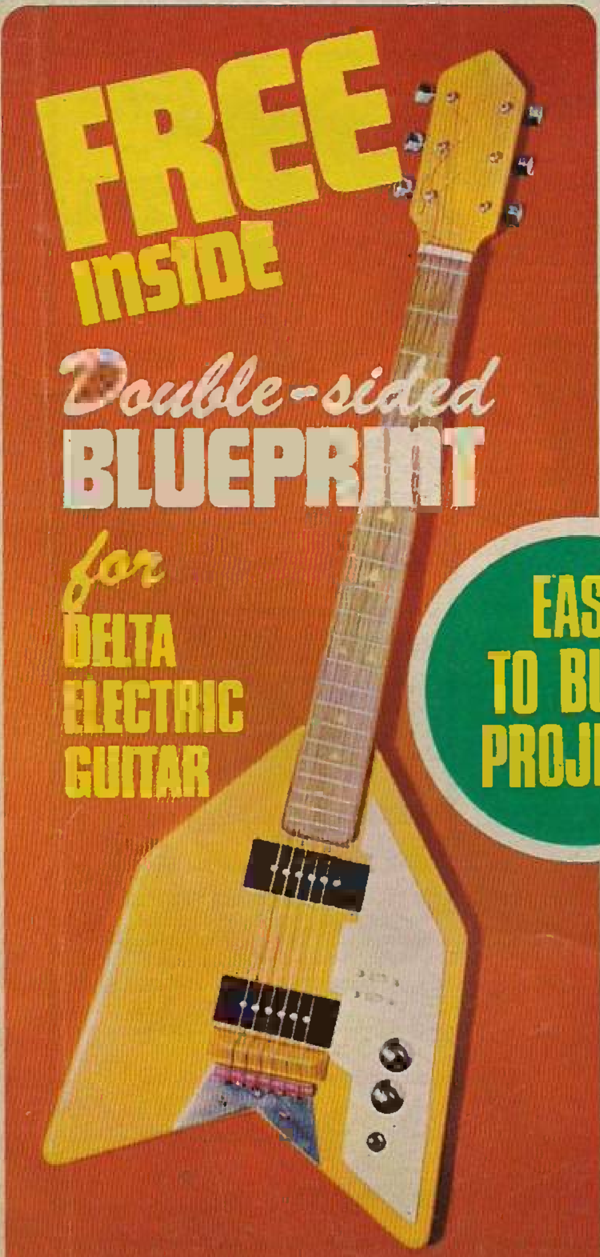
An exciting hobby.... for everyone

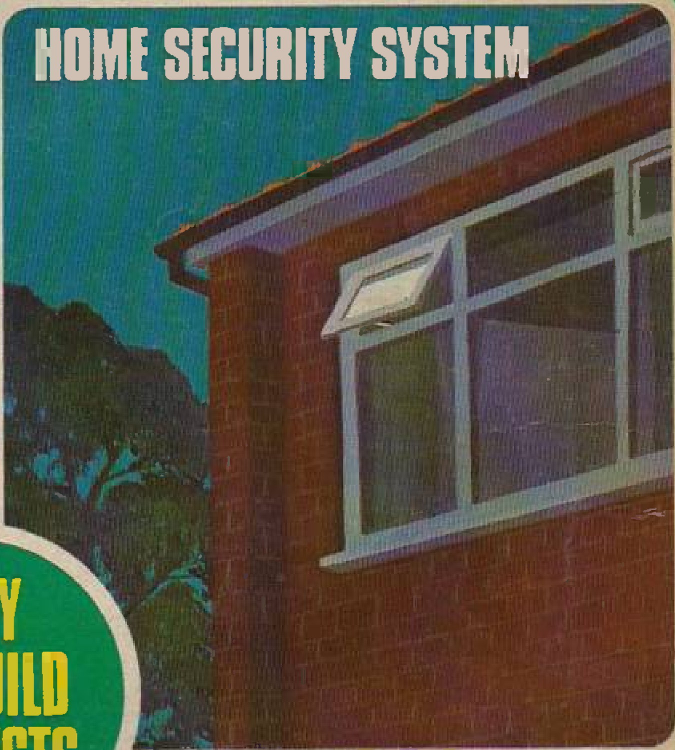
everyday electronics

OCT. 74
20p



FREE INSIDE

Double-sided BLUEPRINT for DELTA ELECTRIC GUITAR



HOME SECURITY SYSTEM

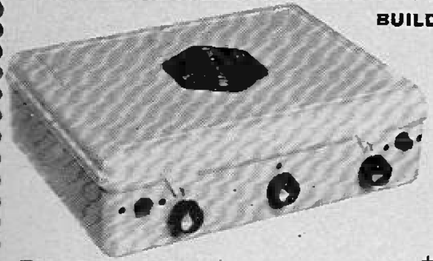
EASY TO BUILD PROJECTS

REACTION TIMER

NEW EDU-KIT MAJOR

COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT.

BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER.



★ 4 Transistor Earpiece Radio ★ Signal Tracer ★ Signal Injector ★ Transistor Tester NPN-PNP ★ 4 Transistor Push Pull Amplifier ★ 5 Transistor Push Pull Amplifier ★ 7 Transistor Loudspeaker Radio MW/LW ★ 5 Transistor Short Wave Radio ★ Electronic Metronome ★ Electronic Noise Generator ★ Batteryless Crystal Radio ★ One Transistor Radio ★ 2 Transistor Regenerative Radio ★ 3 Transistor Regenerative Radio ★ Audible Continuity Tester ★ Sensitive Pre-Amplifier.

★ 24 Resistors ★ 21 Capacitors ★ 10 Transistors ★ 3½ loudspeaker ★ Earpiece ★ Mica Baseboard ★ 3 12-way connectors ★ 2 Volume controls ★ 2 Slider Switches ★ 1 Tuning Condenser ★ 3 Knobs ★ Ready Wound MW/LW/SW Coils ★ Ferrite Rod ★ 6½ yards of wire ★ 1 yard of sleeving, etc. ★ Parts price list and plans 50p (FREE with parts).

Total Building Costs £7·23 P P & Ins. 44p. (Overseas P & P £1·85p.) (+ 8% VAT 57p)

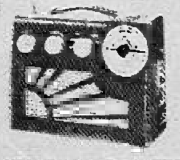
NEW ROAMER NINE

WITH V.H.F. INCLUDING AIRCRAFT

Nine Transistors. 9 Tunable wavebands as Roamer Ten, built in ferrite rod aerial for MW/LW. Retractable chrome plated telescopic aerial for VHF and SW. Push Pull output using 600 mw transistors. 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange control. Attractive all white case with red grille and carrying strap. Size 9½" × 7" × 2½" approx. Parts Price list and Plans 30p (FREE with parts)

Total Building Costs £6·95 P P & Ins. 44p. (Overseas P & P £1·85p) (+ 8% VAT 55p)

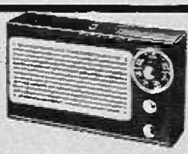
ROAMER TEN



with VHF including aircraft. 10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeakers. 9 Tunable Wavebands. MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band. Built in Ferrite Rod Aerial for MW/LW. Chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600 mw Transistors. Car Aerial and Tape Recording Sockets. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

Total building costs £8·50 P. P. & Ins. 52p (Overseas P. & P. £1·85) (+ 8% VAT 68p)

NEW EVERYDAY SERIES



Build this exciting New series of designs

E.V. 5 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3" loudspeaker. Attractive case with red speaker grille. Size 9" × 5½" × 2½" approx. Parts price list and Plans 15p. Free with parts.

Total Building Costs £2·95 P P & Ins. 30p (Overseas P & P £1·25p) (+ 8% VAT 23p)

E.V. 6 Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts price list and Plans 15p. Free with parts.

Total Building Costs £3·60 P & P Ins. 30p (Overseas P & P £1·25p) (+ 8% VAT 29p)

E.V. 7 Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" loudspeaker. Parts price list and easy build plans 20p. Free with parts.

Total Building Costs £4·08 P P & Ins. 31p (Overseas P & P £1·85) (+ 8% VAT 32p)

"EDU-KIT"

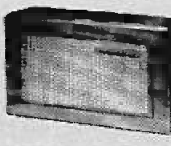
Build Radios, Amplifiers, etc. from easy stage diagrams. Five units including master unit to construct

Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine 3" Tone Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ¾" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans 25p (FREE with parts).

Total Building Costs £5·50 P P & Ins. 33p (Overseas P & P £1·85) (+ 8% VAT 44p)

POCKET FIVE

Now with 3" loudspeaker

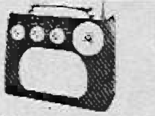


3 Tunable wavebands. M.W./L.W. and Trawler Band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive Black and Gold Case. Size 5½" × 1¼" × 3½" approx. Plans and parts price list 15p. (Free with parts).

Total Building Costs £2·50 P P & Ins. 26p (Overseas P & P £1·25p) (+ 8% VAT 20p)

ROAMER EIGHT Mk 1

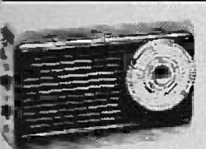
NOW WITH VARIABLE TONE CONTROL



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Chrome plated Telescopic aerial can be angled and rotated for peak short wave listening. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt Ferrite Magnet Loudspeakers. Air spaced ganged tuning condenser Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

Total Building Costs £6·98 P P & Ins. 47p (Overseas P. & P. £1·85) (+ 8% VAT 56p)

TRANSONA FIVE



now with 3" loudspeaker

Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and parts price list 15p (Free with parts).

Total Building Costs £2·75 P P & Ins. 26p (Overseas P & P £1·25p) (+ 8% VAT 21p)

ROAMER SIX

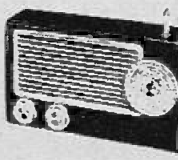
Case and looks as Trans-Eight

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3, Trawler band plus an Extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Plans and parts price list 25p (FREE with parts).

Total Building Costs £3·98 P P & Ins. 31p (Overseas P. & P. £1·85) + 8% VAT 32p)

TRANS EIGHT

5 TRANSISTORS and 3 DIODES



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

Total Building Costs £4·48 P P & Ins. 33p (Overseas P & P £1·25) (+ 8% V.A.T. 36p)

• Callers side entrance "Lavells" Shop
• Open 10-1, 2.30-4.30 Mon.-Fri.—9-12 Sat.

RADIO EXCHANGE CO

61a HIGH STREET, BEDFORD, MK40 1SA Tel. 0234 52367

Reg. no. 788372

I enclose £........... for..............................

Name..............................

Address..............................

....

(Dept. E.E.10.)

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	0·22	AD162	0·39	BC149	0·13	BD124	0·76	BF181	0·33	MAT121	0·22	2G306	0·44
AC113	0·20	AD161 &		BC150	0·20	BD131	0·55	BF182	0·44	MJE2955	0·95	2G308	0·39
AC115	0·22	AD162(MP)	75	BC151	0·22	BD132	0·66	BF183	0·44	MJE3055	0·62	2G309	0·39
AC117K	0·32	ADT140	0·55	BC152	0·19	BD133	0·72	BF184	0·28	MJE3440	0·55	2G339	0·22
AC122	0·13	AF114	0·27	BC153	0·31	BD135	0·44	BF185	0·33	MPF102	0·46	2G339A	0·18
AC125	0·19	AF115	0·27	BC154	0·33	BD136	0·44	BF187	0·30	MPF104	0·41	2G344	0·20
AC126	0·19	AF116	0·27	BC157	0·20	BD137	0·50	BF188	0·44	MPF105	0·41	2G345	0·18
AC127	0·20	AF117	0·27	BC158	0·13	BD138	0·55	BF194	0·13	OC19	0·39	2G371	0·18
AC128	0·20	AF118	0·39	BC159	0·13	BD139	0·61	BF195	0·13	OC20	0·70	2G371B	0·13
AC132	0·16	AF124	0·33	BC160	0·50	BD140	0·66	BF196	0·16	OC22	0·52	2G373	0·19
AC134	0·16	AF125	0·33	BC161	0·55	BD155	0·88	BF197	0·16	OC23	0·54	2G374	0·19
AC137	0·16	AF126	0·31	BC167	0·13	BD175	0·66	BF200	0·50	OC24	0·62	2G377	0·33
AC141	0·20	AF127	0·31	BC168	0·13	BD176	0·66	BF222	£1·05	OC25	0·42	2G378	0·18
AC141K	0·32	AF139	0·33	BC169	0·13	BD177	0·72	BF257	0·50	OC26	0·32	2G381	0·18
AC142	0·20	AF178	0·55	BC170	0·13	BD178	0·72	BF258	0·66	OC28	0·55	2G382	0·18
AC142K	0·28	AF179	0·55	BC171	0·16	BD179	0·77	BF259	0·94	OC29	0·55	2G401	0·33
AC151	0·17	AF180	0·55	BC172	0·16	BD180	0·77	BF262	0·61	OC35	0·46	2G414	0·33
AC154	0·22	AF181	0·55	BC173	0·16	BD185	0·72	BF263	0·61	OC36	0·55	2G417	0·28
AC155	0·22	AF186	0·55	BC174	0·16	BD186	0·72	BF270	0·39	OC41	0·22	2N388	0·39
AC156	0·22	AF239	0·41	BC175	0·24	BD187	0·77	BF271	0·33	OC42	0·27	2N388A	0·61
AC157	0·27	AL102	0·72	BC177	0·21	BD188	0·77	BF272	0·88	OC44	0·17	2N404	0·22
AC165	0·22	AL103	0·72	BC178	0·21	BD189	0·83	BF273	0·39	OC45	0·14	2N404A	0·31
AC166	0·22	ASY26	0·28	BC179	0·21	BD190	0·83	BF274	0·39	OC70	0·11	2N524	0·46
AC167	0·22	ASY27	0·33	BC180	0·27	BD195	0·94	BFW10	0·66	OC71	0·11	2N527	0·54
AC168	0·27	ASY28	0·28	BC181	0·27	BD196	0·94	BFX29	0·30	OC72	0·16	2N598	0·46
AC169	0·16	ASY29	0·28	BC182	0·16	BD197	0·99	BFX84	0·24	OC74	0·16	2N599	0·50
AC176	0·22	ASY50	0·28	BC182L	0·16	BD198	0·99	BFX85	0·33	OC75	9·17	2N696	0·14
AC177	0·27	ASY51	0·28	BC183	0·16	BD199	£1·05	BFX86	0·24	OC76	0·17	2N697	0·15
AC178	0·31	ASY52	0·28	BC183L	0·16	BD200	£1·05	BFX87	0·27	OC77	0·28	2N698	0·27
AC179	0·31	ASY54	0·28	BC184	0·22	BD205	0·88	BFX88	0·24	OC81	0·17	2N699	0·39
AC180	0·22	ASY55	0·28	BC184L	0·22	BD206	0·88	BFY50	0·22	OC81D	0·17	2N706	0·09
AC180K	0·32	ASY56	0·28	BC186	0·31	BD207	£1·05	BFY51	0·22	OC82	0·17	2N706A	0·10
AC181	0·22	ASY57	0·28	BC187	0·31	BD208	£1·05	BFY52	0·22	OC82D	0·17	2N708	0·13
AC181K	0·32	ASY58	0·28	BC207	0·12	BDY20	£1·10	BFY53	0·19	OC83	0·22	2N711	0·33
AC187	0·24	ASY73	0·28	BC208	0·12	BF115	0·27	BSX19	0·17	OC139	0·22	2N717	0·39
AC187K	0·25	ASZ21	0·44	BC209	0·13	BF117	0·50	BSX20	0·17	OC140	0·22	2N718	0·27
AC188	0·24	BC107	0·14	BC212L	0·14	BF118	0·77	BSY25	0·17	OC169	0·28	2N718A	0·55
AC188K	0·25	BC108	0·14	BC213L	0·14	BF119	0·77	BSY26	0·17	OC170	0·28	2N726	0·31
ACY17	0·28	BC109	0·15	BC214L	0·18	BF121	0·50	BSY27	0·17	OC171	0·28	2N727	0·31
ACY18	0·22	BC113	0·11	BC225	0·28	BF123	0·55	BSY28	0·17	OC200	0·28	2N743	0·22
ACY19	0·22	BC114	0·17	BC226	0·39	BF125	0·50	BSY29	0·17	OC201	0·31	2N744	0·22
ACY20	0·22	BC115	0·17	BC301	0·30	BF127	0·55	BSY38	0·20	OC202	0·31	2N914	0·16
ACY21	0·22	BC116	0·17	BC302	0·27	BF152	0·61	BSY39	0·20	OC203	0·28	2N918	0·33
ACY22	0·18	BC117	0·20	BC303	0·35	BF153	0·50	BSY40	0·31	OC204	0·28	2N929	0·23
ACY27	0·20	BC118	0·11	BC304	0·40	BF154	0·50	BSY41	0·31	OC205	0·39	2N930	0·23
ACY28	0·21	BC119	0·33	BC440	0·34	BF155	0·77	BSY95	0·14	OC309	0·44	2N1131	0·22
ACY29	0·39	BC120	0·88	BC460	0·40	BF156	0·53	BSY95A	0·14	OCP71	0·48	2N1132	0·24
ACY30	0·31	BC125	0·13	BCY30	0·27	BF157	0·61	Bu105	£2·20	ORP12	0·48	2N1302	0·16
ACY31	0·31	BC126	0·20	BCY31	0·29	BF158	0·61	C111E	0·55	ORP60	0·44	2N1303	0·16
ACY34	0·23	BC132	0·13	BCY32	0·33	BF159	0·66	C400	0·33	ORP61	0·44	2N1304	0·19
ACY35	0·23	BC134	0·20	BCY33	0·24	BF160	0·44	C407	0·28	P20	0·55	2N1305	0·19
ACY36	0·31	BC135	0·13	BCY34	0·28	BF162	0·44	C424	0·28	P346A	0·22	2N1306	0·23
ACY40	0·19	BC136	0·17	BCY70	0·16	BF163	0·44	C425	0·55	P397	0·46	2N1307	0·23
ACY41	0·20	BC137	0·17	BCY71	0·22	BF164	0·44	C426	0·39	ST140	0·14	2N1308	0·26
ACY44	0·39	BC139	0·44	BCY72	0·16	BF165	0·44	C428	0·22	ST141	0·19	SN1309	0·26
AD130	0·42	BC140	0·33	BCZ10	0·22	BF167	0·24	C441	0·33	TIS43	0·34	2N1613	0·22
AD140	0·53	BC141	0·33	BCZ11	0·28	BF173	0·24	C442	0·33	UT46	0·30	2N1711	0·22
AD142	0·53	BC142	0·33	BCZ12	0·28	BF176	0·39	C444	0·39	ZN414	£1·20	2N1889	0·35
AD143	0·42	BC143	0·33	BD115	0·68	BF177	0·39	C450	0·24	2G301	0·21	2N1890	0·50
AD149	0·55	BC145	0·50	BD116	0·88	BF178	0·33	MAT100	0·21	2G302	0·21	2N1893	0·41
AD161	0·39	BC147	0·11	BD121	0·66	BF179	0·33	MAT101	0·22	2G303	0·21	2N2147	0·79
		BC148	0·11	BD123	0·72	BF180	0·33	MAT120	0·21	2G304	0·27	2N2148	0·63

Type	Price	Type	Price	Type	Price
2N2160	0·66	2N3055	0·55	2N4059	0·11
2N2192	0·38	2N3391	0·16	2N1060	0·13
2N2193	0·39	2N3391A	0·18	2N4061	0·13
2N2194	0·39	2N3392	0·16	2N4062	0·13
2N2217	0·24	2N3393	0·16	2N4284	0·19
2N2218	0·22	2N3394	0·16	2N4285	0·19
2N2219	0·22	2N3395	0·19	2N4286	0·19
2N2220	0·24	2N3402	0·23	2N4287	0·19
2N2221	0·22	2N3403	0·23	2N4288	0·19
2N2222	0·22	2N3404	0·31	2N4289	0·19
2N2368	0·19	2N3405	0·46	2N4290	0·19
2N2369	0·16	2N3414	0·17	2N4291	0·19
2N2369A	0·16	2N3415	0·17	2N4292	0·19
2N2411	0·27	2N3416	0·31	2N4293	0·19
2N2412	0·27	2N3417	0·31	2N5172	0·13
2N2646	0·52	2N3525	0·83	2N5294	0·60
2N2711	0·23	2N3614	0·74	2N5457	0·35
2N2712	0·23	2N3616	0·82	2N5458	0·35
2N2714	0·23	2N3616	0·82	2N5459	0·44
2N2904	0·19	2N3646	0·10	2N6221	0·75
2N2904A	0·23	2N3702	0·13	2S301	0·55
2N2905	0·23	2N3703	0·13	2S302A	0·46
2N2905A	0·23	2N3704	0·14	2S302	0·46
2N2906	0·17	2N3705	0·13	2S303	0·61
2N2906A	0·20	2N3706	0·13	2S304	0·77
2N2907	0·22	2N3707	0·14	2S305	0·86
2N2907A	0·24	2N3708	0·09	2S306	0·86
2N2923	0·16	2N3709	0·10	2S307	0·86
2N2924	0·16	2N3710	0·10	2S321	0·62
2N2925	0·16	2N3711	0·10	2S322	0·46
2N2926(G)	14	2N3819	0·31	2S322A	0·46
2N2926(Y)	12	2N3820	0·55	2S323	0·62
2N2926(O)	11	2N3821	0·39	2S324	0·77
2N2926(R)	11	2N3823	0·31	2S325	0·77
2N2926(B)	11	2N3903	0·31	2S326	0·77
2N3010	0·77	2N3904	0·33	2S327	0·72
2N3011	0·16	2N3905	0·31	2S701	0·46
2N3053	0·19	2N3906	0·30	40361	0·44
2N3054	0·51	2N4058	0·13	40362	0·50

DIODES AND RECTIFIERS

Type	Price	Type	Price	Type	Price
AA119	0·09	BY128	0·17	OA10	0·15
AA120	0·09	BY130	0·18	OA47	0·08
AA129	0·09	BY133	0·23	OA70	0·08
AAY30	0·10	BY164	0·55	OA79	0·08
AAZ13	0·11	BYX38/300	0·46	OA81	0·08
BA100	0·11	BYZ10	0·39	OA85	0·10
BA116	0·23	BYZ11	0·33	OA90	0·07
BA126	0·24	BYZ12	0·33	OA91	0·07
BA148	0·16	BYZ13	0·28	OA95	0·08
BA154	0·13	BYZ16	0·44	OA200	0·07
BA155	0·16	BYZ17	0·39	OA202	0·08
BA156	0·15	BYZ18	0·39	SD10	0·06
BA173	0·16	BYZ19	0·31	SD19	0·06
BY100	0·17	CG62		1N34	0·08
BY101	0·13	(OA91 Eq)	0·06	1N34A	0·08
BY105	0·19	CG651—		1N914	0·06
BY114	0·13	(OA70-79)	0·07	1N916	0·06
BY124	0·13	OA5	0·39	1N4148	0·06
BY126	0·16	OA5 short		1S021	0·11
BY127	0·17	leads	0·23	1S951	0·07

LINEAR I.C's—FULL SPEC.

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

NUMERICAL INDICATOR TUBES

CD66 .. .. £1·87
GR116 .. .. .. £1·70
3015F Minitron .. .. £1·50
MAN 3M. L.E.D. 7-segment 0·127" £1·90
All indicators 0-9 + Decimal point. All side viewing. Full data for all types available on request.

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

DTL 930 SERIES LOGIC I.C's

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

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

VOLTAGE REGULATORS

TO.3 Plastic 1·5 Amps
µA.7805/L129 5V (Equiv. to MVR5V) £1·76
µA.7812/L130 12V (Equiv. to MVR12V) £1·76
µA.7815/L131 15V (Equiv. to MVR15V) £1·76

TRIPLE 66-bit DYNAMIC SHIFT REGISTER EDSR 3166

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

DUAL-IN-LINE SOCKETS.

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

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

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

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

Type	Quantities 1 £ p	25 £ p	100+ £ p	Type	Quantities 1 £ p	25 £ p	100+ £ p	Type	Quantities 1 £ p	25 £ p	100+ £ p
7400	0·18	0·17	0·16	7448	1·10	1·07	1·05	74122	0·88	0·86	0·84
7401	0·18	0·17	0·16	7450	0·18	0·17	0·16	74123	1·58	1·54	1·50
7402	0·18	0·17	0·16	7451	0·18	0·17	0·16	74141	0·85	0·82	0·79
7403	0·18	0·17	0·16	7453	0·18	0·17	0·16	74145	1·58	1·54	1·50
7404	0·18	0·17	0·16	7454	0·18	0·17	0·16	74150	2·50	2·40	2·30
7405	0·18	0·17	0·16	7460	0·18	0·17	0·16	74151	1·10	1·05	1·00
7406	0·39	0·34	0·31	7470	0·32	0·29	0·27	74153	1·20	1·10	1·00
7407	0·39	0·34	0·31	7472	0·32	0·29	0·27	74154	1·98	1·90	1·75
7408	0·25	0·24	0·23	7473	0·41	0·39	0·35	74155	1·20	1·15	1·10
7409	0·25	0·24	0·23	7474	0·41	0·39	0·35	74156	1·20	1·15	1·10
7410	0·18	0·17	0·16	7475	0·60	0·58	0·56	74157	1·20	1·15	1·10
7411	0·28	0·27	0·25	7476	0·44	0·43	0·42	74160	1·73	1·70	1·65
7412	0·30	0·29	0·28	7480	0·74	0·71	0·64	74161	1·73	1·70	1·65
7413	0·32	0·31	9·30	7481	1·30	1·25	1·20	74162	1·73	1·70	1·65
7416	0·40	0·39	0·38	7482	0·90	0·85	0·80	74163	1·73	1·70	1·65
7417	0·40	0·39	0·38	7483	1·20	1·15	1·05	74164	2·20	2·10	2·00
7420	0·18	0·17	0·16	7184	1·10	1·05	1·00	74165	2·20	2·10	2·00
7422	0·30	0·29	0·28	7485	2·00	1·90	1·80	74166	2·35	2·30	2·25
7423	0·40	0·39	0·38	7486	0·35	0·34	0·33	74174	2·00	1·95	1·90
7425	0·40	0·39	0·38	7489	4·00	3·75	3·50	74175	1·40	1·35	1·30
7426	0·40	0·38	0·36	7490	0·74	0·71	0·64	74176	1·60	1·55	1·50
7427	0·40	0·38	0·36	7491	1·10	1·05	1·00	74177	1·60	1·55	1·50
7428	0·45	0·42	0·40	7492	0·74	0·71	0·64	74180	1·60	1·55	1·50
7430	0·18	0·17	0·16	7493	0·74	0·71	0·64	74181	5·00	4·50	4·00
7432	0·40	0·38	0·36	7494	0·85	0·82	0·75	74182	1·50	1·45	1·40
7433	0·42	0·40	0·38	7495	0·85	0·82	0·75	74184	2·40	2·30	2·20
7437	0·45	0·42	0·40	7496	0·96	0·93	0·86	74190	2·15	2·10	2·00
7438	0·45	0·42	0·40	74100	1·50	1·45	1·40	74191	2·15	2·10	2·00
7440	0·18	0·17	0·16	74104	0·70	0·68	0·66	74192	2·15	2·10	2·00
7441	0·74	0·71	0·64	74105	0·70	0·68	0·66	74193	2·15	2·10	2·00
7442	0·74	0·71	0·64	74107	0·44	0·42	0·40	74194	1·90	1·80	1·70
7443	1·20	1·15	1·10	74110	0·60	0·55	0·50	74195	1·60	1·50	1·40
7444	1·20	1·15	1·10	74111	0·95	0·92	0·90	74196	1·73	1·70	1·65
7445	1·98	1·95	1·90	74118	1·10	1·05	1·00	74197	1·73	1·70	1·65
7446	1·20	1·15	1·10	74119	1·50	1·40	1·30	74198	3·45	3·35	3·20
7447	1·10	1·07	1·05	74121	0·50	0·48	0·45	74199	3·10	3·00	2·90

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

ALL PRICES INCLUDE VAT.

- the lowest prices!

P.W. TELE-TENNIS KIT OF PARTS

Including all resistors, capacitors, semi-conductors, I.C. sockets, switches and transformer

Our Usual Price £27.50

SPECIAL OFFER

£23.50 incl. V.A.T. and P. & P.

We regret free pack not applicable to this offer

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

1	25	100+
0·19	0·17	0·16

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

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

1	25	100+
0·47	0·44	0·40

GP 300 TO3 METAL CASE SILICON
Vebo = 100V. Vceo = 60V I.C. = 15 amps. Ptot = 115W. hfe = 20. 100fT. = 1MHz. Suitable replacement for 2N 3055, BDY 11 or BDY 20.

1	25	100+
0·55	0·53	0·51

NEW 8th EDITION
250 pages
TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalents book for European, American and Japanese Transistors. Exclusive to BI-PAK. £1·85 each.

A LARGE RANGE OF TECHNICAL AND DATA BOOKS ARE NOW AVAILABLE EX STOCK. SEND FOR FREE LIST.

SIL. G.P. DIODES		£p
300mW	30	0·55
40PIV(Min.)	100	1·65
Sub-Min.	500	5·50
Fully Tested	1,000	9·90

Ideal for Organ Builders.

AD161/162
PNP
M/P COMP GERM. TRANS. OUR LOWEST PRICE OF 75p *PER PAIR.*

LOOK FOR OUR
AUDIO & ELECTRONIC COMPONENTS ADVERTISEMENTS
PRACTICAL WIRELESS
EVERYDAY ELECTRONICS AND
RADIO CONSTRUCTOR

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-33V. 400mV (DO-7 Case) 12p ea. 1¼W (Top-Hat) 18p ea. 10W (SO-10 Stud) 32p ea.

QUALITY TESTED SEMICONDUCTORS

Pak No.			Price £p
Q1	20	Red spot transistors PNP	0·55
Q2	16	White spot R.F. transistors PNP	0·55
Q3	4	OC 77 type transistors	0·55
Q4	6	Matched transistors OC44/45/81/81D	0·55
Q5	4	OC 75 transistors	0·55
Q6	5	OC 72 transistors	0·55
Q7	4	AC 128 transistors PNP high gain	0·55
Q8	4	AC 126 transistors PNP	0·55
Q9	7	OC 81 type transistors	0·55
Q10	7	OC 71 type transistors	0·55
Q11	2	AC 127/128 Complementary pairs PNP/NPN	0·55
Q12	3	AF 116 type transistors	0·55
Q13	3	AF 117 type transistors	0·55
Q14	3	OC 171 H.F. type transistors	0·55
Q15	7	2N2926 Sil. Epoxy transistors mixed colours	0·55
Q17	5	NPN 2 × ST.141 & 3 × ST.140	0·55
Q18	4	MADT'S 2 × MAT 100 & 2 × MAT 120	0·55
Q19	3	MADT'S 2 × MAT 101 & 1 × MAT 121	0·55
Q20	4	OC 44 Germanium transistors A.F.	0·55
Q21	4	AC 127 NPN Germanium transistors	0·55
Q22	20	NKT transistors A.F. R.F. coded	0·55
Q23	10	OA 202 Silicon diodes sub-min.	0·55
Q24	8	OA 81 diodes	0·55
Q25	15	IN914 Silicon diodes 75 PIV 75mA	0·55
Q26	8	OA95 Germanium diodes sub-min IN69	0·55
Q27	2	10A PIV Silicon rectifiers IS425R	0·55
Q28	2	Silicon power rectifiers BYZ 13	0·55
Q29	4	Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·55
Q30	7	Silicon switch transistors 2N706 NPN	0·55
Q31	6	Silicon switch transistors 2N708 NPN	0·55
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·55
Q33	3	Silicon NPN transistors 2N1711	0·55
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·55
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·55
Q36	7	2N3646 TO-18 plastic 300 MHz NPN	0·55
Q37	3	2N3053 NPN Silicon transistors	0·55
Q38	7	NPN transistors 3 × 2N3703, 2 × 2N3702	0·55

555 I.C. 75p each

MAMMOTH I.C. PACK

APPROXIMATELY 200 PIECES ASSORTED MANUFACTURERS FALL-OUT INTEGRATED CIRCUITS INCLUDING LOGIC 74 SERIES LINEAR and AUDIO AMPLIFIERS

MANY CODED also SOME UNKNOWN TYPES — YOU TO IDENTIFY

PAK NO. M.I.C. 200

PRICE £1·25 per PAK including p & p & V.A.T.

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Money back refund if not satisfied

Pak No.		Description	Price £p
U 1	120	Glass Sub-Min. General Purpose Germanium Diodes	0·55
U 2		Mixed Germanium Transistors AF/RF	0·55
U 3	75	Germanium Gold Bonded Sub-Min. like OA5, OA47	0·55
U 4		Germanium Transistors like OC81, AC128	0·55
U 5	60	200mA Sub-Min. Silicon Diodes	0·55
U 6	30	Sil. Planar Trans. NPN like BSY95A. 2N706	0·55
U 7	16	Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·55
U 8	50	Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·55
U 9	20	Mixed Voltages, 1 Watt Zener Diodes	0·55
U10	20	BAY50 charge storage Diodes DO-7 Glass	0·55
U11		PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·55
U13	30	PNP-NPN Sil. Transistors OC200 & 2S 104	0·55
U14	150	Mixed Silicon and Germanium Diodes	0·55
U15		NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·55
U16	10	3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·55
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	0·55
U18	8	6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·55
U19		Silicon NPN Transistors like BC108	0·55
U20	12	1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·55
U21	30	AF. Germanium Alloy Transistors 2G300 Series & OC71	0·55
U23		MADT's like MHz Series PNP Transistors	0·55
U24	20	Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·55
U25	25	300 MHz NPN Silicon Transistors 2N708, BSY27	0·55
U26	30	Fast Switching Silicon Diodes like IN914 Micro-Min.	0·55
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	1·10
U32	25	Zener Diodes 400mW DO-7 case 3–18 volts mixed	0·55
U33	15	Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·55
U34	30	Silicon PNP Alloy Trans. TO-5 BCY26 2S302/4	0·55
U35	25	Silicon Planar Transistors PNP TO-18 2N2906	0·55
U36		Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·55
U37	30	Silicon Alloy Transistors SO-2 PNP OC200, 2S322	0·55
U38	20	Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·55
U39	30	RF. Germ. PNP Transistors 2N1303/5 TO-5	0·55
U40	10	Dual Transistors 6 lead TO-5 2N2060	0·55
U43	25	Sil. Trans. Plastic TO-18 A.F. BC113/114	0·55
U44	20	Sil. Trans. Plastic TO-5 BC115/116	0·55
U45	7	3A SCR. TO66 up to 600PIV	1·10
U46	20	Unijunction transistors similar to TIS43	0·55
U47	10	TO220AB plastic triacs 50V 6A	£1·10
U48	9	NPN Sil. power transistors like 2N3055	£1·10
U49	12	NPN Sil. plastic power trans. 60W like 2N5294/5296	£1·10

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

FREE
One 55p Pak of your own choice free with orders valued £4 or over

CADMIUM CELLS
ORP12 48p

SIL. RECTS. TESTED

PIV	300mA	750mA	1A		1·5A	3A	10A	30A
50	0·05	0·06	1N4001	0·05	0·08	0·15	0·21	0·60
100	0·05	0·07	1N4002	0·06	0·10	0·17	0·23	0·75
200	0·06	0·10	1N4003	0·07	0·12	0·22	0·25	1·00
400	0·08	0·15	1N4004	0·08	0·15	0·30	0·38	1·35
600	0·09	0·17	1N4005	0·10	0·18	0·36	0·45	1·90
800	0·12	0·19	1N4006	0·11	0·20	0·38	0·55	2·10
1000	0·14	0·30	1N4007	0·12	0·25	0·48	0·65	2·50
1200	—	0·35			0·30	0·58	0·75	3·00

1974 CATALOGUE NOW READY 10p

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

PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·26	0·28	0·39	0·39	0·52	0·55	0·59	1·27
100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0·63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
600	0·59	0·63	0·75	0·75	0·85	1·07	1·38	—
800	0·70	0·77	0·88	0·88	0·99	1·32	1·65	4·40

DIACS
FOR USE WITH TRIACS.
BR100 (D32) 25p each

10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 99p each

TRIACS

VBOM	2A TO-5	6A TO-66	10A TO-48
	p	p	£p
100	33	55	88
200	55	66	99
400	77	88	1·21

INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No. Contents	Price	Pak No. Contents	Price	Pak No. Contents	Price
UIC00 = 12 × 7400	0·55	UIC46 = 5 × 7446	0·55	UIC90 = 5 × 7490	0·55
UIC01 = 12 × 7401	0·55	UIC48 = 5 × 7448	0·55	UIC91 = 5 × 7491	0·55
UIC02 = 12 × 7402	0·55	UIC50 = 12 × 7450	0·55	UIC92 = 5 × 7492	0·55
UIC03 = 12 × 7403	0·55	UIC51 = 12 × 7451	0·55	UIC93 = 5 × 7493	0·55
UIC04 = 12 × 7404	0·55	UIC53 = 12 × 7453	0·55	UIC94 = 5 × 7494	0·55
UIC05 = 12 × 7405	0·55	UIC54 = 12 × 7454	0·55	UIC95 = 5 × 7495	0·55
UIC06 = 8 × 7406	0·55	UIC60 = 12 × 7460	0·55	UIC96 = 5 × 7496	0·55
UIC07 = 8 × 7407	0·55	UIC70 = 8 × 7470	0·55	UIC100 = 5 × 74100	0·55
UIC10 = 12 × 7410	0·55	UIC72 = 8 × 7472	0·55	UIC121 = 5 × 74121	0·55
UIC20 = 12 × 7420	0·55	UIC73 = 8 × 7473	0·55	UIC141 = 5 × 74141	0·55
UIC30 = 12 × 7430	0·55	UIC74 = 8 × 7474	0·55	UIC151 = 5 × 74151	0·55
UIC40 = 12 × 7440	0·55	UIC76 = 8 × 7476	0·55	UIC154 = 5 × 74154	0·55
UIC41 = 5 × 7441	0·55	UIC80 = 5 × 7480	0·55	UIC193 = 5 × 74193	0·55
UIC42 = 5 × 7442	0·55	UIC81 = 5 × 7481	0·55	UIC199 = 5 × 74199	0·55
UIC43 = 5 × 7443	0·55	UIC82 = 5 × 7482	0·55		
UIC44 = 5 × 7444	0·55	UIC83 = 5 × 7483	0·55	UICXI = 25 Assorted 74's	£1·65
UIC45 = 5 × 7445	0·55	UIC86 = 5 × 7486	0·55		

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1.

2N3055
115 WATT SIL POWER NPN
55p EACH

2 Amp. BRIDGE RECTS.

50 v RMS	35p	each
100 v RMS	40p	,,
200 v RMS	45p	,,
400 v RMS	50p	,,
1,000 v RMS	55p	,,

Size 16 mm × 16 mm.

D1699 NPN SILICON DUAL TRANSISTOR
(Similar to 2N2060)

1	25	100+
0·28	0·28	0·23

LINEAR INTEGRATED CIRCUIT PAKS

ULIC709	10 × 709	0·55
ULIC710	7 × 710	0·55
ULIC741	7 × 741	0·55
ULIC747	5 × 747	0·55
ULIC748	7 × 748	0·55

Giro No. 388-7006

Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 15p. Overseas add extra for airmail.
Minimum order 55p. Cash with order please.

Guaranteed Satisfaction or Money Back

Trannies

4 Bush House
Harlow, Essex

★ Price inclusive of VAT

★ Retail shop open 9-5.30 Mon to Sat.

★ Post & Packing 15p

£1 BARGAIN PACKS

- £1 10 NPN Power transistors (like 2N3055) tested no opens no shorts.
- £1 30 Plastic FET'S like 2N3819 U/Test random test shows good yield.
- £1 30 Plastic power NPN transistors like 2N3055 untested.
- £1 250 mixed capacitors.
- £1 500 mixed resistors.
- £1 25 potentiometers.

★ Any 5 packs £4.50 ★
p. & p. 10p per pack.

We stock a large range of electronic semi-conductors at competitive prices. Our new '74 catalogue is now available at 20p.

Electrolytic Capacitors

6·3 VOLT		16 VOLT		40 VOLT	
68μF	6½p	220μF	9p	47μF	6½p
150μF	6½p	680μF	17p	100μF	9p
470μF	11p	1000μF	17p	68μF	10p
680μF	13p	1500μF	25p	220μF	11p
1500μF	18p	2000μF	43p	470μF	19p
2200μF	18p			680μF	25p
3300μF	26p			1000μF	25p
				2200μF	44p

10 VOLT		25 VOLT		63 VOLT	
47μF	6½p	10μF	6½p	1μF	6½p
100μF	6½p	22μF	6½p	2·2μF	6½p
220μF	8p	47μF	6½p	4·7μF	6½p
330μF	10p	100μF	8p	6·8μF	6½p
470μF	10p	150μF	8p	10μF	6½p
1000μF	11p	220μF	10p	22μF	6½p
1500μF	20p	470μF	16p	68μF	10p
2200μF	24p	680μF	20p	100μF	11p
		1000μF	22p	150μF	13p
		2200μF	39p	220μF	19p
		5000μF	68p	330μF	22p
				470μF	26p
				1000μF	44p

16 VOLT		40 VOLT	
15μF	6½p	6·8μF	6½p
33μF	6½p	15μF	6½p
150μF	6½p	33μF	6½p
150μF	8p		

Volume Controls Potentiometers
Carbon track 500Ω to 2·2 meg Ω Log or Linear.
Single 13p. Dual gang (stereo) 44p.
Single type with D.P. switch 26p.

Veroboard

matrix	0·15 matrix	0·1 matrix
2½ x 3¾	17p	22p
2½ x 5	22p	24p
3¾ x 3¾	22p	24p
3¾ x 5	28p	28p
2½ x 17	60p	79p
3¾ x 17	81p	£1·05
Pin insertion tool	—	82p
Spot face cutter	52p	52p
Pack of 36 pins	42p	42p
	20p	20p

Resistors
¼ watt 5% carbon 1p
½ watt 5% carbon 1p
1 watt 10% carbon 3½p

MULLARD POLYESTER CAPACITORS C280 SERIES
250V P.C. mounting: 0·01μF, 0·015μF, 0·22μF, 3½p. 0·33μF, 0·047μF, 0·068μF, 4p. 0·1μF, 4½p. 0·15μF, 0·22μF, 5½p. 0·33μF, 7p. 0·47μF, 9½p. 0·68μF, 12p. 1·0μF, 14p. 1·5μF, 22p. 2·2μF, 27p.

MULLARD POLYESTER CAPACITORS C296 SERIES
400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, 2½p. 0·0068μF 0·01μF, 0·015μF, 0·022μF, 0·033μF, 3½p. 0·047μF, 0·068μF, 0·1μF, 4½p. 0·15μF 6½p. 0·22μF, 8½p. 0·33μF, 12p. 0·47μF, 14p.

SPARKRITE Mk II

Electronic Ignition...

Better on all points
Because you keep your points!

The SPARKRITE MK.2 is a full capacitive discharge electronic system. Specifically designed to retain the points assembly with all the advantages and none of the disadvantages. No misfire because contact breaker bounce is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high rpm. Contact breaker burn is eliminated by reducing the current to about 1/50th of norm, thus avoiding arcing. But you can still revert to normal ignition if need be. In seconds. If points go (very unlikely) you can get replacements anywhere. All these advantages.

● Fitted in 15 minutes. ● Up to 20% better fuel consumption. ● Instant all weather starting. ● Cleaner plugs they last 5 times longer without attention. ● Faster acceleration. ● Faster top speeds. ● Coil and battery last longer. ● Efficient fuel burning with less air pollution.

The kit comprises everything needed

Ready drilled scratch and rust resistant case, metalwork, cables, coil connectors, printed circuit board, top quality 5 year guaranteed transformer and components, full instructions to make positive or negative earth system, and 6 page installation instruction leaflet.

WE SAY IT IS THE BEST SYSTEM AT ANY PRICE!

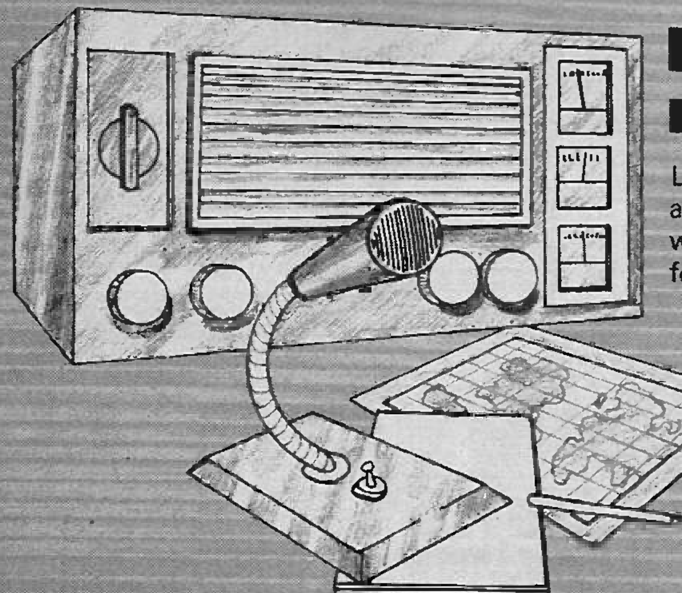
PRICES

D.I.Y. Kit only £10·93 incl. VAT and P & P
Ready Built Unit £13·86 incl. VAT and P & P
(Both to fit all cars with coil/distributor ignition up to 8 cylinders).

We can supply units for any petrol engined vehicle (boat, motorcycle etc) with coil/contact breaker ignition. Details on request. Call in and see us for a demonstration.

Order NOW direct from:—

ELECTRONICS DESIGN ASSOCIATES
(Dept. EE.10) 82 Bath Street, Walsall WS1 3DE Phone 33652



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.

Free!

Brochure, without obligation to:
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL, Dept. EEB 104,
P.O. Box 156, Jersey, Channel Islands.

NAME ____________________

ADDRESS ____________________ Block caps please

BI-PRE-PAK

SUPPLIERS OF SEMI-CONDUCTORS TO THE WORLD

Telephone Corner

COMPLETE TELEPHONES
Normal Household Type

EX. G.P.O. **only 99p** P & P 45p each

TELEPHONE DIALS
Standard Post Office type. Guaranteed in working order.
only 25p POST & PACKING 10p

Tested and Guaranteed Paks

B79	4	1N4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, 1" long, ⅛" dia. High Speed P.O. type	50p
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked.	50p
H38	30	Short lead Transistors, NPN Silicon Planar types	50p
H39	6	Integrated Circuits. 4 Gates BMC 962, 2 Flip Flops BMC 945	50p
H41	2	Sil Power transistors comp pair BD131/132	50p
H63	4	2N3055 type NPN Sil. power transistors. Below spec. devices	50p
H64	4	3819 N Channel FETs 2N3819 in plastic case	50p

Unmarked Untested Paks

B1	50	Germanium Transistors PNP, AF and RF	50p
B66	150	Germanium Diodes Min. glass type	50p
B83	200	Transistors, manufacturers rejects, AF, RF, Sil. and Germs.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	100	Sil. Diodes sub. min. IN914 and IN916 types	50p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	50p
H67	10	3819N Channel FETs plastic case type	50p

Make a rev counter for your car

The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system. **£1·00p each**

Ex GPO Push Button Intercom Telephones

Exactly as internal telephone systems still in everyday use where automatic internal exchanges have not yet taken over. Available in 5, 10 or 15 ways. Complete with circuits and instructions. Price of each instrument is independent of the number of ways. Please phone for latest details of cable.

£2·50 p.p. 35p Per Instrument

Extension Telephones
Ideal for childrens toys **70p** each P. & P. 25p.

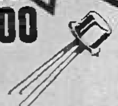
New X Hatch

Our new vastly improved Mark Two Cross Hatch Generator is now available
Essential for alignment of colour guns on all colour T.V. receivers. Featuring plug in IC's and a more sensitive sync. pick-up circuit. The case is virtually unbreakable—ideal for the engineer's toolbox—only measures 3" x 5¼" x 3".
Ready built unit only **£9·95** Complete kit **£7·95**
(includes p. & p. but no batteries)

LM380 AUDIO IC

We have just received a large consignment of LM380 IC's. These are specially selected to a higher grade and are marked with the number SL60745.
This fantastic little 3watt audio IC only requires two capacitors and two potentiometers to make an amplifier with volume and tone control. The quality is good and has to be heard to be believed.
Our special price **£1·00ea** complete with data and projects book

Over 1,000,000 Transistors in stock



We hold a very large range of fully marked, tested and guaranteed transistors, power transistors, diodes and rectifiers at very competitive prices. Please send for free catalogue.

Our very popular 4p transistors
TYPE "A" PNP Silicon alloy, TO-5 can
TYPE "B" PNP Silicon, plastic encapsulation
TYPE "E" PNP Germanium AF or RF
TYPE "F" NPN Silicon plastic encapsulation
TYPE "G" NPN silicon similar ZTX 300 range
TYPE "H" PNP silicon similar ZTX 500 range

8 RELAYS FOR VARIOUS TYPES P & P 27p **£1·00p**

UHF TV Tuner Units

Brand new by a famous manufacturer
Data supplied **£2·50**

Plastic Power Transistors

NOW IN TWO RANGES

These are 40W and 90W Silicon Plastic Power Transistors of the very latest design, available in NPN or PNP at the most shatteringly low prices of all time. We have been selling these successfully in quantity to all parts of the world and we are proud to offer them under our Tested and Guaranteed terms.

Range 1. VCE. Min 15. HFE Min 15.

	1-12	13-25	26-50
40 Watt	20p	18p	16p
90 Watt	24p	22p	20p

Range 2. VCE. Min. 40. HFE Min 40

	1-12	13-25	26-50
40 Watt	30p	28p	26p
90 Watt	35p	33p	30p

Please state NPN or PNP on order.

High Speed Magnetic Counters 4 digit (non-reset) 24V or 48V 4 x 1 x 1 in 33p p & p 5p.

INTEGRATED CIRCUITS
We stock a large range of I.Cs at very competitive prices (from 10p each). These are all listed in our FREE Catalogue, see coupon below.

METRICATION CHARTS now available
This fantastically detailed conversion calculator carries thousands of classified references between metric and British (and U.S.A.) measurements of length, area, volume, liquid measure, weights etc.
Pocket Size 15p Wall Chart 18p

LOW COST DUEL IN LINE I.C. SOCKETS
14 pin type at 15p each } Now new low profile
16 pin type at 17p each } type

BOOKS
We have a large selection of Reference and Technical Books in stock. Details are in our latest Catalogue. Send for it TODAY, using the coupon below. N.B. Books are void of V.A.T.
Send for lists of publications

Our famous P1 Pak is still leading in value

Full of Short Lead Semiconductors & Electronic Components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors.

Please ask for Pak P.1. only 50p

Please send me the FREE Bi-Pre-Pak Catalogue
I enclose large SAE with 5p stamp

NAME ....

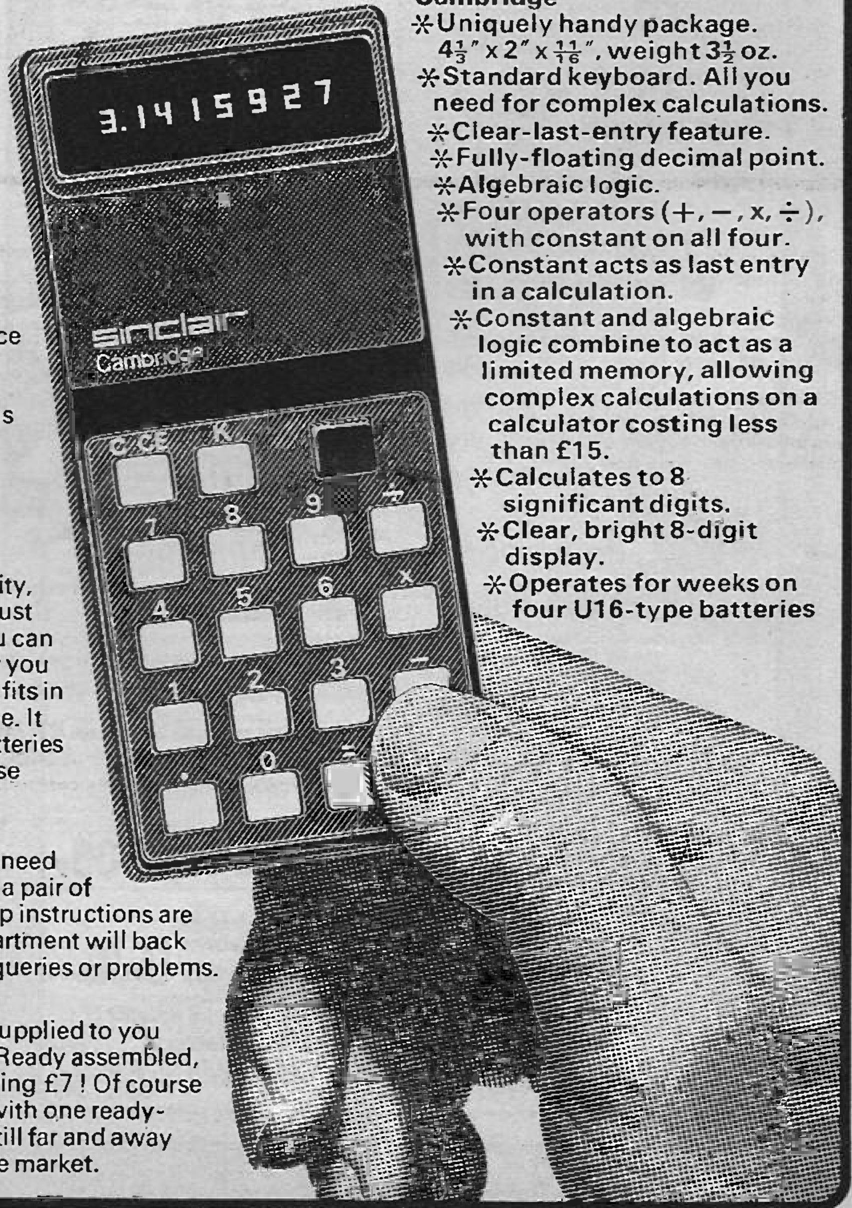
ADDRESS ....

....

Please add current VAT rate
MINIMUM ORDER 50p. CASH WITH ORDER PLEASE. Add 15p post and packing per order OVERSEAS ADD EXTRA FOR POSTAGE
BUY THESE GOODS WITH ACCESS

BI-PRE-PAK LTD
Co Reg No 820919
Dept.D. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX.
TELEPHONE: SOUTHEND (0702) 46344.

Sinclair Cambridge kit. Was £27·45. Now only £14·95! (INC VAT) You save £12·50!



An advanced 4-function calculator in kit form
The Cambridge kit is the world's largest-selling calculator kit.

It's not surprising – no other calculator matches the Sinclair Cambridge in functional value for money; and buying in kit form, you make a substantial saving.

Now, simplified manufacture and continuing demand mean we can reduce even the kit price by a handsome £12·50. For under £15 you get the power to handle complex calculations in a compact, reliable package – plus the interest and entertainment of building it yourself!

Truly pocket-sized
With all its calculating capability, the Cambridge still measures just $4\frac{1}{3}$" x 2" x $\frac{11}{16}$". That means you can carry the Cambridge wherever you go without inconvenience – it fits in your pocket with barely a bulge. It runs on ordinary U16-type batteries which give weeks of normal use before replacement.

Easy to assemble
All parts are supplied – all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our service department will back you throughout if you've any queries or problems.

Total cost? Just £14·95!
The Sinclair Cambridge kit is supplied to you direct from the manufacturer. Ready assembled, it costs £21·95 – so you're saving £7! Of course we'll be happy to supply you with one ready-assembled if you prefer – it's still far and away the best calculator value on the market.

Features of the Sinclair Cambridge

- Uniquely handy package. $4\frac{1}{3}$" x 2" x $\frac{11}{16}$", weight $3\frac{1}{2}$ oz.
- Standard keyboard. All you need for complex calculations.
- Clear-last-entry feature.
- Fully-floating decimal point.
- Algebraic logic.
- Four operators (+, –, x, ÷), with constant on all four.
- Constant acts as last entry in a calculation.
- Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £15.
- Calculates to 8 significant digits.
- Clear, bright 8-digit display.
- Operates for weeks on four U16-type batteries

everyday electronics

PROJECTS..

THEORY.....

MAKING MUSIC

The popularity of the electric guitar shows no sign of waning. Even today we receive requests for details of the EVERYDAY ELECTRONICS Beta Guitar published two years ago.

To meet this persistent demand we now present an entirely new model, the EVERYDAY ELECTRONICS *Delta Electric Guitar*. Designed specially for home construction this instrument takes a novel and distinctive form. So it should appeal to that strong individualistic streak that most guitarists appear to possess.

The electric guitar offers the means to employ electronics in the process of making music thereby opening up entirely different possibilities in sounds. Electronic effects units and amplifying equipment that make all this possible can also be built at home. Suitable designs appear frequently in these pages. So there are untold pleasures ahead for pop and traditional music types alike who build the *Delta*.

BE SECURE

Electronics knows no bounds. So from the joys of music we now turn to something completely different; from the romantic make-believe world of entertainment to the harsh reality of everyday life.

Those who value their property and possessions—not to mention peace of mind—over and above the expenditure of a few pounds and a few hours labour will look with interest into this months' design for a *Home Security System*. It has some interesting features, and the installation should not be beyond the capabilities of the average handiman.

END OF TERM

Another *Teach-In* has run full course. Those thousands of newcomers to electronics who have diligently followed the series will have acquired a good store of basic knowledge concerning electronic fundamentals, circuits, and devices.

They will also have acquired an assortment of components as called-up for the Tutor Board experiments. Many of these components can now be put to permanent use in the building of the *Reaction Timer* described in this issue. But if practical skills are still lacking we advise waiting until next month's feature on the art of soldering can be studied.

MOST EXTRAORDINARY

Finally we must prepare our readers for an odd chap who makes his bow this month. The Prof., like all of his ilk, must be allowed his little idiocyncrasies. But his words and actions will offer enlightenment to many who, like his young companion and ardent fan "Bob", have newly embarked upon a study of electronics.

There's no telling just what Ernest Eversure will be up to next, so be sure to follow each episode month by month!

Fred Bennett

Because of prevailing production problems, no firm publishing date can be announced for the November issue. Readers are advised to check regularly with their local supplier from mid-October onwards.

.EASY TO CONSTRUCT
.SIMPLY EXPLAINED

VOL. 3 NO. 10 OCTOBER 1974

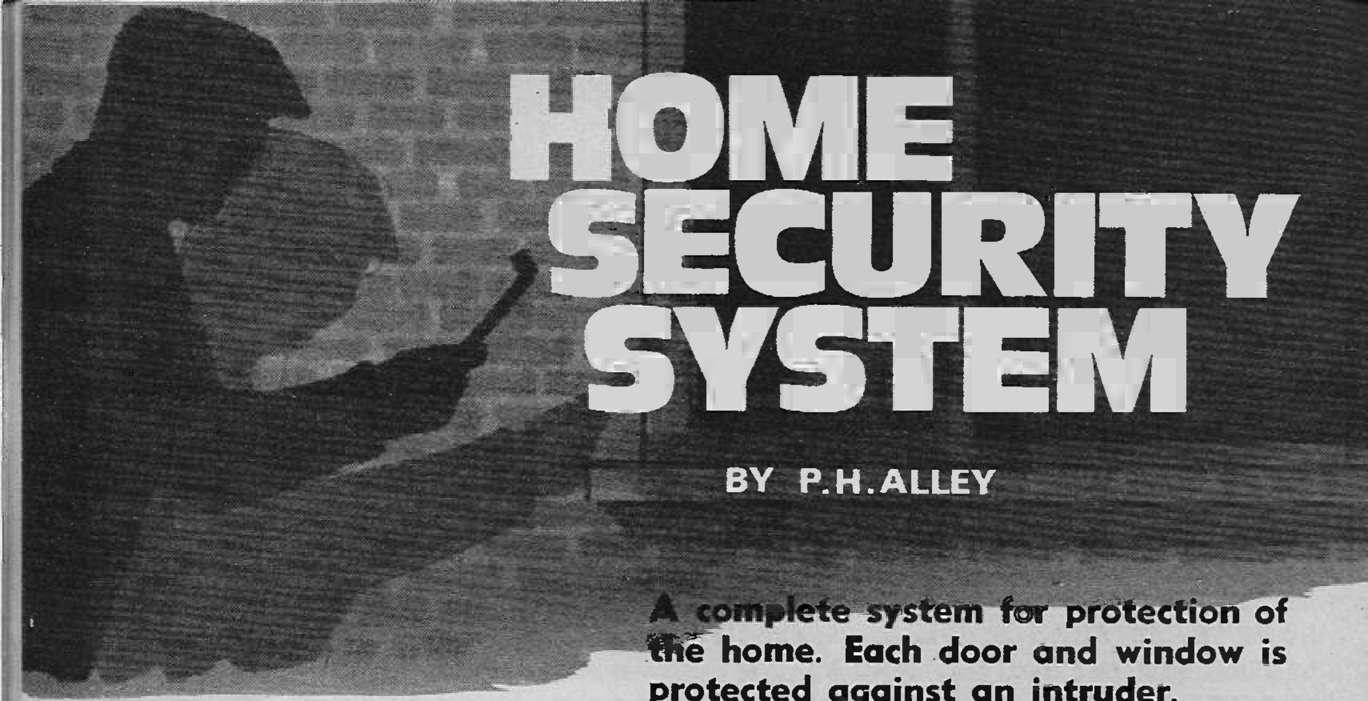
FREE INSIDE EE DELTA GUITAR BLUEPRINT

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Publisher's Annual Subscription Rate, including postage Inland £2.95, Overseas £3·00. International Giro facilities Account No. 5122007. State reason for payment "message to payee". Address to Everyday Electronics, Subscription Department, Carlton House, Great Queen Street, London, WC2E 9PR. Binders for volumes 1 to 3 (state which) and indexes for volume 1 and 2 available for £1.25 and 30p respectively, including postage, from Binding Department, at the above address.

We are unable to supply back copies of Everyday Electronics or reprints of articles and cannot undertake to answer readers' letters requesting designs, modifications or information on commercial equipment or subjects not published by us. An s.a.e. should be enclosed for a personal reply. Letters concerning published articles should be addressed to: The Editor, those concerning advertisements to: The Advertisement Manager, both at the address shown opposite.



HOME SECURITY SYSTEM

BY P.H.ALLEY

A complete system for protection of the home. Each door and window is protected against an intruder.

The number of burglaries increase year by year so presumably it is only a matter of time before there will be an attempted burglary on your home. The chance of the burglar being caught and the stolen goods returned are remote and just as you will have no idea as to the burglar's identity it is doubtful whether the local police will have either, who, after all, are not magicians. In any case even the event of subsequent apprehension and perhaps the return of your property may be relatively unimportant compared to the ransacking and vandalism of your home.

The answer then is to install burglar proofing and stop the robbery at source. This can either be in the form of a dog or in the form of an electronic circuit.

The complete circuit which is capable of being trimmed, modified or added to quite simply is shown in Fig. 1, bearing in mind that each system will be subject to the features of the building in which it is to be installed and the complexity and expense that the reader is willing to undertake.

The main circuit is enclosed in a small wooden box which can be placed in any suitable position, such as the cloak cupboard.

OPERATION

Before operating ensure S1, is to TEST then switch on at the mains. The neon should light up and incidentally this light can be positioned so that it is easily seen when descending the stairs, prompting the first person who gets up in the morning to switch off the system before opening an outside door or window.

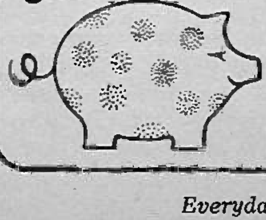
Should any door or window be open with S1 at test its associated microswitch will be closed and a current, dependent on its resistor, will show up on the meter ME1. The meter reading indicates which specific door or window is open and saves the problem of having to check them all. When all are closed the meter reads zero and S1 is placed to alarm.

The system is now armed and if any door or window is opened the associated microswitch will close sending a pulse through C1 to the base of TR2 operating RLA which completes the circuit to the alarm bell via RLA2 thus causing it to ring. Under normal circumstances RLA would only be energised for a second or two dependent on the time constant of Ra, Rb, etc., the input resistance of TR2 and C1. However on initial energisation of the relay C2, which will have been charged up to line voltage when the system was switched on, will now be connected up to the base of TR1 by RLA1. This is connected in a Darlington configuration with TR2 and will keep RLA energised for about 15-20 minutes. The system is thus latched on, and reclosing the door or window will have no effect. Only by switching off the power can the bell be stopped before the time period is up.

Let us now cover the aspect of the alarm being armed whilst you go out shopping, on

FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS
including V.A.T.



£6.50
excluding case and house wiring

*Based on prices prevailing at time of going to press

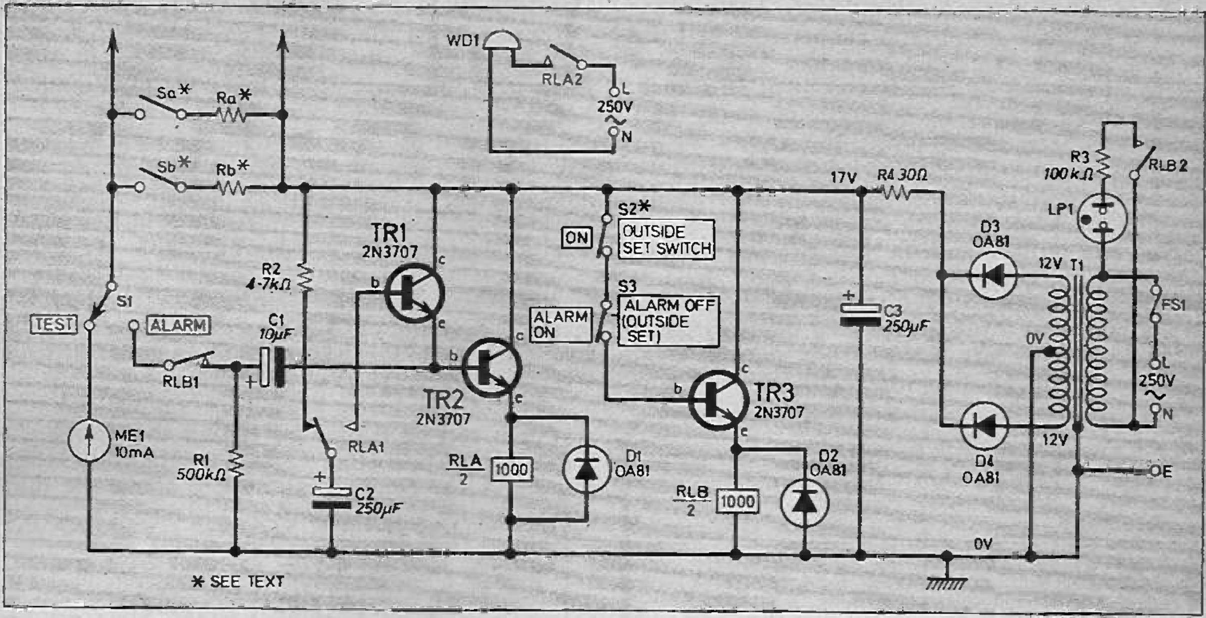


Fig. 1 The circuit diagram of the Home Security System.

holiday, etc. First, and always first, S1 to test: then to alarm if no meter reading. Now close S3 which connects the positive line to the base if TR3 which energises RLB in its emitter line. Contacts RLB1 disconnect all microswitches and contacts, RLB2 disconnects the neon which extinguishes, confirming the system is disarmed.

Leave the house and open S2, situated outside. This disconnects TR3 base de-energising RLB and thus rearming the system. Reverse everything in order to get back into the house. Note that S2 does not necessarily have to be a conventional on/off switch. It can be a plug and socket. Removing the plug disconnects the circuit and it would have to be a very shrewd burglar to tie up the innocent looking socket outside the house with your burglar system.

Note the sensitivity of S2 is effectively 3 times normal since it is in the base circuit of TR3, and exposure to an inclement environment and slight corrosion will not render it unsuitable, nor will the length of wire with its associated resistance be detrimental. This is equally true of the whole circuit, where under normal circumstances low voltage circuits and bad contacts are unreliable as is so often experienced in bell circuits and ordinary torches after months of use.

INSTALLATION

Without doubt the main problem with the installation is to get all the wiring round the house and into the garage (or outside) neatly and with a minimum of surface wiring. Certainly no wire should be capable of being seen or tampered with from outside.

If you are lucky enough to have a house built or in the process of being built the wiring can be completed before plastering the walls. At no time concern yourself with the lengths of low voltage wire involved as its resistance is immaterial as already explained. After completing the wiring make a note of where the wires are so that when subsequently constructing built-in furniture you can avoid putting a nail or screw through it!

For existing houses a cavity wall is a great help and although a lot more wire will be used most of it can be hidden in the cavity.

First decide where the wire will come through the wall and then drill a hole about 15mm diameter. This can be accomplished by using say a 6mm masonry drill at least 130mm long after it has been chucked (in order to get through the inner wall into the cavity) then continue drilling to enlarge the initial hole. The following precautions should be observed. Unless you know exactly where the 250 volt mains wiring runs, drill the first 25mm or so through the plaster gingerly and with a light pressure.

Houses more than about 5 years old invariably have the wire encased in conduit giving the wire reasonable protection. The conduit used upstairs to light switches and power points go up behind the plaster into the loft from where you can trace its path in the wall below. Nowadays mains wiring in the wall has little protection other than a covering of light gauge sheet metal. Although it is not easily drilled through particularly with a masonry drill, do not apply excessive pressure when using an electric drill until you have cleared the plaster.

As a personal precaution ensure the electric drill is earthed, stand on a rubber mat and use rubber gloves. Once the hole has been drilled make up a piece of wire in the form of a hook. Tie a small weight to a length of string and, from the loft, let it down the cavity by an appropriate amount then swing it like a pendulum. Meanwhile the "assistant" downstairs pushes the hook through in the wall, hooks the string and pulls it and its small weight through the hole.

Attach the wire to the string in place of the weight, thread through the hole and haul it up the cavity to the loft. If the wire is supple enough the string can be dispensed with and the wire itself, with a small weight at the end can be dropped down the cavity and hooked. Attach a socket to the end of the wire and fix it in place over the hole in the wall to give a neat appearance.

Alternatively drill through the wall adjacent to and at right angles to the window. In this case a longer hook will be required as a concrete lintel normally extends quite a few inches either side of the window together with its damp course. One last point to note is that the wire cannot be laid horizontally at low level in the cavity because of the tie rods connecting the exterior and interior walls so it ends up as a series of loops (see Fig. 2).

The ducts in a warm air central heating system can be useful for hiding the wiring. To get from *A* to *B* (Fig. 3) push a wire drain cleaning rod (or heavy gauge wire) along the duct then attach the wire and pull it through. To get from *A* to *C* tie light string firmly to a child's spring or battery driven car and send it along the duct. It will fall down the vertical shaft to be retrieved at C by the "assistant" who removes the car, replaces it with the wire which is pulled back through the ducting to *A*.

Another method is to take up the floor boards at strategic points and use the drain cleaning rod, or stiff wire, to pull the wire between the joists (note the spaces between the joists the run at right angle to the floor boards). Cut the floorboards at an angle in Fig. 4 as close to the joist as possible with a key hole saw. Before replacing screw pieces of 2 x 1 battening to the joists as additional support, see Fig. 4b. It is suggested that the piece of floorboard be screwed back into position, both for ease of subsequent removal and to avoid squeaking.

To get the wire out of the house without running it on the surface can be difficult. One way round the problem is to drill a hole in the wooden post of the outside door and fix in a key operated switch. Alternatively place in position two metal studs about 10mm apart on the outside surface of the door joint and make and break the circuit with a small magnet see Fig. 5. Note S2 and S3 can be replaced by one switch entailing a little more inconvenience, i.e., close the switch from outside the house before switching the system on. Leave the house and open the combined S2 and S3 to break the circuit.

As previously mentioned each opening external window and door must be fitted with a microswitch to "guard" it. This is best done with changeover switches since these are readily available and the type required are release to make. These switches are available in miniature sizes (e.g. 12 x 8 x 5mm), can be fixed against the window or door and painted to match the decor. Once thus installed they are unobtrusive and not easily seen by the burglar. Installation of switches for doors and windows is shown in Figs. 6 and 7.

Components....

Resistors
- R1 500kΩ
- R2 4·7kΩ
- R3 100kΩ
- R4 30Ω

Ra, Rb, Rc etc as required—see text—from 1·8kΩ to 18kΩ in approximate 1·8kΩ intervals
All ¼ W ± 10% carbon

SEE SHOP TALK

Capacitors
- C1 10µF elect. 20V
- C2 250µF elect. 20V
- C3 250µF elect. 20V

Semiconductors
- D1–D4 OA81 or similar diodes rated at least 50V 50mA (4 off)
- TR1–TR3 2N3707 silicon *npn* (3 off)

Switches & Relays
- Sa, Sb etc miniature s.p.d.t. (or release to make) microswitches (see text).
- S1 s.p.d.t. toggle or slide switch
- S2 s.p.s.t. key operated switch or may be made from plug and socket—see text.
- S3 s.p.s.t. toggle or slide switch
- RLA 1000Ω 12 to 18V relay with one set of changeover and one set of normally open contacts (see text for additional bell)
- RLB 1000Ω 12 to 18V relay with one set of normally open contacts and one set of normally closed contacts.

Miscellaneous
- ME1 10mA f.s.d. moving coil meter (almost any size—see text)
- WD1 alarm bell, mains operated (see text)
- LP1 neon indicator bulb without series resistor
- T1 mains transformer with 12-0-12V, 50mA secondary
- FS1 500mA fuse and holder

Veroboard 11 holes by 9 strips, 0·15 inch matrix, materials for case or ready made case approx 150mm x 125mm x 100mm, angle bracket for RLA, RLB, T1 and Veroboard mounting, connecting wire, 4BA fixings. Sockets for connection of microswitches—number as required. May be any small two pole types.

HOME SECURITY SYSTEM

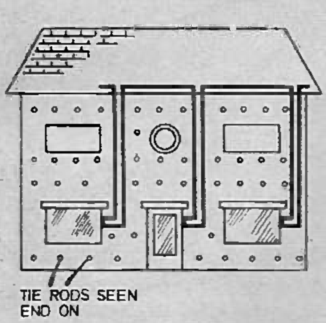


Fig. 2 (left) Wiring of windows and doors through the cavity walls. The tie rods prevent direct connection.

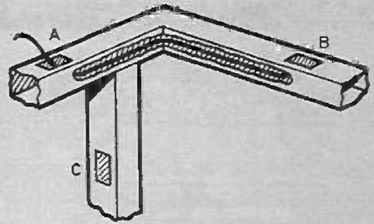
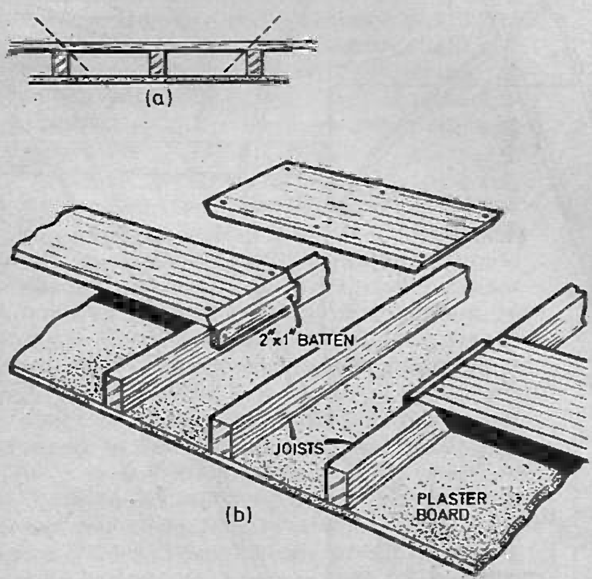


Fig. 3 (above) using warm-air ducting to house the wiring



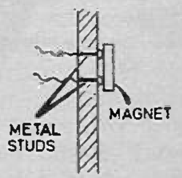


Fig. 5 (above) One method of arranging S2.

Fig. 4 (left) Method of cutting and replacing part of a floorboard to facilitate wiring.

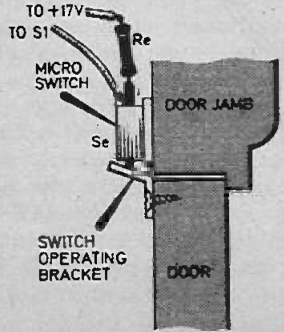
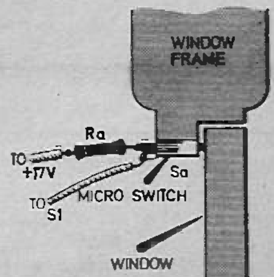


Fig. 6 (left) Arrangement and wiring of the microswitch to protect an inward opening door.

Fig. 7 (right) Micro-switch arrangement for a hinged window. Sliding windows can be arranged with an operating bracket similar to that in Fig. 6.



HOME SECURITY SYSTEM

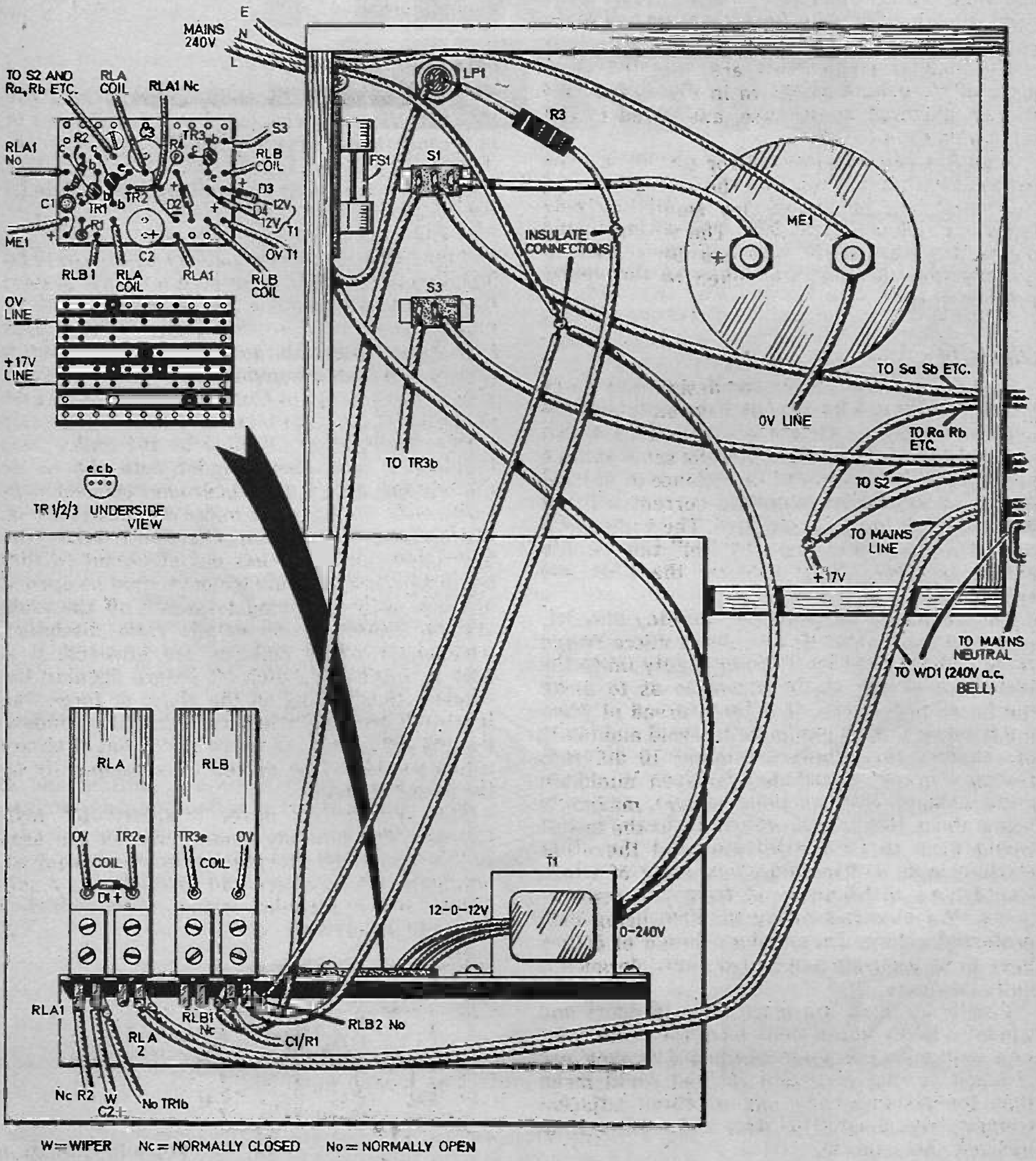


Fig. 8. The construction and wiring of the Home Security System.

CONSTRUCTION

The main circuitry for the unit can be housed in almost any case that has room for the relays, switches and ME1—the size of ME1 is unimportant provided the 1mA divisions can be easily seen so that the offending window or door may be located. It is a good idea to make a list of meter readings and windows/doors, etc., so that everyone can use the unit easily, e.g., 1mA front door, 2mA hall window, 3mA front bay window, etc.

The smaller components are mounted on a piece of Veroboard as shown in Fig. 8, and this is then mounted in the case, and wired to the remaining components.

A socket can be provided for connecting the external wiring and this and the sockets around the house can be almost any small two pole types, e.g., phono, jack, DIN. The wiring to the mains and the alarm bell can be connected directly into the unit and taken to the appropriate points.

DESIGN

Some points concerning the design may be of interest to those who already have suitable components to hand. First the two relays which should both work reliably from the same voltage and RLA should have a coil resistance of at least 500 ohms so that its operating current will not exhaust C2 in too short a period. The value of C2 can be altered to change the "on" time of the alarm. Increase C2 to increase the time and vice versa.

The values of resistors Ra, Rb, etc., plus R1, require some comment. The lowest micro switch resistor must be at least ten to twenty times the resistance of the whole wiring so as to make the latter immaterial. If a 1mA spread of reading is taken to be a minimum to avoid ambiguity of readings this allows a total of 10 different resistors evenly distributed between minimum and maximum (for the 10mA meter), maximum being about 18 kilohms, which means the lowest would need to be 1·8 kilohms and the other resistances in 1·8 kilohm steps, some of which would have to be made up from two resistors in parallel or series owing to them being non-preferred values. These values do not of course have to be accurate and 25 per cent tolerance is quite adequate.

Finally as there are more than 10 doors and windows in my house some have the same resistors and give the same reading but they are grouped so that a certain reading could mean that for instance, any one of three adjacent windows was open. This does not detract from its basic convenience.

Resistor R1 is used simply to get rid of small charges which may build up in C1. This was found to occur without R1 and could be due to the long lengths of wire acting as an aerial. Transistors TR2 and TR3 can be either silicon or germanium but TR1 should be silicon for a low I_{co}, which would be amplified by TR1 and under adverse conditions could be sufficient to energise RLA. Finally D3 and D4 are traditional transistor protection diodes against transient reverse voltages induced in their respective relays when switching on and off. These can be small signal diode types of no specific denomination.

MODIFICATIONS

Instead of using the mains power supply two PP9 batteries in series could be used instead or in conjunction in case of power failure. However if there is a power failure the bell will not ring which means using a low voltage bell and independent battery.

If you have a friendly neighbour, a small low voltage bell with its own battery power could be installed in his house connected into your system though it may be a quick way of losing a friendly neighbour if there are too many false triggerings. Better to get him to install a burglar alarm system and then the undertaking will be mutual. This feature would of course entail an extra pair of normally open contacts on RLA.

One modification installed by the author was to place a slide switch underneath the lip of the window sill in each bedroom, connected in series with the adjacent microswitches (see Fig. 9). Opening this switch effectively takes the associated micro-switches out of circuit so that for instance, a bedroom window could be opened at night without having to switch off the main system. However this entails rigid discipline, particularly where children are involved. It is easy to forget to switch off before opening the window, thus setting off the alarm or forgetting to switch back on when reclosing the window, leaving the associated micro-switch out of circuit which would not be picked up subsequently by the meter reading.

The system has never triggered off mysteriously and now my young children are used to the simple and acceptable discipline required, accidents are very rare and justifiable as a substitute for a periodic system check which I forget to do anyway. ▣

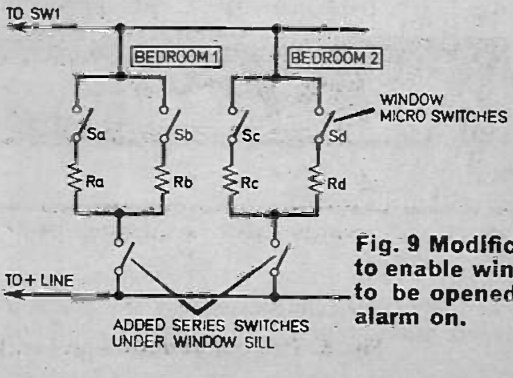
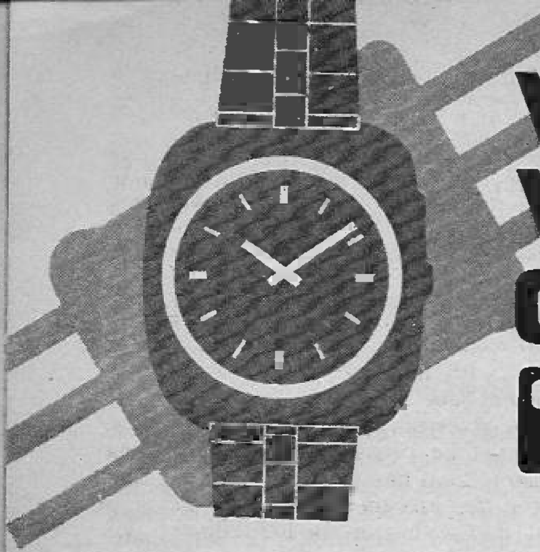


Fig. 9 Modification to enable windows to be opened with alarm on.



WRIST WATCHES GO ELECTRONIC!

BY J.B. DANCE

THE second and last part of our look at modern electronic timepieces.

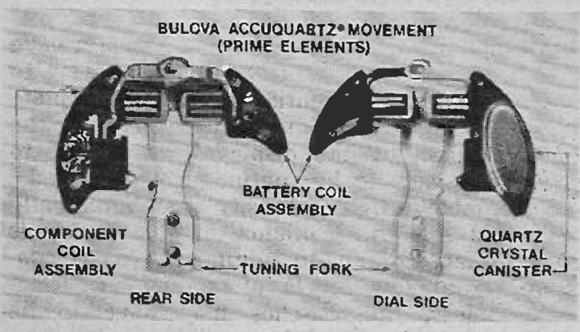
QUARTZ CONTROLLED TUNING FORK

The Bulova Company originally marketed an Accuquartz watch using the Beta 21 movement, but their new thinner Accuquartz employs a quartz oscillator to control the frequency of a tuning fork movement. The 32,768Hz oscillator frequency is divided by a CMOS integrated circuit to produce pulses which operate the $341\frac{1}{3}$Hz tuning fork movement. The latter operates normal watch gearing as in the Bulova Accutron watches.

The new Accuquartz models became available in Europe towards the end of 1972 at prices from £115 (stainless steel) to £675 (gold with a gold bracelet). A range of models is available for both men and women, the accuracy being quoted as 1 to 2 seconds per week.

MOTOROLA KITS

Motorola Timepiece Electronics supply kits containing three parts to large watch manufacturers. Each kit contains a 32,768Hz encapsulated quartz crystal, a CMOS integrated circuit and a miniature stepping motor. The watch manufacturer is free to choose the design of the other parts which include the watch dial and hands, gearing and the power cell.



Some of the major components of the Bulova Accuquartz movement

The integrated circuit divides the oscillator frequency by a factor of 2^{16} to produce 0·5Hz pulses which drive the stepping motor. It contains 312 transistors on a chip 2mm square in a 5 x 6·25 x 7mm ceramic package and requires a current of about 5μA. The output pulses cause the motor to rotate through 180 degrees once per second and this can be used to make the second hand of a watch jump forward at this frequency.

THE ASTROQUARTZ

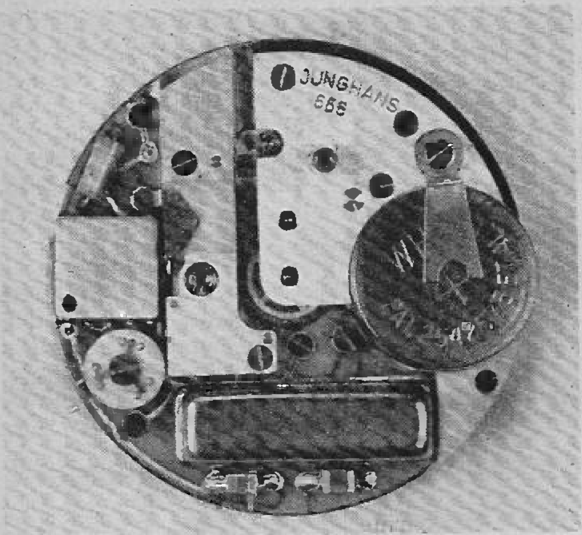
A watch for men known as the Astroquartz is produced by the Junghans Company of Schramberg, Germany. It employs a 32,768Hz quartz oscillator, the quartz crystal itself being shaped rather like a tuning fork with two prongs.

The oscillator frequency is divided by an integrated circuit containing over 200 circuit elements on a 1·6 x 2·1mm chip which consumes about 8μA at 1·3V. The circuit produces output pulses at a frequency of 1Hz. These pulses drive an electromagnetic vibrator which moves the centre second hand twice per second.

The total current consumption is about 14μA from the 1·3V 150mA-hour battery. Temperature changes in the 20 degrees C to 30 degrees C region cause timing errors of less than 0·1 second per day.

THE MEGAQUARTZ

The Omega Division of SSIH (Société Suisse pour l'Industrie Horlogère) in collaboration with the Batelle Institute has developed a model which is claimed to be the most accurate wristwatch yet designed. The accuracy is about 1 second per month. This watch, which is known as the Megaquartz 2400, is in production and is expected to be available at prices from about £425.



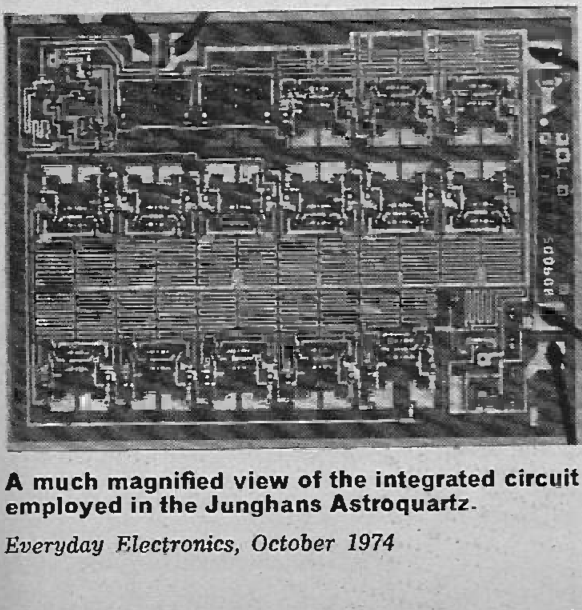
The interior of the Junghans Astroquartz.

The Megaquartz watch employs an AT cut quartz crystal operating in a shear mode at the very high frequency of 2,359,296Hz. A CMOS integrated circuit manufactured by the Intersil Company is used as an analogue divider to reduce the frequency to 1Hz. It employs about 400 transistors on a chip 4mm² in area. The output pulses drive a step-by-step percussion motor.

This watch is constructed in modular form for convenience in manufacture and servicing.

QUARTZ DIGITAL WATCHES

Quartz controlled watches with a digital display have recently appeared on the market. They employ no moving parts whatsoever and provide an accuracy which is usually about one minute per year. Up to the present time two forms of digital display have been used in wristwatches, namely electroluminescent diodes and liquid crystal displays. The choice of display is determined largely by the power required to operate it.



A much magnified view of the integrated circuit employed in the Junghans Astroquartz.

The Omega Time Computer watch employs gallium arseno-phosphide electroluminescent diodes to provide a display in red digits. This watch is expected to be available in the UK at around £300. A similar watch known as the Pulsar is available from the Hamilton Company in the USA (but not in Europe).

A 32,768Hz quartz oscillator is employed in these watches with a CMOS integrated circuit manufactured by the Intersil Company containing 1,238 transistors on a 3·8 x 3·8mm chip.

A button must be pressed when one wishes to read the time from one of these watches. The hours and minutes are then displayed for 1·25 seconds, but if the button is held down, the seconds are displayed until it is released. The watches are powered by two silver oxide cells which have a life of at least a year provided that the average number of readouts does not exceed about 25 per day. These watches can withstand shocks of 2,500*g* and have a scratch-proof face of synthetic ruby.

The Omega Time Computer.

Electroluminescent diodes have the advantage that they have been well tested and should have a very long life. In addition, they are easy to read in low ambient lighting or even in complete darkness. Their main disadvantage is that the current taken by the display is too great to enable the time to be continuously displayed.

The ambient light intensity is automatically measured and the brilliance of the display is adjusted accordingly to minimise current consumption at low levels of ambient lighting. Nevertheless, the watches may have to be shaded with the hand in conditions of bright sunlight.

LIQUID CRYSTAL

A liquid crystal system does not emit light, but merely reflects different fractions of the incident light from different parts of the display. The current required is therefore extremely low (typically about 1μA at 15V). Such watches can display the time continuously. In contrast to diode displays, liquid crystal watches cannot be seen in the dark; indeed, a moderately high ambient light intensity is desirable.

There is still some doubt about the life of liquid crystal displays, but most manufacturers seem to be offering guarantees of some years. Any failure manifests itself as a gradual deterioration in the clarity of the display, but some types may have an indefinite life.

The liquid crystal display is formed by applying an electric field across a suitable nematic chemical. The field is applied by suitable segmented electrodes so that it is in the shape of the digits to be indicated. As the crystals come into alignment, they reflect back the incident light.

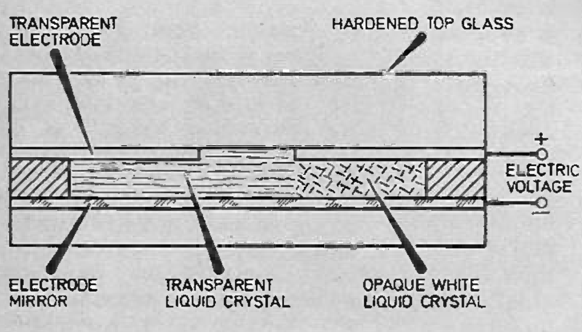


Fig. 9. Basic liquid crystal reflected light readout system.

An alternative system is shown in Fig. 9 in which a mirror is placed behind the display so that light is reflected back to the viewer at those places where no field is applied. Nematic materials cease to show liquid crystal properties above a certain critical temperature. In the case of one watch (manufactured by the Gruen Company) this temperature is about 55 degrees C; a rise in temperature should cause no problems, however, since the normal properties of the display return on cooling.

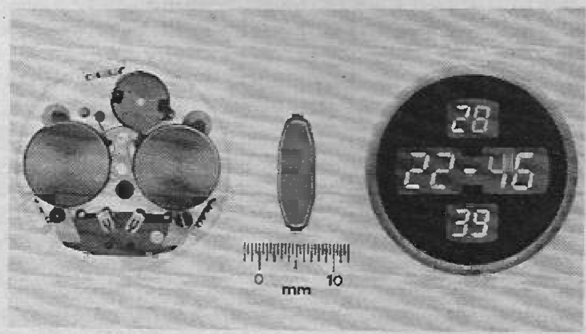
Watches which employ a liquid crystal system to display the hours and minutes (with a colon flashing the seconds between the hour and minute digits) are available from a few manufacturers. The Microma watch contains some 1,500 transistors on a chip 1/75 square inch in area. At £79 (from Rastra Electronics Ltd., Hammersmith W6), it is one of the cheapest quartz controlled watches which has come to the attention of the author.

A similar watch produced by the Optel Corporation in the U.S.A. is expected to be marketed by Avia (Société de Garde-Temps) in the U.K. in the near future. Another watch of a similar type will soon be available from Gruen Industries Inc. under the name Teletime (U.K. agents: Verity Time Co. Ltd., EC1). The quartz oscillator operates at 32,768Hz.

Another type of liquid crystal watch has been designed by Ebauches S.A. in collaboration with Texas Instruments. It provides a continuous readout of the day of the month, the hours, minutes and seconds all in the form of digits. The watch is powered by two 1·35V mercury cells. It is expected to be available from Longines in the near future.

ALARM WATCHES

The watches which have been discussed so far have employed electronics to provide greater accuracy than a conventional watch without any winding of a power spring. The Nepro Company of Switzerland have employed electronics in watches for an entirely different purpose, namely for providing an alarm. At present this Company offers two types of watches with an electronic alarm which are known as the Elevox and the Memotron. The Elevox is especially interesting, since the sound is produced by the vibration of the glass of the watch.



The interior quartz crystal enclosure and display of the Ebauches S.A./Texas watch.

These watches employ 1·5V cells which have a life of about a year with normal use. Although the current taken whilst the alarm is sounding is only 8 to 12mA, the sound intensity is normally adequate to be heard in a busy street.

As the prices of integrated circuits fall and the cost of labour rises still further, it seems almost certain that a much greater proportion of the watches produced in the world will be electronic ones.

Finally it is interesting to note that a recent American report on the solid state watch market predicts that 4·78 million solid state digital watches will be sold in 1980, a 1,600 per cent increase on the 1973 figure. ▣

The Extra-ordinary Experiments of Professor Ernest Eversure

by Anthony John Bassett

Professor Ernest Eversure, or the Prof. as his friends call him, has been experimenting in electronics for more years than anyone can remember and we thought that you might like to hear of, and perhaps repeat, some of his extraordinary experiments. Anthony J. Bassett will be recounting some of the experiments every month so why not follow the Prof's work and learn along with young Bob, his friend.

THE Profesor was seated on a high stool in his laboratory, eagerly devouring a peculiar soupy mixture from a bowl on the nearby workbench. It was one of his own special formulae for healthy food; partly responsible, so the Prof. claims, for some of the ingenious ideas inspiring the Professor's Extraordinary Experiments!

The Prof. is a small, cheery looking fellow; nobody seems to know the Prof's age. He looks quite at home amongst the masses of amazing scientific equipment set up all around.

Seated near the Prof. was one of his many friends, Bob, a young experimenter who was visiting the laboratory. He looked suspiciously at the contents of the Prof's bowl.

Suddenly the Prof. dropped his spoon and leapt into the air with a loud yell. His head missed the nearest lamp by a mere fraction. Landing safely, he grabbed Bob by the shoulder. "I've got an idea!" he shouted excitedly, "Come on, let's try it!"

Hurrying along energetically, the Prof. took the amazed Bob to another part of the laboratory. "It's an idea for the Musical Note Generator circuit you were investigating." he said. Bob had built a two-transistor circuit for generating an audible note (a diagram of his circuit is shown on page 552).

The pitch of the note produced by the oscillator is determined by the control resistor VR1. Bob wanted to build a simple keyboard or note-selector to fit in place of VR1, and if possible to do some simple experiments with different ways of tuning the circuit.

The Prof. mixed a small quantity of very finely powdered graphite with a small quantity of quick-drying varnish to give a thin dark-grey paste.

The Prof. placed this paste in a small jar. "We are going to use this mixture to make some very special devices," he said, "I will show you how to make your own microphones, gramophone pick-ups, and all sorts of interesting, useful and easily-built gadgets."

"This is really exciting" said Bob, "will it help tune my Musical Note Generator too?"

"Aha!" said the Prof., "for that I will show you how to make some very special resistors!" Picking up a hacksaw, he cut off a piece of Paxolin about 25mm long by 12mm wide, and drilled a small hole near each end to fit a small (say 6BA) nut, bolt and solder tag. He rubbed one side of the Paxolin with fine emery cloth or sandpaper to remove the gloss.

While the Prof. soldered a few inches of wire to each tag, Bob asked, "Does this mean we can make some of our own components? This is something I've wanted to try for quite a while!"

"Yes," said the Prof., "it is quite easy to make many electronic components yourself. Even for somebody quite new to the subject, many of the parts you need are easily made without special skill or expensive equipment."

Meanwhile he had assembled the piece of Paxolin together with the nuts, bolts, solder tags and bits of wire.

"There is enough mixture in this jar to make dozens of resistors, and the price of this mixture is only a few pence."

Dipping a small artist's paintbrush in the graphite mixture, the Prof. painted a small ring round the head of each bolt so that the mixture contacted both the ring of the solder tag and the surface of the paxolin where it had been cleaned by the emery paper.

Then he painted a line about 3mm wide joining one ring to the next. Setting the Paxolin carefully down, he explained to Bob,

The Prof's Musical Note Generator

The musical note generator that Bob built was that shown on this page. The basic circuit diagram is shown in Fig. 1 and the construction of the actual unit in Fig. 2.

The components listed below can be purchased for about £1·50 and the complete unit built up on a piece of paxolin or perspex using 6BA nuts, bolts and solder tags. This oscillator can be used with the resistors that the Prof has shown Bob how to make, they go in place of VR1.

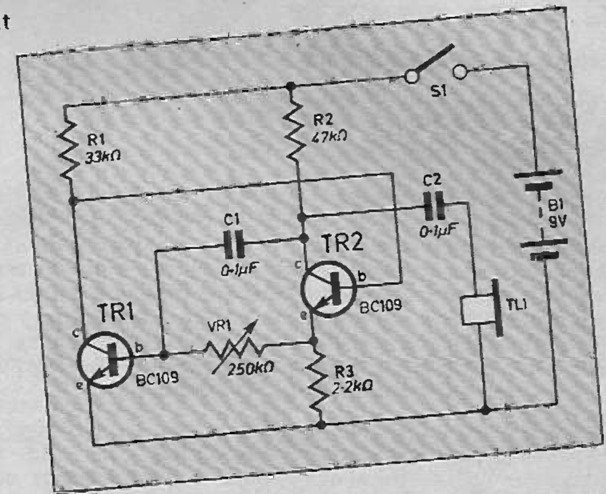


Fig. 1 The circuit diagram of the Musical note generator.

Components....

Resistors
R1 33kΩ
R2 47kΩ
R3 2·2kΩ
All ¼W ± 10% carbon

Capacitors
C1 0·1μF
C2 0·1μF

Transistors
TR1 BC109 silicon *npn*
TR2 BC109 silicon *npn*

Miscellaneous
VR1 250kΩ potentiometer
S1 s.p.s.t. toggle switch
TL1 crystal earpiece
B1 9V battery and connecting clips
Paxolin or Perspex approx. 70mm × 70mm × 3mm, 6BA nuts, bolts and solder tags, connecting wire
Graphite can be obtained from Chemical Laboratory Suppliers, Engineering Suppliers, Art Shops or in slightly impure form by powdering the "lead" in a soft graphite pencil.

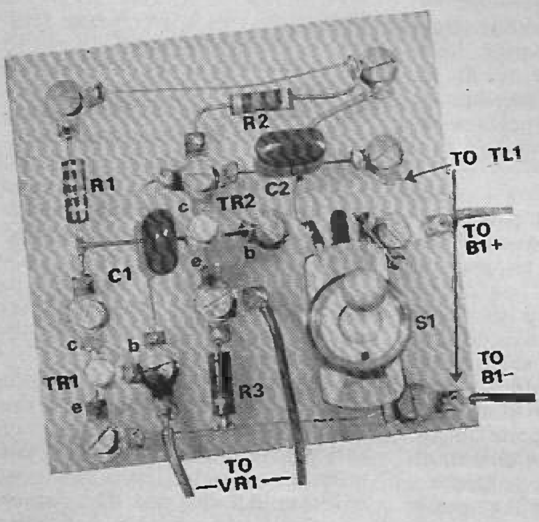
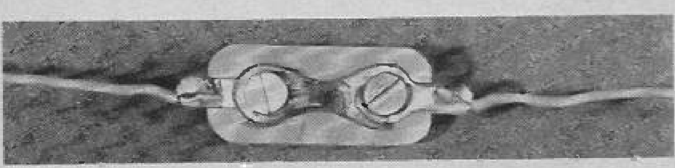


Fig. 2. Photograph of the construction of the musical note generator.



Photograph of the resistor the Prof. made to use with Bob's Musical Note Generator

"Graphite conducts electricity quite well, and most resistors are made of carbon in the form of graphite. The graphite is mixed with an adhesive material to bind the particles together. For this experiment we are using quick-drying varnish to bind the graphite particles into a track which will carry electrical current from one solder tag to the other."

He went on to explain this to Bob in more detail, and after a few minutes had passed, with the Prof. giving answers to some of Bob's questions about resistors, the varnish was found to be dry.

"Now that the varnish is dry," said the Prof., "we should be able to connect this resistor we have just made, to your Musical Note Generator and observe the result."

Bob switched on his Musical Note Generator. A musical note was immediately produced in the earpiece; it was not very loud, but could easily be heard in the laboratory. By adjusting the control VR1, the pitch of the note was caused to rise and fall over a few octaves. Then he switched it off, and borrowing one of the Prof's soldering irons, he removed VR1 and replaced it with the Prof's experimental resistor.

When he switched the Musical Note Generator on again, both the Prof. and Bob were rewarded by the sound of a steady musical note from the earpiece. It worked!

The Prof. and Bob were both really pleased, and the Prof. said, "The next thing is to produce a range of different resistor values."

"Can we make all sorts of different resistors ourselves?" asked Bob.

"Most varieties can be made quite easily," observed the Prof., "resistive powders, pastes and compositions, flexible resistors, elastic resistors, fusible resistors, water soluble resistors," and Bob's eyes grew wider as the Prof. reeled off a huge list with such delicacies as "decrepitating" resistors and all sorts of interesting items.

Before the Prof. could finish this huge list, there came a peculiar whirring sound from amongst the nearby equipment. Strange footsteps which did not sound human! A wierd piece of equipment, covered in dials and lights, came shuffling ominously towards the Professor, waving metal arms and pincers, and emitting strange clicking and whistling sounds.

Bob dropped everything and made for the exit. He made it to the door, but half way through, he turned and dashed back into the laboratory. Could it be there was something even worse out there?

Continued next month!

...Counter Intelligence

BY PAUL YOUNG

A retailer discusses component supply matters.

THE component retailers on the whole are a pretty uncomplaining crowd, considering how their lot has deteriorated over the years, but at last the time has come to ask you to shed a tear for them!

In understanding our problems who knows, it may make your own more tolerable!

GOOD OLD DAYS

In the old days, all we needed to stock was a few valves, resistors, capacitors, the odd speaker or two, and a handful of transformers. All readily available from about a dozen different sources. Then along came the transistors, and the range of everything, doubled, trebled quadrupled, overnight.

In addition, were diodes in about twenty different varieties, thyristors, thermistors, f.e.t.'s, fetron's and triacs.

In place of the simple electrolytic and paper capacitor, we suddenly had, tantalum, polyester, polystyrene, metal foil, mixed dielectrics, and many others to contend with.

NEW DEVICES

We had hardly got our second wind, when stereo arrived, necessitating the stocking of weird ganged potentiometers, logs, lins and anti-logs, all in various values.

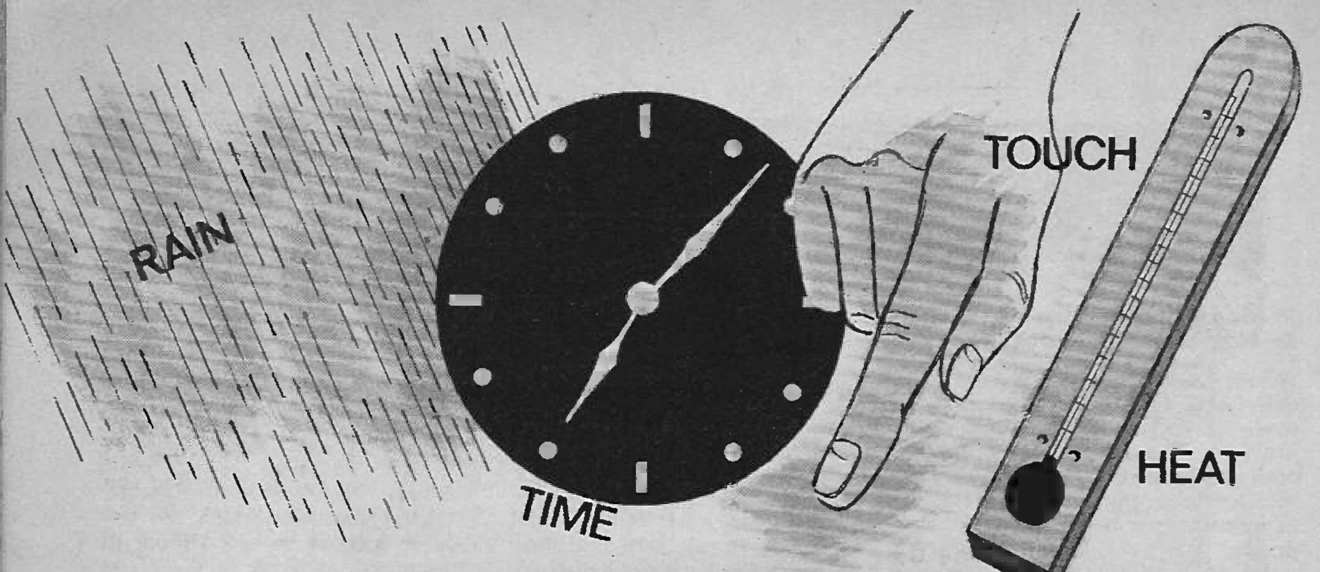
The next thing we found was that due to transistors, all our coil stocks were useless, and so too were our transformers, and as to our potentiometers and resistors, we had vast stocks of the wrong value! In by-gone days, we sold a dozen 2 megohm potentiometers, to every one 5 kilohm one, now suddenly, everyone wanted the latter, while the large stocks of the former just collected the dust.

And finally, while we were still reeling from all these unkind blows of fate, along come i.c.'s which are still proliferating.

I don't know what the suicide rate among component dealers is, but the stomach ulcer rate must be un-commonly high! Our only hope of survival, is to narrow the field on what we sell. This means, that you, the customer, will have to deal with several shops to get all your requirements. It is unfortunate, but you do see our predicament?

The next problem to torment us was difficulty in obtaining stock. First of all the colour television boys, cashing in on the boom, were placing such vast orders for bits and pieces, that we were left out in the cold. To accentuate that problem, the petrol shortage, caused a shortage of plastic.

Like the Dance of the Seven Veils, I keep the worst torment till last. All these splendid magazines like *EE* and *PE* are churning out month by month, mouth watering projects. We have all the bits, within arms reach, but we cannot attempt one of them, because we have no time!



GENERAL PURPOSE *Electronic* SWITCH

By J. Lewis

A versatile circuit that can be used to switch alarms, lamps, heaters etc.

THE beginner in electronics, and sometimes even the hardened professional, is often placed in a quandary. Whilst he sits theorising about the modifications he is planning to make to some intricate piece of test gear he is rudely interrupted by the woman in his life. Be it his wife or mother, who wants to know when he is actually going to build something that (a) works (b) is useful and (c) which he understands. Ignoring the manner in which the question is phased out must usually admit, secretly in one's own conscience, that she does perhaps have a minor valid point.

In order to preserve the peace you ask her what she wants. Usually its some simple device like a rain alarm, or something to switch on the porch light at dusk. In any case what will she do with all the time this device will save, think of all the spare time she gets in any case during the day. Pity that you can't stay at home to do the housework as it would mean you could spend much more time on electronics.

Off to the reference books and back copies of magazines to see if there is any inspiration there. If not then you have to sit down and actually design this circuit which after all is just to keep her quiet.

USES

By now you may have been wondering what this article is all about—well we've all been through it and its about time we united and passed on tips on how the "enemy" can be kept happy and still leave us alone. In this article is described in detail a very useful electronic switch which will, with minor mods, do most of the jobs needed. It can be used as a rain alarm, as a timer, or as a light or temperature switch.

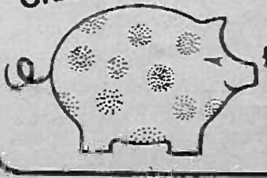
With a little ingenuity the changes can be rung to solve most problems and to fulfil a variety of applications. It also means that you may need only to build one basic unit, the rest can be added when needed by cannibalising the previous one. Thus you can save yourself an enormous amount of time, all the three criteria mentioned above are met, the woman will be happy and you will be able to spend the gained time in your own chosen fashion.

THE CIRCUIT

The basic circuit is shown in Fig. 1. It is a fairly standard sort of configuration which is very reliable and not too particular as to components. In order to understand its operation all one needs to remember is that a transistor is a switch—current can only pass between the collector and emitter if the base is at least 0·6 volts more positive than the emitter. If it is

FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS including V.A.T.



£1.50 basic circuit excluding case

*Based on prices prevailing at time of going to press

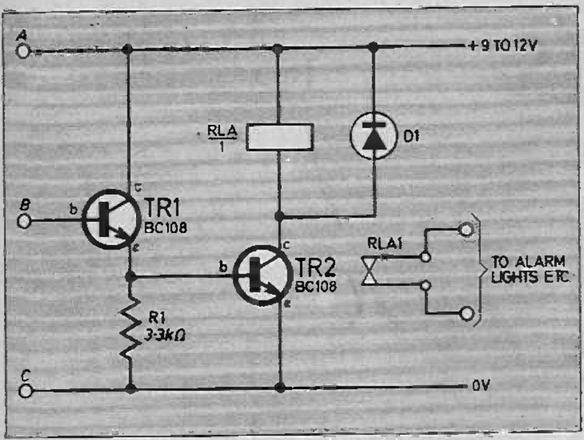


Fig. 1. Circuit diagram of the General Purpose Switch.

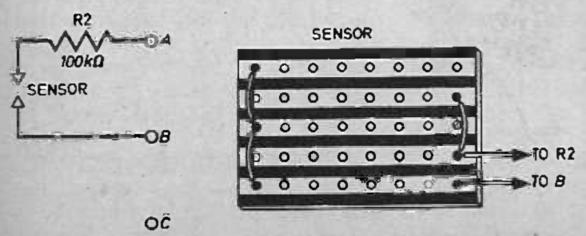
below 0·6 volts then the transistor is said to be *off* whilst if it is above this value then the transistor is *on*, and a current will flow. The purpose of the ancillary items is thus to provide a potential of at least 0·6 volts at the base of TR1 when required. This action will turn TR1 on, and a current will flow through the transistor and also through the resistor, R1. Now when TR1 is off the potential at the top of R1 is 0 volts as there is no current flowing (ohms law tells us this). As soon as a current flows, however, the potential at the top of R1 rises to over one volt and since the top of R1 is directly coupled to the base of TR2 it means that the base of TR2 also is at a potential of one volt, which is more than enough to turn it hard on. When TR2 is turned on a current will flow through the relay and cause it to operate.

MOISTURE DETECTOR

The additional items required to form a moisture or water level detector or a touch switch are shown in Fig. 2. In addition to detecting water it can be used as a touch switch since the skin normally has sufficient moisture on it to cause the circuit to operate.

The operation of this first job should be self evident. All we are doing is to connect the base of TR1 to the positive supply line of 9 volts through water which is an electrical conductor.

Fig. 2. Circuit and sensor construction for the moisture detector.



When this happens the base of TR1 will rise to over 0·6 volts and so turn on the circuit. The resistor R2 is purely a safety device in order to limit the current flowing—in some applications where more sensitivity is required it may be reduced in value or dispensed with.

LIGHT AND HEAT DETECTOR

The light and heat detector circuits are basically the same circuit except that we use a light dependent resistor (l.d.r.) in the first and a temperature dependent resistor (a thermistor) in the second. The l.d.r. has a very high resistance in the dark but this decreases when a light is allowed to fall on it, the thermistor has the property that its resistance decreases as the temperature increases. The circuit is shown in Fig. 3.

To follow the operation of this device one can liken the two resistors to a potentiometer if a potentiometer is connected across a battery. As the wiper is moved up so the voltage at the wiper will increase until the wiper reaches the top of the potentiometer track at which point the voltage will be that of the battery.

Applying this to the two separate resistors (PCC1 and VR1) shown in Fig. 3, if both are equal then the voltage at the junction will be exactly half that of the supply, if the lower one is increased in value then the value of the voltage at the junction must also increase, and vice versa. If we adjust the variable resistor until the voltage at the junction is just below 0·6

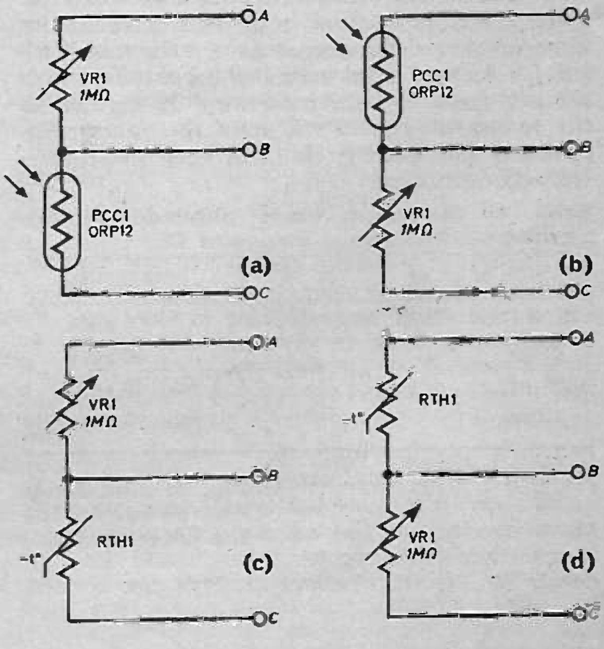


Fig. 3 (a) Switches on with reduction in light (b) switches off with reduction in light (c) switches on with fall in temperature (d) switches off with fall in temperature.

volts; now if the light falling on PCC1 is reduced the resistance of the l.d.r. will rise as will the voltage at the junction to above 0·6 volts and should the junction be connected to the base of TR1 it will turn it on. Thus the circuit will operate when the light level decreases.

Obviously the converse is also true, if the value of VR1 is reduced then the voltage at the junction will rise, transposing VR1 and PCC1 we can get a circuit that switches at a preset higher light level. Similarly by putting the thermistor in place of PCC1 a circuit which turns on when temperature varies is achieved. In all cases the variable resistor is used to set the switching level and thus acts as a level control.

TIMER

The circuit for the timer is shown in Fig. 4. It should be well known that when a current is applied to a resistor and capacitor in series there is a time lag before the capacitor becomes fully charged. During this charging up period the potential at the junction of the resistor and capacitor will slowly rise until it reaches its maximum value. The time it takes is dependent on the values of the resistor and the capacitor, the larger they are the longer it takes.

An analogy is filling a bucket through a hose-pipe—if you have a small bucket and a wide hose the bucket will quickly be filled, if the pipe is narrow and the bucket large it will take much longer.

By connecting the base of TR1 to the junction we can make the transistors switch on when the voltage at the junction is above 0·6 volts; the time it takes depending on the values of VR1 and C1. Table 1 gives some values obtained with the prototype circuit, these are only a guide as component tolerances will alter the values considerably and each circuit will need to be individually calibrated.

Table 1: Maximum times obtained on the prototype with various values of C1

Value of C1	Max. time
100μF	25 secs.
250μF	45 secs.
500μF	1 min. 45 secs.
1000μF	4 min. 10 secs.

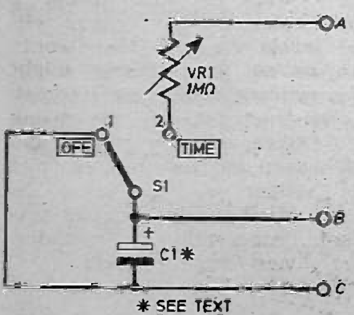


Fig. 4. Additional components for the timer circuit.

Components....

Resistor
R1 3·3kΩ ¼W ±10% carbon

Capacitor
C1 100 to 1,000μF elect. 12V (for timer, see text)

SEE **SHOP TALK**

Potentiometer
VR1 1MΩ carbon linear

Semiconductors
TR1 BC108 silicon *npn*
TR2 BC 108 silicon *npn*
D1 any small silicon diode

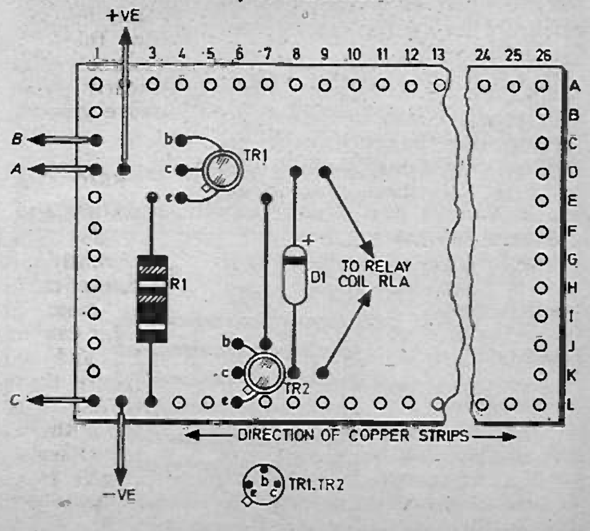
Miscellaneous
RLA1 6 to 12V relay with coil resistance not less than 100Ω and one set of normally open contacts rated as required (see text).
RTH1 THB11 or GL16 bead type thermistor (for "temperature" switch).
S1 s.p.d.t. toggle or slide switch.
PCC1 ORP 12 or equivalent light dependent resistor (for "light" switch).
Veroboard 26 holes by 12 strips by 0·15 inch matrix, connecting wire, 9V battery and clips, case (see text).

CONSTRUCTION

The basic switch circuit is built on a piece of Veroboard measuring about 100mm by 50mm by 0·15inch matrix, this size of the board leaves plenty of room for the relay which can be any type that operates on 6 to 12 volts with a coil resistance of at least 100 ohms.

Commence construction by cutting the board to size using a small hacksaw and file up the edges to give a neat finish. There are no breaks to be made in the copper strip for this design so the next stage is to mount the relay, resistor, diode and transistors on the board in the positions shown in Fig. 5 and solder their leads to

Fig. 5. Layout and wiring of the basic components for the General Purpose Switch.



the copper strips on the underside.

When soldering the transistors and diode it is a good idea to hold the lead in a pair of tapered nose pliers to prevent heat from the iron from reaching the device and possibly damaging it. Once all the components, connections and flying leads have been soldered on check the complete layout against Fig. 5. Make sure the transistor leads are in the right places and the diode is the correct way around, also make sure that there are no dry joints and that no solder is bridging any two adjacent copper strips.

Next connect the flying leads *A*, *B* and *C* to the external components required e.g. those in Figs. 2 to 4 and finally connect the 9V battery or supply observing the correct polarity.

To make a quick check on operation rotate the potentiometer and listen for the relay to click in and out, or touch the sensor in the case of Fig. 2 and listen for relay operation.

POWER SUPPLIES

All of the units mentioned will work from the usual 9 volt batteries and constructors are recommended to use these. If you follow this advice it means that the units are portable and that there is no danger of receiving an electric shock.

Alternatively one could use a battery eliminator giving 9 or 12 volts or build your own power supply unit using one of the circuits given in this magazine, great care must be taken if this course of action is followed to ensure that all leads at mains voltage are adequately insulated and that the unit is correctly earthed.

CASE

Any available case may be used to house these units. Some of the prototypes were fitted inside Veroboxes whilst others were put in home made cases or other commercially available ones. Whatever type you choose one important thing is to provide a reasonable finish. Finish it off by spray painting and labelling with Lettraset. If you do this then she can't complain that it spoils the decor and is an eyesore, remember that functional devices should also be aesthetically pleasing.

OUTPUT

The output for all the units can be taken from the relay contacts and be used to drive warning devices such as lights or bells or more sophisticated ones such as sirens. Should you wish to drive mains powered apparatus check that the relay contacts are rated sufficiently high to take the current and voltage required.

Once again exercise great care with all mains leads and if possible have the completed job checked by a competent electrician before you switch on. If a metal case is used to house the switch and mains is involved in any way make sure that the case is connected to the mains earth. ▣

Ruminations

By Sensor

On the level

A frustrating and irritating aspect of that otherwise excellent programme "Tomorrow's World" is in the paucity of the information given. One is invariably left wishing to know more, but the programme moves on inexorably, leaving one bursting with unspoken questions, and what happens to these fascinating gadgets?

Few appear to reach the production stage. Are there perhaps, hidden snags, difficult and expensive production problems, or just lack of cash to get things off the ground? It would be interesting to learn what happens to these bright ideas.

I was thinking in particular, of one device I saw described on the programme some time ago. It was a small, hand held, detector for static voltage levels. If I understood correctly, the detector was very sensitive and would indicate the static voltage levels at various heights above the ground.

These voltage levels varied from zero at ground level, to a few hundred volts at around twenty or thirty feet. I may not have remembered the figures correctly but the crux of the idea is that the voltage levels are remarkably consistant and are linearly related to the height above ground level.

Possibilities

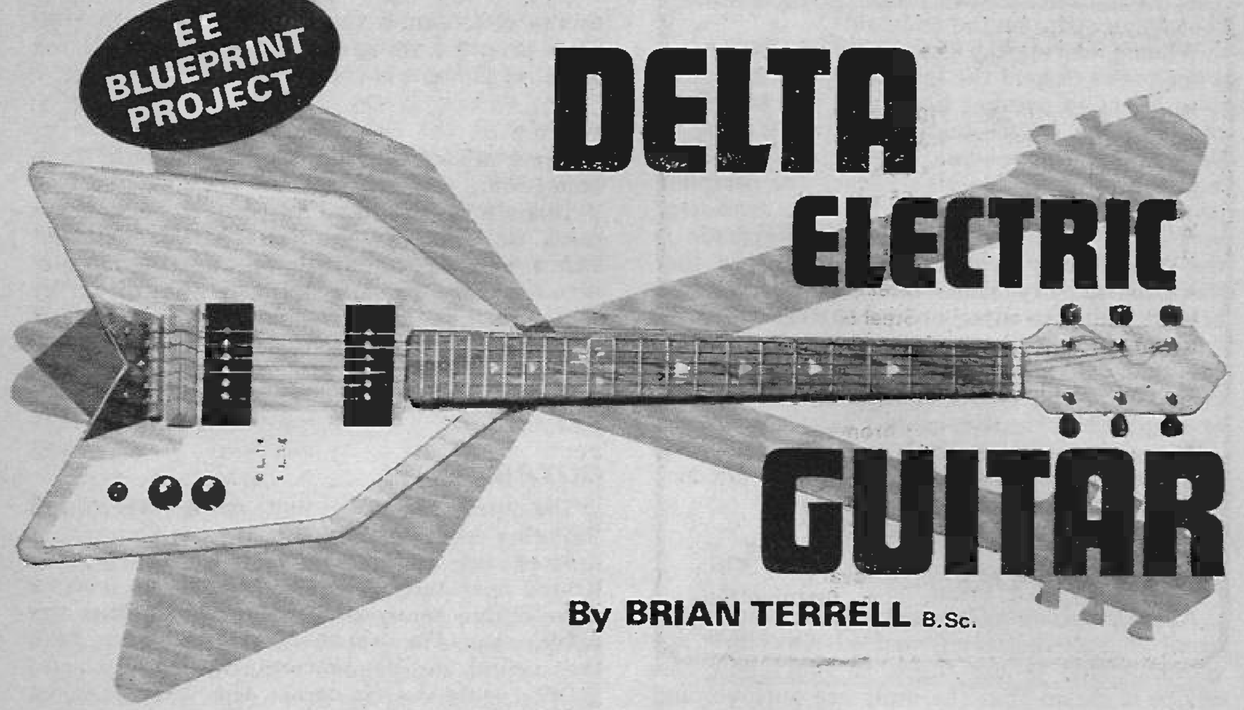
Well, the possibilities are truly fantastic. Here we have, apparently, a kind of electrostatic altimeter capable of working at or very near ground level. The builder can throw away his course stick and spirit level and can measure the height of his walls in volts!

With the aid of a little electronics, servo mechanisms could be built to control the position, relative to ground, of almost anything. How about a new type of car suspension? An electrostatic latch-key would be useful to the reveller, it could emit a visible and acoustic signal when the latch-key was held at the exact height of the lock and thus avoid a lot of useless jabbing.

The gardener's hedging shears could be fitted with a height indicator and with a little preparation could be programmed for topiary work; just imagine the rash of privet peacocks, box squirrels and beech rhinoceros (or rhinoceri) as neighbours vied with each other to have the best display!

But what happens during a thunderstorm? Do the static voltage levels change? One would imagine so; the topiarist might then produce some very interesting abstract patterns, the drunk would give up the struggle and fall asleep on the doorstep, and the builder would express his views, forcibly and probably profanely, concerning the introduction of new-fangled gadgets.

Well, it's all entertainment!



DELTA ELECTRIC GUITAR

By BRIAN TERRELL B.Sc.

A new look solid electric guitar for home construction.

MAKING your own electric guitar may sound quite a formidable task but it is not as difficult as it first appears.

The *Delta Electric Guitar* described in this article with full size drawings on the blueprint given free with this issue of EVERYDAY ELECTRONICS has been designed so that construction is simple and no special tools are required. It can more or less be constructed on the kitchen table fitted with a small portable vice (with the wife's permission of course!). In fact the prototype was indeed fabricated this way and was finished within a week—a couple of hours each evening.

MATERIALS

Most of the materials for construction should be readily available. The only material likely to be difficult to obtain in some areas is the beech wood for the neck/head.

Although beech is recommended, it is not imperative that this is used, any other hardwood can be substituted such as oak (from old furnishings) certain types of mahogany and a host of African hardwoods; your local timber merchant should be able to advise.

However, whatever wood is used you must ensure that it is thoroughly dry, otherwise the finished neck may warp when it does dry out.

In the prototype, the fingerboard was made from a piece of teak. Once again any type of wood can be used provided it is not too soft. On some commercial guitars plywood is used.

Generally speaking, use whatever materials are readily available (within reason) and don't be over fussy about measurements, except of course the fingerboard fret positions, and you will find your guitar a pleasure to build.

BODY

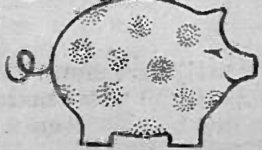
A full-sized drawing of the body is shown in Fig. 1 on the blueprint. In the prototype the body was made in two layers and then later nailed and glued together.

Plywood 18mm thick was used for the bottom layer—this wood laminate is extremely strong and is ideal for securing the neck in position since it will not split. It is easily cut and the edges can be planed to give a clean surface.

The upper layer containing all the cut outs was made from 16mm thick chipboard. This

FOR GUIDANCE ONLY

ESTIMATED COST*
OF COMPONENTS
including V.A.T.



£10 excluding strings and paint

*Based on prices prevailing at time of going to press

Materials ....

Body Plywood 380 x 310 x 18mm
Chipboard 380 x 310 x 16mm
Neck/head Beech 650 x 68 x 24mm
Fingerboard Teak 465 x 55 x 6mm
Scratchplate Perspex 325 x 105 x 3mm
Nut Perspex 42 x 12 x 6mm
Tailplate Aluminium or steel 12 x 7 x 1·5mm
Neck fixing backplate Steel 50 x 70 x 1·5mm
Bridge Beech 100 x 20 x 10mm (see text)
Fretwire 1·4 metres
Miscellaneous
Screws: 40mm No. 10 chrome-plated steel countersunk (4 off), 25mm No. 8 chrome-plated steel countersunk (3 off), 6mm No. 2 chrome-plated round head (5 off)
Veneer pins, 10mm long (3 off); Polyfiller or Plastic Wood; Paint—primer, undercoat and gloss; Evo-Stik wood glue; oval nails 20mm long; machine heads with fixing screws (6 off).

material was chosen because it is very easy to work with, cheap and readily available.

You will see from the blueprint that there are cut-outs to be made in the upper layer to accommodate the neck fixing to the body, the two pick-ups and the controls recess.

If commercial pick-ups are to be used the cut-outs for these should be modified to suit.

Begin construction by marking out the shape and cut-outs on the upper layer. This can be done by measuring techniques or more easily by pinning the blueprint to the chipboard with a piece of carbon paper interposed and then tracing through.

Next, with an ordinary saw, cut out the body shape. Now make the cut-outs with a coping or fret saw. To make this easier, small holes can be drilled at each corner and then the saw cuts are made to join the holes. When this has been satisfactorily done all edges should be cleaned up; plane and rasping file are suitable.

The completed upper layer should now be laid on the 18mm thick plywood which is to form the bottom layer and a pencil line drawn around the perimeter of the body shape. Cut out the bottom layer and then nail and glue the two layers together and later clean up the edges. A suitable adhesive is Evo-Stick wood glue, a white rubbery solution.

NECK AND HEAD

Details of the neck and head are shown in Fig. 2 and Fig. 3 on the blueprint. The neck and head are in one piece which is cut from a piece of beechwood size 650×68×24mm.

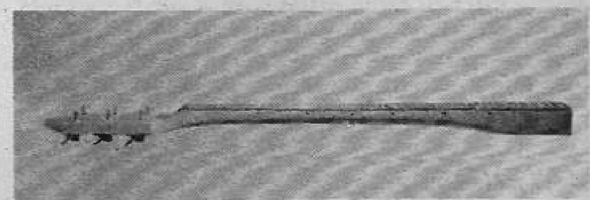
First of all mark out or trace through, on to the 650×68mm face of the wood, the plan view (Fig. 2 left) of the neck and then do the same with the plan view of the head (Fig. 3 right) so that it sits in its correct position at the top of the neck. This is easiest done by aligning the fingerboard or top fret (No. 0) from each plan.

This overall shape should now be cut out using an ordinary saw for the straight edges and a coping (or fret) saw for the internal curves. Do not cut exactly to the line along the neck where the fingerboard is to sit.

Roughly clean up the edges and then mark out along each face (650×24mm) the side elevation views of the neck and head (Fig. 2 right and Fig. 3 left). It will now be seen that there are two sections to be cut away; that in front of the head, when done, causing the head to be set back, and the other along most of the back of the neck.

Make the head cut away first by fixing the neck in the vice and sawing along the cutting line down the length of the head. Now cut across and into the head (remembering there is a radius at this junction) until the section to be removed falls away. The radius can be made using a chisel and round file. The radius of curvature is not critical.

The other section is easiest removed by shaving with a spokeshave (a twin-handled plane). Those with a carpenter's work bench should have no trouble in doing this, but those working on the kitchen table will have to use their ingenuity. This shaving was carried out on the prototype by clamping (with the vice) the body end of the neck to the table so that it was protruding beyond the table edge. The head is rested against one's body and the shaving then carried out with the spokeshave.



Profile photograph of the prototype neck/head assembly with fingerboard fitted and frets inserted. The nut is not yet fitted.

Photograph of the curved area of the neck/head showing required contours where the neck meets the head and the neck meets the body end fixing region.

The back of the neck is to be shaved to a smooth hemispherical shape as shown in the cross-section of Fig. 2. A useful tool to have when carrying out this operation is a pair of external calipers set to just over 15mm. These enable the correct thickness of the neck to be maintained down the length of the neck.

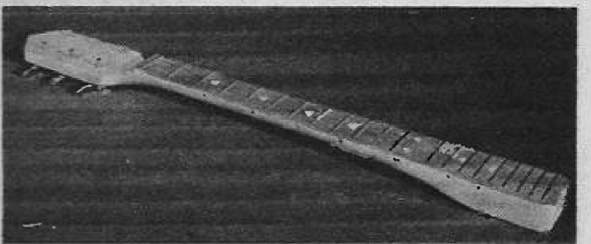
The regions where the neck meets the head, and where the rectangular section of the neck meets the curved section (the part that fixes to the body) are best formed using flat and round files. A course half-round file is useful. Ensure that when this has been done the guiding lines on the upper face of the neck are still visible. Also, ensure the neck face is even.

FIXING THE FINGERBOARD

The fingerboard is shown tinted in Fig. 2 and is made from a piece of 6mm thick teak. This should be cut exactly to the shape shown in Fig. 2, and then glued in position on the neck face.

Evo-Stik wood glue was used on the prototype and three veneer pins were used to hold it in position whilst the glue was drying. These veneer pins can be hammered in fully as the heads will hardly show since they are so small. Alternatively, G-clamps could be used if these are available. Allow the adhesive adequate time to set before proceeding.

Shows the finger position markings (emulsion painted) and useful edge markings (Letraset).



FRETS

Draw a pencil centre line down the length of the fingerboard and then with reference to Fig. 2 (left), mark off the positions of the frets along this line. This can be done with the aid of a pair of draughtsman's dividers, or a compass.

If these are not available, the blueprint should be folded along the face of the fingerboard (Fig. 2 right) and this edge fixed along the centre line drawn on the fingerboard, and the fret positions marked off using a sharp pencil. Remove the blueprint and then pencil in the fret positions across the fingerboard perpendicular to the centre line.

Thin saw cuts should now be made to accommodate the fret wire at each of the positions on the fingerboard. In the prototype the coping saw used for the body cut-outs was found ideal. The depth of cut will normally be one to two millimetres but this depends entirely on the fret wire being used.

Great care should be taken in making these cuts ensuring that they are all parallel and the exact cutting line is used.

Fret wire is obtainable from a lot of musical instrument shops and is bought in metre lengths. About 140cm is required.

Lengths of fret wire should be cut approximately to the length required and then gently tapped with a hammer into its slot on the fingerboard. There is no need to glue the wire in its slot as the fret is secured by the protruding "pimples" along its fixing length.

Each fret should be filed and slightly chamferred at its ends so that running your hand along the fingerboard edge you will hardly feel the presence of the fret.

With this done, each fret, with exception of fret No. 0 should be filed so that its top is flat and low. This takes some time and a lot of patience.

Care must be exercised so that the fingerboard is not marked. All frets should be filed down to the same level—checked by laying a straight edge along the fingerboard—and then smoothed with emery cloth. This is important since a rough fret will have an adverse effect on playing performance.

When you are satisfied with the finished fingerboard, the neck should be filed and sanded so that it is flush with the fingerboard edge. Ensure that the back of the neck is smooth and free from any unevenness.

The holes in the head, Fig. 4, should now be marked out and drilled. The distances of the holes from the edge of the head and the diameter of the holes should be made to suit the machine heads used.

The machine head screw fixing holes, normally four for each, should now be drilled and the machine heads fixed in place.

TAILPLATE

The tailplate (Fig. 4) can be made from almost any material providing it can withstand the stress of the strings. In the prototype 1·5mm thick aluminum was used as this is more readily available than steel plate, copper and brass, which would all be suitable.

The sheet should be marked out, drilled and bent as indicated in Fig. 4 and then secured to the rear end of the body so that the "V" of the tailplate and body are aligned. Suitable fixing screws are 25mm long No. 8s.

NUT

The nut, to be fixed at the top of the fingerboard is detailed in Fig. 5 and is made from Perspex about 6mm thick. If this is not available two 3mm sheets can be glued together.

This fitment should be made with the strings at hand so that the correct width slot can be cut. When complete it should be glued in position as shown in Fig. 2 on the blueprint.

BRIDGE

Details of a fixed bridge are given in Fig. 6. Although this is quite suitable, an adjustable type is recommended which should be available from a lot of musical instrument stockists. If another type of bridge is used it may be necessary to raise the tailplate i.e. stand it on a wooden platform. The height of the platform will be determined by the bridge used.

In the prototype the bridge was made by cutting a slice from the edge (triangular prism) of a piece of beechwood that was left over from the neck/head length and then glueing shaped feet to the underside.

Although the height of the bridge is set nominally at 16mm it may need to be varied. The correct height is best determined by trial and error when the guitar is "strung" in its final painted condition. The bridge feet may need to be shaved or be made up.

A slot is cut at the apex of the bridge to accommodate a length of fret wire.

NECK BACKPLATE AND FIXING

The neck fixing back plate is shown in Fig. 8. In the prototype this was made from a piece of 1·5mm thick steel plate. This should be made before the fixing holes in the body and neck are made.

When this has been satisfactorily completed, it should be laid face down in the correct position in the body neck recess. In other words it will be lying down on the plywood bottom layer. This is then used as a template for drilling the four 4mm diameter holes through the body.

Now place the neck in the body recess and clamp it in position using a hand-vice or G-clamp. Make sure that the frets are protected when carrying out this process by placing a thin slice of wood in the jaws of the clamp.

Using a 4mm drill, drill through the body holes, lightly drill about a millimeter or so into the back of the neck for all four hole positions. This will give the centre position, for the fixing holes to be drilled in the neck.

Suitable fixing screws for this joint are 40mm No. 10 countersunk screws. Drill clearance holes in the back of the neck to accommodate the No. 10 screws to a depth of 20mm. Now secure the neck to the body via the backplate and tighten the screws fully.

The strings and bridge should now be attached and performance checks carried out. The bridge should be sited the same distance from the twelfth fret as the latter is from fret No. 0 and the strings tightened and tuned.

Each fret position for all strings should be tested and any high frets filed down and smoothed. The bridge should be raised or lowered if necessary to provide the best "action". The strings should be fairly close to the finger-board at the body end.

If all is to your satisfaction the assembly can be sanded and prepared for painting etc. All indentations can be filled with filler such as plastic wood or Polyfilla and later sanded.

SCRATCH PLATE

The scratch plate (Fig. 7) also serves as a cover for the control panel recess and was made from 3mm white Perspex. This is easily cut with a hacksaw and can be filed and sanded at the edges.

To bring back the sheen on the sanded edges use a metal polish such as Solvol Antosol sold in garages and car accessory shops.

The slots to accommodate the slide switches are made by drilling holes at the extremes of the slot and filing to shape. The dimensions and fixing holes for the switches obtained may differ from those given—modify to suit.

The scratch plate is held in position by five small screws (preferably chrome plate round head) but should not be fitted to the guitar body until the pick-ups are fitted.

Components....

SEE SHOP TALK

Capacitor
C1 0·47μF

Potentiometers
VR1 100kΩ carbon log
VR2 100kΩ carbon lin.

Switches & socket
S1, 2 single-pole on/off slide (2 off)
SK1 standard jack socket

Transformer
T1 M218 (Zeta Windings)

Pick-ups
Eclipse bottom magnets type 821 (6 off); 30 s.w.g. enamelled copper wire; screened cable, 400mm; brass plate: 70 x 30 x 1mm (baseplate, 2 off), 118 x 70 x 1mm (cover, 2 off); foam rubber 60 x 30 x 2mm (2 off); softwood 60 x 30 x 9mm (2 off); hardwood 90 x 55 x 6mm (2 off); No. 8 25mm roundhead screws; (4 off); No. 4 chrome-plated round-head screws (8 off); 25mm long spring coils (4 off)

PICK-UPS

Details of the pick-ups are shown in Fig. 9. These are low impedance types and require a matching transformer for satisfactory results for imputting into a commercial guitar amplifier.

The pick-ups are semi-adjustable types, that is to say, the whole pick-up assembly can be moved towards or away from the strings as is required. It has been assumed that once the pick-ups have been set, it is not very often they are required to be re-adjusted. In order to re-adjust the pick-ups after final assembly, the pick-up collar must be removed.

Begin by making the pick-up base plate as detailed in Fig. 9, the material should be brass or copper. Now screw the magnets at the specified distances apart on the wooden base-board paying attention to pole polarities and glue this to the brass base plate so that the two holes are aligned.

Two short veneer pins are now tapped into the wooden part, either side of the cable feed hole. These are the anchor points for the coil ends. Feed about 150mm of screened cable through the hole and solder to the two pins.

Bare one end of a length of 30 s.w.g. enamelled copper wire and solder this to one of the pins. Now wind on 100 turns in a clockwise direction. After the last turn, dab some quick drying paint—such as nail varnish—at various points around the coil to stop it from unwinding and then solder the free end to the other pin. More varnish could now be applied.

The pick-up cover must be made from a thin sheet of solderable non-ferrous material such as brass or copper. Aluminium could be used if aluminium solder is available.

The sheet is marked out, cut, bent to shape and soldered internally along the four open edges; all rough edges should now be filed smooth and the corners rounded. Emery cloth can be used to finish off. The pick-up covers can be painted or polished as required.

Glue a layer of thin foam rubber to the inside upper face of the cover and then place over the coil and magnet assembly and solder the cover to the base plate. Repeat the above procedure for the second pick-up.

The two pick-up collars were made from an offcut from the fingerboard; the rectangular cut-out was made with a coping saw. These are fitted over the pick-up assembly and secured to the body by four small screws, one at each corner.

Two small diameter guiding holes are to be drilled in the base of the pick-up recesses to accommodate the pick-up adjusting screws type No. 8, 25mm long roundheads. The latter are passed through the base plate, and then coil springs placed over them and the assembly screwed to the base of the pick-up recess.

The screened cable is led into the control panel recess via the body channels, ready for wiring up. Adjust the pick-ups by means of the two fixing screws to the required height and fit the collars.

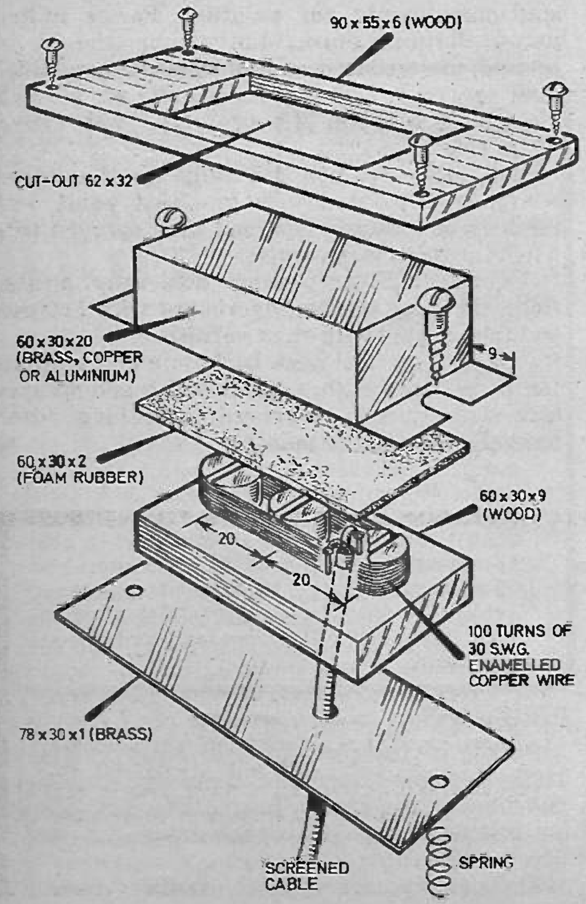


Fig. 9. Details of the pick-ups used in the prototype.

CONTROLS

The circuit diagram of the wiring within the guitar is shown in Fig. 10. The two pick-ups can be selected individually or both together by combinations of S1 and S2. The low level signals from the pick-ups is stepped up by transformer T1. Connected across T1 output is potentiometer VR1, the output being taken from the wiper of VR1. Thus the voltage level can be chosen by varying VR1 and therefore acts as a volume control.

Capacitor C1 and VR2 form the tone control and is a form of low-pass filter. The position of VR2 determines the cut-off frequency. Thus VR2 setting determines the amount of high frequency harmonics that are shunted to ground thereby causing the tone to change.

WIRING UP

First of all glue the transformer to the underside of the scratch plate, see Fig. 11 and then fix all the components to the scratch plate and wire up according to Fig. 11.

It will be necessary to drill a deeper recess in the control panel recess to accommodate the length of the jack socket. With the wiring complete secure the scratch plate in position and the guitar is ready to be tested through an amplifier and loudspeaker.

With both switches in the up position both

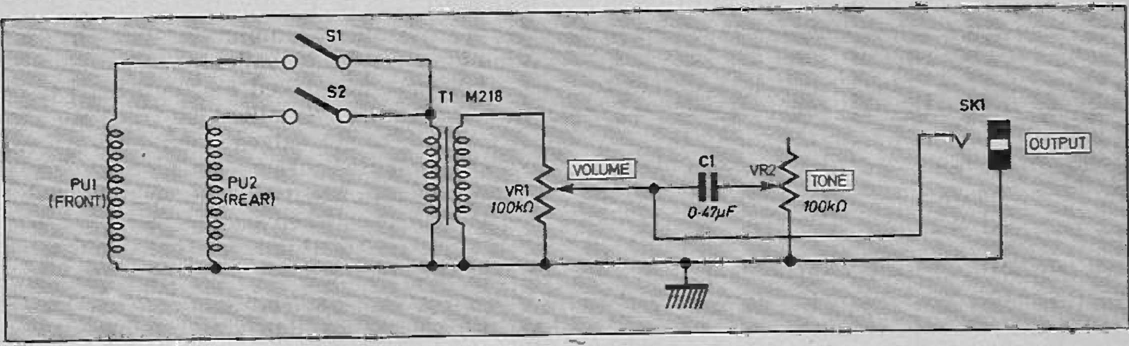


Fig. 10. The circuit diagram of the control system used in the prototype Delta Electric Guitar.

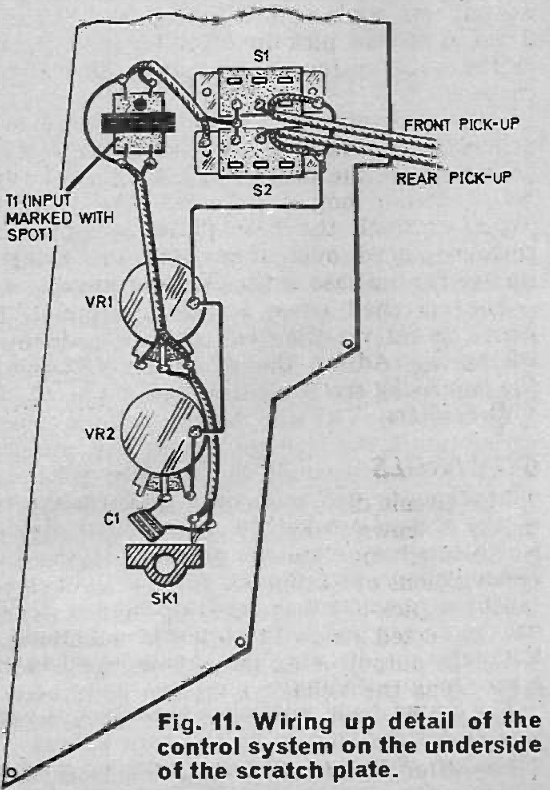


Fig. 11. Wiring up detail of the control system on the underside of the scratch plate.

pick-ups are off. Operating S1 brings in the front pick-up and S2 the rear one. With both switches down both pick-ups are in circuit.

The volume control should work over its entire range. Turning VR2 in an anticlockwise direction should cause the output to become "bassy".

FINISHING

If you are satisfied with the results of all the tests carried out, the guitar can be dismantled and made ready for painting. For a professional durable finish, the guitar should be primed, undercoated and all imperfections filled in or sanded out. Two coats of gloss are advised. The paint used on the prototype was Crown Tivoli Gold.

The finger position markings on the fingerboard were painted with emulsion paint with the help of masking tape and then sprayed with a light coat of clear varnish.

Additional finger position dots were printed along the edge of the fingerboard with Letraset and then coated with clear varnish.

Finally the metal neck backplate and tailplate can be polished with a metal polish and sprayed with clear varnish to prevent tarnishing. Alternatively, they can be painted. ▣

What do you know?

CURRENT

1. Which of the following abbreviations are used to describe the magnitude of current? mV, mA, kΩ, H, µV, µF, V.
2. In an electronic circuit, do the electrons flow from negative to positive or vice versa?
3. Which way does conventional current flow?
4. What does the current rating of a transformer secondary signify?
5. If a diode is rated at 50V 1A, what is the lowest current it will pass?

ANSWERS

1. mA (milliamps).
2. The electrons flow from negative to positive.
3. Conventional current flows from positive to negative—it is opposite to electron flow.
4. The current rating is the maximum current that the transformer can safely supply, it can, of course, supply less current if it is not fully loaded.
5. There is no minimum current. The 1A is the maximum current the diode will safely pass.

REACTION TIMER

A simple circuit that can measure reaction time or other short period delays or events.

By PHIL ALLCOCK

THIS project can be built for use as a party game or for making simple experiments involving the measurement of time between two events. The circuit is straightforward and employs only two transistors.

The design has been arranged so that readers following the *Teach-In '74* series will have virtually all the components necessary for this project. The circuit can be built on the standard *Teach-In '74* Tutor Board or, alternatively, a self-contained arrangement can be employed in which the electronic components are assembled on a small sheet of Veroboard which is mounted inside a plastic box. The box also contains the power supply (battery) and a meter for display of elapsed-time.

Component numbering has been arranged for the Tutor Board, thus VR1 is not used.

CIRCUIT-OPERATING PRINCIPLES

The circuit relies on the charging of a capacitor when supplied with a constant current. Since the charging current is constant the capacitor voltage increases uniformly with time. By ensuring that the capacitor is initially discharged the capacitor voltage rises from zero, up to a level determined by the charging time.

This charging time is made equal to the time to be measured, "reaction time" or any other interval, such as the time for a ball to fall through a given height, can be measured. The range of time covered by the meter can be changed by simple adjustments to the circuit (Fig. 1) and this is described later.

CIRCUIT DETAILS

Capacitor C1 is the timing capacitor which is discharged whenever S1 is in the position shown. Under these conditions the 2N3819 f.e.t. will be conducting and the source will be positive with respect to the battery negative terminal. The extent of this positive voltage is dependent on the setting of the 5 kilohm resistor VR2 and the parameters of the transistor used.

By varying **VR2** the source voltage can be varied until the voltage across the meter is zero. This corresponds to a source voltage of approximately 0·8 volts since the negative side of the meter is taken to a "potential divider" which produces a voltage of about 1/6th of the Zener voltage, at point X.

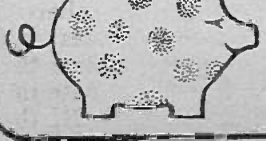
This arrangement is used so that the 2N3819 can be conducting without giving a reading on the meter. Before use, VR2 should be set to give a zero meter reading.

The Zener diode minimises the effect of variation of battery voltage on this zero setting. The capacitor charging process commences immediately the switch S1 is operated to the "measure" position and if required, the make contact of S1 can be used to light a lamp (LP1) via the 100 ohm current-limiting resistor.

As the battery becomes exhausted, the increase in supply current, due to the turn-on of the lamp LP1, will cause a drop in the battery

FOR GUIDANCE ONLY

ESTIMATED COST*
OF COMPONENTS
including V.A.T.



£5·00
excluding case

*Based on prices prevailing at time of going to press

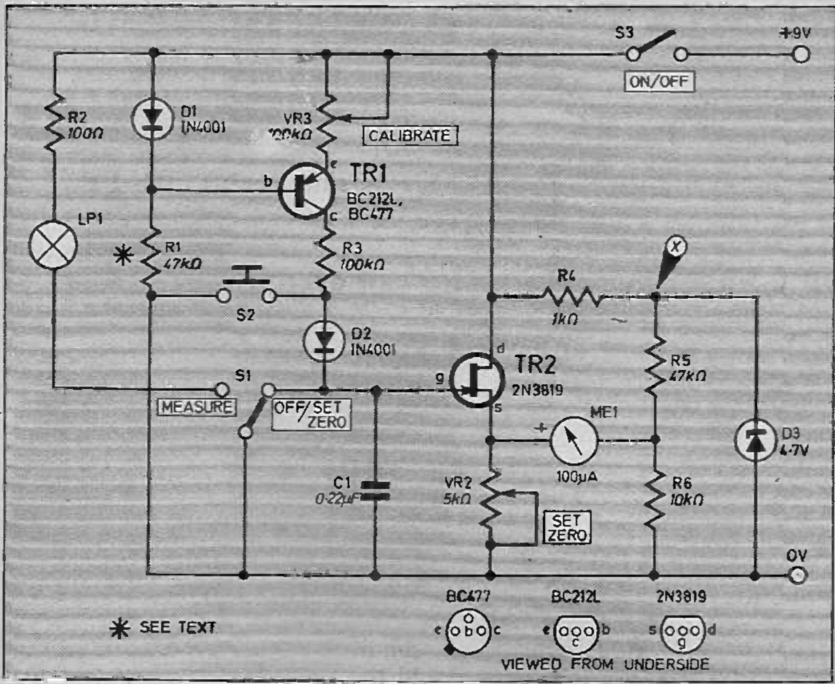


Fig. 1. Circuit diagram for the Reaction Tuner.

terminal voltage, but the Zener diode together with the self compensating action of the f.e.t. bias circuit tend to minimise the effect of this voltage change on the meter zero setting and calibration.

The *pnp* transistor employs a form of diode bias and is used to produce the constant charging current from capacitor C1. When S1 is operated the collector current of TR1 flows via C1 and the f.e.t. gate voltage rises. Since TR2 operates as a source follower the meter is affected by the charging of C1 and the indication thus "follows" the rise in capacitor voltage.

The value of charging current is determined by the setting of VR3 and the value of R1. The voltage across D1, due to the current via R1, is "sensed" by the transistor TR1.

The transistor emitter and collector currents will establish an equilibrium condition between the diode voltage and the total voltage across VR3 and the emitter/base junction of TR1. The values given should allow a full-scale reading on the meter to be reached in one second and VR3 can be set to give this time, using the calibration method covered later.

If other time intervals are required R1 can be changed—increasing R1 to 1 megohm (in the prototype) gave a full-scale reading for an interval of about 25 seconds (with VR3 at zero).

DISCHARGE

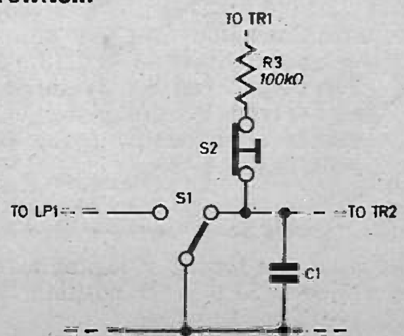
The 100 kilohm resistor, R3, in the collector circuit of TR1 is for protection purposes and does not affect the charging process since the collector current is very small. To terminate the charging process, without discharging C1, the press switch S2 is operated and held closed. This diverts the collector current of TR1 and D2 prevents C1 discharging.

The reverse leakage of D2 can cause a slow discharge but in practice this will not be significant unless a poor quality diode is used. An alternative method is possible using a "press to open" type push button in place of the diode D2. In this case the insulation of the switch (and its leads) must be sufficiently high to minimise any discharge. See Fig. 2.

Whilst on the subject of unwanted discharge paths, the capacitor will have an internal discharge or leakage path of its own. For this reason a good quality capacitor must be used for C1 if reasonable accuracy is to be achieved.

The circuit is reset by restoring S1 to its original position. This discharges C1 so that the circuit is ready for the next measurement. Note that S2 must be held closed (open in the modified circuit) whilst the reading is taken, if the switch is a self restoring type like the usual bell push-button.

Fig. 2 Alternative arrangement using a push to break switch.



CONSTRUCTION

The complete unit can be built on the Tutor Board if required (Fig. 3) or can be made up as a permanent item and built into a case.

The layout for the Veroboard version is illustrated is Fig. 4 and is straightforward. The prototype board used a BC212L (*pnp*) transistor for TR1 and the lead disposition shown is for this type. (The base connections for the BC477 are shown in Fig. 1.)

The copper track used for the gate connection of the f.e.t. should be kept free from excess flux to maintain the high input resistance of this stage. Note that the layout given includes the diode D2 and is correct for a push-to-make switch S2. For a push-to-break switch this diode can be omitted and the S2 leads can then use the holes left vacant. Fig. 5 gives a suggested arrangement for the complete timer and uses a remote switch for S1 so that the start condition can be initiated without the subject knowing. The lead to the remote switch can be connected via a 3 pin plug and socket if required.

In the prototype unit the remote switch was mounted in a small plastic container—the type chemists use for pills.

To use the unit simply switch on and ask the subject to press S2 and hold it down when lamp LP1 lights. Then, without telegraphing the motion switch over S1.

CALIBRATION

For applications requiring long time intervals a stop watch or sweep second hand watch can be used for calibration. Variable resistor VR2 is adjusted to give a zero meter reading with S1 in the "off/set zero" position. Operation of S1 will then initiate the charging process and the "time to reach full-scale" can be measured; VR3 can be adjusted until the correct full scale time is achieved.

If the range is incorrect R1 may be changed. To give a one second full-scale reading, R1 should lie in the range 22 kilohms to 100 kilohms approximately, but this time is difficult to measure even with a stop watch.

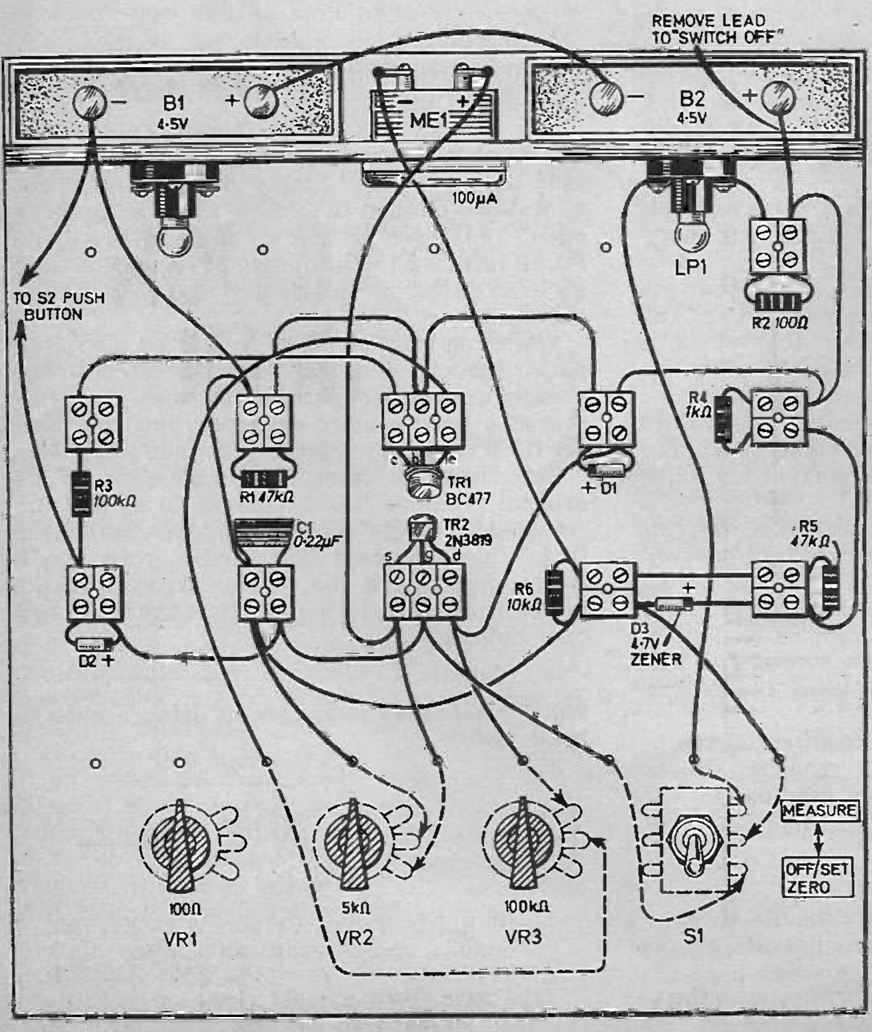
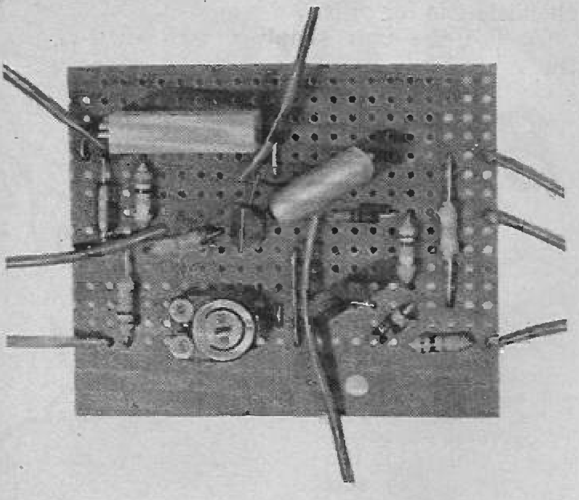


Fig. 3 Tutor Board layout and wiring for the Reaction Timer.



Photograph of the Veroboard for the "permanent" Reaction Timer

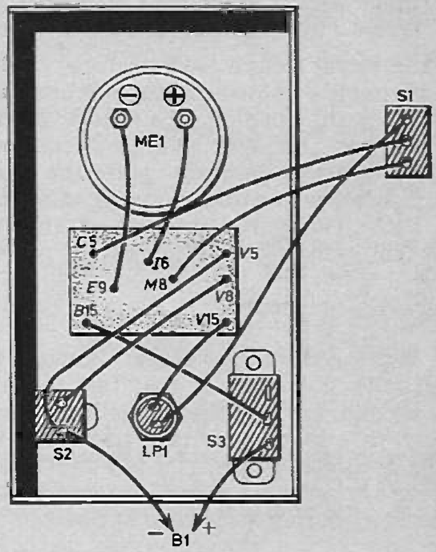


Fig. 5. Layout and wiring of the timer in a small case. S1 is mounted remotely.

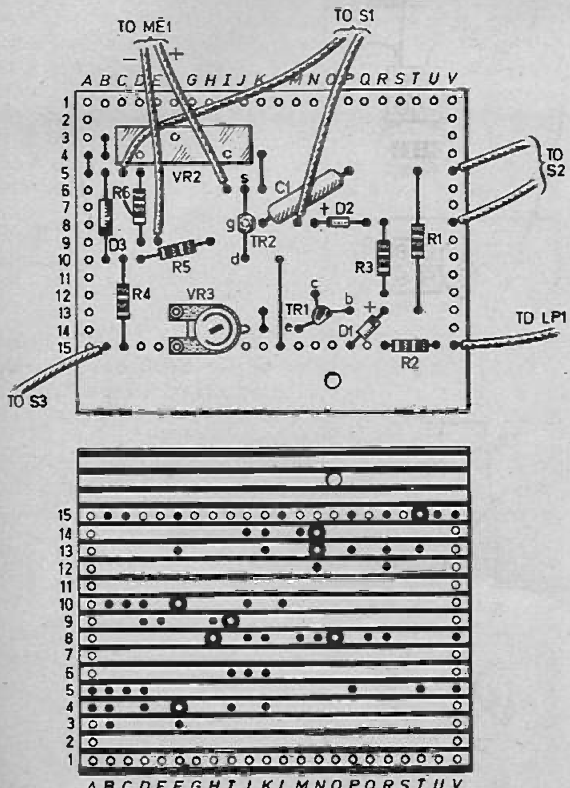


Fig. 4. Veroboard layout and wiring for the Reaction Timer.

REACTION TIMER

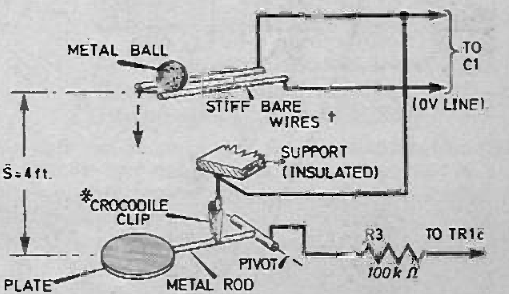


Fig. 6. Illustration of method of calibration. *Crocodile clip tension must allow plate and rod to give "open circuit" when ball hits plate. †Wires must slope downwards *slightly* so that ball falls off.

One method which can be used is to set up a simple "falling ball" experiment and use the known acceleration, due to gravity, to calibrate the system. The arrangement is illustrated in Fig. 6.

A clean metal sphere (ball-bearing) is allowed to fall through a known distance. When the ball leaves its rest position the short circuit is removed from C1 and charging commences. When the ball hits the lower plate the charging circuit is broken and the meter reading can be taken. Since the initial velocity of the ball is zero the fall time will be given by

$$T = \sqrt{\frac{2S}{32}} \text{ seconds}$$

Where S is the distance (in feet) through which the ball falls. If S is set at four feet then T will be 0·5 second. For a full scale calibration corresponding to one second, this test should give one-half full-scale reading. Note that T varies as the square root of the distance S and hence a 16 foot drop is required for $T=1$ second! This will be impractical in most cases so the four foot drop should be used.

The upper contacts are closed via the metal ball and are connected across the switch S1. During the test S1 should be moved to the measure position so that C1 can start to charge as soon as the ball leaves the contacts. The plate should only just remain suported by the crocodile clip so that the impact caused by the ball can break the charging circuit. ▣

Components....

Resistors

R1	47kΩ	R3	100kΩ	R5	47kΩ
R2	100Ω	R4	1kΩ	R6	10kΩ

All ¼W ± 10%

Capacitor

C1 0·22μF

Potentiometers

VR2 5kΩ multiturn or skeleton preset
VR3 100kΩ skeleton preset

Semiconductors

D1, 2 IN4001 silicon diode (2 off)
D3 4·7V 400mW Zener diode
TR1 BC 212L or BC477 silicon *pnp*
TR2 2N3819 f.e.t.

Miscellaneous

LP1 6V 60mA bulb and holder
S1 s.p.d.t. toggle switch
S2 push to make push button (push to break may be used in which case D2 is not required—see text)
S3 s.p.s.t. toggle or slide switch (not essential for Tutor Board layout)
ME1 100μA moving coil meter SEW MR45P or similar.
Veroboard 0·1 inch matrix 18 strips by 22 holes, connecting wire, case and mounting for S1 (see text).

Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

I would like to submit a Bright Idea. It is a simple means of accurately drilling mounting holes for component boards and controls.

A blob of Plasticine, BluTak—or a similar product is placed in the approximate position of the mounting holes and the component board with the mounting screws already in, is positioned and pressed against the case so that imprints are made in the blobs. Holes are then drilled through the imprints and the board can be mounted with the mounting holes in the right positions.

The method with controls, such as potentiometers or switches, is very similar. The control is positioned within the case as accurately as possible and then pressed against a blob of Plasticine on the case, although with controls there is no problem about the separation of the holes. It is often necessary to cram a control into a confined space and it is generally difficult to find the exact spot without resorting to such a method.

P. K. Brown,
Midlothian.

I think that many potential printed circuit board enthusiasts will put off using commercially available resist pens by the comparatively little known and hard to get cleaning agents naphtha, trichlorethylene or MEK.

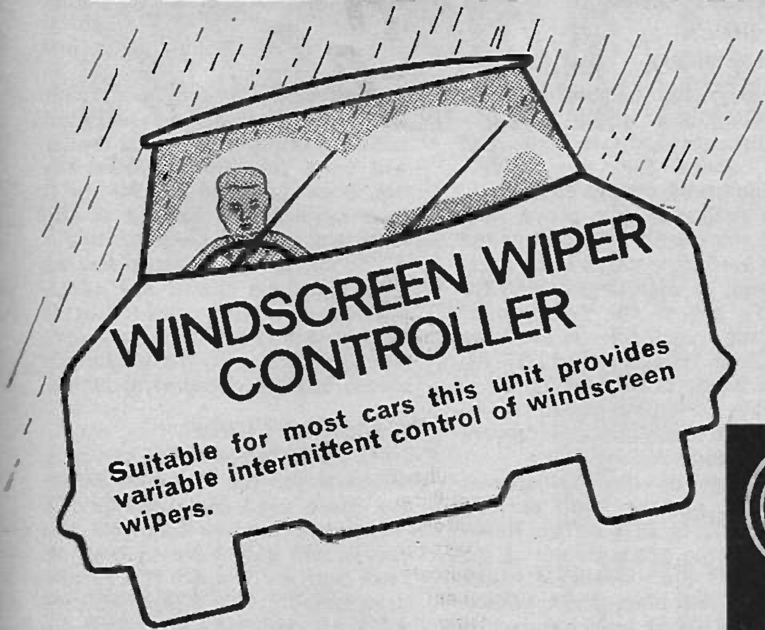
An inexpensive and readily available substitute for the above solvents is benzene cigarette lighter fuel. This commodity can be bought in small tins from most tobacconists and many other shops. This substitute also has an advantage in that it degreases the printed circuit board. But do not get the solvent near a hot soldering iron—benzene is inflamable.

J. Hartley,
Winchester.

Please Note: this column is intended for constructional ideas and ideas relating to electronic construction. It is not our intention to publish circuits of any description.

All items submitted should be original and not previously published. If similar ideas are submitted by two or more readers the first received will be published.

NEXT MONTH!



THESE *Easy to Build* PROJECTS

TAPE NOISE LIMITER

A simple circuit for reducing tape noise on playback from cassette tape machines.

TELEPHONE REMOTE MONITOR

Don't let your phone go unanswered. This monitor will relay the ring to a remote position e.g. garage or garden.

Plus... SOLDERING FOR BEGINNERS

A must for all new constructors. Straightforward explanation and illustrations of soldering.

Because of prevailing production problems, no firm publishing date can be announced for the November issue. Readers are advised to check regularly with their local supplier from mid-October onwards.

everyday electronics

New products and component buying for constructional projects

SHOP TALK

By Mike Kenward

GOING back to the April issue and the *Transistor Assisted Ignition*, those readers that were interested will recall that we gave Marshall's as suppliers for the transistors. Subsequently—in the July issue—we mentioned the difficulty in supply, due to Marshall's being let down on delivery dates.

The situation has not yet improved, however since so many readers still want to build the unit we have asked Marshall's if they are willing to supply two TIP53s instead of one TIP53 and one TIP49—this substitution will not affect the functioning of the unit but does put up the price by nearly £1.

Any readers that are prepared to pay the extra can have their unit now—others may have to wait a few months until Texas decide to make more TIP49s. This increase puts the cost of all the semiconductors including postage, packing and V.A.T. up to £3·80. Write to A. Marshall's (London) Ltd., 42 Cricklewood Broadway, London NW2 3HD.

Delta Guitar

The parts for the contruction of the *Delta Guitar* should be available through hardware shops and music shops—for the bridge, machine heads, strings etc.

The magnets may prove difficult in some areas but most of the larger hardware stores stock them or should be able to get them for you. To get to the "electronic" parts, the transformer is available from Zeta Windings Ltd., 26 All Saints Road, London W.11, or is available to callers from H. L. Smith and Co., 287-289 Edgware Road, London W.C.2.

The cost of the transformer including postage and packing and V.A.T. is £1·85. The knobs shown in the photographs of the prototype are available with coloured (red, blue, green, yellow, violet or black) or chrome top caps from Re-An Products, Burnham Road, Dartford, Kent. The cost for the pair including post and packing and V.A.T. is 50p.

One final point on the components, readers may find it easier to buy d.p.d.t. slide switches rather than the s.p.s.t. that is specified. This, of course, causes no problems, simply disregard four of the connections.

Burglar Alarm

The *Burglar Alarm* relies on microswitches at each window and door to protect the house and therefore one of the major items when buying will be these switches. If you look around you may be able to find some ex-equipment ones that are fairly cheap and small enough to look neat, don't worry about the rating of them, they are only required to pass a few milliamps at low voltage.

Incidentally, since the number of switches and associated resistors required by each reader will vary, the cost of these has not been included in the total cost, neither has the cost of the case which could be home made.

The meter for the alarm testing system can be almost any 10mA moving coil type provided it is not so small that the 1mA divisions are not easily distinguished; simply buy the cheapest available.

Reaction Timer

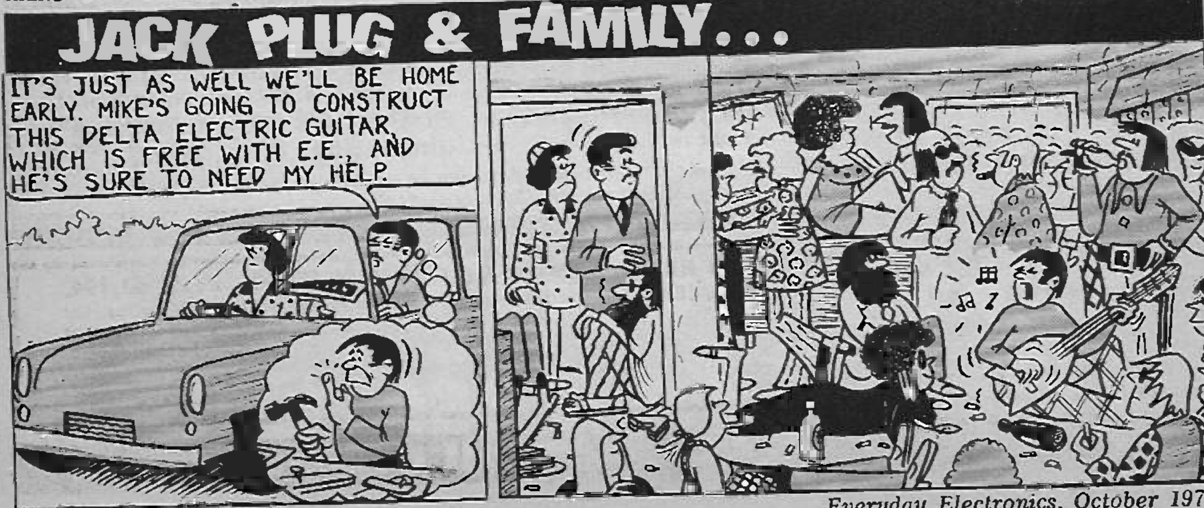
As stated in the article virtually all parts for the *Reaction Timer* are those used for the *Teach-In '74* course, readers following the course will only have to buy the push button. To make the permanent model neatly a skeleton preset and a multiturn preset will be required, although both of these could be normal types mounted in such a way that they are not altered by accident, and connected to the Veroboard by flying leads.

Note that the push button can be one of two types and that D1 is not required if S2 is a push to break type.

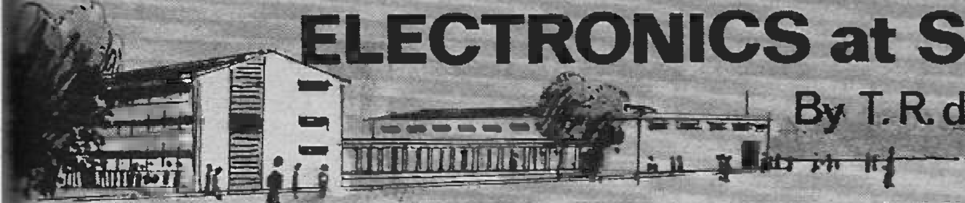
The case can be almost any type of approximately the right size—see components list.

General Purpose Switch

All parts for the *General Purpose Switch* should be readily available. It can easily be housed in any of the small cases on sale.



ELECTRONICS at SCHOOL



By T. R. de Vaux-Balbirnie B.Sc.

WE HAD a very progressive physics master at my old grammar school. A "radio man" through and through, he would give up many a lunch hour for our welfare. He scraped together funds from somewhere and provided us with a "Heathkit" oscilloscope, signal generator and valve voltmeter—at yearly intervals. With transistors becoming available, many a solid-state version of an old valve circuit was knocked together on those heavy oak benches.

WHY ELECTRONICS AT SCHOOL?

People continue to argue their views for and against Comprehensive Education. I uphold it and one of my reasons is that it has undoubtedly facilitated the introduction of such subjects as electronics at school. Even so it has been slow in establishing itself on the curriculum.

Many headmasters have difficulty finding staff willing or able to teach it. Some are deterred by the rather heavy initial capital outlay. Most want to know what it is all about, how it rates as an easy option and what ultimate good it will serve.

Readers of EVERYDAY ELECTRONICS will need little convincing that electronics makes an excellent subject to study at school. Some of the pupils might well make a worthwhile career of it, others taking it up as an absorbing hobby. The rest will, at least, be better informed to treat with care and respect the many pieces of electronic equipment with which they will come into contact over the years.

The ever-increasing hours of leisure which fewer working hours will bring demands possibilities like electronics. Those children who are products of the raising of the school leaving age may find in the subject a willingness to participate in school activity.

Teachers who are interested in electronics or informed parents might well ask whether there are any plans for the introduction of electronics as part of their school's curriculum.

LEARNING ELECTRONICS

We, at St. Peter's, introduced electronics several years ago. Calling it "Practical Electronics" we offer it as a C.S.E. subject to all boys and girls making their decisions for subject options when entering the fourth year.

These children have all studied physics and chemistry up to this time so they should be sufficiently well equipped in basic electrical knowledge to begin the course. Even so, we find that a thorough revision of this is necessary to ensure that they all start at the same level.

The course involves two years of study consisting of two weekly sessions of 80 minutes each and homework.

All the usual components and pieces of basic equipment used in electronics work are studied and the reasons for their operation are discussed. Topics which need mathematical calculation such as potential dividers, Ohm's law and transformers are entered into.

We do not pretend, of course, that the less-able pupil finds this all plain sailing. He may find great difficulty but focuses his attention on the practical side, learning what the various devices do rather than why. A very few realise that electronics is not for them and change their option after only a few weeks. On the whole, however, they enjoy it immensely and pursue the course willingly to the end.

Readers may gain the impression that this is a very theoretical course but this is certainly not the case. We justify the name "Practical Electronics" by illustrating each point with demonstrations, experiments and much class discussion.

CIRCUIT CONSTRUCTION

Much of the work the students do themselves building many of the circuits on S-Decs. I am surprised that many more amateurs do not use these for experimental circuits. Consisting as they do of interconnected rows of holes; resistors, capacitors transistors and the like are simply pushed in according to a carefully planned scheme. Components have a very long life as the wire ends are not shortened thereby. Transistors are not ruined by over enthusiastic use of the soldering iron.

It is, however, essential that the student learns correct soldering technique and how circuits can be built in other ways. For this he may cut a piece of plywood, drive in panel pins and solder to these. At other times he may use matrix board, Veroboard or even etch his own printed circuit board.

Building amplifiers, oscillators and the like he will automatically learn how to use the basic test equipment which is made available, such as transistor testers and oscilloscopes. He will learn to detect faults and to rectify them whether they are due to faulty components or (more frequently) their misrepresentation of the circuit.

PHILOSOPHY

We never feel smug about our subject—in fact we are generally grumbling about some shortcoming. There is, for example, a wish to re-introduce a little work on thermionic valves. Thermionic emission is a fundamental concept which still has a place in our solid-state world. We have no time to do this, however, as other important topics have been added to the syllabus.

We all agree on one basic piece of philosophy—that electronics must not be taught as a "black box" subject. We feel that it would be a big mistake to discuss a lot of integrated circuits which each "do something," the students merely wiring them together.

This does not mean that we ignore integrated circuits—how could we? They are discussed when a similar circuit built of discrete components is already understood and established. In this respect I do not know what will happen in years to come. It sometimes worries me that the role of teaching electronics might ultimately have to change.

EXAMINATION

As the second year of the course draws to a close, C.S.E. examination time comes. First of all, there is a long practical examination where the candidate answers three questions. He builds circuits, makes modifications and draws conclusions. One of the questions involves using a circuit which has been built as one of the earlier projects.

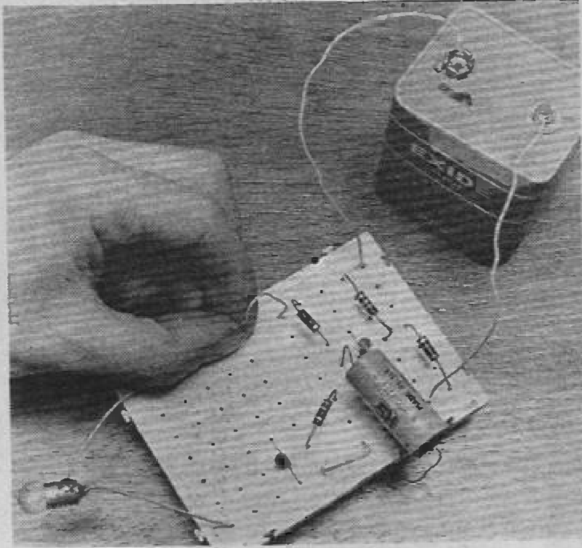
A rigorous theory examination follows a few weeks later. This has questions from all parts of the syllabus. The final mark, hence grade, for the candidate includes assessment of these two examinations plus a mark for the course work—i.e. project circuits, notes about theoretical details and essays which will have been written during holidays.

WORTHWHILE

We find that electronics as a school subject cuts across many of the usual rules when a pupil makes his choice of subjects. The less-able child rubs shoulders with the highly intelligent. We, as educationalists, find this most rewarding. We know the course is worthwhile and this suggests itself when the pupils—without prompting—begin to build their own circuits at home using their new-found knowledge. Then our troubles begin. Amplifiers which refuse to amplify or oscillators which will no oscillate become part of the lunchtime scene. Coffee is abandoned for a leaky capacitor.

REQUIREMENTS

Any school wishing to embark on a similar exercise must do so with much thought. A good stock of the basic materials is, of course, essential as is a supply of good test equipment. Good quality instruments are necessary to withstand a great deal of use and abuse.



An S-Dec being used for a practical demonstration.

An account with R. S. Components and one of the larger retail suppliers are essential.

The teaching staff need not be experts—it sometimes does the children good to see that "sir" can make mistakes and, hopefully, to put them right.

Some components fall to pieces through fair wear and tear and this, together with the necessity to improve the course, means that a reasonable annual allowance must be available to cover these needs. An expert syllabus must be written and a great deal of care here is worthwhile. It must gradually progress in a natural and logical order, maintaining a correct balance between theory and practical work. Mathematical detail must be sufficient for the more able but not so much as to deter the others.

I might finally remark that the wisdom of Solomon is not necessary but the patience of Job is quite an asset. After nearly a year of study I recently grimaced to hear, "How many volts will pass through my relay coil, sir?" ▣

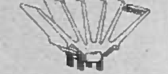
Henry's

TRANSISTORS, VALVES AND SEMI-CONDUCTOR DEVICES · ANY QUANTITIES
UK'S LARGEST STOCKISTS

FREE NEW '74/75 SEMI-CONDUCTOR AND VALVE LISTS Ref No. 36 on request

CASH & CARRY PRICES
For CALLERS or BY POST

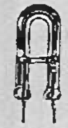
Ref. No.		Price
1	D1203 Telephone Amplifier—Suction	£4·95
2	D1201 Telephone Amplifier—Cradle	£7·50
3	T1206 2 Station Intercomm	£4·95
4	T1306 3 Station Intercomm	£9·95
5	T1406 4 Station Intercomm	£12·50
6	TAIA 2 Station Telephones Intercomm	£13·50
7	WI.2 2 Station Wireless Intercomm	£18·20
8	DP303 Door Phone Intercomm	£7·00
9	PK3 ETCH your own printed circuits	£2·25
10	EA41 Reverberation amplifier	£11·75
11	US50 Ultrasonic switch	£12·75
12	XP4002 Photoelectric alarm system	£13·50
13	Solid state tachometer	£11·30
14	Power dash transistor assisted ignition	£13·50
15	Car auto lock	£2·75
16	4 amp 6-12 volt battery charger	£4·85
17	FF21 Car radio/tape quad adaptor	£4·68
18	Fully disappearing car aerial	£2·00
19	Electric disappearing car aerial	£7·80
20	ET (F1009) Morse Code Key/Buzzer	£1·70
21	VH105 aircraft band convertor	£4·50
22	LM300 50K Disco mic.	£12·95
23	DF50B 50K Communications mic.	£5·75
24	Car lighter plug 12v voltage adaptors 300mA (state 6/7½/9 volt)	£1·95 ea.
25	ST Tuner delay module	£1·50
26	Gravenire 931A photo electric unit (with data)	£3·50
27	3 ch. 3 x 500 watt sound to light	£21·50
28	3 ch. 3 x 1000 watt sound to light plus overide	£41·25
29	150 w. light display projector with wheel	£23·50
30	MM1 (B2005) 4 channel 9 volt mixer	£4·20
31	MX100 deluxe 4 channel mixer	£6·78
32	H67/(G1320) Stereo headphone amplifier	£10·50
33	MP12 6-CH. Slider control mixer	£27·95
34	RE 208 stereo phone adaptor	£2·25
35	MD802 stereo phones	£2·20
36	CIS200 stereo phones	£2·75
37	CI5 250 stereo phones	£6·50
38	G1301 and G1305 stereo phone controls	£2·95
39	Car stereo speakers in pods. Special offer	£2·95 pr.
40	Crystal lapel microphone	£0·60
41	E1052 car speakers front/rear radar	£1·00
42	Bib Groove Clean (Ref. No. 42)	£1·76
43	Bib Record care kit (Ref. No. 43)	£2·20
44	Bib cassette recorder care kit (Ref. No. 26A)	£1·96
45	Bib cassette Tape splicing kit (Ref. No. 24)	£1·64
46	BASF reel-reel Hobby Box	£2·40
47	2000 OHM Headphones	£1·50
48	4000 OHM Headphones	£1·55
49	Cassette Recorder Mic. (2½ x 3½mm Plugs)	£1·85
50	420 ES Microscope	£5·70
51	UP050 Low cost 9 volt eliminator	£2·25
52	RE 527K Tape Head Demagnetiser	£1·70
53	Cambridge pocket calculator	£19·95
54	BC808 % Pocket calculator	£21·95
55	BC817 Memory pocket calculator	£28·95
56	BCM 850 % and memory calculator	£33·25
57	Sinclair scientific calculator	£27·20
	Sinclair Cambridge Memory	£23·95
58	Autex soldering iron kit (SKI)	£3·30
59	Bib record care kit (Ref. No. 59)	£1·17
60	5pc Chassis punch kits	£5·50
61	Longs desoldering tool	£5·50
62	1 amp in line mains suppressors	£2·50
63	BSS2 (E1013) 7 way stereo speaker switch	£2·20
64	Weller 8200D-PK expert gun kit	£6·20
65	'5' Dec breadboaro	£1·98
66	'2' Dec breadboard	£4·29
67	'4' Dec breadboard	£7·50
68	'T' Dec breadboard	£3·65
69	Instant head soldering gun	£2·30
70	40 watt soldering iron	£1·90



ELECTRONIC COMPONENTS

(Post/Packing 15p per 1-6 items GB unless stated)

Ceramic Filters Miniature 10·7 MHZ filters 40p pair.
IC IF Unit CA3089 10·7 MHZ IC £2·94
Sinclair 6 w. IC IC12 with data and PC board £2·10
Radio IC Chip ZN414 Radio IC with circuit £1·20
5 w. IC chip 76003 5 watt amplifier with data £1·50 PC Panel 50p
Strobe Tubes ZFTBA (similar to 4A) £4·00 ZFT12A £5·00



7 segment indicators 3015F with data £1·70 ea
Spring delay units HR42 9" twin spring £3·30 pp 20p HR16" twin spring £6·85 pp 25p

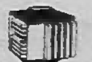
IC Clock MM 5314 single chip clock with CCT £9·00
Ultrasonic transducers with data/circuits £5·90 pr
Fibre optics 0·01" diam. mono filament £5·50 per 100 metres 0·13" diam. 64 fibres £1 per metre 15m diam mares tails £10·50 each
Radio Control XTALS Matched pair for 465 KHZ IF £2·00 pr. for all supernet trans. RX's
Handsets Lightweight telephone handsets brand new complete with diagrams for intercomms £3·00 pr.
Dual impedance and microphones 50k/600 OHM quality cardiod stick mics. with HI-LO and on/off switches and cables.
RE345 Indoor / outdoor professional £10·75
RE350 Anti-feedback IM-quality £11·50

QUALITY CASSETTE TAPES

"Living Sound" made specially for Henry's by EMP Tapes Ltd.
5 screw type with library case
Post paid (GB)

	3 for	6 for	10 for	25 for
C60	£1·10	£2·00	£3·15	£7·50
C90	£1·47	£2·85	£4·65	£11·37
C120	£1·83	£3·54	£5·60	£14·00

SPECIAL OFFER CASSETTE STORAGE



Rotating unit up to 32 cassettes stackable £3·60 pp 15p
Car unit with bracket for 10 cassettes £2·80 pp 10p

ELECTRONIC COMPONENTS & EQUIPMENT

More selection — bigger stocks of electronic components and equipment for supply purpose. Let us quote for your requirements

(Please enclose large SAE with all enquiries)

Build It Yourself

MW/LW Portable radio £7·98 pp 32p
MW/LW Radio tuner £5·25 pp 20p
9 volt regulated power supply £2·15 pp 15p
15 watt inverter £5·20 pp 30p
40 watt inverter £6·80 pp 40p
Sinclair micromatic radio £2·25 pp 15p

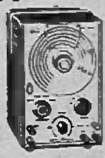
MULTI-KITS

Ready to use and use again. Educational and practical All transistor circuits with full handbacks.

10 in 1, 10 projects £5·95 Post 20p
50 in 1, 50 projects £13·95 Post 25p
150 in 1, 150 projects £21·50 Post 30p
Radionic x 20, 20 (Elec.) Projects £4·95 Post 20p
Radionic x 40 40 (Radio) Projects £9·45 Post 20p

TEST EQUIPMENT

MULTI-METERS



(carr./packing 35p)

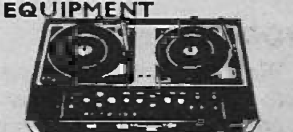
U4324, 20k/V with case	9·25
U435, 20k/V with steel case	£8·75
U4313, 20k/V with steel case	£12·50
U4317, 20k/V with case	£16·50
U4341, 33k/V plus transistor tester steel case	£10·50
U4323, 20k/V plus 1KHZd 465KHZ OSC with case	£7·70
ITI-2, 20k/V slim type	£5·95
THL33D (L33DX) 2k/V Robust	£7·50
TPSSN, 10k/V (Case £2·00)	£8·25
AF105 50k/V Deluxe (case £1·90)	£12·50
S100TR, 100k/V Plus transistor tester	£22·50

General Test Equipment

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

†3100 IMA Strip chart recorder	£44·00
†TE40 AC Multi-voltmeter	£19·75
†TE15 Grid dip meter 440KHZ–28MHZ	£16·50
†TE65 28 Range valve voltmeter	£22·50
†Tk20D RF Generator 120KHZ–500MHZ	£18·95
†Tk22D AF Generator 20HZ–200KHZ	£19·95
*HM350 In circuit transistor tester	£19·50
*C3025 Compact transistor tester	£6·95
*TT145 Deluxe meter 1–300 MHZ	£14·75
†G3–36 R/C osc. 20HZ–200 KHZ	£19·75
*C3042 SWR Meter	£5·75
*SE350A Deluxe signal tracer	£12·95
*SE400 Mini-lab all in one tester	£15·50
C1–5 Scope 500,000 KHZ (carr. £1·)	£43·00
*C3043 5 CH F/A meter 1–300 MHZ	£5·75
Resistance sub box } Post. etc. 20p	£2·40
Capacitator } Post. etc. 20p	£2·10
2 amp variable transformers (carr. £1)	£6·55
Radio activity counter 0–10 (carr. £1)	£9·97
Mains unit for above (carr. 50p)	£3·75

PA-DISCO-LIGHTING EQUIPMENT



Without doubt UK's best range of modular and complete equipment. Lighting, mixing, microphones, accessories, speakers, amplifiers, lenses, etc., etc FREE stock lists (Ref. No. 18) on request CALL IN AND SEE FOR YOURSELF at '309' (see below).

AMTRON KITS

310 Radio control reciever £3·29
300 4-channel R/C transmitter £6·61
345 Superhet R/C receiver £6·61
65 Simple transistor tester £1·66
115 8watt amplifier £4·50
120 12watt amp £4·73
125 Stereo control unit £6·61
127 Noise reduction unit £9·55
157 Private TV loop Trans. £4·95
130 Mono control unit £4·16
605 PowerSupply for 115 £5·31
610 Power supply for 120 £5·31
615 Power supply for 2 x 120 £6·64
230 AM/FM aerial amplifier £3·29
240 Auto packing light £6·90
275 Mic. preamp £6·98
525C 120-160 MHZ VHF tuner £11·31
570S LF generator 10Hz-1mHz £21·45
5755 Sq. wave generator 20Hz-20Khz £19·77
590 SWR meter £9·47
630 STAB Power supply 6-12v 0·25-0·1A £9·24
690 DC motor speed Gov. £3·31
700 Electronic Chaffinch £7·92
707 Windscreen wiper timer £7·97
760 Acoustic switch £12·57
780 Metal Detector (electronics only) £10·91
790 Capacitive Burgular alarm £7·92
835 Guitar preamp. £4·99
840 Delay car alarm £6·99
875 CAP. Discharge ignition for car engine(–Ve Earth) £13·19
80 Scope Calibrator £2·65
255 Level indicator £6·98
525 120-160mHz VHF timer £11·31
715 Photo cell switch £8·97
795 Electronic continuity tester £4·97
860 Photo timer £15·51
235 Acoustic Alarm for driver £8·61
465 Quartz XTAL checker £9·90
220 Signal injector £2·65
390 VOX £13·62
432 Testakit £21·83
670 Buffer Battery Charger £7·59
850 Electronic Keyer £16·37

8% TO BE ADDED TO ALL ORDERS (Export VAT FREE)

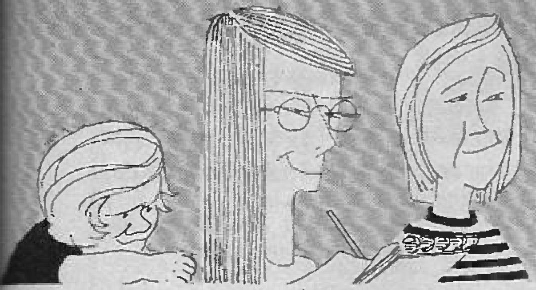
FOR MORE ELECTRONICS, SEE BACK PAGE

Henry's RADIO
EDGWARE ROAD, W2

Electronic Centres
404-406 Electronic Components & Equipment 01-402 8381
309 PA-Disco-Lighting High Power Sound 01-723 6963
303 Special offers and bargains store
All mail to 303 Edgware Road. London W2 1BW

Hi Fi and Electronics Centres Open 9 am - 6 pm

Prices correct at time of preparation. Subject to change without notice. E.&O.E.



Physics is FUN!

By Derrick DAINES

STATIC ELECTRICITY

The ancient Greek word for amber was "elektron". (Drop that little tit-bit at a gathering and see how many conversations you stop!) However, to the modern mind the word "electron" carries with it connotations of electricity, so what's the connection? Easy—2000 years ago the Greeks were all madly rubbing amber to produce the phenomena caused by static electricity.

So—if you've got a bit of amber, rub it. If you haven't, don't worry—plastic will do as well, or better.

Rub it vigorously with wool for 5 or 10 seconds and then pass it over the head of an unsuspecting friend. He will feel a tickling sensation in his scalp and all his hair will rise up towards the plastic as though he had just been to see a horror film, Fig 1.

Static electricity can be induced by rubbing

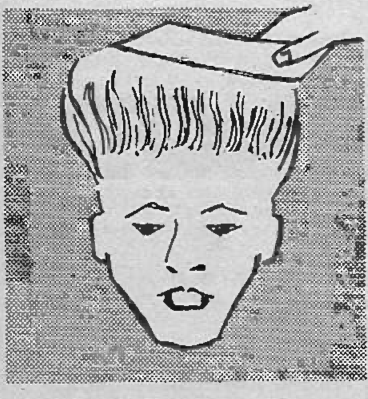


Fig. 1. Rubbing a plastic comb with wool and then passing over the head will cause the hair to stand on end.

If you scout around, trying this and that, you will find that some plastics serve better than others. Polythene sheeting is very good.

Without getting too technical, we can say that electrons (parts of atoms) have actually been transferred from the wool to the surface of the plastic, giving it a positive charge. Let us check this last point.

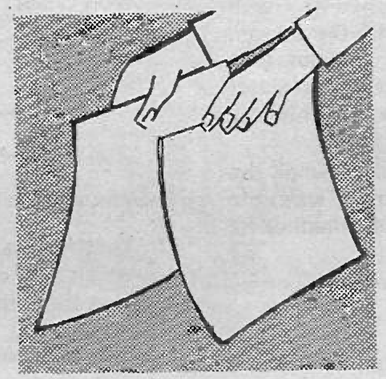


Fig. 2. Two sheets of polythene, when rubbed with wool, will be seen to repel each other when brought close together.

Obtain two identical plastics and rub them with wool. (Don't let them touch.) If the two sheets are now held up near to each other, they will be seen to repel each other, Fig. 2. Remember that like poles of magnets repel? Obviously, here we have the same thing.

Now rub a piece of glass with silk and rub the plastic with wool. If they are held up, the chances are that the plastic sheet will be attracted to the glass. (I say "the chances are" because some plastics will produce negative static, and others positive.)

Electric charges can attract and repel, just like magnets

For an interesting experiment, set the kitchen tap so that it releases water in a small jet—i.e., not broken, yet as slow as possible. Now the same electrified plastic sheet, if brought up to the jet, will deflect the water without actually touching it, Fig. 3.

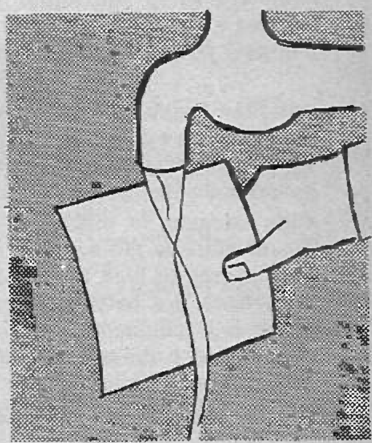


Fig. 3. When a sheet of polythene which has been rubbed with wool is brought up to running water from a tap, the water is deflected (repelled).

Finally for this month, try rubbing a balloon so that it sticks on the ceiling, or see how much cigarette ash you can pick up.

Just one word of warning—all of these experiments work best in a very dry atmosphere. The reason why, we will look into next time.

TEACH-IN '74 END OF TERM TEST

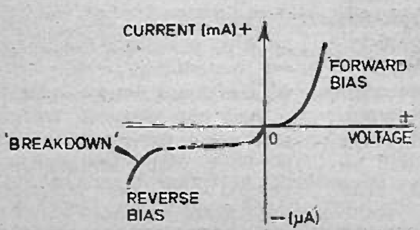
ANSWERS TO LAST MONTH'S QUESTIONS

1. Only the first relationship is correct. The others should be

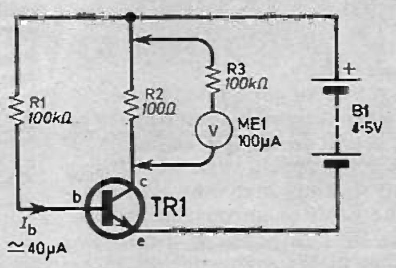
   $$\text{Current} = \frac{V}{R} : \quad \text{Voltage} = \frac{\text{Power}}{\text{Current}}$$

2. For the inductor, voltage equals the inductance value in henries multiplied by the *rate of change* of current in amps/second. For a capacitor, current equals capacitance in farads multiplied by the rate of change of voltage in volts/second.
3. By observing the terminal voltage with and without a suitable load resistor connected.
4. No. A positive gate pulse can only turn the thyristor on. The gate then *loses* control.
5. Yes. With modern transistors the most significant change is that V_{be} falls by about 2mV for every degree C *rise* in temperature.
6. In each case the power rating is 2 watts total since the resistors have equal values. If the resistors are not the same value the answer will depend on which resistor reaches its 1 watt rating first. For the series case with the current common, when the larger value resistor (R1) reaches 1 watt dissipation the lower value resistor (R2, say) will be dissipating $\frac{R2}{R1}$ watts, which is less than 1 watt. For the parallel case, when the lower value resistor (R2) dissipates 1 watt, the higher value resistor (R1) will be dissipating $\frac{R2}{R1}$ watts because in this case the voltage across the resistors is the same.
7. 6 volts reverse bias (maximum).
8. Resonance is a particular condition, in a circuit containing inductance capacitance and resistance, in which the reactive effects of the *L* and *C* tend to oppose each other. The circuit *appears* purely resistive and the applied voltage and current will be in phase.
9. For 10V r.m.s. the peak value is 10 x 1·414, i.e. 14·14 volts. The average value is the peak value divided by π which gives approximately 4·5 volts.
10. Between diagonally opposite corners the resistance will be that of two 20kΩ paths in parallel, i.e. 10kΩ. Between adjacent corners the paths are 10kΩ and 30kΩ in parallel which gives 7·5kΩ.
11. No, except for very low frequencies in which case the needle will vibrate to and fro.
12. A total resistance of 50kΩ is needed so 49kΩ must be added in series with the meter.

Answer to question 13 below Note different current scales.



14. One stable state and one quasi-stable state. The circuit generates a pulse of fixed length when triggered.
15. To prevent eb junction breakdown under reverse-bias conditions.
16. Using say a 100kΩ resistor to supply a fixed base current from a 4·5V battery and a 100Ω resistor as a collector load, the transistor with the highest gain will produce the largest collector current. This can be "measured" by using the voltmeter across the 100Ω resistor.



The circuit used for answer 16.

17. Time constant is a measure of the speed at which the capacitor can charge or discharge. In a time equal to one time-constant, charging (from zero) will be 63 per cent complete. The time constant is given by C x R.

PLEASE TAKE NOTE

In *Semiconductor Primer* No. 20 (September 1974) *R2* should be 27kΩ and the current in *R1* 0·11mA.

The Denco coil for the *Metal Locator* (September 1974) was incorrectly specified as green. Denco are at 355/7/9 Old Rd., Clacton-on-Sea, Essex, CO15. This should be a blue type, range 1T.

ELECTROVALUE

Present THIS MONTH'S SELECTION OF GUARANTEED-TO-SPECIFICATION COMPONENTS

Everything Brand New ★ Attractive Discounts ★ Free Postage (U.K.)

Build that EE Design with EV components

TRANSISTORS

and semi-conductors of many types from simple diodes to ICS photo-sensitive devices, threshold switches, etc. etc.

MINITRON DIGITAL INDICATORS

3015F Seven segment filament, compatible with standard logic modules. 0–9 and decimal point; 9mm characters in 16 lead DIL (some alphabetical symbols available) £1·20

Suitable BCD decoder driver 7447 £1·15

3015G showing + or — & 1 & dec. pt. £1·20

CAPACITORS

DALY ELECTROLYTIC

In cans, plastic sleeved

1000mF/25V 28p 1000/50 41p

5000/100 £2·91 2000/50 57p

5000/25V 62p 5000/50 £1·18

2200/100 £1·56

POLYESTER TYPE C.280

Radial leads for P.C.B. mounting. Working voltage 250V d.c.

0·01, 0·015, 0·022, 0·033, 0·047 ea. 3p

0·068, 0·1, 0·15 ea. 4p

0·22, 5p; 0·33 7p; 0·47 8p; 0·68 11p; 1·0 14p; 1·5 21p; 2·2 24p

SILVERED MICA

Working voltage 500V d.c.

Values in pFs—2·2 to 820 in 32 stages ea. 6p

1000, 1500 7p; 1800 8p; 2200 10p; 2700, 3500 12p; 4700, 5000 15p; 6800 20p; 8200, 10,000 25p

TANTALUM BEAD

0·1, 0·22, 0·47, 1·0 mF/ 35V. ea. 14p

2·2/16V, 2·2/35V, 4·7/16V, 10/6·3V ea. 14p

4·7/35V, 10/16V, 22/6·3V ea. 18p

10/25V, 22/16V, 47/6·3V 100/3V ea. 20p

POLYCARBONATE

Type B42540 Working Voltage—250V

Values in mF:

0·0047; 0·0068; 0·0082; 0·01; 0·012; 0·015 ea. 3p

0·018; 0·022; 0·027; 0·033; 0·039; 0·047; 0·056

0·068; 0·082; 0·1 ea. 4p

CERAMIC PLATE

Working voltage 50V. d.c.

In 26 values from 22pf to 6800pF, each, 2p

POTENTIOMETERS

ROTARY, CARBON TRACK. *Double wipers for good contact and long working life*

P.20 SINGLE linear 100ohms to 4·7megohms, ea. 14p

P.20 SINGLE log. 4·7Kohms to 2·2megohms, ea. 14p

JP.20 DUAL GANG lin. 4·7Kohms to 2·2megohms, ea. 48p

JP.20 DUAL GANG log. 4·7Kohms to 2·2megohms, ea. 48p

JP.20 DUAL GANG Log/antilog 10K, 22K, 47K, 1 megohm only ea. 48p

JP.20 DUAL GANG antilog 10K only 48p

2A DP mains switch for any of above 14p extra.

Decades of 10, 22 and 47 only available in ranges above.

Skeleton Carbon Presets Type PR, horizontal or vertical 6p each.

SLIDER

Linear or log. 4·7K to 1 meg. in all popular values ea. 30p

Escutcheon plates, black, white or light grey, ea. 10p

Control knobs, blk/wht/red/yel/grn/blue/dk. grey/lt. grey ea. 7p

JACKS AND PLUGS

Sockets

2-circuit unswitched S1/SS 12p

2-circuit /2 break contacts S1/BB 15p

3-circuit unswitched (Not GPO) S3SSS 17p

3-circuit with 3 break contacts S3/BBB 20p

2 circuit with chrome nut and black/white/red/green or grey unswitched S5/SS 15p

with 2 break contacts S5/BB 20p

Miniature 3.5mm 2-circuit, (black) 2 br. cont S6/BB 9p

Plugs

2 circuit screened top entry P1 24p

side entry SEP1 36p

Line socket mono 231 40p

Line socket stereo 244 45p

3 circuit unscreened, bl/grey/wh. P4 46p

2 circuit, unscreened, bl/whl/red/bl/grn/gry P2 18p

3 circuit screen top entry P3 53p

side entry SEP3 55p

Miniature 3·5mm 2-circuit screened P5 13p

Min. 3·5mm 2-circ. unscrnd. various colours P6 10p

EV CATALOGUE

2nd printing

(Green and yellow cover)

112 pages, thousands of items; illustrations; diagrams; much useful technical information. The 2nd printing of this catalogue has been updated as much as possible on prices. It costs only 25p post free and includes a refund voucher for 25p for spending when ordering goods list value £5 or more.

INSULATED SCREW TERMINALS

In moulded polypropylene, with nickel plate on brass. With insulating set, washers, tag & nuts. 15A/250V in blk/brwn/red/yel/grn/bl/gry/wh.

Type TP.1, ea. 14p

Suitable plugs Type TP4, 4mm each 7p

Type TP2, 2mm each 4p

ZENER DIODES

Full range E24 values: 400mW: 2·7V to 33V, 14p each; 1W: 6·8V to 82V, 21p each; 1·5W: 4·7V to 75V, 67p each. 20W: 7·5V to 75V 94p each. Clip to increase 1·5W rating to 3 watts (type 266F), 5p.

RESISTORS

Code	Watts	Ohms	1 to 9	10 to 99 (see note below)	100 up
C	1/3	4·7–470K	1·3	1·1	0·9 nett
C	1/2	4·7–10M	1·3	1·1	0·9 nett
C	3/4	4·7–10M	1·5	1·2	0·97 nett
C	1	4·7–10M	3·2	2·5	1·92 nett
MO	1/2	10–1M	4	3·3	2·3 nett
WW	1	0·22–3·9	11	10	8
WW	3	1–10K	9	8	6
WW	7	1–10K	11	10	8

Codes:

C = carbon film, high stability, low noise.

MO = metal oxide, Electrosil TR5, ultra low noise.

WW = wire wound, Plessey.

Values: All E12 except C $\frac{1}{3}$W, C $\frac{3}{4}$W, and MO $\frac{1}{2}$W.

E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.

E24: as E12 plus 11, 13, 16, 20, 24, 30, 36 43, 51, 62, 75, 91 and their decades.

Tolerances:

5% except WW 10% ±0·05Ω under 10Ω and MO $\frac{1}{2}$W 2%.

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order.) Prices for 100 up in units of 100 only.

VEROBOARD

Copper clad 0·1 matrix-2·5 x 3·75 ins. 32p: 3·75 x 3·75 ins.—35p: 2·5 x 5 ins. 35p: 3·75 x 5 ins.—24p.

Copper class 0·15 in. matrix 2·5 x 3·75 ins.—24p: 3·75 x 3·75 ins.—35p: 2·5 x 5 ins. 35p: 3·75 x 5 ins.—44p.

Vero spot face cutter (any matrix) 53p.

0·040 pins (for 0·1 matrix) per 100—36p.

0·052 pins (for 0·15 matrix) per 100—36p.

ELECTROLYTICS

Axial Lead

μF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47	—	—	—	—	—	—	11p	8p
1·0	—	—	—	—	—	11p	—	8p
2·2	—	—	—	—	11p	—	8p	9p
4·7	—	—	—	11p	—	8p	9p	8p
10	—	—	—	—	8p	9p	8p	8p
22	—	—	8p	—	9p	8p	8p	10p
47	8p	—	9p	8p	8p	8p	10p	13p
100	9p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	28p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	18p	23p	26p	37p	41p	—	—
4,700	26p	30p	39p	44p	58p	—	—	—
10,000	42p	46p	—	—	—	—	—	—

KNOBS

In a great variety of modern types, for ¼" shaft, from plastic to solid aluminium as well as pointer and numbered types.

CONNECTORS

DIN from two way to 7 way plugs and sockets, phono types mains connections, etc. etc. Page 88 in Catalogue 7

BAXANDALL SPEAKER KIT

As designed by P. J. Baxandall and described originally in "Wireless World." Simple to assemble, fantastically good results and a greater money saver. Carries 10 watts RMS, 15 ohms impedance. Size 18in x 12in x 10in. Complete kit, including pack-flat cabinet, £14·98.

The size and weight of this product obliges us to charge 70p part cost of carr. in U.K.

Equaliser Assembly, £2·30.

Loudspeaker Unit 59RM109, £2·45.

Cabinet Kit (to Baxandall design), £10·45.

Cross-over choke for additional woofer to above £1·50.

This is EV Service

DISCOUNTS

Available on all items except those shown with NETT PRICES. 10% on orders from £5 to £14·99. 15% on orders £15 and over.

PACKING AND POSTAGE FREE

In U.K. for pre-paid mail orders, except Baxandall. For order list value £2 and under there is an additional handling charge of 10p.

GUARANTEE OF QUALITY

All goods are sold on the understanding that they conform to manufacturers', specifications and satisfaction is guaranteed as such—no rejects, 'seconds' or sub-standard merchandise is offered for sale.

GIRO ACCOUNT—No. 38/671/4002

Prices quoted do not include V.A.T., for which 8% must be added to total nett value of order. Every effort is made to ensure correctness of information and prices at time of going to press. Prices subject to alteration without notice.

APPOINTED STOCKISTS FOR SIEMENS QUALITY PRODUCTS

ELECTROVALUE LTD

All postal communications, mail orders etc. to Head Office at Egham address, Dept. EE10 S.A.E. with enquiries requiring answers.

(Dept. EE10)

28, ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB

Telephone Egham 3603 Telex 264475 Shop hours 9–5.30 daily: Sat. 9–1 p.m.

NORTHERN BRANCH: 680, Burnage Lane, Burnage, Manchester M19 1NA

Telephone (061) 432 4945 Shop hours 9–1 p.m. 2–5.30 daily: Sat 9–1 p.m.

U.S.A. CUSTOMERS are invited to contact ELECTROVALUE AMERICA, P.O. Box 27, Swarthmore PA 19081.

DOWN TO EARTH

By GEORGE HYLTON

"What is *copper loss* as applied to transformers?"

"Loss", here, means loss of energy. We all want our circuits to be efficient, so it's always important to avoid too much loss of energy—especially if it comes from a dry battery, which is an expensive source of energy compared to the mains.

Copper loss is the waste of energy in the resistance of the transformer windings, which are generally made of copper wire. A perfect transformer would have windings with no resistance. When current flowed in its primary and secondary windings there would then be no waste of energy.

Real windings do have resistance, and this causes heat to be produced when current flows, and wastes energy that way.

EQUIVALENT CIRCUIT

It's a little difficult to visualise what is happening in a real winding, where the resistance and inductance are mixed up inseparably. Things are greatly simplified by substituting, just for the purpose of estimating the losses, a fictitious "equivalent circuit", (Fig. 1). Here the winding resistance and the inductance are shown as separate items, (*R1*, *L1*, for the primary, *R2*, *L2* for the secondary).

When the input power and the load are connected, current flows in both primary and secondary.

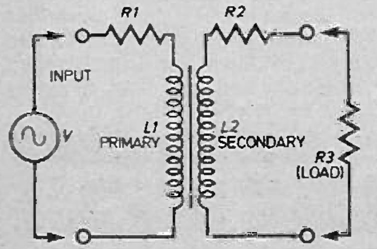


Fig. 1. Equivalent circuit of a transformer.

This sets up voltage drops in *R1* and *R2*. The drop in *R1* reduces the amount of the input voltage *V* which is actually developed across the primary winding. The drop in *R2* robs the load *R3* of some of the voltage which appears across the secondary winding.

It's very easy to see the effect of *R2*, because *R2* is in series with *R3*. For instance, if *R2* equals *R3*, half the secondary voltage is lost in *R2*. So in this case, half the power is lost in *R2*. Not an efficient transformer! But what is the effect of *R1*, the resistance of the primary winding? It comes in series with the primary, but how can you estimate how much voltage is lost in it?

What we need to know is how much *current* flows in the primary. Now, in a perfect transformer *no* current flows in the primary until the load is connected. Then, when it is connected, the primary current depends on both the load and the turns ratio.

The effect of the transformer, as seen by the input, is to make a resistance appear across the primary, a resistance which depends on the load and the turns ratio.

TURNS RATIO

In Fig. 1, the load is *R3*, but *R2* adds to it. As far as the circuit operation goes, the "real" load is *R2* plus *R3*. In the simple case where the turns ratio is 1 to 1, the input "sees" the circuit of Fig. 2.

With this 1 to 1 ratio the transformed load which appears across the primary is unchanged in resistance. In a good transformer *L1* has such a high impedance that you can forget about it. So the input "sees" *R1*, *R2* and *R3* in series. Since the same current flows in all three, the losses are proportional to the voltage drops, and for low loss *R1* and *R2* must be small compared with *R3*. Of course, most transformers don't have 1 to 1 turns ratio. In this case *R2* and *R3* can't be transferred unaltered to the primary to estimate the loss. They have to be adjusted to allow for the turns ratio. The adjustment is quite simple: multiply *R1* and *R2* by the *square* of the ratio, then transfer them to the primary side.

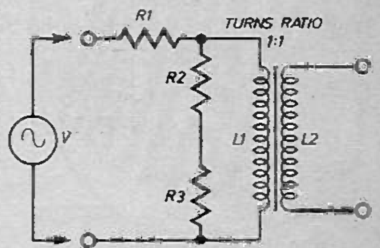


Fig. 2. With a 1 : 1 turns ratio, the load can be transferred to the primary for calculation purposes.

EXAMPLE

A step-down transformer of ratio 10 to 1 is used to match a 3 ohm loudspeaker to a transistor output stage. What is the copper loss if the primary resistance is 50 ohms and the secondary is 1 ohm?

The real load is (3+1) ohms. The square of the ratio is 100, so the transformed load as seen by the input is (300+100) ohms. In series with this is the 50 ohms primary resistance. The total copper-loss resistance, as seen by the input, is (100+50) ohms, which is just half the 3 ohm loudspeaker transformed load of 300 ohms. So two thirds of the power appears in the loudspeaker and one third is lost in the copper. The transistor driving the transformer sees a load of 450 ohms, so the circuit design must be optimised for 450 ohms rather than the 300 ohms which would apply if there were no loss.

Incidentally, this particular transformer is not perfectly designed for the job. The secondary copper loss is twice the primary copper loss. If the primary had been wound with slightly thinner wire, making space for a secondary of slightly thicker wire the overall losses could have been reduced. In a well designed transformer the primary and secondary losses are about equal.

From Down Under

I read with interest the letter from R. Zlitrm in your March 1974 issue and would like to add a plug for an all-electronic echo unit. I have built your *Audio Signal Mixer* and also a phasing unit, and nowhere but nowhere have I been able to find a circuit for an electronic echo.

I must also add my appreciation for the format and level of your magazine. Knowing nothing of electronics at all, although I could read and understand a schematic diagram, I approached the construction of the mixer unit with some trepidation. You can understand my surprise when it worked first go!

As a matter of interest, I decided to build the *Electronic Doorbell,* but found rather quickly that the telephone earpieces required are not available outside of a telephone and the N.Z.P.O. will sell me a phone for approximately $50!

Consequently I am held up while two earpiece inserts are "acquired" through P.O. contacts.

I do feel that your projects should not tend towards heavy integrated circuit use as these seem to be very erratically available and expensive, especially in a place like New Zealand, even though I live in the capital!

Thanks again for a great magazine.

S. J. Doyle,
Stokes Valley,
New Zealand.

Export Order

Following the letter from Mr. Trotman of the West Indies my own experiences in export mail-order show that the majority of your foreign readers have no idea of the postage costs. Invariably a postcard has to be sent requesting anything up to £3 additional postage. My company only charges a few pence for packing.

Would it not be a good idea to publish the parcel post rates to the countries where your magazine is most widely circulated, particularly Australia and New Zealand where a 10lb parcel costs £2·50 to send.

P. B. Green. (Director)
Greenweld Electronics,
Southampton

If publication of postal rates was to be worthwhile all the advertisers would have to state the weight of each item they sell —this is not really on is it?

Transistor Test

I once saw a service engineer "testing" a transistor with nothing more than a fairly simple multimeter. Could you tell me how this is done? I always thought you needed a special instrument to do this.

You can carry out a very rudimentary test on a transistor using a multimeter but you must remember there are limitations to this method. The engineer was probably checking to see that the transistor had not gone open or short circuit. It is not a simple matter to check the gain of the device without a bit more equipment. Basically all he was doing was checking the existance of the two diode junctions—between base and emitter, and base and collector.

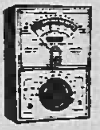
Set your meter to read ohms (if you have several scales choose one that goes up to about 1 megohm). For an *npn* transistor connect the negative (black) lead from the meter to the base and then the other lead to the collector and then the emitter. Both checks should, if the transistor is working, give a low resistance reading (up at the top end of the scale).

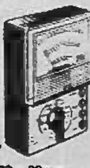
Reverse the leads and connect the positive one to the base and do the test again. This time you should read a resistance of well over 1 megohm for silicon transistors (a bit under 1 megohm for germanium devices). Finally measure between collector and emitter with both polarities of meter lead to check leakage. Again the resistance should be well over 1 megohm.

Remember that you are only checking the existance of the two junctions and the leakage qualities of the device under low current and low voltage conditions—these might not be the same when the device is in a circuit nevertheless most transistor failures are caused by short circuiting or open circuiting and the test is very good for checking these faults.

You should remove the transistor from the circuit before carrying out this test otherwise circuit resistances could modify the results. For *pnp* transistors the technique is the same but you should reverse the polarity of the meter leads to get the same results.

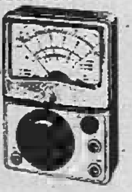
ASK LASKYS
and make no mistake

AUDIOTRONIC Model ATM1

Top value 1,000 opv pocket multimeter. Ranges:— 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistence: 0/150k ohms. Decibels: —10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.
OUR PRICE £3.25 P&P 15p

AUDIOTRONIC Model ATM5

Jewel movement, attractively moulded case with edgwise ohms adjustment. Ranges: 0-3/15/150/300/1200V AC. (2500 opv). 0-6/30/300/600V DC. (6000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x100. —10 to +16dB. Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm.
OUR PRICE £3.95 P & P 20p

MODEL TH12

20,000 opv. Overload protection. Slide switch selector. 0/0.25/2.5/10/50/150/1000V DC. 0/10/50/250/1000V AC. 0/50uA/25/250mA DC. 0/3k/30k/300k/3 Megohms. —20 to +50dB.
OUR PRICE £5.95 P&P30p

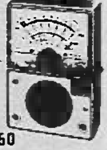
HIOKI Model 720X VOM

A versatile, accurate measuring instrument. 20,000 opv. 0/5/25/100/500/1000V DC. 0/10/50/250/1000V AC. 0—50uA/250mA. 0—20k/2 Megohms.
OUR PRICE £5.97 P&P 30p

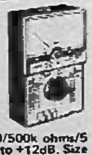
MODEL PL436

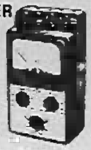
20,000 opv DC. 8000 opv AC. Mirror scale 6/3/12/30/120/600V DC. 3/30/120/600V DC. 60/600μA/60/600mA. 10/100K/1 Meg/10 Meg Ohm. -20 to +46 dB.
OUR PRICE £6.97 P&P 30p.

U4323 MULTIMETER

20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/600/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance: x 10. x 100. x 1,000. x 10,000 (50Ω. 500Ω. 5kΩ. 50kΩ centre scale) Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.
OUR PRICE £7.00 P&P 30p

MODEL HIOKI 730X

30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/μA/30mA/300mA. 2K/200K/2 Meg Ohm. 10 to 63dB.
OUR PRICE £7.50 P&P 30p.

U4324 MULTIMETER

High sensitivity, over-load protected. 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistence: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: —10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
OUR PRICE £8.00 P&P 30p

U435 MULTIMETER

20,000opv. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A DC. 5/25/100mA/0.5/2.5A AC. Resistance: 3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.
OUR PRICE £8.75 P&P 30p

U4312 MULTIMETER

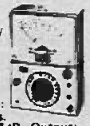
extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.
OUR PRICE £9.75 P&P 60p

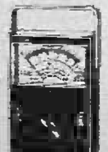
U91 Clamp VOLT AMMETER

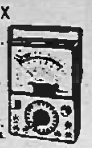
For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.
OUR PRICE £10.50 P&P 30p

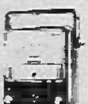
MODEL 500

30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1,000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.
OUR PRICE £13.95 Carr. paid
Leather case for above £1.75

HIOKI 750X VOLT-OHM-MILLIAMETER

43 ranges: 0—0.3/0.6/1.5/3/6/12/30/60/150/300/600/1,200V DC. 0—3/6/15/30/60/120/300/600/1,200V AC. Current: 0—30/60uA/1.5/3/15/30/150/300 mA/6/12A. Resistence: 0—3/300k/3/30Mohms. Decibels: —10 to +17dB. Output:— 0—3/6/15/30/60/120/300V. Accuracy ± 3% DC, ± 4% AC. Sensitivity: 50,000 opv DC. 5,000 opv AC. 4 inch meter. Built in protection. Size: 57 x 102 x 153mm.
OUR PRICE £11.95 P&P 40p

TMK MODEL TW50K

46 ranges, mirror scale. 50k/V DC 50k/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistence: 10k/100k/1 Meg/10 Meg ohms. —20 to +81.5dB.
OUR PRICE £12.50 P&P 20p

HIOKI MODEL 700X

100,000opv. Overload protection. Mirror scale. 0.3/0.6/1.2/1.5/3/6/12/30/60/120/300/600/1200V DC. 1.5/3/6/12/30/60/120/150/300/600/1200V AC. 15/30uA/3/6/30/60/150/500mA/6/12A DC. 2k/200k/2M/20MOhms. -20 to +63dB.
OUR PRICE £14.95 P&P30p

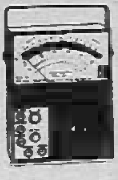
Model HT10084 MULTIMETER

Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/1-/50/250/500/1,000 Volts DC. 2.5/10/50/250/1,000 Volts AC. DC resistence' 0—20/200k/2/20 Meg. ohms. DC current:— 10/250uA/2.5/25/250 mA/10A. AC current:—0—10A. -20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.
OUR PRICE £17.50 P&P 40p

MODEL AS.100D VOM

100,000 opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10μA/6/60/300mA/12Amp. 0/2K/200K/2M/200 Meg Ohm. - 20 to +17dB.
OUR PRICE £17.50 P&P 30p.

KAMODEN HM720B FET VOM

Input impedence 10 Megohms. Ranges:— 0/.25/1/2.5/10/50/1000V DC. 0/2.5/10/50/250/1000V AC. 0/25uA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms
OUR PRICE £21.00 P & P 40p

KAMODEN 360 MULTIMETER

High sensitivity. DC 100kohm/V AC 10kohm/V 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/50/250/1000V AC. Current: 0.01mA/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/10/100M ohms. Decibels —20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with test leads etc.
OUR PRICE £17.50 P & P 40p

TMK MODEL 117 FET ELECTRONIC VOLTMETER

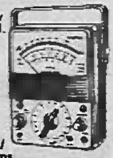
Battery operated. 11 Meg input, 26 ranges. Large 4½" mirror scale. Size: 149 x 117 x 60mm. 0.3—1200V DC. 3—300V RMS AC. 8—800V P.P. DC current 0.12—12mA. Resistence up to 2000MOhms. Decibels: —20 to +51dB. Supplied complete with leads and instructions.
OUR PRICE £18.50 P&P 20p

TMK 100K LAB TESTER

100,000opv. 6½" scale. Buzzer short circuit check. Sensitivity 100,000 opv DC. 5k/V AC DC Volts: 0.5/2.5/10/50/250/1000V AC. 3/10/50/250/500/1000V DC. current 10/100uA/10/10/100/500mA/2.5/10A. Resistence: 1k/10k/100k/10 Meg/100 Meg ohms. Decibels: —10 to +49dB. Plastic case with carrying handle. Size: 190 x 172 x 99mm.
OUR PRICE £19.95 P&P 30p

370WTR MULTIMETER

Features AC current ranges. 20,000opv. 0/0.5/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500/1000V AC. 0/50uA/1/10/100 mA/1/10A DC. 0/100mA/1/10A AC. 0/5k/50k/500k/5 Meg/50 Meg. Decibels: —20 to +62dB.
OUR PRICE £19.95 P&P 30p

KAMODEN 72.200 Multitester

High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges:—0/.06/.3 3/30/120/600/1200V DC. 0/3 12/60/300/1200 V AC. 0/6uA/1.2mA/120mA/600mA/12A DC 0/12A AC. —20 to +63dB. 0/2k/200k/2 Meg/200 Megohms.
OUR PRICE £22.50 P&P 30p

U4317 MULTIMETER

High sensitivity instrument for field and laboratory work. Knife edge pointer, 86mm. mirror scale. Overload protections. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000 V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50uA/0.5/1/5/10/50/250mA/1/5A DC. 0.25/0.5/1/5/10/50/250mA/1/5A AC. Resistance: 0.5/10/100/200 ohms/1/3/30/300k ohms. Decibels: -5 to +10dB Battery operated. Size: 210 x 115 x 90mm. Supplied in carrying case complete with leads.
OUR PRICE £15.00 P&P 40p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter

Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3 /7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.
OUR PRICE £49.00 P&P 50p

ALL PRICES EXCLUDE VAT

TE65 VALVE VOLTMETER

28 ranges. DC volts 1.5—1500V. AC volts 1.5—1500V. Resistance up to 1000 Megohms. 200/240V AC operation. Complete with probe and instructions.
OUR PRICE £17.50 P&P 50p
Additional probes available: RF £2.12. HV £2.50

LB3 TRANSISTOR TESTER

Tests ICO and B. PNP/NPN. Operates from 9V battery. Instructions supplied.
OUR PRICE £3.95 P&P 20p

MODEL AF.105 VDM

50,000 opv. Mirror scale. Meter protection. 0/3/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600/1200V DC. 0/30μA/6/60/300 mA/12 Amp. 0/10K/1m/10m/100 Meg Ohms.—20 to +17dB.
OUR PRICE £12.50 P&P 30p.

LB4 TRANSISTOR TESTER

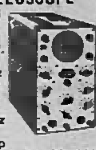
Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.
OUR PRICE £4.50 P&P 20p

U4341 Multimeter & Transistor Tester

27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/6/30/60/150/300/900V DC. 1.5/7.5/30/150/300/750V AC. Current: 0.06/0.6/6/60/600mA DC. 0.3/3/30/300mA AC. Resistance: 0.06/0.6/2/6/20/60/200k ohms/2 Mohms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.
OUR PRICE £10.50 P&P 30p

S100TR MULTIMETER TRANSISTOR TESTER

100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/600uA/12/300mA/6/12A DC 0/10k/1 Meg/100 Meg. —20 to +50dB. 0.01—0.2 MFD Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.
OUR PRICE £19.95 P&P 25p

C15 PULSE OSCILLOSCOPE

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth: 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1—25: HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3—25 Preset triggered sweep 1—3000usec. Free running 20—200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115—230V AC.
OUR PRICE £39.00 Carr. paid

RUSSIAN CI16 Double Beam OSCILLOSCOPE

5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec. to 100 milli-sec/cm. Free running time base, 50Hz—1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.
OUR PRICE £87.00 Carr. paid

SWR METER Model SWR3

Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%. Impedence 52' Indicator 100uA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.
OUR PRICE £4.25 P&P 30p

Also see following pages

MODEL TE15 GRID DIP METER

Transistorised. Operates as Grid Dip, Oscillator, Absorbtion Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in six coils. 500uA meter. 9V battery operation. Size: 180 x 80 x 40mm.

OUR PRICE £19.95 P&P 30p

TRANSISTORISED L.C.R. A.C. BR/8' MEASURING BRIDGE

A new portable bridge offering excellent range and accuracy at low cost. Resistance 6 ranges: 0.1 ohm-11.1 megohm ± 1%. Inductance: 6 ranges: 1 microhenry-111 henries ± 2%. Capacity: 6 ranges: 10pf-1110 mfd ± 2%. Turns Ratio: 6 ranges 1:1 1000 1:11100 ± 1%. Bridge Voltage at 1,000cps. Operated from 9-volt battery. 100 micro amp meter indication. Size 7½" x 5" x 2".

OUR PRICE £25.00 P&P 30p

TE16A TRANSISTORISED SIGNAL GENERATOR

5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm. Complete with instructions and leads.

OUR PRICE £8.97 P&P 30p

MODEL TE20 RF SIGNAL GENERATOR

Six bands. 120kHz–260MHz. Dual output RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output to 8V. Power requirements: 105–125V, 220–240V AC. Size: 193 x 265 x 150mm. Complete with test leads etc.

OUR PRICE £17.50 P&P 50p

TE-200 RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output. Xtal socket for calibration. 220 240V a c. Brand new with instructions. Size 140mm x 215mm x 170mm.

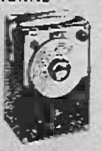
OUR PRICE £17.50 P&P 50p

TE22 SINE SQUARE WAVE AUDIO GENERATOR

Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output impedence 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.

OUR PRICE £24.95 P&P 50p

ARF 300 AF/RF SIGNAL GENERATOR



All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P.P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.

OUR PRICE £37.50 P&P 50p

MODEL MG100 SINE SQUARE WAVE AUDIO GENERATOR

Range 19-220,000Hz Sine Wave 19–100,000 Hz Square Wave. Output Sine or Square wave 10v P to P. Size 180 x 90 x 90mm. Operation 220/240v. A.C.

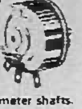
OUR PRICE £19.95 P&P 50p

SPECIAL BARGAIN! FERGUSON 3406 HI-FI SPEAKERS

High quality 2 way speaker systems. 25 Watts. 4–8 ohms. 40Hz–18kHz. Size: 560 x 340 x 255mm. approx. Wood grain finish with black fronts.

OUR PRICE £22.50 PR. P&P £1

POWER RHEOSTATS



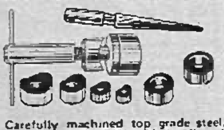
High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Single hole fixing. ¼" diameter shafts. Bulk quantities available.

25 WATT 10/25/50/100/500/1000/2500 ohms. **£1.15** P&P 10p

50 WATT 10/50/100/250/500/1500/5000 ohms. **£1.62** P&P 10p

100 WATT 1/5/10/25/50/250/500/2500 ohms/500 Ohms **£2.34** P&P 15p

CP110 CHASSIS PUNCH SET



Carefully machined top grade steel. Contains 1/2", 5/8", 3/4", 1" and 1 1/8" punches complete with gripper and accessories.

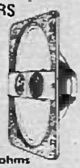
OUR PRICE £3.00 P&P 40p

KE630 3 Station INTERCOM

Master and two sub-stations. Can be used on desk or wall mounted. Complete with cable and batteries.

OUR PRICE £5.25 P&P 50p

EMI LOUDSPEAKERS



Model 350 13 x 8" with single tweeter/crossover. 20–20,000Hz. 15 watts RMS. Available 8 or 15 ohms.

OUR PRICE £7.50 each P&P 37p

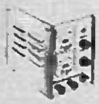
Model 450 13 x 8" with twin tweeter/crossover. 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms.

OUR PRICE £3.62 each P&P 35p

SPECIAL PURCHASE LIMITED QUANTITY! Tannoy 12" DR/8 Bass Speakers

8 ohms. 30 watt. Heavy duty, ideal for Hi-Fi P.A. Group. OUR PRICE £12.50 P&P 50p

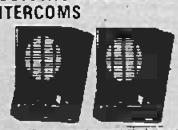
PS200 Regulated POWER SUPPLY UNIT



Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.

OUR PRICE £19.95 P&P 50p

AUDIOTRONIC LE-102A INTERCOMS



Beautifully made and finished in two tone ivory buff, the LE-102A is useful in the home, office or shop and is suitable for use as baby alarm. Wall or desk mounting 57mm speaker mic gives clear 2-way communication with on off and volume control on master unit. Operates on 9V batt. Approx 60ft lead.

OUR PRICE £3.95 P & P 30p

TRITON 4318 PORTABLE 8 TRACK CARTRIDGE PLAYER WITH MW/LW RADIO

Will play 8 track stereo cartridge monaurally. Channel selector switch. Covers medium and long wave bands. Volume and tone controls. Earphone socket. Battery Mains operation.

OUR PRICE £11.95 P & P 50p

EA41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar etc. and output to your amplifier. Volume control and depth of reverberation control. Beau-walnut cabinet. 184 x 77 x 108mm.

OUR PRICE £7.50 P&P 30p

LH02S STEREO HEADPHONES

Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.

OUR PRICE £1.97 P&P 30p

DH02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head band. Impedence 8 ohms. 20–12,000Hz. Complete with lead and plug.

OUR PRICE £2.25 P&P 30p

TE1035 Stereo HEADPHONES

Low cost with excellent response. Foam rubber earcups. Adjustable headband. 8 ohms impedence. Frequency response 25Hz–18kHz. Complete with cable and stereo jack plug.

OUR PRICE £2.60 P&P 30p

SDH8V MONO/STEREO HEADPHONES

Volume control for each channel. 4/16 ohms impedence. Frequency response 20Hz–18kHz. Complete with 10ft. coiled lead and jack plug.

OUR PRICE £4.97 P&P 30p

BH001 HEADSET and Boom Microphone

Moving coil. Ideal for language teaching, communications etc. Headphone impedence 16 ohms. Microphone impedence 200 ohms.

OUR PRICE £5.95 P&P 30p

HANIMEX HRC 3075 CASSETTE RADIO

Covers Medium and FM wave bands. Slider volume and tone controls. Battery Mains operation. Will record direct from radio or through built in condenser microphone. Complete with batteries, earphone, and cassette.

OUR PRICE £24.30 P & P 50p

TRITON CT.555 CASSETTE RECORDER

Battery Mains. Piano key and slider controls. Automatic level control. Complete with mike and earphone.

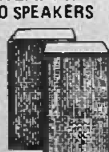
OUR PRICE £10.50 P & P 50p

ZEPHYR TC1500B CASSETTE RECORDER

Battery Mains. Complete with mike, cassette, earphone.

OUR PRICE £9.95 P & P 50p

SPECIAL BARGAIN !! STEREOSOUND SPEAKERS



Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size: 368 x 229 x 190mm. 8 ohms. 8 watts RMS. 16 watts peak. Complete with Din lead.

OUR PRICE £12.95 PAIR P&P 50p

FM TUNER CHASSIS

6 transistor high quality tuner. Size only 153 x 101 x 63mm. 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88–108MHz. Ready built, ready for use. Fantastic value for money.

OUR PRICE £8.95 P&P 20p

Stereo Multiplex Adaptor £5.95 extra

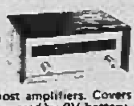
GOODWIN 4 CHANNEL CONVERTER plus pair Audio Development AD-15 speakers

Add 4 channel sound to your existing stereo system with this special package. Converter splits stereo sound into 4 live channels. Bookshelf speakers handles 10 watts and has 70-18,000 Hz performance. Normal retail value £25.50

OUR PRICE £15.80 p&p £1

Converter available seperately £3.95 p & p 50p

Model A1018 FM TUNER



6 transistor high quality unit—3 IF stages and double tuned discriminator. For use with most amplifiers. Covers 88–108MHz. Powered by 9V battery.

OUR PRICE £13.50 P&P 30p

Stereo multiplex adapter £5.95 extra.

SINCLAIR CALCULATORS

Cambridge Ready Built List £19.95 Our Price £17.95 P & P 25p.

Cambridge Kit Our Price £13.50 Post Free.

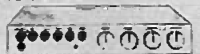
Executive List £39.00 Our Price £35.45 P & P 25p

Executive Memory List £49.00 Our Price £44.50 P & P 25p

Scientific List £49.00 Our Price £27.50 P & P 25

MANY OTHER CALCULATORS IN STOCK FROM AS LITTLE AS £9.00 Send for list

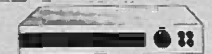
SINCLAIR SYSTEM 2000 STEREO AMPLIFIER AND TUNER



AMPLIFIER

Amplifier output 8 watts per channel RMS. Distortion less than 0.06%. Silicon transistors. Two pick-up plus radio and tape inputs, tape output and scratch filter. Excellent Value.

OUR PRICE £27.50 P & P 60p



FM TUNER

Excellent selectivity and sensitivity. Twin dual-varicap tuning. 4 pole ceramic filter. 19 transistor stereo demodulator giving 40 dB separation. Distortion 0.2% output. Fantastic Value.

OUR PRICE £27.50 P & P 60p

SINCLAIR IC12 INTEGRATED CIRCUIT AMPLIFIER

complete with printed circuit mounting board.

OUR PRICE £1.50 P & P 15p

SINCLAIR Project 80 Modules

Z40 Power Amp	£5.45	P & P 15p
Z60 Power Amp	£6.95	P & P 15p
Stereo 80 Pre-Amp	£11.95	P & P 15p
Active Filter Unit	£6.95	P & P 15p
Project 805	£26.95	P & P 50p
PZ5 Power Supply	£4.98	P & P 30p
PZ6 Power Supply	£7.98	P & P 30p
PZ8 Power Supply	£7.98	P & P 30p
Transformer for PZ8	£4.05	P & P 50p

SINCLAIR Project 80 Packages

2 x Z40/Stereo 80/PZ5	£25.00
2 x Z40/Stereo 80/PZ6	£27.75
2 x Z60/Stereo 80/PZ8	£30.45

POST & PACKING 35p each.

JOSTY KIT HIGH QUALITY CONSTRUCTION KITS

WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.

Post and Packing 15p per kit.

AF20 Mono amplifier	£4.80
AF25 Mixer	£3.60
AF30 Mono pre-amplifier	£2.61
AF35 Emitter amplifier	£2.27
AF80 0.5W mic. amplifier	£4.22
AF305 Intercom	£7.35
AF310/2 Mono Amplifier	£7.56
AT5 Automatic light control	£2.58
AT25 Window wiper robot	£5.82
AT30 Photo cell switch unit	£5.70
AT50 400W triac light dimmer/speed control	£4.80
AT56 2,200W triac light dimmer/speed control	£6.90
AT60 1 channel light control	£7.80
AT65 3 channel light control	£14.55
GP304 Circuit board	£4.94
GP310 Stereo pre-amplifier for use with 2 x AF310	£21.27
GP312 Circuit board	£11.45
GU330 Tremolo unit	£7.50
HF61 Diode detector	£3.32
HF65 FM transmitter	£2.70
HF75 FM receiver	£2.87
HF310 FM tuner	£15.81
HF325 Deluxe FM tuner	£24.12
HF330 Decoder (HF310/325)	£9.96
HF380 lw/vhf aerial amplifier	£5.04
HF395 broadband aerial amp.	£1.77
LF380 Quadraphonic device	£11.36
M160 Multi-vibrator	£1.71
M191 VU Meter	£4.55
M192 Stereo balance meter	£4.97
M1302 Transistor tester	£8.45
NT10 Stabilised power supply 100mA, 9V	£8.15
NT300 Stabilised p. supply	£12.51
NT305 Voltage converter	£4.50
NT310 Power Supply 240 V AC or 2 x 18 V D.C. at 2 amps	£5.71
NT315 Power supply 240V AC to 4.5/15V DC. 500mA.	£9.57

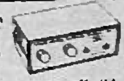
Amateur Electronics by Josty-Kit, the professional book for the amateur—covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 listed below.

OUR PRICE £3.30 (No VAT)

P&P 25p plus VAT.

AE1 100mW output stage	£1.50
AE2 Pre-amplifier	£1.15
AE3 Diode receiver	£1.82
AE4 Flasher	99p
AE5 Astable multi-vibrator	95p
AE6 Monostable multi-vibrator	93p
AE7 RC generator	97p
AE8 Bass filter	90p
AE9 Treble filter	90p
AE10 CCIR filter	90p

TE1021 Stereo Listening Station



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on–off slide switch, stereo headphone socket.

OUR PRICE £2.25 P&P 15p

AUDIOTRONIC LOW NOISE CASSETTES

TYPE	5	10	25
C60	£1.67	£3.00	£7.08
C90	£2.24	£4.25	£10.00
C120	£2.73	£5.17	£12.24

AUDIOTRONIC 8 TRACK CARTRIDGES

TYPE	Each	5	10
40M	85p	£4.00	£7.50
80M	£1.15	£5.40	£10.25

P&P Cassettes 3p. Cartridges 5p each. OVER 10 of either POST FREE!

MP7 MIXER-PREAMPLIFIER

5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics. 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.

OUR PRICE £8.97 P&P 20p

AUDIOTRONIC AHA101 Stereo Headphone Amplifier

All silicon, transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.

OUR PRICE £8.50 P&P 30p

Also see previous page

ALL PRICES EXCLUDE VAT

SEW PANEL METERS

SEW PANEL METERS ARE STOCKED AT 3 LISLE ST., 311 EDGWARE RD., & 152 FLEET ST., or order by post from head office.

ASK LASKYS about Hi fi

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES ETC.

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

*Items with asterisk are Moving Iron type, all others are Moving Coil

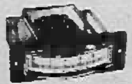
CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm

50uA	£3.80	10V DC	£3.65
100uA	£3.75	20V DC	£3.66
200uA	£3.70	50V DC	£3.65
500uA	£3.65	300V DC	£3.66
50-0-50uA	£3.75	15V AC	£3.75
100-0-100uA	£3.70	300V AC	£3.76
1mA	£3.65	VU Meter	£3.90
5mA	£3.65		
10mA	£3.65		
50mA	£3.65		
100mA	£3.66		
500mA	£3.66		
1A DC	£3.65		
5A DC	£3.65		
10A DC	£3.65		
5V DC	£3.65		

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£4.60	150V AC	£4.45
100uA	£4.50	300V AC	£4.45
500uA	£4.30	VU Meter	£4.90
50-0-50uA	£4.50		
100-0-100uA	£4.45		
1mA	£4.30		
1A DC	£4.30		
5A DC	£4.30		
20V DC	£4.30		
50V DC	£4.30		
300V DC	£4.30		

EDGWISE MODEL PE70
Size: 90 x 34mm



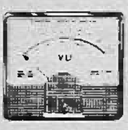
50uA	£4.15
100uA	£4.10
200uA	£4.05
500uA	£3.90
50-0-50uA	£4.10
100-0-100uA	£4.05
1mA	£3.85
300V AC	£3.95
VU Meter	£4.30

MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.

50uA	£8.50	20V DC	£7.60
100uA	£7.90	50V DC	£7.60
50-0-50uA	£7.90	300V DC	£7.80
1mA	£7.60	500mA/5A DC	£8.60
1-0-1mA	£7.60	5V/50V DC	£8.60
1A DC	£7.60	5V/15V DC	£8.60
5A DC	£7.60	1/5A DC	£8.60
5V DC	£7.60	1A/15A DC	£8.60
10V DC	£7.60		
15V DC	£7.80		

CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm

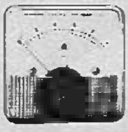


50uA	£5.45	300V DC	£5.20
100uA	£5.40	15V AC	£5.30
200uA	£5.35	300V AC	£5.30
500uA	£5.25	S Meter 1mA	£5.20
50-0-50uA	£5.40	VU Meter	£5.55
100-0-100uA	£5.35	1A AC	* £5.20
500-0-500uA	£5.20	5A AC	* £5.20
1mA	£5.20	10A AC	* £5.20
1-0-1mA	£5.20	20A AC	* £5.20
5mA	£5.20	30A AC	* £5.20
10mA	£5.20		
50mA	£5.20		
100mA	£5.20		
500mA	£5.20		
1A DC	£5.20		
5A DC	£5.20		
15A DC	£5.20		
30A DC	£5.40		
10V DC	£5.20		
20V DC	£5.20		
50V DC	£5.20		
150V DC	£5.20		

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm

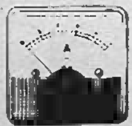
50uA	£4.30	10V DC	£4.10
100uA	£4.25	20V DC	£4.10
200uA	£4.20	50V DC	£4.10
500uA	£4.15	300V DC	£4.10
50-0-50uA	£4.25	15V AC	£4.20
100-0-100uA	£4.20	300V AC	£4.20
1mA	£4.10	VU Meter	£4.40
5mA	£4.10		
10mA	£4.10		
50mA	£4.10		
100mA	£4.10		
500mA	£4.10		
1A DC	£4.10		
5A DC	£4.10		
10A DC	£4.10		
5V DC	£4.10		

CLEAR PLASTIC MODEL MR 45P
Size: 50 x 50mm



50uA	£3.20	300V AC	£3.05
100uA	£3.15	S Meter 1mA	£2.95
200uA	£3.10	VU Meter	£3.40
500uA	£3.00	1A AC	* £2.95
50-0-50uA	£3.15	5A AC	* £2.95
100-0-100uA	£3.10	10A AC	* £2.95
500-0-500uA	£2.95	20A AC	* £2.95
1mA	£2.95	30A AC	* £2.95
5mA	£2.95		
10mA	£2.95		
50mA	£2.95		
100mA	£2.95		
500mA	£2.95		
1A DC	£2.95		
5A DC	£2.95		
10V DC	£2.95		
20V DC	£2.95		
50V DC	£2.95		
300V DC	£2.95		
15V AC	£3.05		

CLEAR PLASTIC MODEL MR38P
Size: 42 x 42mm



50uA	£3.10	20V DC	£2.80
100uA	£3.05	50V DC	£2.80
200uA	£3.00	100V DC	£2.80
500uA	£2.85	150V DC	£2.80
50-0-50uA	£3.05	300V DC	£2.85
100-0-100uA	£3.00	500V DC	£2.85
500-0-500uA	£2.80	750V DC	£2.90
1mA	£2.80	15V AC	£2.90
1-0-1mA	£2.80	50V AC	£2.90
2mA	£2.80	150V AC	£2.90
5mA	£2.80	300V AC	£2.90
10mA	£2.80	500V AC	£3.00
20mA	£2.80	S Meter 1mA	£2.80
50mA	£2.80	VU Meter	£3.20
100mA	£2.80		
150mA	£2.80		
200mA	£2.80		
300mA	£2.80		
500mA	£2.80		
750mA	£2.80		
1A DC	£2.80		
2A DC	£2.80		
5A DC	£2.80		
10A DC	£2.80		
3V DC	£2.80		
10V DC	£2.80		
15V DC	£2.80		

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

50uA	£3.50	10V DC	£3.30
100uA	£3.45	20V DC	£3.30
200uA	£3.40	50V DC	£3.30
500uA	£3.35	300V DC	£3.30
50-0-50uA	£3.45	15V AC	£3.45
100-0-100uA	£3.40	300V AC	£3.45
1mA	£3.30	VU Meter	£3.65
5mA	£3.30		
10mA	£3.30		
50mA	£3.30		
100mA	£3.30		
500mA	£3.30		
1A DC	£3.30		
5A DC	£3.30		
10A DC	£3.30		
5V DC	£3.30		

POSTAGE & PACKING 15p

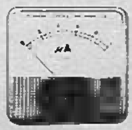
CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm

50uA	£3.95	300V DC	£3.70
100uA	£3.85	15V AC	£3.80
200uA	£3.80	50V AC	£3.80
500uA	£3.75	150V AC	£3.80
50-0-50uA	£3.85	300V AC	£3.90
100-0-100uA	£3.80	500V AC	£3.80
500-0-500uA	£3.70	S Meter 1mA	£4.10
1mA	£3.70	VU Meter	£3.70
1-0-1mA	£3.70	1A AC	* £3.70
5mA	£3.70	5A AC	* £3.70
10mA	£3.70	10A AC	* £3.70
50mA	£3.70	20A AC	* £3.70
100mA	£3.70	30A AC	* £3.70
500mA	£3.70	50mA AC	* £3.70
1A DC	£3.70	100mA AC	* £3.70
5A DC	£3.70	200mA AC	* £3.70
10A DC	£3.70	500mA AC	* £3.70
15A DC	£3.70		
20A DC	£3.80		
30A DC	£3.85		
50A DC	£4.05		
5V DC	£3.70		
10V DC	£3.70		
15V DC	£3.70		
20V DC	£3.70		
50V DC	£3.70		
150V DC	£3.70		

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

50uA	£4.50
100uA	£4.45
500uA	£4.20
50-0-50uA	£4.45
100-0-100uA	£4.40
1mA	£4.20
1A DC	£4.20
5A DC	£4.20
20V DC	£4.20
50V DC	£4.20
300V DC	£4.20
300V AC	£4.30
VU Meter	£4.70

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm



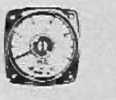
50uA	£3.70	S Meter 1mA	£3.30
100uA	£3.50	VU Meter	£3.80
500uA	£3.35	1A AC	* £3.30
50-0-50uA	£3.50	5A AC	* £3.30
100-0-100uA	£3.45	10A AC	* £3.30
1mA	£3.30	20A AC	* £3.30
5mA	£3.30	30A AC	* £3.30
10mA	£3.30		
50mA	£3.30		
100mA	£3.30		
500mA	£3.30		
1A DC	£3.30		
5A DC	£3.30		
10V DC	£3.30		
20V DC	£3.30		
50V DC	£3.30		
300V DC	£3.30		
15V AC	£3.40		
300V AC	£3.40		

BAKELITE MODEL MR 65 Size: 80 x 80mm

25uA	£5.25	300V DC	£3.60
50uA	£4.00	30V AC	* £3.60
100uA	£3.95	50V AC	* £3.60
500uA	£3.65	150V AC	* £3.60
50-0-50uA	£3.95	300V AC	* £3.60
100-0-100uA	£3.90	500V AC	* £3.60
500-0-500uA	£3.60	VU Meter	£4.10
1mA	£3.60	1A AC	* £3.60
1-0-1mA	£3.60	5A AC	* £3.60
5mA	£3.60	10A AC	* £3.60
10mA	£3.60	20A AC	* £3.60
50mA	£3.60	30A AC	* £3.60
100mA	£3.60	50A AC	* £3.60
500mA	£3.60	500mA AC	* £3.60
1A DC	£3.60	50mV DC	£3.75
2A DC	£3.60	100mV DC	£3.75
5A DC	£3.60		
10A DC	£3.60		
15A DC	£3.60		
30A DC	£3.60		
50A DC	£3.80		
5V DC	£3.60		
10V DC	£3.60		
15V DC	£3.60		
20V DC	£3.60		
50V DC	£3.60		
150V DC	£3.60		

240° Wide Angle 1mA METERS
MW1-8.80 x 80mm

£6·90 P&P 15p



YAMABISHI VARIABLE VOLTAGE TRANSFORMERS
Excellent quality at low cost. Input: 230V 50/60Hz. Output 0–260V.

MODEL S260 BENCH MOUNTING

		P&P
1A	£10.50	50p
2.5A	£12.00	50p
5A	£17.50	50p
8A	£30.35	£1.00
10A	£33.75	£1.00
12A	£35.40	£1.00
20A	£85.00	£1.50
25A	£96.00	£1.50
40A	£120.00	£1.50

MODEL S260B PANEL MOUNTING

1A	£10.00	60p
2.5A	£12.00	50p

ALL PRICES EXCLUDE VAT

ASK LASKYS

FOR MAIL ORDER

We offer a speedy and efficient service by mail order. Remember to add 8% VAT to total value of goods including post and packing.

TO LASKYS HEAD OFFICE AND MAIL ORDER DEPARTMENT
Audiotronic House, The Hyde, London NW9 6JJ. Tel:01-200 1321/8

Please send me the following items

TOTAL PURCHASE PRICE (inc. P&P and VAT) HI-FI PRICE LIST TICK HERE

I enclose cheque postal order money order

I wish to pay by Barclaycard/Access and my number is

NAME

ADDRESS

Signature

Registered in England No 347947 at 12 Lower Grosvenor Place London SW1 OEX E.E. 10.

CALL INTO YOUR NEAREST LASKY'S BRANCH OR SEND COUPON BELOW FOR FREE HI-FI PRICE LIST

CENTRAL LONDON

481 OXFORD ST.	01-493 8640
3 LISLE ST. WC2	01-437 8204
34 LISLE ST. WC2	01-437 9155
118 EDGWARE RD. W2	01-723 9789
193 EDGWARE RD. W2	01-723 6211
207 EDGWARE RD. W2	01-723 3271
311 EDGWARE RD. W2	01-262 0387
346 EDGWARE RD. W2	01-723 4453
382 EDGWARE RD. W2	01-723 4194
109 FLEET ST. EC4	01-353 5812
152/3 FLEET ST. EC4	01-353 2833
10 TOTTENHAM CT. RD.	01-637 2232
27 TOTTENHAM CT. RD.	01-636 3715
33 TOTTENHAM CT. RD.	01-636 2605
42/45 TOTTENHAM CT. RD.	01-636 0845
257/8 TOTTENHAM CT. RD.	01-580 0670

ESSEX

86 SOUTH ST. ROMFORD 20218

205/206 CHURCHILL WEST, VICTORIA CIRCUS, SOUTHEND (Opening September)

KENT

53/57 CAMDEN RD., TUNBRIDGE WELLS 0892-23242

LEICESTERSHIRE

45 MARKET PLACE, LEICESTER 0533-537678

NORTHAMPTONSHIRE

73 ABINGDON STREET, NORTHAMPTON (Opening late October)

STAFFORDSHIRE

30 WULFRUM WAY, WOLVERHAMPTON (Opening late September)

SURREY

1046 WHITGIFT CENTRE, CROYDON 01-681 3027

27 EDEN ST. KINGSTON 01-546 7845

32 HILL ST. RICHMOND 01-948 1441

38/40 EDEN ST., KINGSTON (Opening September)

WARWICKSHIRE

116 CORPORATION ST., BIRMINGHAM 021-236 3503

ALL BRANCHES OPEN FROM 9am to 6pm MON. TO SAT.

West End Service Centre now open at 87 Tottenham Court Rd. W.1. 01-580 3739

BARCLAYCARD & ACCESS
Holders welcome call into any branch or telephone your order to head office on 01-200 0037.
CREDIT TERMS available for Personal Shoppers

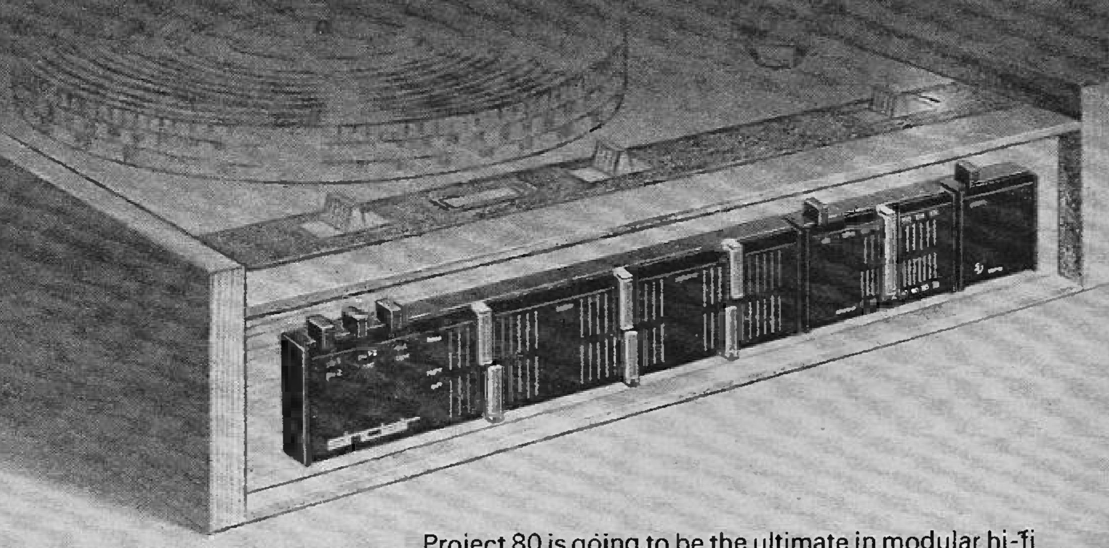
EXPORT Personal exports arranged for overseas visitors. Goods specially packed insured and despatched to all parts of the world at minimum cost exclusive of VAT. Payment by bank transfer certified cheque postal order or money order in any currency.

NO DEPOSIT TERMS available on most goods for personal callers

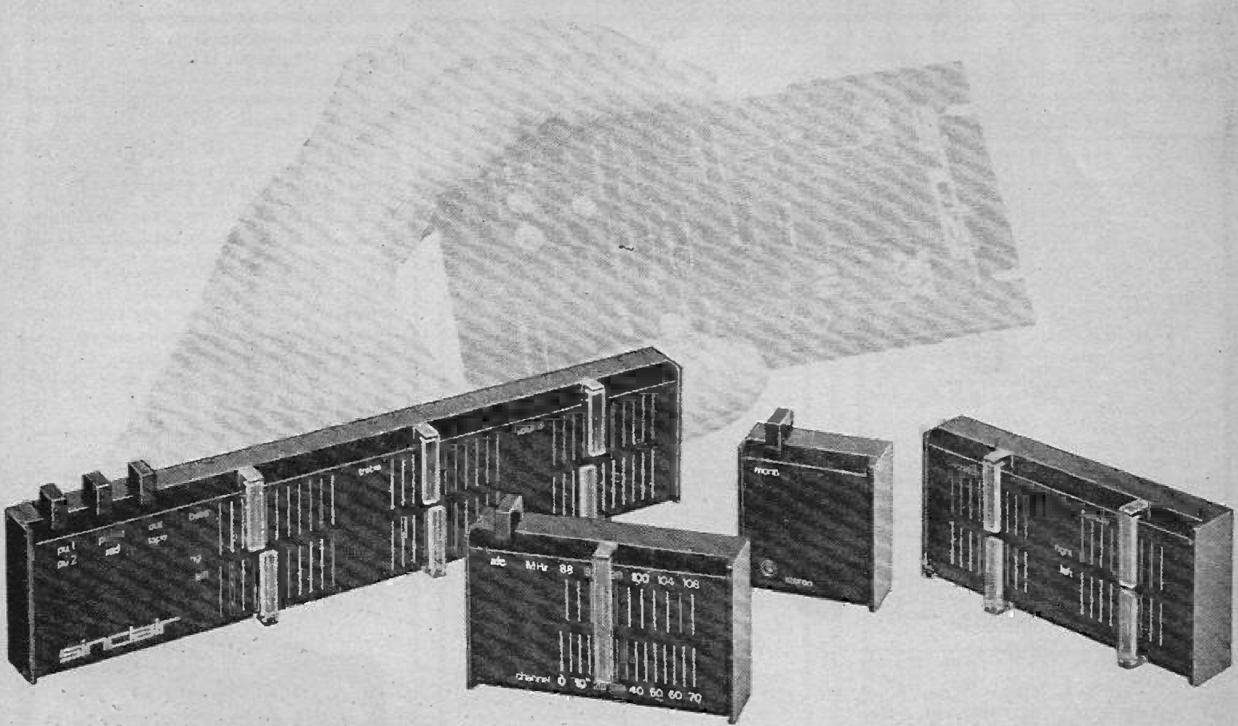
CHEQUES TO THE VALUE OF £30. ACCEPTED FROM PERSONAL SHOPPERS WITH BANKERS CARD. IN OTHER CASES AND FOR AMOUNTS IN EXCESS OF £30. PLEASE ALLOW TIME FOR CLEARANCE. BANKERS DRAFTS ACCEPTED.

All prices correct at 12/8/74 but subject to change without notice E.&O.E.

A member of the Audiotronic Group of Companies



Sinclair Project 80



technically the world's most advanced

Project 80 gives you choice from a range of 9 different modules for combining in a variety of ways to suit your requirements. The Stereo 80 is a versatile pre-amp control unit designed to meet all domestic hi-fi requirements including tape monitoring, high sensitivity magnetic cartridge input, and of course, individual slide controls on each channel for precise output matching. By separating the F.M. tuner and stereo decoder, useful economies can be effected where stereo radio reception is not needed. Two power amplifiers – Z.40 (18 watts RMS continuous into 4 ohms using 35V) and Z.60 (25 watts RMS continuous into 8 ohms using 50V) are available with choice of 3 different power supply units. The PZ.8 with its virtually indestructible circuitry is particularly recommended. For the final word in system building, the Active Filter Unit puts the finishing touch of quality to what are easily the world's most technically advanced hi-fi modules. Any further units likely to be added to Project 80 range will be compatible with those already available.

Stereo 80 Control Unit Size – 260 · 50 · 20mm (10½ · 2 · ¾ins) Finish – Black with white indicators and transparent sliders Inputs – Magnetic pick-up 3mV RIAA corrected; Ceramic pick up 350mV Radio 100mV. Tape 30mV Signal/noise ratio – 60db Frequency range – 20Hz to 15KHz –1dB; 10Hz to 25KHz – 3dB Power requirements – 20 to 35 volts Outputs – 100mV AB monitoring for tape Controls – Press button tape radio and P.U. Sliders on each channel for volume bass treble R.R.P. (add £1·19 V.A.T.) **£11.95**

Project 80 FM Tuner Size – 85 · 50 · 20mm (3½ · 2 · ¾ins) Tuning range Dual varicap – 87·5 to 108MHz Detector I.C. balanced coincidence One I.C. equal to 26 transistors Distortion 0·7% at 1KHz for 30% modulation 4 pole ceramic filter in I.F. section Aerial impedance 75 Ω or 240–300 Ω Sensitivity – 5 microvolts for 30dB S/N ratio Output – 300mV for 30% modulation Power requirements – 25 to 35 volts (R.R.P. add £1·19 V.A.T.) **£11.95**

Project 80 Stereo Decoder Size – 47 · 50 · 20mm (1⅞ · 2 · ¾ins) One 19 transistor I.C. Channel separation greater than 30dB Power requirements – 25V Output 150mV per channel R.R.P. (add 74p V.A.T.) **£7.45**

Active Filter Unit Separate controls on each channel Size – 108 · 50 · 20mm (4½ · 2 · ¾ins) Voltage gain – minus 0·2dB Frequency response – 40Hz to 22KHz controls minimum Distortion – at 1KHz – 0·03% using 30V supply H.F. cut off (scratch) – 22 KHz to 5·5KHz, 12dB/oct slope L.F. cut off (rumble) – 28dB at 20Hz, 9dB/oct slope R.R.P. (add 69p V.A.T.) **£6.95**

Z.40 Power Amplifier Size – 55 · 80 · 20mm (2¼ · 3⅛ · ¾ins) 9 transistors Input sensitivity – 100mV Output 18 watts RMS continuous into 4 Ω (35V) Frequency response – 30Hz 100KHz – 3dB S/N ratio – 64dB Distortion – at 10 watts into 8 Ω less than 0·1% Power requirements – 12 to 35 volts; built-in protection against overload. R.R.P. (add 54p V.A.T.) **£5.40**

Z.60 Power Amplifier Size – 55 · 98 · 15mm (2¼ · 3¾ · ¾ins) 12 transistors Input sensitivity – 100–250mV Output – 25 watts RMS continuous into 8 Ω (50V) Distortion – typically 0·03% Frequency response – 15Hz to more than 200KHz ±3dB S/N ratio – better than 70dB Built in protection against transient overload and short circuiting Load impedance –4 Ω min. safe on open circuit R.R.P. (add 69p V.A.T.) **£6.95**

Power Supply Units PZ.8 Stabilised Re-entrant current limiting makes damage from overload or even direct shorting impossible. Normal working voltage (adjustable) 50V R.R.P. £7·98 – 79p V.A.T. Without mains transformer PZ.6 35V stabilised R.R.P. £7·98 79p V.A.T. PZ.5 30V unstabilised R.R.P. £4·98 49p V.A.T.

To Sinclair Radionics Ltd. St. Ives Huntingdon PE17 4HJ

Please send post paid ______________________

____

for which I enclose Cash/Cheque for £ ________ including V.A.T. ________

Name ______________________

Address ______________________

____

Guarantee

If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair appointed stockists also offer this guarantee. Should any defect arise in normal use, we will service it without charge.

sinclair

Sinclair Radionics Ltd
London Rd., St. Ives
Huntingdon PE17 4HJ
Telephone
St. Ives (0480) 64646

Everyday Electronics Classified Advertisements

RATES: 11p per word (minimum 12 words). Box No. 30p. extra. Semi-display—£7·50 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisement Department, "EVERYDAY ELECTRONICS," I.P.C. Magazines Ltd., Fleetway House, Farringdon Street, London EC4A 4AD.

EDUCATIONAL

C AND G EXAM

Make sure you succeed with an ICS home study course for C and E Electrical Installation Work & Technicians Radio/TV/Electronics Technicians. Telecommus Technicians and Radio Amateurs.

COLOUR TV SERVICING

Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV sets through new home study courses, approved by leading manufacturers.

TECHNICAL TRAINING

Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computer Engineering and Programming. Also self-build radio kits. Get the qualifications you need to succeed.

Free details from:

INTERNATIONAL CORRESPONDENCE SCHOOLS,
Dept 731X, Intertext House, London SW8 4UJ.
Or Phone 01-622 9911

FOR SALE

TUTOR BOARD and kit with all magazines, £8·50 o.n.o. Rainbow, Cheltenham 52575.

MICROPHONES: AKG D109, £12·65; AKG D202E1, £43·45; AKG D190C, £18·70; AKG D190E, £20; AKG D224, £55; Sennheiser MD211N, £49·50; Sennheiser MD413N, £29·70. All brand new and boxed. Send CWO to J. J. Francis (Wood Green) Ltd., Manwood House, Matching Green, Harlow, Essex. Tel: Matching 476.

RECEIVERS and COMPONENTS

COMPONENTS GALORE. Pack of 500 mixed components manufacturers surplus plus once used. Pack includes Resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers etc. Send £1+10p p. and p. c.w.o. to CALEDONIAN COMPONENTS, Strathore Road, Thornton, Fife.

VALVES. 5,000 types, 1930 to 1974. Many obsolete. SAE for quotation. List 10p. Cox Radio, The Parade, East Wittering, Sussex (West Wittering 2023).

3 ASS. M.C. METERS £1·15 (35p). LARGE COMPUTER PANELS. 35-50 Transistors, Long Leads 85p (30p).
COPPER CLAD PAX PANELS 5½" × 5½". 6—50p c.p. 7½" × 9". 6—£1·30 c.p.
SILICON DIODES 650V 1½A. 10 on Tagboard 50p c.p.
T.V. CONVERGEANCE PANELS 2 × AC128 3 Slugged Coils, 3 Slide Switches, 11 W.W. Pots, 3 Carbon Presets, 2 Ferritte Chokes etc. £1·10 c.p.
VALUPAKS. P9 100 S/Mica Caps 67p c.p. send 10p for Lists of others plus Panels etc. Refund on purchase.
7 LBS ASSORTED COMPONENTS £1·75 c.p.

J.W.B. RADIO
2 Barnfield Crescent, Sale, Cheshire M33 1NL
Postage in brackets — Mail Order only

SERVICE SHEETS

SERVICE SHEETS for over 6,000 models of Television, Radios, Transistors, Stereo, Tape Recorders, Record Players, etc., at only 30p plus S.A.E. with free Fault-Finding Guide. Over 50,000 sheets in stock for 10,000 models. S.A.E. enquiries. Catalogue 20p plus S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 429066.

MISCELLANEOUS

RADIO & TELEVISION AERIAL BOOSTERS £2·95p, five television valves 45p. 50p bargain transistor packs, bargain £1 resistor and capacitor packs. UHF-VHF televisions £7·50, carr. £1·50p. S.A.E. for 3 leaflets. ELECTRONIC MAIL ORDER (BURY) LTD., Bridge Street, Ramsbottom, Bury, Lancs.

FERRIC CHLORIDE
Anhydrous technical quality in sealed 1lb packs 1lb 80p; 3lb £1·60; 10lb £4·40.

COMPUTER PANELS
3lbs asstd £1·40; 7lb £2·60; 56lb £16. 12 high quality panels with trimpots, IC's, power transistors etc £2·50, 100 panels £14. Pack of boards containing at least 500 components inc. at least 50 transistors 90p.

3 WATT TAPE AMPLIFIERS
2xECC83, EL84, EZ80 on 12x5x3" chassis with tone & volume controls, 3 watts output to 7x4" 3 Ω speaker (provided) £3·00. Also in case 14x13x9" with non-standard tape deck £4·50. Suitable cassettes £1·08, tape 74p, head 30p.

7lb BARGAIN PARCELS
Hundreds of resistors, capacitors, pots, switches + PC boards with transistors & diodes and loads of odds & ends. Still only £2·25.

PC ETCHING KIT
Contains Ferric chloride, DALO etch-resist pen, 100 sq. ins. copper laminate board, etching dish, abrasive powder and instructions £3·30.

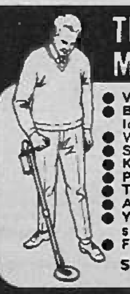
VEROBOARD
Offcuts, 100 sq. ins (no tiny pieces) £1·10. 500 assorted resistors £1·40. 150 mica, ceramic, poly capacitors 80p. 250 1%, 2%, 5% Hi-stabs £1·30. LEO III COMPUTER, all parts available.

GREENWELD ELECTRONICS [EE6]

Mail order, retail & wholesale shop 51, Shirley Park Road, Southampton, Tel (0703) 772501. Also callers at 21 Deptford Broadway SE8, Tel 01-692 2009 & 38 Lower Addiscombe Rd, Croydon, Tel 01-688 2950.
ALL PRICES QUOTED INCLUDE 8% VAT AND POSTAGE. SAE LIST, ENQUIRIES.

PRESSURE SWITCH PADS, 6-12 volts, size 8in x 21in. Suitable for your alarm systems. Price 90p each, plus postage and packing. Phelmetrics, 233 Seymour Grove, Manchester M16 9QS.

CONSTRUCTION AIDS. Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Fascia panels etched aluminium to individual requirements. Printed circuit boards-masters, negatives and boards, one-off or small numbers. Send 6p for list. RAMAR CONSTRUCTOR SERVICES, 29 Shelbourne Road, Stratford-on-Avon, Warks.



TREASURE TRACER MK III Metal Locator

- Varicap tuning
- Britain's best selling metal locator kit
- Weighs only 22oz.
- Speaker and earphone operation
- 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 s.a.e. for leaflet

Complete Kit £9·80 P&P 45p. - 78p VAT
Built, tested and guaranteed £13·75 P&P, 45p. - £1·10 VAT

MINIKITS ELECTRONICS.
35b LANGLEY DRIVE, WANSTEAD
LONDON, E11 2LN (Mail order only)

BEGINNERS, a complete course in electronics for only £3·45, post free. Basic electricity, switching and amplifier circuits. Instructions and components provided. For details of this and other kits send S.A.E. to Electrolern, Lyburn Lodge, Nomansland, Wiltshire.

RESISTORS

New, unused carbon resistors 1p each, bargain pack 100 mixed only 70p. These resistors have to be seen to be believed, so send for a free list and sample. SAE to **C. Green, 143 Sandygate Road, Sheffield 10.**

SUPERB INSTRUMENT cases by Bazelli, manufactured from heavy duty PVC faced steel, choice of 212 types, send for free list: Bazelli Instrument Cases, Dept 24, St. Wilfrid's, Foundry Lane, Halton LA2 6LT, near Lancaster.

NEW

12V 8W
FLUORESCENT LIGHT KIT

You can build this reverse polarity proof light for use in homes, garages, caravans, for camping, or emergency lighting. Everything; tube, all metal-work, all components, P.C.B., instructions, etc., is supplied.

Price only £3·19 inc. VAT p & p
DIFFUSER ONLY 59p extra inc. VAT
ORDER NOW TO -

ELECTRONICS DESIGN ASSOCIATES
82 Bath Street Walsall WS1 3DE
Phone 33652

PSYCHEDELICATESSEN

is the only way to describe the *paradise* of FREAKY gear now available from Boffin.

LOOK!

Kits

NO LICENCE EXAM. Transmitter/Receiver	£6·40
Variable-rate, BRIGHT-FLASH, Pocket Mini-Strobe	£2·40
Ready-Made Modules	
Maxi-Volt SPARK GENERATOR (¼inch spark), 15,000 Volts.	£1·35
Experimental Mini DREAM-LABORATORY	£2·20
SENSITIVE non-anatomical electronic STETHOSCOPE	£2·20
Electronic 'VOICE-THROWER'	£2·20
GHOST-HUNTING AID	£2·20
PEOPLE DETECTOR	£2·20
Experimental WATER-FONE	£4·40
PSYCHEDELIC MEDITATION AID	£2·20
Bird-Watchers' REMOTE MONITOR	£2·20
Psychological CROSS-EYED EARS Device	£4·40
Super SOUND-CATCHER	£2·20

(All prices include VAT, packing & postage)

Send remittance to:

BOFFIN PROJECTS
4 Cunliffe Road, Stoneleigh,
Ewell, Surrey
(Mail order U.K. only)
Or for more details, send 20p for lists, plus free design project sheet

PUBLISHER'S ANNOUNCEMENT

Due to production difficulties existing at the time this issue went to press, we strongly advise readers to check with advertisers the prices shown, and availability of goods, before purchasing.

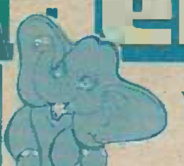
Published approximately the third Friday of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London E.C.4. 4AD. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Publisher's Subscription Rate including postage for one year, Inland £3·95, Overseas £3·00. International Giro facilities account no. 5122007. Please state reason for payment, "message to payee". Everyday Electronics is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

Par hilt

Henry's

SO MUCH MORE – AND YOU PAY LESS VAT WITH HENRY'S LOW PRICES

UK's No. 1 for Electronics and Hi Fi



You can build the Texan and Stereo FM Tuner

Features glass fibre PC board, Gardners low field transformer, 6–IC's, 10–transistors plus diodes, etc. Designed by Texas Instruments engineers for Henry's ad. P.W. 1972. Supplied with full chassis work, detailed construction handbook and all necessary parts. Full input and control facilities. Stabilised supply. Overall size 15¼" x 2¾" x 6¾" mains operated. Free teak sleeve with every kit. £28·50 (GB post paid).

STEREO FM TUNER Features capacity diode tuning, lead and tuning meter indicators, stabilized power supply—mains operated. High performance and sensitivity with unique station indication IC stereo decoder. Overall size in teak sleeve 8" x 2½" x 6¾" Complete kit with teak sleeve £21·00 (GB Post paid)

JOIN THE LARGE BAND OF HAPPY CONSTRUCTORS !

TRANSISTORISED MODULES

Tuners - Power Suppliers - Amplifiers

AMPLIFIERS (All single channel unless stated)

4–300	9 volt 300 MW O/P 3–8 OHM, 1–10 MV I/P Special Offer	1·75
2004	9 volt 250 MW O/P 3–8 OHM, 10–100MV I/P	2·70
104	9 volt 1 watt O/P 8–16 OHM, 10 MV I/P	3·10
304	9 volt 3 watt O/P 4–8 OHM, 10 MV I/P	3·95
555	12 volt 3 watt O/P 8–16 OHM, 150 MV I/P	4·10
555ST	12 volt 1½ + 1½ watt O/P 8 OHM, 150 MV I/P Stereo module	5·95
E1208	12 volt 5 watt O/P 4–16 OHM, 25–60 MV I/P	5·10
608	24 volt 10 watt O/P 4–8 OHM, 30–50 MV I/P	4·95
410	28 volt 10 watt O/P 8 OHM, 160 MV I/P	4·95
620	45 volt 30 watt O/P 4–8 OHM, 150 MV I/P	9·95
Z40	30/35 volt 15 watt O/P 4–8 OHM, 100 MV I/P	5·45
Z60	45/50 volt 25 watt O/P 4–8 OHM, 100–250 MV I/P	6·95
SA6817	24 volt 6 + 6 O/P 8 OHM 100 MV I/P Stereo module	10·20

AMPLIFIERS with controls

E1210	12 volt 2½ + 2½ watts 8 ohms, Stereo	8·25
R 500	Mains 5 watts 4–16 ohms, Mono	6·30
SAC14	Mains 7 + 7 watts 8 ohms, Stereo	11·75
SAC30	Mains 15 + 15 watts 8 ohms, Stereo	14·95
CAO38	9 volt 1½ + 1½ watts 8 ohms, Stereo	6·95
CAO68	12 volt 3 + 3 watts 8 ohms, Stereo	10·50

FM Modules

Mullard LP 1186 FM tuner (front end) with data 10·7 MHZ O/P	4·85
Mullard LP 1185 10·7 MHZ IF unit with data	4·50
Gorler Permability FM tuner (front end) 10·7 MHZ O/P	4·20

FM and AM tuners and decoders

FM 5231 (tu 2) 6 volt fm tuner	7·95
TU3 12 volt version (FM use with Decoder)	7·95
SD4912 Stereo Decoder for Tu 3. 12 volt	7·95
	14·95
SP62H 6 volt stereo FM tuner	4·80
A1007 9 volt MW–AM tuner	11·95
Sinclair 12/45 volt FM tuner stereo recorder for above	7·45
A1018 9 volt FM tuner in cabinet	13·95
A1005M (S) 9–12 volt Stereo decoder FM for above	7·50
106Z 12 volt Stereo decoder general purpose	6·50

All models fitted dials supplied with instructions

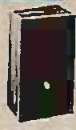
PREAMPLIFIERS

Sinclair	Stereo 60 Preamplifier with controls	6·75
E1300	Cart/Tape/Mic Inputs 9 volt Module	2·85
E1310	Stereo 3–30 mV mal cart 9 volt	4·75
FF3	Stereo 3 mV tape head 9 volt	4·95
3042	Stereo 5–20 mV Mag. cart. mains	5·95
EQ25	Mono 3–250 mV Tape/Cart/Play 9 volt	5·95

Power Supplies—Mains input (* chassis-rest cased)

470C 6/7½/Gear 300 MA with adaptors	2·25
P500 9 volt 500 MA	3·20
HC244R 3/6/7½/9v. 400 MA stabilised	5·50
*P11 24v. ½ amp 3·30 * P15 28V. ½ amp	3·30
*P1080 12V 1A 4·70, *P1081 45V 0·9A	7·80
P12 4½–12V. 0·4–1 amp	7·15
Sk01A 3/6/9/12v 1 amp stabilised	12·75
P1076 3/4½/6/7½/9/12V. ½ amp	4·20
Sk800A 1–15 VOLT 0–½A stabilised	17·50

EXCLUSIVE DECCA KELLY SPEAKERS



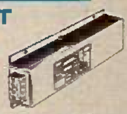
12 watt speaker / tweeter systems 8 in bass/midrange. Melinex domed HF radiator plus crossover. Built into veneered cabinets size 18x12x6½in. PRICE £19·50 pair (carr., etc. £1·00)

EMI SPEAKERS SPECIAL PURCHASE

13 x 8 chassis speakers (Carr./packing 30p each or 50p pr.)

*150 TC 10 watts 8 ohms twin cone £2·20
*450 10 watts 4, 8, 15 ohm with twin tweeters and crossover £3·85 each
EW 15 watt 8 ohm with tweeter £5·25
350 20 watt 8, 15 ohm with tweeter £7·80 ea.
* Polished wood cabinet £4·80 carr., etc. 35p each or 50p pair.

PHILIPS 8 WATT FLUORESCENT UNIT EXCLUSIVE PURCHASE



Brand new Philips 12 volt operated 8 watt fluorescent tube units for standby lighting Complete with tube and instructions Price £3·50 p & p 25p.

EXCLUSIVE 5 WATT IC AMPLIFIERS

Special purchase 5 watt output 8–16 ohm load. 30 volt max. DC operation, complete with data. Price £1·50 each or 2 for £2·85

UHF TV TUNERS

625 line receiver UHF transistorised tuners FM UK operation. Brand new. (Post /packing 25p each).
TYPE A Geared variable as illustrated £2·50
TYPE B 4-button push-button (adjustable) £3·50

JOSTY KITS IN STOCK

(Post etc. 15p each)

AF20	Mono Transistor Amp.	4·80
AF25	Mixer	3·60
AF30	Mono Trans. Pre-amp.	2·61
AF35	Emmiter Amplifier	2·27
AF80	Small 0·5 W. Amplifier for Microphone	4·22
AF305	Intercom	9·52
AF310/2	Mono Amplifier (for Stereo use two)	6·87
M160	Multivibrator	1·71
M1302	Transistor Tester	8·45
M191	Vu-Meter	4·56
M192	Stereo Balance Meter	4·97
LF380	Quadrophonic Device	11·36
AT60	Psychedelic Light Control, Single Ch.	7·80
AT65	Psychedelic Light Control, 3 Chan.	14·55
AT25	Window Wiper Robot	5·82
AT30	Photo Cell Switching Unit	5·70
AT50	400w Triac Light Dimmer Sp. Conc.	4·80
AT56	2·200w Triac Light Dimmer Sp. Cont.	6·90
AT5	Automatic Lt. Cont.	2·58
GU330	Tremelo Unit for Guitars, etc.	7·50
HF61	Diode Detector	3·32
HF65	Frequency Modulated FM Transmitter	2·70
HF75	FM Transis. Receiver	2·87
HF310	FM Tuner Unit	15·81
HF325	De-luxe FM Tuner Unit	24·12
HF330	Stereo Decoder for use with HF310/325	9·96
GP310	Stereo Pre-amp (for use with 2 AF310)	21·27
GP312	Basis Circuit Board	11·45
GP304	Basis Circuit Board	4·94
HF380	Aerial Amp. for LW to VHF	4·94
HF395	Broadband Aerial Amp.	1·77
NT10	Power Supply 100m/a 9V Stab. & 12V Unstab	16·15
NT300	Professional Stab. Power Supply	12·51
NT310	Power Pack 2 x 15 volt 2A	5·71
NT305	Voltage Converter	4·50
NT330	Power Pack AF310/ GP304	6·07
NT315	P/S 240V ac to 4·5–15V dc. 500m/a	9·57
AE1	Output Stage 100mW	1·50
AE2	Pre-amplifier	1·15
AE3	Diode-receiver	1·82
AE4	Flasher	0·99
AE5	A stable Multivibrator	0·95
AE6	Monostable Multivibrator	0·93
AE7	RC Generator	0·97
AE8	Bassfilter	0·90
AE9	Treblefilter	0·90
AE10	CCIR-filter	0·90

AMATEUR ELECTRONICS by Josty Kit, the professional book for this amateur—covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 (see above). PRICE £3·30 (no VAT).

SINCLAIR MODULES & KITS

SINCLAIR PROJECT 80	
ST80 Stereo preamplifier	11·95
Audio Filter Unit	6·95
Z40 15 Watt Amplifier	5·45
Z60 25 Watt Amplifier	6·95
PZ5 Power Supplies for 1 or 2 Z40	4·98
PZ6 Power Supplies (S Tab) for 1 or 2 Z40	7·98
PZ8 Power Supplies (S Tab) for 1 or 2 Z60	7·98
TRANSFORMER FOR PZ8	3·95
FM TUNER	11·95
STEREO DECODER	7·45

All above post paid (BG only)

TRANSISTORS/SEMICONDUCTORS

UK's largest stockists of branded guaranteed devices at low prices.

EXTRA DISCOUNTS
Any one type. Extra 10... for 12 | , 15... 25 | , 20... 100 | .
The above also applies to mixed SN74 series IC.
Get your free stock list now—new '74–'75 edition now available (Ref. No. 36).

HENRY'S HOME ENTERTAINMENT CENTRES

London

354/6 Edgware Rd. W2	01–402 5854
376/8 Edgware Rd. W2	01–723 0818
372 Edgware Rd. W2	01–402 8140
120 Shaftesbury Ave. W1	01–437 9692
230 Tottenham Court Rd. W1	01–580 1785
144 Burnt Oak B'way, Burnt Oak, Edgware	01–952 7402
190/4 Station Rd., Harrow, Middlesex	01–863 7788

Out of Town

256 Banbury Rd., Summertown, Oxford	(0865) 54181
55 Gloucester Rd., Bristol 7	(0272) 45791

FREE STOCK LISTS

No. 36 Transistors/ valves/ semiconductors
No. 18 Disco-lighting—high power sound
No. 17 Hi-Fi TV-Tape Equipment

Send large stamped addressed envelope with all enquiries.

SUPPLIERS OF ELECTRONICS FOR OVER 30 YEARS

8% VAT TO BE ADDED TO ALL ORDERS

Henry's RADIO
EDGWARE ROAD, W2

Electronic Centres
404-406 Electronic Components & Equipment 01-402 8381
309 PA-Disco-Lighting High Power Sound 01-723 6963
303 Special offers and bargains store
All mail to 303 Edgware Road, London W2 1BW

Hi Fi and Electronics Centres Open 9 am - 6 pm

Prices correct at time of preparation. Subject to change without notice. E.&O.E.