested out on the Saturday night and then, early next morning, the three operators re-climbed the 400 stairs and began working soon after 0900. Their first QSO was with G5VY of Tottenham, and then they called various receiving stations, some mobile and some fixed. G5IS heard them well on Inkpen Beacon but he was caught in a local thunderstorm and was unable to effect a two-way QSO.

Their signals were also received 130 miles away by Douglas Walters G5CV who was flying in an aircraft at 10 000ft "somewhere north of the Wash". Doug's report of R9+ was on top of the racket from a totally unsilenced and unscreened aero-engine. G5CV was a reporter for the *Daily Herald* newspaper and the aeroplane was chartered by the Editor for the occasion, another example of the enthusiasm toward wireless experiments in those days!

Kite Aerial

Their most amazing report came from G6PL at Hollin Bank, Yorks. G2NH heard them while he was using a kite aerial at South Harting, Sussex, during the afternoon, but in the morning, on Hindhead in Surrey, he said that their signal was audible "160ft away from a pair of Browns 'A' phones"! The reports rolled in from G2KB Dunstable, G6GZ Farnborough, G6LK Cranleigh, G5JZ Nutley, Kent, G2GG Newbury, G6OA Westcliff, BRS1011 Leigh-on-Sea, G6NA Guildford and BRS1117 at Reigate, Surrey.

Douglas Walters G5CV *operating the 5metre receiver in the chartered* Daily Herald *aircraft.*

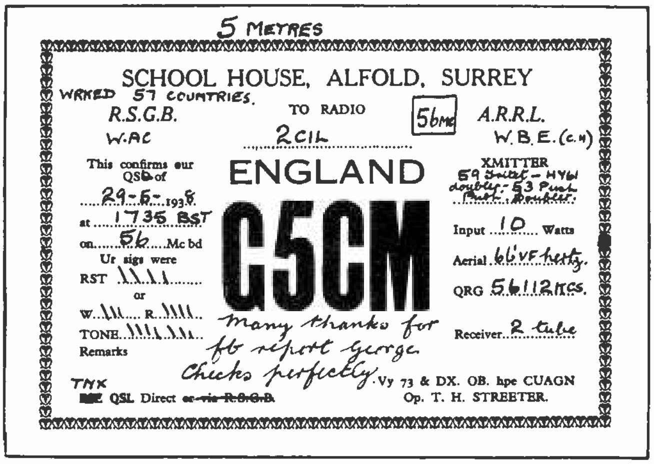
This historic photograph is the property of the RSGB, and is reproduced by their kind permission.

NFD

During the 1938 National Field Day, 2CIL with his brother and 2DCT, installed their receiving equipment in a beacon tower near Horsham, Sussex. Their aerial was a Yagi made up on broomsticks, fed by open wire feeder. It could be used horizontally or vertically so that transmitter polarisation could be observed from the incoming signal. On the Saturday they were listening, by arrangement, to the signals from G8LY who had a sked with GW6AA/P on Snowdon. An hour or so later there was a thunderstorm overhead and the tower lightning conductor took a charge! The receiver and the listeners were installed in a room below the lead roof; the set crackled but stood the shock. When the hail had finished the crew had to venture on to the roof to loosen the guy lines which were bending the broomsticks like a bow! However they received an award from the RSGB for a remarkable log which contained more than 30 entries and an extensive report of the event.

DX!

During the summer of 1939 G5CM was visiting 2CIL and tuned George's receiver to about 56Mc/s, acting on information supplied by Barbara Dunn G6YL, and heard MCW signals from CS3VA situated on an airfield in Spain. It seems that this signal was acting like one of our present day beacons because it was as a regular automatic signal sending "VVV de CS3VA". Of course by 1939 a large number of amateurs in many countries were both interested and active on the 5m band.



5 METRES
SCHOOL HOUSE, ALFOLD, SURREY
WRKED 57 COUNTRIES.
R.S.G.B. TO RADIO 56mc A.R.R.L.
W.AC 2CIL W.B.E.(C.H)
This confirms our QSO of 29-5-1938
at 1735 BST
on 56 Mc bd
Ur sigs were
RST \\\\\\
or
W. \\\ R. \\\\
TONE \\\\\\\\
Remarks
ENGLAND
G5CM
XMITTER [illegible]
Input 10 Watts
Aerial 66' VF hertz.
QRG 56112 KCS.
Receiver 2 tube
Many thanks for fb report George. Checks perfectly. Vy 73 & DX. OB. hpe CUAGN
TNX QSL Direct ~~or via R.S.G.B.~~
Op. T. H. STREETER.

A QSL Card from G5CM acknowledging the 5m report from 2CIL.

They took to the Air

On Sunday May 21 1933, Douglas Walters G5CV took off in a Puss Moth aircraft with two completely shielded 3-valve super-regen 56Mc/s receivers on board. One was his own and the other belonged to George Jessop G6JP (Present General Manager and past President of RSGB). Immediately the plane left the ground, Doug was getting a tremendous signal from G6JP and very soon, altitude now 3000ft, a colossal carrier was heard from G6QB operating from the North Tower at Crystal Palace, mentioned earlier. As the plane flew over London about a dozen 56Mc/s signals were heard including G5MG, G6CJ, G6UH, G2JU and G6VA. When flying 60 miles north-east of London, Doug and his colleagues in the plane heard G6QB at terrific strength and later, at 8000ft, they heard both sides of a QSO between G6CJ and G6QB. Owing to the shortage of fuel the plane turned back toward London when at 10 000ft and at 130 miles out they were still getting a strong signal from G6QB at Crystal Palace. Douglas was convinced that had they been able to carry on in a more northerly direction G6QB's signals would have been heard at 250 miles or more.

TO BE CONTINUED

SUPERSOUND 13 HI-FI MONO AMPLIFIER

A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £15·00. P. & P. £1·20.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram., etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1·5mv into 47k. Input 2·5mv into 47k. (suitable for use with mic. or guitar etc.). Input 3 100mv into 1 meg. suitable for gram. tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240v. Size approx. 12½" w. × 5" h. × 7½" d. Special introductory Price £28·00+£2·50 carr. & pkg.

Mullard LP1159 RF-IF Module 470 kHz £2·25+ P.&P. 20p. Full spec. and connection details supplied. Pye VHF/FM Tuner Head covering 88-108 M/Hz. 10·7 M/Hz I.F. output. 7·8 Volt + earth. Supplied prealigned, with full circuit diagram with precision-geared FM gang and 323Pf + 323Pf A.M. Tuning gang only £3·15 + P. & P. 35p.

STEREO DECODER
SIZE 2" × 3" × ½" ready built. Pre-aligned and tested for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £6·00 plus 20p. P. & P. Stereo beacon light if required 40p extra.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State FM AM Stereo Tuner. Covering M.W. A.M. 540-1605 KHz VHF/FM 88-108 MHz. Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8½"w × 4"h × 9½"d approx.
LIMITED NUMBER ONLY at £28·00 + £1·50 P. & P.

Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2½" × 1". Supplied complete with chrome finished switch buttons. 2 for £1·80+20pP.&P.

10/14 WATT HI-FI AMPLIFIER KIT
A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + SAE (Free with parts). All parts sold separately. ONLY £13·50 P. & P. £1·40. Also available ready built and tested £18·00 P. & P. £1·40.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × 14$\frac{11}{16}$" × 1$\frac{7}{16}$" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.
Only £8·40 each + p. & p. (one 90p, two £1·10).
Now available in either 8" round version or 4½" × 8½" rectangular. 10 watts RMS 60Hz-20KHZ £5·25 + P. & P. (one 65p, two 75p).

SPECIAL OFFER. 6½" long throw, roll surround, ceramic magnet 8 ohm 10 watt speaker chassis. Specially suitable for Hi Fi. £3·95 + 75p P. & P.

2" PLASTIC CONE HF TWEETER 4 ohm, £3·50 per matched pair + 50p P. & P.

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω; Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	£13·50 P. & P. 80p
(Magnetic input components 33p extra)	
POWER PACK KIT ..	£5·50 P. & P. 95p
CABINET	£5·50 P. & P. 95p

SPECIAL OFFER—only £23·75 if all 3 items ordered at one time plus £1·25 p. & p.
Full after sales service
Also avail. ready built and tested £31·25, P. & P. £1·50.

HARVERSONIC STEREO 44
A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9½" × 2½" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only £9·00 plus 50p P. & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at £1·50 + 40p P & P if required. Full connection details supplied.

HA34 3 Valve Audio Amp. 4½ w. output ready built and tested £8·50+£1·40 P. & P. Also HSL 'FOUR' amplifier kit. £8·00 + £1·40 P. & P.

All prices and specifications correct at time of press and subject to alteration without notice.

HARVERSON SURPLUS CO. LTD.

(Dept. P.W.) 170 HIGH ST., MERTON, LONDON, S.W.19. Tel.: 01-540 3985
A few minutes from South Wimbledon Tube Station.
Open 9.30–5.30 Monday to Friday. 9.30–5 Saturday. Closed Wednesday.

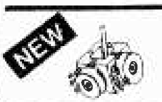
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. SEND SAE WITH ALL ENQUIRIES.

Impress the neighbours with a game they haven't seen yet and proudly tell them you made it yourself

8 GAME T.V. PROJECT

BASED ON AY-3-8600

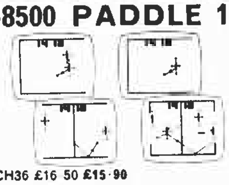
★ Basket-ball ★ Grid-Ball ★ Hockey ★ Tennis ★ Squash ★ Football
+ Two — One-Player Games ★ Horizontal and Vertical Bat Coverage
★ Automatic Ball Speed-Up ★ Players Colour Coded
★ Three Tone Sound-Effects ★ Sound from T.V.
★ Ball Colour Coded to indicate turn in Squash-Game
★ All Components supplied guaranteed including sound and vision modulator C.H 36 UHF.
★ Power requirement 9v battery ★ Just add controls and case.
Basic AY-3-8600 Paddle II Kit B + W only £15·00
Colour only £20·90



JOY STICK CONTROLS

DESIGNED FOR T.V. GAMES
(AY-3-8550-AY-3-8600) Subminiature Size
UNBEATABLE LOW PRICE Two off £3·50

POPULAR AY-3-8500 PADDLE 1



★ Three Tone Sound Effects
★ All components supplied guaranteed just add controls, speaker and case
★ UHF varicap modulator (B+W)
★ Power requirement—9v battery
★ Stock clearance price down
Black + White £10·50 £9·90 Colour CH36 £16 50 £15·90
Mini-Pack P.C.B. + chip B + W £6·90 Colour £7·90

All Projects supplied with easy to follow assembly instructions.
All prices include VAT + Postage. Orders under £10·00 — Add 20p p & p.
Make all Cheques or Postal Orders payable to

TELECRAFT

Retail Shop and Demonstrations — 14 Station Road, New Barnet, Herts
For further Details and Technical Help — Phone 01-440 7033
(French and German spoken) Quantity discount negotiable.
For extra speed phone your order on Barclay-or-Access Cards

SWL'S—YOU OWE YOUR RX A GOOD ANTENNA!

The World-famous JOYSTICK VFA (Variable Frequency Antenna) SYSTEMS continue to prove their worth in many amateur stations world-wide and in Government communication. Tunes continuously 0·5/30·00 MHz. and can be installed in any location. Comes in easily assembled form, carriage paid, 12½% VAT included. Glowing testimonials from many users on our files.

SYSTEM 'A'	**£36·00**
SYSTEM 'J' (improved 'Q')	**£42·60**

PARTRIDGE SUPER PACKAGES

Complete Radio Stations for any Location
All Packages feature the World Record Joystick Aerial (System 'A') with 8' feeder, all necessary cables, matching communication headphones. Delivered Securicor our risk. ASSEMBLED IN SECONDS! BIG CASH SAVINGS!

PACKAGE No. 1	As above with R.300RX SAVE £17·28!	**£210·55**
PACKAGE No. 2	is offered with the FRG7 RX SAVE £12·21!	**£195·00**
PACKAGE No. 3	Here is a lower-price high-quality package, featuring the all-solid state SMC 73 Rx., with all the Partridge extras. SAVE £17·28!	**£154·86**

RECEIVERS ONLY, inclusive delivery, etc.
R.300 £184·50 FRG7 £162·00 SMC73 £128·81

For further details, send 9p stamp. You can phone your Access or Barclaycard number, ring 0843 62535 (or 62839 after office hours).

Box 5, Partridge Electronics Ltd.
Partridge House, Prospect Road, Broadstairs CT10 1LD
G3CED (Callers by appointment) **G3VFA**

audio dummy load

F. G. RAYER G3OGR

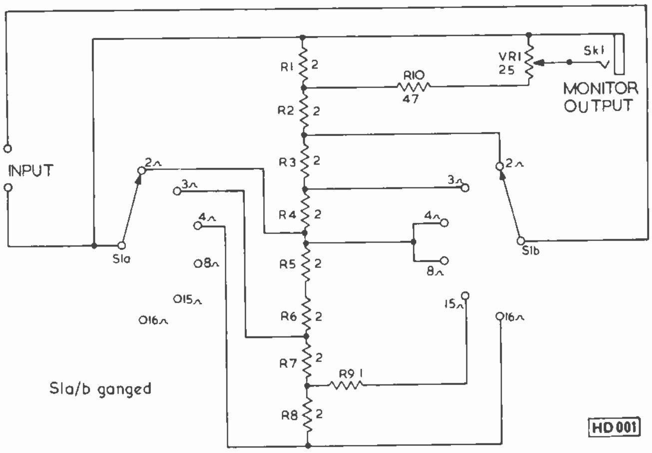


Fig. 1: Circuit diagram. Note that the power sinking capacity is different for various simulated loads—see table. The circuit doesn't include any reactive components; these may be more conducive to amplifier failure than a low value of load resistance.

When an amplifier is left working for a period to check temperature rise, or tested to find its output capability, the audio obtained from the speaker may be a great nuisance or even unendurable! This can be avoided by feeding the audio output into a dummy load. For other than moderately low power, it is convenient to make up the total load with a number of resistors which are individually of relatively low wattage. It is then easy to add a switch which will allow various output loads to be chosen. It is also convenient to add an attenuator and output socket so that a low-level output can be fed to a monitor speaker.

Resistor load

Fig. 1 is arranged to give best utilisation of eight 2Ω 6W resistors and one 1Ω resistor, with a 2-pole 6-way switch. For a 2Ω load, R1/R2 and R3/R4 are in parallel. For 3Ω, R1/R2/R3 and R4/R5/R6 are in parallel. For 4Ω, R1 to R4 are in parallel with R5 to R8. The 8Ω load is secured by R1 to R4 in series, while 15Ω is obtained with R1 to R7 plus R9, and 16Ω with R1 to R8.

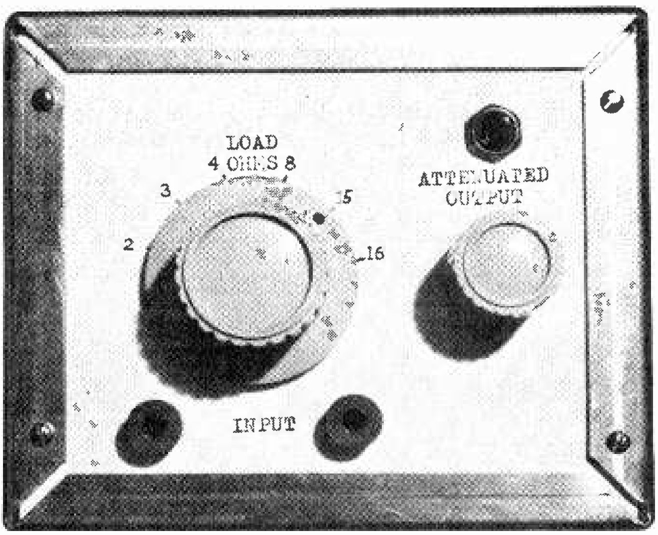
Some of the resistors used were Bulgin 2Ω 6W, while others were the cheaper 2·2Ω 7W type, each with a 22Ω $\frac{1}{2}$W resistor in parallel to obtain 2Ω. Suitable resistors are readily available. It would also be practical to make them from resistance wire, if low values of resistance can be measured accurately.

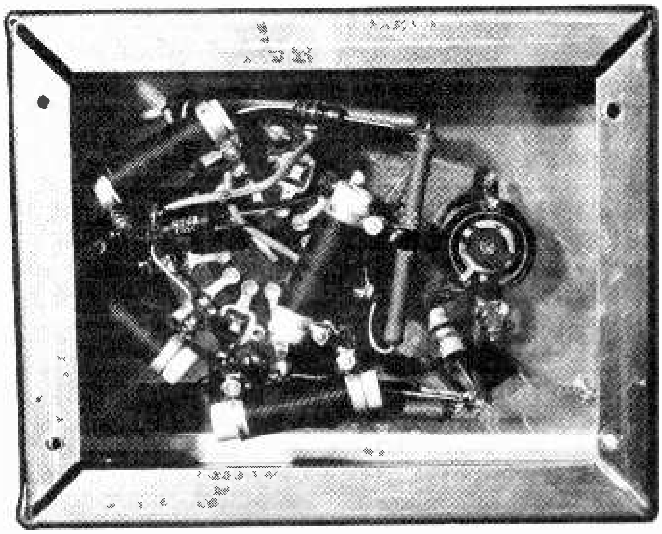
The wattage ratings quoted are for **continuous** operation. For relatively short periods of intermittent use they can be increased by about 20%. For **short** checks, just to find maximum power output, they can be increased by 50% or more.

Due to the way in which it is necessary to switch the resistors, the maximum **continuous** ratings with 6W resistors are as follows:-

2Ω	24W
3Ω	36W
4Ω	48W
8Ω	24W
15Ω	38W
16Ω	48W

The 1Ω 2W resistor limits the power at 15Ω but it was not felt worthwhile to use larger resistors in some positions to secure a 48W rating throughout. R10 and VR1 allow sufficient audio to be fed, with negligible effect on the dummy load value, to a small monitor speaker or headphones.





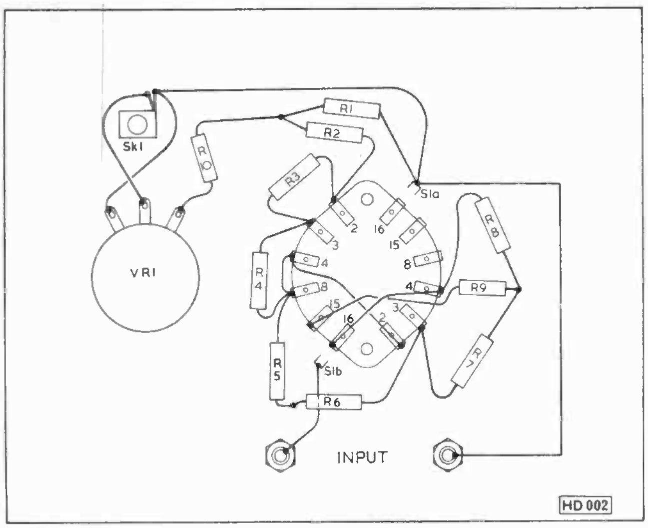


Fig. 2: Wiring diagram.

Where the power output into the dummy load has to be found, the readings obtained have to be put into suitable form. With the load resistance known, the voltage developed across it can be measured with a meter on its AC ranges. With modern instruments this can be expected to be close to the RMS value up to at least several kilohertz. Use the formular $V^2/R=W$, thus for 4V across a 2Ω load, 4 x 4/2=8W. A sine wave unit is necessary for this test.

★ components

Resistors
R1 to R8 2Ω 6W (if 2·2Ω resistors are used then add a 22Ω ½W resistor in parallel with each)
R9 1Ω 2W R10 47Ω ½W VR1 25Ω (not critical) wirewound potentiometer.

Miscellaneous
S1, 2-pole 6-way wafer switch (not miniature type). Sockets or terminals (2). Jack socket. Metal box 130 × 100 × 50mm (5 × 4 × 2in.) approx. Knob for S1.

Construction

A metal box about 130 x 100 x 50mm (5 x 4 x 2in) deep is a convenient size, and the resistors can be soldered directly to the switch tags for support, as in **Fig. 2.** If 2·2Ω resistors are used remember that these need 22Ω resistors in parallel with each. Place the resistors clear of each other, the switch, and box. The box must have some ventilation holes punched in it.

If there is any doubt about the operation of the switch contacts of the actual switch fitted, check these with a meter. A meter with a low ohms range should indicate 2, 3, 4, 8, 15 and 16Ω for progressive switch positions, when connected to the input sockets. Mark these for future reference.

NOTE:- Since either side of the audio output circuit may be earthed it is advisable to ensure that the dummy load is isolated from its metal case by insulating the input terminals and monitor jack from the case. If however one side is earth then connect the case. ●

B. BAMBER ELECTRONICS

Dept. P.W. 5 STATION ROAD, LITTLEPORT, CAMBS., CB6 1QE
Telephone: ELY (0353) 860185 (2 lines) Tuesday to Saturday

PLEASE ADD 8% VAT UNLESS OTHERWISE STATED

A RANGE OF DRAPER TOOLS FOR THE ELECTRONICS ENTHUSIAST

MAINS TESTER SCREWDRIVERS 100 to 500V. Standard size **50p.** Large **70p.**
RADIO PLIERS 5¾" **£1·60.** 6¾" **£1·80.**
DIAGONAL SIDE CUTTERS 6¼" **£1·90.**
SMALL SIDE CUTTERS LJ2. Standard **£3·70.** LJ7 (with wire holding device) **£4·10.**
MIDGET OPEN ENDED SPANNER SETS 0+1 2+2 3+5 4+6 6+8 BA sizes **£2·85** set of 5. 4+4·5 5+5·5 4+6 6+7 8+9 10+11 MM sizes **£3·50** set of 6.
MINIATURE FILE SETS. Set of 6 **£1·90.** Set of 10 **£3·25** (Round, flat, etc.).
TAP AND DIE SETS (18 piece) contain 1 each of 0, 2, 4, 6, 8, BA SIZES in Dies, Plug Taps, Taper Taps + American type tap wrench, T type tap wrench, Die Holder. **£11·60.**
LARGE ELECTROLYTIC PACKS. Contain range of large electrolytic capacitors, low and high voltage types, over 40 pieces, **£3·00** per pack (+ 12½% VAT).

A NEW RANGE OF QUALITY BOXES & INSTRUMENT CASES.
Aluminium Boxes with Lids.

AB10	5¼ × 4 × 1½	60p
AB13	6 × 4 × 2	80p
AB14	7 × 5 × 2½	£1·00
AB15	8 × 6 × 3	£1·30
AB16	10 × 7 × 3	£1·50
AB17	10 × 4½ × 3	£1·30
AB25	6 × 4 × 3	£1·00

Vinyl Coated Instrument Cases
Light Blue tops and White lower sections. Very smart fiinish.

WB1	5 × 2½ × 2½	60p
WB2	6 × 4½ × 1½	£1·10
WB3	8 × 5 × 2	£1·60
WB4	9 × 5½ × 2½	£1·80
WB5	11 × 6½ × 3	£2·00
WB6	11 × 7½ × 3½	£2·25
WB7	12 × 6½ × 5½	£2·60
WB853	8 × 5½ × 3½	£2·00

MAINS TRANSFORMERS. Type 60/2, Mains input 200-210-220-230-240-250V a.c., output 0-20-40-60V at 2A, in Metal and Plastic case, approx. 7½ × 4½ × 4, fully fused (ideal for PSU) £3·00 each.

MAINS TRANSFORMERS. Type 15/300 240V input, 15V at 300mA output, £1·50 each.

MAINS TRANSFORMERS. Type 45/100, 240, 220, 110, 20, 0V input, 45V at 100mA output, £1·50 each.

MAGNETIC DEVICES PROGRAMMERS. Contain 9 fully adjustable cams and 9 change over micro-switches (rated approx. 1A at 240VAC) Needs slow-motion motor to drive (not supplied). Ideal for disco lights, sequence switching, etc. ex equipment £1·50 each.

VIDICON SCAN COILS (Transistor type, but no data) complete with vidicon base £6·50 each. Brand New.

FULL RANGE OF BERNARDS/BABANI ELECTRONICS BOOKS IN STOCK. S.A.E. FOR LIST.

NEW FOR THE VHF CONSTRUCTOR. A range of tuned circuits on formers with slugs and screening cans. Frequencies quoted are approximate, and range can be greatly extended by using varying capacitors in parallel.
Type S (½in. square, dumpy type).
Type SA 20 to 30MHz (when 33pf fitted in parallel).
Type SB 35 to 50MHz (with link winding).
Type SC 70 to 100MHz (with link winding).
Type SD 135 to 175MHz (with link winding)
Type M (Min. ⅜in. square types).
Type MA 19 to 28MHz (when 33pF fitted in parallel).
Type MB 22 to 32MHz (when 33pF fitted in parallel).
Type MC 25 to 35MHz (when 33pF fitted in parallel).
Type MD 38 to 50MHz (when 33pF fitted in parallel).
Type ME 45 to 60MHz (when 33pF fitted in parallel).
Type MF 100 to 200MHz (without slug) when 0 to 30pF variable fitted in parallel.
All the above coils available in packs of five only (same type) at **50p** per pack of 5.

SEMICONDUCTORS
BSX20 (VHF Osc/Mult), 3 for **50p.**
BC108 (metal can), 4 for **50p.**
PBC108 (plastic BC108), 5 for **50p.**
BFY51 Transistors, 4 for **60p.**
BCY72 Transistors, 4 for **50p**
PNP audio type TO5 Transistors, 12 for **25p.**
BF152 (UHF amp/mixer), 3 for **50p.**
2N3819 Fet., 3 for **60p,**
BC148 NPN SILICON, 4 for **50p.**
BC158 PNP SILICON, 4 for **50p.**
BAY31 Signal Diodes, 10 for **35p.**
BA121 Varicap Diodes, 4 for **50p.**

741CG op amps by RCA, 4 for **£1**

RED LEDs (Min. type) 5 for **70p.**

PLASTIC PROJECT BOXES with screw on lids (in black ABS) with brass inserts.
Type NB1 approx 3in. × 2½in. × 1½in. **40p** each.
Type NB2 approx. 3¾in. × 2½in. × 1¼in. **50p** each.
Type NB3 approx. 4¼in. × 3¾in. × 1½in. **60p** each.

MULLARD 85A2 85V STABILISER VALVES (Brand New) **70p** each or 2 for **£1·20.**

TO3 transistor insulator sets, 10 for **50p**

PERSPEX TUNER PANELS (for FM Band 2 tuners) marked 88–108MHz and Channels 0–70, clear numbers, rest blacked out, smart modern appearance, size approx. 8½in × 1½in., 2 for **35p.**

PLUGS AND SOCKETS
N-Type Plugs 50 ohm, **60p** each, 3 for **£1·50.**
PL259 Plugs (PTFE), brand new, packed with reducers, **65p each**
SO239 Sockets (PTFE), brand new (4-hole fixing type). **50p** each

SOLDER SUCKERS (Plunger type). Standard Model, £5. Skirted Model £5·50. Spare Nozzles **60p** each.

NEW MARKSMAN RANGE OF SOLDERING IRONS.
S125D 25W 240V £3·80.
S140D 40W 240V £4·20.
S125DK 25W 240V + bits etc., **KIT** £4·90.

BENCH STAND with spring and sponge for Marksman Irons **£2·38.**
Spare bits MT9 (for 15W) **50p,** MT5 (for 25W) **45p,** MT10 (for 40W) **50p.**
ALL PRICES + 8% VAT.
TCP2 TEMPERATURE CONTROLLED IRON. Temperature controlled iron and PSU. £30 + VAT (£2·40).
SPARE TIPS
Type CC single flat, Type K double flat fine tip, Type P, very fine tip. £1 each + VAT (8p).
MOST SPARES AVAILABLE.

MULTICORE SOLDER
Size 5 Savbit 18 s.w.g. in alloy dispenser, **32p** + VAT (3p).
Size C1SAV18 Savbit 18 s.w.g., **56p** + VAT (4p).
½ Kg. (1·1lb) 60 × 40, 20 s.w.g. on plastic reel **£3** + VAT (24p).

WELLER SOLDERING IRONS
EXPERT. Built-in-spotlight illuminates work. Pistol grip with fingertip trigger. High efficiency copper soldering tip.
EXPERT SOLDER GUN 8100D £9·90.
EXPERT SOLDER GUN KIT (spare bits, case, etc.) **£12·90.**
Spare bits 35p pair.

A LARGE RANGE OF CAPACITORS AVAILABLE AT BARGAIN PRICES, S.A.E. FOR LIST.

MIXED COMPONENT PACKS, containing resistors, capacitors, pots, etc. All new. Hundreds of items. **£2** per pack, while stocks last.

ALU-SOL ALUMINIUM SOLDER (made by Multicore). Solders aluminium to itself or copper, brass, steel, nickel or tinplate, 16 s.w.g. with multicore flux, with instructions, Approx. 1 metre coil **40p** pack. Large reel **£2·75.**

VARICAP TUNERS Mullard type ELC1043/05. Brand New, **£4·40** + 12½% VAT.

BARGAIN PACK OF LOW VOLTAGE ELECTROLYTIC CAPACITORS. Up to 50V working. Seatronic Manufacture. Approx. 100. **£1·50** per pack + 12½% VAT.

OSMOR REED RELAY COILS (for reed relays up to ¼in dia., not supplied) 12V, 500 ohm coil, 2 for **50p.**

We now stock Spiralux Tools for the electronic enthusiast. Screwdrivers, Nut spanners, BA and Metric sizes, pop rivet guns, etc. S.A.E. for list.

Dubilier Electrolytics, 50μF, 450V, 2 for **50p.**
Dubilier Electrolytics, 100μF, 275V, 2 for **50p.**
Plessey Electrolytics, 470μF, 63V, 3 for **50p.**
TCC Electrolytics, 1000μF, 30V, 3 for **60p.**
Dubilier Electrolytics, 5000μF, 35V, **50p** each.
Dubilier Electrolytics, 5000μF, 50V, **60p** each.
ITT Electrolytics, 6800μF, 25V, high grade, screw terminals, with mounting clips, **50p** each.
PLEASE ADD 12½% VAT TO ALL CAPACITORS.

TV PLUGS AND SOCKETS
TV Plugs (metal type), 4 for **50p.**
TV Sockets (metal type), 4 for **50p.**
TV Line Connectors (back-to-back sockets), 4 for **50p.**
Please add 12½% VAT.

Terms of Business: CASH WITH ORDER. MINIMUM ORDER £2. *ALL PRICES INCLUDE POST & PACKING (UK ONLY). SAE with ALL ENQUIRIES Please.* **PLEASE ADD VAT AS SHOWN.** *ALL GOODS IN STOCK DESPATCHED BY RETURN. CALLERS WELCOME BY APPOINTMENT ONLY.*

Head Office and Warehouse
44A WESTBOURNE GROVE
LONDON W2 5SF
Tel: 727 5641/2/3

Z & I AERO SERVICES LTD.

Please send all correspondence and Mail-Orders to Head Office

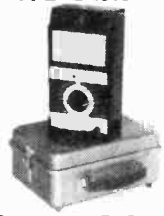
Retail Shop
85 TOTTENHAM COURT ROAD
LONDON W1
Tel: 580 8403
Open all day Saturday

A SELECTION FROM OUR STOCKS OF FULLY GUARANTEED FIRST QUALITY VALVES

												PCL805	0·75
1B3GT	0·65	6AK6	0·65	6CW4	3·75	12BA6	0·65	ECL80	0·60	EZ80	0·35	PD510	3·35
1R4	0·50	6AK7	0·85	6CYS	1·00	12BE6	0·80	ECL81	0·75	GY501	0·85	PL36	0·75
1R5	0·50	6AL5	0·40	6CY7	1·00	12BH7A	0·75	ECL82	0·60	GZ30	0·65	PL81	0·65
1S4	0·40	6AM6	0·65	6DQ6B	1·45	12BY7A	0·80	ECL83	1·15	GZ32	0·65	PL82	0·55
1S5	0·40	6AM8	0·70	6DT6	0·80	35W4	0·70	ECL84	0·70	KT66	4·50	PL83	0·50
1T4	0·40	6AN5	2·50	6GH8A	0·80	50C5	1·00	ECL85	0·65	KT88	5·80	PL84	0·75
1U4	0·70	6AN6	0·85	6GK5	0·70	*75C1	0·80	ECL86	0·75	OA2	0·55	PL95	0·70
1U5	0·80	6AQ5	0·85	6J4	1·00	*85A2	0·85	EF80	0·40	OA3	0·75	PL504	1·05
1X2B	1·20	6AR5	0·70	6J5GT	0·80	*90C1	1·20	EF85	0·48	OB2	0·60	PL508	1·30
2CW4	4·50	6AS6	1·00	6J6	0·55	*807	1·00	EF86	0·55	OB3	0·75	PL802	2·80
*2D21	0·80	6AS7G	1·10	6J7	0·80	*811A	3·20	EF92	0·75	OC2	1·40	PY81	0·70
*3-500Z	40·00	6AT6	0·75	6K6GT	0·85	*829B	6·30	EF97	0·70	OC3	0·75	PY82	0·55
*3E29	6·50	6AU6	0·50	6L6GT	0·80	*832A	6·00	EF98	0·90	OD3	0·75	PY83	0·70
3Q4	0·75	6AV6	0·60	6N7GT	0·85	*866A	3·00	EF183	0·70	PABC80	0·45	PY88	0·70
3S4	0·50	6AW8A	0·75	6Q7	0·90	*872A	6·00	EF184	0·70	PC86	0·70	PY500A	1·30
5AQ5	0·75	6AX4GTB	1·00	6SA7	0·80	*5763	2·85	EFL200	1·00	PC88	0·70	TT21	7·80
5ATB	0·80	6AX5GT	1·30	6SG7	0·80	DAF96	0·60	EH90	0·60	PC92	0·65	TT22	7·80
5T4	0·75	6BA6	0·45	6SK7	0·80	DF96	0·60	EL34	0·95	PC95	0·70	U25	1·00
5U4G	0·60	6BE6	0·48	6SL7GT	0·70	DK92	1·00	EL36	0·95	PC96	0·50	U26	1·00
5U4GB	0·95	6BF5	0·85	6SN7GT	0·70	DL96	0·60	EL81	0·65	PC97	0·95	UABC80	0·58
5U8	0·75	6BF6	0·75	6SQ7	0·80	ECC84	0·60	EL82	0·60	PC900	1·00	UBC81	0·60
5V4G	0·60	6BH6	0·85	6V6GT	0·65	ECC85	0·48	EL83	0·60	PCC84	0·50	UBF89	0·60
5X4G	0·80	6BJ6	1·20	6X4	0·60	ECC86	1·25	EL84	0·45	PCC85	0·60	UBL21	0·85
5X8	0·90	6BN6	0·80	6X5GT	0·60	ECC88	0·75	EL86	0·70	PCC88	0·65	UCC84	0·75
5Y3GT	0·65	6BQ7A	0·65	12AC6	0·80	ECC89	0·80	EL95	0·70	PCC89	0·75	UCC85	0·55
5Z4GT	0·65	6BR8A	1·20	12AD6	0·80	ECC189	0·80	EL504	0·80	PCC189	1·00	UCF80	0·75
6AB4	0·55	6BU8	0·85	12AE6	0·85	ECF80	0·60	EM80	0·65	PCF80	0·65	UCH81	0·65
6AB7	0·60	6BW7	1·00	12AT6	0·60	ECF86	0·80	EM81	0·60	PCF82	0·45	UCL81	0·70
6AC7	0·80	6BZ6	0·65	12AT7	0·50	ECF200	0·90	EM84	0·60	PCF84	0·65	UCL82	0·75
6AF4A	0·70	6BZ7	0·70	12AU6	0·65	ECF201	0·90	EM87	1·00	PCF201	1·10	UCL83	0·80
6AG5	0·65	6C4	0·55	12AU7	0·47	ECF801	0·95	EY51	0·60	PCF806	1·00	UF85	0·50
6AG7	0·85	6CB6	0·55	12AV6	0·60	ECF802	0·95	EY81	0·60	PCL81	0·65	UL84	0·75
6AH6	0·85	6CS7	0·85	12AV7	1·00	ECH81	0·50	EY87	0·60	PCL82	0·75	UM80	0·60
6AJ5	0·65	6CU5	1·00	12AX7	0·47	ECH83	0·60	EY88	0·55	PCL84	0·75	UM81	0·75
6AK5	0·55	6CU6	1·00	12AY7	0·85	ECH200	0·80	EY500A	1·50	PCL86	0·75	UM84	0·45

AC/DC TAUT SUSPENSION MULTIMETERS

TYPE U4315



Sensitivity D.C.	20,000 o.p.v.
Sensitivity A.C.	2,000 o.p.v.
D.C. Current	50μA-2·5A
A.C. Current	0·5mA-2·5A
D.C. Volts	75mV-1000V
A.C. Volts	1V-1000V
Resistance	300Ω-500kΩ
Capacity	0·5μF
Accuracy	2·5% D.C., 4% A.C.

Price complete with pressed steel carrying case and test leads. £14·95
Packing & postage + VAT 8% £1·35

VAT is not included. Please add 12½% on all items except those marked with asterisk, on which VAT is 8%. Postage and packing charges are **£0·10** per £ subject to a minimum of **£0·30.**

OUR NEW 1977/1978 CATALOGUE IS NOW READY AND WILL BE SENT ON RECEIPT OF REMITTANCE FOR £0·30

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article.

The ultimate deterrent?

Calling all motorists. Your salvation from radar speed traps is at hand—literally. An American company has produced a little 8lb receiver which tunes wideband from 8 to 18GHz and will give an alarm if it sniffs any radar radiation. It's intended for front line troops so that they will know when the enemy is watching them on radar. If it's for the military, then it should be good.

Unfortunately, the US Police Departments are also well up in electronics. They have just brought out a small radar which employs a microprocessor to help prevent its detection by "with-it" motorists.

This device will hold the microwave radar signal until the target vehicle is in sight. Then it fires. If the motorist has some form of radar detector, it will be too late to take any slowing down action because by the time he (the motorist) receives a warning, the police radar will already have measured the speed of the vehicle.

And it gets more complex, too. The new police radar also has to measure accurately the speed of the police vehicle—and to do this it has to emit a radar signal—which some motorist might detect! So; the police unit fires its radar emission in little blasts so quickly that it exceeds the integration time of most radar detectors. Pulse, frequency and period are all pseudo-random and it would be extremely difficult to find this complex "radio signature". Even if this were possible the police claim that they can alter all the elements by simply reprogramming the unit.

Seems to me it would be simpler just not to exceed the speed limit—or to stay at home with one of those German TVs and watch both pictures!

A weighty problem

Not having had my weight checked electronically before I was interested in the latest in bathroom scales which give ones weight digitally. The price is around £27 but then I found that the scales are really quite conventional in the weighing part, they just show the weight digitally.

The Americans have come up with something a little better. Certain electronic scales over there use strain gauges to sense the weight and the accuracy is to within one tenth of a pound. Another good idea is that the digital bit which shows you the weight, is a separate unit that can be wall-mounted where you can see it easily. Anyone who, like Ginsberg, has crouched in a precarious position, balanced on the edge of the bathroom scales, knees either side of ears, struggling to read a talcum-encrusted needle, will appreciate the usefulness of the newer approach. Trouble is, these new beasties will weigh heavily on your wallet; between £165 and £225 each! Ah well, back to the fifth lotus weighing position!

Split personality

Have you ever watched television and wondered what's on the other channel? Or perhaps, as an ardent button pusher you've "twitched" from one programme to another and back again? Relax—your worries are over. A German manufacturer has come up with the ultimate—two pictures at the same time—together—simultaneous—like! Just think, "Noddy meets Lady Chatterley", or "Ena Sharples versus the Six Million Dollar Man".

In practice it's not quite so easy to do! Basically, the manufacturer has managed to put a small picture (of the other channel) at the bottom of the screen which is filled with the channel picture that you are watching.

The difficulties become apparent when one considers that the tiny picture must somehow be 'shrunk' and that the single beam from the CRT's electron gun must produce both pictures simultaneously even though they are out of phase with each other. Again, both sweeps, horizontal and vertical, must be quite different to those required for the other picture because of the size difference.

The solution has been to use two memories. Video information is fed into the first memory and then fed out in the required timing sequences. While the first memory is being read out, the second memory is taking in fresh video data. The "memory" used is a form of bucket-brigade device. Here, the signals are delayed by the time taken to pass them from one element in the chain to the next—rather like a chain of people would pass buckets of water to each other along a human chain. Here, the device is passing charges.

Unfortunately, the available BBDs which were conventional types proved useless; basically a MOS arrangement of transistors interspersed with capacitors. In practice, they didn't delay the signal long enough, even though several hundred transistors were employed. The solution was to manufacture a BBD device where the elements were arranged in a matrix with short line elements and low signal losses. In one of these chips, there are some 8,000 elements comprising 4,000 transistors and 4,000 capacitors—all in $12mm^2$.

And all to let you look at two pictures at the same time! Perhaps the smaller picture could come from a CCTV camera pointing down your front path for security surveillance? Come to think of it, the current standard of TV programmes might make Ginsberg's front path more interesting viewing!

Puzzle corner

Computers and chess are often mentioned in the same breath. If you just happen to have an interest in both, then you'll be pleased to hear that the Computer Chess Newsletter has been started. This is aimed at providing information on chess programming for computers, records of games played with computers (and even between computers themselves) plus all sorts of news. If you are interested, why not drop the Editor a line? Write to Douglas Penrod at 1445 La Cima Road, Santa Barbara, California 93101, USA. You must send an IRC (international reply coupon—get one from the Post Office) and the equivalent of a dollar if you want a sample copy of the journal.

Ginsberg

A HEATSINK THERMOMETER

I. HICKMAN

This simple thermometer was made up to check that power transistors on heatsinks were running at a safe temperature. Diode D1 is the temperature sensing element, **Fig. 1**, and is enclosed in a tiny copper heatsink which is held against the surface where temperature is to be measured. A constant current is passed through the diode by R1 from the stabilised voltage across D2. The voltage across D1 varies by approximately 2·1mV per degree Centigrade, resulting in a change of more than 300mV over the range, 0°C to 150°C.

This is measured by M1 the positive terminal of which is returned to the junction of R2 and R3. The potential at this point is set by VR2 such that it equals the voltage across the diode when the latter is at freezing point. Thus the meter reads zero at 0°C. VR1 is set so that the meter reads $\frac{2}{3}$ full scale at the temperature of boiling water, thus FSD corresponds to 150°C. A 5·6V zener was chosen for D2 as this offers nearly zero temperature coefficient and a low slope resistance. By supplying the zener from the high collector slope resistance of a transistor, excellent voltage stability is obtained even using the 9V battery down to a little over 6V. With intermittent use, the battery will last many months.

Construction

Fig. 2 shows how a small piece of 20SWG copper sheet is cut and shaped so that it can be bent up to virtually enclose D1. D1 should be of the "double slug" type of construction where the silicon wafer is sandwiched directly between metal slugs without any intermediate whisker. A fine copper wire, 42SWG or thinner, is soldered to one end of the diode and the other end is soldered into the hole in the heatsink and the lead cut off flush. The diode should be hard up against the heatsink; the soldering process will not damage it. Another fine wire is soldered to the heatsink and the inside filled with Araldite, after arranging the wires in a small loop to minimise heat conduction. The wires are then passed up the inside of a length of 0·2in paxolin tube, to the end of which the diode/heatsink is Araldited.

Finally, the end of the heatsink is carefully filed flat to enable a good thermal contact to be achieved. The probe should be finished by mounting the paxolin tube in a suitable handle, which also contains the transition from the fine copper wires to a lightweight flex. The barrel of a felt tip pen makes a convenient handle.

The rest of the circuit, including the meter and battery, is mounted in a "Bargain Project Box" obtainable from Messrs. Crescent Radio Ltd. All the components except S1, D1 and the battery mount on a small PC board, **Fig. 3**, which fits over the meter terminal posts and is soldered to the meter's soldering tags.

★ components

Resistors

R1	3·3kΩ	VR1	4·7kΩ
R2	2·7kΩ	VR2	4·7kΩ
R3	470Ω	min. skeleton	
R4	47Ω	vertical	
R5	6·8kΩ		

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

Semiconductors

D1 1N916 (see text)
D2 BZY88 C5V6 (5.6V zener)
D3 1N916
Tr1 OC71 or similar

Miscellaneous

M1, meter 100μA FSD Type MR38P, S1, DP slide switch. Copper for heatsink. Material for probe. Metal or plastic box approx 85 × 55 × 37mm ($3\frac{3}{8}$ × $2\frac{1}{4}$ × $1\frac{1}{2}$in.) PP3 battery.

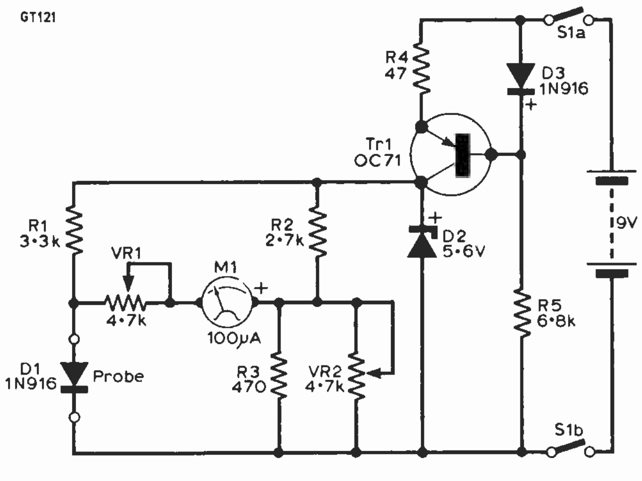


Fig. 1: Complete circuit diagram of the heatsink thermometer.

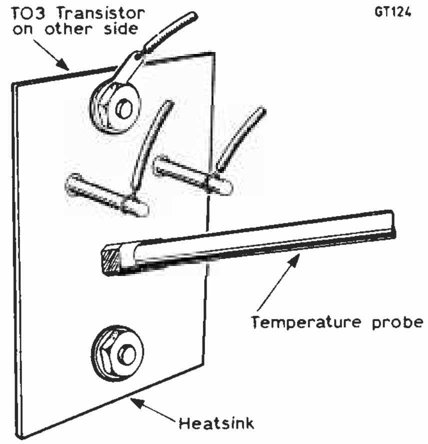


Fig. 4: The temperature probe should be applied to the heatsink, not the transistor case.

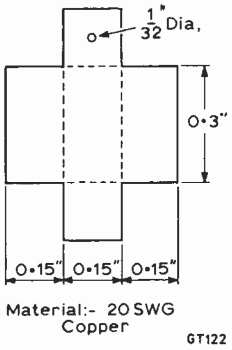
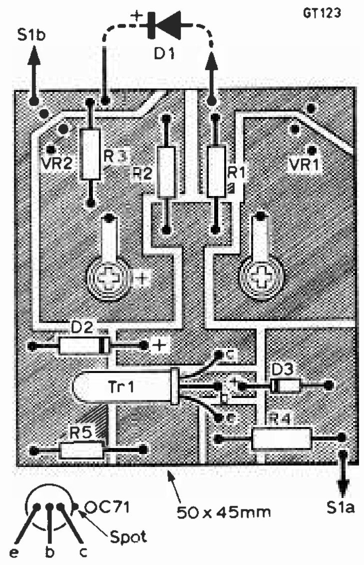
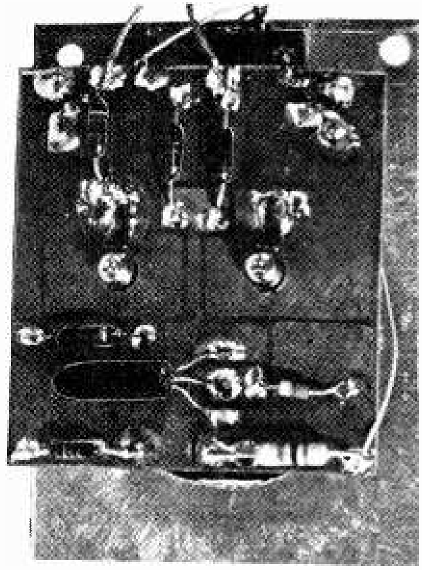


Fig. 2 (above): Temperature probe housing cutting details. Fig. 3 (right): A suggested PCB layout. All components are mounted on the copper side of the board.





Calibration

Having finished construction and checked that 5·6V approx. appears across D2, set VR1 to mid-range and adjust VR2 for zero meter reading when the probe tip is immersed in a mixture of water and melting ice, well stirred. Next, dry the probe and place the tip on the outside surface of a kettle of boiling water, using plenty of heatsink compound. Adjust VR1 for a scale reading of 100°C. The probe will not quite have reached this temperature, but the difference should only be two or three degrees, as can readily be checked by immersing the probe tip. If you do, carefully remove all the heatsink compound first! The thermometer is now calibrated.

Use

The recommended method is to measure the temperature of the heatsink on the opposite side from the power transistor, as in **Fig. 4**. To ensure that the power transistor is running at a safe temperature, it is necessary to deduce the junction temperature of the actual silicon chip inside. From the voltage across and the current through the transistor, calculate its dissipation P in watts. Next, to the thermal resistance from junction to case $R\theta_{j\text{-}c}$ add that from case to heatsink $R\theta_{c\text{-}h}$. These are quoted by the transistor manufacturer on the data sheet. There will usually be three values for $R\theta_{c\text{-}h}$: (a) transistor mounted on heatsink direct (b) ditto, but with silicone grease and (c) insulated by a mica washer. Multiply the dissipation P by the total thermal resistance

$$R\theta_{j\text{-}h} \text{ where } R\theta_{j\text{-}h} = R\theta_{j\text{-}c} + R\theta_{c\text{-}h}$$

to find the temperature of the junction relative to the heatsink. Add this to the measured heatsink temperature and check that the resultant junction temperature is within the manufacturer's rating, e.g. 200°C for a 2N3055. ●

ECONOMY TIMING

With today's very high cost of motoring, an increasing number of people are servicing their own cars. This can save a lot of money, but also lead to some difficulties. The efficiency of an engine depends on a large number of factors, one of which is the condition of the ignition system and how accurately it is set up.

Here lies one of the difficulties. The motorist can set the contact-breaker points gap fairly easily, whereas a garage will use an expensive dwell meter which measures the interval over which the points are closed. The ignition timing is a critical adjustment which has a great influence on fuel consumption, but is not so easily checked by the d-i-y motorist. True he can set the timing statically, using a bulb, but it is much better and more accurate to set the timing with the engine running. Here the professional uses a strobe timing light, but few motorists possess such an expensive piece of equipment.

A short while ago, the author wanted to fit an electronic ignition system to his car to improve its performance and fuel economy. The particular type being fitted used a magnetic sensing system to provide the timing, rather than the more usual mechanical contact-breaker. This meant that the timing method using a bulb could not be adopted. Instead a strobe timing light was necessary, and it was this which led to the development of the low-cost unit described here.

Circuit description

As can be seen from the circuit diagram, **Fig. 1**, a mains-driven power unit provides an output of some 200 to 300 volts d.c. This is connected across the xenon strobe tube, FT1, whose trigger electrode is connected to one of the sparking plugs. Each time a high voltage pulse from the distributor is applied to the plug, the strobe tube will fire, producing a flash of light. The power supply capacitor C1 will be discharged through the tube, and will recharge in the interval before the next trigger pulse.

The requirement for a mains power supply is the one disadvantage of this simple system. However, it does mean that the light output from the tube is greater than that obtained from some other low-cost designs. As the unit will not normally be used very often, it was not considered too great a drawback.

Construction

The timing light is built in two parts: the strobe head itself, with the sparking-plug adaptor attached, and the power unit. The strobe head should be housed in a plastics box, for good insulation, and safety in handling. Constructional details are shown in **Fig. 2**. The strobe tube is mounted in a piece of

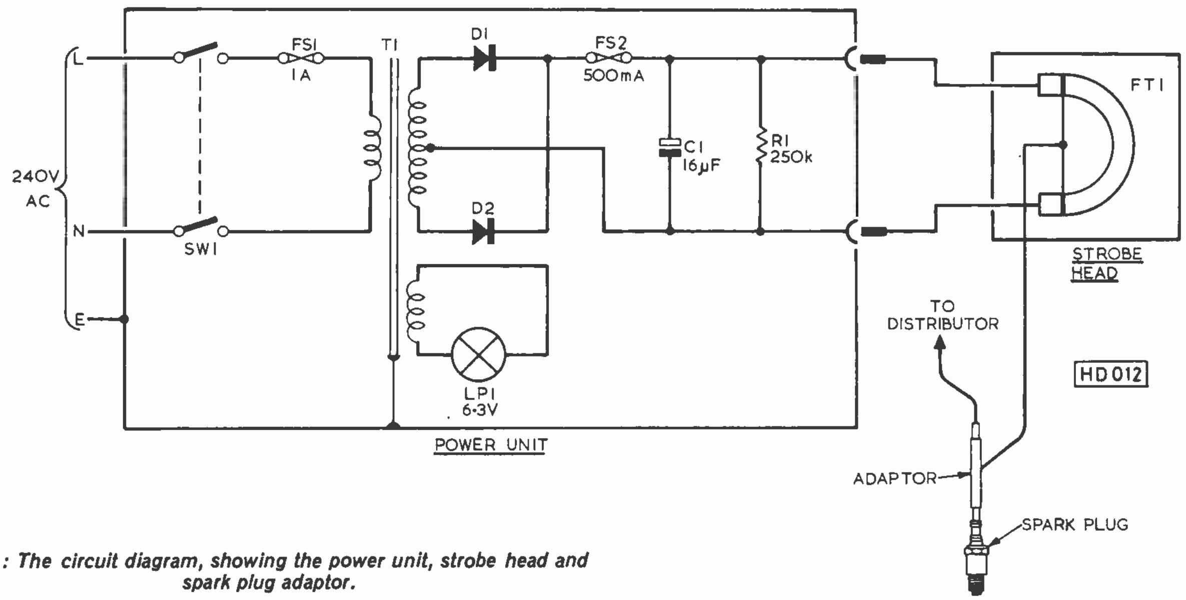


Fig. 1: The circuit diagram, showing the power unit, strobe head and spark plug adaptor.

STROBE

B.HARVEY

5mm (3/16in) thick Paxolin, and held in place by means of some flexible adhesive such as Evostik. The tube, being glass, is fairly fragile, and some care in handling is advisable. The aluminium reflector should be polished using Brasso, etc. to provide the maximum light output from the unit.

The connecting lead to the power unit should be in good quality heavy duty twin mains flexible, while that to the sparking-plug adaptor should be in car HT cable, obtainable from motor accessory shops. A length of one metre is normally adequate.

Sparking-Plug Adaptor

The sparking-plug adaptor is made from a piece of brass rod about 10mm (3/8in) in diameter. One end is turned down in a lathe or electric drill until it will fit firmly into the plug lead cap. The size will depend on the type of plug lead used on your car. Usually, British cars use the plug with the adaptor screwed on the end, but many European cars use only the threaded portion, without the adaptor.

★ components

Resistor
R1 250kΩ 1W

Capacitor
C1 16μF 450V Electrolytic

Diodes
D1, D2 BY100 etc. (400V 1A)

Miscellaneous

T1	Pri: 240V Sec 1: 200-0-200 to 300-0-300V 15mA (see text) Sec 2: 6·3V 0·5A
FT1	Strobe tube (Tandy Cat. 272-1145 or similar)
FS1	1A
FS2	500mA
S1	D.P.S.T. mains switch
LP1	6·3V 0·3A lamp

Holders for lamp and fuses. Plastic box 101 × 54 × 41mm (Tandy Cat. 270-231 or similar). Metal box for power unit. Car HT cable (1m). Terminals or plug and socket for DC output connection. Paxolin, Perspex, aluminium sheet. Cable clamps, grommets, brass rod and plastic tubing for insulation.

The other end of the adaptor is drilled out to fit the top connector of the sparking plug. A slot is then sawn down the length of the hole and the sides sprung slightly inwards to give a firm fit.

Good insulation is essential on the sparking plug adaptor and on all connections inside the strobe head. Remember that the power supply is capable of giving a very dangerous shock, while the trigger lead will have anything up to 20,000 volts on it every time the plug fires.

Power supply

No constructional details are given for the power supply unit, because this can take more or less any form, and it may be that the constructor already has a suitable power pack available. The HT output should be capable of supplying 200-300 volts at not less than 15 milliamps.

For safety and robustness, the power unit should be housed in a meal case. The prototype used a die-cast box. It is advisable not to omit the pilot lamp, which provides a warning of the presence of the HT output.

Engine timing

What is usually referred to as the timing on a car engine, is the point at which the sparking plug fires in relation to the position of the piston in the cylinder. If the spark occurs too early then severe stress and even damage can occur in the valve gear, connecting rod, piston, crankshaft and bearings. If the spark occurs too late, some or all of the power developed by burning the fuel is allowed to dissipate itself to atmosphere via the exhaust pipe. This is not usually so dangerous to the engine as having the spark too far advanced, but is very wasteful.

The exact point at which the fuel air mixture in the cylinder is ignited is critical within close limits. A few degrees out either way causes the efficiency of the engine to drop.

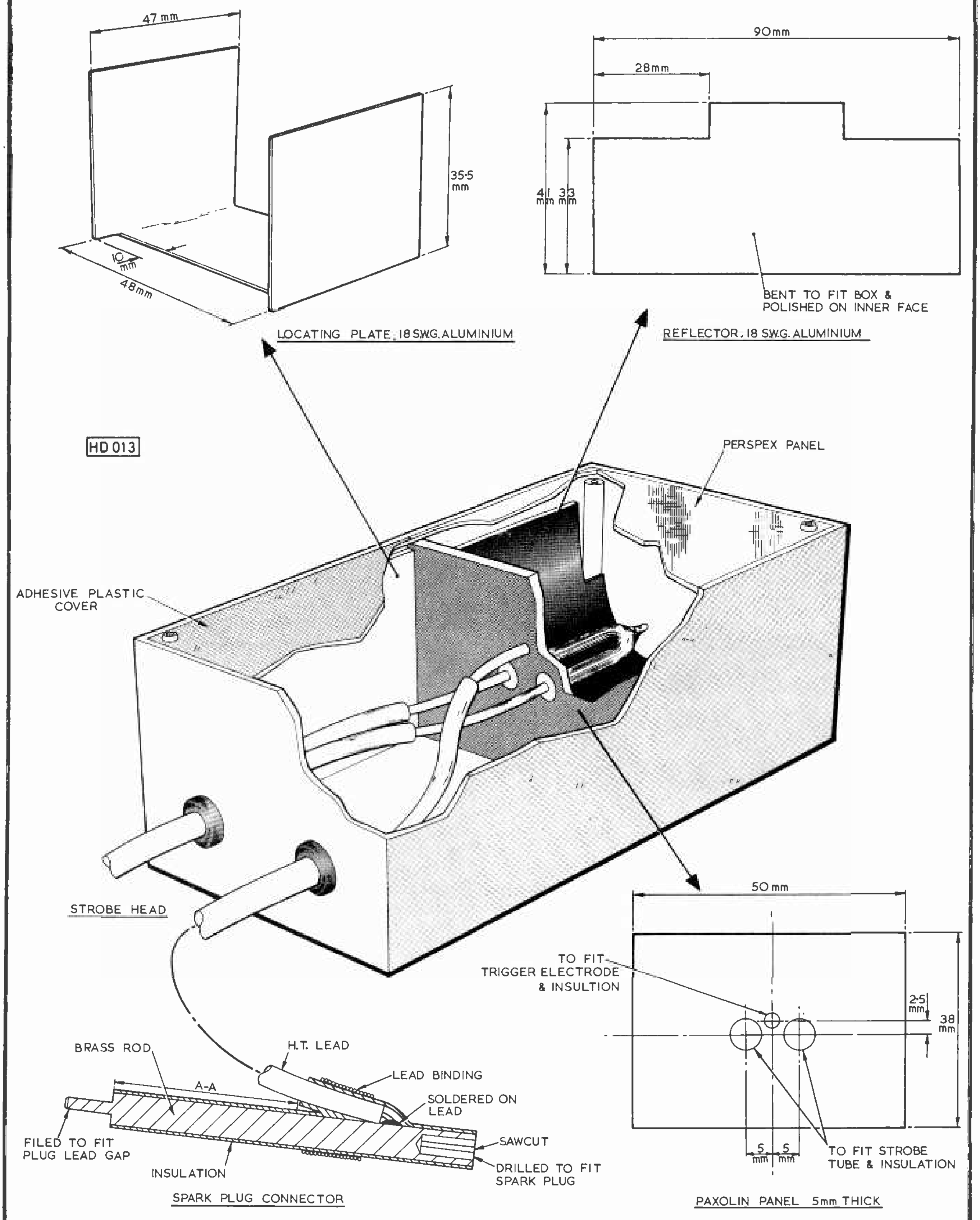


Fig. 2: A cut-away view of the strobe head, also showing dimensional details of the interior construction and a sectional view of the spark plug connector.

In order to check the exact relationship between the timing of the spark and the position of the piston, some form of reference marks have to be used. On most car engines the end of the crankshaft protrudes through the front of the engine casing. On this shaft is mounted a pulley wheel which drives the cooling fan, the dynamo or alternator and sometimes the water pump via the fan belt. On the front face of the crankshaft pulley wheel, or sometimes on the edge, is a mark, indentation or raised portion that coincides with another mark on the body of the engine when one cylinder (usually No. 1, the front one) has its piston at the highest point it can reach, normally referred to as "top dead centre" (t.d.c.).

Therefore we have a simple indicator that shows when one of the pistons has reached top dead centre. If further marks are added corresponding to 5 degrees and 10 degrees before t.d.c. on our reference cylinder then the timing of the engine can be found. This will hold good for the other cylinders of the engine, as the firing of all cylinders is controlled by the distributor cam and cannot change.

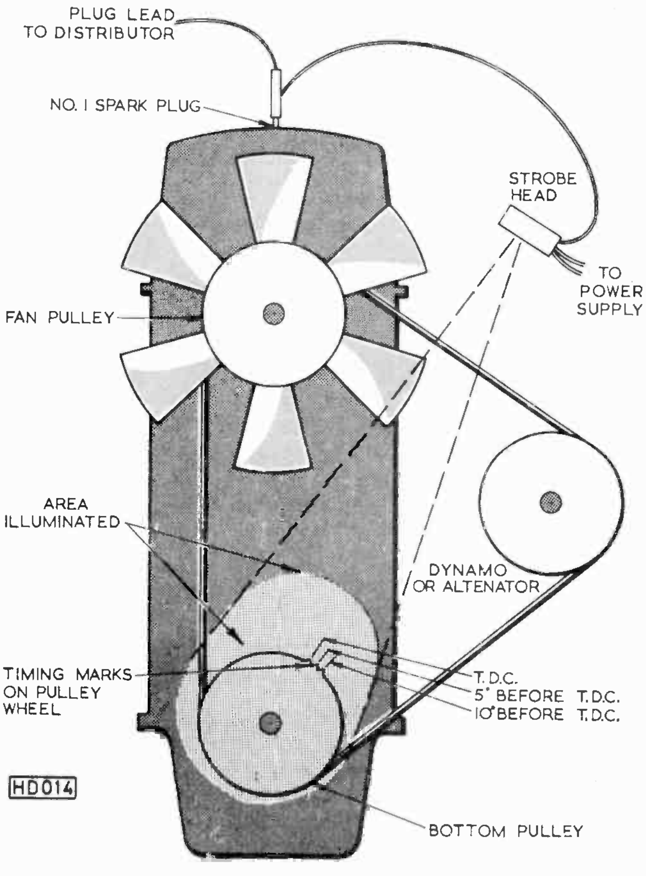


Fig. 3: A general view showing the strobe head illuminating the timing marks on the pulley wheel.

Using the Strobe

The strobe timing light should be connected to its power unit and the sparking plug adaptor connected in the lead to No. 1 cylinder plug. The engine should then be started up and allowed to stabilise its speed. If the power unit is now switched on, the strobe light will flash each time the spark occurs in No. 1 cylinder.

continued on page 757

KINDLY NOTE!

Jubilee Organ Project

i September 1977, p 353. Transistor ident. BFY71 should read BCY71.

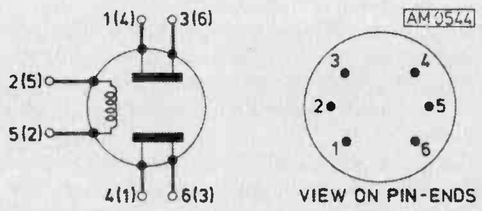
ii November 1977, Part 3. The circuit diagram of the accompaniment section, p 509, shows the base of Tr5 connected to the 12V positive rail. This connection should be broken, leaving the base connected to the free end of R44 (1 megohm) only.
The PCB as purchased from Readers' PCB Services is correct in this detail.

iii The end of R45, shown connected to the 12V positive rail, should go to the junction between R40 and C17.
The PCB as purchased from Readers PCB Services is correct in this detail.

iv Collated components list, p 353 September 1977 contains the information "3-off 33nF"; this should read "3-off 3·3nF Polystyrene."

Gas/Smoke Sensor Alarms, April 1977

We have received a number of queries from readers regarding the pin connections for the TGS812 Gas Sensor used in this design. These are as shown in the diagram below:



The TGS812 is a symmetrical device, and can be plugged into a standard 7-pin miniature (B7G) valve holder.

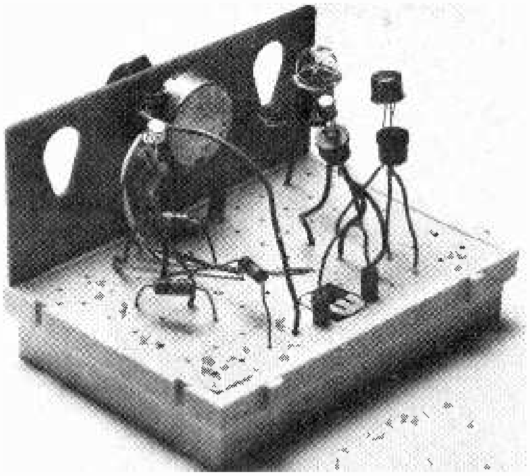
We regret that the pin numbers quoted in Fig. 1 of the article are incorrect. They should be amended as follows:

Pins 1, 2 and 3 to +5V (C1 positive)

Pins 4 and 6 to VR1

Pin 5 to negative supply rail (C1 negative)

S-DeCnology



DAVID GIBSON

12

THIS MONTH

'The Might Light'

This month's S-DeC circuit, the last in the present series, should provide a gripping finish to any party. Two contestants are asked to hold a "probe" in each of their hands. An adjustment is made until a bulb just extinguishes. On the command "Go", each contestant must grip/squeeze his/her two probes as hard as possible. One contestant has the power (depending on the strength of grip) to make the bulb light—the greater the grip the brighter the bulb lights. Conversely, the other contestant can dim the bulb (greater squeeze equals dimmer light) and can keep the bulb turned off.

The circuit uses only eight components (plus a battery) and functions as follows. By gripping the upper pair of probes the "light" contestant puts the resistance of the body in parallel with the resistor R1. The less this body resistance is, the more Tr1 is biased "on" and the more it will drive transistors Tr2 and Tr3. As Tr1 draws more and more current, the voltage developed across VR1 becomes greater and so drives the Darlington pair (Tr2/Tr3) harder "on". As these Darlington-connected transistors draw more current, the bulb in their collector circuit will obviously glow brighter.

The "dark" contestant puts his body resistance across R3. The less resistance there is here, the more Tr1 will turn "off" i.e., the less current it will draw and so less driving voltage will appear across the potentiometer VR1. The resistor R2 was included as a safety measure since, if the "light" contestant probes were accidentally shorted together, then the base of Tr1 would be directly connected to the positive battery rail causing the circuit to draw heavy current.

The potentiometer offers a simple means of balancing the circuit prior to a contest. If both contestants hold the probes lightly, then VR1 is easily adjusted until the bulb just extinguishes. It is more exciting if the bulb is adjusted for a slight glow, as any variation in brightness can then be seen immediately by the onlookers and, of course, the judges!

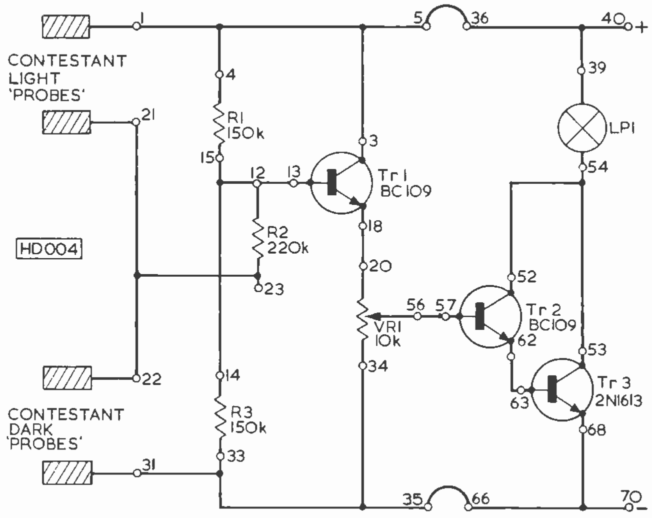


Fig. 1 : The circuit diagram

Once you have assembled the circuit on your S-DeC (don't forget the shorting links between holes 5/36 and 35/66) you should apply the battery voltage, but leave the probes unconnected. It should be possible to swing the potentiometer to light the bulb from full brilliance to completely extinguished. The value of VR1 offers a wide range and can easily adjust for any values of human skin resistance.

The probes are best made from short lengths of metal pipe, about 125mm (5in) long and anything from 12mm (½in) to 25mm (1in) diameter. You can simply paint a band around the top part of each probe, using white and black paint for "light" and "dark" respectively. Don't paint the whole pipe or you will insulate the skin contact from the metal and the circuit will not function.

Games using the circuit are endless and limited only by the imagination. For example, teams could join hands and the leaders then hold the probes. The potentiometer is adjusted and on the command every-

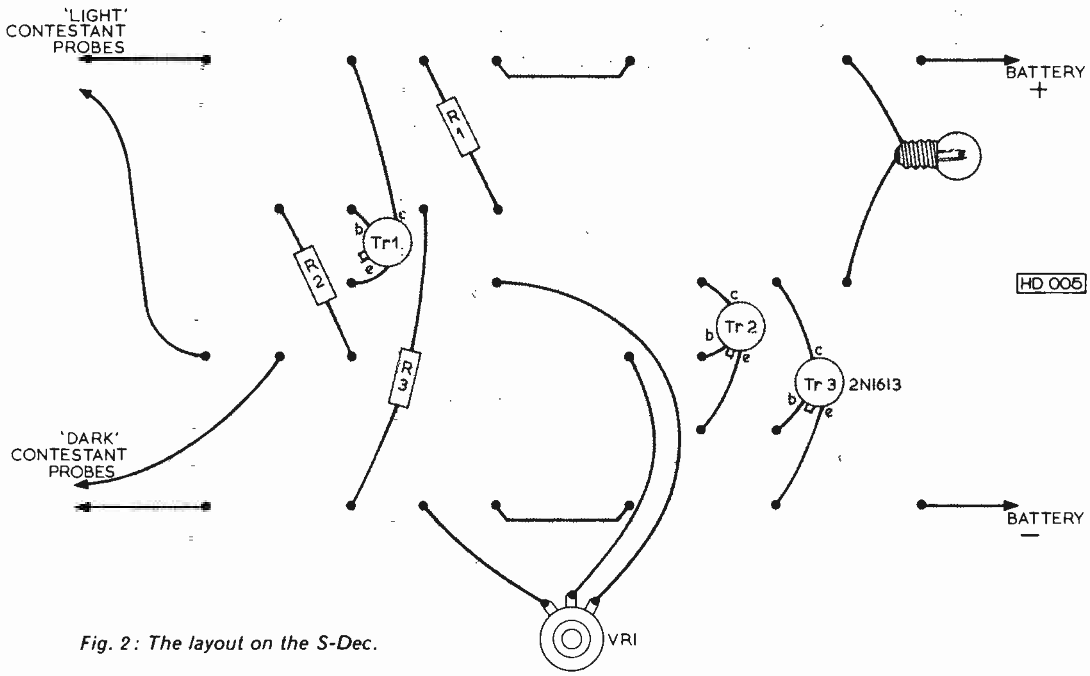


Fig. 2: The layout on the S-Dec.

you will need . . .

R1 150kΩ	Tr1 BC109
R2 220kΩ	Tr2 BC109
R3 150kΩ	Tr3 2N1613
VR1 10kΩ potentiometer	
LP1 6V 100mA bulb	
One S-Dec	
6V battery	
Four pieces metal pipe (see text)	

one must squeeze the wrist of their partners; a sort of "Squeeze-o-War".

Power demands

Battery voltage is not critical and the circuit will function with any voltage from 12V (maximum) down to 4·5V. It ceases to work below 4·5V. The lower voltages mean greater battery life although the bulb does not light quite so brightly at maximum brilliance. Since maximum brightness is not used anyway, it is sensible to use lower voltages. At 6V, the total circuit current measured was slightly under 90mA, and with VR1 adjusted to just extinguish LP1 the current was 24mA. These figures should be taken as a guide only, since the gains of individual transistors could alter this, although in the circuit shown the variations will not be enormous and VR1 can be adjusted for correct circuit operation no matter what.

This is the last S-DeCnology circuit in the series. However, a new series of one-IC circuits will start shortly. The principles of simple circuitry and ease of construction will be carried on, and the new series will use a DeC which can accept ICs plus discrete components.

ECONOMY TIMING STROBE—*contd. from page 755*

If the light flashes only very weakly, it is probably due to the power supply capacitor not recharging sufficiently between trigger pulses. This may be overcome by reducing the value of C1.

The strobe head can now be held in a position that allows it to illuminate the crankshaft pulley (**Fig. 3**), making sure that everything is safely out of the way of the blades of the fan, which are often difficult to see. Due to the stroboscopic effect of the light, the bottom pulley wheel will appear to be stationary. If the engine timing is correct, the two sets of marks on the pulley wheel and the engine body will line up. If they do not, the engine is either too far advanced or retarded. If the engine speed is then increased, a device called a centrifugal governor, housed in the distributor, will automatically advance the engine timing and show if the engine is advanced or retarded.

The precise method of making these checks will vary according to the particular engine. Most cars have the timing set for around 5 degrees before t.d.c. at 1,000 r.p.m. with the vacuum advance disconnected. If the exact procedure is not known then the information can be obtained from the car workshop manual. If it is found that the timing is incorrect then the usual method of adjustment is to rotate the body of the distributor, after first slackening the clamping bolt. Some distributors are provided with an adjusting mechanism which allows the timing to be adjusted over a few degrees by turning an external knurled nut. The letters "A" and "R" on the distributor body indicate which direction of movement advances or retards the timing.

The time required to carry out a timing check is very little, but it can save a considerable amount of money, and is well worth while.

PRODUCTION LINES

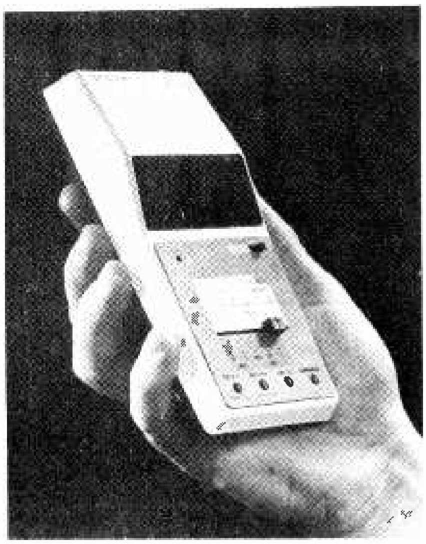
bill tull

NEW FROM SINCLAIR

A new concept—a "personal" digital multimeter, at a price competitive with low-cost analogue multimeters, has been launched by Sinclair Radionics.

Designated the PDM35, this 3½ digit meter measures just 155 × 75 × 30mm. The facilities incorporated were chosen as a result of an international market survey, and allow measurements in the range 1mV to 1000V DC, 1V to 500V AC, 1nA to 200mA DC and 1Ω to 20MΩ. The resistance ranges can also be used for semiconductor junction testing—matching V_{be} etc.

Accuracy on resistance measurements is 1·5%, improving to 1% on



the other ranges. A red LED display is used, and auto-polarity is incorporated. Power is derived from an internal 9V PP3-size alkaline or zinc-carbon battery.

The PDM35 costs £29·95 plus VAT, including test leads, protective carrying pouch and operating manual.

Optional extras available are an AC mains adaptor, padded pouch for protection in the field, and a 30kV EHT probe.

Consumer research also influenced the design of Sinclair's new calculator, the "Enterprise". It led them to abandon liquid crystal displays, increasingly popular with other manufacturers, as "Smudgy, slow and

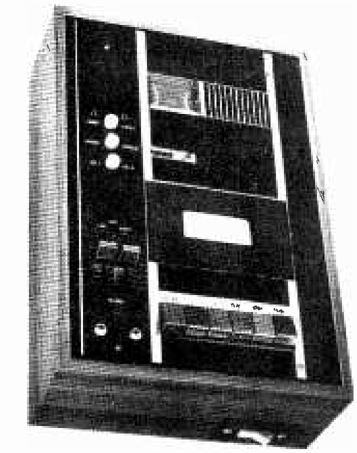
unreliable". Instead a new, bright 5·5mm red LED display was developed. Featuring the four standard functions, plus square root, percent and memory, the Enterprise measures 127 × 51 × 19mm (max.) and is powered by a PP3-type battery.

The price is £9·95 plus VAT, including instruction book and carrying case. An AC mains adaptor is available as an optional extra.

Further details on both these products from *Sinclair Radionics Ltd., London Road, St. Ives, Huntingdon, Cambs PE17 4HJ.*

Cassette deck

Watford Electronics are now supplying, ready built and tested, a stereo cassette deck, which, although not of the supreme highest quality, can boast a very respectable frequency response on Cr02 tape of 80 to 12000 Hz. Compris-



ing a high quality tape transport mechanism, and twin record/playback amplifiers, the TCD 68 is designed to be used in conjunction with an existing Hi-Fi set-up. Correct recording level is achieved by refering to two moving coil meters, while along with the usual cassette tape controls, switches are provided for Cr02/Normal tape, stereo/mono, and oscillator shift. Distortion is said to be around 2% maximum, while W/F is better than 0·25%. Price is £45·50 plus VAT, and if you can't get to the shop, then there's an extra £1·50 p & p.

Watford Electronics, 35 Cardiff Road, Watford, Herts. Tel: Watford 37774

A saw point!

Files and saws don't sound all that electronic do they? but like it or not they're still needed by the electronic enthusiast when filing out holes for potentiometers, and cutting bigger holes for displays etc. Just on the market is a brand new type of tool that combines the features of an awl for making and preparing holes in soft and hard woods and certain plastics, with the features of a rasp for working on metals, ceramic tiles, plastics and wood. Called the RASPAWL, price including VAT is 67p.

Looking very similar to the normal junior hacksaw, the DEEP sawfile

kit differs in that the frame has an extended depth of throat of 6in. This enables the saw to be successfully used on far more jobs than would normally be possible with a regular model. The kit, which is sold in a 'bubble pack' contains the saw frame, two Abrafile blades and a standard junior hacksaw blade. Price including VAT is 70p.

Abrasive Tools Ltd., Abrium Works, Colne Road, Twickenham, TW2 6QE. Tel: 01-894 1273

Transformers galore

Transformers off-the-shelf is the intention of Lascar Electronics and they have formed a new company to provide the service.

The initial range covers 3VA, 6VA, 12VA, 25VA and 50VA types and is available in chassis mounting or printed circuit board mounting formats. The secondary voltages have been carefully chosen to cover most popular applications, but are particularly suited to the construction of regulated power supplies. As an added safety measure, particularly where mains voltages are involved, all the transformers, bar one, are supplied with clip-on terminal insulators at no extra cost.

Providing a transformer can be wound on one of their standard bobbins, with the standard 120V/240V primary, they will wind the secondary, if possible, to your desired specification. Lascar call this their "Blue Riband" service and claim this system results in a drastic reduction in the time required to design, manufacture and deliver special purpose transformers **(Note minimum order 5 transformers).**

A range of transformer development kits is available and is claimed to be the most convenient method of producing prototype or special transformers. The kits are available in 3VA, 6VA, 12VA, 25VA and 50VA sizes and both clamp-mounting and 0·1in printed circuit board mounting transformers can be constructed. A double-section bobbin with a 120V/240V primary already wound is provided. Bobbin shrouds, a mounting clamp, "E" and "I" lamination sections and terminal insulators make up the kit. The constructor can wind the secondary to his own specification on the empty half of the bobbin. Tapped or independent secondaries can be wound using a suitable insulated copper wire (not supplied). The transformer may then be assembled using the instructions provided, and can be finished off with a varnish dip if required.

A fully-priced brochure listing all their standard transformers and kit details is obtainable from:
Lascar Electronics, P.O. Box 12, Module House, Billericay, Essex CM12 9QA. Tel: 02774 3394.

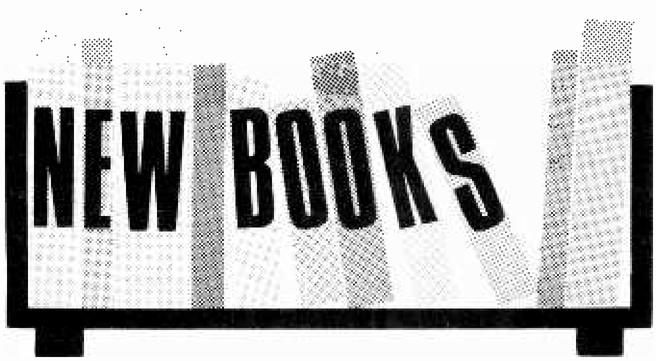
£42 Per Watt.

If you feel like spoiling yourself for the new year, you might be interested in the "Globetrotter 800" from Nordemende. According to Nordemende's marketing agents in Aldershot, Hants, this fully portable mains/battery receiver is the "latest thing" in quality portables. It covers 17 wavebands, dealing with FM, MW, LW, three SW ranges from 1·58 to 19 MHz, and 11 spread short-wave bands. The band-spreading is effected via a double superhet stage, a switchable BFO is included, and a product demodulator is active for SSB reception. Unusual features include a key for switching from LW ferrite rod to an external connection for DF "sonde" for radio navigation.

The power unit incorporates a charging unit for accumulator, automatic cut-off for batteries or accumulator when on mains operation, and a large meter is provided to indicate signal strength for fine tuning and a check on battery condition. The receiver, it is claimed, is fitted with a "large, good speaker", through which is provided 7W (music) power.

At £295, this receiver clearly provides wide coverage—at a price! This does include VAT.

Available from:
Vessco Vision and Radio Ltd., Vessco House, Unit 4, Blackwater Way, Ash Road, Aldershot, Hants.



HOW TO BUILD ADVANCED SHORT WAVE RECEIVERS
by R.A. Penfold

Published by Bernards Ltd., The Grampians, Shepherds Bush Road, London W6 7NF
118 pages £1·20

This very useful little book first describes a basic superhet using two transistors and an IC audio stage plus optional BFO. How the circuits work and how the set should be constructed and aligned is fully covered. The 'How to Build' bit of the title then just dies! The rest of the book contains circuits of alternative front-ends, audio and IF filters, Q-multiplier etc with a description of how they work and ways of connecting to the main receiver. The whole idea is to try all possible combinations and presumably end up with an 'advanced' receiver. However, by no stretch of the imagination could the result be termed 'advanced'. It would still be a basic, albeit effective, receiver.

Other than specifying a dial for the basic receiver no mention is made of tuning dials in general yet the overall performance of any SW set depends entirely upon the quality of the dial mechanism. Excessive backlash, wrong reduction ratio or bad parallax error can ruin an otherwise good receiver. Incidentally, the one facility to be found on any SW receiver worthy of the name is bandspread tuning yet our little book does not even mention the word, as far as I can recall!

The author has based the standard circuits on Denco coils since they are about the only ones available to the home constructor but this does mean that the LC ratio of the tuned circuits is pretty grim on the SW ranges. It must be remembered that the 365pF tuning capacitors are intended to cover the medium and long wave bands as well as the SW bands, accomplished by plugging in the appropriate set of coils. Hardly an advanced design!

On the production of the book itself, symbols such as 'mfd' and 'KHZ' should really not appear today. I would have liked the values of the components to be shown on the circuit diagram of the basic receiver especially as the circuit is necessarily divided up owing to the small page size. The component list is on yet another page. Strangely enough the remainder of the circuits do have the values of components on them! The first circuits show the symbols for the tuning coils and IFTs as if they were mains transformers! Nowhere are they shown as being adjustable by means of their cores.

In spite of these various drawbacks I would still recommend this book to the newcomer to receiver construction as it would give him the very important grounding in practical work that leads to a thorough understanding of receiver operation.

Eric Dowdeswell

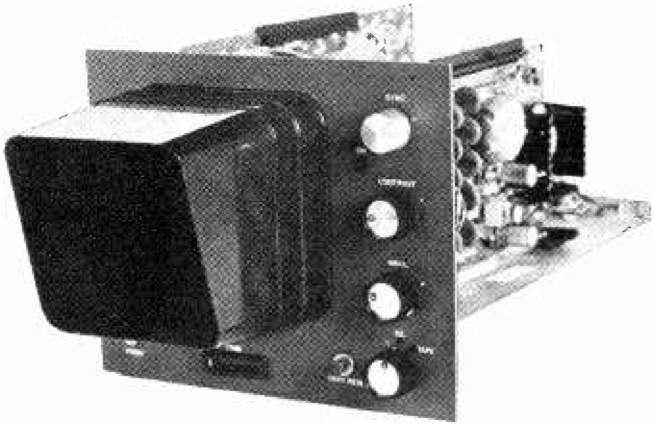
OSCILLOSCOPE VIEWING HOODS

Maurice ALLENDEN

The need for a cathode ray tube viewing hood became apparent when the author developed an interest in slow-scan television and the problem of daylight observation was encountered. Tubes made from thin card met with only limited success but eventually the local Garden Centre provided a solution.

The hoods shown in the photographs were all constructed from black plastic plant pots, which are available in a variety of sizes, both circular and rectangular. Those used in the prototype were of "STEWART" manufacture, 102mm (4in) square.

To provide a mount, the base (i.e. "closed" end) of a pot should be removed, leaving a 32mm (1·25in) rim which is then fixed around the C.R.T. face (Fig. 1). Once in position, it will accommodate a wide range of hoods, two of which are shown in the photographs. The short one would be for general use, whilst the long "radar" type is for viewing in high ambient light.



Construction

A number of pots will need to be purchased, the types and sizes being determined by the C.R.T. In the author's case, a 5FP7 tube of 127mm (5in) diameter was used, so the pot size selected was 102mm (4in) square. Black masking tape was then fixed to the oscilloscope graticule, leaving a square display area of 83mm (3·25in).

Referring to Fig. 1, carefully mark a line 32mm (1·25in) parallel to the open end of the pot—a yellow Chinagraph pencil is well suited for this purpose. Next, take a fine-toothed coping saw (or small hacksaw) and cut across each of the four corners in turn, until the blade goes through the thin plastic. Care is needed with this operation if damage to the pot is to be avoided. Gently saw from each corner until the cuts meet and the pot is divided. The rough edge may now be carefully smoothed and made parallel by means of a fine sanding block. The 32mm section is now fixed to the oscilloscope by making an accurate aperture in the front panel and then bonding with two spots of epoxy resin at each corner.

For existing panels, a small sub-frame of aluminium can be made and the hood mount secured to this. The sub-assembly is then fixed to the instrument with screws (Fig. 1).

Having produced the mount, make up some hoods from other plant pots, cutting and sanding the edges as before. Fig. 2 shows how the various pots are cut. For the larger hood "B," three pots are used. Cut carefully, then use polystyrene cement to butt-joint the sections together; a good, light-resisting design will result.

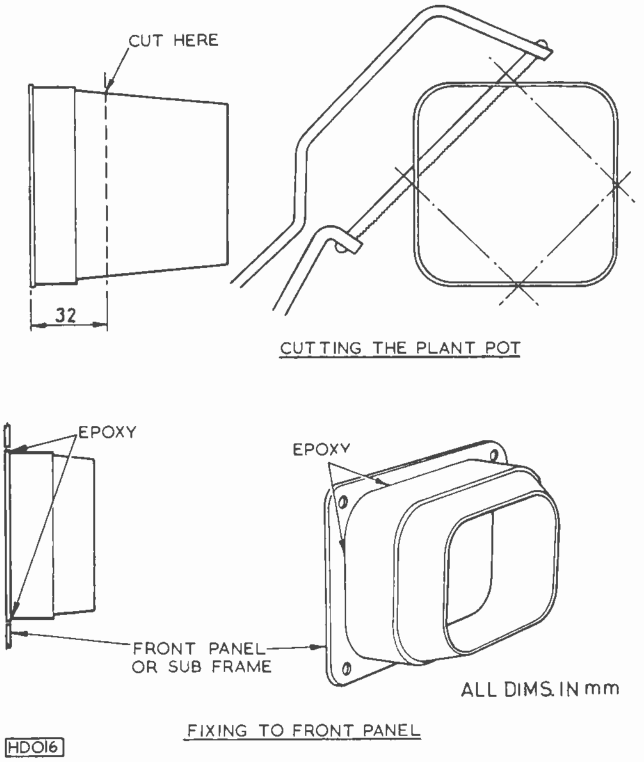
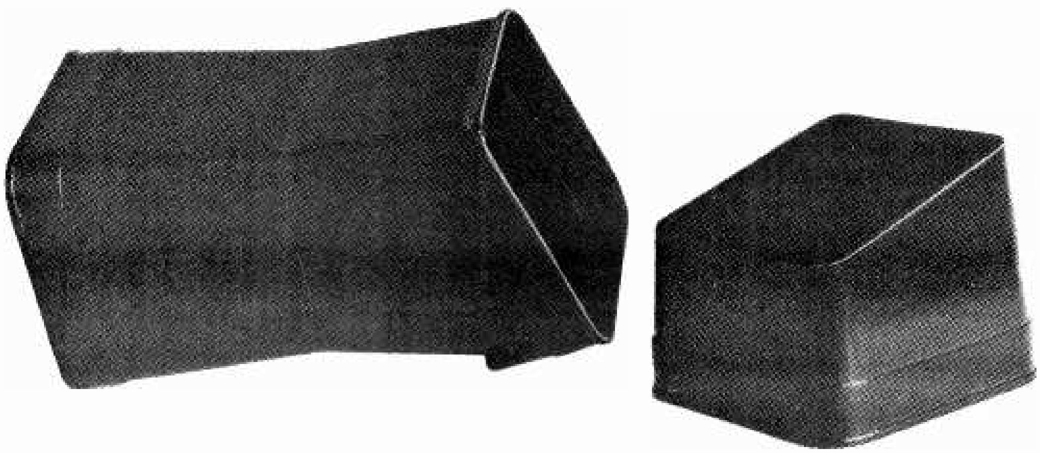


Fig. 1: The mount for the various hoods is made from the rim of one plastic plant pot.



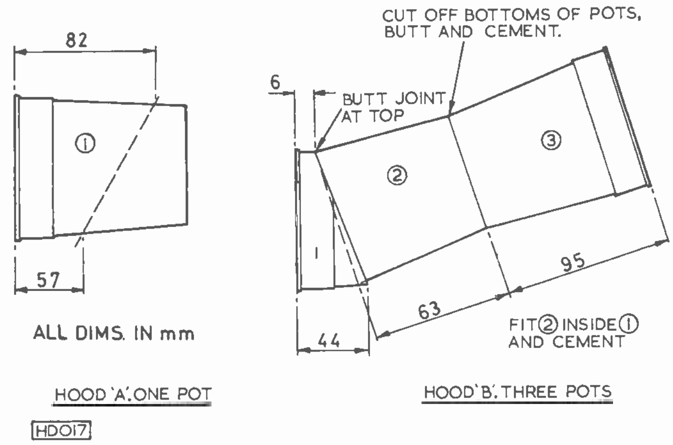


Fig. 2: Cutting details of the short hood, using one pot, and the long hood using three.

Finish

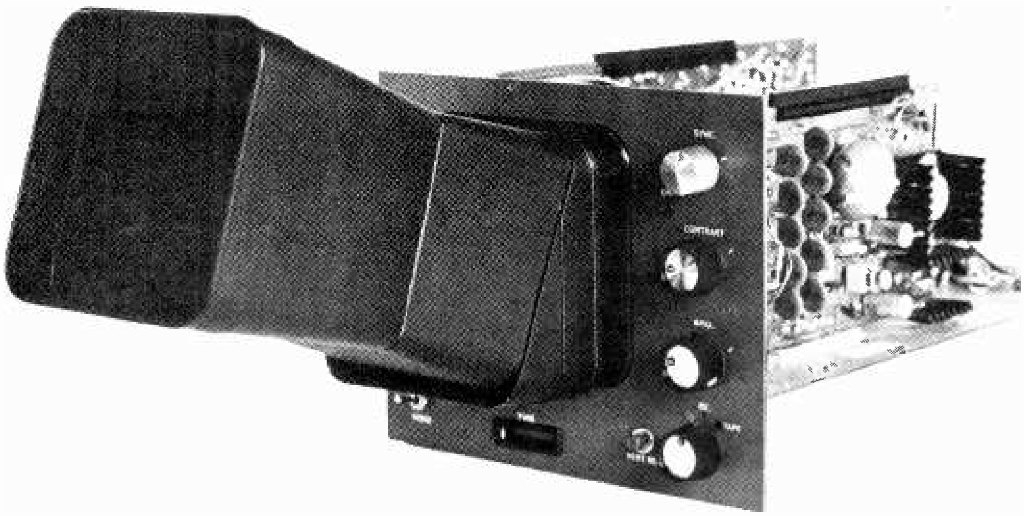
Further improvement can be achieved by spraying the inside with a matt black paint. If a cellulose-based paint is used it will tend to dissolve the surface of the plastic, giving an attractive matt-etched finish. The outside should be masked during this process for protection.

When fixed to the mounting, the hoods should be a nice, snug fit but if trouble is experienced, small pieces of PVC tape can be applied to the inside corners.

The hoods as described have given trouble-free service with the author's SSTV monitor for some time. With imagination, many purpose-built types of low cost and professional appearance can easily be made.

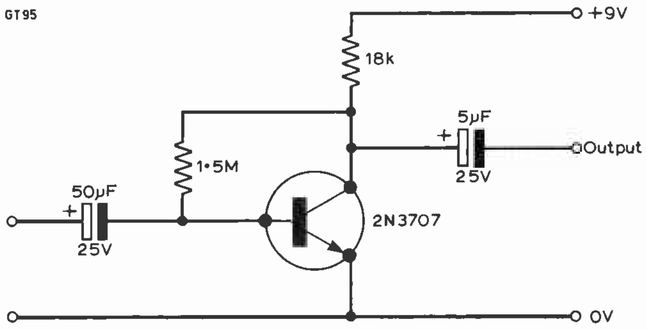
Acknowledgements

The author would like to thank Bob Weston for his assistance in preparing this article.



EXPERIMENTER'S CORNER

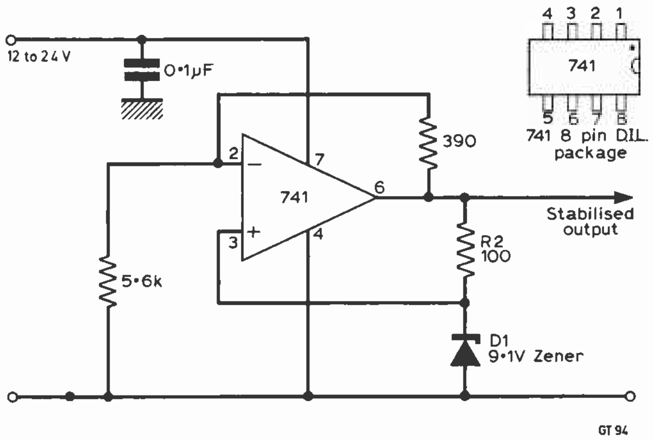
Simple Low-Z Preamp



This general-purpose preamplifier is suitable for a wide range of applications where small signals are involved. Its advantages over more complex designs include ease of construction, cheapness of components, and compact dimensions. Employing a low-noise NPN transistor of the 2N3707 type, which is readily available, the amplifier presents a low to medium input impedance, and is therefore suited to moving-coil microphones, magnetic pick-ups, etc. In the circuit illustrated, the gain is fairly low, but a high-gain transistor may be used, such as the BC109, when very small signals are concerned. Supply is 9V in the circuit shown, but this may be varied from about 5V to 25V according to availability, with consequent shift in input impedance.

D. L. Jones
Denbigh, N. Wales

Basic 9V Stabiliser



Matching supply voltage requirements of ancillary equipment to those of an established installation can sometimes be a problem. This stabiliser circuit is intended for situations where high power is not a fundamental factor, such as supplying a stereo decoder for use with a tuner unit operating on an 18V rail. It uses the versatile 741 operational amplifier, and may be used with any input voltage between about 12 and 24 to give approximately 9V stabilised (positive) output. Control is effected by means of a 9·1V Zener in the circuit shown, but any type operating within the range 4·7V to 12V will do, according to the output voltage required.

Devices for which the unit is suitable include decoders such as the MC1310, and the Mullard LP1186, or other VHF "front ends".

R. N. Soar
Mexborough, S. Yorks

NEXT MONTH IN...

practical WIRELESS

ON SALE FEB. 3RD.

* EXTRA INSIDE!

8~PAGE SUPPLEMENT

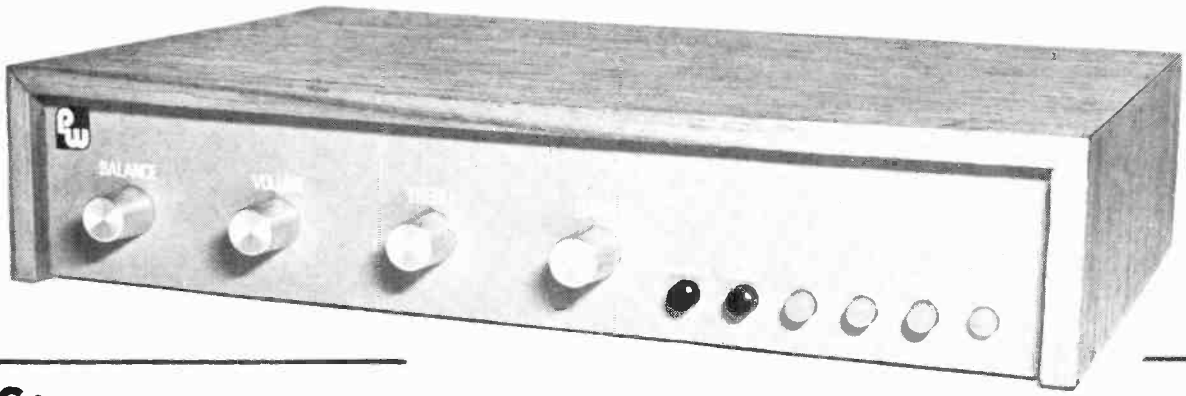
PW GUIDE TO AERIALS ~FROM LONG WAVES TO UHF~

Whether you are listening to an amateur in Australia or to your local radio station, the weakest link in the chain is your receiving aerial!
Use our Free Guide to ensure that your radio equipment is getting what it deserves, the best in aerials.

ALSO:—

PW EUROPA

The "Europa" stereo amplifier gives an output of 30 watts per channel into 4 ohms. Designed with ease of construction in mind, the Europa has almost all components mounted on a single p.c.b., and uses the case as heat-sink for the output transistors. Inputs are provided for magnetic, ceramic or crystal pick-ups, tape-head and timer.



PLUS:—

Starting next month!

U~DeCnology

Following on from the popular S-DeCnology series, David Gibson describes a number of circuits using a single i.c., each one built on another variety of plug-in solderless breadboard, the U-DeC.

DON'T MISS THIS ISSUE!

So you want to pass the R.A.E. (Radio Amateurs' Examination)? No.6

John Thornton Lawrence GW3JGA & Ken McCoy GW8CMY

This month we are taking a break from calculations and theory to look at block and circuit diagrams and how to tackle these in the R.A.E. We will also be discussing valves and semiconductors and various applications for these in amateur radio equipment.

Block Diagrams

The purpose of a **block diagram** is to show, in the clearest possible way, the arrangement of a basic system or piece of equipment, and to show the signal flow through it. A block diagram can sometimes be so effective that no other explanation is necessary, Fig. 34.

In the block diagram of a piece of equipment, it is important that the path of the main signal is clearly shown and this will usually be from left to right. Any other less important signal entering or leaving the main signal flow should do so at right angles, e.g. local oscillator and "S" meter, as shown in the superhet receiver block diagram in Fig. 35. Also see Fig. 6.3 in The Radio Amateurs Examination Manual.

However, if two equally important signal paths exist independently and these join to a common stage later on, then these can be drawn one above the other as shown in Fig. 36.

Block diagrams are concerned primarily with signal flow, signal processing, amplification, etc., no account is taken of how the processing is actually carried out, a valved radio receiver and a transistorised radio receiver may look identical in block diagram form although the detailed circuitry can be very different indeed.

When the block diagram is for a complete piece of equipment such as a receiver, then the power supply may also be included, but this is usually shown on its own away from the main operational part of the diagram as shown in Fig. 35.

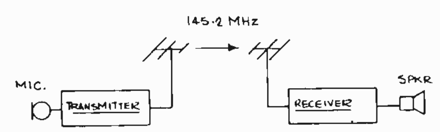


Fig.34

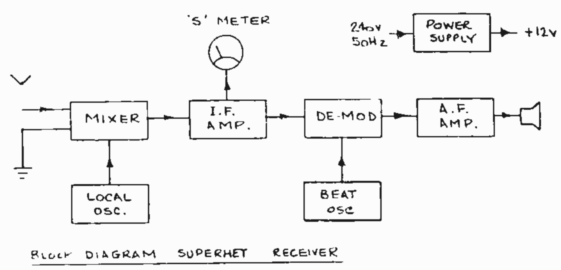


Fig.35

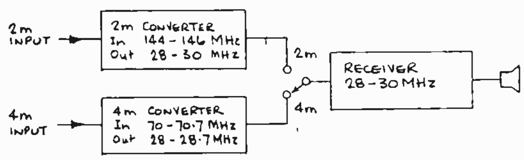


Fig.36

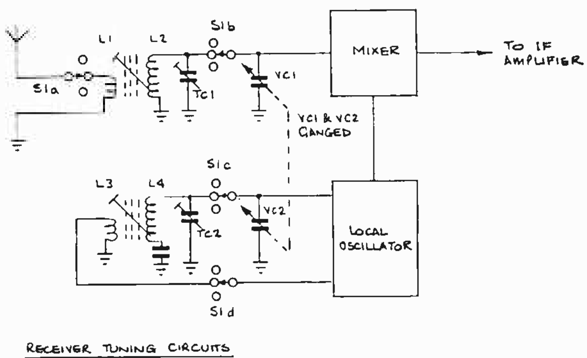


Fig.37

Figs. 34-37: Examples of drawings produced under examination conditions. Obviously this sort of standard is achieved only after considerable practice

Block diagrams are easy to draw using just a pencil and ruler, as these have been, but be sure to allow enough space for labelling the blocks. It is better and quicker to label the blocks directly on the diagram, but if this is not possible it will be necessary to give each item a letter, a, b, c, etc., and include a coded list adjacent to the diagram.

All diagrams should be drawn in pencil (H or HB) and if you have a good eraser (Staedler Noris—Plastic) then you can easily make any corrections or reposition something if you need to. Remember, in the exam, time is of the essence, speed and accuracy in drawing block and circuit diagrams only comes with practice, so plenty of practice in drawing a range of standard types of circuits is required, but more about these later.

Moving in a little closer now, you may be required to show a particular stage of the equipment in slightly more detail, but without going to the complete circuit diagram. The best way of doing this is to retain the basic block diagram approach but to show the important signal handling parts as actual components. The circuit in Fig. 37 shows the tuned circuits of a receiver, without being cluttered by biasing resistors, coupling and decoupling capacitors and so on.

Circuit Diagrams

Circuit diagrams are more difficult and more time-consuming to draw and so more care and attention to detail is required here.

The same rules that applied to the block diagram still apply, signal flow from left to right and other signals join and leave at right angles. In addition, we are now concerned with supply voltages and currents. Remember, we are thinking of conventional current (which flows from the positive supply through the circuit to the negative or zero) and this flow will be down the page from the top to the bottom as shown in Fig. 38.

If the diagram contains blocks of circuitry above or below the main central section then these may be considered as separate blocks each with their own supply lines. For example, in Fig. 35 the beat frequency oscillator may have its own positive supply line immediately above its circuit and the zero line below but with the direct current still flowing conventionally down the page.

For the purposes of the R.A.E. it would be convenient to stick to *npn* transistors throughout as *npn* transistor circuits have the positive line at the top and relate more readily to valve circuits and applications.

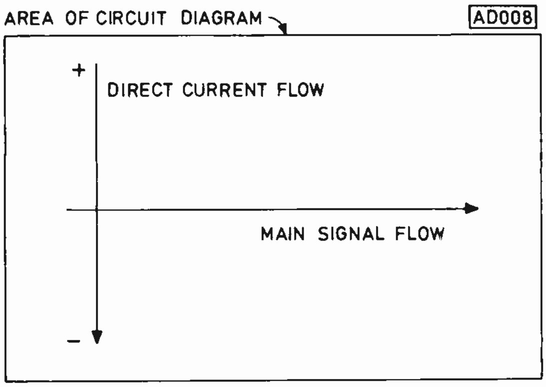


Fig. 38: In a circuit diagram, power supply paths run down the page, signal path across the page from left to right.

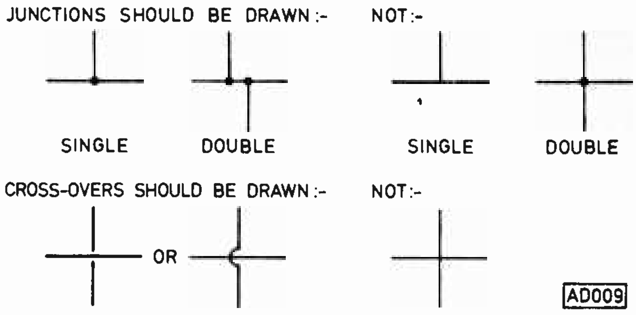


Fig. 39: The best method of drawing junctions is to some extent a matter of opinion.

There is nothing wrong with *pnp* transistors or negative supply lines but it does mean some upside-down thinking when describing these circuits and this is best avoided in the exam. Remember, "*npn* Rules OK!"

The drawing of a circuit diagram is made easier by a moment or two of mental planning. Think of the parts of the circuit that are to be included, allow about 5 to 6cm spacing between valves or transistors, more where there are switches and coils, less where coupling is direct or very simple. Set an imaginary horizon line across the centre of the page and where convenient, keep the valves or transistors approximately on the line. Some circuits require the valves or transistors to be one above the other, space these so that they fit in conveniently. Provisionally, draw in a zero line and a positive supply line and see if you have enough room for everything vertically and horizontally. If you cannot manage to fit the diagram in horizontally then you can, if absolutely necessary, break the drawing and continue it on another sheet. However, this takes up valuable time, so avoid it if you possibly can.

In both the valve and transistor circuits, the direct current path through the resistors can easily be visualised as flowing down the page with the signal path crossing horizontally from left to right. See also Fig. 1. in the November 1977 issue of *PW*.

If the question requires you to insert typical component values then, to save time, this can be done alongside each component on the diagram. If there is not enough room, then the components must be numbered, R1, C1, etc. and a table of values given adjacent to the diagram. It is a good plan to number the components anyway, because, if you are required to describe the operation of the circuit, then the component can be referred to more readily, as for example, "C1" instead of "the input coupling capacitor"

There are various schools of thought on how junctions and crossovers should be drawn and although we are at variance with some of the excellent professional draughtspersons (including those at *PW*) we think that the methods of drawing junctions and crossovers given in Fig. 39. are less likely to be misdrawn or misunderstood when drawn by the examinee under examination conditions. For your own interest, have a look at circuit diagrams in various books and magazines and see how they do their junctions and crossovers.

The actual drawing of the circuit diagram should be done in pencil using a ruler and ideally a stencil. Radio component stencils are available at most big stationers or shops selling drawing instruments. A typical one made by UNO, is type BB4 at £3·85, but this may reasonably be considered too expensive to buy just for use in the R.A.E. As an alternative, use a general purpose stencil which has circles, squares and triangles on it. Faber-Castell make a suitable one (Type 943) which is very useful and considerably less expensive.

All the diagrams in this section have been drawn using a ruler and the above-mentioned stencil.

Remember, drawing circuit diagrams takes time, so read the question very carefully before starting. The diagram should be as detailed as required by the question, but no more.

As a guide, the drawing times for the previous diagrams were as follows:—

Fig. 34.	4 minutes
Fig. 35.	10 minutes
Fig. 36.	8 minutes
Fig. 37.	20 minutes

When you have completed the drawing, check down the page to see that each vertical current path is complete all the way through component, valve or transistor and that the horizontal signal path is also complete whether it be direct or by coupling capacitor or transformer.

Someone said that one picture is worth a thousand words and this could be equally true for a correct and clearly drawn circuit diagram.

VALVES AND SEMICONDUCTOR DEVICES

All the devices that we have discussed up to this point have been what might be called "passive" devices—that is they require no external power source to make them work. The devices which we will be considering next will be of the "active" type.

The Thermionic Diode

Although the thermionic diode has been almost totally superseded by the semiconductor diode in modern radio equipment, a description of its operation will help to show how valves work. Fig. 40 shows the construction of an indirectly-heated diode.

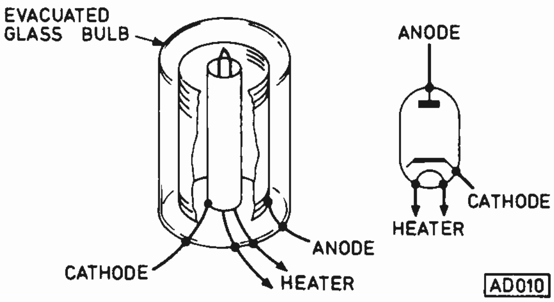


Fig. 40: Basic construction of an indirectly-heated thermionic diode.

The **cathode** structure consists of a narrow cylinder of nickel, coated with a layer of material which readily emits electrons when heated, in the centre of which is a heater.

The cathode is located in the centre of a hollow cylinder of nickel which forms the **anode.** The whole arrangement is contained inside a glass envelope from which all air is evacuated. Connections for the anode, cathode and heater are brought out through glass-to-metal seals.

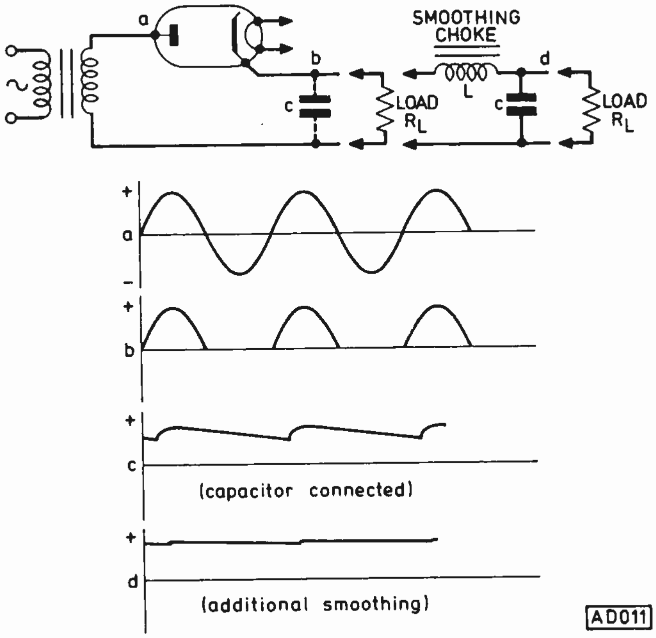


Fig. 41(a): A half-wave rectifier circuit, with voltage waveforms produced at various points.

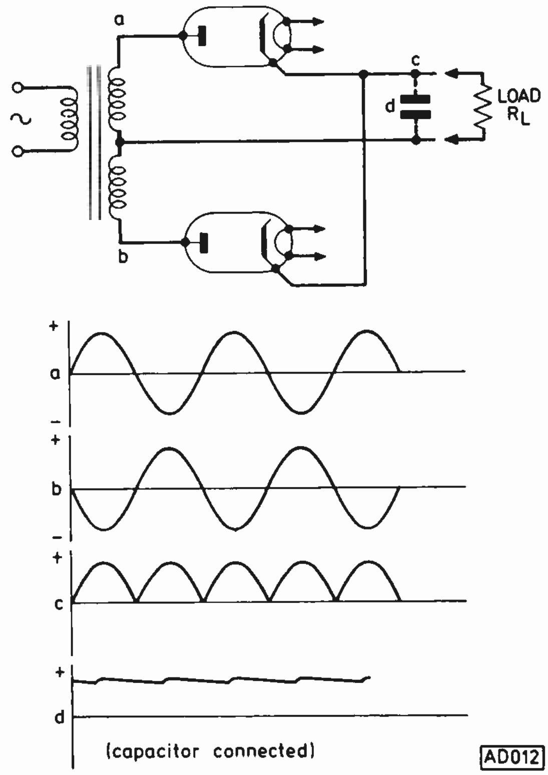


Fig. 41(b): A full-wave rectifier circuit, with waveforms. The ripple frequency is doubled compared with the half-wave case, easing smoothing problems.

When a current is passed through the heater and the cathode becomes heated, electrons, from atoms of the electron-emissive material, break free from the surface and form a "cloud" around the cathode. If a positive potential is applied to the anode then the electrons which are negatively charged, will tend to move in that direction causing a "current" to flow.

Alternatively, if a negative potential is applied to the anode, the electrons will be confined to the cathode region, since like charges repel. If, however, an alternating potential is applied to the anode, then the diode will only pass current or "conduct" during the positive excursion of the anode.

The main application of a thermionic diode is in a **half-wave rectifier** circuit as shown in Fig. 41(a). Alternating voltage is fed to the anode and as the diode conducts only when the anode is more positive than the cathode, then current flows only during the positive half-cycles. This results in only the positive half-cycles of voltage appearing across the load.

By connecting a capacitor across the load, to act as a reservoir, the "chunks" of positive voltage can be smoothed to give an almost constant output. The capacitor is charged or recharged on each positive half-cycle and is discharged by a small amount in between each half-cycle by the current drawn by the load. The output voltage waveform is shown in Fig. 41(a).

By adding an extra diode and a further winding to the transformer, in which the voltage is of the opposite phase to the existing one, we can produce a **full-wave rectifier** circuit in which the two diodes conduct alternately on each half-cycle, as shown in Fig. 41(b). This has the effect of doubling the ripple frequency and reducing significantly the amplitude of the ripple across the smoothing capacitor. Further reduction of ripple can be obtained by adding a choke-capacitor filter.

The Thermionic Triode Valve

The **thermionic triode** (three-electrode) valve is basically similar to the diode except that a "grid" is interposed between the cathode and the anode.

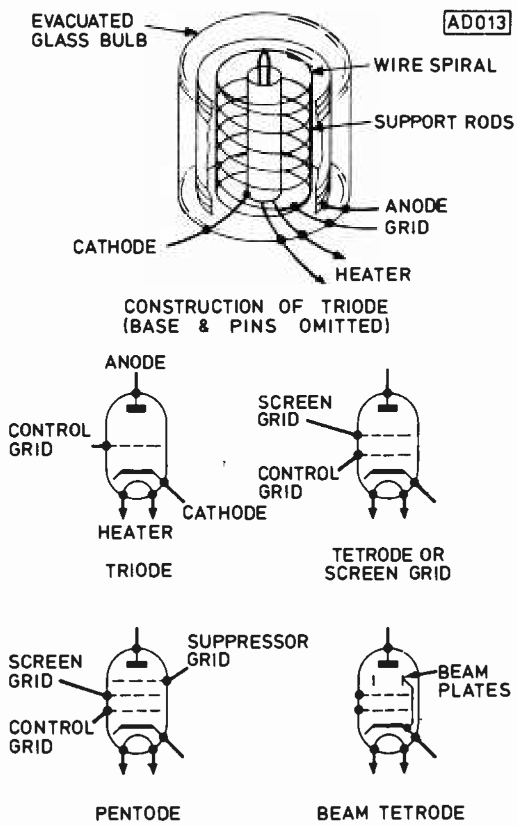


Fig. 42: Basic construction of a thermionic triode, plus circuit symbols for this and some more complex valves.

The **grid** consists of a spiral of wire (usually nickel) arranged around the cathode. The turns are welded to support rods for rigidity, as shown diagramatically in Fig. 42.

If a positive potential is applied to the anode and the grid is connected to the cathode, electrons will leave the cathode, pass through the grid and accelerate towards the anode, causing the valve to "conduct".

If a negative potential is now applied to the grid, the grid structure will repel electrons and if the potential is great enough it will repel all the electrons emitted by the cathode, thus "cutting off" the flow altogether and making the valve non-conductive.

If however, the grid potential is held or biased a few volts negative, it is possible to control the conduction of the valve by small variations of the grid potential about this value.

There are a few simple relationships that we need to remember about the voltages and currents in the triode valve.

Mutual Conductance

The ratio of the change of anode current (for a fixed anode voltage) to a change of grid voltage is known as the **mutual conductance** or "slope" of the valve (symbol g_m). It is usually quoted in mA/V, sometimes millimhos or millisiemens.

$$g_m = \frac{\text{Change in anode current (mA)}}{\text{Change in grid voltage (V)}} = \frac{\Delta Ia}{\Delta Vg}$$

Amplification Factor

The ratio of the change of anode voltage to the change of grid voltage (for a constant anode current) is known as the **amplification factor** of the valve, (symbol μ or mu).

$$\mu = \frac{\text{Change in anode volts}}{\text{Change in grid volts}} = \frac{\Delta Va}{\Delta Vg}$$

Impedance

The ratio of the change in anode voltage to a change in anode current (for a fixed grid voltage) is known as the **impedance** or **a.c. resistance** of the valve (symbol r_a).

$$r_a = \frac{\text{Change in anode volts}}{\text{Change in anode current}} = \frac{\Delta Va}{\Delta Ia}$$

The relationship between mutual conductance, amplification factor and impedance is given by $r_a = \frac{\mu}{g_m}$ and putting this in the form of a memory aid we have the triangle of Fig. 43. Note that if g_m is in milliamps/volt then μ must be multiplied by 1000.

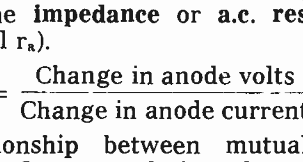


Fig. 43: The Impedance Triangle.

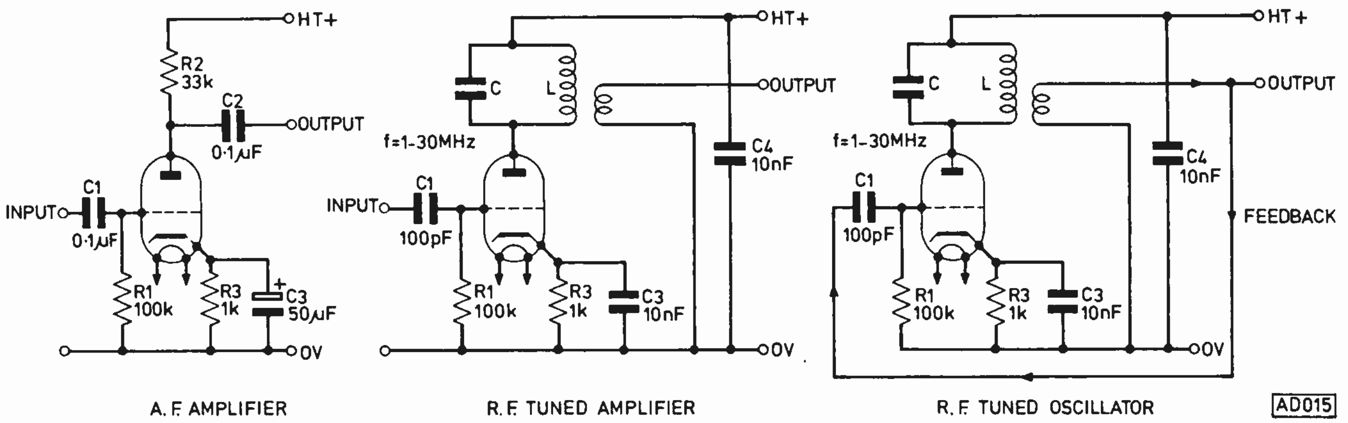


Fig. 44: Basic single-valve circuits for an A.F. Amplifier, a tuned R.F. Amplifier and an R.F. Oscillator.

Tetrodes and Pentodes

The **tetrode** (four-electrode) valve, has an additional grid, known as the **screen grid**, which is placed between the control grid and the anode. This grid, when maintained at a fixed positive potential, has the effect of increasing the amplification of the valve.

The **pentode** (five electrodes) has yet another grid interposed between the screen grid and the anode. This is known as the **suppressor grid.** It is normally connected to the cathode and its purpose is to suppress any secondary electrons which may be emitted from the anode and would otherwise be attracted to the screen grid causing excessive screen current and a reduction in efficiency.

A further improvement in the performance of tetrodes can be achieved by the use of **beam-forming plates.** These plates are arranged in conjunction with the grid structure to focus the electrons emanating from the cathode into a beam, thus reducing the screen-grid current and improving the overall efficiency of the valve. These valves are known as "beam tetrodes".

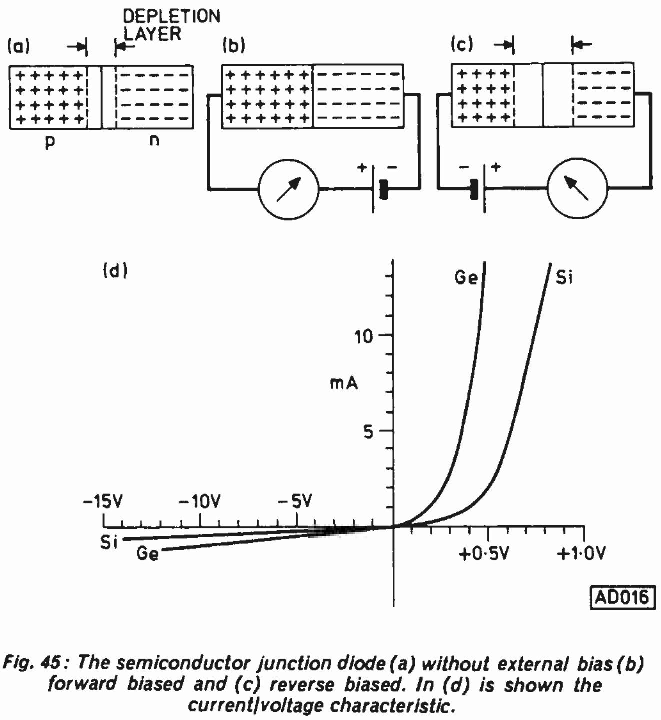


Fig. 45: The semiconductor junction diode (a) without external bias (b) forward biased and (c) reverse biased. In (d) is shown the current/voltage characteristic.

APPLICATIONS OF VALVES

Audio Amplifier

The triode valve in Fig. 44 is used as an **audio-frequency amplifier**. The negative bias voltage for the control grid is provided by including a resistor in the cathode circuit. The current flowing in the anode circuit also flows through the cathode resistor resulting in the cathode being raised to a positive potential of a few volts. Since the grid is held at zero volts by R1 then, with respect to the cathode, the grid appears negative.

An audio frequency voltage applied to the grid will vary the electron flow to the anode (the anode current) and the variation of this current through R2 produces an audio frequency voltage across R2 and also at the output terminal. Capacitor C2 is included to pass this amplified audio frequency voltage but not the standing direct voltage on the anode.

The coupling capacitors C1 and C2 and the decoupling capacitor C3 are chosen to have a low reactance at audio frequencies and the values given are typical, as are the resistor values.

Tuned Amplifier

The DC conditions are similar to the AF amplifier but in this circuit the anode resistor is replaced by a parallel tuned circuit. The impedance of this tuned circuit is maximum at resonance and so the amplifier will have maximum amplification at the resonant frequency. The output could be taken from the anode or from a coupling winding as shown.

As in the previous circuits coupling and decoupling capacitors are chosen to have a low reactance at the operating frequency and the values shown are typical.

Valve Tuned Oscillator

By taking the output from the tuned amplifier and returning this to its input (and assuming that the polarity of the signal is correct) then the circuit becomes an oscillator.

Assume a small signal or disturbance occurs at the grid which produces an amplified signal at the output and this is in the same direction as the original signal.

When this is fed back to the grid the signal is amplified yet again and again until eventually the amplitude is limited by the valve being cut off or made fully conductive. The output signal is then an approximation of a sine wave at a frequency determined by the resonant frequency of L and C.

There are many types of oscillator circuits, all basically consisting of an amplifier with a frequency-selective or tuned circuit to define the frequency of oscillation. Look at some receiver circuit diagrams and find the oscillator tuned circuit and the transistor or valve providing the amplification to maintain the oscillation.

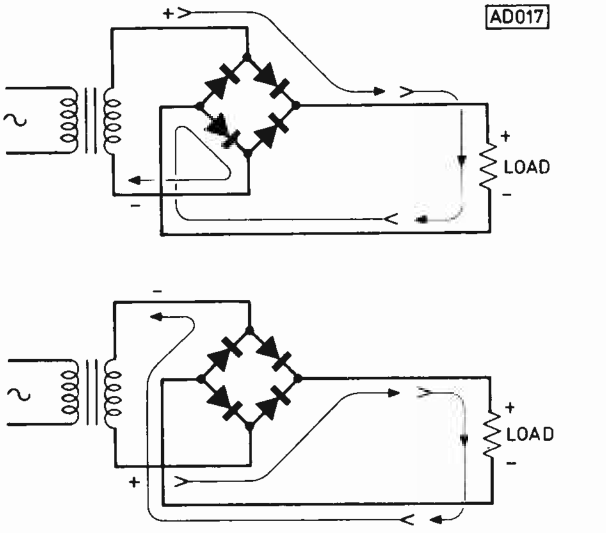


Fig. 46: Current flow around a bridge rectifier circuit.

SEMICONDUCTOR DEVICES

Several of the reference books listed at the beginning of this series contain sections on the nature and behaviour of semiconductor materials and so we will omit these and pass on to describe briefly the semiconductor diode and transistor.

Semiconductor Diode

A semiconductor junction diode consists of a piece of *p*-type semiconductor and a piece of *n*-type semiconductor joined together as shown in Fig. 45(a).

The *p*-type material has an excess of holes and the *n*-type, an excess of electrons. At the junction, electrons and holes cross the junction and recombine leaving a region virtually depleted of all charge carriers, known as the **depletion layer**. Since the *p*-type has lost a few holes it acquires a slight negative charge and the converse is true for the *n*-type which acquires a slight positive charge. Thus there exists a small reverse bias across the junction.

In Fig. 45 we show the "forward biased" condition. The applied voltage has first to exceed this "built-in" reverse bias before current will flow. For silicon materials this is 0·6-0·7 volts and for germanium, 0·2-0·3 volts. Once this potential has been exceeded current flows readily in the "forward" direction.

The "reversed bias" condition is shown in Fig. 45c. Here the depletion layer has been increased in width, i.e. there is a large region where there are no free charge carriers and only a very small leakage current flows.

Increasing the voltage to a very high level will eventually cause the diode to break down. If the current is not limited in any way this will permanently damage or destroy the diode. The characteristic of a semiconductor diode is shown in Fig. 45(d).

Semiconductor diodes have many applications as rectifiers in power supplies, detectors, demodulators, switches etc.

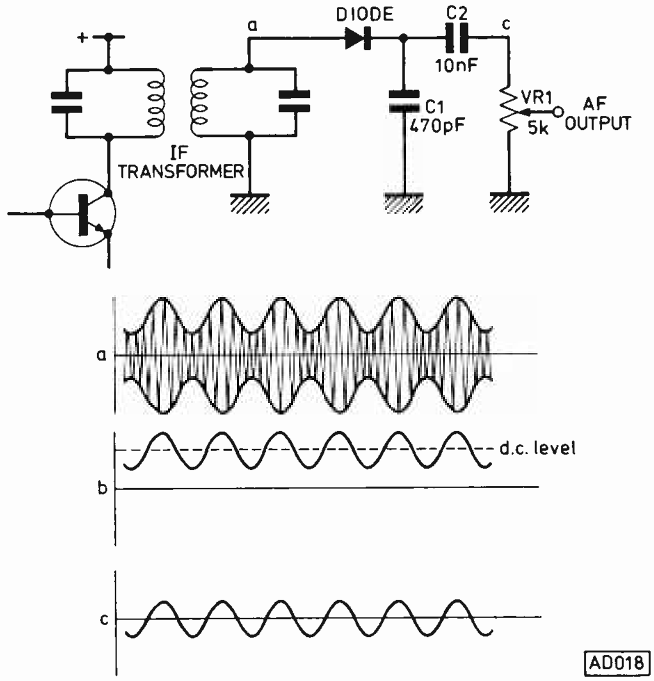


Fig. 47: A diode detector circuit with waveforms produced at various points.

SEMICONDUCTOR DIODE APPLICATIONS

Power Supplies

Because, unlike valves, semiconductor diodes do not require a heater and associated heater supply they are ideal for use in a bridge rectifier circuit which provides full-wave rectification from a single winding. The current flow through the bridge for each half-cycle is shown in Fig. 46.

Diode Detector

The circuit in Fig. 47 shows a simple amplitude modulation detector stage. An r.f. signal at the intermediate frequency, amplitude modulated with audio frequencies, is present at "a". At "b" the negative-going section of the r.f. and a.f. waveforms are removed and the a.f. appears varying about a DC level which is obtained by the "smoothing" action of C1 (similarly to DC power supplies). Capacitor C2 removes this DC level and passes the audio frequencies (now varying about zero level) to the load resistor VR1. From this point the a.f. goes through one or possibly several stages of amplification, to the loudspeaker.

Next month we cover transistors, transmitters and modulation.

THE FORCEFUL MR. FLEMING

"If the thumb and first two fingers of the left hand are held at right angles to each other, the first finger represents the direction of the field, the second shows the current, and the thumb points along the direction of the force". So runs Fleming's Left-Hand Rule. Don't feel dejected if you aren't a Russian gymnast and suffer with very stiff wrists (or happen to have a hand in plaster), the whole thing hinges on a bit of confusion regarding Part 4 of our series "Design Your Own", in which Fleming's Left-Hand Rule is quoted.

Several readers have noted that the Left-Hand Rule is traditionally associated with the electric motor principle, while the Right-Hand Rule covers the dynamo or generator principle. Most text books written before about 1970 will be found to follow this convention, indeed, even as late as 1968, Noakes ("Text-Book of Electricity and Magnetism", Macmillan, London) referred without question to "the Left-Hand motor rule and the Right-Hand dynamo rule". Similarly, Morley and Hughes in their perennial "Principles of Electricity" point out the difference, but without mention of alternative implications.

The definitive version is related to electron flow rather than to conventional current flow, and M. Nelkon in "Electricity" (Arnold, London, 1971), outlines on p.245 the background to the apparent divergence of views:

"Flemings Righ-Hand Rule . . . note that the current direction is that of conventional current, or the movement of positive charges, which is opposite to the movement of electrons or negative charges. Applying the rule to Fig. 1 the middle finger points from P to Q. Hence, this is the direction of the induced emf in the conductor. If a galvanometer is joined to P and Q, completing the circuit, conventional current flow is from Q round to P through the galvanometer. Electrons move through the galvanometer in the opposite direction, from P round to Q".

Diagrammatically, the two opposing concepts involved in this one principle may be summarised by Fig. 2. There is of course no reason why, if you are so inclined, you should not reject modern ideas about electron flow, stick to conventional current, and ignore the assumption that a motor is a generator "inside out" as it were. In other words, it's up to you how you respond on this one. At least one thing is certain—if the lights go out again all over Europe, it will only be the result of industrial action, and not the sudden unaccountable reversal of a universal principle of physics.

Ted Parratt, with acknowledgements to M. Nelkon, "Electricity".

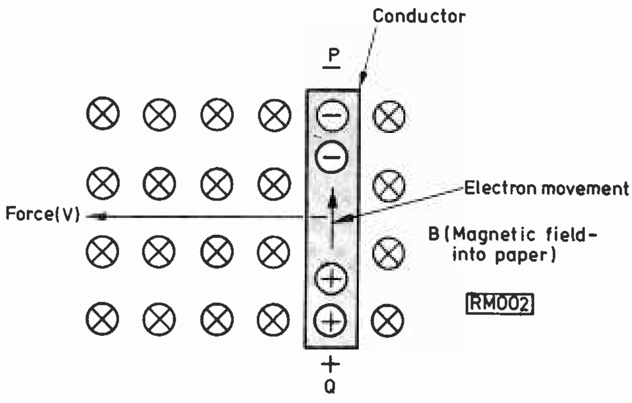


Fig. 1: The application of Fleming's Right-Hand Rule.

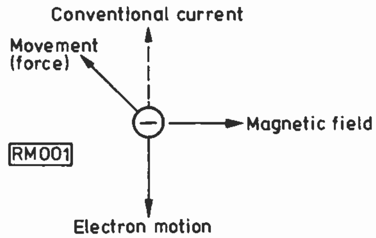
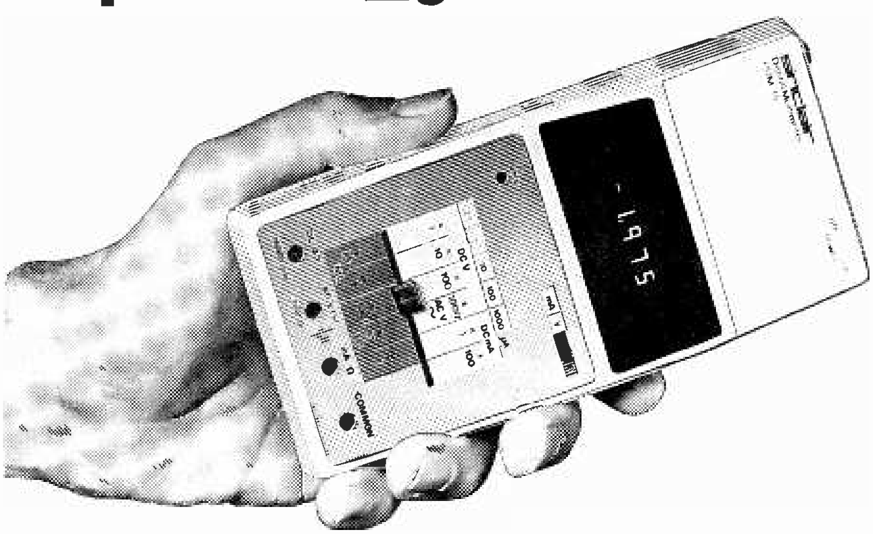


Fig. 2: If electron flow is used instead of conventional current, the opposite "Hand Rule" applies.

The Sinclair PDM35.
A personal digital multimeter for only £29.95 (+8% VAT)



Technical specification

DC Volts (4 ranges)
Range: 1 mV to 1000 V.
Accuracy of reading 1.0% ± 1 count.
Note: 10 MΩ input impedance.

AC Volts (40 Hz-5 kHz)
Range: 1 V to 500 V.
Accuracy of reading: 1.0% ± 2 counts.

DC Current (6 ranges)
Range: 1 nA to 200 mA.
Accuracy of reading: 1.0% ± 1 count.
Note: Max. resolution 0.1 nA.

Resistance (5 ranges)
Range: 1Ω to 20 MΩ.
Accuracy of reading: 1.5% ± 1 count.
Also provides 5 junction-test ranges.

Dimensions: 6 in x 3 in x 1½ in.
Weight: 6½ oz.
Power supply: 9 V battery or Sinclair AC adaptor.
Sockets: Standard 4 mm for resilient plugs.
Options: AC adaptor for 240 V 50 Hz power. De-luxe padded carrying wallet. 30 kV probe.

Now everyone can afford to own a digital multimeter

A digital multimeter used to mean an expensive, bulky piece of equipment.

The Sinclair PDM35 changes that. It's got all the functions and features you want in a digital multimeter, yet they're neatly packaged in a rugged but light pocket-size case, ready to go anywhere.

The Sinclair PDM35 gives you all the benefits of an ordinary digital multimeter – quick clear readings, high accuracy and resolution, high input impedence. Yet at £29.95 (+8% VAT), it costs less than you'd expect to pay for an analogue meter!

The Sinclair PDM35 is tailor-made for anyone who needs to make rapid measurements. Development engineers, field service engineers, lab technicians, computer specialists, radio and electronic hobbyists will find it ideal.

With its rugged construction and battery operation, the PDM35 is perfectly suited for hand work in the field, while its angled display and optional AC power facility make it just as useful on the bench.

What you get with a PDM35

3½ digit resolution.
Sharp, bright, easily read LED display, reading to ± 1.999.
Automatic polarity selection.
Resolution of 1 mV and 0.1 nA (0.0001 μA).
Direct reading of semiconductor forward voltages at 5 different currents.
Resistance measured up to 20 MΩ.
1% of reading accuracy.
Operation from replaceable battery or AC adaptor.
Industry standard 10 MΩ input impedance.

Compare it with an analogue meter!

The PDM 35's 1% of reading compares with 3% of full scale for a comparable analogue meter. That makes it around 5 times more accurate on average.

The PDM35 will resolve 1 mV against around 10 mV for a comparable analogue meter – and resolution on current is over 1000 times greater.

The PDM35's DC input impedance of 10 MΩ is 50 times higher than a 20 kΩ/volt analogue meter on the 10 V range.

The PDM35 gives precise digital readings. So there's no need to interpret ambiguous scales, no parallax errors. There's no need to reverse leads for negative readings. There's no delicate meter movement to damage. And you can resolve current as low as 0.1 nA and measure transistor and diode junctions over 5 decades of current.

The Sinclair credentials

Sinclair have pioneered a whole range of electronic world-firsts – from programmable pocket calculators to miniature TVs. The PDM35 embodies six years' experience in digital multimeter design, in which time Sinclair have become one of the world's largest producers.

Tried, tested, ready to go!

The Sinclair PDM35 comes to you fully built, tested, calibrated and guaranteed. It comes complete with leads and test prods, operating instructions and a carrying wallet. And getting one couldn't be easier. Just fill in the coupon, enclose a cheque/PO for the correct amount (usual 10-day money-back undertaking, of course), and send it to us.

We'll mail your PDM35 by return!

Sinclair Radionics Ltd, London Road, St Ives, Huntingdon, Cambs., PE17 4HJ, England. Regd No: 699483.

To: Sinclair Radionics Ltd, London Road, St Ives, Huntingdon, Cambs., PE17 4HJ.
Please send me ________ (qty) PDM35(s) @ £33.00 (inc £2.40 VAT and 65p P&P) each: .... £ ________
________ (qty) De-luxe padded carrying case(s) @ £3.00 (inc VAT and P&P) each: .... £ ________
________ (qty) AC adaptor(s) for 240 V 50 Hz power @ £3.00 (inc VAT and P&P) each: .... £ ________
I enclose cheque/PO made payable to Sinclair Radionics Ltd for (indicate total amount): .... £ ________
I understand that if I am not completely satisfied with my PDM35, I may return it within ten days for a full cash refund.

Name ....
Address ....
....
....
.... PW/2

sinclair
World leaders in fingertip electronics

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

It would seem that not all readers of this column appreciate the purpose of the "Log Extracts" item at the end of this blurb each month. I get some lengthy logs, obviously copied with a lot of care, which might contain just one entry that qualifies for Log Extracts. So, valuable listening time is being wasted! The idea is that as most listeners to the amateur bands keep a record of the number of different countries or zones heard, either from a sense of personal achievement or to get various certificates, they need to know of any activity from stations in countries or zones not normally or seldom heard. QSL information is most important and a rare station will usually have a "QSL Manager", frequently in the USA, and his callsign is all that is needed initially.

But, what is a "rare" station? Today, most such stations are "DX-peditions" organised by a group of amateurs to a seldom-heard country, and for a limited period. Unfortunately, like so many other ideas, the DX-pedition is frequently taken to extremes by "activating" remote reefs and islets, often under water for a lot of the time, that could not be considered "countries" by any stretch of the normal imagination. However, there are permanent stations in countries where amateur radio is viewed with a jaundiced eye by the authorities. Operation is intermittent and when a station does come on he could be considered as "rare".

The newcomer to amateur radio cannot, logically, expect to know what is rare and what is not until he has had some experience of the various bands and learned their characteristics. So choose your monthly selection of rare ones very carefully, half a dozen would be a lot!

First, an SOS! **David Birch** of Trowbridge, Wilts., are you there? I have mislaid your last letter and so your full address. If you will write to "G2DYM Aerials" you will hear something to your advantage! See their ad. in any issue of PW. **Les Weeks** of Manchester has been busy with his FRG-7 receiver, particularly on 10 and 15m bands. He comments that he has plenty of spare time "owing to muscular dystrophy, bronchitis and emphysema, but otherwise I'm OK"! Our hobby is probably about the best possible for such unfortunate folk. I do hope, Les, that you will soon be able to take your RAE and talk back to the stations that, so far, you have only logged.

A GM4 call in the New Year is the aim of **John Overton** in Glasgow and he has already decided that a Yaesu FR50B and FL50B set-up will do to start with! John is one of the few readers submitting some loggings on CW. Talking of CW, the award of the month for persistence must surely go to **Jess Luxton** G8GMI, a member of the RAIBC, who has copied code for at least a couple of hours a day for the last four years and has now passed his test. I look forward to knowing your new call OM!

Bill Stewart of Dundee had had his FRG-7 for just a week when he wrote to me asking a string of questions on amateur matters! As with all newcomers I referred him to the RSGB's *Guide to Amateur Radio*, £1·38 by post, which contains all the answers, just about. Welcome to our world Bill. Another newcomer is **David Greenhalgh** who hails from Poynton in Cheshire. He has been SW DX-ing but now wants to move up to the amateur bands. Good lad, you are on the right track! However, being only 14 he doesn't have that much bread to spare for a suitable RX so if anyone has a spare set going cheap write to David at 24 Park Avenue, Poynton, Cheshire. Must get you active somehow, Dave!

Simon Robinson was also sans RX until he got hold of a version of the famous B40 at a rally. This plus a 100ft "invisible" aerial down the garden has got him going properly, at last. Simon, of Stocksfield, Northumberland, recently appeared on BBC TV's "Swop Shop" and later enjoyed a tour of the studios. He, too, is a hopeful for the RAE next year. **Dave Peck** BRS37621 remains the sole reader reporting on RTTY activity although I am sure that there must be others. He now has a brand-new Creed 7 printer which he celebrated by copying his first ZL in this mode.

From Worcester, **Bernard Hughes** submits a brief letter and log but since he is BRS25901 he is obviously an old hand at the game! Stations logged included 5W1AZ, HH5RB, HP1PS all of which I consider as "rare". He uses an FRG-7 plus dipoles and a 66ft wire. Regular **Brian Harrison** (Hastings) doesn't like turning his AR88 off in case he misses anything on the 10m band! Don't then, if you can afford to pay for the electricity! Or run the oscillator valve heater from a separate transformer that is permanently on, thus eliminating the annoying warm-up drift on this set. Catch of the Month for **Paul Pasquet** of Farnham, Surrey, was KC4USV/MM at the McMurdo Ice Station in the Antarctic, on 20m, on his new HQ170.

Log extracts

P. Pasquet:— 80m VP8OW **20m** KC4USV/MM ZK1DR 3D6BP **15m** VS6BB UV0EX (Sakahlin Is.) KG4SC **10m** A6XB CX8BE FM0FC HI8LAP HD1DX ZD8EW

B. Hughes:— 20m P29JS VU2LQA 5W1AZ **15m** FM0FC HH5RB HI8FEG HD1DX KZ5PM VP2MF VP2MUU **10m** PY2CSS ZE6JC ZS6AYW

B. Harrison:— 20m CE0AE (Easter Is.) **15m** DU2GL **10m** A4XGB CW0A (Uruguay) EP2RL FG7AX FM7AV HD1DX (Ecuador) HI8XDJ HP1PK HK0QA (San Andres) OA4M OY1A PZ1DP TA1ZB VP2MSA VP8LP VK6HK ZD7HH 3D6BE 5T5ZR

J. Overton:— 40m CW VK3AE ZL3GQ **20m** PJ2FR TR8GB VP8PJ YN1KL FG7AR/FS7 FM7WV FP8DX

D. Peck:— 20m RTTY EA8IY JA4ONZ UA9PP VE1AA VK2SG VK4YS VK6IF YU3EM ZL2AQQ 4X4MR 7X4MD 9H1ET **20m** KG6RT KL7BUY ZL3GS 6W8LZ

All loggings are SSB unless indicated otherwise.

BROADCAST BANDS

SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

It was with regret that the writer listened to the final edition of DXers Calling from Radio Australia. On the air weekly without a break for the past 31 years, this programme finally came to an end on 20 October, though there will be a segment for DXers in Club Forum, which is broadcast at the same times one day earlier, Fridays at 2040 and Saturdays at 0240, 0840 and 1440. On a brighter note, Radio Nacional Espana now has a weekly programme for DXers in its European broadcasts. It can be heard on 7155, 9505 and 11840 kHz on Sundays towards the end of the English transmission. Listen around 2215 GMT.

Harold Emblem (Mirfield) sends news of the Voice of Turkey which is now on 7175 as well as 9515 with its nightly programme in English which starts at 2200. There is a DX programme in English on Monday to Friday at 2230. Harold logged the new channel at 2300 using his Eddystone 730/4. **G. A. Powell** (Lichfield) has been trying the short waves with an old Beethoven domestic set connected to a 40ft length of wire dangling from a 12th floor window (is this safe? A whip aerial on the window would probably give as good results). DX heard with this set-up between 2000 and 2330 included All India Radio and HCJB Ecuador both on the 25m band. The Voice of the Andes, HCJB, Quito Ecuador is operated by World Radio Missionary Fellowship and reports should go to Casilla 691, Quito, Ecuador. DX Party Line, from HCJB is now on the air on Mondays, Thursdays and Saturdays at 2000 on 11955 in the 25m band and 15300 in the 19m band.

"I have tried unsuccessfully to receive Latin American stations and I wonder if you can help me" writes **John Larkin** from Clonmel, Co. Tipperary. John uses a Philips 5-valve receiver with either an 80ft loft aerial or a TV aerial, and his log contains The Voice of Turkey on 9515 at 2225, Radio Havana Cuba on 17885 at 2025 and Radio Australia on 9520 at 0745. Listen for Latin America from 2100 in the evening on the 31m, 25m and 19m bands. On 31m look for Radio Aparacida Brasil on 9635, La Voz de Chile on 9680, Radio Rio Mar Brasil on 9695. On 25m listen for Radio Clarin, Dominican Republic on 11700, Radio Globo Brasil on 11805, Radio Brasil Centro on 11815, Cap Haitien in Haiti on 11835, Radio el Espectador Uruguay on 11835. When conditions are favourable many Latin Americans can be heard between 2100 and midnight on these bands.

It is on the Tropical Bands though, especially 60 metres (4750 to 5060kHz) that Latin America dominates the scene, for it is here that large numbers of low to medium power locals operate, and when there is a path of darkness to the UK they can easily be picked up here. Listen from 2300 onwards through the night for Radio Popular Ecuador on 4800, Radio Clarin, Dominican Republic on 4850 (in English Monday—Friday at 2330), Radio Universo Venezuela 4880, Radio Progresso Honduras 4920, Ecos del Torbes Venezuela 4980, Radio Sutatenza Colombia 5075.

Fred Ainslie's main interest is in the Tropical Bands since "there are no jammers or megawatters and West Africans and South Americans are regulars". Using a homebrew triple conversion receiver he reports hearing VLM4 Brisbane Australia on 4920kHz on several occasions just after dawn (must have been on the long route across the Pacific!), Radio Singapore on 5010 and 5050 (both channels carry the same programme which makes identification easy) and Burma on 4725 closing down in English at 1500. DX from Africa includes Lagos on 4990, Accra on 4915, Mauritania on 4845, Congo on 4765, ELWA Liberia on 4770, Dakar 4890, Benin 4870, Ivory Coast 4940, Togo 5047, all between 2100 and 2300.

"Any gen on Indonesian stations, are they still on the short waves?" asks Fred. Indeed they are. On the International Bands RRI is listed as broadcasting daily in English at 2330 on 9710 and 11970, though the writer has not managed to log it on either channel. On the Tropical Bands, though, there are plenty of Indonesian locals which can be heard in the UK during two time slots daily; from 1400 until sign-off at 1600 and again from sign-on at 2200 until fade-out after midnight. Search on 60m for Ujung Padang on 4719, Medan 4763 and Jakarta on 4774 during the afternoon at this time of year, and for Semerang on 3935 (75m band), Jakarta on 4805, Banda Aceh 4954 and Padang on 4985 in the late evening.

Tropical Band DXers will be interested in the Tropical Bands Survey, which is a 27-page booklet published annually in June, by the Danish Short Wave Club International. It contains a listing of all broadcasting stations in the range 2000 to 5900kHz, including transmission times where known. Stations are classified as Regularly Reported, Seldom Reported, Not Reported but known active, Possible Inactive, and there is information about Indonesian Provinces and Special Districts. Write to the DSWCI, Greve Strandvej 144, DK 2670 Greve Strand, Denmark enclosing 5 International Reply Coupons which are obtainable for 25p each at main post offices, for a copy of the Survey and details of club membership.

Ian McLean, Port Glasgow, has a Worldwide 9-band receiver purchased in Canada, which when connected to a 100ft long wire via a Codar PR40 Preselector pulled in Radio Jerusalem on 9090 at 2000, Cairo on 9495 at 2200, All India Radio on 9590 at 2202, Pakistan on 15110 at 1000, Radio Havana 17885 at 2110 and Radio Australia on 21570 at 0928. (The Address of Radio Australia is PO Box 428G, GPO Melbourne 3001, Australia). Ian has been trying to log Radio Afghanistan and NHK Japan. Try 15365 or 15195 at 1130 for Afghanistan in English in the International Service, or for the Home Service from 1530 until 1740 on 4775kHz in the 60m band.

Radio Japan can be heard in English between 0800 and 0830 on 15325kHz in the 19m band. On Sundays there is Tokyo Calling at 0810, followed by DX Corner at 0820. This transmission is also on the 16m band, though the frequency was not mentioned over the air and it could not be heard by the writer. Much louder reception was obtained, in Japanese at 0755 on 17795 and 17825 followed by the interval signal at 0800 and then talk in Chinese. According to a recent report in Sweden Calling DXers, Radio Japan intends to build relay bases in the Mediterranean and Caribbean area in order to improve reception in Europe and the Eastern United States.

MEDIUM WAVE DX

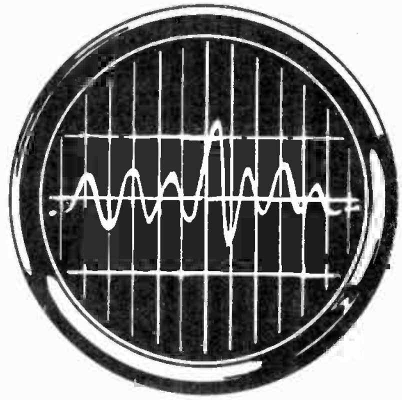
by Charles Molloy G8BUS

A good log of Asiatic and American DX comes from Booterstown, Co. Dublin where **Mike McGovern** uses a Philips BX48A receiver along with a home-made preselector. Stations heard were Taipei in Taiwan, on 600kHz at 2100, Bangkok on 830 at 2300, Fukuoka Japan on 1410 at 2100, Iba in the Philippines 1470kHz at 1600 and Radio Nacional in Paraguay on 920 at 0130. Also KOMO in Seattle on 1000 at 0630, CHQM Vancouver on 1320 at 0530 and KFBK Sacramento on 1530 at 0430.

Although Mike has heard and verified 25 of the 50

LOOK! Here's how you master electronics.

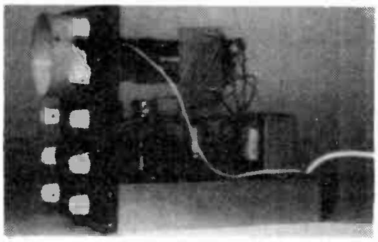
....the practical way.

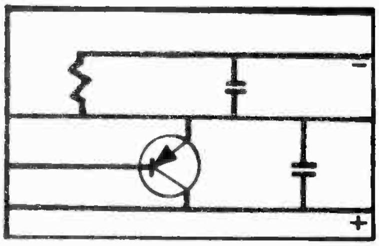


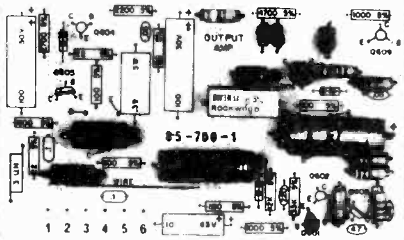
This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical way in easy steps mastering all the essentials of your hobby or to further your career in electronics or as a self-employed electronics engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write, at any time, for advice or help during your work. A Certificate is given at the end of every course.







1 Build an oscilloscope.

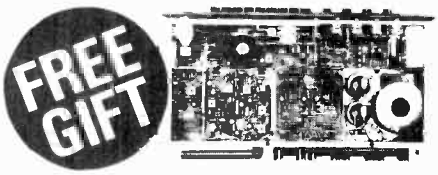
As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.

2 Read, draw and understand circuit diagrams.

In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computors and countless other electronic devices and their servicing procedures.

3 Carry out over 40 experiments on basic circuits.

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v etc.



All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.

Free!

To find out more about how to learn electronics in a new, exciting and absorbing way, just clip the coupon for a free colour brochure and full details of enrolment.

British National Radio & Electronic School

P.O. Box 156, Jersey, Channel Islands.

NAME ____________________

ADDRESS ____________________

WB 2 ____________________ Block caps please

Electronics. Make a job of it....

Enrol in the BNR & E School and you'll have an entertaining and facinating hobby. Stick with it and the opportunities and the big money await you, if qualified, in every field of Electronics today. We offer the finest home study training for all subjects in radio, television, etc., especially for the CITY AND GUILDS EXAMS (Technicians' Certificates); the Grad. Brit. I.E.R. Exam; the RADIO AMATEUR'S LICENCE; P.M.G. Certificates; the R.T.E.B. Servicing Certificates; etc. Also courses in Television; Transistors; Radar; Computers; Servo-mechanisms; Mathematics and Practical Transistor Radio course with equipment. We have OVER 20 YEARS' experience in teaching radio subjects and an unbroken record of exam successes. We are the only privately run British home study College specialising in electronics subjects only. Fullest details will be gladly sent without any obligation.

Become a Radio Amateur.

Learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence.

WL 2

Free!

Brochure without obligation to:

British National Radio & Electronic School

P.O. Box 156, Jersey, Channel Islands.

NAME ____________________

ADDRESS ____________________

____________________ Block caps please

MAIL ORDER DEPT:-

CRESCENT RADIO LTD

1 ST. MICHAELS TERRACE, WOOD GREEN, LONDON, N22 4SJ

TELEPHONE: 888-4474

3 KILOWATT PSYCHEDELIC LIGHT CONTROL UNIT

1000 WATT PER CHANNEL.

Three channel: Bass, Middle, Treble. The input of this unit is connected to the loudspeaker terminals of an amplifier and the required lighting is connected to the output terminals of the unit thus enabling you to produce a fascinating sound to light display.

Full instructions supplied or S.A.E. for details.

Fantastic Value at £20·00 + 8% VAT.

LOUDSPEAKER SELECTION
+ 12½% VAT

2½" 8, 40 and 75 ohm at £1·10
(Please state which impedance is required)

5" 8 ohm CERAMIC at £1·70

8" GOODMANS Audiom 8PA' 8 ohm 15w at £5·26

10" 'ELAC' Dual Cone 8 ohm 10 watt at £4·75

EFFECTS PROJECTOR "150" (150 watt) Ideal for disco work, this versatile machine takes a range of accessories and is of a sturdy metal construction. Comes complete with bulb and 6" Liquid Wheel. Ready to use.
A bargain at £34·00 + 8% VAT.

PIEZO ELECTRIC HORN UNITS 100 watt New High Quality, High Power Tweeter. No Xover required. Freq. Response: 3·8KHz to 28KHz. Spec. Sheet sent on receipt of S.A.E.
OUR PRICE: £7·60 each + 8% VAT.

POWER SUPPLY UNITS + 8% VAT

PP1—Switched 3, 4½, 6, 7½, 9, 12v at 500m/a with on/off switch and pilot light. Approx size: 130 × 55 × 75mm. ONLY £6·00.

PP2—Switched 6, 7½, 9v at 300m/A. This is a sealed, moulded unit fitted with a 3 pin 13A mains plug. Approx. size: 75 × 55 × 45mm. ONLY £4·00.

PP3—DC/DC Power supply for cars. Switched 6, 7½, 9v at 500m/A from 12v DC input. Approx. size: 125 × 68 × 45mm ONLY £6·25.

PP4—Stabilized Power supply. Switched 3, 6, 7½, 9v at 400m/A with on/off switch and pilot light. Approx. size: 115 × 78 × 55mm. ONLY £7·00.

PP5—Heavy duty 12 volt power supply. 1·5A at 12 volt. Approx. size: 155 × 90 × 95mm. ONLY £8·00.

ALUMINIUM BOXES + 8% V.A.T.

AB7 = 5¼" × 2¾" × 1½" = 88p
AB8 = 4" × 4" × 1½" = 93p
AB9 = 4" × 2¾" × 1½" = 88p
AB10 = 5¼" × 4" × 1½" = £1·00
AB11 = 4" × 2½" × 2" = 88p
AB12 = 3" × 2" × 1" = 75p
AB13 = 6" × 4" × 2" = £1·00
AB14 = 7" × 5" × 2½" = £1·20
AB15 = 8" × 6" × 3" = £1·79
AB16 = 10" × 7" × 3" = £1·92
AB17 = 10" × 4½" × 3" = £1·66
AB18 = 12" × 5" × 3" = £1·86
AB19 = 12" × 8" × 3" = £2·34
(please note: all sizes are approx.)

BARGAIN TRANSFORMERS

240v primary, 12-0-12v 500mA secondary. Approx size: 60 × 40 × 50mm. Fixing centres 75mm. PRICE: £1·80 + 8% VAT. Also available Mains transformer with 18v 500mA sec. Price and size same as above.

ACCESS AND BARCLAYCARD ACCEPTED—PHONE ORDERS WELCOMED
ALL PRICES INCLUDE POSTAGE—PLEASE ADD V.A.T. AS SHOWN—S.A.E. WITH ALL ENQUIRIES PLEASE.

Personal callers welcome at: **164-166 HIGH ROAD, WOOD GREEN, N22.** Phone: 888-3206
and **13 SOUTH MALL, EDMONTON N9** Phone: 803-1685

SECURITY SUPERMARKET

WE HAVE STOCKS OF EVERYTHING YOU NEED.
CALLERS WELCOME. OPEN 6 DAYS
EXPRESS POSTAL SERVICE
FREE CATALOGUE SEND S.A.E.

Complete Kit for House £54·00 inc. VAT plus postage

Control Unit 1006B **£19·50** plus £1 p&p
(mains/Battery complete unit)

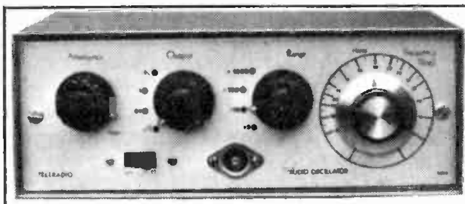
MAGNETIC CONTACTS	75p	TAMPER JUNCTION BOXES	24p
MATS LARGE 28" × 15"	1·20	VIBRATION DETECTORS	1·74
STAIR SIZE 6" × 24"	1·10	DOOR LOOPS COMPLETE	59p
WINDOW FOIL 33 M & S	2·45	BELLS & SIRENS FROM	6·00
KEY SWITCHES	1·95	BELL COVERS FROM	6·00

ELECTRONIC CAR ALARM ONLY £5·00.

Please add VAT 12½%, Post 70p min.

A. D. E. (SECURITY) CO.,
217 WARBRECK MOOR
AINTREE, LIVERPOOL
TEL: 051-525-3440

STOP PRESS ! Trade Price List Available
Applications on Official Stationery only



HIGH QUALITY Very Low Distortion Audio Signal Generator

AN IDEAL INSTRUMENT FOR HI-FI TESTING

Based on a Linsley Hood design.

PRICES, assembled instrument, plastic case **£23**, metal case **£26**. (Kit, **£19·50**). Tax extra 8%. P.P. and Ins. £1.

Specification. Frequency range: 10 Hz–100kHz in 4 steps. Output: 10mV–1 volt in 3 steps. Sine- and Square-wave forms: Dist. below ·02%. Attenuator: Powered by 9V battery.

Other instruments: Millivoltmeter, Frequency Meter, Reg. P.S. Units. THD Analyser. Also Hi-Fi Amp kits 10-100 F.M. Tuners, Kef Speaker Units.

S.A.E. for further information to:

TELERADIO ELECTRONICS (PW)
325, Fore Street, Edmonton, London, N.9. Telephone: 01-807-3719.

states of the USA he has not been successful with Alaska and he suggests the reason might be that the Great Circle path from his QTH to Alaska passes over the north magnetic pole which is in Bathurst Island. This of course is the reason why Alaska and parts of the Pacific are not logged in the UK. In the vicinity of the north magnetic pole absorption of medium wave signals is high and it is this factor rather than distance that prevents world wide reception on the medium waves. DXers in New Zealand and Australia are able to pick up medium wave stations in Europe and it is only the high level of QRM that inhibits reception in the reverse direction.

Another good log, this time from **Fred Ainslie** of Hartlepool, who uses a homebrew receiver and a 100ft long wire. He had modified the receiver so that the second IF is now 100kHz. This gives very good selectivity but has degraded the sound quality. Detuning slightly to either side of the carrier should improve the audio. Fred mentions the 1000kW transmitter in Calcutta on 1130kHz which he has heard regularly signing on at 2145 with the All India Radio theme tune followed by a programme in Chinese.

Highlights from a very comprehensive log include two Asiatics, Quetta Pakistan on 750kHz and Hyderabad India on 1010; four from the Caribbean, St. Vincent on 705, St. Lucia on 840, ZDK Antigua on 1100 and Martinique on 1310 and four Africans, Gambia on 648kHz, Dakar 764, Sierre Leone 1205 and Libreville, Gabon on 1554. All heard between 2300 and 0100 GMT.

David Brooks of Redruth in Cornwall asks for information about receiving far-off stations on the medium waves. First, there must be a path of darkness between transmitter and receiver. There is no DX to be heard during the day on the medium waves! The main obstacle to MW DXing in the UK is interference (QRM) as the band is overloaded with Europeans, many of whom stay on the air all night.

A communications receiver used with a loop aerial will go a long way to reducing QRM but a careful study of station schedules can also help. A number of Europeans do sign off at night, usually around 2300, but on Saturdays many are on extended schedule, so Saturday is actually the worst evening for DXing. On Sundays signing-on times are usually later than during the week and this applies to the BBC whose domestic services are up to one hour later in starting than on other days. Sunday therefore offers quite an advantage to the DXer who listens around sunrise.

A careful study of the European band plan, which incidentally will change next November, will pay big dividends. In Europe, stations are on channels separated by 9kHz (apart from near the band edges) while in other parts of the world the separation is 10kHz and the channels are also on multiples of 10kHz, i.e. the last digit is a zero. It follows from this that at intervals of 90kHz the channels of the two systems coincide and at these points DXing will be difficult. These are 620kHz, 800, 890. 980, 1070, 1160, 1250, 1340, 1430 and 1520kHz. There are other parts of the band where the separation between the closest European and possible DX channels is 4kHz. These frequencies occur in pairs such as 660kHz and 670kHz, 750 and 760, 840 and 850 and so on through the band. Baghdad is on 760kHz which lies between the European channels 755 and 764 and consequently it is logged frequently by DXers in the UK.

A few DX stations operate on what US DXers call a split channel—the last digit is a 5. St. Vincent on 705 logged by Fred Ainslie is an example of a "split" which lies between 701kHz and 710kHz, both heavily occupied by QRM. Studying the European band structure and searching for holes where DX may be found, plus a study of European schedules, will pay off in a big way for the MW DXer who lives in the UK. It may also help to explain to the newcomer to the hobby how quite exotic DX such as Japan, India and Latin America can be heard on occasion on the medium waves.

Derek Taylor (Preston) has been "doing a little experimenting" with loops recently. He fixed up two turns of wire the complete circumference of the room, which in practice is an 8 by 12ft loop. The turns should be vertical, not horizontal. The position of the fixed loop is roughly NE/SW and its effect on the signal strength of Latin American and Caribbean stations was remarkable. When listening to ZDK (1100kHz) on a 40in loop the station could just about be copied, but when the large loop was used a gain of some 10 to 15dB was obtained, while with Radio Margarita, Venezuela on 1020 an attenuator had to be switched in.

The rig in use is a Yaesu Musen FRG7 communications receiver. Derek says that although not very versatile and a little prone to QRM, his large fixed loop could make the difference between a station being unreadable and loud enough at least to get enough for a reception report. This type of aerial cannot be used with a transistor portable or other receiver that has its own internal aerial.

Two YENED (Greek Armed Forces) stations are mentioned in Derek Taylor's log. The 200kW transmitter in Athens on 980kHz can be picked up with a loop as the strong Arabic station (Algiers) that shares the channel, can easily be nulled-out. The other is Thessaloniki on 1178 which is usually swamped by Horby in Sweden and in this case a loop is of little help as the two stations are roughly on a reciprocal bearing from the UK. Horby though, signs off for half an hour from 2130 to 2200, between the end of its domestic and the start of its international service, providing a time slot when the Greek station can be heard loud and in the clear.

Fourteen-year-old **Stephen Cook** has a Realistic DX160 communications receiver coming his way at Christmas and he would like to hear from fellow users. Write to Squirrels Leap, Bonville Chase, Altrincham, Cheshire, WA14 4QA. Postage will be returned.

VHF BANDS

by Ron Ham BRS15744

Congratulations to a frequent contributor, **Alan Baker**, formerly G8LGQ, who, having passed his morse test now sports the callsign, G4GNX. Alan plans to install HF gear both at his home in Newhaven and in his car, and will no doubt chalk up more super DX to add to his already spectacular VHF record. His first HF QSO was with an IT9 on 20m using the Mid-Sussex Amateur Radio Society's club station at Burgess Hill, and, a few days later, he made his first CW contact, from home, on 2m, with G6OX in Surrey and feeling happy with a key, his next QSO was, of course DX; a 559 on 2m with ON4VN.

It was Alan's regular reports that convinced me of the value of the repeater network for propagation studies, which prompted me to buy an FDK TM-56B, 12 channel plus 4 scan, FM monitor receiver, and its arrival coincided with the tropospheric opening which began on October 25th. The origin of this disturbance can be traced back to midnight on the 22nd when the atmospheric pressure gradually increased from 30·0in to 30·25in by midnight on the 24th, and then rose sharply to 30·4in at noon on the 25th where it remained for 24 hours and began to fall at midday on the 26th.

At 1016 on the 25th, a signal from the Bristol Channel repeater, R6, opened the squelch on my new toy, fed with a dipole 30ft AGL, and around the same time there were

539 signals on 70cm from GB3EM and GB3SUT. During the afternoon, G4GNX heard a Lancashire station operating through the Kent repeater, and, throughout the following day, I received strong signals from the repeaters in Birmingham, Bristol, Suffolk and Kent. Often the traffic through GB3BM was overpowering signals from our local repeater, GB3SN, in Hampshire; both on R5.

In the afternoon, **Roy Bannister**, G8LXR, Lancing, heard EI9Q working a 2m station in Crowborough and **Andy Mepham**, G4CBZ/P, worked a GW on 70cm using a vertical-Colinear aerial on Ditchling Beacon, he also worked northern G stations on 2m using a 5/8 whip aerial mounted on his car.

For most of the day I received a watchable picture from Lichfield on Channel 8, strong signals from both the Emley Moor and Sutton Coldfield beacons on 70cm, and, around midday, a variety of continental broadcast stations were audible in Band II. At 1412 on the 29th, **Alan Baker** worked G8HPQ, Nr. Chesterfield, on 2m ssb, during another period of falling pressure, and in less favourable conditions, at 2155 on November 6th, he put out a chance CQ on 2m and contacted G8KHR in Newark.

The AP rose again to 30·2in from noon on the 8th to midnight on the 9th and by 0400 on the 10th it was falling, and, true to form, there was a brief tropospheric disturbance. For most of the morning I received strong signals from 10 continental broadcast stations between 88-100MHz, GW mobiles were opening my squelch via GB3BC and I heard a 59 signal from GU4EON via GB3SN. Around this time, Roy Bannister could hear both the Cambridge and Suffolk repeaters and French stations on S20, while G4GNX heard signals through the Bristol Channel and Kent repeaters and later had a 55 contact with G4DAZ in Bedfordshire.

Stan Heys, Peacehaven, a member of the St. Dunstan's Amateur Radio Society was, since 1972, an active SWL specialising in 80m, however, last August he obtained his licence and now operates on 2m under the call sign G8NOE. Stan has a Uniden 2030 giving him 10 watts of FM to a ¼ wave, loft-mounted ground plane, and so far he has worked about 100 stations and his best DX is St. Austell.

Cmdr. Henry Hatfield, Sevenoaks, and myself recorded several bursts of solar radio noise at 136MHz on October 22nd, 23rd, 25th and 28th, the result of which was no doubt responsible for the ionospheric disturbance reported by the BBC World Service on 27th and 28th. We both recorded further bursts on the 31st and November 2nd, 16th and 18th, noise storm conditions on the 6th and 17th, and high solar noise level on the 12th and 13th, which ties up nicely with the visual aurora reported at 2200 on the 14th and the ionospheric disturbance reported by the BBC World Service on the 16th.

On November 9, Henry gave a most interesting step-by-step survey, illustrated with slides, of the construction and workings of his spectroheliscope, to a packed meeting of the Brighton and District Radio Society. Henry made many comparisons between the reception and bandwidth or radio signals and light waves but emphasised that his optical equipment works at 457 million megahertz. Members and guests present were fascinated by the pictures of the typical solar events which create the radio noise and cause radio blackouts and aurora which are frequently reported through this column and in other journals. On November 11th Henry saw two bright patches on the eastern solar limb and on the 13th he identified two new sunspots, and a fairly active area.

From October 23rd to 27th, **Nigel Golds**, BRS 36910, West Chiltington, Sx, heard 22 countries on 10m, from Israel to Argentina and from Italy to Ukraine. I have paid particular attention to the behaviour of signals from the International Beacon Project stations on 10m and at 1400 on October 31st I received a 539 signal from 3B8MS, Mauritius, and, a 559 from 5B4CY in Cyprus. Almost daily from November 3rd to 19th I heard 5B4CY around 0930 at strengths varying from 539 to 589, in fact, I could leave the receiver tuned to 28·220MHz and wait for its signal to appear. Most lunch times throughout this period, North American stations were as predominant on 10m as the Russian stations were in the early mornings.

Gordon Goodyer, BRS 37345, Petworth, Sx, using his Eddystone 750, a loft-mounted wire dipole and a home-brew, EF183 valve pre-selector did very well on 10m between 1030 and 1500 on the 13th. Gordon heard strong ssb signals from Ukraine to Rhodesia, Norway to North America, Spain to Argentina and much of South America. Between 0930 and 1030 on both the 13th and 15th I received 539 signals from the Bahrain beacon A9XC, 28·245MHz, and during the mornings of November 4, 5, 7, 8, 13, 14, 15 and 17, I heard signals, averaging 549, from ZE2JV a temporary propagation beacon for project TESSA (Transequatorial Scatter to Southern Africa).

Between 0830 and 2330, on November 14th and 18th I monitored the frequency (70·31MHz) of the Polish broadcast station at Gdansk and counted the number of times that its signal bounced off meteor trails (pings) during the Leonids meteor shower. The following rounded off daily figures show that the peak activity occurred on the 16th; total number of "pings" recorded daily were: 14th 7000, 15th 11000, 16th 14000, 17th 9000 and 18th 8000. I would be very interested to have more reports about this form of propagation.

Thanks again for your reports and for the interest you are taking in my column.

NEW BOOKS

MODERN ELECTRONICS MADE SIMPLE
George H. Olsen
Published by W. H. Allen
306 pages £1·75.

On the face of it, this book appears to offer more value, in terms of cash for paper, than book No. 1, but it is debatable whether this is a prerequisite for any technical summary, so alternative judgements must follow.

It is to be hoped, starting at the cover, that readers will not immediately conclude that every technical process is so easily capable of ultimate simplification: "Build Your Own Orbiting Laboratory" is hardly likely to follow hard on the heels of this publication, in spite of the assertion of its title.

To be fair though, its treatment of an immensely wide subject area is at once engaging and concise. There is plenty that is traditional, such as "slabs" on power supplies, Hartley and Colpitts oscillators, use of ICs and so on, and it does move into the more involved processes of synchronisation and principles of television.

The sections dealing with the integration process are lucid and interesting, but I was not so impressed with the somewhat behind-hand diagrams showing typical shadow mask construction. Precision—In-Line, slot aperture colour tubes have been around for long enough to warrant inclusion, especially since moving-coil pick-ups are mentioned, if only at the diagram stage. Overall then, only one or two reservations—at some points information is sketchy—but there is a clear attempt to attack the subject from a wide base, and this can itself introduce the perennial problem of dynamic selection.

A slightly disturbing sensation results from the perusal of page 299, however. Kits for some of the projects are apparently available from **NESLO** Electronics—palindromes are clearly grist to Mr. Olsen's mill!

Ted Parratt

FREE CATALOGUE/ORDER FORM
SEND S.A.E

500+ Top quality Transistors, I.C's, Resistors, Capacitors, Plugs/Sockets, Veroboard/cases, Indicators, Knobs, Switches, Wire and Books at prices you can afford.

741	555	TIL209	IN4001
ONLY 30p	ONLY 50p	ONLY 15p	ONLY 5p

All prices include VAT. P&P FREE over £2.

Name ____________________

Address ____________________

ACE

Get an ACE up your sleeve!

ACE MAILTRONIX LTD
Dept. PW Tootal Street
Wakefield, W. Yorkshire WF1 5JR

NEW
FROM **CASIO,**
OF COURSE.

POCKET WATCH CALCULATOR TWO WAY TIMER ALARM

Ultra slim pocket calculator. LCD display. **6 Digit clock.** Daily (10 second) **Alarm, Timer,** up to 12 hours, or **Repeat Timer** (for example, can be set to buzz every three hours.) **Calculator** Four key memory, percentage, square roots, etc. Battery life **2000 hours** plus. Leatherette case.

AQ 810 An incredible £19·95

Casio

31QR-12B
(ST) 8·5mm thick
£29·95

21QS-10B
(ST. TM) 9·6mm
£34·95

Western Time

LED
6+3 functions
S/S finish
Quality for
£11·95

Superb CASIO LCD watches. Seven functions, light, auto calendar, **STOP-WATCH** (ST) **DUAL TIME ZONE** (TM) All **stainless steel, mineral glass, WATER RESISTANT** to 100 feet. AVAILABLE JANUARY. Casio **chronograph £59·95** and **£64·95. ALARM watch** (ST) **£59·95.**

Send 15p for our illustrated catalogue. Lowest discount prices, widest range. Prices include VAT, P&P. Send cheque, P.O. or phone your credit card number to:—

TEMPUS Dept. P.W.,
19/21 Fitzroy Street,
Cambridge CB1 1EH
Tel. 0223 312866

PRACTICAL WIRELESS T.V. SOUND TUNER

(Nov. 75 article by A. C. Ainslie) *Copy of original article supplied on request*

IF Sub-Assembly (G8) **£6·80.** P & P 75p.
Mullard ELC1043 V'cap UHF Tuner **£4·50.** P & P35p.
3-way Station Control Unit **£1·20.** P & P 25p.
6-way Station Control Unit (Special Offer) **£1·00.**
Power Supply Prtd Circuit Board **£1·00.** P & P 30p.
Res, Caps, Semiconds, etc. for above **£5·80.**
Mains Transformer for above **£2·50.** P & P 30p.

Add 12½% VAT to price of goods. P & P all items 85p.

Callers welcome at shop premises.

MANOR SUPPLIES
172 WEST END LANE, LONDON NW6
(Near W. Hampstead Tube Stn.) Tel. 01-794 8751

V.H.F. TEST SET type 210 provides RF O/P over range 20 to 88Mc/s in 4 bands, approx 10 mill/v O/P C.W. or pulse mod at 5 freq around 30Kc. Also contains noise generator with 50 Ma meter, 2 Mc/s int calibrator, these units have int p.u. but this is not suitable for 50c/s (req 250v ht & 6·3v) supplied in case with Ae rods, cal chart circ & notes. £10·80.

SOLID STATE POWER SWT opto coupled control volts 5/15 dc, will handle 240v at 5 amp or 13 amp on heatsink okay for sound to light units £2·40.

ATTEN X Band var about 40Db w.g.16 new £4·50.

THERMISTORS bead type temp range 20 to 200' C new 65p.

CRYSTAL STANDARD 100Kc & 1 Mc/s in 10X case with circ £2·80.

RECEIVER UNIT small personal receiver covers 500Kc to 18Mc/s in 4 bands with 4 way plug in coil unit, 5 valve unit with BFO in metal case size 6½ × 3½ × 1½" fitted slow motion dial, these require ext phones & HT & LT supplies of 67·5 & 1·5v dc with circ & cal chart £10·80.

CRT VISOR with magnifier size 5 × 4 × 7" £3.

AERIAL DRIVE UNIT was used with radio compass aerial will turn small beam contains two 24v dc motors driving into differential gear with o/p shaft 1¾ × ½" with threaded end, approx overhaul size 6½" dia 6" high less shaft with o/p to work 24v desyn £8·50.

CRYSTALS mixed 10X & 10XJ types in range 5 to 8·5Mc/s 20 for £2·20.

METER panel type 1 Ma fsd special scale 2" new £1·30.

V.H.F. power transis type 2N3375 7·5 watts at 100Mc/s 3 watts at 400Mc/s new £1·80.

CRYSTAL OVEN miniature type 55°C for 12/24v will take two Hc18 type plug in crystals new £1·20.

H. F. RECEIVER R4187 & CONTROL BOX aircraft remote controlled receiver covers 2·8 to 18Mc/s in 3 bands 24 crystal controlled channels, dual conversion Rx with 16 valves, I.F. filters, BFO, N.L. etc as O/P for phones, supplied with control box, copy of handbook & mods to enable Rx to tune 80, 40 & 20 meter bands, these require supplies of 200v ht & 19v DC. £18·30.

SIGNAL GEN type 6 special purpose unit provides 17 crystal controlled O/Ps over range 60 to 70Mc/s with provision for C.W. single & double freq A.M. & F.M. (were used for testing sonar-buoy receivers) as int carrier level meter, 4 stage o/p atten. Require ext p.u. 200v & 6·3 with circ & notes fuller disc on list £25.

U.H.F. RECEIVER single channel crystal controlled 225 to 400Mc/s double conversion, 19" rack mounting O/P 1 watt into 600 ohm fitted RF & AF gain controls uses Hc6/u crystals in range 20/40Mc/s with circ for use on 230v mains £30.

HEATERS flat tubular 240v 150w approx size 6½ × 10" were used for film drying new £1·50.

ROTARY SWTS ceramic 6p 5w ¼" shaft new £1·20.

SWT UNIT precision attn with 1p 24w swt with 16 low value res in scr box new £2.

HELIPOTS 10 Tr 5K small type ¼" shaft new £1·75.

REMOTE CRYSTAL selector with provision for selecting 6 Tx & 6 Rx crystals contains 6c BC108, 6 tub trimmers, coils diodes etc new £1·80.

Above prices include carr/postage & VAT. SAE for list 18 or enquiry, goods ex equipment unless stated new. Shop open Tues to Sat.

A. H. SUPPLIES
122 HANDSWORTH RD., SHEFFIELD S9 4AE
Tel: 444278 (0742)

VALVES

A0165	1·25	EL34	2·20	PL509	2·00
AR8	0·80	EL37	3·00	PL802	2·50
ARP3	0·60	EL41	0·80	PY33	0·60
ATP4	0·50	EL81	0·60	PY80	0·60
B12H	3·00	EL82	0·60	PY81/800	0·55
DAF96	0·60	EL84	0·35	PY82	0·45
DET22	12·85	EL86	0·50	PY83	0·50
DF96	0·60	EL90	0·50	PY88	0·50
DK96	0·80	EL91	1·60	PY500A	1·35
DL92	0·50	EL95	0·70	PY801	0·55
DL96	0·70	EL504	0·80	QQV03-10	
DY86/87	0·45	EL821	3·00		2·00
DY802	0·45	EM31	0·75	QQV06-40A	
E88CC/01	1·30	EM80	0·55		14·00
E180CC	1·30	EM81	0·60	QV03-12	2·00
E182CC	3·50	EM84	0·40	R19	0·80
E810F	6·00	EM87	1·00	S104/1K	2·50
EA50	0·45	EY51	0·45	SC1/400	4·00
EA76	2·00	EY81	0·45	SC1/600	4·00
EABC80	0·40	EY86/87	0·50	SP61	0·85
EAF42	0·70	EY88	0·50	TT21	6·50
EB91	0·30	EZ40	0·60	U25	1·00
EBC33	1·00	EZ41	0·75	U26	0·85
EBC41	0·75	EZ80	0·30	U27	1·00
EBF80	0·45	GZ32	0·65	U191	0·75
EBF83	0·45	GZ33	2·50	U801	0·80
EBF89	0·40	KT66	4·00	UABC80	0·50
EC52	0·40	KT88	5·00	UAF42	0·75
ECC81	0·45	MH4	1·00	UBC41	0·60
ECC82	0·40	ML6	1·00	UBF80	0·50
ECC83	0·40	OA2	0·45	UBF89	0·50
ECC84	0·35	OB2	0·45	UBL1	1·00
ECC85	0·45	PABC80	0·40	UBL21	0·75
ECC86	1·25	PC86	0·65	UCC85	0·50
ECC88	0·55	PC88	0·65	UCF80	0·80
ECC189	0·80	PC92	0·65	UCH42	0·80
ECF80	0·45	PCC84	0·45	UCH81	0·50
ECF82	0·45	PCC85	0·50	UCL82	0·45
ECF801	0·75	PCC89	0·55	UCL83	0·70
ECH42	0·85	PCC189	0·65	UF41	0·75
ECF81	0·45	PCF82	0·40	UF80	0·40
ECH84	0·50	PCF84	0·65	UF85	0·50
ECL80	0·60	PCF86	0·65	UF89	0·50
ECL82	0·40	PCF201	0·90	UL41	0·75
ECL83	1·20	PCF801	0·55	UL84	0·50
ECL86	0·55	PCF802	0·55	UY41	0·55
EF36	0·75	PCF806	0·85	UY85	0·50
EF39	1·00	PCF808	1·00	VR105/30	0·50
EF40	0·70	PCH200	0·80	VR150/30	0·50
EF41	0·75	PCL81	0·60	X61M	1·50
EF80	0·35	PCL82	0·45	X66	0·75
EF83	1·50	PCL83	0·70	Z800U	3·00
EF85	0·45	PCL84	0·50	Z801U	3·50
EF86	0·45	PCL86	0·60	Z900T	1·50
EF89	0·35	PCL805/85		1A3	0·60
EF91	0·65		0·60	1L4	0·30
EF92	0·75	PFL200	0·70	1R5	0·55
EF95	0·45	PL36	0·60	1S4	0·40
EF183	0·40	PL81	0·55	1S5	0·40
EF184	0·40	PL82	0·50	1T4	0·40
EF804	2·00	PL83	0·50	1X2B	0·80
EFL200	0·75	PL84	0·50	2X2	0·80
EH90	0·60	PL504	0·95	2D21	0·55
EL32	0·60	PL508	0·95	2K25	9·00

PLUMBICON TUBES TYPE XQ. 1020R Mullard—£150 each

				14S7	1·00
				19AQ5	0·75
				19G3	10·00
				19G6	6·00
3A4	0·60	6H6	0·45	19H5	17·00
3E29	5·50	6J4WA	1·75	20P3	0·60
3D6	0·40	6J5	0·75	20P4	1·10
3S4	0·50	6J5GT	0·55	25L6GT	0·80
3V4	0·85	6J6	0·35	30C15	1·00
5B/254M	5·50	6J7	0·70	30C17	1·10
5B/255M	5·50	6J7G	0·50	30C18	1·10
5B/258M	5·50	6K7	0·55	30F5	1·00
5R4GY	1·10	6K7G	0·35	30FL12	1·20
5U4G	0·60	6K8GT	0·55	30FL14	1·00
5V4G	0·65	6L6M	1·90	30L15	1·00
5Y3GT	0·65	6L6GT	0·60	30L17	1·00
5Z3	1·00	6L7	0·65	30P12	1·00
5Z4G	0·70	6SA7	0·55	30PL1	1·00
5Z4GT	0·75	6SG7	0·60	30PL13	1·10
6AB7	0·60	6SJ7	0·60	30PL14	1·10
6AC7	0·60	6S87GT	0·50	35L6GT	0·80
6AH6	0·75	6SK7	0·60	35W4	0·60
6AK5	0·45	6SL7GT	0·55	35Z4GT	0·70
6AK8	0·40	6SN7GT	0·55	50C5	0·70
6AL5	0·30	6SQ7	0·65	50CD6G	1·20
6AL5W	0·65	6V6GT	0·60	75	1·00
6AM5	1·60	6X4	0·45	75C1	0·80
6AM6	0·65	6X5G	0·45	76	0·80
6AN8	0·85	6X5GT	0·55	78	0·75
6AQB	0·50	6Y6G	0·95	80	0·75
6AQ5W	0·85	6Z4	0·65	85A2	0·75
6AS6	0·80	6-30L2	0·90	723A/B	9·00
6AT6	0·65	7B7	0·60	803	6·00
6AU6	0·40	7Y4	0·80	805	18·00
6AV6	0·50	9D2	0·60	807	1·00
6AX4GT	0·80	9D6	0·75	813	6·50
6AX5GT	1·00	11E3	11·00	829B	5·50
6B7	0·75	12A6	0·60	832A	4·50
6BA6	0·40	12AL5	0·70	866A	2·80
6BE6	0·45	12AT6	0·45	931A	6·00

Add 12½% for V.A.T.

6BG6G	1·00	12AT7	0·45	954	0·50
6BJ6	0·75	12AU7	0·40	956	0·50
6B07A	0·60	12AV6	0·80	957	0·90
6BR7	2·30	12AX7	0·40	1625	1·00
6BW6	2·80	12BA6	0·50	1629	0·70
6BW7	1·00	12BE6	0·60	2051	1·00
6C4	0·40	12BH7	0·60	5763	2·00
6C6	0·55	12C8	0·55	5933	3·00
6CB6	0·50	12E1	4·25	6057	0·85
6CH6	3·00	12J5GT	0·40	6060	0·85
6CL6	0·75	12K7GT	0·60	6064	0·85
6D6	0·50	12K8GT	0·70	6065	1·20
6EA8	0·80	12Q7GT	0·50	6067	1·00
6F8G	0·75	12SC7	0·55	6080	3·50
6F12	0·65	12SG7	0·55	6146	3·80
6F17	1·00	12SJ7	0·55	6146B	4·20
6F33	4·20	12Y4	0·40	6360	2·00

POSTAGE: £1-£2 20p; £2-£3 30p; £3-£5 40p; £5-£10 60p; over £10 free, minimum order £1.

VIDECON TUBE TYPE P863B English Electric—£20

TF 801D/1/S SIGNAL GENERATOR. Range 10-485MHz in 5 ranges, R.F. output 0-1 V-IV. Source C.M. 50 Ω output impedance. Internal modulation at 1KHz at up to 90%.
TF 801B/2. Spec. as for 801D but minor circuit differences. Few only left.
TF 995A/1 or A/2 or A/2M or A5 SIGNAL GENERATORS. Very high class AM/FM 1·5MHz to 220MHz. Details spec. and price on application.
TF 995/3S with additional amplifier to give extra high output between 1·5 and 6 Mc/s.

TF 1400S DOUBLE PULSE GENERATOR WITH TM 6600/S SECONDARY PULSE UNIT Rep. freq. 10Hz to 100kHz, pulse with 0·1 to 100μ sec. delay —1·5 to +3000μ sec., rise time 30 sec.

TF 144H SIGNAL GENERATOR
HIGH FREQUENCY SPECTRUM ANALYSER. MARCONI TYPE 1094A/S. Basic Freq. range 3 to 30 Mc/s and with LF unit from 100Hz to 3MHz. Measures relative amplitudes up to 60dB.
TF 934 DEVIATION METER. 250MHz.
TF1041 B VALVE MULTIMETER. DC voltage from 300mV to 1,000V AC voltage from 300mV to 300V at up to 1,000MHz.
TF1370 R.C. OSCILLATOR FOR SQUARE & SINE WAVE. Freq. —31·6V rms 10Hz-1MHz square wave 0·73 2pp. 10Hz-100KHz.

SIEMENS

LEVEL OSCILLATOR TYPE BEL 3W518. Frequency from 10KHz to 17MHz. Modulation is external output from +10dB to —60dB in 8 steps and in continuance with wobbler step generator. Imp output 150, 145, 135, 75, 65 ohms.
LEVEL OSCILLATOR TYPE REL 3W29. Frequency from 0·3 to 1200 Kc/s. Modl ext. output from +16dB to —60dB. Impedance output 75, 140, 600 ohms.
36-FOOT AERIAL MASTS consisting of 6 sections 6′ 8″ x 2¼″ dia. Complete with all accessories to erect and instal.
AVO CT190 VALVE TESTERS
LOW RESISTANCE HEADPHONES TYPE CLR £1·50. 40p postage VAT 12½%.
AR88 D & LF SPARES. We hold the largest stock in UK. Write for list.
RF METERS. 0 to 8 amps 2¼″ dia. USA. brand new **£1·50 P&P 25p.**

VAT TEST EQUIPMENT 8%

A lot of these valves are imported and prices vary for each delivery, so we reserve the right to change prices for new stock when unavoidable.

VALVES AND TRANSISTORS

Telephone enquiries for valves, transistors, etc.; retail 749 3934, trade and export 743 0899.

RHODES & SCHWARZ

Z-g DIAGRAPH TYPE 2DU 30-420MHz 50 Ω. Directly measures multiterminal networks, phase shift, phase angle with complementary POWER SIGNAL GENERATOR TYPE SMLM high freq. resolution, internal, external mod. up to 3v out.
FREQUENCY SYNTHESIZER TYPE XUA. 30Hz-30MHz with FREQUENCY INDICATOR TYPE FKM 15-30MHz 30-100MHz.
UHF SIGNAL GENERATOR TYPE SMLM from 30 to 303MHz.
UHF SIGNAL GENERATOR TYPE SLSD from 300 to 300-940MHz.
FREQUENCY INDICATOR TYPE FKM from 30 to 1,000MHz.

C.R. TUBES

DG7–5	15·00	3BF1	8·00
DG13–2	22·00	5FP7	10·00
MW13-35	35·00	88J	9·00
		88L	9·00
VCR139A	10·00	CV1526	10·00

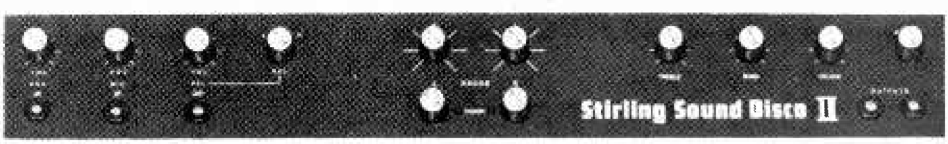
BARROW DRUM (Trolley) WD Mk III on pneumatic wheels.
PANEL METERS
Voltmeters—Micro Ammeters.
Milli Ammeters—Large Selection.
545A. Bandwidth DC to 30MHz (3dB down at 30MHz) ± ⅓dB, depending on plug-in unit. Specification and price on request.
570 CHARACTERISTIC CURVE TRACE
517A OSCILLOSCOPES wide band high voltage cathode ray oscilloscope designed for observing and photographically recording wave from having extremely short rise tmes.
DANA EXACT FUNCTION GENERATOR MODEL 121. Frequency range 0·2Hz to 2MHz (7 ranges), voltage controlled to 10V sweep generator 1ms to 10 sec.
TEXSCAN ELECTRONIC SYSTEM ANALYZER MODEL 9990. Frequency range 10MHz to 300MHz with market controls.
FURZEHILL SENSITIVE VALVE VOLTMETER TYPE V200A full scale from 10mV to 1000V in 6 steps with output amplifier.
TRAINING SET for Radio Operators with 10 key terminals and control frequency and volume.
TRANSMITTER RECEIVER. Transmitter Type M9 receiver Type M17 with fixed frequency (range 240mHz).
TEST SET FT2 for testing Transceivers A40

COLOMOR
(ELECTRONICS LTD.)
120 Goldhawk Rd., London W.12
Tel. 01-743 0899
Open Monday to Friday
9-12.30, 1.30-5.30 p.m.

GREAT SOUND – GREAT VALUE!

Sterling Sound

Disco 2
Mixer Control unit
+ power supply



£39·95
inc. V.A.T. & post free in U.K.

By designing and manufacturing in our own Essex factory, with strict material control and stage by stage checking and then selling direct to YOU, the customer, we can save you pounds, offer better service and guarantee satisfaction. Our latest modular assembly, Disco 2 has already been thoroughly field tested and is ready for immediate service under the toughest working conditions.

- **INPUTS**—Left deck, right deck, mic. and aux.
- **INPUT IMPEDANCE**—47K ohms
- **POWER SOURCE**—220-240V. A.C. Mains
- **CONTROLS**—Mains on-off, master volume, bass ±15db, treble ±15db, L and R mixing, L & R motor switches, selector switch for P.F.L. (Pre-Fade Listening), headphone volume, mic. vol., aux. vol., LED indicators on mains and decks on/off switches.
- **HEADPHONE AMPLIFIER**—Powerful 2 watts into 8 ohms; separate vol. control.
- **TERMINATIONS**—Five ¼″ jack sockets—2 input, 2 output, headphones.
- **SIZE**—23 ″ × 3¾″ × 2½″ max. depth to rear (plus separate power unit). Panel in matt black with controls sensibly grouped for easy handling.
- **PRICE**—Post free, with power unit and inc. V.A.T. **£39·95**
  Delivery ex-stock

SUITABLE STIRLING SOUND POWER AMPS. WITH HEAT SINKS AND POWER SUPPLY UNITS—140PH—£18. 160PH—£22. 1100PH—£26·75

Mail Orders to Dept. PW28

OTHER STIRLING SOUND DISCO/P.A. ITEMS

- **BASIC CONSTRUCTIONAL MODULES**
  SS.104/2 Two channel mixer stage £3·75
  SS.104/4 Four channel mixer stage £7·00
  SS.DTM Output control stage. 30db variation on both treble and bass. Master vol. control. 3mV in for 2V out. 18V working voltage £6·75
- **STIRLING SOUND—LIGHT MODULES**
  SSTL3/250 Three channels, each 250 watts output £9·25
  SSTL3/1000 Three channels, each 1,000 watts £11·50
- **INTEGRATED POWER AMPLIFIERS**
  Ready built in cases, tested and guaranteed —60 watts R.M.S. into 4 ohms
  POWER AMP 60/with two channel mixer £48·00
  POWER AMP 40—40 watts R.M.S. into 4 ohms with two channel mixer £43·00
- **POWER AMP. 100**—100 watts R.M.S. into 4 ohms with 4 channel mixer £85·00
  100 watt SLAVE AMP £50·00
- **READY BUILT ITEMS TESTED AND GUARANTEED**
  SSTL3/250B Sound to light unit 3 channels, 250w. each £23·95
  SSTL3/1000B Sound to light unit 3 channels, 1000w. each £25·95
  £27·95

TO ORDER BY ACCESS OR BARCLAYCARD JUST WRITE OR PHONE IN YOUR NUMBER

ALL PRICES QUOTED INCLUDE V.A.T. AND GOODS SENT POST FREE IN U.K. with C.W.O. orders. Owing to length of time between preparing this ad and its appearance to the public, prices are subject to amendment without notice

Stirling Sound

STIRLING SOUND, 37 VANGUARD WAY, SHOEBURYNESS, ESSEX (03708) 5543 Shop & Showroom 220/224 West Rd., Westcliff-on-Sea (0372) 351048

SMALL ADS

The prepaid rate for classified advertisements is 20 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £6·80 per single column centimetre (minimum 2·5 cms). All cheques, postal orders etc., to be made payable to Practical Wireless and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Wireless, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846)

CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

1. Advertisements are accepted subject to the conditions appearing on our current advertisement rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an infringement of the British Code of Advertising Practice.

2. The publishers reserve the right to refuse or withdraw any advertisement.

3. Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences.

NOTICE TO READERS

When replying to Classified Advertisements please ensure:

(A) That you have clearly stated your requirements.

(B) That you have enclosed the right remittance.

(C) That your name and address is written in block capitals, and

(D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

Receivers and Components

BRAND NEW COMPONENTS BY RETURN.

Electrolytic capacitors 16V, 25V, 50V.—0·47, 1·0, 2·2, 4·7 & 10mfd.—5p. 22, 47—5½p. (50V—6p). 100—7p (50V—8p) 220—8p. (50V—10p) 470—11p. (50V—16p) 1000/16V—15p. 1000/25V—18p. 1000/50V—22p.

Subminiature bead tantalum electrolytics—0·1, 0·22, 0·47, 1·0, 2·2 @ 35V, 4·7/25V—11p. 10/25V—13p. 22/16V. 47/6V, & 100/3V—15p.

Mullard miniature ceramic E12 series 2% 63V. 10pf. to 47pf—3p. 56pf. to 330pf.—4p.

Vertical mounting ceramic plate 50V.
E12 series 22pf-1000pf. E6 series 1500pf-47000pf.—2p.

Polystyrene E12 series 63V horizontal mounting. 10pf to 1000pf—3p. 1200pf. to 10000pf.—4p.

Mullard polyester 250V vertical mounting E6 series. 0·01 to 0·1—4p. 0·15, 0·22—5p. 0·33, 0·47—8p. 0·68—11p. 1·0—13p. 1·5—20p. 2·2—22p.

Mylar (Polyester) Film 100V vertical mounting. 0·001, 0·002, 0·005—3p. 0·01, 0·02—4p. 0·04, 0·05—4½p.

Miniature resistors Highstab E12 series 5%. Carbon Film 0·25W 1Ω to 10MΩ. (10% over 1MΩ)—1p. Metal Film 0·125W, 0·25W & 0·5W 10Ω to 2M2Ω.—1½p. Metal Film 1W. 27Ω to 10MΩ.—2p ea.

1N4148—3p. 1N4002—5p, 1N4006—7p. 1N4007—8p. BC107/3/9, BC147/8/9, BC157/8/9 & BF194 & 197—9p. Fuses 20mm. glass. 1¼" glass & 1" ceramic. 2½p. Post 10p. (Free over £4·00) Prices inclusive of VAT.

THE C. R. SUPPLY CO.
127, Chesterfield Rd., Sheffield S8.

ELECTRONIC CENTRE (STOCKPORT) LTD., 45 Lower Hillgate, Stockport. Tel: 061-480 9791. Packs for DIY enthusiasts. Resistors 100 £1·00, mixed semiconductors large bag £1·20, capacitors various £1·10, thyristors 8A 100V 15 £1·00, rectifier bridges 3A 50V 6 £1·00, 741 OP Amps 5 £1·00. Many other items. SAE with enquiries please. C.W.O. under £2 add 20p.

VALVES

Radio – T.V. – Industrial – Transmitting
We Dispatch Valves to all parts of the world by return of post, Air or Sea mail, 2700 Types in stock, 1930 to 1976. Obsolete types a speciality. List 20p. Quotation S.A.E. Open to callers Monday to Saturday 9.30 to 5.00 closed Wednesday 1.00. We wish to purchase all types of new and boxed Valves.

COX RADIO (SUSSEX) LTD.
Dept. P.W. The Parade, East Wittering, Sussex PO20 8BN
West Wittering 2023 (STD Code 024366)

TEST METER PANELS, £2. Ex-GPO pliers and cutters, 75p each. Transistor Amplifiers, 75p each. P&P 50p per order. ARCHER, Box 139

ORCHARD ELECTRONICS

I.C.s TTL. C/Mos. Linear. Capacitors. Resistors. (E12) SIL/Rectifiers. Diodes. LED. Thyristors. Zeners. Voltage Reg. DIL Sockets. Bridge Rectifiers. Potentiometers. Presets. Triacs. Diac. Plugs. Sockets. Cable. Vero. Carefully selected range, excellent despatch service Same day turn round. S.A.E. List. Suppliers to A.E.R.E. U.K.A.E.A. Governments Depts. Schools. Universities. Manufacturers. Accounts opened for trade and amateur. Join the professionals. Phone by 4 p.m. Goods out 1st class by 5 p.m. Try us and prove it!

ORCHARD ELECTRONICS
Flint House, High Street, Wallingford, Oxon. Telephone 0491-35529

GAMMA ENTERPRISES for transistors, resistors, capacitors, ICs, hardware, etc. Large SAE for catalogue. 18 Landale Road, Peterhead, Aberdeenshire AB4 6QP.

NOSTALGIA COLLECTING

VINTAGE RADIO
1920 to 1950

Receivers, valves, components, service data, historical research, books, magazines, repairs and restorations. A complete service for the collector and enthusiast of vintage radio.

S.a.e. with enquiries and for monthly newsheet. Full 1977 catalogue, 70p post paid.

TUDOR REES (Vintage Services), 64, Broad Street, Staple Hill, Bristol, BS16 5NL. Tel. Bristol 565472.

LED's. Mixed bags of 4 different sizes and 4 different colours. 50 at £5·25, 100 at £9·25 including VAT and post and packing. CWO. Michael Williams Electronics, 47 Vicarage Avenue, Cheadle Hulme, Cheshire, SK8 7JP.

TOUCH CONTROLLED LIGHTING KITS

These KITS replace conventional light switches and control 300W of lighting. No mains rewiring required. Insulated Touch Plates. Easy to follow instructions.
TSD300K—TOUCHSWITCH & DIMMER combined. ONE touch plate to switch light on or off. Brightness controlled by small knob—£5·20.
TS300K—TOUCHSWITCH. TWO touch plates—£4·00
TSA300K—AUTOMATIC. ONE touch plate. Light turns off after preset delay—£4·00.

LD300K—LIGHT DIMMER KIT—£2·80.

400V TRIACS Plastic	
3A	63p
8·5A	79p
12A	84p
16A	105p
20A	155p
6·5A with trigger	80p
Diac	21p

BULK OFFERS	
BC148	£7/100*
555	£28/100
741	£18/100
8A/400V Triac	£71/100
DL727 dual 0·5" 7 seg LED Display	£62/50
555 36p (3 for £1)	
741 24p (5 for £1)	

CMOS	
4001	18p
4007	18p
4011	18p
4013	51p
4015	91p
4016	51p
4017	91p
4040	97p
4049	50p

CLOCK 1KW APPLIANCE TIMER KIT inc. AY-5-1230, 0·5".
LED display, triac, switches, box pcbs, etc. £16·25
AY-5-1230 CLOCK APPLIANCE TIMER IC £4·85
LM3911 THERMOMETER/TEMPERATURE CONTROL I.C. £1·00

QUANTITY DISCOUNTS ON REQUEST
Add 8% (*12½%) VAT + 25p P&P. Mail Order Only to:
T.K. ELECTRONICS (PW)
106 Studley Grange Road, London W7 2LX

CRYSTAL CALIBRATOR!

Put yourself spot-onto any frequency in the LW, MW, SW, or VHF bands. Ingenious circuit gives cw. or int.AM. giving audible tone on harmonics of 1MHz, 100KHz, or 10KHz. Complete KIT only £12·72+8% VAT
or send 15p (not stamps) for details
ROCQUAINE ELECTRONICS
Aldebaran, Le Coudre, St. Pierre-du-Bois, GUERNSEY.

TIRRO ELECTRONICS the mail order division of Ritro Electronics UK offers a wide range of components for the amateur enthusiast. Large SAE or 20p brings list. Grenfell Place, Maidenhead, Berks. SL6 1HL.

BARGAIN SUPPLIES

Barrel kits for £1·99p. Guaranteed 50% or higher yield. 100% money back if not absolutely delighted.

50 pieces SN7400 series may include gates registers, flip flops, who knows? or

50 pieces linear, op-amps etc. 741, 709 555 you to sort, or

50 plastic transistors BC182/4/212 lots of 2N no's, or

6 LED readouts, factory returns—we've no time to test.

100% good devices, our 'A' type barrels all fully tested and guaranteed: £1·99p each.

35 TO3 power transistors, or

4 240/12-0-12 100mA transformer plus power supply P.C.B. brand new, or

200 500mA. 400V. PIV silicon diodes, or

200 capacitors all types all values, or

12 push to make switches red/yellow/green or

1 calculator keyboard 0-9 2 blanks.

Please add 30p per line postage and packing all prices include VAT. **JONES SUPPLIES. 588, ASHTON RD. OLDHAM. LANCS. 061-652-9879.**

TRANSISTORS, Resistors, Caps, Pots, plugs 7 sockets, zeners, TTL, cable, boxes, all at very good prices. 65 Railway Road, Leigh, Lancs. Telephone Leigh 679575.

Books and Publications

SIMPLIFIED TV REPAIRS. Full repair instructions individual British sets £4·50, request free circuit diagram. Stamp brings details unique. TV Publications (Ause PW), 76 Church Street, Larkhall, Lanarkshire.

THE DALESFORD SPEAKER BOOK
by R. F. C. Stephens.

This book is a must for the keen home constructor. Latest technology DIY speaker designs. Contains full plans for infinite baffle and reflex designs for 10-100 watts, also unusual centre-bass system for those who want Hi-fi to be "Heard and not seen". £1·95 (£2.20 post paid. $5 Overseas).

VAN KAREN PUBLISHING
5 SWAN STREET
WILMSLOW
CHESHIRE

HOW TO START A BUSINESS. By popular demand a fully illustrated manual has now been produced, showing, in easy, step by step, stages, how to rewind ARMATURES & FIELD COILS as used in Vacuum Cleaners, Drills and Portable Tools. Chapters on taking data, materials required, test instruments required, rewind instructions, charts, etc. How to cost instruction manual £4·00 plus 30p P & P. CWO. COPPER SUPPLIES, 102 Parrswood Road, Withington, Manchester 20. Dept. PWA.

Radio Receivers

MULTIBAND RADIOS. 12 band . . . Marine, Aircraft, LPSB, HPSB, UHF (430/470), SW1/4, MW, LW, FM, RF gain. BFO. £150. GRUNDIG SATERLITT £199. BFO Units, £16·50. SHARP MW/Aircraft, £13. Langtons, High Street, Rocester, Staffordshire. SAE lists.

Service Sheets

SERVICE SHEETS — COLOUR TV SERVICE MANUALS

Service Sheets for Mono TV, Radios, Record Players and Tape Recorders 75p. Please send large Stamped Addressed Envelope. We can supply manuals for most makes of Colour Television Receivers by return of post.

B.R.C. PYE ECKO PHILIPS ITT/KB SONY G.E.C. HITACHI BAIRD ULTRA INVICTA FERGUSON H.M.V. MARCONI AND MANY MORE

Let us quote you. Please send a Stamped Addressed Envelope for a prompt reply. Also comprehensive T.V. repair manuals by J. M. Court. S.A.E. for details. MAIL ORDER ONLY

G. T. TECHNICAL INFORMATION SERVICE
10 DRYDEN CHAMBERS, 119 OXFORD ST., LONDON WIR 1PA

BELL'S TELEVISION SERVICES for Service Sheets on Radio, TV, etc., 75p plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 Kings Road, Harrogate, N. Yorkshire. Tel: (0423) 55885.

SERVICE SHEETS for Radio, Television, Tape Recorders, Stereo, etc. With free fault-finding guide, from 50p and SAE. Catalogue 25p and SAE. HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.

SERVICE SHEETS, Radio TV, etc., 10,000 models. Catalogue, 24p, plus SAE with orders, enquiries. Telray, 154 Brook Street, Preston PR1 7HP.

LARGE SUPPLIER OF SERVICE SHEETS
All models at 75p plus s.a.e. except colour and Car Radios. Free TV fault finding chart or TV list.
C. CARANNA
71 Beaufort Park London NW11 6BX
01-458 4882

Aerials

G2DYM ANTI-TVI AERIALS

DO OVERCOME TVI PROBLEMS FOR BOTH THE SWL & TRANSMITTING AMATEUR. A 12½p SAE and 39p Stamps bring you full details, article on aerials and copies of genuine testimonials from satisfied customers with their names and full addresses.

LAMBDA, WHITEBALL, WELLINGTON, SOMERSET

For Sale

NEW ISSUES of "Practical Wireless" available from April 1974 edition up to date. Price 65p post free. Bell's Television Services, 190 Kings Road, Harrogate, N. Yorkshire. Tel: (0243) 55885.

94 ISSUES OF PRACTICAL WIRELESS, May 63 to March 76. Offers Mr. S. Elson, Flat 253 Cannock Road, Chadsmoor, Staffs.

EDITIONS OF P.W. AND P.E. from Jan 1967-Dec 1977. 50p per copy, including postage; or £30 for the lot if collected. 214 Chorley New Road, Bolton. Tel (0204) 42545.

Wanted

WANTED. Valves, types PX4 and PX25, new or S/Hand; any quantity. Rees, 64 Broad Street, Staple Hill, Bristol. Tel: 0272 565472.

WANTED. New Valves, Transistors. Top prices, popular types. Kensington Supplies (C), 367 Kensington Street, Bradford 8, Yorkshire.

SURPLUS??? Turn it into cash. Phone 0491 35529 (Oxon).

WANTED NEW Valves, transistors, I.Cs, amplifiers, receivers, televisions (Anything Useful) any quantity. Stan Willetts, 37 High Street, West Bromwich. Tel: 021-553 0186.

CODAR PRESELECTORS, new or used. Write Glasson, 34 Minard Rd., London SE6.

"RADIO AND TELEVISION SERVICING" books wanted from 1964-65 edition up to date. £3·00 plus postage paid per copy by return of post. Bell's Television Services, 190 Kings Road, Harrogate, N. Yorks. Tel: (0423) 55885.

Educational

GO TO SEA as a Radio Officer. Write: Principal, Nautical College, Broadwater, Fleetwood FY7 8JZ.

COURSES—Radio Amateurs Examination, City & Guilds. Pass this important examination and obtain your G8 licence, with an RRC Home Study Course. For details of this, and other courses (GCE, Professional examinations, etc.), write or phone: **THE RAPID RESULTS COLLEGE**, Dept. JX1, Tuition House, London SW19 4DS. Tel: 01-947 7272 (Careers Advisory Service) or for a prospectus only ring 01-946 1102 (24hr recording service).

TELEVISION TRAINING

12 MONTHS' full-time course in Radio & TV for beginners. (GCE—or equivalent—in Maths. and English).

26 WEEKS' full-time course in Mono & Colour TV. (Basic electronics knowledge essential). **13 WEEKS'** full-time course in Colour TV. (Mono TV knowledge essential).

These courses incorporate a high percentage of practical training.

NEXT SESSION commences on April 17th.

Prospectus from: London Electronics College, Department B2, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Practical Wireless for .... insertions.

I enclose Cheque/P.O. for £...................... .

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Practical Wireless).

NAME ....

ADDRESS ....

....

Send to: Classified Advertisement Manager
PRACTICAL WIRELESS,
GMG, Classified Advertisement Dept., Rm. 2337,
King's Reach Tower, Stamford Street.
London SE1 9LS **Telephone 01-261 5846**

Rate
20p per word, minimum 12 words. Box No. **60p** extra.

Company registered in England. Registered No. 53626. Registered office: King's Reach Tower, Stamford Street, London SE1 9LS

Electrical

LIST NO. 28 now ready—Styli illustrated equivalents also cartridges, leads, etc., free for long SAE. Felstead Electronics (PW), Longley Lane, Gatley, Cheadle, Cheshire SK8 4EE.

TIMESWITCHES. Cheap timeswitches, Sangamo 20 amp reconditioned guaranteed for one year. Only £3·70. Also electric eyes. Write:— J. Donohoe, 1 Upper Norfolk St., North Shields, Tyne & Wear.

Ladders

LADDERS. Varnished 20ft 9in extd., £28, carr. £2·40. Leaflets. Also alloy ext. up to 62ft 6in. Ladder Centre (WLS2), Halesfield (1) Telford. Tel: 586644. Callers welcome.

Miscellaneous

ARMATURE & COIL WINDING ENAMELLED COPPER WIRE
Only top quality materials supplied.
All orders dispatched within 24 hrs.

S.W.G.	1 lb reel	½ lb reel
10 to 19	£2·95	£1·60
20 to 29	£3·15	£1·80
30 to 34	£3·45	£1·90
35 to 40	£3·65	£2·10

All prices are inclusive of P. & P. in U.K.
COPPER SUPPLIES, 102 Parrswood Road, Withington, Manchester 20. Tel: 061-445 8753

SUPERB INSTRUMENT CASES by Bazelli, manufactured from P.V.C. faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low 90p, chassis punching facilities at very competitive prices. 400 models to choose from, free literature (stamp would be appreciated). BAZELLI, Dept No 25, St. Wilfrid's, Foundry Lane, Halton, Lancaster LA2 6LT.

MORSE CODE TUITION AIDS
Cassette A: 1-12 w.p.m. for amateur radio examination.
Cassette B: 12-24 w.p.m. for professional examination preparation.
Morse by light system available. Morse Key and Buzzer Unit for sending practice.
Prices each Cassette (including booklets) £4; Morse Key and Buzzer £4.
Prices include postage etc., Overseas Airmail £1·50 extra.
MHEL ELECTRONICS (Dept PW)
12 Longshore Way, Milton, Portsmouth PO4 8LS

MONITOR RECEIVERS Marine or 2M amateur and other station accessories. SAE for details. MDH Radiotelephones, Munster House, Priory Road, Milford Haven, Dyfed. Tel. 06462 5534.

GOVERNMENT SURPLUS
Super Pack 40 Plus
1 12v reversible motor, 5 reed switches (open), 10 micro switches with leads, 5 D.P. Toggle switches, 4 magnetic Microphone/Speakers, 1 spring coil cable, 4 lengths 3 to 15ft multicore cable colour coded and spaded, 5 small magnets, 5 mini (1 x ½") electro magnets PLUS
Send £2·50 plus 50p P & P to **B. B. Supplies (Dept PW) 125 High Street, Deal Kent. Tel. 03045 62573.**
Trade please note new address and telephone number for enquiries.

OUTSTANDING 2200 Hi-Fi FM Tuner. Full coverage 88-102MHz. Varicap tuning. Latest silicon superhet design. Ideal for push button/manual tuning, only £9·95. Unique 3300 stereo class A Amplifier, power 32 watts peak, complete stereo Pre-Amplifier/2 Power Amplifiers, all inputs accepted. Only £10·95. 5500 Tuner Amplifier plus specification as above 2. Only £19·95. All equipment built, tested and guaranteed with full instructions. (P&P 50p.) GREGG ELECTRONICS, 86-88 Parchmore Road, Thornton Heath, Surrey.

SINTEL KITS, COMPONENTS, CMOS etc.

MOT. CMOS Databk	3·50	RCA CMOS Databk.	5·45
6800 Appl. Man.	12·95	Z80 Ass. Lang. Prog. Man.	7·50
NS TTL Databk.	2·10		
Best of Byte Vol. 1	11·95	Z80—CPU Man.	5·60

All items CWO (Books-No VAT) 35p p&p.
Full range in our FREE CATALOGUE which will be sent by return.
SINTEL, P.O. BOX 75F, 209 Cowley Road, Oxford Tel.: (0865) 49791.

VERO Cases 19in x 12in x 4in Cat. No. ICD-2U-8, ideal for amplifiers. Test Gear. £6 each. 01-555 3755.

LOW COST ALUMINIUM BOXES with lids and screws. 3 x 2 x 1-42p, 4 x 3 x $1\frac{1}{2}$-49p, 4 x 3 x 2-56p, 6 x 4 x 2-62p, 6 x 4 x3-72p, 8 x 6 x 2-97p, 8 x 6 x 3-£1·08. Prices include p&p. Harrison Bros., P.O. Box 55, Milton Road, Westcliff-on-Sea, Essex SS0 7LQ.

BUILD THE **TREASURE TRACER MK III** Metal Locator

- Varicap tuning
- Britain's best selling metal locator kit;
- Fitted with Faraday shield.
- Speaker and earphone operation
- 4,000 already sold
- Knocks down to only 17in.
- Prebuilt search coil assembly
- Thoroughly professional finish
- As seen on BBC1 and BBC2 TV
- You only need soldering iron, screwdriver, pliers and snips
- Five transistor circuit

Send stamped, addressed envelope for leaflet

Complete Kit **£15·95** Post £1·20+£1·37 VAT — Built & tested **£20·95** Post £1·20+£1·77 VAT
MINIKITS ELECTRONICS, 6a CLEVELAND ROAD, LONDON, E18 2AN (Mail order only)

NEED A HAND? Kits, projects built to your requirements by professional engineer. K.E.S., 12 Woodside Court, Selbourne Road, Littlehampton, Sussex. Tel: 21858.

PRINTED CIRCUITS and HARDWARE
Readily available supplies of Constructors' Hardware. Printed circuit boards, top quality for individual designs. Prompt service. Send 25p for catalogue from:
RAMAR CONSTRUCTOR SERVICES
Masons Road, Stratford-on-Avon, Warwicks Tel: 4879

IMMEDIATE BY RETURN DELIVERY. Large range of miniature synchronous motors, many speeds 1 rev per hour to 1 rev per 2 days. £1·10 to £2·50 each. 3 and 4 digit mechanical counters, 45p to 85p. 10 amp micro switches at 20p. SAE for list. WALES (ELECTRICAL) LTD., Queen St., Newton Abbot.

BURGLAR ALARM SYSTEMS! 12v siren £5·53, 240v siren £9·61, plastic coated and lettered bell box £5·25. Flush magnetic contact 60p, surface 65p. SAE for price list. C.W.A.S., 11 Denbrook Walk, Bradford BD4 0QS. Bradford 682674. All prices fully inclusive.

NO MORE DING-DONG
Now get MUSIC from your DOORBELL—or your CAR. New programmable Chime announces you or your surprised guests. 119 easy-to-change tunes or PROGRAM YOUR OWN. Just needs speaker and existing bell transformer or 12V. All parts, instructions and programs, postage, money back assurance, send **£17·90** TODAY.
CAMBRIDGE KITS
45 (PB), Old School Lane, Milton, Cambridge

STABILISED P.S.U.s, large range of various voltages and currents, available cased or in chassis form. SAE for full particulars and prices. A. BARTON, PW, Highbanks, Newport Road, Sandown, I.W.

$3\frac{1}{2}$ DIGIT DVM MODULE KIT. Autozero, autopolarity only £37·50. SAE details. MLC, 116 College Road, Southwater, Horsham, Sussex.

ENAMELLED COPPER WIRE

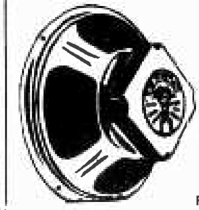
swg	1 lb	8oz	4oz	2oz
14–19	2·40	1·20	·69	·50
20–29	2·45	1·60	·82	·59
30–34	2·60	1·70	·89	·64
35–40	2·85	1·90	1·04	·75

Inclusive of p&p and VAT.
SAE brings Catalogue of copper and resistance wires in all coverings.
THE SCIENTIFIC WIRE COMPANY
PO Box 30, London E4 9BW
Reg. Office: 22 Coningsby Gardens,

H. M. ELECTRONICS
275a FULWOOD ROAD, BROOMHILL, SHEFFIELD S10, 3BD.
BEC. CABINETS (illus'd)

METAL CASES
DRY TRANSFER LETTERING
Send 15p for leaflets (Refundable)
Trade enquiries invited

Sonic
HI-FI DISCOUNT CENTRES



DISCOUNT SPEAKERS
Imp 8 or 15Ω as app.
Guarantees:
TITAN 5 years
FANE 2 years
OTHERS 1 year
ALL PRICES INC. VAT
Prices correct at 27.10.77

HI-FI TYPES	List/Value	Sonic Price
5" FANE 501 Mid or Full range	Sp. Price	£4·95
8" x 5" 15w Various makes	Sp. Price	£3·35
8" A.F. Model 80 Dual Cone	Sp. Price	£5·95
8" A.F. Model 83 Dual Cone	Sp. Price	£6·95
FANE 805	Sp. Price	£5·95
FANE 804	Sp. Price	£4·95
FANE 801 Dual Cone	Sp. Price	£7·95
FANE 8" 808T Dual Cone	Sp. Price	£3·95
FANE 8" 807TP " "	Sp. Price	£4·75
WH'FEDALE L'TON 3XP kit Pr.	£60·70	£44·95
10" DENTON 2XP KIT Pair	£39·15	£27·95
10" " GLENDALE 3XP KIT	£82·44	£59·95
8" FANE MODE ONE KIT	Sp. Price Pair	£19·99
10" ELAC Model 10RM	Sp. Price	£3·85
12" FANE 121/15LR 20w	Sp. Price	£7·95
GROUP/DISCO TYPES		
12" FANE POP 15 15-20w	Sp. Price	£4·75
12" FANE POP 25T 25–30w	Sp. Price	£9·95
12" TITAN T12/45 45w	£15·80	£10·95
12" TITAN T12/60A 60w	£22·50	£12·95
12" TITAN T12/100A 100w	£36·00	£22·95
12" CELESTION G12M	£16·50	£12·99
12" CELESTION G12H 30w	£22·00	£15·95
12" CELESTION G12/50 50w	£25·75	£17·50
12" CELESTION G12/50TC	£28·00	£17·95
12" GOODMANS 12 PD	Sp. Price	£18·95
12" GOODMANS 12 PG	Sp. Price	£17·95
12" FANE 'SPECIALIST' P.A. 80	£26·95	£17·95
12" " " DISCO 80	£28·95	£18·95
12" " " DISCO 100	£30·95	£20·95
12" " " GUITAR 80L	£26·95	£17·95
12" " " GUITAR 80B	£27·95	£18·95
12" FANE CRESCENDO 12A 8Ω	£57·35	£39·95
12" FANE " 15Ω	£57·35	£35·95
12" FANE " 12L 8Ω	£59·95	£41·95
12" FANE " 15Ω	£59·95	£39·95
12" FANE " 12 BASS 8Ω	£56·70	£39·95
12" FANE " 15Ω	£56·70	£35·95
15" TITAN T15/60 60w	£26·00	£18·95
15" TITAN T15/70 70w	£28·00	£19·95
15" TITAN T15/100 100w	£41·00	£28·95
15" FANE 'SPECIALIST' BASS 85	£39·95	£29·95
15" " " BASS 100	£42·00	£31·50
15" GOODMANS 15P	Sp. Price	£23·95
15" CELESTION G15C	£36·00	£26·95
15" FANE CRESCENDO 15/100A 8Ω	£72·95	£49·95
15" FANE " 15Ω	£72·95	£44·95
15" FANE CRESCENDO BASS	£76·00	£49·95
15" " " 15/100LT	£74·69	£49·95
15" " " 15/160 160w	£95·00	£65·95
15" " " 15/125A	£95·00	£69·95
15" " " COLOSSUS 200w	£108·00	£69·95
18" TITAN T18/100 100w	£47·00	£35·95
18" GOODMANS 18P	Sp. Price	£39·95
18" CELESTION G18C	£53·00	£39·95
18" FANE CRESCENDO 18A	£101·95	£69·95
18" FANE CRESCENDO BASS	£89·95	£59·95
18" " 'COLOSSUS' 200w	£115·00	£69·95
HORN UNITS (Carr. 75p)		
CELESTION MH1000 25w	£17·00	£13·75
FANE 910 MK II 50w	£17·75	£10·99
" 920 100w	£59·95	£42·45
" J44 30·50w	£7·95	£4·95
" J73 50w	£11·75	£6·79
" J104 50·70w	£16·95	£9·75
HIGH POWER 'CROSS-OVERS'		
FANE HPX1R or HPX2R Carr. 35p	£3·25	£2·25
ADD-ON HIGH FREQUENCY UNITS		
F.A.L. 'Add-on' Carr. £1	£51·84	£35·95
TITAN T1H 70w Carr. £1	£33·00	£23·95
TITAN T52H 100w Carr. £1	£33·00	£23·95
TITAN T2H Carr. £1	£39·00	£26·95

EXTRA SPECIAL MAIL ORDER OFFER
TITAN TA 50A 50w AMPLIFIER

High sensitivity. Multi purpose three ind. controlled inputs. Controls: Bass, Treble & Presence. Robust, well styled compact cabinet Black Vynide covered. Attractive Black/Silver Fascia. 12 months Guarantee. Carr £1 **£39·95**

Also for personal shoppers only
AMPS, T'TABLES, JINGLE MACHINES, DISCO CONSOLES, LIGHTING, CABINETS, CREDIT TERMS AVAILABLE orders over **£20**
Phone orders accepted from Access & Barclay card holders.
Branches at
403 SAUCHIEHALL STREET Tel: 141 332 0700 GLASGOW
24 NEWGATE SHOPPING CENTRE
Tel: 0632 25168 NEWCASTLE
Mail Orders & Export enquiries to NEWCASTLE Branch. Add 60p carr. on Hi-Fi spkrs. or kits. Otherwise add 95p (12" spkr.) £1·50 (15") £2·50 (18")

Join the Digital Revolution

Understand the latest developments in calculators,

computers, watches, telephones, television, automotive, instrumentation . . .

Each of the 6 volumes of this self-instruction course measures 11¾in × 8¼in and contains 60 pages packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra, to memories, counters and simple arithmetic circuits, and on to a complete understanding of the design and operation of calculators and computers.

Design of Digital Systems.

£7·10

plus 90p pack ng and surface post anywhere in the world.

Overseas customers should send for proforma invoice

Quantity discounts available on request. VAT zero rated.

Also available—a more elementary course assuming no prior knowledge except simple arithmetic.

Digital Computer Logic and Electronics

In 4 volumes:

1. Basic Computer Logic
2. Logical Circuit Elements
3. Designing Circuits to Carry Out Logical Functions
4. Flipflops and Registers

£4·60

plus 90p P. & P.

Offer Order both courses for the bargain price **£11·10**, plus 90p P. & P.—a saving of £1·50.

Designer
Manager
Enthusiast
Scientist
Engineer
Student

These courses were written so that you could teach yourself the theory and application of digital logic. Learning by self instruction has the advantages of being quicker and more thorough than classroom learning. You work at your own speed and must respond by answering questions on each new piece of information before proceeding to the next.

NEW from Cambridge Learning Enterprises:
FLOW CHARTS AND ALGORITHMS—use, design and layout; vital for computing, training, wall charts, etc. **£2·95** plus 45p P. & P.

Guarantee—If you are not entirely satisfied your money will be refunded.

Cambridge Learning Enterprises, Proprietors: Drayridge Ltd. Registered in England No. 1328762.

Reg. Office: Cambridge Learning Enterprises, Unit 7, FREEPOST Rivermill Lodge, St. Ives, Huntingdon, Cambs. PE17 4BR

*Please send me....set(s) of Design of Digital Systems at £8·00 each, P. & P. included

*or....set(s) of Digital Computer Logic and Electronics at £5·50 each, P. & P. included

*or....combined set(s) at £12·00 each, P. & P. included

*or....the Algorithm Writers Guide at £3·40 each, P. & P. included

Name ....

Address ....

....

....

*delete as applicable

No need to use a stamp—just print FREEPOST on the envelope.

PW2

Stirling Sound

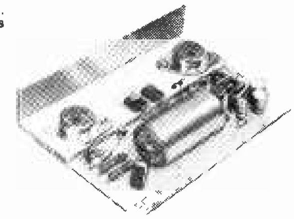
OUR UNIQUE BARGAIN PLAN CLOSES JAN. 31ST

STIRLING POLICY means specs. and prices you can rely on—no hidden extras—nothing to misunderstand. Until Jan 31st, when ordering a power amp. and power supply unit together

DEDUCT	*If ordered with UNIT ONE*	DEDUCT A FURTHER	*If ordered with UNIT TWO*	DEDUCT A FURTHER
5%		£1·00		£1·18

AMPLIFIERS 3 to 100 WATTS R.M.S.

Ready assembled on P.C.Bs., tested and guaranteed. Easy to connect. With instructions. Output ratings ± 1dB.



SS.103	I.C. amp. 3 watts R.M.S. using 20V/8Ω or 14V./4Ω. Input 100mV.	£2·85
SS.103-3	Stereo version of above. 2 I.C.s	£5·00
SS.105	5 watts R.M.S. into 3Ω using 13·5V. Sensitivity — 30mV. THD — 0·3%. 3¼" × 2" × 1".	£3·95
SS.110	10 watts R.M.S. into 4Ω using 24V. Sensitivity — 60mV, THD — 0·3%. 3¼" × 2" × 1".	£4·65
SS.120	20 watts R.M.S. into 4Ω using 34V. Sensitivity — 80mV, THD — 0·3%. 3¼" × 2" × 1".	£5·15
SS.125	25 watts R.M.S. into 8Ω using 50V. Sensitivity — 140mV. Distortion — Less than 0·05% into 8Ω S/N better than 70dB.	£7·25
SS.140	40 watts R.M.S. into 4Ω using 45V. Sensitivity — 300mV. Distortion typically 0·1%. 5" × 3¼" × 1¼".	£6·50
SS.160	64 watts R.M.S. into 4Ω using 50V. Sensitivity — 350mV. Distortion typically 0·1%. 5" × 3¼" × 1½".	£8·50
SS.1100	100 watts R.M.S. into 4Ω using 70V/2A. Input sensitivity — 500mV. Distortion at half-power, typically 0·1%. 5" × 3½" × 1¼".	£10·50
HS.160	Multi-finned heatsink for SS.140 or SS.160.	75p
HS.1100	Ditto for SS.1100	£1·50

THE CONTROL AND PRE-AMP MODULES

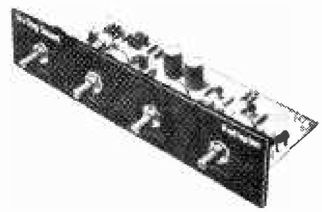
UNIT ONE
Combined stereo pre-amp & active tone control unit. Input sensitivity 50mV for 200mV out, 10/16V operation. Bass ± 15dB at 30Hz; Treble ± 15dB at 100KHz; Balance control; Volume control. For ceramic P.U., radio or tape Inputs. WITH FREE CONTROL PANEL FASCIA **£9·00**

UNIT TWO
With control facilities similar to UNIT ONE but for magnetic cartridge input. R.I.A.A. corrected. Input sensitivity — 5mV for 200mV out (can be varied). WITH FREE CONTROL PANEL FASCIA **£12·43**

CONTROL PANEL FASCIA available separately **50p**

SS.100 basic active stereo tone control module to provide ± 15dB on base at 30Hz and on treble at 10KHz **£3·00**

SS.101 Stereo pre-amp suitable for ceramics, tape, radio, etc **£2·75**



SS.102 Stereo pre-amp for mag. pick-ups· R.I.A.A. corrected **£4·45**

F.M. STEREO DECODER, phase lock loop type, with LED indicator showing when a stereo transmission is being received **£5·25**

POWER SUPPLY UNITS

Every Stirling Sound Power Unit is tested and guaranteed under working conditions before despatch. All units except SS.312 include a stabilised low voltage take-off point (13-15V) for pre-amp, tone control, radio tuner, etc. Outputs quoted minimal unloaded ratings.

SS.312	12V/1A	£6·60
SS.318	18V/1A	£6·95
SS.324	24V/1A	£7·65
SS.334	34V/2A	£8·75
SS.345	45V/2A	£10·75
SS.350	50V/2A	£11·75
SS.360	60V/2A	£12·75
SS.370	70V/2A	£14·75

SS.310/50 Stabilised power supply unit with variable output from 10V to 50V/2A. Short circuit protected **£17·75**

SS.300 Power stabilising unit variable from 10 to 50V/8A for adding to un-stabilised supply units **£5·50**

ALL GOODS POST FREE IN U.K. ALL PRICES INCLUDE V.A.T.
Prices subject to alteration without notice. Order to Dept. PW28A.

STIRLING SOUND, 37 VANGUARD WAY, SHOEBURYNESS ESSEX Phone (03708) 5543

Shop & Showroom 220/224 West Rd., Westcliff-on-Sea. Phone Southend (0702) 351048

ACCESS OR BARCLAYCARD CUSTOMERS—JUST TELL US YOUR NUMBER

STIRLING SOUND, 37 VANGUARD WAY, SHOEBURYNESS

Please send ....

(or as attached list) for which I enclose £...........

NAME ....

ADDRESS ....

....

INDEX TO ADVERTISERS

IT'S EASY WHEN YOU KNOW!

To avoid missing your copy of PRACTICAL WIRELESS—simply complete this order form and hand it to your newsagent.

ORDER FORM

To: ....
(name of newsagent)

Address ....
....
....

Please reserve/deliver every month one copy of PRACTICAL WIRELESS until further notice.

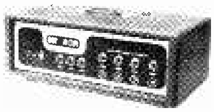
My Name ....

Address ....
....
....

Published on approximately the 7th of each month by IPC Magazines Limited, Westover House, West Quay Road, POOLE, Dorset BH15 1JG. Printed in England by Index Printers, Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (Asia) Ltd.; South Africa—Central News Agency Ltd. PRACTICAL WIRELESS is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to V.A.T. and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

U.K. RETURN OF POST MAIL-ORDER SERVICE ALSO WORLD WIDE EXPORT SERVICE

R.C.S. 100 watt MIXER/AMPLIFIER ALL VALVE



Four inputs. Four way mixing, master volume, treble and bass controls. Suits all speakers. This professional quality amplifier chassis is suitable for all groups, disco, P.A., where high quality power is required. 5 speaker outputs. A/C mains operated. Slave output. Produced by demand for a quality valve amplifier. Send for details.

Chassis only **£94** Price **£110** carr. £5

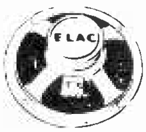
ANOTHER R.C.S. BARGAIN !

ELAC 9 + 5in. HI-FI SPEAKER TYPE 59RM

This famous unit now available, 10 watts, 8 ohm.

Price **£3·45** Post 40p

10" ELAC HI-FI SPEAKER



Large ceramic magnet.
Response: 50-18,000 cps.
Bass resonance 55 cps.
16 ohm impedance
10 watts. Post 40p **£4·50**

TEAK VENEER HI-FI SPEAKER CABINETS

MODEL "A". 20 × 13 × 12in. For 12in. dia. or 10in speaker. Illustrated. **14·50** Post £1·60

MODEL "B" BOOKSHELF For 13 × 8in. or 8in. speaker **£8·50** Post £1

R.C.S. BOOKSHELF CABINET Size 16in. × 6in × 5in. approx. Response 50 to 14,000 cps. 6 watts rms. 8 ohms. **£16 pair** Post £1·30

LOUDSPEAKER CABINET WADDING 18in. wide, 20p ft.

GOODMANS CONE TWEETER

3½in. diam. 18,000 C.P.S. 25 WATTS 8 Ω **£3·25**
8in. Audax 15 watts £4·95.
5in. EMI mid range £5.
10in. 30 watt GOODMANS woofer 4 ohm £10·95.

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£6·75**

TWO CHANNEL STEREO VERSION OF ABOVE £8·50

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated or Mains Supply £2·95. **£3·95**

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/249V. Leaflet S.A.E. **£4·95** Post 40p

WAFER THIN HEATING ELEMENTS

OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse, factory (available in manufacturing quantities). Approx. size 10½ × 8½ × $\frac{1}{16}$in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photo-copiers and print drying equipment.

Ideal for home handyman and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in greenhouse for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides 6 × 4in. 70p; 8 × 6in. 90p; 10 × 7in. £1·15; 14 × 9in. £1·50. 16 × 6in. £1·45; 12 × 3in. 87p; 16 × 10in. £1·70. Ali boxes, many sizes in stock.

DE LUXE BSR HI-FI AUTOCHANGER

Plays 12in. 10in. or 7in. records Auto or Manual. A high quality unit backed by BSR reliability with 12 months guarantee. A.C. 200/250V. Size 13½ × 11½in.
Above motor board 3¼in.
Below motor board 2½in.
With MAGNETIC STEREO CARTRIDGE **£21·50**
Cueing Device, Bias Compensator, Balanced Arm. All Post 75p
GARRARD MINICHANGER. Plays All Records £9·95
BSR P128 with Ceramic Cartridge £19·50

BAKER MAJOR 12" £15·00

Post £1

90-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s rated 25 watts. NOTE: 4 or 8 or 16 ohms must be stated.

MODULE KIT

30-17,000 c/s with tweeter, crossover, baffle 19 × 12½in. Please state 4 or 8 or 16 ohms. **£19·00** Post £1·60

BAKER SPEAKERS "BIG SOUND"

Robustly constructed to stand up to long periods of electronic power. As used by leading groups.
Useful response 30-13,000 cps.
Bass resonance 55 cps.

GROUP "25" 12in. 30 watt 4, 8 or 16 ohms. **£12·00** Post £1

GROUP "35" 12in. 40 watt 4, 8 or 16 ohms. **£14·00** Post £1

GROUP "50/12" 12in. 60 watt professional model. 4, 8 or 16 ohms. **£21·00** Post £1·60
With aluminium presence dome.

GROUP "50/15" 15in. 75 watt 8 or 16 ohms. **£26·00** Post £1·60

Send for leaflets on Disco, P.A. and Group Gear

BAKER 150 WATT QUALITY TRANSISTOR MIXER/AMPLIFIER

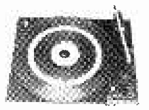
Professional amplifier using advanced circuit design. Ideal for disco, groups, P.A. or musical instruments. 4 inputs 4 way mixing. Master treble, bass and volume controls. 3 speaker output sockets to suit various combinations of speakers. 4-8-16 ohm. Slave output. A/C mains. Guaranteed. Details S.A.E. **£75** Carr. £1·00

100 WATT DISCO AMPLIFIER

MADE BY JENNINGS MUSICAL INSTRUMENTS
4 Speaker outputs volume, treble, bass, controls
CAN BE USED AS 100 WATT SLAVE **£59** Carr. £1

B.S.R. SINGLE PLAYER DECK

3 speed. Plays all size records. Stereo Cartridge. Cueing device. Ideal Disco Deck.



£15·50 Post 75p

DRILL SPEED CONTROLLER/LIGHT DIMMER KIT. Easy to build kit. Will control up to 500 watts AC mains. Post 35p **£3·25**

STEREO PRE-AMP KIT. All parts to build this pre-amp. 3 inputs for high medium or low gain per channel, with volume control and P.C. Board. Can be ganged to make multi-way stereo mixers. Post 35p **£2·95**

P.W. SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three channels. 800 to 1,000 watts each. As featured in Practical Wireless. Cabinet extra £3. Price **£14·00**

200 Watt Rear Reflecting White Light Bulbs. Ideal for Disco Lights. Edison Screw Fitting 75p. Each.

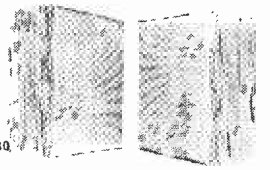
MAINS TRANSFORMERS Post 50p

6 VOLT ½ AMP. £1·00 3 AMP. £1·40
12 VOLT 300 MA. £1·00 750 MA. £1·30
30 VOLT 5 AMP. AND 34 VOLT 2 AMP. C.T. £3·45
20 VOLT 1 AMP. £2·00 2 AMP. £2·20 20-0-20 VOLT 1 AMP. £2·95
30 VOLT 1½ AMP. £2·50 40 VOLT 2 AMP. £2·95
0-20-40-60 VOLT 1 AMP. £3·50 2 × 18 VOLT 6 AMP. £11.

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at

2A. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V	£5·30
1A. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£5·30
2A. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£8·50
3A. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£11·00
5A. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£14·50

R.C.S. BOOKSHELF SPEAKERS



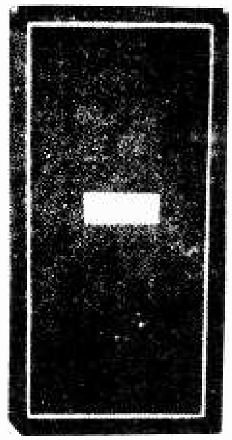
13 × 10 × 6in.
50 to 14,000 cps.
8 watts rms. 8 ohms
£16 pair Post £1·30

BAKER DISCO SPEAKERS

HIGH QUALITY—BRITISH MADE

2 x 12" CABINETS

for Disco or PA all fitted with carrying handles and corners. Black vynide covered. Other cabinets in stock. SAE for leaflet



60 WATT R.M.S. £52
With one horn £60
With two horns £68
Carr. £3

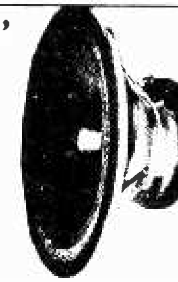
80 WATT R.M.S. £56
With one horn £64
With two horns £72
Carr. £3

100 WATT R.M.S. £69
With one horn £78
With two horns £86
Carr. £5

SINGLE 12inch CABS COMPLETE
30 WATT R.M.S. £32. WITH HORN £40.
40 WATT R.M.S. £34. WITH HORN £42.
60 WATT R.M.S. £41. WITH HORN £49.
CARR £3 EA.

"SUPERB HI-FI"

12in 25 watts



A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Bass Resonance 25cps
Flux Density 16,500 gauss
Useful response 20-17,000cps
8 or 16 ohms models.

£22·00 Post £1·60

"AUDITORIUM"

12in. 35 watts

A full range reproducer for high power. Ideal for Hi-Fi and Discotheques. Electric Guitars, public address, multi-speaker systems, electric organs.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 25-16,000cps
8 or 16 ohms models.

£21·00 Post £1·60

"AUDITORIUM"

15in. 45 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home Hi-Fi.
Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 20-14,000cps
8 or 16 ohms models.

£26·00 Post £1·60

Loudspeaker Cabinet Wadding 18in wide, 20p per ft.

Hi-Fi Enclosure Manual containing plans, designs, crossover data and cubic tables, 68p.

E.M.I. 13½ × 8in SPEAKER SALE!

With tweeter. And crossover. 10W. State 3 or 8 ohm. **£7.95** Post 45p

15W model 8 ohms. **£10·50** Post 65p

GOODMANS 20W Woofer Size 12 × 10in 4 ohms. Rubber cone surround. **£9.95** Post 65p

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, CROYDON

Open 9—6 Wed. 9—1 Sat. 9—5 (Closed for lunch 1.15—2.30)

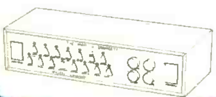
Minimum post 30p. Components List 20p. Cash price includes VAT. Access & Barclay cards welcome. Phone your order Tel. 01-684 1665

MAPLIN

in a modern world of electronics

THE 'DRUMSETTE' RHYTHM GENERATOR

Organists, pianists, guitarists . . . an automatic drum set to accompany you! Nine highly realistic instruments play fifteen different rhythms. Fifteen rhythm-select touch switches and a touch plate for stop/start without rhythm change gives absolute ease of operation. Build it yourself for under £35 including smart teak-effect cabinet. See it and hear it in our shop! Send for full construction details now : MES 49 price 25p

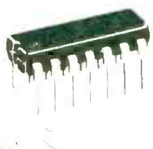


AUDIO MIXER

A superb stereo audio mixer. It can be equipped with up to 16 input modules of your choice and its performance matches that of the very best tape-recorders and hi-fi equipment. It meets the requirements of professional recording studios, FM radio stations, concert halls and theatres. Full construction details in our catalogue. A component schedule is available on request.

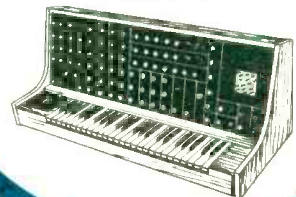
INTEGRATED CIRCUITS

Over 35 pages in our catalogue devoted to hundreds of useful I.C.s. All with data, pin connections and many with applications circuits and projects to build. Post the coupon now!



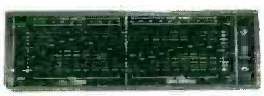
SYNTHESISER

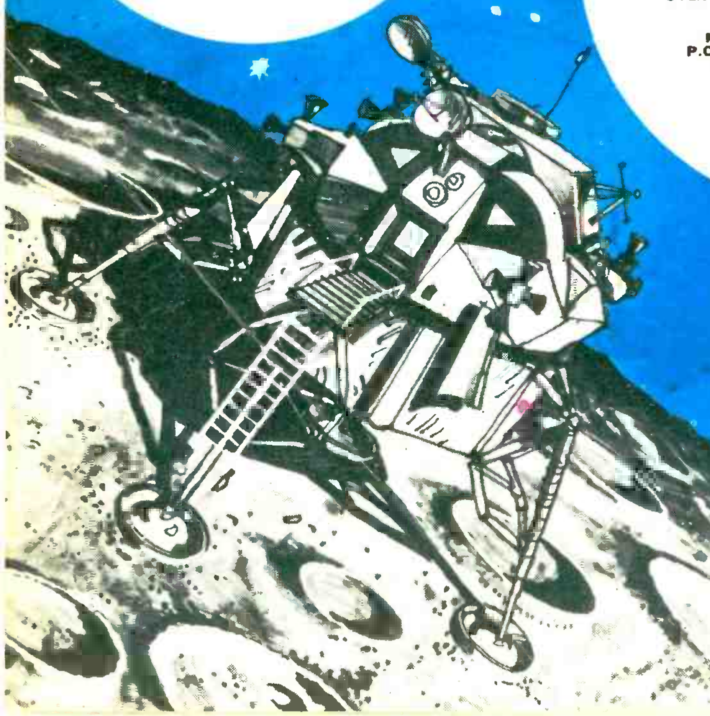
The International 4600 Synthesiser. A very comprehensive unit. Over 400 sold. We stock all the parts costing less than £500 including fully punched and printed metalwork and a smart teak cabinet. Far less than half what you'd pay for a ready made synthesiser of equal quality. Specification on request, full construction details in our construction book £1·50



10 CHANNEL STEREO GRAPHIC EQUALISER

A new design with no difficult coils to wind, but a specification that puts it in the top-flight hi-fi class. All this for less than £70 including fully punched and printed metalwork and woodwork. Send for our component schedule now. Full construction details price 40p.





Who says the Maplin Catalogue's worth having?

"in our 'musts' for readers-to-collect list"—P.E.

"contains . . . just about everything the DIY electronics enthusiast requires"—P.W.

"probably the most comprehensive catalogue we have ever come across"—E.E.

"has been carefully prepared and is very well presented.—R.E.C.

"make the job of ordering components an easy, accurate and enjoyable pastime"—P.W.

"Only one word describes the publication—superb!" E.T.I.

OVER 60,000 COPIES SOLD DON'T MISS OUT! SEND 60p NOW

MAPLIN ELECTRONIC SUPPLIES
P.O. Box 3, RAYLEIGH, ESSEX SS6 8LR
Telephone: Southend (0702) 715155

Shop: 284 London Road, Westcliff-on-Sea, Essex.
(Closed on Monday)
Telephone: Southend (0702) 715157

Our bi-monthly newsletter keeps you up to date with latest guaranteed prices—our latest special offers—details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).

POST THIS COUPON NOW FOR YOUR COPY OF OUR CATALOGUE PRICE 60p

Please rush me a copy of your 216 page catalogue. I enclose 60p, but understand that if I am not completely satisfied I may return the catalogue to you within 14 days and have my 60p refunded immediately.

NAME ....

ADDRESS ....

....

....

....

PW2