PRACTICAL

ELECTRONICS

APRIL 1974

25p

SPECIAL 8 PAGE PULL-OUT FEATURE CAMERA ELECTRONICS

LIQUID CRYSTAL CLOCK

New Series Starting this month...

FIRST STEPS IN CIRCUIT DESIGN

The Hot-Head

You know his type...always blowing hot and cold... getting overheated just when you need him to be controlled and efficient. It's the same with some people's soldering irons.

Hopelessly inefficient heat control can make soldering operations a nightmare; if this is what soldering means to you it's time you woke up to Antex.

Choose a new model from the comprehensive Antex range of soldering instruments, with low-leakage characteristics, unique construction advantages and really precise heat control.

Choose ANTEX–the warm hearted iron

(and keep your cool)

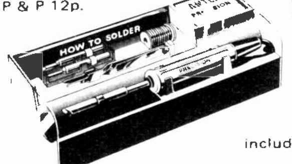
MODEL X25 ▶
220-240 Volts or 100-120 Volts. The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live". Tested at 1500v. A.C. This 25 watt iron with its truly remarkable heat-capacity will easily "out-solder" any conventionally made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron-coated bit 1/8". 2 other bits available 3/32" and 3/16" Totally enclosed element ceramic and steel shaft. Bits do not "freeze" and can easily be removed.
PRICE £2.05
(rec. retail) P & P 10p.
Suitable for production work and as a general purpose iron.

MODEL G ▶
18 watt miniature iron, fitted with long-life iron-coated bit 3/32" Voltage 240, 220 or 110
2 other spare bits available 1/8" and 3/16"
PRICE £2.26 (rec. retail)
P & P 10p.

◀ MODEL CCN
220 volts or 240 volts.
The 15 watt miniature model CCN also has negligible leakage.
Test voltage 4000v. A.C.
Totally enclosed element in ceramic shaft.
Fitted long-life iron-coated bit 3/32".
4 other bits available 1/8", 3/16", 1/4" and 3/64" including Heat Shield.
PRICE £2.48 (rec. retail) P & P 10p.

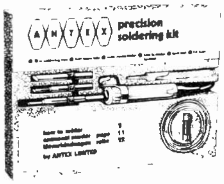
◀ MODEL C
Miniature 15 watt soldering iron fitted 3/32" iron-coated bit.
Many other bits available from 3/64" to 3/16".
Voltages 240, 220, 110, 50 or 24.
PRICE £2.05 (rec. retail)
P & P 10p.

MODEL SK.1 KIT
Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.
PRICE £3.48 (rec. retail)
P & P 12p.



MODEL MLX KIT
Battery operated 12v.
25 watt iron fitted with 15' lead and 2 heavy clips for connection to car battery.
Packed in strong plastic wallet with booklet "How to Solder".
PRICE £2.54
(rec. retail) P & P 12p.

MODEL SK.2 KIT
Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32" heat sink, solder, and "How to Solder" booklet.
PRICE £3.25 (rec. retail)
P & P 10p.



ST3 Stand – This stand is made from high grade insulation material with a chromium plated strong steel spring. It is suitable for all models and replaces all previous stands. The two sponges at the side which are easily replaceable serve to keep the soldering bits clean. Spare bits can be accommodated as shown on the illustration.

PRICE: £1.00
(rec. retail) P & P 10p.

ALL PRICES
include VAT at 10%

ANTEX

☐ Please send the following:

____

____

☐ Please send the ANTEX colour catalogue.

From radio or electrical dealers, car accessory shops or in case of difficulty direct from:
ANTEX LTD. FREEPOST
PLYMOUTH PL1 1BR
(no stamp required) Tel 0752 67377

I enclose cheque/P.O./Cash
(Giro No. 258 1000)______________

NAME ______________________

ADDRESS ____________________

____

PE4 ______________________

RACTICAL
ELECTRONICS

ME 10 No. 4 APRIL 1974

UCTIONAL PROJECTS

ERAL FEATURES

NEWS AND COMMENT

SPECIAL 8-PAGE SUPPLEMENT

Our May issue will be published on Wednesday, April 10, 1974

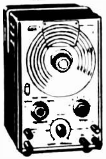
Publisher's Subscription Rate including postage for one year, Inland £3·25, Overseas £3·50. International Giro facilities Account No. 5122007. Please state reason for payment, "message to payee".

Henry's

DON'T RELY ON YOUR MEMORY
BUY NOW AT BARGAIN PRICES
Hi Fi and Transistors – Up to date
Brochures on request

HEN RY'S CATALOGUE
Due to rapid pric
shortages of pap
materials, all price
existing catalogues
apply. Call or phone
prices. A new catalog
be available for Aug/S

UK's LARGEST RANGE OF KITS & GADGETS



TEST EQUIPMENT

MULTIMETERS

(carr., etc. 30p)
ITI-2 20 k/V Slimeline **£5·95**
M210 (Case £1·25) 20k/V Slimline de luxe, **£6·75**
THL33D 2k/V Robust, **£7·50**
U437 10k/V Steel case. A.C. up to 40kHz, **£4·95**
U4324 20k/V with A.C. current ranges, **£8·00**
AF105 (Case £1·90) 50k/V, **£11·95**
U4313 20k/V A.C. current. Steel case, **£10·50**
U4341 Plus built in transistor tester, **£10·50**
Model 500 (Case £1·95) 30k/V, **£9·95**

OTHER EQUIPMENT

SE250B Pocket Signal Injector, **£2·10**. Carr. 15p
SE500 Pocket Signal Tracer, **£1·70**. Carr. 15p
TE15 Grid Dip Meter 440kHz—280MHz, **£15·00**. Carr. 30p
TE40 A.C. Millivoltmeter 1·2MHz, **£19·75**. Carr. 35p
TE65 28 Range Valve Voltmeter, **£22·50**. Carr. 40p
TE20D 120kHz—500MHz RF Generator, **£18·95**. Carr. 40p
TE22D 20Hz—200kHz Audio Generator, **£19·95**. Carr. 40p
SE350A Deluxe Signal Tracer, **£12·50**. Carr. 20p
SE400 Volts/ohms/R-C sub./RF field/RF gen., **£14·75**. Carr. 20p

New Revolutionary Supertester 680R

680R Multi-tester, **£18 50**

Accessories	
Transistor tester	£11·00
Electronic voltmeter	£18·00
Ampclamp	£11·95
Temperature probe	£11·95
Gauss meter	£11·95
Signal Injector	£5·95
Phase sequence	£5·95
EHT Probe	£5·95
Shunts 25/50/100A	£4·50 each

A SELECTION OF INTERESTING ITEMS

C3025 Compact transistor tester, **£6·95**. P. & P. 15p
Q4002 Photoelectric System, **£13·70**
E1310 Stereo mag cart preamp, **£4·80**. P. & P. 25p
Easiphone D1201 telephone amplifier, **£7·50**. P.& P. 25p
D1203 Teleamp with PU coil, **£4·95**. P. & P. 20p
LL1 Door Intercomm. and chime, **£8·40**. P. & P. 25p
US50 Ultrasonic switch transmitter/receiver, **£12·75**
1kW Dimmer/controller, **£3·00**. P. & P. 10p
9in Twin spring unit, for Reverbs, **£3·30**. P. & P. 15p
16in Twin spring unit, for Reverbs, **£6·85**. P. & P. 25p
VHF Aircraft band convertor, **£4·50**. P. & P. 15p
B2005 4 Ch. mic. mixer, **£4·20**. P. & P. 15p
B2004 2 Ch. stereo mixer, **£6·75**. P. & P. 15p
PK3 Kit. Etch your own printed circuits, **£1·95**. P. & P. 20p

C3041 1-250 MHz **£4·25**
C3043 50H. 1-300 MHz **£5·75**

EXCLUSIVE: SPECIAL OFFERS

MW/LW CAR RADIO + or − earth with speaker and fixings. **£6·50** carr/packg. 30p.

8 TRACK CAR STEREO (− earth) with speakers, in pods and fixings. **£12·50** carr/packg. 40p.

Portable Battery Cassette tape player **£7·25**.

Car Lighter Plug and adaptor for all cassette and radio 6/7½/9 volt output (state width). **£1·95** each.

Rotel Stereophones

RH630	£4·50
RH700	£6·75
RH430	£3·30

Rotel RA310 15 + 15 watt Stereo Amplifier (List £52·00) **£34·52**.

Wein W500 Battery/Mains Cassette Recorder **£12·75**.

AKAI GXC40 stereo cassette recorder **£59·95** carr/packg. 50p.

Pair Akai ADM microphones. **£6·95** carr/packg. 20p.

PORTABLE CASSETTE TAPE PLAYER — for car or carry around. **£7·25** carr/packg. 20p.

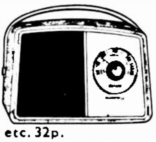
HANIMAX BC808 POCKET CALCULATOR with % key. **£28·95**.

Hanimax BC811M Memory Version **£37·50**.

Mains Unit for BC808, BC811M **£2·85** (state model).

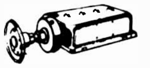
Hanimax H101 Stereo Compact Record Player 2×7w. Complete with speakers (List £54·50). Price **£39·95**. Plus free pair of stereo phones.

BUILD THIS RADIO



PORTABLE MW/LW RADIO KIT using Mullard RF/IF module. Features MW—bandspread for extra selectivity. Slow motion tuning. Fibre glass PVC cabinet. 600MW output. All parts **£7·98** (battery 22p). Carr. etc. 32p.

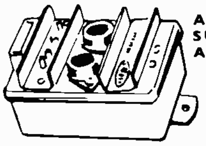
SPECIAL PURCHASES



UFH TV TUNERS CHANNELS 21 to 64. Brand new transistorised geared tuners for 625 Line Receiver IF output. **£2·50**. Post 20p.

EASY TO BUILD KITS BY AMTRON—EVERYTHING SUPPLIED

Model No.		£
310	Radio control receiver	2·98
300	4-channel R/C transmitter	5·95
345	Superhet R/C receiver	5·95
455	AM signal generator	12·33
65	Simple transistor tester	1·40
115	8W amplifier	3·90
120	12W amplifier	4·70
125	Stereo control unit	5·70
130	Mono control unit	3·60
605	Power supply for 115	4·55
610	Power supply for 120	4·55
615	Power supply for 2 × 120	5·73
230	AM/FM aerial amplifier	2·93
240	Auto packing light	5·90
275	Mic. preamplifier	6·08
570	LF generator 10Hz—1mHz	15·80
575	Sq. wave generator 20Hz–20kHz	14·60
590	SWR meter	12·85
620	Ni–CAD Charger 1·2–12V	8·00
630	STAB. Power supply 6–12V 0·25–0–1A	8·15
690	D.C. motor speed Gov.	2·87
700	Electronic Chaffinch	7·00
705	Windscreen wiper timer	6·80
760	Acoustic switch	10·75
780	Metal Detector (electronics only)	9·65
790	Capacitive burglar alarm	6·85
835	Guitar preamp	4·25
840	Delay car alarm	6·15
875	CAP. Discharge ignition for car engine (–Ve Earth)	13·15
80	Scope calibrator	2·25
255	Level indicator	6·15
525	120—160mHz VHF timer	11·30
715	Photo cell switch	7·70
795	Electronic continuity tester	4·30
860	Photo timer	13·25
871	Slide projector auto feed control	7·15
235	Acoustic alarm for driver	7·60
465	Quartz XTAL checker	8·75
220	Signal Injector	2·30
390	VOX	15·50
432	Testakit	19·30
670	Buffer Battery Charger	6·55
885	Capacitive Contact Alarm	6·25
850	Electronic Keyer	18·75
820	Electronic Digital Clock	58·50



ALL KITS OFFERED SUBJECT TO STOCK AVAILABILITY

Prices correct at time of preparation, subject to change without notice.

BUILD THIS TUNER

MW/LW Radio tuner to use with any amplifier. Features Mullard RF/IF module Ferrite aerial, built-in battery. Excellent results. Size: 7in × 2¾in × 3⅞in. All parts **£4·85**. Carr. 15p.

MULTI-USE AND RADIONIC KITS

		£
10–1	10 Projects	3·60
50–1	50 Projects	8·00
150–1	150 Projects	13·20
Telephone Communicator		7·20
X20 20 (Elec)	Projects	4·95
X40 40 (radio)	Projects	9·45

(Carr./Packing 40p)

ALL TRANSISTOR CIRCUITS WITH HANDBOOKS

All types offered subject to availability. Prices correct at time of press E & OE. 10% VAT TO BE ADDED TO ALL ORDERS. UK post, etc. 15p per order unless stated.

GARRARD BATTERY TAPE

GARRARD 2 speed 9 volt tape decks. Fit play and oscillator/erase heads. Wind a controls. Takes up to 4in spools. Brand plete with head circuits. **£9·50**. Carr. 30p.

TOP QUALITY SLIDER CONTROLS

60mm stroke high quality controls complete with knobs (post, etc. 15p any quantity).
Singles Log and Lin
5kΩ, 10kΩ, 22kΩ, 50kΩ, 100kΩ, 250kΩ, 500kΩ, 1 Meg. **45p** each.
Ganged Log and Lin
10kΩ, 22kΩ, 50kΩ, 100kΩ, 250kΩ. **65p** each.
(Quantity discounts available). Complete with knobs.

MARRIOT TAPE

4 TRACK MO
2 TRACK ST
'17' High Imp **£2·00**; '18' Mec pedance, **£2·00**;
Heads for '17' anc **75p**; '63' 2 track r Hi imp., **£1·75**;
Erase Head for '63', (Post, etc. 15p quantity).

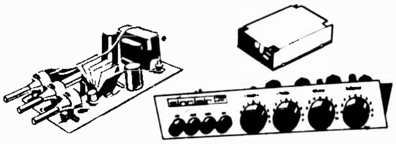
R730/E73 2 Track Mc Record Erase Low Im **75p** pair.

Sinclair, Miniature Amplifiers & Tuner/Decoder

AMPLIFIERS (Carr. etc. 20p).

		£
4–300	0·3 watt 9 volt	1·75
104	1 watt 9 volt	3·10
304	3 watt 9 volt	3·95
555	3 watt 12 volt	4·10
E1208	5 watt 12 volt	5·10
608	10 watt 24 volt	4·95
410	10 watt 28 volt	4·95
E1206	30 watt 45 volt	9·95
E1210	2½ + 2½ watts 12 volt	7·75
RE500	5 watt IC mains operated Amplifier with controls	6·30
SAC14	7 + 7 watt Stereo with controls	11·75
SAC30	15 + 15 watt Stereo with controls	14·95

NEW SINCLAIR PROJECT 80	£
Stereo Preamplifier	11·95
Audio Filter Unit	6·95
Z40 15 Watt Amplifier	5·45
Z60 25 Watt Amplifier	6·95
PZ5 Model for 1 on 2 Z40	4·98
PZ6 Model (S. Tab.) 1 on 2 Z40	7·98
PZ8 Model (S. Tab.) 1 on 2 Z60	7·98
TRANSFORMER FOR PZ8	3·95
Project 605 Kit	19·95
Project 805	£26·95
SP40-5 2Z40/Stereo 80/PZ5	£25·00
SP40-6 2Z40/Stereo 80/PZ6	£27·75
SP60 2Z60/Stereo 80/PZ8	£30·45

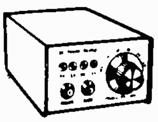


POWER SUPPLIES FOR EVERY PURPOSE

(All cased unless stated chassis)
470C 6/7½/9V 300mA, (Includes Multi-Adaptor for Tape Recorders, etc.), **£2·15**. Post 20p
Car Lighter Voltage Adaptors 300mA (State Voltage 6V, 7½V, 9V), **£1·95** each. Post 25p
SC202 3/6/7½/9V 400mA, **£3·65**. Carr. 30p
HC244R Stabilised version, **£4·90**. Carr. 30p
P500 9V 500mA, **£3·20**. Post 20p
P11 24V 500mA (chassis), **£2·90**. Post 20p
P15 26/28V 1 amp (chassis), **£2·90**. Post 20p
P1080 12V 1 amp (chassis), **£4·50**. Post 20p
P1081 45V 0·9 amp (chassis), **£7·50**. Post 20p
P12 4½—12V 0·4—1 amp, **£7·15**. Post 30p
SE101A 3/6/9/12V 1 amp (Stab.), **£12·50**. Post 25p
RP164 6/7½/9/12 1 amp (Stab.), **£12·95**. Post 30p

FIBRE OPTICS

0·01 dia. Mono Filament, **£3·00** per 50 metre reel.
0·13 dia. 64 Fibres Sheathed, **£1·00** per metre.
SPRAYS 15mm dia. Mares Tail Sprays, **£10·50**.
7 mm dia. **£5·00**.



Henry's RADIO LIMITED
EDGWARE ROAD, W2

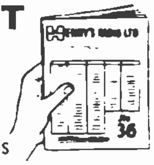
SEE FACING PAGE FOR ADDRESSES

Henry's

UK'S LARGEST RANGE OF TRANSISTORS, IC'S RECTIFIERS, ALL SEMICONDUCTOR DEVICES

BEST PRICES · **RETAIL · TRADE · EXPORT & INDUSTRIAL**

FREE BOOKLET



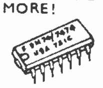
All types of
TRANSISTORS • RECTIFIERS
BRIDGES • SCR's • TRIACS
INTEGRATED CIRCUITS
F.E.T. • LIGHT DEVICES
OVER **1500** DIFFERENT DEVICES

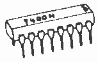
MORE DEVICES
NEW PRICES
NEW RANGES
THIS IS A MUST
FOR ALL
SEMI-CONDUCTOR
USERS!

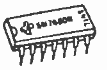
ENTIRELY NEW 1973 EDITION (ask for Booklet No. 36)

SEND FOR YOUR FREE COPY TODAY!

INTEGRATED CIRCUITS. VERY IMPORTANT—**ONLY** BRANDED I.C's ARE TO THE **FULL** MANUFACTURERS' SPECIFICATIONS. **ALL** OTHERS ARE NOT. HENRY'S SELL *ONLY* BRANDED INTEGRATED CIRCUITS . . . FROM **TEXAS** . . . **I.T.T.** . . . **FAIRCHILD** . . . **SIGNETICS** . . . SO WHY BUY ALTERNATIVES OR UNDER SPEC. DEVICES WHEN YOU CAN PURCHASE THE GENUINE ARTICLE FROM US EX STOCK . . . NEED WE SAY MORE!







Type	1–11 £p	12–29 £p	30–99 £p
SN7400N	20	18	16
SN7401N	20	18	16
SN7401AN	38	38	33
SN7402N	20	18	16
SN7403N	20	18	16
SN7403AN	38	38	33
SN7404N	24	21	18
SN7405N	20	18	16
SN7405AN	44	44	38
SN7406N	40	38	35
SN7407N	40	38	35
SN7408N	25	22	19
SN7409N	33	33	28
SN7409AN	44	44	38
SN7410N	20	18	16
SN7411N	25	23	21
SN7412N	28	28	25
SN7412AN	38	38	33
SN7413N	30	27	25
SN7414N	72	72	63
SN7416N	30	27	25
SN7417N	30	27	25
SN7420N	20	18	16
SN7422N	28	28	25
SN7422AN	38	38	33
SN7423N	37	34	32
SN7425N	37	37	32
SN7427N	37	37	32
SN7428N	43	43	37
SN7430N	20	18	16
SN7432N	37	37	32
SN7433N	43	43	38
SN7433AN	57	57	50
SN7437N	43	43	37
SN7438N	43	43	37
SN7438AN	57	57	50
SN7440N	20	18	16
SN7441AN	85	79	73
SN7442N	85	79	73
SN7443N	1·50	1·27	1·13
SN7444N	1·50	1·27	1·13
SN7445N	2·16	2·16	1·89
SN7446N	2·16	2·16	1·89
SN7447AN	1·80	1·80	1·57
SN7448N	1·50	1·27	1·13
SN7450N	20	18	16
SN7451N	20	18	16
SN7453N	20	18	16
SN7454N	20	18	16
SN7460N	20	18	16
SN7470N	33	30	27
SN7472N	38	38	34
SN7473N	44	41	37
SN7474N	48	48	42
SN7475N	59	55	51
SN7476N	45	36	32
SN7480N	80	70	50
SN7481N	1·25	1·10	95
SN7482N	87	80	72
SN7483N	1·20	1·10	1·00
SN7485N	1·87	1·87	1·63
SN7486N	50	50	44
SN7489N	4·32	4·32	3·78
SN7490N	75	70	63
SN7491AN	1·10	1·00	90
SN7492N	75	70	63
SN7493N	75	70	63
SN7494N	85	80	75
SN7495N	85	80	75
SN7496N	1·00	90	83
SN74100N	2·16	1·89	1·89
SN74104N	60	53	45
SN74105N	60	53	45
SN74107N	51	51	45
SN74110N	57	57	50
SN74111N	86	86	75
SN74116N	2·16	2·16	1·89
SN74118N	1·00	90	83
SN74119N	1·92	1·92	1·68
SN74120N	1·05	1·05	92
SN74121N	57	57	50
SN74122N	80	80	70
SN74123N	1·44	1·44	1·26
SN74125N	69	69	60
SN74126N	69	69	60
SN74132N	72	72	63
SN74136N	63	63	55
SN74141N	1·00	90	80
SN74142N	2·88	2·88	2·52
SN74145N	1·44	1·44	1·26
SN74147N	2·30	2·30	1·83
SN74148N	2·01	2·01	1·63
SN74150N	2·30	2·30	2·01
SN74151N	1·15	1·15	1·00
SN74153N	1·09	1·09	95
SN74154N	2·30	2·30	2·01
SN74155N	1·55	1·55	1·00
SN74156N	1·09	1·09	1·00
SN74157N	1·09	1·09	95
SN74159N	2·44	2·44	2·14
SN74160N	1·58	1·58	1·38
SN74161N	1·58	1·58	1·38
SN74162N	1·58	1·58	1·38
SN74163N	1·58	1·58	1·38
SN74164N	2·01	2·01	1·76
SN74165N	2·01	2·01	1·76
SN74166N	2·16	2·16	1·89
SN74167N	4·10	4·10	3·59
SN74170N	2·88	2·88	2·52
SN74172N	5·76	5·76	5·04
SN74173N	1·66	1·66	1·45
SN74174N	1·80	1·80	1·57
SN74175N	1·29	1·29	1·13
SN74176N	1·44	1·44	1·26
SN74177N	1·44	1·44	1·26
SN74180N	1·44	1·44	1·26
SN74181N	5·18	5·18	4·53
SN74182N	1·44	1·44	1·26
SN74184N	2·16	2·16	1·89
SN74185AN	2·16	2·16	1·89
SN74188N	6·48	6·48	5·67
SN74190N	2·30	2·30	2·01
SN74191N	2·30	2·30	2·01
SN74192N	2·30	2 30	2·01
SN74193N	2·30	2·30	2·01
SN74194N	1·72	1·72	1·51
SN74195N	1·44	1·44	1·26
SN74196N	1·58	1·58	1·38
SN74197N	1·58	1·58	1·38
SN74198N	3·16	3·16	2·77
SN74199N	2·88	2·88	2·52

PRICING OF SN7400 SERIES IS CALCULATED ON THE TOTAL NUMBER ORDERED REGARDLESS OF MIX

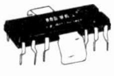
SN74 (HIGH POWER), SN74 (LOW POWER) series in stock. Send for List 36 free on request. Low Profile Sockets, **14** pin, **15p**, **16** pin, **17p**, **8** pin, **14p**.

TRANSISTORS—A selection

For *full* list send for booklet 36 today

	£p
AAZ13	10
AC107	35
AC128	20
AC187	20
ACY17	35
ACY39	65
AD149	50
AD161	39
AD162	39
AF117	20
AF118	50
AF139	33
AF186	40
AF239	44
ASY27	30
BA115	10
BAX13	5
BC107	15
BC108	15
BC109	15
BC109C	14
BC113	16
BC147	12
BC169C	14
BC182	12
BCY32	85
BCY39	1·00
BCY55	2·50
BCY70	15
BCY71	20
BCY72	13
BD124	80
BD131	45
BF115	22
BF180	33
BF194	13
BFX13	25
BFX34	55
BFX88	22
BFY50	20
BFY51	20
BFY64	45
BFY90	75
BLY36	6·25
BSX20	15
BU105	2·20
BY100	15
BY127	15
BYZ13	35
C106D	55
GET111	55
GET115	75
GET880	55
LM309K	1·87
MAT121	25
MJE340	50
MJE520	65
MJE3055	75
MPF105	46
NKT217	45
NKT404	60
OA5	60
OA81	10
OA200	8
OA202	10
OC16	85
OC20	1·25
OC28	65
OC35	55
OC36	65
OC44	18
OC45	18
OC71	15
OC72	25
OC77	55
OC81	28
OC83	25
OC140	65
OC170	25
OC200	55
OC202	90
OCP71	1·00
ORP12	55
ORP60	45
P346A	20
TIL209	25
TIP29A	49
TIP30A	58
TIP31A	61
TIP41A	74
TIP42A	90
TIS43	26
V405A	25
ZTX108	10
ZTX300	14
ZTX302	18
ZTX500	15
2G301	40
2N697	15
2N706	10
2N930	20
2N987	45
2N1132	25
2N1304	22
2N1613	20
2N1671	1·00
2N2147	75
2N2160	69
2N2926	10
2N3053	20
2N3054	45
2N3055	45
2N3440	50
2N3442	1·10
2N3525	80
2N3614	59
2N3702	11
2N3714	1·60
2N3771	1·75
2N3773	2·25
2N3790	2·25
2N3819	35
2N3866	75
2N3903	15
2N4062	14
2N4126	15
2N4871	35
2N5457	36
2S001	3·00
2S026	8·90
2S303	70
40250	45
40361	45
40362	40
40408	50
40486	75
40636	1·00
40430	85

TBA 800 5 WATT I.C.



Suitable alternative to SL403D. 5/30 volt operated. 8/16 ohm 5 watt output.
With circuits and data **£1·50.**
Complete with printed circuit board and components, **£2·75.**

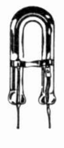
SINCLAIR IC12

With circuits and data. 6 W IC with printed circuit board 28V operated, **£2.**

ZN414 IC

Integrated circuit radio as featured by many magazines. (PW Jan. 73 Reprint Ref. No. 19 for **10p**), **£1·20.**

STROBE TUBE ZFT4A



Suitable for Dec. '73 Pract. Electronics, **£3·00**

ST2 (D32) DIAC	**25p**
CRS1/40 SCR	**45p**
ZFT4	**£3·00**
ZFT8	**£3·50**
ZFT12	**£4·50**

ULTRASONIC TRANSDUCERS

Operate at 40kHz up to 100 yds. Ideal remote switching and signalling, complete with data transmitter and receiver, new I.C. circuits. Per pair, **£5·90.**

TA 960 I.C. with socket **£1·80.**

3015F 7 SEC.

IC size complete with data price **£1·70** each.
(Digital clock circuits Ref. No. 31, **15p**).

TRANSISTORS—SPECIAL OFFERS

2N3055

25	**47p each**
100	**42p each**
500	**39p each**
1000	**34p each**

BY127

25	**12p each**
100	**10p each**
500	**9p each**
1000	**8p each**

AF117

25	**15p each**
100	**13p each**
500	**12p each**
1000	**10p each**

OC35

25	**46p each**
100	**42p each**
500	**38p each**
1000	**34p each**

ZENER DIODES

400m/w BZY88/BZX83. From 3·3V—33V, **10p** each.
1·3W 5% Miniature Tubulars IN4700 series. From 3·3V—33V, **18p** each.
10W. Stnd. Mounting ZS series 6·8V—100V 5%, **40p** each.

LINEAR I.C.

	£ p
702C (T05)	75
709C (T05)	39
709C (DIL)	39
723C (T099)	90
723C (DIL)	90
728C (DIL)	45
728C (T099)	45
741C (T05)	50
741C (DIL)	50
747C (T099)	1·00
747C (DIL)	1·00
748C (DIL)	61

SILICON RECTIFIERS

1 amp series. IN4001 to IN4007. From **6p** each.
1·5 amp. PL4001 to PL4007. From **8p** each.
3 amp. PL7001/IN5400. From **14p** each.
Send for full list 36.

SEMI-CONDUCTOR QUANTITY DISCOUNTS

10% 12+, 15% 25+, 20% 100+
All one type except where quantity discounts shown.
Min. order £1·00 please.

MORE OF EVERYTHING AT HENRY'S

See pages 298, 299 and Back Cover of this magazine.

BEST VALUE

10% VAT

TO BE ADDED TO ALL ORDERS

TRIACS—Stud Mounting with accessories

3 AMP RANGE 1–11

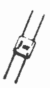
Type	P.I.V.	Price ea.
SC35A	100V	80p
SC35B	200V	85p
SC35D	400V	90p
SC35E	500V	£1·20
6 AMP RANGE		
SC40A	100V	90p
SC40B	200V	95p
SC40D	400V	£1·20
SC40E	500V	£1·50
10 AMP RANGE		
SC45A	100V	£1·05
SC45B	200V	£1·15
SC45D	400V	£1·45
SC45E	500V	£1·85
15 AMP RANGE		
SC50A	100V	£1·45
SC50B	200V	£1·65
SC50D	400V	£1·95
SC50E	500V	£2·25

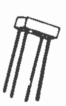
TRIACS—Additional Types

40430 TRIAC (T066)	85p
40669 TRIAC (Plastic)	90p
40486 TRIAC (T05)	75p

NEW RANGES BRIDGE RECTIFIERS

FEATURES SMALL SIZE & LOW COST





250 M/A ¼ AMP P.I.V.

B025/05	50	16p
B025/10	100	18p

¼ × ¼ × ⅛in dia.

½ AMP 1–11

Type	P.I.V.	Price ea.
B05/05	50V	20p
B05/10	100V	22p
B05/20	200V	23p
B05/40	400V	25p
B05/60	600V	27p

½H × ½L × 1/16in. dia.

1 AMP

B1/05	50V	25p
B1/10	100V	25p
B1/20	200V	28p
B1/60	600V	30p

½H × ½L × 1/16in. dia.

1 AMP

W005	50V	29p
W01	100V	30p
W02	200V	32p
W06	600V	35p

⅜ × ⅜in. tubular

2 AMPS

B2/05	50V	35p
B2/10	100V	40p
B2/20	200V	45p
B2/60	600V	50p
B2/100	1000V	55p

½H × ½L × 1/16in. dia.

4 AMPS

B4/100	100V	55p
B4/200	200V	59p
B4/400	400V	65p
B4/600	600V	75p
B4/800	800V	£1·00

½H × ½L × 1/16in. dia.

6 AMPS

B6/05	50V	65p
B6/10	100V	70p
B6/20	200V	80p
B6/40	400V	90p
B6/60	600V	£1·00

½H × ½L × 1/16in. dia.

SILICON CONTROLLED RECTIFIERS

Type	P.I.V.	1–11
1 AMP (TO5)		
CRS 1/05AF	50V	30p
CRS 1/10AF	100V	30p
CRS 1/20AF	200V	35p
CRS 1/40AF	400V	45p
CRS 1/60AF	600V	55p
3 AMP (TO48)		
CRS 3/05AF	50V	40p
CRS 3/10AF	100V	40p
CRS 3/20AF	200V	45p
CRS 3/40AF	400V	55p
CRS 3/60AF	600V	65p
5 AMP	400V	60p
CRS	5/400V	60p
7 AMP (TO48)		
CRS 7/100	100V	60p
CRS 7/200	200V	67p
CRS 7/400	400V	85p
CRS 7/600	600V	95p

All types offered subject to availability. Prices correct at time of press. E. & O.E. U.K. post, etc. 15p per order.

Henry's RADIO LIMITED

EDGWARE ROAD, LONDON W2

404-406 Electronic Components and Equipment 01-402 8381
309 PA – Disco – Lighting High Power Sound 01-723 6963
303 Bargains Store (Callers only)
Home and Car Entertainment Centres. London and branches now open.
120 Shaftesbury Avenue, London W1 01-437 9692
104 Burnt Oak Broadway, Burnt Oak, Edgware 01-952 7402
190-194 Station Road, Harrow, Middlesex 01-663 7788/9
354-356 Edgware Road, London W2 01-402 5854/4736

All mail to
303 Edgware Road,
London W2 1BW

All stores open 9 am to 6 pm six days a week
Hi-Fi – Tape Equipment Discount Stock List Free at all stores

Even Better All Round Sound Reproduction!

New, Improved BD2 Turntable By Connoisseur

Manufactured by:- A. R. Sugden & Co. (Engineers) Ltd.,
Atlas Mill Road, BRIGHOUSE, Yorkshire HD6 1ER.
Telephone: Brighouse (04847) 2142. Telegrams & Cables: Connoiseur, Brighouse.

KEEP WARM AT A COOL PRICE.

Slash central heating costs with AMKIT.

If you can put in electric wiring, you can install Amkit. The unique nylon pipe hot water central heating system, that you install yourself in hours.

Look at these advantages:
- No soldering
- No 'T' junctions
- No special equipment
- No leaks, no lagging, no corrosion
- No structural upheaval

Just reliable, effective central heating (Guaranteed 25 years) at a saving of between £150 & £250. This famous system has been successfully marketed since 1968.

Clip the coupon, and we'll tell you more.

To Autocon Manufacturing Co.
Spring House, 10, Spring Place, London, NW5, 3BH
Please send your brochure telling me all about Amkit.
Name
Address

PE8 AMC

or see for yourself at: THE AMKIT D.I.Y. CENTRE,
15, Procter St., London, W.C.1. (opp Holborn Undgnd).
Open Mon-Fri 9.30 am-5-30 pm. Sat 9 am-1 p.m.

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

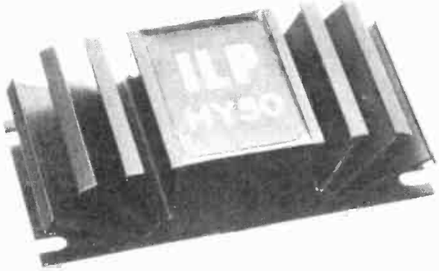
free! Brochure, without obligation to:

BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL
P.O. BOX 156, JERSEY

NAME :
ADDRESS : EB44
BLOCK CAPS please

IP **I.L.P. (Electronics) Ltd**

SECOND GENERATION 25 WATT HYBRID



A brand new hybrid fabrication technique, recently perfected in our laboratories, has enabled us to achieve our latest range of completely integrated devices.
We have now finally reduced the modular audio amplifier to a simple input/output device requiring only the addition of a basic unstabilized (split line) power supply.
The HY50 takes medium power modules to their logical conclusion by incorporating with it a heatsink, which is designed in special high conductivity alloy sufficient for normal audio use without additional chassis sinking. All this without significantly increasing the size of the module comparable in size to a packet of "King-size" cigarettes.
Consistent with modern thinking a triple rated output circuit with a load fuse allows for peak transient response without distortion but ensures the necessary protection.

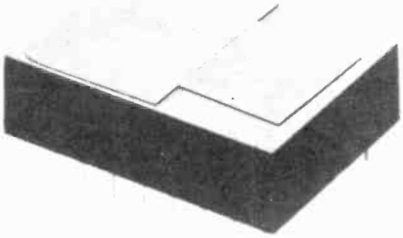
SPEC.

OUTPUT POWER:	25W RMS, 50W peak music power.
LOAD IMPEDANCE:	4–16Ω into 8Ω
INPUT SENSITIVITY:	0dB (0·775V RMS).
INPUT IMPEDANCE:	47kΩ.
TOTAL HARMONIC DISTORTION:	Less than 0·1% at 25W typically 0·05.
SIGNAL/NOISE RATIO:	better than 75dB.
FREQUENCY RESPONSE:	10Hz–50kHz ± 1dB.
SUPPLY VOLTAGE:	±25V.
SIZE:	105 × 50 × 25mm.

Price £5·80 mono £11·60 stereo. Price inclusive of VAT & P. & P.

NEW HY5 PREAMPLIFIER

Unchallenged for two years, the HY5, our unique multifunction preamplifier/tone hybrid, has been brought into line with the advancements in our power hybrids.
Like the HY50, the new HY5 has no external components and has been redesigned to run off a split power line with improvements in signal/noise, overload capability and reduced distortion. The output has been increased to match the power module (0dB), and share the same power supply.
Overall size is reduced by the use of a new thin film circuitry while the device still retains all the functions of the earlier device.
When combined with the HY50 and power supply only potentiometers are required to complete a simple mono amplifier with input and output facilities expected to be found on Hi-Fi amplifiers.
The combination of two HY5's two HY50's sharing a common power supply (PSU50) are linked by a balance control to form a complete stereo system.



SPEC.

INPUTS
Magnetic Pick-up 3mV (within 1dB RIAA curve)
Ceramic Pick-up up to 3mV.
Microphone 10mV.
Tuner 250mV.
Auxiliary 3–100mV.
Input impedance 47kΩ 1 kHz.

OUTPUTS
Tape 100mV.
Main output. 0dB (0·775V).

ACTIVE TONE CONTROLS
Treble ± 12dB at 10kHz
Bass ± 12dB at 100Hz

OVERLOAD CAPABILITY
(equalization stage) 40dB on most sensitive input.

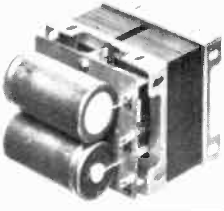
OUTPUT NOISE LEVEL
(below 10mV magnetic input) 68dB.

DISTORTION 0·05% at 1kHz.

SUPPLY VOLTAGE ± 16–25V.

SUPPLY CURRENT 15mA.

Price £4·85 mono £9·70 stereo. Price inclusive of VAT and P. & P.



POWER SUPPLY PSU50

The new PSU50 has a low profile look being only 2¼in high and can be used for either mono or stereo systems.

SPEC.
OUTPUT VOLTAGE ± 25V.
INPUT VOLTAGE 210–240V.
SIZE: L. 70 D. 90 H. 60mm.
Price £5·23. Price inclusive of VAT & P. & P.

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT
CANTERBURY 63218

Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

CHROMASONIC electronics

Dept. 2.
56, Fortis Green Road, London, N10 3HN.

THE P.E. LIQUID CRYSTAL CLOCK

- 12 or 24 hour operation
- Hours and Minutes to Minutes and Seconds at a touch
- Audible Electronic Alarm
- Liquid Crystal Display

- Visual Alarm Set
- Extra "Snooze" Time Alarm
- Radio On/off facility
- MOS I.C. Clock Chip

A complete set of parts to build this up-to-the-minute (sorry) project at a special price. All parts available separately. Ask for Price List.

MM5316 Alarm, Clock Chip	**£16·50**
40 pin I.C. Socket	**44p**
AN4132 4 digit display (inc. socket)	**£14·37**
LM3900 quad amplifier	**77p**

RS Reed Relay	**80p**
Dil Switch	**85p**
Xtal Mike insert	**44p**
14 pin I.C. Socket	**15½p**

NEW Mullard LP1400 Stereo Decoder Module, £4·96 P. & P. 15p. Ex Stock. Leaflet 10p. If purchased with LP1185 & 6. normally **£13·96**—now **£13·49.** Dual 555 Timer 2556 only **£1·65**

VAT INCLUSIVE PRICES OVERSEAS CUSTOMERS DEDUCT ONE ELEVENTH. P & P 10p

---

ERSIN Multicore 5 CORE SOLDER

for fast, easy reliable soldering

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

EASY-TO-USE DISPENSERS

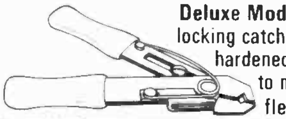
Size 5
Savbit alloy
18 swg, **24p**
(illustrated).
Size 19A
60/40 alloy
18 swg, **25p**
Size 15
60/40 alloy
22 swg, **28p**

IDEAL FOR HOME CONSTRUCTORS

Size 1 cartons in 40/60, 60/40 and Savbit alloys in 7 gauges **36p**

Size 12 REEL for Service Engineers and Electricians. 18 swg Savbit alloy. **£1·16**

BIB WIRE STRIPPER AND CUTTER



Deluxe Model 9 Automatic opening spring, locking catch, plastic-covered handles. Case hardened and precision ground. Adjusts to most wire sizes. Cuts and strips flex, splits plastic twin flex. **75p**

Prices shown are recommended retail, excluding V.A.T.
From Electrical and Hardware Shops. If unobtainable, send 10p p&p direct to:
Bib Hi-Fi Accessories Limited, Hemel Hempstead, Herts HP2 7EP

***STILL AT £42·50**
Solartron CD 711S.2 Double Beam Oscilloscope D.C.—9 Mc/s; 3 MV/cm; trigger delay; crystal calibrator; 4in flat faced tube. In good working condition. Carr. £1·50.

NEW WIDE RANGE WOBBULATOR
5 MHz to 150 MHz up to 15 MHz sweep width. Only 3 controls, preset RF level, sweep width and frequency. Ideal for 10·7 or TV IF alignment, filters, receivers. Can be used with any general purpose scope. Full instructions supplied. Connect 6·3V A.C. and use within minutes of receiving. All this for ONLY **£5·75p.** P. & P. 25p. (Not cased, not calibrated.)

20 Hz to 200 kHz WB.

SINE and SQUARE GENERATOR. Four ranges. Independent amplitude controls, thermistor stabilised. Ready to use, 9V supply required. **£7·85** each. P. & P. 25p (Not cased, not calibrated.)

GRATICULES. 12cm × 14cm high quality plastic **15p** each. P. & P. 5p.
12" Long Persistence Crt, full spec. Price £7·50 to include V.A.T. & carr.

£1 WORTH OF "UFS". Six brand new capacitors all between 15V and 100V. Total capacitance not less than 7,000mF. P. & P. 45p.

PHOTOMULTIPLIER type 931A **£3·25** each. P. & P. 25p.

ROTARY SWITCH PACK. Six brand new switches (1 ceramic; 1 off, 4 pole, 2 way, etc.), 50p. P. & P. 20p.

COMPONENT PACK consisting of 5 pots, various, brand new; 250 resistors ¼ and ½ watt, many high stabs, etc. Fine value at **50p.** P. & P. 17p.

P.C.B. PACKS S & D. Quantity 2sqft—no tiny pieces. **50p** plus P. & P. 20p.

FIBRE GLASS as above **£1** plus P. & P. 20p. Ferric Chloride Resistance Pen FREE (whilst stock lasts) on all purchases of our £1 Fibre Glass pack.

5 CRYSTALS 70 to 90kHz. Our choice, **25p.** P. & P. 15p.

5 **MOVING COIL METERS** various **£2.** P. & P. 37p.

CAPACITOR PACK—50 Brand new components only **50p.** P. & P. 17p.

POTS—10 different values. Brand new—**50p.** P. & P. 17p.

TRIMMER PACK. 2 Twin 50/200pF ceramic 2 Twin 10/60pF ceramic; 2 min. strip with 4 preset 5/20pF on each; 3 air spaced preset 30/100pF on ceramic base. ALL BRAND NEW, **25p** the lot. P. & P. 10p.

FLAT FACED 4" Twin Beam Tube, type CV2193. Green trace. Brand new **£4** each. P. & P. 37p.

LIGHT EMITTING DIODES (Red) from Hewlett-Packard. Brand New **38p** each. Holder **1p** each. Information 5p.

PHOTOCELL equ. OCP71, **13p** each.

PHOTO RESISTOR type Clare 703. Two for **50p.**

MODERN TELEPHONES type 706. Two-tone grey, **£3·75** each. Two-tone green, **£3·75** each. Black, **£2·75** each. P. & P. 25p each.

Also **TOPAZ YELLOW £4·50** each. P. & P. 25p.

IDEAL EXTENSION Telephones with standard GPO type dial, bell and lead coding. **£1·75** each. P. & P. 25p.

DELIVERED TO YOUR DOOR 1 cwt of Electronic Scrap chassis, boards, etc. No Rubbish. FOR ONLY **£3·50.**

PLEASE ADD 10% V.A.T.

OPEN 9 a.m. to 6.30 p.m. ANY DAY

CHILTMEAD LTD

7/9 ARTHUR ROAD, READING, BERKS.
(rear Tech. College) **Tel.: Reading 582605/65916**

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

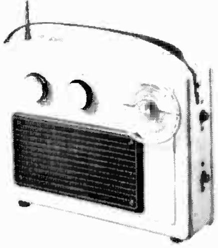
TOTAL BUILDING COSTS

£7·23 (+10% VAT 72p) **P.P. & INS. 44p (Overseas P.P. £1·85p)**

Components include:

● 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)

NEW ROAMER NINE

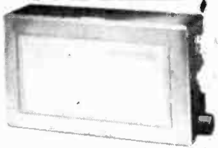


WITH V.H.F. INCLUDING AIRCRAFT

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 VHF section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9¼in × 7in × 2¾in approx. Parts price list and plans 30p (FREE with parts).

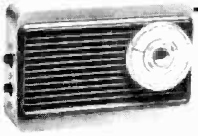
TOTAL BUILDING COSTS £6·95 (+10% VAT 69p) **P.P. & INS. 44p (OVERSEAS P. & P. £1·85)**

POCKET FIVE



3 Tunable wavebands. MW/LW and Trawler Band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive Black and Gold Case. Size 5¼in × 1¼in × 3¼in approx. Plans and parts price list 15p (FREE with parts).

Total Building Costs £2·28 (+10% VAT 22p) **P.P. & Ins. 26p (Overseas P. P. £1·25)**



TRANSONA FIVE

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 £2·50 P.P. & Ins. 26p (+10% VAT 25p) **(Overseas P. & P. £1·25)**

NEW EVERYDAY SERIES

Build this exciting New series of designs

EV5 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9in × 5¼in × 2¾in approx. Parts price list and plans 15p (FREE with parts).

TOTAL BUILDING COSTS £2·73 (+10% VAT 27p) **P.P. & INS. 30p (OVERSEAS P. & P. £1·25)**

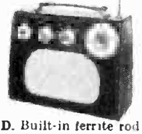
EV6 Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt Battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull Output. Parts price list and plans 15p (FREE with parts.)

TOTAL BUILDING COSTS £3·60 (+10% VAT 36p) **P.P. & INS. 30p (OVERSEAS P. & P. £1·25)**

EV7 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 (+10% VAT 40p) **P.P. & INS. 31p (OVERSEAS P. & P. £1·85p)**

ROAMER EIGHT Mk. I

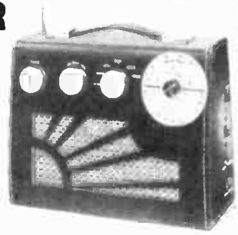


NOW WITH VARIABLE TONE CONTROL

7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Retractable chrome plated telescopic aerial for short waves. Push-pull output using 600mW transistors. Car aerial and tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt Ferrite Magnet loudspeaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9in × 7in × 4in approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

TOTAL BUILDING COSTS £6·98 (+10% VAT 69p) **P.P. & INS. 47p (OVERSEAS P. & P. £1·85)**

ROAMER TEN



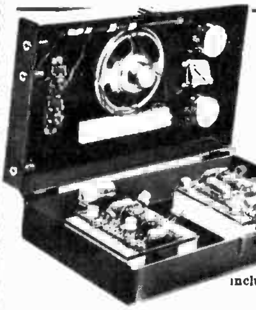
WITH VHF INCLUDING AIRCRAFT

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

Latest 4" 2 watt Ferrite Magnet Loudspeaker. Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. 10 transistors plus 3 diodes. Ganged tuning condenser with VHF section. Separate coil for Aircraft Band. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in × 7in × 4in.

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

TOTAL BUILDING COSTS £8·50 (+10% VAT 85p) **P.P. & INS. 52p (OVERSEAS P. & P. £1·85)**



EDU-KIT

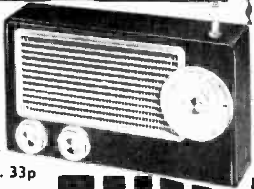
Build Radios, Amplifiers, etc., from easy stage diagrams.

Five units including master unit to construct.

Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine tone 3" moving coil Speaker: Terminal Strip: Ferrite Rod Aerial: 2 Plugs and Sockets: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ½in Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans 25p (FREE with parts).

TOTAL BUILDING COSTS £5·50 (+10% VAT 55p) **P.P. & INS. 33p (OVERSEAS P. & P. £1·85)**

TRANS EIGHT 8 TRANSISTORS AND 3 DIODES



6 TUNABLE WAVEBANDS, MW, LW, SW1, SW2, SW3 AND TRAWLER BAND. Sensitive ferrite rod aerial for MW. and LW. Telescopic aerial for short waves. 3in speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2¾in 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 (+10% VAT 44p) **P.P. & INS. 33p (OVERSEAS P. & P. £1·25)**

ROAMER SIX

CASE AND LOOKS AS TRANS EIGHT 6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, TRAWLER BAND PLUS AN EXTRA MW BAND FOR EASIER TUNING OF LUXEMBOURG, ETC. Sensitive ferrite rod aerial and telescopic aerial for short waves. 3in speaker. 8 stages—6 transistors and 2 diodes, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2¾in approx. Plans and parts price list 25p (FREE with parts).

TOTAL BUILDING COSTS £3·98 (+10% VAT 39p) **P.P. & IN. 31p (OVERSEAS P. & P. £1·85)**

RADIO EXCHANGE LTD

*Callers side entrance "Lavells" shop
*Open 10-1. 2.30-4.30. Mon.-Fri. 9-12 Sat.

To RADIO EXCHANGE CO., 61a HIGH STREET, BEDFORD MK40 ISA
Tel. 0234 52367 Reg. No. 788372

I enclose £ .... for ....

Name ....

Address ....

P.E.4

RTVC

COMPLETE* STEREO SYSTEM

£51·00

40 Watt Amplifier.
Viscount III – R102 now 20 watts per channel.
System I includes,
Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.

Specification
20 watts per channel into 8 ohms.
Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics*. Bass: –12dB to –17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble – 12dB to –12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio*: (all controls at max.) –58dB.
Crosstalk better than 35dB on all inputs.
Overload characteristics better than 26dB on all inputs. Size approx. 13¾″ × 9″ × 3¾″.

Garrard SP25 deck, with magnetic cartridge, de luxe plinth and hinged cover.

Two Duo Type II matched speakers – Enclosure size approx. 17″ × 10½″ × 6½″ in simulated teak. Drive unit 13″ × 8″ with parasitic tweeter.

Complete System £51.00

£69·00

System II
Viscount III amplifier (As System I)
Garrard SP. 25 (As System I)
Two Duo Type IIIA matched speakers— Enclosure size approx. 31″ × 13″ × 11½″. Finished in teak veneer. Drive units approx. 13½″ × 8¼″ with 3¼″ HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.

Complete System £69.00

PRICES: SYSTEM 1

Viscount III R 102 amplifier	£24·20 + £1 p & p
2 Duo Type II speakers	£14·00 + £2·20 p & p
Garrard SP25 with MAG. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p
total	£59.20

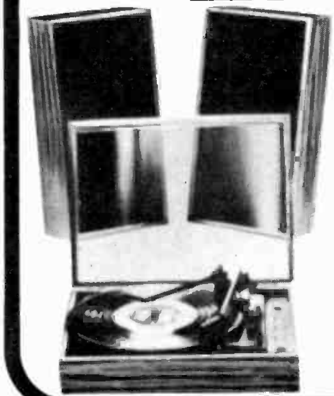
Available complete for only **£51.00** + £3 50 p. & p

PRICES: SYSTEM 2

Viscount R 102 amplifier	£24·20 + £1 p & p
2 Duo Type III A speakers	£39·00 + £4.00 p & p
Garrard SP25 with MAG. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p
total	£84.20

Available complete for only **£69.00** + £4 p & p.

STEREO 21



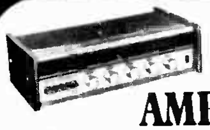
QUALITY SOUND* FOR LESS THAN £19·00

Stereo 21 easy to assemble audio system kit, – no soldering required. Includes:—
BSR 3 speed deck, automatic, manual facilities together with ceramic cartridge.
Two 8″ × 5″ speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

For the technically minded:—

Specifications:
Input sensitivity 600mV: Aux. input sensitivity 120mV: Power output 2.7 watts per channel: Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs. **Overall Dimensions**. Speakers approx. 15½″ × 8″ × 4″. Complete deck and cover in closed position approx. 15½″ × 12″ × 6″. Complete only **£18.95** + £1.60 p & p.

Extras if required.
Optional Diamond Styli **£1.37**
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance, **£3.85.**



DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.
Outputs 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).
Inputs *5 Electrically Mixed Inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling.

INPUT SENSITIVITIES

1) Crystal Mic or Guitar 9mV. 2) Moving coil Mic or Guitar 8mV. 3), 4), 5) Medium output equipment (Gram. Tuner, Monitor, Organ, etc.) – all 250mV sensitivity.
AC Mains 240V. operation.
Size approx. 12½ ins × 6 ins × 3½ ins

£13.50 + 60p.
postage & packing.

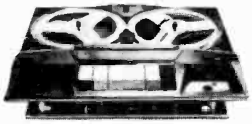
8 TRACK CARTRIDGE PLAYER*

Elegant self selector push button player for use with your own stereo system. Compatible with Viscount III system, the Stereo 21 and the Unisound module.
Technical specification.
Mains input, 240V, Output sensitivity 125mV
Comparable unit sold elsewhere at £24·00 approx.
Yours for only £10.95 + 90p. p & p

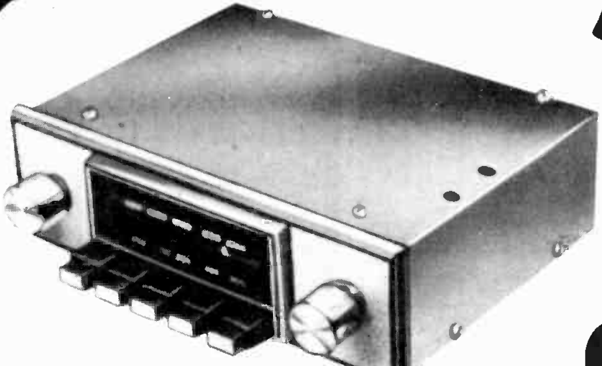
BUILD YOUR OWN STEREO AMPLIFIER*

For the man who wants to design his own stereo —here's your chance to start, with Unisound— pre-amp, power amplifier and control panel. No soldering—just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only. **£7·64 + 55p. p & p**

PE TAPE LINK CONSTRUCTORS

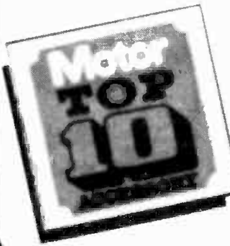


A suitable 3 speed tape deck, less heads. Caters up to 5¾ ins. spools. 240V AC mains. Unused but store soiled hence no warranty. **£4.00 + £1.00 p & p**



Remember! one of the Top Ten Accessory Awards from Motor *magazine*

PUSH BUTTON* CAR RADIO KIT



BUILD YOUR OWN TOURIST PUSH BUTTON CAR RADIO

Technical specification:

1.) **Output** 2.5 watts R.M.S. into 8 ohms. For 12 volt operation on negative or positive earth.

2.) **Integrated circuit output stage**, pre built three stage IF Module.

Controls Volume, manual tuning and five push buttons for station selection, illuminated tuning scale covering full medium and long wave bands.

Size Chassis 7 ins. wide, 2 ins. high and 4 $\frac{5}{16}$ ins. deep approx.

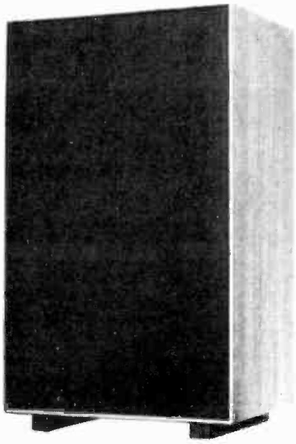
NOTE: The ability to solder on a printed circuitboard is necessary to complete this kit successfully. Circuit diagram and comprehensive instructions 55p free with kit.

Car Radio Kit
£6.60 + 55p. postage & packing.

Speaker including baffle and fixing strips
£1.65 + 23p. postage & packing.

Recommended Car Aerial - fully retractable and locking.
£1.35 post paid.

THE ULTIMATE COMPLETE SPEAKER SYSTEM EMI LE 315



Recommended retail selling price, £86·00.

Our price £45·00 + £3.50 postage & packing.

A professional standard five way speaker system with enclosure giving top quality performance.

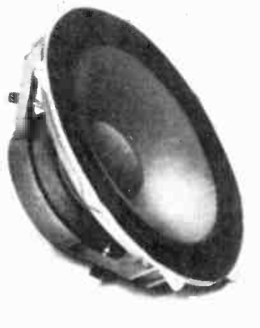
Enclosure Dimensions
approx. (3 ft. × 2 ft. × 1 ft.).

Drive Units
Hand built – 15″ diameter bass with 3″ voice coil,
– two 5″ diameter Mid Range units,
– two 3¼″ HF. units,
plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment.

Powder Handling
Continuous rating 35 W rms., Peak power rating 70 W.

Frequency Response
20 Hz 20,000 Hz.
Impedance 8 ohms

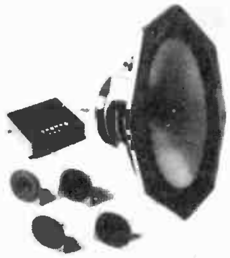
EMI SPEAKERS
FANTASTIC REDUCTION



15″ 14A/780. Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3″ voice coil.

Recommended retail price £40·80.

OUR PRICE £18·70 + £1·50 p & p



950 Kit – Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19″ × 14″ (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.
The four 10,000 gauss tweeters, each 3¼″ dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2″, others 0·5″. Recommended list price £44 00.

OUR PRICE £25·00 + £1·50 p & p
Special Offer.

BARCLAYCARD

Just write your order giving your credit card number
DO NOT SEND YOUR CARD

- **Mail orders to Acton. Terms C.W.O. All enquires Stamped Addressed Envelope. Goods not despatched outside U.K.**
- **Leaflets available for all items listed.* Send stamped addressed envelope.**

R T V C

Radio and TV Components (Acton) Ltd.
21 High Street, Acton, London W3 6NG(D)
323 Edgware Road, London W2
Edgware: 9 a.m.-5.30 p.m. Half day Thurs.
Acton: 9.30 a.m.-5 p.m. Closed all day Wed.

TO SPARK YOUR IMAGINATION!

Kit comprises EVERYTHING:
Case, cables,
coil connectors,
Silicon grease,
8-page
instruction
leaflet.

NEW

the
SPARKRITE
MkII

Electronic Ignition Kit

only £11·62

Fascinating to build. Fantastic improvement to your car's performance. Complete Capacitive Discharge ignition system, fully proven, components fully guaranteed. Printed circuit design. All metalwork drilled ready. Fitted to car in 15 minutes when built.

• Sustained peak performance. • Up to 20% fuel saving. • Instant all-weather starting. Faster acceleration, higher top speed. • Suitable for all engines up to 8 cyls. • Longer spark plug life. • Longer battery life. • Contact breaker burn eliminated. • Purer exhaust gas emission.

A new development from the manufacturers of Gunton ignition. Price: **£11·62** inc. V.A.T. and postage. (12 volt only. State Pos. or Neg. earth). Ready built unit also available **£14·85** inc. V.A.T. and postage. GUARANTEED 5 YEARS.

ORDER NOW To: **ELECTRONICS DESIGN ASSOCIATES,**
82 Bath Street, Walsall WS1 3DE. **Phone: 33652**

Please send me one SPARKRITE Kit complete. I enclose P.O./Cheque for **£11·62**. Or for ready built unit **£14·85**.

NAME

ADDRESS

(Live near Walsall? Call in for an actual workshop demo. It really is convincing).

PE/4

RST

VALVE MAIL ORDER CO.

16a WELLFIELD ROAD, LONDON SW16 2BS

SPECIAL EXPRESS MAIL ORDER SERVICE

Express postage 1p per transistor, over ten post free
INTEGRATED CIRCUITS 5p + 1p each added

	£p
1N21	0·17
IN23	0·35
IN85	0·88
IN253	0·50
IN256	0·50
IN645	0·16
1N725A	0·20
1N914	0·06
1N4007	0·12
1S113	0·25
IS131	0·13
1S202	0·23
2G371	0·40
2G381	0·22
2G414	0·30
2G417	0·25
2N404	0·22
2N697	0·15
2N698	0·30
2N706	0·10
2N706A	0·12
2N708	0·15
2N709	0·40
2N1091	0·55
2N1131	0·25
2N1132	0·25
2N1302	0·18
2N1303	0·18
2N1304	0·22
2N1305	0·22
2N1306	0·28
2N1307	0·28
2N1308	0·28
2N2147	0·75
2N2148	0·60
2N2160	1·00
2N2218	0·23
2N2219	0·25
2N2369A	0·16
2N2444	1·99
2N2613	0·28
2N2646	0·50
2N2904	0·20
2N2904A	0·25
2N2906	0·20
2N2907	0·23
2N2924	0·13
2N2925	0·15
2N2926	0·10
2N3054	0·50
2N3055	0·60
2N3702	0·11
2N3705	0·15
2N3706	0·11
2N3707	0·13
2N3709	0·10
2N3710	0·11
2N3711	0·11
2N3819	0·35
2N4289	0·20
2N5027	0·53
2N5088	0·33
2S301	0·59
2S304	1·15
2S501	0·75
2S703	1·00
AA129	0·20
AAZ12	0·75
AAZ13	0·10
AC107	0·35
AC126	0·25
AC127	0·25
AC128	0·20
AC187	0·20
AC188	0·20
ACY17	0·35
ACY18	0·27
ACY19	0·27
ACY20	0·22
ACY21	0·22
ACY22	0·16
ACY27	0·25
ACY28	0·25
ACY39	0·65
ACY40	0·22
ACY41	0·22
ACY44	0·32
AD140	0·50
AD149	0·50
AD161	0·39
AD162	0·39
AF106	0·30
AF114	0·25
AF115	0·25
AF116	0·25
AF117	0·20
AF118	0·50
AF119	0·20
AF124	0·30
AF125	0·30
AF126	0·30
AF127	0·30
AF139	0·33
AF178	0·55
AF179	0·65
AF180	0·55
AF181	0·50
AF186	0·40
AFY19	1·13

	£p
AFZ11	1·15
AFZ12	2·00
ASY26	0·25
ASY27	0·30
ASY28	0·25
ASY29	0·30
ASY36	0·25
ASY50	0·20
ASY51	0·40
ASY53	0·20
ASY55	0·20
ASY62	0·25
ASY66	0·33
ASZ21	1·00
ASZ23	0·75
AU101	1·50
AUY10	1·00
BC107	0·12
BC108	0·12
BC109	0·12
BC113	0·16
BC115	0·20
BC116	0·20
BC116A	0·23
BC118	0·20
BC121	0·20
BC122	0·20
BC125	0·68
BC126	0·65
BC140	0·55
BC147	0·12
BC148	0·10
BC149	0·12
BC157	0·14
BC158	0·12
BC160	0·63
BC169	0·14
BCY31	0·45
BCY32	1·20
BCY33	0·38
BCY34	0·45
BCY38	0·55
BCY39	1·00
BCY40	0·80
BCY42	0·30
BCY70	0·15
BCY71	0·20
BCZ10	0·60
BCZ11	0·65
BD121	1·00
BD123	1·00
BD124	0·80
BDY11	1·45
BF115	0·22
BF117	0·50
BF167	0·25
BF173	0·28
BF181	0·35
BF184	0·22
BF185	0·22
BF194	0·13
BF195	0·13
BF196	0·15
BF197	0·15
BF861	0·25
BF898	0·25
BFX12	0·20
BFX13	0·25
BFX29	0·28
BFX30	0·28
BFX35	0·98
BFX63	0·50
BFX84	0·25
BFX85	0·28
BFX86	0·25
BFX87	0·25
BFX88	0·22
BFY10	1·00
BFY11	0·50
BFY17	0·40
BFY18	0·45
BFY19	0·55
BFY24	0·45
BFY44	1·00
BFY50	0·20
BFY51	0·20
BFY52	0·20
BFY53	0·17
BFY64	0·45
BFY90	0·75
BSX27	0·50
BSX60	0·93
BSX76	0·18
BSY26	0·17
BSY27	0·20
BSY51	0·50
BSY95A	0·12
BSY95	0·12
BT102/500R	0·75
BTY42	0·92
BTY79/100R	0·75
BTY79/400R	1·10
BY100	0·15
BY126	0·14
BY127	0·15
BY182	0·85

	£p
BY213	0·25
BYZ10	0·45
BYZ11	0·40
BYZ12	0·40
BYZ13	0·35
BYZ15	1·25
BYZ16	0·60
BYZ88C3V3	0·10
BZY88C3V3	0·10
C111	0·55
CRS1/05	0·30
CRS1/40	0·45
CS4B	1·90
CS10B	3·50
DD000	0·15
DD003	0·15
DD006	0·25
DD007	0·40
DD008	0·33
GD3	0·33
GD4	0·10
GD5	0·33
GD8	0·25
GD12	0·10
GET102	0·50
GET103	0·40
GET113	0·35
GET114	0·30
GET115	0·75
GET116	0·85
GET120	0·50
GET872	0·30
GET875	0·40
GET880	0·55
GET881	0·25
GET882	0·35
GET885	0·40
GEX44	0·08
GEX45/1	0·45
GEX941	0·45
GJ3M	0·50
GJ4M	0·50
GJ5M	0·25
GJ7M	0·50
HG1005	0·50
HS100A	0·20
MAT100	0·20
MAT101	0·25
MAT120	0·20
MAT121	0·25
MJE520	0·65
MJE2955	1·10
MJE3055	0·75
MPF102	0·40
MPF103	0·30
MPF104	0·35
MPF105	0·46
NKT128	0·45
NKT129	0·30
NKT211	0·25
NKT213	0·25
NKT214	0·24
NKT216	0·40
NKT217	0·45
NKT218	1·13
NKT219	0·33
NKT222	0·30
NKT224	0·25
NKT251	0·24
NKT271	0·20
NKT272	0·20
NKT273	0·20
NKT274	0·20
NKT275	0·25
NKT277	0·20
NKT278	0·25
NKT301	0·85
NKT304	0·75
NKT403	0·70
NKT404	0·60
NKT678	0·30
NKT713	0·30
NKT773	0·25
NKT777	0·33
O78B	0·33
OA6	0·12
OA47	0·08
OA70	0·10
OA71	0·20
OA73	0·15
OA74	0·15
OA79	0·10
OA81	0·10
OA85	0·15
OA86	0·15
OA90	0·07
OA91	0·07
OA95	0·07
OA200	0·08
OA202	0·10
OA210	0·20
OA211	0·25
OAZ200	0·50
OAZ201	0·45
OAZ202	0·45
OAZ203	0·45
OAZ204	0·45

	£p
OAZ205	0·45
OAZ206	0·45
OAZ207	0·45
OAZ208	0·40
OAZ209	0·40
OAZ210	0·40
OAZ211	0·40
OAZ222	0·45
OAZ223	0·45
OAZ224	0·45
OAZ241	0·25
OAZ242	0·15
OAZ244	0·25
OAZ246	0·15
OAZ290	0·38
OC16	1·00
OC16T	1·00
OC19	0·50
OC20	2·00
OC22	1·00
OC23	1·25
OC24	1·10
OC25	0·40
OC26	0·40
OC28	0·70
OC29	0·65
OC30	0·40
OC35	0·55
OC36	0·65
OC41	0·35
OC42	0·40
OC43	0·70
OC44	0·18
OC44M	0·17
OC45	0·18
OC45M	0·18
OC46	0·27
OC57	0·60
OC58	0·60
OC59	0·60
OC66	0·50
OC70	0·18
OC71	0·15
OC72	0·25
OC73	0·50
OC74	0·30
OC75	0·30
OC76	0·30
OC77	0·55
OC78	0·25
OC79	0·30
OC81	0·28
OC81D	0·28
OC81M	0·20
OC81DM	0·18
OC81Z	0·45
OC82	0·28
OC82D	0·25
OC83	0·25
OC84	0·30
OC114	0·38
OC122	1·00
OC123	1·10
OC139	0·40
OC140	0·65
OC141	0·80
OC169	0·20
OC170	0·25
OC171	0·30
OC200	0·55
OC201	0·80
OC202	0·90
OC203	0·55
OC204	0·65
OC205	1·00
OC206	1·10
OC207	1·00
OC460	0·20
OC470	0·30
OCP71	1·00
ORP12	0·55
ORP60	0·45
ORP61	0·48
PIC44	0·29
SX68	0·20
SX631	0·45
SX635	0·55
SX640	0·75
SX641	0·75
SX642	0·60
SX644	0·85
SX645	0·85
TIS43	0·26
VI5/30P	0·75
V30/201P	0·75
V60/201	0·50
V60/201P	0·75
XA101	0·10
XA102	0·18
XA151	0·15
XA152	0·15
XA161	0·25
XA162	0·25
XB101	0·43
XB102	0·30
XB103	0·35
XB113	0·30
XB121	0·43

	£p
ZS170	0·10
ZS271	0·18
ZT21	0·25
ZT43	0·25
ZTX107	0·12
ZTX108	0·10
ZTX300	0·14
ZTX304	0·24
ZTX500	0·15
ZTX503	0·16
ZTX531	0·25
INTEGRATED CIRCUITS	
7400	0·20
7401	0·20
7402	0·20
7403	0·20
7404	0·20
7405	0·20
7406	0·40
7407	0·40
7408	0·25
7409	0·33
7410	0·20
7411	0·23
7412	0·28
7413	0·30
7416	0·30
7417	0·30
7420	0·20
7422	0·28
7423	0·40
7425	0·37
7427	0·37
7428	0·43
7430	0·20
7432	0·37
7433	0·48
7437	0·48
7438	0·48
7440	0·20
7441AN	0·85
7442	0·85
7450	0·20
7451	0·20
7453	0·20
7454	0·20
7460	0·20
7470	0·33
7472	0·38
7473	0·44
7474	0·48
7475	0·59
7476	0·45
7480	0·80
7482	0·87
7483	1·20
7484	1·00
7486	0·50
7490	0·75
7491A	1·10
7492	0·75
7493	0·75
7494	0·85
7495	0·85
7496	1·00
7497	4·32
74100	2·16
74107	0·51
74110	0·57
74111	0·86
74118	1·00
74119	1·92
74121	0·57
74122	0·80
74123	1·44
74141	1·00
74145	1·44
74150	2·30
74151	1·15
74154	2·30
74155	1·15
74156	1·15
74157	1·09
74170	2·88
74174	1·80
74175	1·29
74176	1·44
74190	2·30
74191	2·30
74192	2·30
74193	2·30
74194	1·72
74195	1·44
74196	1·58
74197	1·58
74198	3·16
74199	2·88
Plug in sockets —low profile	
14 pin DIL	0·15
16 pin DIL	0·17

Open daily to callers: Mon.-Fri. 9 a.m.-5 p.m.
Valves, Tubes and Transistors • Closed Sat. 1 p.m.-3 p.m.
Terms C.W.O. only • Tel. 01-677 2424-7
All orders subject to V.A.T. at 10% rate. This must be added to the total order including postage.

SAXON

Money saving high performance audio equipment
DIRECT FROM OUR OWN FACTORY

Better built
Better performance
Better value

SAXON HI-FI POWER AMPS IN THREE USEFUL SIZES FOR DOMESTIC & COMMERCIAL APPLICATIONS

New versions using 3A "Plastic Power" Driver Transistors now available.

To meet demand, we have included a more powerful module in our well-established and proven range. All these power amplifiers are carefully assembled, tested and guaranteed. They offer superb value for reliability and versatility.

SA35 35W RMS uses 7 transistors and 7 diodes. Carr. paid. **£4·45**

SA50 50 watt RMS
7 transistors, 7 diodes
Carr. paid **£5·65**

SA100 makes an ideal unit in disco assemblies

A real glutton for work. Reliable, tough and compact. 11 transistors, 6 diodes. Carr. paid. **£10·90**

BRIEF SPEC. FOR ALL THREE MODULES

Freq. response	15–40,000Hz ± 1dB
Distortion	0·2% at 1kHz
Loads	4 to 16 ohms
Quiescent current	15mA
Noise	Better than −75dB
Supply voltage	SA35–45V SA50 45/65V SA100 40–70V
Size	4½in × 4in × 1in (SA100) 4in × 3in × 1in (SA35/SA50)

All modules incorporate OPEN AND SHORT CIRCUIT PROTECTION, plus proof against over-dissipation and faulty inductive loads in its SA100

Circuits, connecting instruction and application data are supplied free with all modules.

POWER SUPPLIES
FOR THE SA35, SA50 AND SA10 POWER AMPS. ABOVE

PU45	Unstabilised supply for 2 SA35's	**£4·90**	
PU70	Unstabilised supply for one or two SA50 or SA100	**£7·75**	carr. 40p
PS45	Stabilised module for two SA35's or one SA50	**£3·50**	carr. free
MT45	Transformer for above, heavy duty	**£2·85**	carr. 20p
MT30	Transformer for unstabilised supply complete with rectifier diodes mounted	**£3·50**	carr. 20p
PS70	Stabilised supply module for one or two SA100's	**£4·90**	carr. free
MT70	Transformer for PS70	**£4·90**	carr. 40p

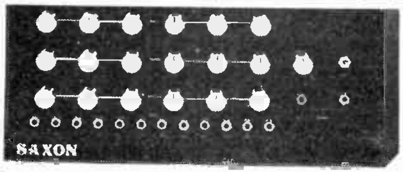
ALL MODULES ARE BUILT ON GLASS FIBRE P.C. BOARD AND SUPPLIED FULLY TESTED

SAXON PA MIXER-CONTROL UNITS

In extra slimline easy-fit case.

Using grouped pairs of inputs (high Z and low Z inputs) with individual bass, treble and volume controls on each pair, plus master control on output of M6HL. These low-noise units will feed all makes of amplifiers, making them ideal for clubs, discos, etc. Standard jack sockets, compact design. In strong metal cases. All Units guaranteed for 3 years.

- **HIGH AND LOW IMPEDANCE INPUTS**
- **BASS/TREBLE/VOLUME ON EACH PAIR**
- **MASTER CONTROL ON OUTPUT**



M4H
4 high Z, 4 low Z inputs, 4 sets of controls. Case 10″ × 8″ and only 2½in deep. Carr. paid. **£18·50** + V.A.T.

M6HL
12 inputs (6 high Z, 6 low Z) 18″ 8″ 2½″ Carr. paid **£27·50** + V.A.T.

Channel section modules, for building your own: gain—16 × (24dB). Tone controls—18dB swing. Carr. paid. **£3·50** + V.A.T.

CONTROL UNITS UNBEATABLE FOR QUALITY AND VALUE

EXCITING NEW STEREO VERSION. MK. II with stereo over-ride and case. (Carr. 30p). **£19·75**
Mono (as shown).

For 9 v. battery operation. As stereo model, less mic. input. Carr. 20p. **£6·50**

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½in × 3in × 4in deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass treble, mains on/off. Comparable to units at over twice the price.

AKG HEADPHONES
World famous D.190C—the one the professionals use—at special bargain price of **£19·50** Plus V.A.T.

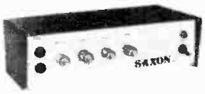
GENERAL PURPOSE MIC.
Dynamic professional quality. Carr. pd. **£9·90**

120 W HEAVY DUTY MODULE
Rugged class A driver stage This module will run from all our mixers, etc., and most other makes. Delivers 120W into an eight ohm load and employs 4 TO3 can (115W) output transistors.

SPECIFICATION
Power output, 120W into 8 ohms
Freq. response, 20–20,000Hz ± 2dB
Input sensitivity, 200mV into 10K
Construction, Fibreglass board
Size, 8in × 4in × 4in (5in with supply)
Low distortion parallel push-pull output stage.

Module and power supply (Carr. 40p) **£18·95**

- **160 watts version with power supply (Carr. 50p)** **£27·90**



SOUND AND LIGHT UNITS

Our popular 3 channel model handles up to 3kW (3,000W) of lighting and incorporates versatile sound control arrangement to enable professional standards to be achieved. Both units are excellent examples of Saxon quality and value.

3 CHANNEL UNIT
Includes bass, middle and treble as well as master controls, 2 amplifier sockets eliminate need for split leads. Up to 3kW lighting load. Suitable for free standing or panel mounting. **£19·75** Carr. 30p.

SINGLE CHANNEL UNIT
Operates from 5–100W amplifiers. Supplied for bass note operation, is easily adapted for treble or mid-range at a cost of about 5p. Carr. pd. **£7·50**

COMPLETE AMPLIFIERS CSE 100
This versatile unit is now available in a black vynide case and so represents even better value than ever delivering speech and music powers of up to 100W RMS and continuous signal outputs of 70W. Two individually controlled inputs with wide range bass and treble controls.

£34·90 carr. free

SAXON 100 £48·50 carr. free
With an RMS output of 120W speech and music, 100W continuous power, four individually controlled FET input stages and wide range bass and treble controls, this amplifier has established itself as a unit offering quality and reliability at low cost.

LOUDSPEAKERS British made bargains!!
12in 25W 8/15 ohms £6·95 carr. 30p. 15in 50W 8/15 ohm £14·50 carr. 50p. 12in 40W 15,000 gauss magnet system 8/15 ohm £11·50 carr. 40p.

V.A.T. Please add 10% to total value of order (including carr.) for Value Added Tax.

Please include S.A.E. with written enquiries

Prices subject to alteration without notice. E. & O.E.

Order and personal shoppers to:
SAXON ENTERTAINMENTS LTD., 329 Whitehorse Road, W. Croydon, Surrey CRO 2HS
Telephone 01-684 6385
From 9.30 a.m.-5.30 p.m.

Prices quoted do not include V.A.T. 10% must be added on to total value of order for V.A.T

TRADE AND EXPORT ENQUIRIES INVITED

TERMS OF BUSINESS
Cash with order (C.W.O.). For C.O.D. please add 35p extra, cash by regd. letter please.

YOU AIN'T HEARD NOTHIN' YET!!

. . . UNTIL YOU TUNE IN TO STEREO PERFECTION WITH 'VARICAP'

'p.e.' f.m. varicap stereo tuner

Size approx. 8¾" × 2¼" × 6½"

This elegant and practical stereo tuner features push button 'spot-on' tuning with up to five simple pre-set stations (no difficult tuning dial and drive cord). Its easy 'no problem' construction requires only a few simple setting adjustments with a D.C. Voltmeter. It incorporates NEW pre-set modules for R.F. and I.F. circuits, this eliminates the need for the usually difficult circuit alignment.
All this, coupled with the latest Motorola high efficiency, Integrated Circuit 'phase lock loop' stereo decoder and automatic stereo lamp indicator, ensures perfect stereo reception.
The 'Varicap' is, in our opinion, THE most easily constructed stereo tuner available which will achieve professional results.
The kit comprises Fibre glass P.C. board, elegant slimline teak veneer cabinet, brushed aluminium front panel, push buttons, instructions, in fact everything you need.
We also supply any of these kit components as separate items.

Total kit price ONLY £28·50 (Inclusive of VAT and postage).

IDEAL FOR USE WITH THE 'TEXAN', 'GEMINI' OR ANY OTHER GOOD QUALITY STEREO AMPLIFIER.

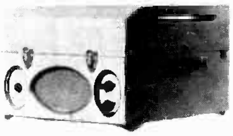
PARTS FOR PRACTICAL WIRELESS PROJECTS:
After many requests, Electro Spares are supplying lists of components for ALL projects featured in 'Practical Wireless' from July 1973 issue onwards. We regret that we cannot supply lists for projects published before this date.
All you have to do is send us a stamped addressed envelope, not less than 9" × 4", stating which project is of interest to you. We will then forward you an individually priced list of the components required, there is, of course, no necessity to purchase a full kit, you may purchase only the parts you require at any one given time.
We believe this method of 'one source' buying can save you time and postage—**AND THAT MEANS MONEY!!**
ALL COMPONENTS SUPPLIED BY ELECTRO SPARES ARE NEW, BRANDED PRODUCTS OF REPUTABLE MANUFACTURERS AND THEREFORE CARRY THE MAKERS' FULL GUARANTEE.

'P.E.' 'GEMINI' STEREO AMPLIFIER
The 'Gemini' is a quality hi-fi stereo amplifier for the home constructor, featuring a genuine 30 watt R.M.S. per channel output into 8 ohms. Total harmonic distortion of 0·02% and a frequency response (−3dB) 20Hz–100kHz, at all power levels.
We are continuing to supply components for this fabulous amplifier, which is now recognised as practically THE ultimate in High-Fidelity.
We know no better unit for the home constructor—hundreds have been supplied throughout the world.
Electro Spares have available a booklet containing full specification, complete constructional information, wiring diagrams and fault finding guide, etc.
The price is 55p + 4p postage, along with which we will send you our new **LOW PRICE LIST**. Price list available separately on receipt of a large S.A.E.
Our new Mail Order department address is set below. We aim for quick, efficient service—or why not pay us a call, we make all enthusiasts welcome and there are no parking problems.

ELECTRO SPARES

288 Ecclesall Road, Sheffield
S11 8PE. Tel: (0742) 668888
'THE COMPONENT CENTRE OF THE NORTH'
es

3W TAPE AMPLIFIERS



Polished wooden cabinet 14 × 13 × 9in containing a sensitive (20µV) 4 valve amplifier with tone and volume controls. 3W output to the 7 × 4in 3Ω speaker. Also included is a non-standard tape deck. Supplied in good working condition with circuit. Mains operated **£3** (£1 up to 200 miles. **£1·25** over). Suitable cassette **£1** (30p), spare head **30p**; tape (ex-computer) **68p** (20p). Amplifier chassis, complete and tested (2 × ECC83, EL84, EZ80) + speaker **£2** (40p), motors **35p** (30p).

7lb BARGAIN PARCELS

Hundreds of new components—resistors, capacitors, crystals, switches, pots, PC boards with transistors, diodes, etc., also loads of odds and ends. Amazing value at **£1·65** (40p).

COMPONENT PACKS

500 assorted resistors **£1** (20p), 2,500 **£4** (40p), 10,000 **£12** (£1), 100,000 **£80** + carr. 3W carbon resistors 11,600 in boxed 100's offers. 300 capacitors, all types **£1** (30p), 150 poly, ceramic, mica, etc., **60p** (10p), 25 10X crystals **£1** (30p).

COMPUTER PANELS

3lb asstd. panels **£1** (30p); 7lb **£2** (40p), 56lb **£13** (c pd). 12 high quality boards with power transistors, trim-pots, IC's, etc., **£2** (30p), 100 panels **£12** (£1). Pack of boards with at least 500 components inc. at least 50 transistors **60p** (20p). Panel with 20 2N2926 type transistors + other parts **20p** (10p). Pack with 25 flat-pack IC's (no info.) **30p** (10p). 2,000 boards **£100** + carr.

NEW COMPONENTS

400V 5A SCR s **60p**; 200V 5A **40p**; OC16 **20p**; OC45 **8p**; OC71 **8p**; OC140 **25p**; OC171 **15p**; BFY18 **12p**; BCY72 **8p**; 2N3055 **35p**; XC121 **5p**; 2N3708 **8p**; 741C 8-pin DIL or TO99 **32p**.

? ? ? ? ? ? ? ? ? ?

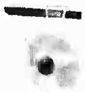
80 + 80 + 20µF 350V **10p**, 10 for **75p** (30p). 8µF 2,500V **£2** (50p); 4µF 2,000V **£1** (40p). 10µF 236V **40p** (15p). 1µF 35V tantalum 12 for **50p**; 1kΩ Resistors 2W **4p**; 10Ω 2W 10 for **25p**; 100kΩ ¼W 100 for **30p** (10p). 4 pole 8-way Yaxley switches **30p** (8p). Crystal + cat's whisker **15p**; 20kΩ 10 turn Colvern WW pots **75p** (10p). Miniature 50V ceramic plate caps. 22pF–1,000pF **2p**; Heavy duty aluminium heat sinks 6 × 5 × 3in with 2 power transistors **80p** (30p). 230V Fans. 2,800 r.p.m. 6½in dia. blades complete with grill and mounting plate **£2·50** (40p). Min. plug in relays with base. 4 c/o contacts 2,500Ω coil **60p** (8p). Microphone matching transformer 20Ω–100k, fully screened, single hole mounting **60p** (8p).
Scopes in stock, for callers, ring for details.

Carr. in brackets, small parts 5p. **ADD 10% VAT.** SAE LIST

GREENWELD ELECTRONICS (PE1)

24 Goodhart Way, West Wickham, Kent. SHOPS AT 21 Deptford Broadway SE8 (Tel. 01-692 2009) and 38 Lower Addiscombe Road, Croydon.

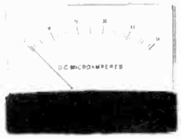
MULTIMETER Model C-7081 GN Range Doubler 50,000 ohm/volt High Sensitivity Meter **£14·40.**



TAPE RECORDER LEVEL METER
500µA, 70p

CARDIOID DYNAMIC MICROPHONE

Model UD-130. Frequency response 50–15,000c/s. Impedance Dual 50K and 600 ohms, **£6·40.**



4½in × 3¼in METER. 30µA, 50µA or 100µA, £3·65.

MULTI-METER
Model 200H
20,000 ohm/volt, **£6·60.**

3 WATT STEREO AMPLIFIER
£4·30

All above prices include 10% V.A.T. Please add 10p for P. & P. on orders under £5. LARGE S.A.E. for List No. 6. Special prices for quantity quoted on request.

M. DZIUBAS
158 Bradshawgate • Bolton • Lancs. BL2 1BA

TRANNIES

All orders to be sent to our new retail shop at:

4 Bush House, Bush Fair,
HARLOW, ESSEX
Telephone 37739

P. & P. 10p.

Catalogue 10p.

All Prices FULLY INCLUSIVE of VAT

74 Series TTL

(National Semiconductors and I.T.T.)
LOW PRICES, HIGH QUALITY

* 100 plus less 10% on the 25+ column

Nos.	1+	25+
7400	20p	16p
7401	20p	18p
7402	20p	18p
7403	20p	18p
7404	21p	19p
7405	21p	19p
7406	54p	49p
7407	54p	48p
7408	29p	24p
7409	29p	24p
7410	20p	18p
7411	23p	21p
7412	40p	33p
7413	31p	29p
7416	49p	47p
7417	57p	53p
7420	20p	18p
7422	60p	58p
7423	60p	58p
7425	60p	53p
7426	35p	31p
7427	55p	51p
7428	85p	79p
7430	20p	18p
7432	42p	33p
7433	97p	91p
7437	77p	74p
7438	77p	74p
7440	20p	18p
7441	81p	78p
7442	81p	78p
7443	£1·40	£1·32
7444	£1·57	£1·52
7445	£2·31	£2·18
7446	£2·31	£2·18
7447	£1·48	£1·37
7448	£1·98	£1·81
7450	20p	16p
7451	20p	19p
7453	20p	19p
7454	20p	18p
7460	20p	18p
7470	33p	27p
7472	33p	30p
7473	46p	42p
7474	44p	40p
7475	63p	57p
7476	55p	51p
7480	£1·10	99p
7481	£1·37	£1·26
7482	£1·10	99p
7483	£1·32	£1·29
7484	£1·32	£1·21
7485	£2·75	£2·64
7486	49p	41p
7489	£4·95	£4·29
7490	82p	71p
7492	84p	65p
7493	82p	66p
7494	£1·04	93p
7495	£1·14	£1·03
7496	£1·25	£1·15
74100	£2·75	£2·58
74104	£1·18	£1·14
74105	£1·18	£1·14
74107	48p	46p
74110	67p	65p
74111	£1·52	£1·40
74118	£1·10	80p
74119	£1·64	£1·54
74121	47p	42p
74122	£1·70	£1·59
74123	£3·35	£3·28
74141	£1·10	99p
74145	£1·65	£1·48
74150	£3·30	£2·75
74151	£1·21	£1·15
74153	£1·32	£1·15
74154	£2·20	£1·87
74155	£1·65	£1·21
74156	£1·65	£1·21
74157	£1·54	£1·43
74160	£2·18	£1·05
74161	£2·18	£2·05
74162	£4·84	£4·54
74163	£4·84	£4·54
74164	£2·73	£2·63
74165	£2·73	£2·63
74166	£4·28	£3·94
74174	£2·78	£2·66
74175	£1·94	£1·81
74176	£1·99	£1·87
74177	£2·75	£2·64
74180	£2·75	£2·64
74181	£6·49	£6·05
74182	£2·16	£2·02
74184	£2·69	£2·42
74190	£3·08	£2·69
74191	£2·30	£2·24
74192	£2·53	£2·30
74193	£2·53	£2·30
74194	£3·27	£3·15
74195	£2·42	£2·30
74196	£2·18	£2·06
74197	£2·18	£2·06
74198	£6·65	£6·05
74199	£6·65	£6·05
74200	£26·40	£21·12

Linear Integrated Circuits

301	DIL	50p
301	TO99	55p
301	8 PIN DIL	46p
301A	DIL	69p
301A	TO99	69p
301A	8 PIN DIL	66p
307	DIL	69p
307	TO99	69p
307	8 PIN DIL	66p
308	TO99	6·45p
308A	TO99	6·40p
709c	DIL	35p
709c	TO99	31p
723c	DIL	99p
723c	TO99	95p
741c	8 PIN DIL	38p
741c	14 PIN DIL	39p
741c	TO99	41p
747c	DIL	46p
748c	DIL	39p
748c	TO99	41p

THE FERRANTI RADIO IC

ZN414 £1·32

Electrolytic Capacitors

4 VOLT

47μF	6½p
100μF	6½p
220μF	6½p
330μF	6½p
1000μF	13p
4700μF	29p

6·3 VOLT

33μF	6½p
68μF	6½p
150μF	6½p
470μF	11p
680μF	13p
1500μF	18p
2200μF	18p
3300μF	26p

10 VOLT

22μF	6½p
47μF	6½p
100μF	6½p
220μF	8p
330μF	10p
470μF	10p
1000μF	11p
1500μF	20p
2200μF	24p

16 VOLT

15μF	6½p
33μF	6½p
150μF	6½p
150μF	8p
220μF	9p
680μF	17p
1000μF	17p
1500uF	25p
2000μF	43p

25 VOLT

10μF	6½p
22μF	6½p
47μF	6½p
100μF	8p
150μF	8p
220μF	10p
470μF	13p
680μF	20p
1000μF	22p
2200μF	39p
5000μF	68p

40 VOLT

6·8μF	6½p
15μF	6½p
33μF	6½p

40 VOLT

47μF	6½p
100μF	9p
68μF	10p
220μF	11p
470μF	19p
680μF	25p
1000μF	25p
2200μF	44p

63 VOLT

1μF	6½p
2·2μF	6½p
4·7μF	6½p
6·8μF	6½p
10μF	6½p
22μF	6½p
68μF	10p
100μF	11p
150μF	13p
220μF	19p
330μF	22p
470μF	26p
1000μF	44p

VOLUME CONTROLS

Potentiometers

Carbon track 500Ω to 2·2MΩ. Log or Linear.
Single 13p. Dual gang (stereo) 44p. Single type with D.P. switch 13p extra.

CARBON SKELETON PRESETS

Small high quality type (linear only). All valves 100·5 megohms.

—1 watt 6p each
—2·5 watt 6½p each

THYRISTORS

P.I.V.	50	100	200
1 Amp	28p	35p	41p
3 Amps	44p	50p	60p
P.I.V.		300	400
1 Amp		44p	53p
3 Amps		—	60p

SLIDE SWITCH

SPST 11p each. D.P.D.T. 13p each.

MINIATURE NEON LAMPS

240V or 110V 1·4 5p. 5 plus 4½p each.

Mullard Polyester Capacitors

C280 SERIES

250V P.C. mounting: 0·01μF, 0·015, 0·022 3½p. 0·033, 0·047, 0·068 4p. 0·1 4½p. 0·15, 0·22 5½p. 0·33 7p. 0·47 9½p. 0·68 12p. 1μF 14p. 1·5μF 22p. 2·2μF 27p.

C296 SERIES

400V: 0·001μF, 0·0015, 0·0022, 0·0033, 0·0047 3p. 0·0068, 0·01, 0·015, 0·022, 0·033 3½p. 0·047, 0·068, 0·1 4½p. 0·15 6½p. 0·22 8½p. 0·33 12p. 0·47 14½p.
160V: 0·01μF, 0·015, 0·022, 0·033, 0·047, 0·068 3½p. 0·1 4p. 0·15 4p. 0·1 4½p. 0·15, 0·22 5½p. 0·33 7p. 0·47 9½p. 0·68 12p. 1μF 14½p. 1·5μF 22p. 2·2μF 24p.

AMTRON KITS

We have been appointed stockists of Amtron high quality construction kits.
(20p P/P on all kits)

UK65 Transistor tester	£2·60
UK120 Hi-Fi Amplifier 12W	£5·20
UK110 Stereo Amp 5 + 5W	£11·07
UK115 Hi-Fi Amp 8W	£4·31
UK220 Signal Injector	£2·57
UK300 Four Channel Radio Control Transmitter	£6·55
UK310 Radio Control Receiver	£3·28
UK325 'GXC2' Channel Splitting Unit, 1000 & 2000Hz	£7·85
UK330 'GXC2' Channel Splitting Unit. 1500 & 2500Hz	£7·86
UK415 Resistor Box	£8·69
UK425 Capacitor Box	£8·39
UK515 MW Radio Receiver	£7·86
UK790 Capacitive Burglar Alarm	£7·57

Many other kits available. Send for the free Amtron Catalogue.

★ These Kit Prices include VAT ★

OUR NEW RETAIL SHOP IS NOW OPEN

Monday to Saturday 9-5.30
Friday late opening 6 o'clock

VEROBOARD

	0·1	0·15
2½ × 3¾	24p	19p
2½ × 5	27p	23p
3¾ × 3¾	27p	23p
3¾ × 5	31p	31p
17 × 2½	82p	63p
17 × 3¾	£1·10	87p
17 × 5 (Plain)		90p
Pin insertion tool	57p	57p
Spot face cutter	46p	46p
Pk 36 Pins	20p	20p

Resistors

¼ watt 5% carbon	1p
½ watt 5% carbon	1p
1 watt 10% carbon	2½p

range 10 ohms to 4·7 megohms.

¼ watt m/o 2%	4p

range 10 ohms to 1 megohms.

MINITRON DIGITAL INDICATOR TYPE 3015F

Read 0·9 and decimals. ONLY £1·65.

PE RHONDO KIT AVAILABLE S.A.E. for List

£1 BARGAIN PACKS

£1	10 Silicon *npn* power transistors (2N3055) tested/unmarked.
£1	30 Plastic FET's unmarked/untested, similar to 2N3819.
£1	20 TO5 transistors *npn* 2 to 5 amp untested/unmarked.
£1	20 TO18 transistors *pnp* like BC178, BC179, etc. untested/unmarked.
£1	30 Plastic 2N3055 unmarked/untested TO220 case.
£1	10 General purpose, fully tested FET's.
£1	500 carbon resistors ¼, ½, 1, 2W.
£1	100 Electrolytic condensers.
£1	250 Ceramic Polystyrene, Silver Mica, etc. Condensers.
£1	250 Polyester, Polycarbonate, Paper, etc. Condensers.
£1	25 Potentiometers assorted.
£1	250 High Stab 1%, 2%, 5% resistors.
£1	1lb Assorted nuts, bolts, washers, spacers, etc.
£1	25 Assorted switches, rotary, lever, micro, toggle, etc.
£1	50 Preset Potentiometers.

★ any 5 packs £4 ★

P/P 10p for *each* Pack.

Transformers

Primary 200–220–240 volt.				P/P
MT111	12V	0·5A	£1·11	16p
MT111/B	24V	0·25A	£1·35	20p
MT71	12V	2A	£1·76	22p
MT71	12V	2A	£1·76	22p
MT71/B	24V	1A	£1·76	22p
MT18	12V	4A	£2·47	36p
MT18/B	24V	2A	£2·47	36p

30 volt transformers

Prim. 200–220–240V. Secondary voltage. 12, 15, 20, 24, 30V or 12–0–12V or 15–0–15V

MT112	0·5A	£1·32	22p
MT79	1A	£1·80	36p
MT3	2A	£2·96	36p
MT20	3A	£3·30	42p
MT51	5A	£4·84	49p

50 volt transformers

Prim. 200–220–240V, Secondary voltage. 19, 25, 33, 40, 50V or 25–0–25 V.

MT102	0·5A	£1·76	30p
MT103	1A	£2·58	38p
MT105	3A	£4·84	52p
MT106	4A	£6·02	52p

60 volt transformers

Prim. 200–220–24 0 Secondary 24, 30, 40, 48, 60V or 24–0–24V or 30–0–30V.

MT124AT	0·5A	£1·76	38p
MT126AT	1A	£2·47	34p
MT127	2A	£3·90	44p

Miniature transformers

Prim. 220 V.

BT606	100mA	6–0–6V	98p	15p
BT909	100mA	9–0–9V	98p	15p
BT12012	100mA	12–0–12V	£1·08	15p
BT24024	100mA	24–0–24V	£1·95	15p

Transistors/ Diodes

AC107	16p
AC126	14p
AC127	13p
AC128	13p
AC142K	22p
AC141K	20p
AC176	15p
AC187	18p
AC187K	20p
AC188	18p
AC188K	20p
ACY17	24p
ACY18	21p
ACY19	25p
ACY20	22p
ACY21	23p
ACY22	18p
ACY39	68p
AD140	40p
AD142	44p
AD143	39p
AD149	38p
AD150	60p
AD161	38p
AD162	38p
AF114	18p
AF115	18p
AF116	18p
AF117	18p
AF118	92p
AF124	27p
AF139	39p
AF239	41p
AL100	77p
AL102	66p
AL103	55p
BC107	11p
BC108	11p
BC109	11p
BC113	15½p
BC116	16p
BC125	16p
BC126	25p
BC132	16p
BC134	16p
BC135	16p
BC137	16p
BC138	36p
BC142	33p
BC143	33p
BC144	30p
BC145	26p
BC147	9p
BC148	9p
BC149	9p
BC153	16p
BC154	17p
BC157	13p
BC158	12p
BC159	14p
BC167	13p
BC168	11p
BC169	11p
BC177	15p
BC179	15p
BC182L	10p
BC183L	11p
BC184L	11p
BC186	33p
BC212L	11p
BC213L	11p
BC214L	11p
BC258	9p
BC259	9p
BC267	14p
BC268	15p
BC300	40p
BC301	32p
BC302	30p
BC303	50p
BC304	40p
BCY70	17p
BCY71	37p
BCY72	17p
BD131	68p
BD132	90p
BD135	42p
BD136	50p
BD141	£1·87
BD142	50p
BF159	33p
BF173	29p
BF177	28p
BF178	29p
BF179	35p
BF194	15p
BF195	17p
BF244	27p
BF260	29p
BF329	18p
BF330	18p
BF390	37p
BFX84	28p
BFX85	35p
BFX86	22p
BFX87	28p
BFX88	26p
BFY50	21p
BFY51	17p
BFY52	17p
BFY64	39p
BFY90	72p
BSX20	19p
C407	22p
C426	33p
C428	31p
C450	17p
MP8111	35p
MP8112	42p
MP8113	35p
MP8121	33p
MP8122	44p
MP8123	50p
NKT211	28p
NKT212	28p
NKT214	25p
NKT217	55p
NKT261	23p
NKT271	20p
NKT274	20p
NKT275	25p
NKT403	71p
NKT405	83p
NKY603F	66p
NKT613G	33p
NKT674	26p
NKT677G	24p
NKT713	32p
NKT773	27p
OC19	55p
OC20	55p
OC23	49p
OC25	45p
OC28	50p
OC29	50p
OC35	50p
OC36	50p
OC44	14p
OC45	14p
OC70	23p
OC71	14p
OC72	14p
OC81	14p
OC83	22p
OC84	28p
TIP29A	53p
TIP30A	64p
TIP31A	64p
TIP32A	78p
TIP33	£1·05
TIP34A	£1·54
TIP35A	£2·53
TIP36A	£3·19
TIP41A	79p
TIP42A	91p
2N706	13p
2N930	23p
2N1131	22p
2N1132	28p
2N1613	22p
2N1711	26p
2N2904	40p
2N2904A	44p
2N2905	46p
2N2924	18p
2N2926	10p
2N3053	26p
2N3054	55p
2N3055	52p
2N3702	11p
2N3703	11p
2N3704	11p
2N3705	11p
2N3706	11p
2N3707	11p
2N3708	11p
2N3709	11p
2N3710	11p
2N3711	9p
2N3794	17p
2N3819	28p
40361	50p
40362	50p
40636	50p

Diodes & Rectifiers

1N914	8p
1N916	8p
1N4148	8p
1844	10p
1N4007	22p
18113	17p
BA100	16p
BA102	25p
BA115	8p
BA144	14p
BA145	22p
BA154	14p
BAX13	14p
BAX16	14p
BAY18	19p
BAY31	9p
BY100	19p
BY126	16p
BY127	19p
BYX10	24p
OA5	19p
OA10	24p
OA47	9p
OA70	8p
OA73	11p
OA79	8p
OA81	9p
OA85	11p
OA90	8p
OA91	8p
OA95	8p
OA200	11p

The Sinclair Cambridge... no other calculator is so powerful and so compact.

Complete kit–£24·95! (PLUS VAT)

The Cambridge – new from Sinclair

The Cambridge is a new electronic calculator from Sinclair, Europe's largest calculator manufacturer. It offers the power to handle the most complex calculations, in a compact, reliable package. No other calculator can approach the specification below at anything like the price – and by building it yourself you can save a further £5·50!

Truly pocket-sized

With all its calculating capability, the Cambridge still measures just $4\frac{1}{2}$″ 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 life 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 £27·45!

The Sinclair Cambridge kit is supplied to you direct from the manufacturer. Ready assembled, it costs £32·95 – so you're saving £5·50! 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.

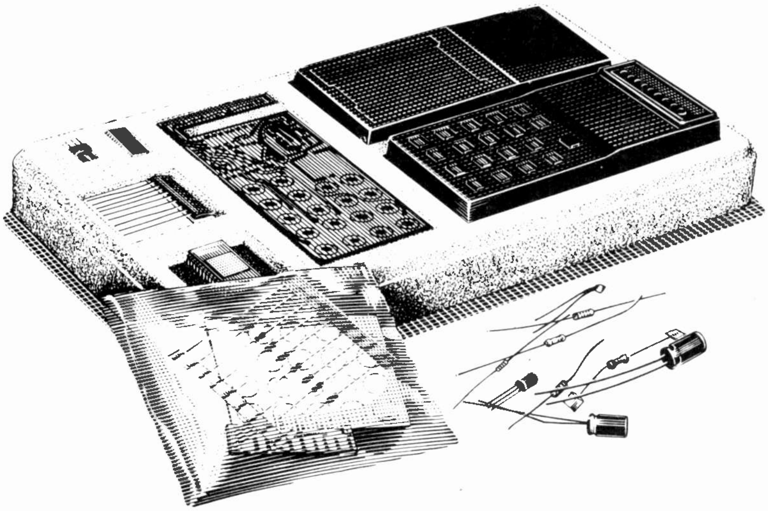
Features of the Sinclair Cambridge

- ✱Uniquely handy package. $4\frac{1}{2}$″ 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 £30.
- ✱Calculates to 8 significant digits, with exponent range from 10^{-20} to 10^{79}.
- ✱Clear, bright 8-digit display.
- ✱Operates for weeks on four U16-type batteries. (MN 2400 recommended.)

A complete kit!

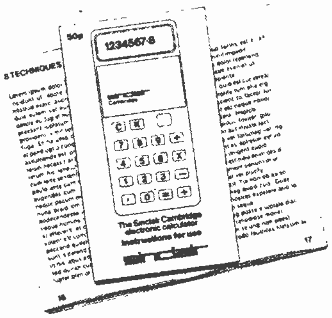
The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge.
Assembly time is about 3 hours.

Contents:
1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



This valuable book – free!
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.



How? It's all explained in this unique booklet, written by a leading calculator design consultant. In its fact-packed 32 pages it explains, step by step, how you can use the Sinclair Cambridge to carry out complex calculations.

sinclair

Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire
Reg. no: 699483 England
VAT Reg. no: 213 8170 88

Why only Sinclair can make you this offer
The reason's simple: only Sinclair – Europe's largest electronic calculator manufacturer – have the necessary combination of skills and scale.

Sinclair Radionics are the makers of the Executive – the smallest electronic calculator in the world. In spite of being one of the more expensive of the small calculators, it was a runaway best-seller. The experience gained on the Executive has enabled us to design and produce the Cambridge at this remarkably low price.

But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them – the Sinclair Project 60 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.
And *you* benefit!

Take advantage of this money-back, no-risks offer today
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch – and we guarantee a correctly-assembled calculator for one year.

Simply fill in the preferential order form below and slip it in the post today.

Price in kit form: £24·95 + £2·50 VAT. (Total: £27·45)
Price fully built: £29·95 + £3·00 VAT. (Total: £32·95)

PE 4 74

To: Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire, PE17 4HJ

Please send me

☐ a Sinclair Cambridge calculator kit at £24·95 + £2·50 VAT (Total: £27·45)

☐ a Sinclair Cambridge calculator ready built at £29·95 + £3·00 VAT (Total: £32·95)

*I enclose cheque for £ , made out to Sinclair Radionics Ltd, and crossed.

*Please debit my *Barclaycard/Access account. Account number ____________

Name ____________

____

Address ____________

____

____

*Delete as required..

PLEASE PRINT

WILMSLOW AUDIO

THE Firm for Speakers!

SPEAKERS

Baker Group 25, 3, 8 or 15 ohm	£6·60
Baker Group 35, 3, 8 or 15 ohm	£7·50
Baker Group 50/12, 8 or 15 ohm	£12·50
Baker Deluxe	£9·75
Baker Major	£7·50
Baker Superb	£12·00
Baker Regent	£7·00
Celestion PST8 (for Unilex)	£2·55
Celestion MF1000, 8 or 15 ohm	£10·45
Celestion HF1300 Mk. II	£6·16
Celestion G12M, 8 or 15 ohm	£12·00
Celestion G12H, 8 or 15 ohm	£15·00
Celestion G15C, 8 or 15 ohm	£24·00
Celestion G18C, 8 or 15 ohm	£33·00
EMI 13 × 8in, 3, 8 or 15 ohm	£2·15
EMI 13 × 8in d/c, 3, 8 or 15 ohm	£2·35
EMI 13 × 8in t/tw, 3, 8 or 15 ohm	£3·60
EMI 13 × 8in type 350, 8 ohm	£8·25
EMI 8 × 5in, cer. mag., 8 ohm	£1·65
EMI 8 × 5in, 10 watt, d/c roll, surr., 8 ohm	£2·50
EMI 6½in, 93850, 4 or 8 ohm	£2·80
EMI 5in, 98132CP, 8 ohm	£2·30
Elac 9 × 5in, 59RM109 15 ohm, 59RM114 8 ohm	£2·65
Elac 6½in d/c roll surr., 8 ohm	£3·35
Elac 6½in d/cone, 8 ohm	£2·65
Elac Tweeter TW4 4in	£1·21
Elac 10in, 8 ohm	£2·65
Fane Pop 100 watt, 18 in	£22·50
Fane Pop 60 watt, 15in	£13·00
Fane Pop 50 watt, 12in	£11·00
Fane Pop 25/2, 12in	£6·40
Fane Pop 15 watt, 12in	£4·40
Fane Crescendo 12A or 12B	£29·00
Fane Crescendo 15	£36·00
Fane Crescendo 18	£47·50
Fane 807T 8 in d/c roll surr., 8 or 15 ohm	£3·85
Fane 808T 8in d/c, 8 or 15 ohm	£2·75
Goodmans 8P, 8 or 15 ohm	£4·49
Goodmans 10P, 8 or 15 ohm	£4·70
Goodmans 12P, 8 or 15 ohm	£11·65
Goodmans 15P, 8 or 15 ohm	£18·00
Goodmans 18P, 8 or 15 ohm	£31·00
Goodmans 12P-D, 8 or 15 ohm	£15·25
Goodmans 12P-G, 8 or 15 ohm	£14·50
Goodmans 12AX Audiomax, 8 or 15 ohm	£39·65
Goodmans Audiom 100	£9·50
Goodmans Axent 100	£6·60
Goodmans Axiom 401	£15·10
Goodmans Twinaxiom 8, 8 or 15 ohm	£6·79
Goodmans Twinaxiom 10, 8 or 15 ohm	£7·61
Kef T27	£4·75
Kef T15	£5·50
Kef B110	£6·50
Kef B200	£7·50
Kef B139	£11·75
Kef DN8	£1·92
Kef DN12	£4·12
Kef DN13	£2·75
Richard Allan 12in d/c, 3 or 15 ohm	£2·50
Richard Allan CG8T 8in d/c 8 ohm	£6·35
WMT1 speaker match. trans., 3–15 ohm	£1·10
Wharfedale Super 10 RS/DD	£9·80
2½in 64 ohm, 70mm 8 ohm, 70mm 80 ohm	65p
7 × 4in, 3, 8 or 15 ohm	£1·38
8 × 5in, 3, 8 or 15 ohm	£1·38
10 × 6in, 3, 8 or 15 ohm	£1·92
S.T.C. 4001G Super Tweeter	£6·19

Speaker Kits

Wharfedale Linton 2 (pair)	£19·25
Wharfedale Glendale 3 (pair)	£34·50
Wharfedale Dovedale 3 (pair)	£52·00
Richard Allan Twinkit (each)	£8·25
Richard Allan Triple 8 (each)	£13·00
Richard Allan Triple (each)	£18·00
Richard Allan Super Triple (each)	£21·50
Goodmans DIN 20 (each)	£8·75
Fane Mode 1 (each)	£9·90
Peerless 20–2 (each)	£10·41
Kefkit 2 (each)	£23·50
Kefkit 3 (each)	£34·00
Helme XLK25 (pair)	£18·17
Helme XLK50 (pair)	£37·18
Baker Major Module	£9·50

P.A. and Hi-Fi speaker cabinets. Send for Free booklet "Choosing a Speaker". Carr. and insurance 75p per kit (£1·50 pair).

PA/Disco Amplifiers

(Carriage and insurance £1)

Baker Major 100 watt	£46·00
Linear 30/40	£25·00
Linear 40/60	£30·00
Linear 80/100	£55·00

Radios/Cassettes

Grundig Solo Boy	£16·00
Grundig Top Boy	£17·75
Grundig Party Boy 500	£22·75
Grundig Melody Boy 500	£26·75
Grundig Elite Boy 500	£26·75
Grundig Signal 500	£26·50
Grundig Yacht Boy 210	£34·00
Grundig Melody Boy 1000	£38·75
Grundig Satellite 2000	£121·00
Grundig C410 Cassette	£28·50
Grundig RF430 mains radio	£26·75
Grundig RF310 mains radio	£22·00
Tanberg TP41	£43·00
ITT Weekend Auto	£18·00
ITT Golf Preset	£24·50
ITT Colt	£11·50
ITT Europa	£20·50
ITT SL53 cassette	£25·75
ITT Studio 60M cassette	£32·75
ITT Studio 73 cassette	£48·00
Bush VTR178, 5 band (inc. air)	£29·00
Koyo KTR1770 11 band	£58·95
Koyo KTR1663 or 1664, 8 band	£42·00
Koyo KTR1883, 5 band	£22·00
Murphy BA209 radio/cassette	£32·75

Carriage and Insurance 75p. FREE with each radio—World radio stations book.

Free with speaker orders over £7—

"Hi-Fi Loudspeaker Enclosures" book. All units guaranteed new and perfect. Prompt despatch.

Carriage 35p per speaker (tweeters and crossovers 20p).

ALL PRICES QUOTED INCLUDE VAT

WILMSLOW AUDIO

Dept. PE

Loudspeakers: Swan Works, Bank Square, Wilmslow, Cheshire, SK9 1HF.
Radios, etc.: 10 Swan Street, Wilmslow, Cheshire. Telephone: Wilmslow 29599

TIME SWITCH

Smith's mains driven clock with 15 amp switch, also notes showing how you can wake up with music playing, kettle boiling or come home to a warm house, warn off burglars, keep pets warm, halve your heating bills, etc **£1·95.**

RECORD PLAYBACK HEADS (TRUVOX)

Individual prices of these are: 2 track record playback heads **50p** each; 4 track record playback heads **72p** each Erase heads are also available separately—2 track **33p**, 4 track **55p**; MV metal mounting shields **39p** each; 2 track-heads already fixed on heavy mounting plate with shield **£1·22.**

RADIO STETHOSCOPE

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece **£2·20**—twin stethoset instead of earpiece **83p** extra—post and ins 20p

ULTRA-SONIC REMOTE CONTROLLER

As featured in this issue! Our 1974 catalogue lists hundreds of bargains and probably many of the parts needed for this project **66p** brings the catalogue and the next 6 monthly supplements.

SLIDE SWITCHES

Slide Switch, 2-pole changeover panel mounting by two 6B.A screws. Size approx 1in × ½in rated 250V lamp. **8p** each, 10 for **73p.** Ditto as above but for printed circuit **6p** each, 10 for **63p. Sub-Miniature Slide Switch.** DPDT 19mm (¾in approx.) between fixing centres **20p** each or 10 for **£1·90.** SP Changeover spring return 250V 1 amp **11p.**

MAINS TRANSISTOR P.P.

Designed to operate transistor sets and amplifiers Adjustable output 6V, 9V, 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others Kit comprises: mains transformer rectifier, smoothing and load resistor condensers and instructions Real snip at only **£1·10.**

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless, August issue **£3·30** plus 20p post and insurance

THYRISTOR LIGHT DIMMER

For any lamp up to 1kW. Mounted on switch plate to fit in place of standard switch Virtually no radio interference Price **£2·95,** plus 20p post and insurance Industrial model 5A **£3·30.** Not on plate

U.V. LIGHTING

Useful for flaw detection in metals and for looking for water marks, etc., also for fitting over tropical fish tanks—African violets and other indoor plants which must have U.V for healthy growth. The outfit comprises of an 8in U V. tube—choke—starter holder and tube ends. Price **£2·20** plus 20p post

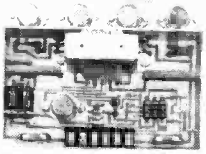
ADD 10% VAT and 25p post and service charge if order under £5

J. BULL (ELECTRICAL) LTD.

(Dept. P.E.), 7 Park St., Croydon CR0 1YD
Callers to: 102/3 Tamworth Rd., CROYDON

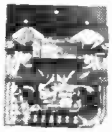
TUAC

NEW TUAC POWER MODULES. Now in their second successful year offering more power and quality than ever before.



TP100
Illustrated
£15·25

- ★ 125 Watts RMS continuous sine wave output
- ★ 4 RCA 150 Watt 15 Amp output transistors
- ★ Special layer wound driver transformer
- ★ Short, open, and thermal overload protection
- ★ Compact size: 7 x 6½ x 3 in.



TL100
Illustrated
£11·50

- ★ 100 Watts RMS sine wave
- ★ 2 RCA 15 Amp output transistors
- ★ Rugged transformer driver
- ★ Full thermal overload protection
- ★ Compact size: 5 x 5 x 3 in.

TL60 **£9·75**

- ★ 60 Watts RMS sine wave
- ★ RCA 115 Watt output transistors
- ★ Only six connections to make
- ★ Same size as TL100

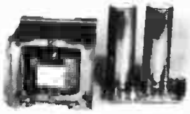
TL30 **£7·50**

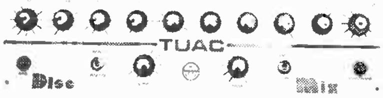
- ★ 30 Watts RMS sine wave
- ★ Full thermal overload protection
- ★ Short and open circuit proof
- ★ Rugged transformer driver

Specification on all four power modules
All output power ratings ±1dB. Output impedance 8–15 Ohms. THD at full power 1% typically 0·5%
Input sensitivity 60mV into 10kΩ. Frequency response 10Hz–25kHz ±2dB. Hum and noise better than −75dB.

Power supplies vacuum impregnated Transformers with supply board incorporating pre-amp supply:

PS 125 ±50 volts for one TP100	£8·75
PS 100 ±45 volts for one TL100	£8·00
PS 60 ±40 volts for one TL60	£6·75
PS 30 ±50 volts for one TL30	£4·50
PSU 2 for supplying Disco Mixer	£4·00





TUAC DISCOTHEQUE MIXER WITH AUTO FADE **£25·50**
Designed for the discerning D.J. of professional standard.
Offering a vast variety of functions.
Controls: Mic Vol, Tone, Over-ride depth, Auto Manual Sw, Tape Vol, L & R Deck Faders, Deck Volume, Treb and Bass, H. Phon Vol, Selector, Master Vol, on/off sw, Max. output 1V RMS. Specification as VA06
PANEL SIZE 18" x 4½" DEPTH 3"

ALL PRICES INCLUDE V.A.T. AND POSTAGE AND PACKING

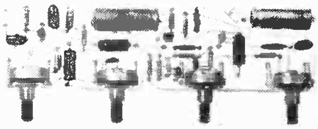
ACCESS & BARCLAY CARDS ACCEPTED, JUST SEND US YOUR NUMBER. H.P. ARRANGED THROUGH PAYBONDS.

PREAMPLIFIERS

All Tuac audio modules are constructed on glass fibre P.C. board, are ready assembled and fully tested. Low noise silicon and FET transistors together with H.S. carbon film resistors are used throughout. Extensive research has gone into the various wide range tone control circuits, producing superb sound quality from any signal.

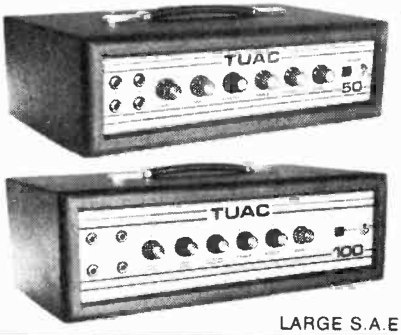
VA08	Vol. Treb. Mid and Bass Controls. HI IMP. FET I/P. Suitable Mic. Guitar. Radio. Crystal/Ceramic P.U. Sensitivity 4mV. Treb +35dB at 16kHz. Mid +20–15dB at 1kHz. Bass +20–10dB at 40 Hz.	£4·25
VA06	Vol. Treb and Bass Controls. 8mV sensitivity. Treb +28–15dB at 12kHz. Bass ±18dB at 40Hz	£3·75
AMF01	**Tuac Auto Fade Unit fades music when you speak.** Auto Mic Over-ride for Disco use. Feed Deck and Mic Pre-amps in. Auto fade O/P to main Amp. 38mV operating level. Depth and Vol. Controls.	£5·00

VA08 ILLUSTRATED



SIZE 6½" x 2" x 1"

TUAC HIGH POWER AMPLIFICATION—built to high standards, and built to last



50 WATT RMS SINE WAVE ALL PURPOSE AMPLIFIER

Suitable for Disco, PA, Guitar, 4 inputs, 2 volume controls, Master volume, treble, middle and bass controls. Rugged circuit, rugged leathercloth covered case, short and open circuit protection. Tone control specification as VA08 pre-amp. FULLY FUSED

50 WATT	£44·00
100 WATT	£66·00

LARGE S.A.E. WITH ALL ENQUIRIES PLEASE

TUAC MAIN DEALERS

BRISTOL DISCO CENTRE, 86 Stokes Croft, Bristol 1. Tel. Bristol 41666.
CALBARRIE AUDIO, 38 Cromwell Road, Luton, Beds. Tel. Luton 411733.
SOCODI, 9 The Friars, Canterbury, Kent. Tel. Canterbury 60948.
G. WALKER AUDIO, 61 South Street, St. Andrews, Fife.

MANUFACTURERS OF ELECTRONIC AND AMPLIFICATION EQUIPMENT
SPECIALISTS IN QUALITY TRANSISTOR EQUIPMENT
OPEN 6 DAYS A WEEK. 9.30 a.m. – 6.00 p.m.

TUAC

TRANSISTOR UNIVERSAL
AMPLIFICATION COMPANY LTD. (DEPT. E)
163 MITCHAM ROAD, LONDON SW17 9PG
01-672 3137/9080

Liquid-Crystal Clocks

MM5316 DIGITAL ALARM CLOCK CHIP—

1 As in P.E. April '74 issue	
MM5316 Chip + data	£15·00
40-pin D.I.L. socket for MM5316	£1·35
LM3900	£0·69
3M Display Film 3in × 1½in	£0·50
KIT PRICE	£17·00 + VAT
DIL2-4 switch	£0·80
2 Bywood 5316-LC Kit	
MM5316 Chip + data	£15·00
40-pin socket	£1·35
RCA Liquid Crystal Display	£13·00
PCB	£2·50
3M Display Film 3in × 1½in	£0·50
KIT PRICE	£30·00 + VAT

Please note that Siemens and RCA L-Cs are not pin compatible. Other kits, chips, displays available.

BYWOOD HAS TIME FOR YOU!

CLOCK DATA SHEETS—S A E ADVICE—PHONE 0422-62757
POST & PACKING—10p OVERSEAS (AIRMAIL) 50p VAT—ALL PRICES EXCLUDE VAT
PAYMENT C W O or ACCOUNT ACCESS ORDERS & PAYMENTS BY PHONE ACCEPTED
QUANTITY DISCOUNTS ON MOST ITEMS—STATE REQUIREMENTS FOR QUOTATION

BYWOOD

BYWOOD ELECTRONICS
181 EBBERNS ROAD
HEMEL HEMPSTEAD
HP3 9RDS. TEL 0442-62757
24 HOUR ANSAPHONE ON-LINE

ENGINEERS

FREE

YOURSELF FOR A BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New Opportunities" shows you how to get them through a low-cost B.I.E.T. home study course. There are no books to buy and you can pay-as-you-learn.

The B.I.E.T. guide to success should be read by every ambitious engineer. Send for this helpful 76 page FREE book now. No obligation and nobody will call on you. It could be the best thing you ever did.

CUT OUT THIS COUPON

POST NOW

CHOOSE A BRAND NEW FUTURE HERE!

Tick or state subject of interest. Post to the address below.

- Practical Radio and Electronics (Technatron) ☐
- Electronic Engineering ☐
- Television Maintenance and Servicing ☐
- General Radio and TV Engineering ☐
- Radio Servicing, Maintenance and Repairs ☐
- C. & G. Radio, TV Electronics, Mechanics ☐
- Radio Amateurs ☐
- Practical TV ☐
- Colour Television ☐
- Computer Electronics ☐
- C. & G. LI Radio TV Servicing cert. ☐
- Post Master General 1st & 2nd class certs. ☐
- C. & G. Electrical Engineering Practise ☐
- C. & G. LI Installations and Wiring ☐
- General Electrical Engineering ☐
- Society of Engineers (Electrical Engineering) ☐
- Electrical Installations and Wiring ☐
- C. & G. Electrical Technicians (Primary) ☐
- C. & G. Telecommunications ☐

To B.I.E.T. **BPE OI** Aldermaston Court, Reading RG7 4PF QK BPE OI

NAME (Block Capitals Please)

ADDRESS

Other subjects

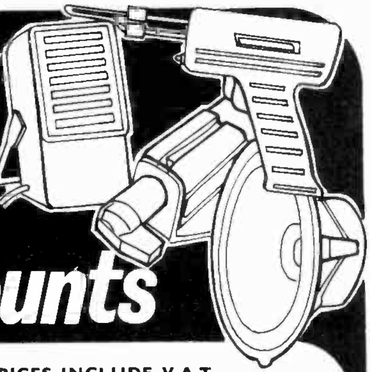
Age

Member of A.B.C.C

Accredited by C A.C C

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

'BIG'



Discounts

ALL PRICES INCLUDE V.A.T.

SPEAKER BARGAINS	£
EMI 13in × 8in 3, 8 or 15 ohm	
Plain	2·05
With Co-Axial Tweeter	2·20
Twin Tweeter	3·55
Type 350, 8 ohm, 20W	8·00
6½in, 8 ohm, 10W	2·70
8in, 8 ohm, 10W	3·75
12in, 8 ohm, 20W	5·50
8in × 5in, C/Mag. 5W	1·20
8in × 5in, Dual cone 8 ohm, 10W	2·45
ELAC 8in 8 ohm Dual cone	2·10
GOODMANS 6½in 8 ohm Dual cone	1·60
FANE, 7in × 4in, 3 or 8 ohm	1·00
8in Dual cone 8 ohm	2·40
CELESTION 8in, 15 ohm	1·55
ADASTRA 10in, 8 or 15 ohm, 10W	3·05
BAKER GROUP 25 12in, 8 or 15 ohm, 25W	6·45
P. & P.	0·25
5in, 8 ohm, 5W C/Mag.	0·85
2½in, 8 ohm or 64 ohm	0·50
P. & P.	0·10

TWEETER AND CROSSOVER	
EMI 3½in, 3 or 8 ohm C/Mag.	1·00
Cone Tweeter 8 or 15 ohm, 10W	2·40
Cone Tweeter 8 ohm, 3W	1·40
Horn Tweeter 8 ohm, 20W	5·85
Dome Tweeter 8 ohm, 30W	4·85
Crossovers CN23 (3 ohm), CN28 (8 ohm), CN216 (16 ohm)	1·05
P. & P.	0·10

KIT FORM CABINETS, TEAK VENEER.	
12in × 12in × 6in with 8in, 8in × 5in or 6½in and 3½in cutout	2·45
17in × 10in × 9in with 8in or 13in × 8in cutout	3·50
18in × 11in × 9in with 13in × 8in cutout for EMI 350	4·25
P. & P. each	0·35

MICROPHONES	
CM20 Crystal Hand	0·50
CM70 Planet stick metal, switch crystal	1·55
DM160 Dynamic uni-dir, ball metal	3·95
UD130 50K/600 ohm, uni-dir, ball metal	4·50
TW206	5·75
CONDENSER MIKE 600 ohm, uni-dir	7·90
Cassette Stick Mike with R. Control on/off switch (2·5 and 3·5mm J/Ply)	1·35
P. & P.	0·15

SOLDERING IRONS	
ANTEX CN240 15W	1·60
SK1 Kit (15 watt iron, 2 spare Bib, etc.)	2·65
X25 25W (low leakage)	1·60
P. & P.	0·10

CARTRIDGES	
ACOS GP91/2SC or GP91/3SC Stereo comp.	1·00
GP93/1 Stereo crystal	1·35
GP94/1 Stereo crystal	1·75
GP95/1	1·35
GP96/1	1·75
GP101	0·75
SONOTONE 9THAC Stereo ceramic, diam.	1·80
19-TI Stereo crystal	0·80
BSR SC5M Stereo ceramic	2·25
SX5H Stereo crystal	1·60
SX5M Stereo crystal	1·60
X5H Mono/stereo	1·25
X5M Mono/stereo	1·25
GOLDRING G800	3·85
G850	2·95
P. & P.	0·05
STYLI FOR ABOVE	
Sapphire 35p D. Diamond	1·25
GOLDRING G800/G850	1·95

BATTERY ELIMINATORS	
240V input 6, 7·5 or 9 300mA	2·20
12V d.c. input (fits in car lighter socket) 6, 7·5 or 9 d.c. output at 300mA	2·20
P. & P.	0·10

TAPES	Stnd.	LP	DP
5in	45p	55p	70p
5¾in	55p	65p	95p
7in	70p	1·00	1·30
P. & P. 1–3 each			0·09
4 or more lot			0·30

LOW NOISE CASSETTES	1–5	6–10	11–20
C60	35p	33p	30p
C90	45p	43p	40p
C120	55p	52p	50p

Cassette Head Cleaner	0·35
P. & P. 1–5 each	0·03
6–10 lot	0·15
11–20 post free	

PLASTIC LIBRARY CASES for	
5in Reels	0·18
5¾in Reels	0·22
7in Reels	0·25
CASSETTE CASES	0·10
P. & P. 1–3 each 5p; 4 or more	0·20

BIB ACCESSORIES	
Tape Editing Kit, Ref. 23	1·30
Recording Tape Splicer, Ref. 20	1·15
Cassette Tape, Editing, Ref. 24	1·40
Cassette Salvage Kit, Ref. 29	0·40
12's Cassette Case, Ref. 34	1.00
Stylus Balance, Ref. 32A	1·15
Spirit Level, Ref. 46	0·50
Hi-Fi Stereo Test Cassette	1·90
Groove-Kleen Record Cleaner	1·90
P. & P.	0·10

BUDGET SPEAKER SYSTEMS

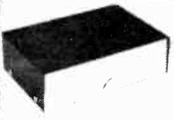
1. Pr. of 10watt 8ohm 2 speaker system in de luxe teak veneer cabinet 18" × 11" × 9" wired, inc. plugs. £25·00 per pair.
2. Pr. of 20watt 8ohm 2 speaker system freq. response 50c.p.s. to 17,000c.p.s. Teak veneer cab. 21½" × 12" × 9" with 12ft. cable and plugs. £29.95 per pair.

Send 25p for COMPLETE CATALOGUE, refundable upon first order.
ALL OUR MERCHANDISE IS FULLY GUARANTEED

Riversdale Electronics

Mail Order Department E/4
P.O. Box 470, Manchester M60 4BU

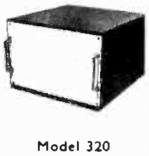
MAPLIN ELECTRONIC SUPPLIES


Model 120

LARGE or SMALL

PROJECTS DESERVE A Centurion PROFESSIONAL QUALITY INSTRUMENT CASE—4 MODELS

Model 120 all aluminium two part construction. Top and sides, blue hammer finish, front, rear and base: white. Others: mild steel three part construction.
Top, base, sides and detachable rear panel, blue hammer. Detachable aluminium front panel finished in white.
Dimensions in inches.


Model 320

Model	W	H	D	Price
120	8	2½	6	£1·85
220	8	6	3½	£2·65
221	8	6	6	£2·90
320	12	8	12	£5·75

Chassis for model 320 £1·75 extra.

Please send s.a.e. for free illustrated leaflet.

ORGAN BUILDERS

MES announce the very latest development in organ circuitry.

THE DMO2

13 Master Frequencies on ONE tiny circuit board.

LOOK AT THESE AMAZING ADVANTAGES

★ 13 frequencies from C8 to C9. ★ Each frequency digitally derived from a SINGLE h.f. master oscillator. ★ Initial tuning for the WHOLE ORGAN: ONE SIMPLE ADJUSTMENT. ★ Relative tuning NEVER DRIFTS! ★ External control allows instant tune-up to other musicians. ★ Outputs will directly drive most types of dividers including the SAJ110. ★ And each output can also be used as a direct tone source. ★ Variable DEPTH AND RATE tremulant optional extra. ★ Gold-plated plug-in edge connexion. ★ Complete fibre glass board (including tremulant if required) ONLY 3·7in. × 4·5in. ★ Very low power consumption.

★ EXTREMELY ECONOMICAL PRICE. ★ Ready built, tested and fully guaranteed.
DMO2T (with tremulant) ONLY £14·25.
DMO2 (without tremulant) £12·25.

★ S.a.e. please for full technical details.

Trade enquiries welcome.

SAJ110 7-stage frequency divider in one 14 pin DIL package. Sine or square wave input allows operation from almost any type of master oscillator including the DMO2 (when 97 notes are available). Square wave outputs may be modified to saw-tooth by the addition of a few components. SAJ110: £2·63 each OR special price for pack of 12: £25·00. S.a.e. please for data sheet.

MAPLIN: Projected site of London's third airport.

P.E. SOUND SYNTHESISER

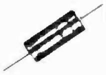
If this project seems expensive YOU HAVEN'T SEEN OUR PRICES!
We are stocking all the parts for this exciting project, from the special I.C.'s right down to the nuts, bolts and spacers for mounting the Veroboards.
Send s.a.e. now for our detailed price lists.

YOU SIMPLY MUST SEE OUR PRICES!

Keyboard 49 note C-C	£14·35
741C 8-pin DIL	36p
MFC 6040 electronic attenuator	£0·05
SG 3402N for Ring Modulator	£1·60
CA 3046	69p

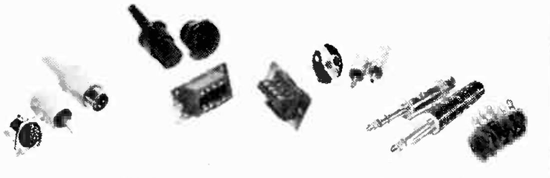
CAPACITORS

Sub-miniature
Axial lead electrolytic



Mfd	V	Price	Mfd	V	Price	Mfd	V	Price
1	63	6p	68	6·3	6p			
1·5	63	6p	68	16	6p			
2·2	63	6p	68	63	10p			
3·3	63	6p	100	4	6p			
4·7	63	6p	100	10	6p	470	6·3	6p
6·8	40	6p	100	25	6p	470	10	10p
6·8	63	6p	100	40	6p	470	25	12p
10	25	6p	100	63	12p	470	40	18p
10	63	6p	150	6·3	6p	680	6·3	10p
15	16	6p	150	16	6p	680	16	12p
15	40	6p	150	25	6p	680	25	18p
15	63	6p	150	40	10p	680	40	22p
22	10	6p	150	63	12p	1000	4	10p
22	25	6p	220	4	6p	1000	10	12p
22	63	6p	220	10	6p	1000	16	18p
33	6·3	6p	220	16	6p	1000	25	22p
33	16	6p	220	25	10p	1500	6·3	12p
33	40	6p	220	40	12p	1500	10	18p
47	4	6p	220	63	18p	1500	16	22p
47	10	6p	330	4	6p	2200	6·3	18p
47	25	6p	330	10	6p	2200	10	22p
47	40	6p	330	16	10p	3300	6·3	22p
47	63	6p	330	63	22p	4700	4	22p

PLUGS AND SOCKETS



DIN PLUGS

2 pin (1 flat)	8p
3 pin	9p
4 pin, 5 pin A (180°), 5 pin B (240°), 6 pin	10p

DIN Sockets

2 pin	6p
3 pin, 4 pin, 5 pin A (180°), 5 pin B (240°), 6 pin	7p

MAINS

P360 3 pin 1·5A chassis plug with line socket. Per pair	28p
SA 2190 3 pin 5A chassis plug	20p
SA 1862 Line socket for above	23p

McMURDO

RP8 8 way chassis plug	47p
RS8 8 way chassis socket	62p

PHONO

Plug plastic	5p
Plug screened	9p
Chassis socket	4p

JACK

Std. ¼" mono plug

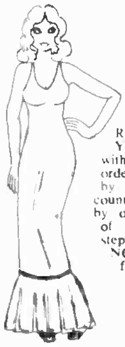
Plastic	13p
Screened	17p

Std. ¼" stereo plug

Plastic	16p
Screened	25p

Open mono socket ¼" 10p; Moulded mono socket ¼" with 2 break contacts 13p; Moulded stereo socket ¼" with 3 break contacts 18p; 3·5mm. plug plastic 8p; screened 11p; open socket 8p.

WE KNOW YOU NEED IT!



The MES 1974 CATALOGUE IS STACKED with dozens of tempting new lines. BRIMMING OVER with clear illustrations and detailed data. WE'RE WAITING TO RUSH YOU A COPY. You'll be IMPRESSED with our POST FREE ordering system. EXCITED by our BIG VALUE discount vounchers. STAGGERED by our UNBEATABLE speed of service. Take the first step towards real service NOW! Send ONLY 25p for our beautifully produced catalogue.

and leave the rest to us!

OMNIUM GATHERUM

PP3, 6, etc., battery clip dual min. **9p.**
PP1, 9, etc., battery clip separate per pair **6p.**
Pair crocodile clips 1 red, 1 black insulated sleeve **7p.**
Solder Multicore 22 s.w.g. 10 metres **20p**
Silicone grease in special dispenser 20ml **43p.**
Red neon 240V panel mounting **25p.**
Lacing Cord. Strong rayon cored PVC 25m **43p.**
Panel fuse holders 20mm **20p**; 1¼in **35p.**

Transformers
LT700 min. output transformer Pri. 1·2kΩ Sec. 5Ω 200mW **37p.**

Sub-min. Mains Transformer
6–0–6V 100mA **95p**, 12–0–12V 50mA **95p.**
Size: Both approx. 30 × 27 × 25mm

Min. Mains Transformer
Size: 46 × 31 × 38mm.
0–12V 250mA, 0–12V 250mA **£1·36.**

Mains Transformer MT3AT
Pri. 200–220–240V. Sec. 12–15–20–24–30V 1A **£3·05.**

Mains Transformer MT206AT
Pri. 200–220–240V. Sec. 0–15–20V 1A. 0–15–20V 1A **£3·66.**

Hook-up wire. 7 strand 0·2mm. PVC covered tinned copper wire for light general connexions up to 1·4A. 11 colours: black, blue brown, green, grey, orange, pink, red, violet, white, yellow. 10 metres of any one colour **20p.** Pack of 11 (1 of each colour) 10m. coils **£2·05.**

Single core screened 6p per metre.
Twin individually screened **9p** per metre.
High quality single screened 50Ω 100pF per metre, ideal for high grade audio connexions **15½p** per metre.

Mains 3-core sub-miniature 1A black PVC covered 19 strand 0·1mm per conductor. **6½p** per metre.

POTENTIOMETERS

Rotary miniature carbon track ¼" spindle

Single gang Lin or Log
5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M (and 1k Lin) 12p

Dual gang (Stereo) without switch Log or Lin 5k to 2M as above 38p.

Single gang with DP switch 250V 2A Log or Lin 5k to 2M as above 24p

PRESETS
Sub-miniature 0·1W Vert or Horiz 100, 250, 500, 1k, 2·5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M 6p

Wirewound 10% 1W ¼" spindle 10, 50, 100R **34p**; 250, 500, 1k, 5k 33p; 10k, 37p; 25k 40p; 50k 44p.

RESISTORS

Carbon Film ⅓W 5% 1Ω to 1M; 10% 1·2M to 10M		E12	1p
Carbon Film ⅛W 5% 1Ω to 10Ω; 10% 1·2M to 10M		E12	1p
Carbon Film ½W 5% 11Ω to 910k	E12 &	E24	1p
Carbon Film 1W 5% 10Ω to 10M		E12	3p
Metal Oxide ½W 2% 10Ω to 1M	E12 &	E24	4p
Wirewound 2½W 10% 0·22ohms to 0·47ohms		E12	10p
Wirewound 2½W 5% 1ohm to 270ohms		E12	10p

E12 values 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades
E24 values 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades

LINEARS

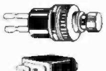
LH0042C. TO99 (TO5). FET i/p Op Amp	£4·69
LM301A. 8-pin DIL. Op Amp	55p
MC1303L. 14-pin DIL. Stereo Preamplifier	£1·39
MC1310P. 14-pin DIL. FM Stereo Decoder (no coils needed)	£3·15
MFC8010. 8-pin case. 1W Audio Power Amp	£1·20
MFC9020. 10-lead case. 2W Audio Power Amp	£1·37
NE555V. 8-pin Dil. Precision Timer	79p
NE561B. 16-pin DIL. Phase Locked Loop	£4·48
SG1495D. 14-pin DIL. Fair Quadrant Analogue Multiplier	£2·70
µA723C. TO99 (TO5). 2 to 37V Voltage Regulator	80p
µA723C. 14-pin DIL. 2 to 37V Voltage Regulator	80p
µA741C. 8-pin DIL. Op Amp	36p
µA741C. 14-pin DIL. Op Amp	45p
µA747C. 14-pin DIL. Dual Op Amp	£1·05
µA748C. 8-pin DIL. Op Amp	39p
ZN414. TO5. TRF Radio	£1·20

More linears are listed in the "PE SOUND SYNTHESISER" box, above.

Full data, pin connexions, etc., on nearly all types listed in our catalogue. Price 25p.

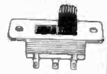
SWITCHES

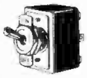
Rotary with adjustable stop 1 pole 2 to 12 way; 2 pole 2 to 6 way; 3 pole 2 to 4 way; 4 pole 2 or 3 way, each 24p.
Mains rotary DPDT 250V 2A 20p.



Push to make non-locking 12p

Slide Miniature DPDT 9p





Toggle 250V 1·5A with ON/OFF plate 25p.

Sub-miniature toggle DPDT (12 × 12·5 × 14mm excl. toggle) 250V 3A 66p

VAT Please add 10% to the final total.

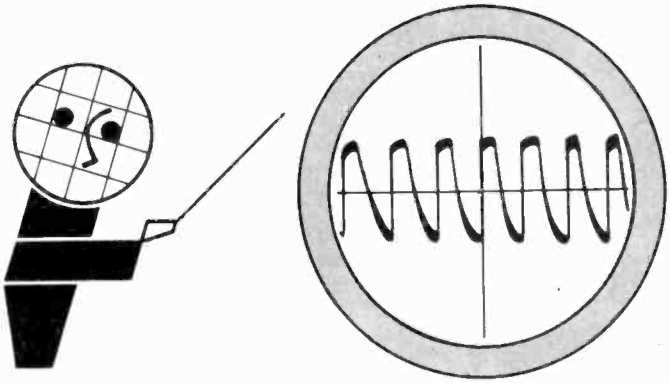
Post and Packing FREE in U.K.
(10p handling charge on orders under 50p.)

Orders and enquiries for catalogues to MAPLIN ELECTRONIC SUPPLIES, P.O. Box 3, Rayleigh, Essex. Tel. Southend-on-Sea 0702 44101

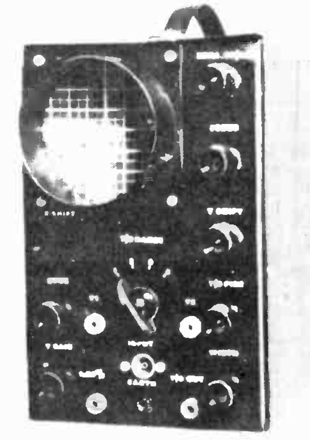
look! electronics really mastered

...practical
...visual
...exciting!

no previous knowledge
no unnecessary theory
no "maths"



BUILD, SEE AND LEARN
step by step, we take you through all the fundamentals of electronics and show how easily the subject can be mastered. Write for the free brochure now which explains our system.

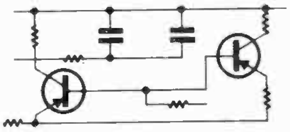


RAPY

1/ BUILD AN OSCILLOSCOPE

You learn how to build an oscilloscope which remains your property. With it, you will become familiar with all the components used in electronics.

2/ READ, DRAW AND UNDERSTAND CIRCUIT DIAGRAMS



as used currently in the various fields of electronics.

3/ CARRY OUT OVER 40 EXPERIMENTS ON BASIC ELECTRONIC CIRCUITS & SEE HOW THEY WORK, including:

valve experiments, transistor experiments amplifiers, oscillators, signal tracer, photo electric circuit, computer circuit, basic radio receiver, electronic switch, simple transmitter, a.c. experiments, d.c. experiments, simple counter, time delay circuit, servicing procedures.

This new style course will enable anyone to really understand electronics by a modern, practical and visual method—no maths, and a minimum of theory—no previous knowledge required. It will also enable anyone to understand how to test, service and maintain all types of electronic equipment, radio and TV receivers, etc.

FREE **POST NOW for BROCHURE**

or write if you prefer not to cut page

To BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL, P.O. BOX 156, JERSEY. Please send your free brochure, without obligation, to: *we do not employ representatives*

NAME BLOCK CAPS

ADDRESS PLEASE EL44

special free gift also to all our students

PE

LIBERATED DESIGN

This month we speak up for those good old liberal attributes of compromise and tolerance, as opposed to analytical exactitude. All in relation to circuit design, we hasten to add.

Without doubt very many constructors (sometimes regardless of extensive practical experience) view the origination of electronic circuits as something of a mystic art indulged in only by mathematical geniuses who have undergone the necessary rigorous training. Textbooks aimed at satisfying the requirements of examining bodies help to preserve such a myth. Of course, a detailed analytical approach to circuit design is appropriate for the student who is hoping to make a career as a designer in the industry, or intent upon following some academic role in this same field. But it is likely that the deep mathematical treatment, with an inevitable attachment to the "equivalent circuit", which forms the keystone of standard textbooks and technical college syllabuses is off-putting, if not downright frightening, to quite a number of those who indulge in electronics purely as a hobby.

This is a pity, for clearly the ability to design from scratch—if only at a modest level—can add enormously to the enjoyment and satisfaction derived from constructional activities alone.

It has to be appreciated that the amateur designer has his own particular needs to meet, and he operates in an entirely different environment to the professional designer. The latter generally works in a commercial world where cost effectiveness often counts more than technical perfection. The amateur by contrast is able to adopt a freer, more realistic approach to certain aspects of electronic circuit design. For, after all, in the end it amounts to this: real components are never perfect, so production spreads and tolerances have to be allowed for, necessitating some compromise between calculated and practical values.

This month sees the appearance of the opening part of a specially commissioned series entitled *First Steps in Circuit Design*. This series is strongly recommended to all those who have previously limited their efforts just to the building of equipment from published designs. Nothing off-putting or frightening here, not even for the beginner (Readers of our companion magazine *Everyday Electronics* please note). Our author has an uninhibited down-to-earth approach and treats the subject of circuit design as an entirely practical operation based upon well known circuit devices, and not as a cold academic exercise. He dispells some misconceptions, like the need for a high degree of arithmetic accuracy in *all* calculations, and presents a number of "home truths" with which experienced commercial designers will, we guess, quietly concur.

First Steps in Circuit Design will conclude with a fully worked-out, step-by-step design procedure for a useful project. A strictly practical design, of course.

F.E.B.

Editor
F. E. BENNETT

Editorial
R. D. RAILTON *Assistant Editor*
D. BARRINGTON *Production Editor*
G. GODBOLD *Technical Editor*
S. R. LEWIS B.Sc.

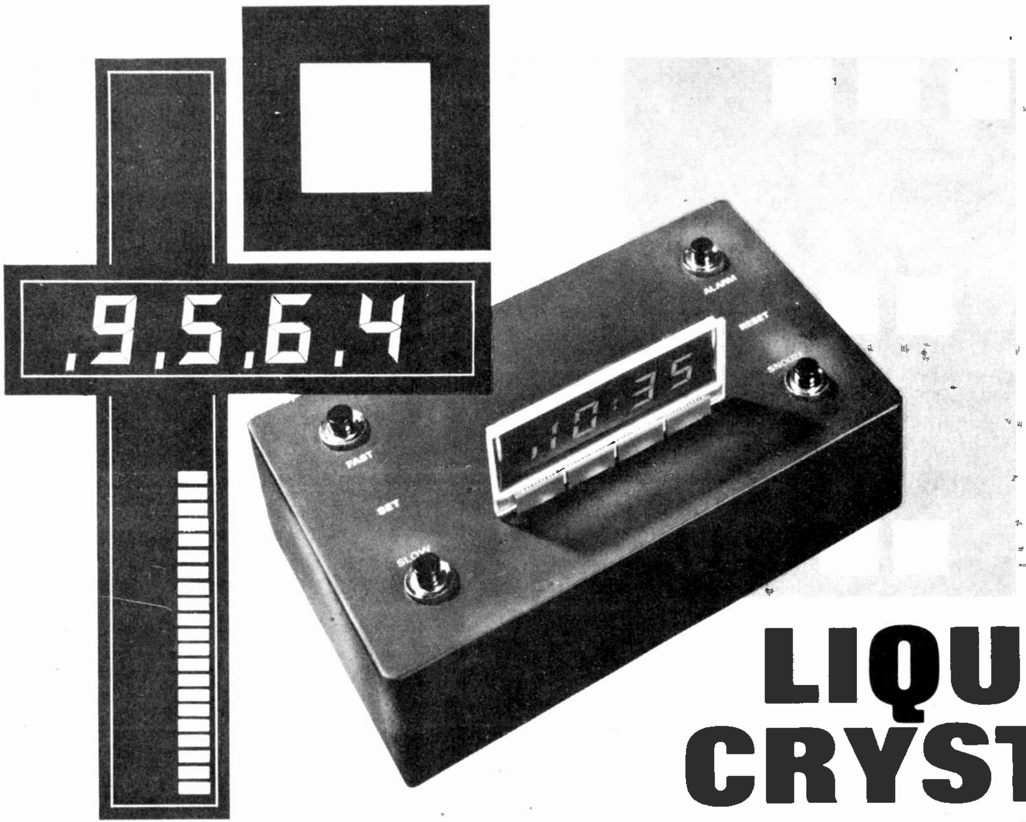
Art Dept.
J. D. POUNTNEY *Art Editor*
J. A. HADLEY
R. J. GOODMAN
K. A. WOODRUFF

Advertisement Manager
D. W. B. TILLEARD
Phone: 01-634 4202

P. J. MEW
Phone: 01-634 4210

C. R. BROWN, *Classified*
Phone: 01-634 4301

Editorial & Advertising Offices:
Fleetway House, Farringdon St.,
London EC4A 4AD
Phone: *Editorial* 01-634 4452
Advertisements 01-634 4202



LIQUID CRYSTAL CLOCK

BY S. GARRETT

THIS article describes the theory and construction of a digital alarm clock, with all the basic but complicated circuitry built into the main clock i.c. The only additions required are peripheral circuits to control power, drive the clock chip, activate radio turn-off, generate the alarm noise, link up the liquid crystal, and control the various facilities.

It's difficult to estimate a precise cost for the complete clock, but it will undoubtedly compare favourably with much earlier digital clocks based on 20 or more i.c.s, but lacking the comprehensive facilities provided by this one.

THE CLOCK CHIP

The integrated circuit used is a National Semiconductors' MM5316. It provides four display possibilities, any single one of which can be selected by switch at the user's choice. They are actual time in hours and minutes; the minutes and seconds counting linked with that time; the time at which the alarm is set; and the time remaining in minutes before the radio turn-off circuit operates.

The i.c. will interface directly with either liquid crystal displays or with seven-segment fluorescent tubes. The former is employed in this project.

The timekeeping function will operate from either 50 or 60Hz mains frequencies, according to the way in which the i.c. is wired, and the display format can be either 12 or 24 hour format. In the former case, leading zeroes are blanked and an a.m. or p.m. indication is provided on both main time and alarm set displays. This is important, of course, in order to make sure the alarm goes off at, say, 7 a.m. rather than 7 p.m.!

The a.m./p.m. indicator in the display also serves as a visual warning if there has been any form of power interruption. In such a situation, the i.c. causes it to pulse at a 1Hz rate, which ceases automatically when the time is reset. This indication is important, because even a momentary power failure will cause the i.c. to reset and display an inaccurate time, which could easily mislead if the power failure had been brief, and the ensuing time indicated were taken at face value.

The device operates over a very wide power supply range of anything between 8 and 29 volts, and this need not be regulated. It is in the familiar d.i.l. package and has 40 pins.

OPERATION

An operational block diagram of the clock chip is shown in Fig. 1 and the pin connections in Fig. 2.

The 50 or 60Hz input at pin 35 is passed through a shaping circuit to square the incoming sine wave. This is a Schmitt trigger designed to provide about 6 volts of hysteresis. A simple external RC filter is employed with the i.c. to remove any possible line voltage transients that could either damage the device or cause it to gain time.

The output of the shaper then passes to a counter chain which performs the actual timekeeping function. The first part of this consists of a programmable prescale counter, set by external wiring to divide the incoming frequency by either 50 or 60.

The resulting 1 pulse per second is then divided by 60 to obtain 1 pulse per minute, and again by 60 to obtain 1 pulse per hour.

The outputs from each of these dividing chains goes to the code converters and output drivers, and the alarm comparator circuits.

The alarm comparator senses coincidence between the alarm counters—which is the set alarm time in hours and in minutes—and the time counters—which is the actual time in hours and minutes. When coincidence is sensed, the comparator output is used to set an internal latch in the alarm circuit. The output of the latch turns on the external alarm driver transistor, which in its turn controls the external circuitry of the alarm noise generator.

The alarm latch remains set for 59 minutes, during which time the alarm noise will continue. If the latch is not manually reset before the 59 minutes are up, it will automatically reset at that point.

The "Alarm Off" control will reset the alarm for a full 24 hours, when it will once again operate at the preset time, or at whatever new time may have been set. The "Snooze" control, on the other hand, turns the alarm noise off for approximately 8 minutes, after which it starts again.

The "Snooze" control can be operated as often as the user wishes during the 59 minutes for which the alarm latch remains set. Clearly the most reluctant getter-up will be able to have seven or eight extra snoozes before he either rises, or abandons himself for the full 24 hours before the alarm sounds again!

RADIO TURN-OFF

The sleep down counter operates with the sleep output to turn a radio (or any simple appliance) off after a preset time of anything up to 59 minutes. The sleep counter display (like all the other display possibilities) is selected by switching to be described shortly. It naturally counts down from 59 to 0 as the clock continues to count up.

As long as the sleep down counter has a minutes output, rather than "0", an internal latch in the sleep circuit remains set. The latch output holds the external sleep driver transistor on, which in its turn maintains continuity in a simple relay circuit for the battery power of a radio.

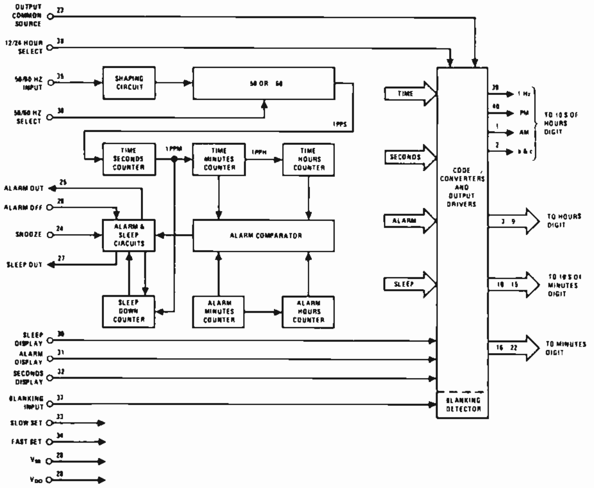


Fig. 1. Block diagram of the MM5316 clock integrated circuit

LIQUID CRYSTAL DRIVE

All of the display output drivers are open-drain devices with their sources common to pin 23, the output common source connection.

This facilitates the generation of the vital square wave drive voltages which are essential for liquid crystal displays. This is external circuitry which will be described later in the article.

Full control of the display possibilities is obtained by five different switching arrangements, all of them simple. First, time setting is achieved via the slow or fast set inputs. These, like the other three to be mentioned shortly, are obtained simply by applying the supply voltage (V_{SS}) to the appropriate pin. "Slow set" causes the clock to advance at 2 minutes per second. "Fast set" speeds up the advance rate to 60 minutes (or 1 hour) per second.

Normally the clock will display the actual time. To change the display to the alarm set time, V_{SS} is applied to the "alarm display" pin. The sleep time is displayed by the same method. With either of these displays, the "Slow" and "Fast" setting controls operate as described, excepting of course that the sleep time counts down rather than up.

When sleep time is being manually controlled, rather than coming under the control of normal clock operation, it will recycle at "00" straight back to "59" and continue counting down for as long as the manual control is applied. It will not do this when controlled normally by the clock—when "00" is reached, the counter becomes inactive, the output is removed, and the radio turns off.

This is obviously necessary if an attached radio really is to be turned off, rather than being momentarily interrupted during the one minute of "00" before coming on again to play merrily for another 59 minutes, and so on through the night!

The final display option is minutes/seconds, rather than hours/minutes. When this option is chosen, the units of minutes being displayed moves to the units of hours position, and the two-digit minutes display is replaced by a two-digit seconds display. With this display, the operation of the "Fast" and "Slow" set controls is automatically changed. The "Fast set" control now causes the seconds count to reset to "00" without a carryover to minutes, and

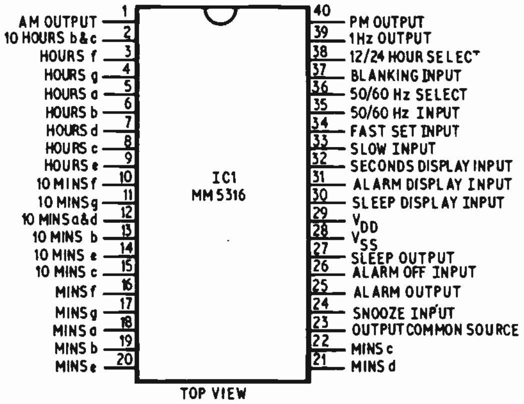


Fig. 2. Pin connections of clock chip

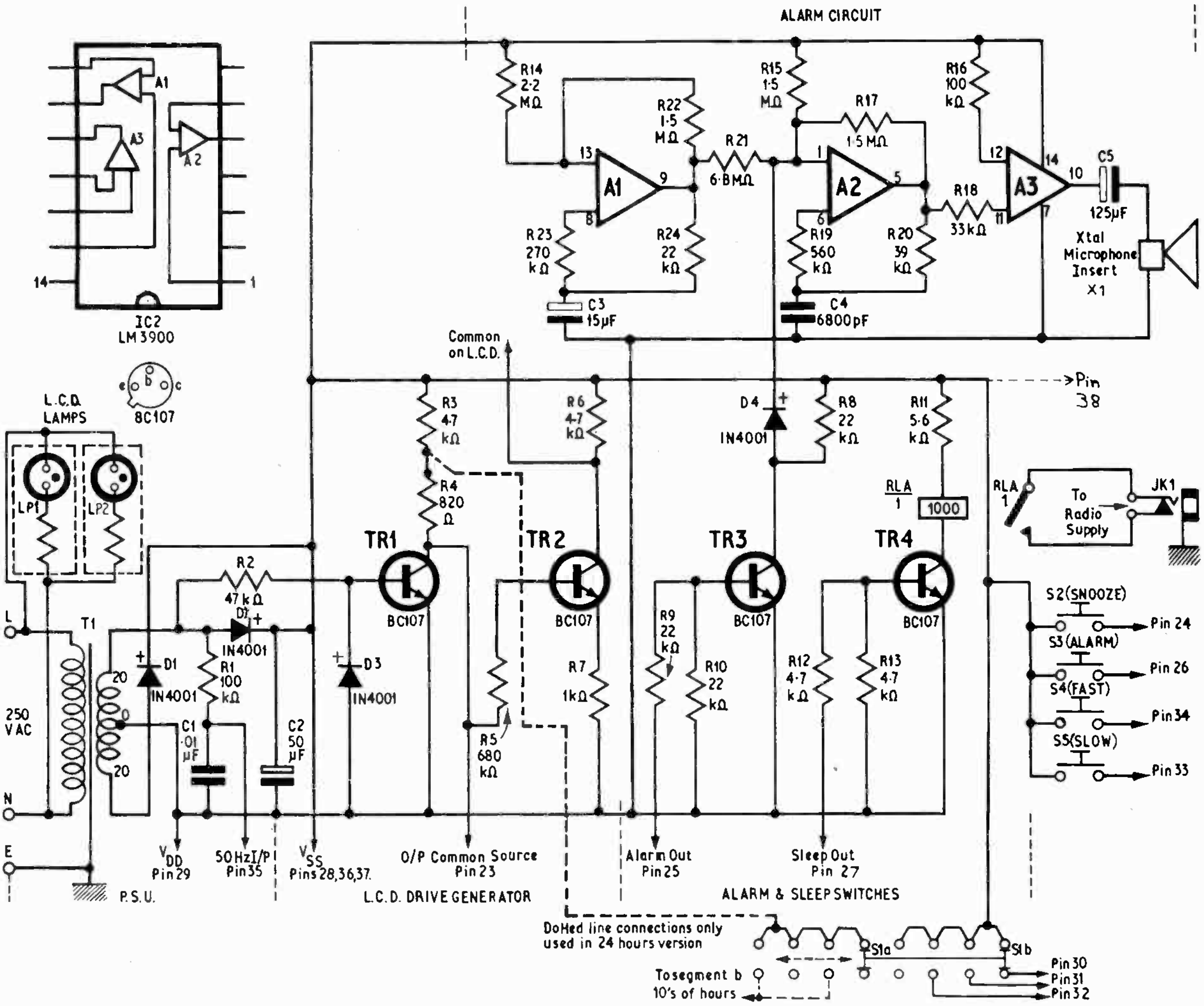


Fig. 3. Complete circuit diagram of the Liquid Crystal Clock. The diagram at top left shows the LM3900 i.c. The MC3401P is an equivalent to this and has the same pin connections.

further prevents any operation of the counting circuits until the control voltage is removed. The "Slow set" control, on the other hand, merely inhibits the input to the counters for as long as the control is applied, but does not cause any reset of seconds.

As will be seen later, this facility is invaluable for accurate setting of the clock against a known time source, such as the Greenwich time signal.

ALARM CONTROL SWITCHING

As in the switching arrangements mentioned above, alarm control is achieved by a momentary or semi-permanent connection of V_{ss} to the appropriate pin on the i.c.

It is worth mentioning that the alarm will remain off for as long as V_{ss} remains applied. However, this project employs a push button to momentarily apply V_{ss}, rather than a toggle switch to apply it until the switch is operated again. The author has found it's only too easy to forget to turn the alarm back on, with disastrous effects the next morning! Those with good memories, on the other hand, may well wish to use a switch instead of the push button.

ALARM NOISE CIRCUIT

Fig. 3 shows the full circuit for the clock. The alarm circuit uses three of the four available amplifiers in the quad amplifier i.c., and have been labelled in the circuit as A1, A2 and A3. A1 and A2 have been designed to operate as oscillators. R22 and R17 provide positive feedback in A1 and A2 respectively. Negative feedback in A1 comes from R24 and C3, while in A2 it is provided by R20 and C4.

In A1, the slowly rising voltage on C3 is translated into current by R23, which causes the amplifier to switch when the value exceeds that provided by R14. C3 begins to discharge when this happens, and the process is then repeated. A1 is operating as a low-frequency square wave oscillator with the component values chosen.

The operation of A2 is almost identical, in that the voltage on C4 causes, via the current-translating effect of R19, the amplifier to switch. This allows C4 to discharge, and the operation to continue repetitively. The frequency of operation is modified by injecting a current into it via R21, which couples the output of A1 into A2. Thus the oscillation of A2 has superimposed on it the oscillatory output effect of A1.

The total output is taken, via R18, to A3 which is serving in this application as nothing more than a loudspeaker driver. It is biased by R16 and overdriven by R18, so that its resultant output is a hard clipped square wave. This is capacitively coupled via C5 to the sound output device, which in this case is a simple crystal microphone insert.

Under normal conditions, the entire circuit is prevented from oscillating by injecting a relatively large current via R8 and D4. This current will flow when TR3, the transistor driven by the alarm output from the clock, is not conducting. However, when this is turned on by the alarm output, the junction of R8 and D4 is pulled down, and current is prevented from flowing into the amplifier, which allows oscillation to commence.

POWER SUPPLIES

One simple power supply derived from a miniature 20-0-20 transformer (T1) is all that is required for the entire circuit. Normal rectification is provided by D1 and D2, with smoothing provided by capacitor C2.

R1 and C1 form the external filter to guard the i.c. against any possible line voltage transients, which could either cause the clock to gain time or, in extreme cases, actually damage the i.c. It is from the junction of R1 and C1 that the synchronising mains frequency input to the clock comes.

LCD DRIVE GENERATOR

TR1 and TR2 form a pulse generating circuit, triggered by the mains frequency via R2.

Diode D3 is used between the base of TR1 and ground, rather than a more conventional resistor, so that a smaller value can be used for R2. This ensures that turn on occurs very quickly at the start of the mains half cycle, and equalises the pulse lengths at the collectors of TR1 and TR2.

The reason for two separate resistors R3 and R4 in the collector of TR1 is to reduce the amplitude of the pulse which is fed from their junction to the "b" segment of the l.c.d. tens of hours digit in the 24 hour version of the clock. This makes sure the amplitude of the directly supplied "b" segment pulse is the same as that on the common connection to the l.c.d. from the collector of TR2. This, in turn, matches the amplitude of the signals from the clock chip to the l.c.d. There is, of course, no connection at the junction of R3 and R4 in the 12 hour version of the clock.

CHIP OUTPUT SWITCHES

Both TR3 and TR4 are acting as simple switches, under the control of the alarm and sleep outputs from the clock chip. Under normal circumstances, the base/emitter resistors R10 and R13 hold the transistors off. When either the alarm output or sleep output from the chip is activated, however, TR3 or TR4 is immediately turned on.

In the case of TR3 this immediately allows the alarm noise generator to operate. In the case of TR4, the transistor's operation is used to activate a simple reed relay, which will close the battery supply circuit to an external radio, whose power is being derived from its own battery, but only via the jack-plug connected in series with the relay.

LIQUID CRYSTAL DISPLAY

Time indication for the clock is provided by a Siemens liquid crystal display. Such displays are very new, but are now being used in a growing number of applications. They have several enormous advantages. For instance, they have extremely small power requirements, which means they can be used extensively in battery-driven circuits. Again, the low voltage and current needs means they can usually be addressed directly by m.o.s. circuits, without intermediate driver stages.

If we are to be fair, the two possible disadvantages of liquid crystal displays should also be mentioned here. First, they produce no light of their own, unlike l.e.d.s, luminescent anode tubes, Nixies and the like. That is to say, the display can only be seen if there is a light source of some sort available to illuminate it. For this reason, two small neon lights have been built into the project (LP1, LP2) at the base of and immediately behind the liquid crystal. These serve to light the digits up with a

COMPONENTS . . .

Resistors

R1	100k Ω	R9	22k Ω	R17	1·5MΩ
R2	47k Ω	R10	22k Ω	R18	33k Ω
R3	4·7k Ω	R11	5·6k Ω	R19	560k Ω
R4	820 Ω	R12	4·7k Ω	R20	39k Ω
R5	680k Ω	R13	4·7k Ω	R21	6·8MΩ
R6	4·7k Ω	R14	2·2MΩ	R22	1·5MΩ
R7	1k Ω	R15	1·5MΩ	R23	270k Ω
R8	22k Ω	R16	100k Ω	R24	22k Ω

All ½W 10% carbon

Capacitors

C1	0·01μF
C2	50μF elect. 40V
C3	15μF elect. 40V
C4	6,800pF
C5	125μF elect. 40V

Transistors

TR1–TR4 BC107 (4 off)

Integrated Circuits

IC1	MM5316
IC2	LM3900 *or* MC3401P (Motorola)

Diodes

D1–D4 1N4001

Liquid Crystal Display

L.C.D.–AN4132 (Siemens) including socket

Relay

RLA1 Reed relay, 1k Ω coil, 9–12V (R.S. Components)

Switches

S1	2-pole 4-way d.i.l. switch type DS-16A
S2–S5	Single pole push to make switches (4 off)

Miscellaneous

T1 20–0–20V, 30mA miniature mains transformer

LP1, LP2 mains neons (2 off), Eddystone diecast box 7¼in × 4½in × 2in.

1-40 pin d.i.l. i.c. socket, 1–14 d.i.l. i.c. socket, 14, 12BA ¾in bolts, 42, 12 BA nuts, 3M display film 3¼in × 1¼in, 0·03in thick, 28 degree angle

JK1—miniature jack socket and plug to suit.

gentle red glow, if the clock is at the bedside at night. If the clock is being used in normal lighting, there will be no difficulty in seeing the digits. In fact, they have the advantage of being considerably larger than most comparable display methods.

The other disadvantage, if it can be called that, lies purely in circuitry. Liquid crystal displays *must* be driven with a reasonably symmetrical alternating voltage. Sine, square, sawtooth; almost any waveform will do, the aim being to avoid any d.c. element in the driving voltage as this will shorten the l.c.d. life, often dramatically.

L.c.d.s use a nematic liquid crystal film, sandwiched between two parallel glass plates. An electric field applied to this film causes it to become milky immediately. The field is produced very simply by applying a voltage to a transparent conductive coating on the inside of the glass plates. The opacity of the liquid crystal under the influence of the charge can be increased by increasing the voltage. Eventually, however, a saturation point is reached, after which no increase in the contrast ratio between the opaque and clear areas occurs.

The process reverses as soon as the driving voltage is removed when almost instantly the liquid crystal reverts to its normal completely transparent condition.

Two types of Siemens liquid crystal display are available for use, according to whether the ambient illumination is expected to come from in front or behind of the l.c.d. The transmissive type is normally completely transparent and is used with rear illumination. The reflective type has a thin mirror coating built in, and is used when the ambient lighting is from the front.

This project uses the transmissive Siemens l.c.d., but the two are quite interchangeable, and if anyone wished to use the reflective type there is no reason why this should not be done. Both have been tried, and the transmissive seems to be the better.

DISPLAY FILM

Display film is a development from the 3M Company, and is again extremely new. It is a thin (between ·01 and ·03 of an inch, according to type) plastic film, made of cellulose acetate butyrate. Actually inside the plastic are a large number of very closely spaced louvres, all at the same angle to each other. In other words, it is exactly like a tiny venetian blind. Placed behind an l.c.d., it allows natural light falling on the plastic at angle—perhaps from a window, or a lamp behind and above the l.c.d.—to pass through the plastic and illuminate the active segments of the display.

When the display is viewed normally from the front, however, it appears to be backed by a completely opaque black sheet, against which the illuminated segments stand out very clearly indeed. The effect is quite clear in the introductory photographs.

The display film is not an essential, since the clock design places it in a case which is sprayed matt black, and has the l.c.d. mounted well forward on the top of the case. Thus the display is normally seen against a matt black background, and is clearly visible. Nevertheless, the project is considerably enhanced by using the film, and it is both inexpensive and obtainable from several of the outlets supplying the l.c.d.

Next month: Full constructional details of the clock will be given.

Readout—

Information please

Sir—We belong to a group researching new techniques of energy provision, conservation and use in domestic dwellings.

In our new proposals we aim to make a maximum use of ambient solar energy by using simple, easy to construct systems for collection, storage and application.

During the past 12 months; operating an integrated prototype dwelling we have built and tested solar water heaters, recycling systems for liquid and solid wastes, various food production systems and for electrical generation using wind power, both high-speed propellers and slow-speed rotor devices.

We would welcome any advice on electrical generation, control circuitry and storage systems. We are interested in the possibility for using small electric motors, ex-car parts, surplus equipment (alternators and dynamos), and the winding of generators for power supplies ranging from 18W-2kW.

Derek Taylor and John Shore,
36, Bedford Square,
London, WC1B 3ES

Group One

Sir—May I through the courtesy of your columns bring to the attention of Component Retailers the way we are attempting to deal with an urgent problem which affects all of us. I refer to the shortage of Electronic Components.

There are many buying Groups operating successfully in commodities ranging from Groceries to Television Sets, but we believe we are the first (and perhaps the only one) dealing in Electronic Components. We are the poor relation of this industry and it is the manufacturer who can buy bigger quantity who comes first. "Group One" has been functioning for about three years during which time it has prevented the total disappearance of many vital components by large purchases. To give us more buying power we would like to recruit more members. Would any Electronic Component Retailer who is interested please contact the writer at the following address.

A. Sproxton (Director),
Home Radio (Components) Ltd.,
234-240 London Road,
Mitcham, Surrey.

POINTS ARISING

CONNOISSEUR BD1 KIT (February 1974, page 35)

The kit is available from most hi fi stockists throughout the country. It is *not* obtainable direct from the manufacturers, A. R. Sugden & Co, as stated in our report. This company wishes it to be made clear that they **do not** supply goods other than through the usual trade channels.

100W INVERTER/CHARGER (February 1974)

Veritronics supply the Printed Circuit Board *only*. Transformers and Inductors can be obtained from Zeta Windings.

THE OTHER SIDE

It has not been the custom to report on the military side of the space activities. In doing so now it is a reminder that though the programmes for the future are not definite, with many astronauts and technologists wondering about their future, the space activities will be kept alive for defence and offence. Apart from the space shuttle and the Mars programmes nothing is definite for the rest of the 70's, though this could change rapidly.

It is a sad reflection that continuance on a grand scale for peaceful purposes should depend upon thoughts of aggression.

Last year Russia launched a whole series of spy satellites in the space of two weeks in October. There is little doubt that these satellites were directed to the events in the middle east.

Again, some of the more sophisticated equipment comes from the requirements set by the services. The returned film capsules must show details not otherwise needed for more formal research. This presupposes that the cameras alone will have had considerable development. These will be available later for peaceful purposes.

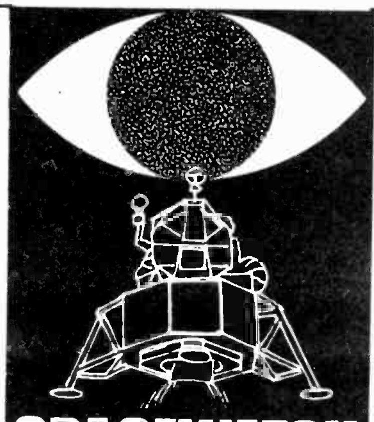
When thinking of the missiles and counter missiles it is usual to do so in the terms of a bomb or similar one-off device. The reality is now somewhat different. Taking the United States who do publish figures, the data shows that up to 1970 some 4,000 warheads were available. By 1975 this figure will have risen to something of the order of 10,000.

As this target has more than halfway reached the number stated it is of interest to consider the type of vehicle which carries the warheads. By far the most advanced is the Multiple Independently Targeted Re-entry Vehicle, *MIRV*. This system enables a single vehicle to carry a number of warheads, which can be directed independently and at different intervals of firing, on a number of separate targets.

Details of Russian devices have not been released by Russia but America believes that a *MIRV* device has been tested.

ACCURATE PICTURE

A knowledge of control devices enables a fairly accurate picture of the system to be made up. The multiple unit vehicle which carries several small satellites appeared quite early, by 1963 in fact. This system has been used for scientific purposes. The first experimental vehicles were not in fact related to defence directly.



SPACEWATCH

BY FRANK W. HYDE

In the *Able-Star* system, which was to be a second stage to the *Thor* booster, the first stop-start control was tested. The Able-Star had restarting facilities with guidance control, an accelerometer and a programmer. The first test in space was as early as 1960. In April of that year two satellites were launched by this type of vehicle. These were a Naval Research Laboratory satellite for solar studies and a Transit satellite.

By 1963 another system of vehicles was under way. This was the *Atlas-Agena* combination. This time there was an entirely different programme for the satellites and they were placed in widely different orbits. In 1963 there was a Test Ban Treaty to be observed and the system was used to monitor that the signatories were complying with the ban. The satellites were called *Vela* and a pair of these were placed in orbits between 62,000 and 72,000 miles high and 180 degrees apart.

In the early 60's the *Titan III* was the largest of the United States booster rockets. A system called Transtage was used in 1966 to put eight satellites in different equatorial orbits. Each satellite weighed about 100 pounds and the orbits were at an altitude of 21,000 miles. This was an ingenious experiment and the procedure adopted was to achieve near circular orbit of the "mother" system using the stop start facilities. This near circular orbit gave a period of slightly more than 22¼ hours. The successive releases resulted in longer periods decided by the amount of boost that each one received.

The system was proven by three further launches of a similar nature at intervals of several months. It was this series of successes that led to final stepping up of these programmes.

Without pursuing the reasons for the strategy or endeavouring to discover the exact situation by a detective exercise, the future progress is such that by 1978 the *MIRV* system will be able to carry up to 24 warheads of increased size and by 1980's larger warheads still.

A few investigators are seeking the answers as to what is being done where, but the only comfort so far, if indeed that is a correct term, is that the technology will not stagnate from lack of funds.

VENUS AND ON TO MERCURY

The sling-shot *Mariner 10* mission to Venus and Mercury has a special place in the Mariner series. Before the original planning for more sophistication than *Mariner 9* could be implemented, a severe cut back of funds in 1969 made rethinking necessary.

A number of problems arise in the *Mariner 10* programme for the reason that in approaching Mercury the thermal increase has to be taken into account without reducing the Venus activity value. For one thing a thermal shield or sunshade of Teflon impregnated glass was required.

Since the solar flux is three times as high in this mission there was no need for the usual four solar power panels and these were reduced to two. However, within the budget allowed ingenuity has made a number of new approaches possible. The weight of the vehicle is of the order of half a ton of which 170 pounds is the scientific payload.

The path of the vehicle will be highly elliptical taking about 170 days and the vehicle will visit Mercury twice. There will be two new cameras for television which will have wide and narrow angle facilities each with three times the original focal length of the Vidicon units. This is mainly because of the "real time" television transmissions. This scheme also required a much higher gain aerial.

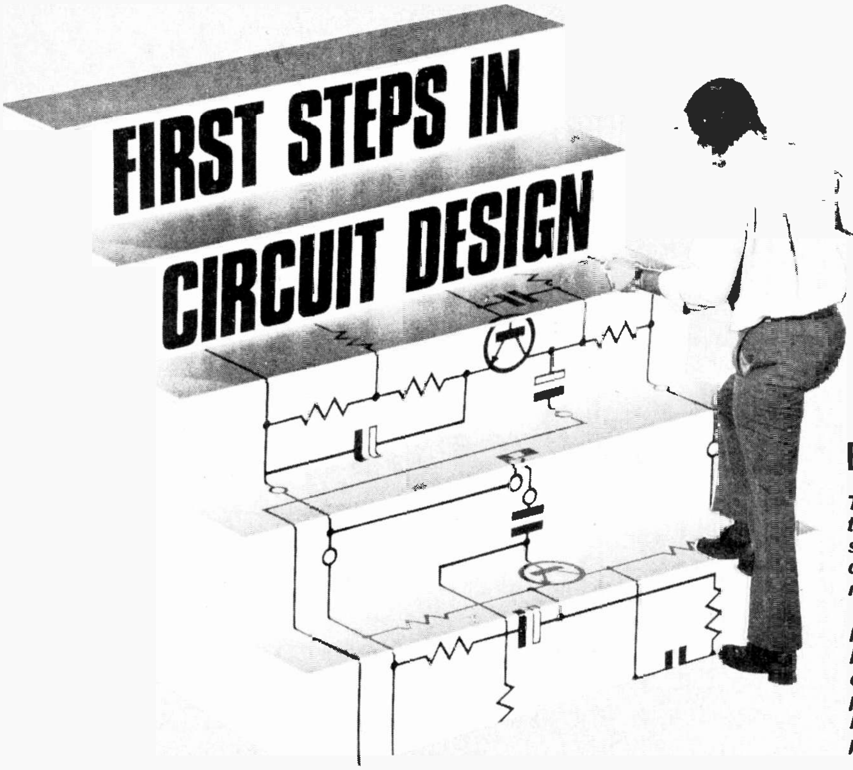
The seven experiments mounted on the probe include two magnetometers. So far there has been no evidence of the two planets having magnetospheres and in consequence this is a vital experiment.

There is a charged particle telescope to observe the solar bombardment of Mercury and two ultraviolet spectrometers to scan the airglow of the Earth and also for atmospheric analysis. Other instrumentation deals with the protons and electrons in the solar wind and an infra-red radiometer is used to check Mercury for hotspots.

The results are important—for a number of well-known astronomers have made predictions with differing ideas.

FIRST STEPS IN CIRCUIT DESIGN

1



By A. P. Stephenson

This series, specially written for the beginner, takes you step-by-step through transistor circuit design in a simple, non-mathematical way.

Design of a small signal amplifier will be followed by a Class B amplifier and the series will conclude with a constructional project so that your theoretical knowledge can be put into practice.

THE DESIGN of equipment to commercial production standards requires wide experience, strong mathematical ability, and an almost encyclopaedic knowledge of current component prices.

A production line design must not only satisfy the specification claimed, it must also make money. This causes the designer to approach all products with a cost effective bias. He must often resist the temptation to include extra components which he, as an engineering purist, feels should be present, because of the watchful eye of the accounts department.

The amateur designer is free from most of these restrictions because he will be concerned with a "one-off" circuit. It will not matter the slightest if he pops in a 1 per cent tolerance resistor where a 20 per cent would have been sufficient. Neither will it matter if a potential divider chain carries a few more milliamps than it needs.

1.1. GETTING STARTED

A stock of resistors and capacitors can be purchased very cheaply from various component suppliers and as for transistors and diodes, they are almost as cheap.

A would-be designer should not be put off by the feeling that his mathematics is not good enough. It is possible to achieve reasonably predictable design even if your mathematical qualifications are G.C.E. "O" level (failed). The vast majority of design work entails little more than elementary arithmetic with a sprinkling of algebra as taught to 13-year-olds.

WHY SHOULD I LEARN TO DESIGN?

There is certainly no need to design your own equipment because of the hundreds of constructional projects published in magazines. Most of these are contributed by old hands at the game who have often come up the hard way and such designs can be safely taken as thoroughly tested pieces of work.

However, there are a few of us who like "doing our own things". There is a tremendous feeling of satisfaction in creating even a simple piece of circuitry particularly after a few voltage checks confirm that the predictions were correct. Practice in simple design is the finest way to get the real feel of electronics.

A word of warning: keep off complex circuitry until experience is gained—too many frustrating failures in the early stages of a hobby can lead to a change of interests.

TEST EQUIPMENT

It is rather pointless designing without being able to test. The following items of test gear should be gradually acquired:

1. Electronic multimeter—This very useful item is quite cheap nowadays and well worth the investment.
2. Audio Signal Generator—Excellent construction kits are available.
3. Oscilloscope—Not essential but increases the fascination of electronics to an almost unbelievable degree. Well worth the £30 or £40 spent.

1.2. HANDLING THE ARITHMETIC

Answers to resistor calculations are seldom required to more than two figures. Transistors are subject to wide variations in specification and any so-called constants like h_{FE} are seldom guaranteed to within 50 per cent (unless a higher price is paid for selected specimens).

Bearing these factors in mind we can state the number one rule of circuit design:

> Don't be too fussy with arithmetic, and if you are, don't expect your voltmeter readings to reflect this or you will be disappointed.

Experience will soon teach you to distinguish between a normal variation due to tolerances and an abnormal condition.

HANDLING ROWS OF NOUGHTS

It is an unpleasant fact of life that amps and ohms are comparatively rare units in transistor circuitry. Most stages operate with currents in the milliamp or microamp range and resistors in the kilohm or megohm range.

To save writing rows of noughts after decimal points, remember that

volts = milliamps × kilohms

and volts = microamps × megohms

If you are proficient in handling powers of ten, note that $1\text{mA} = 10^{-3}\text{A}$, $1\mu\text{A} = 10^{-6}\text{A}$, $1\text{k}\Omega = 10^{3}\Omega$, $1\text{M}\Omega = 10^{6}\Omega$.

It is sometimes necessary to handle time constants, in which the formula is $t = CR$ in seconds, farads and ohms. It is usually more convenient to use μF and MΩ.

1.3. CHOICE OF TRANSISTORS

For amateur design work, almost any silicon transistor can be used, providing it is the small-signal type usually classified as being in the "under 1W" class.

It is best to keep away from germanium specimens as they suffer from severe leakage problems which complicate circuit calculations.

With regard to high power transistors, these again are best avoided until experience is gained with the smaller types. The design of power amplifier stages is not advisable in the early phases of the hobby—they are a little pricey and require considerable design know-how to counteract their intrinsic suicidal tendencies.

The BC107, BC108 and BC109 or their equivalent "lockfit" versions BC147, BC148 and BC149 are perhaps the best bet for the beginner. They are available for a few pence each and large stocks, particularly of the BC108 are held in most radio component shops or mail-order departments. The following notes are based on using the BC108 but it is not essential to use these, in fact a good design philosophy is to make circuits which are almost insensitive to transistor species. This is not possible in all cases but it is still a good guiding principle.

CHOICE OF CIRCUITRY

Simple voltage amplifiers are ideal to practice with and can quickly be hooked up and tested out.

As mentioned above, power amplifiers should be left alone, but it is rather important to have one available to provide loudspeaker drive. Very efficient and cheap power amplifier modules are advertised in mail-order columns of this magazine. They seldom require more than a few hundred millivolts to drive them to full power output.

1.4. HOW TO TREAT A TRANSISTOR

Superficially, a transistor is a crystal blob with three wires sticking out. How it is treated as an electronic device depends on your sense of curiosity.

If you are a stickler for mathematical rigidity and enjoy complexity, this harmless blob will be analysed by means of its equivalent circuit, which is a frightening array of fictitious generators, feedback loops, resistive networks and the odd capacitor or two.

Fortunately the amateur designer (and, if the truth was told quite a few professionals) will have little need to probe so deeply.

THE VARIABLE RESISTOR MODEL

An absurdly simple, but in many cases quite adequate, way to visualise a transistor is shown in Fig. 1.1. Although the diagram shows an *npn* transistor the explanation below is equally valid for *pnp* types.

ACTION OF THE SIMPLIFIED TRANSISTOR

The collector and emitter wires are the two ends of a resistor. The ohmic value of this resistor can be varied by "moving" the base up or down. The movement is obviously not a mechanical movement but a voltage movement.

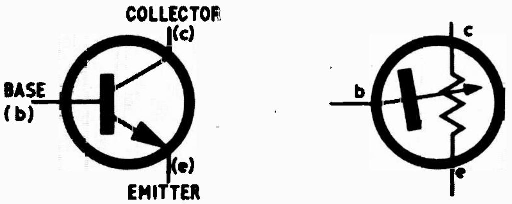


Fig. 1.1. A simple model of transistor action. The collector to emitter resistor is varied by the voltage on the base

As the voltage on the base is moved downwards towards the emitter the resistor becomes larger; if the base voltage moves upwards towards the collector the resistor becomes smaller.

Thus the transistor passes a larger current when the base is up than when it is down. The voltage across the ends (collector and emitter) have little effect on the current through the "resistor".

To avoid the mistake of treating this simple analogy too literally, the resistor becomes almost infinite (open circuit) if the base is very low but never becomes zero ohms (short circuit) even if the base is very high.

The range of movement allowed on the base is seldom more than 100mV or so.

COLLECTOR AND EMITTER CURRENTS ARE EQUAL

The collector current and the base current added together equals the emitter current:

$$i_e = i_c + i_b$$

However, in most transistors, with the exception of large power output types, the base current is so small in relation to the collector current that it can be safely ignored. This is because h_{FE}, which is the ratio I_c/I_b is usually greater than 50 and can reach 300 in some cases.

In virtually all arithmetic calculations it is quite in order to treat I_e and I_c as identical values. (Transistor data manuals seldom give emitter currents, only collector currents.)

1.5. WHEN TO IGNORE COMPONENTS

If a network contains, say, a 1kΩ resistor and you slap a 10kΩ or higher value across it, the network will hardly notice the difference.

For practical purposes the ten times rule may be used, i.e. ignore resistors in parallel which are ten or more times larger.

SMALL RESISTORS IN SERIES

Slipping in an extra 1kΩ in series with an existing 10kΩ or higher will not make much difference.

For practical purposes the ten times rule can again be used, i.e. ignore resistors in series which are ten or more times smaller.

IGNORING CAPACITORS

The ten times rule can be used to simplify capacitor calculations but the application of the rule is the reverse to that of resistance: i.e. ignore small capacitors in parallel with large ones and large capacitors in series with small ones.

1.6. THE IMPORTANCE OF THE VOLTAGE DIVIDER CHAIN

However a group of semiconductors is arranged, they will all require various voltages to set the d.c. operating conditions. It is inconvenient and costly to provide separate power supplies or batteries for each voltage and the usual solution to the problem is to use one common supply and tap various intermediate voltages by means of voltage dividers.

A voltage divider consists of two components which are usually (but not necessarily) resistors connected in series across a supply. The junction of the two is the output voltage tapping (see Fig. 1.2).

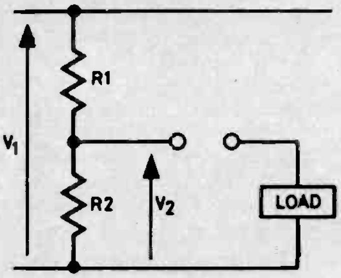


Fig. 1.2. A simple voltage divider using two resistors

THE RESISTOR CHAIN

The chain R1, R2 is the divider which produces the voltage V_2. The intention is to supply the load with voltage. The load is drawn as a black box which in practice could be the base emitter terminal, a diode, or indeed any two terminal device which requires some specific operating voltage.

Don't be misled by the apparent simplicity of the arrangement. It is important enough for its design to be treated as a very important operation. The predictability and stability of any complex circuit is, to a large extent, dependent on the correct choice of values for R1 and R2.

A common mistake is to imagine that V_2 remains the same value when the load is connected as when it was not. Suppose for example that the load requires 5V but the supply rail is 10V. Sticking a couple of 1kΩ resistors across the rail will certainly deliver 5V at the junction; the disappointment comes when the load is connected. If you are lucky the voltage may be nearly 5V but the odds are that the value will hurtle down to a prohibitively low value.

DEFINE THE LOAD

The correct starting point should always be the load itself. It is vital to know not only the voltage it requires but the current it will draw at this voltage.

Assuming this knowledge is available, the basic principle is to ensure the current drain down the chain is much greater than the current required by the load.

As an example, suppose the load requires 1mA and the divider chain is calculated to drain 1A from the supply. It is not too difficult to see that V_2 will remain rock solid whether the load is connected or not. The extra 1mA drain in relation to 1A would only cause negligible change in the output voltage.

This example (particularly with regard to values) is not intended to be a practical one. The wastage on 1A to supply a 1mA load is carrying the principle too far. The examples which follow show how intelligent compromises can be made.

1.7. DESIGN OF A DIVIDER CHAIN

All design work is based on compromise. The voltage divider, because of the insistence on passing much greater current down the chain than is required to feed the load, is a classic example of design compromise.

How great is "much greater"? Since there is no absolute answer to this question, all that can be done is to examine the evils at both ends of the range.

Remembering that the only purpose of a divider chain is to supply the load with a reasonably fixed voltage, the following limits can be noted.

NOT ENOUGH CURRENT DOWN R1, R2

Voltage at tap will fall appreciably when load is connected. Also if the load current is continuously changing, the voltage across the load will vary too much. This is because the current to the load comes from the supply rail via R1 and any changes in current demand will cause significant changes in volts drop across R1.

TOO MUCH CURRENT DOWN R1, R2

This is excellent as far as stability of load voltage is concerned. Any change in current required by the load will be negligible in relation to the large drain current and voltage variations across R1 will be quite insignificant.

The heavy current drain in the divider, however, must be paid for in battery life. Even if the supply is a mains power pack, several dividers in a circuit, all taking excessive currents will mean an increase in the cost of the unit.

There is also another reason why the current should be kept within bounds. In amplifier circuits the signal input is often applied to the centre tap of the divider, which means the resistors will be across the signal input and obviously these will be low in value if they have been designed to pass a large current. A low resistance shunted across a weak signal source will tend to short circuit the poor thing to ground before it is even given the chance to be amplified.

The compromise which strikes a reasonable balance between these two conflicting requirements is normally stated as follows:

> Current down the divider chain should be at least five and preferably ten times the current required by the load.

If the load current normally varies the term "load current" should be taken to mean the largest value expected, i.e. worse case conditions.

In future the value ten times will be used as a rule of thumb except where special demands require it to be overridden.

1.8. WORKED EXAMPLE OF A DIVIDER CHAIN

Calculate suitable values for R_1, R_2 if the divider is to feed 2V to the base of a transistor. The transistor base current is about 0·1mA and the supply rail is 10V.

First draw the circuit as shown in Fig. 1.3 including all known voltages and currents. The 2V dop across R2 is given and the 8V follows from the knowledge that the total voltage drop along the chain must add up to the supply voltage.

The load on the divider is the transistor base current, 0·1mA. Adopting the ten times rule the current down the chain should be at least 1mA. An extra little annoyance, however, is that the top resistor must also carry the 0·1mA to the base, which means it should carry 11 times 0·1mA which equals 1·1mA.

Simple application of Ohm's Law now leads to values for R_1, R_2.

$$R_1 = \frac{8V}{1{\cdot}1mA} = 7{\cdot}27k\Omega \text{ (approx)}$$

$$R_2 = \frac{2V}{1mA} = 2k\Omega$$

APPROXIMATION

It may be mentioned, however, that allowing for eleven times instead of ten times for R1 current is, in most practical applications, a case of being too fussy. After all, it is a little pointless to perform tiresome arithmetic with 11 in the bottom of a division rather than ten when the answer still has to be rounded up or down to suit the nearest preferred resistor value (try finding a 7·27kΩ resistor!). The nearest you will probably find is 7·5kΩ and even that is in the 5 per cent range.

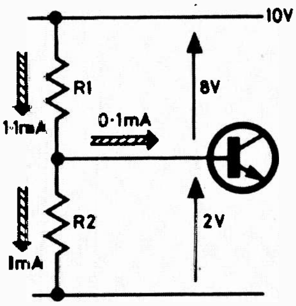


Fig. 1.3. Voltages and currents in divider chain and transistor, for example, mentioned in text

In fact, the only reason for considering the 0·1mA in R1 is to guide you when searching for the nearest resistor amongst those available.

For practice purposes, try calculating R_1 and R_2 in the following cases:

1. A transistor base requires 0·02mA at 4V. The supply rail is 20V.
2. The load is a resistor of 1kΩ requiring 5V. The supply rail is 50V.

Continued Next Month

Strictly

by K. Lenton-Smith

THE dividing line between music and pure noise, as generated electronically, is difficult to define these days. Much of the material in the "Top of the Pops" list is ambivalent in this respect, with white noise being widely used.

"What I enjoy most at the Disco", said a friend recently, "is that the volume is so high that it goes right through your chest!" Being a mere male, he was not fitted with the shock absorbers that dissipate some of this power where the fair sex is concerned. It would seem that this love of decibels, together with an equally oppressive attack on the vision by strobes and frequency-controlled coloured lighting is a fate worse than deaf!

The reader will have noticed, no doubt, that certain security organisations are working on crowd control devices that have strikingly similar characteristics. In this case the stroboscope is geared as a weapon to interfere with brainwaves: low frequency sound at high power is also being used for its crowd-stopping potential. This may explain how discotheque managements keep their patrons—by control!

HYPNOSIS

There is no doubt that a regular and rhythmic beat has a mild hypnotic effect on most people: South American rhythms are fascinating, whilst Reggae is compelling. Western civilisation's jungle drums are welcome, in moderate doses, as a mild soporific to relax the listener. Primitive graphic art and music were mainly rhythmic and there has been little change over several millenia.

No doubt the psychologist can explain why patterns appeal aesthetically, whether to the audio or visual senses. Foot-tapping is a human trait that is by no means the prerogative of the jazz addict: concert orchestra musicians are equally prone—perhaps because of the need to count sixty-four bars rest!

In his day, Bach was a composer of popular music. Those who attempt his works will appreciate that his patterns of both harmony and rhythm are extremely well-ordered. He felt strongly enough to write his 24 preludes to underline the importance of equal-temperament tuning—and working to the twelfth root of two calls for the utmost regularity.

Perhaps all this is explained by the fact that we live by patterns?

POLYPHONIC GENERATION

Whenever a group of enthusiastic organ builders get together, one topic of conversation is inevitable—the merits of various types of generators.

Divider organs, such as the P.E. Organ (no issues available), have much to commend them in terms of cost, weight, and relative simplicity. Assuming the use of discrete components, the principle is to use 12 master oscillators (probably Hartley) tuned through the top chromatic octave, each being followed by its own string of cascaded bistable frequency dividers. Because tuning is controlled by the master oscillator, each divider stage is identical and the shopping list is simplified. The waveform is normally square, though it is possible to produce sawtooth outputs from multivibrators. Blocking oscillators will also give a sawtooth waveform but the coil-winding involved makes this an unpopular project: the instrument would be hardly portable, either.

Phase relationship of any divider string will be locked and serious musicians criticise divider organs on this count for their lack of chorus effect. In practice, this disadvantage is less noticeable when reverberation is employed: the light organist will further break up the clinical divider signals with Leslie speakers and other gadgets and, bearing in mind that keying and couplers are easier to arrange, both the home constructor and commercial manufacturer tend to choose divider systems on economic grounds.

FREE PHASE

The closest equivalent to the pipe organ is obtained with free phase generators. A separately tuned oscillator is used for each frequency throughout the organ and there is no phase relationship between octaves. A good pipe organ will never be precisely in tune, primarily because of temperature/humidity effects, and free phase systems can duplicate the resulting chorus effect realistically.

A piano or organ tuner usually makes each octave progressively and slightly sharp: the brilliance this imparts to a newly-tuned instrument is particularly noticeable. Free phase generators can also be tuned this way, but this is impossible with a divider system employing divide-by-two stages after each oscillator. A trained musician will hear the difference between the two systems despite the tuning deviation being very small.

Sine waves are, of course, pure fundamentals: these have to be mixed in free phase systems to produce complex waveforms such as reed and string tones. Each oscillator's supply is usually keyed (rather than the signal itself) as it is easy to insert a time-constant at this point to control attack and decay to simulate the speech of a pipe. Keying becomes somewhat complex where several pitches have to be keyed simultaneously for resistive mixing.

The many inductances required make this type of organ less usual in the popular commercial field as portability is a selling point. However, the serious musician embarking on building his own instrument would probably choose free phase as the nearest counterpart to a pipe organ.

MOS MASTER

The constructor now finds organ construction simpler than ever. In the December issue, the Hammond "Concorde" and "Regent" were mentioned. The top 12 notes are, in fact, obtained from one oscillator which tunes the complete instrument simultaneously.

A new 16-pin DIL device, type AY-1-0212, is now available to organ builders and, fed with a 2MHz signal, produces the complete top octave between 8368·2Hz and 4434·6Hz. The chromatic outputs may each be fed into a seven-stage i.c. divider (such as type AY-1-5050 in a 14-pin DIL encapsulation) to complete an eight-octave generator system. For a cost of around £35, this competes strongly with discrete components: the 13 devices and single 2MHz oscillator could be made compact and would generally seem to be the answer to the constructor's prayer—unless he happened to be a free phase addict!

YATES ELECTRONICS

(FLITWICK) LTD.

DEPT. PE, ELSTOW STORAGE DEPOT
KEMPSTON HARDWICK
BEDFORD

C.W.O. PLEASE. POST AND PACKING PLEASE ADD 10p TO ORDERS UNDER £2.

Catalogue which contains data sheets for most of the components listed will be sent free on request. 10p stamp appreciated.

CALLERS WELCOME Mon.-Sat. 9 a.m.-5 p.m.

PLEASE ADD 10% VAT

RESISTORS

½W Iskra high stability carbon film—very low noise—capless construction
⅓W Mullard CR25 carbon film—very small body size 7·5 × 2·5mm.
½W 2% ELECTROSIL TR5

Power watts	Tolerance	Range	Values available	Price 1–99	Price 100+
½	5%	4·7Ω–2·2MΩ	E24	1p	**0·8p**
⅓	10%	3·3MΩ–10MΩ	E12	1p	**0·8p**
½	2%	10Ω–1MΩ	E24	3·5p	**3p**
⅓	10%	1Ω– 3·9Ω	E12	1p	**0·8p**
⅓	5%	4·7Ω–1MΩ	E12	1p	**0·8p**
4	10%	1Ω–10Ω	E12	**6p**	**5·5p**

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

DEVELOPMENT PACK

0·5 watt 5% Iskra resistors 5 off each value 4·7Ω to 1MΩ.
E12 pack 325 resistors **£2·40**. E24 pack 650 resistors **£4·70.**

POTENTIOMETERS

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

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0·1 matrix).
Sub-miniature 0·1W, **5p** each. Miniature 0·25W, **7p** each.

TRANSISTORS

AC107	**15p**	AF139	**32p**	BF177	**28p**	OC45	**12p**	2N3710	**11p**
AC126	**12p**	AF178	**32p**	BF178	**32p**	OC70	**12p**	2N3711	**11p**
AC127	**15p**	AF180	**40p**	BF179	**32p**	OC71	**12p**	2N3819	**32p**
AC128	**15p**	AF181	**40p**	BF180	**32p**	OC72	**12p**	2N4062	**12p**
AC131	**12p**	BC107	**12p**	BF181	**32p**	OC81	**12p**	2N4286	**20p**
AC132	**12p**	BC108	**12p**	BF194	**14p**	OC82D	**12p**	2N4289	**20p**
AC176	**15p**	BC109	**12p**	BF195	**14p**	2N2646	**60p**	40360	**35p**
AC187	**22p**	BC147	**12p**	BF197	**15p**	2N2904	**20p**	40361	**35p**
AC188	**22p**	BC148	**12p**	BF200	**32p**	2N2926	**10p**	40362	**40p**
AD140	**50p**	BC149	**12p**	BFY50	**20p**	2N3054	**58p**	40408	**40p**
AD149	**45p**	BC157	**14p**	BFY51	**20p**	2N3055	**60p**	ZTX108	**15p**
AD161	**33p**	BC158	**14p**	BFY52	**20p**	2N3702	**13p**	ZTX300	**15p**
AD162	**36p**	BC159	**14p**	BUY105		2N3703	**12p**	ZTX302	**20p**
AF114	**20p**	BC187	**22p**		**£2·25**	2N3704	**13p**	ZTX500	**15p**
AF115	**20p**	BD131	**75p**	OC26	**45p**	2N3705	**12p**	ZTX503	**20p**
AF116	**20p**	BD132	**75p**	OC28	**50p**	2N3706	**11p**		
AF117	**20p**	BD133	**75p**	OC35	**50p**	2N3707	**12p**		
AF118	**38p**	BF115	**25p**	OC42	**12p**	2N3708	**10p**		
AF126	**20p**	BF173	**20p**	OC44	**12p**	2N3709	**11p**		

ZENER DIODES

400mW 5% 3·3V to 30V, 12p.

WIRE WOUND POTS, 3W, 10, 25, 50Ω and decades to 100kΩ, 35p.

DIODES

RECTIFIER

BY127	1250V	1A	**12p**
IN4001	50V	1A	**7p**
IN4002	100V	1A	**8p**
IN4004	400V	1A	**8p**
IN4006	800V	1A	**10p**
IN4007	1000V	1A	**10p**

SIGNAL

OA85	**7p**
OA90	**5p**
OA91	**5p**
OA202	**7p**
IN4148	**5p**
BA114	**8p**

BRUSHED ALUMINIUM PANELS

12in × 6in = **25p**; 12in × 2½in = **10p**; 9in × 2in = **7p**

SLIDER POTENTIOMETERS

86mm × 9mm × 16mm, length of track 59mm.
SINGLE 10K, 25K, 100K log. or lin. **40p.**
DUAL GANG, 10K + 10K etc. log. or lin. **60p.**
KNOB FOR ABOVE **12p.**
FRONT PANEL **65p.**
18 Gauge panel 12in × 4in with slots cut for use with slider pots. Grey or matt black finish complete with fixings for 4 pots.

THYRISTORS

2N5060 50V 0·8A **30p,**

2N5064 200V 0·8A **47p,**

106F 50V 4A **40p,** 106D 400V 4A **65p.**

ALUMINIUM BOXES

AB7	2¾ × 5¼ × 1½in	**50p**		AB14	7 × 5 × 2½in	**84p**
AB8	4 × 4 × 1½in	**50p**		AB15	8 × 6 × 3in	**£1·08**
AB9	4 × 2¾ × 1½in	**50p**		AB16	10 × 7 × 3in	**£1·22**
AB10	4 × 5¼ × 1½in	**50p**		AB17	10 × 4½ × 3in	**£1·08**
AB11	4 × 2½ × 2in	**60p**		AB18	12 × 5 × 3in	**£1·20**
AB12	3 × 2 × 1in	**44p**		AB19	17 × 8 × 3in	**£1·60**

HEATSINKS

2W **24p**	4W **45p**	TO5 clip **5p**	TO1 single **5p**
3W **36p**	6W **60p**	TO18 clip **5p**	TO1 double **8p**

TRANSFORMERS

All have 240V primary

MT30/2	0–12–15–20–24–30V	2A	**£2·85**
MT50/½	0–19–25–33–40–50V	½A	**£1·90**
MT50/1	0–19–25–33–40–50V	1A	**£2·55**
MT50/2	0–19–25–33–40–50V	2A	**£3·50**
MT60/½	0–24–30–40–48–60V	½A	**£2·10**
MT60/1	0–24–30–40–48–60V	1A	**£2·80**
MT60/2	0–24–30–40–48–60V	2A	**£3·80**

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, **3p.** 0·047μF, 0·068μF, 0·1μF, **4p.** 0·15μF, **6p.** 0·22μF, **7½p.** 0·33μF, **11p.** 0·47μF, **13p.**
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF **3½p.** 0·15μF **4½p.** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p.** 1·0μF, **13p.**

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, **3p.** 0·033μF, 0·047μF, 0·068μF, **3½p.** 0·1μF, **4p.** 0·15μF, 0·22μF, **5p.** 0·33μF, **6½p.** 0·47μF, **8½p.** 0·68μF, **11p.** 1·0μF, **13p.** 1·5μF, **20p.** 2·2μF, **24p.**

MYLAR FILM CAPACITORS 100V

0·001μF, 0·002μF, 0·005μF, 0·01μF, 0·02μF, **2½p.** 0·04μF, 0·05μF, 0·068μF, 0·1μF, **3½p.**

CERAMIC DISC CAPACITORS

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

ELECTROLYTIC CAPACITORS—MULLARD 015/6/7

(μF/V) 1/63, 1·5/63, 2·2/63, 3·3/63, 4·7/63, 6·8/40, 6·8/63, 10/25, 10/63, 15/16, 15/40, 15/63, 22/10, 22/25, 22/63, 33/6·3, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6·3, 68/16, 100/4, 100/10, 100/25, 150/6·3, 150/16, 220/4, 220/6·3, 220/16, 330/4, **6p.** 47/63, 100/40 150/25, 220/25, 330/10, 470/6·3, **7p.** 68/63, 150/40, 220/40, 330/16, 1,000/4, **10p.** 470/10, 680/6·3, **11p.** 100/63, 150/63, 220/63, 1,000/10, **12p.** 470/25, 680/16, 1,500/6·3, **13p.** 470/40, 680/25, 1,000/16, 1,500/10, 2,200/6·3, **18p.** 330/63, 680/40, 1,000/25, 1,500/16, 2,200/10, 3,300/6·3, 4,700/4, **21p.**

SOLID TANTALUM BEAD CAPACITORS **12p**

0·1μF	35V	2·2μF	35V	22μF	16V
0·22μF	35V	4·7μF	35V	33μF	10V
0·47μF	35V	6·8μF	25V	47μF	6·3V
1·0μF	35V	10μF	25V	100μF	3V

VEROBOARD

	0·1	0·15
2½ × 3¾	**22p**	**16p**
2½ × 5	**24p**	**24p**
3¾ × 3¾	**24p**	**24p**
3¾ × 5	**27p**	**27p**
17 × 2½	**75p**	**57½p**
17 × 3¾	**100p**	**78p**
17 × 5 (plain)	—	**82p**
17 × 3¾ (plain)	—	**60p**
17 × 2½ (plain)	—	**42p**
2½ × 5 (plain)	—	**12p**
2½ × 3¾ (plain)	—	**11p**
Pin insertion tool	**52p**	**52p**
Spot face cutter	**42p**	**42p**
Pkt. 50 pins	**20p**	**20p**

JACK PLUGS AND SOCKETS

Standard screened	**18p**	2·5mm insulated	**8p**
Standard insulated	**12p**	3·5mm insulated	**8p**
Stereo screened	**35p**	3·5mm screened	**13p**
Standard socket	**15p**	2·5mm socket	**8p**
Stereo socket	**18p**	3·5mm socket	**8p**

D.I.N. PLUGS AND SOCKETS

2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin
Plug 12p. Socket 8p.
4 way screened cable, **15p**/metre.
6 way screened cable **22p**/metre.

BATTERY ELIMINATOR **£1·50**

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

LARGE (CAN) ELECTROLYTICS

1600μF	64V	**74p**	2500μF	64V	**80p**	4500μF	16V	**50p**
2500μF	40V	**74p**	2800μF	100V	**£2·60**	4500μF	25V	**£1·68**
2500μF	50V	**58p**	3200μF	16V	**50p**	5000μF	50V	**£1·10**

HIGH VOLTAGE TUBULAR CAPACITORS—1,000 VOLT

0·01μF	**10p**	0·047μF	**13p**	0·22μF	**20p**
0·022μF	**12p**	0·1μF	**13p**	0·47μF	**22p**

POLYSTYRENE CAPACITORS 160V 2½%

10pF to 1,000pF E12 Series Values **4p each.**

SMOKE AND COMBUSTIBLE GAS DETECTOR—GDI

The GDI is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector.
Detector GDI, **£2**. Kit of parts for detectors including GDI and P.C. board but excluding case. Mains operated detector **£5·20**. 12 or 24V battery operated audible alarm **£7·30**. As above for PP9 battery, **£6·40**.

PRINTED BOARD MARKER **97p**

Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief.

METERS **£1.90**

1½in scale 500mA, 1mA, 10mA, 100mA.

BULGIN MAINS CONNECTORS

3 pin 1½A	chassis plug	**10p**		3 pin 1½A	chassis socket	**18p**
	line socket	**13p**			line plug	**13p**
3 pin 3A	chassis plug	**10p**		3 pin 3A	chassis socket	**21p**
	line socket	**14p**			line plug	**23p**
3 pin 5A	chassis plug	**16p**		2 pin 5A	line plug	**20p**
	line socket	**18p**				

THERMISTORS

VA1005	**15p**
VA1026	**15p**
VA1033	**15p**
VA1055S	**15p**
VA1066S	**15p**
VA1077	**15p**
R53	**£1·35**

WAVECHANGE SWITCH **23p**

12W **1p,** 4W **3p,** 2W **2p,** 6W **2p,** 3W **4p.**

LINEAR IC's

709 14 pin dil.	**40p**
741 8 pin dil.	**40p**
741 14 pin dil.	**38p**
723 14 pin dil.	**95p**
747 14 pin dil.	**85p**
748 8 pin dil.	**45p**
Dil. sockets 14 pin and 16 pin	**16p**

GLUM?

SICK OF WAITING FOR COMPONENTS

Try our express service (normally return of post)

Prices very competitive — for example:—
½W 5% carbon film resistors — 1p.
½W 2% metal oxide — 3½p.

BC 107/8/9	10p	2N 3704	13p.
BC 177	17p.	2N 3707	13p.
2N 1302/3	16p.	1N 4001/2	6p.
2N 3055	53p.	1N 4003/4	7p.
2N 3702	13p.	1N 4148	5p.
2N 3703	14p.	1N 5401	16p.

SINCLAIR CAMBRIDGE CALCULATOR
only £26.50

PRICES EXCLUDE VAT

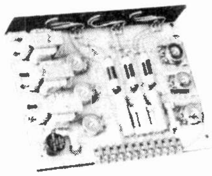
Forward 15p. for our illustrated catalogue to:—
DART ELECTRO SERVICES, 24 South Town,
Dartmouth, Devon. Competitive prices and descriptions of hundreds of components, accessories etc.

Name: ....

Address: ....

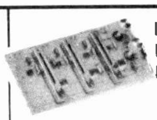
....

Mk III Sound to Light Unit Chassis Version



The audio drive voltage is derived directly from the amplifier output or across the speaker load. The unit converts the audio-frequency signals into a three-coloured light dishlay when used with coloured flood lamps or similar; the colour depending on the frequency of the signal and the intensity on the loudness of the audio source.
Max. power 1·5kW per channel at 240V a.c.
Complete assembly built and tested. Size: 9in × 7in × 3in. Price **£27·50.**

MN3 3 Channel I.C. Mixer Kit



Three channel I.C. audio mixer kit MN3 is specially designed for the home constructor or educational project. Suitable for use in domestic audio, discotheque and simple p.a. applications. The MN3 mixer kit has the following features: advanced design using 5 ICs; slider fader level controls mounted directly to p.c. board; full range bass and treble controls; uses top grade components with fibreglass ready-drilled and tinned printed circuit board and the unit may be operated from twin 9V batteries (PP3) if required.

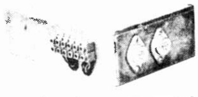
As optional extras, an attractive ready-punched facia panel and control knobs are available. The unit is available as a ready built mixer with facia.

Size: 9·5in × 4·8in × 1·5in (with facia).

Construction manual available separately at 25p.

Kit Price **£11.**

Practical Electronics "Scorpio" Electronic Ignition System Kit



This Capacitor-Discharge Electronic Ignition system was described in the November and December issues of Practical Electronics. It is suitable for incorporating in any 12V ignition system in cars, boats, go-karts, etc.
Case size: 7·25in × 4·5in × 2in approx.
Complete assembly and wiring manual **25p**
Price **£12·10.**

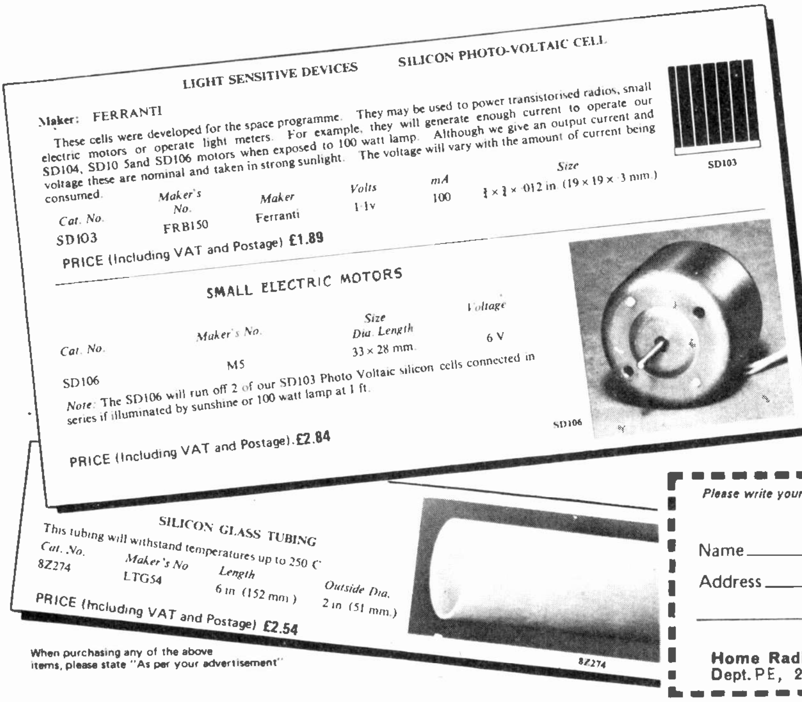
AUDIO EFFECTS

CREATE "PHASE" EFFECT ON YOUR RECORDS, TAPES, ETC., UNIQUE CIRCUITRY ENABLES YOU TO CREATE PHASE EFFECT AT THE TURN OF A KNOB. OPERATES FROM 9V BATTERY (not supplied). COMPLETE KIT OF COMPONENTS WITH PRINTED CIRCUIT BOARD AND FULL INSTRUCTIONS. KIT PRICE **£2·86.**

All prices quoted include postage and VAT.
S.A.E. for further details.

DABAR ELECTRONIC PRODUCTS
98 LICHFIELD STREET, WALSALL
STAFFS WS1 1UZ

A SELECTION of the more unusual items from the famous HOME RADIO (Components) CATALOGUE...



LIGHT SENSITIVE DEVICES SILICON PHOTO-VOLTAIC CELL

Maker: FERRANTI

These cells were developed for the space programme. They may be used to power transistorised radios, small electric motors or operate light meters. For example, they will generate enough current to operate our SD104, SD10 5and SD106 motors when exposed to 100 watt lamp. Although we give an output current and voltage these are nominal and taken in strong sunlight. The voltage will vary with the amount of current being consumed.

Cat. No.	*Maker's No.*	*Maker*	*Volts*	*mA*	*Size*
SD103	FRB150	Ferranti	1·1v	100	¾ × ¾ × ·012 in. (19 × 19 × ·3 mm.)

PRICE (Including VAT and Postage) £1.89

SD103

SMALL ELECTRIC MOTORS

Cat. No.	*Maker's No.*	*Size* *Dia. Length*	*Voltage*
SD106	M5	33 × 28 mm.	6 V

Note: The SD106 will run off 2 of our SD103 Photo Voltaic silicon cells connected in series if illuminated by sunshine or 100 watt lamp at 1 ft.

PRICE (Including VAT and Postage). £2.84

SD106

SILICON GLASS TUBING

This tubing will withstand temperatures up to 250 C

Cat. No.	*Maker's No*	*Length*	*Outside Dia.*
8Z274	LTG54	6 in (152 mm.)	2 in (51 mm.)

PRICE (Including VAT and Postage) £2.54

8Z274

When purchasing any of the above items, please state "As per your advertisement"

It goes without saying that our catalogue lists run-of-the-mill goods like Resistors, Capacitors, Pots and Coils, so we bring to your notice here one or two of the more exotic items. Take the SD103 cell. Apart from its rarity, it's very useful. Recently we built a 3-transistor radio with loud-speakers, and we found that three of these cells would operate it. Regarding the mini motor and silicon glass tubing, your ingenuity will suggest ways in which you can make good use of them. These are but 3 of *thousands* of exciting components in our catalogue. By now you are reaching for your pen and cheque book, but don't just buy the items shown here; get the catalogue and feast your eyes on all 240 pages. At 77 pence it's almost a gift—especially as by using the vouchers as directed you can reclaim 50p. Post the Coupon now with your cheque or P.O. for 77p.

Please write your Name and Address in block capitals

Name ________________________________

Address ______________________________

____

Home Radio (Components) Ltd. Regd No 912966, London
Dept. PE, 234-240 London Road, Mitcham, CR4 3HD.

NEXT MONTH

FREE INSIDE

DOUBLE-SIDED DESIGN CHART

How to build and use the P.E. SOUND BENDER

Centred around a single, simply constructed "Audio Modulator" unit, 'SOUND BENDER' is not just a single sound effect unit, but your key to a host of exciting with-it sounds.
Just feed a music or speech signal to one input and a control signal to the other and you can have, for example a tremolo, a frequency doubler, a ring modulator, or a voice operated fader.

THE CONTENTS FOR MAY INCLUDE ...

PROJECT

An improved BATTERY CHARGER

A fresh look at the Battery Charger. This "fail-safe" design includes short-circuit, reverse-polarity, and overcharge protection—without adding drastically to the costs.

FLASH METER

An accurate and simple-to-operate instrument which will cope with all normal and many abnormal exposure conditions for both black-and-white and colour photography.

PROJECT

SPECIAL FEATURE

FIRST STEPS IN CIRCUIT DESIGN-2

The second article in this new series for Beginners deals with the "parameter jungle", input impedance and voltage gain equations.

PRACTICAL

ELECTRONICS

MAY ISSUE ON SALE APRIL 10, 1974

Subject to the current National industrial situation at the time of going to press

INDUSTRY NOTEBOOK

By Nexus

THE PAN-EUROPEANS

The loud and sour cries of "disaster" from the anti-Common Market lobby are by no means deterring British companies from investing in Europe. As most say, Britain's entry is essentially a long-term strategy as far as real benefits are concerned and there are yet a few years of plodding before the tariffs are finally down.

Of course, at the political level there is still a lot of wrangling. There is bound to be, just as in any free society of any size right down to the local Parish Council. But this need not and should not be a reason for entrepreneurs to hold back their plans for Europe.

You don't need to be a visionary to see the market openings. They are there for all to see as Waldo Thorn, managing director of Celdis Ltd., Reading, pointed out to me recently. Celdis is currently ranking about number five in the UK league table of 100 distributors of electronic components. Turnover is running at £4 million a year from the UK and subsidiaries in Germany and Italy.

Top priority for Celdis is establishment of a French company and this will be in operation within weeks. The German company, based in Bavaria, is to open further offices not only in other areas of Germany but also in Austria and Switzerland. Scandinavia could be next, followed by Spain and Portugal and Northern and Southern Ireland.

Altogether, 27 Celdis locations throughout the UK and Europe are planned and eventually they will all be linked to each other and to strategically located warehouses by data-link and video display terminals. This means that if a customer, say in Manchester, phones his local Celdis office, the sales clerk will interrogate the central computer and perhaps establish that supplies are available in the German warehouse. The operation takes only seconds and he quotes price and delivery. The order is then placed over the network and the goods shipped by air-freight.

Unquestionably this will be the pattern of the future and it will become easier still when we have a Euro-currency and a Euro-language (which I fervently hope will be English!).

Thorn's concept has a touch of the grand design about it. But he is by no means alone. Rival distributors GDS set up a company in Amsterdam last year and have just opened another in Geneva.

Openings in Europe are good for service industries such as component distribution but not, at the moment, for manufacture because in all the main centres there are labour shortages and wage rates are considerably higher than in the UK. In labour-intensive operations it is still far cheaper to manufacture in the UK than in France or Germany, even Italy, though of course things may well change.

WHAT HAPPENED TO CUSTOM MOS?

When MOS techniques first came into prominence, the big ploy of the semiconductor manufacturers was to offer a custom-built service. For a fat fee they would design a device to meet your special requirements. You could even do a deal by owning your own circuit for which you had paid development costs and get a rake-off if it was sold elsewhere.

The pattern is now changing. When MOS caught on in a big way the usual shortages built up and of all products in short supply in 1973 MOS was among the leaders. And the semi-conductor manufacturers, having developed their own standard lines in MOS have been too busy making these to bother overmuch with the "specials".

The man who was once the most valued customer is now regarded as a fuss-pot and relegated to the end of the queue. Unless, of course, you'd care to order a million-off, in which case you can still expect the red carpet to be put out.

The situation, however, is not quite as bad as it sounds because the number of standard devices available is becoming so great that your circuit needs to be very very special if you can't satisfy your design specification with off-the-shelf units. In 1970 over 80 per cent of production was in custom work. In three or four years time, industry sources suggest, custom-built circuits could shrink to five per cent of total production.

THE ENERGY PROBLEM

Round about 1960 I was invited to the official inauguration of the Royal Army Pay Corps' computer at Worthy Down. The RAPC had stolen a march over the RAF and Royal Navy by being the first of the armed services to get their pay and allowance accounts onto a computer.

It was a great day and I well recall my astonishment at seeing a most beautiful ornamental fountain in the middle of the air-conditioned complex in which the installation was housed. Could this be the same British Army I knew all those years ago? Fountains indeed! I soon discovered that the fountain had a deeper purpose than ornamentation. It was part of the heat dispersal network for the megawatts dissipated by the huge IBM valve-model computer.

It is generally supposed that the advent of solid-state eliminated the heat problem. It is much less of course but still there. So much so that a big insurance company in the USA has already had its new building designed to be heated entirely by the IBM computer installation.

The joke is that the design was conceived purely as a financial economy measure before the world fuel crisis. Now the company has all the kudos of appearing to be in the vanguard of the 1974 drive for energy conservation.

Energy re-cycling will be big business from now on—electronically controlled, of course. Expect to see air-conditioning experts like Honeywell jumping on the bandwagon with a giant leap.

CRISIS SPIN-OFF

Tough times may be ahead for consumer electronics but the capital goods sector of the industry retains a buoyant outlook. Big business deals in exchange for Middle East oil will keep many factories busy. A huge upsurge in use of nuclear power and an accelerated North Sea oil programme will inject plenty of gold into the industry. The big headache for the industry is not so much orders but shortage of development engineers and shortage of raw materials.

The British export drive rose to mammoth proportions last year. The British Overseas Trade Board reports having financially supported 1,805 businessmen in 105 outward sales missions to 60 countries as well as sponsoring 6,300 firms exhibiting at 322 overseas trade fairs and exhibitions in 1973.

These roving businessmen didn't come home empty-handed. We've got the orders. Can we deliver the goods?

BRITAIN'S FASTEST SERVICE!

A SELECTION FROM OUR COMPREHENSIVE CATALOGUE

ALL ITEMS ARE BRAND NEW AND FULLY GUARANTEED

AA119	6p
AC107	50p
AC126	20p
AC127	25p
AC128	24p
AC128/AC176	44p
AC151	20p
AC152	25p
AC153	26p
AC176	20p
AC153/176K	52p
AC187K	17p
AC188K	23p
AC187/188K	40p
ACY17	27p
ACY18	20p
ACY19	20p
ACY20	20p
ACY21	19p
ACY22	10p
AD140	60p
AD149	60p
AD161	44p
AD162	44p
AD161/162	88p
AF106	32p
AF114	27p
AF115	27p
AF116	25p
AF117	25p
AF118	44p
AF124	25p
AF125	24p
AF126	24p
AF139	47p
AF186	40p
AF239	52p
AF279	58p
ASY26	25p
ASY27	30p
ASY28	22p
ASY29	30p
BA138	15p
BB103	20p
BB104	34p
BB105	28p
BC107	16p
BC107/BC177	36p
BC108	16p
BC108/BC178	32p
BC109	18p
BC109/BC179	38p
BC109C	18p
BC117	15p
BC140	30p
BC147	12p
BC148	11p
BC149	12p
BC157	13p
BC158	12p
BC159	13p
BC147/157	25p
BC148/158	23p
BC149/159	25p
BC167	11p
BC168	10p
BC169	11p
BC169C	12p
BC177	20p
BC178	18p
BC179	20p
BC182	14p
BC182L	14p
BC183	13p
BC183L	14p
BC184	17p
BC184L	18p
BC212	16p
BC212L	18p
BC238	10p
BC238/308	20p
BC257	11p
BC258	10p
BC259	12p
BC307	12p
BC308	10p
BCY30	25p
BCY31	48p
BCY32	50p
BCY33	20p
BCY34	25p
BCY38	30p
BCY58	18p
BCY70	15p
BCY71	26p
BCY72	14p
BD124	75p
BD131	40p
BD132	40p
BD131/132	80p
BDY20	81p
BF115	23p
BF163	35p
BF167	25p
BF173	29p
BF177	25p
BF178	31p
BF180	35p
BF194	15p
BF195	15p
BF196	15p
BF200	35p
BF254	14p
BF255	15p
BFX13	25p
BFX29	32p
BFX84	25p
BFX85	34p
BFX86	25p
BFX87	30p
BFX88	24p
BFY50	22p
BFY51	19p
BFY52	20p
BFY53	17p
BFY90	£1·20
BPX66	£1·50
BR100	20p
BRY39	45p
BSX19	16p
BSX20	16p
BSX21	20p
BSY27	20p
BSY29	25p
BSY95A	12p
BTY79 400R	£1·80
BT106	£1·20
BY100	20p
BY127	22p
BZY88C3V3	10p
BZY88C3V6	10p
BZY88C3V9	10p
BZY88C4V3	10p
BZY88C4V7	10p
BZY88C5V1	10p
BZY88C5V6	10p
BZY88C6V2	10p
BZY88C6V8	10p
BZY88C7V5	10p
BZY88C8V2	10p
BZY88C9V1	10p
BZY88C10V	10p
BZY88C11V	10p
BZY88C12V	10p
BZY88C13V	10p
BZY88C15V	10p
BZY88C16V	10p
BZY88C18V	10p
BZY88C20V	10p
BZY88C22V	10p
BZY88C24V	10p
BZY88C27V	10p
BZY88C30V	10p
BZX61C7V5	28p
BZX61C8V2	28p
BZX61C9V1	28p
BZX61C10V	28p
BZX61C11V	28p
BZX61C12V	28p
BZX61C13V	28p
BZX61C15V	28p
BZX61C16V	28p
BZX61C18V	28p
BZX61C20V	28p
BZX61C22V	28p
BZX61C24V	28p
BZX61C27V	28p
BZX61C30V	28p
BZY93C9V1	70p
BZY93C12V	70p
BZY93C15V	70p
BZY93C18V	70p
CA3004	£2·03
CA3005	£1·35
CA3011	83p
CA3013	£1·17
CA3014	£1·37
CA3018	72p
CA3018A	83p
CA3020	£1·39
CA3028A	79p
CA3035	£1 37
CA3043	£1·57
CA3044	£1·28
CA3046	70p
CA3048	£2·11
CA3052	£1·62
CA3053	47p
CA3065	£1·28
CA3088E	£1·24
CA3089E	£1·94
CA3090Q	£4·23
CA3123E	£1·80
CD4000AE	55p
CD4001AE	55p
CD4007AE	55p
CD4009AE	£1·16
CD4011AE	55p
CD4012AE	55p
CD4013AE	£1·11
CD4015AE	£2·92
CD4017AE	£2·92
CD4018AE	£2·92
CD4020AE	£3·25
CD4024AE	£2·09
CD4027AE	£1·73
CD4029AE	£4·12
CD4049AE	99p
CR1/051C	54p
CR1/401C	71p
CRS3/05AF	£1·08
CRS3/40AF	£1·53
CZ6	17p
D10 (NTGO10)	40p
HP5082	34p
HS822-33	48p
HT841-33	£2·24
HT861-33	£2·90
HT341-33	£1·02
IR2160	95p
IRC20	46p
IRT84	£2·90
JA424	£2·08
MC1303L	£1 75
MC1305P	£2·80
MC1307P	£1·65
MC1310P	£2·80
MC1330P	80p
MC1352P	£2·00
MC1466L	£4 20
MC1468L	£2·88
MC4024P	£2·20
MC4044P	£2 20
MFC4000B	85p
MFC6030	£1·63
MFC6040	£1·15
MFC8010	£1·38
MFC8040	£1·24
MFC9020	£2 12
MJE371	68p
MJE520	65p
MJE521	62p
MJE2955	£1·08
MJE3055	68p
MJ480	97p
MJ481	£1·25
MJ491	£1·35
MJ802	£4·12
MJ802 MJ4502	£8·56
MJ900	£1·80
MJ1000	£1·50
MJ4502	£4·44
MLM309K	£1·90
MPF102	37p
MPF103 (2N5457)	48p
MPF104 (2N5458)	49p
MPF105 (2N5459)	46p
NE555	78p
NKT0033	96p
NKT211	25p
NKT212	25p
NKT213	25p
NKT216	46p
NKT217	50p
NKT218	25p
NKT223	27p
NKT271	18p
NKT274	18p
NKT275	20p
NKT279A	12p
NKT281	29p
NKT351	75p
NKT401	78p
NKT402	83p
NKT403	71p
NKT404	88p
NKT405	87p
NKT406	69p
NMC409	£1·00
NMC469	88p
NMC505	£3·00
NTGD10	40p
OA10(NTGO10)	40p
OA47	6p
OA79	6p
OA90	6p
OA91	5p
OA95	5p
OA200	6p
OA202	7p
OC25	45p
OC28	78p
OC29	79p
OC35	66p
OC36	69p
OC41	40p
OC42	40p
OC44	20p
OC45	20p
OC71	20p
OC72	20p
OC75	25p
OC76	25p
OC77	40p
OC81	20p
OC81D	20p
OC83	23p
OC84	25p
OC139	25p
OC170	25p
OC171	30p
OCP71M	42p
ORP12	50p
ORP60	50p
ORP61	50p
ORP69	50p
PM7A2	£1·85
PM7A6	£2 50
PN70	10p
PN71	10p
PN107	8p
PN108	8p
PN109	8p
PN3819 (2N3819)	20p
SL103A	50p
SL403A (Rectifier)	60p
SL803A	60p
ST2	20p
TAA263	£1·12
TAA293	97p
TAA310	£1 25
TAA320	75p
TAA861	45p
TAD100	£1·97
TAD110	£1·97
TBA810S	£1·68
TIL112	£2·00
TIL209	35p
TIP31A	60p
TIP32A	70p
TIP41A	85p
TIP42A	£1·00
TIS43	30p
TR1	20p
VA1039	15p
VA1040	15p
VA1066s	15p
VA1077	15p
W005	25p
W01	28p
W02	28p
W04	27p
W06	32p
W08	41p
ZTX107	12p
ZTX108	11p
ZTX300	13p
ZTX302	18p
ZTX303	15p
ZTX304	23p
ZTX314	11p
ZTX320	30p
ZTX330	18p
ZTX500	14p
ZTX501	15p
ZTX502	18p
ZTX503	17p
ZTX504	45p
1N914	4p
1N3754	20p
1N4001	4p
1N4002	4p
1N4003	5p
1N4004	7p
1N4005	7p
1N4006	8p
1N4007	9p
1N4148	4p
1N5400	14p
1N5404	18p
1N5408	25p
1S44	4p
1S920	7p
1S940	8p
2N404	23p
2N696	15p
2N697	17p
2N698	30p
2N706	10p
2N706A	12p
2N708	16p
2N911	50p
2N914	20p
2N918	42p
2N929	25p
2N930	28p
2N1131	24p
2N1132	24p
2N1302	17p
2N1303	17p
2N1304	24p
2N1305	24p
2N1306	30p
2N1307	30p
2N1308	34p
2N1309	34p
2N1559(CR1 401C)	71p
2N1613	15p
2N1711	15p
2N1893	54p
2N2218	33p
2N2218A	44p
2N2219	38p
2N2219A	53p
2N2368	17p
2N2369	17p
2N2369A	17p
2N2484	42p
2N2646	45p
2N2904	44p
2N2904A	49p
2N2905	85p
2N2905A	75p
2N2924	18p
2N2925	20p
2N2926	10p
2N3053	24p
2N3054	65p
2N3055	65p
2N3228	£1 10
2N3391A	29p
2N3525	£1 04
2N3702	14p
2N3703	12p
2N3704	12p
2N3705	12p
2N3706	12p
2N3707	12p
2N3708	12p
2N3709	12p
2N3710	12p
2N3711	12p
2N3773	£2·50
2N3819	28p
2N3820	60p
2N3823E	20p
2N3826	30p
2N3866	£1 10
2N3904	29p
2N3906	29p
2N4058	15p
2N4060	13p
2N4061	13p
2N4062	13p
2N4441	70p
2N4444	£2·20
2N4871	44p
2N4990	68p
2N4991	48p
2N5245	45p
2N5457 (MPF103)	49p
2N5458 (MPF104)	49p
2N5459 (MPF105)	46p
2N5756	£1·20
2N5777	45p
2N6027 (D13T1)	45p
3N84	£1 30
3N128	73p
3N140	92p
3N152	92p
741 T05	45p
741/8DIL	34p
723 T05	£1·02
723 14DIL	£1·02
747 14DIL	48p
748/14DIL	39p
3015F	£1·50
3015G	£2·00
7400	24p
7401	24p
7402	24p
7403	24p
7404	30p
7405	30p
7408	30p
7409	30p
7410	24p
7413	36p
7420	24p
7425	36p
7430	24p
7440	29p
7442	£1·39
7443	£1·74
7444	£1·74
7445	£2·47
7446	£1·74
7447	£1·50
7450	24p
7451	24p
7453	24p
7454	24p
7460	24p
7470	54p
7472	36p
7473	54p
7474	55p
7475	54p
7476	54p
7480	80p
7482	£1·04
7483	£1·58
7486	39p
7490	84p
7491A	£1·54
7492	£1·02
7493	90p
7494	£1·36
7495	96p
7496	£1·78
74100	£1·07
74107	62p
74121	51p
74141	£1·20
74150	£4·02
74151	£1·32
74153	£1·62
74154	£2·40
74155	£1·84
74156	£1·86
74190	£2·16
74191	£2·16
74192	£2·09
74193	£2·09
74196	£1 80
74197	£1·80
40250	66p
40309	40p
40310	60p
40311	42p
40312	62p
40320	42p
40360	56p
40361	45p
40362	45p
40406	52p
40407	40p
40408	54p
40409	62p
40410	62p
40430	£1·13
40468A	44p
40511	£1·82
40575	£1·54
40576	£1·46
40600	70p
40601	70p
40602	45p
40603	70p
40669	£1·00
40673	52p
40739	£1·50

CAPACITORS—ELECTROLYTIC AXIAL LEADS

Mfd	Working Voltage	Price	Mfd	Working Voltage	Price
1·0	40V	11p	100	16V	10p
1·0	100V	9p	100	25V	10p
2·2	25V	11p	100	40V	11p
2·2	63V	9p	100	63V	14p
4·7	40V	9p	220	25V	12p
10	25V	9p	220	40V	13p
10	63V	10p	470	25V	15p
22	25V	10p	1000	25V	23p
22	40V	10p	2200	25V	43p
47	25V	10p	4700	16V	51p
47	40V	10p			

CAPACITORS—METALLISED POLYESTER

Stock values MFD	Price each
0·01 0·015, 0·022 0·033	4p
0·047, 0·068 0·10	5p
0·150 0·220	6p
0·33	8p
0·47	9p
0·68	12p
1·0	15p
1·5	22p
2·2	26p

Order as "Polyesters + Capacitance

CAPACITORS—POLYSTYRENE

Axial leads. Clear encapsulation 5% Tolerance 160 volt working

Stock values	Price each
10pF, 15pF, 22pF, 33pF 47pF 68pF 100pF 150pF, 220pF, 330pF, 470pF 560pF, 680pF 820pF, 1000pF, 1500pF, 2200pF, 3300pF, 4700pF 5600pF 6800pF	4p

Order as Polystyrenes + Capacitance

INTEGRATED CIRCUIT PINS

The lowest priced IC mounting available Pin Sockets come in a reel just drill your board at required centres, drop in pins and solder break off frame holders — Your DIL mounting is complete"

Pin Sockets	1,000 pieces	£7·00
Pin Sockets	100 pieces	£1·00

TRANSDUCERS—ULTRASONIC

A new type of 40khz Ultrasonic Transducers designed to transmit and receive a 40khz signal Supplied with transmitter/receiver circuits of a new design.

SOLD ONLY IN PAIRS

Type No 83181 **NEW LOW PRICE £4·95** per pair

CA3123E Superhet System with RF Amp IF Amp. Mixer, OSC. g c. Detector and Voltage Regulator
Ideal for car radio applications. £1·80

SEVEN WATT AUDIO AMP. I.C.

TBA810S £1·68

Featuring thermal protection. Ideal for car radio applications

PACKAGED CIRCUITS

The complete range of Newmarket modules currently being featured in magazine articles See catalogue for details

ANTEX SOLDERING EQUIPMENT

X25/240V 25W iron	£1·85
SK2/240V, 15W kit	£2·95
MLX 12V 25W kit essential for car tool kit	£2·30
X50TC 240V. 50W temperature controlled	£5·95

ARROW SPECIALISE IN EDUCATIONAL AND GOVERNMENT/ORDERS
—See catalogue for further details.

ARROW SERVICE PLUS

10% DISCOUNT OVER £4. NO POSTAGE AND PACKING. TOP QUALITY PRODUCTS ALWAYS BY RETURN

COMPREHENSIVE CAT. ➡

Important Notice "All prices are *exclusive* of V.A.T. Please add 10% V.A.T. to the final total of your order *after* deducting any discount which may be due."

ARROW ELECTRONICS LTD.

DEPT. PE9, 7 COPTFOLD ROAD
BRENTWOOD
ESSEX

I enclose PO/Cheque for 10p
Name ....
Address ....

Arrow Electronics Limited,
Dept. PE9,
7 Coptfold Road,
Brentwood,
Essex

NOW AVAILABLE IN THE U.K!

CHINAGLIA

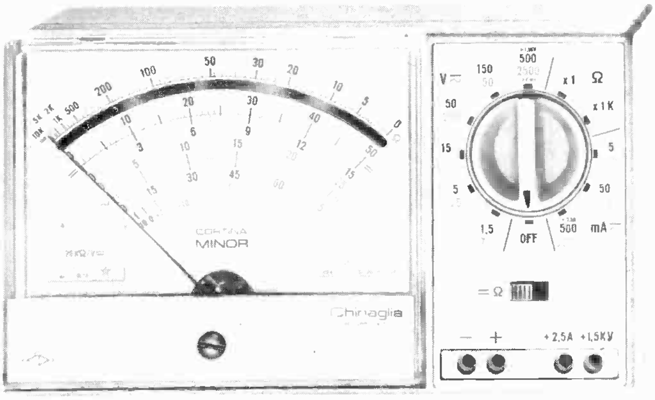
PROFESSIONAL QUALITY TEST EQUIPMENT FROM ONE OF ITALY'S LEADING MAKERS

One example from the big range of sophisticated instruments

CORTINA MINOR

33 RANGE POCKET MULTIMETER

- SENSITIVITY 20,000Ω/VOLT (D.C.), 4,000Ω/VOLT (A.C.).
- ROBUST DIODE PROTECTED PRECISION MOVEMENT.
- 33 RANGES D.C. VOLTS 0–100mV, 1·5V, 5V, 15V, 50V, 150V, 500V, 1.500V. D.C. CURRENT 0–50μA, 5mA, 50mA, 500mA, 2·5A. A.C. VOLTS, 0-7·5V, 25V, 75V, 250V, 750V, 1,500V, A.C. CURRENT 0–25mA, 250mA, 2·5A, 12·5A. dB RANGES, −10 to +69. AF VOLTS RANGES 0–1,500V. RESISTANCE RANGES 10kΩ, 10MΩ F.S.D. CAPACITANCE RANGES 100μF, IF F.S.D.
- ACCURACY—RESISTANCE, D.C. VOLTAGE AND CURRENT, 2·5%. A.C. VOLTAGE AND CURRENT 3·5%.
- RESISTANCE RANGES POWERED BY INTERNAL BATTERIES.
- COMPACT SIZE : 150 x 85 x 40mm. 350gr.
- CLEARLY CALIBRATED DIAL WITH ANTI-PARALLAX MIRROR.
- PROFESSIONAL QUALITY COMPONENTS EMPLOYED THROUGHOUT.
- FULLY GUARANTEED FOR 12 MONTHS.
- AFTER SALES SERVICE AND SPARES FACILITIES.
- SUPPLIED WITH ADDITIONAL SHOCKPROOF PLASTICS CARRYING CASE. TWO HIGHLY INSULATED TEST LEADS AND INSTRUCTION BOOKLET.
- SPECIAL 30kV PROBE FOR D.C. MEASUREMENT AVAILABLE AS AN OPTIONAL EXTRA.



METER PRICE £13·00 (p & p 80p) PROBE £7·50 inclusive of V.A.T.

for further information on the "Cortina Minor" or other instruments from the exciting Chinaglia range write or telephone :—

CHINAGLIA (U.K.) LIMITED

19 Mulberry Walk, London S.W.3. **Telephone 01-352 1897**

TRADE ENQUIRIES WELCOMED

CRESCENT RADIO LTD

11 & 40 MAYES ROAD, LONDON N22 6TL 888 3206

MAIL ORDER DEPT.
No. 11
MAYES RD.
LONDON
N22
6TL.

COMPONENTS AND HI FI FOR THE HOME CONSTRUCTOR

OUR SHOPS ARE OPEN ALL DAY
FROM 9. A.M. TO 6 P.M. 6.30 P.M. ON FRIDAY
(WE CLOSE ALL DAY THURSDAY)

13 SOUTH MALL, EDMONTON, N.9 803 1685

"CRESCENT" BUBBLE LIGHT SHOW

A new and exciting feature for the professional disc jockey or to give the private party an electric atmosphere, a projected kaleidoscope of colour makes the music you produce more interesting and will appeal to the visual as well as the audio senses.

This budget system compares very favourably with the more sophisticated and much higher priced models.

Specification Projectur: 100W, convection cooled, at 30ft the projected image = 16ft: Motor: 1 rev per 2 min. Liquid Wheel: 6in diameter multicolour.

The Motor is fitted to the Projector and can only be purchased as a single unit. The Liquid Wheel, however, is our very popular standard model & may be purchased separately. A bargain Projector with Motor ready for instant use, **£15**; 6in Liquid Wheel, **£5 = £20** + 75p carr.

TRI-VOLT BATTERY ELIMINATOR

Enables you to work your Transistor Radio, Amplifier or Cassette, etc., from the a.c. mains through this compact Eliminator. Just by moving a plug you can select the voltage you require. 6, 7½ or 9 volt. This means all your transistor power pack applications can be handled by this one unit. Approx. size 2¾in × 2¼in × 3¼in. Our Price **£2·75** plus 10p P. & P. Same model suitably wired for the Philips Cassette **£3** plus 10p P. & P.

DIGITAL CLOCK KIT

24-hr. Nixie dig. clock kit. We supply: a complete set of components: a complete set of easy to follow instructions: printed circuits made to make construction as simple as possible: a cabinet and front panel to give a professional finish. All for the price of the components. **£29·50** + 50p P. & P. Please send S.A.E. if you require more information.

"CRESCENT" 100 WATT R.M.S. ALL PURPOSE AMPLIFIER U.BUILD.IT

We supply the three modules for you to build this Disco-Group-P.A. amplifier into the cabinet of your choice.

★ THE POWER AMP MODULE TP100W
170W r.m.s. sq. wave 300W instantaneous peak into 8 ohm (60W into 16 ohm). **£14·28**, carr. 45p.

★ THE PRE-AMP MODULE
Four control pre-amp. Vol., Bass, Treble, Middle controls. Designed to drive most amplifiers using F.E.T. first stage. **£3·96**, carr. 25p.

★ THE POWER SUPPLY MODULE PS100
is supplied complete with the mains transformer. **£9·66**, carr. 50p. Complete fixing instructions are supplied and no technical knowledge is required to connect the three ready wired modules.

A fantastic bargain. If you purchase all three modules. **£25**, carr. 75p. Send S.A.E. for further details on this or our ready built amplifiers.

VAT

Please include 10% VAT on goods plus carriage.

200/250V MAINS RELAY

Heavy duty contacts. 2,500Ω coil. All new and unused D.P.D.T. mains relays **50p** + V.A.T. Carr. Free. Special quantity price: **£40** per 100 relays.

TRI-VOLT CAR SUPPLY

Enables you to work your Transistor Radio, Amplifier or Cassette, etc. from the 12 volt car supply. Positive or negative earth. Approx. size = 2in. × 3¼in. × 1¼in. This converter supplies 6, 7½ or 9 volts and is transistor regulated. A real money saving device for **£2·50** plus 10p P. & P.

CRESCENT "C.300" DISCO CONTROL PACK

A control Unit which when connected to twin decks makes a disco of professional quality. We supply a smart front panel which incorporates controls, switch and input sockets. The control module, I.C. construction incorporating mixing, pre-amp and headphone listening amplifier. The power pack enables this unit to work from the standard mains. * Inputs include Mic., Tape/Cassette and Twin Decks. * Controls include Mic., Tape, Each Deck, Mono, **£14**. Stereo, **£17** plus 20p carr.

MINI LOUDSPEAKERS

2¼in 80 ohm, **50p**; 2¼in 40 ohm, **50p**. Please include 5p P. & P. on each L.S.

CRESCENT CATALOGUE

If you construct you should own one. Send **20p** inc. carriage.

EMI LOUDSPEAKER 450

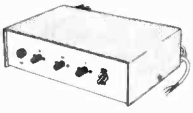
10W 13in × 8in + two 2·2¼in tweeters and cross-over. All wired and ready for use. This ever-popular 450 in 3–8–15 ohm imp.

£3·75 plus 38p P. & P. each.

CRESCENT CASSETTES

Top quality cassettes at unbeatable prices (complete with standard storage case): C60 **31p**, C90 **42p**, C120 **53p** plus 5p P. & P.

3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT



Three Channel: Bass—Middle—Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed)

£18·50 plus 38p P. & P.

If you require more information please send S.A.E.

"CRESCENT BEAT BRITE" SINGLE CHANNEL SOUND TO LIGHT UNIT

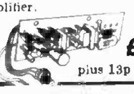
This fantastic little box approx. 4" × 3" × 2½" when connected to the output of a sound source from 1 to 100 watts produces a psychedelic light display of up to 1000 watts. Complete with a sensitive level control the unit is fused and cannot harm your amplifier.

A Bargain at **£7·50** plus 10p.

LOW VOLTAGE AMPLIFIER

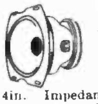
5 transistor amplifier complete with volume control, is suitable for 9V d.c. and a.c. supplies. Will give about 1W at 8 ohm output.

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

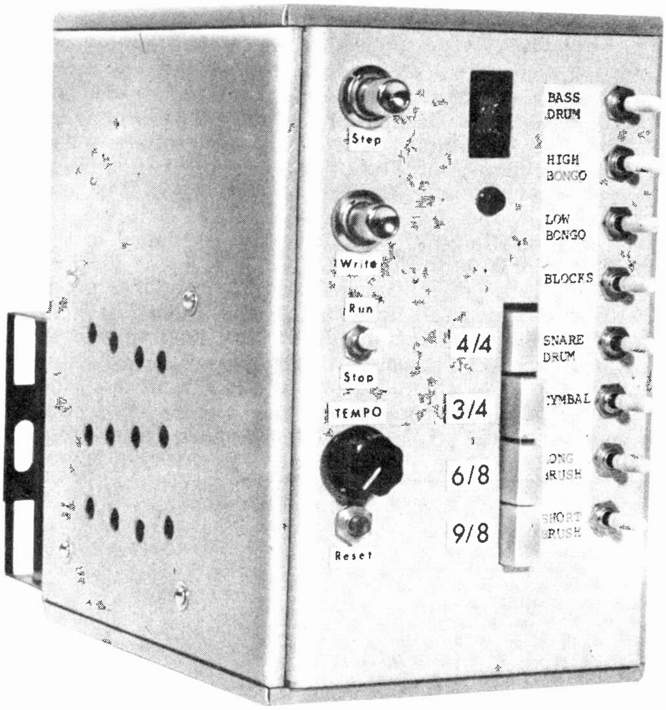


£1·75 plus 13p P. & P.

7in × 4in LOUDSPEAKER



A top quality speaker ideal where small size is important. Manufactured by E.M.I. for a well-known hi-fi set maker. Size: 7in × 4in. Impedance: 8 ohms. Flux: 38,000. Max. Free range: 90Hz to 12kHz. Power handling: 5W. Unbeatable. Price: **£1·60**. Free postage on this item.



Concluding Article

RHYTHM GENERATOR

BY BRICE WARD

All eight percussion generators are contained on a single circuit board with a mixer/pre-amplifier containing six f.e.t.s. The concentration of components makes it necessary to use some care in construction to insure that everything is properly placed and that nothing is left out.

The only lines coming to and from this board are the eight input lines, one output line and the power and ground lines. Completion of the assembly of this board will make the Rhythm Generator ready for operation except for adjustments of the various percussion generators.

BASS DRUM

The circuit diagram for the Bass Drum generator is shown in Fig. 2.1. The circuit is basically a "twin T ringing oscillator". The frequency selection network is shocked into oscillation by the input trigger and decays at a rate determined by VR3.

A positive five volt input signal is applied to the input end of R7 when the Bass Drum is to sound. Assume transistor TR4 has been biased off and the voltage on the collector is close to the full 18 volts.

When the input signal is applied, TR4 is driven hard on and the collector voltage will drop to near zero almost instantaneously. Capacitor C10 has been charged to the full 18 volts and will immediately discharge in about 1/10th of the time of one cycle of the natural resonant frequency of the twin T network, shocking the oscillator into operation.

This oscillation will be sustained for a period of time determined by the setting of VR3. The result is a rapidly starting, slowly decaying oscillation at a frequency determined by the frequency selective network composed of C11, C12, C13, R11, R12, R13 and R14. Capacitor C9 will only serve to insure that should the input pulse be removed before C10 has had a chance to discharge com-

BASS DRUM

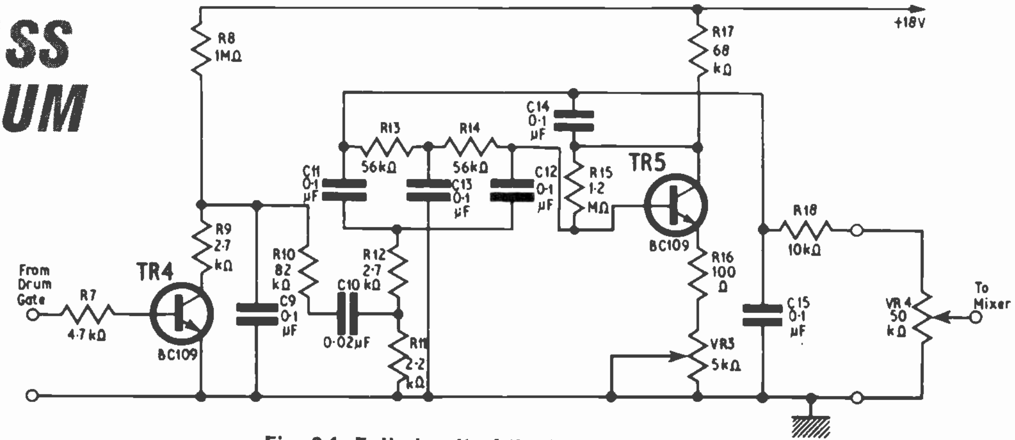


Fig. 2.1. Full circuit of the Bass Drum generator

pletely, the voltage will not rise before it is completely discharged.

R18 and C15 furnish some filtering and final shaping. The overall result is a reasonable simulation of a bass drum and is applied across VR4 where the amplitude of the signal going to the mixer can be adjusted.

HIGH AND LOW BONGOS

The High and Low Bongo circuits are shown in Fig. 2.2. Outside of the difference in a single component value, the circuits operate in a manner similar to the Bass Drum circuit. VR5 and 7 control the length of time that oscillations are sustained and VR6 and 8 control the amount of signal going to the mixer.

WOOD BLOCKS

The Wood Block circuit is a little different in construction but accomplishes essentially the same thing as the first three circuits. TR10 and 11 are connected as a Darlington pair (Fig. 2.3) to convert the five volt input pulse to a very square pulse at the collector of TR11. This is applied to a pulse shaping network composed of C30, R49, R48 and R50.

The resulting differentiated pulse is applied to the base of TR12 causing it to oscillate for as long as the pulse is present on the base. The output is taken from the collector, through C35 and applied to VR9 which allows the amplitude of the signal applied to the mixer to be adjusted.

C31, C32, C33, R50, R51 and R52 are the frequency selective phase shift circuits that will determine the frequency of the damped oscillations.

HIGH AND LOW BONGOS

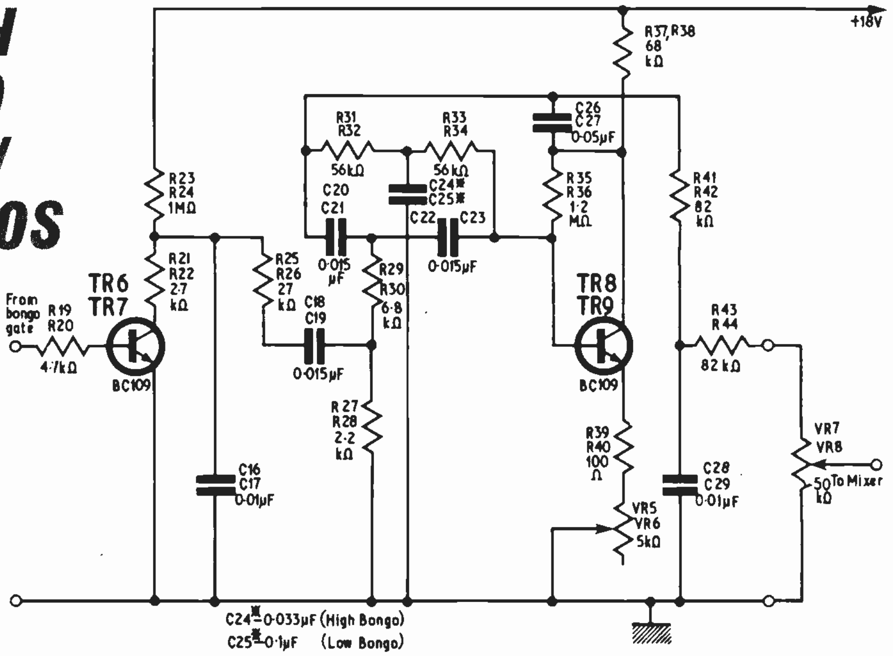


Fig. 2.2. The High and Low Bongo circuits are virtually identical to the Bass Drum circuit

WOOD BLOCKS

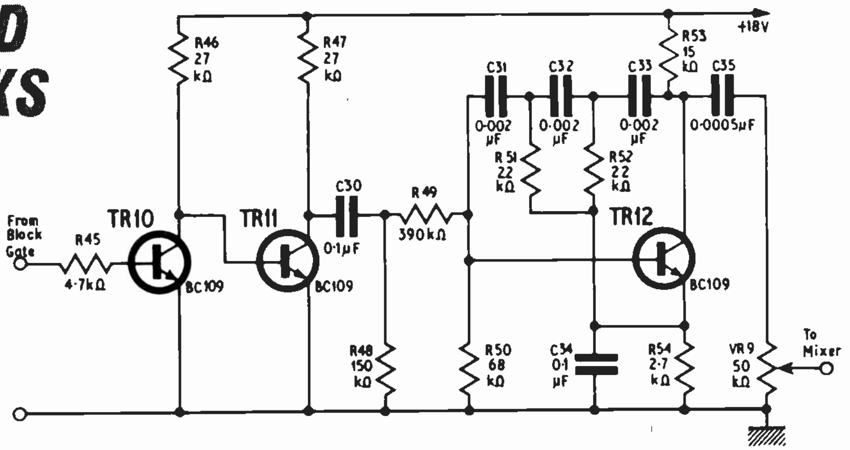


Fig. 2.3. The Wood Block signal is generated using this circuit

SNARE DRUM

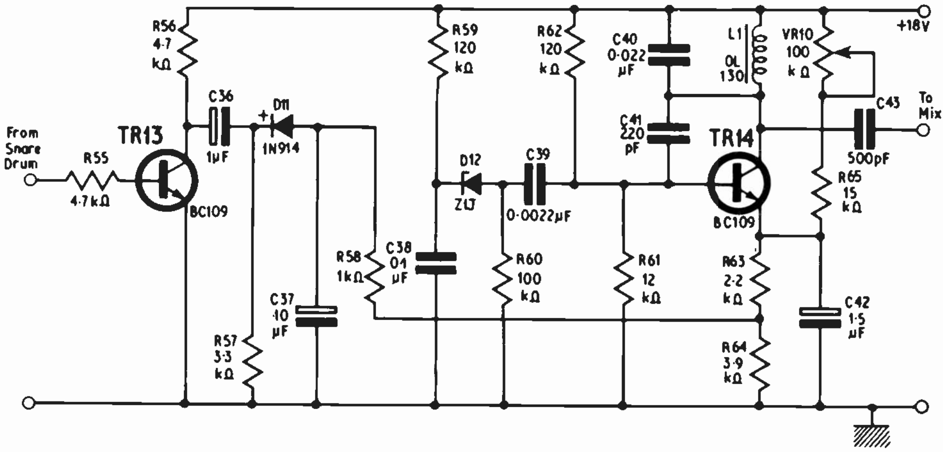


Fig. 2.4. The Snare Drum circuit uses a noise diode, D12, to provide the necessary sound

SNARE DRUM

The circuits so far discussed are very simple, damped oscillators and all feed a single input to a mixer. The remaining percussion circuits use either shaped noise, filtered for a particular frequency or shaped but relatively unfiltered noise. Each of these circuits makes use of a Semitron Z1J noise diode for the generation of this.

In the Snare Drum circuit (Fig. 2.4) transistor TR13 serves to step the input pulse of 5 volts up to 18 volts with the input network consisting of C36, R57, D11, C37 and R58 shaping the input pulse as required for operation of the subsequent stage.

R59, C38, D12, R60 and C39 develop and filter the required noise which is applied, for amplification, to the base of TR14. VR10 adjusts the bias level on the emitter of TR14 to insure that it remains off until the input signal is applied. L1, C40 and C41 are a tank circuit to emphasise certain frequencies.

When a signal is applied, the collector of TR13 drops to near ground potential. The overall effect is to ground the top of R64 removing part of the bias and allowing TR14 to operate for a period determined by C36 and the resistance in circuit with it.

CYMBAL

In the Cymbal circuit (Fig. 2.5) TR15 and the associated circuitry set up the width of the overall signal, while TR16 controls the decay with its associated circuitry.

The output of these two stages is applied to TR17 as a decaying waveform which gates noise through from the Zener diode and its associated circuitry in a controlled manner. The output resonant circuit, composed of C49 and the OL130, provide a natural sounding cymbal percussive attack.

Circuits of this type are, perhaps, not the best available but they represent a compromise between

CYMBAL

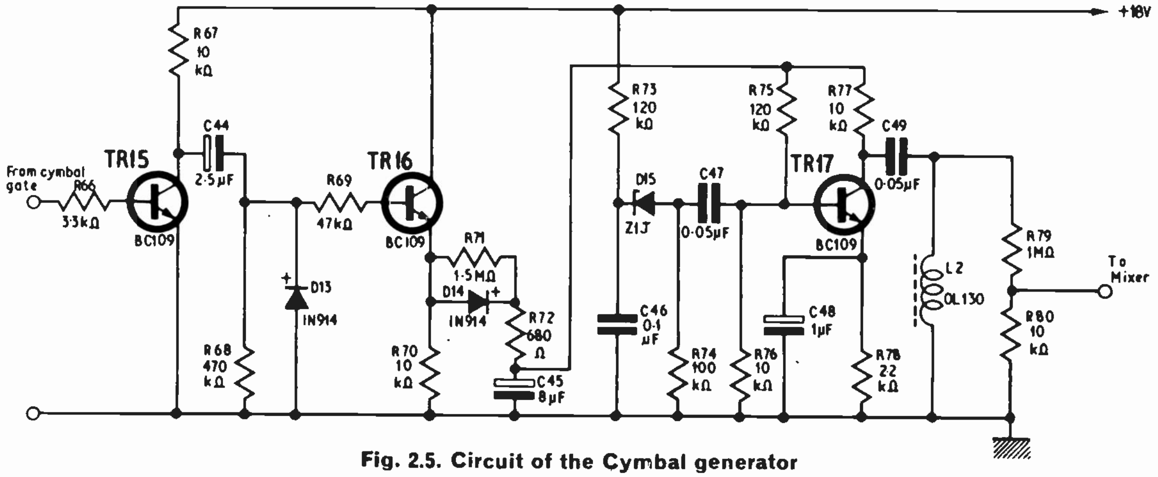
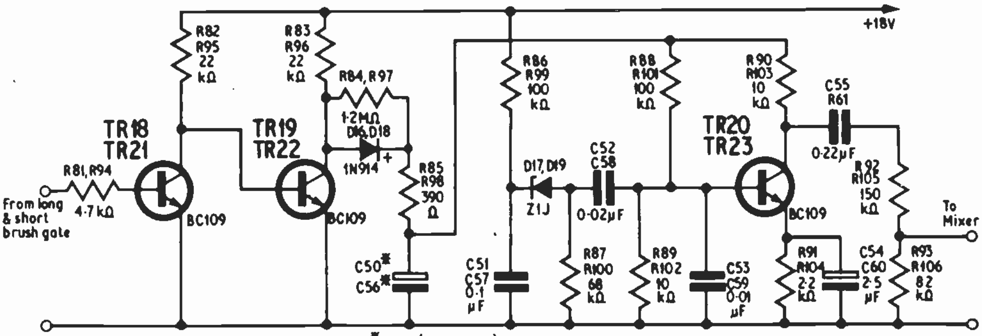


Fig. 2.5. Circuit of the Cymbal generator

LONG AND SHORT BRUSH



C50* 4µF (long brush)
C56* 1µF (short brush)

Fig. 2.6. The Long and Short Brush circuits are identical apart from C50/56

reasonably good operation and extreme complexity in terms of filtering, shaping and oscillatory circuitry.

LONG AND SHORT BRUSH

The Long and Short Brush circuits are given in Fig. 2.6. Apart from a capacitor value change they are identical. Again, a Darlington pair is used to shape the input pulse and C50 and 56 are used to control the decay to effect the long and short brushes respectively. Beyond that the circuitry is similar to the Cymbal stage.

MIXER AND PRE-AMPLIFIER

The Mixer and Pre-amplifier stages chosen use field effect transistors because of the inherent high input impedance and good signal separation afforded by these devices. Fig. 2.7 is the circuit diagram and illustrates the simplicity of the design.

Each input f.e.t. is fed from a capacitor and preset potentiometer to allow the overall output signal at the f.e.t. drains to be adjusted.

The output stage is arranged as a source follower and matches the high output impedance of the Mixer to the input of the Power Amplifier.

MONITOR AMPLIFIER

The output is taken to VR2 for volume control and from there to a monitor Power Amplifier (Fig. 2.8) for final amplification. An output jack is also provided to allow the output to be fed to an external amplifier.

The amplifier circuit given is adequate in output to provide rhythm accompaniment to a home soloist, but for group work a larger external amplifier should be connected. Additional amplification also enhances the instrumental qualities of the generator.

PERCUSSION GENERATOR BOARD

There is, outside of compactness, nothing difficult about the construction of the Percussion Generator Board. It might be a good idea to take the construction in stages beginning with the Mixer/Pre-ampli-

MIXER AND PRE-AMPLIFIER

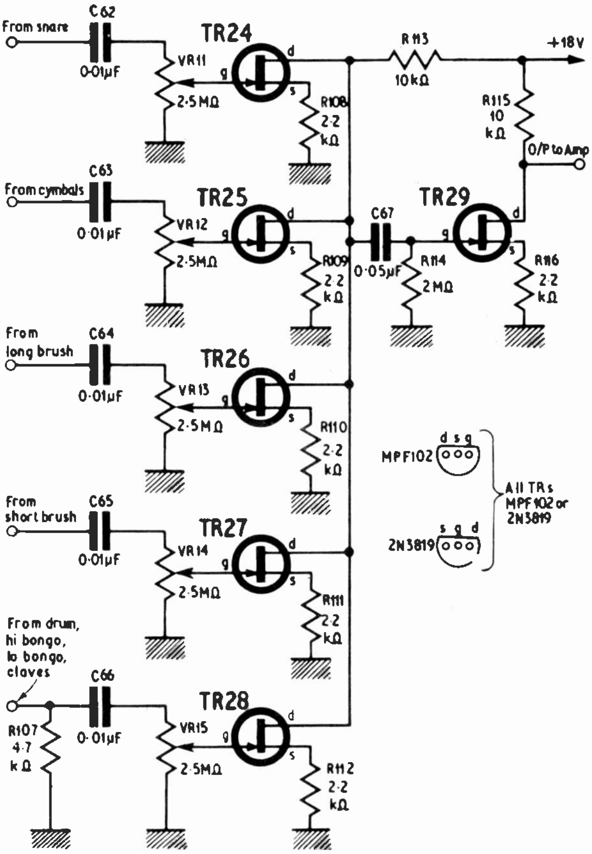


Fig. 2.7. Circuit of the mixer and pre-amplifier stages which use f.e.t.s to provide both good separation and high input impedance

MONITOR AMPLIFIER

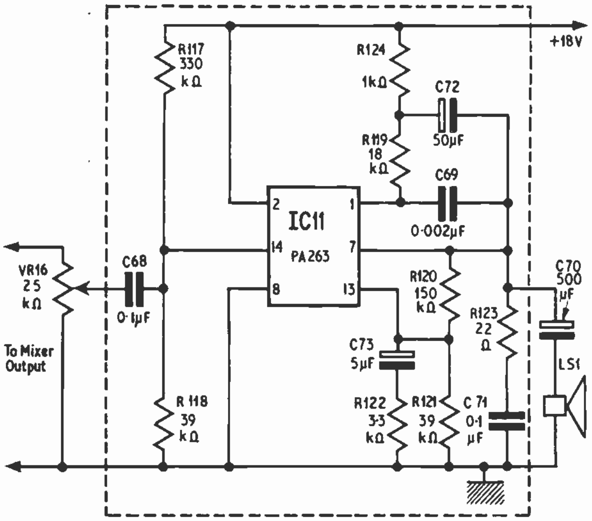


Fig. 2.8. Circuit of 3W amplifier

fier. It would then be possible to build and test each generator as you progress.

The photograph shows the prototype board layout of components which can be followed for grouping the percussion generators.

FINAL ADJUSTMENTS

Before making adjustments, set the volume control on the back panel for a comfortable listening level. Turn the "Stop/Run" switch to "Run" and select the Bass Drum. Press the "Write" switch with the tempo set fast enough to allow a quick program of drum beats to be written into each position. Now reduce the tempo and a steady drum beat should be heard. Adjust VR4 for this.

In a similar manner, select Low Bongos, High Bongos and Blocks. For Low Bongos, adjust VR7 until continuous oscillations occur and then back it off until you have the best sound. For High Bongos, adjust VR5 in a similar manner. Adjust VR6 and VR8 for a level that is compatible with the bass drum. Finally, adjust VR9 with Blocks selected. It will be necessary to fiddle these adjustments to get what you want but the above procedure should have four instruments working.

After adjusting the other four instruments, final volume adjustments can be made on VR4, 6, 8 and 9 with VR5 controlling the overall input to the mixer for these stages.

If, during any of the foregoing adjustments a steady hissing has been heard, VR10 should be adjusted to get rid of it.

Now erase all instruments by putting the instrument selection switches to the right and pressing the "Write" switch long enough to wipe out all sound. Adjust VR10 until a hissing noise is heard, then back it off until it just disappears. Now select the Snare Drum and adjust VR11 to make the volume compatible with the other instruments.

The final three instruments are selected in turn and the volume adjusted using VR12, 13 and 14.

PERCUSSION GENERATOR BOARD

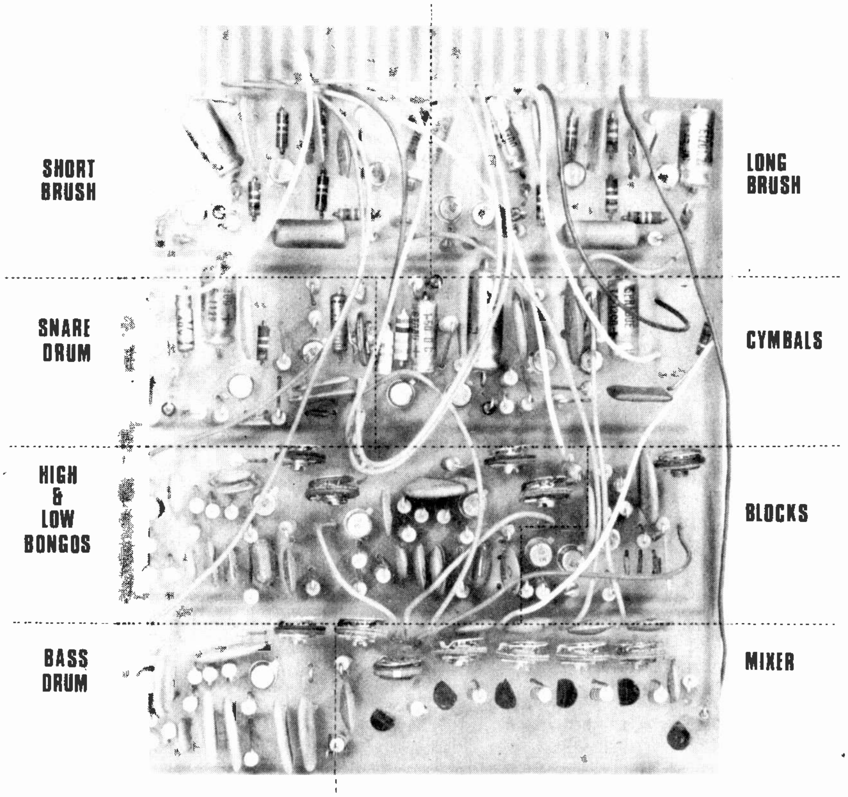


Table 2.1

	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	TIME SIGNATURE
VIENNESE WALTZ	a	h			h	h	a	h			h	h					6/8
FOX-TROT	a		h	h	a		h	h	a		h	h	a		h	h	4/4
SAMBA	a		f	a	a		h	h	a		f	a	a		h	h	4/4
QUICK-STEP	g/h		h		h		h		g/h				h		h		4/4
CHA-CHA	a			f	a		c	c	a			f	a		b	b	4/4
RHUMBA	a	d		d	a	d	a	d	a	d		d	a	d	a	d	4/4
BOSA-NOVA	a	c	c	a	a	c	c	c	a	c	c	a	a	c	c	c	4/4
TANGO	a			f	a		a	f	a			f	a		a	f	4/4
ROCK-N'-ROLL	a		b	b	a		b		a		b	b	a		b		4/4
MARCH/POLKA	a		h		a		h		a		h		a		h		4/4
WESTERN	a			c			a			b	b						6/8
BEGUINE	a	g	c	c	b		c		a	g		b	c		c		4/4

Drum—a
High Bongo—b
Low Bongo—c
Blocks—d
Snare Drum—e
Cymbal—f
Long Brush—g
Short Brush—h

RHYTHM PATTERNS

After final "tuning", the Rhythm Generator is ready to use. A layout, Table 1, displays rhythms with the counter number indicated above and the instruments indicated on the left.

Rhythms from various sources are programmed and illustrated here but others can, of course, be extemporised.

The sequence of events for programming is as follows.

1. Turn the unit on and adjust the volume for a comfortable level, listening to the random sequence that results at switch on.
2. Set the tempo to a fast rate, place all instrument switches to the right and press "Write". This procedure effectively clears every location in storage.
3. Place the "Stop/Run" switch at stop and press reset. This sets the counter to the beginning of the sequence indicated in the program.
4. Set the instrument switches for those instruments indicated in that position to the left and press "Write" . . . then press "Step" to advance to the next position. Repeat step 4 to the end of the rhythm pattern and return the "Stop/Run" switch to "Run".

PROGRAMMING

Programming the final instrument is not a complex thing and requires perhaps 30 seconds to a minute once a little practice has been gained. The "Stop/Run" switch is placed in the stop position. This stops the free-running tempo generator and allows the counter to be stepped through its 16 positions manually.

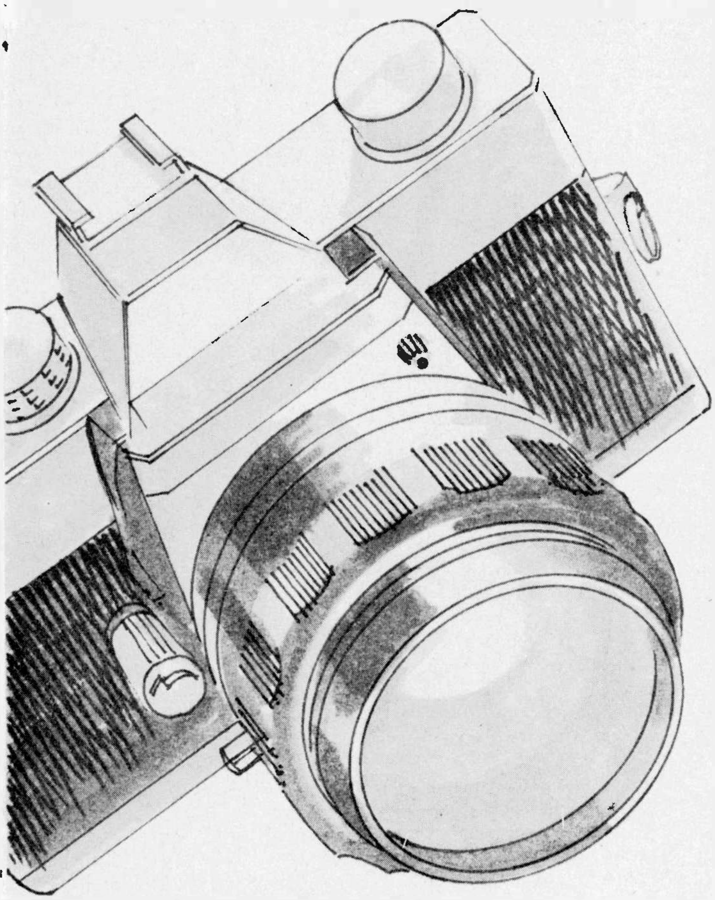
The second step is to push the Reset switch. This resets the counter and associated circuitry. The Minitron will indicate 0. During the course of programming a 4/4 rhythm, the counter will go through 16 counts but the Minitron will go from 0 to 7 twice for a total of 16 indications.

With the counter reset, place those instrument switches to the left where that instrument should sound on the down-beat and press the "Write" switch. Push the "Step" switch to advance the counter to the next position. To have a musical rest, simply leave all instrument switches at the right and push the "Write" switch. Additionally, to wipe out a complete programme, place all instrument switches to the right, set the "Stop/Run" switch to "Run" and the tempo control fully clockwise. Now press and hold the "Write" switch. The counter will now continue to run but no instruments will sound.

Finally, having programmed the desired rhythm, set the "Stop/Run" switch to run and the tempo control to the desired tempo. The instrument will now repeat the programmed rhythm of any 8 instruments at any of 16 beat positions repetitively until stopped or re-programmed.

★

CAMERA ELECTRONICS



P.E. TAKES A LOOK AT ELECTRONIC SYSTEMS IN CAMERAS

ELECTRONIC circuits are being used in more and more types of consumer products, i.e. products used by individuals rather than professional people. About twenty per cent of cameras now use some form of electronic circuit, but this percentage is likely to increase significantly in the near future. Some cameras employ discrete electronic components, but, as in other fields, integrated circuits are becoming more widely used in current designs.

APPLICATIONS

The main application for electronics in cameras is for the measurement of light intensity and for the control of mechanical shutter speeds. In many cameras the electronic circuit automatically adjusts the exposure time according to the amount of light entering the lens.

Most of this article will be devoted to the electronic control of mechanical shutters, but cameras using electronics for other purposes are gradually becoming available.

HISTORY

Although the use of electronic circuits in commercial cameras is a comparatively recent development, the idea is certainly not a new one. As long ago as 1902, Carl Eisner was granted a German patent entitled "A mechanism for the automatic regulation of exposure time in mid-lens shutters according to the intensity of the light". The Carl Eisner Company later became part of the Compur Company who are renowned for their shutters.

Some types of shutters driven by electromagnets were designed in the 1930s but they required a large amount of power and were unsuitable for portable cameras. Little further progress could be made until semiconductors became readily available at economic prices.

ADVANTAGES OF ELECTRONIC SHUTTERS

Modern electronically controlled shutters can provide accurate and reproducible exposure times without the necessity for close tolerance moving parts. The very long exposure times which are often required by professional photographers can be obtained more easily with electronic systems than purely mechanical ones.

For the amateur one of the most important advantages of the electronically controlled shutter is its use in automatic and semi-automatic exposure control systems. These make it possible for any user, however inexperienced, to obtain correct exposure times with certainty.

TYPES OF SHUTTER

In cameras with automatic shutter speed control the correct exposure is automatically set according to the intensity of the incident light. A light sensor in the camera feeds information about the light level (as an electric current) to the electronic circuit which controls the speed of operation of a mechanical shutter. In some cases the operator can override the electronic timing.

In semi-automatic exposure control systems the light intensity is measured and indicated on a meter. As the lens aperture and/or the shutter speed is varied an indicator may move past the meter needle to show whether the exposure setting is satisfactory.

In both systems the film speed is set on a dial which is connected to a variable resistor in the circuit. Either mechanically or electronically timed shutters may be used with semi-automatic systems but fully automatic systems use electronically timed shutters.

Semi-automatic systems are easier to use with less probability of error than a separate meter. Automatic systems provide very accurate exposure times at widely differing light intensities.

Amateur cameras using automatic exposure control are very simple to use and no time is wasted making preliminary adjustments.

LIGHT SENSORS

Selenium cells used to be used as light sensors as they produce current directly from the light without the need for a battery. The use of cadmium sulphide (CdS) photoconductive cells is now more common as they are more sensitive at low light levels. Both types of cell are used because their spectral response matches that of the eye and the modern photographic emulsions whose response is similar.

Cadmium sulphide cells have the disadvantage that their response time to a change in light level is rather long; over ten seconds being required for equilibrium to be reached when the light intensity changes by a factor of 100. This is not normally a difficulty but it should be kept in mind.

THROUGH THE LENS

Almost all cameras have some form of built-in exposure meter. The modern trend is to design cameras in which a fraction of the light entering through the lens is deflected into a photosensitive cell.

Through the lens is often seen referred to as TTL, not to be confused with the electronic abbreviation for transistor-transistor logic.

The Zeiss-Ikon "Contarex Super" is a high class camera which uses a TTL semi-automatic exposure system. The paths of the light beams are shown in Fig. 1. The main reflex mirror is partially silvered and a fraction of the incident light passes through this mirror and is deflected by a secondary mirror onto a cadmium sulphide photoconductive cell.

The reading of the exposure meter is displayed in the viewfinder and also in an additional exposure meter window.

The light intensity is measured over a fairly narrow angle in the centre of the field of view (about seven degrees when the normal type of 50mm focal length lens is employed).

The light intensity is measured with the lens aperture wide open. The focusing of the camera can be carried out in this condition where any focusing error shows up most clearly.

OTHER THROUGH THE LENS SYSTEMS

The Leicaflex SL employs a system which is rather similar to the Contarex except that the photocell is differently placed. However, the secondary mirror folds up into the frame of the reflex mirror when the latter rises, immediately before the exposure is made. During the exposure the secondary mirror prevents light from the viewfinder from passing through the partially silvered reflex mirror into the interior of the camera.

The Leica M5 also employs a CdS cell for semi-automatic exposure control.

The Rolleiflex SL35 is a single lens reflex with a TTL semi-automatic exposure control system using two CdS detectors. One of these cells is placed at each side of the camera in such a way as to give an integrated reading of the light intensity from the viewfinder screen of the pentaprism unit.

The meter reading is a centre weighted one, light at the edges of the field making only a small contribution to the reading.

The Olympus M1 is another single lens reflex with semi-automatic exposure control.

ELECTRONICALLY TIMED SHUTTERS

The electronic shutter timing systems available at the present time employ electronic circuits to con-

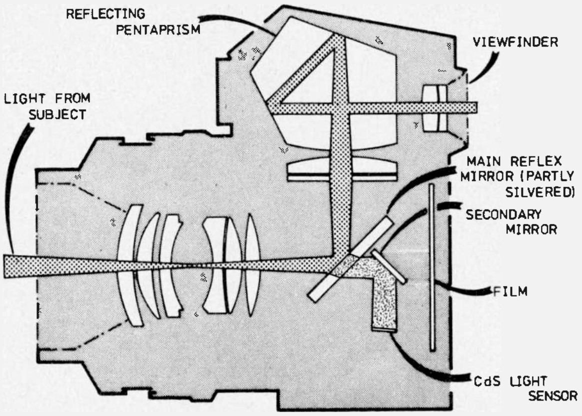


Fig. 1. The light paths in the Contarex Super. A fraction of the incident light is deflected by the small secondary mirror onto the photosensitive cell.

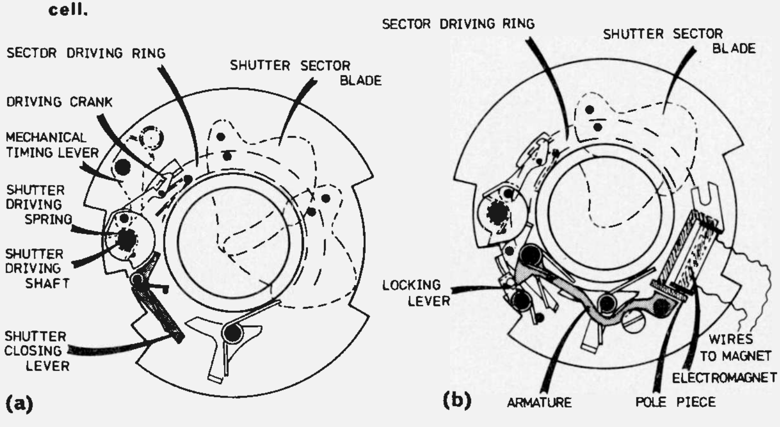


Fig. 2. A mechanically timed and a comparable electronically timed shutter. (a) In the mechanically timed system, the time taken for the timing lever to move controls the exposure. (b) in the electronically timed system the exposure is controlled by the time at which an electromagnet releases the armature.

trol the movement of mechanical shutters. The link between the electronic circuit and the shutter blades is normally an electromagnet.

The mechanical components in an electronically timed shutter may be very similar to those employed in a comparable mechanical shutter as shown in Fig. 2. The metal sector plates of both types of shutter swing about fixed pivot pins when the sector driving ring rotates through a small angle. Rotation of the sector ring can thus cause all of the sector plates to be removed so as to open the shutter.

The mechanical shutter in Fig. 2a uses the priming lever to operate the shutter driving shaft on which the driving spring is wound.

The shutter closes after an interval which is controlled by the braking force applied by the mechanical timing mechanism.

Fig. 2b shows the mechanical shutter employed in the Compur/Prontor 500 electronically controlled shutter; this shutter is used in the Vitessa 500AE camera the circuit of which will be described later. The mechanical timing lever is replaced by an electromagnet in the shutter closing mechanism. The return of the shutter driving ring to close the shutter is prevented by a sprung locking lever. The armature is released by the electromagnet at a time determined by the electronics.

When the priming lever of the shutter is operated to prepare for the next exposure the armature moves to touch the pole piece of the magnet. It is held mechanically against the polepiece until the current flows through the electromagnet to delay the shutter closure.

THE AGFA SELECTRONIC

The Agfa-Gavaert "Selectronic" camera is an example of a camera with an automatic exposure system. The intensity of the light passing through a small window near the top of the camera is measured by a photosensitive cell. The settings of the aperture and film speed each determine the value of variable resistors and these together with the photocell determine the exposure time.

The type of display is shown in Fig. 3. The aperture setting is seen at the top. If the amount of light is too large for the shortest exposure time (1/500 sec) the needle of the meter will move to a red warning mark. At the other extreme the needle will point to a tripod symbol if the exposure is so long that a tripod would be required.

BASIC CIRCUIT

The basic resistance-capacitance timing circuit used in a large number of applications is shown in Fig. 4.

When the shutter is operated switch S1 closes and the shutter opens. The capacitor then commences to charge through the variable resistor VR1. When the voltage on the capacitor is sufficient to trigger the circuit the current to the electromagnet is switched off. A spring then pulls the shutter blades into the closed position.

The variable resistor controls the capacitor charging rate and hence the exposure time.

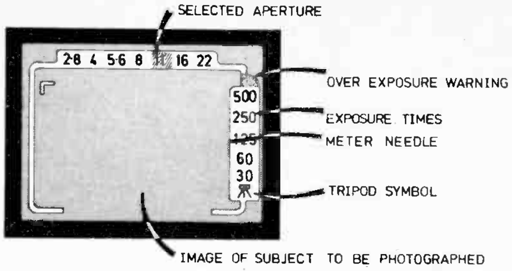


Fig. 3. The appearance in the view finder of the Agfa-Gevaert Selectronic camera. Both the aperture and the exposure time are automatically shown.

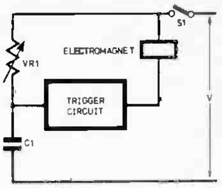


Fig. 4. A basic timing circuit.

MAGNET OPERATION

Because the shutter blades must be moved extremely quickly it is generally more satisfactory to use the electromagnet to close the shutter rather than open it. This means just switching off the electromagnet, letting a spring do the work.

The circuit of Fig. 4 may be arranged to do this by causing the trigger circuit to produce a current which opposes the magnetic field. The magnet then releases an iron armature connected to the shutter driving ring.

BLOCKING OSCILLATOR CIRCUIT

The blocking oscillator shown in Fig. 5 is a typical trigger circuit.

When the shutter is operated S1a closes and S1b opens causing the capacitor to charge up and after a predetermined time the circuit to oscillate.

Initially, the output transistor TR2 is conducting, therefore current passes through the electromagnet. When oscillation starts a current is applied to the base of TR2, causing it to stop conducting thus releasing the armature and closing the shutter.

This causes S1a to open and S1b to close causing C1 to discharge in preparation for the next exposure.

FOUR LAYER DIODE

One of the simplest circuits for timing the closure of a camera shutter is that using a four layer diode. This is a *pnpn* device which conducts when the potential across it reaches a certain value (about 20V) and continues to conduct until the current through it falls below a holding level.

When the shutter is operated the shutter is opened and the start switch of Fig. 6 is closed. As the potential across the capacitor C1 rises a point is reached where the four layer diode "fires" and current is passed to the coils surrounding the permanent magnet. The field of the magnet is cancelled and the soft iron armature is released.

FOUR TRANSISTOR CIRCUIT

Another circuit is shown in Fig. 7. It employs four transistor stages in cascade forming a high gain amplifier. When the shutter is released S1 closes and the shutter opens causing TR4 to conduct, energising the magnet and attracting the armature.

When the base voltage of the first transistor reaches the threshold value for conduction the current is greatly amplified and TR4 is suddenly cut off, releasing the armature and closing the shutter.

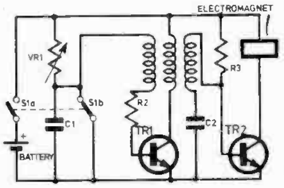
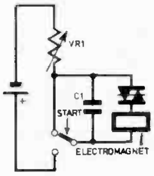


Fig. 5. A blocking oscillator timing circuit.

Fig. 6. A simple timing circuit using a four layer diode.



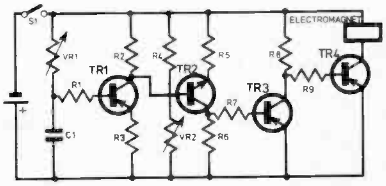


Fig. 7. A timing circuit using four cascaded transistors to provide high gain.

SCHMITT TRIGGER

One of the most commonly used circuits for timing in cameras is the well-known Schmitt trigger. The circuit is used, for example, in the Compur "Electronic 3". The circuit and part of the operating mechanism is shown in Fig. 8.

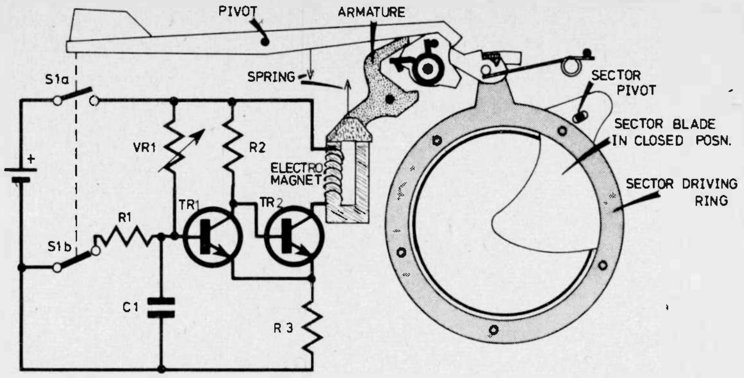


Fig. 8. Diagrammatic representation of the Compur Electronic 3 shutter before operation.

As the voltage across the capacitor rises a point is reached at which the circuit switches very suddenly by feedback action so that TR2 is cut off and TR1 conducts. The current to the magnet is therefore cut off at this instant.

This type of circuit can provide exposure times over a very wide range of values (typically 10,000 to 1) with a single capacitor.

The shutter exposure scale of the Compur "Electronic 3" is 1/200 to 32 seconds.

REMOTE OPERATION

The Compur 5FS is a shutter designed for remote operation. The transistor circuit is contained in the control unit and not in the shutter itself.

The shutter unit itself contains motors for the operation of the shutter and for aperture control. No adjustments are made on the shutter itself. Shutter speeds from 1/60 to 32 seconds are available.

The circuit is shown in Fig. 9. TR1 and TR2 form a Schmitt trigger which switches when the voltage on C2 reaches a preset level. A pulse is then applied to TR3 which causes the magnet to close the shutter spring sectors, and S2 to short circuit C2. The motor tensions the shutter spring automatically. While this is happening the shutter cannot be used and a red warning light appears.

The aperture is controlled by a servo system not described here.

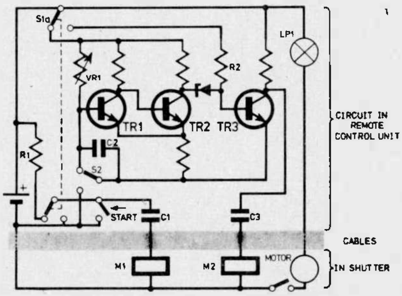
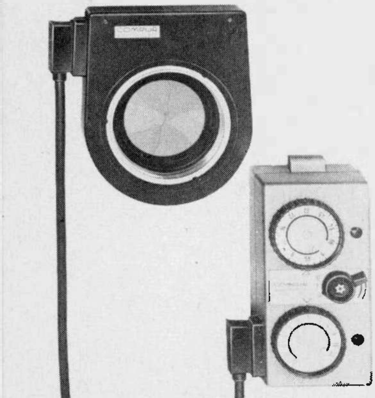


Fig. 9. The timing circuit of the Compur 5FS remotely operated shutter.



The Compur 5FS electronic shutter with its remote control unit. (The connecting cable may be much longer than that shown.)

THE VITESSA 500AE

The Prontor "Vitessa 500AE' was introduced in May 1968. It employs a circuit which automatically sets the exposure over the range 1/500 to 10 seconds.

The timing mechanism is silent so a lamp is used to indicate when the shutter is open. The lamp also functions as a battery tester.

Fig. 10 shows the circuit in its quiescent state. When S1 is closed the light falling on the photoconductive cell PCC1 causes the meter ME1 to deflect by an amount dependent on the light intensity. When the shutter is actuated S2 is switched on so that the current passing through PCC1 is diverted to the time measuring circuit. The shorting switch S3 is operated when the shutter release is pressed so that the current from PCC1 can pass to the capacitor C1.

Switch S1 can now open since the current can pass through S3. After the preset time the circuit is triggered and current ceases to flow through the magnet, thus closing the shutter.

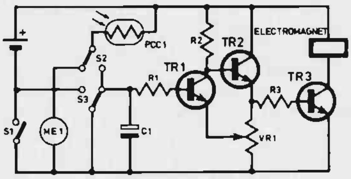


Fig. 10. The circuit used in the Vitessa 500AE. The photoconductive cell initially provides an indication of the light intensity, but is switched into the timing circuit immediately before the exposure.

ULTRA-MINIATURE CAMERA

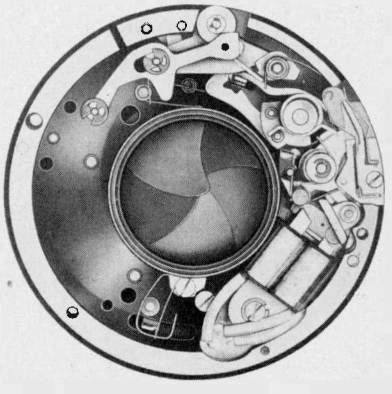
The Minox C is one of the smallest cameras available. It was introduced in 1969 after five years' development, and is only 13·9cm × 2·8cm × 1·6cm.

The basic circuit is shown in Fig. 11. Two magnets are used in this system: one to open and one to close the shutter, this being necessary to obtain the relatively high speed of 1/1000 second. Although the magnets themselves take longer than this to operate it is only the time between their actuation which is important.

When the shutter release lever is pressed, the switch S1 closes and electromagnet M2 is actuated, opening the shutter and contacts S3.

When C1 reaches the threshold voltage after charging through PCC1 the amplifier switches on electromagnet M1 which closes the shutter and opens S2.

The light measuring system is a centre-weighted one; more account



The electronic shutter used in the Kodak Instamatic reflex camera with the cover plate removed.

is taken of light in the centre of the field than near the edge.

THE CONTAREX SE

The Contarex "Super Electronic" camera was introduced in February 1969. It is similar to the Contarex Super already described but an electronic shutter is used. The basic Contarex SE is a semi-automatic camera in which an internal CdS photocell is used to measure the amount of light entering through the lens.

The circuit used in the Contarex SE is shown in Fig. 12. When the shutter speed is selected the appropriate shutter timing resistor R1 is switched into the circuit.

When the shutter release is pressed the shutter opens, the battery is connected and contacts S1 close. The electromagnet holds the shutter open.

When the current passing through R1 has charged C1 up to the threshold voltage, the trigger circuit switches off the current to the electromagnet and the shutter closes. Contacts S2 close to discharge C1.

If the battery fails the shutter operates at only the shortest exposure of 1/1000 second.

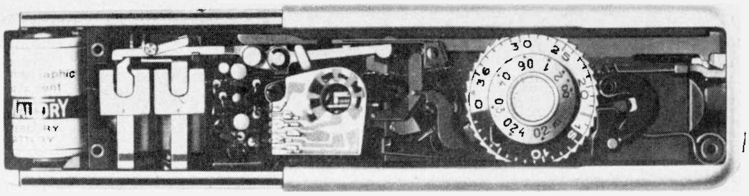
REGULA 35

The Regula "Electronic 35" employs a CdS photocell to provide fully automatic shutter speed control. The aperture is set in the range f/2·8 to f/16 and the shutter closes when the correct exposure has been achieved (in the range 1/250 to 15 seconds).

The circuit of the "Rectormatic 350" shutter employed in the Regula uses a TAA580 integrated circuit as the trigger circuit (Fig. 13). Initially the capacitor is shorted by S2, and S3 is in the measuring position. The current passing through the photocell passes through the indicating meter in the viewfinder.

The main switch S1 is closed before the timing circuit is used. When the shutter release is operated S2 opens and S3 moves to the timing position so that current through the photocell is passed to the capacitor.

The integrated circuit switches at a predetermined level resulting in the magnet being switched off and the shutter being closed. S2 then shorts the capacitor ready for the next exposure.



Internal view of the Minox C. The electromagnets which open and close the shutter are shown to the right of the batteries and the circuit is near the centre.

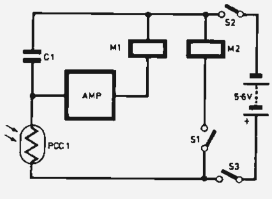


Fig. 11. The basic circuit of the Minox C ultra-miniature camera.

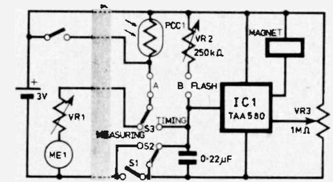


Fig. 13. The circuit of the Regula Electronic 35 camera.

POLAROID CAMERAS

The Polaroid Company is well known for its cameras which produce fully developed black and white photos in 15 to 30 seconds or colour in 1 minute after exposure.

Polaroid cameras employ between-lens shutters but they do not use sectors fitted to a driving ring. When the shutter release is pressed one or two metal plates move to let in the light. After the required exposure time an electromagnet releases another metal plate which is pulled by a spring to close the shutter. The exposure time is automatically controlled by the light intensity.

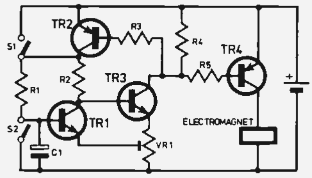


Fig. 12. The shutter timing circuit used in the Contarex SE. Other circuits are employed in the accessories available for use with this camera.

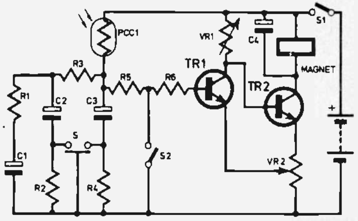


Fig. 14. The circuit used in the Polaroid 340 and 350 cameras.

In the case of model 350 the exposure ranges from 1/1200 to 10 seconds.

The circuit of models 340 and 350 Polaroid Land cameras is shown in Fig. 14. It consists of a Schmitt trigger circuit which is controlled by current from a photoconductive cell.

Both of these cameras produce pictures 4¼in × 3¼in and incorporate an automatic exposure system for flash photographs.

The model 320 is the most economical of the range and model 330 has a non-electronic development timer.

ELECTRONIC DEVELOPMENT TIMER

Model 350 has an electronic development timer which uses two integrated circuits, and a potentiometer to set the required development time. When the exposed film is pulled out the timer is automatically started.

The second integrated circuit forms the timer. A lamp is illuminated during the development period but at the end of this time it is extinguished and the first integrated circuit operates as an oscillator emitting an audible warning.

The Colourpack 82, introduced in April 1973, has a non-electronic development timer and produces pictures 3⅜in × 3¼in in colour or black and white. For black and white the aperture is so small that the depth of field is great making focusing unnecessary.

SEIKO ES SHUTTER

The Japanese Seiko ES shutter is a between-lens shutter using interleaving segments and two electromagnets. It is interesting as no iris diaphragm is employed, the shutter sectors themselves acting as the aperture limiting device.

The shutter opens at a definite rate and closes as soon as the correct amount of light has entered the camera.

Fig. 15 shows the components of this shutter arranged around the lens. The shutter blades are opening in this diagram.

At high light intensities the sectors close without ever having fully opened. At lower light levels they may take about 0·06 seconds to open fully and then remain open until the correct exposure has been attained.

This type of aperture-exposure time system is said to reduce aberrations, provide greater depth of field by using only the minimum necessary aperture, and give clearer images.

THE MINOLTA HI-MATIC E

A Seiko shutter of somewhat similar design is used in the Hi-matic E manufactured by the Minolta Company of Japan. The circuit is shown in Fig. 16.

It was found necessary to use two CdS photocells and an external resistor R6 to obtain the required response curve.

When the shutter release button is pressed the shutter sectors are mechanically opened, S2 is closed, the magnet activated and S3 opened. Capacitor C1 charges through the photocell and the Schmitt trigger circuit switches off the shutter release magnet at the end of the correct exposure time. The lamp is used as a battery check and as a warning indicator.

If the light intensity is below a certain level the Hi-matic E operates a flash automatically and shows in the viewfinder that it is going to do so.

MINOLTA 16 QT

The Minolta Company also manufacture a sub-miniature camera, the Minolta QT which measures only 11cm × 3cm × 4·5cm. Although this camera is semi-automatic the circuit is interesting since it uses active devices.

It has two shutter speeds, 1/250 and 1/30 second. The semi-automatic system indicates in the viewfinder the direction in which the aperture must be changed to achieve a suitable exposure. When the correct setting has been made the lamps in the viewfinder flash alternately.

The circuit is shown in Fig. 17. The four transistors and three resistors are contained in an integrated circuit. The circuit is basically a bridge network in which the unbalance voltage between points A and B is fed to a transistor differential amplifier.

When the incident light intensity is high the resistance of the photocell is low and the potential at A is thus nearer to that of point C than that at D. TR2 and TR4 are therefore non-conducting and lamp LP1 is not illuminated. However, TR1 drives TR3 into conduction and lamp LP2 lights. When the aperture is changed the value of VR1 is altered and the bridge can be balanced, i.e. the potentials at A and B are made equal.

At balance the capacitor connected to the unlighted lamp charges and the current through this lamp increases until it is illuminated and the other lamp extinguished. Thus the circuit is astable, the two lamps flashing alternately.

TL ELECTRO-X

The Yashica "TL Electro-X" is a 35mm single lens reflex which uses two CdS photocells at each side of a pentaprism unit in a through the lens measuring system.

An electronically timed metal focal plane shutter is used to give exposures from 1/1000 to 2 secs.

The circuit uses an integrated circuit. If the amount of light entering the camera as detected by the photocell at the selected aperture is too low for the exposure setting chosen, a lamp is illuminated in the viewfinder, a red arrow indicating the direction in which the correction should be made.

If the light is bright enough to produce over-exposure the integrated circuit switches on another lamp showing an arrow pointing in the other direction.

At the correct exposure setting neither arrow is lit.

When the shutter release button is pressed the front sector of the shutter travels downwards under the action of a spring, and electromagnets are energised to hold the rear section of the shutter in place.

When the threshold voltage on a charging capacitor is reached, current to the electromagnets is cut off and a spring pulls the rear section of the shutter downwards to end the exposure.

ASAHI PENTAX ES

The Japanese Asahi "Pentax ES" is a 35mm SLR which uses CdS photocells located beside the viewfinder eyepiece in a through the lens light measuring system.

It employs a horizontally moving focal plane shutter whose speed is set by the light intensity in the range 1/1000 to 8 seconds.

The electronics is fairly complex consisting of an integrated circuit containing 50 transistors, diodes, etc.

The light intensity, aperture setting and film speed are fed into the circuit by a photoresistor and two mechanically set variable resistors. The current passing through each is fed into separate logarithmic compression circuits which generate an output proportional to the logarithm of the input current.

The integrated circuit then takes these values, makes the necessary computation and produces an output current whose value is proportional to the reciprocal of the required exposure time.

The current is fed to a capacitor from the instant the shutter opens. When the capacitor charges up to a threshold value a trigger circuit switches off the current to the electromagnets and the shutter closes.

MEMORY

During the exposure, light does not fall on the photocell so the output from the logarithmic

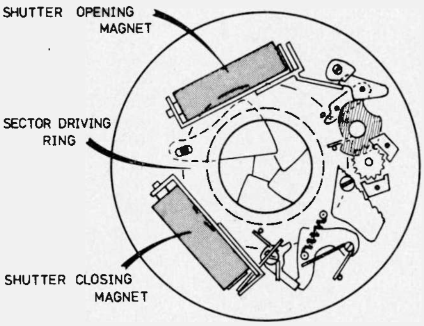
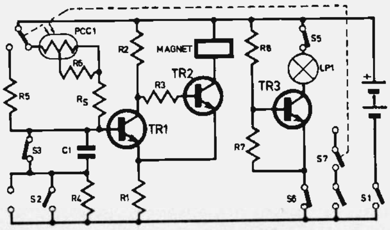
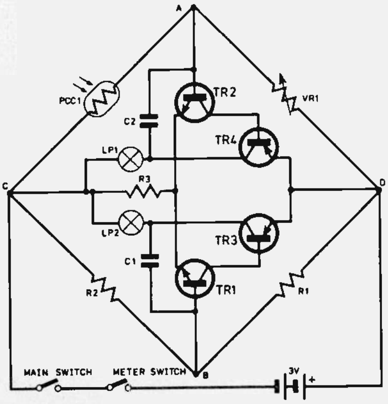


Fig. 15. The mechanical mechanism of the Seiko-ES shutter (left).

Fig. 16. The circuit of the Minolta Hi-matic E shutter (bottom left).

Fig. 17. The circuit of the Minolta QT semi-automatic camera (below).





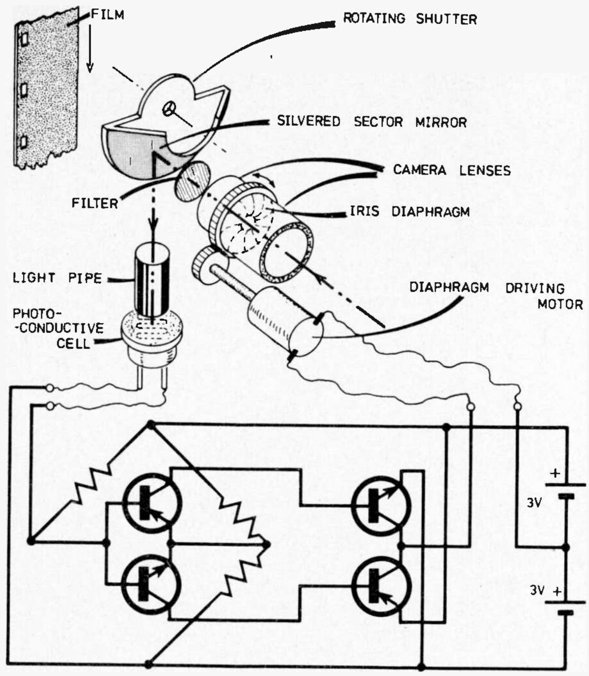


Fig. 18. Aperture control system used in the Moviflex S8.

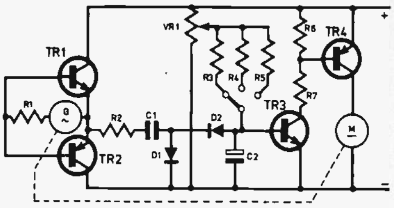


Fig. 19. The electronic speed control system used in the Leitz "Super 8".

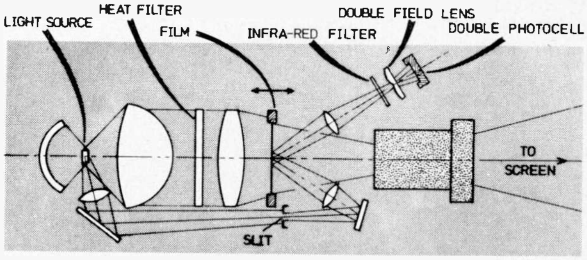


Fig. 20. The optical system used in the Leitz Autofocus projector.

generator in the light intensity measuring circuit is fed to a memory circuit which consists basically of a capacitor connected to a field effect transistor, the high input impedance of the f.e.t. preventing the capacitor discharging.

The meter in the viewfinder of this camera provides an unusually wide indication of exposure times: from 1/1000 to 1 second.

CINE CAMERA EXPOSURE CONTROL

As an example of exposure control in a cine camera, the principle used in the Zeiss-Ikon "Moviflex S8" will be considered. The system employed is shown in simplified form in Fig. 18. Since the exposure time is partly determined by the speed of the film, it is more convenient to control the aperture.

The light from the object to be photographed passes through the iris diaphragm which controls the aperture. The rotating shutter is a conical sector which is silvered on the outside. It covers the aperture leading to the film during the time that the film is moving between successive photographs. In this period the silvered surface reflects the light onto a photocell.

The photocell forms one arm of a bridge which, when balanced, passes no current to the motor which drives the iris diaphragm.

A fall in light produces an inbalance which causes the motor to be driven in such a direction that the iris diaphragm continues to open until the amount of light reaching the photocell reaches its previous value, when the bridge is again balanced. An increase in light drives the circuit into unbalance in the opposite direction reducing the aperture.

The other resistors in the bridge circuit are altered to set film sensitivity, the number of frames per second, and exposure if the photographer wishes to alter it for some reason.

ELECTRONIC SPEED CONTROL

As an example of electronic film speed control the system used in the Leitz "Super 8" will be discussed, the circuit being shown in Fig. 19.

The driving motor has a small tachogenerator connected to it which produces an alternating voltage at a frequency equal to the motor speed.

Transistors TR1 and TR2 produce rectangular pulses of constant amplitude which are fed to the diode pump circuit D1 and D2 which charges C2 with such a polarity as to tend to cut off TR3. The greater the motor speed the greater the current fed to C2.

A current also flows through VR1 and the switch to C2 which tends to oppose this current. When the voltage on C2 reaches more than 0·5V the transistor conducts and reduces the base voltage on TR4 which conducts, thus passing current to the motor.

The current to the motor, and hence its speed, is thus controlled by the current fed into C2 from VR1 minus the current from D2. Resistors R3 to R5 are used to select operating speed.

If the motor goes too fast current from D2 is increased and TR3 and TR4 reduce current to the motor.

AUTOFOCUS

The Pradovit-Color-Autofocus is a system designed by the Leitz Company for keeping the image formed by a projector in focus. The first slide (or first frame of a film) is focused manually, after which time a servo system keeps the image in focus.

The optical system is shown in Fig. 20. A subsidiary optical system forms an image of a slit on the reverse side of the film and the light from this image passes through a converging lens and a filter which only allows the infra-red frequencies to pass to a photocell. This cell is divided into two parts and uses cadmium selenide which responds to infra-red.

When each half of the cell receives equal light as detected by a bridge circuit the image is focused. Any imbalance causes the electronic circuit to drive a motor which corrects the film-to-objective distance.

THE FUTURE

It is only a few years since electronics began to make an important impact in this field of amateur photography. It is probably too early to speculate on the possibilities it offers for the future, but it seems certain that it will be more widely employed as manufacturers gain experience in what, even to them, is a relatively new development.

★

The Minolta Hi-matic E camera.

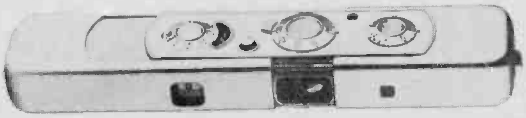
The Yashica Electro MC 35mm camera.

The Polaroid 350 Land Camera.

The Asahi Pentax ES single lens reflex with automatic shutter timing.

The Minolta 16QT ultra-miniature camera.

The Zeiss-Ikon M811 cine camera.



The Minox C ultra-miniature camera.

The Regula Electronic 35 camera with automatic shutter timing.

The Yashica TL Electro X single lens reflex.

Boolean Algebra—2

By B. J. Wood

Design and construction of a simple adder subtractor

IN PART I of this series a number of logic functions and the basic circuit elements needed to carry them into effect were discussed. Now some more complex elements will be considered and the various parts of a simple Adder/Subtractor will be described in function and basic construction.

ADDING THE SINGLE DIGIT

It is an unfortunate fact that none of the simple logic elements so far discussed will actually add two binary bits A and B under all circumstances. Thus for. example, the OR works with $\bar{A}.B$ or $A.\bar{B}$ but it gives a 1 output for $\bar{A}.\bar{B}$.

Again, the NAND is similarly satisfactory but gives a 1 output for A.B. It can be seen that if the two outputs are combined with logic 0 taking precedence over logic 1 the correct answer is produced.

If integrated circuits are to be used in a practical application then the OR function is only obtained by using some other element and manipulating either the input or output. They are a 2-input device.

For example, NANDs are available, in the two input form, four to a package and an OR can be formed by inversion of the NAND inputs as discussed in Fig. 1.2f in Part I.

This brings us to the Exclusive OR.

EXCLUSIVE OR

In Fig. 2.1 the logic diagram of an Exclusive OR (EX. OR) is shown at "a" with the Truth Table at "b". The element is a combination of two NANDs, two NOTs and an AND which, as discussed above, now provide the correct conditions for the addition of binary bits A and B. The output is a logic 1 only when one or other of the inputs is a 1.

When A and B are both at logic 1 the upper NAND output is 0 whilst if A and B are both 0 the output from the lower NAND is 0. The diode AND which follows will produce a 1 output only when both NAND outputs are at logic 1.

EXCLUSIVE NOR

At Fig. 2.1c the circuit of Fig. 2.1a has been altered to operate the other way about. This gives a logic 0 when the two inputs are different and a logic 1 when they are the same. The Truth Table for an EX.NOR is the reverse of Fig. 2.1b.

The new function is the Exclusive NOR and it is interesting to note that it can be achieved with exactly the same circuit elements.

Reverting to the Exclusive OR, this can be obtained in i.c. form, four to a package. It is what is normally termed a half-adder. That is to say it can only add the bits A and B and produce the sum S.

DECIMAL/BINARY

For simplicity the logic dealing with the decimal number 1 will be called the 1's logic and that dealing with decimal 2 the 2's logic. Thus as in the conversion from binary to decimal we have binary numbers equivalent to 1, 2, 4 and 8, we have 1's, 2's, 4's and 8's logic.

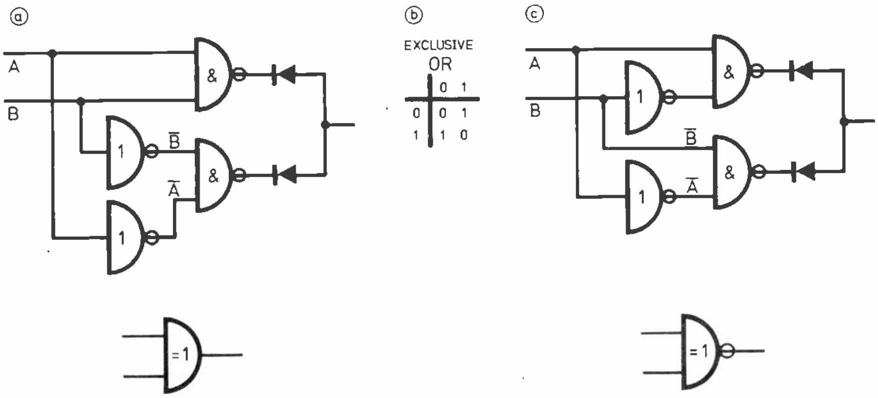
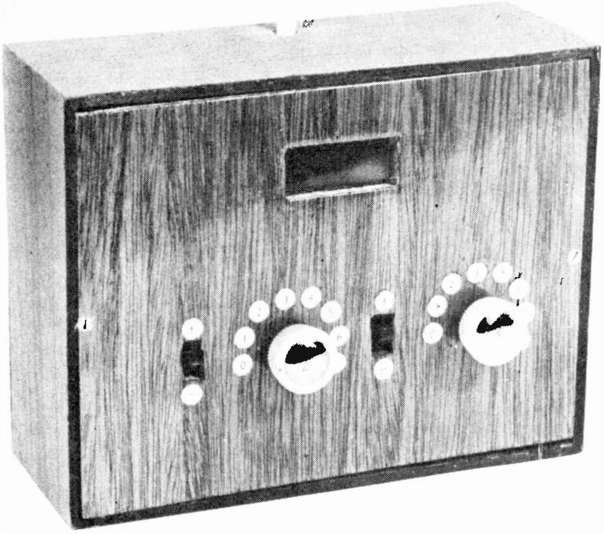


Fig. 2.1. The Exclusive Or (EX.OR) logic diagram together with the NOR version and Truth Table



Thus the Exclusive OR elements which are half-adders are in fact suitable for the 1's position addition, needing only an AND with inputs A and B to provide the carry bit needed for further computation.

TRUTH TABLE

When any binary position above the 1's stage is considered it has to cater for the carry bit *C* which can appear from the preceding stage. The Truth Table 2.1 caters for these positions.

The logic functions inside the dashed box are those of the EX. OR. C_{in} represents the carry forward from a preceding stage and C_{out} the carry to be passed on to a following stage. S is of course the sum output.

For A and B the second group of lines is a repeat of the first.

The table shows that when the C_{in} is a logic 1 the sum is inverted and in fact if one writes out a table for S and C_{in} it is found that a further EX. OR function accepting inputs S and C_{in} will deal with the problem.

In this sense the EX. OR may be described as a conditional inverter since when one of the inputs is held at logic 0 the output becomes a copy of the other input but that when an input is held at logic 1 the output becomes the inversion (complement) of the other input.

Of course, the device for which Table 2.1 is effective is a three-input device. The carry C_{out} becomes logic 1 if any two of the three inputs are at logic 1. Now we are approaching a true adder.

SUBTRACTION

Before becoming involved in circuitry for the C_{out} function, subtraction is important. Table 2.2, which is similar to Table 2.1 in layout, is the Truth Table for a subtraction function. Here, both B and the two carry bits have been given a minus sign. The S should be changed as well.

Comparing the tables, the only difference is in the C_{out} column. The condition B.C is the same in both tables. In the Add mode the other carries are A.B or A.C. The other borrows on Subtract are $\bar{A}$.B. and $\bar{A}$.C.

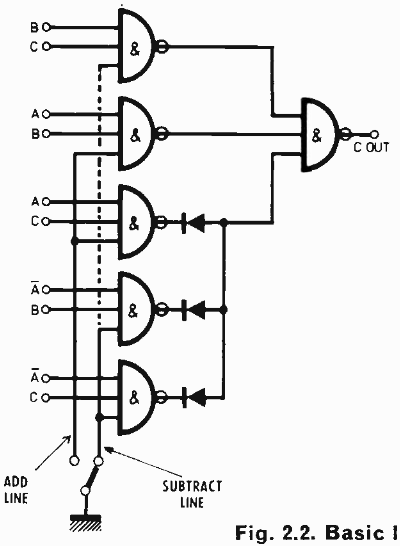


Fig. 2.2. Basic logic circuit for a simple ones Adder/Subtractor

A CIRCUIT

The logic diagram of Fig. 2.2 shows a simple Adder/Subtractor for 1's.

A NAND cannot output a logic 0 while one of its inputs is held at 0. The Add/Subtract switch decides which of the NANDs will be disabled so that only appropriate 1's appear in the final output of the 5-input NAND.

Here a 3-input NAND is used with extra diodes attached to one of the inputs.

A modification is needed for the 1's adder. On Add, only A.B must produce a carry so that the NAND with inputs A.C is not required. B.C, which is a common factor in the full carry/borrow circuit, must not be allowed to operate on Add and has a third input which is earthed in the Add mode.

Fig. 2.3 is the logic circuit diagram for the simple Adder/Subtractor using elements of the types so far discussed. The carry, add and subtract lines can be identified easily. Additionally, the word borrow will be replaced from now on with the word carry, it being assumed that this means borrow where appropriate.

The carry from the 4's adder to the 1's adder poses a problem. It should be remembered that the top carry must remain available so that we know the sum in digital terms is greater than 7.

As has been noted, an EX. OR is prevented from inverting if one of the inputs is held to logic 0. Thus

Table 2.1: Add

A	B	C_{in}	S	C_{out}
0	0	0	0	0
1	0	0	1	0
0	1	0	1	0
1	1	0	0	1
0	0	1	1	0
1	0	1	0	1
0	1	1	0	1
1	1	1	1	1

Table 2.2: Subtract

A	-B	$-C_{in}$	S	$-C_{out}$
0	0	0	0	0
1	0	0	1	0
0	1	0	1	1
1	1	0	0	0
0	0	1	1	1
1	0	1	0	0
0	1	1	0	1
1	1	1	1	1

if the input C to the adder is provided with two diodes in an AND configuration, one fed from the C8 line and one from the subtract line the input will be held at 0 in the Add mode but allowed to take either 0 or 1 in the Subtract mode.

PRACTICAL CIRCUIT

As can be seen, the AND diodes deal with the 4's adder carry problem outlined above.

From the table in Part 1 it will be seen that there are some identical results which are either positive or negative. When they are positive no action needs to be taken as regards the sign of the result. When the answer is negative the fact must be displayed.

If the two input AND connected to the top carry and the subtract line is used it will produce an output N of logic 1 only when the mode is Subtract and the result is negative. Under other conditions the output will be 0. This can be used to operate the minus indicator.

It also has another use. When the result is negative the complement of the answer has to be displayed. The complement is an inversion which is conditional on the negative indication N being at logic 1.

Once again we use an EX.OR element. It is fed with the inputs N and S1 and will invert only if N is logic 1.

In fact there are four EX.ORs in the output section fed from S1, S2, S4 and C8 and producing outputs X1, X2, X4 and X8.

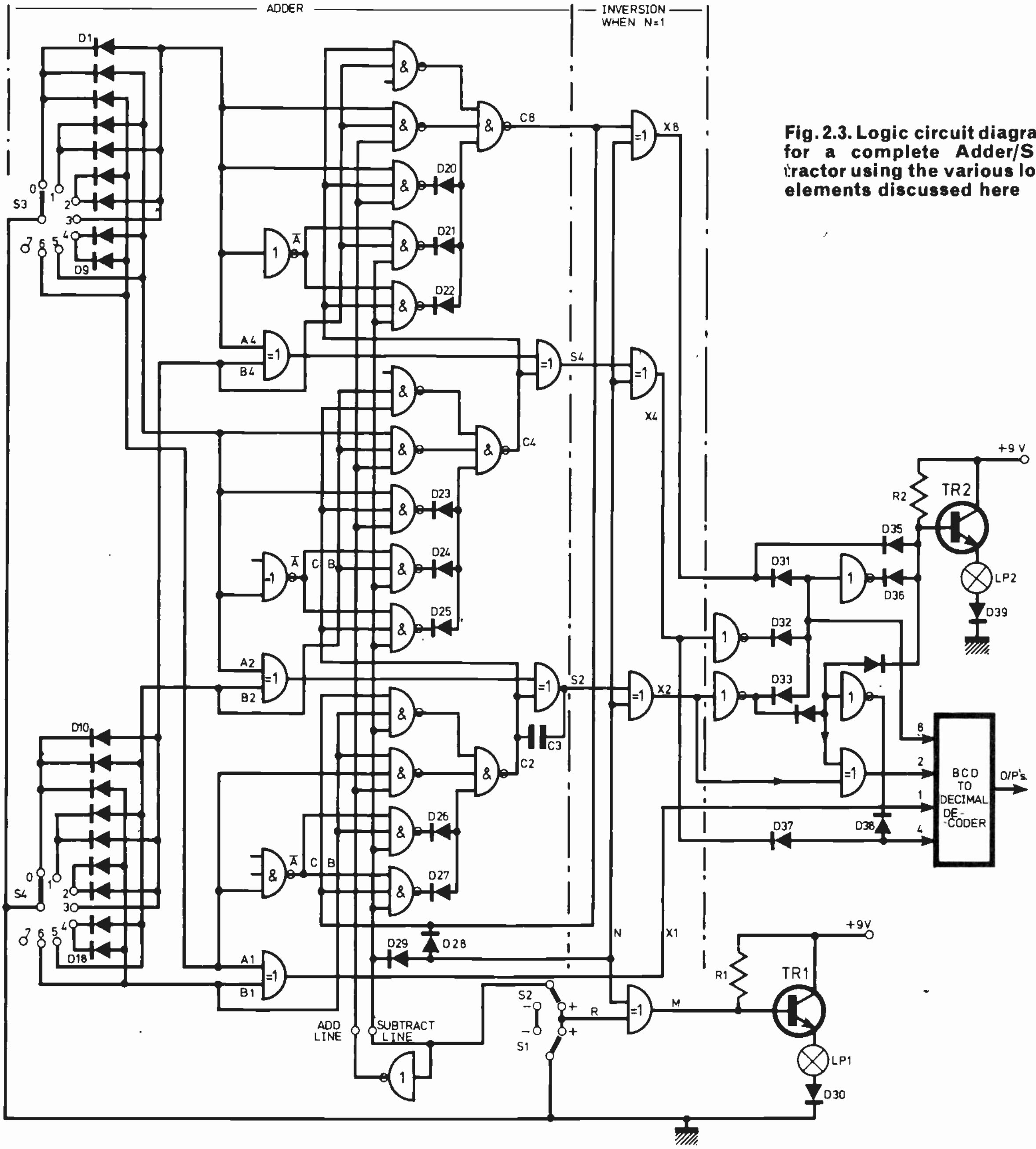


Fig. 2.3. Logic circuit diagrams for a complete Adder/Subtractor using the various logic elements discussed here

DECODING

The binary information so far produced is in hexadecimal format. That is it is to the scale 16, and it gives binary numbers up to decimal 14. In practical terms it is simplest to convert this information to decimal for display by using a binary/decimal decoder, of which a number are available.

But if such a decoder is used it will refuse to give any output if the binary input to it is greater than 9 (binary 1001). Thus when adding, the 8 input to the decoder must be suppressed when the answer exceeds 9.

In fact the output bits X2, X4 and X8 are in a unique condition when the answer is 8 or 9. As a result, if X2 and X4 are inverted three 1's will be produced for an 8 or 9 answer. Feeding these to an AND gives a 1 output for 8 or 9 and a logic 0 for all other conditions. The AND output is fed to the decoder 8 input.

TENS

It is necessary to decide when to display a 1 (decimal) in the tens position. In fact this is when the X8 output is at logic 1 but the 8 input to the decoder is at logic 0. That is to say when the number is greater than 7 but is not 8 or 9.

When the answer is 10 or greater the X2 and X4 bits will in fact supply the wrong information. The X2 will be an inversion and we can use the EX. OR element to clear up this problem.

The X4 is not so simple. There are two ways of examining the problem. In the first place ask the question—"When will the decoder 4 input be logic 1?" or for that matter not 1. The first seems to be when T (input TR2), X2 and X4 are at logic 1 but this would be wrong because the 4 input might be at 1 when the number is less than 10.

The second method gives the correct answer. The 4 input must be sunk to logic 0 when T.X2.

Thus the X4 output is linked to the 4 input of the decoder and a NAND with inputs T and X2 feeds the 4 input in a similar fashion.

Thus the 4 input is now free to follow the X4 output unless the answer is 12 or 13 in which case it is pulled down to logic 0.

DOUBLE NEGATIVE

If the logic for the 1's adder is redrawn as in Fig. 2.3 it can be seen that the sum of A1 and B1 is inverted when the end-around-carry, C8, is 1 and the mode is Subtract. But it is again inverted when N is 1. These two conditions always arise together since N is C8. Subtract.

In the S columns of Table 2.1 and Table 2.2 the arrangement of 1s and 0s is identical for both positive and negative results. So the second and third elements may be replaced by a piece of wire. The end-around-carry is still required to produce a "borrow 2" when necessary. In fact these elements are not included in the final circuit.

ALGEBRAIC ADDITION

As it stands, the machine always treats A as positive while B is accepted as either plus or minus according to the position of the Add/Subtract switch. On subtract, the answer is the *difference* between A and B and the minus sign comes up when B exceeds A. If the mode is subtract and the signs of $+A$ $-B$ are interchanged the numeric answer will be correct but the sign of the answer will be wrong.

COMPONENTS . . .

Resistors
R1 1·8k Ω ¼W. See text R3 12 Ω 2W
R2 1·8k Ω ¼W. See text R4 27 Ω 2W

Capacitors
C1 1,000µF 15V C2 1,000µF 15V
C3 0·01µF disc ceramic

Transistors
TR1 2N706
TR2 2N706

Diodes
D1 to D39 General purpose miniature silicon diodes, 1N914, 1S914, OA5
D40 750mA, 50V PIV
D41 5·1V, 1·5W Zener

Integrated Circuits
1 off 7404
6 off 7410
1 off 7447AN
3 off 7486

Switches
S1 & S2 SPDT toggle or slide
S3 & S4 SP, 11-way rotary or similar

Miscellaneous
T1 6V, 1A mains transformer
Display Minitron 3015F, 2 m.e.s. bulbs, 6V, 40 to 60mA
Veroboard 0·1in Matrix, 5in×3·75in and small offcut 2in×1in
Bulbholders, case, wire, etc.

If the mode is add and $+A$ $+B$ is changed to $-A$ $-B$ the same applies only the sign is wrong.

Two rules may now be stated—

1. If the signs are alike, add—otherwise, subtract.
2. If the sign of A is minus, invert the sign of the answer.

There are a number of ways of implementing these rules but a fairly simple one is shown in Fig. 2.3. Switch S1 is the sign of digit A and switch S2 the sign of digit B. The two switches form an EX.OR with a 1 output when the signs are different and 0 when they are alike. The subtract line (earthed on Add) is fed directly from A/S with an inverter to feed the opposite state to the add line.

If the sign of A is negative, bit R (reverse) is raised to a logical 1 which inverts bit N to give M which now feeds the minus sign for the display. With this arrangement, a zero answer may sometimes be given a minus sign. For example, when the input is -3 $+3$ the answer is 0 but the N bit, theoretically logical 0, is inverted to 1 because the sign of A is negative.

In practice, this will not always be so. The carries form a loop. On Subtract, with A and B both 7, a negative pulse, applied to any input on a carry output NAND will cause that carry to take on a 1 state. The next carry in the chain, sensing B.C, will turn on and the carries will maintain each other. This can arise with other combinations. It is not important, since N is then 1 and inverts 1110 to 0000—the binary 1 bit is not affected—so that the answer still appears as zero.

PRACTICAL DETAILS

The power unit is shown in Fig. 2.4. A small mains transformer T1 with a secondary giving about 6 volts feeds a half wave rectifier D40 with a smoothed output of 8-9 volts. R3 drops the voltage to feed the i.c.s, with D41, a Zener diode, as stabiliser.

R4 is purely a dummy load used only for testing the power supply so that the dissipation of the Zener diode is not exceeded. If battery operation is required, two heavy-duty 4½ volt batteries in series may be used in place of T1 secondary.

The capacitors may then be reduced to 10μF but it is advisable to retain D40 to protect against accidental reverse connection of the battery supply.

The power unit should be built first so that progressive testing may be made on the rest of the equipment.

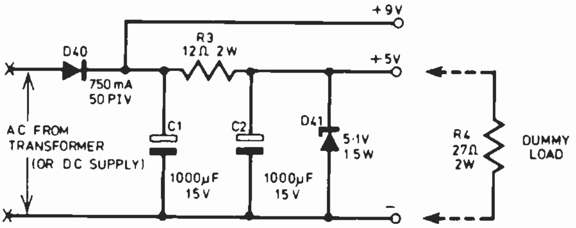


Fig. 2.4. Circuit diagram for a suitable power supply for the Adder/Subtractor

MAIN BOARD

A suggested Veroboard lay-out for the logic circuit elements is shown in Fig. 2.5. All the i.c.s and the lamp driver transistors are mounted directly on the Veroboard. For convenience some of the components are mounted on the reverse, copper strip, side of the board.

TESTING

After assembly make a thorough check of all connections, and trace and remove any stray pieces of copper from the board. When this has been done, connect a wire to the Subtract line so that it may be earthed when required. With the meter across the supply connect up the 5 volt supply.

Check the Add line for logic 0 and the Subtract line for logic 1. All A and B bits should be logic 1 so the instruction to the equipment is 7−7. Check lines C2, C4 and C8. They should be all 1s or all 0s. Check the 7447 inputs, 1, 2, 4 and 8. They should all be 0.

With the testmeter on a low ohms range test the 7447 output making sure that the testmeter positive lead is connected to earth. All outputs except g should give continuity. If C2 etc. are 0, N should be 0. If this is the case, briefly earth any input in one of the carry NAND output sections.

All Cs should then become 1, N is then 1 but the inputs to the 7447 should still be zeros. If C2 etc. are all 1s, briefly earthing the subtract line should bring them to 0s. If there is any difficulty, the value of every bit is checkable—it would be as well to force the carry chain to the all 1s state because this is the more stable.

When the Subtract test is satisfactory, earth the Subtract line. The Add line should become 1. The set-up is now for 7 + 7, all carriers are 1.X2, X4 and X8 are 1s. T is 1. On the 7447 inputs only 4 is 1, 2 having been inverted by T and 8 is suppressed.

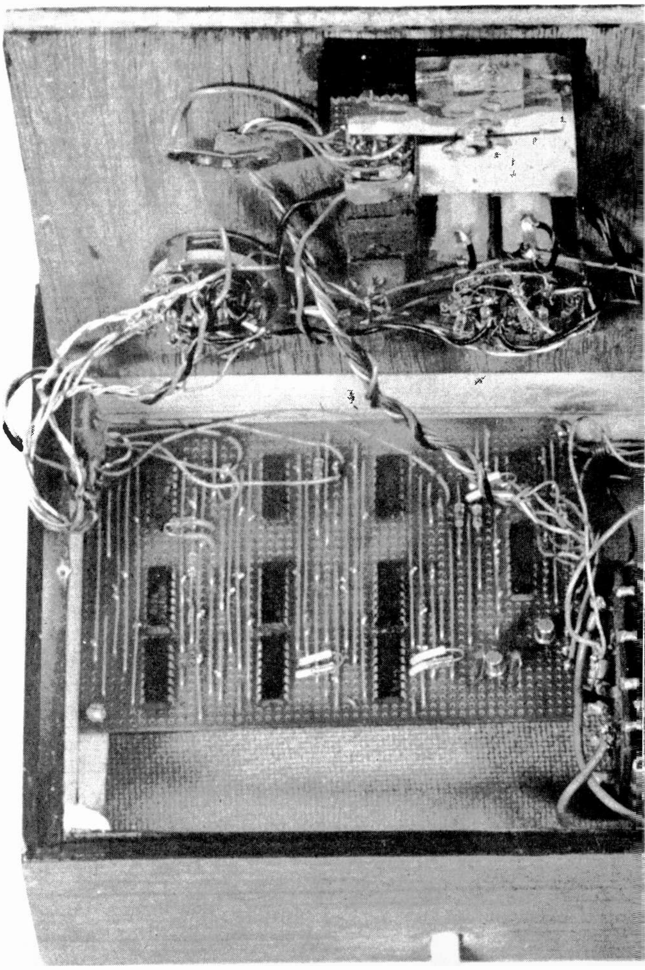
In the foregoing, remember that 1V downwards is 0, 1·6V up is 1, where inputs are concerned.

OUTPUT DISPLAY

The digital display used in the prototype was a Minitron 3015F seven segment type. The connections, from the underside, are given in Fig. 2.6. A small piece of Veroboard is used to mount the 3015F. Pins are inserted to carry the wires from the main circuit board.

With the main circuit board wired up and the a to g connections made between the two units and a 5V supply to the 3015F as indicated, a nought should be displayed. The diodes D30 and D39 shown in the transistor circuits in Fig. 2.3 may not be required.

Test M for logical 1 if the lamp does not light. Earth pin R if necessary to make M into a 1. Decreasing the value of the 1·8kΩ resistor R1 will increase brightness and vice versa. The Ten lamp is tested with the Subtract line earthed. If either lamp remains on with logical 0 input, insert a diode to control it. When satisfied, wire the board up.



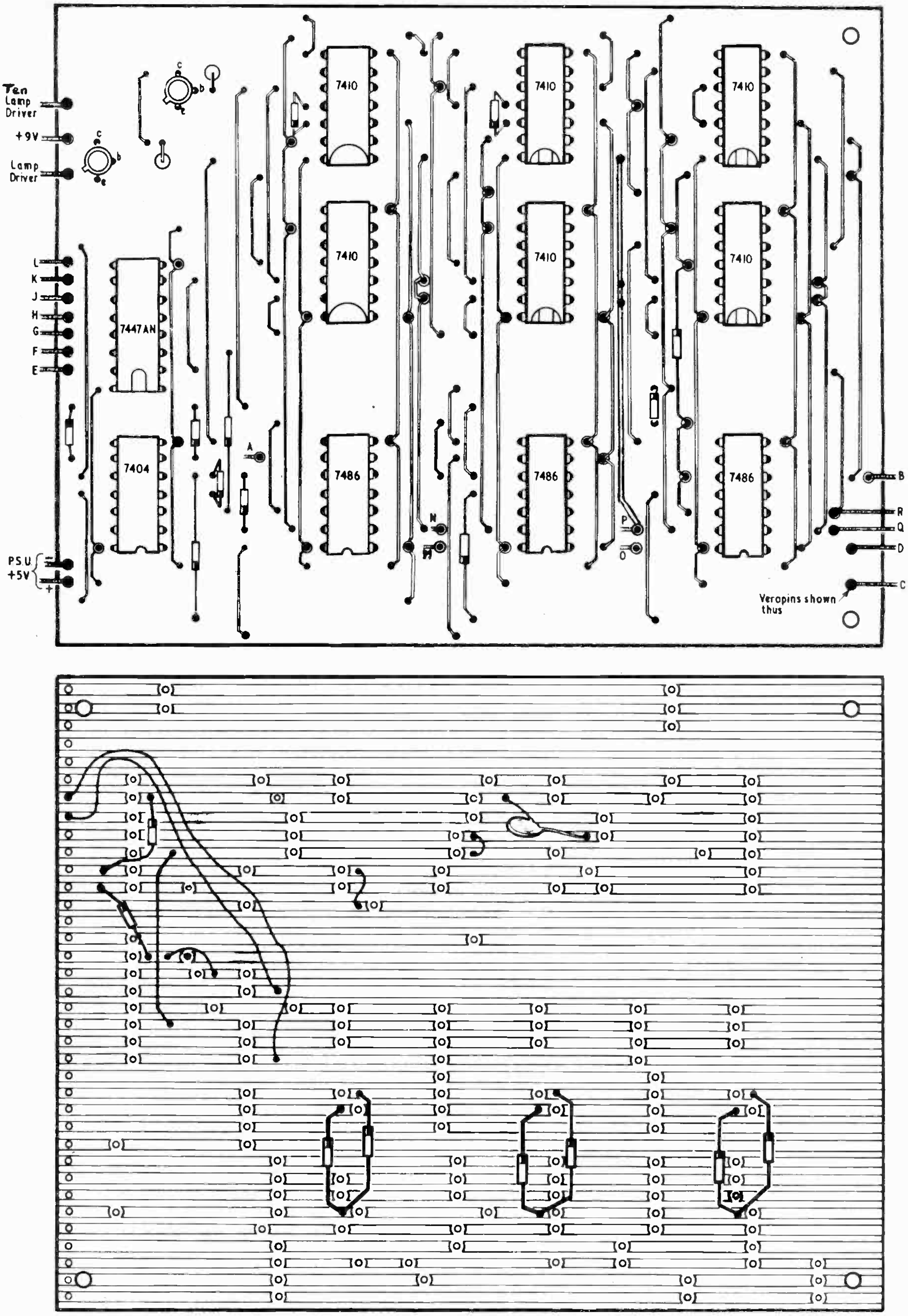


Fig. 2.5. The main circuit Veroboard and component layout for the Adder/Subtractor

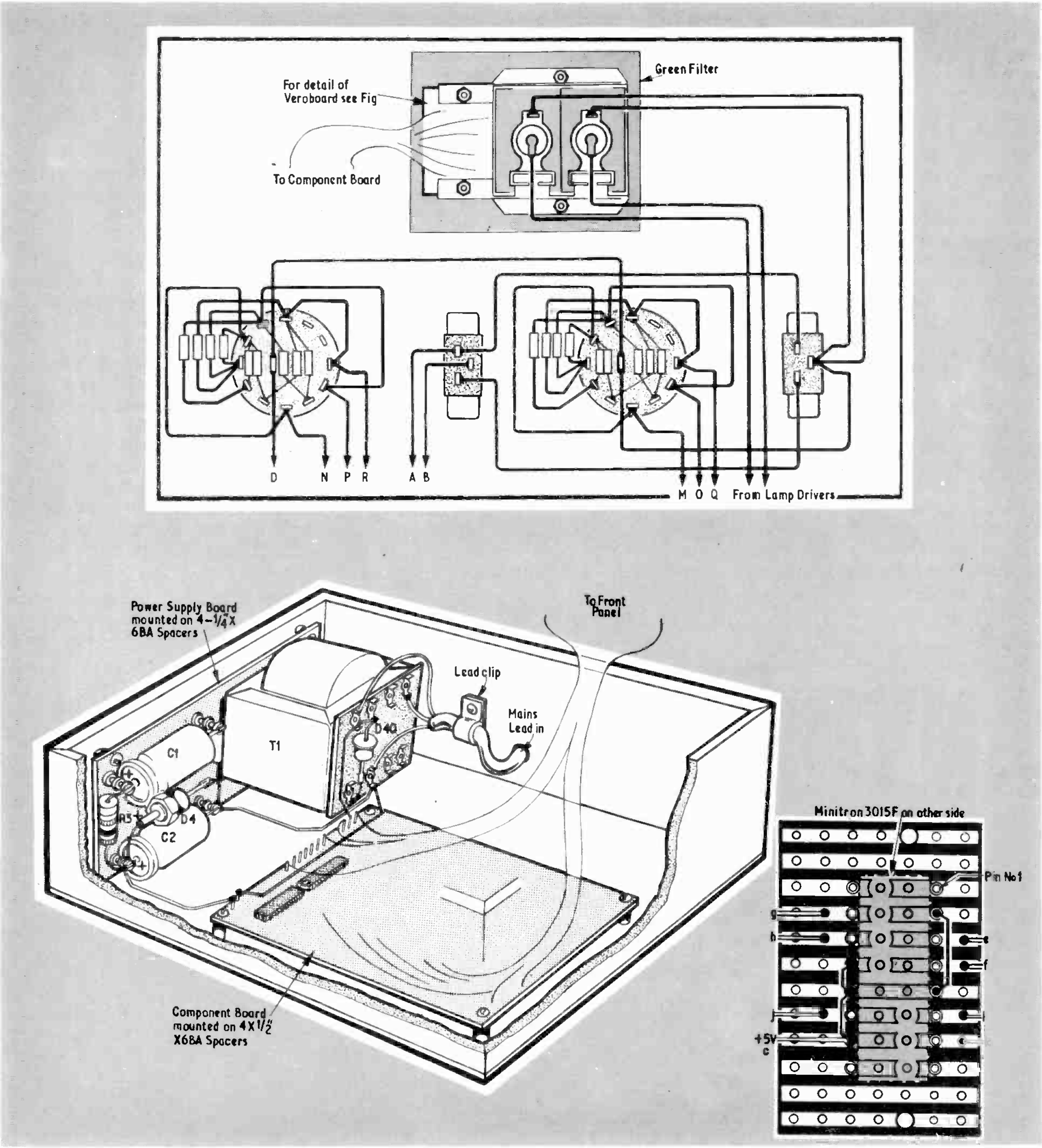


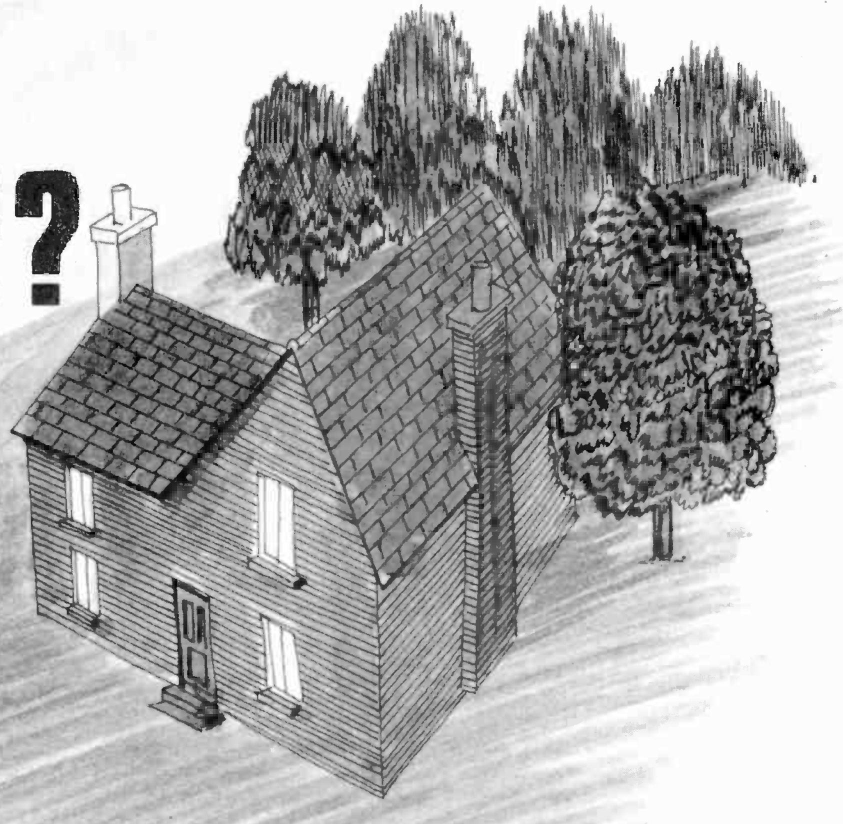
Fig. 2.6. Point-to-point wiring and a suggested case layout for the Adder/Subtractor, together with a Veroboard layout for the display device

INPUTTING

Single-pole, 11-way switches were used for the A and B inputs. This gives three spare contacts to wire the input diodes up to. Each input switch is the same. After wiring test each 1, 2, and 4 lead with the testmeter on ohms.

Finally, the unit may be tested in toto before mounting in its case. Make all connections between the various units with the strip side of the main board eventually uppermost. Switch on with a meter in position as before. Set +0+0. Run A through to 7. With A at 7 run B through to 7 checking each result. Set the B sign to −. Run B down to 0. If any answer is wrong, consider by how much. Is it 1, 2 or 4 out? These are the likely errors and give a guide to the cause. If the A and B inputs are checked, then carry bits, followed by display correcting circuits, any fault should be traceable. The tables and logic diagrams will be a help. ★

ANYONE AT HOME?



BY O.N. BISHOP

A PROGRAMMABLE INTRUDER-DETERRENT SYSTEM

THE "Anyone at Home" began life as a simple programming circuit intended to switch on a room light at dusk when there was no-one at home, thus giving potential intruders the impression that the house was occupied.

The use of integrated circuits has, however, made it possible to expand the flexibility of the programmer to make allowance for variations in ambient light level and to give a timing function.

Clearly, if someone were actually in occupation of a house, lights would go on at dusk and be switched off some time later when everyone went to bed. Using a synchronous motor controller to effect this is not ideal as power cuts will upset the timing and in any case the switched-on interval is always constant. Both give-away factors to the would-be thief.

LOGIC ELEMENTS

The logic diagram of Fig. 1 illustrates a simple system using readily available logic i.c.s to give flexible control dependent on both available light conditions and a timing function.

The two inputs to the system are a very slow-running astable with a period of 17mHz (one cycle per minute) and a light-operated switch which gives an output of 0·2V during daylight (logic 0) and of between 4 and 5V during the dark (logic 1).

The most complex items in the circuit are the two 4-bit binary counters CO1 and CO2, each a 7493 chip. The two are connected in series so that from their combined 8-bit output we can obtain 16 sequences of 16 or a total count of 256.

With these counters, they operate on a negative-going input pulse fed to input A. Each has two reset inputs and when both are at logic 1 the counter is reset. This makes all outputs go to logic 0. With one or both of the resets at logic 0 the counter is enabled and can count incoming pulses.

FUNCTION SEQUENCE

As can be seen, one reset input of each counter is permanently connected to V_{cc} and is thus permantly at logic 1. Now both counters can be reset simply by connecting the other reset input to a 1, or can be enabled by connecting the reset to a 0.

During daylight hours both resets of each counter are at logic 1. Thus the counters cannot count the input pulses from the multivibrator via gate G1. The room light relay remains inactivated.

At dusk, when the available light level has fallen sufficiently, the light operated switch changes state and one reset of each counter is switched to a 0. This enables the counters and, at the same time provides a second 1 input at Gate G6, actuating the room light relay and switching on the controlled lights.

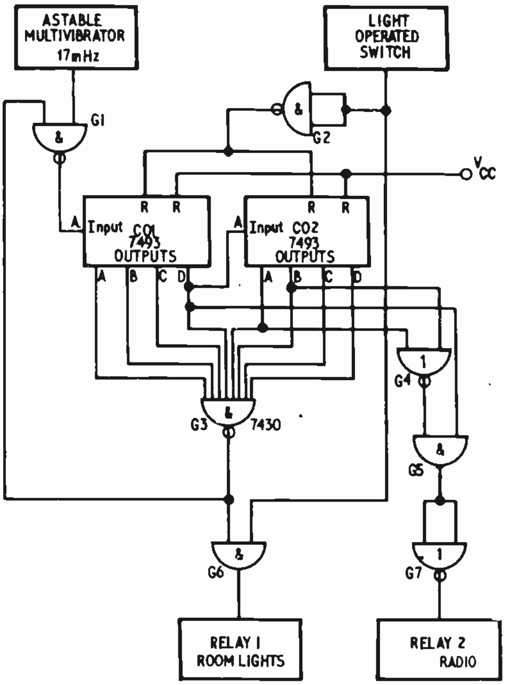


Fig. 1. Logic diagram of the domestic security system provided by six integrated circuits to control operation of electric lights and radio as a deterrent to would-be intruders.

For a period of 4·25 hours the counters count up to 255. At this point in time all eight inputs to gate G3 are at logic 1 and the output will go to 0.

Gate G6 reverts to the 0 state and the room lights are switched off. Gate G1 is prevented from passing any more pulses to the counters, which remain at 255.

At dawn, as the ambient light increases again the light operated switch reverts to the 0 condition. This resets the counters and logic conditions are now reverted to the original state until the next evening.

The reader may like to work out just what happens if for example there is very heavy cloud during the day, activating the light operated switch or if there is a power cut. It will be seen that the sequence is again back in synchronism by the following dusk, whatever happens.

A PROGRAMMING SWITCH

For the purposes of controlling a radio during the evening the circuit also provides a programming switch function. This is effected via gates G4, G5 and G7.

The radio relay is actuated when G7 output is at 0 which means that G5 must be at 1 and this in turn occurs when first counter D output is at 1 and second counter outputs A and B are at 0. Reference to the counting table for the SN 7493 counters indicates that this would occur for a period of 8 minutes (counts 8 to 15 of CO1) every 64 minutes, starting from dusk.

As can be seen, it is comparatively easy to alter the periods of time chosen by simply selecting other sets of inputs for gates G4 and G5. Equally, removal of the inverting gate G7 reverses the sequence of actuation.

The circuit uses several gate types as can be seen. Gates G1, G2 and G3 are all NAND. For G1 and G2 the 7400 chip has been used which carries four gates so we have two to spare. G3 is a 7430, 8-input NAND and all inputs are used.

Gates 4 and 7 are NORs and are two of the four on a 7402. Again we have two to spare. Finally, gate G5 and G6 are ANDs on a 7408 carrying four, so there are two to spare again.

These spare gates may be used as required to wire up other control functions. For example, a tape recorder could be automatically switched on with various household noises recorded to give apparent audible evidence of someone at home. Equally, arrangements can be made for the coffee pot to be switched on at a given instant if required.

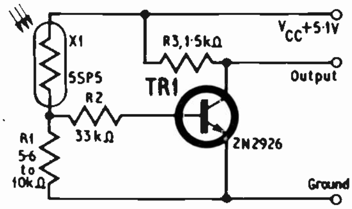
Obviously, many ideas will spring to mind.

LIGHT OPERATED SWITCH

A suggested circuit for the light-operated switch is shown in Fig. 2. As can be seen it is simple in the extreme and operates from a 5 volt supply, making it compatible with the logic circuitry.

As shown, reduction in light intensity increases the resistance of the light dependent resistor, X1, lowering the potential applied to the base of TR1. At a value set by selection of R1 the transistor switches off and the output rises to almost positive rail potential, or logic 1.

Reversing the position of R1 and LDR reverses the effect and switching occurs as light increases if this is required.



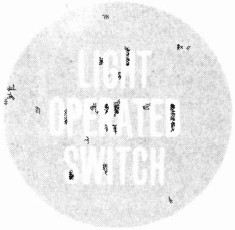


Fig. 2. Circuit diagram of the light-operated switch used with the logic system of Fig. 1. Resistor R1 may be replaced by a variable 10k Ω resistor if variation of set-point is required.

ASTABLE MULTIVIBRATOR

The multivibrator used in the prototype is shown in Fig. 3. The circuit is conventional but of course uses high values of R5, R6, C1 and C2 to give a rate of oscillation of about 17mHz (millihertz). As current drain on the circuit, if the counters were fed directly, is too high for convenience, TR4 forms a buffer which not only cuts down current drain but sharpens up the output pulse as well.

If the periods of operation of the system parts need to be altered then the frequency of the multivibrator can be changed to effect this. For example, extra capacitors can be switched in to C1 and C2.

ASTABLE MULTIVIBRATOR

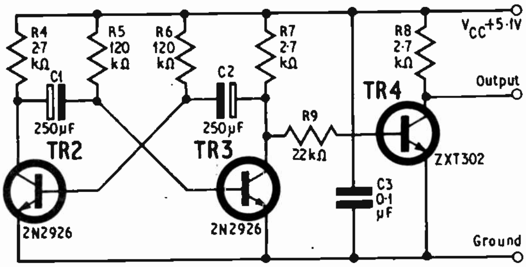


Fig. 3. The slow astable multivibrator which drives the counters in the logic system. C1 and C2 may need selecting for low leakage current in order to ensure the necessary long pulse period.

RELAY CIRCUITS

The relay operating circuits for the room lights and radio or other items can take the form of the circuit of Fig. 4. The relay contacts are not shown as they can take any form required, actuate to make, to break or perhaps changeover. In this way a variety of control functions can be achieved.

RELAY CONTROL

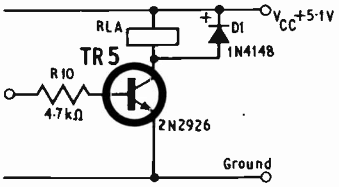


Fig. 4. A relay operating circuit which will accept drive from the logic outputs of the main system. Again simplicity is the keynote.

POWER SUPPLY

A suitable power supply is illustrated in Fig. 5. As can be seen, it is conventional and simple. Of course, the equipment can be battery powered if required using a 6V source.

Alternately, any one of the many published designs for a logic power supply should suffice.

CONSTRUCTION

Fig. 6 shows a suggested Veroboard layout carrying all the logic circuitry, the astable and the light-operated switch. Construction is fairly straightforward and only a few points need watching. For example note that IC5 and 6 are reversed with respect to the remainder of the i.c.s.

Further, several links are included. These may be made using wire or, in the case of adjacent tracks, using blobs of solder though it is always best to use wire where possible.

The layout is not critical and the constructor may for example juggle the light operated switch components around to make room for more i.c.s if further logic is required for other functions.

The connection points marked "To J" and "To K" are the relay control outputs, J for the lamp and K for the radio.

Probably it is best to assemble the astable first and check its period to see if this suits requirements.

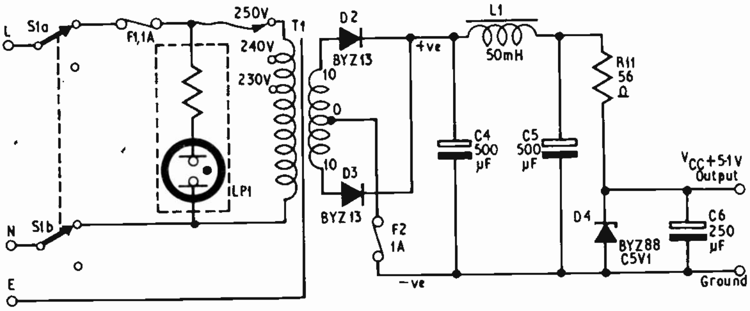
TESTING

The logic used is positive, that is it swings up to +5V in logic 1 state. Testing the astable is simple, just connect a meter to the collector of TR3. It should indicate about 30 seconds of logic 0 and 30 of logic 1. The period can be altered as suggested earlier if needed.

The light switch output can be tested by looking at the output and covering and uncovering the LDR with the hand. The output should go from a 1 to a 0 state.

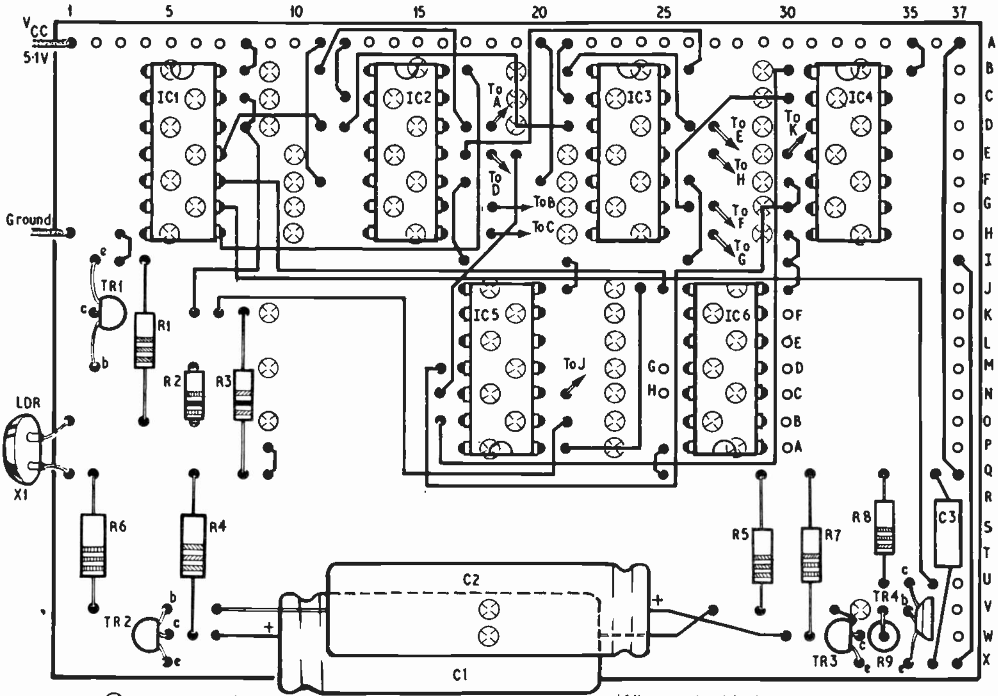
The operation of the counters can be checked by looking at the outputs with the counters running. This is achieved by covering the LDR to simulate darkness. The sequence of count should follow the tables published by Texas but a simple test is to ascertain that the outputs of CO1 will all go to 0 and output A of CO2 will go to 1 on count 16. It takes 4 hours or so to check through in detail but probably for the first time it is worth the effort.

If any error in sequence is discovered then check all the wiring to make certain there are no open circuits or dry joints, shorts or the like. A persistent



POWER SUPPLY

Fig. 5. A suggested power supply for the system. The rectifier diodes can be replaced by a bridge with suitable alteration to the circuit and choke L1 is possibly surplus to requirements.



⊗ indicates breaks in copper track
→ indicates direction of copper track

J&K go to relay drive input

Fig. 6. Veroboard and component layout for the main parts of the system. This unit carries all the logic, the astable and the light-operated switch. The relay actuator and power supply may be mounted on smaller Veroboard sections or, for the relay controls, on the relays themselves.

COMPONENTS . . .

Resistors

R1	5·6k Ω to 10k Ω	R5	120k Ω	R9	22k Ω
R2	33k Ω	R6	120k Ω	R10	4·7k Ω
R3	1·5k Ω	R7	2·7k Ω	R11	56 Ω
R4	2·7k Ω	R8	2·7k Ω		

All 5% ¼W carbon

Capacitors

C1	250μF	C3	0·1μF	C5	500μF
C2	250μF	C4	500μF	C6	250μF

Integrated Circuits

IC1	SN7400; Quad, 2-input NAND, G1 & G2
IC2	SN7493; 4-bit binary counter, CO1
IC3	SN7493; 4-bit binary counter, CO2
IC4	SN7402; Quad 2-input NOR, G4 & G7
IC5	SN7408; Quad 2-input AND, G5 & G6
IC6	SN7430; 8-input NAND, G3

Transistors

TR1	2N2926	TR3	2N2926	TR5	2N2926
TR2	2N2926	TR4	ZXT302		

Diodes

D1	1N4148	D3	BYZ13
D2	BYZ13	D4	BYZ88 C5V1

Miscellaneous

RLA	Type 40 (Radiospares), 185 Ω coil for 6–12V operation Contacts and ratings to suit application
T1	Mains transformer with 10–0–10V secondary
LP1	Neon indicator with integral resistor
F1	1A socket and fuse
F2	1A socket and fuse
S1	DPDT mains toggle switch
L1	50mH choke (use is optional)
X1	5SP5 (Bi-Pre-Pak)

Veroboard; wire; solder; materials for case

fault may be disposed of by connection of a 0·1μF capacitor between the supply and ground to decouple unwanted spikes.

HOUSING

The total consumption of the unit is only in the region of 150mA so it does not need to be housed with a view to heat dissipation. Equally, the power supply will be physically small so the whole could be housed together in a fairly small case or box to suit.

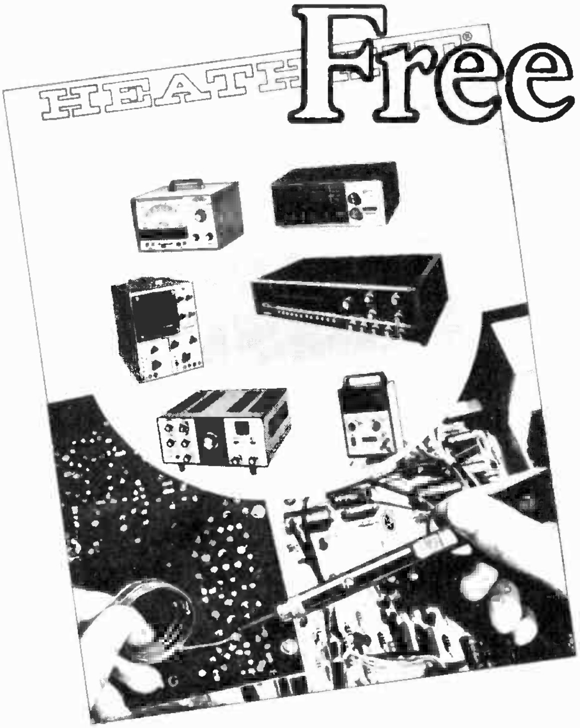
As most constructors will wish to effect their own particular version of this flexible device, detailed construction information has been omitted.

OTHER APPLICATIONS

An obvious area of application, for times of better power availability perhaps, is in window display work where the unit could be adapted to actuate a variety of display activities either during dark or, by reversal of the light detection system, during daylight hours.

Of course, other inputs can be applied in place of the light operated switch and the astable making the system suitable for counting applications and other control functions. ★

Out now! Free



Get the Heathkit Catalogue..and save

Handcrafted electronics with built-in quality and kit form savings.
Hundreds of models to choose from.
Heath offer you outstanding specifications and plus values that will impress you, your family and friends. Want to know more? Send for your personal introduction to the international world of Heathkit electronics . . . the Free Heathkit Catalogue.

Free

Please send me the FREE Heathkit Catalogue & details of Monthly budget plans

NAME ______________________

ADDRESS ______________________

____

____

HEATH
Schlumberger

HEATH (GLOS) LTD DEPT PE/4/74
Bristol Road,
Gloucester GL2-6EE

SHOWROOM LONDON :- 233 Tottenham Ct Rd.

TRANSFORMERS

SAFETY MAINS ISOLATING TRANSFORMERS

Prim. 120/240V. Sec 120/240V Centre Tapped and Screened

ALSO AVAILABLE WITH 115/120V SEC. WINDING

Ref.	VA	Weight		Size cm.	P & P	
No.	(Watts)	lb	oz		£	p
07	20	1	8	7·0 × 6·0 × 6·0	2·32	30
149	60	3	12	9 9 × 7·7 × 8·6	3·45	36
150	100	5	8	9·9 × 8·9 × 8·6	3·79	52
151	200	8	0	12·1 × 9·3 × 10·2	6·45	52
152	250	13	12	12·1 × 11·8 × 10·2	8·41	67
153	350	15	0	14·0 × 10·8 × 11·8	11·20	82
154	500	19	8	14·0 × 13·4 × 11·8	16·25	*
155	750	29	0	17·2 × 14·0 × 14·0	22·10	*
156	1000	38	0	17·2 × 16·6 × 14·0	29·87	*
158	2000	60	0	21·6 × 15·3 × 18·1	49·25	*

AUTO TRANSFORMERS

Ref.	VA	Weight		Size cm.	Auto Taps	P & P	
No.	(Watts)	lb	oz			£	p
113	20	1	0	5·8 × 5·1 × 4·5	0-115-210-240	1·22	22
64	75	2	4	7·0 × 6·7 × 6·1	0-115-210-240	2·40	30
4	150	3	4	8·9 × 7·7 × 7·7	0-115-200-220-240	2·89	36
66	300	6	4	9·9 × 9·6 × 8·6	,, ,,	5·63	52
67	500	12	8	12·1 × 11·2 × 10·2	,, ,,	8·36	67
84	1000	19	8	14·0 × 13·4 × 14·3	,, ,,	15·19	82
93	1500	30	4	14·0 × 15·9 × 14·3	,, ,,	21·99	*
95	2000	32	0	17·2 × 16·6 × 14·0	,, ,,	28·70	*
73	3000	40	0	21·6 × 13·4 × 18·1	,, ,,	39·17	*

CASED AUTO TRANSFORMERS

115 500W enclosed transformer, with mains lead and two 115V outlet sockets, **£9·49**, P & P 67p. 20W version, **£2·02**, P & P 22p.

LOW VOLTAGE SERIES (ISOLATED)

PRIMARY 200-250 VOLTS 12 AND/OR 24 VOLT RANGE

Ref.	Amps.		Weight		Size cm.	Secondary Windings	P & P	
No.	12V	24V	lb	oz			£	p
111	0·5	0·25		8	4·8 × 2·9 × 3·5	0-12V at 0·25A × 2	1·22	22
213	1·0	0·5	1	4	6·1 × 5·8 × 4·8	0-12V at 0·5A × 2	1·44	22
71	2	1	1	12	7·0 × 6·4 × 6·1	0-12V at 1A × 2	1·90	22
18	4	2	2	12	8·3 × 7·7 × 7·0	0-12V at 2A × 2	2·68	36
70	6	3	3	8	8·9 × 8·0 × 7·7	0-12V at 3A × 2	3·20	42
108	8	4	5	8	9·9 × 8·9 × 8·6	0-12V at 4A × 2	3·60	52
72	10	5	6	4	9·9 × 9·6 × 8·6	0-12V at 5A × 2	4·25	52
116	12	6	6	12	9·9 × 10·2 × 8 6	0-12V at 5A × 2	5·10	52
17	16	8	8	12	12·1 × 9·9 × 10·2	0-12V at 8A × 2	6·56	52
115	20	10	11	8	14·0 × 9·6 × 11·8	0-12V at 10A × 2	8·36	67
187	30	15	15	8	14·0 × 12·1 × 11·8	0-12V at 15A × 2	15·40	82
226	60	30	32	0	17·2 × 15·3 × 14·0	0 12V at 30A × 2	28·44	*

30 VOLT RANGE

Ref.	Amps	Weight		Size cm.	Secondary Taps	P & P	
No.		lb	oz			£	p
112	0 5	1	4	6·1 × 5·8 × 4·8	0-12-15-20-24-30V	1·42	22
79	1·0	2	4	7·0 × 6·7 × 6·1	,, ,,	1·92	36
3	2·0	3	4	8·9 × 7·7 × 7·7	,, ,,	2·90	36
20	3·0	4	8	9·9 × 8·3 × 8·6	,, ,,	3·58	42
21	4·0	6	4	9·9 × 9·6 × 8·6	,, ,,	4·25	52
51	5·0	6	12	12·1 × 8·6 × 10·2	,, ,,	5·30	52
117	6·0	8	0	12·1 × 9·3 × 10·2	,, ,,	6·31	52
88	8·0	12	0	12·1 × 11·8 × 10·2	,, ,,	8·18	67
89	10·0	13	12	14·0 × 10·2 × 11·8	,, ,,	10·33	67

50 VOLT RANGE

Ref.	Amps.	Weight		Size cm.	Secondary Taps	P & P	
No.		lb	oz			£	p
102	0·5	1	12	7·0 × 6·4 × 6·1	0-19-25-33-40-50V	1·90	30
103	1·0	2	12	8·3 × 7·4 × 7·0	,, ,,	2·80	36
104	2·0	5	8	7·9 × 8·9 × 8·6	,, ,,	3·87	42
105	3·0	6	12	9·9 × 10·2 × 8·6	,, ,,	5·26	52
106	4·0	10	0	12·1 × 10·5 × 10·2	,, ,,	6·99	52
107	6·0	12	0	14·0 × 10·2 × 11·8	,, ,,	10·35	67
118	8·0	18	0	14·0 × 12·7 × 11·8	,, ,,	13·51	97
119	10·0	25	0	17·2 × 12·7 × 14·0	,, ,,	16·95	*

60 VOLT RANGE

Ref.	Amps.	Weight		Size cm.	Secondary Taps	P & P	
No.		lb	oz			£	p
124	0·5	2	4	7·0 × 6·7 × 6·1	0-24-30-40-48-60V	1·93	36
126	1·0	3	4	8·9 × 7·7 × 7·7	,, ,,	2·70	36
127	2·0	6	4	9·9 × 9·6 × 8·6	,, ,,	4·25	42
125	3 0	8	12	12·1 × 9 9 × 10·2	,, ,,	6·46	52
123	4·0	13	12	12·1 × 11·8 × 10·2	,, ,,	8·36	67
40	5·0	12	00	14·0 × 10·2 × 11·8	,, ,,	9·85	67
120	6·0	15	8	14·0 × 12·1 × 11·8	,, ,,	12·14	82
121	8·0	25	00	14·0 × 14·7 × 11·8	,, ,,	13·65	*
122	10·0	25	0	17·2 × 12·7 × 14·0	,, ,,	20·09	*
189	12·0	29	00	17·2 × 14·0 × 14·0	,, ,,	22·49	*

MINIATURE TRANSFORMERS WITH SCREENS

Ref.	mA	Weight		Size cm.	Volts	P & P	
No.		lb	oz			£	p
238	200		2	2·8 × 2·6 × 2·0	3-0-3	1·31	10
212	1A, 1A	1	4	6·1 × 5·8 × 4·8	0-6, 0-6	1·52	22
13	100		4	3·9 × 2·6 × 2·9	9-0-9	1·12	10
235	330, 330		4	4·8 × 2·9 × 3·5	0-9, 0-9	1·52	10
207	500, 500	1	00	6·1 × 5·4 × 4·8	0-8-9, 0-8-9	2·03	22
208	1A, 1A	1	12	7·0 × 6·4 × 6·1	0-8-9, 0-8-9	2·73	30
236	200,200		4	4·8 × 2·9 × 3·5	0-15. 0-15	1·52	10
214	300, 300	1	4	6·1 × 5·8 × 4·8	0-20, 0-20	1·60	22
221	700 (d.c.)	1	8	7·0 × 6·1 × 6·1	20-12-0-12-20	1·41	30
206	1A, 1A	2	12	8·3 × 7·7 × 7·0	0-15-20, 0-15-20	3·08	38
203	500,500	2	4	8·3 × 7·0 × 7·0	0-15-27, 0-15-27	2·82	38
204	1A, 1A	3	4	8·9 × 7·7 × 7·7	0-15-27, 0-15-27	2·86	38

*Carriage via B.R.S.

PLEASE ADD 10% FOR V.A.T.
INCLUDING P. & P.

BARRIE electronics
3, THE MINORIES, LONDON EC3N 1BJ
TELEPHONE: 01-488 3316/8
NEAREST TUBE STATIONS ALDGATE & ALDGATE EAST

PATENTS REVIEW

The outcome of a patent conference to be held in Luxembourg during early May could well have considerable effect on the future activities of inventors and firms working in the electronics field. Already a patent conference held in Munich last October has decided certain issues that will inevitably have some far reaching effects in the not too distant future.

Because the legal issues are complicated, the practical issues easily pass unrecognised. It is perhaps for this very reason that some legal issues have been agreed rather than more hotly argued by the official negotiators for this country.

CURRENT BRITISH PATENT PRACTICE

For the last 350 years or so Britain has had its own patents system. Although virtually every other country in the world also has its own national system, the British system is one of the oldest.

No two patent systems in the world are exactly the same but all have in common the feature that a national patent protects an invention for a limited number of years (16 in the UK and 20 in some other countries) for that country only. Thus a British patent is active only in the UK, and so on.

The inventions reported monthly in Practical Electronics are all the subject of British patent applications that have been accepted and published by the British Patent Office but some of them may, of course, be patented in other countries. Patenting in most foreign countries is more expensive than in the UK.

EUROPEAN PATENT SYSTEM ALREADY AGREED

In Munich, last October, 21 European countries hammered out and finalised the details for a so-called Europatent scheme to come into force within the next 3 or 4 years. Europatents will be dealt with via a central European Patent Office to be built at Munich.

Under the Europatent Scheme an Applicant will be able to choose between English, German and French as the main language for his application. Once an Applicant has chosen the language for his application it will stay with that application for the rest of its mortal span.

Because British language Europatent applications will originate not only from England but also from USA, Canada, Japan and other countries with English their main language, current estimates are that between 60 and 80 per cent of the applications filed will be in English. This makes a Munich siting look an odd choice and the reasons behind this choice were largely political. Because so few British Patent Office Examiners have so far expressed willingness to live and work in Munich some British language work from Munich will be sub-contracted to the existing British Patent Office to avoid what would otherwise be total chaos. Even so it is now officially regarded as inevitable that some British language applications will be dealt with by foreign speaking Examiners.

An Applicant for a Europatent will be able to choose (or "designate") which of the 21 countries he wishes his Europatent to cover. Because the European scheme will cost a considerable amount of money to run, Applicants selecting only a few countries will pay a disproportionately high fee, but the scheme should be a bargain to Applicants wishing to spread their blanket of protection over most of Europe.

PROPOSED COMMUNITY PATENT

The Luxembourg conference to be held in the near future seeks to establish the wherewithal for a single indivisible community patent for the nine EEC countries. If the UK signs the convention, any British Applicant (e.g. a small electronics company with a new invention) wishing to protect that invention with a Europatent in any one of the nine EEC countries, will be forced automatically to protect it in all nine. Also, to maintain the patent in one country will require maintaining it in all nine.

There is some doubt on the matter of language as applied to EEC patents. It seems clear however that the translation of the patent claims into all Community languages (probably excepting Irish) will be obligatory and it may also be that the application as a whole (i.e. including the descriptions of specific circuits given by way of example, etc) will require translation into English, German and French.

COST

One of the main reasons why interested observers are so off-put by the European schemes (especially the Community scheme) is that the only thing certain about the cost is that it will be high. Because the Munich Patent Office is to be self-supporting and will be built at a cost of around 45 million pounds in loans repayable to the Governments making them, it has been estimated that each Applicant will be contributing something like £1,000 per patent simply to pay for building the Munich Office. This is quite apart from what it will cost to staff the office and pay for the extensive patent novelty searches which are to be sub-contracted to The Hague.

The cost of applying for a patent via Munich and arguing it through to acceptance is still anybody's guess. But no one has disputed that an estimated cost of maintaining a patent *after* it has been granted will be around £5,000. Thus it looks likely that securing and maintaining in force an EEC patent will cost an inventor something in the order of £7,500. Thus the Community Patent Scheme could well put patenting beyond the pale for anyone but the largest commercial enterprises.

It is an EEC aim to minimise the effects on the Common Market of national patents (such as we now have in the UK) and thus it seems highly unlikely that relatively cheap British national patents will continue to flourish if and when this country accedes to the community patent scheme. More than likely most inventors will simply deliberately disclose their ideas to the public so as to prevent anyone (including themselves) securing patent rights.

Copies of Patents can be obtained from the Patent Office Sales, St. Mary Cray, Orpington, Kent. Price 25p each

C. T. ELECTRONICS

267 Acton Lane, London W4 5DG
Tel. 01-994 6275

MAIL ORDER DEPT./REGISTERED OFFICE/COMPONENT COUNTER

semiconductors

AC107	35p
AC125	25p
AC126	25p
AC127	27p
AC128	28p
AC176	27p
ACY17	25p
ACY18	30p
ACY19	30p
ACY20	25p
ACY39	55p
ACY21	30p
AD140	60p
AD149	65p
AD161	40p
AD162	40p
ADZ11	£1·80
AF114	25p
AF115	25p
AF116	25p
AF117	25p
AF118	60p
AF172	30p
ASY28	30p
ASZ21	60p
BA102	33p
BA112	50p
BA114	16p
BA156	15p
BC107	12p
BC108	12p
BC109	12p
BC147	12p
BC148	12p
BC149	12p
BC153	15p
BC157	14p
BC158	15p
BC159	15p
BC169C	14p
BC182	14p
BC183	14p
BC184	14p
BC212	14p
BC213	14p
BC214	14p
BC238	12p
BC239	12p
BCY30	40p
BCY31	55p
BCY32	95p
BCY33	45p
BCY34	60p
BCY38	65p
BCY39	£1·00
BCY55	£1·60
BCY70	22p
BCY71	22p
BCY72	25p
BD121	75p
BD123	75p
BD124	80p
BD131	75p
BD132	75p
BD153	75p
BD156	75p
BDY11	£1·40
BDY17	£1·60
BDY19	£1·95
BF152	20p
BF194	14p
BF195	15p
BFX29	30p
BFX84	30p
BFX85	30p
BFX86	30p
BFX88	30p
BFY10	35p
BFY44	50p
BFY50	25p
BFY51	25p
BFY52	25p
BFY53	25p
BFY90	66p
BSW63	65p
BSW68	80p
BSY95A	12p
C111	50p
C426	40p
BY100	15p
BY126	20p
BY127	20p
BY164	65p
IS100	15p
IS103	20p
MJ340	55p
MJ481	95p
MJ2801	£1·25
MJ2901	£2·20
MJE340	50p
MJE370	75p
MJE371	90p
MJE520	85p
MJE2955	£1·95
MJE3055	85p
MM1613	43p
MM1712	60p
MPF102	45p
MPF103 (2N5457)	35p
MPF104 (2N5458)	35p
MPF105 (2N5459)	40p
MPSA06	35p
MPSA16	30p
MPSA56	35p
MPSU06	75p
MPSU56	70p
NKT135	35p
NKT222	25p
NKT401	65p
NKT404	80p
NKT773	30p
NKT774	25p
OA5	20p
OA10	20p
OA47	10p
OA70	12p
OA79	12p
OA81	10p
OA90	10p
OA91	10p
OA200	10p
OA202	10p
OA210	35p
OA211	38p
OC16	90p
OC19	85p
OC22	55p
OC26	65p
OC28	65p
OC35	80p
OC36	65p
OC42	40p
OC44	20p
OC45	20p
OC70	15p
OC71	17p
OC72	20p
OC75	25p
OC76	25p
OC77	40p
OC81	25p
OC83	25p
OC84	25p
OC139	30p
OC140	30p
OC170	25p
OC171	30p
OC200	50p
OC201	60p
OC202	75p
TIP29A	49p
TIP30A	58p
TIP31A	62p
TIP32A	74p
TIP33A	£1·05
TIP34A	£1·55
TIP35A	£3·35
TIP36A	£2·65
TIP41A	75p
TIP42A	90p
TIP29B	58p
TIP30B	66p
TIP31B	70p
TIP32B	82p
TIP33B	£1·12
TIP34B	£1·68
TIP35B	£2·81
TIP36B	£3·64
TIP41B	83p
TIP42B	98p
TIP29C	71p
TIP30C	78p
TIP31C	85p
TIP32C	£1·05
TIP33C	£1·30
TIP34C	£1·90
TIP35C	£3·20
TIP36C	£4·10
TIP41C	95p
TIP42C	£1·10
TIS50	40p
ZTX107	15p
ZTX300	15p
ZTX500	18p
ZTX501	20p
ZTX504	50p
ZTX531	30p
ZTX550	25p
IN659	8p
IN914	8p
IN916	8p
IN4001	8p
IN4002	9p
IN4003	9p
IN4004	10p
IN4005	12p
IN4006	15p
IN4007	18p
IN4148	7p
2N696	25p
2N697	20p
2N698	25p
2N706	12p
2N706A	15p
2N708	15p
2N930	20p
2N1132	25p
2N1302	16p
2N1303	16p
2N1304	25p
2N1305	25p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1613	25p
2N1711	25p
2N2147	70p
2N2160	65p
2N2217	25p
2N2218	25p
2N2219	25p
2N2222	20p
2N2222A	25p
2N2398	70p
2N2646	50p
2N2846	£1·50
2N2904	25p
2N2905	25p
2N2096	25p
2N2907	25p
2N2926	12p
2N3053	25p
2N3054	65p
2N3055	50p
2N3232	70p
2N3525	95p
2N3702	14p
2N3703	12p
2N3704	12p
2N3705	12p
2N3706	12p
2N3707	12p
2N3708	12p
2N3709	12p
2N3771	£2·70
2N3772	£2·75
2N3773	£2·95
2N3819	35p
2N3820	55p
2N3866	85p
2N3904	22p
2N3905	25p
2N4058	12p
2N4059	12p
2N4060	12p
2N4061	12p
2N4126	17p
2N4286	15p
2N4287	15p
2N4288	15p
2N4289	15p
2N4290	15p
2N4444	£1·90
2N4871	35p
2N4920	80p
2N5191	96p
2N5194	£1·10
40360	50p
40361	50p
40362	55p

DIGITAL INTEGRAL CIRCUITS

SN7400	20p
SN7401	20p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
SN7406	30p
SN7407	30p
SN7408	20p
SN7409	45p
SN7410	20p
SN7411	23p
SN7412	42p
SN7413	30p
SN7416	30p
SN7417	30p
SN7420	20p
SN7422	48p
SN7423	48p
SN7425	48p
SN7427	42p
SN7428	50p
SN7430	20p
SN7432	42p
SN7433	70p
SN7437	65p
SN7438	65p
SN7440	20p
SN7441AN	75p
SN7442	75p
SN7443	£1·00
SN7445	£2·00
SN7446	£2·00
SN7447	£1·75
SN7448	£1·75
SN7450	20p
SN7451	20p
SN7453	20p
SN7454	20p
SN7460	20p
SN7470	30p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	55p
SN7476	45p
SN7480	80p
SN7481	£1·25
SN7482	87p
SN7483	£1·00
SN7484	90p
SN7486	45p
SN7490	75p
SN7491AN	£1·00
SN7492	75p
SN7493	75p
SN7494	80p
SN7495	80p
SN7496	£1·00
SN7497	£6·25
SN74100	£2·50
SN74104	£1·45
SN74105	£1·45
SN74107	50p
SN74110	80p
SN74118	£1·00
SN74119	£1·90
SN74121	65p
SN74122	£1·35
SN74123	£2·70
SN74141	£1·00
SN74145	£1·50
SN74150	£3·35
SN74151	£1·10
SN74153	£1·35
SN74154	£2·00
SN74155	£1·55
SN74156	£1·55
SN74157	£1·60
SN74160	£2·60
SN74161	£2·60
SN74162	£3·40
SN74163	£3·40
SN74164	£2·75
SN74165	£4·00
SN74166	£4·00
SN74167	£6·25
SN74170	£4·10
SN74174	£2·00
SN74175	£1·35
SN74176	£1·60
SN74177	£1·60
SN74180	£1·55
SN74181	£7·00
SN74182	£2·00
SN74184	£2·45
SN74185A	£2·40
SN74190	£1·95
SN74191	£1·95
SN74192	£2·00
SN74193	£2·00
SN74194	£2 50
SN74195	£1·85
SN74196	£1·50
SN74197	£1·50
SN74198	£4·60
SN74199	£4·60

TRIACS

SC40D 6A 400V	£1·00
SC40E 6A 500V	£1·20
SC45D 10A 400V	£1·25
SC45E 10A 500V	£1·45
SC50D 15A 500V	£1·85
228B90 8A 400V	90p
DIAC	25p

S.C.R.

BTY79/400R	75p
CRS1/05	25p
CRS1/10	30p
CRS1/20	30p
CRS1/40	35p
CRS3/035	30p
CRS3/10	30p
CRS3/40	50p
CRS3/60	60p
CRS7/400	70p
CRS7/600	98p
CRS16/100	65p
CRS16/200	72p
CRS16/600	£1·05
C106B	40p
C106D	65p
TIC44	35p
16RC/20	70p
2N3525	£1·05

3A 200V Rec Diode	25p

LINEAR OP. AMPS

709C TO99/DIL	40p
723C TO99/DIL	£1·05
741C DIL	50p
747C TO99/DIL	£1·10
72748P DIL	65p
723C TO99	£1·05
CA3014	£1·55
CA3018	£1·00
CA3028	£1·20
CA3036	£1·00
CA3046	95p
CA3090	£4·85
CA3048	£2·34
MC1303L	£1·85
MFC4000B	60p
SL403D	£1·50
ZN414	£1·25
LM309K	£1·90
TAD100	£1·90
TOKO FILTER	45p
TAD110	£2·00

ZENER DIODES

BZY88 series 400mW 3 3-33V. 5%	15p
1 5 Watt range	25p
10 Watt range	45p

L.E.D.

TIL 209 H.P 5082	28p

L.D.R.

ORP12	60p
OCP71	97p

LOW COST OSCILLOSCOPES

Cossor—1035 D.B., 1049 Mk. 3A D.B. 1049 Mk. 4. D B.
EMI—WM2. WM3B WM7 WM8 WM16 WM18; WM26.
Solartron—AD557 CD513.2. CD523 S.2. CD643. CD6431 1: CD711 S.2
All prices and details on application. phone 01-994 6275. Inspection welcome—call at warehouse.

BRIDGE RECTIFIERS

WO2 1A 100V	38p
BY164 1·4A. 200V	57p
CIC2-100 2A. 100V	39p
6A. 100V	85p

V.A.T.

Unless otherwise stated all prices are **EXCLUSIVE** of V.A T. Please add 10% to all orders. Carriage orders under £5 + 20p. Over £5 post free.

WAREHOUSE

20–24 BEAUMONT ROAD, W.4

SURPLUS COMPONENTS TEST EQUIPMENT. etc., etc

THOUSANDS OF BARGAINS

Test Equipment ★ Oscilloscopes ★ Signal Generators ★ Counters Cabinets ★ Bridges ★ Meters ★ Transmitters ★ Receivers ★ Power Supplies Laboratory Equipment ★ Galvanometers ★ Audio Equipment ★ Video Equipment ★ Meters ★ Battery Chargers ★ Motors ★ Etc. ★ Etc

20 TONS OF ELECTRONIC EQUIPMENT

Resistors ★ Relays ★ Capacitors ★ Switches ★ Transformers ★ Meters Potentiometers ★ Component Panels ★ Semiconductors ★ Cable ★ Valves Etc ★ Etc. ★ Etc.

Regret no lists available Personal callers only. Cash and Carry only

AUDIO ACCESSORY SHOP

17 TURNHAM GREEN TERRACE, CHISWICK, W.4

VALVE AMPLIFIERS

5 Watt	£12·50	50 Watt	£36·25
15 Watt	£24·50	150 Watt	£75·90
30 Watt	£29·50	500 Watt	£124·50

TRANSISTOR AMPLIFIERS

FAL Phase 50W	£39·93	FAL Phase 100W	£69·95

DISCO CONSOLES

FAL Disco Mk. 2	£82·99	FAL Power Disco (with 70W rms. Amp)	£123·75

HEAVY DUTY LOUDSPEAKERS

★ SPECIAL OFFER PRICE ★

15 in. 70W. E M I. 8 ohm £19·50

Decca 8in. 10 watt Hi-Fi Speaker. plus matching tweeter. £7·50 complete. Suitable 2-way cross-over . £1·21

SPEAKER CABINETS

Suitable for any 12 in speaker. covered in Rexine and Vynair Size 18 in. × 18 in. × 8 in. approx. £9·90

DISCO LIGHTING

Sound-lighting module	£7·90
3 channel sound-light	£22·50
Oilwheel 6in dia.	£5·25
Suitable ½rpm motor	£1·00
Strobe 4 Joule	£25·00
Single flash box (100W Red. Blue. Gn Yel.)	£7·50
Triple flash box	£16·25
150W Projector and Wheel	£25·00

TEAK VENEERED SPEAKER CABINETS

For 8 × 5 in. speaker	£3·50 each
For 8 in. + Tweeter	£5·00 each
For 13 × 8 in.	£6·50 each
For 12 in. + Tweeter	£9·90 each

ALSO Audio Connecting Leads. Tape. Cassettes. Stereo Systems. Mixers. Mic. Stands. Speaker Cloth. Turntables. Plinths. Covers. etc . etc

SGS
EA1000
3W
AMPLIFIER
MODULE
£2·45
HANDBOOK
10p

Solidev 15W, Class B Audio Amp, Thick Film Circuit, £3·65; Handbook, 15p.

TBA800 5W Audio I.C., **£1·50**; Data. **10p.**

UA041 5W Amplifier Module **£3·75**

ELECTRONIC COMPONENTS BARGAIN COMPONENT PACKS

Pack No

1 500 Carbon resistors. ½. ¼. 1. 2 watt
2 100 Electrolytic Condensers
3 250 Ceramic. Polystyrene. Silver Mica. etc., Condensers
4 250 Polyester. Polycarbonate. Paper etc . Condensers
5 25 Potentiometers. assorted
6 250 High-stab. 1%. 2%. 5% resistors
7 50 Assorted Tagstrips
8 1lb Assorted nuts. bolts. washers. spacers. etc
9 25 Assorted switches rotary. lever. micro. toggle. etc.
10 50 Preset Potentiometers
13 30 Unmarked OC71 Transistors
14 25 Unmarked 250mW Zener Diode. 4·7V. 5 1V. 6·2V. 7·5V. 9·1V. 10V Measured and tested Please state voltage required
15 50 GE Diode OA47 Equivt

ALL COMPONENTS NEW AND UNUSED £1 + 25p p.p. per pack. £5 for 5 packs p/free.

SPECIAL OFFERS

MINIATURE MAINS TRANSFORMER: Pri. 240V. Sec. 12V, at 100mA. Manuf.: Hinchley. Size: 36mm × 45mm × 40mm. F.C. 53mm. Price: 1 **65p;** 100 **60p** ea.; 1,000 **50p** ea.; 10,000 **40p** ea.

3 CORE PVC INSULATED MAINS CABLE. Grey ML6650. 3mm × 7/0·2mm. Price: 100m **£4·50;** 1,000m **£35**; 10,000m **£330.**

0·47mfd. 50V. MYLAR FILM CAPACITOR. Size: 1in × 0·55in × 0·65in P.C. Mount. Price: 100 **6·8p** ea.; 1,000 **5p** ea.; 10,000 **4·3p** ea.

The Scientists Investigate

The subject of ESP has at last become respectable in circles where once it was passed-off as coincidence, freak phenomena or even rubbish. Qualified scientists are now investigating many aspects of ESP the world over. Not only thought-transference, or telepathy, either. Captain Ed Mitchell, of an earlier *Apollo* mission, has set up a foundation whose aim is to investigate thoroughly many aspects of ESP and related phenomena.

A while ago John Dunne interviewed Mitchell on the John Dunne Programme, BBC Radio 2, in which Mitchell spoke of the remarkable feats of (then little-known) Uri Geller. He spoke of how Geller had, under strictly-controlled and monitored laboratory conditions, caused a gold ring (stated to have been 18 ct. gold) to fracture merely by concentrating his mind upon it. The ring was later placed on a table and constant watch kept on it for an hour or two, whilst it was seen to twist until it took up a shape like the letter "S".

More recently, we in Britain have been able to watch Geller in one or two BBC TV programmes, and to hear his original introduction on Jimmy Young's programme. In the latter, phone calls poured in from housewives who said their spoons and forks were curling up before their eyes as they laid their tables for the midday meal.

Again, to apply logic to this last situation, if the facts are true, and Geller can bend by mind power alone, we have experienced something truly remarkable. This accepted, how can we not consider the fact that the energy (or catalyst which releases this energy) may be carried to places afar by the medium of transmitted radio waves. Only a fool, in these circumstances, would reject the slightest possibility of this being possible, having once witnessed, without doubt, the first phenomenon.

* * *

Geller's performances were only part of the remarkable series of experiments that Ed Mitchell's team have recorded in their investigations, and at some time in the future the entire findings and results will be published for the World to read! One point that Mitchell made was that he tries to keep all experiments free and easy, yet very carefully scientifically controlled, in such a way that his subjects are not held in a state of tension, which, he believes, is the worst enemy to getting results, as appears to be the case if too many highly-sceptical persons are present.

Now to Plant ESP

Let us now go to another, rather unusual aspect of ESP. This concerns the reaction of plants to . . . yes, thought. All right, you are entitled to your point of view, and I grant you this wholeheartedly. But please continue to read, I was a sceptic . . . once!

A man by the name of Backster, in the United States of America, was carrying out experiments on tomato plants. He had hooked a plant up to a sort of lie-detector circuit, to measure the electrical resistance of a lead, while he intended to carry out various "tortures" on the plant. He expected that the plant would show a reaction of some sort when other parts of it were interfered with or disturbed.

ESP etc

By Brian Baily...

After trying various stimuli, and obtaining resistance changes, which were indicated on his super-sensitive equipment, he suddenly had a brainwave. Surely fire would give a strong reaction, as this, of all elements, must be the most dramatic for plant life. As he reached for the lighter, he noticed the meter deflection give a sudden reaction. Being a scientist, he would have been well aware that his sleeve or other parts involved in his sudden movement might well have caused the reaction, perhaps disturbing an electrode or something. But no, after careful analysis he discovered that whenever he decided to apply a flame to the plant, the plant gave the same reaction to . . . his thoughts!

Backster was apparently so engrossed with the evidence of this experiment, that he, in a typical American fashion, took the subject to the greatest possible extreme by monitoring the resistance of a plant or plants in one room, isolated in all ways from the first room. The contraption consisted of a sort of crane-jib suspending a large container of brine-shrimps (live and kicking) over a vat of boiling liquid. At one time, unknown to anyone in the plant room, the shrimps were dropped into the boiling vat. Yes, you have guessed it, the meter pretty well wrapped its needle around the end stop of the scale . . . and at the very instant that the shrimps hit the hot fluid. Dropping dead shrimps into the vat caused no reaction, but the plant would become "numb" to the effect if live ones were killed in quick succession.

* * *

I was personally so taken up by the quoted results of Backster's experiments that I tried out the thought-transference version. I connected a "busy-lizzy" (some call them "wandering sailors" I think) to a high-gain i.c. amplifier, and fed the output to the control line of a voltage-controlled oscillator, which I fed to an audio amplifier. After careful setting of the wire electrodes on one leaf, I adjusted the oscillator frequency to about mid-audio range.

After allowing time for any change in audio pitch to take place, which took about a minute, I waited a little longer to be sure that the pitch was as constant as I could determine by ear. Then I concentrated on the thought of dripping battery-acid on to the leaf. I chose this, because I remember from school-day experiments the taste of sulphuric acid and also, there was an old car battery in the workshop under the bench, and I felt able to dwell on the thought better for these reasons. As the taste came back to me, the oscillator pitch rose sharply, and proceeded to rise out of audibility. To those interested, this was due to the increase in resistance of the plant leaf, bearing in mind the way I had phased the circuits at the time.

This was not all. I satisfactorily repeated the experiment with the same results, for no less than six times altogether. But when I tried it out of direct line-of-vision with the plant, it failed, only to work again when I came back and looked at the plant.

* * *

These experiments were all done in one session, in the evening in Summer, and have not been tried again. Also, I do not know whether Backster found his plants responded with increased resistance like mine, but it would be interesting to find out if the two results tallied.

Next month: "Phantom Photos by Physicists".

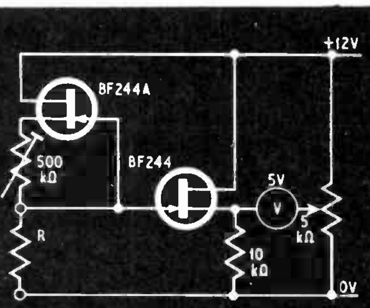


Fig. 20c. A 1MΩ f.s.d. linear scale ohmmeter

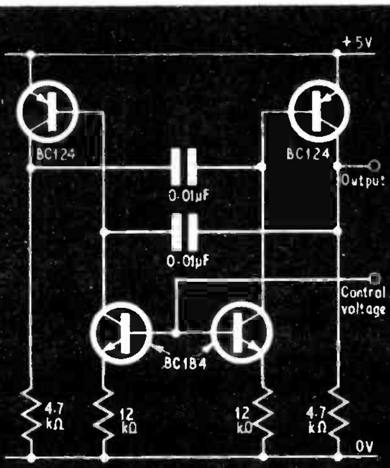


Fig. 21a. Linear voltage to frequency converter

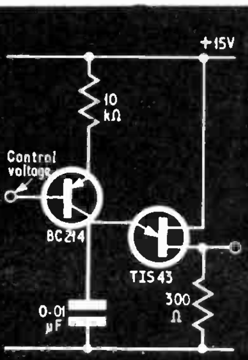


Fig. 21c. Alternative voltage to frequency converter

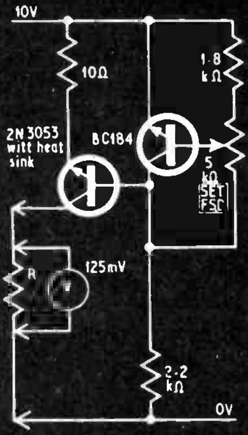


Fig. 20d. A 1Ω f.s.d. linear scale ohmmeter

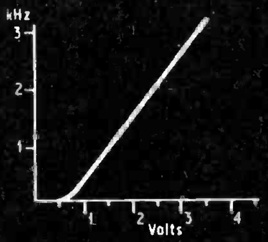


Fig. 21b. Graph of control voltage against output frequency for the voltage to frequency converter

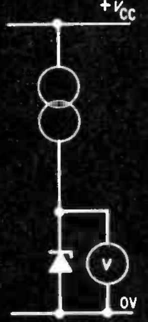


Fig. 22. Zener diode tester using a constant current source

must be drawn on the meter or a calibration chart must be prepared.

The linear scale ohmmeter circuit shown in Fig. 20b enables a conventional voltmeter to be used without any alteration to the meter scale. For instance, it a 1mA current generator is used, a 5V f.s.d. meter will measure resistance up to 5 kilohms.

With the same current, a 1 kilohm scale can be produced by the use of a 1V meter. The meter scale is only linear if the current through the resistor is large compared to the meter current. For a maximum error of 2% from this cause the current source must provide 50 times as much current as the meter f.s.d. current. So if a 20kΩ/V meter is employed, the current generator should supply at least 2·5mA.

HIGH RESISTANCE MEASUREMENTS

If measurements of high resistances are needed, the test current cannot conveniently be more than a few microamps. This imposes a limit of a few nanoamps on the meter current.

A circuit for a 1MΩ meter is given in Fig. 20c. The input current is less than 5nA at 25°C and the error caused by nonlinearity in the amplifier is small. The 5kΩ potentiometer is used to set zero and the 500kΩ resistor is set for f.s.d. with a test resistor of 1MΩ.

CONNECTION ERRORS

One problem associated with ohmmeters designed to measure low resistances is that the resistance of the test leads and the resistance of the connections made by the clips to the resistor being tested can cause quite large errors.

With the circuit shown in Fig. 20d for measuring resistances up to one ohm these errors are avoided. The voltmeter connections are separate from the current generator connections so that the voltage measured depends only on the current and the resistor being measured.

The contact resistance of the current source connections is thus left out of the measurement.

LINEAR VOLTAGE-TO-FREQUENCY CONVERTER

Another circuit which cannot easily be produced without the use of current sources is a linear voltage to frequency converter. The method used is similar to that described earlier in connection with sawtooth generators.

An example of a voltage to frequency converter is shown in Fig. 21a and in Fig. 21b a graph of control voltage against frequency for this circuit is shown.

BI-PRE-PAK

SUPPLIERS OF SEMI-CONDUCTORS TO THE WORLD

Telephone Corner

COMPLETE TELEPHONES

NORMAL HOUSEHOLD TYPE

EX G.P.O. **Only £1·05p** P. & P. 45p each

TELEPHONE DIALS

Standard Post Office type. Guaranteed in working order.

Only 27½p POST & PACKING 16½p

Tested and Guaranteed Paks

B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV 1 amp. plastic	55p
B81	10	Reed Switches, 1" long ⅛" dia. Highspeed P.O. type	55p
B99	200	Mixed Capacitors. Approx. quantity, counted by weight Post & packing 15p.	55p
H4	250	Mixed Resistors. Approx. quantity counted by weight Post & packing 15p.	55p
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked	55p
H38	30	Short lead Transistors, NPN Silicon Planar types	55p
H39	6	Integrated circuits 4 gates BMC 962, 2 flip flops BMC 945	55p
H41	2	BD131/BD132 Complementary Plastic Transistors	55p

Unmarked Untested Paks

B1	50	Germanium Transistors PNP, AF and RF	55p
B66	150	Germanium Diodes Min. glass type	55p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	55p
B86	100	Sil. Diodes sub. min. IN914 and IN916 types	55p
H16	15	Experimenters' Pak of Integrated Circuits. Data supplied	55p
H20	20	BY126/7 Type Silicon Rectifiers 1 amp. plastic. Mixed volts	55p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can	55p

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.

£1·10p 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. Necessary 24 pair cable **22p** per yard. Price of each instrument is independent of the number of ways.

£2.75 p.p. 38½p

Cable can be sent by Parcel Post. Post and Packing per 50 yds.: **73½p.**
Extension Telephones 71½p each, p.p. 27½p. £1·37½ for 2, p.p. 55p. These phones are extensions and do not contain bells.

A Cross Hatch Generator £3·85 post paid

A complete kit of parts including Printed Circuit Board. A four position switch gives X-hatch, Dots, Vertical or Horizontal lines. Integrated Circuit design for easy construction and reliability. A project in the Sep. '72 edition of Television. **Subject to availability.**

New Paks

Tested & Guaranteed

H63	4	2N3055 Type NPN Sil. power transistors. Below spec. devices	55p
H65	4	40361 Type NPN Sil. transistors TO-5 can comp. to H66	55p
H66	4	40362. Type PNP Sil. transistors TO-5 can comp. to H65	

Untested, Unmarked

H67	10	3819N Channel FET's plastic case type.	55p

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 keen 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 ZTX300 range.
TYPE "H" PNP Silicon, similar ZTX500 range.

8 RELAYS FOR £1·10p PNP 27½p.

High Speed Magnetic Counter

4 digit (non-reset)
24V or 48V (state which)
4×1×1 in. 33p, p.p. 5p.

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	**22p**	**20p**	**18p**
90 watt	**26½p**	**24½p**	**22p**
Range 2	VCE Min. 40	HFE Min. 40	
	1–12	13–25	26–50
40 watt	**33p**	**31p**	**29p**
90 watt	**38½p**	**36½p**	**33p**

Complementary pairs matched for gain at 3 amps. 11p extra per pair. Please state NPN or PNP on order.

LM380 AUDIO I.C. as featured in Practical Wireless December issue. Complete with application data, **£1·10.**

INTEGRATED CIRCUITS. We stock a large range of I.C.s at very competitive prices (from 11p 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 DUAL IN LINE I.C. SOCKETS

14 pin type at 16½p each } Now new low
16 pin type at 18p each } profile 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.

Our famous P1 Pak

is still leading in value

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

11p P. & P. on this Pak.

Please ask for Pak P.1. only 55p

Please send me the FREE Bi-Pre-Pak Catalogue.

NAME..

ADDRESS ....

....

ALL PRICES INCLUDE 10% V.A.T.

MINIMUM ORDER 55p. CASH WITH ORDER PLEASE. Add 11p post and packing per order. OVERSEAS ADD EXTRA FOR POSTAGE.

BUY THESE GOODS WITH ACCESS

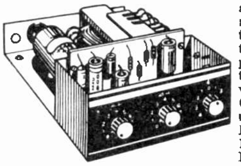
BI-PRE-PAK LTD

Co Reg No 820919

Dept. A. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX.
TELEPHONE: SOUTHEND (0702) 46344.

PRICES INCLUDE VAT

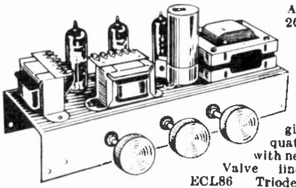
SUPERSOUND 13 HI-FI MONO AMPLIFIER



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

PRICE £12·00 P. & P. 40p.

DE LUXE STEREO AMPLIFIER



A.c. mains 200–240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit. allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11in. w × 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. **Price £10·45.** P. & P. 50p.

NEW! POWER SUPPLY UNIT

200/240V A.C. input. Four switched fully smoothed D.C. outputs giving 6V and 7½V and 9V and 12V at 1 amp on load.

Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case, overall size 6″ × 3½″ × 2½″. Suitable for Transistor Radios, Tape Recorders, Amplifiers, etc., etc. Ready built and tested.

PRICE £5 P. & P. 35p.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2½in × 3in approx. **28p** pair. P. & P. 6p.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations: 0-5-10-15-20-25-30-35-40-60V half wave at 1 amp or 10-0-10, 20-0-20, 30-0-30V, at 2 amps full wave. Size 3inL × 3½inW × 3inD. Price **£2·31.** P.&P. 40p

---

MAINS TRANSFORMER. For transistor power supplies.
Pri. 200/240V Sec. 9-0-9 at 500mA. **£1·10** P. & P. 25p.
Pri. 200/240V Sec. 12-0-12 at 1 amp. **£1·21** P. & P. 26p.
Pri. 200/240V Sec. 10-0-10 at 2 amp. **£1·82** P. & P. 35p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER. For P.U. Tape, Mike, Guitar, etc., and suitable for use with valve or transistor equipment. 9–18V. Battery or from H.T. line 200/300V. Frequency response 15Hz–25KHz. Gain 26dB. Solid encapsulation size 1½ × 1½ × ½in. Brand new — complete with instructions. Price **£1.** P. & P. 15p.

3 REFERENCE ENCYCLOPEDIAS FOR ELECTRONIC ENGINEERS AND DESIGNERS, covering between them, transistor characteristics, diode and transistor equivalents. Many thousands of up-to-date European types listed.

Diode Equivalents	80p	
Transistor Equivalents	90p	
Transistor Characteristics	£1·20	
All three together	£2·60	POST FREE

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A., European and Japanese transistors. ONLY **40p.** Post 5p.

---

8 pole 3 way 2 bank low loss Yaxley type switches 1½″ sections. Standard spindle. 2 switches **66p** + 10p P. & P.

NEW ISSUE—Thyristor, Triac, Diac, etc. encyclopedias **95p** Post Free.

FOR PERSONAL CALLERS ONLY! Limited number of Stereo Radiogram chassis covering LW/MW/FM bands. Mono radio and stereo gram. Overall size approx. 16½″W, 6½″H, 8″D. 4 Watts per channel output. ONLY **£16·50.**

RECORD PLAYER BARGAINS

Mains models. All brand new in maker's packing.

LATEST B.S.R. C109/C129 AUTOCHANGER UNITS. With latest stereo/mono compatible cartridge **£7·60** plus 60p P. & P.

SPECIAL BARGAIN OFFER! Limited number of BSR C123 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge. Brand new. **ONLY £8.00** plus P. & P. 60p.

PRECISION ENGINEERED PLINTHS

Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL65B, AT60, etc., or B.S.R. C123, C109, C129, A21, etc. Black leatherette finish. Size 12½in × 14½in × 3½in high (approx. 7½in high, including rigid smoked acrylic cover). P. & P. 70p. **Now only £4·95**

LATEST ACOS GP91/1SC Mono Compatible Cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·50.** P. & P. 15p.

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus. Diamond Stereo LP and Sapphire 78. ONLY **£2·30.** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£2·80.** P. & P. 15p.

LATEST RONETTE T/O Stereo Compatible Cartridge for EP/LP/Stereo/78. **£1·63.** P. & P. 15p.

LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono/stereo records on mono equipment **£1·50.** P. & P. 15p.

QUALITY RECORD PLAYER AMPLIFIER MK II

A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84. and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. × 3 d. × 6 h. Ready built and tested. PRICE **£5·00.** P. & P. 50p. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE **£6·30.** P. & P. 60p.

SPECIAL OFFER!!

HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16in high × 10½in wide × 6in deep. Fitted with E.M.I. Ceramic Magnet 13in × 8in bass unit, two H.F. tweeter units and crossover. Max. power handling 10W. Available 3, 8 or 15 ohm impedance.

Our Price £9·25 Carr. 75p.

CABINET AVAIL. SEPARATELY **£4·95.** Carr. 65p. Also available in 8 ohm with EMI 13in × 8in. bass speaker with parasitic tweeter. **£7·15.** Carr. 75p.

HARVERSON'S SUPER MONO AMPLIFIER

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

OUR ROCK BOTTOM BARGAIN PRICE **£3·85** P. & P. 40p

LOUDSPEAKER BARGAINS

5in 3 ohm **£1·25,** P. & P. 15p. 7 × 4in 3 ohm **£1·40,** P. & P. 20p. 10 × 6in 3 or 15 ohm **£2·10,** P. & P. 30p. E.M.I. 8 × 5in 3 ohm with high flux magnet **£1·70,** P. & P. 20p. E.M.I. 13½ × 8in with high flux ceramic magnet with parasitic tweeter 3, 8, or 15 ohm **£3·50.** P. & P. 30p. E.M.I. 13 × 8in, 3 or 8 or 15 ohm with two inbuilt tweeters and crossover network **£4·65.** P. & P. 30p.

EMI CERAMIC MAGNET HEAVY DUTY TWEETER. pprox. 3½in. Av. 3 or 8 or 15 ohms. **£1·25** plus 20p p. & p.

BRAND NEW. 12in 15w H/D Speakers, 3, 8 or 15 ohm (state which). Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£9·90.** Guitar models: 25w **£9·90.** 35w **£11·00.** P. & P. 45p each.

SPECIAL OFFER!

LIMITED NUMBER OF BRAND NEW ELAC 10″ TWIN CONE LOUDSPEAKERS. With large ceramic magnet and plasticised cone surround. 8 ohm impedance.

£3·70. P. & P. 35p.

Also available specification as above but size 10″ × 6″ **£2·70** and size 8″ round **£2·60** P. & P. 35p.

12in "RA" TWIN CONE LOUDSPEAKER

10 watts peak handling. 3, 8 or 15 ohm, **£2·75,** P. & P. 36p.

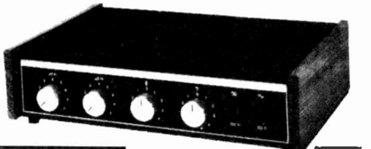
"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11½in × 14 11/16in × 1 3/16in deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only **£6·55** each. P. & P. 34p.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15,000Hz. Matching impedance 8–16 ohms. Easily converted for mono. PRICE **£3·30.** P. & P. 25p.

HAVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EASIER CONSTRUCTION

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. (Very simple to modify to suit magnetic cartridge—Instructions included). Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output 14W r.m.s. per channel into 5 ohms. Frequency response ± 3dB 12–30,000Hz. Sensitivity better than 80mV into 1MΩ. Full power bandwidth ± 3dB 12–15,000Hz. Bass boost approx. to ± 12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35V at 1·0 amp. Overall size—12″ wide × 8″ deep × 2½″ high.

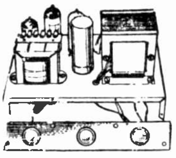
Fully detailed 7-page construction manual and parts list free with kit or send 18p plus large S.A.E.

PRICES	AMPLIFIER KIT,	£11·55	P. & P. 25p.
	(Magnetic input components 33p extra)		
	POWER PACK KIT,	£3.50	P. & P. 35p.
	CABINET,	£3·50	P. & P 35p.

(Post Free if all units purchased at same time). Full after sales service. Also available ready built and tested, **£25·00.** Post Free.

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

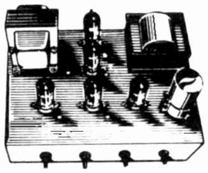
3-VALVE AUDIO AMP. HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£6·00.** P. & P. 45p.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£4·50,** P. & P. 45p.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 15p plus S.A.E. (Free with parts). **All parts sold separately.** ONLY **£9·80.** P. & P. 60p. Also available ready built and tested **£13·00.** P. & P. 70p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. **Our price £1·10 yd.** length. P. & P. 15p per yd. (min. 1 yd.). S.A.E. for samples.

Open 9-5.30 Mon. to Fri.
9-5 Sat. Early closing Wed.

A few minutes from South Wimbledon Tube Station.

HARVERSON SURPLUS CO. LTD.

Dept. PE, 170 High St., Merton, London, S.W.19 Tel. 01-540 3985

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

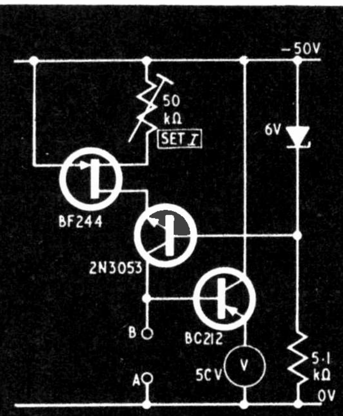


Fig. 23. Transistor breakdown voltage meter

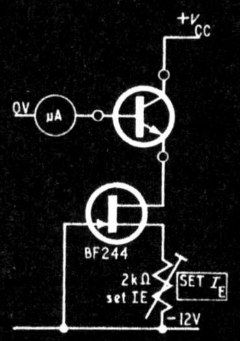


Fig. 24. Transistor gain meter

The BC184 transistors act as controlled current sources. The multivibrator frequency is proportional to the current provided by the BC184 transistors which is proportional to the control voltage. Another voltage to frequency converter is shown in Fig. 21c.

SEMICONDUCTOR TESTING

Another field of application for constant current generators is the testing of many semiconductor devices. For instance, to find the voltage of a Zener diode without a constant current source, it is necessary to measure simultaneously the voltage across the diode and the current through it. The diode is connected to a power supply and the supply voltage is adjusted until the diode current reaches the desired value, when the Zener voltage is read on the voltmeter.

With a current source, the test procedure is simplified. The test circuit is given in Fig. 22. The current generator ensures that the correct current flows through the diode with no need for any adjustment; the Zener voltage is simply read on the meter.

It will be noticed that the circuit of the Zener tester is similar to that of the linear scale ohmmeter and, in fact, the ohmmeter can be used to test Zener diodes provided that the supply voltage of the meter is greater than the sum of the Zener voltage and the knee voltage of the current source.

If a variable current generator is used, the slope resistance of the Zener diode can be found by noting the change in Zener voltage as the current is varied. This circuit can also be used to determine the material from which a semiconductor diode is constructed.

The diode is connected to a current source providing between 1 and 10mA using the circuit of Fig. 22. The diode should be forward biased. If the voltage across the diode is about 0·1 to 0·3V at 1mA or 0·2 to 0·4V at 10mA, the diode is made of germanium.

A silicon diode has a forward voltage of about 0·5 to 0·7V at 1mA and 0·6 to 0·8V at 10mA. The diode, of course, could be one of the junctions of a transistor.

BREAKDOWN VOLTAGES

With only slight alteration, this circuit can be used to measure the breakdown voltages $V_{B(CEO)}$, $V_{B(CBO)}$ and $V_{B(EBO)}$ of transistors. For these measurements, a current of about 100μA is required and the supply voltage must be higher than the expected breakdown voltage. Therefore the constant current generator itself must have a breakdown voltage greater than the supply voltage.

Fig. 23 shows a circuit using a cascode current source with a high breakdown voltage.

To measure $V_{B(CEO)}$ of an *npn* transistor, the base is left unconnected, the collector is connected to terminal A and the emitter is connected to terminal B.

To measure $V_{B(CBO)}$ the collector is connected to terminal A, the base is connected to terminal B and the emitter is not connected.

The $V_{B(EBO)}$ is measured in the same way as $V_{B(CBO)}$ except that the emitter and collector connections are reversed.

To test *pnp* transistors the connections to the tester are reversed. The meter requires an amplifier since the test current is so low. A simple emitter follower as shown in the circuit diagram is suitable in this application because the 0·5V error it causes is unimportant.

MEASURING CURRENT GAIN

Transistor current gain h_{FE} is the ratio of collector current to base current and is usually measured at a specified collector current. The simple method of measuring h_{FE} by applying a known base current and measuring the resulting collector current is unsatisfactory if transistors with a wide gain spread are being tested.

One solution is the use of a current generator to define the emitter current which is virtually the same as the collector current. The test circuit is shown in Fig. 24. The emitter current is set by the f.e.t. current source and the base current is measured by the microammeter. The h_{FE} can then be calculated from the equation:

$$h_{FE} = \frac{I_E - I_B}{I_B}$$
$$\approx \frac{I_E}{I_B}$$

This test circuit has the additional advantage that the collector voltage V_{CC} can be carried independently to study the effect on the operation of the transistor. If a variable current source is employed, the transistor gain at various currents can be determined.

The circuits described above have necessarily covered only some of the possible applications of constant current generators and many more uses will no doubt occur to the reader. ★

INGENUITY UNLIMITED

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

SIMPLE TRANSISTOR TESTER

THIS CIRCUIT (Fig. 1) uses an AC128 or similar ing an approximate value for the common emitter current gain of small signal transistors, and will also indicate whether the transistor under test is *npn* or *pnp*.

When the transistor under test is *npn*, and the top of the circuit is positive relative to the bottom, the transistor will conduct, its base current passing through R1. Part of its collector current flows through D2, the meter and the base emitter junction of TR1. TR1 turns on and l.e.d. D3 lights, indicating *npn*. The meter is proportional to the gain of the transistor under test.

When *pnp* devices are under test conduction occurs via the other half of the bridge causing l.e.d. D4 to light.

Potentiometer VR1 shunts some of the collector current preventing the base currents of TR1 or TR2 becoming excessive whilst the collector current of the transistor under test is kept reasonable.

If ME1 is a 200μA type calibrated 0 to 500 then the value of the shunt should be a ninth of the entire meter and bridge resistance, the prototype using a 100Ω preset. A transistor of known gain is used to set VR1. TR1 and TR2 are any high gain silicon types. The transformer secondary should not have an output in excess of 2·24 volts.

A. D. Baily,
Loughborough, Leics.

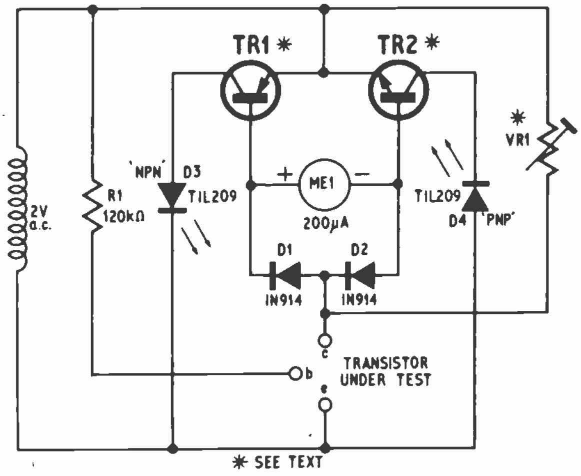
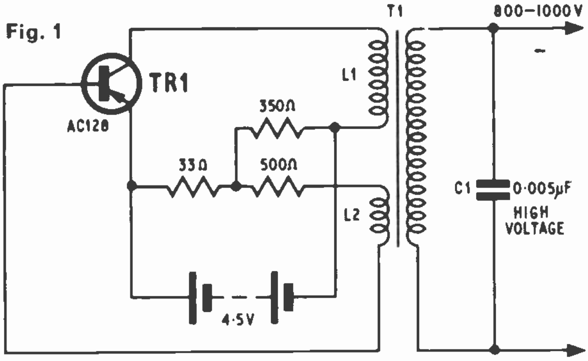


Fig. 1. Circuit diagram for a simple transistor tester

800-1,000V SUPPLY

Fig. 1



THE switch circuit of Fig. 1 uses an n-channel transistor which should be fitted with a heatsink. The battery takes around 250mA but varies with the secondary load.

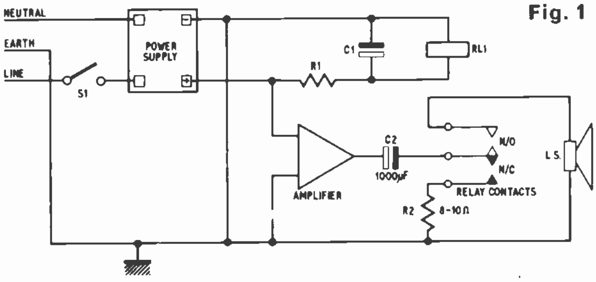
The secondary voltage varies with the load (a load should be present with the battery connected to prevent heating of TR1).

The choice of transformer is not critical but it should have two l.t. windings with L1 at least twice the voltage of L2. C1 is chosen to have a high reactance at the frequency of operation.

J. Hollis, Derby.

SWITCH-ON SURGE ELIMINATOR

Fig. 1



A NUMBER of audio amplifiers suffer from switch-on current surge through the loudspeakers, particularly low impedance speakers.

The circuit of Fig. 1 overcomes the problem by connecting the speakers to the amplifier only after the initial current surge to the output capacitors has occurred.

When the amplifier is initially switched on by S1, C1 starts to charge. At the same time the amplifier output capacitor C2 charges up through R2. When C1 reaches the potential required to operate the relay coil the contacts are switched over replacing the dummy load R2 with the loudspeaker.

The value of R1 is best found by experiment or can be calculated by dividing the supply voltage by the relay rated current and then subtracting the resistance of the relay coil.

C1 should be about, 2,500μF so as to allow the relay contacts to remain open long enough for the output capacitors to become fully charged.

This is normally about 3 to 5 seconds. Only one channel is shown here but for stereo the relay should be two-pole and of course of an operating voltage less than the power supply rail voltage.

J. Farrimond, Wigan, Lancs.

ELECTRONIC SWITCH

The switch circuit of Fig. 1 uses an n-channel f.e.t. (e.g. 2N5457 or MPF102, etc.) to present either a high or a low impedance earth return path to the signal to be switched.

The main advantage of such a system is that it removes the need for audio r.f. signals to be fed to switches, the signal switching can occur on a circuit board whilst the mechanical switch handles only a d.c. signal. This helps reduce hum pick-up and other undesirable strays problems.

As can be seen, in the "off" state the f.e.t. is biased to conduct heavily, thus effectively shorting the a.c. signal to earth. Switching the f.e.t. to the "on" state biases it into the non-conducting region thus presenting a high impedance down the earth path. This allows the a.c. signal to continue virtually unattenuated.

In fact a large number of these switches can be driven from one d.c. switch without risk of cross-talk, thus reducing the number of multiple-pole switches needed. In addition, the control voltage could be obtained from logic outputs.

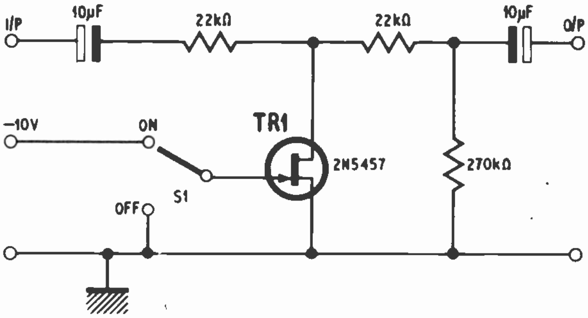


Fig. 1. Switch circuit diagram

Switch performance can be improved if required by biasing the gate slightly positive, about 1V, in the off position.

P-channel f.e.t.s may be used with suitable reversal of the gate voltage. The two capacitors act as d.c. blocks to prevent d.c. appearing at the f.e.t. The stage following the f.e.t. switch should have an impedance in excess of 50kΩ to avoid excess loading.

C. G. Louisson,
Imperial College, London.

NEON TESTER

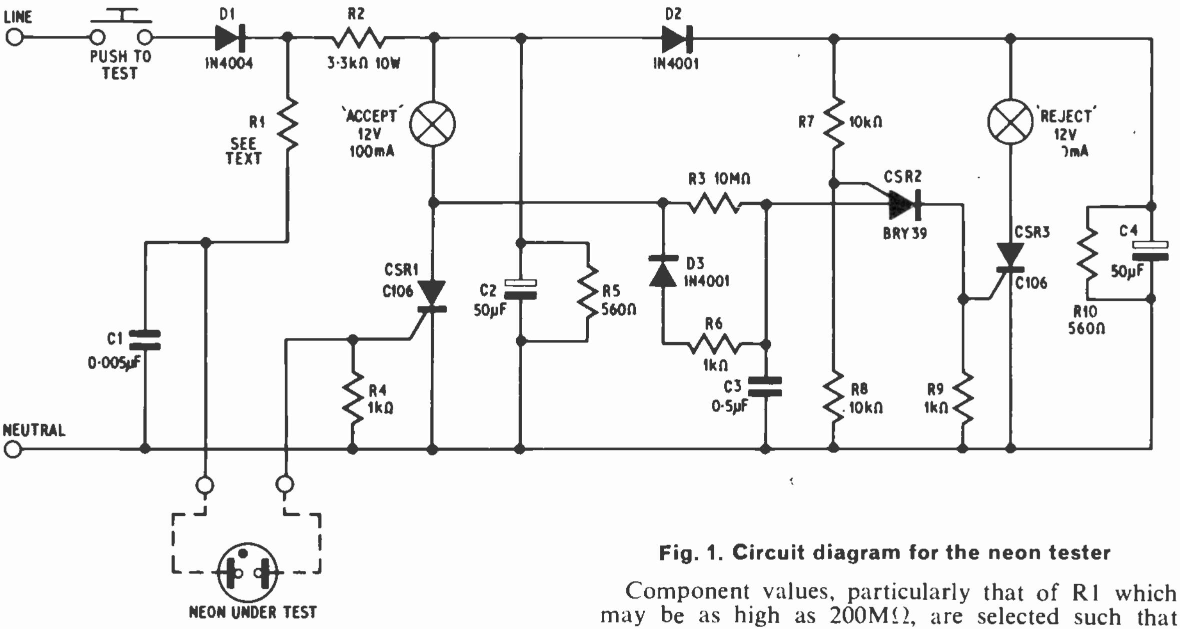


Fig. 1. Circuit diagram for the neon tester

There are many simple timer circuits which make use of neon discharge devices in conjunction with an RC circuit. As is well known, long time delays require large C values and, of course, components with good insulation qualities since the ultimate time period length is usually set by the limitations caused by leakage currents.

The circuit of Fig. 1 is capable of testing neons to assess their suitability as time delay elements.

With the neon under test connected as shown, supply of power by depressing the push-to-test switch energises two timing circuits. The first is via R1 and C1 whilst the other is via R2, the accept lamp, R3 and C3.

Component values, particularly that of R1 which may be as high as 200MΩ, are selected such that an acceptable neon causes the first timing network to reach its striking voltage prior to the second.

When this happens SCR1 will fire and the accept lamp will light up. Releasing the test switch resets the unit for the next test.

Should the neon be rejected through high leakage current, a cracked glass or too high a striking voltage, C3 will become charged more quickly so as to fire SCR2 and 3 and thus illuminate the reject lamp.

Diode D3 and resistor R6 discharge C3 at the end of a test so that the second timing circuit always starts from the same condition.

A. J. Woolward,
Roborough, Plymouth.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0–260V

All Types

SHROUDED TYPE

0·5 KVA (2½ amp) (MAX) £10·00
1 KVA (5 amp) (MAX) £14·70
2 KVA (10 amp) (MAX) £28·10
3 KVA (15 amp) (MAX) £31·25
4 KVA (20 amp) (MAX) £72·50
37·5 amp (MAX) £102·50

CARRIAGE AND PACKING EXTRA

L.T. TRANSFORMERS

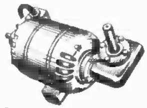
All primaries 220–240V

Type No.	Sec. Taps	Price	Post
1	30, 32, 34, 36V at 5A	£4·70	+45p
2	30, 40, 50V at 5A	£6·90	+60p
3	10, 17, 18V at 10A	£5·00	+50p
4	6, 12V at 20A	£6·50	+60p
5	17, 18, 20V at 20A	£7·30	+60p
6	6, 12, 20V at 20A	£6·90	+60p
7	24A at 10A	£5·30	+50p
8	4, 6, 24, 32V at 12A	£7·20	+60p
9	6 and 12V at 10A	£3·80	+40p

VOLTAGE CHANGING TRANSFORMER

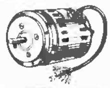
M.f.g. to highest W.D. spec. Auto wound, and tapped 0–130–160–200–250 at least 2kVA. Can also be used as 230–240V input, 115V out for U.S.A. equipment, or reverse to obtain 240V from 115V. The ideal transformer for making up solid state constant voltage unit, by use of taps the following voltages may be obtained 30–40–50–70–90V at 10 amps. Weight 40lb, length, 260mm, height 190mm, width 230mm. In original maker's wooden case, £8. Carr. £1.

PARVALUX TYPE SD19 230/250 VOLT A.C. REVERSIBLE GEARED MOTORS



30 r.p.m. 40 lb. ins. Position of drive spindle adjustable to 3 different angles. Ex-equipment. Tested and in first-class running order. A really powerful motor offered at a fraction of makers' price. **£6·30.** Post 60p.

AEI A.C. MOTOR



Smooth running, powerful, continuously rated, reversible motor 230/250V a.c., 50 cycle 1/50 H.P., RPM 900, 0·25A. **£3·50** post 50p.

METERS NEW! 2½in Flush round. Available in D.C. Amps 1, 5, 10, 15, 20 or A.C. Amps 1, 5, 10, 15, 20, both types **£2·00.** Post 15p. Voltmeter **0-300V** A.C. **£2.** Post 15p.

600 WATT DIMMER SWITCH

Easily fitted. Fully guaranteed by makers. Will control up to 600W of all lights except fluorescent at mains voltage. Complete with simple instructions. **£2·75.** Post 25p.

2000 WATT POWER CONTROL

For Power tools. Heating, Sewing Machines, Lighting, etc **£8·00.** Post 27p.

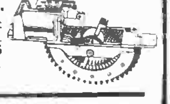
VENNER TIME SWITCH TYPE MSQP

200/250 Volt 2-ON/2-OFF every 24 hours at any manually pre-set time. 20 amp contacts. Fitted diecast case. Tested and in perfect condition **£4·75.** Post 25p.

FOOT SWITCH

Suitable for Motors, Drills, etc., etc. 5 amp. 250 volt. Price **75p.** Post 15p.

UNISELECTOR SWITCHES



NEW **4 Bank 25 Way.** 24V d.c. operation. **£6·90.** Post 30p. **6 Bank 25 Way,** 24V d.c. **£7·90.** Post 30p. **8 Bank 25 Way,** 24V d.c. operation. **£9·50.** Post 40p.

TRIACS

GENERAL ELECTRIC POWER-GLAS TRIACS

10 amp. Glass passivated plastic triac. Latest device from U.S.A. Long term reliability. Type SC146D 10 amp, 400 PIV, **£1.** Post 5p. Type SC146E 10 amp, 500 PIV, **£1·30.** Post 5p. (Inclusive of data and application sheet.) Suitable Diac 18p.

All Mail Orders—Callers—Ample Parking
Dept. PE4, 57 BRIDGMAN ROAD
CHISWICK, LONDON W4 5BB
Phone 01-995 1560
Showroom open Mon.-Fri.

STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.

EXPERIMENTERS' ECONOMY KIT
Speed adjustable 1 to 30 flash per sec. All electronic components including Xenon Tube and instructions **£6·30.** Post 30p.

INDUSTRIAL KIT
Ideally suitable for schools, laboratories, etc. Speed adjustable 1-80 f.p.s.
Approx. ½ output of Hy-Lyght. Price **£12·00.** Post 50p.

HY-LYGHT STROBE MK III
For use in large rooms, halls and utilises a silica tube, printed circuit. Speed adjustable 0-20 f.p.s. Light output greater than many (so called 4 Joule) strobes. **£12.** Post 50p.

THE 'SUPER' HY-LYGHT KIT

Approx. four times the light output of our well proven Hy-Lyght strobe.

- Variable speed from 1-13 flash per sec.
- Reactor control circuit producing an intense white light. ONLY **£20.** Post 75p.

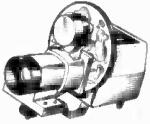
ROBUST, FULLY VENTILATED METAL CASE. For Hy-Lyght Kit including reflector **£4·75.** Post 25p.
Super Hy-Lyght case including reflector **£7.** Post 60p.

7-inch POLISHED REFLECTOR
Ideally suited for above Strobe kits. Price **55p.** Post 15p.

RAINBOW STROBE FOUR LIGHT CONTROL MODULE

Will operate four of our Hy-Lyght or Super Hy-Lyght Strobes in either 1, 2, 3, 4 sequence; 2 + 2; or all together. Thoroughly tested and reliable. Complete with full connection instructions. Price: **£18.** Post 50p. Send S.A.E. for details.

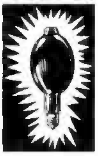
COLOUR WHEEL PROJECTOR



Complete with oil-filled colour wheel. 100 watt lamp. 200/240V AC. Features extremely efficient optical system. **£18·50.** Post 50p.

6 INCH COLOUR WHEEL
As used for Disco lighting effects, etc. Price **£4·50.** Post 30p.

BIG BLACK LIGHT



400Watt. Mercury vapour ultra violet lamp.
Powerful source of u.v. Innumerable industrial applications also ideal for stage, display, discos, etc. P.F. ballast is essential with these bulbs. Price of matched ballast and bulb **£16.** Post £1.
Spare bulb **£7.** Post 40p.

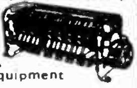
BLACK LIGHT FLUORESCENT U.V. TUBES

4ft 40 watt. Price **£5·50.** Post 30p. **2ft 20 watt, £4·25.** Post 25p. (For use in standard bi-pin fittings.)
MINI. **12in 8 watt, £1·60.** Post 15p. **9in 6 watt, £1·30.** Post 15p. Complete ballast unit and holders for 9in and 12in tube, **£1·70.** Post 25p. (9in and 12in measures approx.)

AUTO FADE COLOUR BLEND MODULE

Will control up to 750W. of lighting. *Automatic* fade-up, fade-down at a manually pre-selected timing, which may be varied between 1 second to 1 minute. Based on 10 amp triac for maximum reliability. Ready built with switch and Time Control, on 4½" x 5" glass P.C. board. Three modules or more can be sequenced to obtain fantastic colour blending effects. Price **£12·50.** Post 30p.

PROGRAMME TIMERS



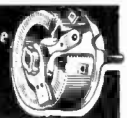
230/240V a.c. 15 r.p.m. Motors. Each cam operates a c/o micro switch. Ideal for lighting effects, animated displays, etc. Ex equipment tested.

4 cam model.	£2·50 post 30p.
6 cam model.	£3·25 post 30p.
12 cam model.	£4·00 post 35p.

All prices are subject to
10% VAT. (10p in the £)
To all orders add 10% VAT to total value of goods including carriage/packaging.

SERVICE TRADING CO

Superior Quality Precision Made NEW POWER RHEOSTATS



New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.

25 WATT 10/25/50/100/250/300/500/1k/ohm **£1·15.** Post 10p.
50 WATT 1/5/10/25/50/100/250/500/1k/1·5k/ohm **£1·60.** Post 10p.
100 WATT 1/5/10/25/50/100/250/500/1k/1·5k/2·5k/3·5k/5k ohm **£2·35.** Post 15p.
Black Silver, Skirted knob calibrated in Nos. 1-9. 1½in. dia. brass bush. Ideal for above Rheostats, **22p** each.

RELAYS SIEMENS, PLESSEY, Etc MINIATURE RELAYS

Col.(1) Coil ohms
Col. (2) Working d.c. volts
Col. 3 Contracts
Col. (4) Price
HD = Heavy duty
*Incl. Base
All prices incl. P. & P.

1	2	3	4
52	4–6	6M	60p*
58	5–9	6 c/o	80p
150	4–9	2 c/o	70p*
185	8–12	6M	60p*
308	9–14	4 c/o	75p*
410	10–18	4 c/o	70p*
700	16–24	4M 2B	60p*
700	16–24	4 c/o	80p*
700	15–35	2 c/o HD	70p*
700	6–12	1 c/o HD	50p*
700	20–30	6 c/o	80p
2,500	36–45	6M	60p*
2,400	30–48	4 c/o	60p
5,800	24–26	2 c/o	60p*
9,000	40–70	2 c/o	60p*
15k	85–110	6M	60p*

6 VOLT D.C. 1 make contacts **35p.** Post 5p.
6 VOLT D.C. 2 make contacts **75p.** Post 5p.

9 VOLT D.C. RELAY
3 c/o 5 amp contacts. 70 ohm coil. **75p.** Post 5p.

12 VOLT D.C. RELAY
3 c/o 5 amp contacts. **75p.** Post 5p.

24 VOLT D.C. 3 c/o **75p.** Post 5p.

CLARE-ELLIOTT TYPE RP7641 G8

Miniature relay. 675 ohm coil. 24 Volt D.C. 2 c/o. **70p** post paid.

100 VOLT A.C.
2 c/o seated type, octal base **£1.** Post 10p.

24 VOLT A.C. Mfg. by ITT.2 h.d. c/o contacts. **55p.** Post 5p.

240 VOLT A.C. RELAY. Mfg. by ITT. 240V A.C. 10 amp h.d. c/o contacts. Octal plug in base. (Similar to illustration below). Price **75p.** Post 5p.

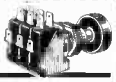
HEAVY DUTY A.C. SEALED RELAYS

230/240 V. 2 c/o. 20 amp contacts. 110 Volt. 2 c/o 20 amp contacts. Either type **£1·25.** Post 10p.

DRY REED RELAYS

Mfg. by ERG, 12 volt d.c. encapsulated.
Single c/o **65p,** post paid. Two c/o **85p,** post paid.
STC 280 ohm coil 6/12V d.c. 3 make metal shrouded. **60p** post paid.
Other types available, state your requirement.

"HONEYWELL" PUSH BUTTON, PANEL MOUNTING MICRO SWITCH ASSEMBLY



Each bank comprises a c/o rated at 10 amps 240V. A.C. Black knob 1 in. Fixing hole ⅜ in. ONE bank **30p;** TWO bank **40p;** THREE bank **50p.** Quote for quantity.

VERY SPECIAL OFFER

Micro Switch. 5 amp c/o contacts. M.f.g. bg. Honeywell. NEW. **Twenty** for **£1·50.** Post 10p (min. 20).

'HONEYWELL' LEVER OPERATED MICROSWITCH

10 amps 250 volt A.C. c/contacts. In maker's carton.
PRICE: 10 for **£1·90.** Post 15p.

INSULATION TESTERS *NEW!*

Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in, W.4in, H.6in, weight 6lb. **1,000V,** 1,000 megohms, **£34.** Post 60p. **500V,** 500 megohms, **£28.** Post 60p.

24 VOLT DC SOLENOIDS

Unit containing 1 heavy duty solenoid approx. 25lb pull 1 inch travel. Two × approx. 1lb pull ½ inch travel. **6** × approx. 4oz. pull ½ inch travel. One 24 volt d.c., 1 heavy duty single make relay. Price **£2·50** P +p 60p. Absolute bargain.

Personal callers only. Open Sat.
9 LITTLE NEWPORT STREET
LONDON WC2H 7JJ
Phone 01-437 0576

Marshall's

A. Marshall & Son (London) Limited
42 Cricklewood Broadway London NW2 3HD, Telephone 01-452 0161
& 65 Bath Street Glasgow G2 2BX, Telephone 041-332 4133

EVERYTHING YOU NEED IN OUR
NEW CATALOGUE
PRICE 20p
AVAILABLE
NOW!

Transistors

2G301	0·15	2N3392	0·13	3N187	1·55	ASY29	0·36	BCY72	0·13	BFY11	0·45
2G302	0·15	2N3393	0·13	3N200	2·49	ASY50	0·20	BCY87	3·54	BFY17	0·90
2G303	0·25	2N3394	0·13	3N201	1·12	ASY55	0·15	BCY88	2·42	BFY18	0·35
2G306	0·30	2N3402	0·18	40050	0·78	BC107	0·16	BCY89	0·97	BFY19	0·35
2G309	0·30	2N3403	0·19	40251	0·81	BC108	0·15	BCZ10	0·35	BFY20	0·50
2G345B	0·25	2N3404	0·24	40309	0·30	BC109	0·19	BCZ11	0·50	BFY29	0·40
2G371	0·15	2N3405	0·27	40310	0·50	BC113	0·13	BD115	0·75	BFY37	0·20
2G374	0·15	2N3414	0·10	40313	0·92	BC114	0·12	BD116	0·75	BFY41	0·43
2N174	1·40	2N3415	0·10	40316	0·50	BC115	0·15	BD121	0·75	BFY43	0·65
2N404	0·43	2N3416	0·15	40318	0·92	BC116	0·15	BD123	0·82	BFY50	0·22½
2N456	0·75	2N3417	0·21	40360	0·46	BC116A	0·18	BD124	0·67	BFY51	0·18½
2N456A	0·75	2N3570	1·25	40361	0·48	BC117	0·21	BD131	0·40	BFY52	0·20½
2N457A	0·80	2N3571	1·12½	40362	0·50	BC118	0·11	BD132	0·50	BFY53	0·16
2N491	3·68	2N3572	0·97	40363	0·61	BC119	0·29	BD135	0·43	BFY56	0·34
2N696	0·15	2N3702	0·11	40389	0·46	BC121	0·23	BD136	0·49	BFY64	0·41½
2N697	0·15	2N3703	0·12	40394	0·56	BC125	0·15	BD137	0·55	BFY75	0·40
2N698	0·25	2N3704	0·14	40395	0·65	BC126	0·20	BD138	0·63	BFY76	0·22
2N699	0·29	2N3705	0·12	40406	0·44	BC132	0·30	BD139	0·71	BFY77	0·24
2N706	0·16	2N3706	0·09	40407	0·33	BC134	0·11	BD140	0·87	BFY78	0·36
2N706A	0·18	2N3707	0·13	40408	0·50	BC135	0·11	BDY10	1·25	BFY90	0·60
2N708	0·14½	2N3708	0·70	40409	0·52	BC136	0·15	BDY11	1·50	BRY39	0·28
2N709	0·38	2N3709	0·11	40410	0·52	BC137	0·15	BDY17	1·50	BSX19	0·13
2N711	0·30	2N3710	0·12	40411	2·25	BC138	0·24	BDY18	1·75	BSX20	0·20½
2N718	0·21	2N3711	0·11	40414	3·55	BC140	0·34	BDY19	1·97	BSX21	0·20½
2N718A	0·49	2N3712	0·96	40467	0·69	BC141	0·29	BDY20	1·05	BSX26	0·49
2N720	0·50	2N3713	1·20	40468A	0·44	BC142	0·23½	BDY38	0·65	BSX27	0·34
2N721	0·55	2N3714	1·38	40600	0·69	BC143	0·21	BDY60	0·85	BSX28	0·25
2N914	0·22	2N3715	1·50	40601	0·67	BC144	0·24	BDY61	1·25	BSX29	0·47
2N916	0·41	2N3716	1·80	40602	0·46	BC145	0·21	BDY62	1·00	BSX60	0·54
2N918	0·47	2N3773	2·65	40603	0·58	BC147	0·12	BF115	0·25	BSX61	0·42
2N929	0·30	2N3779	3·15	40604	0·56	BC148	0·13	BF116	0·23	BSX76	0·15
2N930	0·48	2N3790	2·40	40636	1·10	BC149	0·12	BF117	0·43	BSX77	0·20
2N1090	0·30	2N3791	2·35	40673	0·70	BC153	0·18	BF119	0·58	BSX78	0.25
2N1091	0·32	2N3792	2·69	AC107	0·25	BC154	0·18	BF121	0·25	BSW70	0·28
2N1132	0·54	2N3794	0·10	AC113	0·16	BC157	0·14	BF123	0·27	BSY24	0·20
2N1302	0·18½	2N3819	0·37	AC117	0·20	BC158	0·13	BF125	0·25	BSY25	0·20
2N1303	0·18½	2N3820	0·38	AC121	0·13	BC159	0·14	BF152	0·20	BSY26	0·20
2N1304	0·24	2N3823	1·42	AC126	0·25	BC160	0·37	BF153	0·21	BSY27	0·15
2N1305	0·24	2N3824	1·33	AC127	0·25	BC167B	0·13	BF154	0·16	BSY28	0·15
2N1306	0·31	2N3826	0·23	AC128	0·25	BC168B	0·13	BF158	0·23	BSY38	0·19½
2N1307	0·22	2N3854	0·18	AC141K	0·30	BC168C	0·11	BF159	0·27	BSY39	0·19½
2N1308	0·25	2N3854A	0·16	AC142K	0·25	BC169B	0·13	BF160	0·23	BSY51	0·25
2N1309	0·35½	2N3855	0·19	AC151V	0·14	BC169C	0·13	BF161	0·41½	BSY52	0·25
2N1483	0·90	2N3855A	0·20	AC152V	0·17	BC170	0·11	BF163	0·31½	BSY53	0·25
2N1507	0·30	2N3856	0·19	AC153	0·25	BC171	0·13	BF166	0·31½	BSY54	0·30
2N1613	0·38	2N3856A	0·20	AC153K	0·25	BC172	0·11	BF167	0·21	BSY56	0·79
2N1631	0·38	2N3858	0·16	AC154	0·20	BC182	0·12	BF173	0·24	BSY65	0·15
2N1637	0·36	2N3858A	0·19	AC176	0·18	BC182L	0·12	BF177	0·29	BSY78	0·40
2N1638	0·32	2N3859	0·14	AC176K	0·25	BC183	0·09	BF178	0·35	BSY79	0·40
2N1701	1·19	2N3859A	0·19	AC187K	0·28	BC183L	0·09	BF179	0·43	BSY790	0·45
2N1702	2·15	2N3860	0·19	AC188K	0·34	BC184	0·11	BF180	0·35	BSY95A	0·10½
2N1711	0·45	2N3866	1·09	ACY17	0·35½	BC184L	0·11	BF181	0·34	BU104	1·42
2N1893	0·81	2N3877	0·25	ACY18	0·24	BC186	0·25	BF182	0·40	BU105	2·25
2N2102	0·30	2N3877A	0·26	ACY19	0·27	BC187	0·27½	BF183	0·40	C111	0·53
2N2147	0·70	2N3900	0·21	ACY20	0·22	BC207	0·12	BF184	0·30	D40N3	0·55
2N2148	0·94	2N3900A	0·21	ACY21	0·26	BC208	0·11	BF185	0·17	GET111	0·45
2N2192	0·40	2N3901	0·32	ACY22	0·17	BC212K	0·10	BF194	0·16	GET113	0·25
2N2192A	0·40	2N3903	0·24	ACY28	0·20	BC212L	0·16	BF195	0·17	GET114	0·20
2N2913	0·40	2N3904	0·27	ACY30	0·42	BC214L	0·21	BF196	0·15	GET115	0·50
2N2193A	0·61	2N3905	0·24	ACY39	0·65½	BC237	0·09	BF197	0·15	GET119	0·35
2N2194	0·78	2N3906	0·27	ACY40	0·17	BC238	0·09	BF198	0·18	GET120	0·40
2N2194A	0·30	2N4036	0·62½	ACY41	0·17	BC239	0·09	BF199	0·18	GET535	0·20
2N2218A	0·86	2N4037	0·42	ACY44	0·31	BC251	0·20	BF200	0·40	GET536	0·20
2N2219	0·57	2N4058	0·16	AD136V	0·96	BC252	0·18	BF224J	0·14	GET538	0·20
2N2219A	0·86	2N4059	0·09	AD142	0·50	BC253	0·23	BF225J	0·19	GET873	0·12
2N2220	0·45	2N4060	0·11	AD143	0·45	BC257	0·09	BF237	0·22	GET875	0·15
2N2221	0·41	2N4061	0·11	AD149V	0·66	BC258	0·09	BF238	0·22	GET880	0·35
2N2221A	0·83	2N4062	0·11	AD150	0·63	BC259	0·13	BF244	0·16	GET883	0·20
2N2222	0·60	2N4302	0·25	AD161	0·45	BC261	0·20	BF245	0·33	GET887	0·20
2N2222A	0·91	2N4303	0·47	AD162	0·45	BC262	0·18	BF246	0·43	GET890	0·25
2N2368	0·31	2N4916	0·11	AD161 }	Pr.	BC263	0·23	BF247	0·49	GET895	0·25
2N2369	0·37	2N4917	0·17	AD162 }	1·05	BC300	2·12	BF254	0·16	TIP29A	0·49
2N2369A	0·41	2N4918	0·73	AF109R	0·40	BC301	0·34	BF255	0·17	TIP30A	0·58
2N2646	0·77	2N4919	0·84	AF114	0·25	BC302	0·29	BF257	0·47	TIP31A	0·62
2N2647	1·12	2N4920	0·99	AF115	0·24	BC303	0·54	BF258	0·59	TIP32A	0·74
2N2711	0·13	2N4921	0·73	AF116	0·25	BC307	0·10	BF259	0·55	TIP33A	1·01
2N2712	0·12	2N4922	0·84	AF117	0·20	BC307A	0·10	BF270	0·21	TIP34A	1·51
2N2713	0·17	2N4923	0·83	AF118	0·50	BC308	0·09	BF272	0·53	TIP35A	2·90
2N2714	0·18	2N5172	0·12	AF121	0·22	BC308A	0·12	BF273	0·15	TIP36A	3·70
2N2904	0·55	2N5174	0·22	AF124	0·24	BC308B	0·09	BF274	0·17	TIP41A	0·79
2N2904A	0·70	2N5175	0·26	AF125	0·20	BC309	0·10	BF457	0·53	TIP42A	0·90
2N2905	0·71	2N5176	0·32	AF126	0·19	BC309A	0·10	BF458	0·65	TIP2955	0·98
2N2905A	0·88	2N5190	0·92	AF127	0·20	BC309B	0·10	BFS21A	2·30	TIP3055	0·60
2N2906	0·65	2N5191	0·95	AF139	0·38	BC327	0·21	BF828	0·92	ME0401	0·18
2N2906A	0·70	2N5192	1·24	AF170	0·25	BC328	0·19	BF861	0·27	ME0402	0·20
2N2907	0·38	2N5195	1·46	AF172	0·25	BC337	0·19	BF898	0·20	ME0404	0·13
2N2907A	0·41	2N5245	0·48	AF178	0·55	BC338	0·19	BFW11	0·61	ME0411	0·17
2N2923	0·12	2N5457	0·49	AF179	0·65	BCY30	0·43	BFX13	0·23	ME0412	0·18
2N2924	0·14	2N5458	0·45	AF180	0·50	BCY31	0·51½	BFX29	0·30	ME0413	0·14
2N2925	0·17	2N5459	0·49	AF186	0·40	BCY32	1·15	BFX30	0·25	ME1120	0·25
2N2926		3N128	0·73	AF200	0·35	BCY33	0·34	BFX37	0·33	ME4001	0·09
Green	0·12	3N138	1·65	AF239	0·51	BCY34	0·36½	BFX44	0·33	ME4002	0·11
Yellow	0·11	3N139	1·42	AF240	0·72	BCY38	0·52½	BFX63	2·48	ME4003	0·14
Orange		3N140	0·92	AF279	0·54	BCY39	1·05	BFX68	0·30	ME6101	0·10
	0·11	3N141	0·81	AF280	0·54	BCY40	0·87	BFX84	0·24	ME4102	0·11
2N3053	0·32	3N142	0·58	AFY42	0·74	BCY42	0·15	BFX85	0·30	ME4103	0·10
2N3054	0·86	3N143	0·75	AL102	0·75	BCY43	0·15	BFX86	0·25½	ME4104	0·11
2N3055	0·75	3N152	0·92	AL103	0·70	BCY58	0·21	BFX87	0·28	ME4101	0·14
2N3390	0·26	3N153	0·81	ASY26	0·30	BCY59	0·22	BFX88	0·25	ME6102	0·16
2N3391	0·28	3N154	0·84	ASY27	0·36	BCY70	0·17	BFX89	0·45	ME8002	0·17
2N3391A	0·29	3N159	1·17	ASY28	0·28	BCY71	0·22	BFY10	0·35	ME8003	0·16

Open
9.30 am - 5.30 pm
Mon to Sat
'Return of post'
service
Barclaycards
accepted

Litronix LED's

RL-2 02 03 04	46p
RL54	13p
RL55	42p
RL209	33p
RL4484	31p
RL4850	31p
DL707 (Alphanumeric)	2.35

Litronix LED's
Sescocem
semi-conductors.
Full range of
Cosmos
Capacitors -
Siemens Nitsuko
Ducati

Zener Diodes Sescocem and Mullard

400mw	11p
1w	17p
1½w	25p
10w	40p
20w	52p

Components
supplied for
most projects
in this magazine

Our full range is in
our catalogue
available now-
price 20pence

Prices correct
at 21.1.74

Prices exclusive
of V.A.T.

Post and Packing 13p per order. Europe 25p. Commonwealth (Air) 65p (MIN). Matching charge (audio transistors only) 15p extra per pair. Prices subject to stock availability.

Kellner Construction Kits

We are the sole distributors in U.K.

E83 3 watt Mono Transistor Amplifier Kit	£4·08
E815 15 watt Hi-Fi Transistor Amplifier Kit [two for stereo] with Tone Control and Pre-Amp	£13·20
E830 30 watt Mono Hi-Fi Power Amplifier	£9·20
E850 50 watt Mono Hi-Fi Power Amplifier	£10·53
EV3 Distortion Compensated Pre-Amplifier	£4·00
AV7 Aerial Amplifier. LW, SW, MW, VHF, T/V Channels 2–12	£2·04
UH870 FM Transmitter Kit. 65mHz–145mHz. A GPO Licence is required	£2·79
MUE7 Short Wave and VHF Receiver Kit. Companion to UH870 25mHz–150mHz	£3·22
EW18 Electronic Dice Kit	£6·53
EW20 Electronic Dice with Sensor Button	£7·79
ST800 Strobe Light Kit, 120W/8	£7·86
LO1000 Psychedelic Light Control, single channel	£7·00
LO350 Psychedelic Light Control, three channel	£13·50
NT15 Power Supply—4 to 30V, 1·5W	£7·46
NT85 Professional Stabilized Power Supply, 5 to 70V, 2A	£12·53
D800 800W Light Dimmer Speed Control	£2·98
WT7 Aircraft Communications Tuner 110–130mHz. Built and aligned	£15·46
WT9 Transmitter VFO for 2 meters [144mHz–146mHz]. Built and aligned	£15·46

All prices plus 10% VAT and plus 15p post and packing. All kits with easy to follow instructions and covered by a full guarantee.

Bridge Rectifiers

	Plastic				Metal—Professional quality			
	£	£	£	£	£	£	£	£
	1A	2A	4A	6A	5	15	25	50A
50	0·24	0·32	0·60	0·62	2·22	2·64	3·36	12·30
100	0·36	0·37	0·70	0·75	2·24	3·00	3·60	12·36
200	0·30	0·41	0·75	0·80	2·82	3·78	4·32	14·40
400	0·36	0·45	0·85	1·10	3·72	4·20	5·40	16·38
600	0·40	0·52	0·95	1·25				

AB Potentiometers—carbon

Rotary type 45: Singles (Log and linear) 15p. Single switched (Log and linear) 21p. Doubles (Log and linear) 38p.

Slider type 58: Singles (Log and linear) 30p. Doubles (Log and linear) 50p.

Presets: 0·1 watt 6p, 0·2 watt 6p, 0·3 watt 7½p. Please specify vertical or horizontal.

Diodes and Rectifiers

PIV	50	100	200	400	600	800	1000
1·5	8p	9p	10p	11p	12p	15p	20p
3	15p	17p	20p	22p	25p	27p	30p
10	—	35p	40p	47p	56p	—	—
35	84p	92p	£1·18	£2·15	£2·52	£3·65	£4·20

Cathode Stud Only

IN3766 (35A 800pv) £3·65
1N3786 (35A 1000pv) £4·20

IN34A	10p	BA141	17p	BY237	12½p	OA79	7p
IN914	7p	BA142	17p	BYZ10	35p	OA81	8p
IN916	7p	BA144	12p	BYZ11	32p	OA85	10p
AA119	7p	BA145	17p	BYZ12	30p	OA90	7p
AA129	15p	BA154	12p	OA9	10p	OA91	7p
BA100	15p	BY100	15p	OA10	20p	OA95	7p
BA102	25p	BY126	15p	OA47	7½p	OA200	7p
BA110	25p	BY127	17½p	OA70	7½p	OA202	10p
BA115	7p	BY140	£1	OA73	10p	OA210	27p

Integrated Circuits

Each month we will show a different range of i.c.'s which are kept in stock.

CA3000	2·28	CA3028b	1·17	CA3054	1·19	CD4010ae	1·07
CA3001	3·38	CA3029	0·52	CA3055	1·44	CD4011ae	0·51
CA3002	2·26	CA3029a	0·63	CA3059	1·84	CD4012ae	0·51
CA3004	2·26	CA3030	1·08	CA3060	4·91	CD4013ae	0·99
CA3005	1·50	CA3030a	1·64	CA3062	2·97	CD4014ae	2·66
CA3006	3·47	CA3033	2·92	CA3064	1·42	CD4015ae	2·66
CA3007	3·28	CA3033a	4·93	CA3065	1·42	CD4016ae	1·02
CA3008	1·98	CA3034	1·65	CA3066	2·61	CD4017ae	2·66
CA3008a	3·24	CA3035	1·52	CA3067	2·72	CD4018ae	2·66
CA3010	0·56	CA3036	0·90	CA3068	3·01	CD4019ae	1·23
CA3010a	0·69	CA3037a	2·60	CA3070	2·15	CD4020ae	2·96
CA3011	0·92	CA3038	2·60	CA3071	2·01	CD4021ae	2·70
CA3012	1·11	CA3038a	3·40	CA3072	2·07	CD4022ae	2·58
CA3013	1·30	CA3039	1·00	CA3075	1·46	CD4023ae	0·51
CA3014	1·52	CA3040	2·95	CA3076	1·67	CD4024ae	4·95
CA3015	1·40	CA3041	1·30	CA3078	3·19	CD4025ae	0·51
CA3015a	1·82	CA3042	1·30	CA3080	0·58	CD4027ae	1·58
CA3016	2·61	CA3043	1·73	CA3080a	1·90	CD4028ae	2·34
CA3016a	3·90	CA3044	1·42	CA3086	0·46	CD4029ae	3·79
CA3018	0·88	CA3045	1·50	CA3088e	1·38	CD4037ae	1·93
CA3018a	1·19	CA3046	0·86	CA3089e	2·18	CD4042ae	2·11
CA3019	0·94	CA3047	1·59	CA3090q	4·70	CD4043ae	2·11
CA3020	1·55	CA3047a	2·92	CD4000ae	0·51	CD4044ae	2·11
CA3020a	2·01	CA3048	2·34	CD4001ae	0·51	CD4045ae	2·65
CA3021	1·90	CA3049	1·96	CD4002ae	0·51	CD4046ae	2·84
CA3022	1·61	CA3050	2·28	CD4006ae	2·45	CD4047ae	1·65
CA3023	1·55	CA3051	1·73	CD4007ae	0·51	CD4049ae	0·90
CA3026	1·25	CA3052	1·80	CD4008ae	2·53		
CA3028a	0·88	CA3053	0·52	CD4009ae	1·07		

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
AC107	22	AD161	39	BC145	50 •	BD115	68	BF176	39
AC113	20	AD162	39	BC147	11	BD116	88	BF177	39
AC115	22	AD161 &		BC148	11	BD121	66	BF178	33
AC117K	32	AD162 (MP)		BC149	13	BD123	72	BF179	33
AC122	13		75	BC150	20	BD124	76	BF180	33
AC125	19	ADT140	55	BC151	22	BD131	55	BF181	38
AC126	19	AF114	27	BC152	19	BD132	66	BF182	44
AC127	20	AF115	27	BC153	31	BD133	72	BF183	44
AC128	20	AF116	27	BC154	33	BD135	44	BF184	28
AC132	16	AF117	27	BC157	20	BD136	44	BF185	33
AC134	16	AF118	39	BC158	18	BD137	50	BF187	30
AC137	16	AF124	33	BC159	13	BD138	55	BF188	44
AC141	20	AF125	33	BC160	50	BD139	61	BF194	13
AC141K	32	AF126	31	BC161	55	BD140	66	BF195	13
AC142	20	AF127	31	BC167	13	BD155	88	BF196	16
AC142K	28	AF139	33	BC168	13	BD175	66	BF197	16
AC151	17	AF178	55	BC169	18	BD176	66	BF200	50
AC154	22	AF179	55	BC170	18	BD177	72	BF222	£1·05
AC155	22	AF180	55	BC171	16	BD178	72	BF257	50
AC156	22	AF181	55	BC172	16	BD179	77	BF258	66
AC157	27	AF186	55	BC173	16	BD180	77	BF259	94
AC165	22	AF239	41	BC174	16	BD185	72	BF262	61
AC166	22	AL102	72	BC175	24	BD186	72	BF263	61
AC167	22	AL103	72	BC177	21	BD187	77	BF270	39
AC168	27	ASY26	28	BC178	21	BD188	77	BF271	33
AC169	16	ASY27	33	BC179	21	BD189	88	BF272	88
AC176	22	ASY28	28	BC180	27	BD190	88	BF273	39
AC177	27	ASY29	28	BC181	27	BD195	94	BF274	39
AC178	31	ASY50	28	BC182	11	BD196	94	BFW10	66
AC178	31	ASY51	28	BC182L	11	BD197	99	BFX29	30
AC180	22	ASY52	28	BC183	11	BD198	99	BFX84	24
AC180K	32	ASY54	28	BC183L	11	BD199	£1·05	BFX85	33
AC181	22	ASY55	28	BC184	18	BD200	£1·05	BFX86	24
AC181K	32	ASY56	28	BC184L	13	BD205	88	BFX87	27
AC187	24	ASY57	28	BC186	81	BD206	88	BFX88	24
AC187K	25	ASY58	28	BC187	31	BD207	£1·05	BFY50	22
AC188	24	ASY73	28	BC207	12	BD208	£1·05	BFY51	22
AC188K	25	ASZ21	44	BC208	12	BDY20	£1·10	BFY52	22
ACY17	28	BC107	12	BC209	18	BF115	27	BFY53	19
ACY18	22	BC108	12	BC212L	12	BF117	50	BPX25	94
ACY19	22	BC109	13	BC213L	12	BF118	77	BSX19	17
ACY20	22	BC113	11	BC214L	16	BF119	77	BSX20	17
ACY21	22	BC114	17	BC225	28	BF121	50	BSY25	17
ACY22	18	BC115	17	BC226	39	BF123	55	BSY26	17
ACY27	20	BC116	17	BC301	30	BF125	50	BSY27	17
ACY28	21	BC117	20	BC302	27	BF127	55	BSY28	17
ACY29	39	BC118	11	BC303	35	BF152	61	BSY29	17
ACY30	31	BC119	33	BC304	40	BF153	50	BSY38	20
ACY31	31	BC120	88	BC440	34	BF154	50	BSY39	20
ACY34	23	BC125	18	BC460	40	BF155	77	BSY40	31
ACY35	28	BC126	20	BCY30	27	BF156	53	BSY41	31
ACY36	31	BC132	13	BCY31	29	BF157	61	BSY95	14
ACY40	19	BC134	20	BCY32	33	BF158	61	BSY95A	14
ACY41	20	BC135	13	BCY33	24	BF159	66	Bu105	£2·20
ACY44	39	BC136	17	BCY34	28	BF160	44	C111E	55
AD130	42	BC137	17	BCY70	16	BF162	44	C400	33
AD140	58	BC139	44	BCY71	22	BF163	44	C407	28
AD142	53	BC140	33	BCY72	16	BF164	44	C424	28
AD143	42	BC141	33	BCZ10	22	BF165	44	C425	55
AD149	55	BC142	33	BCZ11	28	BF167	24	C426	39
		BC143	38	BCZ12	28	BF173	24	C428	22

Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
C441	33	ST140	14	2N1307	23	2N2926(R)	11	2N3906	30
C442	33	ST141	19	2N1308	26	2N2926(B)	11	2N4058	13
C444	39	TIS43	33	2N1309	26	2N3010	77	2N4059	11
C450	24	UT46	30	2N1613	22	2N3011	16	2N4060	13
MAT100	21	ZN414	£1·20	2N1711	22	2N3053	19	2N4061	13
MAT101	22	2G301	21	2N1889	35	2N3054	51	2N4062	13
MAT120	21	2G302	21	2N1890	50	2N3055	55	2N4284	19
MAT121	22	2G303	21	2N1893	41	2N3391	16	2N4285	19
MJE2955	95	2G304	27	2N2147	79	2N3391A	18	2N4286	19
MJE3055	62	2G306	44	2N2148	63	2N3392	16	2N4287	19
MJE3440	55	2G308	39	2N2160	66	2N3393	16	2N4288	19
MPF102	46	2G309	39	2N2192	39	2N3394	16	2N4289	19
MPF104	41	2G339	22	2N2193	39	2N3395	19	2N4290	19
MPF105	41	2G339A	18	2N2194	39	2N3402	23	2N4291	19
OC19	39	2G344	20	2N2217	24	2N3403	23	2N4292	19
OC20	70	2G345	18	2N2218	22	2N3404	31	2N4293	19
OC22	52	2G371	18	2N2219	22	2N3405	46	2N5172	18
OC23	54	2G371B	13	2N2220	24	2N3414	17	2N5294	60
OC24	62	2G373	19	2N2221	22	2N3415	17	2N5457	54
OC25	42	2G374	19	2N2222	22	2N3416	31	2N5458	35
OC26	32	2G377	33	2N2368	19	2N3417	31	2N5459	34
OC28	55	2G378	18	2N22369	16	2N3525	83	2N6211	75
OC29	55	2G381	18	2N2369A	16	2N3614	74	2S301	55
OC35	46	2G382	18	2N2411	27	2N3615	82	2S302A	46
OC36	55	2G401	33	2N2412	27	2N3616	82	2S302	46
OC41	22	2G414	33	2N2646	52	2N3646	10	2S303	61
OC42	27	2G417	28	2N2711	23	2N3702	13	2S304	77
OC44	17	2N388	39	2N2712	23	2N3703	13	2S305	86
OC45	14	2N388A	61	2N2714	23	2N3704	14	2S306	86
OC70	11	2N404	22	2N2904	19	2N3705	13	2S307	86
OC71	11	2N404A	31	2N2904A	23	2N3706	13	2S321	62
OC72	16	2N524	46	2N2905	23	2N3707	14	2S322	46
OC74	16	2N527	54	2N2905A	28	2N3708	9	2S322A	46
OC75	17	2N598	46	2N2906	17	2N3709	10	2S323	62
OC76	17	2N599	50	2N2906A	20	2N3710	10	2S324	77
OC77	28	2N696	14	2N2907	22	2N3711	10	2S325	77
OC81	17	2N697	15	2N2907A	24	2N3819	81	2S326	77
OC81D	17	2N698	27	2N2923	16	2N3820	55	2S327	77
OC82	17	2N699	39	2N2924	16	2N3821	39	2S701	46
OC82D	17	2N706	9	2N2925	16	2N3823	31	40361	44
OC83	22	2N706A	10	2N2926(G)	14	2N3903	31	40362	50
OC139	22	2N708	13	2N2926(Y)	12	2N3904	38		
OC140	22	2N711	33	2N2926(O)	11	2N3905	31		
OC169	28	2N717	39						
OC170	28	2N718	27						
OC171	28	2N718A	55						
OC200	28	2N726	31						
OC201	31	2N727	31						
OC202	31	2N743	22						
OC203	28	2N744	22						
OC204	28	2N914	16						
OC205	39	2N918	33						
OC309	44	2N929	23						
OCP71	48	2N930	23						
ORP60	44	2N1131	22						
ORP61	44	2N1132	24						
P20	55	2N1302	16						
P21	50	2N1303	16						
P346A	22	2N1304	19						
P397	46	2N1305	19						
		2N1306	23						

DIODES AND RECTIFIERS

AA119	0·09	BY114	0·13	BYZ18	0·39
AA120	0·09	BY126	0·16	BYZ19	0·31
AA129	0·09	BY127	0·17	CG62	
AAY30	0·10	BY128	0·17	(OA91 Eq.)	
AAZ13	0·11	BY130	0·18		0·06
BA100	0·11	BY133	0·23	CG651—	
BA116	0·23	BY164	0·55	(OA70–OA79)	
BA126	0·24	BYX38/30			0·07
BA148	0·16		0·46	OA5	0·39
BA154	0·13	BYZ10	0·39	OA58L	0·23
BA155	0·16	BYZ11	0·33	OA10	0·39
BA156	0·15	BYZ12	0·33	OA47	0·08
BY100	0·17	BYZ13	0·28	OA70	0·08
BY101	0·13	BYZ16	0·44	OA79	0·08
BY105	0·19	BYZ17	0·39	OA81	0·08

LINEAR INTEGRATED CIRCUITS

Type No.	1	25	100+
72702	50p	48p	45p
72709	35p	33p	30p
72710	45p	43p	40p
72741	40p	38p	35p
72741C	45p	43p	40p
72741P	38p	36p	34p
72748P	38p	36p	34p
SL201C	50p	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
ZN414	£1·20	—	—

NUMERICAL INDICATOR TUBES

		£
3015F	Minitron 7 Segment Indicator . . .	1·50
MAN 3M	L.E.D. 7 SEGMENT DISPLAY 0·127in High Characters. . .	1·90
CD66	Side Viewing "NIXIE TYPE" Tube 16m/m	1·87
GR116	Side Viewing "NIXIE TYPE" Tube 13m/m.	1·70

R.T.L. LOGIC I.C's

	Price each		
	1–24	25–99	100 up
UL900	38p	36p	29p
UL914	38p	36p	29p
UL923	55p	51p	49p

DTL 930 SERIES LOGIC I.C's

		Price	
Type	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
TO3 Plastic 1·5 Amps

UA7805. 5V (Equiv. to MVR 5V) £1·76

UA7812.12V (Equiv. to MVR 12V) £1·76

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	100 up
TSO14	14 pin type	33p	30p	27p
TSO16	16 pin type	38p	35p	32p
BP814	14 pin type (low cost)	16p	14p	12p
BP816	16 pin type (low cost)	17p	15p	13p

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

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

Type	Quantities			Type	Quantities			Type	Quantities		
	1	25	100+		1	25	100+		1	25	100+
	£p	£p	£p		£p	£p	£p		£p	£p	£p
7400	0·18	0·17	0·16	7451	0·18	0·17	0·16	74150	2·90	2·80	2·70
7401	0·18	0·17	0·16	7453	0·18	0·17	0·16	74150	2·90	2·80	2·70
7402	0·18	0·17	0·16	7454	0·18	0·17	0·16	74151	1·10	1·05	1·00
7403	0·18	0·17	0·16	7460	0·18	0·17	0·16	74153	1·30	1·20	1·10
7404	0·18	0·17	0·16	7470	0·32	0·29	0·27	74154	1·98	1·80	1·75
7405	0·18	0·17	0·16	7472	0·32	0·29	0·27	74155	1·50	1·45	1·35
7406	0·39	0·34	0·31	7473	0·41	0·39	0·35	74156	1·50	1·45	1·35
7407	0·39	0·34	0·31	7474	0·41	0·39	0·35	74157	2·00	1·90	1·80
7408	0·20	0·19	0·18	7475	0·50	0·48	0·46	74160	2·10	2·00	1·90
7409	0·20	0·19	0·18	7476	0·44	0·43	0·42	74161	2·10	2·00	1·90
7410	0·18	0·17	0·16	7480	0·74	0·71	0·64	74162	4·40	4·15	3·85
7411	0·28	0·27	0·26	7481	1·30	1·25	1·20	74163	4·40	4·15	3·85
7412	0·39	0·34	0·31	7482	0·96	0·95	0·94	74164	2·20	2·10	2·00
7413	0·32	0·31	0·30	7483	1·20	1·15	1·05	74165	2·20	2·10	2·00
7416	0·48	0·44	0·42	7484	1·10	1·05	1·00	74166	3·20	3·10	3·00
7417	0·48	0·44	0·42	7485	3·50	3·40	3·30	74174	2·50	2·40	2·30
7420	0·18	0·17	0·16	7486	0·35	0·34	0·33	74175	1·75	1·65	1·55
7422	0·55	0·53	0·50	7489	4·00	3·75	3·50	74176	1·85	1·75	1·65
7423	0·55	0·53	0·50	7490	0·74	0·71	0·64	74177	1·85	1·75	1·65
7425	0·55	0·53	0·50	7491	1·10	1·05	1·00	74180	1·50	1·40	1·30
7426	0·50	0·46	0·44	7492	0·74	0·71	0·64	74181	5·00	4·50	4·00
7427	0·50	0·46	0·44	7493	0·74	0·71	0·64	74182	2·00	1·90	1·75
7428	0·55	0·53	0·50	7494	0·85	0·82	0·75	74184	3·20	3·10	3·00
7430	0·18	0·17	0·16	7495	0·85	0·82	0·75	74190	2·15	2·10	2·00
7432	0·50	0·46	0·44	7496	0·96	0·93	0·86	74191	2·15	2·10	2·00
7433	0·75	0·73	0·70	74100	1·50	1·45	1·40	74192	2·15	2·10	2·00
7437	0·70	0·68	0·65	74104	1·07	1·04	1·00	74193	2·15	2·10	2·00
7438	0·70	0·68	0·65	74105	1·07	1·04	1·00	74194	2·98	2·86	2·75
7440	0·18	0·17	0·16	74107	0·44	0·42	0·40	74195	2·00	1·95	1·90
7441	0·74	0·71	0·64	74110	0·60	0·55	0·50	74196	1·95	1·90	1·85
7442	0·74	0·71	0·64	74111	1·38	1·27	1·21	74197	1·95	1·90	1·85
7443	1·20	1·15	1·10	74118	1·10	1·05	1·00	74198	5·00	4·75	4·50
7444	1·20	1·15	1·10	74119	1·50	1·40	1·30	74199	5·00	4·75	4·50
7445	1·98	1·95	1·90	74121	0·50	0·48	0·45				
7446	1·20	1·15	1·10	74122	1·50	1·45	1·40				
7447	1·10	1·07	1·05	74123	3·00	2·90	2·80				
7448	1·10	1·07	1·05	74141	0·85	0·82	0·79				
7450	0·18	0·17	0·16	74145	1·65	1·55	1·45				

Devices may be mixed to qualify for quantity price. (TTL 74 series only.) Data is available for above series of ICs in book form. Price 35p.

-the lowest prices!

BRAND NEW TEXAS GERM. TRANSISTORS
Coded and Guaranteed

Pak No.		EQVT
T1	8 2G3713	OC71
T2	8 D1374	OC75
T3	8 D1216	OC81D
T4	8 2G381T	OC81
T5	8 2G382T	OC82
T6	8 2G344B	OC44
T7	8 2G345B	OC45
T8	8 2G378	OC78
T9	8 2G399A	2N1302
T10	8 2G417	AF117

All 55p each pak

ND120 NIXIE DRIVER TRANSISTOR.
Suitable replacement for BSX21. C407, 2N1893 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 Quantity.

GP100 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+
0·48	0·44	0·40

GP300 TO3 METAL CASE SILICON
Vebo = 100V. Veco = 60V I.C. = 15 amps. Ptot = 115W. hfe = 20. 100fT. = 1MHz. Suitable replacement for 2N3055, BDY11 or BDY20.

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.

UT46 UNIJUNCTION TRANSISTORS
Direct replacement for TIS 43rand BEN 3000 also electrically equivalent to 2N2646

1	25	100+
0·30	0·28	0·22

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8. BSY-27/28/95A. All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p
20	For	0·55
50	For	1·10
100	For	1·92
500	For	8·25
1000	For	14·30

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

Ideal for Organ Builders.

R2400 TO3 NPN SILICON HIGH VOLTAGE
Vebo = 250V. Vceo = 100V. I.C. = 6 amps. Ptot = 30W. hfe = typ. 20 fT = 5MHz.

1	25	100+
0·55	0·50	0·44

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

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

SILICON PHOTO TRANSISTOR. TO-18 Lens end NPN Sim. to BPX25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1-24	25-99	100up
Price each	44p	40p	38p

QUALITY TESTED SEMICONDUCTORS

Pak No.			Price £p
Q 1	20	Red spot transistors *pnp*	0·55
Q 2	16	White spot R.F. transistors *pnp*	0·55
Q 3	4	OC77 type transistors	0·55
Q 4	6	Matched transistors OC44/45/81/81D	0·55
Q 5	4	OC75 transistors	0·55
Q 6	5	OC72 transistors	0·55
Q 7	4	AC128 transistors *pnp* high gain	0·55
Q 8	4	AC126 transistors *pnp*	0·55
Q 9	7	OC81 type transistors	0·55
Q10	7	OC71 type transistors	0·55
Q11	2	AC127/128 Complementary pairs *pnp/npn*	0·55
Q12	3	AF116 type transistors	0·55
Q13	3	AF117 type transistors	0·55
Q14	3	OC171 H.F. type transistors	0·55
Q15	7	2N2926 Sil. Epoxy transistors mixed colours	0·55
Q16	2	GET880 low noise Germanium transistors	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	OC44 Germanium transistors A.F.	0·55
Q21	4	AC127 *npn* Germanium transistors	0·55
Q22	20	NKT transistors A.F. R.F. coded	0·55
Q23	10	OA202 Silicon diodes sub-min.	0·55
Q24	8	OA81 diodes	0·55
Q25	15	IN914 Silicon diodes 75PIV 75mA	0·55
Q26	8	OA95 Germanium diodes sub-min IN69	0·55
Q27	2	10A 600 PIV Silicon rectifiers IS425R	0·55
Q28	2	Silicon power rectifiers BYZ13	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 300MHz *npn*	0·55
Q37	3	2N3053 *npn* Silicon transistors	0·55
Q38	7	*pnp* transistors 4 × 2N3703, 3 × 2N3702	0·55

ELECTRONIC SLIDE-RULE
The MK Slide Rule, designed to simplify Electronic calculations features the following scales:— Conversion of Frequency and Wavelength. Calculation of L, C and fo of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and "e" Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 22cm × 4cm. Complete with case and instructions. Price each: £3·69

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-33V. 400mV (DO-7 Case) 12p ea. 1½W (Top-Hat) 18p ea. 10W (SO-10 Stud) 32p ea.

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		Description	Price
U 1	120	Glass Sub-Min. General Purpose Germanium Diodes	0·55
U 2	60	Mixed Germanium Transistors AF/RF	0·55
U 3	75	Germanium Gold Bonded Sub-Min. like OA5, OA47	0·55
U 4	40	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	25	PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·55
U12	12	Silicon Rectifiers Epoxy 500mA up to 800 PIV	0·55
U13	30	PNP-NPN Sil. Transistors OC200 & 2S 104	0·55
U14	150	Mixed Silicon and Germanium Diodes	0·55
U15	25	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	25	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	30	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	300MHz NPN Silicon Transistors 2N708, BSY27	0·55
U26	30	Fast Switching Silicon Diodes like IN914 Micro-Min.	0·55
U27	12	NPN Germanium AF Transistors TO-1 like AC127	0·50
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	1·15
U30	15	Plastic Silicon Planar Trans. NPN 2N2926	0·55
U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·55
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	25	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 400MHz 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
U41	25	RF Germanium Transistors TO-5, OC45, NKT72	0·55
U42	10	VHF Germanium PNP Transistors TO-1 NKT667, AF117	0·55
U43	25	Sil. Trans. Plastic TO-18 A.F. BC113/114	0·55
U44	20	Sil. Trans. Plastic TO-5 BC115/NPN	0·55
U45	7	3A SCR. TO66 up to 600PIV	1·10

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

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

	PIV	50 £p	100 £p	200 £p	400 £p	600 £p	800 £p
1A	TO5	0·22	0·27	0·27	0·32	0·42	0·63
3A	TO66	0·27	0·27	0·32	0·42	0·52	0·70
5A	TO66	0·39	0·52	0·54	0·59	0·75	0·88
5A	TO64	0·39	0·52	0·54	0·62	0·75	0·88
7A	TO48	0·52	0·55	0·62	0·67	0·84	0·99
10A	TO48	0·55	0·63	0·67	0·88	1·07	1·32
16A	TO48	0·58	0·62	0·67	0·77	0·97	1·50
30A	TO48	1·27	1·54	1·76	1·93	—	4·40

SIL. RECTS. TESTED

PIV	300mA DO7	750mA SO16	1A Plastic	1·5A. SO16	3A SO10	10A SO10	30A TO48
50	0·05	0·06	0·05	0·08	0·15	0·21	0·60
100	0·05	0·07	0·06	0·10	0·17	0·23	0·75
200	0·06	0·10	0·07	0·12	0·22	0·25	1·00
400	0·08	0·15	0·08	0·15	0·30	0·38	1·85
600	0·09	0·17	0·10	0·18	0·36	0·45	1·90
800	0·12	0·19	0·11	0·20	0·38	0·55	2·10
1000	0·14	0·30	0·12	0·25	0·48	0·65	2·50
1200	—	0·35	—	0·30	0·58	0·75	3·00

POST OFFICE TELEPHONE DIALS 60p each

F.E.T.'S

2N3819	31p	2N5458	35p
2N3820	55p	2N5459	44p
2N3821	30p	BFW10	66p
SN3823	31p	MPF105	41p

CADMIUM CELLS
ORP12 48p

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

DIACS
FOR USE WITH TRIACS.
BR100 (D32) 41p each

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

TRIACS

VBOM	2A TO-6	6A TO-66	10A TO-48
	£p	£p	£p
100V	38	55	83
200V	55	66	99
400V	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	UIC86 = 5 × 7486	0·55
UIC01 = 12 × 7401	0·55	UIC48 = 5 × 7448	0·55	UIC90 = 5 × 7490	0·55
UIC02 = 12 × 7402	0·55	UIC50 = 12 × 7450	0·55	UIC91 = 5 × 7491	0·55
UIC03 = 12 × 7403	0·55	UIC51 = 12 × 7451	0·55	UIC92 = 5 × 7492	0·55
UIC04 = 12 × 7404	0·55	UIC53 = 12 × 7453	0·55	UIC93 = 5 × 7493	0·55
UIC05 = 12 × 7405	0·55	UIC54 = 12 × 7454	0·55	UIC94 = 5 × 7494	0·55
UIC06 = 8 × 7406	0·55	UIC60 = 12 × 7460	0·55	UIC95 = 5 × 7495	0·55
UIC07 = 8 × 7407	0·55	UIC70 = 8 × 7470	0·55	UIC96 = 5 × 7496	0·55
UIC10 = 12 × 7410	0·55	UIC72 = 8 × 7472	0·55	UIC100 = 5 × 74100	0·55
UIC20 = 12 × 7420	0·55	UIC73 = 8 × 7473	0·55	UIC121 = 5 × 74121	0·55
UIC30 = 12 × 7430	0·55	UIC74 = 8 × 7474	0·55	UIC141 = 5 × 74141	0·55
UIC40 = 12 × 7440	0·55	UIC76 = 8 × 7476	0·55	UIC151 = 5 × 74151	0·55
UIC41 = 5 × 7441	0·55	UIC80 = 5 × 7480	0·55	UIC154 = 5 × 74154	0·55
UIC42 = 5 × 7442	0·55	UIC81 = 5 × 7481	0·55	UIC193 = 5 × 74193	0·55
UIC43 = 5 × 7443	0·55	UIC82 = 5 × 7482	0·55	UIC199 = 5 × 74199	0·55
UIC44 = 5 × 7444	0·55	UIC83 = 5 × 7483	0·55	UICXI = 25 Assorted 74's	1·65
UIC45 = 5 × 7445	0·55				

Paks 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 ,,
400 v RMS	50p ,,

Size 16 mm × 16 mm.

D1699 NPN SILICON DUAL TRANSISTOR (Similar to 2N2060)

1	25	100+
0·28	0·26	0·23

BIP 19/20 TO3 NPN PLASTIC SILICON
Vebo = 100V. Vceo = 50V. I.C. = 10 amps. Ptot 50W. hfe = typ. 100 fT = 3MHz.

			BIP 19/20 Matched Pair.		
1	25	100+	1	25	100+
0·38	0·35	0·32	0·66	0·61	0·55

ALL PRICES INCLUDE V.A.T.

All prices include V.A.T. *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 11p. Overseas add extra for airmail. Minimum order 55p. Cash with order please.

Guaranteed Satisfaction or Money Back

P.E. RONDO

FULL SPECIFICATION KITS

Complete designer approved kits. Full data and even solder included. Top quality PCBs and components.

- **CBS-SQ DECODER £8.** Post Free + 80p VAT.
- **READY BUILT £11.** Post Free + £1 10 VAT.
- **PRE-AMP BOARD, COMPLETE £3.** Post Free + 30p VAT.
- **MASTER VOL/TONE/BAL. BD. £8·50.** Post Free + 85p VAT.
- **POWER AMP BOARD HEATSINK.** Two reqd. for Rondo **£7·50.** Post Free + 75p VAT.
- **POWER SUPPLY BOARD £5.** Post Free + 50p VAT.
- **MAIN SMOOTHING CAPS £1·50** per pair. Post Free + 15p VAT.
- **MAINS TRANSFORMER £6·25.** Post Free + 62p VAT.
- **PUNCHED CHASSIS £3·25.** Post Free + 32p VAT.
- **RONDO CASE £1·75.** Post Free + 17p VAT.
- **HARDWARE PACK £2.** Post Free + 20p VAT.
- **CONTROL SECTION FASCIA £3·50.** Post Free + 35p VAT.
- **STEREO DECODER KIT £5·95.** Post Free + 59p VAT.
- **STEREO DECODER BUILT AND TESTED £6·95.** Post Free + 69p VAT.
- **GOLDRING G101/2 TURNTABLE Less Cartridge £22·90.** Post £1.
- **DEUTSCHE ELAC CARTRIDGE STS 144/17 £6·90.** Post Free + 69p VAT.
- **READY BUILT LOUDSPEAKERS** (Teak or white veneer) per pair **£42.** Post £2 + £4 40 VAT.
- **COMPLETE SPEAKER KIT WITH DRIVE UNITS CROSS OVER WADDING, ETC.** per pair **£35·50.** Post £2 + £3 75 VAT.
- **COMPLETE SPEAKER KIT WITH DRIVE UNITS CROSS OVER WADDING, ETC.** per pair **£82.** Post £4 + £6 60 VAT.
- **BASS DRIVE UNITS** (2 per cabinet) **£4·25** each. Post Free + 42p VAT.
- **TWEETERS** (2 per cabinet) **£1·20** each. Post Free + 12p VAT.

Details of ancillary parts and author's note available soon.

SPECIAL ANNOUNCEMENT!

ADVANCE ELECTRONICS LTD.

have just appointed us distributors for their famous calculators. Details S.A.E. please.

TRADE GLADLY SUPPLIED

STUDIO ELECTRONICS

P.O. BOX No. 18, HARLOW, ESSEX CM18 6SH
Telephone: Harlow (0279) 25457

ORDER—PLEASE SEND

- CBS-SQ DEC ☐
- CBS-SQ DEC BUILT ☐
- PRE-AMP ☐
- MASTER VOL ☐
- POWER AMPS ☐
- POWER SUPPLY ☐
- CAPACITORS ☐
- TRANSFORMER ☐
- RONDO CASE ☐
- HARDWARE ☐
- CONTROL FASCIA ☐
- STEREO DECODER KIT ☐
- STEREO DECODER Built ☐
- BUILT SPEAKER Teak ( ) ☐
- BUILT SPEAKER White ( ) ☐
- BASS DRIVE UNITS ( ) ☐
- TWEETERS ( ) ☐
- COMPLETE SPEAKER KIT White ( ) ☐
- COMPLETE SPEAKER KIT Teak ( ) ☐
- GOLDRING G101 TURNTABLE Less cart. ☐
- ELAC 144 CARTRIDGE ☐
- Notes ☐

Please insert quantity in open brackets

ENCLOSED £........ CHEQUE/P.O.

NAME ....

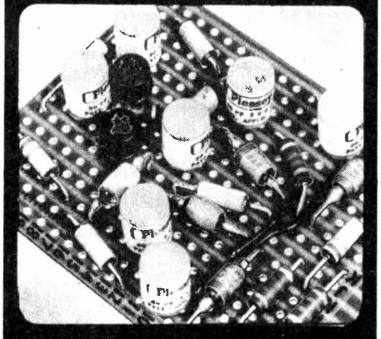
ADDRESS ....

....

....

.... PE 4/4.

VEROBOARD



VEROBOARDS GIVE A PROFESSIONAL FINISH TO YOUR WORK

0.1" and 0.15" pitch, plain and copper clad universal circuit boards.

AVAILABLE FROM YOUR LOCAL RETAILER.

TRADE DISTRIBUTOR N. Rose (Electrical) Ltd., London, W.C.1.

vero

VERO ELECTRONICS LTD.
Industrial Estate, Chandler's Ford,
SO5 3ZR Tel: Chandler's Ford 2952

TELEPRINTER HANDBOOK

AN RSGB PUBLICATION

Price **£5·25**

•

HANDBOOK OF IC CIRCUIT PROJECTS by J. Ashe. Price **£1·50.**

HOW TO USE INTEGRATED CIRCUITS LOGIC ELEMENTS by J. W. Streater. Price **£1·50.**

T.V. ENGINEERS' POCKET BOOK by P. J. McGoldrick. Price **£2·60.**

2nd BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES by B. B. Banbani. Price **£1·05.**

SERVICING WITH THE OSCILLOSCOPE by G. J. King. Price **£2.**

BASIC ELECTRONIC TEST PROCEDURES by I. Gottlieb. Price **£2·15.**

ELECTRONICS POCKET BOOK by J. P. Hawker. Price **£1·70.**

HI FI YEAR BOOK 1974 by C. Sproxton. Price **£1·75.**

BASIC ELECTRONIC CIRCUITS SIMPLIFIED by N. W. Hibbs. Price **£2.**

THE MAZDA BOOK OF PAL RECEIVER SERVICING by D. J. Seal. Price **£4.**

TRANSISTOR AUDIO AND RADIO CIRCUITS by Mullard. Price **£1·90.**

*** ALL PRICES INCLUDE POSTAGE ***

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books

19-21 PRAED STREET
LONDON W2 1NP

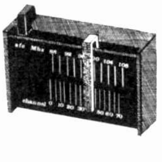
Phone 01-723 4185
Closed Saturday 1 p.m.

SINCLAIR CALCULATORS

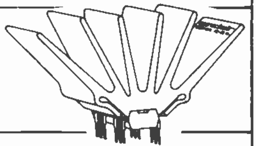
Cambridge Kit **£23·95** (£2·80)
Cambridge Assembled **£25·95** (£3)
Executive **£32·95** (£3·70)
Executive Memory **£39·95** (£4·40)

FERRANTI ZN414
IC radio chip with data **£1·20** (23p) Also available kit of parts to build a MW/LW radio **£2·39** (35p). Send s.a.e. for free leaflet.

SINCLAIR PROJECT 80
AFU **£5·95** (80p)
Z40 **£4·65** (67p)
Z60 **£5·95** (80p)
Q16 **£8·70** (87p)
PZ5 **£4·28** (55p)
PZ6 **£8·98** (92p)
PZ8 **£8·98** (92p)
Decoder **£8·45** (85p)
Tuner **£9·95** (£1·20)
Trans for PZ8 **£2·95** (50p)
Stereo 80 **£9·95** (£1 20)



SINCLAIR SUPER IC12
6W r m s. power
with 44 page
booklet and
printed circuit
£2·10 (43p)



SWANLEY IC TOMORROW
The world's most powerful IC amplifier Similar to the IC12 but rated at 10W r.m.s. power. Supplied with data but no printed circuit **£2·60** (47p)

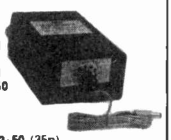
DE LUXE KIT FOR THE IC12
Includes all parts for the printed circuit and volume bass and treble controls needed to complete the mono version **£1·55** (26p) Stereo model with balance control **£3·50** (46p).

IC12 POWER KIT
Supplies 28V 0 5A **£2·47** (50p)

LOUDSPEAKERS FOR THE IC12
5in 8 ohm **£1·10** (27p). 5in x 8in 8 ohm **£1·55** (37p).

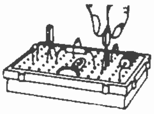
PREAMP KITS FOR THE IC12
Type 1 for magnetic pickups, mics and tuners Mono model **£1·30** (24p) Stereo model **£2·30** (34p). Type 2 for ceramic or crystal pickups Mono **60p** (17p) Stereo **£1·20** (23p).
SEND SAE FOR FREE LEAFLET ON KITS

BATTERY ELIMINATOR BARGAIN
The most versatile battery eliminator ever offered Switched output of 3V, 4·5V, 6V, 7 5V, 9V and 12V att 500mA **£3·75** (60p). Other eliminators stocked, all 50mA: 4½V **£1·50** (30p), 6V **£1·50** (30p); 9V **£1·50** (30p); 7½V cassette type **£2·25** (30p). Double 4½ + 4½V **£2·50** (35p). 6 + 6V **£2·50** (35p). 9 + 9V **£2·50** (35p).



IC RADIO CHIP TBA651
The world's most advanced IC radio chip. Contains RF Amp, oscillator, mixer, IF Amps, wide range AGC circuitry and voltage stabilizer. With data **£2·10** (32p). Send S.A E for free leaflet. A kit of resistors, capacitors and IF filters is available to go with the chip for **£1·75** (29p)

S–DECS AND T-DECS
S–DEC **£1·98** (31p)
T–DEC **£3·63** (47p)
μ–DEC A **£3·99** (51p)
μ–DEC B **£6·99** (81p)
IC carriers
16 dil **£1·77** (25p)
10 T05 **£1·68** (24p)



ZIPPY CABINETS
Attractive plastic instrument cases in 4 sizes P1 80 x 50 x 30mm **60p** (25p). P2 115 x 65 x 40mm **87p** (30p). P3 155 x 90 x 50mm **£1·20** (35p). P4 210 x 125 x 70mm **£1·80** (45p).

ECONOMICAL QUADRAPHONICS **£9·95** (£1·30)
Complete self-contained matrix quadraphonic synthesizer in attractive cabinet. Just feed output of ordinary stereo hi-fi into it and hook up to 4 speakers to obtain the latest experience in sound.

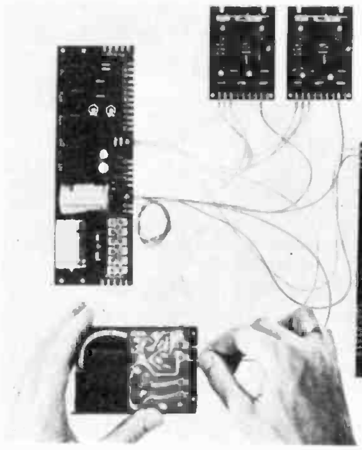
SWANLEY ELECTRONICS

P.O. Box 68, Swanley, Kent, BR8 8TQ

Please add the sum shown in brackets after the price to cover the cost of post and V.A.T. Official credit orders from schools, etc welcome. No V.A.T. on overseas orders which are most welcome.

the economy hi-fi pack

complete down to measured leads-requires no soldering-ready to assemble



Project 605

No other firm has the same experience and manufacturing facilities as Sinclair for the design and production of modules for audio systems. That is why they were able to introduce Project 605 a complete pack produced specially for those wishing to assemble a true high fidelity stereo system at an attractively economical price. In the Project 605 you will find two Sinclair power amplifier modules capable of delivering together 30 watts RMS into 4 ohm loudspeakers, a combined control/pre-amp unit, an A.C. mains power supply unit and the Masterlink unit to which inward and outward connections are made. Wires, colour-coded and tagged with press-on clips make soldering unnecessary. Assembly is straightforward and very easy when you follow the carefully prepared instructions manual. Provision is made for connecting a stereo or mono radio tuner.

FROM DEALERS EVERYWHERE

Specifications
Output – 30 watts music power (10 watts per channel R.M.S. into 3Ω).
Inputs – Mag. P.U. – 3mV. R.I.A.A. correct. Ceramic pick-up, 50mV. Radio – 50 to 150mV. Aux. adjustable between 3mV. and 3V.
Signal to noise ratio – Better than 70dB.
Distortion – Better than 0.2% under all conditions.
Controls – Press buttons for on-off, P.U., radio and aux : Rotary Treble, Bass. Volume and Stereo Balance.
Channel matching within 1dB.
Front panel – brushed aluminium with black knobs.
Project 605 comprises pre-amp/control unit, two power amplifiers, power supply unit. Masterlink, leads and instructions manual complete in one pack. Post free

R.R.P. **£29.95** + £2.99 V.A.T.

sinclair

Sinclair Radionics Ltd, London Rd, St Ives.
Huntingdon PE17 4HJ. St Ives (048 0)6 4311

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

SPECIAL OFFER ! ! !

SMALL ELECTROLYTICS

Ref. No	Capacity	Voltage	Price	Ref. No	Capacity	Voltage	Price
H8/1	1µF	150V	**4p**	H7/4	64µF	15V	**4p**
H8/1A	2µF	150V	**2p**	H7/4A	64µF	35V	**5p**
H8/2	2·2µF	25V	**4p**	H7/5	80µF	16V	**4p**
H8/2A	3·3µF	25V	**4p**	H7/6	100µF	25V	**5p**
H8/3	3µF	50V	**4p**	H7/7	100µF	25V	**4p**
H8/3A	4µF	50V	**4p**	H7/8	125µF	16V	**5p**
H8/4	4·7µF	25V	**4p**	H7/8A	100µF	35V	**6p**
H8/4A	5µF	64V	**4p**	H7/9	100µF	63V	**6p**
H8/5	5µF	10V	**4p**	H7/9A	125µF	4V	**4p**
H8/5A	5µF	150V	**4p**	H7/10	125µF	25V	**6p**
H8/6A	10µF	10V	**4p**	H7/10A	160µF	2·5V	**3p**
H8/7	10µF	70V	**4p**	H7/11	160µF	25V	**6p**
H8/8	16µF	35V	**4p**	H7/11A	150µF	16V	**5p**
H8/8A	16µF	16V	**4p**	H7/13A	200µF	25V	**8p**
H8/9	20µF	6V	**2p**	H7/14	220µF	50V	**10p**
H8/9A	20µF	70V	**4p**	H7/14A	220µF	16V	**6p**
H8/10	22µF	50V	**4p**	H7/15	220µF	25V	**5p**
H8/10A	22µF	100V	**4p**	H7/15A	220µF	35V	**10p**
H8/11	25µF	12V	**4p**	H8/1A	250µF	4V	**3p**
H8/11A	24µF	275V	**4p**	H6/2	250µF	25V	**3p**
H8/12	32µF	15V	**4p**	H6/3A	320µF	2·5V	**3p**
H8/12A	30µF	10V	**4p**	H6/4	320µF	10V	**4p**
H8/13A	32µF	50V	**4p**	H6/4A	330µF	16V	**5p**
H8/14	40µF	25V	**5p**	H6/5	330µF	25V	**10p**
H8/14A	40µF	16V	**4p**	H6/5A	330µF	35V	**15p**
H8/15	47µF	50V	**4p**	H6/8	470µF	25V	**10p**
H8/15A	40µF	35V	**4p**	H6/8A	470µF	35V	**20p**
H7/1	50µF	6V	**3p**	H6/9	500µF	15V	**4p**
H7/1A	50µF	10V	**4p**	H6/9A	400µF	40V	**20p**
H7/2A	64µF	2·5V	**2p**	H6/13A	1000µF	25V	**16p**
H7/3A	64uF	25V	**4p**				

POSTAGE: 15p PER ORDER

ALL GOODS PLUS 10% V.A.T.

MULLARD ELECTROLYTIC CAPACITORS

071 and 072 Series

Type No.	Working Voltage Vdc	Capacitance µF	Max. Ripple Current at 50° C	Weight	Price
071 15332	16	3300	2·4 amps	1oz	**15p**
071 15472	16	4700	3·9 amps	1oz	**17p**
071 15682	16	6800	5·8 amps	1½oz	**22p**
072 15752	16	7500 + 7500	10·5 amps	3oz	**37p**
072 15113	16	11000 + 11000	13·8 amps	4½oz	**49p**
071 16472	25	4700	5·4 amps	1½oz	**22p**
072 16502	25	5000 + 5000	9·6 amps	3½oz	**37p**
072 16752	25	7500 + 7500	12·6 amps	4½oz	**49p**
071 18681	63	680	2·1 amps	1oz	**15p**
106 and 107 Series					
106 16223	25	22000	17 amps	10oz	**£1·12**
106 17103	40	10000	12 amps	7½oz	**94p**
107 10222	100	2200	10 amps	5½oz	**74p**

Type No.	Voltage	Capacitance	Weight	Price
102 15163	16	16000	8oz	**20p**
104 90003	20	39000	16oz	**30p**
102 16802	25	8000	7oz	**25p**
104 90001	45	20000	16oz	**50p**

A further 10% discount on lots of 100 of any one type.

Please calculate the weight of your order and include appropriate postage.

Not over	Ordinary Parcels	Not over	Ordinary Parcels
1½lb	**16p**	10lb	**37p**
2lb	**21p**	14lb	**47p**
4lb	**25p**	18lb	**57p**
6lb	**29p**	22lb	**67p**

UNIJUNCTION TRANSISTORS similar to 2N2646 **25p**

£1 **100 ¼-½ WATT RESISTORS**
100 CERAMIC CAPACITORS
100 DIODES
POSTAGE 15p — PACK No. 1

£1 **1 VERO-BOARD CUTTER**
5 2½in x 1in x 0·15 BOARDS
50 SQ.IN "ODD PIECES" VERO
POSTAGE 15p — PACK No. 3

£1 **20 ASSORTED UNUSED MARKED, TESTED TRANSISTORS BC108, ETC.**
POSTAGE 15p — PACK No. 5

£1 **5 COMPUTER PANELS CONTAINING MASSES OF DIODES, TRANSISTORS, INDUCTORS, RESISTORS AND CAPACITORS**
POSTAGE 25p — PACK No. 7

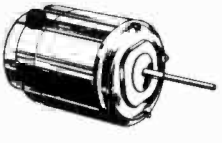
£1 **100 RESISTORS**
100 CERAMIC CAPACITORS
100 POLYSTYRENE CAPACITORS
POSTAGE 15p — PACK No. 2

£1 **100 RESISTORS**
100 CERAMIC CAPACITORS
50 MULLARD POLYESTER CAPACITORS
POSTAGE 15p — PACK No. 4

£1 **1 TRANSISTORISED SIGNAL TRACER KIT**
1 TRANSISTORISED SIGNAL INJECTOR KIT
POSTAGE 15p — PACK No. 6

£1 **100 RESISTORS**
100 CAPACITORS (ASSORTED TYPES)
POSTAGE 15p — PACK No. 8

"SLO-SYN" 3-LEAD SYNCHRONOUS STEPPING MOTOR

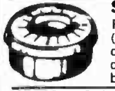


Type SS15. These fine motors are easily reversed, starting and stopping in less than 5° without electrical or mechanical braking. Simple relay circuit can be applied to give DC., to winding for a maximum holding torque of 300oz/in with 35v at 0·35 amps through winding. For AC. (synchronous) operation at 120r., 50Hz. Speed 60 rpm at 60Hz., 72 rpm. STEPPING. Holding torque at 50 steps per second—100 oz/in. Can be wired to give 100 or 200 steps per revolution witn accuracy of 0·1° per step non-cumulative. Torque characteristics can be modified by simple R.C. circuits. Dimensions: dia. 4", body length 4¾", spindle length 2¼" x 5/16" dia. Weight 6½ lbs. BRAND NEW in maker's packing. Offered at less than ½ maker's price OUR PRICE ONLY £15

MAINS SOLENOID by MAGNETIC DEVICES LTD.

A beautifully constructed solenoid at half normal price. A 2-sided bracket is incorporated for vertical or horizontal mounting. Size: 2" x 1½" x 1½". Pull is approximately 2lbs., plunger travel 1¼". Fixing eye takes up to ½" bolt, plunger non-captive. NEW in original maker's boxes. **£1·20**. P. & P. 20p. Large number available, special price for quantity.

SMITHS RINGER-TIMER

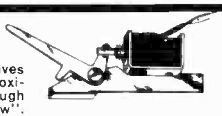


Reliable 15 minute times, spring wound (concurrent with time setting) 15 x 1min divisions, approximately ½" between divisions. Panel mounting with chrome bezel 3¾" dia. **£1·40**. 15p P. & P.

KNOWLE (U.S.A.) MINIATURE MICROPHONE CAPSULES

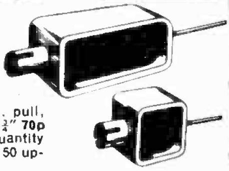
Impedance approx. 200Ω, output 60 or 80 DB at 1 Kc. As used in deaf aids, bugging devices, etc. Size (60 DB) 7/32" x 5/32" x ½"; (80 DB) ⅜" x 5/32" x ⅜". Ex-equipment, all tested. **£1·20** each. P. & P. FREE.

MAINS SOLENOID



This little unit gives vertical lift of approximately 1" through hinged "elbow". Bracket incorporates 2 fixing screws. Length of arm, 2½". 240V AC. Pull at coil is approximately 1lb. **£1**. FREE P. & P. Special quotes for quantities.

SOLENOIDS by WESTOOL



240AC type MM6. 3lb. pull, 2¼" x 1" x 1¼". Travel 1". **90p.** each. P. & P. 10p. 240AC type MM4. 2lb. pull, 1½" x 1¾" x 1". Travel ¾" **70p** each. P. & P. 10p. Quantity discounts: 10-50 10%, 50 upwards 25%.

OPEN FRAME shaded pole GEARED MOTORS

(Dural gear case) 240 AC., 28rpm. NEW HIGH TORQUE, approx. overall size: 3½" x 3¼" x 2¾" + spindle ¼" dia. as Illustrated. **£2·70**. P. & P. 30p. Similar to above, 19rpm. **£2·70**. P. & P. **30p**. 110rpm with pressed steel gear case (similar to above but slightly smaller). **£2·70**. P. & P. 30p.

NORPLEX

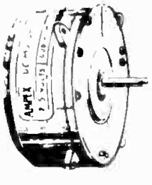
The famous American fibre-glass copper-clad laminate. Finest quality with woven glass base of Epoxy-resin. Excellent Mech. and Elec. conductive properties. Heat resistant, ideal for P.C.'s etc. THIS IS A SPECIAL PURCHASE AND ONLY AVAILABLE WHILE STOCKS LAST! Sizes: 12" x 12"; 24" x 12"; 24" x 24"; FULL SHEET 43" x 37" (11 sq. ft.). Single-sided Copper with thickness of 1/32", 3/64", 3/32". Also double-sided 1/32", 1/16", 3/32". **£1** per sq. ft. Cut sizes (1-10 sq. ft.) 25p. P. & P. Full Sheet **£8** each. Carr. **£1** for 1st sheet plus 25p each additional sheet.

SILVANIA MAGNETIC SWITCH

Now complete with reference magnet!

A magnetically activated switch, vacuum sealed in a glass envelope. Silver contacts, normally closed. Rated 3amp at 120v. 1½amp at 240v. Size: (approx.) 1 7/16" long x ¼" dia. Ideal for burglar alarms, security systems etc., and wherever non-mechanical switching is required. 10 for **£2·10**; P. & P. 15p. 50 for **£8**; 100 for **£16·50**. FREE P. & P. over 10.

AMPEX 7·5v. D.C. MOTOR



This is an ultra precision tape motor designed for use in the AMPEX model AG20 portable recorder. Torque 450GM/CM. Stall load at 500ma. Draws 60ma on run. 600rpm ± speed adjustment. Internal AF/RF suppression. ¼" dia. x 1" spindle, motor 3" dia. x 1⅜". Original cost £16·50. OUR PRICE **£3·30**. P. & P. 25p. Large quantities available (special quotations). Mu-metal enclosure available **75p** each. FREE P. & P.

ALL PRICES NOW INCLUDE V.A.T. UNLESS OTHERWISE STATED

All items are NEW and UNUSED. Postal or carriage charges are for Gt. Britain only. We welcome orders from established companies, educational depts., etc. All orders under £2·50 C.W.O., please. Company orders under £2·50, surcharge 60p unless C.W.O.

ELECTRO-TECH COMPONENTS LTD.

315/317, EDGWARE ROAD,
LONDON, W2.
Tel : 01-723 5667 01-402 5580

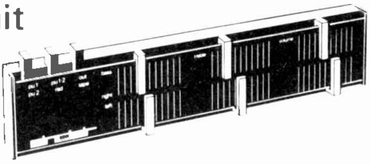
Project 80

the slimmest, most elegant hi-fi modules ever made

2½" high, ¾" deep
Slider controls
New circuitry

Living with hi-fi takes on new meaning with Project 80 modules They can be assembled virtually anywhere, creating opportunities to install systems hitherto only dreamed about and never before made practical. Quality and reliability are everything you could wish for. Units are mounted by 6BA bolts at rear passing through drilled holes, cases are in black with white embellishment

Stereo 80 pre-amplifier and control unit

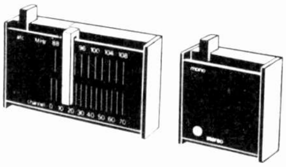


Each channel has independent tone and volume slider controls enabling exceptionally good environmental matching to be obtained A virtual earth input stage forms part of the up-dated circuitry which includes generous overload margins Clear instructions with template are supplied.

Size – 260 × 50 × 20mm (10$\frac{1}{4}$ × 2 × $\frac{3}{4}$ ins)
Inputs – Mag. P.U 3mV RIAA corrected, Ceramic P U, Radio, Tape
S/N ratio – 60db
Frequency range – 10Hz to 25KHz + 3dB
Power requirements – 20 to 35 volts
Outputs – 100mV + AB monitoring for tape
Controls – Press button for tape, radio and P U. Sliders for Volume, Bass and Treble

R R P £11.95 +£1·19 V A T

Project 80 FM tuner and stereo decoder



FM Tuner
Size – 85 × 50 × 20mm
Tuning range – 87.5 to 108 MHz
Detector – I.C. balanced coincidence
AFC – Switchable
One 26 transistor I.C.
Twin dual varicap tuning
Distortion 0.2% at 1 KHz for 30% modulation
4 pole ceramic filter in I.F. section
Sensitivity – 4 microvolts for 30dB quieting
Output – 300mV for 75 KH deviation

Decoder–
With gallium arsenide tuning beacon and 19-transistor I C
Size – 47 × 50 × 20mm

FM tuner R.R.P. £11.95 +£1·19 V A T

Decoder R.R P £7.45 +0·45p V A.T

Project 80 active filter unit

Size – 108 × 50 × 20mm (4$\frac{1}{4}$ × 2 × $\frac{3}{4}$ ins)
Voltage gain – minus 0·2dB
Frequency response – 36Hz to 22KHz, controls minimum
Distortion – at 1 KHz – 0 03% using 30V
HF cut off (scratch) – 22KHz to 5·5KHz, 12dB/oct slope
L.F. cut off (rumble) – 28dB at 20Hz, 9dB/oct slope

R R.P. £6.95 +0·69p V.A.T.

Z.40 & Z.60 power amplifiers

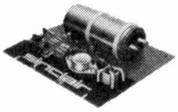
Z.40
Size – 55 × 80 × 20mm
Input sensitivity – 100mV
Output – 15W RMS continuous 8 Ω (35V).
Frequency response – 10Hz – 100KHz ±1dB
Signal to noise ratio – 64dB
Distortion – less than 0·1% at 10W into 8 Ω
Power requirements – 12-35 volts

R R.P £5.45 +0 54p V A.T

Z.60
Size – 55 × 98 × 20mm
Input sensitivity – 100-250mV
Output – 25W RMS 8 Ω (45V)
Distortion – typically 0·03%
Frequency response – 10Hz to more than 200KHz + 1dB
S/N ratio – better than 70dB

R R P. £6.95 +0·69p V A.T

Sinclair power supply units



PZ.8

The worlds most advanced unit in its class. It is a stabilised unit Re-entrant current limiting makes damage from overload or even direct shorting impossible, a principle never before incorporated in a commercially available constructor module Normal working voltage (adjustable) 45V.
R.R P £7·98 + 0·79p V.A T.
Without mains transformer
PZ.5 30V unstabilised
R.R P. £4·98 + 0 49p V A T
PZ.6 35V stabilised
R R P £7·98 + 0·79p V A T.

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 For damage arising from mis use a small charge (typically £1 00) will be made

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 ______________________

____

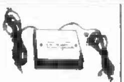
BLOCK LETTERS Apr. 74

sinclair

R O. London Road, St Ives, Huntingdon, PE17 4HJ Phone St Ives (0480) 64311 Reg. No. 699483 England

ELECTRONIC & AUDIO BARGAINS

HILLS HEADPHONE JUNCTION BOX MODEL JB3



For connecting headphones to amplifiers.
OUR PRICE £1·37

VOLUME CONTROLS
5kΩ. 10kΩ. 25kΩ. 50kΩ. 100kΩ. 250kΩ. 500kΩ. 1MΩ:

Lin less switch	15p
Log less switch	15p
Log with switch	27p
Lin stereo less switch	44p

VYNIAR SPEAKER CLOTH
Black or Black and Silver

Sizes: 18in. × 25in.	66p
36in × 25in.	£1·10
36in. × 50in.	£2·20

Send 7p stamp for our samples of Vynlar and Audio Components Catalogue.

SOLDERING IRONS

CCN240	15 Watt	£1·99
X25	25 Watts	£1·65
Replacement Elements		£1·10
Replacement Bits		38p
ST3	Stand	96p

SWITCHES

Small Slide Switch	10p
Large Slide Switch	10p
SPST Toggle Switch	16p
DPDT Toggle Switch	20p
Small (Biased) Push to Test Switch	10p

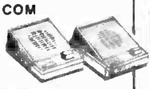
VEROBOARD

	0·1	0·15	Plain 0·15
2·5in × 3·75in	21p	17p	11p
2·5in × 5in	25p	24p	12p
3·75in × 3·75in	26p	24p	—
3·75in × 5in	29p	28p	19p
Spot Face Cutter	39p	39p	
Pin Insertion Tool	50p	50p	

HILLS DYNAMIC HEADPHONES MODEL H101VSM

Extremely high quality with padded Headband and Earcups with Volume Controls and Mono Stereo Switching.
OUR PRICE £4·50.
P/P 30p.

"HOMMER" INTERCOM



2 Station inc. Volume Control On-Off Switch. Batteries & 66ft of Cable
OUR PRICE £3·70

TRANSFORMERS (Miniature)

Prim.	Sec.			
250V	0–6V	0–6V	280mA	£1·35
250V	0–12V	0–12V	150mA	£1·35

CASSETTE TAPE RECORDER DYNAMIC MICROPHONE with Remote Control On-Off Switch.
OUR PRICE £1·60

SPEAKERS

6 × 4 Std. Magnet 8Ω	£1·10
7 × 4 Std. Magnet 3Ω	£1·10
8 × 5 Std. Magnet 8Ω & 3Ω	£1·26

ALUMINIUM BOXES

HB1	5½" × 2½" × 1½"	42p
HB2	4" × 4" × 1½"	41p
HB3	4" × 2½" × 1½"	41p
HB4	5½" × 4" × 1½"	47p
HB5	4" × 2½" × 2"	41p
HB6	3" × 2" × 1"	34p
HB7	7" × 5" × 2½"	66p
HB8	8" × 6" × 3"	84p
HB9	6" × 4" × 2"	54p

VISIT OUR TRADE COUNTER
ALL CALLERS WELCOME
MON.—SAT. 9 a.m. till 5.30 p.m.

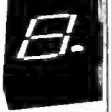
HILLS COMPONENTS LTD.

**ALL PRICES INCLUDE V.A.T.
Please add 10% for P/P.
Min. Order £1·00**

DEPT. (PE4), UNIT NO. 6,
MELINITE INDUSTRIAL ESTATE,
BRIXTON ROAD, WATFORD, HERTS. WD2 5SL. Tel. Watford 27711

TRAMPUS

MONEY BACK IF NOT SATISFIED
all brand new, full spec. Top grade.
Free fabulous NEW catalogue. Send S.A.E.



red+ data ⅛" pin source **LED's 17p! Til209** & clip 22p
BIG ¼ panel clip & RED LED 28p. GREEN & clip 59p
INFRA RED LED £1. IC photo amp 44p. & amp/switch 85p

Digital Display LED ⅓" 0-9DP.DIL. **£1·69**
Minitron type 0-9dPDIL £1·19. SOCKETS 13p.

Calculator batt/mains from £25

IC DIGITAL CLOCK CHIPS.
Texas etc with 4 displays £12. 6 displays & chip £14. pcb £1·49
Mostek date & alarm chips with 6 displays £19.
kit: All parts & case. National chip. 4 digit £20. 6x £23.

GAS sensor TGS308 £2
KIT £4·69
fully built £8

with data **integrated circuits**
741: 8pin 29p, to99 & 14pin 27p 748 33p 709 21p
710 35p 723 59p. 555 timer 79p ZN414 rx. £1·10
703 rf if 28p mc1310 & led £2·76 mc1339 £1·20 TAD100 & if £2
1AMP+ REGULATOR 7805, 5(&7-20)V. also 12 & 15V £1·49
AUDIO AMPS: mfc4000 50p; 1&2W £1·19; 3W £1·29; 6W...

74n TTL low prices.

gates 7400 etc 16P 7413 32P 7447 £1·25
7470/72 32P 7474/76 39P 7490 63P
7492 69P 74121 49P. & all others in cat.
NEW 16pin counter/driver 90/47 £2·25 DALO p.cb. PEN 69p.
DIL SOCKETS: Profesional / gold P. Pins hi or lo Profile 8,14,16 Pin 13p

2N3055 33p. four £1. BC107, BC108, BC109 all 7p ea
IN914 3p ZENERS BZY88 8p. 1A RECTS 50v 3½P 400v 5p. BRIDGE 20p
FETS: 2N3819 19p 2N3823E 20p 4416E 25P BC182/3/4 10P
BC212/3/4 11p BCY70 13p BD131/2 35p ea. BFY51/2/3 15p TIS43 25p
2N2926 Oy 7p 2N3053 15p 2N3702/3/4/5/6/7/8/9/10/11 all 9p ea
2N3904/6 14p HEATSINKS 5f/TO5 18f/TO18 5p. TO3: 4YL 29p TV3 14p
CAPACITORS 25v10, 50, 100uf 5p. DISCS 4p. PRESETS 5p. CARBON-POTS 11P. Switch+11P. Dual 55P. ULTRASONIC TRANSDUCERS £2 ea
FLUORESCENT LIGHTS, 8W. 13" 12VOLT £2·59

Trampus electronics
ADD 10% VAT TO PRICES. P&P. 10P. CWO.
P.O. BOX 29, BRACKNELL, BERKS.

GIRO NO. 331 7056
C.W.O. only. P. & P. 10p on orders below £5
Discount: £10–10%, £20–15% (except net items)
Export Order enquiries welcome (VAT free)

Official Orders accepted from
Educational & Government Departments
ALL PRICES INCLUDE VAT

SPECIAL RESISTOR KITS

10E12	½W	KIT:	10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%).	£3·10	net
10E12	¼W	KIT:	10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%).	£3·20	net
25E12	½W	KIT:	25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%).	£7·20	net
25E12	¼W	KIT:	25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%).	£7·35	net
20E12	½W	KIT:	20 of each E12 value, 10 ohms—1M, a total of 1220 (METAL FILM 5%).	£7·50	net
15E12	1W	KIT:	15 of each E12 value, 10 ohms—1M, a total of 915 (METAL FILM 5%).	£8·15	net
10E12	2W	KIT:	10 of each E12 value, 10 ohms—1M, a total of 610 (METAL FILM 5%).	£12·65	net

MULLARD POLYESTER CAPACITORS C280 SERIES
250V P.C. Mounting: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 3½p. 0·068μF, 0·1μF, 4½p. 0·15μF, 4½p. 0·22μF, 5½p. 0·33μF, 8p. 0·47μF, 9p. 0·68μF, 11p. 1μF, 15p. 1·5μF, 22p. 2·2μF, 25p.

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.
160V: 0·01μF, 0·015μF, 0·022μF, 2½p. 0·047μF, 0·068μF, 3½p. 0·1μF, 0·15μF, 4½p. 0·22μF, 5p. 0·33μF, 6p. 0·47μF, 7½p. 0·68μF, 11p. 1μF, 12½p.

MINIATURE CERAMIC PLATE CAPACITORS
50V: (pF) 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1K, 1K5, 2K2, 3K3, 4K7, 6K8, (μF) 0·01, 0·015, 0·022, 0·033, 0·047, 2½p. each. 0·1, 30V, 4½p.; 0·1; 100V, 5½p.

POLYSTYRENE CAPACITORS 160V 5%
(pF) 10, 15, 22, 33, 47, 68, 100, 150, 220, 330, 470, 680, 1000, 1500, 2200, 3300, 4700, 4p. 6800, 10,000, 4½p.

RESISTORS
CF—High Stab Carbon Film 5% MF—High Stab Metal Film, 5%.

W.	Type	Range	1-9	10-49	50-99	100-249	250-499	500-999	1000+	Size mm
⅛	CF	22-1M	1	0·8	0·65	0·62	0·55	0·5	0·45	2·4 × 7·5
¼	CF	22-2M2	1	0·8	0·65	0·62	0·55	0·5	0·45	3·9 × 10·5
½	CF	22-1M	1	0·8	0·65	0·62	0·55	0·5	0·45	5·5 × 16
¼	MF	10-2M7	1	0·9	0·8	0·7	0·65	0·65	0·6	3 × 7
½	MF	10-2M2	1	0·9	0·8	0·7	0·65	0·65	0·6	4·2 × 10·8
1	MF	10-10M	1·5	1·25	1·25	1·1	1	0·95	0·8	6·6 × 18
2	MF	10-10M	3	2·5	2·5	2	1·75	1·75	1·6	8 × 17·5

For value mixing prices, please refer to our catalogue. (price in pence each)
VALUES AVAILABLE—E12 Series only. Net prices above 100.

PRESET SKELETON POTENTIOMETERS
MINIATURE 0·25W Vertical or horizontal 6p each
1K, 2K2, 4K7, 10K, etc. up to 1MΩ
SUB-MIN 0·05W Vertical, 100Ω to 220KΩ 5p each

Wavechange Switches
1P, 4W; 1P, 12W; 2P, 2W
2P, 4W; 2P, 6W; 3p, 3W
4P, 2W; 3P, 4W; 4P, 3W
26½p

B. H. COMPONENT FACTORS LTD.

(P.E.) 61 CHEDDINGTON ROAD, PITSTONE,
NR. LEIGHTON BUZZARD, BEDS, LU7 9AQ
Tel.: Cheddington 668446 (Std. Code 0296)
PLEASE WRITE FOR FREE CATALOGUE

Miniature Mullard Electrolytics

1·0μF	63V	6p	68μF	16V	6p
1·5μF	63V	6p	68μF	63V	12p
2·2μF	63V	6p	100μF	10V	6p
3·3μF	63V	6p	100μF	25V	6p
4·0μF	40V	6p	100μF	63V	14p
4·7μF	63V	6p	150μF	16V	6p
6·8μF	63V	6p	150μF	63V	15p
8·0μF	40V	6p	220μF	6·4V	6p
10μF	16V	6p	220μF	10V	6p
10μF	25V	6p	220μF	16V	8p
10μF	63V	6p	220μF	63V	21p
15μF	16V	6p	330μF	16V	12p
15μF	63V	6p	330μF	63V	25p
16μF	40V	6p	470μF	6·4V	9p
22μF	25V	6p	470μF	40V	20p
22μF	63V	6p	680μF	16V	15p
32μF	10V	6p	680μF	40V	25p
33μF	16V	6p	1000μF	16V	20p
33μF	40V	6p	1000μF	25V	25p
32μF	63V	6p	1500μF	6·4	15p
47μF	10V	6p	1500μF	16V	25p
47μF	25V	6p	2200μF	10V	25p
47μF	63V	8p	3300μF	6·4	26p

VEROBOARD	0·1	0·15
2½ × 5"	28p	28p
2½ × 3¾"	26p	19p
3¾ × 5"	32p	33p
3¾ × 3¾"	28p	28p
2½ × 1"	7p	7p
2½ × 5" (Plain)	—	14p
2½ × 3¾" (Plain)	—	12p
5 × 3¾" (Plain)	—	22p
Insertion tool	59p	59p
Track Cutter	44p	44p
Pins, Pkt. 25	10p	10p

TRANSISTORS

AC127	16½p	BC212L	12p
AC128	22p	BC213L	12p
BC107	11p	BC214L	17p
BC108	12p	OC44	18p
BC109	13p	OC71	13p
BC148	12p	OC81	16p
BC149	12p	OC170	23p
BC182L	12p	TIS43	33p
BC183L	12p	2N2926	11p
BC184L	13p	2N3702	11p

POTENTIOMETERS
Carbon Track 5K Ω to 2M Ω, log or lin. Single, 16½p. Dual Gang 46p. Log Single with Switch 26p. Slider Pots. 10K, 100K, 500K. 30mm, 34p. 45mm, 47p. 60mm, 55p.

DIODES	
IN4001	6½p
IN4002	7½p
IN4003	9p
IN4004	9½p
IN4005	12p
IN4006	14p
IN914	7p
IN916	7p
BA100	10p
OA5	42p
OA47	9p
OA81	11p
OA200	8p

PLUGS	
DIN 2 Pin	12p
3 Pin	13p
5 Pin 180°	15p
Std. Jack	14½p
2.5mm Jack	11p
Phono	5½p

SOCKETS	
DIN 2 Pin	10p
3 Pin	10p
5 Pin 180°	12p
Std. Jack	14½p
2.5mm Jack	11p
Phono	5½p

ELECTROLYTIC CAPACITORS. Tubular & Large Cans
(uF/V): 2·2/25, 2·2/63, 4·7/10, 4·7/25, 4·7/63, 22/10, 22/25, 22/63, 5p. 2/10, 10/10, 50/10, 100/10, 10/25, 50/25, 10/50, 5½p. 200/10, 100/25, 50/50, 6½p. 500/10, 200/25, 100/50, 9p. 1000/10, 500/25, 200/50, 11p. 2000/10, 1000/25, 500/50, 16½p. 1000/50, 39p. 1000/100, 66p, 2000/25. 27p. 2500/12, 17p. 2500/25. 33p. 2500/50, 62p. 3000/50, 72p. 5000/25, 66p. 5000/50, 94p. 7000/50, 60p. 25,000/25, 74p. HI-VOLT: 8/350, 14p. 16/350, 19p. 32/350, 25p. 50/250, 18p 100/500, 33p.

METALLISED PAPER CAPACITORS
250V: 0·05μF, 0·1μF 4½p, 0·25μF, 5½p, 0·5μF, 6½p, 1μF, 9p.
500V: 0·025μF, 0·05μF, 4½p. 0·1μF, 5½p. 0·25μF, 6½p. 0·5μF, 9p.
1000V: 0·01μF, 10p. 0·022μF, 12p. 0·047μF, 0·1μF, 16p. 0·22μF, 31p, 0·47μF, 39p.

Integrated Circuits	
μA709C	50p
μA741C	55p
μA723C	£1
μL914	35p

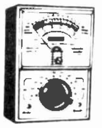
Screened Wire, Metre	5½p
Twin Screened Wire, Metre	10p
Stereo Screened Wire, Metre	10p
Connecting Wire, All colours, Metre	2½p
Neon Bulb, 90V Wire Ended	5 for 24p
Panel Neon, 240V, Red, Amber, Clear	16½p

QUANTITY DISCOUNT
SPECIAL BULK BUY PRICES ARE AVAILABLE BY QUOTATION FOR LARGE PROJECTS AND TRADE

LASKYS

INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

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 £2.95 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, (5000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x 100. –10 to +16dB Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm

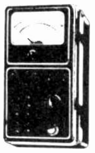
OUR PRICE £3.50 P&P 15p

MODEL C1092 MULTIMETER

Features 5,000 opv jewel movement and a good selection of range functions. Edgwise ohms adjustment. Ranges:– 0–3/15/150 300/1,200V AC (2,500 opv). 0–6/30/300/600 V DC (5,000 opv). DC current. 0–300uA/300mA. Resistence: R x 10, R x 1,000. –10 to +16dB. Complete with battery, test leads and data booklet. Size: 120 x 73 x 28mm.

OUR PRICE £3.75 P&P 35p

MODEL U437 MULTIMETER



10,000opv. A first class, instrument manufactured in USSR to the highest standards. Ranges: 2.5/10/50/250/500/1000V DC. 2.5/10/50/250/500/1000V AC. DC current 100uA/1/10/100mA/1A. Resistence 300 ohms/3/30/300k/3 Meg. ohms. Complete with batteries, test leads, instructions and a sturdy steel carrying case.

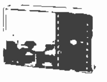
OUR PRICE £4.95 P&P25p

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&P 15p

U4323 MULTIMETER



20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance: 5/50/500 ohms/5/10/100k ohms/1Meg. Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.

OUR PRICE £7.00 P&P 20p

MODEL TE300

30,000opv. Mirror scale. Overload protection. 0/0.6/3/15/60/300/1200V DC. 0/6/30/120/600/1200V AC. 0/30uA/6mA/60mA/300mA/600mA. 0/8k/80k/800k/8 Meg ohms. –20 to +63dB.

OUR PRICE £7.50 P&P 15p

ALL PRICES EXCLUDE VAT

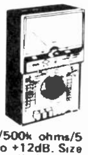
Also see following pages

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 20p

U4324 MULTIMETER



High sensitivity, overload 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.

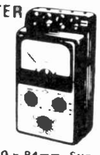
OUR PRICE £8.00 P&P 20p

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 £8.50 P&P 17p

U435 MULTIMETER



20,000opv. Overload protected. 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: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm Supplied complete with leads, crocodile clips and steel carrying case.

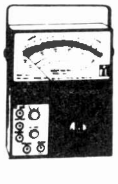
OUR PRICE £8.75 P&P 20p

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 25p

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 £13.95 P&P 25p

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 20p

MODEL 500

30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms

OUR PRICE £10.95 Carr paid

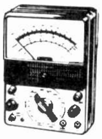
Leather case for above £1.75

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

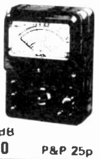
KAMODEN HM720B FET VOM



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 £14.95 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 £17.50 P&P 25p

TE40 HIGH SENSITIVITY AC VOLTMETER

10 Meg input. 10 ranges: 0.001/0.03/0.1/0.3/1/3/11/30/100/300V RMS. 5cps–1.2MHz. –40 to +50dB supplied complete with leads and instructions.

OUR PRICE £17.50 P&P 25p

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.

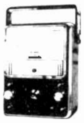
OUR PRICE £49.00 P&P 50p

U4317 MULTIMETER

High sensitivity instrument for field and laboratory work Knife edge pointer, 86mm. mirror scale. 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 20p

Model HT100B4 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 £15.00 P&P 40p

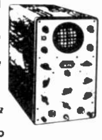
TE65 VALVE VOLTMETER

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 30p

Additional probes available RF £2.12, HV £2.50

CI5 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

LB4 TRANSISTOR TESTER

Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.

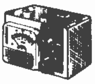
OUR PRICE £4.50 P&P 20p

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 20p

LB3 TRANSISTOR TESTER



Tests ICO and B. PNP/NPN. Operates from 9V battery. Instructions supplied.

OUR PRICE £3.95 P&P 20p

KAMODEN HM350 TRANSISTOR TESTER

High quality instrument to test reverse leak current and DC current. Amplification factor of NPN, PNP, diodes, transistors, SCR's etc. 4" square clear scale meter. Operates from internal batteries. Complete with instructions, leads carrying handle.

OUR PRICE £12.50 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.

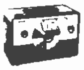
OUR PRICE £15.95 P&P 25p

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 25p

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 40p

ARF 300 AF/RF SIGNAL GENERATOR

All transistorised compact fully portable. AF sinewave 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 £29.95 P&P 50p

AT201 Decade ATTENUATOR

Frequency range 0-200kHz. Attenuator 0–111dB, 0.1dB steps. Impedence 600 ohms. Input power maximum 30dBm. Size: 180 x 90 x 55mm.

OUR PRICE £12.50 P&P 37p

MCA220 Automatic Voltage Stabiliser

Input 88–125V AC or 176–250V AC. Output 120V AC or 240V AC 200V/A rating. P&P 50p

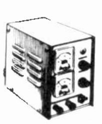
OUR PRICE £11.97

PS1008 Regulated POWER SUPPLY UNIT

Solid state. Output 6, 9 or 12V DC up to 3 Amp. Meter to monitor current. Input 220/240V AC Size: 100 x 82 x 159mm.

OUR PRICE £11.97 P&P 25p

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&P25p

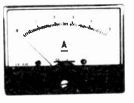
SEW CLEAR PLASTIC PANEL METERS

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.

CLEAR PLASTIC MODEL SO640

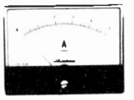
Size: 85 x 64mm



50uA	£3.35		
100uA	£3.30		
200uA	£3.30		
500uA	£3.25		
50-0-50uA	£3.35		
100-0-100uA	£3.30		
1mA	£3.20		
5mA	£3.20		
10mA	£3.20		
50mA	£3.20		
100mA	£3.20	20V DC	£3.20
500mA	£3.20	50V DC	£3.20
1A DC	£3.20	300V DC	£3.20
5A DC	£3.20	15V AC	£3.30
10A DC	£3.20	300V AC	£3.30
5V DC	£3.20	VU Meter	£3.45

CLEAR PLASTIC MODEL SW100

Size: 100 x 80mm



50uA	£4.55		
100uA	£4.35		
500uA	£4.10		
50-0-50uA	£4.35		
100-0-100uA	£4.30		
1mA	£3.95		
1A DC	£3.95		
5A DC	£3.95		
20V DC	£3.95		
50V DC	£3.95	300V AC	£4.00
300V DC	£3.95	VU Meter	£4.75

EDGWISE MODEL PE70

Size: 90 x 34mm

50uA	£4.15
100uA	£3.95
200uA	£3.75
500uA	£3.50
50-0-50uA	£3.95
100-0-100uA	£3.85
1mA	£3.50
300V AC	£3.50
VU Meter	£4.25

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	£7.60		
100uA	£7.05		
50-0-50uA	£7.05		
1A DC	£6.55		
5A DC	£6.55		
5V DC	£6.55	300V DC	£6.55
10V DC	£6.55	500mA/5A DC	£7.70
15V DC	£6.55	5V/50V DC	£7.70
20V DC	£6.55	5V/15V DC	£7.70
50V DC	£6.55	1A/15A DC	£7.70

CLEAR PLASTIC MODEL 85P

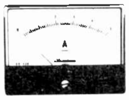
Size: 120 x 110mm

50uA	£4.85		
100uA	£4.70		
200uA	£4.45		
500uA	£4.30		
50-0-50uA	£4.70		
100-0-100uA	£4.45		
500-0-500uA	£4.30		
1mA	£4.30		
1-0-1mA	£4.30		
5mA	£4.30		
10mA	£4.30		
50mA	£4.30		
100mA	£4.30	300V DC	£4.30
500mA	£4.30	15V AC	£4.35
1A DC	£4.30	300V AC	£4.35
5A DC	£4.30	S Meter 1mA	£4.30
15A DC	£4.30	VU Meter	£5.00
30A DC	£4.35	1A AC	* £4.30
10V DC	£4.30	5A AC	* £4.30
20V DC	£4.30	10A AC	* £4.30
50V DC	£4.30	20A AC	* £4.30
150V DC	£4.30	30A AC	* £4.30

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

CLEAR PLASTIC MODEL SD830

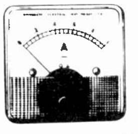
Size: 110 x 83mm



50uA	£3.75		
100uA	£3.70		
200uA	£3.65		
500uA	£3.45		
50-0-50uA	£3.75		
100-0-100uA	£3.70		
1mA	£3.40		
5mA	£3.40		
10mA	£3.40		
50mA	£3.40	10V DC	£3.40
100mA	£3.40	20V DC	£3.40
500mA	£3.40	50V DC	£3.40
1A DC	£3.40	300V DC	£3.40
5A DC	£3.40	15V AC	£3.65
10A DC	£3.40	300V AC	£3.65
5V DC	£3.40	VU Meter	£3.85

CLEAR PLASTIC MODEL 45P

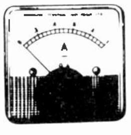
Size: 50 x 50mm



50uA	£3.00		
100uA	£2.85		
200uA	£2.75		
500uA	£2.70		
50-0-50uA	£2.90		
100-0-100uA	£2.75		
500-0-500uA	£2.65		
1mA	£2.65		
5mA	£2.65		
10mA	£2.65		
50mA	£2.65		
100mA	£2.65		
500mA	£2.65	300V AC	£2.70
1A DC	£2.65	S Meter 1mA	£2.75
5A DC	£2.65	VU Meter	£3.00
10V DC	£2.65	1A AC	* £2.65
20V DC	£2.65	5A AC	* £2.65
50V DC	£2.65	10A AC	* £2.65
300V DC	£2.65	20A AC	* £2.65
15V AC	£2.70	30A AC	* £2.65

CLEAR PLASTIC MODEL 38P

Size: 42 x 42mm



50uA	£2.80		
100uA	£2.70		
200uA	£2.65		
500uA	£2.50		
50-0-50uA	£2.75		
100-0-100uA	£2.65		
500-0-500uA	£2.50		
1mA	£2.50		
1-0-1mA	£2.50		
2mA	£2.50		
5mA	£2.50		
10mA	£2.50		
20mA	£2.50		
50mA	£2.50	15V DC	£2.50
100mA	£2.50	20V DC	£2.50
150mA	£2.50	50V DC	£2.50
200mA	£7.50	100V DC	£2.50
300mA	£2.50	150V DC	£2.50
500mA	£2.50	300V DC	£2.50
750mA	£2.50	500V DC	£2.50
1A DC	£2.50	750V DC	£2.50
2A DC	£2.50	15V AC	£2.55
5A DC	£2.50	50V AC	£2.55
10A DC	£2.50	150V AC	£2.55
15A DC	£2.50	300V AC	£2.55
20A DC	£2.50	500V AC	£2.55
3V DC	£2.50	S Meter 1mA	£2.55
10V DC	£2.50	VU Meter	£2.90

CLEAR PLASTIC MODEL SO460

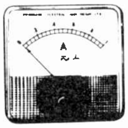
Size: 59 x 46mm

50uA	£3.10		
100uA	£3.05		
200uA	£3.00		
500uA	£2.80		
50-0-50uA	£3.10		
100-0-100uA	£3.05		
1mA	£2.85		
5mA	£2.85		
10mA	£2.85		
50mA	£2.85		
100mA	£2.85	10V DC	£2.85
500mA	£2.85	50V DC	£2.85
1A DC	£2.85	300V DC	£2.85
5A DC	£2.85	15V AC	£3.00
10A DC	£2.85	300V AC	£3.00
5V DC	£2.85	VU Meter	£3.20

POSTAGE & PACKING 15p

CLEAR PLASTIC MODEL 65P

Size: 86 x 78mm



50uA	£4.10		
100uA	£3.45		
200uA	£3.35		
500uA	£3.05		
50-0-50uA	£3.45		
100-0-100uA	£3.40		
500-0-500uA	£2.85		
1mA	£2.85		
5mA	£2.85		
10mA	£2.85		
50mA	£2.85		
100mA	£2.85		
500mA	£2.85	50V AC	£3.10
1A DC	£2.85	150V AC	£3.10
5A DC	£2.85	300V AC	£3.10
10A DC	£2.85	500V AC	£3.10
15A DC	£2.85	S Meter 1mA	£3.15
20A DC	£2.85	VU Meter	£4.10
30A DC	£3.10	1A AC	* £2.85
50A DC	£3.20	5A AC	* £2.85
5V DC	£2.85	10A AC	* £2.85
10V DC	£2.85	20A AC	* £2.85
20V DC	£2.85	30A AC	* £2.85
50V DC	£2.85	50mA AC	* £2.85
150V DC	£2.85	100mA AC	* £2.85
300V DC	£2.85	200mA AC	* £2.85
15V AC	£3.10	500mA AC	* £2.85

BAKELITE MODEL S80 Enlarged Window

Size: 80 x 80mm

50uA	£3.85
100uA	£3.75
500uA	£3.35
50-0-50uA	£3.75
100-0-100uA	£3.65
1mA	£3.00
1A DC	£3.30
5A DC	£3.30
20V DC	£3.30
50V DC	£3.30
300V DC	£3.30
300V AC	£3.30
VU Meter	£4.05

CLEAR PLASTIC MODEL 52P

Size: 60 x 60mm

50uA	£3.85		
100uA	£3.30		
500uA	£2.90		
50-0-50uA	£3.35		
100-0-100uA	£3.25		
1mA	£2.75		
5mA	£2.75		
10mA	£2.75		
50mA	£2.75		
100mA	£2.75		
500mA	£2.75		
1A DC	£2.75		
5A DC	£2.75	S Meter 1mA	£2.85
10V DC	£2.75	VU Meter	£3.95
20V DC	£2.75	1A AC	* £2.75
50V DC	£2.75	5A AC	* £2.75
300V DC	£2.75	10A AC	* £2.75
15V AC	£2.85	20A AC	* £2.75
300V AC	£2.85	30A AC	* £2.75

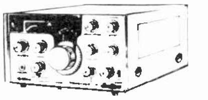
BAKELITE MODEL 65

Size: 80 x 80mm

25uA	£5.05		
50uA	£3.90		
100uA	£3.30		
500uA	£3.00		
50-0-50uA	£3.35		
100-0-100uA	£3.30		
500-0-500uA	£2.85		
1mA	£2.85		
1-0-1mA	£2.85		
5mA	£2.85		
10mA	£2.85		
50mA	£2.85	30V AC	* £2.85
100mA	£2.85	50V AC	* £2.85
500mA	£2.85	150V AC	* £2.85
1A DC	£2.85	300V AC	* £2.85
2A DC	£2.85	500V AC	£2.85
5A DC	£2.85	VU Meter	£4.00
15A DC	£2.85	1A AC	* £2.85
30A DC	£2.85	5A AC	* £2.85
50A DC	£2.85	10A AC	* £2.85
5V DC	£2.85	20A AC	* £2.85
10V DC	£2.85	30A AC	* £2.85
20V DC	£2.85	50A AC	* £2.85
50V DC	£2.85	500mA AC	£2.85
150V DC	£2.85	50mV DC	£3.20
300V DC	£2.85	100mV DC	£3.20

SUPER VALUE TOP QUALITY TRIO equipment

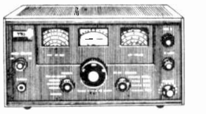
TRIO JR599 RECEIVER



Nine wave-bands covering 1.8–29.7 MHz, 144–146MHz and 10MHz WWV SSB, CW, AM and FM. AF output is more than 1 watt. S Meter. Squelch control. BFO. Variable AF and RF controls. 4–16 ohm output and jack for phones. Power requirement 100/240V AC, 12/14V DC. Size: 270 x 140 x 310mm.

Our Price £132.50 CARR. PAID

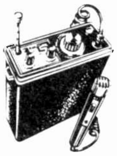
TRIO 9R590S RECEIVER



Four bands covering 550kHz to 30 MHz continuous and electrical band-spread on 10, 15, 20, 40 and 80 mtrs. 8 valve plus 7 diode circuit. 4 to 8 ohm output and phone jack. SSB–CW, ANL, variable BFO. S Meter and separate band spread dial. IF frequency 445kHz, audio output 1½ watt. Variable RF and AF gain controls. 115/250V AC, with instructions.

Our Price £42.50 CARR. PAID

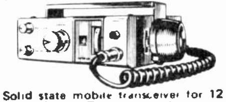
TRIO TR2200 TRANSCEIVER



Fully transistorised portable VHF transceiver Will transmit and receive on six channels between 144–146MHz. 1 watt transmitter. 12V DC internal or external supply. Built-in charger for Ni-Cad cells. Power/volume switch, squelch control, channel selector, mic. socket, earphone/external speaker socket. Complete with microphone and 144.48, 144.72 & 145.32 crystals. Size: 134 x 58 x 180mm.

OUR PRICE £79.50 Carr.paid

BELTEK W5400 CAR TRANSCEIVER



Solid state mobile transceiver for 12 volt DC neg. Transmits and receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: On/off/volume, squelch and channel selector. Internal 3" speaker. Complete with dynamic mic. PTT switch, three sets of crystals for 144.48, 144.6 and 145MHz, mounting bracket and instructions. Size 150 x 70 x 220mm.

OUR PRICE £75.00 P&P 50p

WALKIE TALKIES

SKYFON 100mW

OUR PRICE £24.95 per pair

P302 Two Channel 300mW

OUR PRICE £52.50 per pair

P1003 Three Channel 1 Watt

OUR PRICE £71.25 per pair

P&P 50p per pair

NB. Licence required for use in UK

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

POWER RHEOSTATS

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

25 WATT 10/25/50/100/250/500/1000 Ohms **£1.15** P&P 10p

50 WATT 10/25/50/100/250/500/1000/2500/5000 Ohms. **£1.62** P&P 10p

100 WATT 1/5/10/25/50/100/250/500/1000/2500 Ohms **£2.34** P&P 15p

ALL PRICES EXCLUDE VAT

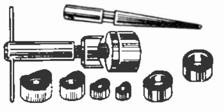
Also see previous page

AUTO TRANSFORMERS

0/115/250V. Step up or step down. Fully shrouded.

80 WATTS	£2.75	P&P 18p
150 WATTS	£3.50	P&P 18p
300 WATTS	£4.50	P&P 23p
500 WATTS	£6.95	P&P 33p
1000 WATTS	£9.50	P&P 38p
1500 WATTS	£12.50	P&P 43p
2250 WATTS	£20.95	P&P 50p
5000 WATTS	£44.95	P&P £1

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

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	30p
2.5A	£12.00	35p
5A	£17.50	37p
8A	£30.35	50p
10A	£33.75	75p
12A	£29.50	75p
20A	£85.00	125p
25A	£95.00	130p
40A	£120.00	150p

MODEL S260B PANEL MOUNTING

1A	£10.00	30p
2.5A	£12.00	35p

BVD5 Vernier TUNING DIAL

App. 7:1 ratio planetary drive vernier dial. Log scale 0–180 degrees. Blank scales 1–5. Dial size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. ¼" diam. shaft

OUR PRICE £1.62 P&P 15p

2 TRANSISTOR RADIO KIT

No Soldering required All connect made with spring clips. Kit includes all parts and wire including ear-piece. Will receive all normal broadcasts on Medium Wave 535–1605kHz. Operates from standard 9V battery or Solar Cell included.

OUR PRICE £1.30 P&P 30p

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 25p

LASKYS

INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

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

TE1018 Deluxe Mono High Impedence Headset.

Sensitive magnetic headset with soft ear pads. Impedence 2,600 ohms (600 ohms DC) Frequency response 200–4,000Hz.

OUR PRICE £2.25 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 HEAOPHONES

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

OUR PRICE £2.60 P&P 30p

SH8DV 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

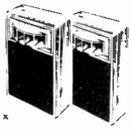
BH001 HEADSET and Boom Microphone

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

OUR PRICE £5.95 P&P 30p

SPECIAL BARGAIN!!

PHONIC 10 Two Way Speakers

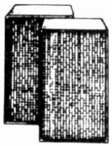


Matched pair of compact book-shelf speakers of unique design Incorporating a 2" high frequency unit & 6" woofer. 8 ohms impedence. Size: 348 x 228 x 110mm.

OUR PRICE £8.85 Pair 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 P&P 50p

AUDIOTRONIC CRITERION SPEAKERS

High quality three way speaker system offering a performance better than more expensive units. Teak finished with dark fronts. Frequency response: 40Hz–20kHz. 8 ohms impedence. Maximum power 20 watts. Size: 476 x 232 x 232mm.

OUR PRICE £27.50 Pr. P&P £1

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.

AE1 100mW output stage	£1.65
AE2 Pre-amplifier	£1.26
AE3 Diode receiver	£2.00
AE4 Flasher	£1.09
AE5 Astable multi-vibrator	£1.05
AE6 Monostable multi-vibrator	£1.02
AE7 RC generator	£1.06
AE8 Bass filter	99p
AE9 Treble filter	99p
AE10 CCIR filter	99p
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	£9.52
AF310 Mono amplifier	£5.91
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	£4.94
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	£6.15
NT300 Stabilised p. supply	£12.51
NT305 Voltage converter	£4.50
NT315 Power supply 240V AC to4,5/15V 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 above.

OUR PRICE £3.30 (No VAT)
P&P 25p plus VAT.

DT55G DIGITAL.CLOCK MECHANISM

Features 24 hour alarm setting. on/off and auto alarm 'sleep switch Illuminated rotary dial with hours, minutes and seconds. Automatically turns off radio, TV, light etc. and with auto-switching will turn on again when required. 240V AC operation. Switch rating 250V–3 Amp.

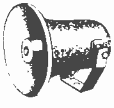
OUR PRICE £5.95 P&P 30p

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 £26.95 PR. P&P £1

RUH6 Reflex Horn Speaker



Built-in driver unit. Impedence 16 ohms. Power rating 10W. Response 380–7000Hz. Size app. 6" x 6" Weather and shock protected.

OUR PRICE £4.97 P&P 30p

RECORD DECKS

P&P 50p

BSR McDONALD	
C114 Mini	£3.95
C129 Mono	£5.50
C137	£7.00
510/TPD	£12.55
610	£11.35
610/TPD	£16.65
710	£22.70
810	£28.30
MP60	£8.90
MP60/ADC K8	£11.50
MP60/TPD	£14.20
HT70	£12.50
HT70/ADC K7E	£15.95
HT70/TPD	£17.80
CONNOISSEUR	
BD1 Kit	£10.20
BD1 Chassis	£12.50
BD2/SAU2/Chassis	£25.50
BD2/SAU2/Plinth/Cover	£32.25
GARRARD	
1025T Stereo	£4.95
2025TC Less cartridge	£6.35
2025TC/KS40A	£6.95
SP25 Mk3	£9.25
SP25 Mk3/G800	£10.95
SP25 Mk4	£10.90
SP25 Mk4/M75–6	£13.90
86SB	£20.00
SL65B	£11.15
SL72B	£17.75
SL95B	£28.00
GOLDRING	
G101 Mk2/P/C	£22.50
GL72	£25.45
GL72P	£33.75
GL75	£32.20
GL75P	£41.65
GL78	£34.60
GL78/P/C	£56.25
GL85/P/C	£72.00

RECORD DECK PACKAGES

BSR McDONALD	P&P 75p
210/SC7M	£7.95
C129	£9.50
MP60/G800	£19.50
MP60/TPD/ADC K8	£16.80
MP60/M44–7	£17.50
HT70/TPD/ADC K7E	£21.25
610/TPD/ADC K8	£19.25
GARRARD	
2025TC/9TA-HC/D	£11.35
SP25 Mk3/G800	£18.15
SP25 Mk3/M44E	£18.25
SP25 Mk3/M44–7	£17.80
SP25 Mk3/M55E	£18.80
SP25 Mk3 Module/M75–6	£19.45
SP25 Mk4/G800	£19.95
SP25 Mk4/AMC50E (M55E)	£21.30
AP76/G800	£26.75
AP76/G800E	£28.95
AP76/M44–7	£27.50
AP76/M44E	£28.00
AP76/M55E	£28.60
AP76/M75ED	£35.20
AP76/M75EJ	£31.20
GOLDRING	
GL72/G800	£35.65
GL75/G800	£40.90
GL75/G800E	£43.35
GL78/G800	£45.65
GL78/G800E	£48.15
G101/P/C/G800	£23.70
RANK DOMUS	
BD2000	£43.60
BA4000	£53.95
BD6000	£67.50
WHARFEDALE	
Linton W30 Teak	£23.90
Linton W30 White	£25.10

AUDIOTRONIC LOW NOISE CASSETTES

TYPE	5	10	25
C60	£1.27	£3.00	£7.08
C90	£2.24	£4.25	£10.00
C120	£2.73	£5.17	£12.24

AUDIOTRONIC CrO2 CASSETTES

TYPE	5	10	25
CR60	£3.92	£7.72	£19.12
CR90	£5.32	£10.46	£25.22

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!

EMI LOUDSPEAKERS

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

OUR PRICE £7.25 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 25p

SINCLAIR CAMBRIDGE CALCULATOR

To build yourself. Complete kit of parts with step by step instructions to build a full specification pocket sized calculator.

OUR PRICE £24.95 P&P free

ALSO AVAILABLE READY BUILT
Recommended Price £29.95

OUR PRICE £27.20 P&P 25p

Also available—

SINCLAIR EXECUTIVE
Recommended Price £39.00

OUR PRICE £35.45 P&P 25p

SINCLAIR EXECUTIVE with MEMORY
Recommended Price £49.00

OUR PRICE £44.50 P&P 25p

SINCLAIR Project 80 Modules

Z40 Power Amplifier	£5.45
Z60 Power Amplifier	£6.95
Stereo 80 Pre-Amplifier	£11.95
Active Filter Unit	£6.95
Project 805	£26.95
PZ5 Power Supply	£4.98
PZ6 Power Supply	£7.98
PZ8 Power Supply	£7.98
Transformer for PZ8	£4.05

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.

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 20p

1021 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.

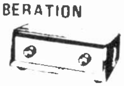
OUR PRICE £2.25 P&P 15p

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

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 20p

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 £9.65 P&P 30p

Stereo multiplex adapter £4.97 extra.

ALL PRICES EXCLUDE VAT

CALL INTO YOUR NEAREST BRANCH OR ORDER WITH CONFIDENCE BY MAIL ORDER

CENTRAL LONDON

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
87 TOTTENHAM CT. RD.	01-580 3739
257/8 TOTTENHAM CT. RD.	01-580 0670
21 OLD COMPTON ST.	01-437 9369
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
378 HARROW RD. W9	01-286 9530

ESSEX

86 SOUTH ST. ROMFORD	70-20218

SURREY

1046 WHITGIFT CENTRE, CROYDON	01-681 3027
27 EDEN ST. KINGSTON	01-546 7845
32 HILL ST. RICHMOND	01-948 1441

KENT

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

LEICESTERSHIRE

45 MARKET PLACE, LEICESTER	0533-537678

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

HEAD OFFICE AND MAIL ORDER DEPARTMENT

AUDIOTRONIC HOUSE,
THE HYDE INDUSTRIAL ESTATE,
THE HYDE, LONDON NW9 6JJ
TELEPHONE: 01-205 3735 & 5651

MAIL ORDER SPECIALISTS
We offer a speedy and efficient service by mail order. Remember to add 10% VAT to total value of goods including carriage and packing and send cash with order to head office. TO AVOID DELAYS PLEASE PRINT NAME AND ADDRESS CLEARLY IN CAPITALS.

BARCLAYCARD & ACCESS
Holders welcome - call into any branch or telephone your order to head office.
CREDIT TERMS available for Personal Shoppers on sales of £50 and over

BARGAIN CENTRE
Many special clearance offers and end of stock lines at 87 TOTTENHAM COURT RD. FOR PERSONAL SHOPPERS.

EXPORT Personal exports arranged for overseas visitors at all our branches. Goods despatched to all parts of the world through our Export Mail Order Department. Immediate attention given to orders.

CHEQUES ACCEPTED FROM PERSONAL SHOPPERS ONLY WITH BANKERS CARD.

All prices correct at 12–2–74 but subject to change.

PART OF THE AUDIOTRONIC GROUP OF COMPANIES

AMAZING MINI·DRILL

FOR PRECISION MODEL WORK

+ 6 TOOLS

Indispensable for precision drilling, grinding, polishing, etching, gouging, shaping. Precision power for the enthusiast. Shockproof. Completely portable power from 4½ volt external battery. So much more scope with MINI-DRILL. Super Kit (extra power, interchangeable chuck) **£6·35** p.p. 13p. De Luxe Professional Kit with 17 tools **£9·40** p.p. 23p. Prices include V.A.T.

Money ref. g'tee. **MERLIN SUPPLY CO.**

Dept. PE4D. Nailsea. Bristol BS19 2LP

F.M.Φ. VARICAP TUNER

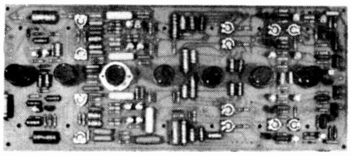
LP1185/86	**£9.00**/pair
MC1310P	**£3.15** each
MFC4060	**78p**
P.C. BOARDS	**£1.87**
READY BUILT BOARDS	**£23.00**
COMPLETE TUNERS IN CABINETS	**£33.00**

NEW! **LP1400 DECODER MODULES**
—LIMITED STOCKS **£4.96**

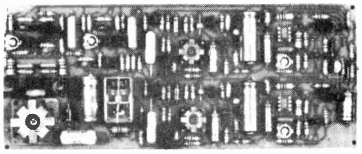
Prices include V.A.T. P. & P. 25p.

B. & B. ELECTRONICS

64 MANNERS ROAD, BALDERTON, NEWARK, NOTTS.
Telephone: NEWARK 6895



PHONOSONICS
PCB's AND KITS



AURORA
Multichannel Sound Controlled Light (PE Apr./Aug. 71). S/c's (excl. SCRs), Rs, Cs, Pots, Cores—8 ch. **£18·42**; 4 ch. **£10·37**. Reg. PSU, **£3·65**. PCB—4 ch. control (4¾in × 10¾in) Mk. 2—also holds rotary or slider pots, **£2·50**. PCB (4¾in × 5in) Mk. 2—for PSU, Sync Gen. 8 cores, 8 SCRs, **£1·30**. SCRs—1A, **75p**.

BIOLOGICAL AMPLIFIER
(PE Jan./Feb. 73). P/A Set—S/c's, i.c.'s, Rs, Cs, Pots, PCB (1½in × 3¾in), **£3·20**. Output Stages—S/c's, Rs, Cs, Pots and Rotary Sw's for Alphaphone, Cardio, Freq. Meter, Vis-Feed, **£3·50**. Set of PCB's for above O/P Stages **£1·20**. Audio Amps: PC7 **£5·20**; EA1000 **£3·30**.

ENLARGER EXPOSURE METER AND THERMOMETER
(PE Sept. 73). S/c's, Thermistor, LDR, Rs, Pots, PCB (2in × 2½in), **£3·90**.

ELECTRONIC PIANO
(PE Sept. 72/Jan. 73). Details in lists.

GEMINI STEREO AMPLIFIER
(PE Nov. 70/Mar. 71). Stereo sets and PCBs. Pre-amp—Rs, Cs, Pots, Sw's—with ½W MO Rs, **£11·32**—with ¼W or ½W CF Rs **£9·60**. PCB (4¼in × 10¾in) **£1·90**. Main Amp—Rs, Cs, Pots, **£5·39**. PCB (3½in × 5in), **£1·15**. PSU—Rs, Cs, Pot, **£3·97**. PCB (2in × 4in), **65p**.

GEMINI STEREO TUNER
(PE Apr./Jun. 72). PCB as publ., **£1·50**.

MICROPHONE MIXER
(PE Apr. 69). S/c's, Rs, Cs, Pots, PCB (3¾in × 4¼in) also holds 6 rotary or 4 slider pots, **£3·70**.

8 WATT AMPLIFIER
(PW Nov./Dec. 72). Pre-amp—S/c's, Rs, Cs, Pots, Sw—Mono, **£2·50**; Stereo, **£5·45**. PCB (3½in × 7½in) (Stereo) also holds rotary or slider pots, and Sw, **£1·50**. Main Amp—S/c's, Rs, Cs, Pot—Mono, **£3·71**; Stereo, **£7·42**. PCB (2½in × 3in) (Mono), **60p**. PSU—**£3·57**.

LOUDHAILER AND SIREN
(Pre-amp and Siren Generator)
(PW Dec. 72). S/c's, Rs, Cs, Pot, PCB (2½in × 2¾in), **£2·20**. (While stocks last.) Main Amp Module PC5+ obtainable to special order, **£6·25**.

REVERBERATION UNIT
(PW Nov./Dec. 72). S/c's, Rs, Cs, Slider Pots, T/fmr, **£7·28**. PCB (2in × 11½in), also holds sliders, **£1·20**. 9in Spring Unit, **£3·75**.

P. & P. 15p | **VAT ADD 10%** | **S.A.E. for FREE LIST**

(THESE TERMS APPLY TO U.K. ONLY—OVERSEAS SEE BELOW)

HI-FI TAPE LINK
(PE Mar./Apr. 73). S/c's, i.c.'s, Rs, Cs, Relay and pc-base, Pot Cores and pc-bases, Sw's, Pots, Panel Lamp—Mono, **£12·78**; Stereo, **£20·41**. PSU, **£3·58**. Main Circuit PCB (3¾in × 9in) Stereo (also holds relay and cores), **£1·95**. Sub-assembly PCB Mk. 2 (2½in × 6½in), **80p**.

PHASING UNIT
(PE Sept. 73). S/c's, Rs, Cs, Pots, PCB (1½in × 2½in), **£2·06**.

PHOTOPRINT PROCESS CONTROL
(PE Jan./Feb. 72). For Colour and B & W—finds exposure, controls timing, stabilises mains voltage. S/c's, SCR, LDR, Rs, Cs, Pots, Relay, Keyswitch, T/fmr, **£7·98**. PCB (3½in × 5½in) also holds pots, Sw, relay, **£1·50**.

SEMICONDUCTOR TESTER
(PE Oct. 73). S/c's, Rs, Cs, Pots, Maka-switches, Sub-assembly PCB, **£5·30**.

ULTRASONIC TRANSMITTER-RECEIVER
(PE May 72). S/c's, Rs, Cs, Pot, Relay, Dual PCB (2in × 5½in), **£4·04**. Transducers excluded.

VIBRASONIC GUITAR PRE-AMP
(PW Sept. 70). Incl. Mic P/A, 2-Guitar P/A, Trem and Tone Controls, Master Volume. S/c's, Rs, Cs, LDR, Rotary Pots, Lamps, Coupling T/fmr, **£6·97**. PCB (3½in × 10¾in) Mk. 2, also holds 7 rotary or slider pots, **£1·75**. PSU **£3·57**.

PROJECT Q4
(PW Oct. 73/Jan. 74). Multisystem Quadraphonic Decoder. S/c's, i.c.'s, Rs, Cs, Pots, Maka-switches, **£9·99**. PSU, **£2·52**. Set of 5 PCB's, **£2·25**.

RONDO
(PE series commencing Sept. 73). Details in lists.

SOUND SYNTHESISER
(PE Feb. 73/Feb. 74). Details in lists.

TAPE NOISE LIMITER
(PE Feb. 72). S/c's, Rs, Cs, Pot, Sw, PCB (1½in × 3in), **£2·30**. Reg. PSU and PCB (1½in × 2½in), **£3·30**.

VERSATILE LIGHT EFFECTS UNIT
Single Channel Sound Controlled Light with built-in variable strobe. (PE Jun. 72). S/c's, Rs, Cs, Pots, T/fmrs, Keyswitch, **£10·38**. PCB Mk. 2 (3½in × 7½in) also holds pots, Sw, coupling t/fmr, **£1·50**. SCR—1A, **75p**.

WIND AND RAIN EFFECTS
(PE Oct. 73). i.c., Rs, Cs, Pots, Special Noise Diode incl. **£1·95**.

MISCELLANEOUS PCBs
LOGICAL RADIO CONTROL (PE Dec. 71/Jan. 72) PCBs "2A", "2B", Decoder, **50p** ea. MODEL SERVO CONTROL (PE Feb./Mar. 72) PCBs "B", Fail-safe, **33p** ea. DIGICAL PSU PCB (PE Aug. 72), **50p**. OSCILLOSCOPE P/A (PE Aug. 72), **33p**. TRIFFID PCB (PE Feb. 73), **60p**.
(Above PCBs as published)
DIGITRONIC (PW Mar. 73) Read-out PCB (1¾in × 3½in), **50p**.

SEMICONDUCTORS

AC128	20p	ORP12	55p
AC176	20p	TIS43	30p
AD161	40p	ZTX107	9p
BC107	13p	ZTX503	14p
BC108	13p	ZTX531	22p
BC109	13p	2N706	13p
BC147	12p	2N914	22p
BC148	12p	2N1304	22p
BC149	12p	2N2219	27p
BC157	12p	2N2905	27p
BC158	12½p	2N3702	12p
BC159	12½p	2N3704	12p
BC182L	12p	2N3819	35p
BC204	14p	2N3823E	39p
BC209c	14p	2N4871	36p
BC212L	16p	2N5777	45p
BCY71	22p	1N914	4p
BFY50	23p	1N4001	6p
BFY52	23p	1N4002	7p
BSY95A	12p	1N4004	10p
MJE2955	111p	1N4005	10p
MJE3055	75p	BA145	23p
OC28	65p		
OC71	14p	OA91	7p
OC84	24p	OA200	8p

ELECTROLYTIC (μF/V)

0·47/63	8p	220/25	10p
1·0/63	6p	220/40	14p
2·2/63	6p	220/63	23p
4·7/63	6p	330/10	6p
6·8/40	6p	470/6·3	6p
10/25	6p	470/10	6p
10/63	6p	470/25	14p
15/40	6p	470/40	20p
22/10	6p	500/64	46p
22/25	6p	680/6·3	10p
33/6·3	6p	680/25	20p
33/16	6p	1000/4	12p
33/40	6p	1000/10	14p
33/50	6p	1000/16	25p
47/6·3	6p	1000/25	25p
47/25	6p	1000/40	40p
47/40	6p	2200/25	45p
47/63	7p	2200/40	50p
100/4	6p	3300/63	130p
100/10	6p	3300/100	360p
100/25	6p	4700/16	60p
100/40	7p	4700/25	75p
100/63	12p	4700/40	93p
150/16	6p		
150/63	12p		
220/10	6p		
220/16	6p		

TANTALUM BEAD

(μF/V)	
0·1/35	12p
0·22/25	12p
0·47/35	12p
1·0/35	12p
1·5/35	16p
2·2/35	12p
4·7/35	12p
10/16	12p
10/25	16p
15/6·3	16p
22/16	16p
47/6·3	16p
100/3	16p

POLYESTER

C280AE	(μF)
0·01	3p
0·015	3p
0·022	3p
0·033	3½p
0·047	3½p
0·068	3½p
0·1	4p
0·15	5p
0·22	5p
0·33	7p
0·47	9p
0·68	11p
1·0	14p

POLYSTYRENE 63V 5% (pF)
10 to 2200pF, **3½p**; 3300 to 8200, **4½p**; 10,000, **5p**.

RESISTORS (E24 SERIES)
¼W, ½W 5% CARBON FILM, 1p; ½W 2% METAL OXIDE, 3½p.

SWITCHES
Maka-switch: Shaft assembly, **54p**; Wafers, **33p**; Screens (per pk. of 5), **12p**; Spacers (per pack of 10), **8p**; DP mains sw. for shaft assy, **30p**. Rotary: 3P4W, 2P6W, **28p** each. Multipole Lever: 4CL/4CL, 4CN/4CL, **£1·30**. Toggle (Std.): SPST, DPDT, **28p**.

OVERSEAS COSTS
LIST: Europe **10p**; Other Countries **20p**. POST AND PACKING on goods will be charged at cost—please state whether surface or air mail required (kit weights are shown in list).
VAT does not apply to export orders.

GENERAL
All PCBs fibreglass, Drilled, Roller-Tinned. Layout and circuit diagram free with PCB. Unless stated "as published" PCBs are designed by Phonosonics. Pots are rotary unless stated as slider. Prices and deliveries subject to stock availability.

PHONOSONICS, DEPT. PE24, 25 KENTISH ROAD, BELVEDERE, KENT DA17 5BW

MAIL ORDER ONLY

ALL OUR PRICES INCLUDE V.A.T.

BSR HI-FI AUTOCHANGER
STEREO AND MONO

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

with STEREO and MONO XTAL **£6·75** Post 25p.

PORTABLE PLAYER CABINET

Modern design. Black rexine covered. Silver front grille. Chrome fittings.

Motor board cut for above BSR deck **£4·50** Post 45p.

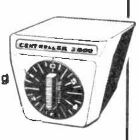
COMPACT PORTABLE STEREO HI-FI

Two full size loudspeakers 13¾ × 10 × 3¾in. Player unit clips to loudspeakers making it extremely compact, overall size only 13¾ × 10 × 8½in., 3 watts per channel, plays all records 33 r.p.m., 45 r.p.m. Separate volume and tone controls. 240V a.c. mains.

Attractive
Teak finish
Weight 13 lb.

Bargain Price
£25
85p carriage

SPECIAL OFFER!
SMITH'S CLOCKWORK 15 AMP TIME SWITCH
0–60 MINUTES



Single pole two-way. Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights, etc. Variable knob. Turn on or off at full or intermediate settings. Makers' last list price £4·50. Brand new and fully guaranteed. Fully insulated.
OUR PRICE £1·65 or £3 pair. Post 25p

WEYRAD P50 — TRANSISTOR COILS

RA2W Ferrite Aerial	85p	Driver Trans. LFDT4	65p
Osc. P50/1AC	40p	Printed Circuit, PCA1	85p
I.F. P50/2CC 470 kc/s	40p	J.B. Tuning Gang	65p
3rd I.F. P50/3CC	40p	Weyrad Booklet	10p
Spare Cores	3p	OPT1	65p

Mullard Ferrite Rod 8 × ⅜in., 20p. 6 × ¼in, 20p. 3 × ¼in, 10p.

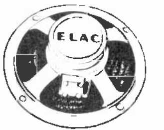
VOLUME CONTROLS

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

80 Ohm Coax 5p yd.

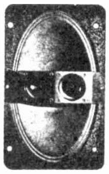
BRITISH AERIALITE
AERAXIAL-AIR SPACED
40 yd, £1·75; 60 yd, £2·60
FRINGE LOW LOSS
Ideal 625 and colour **10p yd**

8in. or 10in. ELAC HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 c/s. Bass resonance 55 c/s. 8 ohm impedance, 8in 10 watts, 10in 12 watts music power. **£3·75** Post 25p

E.M.I. 13½ × 8in. SPEAKER SALE!



With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£4·50** Post 25p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45–60 c/s. Flux 10,000 gauss. **£2·75** State 3 or 8 or 15 ohm. Post 25p

Bookshelf Cabinet 16 × 10 × 9in. **£5·50** Teak finish Post 45p

SET OF 3 MOTORS FOR COLLARO STUDIO 115 VOLT TAPE DECK
£2·50 Post 50p

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in sides 6 × 4in 45p; 8 × 6in 53p; 10 × 7in 85p; 12 × 8in 85p; 14 × 9in 90p; 16 × 6in 90p; 12 × 3in 50p; 16 × 10in £1.
ALUMINIUM BOXES, 3 × 3 × 3in 60p; 4 × 4 × 4in 70p; 6 × 4 × 4in 80p; 9 × 4 × 4in £1; 12 × 4 × 4in £1·30.
ALUMINIUM PANELS 18 s.w.g. 6 × 4in 9p; 8 × 6in 15p; 14 × 3in 16p; 10 × 7in 19p; 12 × 5in 20p; 12 × 8in 28p; 16 × 6in 28p; 14 × 9in 34p; 12 × 12in 40p; 16 × 10in 50p.
PAXOLIN PANEL 10 × 8in 15p.

ANOTHER R.C.S. BARGAIN!
4 TRANSISTOR MONO AMPLIFIER

Powerful 3 watt output, 15 ohm. AC mains operated with transformer. 3-Controls, volume, treble, bass and On/Off switch with knobs. Ready made on printed circuit board. Fused inputs and outputs. Famous make, size 8in wide × 4in deep × 3in high. Suitable 7" × 4" speaker, £1. **£5·95** Post 20p

R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer Input 200/240V a.c. Output voltages available 8 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less
PLEASE STATE VOLTAGE REQUIRED
Details S.A.E. Size 3½ × 1½ × 1¾in. **£2·20** Post 25p

R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9–12V or H.T. line 200–300V d.c. operation. Size: 1¾ x 1½ x ½ in. Response 25 c/s to 25 kc/s. 26 dB gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **99p** Post 20p

ELECTRO MAGNETIC PENDULUM MECHANISM

1·5V d.c. operation over 300 hours continuous on SP2 battery, fully adjustable swing and speed. Ideal displays, teaching electro magnetism or for metronome, strobe, etc. **95p** Post 20p

BRITISH FM/VHF TUNING HEART

88 to 108 M/CS British made. 2 Transistors ready aligned requires 10·7 M/CS I.F. Complete with tuning gang. Connections supplied but some technical experience essential.
Our price £3·95 Post 20p

MAINS TRANSFORMERS
ALL POST 25p each

Eagle MT12 12–0–12V 50 mA	90p
250–0–250 80 mA, 6·3V 3·5A 6·3V 1A or 5V 2A	£2·50
350–0–350 80 mA, 6·3V 3·5A, 6·3V 1A or 5V 2A	£3·00
300-0-300V 120 mA, 6·3V 4A C.T.; 6·3V 2A	£3·95
MINIATURE 200V 20 mA, 6·3V 1A 2½ × 2½ × 2in	75p
MIDGET 220V 45 mA, 6·3V 2A 2½ × 2½ × 2in	90p
HEATER TRANS. 6·3V 1·5A	75p

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V £3·00
1 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £3·00
2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £4·00
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £9·75
5, 8 and 13V; 5 amp. £1·20. 3 amp. 3, 5, 8, 10, 13 and 5–0–5V £1·30, Ditto 5 amp. £1·50; 6–0–6V 500mA 90p 9V 1 amp. 95p, 12V 300mA 75p, 12V 500mA 85p, 12V 750mA 95p, 40V 1 amp. £1·75.
AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W £3·00; 500W £6·25; 750W £10; 1000W £15
CHARGER TRANSFORMERS. Input 200/250V, for 6 or 12V, 1½ amp £1·50; 2 amp £1·80; 4 amp £2·50
BATTERY CHARGERS. Ready built with leads and clips 1½ amp £2; 4 amp £4; 5 amp £4·50.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs, 1½ amp 40p; 2 amp 55p; 4 amp 85p.

MAINS ISOLATING TRANSFORMER

Primary 0–110–240V. Secondary 0–240V. 3A. 720W. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make. (Value £19). OUR PRICE **£10** Carr. 50p
Can be used as 800W auto transformers 240–110V.
IDEAL FOR COLOUR T.V. OR GARDEN TOOLS.

NEW ELECTROLYTIC CONDENSERS

2/350V	14p	250/25V	14p	50 + 50/300V	50p
4/350V	14p	500/25V	20p	60 + 100/350V	85p
8/450V	18p	1000/25V	35p	32 + 32/250V	20p
16/450V	22p	1000/50V	47p	32 + 32/450V	60p
32/500V	50p	8 + 8/450V	22p	350 + 50/325V	55p
25/25V	10p	8 + 16/450V	25p	100 – 50 + 50/350V	55p
50/50V	10p	16 + 16/450V	40p		
100/25V	10p	32 + 32/350V	40p		

LOW VOLTAGE ELECTROLYTICS.
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p.
500mF 12V 15p; 25V 20p; 50V 30p.
1000mF 12V 17p; 25V 35p; 50V 47p; 100V 70p.
2000mF 6V 25p; 25V 42p; 50V 57p.
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.

CERAMIC, 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V–0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p. 500V–0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p.
SILVER MICA. Close tolerance 1%. 2·2–500pF 8p; 560–2,200pF 10p; 2,700–5,600 pF 20p; 6,800pF–0·01, mfd 30p each.
TWIN GANG, "0–0" 208pF + 176pF, 65p; 500pF standard 45p. 365pF + 365pF with 25pF + 25pF, Slow motion drive 50p.
SHORT WAVE SINGLE. 10pF, 30p, 25pF, 55p, 50pF, 55p.
NEON PANEL INDICATORS 250V AC/DC. Amber 20p.
RESISTORS. ¼W, ½W, 1W, 20% 1p; 2W, 5p. 10Ω to 10M.
HIGH STABILITY. ½W 2% 10 ohms to 6 meg., 10p.
Ditto 5%. Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 10p each; 0·5 ohm to 8·2 ohms 10p.
TAPE OSCILLATOR COIL Valve type 35p.

NEW MODEL "BAKER LOUDSPEAKER", 12IN 50 WATT. GROUP 50/12. 8 OR 15 OHM HIGH POWER FULL RANGE PROFESSIONAL QUALITY. **£17·60**

BAKER MAJOR 12" £9·90

Post free
30–14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s. Rated 20W. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£12·50**
Please state 3 or 8 or 15 ohms. Post free

BAKER "BIG-SOUND" SPEAKERS Post free

'Group 25'	'Group 35'	'Group 50'
12in, 25W **£8·80**	12in. 35W **£9·90**	15in. 50W **£22**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK VENEERED HI-FI SPEAKER & CABINETS

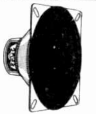
For 12in or 10in dia. speaker	20 × 13 × 9in, £9·90. Post 25p
For 13 × 8in or 8in speaker	16 × 10 × 9in, £5·50. Post 25p
For 8 × 5in speaker	16 × 8 × 6in, £4·40. Post 25p
For 6in and Tweeter	12 × 8 × 6in, £4·00. Post 25p

LOUDSPEAKER CABINET WADDING 18in wide, 15p ft.

GOODMANS 6½in. HI-FI WOOFER

8 ohm. 10W. Large ceramic magnet. Special Cambric cone surround. Frequency response 30–12,000 c/s. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4**
Suitable Cabinet 12 × 8 × 6 £4 Suitable Tweeter £2

ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3¼ × 3¼ × 2in deep. Rating 10W. 3 ohm.
Crossover £1·25 **£1·90** Post 20p.

SPEAKER COVERING MATERIALS. Samples Large S.A.E.
Horn Tweeters 2-16kc/s, 10W 8 ohm or 15 ohm £1·95.
De Luxe Horn Tweeters 2-18kc/s, 15W, 15 ohm £3.
CROSSOVERS, TWO-WAY 3,000 c/s 3 or 8 or 15 ohm £1·25.
LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in., £1·25; 6½in., £1·50; 8 × 5in, £1·60; 10in, £2·00; 8in, £1·75; 10 × 6in, £1·90.
SPECIAL OFFER! 80 ohm, 2½in, 2¾in; 35 ohm, 2in, 3in, 25 ohm, 2½in dia., 3in dia., 5in dia.
15 ohm, 3½in dia, 6 × 4in, 7 × 4in, 8 × 5in.
3 ohm, 2½in, 2¾in, 3½in, 5in dia. (6 × 4in 8 ohms £1·50.) **£1 EACH TYPE**
RICHARD ALLAN TWIN CONE LOUDSPEAKERS, 8in. DIAMETER 4W £2·50. 10in diameter 5W £2·50; 12in diameter, 6W, £2·95.
VALVE OUTPUT TRANS. 40p; MIKE TRANS. 50:1 40p.
5 WATT MULTI-RATIO, 3, 8 and 15 ohms 80p.
Mike trans. mu metal 100 : 1 £1·25.

MAJOR 100 WATT ALL PURPOSE GROUP AMPLIFIER

All purpose transistorised ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. Guaranteed. Details SAE. **£49** Carr. £1·00
PROFESSIONAL VALVE MODEL, 100W, callers only, £89.

BARGAIN AM TUNER. Medium Wave. Transistor Superhet, Ferrite aerial. 9 volt. **£4·95**

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9V. **£3·95**
TWO CHANNEL STEREO VERSION **£5·95**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume. Treble and bass controls. 18 volt d.c. **£4·50**

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 16p. OUTLET BOXES, SURFACE 25p. FLUSH 60p. TWIN 85p. BALANCED TWIN RIBBON FEEDER 300 ohms. 5p yd. JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead-Socket 45p. Phono Plugs 5p. Phono Socket 5p. JACK PLUGS Std. Chrome 15p; 3·5mm Chrome 12p. DIN SOCKETS Chassis 3-pin 10p. 5-pin 10p. Din SOCKETS lead 3-pin 18p; 5-pin 15p. DIN PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS, 5p; CERAMICS 8p; CANS 5p.

REVERSIBLE 4 POLE MOTOR

1,400 r.p.m. Reversible 42 Watt, spindle 1½" × 3/16", size 3¼" × 3", As illustrated. With Cooling Fan. a.c. 240V. **£1·95** Post 25p

E.M.I. GRAM. MOTOR.

120V or 240V a.c.
2,400 r.p.m. 2 pole 70mA. Size 2¼ × 2¼ × 2¾in. **£1** Post 25p.

SPECIAL OFFER

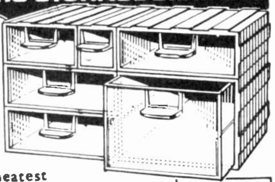
100 ohm 20W Rheostat 2¾in diam. Ceramic Former, screw terminals, ¼in diam. spindle. 95p, post 25p.

RADIO COMPONENT SPECIALISTS

Radio Books and Component Lists 10p. (Minimum posting charge 20p.)

337 WHITEHORSE ROAD, CROYDON
Open 9–6. Wed. 9–1, Sat. 9–5 (Closed for lunch 1.15–2.30)
Buses 50, 68, 159. Rail Selhurst. Tel. 01-684 1665

I-N-T-E-R-L-O-C-K-I-N-G PLASTIC STORAGE DRAWERS



DISCOUNT PRICES

5 SIZES ALL INTERLOCK

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots/ ID and 2D have removable space dividers. Build up any size cabinet for wall, bench or table top.

BUY AT TRADE PRICES!

SINGLE UNITS (ID) (5ins × 2¼ins × 2¼ins). **£1·40** DOZEN.

DOUBLE UNITS (2D) (5ins × 4½ins × 2¼ins). **£2·30** DOZEN.

TREBLE (3D) £2·50 for 8.

DOUBLE TREBLE 2 drawers, in one outer case **(6D2), £3·60** for 8, **EXTRA LARGE SIZE (6DI) £3·40** for 8.

PLUS QUANTITY DISCOUNTS!

Orders £10 and over DEDUCT 5% in the £
Orders £20 and over DEDUCT 7½% in the £
Orders £50 and over DEDUCT 10% in the £

PACKING/POSTAGE/CARRIAGE: Add 35p to all orders under £10..Orders £10 and over, packing/postage/carriage free.

QUOTATIONS FOR LARGER QUANTITIES

Please add 10% V.A.T. to total remittance

FLAIRLINE SUPPLIES (Dept. PE4) 124 Cricklewood Broadway, London, N.W.2
Tel. 01-450 4844

OSMABET LTD.

We make transformers amongst other things.

AUTO TRANSFORMERS, 110/200/220/240V.
30W, **£1·70**; 50W, **£2·40**; 75W, **£2·85**; 100W, **£3·80**; 500W, **£10·80**; 750W, **£14·25**; 1000W, **£18·00**, etc.

LOW VOLTAGE TRANSFORMERS
Prim. 200/240V a.c. 6·3V 1·5A, **£1·20**; 3A, **£1·50**; 6A, **£2·55**; 12V 1·5A, **£1·50**; 3A, **£2·55**; 6A CT, **£3·40**; 18V 1·5A CT, **£2·55**; 24V 1·5A CT, **£2·55**; 3A CT, **£3·45**; 5A, **£4·80**; 8A, **£7·35**; 12A, **£10·85**; 40V 3A CT, **£4·50**; 50V 6A CT, **£13·50**; 25V 2A + 25V 2A, **£4·90**; 12V 4A + 12V 4A, **£4·90**.

LT TRANSFORMERS TAPPED SEC. Prim. 200/240V
0–10–12–14–16–18V 2A, **£2·60**; 4A, **£3·75**;
0–12–15–20–24–30V 2A, **£3·40**; 4A, **£4·50**;
0–5–20–30–40–60V 1A, **£3·40**; 2A, **£4·50**;
0–40–50 60–80–90–100–110V 1A, **£4·90**.

MIDGET RECTIFIER TRANSFORMERS
For FW rect.; 200/240V a.c. 9–0–9V 0·3A, 12–0–12V 0·25A or 20-0-20V 0·15A, **£1·65** each; 9–0–9V 1A, **£1·85**; 12-0-12V 1A or 20-0-20V 0·75A, **£1·50** each.

MAINS TRANSFORMERS
Prim. 200/240V a.c. TX6 sec., 425–0–425 500 Ma, 6·3V CT 6A, 6·3V CT 6A, 0–5–6·3V 3A, **£16·50**; TX1 425–0–425V 250 Ma, 6·3V CT 4A, 6·3V CT 4A, 0–5–6·3V 3A, **£9·75**; MT3 Prim. 0–110–240V sec. 250V 100 Ma, 6·3V 2A, E/S, **£2·70**.

O/P TRANSFORMERS FOR POWER AMPLIFIERS
P.P. sec, tapped 3–8–15ohms, A–A 6·6K Ω 30W, **£5·70**; A–A 3K Ω 50W, **£9·00**; 100W (EL34 KT88, etc.), **£15·75**; tapped Multi O/P 10W **£3**.

G.E.C. MANUAL OF POWER AMPLIFIERS
Covering valve amplifiers of 30W to 400W **35p**.

LOUDSPEAKERS FOR AMPLIFIERS
BAKER 25W, **£7·60**; 35W, **£8·40**; HI-FI Major Module 20W w/tweeter Xover, **£11·80**; Baker speaker lists; FANE 50W, **£10·50**; 60W, **£13·50**; HI-FI speakers, EMI bass 13 × 8in 3 or 15 Ω, **£2·00**; 5in 8 Ω, **£1·15**; 7 × 4in 15 Ω, **£1·60**; 8 × 5in 3, 8, 15, 25 or 80 Ω, **£1·75** each.

LOUDSPEAKERS
2¾in 8, 16 or 75 Ω, 2½in 8 or 25 Ω, 2¾in 80 Ω, 3in 3, 8, 25 or 35 Ω, 3½in 8, 15 or 80 Ω **90p** each; 5in 3, 8 or 25 Ω, 5 × 3in 3 or 8 Ω, **£1·05**; 7 × 4in 3 or 15 Ω, 6½in 3 Ω, 8 × 2¾in 3 Ω, **£1·25**; 10 × 6in 3 Ω, **£1·50**

SPEAKER MATCHING TRANSFORMERS
12W 3 to 8 or 15 Ω up or down **£1·30**.

"INSTANT" BULK TAPE/CASSETTE ERASER
Instant erasure, tape spools, cassettes, demagnetises tape heads. 200/240V a.c. **£3·25**

RELAYS, SUB-MINIATURE
15, 20 or 30V d.c. 2 CO's **50p** each

12V d.c. FLUORESCENT LIGHTING
Silicon transistor invertor for 20W tube, **£5·75**

TAPE RECORDER MOTORS
New, Blowers, fans, etc., 110V a.c. **50p**.

Carriage and VAT on all orders.

S.A.E. ENQUIRIES-LISTS, MAIL ORDER ONLY
46 Kenilworth Road, Edgware, Middx. HA8 8YG
Tel. 01-958 9314

A DEXTER DIMMASWITCH

The DEXTER DIMMASWITCH is an attractive Dimma unit which simply replaces the normal light switch. It is available as a complete "ready to install" unit or "simple to assemble" kit. Two models are available controlling up to 300W or 600W of all lights, except fluorescents, at mains 200-250V, 50Hz. All DEXTER DIMMASWITCH models have built-in radio interference suppression.

600 watt	£3.52	Kit form £2.97
300 watt	£2.97	Kit form £2.42

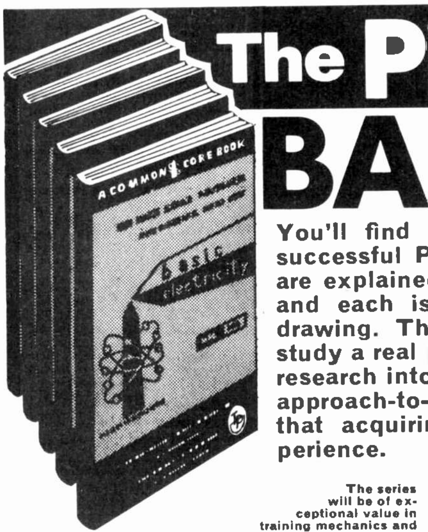
All plus 12p post and packing

Prices include VAT. Please send c.w.o. to:

DEXTER & COMPANY
1 ULVER HOUSE
19 KING STREET
CHESTER CH1 2AH
Tel: 0244-25883

AS SUPPLIED TO H.M. GOVERNMENT DEPARTMENTS, HOSPITALS, LOCAL AUTHORITIES, ETC.

The Pictorial Method



BASIC

ELECTRICITY (5vols)
ELECTRONICS (6vols)
TELEVISION (3vols)

You'll find it easy to learn with this outstandingly successful PICTORIAL METHOD. The essential facts are explained in the simplest language, one at a time, and each is illustrated by an accurate cartoon-type drawing. These clear and concise illustrations make study a real pleasure. The books are based on the latest research into simplified learning techniques. This easy-approach-to-learning method has proved beyond doubt that acquiring knowledge can be an enjoyable experience.

YOUR 100% GUARANTEE

Should you be, in any way dissatisfied with the MANUALS your money will be refunded by return of post.

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

WHAT READERS SAY

I am well pleased with Basic Electronics which are a great help in my appreciation of circuit functions.
T.L., Southampton

They are exactly what I have been looking for—a grateful student.
L.A.S., Oxford

Congratulations on the finest set of books it has been my privilege to study.
C.A., Loughton

I find the manuals exceedingly informative and worth every penny.
P.J.L., Leighton Buzzard

POST NOW FOR THIS OFFER!

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

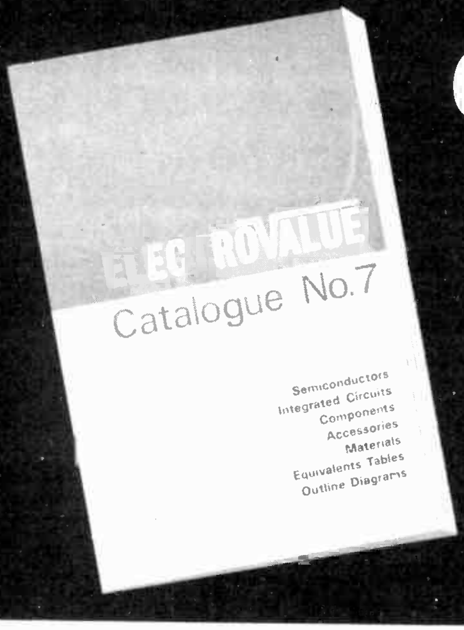
Please find enclosed P.O./Cheque value £...........
BASIC ELECTRICITY 5 parts £5·30 ☐
BASIC ELECTRONICS 6 parts £6·40 ☐
BASIC TELEVISION 3 parts £3·60 ☐
Tick Set(s) required. Prices include Postage

YOUR 100% GUARANTEE. If after 10 days examination you decide to return the Manuals your money will be refunded in full.

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

ELECTROVALUE

CATALOGUE 7



An **A** to **Z** guide to component buying

On the index page of Catalogue 7, between "Aluminium Boxes" and "Zener Diodes" are over 200 references to contents amounting in all to thousands of items, classified, described, often illustrated, and priced. There is a wealth of technical diagrams and data. At 25p, Catalogue 7 is excellent value by any standard. With the 25p Refund Voucher it costs you virtually nothing when you order £5-worth or more.

25p **INCLUDING 25p REFUND VOUCHER AVAILABLE ON ORDERS £5 OR MORE LIST VALUE**

★ A selection from EV Catalogue 7

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

MINITRON DIGITAL INDICATORS
3015IF Seven segment filament, compatible with standard logic modules. 0–9 and decimal point; 9mm characters in 16 lead DIL, **£1·20**. Now available in 8mA or 15mA per segment rating.
Suitable BCD decoder driver, **£1·15.**
3015G showing + or — and I and dec. pt, **£1·20.**

DALY ELECTROLYTIC CAPACITORS
in cans, plastic sleeved
1,000mF/25V, **28p**; 5,000mF/25V, **62p**; 1,000mF/50V, **41p**; 2,000mF/50V, **57p**; 5,000mF/50V, **£1·18**; 5,000mF/100V, **£2·91.**

POLYESTER CAPACITORS TYPE C280
Radial leads for P.C.B. mounting. Working voltage 250V d.c.
0·01, 0·015, 0·022, 0·033, 0·047, **3p** each; 0·068, 0·1, 0·15, **4p** each; 0·22, **5p**; 0·33, **7p**; 0·47, **8p**; 0·68, **11p**; 1·0, **14p**; 1·5, **21p**; 2·2, **24p.**

SILVERED MICA CAPACITORS
Working voltage 500V d.c.
Values in pF—2·2 to 820 in 32 stages, **6p** each; 1,000, 1,500, **7p** each; 1,800, **8p**; 2,200 **10p**; 2,700, 3,600, **12p** each; 4,700, 5,000, **15p** each; 6,800 **20p**; 8,200, 10,000 **25p** each.

POTENTIOMETERS
ROTARY, CARBON TRACK.
Double wipers for good contact and long working life.
P20 SINGLE linear 100 ohms to 4·7MΩ, **14p** each.
P20 SINGLE log, 4·7kΩ to 2·2MΩ, **14p** each.
JP20 DUAL GANG linear 4·7kΩ to 2·2MΩ **48p** each.
JP20 DUAL GANG log, 4·7kΩ to 2·2MΩ **48p** each.
JP20 DUAL GANG log/antilog 10L, 22K, 47K, 1MΩ only, **48p** each.
JP20 DUAL GANG antilog 10k only **48p.**
2A DP mains switch with any of above **14p** extra.
Decades of 10, 22 and 47 only available in ranges above. **SKELETON CARBON PRESETS 6p** each.

SLIDER POTENTIOMETERS
Linear or log, 10kΩ to 1MΩ in all popular values, **30p** each.
Escutcheon plates, black, white or light grey, **10p** each.
Control knobs blk/wht/red/yel/grn/blue/dk. grey/lt grey, **7p** each.

ELECTROLYTIC CAPACITORS
Axial Lead

uF	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	9p	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	—	—	—	—	—	—

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 & POSTAGE
FREE in U.K. For mail orders for £2 list value 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.

Prices quoted do not include VAT, for which 10% must be added to total nett value of order. Prices subject to alteration without notice. S.A.E. with written enquiries please.

RESISTORS

Code	Watts	ohms	1–9	10–99 (see note below)	100 up	
C	1/20	82–220K	9	8	7·5	
C	⅓	4·7–470K	1·3	1·1	0·9	nett
C	½	4·7–10M	1·3	1·1	0·9	nett
C	¾	4·7–10M	1·5	1·2	0·97	nett
C	1	4·7–10M	3·2	2·5	1·92	nett
MO	½	10–1M	4	3·3	2·3	nett
WW	1	0·22–3·9	7	7	8	
WW	3	1–10K	7	7	8	
WW	7	1–10K	9	9	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 C⅓W, C¾W and MO½W at E.12.
E12, 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82.
E24 as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.
Tolerances—All 5% except MO at 2% and WW1 at 10% ± 0·05Ω.

Prices and in pennies 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.) 100 rates apply to units of 100 only.

ZENER DIODES full range E24 values: 400mW: 2·7V to 36V, **14p** each; 1W: 6·8V to 82V, **21p** each; 1·5W: 4·7V to 75V, **48p** each. Clip to increase 1·5W rating to 3 watts (type 266F) **4p.**

VEROBOARD
Copper clad 0·1 in. matrix—2·5 × 3·75 ins. **24p.** 3·75 × 3·75 ins., **27p.** 2·5 × 5 ins., **27p.** 3·75 × 5ins., **30p.**
Copper clad 0·15 in. matrix—2·5 × 3·75 ins., **18p.** 3·75 × 3·75 ins., **27p.** 2·5 × 5 ins., **27p.** 3·75 × 5 ins., **33p.**
Vero spot face cutter (any matrix), **43p.** 0·040 pins (for 0·1 matrix) per 100, **30p.** 0·052 pins (for 0·15 matrix) per 100, **30p.**

GIRO ACCOUNT No. 38/671/4002

All postal communications, mail orders, etc., to Head Office at Egham address, Dept. PE4.

ELECTROVALUE LTD

28 ST. JUDES ROAD · ENGLEFIELD GREEN · EGHAM · SURREY TW20 0HB
Telephone: Egham 3603 Telex 264475
Shop hours—9-5.30 daily. Saturdays 9-1 p.m.
NORTHERN BRANCH: 680 BURNAGE LANE · BURNAGE · MANCHESTER M19 1NA
Telephone 061-432 4945
Shop hours—Daily 9-1 and 2-5.30 p.m. Saturdays 9-1 p.m.

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

Practical Electronics Classified Advertisements

RATES: 9p per word (minimum 12 words). Box No. 20p extra. Semi-Display £7 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisement Manager, "Practical Electronics" IPC MAGAZINES LTD., Fleetway House, Farringdon Street, London EC4H 4AD

FOR SALE

FIBRE OPTICS

Flexible Light Pipe for conveying lights to inaccessible positions. Fibroflex Type I. Glass 1·14mm effective dia. PVC sheathed. **44p** per metre. (VAT inc.), P. & P. 10p. Any quantity.

Polariser Sheet up to 1 sq. ft. max. size. **16½p** per sq. in. (VAT inc.), P. & P. up to 6 in. square **10p**; over 6 in. square **30p**

- ★ Cut down glare
- ★ See those nixie tubes
- ★ Cross them for light control
- ★ Make your own strain gauge for plastics and glass

Circuit Board Etching Kits. Full instructions. **£1·37½** (VAT inc.), P. & P. **20p**

Photographic CDS Light Cells—used (with part of original circuit free), **33p** (VAT inc.). Post free.

All items are strictly C.W.O.

From: **ARVIN SERVICE COMPANY**
12 CAMBRIDGE ROAD
ST. ALBANS

SEEN MY CAT? 5,000 items. Mechanical and Electrical Gear, and materials. S.A.E. K. R. WHISTON, Dept. PE, New Mills, Stockport.

TV LINE OUT-PUT TRANSFORMERS
Tidman Mail Order Ltd., 236 Sandycombe Road, Richmond, Surrey TW9 2EQ
01-948 3702

CATALOGUE NO. 18, Electronic and Mechanical Components and manufacturers' surplus. Credit vouchers value 50p. Price **23p,** including post. ARTHUR SALLIS RADIO CONTROL LTD., 28 Gardner Street, Brighton, Sussex.

MORSE MADE EASY!!

FACT NOT FICTION. If you start **RIGHT** you will be reading amateur and commercial Morse within a month (normal progress to be expected).

Using scientifically prepared 3-speed records you automatically learn to recognise the code **RHYTHM** without translating. You can't help it, it's as easy as learning a tune. 18 W.P.M. in 4 weeks guaranteed.

Beginner's Section only **£3·30**, complete course **£4·50** P.P.I., etc., plus 10%.

Overseas £1 extra) details only, 4p stamp. **01-660 2896**

G3HSC (Box 19), 45 GREEN LANE, PURLEY, SURREY

SAVE PETROL—Know instantly your mpg with a Baron mpg Meter. Model 1b now available suitable for 12V neg. or pos. earth cars with S.U. electric fuel pump, not P.I. models. Kit complete with all components P.C. board and 8 IC's; requires 1mA meter (not supplied). **£10·50** plus 20p P. & P. Please state make, model and year. BARON ELECTRONICS, 176 Brookhurst Avenue, Bromborough, Wirral, L63 0PF.

LIGHTSHOW PROJECTORS from only **£17.** effect wheels from only **£4.** Many lightshow bargains at ROGER SQUIRE'S (Disco Centre), 176 Junction Road, London, N.19. Tel. 01-272 7474.

OSCILLOSCOPE SOLARTRON CD711S. With full instruction manual. Needs attention. Yorks West Riding. **£25.** P. McLEMAN, 21 Apley Close, Harrogate, Yorks., HG2 8PS.

ULTRASONIC AMPLIFIERS. Two M.E.L. Amplifiers 70W **£17**, 35W **£15.** 01-363 4076 (Enfield).

LADDERS

LADDERS. "Special Offer" unvarnished triples. 9ft 7in closed—23ft 1in extended. **£18·90** delivered. HOME SALES LADDER CENTRE (PEE2), Haldane (North), Halesfield (1), Telford, Shropshire. Tel. 0952 586644.

SITUATIONS VACANT

TECHNICIANS AND ENGINEERS FOR ST. ALBANS AND LUTON

QUALIFIED OR NOT!

OPPORTUNITIES for challenging work on testing and calibrating valve and solid-state electronic measuring equipments embracing all frequencies up to u.h.f. in Production, Service and Calibration departments.

APPLICATIONS are invited from people of all ages with experience or formal training in electronics and from Ex-Services technicians.

HIGHLY COMPETITIVE SALARIES, negotiable and backed by valuable fringe benefits. Overtime normally available.

GENEROUS RE-LOCATION EXPENSES available in most instances.

CONDITIONS excellent; free life assurance, pension schemes, canteen, social club.
37½ hour, 5-day, working week.

WRITE or phone for application forms quoting reference PE744.

mi

MARCONI INSTRUMENTS LTD,
Longacres, St. Albans, Herts
Tel: St. Albans 59292
Luton Airport, Luton, Beds
Tel: Luton 33866

A GEC-Marconi Electronics Company

1971
THE QUEEN'S AWARD TO INDUSTRY 1971

SERVICE SHEETS

SERVICE SHEETS for Televisions, Radios, Transistors, Tape Recorders, Record Players, etc., from **5p** with free Fault-Finding Guide. S.A.E. orders/enquiries. Catalogue **15p.** HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 29066.

SERVICE SHEETS, Radio, TV, etc. 8,000 models. Catalogue **15p.** S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

WANTED

TOP PRICES PAID
NEW VALVES AND TRANSISTORS
Popular T.V. and Radio types
KENSINGTON SUPPLIES (B)
367 Kensington Street
Bradford 8, Yorks.

WAR GAMES COMPUTER. Urgently wanted. Constructed to Practical Electronics Published Circuit and in working order. Excellent price offered. Rattray 373 1424.

MEN!
£70p.w.
can be yours

Jobs galore! 144,000 new computer personnel needed by 1977. With our revolutionary, direct-from-America, course, you train as a Computer Operator in only **4 weeks!** Pay prospects? £3,500 + p.a. After training, our exclusive appointments bureau—one of the world's leaders of its kind—introduces you **FREE** to world-wide opportunities. Write or 'phone **TODAY,** without obligation.

London Computer Operators Training Centre
S62, Oxford House
9-15 Oxford Street, W.1
Telephone 01-734 2874

ELECTRONICS VACANCIES

Ministry of Defence Experimental Establishment in the Lake District requires experienced electronics mechanics to instal, maintain and develop a wide range of interesting equipment.

Rate of pay for 40-hour, 5-day week £31·03, plus a productivity bonus of £2·65 per week. A guaranteed week agreement is in force.

The posts are pensionable, there is a sick pay scheme, three weeks' annual paid holiday and an assisted travel scheme. There is a prospect of housing accommodation within a reasonable period for a married man, hostel accommodation is immediately available for single men.

If you have served a recognised apprenticeship or have had equivalent service training and would like to work in a beautiful part of the country, send for an application form to:

Personnel Officer
Ministry of Defence (Procurement Executive)
Eskmeals, Bootle Station
Cumberland LA19 5YR
Telephone: Ravenglass 214/5/6

EDUCATIONAL

CITY AND GUILDS EXAMINATIONS

Make sure you succeed with an ICS home study course for C & G Electrical Installations, Telecommunications Technicians and Radio Amateurs. Free details from: International Correspondence Schools, Dept. 730E, Intertext House, London, SW8 4UJ.

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. Also radio and audio courses. Free details from: International Correspondence Schools, Dept. 730E2, Intertext House, London, SW8 4UJ.

TECHNICAL TRAINING

Get the qualifications you need to succeed. Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computer Engineering and Programming. Also self build radio kits. Free details: International Correspondence Schools, Dept. 730E3, Intertext House, London, SW8 4UJ.

DIRECT FROM MANUFACTURER—a comprehensive catalogue of U.H.F. and V.H.F/F.M. aerials, fixing brackets, chimney lashings, clamps, masts, amplifiers, cable, etc., for the D.I.Y. enthusiast. Complete with useful installation hints. Send **3p** stamp to CLAYDEW ENTERPRISES (P.E.), 261 Hardness Street, London, SE24.

RECEIVERS AND COMPONENTS

R.T. SERVICES

(MAIL ORDER ONLY)

77 Hayfield Rd., Salford 6, Lancs.

Veroboard 6×5 0·1 Matrix, 2 for **£1.** 4×4½ 0·1 Matrix, 4 for **£1.** 12×3¾ 0·15 Matrix, **75p each.**
Mullard A.M. Module. I.F. Strip, LP1166, **£1·10** inc. P.P.
FM Tuner with R.F. Stage and A.G.C., 3 transistors, neg. earth, 2½×2×1½ in with circuit, **£1·37½** inc. P.P.
Crouzet Geared Motors, 30-60 r.p.m. New, **£1·54** inc. P.P.
UHF TV Tuners. Transistorised, **£1·65** inc. P.P.
VCR138 CRT. New, boxed, **£3·30** inc. P.P.
Transformers. 7·5V + 7·5V ½A, **66p** inc. P.P. 12-0-12V, 100mA, **90p** inc. P.P. 9-0-9V, 100mA, **69p** inc. P.P. 20V, 1A, **88p** inc. P.P.
Transformers. 52-0-52V, 1A + 22-0-22V, 200mA, **£2·20** inc. P.P.
P.C. Board. S/S, 5½ × 5½in, 10 for **70p** inc. P.P.
Panel with 2 SN7490, 2 SN7441 counting circuit with end connector, **£2·20** inc. P.P.
Transistorised Timer. Variable delay. 110 or 250V A.C. input. With instructions. Brand new, **£2** inc. P.P. Size 3" × 2" × 2".
10" Speaker in Cabinet, 3 Ω with long lead and jack plug made by Pye. Ex-Govt., brand new **£5·50** inc. P.P.
Electrolytic Capacitors, 4,000 MF,50 VW, 4½" × 1¾" **75p.** inc. PP.
Ampex Tape 7in. L.P. 1,800ft, **£1·60** inc. P.P.

I.C.s. 74 Series. Brand new, untested, unmarked. Ideal for experimenters. 25 for **35p.** Why not try a pack? SELECTED SEMICONDUCTORS, 17 Coniston Way, Elm Park, Hornchurch, Essex.

PRECISION
POLYCARBONATE CAPACITORS

Close tolerance. High stability Extremely low leakage All 63V d c. Plus or minus 1% tolerance. 0·47μF. **56p;** 1 0μF. **66p;** 2·2μF **80p;** 4·7μF **£1·30;** 6·8μF. **£1·64;** 10μF **£2;** 15μF. **£2·75.** Also available ±2% and ±5%. ex. stock

TANTALUM BEAD CAPACITORS: Values available 0·1 0·22. 0 47. 1 0. 2 2. 4·7. 6 8μF at 15V/25V or 35V 10μF at 16/20V or 25V. 22μF at 6/10V or 16V. 33μF at 6V or 10V; 47μF at 3V or 6V. 100μF at 3V. All at **10p** each. 10 for **95p;** 50 for **£4.**
TRANSISTORS: BC107. BC108. BC109. All at **9p** each. 6 for **51p;** 12 for **96p.** May be mixed for quantity price BC182 and BC212 at **10p** each AF178 at **30p** each All brand new and marked Full spec devices.

POPULAR DIODES. **IN914, 6p** each. 8 for **45p;** 18 for **90p. IN916, 8p** each. 6 for **45p;** 14 for **90p. IS44, 5p** each 11 for **50p;** 24 for **£1.** All brand new and marked

NEW LOW PRICE—400 mW Zeners. Values available 4 7. 5 6. 6·8. 7 5. 8·2. 9 1. 10. 11. 12. 13 5. 15V Tol ±5% at 5mA All new and marked Price **7p** each. 6 for **39p;** 14 for **84p.** Special offer 6 of each voltage (66 zeners) **£3·65.**

RESISTORS. Carbon film 5%. ⅓W at 40°C. ¼W at 70°C Range from 2·2Ω to 2 2MΩ in E12 series. i e 10. 12. 15. 18. 22 27 33. 39 47 56. 68 82 and their decades. High stability. low noise All at **1p** each. **8p** for 10 of any one value. **70p** for 100 of any one value Special pack—10 of each value 2 2Ω to 2 2MΩ (730 resistors) **£5.**

440V A.C. CAPACITORS: 0 1μF size 1⅛in × ⅜in **40p;** 0 25μF (1⅜in × ⅜in). **55p;** 0 47 and 0 5μF (1⅜in × ¾in) **66p;** 1 0μF (2in × ¾in) **85p;** 2 0μF (2in × 1in). **£1·15.**

SILICON PLASTIC RECTIFIERS 1·5A. Brand new wire-ended DO27 100PIV at **7p** each 4 for **26p.** 400PIV at **8p** each 4 for **30p;** 800PIV at **11p** each 4 for **42p.**

7p post and packing on all orders below £5
Export orders—please add cost of air/sea mail

PLEASE ADD 10% VAT TO ALL ORDERS
Send S A E for lists of other ex-stock items L E D s. disc capacitors. electrolytics etc Wholesale price lists available to bona fide companies

MARCO TRADING

Dept. E4, The Maltings Station Road
Wem, Salop.
Tel Nantwich (Cheshire) 63291

LARGE COMPUTER PANELS. Average 40 transistors. Plenty of components, **84p** (25p). **AMERICAN PANELS,** 2N series transistors. Quality components, 4, **55p** (10p). **7400 SERIES I.C.S. ON PANEL(S),** 10, **£1** post paid. **M.C. METERS, THREE ASSORTED** 2·3in, **£1·15** (27p). **5-FIGURE RESETTABLE COUNTER.** 18/22V. Works on 12V, **£2·20** (20p). **SILICON DIODES,** 650V 1½A. 10 on tagboard, **35p** (5p). **PANELS WITH 10 S.C.R's** 30V 1½A ferrite cores and 12 transistors, **£1** (10p). **COPPER CLAD PAX. PANELS,** 5½ × 5½in, 6, **45p** c.p. 7½in × 9in **25p.** c.p. 6, **£1·25** c.p. 8½in × 9in. **30p** c.p. 6, **£1·35** c.p. 10in × 9in **35p** c.p. 6, **£1·45** c.p. **WIRE ENDED NEONS,** 10, **50p** (8p). **FOUR PIANO KEY SWITCH WITH INTERLOCK, 33p** (7p). **SILVER MICA CAPACITORS,** 100 assorted, **55p** c.p. **10 ASSORTED MIDGET POTENTIOMETERS 60p** c.p. **VALUPAKS.** From **25p to 75p.** Send 10p stamps for list of these and panels, etc. Refund on purchase.
7lb ASSORTED COMPONENTS, £1·65 c.p.
2lb ASSORTED COMPUTER PANELS £1·65 c.p.

J.W.B. RADIO

2 BARNFIELD CRESCENT, SALE, CHESHIRE M33 1NL

Postage in brackets. Mail order only

DRY REED INSERTS

Overall length 1 85" (Body length 1·1"). Diameter 0 14". Max. ratings 250v D.C. and 500 mA. Gold clad normally open contacts. **69p** per dozen; **£4·12** per 100; **£30·25** per 1,000; **£275** per 10,000. VAT and post paid.

G.W.M. RADIO LTD.
40/42 Portland Road, Worthing, Sussex 0903 34897

5 N-CHANNEL FETs. Type 3819E (2N3819) for **£1** (inc. VAT). Full spec. transistors complete with circuit details for building voltmeter, timer, ohmmeter, etc. For complete list of FETs and other transistors available 4nd 10p P.O. REDHAWK SALES LTD., 5 Station Road, Gerrards Cross, Bucks. Mail Order Only.

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. & P. C.W.O. to: CALEDONIAN COMPONENTS, Strathore Road, Thornton, Fife.

Mullard Components

CARBON FILM RESISTORS
High stability, very low noise. E12 series 4R7-1M. Prices are per ohmic value. Ignore fractions.

	1+	100+	1,000+
0·33W 5%	0·7p	0·7p	0·6p

POLYESTER CAPACITORS
C280 series. 250V PC mounting: 0·01, 0·015, 0·022, **2p**; 0·033, 0·047, 0·068, 0·1, **3p**; 0·15, 0·22, **4p**; 0·33, **5p**; 0·47, **6p**; 0·68, **8p**; 1·0, **10p**; 1·5, **14p**; 2·2, **16p**.

All prices include VAT. Please add 10p postage and packing on orders below £2. Fast service. Cash with order only. Send 5p stamp for our comprehensive catalogue.

C. N. STEVENSON
304 Avery Hill Road, London SE9 2JN

COMPONENT SALE

1,000's of components for disposal following wholesaler closing industrial electronics department.

OVER 200 TYPES OF CAPACITOR: Electrolytic, paper, metallised film at knock down prices (e.g. 0·04mfd 150V at 1·5p, 10mfd 16V at 3p).

Also large quantity of switches, fuseholders, semiconductors, variable transformers at unrepeatable prices.

Complete balance of stock must go.

Send 4p in stamps and address for lists.

O & M SERVICES (P.E.)
281A BURY OLD ROAD, PRESTWICH
MANCHESTER, LANCS. M25 5JA

MAINS UNIT FOR TRANSISTOR RADIO ONLY

For single outputs, 6v, 9v, **£2.20**
For two separate outputs, 6v + 6v., 9v + 9v, **£2.75**. P. & P. 20p per unit.
(Please state outputs reqd.).
All units are completely isolated from mains by double wound transformer ensuring 100% safety. ALL PRICES INCLUDE VAT.
R.C.S. Products (Radio) Ltd. (Dept. P.E.)
36 Raymond Avenue, South Woodford,
London E18 2HG.

BRAND NEW COMPONENTS by return Electrolytics 16V, 25V, 50V—0·47, 1, 2·2, 4·7 10 mF, **4p**; 22, 47, **4½p** (50V, **5p**); 100, **5½p** (50V, **7p**); 220, **6p** (50V, **9p**). Subminiature bead-type tantalums 0·1/35V, 0·22/35V, 0·47/35V, 1/35V, 2·2/35V, 4·7/35V, 10/16V, **8p.** Mylar Film 100V—0·001, 0·002, 0·005, 0·01, 0·02, **2p**; 0·04, 0·05, **3p**; 0·068, 0·1, **3½p**. Polystyrene 63V E12 series 10–1,000pF, **2p**; 1,200–10,000pF, **3p**. Miniature highstab resistors, 5%, E12 series—Carbon Film ⅓W, 1Ω–10MΩ (10% over 1 MΩ). Metal Film ⅛W, 10Ω–2·2MΩ and 1W, 27Ω–10MΩ all **¾p** each. Postage 8p. The C.R. SUPPLY CO., 127 Chesterfield Road, Sheffield, S8 0RN.

RADIO & TELEVISION AERIAL BOOSTERS **£2·95,** five television valves **45p.** **50p** bargain transistor packs, bargain **£1** resistor and capacitor packs. UHF-VHF televisions **£7·50.** Carr. £1·50. S.A.E. for 3 leaflets. VELCO ELECTRONICS, Bridge St., Ramsbottom, Bury, Lancs.

---

74 TTL — Lowest prices. First grade ceramic packaged devices. 7400 **10p**, 7473 **27p**, 7474 **27p**. Data Booklet **10p**. Postage and packing 10p. A. TOOTELL, 9 Mendip Close, St. Albans, Herts.

TUNBRIDGE WELLS. Components from TELESERVICE, 108 Camden Road, Tunbridge Wells, Kent. Telephone 31803.

MINIATURE CERAMIC CAPACITORS 50V 25 each E6 value 22pF to 1,000pF. Total 275. **£3·75.** NEK ELECTRONICS (P7), 28 Carnegie Road, St. Albans, Herts.

OFFICIAL APPOINTMENTS

LONDON BOROUGH OF HILLINGDON

BARNHILL COMPREHENSIVE SCHOOL

Barnhill Lane, Hayes, Middlesex

Temporary teacher required as soon as possible for General Subjects which could include English, Geography and/or Mathematics.

APPLY IMMEDIATELY

Application forms from and returnable to the Headmaster/Headmistress.

London Allowance Payable: 75% removal expenses in appropriate cases and some assistance with temporary accommodation may be possible.

BUILD THE **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
- Five transistor circuit
- Thoroughly professional finish
- You only need soldering iron, screwdriver, pliers and snips
- As seen on BBC-1 & BBC-2 TV

Send s.a.e. for leaflet

Complete kit Post 35p **£9·80** Built tested and guaranteed Post 35p **£13·75**

MINIKITS ELECTRONICS, 35g LANGLEY DRIVE, WANSTEAD, LONDON E11 2LN (Mail Order only)

Build the Mullard C.C.T.V. Camera

Kits are now available with comprehensive construction manual (also available separately at 76½p)
SEND 5" × 7" S.A.E. FOR DETAILS TO:
CROFTON ELECTRONICS
15/17 Cambridge Road, Kingston-on-Thames, Surrey KT1 3NG

DON'T LOOK

unless you can resist the temptation to get these super 'attention-getters':

★ POCKET-SIZED **MAXI-VOLT** Big ¼ inch Spark Generator (instant 15,000 volts!) Ready-made, needs no batteries. Carry it around anywhere. Only weighs about 3 oz (85g). Send **£1·35** for your Maxi-volt now!

★ UNIQUE **TRANSMITTER/RECEIVER KIT.** No licence examinations or tests required to operate this transistorised equipment. Easy to build. Get transmitting. Send **£5·90** for yours now!

★ PSYCHEDELIC **MINI-STROBE KIT.** Take a pocket-sized lightning storm to Disco's and Parties. "BRAIN-FREEZE" 'EM with vari-speed stop-motion flashes. Includes super case, too. Send **£2·20** now!

(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 15p for lists, plus free design project sheet

fibre optic suppliers

LOW COST LED—MLED 500, MV 54
MLED 500 is in TO92 case, for PC board mounting MV 54 is T¾ size, 2mm, miniature. Both emit visible red light. Current requirement 20mA, 150Ω resistors available for 5V d.c. (TTL) operation.

2N5777—SILICON PHOTO DARLINGTON AMPLIFIER
Economical, high sensitivity. TO92, LIGHT DETECTOR

	1	2	5	10	25
MLED500	22p	44p	£1·10	£2·20	£3·74
MV54	22p	44p	£1·10	£2·09	£3·52
150Ω	—	—	—	—	11p
2N5777	55p	£1·10	£2·53	£4·62	£9·90

ULTRASONIC TRANSDUCERS—TRANSMITTER RECEIVER PAIR
40kHz for burgular alarm, remote control, novelties. Great value at **£3·85** per trans/receiver pair.

HNCP 37—NEUTRAL CIRCULAR POLARISER
Reduce glare on crt's, meters, displays, panels. 50mm × 50mm (2in), **66p**; 75mm × 75mm, **£1·21**; 150mm × 150mm, **£4·40.**

CROFON 1610—64 FILAMENT LIGHT CONDUIT
1·8mm active dia., 3·3mm o/d. Simply cut to length and conduct light where required. For displays, internal illumination, multiple point lighting. 1 metre, **£1·32**; 2m, **£2·64**; 5m, **£5·50**; 10m, **£10·45.**

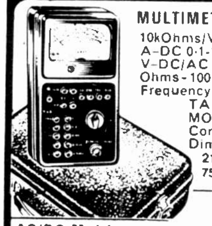
FP40—PLASTIC OPTICAL MONO-FIBRE, 1mm DIAMETER
Single strand unjacketed light guide, simple to use. 5 metres, **£1·10**; 10m, **£1·98**; 25m, **£3·85.** FP20 (0·5mm) and FP60 (1·5mm) also available.

MARE'S TAILS FOR DECORATIVE DISPLAYS
7,000 fibres, professionally finished, beautiful. Add lamp, stand, cover to make a Fibre Optic Lamp. Eye catching in boardroom, hall or foyer, **£11·00** each.

All prices shown include P. & P., VAT. C.W.O. please. For full information on our complete range, send 9in × 6in S.A.E. to

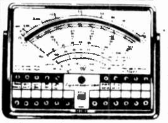
FIBRE OPTIC SUPPLIERS (PE)
P.O. Box 702 London W10 6SL

MORE RANGES FOR LESS MONEY!



MULTIMETER AC-DC Type U-437
10kOhms/V 2·5% Precision
A–DC 0·1-1A – 5 Ranges
V–DC/AC 2·5 to 1000 V – 6 Ranges.
Ohms - 100 to 1 MegOhm – 4 Ranges.
Frequency: 45-40kHz – 2 Ranges.
TAUT SUSPENSIONS MOVEMENT.
Complete with steel case.
Dimensions without case: 212 x 118 x 75mm **£4.95**

AC/DC Multimeter type U4324
A-DC 0·06-3A – 6 Ranges.
A-AC 0·3-3A – 5 Ranges.
V-DC 0·6-1200 V – 9 Ranges.
V-AC 3-900 V – 8 Ranges.
Frequency: 45 to 20kHz–2 Ranges.
Resistance: 500 Ohm to 5 MOhm–5 Ranges. Decibel: —10 to + 12dB – 2 Ranges. Accuracy ± 2·5%.
Dimensions: 167 x 98 x 63 mm.
Only **£8.00**



SUPERTESTER 680 R ICE
10 Fields – 80 Ranges: Plus a lot of accessories for measurements of 500A-AC 100 A/DC– Temperature– —50C to + 200C– Magnetic fields up to 15 KGauss– Phase indicator– EHT 25kV Electronic Volt Ohm– meter Transistor Diode Tester etc.
Dimensions: 128 x 95 x 32 mm– 300 grams 20kOhm/V Accuracy 1% DC **Ask for free catalogue** **£18.50**
Accessories Extra

Add 10% VAT to all items + 35p P & P
ELECTRONIC BROKERS LTD.
49-53 Pancras Road London NW1 2QB. Tel: 837 7781

METER REPAIRS. Ammeters, voltmeters, multi-range meters, etc. Send to: METER REPAIRS, 39 Chesholm Road, London, N16 0DS.

EXPERIMENTERS! Hundreds of unusual items cheap. 1974 catalogue 5½p. GRIMSBY ELECTRONICS, 64 Tennyson Road, Cleethorpes, Lincs. (Mail Order Only).

BA NUTS, BOLTS and WASHERS
per 100

Size	Nuts	Bolts	W rs
4	44p	55p	35p
6	35p	44p	35p

BA SPANNER SET 29p Each

CORED SOLDER ¼lb reel 62p Each

SELF TAPPING SCREWS Box of 100 assrt * 36p

FASTENERS Box of 100 Assrt 55p

PVC 100 GROMMETS ¼in 5/16in or ⅜in hole State size 44p

TOGGLE SWITCHES SP/ST 26p SP/DT 37p

CONTINUITY PROBE 25p Each

5in PLIERS * OR SIDE CUTTERS Insulated Handles 99p Each

* While stocks last — Post free over £2 — Orders under £2 add P & P 15p — All prices inc VAT

SILHILL PRODUCTS, Dept. PE4
226 Mary St., BIRMINGHAM B13 9RJ (021-440 3600)

ENAMELLED COPPER WIRE

S.W.G.	1lb Reel	½lb Reel
10–14	£1·40	80p
15–19	£1·40	80p
20–24	£1·43	83p
25–29	£1·52	91p
30–34	£1·57	97p
35–40	£1·69	£1·04

Please add 10% to all above prices to cover VAT
The above prices cover P. & P. in U.K. Supplied by
INDUSTRIAL SUPPLIES
102 Parrswood Rd., Withington, Manchester 20
Telephone No. 061-224 3553

CABINET FINISHING COMPONENTS

Recess cabinet handles (plastic—black) **22p** each (metal—chrome bar) **£1·90** each
Cabinet corner pieces (black plastic) **10p** each (metal small) **5p** each
Strap handles (black—chrome ends) 11in **66p** each 9½in **55p** each
Cabinet covering cloth (vox type—black) 50in wide **£1·75** per yard
Speaker cloth (plain or silver stripe Laney type 50in wide **£1·65** per yard
Cabinet feet (black plastic 1½in diameter) **7p** each
Jack socket recess plates (black plastic) **7p** each
Jack sockets (chromed bezel) **22p** each
vent grills (black plastic) 5½in · 1½in **22p** each 6¾in · 3½in **16p** each
Cabinet castors (rubber tyred 4 hole fixing) **62p** each (plastic wheel—with brake) **98p** each (plastic wheel—bolt fixing) **62p** each
14oz matt black spray paint **90p** each
1 pint cabinet cloth adhesive **£1·10** each
Handy trimming knives **10p** each
Plastic piping for baffle edging (black or white) **6p** per yard
All prices include VAT
Post and packing Orders under £1 20p Orders between £1 and £10 35p Orders over £10 Free

MAIL ORDER DEPT, P.E.1, HAMILTONS OF TEESSIDE
26 Newport Road, Middlesbrough, Teesside. Tel. 0642 47314 Ext. 24.

CLEARING LABORATORY, scopes, V.T.V.M's, V.O.M's, H.S. recorders, transcription turntables, electronic testmeters, calibration units, P.S.U.'s, pulse generators, D.C. null-potentiometers, bridges, spectrum analysers, voltage regulators, sig-gens, M C relays, components, etc. Lower Beeding 236.

BARGAIN LISTS. Connectors, instrument boxes, spark generators, silicon diodes, transistors, new items very low prices. S.A.E. illustrated lists. FREAR, 2 Richmond Terrace, Ulverston, Lancs. LA12 0BU.

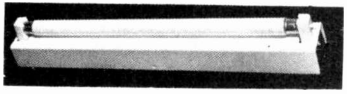
HARDWARE SUPPLIES—Sheet aluminium individual sizes or standard packs, drilled to spec. Screws, nuts, washers, etc., Fascia panels in aluminium individual requirements. Printed circuit boards, one-off or small runs. Printed circuit drafting tapes, etc., **7p** for list. RAMAR CONSTRUCTOR SERVICES, 29 Shelbourne Road, Stratford-on-Avon, Warwks., CV37 9JP.

LOW COST I.C. MOUNTING. I.C. pin sockets in lengths of 100 for **60p** (P. & P. 5p). Quantity rates. S.A.E. details and sample. GASKELL, "Oak Lodge," Tansley, Derbyshire.

TWO GODDARD 61 NOTE KEYBOARDS, £9 each. Harmonics contact assemblies, 61 note, 4 pitch, **£12**; 2 pitch, **£10**. JAQUES, 47 Newstead Road, Urmston, Manchester.

12 VOLT FLUORESCENT LIGHTS

(as illustrated)



Beat power cuts. Be independent. Ideal for caravans, tents, emergency lighting, etc. Works anywhere where 12v is available. Guaranteed for six months. Ready to use at:

12ins. 8 watt £4 post paid

Including V.A.T.

SALOP ELECTRONICS, 23 WYLE COP SHREWSBURY, SHROPSHIRE. Callers welcome. For lists or enquiries, large s.a.e. Tel.: Shrewsbury 53206

BUILD OR BUY a

MINIATURE TRANSMITTER

A precision piece of equipment that has been designed and produced after 2 years' research and development. The smallest transmitter available in the U.K. 2in x 1in approx. Fits in the palm of your hand. Can pick up and transmit voices and minute sounds, excellent range up to ¼ mile. Can be worn round the neck, held in the hand or placed on a shelf. Receive on a VHF radio. Universal battery connections enable use of PP3 battery operates 9–15 volts, no other connections (completely self-contained) to operate, simply switch on. Used the world over, many applications. Fully transistorised printed circuit. Guaranteed for 12 months.

Assembled unit ready to use	£15·50
Kit with step-by-step assembly instructions	£11·50
If required, suitable radio for receiving transmitter	£13·50

Ins., P. & P. 45p

MULHALL ELECTRONICS (P.E.)
Ardglass, Co. Down, U.K. BT30 7SF.
(Exporters to 14 countries)
(R.A.E. licence required)

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

BUILD A CHORDING PROFESSIONAL SYNTHESISER

using **Dewtron** (Regd. Trademark)

PROFESSIONAL MODULES

LATEST ADDITIONS INCLUDE PITCH-TO-VOLTAGE AND SEQUENCE MODULES! AND MANY OTHERS.

CASH SAVINGS by buying modules and parts in bulk! All modules are available separately: Ring Modulator RM2, **£8.** Voltage-controlled Oscillator VC01, **£10·50,** giving sawtooth and square-wave outputs. Envelope shapers, ES1, self-triggered or ES2 keyboard-triggered, either type **£13.** White noise type WN1, **£7.** Voltage-controlled amplifier VCA1, **£10.** Voltage-controlled selective amplifier (filter for waa-waa, etc.) SA1, **£13.** Voltage-controlled Phase PH1, **£17.** Automatic Announcement Fader module for fading of music by microphone announcement, AF1, **£10.** etc., etc. ALL MODULES ARE BUILT, TESTED AND SEALED FOR LONG LIFE. Simply connect coloured wire connections as per easy instructions, build cabinet and wire in controls and patchboard connections! Joystick controls **£5·50.** REVERB Module and spring unit **£15.** V.A.T. 10% extra. V.A.T. paid orders over **£75.**

The Synthesiser shown above is the **Dewtron** "Apollo" A.1. which we sell ready-built to professionals. Believe it or not, it uses the SAME precision modules as we sell to you, the Constructor, to build any kind you like. The revolutionary Modumatrix system of routing makes old-fashioned patching a thing of the past. VCO-2 voltage-controlled oscillator module has accurate built-in log-law for chording and other professional effects. 3 and 4 octave keyboards and contacts. **VCO-2 STABLE, PRECISION V/C OSCILLATOR** gives SINE, TRIANGULAR AND SQUAREWAVE outputs, 1 volt/octave voltage control. **£24** each or **£27** each 2 or more matched. **SHE-1 SAMPLE, HOLD AND ENVELOPE MODULE** gives variable attack, sustain, touch sensitive playing when used with VCO-2 signals. **£17.** OFT-1 chording module **£9.** Modules (except VCO-1) guaranteed two years.

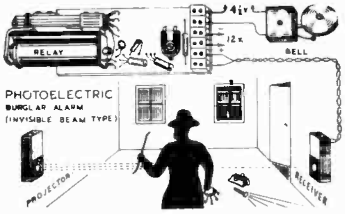
With over 7 years' unblemished reputation in these pages, ***Dewtron*** *continues to lead in new technical developments in electronic sound effects! Ask any of our customers. See our products in the music stores, too. Suppliers of special equipment to leading groups. Our modules are used in professional equipment by other manufacturers and in our own built synthesisers, e.g. "Gipsy" G.I.*

Send 15p for full catalogue of our famous musical effects.

D.E.W. LTD. **254 Ringwood Road, FERNDOWN, Dorset BH22 9AR**

PHOTOELECTRIC KIT

CONTENTS. P.C. Chassis Board, Chemicals, Etching Manual, Infra-Red Phototransistor, Latching Relay, 2 Transistors, Diode, Resistors, Gain Control, Terminal Block, Elegant Case, Screws, etc. In fact everything you need to build a Steady-Light Photo-Switch/Counter/Burglar Alarm, etc. (Project No. 1) which can be modified for modulated-light operation with a few additional components.



PHOTOELECTRIC KIT

£2·85

Postage and Pack. 15p (U.K.)
Commonwealth
SURFACE MAIL 25p
AIR MAIL £1·40
Australia, New Zealand, S. Africa, Canada and U.S.A.

Also Essential Data Circuits and Plans for Building
10 Advanced Designs

INVISIBLE BEAM OPTICAL KIT

Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photocell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.
CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks. Infra-red filter, projector lamp holder, screws, nails, brackets, building plans, etc. Price **£1·45.** Postage and Pack. 10p (U.K.). Commonwealth: Surface Mail 20p. Air Mail 50p.

LONG RANGE INVISIBLE BEAM OPTICAL KIT

CONTENTS: As above. Twice the range of standard kit. Larger Lenses, Filter, etc. Price **£2·10.** Postage 15p (U.K.). Commonwealth: Surface 20p, Air Mail £1·15.

BIOFEEDBACK AMPLIFIER KIT

Tunable, General-Purpose, Interference-Rejecting Differential Amplifier for experimental investigation of signals produced by the brain, heart and muscles. When used with an oscilloscope, or aural indicator, it enables you to monitor your brainwaves, learn to relax, meditate, etc.
CONTENTS: All Capacitors, Resistors, Pots, Semiconductors, I.C., Electrodes, Leads, Chassis, Case, Batteries, Plans and Instructions. Price **£4·75** postage and pack. 25p (U.K.). Commonwealth: Surface 30p. Air Mail £1.

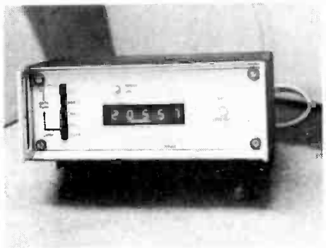
ALPHA-BETHA-THETA BRAINWAVE MONITOR KIT

Aural Brainwave Indicator for use with a Biofeedback Amplifier. Converts subsonic brain frequencies into audible signals for easy recognition.
CONTENTS: Resistors, Pots, Capacitors, Transistors, Diodes, Leads, Chassis, Case, Earphone, Battery, Plans and Instructions. Price **£3·25.** postage and pack. 15p (U.K.). Commonwealth: Surface 25p. Air Mail 75p.

YORK ELECTRICS Mail Order Dept.
335 BATTERSEA PARK ROAD, LONDON, S.W.11

Send S.A.E. for full details, a brief description of all Kits and Projects

A Quality 30 MHz Counter for under £100



MEMORY DISPLAY
4 GATE TIMES
AUTO INPUT LEVEL
10 mV SENSITIVITY
10 MHz CLOCK
1 Hz RESOLUTION

Shortly available: 200 MHz version at £200

FOR HIRE OR SALES CONTACT: **John Ticehurst**
P.H. Electronics (Sales) Ltd.
Sandwich Industrial Estate
Sandwich, Kent CT13 9LN
Tel.: Sandwich 2517

BAKER 12" MAJOR £11·55

30-14,500 cps. Double cone woofer and tweeter loudspeaker. Baker ceramic magnet assembly, flux density 145,000 gauss. BASS RESONANCE 40 cps 20 watt RMS.

MAJOR MODULE KIT £14·85

30-17,000 cps. woofer, tweeter, crossover and baffle as illustrated. Size 19in × 13in.

NOTE—When ordering state 3 or 8 or 15 ohms.

BAKER LOUDSPEAKERS 100% BRITISH MADE

Regent 12 in. 15W £10·45	Superb 12 in. 20W £18·70	New Group 50/12
Major 12 in. 20W £11·55	Group 25 12 in. 25W £10·45	12 in. 50W £17·60
Deluxe 12 in. 15W £13·20	Group 35 12 in. 35W £11.55	30-16000 cps.

BAKER LOUDSPEAKER CO., BENSHAM MANOR PASSAGE
THORNTON HEATH, SURREY Tel. 01-684-1665
PRICES INCLUDE VAT. HI-FI ENCLOSURE PLANS 42p

FREE!

Practical Radio & Electronics Certificate course includes a learn while you build ***3 transistor radio kit.*** Everything you need to know about ***Radio & Electronics*** maintenance and repairs for a ***spare time income*** and a ***career*** for a better future.

Over 150 ways to engineer a better future

HIGHER PAY

A BETTER JOB

SECURITY

find out how in just 2 minutes

That's how long it will take you to fill in the coupon. Mail it to B.I.E.T. and we'll send you full details and a free book. B.I.E.T. has successfully trained *thousands* of men at home - equipped them for higher pay and better, more interesting jobs. We can do as much for YOU. A low-cost B.I.E.T. home study course gets results fast - makes learning easier and something to look forward to. There are no books to buy and you can pay-as-you-learn.

Why not do the thing that really interests you? Without losing a day's pay, *you* could quietly turn yourself into something of an expert. Complete the coupon (or write if you prefer not to cut the page). No obligation and nobody will call on you . . . but it could be the best thing you ever did.

Others have done it, so can you

"Yesterday I received a letter from the Institution informing that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained a view echoed by two colleagues who recently commenced the course".-- Student D.I.B., Yorks.

"Completing your course, meant going from a job I detested to a job that I love, with unlimited prospects".– Student J.A.O. Dublin.

"My training with B.I.E.T. quickly changed my earning capacity and, in the next few years, my earnings increased fourfold". –Student C.C.P., Bucks.

FIND OUT FOR YOURSELF

These letters -- and there are many more on file at Aldermaston Court – speak of the rewards that come to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help *you*. **Write to B.I.E.T. Dept. BPE 10 Aldermaston Court, Reading RG7 4PF.**

CUT OUT THIS COUPON

Tick or state subject of interest.
Post to address below.

MECHANICAL
- Society of Engineers— A.M.S.E. (Mech.) ☐
- Institute of Engineers & Technicians (A.M.I.E.) ☐
- CITY & GUILDS Gen. Mech. Eng. ☐
- Maintenance Eng. ☐
- Welding ☐
- Gen. Diesel Eng. ☐
- Sheet Metal Work ☐
- Eng. Inspection ☐
- Eng. Metallurgy ☐

ELECTRICAL & ELECTRONIC
- Society of Engineers— A.M.S.E. (Elec.) ☐
- CITY & GUILDS Gen. Electrical Engineering ☐
- Electrical Installations ☐
- Electrical Maths ☐
- Computer Electronics ☐
- Electronic Eng. ☐
- Practical Radio & Electronics (with kit) ☐

MANAGEMENT & PRODUCTION
- Institute of Cost & Management Acctnts. ☐
- Computer Programming ☐
- Works M'ment. ☐
- Work Study ☐
- Gen. Production Eng. ☐
- Estimating & Planning ☐
- Storekeeping ☐
- Management Skills ☐
- Quality Control ☐

DRAUGHTSMANSHIP
- Institute of Engineering Designers (A.M.I.E.D.) ☐
- General Draughtsmanship ☐
- Elec. Draughtsmanship ☐
- Architectural Draughtsmanship ☐
- Technical Drawing ☐

RADIO & TELECOMMUNICATIONS
- CITY & GUILDS, Radio, TV/ Electronics ☐
- CITY & GUILDS Telecoms. ☐
- Gen. Radio & TV Eng. ☐
- Radio Amateurs Exam ☐
- Radio Servicing ☐
- TV Servicing ☐
- Colour TV ☐

AUTOMOBILE & AERONAUTICAL
- Institute of the Motor Industry A.M.I.I. ☐
- MAA IMI ☐
- CITY & GUILDS Auto Eng. ☐
- Gen. Auto Eng. ☐
- Motor Mechanics ☐
- Auto Diesel Eng. ☐
- Garage M'ment. ☐
- ARB Aero Engineering Certs. ☐
- Gen. Aero Eng. ☐

CONSTRUCTIONAL
- Society of Engineers— A.M.S.E. (Civ.) ☐
- Institute of Building—L.I.O.B. ☐
- A.B.T. Clerk of Works ☐
- Construction Surveyors Institute—L.C.S.I. ☐
- CITY & GUILDS (General Building (all branches) ☐
- Heating & Vent. ☐
- Inst. Clerk of Works ☐
- Site Surveying ☐
- Health Engineering ☐
- Road Construction ☐
- Quantities, Estimates ☐
- Hydraulics ☐
- Structural Eng. ☐

GENERAL
- Agricultural Eng. ☐
- Council of Eng. Institutions ☐
- Farm Science ☐
- Plastics ☐

Supplementary courses for Nat. Certificates.

G.C.E.
– choose from 58 'O' & 'A' level subjects.

Coaching for many exams, including C & G

POST TODAY FOR A BETTER TOMORROW

To B.I.E.T., Dept. BPE 10 QN
Aldermaston Court, Reading RG7 4PF
BPE 10

NAME
Block Capitals Please
ADDRESS

OTHER SUBJECTS

AGE

Accredited by C.A.C.C.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Published approximately on the 15th of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd. Publishers' Subscription Rate (including postage): Inland £3·25, Overseas £3·50.

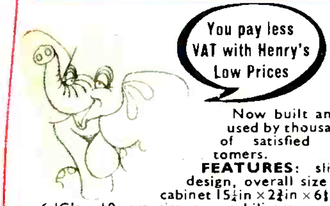
Practical Electronics is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

Henry's

DON'T RELY ON YOUR MEMORY
BUY NOW AT BARGAIN PRICES
Hi Fi and Transistors – Up to date
Brochures on request

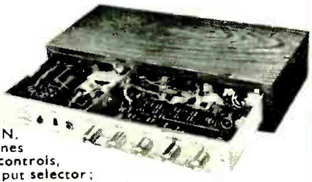
HENRY'S CATALOGUE

Due to rapid price changes, shortages of paper and raw materials, all prices in the existing catalogues no longer apply. Call or phone for latest prices. A new catalogue will be available for Aug/Sept 1974.



BUILD THE
TEXAN
20 + 20 WATT IC STEREO AMPLIFIER

As featured by Practical Wireless 1972



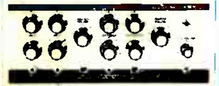
Now built and used by thousands of satisfied customers.
FEATURES: slim design, overall size in cabinet 15¼in × 2¾in × 6⅛in 6-IC's, 10 transistors, stabilisers, Gardeners low field transformer, Fibre Glass PC Panel, complete chassis work. Now available built and tested as well as in kit form.
HIGH QUALITY & STABILITY ARE PREDOMINATE FEATURES—DEVELOPED TEXAS ENGINEERS FOR PERFORMANCE, BY RELIABILITY AND EASE OF CONSTRUCTION.
FACILITIES. On/off switch indicator, headphones socket, separate treble, bass, volume and balance controls, scratch and rumble filters, mono/stereo switch, input selector; Mag. P.U., Radio Tuner, Aux. Can be altered for Mic, Tape, Tape-head, etc. Constructional details Ref. No. 21, 30p. Distributed by Henry's throughout UK.

FREE Teak cabinet with complete kit.

KIT PRICE **£28·50** (+ VAT + 50p carr/packing) or

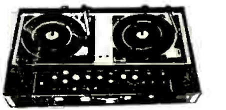
built and tested **£35·00** (+ VAT + 50p carr/packing) as illustrated

EARN YOURSELF EASY MONEY, WITH PORTABLE DISCO EQUIPMENT



DISCO MINI: A complete portable disco, fitted mixer/preamp, 2 decks all facilities . .	£98·50
As above but with Slider Controls . .	£118·50
100 watt amplifier for above	£49·50
SDLS100: 100 watt mixer/amplifier with slider controls	£69·00
R50: 50 watt mixer/amplifier	£49·50
R100 100 watt mixer/amplifier	£57·50
DISCO AMP: 100 watt mixer/amplifier	£73·00
Northcourt	
400 40 watt mixer amp	£37·50
800 80 watt mixer rmp	£45·00
DISCO MIXER/PREAMPLIFIERS (O/P for up to 6-100 watt amplifiers):	
SDLI (rotary controls):	£49·50
SDLII (slider controls):	£58·50
DISCO VOX (slider controls): The complete disco preamp.	£72·00
DJ100: 100 watt power amplifier for above	£49·50
DJ30L Mk II 3 channel 3kW sound to light	£41·25
DJ30L Mk III. Slider Controls	£45·50
DJ DISCLITE. As 30L/II + Variable speed flashes	£54·00
DIMAMATIC. 1kW adjustable speed auto dimmer	£25·00
Carlsbro Reverberation Unit	£44·00
Disco anti-feedback microphone	£11·95
Colt 150 watt liquid wheel projector . .	£23·50
150 watt QI liquid wheel projector . .	£50·00
150 watt QI cassette wheel projector . .	£50·00
Spare Effects and Liquid cassettes, large range of patterns	£6·00
Mini spot bank fitted 3 lamps	£12·95
Auto Trilite (mini with flashers)	£17·00
Bubblemaster with 1 gal. liquid	£41·15

MIXERS/MICS/SPEAKERS/LIGHTING
U.K.'s largest range of Disco lighting
6in liquid wheels **£5·00** Various Cassettes £6·00
FREE STOCK LIST Ref. No. 18 ON REQUEST
AKG/RESLO/DJ/CARLSBRO/EAGLE CHASSIS AND COMPLETE SPEAKER SYSTEMS, MEGAPHONES, TURNTABLES, PUBLIC ADDRESS COMPONENTS, MICS., STANDS, MIXERS, CABINETS



All prices carr. paid (UK) (VAT EXTRA).
Barclaycard/Access call, write or phone your order 01-723 6963—easy terms for callers.

EXCLUSIVE DECCA KELLY SPEAKERS

12 watt speaker Tweeter systems. 8in Bass/Midrobe and Melinex Domed HF radiator plus crossover **£12·50** per pair of systems (carr/packg. 40p) or built into veneered cabinets, size 18 × 12 × 6½in. **£19·50** pair (carr. £1).

HI-FI TAPE EQUIPMENT

U.K.'s largest range with discounts and demonstrations for callers. Latest stock lists on request (Ref. No. 17).
Phone 01-402 4736 for Barclay/Access Card, Direct orders and latest prices.

TRANSISTORS/ SEMICONDUCTORS

U.K.'s largest range for every application. Small quantity discounts. Also Trade, Export and Industrial enquiries invited. Latest stock list (Ref. No. 36). Including valves on request.

ELECTRONICS SUPPLIES

Specialists in electronics for more than 30 years. Trade and industry supplies — every type of component and equipment.

SINCLAIR PROJECT 80

Stereo Preamplifier . .	£11·95
Audio Filter Unit . .	£6·95
Z40 15 watt Amplifier	£5·45
Z60 25 watt Amplifier	£6·95
PZ5 Mod. for 1 or 2 Z40	£4·98
PZ6 Mod. (S Tab) 1 or 2 Z40	£7·98
PZ8 Mod. (S Tab) 1 or 2 Z60	£7·98
TRANSFORMER FOR PZ8	£3·95
NEW FM TUNER . .	£11·95
STEREO DECODER	£7·45

All items post paid.

BUILD THE NEW HENELEC STEREO FM TUNER

A completely new high stability stereo FM tuner. Features variable capacity diode tuning, stabiliser power supply, IC Decoder, high gain low noise. IF stages. LED indicators, Tuning meter, AFC, Easy to construct and use. Mains operated. Slim modern design with fibre glass PC, teak cabinet, etc. Available as a kit to build or ready built. Overall size: 8in × 2¾in × 6⅛in. Produced to give high performance with a realistic price. (Parts list and constructional details Ref. No. 5, 30p.) Henry's are sole distributors UK and Europe.

Kit Price **£21·00** (+ VAT)

or built and tested **£24·95** (+ VAT)

LIVING SOUND LOW NOISE TOP QUALITY CASSETTES MADE BY EMI TAPES LTD. TO INTERNATIONAL STANDARDS ESPECIALLY FOR HENRY'S. ALL POST PAID LESS THAN ½ REC. PRICES. COMPLETE WITH LIBRARY CASES.

	3 for	6 for	10 for	25 for
C60	£1·10	£1·98	£3·00	£7·40
C90	£1·46	£2·80	£4·60	£11·25
C120	£1·80	£3·45	£5·50	£13·45

Quantity and trade enquiries invited.

LEARN A LANGUAGE—complete with phrase book. German, French, Spanish, Italian. **£1·36** per course. **£5** for any 4.

LOW COST HI-FI SPEAKERS
SPECIAL OFFERS

EMI 13in × 8in—full range speakers (post 20p each or 30p pair); *150TC—8 ohms Twin Cone 10 watt, **£2·20** each or **£4** pair; *450 10 watt c/o Twin Tweeters 3, 8 or 15 ohms, **£3·85** each; EW 15 watt 8 ohms c/o Tweeter, **£5·25** each; 350 20 watt c/o Tweeters 8 or 15 ohms, **£7·80** each.
* Polished wood cabinet **£4·80**, post 35p.

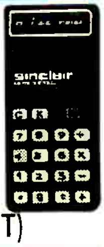
8 ohms full range (post 20p)
FR4 4in 5 watt, **£4·15**; FR65 6½in 10 watt, **£6·30**; FR8 8in 15 watt, **£8·50**; FR23 9 × 6in 15 watt, **£8·40**.

BASS AND MID RANGE—8 ohms (post 20p)
AA12 5in 15 watt, **£3·75**; B110 5½in 15 watt, **£7·20**; B200 8in 15 watt, **£8·50**; B139/2 13in × 8in 30 watt LF, **£13·75**.

TWEETERS AND CROSSOVERS (post 20p)
K2006 10 watt 8 or 15 ohms, **£2·10**; FHT6 15 watt 8 ohms, **£3·35**; K2011 30 watt 8 ohms, **£4·80**; T27 KEF, **£5·50**; Axent 100 30 watt 8 ohms **£5·50**; K4009 1kHz/5kHz c/o, **£2·70**; SN75 3kHz var. c/o, **£3·10**.

SPEAKER KITS (carr. etc. 35p)
20-2 8in 30 watt, **£24·50** pair; 20-3 8in 40 watt, **£35·95** pair; LINTON 2 20 watt, **£18·30** pair; GLENDALE 3 30 watt, **£32·95** pair; DOVEDALE 3 50 watt, **£51·50** pair; KEF KK2, **£55·00** pair; KEF KK3, **£78·00** pair.

BUILD YOURSELF A POCKET CALCULATOR



A complete kit, packaged in a polystyrene container and taking about 3 hours to assemble—that's the Sinclair Cambridge pocket calculator from Henry's. Some of the many features include interface chip, thick-film resistor pack, printed circuit board, electronic components pack. Size: 4⅓in long × 2in wide × 11/16in deep.
Free of charge with the kit for the more advanced technologist is a 32-page booklet explaining how to calculate Logs, Tangents, Sines, etc.

Price **£24·95** (+ VAT)

Also assembled ready to use **£27·20** (+ VAT)

10% VAT TO BE ADDED TO ALL ORDERS. EXPORT SUPPLIED. Prices and descriptions correct at time of proof. Subject to change without notice E & O E. See pages 298 and 299 of this magazine.

Like a permanent job at Henry's? Experienced and trainee salesmen required. Tel. 01-402 8791.

Henry's RADIO LIMITED
EDGWARE ROAD, LONDON W2

404-406 Electronic Components and Equipment 01-402 8381
309 PA – Disco – Lighting High Power Sound 01-723 6963
303 Bargains Store Callers only!
Home and Car Entertainment Centres London and branches now open
120 Shaftesbury Avenue London W1 01-437 9692
104 Burnt Oak Broadway Burnt Oak Edgware 01-952 7402
190-194 Station Road, Harrow Middlesex 01-663 7788/9
354-356 Edgware Road, London W2 01-402 5854/4736

All mail to
303 Edgware Road,
London W2 1BW

All stores open 9 am to 6 pm six days a week
Hi-Fi Tape Equipment Discount Stock List Free at all stores