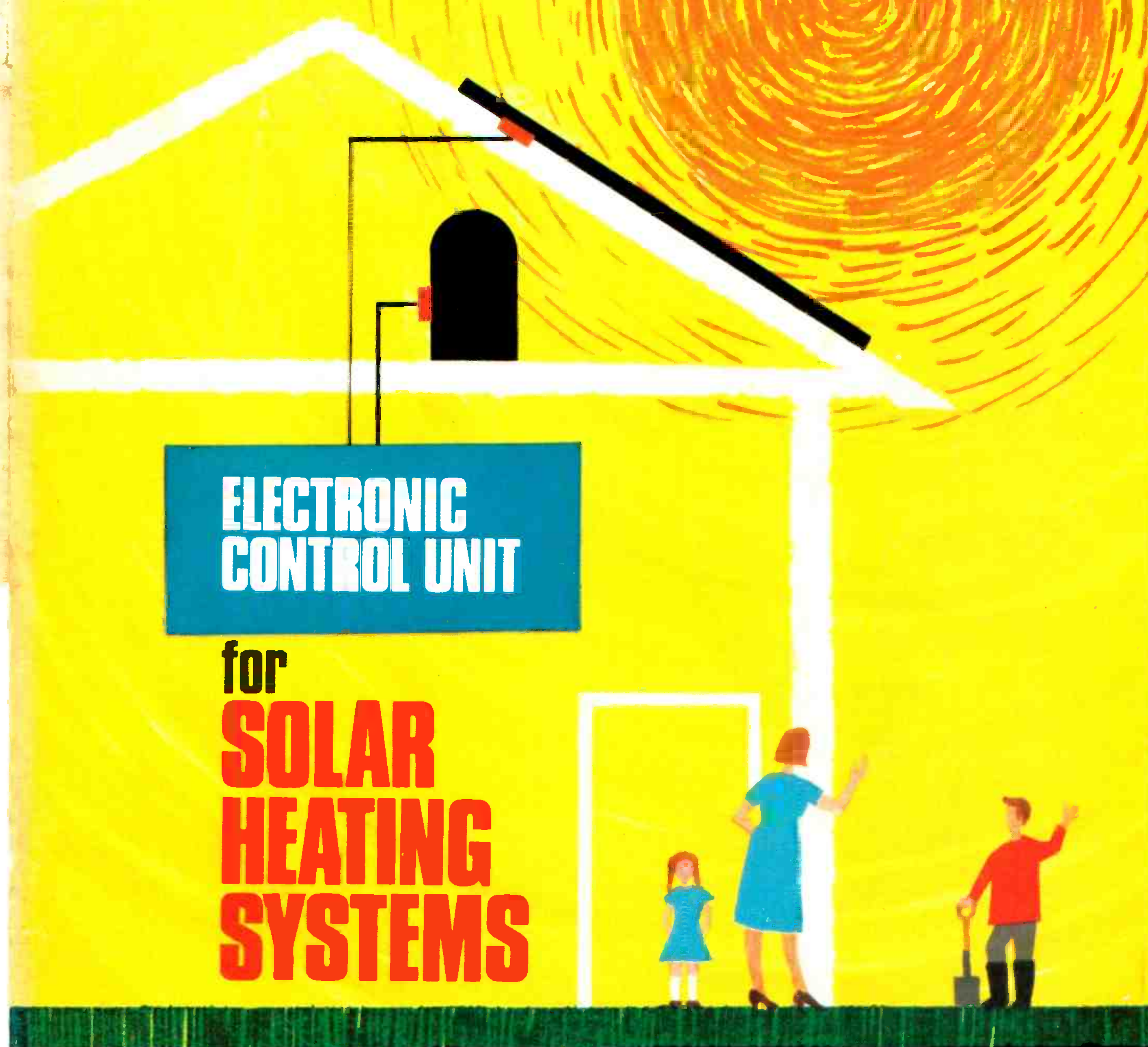
PRACTICAL

ELECTRONICS

FEBRUARY 1977

40p



ELECTRONIC CONTROL UNIT for SOLAR HEATING SYSTEMS

ALSO INSIDE...

RADIO CONTROL - Part 2 · I.C. SNAP

SEVEN SEGMENT DISPLAY for Oscilloscopes

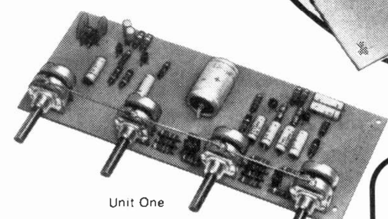
Stirling Sound

QV* MODULES FOR COST-CONSCIOUS CONSTRUCTORS

STIRLING SOUND policy is to ensure customer satisfaction by designing and making their products in their own factory in Essex and selling direct. Production control-checked throughout. All QV Modules are compatible within the range and with much other equipment

SS140
40 watts r.m.s. into 4 ohms using 45V supply such as SS345. Ideal for small discos and P.A. 101 × 76 × 19mm (4 × 3 × ¾in)
£3·95†

PRE AMP/TONE CONTROL MODULES



Unit One

UNIT ONE

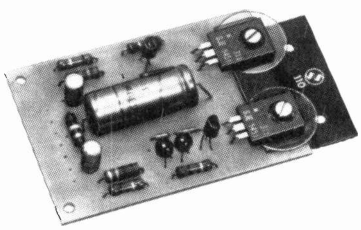
Combined pre-amp with active tone-control circuits ±15dB at 10kHz treble and 30Hz bass. Stereo. Vol balance treble bass. 200mV out for 50mV in. Takes 10–16V £7·80

SS100 Active tone control stereo ±15dB on bass and on treble £1·60

SS101 Pre-amp for ceramic cartridges, radio, tape. Stereo. Passive tone control circuit shown in data supplied £1·60

SS102 Stereo pre-amp for low output magnetic P.U.s. R.I.A.A. corrected. Linear feedback facility £2·65

POWER AMPLIFIERS FROM 3 TO 100 WATTS R.M.S.



New style for power amps SS105, SS110 and SS120

THE NEW SS1100

Delivers 100 watts r.m.s. into 4 ohms using 70 volt supply. Heavy duty, ruggedly constructed module complete with output capacitor and heatsink-type mounting bracket. Size approx. 140 × 76 × 32mm. Just the job for disco or P.A. use. 9·45†

Large Heatsink— £1·00†

SS103 3 watt r.m.s. mono I.C. with built-in current, short, and thermal protection £1·75

SS103-3 Stereo version of above £3·25

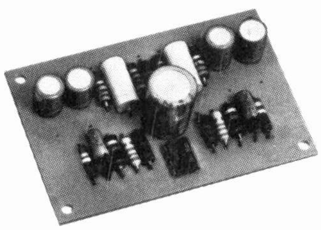
SS105 5 watts r.m.s. into 4 ohms, using 12V (SS312 for example) £2·25

SS110 10 watts r.m.s. using 24V and 4 ohm load. Use SS324 as the power supply £2·75

SS120 20 watts r.m.s. into 4 ohms using 34V. Use SS324 for your power supply £3·25

Modules SS105/110/120 all measure 89 × 50 × 19mm (3½ × 2⅛in). Suitable power supplies will be found in the accompanying range

VAT for power supplies ordered with amps SS103–SS120 becomes 12%



FM TUNING MODULES

SS201 Front end tuner, slow geared drive, two gang A.F.C. facility. Tunes 88–108MHz £5·00

SS202 I.F. amplifier. Metering and A.F.C. facilities £2·65

SS203 Stereo Decoder for use with the above or other FM mono tuners. A LED may be fitted £3·85

Appropriate technical data with all modules

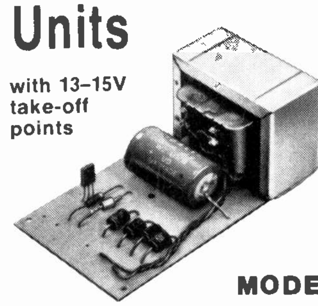
*THE BUILT-IN QV FACTOR

means Stirling Sound's guarantee of QUALITY AND VALUE to give you today's best value all round.

TODAY'S BEST VALUE IN

Power Supply Units

with 13–15V take-off points



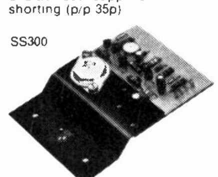
7 MODELS TO CHOOSE FROM

All the following are supplied assembled complete with mains transformers and low volt take-off points except SS312. Complete with mains transformers (except SS300). All at 8% VAT rate. Add 50p for p/p any model except SS300.

SS312	12V/1A	£3·75†
SS318	18V/1A	£4·15†
SS324	24V/1A	£4·60†
SS334	34V/2A	£5·20†
SS345	45V/2A	£6·25†
SS350	50V/2A	£6·65†

SS300 POWER STABILISING UNIT

Adjustable from 10V/2A to 50V/8A for adding to unstabilised supplies. With built-in protection against shorting (p/p 35p) £3·25†



SS300

SS310/50
Stabilised power supply with variable output from 10 to 50V/2A. With built-in protection against shorting
£11·95†

WHEN ORDERING

Add 35p for p/p unless stated otherwise. VAT add 12½% to total value of order unless price is shown † when the rate is 8%. Make cheques, etc., payable to Bi-Pre-Pak Ltd. Every effort is made to ensure correctness of information at time of going to press. Prices subject to alteration without notice.

Stirling Sound

A member of the Bi-Pre-Pak group

220–224 WEST ROAD, WESTCLIFFE-ON-SEA, ESSEX SS0 9DF

Telephone Southend (0702) 46344

PERSONAL CALLERS WELCOME

PRACTICAL
ELECTRONICS

VOLUME 13 No. 2 FEBRUARY 1977

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

Our March issue will be on sale on Friday, February 11, 1977

(for details of special Free wallchart and other contents, see page 125)

© IPC Magazines Limited 1977. Copyright in all drawings, photographs and articles published in PRACTICAL ELECTRONICS is fully protected, and reproduction or imitations in whole or part are expressly forbidden. All reasonable precautions are taken by PRACTICAL ELECTRONICS to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

Join the Digital Revolution

Understand the latest developments in calculators,

computers, watches, telephones,

television, automotive instrumentation. . .

Each of the 6 volumes of this self-instruction course measures 11½" × 8¼" and contains 60 pages packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra, to memories, counters and simple arithmetic circuits, and on to a complete understanding of the design and operation of calculators and computers.
Design of Digital Systems.

£6·20

plus 80p packing and surface post anywhere in the world.

Payments may be made in foreign currencies.

Quantity discounts available on request.

VAT zero rated.

Also available—a more elementary course assuming no prior knowledge except simple arithmetic.
Digital Computer Logic and Electronics
In 4 volumes:

1. Basic Computer Logic
2. Logical Circuit Elements
3. Designing Circuits to Carry Out Logical Functions
4. Flipflops and Registers

£4·20

plus 80p P. & P.

Offer Order both courses for the bargain price £9·70, plus 80p P. & P.

Designer
Manager
Enthusiast
Scientist
Engineer
Student

These courses were written so that you could teach yourself the theory and application of digital logic. Learning by self instruction has the advantages of being quicker and more thorough than classroom learning. You work at your own speed and must respond by answering questions on each new piece of information before proceeding to the next.

Guarantee—no risk to you

If you are not entirely satisfied with Design of Digital Systems or Digital Computer Logic and Electronics, you may return them to us and your money will be refunded in full, no questions asked.

To Cambridge Learning Enterprises (Dept. ENG)
FREEPOST, St. Ives, Huntingdon, Cambs. PE17 4BR

*Please send me....set(s) of Design of Digital Systems at £7·00 each, p & p included

*or ... set(s) of Digital Computer Logic and Electronics at £5·00 each, p & p included

*or ...combined set(s) at £10 50 each, p & p included

Name ....

Address ....

....

....

*delete as applicable
No need to use a stamp—just print FREEPOST on the envelope. PE2

LEKTROPACKS

17 Turnham Green Terrace, Chiswick, London, W.4. Tel: 01-994 2784

★ NEW ★ FULLY GUARANTEED COMPONENT PACKS ★ FULL SPEC. SEMI-CONDUCTORS ★ AVAILABLE IN LOW COST PACKS OF TEN ★ ALL PRICES INCLUDE VAT AND U.K. POSTAGE ★ NO HIDDEN EXTRAS ★ TEN PACKS LESS 15%.

	Price per 10		Price per 10				Price per 10		
AC126	£1·50	BD131	£3·00	OA202	£0·80	TIP35A	£13·50	2N2906	£2·50
AC128	£1·20	BD132	£3·50	OA211	£2·50	TIP35B	£14·50	2N2907	£2·00
AC176	£1·20	BF194	£1·00	OC71	£1·00	TIP35C	£15·30	2N2926	£1·20
BC107	£1·00	BF195	£1·00	TIP29A	£4·50	TIP36A	£30·00	2N3053	£2·20
BC108	£0·00	BFY50	£2·20	TIP29B	£5·50	TIP36B	£32·00	2N3054	£4·50
BC114	£1·00	BFY52	£2·80	TIP29C	£6·90	TIP36C	£38·00	2N3055	£5·00
BC126	£1·00	BFY90	£10·00	TIP30A	£5·40	TIP41A	£8·30	2N3643	£2·80
BC147	£1·20	BFX29	£2·80	TIP30B	£6·90	TIP42A	£8·10	2N3702	£1·50
BC148	£1·20	BFX84	£3·00	TIP30C	£7·80	TXAL228B 3A		2N3703	£2·40
BC168	£1·20	BFX87	£3·00	TIP31A	£5·50	400V Triac	£9·50	2N3706	£1·20
BC182	£1·20	BFX88	£2·50	TIP31B	£6·90	1N914	£0·60	2N3707	£1·50
BC183	£1·20	BY127	£1·20	TIP31C	£7·80	1N4003	£0·60	2N3819	£2·20
BC184	£1·20	BZY59	£1·00	TIP32A	£8·00	1N4004	£0·70	2N3820	£2·50
BC212	£1·20	C106B	£5·00	TIP32B	£8·50	1N4005	£0·75	2N3904	£1·80
BC213	£1·20	D30 Diac	£1·50	TIP32C	£9·00	1N4006	£0·90	2N3905	£1·80
BC214	£1·20	MFC4000	£6·00	TIP33A	£9·00	1N4148	£0·70	2N3906	£2·00
BC237	£1·20	MPF103	£3·80	TIP33B	£11·80	2N706	£1·20	40360	£4·00
BCY38	£10·00	MPF104	£3·80	TIP33C	£13·00	2N708	£1·50	40361	£4·00
BCY70	£2·20	NKT135	£2·00	TIP34A	£13·50	2N930	£2·00	40362	£4·00
BCY71	£2·00	OA10	£2·00	TIP34B	£14·00	2N2219	£2·20		
BCY72	£2·00	OA200	£0·80	TIP34C	£15·30	2N2904	£2·60		

WIRE ENDED ELECTROLYTICS (Mullard, Sprague, etc.) 10 for **60p.**

mF	Volts	mF	Volts	mF	Volts
4	64	10	63	47	10
4·7	63	15	40	50	40
5	50	22	10	64	64
6·8	40	22	35	100	10
10	12	33	40	100	16
10	25	33	100	100	40

SUB-MINIATURE PRESET POTS (horiz. or vert. P.C. Mounting) 10 for **50p.**
50, 100, 250, 500, 1K, 2K, 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M, ohms.

THERMAL GAS SENSOR. Figaro TGS105 **£2·25** each. As used in Sept. '76 P.E. Gas/Smoke Detector.
Organ Constructors
13-NOTE BASS PEDAL BOARD
Hard wearing plastic covered steel levers. Change-over contacts on each note. Slightly shop-soiled therefore less than half price **£12·50 each**
Miniature Mains Transformers
Pri 240V a.c. Sec. 12V 150mA. 10 for **£5·75.**

CELESTION 2in and 3in Tweeters. Suitable for systems up to 20W.
Available in 4, 8, 16 ohms. Impedance. **£1·50** each. 2 for **£2·90**, 10 for **£25·00.**
Crossover network suitable for above tweeters **£1·50.**

SPECIAL REDUCTIONS OF EAGLE INTERNATIONAL PRODUCTS
While Stocks Last

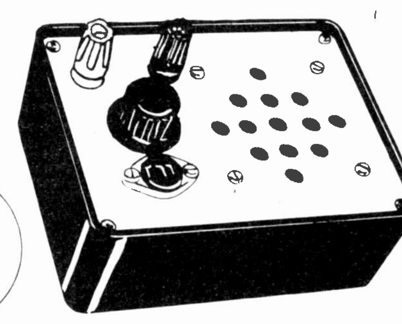
		RRP	Reduced to
TPA160	P.A. Amplifier 240V a.c.	£149·00	£99·00
TPA40	P.A. Amplifier 240V a.c./12V d.c.	£61·00	£39·50
AG71	Audio Signal Generator	£61·00	£39·50
SG70	R.F. Signal Generator	£54·00	£35·00
SAC14	7 + 7W Stereo Amp. Module	£9·50	£7·50
SAC30	15 + 15W Stereo Amp Module	£14·50	£10·95

All prices include VAT and U.K. Postage. Callers welcome.

DORAM kits

DORAM KITS CONTAIN EVERYTHING DOWN TO THE LAST NUT

TEST BENCH AMPLIFIER 1W

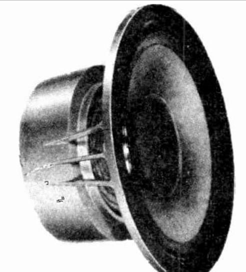


£4·59 +S

For use in fault finding, development work and testing equipment without its own audio output stage. This invaluable portable equipment may be used with its own built-in speaker or with an extension loudspeaker. Screw terminal input connections.
£4·59 + S (order code 991-495). Subject to availability

O'seas orders—add 15% for P + P. All items offered for sale subject to the Terms of Business as set out in Doram Edition 3 catalogue, price 60p. The Doram Kit brochure is also available, price 25p. Combined price only 70p which also entitles you to 2 × 25p vouchers, each one usable on any order placed to the value of £5·00 or more (ex. VAT).

DORAM ELECTRONICS LTD
P.O. Box TR8, Wellington Road Industrial Estate, Leeds LS12 2UF.
An Electrocomponents Group Company



WILMSLOW AUDIO

THE Firm for speakers!

SPEAKERS

Baker Group 25, 3, 8 or 15 ohm	£13·00
Baker Group 35, 3, 8 or 15 ohm	£14·50
Baker Group 50/12 8 or 15 ohm	£14·00
Baker Group 50/15 8 or 15 ohm	£18·62
Baker Deluxe 124, 8 or 15 ohm	£17·50
Baker Major 3, 8 or 15 ohm	£15·00
Baker Superb 8 or 15 ohm	£22·50
Baker Regent 12in 8 or 15 ohm	£12·50
Baker Auditorium 12in 8 or 15 ohm	£14·85
Baker Auditorium 15in 8 or 15 ohm	£19·41
Castle 8RS/DD 4 or 8 ohm	£9·28
Celestion G12M 8 or 15 ohm	£12·95
Celestion G12H 8 or 15 ohm	£15·95
Celestion G12/50 8 or 15 ohm	£18·00
Celestion G12/50TC 8 or 15 ohm	£20·00
Celestion G12/50 2236 s/cone	£18·00
Celestion G12/50 2239 s/cone, alum. dome	£18·50
Celestion G15C 8 or 15 ohm	£26·95
Celestion G18C 8 or 15 ohm	£39·95
Celestion HF1300 8 or 15 ohm	£7·50
Celestion HF2000 8 ohm	£8·55
Celestion MH1000 8 or 15 ohm	£13·50
Coles 4001G	£5·90
Coles 4001K	£5·90
Decca London ribbon horn	£29·95
Decca London CO/1000/8 crossover	£6·95
Decca DK30 ribbon horn	£19·95
Decca CO/1/8 crossover (DK30)	£4·75
EMI 14 × 9in bass 8 ohms, 14A770	£11·92
EMI 8 × 5in, 10W, d/cone, roll surr.	£3·75
EMI 6½in d/cone, roll surr., 8 ohm	£3·93
EMI 8in roll surr. bass	£5·73
EMI 5in mid range	£3·15
Elac 59RM 109 (15 ohm), 59RM114 (8 ohm)	£3·38
Elac 6½in d/cone, roll surr., 8 ohm	£3·95
Elac 10in 10RM239, 8 ohm	£3·95
Eagle FR4	£5·51
Eagle FR65	£8·95
Eagle FR8	£11·95
Eagle FR10	£14·06
Eagle HT15	£3·96
Eagle HT21	£4·95
Eagle MHT10	£4·00
Eagle FF28 Multicell. horn	£5·95
Fane Pop 15, 8 or 16 ohm	£5·50
Fane Pop 33T, 8 or 16 ohm	£9·75
Fane Pop 50, 8 or 16 ohm	£12·50
Fane Pop 55, 8 or 16 ohm	£16·75
Fane Pop 60, 8 or 16 ohm	£19·95
Fane Pop 70, 8 or 16 ohm	£21·75
Fane Pop 100, 8 or 16 ohm	£33·95
Fane Crescendo 12, 8 or 16 ohm	£42·95
Fane Crescendo 12BL, 8 or 16 ohm	£44·95
Fane Crescendo 15/100A, 8 or 16 ohm	£54·95
Fane Crescendo 15/125, 8 or 16 ohm	£64·95

SPEAKERS

Fane Crescendo 18, 8 or 16 ohm	£75·95
Fane 910 Mk II horn	£15·75
Fane 920 Mk II horn	£45·95
Fane HPX1 crossover 200W	£2·50
Fane 13 × 8in, 15W dual cone	£5·50
Fane 801T 8in d/c, roll surr.	£8·96
Gauss 12in	£95·00
Gauss 15in	£110·00
Gauss 18in	£121·00
Goodmans Axent 100	£8·50
Goodmans Audiom 200 8 ohm	£14·95
Goodmans Axiom 402 8 or 15 ohm	£22·00
Goodmans Twinaxiom 8, 8 or 15 ohm	£10·60
Goodmans 8P 8 or 15 ohm	£6·50
Goodmans 10P 8 or 15 ohm	£6·95
Goodmans 12P 8 or 15 ohm	£16·50
Goodmans 12PG 8 or 15 ohm	£17·75
Goodmans 12PD 8 or 15 ohm	£18·75
Goodmans 12AX 8 or 15 ohm	£44·00
Goodmans 15AX 8 or 15 ohm	£49·00
Goodmans 15P 8 or 15 ohm	£24·00
Goodmans 18P 8 or 15 ohm	£39·95
Goodmans Hifax 750P	£16·00
Goodmans 5in midrange 8 ohm	£4·05
Jordan Watts Module, 4, 8 or 15 ohm	£15·36
Kef T27	£5·75
Kef T15	£10·75
Kef B110	£7·95
Kef B200	£9·25
Kef B139	£17·95
Kef DN8	£2·50
Kef DN12	£6·95
Kef DN13 SP1015 or SP1017	£4·95
Lowther PM6	£32·00
Lowther PM6 Mk 1	£35·00
Lowther PM7	£48·60
Peerless KO10DT 4 or 8 ohm	£8·25
Peerless DT10HFC 8 ohm	£9·50
Peerless KO40MRF 8 ohm	£9·95
Peerless MT225HCF 8 ohm	£3·40
Richard Allan HP8B	£12·50
Richard Allan LP8B	£8·50
Richard Allan DT20	£6·25
Richard Allan CN8280	£16·95
Richard Allan CN820	£3·15
Richard Allan Super Disco 60W 12in	£16·95
Richard Allan CG15 15in bass	£27·45
Richard Allan Super Disco 10in 50 watt	£13·25
Richard Allan Super Disco 8in 50 watt	£12·95
Radford BD25	£23·20
Radford MD9	£11·50
Radford MD6	£15·75
Radford TD3	£8·25
Radford Cross Over Network	£14·75
Tannoy 10in Monitor HPD	£78·00
Tannoy 12in Monitor HPD	£86·00
Tannoy 15in Monitor HPD	£99·95
Wharfedale Super 10 RS/DD 8 ohm	£13·50

SPEAKER KITS

Baker Major Module 3, 8 or 15 ohm	*each*	£13·50
Fane Mode One Mk II 15W	*each*	£10·35
Fane D40 Disco Kit	*each*	£19·95
Goodmans DIN 20 4 or 8 ohm	*each*	£15·75
Goodmans Mezzo Twin Kit	*pair*	£51·95
Helme XLK 30	*pair*	£21·95
Helme XLK 35	*pair*	£26·75
Helme XLK 40.	*pair*	£38·50
Kefkit 1	*pair*	£53·50
Kefkit III	*each*	£49·00
Peerless 1060	*pair*	£54·00
Peerless 1710	*each*	£46·50
Peerless 1120	*each*	£54·00
Peerless 2050	*pair*	£39·50
Peerless 2060	*pair*	£53·00
Richard Allan Twin assembly	*each*	£13·95
Richard Allan Triple 8	*each*	£20·75
Richard Allan Triple 12	*each*	£25·95
Richard Allan Super Triple	*each*	£29·50
Richard Allan RA8 Kit	*pair*	£37·80
Richard Allan RA82 Kit	*pair*	£59·40
Richard Allan RA82L Kit	*pair*	£65·70
Wharfedale Denton 2XP kit	*pair*	£23·25
Wharfedale Linton 3XP kit	*pair*	£34·25
Wharfedale Glendale 3XP kit	*pair*	£49·50

HI-FI ON DEMONSTRATION in our showrooms:

Akai, Armstrong, Bowers & Wilkins, Castle, Celestion, Dual, Goodmans, Kef, Leak, Pioneer, Radford, Richard Allan, Rotel, Tandberg, Trio, Videotone, Wharfedale, etc.—ask for our Hi-Fi discount price list.

THIS MONTH'S SPECIALS! (Carr. £2·50)

Rotel RA412	£77·95
Rotel RX202 Mk. II	£97·50
Videotone Minimax II	£43·00
Videotone Saphir II	£49·00
Pioneer SX450	£116·00
Sansui SC2000/2002	£149·70

We stock the complete Radford range of amplifiers, preamplifiers, power amplifiers, tuners, etc., and also Radford Audio Laboratory equipment, low distortion oscillator, distortion measuring set, audio noise meter, etc.

ALL PRICES INCLUDE VAT
(PRICES CORRECT AT 10/12/76)
Send stamp for free 38 page booklet "Choosing a Speaker"

ALL UNITS GUARANTEED NEW AND PERFECT

Carriage and insurance: Speakers up to 12in 60p; 12in £1; 15in £1·75; 18in £2·50. Kits £1 each (£2 per pair). Tweeters and Crossovers 33p each.

Complete kits in stock for Radford Studio 90, Radford Monitor 180, Radford Studio 270, Radford Studio 360, Hi-Fi Answers Monitor (Rogers), Hi-Fi News No Compromise (Frisby), Hi-Fi News State of the Art, Wireless World Transmission Line (Bailey), Practical Hi-Fi and Audio Monitor (Giles), Practical Hi-Fi and Audio Triangle (Giles), Popular Hi-Fi (Colloms), etc.

On dem. Answers Monitor, State of Art, etc.

Construction leaflets for Radford, Kef, Jordan Watts, Tannoy, Hi-Fi Answers Monitor, free on request.

P.A. amplifiers, microphones, etc., by Shure, Linear, Eagle, Beyer, AKG, etc.

FREE with orders over £10—"Hi-Fi Loudspeaker Enclosures" book.

WILMSLOW AUDIO

Dept PE

Loudspeakers, mail order and export: Swan Works, Bank Square, Wilmslow.

Hi-Fi, Radio and TV: Swift of Wilmslow, 5 Swan Street, Wilmslow, Cheshire.

PA, Hi-Fi and Accessories: Wilmslow Audio, 10 Swan Street, Wilmslow, Cheshire.

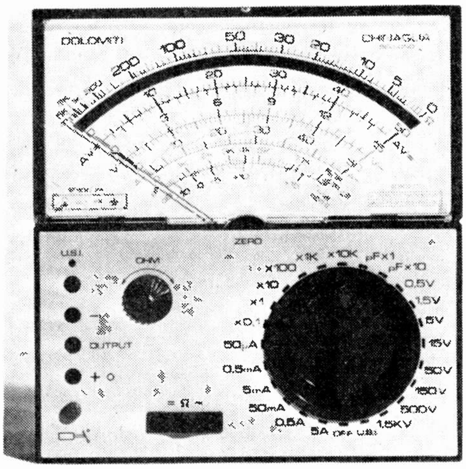
Telephone: Loudspeakers, mail order and export—Wilmslow 29599; Hi-Fi, Radio, etc.—Wilmslow 26213.

Access and Barclaycard orders accepted by phone

FROM THE BIGGEST RANGE OF GOOD QUALITY MULTIMETERS

CHINAGLIA

PRESENT THE



DOLOMITI

20kΩ/V a.c. and d.c.

A NEW HIGH SENSITIVITY MULTIMETER WITH ALL THE FEATURES YOU WILL EVER NEED

Accuracy: d.c. ranges, ±2·0%, a.c. and Ω ranges ±2·5%.
39 ranges: d.c. V, 0–150mV, 500mV, 1·5V, 5V, 15V, 50V, 150V, 500V, 1·5kV; d.c. I, 0–50μA, 500μA, 5mA, 50mA, 500mA, 5A; a.c. V, 5V, 15V, 50V, 150V, 500V, 1·5kV; a.c. I, 5mA, 50mA, 500mA, 5A; dB −10 to +65 in 6 ranges. Ω 0–0·5kΩ, 5kΩ, 50kΩ, 500kΩ, 5MΩ, 50MΩ, pF50kpF, 500kpF.

Automatic overload protection and high current range fusing
Scale mirror and fine pointer for accuracy of reading. Single knob main range switching and all panel controls. C.E.I. Class 1 movement with sprung jewel bearings. Extended 92mm scale length for extra clarity. Compact ABS case 125 × 131 × 37mm. Weight 650g with batteries. Supplied complete with carrying case, fused leads, hand-book and full 12-month guarantee. Optional 30kV d.c. probe available.

Meter £45·90 incl. VAT (£1 P. & P.)
30kV Probe £12·85 incl. VAT

For details of this and the many other exciting instruments in the Chinaglia range, including multimeters, component measuring, automotive and electronic instruments, please write or telephone.

ALCON Instruments Ltd.

19 MULBERRY WALK · LONDON SW3 6DZ · TEL. 01-352 1897

WELBROOK STEREO

This new hi-fi amplifier from Welbrook is the result of painstaking design incorporating 5 I.C.s 22 transistors plus 10 diodes and offers outstanding value for money to the discerning enthusiast.

30W RMS per channel into 8 ohms load. Total harmonic distortion less than 0·1% at all power levels.

Hum/Noise:
- −80dB Tape/Tuner
- −65dB Disc (Magnetic Input)

Complete unit comprising power supply, pre-amplifier with filter networks, two power amplifiers and loudness control all in teak finished cabinet only **£88** plus VAT.

As above but without filters and loudness control only **£79** plus VAT.

Also available in module form complete with front panel but without cabinet—easily assembled by the average enthusiast.

Send for details and price list to:

Welbrook Engineering & Electronics Ltd
Brooks Street, Hillgate
Stockport SK1 3HT

1¾in DIA. SUB-MINIATURE 8 OHM LOUDSPEAKERS, ¾in depth, **75p** each.
CRYSTALS 10XAJ TYPE, 600kHz **50p**, 7MHz **60p**, 8MHz **60p**; **10X TYPE**, 4MHz **60p**, 5MHz **50p**, 6MHz **60p**.
WIRE ENDED GLASS TYPES, 60kHz **£1·50**, 150kHz **£1·50**, 28kHz **50p**, 28·5kHz **50p**.
100 ASSORTED SUB-MINIATURE 50 V.W. DISC CERAMICS, from 3·3pF to 0·01μF. **57p**.
200 ASSORTED ¼W, ½W CARBON FILM RESISTORS. Odd values, **75p**.
60 ASSORTED WIRE WOUND RESISTORS, 1 to 10W, **57p**.
AUDIO I.C.s. SN76001 **50p**, TBA641 **80p**, TAA611B **65p**, SN76013ND **£1**, TBA800 **85p**, LM380 **80p**.
50 AC128 TRANSISTORS, marked but untested, **57p**.
30 AF117–OC170 TRANSISTORS, untested, **57p**.
30 ASSORTED 10XAJ CRYSTALS, between 5·1MHz and 7·9MHz, **£1·10**.
10,000μF 16V.W. ELECTROLYTIC CAPACITORS, **15p**, 4 for **50p**.
0·0005μF 75K.V.W. VISCONEL CAPACITORS, **50p** each.
WAYRAD 10·7MHz DOUBLE TUNED TRANSISTOR I.F.s, **11p** each.
455kHz VERSION OF LP1175 FILTER, with connections, **55p**.
10 GLASS REED SWITCHES, single pole make, **50p**.
NE556 DUAL TIMER I.C., **90p**.
20 ASSORTED F241A CRYSTALS, 54th harmonic between 71MHz and 98MHz, **£1·10**.
CERAMIC PL504 VALVE BASES, 6 for **50p**.
JAPANESE 5K EDGEWISE TRANSISTOR RADIO VOLUME CONTROLS, 3 for **57p**.
BOOKS: "Practical Test Equipment", **75p**; "Simple Short Wave Receivers", **60p**; "Practical Electronic Projects", **75p**. The three books for **£1·60**.
100 ASSORTED MULLARD C280 POLYESTER CAPACITORS, **57p**.
COMPRESSION TRIMMERS, 10pF, 30pF, 50pF, 150pF, 750pF, 1,000pF. All **6p** each.
BF180 or BF181 NPN TRANSISTORS, 5 for **60p**.
20 ASSORTED SILICON PHOTO and DARLINGTON TRANSISTORS, untested, **£1**.
TIL209 RED LEDS, 6 for **57p**.
MAINS TRANSFORMERS, 240V a.c. input, 18V 500mA output, **85p**.
ROCKER SWITCHES, 5A 240V on–off, **15p** each, 4 for **50p**, 12 for **£1**.
20 ASSORTED TUNING VARACTOR DIODES, untested, **45p**.
2A R.F. CHOKES, brand new, 6 for **50p**.
1,000μF 35V.W. WIRE ENDED ELECTROLYTICS, 4 for **50p**.
50 BC107–8–9 TRANSISTORS, untested, **57p**.
TEXAS 800V 2A PLASTIC TO3 POWER NPN TRANSISTORS, **50p** each, 3 for **£1·10**.
TEXAS POWER PNP DARLINGTONS TYPE TIP117, **35p** each.
RCA741 OP-AMP 8 LEAD DIL, 5 for **£1**.
FETs, like 2N3819, 6 for **75p**.
MINIATURE 8μF 300 V.W. ELECTROLYTICS, 10 for **57p**.
SOLAR CELLS, 5V 5mA, 35p each.
VHF TUBULAR TRIMMERS, 3pF **5p**, 8pF **8p**, 12pF **5p**.
VHF POWER TRANSISTORS, unmarked, good, 2N3553, 3 for **£1·10**.
AR88 L.F. CHOKES, brand new, **£1** each.

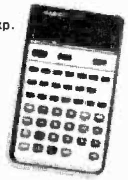
Please add 20p post and packing on orders under £2. Overseas orders at cost.

J. BIRKETT
RADIO COMPONENT SUPPLIERS
25 The Strait, Lincoln LN2 1JF
Tel. 20767

barclay ELECTRONICS

TECHNOLOGICAL PRECISION PRODUCTS

CASIO



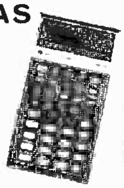
fx-201P (Illus.) 10 digit or 8 digit, 2 Exp. 127 Steps. 10 Inde. mems, cos, sin, tan. All log functions Degree Rad. Unconditional jump and manual jump as well as indirect address, subroutine etc. The programme function allows you to handle any type of calc. under any condition ***£49·95**

fx-102. The world's first fractional calculator. 10 digits or 8 plus 2 Exp. sin, cos, tan. Deg. rad. (exp. $10^{\pm 99}$). Trig. Inverse common & Natural logs. Reciprocals. Sexagesimal, Pi entry. Statistical calcs. incl. 2 kinds of Standard deviation and other applications. ***£19·95**

fx-19. 8 digits or 6 plus 2 Exp. Trig. inverse trig. All log functions. Sqr roots, Reciprocals. Sexagesimal/Decimal conversions, 2 kinds of Standard Deviation and other applications. ***£16·95**

AL8 A-dig. Fractional Calcs. standard deviations remainder from division. Time calcs. 2 mem. facs. $^2\sqrt{\ }$, %. **£13·95**

TEXAS



SR56 (Illus.) 100 Step programmable. 10 digit, 2 Exp. 10 Inde memories, all log trig and Stat functions. Can be programmed for maths, electronic engineering, statistical, financial and navigation. **£57·95(R)**

SR52. 224 programme steps. 20 Independent memories. 9 level parenthesis. Card programmable. Supplied with 20 blank magnetic cards and prog. manual **(R)£199·00**

Any of the following pre-programme manuals: 1. Statistics. 2. Electrical Engineering. 3. Mathematics. 4. Finance. ONLY £25 each

SR51. 10 digit, 2 Exp. Rechargeable. All log and trigs, Hyperbolic x to the root of y. Rad & Deg. Factorial. Mem. 3 Inde. mems. Linear regression. Mean, variance, standard deviation. Permutation, Perms. Random number generation + 20 basic converts., and their inverse. **(R)£47·95**

TI30. 48 functions plus Algebraic operating system. 15 seats parenthesis. Constant, roots, powers, reciprocals. Sci notation. Log, trig, deg rad, mem, step function. **£15·95.** Charger **£7·95**

NOVUS

4640 (Illus.) 10 digit, 2 Exp. 54 functions. 4-level roll stack. 3 Fully addressable memories. Logs, Trigs, Stat and Metric conversions etc. **(R)£42·95**

4650. 8 digit, 2 Exp. Algebraic logic. 2-level parentheses. Full mem. Addressable. Trig, sin, cos, tan and inverse trig functions. Deg rad. Reciprocal, Sq root. Powers and Pi entry. Mem Ex and Register Ex **(R)£27·50**

4525. 8 + 2 Exp. 100 step prog. R.P.N Full log and trig. XY Exchange. Mem. 4 roll stack, skip, delete. Additional progs within the 100 step **(R)£34·95**

4515. 100 step prog version **(R)£31·95**

6035. 100-step programmable Statistician. Rechargeable. **(R)£34·95**

6025. Rechargeable. Financier 100-step programmable **(R)£34·95**

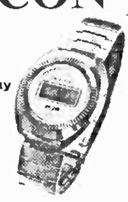
4510. 8 digits. 3 level stack. All trig & log functions. $\sqrt{\ }$. π. Reciprocal Memory, etc. **£12·95***

6030. Statistician. **£15·95***

6010. Metric. **£15·95***

The ZYCON *range of Quality Electronic Watches*

L.C.D.



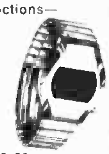
KLC3
L.C.D. Constant display Shows Hrs, Mins & pulsating secs. Chrome finish with Stainless Steel back and **FREE** Adjustable S/Steel bracelet. **£24·50**
Gold Plate £26·45

KLC9
Constantly shows hrs, mins & Pulsating secs. Press command button for mth & date, press again for mins & secs. May be set to alternate hr & mins to mth & date every 2 secs. resets to time. 4 yr cal. 'Nite Lite' **£37·90**
Gold Plate £42·40.
FREE matching bracelets with each.

KLCS
U.S.A. MODULE
Continuous hrs, mins & pulsating secs. Press command button for mth & date. Press again for secs readout. Setting for alternating hrs & mins to mth & date every 2 secs. Auto-time reset. 4 yr calendar. 'Nite-lite'. FREE matching S/Steel bracelet **£39·95**

L.E.D.

KED5
5-Functs. Shows Hrs, Mins, Secs, Mth & Date. 4-Yr calendar. Beautifully finished with S/steel back & **FREE** Leatherette Strap. **£19·95**
Gold Plate £22·95



KED6 A fantastic 6-Functions—window display shows Hrs, Mins, Secs, Mth & Date. **Day of week in letters.** Single button. Auto-hold & Fade-out. 4 Yr calendar. Case in Heavy Rhodium on Brass + S/steel back. **FREE** matching S/steel adjustable bracelet.
£29·95 Gold Plate £33·90

KED6 PLUS
Month & Day of the Week in Letters! Shows Hrs, Mins, Secs, Date, Mth & Date, Day of Week, Auto 4-Yr calendar, A.M./P.M. Set/Indicate. **One of the most sophisticated watches at this price.** Accurate to within a few secs a year. Finished in Satin Stainless Steel with **FREE** matching Steel bracelet. Trimest watch in the world.
£37·50 ONLY Gold Plate £40·50

EXCLUSIVE! Digital Alarm Watch

Just arrived and only from us! Shows Hrs, Mins, Secs, Mth, Date & Day! Advance bleep as a reminder then PULSATING BLEEP for 15 secs unless stopped when it will bleep 5 mins later as a further reminder AM/PM feature. Simple to set. Alarm-set check. Single command button for all time functions. **NO MORE PARKING FEES!** Solid Stainless Steel throughout with matching bracelet.
ONLY **£98·90** +£1·50 Ins. & P&P.

LADIES DIGITAL

THE IDEAL PRESENT!

An elegant 6-function watch. Shows Hrs, Mins, Secs, Mth, Date, Day! She'll love this piece of **miniaturised electronic** wizardry! Gold Plate or with stylised Chrome Bezel, each with matching bracelet.
GOLD PLATE £39·95
S/Steel **£36·95**
+ £1·50 Ins. P&P

AT LAST—THEY'VE ARRIVED! SOLAR WATCHES AND YOU HAVE A CHOICE OF TWO!

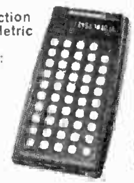
Restrained elegance by **ZYCON**
Ultra thin dress watch exclusive to us. In 20 micron **GOLD PLATE!** Shows Hours, Minutes, Seconds and Date. Backlight for viewing in darkness. **This is the neatest Solar Watch** we have seen! With flexible, adjustable Gold Plated bracelet.

£120·00
+£1·50 Ins. & P&P

AND FOR THE SPORTSMAN . . .
A really rugged watch in solid Stainless Steel with Stainless Steel adjustable band. Shows Hours, Minutes, Seconds, Month and Date. Ideal for wearing when indulging in outdoor activities.
£115·00 £1·50 Ins. & P&P

ALL WATCHES COME IN FREE PRESENTATION BOX
ALL ZYCON WATCHES CARRY OUR **'NO QUIBBLE'** *1 YEAR GUARANTEE*

CBM



4190R (Illus.) 10-digit, 2 Exp. 90 function pre-programmed. Metric conversions. Extra functions to the 4148R: Perms and combinations. Gamma. Poisson and Binomial distributions, factorial, complex numbers, hyperbolic functions, linear regression and integration of Y = f(x). **(R)£36·95**

7919D. 8-digit or 5-digit + 2 Exp. Full trig and log functions. Sq root. Reciprocals Y^x, X^2, π. Register exchange. Memory plus. Store recall. Sign change. Algebraic logic **£10·95***

4148. 10-digit + 2 Exp. Full log and trig funct. X^2, Reciprocal, π, x root of y. Polar rectangular co-ordinates. 2-store mem. Mean and Standard deviation. **(R)£26·95**

1800. As 4148 but Green display and Bat operation. **£20·95***

SINCLAIR

CAMBRIDGE SCIENTIFIC
5-digit ● 2 Exp ● C & CE key ● sin ● cos ● tan ● arcsin ● arccos and tan ● reciprocal ● E to the X ● natural log ● antilog ● memory + ● memory − ● memory exchange ● memory cancel ● EE exponent ● change notation ● PLUS a degree radian switch. ONLY **£8·95**

OXFORD 300—Larger version of above. **£13·90***

DECIMO DIGITAL CLOCK RADIO

LARGE DIGITAL READOUT

This is the most unique clock/radio in the country today having a soft, 1½" high orange-glow digital readout which is completely silent and non-pulsating. In a beautifully styled enclosure with up-to-date VHF/MW radio. You can awake to soft music or alarm—and if you want up to ten minutes more—just press the drowse button. Automatic 80 minute 'sleep' button in case you drop off while the radio is on!

OUR PRICE **£33·95** Plus £1 P&P

ROCKWELL

64RD (Illus.) 12-digit or 8-digit + 2 Exp. Additional to the **44RD.** Polar rec., co-ordinates. Log Trig, rad or grad. **£24·50***

44RD. 9-digit or 5-digit and 2 Exp. Green Display. Store. Similar to the 63R less factorial. **£19·50***

24K. Stainless Steel Slimline. Green display. In beautiful leatherette wallet to hold pen, note pad and credit cards (all included). Full memory. Click buttons. Rechargeable. Including recharger. **(R)£21·95**

ALL ITEMS CARRY 1 YR. GUAR. PRICES INCLUDE V.A.T.
* Free B.S.I. adaptor. (R) Free recharger

ORDER FORM

PHONE CALLS AND PERSONAL CALLERS WELCOME MONS to THURS BETWEEN 2 & 5 p.m. 01-458 4755. SUNDAYS 10 a.m. to 1 p.m.
To: BARCLAY ELECTRONICS Dept. PE1, 1115 FINCHLEY ROAD, TEMPLE FORTUNE, LONDON N.W.11

Please send me ....

with/without optional mains adaptor. I enclose cheque/money order total

value £.............................. Please add 55p to all items to cover p. & p.

NAME ....

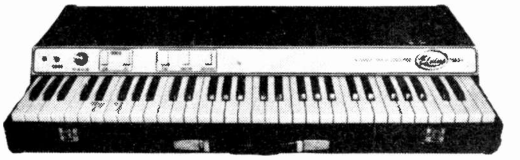
ADDRESS ....

....

....

PHONE BARCLAYCARD OR ACCESS ORDERS.

barclay ELECTRONICS



Build yourself this high quality touch-sensitive piano. The design also features the new transpose control which is an external tuning control—this tunes the entire keyboard higher or lower than the concert pitch by one whole octave. Two models are available: TS50 which is a straight piano and TS53 has piano, honky tonk, harpsichord, and fast and slow tremolo effects. These professional pianos can be built in just 12 hours.

Parts List	Price
Constructional details	£1·50
ESU/5 Divider and Touch-Sensitive Keyer Unit	
1 × AY-1-5051 i.c. divider	£1·20
25 × diodes low noise high resistance (5p each)	£1·25
5 × transistors 2N3703 (12p each)	60p
10 × elect. caps 3·3μF 25V (5p each)	50p
48 × resistors watt 5% (1p each)	48p
12 × terminal pins (½p each)	6p
1 × p.c.-board, drilled	£1·00
2 × 0·01 (4p each)	8p
3 × 0·02 (4p each)	12p
Total Price per unit (11 units required)	£5·29
ESU/6 Divider and Touch-Sensitive Keyer Unit	
1 × AY-1-6721/5	£1·30
30 × diodes low noise high resistance (5p each)	£1·50
6 × transistors 2N3703 (12p each)	72p
12 × elect. caps 3·3μF 25V (5p each)	60p
58 × resistors watt 5% (1p each)	58p
14 × terminal pins (½p each)	7p
1 × P.C. board, drilled	£1·00
2 × 0·01 (4p each)	8p
4 × 0·02 (4p each)	16p
Total Price (only 1 unit required)	£6·01
Power Supply	
3 × yards main cable (10p yard)	30p
1 × mains transformer 20-0-20 1A	£2·45
1 × mains plug and socket	76p
2 × fuse holders (20p each)	40p
2 × fuses 1A (6p each)	12p
4 × rectifier diodes (5p each)	20p
2 × elect. caps 2,200μF 40V (95p each)	£1·90
1 × elect. caps 1,000μF 35V	40p
2 × resistors 5W (12p each)	24p
1 × neon lamp	25p
1 × pot with switch	54p
1 × metal knob	55p
2 × capacitor clamps (5p each)	10p
1 × chassis	60p
Total Price (only 1 unit required)	£8·81
1 × voltage regulator	£1·75
1 × 5-octave keyboard C-C or F-F	£22·00
1 × cabinet, front plate and fittings	£26·00
1 × jack socket	15p
1 × switched jack socket	50p
1 × stereo jack socket	25p
1 × stereo jack plug	25p
4 × rocker switches (29p each)	£1·16
1 × headphone amp. built and tested	£2·89
1 × loud and soft pedal	£6·00
1 × tremolo unit for TS53 only	£3·68
1 × toneforming unit for TS53 only	£5·50
1 × variable capacitor, 10 turns	£3·72
1 × GU500 built and tested, M.T.G.	£14·05
3 × yards gold wire (59p yard)	£1·77
2 × yards rhodium bar (£1·50 yard)	£3·00
3 × yards 25 core cable (58p yard)	£1·74
61 × terminal pins (½p each)	30½p
1 × pre amp for TS50 only	£1·95

SPECIAL OFFER ORGAN I.C.'s: AY-1-0212 £6·23, AY-3-0214 £7·08, AY-1-5051 £1·34, AY-1-6721/5 £1·45, AY-1-6721/6 £1·62, AY-1-5050 £1·96, AY-1-1313 £6·18, AY-5-1315 Rhythm Gen. £5·05; AY-5-1317A Chord Gen. £6·02p, **READY BUILT UNITS:** GU500 M.T.G. £14·05, GD500/5 M.T.G. and 5-stage dividers 73 O/P £39·95; GD500/6 M.T.G. and 6-stage dividers 85 O/P £48·50; GD500/7 M.T.G. and 7-stage dividers 96 O/P £52·50. **KEYBOARDS:** 4-octave £24, 5-octave £26. All Prices inc. VAT.

TS50 Complete Kit £168·81 + £21·10 VAT
TS53 Complete Kit £172·72 + £21·59 VAT

Carriage on Complete Kit £6 (U.K. only).

Wide range of Electronic Organ Kits available, i.e. Mayfair Mk. II Portable Organ—4 octave keyboard, 4 pitches, 10 voices, sustain, vibrato, split keyboard, transpose control. Price £166 inc. VAT, carriage £6 (U.K. only). Overseas customers C.I.F. at cost.

Also available from stock, a huge quantity of specialised I.C.s and components. Send 60p for catalogue. Data Sheets for organ I.C.s 25p.

Elvins Electronic Musical Instruments

Showroom: **12 Brett Road, Hackney, London E8 1JP. Tel. 01-986 8455**
Component Shop: **40a Dalston Lane, Dalston Junction, London E8 2AZ. Tel. 01-249 5624**

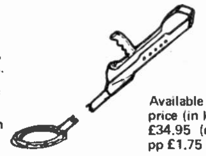
---

ambit® INTERNATIONAL

The acknowledged RF and tuner specialists have applied a little wireless experience to metal locators.

announcing
The Bionic-Ferret 300

A new VCO differentiating metal locator, with the power to locate a ½p at 8 inches.
Featuring:
Automatic tuning stabilizer, two levels of sensitivity, meter output, continuous or variable tone operation, low battery drain stylish plastic housings, shielded search coil(s), headphone or speaker outlets



Available at the low price (in kit form) of £34.95 (ex VAT) pp £1.75

and our usual range of wireless components

Radio ICs:		£.p
CA3089E	FM IF	1.94
HA1137W	improved 3089	2.20
76660N	FM IF	0.75
TBA120	FM IF	0.75
uA720	AM radio	1.40
HA1197	AM radio	1.40
TBA651	AM radio	1.81
KB4400	imprvd. 1310	2.20
CA3090AQ	PLL MPX	3.75
HA1196	Best mpx ic	4.20
Audio ICs: (all SC proof)		
LM380N	2W	1.00
LM381N	Preamp	1.81
TBA810A	7W AF	1.09
TCA940	10W	1.80
TDA2020	20W	2.99
Misc. ICs.		
MC1350P	Linear 'F	0.80
uA753	FM IF amp	0.99
MC1496	Bal. mixer	1.25
LM3900	quad amp	0.68*

Misc: PLLs etc:		£.p
NE560/1/2	HF PLL	3.50*
NE565/6	LF PLL	2.50*
ZN425 a/d, d/a		3.90*
uA723	Regulator	0.80*
TAA550B	Varicap reg	0.50*
TDA1412	12v/.6A	0.95*
TOKO coils- further specs in catalogue		
455/470kHz	IFTs	0.30
10.7MHz	IFTs	0.33
MW osc coils		0.30
MPX coils	Filters etc	0.33
FM Ratio detect. 10.7MHz		0.60
FM ratio det for 455kHz		0.60
FM quad detector coils		0.33
Various min. chokes OA		
88-108 FM tunerhead coils		0.33
BLR3107N stereo pilot tone filter block		1.90
455kHz mech. filtr. 4&7kHz Bandwiths (MFHT types)		1.95

Tuner modules AM/FM:	
7020	twin ceramic IF for FM with all 3089 features (kit) £5.25
7030	linear phase filter version of 7020. (kit) £7.67 Built/aligned £10.95
EF5800	6 circuit dual MOSFET tunerhead £14.00
EF5801	As EF5800, but with DS PCB, and FET osc buffer for DFM £17.45
EF5600	5 circuit tunerhead from TOKO £12.95
EC3302	Low cost 3 cct. head £5.50
996	New MPX decodr. with HA1196 (kit) £12.99
197	Varicap AM tuner with HA1197 (kit) £9.65

Lots more in our revised catalog.

Postage 22p per order, CWO please, remember to add VAT at the current rate (indicates lower rate applicable). Catalogue 40p, includes details of tuners, and other products.......

37 High Street, Brentwood, Essex
telephone 0277-216029

LOW, LOW PRICES ON BRANDED COMPONENTS.

These are the same components we supply in millions to industrial users. That's your guarantee of quality and service. It's also how we can maintain these sensationally low prices.

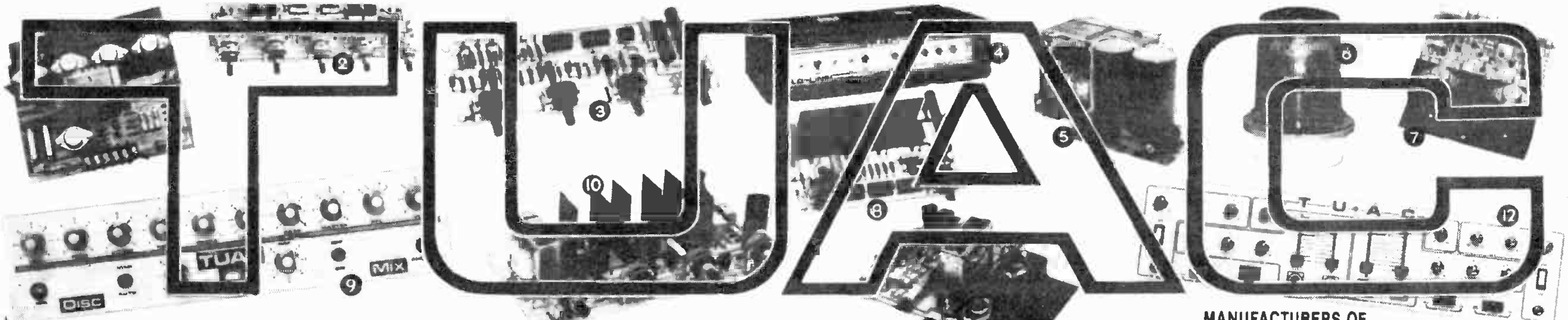
● All 'big name' manufacturers ● Same day service ● Money back guarantee

COS/MOS	
CD 4000AE	0.19
CD 4001AE	0.19
CD 4002AE	0.19
CD 4006AE	1.08
CD 4007AE	0.19
CD 4008AE	0.88
CD 4009AE	0.52
CD 4010AE	0.52
CD 4011AE	0.19
CD 4012AE	0.19
CD 4013AE	0.52
CD 4014AE	0.92
CD 4015AE	0.92
CD 4016AE	0.52
CD 4017AE	0.92
CD 4018AE	0.92
CD 4019AE	0.52
CD 4020AE	1.01
CD 4021AE	0.92
CD 4022AE	0.88
CD 4023AE	0.19
CD 4024AE	0.72
CD 4025AE	0.19
CD 4026AE	1.58
CD 4027AE	0.52
CD 4028AE	0.83
CD 4029AE	1.05
CD 4030AE	0.52
CD 4031AE	2.02
CD 4032AE	0.98
CD 4033AE	1.28
CD 4034AE	1.75
CD 4035AE	1.07
CD 4036AE	0.87
CD 4038AE	0.99
CD 4040AE	0.98
CD 4041AE	0.77
CD 4042AE	0.77
CD 4043AE	0.92
CD 4044AE	0.86
CD 4045AE	[illegible]
CD 4046AE	1.22
CD 4047AE	0.84
CD 4048AE	0.52
CD 4049AE	0.52
CD 4050AE	0.52
CD 4051BE	0.86
CD 4052BE	0.86
CD 4053BE	0.86
CD 4054BE	1.07
CD 4055BE	1.21
CD 4056BE	1.21
CD 4060AE	1.02
CD 4063BE	1.00
CD 4066AE	0.57
CD 4067BE	3.42
CD 4068BE	0.20
CD 4069BE	0.20
CD 4070BE	0.54
CD 4071BE	0.20
CD 4072BE	0.20
CD 4073BE	0.20
CD 4075BE	0.20
CD 4076BE	1.42
CD 4077BE	0.54
CD 4078BE	0.20
CD 4081BE	0.20
CD 4082BE	0.20
CD 4085BE	0.66
CD 4086BE	0.66
CD 4089BE	1.47
CD 4093BE	0.73
CD 4094BE	1.71
CD 4095BE	0.96
CD 4096BE	0.96
CD 4097BE	3.41
CD 4099BE	1.68
CD 4502BE	1.13
CD 4510BE	1.24
CD 4511BE	1.43
CD 4514BE	2.51
CD 4515BE	2.87
CD 4516BE	1.25
CD 4520BE	1.14
CD 4527BE	1.44
CD 4532BE	1.32
CD 4555BE	0.84
CD 4556BE	0.84
AUDIO I.C's	
CA 3028A	0.83
CA 3035	1.41
CA 3045	2.99
CA 3046	0.73
CA 3048	1.78
CA 3052	1.73
CA 3053	0.48
CA 3065	1.40
CA 3075	1.35
CA 3080	0.54
CA 3081	0.82
CA 3082	0.84
CA 3089E	2.01
CA 3090E	0.92
CA 3097E	0.99
CA 3127E	1.31
CA 3600E	1.01
D.I.L. Sockets	
8 pin	0.16
14 pin	0.20
16 pin	0.22
24 pin	0.33
28 pin	0.37
I.C's	
LM 555CN	0.53
703CN	0.98
709CN	0.40
710CN	0.56
711CN	0.63
8 pin 741CN	0.79
747CN	1.07
748CN	0.49
3900CN	0.75
301AN	0.58
DIODES	
1N 4001	0.04
1N 4002	0.04
1N 4003	0.04
1N 4004	0.05
1N 4005	0.05
1N 4006	0.05
1N 4007	0.05
1N 4148	0.02
1N 914	0.03
BZY 88c 2.7v – 33v	0.06
OA 47	0.05
OA 200	0.07
OA 202	0.07
I.C's	
SN 7400N	0.22
SN 7401	0.23
SN 7403	0.23
SN 7404	0.25
SN 7408	0.26
SN 7409	0.26
SN 7410	0.23
SN 7413	0.52
SN 7417	0.37
SN 7420	0.23
SN 7427	0.31
SN 7430	0.23
SN 7432	0.30
SN 7437	0.35
SN 7441	0.90
SN 7442	0.90
SN 7445	1.51
SN 7447	1.65
SN 7447A	1.41
SN 7448	1.51
SN 7470	0.46
SN 7472	0.31
SN 7473	0.46
SN 7474	0.39
SN 7475	0.60
SN 7476	0.49
SN 7482	0.90
SN 7485	1.31
SN 7489	2.91
SN 7490	0.71
SN 7491	1.01
SN 7492	0.71
SN 7493	0.71
SN 7495	0.81
SN 74107	0.42
SN 74121	0.46
SN 74122	0.65
SN 74141	0.91
SN 74145	1.01
SN 74154	1.62
SN 74174	1.26
SN 74180	1.61
SN 74181	3.64
SN 74192	1.61
SN 74193	1.61
SN 74196	1.11
TRANSISTORS	
2N 696	0.19
2N 706	0.13
2N 1711	0.39
2N 2102	0.70
2N 2369	0.23
2N 2905	0.32
2N 3053	0.18
2N 3054	0.58
2N 3055	0.67
2N 3440	0.57
2N 3442	1.54
2N 3702	0.17
2N 3703	0.17
2N 3704	0.18
2N 3706	0.17
2N 3708	0.15
2N 4036	0.59
2N 4037	0.48
2N 5296	0.42
3N 128	0.71
3N 140	0.89
3N 141	0.79
40360	0.24
40361	0.25
40362	0.26
40406	0.42
40407	0.33
40408	0.48
40409	0.49
40410	0.49
40411	2.44
40595	0.80
40594	0.69
40636	1.06
40673	0.49
BC 107	0.14
BC 108	0.13
BC 109	0.16
BC 237	0.12
BCY 70	0.18
BCY 71	0.20
BCY 72	0.11
BFX 29	0.37
BFX 30	0.40
BFX 84	0.27
BFX 85	0.33
BFX 88	0.28
BFY 50	0.28
BFY 51	0.27
BFY 52	0.27

Terms – cwo, add 8% VAT on Cos/Mos and 12½% VAT on Transistors, Diodes etc plus 15p postage and packing

Rosebank Parade, Plough Road, Yateley, Camberley, Surrey. Tel: 0252 871388.

ROWNSGEM LTD.



TRANSISTOR UNIVERSAL AMPLIFICATION Co. Ltd. PHONE 01-672 3137/672 9080

MANUFACTURERS OF
ELECTRONIC AND AMPLIFICATION EQUIPMENT

9 MONO DISCO MIXER
WITH AUTO FADE

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; Treble and Bass; H. Phon Vol Selector; Master Vol On/Off sw. Max output 3V RMS.
Specification: Deck Inputs—50mV into 1MΩ; Deck Tone Controls—treble total range 36dB at 15kHz—Bass total range 36dB at 50Hz. Mic input—200 ohms upwards 2mV into 22k. Mic Tone Control—Total range 40dB at 15kHz. Tape input—100mV into 200 ohms. Power requirements 20–50 volts d.c. at 50mA. R.I.A.A. comp mag inputs available 75p extra.
PANEL SIZE 18 × 4½in. DEPTH 3in.

£39·75

12 STEREO DISCO MIXER. T/S SWITCHING, etc. £115·00

4 CHANNEL SOUND TO LIGHT SEQUENCE CHASER—4LSMI 8

- **RCA 8A Triacs**
- 1000W per channel
- Fully suppressed and fused
- Switched master control for sound operation from ¼W to 125W
- Speed control for fixed rate sequence from 8 per minute to 50 per second
- Full logic integrated circuitry with optical isolation for amplifier protection
- Full wave control
- 13 easy connections

Patents applied for

£18·75

Model 501 500W per channel as above without sound triggering £12·25

10 3 CHANNEL LIGHT MODULATOR

- RCA 8A Triacs
- 1000W per channel
- Each channel fully suppressed and fused
- Master control to operate from 1W to 100W
- Full wave control
- 12 easy connections

£18·00

(Single Channel Version 1500 Watts £9·50)

3 ADD SEQUENCE CHASING AND DIMMING EFFECTS TO YOUR TUAC 3 CHANNEL LIGHT MODULATOR

- Speed Control 3 per min. to 10 per sec
- Full logic integrated circuitry
- Dimmer control to each channel
- 9 easy connections

SEQUENCE DIMMER MODULE—3SDM1

£13·00

6 FUZZ LIGHTS RED GREEN BLUE AMBER £21·50

FRONT PANEL FOR LIGHTING EFFECT MODULES

(complete with switches, neons and knobs) as illustrated

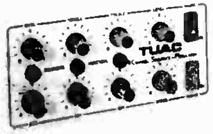
Size: 8" × 4½"

◄ For S1LMB

£6·50

▲ Size: 6½" × 4½"
For 4LSM1

£5·50



Size: 9" × 4½"

◄ For S1LMB
combined with 3SDM1

£7·50

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

Send large stamped addressed envelope with all enquiries for fully illustrated 12 page catalogue. Trade and Export Enquiries 01-672 9080

STOCKISTS—CALLERS ONLY

Geo Mathews 85 87 Hurst Street Birmingham (Tel 021 622 1941)
Arthur Sallis Ltd 28 Gardner Street (Tel Brighton 65806)
Bristol Disco Centre 25 The Promenade Gloucester Road (Tel Bristol 41666)
Soccodi 9 The Friars (Tel Canterbury 60948)
Cookies Disco Centre 132 West Street (Tel Crewe 4739)
H B Electronics 54 Montagu Street (Tel Kettering 83922)
Leighton Electronics Centre 59 North Street (Tel Leighton Buzzard 2316)
Garland Bros Ltd Deptford Broadway London 01-692 4412
Damon Electronics 99 Carrington Street (Tel Nottingham 53880)
Luton Disco Centre 88 Wellington Street Luton (Tel Luton 411733)
Mitchell Electronics 7 Queen Street (Tel Salisbury 23689)
Session Music 163 Mitcham Road Tooting (Tel 01-672 3413)
Mon-Sat 9 30 a m—5 30 p.m. Half Day Wed 9 30 a m—1 p.m.

THE PIEZO SUPER HORN
has all the features! *ONLY* £10·95

● NEEDS NO CROSS-OVER NETWORK ● FREQUENCY RESPONSE 4,000–30,000Hz ±3dB ● PATENTED MOMENTUM DRIVE PRINCIPLE ● NO VOICE COILS OR MAGNETS ● HIGH INTERNAL IMPEDANCE ● ADAPTS TO ANY SYSTEM ● HIGH ACCOUSTIC OUTPUT ● MANY CAN BE CONNECTED IN SERIES TO FORM AN ARRAY—INCREASED OUTPUT ● POWER HANDLING CAPACITY 25 volts RMS—see chart

POWER HANDLING GUIDE

System Impedance	Capacity
2 ohms	312 watts
4 ohms	156 watts
8 ohms	78 watts
16 ohms	39 watts

COMPACT—
3¾ × 3¾ × 2¼in.

AMPLIFIER MODULES

7 **TL30** D.C. COUPLED 5 × 5 × 1½in.
- 30 watt R.M.S. continuous sine wave output
- 8 transistors 4 diodes

£12·50

11 **TL60** 5 × 5 × 3in
- 60 watt R.M.S. continuous sine wave output
- 2 R.C.A. 110 watt 15 amp transistors

£16·75

11 **TL100** 5 × 5 × 3in
- 100 watt R.M.S. continuous sine wave output
- 2 R.C.A. 150 watt 15 amp transistors

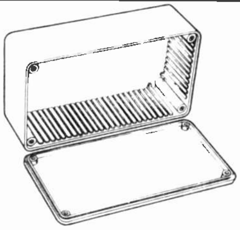
£18·75

1 **TP125** 7 × 6½ × 3in
- 125 watt R.M.S. continuous sine wave output
- 4 R.C.A. 150 watt 15 amp output transistors

£23·25

TO ORDER BY POST
Make cheques/P.O.s payable to TUAC LTD (PE 27 or quote Access/Barclaycard No. and post to TUAC LTD. (PE27), 119 Charlmont Road, London SW17 9AB. We accept phone orders from Access/Barclaycard Holders. Phone 01-672 9080

SUPPLIERS TO H.M. GOVT. DEPTS. MANUFACTURED AND ASSEMBLED IN GT. BRITAIN FULLY TESTED AND GUARANTEED



PLASTIC BOXES IN 5 SIZES

Easily drilled or punched, grey ABS boxes incorporate slots for 1.5mm pcb's with lid fixing screws running into integral brass bushes

100x50x25mm	51p	(1-9)	49p	(10+)
112x62x31mm	59p	(1-9)	52p	(10+)
120x65x40mm	68p	(1-9)	62p	(10+)
150x80x50mm	77p	(1-9)	74p	(10+)
190x110x60mm	£1.33	(1-9)	£1.30	(10+)

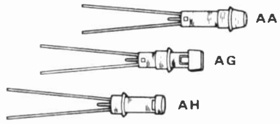
Polystyrene version
Plain inside, no integral bushes

112x61x31mm	35p	(1-9)	32p	(10+)

Add 25p per £1 order value for Post & Packing

TYPE A NEON INDICATORS

Held in 8mm hole by plastic bezel
150mm wire leads



Red, Amber, Clear, Opal 19p each
Green 28p each

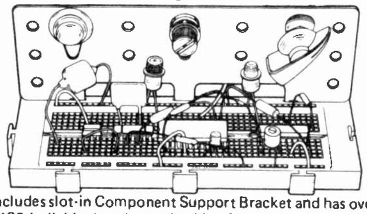
TYPE MP NEON INDICATOR

150mm leads, held in 6.4mm hole by nut

Red, Amber, Clear, Opal 20p each

On all orders quote reference PE/2/77

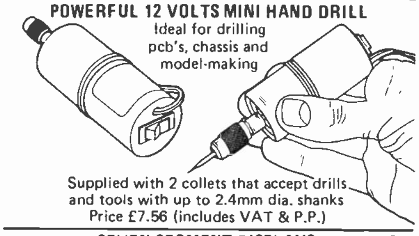
Stop wasting time soldering
The NEW MW BREADBOARD accepts
Transistors, LED's, Diodes, Resistors, Capacitors and all DIL packages with 6 to 40 pins



Includes slot-in Component Support Bracket and has over 400 individual sockets, plus Vcc & Ground Bus Strips
Price £9.72 (includes VAT & P.P.)

POWERFUL 12 VOLTS MINI HAND DRILL

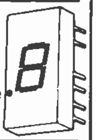
Ideal for drilling pcb's, chassis and model-making



Supplied with 2 collets that accept drills and tools with up to 2.4mm dia. shanks
Price £7.56 (includes VAT & P.P.)

SEVEN SEGMENT DISPLAYS

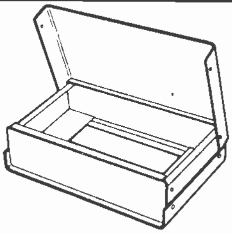
Economy Quality – Only 66p
0.3" – Red
Common Anode – Left Decimal



Full specification displays also available
Red, Green and Yellow
£1.35 each inc. data

P.P. Note. Unless included in price add 25p post & packing for orders totalling under £10 Prices include VAT and are valid in UK only for 2 months from journal issue date.

Michael Williams Electronics
47 Vicarage Av., Cheadle Hulme, Cheshire SK8 6JP

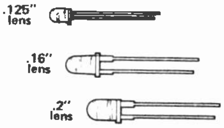


EYE CATCHING INSTRUMENT CASE

Removable Red, Orange or Grey covers
Black chassis with support brackets
Overall size 250x167x68mm
Price £11.86 (includes VAT & P.P.)

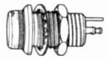
ECONOMY QUALITY LED's

50 for only £5
100 for only £9
Mixed bags, all sizes, various colours



FULL SPEC. INDIVIDUAL LED's

Red (any size) £0.75/pack
Green, Yellow, Orange (any size) £1.20/pack
Packs contain 5 LED's, clips and data



DH LAMPHOLDER

For LES or Midget flange lamps
13mm hole fixing, lamp not included
Red, Blue, Green, Amber, Clear, Opal, Orange
Price 25p each (See P.P. Note below)

Quantity quotations on request.

---

complete DIGITAL CLOCK KITS

TEAK CASES

prompt order despatch

NON-ALARM
£10·65
+85p VAT
ALARM
£13·43
+£1·07 VAT
(Prices include P. & P.)

"DELTA"

GENUINE TEAK OR PERSPEX CASE

DELTA DATA: 4 Radiant Red ½in high LEDs. 12hr display with a.m./p.m. indication. Beautiful Burma Teak Case or Pretty Perspex in white, black, blue, red, green. Power failure is indicated by flashing display.

MODULES: Kits can be bought without case—Non-Alarm £9; Alarm £12·50 inclusive.

READY BUILT: Buy a working tested module and fit your own case—Non-Alarm £9·50, Alarm £13; or put it with our case parts (£4·32) and save on complete clock price. Complete clock ready built. 2yr guarantee—Non-Alarm £13·50, Alarm £16·50.

ALARM FEATURES: Pulsed tone. Tilt operated 10 minute "Snooze" period. Single switch setting. Optional extra mercury switch (45p) allows alarm reset by tilting clock. Digit brightness is automatically controlled to suit lighting level.

"ALPHA"	**CHRISTMAS OFFER**	4 Glowing Green ½in high digits 12 or 24 hour. Non-Alarm	Built and Tested Module plus Perspex Case	**£11** incl.

NOVUS CALCULATORS 650 £5·40 850 £6·75 4510 £16·20 6030 £21·60

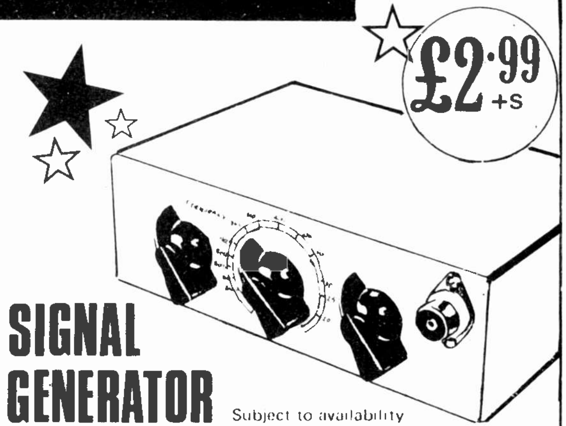
Send payment with order. S.A.E. for complete range of clocks, calculators and components

BARCLAYCARD
Buy it with Access

Pulse Electronics Ltd
Dept. PE8, 202 Shefford Road, Clifton Shefford, Beds.
Telephone: Hitchin (0462) 814477

Doram kits

DORAM KITS CONTAIN EVERYTHING DOWN TO THE LAST NUT



SIGNAL GENERATOR

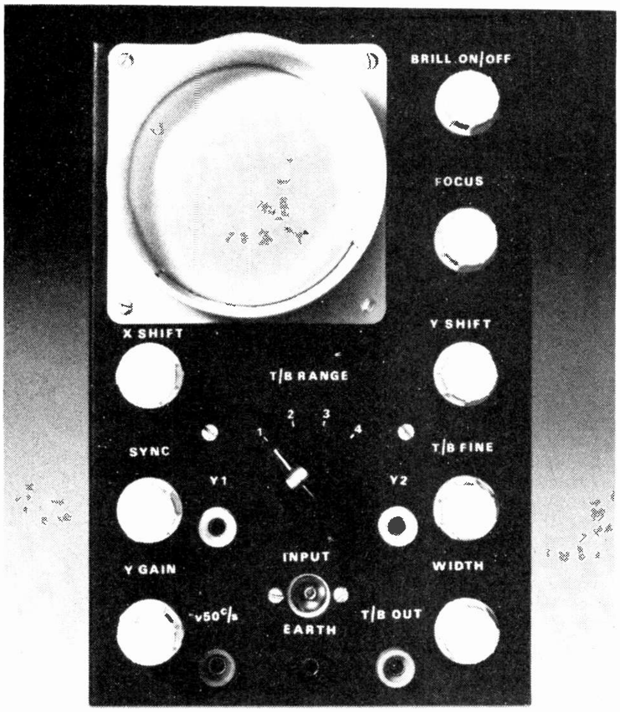
Subject to availability

Ideal for audio testing this handy portable unit is excellent value for money, giving an audio frequency signal variable in amplitude and frequency between 20Hz and 20KHz.
£2.99+S (order code 991-906)

O'seas orders—add 15% for P + P. All items offered for sale subject to the Terms of Business as set out in Doram Edition 3 catalogue, price 60p. The Doram Kit brochure is also available, price 25p. Combined price only 70p which also entitles you to 2 × 25p vouchers, each one usable on any order placed to the value of £5·00 or more (ex. VAT).

DORAM ELECTRONICS LTD
P.O. Box TR8, Wellington Road Industrial Estate, Leeds LS12 2UF.
An Electrocomponents Group Company

Bring 'scope' to your interest.

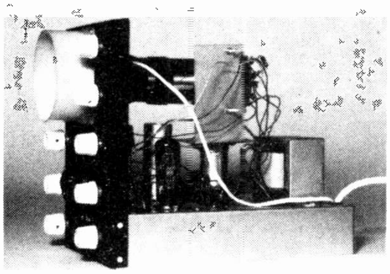


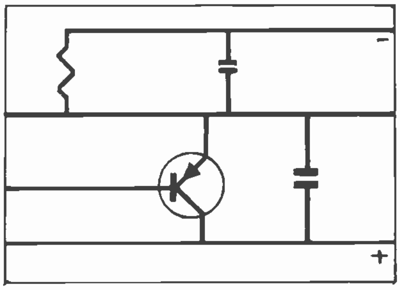
'There's only one way to master electronics... to see what is going on and learn by doing.'

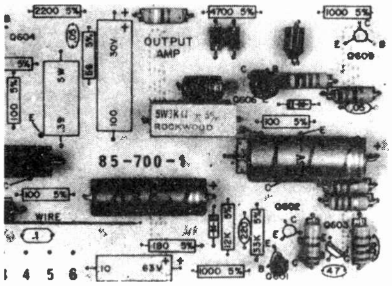
This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

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

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







1 Build an oscilloscope.

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

2 Read, draw and understand circuit diagrams.

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

3 Carry out over 40 experiments on basic circuits.

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

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

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

Write to:- British National Radio & Electronics School, P.O. Box 156, Jersey, Channel Islands.

NAME ____________________

ADDRESS ____________________

PEB 27

BI-PAK

P.O. BOX 6
WARE, HERTS
63a High Street, Ware, Herts

SEMICONDUCTORS

POSTAGE AND PACKING
Please add 25p. Overseas add extra for airmail. Minimum order £1.

2nd GREAT WINTER SALE!

74 SERIES TTL ICs

TYPE	QUANTITY 1 £p	QUANTITY 100 £p	TYPE	QUANTITY 1 £p	QUANTITY 100 £p	TYPE	QUANTITY 1 £p	QUANTITY 100 £p
7400	0·09	0·08	7448	0·70	0·68	74122	0·45	0·42
7401	0·11	0·10	7450	0·12	0·10	74123	0·65	0·62
7402	0·11	0·10	7451	0·12	0·10	74141	0·68	0·65
7403	0·11	0·10	7453	0·12	0·10	74145	0·75	0·72
7404	0·11	0·10	7454	0·12	0·10	74150	1·10	1·05
7405	0·11	0·10	7460	0·12	0·10	74151	0·65	0·60
7406	0·28	0·25	7470	0·24	0·23	74153	0·70	0·68
7407	0·28	0·25	7472	0·20	0·19	74154	1·20	1·10
7408	0·12	0·11	7473	0·26	0·22	74155	0·70	0·68
7409	0·12	0·11	7474	0·24	0·23	74156	0·70	0·68
7410	0·09	0·08	7475	0·44	0·40	74157	0·70	0·68
7411	0·22	0·20	7476	0·26	0·25	74160	0·95	0·85
7412	0·22	0·20	7480	0·45	0·42	74161	0·95	0·85
7413	0·26	0·25	7481	0·90	0·88	74162	0·95	0·85
7416	0·28	0·25	7482	0·75	0·73	74163	0·95	0·85
7417	0·26	0·25	7483	0·88	0·82	74164	1·20	1·10
7420	0·11	0·10	7484	0·85	0·80	74165	1·20	1·10
7422	0·19	0·18	7485	0·10	1·00	74166	1·20	1·10
7423	0·21	0·20	7486	0·28	0·26	74174	1·10	1·00
7425	0·25	0·23	7489	2·70	2·50	74175	0·85	0·82
7426	0·25	0·23	7490	0·38	0·32	74176	1·10	1·00
7427	0·25	0·23	7491	0·65	0·62	74177	1·10	1·00
7428	0·36	0·34	7492	0·43	0·35	74180	1·10	1·00
7430	0·12	0·10	7493	0·38	0·35	74181	1·90	1·80
7432	0·20	0·19	7494	0·70	0·68	74182	0·80	0·78
7433	0·38	0·36	7495	0·60	0·58	74184	1·50	1·40
7437	0·26	0·25	7496	0·70	0·68	74190	1·40	1·30
7438	0·26	0·25	74100	0·95	0·90	74191	1·40	1·30
7440	0·12	0·10	74104	0·40	0·35	74192	1·10	1·00
7441	0·60	0·57	74105	0·30	0·25	74193	1·05	1·00
7442	0·60	0·52	74107	0·30	0·25	74194	1·05	1·00
7443	0·95	0·90	74110	0·48	0·45	74195	0·80	0·75
7444	0·95	0·90	74111	0·75	0·72	74196	0·90	0·85
7445	0·80	0·75	74118	0·85	0·82	74197	0·90	0·85
7446	0·80	0·75	74119	1·30	1·20	74198	1·90	1·80
7447	0·70	0·68	74121	0·28	0·26	74199	1·80	1·70

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

LINEAR ICs

TBA800	*75p
72709 14 pin DIL	*20p
741P 8 pin DIL	*18p
72747 14 pin DIL	*36p
748P 8 pin DIL	*25p
NE555 Timer	38p
NE556 Dual Timer	78p

IC SOCKETS

	Order No.	
BPS8 8 pin	1611	9p
BPS14 14 pin	1612	10p
BPS16 16 pin	1613	11p

TRIACS

		Order No.	
2A/400	TO5	TR12A/400	50p
10A/400P	Plastic	TR110A/400P	80p

ZENER PAKS

400mW
PAK No.
1 Containing 20 3V-10V
2 Containing 20 11V-33V
£1 per PAK*

DIACS

BR100 15p D32 15p

CAPACITOR PAKS

16201 18 Electrolytics 0·47µF–10µF
16202 18 Electrolytics 10µF–100µF
16203 18 Electrolytics 100µF–680µF

BUY ONE OF EACH
Special Price £1·20* the 3

16160 24 Ceramic Caps 22pF–82pF
16161 24 Ceramic Caps 100pF–390pF
16162 24 Ceramic Caps 470pF–3,300pF
16163 21 Ceramic Caps 4,700pF–0·047µF

BUY ONE OF EACH
Special Price £1·60* the 4

RESISTOR PAKS

16213 1/8th 100 ohm–820 ohm
16214 1/8th 1kΩ–8·2kΩ
16215 1/8th 10kΩ–82kΩ
16216 1/8th 100kΩ–1MΩ

BUY ONE OF EACH
Special Price £1·60* the 4

TRANSISTORS

Type	Price	Type	Price
AC128	10p	OC44	12p
AC153K	18p	OC45	12p
AC176	19p	OC71	9p
AC176K	22p	OC72	14p
AC187K	22p	OC81	14p
AC188	12p	ZTX107	*6p
AC188K	22p	ZTX108	*6p
BC107	6p	ZTX109	*6p
BC108	6p	ZTX300	*7p
BC109	6p	ZTX301	*7p
BC118	*10p	ZTX302	*9p
BC154	*16p	ZTX500	*8p
BC147	*8p	ZTX501	*10p
BC148	*8p	ZTX502	*12p
BC149	*8p	2N696	10p
BC157	*10p	2N697	11p
BC158	*10p	2N706	7p
BC159	*10p	2N706A	8p
BC169C	*10p	2N708	8p
BC170	*6p	2N1613	15p
BC171	*6p	2N1711	15p
BC172	*6p	2N1893	18p
BC177	12p	2N2217	18p
BC178	12p	2N2218	15p
BC179	12p	2N2218A	18p
BC182L/K	*9p	2N2219	15p
BC183	*9p	2N2219A	18p
BC184	*9p	2N2221	15p
BC212L/K	*10p	2N2221A	16p
BC213	*10p	2N2222	15p
BC214	*10p	2N2222A	16p
BC251	*6p	2N2369	12p
BC327	*12p	2N2369A	12p
BC328	*12p	2N2904	14p
BC337	*11p	2N2904A	15p
BC338	*11p	2N2905	14p
BF115	10p	2N2905A	15p
BF167	10p	2N2906	12p
BF173	10p	2N2906A	14p
BF194	*9p	2N2907	12p
BF195	*9p	2N2907A	13p
BF196	*12p	2N2926G	*8p
BF197	*12p	2N2926Y	*7p
BF198	*12p	2N3053	14p
BF199	*12p	2N3055	38p
BF257	26p	2N3702	*7p
BF258	29p	2N3703	*7p
BF259	34p	2N3704	*6p
BFX29	18p	2N3705	*6p
BFX84	15p	2N3706	*7p
BFX85	20p	2N3903	*11p
BFX86	20p	2N3904	*11p
BFY50	12p	2N3905	*11p
BFY51	12p	2N3906	*11p
BFY52	12p	2N5172	*9p
BFY53	12p		

VAT
Add 8%–12½% to items marked*

DIODES

OA47	5p		
OA81	5p		
OA85	6p	IN4006	7p
OA91	5p	IN4007	8p
OA200/BAX13	5p	IN5400	11p
OA202/BAX16	5p	IN5401	12p
IN914	4p	IN5402	13p
IN4148	4p	IN5403	14p
IN4001	3p	IN5404	15p
IN4002	4p	IN5405	16p
IN4003	5p	IN5406	17p
IN4004	6p	IN5407	18p
IN4005	6p	IN5408	20p

VOLTAGE REGULATORS

MVR7805 85p; MVR7812 85p; MVR7815 **85p.**

OPTOELECTRONICS

LED DISPLAYS
DL707 0·3in (Order No. 1510), **£0·70.** DL747 0·6in (Order No. 1511), **£1·50.**

LEDs
TIL209 RED 0·125in (Order No. 1501), FLV117 RED 0·2in (Order No. 1504).
5 of either **50p**

PHOTO DEVICES

ORP12 (Order No. 1515), **38p.** OCP71 (Order No. 1520), 5 for **£1.**

THYRISTORS

	Order No.	
TO5		
1A/50 PIV	THY1A/50	18p
1A/400 PIV	THY1A/400	32p
1A/600 PIV	THY1A/600	38p
TO66		
5A/50 PIV	THY5A/50	25p
5A/400 PIV	THY5A/400	40p
5A/600 PIV	THY5A/600	50p
TO48		
16A/50 PIV	THY16A/50	40p
16A/400 PIV	THY16A/400	60p

UNIJUNCTION

UT46/TIS43 **18p**

FET

2N3819 **15p**

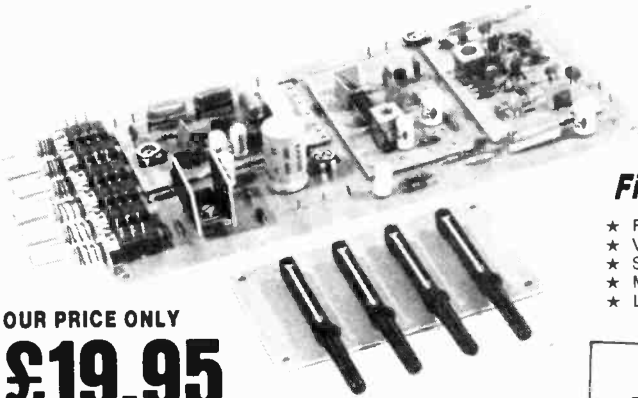
ORDERING

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

PCB MARKER PENS 50p

BI-PAK

HIGH QUALITY AUDIO EQUIPMENT—MONO AND OTHER MODULES FOR STEREO



NEW

STEREO FM TUNER

Fitted with Phase Lock-loop Decoder

- ★ FET Input Stage
- ★ VARI-CAP diode tuning
- ★ Switched AFC
- ★ Multi turn pre-sets
- ★ LED Stereo Indicator

Typical Specification:
Sensitivity 3μ volts
Stereo separation 30dB
Supply required 20–30V at 90 Ma max.

OUR PRICE ONLY

£19.95

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, by simply changing the settings of the pre-set controls.
Used with your existing audio equipment or with the BI-KITS **STEREO 30** or the **MK60** Kit etc. Alternatively the **PS12** can be used if no suitable supply is available, together with the Transformer T461.
The S450 is supplied fully built, tested and aligned.
The unit is easily installed using the simple instructions supplied.

STEREO PRE-AMPLIFIER PA 100

A top quality stereo pre-amplifier and tone control unit. The six push-button selector switch provides a choice of inputs together with two really effective filters for high and low frequencies, plus tape output.

Frequency Response +1dB 20Hz–20kHz.
Sensitivity of Inputs:
1. Tape Input 100mV into 100k ohms
2. Radio Tuner 100mV into 100k ohms
3. Magnetic P.U. 3mV into 50k ohms

P.U. Input equalises to R1AA curve within 1dB from 20Hz to 20kHz. Supply 20–35V at 20mA. Dimensions —299 × 89 × 35mm.

£13.50 *P. & P. 45p*

MK60 AUDIO KIT:
Comprising: 2 × AL60's, 1 × SPM80, 1 × BTM80, 1 × PA100, 1 front panel and knobs. 1 Kit of parts to include on/off switch, neon indicator, stereo headphone sockets plus instruction booklet. **COMPLETE PRICE** £27·55 *plus 62p postage.*
TEAK 60 AUDIO KIT:
Comprising. Teak veneered cabinet size 16¾ × 11½ × 3¾in, other parts include aluminium chassis, heatsink and front panel bracket plus back panel and appropriate sockets etc. **KIT PRICE** £9·20 *plus 62p postage.*

VAT ADD 12½%

AL 60

25 Watts (RMS)

- **Max Heat Sink temp. 90°C.** ● **Frequency response 20Hz.**
- **Distortion better than 0·1 at 1kHz.** ● **Supply voltage 15–50V.**
- **Thermal Feedback.** ● **Latest Design Improvements.**
- **Load—3, 4, 5 or 16 ohms.** ● **Signal to noise ratio 80dB.**
- **Overall size 63 × 13mm.**

Especially designed to a strict specification. Only the finest components have been used and the latest solid-state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

ONLY **£3.95**

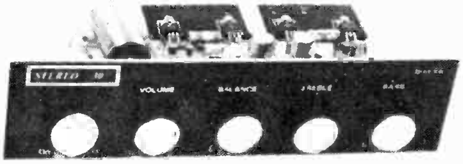
Stabilised Power Supply Type SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers. up to 15 watts (r.m.s.) per channel simultaneously. With the addition of the Mains Transformer **BMT80,** the unit will provide outputs of up to 1·5A at 35V. Size: 63 × 105 × 30mm. Incorporating short circuit protection.

INPUT VOLTAGE	33–40V A.C.
OUTPUT VOLTAGE	33V D.C. Nominal
OUTPUT CURRENT	10mA–1·5 amps
OVERLEAD CURRENT	1·7 amps approx.
DIMENSIONS	105 × 63 × 30mm
TRANSFORMER BMT80	£2·60 + 62p postage

£3.00

STEREO 30 COMPLETE AUDIO CHASSIS



7 + 7 **WATTS R.M.S.**
The Stereo 30 comprises a complete stereo pre-amplifier. power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up. stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions. black front panel, knobs. mains switch, fuse and fuse holder and universal mounting brackets enabling it to be installed in a record plinth. cabinets of your own construction or the cabinet available. Ideal for the beginner or the advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty (can be installed in 30 mins.)

TRANSFORMER £2·45 plus 62p P. & P.
TEAK CASE £3·65 plus 62p P. & P.

£15.75 *P. & P 45p*

TRAMPUS ELECTRONICS LTD

58-60 GROVE RD. WINDSOR, BERKS. SL4 1HS.
TEL. 54525

ADD 8% VAT TO PRICES MARKED *
ADD 12½% TO ALL OTHER PRICES.
OR AS CURRENT VAT LEGISLATION
SEND C.W.O.(EXCEPT GOV'T DEPT)
POST & PACKING 20P FOR THE U.K.
BARCLAYCARD & ACCESS BY POST
OR £5 MIN ON TELEPHONE ORDERS.
NEW CATALOGUE LIST FREE S.A.E.
MONEY BACK IF NOT SATISFIED.

FAST SERVICE

NORMALLY 24 HOURS
ON EX STOCK ITEMS

SEVEN SEGMENT LED DISPLAYS
BRIGHT DL707 COM ANODE &
DL704 COM CATH. 0.3" £1*
DL747 0.6"JUMBO CA £1.25*

DIGITAL CLOCK IC 51224 £4*
ZENON STROBE TUBES £4 & £7*

RED LEDS 10P.

RED LEDS 209 STYLE 0.125"
OR 0.2" DIA. NO CLIP 10p*

TIL209 RED LED & CLIP 12p*
BIG 0.2" RED LED & " 14p*
GREEN OR ORANGE LEDS 29p*
ORP12 54p*2N5777/OCP71 34p*

TRAMPUS
THE GREAT
BRITISH
DISTRIBUTOR

INDUSTRIAL, EDUCATIONAL, TRADE
& EXPORT SUPPLIED. SEND FOR
OUR FREE CATALOGUE LIST SAE
MANUFACTURERS EXCESS STOCKS
PURCHASED. DISCOUNTS 10% OFF
100 up. 15% OFF 1000 up....

TOP DISCOUNTS.

INTEGRATED CIRCUITS

555 TIMER 34p*
556 2 x 555 90p*
703 RF/IF AMP 29p
709 T099 or DIL26p*
710 DIL14 35p*
723 Regulator 44p*
741 DIL 8pin 21p*
741 DIL 14pin 31p*
741 T099 33p*
747 DUAL 741 69p*
748 DIL 8 pin 32p*
7805 5V1A+reg£1.35*
7812 & 7815ea£1.40*
76013 6W AF £1.50
AY51224 CLOCK £4 *
CA3046 54p*
ICL8038 Sigen £4 *
LM300H £1 *
LM301A Dil 8 33p*
LM309K 5V reg £2 *
LM309H T05 can £1*
LM318 70VusOPA £3*

LM380(60745) £1
LM381 Preamp £2
LM3900 4xOPA 53p*
MC1303 2xPre £2
MC1310 stereo£2
MC1312P SQ £1.70
MC1330 75p
MC1339 Preamp£2
MFC4000B ¼W 72p
MFC6030 £1
NE536 FETOPA £2*
NE540 or 550 £2*
NE555 TIMER 34p*
NE556 2x555 90p*
NE560/1/2/5/6/7£3
SN72741 as 741
SN76660 IF 74p
SN76611 IF £1
TBA800 5W AF 84 p
TBA810 7W AF 94p
ZN414 Radio £1.19
NEW 1466/69 £4

CMOS TTL

CMOS		TTL		TTL	
4000	14p*	7400	12p*	7490	39p*
4001	15p*	7401	13p*	7491	75p*
4002	16p*	7402	15p*	7492/93	45p*
4007	16p*	7404	19p*	7495/96	72p*
4009	50p*	7408/10	18p*	74100	£1.25*
4011	16p*	7413	29p*	74107	32p*
4012	17p*	7440	16p*	74121	29p*
4049	50p*	7441	71p*	74123	69p*
4069	20p*	7442	72p*	74141	74p*
4501	26p*	7447	79p*	74145	85p*
4511	£1.65*	7470/72	27p*	74147	£2.50*
4528	£1*	7473/74	31p*	74151	75p*
4543	£2*	7475/36	35p*	74154	£1.40*
4553	£5*	7486	35p*	74196	£1.50*

DIL SOCKETS PROFESSIONAL QUALITY
8pin, 14pin & 16pin ALL 12p ea *

SOLDERCONS 100 49p* 1000 £3.95*

NEW LOW PRICES.

TRANSISTORS AND DIODES

*INS BUSH SET 5p ea**
*MATCHING 20p Pr**
AC127/8 176 15p*
AD161/162 ea36p*
BC107 8p*
BC107B 13p*
BC108 8p*
BC108B or C 13p*
BC109 9p*
BC109B or C 12p*
BC147/8/9 8p
BC157/8/9 11p
BC167/8/9 12p
BC177/8/9 16p
BC182/3/4a/L10p
BC212/3/4a/L12p
BCY70/1/2 15p*
BD131/132ea 36p*
BFY50/51 15p*
BFY52/53 16p*
BSX 19/20/2119p*
BZY88 ZENER 10p
C106D SCR 54p*
MJ2955 T03 99p*
MJE2955 99p*
MJE3055 65p*
OA81/91 5p
TIP29 & 30 40p*

TIP31/32 50p*
TIP31c32c68p*
TIP41/42ea 66p*
TIP41c42c"£1.50*
TIP2955 69p*
TIP3055 65p*
TIS43 UJT 26p
1N914/4148 4p
1N4001/2 4p*
1N4004 5p*
1N4007 7p*
2N706/8 14p*
2N2646 UJT 40p*
2N2904/5pnp29p*
2N2926 ory 7p*
2N3053 17p*
2N3055 90W 33p*
2N3055 115w45p*
2N3614 T03 £1*
2N3702/3/4 10p
2N3705/6/7 9p
2N3708/9 9p
2N3710/11 15p
2N3819 &23e17p
2N3820 PFET40p
2N3904/5/6 15p
2N5457 FET 32p
BRIDGE1A50 20p*

BARGAIN PAKS FULL SPEC £1ea.

PAK A: 11 RED LEDS full spec £1*
PAK B:5 741C 8 PIN OP AMP £1*
PAK C:4 2N3055 £1* D 12 BC109 £1*
PAK E: 11 BC182 £1 F 11 2N3704 £1
PAK G: 7 BFY51 £1* H 8 2N3819 £1
PAK J: 6 2N3053 £1* K 40x1N914 £1
PAK M: 3 T099 3055 £1*N 25 OA91£1
PAK P: 20 PLASTIC BC109 TYPEnpn£1

10-365PF TUNER. SINGLE GANG FOR
MED/SHORT WAVE. XTAL SET etc £1*
SET3/IF CANS 455/470KHZ TOKO £1*

Full spec devices

DALO pen 75p

PCB ETCH KIT 3 ITEMS £2*
ETCH RESIST PEN 2TIPS 75p*
FEC ETCH PAK TUB 600gm £1*
6x4" SRBP 45p*NYLON F/G£1*

SCR AND TRIACS BR100 25p*
TAG 1A400V 50p*1A600V 69p*
1A50V 37p*.C106D 4A400 60p*
TRIACS:SC146D 10A400V £1*
DISCO TRIAC 15A400V £2*

AUDIBLE WARNING BLEEPER
12V35mA £1.20*10 off £1*
CAPACITORS 22pf - .o1 5p
ELECTROLYTIC IN 10 & 25V
1/2/10/50/100 7p 50V 10p
200/500 10p.1000/25 20p

POTENTIOMETERS AB etc20p
PRESETS 6p ¼WRESISTORS 2p
HEATSINKS T05 or 18 7p
T03 16p.T03 4"finned 50p
DIN:PLUGS all 15p.Sock 10p
SWITCHES SPST 20p Dpdt 29p

GAS DETECTOR TGS 308etc£4*

vero

VERO 0.1" PITCH COPPERCLAD
2½"x5" 40p* 3¾"x5" 45p*
2½"x3½"36p* 3¾"x3¾" 40p*
3¾x17" £2 FACE CUTTER 65p*
DIL BREADBOARD 2"x4" £1 or
6"x4" £2.VERO PINS 36 30p*

BLACK PLASTIC CASES 42mmx
80x60 50p*100x75 60p*99x
120 70p.DESOLDER BRAID 50p

C J L

CJL LTD. P.O. BOX 34, 92 NORTHGATE, CANTERBURY
(P & P AND VAT INCLUDED)

Aerials, extend 15–120cm	£1·50
Foot Switches, Snap action	£3·50
Keynectors	£3·95
Power Supply Units, Compact. Switchable 6, 7·5, 9V, 250mA	£3·75
S-DeCs	£2·20
Signal Injectors—AF/RF (self-contained)	£4·95
Audio Modules (Bi-Pak)	
Amplifiers:	
25W RMS £4·25 / 10W RMS	£3·50
125W RMS £16·00 / 35W RMS	£7·70
PA100 £13·30 / PA12	£7·50
S450 £18·75 / SPM80	£3·55
T538 £3·20 / BMT80	£3·50
Earphones/Headphones:	
Crystal £0·65 / Stethoscope	£1·35
2,000Ω £3·85 / Stereo	£4·15
Intercoms, 2 station	£6·75
Microphones, lapel crystal	£1·15
Desk Crystal £1·45 / Dynamic	£2·15
Tape Editing/Joining Kits:	
¼in Tape £2·25; Cassette Tape	£2·30
Tape Head Demagnetisers	£3·65
Test Cassettes	£2·30
Soldering Irons (Antex)	
15W "C" Miniature Irons	£3·20
15W "CCN" Low Leakage Irons	£3·45
17W "CX" Low Leakage Irons	£3·20
18W "G" Miniature Irons	£3·25
25W "X25" Low Leakage Irons	£2·90
"SK1" Soldering Kits "C" Iron, 2·3 and 4mm spare bits, heat sink, solder, "How to Solder" booklet	£4·95
"MLX" 12V, 25W Iron Kits. 4½m lead and clips, wallet, "How to Solder" booklet	£4·10
Elements "C" £1·50; "CCN"	£1·85
"CX" £1·50; "G" £1·85; "X25"	£1·60
Bits $\frac{3}{32}$in, ⅛in, $\frac{3}{16}$in each (N.B. state type of iron)	£0·50
"ST3" Stands—for all models Insulated base. Plated spring. Cleaning sponges. Space for spare bits	£1·45
Solder in handy dispenser	£0·45
Wire Strippers/Cutters; Bib 8B, 8 gauge selector	£0·85

PLAIN PAK STRIP

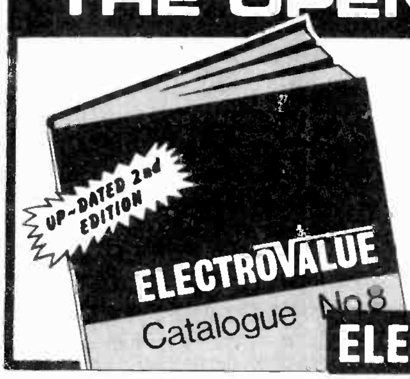
Patents applied for

The easiest way to make p/c boards without etching. Plain PAK STRIP is a very thin, flexible p/c board with a self adhesive backing. Cut out shapes with scissors or—lay a sheet on to paxolin—mark out design with a pencil—cut and lift unwanted copper sections with a scalpel or sharp model knife. It's so easy you can make a p/c board in minutes. 6in × 4in sheet of plain Paxolin, 10p. 6in × 4in sheet 39p inc. VAT, postage and instructions. S.A.E. for details or ask your local retailer.

Print-A-Kit Electronic Supplies

408 Sharrowvale Road, Sheffield, S11 8ZP

THE OPEN DOOR TO QUALITY



This catalogue—Electrovalue Catalogue No. 8 (Issue 2, up-dated)—offers items from advanced opto-electronic components to humble (but essential) washers. Many things listed are very difficult to obtain elsewhere. The company's own computer is programmed to expedite delivery and maintain customer satisfaction. Attractive discounts are allowed on many purchases; Access and Barclaycard orders are accepted.

★ **FREE POSTAGE** on all C.W.O. mail orders over £2 list value (excluding VAT) in U.K. If under, add 15p handling charge.

144 pages post paid

40p inc. refund voucher worth 40p

All communications to Head Office, Dept. PE12/2, **28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB.** *Phone Egham 3603. Telex 264475. Hours 9–5.30 daily. 1 pm Sats.*

ELECTROVALUE LTD

NORTHERN BRANCH: 680 Burnage Lane, Burnage, Manchester M19 1NA. Phone 061-432 4945. *Hours 9–5.30 pm. 1 pm Sats.*

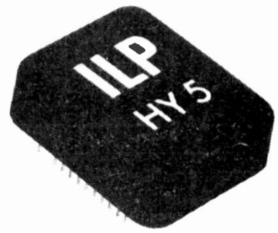
15-240 WATTS!

HY5
Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc.) are catered for internally, the desired function is achieved either by a multi-way switch or direct connection to the appropiate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: complete pre-amplifier in single pack, multi-function equalisation, low noise, low distortion, high overload; two simply combined for stereo
APPLICATIONS: hi-fi, mixers, disco; guitar and organ; public address
SPECIFICATION: Inputs-magnetic pick-up 3mV, ceramic pick-up 30mV; tuner 100mV; microphone 10mV, auxiliary 3-100mV, input impedance 47kΩ at 1kHz. Outputs—tape 100mV, main output 500mV R.M.S. Active Tone Controls—treble ±12dB at 10kHz; bass ±12dB at 100Hz Distortion—0 1% at 1kHz. signal/noise ratio 68dB. Overload—38dB on magnetic pick-up Supply Voltage—±16-50V.

Price **£4·75** + 59p VAT. P. & P. free
HY5 mounting board B.1. **48p** + 6p VAT. P. & P. free



HY30
15W into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of: I.C., heatsink P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up to date technology available.

FEATURES: complete kit, low distortion; short, open and thermal protection; easy to build
APPLICATIONS: updating audio equipment, guitar practice amplifier, test amplifier; audio oscillator.
SPECIFICATION: Output Power—15W R M.S into 8Ω. Distortion—0·1% at 15W. Input Sensitivity—500mV. Frequency Response—10Hz-16kHz −3dB.

Price **£4·75** + 59p VAT. P. & P. free

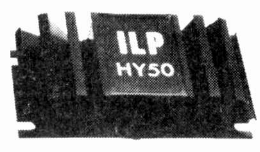
AVAILABLE EX STOCK

HY50
25W into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: low distortion; integral heatsink only five connections, 7 amp output transistors, no external components.
APPLICATIONS: medium power hi-fi systems, low power disco, guitar amplifier.
SPECIFICATION: Input Sensitivity—500mV. Output Power—25W R.M.S. into 8Ω. Load Impedance—4-16Ω. Distortion—0 04% at 25W at 1kHz. Signal/Noise Ratio—75dB. Frequency Response—10Hz-45kHz −3dB. Supply Voltage—±25V. Size—105 × 50 × 25mm.

Price **£6·20** + 77p VAT. P. & P. free

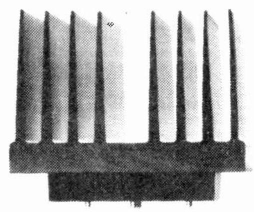


HY120
60W into 8Ω

The HY120 is the baby of I.L.P.'s new high power range, designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: very low distortion; integral heatsink, load line protection, thermal protection five connections; no external components.
APPLICATIONS: hi-fi, high quality disco, public address, monitor amplifier, guitar and organ
SPECIFICATION: Input Sensitivity—500mV. Output Power—60W R.M S into 8Ω. Load Impedance—4-16Ω. Distortion—0·04% at 60W at 1kHz. Signal/Noise Ratio—90dB. Frequency Response—10Hz-45kHz −3dB. Supply Voltage—±35V. Size—114 × 50 × 85mm

Price **£14·40** + £1·16 VAT. P. & P. free



HY200
120W into 8Ω

The HY200 (now improved to give an output of 120 watts) has been designed to stand the most rugged conditions such as disco or group while still retaining true hi-fi performance.

FEATURES: thermal shutdown very low distortion load line protection, integral heatsink; no external components.
APPLICATIONS: hi-fi, disco, monitor, power slave, industrial, public address
SPECIFICATION: Input Sensitivity—500mV. Output Power—120W R.M S into 8Ω Load Impedance—4-16Ω. Distortion—0·05% at 100W at 1kHz. Signal/Noise Ratio—96dB. Frequency Response—10Hz-45kHz −3dB Supply Voltage—±45V Size—114 × 100 × 85mm

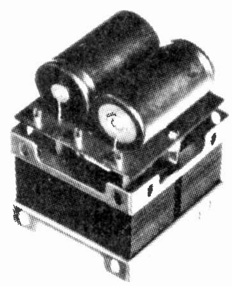
Price **£21·20** + £1·70 VAT. P. & P. free

HY400
240W into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco or public address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: thermal shutdown, very low distortion, load line protection, no external components
APPLICATIONS: public address, disco, power slave, industrial.
SPECIFICATION: Output Power—240W R M.S into 4Ω. Load Impedance—4-16Ω Distortion—0 1% at 240W at 1kHz Signal/Noise Ratio—94dB. Frequency Response—10Hz-45kHz −3dB Supply Voltage—±45V. Input Sensitivity—500mV. Size—114 × 100 × 85mm.

Price **£29·25** + £2 34 VAT. P. & P. free



POWER SUPPLIES: PSU36—suitable for two HY30s **£4·75** + 59p VAT. P. & P. free. **PSU50**—suitable for two HY50s **£6·20** + 77p VAT. P. & P. free. **PSU70**—suitable for two HY120s **£12·50** + £1 00 VAT. P & P. free. **PSU90**—suitable for one HY200 **£11·50** + 92p VAT. P. & P. free. **PSU180**—suitable for two HY200s or one HY400 **£21** + £1·68 VAT P. & P free

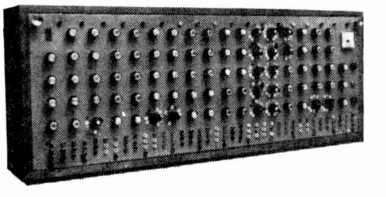
TWO YEARS' GUARANTEE ON ALL OUR PRODUCTS

I.L.P. Electronics Ltd.
Crossland House,
Nackington, Canterbury
Kent CT4 7AD
Tel (0227) 63218

Please supply ....
Total Purchase price ....
I Enclose: Cheque ☐ Postal Orders ☐ Money Order ☐
Please debit my Access account ☐ Barclaycard account ☐
Account number ....
Name and Address ....
....
Signature ....

Registered office No. 1032630

SYNTHESISERS, SOUND EFFECTS AND PHONOSONICS



COMPONENTS SETS include all necessary resistors, capacitors, semiconductors, potentiometers and transformers, Hardware such as cases, sockets, knobs, etc. are not included but most of these may be bought separately. Fuller details of kits, PCBs and parts are shown in our lists.

CIRCUIT AND LAYOUT DIAGRAMS are supplied free with all PCBs designed by Phonosonics.

PHOTOCOPIES of the P.E. texts for most of the kits are available—prices in our lists.

MAIL ORDER SUPPLIERS OF QUALITY PRINTED CIRCUIT BOARDS, KITS AND COMPONENTS TO A WORLD-WIDE MARKET.

P.E. SYNTHESISER
(P.E. Feb. 73 to Feb. 74)
The well acclaimed and highly versatile large-scale mains-operated Sound Synthesiser complete with keyboard circuits. All function circuits may be used independently, or interconnected. The greater the number of circuits, the greater the versatility. Other circuits in our lists may be used with the Synthesiser to good advantage (notably P.E. Minisonic, Phasing Unit, Wind and Rain, Rhythm Generator, Sound Bender, Voltage Controlled Filter, Guitar Effects Pedal).

THE MAIN SYNTHESISER
Stabilised power supply £12·05
Two Linear Voltage Controlled Oscillators and one Inverter—all 3 circuits £17·80
PCB (2 are required) each £1·63
Two Ramp Generators and Two Input Amplifiers
all 4 circuits £5·92
PCB (holds all 4 circuits) £1·51
Sample-Hold and Noise Generator £7·95
PCB (holds both circuits) £1·87
Tone Control £2·68
PCB 88p
Reverberation Amplifier £7·23
Sprine Line unit for Reverb. Amp. £5·50
Ring Modulator £4·24
Peak Level Meter Circuit £1·50
100μA Panel Meter £4·99
PCB to hold Reverb, Ring Mod and Meter Circuits £2·14
Envelope Shaper £6·04
PCB £1·60
Voltage Controlled Amplifier and Differential Amplifier £8·69
PCB (holds both circuits) £1·45

THE SYNTHESISER KEYBOARD CIRCUITS
(Can be used without the Main Synthesiser to make an independent musical instrument)
Two Logarithmic Voltage Controlled Oscillators
Component set £15·28
PCB (holds both circuits) £2·86
Divider, 2 Hold Circuits, 2 Modulation Amplifiers, Mixer and 2 Envelope Shapers £21·88
PCB (holds the first 6 circuits) £1·98
PCB for both Envelope Shapers £1·70
Keyboard Stabilised Power Supply £7·61
Printed Circuit Board £1·04

GUITAR EFFECTS PEDAL (P.E. July 75)
Modulates the attack, decay and filter characteristics of an audio signal not only from a guitar but from any audio source, producing 8 different switchable effects that can be further modified by manual controls. Possibly the most interesting of all the low-priced sound effects units in our range. Circuit does not duplicate effects from the Guitar Overdrive Unit.
Component Set with special foot operated switches £6·79
Alternative component set with panel mounting switches £4·90
Printed Circuit Board £1·43

SOUND BENDER (P.E. May 74)
A multi-purpose sound controller, the functions of which include envelope shaper, tremolo, voice-operated fader, automatic fader and frequency-doubler.
Component Set for above functions (excl. SWs) £7·24
Printed circuit board £1·74
Optional extra—additional Audio Modulator, the use of which, in conjunction with the above component set, can produce "jungle-drum" rhythms.
Component Set (incl. PCB) £2·76

PHASING UNIT (P.E. Sept. 73)
A simple but effective manually controlled unit for introducing the "phasing" sound into live or recorded music.
Component Set (incl. PCB) £2·85

PHASING CONTROL UNIT (P.E. Oct. 74)
For use with the above Phasing Unit to automatically control the rate of phasing.
Component Set (incl. PCB) £4·25

WAH-WAH UNIT (P.E. Apr. 76)
The Wah-wah effect produced by this unit can be controlled manually or by the integral automatic controller.
Component Set incl. PCB £3·20

P.E. JOANNA (P.E. May/Sept. 75)
A five-octave electronic piano that has switchable alternative voicing of Honky-Tonk piano, ordinary piano, harpsichord, or a mixture of any of the three, together with facilities including fast and slow tremolo, loud and soft pedal switching, and sustain pedal switching. The power amplifier typically delivers 24 watts into 8 ohms. The PCBs have been redesigned by ourselves making improved use of the space available.

Main Power Supply £10·09
Tone Generator and Top C Envelope Shaper £10·61
PCB for Main PSU, Tone Gen & Top C E.S. £2·31
Envelope Shapers for all notes (except Top C) £37·68
Set of PCBs for Envelope Shapers (except Top C) £11·88
Voicing and Pre-Amp Circuits £10·53
PCB for Voicing and Pre-amp £2·80
Power Amplifier (incl. separate Power Supply) £15·06
PCB for Power Amp and PSU 95p

RHYTHM GENERATOR (P.E. Mar./Apr. 74)
Programmable for 64,000 rhythm patterns from 8 effects circuits (high and low bongos, bass and snare drums, long and short brushes, blocks and soft cymbal), and with variable time signatures and rhythm rates. Really fascinating and useful.
Tempo, Timing and Logic circuits £12·68
PCB for above circuits (double-sided) £3·24
Component set for all 8 effects circuits £12·72
PCB for all 8 effects £3·74
Simple mixer (our design) incl. PCB £3·95
Alternative mixer with external volume controls, incl. PCB £10·94
Power Supply for T, T and L, and Effects, incl. PCB £7·10
(See our list for Power Supplies for Mixers)

REVERBERATION UNIT (P.W. Nov./Dec. 72)
A high quality unit having microphone and line input pre-amps, and providing full control over reverberation level.
Component Set (excl. spring unit) £8·79
Printed Circuit Board £1·93
9 in. Spring Unit £5·50
Panel Meter (50μA) (optional) £4·99

WIND AND RAIN UNIT
A manually controlled unit for producing the above-named sounds.
Component set incl. PCB £3·37

GUITAR OVERDRIVE UNIT (P.E. Aug. 76)
Sophisticated, versatile Fuzz unit, including variable and switchable controls affecting the fuzz quality whilst retaining the attack and decay, and also providing filtering. Does not duplicate the effects from the Guitar Effects Pedal and can be used with it and with other electronic instruments.
Component set using dual slider pot £6·57
Component set using dual rotary pot £5·80
Printed circuit board £1·37

FUZZ UNIT
Simple Fuzz unit based upon P.E. 'Sound Design' circuit.
Component set incl. PCB £1·98

TREMOLO UNIT
Based upon P.E. 'Sound Design' circuit.
Component set incl. PCB £3·19

TREBLE BOOST UNIT (P.E. Apr. 76)
Gives a much shriller quality to audio signals fed through it. The depth of boost is manually adjustable.
Component Set incl. PCB £2·31

25 WATT MONO AMPLIFIER (P.E. Sept. 75)
A good general purpose integrated circuit power amplifier typically delivering 25 watts into 8 ohms. Power bandwidth 20Hz to 20kHz, 3dB, Input impedance 20km. Distortion 0·2%. Suitable for use with any of our sound producing kits.
Component Set incl. power supply £15·06
Printed Circuit Board 95p
For stereo use two sets and PCBs are required.

P.E. MINISONIC MK I
(P.E. Nov. 1974 to March 1975)
A portable, battery or mains operated, miniature sound synthesiser, with keyboard circuits. Although having slightly fewer facilities than the large P.E. Synthesiser, the functions offered by this design give it great scope and versatility. Like the large Synthesiser it too may be advantageously used with other circuits in our lists.
Basic component set £41·58
Set of PCBs £7·71
Full details in our list.

P.E. MINISONIC MK 2
More sophisticated version of the MK I.
Basic component set from £52·15
Set of PCBs £9·10
Full details in our list.

DISCOSTROBE (P.E. Nov. 76)
4-channel light-show controller giving a choice of sequential, random, or full strobe mode of operation.
Basic component set £19·43
Printed circuit board £2·85

ENVELOPE SHAPERS
Both of the kits below have manual control over their Attack, Decay, Sustain and Release functions. Both kits include PCB (VCA means Voltage Controlled Amplifier)
Envelope Shaper and VCA (P.E. Apr. 76) £6·50
Envelope Shaper (without VCA) (P.E. Oct. 75) £4·62

VOICE OPERATED FADER (P.E. Dec. 73)
For automatically reducing music volume during "talk-over"—particularly useful for Disco work or for home-movie shows.
Component Set incl. PCB £3·74

VOLTAGE CONTROLLED FILTER (P.E. Oct. 74)
An independently designed VCF that can be used with the P.E. Synthesiser.
Component Set £3·67
Printed Circuit Board £1·38

P.E. TUNING FORK (P.E. Nov. 75)
Produces 84 switch-selected frequency-accurate tones. An LED monitor clearly displays all beat note adjustments. Ideal for tuning acoustic and electronic musical instruments alike.
Main Component Set incl. PCB £14·77
Power Supply set incl. PCB £6·95

P.E. SYNCHRONOME (P.E. Mar. 76)
An accented-beat electronic metronome, providing duple, triple and quadruple times with full control over the beat rate. Can also be used as a simple drum-beat rhythm generator. Includes power supply.
Component Set incl. loudspeaker £10·68
Printed Circuit Board £1·70

PEAK LEVEL INDICATOR (P.E. Mar. 76)
A twin-channel visual display unit for monitoring the peak level of audio signals. Well suited for use when inter-coupling our many sound producing kits to help avoid signal over-loading.
Component Set incl. PCB (as published) £3·84

POST AND HANDLING
U.K. orders—under £15 add 25p plus VAT, over £15 add 50p plus VAT. Keyboards £1·50 plus VAT.
Optional Insurance for compensation against loss or damage in post, add 35p in addition to above post and handling.
Eire, C.I., B.F.P.O., and other countries are subject to Export postage rates.

DON'T FORGET VAT!
Add 12½% (or current rate if changed) to full total of goods, post and handling. (Does not apply to export orders).

EXPORT ORDERS are welcome, though we advise that a current copy of our list should be obtained before ordering as it also shows Export postage rates. All payments must be cash-with-order, in Sterling and preferably by International Money Order or through an English Bank. To obtain list for Europe send 20p, for other countries send 40p.

PHONOSONICS • DEPT. PE52 • 22 HIGH STREET • SIDCUP • KENT DA14 6EH
MAIL ORDER AND C.W.O. ONLY SORRY BUT NO CALLERS PLEASE

OTHER PROJECTS

PHOTOGRAPHS in this advertisement show two of our units containing some of the P.E. projects built from our kits and PCBs. The cases were built by ourselves and are not for sale, though a small selection of other cases is available.

LIST—Send Stamped Addressed Envelope with all U.K. requests for free list giving fuller details of PCBs, kits, and other components.

OVERSEAS enquiries for list: Europe—send 20p; Other Countries—send 40p.

KEYBOARDS AND CONTACTS

Kimber-Allen Keyboards as required for many published circuits, including the **P.E. Joanna, P.E. Minisonic,** and **P.E. Synthesiser.** The manufacturers claim that these are the finest moulded plastic keyboards available. All octaves are C to C. The keys are plastic, spring-loaded and mounted on a robust aluminium frame.
3 Octave (37 notes) **£24·85**. 4 Oct (49 notes) **£29·50**. 5 Oct (61 notes) **£34·50**.
Contact Assemblies for use with above keyboards: Single-pole change-over (type SP) as for P.E. Joanna and P.E. Minisonic. Two-pole normally open-make-break (type DP) as for P.E. Synthesiser. Special contact assembly (type 4PS) having 4 poles, 3 of which are normally-open make-break contacts and the fourth is a change-over contact—this special assembly enables THE SAME KEYBOARD to be used with the P.E. Synthesiser, P.E. Minisonic and the P.E. Joanna simultaneously thus avoiding the cost of more than one keyboard.

Contact	*Each*	*3 Octave Set*	*4 Octave Set*	*5 Octave Set*
SP	**24p**	**£8·88**	**£11·76**	**£14·64**
2P	**27p**	**£9·99**	**£13·23**	**£16·47**
4PS	**53p**	**£19·61**	**£25·97**	**£32·33**

PRINTED CIRCUIT BOARDS for use with the above contacts and thus eliminating most of the inter-wiring required, are available. Details in our lists.

SOUND-TO-LIGHT (P.E. Apr./Aug. 71)

The ever-popular **Aurora**—4 or 8 channels each responding to a different sound frequency and controlling its own light. Can be used with most audio systems and lamp intensities. A MUST for any Disco, and a fascinating visual display for the home.

4 Channel Component Set (excl. thyristors)	£14·42
8 Channel Component Set (excl. thyristors)	£25·75
Power Supply Component Set	£5·35
PCB for 4 frequency channels	£3·65
PCB for power supply and 8 lamp drivers	£1·70
1A 400V thyristors (1 per chan. req.) each	75p
Panel meter (1μA) (optional)	£4·99

3-CHANNEL SOUND-TO-LIGHT (P.E. Apr. 76)

A simple but effective sound-to-light controller capable of operating 3 lamps each of approximately 700 watts. Includes power supply, thyristors, and by-pass switches.

Component Set incl. PCB	£11·18

BIOLOGICAL AMPLIFIER (P.E. Jan./Feb. 73)

Multi-function circuits that, with the use of other external equipment, can serve as lie-detector, alphaphone, cardiophone etc.

Pre-Amp Module Component Set incl. PCB	£4·11
Basic Output Circuits—combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lamp-driver circuits	£5·95
Audio Amplifier Module Type PC7	£6·75

TAPE NOISE LIMITER

Very effective circuit for reducing the hiss found in most tape recordings. All kits include PCBs.

Standard Tolerance Set of Components	£2·85
Superior Tolerance Set of Components	£3·30
Regulated Power Supply (will drive 2 sets)	£4·69

SINE AND SQUARE WAVE GENERATOR (P.E. July 75)

Suitable for audio, digital, or general purpose. Controllable through 4 decade ranges 10Hz to 100kHz, switched attenuation through 10 ranges from 10V to 1mV peak-to-peak.

Component Set. While stocks last	£9·83
PCB for above components	£1·76
Power Supply	£6·21
PCB for Power Supply	£1·06

SEMI CONDUCTOR TESTER (P.E. Oct. 73)

Essential test equipment for the enterprising home constructor. While stocks last.

Set of resistors, capacitors, semiconductors, potentiometers, makaswitches and PCB	£8·86
Panel meter (500μA)	£4·99

P.E. MINIMIX 6 (P.E. Nov./Dec. 75)

Each of the 6 input channels has its own gain, volume and panning controls. The volume of the twin channel outputs are fully manually controllable, as are the headphone and pre-fade monitoring facilities. Twin VU meters provide visual display of channel audio levels. Ideal for use with effects and synthesiser kits.
For details see our list. While stocks last.

8-INPUT MIXER

A simple mixer having 8 inputs each of which has a preset level control and which are combined into one output channel having a preset over-all level control and a master output volume control. Designed for inter-coupling our various sound effects and synthesiser kits.

Component set incl. PCB	£3·95

TRANSISTORS

AC128	20p
AC176	20p
BC107	14p
BC108	14p
BC109	14p
BC147	12p
BC148	12p
BC149	12p
BC157	13p
BC158	13p
BC159	13p
BC182L	12p
BC184	12p
BC187	25p
BC204	14p
BC209C	14p
BC212L	15p
BC213	15p
BC478	28p
BCY71	22p
BD131	44p
BD132	54p
BFY50	22p
BFY51	22p
BFY52	24p
BSY95A	22p
MJE2955	110p
OC28	60p
OC71	17p
OC72	25p
OC84	25p
ORP12	66p
ZTX107	12p
ZTX108	9p
ZTX501	13p
ZTX503	15p
ZTX531	23p
2N706	13p
2N914	22p
2N1304	22p
2N2219	27p
2N2905	35p
2N2905A	36p
2N2907	22p
2N3053	18p
2N3054	66p
2N3055	48p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N4060	12p
2N4871	36p
2N5245	51p
2N5777	45p

INTEGRATED CIRTS.

709	T05	40p
709	8-pin DIL	40p
723	T05	95p
741	8-pin DIL	32p
748	T05	63p
748	8-pin DIL	63p
μA7805	T0220	165p
μA7808	T0220	165p
μA7812	T0220	165p
μA7815	T0220	165p
μA7818	T0220	165p
AY-1-0212		622p
AY-1-6721/6		188p
CA3046		71p
SG3402N		220p

PRICES ARE CORRECT AT TIME OF PRESS. E. & O.E. DELIVERY SUBJECT TO AVAILABILITY.

PHONOSONICS

Hi-Fi Systems that *GROW* with you

At last someone has come up with a flexible approach to quality hi-fi that doesn't become obsolete as you become more discerning.

Take an initial standard 20W r.m.s. + 20W r.m.s. stereo and with simple modifications this can be expanded to give a powerful 40W + 40W stereo system together with additional multi frequency rumble, hiss and stereo image width controls.

Currently available from stock:–

Stereo Pre-Amp Module CP-P1

- 2 channel pre-amplifier.
- Ideal for use with record player, tape, microphone, tuner inputs etc.
- No external components required other than potentiometers for bass, treble, balance, volume controls and input selector switch.
- The CP-P1 is internally protected against accidental reverse power connection.

PRICE **£13.30**
+£1.66 VAT

Specification

Input	Sensitivity	Signal/Noise	Impedance
Magnetic	3mV	>70dB	47kΩ
Tuner	100mV	>70dB	10kΩ
Tape	100mV	>70dB	10kΩ
Auxiliary	1-100mV	60dB-70dB	200kΩ

Magnetic i/p overload: 33dB;
Distortion: 0·04% at 1kHz;
Output: 1V r.m.s. into 10kΩ.
Supply voltage: ± 18V nominal;
Tone controls: Bass ±12dB at 100Hz, Treble ±12dB at 10kHz.

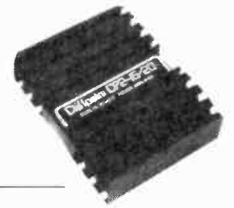
Stereo Amplifier Module CP2-15-20

- The CP2-15-20 is designed to give either a 20W + 20W stereo amplifier or alternatively a 40W single channel amplifier.
- No external components required.
- Safety features include built-in protection against accidental reverse power connection and thermal shut down facility to prevent over dissipation.

Specification:

PRICE **£12.85** +£1.61 VAT

Power output: 40W r.m.s. into 8Ω, 1 channel; or 30W r.m.s. into 15Ω, 1 channel; or 20W r.m.s. + 20W r.m.s. into 4Ω, 2 channel; or 15W r.m.s. + 15W r.m.s. into 8Ω, 2 channel.
Input sensitivity: 1V r.m.s.; **Frequency response**: 20Hz-20kHz, at −3dB; **Distortion**: 0·04% at 15W; **Supply Voltage**: ± 18V nominal; **Size**: 5·1 x 4 x 1·25in. (130 x 102 x 32mm).



Also available:—

Audio Function Module CP-FG1

For those requiring a wider range of facilities this module provides:—
- Bass and treble filter controls including switchable cut-off frequencies for rumble and hiss reduction.
- Stereo separation control.
- Complete except for switches and potentiometers.

PRICE **£11.75**
+£1.47 VAT

Power supply: Module CP-PS 18/2D

Suitable for one 20W + 20W complete system. A 40W + 40W system can be produced using 2 power supplies.

PRICE **£5.75** +72p VAT

These products carry a 2 year guarantee.

Cliffpalm Ltd.

DEPT. HF/PE,
13 HAZELBURY CRESCENT
LUTON, BEDS LU1 1DF

Prices include full application data, post and packaging.

Phone your order quoting 'Access' Card No.

Please rush me

I enclose a cheque/postal order crossed and made payable to Cliffpalm Limited for: £

NAME

ADDRESS

RETURN OF POST MAIL ORDER SERVICE

R.C.S. 10 WATT AMPLIFIER KIT

This kit is suitable for record players, tape play back, guitars, electronic instruments or small P.A. systems. Two versions are available. A mono kit or a stereo kit. The mono kit uses 13 semiconductors. The stereo kit uses 22 semiconductors with printed front panel and volume, bass and treble controls. Spec. 10W output into 8 ohms, 7W into 15 ohms. Response 20c/s to 30kc/s, input 100M.V. high imp. Size 9¼in × 3in × 2in.

Mono kit **£11·25** Stereo kit **£18** post 45p

Easy to build. Full instructions supplied.

ELAC 10 inch

Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 c/s. Bass resonance 55 c/s. 8 ohm impedance. 10W.

9 × 5in. model £3·25. **£5·50**

MAINS TRANSFORMERS

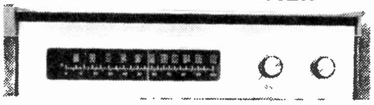
ALL POST 50p each.

250–0–250V 70mA, 6·3, 2A **£2·95**
250–0–250 80mA, 6·3V 3·5A, 6·3V 1A or 5V 2A **£4·60**
350–0–350 80mA, 6·3V 3·5A, 6·3V 1A or 5V 2A **£5·80**
300–0–300 120mA, 6·3V 4A C.T., 6·3V 2A **£7·00**
220V 45mA, 6·3V 2A **£1·75p**
HEATER TRANS, 6·3V 3A, £1·45 ½ amp. **95p**
GENERAL PURPOSE LOW VOLTAGE.
Tapped outputs at 2A 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V **£4·60**
1A 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£4·60**
2A, 6, 8, 12, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£7·00**
3A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£8·70**
5A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£11·25**
5, 8, 10, 16V ½A £2. 6–0–6V 500mA £1. 9V 1A £1
12V 300mA £1. 12V 500mA £1. 12V 750mA £1.
40V 2A tapped 10V or 30V £2·95. 20V 3A £2.
40V 2A £2·95. 30V 5A + 34V 2A ct. £3·75.
20–0–20V 1A £2. 30V 1½A £1·75. 20V 1A £1·80.
60V, 40V, 20V or 20-0-20V, 1A £3·50.
AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W £5; 250W £6; 400W £7; 500W £8.
CHARGER TRANSFORMERS. Input 200/250V for 6 or 12V 1½A £2·75; 4A £4·60.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs 1½A 40p; 2A 55p; 4A 85p.

R.C.S. STABILISED POWER PACK KIT

All parts including printed circuit and instructions to build this unit. Voltages available: 6V, 7·5V, 9V, 12V. Up to 100mA output.
Please state voltage required. **£2·95** Post 45p.

R.C.S. STEREO FM TUNER



This completely cased mains powered Hi-Fi Tuner with brushed aluminium facia is British made using the latest circuitry. Bargain. **£27·50** Post 45p
Stereo Tuner/Amplifier Chassis. Brand new £33·50.

BARGAIN 3W AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. **£3·95**

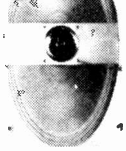
WAFER THIN HEATING ELEMENTS

Size 10¾ × 8½ × 1/16 in. Operating voltage 200/250V a.c. 250W approx. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos.

ONLY **40p** EACH (FOUR FOR **£1·50**)

ALL POST PAID—Discounts for quantity.

E.M.I. 13½ × 8in SPEAKER SALE!



With tweeter. And crossover. 10W. **£5·95**
State 3 or 8 ohm.
As illustrated. Post 45p

15W model **£8·50**
8 or 15 ohms. Post 65p

20W model **£9·50**
8 or 15 ohms. Post 65p

BAKER MAJOR 12 £14·95

Post £1·00

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 25W. NOTE: 4 or 8 or 16 ohms must be stated.

Module kit, 30–17,000 c/s with tweeter, crossover, baffle and instructions. As illustrated. **£18·95**

Please state 3 or 8 or 15 ohms. Post £1·60

"BIG SOUND" BAKER SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups and discos. Useful response 30–13,000 c/s. Bass Resonance 55 c/s.

GROUP "25" 12in 30W 4, 8 or 16 ohms. **£11·95** Post £1

GROUP "35" 12in 40W 4, 8 or 16 ohms. **£13·95** Post £1

GROUP 50/12in 60W 8 or 16 ohms with aluminium presence dome. **£20·95** Post £1·60

GROUP "50" 15in 75W 8 or 16 ohms. **£24·95** Post £1·60

Disco, Group + PA Cabinets in stock. Send for Leaflet. Cabinet Fittings, Handles, Corners, Feet, Covering Material all in stock.

BAKER 150 WATT ALL PURPOSE TRANSISTOR MIXER AMPLIFIER

Ideal for Groups, Disco, P.A. and Musical Instruments. 4 inputs speech and music. 4 way mixing. Output 4/8/16 ohm. a.c. Mains. Separate treble and bass controls. **£68** Carr. £1·50
50 watt model £49.

NEW 'DISCO 100 WATT' £52

ALL TRANSISTOR AMPLIFIER CHASSIS
2 inputs. 4 outputs separate volume treble and bass controls. Ideal disco or slave amplifier chassis. Carr. £1
BLACK CARRYING CABINET AVAILABLE £9.

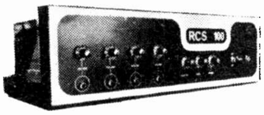
PW SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three 1,000W channels. As featured in Practical Wireless. **£12·50** CABINET extra £3.

GOODMANS CONE TWEETER

18,000 c/s. 25W 8 ohm. Price **£3·25**
E.M.I. 5in. mid range 25W £4·95.

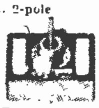
R.C.S. 100 WATT VALVE AMPLIFIER CHASSIS



Professional model. Four inputs. Treble, Bass, Master Volume Controls. Ideal disco, P.A. or groups. S.A.E. for details. 5 speaker outputs. **£85**
3 or 8 or 15 ohm. 100V line to order. plus £2·50 carr.
Suitable carrying case £16·50.

E.M.I. GRAM MOTOR **£1·25**
120V or 240V a.c. 2,400 r.p.m. 2-pole 70mA. Size 2¾ × 2¼ × 2¼in. Post 30p

E.M.I. TAPE MOTOR



4 pole, 240V a.c. 185 mA 1,400 r.p.m. Spindle ¼in dia. 75V version £1. (Illustrated). Size 3¼ × 2¼ × 2¼in. **£2·00** Post 30p

COLLARO GRAM MOTOR 120V GEAR BOX 25:1 95p. **75p**

PHILIPS GRAM MOTOR 6 VOLT A.C. £1·50

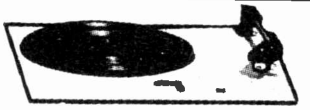
BSR HI-FI AUTOCHANGER

Plays 12in, 10in or 7in records Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. A.c. 200/250V. Size 13½ × 11¼in. Above motor board 3¼in. Below motor board 2½in. With STEREO/MONO CARTRIDGE. **£11·95** All Post 75p
Single Player version £13·50.
GARRARD AUTOCHANGER Model 6300 **£14·95**
GARRARD MINICHANGER 12 × 8in **£8·95**

PORTABLE PLAYER CABINET £4·50

Post 50p.

Modern design. Size 16in × 15in × 7in rexine covered. Large front grille. Hinged lid. Chrome fittings. Motor board cut for Garrard or BSR deck.



R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop, stereo/compat. cartridge. Baseplate. Size 11in × 8½in. Turntable. Size 7in diameter. A.c. mains. 220/250V.
3 speeds plays all size records. **£6·95** Post 45p
Two for £13. Post 75p.

HEAVY METAL PLINTHS

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Silver grey finish. **£5·95**
Model "A". Size 12¼ × 14¾ × 7¼in.
Model "B". Size 16 × 13¾ × 7in. £6·95. Post 75p.
Extra Large Plinth and Cover, Size 20 × 17½ × 9in. Callers only £18·50.

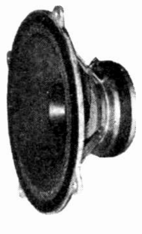
TINTED PLASTIC COVERS ONLY
Sizes: 'A'—14¼in × 12¼in 4¼in, £2·50. 'B'—20¼in 12¼in × 4¼in, £3. 'C'—17¼in 13¼in 3¼in, £2·25. 'D'—16¼in 14in 4in, £3·50.
'E'—19in × 14¼in × 4¼in, £3·50.
Ideal for record decks, tape decks, etc. Post 75p.

BAKER HI-FI SPEAKERS

HIGH QUALITY—BRITISH MADE

SUPERB

12in 25 watts

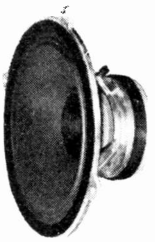


A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Bass Resonance 25 c/s
Flux Density 16,500 gauss
Useful response 20–17,000 c/s
8 or 15 ohms models.

£21·95 Post £1·60

AUDITORIUM

12in 35 watts



A full range reproducer for high power. Electric Guitars, public address, multi-speaker systems, electric organs. Ideal for Hi-Fi and Disco-theques.
Bass Resonance 35 c/s
Flux Density 15,000 gauss
Useful response 25–16,000 c/s
8 or 15 ohms models.

£20·95 Post £1·60
15in model 45 watts £24·95. Post £1·60

BLANK ALUMINIUM CHASSIS, 18 s.w.g. 2½in sides. 6in × 4in, 70p; 8in × 6in, 90p; 10in × 7in, £1·15; 14in × 9in, £1·50; 16in × 6in, £1·45; 12in × 3in, 87p; 16in × 10in, £1·70. 12in × 8in, £1·35.

ALUMINIUM PANELS, 18 s.w.g. 6in × 4in, 15p; 8in × 6in, 25p; 10in × 7in, 30p; 12in × 5in, 30p; 12in × 8in, 40p; 16in × 6in, 45p; 14in × 9in, 50p; 12in × 12in, 55p; 16in × 10in, 75p.

ALUMINIUM ANGLE BRACKET, 6in × ¾in × ¾in, 15p.
ALUMINIUM BOXES, MANY SIZES IN STOCK.

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, CROYDON

Open 9—6 Wed. 9—1 Sat. 9—5 (Closed for lunch 1.15—2.30)

Minimum post 30p. Access and Barclaycard Welcome. Radio Books and Components Lists 10p. Rail Selhurst. Tel. 01-684 1665

PE

THE SUNNY SIDE

Is there a future for Solar Energy in this country? If in mid-winter this seems a factitious question, remember last summer. It may happen again. In cold reality, the United Kingdom is in danger of losing out in this latest technological race. For in terms of investment by government and industry for research and development into ways of harnessing thermal and light radiations from the Sun we are lagging far behind the United States, France, Germany, and Japan.

Perhaps to some this seems to be right, in recognition of our geographical position and taking into account our indigenous sources of coal, gas and oil. Yet it has been computed that we may be able to derive 10–20 per cent of our total energy requirements from the Sun. There is no basic shortage of solar energy, but the problem is finding economic techniques for collecting and storing this "free energy". These are salient points made in the report on the future of solar energy in the UK, published last year by the United Kingdom Section of the International Solar Energy Society.

From predictions to practice. At present the most obvious activity in harnessing solar energy for domestic purposes is its application to the heating of water supplies. Solar thermal systems are now offered by a number of companies, while it seems that quite a few private individuals have devised and built their own installations. Another fruitful area for the d.i.y. enthusiast has thus opened up.

Solar thermal systems are essentially plumbing jobs but they do call for a certain amount of attendant electronics, for example in the form of automatic pump control, for maximum efficiency in operation. Circuitry for a typical control system is described in our pages this month. This is the first design we have presented tailored specifically for a solar power application. It is very possible that via the electronics some readers will be induced to having a go at building a complete system for themselves.

Our own interest in solar thermal energy is limited, being of but a peripheral nature. But Solar Energy in its wider and more general sense is a topic we cannot ignore. Apart from the increasing use of thermal radiation from the Sun, the direct generation of electricity from sunlight by means of solar cells holds out great promise for the future. The most commonly used solar cell is basically a silicon photo-diode, so we are on fairly familiar ground here. Arrays of solar cells are producing low wattage supplies for innumerable purposes in all kinds of situations around the world, frequently for unattended remote installations such as microwave repeater stations and railway signalling systems. They are also beginning to be used in consumer products like solar powered digital wristwatches. Unfortunately the cost of photovoltaic devices remains high, although large reductions in unit cost have been achieved in the last year or so.

Overall, terrestrial applications of solar cells will be more beneficial in the warmer countries than here, that is true. The export potential for solar cells and related hardware, especially to the developing countries in the Middle East and Africa, must be enormous. All of us in the UK have a vested interest in Solar Energy for our own use, and even more importantly as a earner of much needed foreign currency.

F.E.B.

Editor
F. E. BENNETT

Editorial
G. C. ARNOLD *Assistant Editor*
D. BARRINGTON *Production Editor*
G. GODBOLD *Technical Editor*
M. ABBOTT

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

Advertisement Manager
D. W. B. TILLEARD
Phone: 01-634 4504

P. J. MEW
Phone: 01-634 4181

C. R. BROWN *Classified*
Phone: 01-261 5762

Make-up and Copy Dept.
Phone: 01-634 4372

Editorial & Advertising Offices:
Fleetway House, Farringdon St.
London EC4A 4AD
Phone: *Editorial* 01-634 4452
Advertisements 01-634 4504

THIS article describes the construction of a unit which will control the circulating pump in a solar heating system. In solar heating systems it is sometimes impracticable to use the thermo syphon technique for heat transfer, especially when the solar panels are roof-mounted above the level of the storage tank.

TYPICAL SYSTEM

A typical domestic solar water heating system is shown in Fig. 1 and up to 60 per cent of the incident energy can be transmitted to the water using a flat-plate collector. The pipework from the collector to the tank and the tank itself are lagged with insulating material. A flat-plate collector can be made quite easily from an old radiator. The cast-iron radiators tend to be rather heavy and the more modern pressed-steel ones are preferable.

All paint is removed from the radiator by means of paint stripper or a blow lamp and the radiator repainted with matt black paint, for example, blackboard paint. The burning off of old paint is important since any light coloured paint under the black surface will reduce the collecting efficiency. A wooden box is made, about 150mm in depth (see Fig. 2) and slightly larger than the radiator. A layer of fibreglass or polystyrene insulation is glued to the bottom of the box and over this is put a layer of cooking foil. The radiator is then fixed into the box. Ideally the box should have a glass front but polythene may be used with reduced efficiency.

If more than one collector is used then they may be plumbed together in series. In some installations an antifreeze is used as the heat transfer medium and therefore the system remains operational the whole year. In others the collectors are drained in winter months to prevent freezing. The collector is installed facing south and at an angle of 30° to the horizontal—this angle is considered optimum for fixed installations.

The estimated usable radiation in Britain on a warm summer day is 0·7–0·9kW m^{-2} but alas this drops to about one tenth of this figure in winter. In summer water temperatures of up to 52°C can be expected.

UNIT ACTION

The unit described senses the temperature of the solar panel and compares it with the temperature of the water in the storage tank. When heat is available from the solar panel then the circuit will switch on a pump for a set time period. The circuit is designed to be operated from mains, although it may be operated from a 12 volt car battery, which could be charged from a wind generator. The battery system may be of interest to those people in a remote situation where mains electricity is not available and a d.c. driven pump is used.

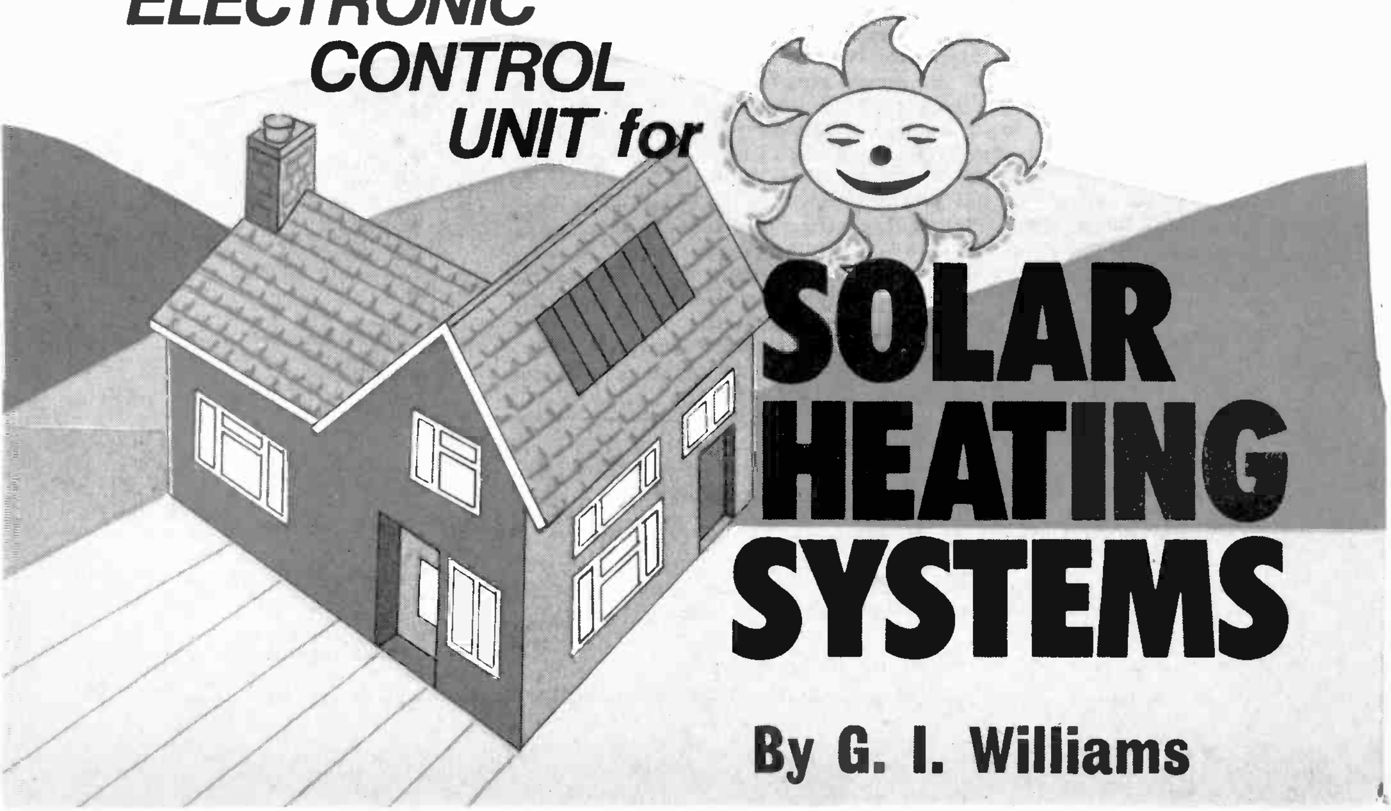
CIRCUIT DESCRIPTION

The circuit (Fig. 3) consists of a Wheatstone bridge made up of thermistor resistances TH1 and TH2 and the resistances each side of the wiper of VR1.

The operational amplifier acts as an open-loop voltage comparator with very low hysteresis. When the voltage at point A is negative with respect to point B the amplifier is driven into saturation and the output voltage approaches the 12 volt line. This is the quiescent state of the circuit.

When the roof thermistor TH1 increases above a preset value (+5°C relative to TH2) then the output of IC1 switches to a low state (about 2 volts). This transition triggers the timing circuit IC2 and the relay operates for a period of about 9 minutes.

ELECTRONIC CONTROL UNIT for SOLAR HEATING SYSTEMS



By G. I. Williams

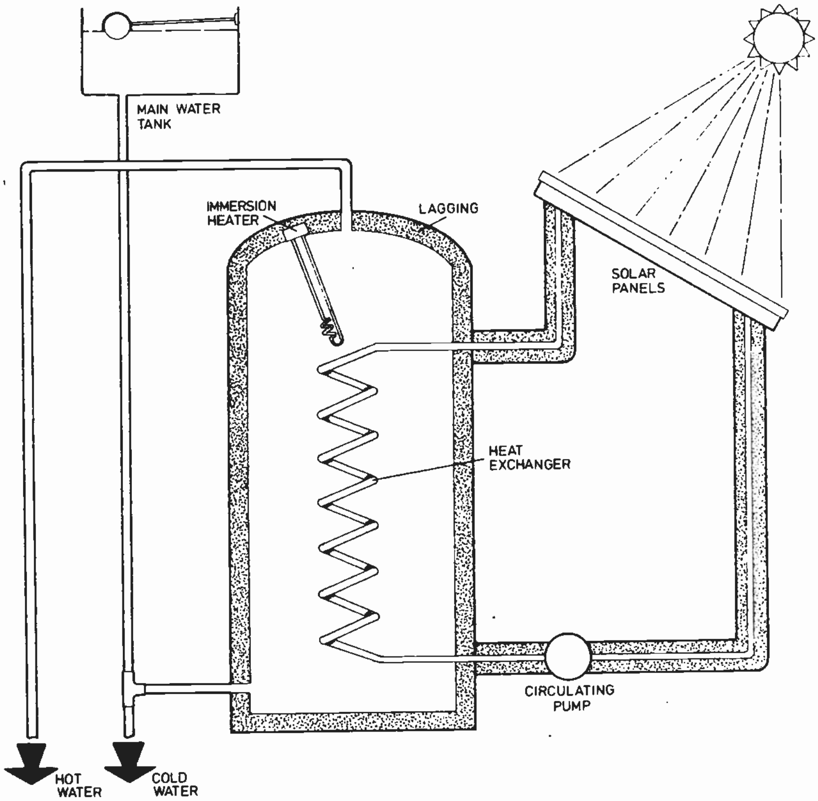


Fig. 1. Typical solar water heating system

The resistor R5 is an economy resistor and is switched in by the relay contact RLA1 when the relay operates. This is done to reduce the current drain from the power supply since the holding current for a relay is less than the operate current.

The circuit will continue to operate down to a supply of 9 volts but for reliable operation the supply voltage should not fall below 11 volts.

The thermistors used are miniature-bead types which have a nominal resistance of 4·7 kilohms at 25°C. In the prototype the thermistors used did not have matched characteristics and tests at 10°C and 50°C showed that the differential switching point changed by less than 0·5°C.

If the output of IC1 is still low at the end of the timing period then the timer will hold the relay in until the temperature of TH1 falls below the preset level. The diode D2 shorts the back e.m.f. transient voltages developed. A gold bonded germanium diode should be used since retriggering of the circuit occurs if a general purpose silicon diode is used.

CIRCUIT ASSEMBLY

The main circuit was assembled on a piece of 0·1 inch matrix Veroboard as shown in Fig. 4. The completed circuit board, power supply and relay were mounted in a small, die-cast aluminium box. The Veroboard was mounted with 6B.A. nylon nuts and bolts ensuring that all leads beneath the Veroboard were cut short.

A suitable mains p.s.u. is shown in Fig. 5 but because of its simplicity no constructional details are given.

THERMISTOR PROBE ASSEMBLY

The connecting lead for the thermistors is a lightweight single-cored screened cable of 2mm diameter.

First the thermistor leads are cut to lengths of

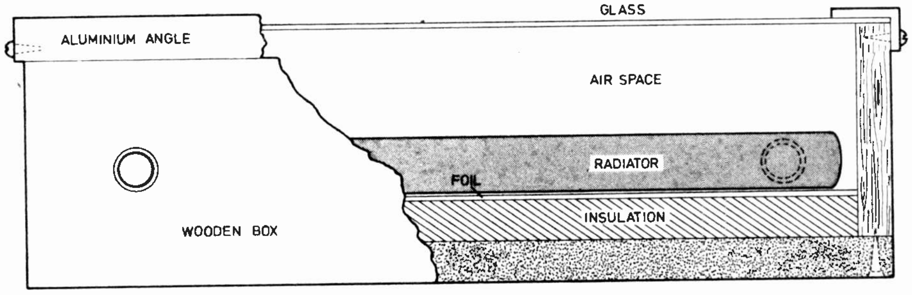


Fig. 2. Homemade solar collector panel

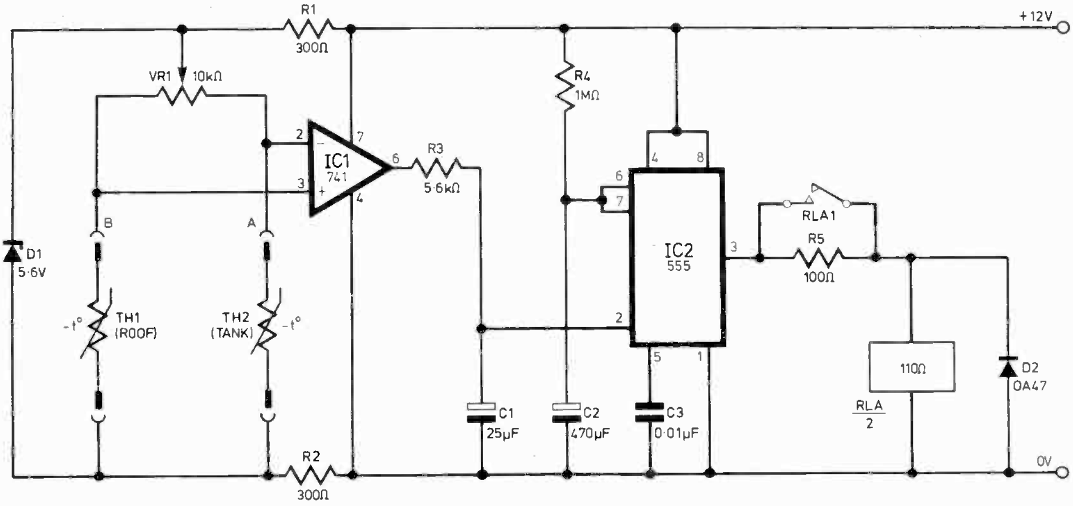


Fig. 3. Circuit diagram

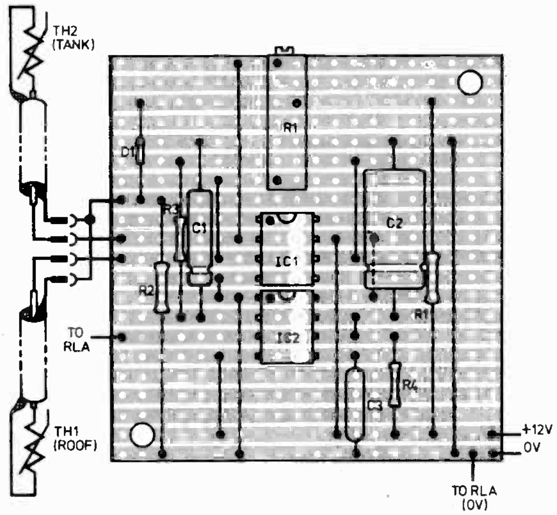


Fig. 4. Board and wiring details

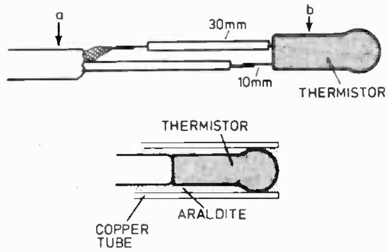


Fig. 6. Thermistor probe assembly

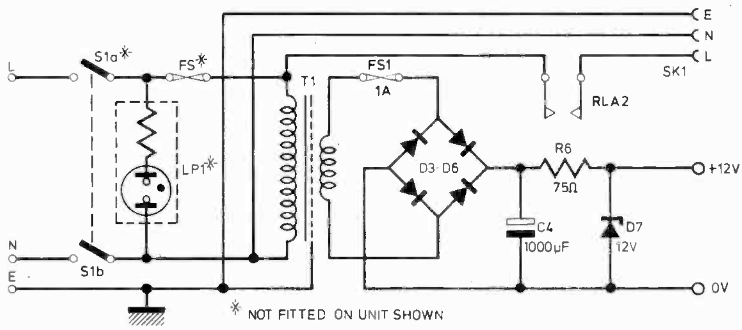


Fig. 5. Circuit of suitable p.s.u.

COMPONENTS...

Resistors

R1	300Ω, ¼W	R4	1·0MΩ, ¼W
R2	300Ω, ¼W	R5	100Ω, 1W
R3	5·6kΩ, ¼W	R6	75Ω, 1W

All 5% carbon

Potentiometers

VR1 10k Ω ¾in, 20 turn cermet

Capacitors

C1	25µF, 15V	C3	0·01µF low voltage ceramic
C2	470µF, 15V	C4	1,000µF, 25V

Semiconductors

IC1	741C	IC2	NE555V
D2	OA47 Germanium diode		
D3–D6	Bridge Rectifier (R.S. Components 261–772)		
D1	BZY88 Zener diode 5·6V		
D7	BZX61 Zener diode 12V		

Miscellaneous

TH1 & TH2 Bead thermistors type GM472 or VA3404. TI Mains transformer 12 volt 0·25A secondary (R.S.). RLA Relay 12 volt (110Ω) 10A contacts (R.S.) with relay base. SK1 13-amp surface mounting socket, FS1–1A fuse. Die-cast box. Approx. 170×114×50mm. Lengths of single core screened cable (2mm) depending upon installation. 100mm length of copper tubing for probes. Heat shrink sleeving, 2·4mm. Silicone rubber sleeving, 0·5mm. 6B.A. nylon nuts and bolts, 25·4mm long. Piece of 0·1 in Matrix board, 57mm×57mm

30mm and 10mm as in Fig. 6. A 25mm length of 0·5mm silicone rubber sleeving is slid over the longer lead which is then soldered to the screen of the connecting cable. The shorter lead goes to the inner.

A 38mm length of 2·4mm heat shrink sleeving is slid over the assembly to cover from (a) to (b) leaving the bead free. The sleeving is now shrunk with an even heat.

Cut a 50mm length of suitable size copper tubing and trim the ends, removing all burrs. The assembly is now cemented into the tube using Araldite so that the thermistor bead is just inside the end of the copper tube. This is best done by inserting the assembly into the tube so that the tube is over the connecting cable. The Araldite is then "plastered" from (a) to (b) and the assembly is gently pulled into the tube by the connecting cable—all excess Araldite is then wiped off. Finally, when the Araldite is set, the point at which the connecting cable enters the tube can be waterproofed with a thin piece of self-amalgamating tape.

When finished, measure the resistance of the probe to ensure no short circuits and test to see that the resistance changes with temperature.

SETTING UP

It is difficult to give exact instructions for this because nearly all solar heating installations are different. A trial and error process seems best but it is suggested that the following starting point is tried.

Set up the temperature differential switching point to be +5°C. This is done by putting the "roof" probe into a jar of water and gradually heating until the water is 5°C above ambient. With a voltmeter on the output of IC1 (pin 6) VR1 is adjusted so that the output goes high (12 volts) with both thermistor probes at the same temperature. As the water temperature increases to +15°C, VR1 is adjusted to switch low (2 volts) at exactly +5°C. If the temperature of the water is raised slowly and the water stirred, then the switching point can be tracked with VR1.

The timing period may be adjusted by altering C2 or R4. The period is given by the equation —

$$t = 1{\cdot}1\ C2\ R4$$

where t is in seconds, R4 is in ohms and C2 is in farads.

The exact time required will depend upon pump flow, volume of water in the system, positioning of thermistors, etc.

The roof thermistor should be mounted in contact with the solar panel, but shielded from direct sun light. The tank thermistor should be placed on the outlet pipe of the heat exchanger unit and taped on with insulating tape. It is not considered that the waterproofing of the thermistors is good enough for the thermistor to be mounted in the tank.

If needed, R4 may be made variable together with VR1 on the front panel of the box. The unit can then be calibrated with scales of degrees heat differential and timing period in minutes. ★

POINTS ARISING

RANDOM TONE GENERATOR *(January 1976)*

A number of errors unfortunately appeared in this article.

These were as follows:

In Fig. 1, pin 6 of ICI should be connected to the negative supply rail and not to the top of R4.

In Fig. 2, pin 6 of ICI should be isolated from R4 and linked to pin 2 and 7.

In Fig. 2, the collector of TR4 should be linked to the positive end of C5.

Even after these corrections have been made, a number of constructors have told us that their unit still would not work, generally only a single tone being generated. The Author, Mr. W. G. Ross, has investigated this fault, and advises as follows:

"The problem with the unijunctions is probably due to the large spread in the characteristics of these devices. It is likely that the pulse from TR2 is insufficient to trigger IC2 and increasing R2 to 22Ω should solve this problem. With some UJT's a larger increase may be necessary.

It may be found with TR1 that some UJT's may not oscillate at 50 kHz and in this case R3 should be increased to 15kΩ. This will reduce the oscillation frequency but will not adversely affect the operation of the unit".

CINE/TAPE SYNCHRONISER *(October/November 1976)*

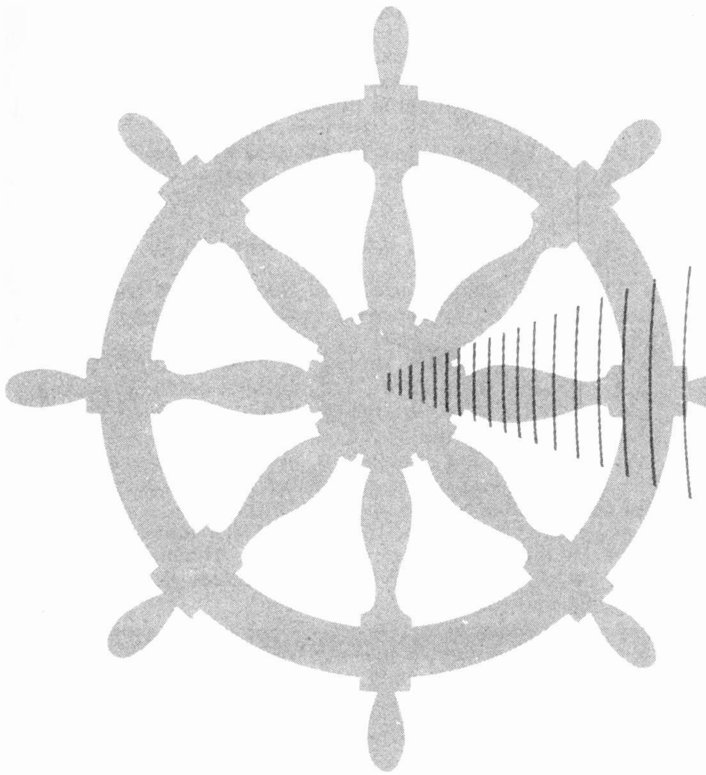
We understand that Fibre Optic Supplies have now ceased trading. Components D1, D18 and TR2, or suitable equivalents, can be obtained from the following sources.

D1: Use MRD450 available from Greenweld Electronics.

TR2: 2N5777 listed in current Phonosonics advertisement.

D18: MLED500, any general purpose l.e.d. can be used here.

The addresses of the two firms mentioned above can be obtained from the advertisement pages.



Low Cost RADIO CONTROL SYSTEM

By G.D. SOUTHERN

Part 2 – DECODER

In this final part details for constructing the decoder are given together with instructions for selecting the resistance values for both coders. These fix the centre frequency for each tone channel.

DECODER ACTION

The complete decoder is shown in Fig. 1. Here the receiver output is connected to pin 5 of a 74121 monostable. The time constant of this is set by the values of R1 and C1.

The output from pin 6 is used to switch TR1 on and off thereby enabling the discharge and charge of the capacitor C2.

During the off state of the monostable, C2 charges via R3 and R4 (Fig. 2c). The increasing voltage on the positive plate is applied to the non-inverting input of IC2. When this is within 2mV of the voltage set by the divider network R5 and R6 the output of IC2 swings from negative to positive. The limits here are −3V and +4V.

Fig. 2c shows the preset voltage for triggering the comparator as Vc′.

The output from IC2 is applied to the "D" input of bistable IC6 via resistor R7. From the waveforms it can be seen that when the comparator output and monostable clock output is positive a logic "1" level is stored in the bistable.

With the discharge of C2 the comparator output will fall to its negative value at a point when the capacitor voltage is lower than the 2mV threshold. As the bistable is an edge triggered device, any change of information at the "D" input is irrelevant after the positive rise of the clock pulse, so the information will be held in the store until the next clock pulse arrives.

MULTI-CHANNEL SYSTEM

For a four channel system, four comparator circuits have their non-inverting inputs connected in parallel across C2. As their collective shunt impedance is about half a megohm the effect on the charge/discharge characteristics of C2 is negligible.

Although the circuit has been designed for four channels, there is a fifth channel in the form of a modulation detector which will provide an output whenever the transmitter is radiating a tone frequency as long as the tone frequency is within the overall limits of the system governed by the monostable time constant.

This channel was used to provide stop-start controls for the electric drive motor of a model boat. When the tone output of the receiver drops below the threshold level of the Schmitt-trigger in IC1 the motor will stop. This is a useful feature giving the system a fail-safe device in the event of the model running out of range, or a failure in the transmitter/receiver.

OUTPUT GATING

With a low frequency input all four outputs will be on, whereas at the high frequency end, only 0/P1 will be on. Some form of gating is required, so that only one output is on within a frequency band. 0/P5, of course, is on for any frequency in the range. The simplest and cheapest method of doing this is to gate the "Clear" inputs of the bistables using diode gates. One of the problems involved in using this method is that the volts drop across diode junction is between 0·6 and 0·8 volts for a silicon diode.

For a TTL logical "0" input condition, the input voltage must be less than 0·8 volts. The typical

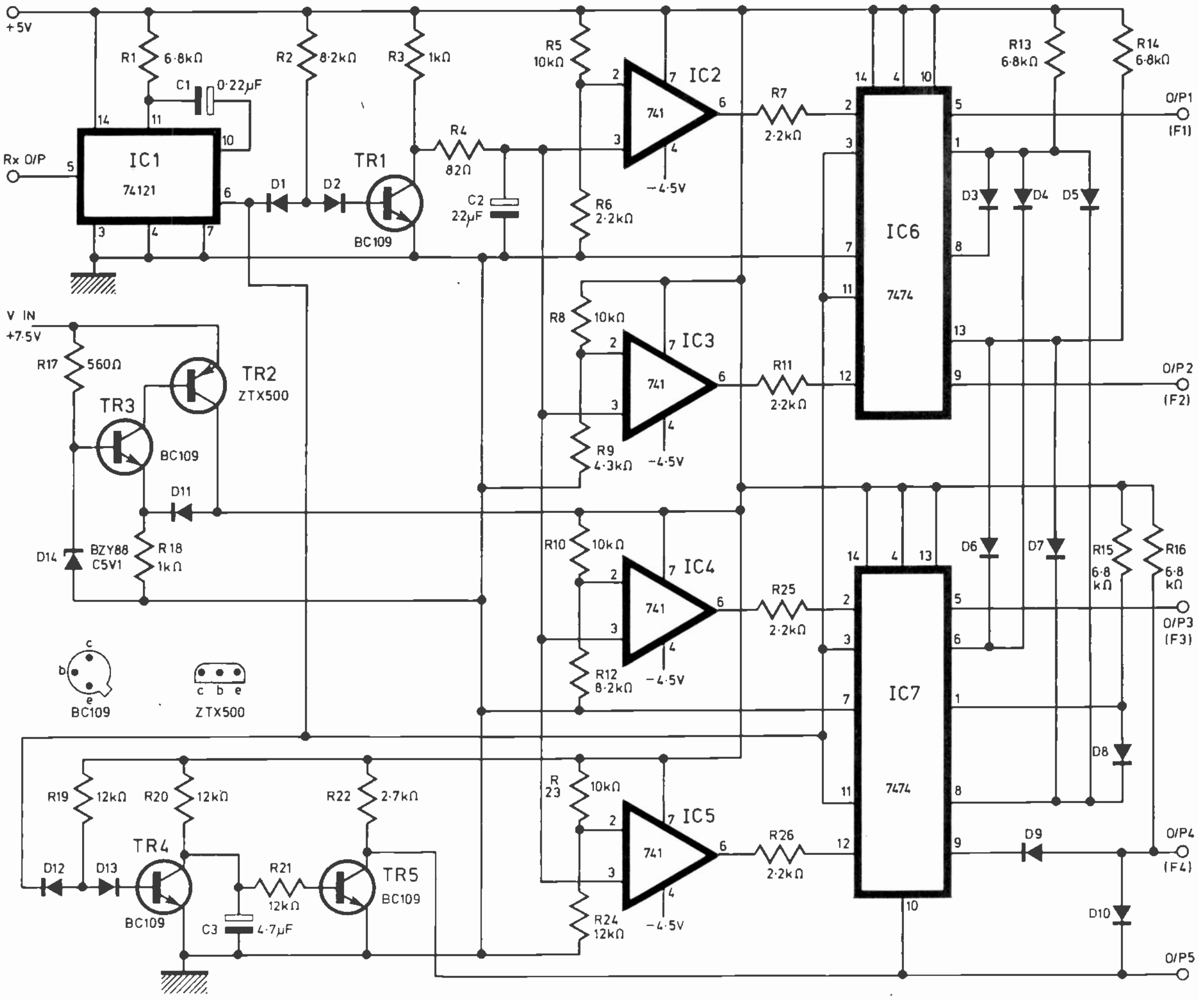


Fig. 1. Circuit of four channel tone decoder

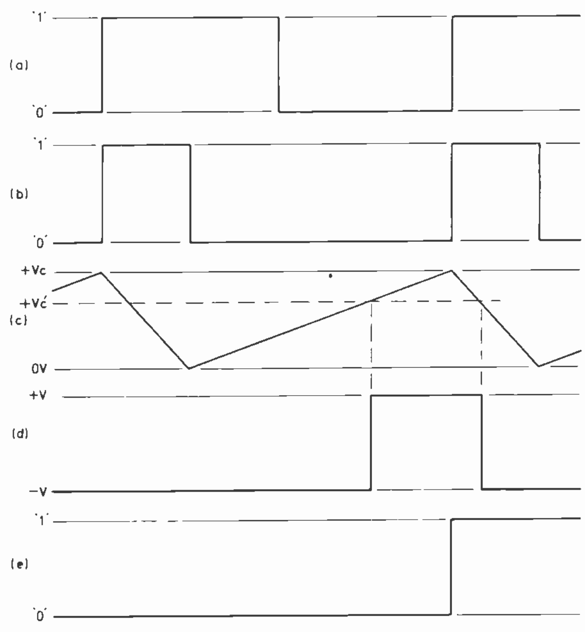


Fig. 2. Circuit waveforms: (a) in from receiver at IC1 (pin 5); (b) Monostable output at pin 6; (c) charge and discharge of C2 controlled by the switching transistor TR1; (d) the comparators switch according to the Vc' level set by the potential dividers at the pin 2 inputs. These also fix the frequency "band" of operation for each channel; (e) Bistable Q output

logical "0" output voltage for a 7474 bistable is 0·22 volts, with a maximum figure of 0·4 volts.

Thus, under worst case conditions the voltage at the 7474 clear input could be 1·2 volts, which is well out of limit. (The low input at the "Clear" input sets the bistable "Q" output to "0".)

The diode used in this circuit is a gold-bonded germanium type 0A47. This type of diode has a maximum forward volts drop of 0·4V at 10mA, so that the worst case condition will be less than the TTL "0" level input condition. When 0/P4 is triggered the bistables $\overline{Q}$ (IC7 pin 8) output will fall to zero and diodes D5, D7, D8 will conduct, so presenting "low" inputs to the "Clear" inputs of the other bistables, setting 0/P1, 0/P2, 0/P3 to zero.

Similarly, when 0/P3 is triggered the bistables $\overline{Q}$ output (IC7/6) will fall to zero and diodes D4, D6 will conduct, presenting "low" inputs to the "Clear" inputs (pins 1, 13) of IC6, setting 0/P1, 0/P2 to zero. It can be seen that each channel will work only within its own frequency band.

FREQUENCY BANDS

The frequency "bands" for the various outputs are as follows:

F1	(0/P1)	478–631Hz
F2	(0/P2)	381–478Hz
F3	(0/P3)	317–381Hz
F4	(0/P4)	150–317Hz

Note that 0/P4 is unreliable below 150Hz because capacitor C3 is able to charge during the Q = 0 period of the monostable owing to the lengthy switch off time.

The above "bands" can be easily altered by substituting resistors in the potential divider networks ((R5, R6 and R8, R9, etc. etc.). By choosing popular values, the above frequencies were arrived at.

COMPONENTS . . .

Resistors

R1, R13–R16	6·8kΩ (5 off)
R2, R12	8·2kΩ (2 off)
R3, R18	1kΩ (2 off)
R4	82Ω
R5, R8, R10, R23	10kΩ (4 off)
R6, R7, R11, R25, R26	2·2kΩ (5 off)
R9	4·3kΩ
R17	560Ω
R19, R20, R21, R24	12kΩ
R22	2·7kΩ

All ¼W high stab.

Capacitors

C1	0·22μF	Tantalum	35V
C2	2·2μF	,,	35V
C3	4·7μF	,,	35V

Semiconductors

D1–D2, D11–D13	IN914 (5 off)
D3–D10	OA47 (8 off)
D14	BZY88 C5V1
TR1, TR3–TR5	BC109 (4 off)
TR2	ZTX500
IC1	74121
IC2–IC5	741 (4 off)
IC6–IC7	7474 (2 off)

THE FIFTH CHANNEL

The "Q" output from the monostable is used to drive a transistor TR4 in the same way as transistor TR1. If Q = 0 for a long period—e.g. when the transmitter (Tx) is switched off. Capacitor C3 will charge to approximately half supply voltage, causing TR5 to saturate. This will apply a low input to the preset of IC7 (pin 10) and sets the "Q" output of IC7 (pin 9) to 1, thus setting the "Q" outputs of the other bistables to "0". 0/P4 is set to zero by the "AND" gate composed of diodes D9, D10, R16. So in the event of a transmitter or receiver switch off or failure the four bistable stores are set to zero.

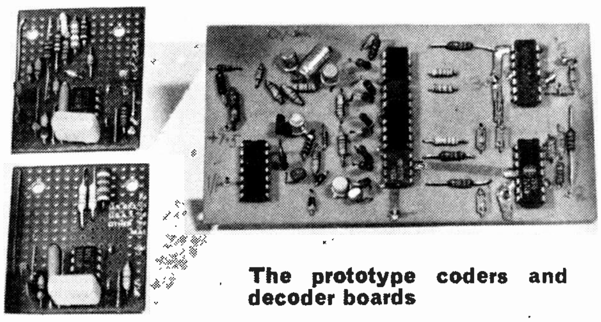
As soon as the monostable is triggered and its "Q" output equals 1, transistor TR4 saturates, which discharges C3. If the monostable input frequency is above 150Hz, capacitor C3 is unable to charge during the "Q" equals "0" period, because the time constant C3, R20, R21 is too large. When C3 is discharged, transistor TR5 switches off, allowing the bistables to function normally and a high output voltage level to be available at 0/P5.

STABILISER

The 7·5 volt supply line is stabilised at 5·1 volts by a Zener diode. The emitter voltage of TR3 will be equal to the Zener voltage minus the base emitter voltage of TR3. The circuit R17, D14, TR3, R18 provides a constant current drive for the base emitter junction of TR2. This drive current is amplified by TR2. However, the collector voltage of TR2 is held at the emitter voltage of TR3 plus the forward voltage drop of diode D11.

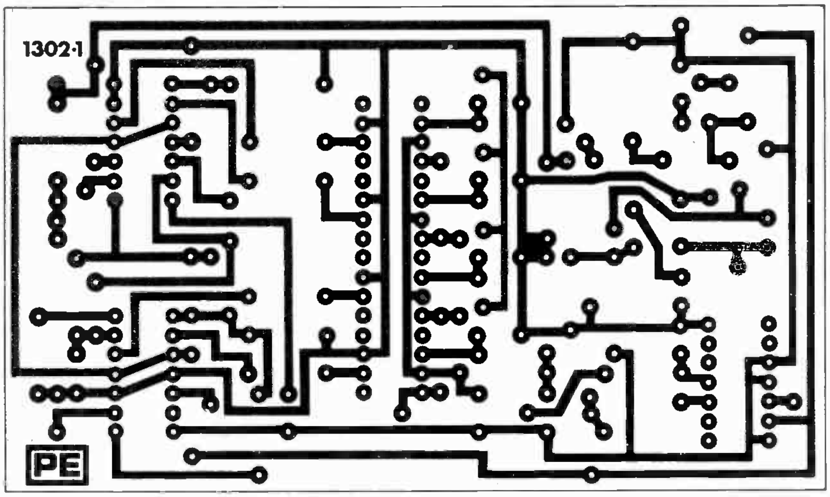
CONSTRUCTION

As the completed circuit board has to fit in a model, construction has to be as compact as possible. Although Veroboard is extremely convenient to use, construction of a circuit of this complexity and size is extremely difficult. Printed circuit board was thus used and the final board size was 114 × 133mm (Fig. 3). The board is drilled and then thoroughly cleaned and the circuit drawn out with a p.c.b. marker pen. (Using photographic methods the board size could probably be reduced still further). It is then etched with a ferric chloride solution and cleaned in the normal manner.



The prototype coders and decoder boards

DECODER CIRCUIT BOARD



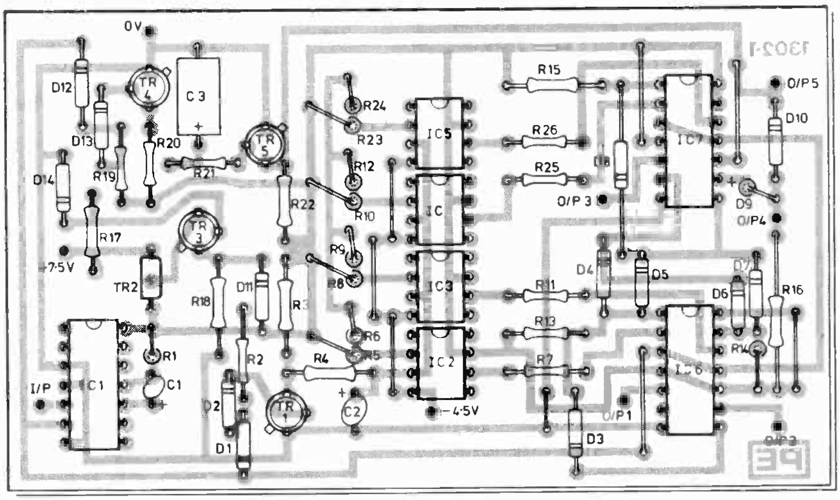


Fig. 3. Printed circuit board pattern and component layout

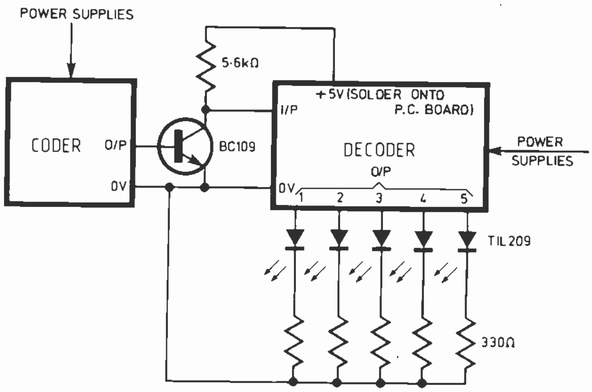


Fig. 4. Interconnections for adjustment of coders

ADJUSTMENT OF THE CODERS

The circuit is quite straightforward to set up. The decoder circuit is connected to its power supplies. Light emitting diodes are wired in series with 330Ω ½W ballast resistors and connected from each respective output to the 0V line (Fig. 6).

Coder 2 circuit is now connected to a 9V battery (but not switched on) and its output wired to the input of the decoder board. Resistor R5 is now replaced with a 50 kilohm linear potentiometer with a 2·2 kilohm resistor in series.

Switch on the coder supply. The l.e.d. connected to 0/P5 should now light. Rotate the potentiometer to its minimum resistance and then slowly increase its resistance until the l.e.d. on 0/P1 lights. Now switch off the coder circuit.

Disconnect the potentiometer and measure its resistance on an ohm meter. This value, plus the 2·2 kilohm resistor in series is the maximum value for R5. Choose a resistor with a value lower than this.

The maximum frequency limit for the decoder circuit monostable, with the values chosen, is around 850Hz, so a preferred value will probably be suitable.

Connect R5 into circuit, and wire the potentiometer with its series resistor in place of R1. Short out push button 1 and switch on the coder supply. Slowly rotate the potentiometer from its position of minimum resistance. Check the points at which the l.e.d. on 0/P1 lights and the point at which it extinguishes and the l.e.d. on 0/P2 lights. Switch off the supply to the coder unit and measure the resistance of the potentiometer and its 2·2 kilohm series resistance at both these points. These two values fix the band limits of 0/P1. Now choose a fixed resistor as near to the centre of these limits as possible.

Remove the potentiometer and 2·2 kilohm resistor and substitute the fixed resistance and remove the short across push-button 1. Switch on the coder circuit, the 0/P5 l.e.d. should light. Press push-button 1 and the 0/P1 l.e.d. should also light. If all is in order, repeat the above operation for resistors R2, R3, R4 that is, 0/P2, 0/P3, 0/P4. Choosing values near to the centre of the frequency bands ensures that any drift which occurs will only vary the frequency slightly within the individual bands.

Coder 1 is set up in a similar manner to the above method. Here, of course, R4 is the first resistor for adjustment. ★

BOOK REVIEWS

ELECTRONICS POCKET BOOK (3rd Edition)
By P. J. McGoldrick
Published by Newnes Technical Books
349 pages, 185 × 120mm. Price £3.75

A NEW edition of this useful book, extended and reorganised to include more up-to-date information on semiconductor devices. Contents range from basic materials theory through thermonic, semiconductor, photo-electric and electro-magnetic devices, amplifiers, oscillators, logic and computers, to measurements, control and power supplies. A final chapter on installation, maintenance and safety is followed by 28 pages of reference data. The treatment is generally non-mathematical, being aimed at students, technicians and amateur constructors.

In retaining a considerable amount of material on valved circuits, treatment of most sections is necessarily brief. It does seem unfortunate, however, that no space could have been found to mention, for instance, Schottky or CMOS devices.

G.C.A.

110 ELECTRONIC ALARM PROJECTS FOR THE HOME CONSTRUCTOR
By R. M. Marston
Published by Newnes Technical Books
112 pages, 215mm × 138mm. Price £2·95

A GENUINE step by step analysis of alarm logic, for those already familiar with linear and digital semiconductor devices. The book gives working circuit diagrams at every stage

M.A.

28 TESTED TRANSISTOR PROJECTS
By R. Torrens
Published by Bernards (Publishers) Ltd.
85 pages, 180mm × 108mm. Price 95 pence

A FAIRLY predictable arrangement for this sort of book, but with some good projects in it. The *calculator as a timer* and *ultrasonic intruder alarm* are interesting to name but two. All circuits have been built and tested by the author, and are designed in interchangeable blocks to allow the constructor to produce his own hybrid projects. Otherwise the exclusion of integrated circuits has resulted in limitations.

M.A.

SOLID STATE HI-FI AND AUDIO ACCESSORIES
By M. H. Babani
Published by Bernards (Publishers) Ltd.
95 pages, 180×108mm. Price 85p

FOR anyone interested in the audio field, here are eleven useful constructional projects, including a stereo decoder, a mixer, an assortment of preamps and a glide-tone generator. Most of the material has appeared previously in *Electronics Australia*.

G.C.A.

BY FRANK W. HYDE

AN ASTEROID NUMBERED 1976 UA

An asteroid passed within 750,000 miles of the Earth in October 1976. This is the closest known approach for such a body, except Hermes which came to within half a million miles. Asteroid 1976 UA was photographed by three independent teams at Mount Palomar on the night of 24/25 October 1976, and the orbit of this small body was calculated. It orbits the Sun in 0·775 years.

At this speed it has the shortest period of any known asteroid. At its furthest distance from the Sun it is about 1·22 astronomical units, that is, 1·22 times the average distance from the Earth to the Sun. It would seem that its diameter cannot be more than a few hundred yards to fit these figures. The asteroid makes a close approach to the Earth every three years. However, according to Dr B. Marsden, who controls an international service for notifying astronomers of such events, it is not likely that 1976 UA will come as close again for hundreds of years.

LARGEST RADIO TELESCOPE

The Very Large Aperture (VLA) telescope is already taking shape on the plains of San Augustin in New Mexico. Six of the 27 steerable dishes have been accepted as operational and final completion is scheduled for the end of 1979.

The arrangement of the telescope units is in the form of a "Y" with equal arms of 21km in length. It will operate on the aperture synthesis principle originated by Sir Martin Ryle, the Astronomer Royal, and his colleagues. Each of the units is a dish 25m in diameter. When in operation the telescope will be equivalent to a dish of 27km in diameter. Part of the work to be done when it is in final operation will be the search for extra-terrestrial life. This programme will be under the control of Professor Carl Sagan who is a specialist in these matters.

PLUTO

A three man team consisting of D. P. Cruikshank, C. B. Pilcher and D. Morrison from Hawaii have been busy at Kitt Peak Observatory with the 4m optical telescope. They examined Pluto in near infra-red and, from the absorption bands, now suggest that it is perhaps no larger than the Moon. Hitherto the estimate of size has been considered as being between 5,000 and 7,000km. The frost that appears to cover a large part of the surface is of a kind which differs very much from water or ammonia. It is thought that methane might be the element involved.

If indeed the visual brightness is due to the frozen methane, it could well be that the planet is still smaller than the Moon. In that case it would not be dense enough to cause the perturbations of Uranus and Neptune. It follows therefore that some other body or bodies are involved. This calls to mind the claim of the Russian astronomers to have found indications that there are two more Transplutonian planets. These were noted in a previous *Spacewatch*.

MARS

When Mars passed behind the Sun in November 1976 it marked the end of the first phase of the *Viking* mission. Out of touch with the Earth temporarily, it came as a natural break and a time to assess the progress that had been made. The next phase will continue for many months and if the equipment follows the same high standard of performance that has characterised space progress, it may continue for years.

Looking back on the last few months there have been five major surprises. The discovery that the two polar caps were water ice and not solid carbon dioxide, as had been supposed, was an important one. Allied with the fact that the two landing sites were of a similar nature, a new assessment of the planet was needed. To this also must be added the weather difference. The summers on Mars are mild.

Finally, two more surprises: the absence of organic molecules and the very perplexing biological results. Both the landing sites were similar in appearance and the soil similar in texture with a large proportion of iron. A test run on similar rocks on Earth revealed that the Mars and the Earth rocks could be mixed together and it would be very difficult to decide which was which. The pictures from the orbiters show great variations over the terrain yet all local pictures show homogeneous conditions. This is an extremely puzzling matter.

The biological problems are also perplexing. The organic chemistry experiment was crucial to the life study because without the organic compounds life would seem to be impossible. Yet there were apparently life-like processes well known on Earth. Without the organic compounds it cannot be concluded that these life-like signs are life in the sense that it is generally understood. There is the further difficulty that experiments are not showing repetitive results.

The presence of water ice in large quantities indicates that water has played a prominent part in the history of Mars. Rough checks show that the ice caps may be many hundreds of feet thick. The weather has been mild with little wind and none of the very low temperatures that were expected. Of course this condition may vary when the northern hemisphere has been observed through the winter.

Another reassessment that had to be made was in regard to the seismic conditions. It was expected that high winds would give false results from the seismometers since the instruments were mounted on the tops of the landers. However, not only were there no special effects from wind, neither were any Marsquakes recorded over a period of two months. In spite of the extreme sensitivity of the instruments no significant results have been found. This poses another question. Since the continuous movements of plates on Earth cause constant seismic effects, the absence of these on Mars may well mean that plate techtonics are not applicable to the planet.

Summarising some of the other outstanding points that have been highlighted:

Extensive evidence of volcanic action with wind and ice erosion over the whole planet.

Quite spectacular evidence of water flooding on an extensive scale.

The age of Mars is rather greater than was thought.

Innumerable high resolution photographs have made accurate measurements of craters and other features possible, with better dating.

The sky is largely pink.

The rocks are of many varieties and form, but all are covered in fine red dust.

Confirmation has been found of very extensive glaciation which has modified the surface.

The evidence of a magnetic field.

MEMORIES PART TWO

A TWO-PART ARTICLE BY A.BRIAR

IN discussing briefly the function of ROMs in the beginning of Part 1 it was found that this type of memory had the information programmed into the device. Now what exactly is this type of memory?

READ ONLY MEMORIES (ROMs).

Perhaps the simplest way of explaining the actions and effects of Read Only Memories is with the help of a diode matrix. Fig. 7 shows a diode matrix which will convert all the letters of the alphabet into teleprinter code. This is a fixed format program and is never likely to change and thus is an ideal candidate for programming into an integrated circuit ROM.

In fact this diode matrix is a ROM in its own right since it fulfills all the requirements of the description already given for this type of memory. The information is already programmed into the matrix by reason of the fact that only the signal paths that are required are actually wired into it. Thus, by providing the *Y* signal line with a high level the corresponding output is *HLHLH* (which is the correct combination for the letter *Y* in teleprinter code).

Visualising a much larger ROM but programmed into an i.c., it will be apparent that this device is ideal for computer microprograms and sub-routines.

There are many types of ROM and the family tree shown in Fig. 8 separates them for simplicity.

MASK PROGRAMMABLE ROM

Originally, the only ROMs available needed to be programmed for the user by the manufacturer of the device to the former's requirements and was usually only undertaken for orders of about £30,000 in one year.

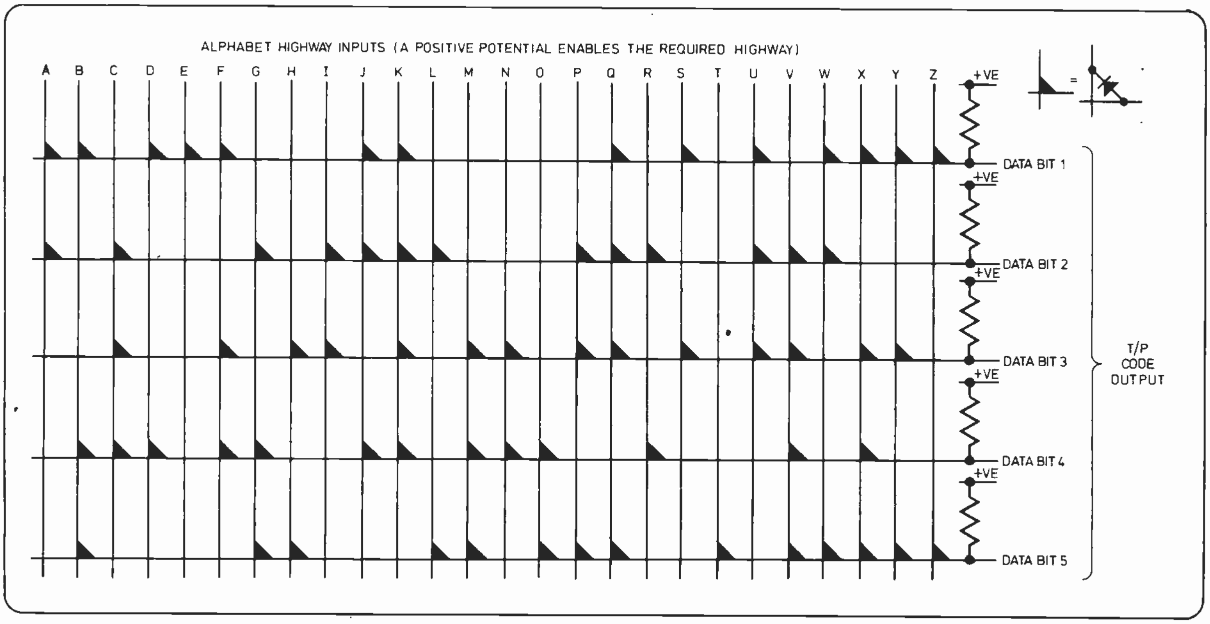
The reason for this limitation was that a considerable amount of work needed to be undertaken by the manufacturer to prepare a mask for the final etching process in the manufacture of the i.c. with the required connections programmed onto it. This mask was used to selectively etch away the final coating of aluminium from the silicon wafer. Since this final coating is used to connect to the individual stages within the i.c. then only those required are left to be available at the output (the actual connections to the stages of the memory are the row and column contacts).

This method of programming is still available but is only of value to those users needing a large quantity of identically programmed ROMs.

PROGRAMMABLE ROM (PROM)

Programmable ROMs are much more versatile than the mask programmable ROMs in that the programming of the device can be done quite simply and economically for small quantities, and can even be done by the amateur. Within this family of devices are two major groups namely the FUSIBLE BIPOLAR PROM and the ERASABLE PROM (EPROM).

Fig. 7. Fixed format read only memory example using diodes (converts letters of the alphabet to Baudot code)



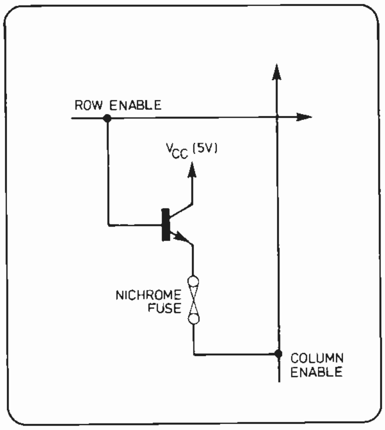


Fig. 9. Position of Nichrome fuse in circuit

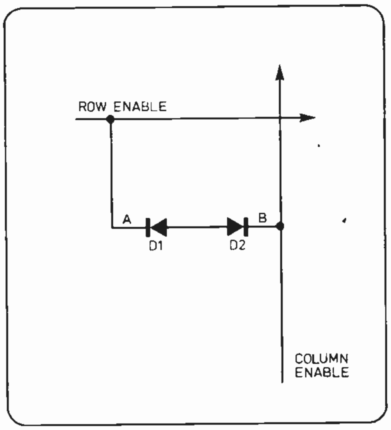


Fig. 10. Schematic diagram for avalanche induced migration

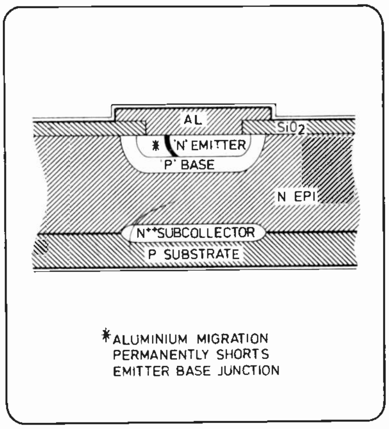


Fig. 11. Cross section of a programmed cell showing effect of avalanche induced migration

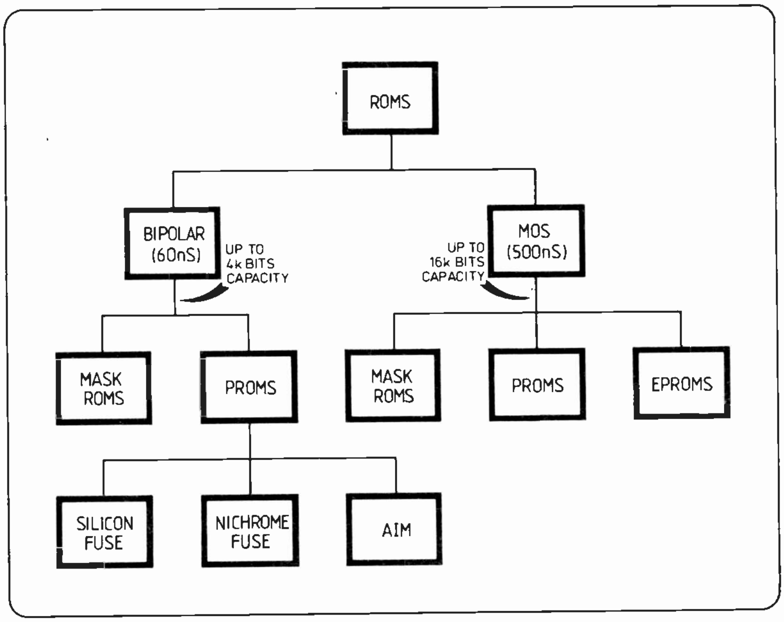
FUSIBLE BIPOLAR PROM

The fusible PROM is a device where the required program can be easily selected by the process of burning out or fusing the unrequired links within the memory. There are three major ways of achieving this effect: the Nichrome Fuse, Avalanche Induced Migration and the Polysilicon Fuse.

The Nichrome Fuse: This method was the first attempted at the fusible PROM device. Nichrome is an alloy of nickel and chrome and is deposited in a very thin layer as a link between the column and row lines of the i.c. memory. By passing a heavy current through this link it can be "blown" thus open-circuiting the line.

Referring to Fig. 9 it will be noted that if the fuse is left intact, then by selection of the row the transistor is allowed to conduct and the column line is pulled towards V_{cc}. If the fuse is "blown" then the column line is kept floating and there will be no effect.

Fig. 8. Family tree—read only memories



There is a nichrome fuse associated with each element of the ROM and thus by selectively burning out the fuses the required program may be obtained. Unfortunately there are many problems with this type of device including:

(a) difficulty in obtaining a good and reliable nichrome contact.
(b) difficulty in obtaining the required thickness of nichrome deposit (which is approx. 200 ångströms in order to achieve the desired resistance for the fuse.
(c) an extremely difficult phenomenon called "growback". The nichrome fuse, once blown, has been found to relink itself such that the i.c. can revert back to the unprogrammed state after a period of time. This makes the nichrome fuse unreliable for industry and as yet no way has been found to overcome this growback phenomenon.

Avalanche Induced Migration: This type of PROM relies on the effect of two reverse biased diodes as shown in Fig. 10. These diodes are across the row and column lines for each element of the PROM and, in the unprogrammed state there can be no current path between the two address lines due to the back biasing effect.

If a heavy flow of electrons is passed in the direction *A–B* then D1 will become short circuit due to the migration of aluminium atoms through the *np*-junction. Fig. 11 shows a cross-section through the junction of a programmed cell.

Although this method does not have the problems associated with the nichrome fuse only one major manufacturer seems to use it and that is Intersil (who invented the process).

There is conflicting information available as to the merits of this method, though it seems that the amount of current required to program the device is critical

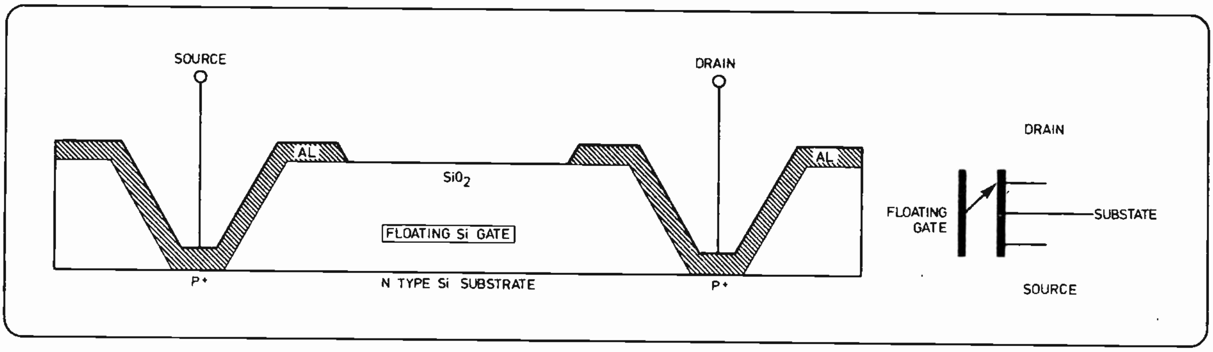


Fig. 12. Floating gate avalanche injection storage cell

as too little can cause intermittent contact and too much can cause damage to other parts of the i.c. Once programmed, however, this device will retain the information indefinitely.

The Polysilicon Fuse: This method is the most popular amongst the major i.c. manufacturers. As with the nichrome fuse a small deposit of fusible material is deposited during the final stages of manufacture of the i.c. but in this case the material is polycrystalline silicon. The thickness of this fuse is approx. 3,000 ångströms (about 15 times greater than nichrome) and the fuse can be blown by application of successively wider current pulses. With this method there is no problem at all with growback.

ERASABLE AND ELECTRICALLY REPROGRAMMABLE ROM (EPROM)

The erasable and electrically reprogrammable ROM, when introduced about five years ago, was a completely new step in the field of PROMs. It has all the characteristics of the normal PROM but in addition has the ability to have the programmed information erased thereby returning the i.c. to its unprogrammed state.

The device uses MOS technology and works on a method called the Floating Gate Avalanche Injection MOS (FAMOS) which was developed by Intel. This system does not use the conventional method of fusing but utilises a migrating charge within a silicon gate MOS field effect transistor (MOSFET) and can be seen in Fig. 12.

This MOSFET does not have any connection to the gate (which is considered to "float"). Now, if a junction voltage in excess of −30V is applied to the device (which is of the *p*-channel type) then the floating gate will be injected with electrons from either the source or the drain due to the avalanche effect at that *pn*-junction.

The amount of charge is a function of amplitude and duration of the applied junction voltage and is retained within the floating gate since the latter becomes surrounded by thermal oxide which is a very low conductivity dielectric.

The charge can in fact be retained for years without any significant decay and the manufacturers claim that after ten years at 125 deg. C only 30 per cent of the stored charge will be lost. The presence or absence of the charge determines whether the MOSFET will act as a short circuit path or as a very high resistance between the row and column lines and so the device may be programmed as required.

ERASING BY UV LIGHT

Once the information is required to be erased the i.c. is subjected to ultra-violet light for about 15 minutes through a small access window located on the top of the device. This UV light causes a flow of photocurrent from the floating gate back to the silicon substrate thereby discharging the gate to its initial no-charge condition.

The access window itself is made from transparent quartz and, although always exposed to daylight, neither conventional and fluorescent lighting nor sunlight has any effect on the stored data. The programming and erasing operations can be carried out an indefinite number of times.

CHARGE COUPLED DEVICES (CCDs)

Charge Coupled Devices are more recent innovations in the field of memory systems and are internally organised as extremely long serial shift registers. A typical memory capacity is 16384 BITS where the i.c. is organised as sixty-four separate registers of 256 BITS.

Although there are two basic methods of operation of CCDs, only one will be discussed here, the Surface Channel method as used in the 2416 CCD device by Intel.

Imagine a *p*-type substrate with eight gates as shown in Fig. 13. Applying a positive potential to one of the gates causes a potential "well" to be formed beneath it by repelling all the majority substrate carriers from the vicinity. If a negative charge is now injected into this region it will be attracted into the "well" and, on removal of the positive potential on the gate, will remain trapped there.

By applying a sequence of pulses to the gates as shown in Fig. 14 the charge, once injected, may be successively moved along the substrate by the overlapping action of the "wells" thus created beneath the gates.

Although the system looks fairly straightforward there are drawbacks, one of these being that a small amount of the charge is lost as it traverses along the substrate. This necessitates the charge being "topped up" by refresh amplifiers every 64 stages. Now, since this device has 64 registers, each of 256 BITS, this creates a problem and so the register is in fact split up into four registers each of 64 BITS to make one long register of effective length 256 BITS. Also, due to the interleaving of the shift pulses, only two refresh amplifiers are required and the information travels through the complete 256 stages in the manner shown in Fig. 15.

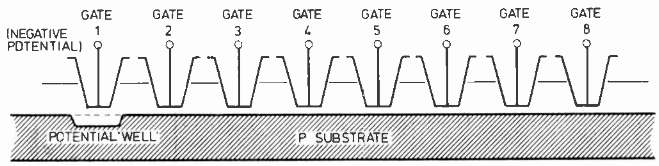


Fig. 13. Cross section schematic of eight-gate charge coupled device

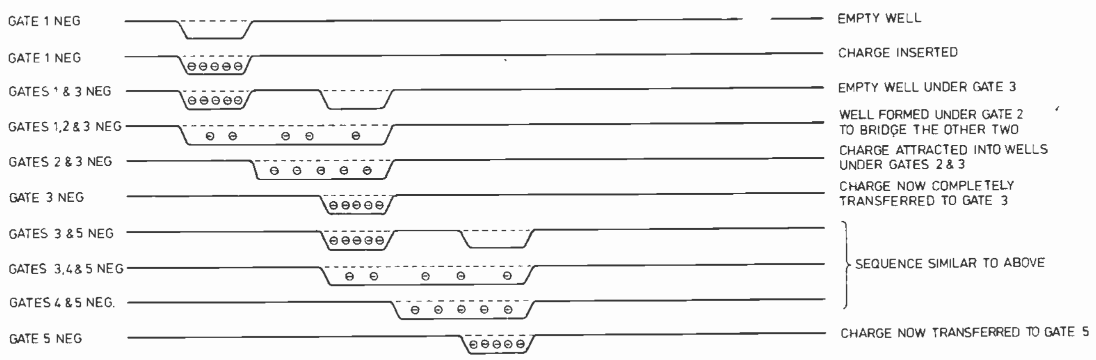


Fig. 14. Transference of charge along charge coupled device

NOTE

In Part 1 last month, the formulae quoted on page 28 are incorrect. For a logical "1" stored, the voltage on C_2 will increase to

$$V_F = V' \frac{C_1 + KC_2}{C_1 + C_2}$$

where K is a function of C_1, and is usually slightly less than 2.

For a logical "0" stored, the voltage on C_2 will increase to

$$V_F = V' \frac{C_1}{C_1 + C_2}$$

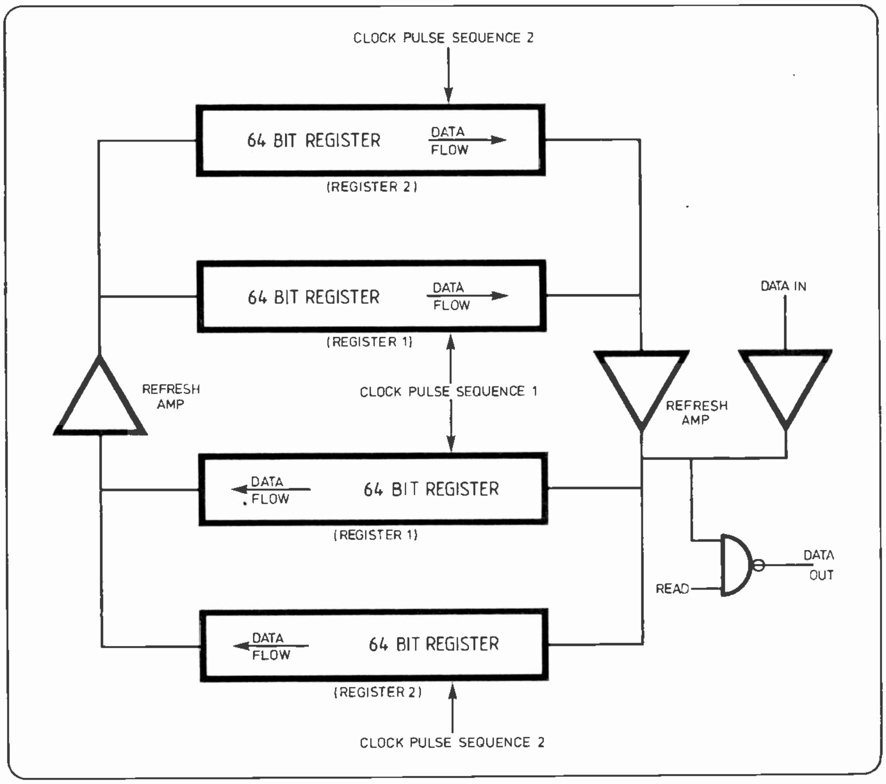


Fig. 15. Data flow of one of the 64 256-bit registers in 2416 device

SIMILARITY TO DRUM STORE

Since there are a total of 64 registers which are all independent from each other as far as the information is concerned, the organisation of the complete i.c. is analogous to a drum store of 64 tracks.

In a drum store the drum itself revolves thus presenting information on all tracks as the tracks pass the take-off point; in the CCD it is the information itself which is rotating past the take-off point and thus the memory may be accessed at will since the cyclic position of the individual registers will be known. This action is shown diagrammatically in Fig. 16.

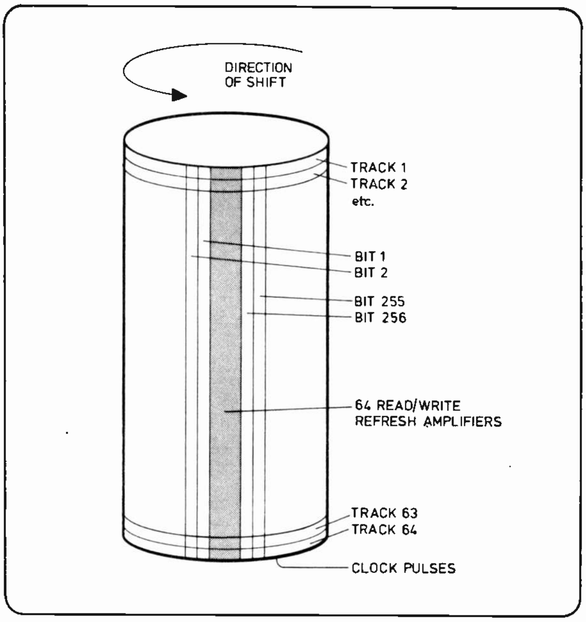


Fig. 16. Drum store organisation analogy of 2416 device

FUTURE TRENDS

With so many developments in the last two decades in the field of semiconductor memories one could be excused for thinking that the limit has almost been reached in this technology. However, there are still numerous areas where, in a few years and after more research, further strides will in all probability be made.

The EPROM is a likely candidate for further improvement. At present the only method whereby the data may be erased is by use of ultra-violet light, exposing the chip to it for some minutes. This is obviously very time-consuming and is not practical to incorporate this erase function into an on-line computer memory system.

Further research must bring forth a new method of erasing the data stored which is significantly faster and which is comparatively easy to accomplish. Once this has been achieved a completely new breed of semiconductor memory will have been born combining the characteristics of the static RAM with the characteristics of the non-volatile ROM. These characteristics would include:

1. The ability to store the data as required and, should the power be lost or the memory itself be removed then the information within the memory would remain intact.

2. The ability to modify or update the information by erasing completely and then re-writing with the new data at comparable speeds to existing RAMs.

SOCIAL EFFECTS

The implications of the development of such a device are staggering for they would have immediate influences on our way of life. Some possibilities are suggested below.

There would be no need for conventional bank cheque cards and the use of cheques and even hard cash would be cut dramatically. It would be sufficient for each account holder to have his own card with a small and cheap memory built into it. When the holder needs to go to the bank to obtain or pay in money, the memory (which would hold all the information on his account including his current balance) would be automatically updated by a corresponding machine under the control of the cashier.

Similarly, the account holder could go shopping with his card using it in an identical way to the current credit cards.

Shopkeepers would have a similar device to that of the banks such that the cost of the goods or services would be automatically deducted from the amount held in the account holder's memory card. A detailed record of all transactions completed would be printed out at the end of each day to be sent to the shopkeeper's bank.

Also, shopkeepers would have no further worries similar to stolen or "rubber" cheques with this system, since not only would the true account balance be held on the customer's memory card (including any overdraft facility granted by the bank) but also each card holder would have memorised his own personal privacy code (corresponding to the code hidden inside the memory) to prevent unauthorised use of the card.

A similar memory card could be held by individuals for medical purposes which would be invaluable in the event of an accident since it could hold all the necessary vital information that the hospitals need fast such as age, blood group, doctor's name, next of kin, home address, etc.

At present computer installations use a great deal of off-line storage in the form of magnetic tape, disc stores, drum stores, etc. which are bulky but comparatively cheap. Large scale production of this new generation of semiconductor memories would largely supplant these existing storage systems since, although perhaps not as cheap (per stored word) the floor area savings, the greater reliability (due to their non-mechanical operation) and also (and perhaps most important) the faster accessing time of these new memories would make them an economic necessity.

It must also be expected that even greater capacities within each chip will be forthcoming in the future. With so much data about personal incomes, bank accounts, criminal records, medical histories, bad debt records, etc. already held on computer memories, one wonders if in the future we really *will* say "Thanks—for the memory". ★

Unique full-function 8-digit wrist calculator... available only as a kit.

A wrist calculator is the ultimate in common-sense portable calculating power. Even a pocket calculator goes where your pocket goes – take your jacket off, and you're lost!

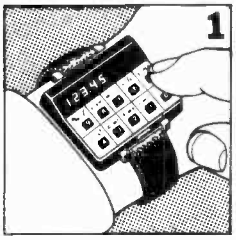
But a wrist-calculator is only worth having if it offers a genuinely comprehensive range of functions, with a full-size 8-digit display.

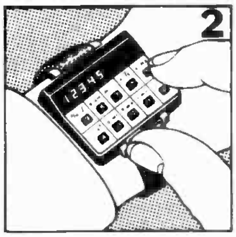
This one does. What's more, because it *is* a kit, supplied *direct* from the manufacturer, it costs only a very reasonable £9.95 (plus 8% VAT, P&P). And for that, you get not only a high-calibre calculator, but the fascination of building it yourself.

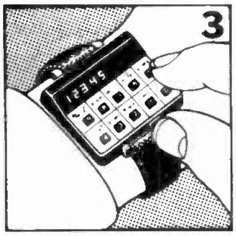
How to make 10 keys do the work of 27

The Sinclair Instrument wrist calculator offers the full range of arithmetic functions. It uses normal algebraic logic ('enter it as you write it'). But in addition, it offers a % key; plus the convenience functions $\sqrt{x}$, $1/x$, x^2; plus a full *5-function memory.*

All this, from just 10 keys! The secret? An ingenious, simple three-position switch. It works like this.







1. The switch in its normal, central position. With the switch centred, numbers – which make up the vast majority of key-strokes – are tapped in the normal way
2. Hold the switch to the left to use the functions to the left above the keys...
3. and hold it to the right to use the functions to the right above the keys.

The display uses 8 full-size red LED digits, and the calculator runs on readily-available hearing-aid batteries to give weeks of normal use.

Assembling the Sinclair Instrument wrist calculator

The wrist calculator kit comes to you complete and ready for assembly. All you need is a reasonable degree of skill with a fine-point soldering iron. It takes about three hours to assemble. If anything goes wrong, Sinclair Instrument will replace any damaged components *free:* we want you to enjoy assembling the kit, and to end up with a valuable and useful calculator.

Contents

Case and display window.
Strap.
Printed circuit board.
Switches.
Special direct-drive chip (no interface chip needed).
Display.
Batteries.

Everything is packaged in a neat plastic box, and is accompanied by full instructions. The only thing you need is a fine-point soldering iron.

All components are fully guaranteed, and any which are damaged during assembly will be replaced free.

The wrist-calculator kit is available only direct from Sinclair Instrument. Take advantage of this 10-day money-back undertaking.

Send the coupon today.

KIT ONLY £9.95 PLUS VAT, P&P

Sinclair Instrument Ltd,
6 Kings Parade, Cambridge,
Cambs., CB2 1SN.
Tel: Cambridge (0223) 311488.

To: Sinclair Instrument Ltd,
6 Kings Parade, Cambridge, Cambs., CB2 1SN.

* Please send me ... (qty) Sinclair Instrument wrist-calculator kits at £9.95 plus 80p VAT plus 25p P&P (Total £11).

* I enclose cheque/PO/money order for £ ....

* Complete as applicable.

Name ______________________

Address ______________________

____

____

(Please print)
I understand that you will refund my money in full if I return the kit undamaged within 10 days of receipt.

PE/2

Semiconductors from LYNX ELECTRONICS

THYRISTORS

PIV	·8A (TO92)	1A (TO5)	3A (C106)	4A (TO220)	6A (TO220)	8A (TO220)	10A (TO220)	15A (TO48)
50	0·20*	0·25	0·35	0·32	0·41	0·42	0·47	0·96
100	0·25*	0·25	0·40	0·37	0·47	0·48	0·54	1·02
200	0·27*	0·35	0·45	0·40	0·58	0·60	0·68	1·14
400	0·30*	0·40	0·50	0·45	0·87	0·88	0·98	1·40
600	—	0·65	0·70	—	1·09	1·19	1·26	1·80

TRIACS (PLASTIC TO—220 PKGE ISOLATED TAB)

	4A		6·5A		8·5A		10A		15A	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
100V	0·60	0·60	0·70	0·70	0·78	0·78	0·83	0·83	1·01	1·01
200V	0·64	0·64	0·75	0·75	0·87	0·87	0·87	0·87	1·17	1·17
400V	0·77	0·78	0·80	0·83	0·97	1·01	1·13	1·19	1·70	1·74
600V	0·96	0·99	0·87	1·01	1·21	1·26	1·42	1·50	2·11	2·17

N.B. Triacs without internal trigger diac are priced under column (a). Triacs with internal trigger diac are priced under column (b). When ordering please indicate clearly the type required.

TTL 74 Series Plastic

7400	0·16
7401	0·16
7402	0·16
7403	0·16
7404	0·18
7405	0·18
7406	0·51
7407	0·18
7408	0·18
7409	0·18
7410	0·16
7412	0·25
7413	0·25
7414	0·72
7416	0·43
7417	0·43
7420	0·16
7422	0·38
7423	0·40
7425	0·30
7427	0·48
7428	0·53
7430	0·16
7432	0·37
7433	0·49
4737	0·35
7438	0·35
7440	0·16
7441	0·76
7442	0·65
7445	1·50
7446	2·56
7447	0·81
7448	0·81
7450	0·85
7451	0·16
7453	0·18
7454	0·18
7460	0·18
7470	0·32
7472	0·26
7473	0·30
7474	0·32
7475	0·47
7476	0·36
7480	0·55
7481	1·26
7482	0·75
7483	1·12
7484	0·85

LINEAR ICS

307	0·55*
380	0·90*
555	0·35
565	2·00*
566	1·50*
567	2·00*
709	0·35
741	0·28
748	0·35
3900	0·70*
CA3045	0·85*
CA3046	0·50*
MC1304P	1·56
MC1307P	1·17*
MC1458P	0·77
TAA300	1·61
TAA310A	1·38
TAA550	0·45*
TAA611B12	1·25*
TBA530	1·85*
TBA570	0·98*
TCA270	1·95*

LYNX

Special offer
Red LED
TIL209
10p

OPTOELECTRONICS

Displays		Discretes	
704	0·95	0·2 Red	0·13
707	0·95	0·2 Green	0·20
727	1·95	0·2 Clear	0·16
728	1·95	OCP71	0·90
747	1·80		
750	1·80		

ITT BRANDED TRANSISTORS

Medium voltage, high gain. Type BSY65 similar to BC107/8/9.

5 pcs .... 0·35
25 pcs .... 1·20
100 pcs .... 3·50

NPN TO-3 POWER TRANSISTORS

Fully tested but unmarked. Similar to 2N3055 except BVCEO = 50V +.
HFE (gain) = 20 + at 3A.
VCE SAT <1·3V at 3A.

Pack of 10	£1·80
Pack of 20	£3·40
Pack of 50	£7·50
Pack of 100	£13·00

Ideal for power supplies, audio output, etc.

SPECIAL OFFER — SG309K

1A TO3 5V £1·25

REGULATORS

723	0·45	7818	1·50
1 amp Plastic		LM340-5	1·35
7805	1·50	LM340-12	1·35
7812	1·50	LM340-15	1·35
7815	1·50	LM340-18	1·35

IC SOCKETS

8 Pin	0·16	24 Pin	0·45
14 Pin	0·16	40 Pin	0·80
16 Pin	0·18		

TO3 HARDWARE INC.

1 Mica—2 washers
Solder TA6
2 Nuts/Bolts
Washers
50 for 65p

TRANSISTORS, DIODES, RECTIFIERS

										CRS3-10	0·45	TIP32A	0·64	2N3054	0·40
AC126	0·15	BC117	0·19*	BC301	0·32	BDY60	1·70	BT109	1·00	CRS3-20	0·50	TIP34	1·05	2N3055	0·50
AC127	0·16	BC125	0·18*	BC323	0·60	BDY61	1·65	BT116	1·00	CRS3-40	0·60	TIP41A	0·68	2N3440	0·56
AC128	0·13	BC126	0·20*	BC327	0·18*	BDY62	1·15	BU105	1·80*	CRS3-60	0·85	TIP42A	0·72	2N3442	1·20
AC128K	0·25	BC141	0·28	BC328	0·16*	BF178	0·28	BU105/02	1·90*	MJ480	0·80	IN2069	0·14	2N3525	0·50
AC141	0·18	BC142	0·23	BC337	0·17*	BF179	0·30	BU126	1·60*	MJ481	1·05	IN2070	0·16	2N3570	0·80
AC141K	0·28	BC143	0·23	BC338	0·17*	BF194	0·10*	BU204	1·60*	MJ490	0·90	IN4001	0·04*	2N3702	0·10*
AC142	0·18	BC144	0·30	BCY30	0·55	BF195	0·10*	BU208	2·60*	MJ491	1·15	IN4002	0·05*	2N3703	0·10*
AC142K	0·28	BC147	0·09*	BCY31	0·55	BF196	0·12*	BY206	0·15	MJE340	0·40*	IN4003	0·06*	2N3704	0·10*
AC176	0·16	BC148	0·09*	BCY32	0·60	BF197	0·12*	BY207	0·20*	MJE371	0·60	IN4004	0·07*	2N3705	0·10*
AC176K	0·25	BC149	0·09*	BCY33	0·55	BF224J	0·18*	BYX36-		MJE520	0·45	IN4005	0·08*	2N3706	0·10*
AC187	0·18	BC152	0·25*	BCY34	0·55	BF244	0·17*	300	0·12*	MJE521	0·55	IN4006	0·09*	2N3707	0·10*
AC187K	0·25	BC153	0·18*	BCY38	0·50	BF257	0·30*	600	0·15*	OA5	0·50*	IN4007	0·10*	2N3714	1·05
AC188	0·18	BC157	0·09*	BCY39	1·15	BF258	0·35	900	0·18*	OA90	0·08	2N696	0·14	2N3715	1·15
AC188K	0·25	BC158	0·09*	BCY70	0·12	BF337	0·32	1200	0·21*	OA91	0·08	2N697	0·12	2N3716	1·25
AD140	0·50	BC159	0·09*	BCY71	0·18	BFW60	0·17*	BYX38-		OC41	0·15	2N706	0·10	2N3771	1·60
AD142	0·50	BC160	0·32	BCY72	0·12	BFX29	0·26	300	0·50	OC42	0·15	2N929	0·14	2N3772	1·60
AD143	0·46	BC161	0·38	BD115	0·55	BFX30	0·30	600	0·55	OC44	0·32	2N930	0·14	2N3773	2·10
AD149	0·45	BC168B	0·09*	BD131	0·36	BFX84	0·23	900	0·60	OC45	0·32	2N1131	0·15	2N3819	0·28*
AD161	0·35	BC182	0·11*	BD132	0·40	BFX85	0·25	1200	0·65	OC70	0·30	2N1132	0·16	2N3904	0·16*
AD162	0·35	BC182L	0·11*	BD135	0·36	BFX88	0·20	BZX61 Series		OC71	0·35	2N1304	0·45	2N3906	0·11*
AL102	0·95	BC183	0·10*	BD136	0·39	BFY50	0·20	Zeners	0·20	OC72	0·22	2N1305	0·40	2N4124	0·14
AL103	0·93	BC183L	0·10*	BD137	0·40	BFY51	0·18	BZX83 or		OC84	0·40	2N1711	0·18	2N4290	0·12
AF114	0·20	BC184	0·11*	BD138	0·48	BFY52	0·19	BZX88 Series		SC40A	0·73	2N2102	0·44	2N4348	1·20
AF115	0·20	BC184L	0·11*	BD139	0·58	BFY64	0·35	Zeners	0·11	SC40B	0·81	2N2369	0·14	2N4870	0·35*
AF116	0·20	BC207B	0·12*	BD181	0·86	BFY90	0·65	C106A	0·40	SC40D	0·98	2N2369A	0·14	2N4871	0·35*
AF117	0·20	BC212	0·11*	BD182	0·92	BR100	0·20	C106B	0·45	SC40F	0·65	2N2484	0·16	2N4919	0·70*
AF118	0·50	BC212L	0·11*	BD183	0·97	BFY39	0·40	C106D	0·50	SC41A	0·65	2N2646	0·50	2N4920	0·50*
AF139	0·35	BC213	0·12*	BD232	0·60*	BSX19	0·16	C106F	0·35	SC41B	0·70	2N2905	0·18	2N4922	0·58*
AF239	0·37	BC213L	0·12*	BD233	0·48*	BSX20	0·18	CRS1/05	0·25	SC41D	0·85	2N2905A	0·22	2N4923	0·46*
BC107	0·09	BC214	0·14*	BD237	0·55*	BSX21	0·20	CRS1/10	0·25	SC41F	0·60	2N2926R	0·10*	2N5060	0·20*
BC107B	0·09	BC214L	0·14*	BD238	0·60*	BSY95A	0·12	CRS1/20	0·35	ST2	0·20	2N29260	0·09*	2N5061	0·25*
BC108	0·09	BC237	0·16*	BD184	1·20	BT106	1·00	CRS1/40	0·40	TIP29A	0·44	2N2926Y	0·09*	2N5062	0·27*
BC109	0·09	BC238	0·16*	BDY20	0·80	BT107	1·60	CRS1/60	0·65	TIP30A	0·52	2N2926G	0·10*	2N5496	0·65
BC109C	0·12	BC300	0·34	BDY38	0·60	BT108	1·60	CRS3-05	0·34	TIP31A	0·54	2N3053	0·15		

P. & P. 20p per order—overseas 80p. Matching 20p per pair.
VAT 8% except for items * which are 12½%. No VAT on overseas. Access and Barclaycard welcome.

LYNX ELECTRONICS (LONDON) LTD

Higham Mead, Chesham, Bucks

Telephone (02405) 75154. Telex 837571

OSMABET LTD

We make transformers amongst other things

LOW VOLTAGE TRANSFORMERS
Prim. 200/240V a.c., 5V 1A 60p; 6·3V 1·5A £1·65; 3A £2·10; 6A CT £3·75; 12V 1·5A £2·10; 3A £3·75; 6A CT £5·25; 18V 1·5A CT £3·45; 24V 1·5A CT £3·75; 3A CT £5·25; 5A £8; 8A £11·25; 12A £16·50; 40V 3A CT £7·50; 50V 6A CT £18·75; 25V 2A + 25V 2A £7; 12V 4A + 12V 4A £7.

LT TRANSFORMERS TAPPED SEC. Prim 200/240V 0–10–12–14–16–18V 2A, £4; 4A, £5·25. 0–12–15–20–24–30V 2A, £4·50; 4A, £6·75. 0–5–20–30–40–60V 1A, £4·85; 2A, £6·75. 0–40–50–60–80–100–110V 1A, £7.

MIDGET RECTIFIER TRANSFORMERS
For FW rect 200/240V a.c., 6–0–6V 1·5A or 9–0–9V 1A £2·25 each, 12–0–12V 1A, or 20 0 20V 0·75A, or 9–0–9V 0·3A, or 12–0–12V 0·25A, or 20–0–20V 0·15A, or 6V 0·5A + 6V 0·5A, or 9V 0·35A + 9V 0·35A, or 12V 0·25A + 12V 0·25A, or 20V 0·15A + 20V 0·15A, all at £2·65 each

LOUDSPEAKERS
2½in 8Ω, 2½in 8 or 25Ω, 3in 3, 8 or 35Ω, 3½in 15Ω, £1 each; 8 × 5in 3, 8 or 25Ω, £1·75; Goodmans 6½in twin cone, hi-fi, 4Ω, £2·50; 7 × 4in, 3·8, 15 or 25Ω, £1·50.

"INSTANT" BULK TAPE/CASSETTE ERASER
Instant erasure any diameter tape spool or cassette, demagnetises tape heads, 200/240V a.c., £3·75.

SYNCHRONOUS GEARED MOTORS 200/240V a.c.
Brand new Smiths, built in gearbox, 6 r.p.h., £1·25 each.

PAPER TUBULAR CONDENSERS
4·7mF, 160V, 30 × 20mm, 20p (100 for £10).

SPEAKER MATCHING AUTO TRANSFORMER
12W, 3 to 8 or 15Ω, up or down, £1·65.

G.E.C. MANUAL OF POWER AMPLIFIER COVERING VALVE AMPLIFIERS OF 30W TO 400W 50p.

CABLES — CABLES — CABLES

MICROPHONE TWIN H/DUTY, BRAIDED SCREEN
Professional cable for stage, studio, outdoor. PVC covered, grey, 20p per metre.

MULTI WAY SCREENED, PVC COVERED
36 way £1; 25 way 75p; 14 way 50p; 6 way 25p; 4 way 20p; 2 way 10p; 1 way 6p per metre.

LOW LOSS CO-AXIAL CABLE 75Ω
UHF, white, 16p per metre; VHF, white, 9p per metre.

BALANCED TWIN FLAT FEEDER 300Ω
40p per 10 metres.

FLEXIBLE PVC MINI 3-CORE CABLE, 19/0·10MM
100 metres £3·50. Ideal for speakers, intercoms, etc.

TWIN FIG. 8 CABLE
Polarised, £3/100m. Screened stereo £1/15m.
ALL TYPES DOMESTIC AND COMMERCIAL CABLES, ALL SIZES AND COLOURS CONNECTING WIRES, MULTI SCREENED AND UNSCREENED CABLE.
TRADE ENQUIRIES INVITED
Carriage and VAT extra on all orders
S.A.E. ENQUIRIES. LISTS. MAIL ORDER ONLY

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

THE CATHODE-RAY OSCILLOSCOPE AND ITS USE

by G. N. Patchett — Price £3·85

COMPUTER TECHNOLOGY FOR TECHNICIANS AND TECHNICIAN ENGINEERS Vol. I by R. V. Watkin — Price £3·75

ACTIVE-FILTER COOKBOOK by D. Lancaster — Price £10·00

PRACTICAL SOLID STATE D.C. SUPPLIES by T. D. Towers — Price £6·00

110 INTEGRATED CIRCUIT PROJECTS FOR THE HOME CONSTRUCTOR by R. M. Marston — Price £2·75

SEMICONDUCTOR DEVICES by N. M. Morris — Price £4·30

FOUNDATION OF WIRELESS AND ELECTRONICS by M. G. Scroggie — Price £4·25

PRACTICAL ELECTRONIC PROJECT BUILDING by A. C. Ainslie — Price £2·30

COLOUR TELEVISION PICTURE FAULTS by K. J. Bohlman — Price £2·80

OPERATIONAL AMPLIFIERS DESIGN AND APPLICATIONS by Tobey — Price £7·00

TTL DATA BOOK by National — Price £3·10

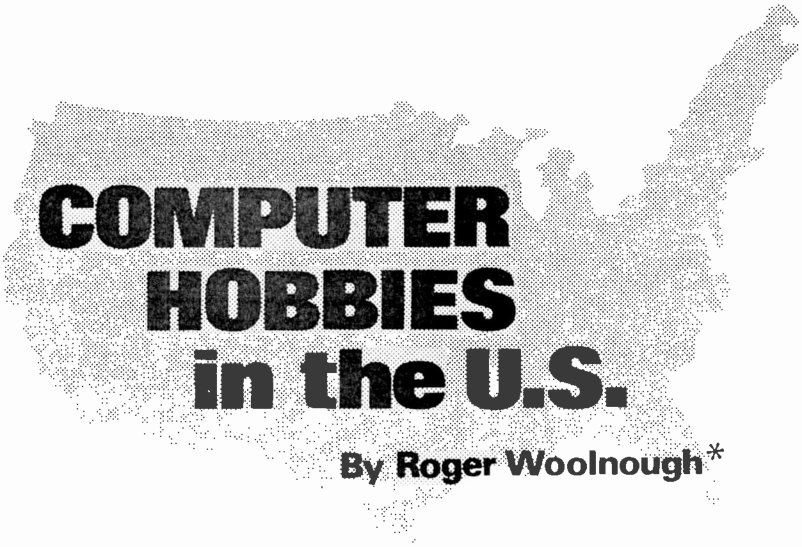
★ PRICES INCLUDE POSTAGE ★

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books

19-21 PRAED STREET
LONDON W2 INP

Phone 01-723 4185
Closed Saturday 1 p.m.



COMPUTER HOBBIES in the U.S.

By Roger Woolnough*

IN a hotel in Atlantic City last August, about 5,000 people attended a computer show at which more than 100 firms showed their products. By the standards of American computer events, it may sound modest, but what made this exhibition unusual was that the visitors were not professionals, but amateurs. The show, called Personal Computing 76, was an example of the remarkable boom in computer hobbies in the United States, which has grown so rapidly in the past two years that it has taken both the electronics industry and the retail trade completely by surprise.

HOW IT BEGAN

Improbable though it may seem, it all began in Albuquerque, New Mexico, the home town of a small company called MITS Inc. In December 1974, MITS introduced a computer in kit form called the Altair, built round an Intel microprocessor. The main market was expected to be the small business user, but MITS found that the Altair was being bought not by companies, but by individuals—and bought in incredible quantities. Within 18 months, MITS had sold some 8,000 Altairs, about 80 per cent going to the hobby market.

Before long, other companies entered the market, so that today there are about 30 computer kits being offered. At first, they were sold by mail, but there was a clear need for more direct contact with the customers—if anyone is in need of advice, it is surely an amateur building and using a computer. As a result, computer clubs and computer shops began to spring up.

There are now about 70 clubs for computer amateurs in the United States, and there are estimated to be 100,000 people belonging to them or otherwise actively engaged in the hobby. One club, the Southern California Computer Society, was formed by a handful of enthusiasts in June 1975, and in little more than a year grew to over 8,000 members. Other clubs have experienced similar rates of growth.

Retail computer stores in the States now number about 50 and are also growing fast. One of the best known chains, the Byte Shop "Affordable Computer Stores", runs as a franchise operation. The first shop opened in Mountain View, near San Francisco, in December 1975, and it was expected that 30 Byte Shops would be operating by Christmas 1976.

Magazines for computer hobbyists have also appeared. The most successful, *Byte Magazine*, grew to a paid circulation of over 50,000 within a year of its first issue in September 1975.

GREAT APPEAL

Although the boom in home computing took the electronics industry unawares, it is not difficult —in retrospect—to see its appeal. For the constructor, it offers the opportunity to use his ingenuity in building equipment and making it work—something which has attracted the enthusiast since at least the early days of radio. The microprocessor made possible a small and relatively low-cost central processing unit (some look more like hi-fi equipment than computers), while the rapid growth and high innovation rate of professional computing meant there was a lot of surplus equipment on the market in the form of teleprinters, VDUs, and other peripherals.

There is also a whole generation of people who have grown up with an easy familiarity with computers. Even those who have not entered computing as a career have probably been taught simple programming at school or college.

What the hobby computers are used for is limited only by the imagination of the enthusiasts. There are applications groups for such activities as games, electronic music, education, and voice synthesis, as well as more way-out topics like biofeedback, biorhythms, astrology, and extra-sensory perception.

TYPES OF HOBBYISTS

Broadly speaking, the computer hobbyists can be placed into three groups. First there are the people whose main interest is in the hardware. They may even scorn the computer kits, and start from the basics with a microprocessor, a handful of i.c.s, and a bare board. Once their computer system is built, their joy will come from continually modifying and extending it. They are the equivalent of the hi-fi addicts who never listen to the music.

The next group consists of the people who are chiefly concerned with software. They may construct their computer from a kit, but will just as soon buy it ready-built (if they can afford it). What they really want to do is get ahead with devising programs as a form of intellectual exercise. They may use their computer to play mathematical games or run chess tournaments of mind-bending complexity.

The third group comprises people whose main hobby is something else altogether, but who feel that a computer can help them enjoy it much more. The model train enthusiast might want to automate his layout, amateur radio operators may wish to generate and decode high-speed morse, and the amateur astronomer will have many calculations which a computer can help him undertake.

There is a fourth group which, while important, is not strictly speaking in the hobby field at all. Many business and professional people in the United States are now finding that the hobby computer is just what they need in their working lives. Their status in the hobby field may be a little suspect, but they are certainly enthusiasts. They take a full part in the activities of the computer clubs, and have no hesitation in sharing their experiences. For example, a Texas attorney has described how he tried to build an automatic typewriter for use in his office.

PROSPECT FOR BRITAIN

Will the boom in computing as a hobby come to Britain? It seems

*Editor, Electronics Weekly

quite likely, though how soon is difficult to decide. One problem is cost. Despite the fall in price of microprocessor chips, at the moment it would probably be necessary to pay out between £150 and £1,000 to set up a usable system to start computing at home.

Even in the United States, the price of entry is reckoned to be fairly high in relation to disposable income. One American commentator has said that anyone wishing to enter computing as a hobby would probably have to choose whether to spend his money on a new boat, car, or trailer, or on a computer system. In Britain, not many people are fortunate enough to be able to make that choice.

But in electronics, one thing certain is that any product based on semiconductors is going to show rapid falls in price. So we can expect hobby computer kits which will be much cheaper than those on the market at present.

Another factor is the competitiveness which seems bound to enter the business before long. As the American hobby computer market is expected to be running at 15–20,000 units a year by 1980, the large semiconductor companies which make the microprocessor chips may well enter the business, just as they have entered calculators and digital watches. They can be expected to follow the same downward trend in pricing as they pass on the benefits of the semiconductor learning curve. These companies, too, already have established worldwide marketing outlets, whereas many of the existing hobby computer firms are what are known as "mom and pop" companies.

Once hobby computers become freely available in Britain at the right price, there seems no reason why they should not find a ready market. Many people are now familiar with the principles of computing, and there is, of course, a flourishing interest in home constructional projects.

And apart from providing an outlet for endless ingenuity, the home computer may also appeal to those trying to reduce the odds against them in this robot-ridden age. As one American enthusiast said, "I wanted a small computer so I could take on all those big computers."

NEWS BRIEFS

Darling

THE outstanding success at the 1976 International Amateur Tape Recording Contest in Lausanne was an entry from a British group from Holmer Green Secondary School in Bucks. Entitled "Darling", the two and a half minute tape won the coveted Grand Prix, which this year was a magnificent Revox A700 tape recorder worth over £1,300, and several other national and international prizes including the 3M Cup.

The group were presented with their Revox A700 by Stephen Holmes of F. W. O. Bauch Limited, UK distributors of Studer-Revox audio equipment. The winners were Colin Humphreys, Carol Chamberlain, and John Smith. They received their awards at the British Amateur Tape Recording Contest prizegiving on November 12. at the International Press Centre.

Two other British entries achieving international honours were from wildlife recordists Bill Jackson and Richard Savage. Mr Savage's entry won a Neumann condenser microphone worth some £250.

New Permanent-Magnet Machine

A NEW form of permanent-magnet machine giving a high specific output from an imbricated rotor having a stabilising element has been developed at the University of Southampton by Mr K. J. Binns, Reader in Electrical Machines.

As an alternator, the machine gives a high output for the frame size using a standard stator and requires neither d.c. excitation nor slip rings and brushes. The machine has a stabilising feature which damps out oscillation and helps when it is feeding into a voltage regulator.

The machine can be run as a motor using an invertor and position sensor. The power factor and efficiency in this mode of operation are considerably higher than the corresponding values for an induction motor. For example, efficiencies of up to 90 per cent can be achieved in motors rated at several kilowatts. Speed range is very wide and notable features are the smooth running at very low speed (say 5rev/min), and the ability to self start without forcing.

The machine uses a conventional stator with a new design of rotor based on disc magnets that produces a very high airgap field.

When this machine is used as an invertor-fed drive using a position sensor, the combination of a very high airgap field with a stabilising element gives it the capability of a very high torque over a wide speed range. The stabilising element minimises any hunting tendency (load angle oscillation) whether the machine is generating or motoring.

Companies interested in building motors of this type are invited to contact Peter Thompson, Electrical Engineering and Electronics Group, to discuss licensing arrangements. A demonstration of a working prototype at the University can be arranged for potential licensees.

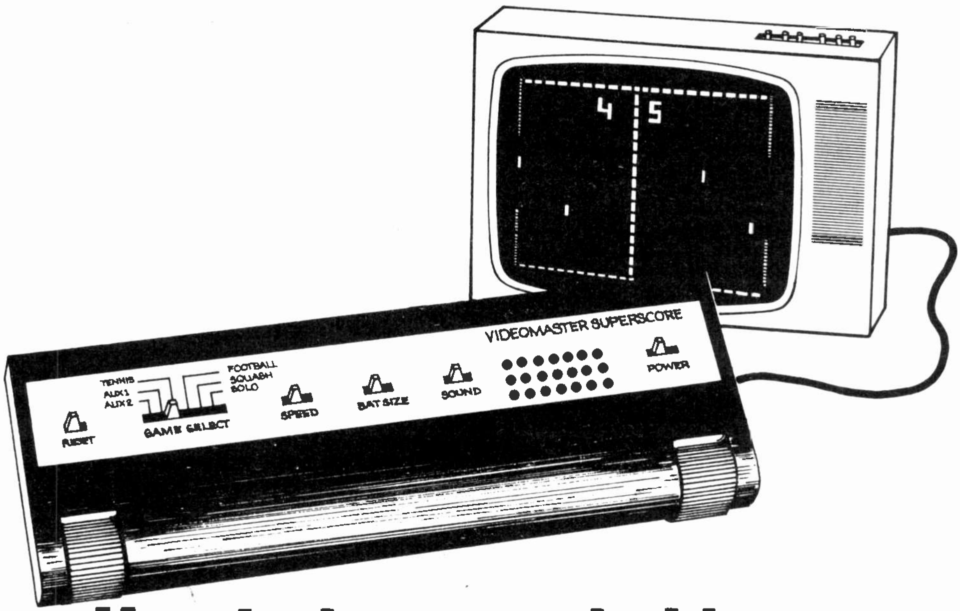
EMI-Scanner for Thailand

THE EMI-scanner has scored its first success on the South-east Asia mainland, with a £204,000 order placed by the Siam Medical Company Limited.

The comprehensive system to be supplied, built around the EMI-Scanner CT1010 specialist neuroradiological tool, will be under the direction of a noted neuro-surgeon, Dr Rasmi Wannison, who was influential in negotiating the order for installation in the Siam General Hospital, Thailand. It will be delivered in December and installed for routine clinical investigations on patients displaying symptoms of neurological disorders, to coincide with the hospital's 5th anniversary in January 1977.

The CT1010 uses the technique of computerised axial tomography invented by EMI's Central Research Laboratories in 1968, to provide the doctor with information about soft tissue structures in the head from a painless examination lasting only a few minutes. The head is examined as a series of cross-sectional slices from the top of the skull down to the larynx.

The CT1010, the most advanced equipment available for this purpose anywhere in the world, and its sister machine, the EMI-Scanner CT5005 for whole-body examinations, have revolutionised the application of X-rays to the investigation of bodily ailments and have been hailed as the most significant advances in this field since Roentgen's discovery of X-rays in 1895.



Here's the remarkable new VIDEOMASTER™ Superscore Home TV Game

Get it together for only £24.95

Available to you in kit form at the same moment as its national launch, the brilliant new Videomaster Superscore contains the latest product of MOS technology: a TV game chip.

The logic contained in it had previously to be generated by 100 TTL devices. Now it is condensed into one 28-pin chip.

This all-new Videomaster plugs into your 625-line UHF TV set (for overseas customers having VHF sets we can supply the necessary VHF modulator) to give you four exciting games (including tennis and football) and two future game options. It features on-screen digital scoring, realistic hit sounds, two bat sizes, two ball speeds, automatic serving and much more. It runs on six $1\frac{1}{2}$ volt SP11 type batteries (not supplied).

The Videomaster Superscore kit costs only £24.95 including VAT (recommended retail price of the ready built model is over £40.00) and comes complete with ready-tuned UHF or VHF modulator, circuit board with printed legend, all resistors, transistors and diodes, built-in loudspeaker, socket for mains adaptor, and, of course, the TV game chip itself.

Easy to put together the Superscore has full assembly instructions, circuit diagram and circuit description. Don't miss this chance to own the newest electronic game at such low cost.

POST TODAY TO:

Videomaster Ltd 14/20 Headfort Place, London SW1X 7HN

Please send me (insert No. requ'd)................Videomaster Superscore Kits at £24.95 (inc. VAT & P&P in UK) or £23.10+£4.00 for P&P overseas)

I enclose my cheque/money order* for £................ VHF modulator required YES/NO* PE87

NAME ____________________

ADDRESS ____________________

____

ALLOW 21 DAYS FOR DELIVERY

* delete as necessary

TAMBA ELECTRONICS

QUALITY PRODUCTS FOR HI-FI, DISCO, P.A. GROUP AND CLUB USE

AMPLIFIER AND MIXER MODULES 25 WATTS–100 WATTS RMS

TAM1000 100W 4 ohms 65V	£9·80
TAM500 50W 4 ohms 45V	£7·50
TAM250 25W 8 ohms 45V	£4·75
POWER SUPPLIES	
For 1 or 2 TAM250/500	£7·50
For 1 or 2 TAM1000	£9·80
(Carriage 50p on supplies)	

- Suits loads 4–16 ohms
- 20–20,000 Hz ±1dB
- Silicon circuitry throughout
- Glass fibre P.C.B.
- High sensitivity (100mV 10k)
- Low distortion (0·1%)
- Low profile (1in high 3½in × 3in)
- 75% efficient
- Accepts most mixer/pre-amplifiers
- Four simple connections

High grade components used throughout: Texas, Mullard, R.C.A., Plessey, etc.

NEW

ALL PURPOSE MIXER/PRE-AMP.

(with 60mm slider volume)

- Suitable for multiple input systems
- High and low impedance inputs
- High sensitivity
- Built-in supply smoothing
- 20–20,000 Hz ±1dB
- −80dB noise level
- Accepts a wide variety of inputs
- Wide range bass and treble controls

Use up to 10 PRE-AMPS with 1 power

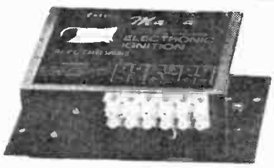
Printed circuit board assembly with treble and bass controls plus slider volume control **£6·50**

You may order as follows: C.W.O. (crossed cheques, P.O.s, M.O.s etc)—C.O.D. (60p extra). We accept Access and Barclaycard—send or telephone your number—do not send your card. Add VAT at 8% to orders for 50 and 100W units and at 12½% for 25W units.

Hours, 9.30 a.m.–5 p.m. Monday — Saturday. Callers welcome. Tel: (01) 684 0098

TAMBA ELECTRONICS

Bensham Manor Road Passage, Bensham Manor Road, Thornton Heath, Surrey.



THE *"Manta"*

CAPACITIVE DISCHARGE ELECTRONIC IGNITION UNIT

THE NEW, HIGHER RELIABILITY VERSION OF THE P.E. "SCORPIO MK II" IS NOW AVAILABLE IN KIT FORM!! Our thousands of satisfied customers report:

More miles per gallon (customers reports give 10%–25% saving —letters available)

An increase in overall performance—your 4 cylinder car feels like a 6 cylinder

No more cold morning splutters—saves you even more petrol through much less use of choke.

The price? A snip at only **£16·50**, fully inclusive of all parts, instructions, postage/packing and V.A.T. (ready built unit available—£19·85 fully inclusive)

All parts to high specification, first quality and brand new

Construct this invaluable accessory, following our easy step by step instructions (also available separately, price 30p post paid). Send for our free interesting six page brochure—"Electronic Ignition—How it Works" (S.A.E. Please) to:

ELECTRO SPARES

Dept. P.E., 187a Sheffield Road, Chesterfield, Derbyshire S41 7JQ. Telephone: Chesterfield (0246) 36638

SEMICONDUCTOR UPDATE... By R.W. COLES

8080 Z80 D17AL

DM71/LS95, LS96, LS97, LS98

MICROPROCESSORS I TO Z?

You may have heard of the Intel **8080** Microprocessor chip, a powerful 8-bit device using fast *n*-channel MOS technology which comes about as close as it is possible to get to being the 8-bit "Industry Standard" at the moment. The 8080 has a powerful set of 78 instructions, can handle Interrupts and Direct Memory Access (D.M.A.) transfers and requires only a handful of extra peripheral chips for circuit operation.

It all sounds bang-up-to-the-minute and highly desirable stuff, but such is the pace of microprocessor development that it can now be made to look like a seven-stone weakling when compared to the amazing Zilog **Z80** which seems to have been designed for the job of kicking sand into the face of its skinny Intel rival. It certainly is intended as a rival to the 8080 because it uses the same instruction types and so can run 8080 programs with little or no modification, making swopping to the new chip easy for established 8080 users.

The strength of the Zilog challenge lies in the fact that while the Z80 does everything the 8080 does, it also does lots more besides, and it does it with less hardware, less software and at a higher speed, in short it does it *better*, a fact which even Intel would have to concede!

Of course, clever chips are not the end of the microprocessor story, and Intel has an enviable reputation for supporting its own microprocessor range with development systems, prototyping cards and software facilities.

On the face of it Zilog also seem to be backing up their new fledgling very well with a powerful development system and software, but only time will decide whether they are capable of seriously denting the strong position of Intel, who, it is rumoured, are even now working up some potent "dynamic-tension" for retaliation!

The Z80 is distributed by: Lock Distribution, Neville Street, Oldham, Lancs., OL9 6LF.

VERSATILE BUFFER

New from National is the **DM71/LS95, LS96, LS97** and **LS98** series of tri-state digital buffers which are intended for use in bus-orientated logic systems such as those associated with microprocessors.

These devices are noteworthy because they incorporate lots of useful features which make them a valuable addition to the TTL logic family. The LS stands for Low-power Shottky technology which means these devices exhibit the speed of standard TTL but consume only a fraction of the power-per-gate. Tri-state means that in addition to the current sinking logic 0 state, and the current sourcing logic 1 state, a third, high impedance, state exists which allows the connection of several buffer outputs to the same "bus" wire as long as only one is active at a time.

These features are not entirely new of course, but the package they come in certainly is because it is a standard (16-pin) width package with no fewer than 20 pins to allow not six, but eight, separate buffers in a single compact DIL. Eight buffers in a package is desirable, particularly for eight-bit microprocessor applications, and the new series includes inverting and non-inverting types with a choice of dual four-bit output-enable or a gated eight-bit output-enable.

GOING DOTTY

Seven segment l.e.d.s, once so expensive are now freely available at knock-down prices and are widely used in amateur projects such as clocks and games.

With seven segment displays it is, of course, only possible to display the numerals 0 to 9 with ease, while the letters of the alphabet are impossible, or at best, weird representations which are unsuitable for most applications.

A need for a low cost alphnumerical display for hobby applications is now arising due to the increasing sophistications of home-built systems which can even include the power of the low cost microprocessors. But, unfortunately, the cost per digit looks prohibitive due to the large number of separate l.e.d. "dots" required to provide a realistic character font. Professional 7 × 5 dot matrix l.e.d. displays have been around for some years, but have only been used in a limited way due to their high cost and the difficulty of connecting up the array in a practical system.

Now at last, ITT Components have had a real go at the problem and have come up with the **D17AL** dot matrix display in a low cost epoxy package and made easy to drive thanks to an on-chip MOS shift register which reduces the input data wires to just *one*! Appropriate dot patterns for an input data word are looked up in an external "Character Generator" ROM or a Microprocessor "look-up-table" and the on-chip 35-bit shift register is loaded with the pattern in serial form.

Any number of D17AL devices can be cascaded to produce multi character displays, since the end of the shift register is available on a package pin to provide the input to a following device, the whole display can then be loaded in serial form by applying the correct number of shift pulses to the common "clock" line.

The D17AL is available in red or green, and has a creditable 17mm character height. Brightness is controlled by varying the control voltage on a single pin and current limiting for each l.e.d. is provided internally.

A device like this looks ideal material for future amateur projects, but at present, prices are still rather a problem. I have included the D17AL on this page to show that a potentially low cost solution is in sight and no doubt we shall all be "going dotty" in the near future.

Data on the D17AL is available from: STC Limited, Optical Equipment Division, Westfield Mill, Broad Lane, Bramley, Leeds.

input impedance, and is preceded by a switched attenuator to cover different ranges of input signal. Considerable negative feedback is used to stabilise calibration and minimise zero drift on d.c.

The practical circuit is illustrated in Fig. 1. Starting with the input sockets, it will be seen that the a.c. input JK1 is capacitively coupled to the d.c. input JK2. From there, the connection goes direct to the top of the attenuator network. The switching contact on JK2 is arranged so that only JK1 can be used when the 0·02 volt range is selected. Range switch S1 operates by controlling the negative feedback as well as changing the attenuator resistors. The sequence is shown in Table 1. Capacitors C2 and C3 are for frequency compensation. Adjustment of C2 is discussed later.

The input to the amplifier is via R4 which, together with diodes D1 and D2, give protection against excessive input voltage. Both the forward

MILLIVOLTMETER

By D.W. EASTERLING

THE ordinary multirange meter is very convenient for general workshop use, but its relatively poor frequency response and sensitivity make it unsuitable for overall circuit analysis such as the determination of gain, attenuation and frequency response. The measurement of small d.c. voltages associated with bias, a.g.c. and discriminator networks, which often have impedances higher than the input resistance of the meter, is also difficult. The solution to these problems is to use an electronic millivoltmeter such as the one described here.

This instrument has three d.c. and four a.c. ranges, enabling readings to be made from 20 volts down to 5 millivolts d.c. and 2 millivolts a.c.. Both positive and negative d.c. voltages can be measured, the polarity being with respect to the metal case (earthy line). This helps to minimise the effect of mains hum, and prevents instability in the equipment being investigated. Calibration on a.c. ranges is in r.m.s. values and presupposes a sinusoidal waveform, or one close to it. Frequency response is flat from 20Hz to 200kHz, except on the 0·02V range, when it is flat to 20kHz, and 3dB down at 50kHz.

The instrument is powered by a 9 volt battery controlled by the range switch, and has connections brought out to front panel sockets for supplying auxiliary units when required. Zero drift on d.c. ranges, often a problem with electronic voltmeters, is negligible once initial adjustment is made to the ZERO control. In addition to cancelling out internal potential differences, the ZERO control can also be used over a limited range to balance out off-set voltages introduced at the input; a useful feature when using transducer probes.

CIRCUIT

The basic circuit consists of a wideband amplifier coupled via a bridge rectifier to a 0 to 200 microampere moving coil meter. The amplifier has a high

TABLE 1

Range	Input	Attenuator	Negative Feedback
OFF	Disconnected	—	—
20V	a.c./d.c.	÷100 (R1, R3)	Normal
2V	a.c./d.c.	÷ 10 (R1, R2)	Normal
0·2V	a.c./d.c.	Direct	Normal
0·02V	a.c.	Direct	Reduced by R6

and reverse resistances of the diodes are high until the voltage across them exceeds 0·5V (more than sufficient for full scale deflection) when the forward resistance decreases and considerably limits the signal at the gate of the field effect transistor TR1. Notice that the earthy end of the diodes and input circuit does not go to the negative rail, but via R7 to the emitter of TR3. This is the main negative feedback line.

The output from the source of TR1 is the signal superimposed on a standing d.c. voltage of 5V. Due to the low impedance at this point, adjustment of the ZERO control VR1 affects only the standing potential and not the signal. The signal, together with any changes in the standing potential due to adjustment of VR1, is passed by the Zener diode D3 to the base of TR2. The purpose of D3 is to preserve a fixed potential difference of 3·9 volts between the source of TR1 and base of TR2 without attenuating the signal. This allows TR2 to be supplied by nearly the full battery voltage and so achieve maximum gain, linearity and dynamic range. The output of TR2 is taken from the collector direct to the base of TR3.

COMPONENTS . . .

Resistors

R1	2MΩ	R10, R12	4·7kΩ (2 off)
R2	220kΩ	R11	100Ω
R3	22kΩ	R13	470Ω
R4, R7–R9, R16	10kΩ (5 off)	R14	2·2kΩ
R5	22kΩ (or 20kΩ preset*)	R15	1kΩ (or 1kΩ preset*)
R6	220Ω (or 200Ω preset*)	R17	100kΩ

R1–3 2% ½W metal oxide, remainder 5% ¼W *See text

Potentiometer

VR1 5kΩ lin.

Capacitors

C1	0·1μF 250V polyester	C5	1,000pF polystyrene
C2	3–30pF trimmer	C6, C7	22μF 10V elect. (2 off)
C3	680pF 63V ceramic	C8	1,000μF 16V elect.
C4	47μF 25V elect.		

Semiconductors

TR1	2N3819
TR2	BC109
TR3	BC107
D1, D2, D4	1N4148 silicon diode (3 off)
D3	BZY88 C3V9 400mW 3·9V Zener
D5, D6	OA91 germanium diode (2 off)
D7	BZY88 C4V3 400mW 4·3V Zener

Miscellaneous

ME1 Microammeter 0–200μA
S1 3-pole 5-way wafer switch
S2 3-pole 4-way wafer switch
JK1, JK2 ¼in jacks with break contacts (2 off)
Group board, miniature 18-way;
9 volt battery;
aluminium case 176 × 125 × 65mm.

Transistor TR3 contributes little gain, but does increase the output voltage sufficiently to operate the rectifier mainly over the linear part of its characteristic. At the same time, the emitter circuit provides a suitably phased low impedance source of negative feedback which is held at the required d.c. level by D4. This is not a Zener diode, but uses the forward current characteristic of a silicon diode to maintain a potential difference of 0·5 volts.

The main purpose of S2 is to switch the microammeter to various parts of the circuit depending on the measurement required. Starting with BATTERY CHECK, it will be seen that the meter is placed in series with R17 across the battery so that the circuit behaves as a simple voltmeter. When S2 is at D.C. NEGATIVE, the negative terminal on the meter is connected via R15 to the collector of TR3, and the standing voltage at this point is balanced out by the positive terminal going to the Zener network D7, R14. The meter connections are reversed when S2 is switched to D.C. POSITIVE. Finally, with S2 at A.C. the meter is in series with R16 across the bridge rectifier. In this position S2a comes into use, bypassing some of the a.c. negative feedback to the negative rail via C4 and R5. Greater sensitivity is obtained for the 0·02V range when S1c shunts R5 by R6.

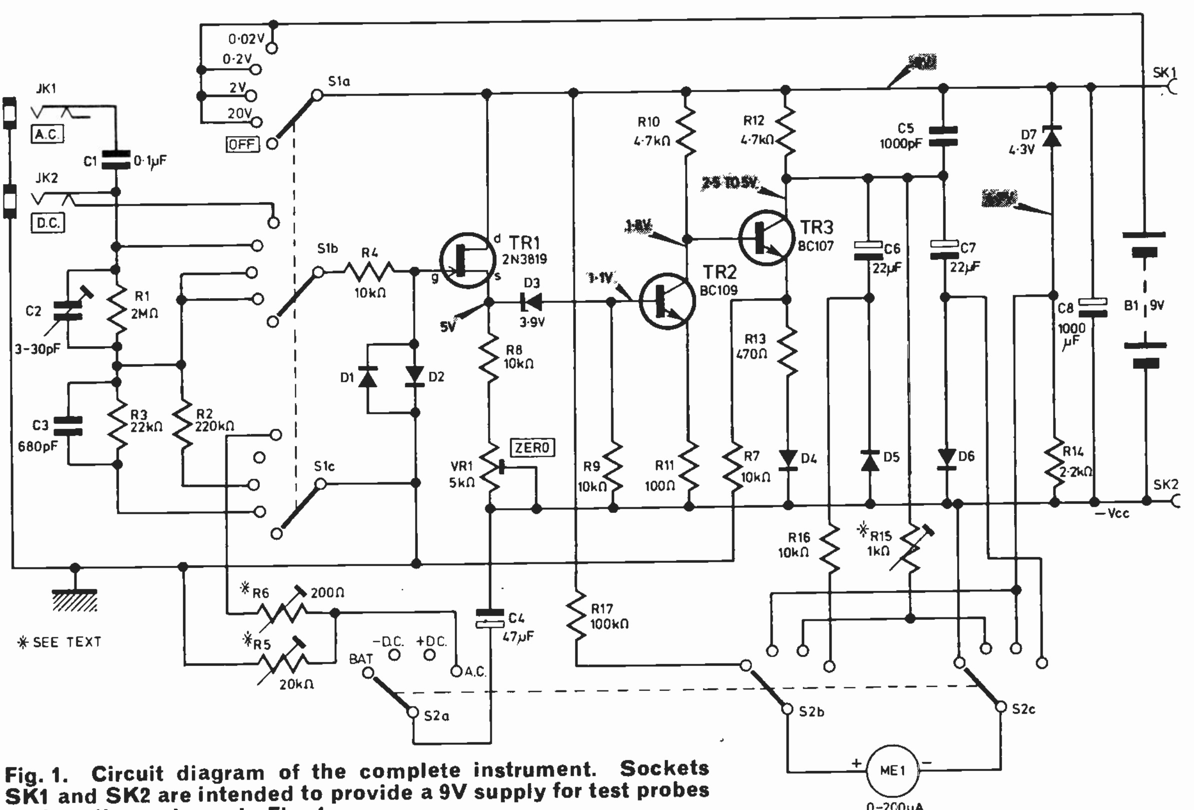


Fig. 1. Circuit diagram of the complete instrument. Sockets SK1 and SK2 are intended to provide a 9V supply for test probes such as those shown in Fig. 4

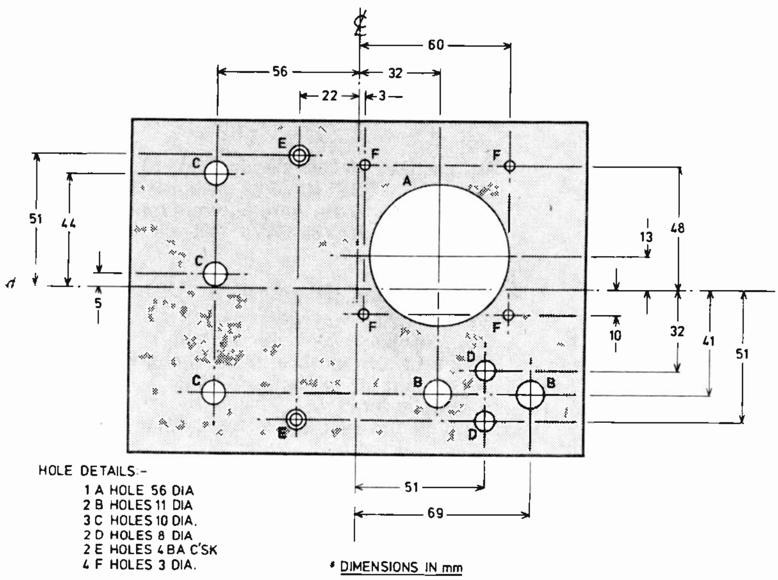


Fig. 2. Drilling details of the front panel of the millivoltmeter

CONSTRUCTION

The instrument is housed in a standard aluminium box measuring 176 × 125 × 65mm. All components are mounted in the lid, which becomes the front panel. The drilling details are shown in Fig. 2. Because it is difficult to measure accurately from the radiused edges, all dimensions are from centre lines. The distance between holes E depends on the spacing of the holes in the tagboard. Boards made by different manufacturers may vary, and so it is well to check before drilling the panel. Holes F secure the microammeter, and again the actual positions may have to be varied slightly, those quoted being for an S.E.W. SD830 movement.

In order to provide a suitable background for the switch and socket legends, the front panel can be covered by self adhesive vinyl sheet such as Contact or Fablon. This material will accept transfers and instant dry lettering which should be protected by a coat of clear varnish. The vinyl sheet is applied after the panel has been drilled but before the components are mounted. The tagboard is secured by 4BA countersunk bolts through holes E, one full nut being used on each bolt as a spacer to lift the board away from the panel and so prevent the tags shorting out. The spacer nut fitted to the bolt nearest R1 also secures a solder tag which is used to connect a double earthing lead to the case. One lead subsequently connects the jack sockets, and the other goes to the earth tags on the board.

WIRING

The wiring diagram is shown in Fig. 3. For the sake of clarity not all the wiring is drawn but the connections are indicated. For instance, the left-hand tag of R1 goes to C2, C1 and JK2, and also to tag 4 on S1b. The other end of R1 goes to tags 2 and 3 also on S1b. All tags 1 on S1 are unused as all three switch segments are open circuit in the OFF position.

It will be noticed that although Fig. 1 shows resistors R5, R6 and R15 as adjustable, Fig. 3 does not. Cheap preset controls are unsuitable for this job and it would be better to use helical trimpots, but these are expensive. The writer used fixed resistors, trimming down to the required value by shunting them with higher values.

The usual base connections to TR1 are shown going to the tagboard. Some field effect transistors marked 2N3819 have a different base configuration, but apart from the difference in connections the performance of the two types appears similar.

TEST AND CALIBRATION

Normal voltages are shown on the circuit diagram Fig. 1. Exact values will vary slightly from one instrument to the other and will also depend on the battery state. Voltages are with respect to the negative rail and were measured with a 20,000 ohms per volt multimeter. Total current consumption is about 5mA.

Initial tests should be made with the instrument switched to 20V r.m.s. The pointer after an initial kick should return to zero. If all appears well and the battery current is normal, switch the instrument to D.C. POSITIVE and adjust the ZERO control to bring the pointer to zero reading. Now switch to D.C. NEGATIVE; the zero should remain constant. Finally try the BATTERY CHECK; the meter should read between 75 and 95 microamperes (7·5 to 9·5 volts). Get into the habit of starting each test from the OFF position, and in the case of d.c. measurements, zero the meter on the 20V range.

The calibration procedure starts with the 0·2V d.c. range. Apply a d.c. input of exactly 0·2 volts. This can be derived from a potentiometer network across a battery, and should be monitored by the best quality d.c. voltmeter available to the constructor. Now trim R15 until the instrument being calibrated reads exactly 20 microamperes. The 2V and 20V ranges can be checked, preferably at or near the maximum end of the ranges, by applying the appropriate monitored input. Although for reasonable accuracy it should not normally be necessary to adjust the input attenuator, adjustment can be made to the 2V range by changing the value of R2, and to the 20V range by changing the value of R3.

Calibration on a.c. also commences with the 0·2V range. This time R5 is trimmed for a meter reading of 200 microamperes when 0·2V r.m.s is applied to the a.c. input socket JK1. The frequency of the test signal must not exceed 1,000Hz during this stage of calibration. Once R5 is set, the calibration on the 2V and 20V ranges should follow automatically. Finally, with the test signal reduced to 0·02V r.m.s., the lowest a.c. range can be set by trimming R6.

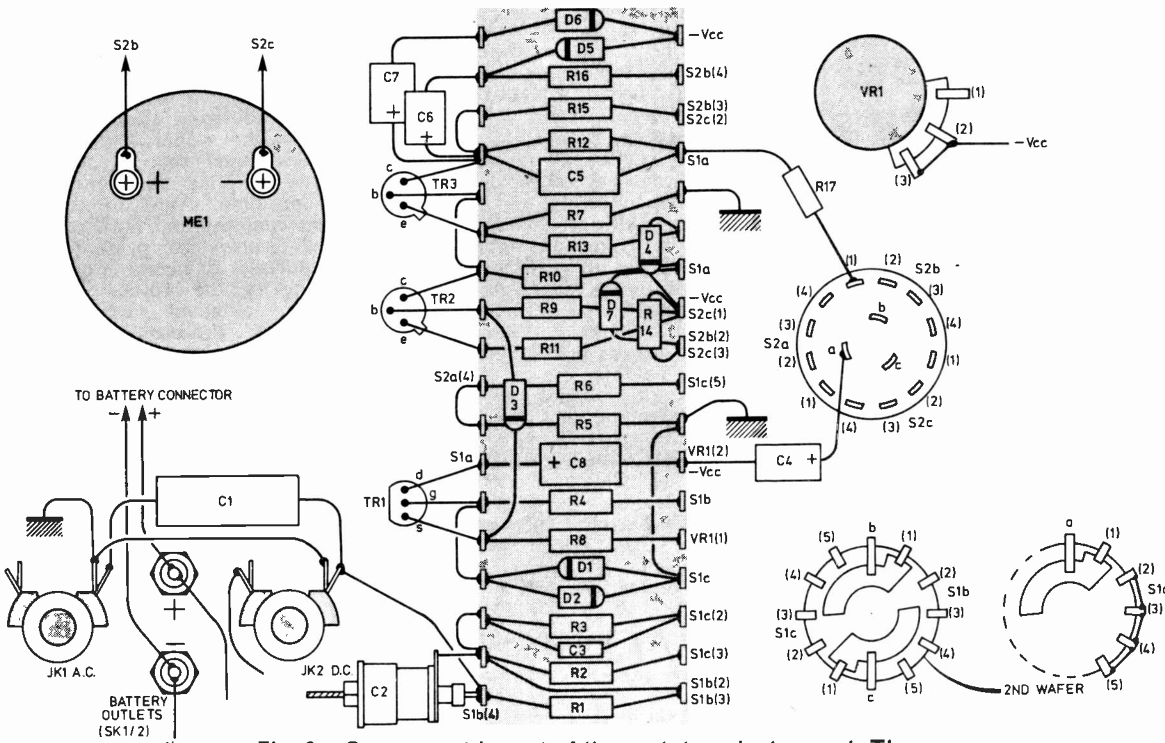


Fig. 3. Component layout of the prototype instrument. The labels against the tagboard indicate wiring destinations

Note that very low meter deflections on all a.c. ranges are suspect because of the rectifier characteristic, but with ranges overlapping, this limitation is only significant on the lowest range below 2 millivolts.

Frequency response checks may now be made using an audio frequency signal generator, if available. Starting at about 100Hz the generator is set to produce a reading on the instrument being calibrated of about 150 microamperes. Keeping the output level of the generator constant, tune it down to its lower frequency limit, and then in the reverse direction to its maximum frequency. Throughout this process the meter reading should be noted.

When switched to the 0·2V range the reading should be sensibly constant from just below 20Hz to 200kHz. The process should now be repeated for the 2V range, although this time it will probably be necessary to adjust C2 for optimum results, the aim being to get a constant reading over the widest possible range of input frequencies. The 20V range should be the next to be checked. Ideally, if the 2V range was set correctly, the 20V range should follow automatically. In practice it will be necessary to find the best C2 setting for both ranges, and this will undoubtedly involve some compromises. The final result should be, however, a bandwidth very similar to that obtained for the 0·2V range. Finally, the 0·02V range may be checked. No attempt has been made to provide frequency compensation on the lowest range, and it will be seen that the bandwidth is limited to 20kHz, falling by 3dB at 50kHz.

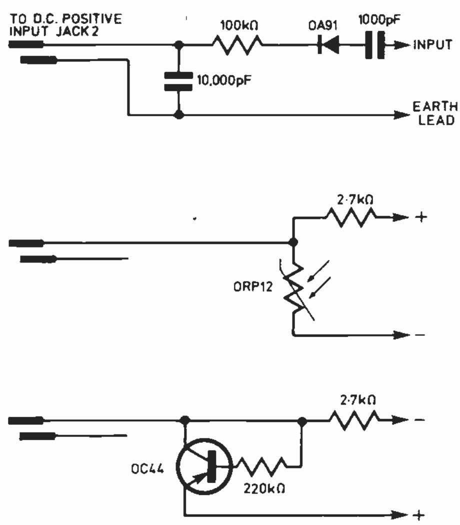


Fig. 4. Three examples of special purpose test probes. From top to bottom, these are a v.h.f. probe, a light probe and a temperature probe

OTHER APPLICATIONS

In addition to the measurement of a.c. and d.c. voltages, the meter just described can be the basis of a number of instruments useful to the experimenter. Some basic ideas are illustrated in Fig. 4. The simple diode probe enables comparative readings to be made well into the v.h.f. range. Fitted with a microphone the instrument becomes a sound or noise meter. Other probes enable light and temperature readings to be made. Various other transducers can be devised to cover almost every kind of phenomenon. ★

MARKET PLACE

Items mentioned in this feature are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned. All quoted prices are those at the time of going to press.

CALCULATORS

Two new portable Oxford calculators, replacing all previous models, have just been announced by **Sinclair Radionics.** These new models have been designed after analysing the views of a cross section of our society, including retailers and wholesalers.

In addition to the four normal arithmetic and six trigonometric functions (in degrees and radians), the Oxford "Scientific" offers logs base$_e$, logs base$_{10}$, antilogs, y^x, memory, two levels of parentheses, sign change, plus the four slide-rule functions: x^2, $\sqrt{x}$, $1/x$, and π.

Accuracy is claimed to be $\pm$ one unit in the 8th significant digit on arithmetic and slide-rule functions, and ± 2 units on all other functions. The large green 8-digit display shows results in normal or scientific (mantissa plus exponent) notation.

The Oxford "Universal" follows the proven formula of the now-discontinued Oxford 200, with $+$, $-$, $\times$, $\div$, %, a constant, a large green display, and a six-function memory. However, as a result of consumer demand, three convenience functions have been added: $\sqrt{x}$, $1/x$, and x^2.

Both of these two new calculators offer mains or battery operation. A mains adaptor is available, or each calculator gives several weeks of normal use on a PP3 battery.

Available from most big stores and stationers, the Oxford "Universal" has a recommended retail price of £11·95 plus 8% VAT. This is £1 cheaper than the previous Oxford 200 version. The Oxford "Scientific" has a recommended retail price of £14·95 plus 8% VAT.

MULTIMETER

Utilising established valve-voltmeter techniques to achieve a stable and reliable instrument, the Chinaglia VTVM 2002 electronic multimeter is the latest product being marketed by **Alcon Instruments** suitable for the servicing technician.

With a wide 100 degree mirror-scale movement for analogue display and some 21 ranges showing an input impedance of 22MΩ on d.c. and 1MΩ shunted by 30pF on a.c., the 2002 is capable of wide ranging measurements. For example, it can display d.c. volts, peak or r.m.s.; a.c. volts; power in dB and resistance in ohms.

Accuracy is claimed to be $+2·5$ per cent on d.c. and resistance and 3·5 per cent on a.c. When on a.c. the frequency range is 25Hz to 100kHz $\pm$1dB and this can be extended by using an optional r.f. probe to cover up to 250MHz.

The resistance ranges are particularly interesting, providing the ability to differentiate between resistance as low as 0·2Ω or as high as 100MΩ. To cater for the TV world there is an optional high voltage probe extending the upper voltage to 30kV.

Complete with leads and instructions, the Chinaglia 2002 costs £98·60, including VAT, postage and packing. Further information is available from **Alcon Instruments Ltd. (Dept. P.E.), 19 Mulberry Walk, London SW3 6DZ.**

DISPLAY SWITCHES

A new range of compact 7-segment l.e.d. display modules with integral pushbutton-actuated decade switch is now available from **Contraves Industrial Products.**

Known as Multicount modules, these combined display and switch units can be assembled into multi-decade display and switching banks, with any desired number of digits, for instrument control panel mounting. Front panel mounting of the modules is achieved with push-in end brackets and locating dowels ensure positive and accurate alignment of module stacks. A full-length red filter spans all l.e.d. display in each bank.

A variety of optional functions is available, including built-in memory, up/down counter, comparator and sign display. Even TTL or CMOS logic may be specified and dummy modules can be supplied for incorporation of additional electronics, pushbuttons, etc.

The bi-directional decade switch, with BCD output, can function independently from the digital display, or may be connected internally or externally to the display logic. This combination of switch and display within one single housing reduces panel space required and greatly simplifies mounting and interconnection. Applications include event counting and limiting, timing, clock displays and position control.

Addresses of nearest stockists and costings for the Multicount modules can be obtained from **Contraves Industrial Products Ltd., Time House, (Dept P.E.), Station Approach, Ruislip, Middlesex HA4 8LH.**

NEW CATALOGUES

We have received a fair selection of components and kit catalogues this month which we can recommend to readers for their reference library. Of course, all prices should first be checked with firms direct or with current advertisements before ordering any goods. The catalogues received are as follows:

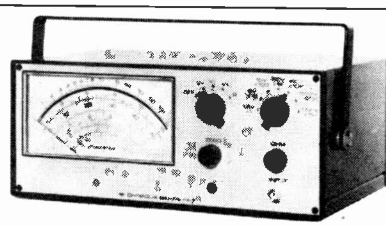
Home Radio Components Catalogue
Charge: £1·40. 192 pages
Home Radio (Components) Ltd., 234–240 London Road, Mitcham, Surrey CR4 3HD.

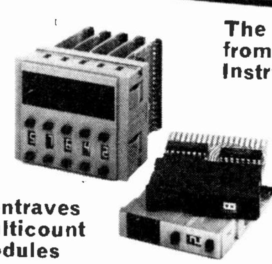
Arrow Electronics Components Catalogue No. 9
Charge: 40p. 44 pages
(overseas orders welcome)
Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex CM14 4BN.

Tandy 1977 Catalogue
Charge: Free. 100 pages
Available from any **Tandy** Store.

Heathkit Winter '76–77 Catalogue
Charge: Free. 40 pages
Heath (Gloucester) Ltd., Bristol Road, Gloucester GL2 6EE.

New Oxford Scientific from Sinclair


The VTVM2002 from Alcon Instruments


Contraves Multicount Modules

PE Star line-up for March

FREE INSIDE!

DIODE IDENTICHART

Lists the most commonly available small signal, Zener and power diodes with important parameters and comparable types for easy replacement.

CONSTANT VOLUME INTERCOM

An inter-communicator is one of the most useful of all electronic equipments.

Here is an improved design incorporating automatic volume control. This overcomes those commonly experienced nuisances of inaudible speech and over-loud speech with attendant noise and distortion.

HEAR IN THE CLEAR!

NEW SERIES MICROPROCESSORS EXPLAINED

An important and vital series for everyone interested in following the latest developments in electronics. These articles provide a straightforward explanation of microprocessors and what they can do; and offer guidance as to their likely practical use by constructors in the immediate future.

Essential reading for all enthusiasts!

pH METER

Gardeners, aquarium owners, home brewers and chemists; build your own pH meter. Learn the meaning of pH and how it can be measured accurately. This instrument may be used as a voltmeter too!

AUTOWAH

Look no feet! Most *wah* and *swell* pedals by definition have to be operated by a footswitch. This unit can give either effect, automatically triggering from each new note played on the guitar.

Don't be disappointed — place a firm order with your newsagent *NOW*

PRACTICAL
ELECTRONICS

OUR MARCH ISSUE WILL BE PUBLISHED ON FRIDAY, FEBRUARY 11, 1977

SEVEN SEGMENT DISPLAY for OSCILLOSCOPES

by L. Newell

DURING the testing of a digital clock system which did not require a display in its final application, a need was found for a circuit that would permit display of the output, and of the intermediate stages, without wiring many l.e.d.s and their driving circuits. Such a circuit could also be used to display the output of instruments such as timers and DVMs, etc. and notes on possible applications are included later. It was decided to use an oscilloscope as the display medium, due to its flexibility and availability.

The circuit to be described is essentially a Read Only Memory (ROM) containing the numerals 0 to 9, in seven-segment format. Additional circuitry will permit numbers to be displayed on an oscilloscope, *without* intensity modulation being necessary. This is a considerable advantage, since most cheap oscilloscopes do not have a Z input; even when they do, it is often difficult to drive.

The system uses TTL i.c.s throughout, and is cheaper and easier to use than an MOS ROM containing ASCII characters. The total cost is about £7, which is almost independent of the number of digits displayed.

CHARACTER GENERATION

The method of generation of characters on the oscilloscope will decide some of the features of the ROM, so this is treated first. Standard ASCII characters are formed on a 7 × 5 matrix of dots (e.g. see PRACTICAL ELECTRONICS, March 1972). For convenience, an 8 × 8 matrix is used here, in order to leave a space of three columns between adjacent digits, and of one row beneath each digit. This leaves room for other symbols (e.g. a minus sign) to be added if desired.

The row and column numbering and segment identification are shown in Fig. 1. Notice that Row 1 is at the *bottom* of the character, for reasons to be explained shortly. Since seven-segment characters are used, the dots on each "bar" can be activated at the same time, thus minimising the logic necessary.

The dots are formed on the oscilloscope by a series of staircase waveforms, each with eight steps. By decreasing the timebase speed, the steps of the staircase will be contracted, and appear as dots. The transitions between levels are, by contrast, so fast that they are not seen.

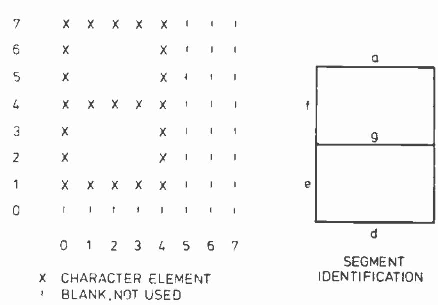


Fig. 1. Digit element numbering and seven-segment identification

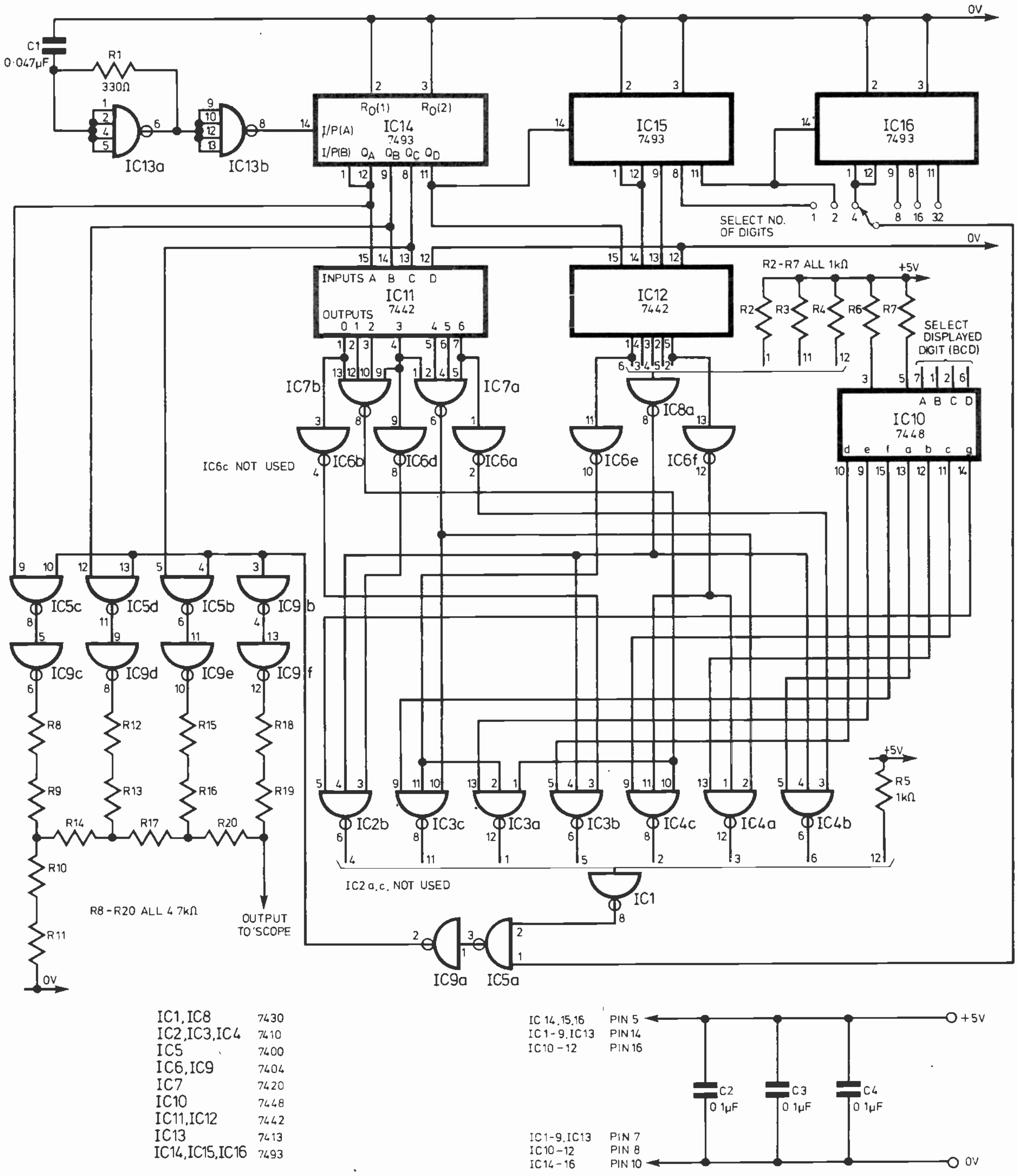


Fig. 2. Complete circuit diagram

The staircase is generated by a digital-to-analogue converter (DAC) using IC5, IC9 and an "R-2R" ladder network. See the circuit diagram Fig. 2. This circuit gives a voltage at the output that is proportional to the binary number set up at the input. The DAC is driven by a 3-bit binary counter, to give a step on the waveform for each row of the character. Thus the DAC input is connected to the Row Address input. If the DAC output is examined with an oscilloscope, a series of staircase waveforms will be seen. With a slow timebase speed, the steps of the staircase will appear as dots.

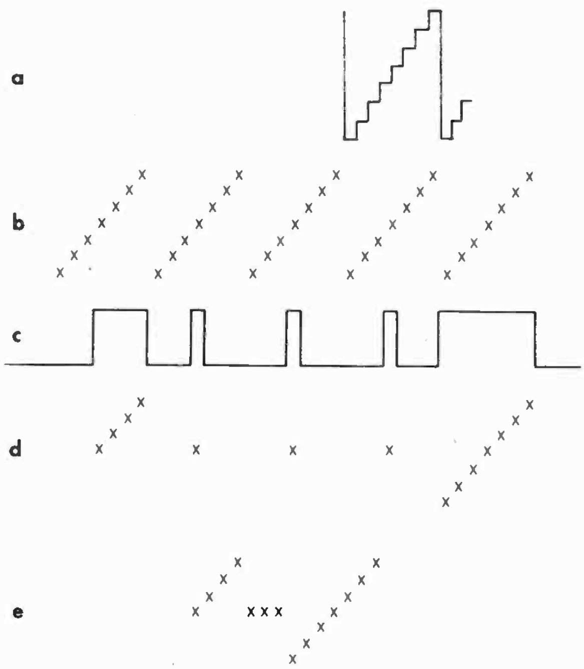
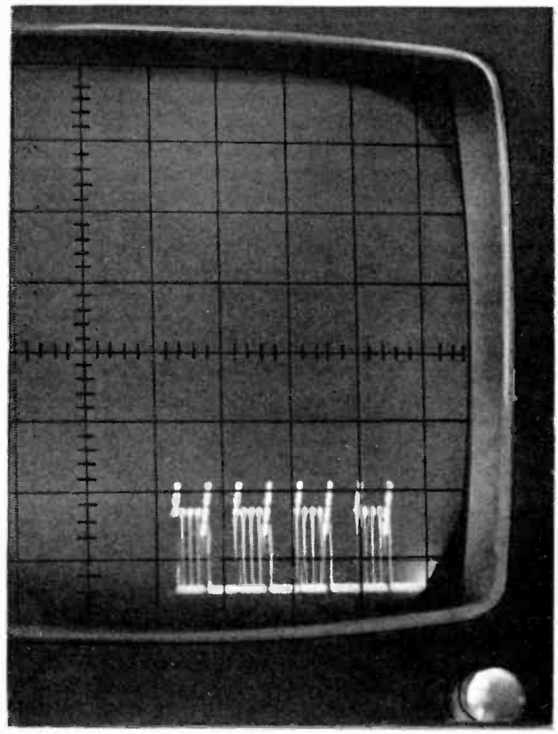


Fig. 3. An example of character generation, the figure "4"
(a) DAC output—8 step staircase. (b) Dots on 'scope, unmodulated. (c) Modulation from ROM. (d) Resultant display. (e) Slower timebase



The structure of the display is apparent when c.r.t. brightness is increased

The method of character generation from these dots is shown in Fig. 3, which uses the digit "4" as an example. It can be seen that the parts of the waveform that are not required are "gated out" by the signals from the ROM. In order that the digits will stand clear of the baseline formed by these transitions to zero, a fourth section is added to the DAC, driven directly by the ROM output. This raises the characters up by a distance equal to their own height.

For ease of viewing, the line of numbers is separated into blocks of 1, 2, 4, etc. digits by gating the output of the ROM with a signal from the addressing circuitry, described later. This makes alternate sections of the display appear blank.

READ-ONLY MEMORY

When the BCD code for the required character is set up on the input to the ROM, the elements of the digit are selected in sequence by the Row and Column Address inputs. The ROM generates a signal such that when an element is addressed, the output goes to a logic 1, otherwise it is at logic 0.

The Row and Column Address inputs are decoded by BCD to 1-of-10 circuits IC11 and IC12. These have "active low" outputs (i.e. the addressed output goes to a logic 0, while all others are at logic 1). The character input is decoded by IC10, a seven-segment decoder with active high TTL outputs. The three decoders produce a unique set of outputs for any row, column and digit selected. These outputs are processed by a series of NAND gates (here acting as OR gates) in order that the

COMPONENTS . . .

Resistors

R1 330Ω
R2–R7 1kΩ (6 off)
R8–R20 4·7kΩ (13 off)
All ¼W 5% carbon film

Capacitors

C1 0·047µF disc ceramic
C2–C4 0·1µF disc ceramic (3 off)

Integrated Circuits

IC1, IC8	7430 (2 off)
IC2–IC4	7410 (3 off)
IC5	7400
IC6, IC9	7404 (2 off)
IC7	7420
IC10	7448
IC11, IC12	7442 (2 off)
IC13	7413
IC14–IC16	7493 (3 off)

Miscellaneous

Vero DIP Breadboard 13401. Wiring pins

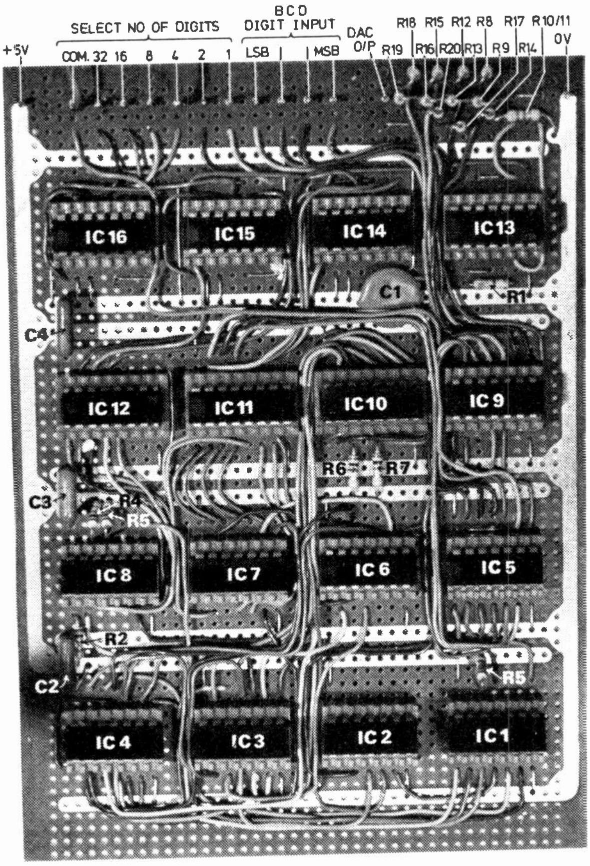


Fig. 4. Component layout. All wiring is carried out on top of the board

appropriate Row or Column is activated continuously for each horizontal or vertical segment respectively.

Since the DAC output will go from zero upwards when the Row Address counts from "000" to "111", the staircase formed will lean to the right, giving a pleasing appearance to the characters. Thus it is necessary that Row input "000" selects the *bottom* row of elements of the digit, hence the wiring of the NAND gates.

Each of the three logic signals necessary to activate an element (i.e. Row, Column and Character) is applied to a series of 3-input NAND gates IC2, IC3 and IC4, one for each segment of the display. When a segment is selected, the output of the appropriate NAND gate will go low. The signals from each gate are combined in an 8-input NAND gate IC1, again giving the OR function. Thus when an element is selected at the Row, Column and Character input, the output goes high as required. This completes the ROM itself.

ADDRESSING CIRCUITRY

A Schmitt trigger oscillator followed by a buffer (IC13) is used to drive three 4-bit counters IC14, IC15 and IC16 (7493), the first two of which drive the Row and Column address inputs. Since the digits are to be displayed on a horizontal line, the row inputs are scanned at eight times the rate of the column inputs. The last counter is used as a "memory address" output. It could be used to operate a multiplexer, or to select the location in a memory where the digit to be displayed is stored. By moving a wire link 1, 2, 4 . . . 32 digits may be displayed. This is used to gate the output of the ROM, as explained earlier.

CONSTRUCTION AND SETTING UP

The prototype was constructed on a Veroboard DIL Layout Sheet as shown in Fig. 4. It is recommended that sockets be used for the i.c.s as a precaution against damage. The layout is in no way critical. The supply rail should be decoupled by a $0{\cdot}1\mu F$ capacitor every four i.c.s C2, C3 and C4. The current consumption is about 300mA, and it will be found that IC10 gets quite warm when many "blank" characters are displayed (i.e. all the 7448 outputs are on).

APPLICATION NOTES

As mentioned earlier, the circuit was designed to display the output of a digital clock. For this and most applications, a multiplexer is needed. It should be remembered that blank spaces between digits may be selected with the input "1111". A digital voltmeter or calculator can also be used if provided with the correct interface. A simpler application would be to display an oscilloscope's calibration settings beside the waveform being examined, possibly for photographic purposes. This is done by using the range switching to control the character input. Indeed, any digital system that uses BCD data can be examined, when the circuit becomes a useful test instrument.

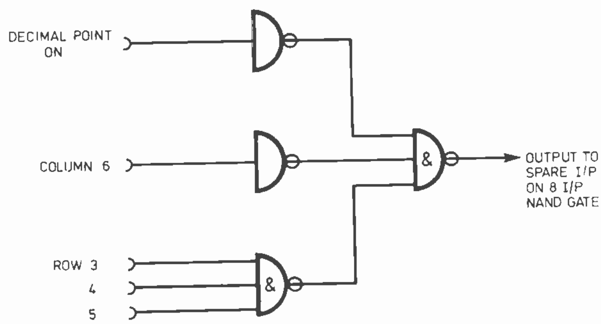


Fig. 5. Circuit for the addition of a decimal point

In practice, the circuit fulfilled the required function of a display for a clock. It has also proved useful in checking the operation of i.c. counters and flip-flops.

A decimal point may be added by means of the circuit in Fig. 5. Other symbols made of straight lines could be implemented. It should be noticed that there will be an additional input for each symbol, making multiplexing more complex. An advanced system with a large memory might display several lines of data. ★

INDUSTRY NOTEBOOK

By Nexus

HOW TO SAVE

I'm all for economy in these difficult times. We all need to trim our spending a bit. How splendid, then, that the Post Office should announce equipment savings of no less than £100 million. And this on top of chopping 25,000 jobs.

Alas, the Post Office, when you read the small print, hasn't saved a penny. That £100 million is the amount of overspending that would have been made on new exchange equipment to 1980 but for the discovery by the planners that existing equipment is being used inefficiently. And on the jobs front the Post Office, again reading the small print, doesn't seem to have fired many, if any, of the workers, but has managed to save the equivalent of 25,000 jobs which is not quite the same thing.

Actually, the paper "savings" on equipment is to be £220 million if projected through to the 1980s. The revised programme of spending, says the Post Office, "will have a significant impact on the telecommunications industry". They can say that again! Bad news for the industry, of course, because if over-capacity can't be switched to exports, many thousands of jobs are at stake, mostly in the Midlands.

How did the Post Office get its sums wrong? Well, it appears that a high-powered study team instituted in 1974 has been to the United States, Canada and Sweden to see how the administrations of these countries conduct their telephone business. And the team picked up a few ideas on methods of traffic measurement which gives a better appreciation of how to match equipment at the exchanges to the load it has to bear.

After generating tons of data and processing it through computers the planners believe that with a bit of juggling and by re-using some of the old electromechanical equipment they can get by with far less new equipment than was originally thought. Bad news, as I have said, for the industry but good news for the 14 million telephone subscribers. Even with only £100 million saved they can all, theoretically, have a £7 rebate on their bills. And I can theoretically, as it were, forecast they won't get a penny.

Of course the Post Office is to be congratulated on putting its house in order. But I suspect that the high-powered team and all the data processing is only half the story. The other half is that a lot of the proposed new equipment is now unnecessary because ordinary folk can no longer afford to use the telephone so frequently since the last round of penal charge increases. This view seems to be supported by the reduction in charges on calls through the operator which came into effect on January 4. This was announced by the Post Office as a New Year "gift" to customers worth about £5 million.

Anyway, I was more than pleased to note the go-ahead for a full-scale trial of the millimetric waveguide system which is said to have good export potential. The 50mm diameter glass fibre pipe can carry half a million simultaneous telephone conversations or 300 TV channels or a mixture of both. The enormous traffic capacity through a single pipe makes it truly cost-effective although the pipe itself is expensive, according to one report costing about £20 per metre.

The operational link is to be between Reading and Bristol, a distance of some 123,000 metres so it will be a costly experiment but necessary to prove the system. Nice business for BICC who make the pipe and Marconi who make the electronics. Useful, too, if the present Reading–Bristol trunk suddenly needs up to another half million lines or the TV authorities go channel-mad.

ACCELERATED DELAY!

Odd item of new-speak is that members of the IEE in far away places like the USA can now get their journals by a system called Accelerated Surface Post (ASP) which suggests to me fast trains and ships. The extra fee is either £1·50 or £2·00 a year respectively for "IEE News" and "Electronics and Power" for rapid transit, which is fair enough. But reading the small print (at which I am becoming quite expert) I find that ASP is not fast surface post but slow bulk airmail. So slow that delivery time is quoted as of the order of 14 days. How's that for progress? Maybe there was a misprint and ASP really means Accelerated Service Post. Either way its a vivid example of the lowered standard in public services we have come to tolerate through the years.

MORE PROFITS

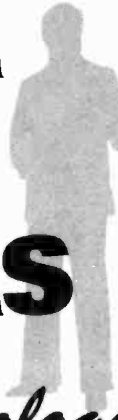
Last month I was taking to task those merchants of doom forecasting the demise of the British electronics industry. I can now report more good news. Plessey's third quarter results were 28 per cent up in sales over the corresponding period of the previous year and profits up nearly 20 per cent, confirming the underlying trend of improvement. Decca's turnover for the year was up £15 million to £170 million with record exports of £49 million. Cable & Wireless, the consistently profitable earner of overseas currency, improved profits by 49 per cent while earning £41 million in foreign currency as against £27 million in the previous year.

Looking to the future we find GEC claiming to be the first European company with an all-solid-state TV camera using charge coupled devices, with production promised for this year. Big expansion in thick films is being forecast by ITT's David Boswell at the Paignton, Devon, plant. He forecasts a three-fold increase in the UK market by 1980. A Mackintosh survey forecasts a 12·9 per cent growth for the European electronics industry this year.

Meantime, solid orders are flowing in. MEL has just picked up some new Clansman business bringing the order book for Clansman military radios to over £10 million. On the investment side Marconi has just opened a new £1 million PCB facility at Hillend, Fife. Helping to pay for this are bumper contracts such as the £1 million order from the Post Office for PCM equipment and another £1 million from Algeria for radio communications.

Marconi is now doing so well that they hardly bother to announce anything involving less than £1 million! But an interesting statistic is that in nearly 10 years of making PCM equipment, Marconi has averaged a PCM order intake of £1,200 every hour of every working day over the period. Another is that the Hillend plant had 850 people in 1974 and now has 2,000 with plenty of vacancies still available.

But if anyone believes that managing a big concern is easy they may like to dwell on the fact that with present interest rates it costs £2,500 a week to maintain £1 million of stock for work in progress. Just one of the headaches faced by managers who take all the kicks for an income not much more in take-home terms than shop-floor workers.



MICROPROCESSOR FORUM for CONSTRUCTORS

Your way into Tomorrow's Technology

UNDER THE JOINT SPONSORSHIP OF NATIONAL SEMICONDUCTOR, A. MARSHALL LTD. AND PRACTICAL ELECTRONICS.

(Co-ordinator for Joint Sponsors: Dennis Dolling Ltd.)

- Come and hear the experts
- Ask your questions
- Join in the informal discussion
- Participate in the practical demonstrations

THE SPEAKERS WILL BE: Dave Brown and Stuart May of National Semiconductor

BERNERS HOTEL, BERNERS STREET, LONDON W.1.
SATURDAY FEBRUARY 26 1977 2-5p.m.

Admission £2·50 (inclusive of VAT), this includes a comprehensive Data Pack. Applications for tickets must be made on the coupon provided below. A maximum number of 3 tickets may be ordered on one coupon. Tickets will be issued strictly in order of receipt of completed coupons with correct remittances. Accommodation is limited. So book without delay.

Remittances must be by postal order or cheque (name and address on back of cheque please), and made payable to Dennis Dolling Ltd.

Please use BLOCK CAPITALS

TO: MICROPROCESSOR FORUM (PE)
Dennis Dolling Ltd., 13-17 Southgate Road, Potters Bar, Herts. EN6 5DS

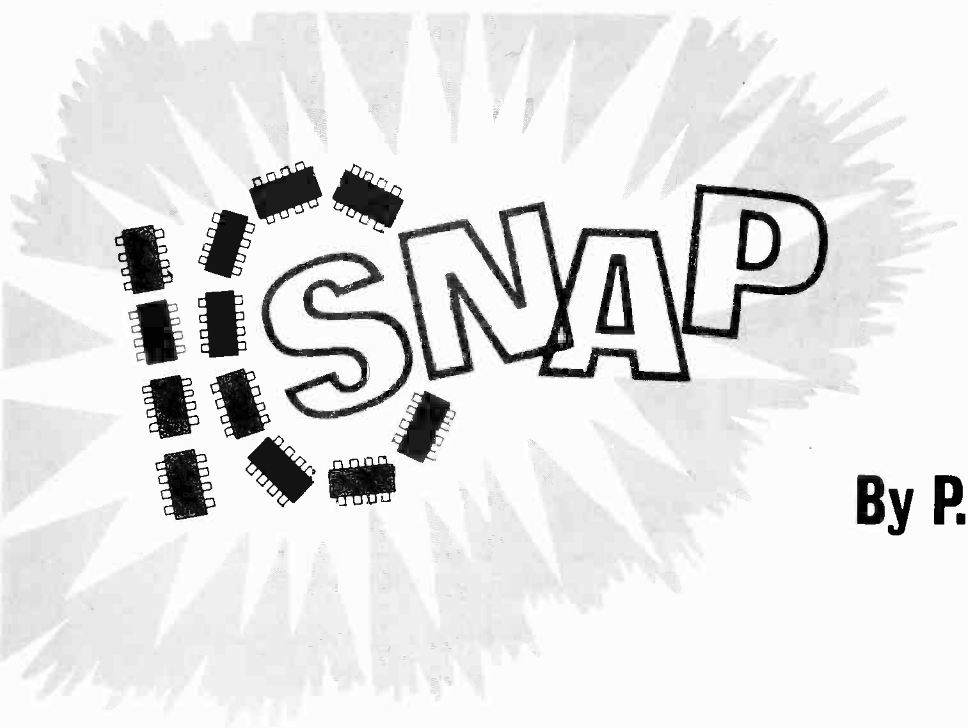
Please reserve ☐ * seats for the Microprocessor Forum for Constructors.

I enclose P.O./Cheque No.__________ Value__________

Name______________________________

Address______________________________

* 1, 2 or 3 (maximum) PE 2/77



SNAP

By P. D. SCARGILL

THE circuit described is an electronic equivalent of the well-known card game "snap", in which two players pit their reflexes against each other over the chance turning of a card.

The design shown in Fig. 1 overcomes two main problems associated with the card game: (a) the need for a fair card dealer, and (b) the problem of a draw. The first difficulty is overcome by means of a delayed action "pair" light which comes on after a time, which with the circuit values given will be from 10 to 15 seconds after the game is set.

The second problem just does not arise with this version of the game, as the electronics can register the first of two close responses to within a fraction of a microsecond using TTL, rendering the chances of a draw totally negligible. If a player gives a false response, or accidentally pushes his or her response button before the "pair" light comes on, the game is automatically nulled, and a "cheat" light comes on.

PLAY

Play commences when the reset button is pressed. After a fixed time delay, the "pair" light will illuminate, and the first player to press his or her response button wins. A "game accepted" light will come on together with the winning player's own light.

CIRCUIT OPERATION

A glance at Fig. 1 shows that the circuit is quite straightforward; G1 and G2 forming bistable A (for player A), and G3 and G4 forming bistable B. These bistables are interconnected via D4 and D5 so that the first one to be triggered will inhibit the other from latching. If, for example, S1 is pressed first, then bistable A becomes "set", and D6 illu-

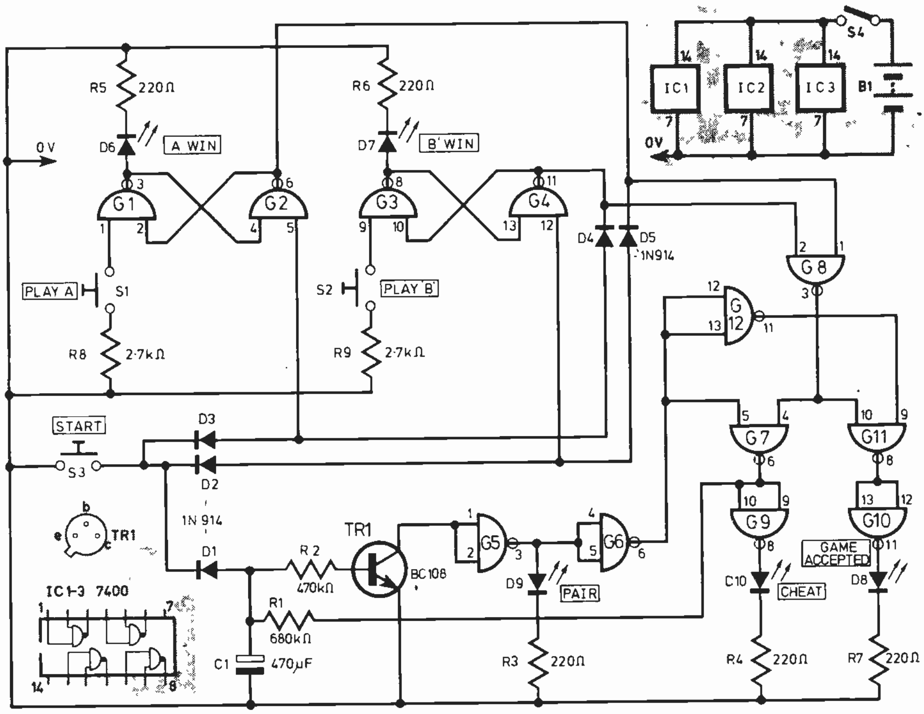


Fig. 1. Circuit diagram of the IC Snap game. Pin details of TR1 and the i.c.s. shown viewed from underneath.

minates. In this condition G4 input is held at logical 0, therefore bistable B can be toggled by S2 but cannot latch. In the event of a near simultaneous response by both players, both D6 and D7 would light up; but the final decision as to the winner would come when the players released their buttons. The one whose l.e.d. remained alight would be the winner! The reverse is true of course if S2 is pressed first.

The bistable outputs are gated together at G8 and taken to the "game accepted" and "cheat" logic, while the time delay is generated by R1, R2, C1 and TR1. The "pair" light (D9) is driven by the output of G5, which is the inverted signal from the collector of TR1. The time delay components may be altered if desired. However, 10 to 15 seconds as set, is too long for the player to anticipate, and not long enough to allow boredom to set in. As can be seen, if the "cheat" logic is activated, G7 output goes to 0 and stops C1 charging, hence stopping the game. D1, D2 and D3, together with S3 will reset the two bistables and the timer. Pressing this switch starts off the game.

CONSTRUCTION AND LAYOUT

Layout is not in any way critical and therefore construction is left to the individual. However, one or two points are made for guidance. Although the 7400 family of i.c.s are quite robust, care should be taken when soldering to avoid overheating. The prototype was made simply by placing the components on a piece of stiff board, and applying a drop of quick-set adhesive to hold them in place. Then they were wired together with fine plastic insulated single core wire, the whole assembly being covered with resin *after* testing.

TESTING

Check the wiring carefully and then connect to the batteries. Press S3, and upon release all lights should be out. Immediately press S1 or S2, and its associated l.e.d. (D6 or D7) should light up, along with the "cheat" light. Reset S3 and wait until the "pair" light comes on. Press S1 or S2, and again D6 or D7 will illuminate but this time with the "game accepted" light.

When all lights are checked the assembly can be encased, and encapsulated with resin if desired, except the batteries, lights and switches of course! Finally connect the on/off switch in the positive battery lead and the job is finished. ★

COMPONENTS . . .

Resistors
R1 680kΩ
R2 470kΩ
R3–R7 220Ω
R8–R9 2·7kΩ
All ⅛W 10%

Transistors
TR1 BC108

Integrated Circuits
IC1–IC3 7400 (3 off)

Diodes
D1–D5 1N914
D6–D10 L.E.D.s (5 off)

Capacitors
C1 470μF 10V elect.

Miscellaneous
S1, S2 and S3 S.P. push to make (momentary action) switch.
S4 S.P.S.T. on/off switch. Four 1·5V pen-torch cells. Case (a cig:r box was used for the prototype).

NOISE SOURCES

BY D. MAYNARD

ALL electronic systems suffer from noise to a greater or lesser extent. Sometimes, a large amount of noise can be tolerated; at other times noise becomes so significant that it causes circuits to malfunction. Audio equipment is an example where the noise does not necessarily affect the electronics but has a disturbing effect on the listener. Lets have a look at various sources of noise, and then see how noise can be kept to a minimum.

NOISE SOURCES

Thermal Noise

Thermal noise occurs in all systems and is usually associated with resistors. The amount of noise from a resistor depends on its absolute temperature (T), the value of the resistor (R), and the bandwidth (B) of the circuit which contains the resistor. Because noise is a random fluctuating signal and not sinusoidal, it is useless to quote the mean square noise voltage. It is then possible to calculate the noise power present in a circuit due to a resistor.

Fig. 1 shows a noise equivalent circuit for a resistor. R_i is the input resistance of the circuit following the resistor. The simplest result for noise power comes if the input resistance is made equal to the resistor in question.

Mean square noise voltage = 4KTBR

where K = Boltzmann's constant.

T = Absolute Temperature in degrees Kelvin.

B = Bandwidth in Hertz.

R = Resistor value in Ohms.

The equivalent r.m.s. voltage source has a value of $2\sqrt{KTBR}$. The voltage (V_i) across the input resistor is half of this if R_i is equal to R.

The power dissipated in R_i due to this voltage is then $\frac{KTBR}{R}$ = KTBwatts. This result is very useful if we want to determine the noise power at the input to a radio receiver for example.

Shot Noise

In thermionic devices, a heated surface produces shot noise. Heating agitates the electrons and this is what is required for amplification. However, there is a random fluctuation in the quantity of electrons leaving the heated surface. The random fluctuation appears as noise. The actual value of this noise depends on the current, the circuit bandwidth and also the type of device.

Partition Noise

In multi-electrode devices certain electrons hit the electrodes. The result is another random variation in signal level—noise to you and me. The partition noise so produced depends on the electrode currents and the bandwidth again.

Transistor Noise

Noise from a transistor is due to three sources which can be equated to the three types of noise already mentioned. The base region has a resistance, producing noise equivalent to thermal noise. Minority carriers diffuse across the base-collector junction forming a leakage current. Fluctuations in this current produce noise. We can think of this as shot noise. Finally the recombination of carriers in the base region, which fluctuates, can be likened to partition noise as electrons disappear into holes. All transistors produce noise but some are designed so that the noise is minimised.

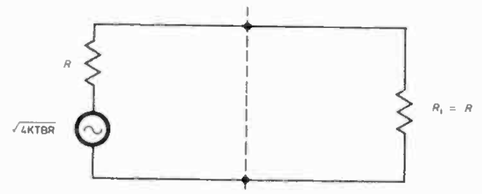


Fig. 1. Noise equivalent circuit of a resistor

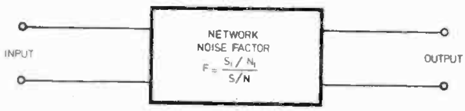


Fig. 2. Network noise factor

NOISE FACTOR

If the noise from a device or system is important, its noise factor is usually quoted. It may be in the form of a number, or alternatively it can be expressed in decibels. For any system, it is the ratio of the useful signal to the noise that we need to know rather than the absolute level of the noise.

Fig. 2 shows diagrammatically a network which could be a system or a single device. The input signal to noise ratio is $\frac{S_i}{N_i}$ and the output signal to noise ratio $\frac{S}{N}$. The noise factor is the ratio of the ratios.

$$\text{Noise Factor } F = \frac{S_i/N_i}{S/N} = \frac{S_iN}{SN_i}$$

In decibels this is:

$$F = 10 \log_{10} \frac{S_iN}{SN_i}$$

Or, if the input signal to noise ratio is D_i dB and the output signal to noise ratio is D dB, then

$$F = (D_i - D) \text{ dB}$$

The network introduces noise and therefore the ratio of signal to noise at the input is always greater than the ratio at the output because of the contribution due to the network itself. Taking an example, we can demonstrate this. The input signal to noise ratio is, let us say, 70dB. If the network has a gain of 30dB, then the signal at the output will be 30dB higher. Assuming for the moment that the network contributes no noise, the noise power will be 30dB higher as well. The signal to noise ratio has not changed. However, when a measurement is made, the output signal to noise ratio is found to be 57 dB, let us say. Then—

$$F = 70 - 57 = 13\text{dB}.$$

In numerical terms the input signal to noise ratio is 20 times the output ratio. Fig. 3 shows the different signal to noise ratios at the input and the output of a network.

LOW NOISE CIRCUITS

Low noise devices are, in general, more expensive than standard types. Also, because minimum noise is optimised, other parameters may suffer. We therefore like to limit the use of low noise devices to essential places in the circuitry.

Consider the amplifier of Fig. 4. It consists of a number of stages, all having gain. Noise due to the first stage N_1 is amplified by the following two stages, noise in the second stage (N_2) is amplified by the final stage, and then we have noise due to the final stage itself (N_3). If there is noise at the input to the amplifier (N_B) then that is amplified by all three stages. We can say that at the amplifier output:

$$\text{Total noise} = N_B G_1 G_2 G_3 + N_1 G_2 G_3 + N_2 G_3 + N_3$$

If each of the stages has a gain of 10, then we have:

$$\text{Total Noise} = 1{,}000 N_B + 100 N_1 + 10 N_2 + N_3$$

It is obvious from this that noise at the input and also that due to the first stage affect the total noise the most.

The noise at the input can only be changed by altering the temperature or the circuit bandwidth. Neither of these propositions are usually possible and so we are left with using low noise devices in the first few stages. If you are having problems with excessive noise, try substituting active devices in the input stages. Immersing the amplifier in liquid helium might cure the high noise but the solution would prove rather expensive. ★

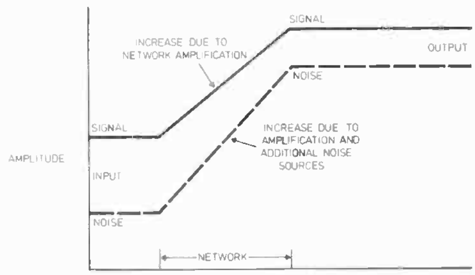


Fig. 3. Signal to noise levels at input and output of a network.

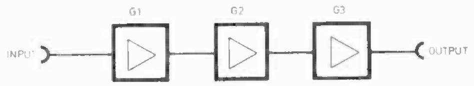


Fig. 4. Three stage amplifier

SOUND DESIGN

A PRACTICAL ELECTRONICS PUBLICATION

A SPECIAL SELECTION OF MUSICAL PROJECTS FROM PE

THE MINISONIC MK2 SOUND SYNTHESISER

An up-dated version of the published Mk 1, the Mk 2 has an integral keyboard, two 250 mW monitoring channels and loudspeakers, and facilities for amplitude, frequency and harmonic modulation.

THE JOANNA ELECTRONIC PIANO

has realistic piano effect with touch-sensitive keyboard and additional choice of harpsichord or honky-tonk voicing.

THE ORION STEREO AMPLIFIER

A hi-fi amplifier with output of over 20 + 20 watts. Compact and complete in one unit, it measures only 14" × 6" × 2".

PLUS

Some great sound effects units for guitars, keyboard instruments and general recording.

Available Now £1.20 POST PAID

(Please allow at least 2 weeks for delivery)

If you do not wish to mutilate your copy of the magazine, please send your order on a separate sheet.

To: Practical Electronics
IPC Magazines Ltd., Receiving Cashiers Dept.,
King's Reach Tower, Stamford Street, London SE1 9LS

Please send me .... copy(ies) of "Sound Design". I enclose a Postal Order/Cheque for £1.20 (post paid) or (state amount for more than one copy) .... (£2.35 post paid for 2 copies)

PLEASE WRITE IN BLOCK LETTERS

Name ....

Address ....

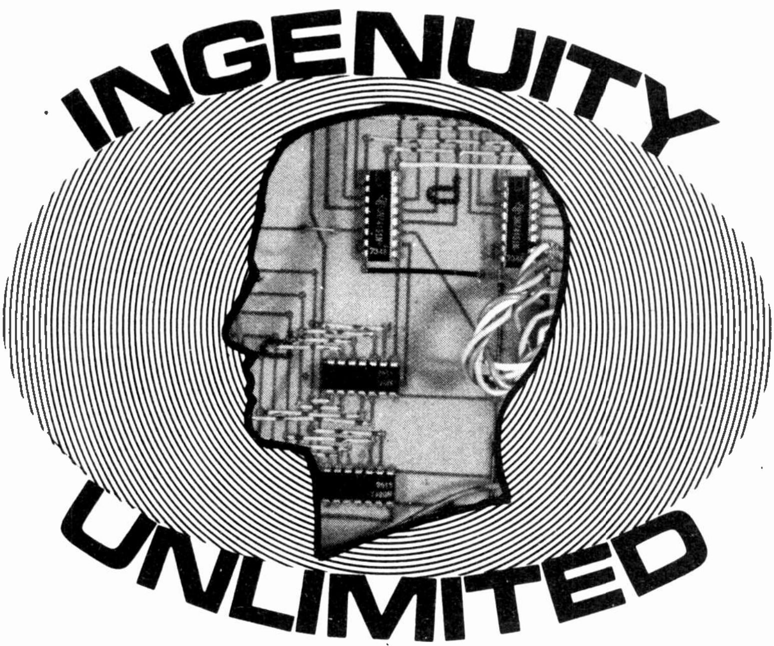
....

.... Post code ....

Remittances with overseas orders must be sufficient to cover despatch by sea or air mail as required. Payable by International Money Order only.

PE 810

Company registered in England. Regd. No. 53626
A subsidiary of Reed International Limited.



A selection of readers' original circuit ideas. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

Why not submit *your* idea? Any idea published will be awarded payment according to its merits.

Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

Each idea submitted must be accompanied by a declaration to the effect that it is the original work of the undersigned, and that it has not been accepted for publication elsewhere.

POLYPHONIC KEYBOARD SYSTEM

THE odd sounds, which on the average synthesiser, result from forgetful (or otherwise) depression of two keys at the same time, are due to the use in most keyboards of single pole switch contacts with all the keys wired in parallel. This can be overcome by using change-over switches in series. If the "Minisonic" has been built using GJ type switches in conjunction with the h.f. oscillator and detector system, a simple rewiring job is all that is required.

Where a keyboard has not yet been built, the system described here allows for simultaneous programming of two or more voltage controlled oscillators from separate keys.

Using change-over switches, one pole is required for each VCO to be programmed. This system is shown in Fig. 1. When key 1 is pressed VCO1 is connected to control voltage point 1, VCO2 is connected to the upper row of switches, and VCO3 to the middle row. If key 2 is now pressed, VCO2 is connected to CV point 2, and VCO3 to the upper row of switches. If key 3 is pressed VCO3 is connected to CV point 3. Thus all three VCOs can be programmed by separate points on the control voltage chain.

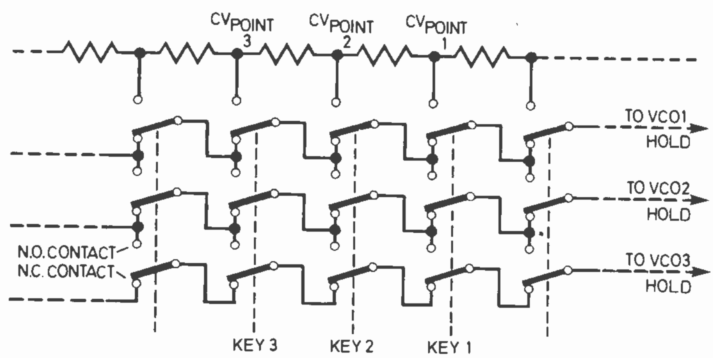


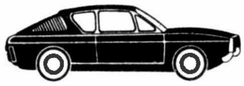
Fig. 1

Since the hold module for each VCO has an input impedance in excess of 2,000MΩ, there is minimal loading on the chain of resistors, and none is shorted out.

The switches may be either GJ types activated in pairs, or threes by one key, or else special assemblies can be made using printed circuit board and gold plated wire.

E. F. Flint,
Glasgow.

AUTOMATIC CAR AERIAL



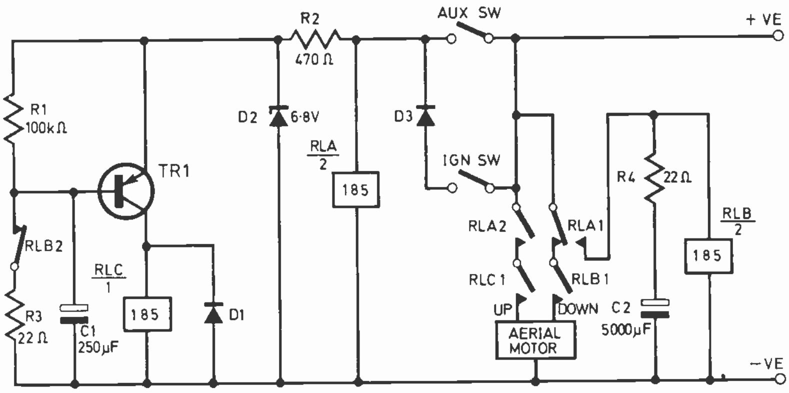


Fig. 1

A CIRCUIT which will raise an electric aerial to its limit on operating the ignition switch, and lower it again when switching off the ignition is shown in Fig. 1. The problem lay in supplying power to the "up" lead for two or three seconds only when the aerial was required, and to the "down" lead for a similar time. An extra requirement for the down operation was that no power be consumed by the circuit when the ignition switch was off.

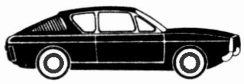
When the ignition key is operated, power is supplied to relay RLA. Capacitor C2 is charged, and relay RLB is operated through contact RLA1. The down lead of the aerial motor is isolated via the now open contact RLA1. RLC operates, and power is supplied to the "up" lead via the closed contacts RLA2, and RLC1. Once C1 charges up, RLC drops out and power is no longer supplied to the aerial motor. Zener diode D2 is required to stabilise the voltage on the timer circuit. Diode D3 ensures that power is still supplied to the aerial when the starter motor is operated.

When the ignition switch is put back to the "off" position, RLA drops out and power is supplied to the "down" lead via the closed contacts of RLA1 and RLB1. Power is disconnected from C2 and RLB. Capacitor C2 discharges through RLB, and after a few seconds RLB1 opens, breaking the power to the down lead. Contact RLB2 discharges C1 in readiness for the next operational cycle.

The values of C1 and C2 are chosen to ensure that the aerial goes fully up and down respectively.

R. J. Darling,
Uddingston,
Glasgow.

OVERHEAT INDICATOR



THIS device (Fig. 1) gives an audible or visual indication if the sensor temperature exceeds a preset value. The latter can be situated either at the engine, gearbox, or brakedrums, depending on requirements.

The sensor, R1, is a carbon rod thermistor which reduces its resistance value as the temperature increases. The temperature at which the relay operates is adjustable by VR1. When the thermistor temperature increases, the base voltage of TR1 is sufficient to produce energisation of the relay.

The transistor used for TR1 depends on the car earthing. With a negative earth TR1 should be a 2N3053, or with a positive earth a BC461. With a positive earth D1 polarity and the unit supply rails should be reversed. With either earthing system, D1 prevents back-e.m.f. damaging TR1. The 12V supply line is taken via the vehicle ignition switch.

J. W. Cheshire,
Sutton Coldfield.

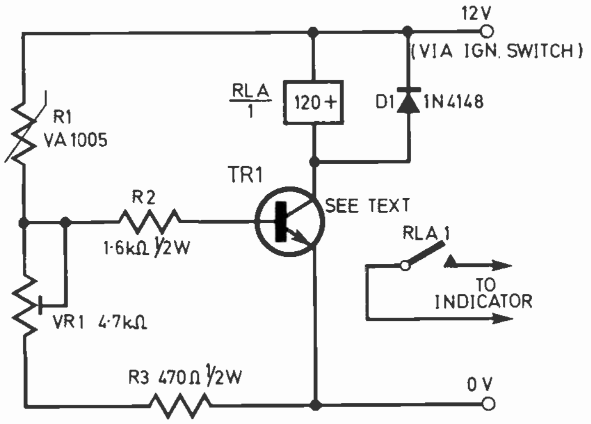


Fig. 1

CHEAP OVER-VOLTAGE PROTECTOR

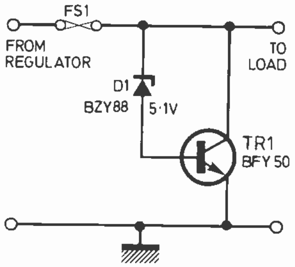


Fig. 1

If the regulator supplying TTL integrated circuits fails, the maximum V_{cc} rating of seven volts may be exceeded, causing expensive damage. The circuit shown in Fig. 1 will remove the supply if the voltage rises above about 5·7V.

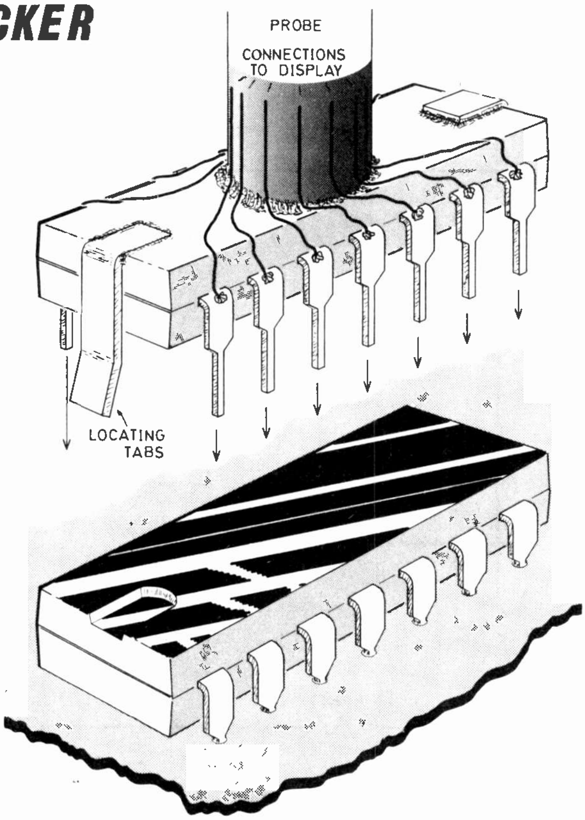
With a supply of 5V, Zener diode D1 will not pass current and consequently TR1 will be switched off. Normally, therefore, the circuit draws no current. When the supply exceeds 5·7V (5·1V Zener breakdown plus 0·6V base-emitter potential) D1 will conduct, switching TR1 on. The current through TR1 will increase until it blows fuse F1, so removing the supply. To blow a 1 amp fuse the Zener diode passes only about 25mA, well within the capability of a 400mV device.

By using Zener diodes of different voltage ratings, the circuit can be used on other supply lines, up to a limit of 30 volts when using the BFY50.

A. Damper,
Carshalton,
Surrey.

DIGITAL LOGIC CHECKER

As a very simple logic test clip and probe, it is possible to use an old integrated circuit package. The old i.c. will need to have its internal circuitry removed so that it doesn't affect the operation of the probe. This can be done by breaking open the i.c. and scraping away the silicon chip and fine gold connecting wires. Metal–plastic–metal sandwich type i.c.s are better for this purpose than plastic or ceramic packages, as it is generally easy to break off the top metal layer exposing the chip itself.



Connections can be made by soldering fine wires to the top of the pins, as close to the package as possible to avoid the pins becoming loaded with too much solder and wire, which would cause them to lose much of their natural resilience. The unit can then be glued to the base of the probe, which can be applied "piggy-back" to the i.c. under test (Fig. 1).

The method of wiring the indicator l.e.d.s is shown in Fig. 2, the circuit being repeated seven or eight times over for 14 or 16-pin i.c.s. It was found that 0·125in MAN3 l.e.d.s by Monsanto gave the brightest display consistent with a reasonable current consumption, allowing 1kΩ series resistors to be used.

P. D. Maddison,
Blackburn,
Lancs.

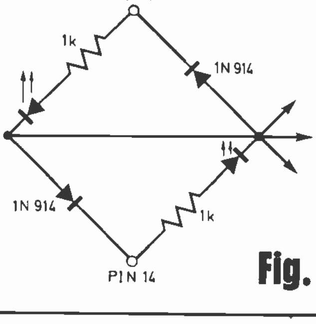


Fig. 2

Get a great deal from

Marshall's

Call in and see us 9-5.30 Mon-Fri 9-5.00 Sat   Trade and export enquiries welcome

A Marshall (London) Ltd Dept: PE
40/42 Cricklewood Broadway London NW2 3ET
Tel: 01-452 0161/2 Telex. 21492
& 85 West Regent St Glasgow G2 2QD
Tel: 041-332 4133
& 1 Straits Parade Fishponds Bristol BS16 2LX
Tel: 0272-654201/2

168 page catalogue with 500 new lines, 55p post paid (40p to callers)

TOP 500 SEMICONDUCTORS FROM THE LARGEST RANGE IN THE U.K.

All devices manufacturer's branded stock

2N456	1·40
2N456A	1·54
2N457A	1·70
2N490	4·60
2N491	5·00
2N492	5·75
2N493	5·98
2N696	0·25
2N697	0·16
2N698	0·82
2N699	0·55
2N706	0·12
2N706A	0·12
2N708	0·21
2N709	0·50
2N711	0·55
2N718	0·22
2N718A	0·40
2N720	0·69
2N914	0·22
2N916	0·43
2N918	0·34
2N929	0·25
2N930	0·26
2N1302	0·37
2N1303	0·37
2N1304	0·40
2N1305	0·40
2N1306	0·45
2N1307	0·45
2N1308	0·60
2N1309	0·60
2N1671	1·80
2N1671A	1·92
2N1671B	2·12
2N1711	0·27
2N1907	5·50
2N2102	0·60
2N2147	1·40
2N2148	1·65
2N2160	1·10
2N2218A	0·47
2N2219	0·42
2N2219A	0·52
2N2220	0·35
2N2221	0·22
2N2221A	0·26
2N2222	0·25
2N2222A	0·25
2N2368	0·17
2N2369	0·25
2N2369A	0·21
2N2646	0·55
2N2647	1·10
2N2904	0·36
2N2904A	0·37
2N2905	0·37
2N2905A	0·38
2N2906	0·28
2N2906A	0·25
2N2907	0·21
2N2907A	0·22
2N2924	0·15
2N2925	0·17

2N2926	
Green	0·13
Yellow	0·13
Orange	0·13
2N3053	0·25
2N3054	0·50
2N3055	0·65
2N3390	0·37
2N3391	0·34
2N3392	0·14
2N3393	0·15
2N3394	0·15
2N3402	0·30
2N3414	0·15
2N3415	0·17
2N3416	0·23
2N3418	0·27
2N3440	0·57
2N3441	0·78
2N3442	1·20
2N3638	0·16
2N3638A	0·16
2N3639	0·30
2N3641	0·20
2N3702	0·17
2N3703	0·15
2N3704	0·15
2N3705	0·15
2N3706	0·14
2N3707	0·18
2N3708	0·14
2N3709	0·15
2N3710	0·14
2N3711	0·15
2N3712	1·20
2N3713	2·30
2N3714	2·45
2N3715	2·45
2N3716	2·60
2N3771	1·60
2N3772	1·70
2N3773	2·65
2N3789	2·60
2N3790	2·75
2N3791	2·75
2N3792	2·90
2N3794	0·20
2N3819	0·36
2N3820	0·29
2N3823	0·61
2N3904	0·21
2N3906	0·22
2N4036	0·67
2N4037	0·55
2N4058	0·20
2N4059	0·15
2N4060	0·20
2N4061	0·17
2N4062	0·18
2N4126	0·17
2N4289	0·30
2N4919	0·85
2N4920	0·90
2N4921	0·60

2N4922	0·65
2N4923	0·70
2N5190	0·70
2N5191	0·80
2N5192	1·00
2N5195	1·10
2N5245	0·29
2N5294	0·35
2N5295	0·40
2N5296	0·36
2N5298	0·40
2N5457	0·29
2N5458	0·26
2N5459	0·29
2N5492	0·42
2N5494	0·45
2N5496	0·50
2N5777	0·45
2N6027	0·45
3N128	0·80
3N139	1·45
3N140	1·00
3N141	0·85
3N200	2·60
40361	0·45
40362	0·48
40363	1·00
40389	0·60
40394	0·60
40395	1·20
40406	0·48
40407	0·38
40408	0·50
40409	0·55
40410	0·55
40411	2·30
40594	0·75
40595	0·85
40601	0·70
40602	0·50
40603	0·60
40604	0·60
40636	1·15
40673	0·73
AC126	0·37
AC127	0·44
AC128	0·37
AC151V	0·35
AC152V	0·50
AC153	0·40
AC153K	0·42
AC154	0·45
AC176	0·40
AC176K	0·45
AC187K	0·46
AC188K	0·45
AC187	0·45
AC188	0·42
AD142	0·65
AD143	0·75
AD149	0·74
AD150	1·20
AD161	0·75
AD162	0·75

AD161 } AD162 }	PR 1·70
AF106	0·45
AF114	0·65
AF115	0·65
AF116	0·65
AF117	0·65
AF118	0·65
AF124	0·65
AF125	0·65
AF126	0·65
AF127	0·65
AF139	0·69
AF186	0·50
AF200	0·70
AF239	0·74
AF240	0·90
AF279	0·80
AF280	0·85
AL102	1·50
AL103	1·50
BC107	0·14
BC108	0·12
BC109	0·15
BC113	0·17
BC115	0·19
BC116	0·19
BC116A	0·20
BC117	0·22
BC118	0·16
BC119	0·30
BC121	0·45
BC125	0·18
BC126	0·25
BC132	0·30
BC134	0·15
BC135	0·15
BC136	0·19
BC137	0·14
BC140	0·60
BC141	0·65
BC142	0·30
BC143	0·30
BC147	0·10
BC148	0·10
BC149	0·13
BC153	0·27
BC154	0·27
BC157	0·12
BC158	0·11
BC160	0·78
BC167	0·12
BC168	0·12
BC168	0·12
BC169	0·12
BC169	0·12
BC170	0·16
BC171	0·14
BC172	0·12
BC177	0·19
BC178	0·18
BC179	0·21
BC182	0·11
BC182L	0·14

BC183	0·11
BC183L	0·14
BC184	0·12
BC184L	0·14
BC207	0·11
BC208	0·10
BC212	0·14
BC212L	0·17
BC214L	0·17
BC237	0·17
BC238	0·12
BC239	0·16
BC251	0·15
BC253	0·22
BC257	0·17
BC258	0·17
BC259	0·18
BC261	0·21
BC262	0·19
BC263	0·30
BC300	0·45
BC301	0·45
BC302	0·40
BC303	0·60
BC307	0·20
BC308	0·18
BC309C	0·25
BC317	0·14
BC318	0·13
BC337	0·19
BC338	0·21
BC547	0·12
BC548	0·10
BC549	0·13
BCY30	1·03
BCY31	1·06
BCY32	1·18
BCY33	0·90
BCY34	0·98
BCY38	2·00
BCY42	0·60
BCY58	0·55
BCY59	0·32
BCY70	0·25
BCY71	0·26
BCY72	0·24
BD115	1·20
BD116	1·20
BD121	2·00
BD123	2·00
BD124	2·00
BD131	0·51
BD132	0·54
BD135	0·42
BD136	0·42
BD137	0·45
BD138	0·48
BD139	0·50
BD140	0·50
BD529	0·35
BD530	0·38
BDY20	1·13
BF115	0·36
BF117	0·70
BF121	0·55
BF123	0·55

BF152	0·25
BF153	0·25
BF154	0·25
BF159	0·35
BF160	0·30
BF161	0·60
BF166	0·40
BF167	0·33
BF173	0·33
BF177	0·38
BF178	0·45
BF179	0·48
BF180	0·45
BF181	0·45
BF182	0·45
BF183	0·45
BF184	0·35
BF185	0·30
BF194	0·12
BF195	0·11
BF196	0·13
BF197	0·14
BF198	0·15
BF200	0·31
BF225J	0·25
BF244	0·35
BF245	0·34
BF246	0·75
BF254	0·20
BF255	0·20
BF257	0·37
BF258	0·49
BF259	0·49
BFR39	0·24
BFR79	0·24
BFS21A	2·60
BFS28	1·04
BFS61	0·30
BFS98	0·27
BFX29	0·36
BFX30	0·38
BFX84	0·38
BFX85	0·41
BFX87	0·35
BFX88	0·32
BFX89	0·95
BFY50	0·30
BFY51	0·38
BFY52	0·36
BFY53	0·34
BFY90	1·27
BRY39	0·50
BSX20	0·31
BSX21	0·32
BU105	3·05
BU205	2·40
C106D	0·65
CA3020A	1·50
CA3028A	0·85
CA3035	1·35
CA3046	0·73
CA3048	2·15
CA3052	1·62
CA3080A	1·10
CA3089E	2·00
CA309AQ	4·25

CA3130	0·88
LM301A	0·47
LM308N	1·32
LM309K	1·60
LM380	0·98
LM381AN	2·07
LM702C	0·75
LM709	
TO99	0·40
8DIL	0·40
14DIL	0·40
LM710	0·45
LM723C	0·60
LM741	
TO99	0·38
8DIL	0·35
14DIL	0·40
LM747CN	0·78
LM748	
8DIL	0·44
14DIL	0·41
LM3900N	0·55
LM7805P	1·39
LM7812P	1·39
LM7815P	1·39
LM7824P	1·39
LOO5TI	1·60
MC1303	1·47
MC1310	1·98
MC1330P	0·75
MC1351P	0·87
MC1352P	0·87
MC1466L	3·95
MC1469R	2·50
MEO402	0·20
MEO404	0·15
MEO412	0·20
ME4102	0·10
ME4104	0·10
MJ480	1·05
MJ481	1·30
MJ490	1·05
MJ491	1·55
MJ2955	1·21
MJE340	0·58
MJE2955	1·25
MJE3055	0·75
MJE370	0·68
MJE371	0·81
MJE520	0·65
MJE521	0·75
MP8111	0·35
MP8112	0·40
MP8113	0·45
MPF102	0·30
MPSA05	0·20
MPSA06	0·20
MPSA12	0·35
MPSA55	0·20
MPSA56	0·20
MPSU05	0·40
MPSU06	0·40
MPSU55	0·45
MPSU56	0·45
NE555V	0·48
NE556	1·30
NE560D	4·48

NE561	4·48
NE565A	1·30
OC28	2·00
OC35	1·50
OC42	0·50
OC45	0·75
OC71	0·45
OC72	0·45
OC81	0·75
OC83	0·50
ORP12	0·70
R53	1·80
SL414A	2·35
SL610C	2·35
SL611C	2·35
SL612C	2·35
SL620C	3·50
SL621C	3·50
SL623C	5·75
SL640C	4·00
SL641C	4·00
SN76003N	2·36
SN76013N	1·50
SN76023N	1·45
SN76033N	2·50
ST2	0·20
TAA263	1·25
TAA300	2·67
TAA350	2·48
TAA550	0·60
TAA611C	2·25
TAA621	2·15
TAA661B	1·32
TBA641B	2·50
TBA651	1·80
TBA800	1·20
TBA810	1·16
TBA820	1·03
TBA920	1·79
TIL209	0·30
TIP29A	0·50
TIP29C	0·75
TIP30A	0·60
TIP30C	0·85
TIP31A	0·62
TIP31C	0·85
TIP32A	0·75
TIP32C	1·00
TIP33A	1·00
TIP33C	1·45
TIP34A	1·20
TIP34C	1·70
TIP35A	2·50
TIP36A	3·35
TIP41A	0·70
TIP41C	1·00
TIP42A	0·90
TIP42C	1·20
TIP2955	1·00
TIP3055	0·50
TIS43	0·30
ZTX300	0·15
ZTX301	0·15
ZTX302	0·20
ZTX500	0·15
ZTX501	0·15
ZTX502	0·18
ZTX530	0·23
ZTX531	0·22

WE ARE NOW IN NEWCASTLE-ON-TYNE!

Marshall Aitken Ltd.
35 High Bridge
Newcastle-on-Tyne
Tel.: 0632 26729

P.C. MARKER PEN DALO 33PC. 87p.
ZENER DIODES 400MW 11p, 1W 17p, 2·5W 35p.
IC SOCKETS 8 DIL 14p, 14 DIL 15p, 16 DIL 16p.
RESISTORS ¼W 2p (100 per value £1·30) ½W 3p (100 per value £2·00)
SCORPIO CAR IGNITION KIT £12·95.
JUMBO 7 SEGMENT DISPLAYS £2·16.
DL 707 £1·60.
MINITRON £1·50.
LEDs Red, green and yellow, 0·2in or 0·16in dia. 24p.

SEE MARSHALL'S FOR CMOS

CD4000	0·20	CD4018	1·01	CD4042	0·83
CD4001	0·20	CD4019	1·10	CD4043	1·00
CD4002	0·20	CD4020	1·12	CD4044	0·94
CD4006	1·18	CD4021	1·01	CD4045	1·43
CD4007	0·20	CD4022	0·97	CD4046	1·32
CD4008	0·87	CD4023	0·20	CD4047	1·15
CD4009	0·57	CD4024	0·79	CD4049	0·56
CD4010	0·57	CD4025	0·20	CD4050	0·56
CD4011	0·20	CD4027	0·56	CD4510	1·54
CD4012	0·20	CD4028	0·91	CD4511	1·54
CD4013	0·57	CD4029	1·17	CD4516	1·40
CD4014	1·01	CD4030	0·57	CD4518	1·25
CD4015	1·01	CD4031	2·26	CD4520	1·25
CD4016	0·56	CD4037	0·97	CD4553	4·07
CD4017	1·01	CD4041	0·83		

Please enquire about CMOS not listed

MICROPROCESSORS FROM MARSHALL'S

Read the article, buy the kits!
SCAMP INTRO KIT £62·37
KEYBOARD KIT £59·85
Contact Marshall's for RAM's, ROM's and PROM's.
Full range of Low Power Schottky and Octal Tristate Buffers.

TTL FROM NATIONAL, ITT, TEXAS, SIGNETICS, ETC.

												SN74154	1·48	SN74181	2·85
												SN74157	0·78	SN74190	1·48
SN7400	0·21	SN7412	0·21	SN7438	0·30	SN7460	0·21	SN7484	1·00	SN74107	0·33	SN74160	1·20	SN74191	1·27
SN7401	0·21	SN7413	0·51	SN7440	0·21	SN7470	0·35	SN7485	1·48	SN74118	0·99	SN74161	1·20	SN74192	1·27
SN7402	0·21	SN7416	0·46	SN7441	0·80	SN7472	0·29	SN7486	0·32	SN74119	2·02	SN74162	1·20	SN74193	1·27
SN7403	0·26	SN7417	0·46	SN7442	0·61	SN7473	0·33	SN7490	0·49	SN74121	0·39	SN74163	1·20	SN74196	1·27
SN7404	0·26	SN7420	0·21	SN7446	0·96	SN7474	0·33	SN7491	0·77	SN74122	0·54	SN74164	0·98	SN74197	0·90
SN7405	0·26	SN7423	0·30	SN7447	0·89	SN7475	0·46	SN7492	0·49	SN74123	0·46	SN74165	0·98	SN74198	0·90
SN7406	0·59	SN7425	0·30	SN7448	0·89	SN7476	0·39	SN7493	0·49	SN74141	0·60	SN74167	4·20	SN74199	2·28
SN7407	0·59	SN7427	0·30	SN7450	0·21	SN7480	0·55	SN7494	0·85	SN74145	0·83	SN74174	0·98	SN76003N	2·28
SN7408	0·22	SN7430	0·21	SN7451	0·21	SN7481	1·25	SN7495	0·61	SN74150	1·66	SN74175	0·98	SN76013N	1·90
SN7409	0·22	SN7432	0·20	SN7453	0·21	SN7482	0·77	SN7496	0·88	SN74151	0·85	SN74176	0·96	SN76023N	1·91
SN7410	0·21	SN7437	0·43	SN7454	0·21	SN7483	1·04	SN74100	1·23	SN74153	0·85	SN74180	2·96	SN76033N	2·50

Potentiometers 1kΩ to 2MΩ (E3)

Linear or Log	Single	Double
Rotary Pots (no 1kΩ log)	25p	75p
Rotary Switched	55p	—
Sliders	45p	75p

Full range of VERO products stocked. See catalogue for details

Presets—Horizontal or Vertical
0·1W 9p 0·3W 11p

DIN PLUGS— 14p DIN CHASSIS SOCKETS—10p
3-pin, 4-pin, 5-pin 180°, 5-pin 240°, 6-pin, 7-pin and Speaker

LINE SOCKETS—14p each
3 pin, 5 pin 180° and Speaker

PHONO PLUGS (screw top)
Red, white, black, green or pellow **10p**, Chrome **15p**

LINE PLUGS (same colour) **10p**, Chrome **15p**

PHONO CHASSIS, sockets
single **7p**, double **10p**, **3**-way **12p**, 6-way **25p**, 8-way **35p**

JACK PLUGS AND SOCKETS
¼in mono plastic plug **15p**
¼in mono chrome plug **22p**
¼in chrome line socket **15p**
¼in plastic switch socket **18p**
¼in stereo plastic plug **20p**
¼in stereo chrome plug **30p**
¼In stereo plastic line socket **20p**
¼in stereo chrome line socket **35p**
¼in stereo plastic switched socket **25p**
3·5mm plug **10p**; 3·5mm socket **10p**; 3·5mm line socket **10p**;
2·5mm plug **10p**; 2·5mm socket **10p**

SUB-MIN CERAMICS 63V 1pF–0·015μFd **5p**

5% POLYSTYRENE CAPACITORS
10pF–1,000pF **6p**
1,500pF–0·01μFd **10p**

Full range of MICA, POLYESTER, POLYCARB, TANTALUM and ELECTROLYTICS always in stock.

SEND FOR OUR NEW 168 PAGE CATALOGUE WITH 500 NEW LINES—CRAMMED WITH NEW PRODUCTS, TECHNICAL INFORMATION AND ALL BACKED BY THE USUAL SUPERLATIVE MARSHALL'S SERVICE—FOR ONLY 55p POST PAID OR 40p TO PERSONAL CALLERS.

NATIONAL CLOCK MODULE WITH ALARM OR SNOOZE £8·50
TRANSFORMER £1·30
SWITCHES £1·55

PLEASE ADD VAT TO YOUR ORDER.   POSTAGE AND PACKING 30p.

ALL PRODUCTS FULLY GUARANTEED TO MANUFACTURER'S SPECIFICATIONS

SHIPMENT MADE VIA AIR-POSTAGE PAID 3 DAYS FROM RECEIPT OF ORDER

TTL

7400	£0-10p	7451	£0-13	74154	-86
7401	11	7453	13	74155	75
7402	11	7454	10	74156	71
7403	11	7460	11	74157	71
7404	13	7464	21	74161	95
7405	13	7465	21	74163	90
7406	22	7472	22	74164	1-10
7407	22	7473	26	74165	1-25
7408	14	7474	26	74166	1-15
7409	14	7475	37	74173	95
7410	10	7476	23	74175	95
7411	16	7483	70	74176	95
7413	29	7485	80	74177	85
7416	22	7486	24	74180	80
7417	22	7489	1-50	74181	2-50
7420	11	7490	40	74182	80
7422	22	7491	71	74184	1-55
7423	22	7492	44	74185	1-30
7425	22	7493	35	74190	95
7426	23	7494	45	74191	95
7427	22	7495	49	74192	90
7430	12	7496	55	74193	85
7432	22	74100	79	74194	95
7437	25	74105	60	74195	72
7438	21	74107	27	74196	1-00
7440	11	74121	28	74197	75
7441	60	74122	50	74198	1-70
7442	55	74123	55	74199	1-70
7443	55	74125	50	74200	3-90
7444	60	74126	50		
7445	75	74141	68	74132	-50
7446	85	74145	75		
7447	73	74150	59		
7448	80	74151	60		
7450	12	74153	56		

CMOS

4000A	21	4018A	89	4066A	72
4001A	21	4020A	1-22	4068A	36
4002A	21	4021A	1-13	4069A	36
4006A	1-10	4022A	90	4071A	22
4007A	22	4023A	21	4072A	29
4008A	1-46	4024A	72	4073A	32
4009A	47	4025A	21	4075A	32
4010A	44	4027A	48	4078A	32
4011A	22	4028A	81	4082A	29
4012A	21	4030A	37	4518A	1-69
4013A	37	4035A	1-04	4528A	1-31
4014A	1-22	4040A	99	4585A	1-71
4015A	1-22	4042A	1-21	4901A	31
4016A	46	4049A	48		
4017A	98	4050A	48		

74C00	24	74C74	72	74C162	2-05
74C02	33	74C76	1-07	74C163	2-05
74C04	47	74C107	94	74C164	2-21
74C08	47	74C151	1-83	74C173	1-83
74C10	41	74C154	2-21	74C195	1-90
74C20	41	74C157	1-38	80C95	94
74C42	1-36	74C160	2-05	80C97	94
74C73	98	74C161	2-05		

10% OFF WITH £15 ORDER
15% OFF WITH £50 ORDER

THESE DISCOUNTS APPLY TO TOTAL OF ORDER — SPECIALS INCLUDED

SPECIAL DEVICES

372	AF-IF Strip Detector DIP	£2-08
546	AM Radio Receiver Subsystem DIP	-53
1310	FM Stereo Demodulator DIP	2-05
1496	Balanced Modulator-Demodulator	-70
1800	Stereo multiplexer DIP	1-76
ULN2208	FM Gain Block 34db (typ) mDIP	-84
ULN2209	FM Gain Block 48db (typ) mDIP	-86
2513	Character Generator 64x8x5 DIP-24	7-24
3046	Transistor Array DIP-14	-52
8038	Volt. controlled osc.	2-95

CALCULATOR CHIPS

CT5002	12 digit, 4 function fixed decimal — battery operation 40 pin	£1-99
CT5005	12 digit, 4 function plus memory, fixed decimal 28 pin	2-06
MM5725	8 digit, 4 function, floating decimal 28 pin	1-37
MM5736	6 digit, 4 function, 9V battery operation 18 pin	2-78
MM5738	8 digit, 5 function plus memory and constant floating decimal, 9V battery operation 24 pin	2-78
MM5739	9 digit, 4 function, 9V battery operation 22 pin	2-78

SPECIALS

723 V Reg DIP 44

555 Timer mDIP 24

1702A UV ERASABLE PROM — 2048 bit static PROM 256x8 elect programmable & erasable TTL/DTL comp. **£5**

LINEAR

311 DIP	-59
340T-5V	-89
340T-15V	-89
376	-29
711	-39
1458 mDIP	-29

2102 1024 bit N channel static RAM **£1**

7475	26	74153	44
7489	1-37	9601	26
7490	33	9602	32

AUTO CLOCK KIT

6 digits .375" red led's
Operates from 12V DC or AC
Crystal control for high accuracy
Supplied with case & mounting bracket
Contains internal 9V battery for operation of timing circuit (without display) when removed temporarily from power.
Uses 5314 clock circuit
Supplied with all necessary components and assembly instructions **£23**

LINEAR

		324	1-23	560	2-23
301	21	339	1-06	562	2-23
302	49	340K	1-48	565	1-38
304	56	370	92	566	1-38
305	60	372	51	567	1-38
307	44	373	35	709	31
308	69	376	38	710	24
309K	1-25	380	93	711	51
310	75	380-8	1-02	739	75
311	67	381	1-13	741	29
319	82	382	1-13	747	54
320T	1-12	531	2-07	748	31
320K	1-32	540	1-38	75491	58
322	69	556A	1-02	75492	63

CLOCK CHIPS

MM5311	6 digit multiplexed BCD, 7 seg 12-24 Hr, 50-60 Hz 28 pin	£3-07
MM5312	4 digit multiplexed BCD, 7 seg 1 pps, 12-23 Hr, 50-60 Hz 24 pin	2-23
MM5314	6 digit multiplexed 12-24 Hr, 50-60Hz 24 pin	3-07
MM5316	4 digit, 12-24 Hr, 50-60 Hz, alarm 40 pin	2-78
CT7001	6 digit, 12-24 Hr, 50-60 Hz, alarm, timer and date circuits 28 pin	4-80

LED DISPLAYS

MAN 1	£1-15	ME4	-29
MAN 2	2-95	MV108	19
MAN 3A	-15	MV50	10
MAN 5	1-50	NSL100	10
MAN 82	1-97	NSL101	10
DL 10A	2-08	NSL102	10
NSN71L	-89	MV5020	
NSN71R	-89	ORANGE	12
NSN74R	-89	RED	10
FND359	-89	CLEAR	12

Date sheets on request. Add 20p ea. if item is priced below 50p each.

BANKAMERICARD MASTERCHARGE CHARGEX
BARCLAYCARD ACCESS EUROCARD

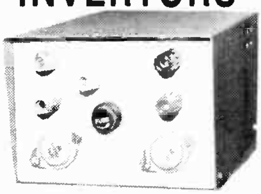
Satisfaction guaranteed. Shipment will be made postage prepaid within 5 days from receipt of order. Payment may be made with personal check, charge card (include number and exp. date), international money order (include receipt) or bank cheque made payable in U.S.$

Add 50p to cover shipping and handling if order is less than £5.

The above prices do not include any taxes leviable by a purchasers country of residence.

INTERNATIONAL ELECTRONICS UNLIMITED
P.O. BOX 3036 / MONTEREY, CA. 93940 USA
PHONE (408) 659-3171

INVERTORS



240v–50Hz from your 12v car battery

25 watt—£4·75	300 watt (24v)—£26·45
40 watt—£8·27	400 watt (12v)—£39·05
75 watt—£12·03	500 watt (24v)—£48·18
150 watt—£21·27	1kW (50v)—£127·00
300 watt (12v)—£33·03	1·5kW (110v)—£140·80

All above Invertors are in kit form but may be purchased built up in metal case & ready for use. Price list sent on receipt of s.a.e. Prices include post & packing.

P.W. AUTOMATIC EMERGENCY SUPPLY

240v–50Hz–150 watt invertor with built in battery charger. In event of power failure switches over automatically from battery charging to invertor operation. Cct. as appeared in Dec. 72 P.W. Complete kit of parts (excluding meter) £24·50 + £1·70p. & p.

DIGITAL WATCH

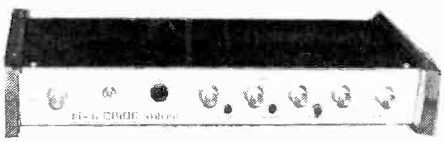
L.E.D. display giving hours, minutes, seconds and date. Design based on American technology, and fantastic value at £16 + 30p p. & p.
One year guarantee.

TRANSFORMERS & COILS

Both high volume & small order capacity available.
Special offer. Miniature mains transformer 6–0–6v–6V.A.—85p plus 10p p. & p.

TRADE & EXPORT ENQUIRIES WELCOMED

P.E. ORION STEREO AMPLIFIER



20 + 20 Watts r.m.s. into 8 ohm load. Distortion less than 0·01% 100Hz–10kHz. Frequency response ± 1dB 20 Hz to 20 kHz. Hum level virtually nil with volume full on.

This is a power amplifier of superb quality incorporating the very latest design features. Professional hi-fi enthusiasts have classed it as fantastic and real value for money. The CCT incorporates a low flux transformer and inputs for disc, tape, tuner, etc.

Complete kit of parts including slim line bookend case, silk screened front panel & knobs. **£47·30** incl. VAT & p. & p.

The bookend case, I.C.s & semiconductors, P.C. board, Transformer, etc. may be purchased separately if desired. Send S.A.E. for further information.

P.E. ORION TUNER

Full kit of parts for this superb tuner unit to compliment the now well established amplifier. Parts may also be purchased separately. Send S.A.E.

ASTRO IGNITION

ASTRO IGNITION SYSTEM

Complete kit of parts for this proven and tested system **£10·45** incl. VAT. Ready built with only two connections to alter **£13·75** incl. VAT. Thousands have used this system both home and abroad. Consider these *advantages* more power, faster acceleration, fuel economy, excellent cold starting, smoother running, no contact breaker burning. Also because of the high energy spark, the fuel mixture can be made weaker giving further economy and fewer plug problems. Fitting time when built 5 minutes approx. Please state whether positive or negative earth. Trade and export enquiries welcomed.

ASTRO ELECTRONICS
Spring Bank Road, West Park
Chesterfield.

PERCUSSION EFFECTS

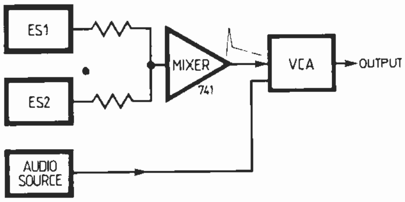


Fig. 1

SIMPLE envelope shapers used in synthesisers like the Minisonic are unable to produce a percussive envelope shape since there is only control for the attack and decay, the sustain being controlled by the time the key is held. On ADSR envelope shapers the attack, decay, sustain and release can be pre-set and more variety in the envelope shapes obtained.

Using two AD envelope shapers, the control signals can be mixed with each other and a combination envelope formed which is used to control the VCA in the usual way, as in Fig. 1.

The mixer can be formed from a 741; the output level being equal to the sum of the input levels. As an example a piano envelope can be more realistically imitated by setting the attack on both ES to min, and the decay to a few milliseconds on one and to about three seconds on the other.

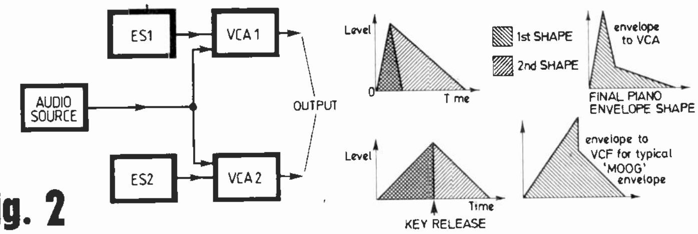


Fig. 2

Other strange envelope shapes can be formed from the system, as in Fig. 2.

Miss L. Robinson,
Wilmslow, Cheshire.

SIMPLE COMPRESSOR

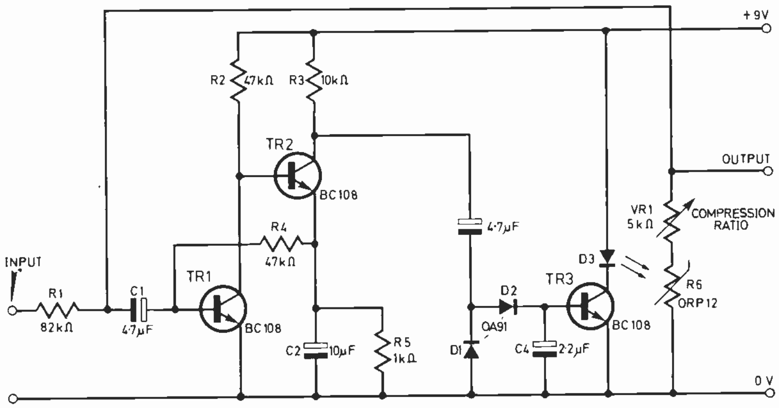


Fig. 1

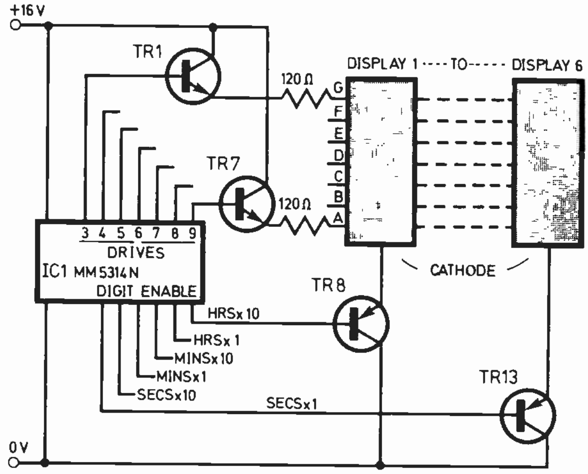
THIS circuit (Fig. 1) was designed to provide sustain on a guitar with a relatively insensitive pickup, though it could be used for other instruments or signals.

Transistors TR1 and TR2 form a high gain self-stabilising pair. The output is rectified by D1, D2, smoothed by C4 and applied to TR3 which controls the brightness of the l.e.d. D3. The light from the l.e.d. falls on the light dependent resistor, varying its resistance and so controlling the level of the input signal by voltage divider action via VR1.

The l.e.d. used was a 0·2in high-intensity red type mounted over the l.d.r., the whole assembly being enclosed in a lightproof screened box.

Q. A. Rice,
Mitcham,
Surrey.

SIMPLIFIED CLOCK DISPLAY



In Fig. 1, a circuit is shown which makes it possible for common cathode displays to be used in the electronic clock of P.E. August 1975, which made use of common anode displays. Using this method, only seven resistors are used (instead of twenty-one) for the interfacing of the displays.

Thus, the clock can be made more economically, and a printed circuit board can be designed with ease. For the current limiting resistor, 120Ω should be suitable for a 16V supply.

N. Coxhead,
Pyrford,
Surrey.

HEADS OR TAILS

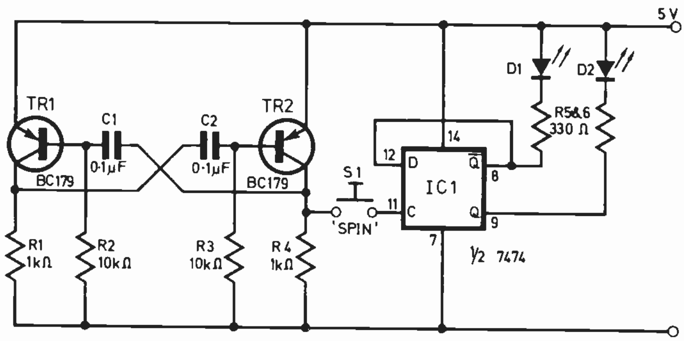


Fig. 1

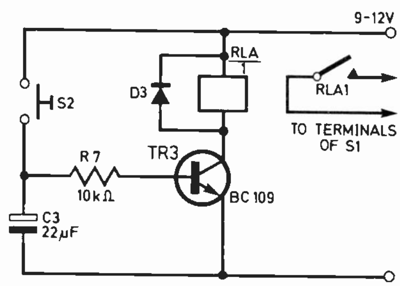


Fig. 2

Most published designs for heads or tails circuits rely on a bistable whose state is changed by a squarewave, the bistable being in one state during the mark, and the other during the space. This means that if the bistable is not to be biased towards any one state, the mark space ratio of the squarewave must be exactly 1 : 1. This is hard to achieve, due to component tolerances in the oscillator.

The circuit in Fig. 1 overcomes this difficulty by using an edge triggered bistable, which changes state whenever a positive-going edge appears at the clock input. Since the time between two consecutive edges is independent of the mark space ratio, l.e.d.s D1 and D2 are on for equal periods.

The squarewave is provided by TR1 and TR2, and the bistable is one half of a 7474. The l.e.d. currents are limited by R5 and R6, preventing the outputs of IC1 from being overloaded. S1 is a push-to-make release-to-break switch, which could be replaced by a relay with a delay to simulate the spinning of a coin. A suitable delay circuit of a few seconds is given in Fig. 2.

It should be noted that the frequency of the oscillator is twice the switching frequency of the bistable.

P. Chambers,
Winchmore Hill,
London.

TRANSFORMERS

ALL EX-STOCK—SAME DAY DESPATCH

NO HIDDEN EXTRAS— *Prices correct at 14th December 1976.* Prices include VAT and P. & P. EXCEPT † WHERE CARRIAGE WILL BE ACCORDING TO WEIGHT AND DISTANCE—BRS. **Electrosil Resistors, Semiconductors and Multi-meters.**

MAINS ISOLATING
PRI 220/240V
SEC 120/240V
CENTRE TAP WITH SCREEN

Ref	VA(Watts)	£
07*	20	4·57
149	60	6·68
150	100	7·65
151	200	11·95
152	250	14·47
153	350	17·14
154	500	19·73
155	750	27·25†
156	1000	37·97†
157	1500	43·33†
158	2000	48·34†
159	3000	76·36†

*115V or 240V Sec. only.

30 VOLT RANGE
Prim. 220-240V
Sec 0-12-15-20-24-20V

Ref	Amps	£
112	0·5	3·15
79	1·0	4·00
3	2·0	5·55
20	3·0	6·87
21	4·0	7·93
51	5·0	9·55
117	6·0	10·69
88	8·0	14·15
89	10·0	14·51

60 VOLT RANGE
Prim. 220-240V
Sec 0-24-30-40-48-60V

Ref	Amps	£
124	0·5	3·94
126	1·0	5·43
127	2·0	7·65
125	3·0	11·00
123	4·0	13·07
40	5·0	14·20
120	6·0	16·64
121	8·0	19·56†
122	10·0	24·09†
189	12·0	25·16†

12 and or 24 Volt
PRIMARY 220-240 VOLTS

Ref	Amps 12V	24V	£
111	0·5	0·25	2·30
213	1·0	0·5	3·01
71	2	1	3·69
68	3	-	5·10
18	4	2	4·56
85	5	-	5·61
70	6	3	6·36
108	8	4	7·34
72	10	5	7·86
116	12	6	8·39
17	16	8	10·48
115	20	10	15·42
187	30	15	19·50
226	60	30	21·94†

HIGH VOLTAGE
Mains Isolating
Prim. 200/220 or 400/440
Sec. 100/120 or 200/240

VA	Ref.	£
60	243	6·62
350	247	15·23
1000	250	32·68†
2000	252	54·80†

50 VOLT RANGE
Prim. 200-240V
Sec. 0-19-25-33-40-50V

Ref. No.	Amps	£
102	0·5	4·07
103	1·0	5·27
104	2·0	7·17
105	3·0	8·77
106	4·0	11·26
107	6·0	17·29
118	8·0	18·62
119	10·0	22·04†

C1000 MINI-MULTIMETER
D.C.—1,000V. A.C.—1,000V. 1,000Ω/V
D.C. 1—100mA. Res.—150kΩ.
BARGAIN AT £5·24

ANTEX SOLDERING IRONS
15W £4·08 18W £4·08 25W £3·80
SOLDERING IRON KIT £5·66
STAND FOR ABOVE £1·84

MAGNETIC TO CERAMIC CARTRIDGE CONVERTOR
OPERATING VOLTAGE 20-45V only £3·59.

RANGE OF PANEL METERS

COMPONENT PACKS
200 Mixed value resistors (count by weight)
150 Mixed value capacitors (count by weight)
30 Mixed value precision resistors ½W 2%
15 Assorted pots and pre-sets
10 Reed switches
3 Micro switches
15 Wire wound resistors—mixed wattage
1 Pack wire 50 metres, assorted colours
PLEASE STATE PACK REQUIRED 90p PER PACK

SCREENED MINIATURES

Ref mA	Volts	£
238 200	3-0-3	2·50
212 1A, 1A	0-6, 0-6	2·97
13 100	9-0-9	2·28
235 330, 330	0-9, 0-9	2·39
207 500, 500	0-8-9, 0-8-9	3·14
208 1A, 1A	0-8-9, 0-8-9	4·51
236 200, 200	0-15, 0-15	2·28
214 300, 300	0-20, 0-20	3·22
221 700 (OC)	20-12-0-12-20	3·66
206 1A, 1A	0-15-20, 0-15-20	5·37
203 500, 500	0-15-27, 0-15-27	4·77
204 1A, 1A	0-15-27, 0-15-27	6·00
S112 500	12, 15, 20, 24, 30	3·15

HIGH QUALITY MODULES

5 Watt RMS AMPLIFIER	£3·59
10 Watt RMS AMPLIFIER	£3·98
25 Watt RMS AMPLIFIER	£4·94
125W RMS AMPLIFIER	£17·61
PRE-AMP for 3-5-10W	£8·09
PRE-AMP for 25W	£15·57
POWER SUPPLIES 3-5-10W	£1·72
POWER SUPPLIES 25W	£4·43
TRANSFORMER 5-10W	£3·89
TRANSFORMER 25W	£5·74
BSR 144R (Chassis with magnetic cartridge)	£27·78
Garrard SP25 1V (Chassis)	£22·80

AUDIO KIT 25W
2 + 25W Amplifiers, 1 + Pre-Amp
1 + Power supply, 1 + Transformer
1 + Front Panel
1 + Kit of parts to include on/off switch, neon ind. Stereo headphone socket. Plus Instructions book £32·18.

TEAK AUDIO KIT 25W
Teak veneered cabinet
Aluminium chassis, heat sink and front panel brackets plus back panel and sockets etc. £11·21

CARTRIDGES

Magnetic Sonotone 100	£5·31
Ceramic E.E.I.CS 2000	£2·72
ALOS GP93-1	£2·38
AT55 (magnetic)	£4·42

AUTO TRANSFORMERS

Ref (Watts) VA		Auto Taps	£
113	20	0-115-210-240	2·81
64	75	0-115-210-240	4·65
4	150	0-115-200-220-240	6·24
66	300	0-115-200-220-240	8·62
67	500	0-115-200-220-240	13·10
84	1000	0-115-200-220-240	19·70
93	1500	0-115-200-220-240	23·62†
95	2000	0-115-200-220-240	31·56†
73	3000	0-115-200-220-240	45·78†

DECS SOLDERLESS BREAD-BOARDING

S Dec 70 contacts	£2·41
T Dec 208 contacts	£3·92
U Dec "A" for I.C.s. etc.	£4·58
U Dec "B" for I.C.s. etc.	£7·82

BRIDGE RECTIFIERS

		£
200V	2A	0·67
400V	2A	0·72
200V	4A	0·89
500V	10A(PM 7A6)	2·70

NEW STEREO 30
Complete Stereo Chassis inc. 7 + 7W RMS. Amp. Pre-amp. Power Supply. Front Panel, Knobs (only needs Mains Trans.). Stereo 30 £18·89 Mains Trans £3·89. Teak veneered cab. £4·54.

BSR MP60 module with magnetic cartridge £38·29

POWER UNIT
Plugs direct into 13A 3 pin socket. 6-7·5-9V 300mA with multi-plug £3·59.

CASED AUTO TRANSFORMERS
240V cable in and U.S.A. 2 pin outlet

20VA	£4·95	Ref 113W
150VA	£8·94	Ref 4W
500VA	£15·11	Ref 67W
1000VA	£22·84†	Ref 84W
2000VA	£35·86†	Ref 95W

ELECTRONIC CONSTRUCTION KIT
10 projects (including Electronic Organ). Ideal gift at £8·63 (no soldering)

TEST METERS

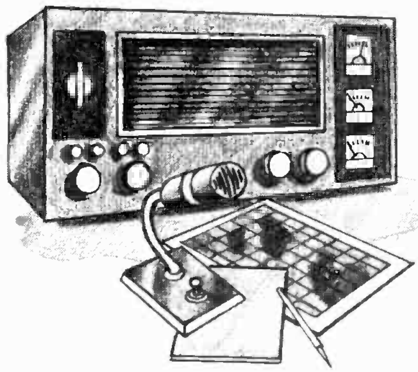
AVO 8 MK5	£67·33
AVO 72	£26·86
AVO TT 169	£28·94
AVO MM5	£23·48
U4315 (USSR) inc. steel carry case	£16·52

POWER UNIT
3-4 5-6-7 5-9-12V at 500mA £5·18
SPAB 3-6-7·5-9V 400mA £6·98

STEREO FM TUNER WITH PHASE-LOCK LOOP
4 Pre-selected stations supply 20-35V. 90mA Max. £22·72

Barrie Electronics Ltd.
3, THE MINORIES, LONDON EC3N 1BJ
TELEPHONE: 01-488 3316/7/8
NEAREST TUBE STATIONS: ALDGATE & LIVERPOOL ST.

Careers and Hobbies in Electronics.



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

Become a Radio Amateur.

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

FREE!

Brochure without obligation to:
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL,
P.O. BOX 156, JERSEY, CHANNEL ISLANDS.

NAME ____________________
ADDRESS ____________________
____________________ BLOCK CAPS PLEASE

GREENWELD

443 Millbrook Road Southampton
SO1 OHX Tel:(0703) 772501

All mail orders and callers to this address please—callers only to 21 Deptford Broadway, SE8 (Tel 01-692 2009) and 38 Lower Addiscombe Road, Croydon

44 PAGE CATALOGUE
10P + LARGE S.A.E.
Free with orders over £2

DIGITAL I.C.s

7400	**12p**	7450	**15p**	7495	**73p**
7401	**14p**	7451	**14p**	7496	**85p**
7402	**14p**	7453	**14p**	74107	**37p**
7404	**17p**	7454	**14p**	74121	**36p**
7405	**23p**	7460	**14p**	74122	**51p**
7406	**28p**	7472	**29p**	74123	**64p**
7408	**14p**	7473	**29p**	74132	**56p**
7410	**13p**	7474	**29p**	74150	**173p**
7413	**28p**	7475	**51p**	74154	**144p**
7414	**62p**	7476	**29p**	74155	**73p**
7420	**14p**	7483	**91p**	74157	**66p**
7430	**14p**	7486	**40p**	74159	**200p**
7432	**18p**	7490	**46p**	74174	**110p**
7437	**18p**	7491	**75p**	74179	**120p**
7440	**15p**	7492	**52p**	74180	**120p**
7447	**84p**	7493	**52p**	74367	**120p**

SLD2128 dual 128 bit static shift register £2.

DIL Sockets—8 pin **12p**; 14 pin **13p**; 16 pin **14p**. 100+ less 25%

LINEAR I.C.s

741 **25p**; 555 **40p**; 723 (TO99) **50p**
Plastic Voltage Regulators:
TO126 case 5V 600mA **80p**, 12V 500mA **80p**

TRANSISTORS

AC127	**15p**	BC183	**12p**	2N2646	**42p**
AC128	**15p**	BC184	**12p**	2N2926G	**12p**
AC176	**16p**	BC212	**14p**	2N3053	**18p**
AC187	**18p**	BC213	**14p**	2N3054	**49p**
AC188	**18p**	BC214	**14p**	2N3055	**38p**
AD161	**35p**	BCY70	**15p**	2N3440	**54p**
AD162	**35p**	BCY71	**15p**	2N3442	**£1·20**
BC107	**10p**	BCY72	**15p**	2N3702	**10p**
BC108	**10p**	BD131	**38p**	2N3703	**10p**
BC109	**10p**	BD132	**40p**	2N3704	**10p**
BC109C	**15p**	BFY50	**15p**	2N3705	**10p**
BC147	**10p**	BFY51	**15p**	2N3708	**10p**
BC148	**10p**	BFY52	**15p**	2N3819	**22p**
BC149	**10p**	TIP41A	**60p**	2N4059	**10p**
BC157	**10p**	TIP42A	**75p**	2N4418	**10p**
BC158	**10p**	TIP2955	**96p**	2N5294	**30p**
BC159	**10p**	TIP3055	**42p**	40673	**50p**
BC161	**18p**	2N2219	**28p**		
BC182	**12p**	2N2369	**22p**		

VEROBOARD

Good size offcuts all packs contain 100 sq in (About 8 pieces) All packs **£1·20**.
Pack A, all 0 1in pitch.
Pack B all 0 15in pitch
Pack C mixed 0 1 and 0 15
Pack D all 0 1in plain
Also available by weight 1lb **£3·45**; 10lbs **£30**.
17 × 3½ × 0 1in sheets **£1·90**; 0 15 **£1·60**.
0 1in or 0 15in pins, single or double sided **35p**/100

DIODES AND LEDs AND SCR's

500V 5A SCR **45p**; 400V 2A Triac **80p**; Diac BR100 **25p**; 400V 15A Triac **£1·50**; ORP12 **60p**; MRD450 **40p**; TIL209 Red LED **15p**; 0 2in LED Red **22p**; green, yellow or amber **24p**
1N4002 **5p**; 1N4004 **6p**; 1N4007 **9p**; 1N4148 **4p**; BY127 **12p**; 100V 3A **12p**; 400V 3A **15p**; OA81 **5p**; OA91 **5p**
50V 1A bridge **22p**; 800V 1A **40p**; 250V 2½A **40p**; 200V 5A **70p**; 500V 6A **£1·60**.
Zeners—400mW BZY88. All voltages from 3V to 30V **10p**
1 3W plastic from 3V to 200V **20p**

RESISTORS

Carbon film 5% ¼W miniature All values in E12 series from 1Ω to 10MΩ (over 1MΩ 10%) **1½p** each
Metal Film 5% 1W All values in E12 series from 27Ω to 10MΩ **2½p**.
Sub-min presets, vert or horiz all values from 20Ω to 4MΩ. **7p**.
Standard pots, lin or log, **22p**.
Wirewound 2½W 0 25, 0·33, 0·47 1Ω **8p**.
Wirewound 5W all values from 1Ω to 47K **10p** each

TRANSFORMERS

6–0–6V 100mA **90p**; 9–0–9V 100mA **95p**; 12–0–12V 50mA **90p**; 12–0–12V 100mA **£1**; 12–0–12V 1A **£2·80**; 20V 55mA **90p**; 22V 100mA **£1**; 29V 50mA **85p**; 6 3V 1½A **£1·95**; 6–0–6V 1½A **£2·30**; 12V 150mA **80p**; 17V 1A **£1·80**; 25V 1½A **£2·30**; 30–0–30V 1A **£3·70**.

REEDS

1in Inserts, **5p**; 10/**40p**; 100/**£3·50**. DIL relay, 3·7–10V, **£2·20**.

WIRE

Enamelled copper wire on 2oz reels SWG/price: 16/**32p**, 18/**34p**, 20/**36p**, 22/**38p**, 24/**40p**, 26/**42p**, 28/**44p**, 30/**46p**, 32/**48p**, 34/**50p**, 36/**52p**, 38/**54p**, 40/**56p**.

RF CHOKES

0 75, 2·95, 6·8, 10, 22, all **10p** each, 1 5, 2 5, 5 0, 7 5, 10mH, all **30p** each

CAPACITORS

Ceramic plate. 22pF to 1,000pF **2p**; polyester 1,000 to 6,800pF **5p**; 0·01, 0·015, 0·022, 0·033, 0·047, 0·068, 0·1mF **4p**; 0·15, 0·22mF **5p**; 0·33 **6p**; 0·47 **8p**; 0·68 **10p**; 1mF **12p**; 2·2mF **16p**; 3·3mF **24p**. 1,000pF feedthrough **5p**.
1% 1,000pF, 10,000pF **15p**; 0·1µF, 0·2µF, 0·25µF **30p**; 2·2µF **55p**.
Polystyrene 10pF to 1,000pF **4p**; 1,200pF to 10,000pF **8p**. All 2½%.
Electrolytics:
All 25V· 0·47, 1, 2·2, 4·7, 10, 22, 47mF **6p**; 100mF **7p**; 220mF **9p**; 470mF **11p**; 1,000mF **18p**; 2,200mF **27p**; 40V 47mF **7p**; 100mF **8p**; 220mF **10p**; 470mF **18p**; 1,000mF **32p**; 2,200mF **48p**.
Tantalum bead, mF/V. 0·1/35, 0·22/35, 0·33/35, 0·47/35, 1/35, 2·2/16, 2·2/35, 3·3/35, 4·7/35, 6·8/35, 10/16; 10/25, 15/10, 22/6·3, 22/10, 22/16; 33/10, 47/6·3, 100/3. **12p** each.

BREADBOARDS

S-DEC Breadboard **£2·10**;
T-DEC Breadboard **£3·75**.
Special price to colleges etc. for quantities—ring for quote.

CALCULATORS—£2·75!

There has to be a catch—these Rapidman 1208 machines are a mains-powered desk top calculator with 0–9 and dec point, and 7 function keys inc. %, but the liquid crystal display is missing However, apart from this they are complete with PSU, 3 ICs + discrete components. Overall size 11 × 7 × 3in. Only **£2·75**.

KEYBOARDS

Front half of calculator, really. Case 130 × 75mm has display window, 2 slide switches and 25 keys Only **£1**.

DISPLAYS

Brand new 7-segment LEDs, 9 MAN3M on PCB with multiplexed output **£1·35**.

VEROBOXES AND CASES

Professional 2 part boxes made of dark and light grey high impact polystyrene

2518	120 × 65 × 40mm	**£2·05**
2520	150 × 80 × 50mm	**£2·40**
2522	188 × 110 × 60mm	**£3·15**

Sloping front version, ideal for mixers

2523	220 × 174 × 100/52mm	**£5·75**

Cases, white plastic top and bottom, front and back aluminium panels that slot in Type

1410	205 × 140 × 40mm	**£3·20**
1411	205 × 140 × 75mm	**£3·60**
1412	205 × 140 × 110mm	**£4·55**
1237	154 × 85 × 40mm	**£2·00**
1238	154 × 85 × 60mm	**£2·50**
1239	154 × 85 × 80mm	**£3·00**

Small general purpose plastic boxes

1413	71½ × 40 × 24½mm	**36p**
PB1	115 × 75 × 36mm	**52p**

DEVELOPMENT PACKS

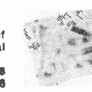
Save ££££s by buying a full range of components at one go! All full spec marked devices no rejects or old stock
50V ceramic plate capacitors 5% 10 of each value, 22pF to 1,000pF Total 210 capacitors **£2·70**.
CR25 carbon film resistors, ⅓ watt 5% 10 of each value 10Ω to 1MΩ total 610 **£6·00**.
Extended range 1 ohm to 10M 850 resistors **£8·30**.
Electrolytics, wire ended 25V working 10 each of 1, 2 2 4 7, 10 22, 47 and 100mF 70 capacitors for **£3·20**.
Zeners, 400mW 5% BZY88 10 each 3V to 30V total 260 **£14·00**.
½ pack 5 of each value **£8·20**.
Tantalum Bead caps, 14 values from 0 1 35 to 100/3, 10 of each total 140 caps **£12·00**.

See Practical Wireless for details of packs of components, surplus goods, etc. All prices quoted include VAT at 8 or 12½%. Add 20p postage on orders under £3 Most orders despatched on day of receipt. SAE with enquiries. Send 10p for Multimeter catalogue—free on request on orders over £3. Official Orders accepted from Schools, etc. Export/wholesale enquiries welcome. Surplus components always wanted.

SOLDERLESS BREADBOARDING — DECS

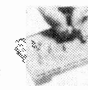
The famous DEC System of Solderless Breadboarding is ideal for both the young and more mature students of Electronic Engineering as it enables circuits to be tried and tested without the use of soldering and because of the specially designed contacts allows components to be used over and over again. It is also extremely useful for the Circuit Designer who wishes to experiment with and perfect his circuit quickly yet economically.

S-DEC (Model PB11)



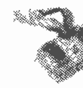
This, the most popular Board, is designed solely for the use of discrete components and is particularly useful for basic educational purposes.
(No. of Contacts: 70) 1 off **£1·98**, 5 off **£1·78**

T-DEC (Model PB21)



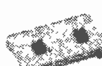
This Board allows 2 TO5 or 1 DIL IC Station to be used and so is primarily intended for discrete work or for linear IC application where considerable numbers of discrete components may be required.
(No. of Contacts 208) 1 off **£3·62**, 5 off **£3·21**

µ-DEC 'A' (Model PB31)



The µ-DEC 'A' is specially designed for ease of use with IC's and allows 2 DIL or 4 TO5 stations to be used but will accommodate discrete components with equal facility.
(No. of Contacts: 208) 1 off **£3·97**, 5 off **£3·53**

µ-DEC 'B' (Model PB41)



The µ-DEC 'B' is for similar uses as µ-DEC 'A', but has two 16 lead IC sockets as part of the Board.
(No. of Contacts 208) 1 off **£6·97**, 5 off **£6·19**

DEC ACCESSORIES

16 DIL adaptor (with socket) PB062	**£1·92**
10 TO5 adaptor (with socket) PB072	**£1·80**
Single ended leads (set of ten) PB101	**£0·90**
Double ended leads (set of ten) PB102	**£0·99**
1mm plugs (set of ten) PB103	**£0·45**

All prices include 8% VAT. P. & P. 25p.

Our retail counter is now open, stocking a large variety of audio and electronic parts and accessories, branded and surplus.
WE ARE SITUATED 2 MIN. WATFORD JUNCTION STATION

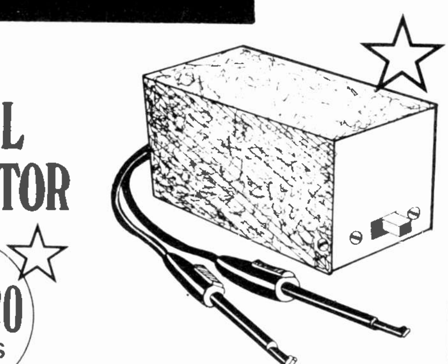
THE COMPONENTS CENTRE

7 Langley Road, Watford, Herts., WD1 3PS.
Tel.: Watford 45335

DORAM kits

DORAM KITS CONTAIN EVERYTHING DOWN TO THE LAST NUT

IC SIGNAL INJECTOR



£2·20 +S

For audio fault finding, this battery operated unit may be simply attached at any point in the circuit to provide a 1KHz square wave for pre-settable amplitude, up to 5V. Using only one IC the unit, complete with battery, is incorporated in a case only 50x50mmx 100mm long with probes to provide connection to circuit. Easy to construct for only:
£2.20 + S VAT (Order code 991-877) Subject to availability

O'seas orders—add 15% for P + P. All items offered for sale subject to the Terms of Business as set out in Doram Edition 3 catalogue, price 60p. The Doram Kit brochure is also available, price 25p. Combined price only 70p which also entitles you to 2 × 25p vouchers, each one usable on any order placed to the value of £5·00 or more (ex. VAT).
DORAM ELECTRONICS LTD
P.O. Box TR8, Wellington Road Industrial Estate, Leeds LS12 2UF.
An Electrocomponents Group Company

PATENTS REVIEW...

SOLAR ENERGY BP1 445 369

In BP 1 445 369, the German company of Rowenta-Werke GmbH provides a useful technical recap on work to date on photo-electrically converting sunlight to electrical energy, for instance, using silicon cells to power domestic equipment such as clocks.

It is confirmed that the main problem to date lies in selecting a cell which will operate efficiently over the wide range of ambient lighting likely to be encountered in the earth's atmosphere. This is likely to be some 60,000 lux in bright sunlight and as little as 200 lux on a very cloudy day.

Curves are plotted for the energy conversion characteristics of presently available cells. It is claimed that the secret for efficient operation over a wide range of different illumination intensities is keeping the operating voltages of a mosaic of photoelectric cells always at the optimum working points on their characteristic curve locus.

This is achieved in the patent by connecting a storage capacitor across the photoelectric cells and applying the output to a d.c. converter circuit. This then supplies the working load, for instance a high value capacitor and accumulator serving as energy stores, with the necessary power.

According to the invention, the converter circuit has an adjustable frequency of operation automatically controlled by a photoconductive resistor which receives light from the same source of illumination as the generator cells. If necessary a neutral density filter is used to balance the light received by the two cell types.

Two circuits are given for light controlled transformer circuits, in which the frequency of operation rises with decreasing illumination and falls with increasing illumination. Another circuit is given where the frequency rises with rising illumination and falls with falling illumination. But in either case, the circuit operates to ensure that only that amount of energy is taken from the capacitor which can subsequently be delivered by the photoelectric cells under the sensed prevailing illumination.

SIMPLIFIED TELECINE BP1 444 591

If a recent patent (BP 1 444 591) were not from the giant Matsushita Electrical Industrial Co. Ltd., of Osaka, Japan, and named five separate inventors, it could easily be dismissed as yet another armchair invention inadequately thought through. The patent pedigree, however, suggests that the idea, although simple, may open up interesting avenues of experiment for anyone with an old cine projector available for modification.

The patent claims a generally conventional cine projector, but with the projection lamp replaceable (by the movement of a slide or the turn of a rotor) with a photoelectric converter. The lamp is used when it is required to project films on a matt reflective screen in the usual manner.

To display a film on the screen of a domestic TV set, the lamp is replaced with the converter and the projector optics focused on the screen of a television receiver. In this way the converter receives light from the flying spot on the screen via the film running through the projector. The converter converts the varying light signals into correspondingly varying electric signals which are used to modulate the brightness of a video display.

It is suggested that one TV tube can perform the function of both image display tube and flying spot tube, to provide a TV display of the film image.

Although such a technique sounds unworkable (for instance, there are the problems of video feedback and the effect of using intermittent film transport as commonly found in domestic projectors) electronics experimenters may well find the basic idea behind the patent a trigger for further thought.

JACKETED WIRES BP 1 433 526

A clever new method of producing a precision jacketed wire, for instance for use in temperature measuring and control techniques, is patented by G. Rau of Germany, in BP1 433 526.

The object is to provide mechanical support for an extremely thin metallic resistor wire by means of a tough insulating jacket, but without interfering with its electrical resistance and the consistent transmission of heat to and from the wire. These requirements are normally mutually contradictory and the patented answer is to produce the insulating jacket by a gas-metal reaction.

A wire metal core is inserted into a silver tube. The core and tube are a mechanically manageable size, but are subsequently drawn to reduce their diameter to the desired size. The drawn composite is then heated to 800° C for three hours, permeation of oxygen from the air into the interface between the core and tube creating an oxide layer which serves as an insulating jacket of precision dimensions. As an alternative, a nitrogen reaction can be promoted to produce a nitrogen-based insulating layer.

IN BRIEF

BP 1 446 747 — Nissan Motor Co. Ltd: *Vehicle Safety Harness*. Complicated circuitry to prevent an engine being started and run from cold if the driver and passenger seat belts have not been fastened, but with over-ride circuitry which enables the engine to be re-started after a stall even without belt fastening. Intended to cope safely with emergencies such as engine stall on a level crossing, where rapid re-start is more important than belt fastening.

BP 1 445 883 — Sepro Soc. D'Etudes: *Automatic Collision Alarm*. An intertia electric switch system for incorporation in a motor vehicle, the switch being slugged sufficiently to prevent its closure under all normal driving conditions. But it closes on substantial impact to trigger and hold an alarm circuit closed. In this way a car damaged by impact on a motorway can automatically transmit radio alarm signals and/or flash warning lights to following traffic to prevent another collision.

Copies of Patents can be obtained from the Patent Office Sales, St Mary Cray, Orpington, Kent Price 95p each

Readout— A SELECTION FROM OUR POSTBAG

Readers requiring a reply to any letter must include a stamped addressed envelope. We regret that we cannot answer any technical queries on the telephone.

Transistor Socket

Sir—I recently made a transistor tester and had to find a simple, reliable method of connecting the transistors under test.

A 5-pin 240 degree panel mounting DIN socket provided the answer. The tester leads were connected as shown in Fig. 1.

The DIN socket allows easy and firm connection for most transistor configurations, without having to bend or twist the often short leads!

H. Jacobs
Twickenham.

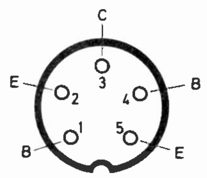


Fig. 1

Seeking the truth?

Sir,—I feel duty bound to write in reply to the article on the Electropsychometer under the *Patents Review* section of PRACTICAL ELECTRONICS (August).

I have a document in front of me dated September 14, 1976, from one Lee Torbush, an employee of the Bureau of Medical Devices of the US Food & Drug Administration. In his view "The E-Meter (electropsychometer) is not capable of, nor is it possible to use it as a lie detector, or any such similar instrument. It is a religious artifact used by a Minister of the Church of Scientology to help in the Pastoral Counselling process."

I hope this information will be of some value to any budding Kojaks who believed that the circuit diagram outlined in the article would produce a lie detector. To make any effective use of the instrument outlined in the article they would have to undergo training as a Scientology Minister.

P. Thomson,
East Grinstead.

Perhaps we can help you turn that old wish into reality

As all electronics constructors know, one of the secrets of happiness is to spend leisure time on work that is both interesting and constructive. Unfortunately, one's enjoyment of the hobby is soon spoilt if you can't obtain the right components. That's where Home Radio Components come in and if you're a regular reader of these advertisements you'll know exactly what we three "typical customers" recommend. Here it is—the first step is to invest in a Home Radio Components catalogue. This will enable you to locate quickly and easily the parts you need for the project you have in mind. Then, to buy the components you have a choice of three methods. 1, You can visit Home Radio's shop in Mitcham, above Tesco's almost opposite Mitcham Baths. 2, You can send a cheque or P.O. for the items you need, in the normal Mail Order way. 3, You can join Home Radio's Credit Scheme and settle your account monthly. Full details of this popular scheme are given in the catalogue.

Whichever method you use, you will enjoy the prompt personal service Home Radio always strive to give. So, back to the first step, send off the coupon with £1·40 for your copy of the catalogue—it's a superb production!

Please write your Name and Address in block capitals

NAME

ADDRESS

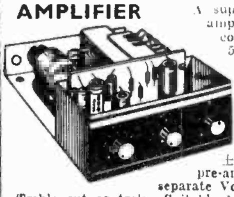
HOME RADIO (Components) LTD Dept PE
234-240 London Road, Mitcham, Surrey CR4 3HD

Regd No 912966 London

POST THIS COUPON with £1·40, cheque or P.O.

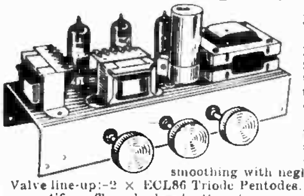
HOME RADIO (Components) LTD Dept PE 234-240 London Road Mitcham CR4 3HD Phone 01-648 8422

SUPERSOUND 13 HI-FI MONO AMPLIFIER



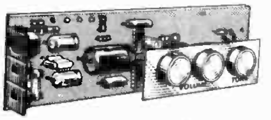
A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into ohms. Frequency response 12Hz. 30KHz ±3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep AC 200/250V. PRICE £13·75. P. & P. £1·00.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. 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 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built and tested to a high standard. £12·40. P. & P. £1·30.

HARVERSONIC STEREO 44



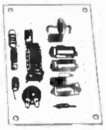
A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume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

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 3in. long × 3½in. wide × 3in. deep. Price £2·90. P. & P. 90p.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9-0-9 at 500 mA. £1·50. P. & P. 60p.
Pri. 200/240v. Sec. 12-0-12 at 1 amp. £1·65. P. & P. 60p.
Pri. 200/240v. Sec. 10-0-10 at 2 amp. £2·35. P. & P. 90p.
Pri. 200/240v. Sec. 23v. at 1·5 amp. 6v at ·6 amp. 8v. at 50 mA. £2·00 + 65p P. & P.

ALL PURPOSE 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" × 3¼" × 2¼". Ready built and tested. **Price £6·75. P. & P. 85p.**

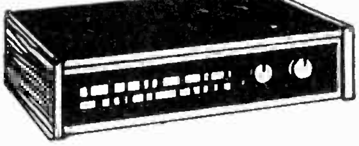
STEREO-DECODER SIZE 2" × 3" × ½"



Ready built. Pre-aligned and tested. Sens. 20-560mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £5·62 plus 20p P. & P. Stereo beacon light if required 40p extra.

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 wide × 3in deep × 6in high. Ready built and tested. PRICE £7·00. P. & P. 90p.
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £8·00. P. & P. £1·00.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER

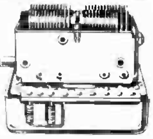


Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-gain, low noise IF stages. Automatic frequency control to "lock on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12½in wide × 8in deep by 2½in high. Supplied ready built, fully tested and fully guaranteed. AC mains 200/240V (not available in kit form).

Special Offer £22·50 + £1·40 P. & P.

SPECIAL OFFERS

Mullard LP1159 RF-IF Double Tuned Amplifier Module for nominal 470kHz. Size approx. 2¾" × 1¼" × ¾" 7·6V + earth. Brand new pre-aligned. Full specification and connection details supplied. £2·25 + P. & P. 12p.



Pye VHF/FM Tuner Head covering 88-108M/Hz. 10·7M/Hz IF output 7-8V + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM Gang and 323 Pf + 323 Pf AM Tuning Gang only £3·15 + P. & P. 35p.

PRECISION MADE
Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2½" × 1". Supplied complete with chrome finished switch buttons 2 for £1·50 + 20p. P. & P.

HI-FI LOUDSPEAKER SYSTEM MkII
Beautifully made simulated teak finish enclosure now with most attractive slatted front. Size 16½" high × 10¼" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. AVAILABLE IN NOMINAL 4 ohm, 8 ohm or 16 ohm impedance (state which). Handling power 10 watts R.M.S.
OUR PRICE £12·80 each. Carr. £1·90
Cabinet Available Separately £7·60 each Carr. £1·40.
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter £11·10 each. Carr £1·90.

LOUDSPEAKER BARGAINS
5in. 3 ohm £1·45, P. & P. 35p. 7 × 4in. 3 ohm £1·69, P. & P. 48p. 10 × 6in. 3 or 15 ohm £2·50, P. & P. 75p. E.M.I. 8 × 5in. 3 ohm with high flux magnet £2·06, P. & P. 50p. E.M.I. tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, £2·00 + 25p, P. & P.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £1·50 yd. length. P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples.

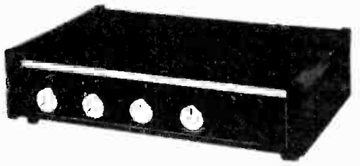
"POLY PLANAR" WAFER-TYPE. WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × 14¾" × 1⅜" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, etc. and used with or without baffle. Send S.A.E. for details. Only £8·40 each. P. & P. 75p for one. 90p for two.

Now also available 8"-8 ohm. 10 watts r.m.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars. £5·10 + P. & P. (one 35p. two 65p).

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. £1·60. P. & P. 18p.
CERAMIC STEREO CARTRIDGE. Universal mounting brackets and turnover stylus. 70mV per channel output. ONLY £1·90. P. & P. 18p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. ONLY £2·36, P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £2·86. P. & P. 18p.
LATEST CRYSTAL T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo 78. £1·80. P. & P. 18p.
LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £1·58. P. & P. 18p.

OUR PRICES INCLUDE VAT AT CURRENT RATES

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT

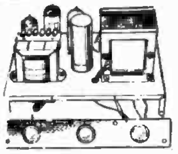


A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal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

AMPLIFIER KIT	£13·50 P. & P. 65p
(Magnetic input components 33p extra)	
POWER PACK KIT	£5·50 P. & P. 85p
CABINET	£5·50 P. & P. 85p

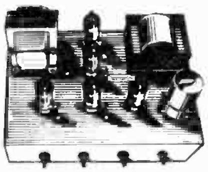
Special offer—only £23·75 if all 3 units ordered at one time plus £1·00 P. & P.
Full after sales service
Also available ready built and tested £31·25. P. & P. £1·00.

3-VALVE AUDIO AMPLIFIER HA34 MK II.



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4¾"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 £8·20. P. & P. £1·00.
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £7·60. P. & P. £1·00.

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 25p + SAE (Free with parts). All parts sold separately. ONLY £12·00. P. & P. £1·35. Also available ready built and tested £16·50. P. & P. £1·35.

SPECIAL OFFER
Latest model Garrard 6300 Auto/Manual changer de luxe with cueing lever, bias compensator, counter-balanced low resonance arm and fitted with Acos 104 diamond ceramic stereo cartridge. PRICE ONLY £14·50 + £1·50 P. & P.

Limited number of the latest BSR C142 Auto/Manual changer de-luxe. Lightweight tubular arm with adjustable counterweight cueing lever, bias compensator. PRICE £13·00 + £1·40 P. & P.

Also similar but without cueing lever or bias compensator. ONLY £11·00 + £1·40 P. & P.

New but very slightly marked 'GLENBURN' BSR automatic record changer decks fitted with cueing lever, lightweight arm and ceramic Hi-Fi stereo/compatible cartridge. Can be used for automatic or manual play. PRICE £9·56 + £1·20 P. & P.

Open 9.30-5.30 Monday to Friday. 9.30-5 Saturday
Closed Wednesday.
Prices and specifications correct at time of press. Subject to alteration without notice

HARVERSON SURPLUS CO. LTD.

(Dept. P.E.) 170 HIGH ST., MERTON, LONDON, S.W.19 Tel.: 01-540 3985
A few minutes from South Wimbledon Tube Station
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.

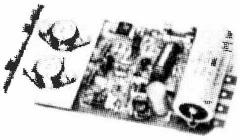
SAXON ENTERTAINMENTS LTD

A FULL RANGE OF PRINTED CIRCUIT MODULES FOR ALL P.A. & DISCO & GROUP APPLICATIONS

SYSTEM 7000 HAS IT!

A COMPLETE SELECTION OF READY TO USE PROFESSIONAL QUALITY AUDIO & LIGHTING EQUIPMENT

POWER AMPLIFIER MODULES 30—240 WATTS



- Fully tested & guaranteed.
- Full RMS Sine Wave output.
- Distortion typically 0·2%
- 10 Transistors, 4 Diodes.
- Response 30HZ-30KHZ
- Fully short & open circuit proof
- Sensitivity suits most mixers.
- Built-in surge suppression & compensation
- Twin D.C. & output fuses.
- Top-grade components throughout.

30 Watts rms	60 Watts rms		120 Watts rms		240W rms
SA308 30W rms/ 8 ohms **£9·50**	SA604 60W rms/ 4 ohms **£12·50**	SA608 60W rms/ 8 ohms **£13·50**	SA1204 120W rms/ 4 ohms **£14·50**	SA1208 120W rms/ 18 ohms **£21·00**	SA2404 240W rms/ 4 ohms **£25·50**

POWER SUPPLIES FOR THE ABOVE MODULES—READY WIRED & FUSED ON GLASS FIBRE PCB

PM301 For 1/2 SA308 **£9·90**	PM601/4 For 1/2 SA604 **£12·50**	PM601/8 For 1/2 SA608 **£12·50**	PM1201/4 For 1 SA1204 **£12·50**	PM1201/8 For 1 SA1208 **£12·50**	PM1202/4 For 2 SA1204 **£19·50**	PM1202/8 For 2 SA1208 **£19·50**	PM2404/1 For 1 SA2404 **£19·50**

DISCO MIXER MODULES Mono or Stereo (with Auto Fade)

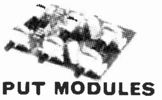
Printed circuit module assembled & tested with all components ready mounted.

Mono **£19·50** Stereo **£29·50**

* Front panel to suit **£3·50**

- Mixes two decks, tape and mic.
- Wide-range bass & treble controls on mic. & music channels.
- Variable autofade (mic. override)
- Ample headphone power.
- Needs only front panel* knobs and selector switch.
- Push-pull monitor circuit.
- 20HZ-20KHZ—Noise —77dB
- Comprehensive wiring details provided
- Perfect for incorporation in *your* system

ALL PURPOSE CUSTOM—MIXER MODULES (Mono or Stereo)



- Using these modules, mixers may be built to your specification up to 20 Channels, mono or stereo, or a combination of both. System 7000 custom-mixer modules have monitoring facilities too!

INPUT MODULES

- Accept low/high 2 mics, ceramic & magnetic cartridges, all musical instruments & line signals
- Low-noise circuitry—high grade components
- Wide-range bass & treble controls (23dB)
- 20HZ-30KHZ Noise —80dB
- Echo sound/return etc easily fitted

Mono—IM7001M
Stereo—IM7001S **£5·50**

MIXING MODULES

- Only one required per mixer track whether mono or stereo
- Feeds up to ten power modules
- Complete with ¼W monitor amplifier
- Accepts up to 20 input modules
- Will match any other make of amplifier

Mono—IM7002M
Stereo—IM7002S **£9·00**

Power supply for up to 20 modules—PPM18 **£8·50**

QUADRAFECT FOUR CHANNEL 4KW SEQUENCER WITH DIMMERS

NEW

A COMPLETE LIGHT SHOW!!

£29·50

* PANEL **£2·50**

THE ONLY MODULAR SOUND TO LIGHT UNIT WITH:

* Four integral dimmers.
* Two + Two sequencer
* Automatic audio level

- RCA 8A Triacs
- Sequence 0·5-20HZ
- I.C. circuitry
- Needs only front panel*
- Audio trigger 1-240W
- Fully suppressed
- Individual fuses
- Complete with speed Slider control

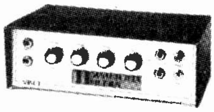
THREE CHANNEL 3KW SOUND/LITE—Low Cost—Superb Value

£16·50

* Panel **£2·50**

- Long-established Saxon design
- Individual level controls + master
- RCA 8A Triacs
- 1W-240W input
- Individual channel fuses
- Needs only front panel*

SYSTEM 7000 MINOTAUR 100—All Purpose Wide Range Amplifier



- 100W rms — 1dB
- Standard 8 ohm output
- Twin mixed inputs accept a wide range of signals
- 30HZ-30KHZ ±2dB
- 23dB bass/treble

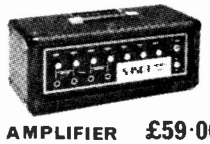
An extremely compact and versatile amplifier with full protection and a clean, attractive appearance. Ideal for all groups, disco's & clubs

£49·50

- Vynide covered case
- Fully short proof
- Superb value for money

A four input, high power amplifier which will deliver up to 150 watts output. An absolute must where multiple mixing & power are required

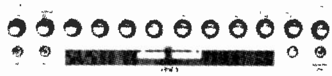
- Four individually mixed inputs
- Wide range bass/treble+master



SAXON 150 HEAVY DUTY AMPLIFIER £59·00

SYSTEM 7000 COMPLETE DISCO MIXERS (with Auto Fade)

*Ready to plug in & use
* Mono or Stereo



The choice of the professional D.J.

Controls: Mic. volume, bass, treble, A/fade depth, tape, L/deck r/deck vols., treble, bass, master, headphones vol., selector, left/right fader.

MONO 18V **£37·50** MONO MAINS **£43·50**

- Automatic mic. override
- Mixes two decks, tape & mic
- Facilities as for modular version opposite
- Mute positions on headphone selector for ease of monitoring
- Two tone stainless steel panel
- Sockets on front & rear panels
- Left/right deck fader
- May be operated from any power supply or from mains

Stereo 18V **£53·50**
Stereo Mains **£59·50**

SYSTEM 7000 COMPLETE CUSTOM MIXERS (Mono or Stereo)

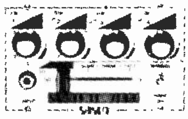
- Similar to the modules opposite these mixing modules are complete with front panels, sockets, knobs, monitor switch etc. Up to 20 channels (mono or stereo) may be incorporated in one system with any number of output tracks.

Ideal for the economical & quick assembly of a purpose built mixer with individual channel monitoring, and optional extra facilities—consult our technical dept. to discuss *your* needs.

- Stainless steel panels
- Built-in monitoring
- Will feed all amplifiers
- Professional appearance
- Accepts all types of signals
- Infinitely adaptable

Mono input module	**£8·50**
Stereo input module	**£12·00**
Mono mixing module	**£8·50**
Stereo mixing module	**£12·00**
Power supply	**£8·50**

SYSTEM 7000 LIGHTING CONTROL MK II



NEW

HAS YOUR SOUND TO LIGHT CONVERTER GOT:

- 4000W Handling
- Integral individual dimmers
- Automatic audio level control
- Two + Two sequence facility

OURS HAS! — PLUS:

- Stainless steel panel
- Heavy duty terminations
- Bondene case
- Matches System 7000 mixers

ALL YOUR ELECTRONIC LIGHTING NEEDS IN ONE SUPERBLY DESIGNED UNIT. **£42·50**

SAXON SOUND-LITE—An old design with improved appearance

- Scintillating performance
- Similar to Mk II lighting control in appearance
- 3KW power handling
- Individual bass, treble, middle & master controls
- 1-240W input
- Fully fused & isolated

Complete with heavy duty terminations

£24·75

EXPORTERS TO 17 COUNTRIES — ENQUIRIES WELCOMED — NATIONWIDE DISTRIBUTION BY NORMAN

BRANCHES AT CROYDON & WALLINGFORD

CUSTOMERS INCLUDE BBC, LONDON WEEKEND TV, SCOTTISH TELEVISION, NATIONAL TYRES, POST OFFICE, GOVT. DEPTS.

A READY-TO-USE 100W STEREO DISCO WITH BUILT-IN SOUND/LITE SEQUENCER AND LIGHTS FOR ONLY £199

THE CENTAUR

(Carr free in U.K.)

- 100W rms stereo output
- Twin heavy duty loudspeaker
- Four channel fully automatic sound-lite with variable speed sequence
- I.C. pre-amp with tape input & X fade
- Separate mic. & music treble and bass controls
- Attractive Vynide cabinets
- Twin BSR decks with autostop & lift arm

Incredible value for money—2/3 cost of separate parts!

- All connecting leads supplied—ready to plug in
- Loudspeakers have kick-proof grills
- Four colour built-in light display gives ever changing pattern with or without music

A READY-TO-USE 50W MONO DISCO COMPLETE WITH TWIN HEAVY DUTY LOUDSPEAKERS FOR ONLY £89·90

- 50W rms output
- Twin heavy duty loudspeakers
- Separate mic. input
- Wide range bass & treble controls
- Smart Vynide cases—clip together to form one neat package
- Twin BSR decks with lift & autostop
- Tremendous value—price includes leads just plug in & go!

Accessories for complete discos & other systems

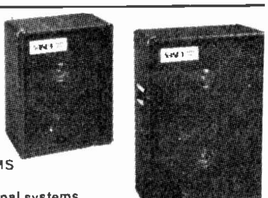
- Electret Condenser Mic ECM31 C/W windshield & clip £12·00
- ECM78—as above but duel impedance with removable lead £13·00
- Crown Stereo Headphones £6·75
- Heavy duty boom mic. stand £12·50

CUSTOM BUILT DISCOS

A full range of custom consoles are available using System 7000, from 50W mono to 500W stereo. Ask for our price list.

LOUDSPEAKER CABINETS

- Kick proof grills.
- Jointed construction
- Protective corners
- Heavy duty units
- Black Vynide finished.
- Smart & professional



Single Twelve: Empty £14
With 60W unit £33·00
Twin Twelve: Empty £24
With units from £59·00
Folded Horn—Full range P.A. Bin 100W RMS £120·00

This cabinet is 3–4 times as loud as conventional systems for a given input power—thus there is a saving in overall size & cost.

- Many other cabinets available—ask for details.

EMPTY DISCO CONSOLES

£19 with plain motorboard. £21 with cutouts.

- Black Vynide finish
- Protective corners
- With your choice of cutouts

STROBES & PROJECTORS (We stock the full Pluto range) Send for details

SUPERSTROBE £19·75

- 2–3 Joules
- 80W Tube for long life
- Compact 4" × 4" × 4"

PRO-STROBE £32·50

- 6–8 Joules
- External trigger
- Long Life tube timer circuit

150 WATT LIQUID WHEEL PROJECTOR

- Accepts all accessories
- C/w with wheel & motor plate
- Sturdy steel construction

Remarkable value—Sold elsewhere at £39·50. Our price is only: £31·50

Please add 8% VAT to all orders (12½% for SA308/PM301)
We accept Access & Barclaycard—simply telephone or send your card number—Do not send your card.

You may pay by cheque, crossed postal orders, cash (registered) or bank draft

To order—or for advice phone (01) 684 6385 or (01) 684 0098
Mail orders to: 327-333 Whitehorse Rd., Croydon, Surrey CR0 2HS
Shop open 9am–5pm Mon.–Sat. Mail order desk 10am–3pm Mon.–Fri.

Wallingford Branch: Flint House, High St., Wallingford, Oxon
(Callers only)
9am–5pm Mon.–Sat. Telephone (0491) 35529

ROSE ELECTRICAL TO BONA FIDE TRADE CUSTOMERS

Sparkrite mk2

Capacitive discharge electronic ignition kit

VOTED BEST OF 8 SYSTEMS TESTED BY 'POPULAR MOTORING' MAGAZINE

- * Smoother running
- * Instant all-weather starting
- * Continual peak performance
- * Longer coil/battery/plug life
- * Improved acceleration/top speeds
- * Up to 20% better fuel consumption

Sparkrite Mk. 2 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 15/30 mins.

Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

Ready drilled pressed steel case coated in matt black epoxy resin, ready drilled base and heat-sink, top quality 5 year guaranteed transformer and components, cables, coil connectors, printed circuit board, nuts, bolts, silicon grease, full instructions to make the kit negative or positive earth, and 10 page installation instructions.

OPTIONAL EXTRAS

Electronic/conventional ignition switch.
Gives instant changeover from "Sparkrite" ignition to conventional ignition for performance comparisons, static timing etc., and will also switch the ignition off completely as a security device, includes switch connectors, mounting bracket and instructions. Cables excluded.
Also available RPM limiting control for dashboard mounting (fitted in case on ready built unit).

CALLERS WELCOME. For Crypton tuning and fitting service – 'phone (0922) 33008.

PRICES INCLUDE VAT, POST AND PACKING.

Improve performance & economy NOW

POST TODAY!

Quick installation No engine modification required

Electronics Design Associates, Dept. PE2
82 Bath Street, Walsall, WS1 3DE. Phone: (0922) 33652

Name ....

Address ....

	QUANTITY REQ'D
Mk. 2 DIY Ass. Kit @ £11.80	
Mk. 2 Ready Built Negative Earth @ £14.97	
Mk. 2 Ready Built Positive Earth @ £14.97	
Ignition Changeover switches @ £4.30	
R.P.M. Limit systems in above units @ £2.42	

I enclose cheque/PO's for £ ____________

Cheque No.

Send SAE if brochure only required.

GOOD NEWS FROM

Connoisseur

THE NEW BD2/A

Based on the popular BD2, the new BD2/A offers the hi-fi enthusiast all the features usually associated with Connoisseur turntables, such as low rumble, wow and flutter, plus the addition of an automatic pick-up arm lift-off at the end of the record. This is achieved by an ingenious, though simple, electro-magnetic system, which avoids having any physical contact with the pick-up arm. It is possible, therefore, to use top quality cartridges, tracking at less than one gram, without putting any extra side pressure on the stylus.

The BD2/A comes either as a chassis model, or mounted on a slimline plinth, standing on rubber anti-vibration feet, finished in genuine American walnut, and fitted with a bronze, hinged dust cover. For those with restricted space, a compact plinth measuring only 13½" · 15½" · 5⅛" is still available.

Specification

Rumble - 65dB when measured in accordance with DIN 45539 using weighting network, referred to 7cm/sec. at 330Hz.

Wow and flutter Less than 0,1%.

Hum level - 80dB.

The BD2/A sells for a recommended price of only £55.00 + VAT. Ask your local hi-fi dealer, or write to the factory, for further details.

Connoisseur

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

CMOS WITH DISCOUNTS!

Any mix: Discount 10% for 25+, 25% for 100+, 33⅓% for 1,000+

C US 4 CMOS!

4000	0·20	4037	1·08	4075	0·24	14175	1·04	14528	1·22
4001	0·20	4038	1·20	4076	1·71	14194	1·17	14529	1·72
4002	0·20	4039	3·09	4077	0·65	14410	5·70	14530	0·95
4006	1·31	4040	1·10	4078	0·24	14411	0·54	14531	1·74
4007	0·20	4041	0·83	4081	0·24	14412	17·07	14532	1·39
4008	1·07	4042	0·83	4082	0·24	14415	7·35	14534	0·15
4009	0·60	4043	1·12	4085	0·80	14419	2·07	14536	4·00
4010	0·60	4044	1·04	4086	0·80	14422	4·90	14537	13·17
4011	0·20	4045	1·50	4089	1·74	14435	7·03	14539	1·24
4012	0·20	4046	1·40	4093	0·09	14440	11·50	14541	1·62
4013	0·60	4047	1·01	4094	2·00	14450	2·07	14543	1·82
4014	1·12	4048	0·60	4095	1·18	14451	2·07	14549	4·10
4015	1·12	4049	0·60	4096	1·18	14490	6·51	14552	10·50
4016	0·60	4050	0·60	4097	4·13	14501	0·20	14553	4·66
4017	1·12	4051	1·04	4098	1·22	14502	1·30	14554	1·67
4018	1·12	4052	1·04	4099	2·03	14503	0·75	14555	1·01
4019	0·60	4053	1·04	40101	1·76	14505	4·38	14556	1·01
4020	1·24	4054	1·28	40102	2·16	14506	8·57	14557	4·65
4021	1·12	4055	1·46	40103	2·16	14507	0·80	14558	1·25
4022	1·07	4056	1·46	40104	2·26	14508	3·08	14559	4·10
4023	0·20	4057	29·01	40107	0·60	14510	1·51	14560	2·17
4024	0·87	4059	6·20	40108	6·10	14511	1·74	14561	0·70
4025	0·20	4060	1·24	40109	2·21	14512	1·03	14562	5·59
4026	1·62	4061	25·60	40181	4·30	14514	3·47	14566	1·67
4027	0·60	4062	10·10	40182	1·73	14515	3·47	14568	3·15
4028	1·00	4063	1·22	40194	2·28	14516	1·51	14569	3·72
4029	1·27	4066	0·60	40257	2·26	14517	4·02	14572	0·27
4030	0·60	4067	4·13	4700	1·75	14518	1·30	14580	6·35
4031	2·46	4068	0·24	7083	4·25	14519	0·57	14581	4·30
4032	1·10	4069	0·24	14160	1·10	14520	1·30	14582	1·64
4033	1·55	4070	0·65	14161	1·18	14521	2·77	14583	0·84
4034	2·11	4071	0·24	14162	1·18	14522	2·15	14584	71p
4035	1·31	4072	0·24	14163	1·18	14526	2·15	14585	1·10
4036	3·00	4073	0·24	14174	1·08	14527	1·76		

'E' LED DISPLAYS

DL-704E 0·3"	70p
DL-707E 0·3"	70p
DL-728E 2 × 0·5"	£1·80
DL-727E 2 × 0·5"	£1·80
DL-750E 0·6"	£1·50
DL-747E 0·6"	£1·50

RED LEDS

0·1"	15p
0·2"	15p

CLOCK CHIPS

AY-5-1224A	£3·50
MK 50253	£5·50

SOLDERCON PINS

100	60p
1000	£4·00
2500	£8·75

DIL SOCKETS 8/14/16 PIN 15p

RED ACRYLIC FILTER
For L.E.D. displays
157 × 92 × 3mm 70p

PUSH SWITCHES
Type SW9 15p

OP-AMPS

CA 3130 (COS/MOS)	£1·00
CA 3140 (BIMOS)	95p
741 Minidip	25p
555 Timer	45p

Terms: C.W.O. Add VAT to all prices at 8%. Post, etc. U.K. 25p (+ 2p = 27p) per order. All orders processed same day. Official Govt., 'Varsity, Poly., etc. orders (written or telephoned) welcome.

GREENBANK ELECTRONICS (Dept. E2P)

94 New Chester Road, New Ferry, Wirral, Merseyside, L62 5AG, England
Tel: 051-645 3391

PHILIPS

YOU & PHILIPS HI-FI KITS

The top sellers for home assembly in Europe – now available in the U.K.

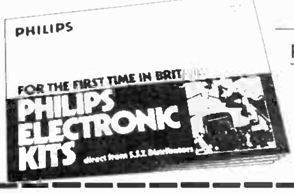
Now – read all about the Philips range of quality kits for home assembly – mixers, amplifiers, speakers, etc, etc. Send today to S.S.T. Distributors (Electronic Components) Ltd., West Road, Tottenham, London N17 0RN

Please send me, quickly, the new colour catalogue. PE21

Name

Address

Postcode



free SEND TODAY!

S.S.T. Distributors is a member of the Philips Group of Companies

P. F. RALFE

10 CHAPEL ST. LONDON NW1 Phone 01-723 8753

MUFFIN INSTRUMENT FANS
Dimensions 4·5in × 4·5in × 1·5in. Very quiet running, precision fan specially designed for cooling electronic equipment, amplifiers, etc. For 110V. a.c. operation (practice is to run from split primary of mains transformer or use suitable mains dropper). CC only 11 watts. List price over £10 each. Our price, in brand new condition, is **£4·86.**

500 V TRANSISTORISED INSULATION TESTERS
Small size, lightweight. 13 × 7 × 4cm. Reads insulation from 0·2 to 100MΩ. Brand new, only **£17·28. P. & P. 22p.**

HELIPOT TURNS COUNTER
Beckman "Duodial" counting dials. Miniature type (22mm dia.). Counting up to 15 turns. Brand new, complete with mounting instructions. **£2·70.**

BRIDGE RECTIFIERS
Encapsulated silicon type. Ex-equipment, Texas, ITT. 200 PIV, 12A, **£2·70**; 400 PIV, 4A, **£1·35.** Postage 10p.

ADVANCE R.F. SIGNAL GENERATORS

E2 100kHz–100MHz	£37·80
Q1 7·5–250MHz	£37·80
62 100kHz–220MHz	£43·20
P1 100kHz–100MHz	£37·80
SG63A 7·5–230, AM/FM	£81

Tested and guaranteed. Carriage on the above, £2 extra.

SWISS HOUR METERS
National Watch Co. 110V 50Hz. 5 digits. Size approx. 5 × 3·5 × 2·5cm. Digit height 3mm. Brand new. **£1·62. P. & P. 10p.**

MARCONI R.C. OSCILLATORS TF1101
20Hz–200kHz signal generators. Distortion 0·5% or with filter 0·1%. 60dB step attenuator. Continuously variable output up to 20V. Metered o/p. 250V mains operation. In first class condition and guaranteed, **£81.**

EDDYSTONE DIALS 898
Horizontal slide rule tuning dials type 898. Complete. Tuning knob, un-marked scale plate, flywheel, pointer, etc. Brand new in boxes with cutting template. List price is over £15. OUR PRICE ONLY **£9·18. P. & P. 32p.**

AVO MULTIMETERS
Multiminor type Mk. 4. Small, light-weight instrument. 14 × 9 × 3½cm. Measures V. a.c./d.c. to 1kV. d.c. I. from 0·1mA to 1A. Resistance ranges 10kΩ/V d.c. and 1kΩ/V a.c. Tested and in good condition. Price only **£9·18.** P. & P. 32p.

HELICAL POTENTIOMETERS
Helipot 45 × 50mm, 10 turns, 30kΩ, **£1·62.** Beckman 33 × 17mm, 360°, 10kΩ, **£1·62.** Reliance 20 × 50mm, 10 turns, 5kΩ, **£1·62.** Beckman double-gang, 360°, 1kΩ, **£1·62.** Beckman 22 × 37mm, 10 turns, 1kΩ, **£2·16.** Beckman 22 × 37mm, 10 turns, 500Ω, **£1·62.** Reliance 12 × 40mm, 10 turns, 500Ω, **£1·62.** Colvern 45 × 35mm, 3 turns, 250Ω, **£1·62.** Colvern 45 × 35mm, 3 turns, 20Ω, **£1·62.** All brand new and guaranteed. Please add 10p each for postage.

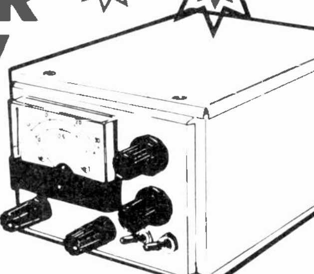
PRICES QUOTED INCLUDE VAT. USUAL DESPATCH TIME FOR MAIL ORDERS IS 1-3 DAYS. WE URGENTLY REQUIRE FOR STOCK QUALITY USED TEST EQUIPMENT. PLEASE CALL US AT THE ABOVE NUMBER

Doram kits

DORAM KITS CONTAIN EVERYTHING DOWN TO THE LAST NUT

POWER SUPPLY

Subject to availability



£19·95 +S

An invaluable piece of equipment for the enthusiasts workshop. This 3-30V d.c. power supply fulfils virtually all experimentation requirements. Avoid frustration and circuit damage with the variable current limit (0·1A max).
Regulation typically better than 0·5% (max 3%).
Ripple voltage typically better than 20mV (max 120mV).
Only £19·95+S (order code 997-027).

O'seas orders—add 15% for P + P. All items offered for sale subject to the Terms of Business as set out in Doram Edition 3 catalogue, price 60p. The Doram Kit brochure is also available, price 25p. Combined price only 70p which also entitles you to 2 × 25p vouchers, each one usable on any order placed to the vvalue of £5·00 or more (ex. VAT).

DORAM ELECTRONICS LTD
P.O. Box TR8, Wellington Road Industrial Estate, Leeds LS12 2UF.
An Electrocomponents Group Company

RST VALVE MAIL ORDER CO.

Climax House
159 Fallsbrook Road, London SW16 6ED
SPECIAL EXPRESS MAIL ORDER SERVICE

	£p
1N21	0·75
1N23	0·35
1N85	0·88
1N253	0·50
1N256	0·50
1N645	0·16
1N725A	0·20
1N914	0·06
1N4007	0·11
1S113	0·30
1S202	0·23
2G371	1·00
2G381	0·22
2G414	0·30
2G417	0·25
2N404	0·40
2N697	0·17
2N698	0·30
2N706	0·12
2N706A	0·12
2N708	0·15
2N709	0·40
2N1091	0·55
2N1131	0·23
2N1132	0·25
2N1302	0·30
2N1303	0·40
2N1304	0·45
2N1305	0·45
2N1306	0·50
2N1307	0·50
2N1308	0·50
2N2147	1·20
2N2148	1·20
2N2160	0·75
2N2218	0·25
2N2219	0·25
2N2369A	0·25
2N2444	1·99
2N2613	1·00
2N2646	0·50
2N2904	0·25
2N2906	0·22
2N2907	0·25
2N2924	0·16
2N2925	0·15
2N2926	0·15
2N3054	0·55
2N3055	0·60
2N3702	0·13
2N3705	0·13
2N3706	0·13
2N3707	0·13
2N3709	0·12
2N3710	0·13
2N3711	0·13
2N3819	0·37
2N4289	0·30
2N5027	0·53
2N5088	0·33
2S301	0·75
2S304	1·35
2S501	0·75
2S703	1·50
40250	0·54
40251	0·81
AA129	0·15
AAZ12	0·75
AAZ13	0·18
AAZ17	0·16
AC107	0·75
AC126	0·25
AC127	0·25
AC128	0·22
AC187	0·25
AC188	0·25
ACY17	0·55
ACY18	0·55
ACY19	0·55
ACY20	0·55
ACY21	0·55
ACY22	0·35
ACY27	0·35
ACY28	0·25
ACY39	1·00
ACY40	0·55
ACY41	0·55
ACY44	0·32
AD140	0·65
AD149	0·65
AD161	0·45
AD162	0·45
AF106	0·35
AF114	0·25
AF115	0·25
AF116	0·25
AF117	0·25
AF118	0·75
AF119	0·20
AF124	0·30
AF125	0·30
AF126	0·30
AF127	0·30
AF139	0·40
AF178	0·55
AF179	0·65
AF180	1·50

	£p
AF181	0·50
AF186	1·60
AFZ11	2·50
AFZ12	2·50
ASY26	0·40
ASY29	0·45
ASY36	0·25
ASY50	0·30
ASY51	0·40
ASY55	0·20
ASY55	0·20
ASY62	0·25
ASY66	0·33
ASZ21	1·00
ASZ25	0·75
AU104	1·00
AUY10	1·50
BC107	0·14
BC108	0·14
BC109	0·15
BC113	0·15
BC115	0·20
BC116	0·20
BC116A	0·23
BC118	0·20
BC121	0·20
BC122	0·20
BC125	0·25
BC126	0·25
BC140	0·55
BC147	0·10
BC148	0·08
BC149	0·10
BC157	0·12
BC158	0·10
BC160	0·63
BC169	0·15
BCY31	0·80
BCY32	1·00
BCY33	0·70
BCY34	0·75
BCY38	1·25
BCY39	1·50
BCY40	1·25
BCY42	0·30
BCY70	0·18
BCY71	0·22
BCZ10	0·60
BD121	1·55
BD123	1·50
BD124	0·75
BDY11	1·45
BF115	0·20
BF167	0·20
BF173	0·25
BF181	0·30
BF184	0·30
BF185	0·30
BF194	0·10
BF195	0·10
BF196	0·12
BF197	0·12
BF861	0·25
BF898	0·25
BFX12	0·35
BFX13	0·35
BFX29	0·28
BFX30	0·28
BFX35	0·98
BFX63	0·50
BFX84	0·24
BFX85	0·28
BFX86	0·25
BFX87	0·25
BFX88	0·25
BFY10	0·50
BFY11	0·50
BFY17	0·40
BFY18	0·50
BFY19	0·50
BFY24	0·45
BFY44	1·00
BFY50	0·21
BFY51	0·21
BFY52	0·23
BFY53	0·23
BFY64	0·45
BFY90	0·81
BR100	0·40
BSX27	0·28
BSX60	0·93
BSX76	0·20
BSY26	0·25
BSY27	0·23
BSY51	0·50
BSY95A	0·20
BSY95	0·20
BTY42	0·92
BY100	0·45
BY126	0·12
BY127	0·12
BY182	0·85

	£p
BY213	0·25
BYZ10	0·45
BYZ11	0·45
BYZ12	0·40
BYZ13	0·42
BYZ15	1·85
BYZ16	0·60
BZY88	0·10
C111	0·55
CRS1/05	0·45
CRS1/40	0·60
CS4B	1·90
CS10B	3·50
DD000	0·15
DD003	0·15
DD006	0·25
DD007	0·40
DD008	0·38
GD3	0·38
GD4	0·10
GD8	0·25
GD12	0·10
GET102	0·50
GET103	0·85
GET113	0·85
GET114	0·95
GET115	1·50
GET116	1·50
GET120	0·50
GET872	0·30
GET875	1·00
GET880	1·00
GET881	0·25
GET882	1·00
GET885	0·95
GEX44	0·08
GEX45,1	0·55
GEX941	0·45
GJ3M	0·65
GJ4M	0·65
GJ5M	0·65
GJ7M	0·65
HG1005	0·50
HS100A	0·40
MAT120	0·20
MAT121	0·25
MJE340	0·42
MJE520	0·60
MJE2955	1·25
MJE3055	0·75
MPF102	0·40
MPF103	0·40
MPF104	0·40
MPF105	0·40
NE555	0·42
NKT128	0·45
NKT129	0·80
NKT211	0·45
NKT213	0·25
NKT214	0·50
NKT216	0·60
NKT218	0·45
NKT219	0·33
NKT222	0·50
NKT224	0·25
NKT251	0·24
NKT271	0·20
NKT272	0·20
NKT273	0·20
NKT275	0·25
NKT277	0·20
NKT278	1·00
NKT301	1·25
NKT304	1·00
NKT403	1·00
NKT404	1·25
NKT678	0·30
NKT7[illegible]3	0·30
NKT773	0·25
NKT777	0·38
OA5	0·75
OA6	0·55
OA47	0·10
OA70	0·15
OA71	0·20
OA73	0·15
OA74	0·15
OA79	0·12
OA81	0·15
OA85	0·18
OA86	0·15
OA90	0·07
OA91	0·07
OA95	0·08
OA200	0·10
OA202	0·10
OA210	0·20
OA211	0·35
OAZ200	0·65
OAZ201	0·65
OAZ202	0·65
OAZ203	0·65

	£p
OAZ204	0·65
OAZ205	0·45
OAZ206	0·65
OAZ207	0·65
OAZ208	0·40
OAZ209	0·40
OAZ210	0·65
OAZ211	0·65
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	1·25
OC16T	1·00
OC22	2·00
OC23	2·25
OC24	2·25
OC25	0·65
OC26	0·60
OC28	0·75
OC29	0·75
OC30	0·40
OC35	0·75
OC36	0·75
OC41	0·45
OC42	0·50
OC43	1·00
OC44	0·45
OC44M	0·17
OC45	0·45
OC45M	0·18
OC46	0·27
OC57	0·60
OC58	0·60
OC59	0·60
OC66	0·50
OC70	0·35
OC71	0·25
OC72	0·45
OC73	0·75
OC74	0·45
OC75	0·50
OC76	0·45
OC77	0·75
OC78	0·45
OC79	0·45
OC81	0·50
OC81M	0·20
OC81DM	0·18
OC81Z	1·00
OC82	0·75
OC82D	0·25
OC83	0·55
OC84	0·45
OC114	0·38
OC122	1·35
OC123	1·55
OC139	1·10
OC140	1·50
OC141	1·50
OC169	0·20
OC170	0·50
OC171	0·50
OC200	1·00
OC201	1·75
OC202	1·50
OC203	1·50
OC204	1·50
OC205	1·75
OC206	1·50
OC207	1·00
OC460	0·20
OC470	0·30
OCP71	1·25
ORP12	0·60
ORP60	0·65
ORP61	0·65
SX68	1·50
SX631	1·25
SX635	0·55
SX640	1·50
SX641	0·75
SX642	1·50
SX644	0·85
SX645	0·85
TIC44	0·30
V15/30P	1·50
V30/201P	1·50
V60/201	0·50
V60/201P	1·50
XA101	0·10
XA102	0·18
XA151	0·15
XA152	0·15
XA161	0·25
XA162	0·25
XB101	0·48
XB102	0·30
XB103	0·35
XB113	0·30

	£p
XB121	0·43
ZS170	0·10
ZS271	0·20
ZT21	0·25
ZT43	0·25
ZTX107	0·10
ZTX108	0·10
ZTX300	0·12
ZTX304	0·22
ZTX500	0·12
ZTX503	0·16
ZTX531	0·25
INTEGRATED CIRCUITS	
7400	0·16
7401	0·16
7402	0·16
7403	0·16
7404	0·26
7405	0·22
7406	0·42
7407	0·42
7408	0·28
7409	0·28
7410	0·16
7411	0·25
7412	0·30
7413	0·36
7416	0·36
7417	0·36
7420	0·16
7422	0·25
7423	0·87
7425	0·87
7427	0·87
7428	0·40
7430	0·16
7432	0·87
7433	0·87
7437	0·37
7438	0·37
7440	0·22
7441AN	0·92
7442	0·79
7450	0·16
7451	0·16
7453	0·16
7454	0·16
7460	0·16
7470	0·36
7472	0·38
7473	0·41
7474	0·42
7475	0·59
7476	0·45
7480	0·60
7482	0·87
7483	1·10
7484	1·00
7486	0·47
7490	0·55
7491AN	1·00
7492	0·70
7493	0·70
7494	0·80
7495	0·80
7496	0·95
7497	3·87
74100	1·89
74107	0·45
74110	0·58
74111	0·86
74118	0·90
74119	1·68
74121	0·50
74122	0·70
74123	1·00
74141	0·90
74145	1·26
74150	1·75
74151	1·00
74154	2·00
74155	1·00
74156	1·00
74157	0·95
74170	2·52
74174	1·57
74175	1·10
74176	1·26
74190	2·00
74191	2·00
74192	2·00
74193	2·00
74194	1·30
74195	1·10
74196	1·20
74197	1·20
74198	2·77
74199	2·52

Plug in sockets —low profile
8 pin DIL 0·12
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 Saturday
Terms C.W.O. only • Tel. 01-677 2424-7
Quotations for any types not listed.
Post and Packing 15p per order.
V.A.T. to be added. Plastic Transistors 12½%. Metal Can Transistors 8%. Integrated Circuits 8%.

Prices correct when going to press.

GIRO NO 331 7056 Access and Barclay card accepted
C.W.O. only Terms of business as in our Catalogue
Export Order enquiries welcome (£5 min.)

Official Orders accepted from Educational and Government Departments
ALL PRICES include VAT and P. & P.
E & O E
SHOP HOURS 9-12.30, 1.30-5.00 5 DAYS
CLOSED WEDNESDAY

1977 ISSUE 66 PAGES—3,000 ITEMS
FULLY ILLUSTRATED
*20p CREDIT VOUCHERS
*ALL NEW STOCK
*SATISFACTION GUARANTEED
*DISCOUNTS

Boxes — Cases — Kits — PC Materials — Tools — Resistors — Test Meters — Capacitors — Hardware — Semiconductors — Books — Pots — Coils —Audio Accessories — Screws Connectors — Audio — Modules —Veroboard — Transformers— Knobs — Calculators — Audio Leads —Batteries — S dec Storage Units — Heatsinks, etc., etc.

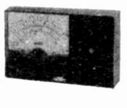
SPECIAL CAPACITOR KITS

C280 Kit—PC Mounting polyester 250V 5 of each value: 0·01, 0·022, 0·047, 0·1, 0·22µF, 2 of 0·47, 1µF, **£1·81 net**.
C296 Kit—Tubular polyester, 400V, 5 of each value 0·01, 0·022, 0·047, 0·1, 0·22µF, 2 of 0·47µF, **£2·43 net**.
Ceramic Kit—square plaque, 50V 5 of each value, 22, 33, 47, 100, 220, 330, 470, 1000pF, 220, 4700pF, 0·01µF, **£1·71 net**.

SPECIAL RESISTOR KITS (CARBON FILM 5%) (Prices include post & packing) 10E12 ¼W or ½W KIT: 10 of each E12 value, 22 ohms—1M, a total of 570 **£5·04 net**
25E12 ¼W or ½W KIT: 25 of each E12 value, 22ohms—1M, a total of 1425 **£11·70 net**

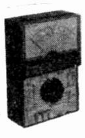
B. H. COMPONENT FACTORS LTD.

MULTIMETER U4323



22 Ranges plus AF/IF Oscillator 20,000Ω/Volt.
Vdc—0·5—1000V in 7 ranges
Vac—2·5—1000V in 6 ranges
Idc—0·05—500mA in 5 ranges
Resistance—5Ω—1MΩ in 4 ranges.
Accuracy—5% of F.S.D.
OSCILLATOR—1KHz and 465KHz (A.M.) at approx. 1 Volt.
Size—160 × 97 × 40mm.
Supplied complete with carrying case, test leads and battery.
PRICE **£13·96 net** U4323

MULTIMETER U4324



34 Ranges. High sensitivity.
20,000Ω/Volt.
Vdc—0·6—1200V in 9 ranges.
Vac—3—900V in 8 ranges.
Idc—0·06—3A in 6 ranges.
Iac—0·3—3A in 5 ranges.
Resistance—25Ω—5MΩ in 5 ranges.
Accuracy—dc and R—2½% of F.S.D.
ac and db—4% of F.S.D.
Size—167 × 98 × 63mm.
Supplied complete with storage case, test leads, spare diode and battery
PRICE **£16·66 net** U4324

MULTIMETER U4341

27 Ranges plus Transistor Tester.
16,700Ω/Volt.
Vdc—0·3—900V in 8 ranges.
Vac—1·5—750V in 6 ranges.
Idc—0·06—600mA in 5 ranges.
Iac—0·3—300mA in 4 ranges.
Resistance—2KΩ—2MΩ in 4 ranges. Accuracy—dc—2½%. ac—4% of F.S.D.
jfe—10—350 in 2 ranges.
Size—115 × 215 × 90mm.
Complete with carrying case, test leads, and battery.
PRICE **£16·66 net** U4341

MULTIMETER U4313

33 ranges. Knife edge with mirror scale.
20,000Ω/Volt. High accuracy, mVdc—75mV.
Vdc—1·5—600V in 9 ranges.
Vac—1·5—600V in 9 ranges.
Idc—60—120 microamps in 2.
Idc—0·6—1500mA in 6 ranges.
Iac—0·6—1500mA in 6 ranges.
Resistance—1KΩ—1MΩ in 4 ranges.
db scale—10 to + 12db.
Accuracy—dc—1½%, ac—2½%.
Size—115 × 215 × 90mm.
Complete with carrying case, test leads, and battery.
PRICE **£19·90 net** U4313

(P.E.), LEIGHTON ELECTRONICS CENTRE, 59 NORTH STREET, LEIGHTON BUZZARD, LU7 7EG.
Tel.: Leighton Buzzard 2316 (Std. Code 05253)

INTERLOCKING PLASTIC STORAGE DRAWERS

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. 1D and 2D have space dividers. Build up any size cabinet for wall, bench or table top.

As supplied to Post Office, Industry and Government Depts.

SINGLE UNITS (1D) (5in × 2½in × 2½in). **£2·50** DOZEN.
DOUBLE UNITS (2D) (5in × 4½in × 2½in). **£4·40** DOZEN.
TREBLE (3D) £4·20 for 8.
DOUBLE TREBLE 2 drawers, in one outer case **(6D2), £6·50** for 8.
EXTRA LARGE SIZE (6D1) £5·50 for 8.

PLUS QUANTITY DISCOUNTS
Orders over £20, less 5%.
Orders over £60, less 7½%.

PACKING/POSTAGE/CARRIAGE: Add 75p to all orders under £10. Orders £10 and over, please add 10% carriage.
QUOTATIONS FOR LARGER QUANTITIES
Please add 8% V.A.T. to total remittance
All prices correct at time of going to press

FLAIRLINE SUPPLIES
(Dept. PE2)
124 Cricklewood Broadway, London NW2
Tel. 01-450 4844

CLEARANCE OFFER
At virtually cost price

INSTAR 103P LIQUID CRYSTAL DISPLAY WATCHES. As previously advertised ONLY £17·50 to clear

NEW FROM AMERICA
Liquid Crystal Display Watches from Fairchild Timeband

5+4 functions. Continuous read-out of hrs., mins. and pulsating secs. Single command button, push once for month/date (auto reset), twice for secs. (manual reset).
PLUS Programmed 4-year calendar, backlight for night viewing, optional continuously alternating time/date display, a.m./p.m. setting indicator.
High contrast L.C.D. display visible in bright sunlight. Supplied in Presentation Boxes, these are superb watches selling in jewellers' shops for up to £80.

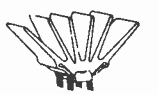
TC 411 White **£29·50**
TC 410 Gold **£32·50**
On Leather Strap
TC 413 White **£34·50**
TC 412 Gold **£37·50**
Matching adjustable bracelet.

No moving parts to wear out, clean or oil. Accuracy to a few secs./month. We believe our prices are the lowest anywhere and include VAT at 8% and P. & P. Free battery(s). No quibble 1 Year Guarantee.
Send Cheque/Money Order to:

TEMPUS
Dept. P.E., 5–7 Norfolk Street Cambridge CB1 2LD.
A Lot of Time for the Money

PRINTED CIRCUIT KIT £4·25*
Make your own printed circuits. Contains etching dish, 100sq.in of pc board, 1lb ferric chloride, dalo pen, drill bit, laminate cutter.

JC12 AMPLIFIER



6W IC audio amp with free data and printed circuit. **£2·25***

DELUXE KIT FOR JC12
Contains extra parts except JC12 needed to complete the amp including balance, volume, bass and treble controls. Mono **£2·33**. Stereo **£4·95**.

JC12 POWER KIT
Supplies 25V 1A **£3·75**.

JC12 PREAMP KITS
Type 1 for magnetic pickups, mics and tuners. Mono **£1·50**. Stereo **£3**. Type 2 for ceramic or crystal pickups. Mono **88p**. Stereo **£1·76**.

SINCLAIR IC20
IC20 10W + 10W stereo integrated circuit amplifier kit with free printed circuit + data **£4·95**.
PZ20 Power supply kit for above **£3·95**.
VP20 Volume, tone-control and preamp kit **£7·95**.

JC40 AMPLIFIER
New integrated circuit 20W amplifier kit complete with chip, printed circuit and data **£4·45**.

FERRANTI ZN414
IC radio chip **£1·44**. Extra parts and pcb for radio **£3·85**. Case **£1**. Send S.A.E. for free data.

BATTERY ELIMINATOR BARGAINS

MILLENIA KITS*
5 transistor highly stabilized power units. Switched 1–30V in 0 1V steps. Send S.A.E. for free leaflet. 1 amp kit **£12·45**. 2 amp kit **£14·95**. Case **£2·95** extra.

RADIO MODELS
50mA with press-stud battery connectors. 9V **£3·45**. 6V **£3·45**. 9V + 9V **£5·45**. 6V + 6V **£5·45**. 4½V + 4½V **£5·45**.

CASSETTE MAINS UNITS
7½V with 5 pin din plug. 150mA **£3·95**.

3-WAY MODELS*
With switched output and 4-way multi-jack connector. Type 1: 3/4½/6V at 100mA **£3·20**. Type 2: 6/7½/9V at 150mA **£3·30**.

FULLY STABILIZED MODEL £5·45*
Switched output of 3/6/7½/9V stabilised at 400mA

CAR CONVERTORS £5·10*
Input 12V d.c. Output 6/7½/9V d.c. 1A stabilized.

BATTERY ELIMINATOR KITS
Send S.A.E. for free leaflet on range.
100mA radio types with press-stud battery terminals. 4½V **£2·10**. 6V **£2·10**. 9V **£2·10**. 4½V + 4½V **£2·80**. 6V + 6V **£2·80**. 9V + 9V **£2·80**.
100mA cassette type 7½V with 5 pin din plug **£2·10**.
Transistor stabilized 8-way type for low hum. 3/4½/6/7½/9/12/15/18V. 100mA **£3·50**. 1A **£6·50**.
Heavy duty 13-way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42V. 1A model **£4·95**. 2A model **£7·95**.
Car convertor kit Input 12V d.c. Output 6/7½/9V d.c. 1A transistor stabilized **£1·95**.

MAINS TRANSFORMERS
6–0–6V 100mA **£1**. 9–0–9V 75mA **£1**. 18V 1A **£1·95**. 0/12/15/20/24/30V 1A **£4·30**. 12–0–12V 50mA **£1**. 0/12/15/20/24/30V 2A **£5·95**. 20V 2½A **£2·95**. 6–0–6V 1½A **£2·85**. 9–0–9V 1A **£2·55**. 12–0–12V 1A **£2·95**. 15–0–15V 1A **£3·20**. 30–0–30V 1A **£4·10**.

S-DECS AND T-DECS*

S-DeC **£2·24**.
T-DeC **£4·05**.
µ-DeCA **£4·45**.
µ-DeCB **£7·85**.
IC carriers with sockets 16 dil **£2·05**. 10TO5 **£1·95**.

SINCLAIR CALCULATORS AND WATCHES
Cambridge Memory **£5·95**. Cambridge Scientific **£8·95**. Oxford Sci. **£13·30**. Programmable Scientific with free mains unit **£19·95**. Mains adaptors for other models (state type) **£3·20**. Assembled Grey Watch with free stainless steel bracelet **£16·45**. White watch **13·95**.

SINCLAIR PROJECT 80 AUDIO MODULES
PZ5 **£4·95**. PZ6 **£8·70**. Z40 **£5·75**. Project 805Q **£18·95**.

BI-PAK AUDIO MODULES
S450 tuner **£20·95**. AL60 **£4·60**. PA100 **£13·95**. MK60 audio kit **£30·60**. Teak 60 **£13·95**. Stereo 30 **£16·95**. SPM80 **£4·25**. BMT80 **£3·70**. Send S.A.E. for free data.

SAXON ENTERTAINMENTS MODULES
SA1208 **£20·50**. SA1204 **£19**. SA608 **£13**. SA604 **£12**. PM1201/8 **£12**. PM1202/8 **£19**. PM1201/4 **£12**. PM1202/4 **£19**. PM601/8 **£12**. PM601/4 **£12**.

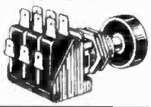
SWANLEY ELECTRONICS
No Callers—Mail order only
Dept. PE, PO BOX 68, 32 Goldsel Rd., Swanley, Kent
Send S.A.E. for free leaflets on all kits. Post 30p on orders under £2·23, otherwise free. Prices include VAT. Overseas customers deduct 7% on items marked *, otherwise 11%. Official orders welcome.

RELAYS SIEMENS, PLESSEY, Etc. MINIATURE RELAYS

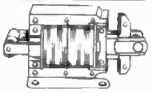
RELAYS. WIDE RANGE OF A.C. and D.C. RELAYS AVAILABLE from stock, phone or write in your enquiries.

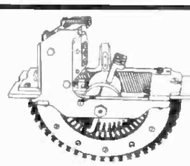
GENTS' 4in ALARM BELL.

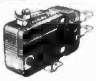
3-4½V d.c.
Price **£4·50.** P. & P. 50p.

HONEYWELL PUSH BUTTON PANEL MOUNTING MICRO SWITCH ASSEMBLY.

Each bank comprises of a changeover rated at 10 Amp. 250V a.c. Black knob 1in dia. fixing hole ⅜in. Prices: One bank **40p.** Two bank **50p.** Three bank **60p.** Min. order 5 pieces. P. & P. 50p.

21 WAY SELECTOR SWITCH WITH RESET COIL. The ingenious electro mechanical device can be switched up to 21 positions and can be reset from any position, energising the reset coil. 230/240V a.c. operation. Unit is mounted on strong chassis, complete with cover. Price £5·50. P. & P. 75p.

NEW HEAVY DUTY SOLENOID. mfg. by Magnetic Devices. 240V a.c. operation approx. 20lb pull at 1·25in. Price **£7.** P. & P. 75p.


UNISELECTOR SWITCHES

4 bank, 25 way 75 ohm. Coil, 36–48V d.c. operation. Ex. **New** equipment **£4·25**, P. & P. 75p. Total price inc. VAT **£5·40.**

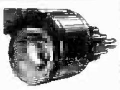
MINIATURE C/O ROLLER MICRO SWITCH

OMRON Type V15 FL22/IC. 10 for **£2.** Post 50p. (Min. order 10).
Sub miniature Burgess Button Type V.4.T.1. 10 for **£2·50.** 50 for **£10.** Post paid.
BF LEVER OPERATED 20 amp. C/O. Mfg. by Unimax USA, 10 for **£4,** P. & P. 50p (min. order 10).

MINIATURE UNISELECTOR
12 volt 11-way, 4 bank (3 non-bridging, 1 homing), **£2·50,** p.p. 35p.

24 VOLT DC SOLENOIDS
UNIT containing 1 heavy duty solenoid approx. 25lb pull 1 inch travel. Two × approx. 1lb pull ¼ inch travel. 6 × approx. 4oz. pull ¼ inch travel. One 24 volt d.c., 1 heavy duty single make relay. Price **£3·00.** Post £1. **ABSOLUTE BARGAIN.**

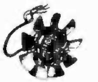
600 WATT DIMMER SWITCH

Easily fitted. Fully guaranteed by makers. Will control up to 600W of lighting except fluorescent at mains voltage. Complete with simple instructions. **£3·65.** Post 25p.
1,000 watt model, **£5·60.** Post 25p.
2,000 watt model, **£9·75.** Post 40p.

CENTRIFUGAL BLOWER

Mfg by Smiths Industries. 230/240V a.c. Miniature Model. Series SE/200. Size 95mm × 82mm × 82mm. Aperture 38mm × 31mm. 12 c.f.m., **£2·75.** Post 50p.
Mfg. by Fracmo 115/230V a.c. 2800/3400 r.p.m. Fan type aperture 3" × 2½" VBL4 25/L. Price **£12.** Post £1.

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. **500V,** 500 megohms, **£40.** Post 80p. 1,000V, 1,000MΩ, **£46.** Post 80p.

BLOWER UNIT

200/240V a.c. precision German built. Dynamically balanced, quiet, con rated, reversible. Consumption 60mA. Size 120mm dia. × 60mm deep. Price £3·50. Post 50p.

All Mail Orders—Callers—Ample Parking
Dept. PE11, 57 BRIDGMAN ROAD CHISWICK, LONDON W4 5BB
Phone 01-995 1560
Showroom open Mon.-Fri.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0–260V All Types
SHROUDED TYPE

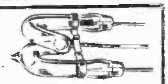
200 watt (1 amp) inc. AC voltmeter **£11·50**
0·5 KVA (2½ amp) (MAX) **£11·50**
1 KVA (5 amp) (MAX) **£18·00**
2 KVA (10 amp) (MAX) **£30·00**
3 KVA (15 amp) (MAX) **£38·00**
4 KVA (20 amp) (MAX) **£60·00**
CARRIAGE AND PACKING EXTRA

L.T. TRANSFORMERS
0, 10, 17, 18 Volt at 10 amp. **£10·45.** Post £1·00
0, 4, 6, 24, 32 Volt at 12 amp. **£13·00.** Post £1·00
0, 6, 12 Volt at 20 amp. **£11·85.** Post £1·00
0, 12, 24 Volt at 10 amp. **£12·35.** Post £1·00
0, 6, 12, 17, 18, 20 Volt at 20 amp. **£14·15.** Post £1·00
Other types to order at short notice—Phone your enquiries.

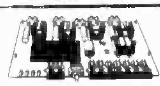
AUTO TRANSFORMERS
Step up, step down, 0-115/200/220/240 volts at 75 watt **£3·60.** Post 40p. 150 watt **£5·15.** Post 50p. 300 watt **£7·45.** Post 60p. 500 watt **£11·00.** Post 75p. 1000 watt **£16·20.** Post 90p.

STROBE! STROBE! STROBE!

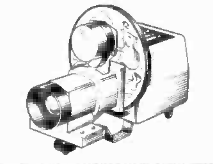
HY-LIGHT STROBE MK IV
Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation. For use in large rooms, halls and utilises a silica tube, printed circuit. Speed adjustable 0-20 f.p.s. Light output greater than many (so called 4 Joule) strobes **£15·40.** Post 75p. Specially designed case and reflector **£8·25.** P. & P. £1. Super high light approx. 4 times more output. S.A.E. for leaflet.

XENON FLASHGUN TUBES

Range available from stock. S.A.E. for details.

ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES
4ft 40 watt, £6·00 (callers only).
2ft 20 watt, £4·60. Post 60p. (For use in standard bi-pin). MINI. **12in 8 watt, £1·75.** Post 25p. **9in 6 watt, £1·40.** Post 25p. **6in 4 watt, £1·40.** Post 25p. Complete ballast unit and holders for 9in and 12in tube, **£2·50.** Post 30p. (9in and 12in measures approx.)

SQUAD LIGHT

A new conception in light control. Four channels each capable of handling 750 watts of spot lights, flood lights or dozens of small mains lamps. Seven programs all speed controlled plus flash modulation, effectively giving 14 different displays. Makes sound-to-light obsolete. Completely electrically and mechanically noise free. Price only **£60.** Post 75p. S.A.E. (Foolscap) for further details.

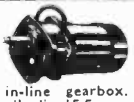
WIDE RANGE OF DISCO LIGHTING EQUIPMENT
S.A.E. (Foolscap) for details.

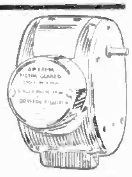
COLOUR WHEEL PROJECTOR TYPE P150 INTACHANGE

200/240V a.c. 50Hz 150W lamp, complete with oil filled colour wheel and motor plate. Takes intachange accessories and full range of lenses. **£29·95.** Post £1·35. (Total inc. VAT & Post, **£33·70.**)

BIG BLACK LIGHT
400W Mercury Vapor Ultra Violet Lamp. Powerful source of UV P.F. ballast unit is essential with this lamp. Price of bulb and matched ballast unit. **£28.** Post £2. Spare bulb only **£10.** Post 80p.

VAT
AT CURRENT RATE MUST BE ADDED TO ALL ORDERS FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE UNLESS OTHERWISE STATED.

SERVICE TRADING CO.

GEARED MOTORS

100 r.p.m. **115 lb. in.** 110V, 50Hz. 2·8A, single phase, split capacitor motor. Immense power. Continuously rated. Totally enclosed. Fan cooled in-line gearbox. Length 250 mm. Dia. 135 mm. Spindle dia. 15·5 mm. Length 145 mm. Ex-equipment tested **£12.** Post £1·50. Suitable transformer 230/240V operation **£8.** Post 75p.

DRAYTON MOTOR Type RQR

230/250V 50c. Continuously rated 1 r.p.m. 90 lb. in. Reversible Motor. Twin spindle size 100mm by 140mm by 125mm. Shaft 50mm by 8mm. Weight 2 kg.
New Price £16·50, P. & P. £1.

BODINE TYPE N.C.I.

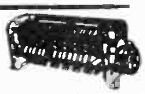
(Type J) 71 r.p.m. torque 10 lb. in. **Reversible** 1/70th h.p. 50Hz.
The above precision made U.S.A. motor is offered in 'as new' condition. Input voltage of motor 115V A.C. Supplied complete with transformer for **230/240V A.C. input.**
Price, either type **£6·25.** Post 75p or less transformer **£3·75.** Post 65p.
(Type 3) 71 r.p.m. 4 lb.ins. 230V a.c. Continuously rated. Non-reversible. **£6·50.** Post 75p.

15 R.P.M.
Type SD48 80 lb. in. Input 100/200 volt A.C. Length incl. gearbox 270 mm. Height 135 mm. Width 150 mm. drive shaft 16 mm. Weight 8·5 Kilos. BRAND NEW. Price **£10.** Carr. £1.
Suitable transformer for use on 220/240 volt A.C. **£3·85.** Post 50p.

24 R.P.M. 230V a.c. Continuously rated. Mfg. Mycalex. Ex-equip. Fully tested. **£3·85.** Post 75p.

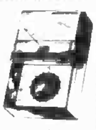
1 R.P.M. 230/240V A.C. SYNCHRONOUS! Ex-equipment. Thoroughly tested and guaranteed. **ONLY £1·50.** Post 20p.

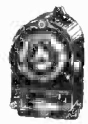
20 R.P.M. 230/240 volt a.c. miniature motor. Price **£1.** Post 20p.

PROGRAMME TIMERS

230V operation a.c. 15 or 20 r.p.m.
6 cam model **£5.** Post 60p.
9 cam model **£6·50.** Post 60p.
12 cam model **£7·50.** Post 60p.
Also available for **50V** operation. Prices as above.

METERS NEW—90 mm Diameter

Type: 65CS D.C. M/C 2, 5, 10, 20, 50 amp. **£2·75.** Post 20p. 100 amp **£3·25.** Post 20p.
Type: 62T2 A.C. M/I 1, 20, 50 amp. **£2·50.** Post 20p. 0-300 volt. A.C. M/I **£2·75** and 300 volt A.C. R/M/C. **£3.** Post 30p.

WHY PAY MORE?!

MULTI RANGE METER. A.C. volts 2·5-500. D.C. volts 2·5-500 (Sensitivity 2000Ω/V D.C. and A.C.) D.C. current 0/1/10/100 mA. Ohms range. Sturdy compact moving coil instrument with 21 ranges, dimensions 120 × 80 × 44 mm. Weight 0·32 kg. SERVICE TRADING CO. Price **£5·50.** Incl. leads and battery. Post 50p. (Total price incl. VAT and Post **£6·48**).

TIME SWITCH

'Horstmann' Type V Mk. II Time switch. 200/250 volt A.C. Two on/two off every 24 hours, at any manually pre-set time. 30 amp contacts. 36 hour spring reserve in case of power failure. Day omitting device. Fitted in heavy high impact case, with glass observation window. Built to highest Electricity Board Spec. individually tested. Price **£7·75.** Post 50p. (Total inc. VAT **£8·91**)

Superior Quality Precision Made NEW POWER RHEOSTATS

New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
25 WATT 10/25/50/100/150/250/500/1k/1·5k ohm. **£1·90.** Post 20p.
50 WATT 1/5/10/25/50/100/250/500/1k ohm. **£2·40.** Post 25p.
100 WATT 1/5/10/25/50/100/250/500/1k/1·5k/2·5k/3·5k/5k ohm **£3·70.** Post 35p.
Black Silver, Skirted knob calibrated in Nos. 1–9 1⅛in. dia. brass bush. Ideal for above **22p** each.

Personal callers only. Open Sat.
9 LITTLE NEWPORT STREET LONDON WC2H 7JJ
Phone 01-437 0576

B. BAMBER ELECTRONICS

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

PLEASE ADD 8% VAT UNLESS OTHERWISE STATED — PLEASE ADD 8% VAT UNLESS OTHERWISE STATED

GARRARD 9V DC MINIATURE MOTORS, Type 318M, 3200 RPM governed, size approx. 1¼in. dia. x 1¼in. high, with 2mm spindle. Brand New. **60p each or 2 for £1.**

SILICON HIGH VOLTAGE RECTIFIER STICKS, BY185 (new) 35kV 2·5mA **£1 each,** BY140 (ex-equip) 12kV 2·5mA **45p** each.

VARIABLE STABILISED POWER SUPPLY, mains input, 0–24V output, stabilised and current limiting at 500mA + 32V at 50mA. Brand new by British manufacturer. Size approx. 7¾ x 2½ x 4in. complete with external 5kΩ 3-turn pot for voltage control. Connection data supplied. **£7.**

50μA (25–0–25μA) **EDGEWISE METERS,** modern type by Sangamo Western, display area ⅞ x 1¾in. with 2 mounting lugs. (Can be zeroed left or right hand.) Sorry Sold Out.

MAINS ISOLATION TRANSFORMERS. Tapped mains input. 240V at 3A + 12V at 500mA output. New, boxed, made by Gardners. **£12.**

SOLDER SUCKERS (Plunger Type). Standard Model, **£4·50.** Skirted Model, **£4·95.** Spare Nozzles **60p** each.

Good Quality Pressure Guages. 2½in. dia. flange mounting. 2 models avail. 0–60 lb/sq.in., 0–100lb/sq.in. Sorry Sold Out.

2N3055 type Transistors. O.K., but unmarked, 5 for **£1.**

110V NEONS, SCREW-IN-TYPE, 4 for **50p.**

SLOW MOTION MOTORS (suitable for programmers, displays, etc.) 230–240V a.c. input, rotation, 1 rev. every two to three minutes, **£1·25** each.

MINIATURE PLIERS. High quality "Crescent", made in USA. **£4·35** +VAT **(35p).**

SIDE CUTTERS. High quality, **£3·70** + VAT **30p.**

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

4MHz XTAL PACKS (10 assorted xtals between 4MHz and 5MHz), our selection only. **£1** Pack.

PROGRAMMERS (magnetic devices). Contain 9 microswitches (suitable for mains operation) with 9 rotating cams, all individually adjustable. Ideal for switching disco lights, displays, etc., or industrial machine programming. (Need slow motion motor to drive cams, not supplied.) 9 switch version **£1·50.**

HEAVY DUTY HEATSINK BLOCKS, undrilled, base area 2½in. x 2in. with 6 fins, total height 2½in. **50p** each.

SPERRY 7-SEGMENT P.G.D. DISPLAYS, digit height 0·3in. red, with decimal points, 150V to 200V (nominal 180V) operation. These are high-volt industrial type and therefore brighter than normal displays. All brand new. AT THE BARGAIN PRICE OF 50p PER DIGIT. TYPE 332 (two digits in one mount) **£1** each. (Sorry, no single digit available.) Data supplied.

BSX20 (VHF Osc/Mult), 3 for **50p.**
BC108 (metal can), 4 for **50p.**
PBC108 (plastic BC108), 5 for **50p.**
BFY51 Transistors, 4 for **60p.**
BCY72 Transistors, 4 for **50p.**
PNP audio type TO5 Transistors, 12 for **25p.**
BF152 (UHF amp/mixer), 3 for **50p.**
2N3819 Fet., 3 for **60p.**
BC148 NPN SILICON, 4 for **50p.**
BC158 PNP SILICON, 4 for **50p.**
BAY31 Signal Diodes, 10 for **35p.**
BA121 Varicap Diodes, 4 for **50p.**
1N914 Diodes, 10 for **25p.**

SMALL MAINS SUPPRESSORS (small chokes, ideal for radio, Hi-Fi inputs, etc.), approx. ½in. x 1¼in., 3 for **50p.**

PERSPEX TUNER PANELS (for FM Band 2 tuners) marked 88–108MHz and Channels 0–70, clear numbers, rest blacked out, smart modern appearance, size approx. 8½in. x 1¼in., 2 for **35p.**

Lead suppressors (10kohm) for mobile plug leads, 4 for **50p.**

HEAVY DUTY RELAYS, 24V d.c. operated (will work on 18V) 3 heavy duty make contacts (around 10A rating) + 4 change over contacts + 1 break contact. New, complete with mounting bracket. (Ideal for switching HT on Linears.) Many uses for this high quality unit. **£1·50** each.

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

ALU-SOL ALUMINIUM SOLDER (made by Multicore). Solders aluminium to itself or copper, brass, steel, nickel or tinplate, 16 s.w.g. with multicore flux, with instructions. Approx. 1 metre coil **30p** pack. Large reel **£2·75.**

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

I.C.'s some coded, 14 DIL type, untested, mixed, 20 for **25p.**

Mobile Converters, 24V DC input 13·8V at approx. 3·4A DC output, fully stabilised. **£3·50** each (ideal for running 12V car radio from 24V lorry battery).

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

Miniature earphones with min. jack plug, 2 for **50p** + 12½% VAT.

I.F. Cans, ½in. square, suitable for rewind, 6 for **30p** + 12½% VAT.

TWIN I.F. CANS, approx. 1in. x ½in. x 1in. high, around 3·5–5MHz, 2 separate transformers in 1 can, internally screened, 5 for **50p** + 12½% VAT.

Dubilier Electrolytics, 50μF, 450V, 2 for **50p.**
Dubilier Electrolytics, 100μF, 275V, 2 for **50p.**
Plessey Electrolytics, 470μF, 63V, 3 for **50p.**
TCC Electrolytics, 1000μF, 30V, 3 for **60p.**
Plessey Electrolytics, 1000μF, 180V, **40p** each (3 for **£1**).
Dubilier Electrolytics, 5000μF, 35V, **50p** each.
Dubilier Electrolytics, 5000μF, 50V, **60p** each.
ITT Electrolytics, 6800μF, 25V, high grade, screw terminals, with mounting clips, **50p** each.
Plessey Electrolytics, 10,000μF at 63V, **75p** each.
Plessey Cathodray Capacitors, 0–0·4μF at 12·5kV DC Screw terminals. **£1·50** each.
PLEASE ADD 12½% VAT TO ALL CAPACITORS.

TV PLUGS AND SOCKETS
TV Plugs (metal type), 5 for **50p.**
TV Sockets (metal type), 4 for **50p.**
TV Line Connectors (back-to-back sockets), 4 for **50p.**
Please add 12½% VAT.

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

PLUGS AND SOCKETS
N-Type Plugs 50 ohm, **60p** each, 3 for **£1·50.**
PL259 Plugs (PTFE), brand new, packed with reducers, **65p** or 5 for **£3.**
SO239 Sockets (PTFE), brand new (4-hole fixing type), **50p** each or 5 for **£2·25.**
25-way ISEP Plugs and Sockets, **40p** set (1 plug + 1skt).
Plugs and sockets sold separately at **25p** each.

BNC PLUGS (ex-equip), 5 for **£1·50.**

WELLER SOLDERING IRONS
EXPERT. Built-in-spotlight illuminates work. Pistol grip with fingertip trigger. High efficiency copper soldering tip.
EXPERT SOLDER GUN, £6·80 + VAT (54p).
EXPERT SOLDER GUN KIT (spare bits case, etc.), **£9·80** +VAT **(78p).**
SPARE BITS, PAIR, **30p** + VAT **(2p).**
MARKSMAN SOLDERING IRONS
SP15D 15W **£3** + VAT **(24p).**
SP25D 25W **£3** + VAT **(24p).**
SP25DK 25W + bits, etc., kit **£3·85** + VAT **(31p).**
SP40D 40W **£3·44** + VAT **(28p).**
BENCH STAND with spring Marksman Irons, **£2·22** + VAT **(18p).**
SPARE BITS
MT8 for 15W, **46p** + VAT **(4p).**
MT4 for 25W, **38p** + VAT **(3p).**
MT10 for 40W, **42p** + VAT **(3p).**
TCP1 TEMPERATURE CONTROLLED IRON. Temperature controlled iron and PSU, **£20** + VAT **(£1·60).**
SPARE TIPS
Type CC single flat, Type K double flat fine tip, Type P, very fine tip, **£1** each + VAT **(8p).**
MOST SPARES AVAILABLE.

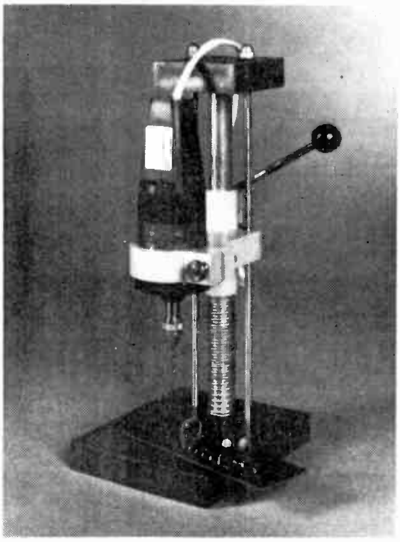
MULTICORE SOLDER
Size 5 Savbit 18 s.w.g. in alloy dispenser, **32p** + VAT **(3p).**
Size C1SAV18 Savbit 18 s.w.g., **56p** + VAT **(4p).**
Size 12 SAVBIT 18 s.w.g. on plastic reel **£1·80** + VAT **(15p).**
½kg (1·1lb) 60/40, 20 s.w.g. on plastic grille **£3.**

Terms of Business: CASH WITH ORDER. MINIMUM ORDER £2. *ALL PRICES INCLUDE POST & PACKING (UK ONLY). SAE with ALL ENQUIRIES Please.* **PLEASE ADD VAT AS SHOWN.** *ALL GOODS IN STOCK DESPATCHED BY RETURN. CALLERS SATURDAYS ONLY 9.30–12.00, 1.30–5.00*

A MINIATURE POWER TOOL

to speed your building

- Super 30 Kit (30 Tools) (incl. drill without stand) **£17·62** plus P. & P. 85p
- Super 10 Kit (10 Tools) (incl. drill without stand) **£13·74** plus P. & P. 65p
- Mk. II Drill Stand **£4·40** plus P. & P. 35p
- Mk. II Drill only **£8·79** plus P. & P. 35p
- Flexible Drive Shaft **£5·46** plus P. & P. 25p
- Transformer 240V a.c./12V d.c. **£6** plus P. & P. 70p



Replacement drills, stones, burrs, etc. **40p** each. Circular saw blades **50p** each. **£2** per set of 4 sizes. P. & P. any quantity 20p.

All VAT inclusive

PRECISION PETITE LTD.

119a High Street, Teddington, Middlesex TW11 8HG
Tel. 01-977 0878 (24-hour answering service)

9" × 4" S.A.E. please for leaflet and order form

TELEPHONES—Modern style 706 Black or two-tone grey **£4·50** each. Older black style **£1·50** each, P. & P. 75p. All with bells and dial.
SEMICONDUCTORS—All at **8p each***, P. & P. extra. Guaranteed all full spec. devices. Manufacturer's markings:
BC147; BC158; 2N3707; BC107; BF197; BC327; 2N4403; BC172B; BC261B; BC251B; BC348B; BC171A/B.
2N3055RCA **50p each,** P. & P. 8p.
2N5879 with 2N5881 Motorola 150 watt. Comp. pair £2 pair, P. & P. 15p.
★ Linear amp 709 **25p** each, P. & P. 8p.
★ SPECIAL OFFER BC204 and BC207A **4p** each, P. & P. extra.
★ BEEHIVE TRIMMERS. 3/30pF. Brand new. 10 off **40p,** P. & P. 15p.
★ TRIMMER PACKS. As previously advertised. **25p** each, P. & P. 15p.
★ Meter PACKS—3 different meters £2, P. & P. £1.
DON'T FORGET YOUR MANUALS. S.A.E. with requirements.
GRATICULES 12 × 14 cm high quality plastic **15p** each, P. & P. 10p.
★ CAPACITOR Pack. 50 Brand New components only **50p,** P. & P. 48p.
★ 3lb Electronic Goodies £1·60, post paid.
★ High Value Printed Board Pack—hundreds of components, transistors, etc.—no flat to the board transistors **£1·65** post paid.
★ 1000f Feed thru Capacitors 10 for **30p.** P. & P. 15p.
HIVAC Min Neons. Approx 60V Brand New 10 off **20p,** P. & P. extra.
FIBREGLASS BOARD PACK. More board—less money. Larger pieces. Not less than 2·5 sq ft for **95p,** P. & P. 65p.
Double or single sided cut to any size. New Lower Price **1p** per sq in. P. & P. extra.

TRANSFORMERS—All 240V 50HZ Inputs
Type A 17–0–17V 250mA; 7·5–0–7·5V 250mA 0–20V 5 amps; 0–4V 5 amps; 0–1–1·5V 5 amps. £2 each, P. & P. £1·25.
Type B 17–0–17V 250mA; 8–0–8V 250mA; 0–12·5–13·5V 5 amps; 0–1·5–2V 5 amps, **£1·50 each,** P. & P. £1.
Type C 19–0–19V 250mA; 8–0–8V 250mA; 0–7·5V 5 amps; 0–1·4V 5 amps; **£1·25 each,** P. & P. £1·25.

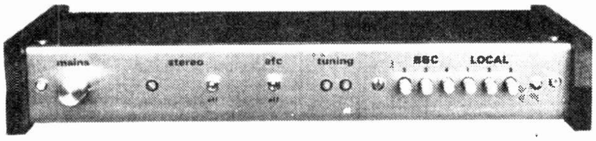
*** VAT 12½%, otherwise 8%**
Minimum order £2. Excess postage refunded

CHILTMEAD LTD

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

Access — BARCLAYCARD

ORION stereo tuner



Complete set of semiconductors £4·99
Mullard LP1186 tuner head £7·75
High quality glass fibre P.C.B. £2·45

ORION AMPLIFIER

Complete set of semiconductors £9·40
High quality glass fibre P.C.B. £2·99
Both the above PCB's are screen printed with component locations.

FERRANTI semiconductors

BZV zeners all types	10p	BFS98	16p	ZTX107	11p	ZTX239	10p	**MOTOROLA**	
BC415P	17p	MS4A*	£1·35	ZTX108	9p	ZTX320	16p	BD699*	£1·14
BFS60	15p	ZS170	13p	ZTX109	11p	ZTX384	17p	BD700*	£1·28
BFS61	15p	ZS178	54p	ZTX212	15p	ZTX450	16p	MC1310P	£1·80
BFS97	15p	ZS271*	23p	ZTX213	15p	ZTX550	16p	MC1357PQ	£1·65
		ZTXA20	10p	ZTX214	17p	2N3055*	70p		

We can supply any FERRANTI semiconductor device to order S.A.E. for list

FERRANTI CDI INTEGRATED CIRCUITS. All with circuits and data

ZN414 radio microcircuit £1·00 ZN425E* D to A converter £3·50
ZN424E low noise audio i.c. £1·00 ZN1034E* precision timer i.c. £1·80
ZN1040E* universal count/display i.c. £7·50

PE TV SOUND SEPARATOR

Complete set of semiconductors £2·30. High quality glass fibre p.c.b £1.

PHASE LOCKED STEREO DECODER

To Motorola specification. COMPLETE KIT ONLY £3·50, including MC1310P, glass fibre p.c.b., all resistors and capacitors, LED indicator, and full instructions.

POSTAGE AND PACKING 15p per order. Orders over £5 post free. All devices are top grade, brand new and to full manufacturer's spec. We do not sell seconds or rejects. Send S.A.E. for data sheet and price list.

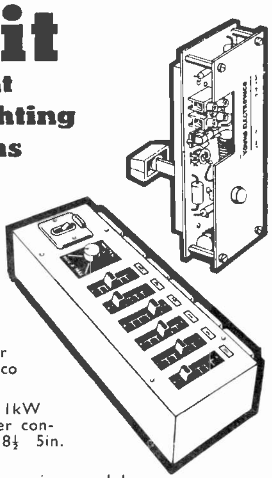
PRICES DO NOT INCLUDE VAT—ADD 8% TO ITEMS MARKED * AND 12½% TO ALL OTHERS

DAVIAN ELECTRONICS

13 Deepdale Avenue, Royton, Oldham, Lancs. (Mail order only)

Dimmit

range of light dimmers and lighting control systems



Illustrated is the popular PMSD1000 module. A 1kW slider control dimmer, interference suppressed, 60mm slider range size 4½×2×1½in. Ideal for low cost stage and disco lighting. Used by schools, theatres, studios, etc. Complete with scale plate, fixing screws and full instructions. **£9·06** inc. VAT and postage and packing.

Complete compact light dimmer systems for stage, club and disco lighting, etc.

DD61M (illustrated). Six 1kW channels, six outlet sockets, master control, mains on/off switch, size 23×8½×5in. Price **£131** inc. VAT and P. & P.

DD61-B. Six 1kW channels, using module PMSD1000, lowest cost system. Price **£66·50** inc. VAT and P. & P.

ALL PRICES REDUCED FOR A LIMITED PERIOD

The Dimmit range includes rotary and slider control dimmers and sound to light converters for home, entertainment and professional applications. Ratings 1kW, 2kW, 3kW.

All products are guaranteed and are supplied with full instructions and applications. Full after-sales service. Technical advice given.

For full information on all modules and lighting control systems send for our FREE illustrated catalogue and price list. Callers welcome, visit our showroom for a demonstration of any of the modules or systems. Mon.-Fri. 9.30 to 6.0 p.m. Sat. by arrangement.

YOUNG ELECTRONICS LTD.

184 Royal College Street, London NW1 9NN Tel. 01-267 0201

TRAIN FOR SUCCESS

in Radio, Television & Electronics

ICS have helped thousands of ambitious people to move up into higher paid more secure jobs in the field of electronics - now it can be your turn. Whether you are a newcomer to the field or already working in the industry, ICS can provide you with the specialised training so essential to success.

Personal Tuition and Guaranteed Success

The expert and personel guidance by fully qualified tutors, backed by the ICS guarantee of tuition until successful, is the key to our outstanding record in the technical training field. You study at the time and pace that suits you best and in your own home. In the words of one of our many successful students: "Since starting my course, my salary has trebled and I am expecting a further increase when my course is completed."

City and Guilds Certificates

Excellent job prospects await those who hold one of these recognised certificates. ICS can coach you for:

Telecommunications Technicians
Radio, T.V. Electronics Technicians
Technical Communications
Radio Servicing Theory
Radio Amateurs
Electrical Installation Work
Also MPT Radio Communications Certificate

Diploma Courses

Colour T.V. Servicing
Electronic Engineering & Maintenance
Computer Engineering and Programming
Radio, T.V. and Audio, Engineering & Servicing
Electrical Engineering, Installations & Contracting

Other Career Courses

A wide range of other technical and professional courses are available including GCE.

FREE BOOK

Post this coupon or 'phone today for free ICS careers guide.

Name ______________________

Address ______________________

____

______________________ Age ________

ICS

To ICS, Dept. 771C, Intertext House, London SW8 4UJ
or telephone 01-622 9911 (all hours)

SMALL ADS

The prepaid rate for classified advertisements is 15 pence per word (minimum 12 words), box number 40p extra. Semi-display setting £12.00 per single column inch (2.5cm). All cheques, postal orders etc., to be made payable to Practical Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5918).

CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

1. Advertisements are accepted subject to the conditions appearing on our current advertisement rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an infringement of the British Code of Advertising Practice.
2. The publishers reserve the right to refuse or withdraw any advertisement.
3. Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences.

RECEIVERS AND COMPONENTS

R. T. SERVICES

(MAIL ORDER ONLY)

75 Hayfield Rd., Salford 6, Lancs.

PANEL with 6 2N3055 transistors plus 6 N.P.N. and 6 P.N.P. transistors **£1·75** inc.

FM TUNER with R.F. Stage and A.G.C. 3 transistors, neg. earth 2½ × 2 × 1½in with circuit, **£1·75**.

MAINS INPUT TRANSFORMERS 20V-0-20V at 2 amp, **£3·95.** New. 6V at 1 amp, **£1·45.** New. 12V at ½ amp, **£1·45.** New.

Mixed Pack of C280 series Mullard capacitors, 100 for **£1·15** inc., P. & P. Send S.A.E. for our list prices.

Tel. 061–236 1541

All prices include VAT and P. & P.

Mullard Components

Electrolytic Capacitors. 015/016 Series.

25V	25V	63V	63V	63V	63V
10	47	1·0	4·7	15	47
22	100	2·2	10	22	
4½p	5p	4½p	4½p	5p	6p

Polyester Capacitors. C280 Series. 250V PC mounting. 0·01, 0·015, 0·022, 0·033, 0·047, 0·068, 0·1, 3½p; 0·15, 0·22, 4½p; 0·33, 6½p; 0·47, 7½p; 0·68, 10p; 1·0, 12p; 1·5, 18p; 2·2μF, 21p.

Carbon Film Resistors. 0·33W 5% Hi-stability E12 series 4·7Ω-1M. Your selection **1p** each, **0·9p** 10+, **0·85p** 100+.

Return of post service. Prices include 12½% VAT. Allow 15p for carriage. Mail order only. All components brand new.

C. N. Stevenson (PE)
304 Avery Hill Road, London SE9 2JN

BRAND NEW COMPONENTS BY RETURN

Electrolytic Capacitors 16V, 25V, 50V — 0·47, 1·0, 2·2, 4·7 and 10mF **5p**; 22, 47 **5½p** (50V **6p**); 100 **7p** (50V **8p**); 220 **8p** (50V **10p**); 470 **11p** (50V **16p**); 1,000 (16V) **15p**, 1,000 (25V) **18p**, 1,000 (50V) **22p**.
Subminiature Bead Tantalum Electrolytics—0·1, 0·22, 0·47, 1·0, 2·2 at 35V, 4·7/25V **11p**; 10/25V **13p**; 22/16V, 47/6V and 100/3V **15p**.
Mullard Min. Ceramic E12 Series 2% 63V—10–47pF **8p**; 56–330pF **4p**.
Vertical Mounting Ceramic Plate 50V—E12 series 22–1,000pF and E6 series 1,500–47,000pF **2p**.
Polystyrene E12 Series 63V Horizontal Mounting—10–1,000pF **8p**; 1,200–10,000pF **4p**.
Mullard Polyester 250V Vertical Mounting E6 Series—0·01–0·1 **4p**; 0·15, 0·22 **5p**; 0·33, 0·47 **8p**; 0·68 **11p**; 1·0 **13p**; 1·5 **20p**; 2·2 **22p**.
Mylar (Polyester) Film 100V Vertical Mounting—0·001, 0·002, 0·005 **3p**; 0·01, 0·02 **4p**; 0·04, 0·05 **4½p**.
Miniature Resistors Highstab. E12 Series 5% Tolerance—Mullard C Film 33W 1Ω–10MΩ (10% over 1MΩ) **1p**; **Metal Film** ⅛W, ¼W and ½W 10Ω–2M2Ω **1½p**; **Metal Film 1W** 27Ω–10MΩ **1¾p**.
1N4148 8p; 1N4002 **5p**; 1N4006 **7p**; 1N4007 **8p**; BC107/8/9, BC147/8/9, BF157/8/9, BF194/7 **9p**.
Fuses 20mm glass, 1¼in glass, 1in ceramic **2½p**.
Post 10p (free over £4). Prices inclusive of VAT.

THE C.R. SUPPLY CO.
127 Chesterfield Road, Sheffield S8 0RN

P.C.Bs Paxolin, 5¼in × 5¼in, 6 for **85p**, 12in × 9in **60p**, 17½in × 9½in, **90p. Fibre Glass,** 13in × 5¼in, **80p**, 13in × 11in, **£1·50.** D.S. 7in × 8in, **70p. Neons,** 20 for **£1.** 5 Figure Resettable Counter 18/22V works on 12V, **£3. Assorted 74 Series I.Cs** on panel(s), 10 for **90p. 3 Assorted Meters £2·10.** 100 Assorted S/Mica Caps **75p. Silicon Diodes** 650V 1½A, 10 for **60p.**
List 15p. Refund on purchase.
7 lb Assorted Components, **£2·75.**

J. W. B. RADIO
2 Barnfield Crescent, Sale, Cheshire, M33 1NL
All items post paid. Mail order only.

TURN YOUR SURPLUS capacitors, transistors, etc., into cash. Contact COLES-HARDING & CO., P.O. Box 5, Frome, Somerset. Immediate cash settlement.

LEDs

panel clip 1p	0·125	0·2
RED	15p	19p
G/Y	27p	33p
OR	27p	33p

INFRA RED 550μW Axial lead **49p** 6mW **£1·55**
OPTO Data free
ORP12 **55p**

OPTO-ISOLATORS			
TIL111	1·5kV,	150khz	£1
4350	2·5kV,	5MHz	£2·25
Avdelbond 2gm			65p

SCR's	50V	100V	400V	Diac
TO5 1A	25p	27p	46p	BR100
TO66 3A	27p	35p	50p	21p

400V TRIACS 2A **60p** 10A **£1·50**

AC125/6/7/8	15p
AD161/162	40p
AF117	20p
AF124/5/6/7	34p
BC/107/8/9	9p
BC109C	12p
BC147/8/9	10p
BC157/8/9	11p
BC167/8/9	11p
BC169C	12p
BC177/8/9	17p
BC182/3/4/L	11p
BC186/7	30p
BC212/3/4L	12p
BCY70/71/72	13p
BF194/5	12p
BF196/7	14p
BFY50/51	16p
BFX29	30p
BFX84	24p
BSX19/20	16p
OC71	10p
2N706	10p
2N1711	20p
2N2219	20p
2N2904/5/6/7	18p
2N2904/5/6A	18p
2N2926(R)	7p

2N2926(G)	12p
2N3053	15p
2N3054	45p
2N3055	41p
2N3702/3/4	12p
2N3903/4/5/6	16p
2N2646	45p
TIS43	25p
MPF102	40p
2N3819	25p
2N3823	30p
IN914	3p
IN4001	5p
IN4002/3	6p
IN4004/5	7p
IN4006/7	6p
IN4148	4p
BA100	9p
BY127	16p
OA47	6p
OA70 OA79	8p
OA81 OA90	7p
OA91 OA95	6p
OA200	6p
OA202	7p

ZENERS 2·7-33V BZY88 or sim **9p**

VOLTAGEREGS.
5V 7805 Plastic
12V 7812 1 Amp
15V 7815 all
18V 7818 £1·50
723 DIP14 50p

BRIDGE RECTS.	
2A 50V	30p
2A 100V	36p
2A 200V	41p
2A 400V	46p

555 Timer	60p
556 2 × 555	£1·10
LM380	£1·00
7400	16p

OP. AMPS	
709 all	25p
741 8-pin	29p
748 D.I.L.	36p

D.I.L. SOCKETS	
8-pin	12p
14-pin	13p
16-pin	14p
Mica + bushes TO3 TO66	5p
Dalo Pen	70p

PRICES INCLUSIVE + **15p** P. & P. (1st class)

ISLAND DEVICES, P.O. Box 11, Margate, Kent

VALVES—Radio, TV, industrial, transmitting. We dispatch to any part of the world by return of post, Air or Sea Mail. 2,700 types in stock. 1930 to 1976 obsolete types a speciality. List 20p. Quotation S.A.E. Open to callers. Mon. to Sat. 9.30–5.00, closed Wed. 1.00. We purchase all types of new and boxed valves. COX RADIO (Sussex) Ltd., Dept. P.E., The Parade, East Wittering, Sussex, PO20 8BN. West Wittering 2023. (STD code 024366).

1N4148 4p, Disc Ceramics ·01, ·02, ·04. 3p. Polyester Caps C280·1 250V 2p ea. 16p doz. Large Red L.E.D.s 20p ea. 6 for £1. Loudspeakers 8Ω 2", 2½" 75p ea. Mains Relay Treble Pole c/o £1·10. Siren 6V DC £1·28p. 90V Neons 8p. 1N4001 8p. Small mains Motor 250 rpm 48p. Intercom Cases 35p. Asstd Transistor IFs 8 for 50p. BC107/8/9 15p. Resistors ¼W 2p ea. Prices include VAT. Add 15p Post.

GRIMSBY ELECTRONICS
64 Tennyson Road, Cleethorpes, Humberside
100's of Bargains at our Lambert Road Components shop (open Saturdays) 1976-77 List 9p.

Precision Polycarbonate Capacitors

All High Stability—extremely Low Leakage

440 V A.C. RANGE

Value (μF)	Dimensions (mm) L	D	Price each
0·1	27	12·7	68p
0·15	27	12·7	80p
0·22	33	16	86p
0·25	33	16	92p
0·33	33	16	99p
0·47	33	19	£1·10
0·5	33	19	£1·16
0·68	50·8	19	£1·25
1·0	50·8	19	£1·37
1·5	50·8	25·4	£1·64
2·0	50·8	25·4	£1·95

63V D.C. RANGE

Value μF	±1%	±2%	±5%
0·01–0·2	£1·28	75p	50p
0·22–0·47	£1·32	77p	51p
0·68	£1·44	84p	56p
1·0	£1·56	91p	60p
1·5	£1·74	£1·16	67p
2·2	£1·98	£1·32	75p
3·3	£2·40	£1·60	99p
4·7	£2·82	£1·88	£1·23
6·8	£3·48	£2·32	£1·47
10	£4·98	£3·32	£2·01
15	£7·14	£4·76	£2·88
22	£9·66	£6·44	£3·90

TANTALUM BEAD CAPACITORS—Value available: 0·1, 0·22, 0·33, 0·47, 0·68, 1·0, 2·2, 3·3, 4·7, 6·8μF at 15V/25V or 35V; 10·0μF at 16V/20V or 25V; 22·0μF at 6V/10V or 16V; 33·0μF at 6V or 10V; 47·0μF at 3V or 6V; 100·0μF at 3V. All at **12p*** each, 10 for **£1·10***, 50 for **£5***, 100 for **£9***.

TRANSISTORS & I.C.'s

BC107/8/9	9p	*BC212/212L	12p	2N3055	50p
*BC114	12p	*BC213/213L	11p	OC71/2	20p
*BC147/8/9	10p	*BC214/214L	11p	*NE555Timer	61p
*BC153	16p	*BF194/5	12p	*741C 8pin DIL	32p
*BC154/7/8/9	12p	BFY50/1/2	20p		
*BC182/182L	11p	AF178	40p	ZN414	£1·15
*BC183/183L	11p	AF239	38p	SN76013ND	
*BC184/184L	12p	*2N3702/4	11p		£1·50

POPULAR DIODES—1N914 **6p**, 8 for **45p**, 18 for **90p**; 1N916 **8p**, 6 for **45p**, 14 for **90p**; 1S44 **5p**, 11 for **50p**, 26 for **£1·00**, 1N4148 **5p**, 6 for **27p**, 12 for **48p**; 1N4001 **5½p**; 002 **6p**; 003 **6½p**; 004 **7p**; 005 **7½p**; 006 **8p**; 007 **8½p**.

LOW PRICE ZENER DIODES—400mW, Tol. ±5% at 5mA. 3V; 3V3; 3V6; 4V7; 5V1; 5V6; 6V2; 6V8; 7V5; 8V2; 9V1; 10V; 11V; 12V; 13V; 13·5V; 15V; 16V; 18V; 20V; 22V; 24V; 27V; 30V; 33V. All at **7p** each, 5 for **33p**, 10 for **65p**, 50 for **£3·12.** SPECIAL OFFER: 100 Zeners (may be mixed) for **£6·00.**

RESISTORS—High stability, low noise carbon film 5% ½W at 40°C, ¼W at 70°C. E12 series only—from 2·2Ω to 2·2MΩ. 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***.

SILICON PLASTIC RECTIFIERS—1·5 amp, wire-ended DO27: 100 P.I.V. **7p** (4 for **26p**); 400 P.I.V. **8p** (4 for **30p**).

BRIDGE RECTIFIERS—2½ amp: 200V **40p**; 350V **45p**; 600V **55p.**

SUBMINIATURE VERTICAL PRESETS—0·1W only: All at **5p*** each; 50; 100; 220; 470; 680 ohm; 1k; 2k2; 4k7; 6k8; 10k; 15k; 22k; 47k; 100k; 320k; 680k; 1M; 2M5; 5M.

PLEASE ADD 20p POST AND PACKING ON ALL ORDERS. EXPORT—ADD COST OF SEA/AIRMAIL. Add 8% VAT to all items except those marked with * which are 12½%

Send S.A.E. for additional stock lists.
Wholesale price lists available to bona fide companies.

MARCO TRADING (Dept. P.3)
The Old School, Edstaston, Wem, Shropshire
Tel: Whixall 464/465 (STD 094 872)
(Proprs. Minicost Trading Ltd.)

SERVICE SHEETS

BELL'S TELEVISION SERVICES for service sheets on radio, TV, etc., **75p** plus S.A.E. Colour TV service manuals on request. S.A.E. with enquiries to B.T.S., 190 Kings Road, Harrogate, N. Yorkshire. Tel. 0423 55885.

SERVICE SHEETS, Radio, TV, etc., **50p** and S.A.E. Catalogue **20p** and S.A.E. HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.

SERVICE SHEETS, radio, TV, etc. 10,000 models. Catalogue **24p** plus S.A.E. with orders-enquiries. TELRAY, 154 Brook Street, Preston, PR1 7HP.

LADDERS

LADDERS, varnished, 25½ ft. extd., **£27·64.** Carr. **£1·90.** Leaflet. Immed. despatch. THE LADDER CENTRE (PEE3), Halesfield (1), Telford, Salop. Tel. 586644.

EDUCATIONAL

TECHNICAL TRAINING

Get the training you need to move up into a higher paid job. Take the first step now—write or phone ICS for details of ICS specialist homestudy courses on Radio, TV, Audio Eng. and Servicing, Electronics, Computers; also self-build radio kits. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. 772B, Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)

CITY & GUILDS EXAMS

Study for success with ICS. An ICS homestudy course will ensure that you pass your C. & G. exams. Special courses for: Telecoms. Technicians, Electrical Installations, Radio, TV & Electronics Technicians Radio Amateurs. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. 772B, Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)

COURSES—RADIO AMATEURS EXAMINATION. City and Guilds. Pass this important examination, and obtain your G8 licence, with an R.R.C. Home Study Course. For details of this, and other courses (G.C.E., Professional Examinations, etc.) write or phone: THE RAPID RESULTS COLLEGE, Dept. JS1, Tuition House, London, SW19 4DS. Tel. 01-947 7272 (Careers Advisory Service) or for a prospectus only ring 01-946 1102 (24 hr. recording service).

COLOUR TV SERVICING

Learn the techniques of servicing Colour TV sets through new homestudy course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Other courses for radio and audio servicing. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. 772B, Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)

FOR SALE

AMATEUR DISPOSING of "as new" equipment. Many unused items. (Laskys) meters **£2,** (EV) S-DECs, **£1,** Pots **20p.** Send S.A.E. for List. 19 Albert Road, Southend, Essex.

NEW ISSUES of "Practical Electronics" available from April 1974 up to date. Cover price plus 17p postage per copy—BELL'S TELEVISION SERVICES, 199 Kings Road, Harrogate, N. Yorkshire. Tel. (0423) 55885.

KENT COUNTY COUNCIL

Tenders are invited for the sale of surplus Constabulary Operations Room equipment consisting of a Mark IV Thermionic Tape Recorder, a Sealecto panel for indicating vehicle position and Panels containing numerous relays and uniselectors. Write for tender forms to the **County Supplies Officer, County Supplies Department, Sandling Road, Maidstone, Kent ME14 2LP,** to whom sealed tenders must be returned by Friday, 4th February, 1977.

PRACTICAL ELECTRONICS, November 1964 (first issue) to December 1974. Up to 1971 in binders. All good condition. Offers. NEWNHAM, 18 Milford Drive, Ilkeston, Derbyshire.

DEWTRON. Pair matched VCO2s **£40,** SHE 1 **£10,** PPA **£5.** Little used. N. TURNBULL, 6 Kingsley Road, Brighton.

SITUATIONS VACANT

RADIO TECHNICIANS

Government Communications Headquarters has vacancies for Radio Technicians. Applicants should be 19 or over.

Standards required call for a sound knowledge of the principles of electricity and radio, together with 2 years experience of using and maintaining radio and electronic test gear.

Duties cover highly skilled telecommunications/electronic work, including the construction, installation, maintenance and testing of radio and radar telecommunications equipment and advanced computer and analytic machinery.

Qualifications: Candidates must hold either the City and Guilds Telecommunications Part I (Intermediate) Certificate or equivalent HM Forces qualifications.

Salary scale from **£2,230** at 19 to **£2,905** at 25 (highest pay on entry) rising to **£3,385** with opportunity for advancement to higher grades up to **£3,780** with a few posts carrying still higher salaries. Pay supplement of **£313·20** per annum.

Annual leave allowance is 4 weeks rising to 6 weeks after 27 years service.

Opportunities for service overseas.

Candidates must be UK residents.

Further particulars and application forms available from:
Recruitment Officer, Government Communications Headquarters
Oakley, Priors Road, Cheltenham, Glos. GL52 5AJ
Tel.: Cheltenham (0242) 21491 (Ext. 2270)

BOOKS AND PUBLICATIONS

NEW BOOKS READY NOW

BP34	Practical Repair and Renovation of Colour TVs	95p
BP35	Handbook of IC Audio Preamp and Power Amplifier Construction	95p
221	28 Tested Transistor Projects	95p
222	Solid State Shortwave Receivers for Beginners	95p

Obtainable through most large branches of W. H. Smith, good bookshops, component dealers, mail-order houses, etc.

S.A.E. BRINGS FULL LIST OF TITLES

BABANI PRESS & BERNARDS (Publishers) LTD.
THE GRAMPIANS, SHEPHERDS BUSH RD., LONDON, W6 7NF 01-603 7296/2581

PRACTICAL ELECTRONICS, November 1964 to May 1975. Good condition, 3 copies missing. Offers. 28 Kennion Road, St. George, Bristol 5.

START YOUR OWN BUSINESS REWINDING ELECTRIC MOTORS

This unique instruction manual shows step by step how to rewind motors, working part or full time, without previous experience. Everything you need to know easily explained, including where to obtain materials, how to get all the work you need, etc., etc. A goldmine of information and knowledge. Only **£3·90** plus 26p P. & P. From:

MAGNUM PUBLICATIONS, Dept. PE5
Brinksway Trading Estate, Brinksway
Stockport SK3 0BZ
Overseas Distributors wanted.

WANTED

WANTED, NEW VALVES, TRANSISTORS, top prices, popular types—KENSINGTON SUPPLIES (B), 367 Kensington Street, Bradford 8, Yorkshire.

ELECTRICAL

STYLI, CARTRIDGES AND AUDIO LEADS, etc. For the best at keenest prices send S.A.E. for free illustrated list to: FELSTEAD ELECTRONICS (PE), Longley Lane, Gatley, Cheadle, Cheshire, SK8 4EE.

MISCELLANEOUS

H.M. ELECTRONICS

275a Fulwood Road, Broomhill, Sheffield S10 3BD

BEC CABINETS

Give your project that professional looking finish. Build it in a BEC.

Dry transfer lettering now available . . .

ORION cabinet still available punched or unpunched
Send 15p (refundable) for leaflets

SUPERB INSTRUMENT CASES by Bazelli, manufactured from heavy-duty pvc faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low **82p.** Examples: width, depth, height, 8in. × 5in × 3in, **£1·70**; 10in × 6in × 3in, **£2·42**; 10in × 8in × 3in, **£3·02**; 12in × 10in × 3in, **£3·96**; 8in × 4in × 4in, **£1·98**; 10in × 6in × 4in, **£2·97**; 12in × 8in × 4in, **£3·96**; 7in × 7in × 5in, **£2·91**; 8in × 10in × 6in, **£3·96**; 12in × 8in × 7in, **£4·40**; 12in × 12in × 7in, **£4·84**. Plus 85p carriage and 8% VAT. Over 400 models to choose from. Prompt despatch. Free literature (stamp would be appreciated): BAZELLI, Dept. No. 23, St. Wilfrid's, Foundry Lane, Halton, Lancaster LA2 6LT.

CABINET FITTINGS

FOR

Stage Loudspeakers and Amplifier Cabs

Fretcloths, Coverings, Recess Handles, Strap Handles, Feet, Castors, Locks and Hinges, Corners, Trim, Speaker Bolts, etc., etc.

Send 2 × 8½p Stamps for samples and list.

ADAM HALL (P.E. SUPPLIES)
Unit Q, Starline Works, Grainger Road Southend-on-Sea, Essex.

LOW COST I.C. MOUNTING for any size DIL package. 100 Soldercon sockets **65p. 7** and 8 hole plastic supports **5p**/pair. Quantity rates. S.A.E. details and sample. Trial pack **65p** (P. & P. 10p/order). PKG ELECTRONICS, Oak Lodge, Tansley, Derbyshire, DE4 5FE.

AUDIO TEST OSCILLATOR

VERY LOW DISTORTION (0·02%) £22 + Tax 8%

Based on a Linsley Hood design it provides both SINE and SQUARE wave signals over range 10Hz–100kHz in four steps. Output over 1 volt fully attenuated. Self powered with 9V battery. In Kit form **£17.**
S.A.E. for leaflets. Also available T.H.D. Analyser. MVMT. F.M. Sig. Gen. 0/60V 1A. P.S.U.

TELERADIO ELECTRONICS
325 Fore Street, Edmonton N9 0PE
Tel. 01-807 3719

DIGITAL CLOCK KITS

of only 5 components with full instructions for assembly of 12 hour clock, excluding case **£11·50.** Logic Checker for ICs dual tone. Dat: op. for TTL and CMOS **£26·50.**
All prices inclusive (mail order only).

FULSHAW ELECTRONIC CONTROLS LTD.
39 Thornsett, Birch Vale, Nr. Stockport, Cheshire, SK12 5BP.

Musical Miracles!

by Dewtron ®

Build your own synthesiser or musical effects using some of the huge range of **DEWTRON** modules. Or, build fuzz or waa-waa at budget prices using special kits.

Send 20p for Catalogue from:

D.E.W. Ltd., 254 Ringwood Road, Ferndown, Dorset BH22 9AR.

RECHARGEABLE NICAD BATTERIES "AA" (HP7), £1·05; Sub. "C" **£1·29;** "C" (HP11) **£2·02;** "D" (HP2) **£2·92;** PP3 **£4·98.** Matching chargers, respectively, **£4·48, £4·48, £5·24, £5·24, £3·98.** All prices include VAT. Add 10% P. & P. S.A.E. for full list, plus, if wanted, 35p for "Nickel Cadmium Power" booklet. SANDWELL PLANT LTD., 1 Denholm Road, Sutton Coldfield, West Midlands, B73 6PP. Tel. 021-354 9764.

BUILD THE TREASURE TRACER MK III Metal Locator

- Varicap tuning
- Britain's best selling metal locator kit
- Fitted with Faraday shield
- Speaker and earphone operation
- 4,000 already sold
- Prebuilt search coil assembly
- Five transistor circuit
- Thoroughly professional finish
- You only need soldering iron, screw-driver, pliers and snips
- As seen on BBC-1 and BBC-2 TV

Send stamped, addressed envelope for leaflet

Complete Kit **£14·75** Post £1 + £1·18 VAT
Built and tested **£19·75** Post £1 + £1·58 VAT

MINIKITS ELECTRONICS, 6g CLEVELAND ROAD LONDON E18 2AN (Mail Order Only)

ENAMELLED COPPER WIRE

SWG	1 lb £	4 oz £	2 oz £
14-19	2·40	0·60	0·50
20-29	2·45	0·82	0·59
30-34	2·60	0·89	0·64
35-40	2·85	1·04	0·75

Inclusive of P. & P. and VAT.
S.A.E. brings catalogue of copper and resistance wires in all coverings.

THE SCIENTIFIC WIRE COMPANY
P.O. Box 30, London, E4 9BW

VERO BOXES, cases, boards, etc. Send stamp for Vero booklet and price list. CAVERN ELECTRONICS, 94 Stratford Road, Wolverton, Milton, Keynes, MK12 5LU.

NO LICENCE EXAMS NEEDED

To operate this miniature, solid-state **TRANSMITTER RECEIVER** kit. Only **£8·25** plus 20p P. & P.
'Brain-freeze' 'em with a **MINI-STROBE** kit, pocket-sized 'lightning flashes', vari-speed, for disco's and parties. A mere **£3·80** plus 20p P. & P.
Experiment with a psychedelic **DREAM LAB,** or pick up faint speech/sounds with the **BIG EAR** sound-catcher: ready-made modules. **£4·75** plus 20p P. & P.
LOTS MORE! Send 20p for lists.
(Prices include VAT).
(Mail Order U.K. only).

BOFFIN PROJECTS
4 Cunliffe Road
Stoneleigh, Ewell, Surrey (P.E.)

I.C. EXPERIMENTER'S KITS

Learn about modern electronics with our new series of Kits on digital logic techniques. Each Kit contains specially selected I.C.s, Holders, Veroboard, L.E.D.s, and Instructions.
Available at **£4·00** each (including P. & P.)
Kit One—Gates Kit Two—Flip-Flops
Kit Three—Shift Registers
Kit Four—Counters Kit Five—Displays
S.A.E. for further details to:

AUTOMATED HOMES
69 High Street, Ryton, Coventry CV8 3FJ
(Mail Order Only)

METER REPAIRS. Ammeters, voltmeters, multi-meters, etc., contact: METER REPAIRS, 21 Mount Road, Benfleet, Essex, SS7 1HA.

GLASS FIBRE P.C.B.'s

From your own tape, film or ink master.
Send S.A.E. for quotation.
PRACTICAL ELECTRONICS P.C.B.'s in glass fibre, tinned and drilled.
June 76 Transmitter 93p, Coder 84p.
July 76 Receiver 90p, Decoder 73p,
Interface 56p. August 76 Servodrive 69p,
Servo Amp 54p, Relay Driver 62p.
Complete set of above boards £5·30.
Sept. 76 Tone Generator 66p, Tone Decoder 72p. Sept. 76 Cross-Hatch Generator £2·85.
Nov. 76 Hazard Warning Flasher 68p.
Dec. 76 FM Stereo Tuner £2·58. Send S.A.E. for information on current boards.
C.W.O. please.

PROTO DESIGN
4 Highcliffe Way, Wickford, Essex SS11 8LA

ENAMELLED COPPER WIRE

S.W.G.	1lb reel	½lb reel
10 to 19	£2·95	£1.60
20 to 29	£3·15	£1·80
30 to 34	£3·45	£1·90
35 to 40	£3·65	£2·10

All the above prices are inclusive of postage and packing in the U.K.

COPPER SUPPLIES
102 Parrswood Road, Withington, Manchester 20
Telephone 061-445 8753

BURGLAR ALARMS SUPPLIES AND EQUIPMENT

S.A.E. FOR FREE CATALOGUE

LARGE SIZE PRESSURE MATS
28 in. × 15 in. £1·20

MAGNETIC SWITCHES
with magnets from 75p

BELLS · SIRENS · ALARM-UNITS · CABLE BELL COVERS · WINDOW FOIL · VIBRATION CONTACTS · ULTRASONIC AND INFRA-RED DETECTORS · INTERTIA SWITCHES.

A. D. ELECTRONICS
217 Warbreck Moor, Aintree
Liverpool L9 0HU. Tel. 051-525 3440

P.C.Bs FAST . . .
24-HOUR SERVICE FROM YOUR TAPE OR FILM ART

1·6 mm glass fibre + 1 oz copper + solder varnish £1·15 + 3p/sq.in. (VAT and P. & P. inc.)
S.A.E. for quantity discounts/specials, prototype service—circuit design, layouts, assy. and test.

MICRONICS ELECTRONICS ENG. SERVICES
13a Clive Rd., Birkdale, Southport, M/side, PR8 4RZ
Phone: Southport (0704) 64935

100 Resistors 75p

¼W 5% c/FILM 2 2Ω–2·2MΩ (E12)
10 each of any value

C60 CASSETTES 32p
C90 CASSETTES 45p
All Cassettes in Plastic Case with Index and Screwed Assembly

All prices include VAT. Add Postage 10p in £1.

Quantity Discounts
10 Units 5%
50 Units 7%
100 Units 10%

SALOP ELECTRONICS
23 WYLE COP,
SHREWSBURY
Tel. 53206

PRINTED CIRCUIT BOARDS supplied in glass fibre and drilled varnished (**8p** per sq in) or tinned (**10p** per sq in). P. & P. 30p. R. F. DARLISON, 1 Valentine Drive, Oadby, Leicester. Tel. (0533) 716273.

PRINTED CIRCUITS and HARDWARE

Readily available supplies of Constructors' hardware, Aluminium sheet and sections. Printed circuit boards, top quality for individual or published designs.

Prompt service.

Send 15p for catalogue.

RAMAR CONSTRUCTOR SERVICES
Masons Road, Stratford on Avon
Warwicks. Tel. 4879

CLEARING LABORATORY, scopes, recorders, testmeters, bridges, audio, R.F. generators, turntables, tapeheads, stabilised P.S.U.s, sweep generators, test equipment, etc. Lower Beeding 236.

NOTA BENE

When replying to Classified Advertisements please ensure:
(A) That you have clearly stated your requirements.
(B) That you have enclosed the right remittance.
(C) That your name and address is written in block capitals, and
(D) That your letter is correctly addressed to the advertiser.
This will assist advertisers in processing and despatching orders with the minimum of delay.

SINTEL

SINTEL FOR KITS-CMOS-DISPLAYS-MEMORIES-BOOKS-MICROPROCESSORS

Components from leading manufacturers only

KITS

CAR CLOCK "AUT-CK" £17·85

The SINTEL Autoclock is a four-digit car clock in an attractive mini white case. Features: large 0·5in red LED displays—High frequency quartz crystal timebase—an internal backup battery supplies power if the car battery voltage drops below nine volts when starting the engine, or if the clock is temporarily disconnected—only high quality components are used, Piher resistors, roller tinned fiberglass PCB's, etc. Full instructions included. Simple but sophisticated circuitry gives you good performance at low cost. You benefit from our experience in clock design.

Complete kit less battery—Order as "AUT-CK" .... £17·85
Also available less case—order as "AUT-MODULE KIT" .... £16·45
Other Kits: For details see previous adds or Catalogue:
"ACK" Advanced 6 digit alarm clock kit .... £26·80
"GCK" 4 digit mini mantlepiece clock (green displays) .... £14·40
"XTK" 50Hz crystal timebase kit .... £6·28
"ACK + BBK + XTK" .... £33·58   "GCK + GBBK + XTK" .... £19·40

*Send or phone for **FREE CATALOGUE** giving details of our complete range of **Clock kits, LED displays, Cases**, and other components*

memory ic's and microprocessors

Please: Microprocessors should only be bought by experienced constructors. Sorry, we cannot answer technical queries or supply data other than from our data selection.

MPU's

IM6100CCDL	£45·36
8080A (2μS)	£32·25
6800	£33·87
ISPA/500 (SC/MP)	£18·75
2650	£27·00
6820	£17·67
6850	£17·67
8224	£9·76
8228	£12·16
8251	£17·67
8255	£17·67

MEMORY IC's
Intel 2102–6 (New version of 2102–2. 16 pin IC, TTL compatible. Single +5V supply. 650nsec., 1024 × 1 bit Static NMOS RAM .... £3·61
Intel 2112A-4 650nsec. 256 × 4 bit Static NMOS RAM .... £4·76
Intersil IM6508C CMOS 1024 × 1 bit Static RAM .... £8·05

SINTEL

Add 8% VAT + 25p P. & P. on all orders. Phone orders see "Fast service" for details. Export orders welcome, but you must contact us first for special order form and postage rates. **OFFICIAL ORDERS WELCOME.**

DATABOOKS and DATASHEETS (NO VAT ON THESE)

NEW 1976 RCA CMOS and Linear IC Combined Databook .... £6·70
New 1976 RCA Databook on Power Transistors, SCR's, Thyristors, etc .... £7·30
National Semiconductor 7400 series TTL Databook, c. 200 pages .... £3·45
T.I. Pin-Out Card Index. Set of cards with pin-outs (top and bottom views) of T.I. TTL range and many other T.I. IC's .... £2·95
Intel Memory Design Handbook, c. 280 pages .... £5·20
Intel 8080 Microcomputer Systems Users Manual, c. 220 pages .... £5·25
Motorola McMOS Databook (Vol 5 Series A) c. 500 pages .... £3·50
Motorola M6800 Microprocessor Applications Manual, c. 550 pages .... £12·95
Motorola M6800 Programming Manual, c. 200 pages .... £5·35
Motorola Booklet Introducing Microprocessors .... £1·80
National SC/MP Introkit Users Manual .... £0·75
National SC/MP Programming and Assembly Manual .... £6·30
National SC/MP Technical Description .... £1·95
2650 Microprocessor Manual 220 pp .... £24·50
DATASHEETS on Microprocessors: (usually Xerox Copies)
Intersil IM6100, 12 bit, CMOS .... £0·75   RCA CDP1802, 8 bit, CMOS .... £0·75
National SC/MP, 8 bit, low cost .... £0·75   Zilog Z80 (Enhanced 8080) .... £0·75
Signetics 2650, 8 bit, low cost .... £0·75   Motorola MC6800 .... £0·75

FAST SERVICE We guarantee that telephone orders for goods in stock, received by 4.15 p.m. Mon.–Fri. will be despatched the same day First Class Post (books and kits by parcel post), and our stocking is good. Private customers should telephone order quoting their Access or Barclaycard number, with a minimum order value of £5. Official orders no minimum.

CMOS from the top manufacturers, mainly RCA and MOTOROLA

CD4000	0·17	CD4028	1·03	CD4053	1·07	CD4086	0·82
CD4001	0·18	CD4029	1·31	CD4054	1·33	CD4089	1·78
CD4002	0·17	CD4030	0·64	CD4055	1·51	CD4093	0·92
CD4006	1·35	CD4031	2·55	CD4056	1·51	CD4094	2·15
CD4007	0·18	CD4032	1·23	CD4057	27·95	CD4095	1·20
CD4008	1·11	CD4033	1·60	CD4059	5·48	CD4096	1·20
CD4009	0·64	CD4034	2·19	CD4060	1·28	CD4097	4·28
CD4010	0·64	CD4035	1·35	CD4062	9·07	CD4099	2·11
CD4011	0·20	CD4036	3·65	CD4063	1·26	CD4502	1·43
CD4012	0·19	CD4037	1·09	CD4066	0·71	CD4510	1·57
CD4013	0·64	CD4038	1·24	CD4067	4·28	CD4511	1·80
CD4014	1·16	CD4039	3·55	CD4068	0·24	CD4514	3·15
CD4015	1·16	CD4040	1·23	CD4069	0·24	CD4515	3·60
CD4016	0·64	CD4041	0·96	CD4070	0·67	CD4516	1·58
CD4017	1·16	CD4042	0·96	CD4071	0·24	CD4518	1·25
CD4018	1·16	CD4043	1·16	CD4072	0·24	CD4520	1·43
CD4019	0·64	CD4044	1·07	CD4073	0·24	CD4527	1·82
CD4020	1·28	CD4045	1·61	CD4075	0·24	CD4532	1·65
CD4021	1·16	CD4046	1·53	CD4076	1·61	CD4555	1·04
CD4022	1·11	CD4047	1·04	CD4077	0·60	CD4556	1·04
CD4023	0·24	CD4048	0·64	CD4078	0·24	MC14528	1·22
CD4024	0·89	CD4049	0·64	CD4081	0·24	MC14553	4·68
CD4025	0·24	CD4050	0·64	CD4082	0·24	IM6508	8·05
CD4026	1·98	CD4051	1·07	CD4085	0·82		
CD4027	0·64	CD4052	1·07				

CLOCK CHIPS

AY51202	2·89
AY51224	3·50
MK50253	5·60

VEROCASES

751410J	2·84
751411D	3·04
751237J	1·72
751238D	2·15

SUNDRY

CA3130	1·14
uA741	0·35

SOLDERCON PINS

100	0·50
1,000	4·00

SINTEL
53B ASTON STREET
OXFORD
Tel. 0865 49791

BARCLAYCARD

MAGENTA electronics ltd.

PE1, 61 Newton Leys, Burton on Trent, Staffs. DE15 0DW

COMPONENTS AND HARDWARE

LATEST CATALOGUE contains NEW PRODUCTS
(S.A.E. for new products sheet only)
25p VOUCHER INCLUDED
Send for your copy now—25p

BUILD THESE PROJECTS!

EXPERIMENTERS' POWER SUPPLY
TRANSISTOR TESTER
TEST METER RANGE EXTENDER
Circuits and details—send 20p per item—refunded when all parts are ordered. Or send S.A.E. for further information

---

IT'S EASY WHEN YOU KNOW!

To avoid missing your copy of PRACTICAL ELECTRONICS—simply complete this order form and hand it to your newsagent.

ORDER FORM

To: ....
(name of newsagent)

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

Please reserve/deliver every month one copy of PRACTICAL ELECTRONICS until further notice.

My Name ....
Address ....
....
....

CRESCENT RADIO LTD.

164-166 HIGH ROAD, WOOD GREEN, N22
(also) 13 SOUTH MALL, EDMONTON, N.9
MAIL ORDER DEPT.
1 ST. MICHAELS TERRACE, WOOD GREEN, LONDON N22 4SJ
Phone: 888-4474

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 75p. P. & P. +8%.

FERRIC CHLORIDE
Anhydrous ferric chloride in double sealed one pound poly packs.
Our Price 65p + P/P + VAT at 8% per lb.

BARGAIN PROJECT BOX
A plastic box with moulded extrusion rails for PC or Chassis panels with metal front plate fitted with four screws (all supplied). Our Price 50p +8%.

EFFECTS PROJECTOR "150"
No disco should be without our new effects projector, we believe that this is the most versatile machine for projecting coloured images to supplement your music. Spec.: Volts—220/240, a.c., 50 Hz, Lamp—A1/167 150W, Standard Lens—60 mm. A sturdy metal construction and takes a range of lenses and accessories. Comes complete with 6in wheel and ready to use. A bargain at £27 + VAT 8%.

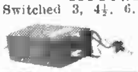
"C100" 100 WATT AMPLIFIER
All built and tested, mounted on a plain aluminium chassis which measures 18 × 9½ × 4in, and which you can mount into a cabinet of your choice.
Four controlled inputs, master volume, treble, middle and bass controls. S/C protected output. 100W clean into 8 ohm L/S. Ideal for disco, music groups, PA. and clubs.
A bargain at **£42** + £1 carr. + 8% VAT.

TI MULTI-METER

Ideal tester for everybody interested in electronics. Weighing less than 100 grammes and only 60 × 24 × 90 mm.
Ranges: A.c. volts: 0-10V, 50V, 250V, 1,000V. D.c. volts: 0-10V, 50V, 250V, 1,000V. D.c. current: 0-1mA, 0-100mA. Resistance: 0-150 kohm.
Price **£4·75** + 8% VAT.

TIE-CLIP CONDENSER MICROPHONE
Omni-Directional 600 ohm 40–15,000Hz. Extra long lead. Ideal for stage work, conferences, etc.
Price **£8·50** + 12½% VAT.

PPI POWER SUPPLY UNIT
Switched 3, 4½, 6, 7½, 9 and 12V at 500 mA.



With on/off switch and pilot light.
Size: 130 × 55 × 75 mm.
Only **£4·50** + 8% VAT.

CASSETTE MICROPHONE
On/off switch for remote control. Split lead with 2·5 mm and 3·5 mm plugs, standard cassette mics. to suit all types, Complete with desk rest.
Please state which impedance required, 200 ohm/50 kohm.
Price £1·60 + 12½% VAT.

DUAL/IMP HAND MICROPHONE
The perfect hand/stand mic. for stage, group, disco, etc. Finished in matt silver and black. Cardioid dynamic.
Dual Imp: 600 ohm/50 kohm, 60-15,000Hz. With an on/off switch.
Price **£8·75** + 12½% VAT.

U.K. CARRIAGE 50p UNLESS OTHERWISE STATED
VAT—All prices are excluding VAT. Please add to each item the VAT rate indicated.

TTLs by TEXAS

7400	16p		
74H00	30p	7495	75p
74LS00	32p	7496	90p
74S00	48p	7497	340p
7401	16p	74100	119p
7402	16p	74104	60p
7403	18p	74105	60p
7404	24p	74107	36p
74H04	40p	74109	70p
7405	25p	74110	55p
7406	45p	74111	80p
7407	45p	74116	220p
7408	25p	74118	90p
7409	27p	74120	95p
7410	18p	74121	32p
74H10	30p	74122	53p
7411	28p	74123	73p
7412	28p	74125	70p
7413	36p	74126	76p
7414	96p	74128	90p
7416	35p	74132	76p
7417	40p	74136	81p
7420	18p	74141	85p
7421	43p	74142	300p
7422	27p	74145	90p
7423	36p	74147	275p
7425	33p	74148	173p
7427	40p	74150	136p
7430	18p	74151	77p
7432	34p	74153	92p
7437	37p	74154	164p
7438	37p	74155	97p
7440	18p	74156	97p
7441	85p	74157	96p
7442	75p	74158	160p
7443	130p	74159	220p
7444	130p	74160	108p
7445	108p	74161	108p
7446	108p	74162	108p
7447	90p	74163	108p
7448	90p	74164	130p
7450	18p	74165	150p
7451	18p	74166	136p
7453	18p	74167	340p
7454	16p	74170	250p
7460	20p	74173	160p
7470	32p	74174	130p
7472	32p	74175	92p
7473	36p	74176	130p
7474	37p	74177	130p
7475	48p	74180	118p
7476	37p	74181	324p
7480	54p	74182	88p
7481	108p	74185	144p
7482	85p	74186	995p
7483	95p	74190	155p
7484	103p	74191	160p
7485	130p	74192	130p
7486	36p	74193	130p
7489	340p	74194	130p
7490	43p	74195	104p
7491	90p	74196	130p
7492	55p	74197	130p
7493	43p	74198	214p
7494	96p	74199	218p

C-MOS ICs

4000	21p
4001	21p
4002	21p
4006	110p
4007	22p
4009	67p
4011	21p
4012	21p
4013	55p
4014	110p
4015	120p
4016	54p
4017	110p
4018	120p
4019	54p
4020	120p
4022	100p
4023	21p
4024	75p
4025	19p
4026	220p
4027	81p
4028	152p
4029	120p
4030	58p
4042	90p
4043	100p
4046	150p
4047	110p
4049	68p
4050	54p
4055	120p
4055	140p
4056	145p
4060	120p
4069	40p
4071	29p
4072	29p
4081	25p
4082	29p
4093	95p
4510	142p
4511	160p
4516	140p
4518	140p
4528	130p
4553	575p

MEMORY

RAM	
2102	270p
2112	450p
ROM	
2513	850p

Branded devices from RCA, Texas, Motorola, Mullard, etc.

OP AMPS

1458	75p
301A	40p
3130	100p
3140	100p
3900	70p
536T	300p
709	30p
741	25p
747	70p
748	40p
776	175p

Linear ICs

AY-1-0212	650p
CA3028A	112p
CA3046	85p
CA3048	275p
CA3053	75p
CA3080	97p
CA3089E	250p
CA3090AQ	500p
ICL8038C	370p
ICL8038B	600p
LM318N	175p
LM380	115p
LM381	190p
LM389N	175p
M252	850p
MC1310P	200p
MC1351P	104p
MC1495	370p
MC1496	115p
MC3340P	160p
MFC4000B	90p
NE540L	140p
NE555	40p
NE556	90p
NE561	425p
NE562	425p
NE565	200p
NE566	200p
NE567	200p
2567	400p
SG3402N	275p
SN72710N	45p
SN72733N	150p
SN76003N	275p
SN76008	275p
SN76013N	175p
SN76018	275p
SN76023N	175p
SN76033N	275p
SN76660N	85p
TAA621A	275p
TAA661B	150p
TBA120	75p
TBA641B	300p
TBA651	275p
TBA800	100p
TBA810	125p
TBA820	100p
TDA2020	400p
ZN414	140p

AC125	20p	BF196/7	18p	TIP42C	90p	2N3866	95p
AC126/7	20p	BF200	40p	TIP2955	78p	2N3904/5	22p
AC128	20p	BF244/B	40p	TIS43	40p	2N3906	22p
AC141/2	20p	BF257/8	36p	TIS93	30p	2N4060	12p
AC176	20p	BFR39/40	34p	ZTX108	12p	2N4123/4	22p
AC187/8	20p	BFR79/80	34p	ZTX300	16p	2N4125/6	22p
AC187K	25p	BFR88	40p	ZTX500	20p	2N4401/3	34p
AC188K	25p	BFX29/30	34p	2N697	25p	2N4427	97p
AD149	50p	BFX84/85	30p	2N698	40p	2N4871	40p
AD161/2	30p	BFX86/7/8	30p	2N706/8	22p	2N5296	65p
AF114/5	22p	BFY50	18p	2N918	43p	2N5457/8	40p
AF116/7	22p	BFY51	16p	2N930	19p	2N5459	40p
AF124	36p	BFY52	18p	2N1131/2	25p	2N6027	60p
AF127	36p	BRY39	45p	2N1304/5	45p	2N6107	70p
AF139	43p	BSX19/20	20p	2N1306/7	45p	2N6247	200p
AF239	48p	BU105	175p	2N1613	22p	2N6254	140p
BC107/B	10p	BU108	315p	2N1711	22p	2N6292	70p
BC108/B	10p	MJ2955	130p	2N1893	32p	3N128	97p
BC109/C	11p	MJE340	45p	2N2160	99p	3N140	105p
BC147/8	9p	MJE2955	130p	2N2219	22p	3N141	97p
BC149/C	10p	MJE3055	97p	2N2222	22p	3N187	200p
BC157	11p	MPF102/3	40p	2N2369	15p	40361/2	45p
BC158/9	12p	MPF104/5	40p	2N2484	32p	40409/10	65p
BC169C	16p	MPSA06	37p	2N2646	48p	40411	325p
BC172/B	12p	MPSA12	61p	2N2904/A	22p	40594	90p
BC177/8	20p	MPSA56	37p	2N2905/A	22p	40595	97p
BC179	20p	MPSU06	78p	2N2906/A	24p	40673	70p
BC182/3	12p	MPSU56	98p	2N2926RB	9p		
BC184	14p	OC28	79p	2N2926OYG	11p		
BC187	32p	OC35/36	79p				
BC212	14p	OC71	25p	2N3053	20p		
BC213	12p	R2008B	225p	2N3054	54p		
BC214	16p	R2010B	225p	2N3055	54p		
BC478	32p	TIP29A	50p	2N3442	151p		
BCY70	20p	TIP29C	62p	2N3702/3	14p		
BCY71	24p	TIP30A	60p	2N3704/5	14p		
BD131	40p	TIP30C	72p	2N3706/7	14p		
BD132	43p	TIP31A	56p	2N3708/9	14p		
BD135	54p	TIP31C	68p	2N3773	320p		
BD136	55p	TIP32A	63p	2N3819	27p		
BD139	56p	TIP32C	85p	2N3820	50p		
BD140	60p	TIP33A	97p	2N3823	54p		
BDY56	225p	TIP34A	124p				
BF115	24p	TIP35A	243p				
BF167	25p	TIP35C	290p				
BF173	27p	TIP36A	297p				
BF178	40p	TIP36C	360p				
BF180	40p	TIP41A	70p				
BF184	30p	TIP41C	84p				
BF194/5	12p	TIP42A	78p				

TRIACS

Amp	Volts	
3	400	130p
6	400	162p
6	500	194p
10	400	200p
10	500	270p
15	400	300p
15	500	340p
40430		108p
40669		108p

DIAC

BR100 32p

VOLTAGE REGULATORS (Plastic) Fixed

1 Amp + ve			1 Amp − ve		
5V	7805	130p	5V	7905	200p
12V	7812	130p	12V	7912	200p
15V	7815	130p	15V	7915	200p
18V	7818	150p	18V	7918	200p
24V	7824	150p	24V	7924	200p

LM309K (TO3) 5V 1A, 150p; LM323K (TO3) 5V 3A, 700p; TBA625B (TO5) 12V 0·5A 90p; 7805 (TO3), 150p; 1468 Dual preset ±15V 16 pin DIL, 300p; LM327N Dual Polarity ±15V, ±12V, ±5V, −12V, 100mA 14 pin DIL 300p.
VARIABLE: 723 14 pin DIL, 40p.

OPTO DEVICES

OCP70	40p	TIL209 Red	16p
OCP71	120p	TIL211 Green	34p
ORP12	70p	TIL32 Infrared	75p
3015F	175p	0·2in. Red LED	21p
DL704	160p	0·2in. Green LED	34p
DL707	160p	0·2in. Amber LED	32p
DL747	250p	Mounting clips	2p

SCR-THYRISTORS

1A 50V TO5	43p
1A 100V TO5	48p
1A 400V TO5	56p
3A 400V Stud	61p
16A 400V Plastic	195p
16A 600V Plastic	240p
BT106 1A 700V Stud	140p
C106D 4A 400V Plastic	64p
MCR101 0·5A 15V TO92	30p
2N3525 5A 400V TO66	108p
2N4444 8A 600V Plastic	200p
2N5060 0·8A 30V TO92	34p
2N5064 0·8A 200V TO92	45p

Low Profile DIL SKTS by Texas

8 pin	12p
14 pin	13p
16 pin	14p
18 pin	32p
24 pin	40p
28 pin	60p
40 pin	75p

BRIDGE RECTIFIERS

1A 50V	25p
1A 100V	27p
1A 400V	30p
1A 600V	35p
2A 50V	35p
2A 100V	40p
2A 200V	48p
3A 600V	70p
4A 100V	75p
6A 50V	78p
6A 100V	84p
6A 400V	99p

DIODES

BY100	35p
BY126	12p
BY127	12p
OA47	8p
OA81	15p
OA85	15p
OA90	7p
OA91	8p
OA95	8p
OA200	7p
OA202	9p
1N914	4p
1N4001	6p
1N4002	6p
1N4004	7p
1N4007	8p
1N4148	4p

ZENERS

400mW	11p
1W	22p

OTHER

Z5J 125p

VAT INCLUSIVE PRICES — Add 20p P. & P.
MAIL ORDER ONLY — Govt., Colleges orders accepted

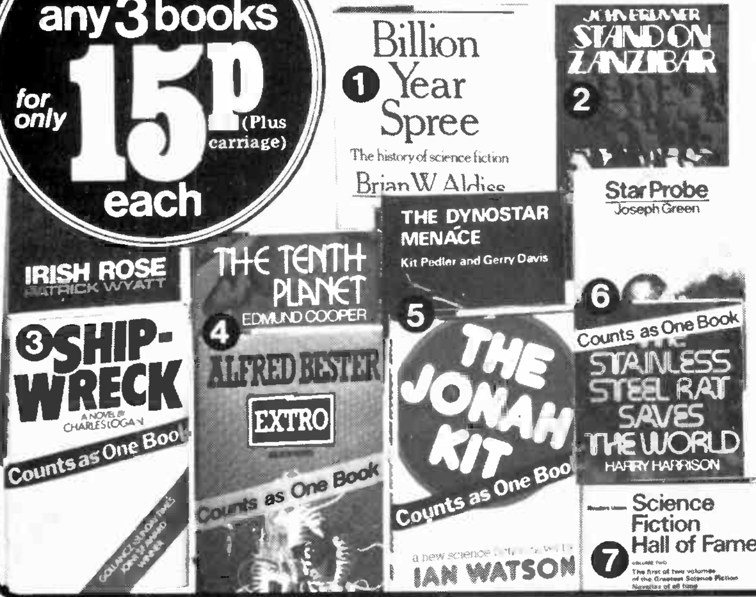
TECHNOMATIC LIMITED

54 Sandhurst Road, London NW9. Tel. 01-204 4333 Telex: 922800

INDEX TO ADVERTISERS

Save up to £17.30 when you join the Science Fiction Book Club

TAKE any 3 books for only 15p (Plus carriage) each



POST TODAY SEND NO MONEY JR

To: Science Fiction Book Club, P.O. Box 6, Brunnel House, Ford Road, Newton Abbot, Devon

I would like to join the Science Fiction Book Club for a six month's membership (one book a month) and will thereafter give one month's notice if I wish to resign. I claim the three introductory books indicated at the special introductory price of 15p each (plus 45p p & p) and will pay on receipt for any books I choose.

PLEASE SEND BOOKS NOS

Mr/Mrs/Miss_____

Address_____

Signature_____

(Signature of Parent Guardian if under 18)

Join the thousands of Science Fiction fans who enjoy monthly selections of hardback SF at paperback prices. Bargains at up to 65% discount off publishers' prices. We bring you all the top writers, your only commitment is to take a book a month for six months. You will stay with us a lot longer when you have seen the hundreds of 'Extra' books offered in our monthly news-letters and catalogues— all at big discounts

P.O. Box 6, Brunnel House, Ford Road, Newton Abbot, Devon

Reg in England No 843946

CAMERA KITS AND READY BUILT MODULES

Whether professional, student, teacher or amateur, a CROFTON module is the answer

Apart from our popular C.C.T.V. Camera Kits we are launching a range of ready built, tested, and guaranteed electronic modules both for trade and end user.

The ultimate range will be extensive. Some of the existing modules available are:

● E.T.I. Master Mixer ● E.T.I. Electronic ignition ● Wide range R.F. Wobbulator ● E.T.I. Digital Voltmeter ● E.T.I. Frequency Meter ● Video Amplifier ● Video Mixer ● Sound/Video Modulator ● Guitar Amplifier ● As well as all E.T.I. P.C.B.s, V.L.F. Transmitters and Receivers ● Send S.A.E. for information

Secondhand cameras and monitors always available

CROFTON ELECTRONICS LTD

Dept. E, 35 Grosvenor Road, Twickenham, Middx. Tel. 01-891 1923

Make light work of wiring with the NEW SELF ADHESIVE WIRE STAPLES

Countless uses in industry and offices

*QUICK AND EASY TO APPLY – EVEN IN AWKWARD PLACES
*SAVES DAMAGE TO WOOD AND PAINTWORK
*STICKS ON INSTANTLY : HOLDS WIRE FIRMLY

You'll save enormous time and trouble with the new Brandauer adhesive staple. Just peel off the backing strip and press staple into place. Then bend clips over to hold wire firmly in position. No messing with pins, tacks, soldering or drilling. No damage to woodwork, e.g. skirting boards. Use the Brandauer Staple for any wall, frame or cabinet wiring jobs — it's wonderfully easy for fitting in those awkward corners.

Send now for details to:

SPECIAL PRODUCTS DISTRIBUTORS LTD.
81 Piccadilly, London W1V OHL. Tel: 01-629 9556.

Published approximately on the 15th of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London EC4. 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.
Subscriptions not available at home or overseas.
International Giro facilities Account No. 5122007. Please state reason for payment, "message to payee".
Practical Electronics is sold subject to the following conditions, namely, that it shall not, with out 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, excluding Eire where the selling price is subject to V.A.T., 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.

The new Maplin Catalogue is no ordinary catalogue...

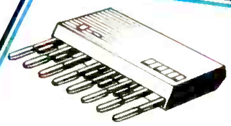
Hundreds of fascinating new lines.

Several major new projects to build.

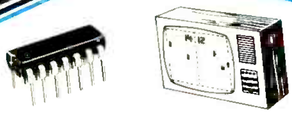
Hundreds of photographs and illustrations

Super Discount Voucher Scheme – saves you pounds!

A range of ready-made musical effects units: Echo Chamber, Fuzz-Waa Pedal, Vibra-Chorus (tremolo, vibrato, phasing). Just compare our prices for these professional units.

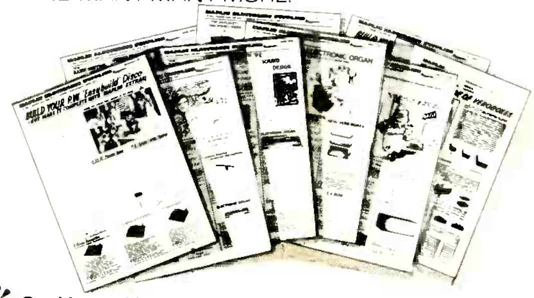


Projects section includes full construction details of a guitarist's/organist's 13-note foot pedal. Features a very realistic bass guitar sound plus four organ stops on two footages. Self-contained, simply plugs into any amplifier.



Semiconductor section includes full details of a range of fascinating I.C.s: TV games, Rhythm generator, Preset on and off timer/clock—plus radio I.C.s, op. amps., voltage regulators, mono and stereo power amp. I.C.s, etc.

Catalogue includes a very wide range of components: hundreds of different capacitors; resistors; transistors; I.C.'s; diodes; wires and cables; discotheque equipment; organ components; musical effects units; microphones; turntables; cartridges; styli; test equipment; boxes and instrument cases; knobs, plugs and sockets; audio leads; switches; loudspeakers; books; tools – AND MANY MANY MORE.



SEND THIS COUPON FOR **YOUR** COPY OF OUR CATALOGUE ON APPROVAL! Price 50p – SEND NO MONEY NOW.
Please rush me a copy of your brand new 1977/78 catalogue the instant it is published. Only if I am completely satisfied that it is worth every penny, will I send 50p within 14 days of receipt. If I am not satisfied, I may return the catalogue to you within 14 days without obligation. I understand that I need not purchase anything from your catalogue should I choose to keep it.

NAME ______________________

ADDRESS ______________________

______________________ PE2

Maplin Electronic Supplies P.O. Box 3, Rayleigh, Essex, SS6 8LR

Owing to delay in completion of larger warehouse, catalogue will be delayed by up to four weeks – so there's still time to order before publication and get your pack of ten super special offer coupons, giving big discounts on ten different popular items. YOU COULD SAVE POUNDS! – SO DON'T DELAY – FILL IN AND POST COUPON NOW!

* **Our bi-monthly newsletter keeps you up to date with latest guaranteed prices – our latest special offers (they save you pounds) – details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).**

MAPLIN
ELECTRONIC SUPPLIES
P.O. BOX 3, RAYLEIGH, ESSEX SS6 8LR
Shop: 284 London Road, Westcliff-on-Sea, Essex
(Closed on Monday) Telephone: Southend (0702) 47379