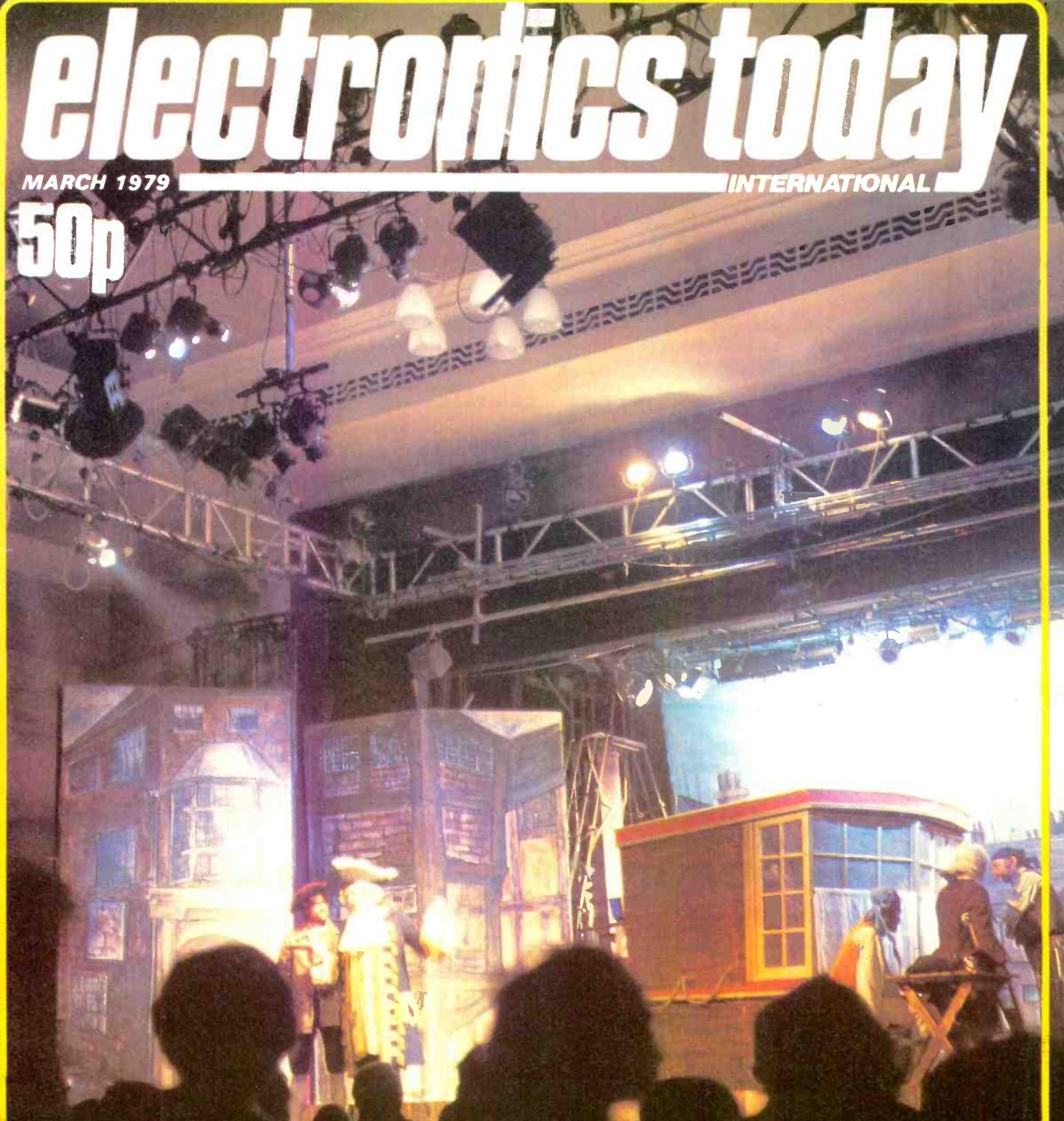


electronics today

MARCH 1979

INTERNATIONAL

50p



STAGE LIGHTING CONTROLLER

Cellular Logic * Analogue To Digital

Visual Hi-Fi * Magnetic Amplifiers

... NEWS ... PROJECTS ... MICROPROCESSORS ... AUDIO ...

CHROMATHEQUE 5000

5 CHANNEL LIGHTING EFFECTS SYSTEM

All kits also available as separate packs (e.g. P.C.B., component sets, hardware sets, etc.) Prices in FREE CATALOGUE



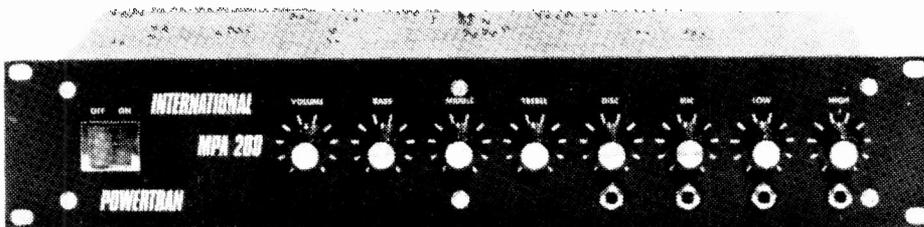
**COMPLETE KIT
ONLY
£49.50 + VAT!**

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward

Kit includes fully finished metalwork, fibreglass PCB, controls, wire, etc. — Complete right down to the last nut and bolt!

LAST MONTH'S FRONT COVER FEATURE!

100 WATT (rms into 8Ω) MIXER / AMPLIFIER



**COMPLETE KIT
ONLY
£49.90 + VAT!**

Parts to build power amp module only. (PCB, res, caps, s/cs)

£10.60 + VAT

Custom designed toroidal transformer with mounting clamp

£10.50 + VAT

Parts for power supply only (caps, rects, fuses, F. holders)

£3.40 + VAT

Kit includes fully finished metalwork, fibreglass PCB, controls, wire, etc. Complete right down to the last nut and bolt!

TRANSCENDENT 2000

SINGLE BOARD SYNTHESIZER

LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.

The TRANSCENDENT 2000 is a 3 octave instrument transposable 2 octaves up or down giving an effective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, fully assembled solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or 1/2% metal trim) and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibreglass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it can be built easily in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesizer comparable in performance and quality with ready built units selling for between £500 and £700!



**COMPLETE KIT
ONLY
£172.00 + VAT!**

Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more elaborate than a multi-meter and a pair of ears!

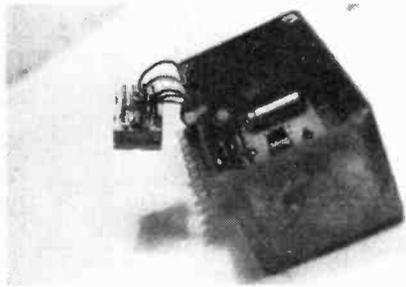
POWERTRAN

Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

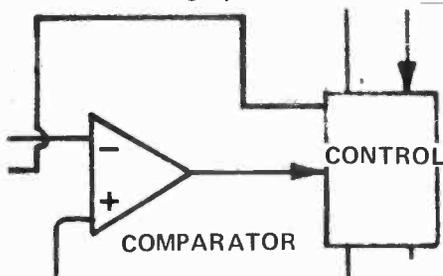
**ORDERING INFORMATION
AND MORE KITS ON PAGE 6**

electronics today

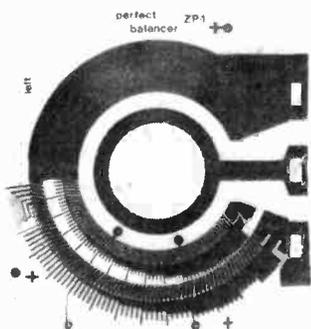
MARCH 1979 VOL 8 NO 3 INTERNATIONAL



Strike a Light p27



p14



Gold in them hills p75

FEATURES

- NEWS DIGEST **9** All the latest
- ANALOGUE TO DIGITAL CONVERSION **14** Modern conversion techniques
- CLIP **33** Cellular Logic Image processors Ok?
- WHO NEEDS ELECTRONICS **45** Magnetic Amplifiers, watts that?
- MICROFILE **63** News from MPU's
- AUDIOPHILE **75** Visual Hi-Fi but how does it sound?
- TECH-TIPS **81** Your circuits, not bad either

PROJECTS

- HEADLAMP DELAY **27** Watch what your doing
- LOGIC TRIGGER **39** Scope for improvement
- STAGE DIMMER **50** Thespians read on
- POWER METER **67** Just how many watts have you got?

INFORMATION

- HOBBY ELECTRONICS, PREVIEW **25** Don't miss this one!
- BOOK SERVICE **31** Bookworms corner
- MARKET PLACE **36** Watch this space
- ETI PRINTS **38** The finishing touch
- ETI SPECIALS **49** Never be without one
- NEXT MONTH IN ETI **61** Why not place your order now
- SUBSCRIPTIONS **64** Pay now — read later
- COMPUTING TODAY **79** Out on its own, don't miss it

OUR THANKS TO LAMBETH TOWN HALL FOR THE COVER PICTURE THIS MONTH, A SCENE FROM THEIR PRODUCTION OF TREASURE ISLAND.

INTERNATIONAL EDITIONS

- AUSTRALIA Collyn Rivers
Publisher
Les Bell
Acting Editor
- Holland Anton Kriegsman
Editor-in-Chief
- CANADA Steve Braidwood
Editor
Graham Wideman
Assistant Editor
- GERMANY Udo Wittig
Editor



EDITORIAL AND ADVERTISEMENT OFFICE
25-27 Oxford Street, London W1R 1RF. Telephone 01-434 1781/2. Telex 8811896

- Ron Harris B.Sc Editor
- Halvor Moorshead Editorial Director
- Diego Rincon Art Director
- Ray Marston Project Editor
- Rick Maybury, Ian Graham B.Sc Editorial Assistants
- Paul Edwards, Tony Strakas Technical Illustrators
- Pete Howells Production
- Steve Ramsahadeo Project Development
- Margaret Hewitt Administration
- Alan Carlton Office Manager
- Kim Hamlin, Brenda Goodwin Reader Services
- Tim Salmon, Cliff Bailey
- Val Tregidgo
- David Sinfield Provincial Advertising Manager
- Joy Cheshire Advertising Production

PUBLISHED BY Modmags Ltd., 25-27 Oxford Street, London W1R 1RF
DISTRIBUTED BY Argus Distribution Ltd. (British Isles)
Gordon & Gotch Ltd. (Overseas)
PRINTED BY QB Limited, Colchester

Electronics Today International is normally published on the first Friday of the month prior to the cover date

COPYRIGHT: All material is subject to world wide Copyright protection. All reasonable care is taken in the preparation of the magazine to ensure accuracy but ETI cannot be held responsible for it legally. Where errors do occur a correction will be published as soon as possible afterwards.

It's W-W-WINTER S-S-

74 SERIES TTL IC's

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.07	7427	£0.21	7472	£0.19	74107	£0.22	74165	£0.65
7401	£0.09	7428	£0.25	7473	£0.22	74110	£0.35	74166	£0.75
7402	£0.09	7430	£0.08	7474	£0.22	74111	£0.55	74167	£2.00
7403	£0.09	7432	£0.20	7475	£0.27	74116	£0.75	74174	£0.60
7404	£0.09	7433	£0.28	7476	£0.22	74119	£1.10	74175	£0.60
7405	£0.09	7437	£0.20	7480	£0.40	74121	£0.22	74176	£0.55
7406	£0.22	7438	£0.20	7481	£0.80	74122	£0.35	74177	£0.55
7407	£0.22	7440	£0.10	7482	£0.65	74123	£0.38	74180	£0.80
7408	£0.12	7441	£0.45	7483	£0.55	74136	£0.50	74181	£1.25
7409	£0.12	7443	£0.58	7485	£0.82	74141	£0.50	74182	£0.55
7410	£0.09	7444	£0.68	7486	£0.22	74145	£0.54	74184	£1.00
7411	£0.15	7442	£0.38	7484	£0.65	74151	£0.45	74190	£0.68
7412	£0.14	7445	£0.64	7489	£1.60	74153	£0.45	74191	£0.68
7413	£0.22	7446	£0.60	7490	£0.30	74155	£0.45	74192	£0.65
7414	£0.45	7447	£0.45	7491	£0.60	74154	£0.80	74193	£0.60
7415	£0.22	7448	£0.52	7492	£0.32	74155	£0.48	74194	£0.55
7417	£0.22	7450	£0.09	7493	£0.28	74156	£0.48	74195	£0.55
7420	£0.09	7451	£0.09	7494	£0.70	74157	£0.48	74196	£0.60
7421	£0.19	7452	£0.09	7495	£0.95	74160	£0.55	74197	£0.58
7422	£0.15	7453	£0.09	7496	£0.48	74161	£0.60	74198	£1.00
7423	£0.20	7454	£0.09	74100	£0.80	74162	£0.60	74199	£1.00
7425	£0.18	7460	£0.09	74104	£0.35	74163	£0.60	74279	£1.00
7426	£0.21	7470	£0.24	74105	£0.35	74164	£0.65		

CMOS IC's

Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.12	CD4017	£0.85	CD4031	£1.60	CD4055	£1.00
CD4001	£0.13	CD4018	£0.70	CD4035	£0.90	CD4069	£1.15
CD4002	£0.13	CD4019	£0.35	CD4037	£0.78	CD4069	£0.15
CD4006	£0.80	CD4020	£0.80	CD4040	£0.78	CD4070	£0.15
CD4007	£0.14	CD4021	£0.75	CD4041	£0.68	CD4071	£0.15
CD4008	£0.80	CD4022	£0.75	CD4042	£0.68	CD4072	£0.15
CD4009	£0.40	CD4023	£0.13	CD4043	£0.78	CD4081	£0.15
CD4010	£0.42	CD4024	£0.55	CD4044	£0.78	CD4082	£0.16
CD4011	£0.13	CD4025	£0.13	CD4045	£1.15	CD4510	£0.80
CD4012	£0.14	CD4026	£1.00	CD4046	£0.95	CD4511	£0.80
CD4013	£0.35	CD4027	£0.45	CD4047	£0.75	CD4516	£0.85
CD4014	£0.70	CD4028	£0.60	CD4049	£0.35	CD4518	£0.85
CD4015	£0.70	CD4029	£0.40	CD4050	£0.35	CD4520	£0.85
CD4016	£0.35	CD4030	£0.55	CD4054	£0.95		

BOOKS BY BABANI

The following books are offered at 10% off their normal retail price

	Normal Price	Sale Price
BP6	£0.60	£0.45
BP14	£1.10	£0.99
BP22	£0.75	£0.68
BP24	£0.95	£0.86
BP26	£0.85	£0.77
BP27	£0.90	£0.81
BP32	£1.00	£0.90
BP34	£0.95	£0.86
BP35	£0.95	£0.86
BP36	£0.95	£0.86
BP37	£1.10	£0.99
BP39	£1.25	£1.13
BP40	£2.50	£2.25
BP41	£2.75	£2.48
BP42	£0.95	£0.86
BP43	£1.10	£1.00
BP44	£1.15	£1.04
BP45	£1.15	£1.04
BP46	£1.15	£1.04
BP47	£1.15	£1.04
BP48	£1.15	£1.04
BP49	£1.15	£1.04
BP50	£1.15	£1.04
BP55	£0.95	£0.86
BP160	£0.95	£0.86
BP202	£0.95	£0.86
BP205	£0.95	£0.86
BP213	£0.95	£0.86
BP215	£0.95	£0.86
BP216	£0.95	£0.86
BP217	£0.95	£0.86
BP221	£0.95	£0.86
BP222	£0.95	£0.86
BP223	£0.95	£0.86
BP224	£0.95	£0.86
BP225	£0.95	£0.86
BP226	£1.20	£1.08
BP227	£1.20	£1.13
BP228	£1.20	£1.13
RCC	£0.10	£0.09

VPS30 Variable Regulated Stabilised Power Supply Module

Incorporating a short circuit protection and current limiting.

Voltage Regulation	2.30v
Regulated Current	0-2A
AC Input Maximum	25v

Eliminates the use of batteries and thus saves Es — can be used time and time again. **ONLY £7.60 + V.A.T.**

BRAND NEW ITT 923 Silicon Diodes 200mA 200v.	
100 off	£2.00
500 off	£9.00
1,000 off	£15.00
10,000 off	£130.00

Single-sided Fibre-glass Board. S143.

12" x 3 1/2" approx. 2 pcs **£0.60**

THYRISTORS

No THY1A/50	1 Amp	50 volt	T05	18p
No THY1A/400	1 Amp	400 volt	T05	32p
No THY3A/50	3 amp	50 volt	T064	25p
No THY3A/200	3 Amp	200 volt	T064	32p
No THY3A/400	3 Amp	400 volt	T064	40p
No THY5A/50	5 Amp	50 volt	T066	25p
No THY5A/400	5 amp.	400 volt	T066	40p
No THY5A/600	5 Amp	600 volt	T066	50p
No C106/4	6 Amp	400 volt	T0220	42p

TRIAC

S84	8 Amp	400 volt	T0220 Plastic	80p
-----	-------	----------	---------------	-----

DIACS

ITT	V413	equat		12p
BR100	O32			12p

CAPACITOR PAKS

16201	18 Electrolytics	4.7µF — 10µF		
16202	18 Electrolytics	10µF — 100µF		
16203	18 Electrolytics	100µF — 680µF		
All 3 at SPECIAL PRICE of £1.20*				
16160	24 Ceramic Caps	22pF — 82pF		
16161	24 Ceramic Caps	100pF — 390pF		
16162	24 Ceramic Caps	470pF — 3300		
16168	21 Ceramic Caps	4700pF — 0.047µF		
All 4 at SPECIAL PRICE of £1.60				

RESISTOR PAKS

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

VOLTAGE REGULATORS

Positive				
No MVR7805	µA7805	T0220	55p	
No MVR7812	µA7812	T0220	55p	
No MVR7815	µA7815	T0220	55p	
No MVR7818	µA7818	T0220	55p	
No MVR7824	µA7824	T0220	55p	
Negative				
No MVR7905	µA7905	T0220	75p	
No MVR7912	µA7912	T0220	75p	
No MVR7915	µA7915	T0220	75p	
No MVR7918	µA7918	T0220	75p	
No MVR7924	µA7924	T0220	75p	
µA723C T099	38p	72723	14 pin DIL	38p
LM309K T03				£1.20

SWITCHES

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

AUDIO LEADS

Order No.				
127	Audio lead 5 pin DIN plug to 4 phono plugs			90p*
29	Audio lead 5 pin plug to 5 pin DIN plug — Mirror Image			70p*
130	5-metre lead 2 pin DIN plug to 2 pin DIN inline socket			45p*

AUDIO PLUG AND SOCKET PAKS

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

P.C. BOARD

S110	Mixed Bundle P.C.B. Fibre-glass/paper, single and double-sided. Fantastic value	75p
------	---------------------------------------------------------------------------------	-----

SPECIAL OFFER!

UNTESTED SEMICONDUCTOR PAKS

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

No. 16130	100 Germ. Gold bonded diodes like OA47	40p
No. 16131	150 Germ. Point contact diodes like OA70/81	40p
No. 16132	100 200mA Sil. diodes like OA200	40p
No. 16133	150 75mA Sil. Fast switching diodes like IN4148	40p
No. 16134	50 750mA Sil. top hat Rects.	40p
No. 16135	20 3 amp Sil. stud Rect.	40p
No. 16136	50 400mw Zeners D. O. 7 case	40p
No. 16137	30 NPN Plastic trans. like BC107/8	40p*
No. 16138	30 PNP Plastic trans. like BC177/8	40p*
No. 16139	25 NPN trans. like 2N697/2N1711 T039	40p
No. 16140	25 PNP trans. like 2N2905 T039	40p
No. 16141	30 NPN trans. like 2N706 T018	40p
No. 16143	30 NPN Plastic trans. like 2N3906	40p*
No. 16144	30 PNP Plastic trans. like 2N3905	40p*
No. 16145	30 PNP Germ. trans. like OC71	40p
No. 16147	10 NPN T03 Power trans. like 2N3055	80p

I.C. SOCKET PAKS

No. S66	11 x 8 pin DIL Sockets	£1.00
No. S67	10 x 14 pin DIL Sockets	£1.00
No. S68	9 x 16 pin DIL Sockets	£1.00
No. S69	4 x 2 pin DIL Sockets	£1.00
No. S70	3 x 28 pin DIL Sockets	£1.00

RESISTORS

40 MIXED VALUES 1 watt & 2 watt all £0.60*

PROGRAMMABLE UNIUNCTION

2N6027 supplied with Data £0.24

MATCHED PAIRS OF PNP GERMANIUM MED. POWER TANS

		2 amp	750mW		
	VCE	VCB	HFE		
NKT301	40	60	30-100	35p	per pair
NKT302	40	60	50-100	35p	per pair
NKT303	20	30	30-100	25p	per pair
NKT304	20	30	50-150	25p	per pair

From U.S.A. by

DINDY
SCREW CASED
LOW NOISE
CASSETTES



Order No. S53 10 for £3.50*

HEAD-CLEANING CASSETTE 45p each

RETURN OF THE AL20A

By popular demand — this useful 5 watt RMS Power Amplifier is offered at the re-introductory price of £2.75 + V.A.T. — Hook-up and data supplied.

ETCH RESIST PENS

Order No. 1609 50p each

UNIUNCTION TRANSISTORS

UT46	TIS43	20p
FET's		
2N3819	15p	2N545B 18p

2 AMP. BRIDGE RECTIFIERS

SALE T-T-TIME again!

SPECIAL OFFER! COMPONENT PAKS

Order No	Quantity	Price
16168	5 pieces Assorted Ferrite rods	40p
16169	2 pieces Tuning gangs MW/LW	40p
16170	50 metres Single strand wire assorted wire	40p
16171	10 Reed switches	40p
16172	3 Micro switches	40p
16176	20 Assorted electrolytics	40p
16177	1 pack Assorted Hardware nuts/bolts, etc	40p
16179	20 Assorted tag strips and panels	40p
16180	15 Assorted control knobs	40p
16184	15 Assorted Fuses 100mA 5 amp	40p
16188	60 $\frac{1}{2}$ W resistors mixed values	40p
16187	30 metres stranded wire assorted colours	40p
S100	120 $\frac{1}{4}$ watt resistors Pre-formed 1978 Prod Our mix	60p
S101	120 $\frac{1}{2}$ watt resistors Pre-formed 1978 Prod Mixed values	60p
S102	250 $\frac{1}{4}$ watt resistors Range 100 ohms-10 meg	£2.00
S103	220 $\frac{1}{2}$ watt resistors Range 100 ohms-10 meg	£2.00
S104	60 Low ohms $\frac{1}{4}$ watt resistors 10 100 ohms	60p
S105	40 Low ohms $\frac{1}{2}$ watt resistors 10-Ohms	60p
S106	25 Mixed wirewound resistors	60p
S107	20 Tantalum bead caps 0.22-100M Ω Our mix	£1.00
S108	High-quality electrolytics 10mF-500mF voltage range 15-50V Our mix 40 for	£1.00
16204	C280 Pak Contains 50 metal foil caps	£1.00

POTENTIOMETERS

Slider 40mm TRAVEL

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

Slider 60mm TRAVEL

S30	6 x 2.5K LOG Single	40p
S32	6 x 50K LIN Single	40p
S34	4 x 5K LOG Dual	40p
S36	4 x 100K LOG Dual	40p
S37	4 x 1.3 MEG LOG Dual	40p
S94	6 x 220K LIN Single	40p
S95	6 x 100K LOG Single	40p
S96	6 x 500K LIN Single	40p

S38 Mixed slider pots—various values and sizes, our mix only £1.00

S39 6 x Chrome slider knots 40p

WIREWOUND

S90 Wirewound Pots Linear 1 Watt rpnng Mixed—useful values 5 for £1.00

CARBON TYPES

S91 Car Radio type Dual Switched Pot P.C mounting 100K Lin switched 2.5K Lin each 60p

DUAL POTS P.C. MOUNTING

6mm Shaft

S92 4 x 100K Lin £1.00

S93 4 x 100K Log £1.00

16173 15 Rotary Pot Assorted 40p

16186 25 Pre-sets Assorted Values 40p

ZENER PAKS

No S55 20 mixed values 400mW Zener diodes 3-10V

No S56 mixed values 400mW Zener diodes 11-33V

No S57 10 mixed values 1W Zener diodes 3-10V

No S58 10 mixed values 1W Zener diodes 11-33V

SILICON POWER TRANS. N.P.N.

S97 8D371 2 Amp 1.2w 60Vceo Hfe 40-400 Case T092 with heat tab — 5 for

S98 2N5293 R.C.A. 36w 4 Amps 75Vceo Hfe 30-120 — 5 for

Crystal Ear Pieces

S126 Less plug £0.20

Plugs for above

No 16106 2 5 plastic £0.09

No 1697 3 5 plastic £0.11

Mono Crystal Cartridge

S127 GP91/15C Special Offer £1.00

Nickel Cadmium Rechargeable Batteries, 1.25v

S128 3500D Cell size=U2 £2.50

S129 900C Cell size=1/2U11 £0.90

S130 Complete kit of parts to build nickel cadmium charger £3.50

Super Save Pak

S124 6 x 741P £1.00

S125 5 x 555 £1.00

S138 Suplus/End of Manufacturers Line/Pre-amp with Bass, Treble Volume Control & circuit diagram supplied ONCE ONLY OFFER, £1.25.

S137 20 Assorted Slider Knobs — Chrome Black £1.00

S131 2 x 12v Relays, plastic case £0.70

S132 2 x 24v Relays, plastic case £0.80

S133 1 Switch bank, 5-way incl silver knob £0.75

S134 2 x Magnets suitable for reed switches £0.10

S135 1 Veroboard pak 2 pcs 45sq ins approx £0.80

S136 15 Veroboard pak, 2 pcs 60sq ins approx £1.10

16199 1 Veroboard pak, 30sq ins approx £0.50

16200 15 Veroboard pak, 30sq ins approx £0.50

TOOLS

No 2011 5" wire cutters £1.55

No 2012 5" long wire plier £1.45

SUPER DUPER COMPONENT BOX

Min. 30lbs in weight consisting of a fantastic assortment of Electronic Components — Pots, Resistors, Condensers, Switches, Relays, Board-Semiconductors wire hardware etc etc etc

* This is a large box and is sent separate to your order *

S140. £2.50 including p&p.

TRANSFORMERS SALE OFFER

S141 0.235 240v primary 0-55v at 2Amp secondary £4.50 + £1.00 p&p.

S142 0.349 240v primary 0-20v at 2Amp secondary, £3.50 + £0.86 p&p.

COMPLETE AMPLIFIER KITS

STA15 15 watts per channel amplifier kit CONSISTS: 2 x AL60 — 1 x PA100 — 1 x SPM80 — 1 x 2034 transformer — 2 x coupling capacitors £37.70 inc. V.A.T. + 85p p&p.

STA25 25 watts per channel amplifier kit CONSISTS: 2 x AL60 — 1 x PA100 — 1 x SPM120/45 — 1 x 2040 transformer — 1 x RESERVOIR CAPACITOR — 2 x coupling capacitors £41.45 inc. V.A.T. + £1.16 p&p.

STA35 35 watts per channel amplifier kit CONSISTS: 2 x AL80 — 1 x PA100 — 1 x SPM120 — 1 x 2041 transformer — 1 reservoir capacitor — 2 x coupling capacitors £48.45 inc. V.A.T. + £1.16 p&p.

STA50 50 watts per channel amplifier kit CONSISTS: 2 x AL120 — 1 x PA200 — 1 x SPM120/65 — 1 x 2041 transformer — 1 reservoir capacitor — 2 x coupling capacitors £58.20 inc. V.A.T. + £1.16 p&p.

STA125 125 watts per channel amplifier kit CONSISTS: 2 x AL250 — 1 x PA200 — 2 x SPM120/65 — 2 x 2041 transformers — 1 x reservoir capacitor — 2 x coupling capacitors £72.85 inc. V.A.T. + £1.25 p&p.

TRANSISTORS

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	25p	BC177	12p	BF194	9p	TIP32A	34p	2N1613	15p
AC126	14p	BC178	12p	BF195	9p	TIP32B	35p	2N1711	15p
AC127	16p	BC179	12p	BF196	12p	TIP32C	36p	2N1893	28p
AC128	16p	BC182	9p	BF197	12p	TIP41A	34p	2N2218	15p
AC128K	24p	BC182L	9p	BF200	25p	TIP41B	35p	2N2218A	18p
AC176	16p	BC183	9p	BF209	22p	TIP41C	36p	2N2219	15p
AC176K	24p	BC183L	9p	BF209	22p	TIP42A	36p	2N2219A	18p
AC187	16p	BC184	9p	BF250	12p	TIP42B	37p	2N2221	15p
AC187K	26p	BC184L	9p	BF251	12p	TIP42C	38p	2N2221A	16p
AC188	16p	BC212	10p	BFY52	12p	TIP2955	65p	2N2222	15p
AC188K	26p	BC212L	10p			TIP3055	42p	2N2222A	16p
AD161/		BC213	10p	MPSA05	22p	ZTX107	6p	2N2369	10p
162 MP	80p	BC213L	10p	MPSA06	22p	ZTX108	6p	2N2904	14p
AF139	30p	BC214	10p	MPSA55	22p	ZTX109	7p	2N2904A	15p
AF239	30p	BC214L	10p	MPSA56	22p	ZTX300	7p	2N2905	14p
BC107	6p	BC251	10p			ZTX301	7p	2N2905A	15p
BC108	6p	BCY70	12p	OC44	12p	ZTX302	9p	2N2906	12p
BC109	6p	BCY71	12p	OC45	12p	ZTX500	8p	2N2906A	14p
BC118	10p	BCY72	12p	OC71	9p	ZTX501	10p	2N2907	12p
BC147	8p	BD115	40p	OC72	12p	ZTX502	12p	2N2907A	13p
BC148	8p	BD131	35p	OC75	10p	2N696	10p	2N2926G	8p
BC149	8p	BD132	37p	OC81	14p	2N697	10p	2N2926Y	7p
BC154	16p	BF115	17p	TIP29A	35p	2N706	7p	2N3053	12p
BC157	9p	BF167	19p	TIP29B	36p	2N706A	8p	2N3055	35p
BC158	9p	BF173	20p	TIP29C	36p	2N708	8p	2N3702	7p
BC159	9p	BF180	25p	TIP30A	36p	2N1302	12p	2N3703	7p
BC169	10p	BF181	25p	TIP30B	37p	2N1303	15p	2N3704	6p
BC170	6p	BF182	25p	TIP30C	38p	2N1304	15p	2N3903	11p
BC171	6p	BF183	25p	TIP31A	32p	2N1307	18p	2N3904	11p
BC172	6p	BF184	25p	TIP31B	33p	2N1308	22p	2N3905	11p
BC173	7p	BF185	25p	TIP31C	34p	2N1309	22p	2N3906	11p

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA119	5p	BAX16/		BYZ16	30p	OA85	7p	IS44	3p
AAZ13	4p	OA202	5p	BYZ17	28p	OA90	6p		
BA100	6p			BYZ18	28p	OA91	7p	IN5400	10p
BA115	5p	BY100	15p	BYZ19	28p	OA95	7p	IN5401	11p
BA144	5p	BY127	10p	OA47	5p			IN5402	12p
BA148	10p	BY210	32p	OA70	5p	IN34	5p	IN5404	13p
BA173	10p	BY211	32p	OA79	7p	IN60	6p	IN5406	16p
BAX13/		BY212	32p	OA81	7p	IN914	4p	IN5407	17p
OA200	5p	BY213	30p			IN148	4p	IN5408	19p

LINEAR I.C.'s

TBA800	£0.75	uA709	£0.20	748P	£0.28
TBA810	£0.85	uA711	£0.25	uA748	£0.28
TBA820	£0.65	uA703	£0.20	72558	£0.45
LM380	£0.80	741P	£0.18	MC1310P	£1.25
LM381	£1.25	72741	£0.20	76115	£1.25
72709	£0.20	uA741C	£0.20	NE555	£0.22
		72747	£0.55	SL144A	£1.80

ZN 414 RADIO CHIP 75' OPTOELECTRONICS

DISPLAYS

No 1510 707 LED Display £0.70

No 1511 747 LED Display £1.50

No 1512 727 Dual LED Display £1.55

2ND QUALITY LED PAKS

No 1507 10 Assorted Colours & Sizes £0.75

No S122 10 x 125 Red £0.60

No S123 10 x 2 Red £0.60

LED CLIPS

No 1508/125 125 5 for £0.12

No 1508/2 2 5 for £0.15

No S139 Infra-red Emitter, Fairchild FP1000 £0.50

SPECIAL REDUCTIONS

No 1514 NORP 12 45p each

No S76 OCP71 5 for £1.00

No SB3 5 NIXIE Tubes ITT 5870 ST £2.00

No. S77 (including Data) .

Noen Indicator Lamps 230 AC State Colour (Red, Amber and Green) 25p each

P.O. RELAYS

S85 — 2 Off Post Office relays 40p

BATTERY HOLDERS

to take 6 x HP7's

Order No. 202 10p each

EX-G.P.O. MICROSWITCHES

Order No S51 4 for 50p

CABLE CLIPS

084—50 2 ??? round single pin fixing 30p

MAMMOTH I.C. PAK

Approx 200 Pieces, Assorted fall-out integrated circuits, including Logic, 74 series, Linear, Audio and D.T.L. Many coded devices, but some unmarked — you to identify

Order No 16223 £1.00

POWER SUPPLY STABILIZER BOARD

Unused ex-equipment stabilizer board Input 30V D.C Output 20V Complete with circuit diagram

Order No. SB1 £1.25

ORDERING

Minimum postage and packing for Sale Orders £0.50 PLUS any further postage as stated as per this Sale Advertisement.

Overseas Orders — ADD extra for Air-mail.

V.A.T.

Please ADD V.A.T. as follows: 12½% to items marked *. 8% to unmarked items. NO V.A.T. on Books.

I.C. EXTRACTION TOOL

O/D 2015 30p each

BI-PAK

DEPT. E.T.I. 3, P.O. Box 6, Ware, Herts.

COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

<p>CAPACITORS Electrolytic Axial Leads 10% to +50% Tol</p> <table border="1"> <thead> <tr> <th>µF</th> <th>V.d.c.</th> <th>16</th> <th>25</th> <th>40</th> <th>63</th> </tr> </thead> <tbody> <tr><td>1.0</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>1.5</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>2.2</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>3.3</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>4.7</td><td></td><td></td><td></td><td></td><td>8</td></tr> <tr><td>6.8</td><td></td><td></td><td></td><td></td><td>9</td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td>9</td></tr> <tr><td>15</td><td></td><td>7</td><td>7</td><td></td><td>10</td></tr> <tr><td>22</td><td></td><td>7</td><td>7</td><td></td><td>12</td></tr> <tr><td>33</td><td></td><td>7</td><td>7</td><td></td><td>12</td></tr> <tr><td>47</td><td></td><td>7</td><td>7</td><td>10</td><td>12</td></tr> <tr><td>68</td><td></td><td>8</td><td></td><td></td><td></td></tr> <tr><td>100</td><td></td><td>8</td><td>8</td><td>12</td><td></td></tr> <tr><td>150</td><td></td><td>8</td><td>9</td><td></td><td>29</td></tr> <tr><td>220</td><td></td><td>12</td><td></td><td></td><td></td></tr> <tr><td>330</td><td></td><td></td><td></td><td>24</td><td>34</td></tr> <tr><td>470</td><td></td><td></td><td></td><td>28</td><td>37</td></tr> <tr><td>680</td><td></td><td>19</td><td>28</td><td>36</td><td>50</td></tr> <tr><td>1000</td><td></td><td>23</td><td>25</td><td>55</td><td></td></tr> <tr><td>1500</td><td></td><td>32</td><td></td><td></td><td></td></tr> <tr><td>2200</td><td></td><td>39</td><td></td><td></td><td></td></tr> </tbody> </table> <p>Order Code Cap 015 + µF + V.d.c.</p>	µF	V.d.c.	16	25	40	63	1.0					8	1.5					8	2.2					8	3.3					8	4.7					8	6.8					9	10					9	15		7	7		10	22		7	7		12	33		7	7		12	47		7	7	10	12	68		8				100		8	8	12		150		8	9		29	220		12				330				24	34	470				28	37	680		19	28	36	50	1000		23	25	55		1500		32				2200		39				<p>Electrolytic Can Type High Ripple, IEC Grade 1, Low E.S.R. Supplied complete with Vertical Fixing Clip</p> <table border="1"> <thead> <tr> <th>µF</th> <th>V.d.c.</th> <th>16V</th> <th>25V</th> <th>35V</th> <th>40V</th> <th>50V</th> <th>63V</th> </tr> </thead> <tbody> <tr><td>2200</td><td>16V</td><td>2.6A</td><td>3.6A</td><td>184</td><td></td><td></td><td></td></tr> <tr><td>10000</td><td>16V</td><td>5.8A</td><td>8.1A</td><td>222</td><td></td><td></td><td></td></tr> <tr><td>22000</td><td>16V</td><td>9.8A</td><td>13.7A</td><td>346</td><td></td><td></td><td></td></tr> <tr><td>47000</td><td>16V</td><td>1.3A</td><td>1.8A</td><td>175</td><td></td><td></td><td></td></tr> <tr><td>100000</td><td>16V</td><td>4.6A</td><td>6.4A</td><td>201</td><td></td><td></td><td></td></tr> <tr><td>220000</td><td>16V</td><td>8.0A</td><td>11.2A</td><td>264</td><td></td><td></td><td></td></tr> <tr><td>470000</td><td>16V</td><td>12.8A</td><td>17.9A</td><td>438</td><td></td><td></td><td></td></tr> <tr><td>1000000</td><td>16V</td><td>0.9A</td><td>1.2A</td><td>166</td><td></td><td></td><td></td></tr> <tr><td>2200000</td><td>16V</td><td>2.4A</td><td>3.3A</td><td>188</td><td></td><td></td><td></td></tr> <tr><td>4700000</td><td>16V</td><td>5.6A</td><td>7.8A</td><td>231</td><td></td><td></td><td></td></tr> <tr><td>10000000</td><td>16V</td><td>9.2A</td><td>12.8A</td><td>367</td><td></td><td></td><td></td></tr> <tr><td>22000000</td><td>16V</td><td>1.8A</td><td>2.5A</td><td>190</td><td></td><td></td><td></td></tr> <tr><td>47000000</td><td>16V</td><td>4.0A</td><td>5.6A</td><td>235</td><td></td><td></td><td></td></tr> <tr><td>100000000</td><td>16V</td><td>7.5A</td><td>10.5A</td><td>376</td><td></td><td></td><td></td></tr> <tr><td>220000000</td><td>16V</td><td>4.0A</td><td>5.6A</td><td>222</td><td></td><td></td><td></td></tr> <tr><td>470000000</td><td>16V</td><td>7.8A</td><td>10.9A</td><td>346</td><td></td><td></td><td></td></tr> </tbody> </table> <p>Order Code Cap HR + µF + Volts</p>	µF	V.d.c.	16V	25V	35V	40V	50V	63V	2200	16V	2.6A	3.6A	184				10000	16V	5.8A	8.1A	222				22000	16V	9.8A	13.7A	346				47000	16V	1.3A	1.8A	175				100000	16V	4.6A	6.4A	201				220000	16V	8.0A	11.2A	264				470000	16V	12.8A	17.9A	438				1000000	16V	0.9A	1.2A	166				2200000	16V	2.4A	3.3A	188				4700000	16V	5.6A	7.8A	231				10000000	16V	9.2A	12.8A	367				22000000	16V	1.8A	2.5A	190				47000000	16V	4.0A	5.6A	235				100000000	16V	7.5A	10.5A	376				220000000	16V	4.0A	5.6A	222				470000000	16V	7.8A	10.9A	346				<p>Miniature Low Value Polystyrene, Axial, ±1% Tol., > 63V D.C. Wkg Ceramic Plate, Radial, Low K, 1.8pF - 8.2pF - 25pF Tol., 10-330pF - 2% Tol., 100V D.C. Wkg Ceramic Plate, Radial, Med K, ±10% Tol., 100V D.C. Wkg Ceramic Plate, Radial, High K, ±20% to +80% Tol., 63V D.C. Wkg</p> <table border="1"> <thead> <tr> <th>µF</th> <th>424</th> <th>632</th> <th>630</th> <th>629</th> <th>µF</th> <th>424</th> <th>632</th> <th>630</th> <th>629</th> <th>nF</th> <th>424</th> <th>632</th> <th>630</th> <th>629</th> </tr> </thead> <tbody> <tr><td>1</td><td></td><td></td><td></td><td></td><td>100</td><td>16</td><td>6</td><td></td><td></td><td>10</td><td>25</td><td></td><td></td><td>6</td></tr> <tr><td>1.2</td><td></td><td></td><td></td><td></td><td>120</td><td>16</td><td>8</td><td></td><td></td><td>12</td><td>26</td><td></td><td></td><td></td></tr> <tr><td>1.5</td><td></td><td></td><td></td><td></td><td>150</td><td>16</td><td>8</td><td></td><td></td><td>15</td><td>26</td><td></td><td></td><td></td></tr> <tr><td>1.8</td><td></td><td></td><td></td><td></td><td>180</td><td>16</td><td>8</td><td></td><td></td><td>18</td><td>27</td><td></td><td></td><td></td></tr> <tr><td>2.2</td><td></td><td></td><td></td><td></td><td>220</td><td>16</td><td>8</td><td></td><td></td><td>22</td><td>28</td><td></td><td></td><td>8</td></tr> <tr><td>2.7</td><td></td><td></td><td></td><td></td><td>270</td><td>18</td><td>8</td><td></td><td></td><td>27</td><td>38</td><td></td><td></td><td></td></tr> <tr><td>3.3</td><td></td><td></td><td></td><td></td><td>330</td><td>18</td><td>8</td><td></td><td></td><td>33</td><td>41</td><td></td><td></td><td></td></tr> <tr><td>3.9</td><td></td><td></td><td></td><td></td><td>390</td><td>18</td><td>8</td><td></td><td></td><td>39</td><td>43</td><td></td><td></td><td></td></tr> <tr><td>4.7</td><td></td><td></td><td></td><td></td><td>470</td><td>18</td><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>5.6</td><td></td><td></td><td></td><td></td><td>560</td><td>16</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6.8</td><td></td><td></td><td></td><td></td><td>680</td><td>16</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>8.2</td><td></td><td></td><td></td><td></td><td>820</td><td>16</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td>1000</td><td>16</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>12</td><td></td><td></td><td></td><td></td><td>1200</td><td>16</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>15</td><td></td><td></td><td></td><td></td><td>1500</td><td>18</td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>18</td><td></td><td></td><td></td><td></td><td>1800</td><td>18</td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>22</td><td></td><td></td><td></td><td></td><td>2200</td><td>18</td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>27</td><td></td><td></td><td></td><td></td><td>2700</td><td>18</td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>33</td><td></td><td></td><td></td><td></td><td>3300</td><td>18</td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>39</td><td></td><td></td><td></td><td></td><td>3900</td><td>18</td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>47</td><td></td><td></td><td></td><td></td><td>4700</td><td>23</td><td>7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>56</td><td></td><td></td><td></td><td></td><td>5600</td><td>23</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>68</td><td></td><td></td><td></td><td></td><td>6800</td><td>23</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>82</td><td></td><td></td><td></td><td></td><td>8200</td><td>23</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>	µF	424	632	630	629	µF	424	632	630	629	nF	424	632	630	629	1					100	16	6			10	25			6	1.2					120	16	8			12	26				1.5					150	16	8			15	26				1.8					180	16	8			18	27				2.2					220	16	8			22	28			8	2.7					270	18	8			27	38				3.3					330	18	8			33	41				3.9					390	18	8			39	43				4.7					470	18	8								5.6					560	16	5								6.8					680	16	5								8.2					820	16	5								10					1000	16	5								12					1200	16	5								15					1500	18	6								18					1800	18	6								22					2200	18	6								27					2700	18	6								33					3300	18	6								39					3900	18	6								47					4700	23	7								56					5600	23									68					6800	23									82					8200	23								
µF	V.d.c.	16	25	40	63																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
1.0					8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
1.5					8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
2.2					8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
3.3					8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
4.7					8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
6.8					9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
10					9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
15		7	7		10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
22		7	7		12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
33		7	7		12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
47		7	7	10	12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
68		8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
100		8	8	12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
150		8	9		29																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
220		12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
330				24	34																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
470				28	37																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
680		19	28	36	50																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
1000		23	25	55																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
1500		32																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
2200		39																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
µF	V.d.c.	16V	25V	35V	40V	50V	63V																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
2200	16V	2.6A	3.6A	184																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
10000	16V	5.8A	8.1A	222																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
22000	16V	9.8A	13.7A	346																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
47000	16V	1.3A	1.8A	175																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
100000	16V	4.6A	6.4A	201																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
220000	16V	8.0A	11.2A	264																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
470000	16V	12.8A	17.9A	438																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
1000000	16V	0.9A	1.2A	166																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
2200000	16V	2.4A	3.3A	188																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
4700000	16V	5.6A	7.8A	231																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
10000000	16V	9.2A	12.8A	367																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
22000000	16V	1.8A	2.5A	190																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
47000000	16V	4.0A	5.6A	235																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
100000000	16V	7.5A	10.5A	376																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
220000000	16V	4.0A	5.6A	222																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
470000000	16V	7.8A	10.9A	346																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
µF	424	632	630	629	µF	424	632	630	629	nF	424	632	630	629																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
1					100	16	6			10	25			6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
1.2					120	16	8			12	26																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
1.5					150	16	8			15	26																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
1.8					180	16	8			18	27																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
2.2					220	16	8			22	28			8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
2.7					270	18	8			27	38																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
3.3					330	18	8			33	41																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
3.9					390	18	8			39	43																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
4.7					470	18	8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
5.6					560	16	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
6.8					680	16	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
8.2					820	16	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
10					1000	16	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
12					1200	16	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
15					1500	18	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
18					1800	18	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
22					2200	18	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
27					2700	18	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
33					3300	18	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
39					3900	18	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
47					4700	23	7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
56					5600	23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
68					6800	23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
82					8200	23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
<p>Tantalum Bead 20% Tol</p> <table border="1"> <thead> <tr> <th>µF</th> <th>V.d.c.</th> <th>3.15</th> <th>6.3</th> <th>10</th> <th>16</th> <th>25</th> <th>35</th> </tr> </thead> <tbody> <tr><td>0.1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>0.15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>0.22</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>0.33</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>0.47</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>0.68</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>1.5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>2.2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>3.3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>4.7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6.8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>22</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>33</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>47</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>68</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>Order Code Cap PR + µF + Volts</p>	µF	V.d.c.	3.15	6.3	10	16	25	35	0.1								0.15								0.22								0.33								0.47								0.68								1								1.5								2.2								3.3								4.7								6.8								10								15								22								33								47								68								100								<p>Electrolytic Radial Leads -10% to +50% Tol</p> <table border="1"> <thead> <tr> <th>µF</th> <th>V.d.c.</th> <th>6.3</th> <th>10</th> <th>16</th> <th>25</th> <th>35</th> <th>40</th> <th>50</th> <th>63</th> </tr> </thead> <tbody> <tr><td>47</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>68</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>1.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>1.5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>2.2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>3.3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>4.7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6.8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>22</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>33</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>47</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>68</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>150</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>220</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>Order Code Cap 034 + µF + Volts</p>	µF	V.d.c.	6.3	10	16	25	35	40	50	63	47										68										1.0										1.5										2.2										3.3										4.7										6.8										10										15										22										33										47										68										100										150										220										<p>Polyester Radial Leads Dipped Type, ±20% Tol., 250V D.C. Wkg, C280/352 Style Moulded Type, ±10% Tol., >100V D.C. Wkg, 10.2mm Pitch Centres Moulded Type, ±10% Tol., >100V D.C. Wkg, 7.6mm Pitch Centres</p> <table border="1"> <thead> <tr> <th>µF</th> <th>352</th> <th>360</th> <th>PHE280</th> <th>µF</th> <th>352</th> <th>360</th> <th>PHE280</th> </tr> </thead> <tbody> <tr><td>001</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>0015</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>0022</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>0033</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>0047</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>0068</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>01</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>015</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>022</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>033</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>047</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> <tr><td>068</td><td></td><td></td><td></td><td>5</td><td>6</td><td></td><td></td></tr> </tbody> </table> <p>Order Code Cap 352 Cap 360 Cap PHE280 + Value</p>	µF	352	360	PHE280	µF	352	360	PHE280	001				5	6			0015				5	6			0022				5	6			0033				5	6			0047				5	6			0068				5	6			01				5	6			015				5	6			022				5	6			033				5	6			047				5	6			068				5	6																																																																																																																																																																																																									
µF	V.d.c.	3.15	6.3	10	16	25	35																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
0.1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.15																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.22																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.33																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.47																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.68																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
1.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
2.2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
3.3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
4.7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
6.8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
15																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
22																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
33																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
47																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
68																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
µF	V.d.c.	6.3	10	16	25	35	40	50	63																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
47																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
68																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
1.0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
1.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
2.2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
3.3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
4.7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
6.8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
15																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
22																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
33																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
47																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
68																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
150																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
220																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
µF	352	360	PHE280	µF	352	360	PHE280																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
001				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0015				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0022				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0033				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0047				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0068				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
01				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
015				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
022				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
033				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
047				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
068				5	6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
<p>CASES Small Desk Console - Boss Industrial Mouldings Sloped Front Console, Recessed Top ABS Base, C/W Brass Bushes, In Orange 1mm Aluminium Top Panel Finished Grey</p> <p>Order Code W161, D96, H39 (57) 186 Case BIM1005 OR W215, D130, H47 (73) 268 Case BIM1006 OR</p>	<div style="text-align: center;"> <h2>Professional Components for the Amateur</h2> </div>		<p>HARDWARE D.I.L. Sockets</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>11</th> <th>14</th> <th>13</th> <th>16</th> <th>66</th> <th>78</th> <th>127</th> </tr> </thead> <tbody> <tr><td>8 Pin Low Profile Socket Tin</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>14 Pin Low Profile Socket Tin</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>16 Pin Low Profile Socket Tin</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>24 Pin Low Profile Socket Gold</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>28 Pin Low Profile Socket Gold</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>40 Pin Low Profile Socket Gold</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>Fuseholders</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>10</th> <th>26</th> <th>24</th> <th>23</th> <th>23</th> </tr> </thead> <tbody> <tr><td>Individual Type for 1 x T05 50°C/W</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>Individual Type for 1 x T06 10.5°C/W</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>Individual Type for 1 x T07 7.2°C/W</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>Individual Type for 1 x T012 17°C/W</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>Individual Type for 1 x T022 17°C/W</td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>P.C.B. Components</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>92</th> <th>55/Pack</th> <th>55/Pack</th> </tr> </thead> <tbody> <tr><td>Dialo Pin, Blue Ink, Slow Drying</td><td></td><td></td><td></td></tr> <tr><td>Single Sided P.C.B. Pins .040" Diam. 100 pcs</td><td></td><td></td><td></td></tr> <tr><td>Double Sided P.C.B. Pins .040" Diam. 100 pcs</td><td></td><td></td><td></td></tr> </tbody> </table>	Order Code	11	14	13	16	66	78	127	8 Pin Low Profile Socket Tin								14 Pin Low Profile Socket Tin								16 Pin Low Profile Socket Tin								24 Pin Low Profile Socket Gold								28 Pin Low Profile Socket Gold								40 Pin Low Profile Socket Gold								Order Code	10	26	24	23	23	Individual Type for 1 x T05 50°C/W						Individual Type for 1 x T06 10.5°C/W						Individual Type for 1 x T07 7.2°C/W						Individual Type for 1 x T012 17°C/W						Individual Type for 1 x T022 17°C/W						Order Code	92	55/Pack	55/Pack	Dialo Pin, Blue Ink, Slow Drying				Single Sided P.C.B. Pins .040" Diam. 100 pcs				Double Sided P.C.B. Pins .040" Diam. 100 pcs																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
Order Code			11	14	13	16	66	78	127																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
8 Pin Low Profile Socket Tin																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
14 Pin Low Profile Socket Tin																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
16 Pin Low Profile Socket Tin																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
24 Pin Low Profile Socket Gold																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
28 Pin Low Profile Socket Gold																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
40 Pin Low Profile Socket Gold																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Order Code	10	26	24	23	23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Individual Type for 1 x T05 50°C/W																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Individual Type for 1 x T06 10.5°C/W																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Individual Type for 1 x T07 7.2°C/W																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Individual Type for 1 x T012 17°C/W																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Individual Type for 1 x T022 17°C/W																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Order Code	92	55/Pack	55/Pack																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Dialo Pin, Blue Ink, Slow Drying																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Single Sided P.C.B. Pins .040" Diam. 100 pcs																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Double Sided P.C.B. Pins .040" Diam. 100 pcs																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
<p>Plastic Boxes - Boss Industrial Mouldings Moulded Box and Close Fitting Flanged Lid ABS Box, C/W Brass Bushes, and Lid in Orange</p> <p>Order Code L112 W62 D31 87 Case BIM2003 OR L150 W80 D50 115 Case BIM2005 OR L190 W110 D60 195 Case BIM2006 OR</p>	<div style="text-align: center;"> <h2>Professional Components for the Amateur</h2> </div>		<p>Fuses</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>8</th> <th>17</th> <th>77</th> <th>56</th> </tr> </thead> <tbody> <tr><td>P.C.B. Mounting, Open Type</td><td></td><td></td><td></td><td></td></tr> <tr><td>Chassis Mounting, Open Type</td><td></td><td></td><td></td><td></td></tr> <tr><td>Panel Mounting, Screwdriver Slot</td><td></td><td></td><td></td><td></td></tr> <tr><td>Panel Mounting, Finger Release</td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>Lampholders, Panel Mounting</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>75</th> <th>95</th> </tr> </thead> <tbody> <tr><td>Low Voltage, Red, Amber or Green</td><td></td><td></td></tr> <tr><td>Internal Neon 200/240V Red or Amber</td><td></td><td></td></tr> </tbody> </table>	Order Code	8	17	77	56	P.C.B. Mounting, Open Type					Chassis Mounting, Open Type					Panel Mounting, Screwdriver Slot					Panel Mounting, Finger Release					Order Code	75	95	Low Voltage, Red, Amber or Green			Internal Neon 200/240V Red or Amber																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Order Code			8	17	77	56																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
P.C.B. Mounting, Open Type																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Chassis Mounting, Open Type																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Panel Mounting, Screwdriver Slot																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Panel Mounting, Finger Release																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Order Code	75	95																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Low Voltage, Red, Amber or Green																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Internal Neon 200/240V Red or Amber																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
<p>Plastic Boxes with Metal Lids - Boss Industrial Mouldings Recessed Top Box ABS Base, C/W Brass Bushes, In Orange 1mm Aluminium Top Panel Finished Grey</p> <p>Order Code L85 W56 D29 97 Case BIM4003 OR L111 W71 D42 130 Case BIM4004 OR L161 W96 D53 182 Case BIM4005 OR</p>	<div style="text-align: center;"> <h2>Professional Components for the Amateur</h2> </div>		<p>Bulbs, Low Voltage, L.E.S.</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>22</th> </tr> </thead> <tbody> <tr><td>6V, 0.36W; 6.5V, 1W; 14V, 0.75W</td><td></td></tr> </tbody> </table>	Order Code	22	6V, 0.36W; 6.5V, 1W; 14V, 0.75W																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
Order Code			22																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
6V, 0.36W; 6.5V, 1W; 14V, 0.75W																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
<p>RESISTORS Carbon Film, Fixed</p> <table border="1"> <thead> <tr> <th>0.25W, E24 Values IRO-10M, 5% Tol.</th> <th>1.5 ea.</th> <th>90p/100 (Mult 10/Value)</th> <th>£7.90/1000 (Mult 100/Value)</th> <th>Res RD%</th> <th>Order Code</th> </tr> </thead> <tbody> <tr><td>0.5W, E12 Values IRO-4M7, 10% Tol.</td><td>2 ea.</td><td>1.25p/100 (Mult 10/Value)</td><td>£10.10/1000 (Mult 100/Value)</td><td>Res RD% + Value</td><td></td></tr> </tbody> </table> <p>Metal Film, Fixed</p> <table border="1"> <thead> <tr> <th>0.5W, E24 Values, SR1-M, 2% Tol.</th> <th>6 ea.</th> <th>3.80/100 (Mult 10/Value)</th> <th>£32.40/1000 (Mult 100/Value)</th> <th>Res MR30</th> <th>Order Code</th> </tr> </thead> <tbody> <tr><td>2.5W, E12 Values 10R-27K, 5% Tol.</td><td>13 ea.</td><td>7.90/100 (Mult 10/Value)</td><td></td><td>Res PR52 + Value</td><td></td></tr> </tbody> </table> <p>Metal Glaze, Fixed</p> <table border="1"> <thead> <tr> <th>0.5W, E24 Values, IM-33M, 5% Tol.</th> <th>10 ea.</th> <th>5.40/100 (Mult 10/Value)</th> <th></th> <th>Res VR37 + Value</th> <th>Order Code</th> </tr> </thead> <tbody> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>	0.25W, E24 Values IRO-10M, 5% Tol.	1.5 ea.	90p/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD%	Order Code	0.5W, E12 Values IRO-4M7, 10% Tol.	2 ea.	1.25p/100 (Mult 10/Value)	£10.10/1000 (Mult 100/Value)	Res RD% + Value		0.5W, E24 Values, SR1-M, 2% Tol.	6 ea.	3.80/100 (Mult 10/Value)	£32.40/1000 (Mult 100/Value)	Res MR30	Order Code	2.5W, E12 Values 10R-27K, 5% Tol.	13 ea.	7.90/100 (Mult 10/Value)		Res PR52 + Value		0.5W, E24 Values, IM-33M, 5% Tol.	10 ea.	5.40/100 (Mult 10/Value)		Res VR37 + Value	Order Code							<div style="text-align: center;"> <h2>Professional Components for the Amateur</h2> </div>		<p>Skeleton Presets, Miniature</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>7</th> <th>7</th> </tr> </thead> <tbody> <tr><td>0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting</td><td></td><td></td></tr> <tr><td>0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting</td><td></td><td></td></tr> </tbody> </table> <p>Skeleton Presets, Standard</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>10</th> <th>10</th> </tr> </thead> <tbody> <tr><td>0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting</td><td></td><td></td></tr> <tr><td>0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting</td><td></td><td></td></tr> </tbody> </table> <p>Potentiometer, Rotary</p> <table border="1"> <thead> <tr> <th>Order Code</th> <th>34</th> <th>34</th> </tr> </thead> <tbody> <tr><td>0.5W, E3 Values, 1K-2M2 Lin</td><td></td><td></td></tr> <tr><td>0.25W, E3 Values, 4K7-2M2 Log</td><td></td><td></td></tr> </tbody> </table>	Order Code	7	7	0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting			0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting			Order Code	10	10	0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting			0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting			Order Code	34	34	0.5W, E3 Values, 1K-2M2 Lin			0.25W, E3 Values, 4K7-2M2 Log																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.25W, E24 Values IRO-10M, 5% Tol.	1.5 ea.	90p/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD%	Order Code																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0.5W, E12 Values IRO-4M7, 10% Tol.	2 ea.	1.25p/100 (Mult 10/Value)	£10.10/1000 (Mult 100/Value)	Res RD% + Value																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
0.5W, E24 Values, SR1-M, 2% Tol.	6 ea.	3.80/100 (Mult 10/Value)	£32.40/1000 (Mult 100/Value)	Res MR30	Order Code																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
2.5W, E12 Values 10R-27K, 5% Tol.	13 ea.	7.90/100 (Mult 10/Value)		Res PR52 + Value																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
0.5W, E24 Values, IM-33M, 5% Tol.	10 ea.	5.40/100 (Mult 10/Value)		Res VR37 + Value	Order Code																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Order Code	7	7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Order Code	10	10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Order Code	34	34																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
0.5W, E3 Values, 1K-2M2 Lin																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.25W, E3 Values, 4K7-2M2 Log																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					

POWERTRAN

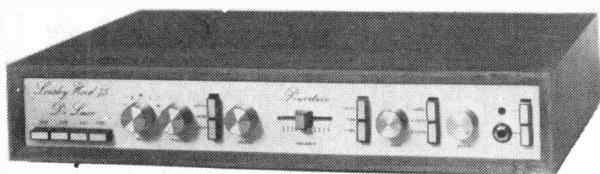
PSI 4002 STUDIO MODEL



cabinet size 17.2" x 17.2" x 6.7"

COMPLETE KIT ONLY £196.90 + VAT

READ THE REVIEW
IN SOUND INTERNATIONAL DEC. '78!



T20 + 20 20W STEREO AMPLIFIER £33.10 + VAT

This kit, based upon a design published in Practical Wireless, uses a single printed circuit board and offers at very low cost, ease of construction and all the normal facilities found on quality amplifiers. A 30 watt version of this kit (T30 + 30) is also available for £38.40 + VAT.

POWERTRAN SFMT TUNER £35.90 + VAT

This is a simple low cost design which can be constructed easily without special alignment equipment but which still gives a first-class output suitable for feeding any of our very popular amplifiers or any other high quality audio equipment. A phase-locked-loop is used for stereo decoding and controls include switchable afc, switchable muting and push-button channel selection (adjustable by controls on the front panel). This unit matches well with the T20 + 20 and T30 + 30 amplifiers.

WWII TUNER £47.70 + VAT

This cost reduced model of our highly successful Wireless World FM Tuner kit was designed to complement the T20 + 20 and T30 + 30 amplifiers and the cabinet size, front panel format and electrical characteristics make this tuner compatible with either. Facilities included are pre-aligned front-end module, switchable afc, adjustable switchable muting, LED tuning indication and both continuous and push-button channel selection (adjustable by controls on the front panel).

COMPLETE KITS: Our complete kits really are complete. All of the projects shown on this page are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet, cables, nuts, bolts, etc., and full instructions — in fact everything!

All of the kits shown on this page are available as separate packs (except the Powertran SFMT Tuner) for those customers who wish to spread their purchase or perhaps make their own cabinets or metalwork. Prices are given in our FREE CATALOGUE.

PRICE STABILITY: Order with confidence irrespective of any price changes. We will honour all prices in this advertisement until April 30th, 1979, if the March, 1979, issue is mentioned with your order. Errors and VAT rate changes excluded.

EXPORT ORDERS: No VAT. Postage charged at actual cost plus 50p handling and documentation.

U.K. ORDERS: Subject to 12½% surcharge for VAT* (i.e. add ½ to the price). No charge is made for carriage. *or at current rate if changed.

SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit.

SALES COUNTER: If you prefer to collect your kit from the factory, call at Sales Counter (at rear of factory). Open 9 a.m. - 4.30 p.m. Monday-Thursday

FOR ELECTRONIC KITS OF DISTINCTION

200 + 200 watt AMPLIFIER

As featured in *Electronics Today International*

400W rms continuous — 800W peak!

0.03% THD at FULL power!

PLUS all the following features too!

- * Each channel totally independent with its own stabilised power supply driven by custom designed TOROIDAL transformers!
- * Inherent reliability — monster heat sinks for cool running at the hottest venues — electronic open and short circuit protection!
- * Ultra low feedback (an incredible low 14dB overall!), super high slewing rate (20V/μs), 200W rms continuous to 4 ohm from EACH channel, input sensitivity 0.775V (0dB)
- * Professional quality components, sturdy 19" rack mounting chassis complete with sleeve and feet for free standing work too.
- * Easy to build — plenty of working space with ready access to all components, minimal wiring, extensive instruction suitable for both experience constructors and newcomers to electronics.
- * Value for money — quality and performance comparable with ready-built amplifiers costing over £600!

DE LUXE EASY TO BUILD LINSLEY HOOD
75W STEREO AMPLIFIER £99.30 + VAT

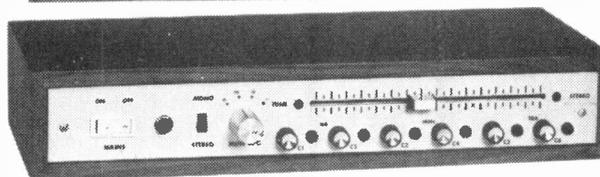
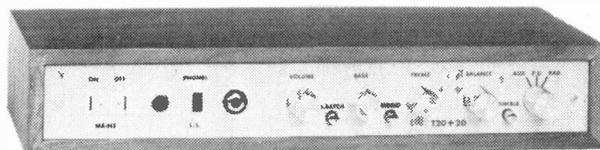
This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in Hi-Fi News and Record Review and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring whilst distortion is less than 0.01%.

WIRELESS WORLD FM TUNER £70.20 + VAT

A pre-aligned front-end module makes this Wireless World published design very simple to construct and adjust without special instruments. Features include an excellent m. rejection, push-button station selection as well as infinitely variable tuning and a phase locked loop stereo decoder incorporating active filters for "birdy" suppression.

LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

This design, published in Wireless World, although straightforward and relatively low cost provides a very high standard of performance. There are separate record and replay amplifiers and switchable equalisation together with a choice of bias levels are also provided. The mechanism is the Goldring-Lenco CRV with electronic speed control.



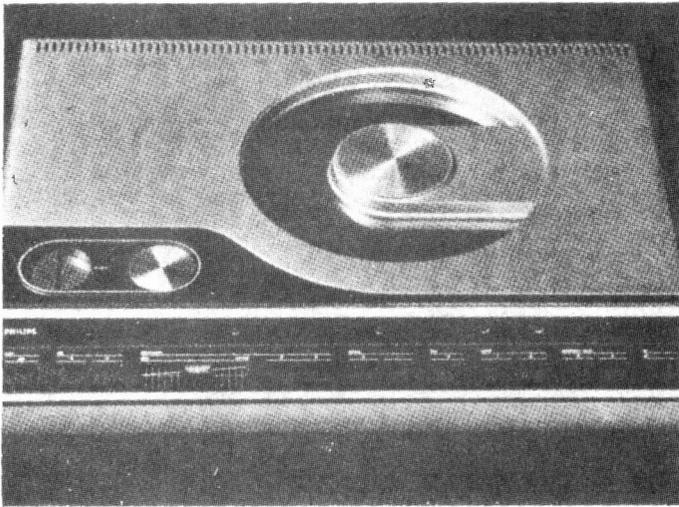
OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NM

ANDOVER
(STD 0264) 64455

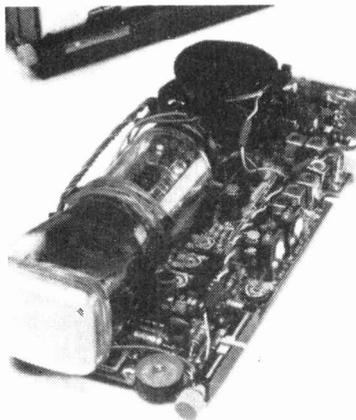
news digest.....



VIDEO DISC REVISITED

It looks like the video disc is rearing its domestic head again. Philips have introduced a 60

minutes per side system, release and price for UK market have yet to be announced, but be prepared for yet another compatibility war as other manufacturers join the fray.



SINCLAIR ANNOUNCE UK MICROVISION

A 'UK only standard' version of the top selling Microvision has been developed by Sinclair Radionics. Outwardly it has the same dimensions as the International version, but fewer controls. Good news for bank managers too, it costs less than half the previous version at less than £100. Further details from Sinclair Radionics, London Road, St Ives, Huntingdon, Cambs. PE17 4HJ.

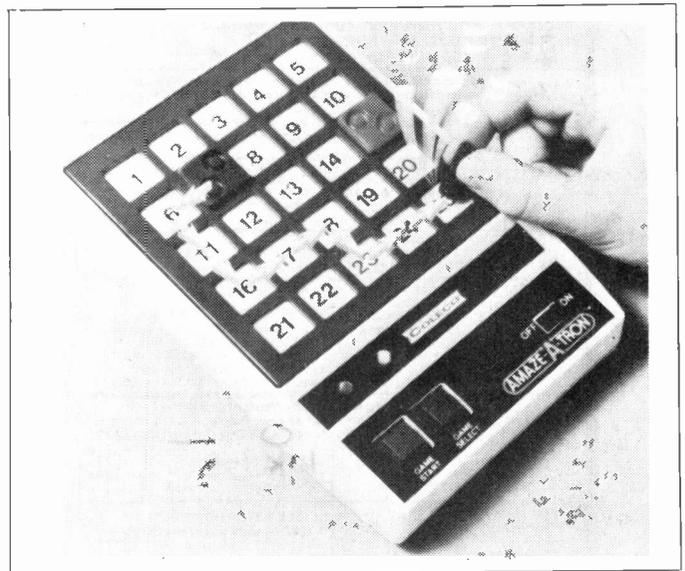
STRIKE A BLOW

We are reliably informed that due to the industrial action within the transport industry, copies of ETI have not reached some areas for last month's (February) issue. We apologise to our readers for this and hop you'll bear with us through the trouble.

Owing to the continuing — as we go to press — troubles, this issue too may be delayed. In some cases this may well be severe. If you read this later than you would normally have done so — thank you for sticking it out, and we promise normal service will be resumed as soon as possible.

Ron Harris
Editor

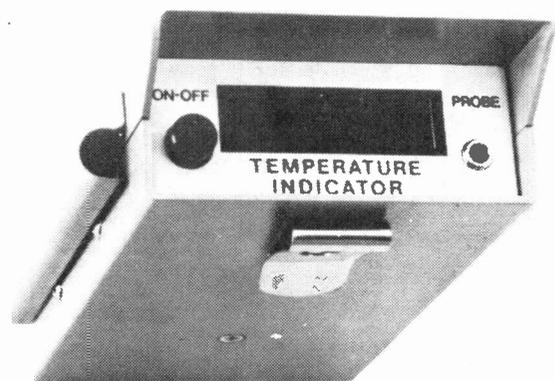
HAND-HELD GAMES



After the inroads made into the leisure market by TV video games, a new generation of hand-held calculator-style games seem to be making their way across the Atlantic. The 'AMAZE-A-TRON' (groan) is a micro-based game specifically aimed at the 5 years and up age range. It is basically a maze game

with a claimed one million variations. Also in the pipeline are 'ZAP' a missile game, 'DIGITS' a code game, and 'LIL GENIUS' a teaching type calculator. Prices will range from £9-£18 and will be marketed by Spectrum Electronic Games, 113-115 Gloucester Road, London SW7 4TE.

HOT STUFF



Details of a new pocket-sized thermometer, 'computerised' no less, have just arrived. Designated the ITS there are four models in the range, two cover the range 0-110°C and the other two from -35°C to 149°C. The LED display can handle Fahrenheit as well as Centigrade. More

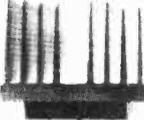
than 25 interchangeable probes are available for various applications, and its rugged high impact aluminium case is ideal for field use. Contact British Rotothem Co Ltd for further details at Kenfig Industrial Estate, Margam, Port Talbot, West Glam. SA13 2PW (South Wales).

WATFORD ELECTRONICS

ILP MODULES 15-240 WATTS

We are now stockists for these world famous fully guaranteed (2 years guarantee on all modules) Pre amps, Amplifiers & Power Supplies

- HY5** Preamplifier Input magnetic pickup 3mV, ceramic 30mV Output Mains 500mV RMS, Distortion 0.1% at 1KHz **Price: £6.27**
- HY30** Amplifier Kit 15 Watts into 8Ω, extremely easy to construct Output 15W RMS, Distortion 0.1% at 15W Freq 10Hz-16KHz Supply +18V **Price: £6.27**
- HY50** Hi-Fi Amplifier Module 25 Watts 8Ω Input Sensitivity 500mV Output 25W RMS, Distortion 0.04% at 25W Freq 10Hz-45KHz Supply +25V **Price: £8.18**
- HY120** Amplifier Module — 60 Watts 8Ω Input sens 500mV Output 60W RMS, Distortion 0.04% Freq 10Hz-45KHz Power Supply +35V **Price: £18.98+**
- HY200** Hi-Fi/Disco Amplifier Module — 120 Watts 8Ω Input sens 500mV 120W RMS, Freq 10Hz-45KHz Power Supply +45V Size 114 x 100 x 85mm **Price: £27.99+**
- HY400** (Big Daddy) Amplifier Module — 240 Watts 4Ω Ideal for High Power Disco or P.A. Output 240 Watts RMS 4Ω 114 x 100 x 85mm, Distortion 0.1% **Price: £38.60+**



- POWER SUPPLIES**
- PSU36 — Drives 2 x HY30s **£6.44**
 - PSU50 — Drives 2 x HY50s **£8.18**
 - PSU70 — Drives 2 x HY120s **£14.58+**
 - PSU90 one HY200 **£15.10+**
 - PSU180 2 x HY200 or one HY400 **£25.42+**

JACK PLUGS		SOCKETS		SWITCHES*		SLIDE 250V		
Screened chrome	Plastic body	open metal	moulded with bakelite	metal	DPST	1A DPDT	1A DPDT c/over	
2.5mm 13p	10p	8p	8p	SPST 28p	DPST 34p	35mm	15p	
3.5mm 13p	10p	8p	8p	DPDT 38p	DPDT 38p	1/2A DPDT	13p	
MONO 25p	14p	13p	20p	4 pole on/off 54p	4 pole 2-way 24p	4 pole 2-way	24p	
STEREO 32p	17p	15p	24p	SUB-MIN TOGGLE	SP changeover 59p	PUSH BUTTON	Spring loaded	
				SPST on/off 54p	SPST c/over 59p	SPST on/off 60p	SPST c/over 65p	
				SPST based 85p	DPDT 6 tag 55p	MINIATURE	Non Locking	
				DPDT 6 tags 70p	DPDT centre off 79p	Push to Make 15p	Push Break 25p	
				DPDT Biased 115p				
DIN	PLUGS	SOCKETS	In Line	ROTORARY	Make your own multiway Switch Adjustable Stop Shifting Assembly. Accommodate up to 6 Wafers 69p			
2 PIN Loudspeaker 10p	7p	20p		Mains Switch DPST to fit 34p	Break Before Make Wafers 1 pole/12 way 2p/6 way 3p/4 way 4p/3 way 6p/2 way 47p	Spacer and Screen 5p		
3.4.5 Audio 13p	8p	20p		ROTORARY (Adjustable Stop)	1 pole/2 to 12 way 2p/2 to 6 way 3 pole/2 to 4 way 4 pole/2 to 3 way 41p			
CO-AXIAL (TV)	14p	14p	14p	ROTORARY	Mains 250V AC 4 Amp 45p			
PHONO	10p	8p single 12p	12p					
assorted colours 15p	8p double 15p 4-way	20p						
BANANA	11p	12p						
4mm 10p	10p							
2mm 10p	10p							
1mm 6p	6p							
WANDER	6p	6p						
3mm 15p	20p							
DC Type 15p	15p							
AC 2-pin American 15p	15p							

TRANSFORMERS* (Mains Prim. 220-240V)

5.0-6V 9.0-9V 12.0-12V 100mA **95p**

8VA: 6V-5A 6V-5A 9V-4A 9V-4A 12V-3A 12V-3A 15V-2.5A 15V-2.5A **195p**

12V: 4 5V-1.3A 4 5V-1.3A 6V-1.2A 6V-1.2A 12V-5A 12V-5A 15V-4A 15V-4A 20V-3A 20V-3A **220p** (20p p&p)

24VA: 6V-1.5A 6V-1.5A 9V-1.3A 9V-1.3A 12V-1A 12V-1A 15V-8A 15V-8A 20V-6A 20V-6A **290p** (45p p&p)

50VA: 6V-4A 6V-4A 9V-2.5A 9V-2.5A 12V-2A 12V-2A 15V-1.5A 15V-1.5A 20V-1.2A 20V-1.2A 25V-1A 25V-1A 30V-8A 30V-8A **350p** (50p p&p)

100VA: 12V-4A 12V-4A 15V-3A 15V-3A 20V-2.5A 20V-2.5A 30V-1.5A 30V-1.5A 40V-1.25A 40V-1.25A 50V-1A 50V-1A **650p** (60p p&p) (N.B. p&p charge to be added above our normal postal charge)

ALUM. BOXES* WITH LID

3x2x1 **45p**

2 1/2 x 5 1/2 x 1 1/2 **68p**

4x4 1/2 **68p**

4x2 1/2 x 1 1/2 **60p**

4x5 1/2 x 1 1/2 **78p**

5x4 1/2 **64p**

6x4 1/2 **88p**

7x5 1/2 **114p**

8x6 1/2 **148p**

10x7 1/2 **172p**

10x4 1/2 x 3 **142p**

12x5 1/2 x 3 **165p**

12x8 1/2 x 3 **210p**

PANEL METERS*

FSD 60x46x35mm **85p**

0-500uA 0-100uA 0-500mA 0-1mA 0-10mA 0-500mA 0-10mA 0-1A 0-2A 0-25V AC 0-50V AC 0-300V AC 0-50V VU **475p each**

4 1/2 x 3 1/2 x 1 1/2 0-50uA 0-100uA 0-500uA **595p each**

OHIO SCIENTIFIC Superboard II **£263.84+**

ETI CLICK Eliminator All parts available

COMPUTER HARDWARE*

2101 **99p**

2102 **100p**

2111 **175p**

2114 **785p**

2513 **595p**

2516 **£29.50**

2532 **75p**

2708 **775p**

27L08 **1095p**

2716 **1650p**

3064 **T8A**

4027 **250p**

4047 **750p**

74S188 **165p**

74S262 **875p**

74S287 **325p**

74S470 **325p**

74S475 **825p**

81LS95 **99p**

81LS96 **99p**

9900 **£35**

TMS6011 **325p**

Z80 **1195p**

CMOS*

4000 **15p**

4001 **17p**

4002 **17p**

4006 **105p**

4007 **18p**

4008 **87p**

4009 **50p**

4010 **50p**

4011 **18p**

4012 **18p**

4013 **42p**

4014 **86p**

4015 **89p**

4016 **45p**

4017 **89p**

4018 **4046**

4019 **4047**

4020 **99p**

4021 **91p**

4022 **88p**

4023 **20p**

4024 **65p**

4025 **19p**

4026 **180p**

4027 **45p**

4028 **81p**

4029 **99p**

4030 **58p**

4031 **205p**

4032 **100p**

4033 **145p**

4034 **196p**

4035 **111p**

4036 **325p**

4037 **100p**

4038 **108p**

4039 **320p**

4040 **105p**

4041 **80p**

4042 **75p**

4043 **94p**

4044 **88p**

4045 **145p**

4046 **128p**

4047 **87p**

4048 **58p**

4049 **48p**

4050 **48p**

4051 **72p**

4052 **4097p**

4053 **72p**

4054 **72p**

4055 **4160p**

4057 **4161p**

4059 **4162p**

4060 **4163p**

4063 **4174p**

4066 **4175p**

4067 **4194p**

4068 **22p**

4069 **22p**

4070 **32p**

4071 **21p**

4072 **21p**

4073 **21p**

4075 **23p**

4076 **86p**

4077 **40p**

4078 **21p**

4081 **20p**

4082 **21p**

4085 **74p**

4086 **73p**

4089 **150p**

4090 **85p**

4094 **190p**

4096 **105p**

4097 **372p**

4098 **110p**

4099 **145p**

4100 **109p**

4101 **109p**

4102 **109p**

4103 **109p**

4104 **109p**

4105 **109p**

4106 **109p**

4107 **109p**

4108 **109p**

4109 **109p**

4110 **109p**

4111 **109p**

4112 **109p**

4113 **109p**

4114 **109p**

4115 **109p**

4116 **109p**

4117 **109p**

4118 **109p**

4119 **109p**

4120 **109p**

4121 **109p**

4122 **109p**

4123 **109p**

4124 **109p**

4125 **109p**

4126 **109p**

4127 **109p**

4128 **109p**

4129 **109p**

4130 **109p**

4131 **109p**

4132 **109p**

4133 **109p**

4134 **109p**

4135 **109p**

4136 **109p**

4137 **109p**

4138 **109p**

4139 **109p**

4140 **109p**

4141 **109p**

4142 **109p**

4143 **109p**

4144 **109p**

4145 **109p**

4146 **109p**

4147 **109p**

4148 **109p**

4149 **109p**

4150 **109p**

4151 **109p**

4152 **109p**

4153 **109p**

4154 **109p**

4155 **109p**

4156 **109p**

4157 **109p**

4158 **109p**

4159 **109p**

4160 **109p**

4161 **109p**

4162 **109p**

4163 **109p**

4164 **109p**

4165 **109p**

4166 **109p**

4167 **109p**

4168 **109p**

4169 **109p**

4170 **109p**

4171 **109p**

4172 **109p**

4173 **109p**

4174 **109p**

4175 **109p**

4176 **109p**

4177 **109p**

4178 **109p**

4179 **109p**

4180 **109p**

4181 **109p**

4182 **109p**

4183 **109p**

4184 **109p**

4185 **109p**

4186 **109p**

4187 **109p**

4188 **109p**

4189 **109p**

4190 **109p**

4191 **109p**

4192 **109p**

4193 **109p**

4194 **109p**

4195 **109p**

4196 **109p**

4197 **109p**

4198 **109p**

4199 **109p**

4200 **109p**

4201 **109p**

4202 **109p**

4203 **109p**

4204 **109p**

4205 **109p**

4206 **109p**

4207 **109p**

4208 **109p**

4209 **109p**

4210 **109p**

4211 **109p**

4212 **109p**

4213 **109p**

4214 **109p**

4215 **109p**

4216 **109p**

4217 **109p**

4218 **109p**

4219 **109p**

4220 **109p**

4221 **109p**

4222 **109p**

4223 **109p**

4224 **109p**

4225 **109p**

4226 **109p**

4227 **109p**

4228 **109p**

4229 **109p**

4230 **109p**

4231 **109p**

4232 **109p**

4233 **109p**

4234 **109p**

4235 **109p**

4236 **109p**

4237 **109p**

4238 **109p**

4239 **109p**

4240 **109p**

4241 **109p**

4242 **109p**

4243 **109p**

4244 **109p**

4245 **109p**

4246 **109p**

4247 **109p**

4248 **109p**

4249 **109p**

4250 **109p**

..... news digest

LOST AND FOUND AT SEA DEPARTMENT

An interesting variation on the programmable calculator has sailed into our offices. Texas Instruments have introduced a TI58, complete with brass handled, mahogany case and adaptor/charger. Software in-

cludes a 30 programme navigational package. It will tell you just about everything from where you are, to how fast you'll be going somewhere else. Want to know more, then contact: Texas Instruments Limited, European Consumer Division, Manton Lane, Bedford MK41 7PA.



ELECTRONIC SUMMER SCHOOL

The Department of Electrical Engineering Science at the University of Essex will be holding its annual electronics summer school for teachers during the week 9th-13th July, 1979. This year, as well as courses in linear circuit design and digital circuit design, a third course in electronic systems is also available which is closely related to the A.E.B. electronics systems A-level. Further information on the Summer School may be obtained from The Department of Electrical Engineering Science, University of Essex, Wivenhoe Park, Colchester CO4 3SQ.

ORIENTAL TELETEXT SCHOOL

Sony are to launch a Teletext equipped receiver with infra red remote control. This is the first eastern set in a virtually all-European market. Costing about £800, it is likely to give the home TV industry some added headaches. The sets are to be built at the Bridgend factory.

CATALOGUE CORNER

This month's releases include the 1979 Marshalls catalogue, usual comprehensive assortment of components and hardware. Interesting to see they deal in KIM and PET, all in all not bad for value for your 40p.

Codespeed ELECTRONIC MAIL ORDER

All Full Spec. Devices

T03 HEAT SINKS!!! Two types of heat sink. Ex-equipment, but condition as new. Most still contain a power transistor (condition unknown). Christmas tree type, 92 x 66 x 35mm **20p each**. Rectangular type 130 x 63 x 32mm **30p each**. Please add 25p per heat sink post and packing.

PACK M1. Contains two brand new multifunction calculator keyboards. Excellent key action. Only **£1.00**.

PACK T2. A high contrast 3 1/2 digit Liquid Crystal wristwatch display with data. Don't miss out — only **£1.00**.

PACK T4. At a new low price, what a bargain! A 0.8" common cathode, 3 1/2 digit, 12-hour clock display. Now offered at only **£3.95**.

PACK S1. 25 miniature glass 1N3470 germanium diodes (600mA 35v). All brand new (at just 2p each how can you go wrong?) 25 diodes for **50p**.

PACK S2. 4 x MEU21 programmable unijunction transistors (P.U.T.) Lots of uses long delay timers, oscillators and many more. All brand new. With data and usage sheet, 4 for **50p**.

PACK S3. 10 x 1N4151 high-speed switching diodes. Same as 1N4148, but has higher P.I.V. 10 for **35p**.

PACK P1. With this MM5330 digital voltmeter I.C. we include the data sheet and circuit diagram to build a high accuracy digital multimeter. Only **£3.95**.

PACK E2. Calculator style L.C.D. 8 digit with right-hand decimal points. Digit height 0.33". With data only **£2.95**.

PACK E3. The same as Pack E2, but has 0.5" high digits **£4.25**.

EVER THOUGHT of using 7 segment gas discharge displays as an alternative to LED's or LCD's? Gives a nice bright orange display and are comparatively very low in price. Requires 180v d.c. supply (easily achieved in mains-operated projects) All have right-hand decimal points and are supplied with data.

PACK E4. 0.3" high 1 1/2 digit display. Now only **50p**.

PACK E5. A 0.3" high dual digit display. Now only **50p**.

PACK E7. A 0.25" high 12 digit display with free socket. **£1.50**.

PACK DM1. Want to buy 115 quality switching diodes for 50p? These 14 pin chips each contain 23 matrix diodes. 5 chips for **50p**.

All Untested Packs

PACK M4 CALCULATORS!!! This pack contains a production line reject calculator. Either repair them (not much wrong with some of them) or strip them for spares. Lots of accessible goodies inside, approximately 25 transistors, 2 chips, display case and detachable keyboard. Such a bargain, you can't go wrong. Only **£2.50**.

PACK MU1 (untested — so no guarantees) 2 x Upper half of hand held calculator case with integral keyboard. Ex-equipment, but believed to be O.K. A gift at only **50p** the pair.

PACK DL1 (untested — so no guarantees) A bumper pack of 30 mixed I.C.s. You test them and save EEE's. Could include anything linear or digital. A snip at only **£1.00**.

PACK E1 (80% guaranteed good) Contains 5 seven segment LED displays. Digit height 0.127" with right-hand decimal. Common cathode. Still only **£1.00**.

Your satisfaction is guaranteed or return the complete pack for replacement or a refund.

For free catalogue send stamped addressed envelope. Postage and packing please add 25p (overseas orders add 60p).

CODESPEED, P.O. Box 23, 34 Seafield Road, Copnor, Portsmouth, Hants, PO3 5BJ

..... news digest.....



This is apparently same sort of aircraft navigation aid, but secret sources indicate it is in fact the British Home Stores Lamphard farm.

MAINS OPERATED ELECTRONIC DIGITAL ALARM CLOCK

IMMEDIATE DELIVERY

£8.95

INCL V A T
POST PAID

THREE FOR £26.00
POST FREE

E.T.I. RECOMMEND THIS MODEL

- Hanimex HC-1100
- Large Bright LED display
- White case with red display on black background
- Adjustable dim/bright control
- Silent operation, all electronic
- Space age technology L.S.I. circuitry
- Alarm and 9 minute snooze repeater
- P.M. indicator
- Hour and minute display
- Size 100mm x 130mm x 60mm high
- Fully guaranteed

BARCLAY ACCESS

Just phone in number



HENRY'S
RADIO

HENRY'S RADIO
404 Edgware Rd. London W2
PHONE (01)723 1008 ENGLAND

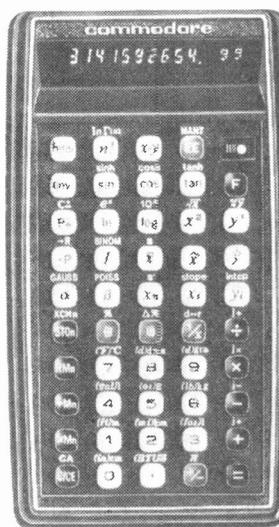
LCD POCKET TV

Matsushita have developed a pocket TV with better resolution than any previous LCD type. 57,600 elements are arranged in a 240x240 matrix which measures 2.4 inches (presumably diagonally). But even though CMOS circuits are used the TV consumes 1.5 W.

BBC TV TRANSMITTER OPENS AT LOCH NESS

We couldn't resist this one, the transmitter is sited at Wester Erchlite, opposite Urquhart Bay. We hear the installation is O.K. so far, but they have had a few teething troubles with programmes like 'All Creatures Great and Small,' something to do with frequency lock.

LANDLUBBER'S CALCULATOR



For those of us who are land-based, and taking O/A or degree level studies, Commodore have introduced an updated version of their successful 419OR, designated the SR919OR. It has nine memories with over 100 scientific functions at only £30. It has all the usual features, 10 + 2 LED display, rechargeable batteries and a 1 year guarantee. Your local calc. shop should be able to show you it in action.

NEW CASES FROM VERO

New Eurocard-sized cardframes have just been announced by Vero. The frames, called the KM6, are available from Vero Electronics Ltd, Industrial Estate, Chandlers End, Eastleigh, Hampshire SO5 3ZR.

STEVENSON

Electronic Components

METAL FILM RESISTORS

A range of high precision, very high stability, low noise resistors. Rated at 1/4W. 1% tolerance. Available from 51 ohms to 330K in E24 series. Any mix

	each	100+	1000+
1/4W 1%	4p	3.5p	3.2p

Special development pack consisting of 10 of every value from 51 ohms to 330K (a total of 930 resistors) £23.75

BRIDGE RECTIFIERS

Type	PIV	I	Type	PIV	I
W005	50	1A	2KBB10	100	2A
W01	100	1A	2KBB20	200	2A
W02	200	1A	2KBB40	400	2A
W04	400	1A	BY225	200	4.2A

REGULATORS

78L05	30p	79L05	70p	LM309K	110p
78L12	30p	79L12	70p	LM317	220p
78L15	30p	79L15	70p	LM323K	530p
7805	60p	7905	80p	LM723	35p
7812	60p	7912	80p		
7815	60p	7915	80p		

SWITCHES

Subminiature toggle. Rated at 3A 250V.

SPDT	65p	SPDT centre off	70p
DPDT	75p	DPDT centre off	90p

Standard toggle.

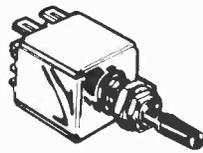
SPST	34p	DPDT	48p
------	-----	------	-----

Wavechange switches.

1P12W, 2P6W, 3P4W or 4P3W all 37p each.

Miniature switches (non-locking)

Push to make	15p	Push to break	20p
--------------	-----	---------------	-----



THYRISTORS AND TRIACS

Plastic cased Thyristors. Texas.

	4A	8A	12A
100V	36p	45p	62p
200V	42p	53p	68p
400V	51p	66p	86p

Plastic cased Triacs. Texas.

All rated at 400V

	4A	70p	12A	90p	20A	185p
	8A	80p	16A	95p	25A	215p

We now have an express telephone order service. We guarantee that all orders received before 5pm. are shipped first class on that day. Contact our Sales Office now! Telephone: 01-464 2951/5770.

ORDERS
DESPATCHED
BY RETURN
POST

Quantity discounts on any mix TTL, CMOS, 74LS and Linear circuits: 25+ 10%. 100+ 15%. Prices VAT inc. Please add 30p for carriage. All prices valid to 30th April 1979. Official orders welcome.

BARCLAYCARD AND
ACCESS WELCOME.



TRANSISTORS

AC127	17p	BCY71	14p	ZTX109	14p
AC128	16p	BCY72	14p	ZTX300	16p
AC176	18p	BD131	35p	2N697	12p
AD161	38p	BD132	35p	3N1302	38p
AD162	38p	BD135	38p	2N2905	22p
BC107	8p	BD139	35p	2N2907	22p
BC108	8p	BD140	35p	2N3053	18p
BC109	8p	BF244B	36p	2N3055	50p
BC147	7p	BFY50	15p	2N3442	135p
BC148	7p	BFY51	15p	2N3702	8p
BC149	8p	BFY52	15p	2N3704	8p
BC158	9p	MJ2955	98p	2N3705	9p
BC177	14p	MPSA06	20p	2N3706	9p
BC178	14p	MPSA56	20p	2N3707	9p
BC179	14p	TIP29C	60p	2N3708	8p
BC182	10p	TIP30C	70p	2N3819	22p
BC182L	10p	TIP31C	65p	2N3904	8p
BC184	10p	TIP32C	80p	2N3905	8p
BC184L	10p	ZTX107	14p	2N3906	8p
BC212	10p	ZTX108	14p	2N4058	12p
BC212L	10p			2N5457	32p
BC214	10p			2N5458	30p
BC214	10p			2N5459	32p
BC477	19p			2N5777	50p
BC478	19p				
BC479	19p				
BC548	10p				
BCY70	14p				

DIODES

1N914	4p	1N4148	3p
1N4001	4p	1N5401	13p
1N4002	4p	1N5402	15p
1N4004	5p	1N5404	16p
1N4006	6p	1N5406	18p

BZY88 series 2V7 to 33V 8p each.

LINEAR

A SELECTION ONLY!
DETAILS IN CATALOGUE.

709	25p	LM324	50p	NE556	60p
741	22p	LM339	50p	NE565	120p
747	50p	LM380	75p	NE567	170p
748	30p	LM382	120p	SN76003	200p
CA3046	55p	LM1830	150p	SN76013	140p
CA3080	70p	LM3900	50p	SN76023	140p
CA3130	90p	LM3909	60p	SN76033	200p
CA3140	70p	MCI1496	60p	TBA800	70p
LM301AN	28p	MCI458	35p	TDA1022	650p
LM318N	125p	NE555	25p	ZN414	75p

OPTO

LEDs	0.125in.	0.2in.	
Red	TIL209	TIL220	9p
Green	TIL211	TIL221	13p
Yellow	TIL213	TIL223	13p
Clips	3p	3p	

DISPLAYS

DL704	0.3 in CC	130p
DL707	0.3 in CA	130p
FND500	0.5 in CC	100p



RESISTORS

Carbon film resistors.
High stability, low noise 5%.

E12 series. 4.7ohms to 10M. Any mix.

	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res.)
0.5W £7.50. 0.25W £5.70

CAPACITORS

HERE ARE JUST
A FEW OF THE
CAPACITORS STOCKED

TANTALUM BEAD	each
0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V	9p
4.7, 6.8, 10uF @ 25V	13p
22 @ 16V, 47 @ 6V, 100 @ 3V	16p

MYLAR FILM

0.001, 0.01, 0.022, 0.033, 0.047	3p
0.068, 0.1	4p

RADIAL LEAD ELECTROLYTIC

63V	0.47	1.0	2.2	4.7	10	5p
			22	33	47	7p
						13p
			220			20p
25V	10	22	33	47		5p
	100					8p
		220				10p
			470			15p
						23p
10V		220				5p
			470			9p
						13p
			2200			23p

74LS

LS00	16p	LS95	65p
LS01	16p	LS123	56p
LS02	16p	LS125	40p
LS03	16p	LS126	40p
LS04	16p	LS132	60p
LS08	16p	LS136	36p
LS10	16p	LS138	54p
LS13	30p	LS139	50p
LS14	70p	LS151	50p
LS20	16p	LS153	50p
LS30	16p	LS155	80p
LS32	24p	LS156	80p
LS37	26p	LS157	45p
LS40	22p	LS164	90p
LS42	53p	LS174	60p
LS47	70p	LS175	60p
LS48	48p	LS190	80p
LS54	16p	LS192	70p
LS73	29p	LS193	70p
LS74	29p	LS196	80p
LS75	44p	LS251	60p
LS76	35p	LS257	55p
LS78	35p	LS258	55p
LS83	60p	LS266	40p
LS85	70p	LS283	60p
LS86	33p	LS290	55p
LS90	45p	LS365	45p
LS93	45p	LS366	45p
		LS367	45p
		LS368	45p
		LS386	35p
		LS670	180p

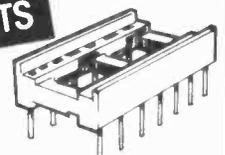
TTL

7493	34p
7494	52p
7495	52p
7496	50p
74121	25p
74122	33p
74123	40p
74125	35p
74126	35p
74132	50p
74141	56p
74148	90p
74150	70p
74151	50p
74156	52p
74157	52p
74164	70p
74165	70p
74170	125p
74174	68p
74177	58p
74190	72p
74191	72p
74192	64p
74193	64p
74196	55p
74197	55p

CMOS FULL DETAILS IN CATALOGUE

4001	15p	4029	60p
4002	15p	4040	68p
4007	15p	4042	54p
4011	15p	4046	100p
4013	35p	4049	28p
4015	60p	4050	28p
4016	35p	4060	40p
4017	55p	4068	20p
4018	65p	4069	16p
4023	15p	4071	16p
4024	45p	4075	16p
4026	95p	4093	48p
4027	35p	4510	70p
4028	52p	4511	70p
		4518	70p
		4520	65p

SKTS



Low profile by Texas

8 pin	10p	24 pin	24p
14 pin	12p	28 pin	28p
16 pin	13p	40 pin	40p

Soldercon pins: 100 50p
1000: 370p

AT LAST! OUR
NEW 40 PAGE
CATALOGUE
OF COMPONENTS
IS AVAILABLE.
SEND S.A.E.



Mail orders to: STEVENSON (Dept ET)

236 High St, Bromley, Kent, BR1 1PQ, England

SINTEL

**SOME 74LSPTL
NOW AVAILABLE
PLEASE SEND FOR LIST**

NEW PRICES AND SOME NEW CMOS ADDITIONS

If you need your CMOS by return - buy it from SINTEL

CD4000	0.15	CD4027	0.44	CD4051	0.82	CD4086	0.64	CD40182	1.40
CD4001	0.17	CD4028	0.77	CD4052	0.82	CD4089	1.39	CD40192	1.40
CD4002	0.17	CD4029	1.03	CD4053	0.82	CD4093	0.80	CD40193	1.40
CD4006	1.04	CD4030	0.50	CD4054	1.04	CD4094	1.69	CD40194	1.19
CD4007	0.18	CD4031	2.00	CD4055	1.18	CD4095	0.94	CD40257	1.48
CD4008	0.87	CD4032	0.89	CD4056	1.18	CD4096	0.94	CD4502	0.81
CD4009	0.50	CD4033	1.25	CD4059	4.29	CD4097	3.35	CD4510	1.01
CD4010	0.50	CD4034	1.71	CD4060	1.00	CD4098	0.98	CD4511	1.25
CD4011	0.18	CD4035	1.06	CD4061	0.98	CD4099	1.65	CD4514	2.47
CD4012	0.20	CD4036	2.86	CD4066	0.55	CD40100	2.50	CD4515	2.82
CD4013	0.43	CD4037	0.85	CD4067	3.35	CD40101	1.61	CD4516	1.01
CD4014	0.83	CD4038	0.96	CD4068	0.20	CD40102	2.13	CD4518	0.97
CD4015	0.83	CD4039	2.78	CD4069	0.20	CD40103	2.13	CD4520	1.04
CD4016	0.48	CD4040	0.97	CD4070	0.48	CD40104	1.10	CD4527	1.43
CD4017	0.79	CD4041	0.76	CD4071	0.20	CD40105	1.08	CD4532	1.21
CD4018	0.83	CD4042	0.89	CD4072	0.20	CD40106	0.82	CD4555	0.78
CD4019	0.50	CD4043	0.88	CD4073	0.20	CD40107	0.69	CD4556	0.78
CD4020	1.11	CD4044	0.84	CD4075	0.20	CD40108	5.36	MC14528	0.83
CD4021	0.90	CD4045	1.26	CD4076	1.17	CD40109	1.03	MC14553	4.43
CD4022	0.82	CD4046	1.20	CD4077	0.39	CD40110	1.19	IM6508	8.05
CD4023	0.18	CD4047	0.89	CD4078	0.20	CD40161	1.19		
CD4024	0.70	CD4048	0.50	CD4081	0.20	CD40162	1.19		
CD4025	0.20	CD4049	0.50	CD4082	0.20	CD40163	1.19		
CD4026	1.55	CD4050	0.43	CD4085	0.64	CD40181	3.40		

For our full range of components send for Free Catalogue

Our offices are at Chapel Street, Oxford, but please do not use this as a postal address.

PRICES VALID UNTIL 31st MARCH 1979

OFFICIAL ORDERS ARE WELCOME from Companies Govt Depts Natn Inds Univs Polys
ORDERS: C W O add VAT @ 8% + 35p p&p TELEPHONE and CREDIT (invoice) ORDERS add VAT @ 8% + 60p
p&p minimum charge (the balance will be charged at cost) Please see FAST SERVICE EXPORT ORDERS welcome
no VAT but add :0% (Europe) 15% (Overseas) for Air Mail p&p For Export postage rates on heavy items - contact us first

ORDERS TO: SINTEL, PO BOX 75A, OXFORD
Tel: 0865 49791

FAST SERVICE: We guarantee that Telephone Orders for goods in stock, received by 4.15 p.m. (Mon-Fri.) will be despatched on the same day by 1st Class Post (some heavy items by parcel post) and our stocking is good. Private customers should telephone and pay by giving their Access or Barclaycard number, with a minimum order value of £5. Official orders, no minimum.

SINTEL

**BULK PURCHASE - EXCLUSIVE TO HENRY'S
ALLOWS US TO SELL AT SUCH FANTASTIC PRICES!**

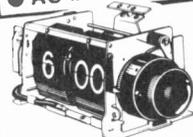
QUALITY ITEMS
Compare performance and specification with units costing 3 times as much!

**DIGITAL
24 HOUR
CLOCK**

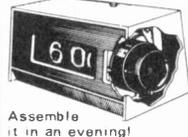
WITH
BUILT IN
ALARM

AS USED IN **BRAUN**
DIGITAL CLOCKS

- SILENT RUNNING
- LARGE ILLUMINATED NUMERALS
- AC MAINS ● SIZE 6 1/2 x 2 1/4 x 2 3/4



MECHANISM ONLY



Assemble it in an evening!
MECHANISM & CASE
Inc. assembly instructions



Modern Styling
COMPLETE UNIT

£5.00

£6.99

£7.99

THREE FOR £13.50

THREE FOR £20

POST & VAT INCLUSIVE

Send cheque, P.O./M.O. for the correct amount which includes VAT and P & P or pay by Access/Barclaycard. Send name/card number (if applicable) and address to:

HENRY'S RADIO
404 EDGWARE ROAD,
LONDON W2 1ED

EXPORT ENQUIRES INVITED

AVAILABLE ONLY FROM

**HENRY'S
Radio**

DELIVERY FROM STOCK

.....news digest.....

FIBRE OPTIC LIGHT PEN

Light pens have never figured very greatly in the amateur market, but this device from Optronic Fort Ltd hopes to change that, particularly with the tremendous interest in mini-computers. It is TTL compatible and uses a pin-photodiode, weighs only 35 grammes and can be yours for only £175. Call them at Cambridge Science Park, Milton Road, Cambridge CB4 5BH.



VIDEO DISC 2

Further to the Philips video disc launch, news has just arrived about the RCA 'Selecta Vision' video disc system, pioneered in the USA. The RCA system uses a grooved disc, with diamond stylus. The disc rotates at 450 rpm, and has one hour's playing time per side. Again only drawing as you can't record your own material, but just think, you will be able to buy your own copy of Star Wars or even Emmanuel, if you see that way inclined, and you can see the good bits over and over again, Cor.

BREADBOARD '79

What! already. Well this year there are two dates to put into your Letts Electronic diaries. The Midlands show will be at Bingley Hall, Birmingham, on May 23rd-26th, and the London show is at the Royal Horticultural Hall, Westminster, December 4th-8th. Figures show over 10 000 people attended the first show, and that's a fantastic response for the first ever home electronics exhibition, indeed the Birmingham show is due entirely to response from contributors and visitors, we'll see you there.

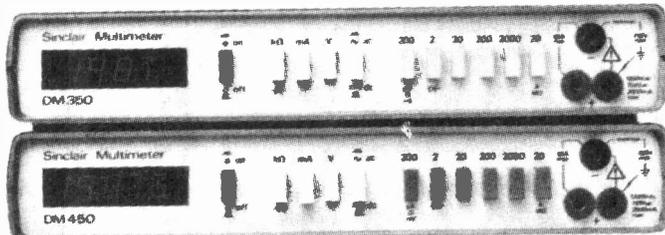
MEMORIAL FUND

Following the tragic death of John Miller Kirkpatrick a memorial fund has been established for the benefit of his family. Those wishing to make a donation should send this to: John Miller Kirkpatrick Memorial, Lloyds Bank Ltd, 39 Threadneedle Street, London EC2.

SINCLAIR AGAIN

Two new laboratory quality multimeters are promised for 1979. As usual you can expect the Sinclair innovations in cost and features. These instruments which rejoice

under the titles of DM450 (4 1/2 digit 5 function) and DM350 (3 1/2 digit, 34! ranges). They both have good technical specifications and accessories. See the Microvision article for Sinclair's address.



SAVE MONEY! SAVE TIME!

If you continually solder and de-solder when building, testing and trying out modifications on circuits, you're wasting money. Heat damage and solder build-up waste boards and components faster than anything.

You're also wasting money if you're building circuits and you scrap them just because you've no further use for them.

In both cases you're wasting time too.

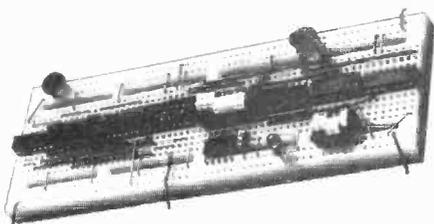
Breadboards are fully re-usable and avoid these losses – you only need to hard wire your circuit to keep the final design.

LEKTROKIT offer you a full range of breadboards, any of which allows you to build a circuit or try out mods in a fraction of the time. And with no soldering or de-soldering.

Your components – IC's or discretes – simply plug in. Your interconnections are merely a matter of pushing in solid wire – up to 0.032 inches.

So you save money. And you save time.

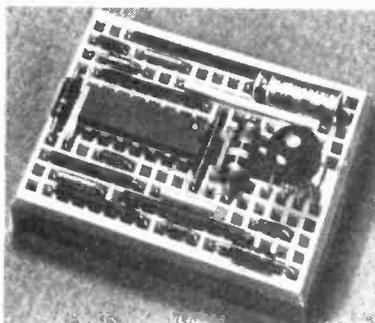
Further, LEKTROKIT breadboarding is expandable to match whatever configuration you require. All boards are ready prepared for mounting with screws or adhesive backing.



Lektrokit Super Strip SS2

Only £11.05 inc. p & p and VAT

Super Strip accepts *all DIP's*—as many as nine 14-pin at a time—and/or TO-5's and discrete components. With interconnections of any solid wire up to 20 AWG. *And no soldering.* Super Strip has 840 contact points, combining a power/signal distribution system with a matrix of 640 contacts in groups of 5. Distribution system has 8 bus-bars, each with 25 contact points.



Lektrokit Breadboards and Bus Strips

From £3.25 inc p & p and VAT

The modular, solderless system! Breadboards that link together for any size, any configuration. With pitch of 0.1" to accept all IC's. Just take each component, choose its hole and push it in.

BREADBOARDS			BUS STRIPS	
Model	Contacts	Price, each	Model	Price
264L	640	£8.32	212R	£1.78
248L	480	£6.65	209R	£1.62
234L	340	£5.75	206R	£1.45
217L	170	£3.25		

(All prices include p & p and VAT)

Lektrokit's policy is the right product, whatever the project, at the right price. And it's backed by a nationwide network of retailers. Send for the name of the dealer nearest you—plus a FREE full-colour catalogue.

Write to:- LEKTROKIT LTD., London Road, Reading, Berks. RG6 1AZ. Or send coupon.

LEKTROKIT

To Lektrokit Limited, London Road, Reading, Berks, RG6 1AZ.

Tel. Reading (0734) 669116/7.

Please send me the name of my nearest Lektrokit dealer—plus FREE catalogue.

Please supply the following (list items required)

..... I enclose P.O./cheque for £

(Allow 28 days for delivery. All prices above include packing, postage and VAT).

Name

Address

ETI

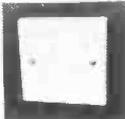
COMPLETES THE CIRCUIT

LIGHTING CONTROL KITS 300w TD300K

Lightdimmer Kit with NO knob. Dimming and on/off functions are controlled by touch. Features include:

- ★ No mains rewiring
- ★ Switches on to preset brightness
- ★ Can be switched and dimmed from many locations using TDE/K kit making 2-way switching easy

****PRICE TDK £8.99**
TDE/K £1.50



TRIAC BARGAINS

400V Plastic Case	58p
3A	80p
6.5A with trigger	74p
8A	84p
12A	105p
16A	165p
20A	190p
25A	21p
SCR (C106D) 5A/400V	50p
Diac	21p

COMPONENTS

0.2" L.E.D.S.	£1.10
Red 12p	25p
Green 21p Yellow	£1.50
DL727 5 digit	£8.10
LCD 5 4 digit	50p
LDR 5" dia	(4 for £1.00)
NE555	(5 for £1.00)
741	£1.00
LM3911 temperature IC	£3.25
AY-5-1224	£4.85
AY-5-1230	£1.80
ZN1034E	£9.25
ICL7106 DVM IC	6p
1N4001	4p
1N4148	10p
BC182L	20p
2N3819	

MINI MAINS TRANSFORMERS

Standard 240V mains primary	
100mA secondary	
6-0.6V	85p
9-0.9V	90p
12-0.12V	95p

DIGITAL VOLTMETER THERMOMETER KIT

Based on the 7106 single IC 3 1/2 digit DVM the kit contains a PCB, resistors, capacitors, presets, IC and 0.5 liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single transistor as the sensor.

ONLY £21.99



24 HR. CLOCK/APPLIANCE TIMER KIT

Switches any appliance of up to 1kW on and off at preset times once a day. KIT contains AY-5-1230 Clock/Appliance Timer IC, 0.5 LED display, mains supply, display drivers, switches, LEDs, triac complete with PCBs and full instructions. **£14.90**

White box (56x131x71mm)—drilled **£2.50**
undrilled **£2.20**
Ready-built **£22.50**



PLEASE ADD 8% V A T (*12 1/2%) TO ABOVE PRICES
QUANTITY DISCOUNTS ON REQUEST. ADD 25p POSTAGE & PACKING. MAIL ORDER ONLY TO:
T.K. ELECTRONICS (ETI), 106 Studley Grange Road, London W7 2LX

TARGET ELECTRONICS

16 Cherry Lane
Bristol BS1 3NG

Telephone:
0272-421196

Official orders welcomed. Govt./Educational Depts. etc

Size 60mm x 45mm x 40mm

T21	0.50µA	T30	0-1Amp
T22	0.100µA	T33	0-50v AC
T23	0.500µA	T34	0-300v AC
T24	0-1mA	T35	'S' Meter
T25	0.5mA	T36	Vu Meter
T26	0-10mA	T40	50-0.50µA
T27	0-50mA	T41	100-0.100µA
T28	0-100mA	T42	500-0.500µA
T29	0-50mA	T43	0-30v DC

Price £5.10 P&P 25p

Size 110mm x 82mm x 43mm

043	0-30µA	0420	0-200µA
045	0-50µA	0450	0-500µA
0410	0-100µA		

Price £5.90

10 or more 10% Discount. P&P 50p

TRANSISTOR SPEAKERS

645S	2 1/2	64ohms	
3W80	2 1/2	Bohms	All
1W2	2 1/4	Bohms	@
5012	2	Bohms	75p
4512	1 3/4	Bohms	
3812	1 1/2	Bohms	

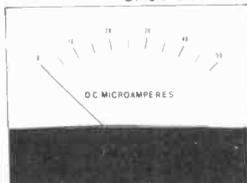
10 or more 10% Discount. P&P 25p

DESOLDERING TOOLS



4110	£4.75	P&P 25p
4111	£5.65	
4112	£7.42	

High suction pump with automatic ejection. Knurled, anti-corrosive casing. Teflon nozzle.



PANEL METER with ILLUMINATION WIRING

Dials are clearly figured on bright white for easy reading. 2.5% F.S.D. accuracy. Zero adjustment at front. Cushioned pointer stops. Complete with mounting nuts and washers. Prewired and have lamp terminals installed on rear. Snap off front cover and insert Lamp Kit (opp extra) 65p

Two 6.3V bulbs for press-in fitting onto pre-wired connector blocks which require 12.6V external power through the rear terminals already fitted

TRANSFORMERS

PRIMARYS 240V		
TR1	6-0.6	100MA 80p
TR2	9-0.9	75MA 83p
TR3	12-0-12	50MA 90p
TR4	12-0-12	100MA £1.10
TR1A	6-0.6	100MA 92p
		Int screen
TR2A	9-0.9	75MA £1.00
		Int screen
TR3A	12-0-12	50MA £1.10
		Int screen

●MOT Output Transformer 1 2K-Bohm 200MW 27p

P&P for above 25p



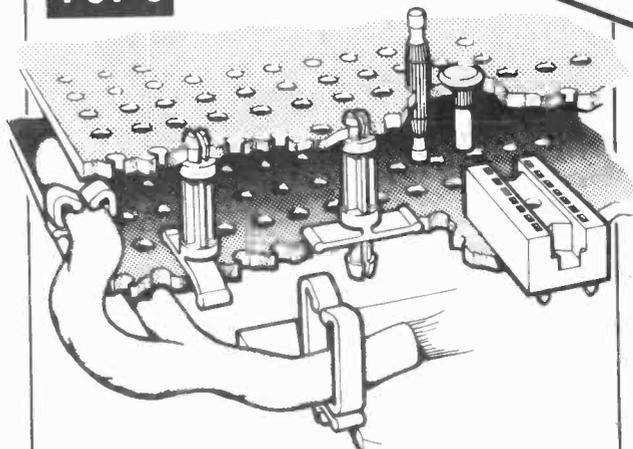
NASCOM 1 DISTRIBUTOR

● Please add 12 1/2% VAT. Remainder 8% VAT
Large selection of aluminium boxes & Instrument Cases
Phone in your Access or Barclaycard order. Catalogue 25p post paid



OUR RANGE OF PRODUCTS ARE NOW INDIVIDUALLY AND ATTRACTIVELY PACKAGED

vero



Our new catalogue lists circuit board accessories for all your projects – DIP sockets, pins, stand-offs, cable clips, hand tools. And we've got circuit boards, module systems, cases and boxes – everything you need to give your equipment the quality you demand. Send 25p to cover postage and packing, and the catalogue's yours.

VERO ELECTRONICS LTD. RETAIL DEPT.

Industrial Estate, Chandlers Ford, Hants. SO5 3ZR
Telephone Chandlers Ford (04215) 2956



STEREO DYNAMIC RANGE CONTROLLER CP-DR1

'Noise-free' Cassette Recordings (with an additional 30 db dynamic range); signal expansion (to recover lost dynamics) and compression (for listening in noisy environments) are all achievable with the **Magnum CP-DR1**.

If you wish to avoid point-to-point wiring, use the newly-announced **CP-MPC4** interconnection board and build your system within the hour. We can provide any suitable pots, etc. that you may require. The **CP-MPC4** also has provision for a **CP-TM1** if you wish to monitor signal levels.

CP-DR1 — £41.40 incl. (U.K.) £43.40 incl. (Export)
CP-MPC4 — £6.86 incl. (U.K.) £8.86 incl. (Export)

Also available: Pre-amplifiers, Power Amplifiers, Filters, Peak Programme Monitors, Active Crossovers, Stereo Function Modules, Power Supplies, plus all pots., switches, etc.

MAGNUM AUDIO Ltd.

DEPT. ET2, 13 HAZELBURY CRESCENT
LUTON, BEDS, LU1 1DF
TEL: 0582 28887

SEND LARGE S.A.E. FOR DETAILS

SEMICONDUCTOR OFFERS ALL FULL SPEC.

Common anode 0.3" 7 seg displays Toshiba type TLR303 65p. F.E.T.s similar to 2N3819 18p. 3N140 Mosfets 50p. M203 Dual Matched Pairs Mosfets Single Gate per F.E.T. 40p Intel 1024 bit MOS Rams 95. Mullard BB113 Triple Varicap Diode 35p. MC1310 Stereo Decoder I.C.s £1.20. CD4051 CMOS 50p. 500v 600mA Bridge Recs (ex equip) 25p. 1N4002 100V 1A Diodes 4p. 14005 800v 1A Diodes 7p. E.H.T. SIL Rec 15Kv 2.5mA 15mm x 5mm 30p. 7812 12v 1A Plastic V. Regs 95p. MAN3A 3mm LED Displays 50p. 741S (wide bandwidth) 35p. LM380 80p. LM381 90p. ZN414 75p. TIL305 Alpha-numerical Displays with data £2.75. ORP61 Mullard, new boxed, 30p. Special offer: 5G5 TGA800 ICs, 10 for £5.00. 741 8-pin 6 for £1. NES55 27p each.

MICROPHONES. EM506 Condenser Mikes. Uni-directional. F.E.T. Amp. Dual imped., 50K/600ohms. 3D-18KHz. on/off switch. £11.00. Miniature Tie Pin Condenser mike 1K imp. omni-directional, uses hearing aid battery (supplied) £4.95. Grundig Electret Inserts with built-in F.E.T. Preamp £1.50. Crystal Mike Inserts 37mm 45p. Electret Condenser Mikes 1K imp. with std. Jack Plug £2.85. Cassette Condenser Mikes with 2.5 and 3.5 Jack Plugs £2.85. Standard Cassette Mikes 200 ohm Imped with 2.5 and 3.5 Jack Plugs £1.20.

MORSE KEYS — Hi-speed Type, all metal. £2.25. Plastic morse Keys 95p.

TOSHIBA L.E.D.s. — TLG113 0.2" green 16p. TLG115 0.2" green, diff lens 17p. TLG1070.2" green flat top 17p. TLR1120.2" clear infra red 20p.

NEW LOW COST MULTIMETERS — KRT100 — 1,000V P.V. 1,000 volts AC/DC 150mA (max.) D.C. current 0-100K Resistance. Range Selector Switch. £4.65

KRT101 Model. Same ranges above but range selection by test probe insertion. £3.75.

MOTORS. 1.5 to 6v DC Model 20p. 115v AC min. 3 R.P.M. with Gearbox 30p. 240v AC Synch Motor 1/5th R.P.M. 65p. Crouzet 115v AC 4 R.P.M. Motors, new 95p. 12v DC 5-pole 35p.

BOXES. Black A B S. Plastic with brass inserts and lid. 75 x 56 x 35mm 40p. 95 x 71 x 35mm 49p. 115 x 95 x 16mm 57p.

TOOLS. Radio pliers, 5in. insulated handles £1.40. Diagonal side cutters, 5in. insulated handles £1.40.

MAINS TRANSFORMERS, all 240v AC primary. Postage shown in brackets per transformer.

8-0-8 100mA, 9-0-9 75mA, 12-0-12 50mA, 75p each (15p). 0-4-6-9 150mA, no mounting bracket, 65p (20p). 12-0-12 100mA, 95p (15p). 12v 500mA, 95p (22p). 12v 2 Amp, £2.25 (45p). 12v 4 Amp, £2.75 (54p). 15-0-15v 1 Amp, £2.10 (45p). 30-0-30v 1 Amp, £2.75 (54p). 0-12-15-20-24-30v tapped at 2 Amp, £4.50 (54p). 20-0-20v 2 amp, £3.50 (54p). 25v 1.5 Amp, £1.45 (45p). 18v 1.5 Amp rectified, £2.00 (45p). 35v 2 Amp, 2.5v 2 Amp toroid, £2.95 (54p). 20v 2.5 Amp, £2.20 (54p). 1.1 Xenon/triac pulse transformer, 30p.

SWITCHES — Min. Toggle, SPST 8 x 5 x 7mm 45p. DPDT 8 x 7 x 7mm 60p. DPDT Centre Off 12 x 11 x 9mm 75p. OPDT C/O Sliders 20p. R.S. Single Pole C/O Push Buttons 45p. Roller Micro Switches 15p. Min. Micro Switches 13 x 10.4mm 20p. Min. Push to make or push to break Switches 16 x 6mm 15p.

SOLDER SUCKER. Plunger type, eye protection, replaceable nozzle, high suction. £4.95. Reed switches 28mm norm. open, 6p each.

TAPE HEADS — Cassette Stereo £3.00. BSR MN 1330 1/2 Track Dual Impedance Rec./Playback 50p. BSR SRP90 1/4 Track Stereo Rec./Playback £1.95. TD10 Assemblies, two heads, 1/4 Track Rec./Playback Staggered Stereo with built-in erase per head £1.20. Tape Head Demag 240v AC £1.95.

BUZZERS — GPO Type 6-12v 20c. Min Solid State Buzzers 6-9-12 or 24v 15mA 75p. Smiths 5-12v Transistorised Audible Warning Device 30mm 30p.

U.H.F. TV Transistorised Push Button Tuners (not Varicap, new and boxed, £2.50).

MURATA MA401L. 40kHz Transducers, rec./send. £3.25 pair.

METERS — Grundig Batt. Level Meter 1mA 40 x 40mm £1.10. Min. Level Meter 200v a 25 x 15mm 75p. Ferranti 600v AC Meter £3.95.

EDGE METER — Large scale 0-100, new £2.75.

TWO WAY BATTERY OPERATED INTERCOMS. £5.00 + 34p P&P.

LA1230 adj. core 15mm dia. 14mH-18mH. HI Q. 10p each.

8 TRACK 12 volt motors new, £1.25
CASSETTE MOTORS 6 volt new, £1.25

NAT. SEM — LM340T 6v 1A voltage regulators 40p. LM309K 5V TO3 Voltage Regulators 78p. 723 14 pin Voltage Regulator ICs. 40p each.

12-WAY MOTORIZED CAM UNITS. 50v AC low rev. motor driving 12 C/O micro switches, supplied with a capacitor for 240v AC use. Ex. equip £1.95 + 35p P&P.

TEXAS BY205 800v 6A SIL Recs (Flatback) 18p.

8 WAY RIBBON-CABLE, min sbld core. 15p metre.

POSTAGE 30p UNLESS OTHERWISE SHOWN (EXCESS POSTAGE REFUNDED WITH ORDER). OVERSEAS POST AT COST. VAT INCLUDED IN ALL PRICES.

S.A.E. FOR NEW ILLUSTRATED LISTS

ORDER ADDRESS

PROGRESSIVE RADIO
31 CHEAPSIDE, LIVERPOOL 2

BUILD THE TREASURE TRACER



MK III

METAL LOCATOR

AS SEEN ON BBC-1 & BBC-2 TV

- Genuine 5 silicon transistor circuit, does not need a transistor radio to operate.
- Incorporates unique varicap tuning for extra stability.
- Search head fitted with Faraday screen to eliminate capacitive effects.
- Loudspeaker or earphone operation (both supplied).
- Britain's best selling metal locator kit, 4,000 already sold.
- Kit can be built in two hours using only soldering iron, screwdriver, pliers and side-cutters.
- Excellent sensitivity and stability.
- Kit absolutely complete including drilled, tinned, fibreglass p.c. board with components sitting printed on.
- Complete after sales service.
- Weighs only 22oz.; handle knocks down to 17" for transport.

Send stamped, self-addressed envelope for literature.

Complete kit with pre-built search coil

£15.95
Plus £1.20 P&P
Plus £1.37 VAT (8%)

Built, tested and Guaranteed

£20.95
Plus £1.20 P&P
Plus £1.77 VAT (8%)

MINKITS ELECTRONICS,
6d Cleveland Road, South Woodford,
LONDON E18 2AN
(Mail order only)

CALCULATORS

SCIENTIFIC

SPECIAL OFFER
TEXAS T159 together with PC100B
(Complete as manufacturer's specifications)
£285.00

- TEXAS /HP Accessories available
- TEXAS T159 (New Card prog 960 prog steps of 100 mem) **£156.50**
- TEXAS T158 (New Key prog 480 steps or 60 mem) **£60.00**
- TEXAS PC100B (New updated Printing Unit for T158 / T159) **£140.00**
- TEXAS T157 (Key Prog 8 mem. 150 Keystrokes / 50 Prog Steps) **£26.20**
- TEXAS T137 (New — same spec. as T130, but 3 mem) **£13.95**
- TEXAS T145 (New updated version of the Texas T140) **£19.95**
- TEXAS 42MBA (10 Dig Fin / Stat Prog 12 mem 32 keystrokes) **£42.95**
- TEXAS TI PROGRAMMER (Hexadecimal Oct) **£46.50**
- TEXAS T151/iii (New 8 Dig = Exp 10 mem 32 Prog Steps Stat / Sci) **£28.50**
- TEXAS T125 (new LCD Sci / Stat) **£18.90**
- TEXAS Little Professor (Child's Calculator / Game 5 / 9 year olds) **£10.00**

"SLIM-LINE" Chronograph BARGAIN OFFER

You will not believe the luxury of this "slim line" 12 function Chronograph until you have worn it until you have enjoyed the compliments it generates. The "Slim-line" Chronograph gives continuous easy to read LCD display of hours, minutes, seconds, AM/PM. At the touch of button you have date — month date — day of week — reverting to normal display time at the release of the button. Press again for immediate stop watch / lap time facility to 1/100 second. The "Slim-line" even has a powerful back light for easy night use, the casing is chrome finished with matching linked bracelet. We are so certain you will be delighted and satisfied with this "Slim-line" Chronograph that in addition to the One Year Warranty we are offering a 14-day money back guarantee if you are not entirely satisfied.



ONLY £20.00 + £1.00 p/p ins. Send cheque/P.O. or order via Barclay/Access credit card today under our Special 14-day Trial Offer.

- TEXAS T158 with Applied Statistics **£80.00**
- TEXAS T159 with PC100B and Applied Statistics **£305.00**

WINTER SALE

TEXAS T159 Calculator (complete as manufacturer's spec. master module, charger, etc.). PLUS statistics module and extra set of 40 Blank Prog Cards with wallet, etc. **ONLY £180**

- CBM 9190R (as 4190R but with 9 memories) **£27.50**
 - CBM Pro 100 (7.2 Step Prog) **£29.50**
 - HP 19C (Cont Mem key Prog Printer) **£129.00**
 - HP 29C (as 19C but no Printer) **£93.00**
 - HP33E (8 mem Pro Sci / Stat) **£64.00**
 - HP32E (Advanced Sci with Statistics) **£50.00**
 - HP27 (10 Mem Sci / Fin / Stat) **£73.50**
 - HP31E (New Sci replaces HP21) **£35.00**
 - HP67A (Card Prog 2.4 Steps 26 Mem) **£25.75**
 - HP97A (Fully prog with Printer) **£42.20**
- All HP range avail. inc. new E range.
CASIO FX360 (New 10 Dig + Exp 7 Mem 8) (St. Div Lin Regr. etc.) **£45.00**
CASIO AQ 1000 (LCD Cal 3-way Stop Watch / Alarm) **£20.00**
CASIO FX3100 (New version of FX3000-LCD Sci / Sid / Div Poles Rec. etc.) **£22.50**
CASIO FX8000 (as above + Stop Watch / Alarm) **£27.73**

LOW PRICED COMPUTING

THE COMMODORE PET COMPUTER

with 8K bytes RAM 2001:8
A complete personal computer that operates anywhere by simply plugging into Main supply. Allows communications directly from BASIC to IEEE — 488 standard devices —

Cassette, Video Display Unit and Keyboard built into PET Fully guaranteed Warranty by CBM complete only **£643**

NOW IT'S YOU AGAINST COMPUTERS

- CHESS CHALLENGER '3' (3 levels of game — beginner to expert) **£120.32**
 - CHESS CHALLENGER '10' (10 levels of game from beginner to master) **£180.00**
 - BORRIS the most advanced chess computer yet BORRIS will even play against itself. Therefore ideal for learning from beginner to master BORRIS will PROMPT you to better play! **£184.26**
 - COMPUTER-CHECKERS-DRAUGHTS (4 levels of play) **£83.28**
 - GAMMON MASTER (with doubling dice) **£138.84**
- FREE — Mains / Charger included
- GOODS FULLY GUARANTEED. PRICES EXCLUDE VAT (ADD 8%)
BUT INC. P&P CHEQUE WITH ORDER
Company / Hospital and Government orders accepted by phone
Barclaycard / Access accepted by phone

Tel. 01-455 9855

EXPORT ORDERS WELCOMED

Air Freight / Air Post Delivery
Quotations on request. Payments via Letter of Credit / Int Money Order / American Express, etc.

MOUNTAINDENE

22 Cowper St., London, EC2

DIGITAL TO ANALOGUE TECHNIQUES

Digital to Analogue conversion (DAC) is a fast growing section of electronics. Tim Orr explains some of the more practical applications.

ELECTRONICS HAS CHANGED enormously in the past ten years, having swung away from valves, germanium transistors, even from discrete devices themselves. The trend is towards more and more complex integrated circuits, complete systems in a chip, large scale integration (LSI). Also the trend has swung heavily towards digitally based systems rather than analogue ones, partly because the IC manufacturers can get a greater success rate from making digital devices and partly because there are very many applications which can only be contemplated with a digital device. Such examples as pocket calculators and microprocessors spring immediately to mind. However there are several areas where analogue techniques present the only realistic solution (at this moment in time), such as tone controls in an audio amplifier. In fact, good cases can be made out for both analogue and digital systems and there are many examples where both are needed. In these it will be necessary to change from the analogue to the digital world or vice versa and to do this, some sort of conversion process has to be practised.

Digital to Analogue Conversion.

The job of a digital to analogue converter (DAC) is to convert a binary code (a digital data word) into an analogue voltage. The data word is a digital representation of that analogue voltage. Thus if we presented the DAC with a digital word that was linearly increasing in magnitude, the output would be a linearly increasing analogue voltage. This digital word would be the output of a binary counter driven by a constant clock frequency. The analogue output is a linear ramp, or rather a linear staircase where the step size is controlled by the "size" of the DAC. If the DAC is an 8 bit device, ie it can accept data words 8 bits wide, then it can generate a possible 2^8

discrete output level. Now 2^8 is 256, so therefore an 8 bit DAC could generate a staircase with 256 steps in it. The resolution of the DAC is thus 1 part in 256, or rather a change of one LSB (least significant bit) in the data word will make the output voltage change by $1/256$ th of the full scale output.

To get really fine resolution then a high performance DAC is needed. DAC prices seem to be almost linearly proportional to their resolution. I have got several DAC's amongst my collection of bits. There is an 8 bit DAC costing about £4, a 12 bit DAC costing about £35 and a 16 bit DAC costing just over £200. It is now possible to buy a monolithic (a single IC) DAC with a bit size of 6, 8, 10 and 12, but above this the devices are usually modular.

Size And Resolve

Fig 2 shows the relationship between DAC size and resolution. Notice that a 16 bit DAC with a 10 V full scale output is made up of a staggering 65,536 discrete

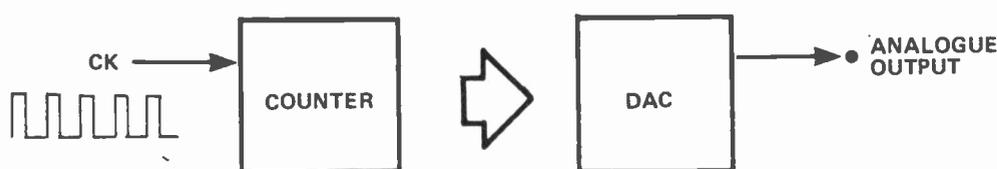
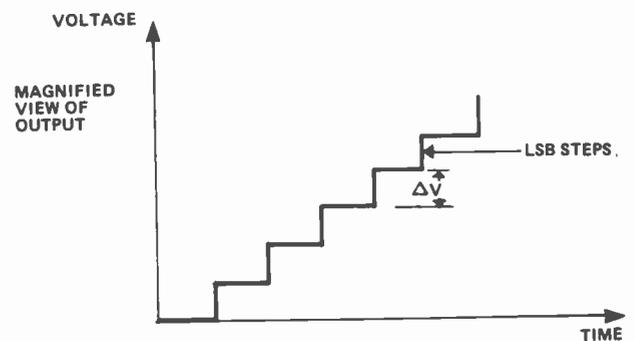


Fig 1. Converting binary code to analogue voltage.

WORDLENGTH n	RESOLUTION 1 PART IN 2 ⁿ	MAXIMUM THEORETICAL DYNAMIC RANGE	BIT SIZE ASSUMING FULL SCALE = 10V
1	2	6dB	5.0V
2	4	12dB	2.5V
3	8	18dB	1.25V
4	16	24dB	0.625V
5	32	30dB	0.312V
6	64	36dB	0.156V
7	128	42dB	78.1mV
8	256	48dB	39.1mV
9	512	54dB	19.5mV
10	1024	60dB	9.7mV
11	2048	66dB	4.8mV
12	4096	72dB	2.4mV
13	8192	78dB	1.2mV
14	16384	84dB	610uV
15	32768	90dB	305uV
16	65536	96dB	152uV

Fig 2. Relationship between size and resolution.

levels each 152 μ V in size. (There is also available an 18 bit device, costing a small fortune. The larger the bit size of the DAC, the larger is the dynamic range (best signal to noise ratio) of its output. This increases by 6 dB per bit. Thus a 10 bit DAC can give a best range of 60 dB.

The human anatomy has developed over the last few million years to respond to its environment. This has resulted in the following performance figures. The sensitivity of the eye to colour is not that good. Colour television transmission doesn't give much of its bandwidth to the colour part of the signal. Have a look at a TV and see how well defined the colour is; it is usually just "sort of smeared around" the subject. Thus it is possible to get quite good digital video using only 4 bits for the colour. The eye sensitivity to resolution is somewhat better, but even so an 8 bit oscilloscope memory will look fairly continuous, giving little indication that it is made up of discrete steps.

Ear Lead

However the ear can still outperform present day technology. Using a 16 bit high quality audio system a trained ear can still detect the difference between the digitally processed sound and the original. Thus, when using DAC's in professional audio equipment great care has to be taken to eliminate all types of aberrations in the system. These digital aberrations don't just worsen

the signal to noise ratio (as an analogue system might), but they produce discordant harmonic distortion, sidebands like those obtained from ring modulation and other little funnies.

Figure 3 shows a DAC system in operation. The output of the DAC is meant to produce nice clean square wave steps, but the leading edges of these steps always have small spikes (glitches), caused by the switching times associated with the DAC's internal workings. These glitches are not regular in nature and so filtering cannot eliminate them. The glitches give the sound a "dirty" quality, or, if the system is an oscilloscope display it produces fuzzy pictures.

The glitches can be removed with a little module called a DEGLITCHER, fig 4. This is a logic controlled sample and hold which holds during the glitch period, but otherwise tracks the signal from the DAC. Thus the glitches are ignored. The output from the deglitcher then passes through a low pass filter and this removes the "stepped" quality of the signal and produces a smooth analogue output. The cut off frequency of this filter is very important and is related to the data rate of the DAC. The rule of thumb is that the filter cut off frequency should always be less than half of the data rate frequency.

Buying And Building

DAC's can be bought fairly cheaply as complete IC's or they can be constructed out of generally available parts, fig 5. This circuit uses precision buffers (a CD4041 will do), E24 resistors and a FET op amp. The buffers are run from a +10 V supply and their purpose is to provide high (+10 V) and low (0 V) output with low source resistance. They are driven by a 6 bit data word, the MSB (most significant bit) thus drives the 7k5 resistor, the LSB (least significant bit) the 240k resistor. So, when the MSB changes, the output of the op amp will move by a large amount (5 V), but when the LSB changes the output will only change a little (0V156). Going from the MSB down to the LSB, each bit has only half the effect of its predecessor. This is obtained by doubling the resistor values (7k5, 15k, 30k, 60k, 120k, 240k).

A 6 bit DAC can produce 2^6 discrete output levels. Now 2^6 is 64 and so the overall resistor tolerance should be ± 1 part in 2×64 , which comes out at $\pm 0.8\%$. This type of DAC is known as a resistance ladder DAC, but in its presented form it is rather limited. For instance, a 10 bit device would require a resistor range of 1024 to 1 and a tolerance of 0.05%.

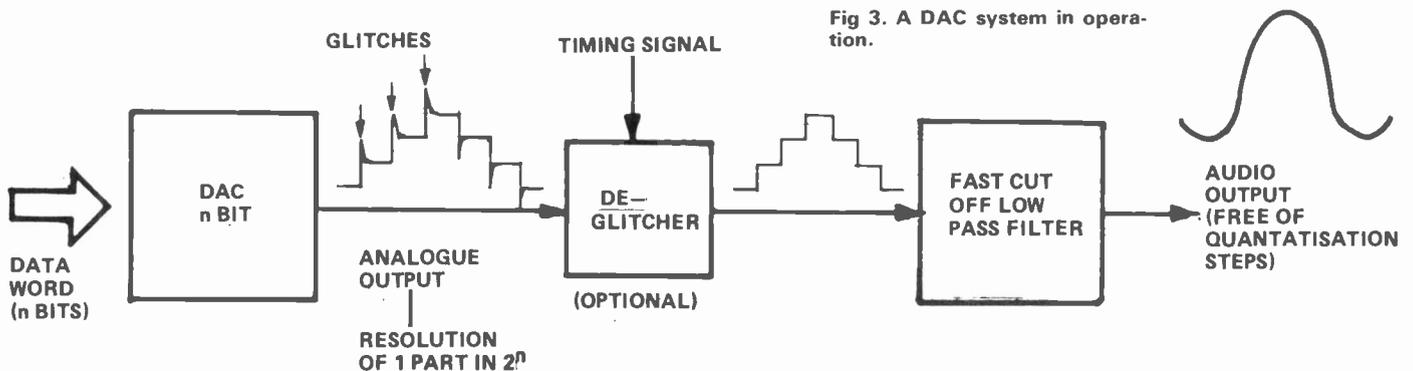


Fig 3. A DAC system in operation.

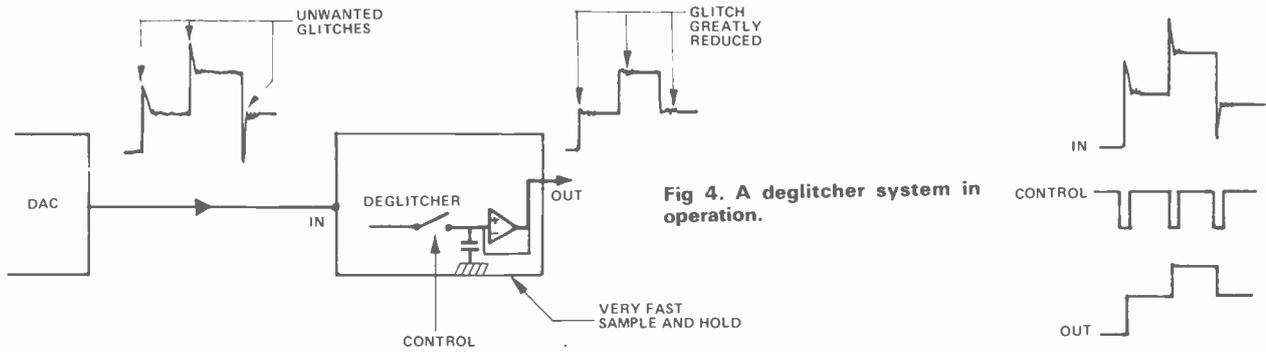


Fig 4. A deglitcher system in operation.

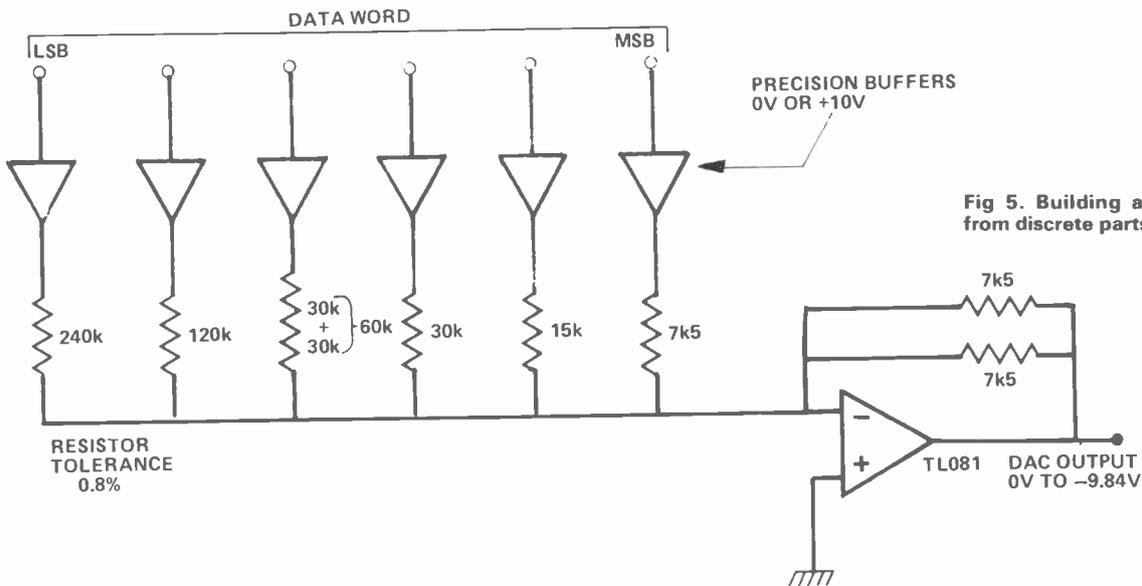


Fig 5. Building a DAC circuit from discrete parts.

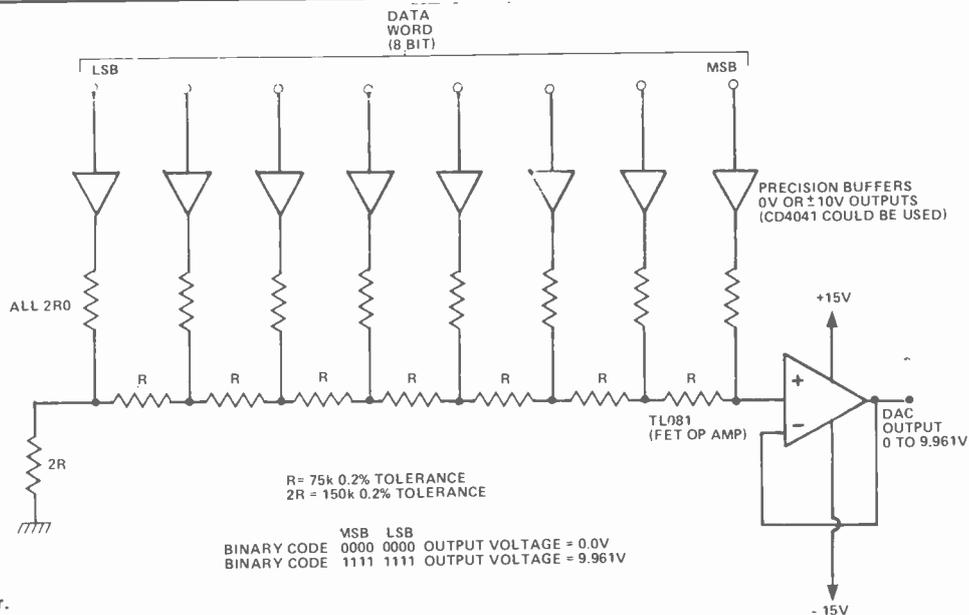


Fig 6. An R-2R ladder.

Multiple Choice

The DAC shown in Fig 6 overcomes the problem of multiplicity of resistor values; only two are needed. The resistor tolerance

still applies. Also the ratio between the resistor value and the buffer ON/OFF resistance is important. The 2R resistors connected to the buffers should ideally be 2R — (the buffer output resistance).

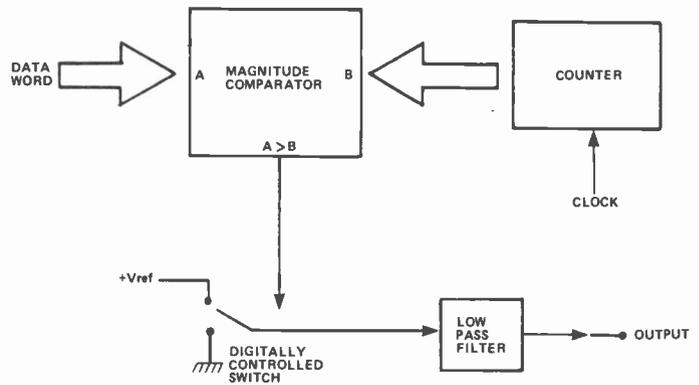
Counting On This

A "counting" type ADC is composed of a fast comparator, a gate, a counter and a DAC. This is why ADC's always cost more than DAC's, the ADC uses a DAC to do the conversion. Assuming that the analog input is positive, and the DAC produces a positive output, the conversion operation is as follows:

1) The signal "start conversion" is generated. This resets the counter to all zero's, the DAC output goes to zero, the comparator output goes high and so the clock is allowed to enter the counter. Thus the count proceeds and the DAC generates a positive going staircase.

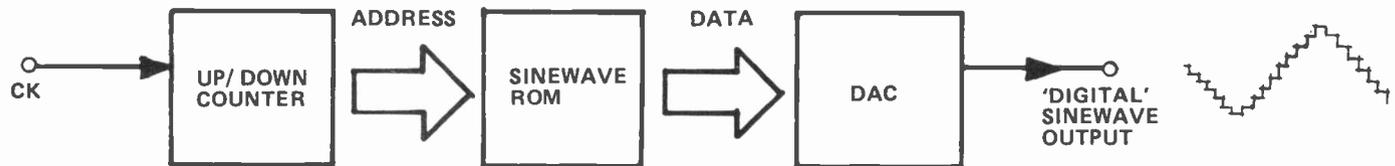
2) When the DAC output exceeds the level of the analog input the comparator output goes low, the counter stops. This is the end of the conversion, and the data that is held on the counters output is the data output. It would then be transferred to some latches, and held there until the next conversion is finished.

This data word describes as precisely as is possible the magnitude of the analogue input. Although simple to operate, this method has a major disadvantage, it is slow. Imagine that the ADC is a 10 bit device and the clock frequency is 500KHz,



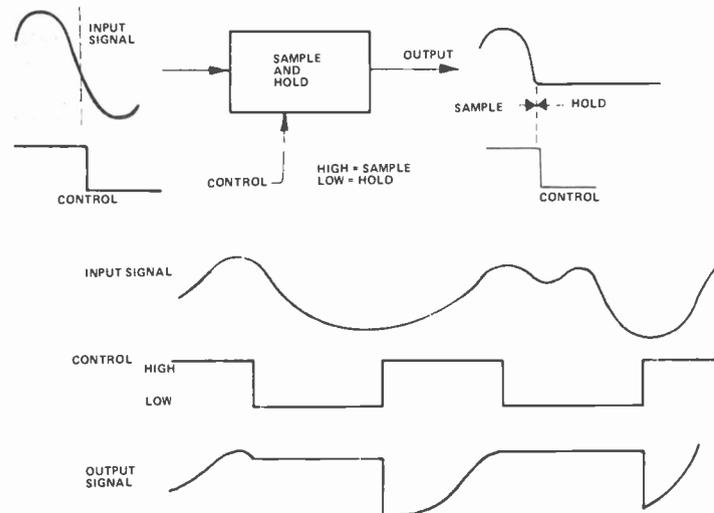
then the longest conversion time will be 1024 counts at $2\mu\text{Sec}$ per count which is 2.048mSec, this means that the conversion rate will be less than 500 per second.

Memory Planning



The data that drives DAC's can come from several sources. It could be generated by computation or read from a programmed memory as shown. In this example a ROM (read only memory), has been programmed with the data necessary to produce a

sinewave. An updown counter provides the address for the ROM and the data is converted into an analog output by the DAC. The clock frequency divided by the size of the counter determines the sinewave frequency.

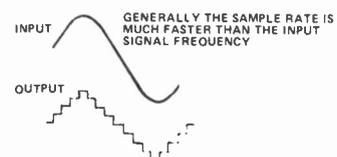


Data Lining

Another method of generating data is to convert analogue information into digital words. The signal must first be passed through a low pass filter, the cut off frequency of which must be less than half of the conversion frequency. The signal is then "held" in a sample and hold unit so that the ADC can do its conversion on a static signal. Control logic sends commands to the ADC giving it various instructions. The sequence of events is:

- 1) Tell sample and hold to HOLD.
- 2) Tell ADC to start conversion (SC).
- 3) Conversion finished, generate end of conversion signal (EOC).
- 4) Tell sample and hold to SAMPLE.

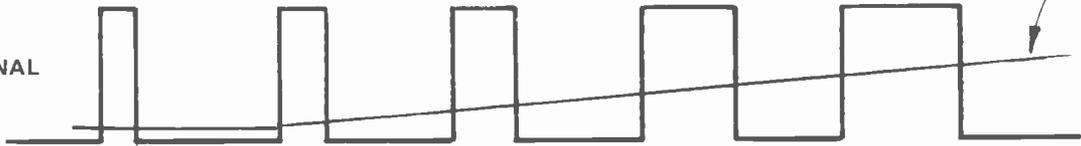
The process then repeats itself. The sample and hold mechanism is shown below. Generally, in one period and the input signal several ADC conversions will be done. The data generated is then stored, processed or transmitted.



Mark Time

MARK SPACE SIGNAL FROM SWITCH

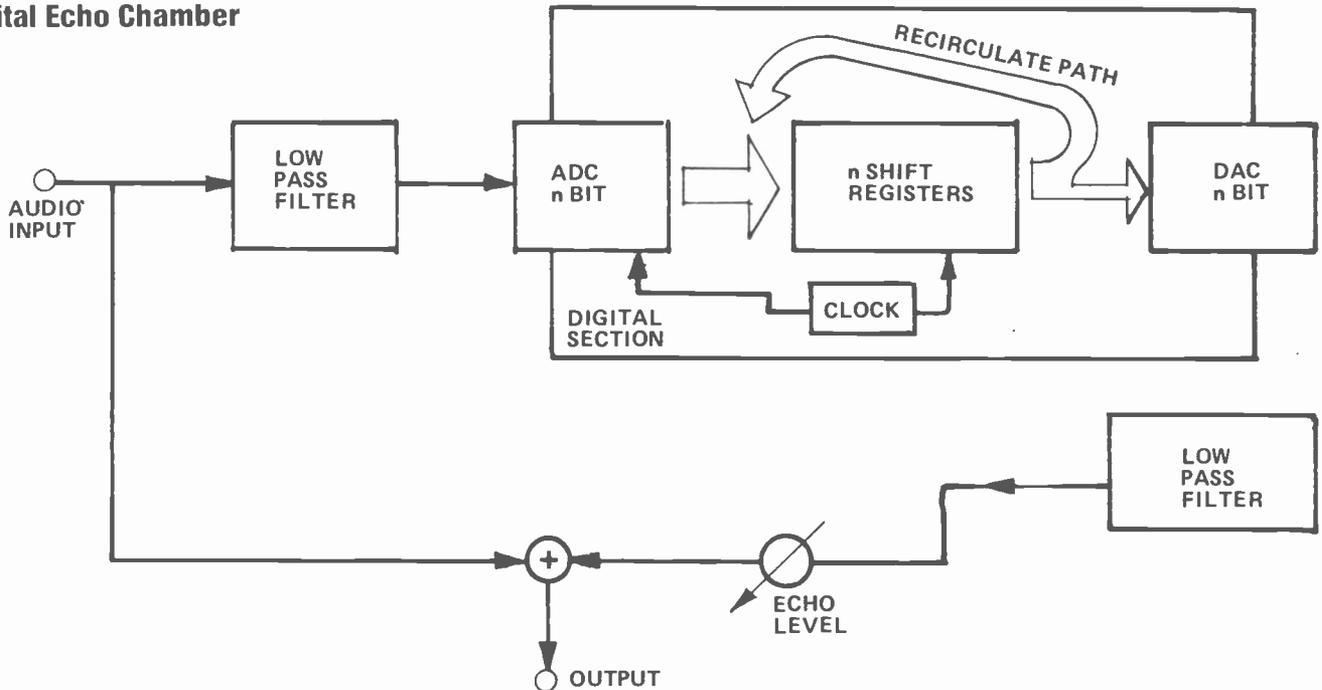
FILTERED OUTPUT



Yet another type of DAC, a mark space modulation DAC is shown above. The data word is presented to one side of a magnitude comparator, the output from a fast running counter to the other. When the counter is greater than the data word the A > B output goes low. The output is a mark space waveform the ratio of which is linearly proportional to the magnitude of the

data word. The mark space signal operates a precision switch, the output of which is lowpass filtered, providing a smoothed DC output. This type of DAC requires a fast running counter, but gives a relatively low bandwidth output signal. It is a good solution for a system where lots of slow moving outputs are required, because the counter can be common to all the DAC's.

Digital Echo Chamber



There are several professional echo chambers that are all digital. The audio input is converted into a digital word and then put into a parallel set of shift registers. A 10 bit system would use 10 sets of registers. The clock that starts the ADC conversion also shifts the data along the shift registers. The data coming out of the shift registers is then converted back into an analogue voltage by the DAC. It is then filtered and mixed with the original signal.

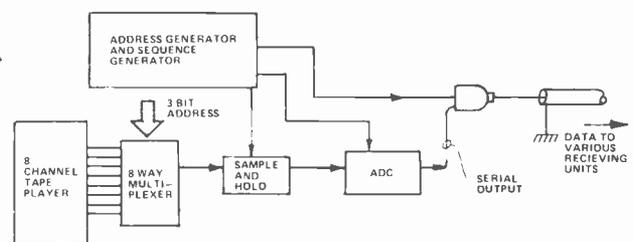
The echo can be made to repeat indefinitely by using the digital recirculate path around the shift registers. The amount of

digital storage required is rather large. Let us assume that we want a good quality echo. This would be a 10kHz bandwidth, 60 dB dynamic range which implies a clockrate of about 25kHz and a 10 bit system. Thus to store 1 second of sound (to give one second delay), we would need 10 x 25,000 bits of memory, 0.25 Mbits!

The usual solution to this dilemma is to get longer delays at the expense of bandwidth. Thus a 1 second delay would be 1kHz bandwidth, a 0.1 second delay would be 10 kHz bandwidth. This would only require 25K of memory.

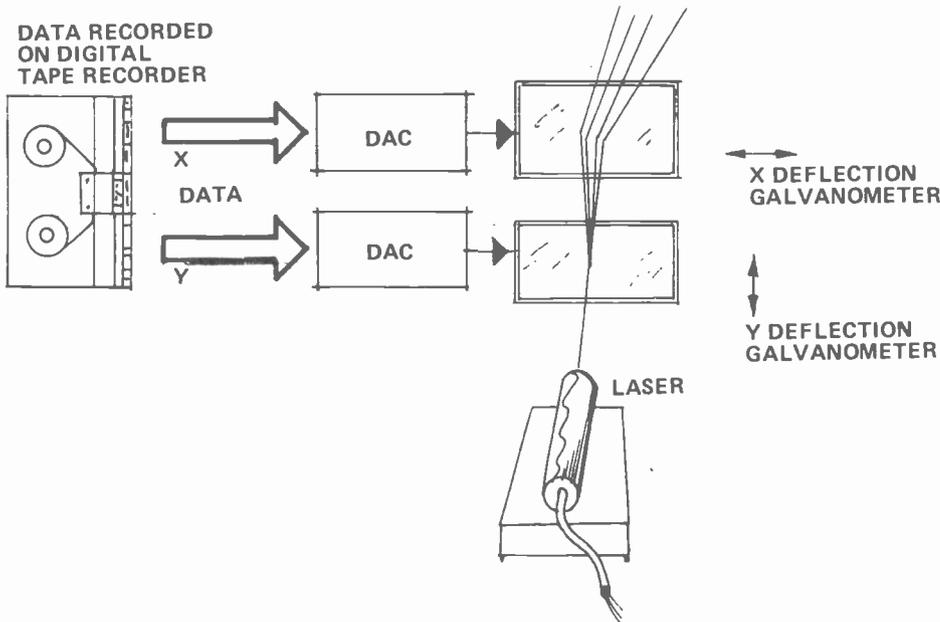
Multiplexed Sound System

Next time you are on an aircraft with a multichannel music system, it is quite possible that the sound you are hearing via your stethoscope is digitally generated. The sounds are usually stored on a multichannel tape player and each channel is connected to a multiplexer. This is a digitally controlled rotary switch and it is continually scanning all the audio channels. The output of the multiplexer is then fed to the ADC. Thus each channel is converted to a digital code. This digital code is then transmitted in serial mode and mixed with a sync pulse. The transmitted information is a series of serial data words, each representing a small piece of the eight music channels, plus some synchronisation data which passes down a two wire system to each receiving unit. This saves wire weight, there is less crosstalk and low pickup due to the high noise immunity of digital systems.



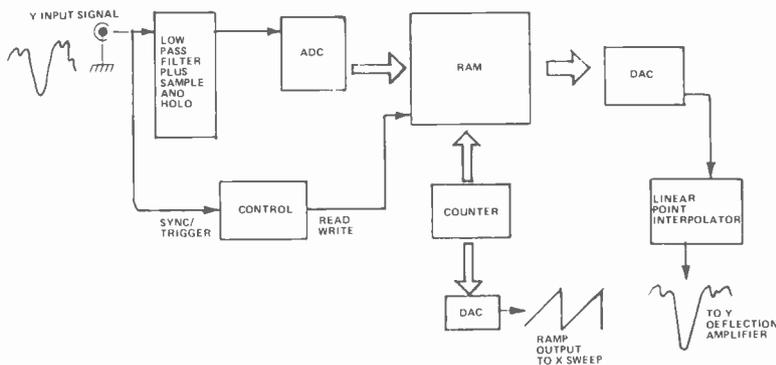
Laser Light Show.

One of the recent laser light shows in London used a digital tape recorder to store the data for the show. Two outputs were produced which were converted into control voltages by DAC's. These voltages were then used to manipulate the X and Y Co-ordinates of the laser. Thus it was possible to draw pictures and cartoon characters with a moving laser beam.



Digital Memory for an Oscilloscope.

There are several products on the market that enable an ordinary oscilloscope to store waveform information. This is particularly useful if you are trying to capture non-repeating events. The system is very similar to the digital echo unit, there is an ADC, a memory and a DAC. Also there is a trigger circuit so that one shot events can be captured and a ramp generator to produce the X sweep. The output of the DAC is rather interesting, because it is not low pass filtered, but it uses a linear point interpolation device. Basically, what this does is to join up the dots, so that a waveform that is represented by only a few points, can be made to look like the original signal. The visual results of interpolation are very good indeed.



TIMETRON Recommended by TEMPUS

Until TEMPUS have re-established their business we will be pleased to supply you from the superb range of **QUALITY CASIO PRODUCTS**. A well-known consumer magazine has published a report on digital watches which supports our opinion that CASIO and SEIKO are probably the best watches in the world, with CASIO offering unbeatable value for money.

NEW CASIO 46CS-27B

Almost certainly the **slimmest and most sophisticated alarm/chronograph watch available today**. liquid crystal display of hours, minutes, seconds, day. And with day, date, month and year perpetual calendar.

- Optional 12-hour clock (with am/pm indicators) or 24-hour display
- 24-hour alarm setting
- Optional hourly chimes
- Chronograph measures in units of 1/100 seconds to six hours
- Net, lap and 1st and 2nd place times
- All stainless steel case only 7.8mm thick
- Mineral glass face
- Water resistant to 100ft
- ± 10 seconds/month R.R.P. £89.95



£74.95

CASIO CHRONOGRAPH 46CS-22B

Similar functions to the above watch but without the alarm and chime. (R.R.P. £69.95) **£54.95.**

CASIO SPORTS WATCHES, LCD, 6 digits, 1/100 second stopwatch, net lap and 1st and 2nd place times. Time and calendar display. F-100 resin case, strap (£29.95) £24.95

52QS-14B, S/S encased, bracelet (£44.95) £34.95

NEW CASIO CARD WATCH THE INCREDIBLE MQ-11

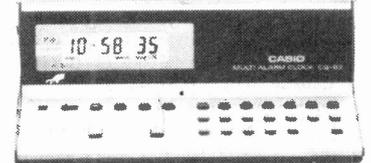


Microcomputer Quartz Sensor Touch keys LC Display of hours, minutes, seconds, am/pm, full calendar display of day, date and every Sunday. Also digital date, month, year. And day, Sundays. Three date memories. Two independent alarms with hold and display fac. Countdown alarm/timer, or Time Memory (24 hr.), or 1/10 sec stopwatch.

Will display any monthly calendar from 1901 to 2099. Memories and displays three optional important dates. Calculator with Sensor Touch keys, full memory, %, √, K. Battery life approx. 1 year. 3/16 x 2 1/2 x 3 1/2 inches. Leatherette wallet with window (£34.95) **An incredible £29.95.**

NEW CASIO CQ-82

LCD calculating alarm clock with snooze facility.



6 digit LC Display of time, with nightlight. Four alarms, one with snooze facility. Calculator with %, √, K. Long battery life, compact size (£24.95)

£19.95

CQ-81, Calculating alarm clock now only £14.95

PQ-7, Alarm clock, alarm/timer, stopwatch Now £17.95

NEW CASIO AQ-2000

Calculating alarm clock with stopwatch and calendar **£24.95**

ST-24, Card Time Calculator, stopwatch, 2 alarm-timers £19.95

NEW LCD calculators with full memory, %, √, K. Most have battery saving APO (Automatic Power-Off)

LC-79, Sensor touch Mini Card with APO. A very rigid 1.16 x 2 1/2 x 3 1/2 inches. Beautifully styled. Pouch £15.95

LC-841, APO Rigid 1 1/2 x 2 1/2 x 4 1/2 in. Pouch £12.95

NEW HL series Two AA batteries last 6,000 - 10,000 hours

HL-801 8 digits £9.95, HL-101 (10) £12.95, HL-121 £19.95.

LCD SCIENTIFIC CALCULATORS, FX-48 £19.95

FX-2500 £21.95, FX-3100 £25.95, FX-8000 £29.95.

Most CASIO products in stock. Send 15p for brochures.

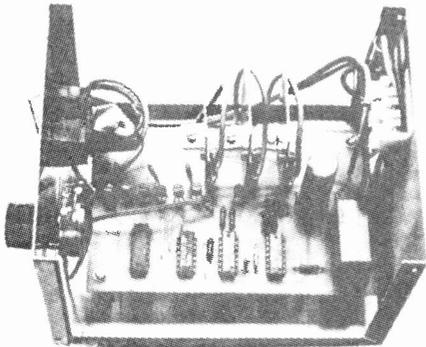
Prices include VAT, P & P. Send cheque, P O or phone your Access or Barclaycard to

TIMETRON Dept. ET1, Beaumont Suite
154-167 East Road
Cambridge CB1 1DB
Telephone 0223 67503
Callers welcome by appointment

**Next
Month**

Hobby Electronics

Light Chaser



A light chaser is a mechanical or electronic gadget which controls three or more lights arranged in a chain; these are flashed on, one at a time, in sequence to create an illusion of movement. They are used at fairgrounds, in advertising, in shop windows and in discos. Our project to build one is both simple and easy to build.

Decibels

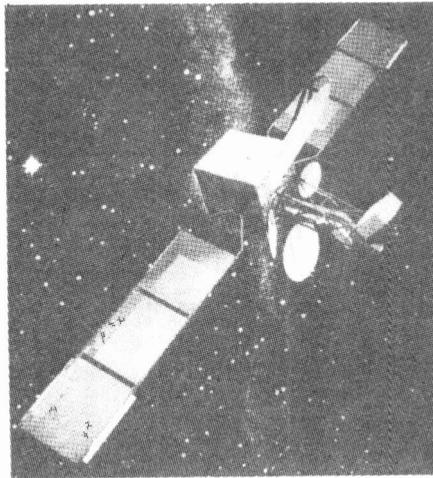
dB

Not surprisingly those who are new to electronics are confused by the apparently crazy use of decibels to describe gain or attenuation. Why not use easily understood numbers? We tell you and hope to convert you.

Photographic Timer

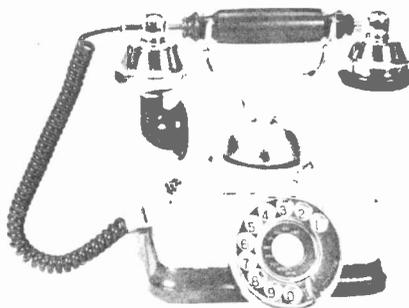
A project for those of you who do more than click the shutter. Our unit is in the mains lead to your enlarger (although battery operated) and allows you to set exposure times between 0.9 and 100 seconds in two infinitely variable ranges.

Communications Satellites



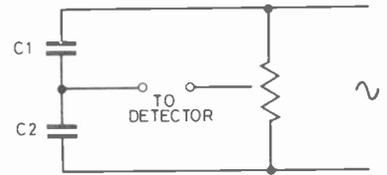
Speak to someone on the 'phone outside Europe and the chances are that your voice will spring out into space for thousands of miles on the way. The commercial ends of the space programme are described

Telephones



Do you know how the 'phone, one of the most widespread pieces of electronics, works? Lots of exciting things are happening on this front; we pull back the curtain and take a peep next month

Crossing your Bridges



The Wheatstone Bridge is one of the commonest circuit configurations in electronics. Next month K. T. Wilson examines the theory of this and describes the variations that we now use.

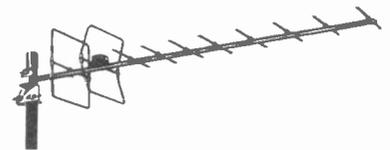
Experimenters Power Supply

Second in our series of test gear projects is a 0-20V, 1A bench power supply, stabilised of course as well as short circuit protected.

Workshop Test Gear

The HE project team have prepared a feature giving their views about what you need in the way of test gear in your workshop. It's a thoroughly practical approach and continually bears in mind the limitations of finance.

How TV Signals are Propogated



Put up an aerial in most areas of Britain and you'll have no trouble in getting a good signal but that's only because the broadcast engineers have taken into account a multitude of factors. We take a look at this subject in the March issue.

The March issue will be on sale February 9th

The items mentioned here are those planned for the next issue but circumstances may affect the actual content.

SAME AS ETI OFFER

5 FUNCTION LCD

Hours, mins, secs, month, date, auto calendar, back-light, quality metal bracelet.



£7.65

Guaranteed same day despatch

Very slim, only 6mm thick.

POCKET CALCULATOR + ALARM CLOCK PLUS 3-WAY STOPWATCH



★ Calculator with %, √ & memory.
★ Continuous clock with
★ Hrs, mins, secs, day, month, day of week
★ Alarm
★ Stop-watch with 1/10 secs to 10 hours + lap and split-time modes, 1st and 2nd.
★ Batteries last 1 year continuous operation
★ Dimensions 1/4" x 2 3/4" x 4 3/4" in.
★ Complete with leatherette wallet.

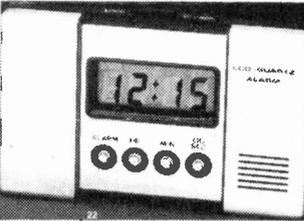
LIST PRICE £24.95
METAC SPECIAL EXCLUSIVE PRICE
£18.50

Cannot be found cheaper anywhere else

*** QUARTZ LCD ALARM ***

Snooze + backlight. Batteries last 1 year approx. Includes batteries and travel pouch. Excellent value

£17.65



Guaranteed same day despatch

THOUSANDS SOLD 11 FUNCTION SLIM CHRONO

6 digit 11 functions

- ° Hours, mins, secs.
- ° Day, date, day of week.
- ° 1/100, 1/10, secs, 10 x secs, mins.
- ° Split and lap modes.
- ° Back light, auto calendar.
- ° Only 8 mm thick.

This same watch is being sold for £22.00 in newspaper and magazine special offer ads.



Metac Price
£12.65

Guaranteed same day despatch

SEIKO SUPERIOR WATCHES

World famous piercing alarm chronograph

Please ring for delivery details



ALARM CHRONO
List price £130
Metac Price £105

SEIKO SUPERIOR WATCHES

Please ring for delivery details



CHRONOGRAPH
List price £85
METAC PRICE £68

SEIKO SUPERIOR WATCHES

6 digit, 7 function watch with 4 alarms & volume control.

Please ring for delivery details.



MULTIPLE ALARM
List price £120
METAC PRICE £98

SEIKO SUPERIOR WATCHES

Full spec. calculator + 6 function watch.

Please ring for delivery details.



CALCULATOR WATCH
List price £165
METAC PRICE £127

HANIMEX Electronic LED Alarm Clock

Same as ETI offer
Thousands sold



Alarm (Slide Switch)
Dim/Bright (Slide Switch)
Fast
Slow
Snooze
p.m. Indicator
Hour Display
Minute Display
Cutton
Time set Lock switch
Alarm On Indicator

Feature and Specification

- ★ Hour / minute display
- ★ Large LED display with p.m. and alarm on indicator
- ★ 24 Hours alarm with on-off control
- ★ Display flashing for power loss indication
- ★ Repeatable 9-minute snooze
- ★ Display bright/dim modes control

Size 5.15 x 3.93 x 2.36 (131mm x 100mm, x 60mm)
Weight: 1.43 lbs (0.65 kg)

Guaranteed same day despatch

£8.65

GENUINE SOLAR

5 function LCD

- ★ Solar panel with battery back-up.
- ★ Back light + auto calendar.
- ★ Hours, mins, secs, day, date.
- ★ Quality metal bracelet.



£10.95

Guaranteed same day despatch

LADIES LCD

Only 25 x 20 mm and 6 mm thick. 5 function: hours, mins, secs, day, date, + back light and auto cal. Elegant metal bracelet in silver or gold. State preference.



£9.95

Guaranteed same day despatch

ALARM LCD

6 digit 7 functions + penetrating alarm.

Hours Mins
Secs Day Date
Alpha Day Year.
Back light + 200 year calendar.



ONLY
£19.65

THE METAC DIGITAL CLOCK COMPLETE KIT

- ★ Pleasant green display - 12/24 Hour readout
- ★ Silent Synchronous Accuracy - Fully electronic
- ★ Pulsating colon - Push-button setting
- ★ Building time 1 Hr - Attractive acrylic case
- ★ Easy-to-follow instructions - Size 10.5 x 5.7 x 8 cm
- ★ Ready drilled PCB to accept components

PRICE £6.65



Mistral

FLUORESCENT DISPLAY CLOCK RADIO



- ★ Mains operated
- ★ Soft glow green display
- ★ MW / FM & LW radio
- ★ Alarm with 9 min. snooze feature
- ★ Programmable play-to-sleep setting
- ★ Brightness control

METAC PRICE ONLY
£19.95

DIGITAL LED CLOCK



- ★ Automatic brightness control
- ★ Weekend alarm cancel
- ★ 9 minute snooze alarm

OUR PRICE £10.95

All products carry full 12 months' guarantee. Please add 30p p&p with all orders. All prices include VAT.

Shops open 9.30 to 6.00 daily.

Trade enquiries welcome. **Delivery:** One week. Except where same day delivery is stated.

ALARM CHRONOGRAPH WITH DUAL TIME ZONE FACILITY

- Constant LCD display of hours and minutes, plus optional seconds or date display, plus day of the week and am/pm indication
- Perpetual calendar: day, date, month and year.
- 24-hour alarm with on/off indication.
- 1/10 second chronograph measuring net, lap and first and second place times.
- Dual time zone facility. Night light.



£27.95

GENUINE SOLAR CHRONOGRAPH

£15.95

6 digit, 11 function. Hours Min Secs 1/100 1/10 Secs Mins Split & lap modes. Auto cal + back light. Powered from solar panel with battery back-up.



PLEASE NOTE

All our products carry full money back 10-day reassurance. Watches are despatched by **FIRST-CLASS POST**. They are fitted with new batteries, and include guarantee and instructions. Battery fitting service is available at our shops for no extra charge. We stock most watch batteries and this service is available to all. Metac have been selling electronic watches probably longer than anyone else in the UK. We take care of your watch not just this year but next year and the years after that.

Telephone Special
24-hour phone service
Credit-card customers are welcome to buy phone—simply phone 01-723 4753 with your credit-card number to place your order.

METAC Electronics & Time Centre

67 HIGH STREET
DAVENTRY, NORTHANTS
Tel. (032 72) 76545

327 EDGWARE ROAD
LONDON W2
Tel. (01) 723 4753

Barclay & Access welcome
Phone or Send Card Number with order



HEADLIGHT DELAY

Use your car headlights to give post-parking illumination with this simple unit.

THIS SIMPLE LITTLE UNIT lets you use your car head or spot lights to illuminate your pathway for a pre-set period of about 50 seconds after you have parked the vehicle. At the end of this period the unit turns the lights off automatically.

The unit thus enables you to avoid walking into dustbins or tripping over junk that may be obstructing your private driveway, and helps you avoid stepping into various nasty bits that may be laying on the public sidewalk. The unit is easy to install in the vehicle.



Construction and Use

Construction of the unit should present no problems at all. The relay can be any 12V type with a coil resistance of 120ohms or greater, and with two or more sets of N.O. contacts that are rated at 3 amps or greater.

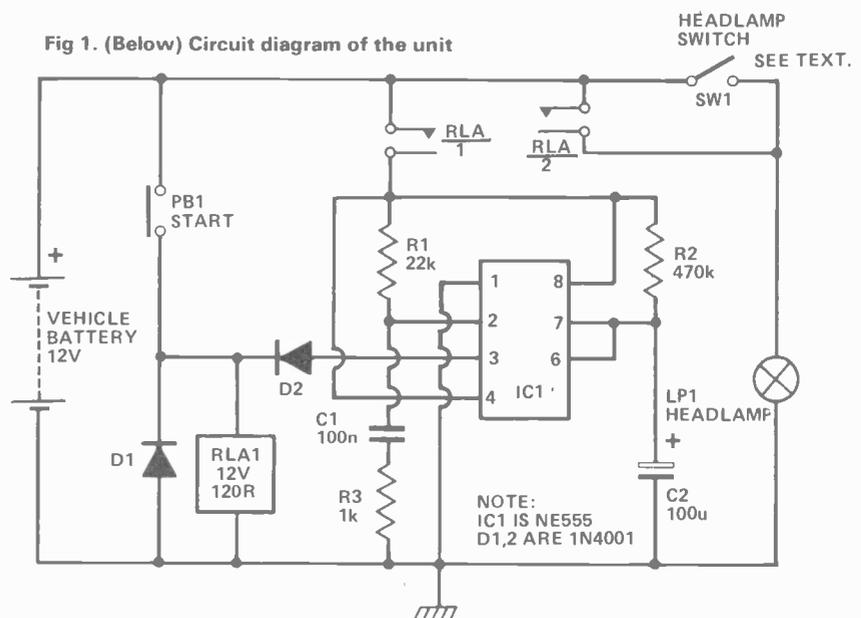
When it comes to installing the unit, note that two methods of correction to the vehicle are possible. On some vehicles the headlight switch is connected directly to the battery so that the headlights operate even when the ignition is turned off (see Fig 2a). In this case take connection 4 of the 5-way terminal block directly to the live side of headlamp switch SW1, and connection 5 to the headlamp side of SW1.

The alternative connection is shown in Fig 2b. Here, the headlight switch is wired in series with the vehicle's ignition switch, so that the headlights only operate when the ignition is turned on. If your vehicle uses this type of connection, take connection 4 of the 5-way terminal block to the live side of the ignition switch, and take connection 5 to the headlamp side of SW1. ►

BUYLINES

With the small number of components involved, it would be surprising if there were any problems in obtaining them.

Fig 1. (Below) Circuit diagram of the unit



HOW IT WORKS

The unit is designed around a type-555 timer i.e., with a relay output. The relay has two sets of normally-open contacts. Normally, START switch PB1 and the relay contacts are open, so zero power is fed to the timer circuit and (assuming that HEADLIGHT switch SW1 is open) the headlights are off. Circuit Action is initiated by briefly closing push-button switch PB1.

When PB1 is momentarily closed power is fed directly to the relay coil, and the relay turns on. As the relay turns on contacts RLA/2 close and apply power to the headlights and contacts RLA/1 close and apply power to the timer circuit, but pin 2 of the IC is briefly tied to ground via C1 and R3 at this moment, so a negative trigger

pulse is immediately fed to pin 2 of the IC and a timing cycle is initiated. Consequently, pin 3 of the IC switches high at the moment that the relay contacts close, and thus locks the relay on irrespective of the subsequent state of switch PB1.

The 555 is wired as a one-shot timer or monostable with a timing period of about 50 seconds (determined by R2 and C2). Thus, the relay and headlights are held on for the duration of this 50 second timing period. At the end of the timing period pin 3 of the IC switches to the low state, so the relay turns off and contacts RLA/1 and RLA/2 open, removing power from the timing circuit and the headlights. The operating sequence is then complete.

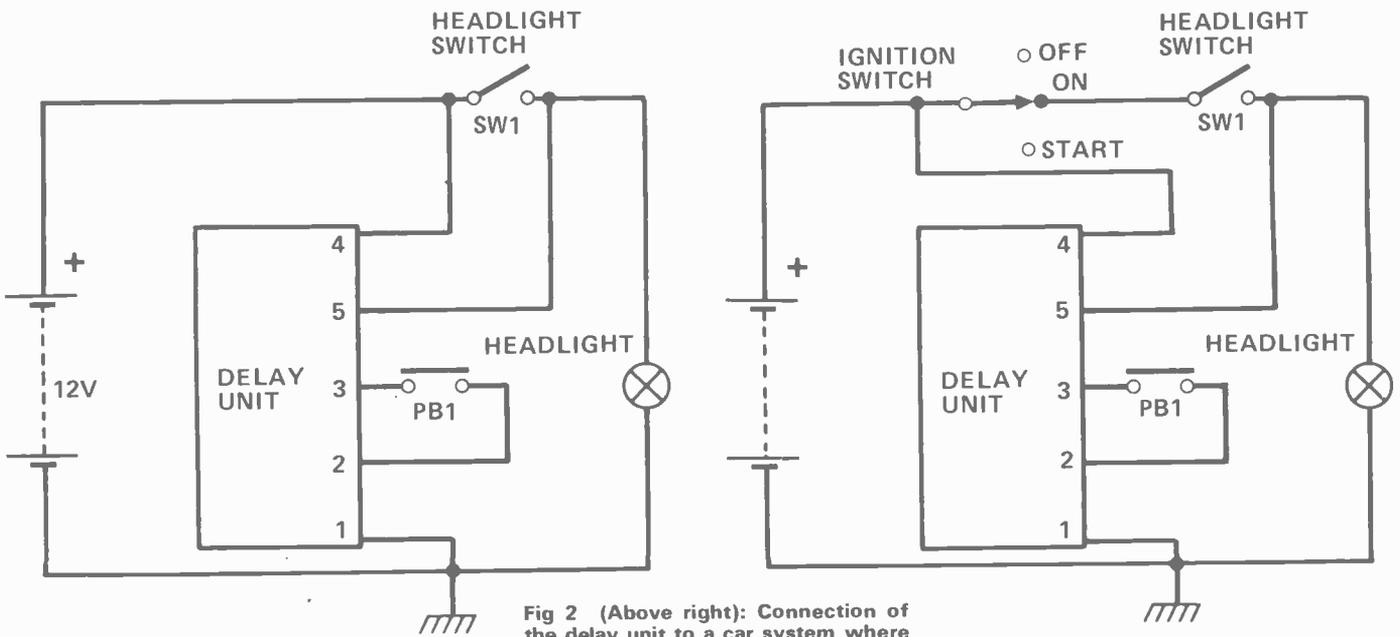


Fig 2 (Above right): Connection of the delay unit to a car system where the headlights are independent of the ignition switch.

(Above Left): Connection to all other systems!

PARTS LIST

RESISTORS

R1, 22k
R2, 470k
R3, 1k

CAPACITORS

C1, 100n polyester
C2, 100u elect.

SEMICONDUCTORS

IC1 NE555
D1, 2 IN4001

MISCELLANEOUS

Relay rated at 3A 2 pole c/o Coil 7120
SPST push button 5 way terminal. Block rated at 5A Die-cast case.

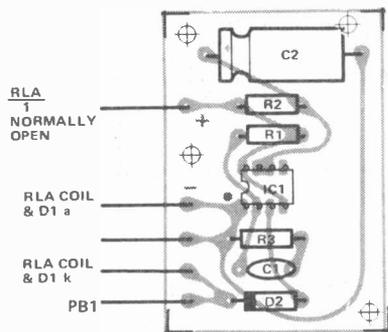


Fig 3. (Left): Component overlay for the delay unit

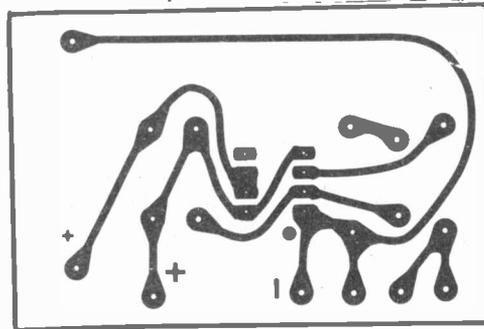


Fig 4. (Left): Wiring of the delay unit to a 5 terminal connection block

Fig 5. (Above): Full size foil pattern of the headlight delay PCB.

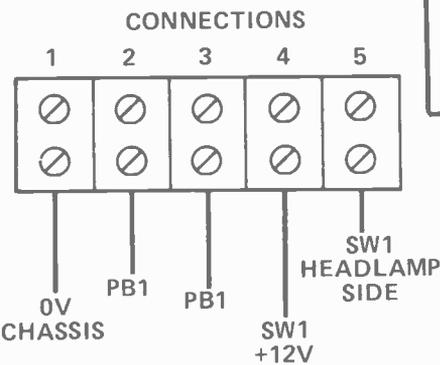
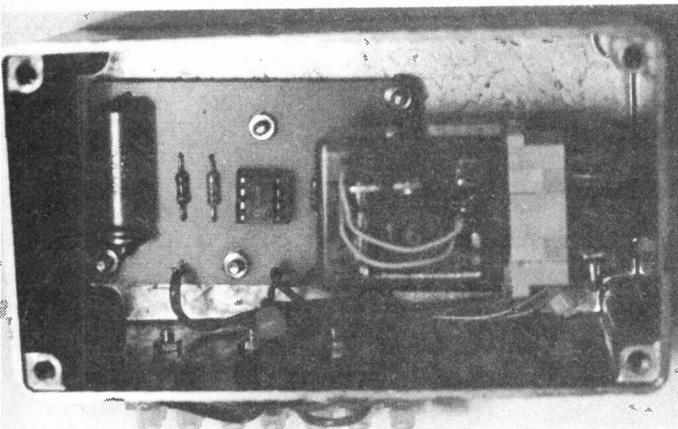
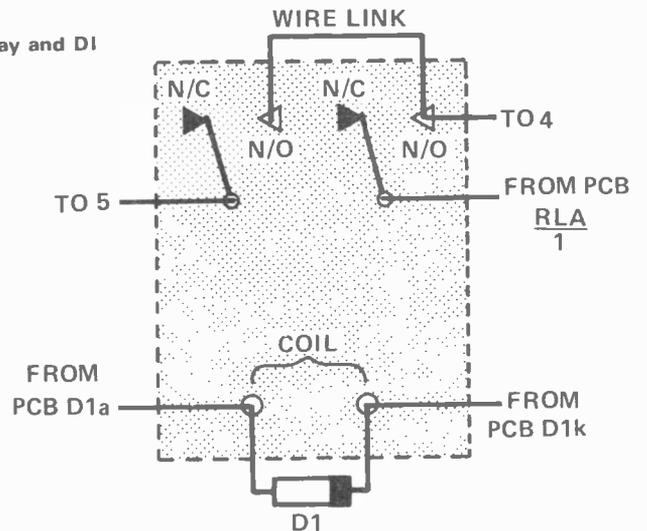


Fig 6. (Below right): The relay and DI wiring.

RELAY CONNECTIONS 2 POLE C/O 3A RATED



LEADING DETECTOR DESIGNS NOW AVAILABLE AS KITS



Super performance true TR/IB (Transmit Receive/Induction Balance metal detector using the very latest integrated circuitry. The most sophisticated detector now available in kit form. Range for coin 8" to 12" depending on conditions: PP3 battery lasts over 50 hours: fully adjustable shaft and search head. Plus many other refinements. If you are thinking of buying any other detector — phone us first (without obligation) for a frank comparative assessment. Or send S.A.E. for instruction sheet which gives more information than space here permits.

"Shadow" metal detector £29.95 post paid
 "Shadow" kit (pre-wound coils) £22.50 post paid
 Send 25p for assembly manual — refundable against kit purchase.
 Padded headphones £5.50 post paid.

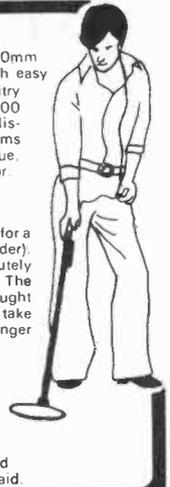
Building your own detector? Then we can supply the hardware 'shell'. Including fully adjustable shaft with handle. Special clips to mount your own control housing (any box is suitable) and search head mouldings with adjustable ball joint hinge. Suitable for any type of detector (BFO-TR-IB-PI etc.) including those published in this and other magazines. As used for our own 'Shadow' detector. Supplied undrilled as a kit with full instructions.

Detector "Shell" kit £7.50 post paid.

SPECIAL OFFER To every purchaser of our 'Shell' kit we are giving away a copy of our publication 'Metal detector design notes' which gives much useful information on many different types of metal detectors and detection techniques, including TR, IB, BFO, PI, VLF, Proton Magnetometer, Discriminators, Phase locked loops, Harmonix mixing, hall effect, Off resonance, Coupled field, Faraday shields, Push button tuning, Legal frequencies, other legal requirements, how to obtain Home Office approval, etc. etc. Contains many interesting circuits (including commercial designs) too numerous to list. A wealth of priceless information much of which has not been published before.

QUALITY NOTE All Altek detectors use high grade epoxy/glass roller tinned boards. Some manufacturers still use plain copper which quickly corrodes in damp weather. All Altek detectors are Home Office approved. Phone in your credit card number now (24 hour answering).

A good all round low cost metal detector. 200mm (8") annular search head gives wide scan with easy pinpointing. Simple high efficiency B.F.O. circuitry draws < 5mA, inexpensive battery gives over 100 hours search time. Ferrous/non ferrous discrimination possible. Extra lightweight, 300 gms (10.5 ozs) with battery — eliminates arm fatigue, even for a child. The lowest priced metal detector.
ALT3 — £12.95 + £1 towards p&p



Build it yourself. Very detailed manual — ideal for a beginner as a first project (must be able to solder). Pre-wound search loop and tuning coil, absolutely everything supplied except tools and battery. The least expensive way of buying. The parts bought separately might cost you more, certainly it'd take more time. Makes a great present for a younger brother, etc (buy it for him — use it yourself!).
ALT3 (kit) — £9.95 + £1 towards p&p.

Send 25p for assembly manual — refundable against kit purchase.
 Accessories for ALT3
Stethoscope adaptor 85p post paid
Padded headphones £4.90 post paid.

All prices include VAT

Mail Order only please Callers by appointment

Write or Phone - Now !!

Altek Instruments
 Dept. ETB, 1 Green Lane
 Walton-on-Thames, Surrey



(093 22)
 44110
 ANYTIME!

B. BAMBER ELECTRONICS

DEPT. ETI, 5 STATION ROAD, LITTLEPORT, CAMBS. CB6 1QE
 Tel. ELY (0353) 860185 (Tues. to Sat.)

CASH WITH ORDER. (MINIMUM ORDER £2.00)
 PLEASE ADD VAT AS SHOWN
 POST PAID (UK ONLY), SAE WITH ENQUIRIES
 CALLERS WELCOME BY APPOINTMENT ONLY

ALL BELOW — ADD 8% VAT

HIGH QUALITY RELAYS, 4 pole c/o. BA contracts. 12V DC coil, 150 ohm. Size approx. 1" x 3/4" x 1 1/4". with plastic covers. 80p each or 2 for £1.50.
IC TEST CLIPS, clip over IC while still soldered to pcb or in socket. Gold-plated pins, ideal for experimenters or service engineers. 28 pin DIL £1.75. 40 pin DIL £2.00. Or save by buying one of each for £3.50.
MAINS TRANSFORMERS, TYPE 15/300 240V input. 15V at 300mA output. £1.50 each.
MAINS TRANSFORMERS, TYPE 45/1000, 240, 220, 110, 20, 0V input. 45V at 100mA output. £1.50 each.
SPECIAL OFFER FOR COMPUTER BUILDERS, ETC. 19 way ribbon cable, decimal coded, 4 Metres for £1.25. 13 way heavy-duty ribbon cable, decimal coded (ideal for PSU runs), 3 metres for £1.50.
SUB-MINIATURE ROTARY SWITCHES, 4 x 5-way make contacts. Size approx. 3/8" dia., 1" deep, 3/16" spindle, 50p each.
30pf BEEHIVE TRIMMERS, Brand new, 4 for 50p.
Min. 50pf AIR SPACE TRIMMERS, approx. 3/8" square, 3 for 50p.
Min. 50pf COMPRESSION TRIMMERS, 1/2" x 5/16", 4 for 50p.

FULL RANGE OF BERNARDS/BABINI ELECTRONICS BOOK IN STOCK. S.A.E. FOR LIST.

DOE TO A CHANGE OF SUPPLIER, OUR STOCK ALUMINIUM BOXES AND VINYL COVERED EQUIPMENT CASES WILL BE AS FOLLOWS

Aluminium Boxes with Lids	
All 1x2x1	60p
AL2 4x3x1 1/2	70p
AL3 4x3x2	80p
AL4 6x4x2	90p
AL5 6x4x3	£1.25
AL6 8x6x2	£1.50
AL7 8x6x3	£1.75

Vinyl Coated Instrument Cases Blue Tops with Plain Lower Sections Very smart finish	
BC05 ... 5x2 1/2 x 2 1/2	£1.00
BC1 ... 6x4 1/2 x 2	£2.00
BC2 ... 6x4 x 3 1/2	£2.25
BC3 ... 8x5 1/2 x 2 1/2	£2.50
BC4 ... 10x8 1/2 x 3	£3.00
BC7 ... 12x6 1/2 x 5	£3.25

ALL BELOW — ADD 8% VAT

MIXED COMPONENT PACKS. Containing resistors, capacitors, switches, pots, etc. All new, and hundreds of items. £2.00 per pack, while stocks last.
IC AUDIO AMP PCB. Output 2 watts into 3 ohm speaker, 12V DC supply, size approx. 5 1/2" x 1 1/2" x 1 1/2" high, with integral heatsink. complete with circuit. £2.00 each.
NICAD CHARGER CONVERTER PCB. (Low power inverter). Size approx. 4" x 1 1/4" x 1" high. 12V DC supply, 60V DC output, through pot on pcb, for charging Nicads, etc ideal for charging portable batteries from mobile supply). Only needs one BFY50/51/52 or similar transistor, which can be mounted direct on the pcb pins on board, fitted with a star-type heatsink (not supplied). £2.00 each.

THE NEW EAGLE INTERNATIONAL CATALOGUE IS AVAILABLE ON REQUEST containing Audio, In-car, and test equipment, etc.

DECIMAL KEYBOARDS, pressure sensitive type, when pressed contacts go from 0/C to approx. 25 ohms. Switches only, no encoders. Size approx. 3" x 3", with large square touch plates. 0-9 + Clear, A, B, Dual Watch, and spare. Few only. £2.00 while stocks last.

TRANSISTORS
 BFY51 Transistors, 4 for 60p
 BCY72 Transistors, 4 for 50p
 BSX20 (VHF osc/mult.), 3 for 50p
 BC107 (metal can) 4 for 50p
 BC108 (metal can) 4 for 50p
 PBC108 (plastic BC108), 5 for 50p
 BF152 (UHF amp/mixed), 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
 741CG RCA OP Amps 4 for £1.00
 SCRs 400V at 3A, stud type, 2 for £1.00
 TIP2955 Silicon PNP power transistor. 60V at 15A. 90 Watts. Flat pack type. 2 for £1.50
 GERMANIUM DIODES, approx 30 for 30p.
 1N4148 (1N914) diodes 10 for 25p.

VALVES
 QV03/20A (ex. equipment) £3.00
 QV03/10 (ex. equipment), 75p or 2 for £1.20
 6BH6 (ex. equipment), 2 for 50p
 All the above valves are untested, except for heaters, and no guarantee of percentage of emission is given.
 Sony, no returns.
 MULLARD 85A2 85V STABILISER VALVES (brand new), 70p each or 2 for £1.20.

ALL BELOW — ADD 8% VAT

RED LEDs (Min. type) 5 for 70p
VIDICON SCAN COILS (Transistor type, but no data), complete with vidicon base. £6.50 each. Brand new AEI CS10B/R MICROWAVE DIODES, up to X-Band, max. noise figure 8.5dB at 9.275GHz, 40p each.
DIE-CAST BOXES
SIZE APPROX.
 4.3" x 2.3" x 1.2" (111 x 60 x 30mm) £1.25
 4.8" x 2.3" x 1.5" (121 x 60 x 38mm) £1.75
 4.8" x 3.8" x 1" (121 x 95 x 25mm) £2.10
 4.8" x 3.8" x 2" (121 x 95 x 51mm) £2.45
 6.8" x 4.8" x 2" (171 x 121 x 51mm) £3.10
 4.8" x 3.8" x 3" (121 x 95 x 76mm) £3.50
 6.8" x 4.8" x 4" (171 x 121 x 101mm) £4.37
 6.8" x 5.8" x 2" (222 x 146 x 51mm) £4.25
 10.6" x 6.8" x 2" (273 x 171 x 51mm) £5.30

SPIRALUX Tools for Electronics enthusiast. SAE for list.

SOLDER SUCKERS (Plunger Type)
 Standard Model. £6.50
 Skirted Model. £6.00
 Spare Nozzles, 65p each
WELLER WP600 Mains operated temperature control, soldering iron. £15.00
SPARE TIPS (for WP600). Two types available. TYPE CC7 (W60D) Standard. TYPE AA7 (W60D). Finer tip. £1.60 each
WELLER TCP2 temperature controlled soldering iron, and PU2D power unit (replaces Weller TCP1). Iron + PSU £30.00 Spare tips CC7 (standard), or K7 (finer tip) £1.50 each
 Slider Switches, 2 pole make and break (or can be used as 1 pole change-over by linking the two centre pins), 4 for 50p.

PLASTIC PROJECT BOXES, with screw on lids (in black ABS) with brass inserts.
 Type N81 approx. 3 1/4" x 2 1/4" x 1 1/4" 45p each.
 Type N82 approx 4" x 3" x 1 1/4" 55p
 Type N83 approx 4 1/4" x 3 1/4" x 1 1/4" 65p each
 Type N84 approx. 8 1/2" x 5 1/2" x 3 1/4" £1.50 each
OSMOR 10V REED RELAY COILS (1k ohm coil) to fit 1/4" reeds (not supplied), 2 for 50p.
HF CHOKES wound on 1/4" x 1" long ferrites. 4 for 50p.
VHF CHOKES wound on 6-hole tubular ferrites. 5 for 40p
DUAL TO18 HEATSINKS 1" x 1/2" x 1/2" with screw-in clamps, 3 for 50p.

ALL BELOW — ADD 8% VAT

GLASS BEAD FEEDTHROUGH INSULATORS, solder-in type, overall dia. 5mm, pack of approx. 50 for 50p.
LARGE GLASS BEAD FEEDTHROUGH INSULATORS, as above but 8mm dia. pack of approx. 50 for 70p.
20 RELAYS, PCB mounting type, single pole change-over, 35p each.
10.7MHz SSB X-TAL FILTERS (2.4kHz Bandwidth) Low imp. type, Carrier and unwanted sideband rejection min. -40dB (need 10 69835 & 10 70165 xtals for USB/LSB, NOT SUPPLIED). Size approx. 2" x 1 1/2" x 1/2" £10.00 each
LOW PASS FILTERS (low imp. type), 2.9MHz, small metal encapsulation, size approx. 1 1/2" x 1/4" x 1/4" 75p each.

ALL BELOW — ADD 12 1/2 % VAT

CELESTION 8" x 5" ELLIPTICAL SPEAKERS, 20 ohm, 3 watts rated, £1.50 each + 12 1/2% VAT.
VARICAP TUNERS, Mullard type. ELC1043/05. £5.00
BSR AUTOCHANGE RECORD PLAYER DECKS with cue device, 33-45-78 rpm, for 7", 10", 12" records. Fitted with SC12M Stereo Ceramic cartridge and stylus. Brand new. £14.00 + 12 1/2% VAT.
GARRARD AUTOCHANGE RECORD PLAYER DECKS, Model 6 300, with cue device, 33-45-78 rpm, for 7", 10", 12" records. Fitted with KS41B Stereo Ceramic cartridge and stylus. Brand new. £16.00 + 12 1/2% VAT.
TV LINE LINEARITY COILS, Special offer 10 for £1.00
TV SCAN COILS, B/W, to fit 110 degree tubes. £1.00
TV Plugs (metal type), 4 for 50p
3-pin Din Plugs, 4 for 50p
Din 3-pin Line sockets, 15p each
Din Speaker Skts, 2-pin, 4 for 30p
Dubilier Electrolytics, 50uF 450V, 2 for 50p
Dubilier Electrolytics, 100uF 275V, 2 for 50p
Plessey Electrolytics, 470uF 63V, 3 for 50p
TCC Electrolytics, 1000uF 30V, 3 for 60p
Dubilier Electrolytics 5000uF 35V, 50p each
Dubilier Electrolytics, 5000uF 50V, 60p each
ITT Electrolytics, 6800uF 25V, high grade, screw terminals, with mounting clips, 50p each.
Resistor PKs approx 300 pieces 1/2 to 2 watt types, mixed values, our selection, £1.00 each
LARGE ELECTROLYTIC PACKS, Contain range of large electrolytic capacitors, low and high voltage types, over 40 pieces. £3.00 per pack (+ 12 1/2% VAT).

A RANGE OF CAPACITORS AVAILABLE AT BARGAIN PRICES. SAE FOR LIST.

ETI BOOK SERVICE

BEGINNERS

Beginners Guide to Electronics Squires £2.65
Beginners Guide to Transistors Reddihough £2.65
Electronic Measurement Simplified C. Hallmark £2.20
Electronics Self Taught Ashe £4.40
Beginners Guide to Integrated Circuits Sinclair £3.15
Principles of Transistor Circuits S. Amos £4.75
Understanding Electronic Circuits Sinclair £4.10
Understanding Electronic Components Sinclair £4.10
Beginners Guide to Radio King £3.15
Beginners Guide to Audio Sinclair £3.10

COOKBOOKS

TV Typewriters Cookbook £7.75
CMOS Cookbook £8.20
Active Filters £11.30
IC Timer Cookbook £7.50
IC Op-Amp Cookbook £10.00
Video Cookbook £7.00
TTL Cookbook £7.55

APPLICATIONS

Advanced Applications for Pocket Calculators J. Gilbert £4.20
Build Your Own Working Robot D. Heiseman £3.70
Electronics and Photography R. Brown £2.30
Fire and Theft Security Systems B. Wells £2.00
How To Build Proximity Detectors and Metal Locators J. Shields £3.90
How To Build Electronic Kits Capel £2.10
Linear Integrated Circuit Applications G. Clayton £5.40
Function Circuits Design & Applications Burr Brown £15.95
110 Electronic Alarm Projects R. M. Marston £3.45
110 Semiconductor Projects for the Home Constructor R. M. Marston £3.25
110 Integrated Circuit Projects for the Home Constructor R. M. Marston £3.25
110 Thyristor Projects Using SCRs R. M. Marston £2.95
Handbook of IC Circuit Projects Ashe £2.30
Practical Electronic Project Building Ainslie and Colwell £2.45

TV AND HI-FI

Audio Handbook G. King £6.50
Cassette Tape Recorders J. Earl £5.25
Solid State Colour TV Circuits G. R. Wilding £6.35
Hi-Fi Loudspeakers and Enclosures Cohen £8.20
How To Build Speaker Enclosures Badmateff £3.90
Master Hi-Fi Installation King £2.80

LOGIC

Logic Design Projects Using Standard ICs J. Wakerly £5.10
Practical Digital Design Using ICs J. Greenfield £12.50
Designing With TTL Integrated Circuits Texas Instruments £9.05
How To Use IC Circuit Logic Elements J. Streater £3.65
110 COSMOS Digital IC Projects for the Home Constructor R. M. Marston £3.20
Understanding CMOS Integrated Circuits R. Melen £4.00
Digital Electronic Circuits and Systems R. M. Morris £3.50
MOS Digital ICs G. Flynn £5.10

COMPUTING

Microprocessors and Microcomputers B. Soucek £18.80
Microprocessors D. C. McGlynn £8.40
Introduction to Microprocessors Aspinall £6.40
Modern Guide to Digital Logic (Processors, Memories and Interfaces) £4.30
Beginners Guide to Microprocessors £4.70
Beginners Basic Gosling £3.35

OP-AMPS

Applications of Operational Amplifiers Graeme (Burr Brown) £8.30
Designing With Operational Amplifiers Burr Brown £16.65
Experiments With Operational Amplifiers Clayton £3.40
110 Operational Amplifier Projects for the Home Constructor R. M. Marston £2.95
Operational Amplifiers Design and Applications G. Tobery (Burr Brown) £7.40
Op-Amp Circuit Design & Applications J. Carr £4.00

TEST INSTRUMENTS

The Oscilloscope In Use Sinclair £3.10
Test Instruments for Electronics M. Clifford £2.40
Working With the Oscilloscope A. Saunders £1.95
Servicing With the Oscilloscope G. King £5.60
Radio Television and Audio Test Instruments King £5.90

SERVICING

Electronic Fault Diagnosis Sinclair £3.20
Rapid Servicing of Transistor Equipment G. King £2.95
Tape Recorder Servicing Manual Gardner Vol. 1: 1968-70 £8.50
Vol. 2: 1971-74 £8.50
FM Radio Servicing Handbook King £4.80

COMMUNICATIONS

Communication Systems Intro To Signals & Noise B. Carlson £7.50
Digital Signal Processing Theory & Applications L. R. Rabiner £23.80
Electronic Communication Systems G. Kennedy £8.50
Frequency Synthesis. Theory & Design Mannassewitsch £23.40
Principles of Communication Systems H. Taub £8.10

THEORY

Introduction to Digital Filtering Bogner £10.20
Transistor Circuit Design Texas Instruments £9.35
Essential Formulae for Electrical and Electronic Engineers N. M. Morris £1.65
Modern Electronic Maths Clifford £6.70
Semiconductor Circuit Elements T. D. Towers £6.40
Foundations of Wireless Electronics M. G. Scroggie £4.45
Colour Television Theory Hudson £6.20

REFERENCE

Transistor Tabelle (Includes physical dimensions) £4.10
Electronic Engineers Reference Book (Ed. 4) L. W. Turner £27.70
Solid State Circuit Guide Book B. Ward £2.25
Electronic Components M. A. Colwell £2.45
Electronic Diagrams M. A. Colwell £2.45
Indexed Guide to Modern Electronic Circuits Goodman £2.30
International Transistor Selector T. D. Towers £6.00
International FET Selector T. D. Towers £4.35
Popular Valve/Transistor Substitution Guide £2.25
Radio Valve and Semiconductor Data A. M. Bell £2.60
Master Transistor/Integrated Circuit Substitution Handbook £5.60
World Radio TV Handbook 1978 (Station Directory) £8.00
Radio, TV and Audio Technical Reference Amos £24.85
TV Technicians Bench Manual (New Ed.) Wilding £5.10

MISCELLANEOUS

Integrated Electronics J. Milman £7.90
Microelectronics Hallmark £3.90
Practical Solid State DC Supplies T. D. Towers £6.20
Practical Triac/SCR Projects for the Experimenter R. Fox £2.25
Printed Circuit Assembly Hughes & Colwell £2.45

Fallen behind recent advances?
Just starting out?
Need a decent reference book?
ETI Book Service provides an easy
way of getting your hands
on the right title.

How to order: Make cheques etc payable to ETI Book Service. Payment in sterling only please. Orders should be sent to: ETI Book Service, PO Box 79, Maidenhead, Berks. All prices include P&P.

TAMTRONIK LTD. (DEPT. ETI)

217 TOLL END ROAD, TIPTON
WEST MIDLANDS DY4 OHW

TEL. 021-557 9144

PRINTED CIRCUIT BOARDS and KITS FOR ETI PROJECTS

ADDITIONAL PRINTED CIRCUIT BOARDS

Pcbs are available for all projects from September 1976 (except where copyright restrictions exist)

Mag. Issue	Project	Kit Ref.	P.C.B.	Kit	Kit contents (see key)
Sep 77	'Graphic Equaliser	601	1 75	20 28	BFGH
Sep 77	'Graphic Equaliser P.S.U	602	65	1 94	BFG
Oct 77	'Watchdog	604	90	18 80	BEGHL
Oct 77	'Watchdog P.S.U	605	75	6 14	BEH
Aug 77	'Sweep Oscillator	606	2.90	36 41	BFGHL
Sep 77	'Stereo Simulator	607	1 75	23 30	BEGHL
Dec 77	'Fridge Alarm	608	70	5 77	BFHL
Nov 76	'General Purpose Preamp	609	70	3 83	BEG
Jul 77	'GSR Monitor	612	80	16 55	BEGHL
Apr 77	'Burglar Alarm	613	70	9 00	BEGH
Feb 77	'Bench Amplifier	615	80	11 10	BEGHL
Nov 77	'Compendium	617	1 75	23 30	BEGHL
Mar 77	'50 watt High Power Amp	618	1 45	7 91	BE
Mar 77	'100 watt High Power Amp	619	1 45	10 61	BE
Mar 77	'High Power Amp P.S.U.	620	1 20	14 75	BEJ
Oct 77	'Digital Thermometer	621	1 40	18 70	BFGHL
Feb 77	'LED Dice	624	60	5 83	BEGHL
	'Active Crossover (2 pcbs)	625	2 40	12 70	BFGHL
	'Marker Generator	626	90	6 97	BEGHL
	'Skeet	627	1 75	18 37	BEGHL
	'Flash Trigger	628	75	5 07	BEGJ
	'Disco Light Show	629	3 30	21 94	BFGJ
	'Pink Noise Generator	630	70	3 35	BEJ
	541 Train Controller	T001	80	15 86	BEGHL
	444 5 watt Stereo (2 pcbs)	T002	2 15	26 47	BEGK
	448 Disco Mixer	T003	1 75	16 36	BEJ
	Clock B	T004	2 30	13 61	BE
	House Alarm A	T005	2 20	25 68	BEHM
	House Alarm B	T006	95	3 99	BE
	Metal Locator Mk II	T007	1 05	19 10	BEHL
	Frequency Shift P.S.U	T008	75	4 89	BE
	Frequency Shifter	T009	1 65	21 04	BEJ
	L.C.D. Meter	T010	1 10	25 72	BEG
	Light Dimmer	T011	65	7 17	BEH
	Gas Monitor	T012	90	13 96	BEHL
	Star Trek Radio	T013	95	7 97	BFH
	Stars & Dots	T014	2 00	22 28	BEHL
	Spectrum Analyser (2 pcbs)	T015	9 75	66 53	CEHM
	Wein Oscillator	T016	1 00	14 56	BEHL
	Torch Finder	T018	55	1 82	BE
	Temperature Meter	T019	1 10	25 51	BEG
	Eiwei Plant Waterer	T020	1 00	5 03	BEH
	Cross Hatch Generator	T021	1 40	12 84	BEGHL
	Slide Timer	T022	2 30	23 26	BEJL
	Wheel of Fortune	T023	1 35	8 36	BEHL
	Complex Sound Generator	T024	2 95	21 88	BEH
	R.F. Power Meter	T025	1 20	12 94	BEHL
	Power Bulge	T026	70	2 98	BEHL
	Telephone Bell Extender	T027	1 00	9 65	BEHL
	Proximity Switch	T028	1 95	13 11	BEGH
	Ultra Sonic Receiver	T029	70	9 03	BEH
	Ultra Sonic Transmitter	T030	55	4 57	BEH
	Cuts Cassette Interface	T031	2 25	12 76	BEH
	Audio Oscillator (2 pcbs)	T032	2 90	33 74	BEHL
	Car Alarm (2 pcbs)	T033	1 80	5 52	BEJ
	Wine Temperature Meter	T034	1 10	5 79	BEHL
	Curve Tracer	T035	1 00	9 31	BEHL
	Eprom Programmer	T036	2 25	20 21	BEH
	Eprom Programmer P.S.U	T037	1 30	5 09	BF
	Car Tachometer	T038	1 75	10 00	BE
	Digital Dial (2 pcbs)	T039	1 80	16 77	BE
	Digital Dial (Ext. T039)	T040	1 25	7 60	BE
	Log Converter	T041	3 50	23 66	BE
	Tape Slide Synchroniser	T042	2 10	17 47	BEHL
	Tape Noise Limiter	T043	70	3 04	BEHL
	Light Activated Tachometer	T044	2 10	31 99	BEH

*Top Projects No. 6. Photocopy of any of above projects — 30p

1976	Mar	Audio Level Meter	1 20	June	Digital Freq. Meter (Set 4)	3 40
	May	Audio Exp./Compressor	3 95		Bass Enhancer	2 70
	Sep.	560 ABC VDU (Set 3)	5 60	Jul	081 Tachometer	60
		710 2m Power Amp	1 00		Micro Amplifier	65
		241 Double Dice	1 50		Alarm Alarm	50
		252 1-2 Hour Timer	60	Aug	Moisture Indicator	75
		152AB TV Pattern Gen (Set 2)	3 15		Bongas	75
	Nov.	543AB STD Timer (Set 2)	2 20	Sep	Egg Timer	70
		544 Heart Rate Monitor	1 10		Loud Hailer	70
	Dec.	447 Audio Phaser	1 60		Continuity Tester	60
		446 Audio Limiter	1 35	Oct.	Spirit Level	95
					3 Channel Tone Control	80
				Nov.	Clock A	1 15
					Rev. Monitor	1 10
				Elect	CMOS Switched Pre Amp (Set 2)	3 80
					132 Experimenters P.5	1 00
				1977	555 Timer pcb	70
	Jan	570 Reaction Tester	1 60	1978		
		549 Metal Locator I	95	Jan	Hammer Throw (Set 3)	5 25
		Patch Detector	60		Race Track	1 35
		Passport Trans	60	Jan	Acc. Beat Metronome	75
	Feb.	448A Headphone Amp	60	Feb.	Porch Light	80
		449 Balanced Pre-Amp	75		588 Shutter Timer	1 30
		449A VU Meter	1 10		RMS Meter	1 10
		Door Bell	75	Mar	Line Follower	70
	Mar.	155 ABCD Digital Voltmeter (Set 4)	4 30	Apr.	Rain Alarm	1 10
		D/R Controller	70	May	Electronic Ignition	1 05
		Function Generator	95		Helping Hand (Set 2)	2 20
		Temperature Alarm (Set 2)	1 40	1979		
	Apr	Fuzz	60	Jan	Digital Module A	1 10
		630 Hex Display	70		Digital Module B	70
		P.S.U	60		Digital Module C	75
		804 TV Game	1 70	Feb	VCT	1 55
	May	Metronome (Simple)	60		Twonky	2 45
		Inject Tracer	80			

SYSTEM 68

631	Mainframe PSU	2 75
	VDU A	3 00
	VDU B	2 95
	CPU	2 90
	TTY	2 25
	Cuts & 4K Ram	2 45
	10% Discount	— 4 pcbs or more
	Full set of 7 pcbs	£15.00

KITS WITH A PROFESSIONAL FINISH

SPECTRUM ANALYSER

June '78 Ref. T015
Includes: 2 x Pcbs with component screened layout. Components, switches, Electret Microphone, etc.
Screen printed End Plate, Screen printed Case.
Price including VAT £66.50 P.&P. 30p

HOUSE ALARM

Jan. '78 Ref. T005/6
Control Console for complete house protection.
Kit includes Vero 'G' range brushed aluminium instrument case with black front panel screen printed.
Price including VAT £2967 P.&P. 30p

KEY TO KIT CONTENTS

- A Vero-board(s)
- B Printed Circuit Board(s)
- C With Screen printed component layout.
- D Tag strip
- E All Resistors, potentiometers, capacitors, semi-conductors
- F As E but with exclusions. Please ask for details.
- G D/I and/or transistor sockets and/or soldercon pins
- H Hardware includes switches, knobs, lamps and holders, fuses and holders, plugs and sockets, microphones, transformers, speakers, meters, relays, terminal blocks, battery connectors, etc. BUT excludes nuts, bolts, washers, connecting wire, batteries and special miscellaneous items.
- J As H but with exclusions. Please ask for details.
- K As H but including connecting wire.
- L Suitable case(s)
- M Suitable case with screen printed fascia
- N Full kit to magazine specified standards
- P Kit with professional finish — incorporating all prime features including screen printed pcb and case where appropriate

SPECIAL OFFERS

Plug-in mains PSU 3v/6v/9v/12v DC 300MA.
Suitable for calculators, TV Games, etc. £2.99
100 x 1/2W 1k resistors 30p
4 x NE 555 £1.00

Pcbs and kits available from TAMTRONIK LTD. for projects from HOBBY ELECTRONICS AND EVERYDAY ELECTRONICS. Send s.a.e. for free catalogue. Please quote project and kit reference number when details of a specific kit are required, s.a.e.

Tamtronik Ltd. reserves the right to change kit content without notice to incorporate current modifications or to make valid substitutions for temporarily unavailable components.
The majority of kits advertised can be supplied from stock, however please allow 21 days delivery since demand on any kit is unpredictable.

SOLDERING IRONS & ACCESSORIES

SRB 18 watt iron, incl. No. 20 bit	£3.78	Spare bits	44p
Stand	£3.25	BIT SIZES	
Solder - Sautbit 20ft.	52p	No. 19 (1.5mm), No. 20 (3mm), No. 21 (4.5mm), No. 21 (6mm)	
L.c. Desoldering bit	£1.00		

IDEAL FOR THE HOME CONSTRUCTOR

Kits can be supplied excluding pcb and/or case. Send s.a.e. for details naming kit and kit reference and free catalogue.
Trade and Educational enquiries welcome

P.&P. 30p
Prices include VAT

Visit our shop at Telephone or Letter
32 Market Place
Great Bridge, Tipton
West Midlands



NASCOM 1

KIT £213.30. BUILT £263.30

PERSONAL COMPUTERS

OHIO SCIENTIFIC SUPERBOARD 11

BUILT £284.95

Texas I.C. Sockets

Low Profile	
Packs of 10	
8 pin	1.10 22 pin 1.90
14 pin	1.20 24 pin 2.20
16 pin	1.40 28 pin 2.60
18 pin	1.70 40 pin 3.30
20 pin	1.80

LOOK

24-Tune Door Chimes Genuine Chroma-Chime
KIT — £9.95
BUILT £15.95

AY-3-8500	£3.90
AY-3-8603 (Road Race)	£4.90
E.T.I. Tank PCB	50p

To clear, Electronic Flashguns, faulty £1.95

Please include s.a.e. with orders for special offers

Logic 5

The Computer Numbers Game. Match wits with Logic 5. Generates a secret 3, 4 or 5 digit number at random. Test your logic. Discover the number in fewest entries on the keyboard. Uses 1 x PP3 not supplied.

£18.95

BURGLAR ALARM KITS for home, car, boat, tent, bike. Send s.a.e. for prices and information

LOOK!

Complete single channel R/C Car, working but need attention. Few only

£4.50

METAL DETECTORS

BFO ALT3	£13.95
BFO 898	£9.95
NEW IB 89N	£29.95

Features Speaker, Meter, Telescopic Stem, Volume Control, Tuning Control, Induction Balance at BFO price. Complete with Battery and Ear Piece

BRISTLE DARTBOARD Only £9.95 + £1.00 P&P

4 Digit Alarm Clock chip and display GI CK3000 1.0 + Plasma Display £4.90

Babani Books s.a.e. for list

All prices include P&P & VAT unless shown otherwise

N.I.C. MODELS

27 Sidney Road, London N22 4LT

Please allow up to 21 days for delivery.

ATTENTION NASCOM USERS

GRAPHICS ADD ON BOARD £9.90

Complete kit to upgrade your NASCOM for graphics capability includes full documentation and demonstration program.

STOP PRESS: Just released —

Software for the big boys!

Star Ships £5.00

Pontoon £5.00

... require Comp S100 expansion plus tiny basic ...

Fruit Machine £5.00

Pilot £5.00

Othello £2.00

... runs on a basic Nascom ...

For delivery information see our advert on the inside back cover of this magazine.

COMP COMPUTER COMPONENTS

CELLULAR LOGIC IMAGE PROCESSING

At University College, London, there is a research group working on a method of image processing which could prove to be the link between the human eye and the TV camera. Computing Today's Phil Cohen talked to Dr. Michael Duff about Cellular Logic Image Processing.

CELLULAR LOGIC IMAGE PROCESSING was first proposed in 1958 by S. Ungar in the States. It was suggested that the cells of the human eye do a lot of the processing *before* what we see is fed up the optic nerve to the brain.

What exactly do we mean by image processing?

Generally, it means processes like perimeter-finding — producing the outline of an object, or skeletonising — finding a set of lines which are unbroken and follow the object's shape.

This sort of process can be used in such diverse applications as fingerprinting, character recognition (OCR) or even intruder detection (spotting movement on a TV picture) but perhaps the two most useful areas will be biomedical scanning — chromosome counting or looking for abnormalities on X-ray plates — and production line quality control.

Parallel Processing

The model of the human eye previous to 1958 was of a simple camera — the point-by-point information was fed to the brain, which did all the clever processing.

However, it was pointed out that for processes such as edge-finding it was much more efficient to use a

parallel processing system.

The essential difference between serial and parallel processing schemes is that in a serial scheme the data is processed bit by bit in a central unit (CPU) and the intermediate results are stored in memory. In parallel processing the data is fed in as an array and the processing takes place all at the same time — *there is one processor for each data element*. The intermediate results are passed from processor to processor as the calculations continue.

In the human eye, then, the question is: could a number of cells just behind the light-detecting ones be the parallel processors, responding to commands from the brain to find the edges of objects, or detect movement? Certainly it is known that the edges of the field of vision are extraordinarily good at spotting movement — could this be because the structure of the eye is different there?

The Processors

Going back to the CLIP machine, in this sort of application the type of processor we are talking about is in no way as complex as a modern MPU. The sort of data it receives are single-bit inputs from the image sensor

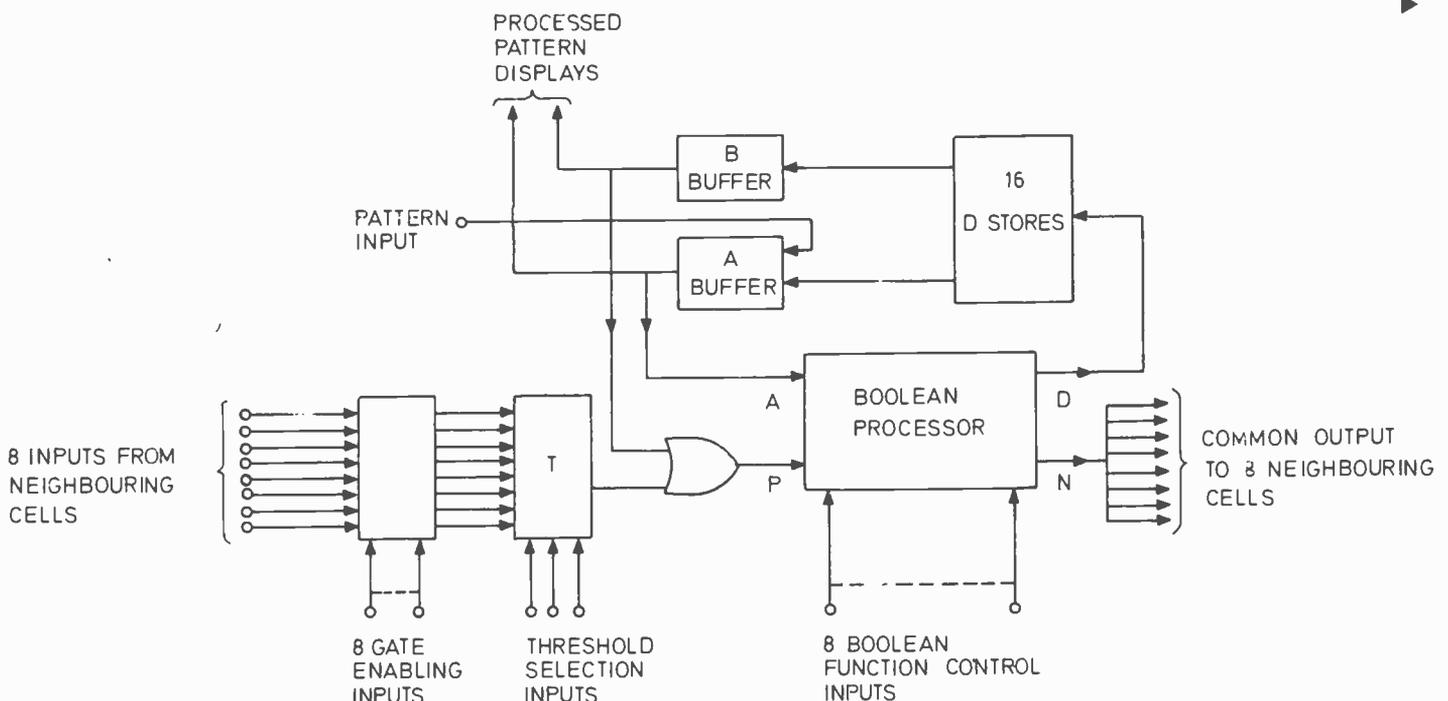


Fig. 1: The block diagram of one of the processors.

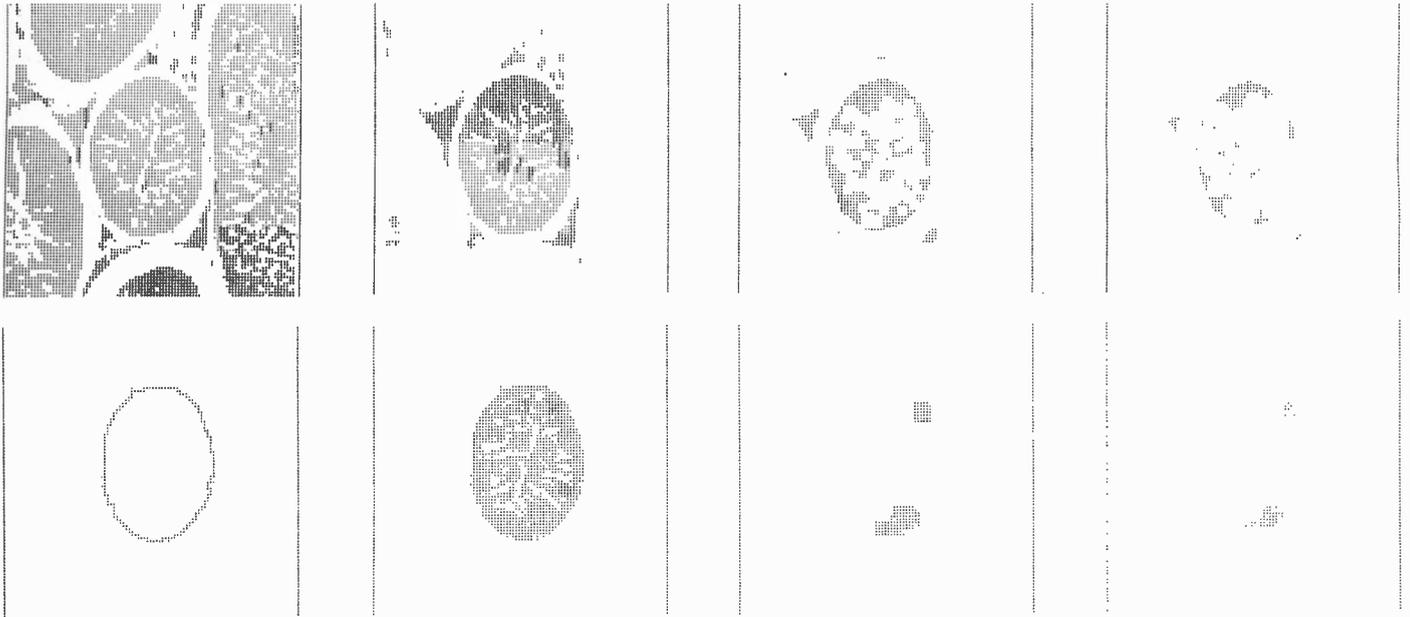


Fig. 2: Stages in the processing of a microscope picture of part of a rat's anatomy.

associated with it and one bit each from the eight nearest processors' outputs.

Why eight? Well, this provides an optimum "connectivity" — too few and the processing becomes slow, too many and the cost of connecting the processors together becomes enormous.

The sort of operation the processor would have to perform would be to give an output if any of its neighbours gave an output *and* the image bit fed to it was a "0".

The program example (in PET BASIC) given shows the usefulness of this sort of process. Of course, we cannot perform parallel processing directly in BASIC — the program has to scan the image bit by bit, simulating the action of each processor in turn.

The important thing about using this sort of scheme for image processing is that the outputs of the units will change in "waves", travelling at speeds dependant on the propagation delay of the devices involved. This means that, by having four "edge registers" which are not connected to the image input, we can do things like finding the outer edge of an object by starting a signal from the edge registers and programming the processors to stop propagating it at the edge of the object. The program example carries out this sort of process.

Structure

In the CLIP machine, the processors each have the structure shown in Fig 1. Each is connected to its eight neighbours and its output fans out to the same neighbours. There is also a "pattern input" for connection to the picture signal (which is derived from a TV camera and multiplexed to provide each processor with a 1-bit signal from one point of the camera's image).

The gate enabling threshold selection and function control inputs are from a programming bus common to all processors.

The gate enabling inputs allow instructions like "If the output from the processor to the left is '1' . . ." The threshold selection inputs allow "If more than three inputs are '1' . . ."

Combining the two allows very comprehensive processing of the inputs — "If any two of the processors to the left give an output . . ." for example.

There are also various buffers for more complex instruction types.

The boolean processor itself can be programmed via the function controls to "look" like any combination of memory-less logic gates.

Implementation

The processors come in custom-built ICs, each chip containing eight units. The CLIP 4 machine contains an array of 96 x 96 processors.

CLIP 4 is the product of ten years of research at University College. It's a commercially viable product — it fits into one 7-foot instrumentation rack, including power supplies and controller. The cost? In the region of £30-40 thousand.

The processors themselves are based on NMOS technology and the control circuitry (the part that acts as a "conductor" — in the musical sense — directing all of the processors) is implemented in hardware — an MPU would be too slow!

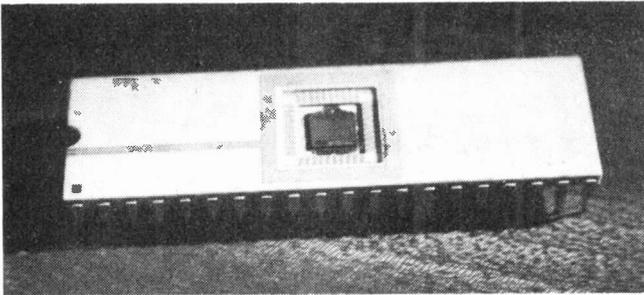
The input signal is from a TV camera (only part of the picture is used — 96 lines x 96 points). This is encoded either as a black and white picture with no grey or as a grey-scale image. CLIP can handle grey-scale pictures, performing processes such as smoothing.

The output from the system would be to a video monitor or, in some applications, just a few bits of data to another peripheral, such as a warning indicator in the case of intruder detection.

Software

The software for the system consists of a series of inputs for the function-definition bus of the processors and a loop structure which is linked to the processor outputs.

Looking at Fig. 2, the machine is trying to find the outline of the largest isolated mass of black in the input pattern.



One of the chips in the CLIP — each contains eight processors.

The original input is shown in the top left. The first instruction propagates white from the edge registers through all connected black. This leaves the pattern second from the left on the top line. The program then "erodes" the image by removing all black dots not surrounded by black and then removing their neighbour black dots as well.

It repeats this erosion until one more step would cause all black to vanish completely. This leaves the image as it is at the end of the top line.

The program then surrounds each black by eight blacks. It does this twice. It then recalls from the original input pattern the part which is "connected" to the current pattern. The last step finds its outline.

Naturally, this sort of software cannot be written in a conventional language — the group have developed what is effectively an assembler for the system and all the groups working on image processing worldwide are due to meet this spring to discuss a suitable high-level language.

Applications

One very interesting application mentioned earlier is production line control. CLIP can tell the difference between an object which has been correctly punched out of metal and one with the wrong surface area or the wrong number of holes, etc.

The amazing thing is that it can do this fifty times a second! In fact, the machine can perform 1500 parallel processes per TV frame period.

The machine could be fitted to the "reject" solenoid on a production line so that badly produced pieces could be pushed off the line.

Another area in which the machine could be useful is in microscopic counting. There are systems available already which will count the number of items in a picture, or even the number between certain size limits, but the inherent flexibility of CLIP make it invaluable for complex tasks such as red blood cell deformity checking and other applications where previously a human operator was the only alternative.

One slightly more frightening possibility is the use of such a system in facial recognition — enabling authorities to keep track of every individual automatically.

When the system was first proposed about ten years ago, the device which was envisaged was a pair of super-binoculars, with photo-diodes at one end and LEDs at the other, modifying images so that only moving objects, or even more selectively, only enemy tanks would be seen! This is some way from the present state of the art but in a few years . . . who knows?

We would like to thank Dr Michael Duff and University College in general for their help. ETI

CLIP SIMULATION PROGRAM

The following program simulates the action of the CLIP machine by pretending to be each processor in turn in a 10 x 10 array. It's very slow to run (several minutes) and this shows the advantage which a parallel processing system has over a serial one.

10 S = 10

S is the dimension of the 2-dimensional square processor array.

20 DIM A(S, S), B(S, S)

A is the image input to the system. B represents the processor outputs. Load the image into the system:

```
30 FOR I = 2 TO S - 1
40 FOR J = 2 TO S - 1
50 READ A(S, S)
60 NEXT J
70 NEXT I
```

The outer layer of processors represent the edge register, in which we can initialise processing 'ripples' (see text).

```
80 DATA 0,0,0,0,0,0,0
90 DATA 0,1,1,1,1,1,0
100 DATA 0,1,0,0,1,0,0,0
110 DATA 0,1,1,0,1,1,0,0
120 DATA 0,1,1,0,1,1,1,0
130 DATA 0,1,1,1,1,1,0,0
140 DATA 0,0,0,0,0,0,0,0
150 DATA 0,0,0,0,0,0,0,0
```

Now for the 'seed' which will propagate during processing. Note that it's in the edge register:

1010 B(S, S) = 1

Now print the results so far:

```
1014 GOSUB 2000
1015 F = 0
```

F is set to 1 if any changes are made.

```
1020 FOR I = 2 TO S - 1
1030 FOR J = 2 TO S - 1
```

... For each processor

```
1040 FOR K = -1 TO 1
1050 FOR L = -1 TO 1
```

... For each of the eight 'connected' processors

```
1055 IF L = 0 AND K = 0 THEN 1090
```

... Except the one we're simulating

```
1060 IF B(I + K, J + L) <> 1 OR A(I, J) <> 0 THEN 1090
```

skips the next bit unless the image is zero at this point and one of the neighbours outputs is one.

```
1070 IF B(I, J) = 0 THEN F = 1
```

B(I, J) is going to be set to 1. F is set to 1 if this represents a change.

```
1080 B(I, J) = 1
1090 NEXT L: NEXT K: NEXT J: NEXT I
1130 IF F = 1 THEN 1014
1140 STOP
```

repeats the process until the output is stable (ie there were no changes during this pass).

The following subroutine prints the results:

```
2000 REM PRINT
2010 PRINT " " : REM CLEAR SCREEN CHARACTER
2020 FOR I = 1 TO S
2030 FOR J = 1 TO S
2040 IF A(I, J) = 1 THEN PRINT "A";: GOTO 2060
2050 PRINT " ";
2060 NEXT J
2070 PRINT " ";
2080 FOR J = 1 TO S
2090 IF B(I, J) = 1 THEN PRINT "B";: GOTO 2110
2100 PRINT " ";
2110 NEXT J
2120 PRINT
2120 NEXT I
2140 RETURN
```

Catronics **MARCH SPECIALS!**

NEW KEYBOARD KIT

Catronics Ltd are proud to announce the introduction of the world's first modular Keyboard Kit available to the home constructor!

All components are of Catronics' usual high quality and FULLY GUARANTEED. The printed circuit board is designed to take a maximum of 70 keys but may be assembled with a smaller number of keys for a simpler keyboard.

The board is not dedicated to any specific coding, allowing it to be used for any project whether it requires ASC11, Baudot or any other code. This makes it suitable for many projects including

**E.T.I. — System 68 MPU (54 keys)
Auto morse sender, etc.**

The Keyswitches themselves are single pole push-to-make type and require no extra mechanical mounting arrangements.

A legend sheet is provided with each kit enabling the constructor to label the keys to suit individual requirements.

Catronics price: Kit for 70 station Keyboard: £29.00
Please add 50p for post & packing

TELETEXT DECODERS

From Catronics — the Number One company for Teletext Decoders for CEEFAX and ORACLE. We now offer a wide range starting at below £145

KITS — Based on 'Wireless World' design

Basic upper case only — £144.50 Standard decoder — £157.25

De-luxe with ALL new facilities — £194.40

KITS — Based on 'Television' magazine design

Complete kit (as published) — £220

READY BUILT DECODERS

Prices range from £230 to a full specification professional model at £310. Send SAE for full details

2 METER POWER AMP.

(ETI project 710 — September '76)

This is a simple-to-build, easily-aligned Class C PA suitable for CW and FM amplification at 2 metres from a nominal 13.5V (-ve earth) supply (7 amps at full power). T/R switching is performed by diodes and ¼ wave lines. A power input of 10 watts is required for the nominal 40 watts output power.

Complete with cabinet — £19.50 + 65p p&p.

LOW COST V.D.U.

(ETI project 560 — Aug/Sept/Oct '76)

All components available for this popular low cost V.D.U. project. Complete kit

Special Price £62.00 + £1.00 p&p

Separate components —

PCB set £7.20; 2112-2, £3.50; 2513, £8.00; 555, 47p

FREQUENCY COUNTER CHIPS

The following counter i.c.s. are now available

74C926 £5.85; MK50395 £7.55; ICM 7208 £15.70; ICM 7216C £22.70; ICM 7216D £19.65; ICM 7726 £27.20. Application information also available.

Try us for 7 segment displays, display drivers and prescaler i.c.s.

Please add min. 30p p&p

SALE OFFER OF 7400 SERIES

The following are Special Sale Prices — please quote 'ETI' advert on your order. All new full specification. Full Guarantees. Mostly National and Texas products

7400	14p	7421	31p	7483	78p	74145	£1.24	74177	84p
7402	14p	7427	29p	7485	£1.12	74150	£1.07	74180	92p
7403	14p	7428	38p	7486	33p	74153	69p	74188	£3.40
7404	15p	7430	18p	7490	36p	74157	72p	74192	£1.38
7406	40p	7432	27p	7492	52p	74161	99p	74193	£1.38
7408	18p	7440	18p	7493	39p	74164	£1.12	74195	£1.03
7410	16p	7442	73p	7496	97p	74165	£1.12	74196	£1.00
7411	22p	7447	75p	74107	35p	74166	£1.60	74221	£1.75
7412	24p	7473	35p	74121	29p	74170	£2.48	74H00	35p
7414	78p	7474	29p	74123	79p	74174	94p	74H04	44p
7420	17p	7475	46p	74126	81p	74175	94p	74H10	39p

10% DISCOUNT on TTL orders over £20

All prices INCLUDE VAT

Please note our minimum U.K. post and packing charge, except where indicated, is 30p. EXPORT ORDERS welcomed.

**CATRONICS LTD.,
COMMUNICATIONS HOUSE,
(DEPT. 953)
20 WALLINGTON SQUARE,
WALLINGTON, SURREY SM6 8RG
Tel. 01-669 6700. Open Mon.-Fri. 9 a.m.-5.30 p.m.
1 p.m. Sat.**

ETI

Ladies LCD Watch



... and don't you ever say we don't listen to you again! Ever since we first did a gentlemen watch, we have been dealing with a constant never ending stream of requests for a ladies model. Well at long last we can claim to have done something about it!

It wasn't easy arranging this sort of price on a product this good — but ETIs done it again! The watch is small enough to look good on the prettiest wrist, and accurate enough to satisfy the most fastidious. Normal display shows time of course, with both date and seconds available on a push of a button. A backlight is also included.

Battery life should be greatly in excess of a year, and the bracelet is a smart stainless steel.

£9.95

Inclusive of VAT and Postage

An example of this watch can be seen and examined in our reception at our Oxford Street offices.

LADIES LCD WATCH

To:
Ladies LCD Watch Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed my cheque/PO for £9.95 (made payable to ETI Magazine) for a ladies LCD watch

Name

Address

Please allow 14 days for delivery.

MARKET PLACE

Digital Alarm



Size: 105mm wide 115mm deep x 55 mm high.

THIS IS THE THIRD digital alarm clock that we are offering (we regret the earlier versions are no longer available). We have sold thousands and thousands of these and our buying power enables us to offer a first rate branded product at a really excellent price.

The Hanimex HC-1100 is designed for mains operation only (240V/50Hz) with a 12 hour display, AM/PM and Alarm Set indicators incorporated in the large display. A switch on the top controls a Dim/Bright display function.

Setting up both the time and alarm is simplicity itself as buttons are provided for both fast and slow setting and there's no problem about knocking these accidentally as a 'locking' switch is provided under the clock. A 9-minute 'snooze' switch is located at the top.

£8.95

Inclusive of VAT and Postage

An example of this clock can be seen and examined in our reception at our Oxford Street offices.

DIGITAL ALARM

To:
Hanimex Alarm Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

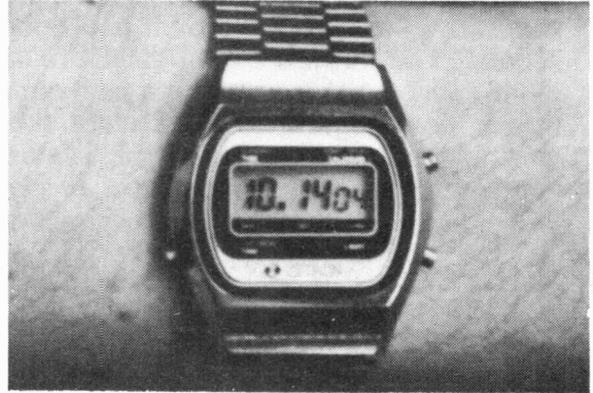
Please find enclosed my cheque PO for £8.95 (payable to ETI Magazine) for a Hanimex Digital Alarm Clock.

Name

Address

Please allow 28 days for delivery

LCD Chrono



We feel we've got to tell you carefully about this offer which we're introducing for the first time. Why? Because our price is so enormously lower than anywhere else you may suspect the quality.

The exact same watch is currently being offered by another magazine as a special at £24.95 — some of the discounters are selling it at £29.95 the price to ETI readers for exactly the same watch is £12.95.

The display is LCD and shows the seconds as well as the hours — and minutes — press a button and you'll get the date and the day of the week.

Press another button for a couple of seconds and you have a highly accurate stopwatch with hundredths of a second displayed and giving the time up to an hour. There is a lap time facility as well — and of course a back light.

Our Chrono comes complete with a high grade adjustable metal strap and is fully guaranteed

£12.95

(Inclusive of VAT and Postage)

An example of this LCD Chronograph can be seen and examined at our Oxford Street offices.

LCD WATCH

To:
LCD Watch Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed my cheque/P.O for £12.95 (payable to ETI) for my LCD Chronograph.

Name

Address

Please allow 14 days for delivery

ETIPRINTS

ETIPRINTS are a fast new aid for producing high quality printed circuit boards. Each ETIPRINTS sheet contains a set of etch resistant rub down transfers of the printed circuit board designs for several of our projects. ETIPRINTS are made from our original artwork ensuring a neat and accurate board. We thought ETIPRINTS were such a good idea that we have patented the system (patent numbers 1445171 and 1445172).

HOW IT WORKS



Lay down the ETIPRINT and rub over with a soft pencil until the pattern is transferred to the board. Peel off the backing sheet carefully making sure that the resist has transferred. If you've been a bit careless there's even a 'repair kit' on the sheet to correct any breaks!

BUYLINES

ORDER TODAY

Send a cheque or P.O. (payable to ETI Magazine) to —

**ETI PRINT
ETI MAGAZINE,
25/27 OXFORD STREET, LONDON W1R 1RF.**

75p inc p&p

PARTS LIST

Shown below is the listing for the last years ETIPRINTS. Earlier sheets are available, ring Tim Salmon for details.

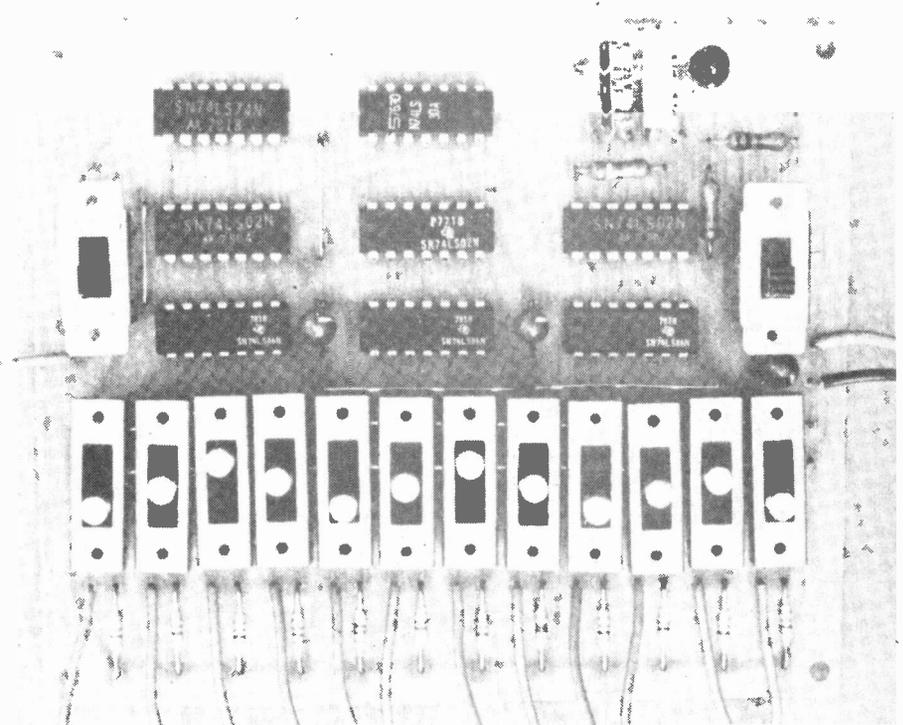
003	Race Track Game	Jan 78
	Hammer Throw	Jan 78
	Freezer Alarm	Dec 77
004	Metal Locator Mk II	Feb 78
	Ultrasonic Tx/Rx	Feb 78
	5 Watt Stereo Amp (modified)	Jan 77
	Metronome	Feb 78
	Shutter Time	Feb 78
005	Op-Amp Supply	Mar 78
	Frequency Shifter	
	LCD Panelmeter	
	Light Dimmer (3 times)	
006	CMOS Switched	"Electronics Tomorrow"
	Preamp	
	From Experimenters P.S.U.	
	555 Boards (twice)	
007	Star Trek Radio	May 78
	CD Ignition	May 78
	CCD Phaser	May 78
	White Line Follower	April 78
008	Tank Battle	May 78
	Helping Hand	
009	AM/FM Radio	June 78
	Bridge Oscillator	
	CMOS Stars & Dots	
010	Bench Amplifier	Project Book Six
	Freezer Alarm	
	Marker Generator	
	LED Dice	
	Watchdog (2 PCBs)	
011	Noise Generator	Project Book Six
	General Preamp	
	Flash Trigger	
	Comander	
	Active Crossover (2 PCBs)	
012	Disco Lightshow	Project Book Six
	Stereo Simulator	
	Digital Thermometer	
013	Amplifier Module	Project Book Six
	Amplifier PSU	
	Equaliser	
	Equaliser PSU	
014	Skeet Game	Project Book Six
	Sweep Oscillator	
	Burglar Alarm	
	GSR Monitor	
015	UFO Detector	July 78
	Torch Finder (twice)	July 78
	Etiwet (twice)	Aug 78
016	Stac Timer	Sept 78
	Xhatch Gen	
	Wheel of Fortune	
017	Complex Sound Gen	Oct 78
	Tele Bell Extender	
	Power Bulge	
018	RF Power Meter	Oct 78
	Proximity Switch	Oct 78
	Audio Oscillator (2)	Nov 78
019	Car Alarm (2)	Dec 78
	Wine Temp (2)	Dec 78
	Curve Tracer	Dec 78
020	Digital Tacho	Jan 79
	Module	Jan 79
	Digital Dial	Jan 79

LOGIC TRIGGER

No need to be in the dark any more, see your pulses, doing their stuff before your very eyes.

WHEN USING AN oscilloscope to examine or fault find digital circuitry, it is often desirable to see what happens just before a pulse or edge occurs. An example of this is when measuring the propagation delay in a ripple counter. Here it is easy to trigger on the last output but the edge of the counter input which initiated the change in the output may have occurred over 100 ns earlier. Even with the delay line built into modern oscilloscopes the edge is too early to see.

Triggering on the input waveform allows this edge to be seen but if the output pulse occurs only once every thousand or so pulses it will not be seen. With this unit, the output of all the stages in the divider can be examined and a pulse can be generated anywhere in the cycle. By selecting a pulse very close to, but before, the edge in question and using it to trigger the oscilloscope (use ext trigger) both the clock waveform and output waveform can be seen.



SPECIFICATION

Modes	Asynchronous or synchronous
No. of inputs	12 address, 1 clock
Loading address clock	0.4 UL (TTL) 0.4 UL (TTL)
Pulse extension mono	10 ms
Pulse indication	LED
Minimum pulse detectable	<40 ns
Propagation delay	<45 ns
Trigger (synchronous)	positive or negative edge of clock input
Set up time (synchronous) address to clock	<40 ns
Output	logical "1" when input agrees with switch setting and/or clock (synchronous only)
Power requirement	+5V @ 50 mA

With the advent of microprocessors it has become increasingly difficult to fault find as things happen (e.g. the CE input to a memory may go low) only when a particular address is given. As the address bus is always in motion it is almost impossible to trigger the scope on any one address. Again with this unit the address bus is interrogated along with the necessary write or read lines, and its output can be used to trigger the oscilloscope only when the correct sequencer is received.

Construction

We mounted all the components on the board including the switches. The only difficult (fiddly) bit is the writing of the three position slide switches which have to be preassembled before fitting to the pcb. The wiring is shown in fig. 3.

To aid this we have provided 12 holes in the pcb the size of the toggle of the switches; if the

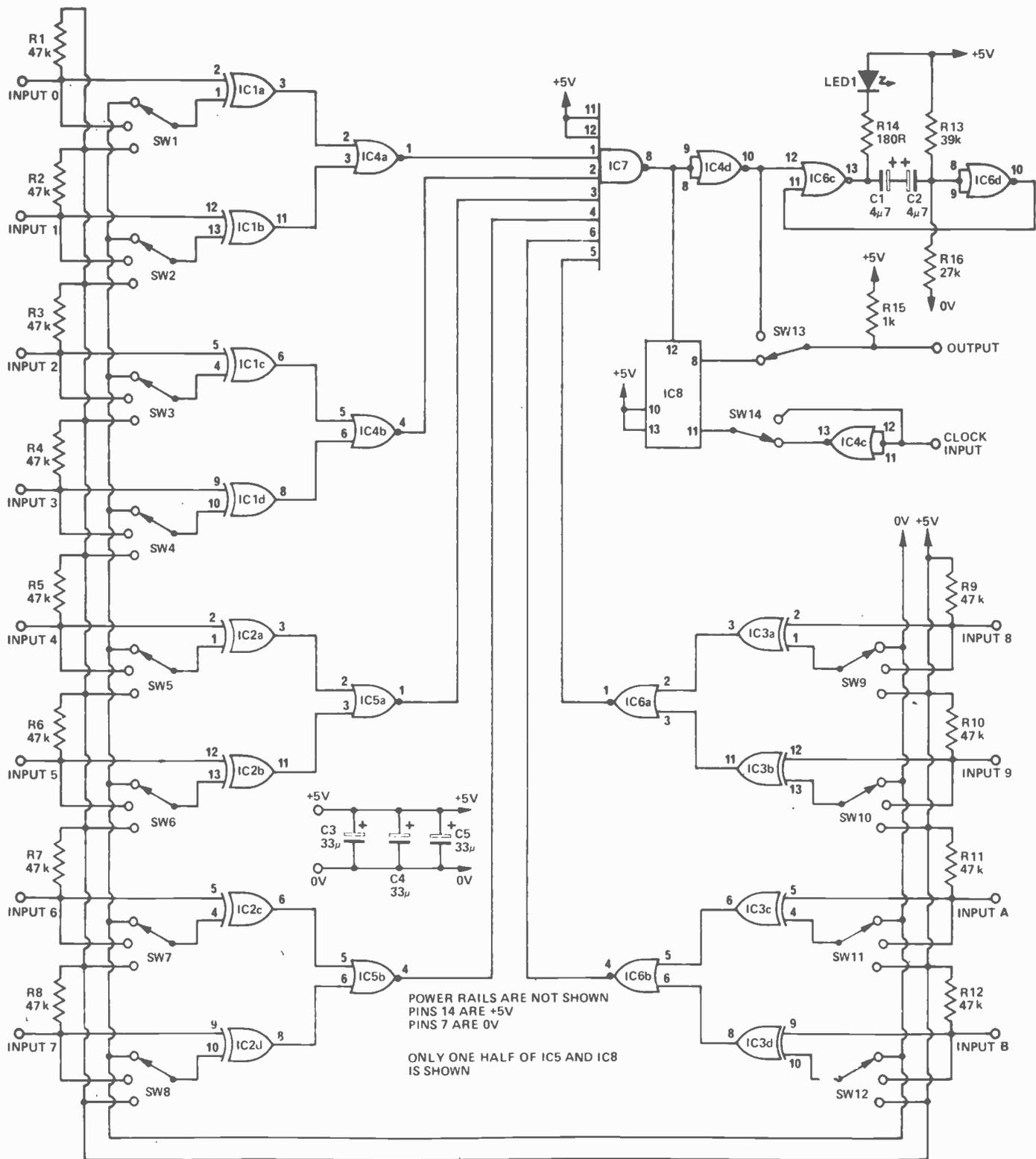


Fig 1. Full circuit diagram of the logic unit.

PARTS LIST

RESISTORS		all ½W, 5%
R1-R12		47k
R13		39k
R14		180R
R15		1k
R16		27k
CAPACITORS		
C1,2		4µ7 25Velectro
C3-C5		33µ 16V tantalum
SEMICONDUCTORS		
IC1-IC3		74LS86
IC4-IC6		74LS02
IC7		74LS30
IC8		74LS74
LED1		Red LED
MISCELLANEOUS		
PC board ETI 141		
Twelve 3 position slide switches		
Two 2 position slide switches		
Front panel		
Box to suit		

Fig 2 (right): Foil pattern shown full size.

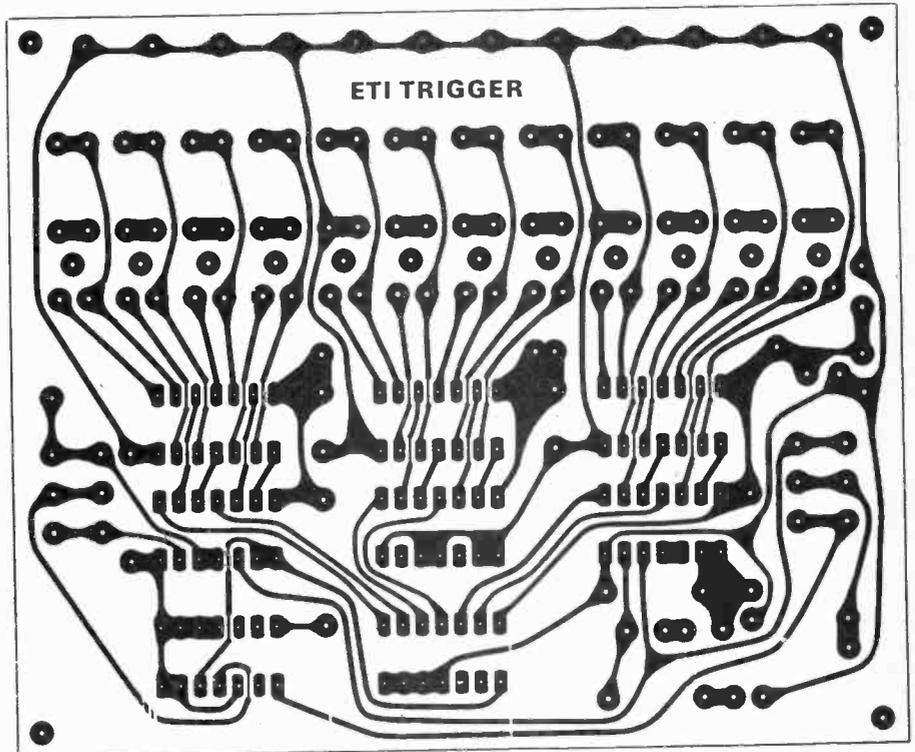
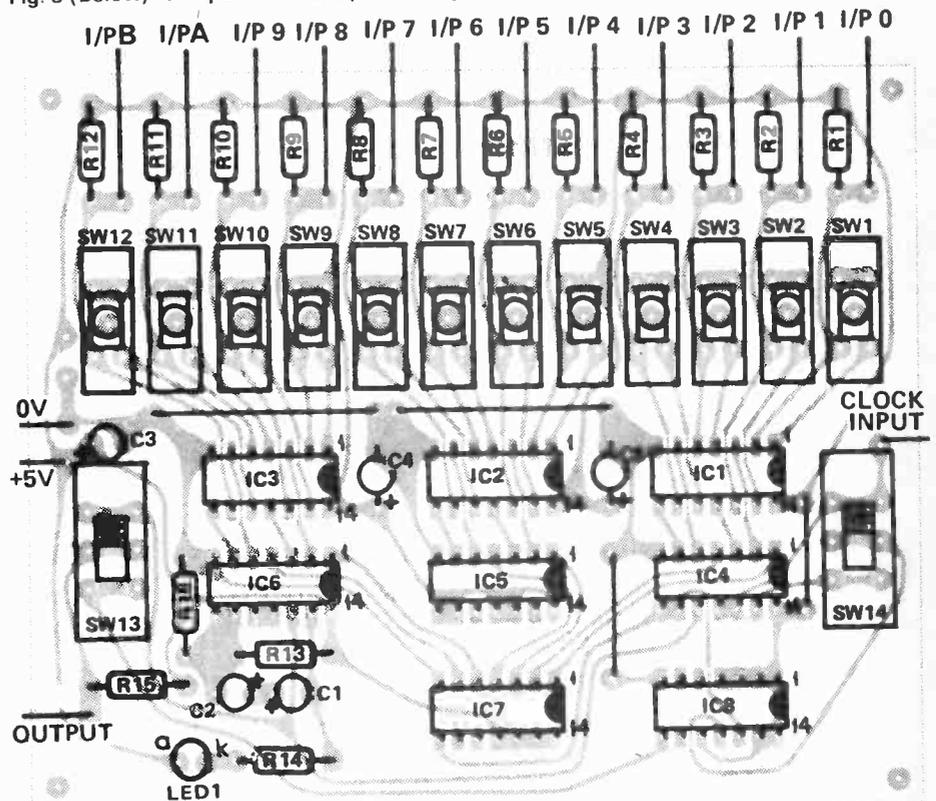


Fig. 3 (Below). Component overlay of the logic trigger



HOW IT WORKS

The twelve inputs are compared to the levels set on the slide switches SW1-SW12 by the exclusive OR gates IC1-IC3. These ICs have a high output only if the two inputs differ. If they are the same, either both low or both high, the output will be low. If the two inputs are joined together, as when the switches are in the don't care position, the output will always be low.

The outputs from the exclusive OR gates are combined in pairs by the NOR gates IC4-IC6. If the 12 input signals match the preset selection, the output of all 6 NOR gates will be high. If any one is not in agreement with the selection one or more of the NOR gates will have a low output.

These NOR gate outputs are combined by IC7 which is an eight input NAND gate. The output of this gate will low only if all 12 inputs match. The output of this IC is inverted by IC4/d to provide the asynchronous output.

This output also triggers the monostable formed by IC6/c and IC6/d. This gives a 10 ms long pulse of light the LED indicating a pulse was received. If it is a steady state signal the LED will stay on.

The output of the NAND gate, IC7, also joins the data input of IC8 (D type flip flop). This IC is toggled on the positive edge of the clock waveform transferring the data to the output. This is the synchronous output. To allow for either positive or negative synchronization an inverter is used on the clock input and either polarity can be selected by SW13.

switches are initially placed upside down in these holes the board will act as a template to provide the correct spacing. We have also used two wires of the switch to provide mechanical support. While only a single pole switch is needed the

only ones readily available are two pole.

The switches can now be mated to the PC board with the two longitudinal wires being terminated in the holes provided at the end of the switch bank.

ETI

Greenbank

Greenbank Electronics
(Dept T3E) 92 New Chester Road, New Ferry
Wirral, Merseyside. L62 5AG
Tel: 051-645 3391

TERMS, VAT, C.W.D. Cheques etc payable to Greenbank Electronics.
All prices at 8% except where stated otherwise. Post etc. UK 25p
[+2p VAT = 27p] per order. Export: NO VAT but add 75p [Europe] and
£2.50 elsewhere.
[Polys. universities. gov. depts. etc can telephone their orders for
immediate despatch on account.]

CMOS

These cut prices for Amateur Users and Export. Note: Industrial users — quantity prices available.

Mostly Motorola, RCA	
4000	15p
4001	17p
4002	17p
4006	£1.05
4007	18p
4008	87p
4009	87p
4010	50p
4011	18p
4012	18p
4013	42p
4014	86p
4015	89p
4016	45p
4017	89p
4018	89p
4019	48p
4020	99p
4021	42p
4022	86p
4023	20p
4024	66p
4025	19p
4026	£1.80
4027	45p
4028	81p
4029	99p
4030	58p
4031	£2.05
4032	£1.40
4033	£1.45
4034	£1.96
4035	£1.11
4036	£2.45
4037	£1.00
4038	£1.08
4039	£2.45
4040	£1.05
4041	80p
4042	75p
4043	94p
4044	90p
4045	£1.45
4046	£1.28
4047	87p
4048	58p
4049	48p
4050	48p
4051	72p
4052	72p
4053	72p
4054	£1.10
4055	£1.28
4056	£1.34
4057	£25.70
4059	£4.80
4060	£1.15
4061	£15.67
4062	£10.00
4063	£1.09
4064	N/S
4065	N/S
4066	57p
4067	£3.80
4068	27p
4069	20p
4070	23p
4071	21p
4072	21p
4073	21p
4075	23p
4076	85p
4077	23p
4078	21p
4081	20p
4082	21p
4085	74p
4086	73p
4089	£1.50
4093	63p
4094	£1.90
4095	£1.05
4096	£1.05
4097	£3.72
4098	£1.10
4099	£1.45
40061	N/S
40100	£2.50
40101	£1.61
40102	£2.12
40103	£2.12
40104	£1.45
40105	£1.06
40106	61p
40107	68p
40108	£5.36
40109	£1.02
40181	£3.39
40182	£1.40
40192	£1.40
40193	£1.40
40194	£1.18
40197	£1.48
4160	£1.08
4161	£1.08
4162	£1.08
4163	£1.08
4174	£1.08
4175	99p
4194	£1.08
4408	£6.59
4409	£6.59
4410	£5.73
4411	£9.58
4412WP	£8.18
4415W	£7.50
4415F	N/S
4419	£2.68
4422	£5.00
4431	TBA
4433	£1.32
4435	£7.93
4441	£11.58
4450	£2.67
4451	£2.67
4452	TBA
4461	£2.18
4462	£2.42
4465	£6.54
4490FP	£4.92
4490VP	£5.56
4501	17p
4502	91p
4503	69p
4505	£5.71
4506	51p
4507	55p
4508	£2.48
4510	99p
4511	81p
4514	£2.65
4515	£2.99
4516	£1.08
4517	£1.02
4519	51p
4520	£1.08
4521	£1.88
4522	£1.08
4524	N/S
4526	£1.08
4527	£1.52
4528	99p
4529	£1.14
4530	85p
4531	£1.45
4532	£1.27
4534	£5.13
4536	£3.69
4537L	£13.23
4538	£1.25
4539	91p
4541	£1.14
4543	£1.59
4549	£3.69
4552	£10.55
4553	£3.87
4554	£1.19
4555	78p
4556	78p
4557	£3.86
4558	£1.14
4559	£3.69
4560	£1.84
4561	95p
4562	£5.33
4566	£1.59
4568	£2.38
4569	£2.57
4572	25p
4573	25p
4574	45p
4581	£2.62
4582	98p
4583	76p
4584	43p
4585	£1.01
4589	£2.06
4700	£1.75

VIDEO

UM111136 UHF Ch.36 Vi-	
sion Modulator £2.50	
[+12% VAT]	
UM1231 UHF Ch.36 Vision	
Modulator wide bandwidth	
(for computers etc.) £4.70	
[+8% VAT]	

QUARTZ

32.768 KHz	£3.23
(Watch)	
60 KHz	£9.95
100.0 KHz	£3.62
200.0 KHz	£3.92
204.8 KHz	£3.92
262.144 KHz	£3.92
307.2 KHz	£3.92
312.5 KHz	£3.92
455.0 KHz	£4.95
1.000 MHz	£3.62
1.008 MHz	£3.92
1.280 MHz	£3.92
1.8432 MHz	£3.62
2.000 MHz	£3.62
2.097152 MHz	£3.23
2.4576 MHz	£3.62
2.56250 MHz	£3.62
3.000 MHz	£3.62
3.2768 MHz	£1.95
3.579545 MHz	£3.23
4.000 MHz	£2.90
4.032 MHz	£3.23
4.096 MHz	£3.23
4.194304 MHz	£3.23
4.433619 MHz	£1.25
4.608 MHz	£3.23
4.800 MHz	£3.23
4.915 MHz	£3.23
5.000 MHz	£3.23
5.0688 MHz	£3.23
5.120 MHz	£3.23
5.185 MHz	£3.23
6.000 MHz	£3.23
6.144 MHz	£3.23
6.400 MHz	£3.23
6.55360 MHz	£3.23
7.000 MHz	£3.23
7.168 MHz	£3.23
7.680 MHz	£3.23
7.88432 MHz	£3.23
8.000 MHz	£3.23
8.388608 MHz	£3.23
9.375 MHz	£3.92
9.800 MHz	£3.92
10.000 MHz	£3.23
10.100 MHz	£3.23
11.000 MHz	£3.92
12.000 MHz	£3.92
14.31818 MHz	£3.23
18.000 MHz	£3.23
18.432 MHz	£3.23
20.000 MHz	£3.62
20.134 MHz	£3.23
21.134 MHz	£3.23
27.648 MHz	£3.92
38.6666 MHz	£3.23
48.000 MHz	£3.23
100.000 MHz	£3.23
116.000 MHz	£3.23

VEROBOARD

0.1" Pitch with copper	
strips	
2 1/2" x 1" (pack of 5)	59p
2 1/2" x 3 1/2"	41p
2 1/2" x 5"	49p
2 1/2" x 17"	£1.52
3 1/2" x 3 1/2"	£1.59
3 1/2" x 5"	56p
3 1/2" x 17"	£1.95
4 7/8" x 17 1/2"	£2.52
0.1" Plainboard (no	
strips)	
3 1/2" x 2 1/2"	28p
3 1/2" x 5"	45p
3 1/2" x 17 1/2"	£1.28
Terminal pins £1.50/500	
V4 DIP board	98p
DIP breadboard	£2.42
Spot trace cutter	82p
Pin insertion tool	99p

SOLDERCON PINS

100 500	£0.00
1000 1000	£0.00

DIL SOCKETS

8/14/16 pin	10p/12p/13p
18/20/22 pin	18p/20p/25p
24/28/40 pin	30p/40p/50p

TIMER ICs

NE555/556	29p/49p
-----------	---------

OP-AMPS

(All Mini dips)	
CA 3130C	84p
CA 3140C	35p
UA 741 (Texas)	22p
6x 741 (Texas)	£1.00

SPECIAL

NSB 381 Multiplax and	
4x 0.3" common cathode	
prime quality	£2.95

LED DISPLAYS

DL-704E/707E	85p
DL-727E/728E	£2.00
DL-747E/750E	£1.80
FD 500/560	£1.20

LIQUID CRYSTAL DISPLAY

4 x 0.5" Digits 40 pin OIL	£8.95
----------------------------	-------

CLOCK CHIPS

AY-5-1224	£2.60
MK 50293	£5.50
MK 50362/50366	£5.50
MC 14440(LD/C)	£9.95

SIX DECADE COUNTERS

MK 50395/6/7	£8.75
MK 50398/9	£6.20

TIMEBOX. Digital Clock

Case: 56 x 131 x 71.5 mm
with red acrylic window.
Case colour white. £2.50

DATA

Note: in this section all data books are subject to 0% VAT. For postage see 'Terms' at top of page.

c650 page COSMOS Databook (RCA)	£4.95
c200 page CMOS Databook (Motorola)	£3.50
CMOS Databook (National)	£2.20
MC 14500B ICD Handbook (Motorola)	£2.25
Understanding Microprocessors (Motorola)	£2.75
M6800 Microprocessor Applications Manual (Motorola)	£9.95
A Guide to SC/MP Programming (Kemitrol)	£3.50
A Guide to Xibug (Kemitrol)	£2.75
SC/MP Technical Description (National)	£2.76
SC/MP Microprocessor Applications Handbook (National)	£3.45
SC/MP Programming + Assembler Manual (National)	£3.00
NBL Reference Manual (National)	£3.45
16-page data for IMS 8154 (ISP 84/650) (National)	50p
20-page data for SC/MP II (National)	50p
CDP 1802 MPU User Manual (RCA)	£4.50
CDP 1802 Subroutines (RCA)	£4.50
COSMAC MPU Guide (RCA)	75p
Memory Data (National)	£2.30
MOS/LSI (National)	£2.40

Certain of the above data are subject to manufacturers' delays, so please check stock if urgently required.

SPECIAL: Z80 DATA PACK

£13.95
A set of the following 5 Z80 data manuals and all the related data we can find of interest to the Z80 user.

Approximate weight 1.75kg	
c30 page Z80 CPU Technical Manual	
c10 page Z80 CTC Product Specification	
c25 page Z80-P10 Technical Manual	
c20 page Z80 Programming Manual	
c25 page Z80 Micro Reference Manual	

74C

74C00	24p
74C02	24p
74C04	24p
74C08	24p
74C10	24p
74C14	£1.41
74C20	24p
74C23	24p
74C24	24p
74C28	92p
74C48	£1.38
74C73	54p
74C74	54p
74C76	54p
74C63	£1.29
74C85	£1.28
74C86	64p
74C89	£4.38
74C90	85p
74C93	85p
74C95	£1.04
74C107	£1.22
74C150	£4.12
74C151	£2.46
74C154	£3.67
74C157	£2.20
74C160	£1.10
74C161	£1.10
74C162	£1.10
74C163	£1.10
74C164	£1.04
74C165	£1.04
74C17	54p
74C174	51p
74C175	90p
74C192	£1.10
74C193	£1.10
74C195	£1.04
74C200	£6.78
74C221	£1.36
74C273	£1.73
74C283	£1.73
74C901	54p
74C902	54p
74C903	54p
74C904	54p
74C905	£7.26
74C906	54p
74C907	54p
74C908	96p
74C909	£1.63
74C910	£6.78
74C911	£7.13
74C912	£7.13
74C914	£1.41
74C915	£1.10
74C918	£1.06
74C921	£1.83
74C922	£3.66
74C923	£3.73
74C924	TBA
74C925	£4.84
74C926	£4.84
74C927	£4.84
74C928	£4.84
74C929	£11.33
74C948	TBA
80C95	54p
80C96	61p
80C97	54p
80C98	61p
82C19	£4.13
88C29	£1.93
88C30	£1.93

BUGS

ETIBUG 1	£19.95
ETIBUG 2	£19.95
KITBUG	£14.95
MKBUG 6830-7	£13.70

CHAR. GEN. KEYBOARD ENCODER

MCM 6571/6575/6576	£6.70
MCM 66760	£9.75
MK 5302	£15.29
RO-3-2513	£5.50
DM 8878 CAB/BWF/CAN	£12.95
AY-5-2376	£9.75

BASICS

The Age of Affordable Personal Computing Has Finally Arrived

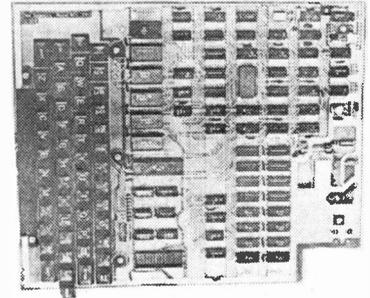
Ohio Scientifics

Superboard II

Full 8K basic and 4K user RAM
Built and tested

£263.84

+ 8% VAT



Ohio Scientific has made a major breakthrough in small computer technology which dramatically reduces the cost of personal computers. By use of custom LSI micro circuits, we have managed to put a complete ultra high performance computer and all necessary interfaces, including the keyboard and power supply, on a single printed circuit board. This new computer actually has more features and higher performance than some home or personal computers that are selling today for up to \$2000. It is more powerful than computer systems which cost over \$20,000 in the early 1970's.

This new machine can entertain your whole family with spectacular video games and cartoons, made possible by its ultra high resolution graphics and fast BASIC. It can help you with your personal finances and budget planning, made possible by its decimal arithmetic ability and cassette data storage capabilities. It can assist you in school or industry as an ultra powerful scientific calculator, made possible by its advanced scientific math functions and built-in "immediate" mode which allows complex problem

solving without programming! This computer can actually entertain your children while it educates them in topics ranging from naming the President of the United States to tutoring trigonometry all possible by its fast extended BASIC graphics and data storage ability.

The machine can be economically expanded to assist in your business, remotely control your home, communicate with other computers and perform many of the other tasks via the broadest lines of expansion accessories in the microcomputer industry.

This machine is super easy to use because it communicates naturally in BASIC, an English-like programming language. So you can easily instruct it or program it to do whatever you want, *but you don't have to*. You don't because it comes with a complete software library on cassette including programmes for each application stated above. Ohio Scientific also offers you hundreds of inexpensive programs on ready-to-run cassettes. Program it yourself or just enjoy it, the choice is yours.

Standard Features

- Uses the ultra powerful 6502 microprocessor
- 8K Microsoft BASIC-in-ROM
- Full feature BASIC runs faster than currently available personal computers and all 8080-based business computers.
- 4K static RAM on board expandable to 8K
- Full 53-key keyboard with upper-lower case and user programmability
- Kansas City standard audio cassette interface for high reliability
- Full machine code monitor and I/O utilities in ROM
- Direct access video display has 1K of dedicated memory (besides 4K user memory), features upper case, lower case, graphics and gaming characters for an effective screen resolution of up to 256 by 256 points. Normal TV's with overscan display about 24 rows of 24 characters, without overscan up to 30 x 30 characters.

Extras

- Available expander board features 24K static RAM (additional mini-floppy interface, port adapter for printer and modem and OSI 48 line expansion interface.
- Assembler/editor and extended machine code monitor available.

Fully built and tested. Requires only +5V at 3 amps and a videomonitor or TV and RF converter to be up and running.

There is enormous interest in Superboard, so order early if you wish to avoid inevitably long delivery dates later this year.

FREE 15-DAY TRIAL

Lotus Sound have had so many enquiries with questions about various aspects of Superboard II that in order to save time and ensure your satisfaction we are offering to return the full price to anyone who returns their machine, in good order, within 15 days of delivery.

SOUND

4 MORGAN ST., LONDON E3 5AB

(Phone for appointment)

ELECTRONICS TODAY INTERNATIONAL — MARCH 1979

Commands

CONT LIST NEW NULL RUN

Statements

CLEAR	DATA	DEF	DIM	END	FOR
GOTO	GOSUB	IF...GOTO	IF...THEN	INPUT	LET
NEXT	ON...GOTO	ON...GOSUB	POKE	PRINT	READ
REM	RESTORE	RETURN	STOP		

Expressions

Operators

-, +, *, /, ↑, NOT, AND, OR, >, <, <>, >=, <=, =
RANGE 10⁻³² to 10⁺³²

Functions

ABS(X)	ATN(X)	COS(X)	EXP(X)	FRE(X)	INT(X)
LOG(X)	PEEK(I)	POS(I)	RND(X)	SGN(X)	SIN(X)
SPC(I)	SQR(X)	TAB(I)	TAN(X)	USR(I)	

String Functions

ASC(X\$)	CHR\$(I)	FRE(X\$)	LEFT\$(X\$,I)	LEN(X\$)	MID\$(X\$,I,J)
			RIGHT\$(X\$,I)	STR\$(X)	VAL(X\$)

Plus variables, arrays and good editing facilities.

To: **LOTUS SOUND**
4 MORGAN ST., LONDON E3 5AB

Please send me Ohio Scientific Superboard Computer(s)
I enclose cheque/PO for £

Name

Address

ETI 3

TRANSISTORS

AC107	0.23	BC117	0.15	BC206	0.10	BC550B	0.11	BF184	0.20	BU205	1.30	2N1613	0.10
AC125	0.17	BC118	0.12	BC206B	0.11	BC542	0.55	BF185	0.20	BU206	1.50	2N1671	1.10
AC126	0.17	BC119	0.25	BC207	0.10	BC548	0.20	BF194	0.07	BU208-02	1.75	2N1671B	2.20
AC127	0.18	BC120	0.15	BC207B	0.09	BC549	0.13	BF194A	0.06	BU209	3.90	2N1711	0.20
AC127K	0.23	BC125B	0.16	BC212A	0.10	BC549B	0.10	BF195	0.07	BU210	1.50	2N1711B	0.25
AC128	0.14	BC126	0.15	BC213L	0.10	BC549C	0.10	BF195A	0.07	BU211	2.00	2N1905	0.25
AC128K	0.25	BC136	0.15	BC214L	0.10	BC549D	0.10	BF195B	0.07	BU212	2.00	2N1905	0.25
AC128/176	0.42	BC137	0.15	BC237	0.15	BC549E	0.10	BF196	0.06	BU213	2.00	2N2000	1.00
AC142	0.18	BC138	0.30	BC237A	0.15	BC549F	0.10	BF197	0.06	BU214	4.50	2N2188	2.00
AC143	0.53	BC140	0.20	BC237C	0.21	BC549G	0.10	BF198	0.06	BU215	4.50	2N2188	2.00
AC150	0.50	BC141	0.20	BC238	0.15	BC549H	0.10	BF199	0.06	BU216	4.50	2N2188	2.00
AC176	0.16	BC142	0.20	BC238B	0.10	BC549I	0.10	BF200	0.06	BU217	4.50	2N2188	2.00
AC187	0.50	BC147	0.06	BC238C	0.10	BC549J	0.10	BF201	0.06	BU218	4.50	2N2188	2.00
AC187K	0.50	BC147B	0.06	BC251A	0.15	BC549K	0.10	BF202	0.06	BU219	4.50	2N2188	2.00
AC188K	0.50	BC148	0.06	BC251B	0.17	BC549L	0.10	BF203	0.06	BU220	4.50	2N2188	2.00
AC190	0.50	BC149	0.06	BC252A	0.15	BC549M	0.10	BF204	0.06	BU221	4.50	2N2188	2.00
AC192	1.82	BC148B	0.07	BC252B	0.17	BC549N	0.10	BF205	0.06	BU222	4.50	2N2188	2.00
AD142	0.87	BC149	0.06	BC252C	0.20	BC549O	0.10	BF206	0.06	BU223	4.50	2N2188	2.00
AD143	0.87	BC157	0.06	BC258	0.20	BC549P	0.10	BF207	0.06	BU224	4.50	2N2188	2.00
AD149	0.85	BC157A	0.07	BC261A	0.10	BC549Q	0.10	BF208	0.06	BU225	4.50	2N2188	2.00
AD151	0.35	BC158	0.07	BC262	0.20	BC549R	0.10	BF209	0.06	BU226	4.50	2N2188	2.00
AD151/162	0.78	BC158A	0.06	BC267A	0.21	BC549S	0.10	BF210	0.06	BU227	4.50	2N2188	2.00
AD162	0.35	BC158B	0.06	BC267B	0.22	BC549T	0.10	BF211	0.06	BU228	4.50	2N2188	2.00
AD282	0.36	BC159	0.07	BC268	0.21	BC549U	0.10	BF212	0.06	BU229	4.50	2N2188	2.00
AD283	0.36	BC159A	0.07	BC268A	0.25	BC549V	0.10	BF213	0.06	BU230	4.50	2N2188	2.00
AD276	4.74	BC159B	0.07	BC268B	0.15	BC549W	0.10	BF214	0.06	BU231	4.50	2N2188	2.00
AD211	4.05	BC161	0.25	BC307A	0.15	BC549X	0.10	BF215	0.06	BU232	4.50	2N2188	2.00
AF106	0.45	BC167	0.07	BC307B	0.15	BC549Y	0.10	BF216	0.06	BU233	4.50	2N2188	2.00
AF109K	0.36	BC168	0.06	BC307C	0.15	BC549Z	0.10	BF217	0.06	BU234	4.50	2N2188	2.00
AF124	0.25	BC169	0.06	BC309A	0.15	BC549AA	0.10	BF218	0.06	BU235	4.50	2N2188	2.00
AF125	0.25	BC170B	0.07	BC317B	0.15	BC549AB	0.10	BF219	0.06	BU236	4.50	2N2188	2.00
AF126	0.25	BC170C	0.07	BC322	0.10	BC549AC	0.10	BF220	0.06	BU237	4.50	2N2188	2.00
AF127	0.25	BC171	0.06	BC327	0.18	BC549AD	0.10	BF221	0.06	BU238	4.50	2N2188	2.00
AF130	0.32	BC171A	0.07	BC328	0.16	BC549AE	0.10	BF222	0.06	BU239	4.50	2N2188	2.00
AF178	0.30	BC171B	0.07	BC337	0.16	BC549AF	0.10	BF223	0.06	BU240	4.50	2N2188	2.00
AF179	0.30	BC172	0.06	BC338	0.16	BC549AG	0.10	BF224	0.06	BU241	4.50	2N2188	2.00
AF200	0.36	BC172A	0.07	BC348A	0.15	BC549AH	0.10	BF225	0.06	BU242	4.50	2N2188	2.00
AF201	0.39	BC172B	0.07	BC350A	0.17	BC549AI	0.10	BF226	0.06	BU243	4.50	2N2188	2.00
AS173	0.30	BC172C	0.07	BC441	0.20	BC549AJ	0.10	BF227	0.06	BU244	4.50	2N2188	2.00
AS215	0.60	BC173	0.06	BC476	0.24	BC549AK	0.10	BF228	0.06	BU245	4.50	2N2188	2.00
AS216	0.60	BC174	0.06	BC477	0.24	BC549AL	0.10	BF229	0.06	BU246	4.50	2N2188	2.00
AS217	0.60	BC174B	0.07	BC478	0.24	BC549AM	0.10	BF230	0.06	BU247	4.50	2N2188	2.00
AU103	0.90	BC177A	0.12	BC547A	0.11	BC549AN	0.10	BF231	0.06	BU248	4.50	2N2188	2.00
AU107	1.00	BC177B	0.12	BC547B	0.11	BC549AO	0.10	BF232	0.06	BU249	4.50	2N2188	2.00
AU110	0.90	BC178	0.12	BC547C	0.11	BC549AP	0.10	BF233	0.06	BU250	4.50	2N2188	2.00
AU112	0.90	BC179	0.12	BC548A	0.11	BC549AQ	0.10	BF234	0.06	BU251	4.50	2N2188	2.00
BC107	0.06	BC179A	0.09	BC548B	0.11	BC549AR	0.10	BF235	0.06	BU252	4.50	2N2188	2.00
BC107A	0.07	BC182B	0.09	BC548C	0.11	BC549AS	0.10	BF236	0.06	BU253	4.50	2N2188	2.00
BC108	0.07	BC183A	0.09	BC549A	0.11	BC549AT	0.10	BF237	0.06	BU254	4.50	2N2188	2.00
BC109	0.06	BC183B	0.09	BC549B	0.11	BC549AU	0.10	BF238	0.06	BU255	4.50	2N2188	2.00
BC109A	0.07	BC183C	0.10	BC550	0.11	BC549AV	0.10	BF239	0.06	BU256	4.50	2N2188	2.00
BC109B	0.07	BC184	0.09	BC557	0.11	BC549AW	0.10	BF240	0.06	BU257	4.50	2N2188	2.00
BC109C	0.06	BC184A	0.09	BC557A	0.11	BC549AX	0.10	BF241	0.06	BU258	4.50	2N2188	2.00
BC109D	0.07	BC184B	0.10	BC557B	0.11	BC549AY	0.10	BF242	0.06	BU259	4.50	2N2188	2.00
BC109E	0.07	BC186	0.19	BC557C	0.11	BC549AZ	0.10	BF243	0.06	BU260	4.50	2N2188	2.00
BC113	0.12	BC187	0.19	BC558	0.11	BC549BA	0.10	BF244	0.06	BU261	4.50	2N2188	2.00
BC114	0.15	BC204	0.06	BC558A	0.11	BC549BB	0.10	BF245	0.06	BU262	4.50	2N2188	2.00
BC116	0.13	BC204B	0.09	BC558B	0.11	BC549BC	0.10	BF246	0.06	BU263	4.50	2N2188	2.00

DIODES

AA119	0.17	BA243	0.85	BY142	0.45	BY204-B	0.85	ITT827	2.35	0A86	0.20	1N5403	0.15
AA121	0.11	BA113	0.06	BY146	0.50	BY204-10	0.75	ITT828	2.20	0A90	0.07	1N5404	0.16
AA123	0.08	BA113B	0.06	BY176	0.50	BY210-400	0.45	ITT829	0.35	0A91	0.35	1N5405	0.25
AA143	0.15	BA117	0.10	BY179	0.50	BY210-800	0.45	ITT1075	0.25	0A95	0.06	1N5406	0.20
AA144	0.09	BA105B	0.35	BY182	1.85	BY210-800-0.50	0.50	ITT2001	0.25	0A202	0.07	1N5407	0.19
BA102	0.30	BA105C	0.35	BY184	0.70	BY210-800-0.55	0.55	ITT2002	0.20	ST2	0.14	1N5408	0.20
BA111	0.98	BA1106	0.45	BY187	1.70	BY210-1	0.35	NR502	0.75	1N4001	0.50	1N5409A	6.75
BA115	0.25	BA112	1.25	BY198	0.75	BY255-350	0.45	NR813	0.90	1N4002	0.85	1N5781	0.80
BA145	0.15	BA100	0.20	BY199	0.50	BY255-600	0.45	NR854	1.80	1N4003	0.05		
BA148	0.12	BA101	0.30	BY201-2	0.40	BY271-350	0.90	NR856	2.10	1N4004	0.06		
BA154	0.10	BY100	0.20	BY201-3	0.40	BY271-600	1.15	NR922A	1.55	1N4005	0.06		
BA155	0.12	BY103	0.35	BY201-4	0.45	BZ161 series		MY2203	1.60	1N4006	0.07		
BA156	0.12	BY118	1.45	BY201-5	0.55			MY5400	0.65	1N4007	0.08		
BA157	0.45	BY126	0.15	BY201-6	0.55	BZ168 series		0A47	0.07	1N4148	0.84		
BA158	0.65	BY127	0.15	BY201-12	0.60			0A70	0.07	1N4150	0.45		
BA159	0.75	BY130	0.15	BY203-16	0.85	BZ168 series		0A71	0.05	1N4448	0.25		
BA182	0.45	BY133	0.10	BY203-20	1.00	ITT44	0.10	0A81	0.12	1N5401	0.12		
BA201	0.15	BY134	0.45	BY204-4	0.45	ITT210	1.35	0A85	0.12	1N5402	0.15		

LINEAR INTEGRATED CIRCUITS

CA3020	1.75	MC1350P	3.85	SN760230D	2.15	TA4570	2.85	TA8400	2.25	TA8700	3.85	TC4270	3.00
CA3046	0.80	SA4570	4.20	SN76033N	2.48	TA6821	8.95	TA8410	2.40	TA8700B	2.25	TC4270B	3.80
CA3048	2.50	SA4700	10.15	SN76110M	1.50	TA6830S	5.10	TA8420	2.50	TA8720	5.10	TC4270C	3.00
CA3065	7.50	SA3560	2.75	SN76131H	2.00	TA6830S	5.10	TA8420A	5.10	TA8720A	5.10	TC4270S	2.25
CA3099C	4.50	SB4570	2.75	SN76228B	3.15	TA6861A	1.70	TA8420B	2.50	TA8720B	2.10	TC4270S	3.40
CA3090D	4.50	SB4750	2.75	SN76229B	2.50	TA6861B	1.80	TA8420C	2.50	TA8720C	2.10	TC4270S	3.40
ET78016	4.95	SC9503P	2.00	SN76227H	2.50	TA7000	3.50	TA8430D	2.50	TA87500	2.50	TC4800	12.40
MC1303A	1.50	SL414A	4.85	SN76532N	3.15	TA8440	4.50	TA8450	2.50	TA8800	0.90	TC4830	6.15
MC1304P	2.00	SL415A	6.30	SN76533N	2.70	TA8440A	4.50	TA8450A	2.25	TA8800B	0.85	TC4840	6.75
MC1305	5.15	SL416	6.30	SN76534N	1.80	TA8440B	3.05	TA8450B	3.50	TA8800C	3.40	TC4870	2.85
MC1307P	2.85	SL913B	10.70	SN76535N	1.80	TA8440C	1.50	TA8450C	3.80	TA8800D	3.40	TC4870B	2.85
MC1310P	1.60	SL1310	5.65	SN76566A	1.60	TA8440D	2.70	TA8450D	3.80	TA8800E	3.40	TC4870C	2.85
MC1327P	2.75	TA300	3.75	SN76567A	3.75	TA8440E	1.60	TA8450E	3.80	TA8800F	3.40		

WHO NEEDS ELECTRONICS?

K. T. Wilson explores the all too frequently ignored and misunderstood field of Magnetic Amplifiers.

THINK OF AMPLIFICATION, and you automatically think of transistors. Perhaps if you're a bit longer in the tooth you remember valves. Have you ever thought of large amounts of power gain being obtained without using either transistors or valves? It's power gain we're talking about, too, not just voltage gain. A transformer will give voltage gain, up to 100 times, but at the expense of current, so that the power out is never quite as much as the power in. There's no *power* gain there, but a device called the magnetic amplifier, which looks very like a transformer, can give very large values of power gain, can control AC power into a load very smoothly, and is used in the sort of applications where thyristors would be a natural choice for many.

The magnetic amplifier has been used in industrial control for decades, yet has never really caused any stir of interest anywhere else. Perhaps it's because it's always a ready-made item, but then so is an IC amplifier, and everyone seems to make use of those. Perhaps it's just because so very few people outside the ranks of professional engineers know just what a magnetic amplifier is. Let's remedy that!

Induced Knowledge

To start with, we need a pretty clear idea of what happens inside an inductor. A simple inductor has a winding which consists of insulated wire wound round a core of a soft magnetic material. Soft doesn't mean that you can spread it on your bread, but that the material magnetises easily, and demagnetises just as easily. Take a piece of this material, hold a magnet near it, and it's magnetised. Take a magnet away and it's demagnetised. This material we use for the cores of inductors, transformers, electric motors, relays etc.

An inductor makes use of this 'soft' magnetism. The winding has an alternating current flowing in it. This alternating current (changing smoothly from a peak in one direction to a peak in the opposite direction and back) causes the core of the inductor to magnetise. The magnetism isn't steady like a bar magnet, but alternating, which is the point of using soft magnetic material. a graph of the magnetism (called flux density) of the core plotted against time would, ideally, have exactly the same shape as that of the waveform of the AC applied.

So far so good — it's an alternating magnet. But we've known for about 150 years (or someone has) that

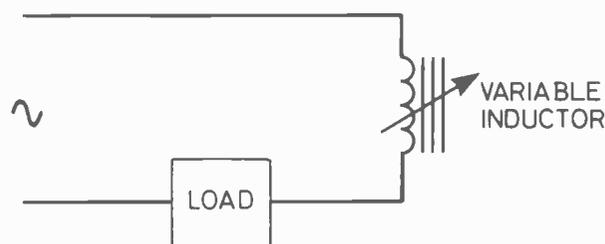


Fig. 1. Control of a load using a variable inductor, this configuration has very little power lost as heat, unlike a resistive controller.

wherever there's an alternating magnetic field, any piece of wire or other metal will have an alternating voltage induced.

Stick a piece of wire near your alternating magnet and you'll find an alternating voltage across the ends of the wire. The voltage is small if you use just a few centimetres of straight wire, but if you wrap several metres or wire round the core, so that all the magnetism of the core is at the centre of the coil of wire, then you find quite a respectable amount of AC. Recognise it?, a transformer.

Laying Down the Laws

The laws of Electricity are very consistent, though, *Any* coil of wire around a core that has an alternating magnetic field will have an AC voltage induced. That means that if we have only one coil, and we send AC through to generate the magnetism, it will *also* have an AC voltage induced in it. This voltage which the text books call a "back EMF", opposes the current which causes the magnetism which causes the voltage.

Result?

It's a darn sight more difficult to pass AC through an inductor than it is to pass DC!

When we use an inductor in a DC circuit, then apart from some effects at the moments of switch-on and switch-off the thing behaves like a resistance, good old Ohm's Law and all the rest, and a fairly low value of resistance at that.

Now you might think that it should pass the same amount of current for AC as for DC, but it doesn't.

Imagine that the resistance is $2R$, so that 10 V DC passes 5 A. Apply 10 V AC and the current's nothing like 5 A. It's not because Ohm's law stops working, it's because of the induced voltage. We're trying to push AC ►

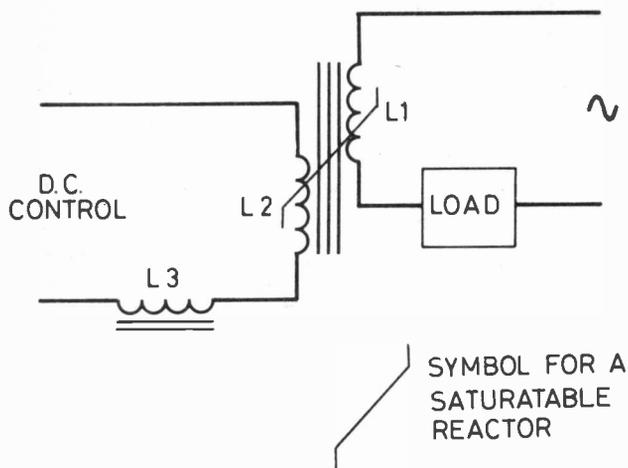


Fig. 2. Simple magnetic amplifier circuit, showing DC control winding.

through with one voltage, and the induced voltage is opposing our efforts. It's only the difference between the two voltages that has any effect at all.

Impedance Impediment

Suppose for example, that with 10 V AC applied, the induced voltage is 9V9. This makes the difference equal to 0V1, and the current is

$$\frac{0.1}{2} = 0.05 \text{ A, (by Ohm's Law)}$$

Now these are calculations we seldom bother to make. Instead we measure a quantity called the self-inductance, L , of the coil and use this quantity and the resistance value to calculate impedance, which is the ratio

$$\frac{\text{AC voltage}}{\text{AC current}}$$

for the coil. In our example, 10 V causes 0.05 A to flow, making the impedance $10 / .05 = 200 \text{ R}$, not a particularly large impedance, but much greater than the resistance of 2 R.

The useful thing about an impedance is that there's practically no loss of power in it. Pass a current through a 200 R resistor, and you lose energy in the form of heat the amount of heat lost per second is $200 \times (\text{current})^2$ joules for a 200 R resistor. The same current through the inductor in our example doesn't look anything like this — only its resistance loses heat, and that's only $2 \times (\text{current})^2$ joules, because the resistance is only 2 R.

We can therefore use an inductor to control the flow of AC in a circuit (see Fig. 1) with none of the power loss that a resistor would cause. Now if we could just have a variable inductor, we could be very neatly control the flow of current in that circuit. Of course, we could use an inductor with tapped turns and slide contacts, built like a potentiometer, and we make use of just such a device, the familiar Variac. It's possible though, to control the inductance of a winding with no mechanical movement at all, and what makes it possible is the effect called saturation.

Control-A-Coil!

When we send a current, AC or DC, through a coil of wire which is wound round a magnetic core, we can't pass as much current as we like and expect the magnetism to keep pace. At some stage in the game the core saturates, which means that it's as magnetised as it's ever going to be, no matter how much current is used. Now when a core is saturated like this, a change of current doesn't cause a change in the magnetism, so there's no more induced voltage. In other words, the inductance is no more and the impedance is practically zero.

Let the AC flow to it's load through an inductor whose core we can cause to saturate. How? By passing DC through another winding, by making the core of material which saturates easily, and the making the core continuous with no air gap.

That's our recipe for a magnetic amplifier.

Amps For Amps

Figure 2 shows a simple magnetic amplifier circuit. The inductor L1 has a large inductance when the core is not saturated, because of that, its impedance is very large, enough to make the current in the circuit very small. Now let DC flow through the second winding L2, and the core saturates.

If we can keep the core saturated for the whole of the AC cycle, then the inductance of L1 is almost zero, and the full amount of AC current flows through the load.

We don't of course, have to switch between saturation and no-saturation. We can adjust the control current so that the core saturates only on half of the AC cycle, or in peaks so that the average current through the load is controlled.

Self Satisfied

Even such a simple magnetic amplifier has a lot of advantages, such as low power dissipation and high power gain, but better results are possible by using what is called a self-saturating design. Self-saturation is a form of positive feedback, using some of the signal current to assist the DC control current. Fig 3 shows a half-wave self-saturating circuit. The rectifier D1 ensures that only one direction of current flows through the coil L1 and the rated load current will cause the core to be close to saturation. The DC control current in winding L2 need only be quite small to cause the core to saturate on peaks, so that less power is needed to control the load current, and power gain is much higher.

Only half cycles are passing into the load, however, so that a full wave version is more desirable.

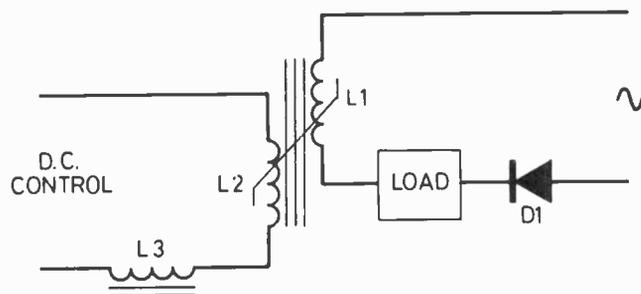


Fig. 3. Half-wave control using self-saturation.

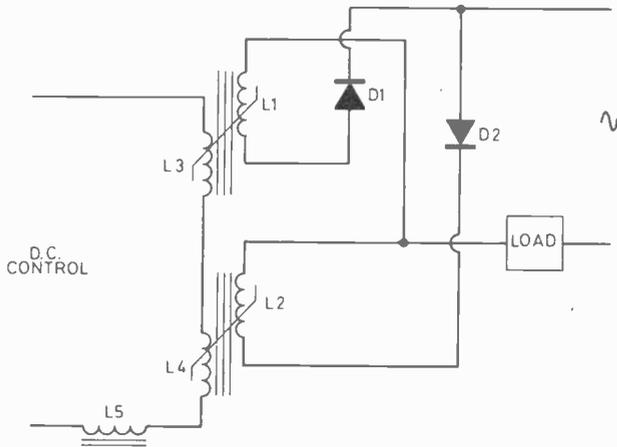


Fig. 4. Full-wave amplification with self saturation, by positive feedback.

A full-wave self-saturating magnetic amplifier is shown in Fig 4. Two sets of windings are used, each handling half of the wave, with rectifiers ensuring that

the AC wave is split into its two halves.

In all these circuits, an additional inductor is used in the DC control line to prevent AC appearing in the control circuit because of transformer action.

Going Straight

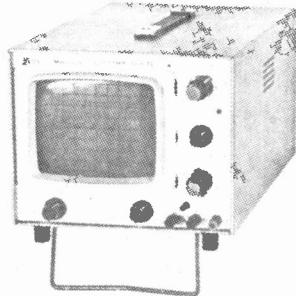
DC amplification? Simple enough, just rectify the output of the magnetic amplifier — the self-saturating full wave type already has two rectifiers included in the circuit and only two more are needed. More sensitivity? Add another winding to pass DC bias current, and the sensitivity increases because the bias can be set so that the core is very close to saturation.

Nothing could be *that* perfect, there has to be a snag somewhere, and response time is it for magnetic amplifiers. Being slow beasts a sudden change of control signal may not cause much change in the output current until several cycles of AC have passed through. Nevertheless for stabilising AC supplies, for control of large AC loads and for high power gains magnetic amplifiers are not so easily displaced by electronics. There's not much to go wrong, they can be built to order, and they can be repaired.

Ever tried to put a new junction into a thyristor? **ETI**

KRAMER DOES IT AGAIN!!! THE FIRST 5 INCH, 10 MHz SCOPE WITH X5 MAGNIFIER FOR LESS THAN £150

- Large 5" flat CRT
- DC to 10 MHz bandwidth
- 10mV to 50V/cm in 12 calibrated steps
- 0.5 μ S to 0.1 Sec/cm sweep range in 6 calibrated steps plus 12.1 Vernier
- Magnifier x5
- Fully automatic trigger
- DC to 1.5 MHz horizontal bandwidth
- Optional Probe Kit with x1 and x10 attenuators available
- Fastest sweep 10ns/cm with Magnifier
- 1.6 KV EHT for high intensity, well focused trace.



The Model 3106C Oscilloscope is a general purpose, high quality oscilloscope, giving research grade performance at budget price. Ideal in students labs at all levels of education, as well as, in repair service shops and production line testing. The Model 3106C meets the requirement for a dependable oscilloscope at surprisingly low cost. Its sturdy construction, quality components and proficient manufacturing, combine to make this oscilloscope an exceptionally reliable laboratory instrument.

The design of the 3106C is thoroughly user oriented. This is reflected in the simple easy to use, robust control panel and switches, in the single PC board layout with easy access to all components and rugged chassis. The versatility, performance and dependability combine to make this oscilloscope an outstanding value-for-money instrument.

All these features for only **£147.95 + £11.84 VAT (includes delivery)**
Send SAE for brochure

KRAMER & CO. 9 October Place, Holders Hill Road, London NW14 1EJ

TELEX 88894 Attn Kramer K7. TEL: 01-203 2473
MAIL ORDER ONLY

LINES FROM OUR VAST STOCKS—IMMEDIATE DELIVERY

All below manufacturers' prices — all new stocks. Quantity discounts — export enquiries invited. Postage & packing 35p per order

CALCULATOR CHIPS General instrument GIMT4 on anti-static foam 24 pin D1 L socket for use with Bowmar display £1.50 ea Pack of 25 chips £25, 100 for £80, 500 for £350.

BOWMAR 9 DIGIT CALCULATOR DISPLAY with PC connector 0.2 digits Common cathode with red bezel £1.25 ea 10 for £10, 100 for £85.

TEXAS 19 gold plated snap key contact on gold-plated P C board Size 70x80x2mm 75p ea ORP12 light dependent resistance (Eq = RPY30) 2 for £1, 10 for £4, 100 for £35.

FAIRCHILD FND10 0.15" 7 segment display C cathode 50p, 10 for £4.50, 100 for £40.

TBA 120A TV I C amplifier Siemens 75p, 10 for £6, 100 for £50, 1 000 for £350.

BECKMAN 500 kcs Triggerable clocking oscillator for use with calculator chips 5v supply with circuit £1, 10 for £8, 100 for £85.

BURROUGHS 9 DIGIT Panaplex calculator display 7 segment 0.25" digits Neon type with red bezel socket and data £1.95 ea 10 for £17.

ALMA PUSHBUTTON high reliability reed switches Pushits make 18x27x18mm 40p ea 10 for £3.50, 100 for £33.

SMITHS INDUSTRIES Audible warning devices 6-12 volts 2 transistors 30x10mm encapsulated 50p ea 10 for £4, 100 for £35, 1 000 for £300.

HONEYWELL PROXIMITY DETECTOR integral amplifier 8v D C £2.50 ea 10 for £20, 100 for £175.

OSMOR CHANGE OVER REED RELAY 1.2v coil 20m a operating current 59x17x13mm 75p ea 10 for £5, 100 for £45, 1000 for £400.

MARRIOTT TAPE HEADS Quarter track all at 50% discount

Type Each Per 10 Per 100

XRPS18 Record Replay £3.00 £20.00 £150.00

XRPS36 Record Replay £4.00 £30.00 £200.00

XES11 Erase £1.25 £10.00 £80.00

MULLARD AD161—AD162 Matched pairs

Pair 10 pairs 100 pairs 500 pairs

£1.00 £8.00 £70.00 £300.00

Cans of 600 pairs £350 Ex stock

SOLDER (multicore type) Servicol 10 metres for £1, 50 metres for £4, 100 m £7

RADIATION DETECTORS Quartz Fibre Dosimeters Pen type with clip with lens and scale 0.50R Originally over 15 OUR PRICE 95p EACH, 10 for £8, 10 for £60, 1 000 for £500.

CLOCKING OSCILLATOR (Pye Dynamics) thick film 1MHz supply 5v 19x25x6mm 85p, 10 for £7, 100 for £60.

TV TUNERS by Mullard U H F 38 mcs size 3 1/4x2 1/4x1 1/2 £2.50 ea 10 for £20, 100 for £175, 500 for £750, 1 000 for £1,250.

TV SOUND TUNER KIT. Through your F M tuner. Kit of parts with instructions £5.50. Ready-built tested £7.00.

JOYSTICK CONTROLS. (Ideal for TV Games model control) sturdily constructed compact giving full 360 movement and control. Each unit fitted 4 off 100K linear controls. Pair £4.00.

T4/RF LONG-MEDIUM & F/M TUNER WITH MC1310 DECODER * 5 BUTTON SELECTOR SWITCHES * INPUT SELECTORS FOR GRAM AND TAPE * Supplied complete with FRONT-END TUNER AND FERRITE AERIAL * SIMPLE CONNECTIONS * Size 19x13x6cm

POWER UNIT KIT FOR ABOVE MODELS

25/28 VOLTS £2.95

MULLARD TUNER MODULES with data LP1171 combined AM FM IF strip — £3.50 * LP1179 FM front end with AM tuning gang used with LP1171 — £3.50 * LP1171 and 79 pair — £5.75, 10 pairs for £50, 100 pairs for £400.

SEVEN DIGIT MINIATURE COUNTER by Durant 12.24 volts D C 3 Watts Size 40x25HX 55L mm £1 each, 10 for £9, 100 for £80.

2N3055A TO3 POWER 80 VOLT VERSION. 10 for £2.50, 100 for £22.00, 1 000 for £200.

TRANSISTORS BY MULLARD, TEXAS, FAIRCHILD

Price ea per Quantity prices

10 100 500 1,000

AC128 0.230 0.200 0.180 0.150

AD149 0.750 0.650 0.550 0.490

AD161 0.380 0.330 0.290 0.250

AD162 0.380 0.330 0.290 0.250

BC107 0.100 0.085 0.075 0.065

BC109 0.110 0.095 0.080 0.070

BC109C 0.120 0.100 0.085 0.075

BC114 0.080 0.065 0.050 0.040

BC132 0.080 0.065 0.050 0.040

BC153 0.085 0.070 0.055 0.045

BC172 0.075 0.060 0.050 0.040

BC173 0.075 0.060 0.050 0.040

BC205 0.070 0.055 0.040 0.035

BC208C 0.075 0.060 0.050 0.040

BC209 0.075 0.060 0.050 0.040

BD181 0.600 0.500 0.440 0.400

BD182 0.700 0.600 0.500 0.440

BF181 0.240 0.200 0.185 0.160

BFY50 0.180 0.160 0.140 0.125

BFY51 0.180 0.160 0.140 0.125

BFY64 0.220 0.195 0.175 0.150

BFY90 0.750 0.680 0.630 0.550

BZ205 1.000 0.900 0.800 0.750

BY208 1.250 1.100 1.000 0.950

BY127 0.110 0.090 0.075 0.065

CA308S 0.440 0.385 0.350 0.300

LM311H 0.700 0.600 0.550 0.500

TBA258X5 0.680 0.600 0.550 0.500

LOW PRICES EX-STOCK

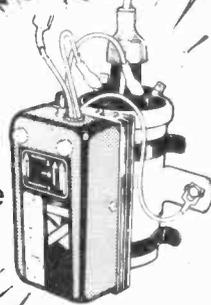
Buy it with Access **HENRY'S RADIO** All mail to: Henry's Radio 404 Edgware Rd London W2 Phone (01) 723 1008

The latest kit innovation!

from **Sparkrite**

*Sparkrite -
was featured by Shaw Taylor
in "DRIVE IN"*

the quickest fitting
CLIP ON
capacitive discharge
electronic ignition
in KIT FORM



- Smoother running
- Instant all-weather starting
- Continual peak performance
- Longer coil/battery/plug life
- Improved acceleration/top speeds
- Optimum fuel consumption

Sparkrite X4 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 1/3 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). The circuit incorporates a voltage regulated output for greatly improved cold starting. The circuit includes built in static timing light, systems function light, and security changeover switch. All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

Die pressed epoxy coated case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips, and accessories. Top quality 5 year guaranteed transformer and components, cables, connectors, P.C.B., nuts, bolts and silicon grease. Full instructions to assemble kit neg. or pos. earth and fully illustrated installation instructions.

NOTE - Vehicles with current impulse tachometers (Smiths code on dial RV1) will require a tachometer pulse slave unit. Price £3.85 inc. VAT, post & packing.

**Electronics Design Associates, Dept. ET1 3
82 Bath Street, Walsall WS1 3DE. Phone: (9) 614791**

Name
Address

Phone your order with Access or Barclaycard

including postage and packing UK only

QUANTITY REQD.

Send SAE if brochure only required

I enclose cheque/PO's for

£

Cheque No.

X4 KIT £16.65 inc. VAT

TACHO PULSE SLAVE UNIT
£3.85 inc. VAT

Access or Barclaycard No.

Here's why you should buy an I.C.E. instead of just any multimeter

- * Best Value for money.
- * Used by professional engineers, D.I.Y. enthusiasts, hobbyists, service engineers.
- * World-wide proven reliability.
- * Low servicing costs.
- * 20K/volt sensitivity and high accuracy.
- * Large mirror scale meter.
- * Fully protected against overload.
- * Large range of inexpensive accessories.
- * 12 month warranty, backed by a full after sales service at E.B.Sole U.K.Distributors.

Prices from £16.60 —
£32.00 + VAT



I.C.E

ELECTRONIC BROKERS LIMITED
49-53 Pancras Road, London NW1 2QB.
Tel: 01-837 7781. Telex: 298694.

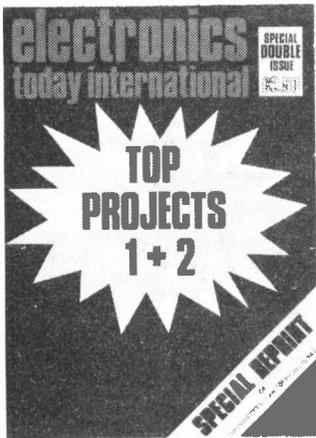
Please send me full colour leaflet and prices on whole ICE range including accessories.

Name

Address

ET1

SPECIALS



TOP PROJECTS

Book 1 + 2: £2.50 + 25p P&P.

Master mixer, 100W guitar amp, low power laser, printmeter, transistor tester, mixer preamp., logic probe, Ni-Cad charger, loudhailer, 'scope calibrator, electronic ignition, car theft alarm, turn indicator canveller, brake light warning, LM3800 circuits, temperature alarm, aerial matcher, UHF-TV preamp., metal locator, four input mixer, IC power supply, rumble filter, IC tester, ignition timing light, 50W stereo amp. and many more.

Book 3: SOLD OUT!

Book 4: £1.00 + 25p P&P.

Sweet sixteen stereo amp., waa-waa, audio level meter, expander/compressor, car theft alarm, headlamp reminder, dual-tracking power supply, audio millivoltmeter, temperature meter, intruder alarm, touch switch, push-button dimmer, exposure meter, photo timer, electronic dice, high-power beacon, electronic one-armed bandit . . .

Book 5: £1.00 + 25p P&P.

5W stereo amp., stage mixer, disco mixer, touch organ, audio limiter, infra-red intruder alarm, model train controller, reaction tester, headphone radio, STD timer, double dice, general purpose power supply, logic tester, power meter, digital voltmeter, universal timer, breakdown beacon, heart rate monitor, IB metal locator, temperature meter . . .

Book 6: £1.00 + 25p P&P.

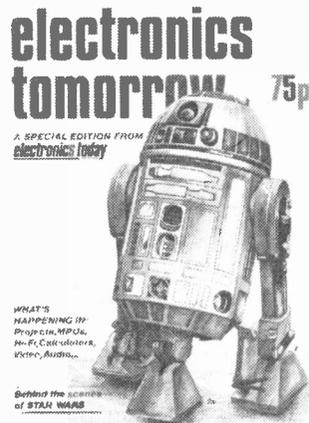
Graphic equaliser, 50/100W amp. modules, active crossover, flash trigger, "Star and Dot" game, burglar alarm, pink noise generator, sweep oscillator, marker generator, audio-visual metronome, LED dice, skeet game, lie detector, disco light show . . .

Graphic Equaliser....Marker Generator
Power Amplifier Modules....62 Sound
CCTV Camera.....Headphone Adaptor
LED Dice....Sound-Light Flash Trigger
Expander-Compressor.....Skeet Game
Rough A.....Calculator
ETI TOP PROJECTS
NO 6 electronics today £1
Burglar Alarm...Digital Thermometer
Stars & Dots Logic Game....Lightshow
Active Crossover....Hear and Tell Unit
Pink Noise Generator.....GSR Monitor
Sweep Oscillator....Stereo Simulator

ELECTRONICS TOMORROW

Comprised entirely of new material, the edition covers such diverse topics as Star Wars and Hi-Fi! The magazine contains projects for everyone — none of which have appeared in ETI — and a look at the future of MPUs, audio, calculators and video. How can you not read it?

75p + 25p P&P.



ETI CIRCUITS

Books 1 & 2.

Each volume contains over 150 circuits, mainly drawn from the best of our Tech-Tips. The circuits are indexed for rapid selection and an additional section is included which gives transistor specs, and plenty of other useful data. Sales of this publication have been phenomenal — hardly surprising when the circuits cost under 1p each!

£1.50 + 25p P&P each.

TRANSDUCERS IN MEASUREMENT AND CONTROL

This book is rather an unusual reprint from the pages of ETI. The series appeared a couple of years ago in the magazine, and was so highly thought of by the University of New England that they have republished the series splendidly for use as a standard textbook. Written by Peter Sydenham, M.E., Ph.D., M.Inst.M.C., F.I.L.C.A., this publication covers practically every type of transducer and deals with equipment and techniques not covered in any other book. Enquiries from educational authorities, universities and colleges for bulk supply of this publication are welcomed: these should be addressed to H. W. Moorshead, Editor.

£3.00 + 25p P&P.

TRANSDUCERS IN MEASUREMENT AND CONTROL

by PETER H SYDENHAM
M.E., Ph.D., M. Inst. M.C., F.I.L.C.A.

THE UNIVERSITY OF NEW ENGLAND

FROM THE PUBLISHERS OF
ELECTRONICS TODAY INTERNATIONAL

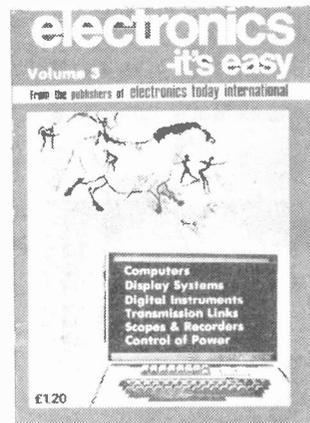
ETI CIRCUITS No 2

£1.50

ELECTRONICS — IT'S EASY Books 1, 2 & 3.

Our successful beginners series came to an end some time ago now, and the whole series is available from us in reprint form. The three books between them contain all the information presented in the series (sometimes in more detail!) and together form an excellent starting point for anyone interested in learning the art of electronics.

£1.20 + 25p P&P each.



ORDER FROM

Specials
Modmags Ltd
25-27 Oxford Street
London W1R 1RF

Postage and packing also refers to overseas. Send remittance in Sterling only.

Please mark the back of your cheque pr PO with your name and address.

from ETI

STAGE DIMMER

A comprehensive unit designed to handle up to 20A per channel with emphasis upon ease of construction and versatility in operation

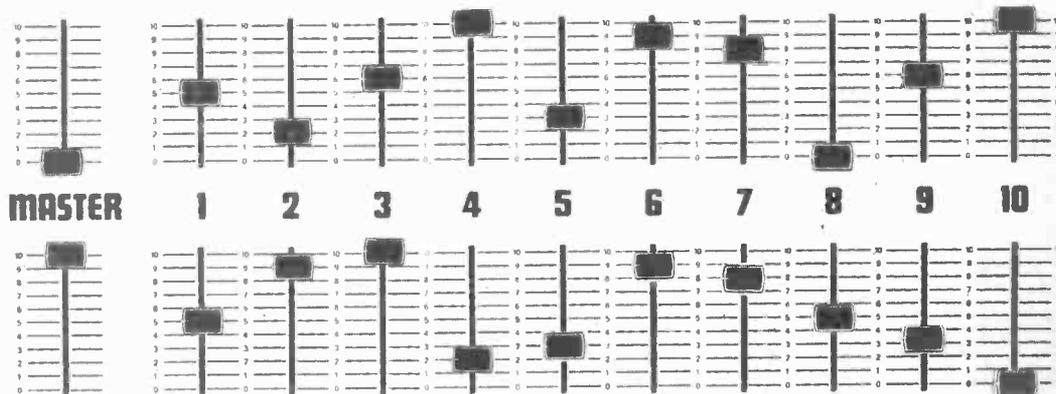
SINCE THE EARLY DAYS of the theatre the need for lighting has been all-important. Just as important has been the need for control of that lighting. This ranges from very crude initially to very sophisticated today, often with a computer doing the controlling in the creation of special moods and effects.

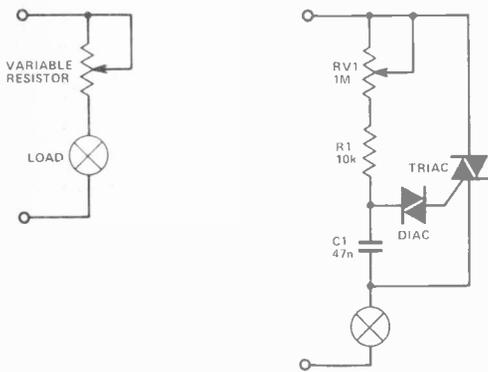
The first types of dimmer used, of which there are still some examples in older theatres, was a variable resistance type which used either a variable or switched power resistor in series with the load. With small loads a wire wound resistor or a carbon pile was used while larger loads used a tank of saline solution with a central

electrode which was raised or lowered in the liquid, effect vely changing the resistance. This type of dimming, while reasonably effective, dissipated a lot of power which made life uncomfortably hot for the operator, since to minimise mechanical linkages the dimmers themselves were often in the control room.



Theatrical Lighting Controller eti 588





Electronics

With the advent of electronics, life was a little bit easier. The use of phase controlled dimming using thyratrons and later SCRs and Triacs reduced the heat dissipation dramatically (if you'll excuse the pun) and also allows the control to be physically separate from the dimmer. Besides being easier for the operator performances were greatly enhanced by the much better control available.

Today the use of phase control is almost universal as it is simple, reliable and cheap. Another method in use today is by magnetics; this type has the advantage of generating no RFI but unfortunately is expensive.

The problem of RFI is common to all phase control circuits, but can usually be reduced to acceptable levels by the use of a choke and several capacitors. For RFI the choke need not be very large, but one other effect of phase control is the audible rattling of the lamp filament (especially with the larger globes) which is due to the sudden application of power, and the magnetic field so produced, each half cycle. This can be cured by reducing the rate of the rise of current by using a larger choke.

Type Casting

We have given some schematic diagrams of types of dimmers which have been used previously. Fig. 1 is the oldest type comprising simply a variable resistor in series with the load. The second (Fig. 2), probably the most common type in use today (mainly in homes) is very simple but lacks the versatility needed for theatrical work.

The third type (Fig. 3) is in common use and while still very simple does have many good features. These include having the

Fig 1. (Far left). The earliest type of dimmer employing just a variable resistor controlling the load.

Fig 2. (Left). Common! The most usual kind of light dimmer in use today.

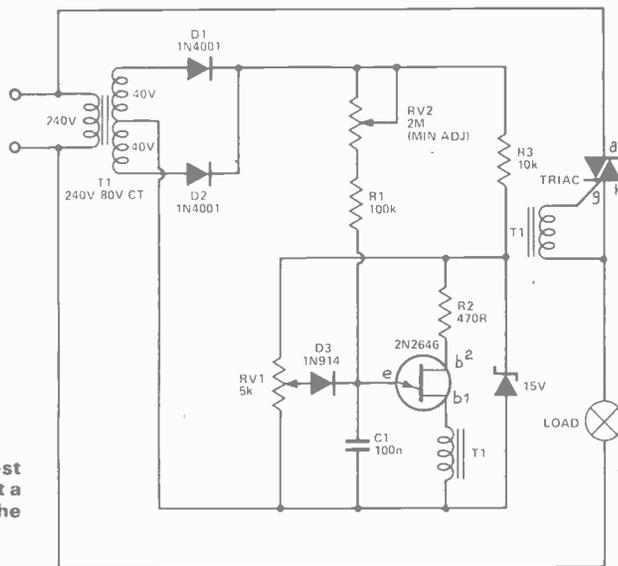
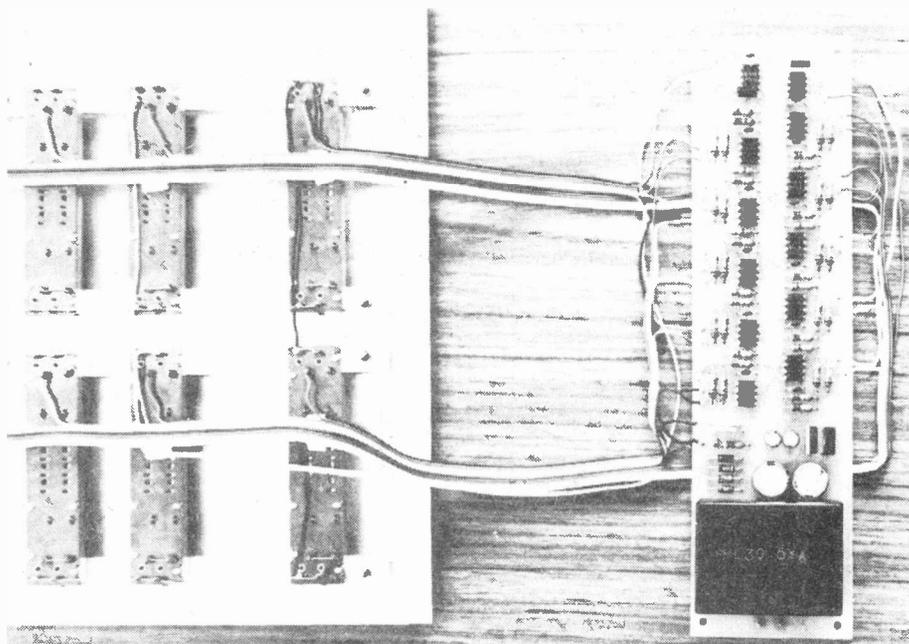
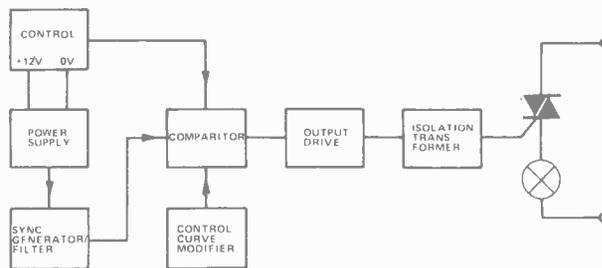


Fig 3. (Right). A more refined realisation of the art, which at least has the control isolated!



control potentiometer isolated from the mains voltage and also a modified control curve to give a better input-output voltage relationship. Synchronization is referred to the zero crossing of the mains voltage, making the unit more suitable for driving inductive

(fluorescent) loads; this also eliminates hysteresis which occurs with the simple dimmers.

The dimmer to be described here is more complex than most but a great deal of effort has been taken to ensure that *all* problems have been solved. A low pass filter, with phase

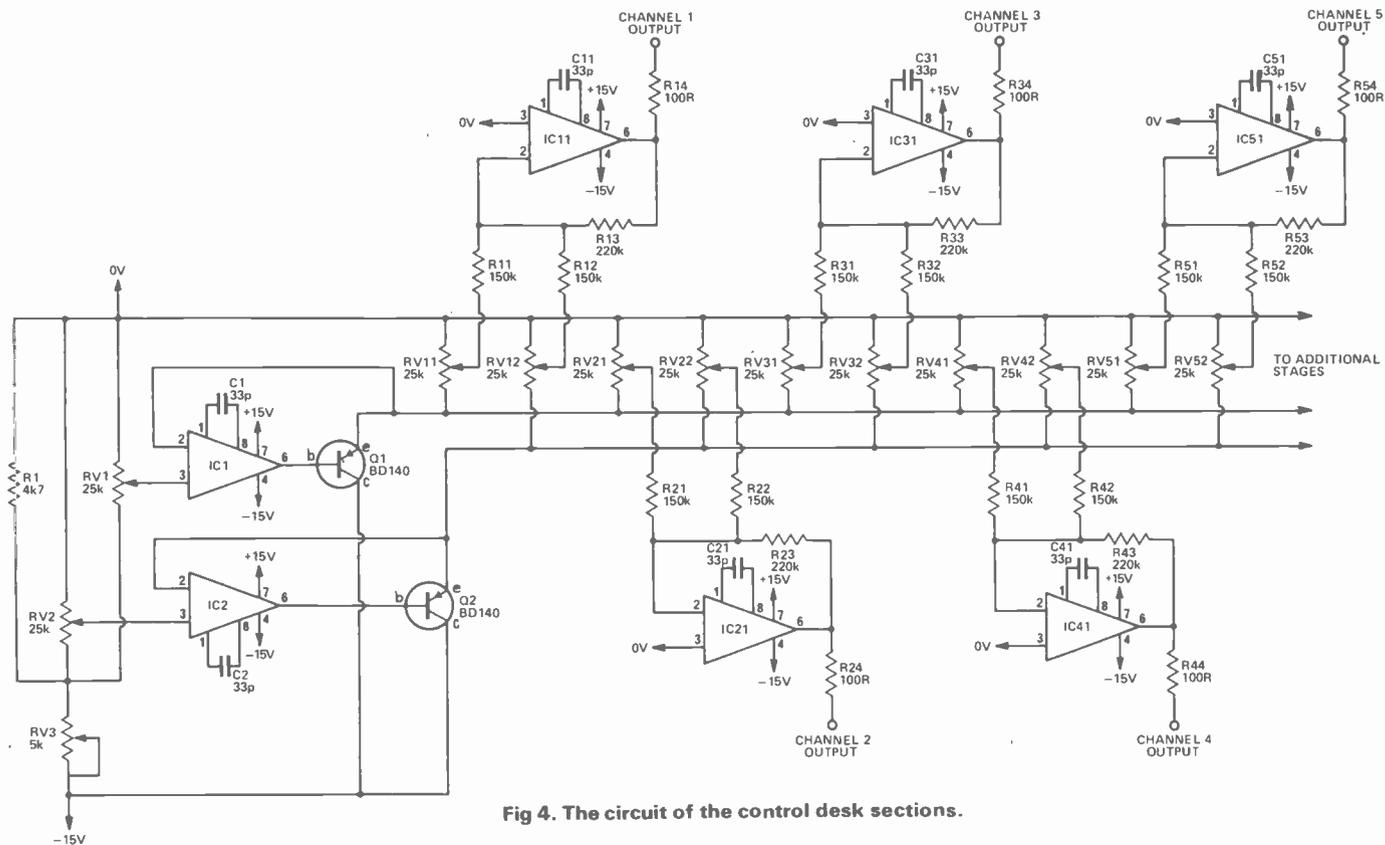


Fig 4. The circuit of the control desk sections.

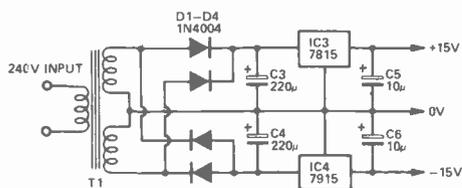


Fig 5. Power supply circuit

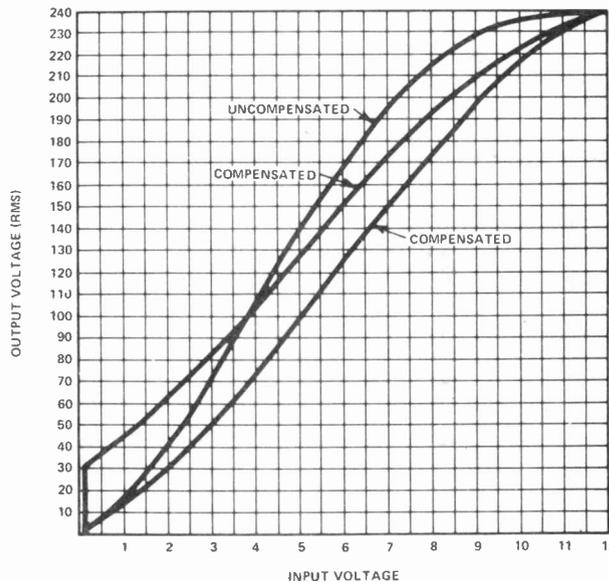
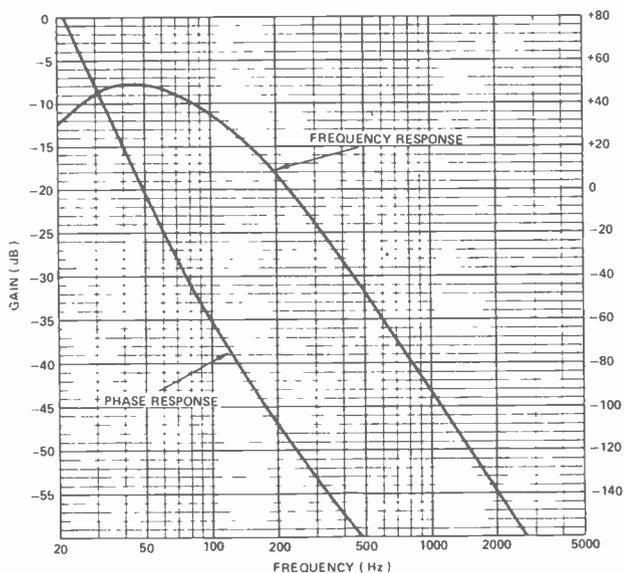
HOW IT WORKS ~ CONTROLLER

There are two controls for each dimmer along with two master controls. The master controls vary the voltage on the individual level control potentiometers from 0 V (no light) to -8 volts (full light). Normally one master will be at maximum and the second at zero. The outputs of the two controls for each dimmer are added by an operational amplifier, referred to 0 V. As one set of potentiometers has 0 V on both of its ends it

can be varied without changing the output allowing it to be set for the next scene. By varying the master controls together, but in opposite directions, the complete lighting set up can be smoothly varied from one scene to the next.

As we need +12V out to drive the dimmers the supply voltage of the control desk is ± 15 volts.

Fig 6. (Below). Showing the phase v frequency responses effect of compensation upon response



PARTS LIST

Resistors all 1/2W 5%

R1	4k7
R11,12,21,22,31	
32,41,42,51,52,	
61,62,71,72	150k
R1,82,91,92,101,102	
R13,23,33,43,53	220k
63,73,83,93,103	
R14,24,34,44,54,	100R
64,74,84,94,104	

POTENTIOMETERS

RV3	25k 1in. 60mm slide 5k trimmer
-----	-----------------------------------

CAPACITORS

C1,2	33p ceramic
C3,4	220u 50V
C5,6	10u 25V
C11,21,31,41	33p ceramic
C51,61,71,81	33p ceramic
C91,101	33p ceramic

SEMICONDUCTORS

IC1,2	301A
IC3	7815
IC4	7915
IC11,21,31,41	301A
51,61,71,81	
91,101	
Q1,2	BD140
D1-D4	1N4001

MISCELLANEOUS

Transformer	30V
Box and front panel	5W
Knobs to suit	

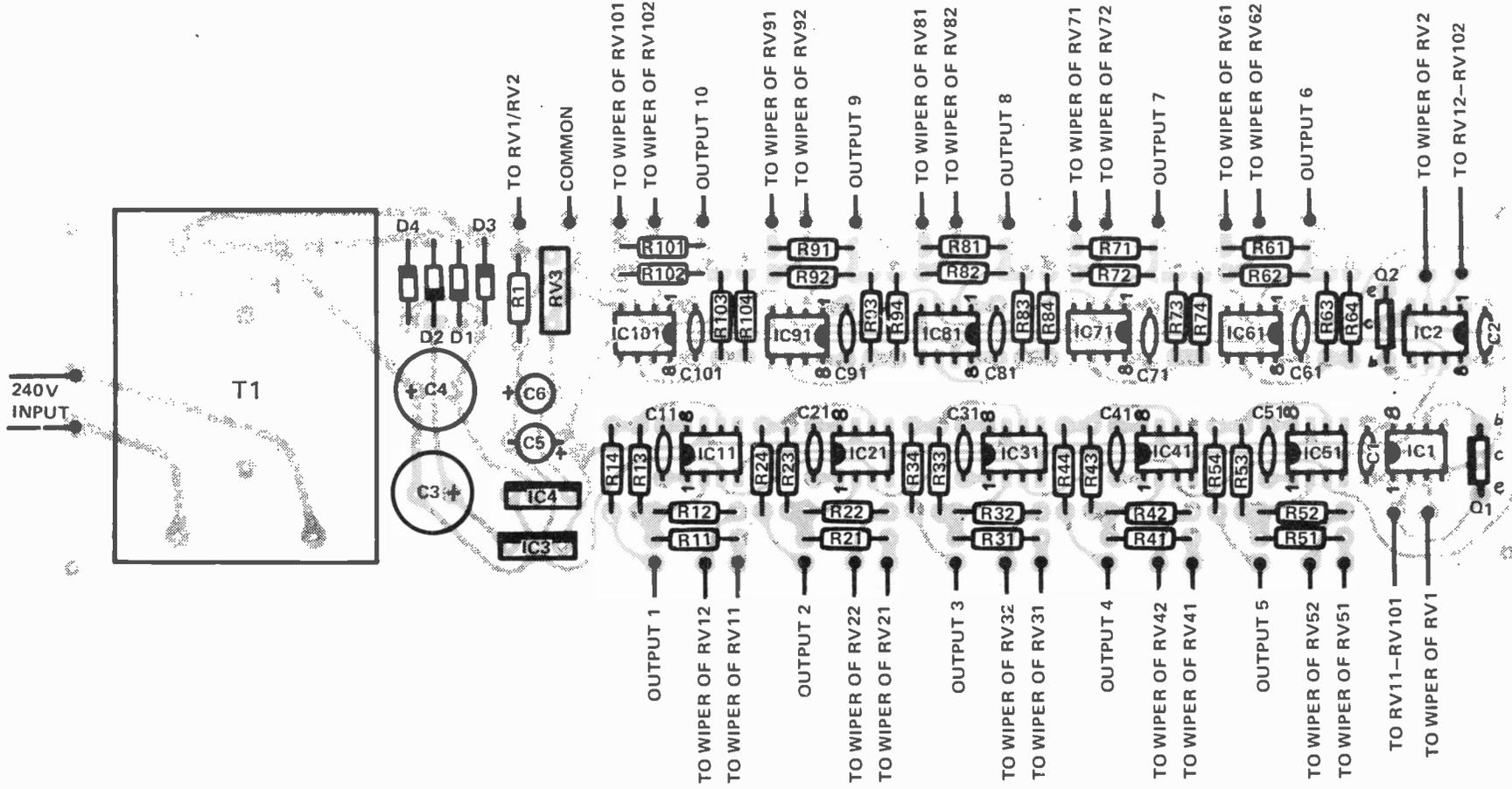


Fig 7. (Right): Component Overlay for the Controller Module.

BUYLINES

Apart from the pulse transformer T1 — for details of which see Table One — none of the components in this (admittedly huge) project should tax your local supplier overmuch. If you send us an SAE we will send you the foil patterns for the PCBs used here, as they were simply too big to print full size.

Any 400V ten or twenty amp triac will probably serve if you can't find the specified type easily.

correction, is used to ensure accurate synchronization. The control curve is also modified to give a subjectively more linear response and it has the ability to drive a fluorescent load without requiring a ballast resistor. Both the maximum and minimum light levels are adjustable without interaction giving reliable and predictable output. This is especially necessary if a dimmer fails for some reason and is replaced by a spare unit.

The Protection racket

The protection of SCRs and Triacs, especially Triacs, is usually difficult as they tend to fuse faster than the fuse purportedly protecting them. The use of a cheap Triac which requires an expensive fuse to protect it is false economy. We have used a large rugged Triac (40 A device for the 20 A dimmer) which allows economical fuses to be used, especially for the 10 A version.

On the control side we will be describing a panel with two sets of long sliders per dimmer with two master controls which allow the next scene to be set up then faded in when required. A digital memory which can 'prerecord' scenes and recall them on demand may be published later.

Dimmer Module — Construction

Assemble the boards with the aid of the overlay. The heatsink should be drilled and tapped for the triac to allow easy replacement if ever necessary. Note that the mounting of the fuse is different for the 10 and 20 A dimmers.

The choke is bolted onto the PCB using the long clamping bolts, preferably using rubber grommets in the holes in the board (they may have to be drilled out to do this). The leads from the choke should be bent such that they go into the holes provided without going near the mounting bolts which are at earth potential. The leads can now be soldered (both sides on the 20 A unit).

The pulse transformer can now be added according to Table 1. Be careful when winding this transformer not to damage the insulation on the wire as there is 240 V between windings. We also recommend some epoxy between the transformer and the board.

The printed circuit boards for the two versions of the dimmer board are identical in layout and differ only in that the connector end of the 20 A board is double sided to present a greater area of contact with the connectors.

Controller-Construction?

The component numbering system used on the controller drawings is designed to indicate which channel a particular component is part of. The printed circuit board drawing for the dimmer board is too large to publish in the magazine at full size; however, the pattern is available from our offices for the cost of an SAE — a large SAE!

If the dimmer modules are not required to be connected through sockets, the total cost can be reduced by connecting directly to the modules and mounting them in a box. In the 20 A unit the heavy wires should be bolted on to the appropriate pads to ensure contact to both sides of the board.

One more modification to the control desk is the addition of a black-out switch which allows all lights to be blacked out without moving the master control. This is simply done by switching the supply voltage on the master potentiometers from the 8 V supply as set by RV3 to 0V. RV3 should be adjusted such that with one master at maximum, the second at minimum and one

individual control at maximum that its output voltage should be +10 volts.

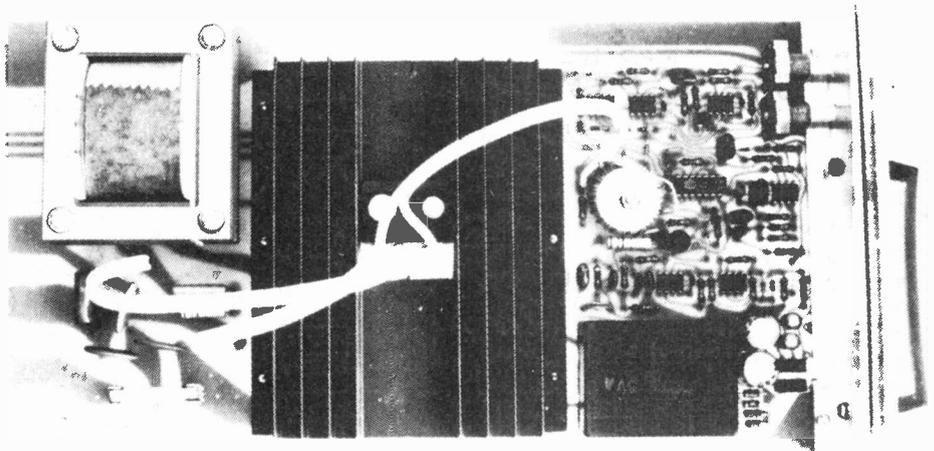
Setting up

With the dimmer module the trim potentiometer has to be adjusted so that the output pulse from IC7 occurs at the very end of each half cycle. This is easiest set using an oscilloscope although an approximate setting can be made without one.

If the dimmer is connected up to a reasonably heavy load and adjusted for about 1/3 level it will probably be found that with RV3 at one end the light level is not stable and tends to flash. This is caused by the sync pulse occurring after the end of the half cycle and the trigger pulses from the previous half cycle triggering the next. The trim potentiometer RV3 should be turned back about 1/4 turn from the position at which this effect stops.

Max and Min

When adjusting the maximum and minimum levels the minimum should be adjusted first. Note that the control potentiometer must be slightly up off zero to get any light and minimum should be adjusted at this point. The maximum should be adjusted with both the master and individual control at maximum and set to the point where the light level is just starting to drop. ▶



Shown above is a completed dimmer module

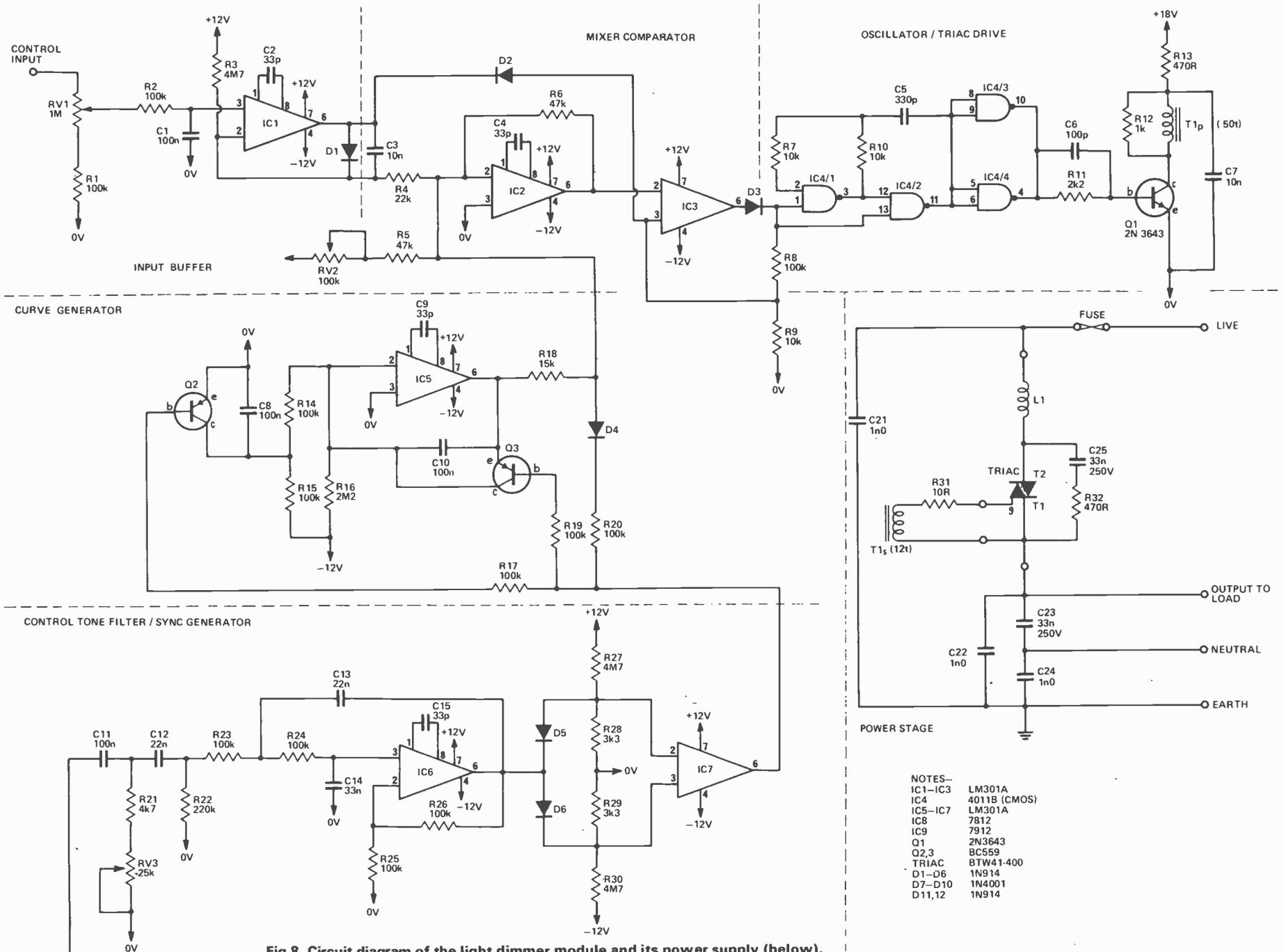


Fig 8. Circuit diagram of the light dimmer module and its power supply (below).

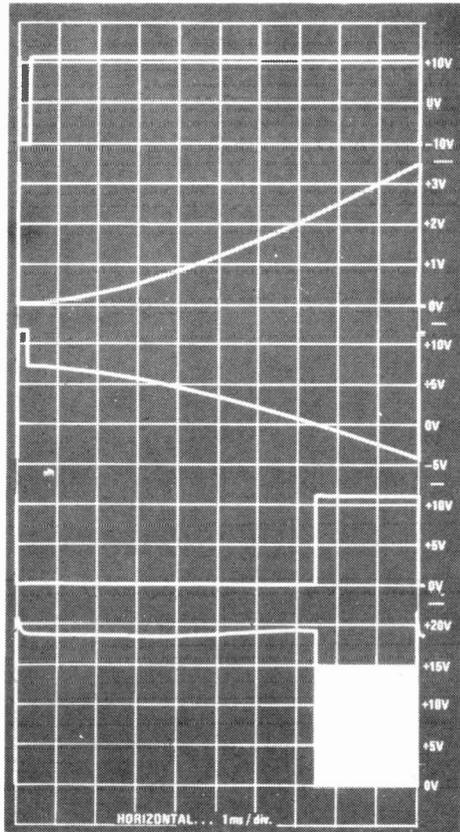
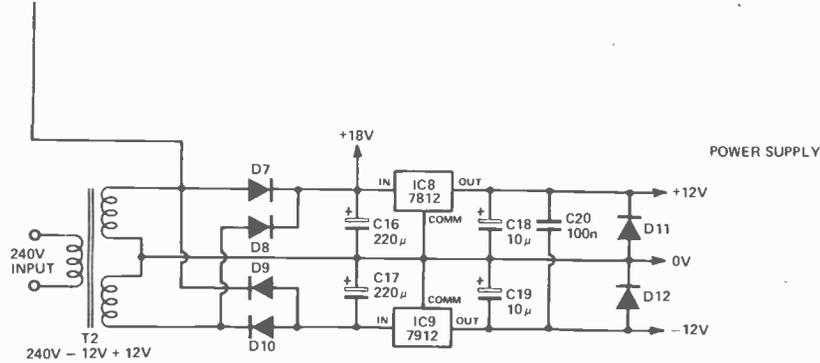


Fig 9. Waveforms shown are: Sync pulse (output IC7), curve generator (output IC5), mixer output (output IC2), oscillator output (IC4), transformer drive (Q1).

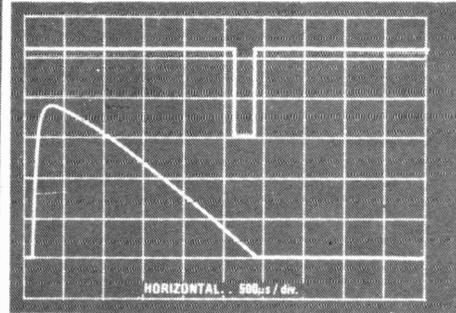


Fig 10. Relationship between the end of half cycle and the sync pulse.

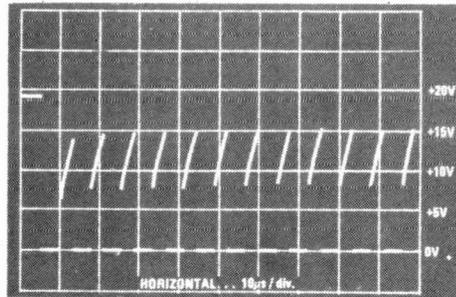


Fig 11. An expanded view of the drive waveform showing Q1 collector voltage.

HOW IT WORKS - DIMMER MODULE

To help explain the operation the circuit can be broken into seven sections.

1. Power supply

This is a simple full wave rectifier which gives about ± 18 V after being filtered by C16 and C17. Using 3 terminal regulators this is reduced to ± 12 volts which is needed for the circuitry.

2. Control tone filter and sync generator

As the name implies this removes the control tones that the supply authority superimposes on the mains voltage. These are normally about 1050 Hz and can cause problems by upsetting synchronization of dimmers. The filter is a low pass type comprising IC6 and associated components. As filters always alter the phase relationship this is corrected using phase shift networks. C11/R21 and C12/R22. Potentiometer RV3 is used to ensure the phase shift is zero (at 50 Hz) with normal component variations. If the output of IC6 is between +0.6 volts and -0.6 volts, neither D5 nor D6 will be forward biased sufficiently to change the input voltages to IC7 so its output will be -10 volts. As the output voltage of IC6 is a 'clean' 50 Hz sine wave of about 6 volts amplitude this will only occur at a small region about the zero crossing point. At all other times the output of IC7 will be +10 volts. The result is a negative pulse, about 250 μ s wide at the zero crossing point of the 50 Hz.

3. Curve generator

This produces the output shown in Fig. 6. When the sync pulse occurs, transistors Q2 and Q3 discharge capacitors C8 and C10. Immediately on release of the sync pulse the output of IC5 begins to ramp up slowly due to R16 charging C10. However, while initially the voltage across R14 is zero and therefore does not affect the charging of C10, as C8 begins to charge due to R15 its effect becomes more and more dramatic. A curve is necessary as it gives a better input/output voltage relationship but the curve must be reproduceable hence the circuit used.

4. Input buffer

This serves two purposes; firstly, it allows a

megohm input impedance and secondly it detects when the input voltage falls below 0.1 volt and turns the dimmer output completely off. This allows the minimum light control to be turned up to give a better control range, ie with the filaments just glowing, yet have them off if the control voltage is reduced to zero.

If the voltage is above 0.1 volt, the diode D1 will lift the voltage on pins of IC1 to equal that of the input on pin 3. However if the voltage falls below this level, the voltage on pin 2 will remain at about 0.1 volt due to R3 and the output of IC1 will go to about -10 volts.

5. Mixer-comparator

IC2 mixes the input voltage, the output of the curve generator the sync pulse and the minimum adjustment potentiometers. This gives the waveform shown in Fig. 2 with the input voltage and the minimum adjustment only moving the curve up and down without altering the shape. When the output of IC2 falls below zero volts the output of IC3 goes from -10 V to +10 volt with D3 and R8/9 providing about 1 volt of positive feedback. The voltage has to rise to above 1V to force the output back to -10 volts. The diode is necessary to ensure that the voltage at the input of the oscillator IC4 remains within the supply voltage of the IC (+12 V, 0 V).

6. Oscillator/triac drive

A CMOS oscillator IC4 is used to drive Q1 which supplies the energy for the pulse transformer T1. The oscillator will only operate when the control inputs (pins 1 and 13) are +10 V. The frequency is controlled by C5 and is set at about 150 kHz. Resistor R13 provides current limiting for the pulse transformer while R12 prevents the reverse voltage damaging Q1 if the load on the secondary load (the triac) becomes disconnected.

7. Power stage

This is simply a triac with a choke in series to prevent both RF1 and 'filament rattle' and a fuse to protect against short circuits. Capacitors are also used as bypasses to help prevent RF1.

PARTS LIST

RESISTORS all 1/4W 5%

R1,2,8,14,15, 17,19,20,23-26, ,	100k
R3,27,30	4M7
R4	22k
R5,6	47k
R7,9,10	10k
R11	2k2
R12	1k
R13	470R 1W
R16	2M2
R18	15k
R21	4k7
R22	220k
R28,29	3k3
R31	10R
R32	47R 1W

POTENTIOMETERS

RV1	1M linear
RV2	100k linear
RV3	25k trimmer

CAPACITORS

C1,8,10,11,20	100n polyester
C2,4,9,15	33p ceramic
C3,7	10n polyester
C5	330p ceramic
C6	100p ceramic
C12,13	22n polyester
C14	33n polyester
C16,17	220u 25V
C18,19	10u 25V
C21,22,24	1n polyester
C23,25	33n 250V AC

SEMICONDUCTORS

IC1-3,5,6,7	LM 301A
IC4	4011B
IC8	7812
IC9	7912
Q1	2N3643
Q2,3	BC 559
TRIAC	BTW41/400
D1-D6,11,12	1N 914
D7-D10	1N 4001

MISCELLANEOUS

T1 see text, T2 24V, 5VA, heatsink and choke and fuse 10A or 20A to suit, fuse holders.

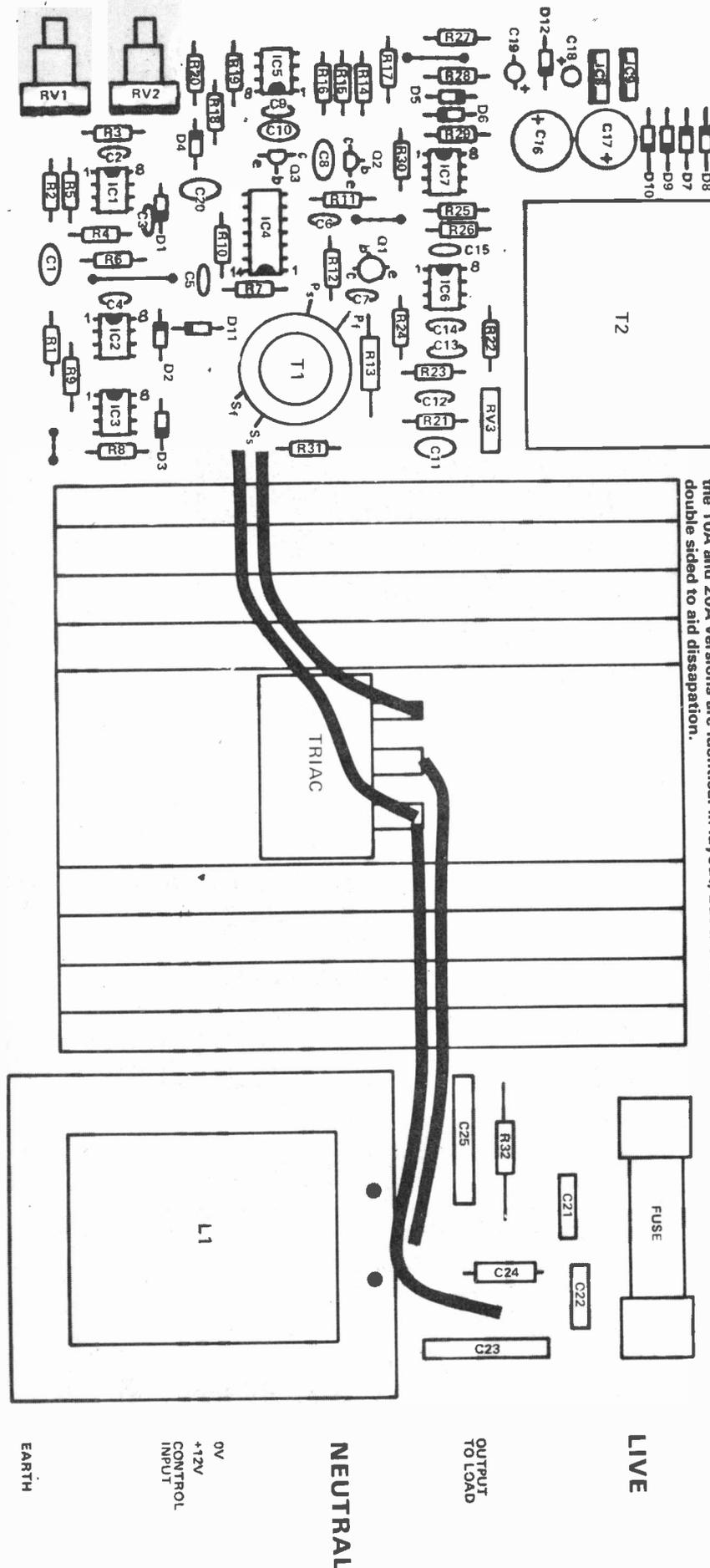


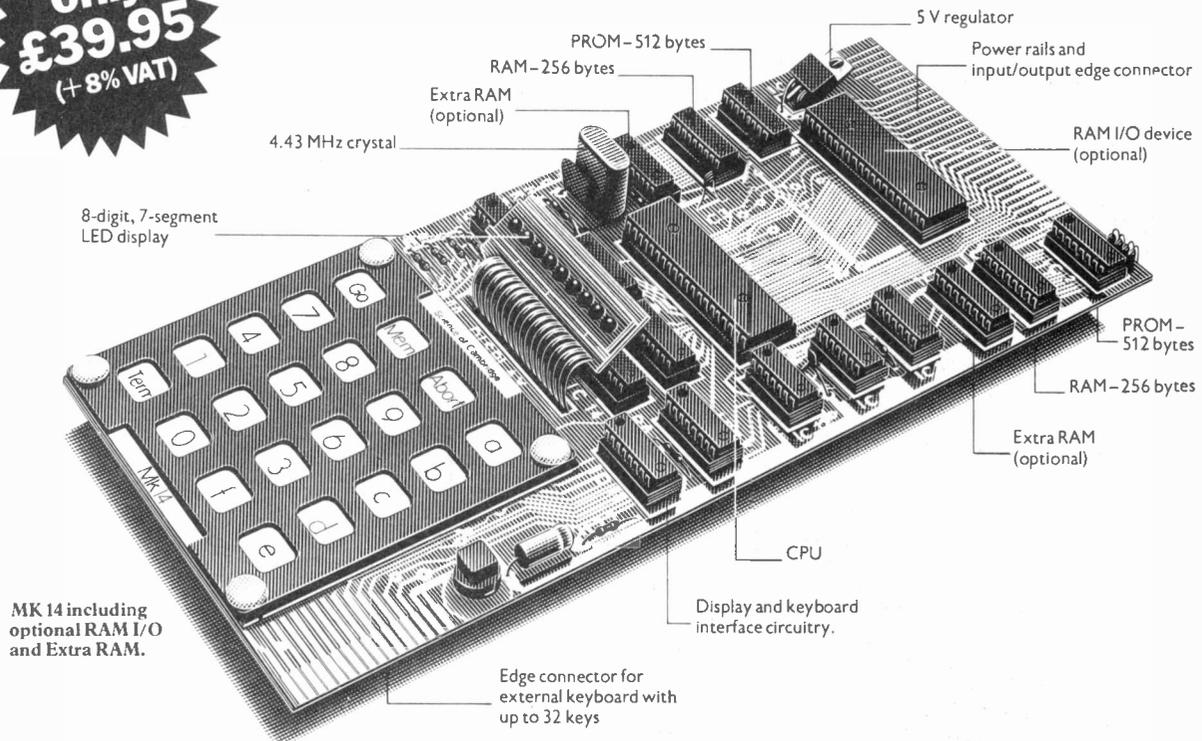
Fig 12. Component Overlay for the dimmer module board. Both the 10A and 20A versions are identical in layout, but the 20A is double sided to aid dissipation.

TABLE ONE

The pulse transformer T1 is the most difficult component in the project to find or produce. Tandy market a 4:1 device and this must be first choice. If this, and all other, commercial units prove elusive — try winding it yourself onto a ferrite ring of about 2in outside diameter, using 50 turns and 12 turns for the windings to obtain the required ratio. Some experimentation may be needed here in order to get the triac to fire properly, and we do not recommend you try this unless you have wound coils previously.

From Science of Cambridge: the new MK 14. Simplest, most advanced, most flexible microcomputer – in kit form.

**only
£39.95
(+ 8% VAT)**



MK 14 including optional RAM I/O and Extra RAM.

The MK 14 is a complete microcomputer with a keyboard, a display, 8 x 512-byte pre-programmed PROMs, and a 256-byte RAM programmable through the keyboard.

As such the MK 14 can handle dozens of user-written programs through the hexadecimal keyboard.

Yet in kit form, the MK 14 costs only £39.95 (+ £3.20 VAT, and p&p).

More memory – and peripherals!

Optional extras include:

1. Extra RAM – 256 bytes.
2. 16-line RAM I/O device – allowed for on the PCB – giving further 128 bytes of RAM.
3. Low-cost cassette interface module – which means you can use ordinary tape cassettes/recorder for storage of data and programs.
4. Revised monitor, to get the most from the cassette interface module. It consists of 2 replacement PROMs, pre-programmed with sub-routines for the interface, offset calculations and single step, and single-operation data entry.
5. PROM programmer and blank PROMs to set up your own pre-programmed dedicated applications.

All are available now to owners of MK 14.

A valuable tool – and a training aid

As a computer, it handles operations of all types – from complex games to digital alarm clock functioning, from basic maths to a pulse delay chain. Programs are in the Manual, together with instructions for creating your own genuinely valuable programs. And, of course, it's a superb education and training aid – providing an ideal introduction to computer technology.

SPECIFICATIONS

● Hexadecimal keyboard ● 8-digit, 7-segment LED display ● 8 x 512 PROM, containing monitor program and interface instructions ● 256 bytes of RAM ● 4 MHz crystal ● 5 V regulator ● Single 8 V power supply ● Space available for extra 256-byte RAM and 16 port I/O ● Edge connector access to all data lines and I/O ports

Free Manual

Every MK 14 kit includes a Manual which deals with procedures from soldering techniques to interfacing with complex external equipment. It includes 20 sample programs including math routines (square root, etc), digital alarm clock, single-step, music box, mastermind and moon landing games, self-replication, general purpose sequencing, etc.

Designed for fast, easy assembly

The MK 14 can be assembled by anyone with a fine-tip soldering iron and a few hours' spare time, using the illustrated step-by-step instructions provided.

How to get your MK 14

Getting your MK 14 kit is easy. Just fill in the coupon below, and post it to us today, with a cheque or PO made payable to Science of Cambridge. And, of course, it comes to you with a comprehensive guarantee. If for any reason, you're not completely satisfied with your MK 14, return it to us within 14 days for a full cash refund.

Science of Cambridge Ltd,
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Telephone: Cambridge (0223) 311488

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.

Please send me the following, plus details of other peripherals:

MK 14 Standard Microcomputer Kit " £43.55 (inc 40p p&p.)

Extra RAM " £3.88 (inc p&p.)

RAM I/O device " £8.42 (inc p&p.)

I enclose cheque/money order/PO for £ _____ (indicate total amount.)

Name _____

Address (please print) _____

Allow 21 days for delivery.

Science of Cambridge

CHROMASONIC electronics

your soundest connection in the world of components

DEPT. ET1, 56 FORTIS GREEN ROAD
MUSWELL HILL, LONDON N10 3HN
TELEPHONE: 01-883 3705

LOW POWER SCHOTTKY and TTL CMOS BITS and PIECES

Schottky				TTL				CMOS				Static RAM's				Dynamic RAM				CPU's				E-Prom's UV				TriState Buffers				DIL (Texas)				Interface				Wire Wrap				OPTO																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS	N	LS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
7400	13	19	7476	30	29	74170	1.85	1.85	4000	15	4077	21	2102A (350ns)	1+	17-83	64+	LM326N	2.60	7401	13	19	7478	30	29	74173	1.41	.88	4001	16	4081	21	2102A-2 (650ns)	1.05	.88	88+	LM345K	8.10	7402	15	19	7482	30	29	74174	1.01	1.05	4002	16	4082	21	2111A-1 (500ns)	1.29	1.15	1.08	L129/30/31	.85	7403	15	19	7483	30	29	74175	.81	1.05	4006	18	4086	21	2112A-2 (250ns)	2.49	2.19	1.78	I.C.'s		7404	16	21	7485	1.18	.88	74176	1.01	1.01	4007	18	4086	21	2112A-2 (350ns)	2.14	1.90	.86	CA3080	.75	7405	16	21	7486	2.25	.29	74177	1.01	1.01	4008	18	4086	21	MM5257 (TMS4044)	1.07	.96	6.75	CA3130E	.90	7406	26	—	7489	2.60	—	74178	1.01	1.01	4009	18	4086	21	2114 (450ns)	8.10	7.19	6.75	CA3140E	.37	7407	26	—	7490	3.4	.62	74179	1.01	1.01	4010	18	4086	21	6810	8.10	7.19	2.52	LM301AN	.30	7408	17	19	7491	73	1.05	74181	—	—	4011	18	4508	2.46	—	—	—	—	5.97	LM324N	.73	7409	17	19	7492	46	.75	74182	.81	—	4012	18	4510	1.07	4116	12.75	8.253	5.10	LM348N	.99	7410	15	19	7493	34	.65	74183	1.81	1.62	4013	18	4511	95	8080	8.255	8.255	5.51	LM380N	.97	7411	25	19	7495	54	.88	74188	2.97	—	4014	18	4514	2.70	8080	5.95	Regulators	—	LM3811N	1.33	7412	18	19	7496	67	1.85	74189	3.17	2.25	4015	18	4515	2.70	8080	8.99	78L series	—	LM3900N	.65	7413	27	40	74107	27	.35	74190	1.21	.75	4016	18	4516	1.07	9900	42.50	+ (POS) 100mA	—	LM3909N	.70	7414	17	19	74109	44	.35	74191	1.21	.75	4017	18	4517	4.10	1702AQ	5.75	5v, 6v, 8v, 12v & 15v	—	SN76001N	1.02	7415	—	19	74112	—	.35	74192	1.21	1.85	4018	18	4518	95	2708Q	7.87	2708Q	—	SN76003N	2.32	7416	—	19	74113	—	.35	74193	1.21	1.85	4019	18	4519	2.54	81LS95	—	+ (POS) 500mA	—	SN76013N	1.55	7417	34	—	74114	—	.35	74194	1.21	1.01	4020	18	4522	1.89	81LS96	—	— (NEG) 500mA	—	SN76023N	1.55	7420	16	19	74121	27	—	74195	1.01	1.05	4021	18	4526	1.89	81LS98	—	— (NEG) 500mA	—	T8AB10AS	.90	7421	—	19	74122	50	.75	74196	1.18	1.05	4022	18	4528	92	81LS99	—	— (NEG) 500mA	—	TCA90	1.75	7422	—	19	74123	60	.78	74197	1.18	1.05	4023	18	4534	7.12	81LS97	—	— (NEG) 500mA	—	ZN414	.90	7423	25	—	74124	—	1.25	74198	1.81	—	4024	18	4536	3.74	81LS98	—	— (NEG) 500mA	—	ZN424E	1.35	7425	25	19	74125	51	.39	74199	1.81	—	4025	18	4543	1.62	74365	—	— (NEG) 500mA	—	ZN425E	3.78	7426	25	19	74126	51	.39	74221	—	.99	4026	18	4553	4.53	74366	—	— (NEG) 500mA	—	ZN4459CT	3.54	7427	39	19	74132	78	.65	74240	—	.28	4027	18	4556	1.51	74367	—	— (NEG) 500mA	—	ZN1034E	2.03	7428	38	21	74133	—	.19	74241	—	.25	4028	18	4558	1.02	74368	—	— (NEG) 500mA	—	ZN1040E	8.43	7430	18	19	74136	—	.39	74242	—	2.25	4029	18	4585	1.07	74368	—	— (NEG) 500mA	—	ZNA116E	6.75	7432	25	19	74138	—	.55	74243	—	2.25	4030	18	4585	1.07	74368	—	— (NEG) 500mA	—			7433	—	28	74139	—	.55	74247	—	.95	4032	18	4585	1.07	74368	—	— (NEG) 500mA	—			7437	25	25	74141	76	—	74248	—	.95	4034	18	4585	1.07	81LS95	—	— (NEG) 500mA	—			7438	25	25	74145	75	1.05	74249	—	.95	4035	18	4585	1.07	81LS96	—	— (NEG) 500mA	—			7440	17	19	74147	1.59	—	74251	—	.99	4040	18	4585	1.07	81LS97	—	— (NEG) 500mA	—			7441	70	—	74149	1.38	—	74252	—	.99	4042	18	4585	1.07	81LS98	—	— (NEG) 500mA	—			7443	50	55	74150	1.08	—	74253	—	.99	4043	18	4585	1.07	81LS99	—	— (NEG) 500mA	—			7445	60	—	74151	.67	.88	74258	—	.99	4044	18	4585	1.07	81LS97	—	— (NEG) 500mA	—			7446	60	—	74153	.67	.48	74259	—	1.50	4049	43	22pin	24	8216	—	— (NEG) 500mA	—			7447	60	.87	74154	1.31	1.35	74266	—	.35	4050	43	24pin	26	8224	—	— (NEG) 500mA	—			7448	16	.87	74155	.67	.78	74273	—	2.25	4051	43	28pin	30	8228	—	— (NEG) 500mA	—			7449	—	.87	74156	.67	.78	74279	—	.48	4052	43	28pin	30	8224	—	— (NEG) 500mA	—			7450	16	19	74157	.67	.55	74283	—	.99	4053	43	40pin	44	8224	—	— (NEG) 500mA	—			7451	16	19	74158	—	.52	74290	—	.83	4054	1.29	8pin	23	8224	—	— (NEG) 500mA	—			7453	16	—	74160	1.21	.99	74293	—	.83	4055	1.46	8pin	23	8224	—	— (NEG) 500mA	—			7454	—	19	74161	1.21	.65	74295	—	1.05	4056	5.18	16pin	34	8224	—	— (NEG) 500mA	—			7455	—	19	74162	1.21	1.85	74298	—	1.25	4060	1.24	16pin	37	8224	—	— (NEG) 500mA	—			7460	16	—	74163	1.21	.85	74305	—	.51	4068	.48	18pin	43	8224	—	— (NEG) 500mA	—			7470	22	—	74164	1.08	1.15	74366	—	.51	4068	.21	20pin	55	8224	—	— (NEG) 500mA	—			7472	23	—	74165	1.08	.78	74367	—	.51	4069	.21	24pin	60	8224	—	— (NEG) 500mA	—			7473	28	29	74166	1.02	—	74368	—	.51	4070	.21	28pin	65	8224	—	— (NEG) 500mA	—			7474	28	29	74168	—	1.85	74386	—	.38	4071	.21	36pin	95	8224	—	— (NEG) 500mA	—			7475	44	43	74169	—	1.85	74670	—	1.85	4072	.21	40pin	105	8224	—	— (NEG) 500mA	—		

V.A.T. inclusive prices *8 others 12.5%. Export Customers deduct V.A.T. 2/27 from 1/9 from others.
Postage and Packing 25p. Trade and Export Inquiries most welcome. Hours 9.00 am - 5.00 p.m.
Now available our ORDER-RING line, just phone your order through with your Access or Barclaycard number and providing the order is received by 3.00 p.m. the components will be despatched the same day (min tel. order £5.00)

QUALITY STUFF AT KNOCK-DOWN PRICES

TRANSISTORS	8C213	10p	8FX30	32p	2N3054	44p	7451	12p	74177	50p	4070	12p	1N5401	14p	7912	80p	7918	80p	
AC126	17p	8C214	10p	8FX85	20p	2N3055	44p	7453	12p	74180	80p	4071	12p	1N5402	15p	7915	80p	7924	80p
AC127	16p	8C237	12p	8FX86	27p	2N3702	8p	7454	12p	74181	130p	4072	12p	1N5404	20p				
AC128	14p	8C238	14p	8FX87	20p	2N3703	8p	7460	14p	74182	50p	4073	16p						
Matched		8C301	30p	8FY50	15p	2N3704	8p	7470	24p	74190	70p	4081	16p						
128/176	35p	8C303	30p	8FY51	12p	2N3706	8p	7472	24p	74191	70p	4082	14p						
AC141	24p	8C328	13p	8FY53	17p	2N3707	8p	7473	25p	74192	60p	4086	58p						
AC142	18p	8C338	13p	8SX19	20p	2N3710	8p	7474	25p	74193	60p	4087	60p						
AC151	22p	8C547	11p	8SX20	18p	2N3711	8p	7475	25p	74194	50p	4088	14p						
AC152	22p	8C548	11p	8U205	130p	2N3772	172p	7476	25p	74195	50p	4089	14p						
AC153	25p	8C549	11p	8U208	150p	2N3773	275p	7480	40p	74196	50p	4090	14p						
AC176	16p	8C557	11p	OC25	76p	2N3866	54p	7485	60p	74197	50p	4091	14p						
AC187	23p	8CY30	60p	OC28	87p	2N3904	8p	7486	24p	74198	100p	4092	14p						
AC188	20p	8CY34	66p	OC35	76p	2N4061	12p	7490	25p	74199	100p	4093	14p						
AD149	65p	8CY59	24p	OC71	16p	2N4062	12p	7491	16p			4094	14p						
AD161	35p	8CY70	14p	OC72	26p			7492	35p			4095	14p						
AD162	35p	8CY71	14p	OC84	42p			7493	30p			4096	14p						
AF114	23p	8O115	30p	TIP29	37p			7494	50p			4097	14p						
AF118	30p	8O121	70p	TIP30	35p			7495	45p			4098	14p						
AF125	25p	8O123	60p	TIP31	45p			7496	45p			4099	14p						
AF126	25p	8O124	77p	TIP32	45p			7497	120p			4100	14p						

electronics today

international

What to look for in the April issue: On sale March 2nd

Amp Survey

Build-it-yourself hi-fi continues to flourish, and new designs appear almost daily. Power amplifiers are a favourite in the field, and their numbers, by now, are legion.

Unfortunately there is no way for the home constructor to 'listen in' to a module before he builds it, and thus he is left to fall back on the spec. sheets. Fine if you like it, rotten if you don't.

Next month we're surveying the field, giving full details of all the models we can find, and putting the market leaders against top quality commercial equipment to find out how they sound.

MAINS SEEKER

So you are about to drill the living room wall to hang up those shelves you promised the wife 7 years ago. Black & Decker in hand you advance to the plaster. Wait a minute there a mains socket right beneath.

Doubt sets in — to drill or not to drill — that is the question. Which way do the wires run? Will you black out the entire Universe if you try it? How can you find those wires?

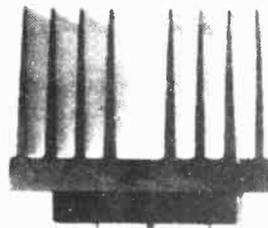
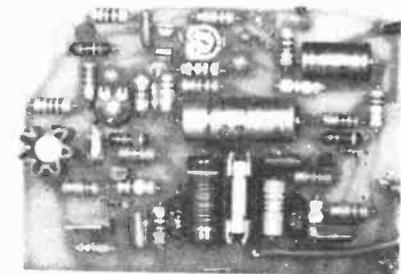
Simple really — just read ETI next month when we have a neat little project to show you exactly where the mains wires lie!

OCTAVE SHIFTER

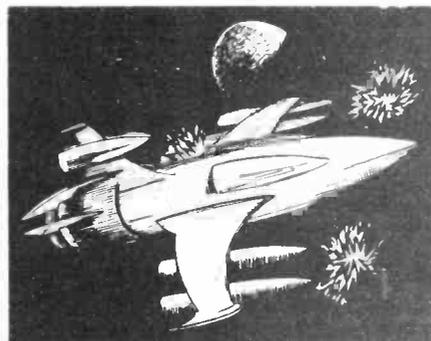
A superb little circuit to add that instant 'jump' to guitar playing. Operated by a footswitch the effect has a unique sound all its own — not to be missed — no strings attached to this one.

3080

Well ten of them anyway The 3080 is a much under-rated device, and next month's IETs circuit man Tim Orr hopes to put that right with ten ways to use device, all comprehensively explained to help you design the other 3070 circuits yourself.



AMBUSH



Your starship crashes through the void — running between the lines of enemy dreadnoughts to deliver medical supplies to the seiged plant of Tora. In order to preserve energy your ship has no weapons, only its shields and its speed.

Missiles can appear from any direction, and to destroy them you must actuate your shields at the precise moment of impact, thereby conserving power and allowing the engines to keep you moving at Warp Factor 20.

Can you make it through the Ambush and make Capt. Kirk look a cissy?

microfile.....

ALTHOUGH out of the first flush of youth I still consider myself to be young at heart so the young computing funfair seemed just the thing for me. Organised by the British Computer Society (BCS) the fair filled the Bloomsbury Centre Hotel early in January with the younger members of the ever growing group of people with an interest in computers.

Following on from the 'Living with Computers' conference, again organised by the BCS and held in the Institute of Education near the Bloomsbury Centre, the event provided a fitting climax to a very stimulating few days.

The funfair included exhibits ranging from mini-computers, computers being used for choreography in ballet, computer controlled games, DIY computer kits, a micro-computer controlled railway and many stands showing how the computer is in use in our everyday life. Among this last group of exhibits were the Abbey National Building Society (they got the computing habit, they have) and the police, showing that big brother was alive and well at the funfair.

The NASCOM stand was a great attraction for many people, demonstrating as it did the latest add ons to that popular DIY computer kit, the NASCOM 1. The buffer board, mother board and expansion RAM cards allowed the NASCOM's on display to run the 2K BASIC interpreter NASCOM are now producing. The BASIC includes all the facilities common to basics of this size, interger arithmetic, 26 variables (Designated A-Z), single dimension array plus assorted commands, operators and functions. In addition a machine code call greatly extends the power of the interpreter. NASCOM's super tiny BASIC makes use of this machine code call to provide amongst other commands, an edit function which allows the insertion/deletion of individual characters within a line, a renumber command and a facility for string inputs — something sadly lacking in the basic BASICS.

Undoubtedly though the exhibits that caused the greatest interest amongst the younger generation that made up the majority of the visitors to the fair were the rows of amusement machines. Everything from cowboys at the OK coral to star wars in space quadrant 0040. 7689. Microprocessors have revolutionised the arcade industry, both in bringing arcade type games into the home and in dramatically increasing the sophistication and supposedly, entertainment value of the machines in the public domain. Certainly the young audience were impressed.

Altergo ran a painting competition in conjunction with the funfair and Saturday saw the prize giving ceremony. The subject for the painting was "My Friendly Computer." The first prize was an Altergon robot, a beast that walks, talks, moves and flashes its eyes. Talking of beasts brings us onto beauty and Joanna Lumley — of the new Avengers — who presented the prize to the winner of the competition — 12 year old Fiona Mackay.

As well as the exhibition stands a concurrent series of lectures was presented in a hall adjacent to the main event. The lectures concentrated on introducing people to the various aspects of computing and the careers potential offered by the computing industry. These were well attended in spite of the attractions of the aforementioned amusement machines.

All in all a successful gathering that introduced the fascinating and diverse world of the computer to people who will form the systems engineers, computer operators, engineers etc. of tomorrow.



Any excuse to get a robot onto the pages of ETI is eagerly taken up. The fact that there are a couple of ladies in frame is incidental. The robot was first prize in the painting competition organised by Altergo. Fiona Mackay won the robot which was presented by Joanna Lumley.

Following on from my item last month concerning low cost keyboard designs Mr Charles Lacey has written to me with details of a project along these lines that is at the prototype stage. Designed as a touch keyboard with fifty keys including space bar, 2 shift keys, a delete key and two spare controls the system is more elegant than my attempt. Looking back at the circuit I proposed it does seem a bit clumsy.

With luck Mr Lacey should have a very nice project in a couple of months time. We'll keep in touch.

By the way if anybody else has had ideas along these lines please let me know.

Finally may I add my own tribute to John Miller-Kirkpatrick who died last December. I'd known John just on two years and it was the System 68 project that brought us together. John handled the design and construction of the system while I dealt with the production from the magazine's end. System 68 had many teething problems but it was the first such project tackled in this country, way ahead of its time, and John remained enthusiastic throughout the problems and put in vast amounts of time to get things sorted out.

The last time I saw John was at the Breadboard exhibition. He took a keen interest in all of the stands and no doubt had a few ideas of his own for things to tackle in the future.

ETI

WHAT'S MISSING?

An ETI T-Shirt of course!

Our little lady is perfectly intact thank you! We took her T-Shirt away just to show you how lost you'd be without one.

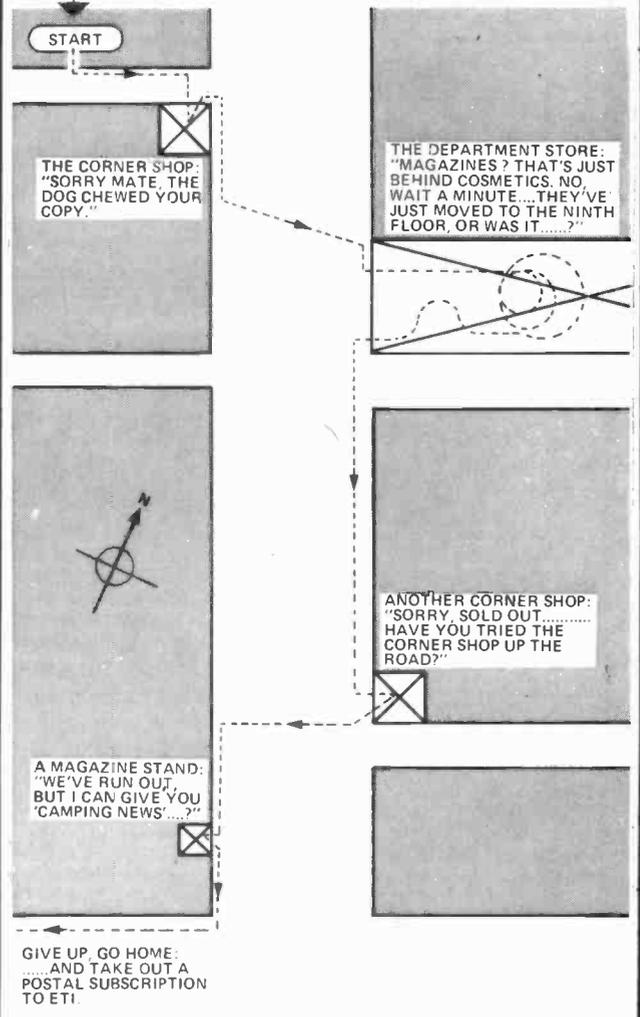
(At least that's what we told her anyway.)

After all they are printed back & front on high quality cotton — black logo on red background — and cost a mere £2.00 all inc.

Orders to:
ETISHIRTS
25 27 OXFORD ST
LONDON W1 1RF

Please specify size — S M or L
and allow 14 days for delivery.

NON-SUBSCRIBERS START HERE



It can be a nuisance can't it, going from newsagent to newsagent? "Sorry squire, don't have it — next one should be out soon."

Although ETI is monthly, it's very rare to find it available after the first week. If it is available, the newsagent's going to be sure to cut his order for the next issue — but we're glad to say it doesn't happen very often.

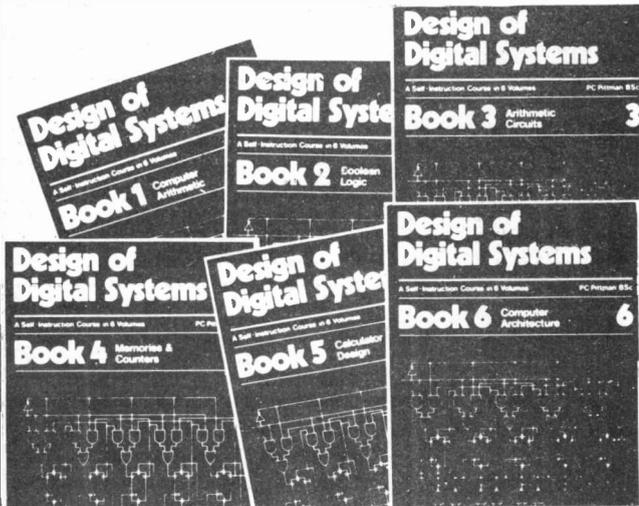
Do yourself, your newsagent and us a favour. Place a regular order for ETI; your newsagent will almost certainly be delighted. If not, you can take out a postal subscription so there's nothing for you to remember — we'll do it for you.

For a subscription, send us £7.00 (£8.00 overseas) and tell us which issue you want to start with. Please make your payment (in sterling please for overseas readers) to ETI Subscriptions and keep it separate from any other services you want at the same time.

**ETI Subscriptions
Map Publications
PO Box 35
Bridge Street
Hemel Hempstead
Herts**

Understanding Digital Electronics

New teach-yourself courses



Design of digital Systems is written for the engineer seeking to learn more about digital electronics. Its six volumes — each A4 size — are 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 finally to a complete understanding of the design and operation of calculators and computers.

The contents of Design of Digital Systems include:

- Book 1** Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems; binary multiplication and division.
- Book 2** OR and AND functions; logic gates NOT, exclusive OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws, canonical forms; logic conventions; Karnaugh mapping; three-state and wired logic.
- Book 3** Half adders and full adders; subtractors, serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.
- Book 4** Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive-OR feedback counters; random access memories (RAMs) and read only memories (ROMs).
- Book 5** Structure of calculators, keyboard encoding; decoding display data; register systems; control unit; program ROM, address decoding; instruction sets; instruction decoding, control program structure.
- Book 6** Central processing unit (CPU); memory organisation; character representation; program storage; address modes; input/output systems, program interrupts, interrupt priorities; programming; assemblers; computers, executive programs operating systems and time sharing.



Digital Computer Logic and Electronics is designed for the beginner. No mathematical knowledge other than simple arithmetic is assumed, though the student should have an aptitude for logical thought. It consists of four volumes — each A4 size — and serves as an introduction to the subject of digital electronics. Everyone can learn from it — designer, executive, scientist, student, engineer.

Contents include Binary, octal and decimal number systems; conversion between number systems; AND, OR, NOR and NAND gates and inverters; Boolean algebra and truth tables; De Morgans Laws, design of logic circuits using NOR gates, R-S and J-K flip flops; binary counters, shift registers and half adders

CAMBRIDGE LEARNING ENTERPRISES, UNIT 16, RIVERMILL SITE, FREEPOST, ST. IVES, HUNTINGDON, CAMBS. PE17 4BR, ENGLAND
TELEPHONE: ST. IVES (0480) 67446
 PROPRIETORS DRAYRIDGE LTD. REG. OFFICE RIVERMILL LODGE, ST. IVES
 REGD. IN ENGLAND No. 1328762.

In the years ahead the products of digital electronics technology will play an important part in your life. Calculators and digital watches are already commonplace. Tomorrow a digital display could show your vehicle speed and petrol consumption; you could be calling people by entering their name into a telephone which would automatically look up their number and dial it for you.

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

After completing these courses you will have broadened your career prospects and increased your fundamental understanding of the rapidly changing technological world around you.

The six volumes of Design of Digital Systems cost only: £8.10 } + 90p. post & packing
And the four volumes of Digital Computer Logic and Electronics cost only: £4.60 }
But if you buy both courses, the total cost is only: £12.00 - + £1 post & packing

Price includes surface mail anywhere in the world — Airmail extra.

Flow Charts & Algorithms

HELP YOU PRESENT

safety procedures, government legislation, office procedures, teaching materials and computer programs by means of YES and NO answers to questions.

THE ALGORITHM WRITER'S GUIDE explains how to define the questions, put them in the best order and draw the flow chart, with numerous examples shown. All that students require is an aptitude for logical thought. Size A5, 130 pages. This book is a MUST for those with things to say.

£2.95 + 45p post & packing by surface mail anywhere in the world. Airmail extra.

GUARANTEE

If you are not entirely satisfied your money will be refunded.

Cambridge Learning Enterprises, Unit 16, Rivermill Site
 Freepost, St. Ives, Huntingdon, Cambs. PE17 4BR
 England.

Please send me the following books

- sets Digital Computer Logic & Electronics @ £5.50, p & p included
- sets Design of Digital Systems @ £9.00, p. & p. included
- Combined sets @ £13.00, p & p included
- The Algorithm Writer's guide @ £3.40, p & p included

Name

Address

I enclose a cheque/PO payable to Cambridge Learning Enterprises for £.....

Please charge my Access/Barclaycard/Visa/Eurocard/Mastercharge/Interbank account number

Signature *deleted as appropriate
 Telephone orders from credit card holders accepted on 0480-67446 (ansafone). Overseas customers should send a bank draft in sterling drawn on a London Bank. ETI 16.

L.P. ENTERPRISES

Room ET
313 Kingston Road, Ilford
Essex IG1 1PJ, England

From the representatives in Europe . . . for America's leading Micro-computer magazines and books, for the hobbyist, educationist and professional alike, we bring you a little light browsing! Reading maketh a full man . . . Francis Bacon (1561-1626).

Introduction to Microcomputers	
Volume 0 The Beginners Book	£5.95
Volume 1 Basic Concepts	£6.30
Volume 2 Some Real Microprocessors (without binder)	£18.95
Volume 2 Some Real Microprocessors (with binder)	£24.70
Volume 3 Some Real Support Devices (without binder)	£11.95
Volume 3 Some Real Support Devices (with binder)	£17.70
6 Updating supplements for Vol 2 (for 1 year)	£18.95
6 Updating supplements for Vol 3 (for 1 year)	£18.95
6 Updating supplements for Vol 2 } (for 1 year)	
6 Updating supplements for Vol 3 }	£30.00
Binder (specify for Vol 2 or Vol 3)	£5.75
1 Updating supplement for Vol 2	£4.00
1 Updating supplement for Vol 3	£4.00

6800 Programming for Logic Design	£6.30
8080 Programming for Logic Design	£6.30
Z80 Programming for Logic Design	£6.30

Basic Computer Games	£5.50
What To Do After You Hit Return	T.B.A.
8080 Galaxy Game	£7.85
The Colossal Computer Cartoon Book	£3.95
Computer Rage (A Board Game)	£6.95
Artist and Computer	£3.95
Games with a Pocket Calculator	£1.75
Games, Tricks and Puzzles for a Hand Calculator	£2.49

Z80 Instruction Handbook	£3.50
8080 Programmers Pocket Guide	£1.95
8080 Hex Code Card	£1.95
8080 Octal Code Card	£1.95

Dr Dobbs Journal Vol 1	£10.00
Best of Byte	£8.95
Scelbi Byte Primer	£9.95
Best of Creative Computing Vol 1	£6.95
Best of Creative Computing Vol 2	£6.95
Best of Micro	£5.50

8080A / 8085 Assembly Language Programming	£6.45
6800 Assembler Language Programming	£6.45
8080 Software Gourmet Guide and Cookbook	£7.95
6800 Software Gourmet Guide and Cookbook	£7.95

MAGAZINE SUBSCRIPTIONS	U K price	Overseas price
Subscriptions start within 3 weeks		
Personal Computing (12 per year)	£16.00	£17.00
Interface Age (12 per year)	£20.00	£20.50
Dr Dobbs Journal (10 per year)	£13.00	£13.50
Computer Music Journal (4 per year)	£8.50	£9.00
People's Computers (6 per year)	£8.00	£8.50
RYTE (12 per year)	£21.00	£21.00
Creative Computing (12 per year)	£16.00	£16.50
Calculators and Computers (7 per year)	£10.00	£10.50
Kilobaud (12 per year)	£20.00	£21.00
73 (12 per year)	£20.00	£21.00
MICRO-6502 Journal (12 per year)	£11.50	£12.50

First Book of Kim	£6.50
Microprocessors from Chips to Systems	£7.95
Microprocessor Interfacing Techniques	£7.95
Z80 Microcomputer Handbook	£7.50
T V Typewriter Cookbook	£7.50
T T L Cookbook	£7.50
CMOS Cookbook	£7.95
IC OP Amp Cookbook	£9.50
RTL Cookbook	£4.25

Some Common BASIC Programs	£6.30
Computer Programs that Work (in BASIC)	£2.55

Introduction to Personal and Business Computing	£4.95
Getting Involved with Your Own Computer	£4.75
Your Home Computer	£7.95
How to Profit from your Personal Computer	£5.50
Reference Book of Personal & Home Computing	£4.95
Hobby Computers are Here	£3.95
New Hobby Computers	£3.95
Understanding Microcomputers and small Computer Systems	£7.95

Instant BASIC	£7.50
My Computer Like Me	£2.75
When I speak in BASIC	£6.50
Basic BASIC	£6.00
Advanced BASIC	£4.00
Introduction to PASCAL	

Accounts Payable and Account Receivable	£10.95
Payroll with Cost Accounting	£10.95
General Ledger	£10.95

BASIC Software Library:	
Vol 1: Business and Games Programs	£17.50
Vol 2: Maths, Engineering, Statistical Programs	£17.50
Vol 3: Advanced Business Programs	£26.95
Vol 4: General Purpose Programs	£7.95
Vol 5: Experimenters Programs	£7.95
Vol 6: Miniature Business System	£32.50
Vol 7: Chess / Medbil / Wdpros Programs	£26.95

8080 Standard Monitor	£9.95
8080 Standard Editor	£9.95
8080 Standard Assembler	£9.95
Special package: 8080 Assembler, Editor, Monitor	£20.00
Tiny Assembler for 6800 Systems	£5.75

MAGAZINE BACK ISSUES	
Personal Computing	£1.75
Interface Age	£2.25
Dr. Dobbs Journal	£1.75
ROM	£1.75
Computer Music Journal	£2.50
People's Computers	£1.75
BYTE	£2.25
Creative Computing	£1.75
Calculators and Computers	£1.75
Kilobaud	£2.25
73	£2.25
Micro-6502 Journal	£1.50
Magazine Storage Box (Holds 12)	£1.25

HOW TO ORDER

Please note our prices include postage and packing, but not insurance, if wanted add 12p for every £10 of books ordered. Make cheques, PO's etc. payable to:-

L.P. Enterprises.
 CREDIT CARDS accepted
 BARCLAYCARD VISA/ACCESS
 DINERS CLUB/AMERICAN EXPRESS

Phone: 01-553 1001 for Credit Card orders (24-hour service)

Send to address above
 Indicate Payment Method:

All Orders must be Prepaid
 Total Enclosed £

. My cheque, P.O., I.M.O. is enclosed in **Sterling** on **U.K. Bank**

. Charge to Barclaycard/Visa/Access/Diners/American Express

Credit Card No Expiry Date

Name

Address

. POSTCODE

Signature

All publications are published in U.S.A. and shipped air-freight by **L. P. Enterprises**. In unusual cases, processing may exceed 30 days.
 * At time of going to press, price of binders unknown. Telephone enquiries welcome.

TRADE ENQUIRIES WELCOME

OHIO SCIENTIFIC

Microcomputers from the world's largest
full-line manufacturer



The C2-4P Mini Floppy

20K RAM
Basic + Assembler
Personal, Games, Small
Business & Educational Disks
90K Mini Floppy Storage
Printer Interface
OS 65D V.30 Operating System
Only £1595.00 Complete + VAT.

Economic expandable
systems with good disk
based software, available
now.

See your nearest
dealer for full price
list and catalogue.



**Abacus
Computers
Limited**

62 New Cavendish Street
London W1 Tel: 01-580 8841

Mutek
Quarry Hill, Box Corsham
Wiltshire SN14 9HT
Tel: 0225-743289

Other systems available include the
C3 OEM with 32K RAM, 512K of disk storage and
BASIC as standard, £2950.00 + VAT. (FORTRAN and
COBOL available as extras.) All dealer enquiries
direct to Abacus Computers Limited.

**Thames Personal
Computers**
13 Wilmot Way Camberley
Surrey Tel: 0276-27860
Linn Products
235 Drakemire Drive
Castlemilk Glasgow

G45 95Z Scotland
Tel: 041-634 3860
U Microcomputers
PO Box 24 Northwich
Cheshire CW8 1RS
Tel: 0606-75627

AUDIO POWER METER

An accurate way to determine what's watt in your hi-fi system, with our true reading power meter

POWER IS PROBABLY the least understood and most misrepresented quantity in the electric measurement system. This is especially so in the area of audio amplifier and speaker specifications when terms like peak, peak to peak, music and RMS are related to power.

Power is simply the rate at which energy is being used. It is expressed in watts and the value may vary from femtowatts (10^{-12} W), as in the input power of a FET, to thousands of megawatts in the power generation field. The term thousand megawatts is generally used in preference to the more correct term, gigawatts.

Power can be calculated simply by multiplying voltage and current:

$$P = EI$$

In a DC circuit where both voltage

and current remain constant no problem arises. However in an AC or a DC circuit where the voltage is not constant with time, this formula only holds for instantaneous power as the power varies with time. Power as we usually use the term is the time average of this. If the load is resistive, i.e. contains no inductance or capacitance, and we can measure the RMS value of the voltage, we can still use this simple formula. However measuring the RMS voltage is not easy as most voltmeters measure the peak or average rectified voltage with a suitable scaling factor built in to give a correct result when measuring a sine wave signal.

Reactive Reaction

If the load is reactive the current and voltage will no longer be in phase,

i.e. the peaks do not occur at the same point in time. The difference can be expressed either by the phase angle in degrees or by the cosine of this angle (known as the power factor). The current waveform can either be ahead of the voltage (leading) or behind it (lagging). Capacitive circuits give rise to a leading power factor while inductive circuits lag.

If working with a sine wave, and if the power factor is known, the formula for power can be expressed as:

$$P = EI \cos \phi$$

where ϕ is the phase angle. In a DC circuit $\cos \phi$ is unity so the formula holds for this case as well. An example is a 40 W fluorescent light which takes 430 mA from the 240 V mains. At first sight, this implies a ▶



power consumption of over 100 W, until it is realised that its power factor is about 0.45 lagging. The formula above, using $\cos \phi = 0.45$, thus gives a power consumption of only 46.4 W. (The additional 6 odd watts is dissipated in the ballast.) The product of voltage and current is known as the VA rating and is used when calculating the currents in a circuit. If a capacitor is connected across a sine wave AC circuit the current taken can be calculated by dividing the voltage by the reactance of the capacitor. While this circuit draws current, it has a power factor of very near zero (90° phase lead) and therefore takes no power! By adding the correct amount of capacitance to an inductive circuit (i.e. the fluorescent light) the power factor can be altered, reducing the current drawn (but not the power).

Confused yet?

Ample Reason

Getting back to audio amplifiers and their ratings, the problem lies in the complex nature of the music waveform and how to specify the amplifier's rating. As the waveform is far from a constant sine wave with the peak power being anything up to 20 times the average, numerous methods such as peak power, peak to peak power, music power, etc. evolved. However, for a long time there was no set standard, and one amplifier advertised with a 50 W (music) rating was in fact a 5 W stereo amplifier. The situation got so out of hand that the US Government brought down legislation on how amplifiers were to be tested. This is with a continuous sine wave signal with level set so that the distortion is at a specified level and power calculated from the RMS output voltage: hence the term RMS power. Note however that the term RMS refers to the method of measurement, i.e. the use of RMS voltage, and it is not the RMS value of the power waveform. It is, in fact, the average of the power waveform.

Speakers are just as confusing. They are normally specified not in terms of the power they can dissipate, but the maximum power of amplifier they are suitable for. This is due to the fact that music is never (well, rarely) a continuous sine wave and the average power in the speaker may be only 10% of the RMS rating of the amplifier, even with the amplifier clipping.

To measure the power actually being delivered to the speaker under music conditions, a wattmeter must be used.

Design Features

To multiply current and voltage together we had the choice of analogue or digital techniques. Unfortunately while digital is the 'in' thing, offering versatility and accuracy, it is not fast enough to calculate the instantaneous power on high frequencies. We therefore chose the analogue method.

Looking around the ICs, the only ones with reasonable price and availability were the MC1494, 1495 and 1496. The 1496 (or 796) is the cheapest and most readily available, but has the disadvantage of not being able to multiply DC signals or AC signals with a DC offset. The 1494 and 1495 are about the same price, and of the two, the 1494 was more linear and easier to use.

We chose not to use any input buffer on the voltage input but had to pay the penalty of having a lower input impedance than normal with voltmeters.

Using the Power Meter

To use the meter we must measure both voltage and current. There must be a common point for these measurements. The current

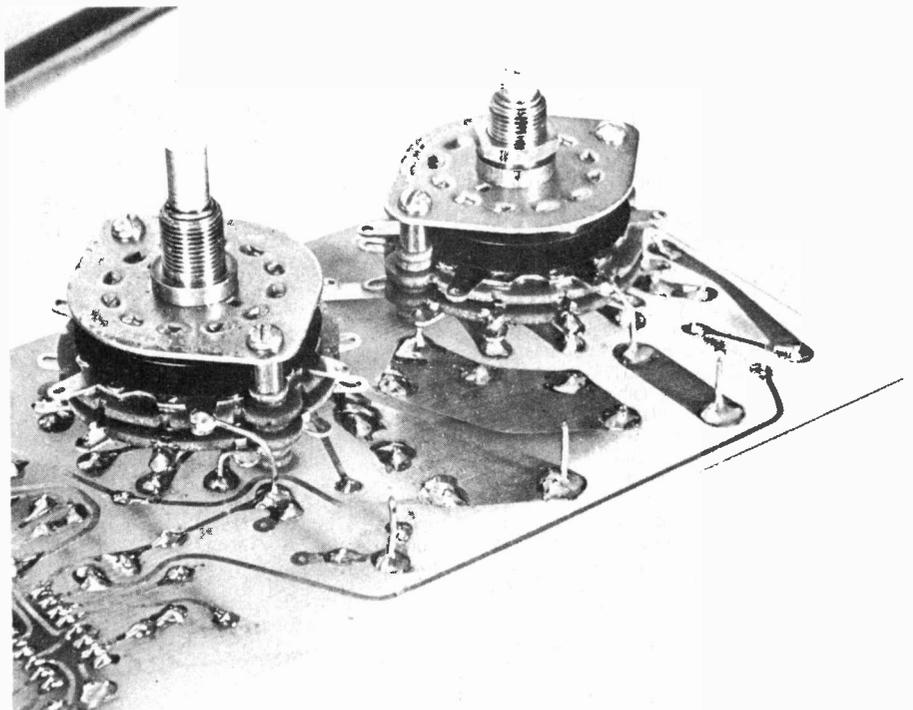
connection can be in either of two ways as shown in the drawings below. One measures the power out of the supply and the second the power into the load. The difference? The current shunt in the wattmeter drops one volt when working at the full range value and this may or may not affect the reading. At 10 A this accounts for 10 W which, if the power being measured is only 100 W, is a 10% error — although if the measured power is 2400 W the error is only 0.4%.

The range of the meter is the product of the individual ranges, i.e. on 30V and 1 A the fsd is 30 W, while 30 V and 3 A gives 100 W FSD. To help give a reading reasonably high on the scale, the voltage range can be overvoltage by a factor of 2. Due to power dissipation problems this should not be attempted on the current ranges. The peak voltage or current can be as high as three times the range value.

Construction

We mounted all the components associated with the meter and the switches on a single pc board and if the same or similar case is to be used this is recommended.

Except for the meter and the switches the components are mounted on the 'normal' side of the pc board. These should be mounted ▶



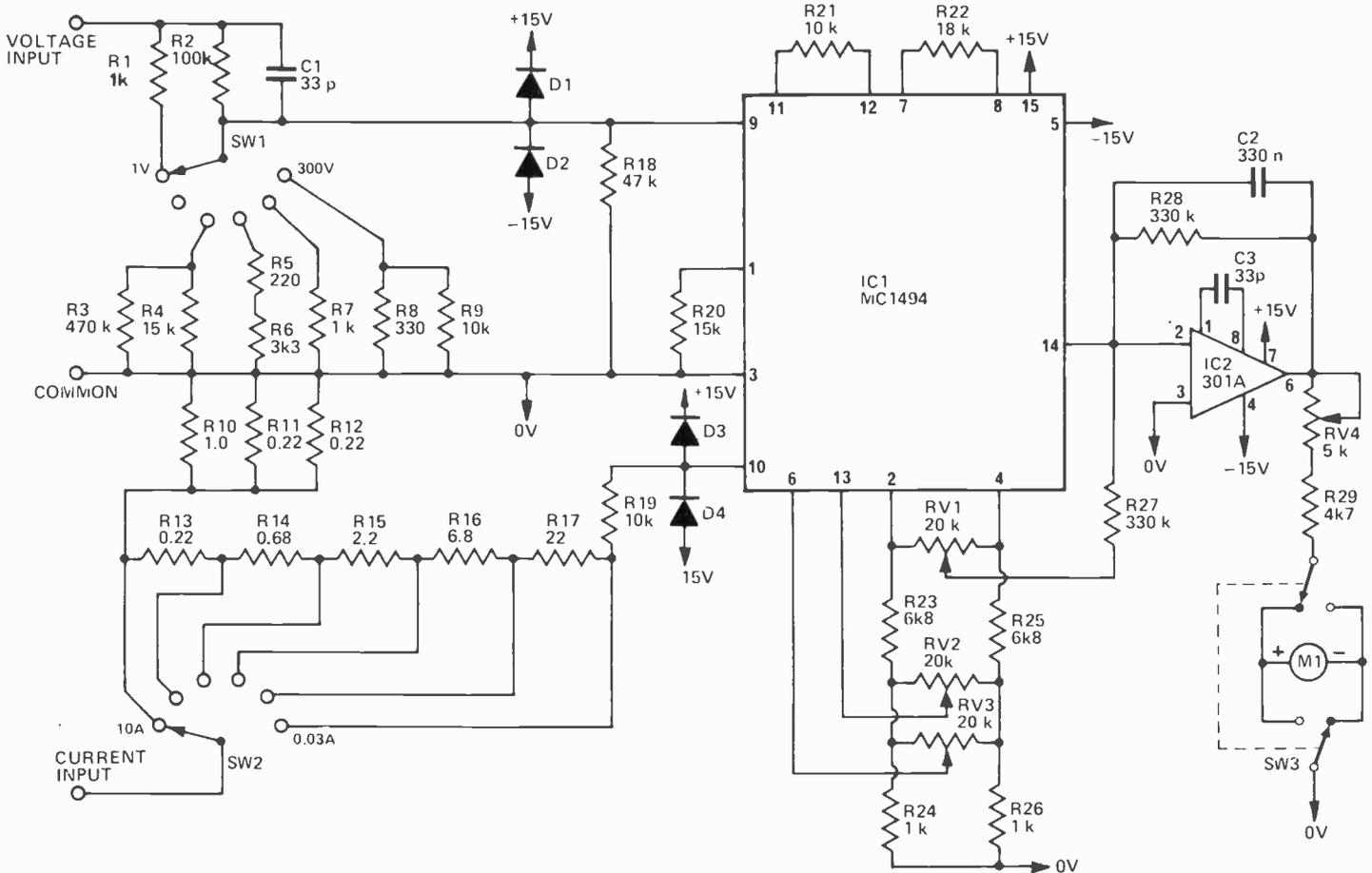


Fig. 1. The circuit diagram of the audio power meter.

HOW IT WORKS

Power is the product of current and voltage. This holds irrespective of the nature of the load, provided you are talking about instantaneous power. By multiplying current and voltage together and then taking the average of these instantaneous values we find the true power. Again this works irrespective of the load.

In this circuit the multiplying is done by IC1 (MC1494), the output of which is a current proportional to the product of the inputs. For more detailed notes on this IC, see the separate section. The current output of this IC is converted to a voltage by IC2 with C2 providing the averaging. The meter is then simply wired across the output of this IC with a meter reversing switch provided. This reversing switch is needed not to measure negative power, but to correct for reversed readings due to differing external connections.

The power supply is a full wave bridge with a centre tap giving about $\pm 20V$ DC which is then regulated to the $\pm 15V$ required by IC1.

Adjustments for zeroing the voltage and current inputs are provided by RV2 and RV3 while RV1 compensates for offsets in the output. These are supplied by a stable $\pm 4V$ reference in IC1. Range switching is done by SW1 and SW2. Protection against overvoltageing the IC is provided by D1 - D4.

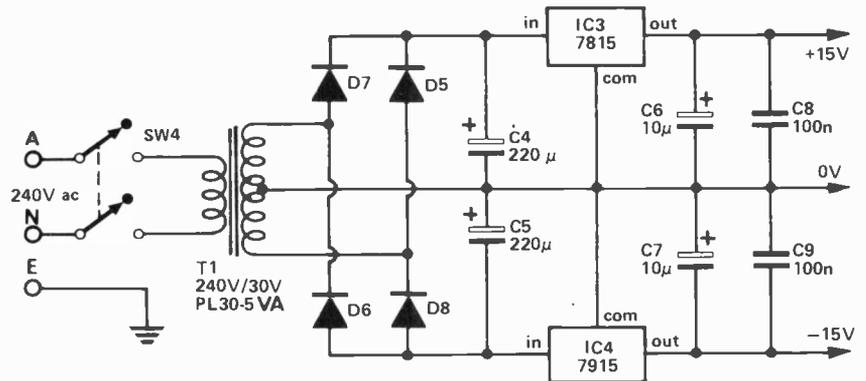
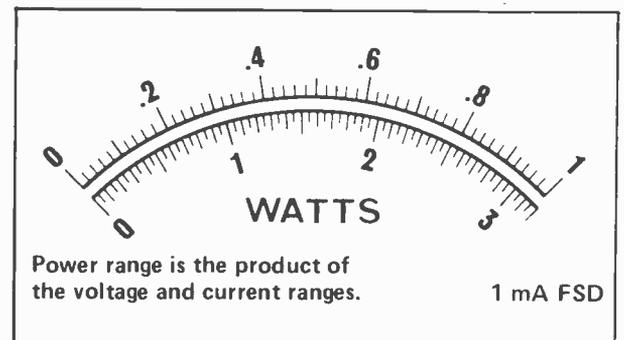


Fig. 2. Power Supply Circuit.

Right: meter scale designed for a 1mA FSD meter. These scales may need to be altered for differing meter units.



PARTS LIST

Resistors all 5% 1/2W unless stated

R1, 7, 24, 26	1k
R2	100k
R3	470k
R4, 20	15k
R5	220R
R6	3k3
R8	330R
R9, 19, 21	10k
R10	1R 1W
R11-13	OR22 5W
R14	OR68 5W
R15	2R2 1W
R16	6R8 1W
R17	22R
R18	47k
R22	18k
R23, 25	6k8
R27, 28	330k
R29	4k7

POTENTIOMETERS

RV1-3	20k trimmer
RV4	5k trimmer

CAPACITORS

C1	33p 500V ceramic
C2	330n polyester
C3	33p ceramic
C4, 5	220u 35V electrolytic
C6, 7	10u 25V electrolytic
C8, 9	100n polyester

SEMICONDUCTORS

IC1	MC1494
IC2	301A
IC3	7815
IC4	7915

D1-D4	1N914
D5-D8	1N4004

MISCELLANEOUS

PCB
 SW1, 2 two pole 6 position 10A rotary
 Radiospares
 SW3, 4 two pole toggle switches
 Transformer 15-0-15, 5VA
 Meter 1mA FSD
 Three binding posts
 Instrument case 255 x 100 x 205mm
 Power cord and clamp
 Two knobs
 Front panel

BUYLINES

Most of the parts for this project are readily available. Two things which may cause trouble are the switch assemblies and the quadrant multiplier itself.

The switch is an RS unit and as such can be obtained from any of their stockists. As for the IC, Tamtronik — who advertise on page 32 of this issue — can supply this and by the time you read this they will be able to sell you all the rest as well!

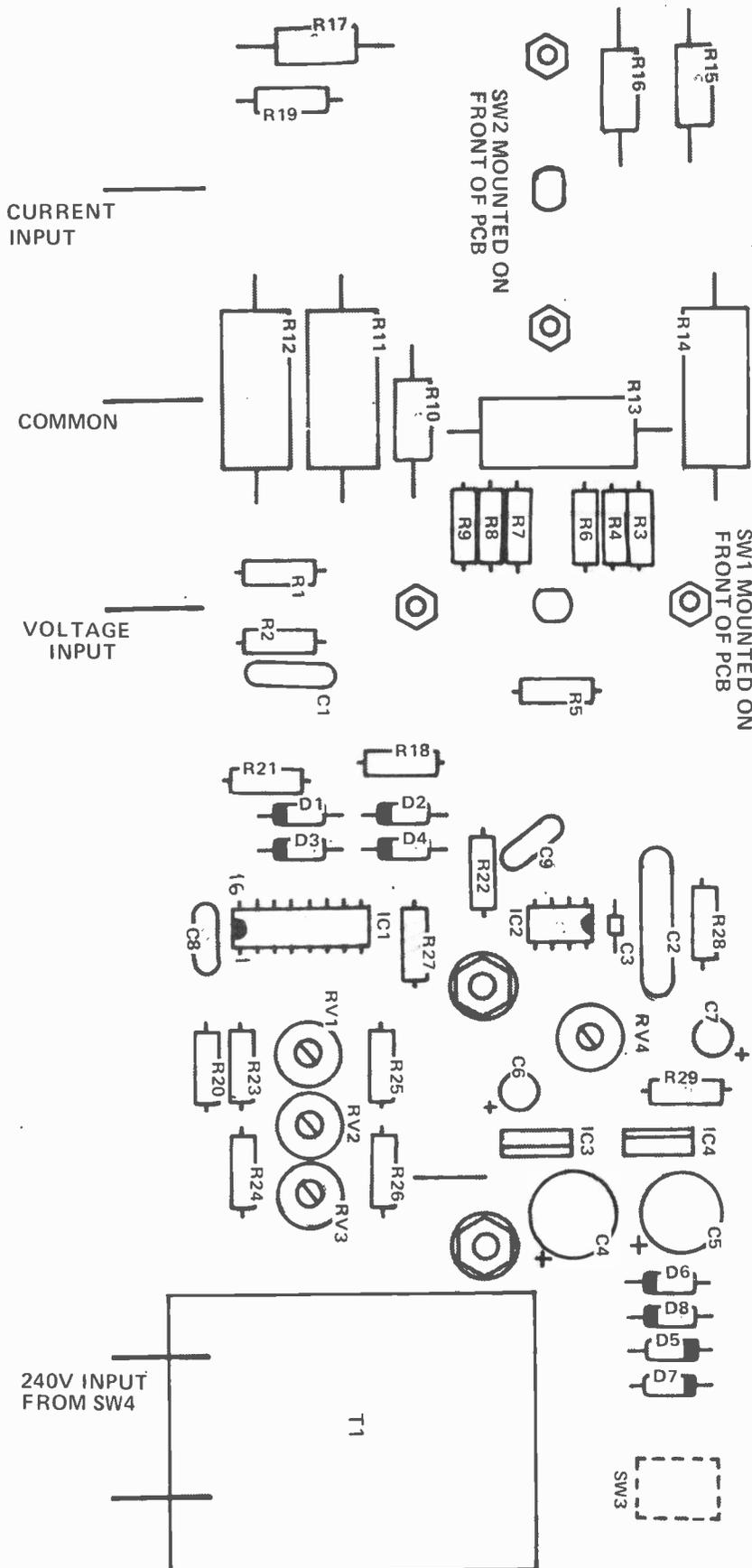


Fig. 3. Overlay for the Power Meter.

first with the only critical part of the assembly in the area of the range switches. Here the high powered resistors should be spaced at least 5mm from the PCB as they run hot at maximum current. Also the leads of all the resistors in this area should be cut off close to the pc board after soldering. This is to give adequate clearance to the rotary switches. We used two self tapping screws into the plastic of the transformer case to help fix it onto the board. We have made ▶

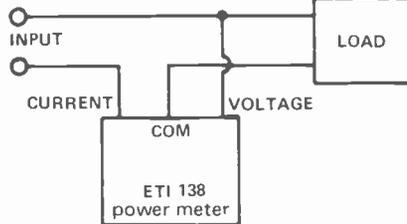


Fig. 4. This connection measures the power into the load.

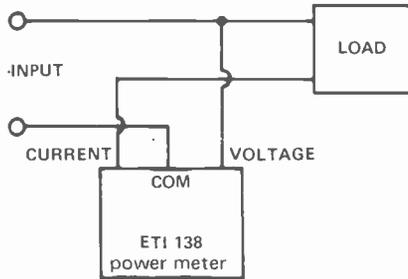


Fig. 5. This connection measures the power out of the supply.

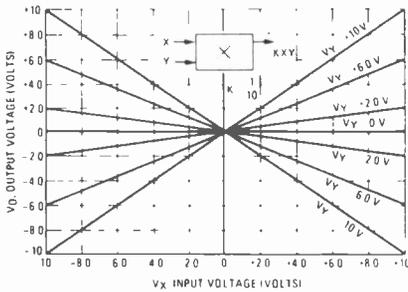


Fig. 6. Transfer characteristics of the IC.

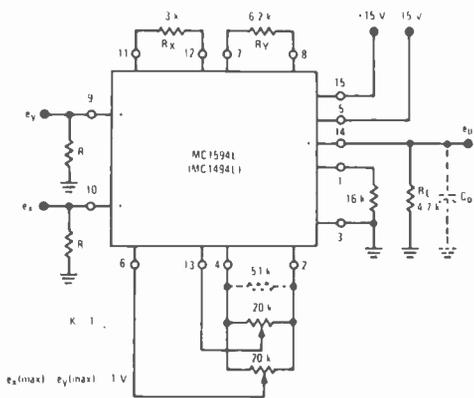


Fig. 7. Typical connections for a wide band multiplier or balanced modulator.

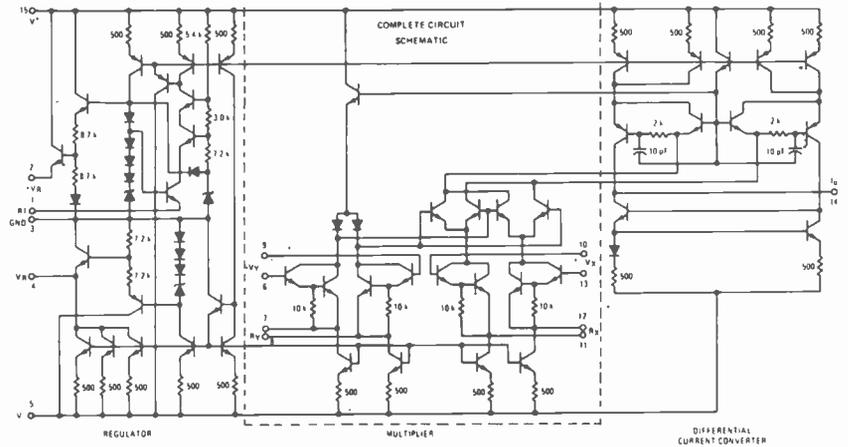


Fig. 8. The internal circuit diagram of the IC.

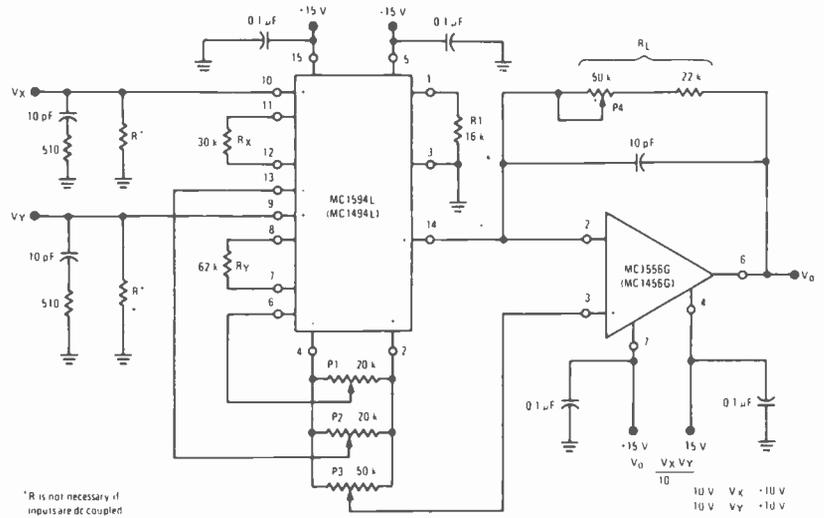


Fig. 9. Typical connection of a low frequency multiplier. For a squaring circuit simply parallel the two inputs. In this case pin 6 can be connected to 0V and P1 deleted.

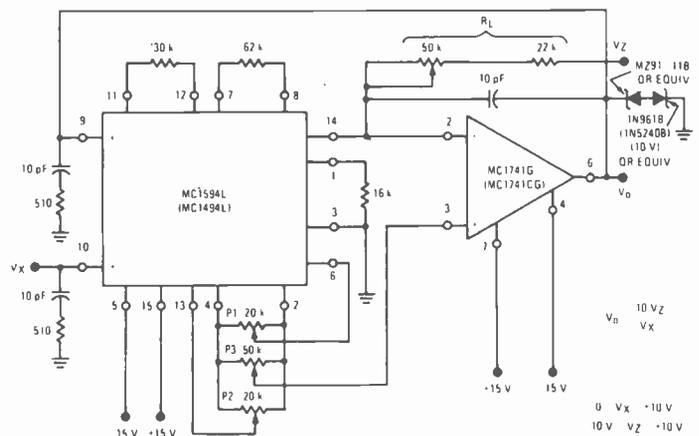
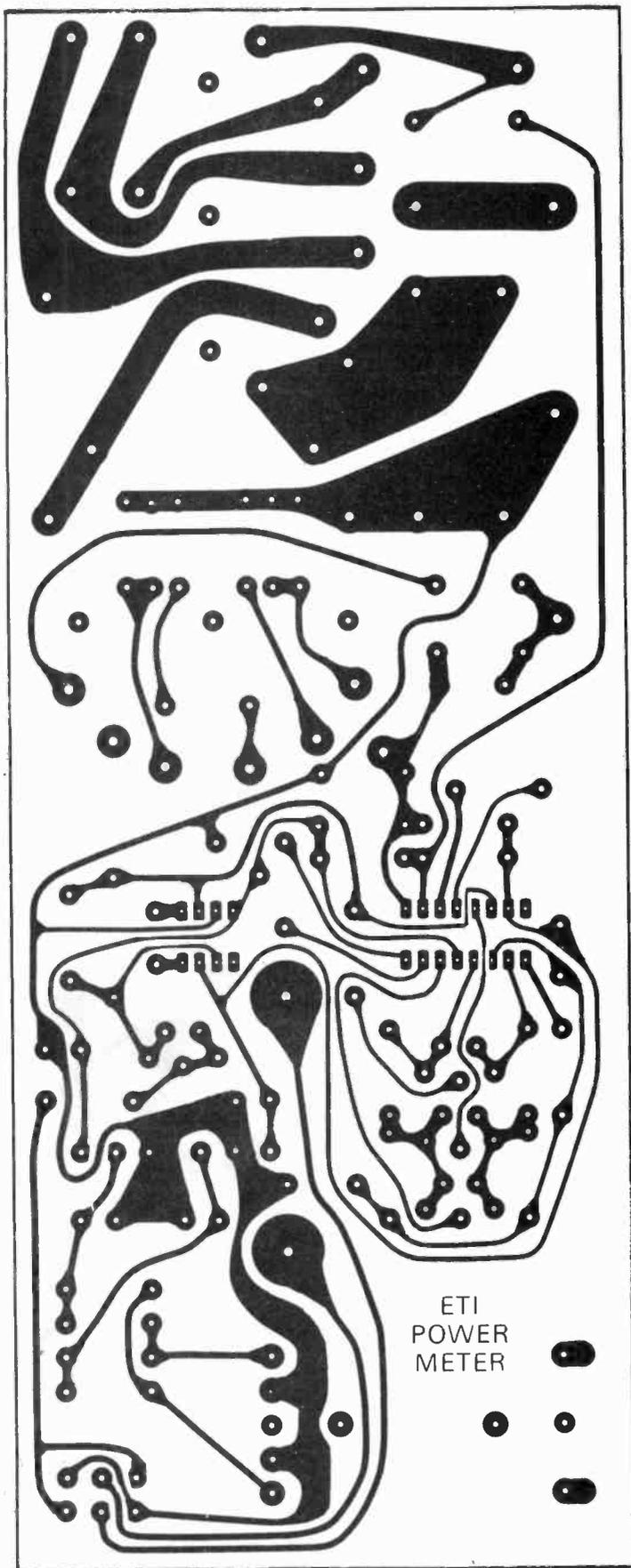


Fig. 10. Typical connection of a divide circuit. For the square root joins pin 9 and 10. Like the squaring circuits pin-6 can be connected to 0V and P1 deleted.

Full size foil pattern for the power meter.



allowance for either the cermet (VTP) or the normal carbon trim potentiometer.

Calibration

Four adjustments are required, which are performed as follows:

Select the 1 V and 0.03 A ranges and switch on. If the meter reads in reverse, toggle SW3. Don't worry about the reading unless it is off scale. If it is, adjust RV1 to bring it back towards zero. Now apply a voltage of about 1 V DC to the voltage input and note the meter deflection. Adjust RV2* until there is no deflection when this voltage is applied. Now apply the voltage to the current input (it will take about 30 mA) and adjust RV3 until there is no deflection. Recheck the voltage input and readjust if necessary.

Now with no voltage applied adjust RV1 to give zero output. Apply exactly 1 V to both current and voltage inputs and adjust RV4 to make the meter read FSD.

This is all the calibration that should be necessary.

About the 1494

The 1494 is a variable transconductance multiplier with a bidirectional current source output. What this means is that it looks at the voltage on the two points and gives an output current potential to the product of the two. Typical applications include: multiply, divide, square, square root, phase detection, frequency doubling, balanced modulation/demodulation and electronic gain control. An internal circuit diagram is given for those interested.

Values and Limitations

- 1 For best temperature coefficient R1 (pin 1 to 0V) should be 16k (we used 15k as it is easier to obtain). This sets the value of all the current sources inside the IC ($I1 = 8 / R1$)
- 2 The value of Rx (pin 11 to pin 12) should be $\geq 3x$ peak input voltage(X) expressed in k ohms.
- 3 The value of Ry (pin 7 to pin 8) should be $\geq 6x$ peak input voltage(Y) expressed in k ohms.
- 4 Choose the scaling factory required ie $V_{out} = K \cdot V_x \cdot V_y$.
- 5 Load resistance (pin 14 to 0V) can be calculated by $R_L = (K \cdot R_x \cdot R_y \cdot I1) / 2$
- 6 If RL is connected between pin 14 and 0V without an inverting amp. the frequency response is limited by the output capacitance of 10pF.
- 7 For best temperature coefficient the load between pins 2 and 4 should be 8.6k.

ETI

AUDIO AND TEST EQUIPMENT CENTRE

MICROCOMPUTERS LEVEL I AND II TRS80 IN STOCK

ALL PRICES INCLUDE VAT

Only regular stocks listed — other makes and models available
Telephone your order with Access and Barclaycards or send cheque with order.



SUPER 10



DM235



TE20D

LONDON'S TEST GEAR CENTRE
OPEN 6 DAYS A WEEK 9 am-6 pm

SCOPES — IN STOCK

3" 5MHz single beam	89.90
MS15, 15MHz Batt/mains portable	286.00
MS215, Dual trace version of above	360.00
Super 8 Scope x 6MHz single beam	149.00
Super 10 Scope x 10MHz Dual trace	225.00
4D25, Scope x 25MHz Dual trace	339.00
PROBES x 1 x 10 14.50, x 10 9.95 x 1 7.95 For 456/4D10A 4D25	

LOW COST
5MHz
Scope
£89.90

LED AND LCD DIGITAL MULTIMETERS

DM235 Sinclair portable 3 1/2 digit LED	49.95
DM35 Sinclair Pocket 3 1/2 digit LED	29.95
DM350 New Sinclair 3 1/2 Digit	69.95
DM450 New Sinclair 4 1/2 Digit	99.95
(30kV Probes 18.25, Mains adaptors 3.75, DM carrycase 8.95)	
LM3A 3 Digit	66.00
LM3.5A 3 1/2 Digit	106.00
LM40A 4 Digit	210.00
LM300 3 digit	87.00
LM350 3 1/2-digit	98.00

NEW LCD
Dmm 3 1/2
DIGIT
Only
£49.95

MULTI-METERS — GENERAL PURPOSE & ELECTRONIC

Multi-Range Instruments featuring AC/DC volts DC current Resistance Ranges all with mirror scales except T1 IT1 2 T12 TM3A (TM3 AC volts only) some with AC current etc

TM11 incredible 120 Range Electronic Multi-meter	136.00
TM3B AC Micro voltmeter 3MHz ~4 Megohm	130.00
TM6B Broadband voltmeter 300kHz 400MHz	196.00
360TR 100k volt	36.95
PROE 20k volt	29.95
7081 50k volt	21.95
TmK500 30k volt	21.95
680R 20k volt	34.50
7200 20k/volt	17.95
Micro80 20k/volt	17.90
IT1-2 20k/volt	11.95
LT22 20k/volt	14.50
T12 5k/volt	8.50
LT101 1k/volt	6.95
AT205 50k volt 21 range multi meter	25.95
K200 FET VOM 3B Ranges	77.00
GT101, 20k Volt 23 Ranges Transistor Checker - Continuity Checker	17.95

AVO BS and a large range of replacement test leads in stock

GENERAL EQUIPMENT

TE7 Signal Tracer	8.95
SWR50 SWR/Power Meter	19.50
LP30 30MHz Low Pass Filter	4.95
CX3A 150watt 3-way AC Switch	7.50
DC25kV 100 Meg HV Probe	11.95
DRS10 36 Value Resis. Box	3.95
FX2000 Xtal Marker	11.95
TR1000 Transistor checker in/out circuit	7.50
MOD83 Signal Injector	21.50
LB1 Transistor/Diode Checker	35.95
3101 Clamp Meter 0/1 K ohm 0/150/300/600 AC Volts 0/300 Amp	9.95
C3042 SWR & FS Meter	11.95
MS319 2x100 Watt Audio Watt Meter	48.00
*500V Megohmmeter 500 Megohms	55.00
*1000V Megohmmeter 1000 Megohms	19.95
*2 1/2 Amp Variable Transformer	33.00
*5 Amp Variable Transformer	46.00
Decade Resis. Boxes:	
1-1 110 ohm in steps of 1 ohm	33.00
10-111 110 ohm in steps of 10 ohms	33.00
1-1 111 110 ohm in steps of 1 ohm	42.50
Cap. Decade Box:	
10pF - 111 110pF in steps of 10pF	33.00

GENERATORS

TG152 Series RC Oscillators	
Sine/Square output 3Hz-300kHz	75.00
TG152D	95.00
TG152 Dm (with meter)	
TG200 Series RC Oscillators	
Sine/Square output 1Hz-1MHz	100.00
TG200D	121.00
TG200 Dm (with meter)	126.00
TG200 Dmp (Meter & Fine control)	267.00
TG66A Digital Sine Wave Decade control	267.00
0 2Hz-1 22MHz	
TE22D (audio) 4 bands Sine 20 200kHz	65.00
Square 20 150kHz	
TE20D (RF) 6 bands 120kHz-500MHz	57.00

LOGIC PROBES AND MONITORS

LT2000 Economy Probe 10MHz	11.95
LM1 Monitor	31.00
LP1 Probe 10MHz	33.48
LP2 1 5MHz	19.44
16 Pin IC test clip	2.20

PIEZO HORN TWEETERS

Up to 100 watts each. No x-over reqd. Only 4.95 each (P/P 20p)
10% Discount for 10 Plus



MICROPHONES, SPEAKERS AND COMPONENTS LARGE RANGE IN STOCK



TM11



TMK500

MAX 550 550 MHz Pocket Frequency Counter	£99.50
MAX 50 50 MHz Pocket Counter	£57.50
500 MHz Prescaler for MAX 100 or 50	£37.80
MAX100 100 MHz 8 digit ball operated counter	£37.75



TM3

CALL IN AND SEE FOR YOURSELF

PRICES CORRECT AT JAN. 17th. E.&O

AUDIO ELECTRONICS

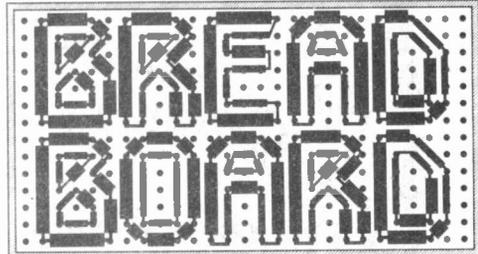
301 EDGWARE RD., LONDON W2 1BN
01-724-3564. OPEN 9-6, MON-SAT.

ALSO AT 248 TOTTENHAM COURT ROAD W 1

FREE CATALOGUE

SEND STAMPED 12" x 10" UK
ADDRESS ENVELOPE (MIN 9" x 6" 1")
FOR YOUR COPY NOW

Following the success of Breadboard '78, Trident Exhibitions announce



The second hobby electronics show

Information on exhibiting from:
Trident International Exhibitions Limited,
Abbey Mead House, 23a Plymouth Road,
Tavistock, Devon. PL19 8AU.
Telephone (0822) 4671 Telex 45412 TRITAV

December 4th-8th Royal Horticultural Hall, Westminster, London SW1

BUILD THE 12,000 ALREADY SOLD NASCOM I COMPUTER



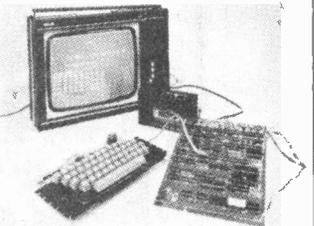
NEW LOW PRICE
£165 + 8% VAT
POST FREE

KITS IN STOCK:

BRITISH DESIGN U.K. BEST SELLING KIT
FULL AFTER SALES SERVICE & GUARANTEE
NATIONAL DISTRIBUTOR

FREE B-BUG WITH EVERY KIT

- Supplied in kit form for self assembly
- Full documentation supplied
- Fully screened double-sided plated through hole printed circuit board
- Full 48 key keyboard included
- 2K x 8 Ram
- IK x 8 monitor program providing
- Powerful Mostek Z80 CPU
- 16 x 48 character display interface to std unmodified TV
- TV display memory mapped for high speed access
- On board expansion to 2K x 8 EProm
- On board expansion for additional 16 1 O lines
- Memory may be expanded to full 60K



SOFTWARE

- IK x 8 monitor program providing
- 8 operating commands supporting Mem examine modify tabulate copy break single step execute tape load tape dump
- Reflective monitor addressing for flexible monitor expansion through user programs
- Monitor sup routines include — delay ASCII coding binary to hex conversion clr screen scroll up string print cursor shift and many others

OTHER HARDWARE

EXPANSION

* Expansion buffer board	£25.00
MEMORY KITS (inclusive all hardware)	
8K	£85.00
16K	£140.00
32K	£200.00
* I O board with decoders and all hardware except	£35.00
ICS	£35.00
Will accept up to 3 PIOs, 1 CTC and 1 UART.	

* 3A power supply for up to 4K expansion	£19.80
* 3A power supply for up to 4K expansion MKII	£24.50
* 8A power supply for larger than 32K expansion	£60.00
* Expansion card frame	£29.50
* EProm Programmer	£40.00
* EProm Eraser	£25.00
* keyboard Cabinet	£3.50
* Programming Manual	£4.00

NEW T 4 Operating System in (2) 2708 EPROMS upwards compatible from T2 & B Bug
TINY BASIC
SUPER TINY BASIC (with Editor & Machine Utility routines)
ZEAP ASSEMBLER EDITOR

VAT 8% all items except books • Demonstrations continuous daily We welcome export — Educational and Industrial Enquiries
FREE BROCHURE — SEND S.A.E. 9 1/2 x 6 1/2 STAMP 12 1/2p.

Henry's RADIO

All mail to:
Henry's Radio
404 Edgware Rd
London W2
Phone (01) 723 1008



WE HAVE TO GO

DUE TO REDEVELOPMENT IN THE AREA AND BY ORDER OF THE LOCAL COUNCIL ALL OUR STOCKS MUST BE SOLD BY THE 28th FEBRUARY. THEREFORE NORMAL TRADE PRICES UP TO THE 6th FEBRUARY — PRICE REDUCTIONS START ON THE 7th FEBRUARY PROGRESSIVELY REDUCING TO ZERO ON 28th FEBRUARY.

NO FURTHER TRADING AT ARTHUR ROAD WILL TAKE PLACE AFTER FEBRUARY 28th.

WE THANK PAST AND PRESENT CUSTOMERS FOR THEIR SUPPORT AND WISH THEM WELL IN THE FUTURE.

CLOSING DOWN SALE

FEBRUARY 7th-28th

MONDAY to SATURDAY

10 a.m. to 4 p.m.

Admission strictly in turn — no queue jumping by anybody

CASH (NOTES) ONLY

NO other terms for anyone

NO cheques; **NO** Barclaycard; **NO** Access

NO official orders

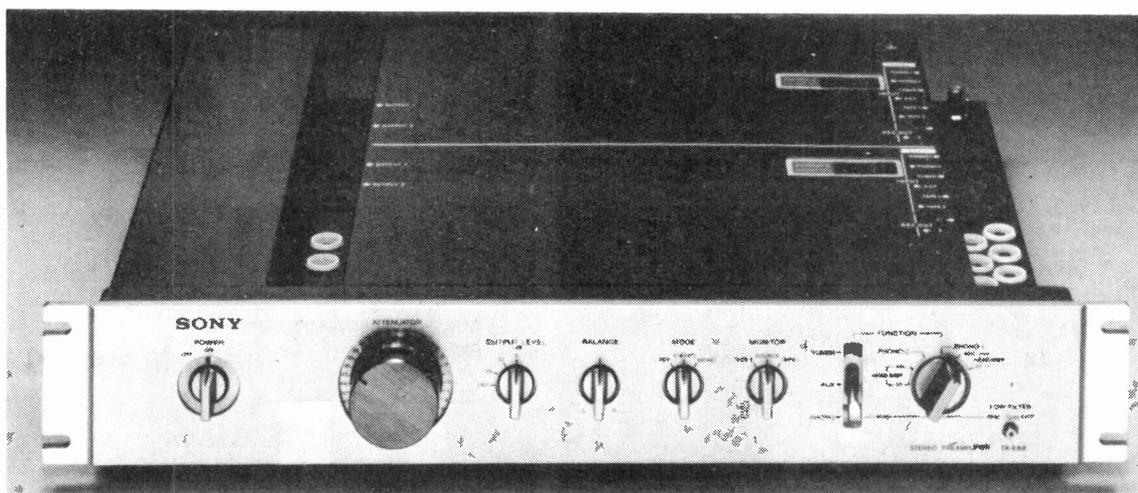
A branch of Midland Bank is situated approx. 400 yards away — other banks within ½ mile

CHILTMEAD LTD

7/9 ARTHUR ROAD, READING, BERKS (rear Technical College, King's Road). Tel: Reading 582605

audiophile.....

VISUALLY HI~FI? SONY'S TAE88 PREAMP



BY NOW I expect most of you have already heard of the TA-E88 pre-amp, the Sony flagship design. Costing a mere £699 it has been designed to match the TA-N88 VFET power amp, and uses FETS in the later stages of its circuitry. Overall the finish of the unit is probably up to a £700 standard. All sockets are gold plated, and a gold ended twin phono lead is supplied as standard. The controls are very nice to operate, and the volume and balance controls are very special indeed. Stepped attenuators are employed, but the operation is so smooth as to make you doubt it.

As you can see from the internal shot below, the signal path lies entirely along the PCB. There are no leads from the board carrying signal potentials, all switches and sockets are mounted in place, and extended to the front panel where need be.

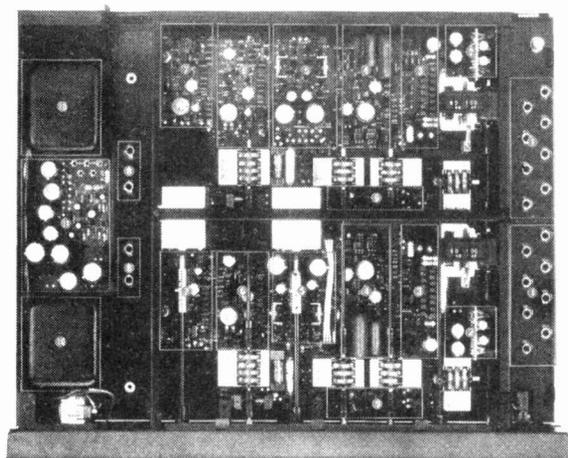
Shifting Load

There is even provision for switching about the resistance and capacitance associated with the magnetic phono inputs. Gold plated switches of course. Adjustment is variable between 10k-100pf and 100k-500pf. A useful provision this.

Completely separate channels — and PSUs — keep the right insensitive to the meanderings of the left and with the moving coil inputs especially this can be no bad thing.

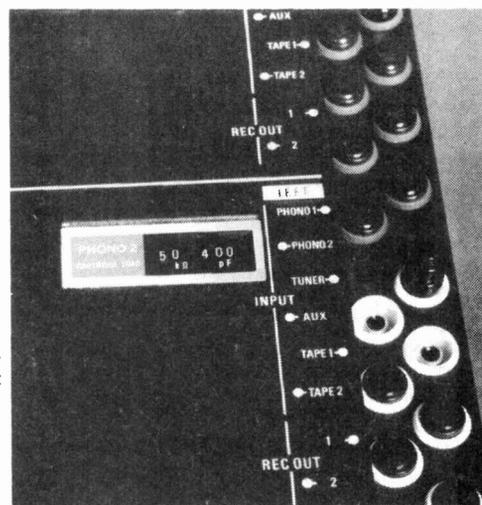
The head amp incorporated is a version of Sony marketed HA55, one of the best mains powered units on the market, and has two possible input impedances.

All this and no tone controls. It should be interesting to go through the circuit section by section, so I suppose the place to begin is the beginning. ▶



Right: an internal shot of the TAE88. The two channel construction can be clearly seen.

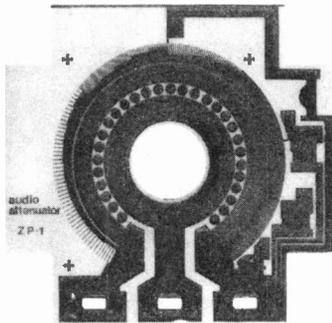
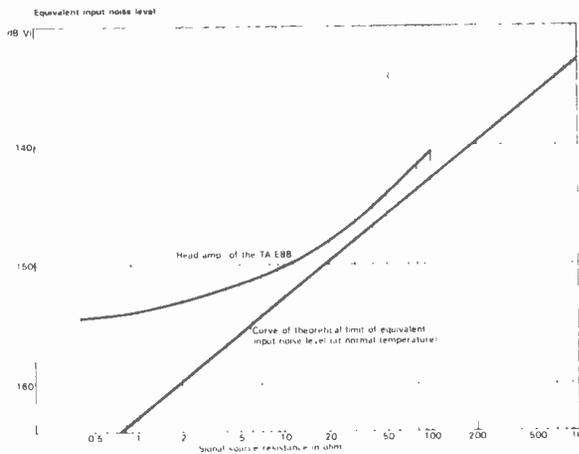
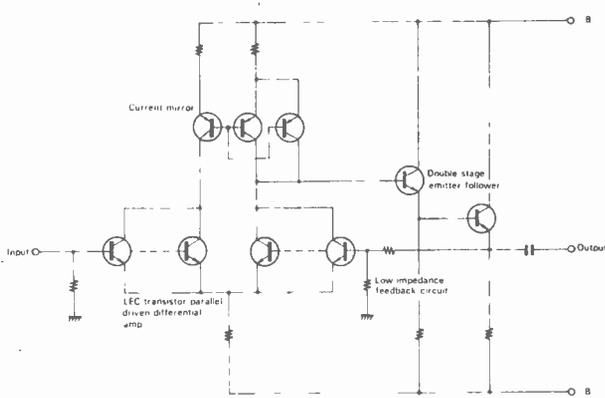
Left: a close up of the cartridge load switching and gold input sockets!



Head Start

As shown below, the moving coil amp consists of a differential pair with current mirror driving an emitter follower output stage.

The differential circuit consists of cascade connected transistors to get the noise and gain figures required, and 44dB of negative feedback is applied to lower distortion as usual. Low impedance feedback paths like this are fine for some applications, but need careful design indeed to avoid becoming more of a hindrance than a help.



Above: moving coil input circuit and performance graph.

Left: the PCB from the balance control. Each 'step' is connected to a precision resistor!

Magnetic Charm

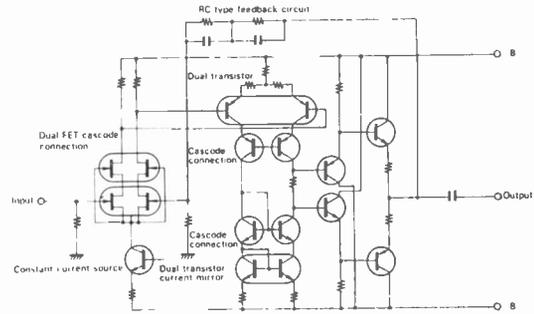
For more normal pickups the TA88 employs dual FET inputs (in cascode mode) and more conventional RC feedback equalisation circuitry. The FETs used were developed specially for the amplifier, when your 'Sony' of course you can get these things done.

The second stage is a differential amplifier also, to further stabilise and give the overall circuit greater immunity from current source drift. Dual transistors are

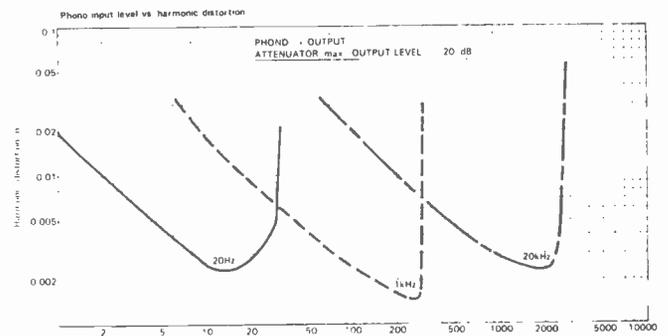
used in both the second differential amplifier and in the constant current stages of the circuit.

The output is once more an emitter follower following an emitter follower, and the components used are the expensive metal film resistors and polypropylene capacitors. Still when you've got £700 to spend — why not eh?

Equalisation is unusually accurate at 0.2%.

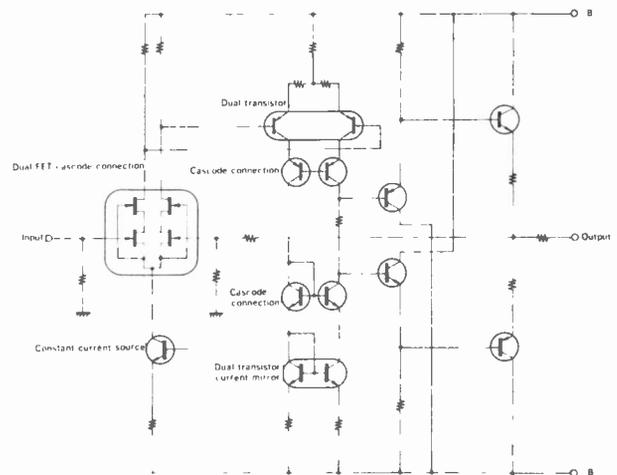


Magnetic cartridge input board.

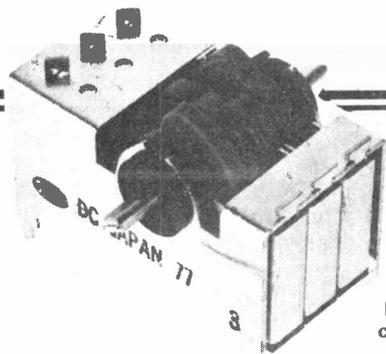


Standing At The Buffers

Buffer stages are liberally employed in the TAE88, between source inputs (non phono) and selector, and then either side of the volume control. Sony call the output amp a 'flat' amplifier for no reason I can fathom.



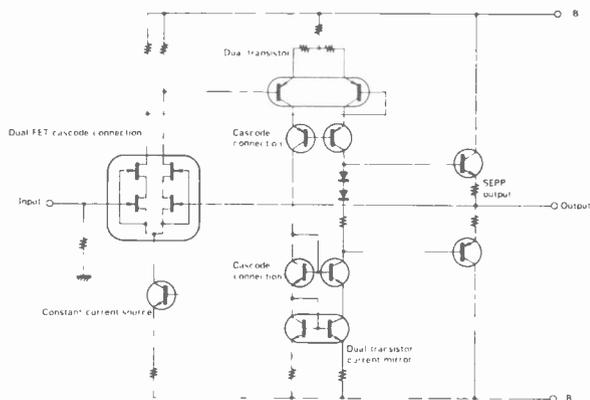
Buffer amplifier circuitry.



One of the PCB mounted cam switches.

You can see the circuit for the buffer circuit opposite. Once again dual FET inputs, and if you thought that there is a very strong similarity between this and the phono amps, I don't think you'll get many arguments from me.

The 'flat' amplifier (below) differs in as much as it is designed to work into the load presented by cable and power amp. To do this without loss of frequency res-



Output buffer circuit.

ponse, a design closely akin to a power amplifier configuration has been adopted.

Output impedance is about 100 ohms, so that fairly long interconnection runs can be tolerated, and up to 15 V can be safely output at around .001% THD.

Lugged Around

After reading through all the imposing technical info supplied with the unit I was almost afraid to wire up the box into my merely mortal system. I suppose I suspected some form of electron snobbery whereby the TAE88 would refuse to 'talk' to any power amp of less than immaculate pedigree.

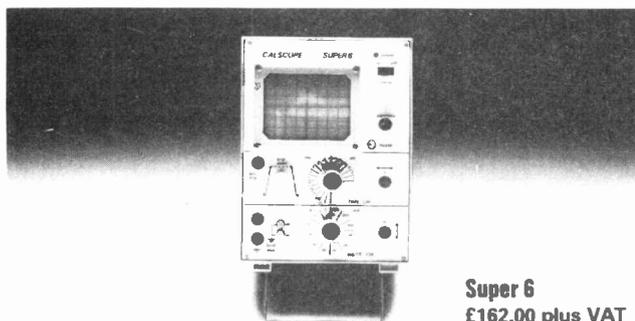
In practice however it was a case of 'noblesse oblige' and the Sony worked impeccably with the rest of the universe. Several power amplifiers were tried, including the Lecson AP3II and a Crimson set up.

At first the TAE88 sounds very impressive with a particularly good bass end. The treble is a little thin, but nothing to comment adversely on. After a while though I came to suspect that maybe the unit wasn't as good as I thought at first, and perhaps adds a certain metallic quality to the sound.

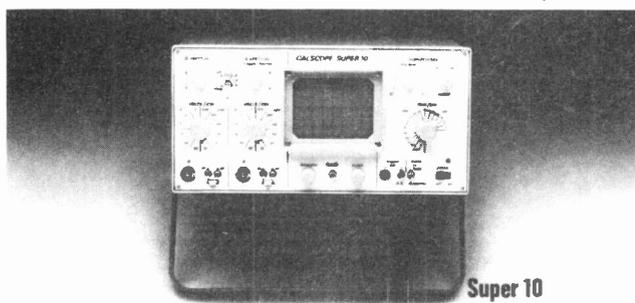
Using the unit is a treat of the first order, and it inspires confidence better than Mr Callaghan ever did. Reservations must inevitably include that optimistic price level, and the less than perfect (just!) sound quality — which is as close to excellent as any other (but no closer!), but is more expensive approximation.

A lovely machine nonetheless and if Sony can pull down the price (exit gold?) one which would have received a wholehearted recommendation. **ETI**

The professional scopes you've always needed.



Super 6
£162.00 plus VAT



Super 10
£219.00 plus VAT

When it comes to oscilloscopes, you'll have to go a long way to equal the reliability and performance of Calscope

Calscope set new standards in their products, as you'll discover when you compare specification and price against the competition.

The Calscope Super 10, dual trace 10 MHz has probably the highest standard anywhere for a low cost general purpose oscilloscope. A 3% accuracy is obtained by the use of stabilised power supplies which cope with mains fluctuations.

The price £219 plus VAT.

The Super 6 is a portable 6MHz single beam model with easy-to-use controls and has a time base range of 1µs to 100ms/cm with 10mV sensitivity. Price £162 plus VAT.

CALSCOPE DISTRIBUTED BY
Marshall's Electronic Components,
Kingsgate House,
Kingsgate Place,
London, N.W.6.

Audio Electronics,
301 Edgware Road, London W.2.
Tel: 01-724 3564
Access and Barclay card facilities
(Personal Shoppers)

Maplin Electronics Supplies Ltd.
P.O. Box 3
Rayleigh, Essex.
Tel: 0702 715 155
Mail Order

CALSCOPE

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 appropriate 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 equalization — Low noise — Low distortion — High overload — two simply combined for stereo

APPLICATIONS: Hi-Fi — Mixers — Disco — Guitar and Organ — Public address

SPECIFICATIONS:

INPUTS: Magnetic Pick-up, 3mV Ceramic Pick-up 30mV Tuner 100mV Microphone 10mV

Auxiliary 3-100mV; input impedance 47k Ω at 1kHz
OUTPUTS: Tape 100mV; Main output 500mV R.M.S

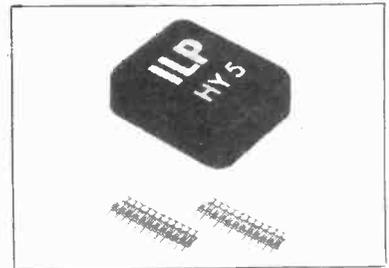
ACTIVE TONE CONTROLS: Treble - 12dB at 10kHz Bass + at 100Hz

DISTORTION: 0.1% at 1kHz; Signal/Noise Ratio 68dB

OVERLOAD: 38dB on Magnetic Pick-up; **SUPPLY VOLTAGE:** \pm 16.50V

Price £6.27 + 78p VAT. P&P free.

HY5 mounting board B1 48p + 6p VAT P&P free



HY30 15 Watts into 8 Ω

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

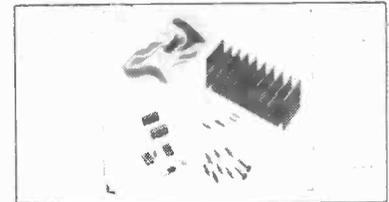
SPECIFICATIONS:

OUTPUT POWER: 15W R.M.S. into 8 Ω ; **DISTORTION:** 0.1% at 15W

INPUT SENSITIVITY: 500mV; **FREQUENCY RESPONSE:** 10Hz-16kHz — 3dB

SUPPLY VOLTAGE: \pm 18V

Price £6.27 + 78p VAT. P&P free.



HY50 25 Watts into 8 Ω

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

SPECIFICATIONS: **INPUT SENSITIVITY:** 500mV

OUTPUT POWER: 25W RMS into 8 Ω ; **LOAD IMPEDANCE:** 4-16 Ω ; **DISTORTION:** 0.04% at 25W at 1kHz

SIGNAL/NOISE RATIO: 75dB; **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB

SUPPLY VOLTAGE: \pm 25V; **SIZE:** 105.50 x 25mm

Price £8.18 + £1.02 VAT. P&P free.



HY120 60 Watts into 8 Ω

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

SPECIFICATIONS:

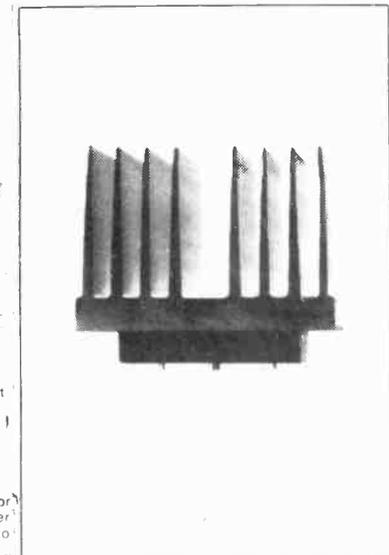
INPUT SENSITIVITY: 500mV

OUTPUT POWER: 60W RMS into 8 Ω ; **LOAD IMPEDANCE:** 4-16 Ω ; **DISTORTION:** 0.04% at 60W at 1kHz

SIGNAL/NOISE RATIO: 90dB; **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB; **SUPPLY VOLTAGE:** \pm 35V

Size: 114 x 50 x 85mm

Price £19.01 + £1.52 VAT. P&P free.



HY200 120 Watts into 8 Ω

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

SPECIFICATIONS:

INPUT SENSITIVITY: 500mV

OUTPUT POWER: 120W RMS into 8 Ω ; **LOAD IMPEDANCE:** 4-16 Ω ; **DISTORTION:** 0.05% at 100W at 1kHz

SIGNAL/NOISE RATIO: 96dB; **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB; **SUPPLY VOLTAGE:** \pm 45V

SIZE: 114 x 100 x 85mm

Price £27.99 + £2.24 VAT. P&P free.

HY400 240 Watts into 4 Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 Ω ! 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

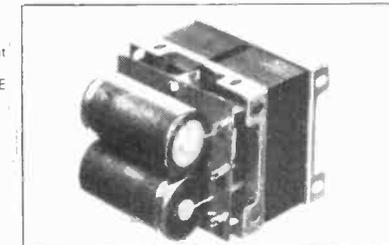
SPECIFICATIONS:

OUTPUT POWER: 240W RMS into 4 Ω ; **LOAD IMPEDANCE:** 4-16 Ω ; **DISTORTION:** 0.1% at 240W at 1kHz

SIGNAL/NOISE RATIO: 94dB; **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB; **SUPPLY VOLTAGE:** \pm 45V

INPUT SENSITIVITY: 500mV; **SIZE:** 114 x 100 x 85mm

Price £38.61 + £3.09 VAT. P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's **£6.44 + 81p VAT**
PSU50 suitable for two HY50's **£8.18 + £1.02 VAT**
PSU70 suitable for two HY120's **£14.58 + £1.17 VAT**
PSU90 suitable for one HY200 **£15.19 + £1.21 VAT**
PSU180 suitable for two HY200's or one HY400 **£25.42 + £2.03 VAT**

TWO YEARS' GUARANTEE ON ALL OF OUR PRODUCTS

I.L.P. Electronics Ltd.

**Graham Bell House
Roper Close
Canterbury
Kent CT2 7EP
Tel (0227) 54778**

Please Supply _____

Total Purchase Price _____

I Enclose Cheque Postal Orders Money Order

Please debit my Access account Barclaycard account

Account number _____

Name & Address _____

Signature _____

computing today

If you're wondering why *COMPUTING TODAY* is missing from this copy of *ETI* the answer is simple, it's probably still on your newsagent's shelf. You guessed it, as promised (or threatened) *CT* has gone solo, go on, treat yourself, we hope you won't be disappointed.

TANGERINE- ONE BOARD VDU

TANGERINE the sweet alternative to seven segment-displays. Don't be pipped at the post, we've got under the skin of this really versatile one-board VDU.

MICRO- BIOLOGY

Continuing the series with an almost indecently intimate look at the good old 6800 MPU.

SOFTSPOT

This very popular feature continues to bring you the very lat-

TRITON EXPANSION

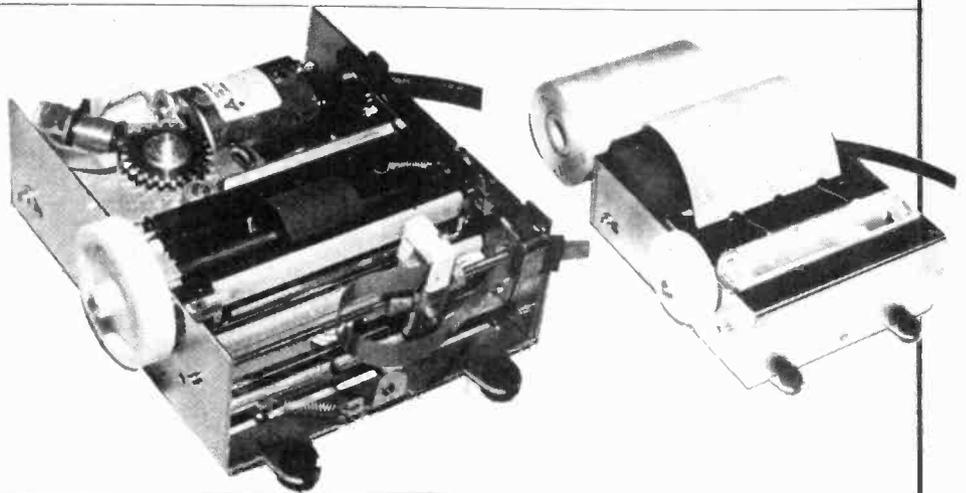
Add another 8K of RAM to your *TRITON* and it will now have the

INTRODUCING BASIC

Probably the most widely used 'High Level Language' today. You may forget *FORTRAN*, even criticise *COBOL* but never be

without *BASIC*.

The language of MPUs will be explained as you have never seen it before.



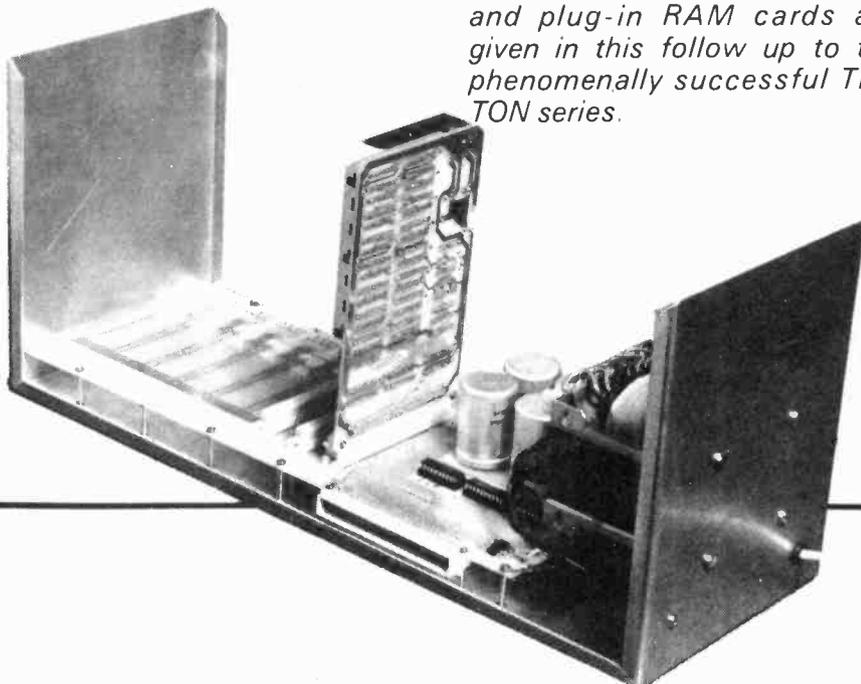
est in new programs, and compiles (groan) all the most up-to-date programming ideas and techniques.

S100 PRINTER

Hard up for hard copy? Tired of losing those valuable programme listings? Then this is for you. This printer uses the almost universal S100 bus format, low cost mechanics and readily available electronics. It will represent a substantial saving over commercial units.

STOMPER

Do you dislike insects? Are you a conservationist? Well this program allows you to stamp on insects without damaging the environment, they even give a satisfying *SPLAT* when you crush them. Good fun for software *Arachniphobiacs*.



**SECOND GENERATION
INDUCTION
BALANCE
METAL
DETECTOR**

**DESIGNED SPECIALLY
FOR THE HOME
CONSTRUCTOR**

**EASY
TO
BUILD**



**EASY
TO
USE**

- A second generation Induction Balance system with improved Variable-Tone detection.
- Designed by professionals for easy assembly by amateurs but with very good performance.
- The search coils are fully assembled and adjusted for you.
- Automatically rejects ground effect

Uses include:

- ★ Treasure hunting — it's amazing what you can find in the garden or on the beach.
- ★ Finding lost metallic items.
- ★ Locating waterpipes and cables under floorboards or in walls.
- ★ Checking old timber for nails before cutting, etc., etc., etc., etc.

KIT - COMPLETE WITH PRE-ASSEMBLED SEARCH COILS

£16.50

Plus £1-00p&p Plus £1-32 VAT

ASSEMBLED & TESTED

£22.50

Plus £1-00p&p Plus £1-80 VAT

Send sae for free components stocklist

Communication Measurement Ltd.
15 MALLINSON OVAL, HARROGATE, YORKS.

1979 GOODIES

7409N 10p, £8-100, 7460N 10p, £8-100
74109N 15p, £12-100, 74155 35p, Min
Order 10 of one type — 100+ POA p/p 20p

PIHER SLIDER POTS 47K Log Track 70 mm
Overall 85mm, Singles 20p, £15-100, Doubles
50p, £40-100, Min Order 10, 100+ POA, p/p
20p.

MAINS TRANSFORMER
250v Prim 0-10v-18v 2 amp £1.00 + 50p
p/p. Octal Cable fitting plug, 20 way, 20p.
Chassis mounting plug, 20 way, 20p. Cable
mounting socket, 20 way, 20p p/p 20p

74S40 25p, 74S64 30p, MC1488L 75p,
MC1489AL 75p 20p p/p.

TRIMPOTS 50Ω T05 20p, 100Ω Cermet 20p,
100Ω Painton PCB 20p, 200Ω ditto 20p, 250Ω
ditto 20p, 500Ω ditto 20p, 1K ditto 20p, 2K
ditto 20p, 2K Helitrim 20p, 5K PCB 20p, 1M
skeleton min. vert. 12p p/p 20p.

CANNON D-TYPES. Only ones left: 15 way
socket 50p, 37 way plug 80p, 50 way socket
£1 20, 50 way wire wrap socket £1 30, 25 way
ribbon plugs 90p. Cinch 25-way plastic cover
60p. Metal cover and retainer 80p. P/P 20p

NEW SN76477 sound generator IC (train,
plane, explosion, phaser gun etc.) with data,
£2 50 + 20p P/P.

TTL 74 SERIES

7400 12p	7401 12p	7402 15p
7404 14p	7407 30p	7409 16p
7410 13p	7412 18p	7414 45p
7416 24p	7417 25p	7420 15p
7427 30p	7428 32p	7430 15p
7432 26p	7438 30p	7442 50p
7451 15p	7472 76p	7460 15p
7474 28p	7475 30p	7485 95p
7486 30p	7490 30p	7491 80p
7495 60p	7496 55p	7497 £1.50
74107 30p	74109 50p	74121 25p
74123 48p	74150 90p	74151 60p
74153 70p	74154 £1.10	74155 80p
74157 60p	74162 90p	74163 90p
74164 £1.00	74165 £1.10	74188 £2.50
74190 £1.00	74192 90p	74195 90p
74198 £1.30	74279 £1.20	74284 £3.60
74368 £1.35	75450 35p	76660 50p
		P/P 20p

SUPERSAVER 1 Vero 2245, 2 edge connector
22 x 22 key at 7H 35p + P/P 20p

SUPERSAVER 2 Hybrid Systems DAC 371-8
(8-bit) DIL packaged + data, ideal MPU users,
brand new £2 (fraction of original cost) p/p
20p.

SUPERSAVER 3 IR Bridge rectifier type 12T
20T (12 amps 200V) 3 phase or single phase,
95p + P/P 20p

MEMORIES 2708 £6-85, 2102 (Signetics)
£1, 1702A £2.95, 2513 (upper case) £4.65,
Mostek MK4012N (1024 x 1), few only, 68p,
p/p 20p.

SUBMIN. TOGGLES (C & K, USA) spco
extended toggle (1 25 inch) superb quality 75p.
Standard submin. toggle dpco 80p, p/p 20p.

9-WAY MALE/FEMALE connector (Elco
8129) 0.1 inch pitch, PCB mounting ideal for
bussing two PCBs together 35p/pair p/p 20p.

LEDS (red) TIL 209 8p, 0 2 10p, Vernitron
Ceramic fillers FM-4 10.7MHz 45p, BD 236
40p, 2N3055 (TI) 40p, BC183L 10p, BC213L
10p, BF195 10p, 2521V (Dual 128 bit static
shift register 65p), RS 12-0-12 50mA sub-
miniature transformer £1 35, 5LT01 (green
phosphor) £4, suitable clock IC £3 25,
TMS3128NC (static shift reg) £1 25,
LM711CH T0-99 (Voltage comparator) 25p,
FPE 100 infra red emitter + data 15p,
MM5314 £2 95, DIL SWTS 4 way 60p,
TBAB10S + DATA 65p.

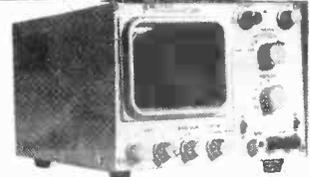
P/P 20p

All enquiries Sae please, Cat. SAE 8x6
or free with goods. P/P same for
quantities except where greater than
£1.

Rush orders as some stocks are limited

L. B. ELECTRONICS
43 WESTACOTT, HAYES,
MIDDLESEX UB4 8AH, ENGLAND

**MORE SCOPE FOR
YOUR MONEY**



SPECIFICATIONS

**ELMAC
4" SCOPE**

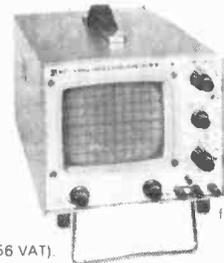
ELECTRICAL DATA
VERTICAL AXIS (Y) Deflection Sensitivity — 100mV/division
Bandwidth (between 3 dB points) — DC — 5MHz. Input Attenuator
(calibrated) — 9 step 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50/div.
Input Impedance — 1 Meg/40 pF in shunt. Input Voltage — Max —
600V P.P.
HORIZONTAL AXIS (X) Deflection Sensitivity — 0.400mV/division
Bandwidth (between 3 dB points) — 1Hz-350KHz. Gain
Control — Continuous when time bases in EXT position. Input
Impedance — 1 Meg. Input Voltage — Max — 600V P.P.
TIME BASE. Sweep Range (calibrated) — 100msec/div to 1µ
sec/div in 5 steps. FINE Control — Variable between steps —
includes time-base calibration position. Blanking — Internal — on
all ranges.
SYNCHRONISATION Selection — Internal, external. Synchronisation
Level — Continues from positive to negative.
POWER SUPPLY Input voltage — 115/220V AC- 10% at
50/60Hz. Power Dissipation — 18W
CRT DATA — Air — flat face, single beam — Maximum height
voltage — 5kV — Fitted with 8x10 division blue filter graticule
PHYSICAL DATA Dimensions — 15cm(h)x20.5cm(w)x28cm(d)
Weight — 4.3Kg(approx.). Stand — 2 position flat and inclined
Case — Steel, epoxy enamelled. Front panel — Aluminium,
enamelled epoxy printing. (As recommended by ETI)
5 MEG @ £83.25. VAT £6.66. CARRIAGE £1 50. SPEC AT5
ELMAC 4"

Cash with order

Test leads available £2.00

£99 (+ £7.92 V.A.T.)

Barclay and Access



5" CRT

SAE for
further details

£132

(+ £10.56 VAT).

6MHz OSCILLOSCOPE 3106B

10mV to 50V/cm in 12 calibrated steps 0.5µS to
0.1Sec/cm sweep range in 6 calibrated steps plus 12:1
Vernier. Magnifier x5. Fully automatic trigger. DC to
1.5MHz horizontal bandwidth.

Our 3106B with 1,600v acceleration voltage, 10
mv/cm sensitivity, auto trigger for the full bandwidth
and X5 magnifier giving 1000NS/cm. Fastest sweep
time (equivalent to 15 MHz oscilloscopes) SAE for
brochure.

ALARM CHRONO WITH DUAL TIME

Time: Gives hour, min, sec, day, am or pm.
Calendar: gives hour, minute, day or date by
your selection.

Dual Time: Time in any city in the world at
your choice.

Alarm: Sounds every day at set time until
reset or cancelled.

Chrono-timer: Up to 12 hrs 59 min 59.9
secs and lap times.



SINCLAIR ENTERPRISE

£23.95

79-step programmable calculator (Trigonometric functions, logs,
etc.) has seven independent
memories which can be used
under program control. Forward
or backward stepping facility for
examining the stored programme
and conditional branching under
program control. We have
thrown in case, mains adaptor,
alkaline battery and a three-
volume software library contain-
ing 316 programs and an
instruction manual.



TEXAS

PC100B £151 20, T157 £28 30, T151-3 £28 40
T158 £64 80, T159 POA Little Prof. £10 80

CASIO

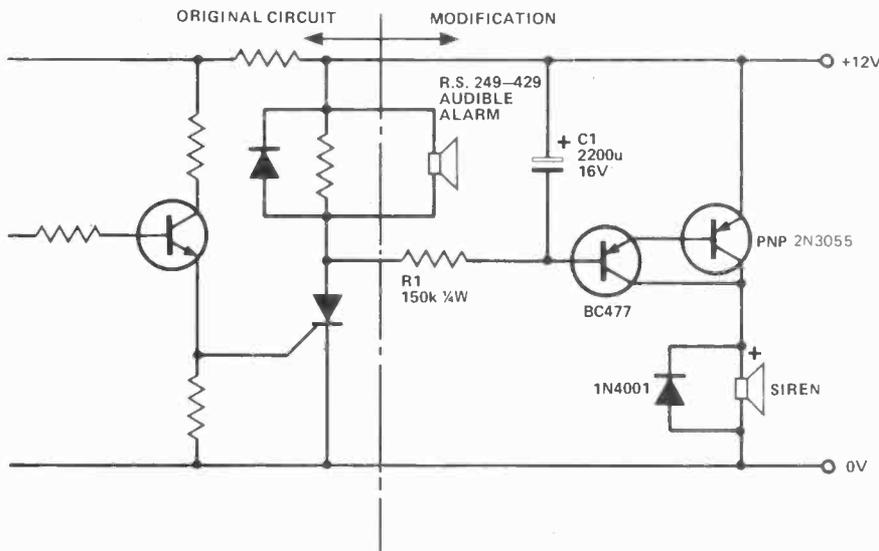
CO81 £17.90 PQ7 £19.90 FX3100 £24 30

CBM

COMMODORE Pet Computer 2001/8K £695
Boris Microprocessor chess game £199
Gammon Master II (computer backgammon) £149 95
Atari Microprocessor cassette TV game £149

KRAMER & CO.

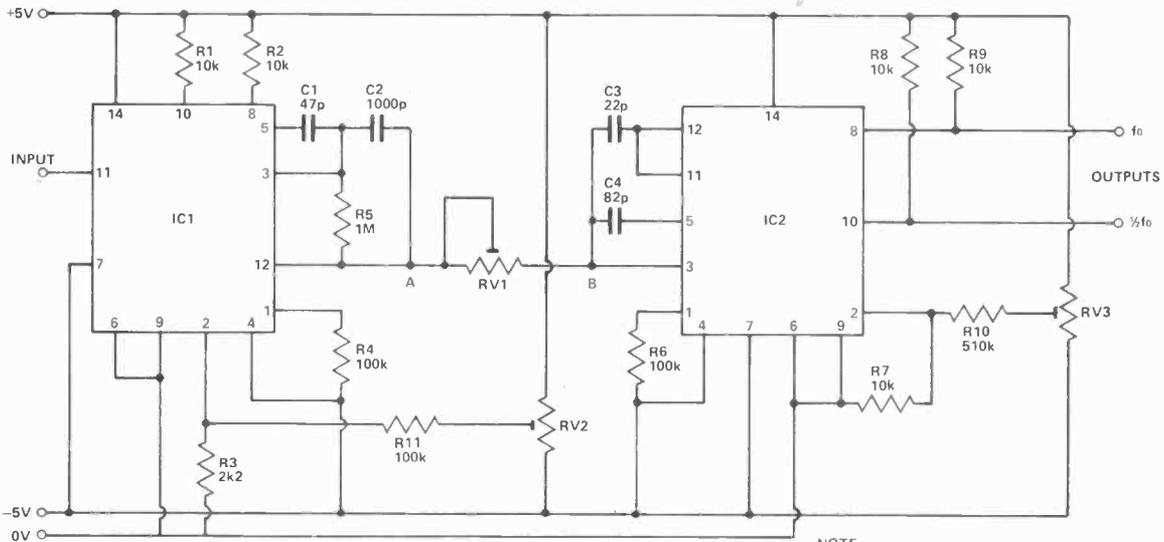
9 October Place, Holders Hill Road
London NW4 1EJ. Telex: 888941
attn. Kramer k7. Tel: 01-203 2473
Mail order only. Callers by appointment



Less Alarming

J. Master.

The April, 1977 ETI Burglar Alarm works well enough but I thought you may be interested in this modification which enables a low power audible alarm to sound 40 seconds before the main alarm. The main advantage is that the alarm can be set when one is retiring to bed at night and if the alarm is inadvertently triggered at least there is enough time to turn the unit off before the main alarm sounds. This also applies when people come home with the alarm set, no front door by-pass switch is required and accidental setting off of the alarm is avoided. The delay time can be varied by altering R1 and C1.



NOTE:
IC1,2 are RS Voltage to Frequency Chip
No. 307-070
RV1,2,3 are 50k 20 turn trimmers

Keyboard Guitar

A. Parker

The purpose of this project is to convert the waveform from a guitar or other instrument into pure square or pulse waveforms of the same frequency. The circuit is basically a frequency to voltage converter feeding a linear VCO.

The construction is straightforward provided the usual care is taken with the Cmos chips. For RV1, 2 and 3 we suggest 20 turn presets

as these will be needed for fine tuning of the circuit later. Also as an aid in testing we suggest that VR1 should NOT be soldered in until after initial testing has been completed.

The tuning of the circuit is best done using a Meter, PSU, Signal Generator and frequency meter if possible. First set the sig gen to some suitable frequency (ie 100 Hz) and using the meter between point A and earth adjust RV2 to give a voltage according go the formula

$$V = F_{in} \times 10^{-3}$$

$$\text{(for 100 Hz } V = 100 - V)$$

Now using an ACCURATE PSU set point B to +1 V and using VR3 adjust the output to 1 kHz then set to +10 V and adjust to 10 kHz. Now solder RV1 and adjust until

$$F_{in} = F \text{ out}$$

(NB This is a gross over simplification and patience is vital. Remember the price of the Chips before you throw them out of the window).

Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items.

ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 25-27 Oxford St., London W1R 1RF.

GREENWELD

443 Millbrook Road, Southampton
SO1 0HX Tel: (0703) 772501

All prices quoted include VAT. Add 25p UK/BFPO Postage. Most orders despatched on day of receipt. SAE with enquiries please. **MINIMUM ORDER VALUE £1.** Official orders accepted from schools, etc. (Minimum invoice charge £5). Export/Wholesale enquiries welcome. Wholesale list now available for bona-fide traders. Surplus components always wanted.

BUY A COMPLETE RANGE OF COMPONENTS AND THESE PACKS WILL HELP YOU

- ★ **SAVE ON TIME**—No delays in waiting for parts to come or shops to open!
- ★ **SAVE ON MONEY**—Bulk buying means lowest prices—just compare with others!
- ★ **HAVE THE RIGHT PART**—No guesswork or substitution necessary!

ALL PACKS CONTAIN FULL SPEC. BRAND NEW, MARKED DEVICES—SENT BY RETURN OF POST. VAT INCLUSIVE PRICES

K001 50V ceramic plate capacitors, 5% 10 of each value 22pF to 1000pF. Total 210. **£3.35**

K002 Extended range, 22pF to 0.1µF. 330 values **£4.90**

K003 Polyester capacitors, 10 each of these values: 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1, 0.15, 0.22, 0.33, 0.47µF. 110 altogether for **£4.75**

K004 Mylar capacitors, min 100V type. 10 each all values from 1000pF to 10,000pF. Total 130 for **£3.75**

K009 Extended mylar pack. Contains all values from 1000pF to 0.47µF. Total 290 capacitors for **£11.25**

K005 Polystyrene capacitors, 10 each value from 10pF to 10,000pF. E12 Series 5% 160V Total 370 for **£12.30**

K006 Tantalum bead capacitors, 10 each of the following: 0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1, 2.2, 3.3, 4.7, 6.8, all 35V; 10/25, 15/16, 22/16, 33/10, 47/6, 100/3. Total 170 tants for **£14.20**

K007 Electrolytic capacitors 25V working, small physical size. 10 each of these popular values: 1, 2.2, 4.7, 10, 22, 47, 100µF. Total 70 for **£3.50**

K008 Extended range, as above, also including 220, 470 and 1000µF. Total 100 for **£5.90**

K021 Miniature carbon film 5% resistors, CR25 or similar. 10 of each value from 10R to 1M. E12 series. Total 610 resistors **£6.00**

K022 Extended range, total 850 resistors from 1R to 10M **£8.30**

K041 Zener diodes, 400mW 5% BZY88, etc. 10 of each value from 27V to 36V. E24 series. Total 280 for **£15.30**

K042 As above but 5 of each value **£8.70**

STEREO AMPLIFIER CHASSIS £5.50

Complete and ready built. Controls: Bass, treble, volume/on-off, balance. 8 transistor circuit gives 2 watts per channel output. Just needs transformer and speakers for low cost stereo amp. Suitable metal cabinet (W374) **£2.00**—or buy the amp, case and transformer for **£10.00** and get DIN speaker sockets and knobs free!

AMPLIFIER KIT £1.75

Mono gen. purpose amp with tone and vol./on-off controls. Utilizes sim. circuitry to above amp. Output 2W into 8 ohms. Input matched for crystal cartridge. 4 transistor circuit. Simple to build on PCB provided. Can be either battery or mains operated. (For mains powered version add **£2.20** for suitable transformer). Blue vinyl covered aluminium case to suit (W372) **£1.30**.

BC182B OFFER

Special Offer for quantity users 1k. 035 + VAT. 5k. 032 + VAT. Price negotiable on 10k + approx. 80k available.

PC ETCHING KIT MK III

Now contains 200 sq. ins. copper clad board, 1lb Ferric Chloride, DALO etch-resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions **£4.25**.

EDGE CONNECTORS

Special purchase of these 0.1" pitch double-sided gold-plated connectors enables us to offer them at less than one-third of their original list price!

32-way **72p**; 40-way **90p**.

THE NEW 1978-9 GREENWELD CATALOGUE

FEATURES INCLUDE:

- ★ 50p Discount Vouchers
 - ★ Quantity prices for bulk buyers
 - ★ Bargain List Supplement
 - ★ Reply Paid Envelope
 - ★ Priority Order Form
 - ★ VAT inclusive prices
- Price 30p + 15p Post.

HEAT SINK OFFER

Copper T05 sink 17mm dia x 20mm. 10 for 40p; 100 for **£3**; 1,000 for **£25**.

74 SERIES PACK

Selection of boards containing many different 74 series ICs. 20 for **£1**; 50 for **£2.20**; 100 for **£4**.

TMS4030 RAM

4096 bit dynamic RAM with 300ns access time; 470ns cycle time; single low capacitance high level clock i/p; Fully TTL compatible; Low power dissipation. Supplied with data **£2.75**.

MISCELLANEOUS ICs

Supplied with data if requested. MC3302 quad comp. **120p**; 710 diff comp. (T099) **40p**; ZN1034E precision timer **£2.25**; LM711 Dual diff comp **65p**; LM1303 dual stereo pre-amp **75p**; MC1469R voltage reg **£1.50**; UPC1025H audio **£3.50**; 575C2 audio **£2.88**; TDA2640 audio **£2.92**; TBA810S audio **70p**; SN75110 dual line driver **70p**; MC8500 CRCC gen POA.

OSCILLOSCOPES

We have available from stock the following SCOPEX models: 4D10A—DC-10MHz; 10mV sensitivity. Stab. power supplies; Dual beam; 3% accuracy. Excellent value at **£214** inc. VAT and carriage. 4S6—DC-6MHz; 10mV sensitivity. Ideal portable scope. Solid state circuitry. All for **£150** inc. VAT and carriage.

RESISTOR PACK

Carbon film 5% mostly 1/4W, few 1/2W resistors. Brand new but have pre-formed leads, ideal for PC mntg. Wide range of mixed popular values at the unrepeatable price of **£2.50** per 1,000. **£11** per 5,000.

DIN SOCKET OFFER

2 pin switched speaker socket. PC mntg; 5 pin 180° PC mntg; or chassis mntg. (clip fix). All the same price, any mix: 10 for **70p**; 25 for **£1.60**; 100 for **£5.50**.

PUSH BUTTON SWITCH BANKS

Lots of diff. types illustrated in Bargain List No. 6—send SAE for your copy.

RELAYS

W847 Low profile PC mntg 10 x 33 x 20mm 6V coil, SPCO 3A contacts **93p**.
W817 11 pin plug in relay; rated 24V AC, but works well on 6V DC. Contacts 3 pole c/o rated 10A. **95p**.
W819 12V 1250R DPCO 1A contacts. Size 29 x 22 x 18mm min. plug-in type **72p**.
W839 50V ac (24V DC) coil. 11 pin plug-in type. 3 pole c/o 10A contacts. Only **85p**.
W846 Open construction mains relay. 3 sets 10A c/o contacts. **£1.20**.
Send SAE for our relay list—84 types listed and illustrated.

LOW COST PLASTIC BOXES

Made in high impact ABS. The lids are retained by 4 screws into brass inserts. Interior of box has PCB guide slots (except V219).

V210 80x62x40mm black **58p**
V213 100x75x40mm black **72p**
V216 120x100x45mm black **86p**
V219 120x100x45mm white **86p**

DIODE SCOOPIII!

We have been fortunate to obtain a large quantity of untested, mostly unmarked glass silicon diodes. Testing a sample batch revealed about 70% useable devices—signal diodes, high voltage rets and zeners may all be included. These are being offered at the incredibly low price of **£1.25**/1,000—or a bag of 2,500 for **£2.25**. Bag of 10,000 **£8**. Box of 25,000 **£17.50**. Box of 100,000 **£60**.

ELECTROVALUE

FOR A GOOD DEAL BETTER THAN MOST

WE PAY POSTAGE on U.K. C.W.O. orders over £5.00 list value.

WE GIVE DISCOUNTS on C.W.O. in U.K. orders—5% on list value over £10.00, 10% on list value over £25.00.

WE GUARANTEE all goods are brand new, clean and to specification—no seconds, no surplus.

WE GIVE SERVICE to all orders, large or small—we use microfilm order storage, computer processing and double check personal supervision.

Specialists
Mail Order
Suppliers
since 1964

This month's ELECTROVALUABLES

Electrovaluables are our own overstock items offered from time to time at greatly reduced prices. Orders for these items should quote 'Electrovaluables' and also description and price as advertised. PRICES ARE NET AND V.A.T. MUST BE ADDED @ 8% or 12 1/2% where prices show. Subject to prior sale.

- | | | | |
|---------------------------------------------------------|------------|---------------------------------------------------|--------------------|
| SOLDERING IRONS | £3 | TRANSFORMER CORES | 20p |
| Type 31 100V 60W | £4 | 0.5W 50 Hz Unisil. Belclera kit ES | |
| Type 62 110V 75W | | | |
| VYNAIR 36" x 25" | 90p | CAPACITORS | 20p |
| Rhapsody (black & fleck) | 90p | 2000µF 50V | |
| Oyster (beige) | 90p | | |
| Freno (black) | 90p | POTENTIOMETERS | 20p |
| | | Carbon track single gang 2K? log standard spindle | 8 for £10 |
| SWITCHES | | P20 + switch 470K 1M log | 3 for £1 |
| Rocker DP/ST Type 50A 20p | | JP20 47K 1in. short spindle | 3 for £1 |
| LAMPS | 15p | 2M2 1in. long spindle | 3 for £1 |
| 9mm clear neon | | 100K log. 2M2 log. | 3 for £1 |
| HEAT CLIPS | 10 for 30p | 1M log. rev log short spindle | 3 for £1 |
| T01 crinkle 224F | | | |
| PITMAN BOOKS | £4 | WIRE WOUND | 100, 150, 150, 150 |
| (Zero rated for VAT) | | Colvern 905C. 1K5, 5K, 15K, 50K | any 2 £1 |
| Radiocontrol for Models No. 2313 (RRP £6) | £3.50 | | |
| Hi-Fi for the Enthusiast No. 4972 (RRP £5) | £3.50 | | |
| Radio Construction for the Amateur No. 8684 (RRP £2 50) | £1.75 | | |
| (All three titles for £8.50) | | | |
| VEROBOARD | 20p | | |
| 5" x 3 4" x 2" matrix | | | |

WE ARE NATIONAL DISTRIBUTORS FOR

NASCOM COMPUTER KITS
for delivery from stock. Brochure and prices on application. Also supporting Nascom items. Enquiries invited.

MOTOROLA D.2 MICROPROCESSOR EVALUATION KIT
(for the M.6800 Microcomputer—£175.87 net + V.A.T.)

CATALOGUE 9

Yours for the asking—and it's FREE

Completely revised, up-dated and more attractively presented, 120 pages—Semi-conductors, I.C.s. Opto-electronics, Rs. Cs. materials, tools, connectors, etc., etc. And you'll be delighted with our three-month competitive stabilised price list system. It means that you can order in confidence at all times from Electrovalue.



Successful projects begin with Electrovalue Catalogue 9

TWO DEPOTS TO SERVE YOU NORTH AND SOUTH

ELECTROVALUE LTD

Head Office: Dept. ET13, 28 St. Jude's Road, Englefield Green, Egham, Surrey TW20 0HB. Telephone Egham 3603. Telex 264475.

Northern Branch: 680 Burnage Lane, Burnage, Manchester M19 1NA (061) 432 4945

Shop hours (both depots) 9-5.30 daily, 1.0 p.m. Sats.

CBM Shoot

I. Holdstock
Shown here is the Shooting Program that I have devised for use on the Commodore PR-100 Programmable Calculator.

The idea is to try to shoot at targets that appear at random ranges. To do this the operator has to guess the correction that is necessary to score a Bullseye. To make things more difficult it is assumed that there is a strong wind blowing from the left, and the correction has to accommodate for this as well. The program works out where the shot would have hit the target and gives a score accordingly out of 5. Points are deducted for complete misses. The number of shots actually fired is stored, together with the total score. To use the program you enter the keystrokes and go to 00. Then 1000 is entered in memory 6. Then take the Sin of any integer less than 100 and run the number obtained. A random range will be displayed. Using the chart below the program listing, the operator has to guess the corrections necessary to score a bullseye and enter them at the correct stages into the program. A score will be displayed after the last correction. To re-use the program, simply press run after the score has been displayed, and a new range will be shown. Before the second correction is entered, 0 will be displayed. If the present range has been forgotten, it is simply obtained by pressing MR 1. (See instructions at the end of the program listing).

STEP NO	KEYSTROKE	CHECK CODE			
00	M	51	52	SKIP	15
01	0	91	53	GO TO	14
02	1	81	54	5	72
03	F	21	55	7	61
04	M+	84	56	+	94
05	7	61	57	F	21
06	MR	52	58	M+	84
07	0	91	59	2	82
08	+	84	60	5	72
09	pi	45	61	—	85
10	=	95	62	MR	52
11	y ^x	34	63	2	82
12	5	72	64	=	95
13	=	95	65	F	21
14	F	21	66	M+	84
15	Frac	51	67	8	62
16	M	51	68	STOP	13
17	0	91	69	GO TO	14
18	X	74	70	0	91
19	MR	52	71	2	82
20	6	73			
21	=	95			
22	M	51			
23	1	81			
24	STOP	13			
25	—	85			
26	MR	52			
27	0	91			
28	inv	31			
29	tan	24			
30	=	95			
31	F	21			
32	int	52			
33	SKIP	15			
34	GO TO	14			
35	3	83			
36	8	62			
37	+	94			
38	M	51			
39	2	82			
40	C/CE	25			
41	STOP	13			
42	—	—			
43	(64			
44	MR	52			
45	1	81			
46	X	74			
47	2	82			
48	tan	24			
49	=	95			
50	F	21			
51	int	52			

TO USE: FIRSTLY F C/CE THEN,
A) GO TO 00
B) 1000 in memory 6
C) Any 2 digit number, then SIN it
D) RUN — the range is displayed
E) Enter elevation guess—RUN
F) 0 will be displayed
G) Enter windage guess — RUN
H) Score will be displayed
I) RUN — a new range is displayed
J) Enter elevation guess — RUN
K) 0 will be displayed
L) Enter windage guess — RUN
M) Score will be displayed
— and so on.

USEFUL HINTS

RANGE	ELEVATION	WINDAGE
000	0	0
100	5	3
300	16	10
500	26	17
700	34	24
1000	45	35

The number of shots fired is in memory 7; the score is in memory 8.
BULLSEYE is 5
INNER is 4
MAGPIE is 3
OUTER is 2
MISS is 0 or —N. Points are deducted for misses.

Versatile CMOS Test bed

J. Anderson

It is a cheap and easily constructed transistor tester utilising inexpensive and readily available CMOS ICs.

It not only carries out the normal GO/NO-GO test but will differentiate between PNP & NPN type as well as identifying their base leads.

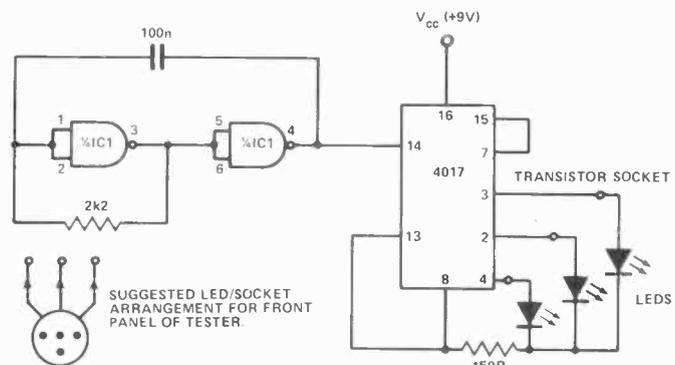
Use of the tester is simple and is as follows:

- 1) GO/NO-GO:—If the transistor is "a dud", either all the LEDs will come on or they will all go out.
- 2) PNP/NPN differentiation.—a PNP only one of the LEDs will come on.
- b) NPN one of the LEDs will go out.
- 3) base lead identification:—the

base lead is identified by the "odd LED out". (ie the one LED that is on with the other two out or the one that is out with the other two on).

The unit will also test diodes by the use of only two of the sockets of

the transistor socket in this case the anode of the diode is identified by the LED associated with its lead going out. The device also tests and identifies the gates of JUGFETs, SCRs & TRIACS.



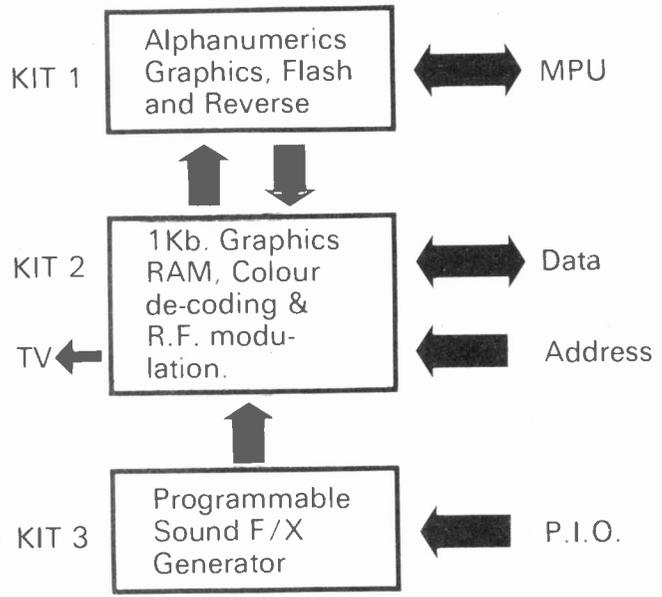
SUGGESTED LED/SOCKET ARRANGEMENT FOR FRONT PANEL OF TESTER.

7400	10p	7460	12p	74137	90p	74195	50p	4055	130p	CA 3140	60p	LM 3909 N	65p	TBA 480 Q	200p		
7401	10p	7470	25p	74138	100p	74196	50p	4056	120p	LF 356	80p	MC 1310 P	140p	TBA 520 Q	200p		
7402	10p	7472	20p	74141	50p	74197	50p	4060	100p	LF 357	80p	MC 1312 P	150p	TBA 530 Q	200p		
7403	10p	7473	25p	74142	180p	74198	100p	4066	35p	LM 211 H	250p	MC 1314 P	190p	TBA 540	200p		
7404	12p	7474	25p	74143	270p	74199	100p	4069	12p	LM 300 TR5	170p	MC 1315 P	230p	TBA 550 Q	250p		
7405	12p	7475	25p	74144	270p	74293	90p	4070	12p	LM 301 AN	30p	MK 50398	650p	TBA 560 C	250p		
7406	25p	7476	25p	74145	55p	74L500	18p	4071	12p	LM 304	200p	MM 5314	380p	TBA 641 A12	250p		
7407	25p	7480	40p	74147	100p	745112	80p	4072	12p	LM 307N	65p	MM 5316	480p	TBA 700	180p		
7408	12p	7481	85p	74148	90p	CMOS			4081	12p	LM 308 TO5	100p	NE 529 K	150p	TBA 720 Q	225p	
7409	12p	7482	75p	74150	65p	4000	12p	4082	12p	LM 308 DIL	100p	NE 555	25p	TBA 750 Q	200p		
7410	12p	7483	75p	74151	45p	4001	12p	4093	70p	LM 309 K	100p	NE 556	90p	TBA 800	80p		
7411	15p	7484	70p	74153	45p	4002	12p	4510	60p	LM 310 TO5	150p	NE 562 B	400p	TBA 810	100p		
7412	15p	7485	60p	74154	70p	4006	80p	4511	70p	LM 311 TO5	150p	SAD 1024	1500p	TBA 820	100p		
7413	25p	7486	25p	74155	45p	4007	14p	4516	65p	LM 317 K	325p	SL 917 B	650p	TBA 920 Q	280p		
7414	45p	7489	130p	74156	45p	4009	30p	4518	65p	LM 324	70p	SN 76003 N	150p	TCA 270 Q	220p		
7416	25p	7490	25p	74157	45p	4011	12p	4520	65p	LM 339	60p	SN 76013 N	110p	TCA 270 S	220p		
7417	25p	7491	40p	74160	55p	4012	12p	4528	80p	LM 348 N	90p	SN 76013 ND	125p	TCA 760	300p		
7420	12p	7492	35p	74161	55p	4013	30p	4583	70p	LM 380	60p	SN 76023 N	110p	TCA 4500 A	450p		
7421	20p	7493	30p	74162	55p	4015	50p	LINEAR			LM 381 N	90p	SN 76023 ND	125p	TDA 1008	350p	
7422	15p	7494	70p	74163	55p	4016	30p	AY3 8500	450p	LM 382	90p	SN 76033 N	150p	TDA 1034	450p		
7423	20p	7495	45p	74164	60p	4017	50p	CA 3039	70p	LM 391	180p	SN 7627 N	160p	TDA 2002	300p		
7425	20p	7496	45p	74165	60p	4018	55p	CA 3046	60p	LM 555	25p	SN 76228 N	180p	TDA 2020	300p		
7426	22p	7497	120p	74166	75p	4019	40p	CA 3060	225p	LM 709 C	40p	SN 76660 N	75p	TL 084	120p		
7427	22p	74100	80p	74167	160p	4020	50p	CA 3065	200p	LM 710 TO5	60p	TAA 300	100p	XR 320	250p		
7428	25p	74104	40p	74170	100p	4022	50p	CA 3076	250p	LM 710 DIL	65p	TAA 350	190p	XR 2206	450p		
7430	12p	74105	40p	74173	80p	4023	12p	CA 3080	75p	LM 723 TO5	40p	TAA 550	35p	XR 2207	450p		
7432	20p	74107	25p	74174	60p	4024	40p	CA 3084	250p	LM 723 DIL	40p	TAA 570	220p	XR 2208	600p		
7433	28p	74108	100p	74175	60p	4025	12p	CA 3085	85p	LM 733	120p	TAA 661B	140p	XR 2216	650p		
7437	20p	74166	75p	74176	50p	4026	80p	CA 3086	60p	LM 741	20p	TAA 700	350p	XR 2567	250p		
7438	20p	74109	25p	74177	50p	4027	30p	CA 3088	190p	LM 748	40p	TAA 790	350p	XR 4136	150p		
7440	12p	74118	75p	74178	75p	4028	45p	CA 3089	160p	LM 1303 N	100p	TAD 100	150p	XR 4202	150p		
7441	45p	74120	80p	74179	120p	4029	50p	CA 3090AQ	360p	LM 1458	100p	TAD 110	130p	XR 4212	150p		
7442	40p	74121	25p	74180	90p	4030	30p	CA 3123 E	130p	LM 3080	75p	TBA 120 S	60p	XR 4739	150p		
7443	60p	74122	35p	74181	130p	4032	80p	CA 3130	100p	LM 3900	55p	TBA 120 T	85p	ZN 414	100p		
7444	60p	74123	40p	74182	50p	4033	100p	IN 4148 Diodes by ITT / Texas, 100 for £1.50									
7445	65p	74125	35p	74184	120p	4040	60p	Static Ram 2102 1024x1 bit 450 nano sec, £1.00 each									
7446	50p	74126	35p	74185	100p	4043	60p	2112 256x4 bit 450 nano sec, £2.50									
7447	50p	74128	60p	74188	320p	4046	90p	Murata Ultrasonic Transducers 40kHz, £2.00 each; £3.50 pair									
7448	50p	74130	120p	74190	70p	4047	80p	First grade LEDs 125 or 0.2" red 10p each 100 for £7.50, 1,000 for £60.									
7450	12p	74131	90p	74191	70p	4048	50p	All prices include post and VAT									
7451	12p	74132	45p	74192	60p	4049	25p	T. POWELL									
7453	12p	74135	90p	74193	60p	4050	25p	306 ST. PAULS ROAD, HIGHBURY CORNER, LONDON, N.1. TEL. 01-226 1489									
7454	12p	74136	80p	74194	55p	4054	100p	Barclay / Access credit cards accepted									



Announce the expandable system for the NASCOM 1* VDU

Microcomputer Accessories



- Kit 1 provides 64 graphics pre-programmed on a 2708 EPROM. Other features include inverse video (black characters on white background) and flash (adjustable flash rate). Available now. Price £32.50.
- Kit 2 when used in conjunction with kit 1 provides 1Kb of programmable colour graphics. Also included is a colour/audio R.F. modulator enabling direct connection to a colour TV aerial socket (NTSC or PAL). Available April. Price £52.20.
- Kit 3 is a programmable sound effects generator which can be used by itself or with kit 2 to provide audio from a TV loudspeaker. The generator can provide "bell" sounds for keyboard, etc. Available April. Price £18.96.

*Conversion boards will shortly become available for other systems.

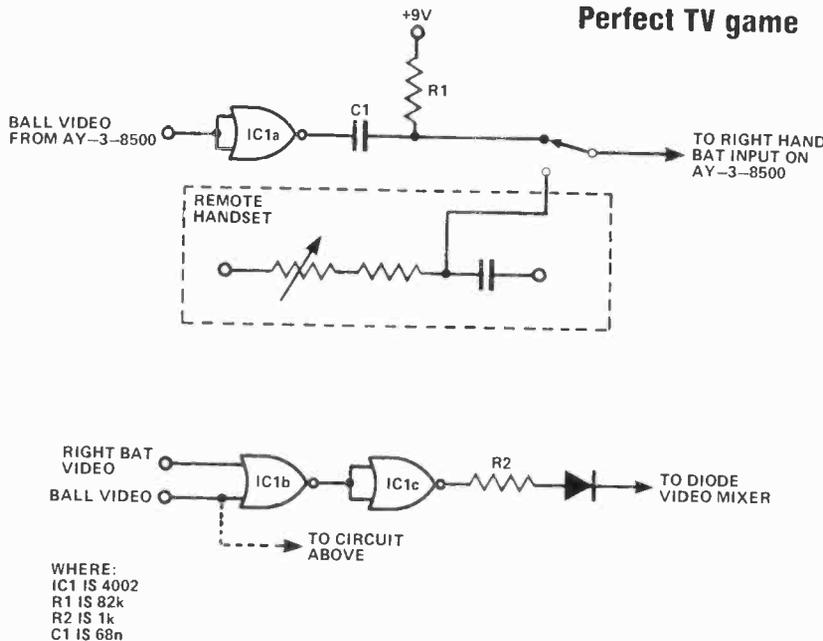
Keep your Programs in order! Use our Machine Code Programming Sheets. A4 size available now in pads of 100 sheets. Suitable for any micro being programmed in machine code. Price £1.75 each.

All kits supplied include fibre-glass PCB, all components and full documentation. Ready made kits available at £2 extra. Please add 8% VAT and 50p postage/packing.

J.W.M. (Electronics) Ltd., 60 Balcombe Street, London, N.W.1 TEL. 01-262 2936
01-402 9244

Perfect TV game

B. Harvey



The circuit shown allows a player to play tennis or squash against a perfect opponent, which is useful if one wishes to practise and cannot find another player.

The circuit 'plays' tennis or squash simply following the ball up and down the screen, thus it is always in the right place in order to hit the ball.

Although the circuit appears simple, (it only uses one gate from one IC!) the way it works is quite complex, suffice to say that it relies upon the way the AY-3-8500 games chip determines bat position from the setting of the hand controls.

The only modifications to the TV game are: (i) One lead connected to the ball video output of the games chip.

(ii) A switch wired in, selecting either a manual or an automatic player on the right hand bat.

(iii) This may not be necessary in home built games that use CMOS video mixers, but may have to be used in commercial units that sometimes use diode mixing circuits. The modification is shown and uses gates from the same IC. This will give a brighter bat and ball which is useful when playing squash.

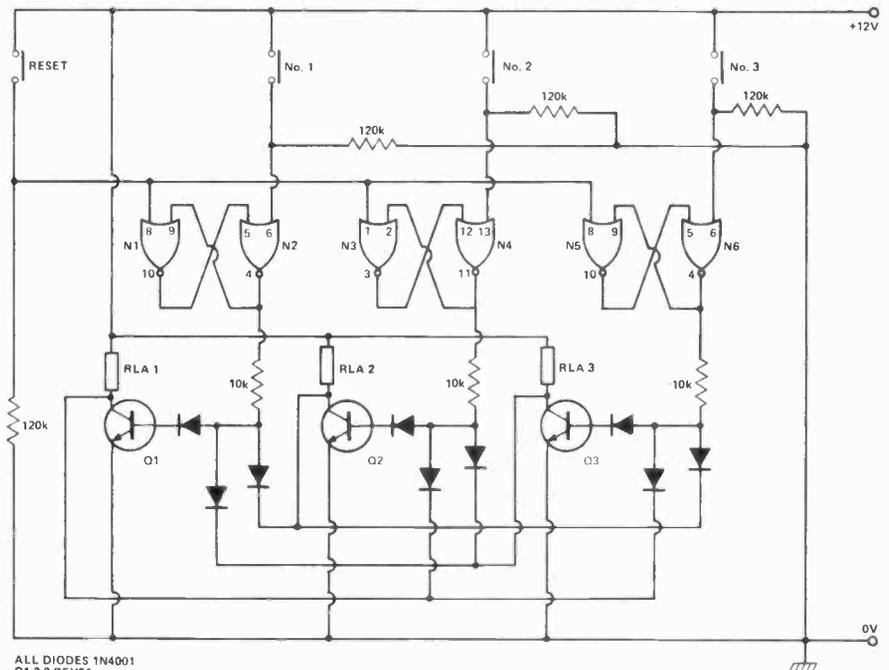
Sequence Switch

B. Willis.

The circuit right was designed to enable three relays to be individually switched by their appropriate buttons but such that only one relay can be energised at any one time. When any one relay has been energised the corresponding collector falls to near zero volts, which is connected to the base of the remaining two transistors; now if another relay is attempted to be energised the base of it's transistor will remain bottomed and keep the relay off. The rest button must be pressed before another relay can be energised. D1 ensures that each transistor is kept off until the voltage applied to the base exceeds 0.6 V.

The flip-flops and push buttons can of course be replaced with standard switches if momentary action is not required.

The circuit was used to control three radio transmitters where it was important that two should not be



ALL DIODES 1N4001
Q1,2,3 BFY51
N1 - N4 CD4001
N5, N6 74CD4001
RELAYS 120R OR ABOVE

switched on at the same time. The circuit lends itself to further applications; for example, switching various

inputs into an amplifier where it can replace the self-cancelling selector buttons.

ambit international [®]

The PW Sandbanks Metal Locator: a kit based on this recently published design for this uniquely effective type of metal locator is available for only £35.00 + 8% VAT. The kit closely resembles the appearance as published, except that a close fitting injection molded housing replaces the vacuum molded electronics box - to improve the environmental suitability of the construction. Carriage for complete kits £1.

The New Catalogue - "Tecknowledgey Part 2"

Part 2 of the catalogue: by the time this advert reaches the press, part 2 should be on sale. Sorry it's late, but it contains so many new and interesting things that we felt we had to hold up production to include them. Part three by the autumn - and ready there are many new items to go in! Part one 45p, part 2 50p. (inc PP etc).

Radio ICs	
TD1062	HF/VHF tunerhead 1.95
TD1083	One chip AM/FM rx 1.95
TD1090	One chip HiFi am/fm 3.35
TD1220	One chip am/fm rx 1.75
HA1197W	HiFi AM tuner IC 1.40
CA3123E	AM tuner IC 1.40
TBA651	AM tuner IC 1.81
CA3089E	Famous FM IF system 1.94
CA3189E	As 3089+ deviation mute 2.75
HA1137W	AF preamp, adj. agc 2.20
TBA120	improved S/N 3089 2.75
TBA120S	limiting amp+detector 0.75
MC1350P	high gain 1.00
MC1330P	agc'd IF preamp 1.20
MC1330P	synch AM/video detector 1.35
KB4406	Cascade IF preamp 0.85
uA753	limiting FM preamp 1.95

Communications circuits	
SD6000	DMOS RF/Mixer pair 3.75
KB4412	Bal mixers, IF+agc 2.55
KB4413	AM/SSB det. squelch, agc 2.75
KB4417	mic processor 2.55
MC3357	best thing in NBFM yet 3.12
MC1496P	popular double bal mixer 1.25
Multiplex decoders + noise blanker	
MC1310P	popular PLL decoder 2.20
uA758	buffered 1310 2.20
CA3090AQ	RCA PLL decoder 3.25
HA1196	improved PLL decoder with stereo preamps 3.95
HA11223	19kHz pilot cancel, low distortion, high S/N 4.35
KB4437	as HA11223 with remote VCD kill facility 4.55
KB4438	stereo MUTING preamp for post decoder mute 2.22
KB4423	impulse noise blanker 2.53

Discrete devices: more than ever:

BF960	800MHz/2.8dB nf mosfet 1.60*
BF961	200MHz/2.0dB nf .. 0.80*
40822	FM RF amp 0.43*
40823	FM mixer 0.51*
40673	Famous MOSFET 0.55*
2SJ49/2sK133	120v/100W MOSPOWER output devices 10.50*

LEDS:	the best value today		
	3mm	5mm	2.5x5mm
Red	0.14	0.14	0.17
Green	0.18	0.16	0.20
Yellow	0.18	0.15	0.20
Orange	0.22	0.29	0.24

100 off mix, 25% discount. All are AEG first grade types - absolutely no junk. 5mm clips for panel mounting 0.03 each

Misc. ICs for radio/audio applications	
UZ37B	5 LED bargraph driver 0.80*
SAS6610	4 station touch tune IC 1.48*
SAS6710	adds 4 stations to 6610 1.48
MSM5523/4	LW, MW, SW and FM digital frequency readout plus clock, timers, stopwatch £14*
MSM5526	LW/MW/FM DFM with direct drive for LCD £11*
TCA730	DC volume control 3.50
TCA740	DC tone control 3.50
TDA1028	DC input switch 3.50
TDA1029	DC mode switch 3.50

Radio and Tuner modules
We cannot really list all the details we would like to here - but with advent of the new mark 3 tuner system, the Dorchester and matching AF units, Ambit offers you the widest choice ever, plus hardware and styling that matches the very high standards we have set in this new range.

At last, DIY HiFi which looks as if it isn't.

That's not to say it doesn't look like HiFi - just that it doesn't look like the usual sort of thing you have come to associate with DIY HiFi. The Mk3 outstrips and outperforms all British made HiFi tuners, and most imported ones too. Certainly at the price, there isn't one near it. But more than that, it looks superb. A small pic here would be an insult, so send an SAE for details on the kit that looks as if it isn't. It's something else.....

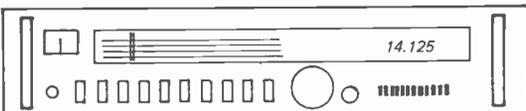
- * Exceptionally high performance - exceptionally straightforward assembly
- * Baseboard and plug-in construction. Future circuit developments will readily plug in, to keep the MkIII at the forefront of technical achievement
- * Various options and module line-ups possible to enable an installment approach to the system

and now previewing the matching 60W/channel VMOS amplifier:

- * Matching both the style and design concepts of the MkIII HiFi FM tuner
- * Hitachi VMOS power fets - characterized especially for HiFi applications
- * Power output readily multiplied by the addition of further MOSFETs
- * VU meters on the preamp - not simply dancing according to vol level
- * Backed with the usual Ambit expertise and technical capacity in audio

The PW Dorchester - LW, MW, SW, & FM stereo tuner

THE DIGITAL DORCHESTER ALL BAND TUNER



With styling and dimensions to fit in with the rest of AMBIT's new range of tuner & audio equipment.

When the new range of OKI digital frequency display ICs was announced, the original prototype of the Dorchester had been made - but since so many of you wanted to use the OKI frequency counterdisplay system with the Dorchester, we quickly designed a unit to incorporate the necessary facilities. The Digital Dorchester is designed in 19 inch form, and forms a perfect match for the other units in the range. If you don't want to go to the expense of the full Ambit DFM1 module, with AM/FM/Time/Timers, then the MA1023 clock module can be used instead.

The Dorchester has been described in PW Dec., Jan. and Feb. issues - but for those of you who may have missed it - it is an All Band broadcast tuner, covering LW/MW/SW and FM stereo in 6 switched ranges. Construction is very straightforward, with all the switching being PCB mounted - and the revolutionary TDA1090 IC used for AM/FM.

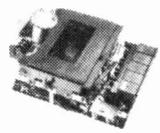
The electronics for the radio section of the Dorchester remain unchanged at £33.00, with 12.5% VAT. The hardware package, of case, meter, PSU now costs £33.00 + 8% with the MA1023 available for an extra £5 only. For the fully digital version, with Ambit DFM1, the price is £56.50 + 8% VAT.

TERMS etc: CWD please, VAT on Ambit items is generally 12%, except where marked (*). Catalogue part 1:45p, part 2 50p all inclusive. Postage 25p per order, carriage on tuner kits £3. Phone Brentwood (0277) 216029/227050 9am-7pm. Callers welcome inc. Saturdays.

2 Gresham Road, Brentwood, Essex.

AUDIO MODULES 1 Stereo Cassette Deck N999

Complete with electronics uses: Music centres, disco consols, tape editing, etc. Freq resp 63 Hz-10KHz. WOW: 0.15% FLUTTER: 0.18% channel; separation 55dB. Electronic speed control. ALC Mic and line inputs. JAPANESE manufacture - requires 12 VDC. **£23.95.**



RF MODULES 6 Surplus RF Board 020

Complete MW / LW / FM / MPX Tuner uses 3-stage FET front end 2 ceramic filters 3089E-1310 Decoder. AM section built around 3132E, 2-stage tuning comes with 4-way switch - ferrite rod aerial. **£9.99.**



2 Preamp Amp - PSU Wimborne 11W per channel.

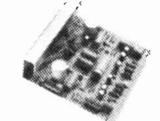
Four Rotary controls. Vol., Bass, Treble, Bal. 2 x PSUs for RF Board - cassette deck, LM 387 preamp IC driver. TIP 31 - TIP 32 Output Pairs. Special price includes transformer, **£16.95.** (October, 1978, PW).



7 RF 030

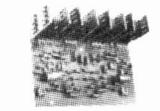
Improved version of above extra gain stage imposed S/N ratio and 1.5 µV sensitivity for 26dB S/N way selector switch AFC stereo/mono switching - two additional inputs. **£19.95.**

3 AMP 041 8 watt RMS per channel amp - preamp supplied with pots. Fully complementary requires 28 VDC. Price complete **£6.99.**



8 RF 040 MW/LW/FM/MPX varicap tuned RF board as per 78 Nov./Dec. PW Dual gate MOSFET front end, 2 x 1F gain stages 3189 Deviation mute, interstation mute, MPX filters. STAB PSU 1µV sensitivity and 75dB S/N ratio. AM Section also varicap tuned HA1197, excellent performance. Special price **£28.95.**

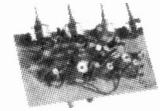
4 AMP 020 Stereo power amp 30 W RMS per channel. Class AB1 TIP 34A - TIP 33A. 16 Transistor circuit. Fre. resp. 15Hz - 18 KHz - 1dB. **£7.99.**



9 VT01 108-150MHz MOSFET front end 26dB gain. 10.7MHz 1F output. Covers 2 metres. Amateurs. Aircraft, etc. **£7.99.**



5 Matching Hi-Fi Preamplifier, four rotary controls, Vol., Bal., Treble, Bass. Treble - 14dB Bass-14dB facility for loudness control. **£6.99.**



10 IF15 Matching IF Strip double conversion 10.7MHz/470 KHz AM/NB/FM. Excellent performance. **£12.95.**

We have all parts in stock for the Wimborne Music Centre - parts for amps / tuner amps and music centres up to 25 watts per channel. We stock all hardware and trim to give units a professional finish. Front panels, meters, knobs, sockets, etc

ESE RAILWAY HOUSE, HARDHAM CROSSING, PULBOROUGH, SUSSEX

OSTS

Since AMBIT introduced the "One Stop Technology Shop" to our service, we have been pleased to see just how many users of electronic components appreciate our guarantee to supply goods only from BS9000 approved sources. More than ever, professional and amateur electronics engineers cannot afford to waste time on anything less than perfect pedigree products.

SEE THE AMBIT AD TOO!

CD4000 CMOS

4000	17p	4059	563p	4522	149p
4001	17p	4060	115p	4527	157p
4002	17p	4063	109p	4528	102p
4006	109p	4066	53p	4529	141p
4007	18p	4067	40p	4530	90p
4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	380p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	150p
4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
4047	99p	4513	206p		
4048	60p	4514	260p		
4049	55p	4515	300p		
4050	55p	4516	125p		
4051	65p	4517	32p		
4052	65p	4518	103p		
4053	65p	4519	57p		
4054	120p	4520	109p		
4055	135p	4521	236p		

TERMS: CWO pes., VAT to be added at 8% (inland), pp 25p per order. When ordering from the OSTs and Ambit - a single combined remittance and pp charge is sufficient. Account details OA.

2 Gresham Road, Brentwood, Essex.

Micromarket PRICES SLASHED

6800 series	8216	1.95	2114	£10
6800P	8224	3.50	2708	£10.55
6820P	8228	4.78		
6850P	8251	6.25		
6810P	8255	5.40		
6852				
8080 series	2102	£1.70		
8080	2112	£3.40		
8212	2513	£7.54		
	4027	£5.78		

Voltage Regs

NEW LOW PRICES
 7800 series UC TO220 package 1A all 95p
 7900 series UC TO220 package 1A all £1
 78MUC series TO220 package 1/2A all 90p
 78LCP series TO92 100mA all 35p
 L200 up to 3A/adjustable V&A 195p
 78MGT2C 1/2amp adjustable volts 175p
 79MGT2C 1/2amp adjustable volts 175p
 723C precision controller 65p
MAINS FILTERS FOR NOISE/RFI etc
 1 amp in IEC connector £4.83
 5 amp in 'wire in' case £3.87
 NE550A 73p

LINEARS non-consumer

BIMOS			
CA3130E	84p	LM339N	66p
CA3130T	90p	LM348N	186p
CA3140E	35p	LM3900N	60p
CA3140T	72p	709HC to5	64p
CA3160E	90p	709PC di	36p
CA3160T	99p	710HC to5	65p
		710PC di	59p
Op amps		723CN	65p
LM301AH	67p	741CH to5	66p
LM301AN	30p	741CN 8di	27p
LM308H	121p	747CN	70p
LM308N	77p	748CN	36p
LM318H	279p	NE531T	120p
LM318N	224p	NE531N	105p

OPTO 7 seg displays

0.43" High Efficiency HP:	
5082: 7650 red CA	
5082: 7653 red CC	
5082: 7660 yellow CA	233p
5082: 7663 yellow CA	
5082: 7670 green CA	
5082: 7673 green CC	
0.3" Standard HP	
5082: 7730 red CA	147p
5082: 7740 red CC	
0.5" Fairchild	
FND500 red CC	150p
FND507 red CA	150p

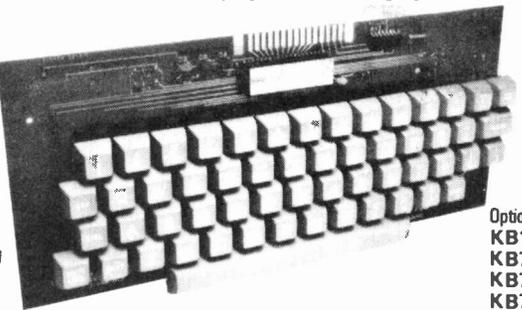
TTL: Standard AND LP Schottky

N'	LSN'	N'	LSN'	N'	LSN'	N'	LSN'	LSN				
7400	13	20	7455	35	24	74126	57	44	74185	134	74377	124
7401	13	20	7460	17		74128	74		74188	275	74378	93
7402	14	20	7463	17		74132	73	78	74190	115	74379	130
7403	14	20	7470	28		74133		29	74191		74386	37
7404	14	24	7472	32		74136		40	74192	105	74390	140
7405	18	26	7473	28		74138		60	74193	105	74395	139
7406	38		7474	27	38	74139		60	74194	105	74396	133
7407	38		7475	38	40	74141	56		74195	95	74398	180
7408	17	24	7476	37		74142	265		74196	99	74399	150
7409	17	24	7478			74143	312		74197	85	74445	92
7410	15	24	7480	48		74144	312		74198	150	74447	90
7411	20	24	7481	86		74145	65		74199	160	74490	140
7412	17	24	7482	69		74147	175		74248		74668	110
7413	30	52	7483A			74148	109		74249		74670	249
7414	51	130	7484	97		74150	99		74251		93	
7415	24		7485	104	99	74151	64	84	74253		90	MISCELLANY
7416	30		7486		40	74153	64	54	74257		108	NE555 30p
7417	30		7489	205		74154	96		74258		153	NE555 78p
7420	16	24	7490	33	90	74155	54	110	74259		420	NE555 180p
7421	29	24	7491	76	110	74156	80	110	74260		153	ICM7217 950p
7422	24	24	7492	38	78	74157	67	55	74261		353	ICM7208 1485p
7423	27		7493	32	99	74158		60	74266		40	LCD DVM IC
7425	27		7494	78		74159	210		74273		124	LCD DVM IC
7426	36	27	7495A	65	99	74160	82	130	74275		312	955p
7427	27	29	7496	58	120	74161	92	78	74279		105	LCD DVM KIT
7428	35	32	7497	185		74162	92	130	74283		120	2480p
7430	17	24	74100	119		74163	92	78	74290		90	3 1/2 digit LCD
7432	25	24	74104	63		74164	104		74293		95	display 1150p
7433	40	32	74105	62		74165	105		74295		120	ICL7107 LED
7437	40	24	74107	32	38	74166			74298		100	DVM kit 2065p
7438	33	24	74109	63	38	74167	20		74324		157	ICM7216 - 8 digit
7440	17	24	74110	54		74168			74325		242	10MHz DFM/
7441	74		74111	68		74169		200	74326		247	timer £19.82
7442	70	99	74112	88		74170	230	200	74327		247	(for LED C.Cath)
7443	115		74113		38	74172	625		74352		100	SCALAR ICs
7444	112		74114		38	74173	170		74353		100	8629 150MHz
7445	94		74116	198		74174	87	120	74362		715	divide by 100
7446	94		74118	83		74175	87	110	74365		49	420p
7447	82		74119	119		74176	75		74366		49	95H90DC 780p
7448	56	99	74120	115		74177	78		74367		43	11C90DC 1400p
7449	57	99	74121	25		74180	85		74368		49	8618 new-divide
7450	17		74122	46		74181	165	350	74373		77	by 10 or 10
7451	17		74123	48		74182	160		74374		77	for 120/60MHz
7453	17		74124			74183		210	74375		60	450p
7454	17	24	74125	38	44	74184	135					

The ICL7216BPI is still the cheapest way to make a full 8 digit/ 10MHz frequency counter/timer, and with 10 external components - display - it is also one of the simplest. For £19.82, it takes a lot of beating. The mains filters have been extended now to include a 5amp IEC version at £5.10, and with the amount of electronic noise on the average supply (next door's fridge, for instance) it is a really worthwhile addition to any sensitive equipment. LPSN TTL now includes many more of latest types, all - of course - are absolutely prime first quality types. And don't forget our range of OPTO displays includes Hewlett Package high efficiency 0.43" types in all colours - renowned as the finest quality in the market. For other types of component - discrete LEDs, radio and audio devices, tuner modules, kits etc., see our other advertisements for more details - or send for the AMBIT catalogue system. Part one (45p) includes details of our background 'standard' items, and the new part two includes all the latest introductions and developments, plus a rundown on OSTs.

NEW LOW PRICES

56-STATION ASCII KEYBOARD NOW IN STOCK - ASCII KEYBOARD MODEL KB756



KB756 mounted on PCB
ONLY £49.50
 (mail order total £55.08)

KB756M:F including metal mounting frame for extra rigidity,
ONLY £55.00 (mail order total £61.02)

SELF-SCAN ALPHANUMERIC PANEL DISPLAY
 16/18 position display with 64 character repertoire, 5x7 dot matrix. Input 6-bit BCD-code, power requirements +5v, -12v. Character size 0.40" x 0.28" Overall dimensions 8 1/4" x 2 1/4" x 1 1/4". Supplied with full technical data. Price £56.00 + 75p P&P + 8% VAT (Mail order total £60.21).

Optional Extras:		Mail Order Total
KB15P Edge Connector	£ 3.25	£ 4.05
KB701 Plastic Enclosure	£12.50	£ 14.31
KB702 Steel Enclosure	£25.00	£28.62
KB710 Numeric Pad	£ 8.00	£ 9.18
KB2376 Spare ROM Encoder	£12.50	£14.04

SEAELECTRO PATCH BOARDS

Programme boards for switching and interconnecting input/output circuits. 11 x 20 XY matrix. Interconnection is by means of shorting, skip and component holding pins (not supplied). Dimensions: 7 1/2" x 5 1/4" x 1"

PRICE: £12.50
 (mail order total £14.58)

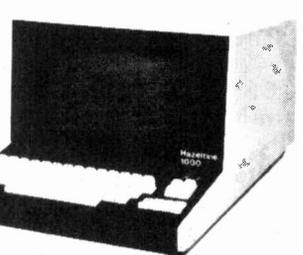
NEW KEYTOP/KEYSWITCH KITS

Pack of 56 keyswitches plus 56 keytops comprising standard ASCII character set. Ideal as basis for self-build keyboard projects.

BRAND NEW SURPLUS PRICE: £15.00
 (mail order total £17.28)

Reconditioned HAZELTINE VISUAL DISPLAY UNIT

- * Teletype Compatible
- * 12" Diagonal Screen
- * TTY Format Keyboard
- * 12 lines of 80 characters
- * 64 ASCII Character Set
- * 5 x 7 Dot Matrix
- * Switch-selectable Transmission Speeds up to 9600 baud
- * Switch-selectable Parity
- * Standard CCITT V.24 Interface



MODEL H-1000 PRICE £350 + carriage and VAT

Also available: -
Model H-2000: Buffered/Editing model with direct cursor addressing, dual intensity video, and detachable keyboard with separate numeric and edit clusters. 27 lines of 74 characters. Price £495.00 + carriage + VAT.

We also specialise in: DEC minis - PDP8 and PDP11 processors, add-on memory, peripherals and spares. Hard copy terminals - ASR 33 and KSR 33 Teletypes, Data Dynamics 390, Texas Silent 700. Send for complete lists.

ELECTRONIC BROKERS LTD.
 49-53 Pancras Road, London NW1 2QB.
 Tel: 01-837 7781. Telex: 298694.

A copy of trading conditions supplied on request

Marshall's Electronics



A. Marshall (London) Ltd., Dept. ETI. Head Office mail order: Kingsgate House, Kingsgate Place, NW6 4TA. Tel: 01-624 0805
 Retail Sales London: 40-42 Cricklewood Broadway, NW2 3ET. Tel: 01-452 0161/2. Telex: 21492. London: 325 Edgware Road, W2. Tel: 01-723 4242.
 Glasgow: 85 West Regent Street, G2 2QD. Tel: 041-332 4133. Bristol: 1 Straits Parade, Fishponds Road, B516 2LX. Tel: 0272 654201.

2N1304	0.80	2N3772	2.20	40409	0.82
2N1305	1.00 <td>2N3773</td> <td>3.15 <td>40410</td> <td>0.82</td> </td>	2N3773	3.15 <td>40410</td> <td>0.82</td>	40410	0.82
2N1306	1.00 <td>2N3819</td> <td>0.36 <td>40411</td> <td>3.10</td> </td>	2N3819	0.36 <td>40411</td> <td>3.10</td>	40411	3.10
2N1307	1.00 <td>2N3820</td> <td>0.39 <td>40412</td> <td>0.68</td> </td>	2N3820	0.39 <td>40412</td> <td>0.68</td>	40412	0.68
2N2219	0.38 <td>2N3903</td> <td>0.20 <td>40414</td> <td>4.99</td> </td>	2N3903	0.20 <td>40414</td> <td>4.99</td>	40414	4.99
2N2219A	0.39 <td>2N3904</td> <td>0.18 <td>40594</td> <td>0.87</td> </td>	2N3904	0.18 <td>40594</td> <td>0.87</td>	40594	0.87
2N2369	0.27 <td>2N3905</td> <td>0.18 <td>40595</td> <td>0.98</td> </td>	2N3905	0.18 <td>40595</td> <td>0.98</td>	40595	0.98
2N2369A	0.27 <td>2N3906</td> <td>0.18 <td>40636</td> <td>1.37</td> </td>	2N3906	0.18 <td>40636</td> <td>1.37</td>	40636	1.37
2N2646	1.70 <td>2N4036</td> <td>0.72</td> <td>40673</td> <td>0.80</td>	2N4036	0.72	40673	0.80
2N2647	1.55 <td>2N4037</td> <td>0.60</td> <td>40126</td> <td>0.48</td>	2N4037	0.60	40126	0.48
2N2904	0.75 <td>2N4400</td> <td>0.16</td> <td>40127</td> <td>0.54</td>	2N4400	0.16	40127	0.54
2N2905	0.31 <td>2N4401</td> <td>0.20</td> <td>40128</td> <td>0.48</td>	2N4401	0.20	40128	0.48
2N2906	0.25 <td>2N4402</td> <td>0.20</td> <td>40151</td> <td>0.54</td>	2N4402	0.20	40151	0.54
2N2907	0.25 <td>2N4403</td> <td>0.20</td> <td>40152</td> <td>0.54</td>	2N4403	0.20	40152	0.54
2N2908	0.17 <td>2N4559</td> <td>0.32</td> <td>40153</td> <td>0.59</td>	2N4559	0.32	40153	0.59
2N3053	0.25	2N6027	0.64	40153K	0.59
2N3054	0.72	2N6121	0.41	40176K	0.70
2N3055	0.75 <td>2N6122</td> <td>0.41</td> <td>40177</td> <td>0.70</td>	2N6122	0.41	40177	0.70
2N3402	0.21 <td>2N6123</td> <td>0.48</td> <td>40187</td> <td>0.59</td>	2N6123	0.48	40187	0.59
2N3404	0.21 <td>2N6124</td> <td>0.45</td> <td>40187K</td> <td>0.65</td>	2N6124	0.45	40187K	0.65
2N3405	0.21 <td>2N6125</td> <td>0.47</td> <td>40188</td> <td>0.65</td>	2N6125	0.47	40188	0.65
2N3663	0.29 <td>2N6126</td> <td>0.48</td> <td>40188K</td> <td>0.64</td>	2N6126	0.48	40188K	0.64
2N3702	0.14	3N81	3.50	40136	2.75
2N3703	0.14	3N140	1.10	40142	1.45
2N3704	0.14	3N141	1.10	40143	1.45
2N3705	0.14	3N142	0.75	40149	2.85
2N3706	0.14	3N200	2.85	40150	3.10
2N3707	0.14	3N201	1.35	40161	1.00
2N3708	0.12	40661	0.55	40162	1.00
2N3709	0.12	40662	0.55	40163	1.00
2N3710	0.12	40613	1.45	40165	0.70
2N3711	2.15	40408	0.82	40200	1.30

BC307	0.16	BCY70	0.21	BF224J	0.22
BC307A	0.16 <td>BCY71</td> <td>0.26 <td>BF225J</td> <td>0.27</td> </td>	BCY71	0.26 <td>BF225J</td> <td>0.27</td>	BF225J	0.27
BC307B	0.16 <td>BCY72</td> <td>0.18 <td>BF337</td> <td>0.49</td> </td>	BCY72	0.18 <td>BF337</td> <td>0.49</td>	BF337	0.49
BC308	0.16 <td>BCY77</td> <td>0.70 <td>BF538</td> <td>0.52</td> </td>	BCY77	0.70 <td>BF538</td> <td>0.52</td>	BF538	0.52
BC308A	0.16 <td>BCY78</td> <td>2.20 <td>BF540</td> <td>0.24</td> </td>	BCY78	2.20 <td>BF540</td> <td>0.24</td>	BF540	0.24
BC308B	0.16 <td>BCY80</td> <td>2.20 <td>BF541</td> <td>0.22</td> </td>	BCY80	2.20 <td>BF541</td> <td>0.22</td>	BF541	0.22
BC309	0.16 <td>BCY81</td> <td>0.55 <td>BF539</td> <td>0.30</td> </td>	BCY81	0.55 <td>BF539</td> <td>0.30</td>	BF539	0.30
BC309A	0.16 <td>BCY82</td> <td>0.75 <td>BF840</td> <td>0.29</td> </td>	BCY82	0.75 <td>BF840</td> <td>0.29</td>	BF840	0.29
BC309B	0.16 <td>BCY83</td> <td>0.40 <td>BF838</td> <td>0.30</td> </td>	BCY83	0.40 <td>BF838</td> <td>0.30</td>	BF838	0.30
BC309C	0.16 <td>BCY84</td> <td>0.40 <td>BF839</td> <td>1.37</td> </td>	BCY84	0.40 <td>BF839</td> <td>1.37</td>	BF839	1.37
BC310	0.16 <td>BCY85</td> <td>0.41 <td>BF550</td> <td>0.35</td> </td>	BCY85	0.41 <td>BF550</td> <td>0.35</td>	BF550	0.35
BC310A	0.16 <td>BCY86</td> <td>0.41 <td>BF551</td> <td>0.35</td> </td>	BCY86	0.41 <td>BF551</td> <td>0.35</td>	BF551	0.35
BC310B	0.16 <td>BCY87</td> <td>0.41 <td>BF552</td> <td>0.35</td> </td>	BCY87	0.41 <td>BF552</td> <td>0.35</td>	BF552	0.35
BC310C	0.16 <td>BCY88</td> <td>0.43 <td>BF900</td> <td>1.35</td> </td>	BCY88	0.43 <td>BF900</td> <td>1.35</td>	BF900	1.35
BC311	0.16 <td>BCY89</td> <td>0.70 <td>BR101</td> <td>0.55</td> </td>	BCY89	0.70 <td>BR101</td> <td>0.55</td>	BR101	0.55
BC312	0.12 <td>BCY90</td> <td>0.44 <td>BR339</td> <td>0.57</td> </td>	BCY90	0.44 <td>BR339</td> <td>0.57</td>	BR339	0.57
BC312A	0.12 <td>BCY91</td> <td>0.59 <td>BSY95A</td> <td>0.35</td> </td>	BCY91	0.59 <td>BSY95A</td> <td>0.35</td>	BSY95A	0.35
BC312B	0.12 <td>BCY92</td> <td>0.48 <td>BU194</td> <td>1.80</td> </td>	BCY92	0.48 <td>BU194</td> <td>1.80</td>	BU194	1.80
BC312C	0.12 <td>BCY93</td> <td>0.59 <td>BU105</td> <td>1.55</td> </td>	BCY93	0.59 <td>BU105</td> <td>1.55</td>	BU105	1.55
BC313	0.12 <td>BCY94</td> <td>1.55 <td>BU109</td> <td>2.00</td> </td>	BCY94	1.55 <td>BU109</td> <td>2.00</td>	BU109	2.00
BC313A	0.12 <td>BCY95</td> <td>1.90 <td>BU126</td> <td>2.06</td> </td>	BCY95	1.90 <td>BU126</td> <td>2.06</td>	BU126	2.06
BC313B	0.12 <td>BCY96</td> <td>2.10 <td>BU204</td> <td>2.20</td> </td>	BCY96	2.10 <td>BU204</td> <td>2.20</td>	BU204	2.20
BC313C	0.12 <td>BCY97</td> <td>5.90 <td>BU205</td> <td>2.40</td> </td>	BCY97	5.90 <td>BU205</td> <td>2.40</td>	BU205	2.40
BC314	0.12 <td>BCY98</td> <td>6.50 <td>BU206</td> <td>2.70</td> </td>	BCY98	6.50 <td>BU206</td> <td>2.70</td>	BU206	2.70
BC314A	0.12 <td>BCY99</td> <td>0.39 <td>BU209</td> <td>2.70</td> </td>	BCY99	0.39 <td>BU209</td> <td>2.70</td>	BU209	2.70
BC314B	0.12 <td>BCY00</td> <td>0.37 <td>J310</td> <td>0.64</td> </td>	BCY00	0.37 <td>J310</td> <td>0.64</td>	J310	0.64
BC314C	0.12 <td>BCY01</td> <td>0.16 <td>J300</td> <td>0.37</td> </td>	BCY01	0.16 <td>J300</td> <td>0.37</td>	J300	0.37
BC314D	0.12 <td>BCY02</td> <td>0.16 <td>ME401</td> <td>0.22</td> </td>	BCY02	0.16 <td>ME401</td> <td>0.22</td>	ME401	0.22
BC315	0.12 <td>BCY03</td> <td>0.18 <td>ME402</td> <td>0.17</td> </td>	BCY03	0.18 <td>ME402</td> <td>0.17</td>	ME402	0.17
BC315A	0.12 <td>BCY04</td> <td>0.19 <td>ME4011</td> <td>0.22</td> </td>	BCY04	0.19 <td>ME4011</td> <td>0.22</td>	ME4011	0.22
BC315B	0.12 <td>BCY05</td> <td>0.19 <td>ME4012</td> <td>0.22</td> </td>	BCY05	0.19 <td>ME4012</td> <td>0.22</td>	ME4012	0.22
BC315C	0.12 <td>BCY06</td> <td>0.19 <td>ME4013</td> <td>0.22</td> </td>	BCY06	0.19 <td>ME4013</td> <td>0.22</td>	ME4013	0.22
BC315D	0.12 <td>BCY07</td> <td>0.19 <td>ME4014</td> <td>0.22</td> </td>	BCY07	0.19 <td>ME4014</td> <td>0.22</td>	ME4014	0.22
BC315E	0.12 <td>BCY08</td> <td>0.19 <td>ME4015</td> <td>0.22</td> </td>	BCY08	0.19 <td>ME4015</td> <td>0.22</td>	ME4015	0.22

WE STOCK MORE

Stocking distributors officially appointed:

NATIONAL	VERO
TEXAS	ANTEX
MULLARD	ELECTROLUBE
SIEMENS	SIFAM
SECOSEMI	ARROW HART

makes components buying easy

NEW 1979 CATALOGUE

48-page catalogue — new enlarged micro section — largest range of quality components from franchised suppliers available in the UK. All VAT inclusive prices. Over 8,500 line items plus lots more. 50p post paid or 40p to callers at any of our four branches.

MAIL ORDER

Quick service on all orders — please add 40p for p.&p. Telephone orders £10 minimum.

Credit cards welcome.

CA3018	0.75	LM340T-5	0.88	LM1496N	0.97
CA3020	2.20	LM340T-12	0.88	LM1800N	1.94
CA3020A	0.90	LM340T-15	0.88	LM1801N	2.25
CA3025A	1.25	LM340T-24	0.88	LM1808N	2.10
CA3026B	1.50	LM341P-5	0.56	LM1812N	6.20
CA3030A	2.20	LM341P-12	0.56	LM1820N	1.16
CA3038	2.90	LM341P-15	0.56	LM1828N	1.90
CA3038A	4.10	LM345X	0.97	LM1830A	1.90
CA3045	1.55	LM348N	0.95	LM1845N	1.50
CA3045A	0.77	LM348N	0.95	LM1848N	1.98
CA3048	2.45	LM350K	0.60	LM1850N	1.90
CA3052	1.78	LM358N	0.60	LM1889N	2.50
CA3080	0.85	LM360N	3.00	LM1890N	2.00
CA3080A	2.10	LM370N	3.30	LM2070K-8	1.80
CA3086	0.50	LM371N	2.35	LM2517N-8	1.00
CA3086E	1.87	LM373N	3.35	LM3010N	0.60
CA3092	2.90	LM374N	3.35	LM3020N	0.55
CA3090	4.40	LM377N	1.80	LM3022N	0.55
CA3130	1.06	LM378N	2.40	LM3900N	0.68
CA3140	1.04	LM3795N	4.25	LM3905N	1.15
LF355N	0.80	LM380N-8	1.06	LM3909N	0.78
LF357N	0.80	LM381A	2.05	LM3913N	1.10
LF1320N1	3.00	LM381A	1.69	LM3913N	1.10
LF1333N1	3.00	LM382N	1.32	LM3913N	1.10
LF1374N1	0.49	LM384A	1.55	LM3913N	1.10
LM3011	0.38	LM386N	0.88	LM3915K	1.56
LM3017	0.50	LM387N	1.10	LM3920K	1.56
LM308N	0.55	LM388N	1.00	LM3920K	1.56
LM309K	1.95	LM389N	1.00	LM3920K	1.56
LM317K	3.35	LM390N	0.81	LM3920K	1.56
LM317MP	1.35	LM390N	0.81	LM3920K	1.56
LM317T	2.20	LM390N	0.81	LM3920K	1.56
LM318N	2.45	LM390N	0.81	LM3920K	1.56
LM3201-5	1.86	LM390N	0.81	LM3920K	1.56
LM3201-12	1.86	LM390N	0.81	LM3920K	1.56
LM3201-15	1.86	LM390N	0.81	LM3920K	1.56
LM3201-24	1.86	LM390N	0.81	LM3920K	1.56
LM320MP-5	1.15	LM390N	0.81	LM3920K	1.56
LM320MP-12	1.15	LM390N	0.81	LM3920K	1.56
LM320MP-15	1.15	LM390N	0.81	LM3920K	1.56
LM320MP-24	1.15	LM390N	0.81	LM3920K	1.56
LM322K	5.75	LM390N	0.81	LM3920K	1.56
LM324	0.75	LM390N	0.81	LM3920K	1.56
LM325	1.70	LM390N	0.81	LM3920K	1.56
LM337K	3.86	LM390N	0.81	LM3920K	1.56
LM337MP	1.78	LM390N	0.81	LM3920K	1.56
LM337T	2.98	LM390N	0.81	LM3920K	1.56
LM338K	P.O.A.	LM390N	0.81	LM3920K	1.56
LM339N	0.60	LM390N	0.81	LM3920K	1.56

EXPAND AND GROW WITH KIM

AMERICA'S FASTEST SELLING MOST POPULAR 6502 BASED SYSTEM — EASILY EXPANDED INTO A PERSONAL HOME COMPUTER NEW LOW PRICE

The basic KIM 2 includes Hex keyboard and display, audio cassette interface, VDU interface. Superb documentation, 2K monitor software in ROM. Powerful instruction set. The beauty of this system is the ease of extension and versatility, with all the possible future requirements catered for. Up and running in minutes. Any future benefits from Commodore PET computer will be software compatible with their KIM system and in fact your KIM system has the design flexibility to suit any requirements.

KIM 15 EXPANDABLE — Expand as you learn up to 65K.
 Documentation, 2K monitor software in ROM. Powerful instruction set. £108.00

KIM 3 — 8K static RAM card plugs into motherboard. £141.00

KIM 4 — Motherboard (takes 6 x KIM 3) + power supply. £75.50

The Commodore PET and KIM are both based on the 6502 micro VDU INTERFACE — VDU card — takes control. £151.00

Fully assembled TTY Card — ASCII keyboard in — converts TV set to cheap computer terminal via aerial socket. Also standard RS232C connector for micro, computer or modem. 16 lines x 8 characters. SEND SAE NOW FULL DETAILS.

PET 2001 COMPUTER

Suitable for educational, commercial, scientific and domestic applications. Memory-8k ram (expandable to 32k external). Display — 1,000 characters 40 col x 25 rows. Keyboard — full ASCII character set + graphics, separate numeric keypad. Other features include — reliable cassette unit, comprehensive I/O facilities, 8K resident basic interpreter. Send SAE 9" x 6" for data and software list.

HARDWARE PRICES
 PET 2001-8 695.00 PET SECOND CASSETTE 59.40 PET 2001 PRINTER 459.00

SN7400N	0.17	SN7480N	0.60	SN74181N	2.00
SN7401N	0.17 <td>SN7481N</td> <td>1.00 <td>SN74182N</td> <td>0.80</td> </td>	SN7481N	1.00 <td>SN74182N</td> <td>0.80</td>	SN74182N	0.80
SN7402N	0.17 <td>SN7482N</td> <td>1.00 <td>SN74184N</td> <td>1.50</td> </td>	SN7482N	1.00 <td>SN74184N</td> <td>1.50</td>	SN74184N	1.50
SN7404N	0.15 <td>SN7483N</td> <td>1.05 <td>SN74185N</td> <td>1.50</td> </td>	SN7483N	1.05 <td>SN74185N</td> <td>1.50</td>	SN74185N	1.50
SN7405N	0.22 <td>SN7484N</td> <td>1.20 <td>SN74186N</td> <td>1.07</td> </td>	SN7484N	1.20 <td>SN74186N</td> <td>1.07</td>	SN74186N	1.07
SN7406N	0.39 <td>SN7485N</td> <td>0.80 <td>SN74188N</td> <td>2.10</td> </td>	SN7485N	0.80 <td>SN74188N</td> <td>2.10</td>	SN74188N	2.10
SN7407N	0.39 <td>SN7486N</td> <td>0.36 <td>SN74189N</td> <td>0.60</td> </td>	SN7486N	0.36 <td>SN74189N</td> <td>0.60</td>	SN74189N	0.60
SN7408N	0.22 <td>SN7487N</td> <td>0.36 <td>SN74190N</td> <td>2.85</td> </td>	SN7487N	0.36 <td>SN74190N</td> <td>2.85</td>	SN74190N	2.85
SN7409N	0.22 <td>SN7488N</td> <td>0.36 <td>SN74191N</td> <td>0.90</td> </td>	SN7488N	0.36 <td>SN74191N</td> <td>0.90</td>	SN74191N	0.90
SN7410N	0.22 <td>SN7489N</td> <td>0.36 <td>SN74192N</td> <td>0.90</td> </td>	SN7489N	0.36 <td>SN74192N</td> <td>0.90</td>	SN74192N	0.90
SN7411N	0.20 <td>SN7490N</td> <td>0.60 <td>SN74192N</td> <td>1.87</td> </td>	SN7490N	0.60 <td>SN74192N</td> <td>1.87</td>	SN74192N	1.87
SN7412N	0.20 <td>SN7490A</td> <td>0.60 <td>SN74193N</td> <td>0.90</td> </td>	SN7490A	0.60 <td>SN74193N</td> <td>0.90</td>	SN74193N	0.90
SN7413N	0.20 <td>SN7491A</td> <td>0.60 <td>SN74194N</td> <td>0.55</td> </td>	SN7491A	0.60 <td>SN74194N</td> <td>0.55</td>	SN74194N	0.55
SN7414N	0.36 <td>SN7492A</td> <td>0.60 <td>SN74195N</td> <td>0.55</td> </td>	SN7492A	0.60 <td>SN74195N</td> <td>0.55</td>	SN74195N	0.55
SN7415N	0.36 <td>SN7493A</td> <td>0.60 <td>SN74196N</td> <td>0.90</td> </td>	SN7493A	0.60 <td>SN74196N</td> <td>0.90</td>	SN74196N	0.90
SN7416N	0.25 <td>SN7494A</td> <td>0.90 <td>SN74197N</td> <td>0.85</td> </td>	SN7494A	0.90 <td>SN74197N</td> <td>0.85</td>	SN74197N	0.85
SN7417N	0.25 <td>SN7495A</td> <td>0.76 <td>SN74198N</td> <td>1.25</td> </td>	SN7495A	0.76 <td>SN74198N</td> <td>1.25</td>	SN74198N	1.25
SN7418N	0.22 <td>SN7496A</td> <td>0.54 <td>SN74199N</td> <td>1.25</td> </td>	SN7496A	0.54 <td>SN74199N</td> <td>1.25</td>	SN74199N	1.25
SN7419N	0.22 <td>SN7497A</td> <td>0.54 <td>SN74200N</td> <td>6.70</td> </td>	SN7497A	0.54 <td>SN74200N</td> <td>6.70</td>	SN74200N	6.70
SN7420N	0.22 <td>SN7498A</td> <td>0.54 <td>SN74201N</td> <td>1.36</td> </td>	SN7498A	0.54 <td>SN74201N</td> <td>1.36</td>	SN74201N	1.36
SN7421N	0.22 <td>SN7499A</td> <td>0.54 <td>SN74202N</td> <td>1.87</td> </td>	SN7499A	0.54 <td>SN74202N</td> <td>1.87</td>	SN74202N	1.87
SN7422N	0.22 <td>SN7500N</td> <td>0.54 <td>SN74203N</td> <td>0.55</td> </td>	SN7500N	0.54 <td>SN74203N</td> <td>0.55</td>	SN74203N	0.55
SN7423N	0.22 <td>SN7501N</td> <td>0.54 <td>SN74204N</td> <td>0.55</td> </td>	SN7501N	0.54 <td>SN74204N</td> <td>0.55</td>	SN74204N	0.55
SN7424N	0.22 <td>SN7502N</td> <td>0.54 <td>SN74205N</td> <td>0.55</td> </td>	SN7502N	0.54 <td>SN74205N</td> <td>0.55</td>	SN74205N	0.55
SN7425N	0.22 <td>SN7503N</td> <td>0.54 <td>SN74206N</td> <td>0.55</td> </td>	SN7503N	0.54 <td>SN74206N</td> <td>0.55</td>	SN74206N	0.55
SN7426N	0.22 <td>SN7504N</td> <td>0.54 <td>SN74207N</td> <td>0.55</td> </td>	SN7504N	0.54 <td>SN74207N</td> <td>0.55</td>	SN74207N	0.55
SN7427N	0.22 <td>SN7505N</td> <td>0.54 <td>SN74208N</td> <td>0.55</td> </td>	SN7505N	0.54 <td>SN74208N</td> <td>0.55</td>	SN74208N	0.55
SN7428N	0.22 <td>SN7506N</td> <td>0.54 <td>SN74209N</td> <td>0.55</td> </td>	SN7506N	0.54 <td>SN74209N</td> <td>0.55</td>	SN74209N	0.55
SN7429N	0.22 <td>SN7507N</td> <td>0.54 <td>SN74210N</td> <td>0.55</td> </td>	SN7507N	0.54 <td>SN74210N</td> <td>0.55</td>	SN74210N	0.55
SN7430N	0.22 <td>SN7508N</td> <td>0.54 <td>SN74211N</td> <td>0.55</td> </td>	SN7508N	0.54 <td>SN74211N</td> <td>0.55</td>	SN74211N	0.55
SN7431N	0.22 <td>SN7509N</td> <td>0.54 <td>SN74212N</td> <td>0.55</td> </td>	SN7509N	0.54 <td>SN74212N</td> <td>0.55</td>	SN74212N	0.55
SN7432N	0.22 <td>SN7510N</td> <td>0.54 <td>SN74213N</td> <td>0.55</td> </td>	SN7510N	0.54 <td>SN74213N</td> <td>0.55</td>	SN74213N	0.55
SN7433N	0.22 <td>SN7511N</td> <td>0.54 <td>SN74214N</td> <td>0.55</td> </td>	SN7511N	0.54 <td>SN74214N</td> <td>0.55</td>	SN74214N	0.55
SN7434N	0.22 <td>SN7512N</td> <td>0.54 <td>SN74215N</td> <td>0.55</td> </td>	SN7512N	0.54 <td>SN74215N</td> <td>0.55</td>	SN74215N	0.55
SN7435N	0.22 <td>SN7513N</td> <td>0.54 <td>SN74216N</td> <td>0.55</td> </td>	SN7513N	0.54 <td>SN74216N</td> <td>0.55</td>	SN74216N	0.55
SN7436N	0.22 <td>SN7514N</td> <td>0.54 <td>SN74217N</td> <td>0.55</td> </td>	SN7514N	0.54 <td>SN74217N</td> <td>0.55</td>	SN74217N	0.55
SN7437N	0.22 <td>SN7515N</td> <td>0.54 <td>SN74218N</td> <td>0.55</td> </td>	SN7515N	0.54 <td>SN74218N</td> <td>0.55</td>	SN74218N	0.55

EMI SPEAKER BARGAIN

Stereo pair 350 kit. System consists of 13" x 8" approx. woofer with rolled surround, 2 1/2" approx. Audax tweeter, crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS, 20 watts max. 8 ohm impedance.

£14.95 Per stereo pair + £3.40 p&p.

★ As above but complete with all woodwork in kit form, finished in simulated teak veneer, with instructions. **£28.00** Per stereo pair Size approx 20" x 11" x 9 1/2" + £5.00 p&p.



BSR Manual single play record deck with auto-return and cueing lever, fitted with stereo ceramic cartridge 2 speeds with 45 r.p.m spindle-adaptor ideally suited from home or disco use. **£10.95** p&p **£2.55**

TURNTABLE BARGAINS FOR PERSONAL SHOPPERS

GARRARD 86SB Deck **£26.95** | GARRARD SP25 MKIV Deck with Shure head **£25.95**
Plinth and cover for BSR decks **£6.00**

BARGAINS FOR PERSONAL SHOPPERS

PORTABLE STEREO RADIO CASSETTE RECORDER UNREPEATABLE



MW, LW, SW and Stereo VHF 6 watts output Battery/Mains operation **£69.95**
160 16 VOLT MAINS TRANSFORMER, 2 1/2 amp. **£2.50**

Garrard Record auto deck on plinth with stereo cartridge ready wired **£18.95**

LED 5 function men's digital watch stainless steel finish **£5.95**

LCD 5 function men's digital watch stainless steel finish **£6.95**

LCD 8 Function CHRONOGRAPH men's digital watch, stainless steel finish **£13.95**

Battery/Mains Cassette Recorder with built-in Mic. **£12.95**

AM/FM DIGITAL CLOCK RADIO Accurate 4 Digit Electronic Clock with 1/2" LED display, Buzzer and snooze timer. **£11.95**

125 Watt Power Amp Module **£13.95**

Mains power supply for above unit. **£3.50**

MUSIC CENTRE CABINET with hinged smoke acrylic top, finished in natural teak veneers, size 30 1/2" x 14 1/2" x 7 1/2" approx. **£5.95**

MULLARD Built power supply **£1.50**

DECCA DC 1000 Stereo Cassette P.C.B. complete with switch oscillator coils and tape-heads. **£2.95**

DECCA 20w Stereo speaker kit comprising 2 8" approx. bass units + 2 3 1/2" approx. tweeter inc. crossovers **£20.00**

VIDEOMASTER Super Score TV Game with pistol mains operation **£14.95**

PORTABLE RADIO/CASSETTE RECORDER, AM/FM with clock. LW, MW, SW, VHF mains/battery operation. **£41.95**

7" TAPE TRANSPORT Mechanism—a selection of models from **£8.95**

SANYO Nic/cad battery, with mains charger equivalent in size and replaces 4 SP11 type batts. Size 3 3/4" x 1 1/4" x 2" approx. **£7.50** p&p **£1.50p**

AM/FM STEREO TUNER AMPLIFIER CHASSIS COMPLETE WITH DECODER

Ready built. Designed in a slim form for compact, modern installation. Rotary Controls Vol On/Off, Bass, Treble, Balance. Push Buttons for Gram, Tape, VHF, MW, LW.

Power Output 5 watts per channel Sine at 2% THD into 15 Ohm 7 watts speech and music.

Tape Sensitivity Playback 400mV/30K OHM for max output Record 200mV/50K output available from 25KHz (150mV/100K) deviation

FM signal Frequency Range (Audio) 50Hz to 17KHz within ±1dB

Radio FM sensitivity for 3dB below limiting better than 10 uV

AM sensitivity for 20dB S/N MW 350 uV/Metre LW 1mV/Metre

Size approx length 16 1/2" x height 2 1/4" x depth 4 1/4" **£19.95** p&p **£2.50**

240 Volts AC Complete with Circuit diagram.

Mullard

AUDIO MODULES IN BARGAIN PACKS

CURRENT CATALOGUE PRICE £ AT OVER 25 PER PACK

SEE OUR PRICES

1 PACK 1. 2 x LP1173 10w. RMS output power audio amp modules, +1 LP1182/2 Stereo pre amp for ceramic and auxiliary input. **OUR PRICE £4.95** p+p **£1.00**

2 PACK 2. 2 x LP1173 10w. RMS output power audio amp modules + 1 LP1184/2 Stereo pre amp for magnetic, ceramic and auxiliary inputs. **OUR PRICE £7.45** p+p **£1.00**

illus. **OUR PRICE £7.45** p+p **£1.00**

ACCESSORIES

Suitable power supply parts including mains transformer, rectifier, smoothing and output capacitors. **£1.00** p+p **£1.95**

Recommended set of rotary stereo controls comprising BASS, TREBLE, VOLUME and BALANCE. **p+p 50p 95p**



GARRARD BARGAIN

LIST PRICE ~~£95.00~~

OUR PRICE **£39.95**

86 SB MKII. Belt drive, 2 speed turntable module with plinth and cover.



20 x 20 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet. Silver fascia with aluminium rotary controls/pushbuttons, red mains indicator and stereo jack socket. Functions switch for mic, magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features two mains outlets DIN speaker and input sockets plus fuse 20x20 watts RMS 40x40 watts peak. For use with 8 to 15 ohm speakers **£29.90** + £2.50 p&p

SPECIAL OFFER **FOR PERSONAL SHOPPERS ONLY**

FREE 4 dimensional stereo sound adaptor, when purchasing the 20x20 Viscount amplifier.

30x30 WATT AMPLIFIER IN KIT FORM

For the experienced constructor complete in every detail, same facilities as Viscount IV, but with 30x30 output. 60x60 watts peak. For use with 4-15 ohms speakers. **£23.00** without cabinet. **£29.00** complete with cabinet. p&p **£2.50** in each case.

£23.00 + £2.50 (NOTE Cabinet not without cabinet p&p available separately.) **£29.00** + p&p **£2.50** complete with cabinet.

SPECIAL OFFER Complete with case **30x30 WATT AMPLIFIER IN KIT WITH SPEAKERS**

2 Goodman compact 12" bass woofers with cropped size 14,000 Gauss magnet. 30 watt RMS handling + 3 1/4" approx. tweeters and crossovers. **£49.00** + p&p **£4.00**

BUILT AND READY TO PLAY **39.00** + p&p **£2.50**

30x30 Viscount. Available fully built and tested.



50 WATT MONO DISCO AMP

£29.95 P&P **£2.50**
Size approx. 13 1/2" x 5 1/4" x 6 3/4"

50 watts rms, 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

SPECIAL OFFER The above 50 watt amp plus 4 Goodmans Type 8P, 8" speakers. Package price **£45.00** + **£4.00** P&P.

70 & 100 WATT MONO DISCO AM

Size approx. 14" x 4" x 10 1/2"

Brushed aluminium fascia and rotary controls

Five vertical slide controls master volume, tape level, mc level, deck level, PLUS INTER DECK FADER

for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control 70 watt peak **£57** (PFL) lets YOU hear next disc before fading 140 watt peak p & p **£4.00**

Output 100 watts RMS 200 watts peak. 100 watt **£65**



STEREO CASSETTE TAPE DECK ASSEMBLY

Consisting of ready built tape transport system/mechanism mated to the electronics.

Unit is ready built for installing into cabinet of own choice. Features include

pause control, solenoid assisted auto-stop, 3 digit tape counter, belt driven balanced fly wheel by DC motor

with electronic speed control. twin VU meters Specification Power

Output, more than 0.5v, mc -85dB 10K-7A, DIN -47dB 100K-7A

Track 2 channel stereo record play-back. Tape speed 4.8cm/sec Freq.

response 50 1200 Hz signal to noise ratio 42dB Recording system AC bias Erasing system AC Erase Bias Freq. 57KHz. Compatible for both normal and chrome dioxide tapes. Size of mechanism only 4 1/2" x 6 1/4" x 11 1/4" approx.

included a moulded top-plate as illustrated **£25.00** P&P **£2.50**

13 3/4" x 9 1/4" approx. with circuit diagram **£25.00** P&P **£2.50**

Opt. extras Mains transformer to suite **£2.50** + **£1.00** p & p.



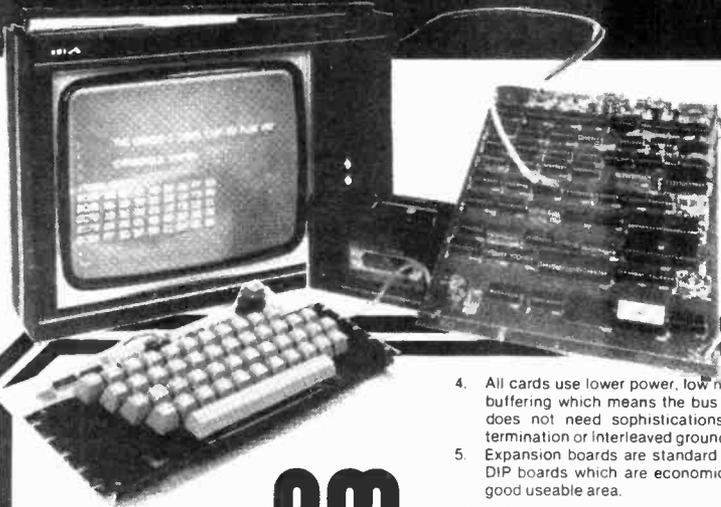
323 EDGWARE ROAD, LONDON W2
21E HIGH STREET, ACTON W3 6NG

ALL PRICES INCLUDE VAT AT 12 1/2%

All items subject to availability. Price correct at 15.12.78 and subject to change without notice.

Personal Shoppers EDGWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am-5.30pm. Half day Thursday. ACTON: Mail Order only. No callers. GOODS NOT DESPATCHED OUTSIDE UK

NASCOM 1 AT MICRODIGITAL



The Microcomputer only shop providing a complete service from a single chip to a commercial data processing installation. Well worth a visit for a look around and a chat.



NASCOM I £178.20

From 10th February 1979.
Includes VAT and carriage.

The Nascom I was exceptional value for money at the old price, now it is unbeatable. The Nascom I is the best possible introduction to the world of personal computing, yet it has the power and flexibility to be expanded into a full data processing system.

The specification includes powerful Z80 processor, parallel I/O controller with two 8 bit ports UART driving cassette Interface or most serial peripherals, video output to plug in the ariel socket of your T.V., 2K bytes of RAM (1K user and 1K video), proven 1K byte monitor program in EPROM and a spare EPROM socket.

The kit is complete, all that is required is a power supply a domestic T.V. and a domestic cassette recorder.

POWER SUPPLIES

There are two power supplies available, a 3 amp supply which will power the basic kit and some expansion and an 8 amp supply with toroidal transformer which will power a very large system. Both supplies can be mounted in the vero frame.

3 amp P.S.U. kit **£26.46**

8 amp P.S.U. kit **£64.80**

EXPANSION

Nascom I is expanded by connection to a buffer board which creates a 77 way bus structure "NASBUS" into which expansion boards plug directly. The bus structure is carried along a motherboard which allows future boards to be added and to keep your computer neat the Nascom I, power supply, buffer board, mother board and expansion boards can all be mounted in a vero frame.

Buffer Board **£27.00**

Mother board **£10.26**

Mini Motherboard **£3.13**

Vero frame **£31.86**

NASBUS

The 77 way Nasbus has the following advantages:—

1. Uses standard Veroboard as a motherboard and Standard 0.1 single sided edge connectors for expansion cards. These components are readily and cheaply available.
2. The bus structure leaves 8 spare data lines and 4 spare address lines for future use of 16 bit processors.
3. The power lines are regulated, on board regulators are therefore not needed which obviates the necessity for fan assisted cooling.

All prices include VAT and Carriage

4. All cards use lower power, low noise shottky buffering which means the bus is quiet and does not need sophistications like active termination or interleaved ground planes.
5. Expansion boards are standard 8" x 8" vero DIP boards which are economic and give a good useable area.

MEMORY

The memory expansion board can carry 16 dynamic RAM chips, these can be either 4K bit or 16K bit chips and the board is offered with 8, 16 or 32K bytes of RAM. The 16K board can be expanded to 32K by plugging in 8 more 4116 chips.

The memory expansion board also has room for 4 2708 UVEPROMS each of 1K bytes and a lot of pre-programmed systems software is available to fit these sockets.

8K RAM board kit **£91.80**

16K RAM board kit **£151.20**

32K RAM board kit **£216.00**

Set **£75.60**

8 x 4116 **11.34**

INPUT/OUTPUT

For people wanting to use more peripherals than the standard kit allows for, Nascom are producing an I/O board which can carry a counter timer chip and a number of PIO's and UARTS. This will be available in March.

I/O board **£37.80**

CTC **£8.64**

UART **£5.94**

PIO **£8.64**

BASIC

To allow high level language programming Nascom have produced a 2K Tiny basic and a 3K Super Tiny Basic in 2 or 3 2708 EPROMS respectively. Also available is an 8K Microsoft precision floating point basic in 8 2708's which will be available in April on a single 64K bit ROM to fit the EPROM board.

Tiny Basic **£27.00**

Super Tiny Basic **£37.80**

8K Basic (8 x 2708) **£108.00**

8K Basic (ROM) **£43.20**

EPROM BOARD

Available in March this board will carry 8 x 2708 UVEPROMS and the 64K bit ROM containing basic. The board can also be used for burning in 2708 UVEPROMS.

EPROM BOARD **£43.20**

GRAPHIC BOARD

Allows high resolution graphics on your Nascom I. Contains 4K of RAM.

Graphics board **£102.60**

MONITOR

Nascom have written a new monitor, T4 the most powerful yet available for this machine it contains many desirable features not found on any other monitor. T4 comes in 2 x 2708 to plug into the main Nascom I board.

Nasbug T4 **£27.00**

FIRMWARE

A powerful editor assembler zeap 15 available to run under Nasbug in 3 x 2708 or on tape. ICL Dataskill have produced a letter Editor available in 2 x 2708.

Zeap (tape) **£32.40**

Zeap (Eprom) **£48.60**

Letter Editor **£75.60**

THE FUTURE

In the near future a mini-floppy disk system will be available with either single or double drive. These will probably offer in excess of 1/2 a megabyte and 1 megabyte respectively at prices that will allow even the hobbyist to have a large data base. To take full advantage of the business and scientific uses opened up by disks Nascom intend to release several high level languages. Looking further forwards Nascom is a developing product, and the fact that many thousands are now in use will ensure that the latest in computer technology will be available at a competitive price.

OPENING HOURS: 9.5.30 Monday to Saturday.
Friendly, expert staff always on hand!

Phone in your Access/Barclaycard Number on **051-236-0707**

or complete this order form

PLEASE SEND ME:



I ENCLOSE:

CHEQUE/POSTAL ORDER NO.

BARCLAYCARD NO.

ACCESS CARD NO.

NAME

ADDRESS

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



MICRODIGITAL LTD. 25 BRUNSWICK STREET LIVERPOOL L2 0BJ Tel: 051-236 0707

WATCH + VIDEO GAMES BARGAINS



VT01 6 FUNCTION STOPWATCH
LCD. Hour. Min. Sec.
Month. Date. S/S strap.
Backlight.

ONLY £8.95



VT07 12 FUNCTION CHRONOGRAPH
Hour. Min. Sec., Date.
Month. 1/100th Sec. Time.
or 2 Event.

ONLY £12.95



VT05 CHRONOGRAPH ALARM
Dual Time Zone
Chrono lap time
alarm

ONLY £27.95



VT08 ALARM ONLY version of VT05

ONLY £19.95



VT06 ALARM/STOPWATCH CLOCK

ONLY £10.95

Full watch and TV Games Catalogue on request

ATARI VIDEO COMPUTER

with big range of Cartridges
7 currently available plus
NEW Breakout,
Basic Math, Basketball



Plus more due shortly including chess, backgammon and Indy 500

£139.95 VAT inc. with Combat Cartridge

£13.45 VAT inc. most Cartridges

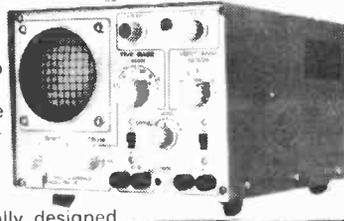
VIDEOTIME PRODUCTS

56 Queens Road
Basingstoke, Hants RG21 1REA
Tel: (0256) 56417. Telex: 858747

We welcome Barclay & Access Orders by telephone (Trade and Export enquiries welcome)

OSCILLOSCOPE

WITH FULL INSTRUCTION MANUAL



FEATURES

- Response: DC to 5MHz.
- Sensitivity: 100mV to 50V/division.
- Fully calibrated time-base circuit and automatic blanking.
- 100% solid state
- utilising 13 transistors, 1 FET and 1 specially designed time-base module.
- Stabilised power supplies and active sync circuits.
- Rugged construction together with portability.
- Inexpensive — excellent value and performance.

FULL INSTRUCTION & OPERATING MANUAL

FROM STOCK £83.25
Add VAT **£6.66**
Carriage **£1.50**
EXPORT ADD **£5.00**

SPECIFICATIONS

ELECTRICAL DATA

VERTICAL AXIS [Y]

Deflection Sensitivity — 100mV/division
Bandwidth [between 3dB points] — DC — 5MHz
Input Attenuator — (calibrated) — 5 step 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50V/div
Input Impedance — 1 Meg/40pF in shunt
Input Voltage — Max — 600V P-P

HORIZONTAL AXIS [X]

Deflection Sensitivity — 0.40mV/division
Bandwidth [between 3dB points] — 1 Hz — 350kHz
Gain Control — Continuous, when time base in EXT position
Input Impedance — 1 Meg
Input Voltage — Max — 600V P-P

TIME BASE

Sweep Range (calibrated) — 100ms/div to 1h sec/div in 5 steps.

**Also at 248 Tottenham Court Road, London, W.1.
301 Edgware Road, London, W.2**

Henry's RADIO

All mail to: Henry's Radio
404 Edgware Rd. London W2
PHONE (01)723 1008 ENGLAND



Wilmslow Audio

THE firm for speakers!

Send 15p stamp for the world's best catalogue of Speakers, Drive Units, Kits, Crossovers, etc., and discount price list.

● AUDAX ● BAKER ● BOWERS & WILKINS ● CASTLE ● CELESTION ● CHARTWELL ● COLES ● DALESFORD ● DECCA ● EMI ● EAGLE ● ELAC ● FANE ● GAUSS ● GOODMAN'S ● I.M.F. ● ISOPHON ● JR ● JORDAN WATTS ● KEF ● LEAK ● LOWTHER ● MCKENZIE ● MONITOR AUDIO ● PEERLESS ● RADFORD ● RAM ● RICHARD ALLAN ● SEAS ● TANNOY ● VIDEOTONE ● WHARFEDALE ● SHACKMAN ● AUDIOMASTER ● TANGENT ● STAG ● YAMAHA

WILMSLOW AUDIO Dept. ETI

SWAN WORKS, BANK SQUARE, WILMSLOW
CHESHIRE SK9 1HF

Discount HiFi, etc., at:
5 Swan Street and 10 Swan Street

TEL. WILMSLOW 529599 FOR SPEAKERS
WILMSLOW 526213 FOR HI-FI

NO DISCO SYSTEM IS COMPLETE WITHOUT...



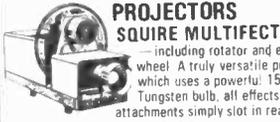
PIEZO HORNS
FANTASTIC SPECIAL OFFER TO READERS OF THIS PUBLICATION.
Tweeters for your disco. PA system or Hi-Fi. Frequency range 5K-20K. No X over required. They can be used in any PA system up to 100W. Why pay more? OUR PRICE ONLY **£4.99** each (P&P 35p each)



CITRONIC MM 313 MIXER
Ideal for the DIY enthusiast building up a complete disco system. 4/5 ch. mono. inc. LED indicators, connections via phono sockets at rear. Bargain price, including PSU
£80.46 inc VAT (P&P £1.50)



BULGIN OCTAL PLUGS AND SOCKETS
There's always hundreds of Bulgin Octal multiway plugs and sockets in stock at Roger Squire's. Each pin rated 5A. Perfect for your Sound to Light System. P552 SOCKET **£0.65** (P&P 35p) P551 PLUG **£1.84** (P&P 35p). Carriage on 10 or more nominal £1.00. Also available 6-way multicore cable (5 Amps per core) ex stock £0.85 per metre. Please phone for carriage quote



PROJECTORS
SQUIRE MULTIFECT 150
— including rotator and effects wheel. A truly versatile projector which uses a powerful 150W Tungsten bulb, all effects attachments simply slot in ready for use.
A BARGAIN AT £40.50 (P&P £1.00)



STARLITE 250
An exclusive new line to Roger Squire's Disco Centres. Superb high powered 250 W quartz halogen bulb, fan cooled, accepts wide range of multifect attachments. Unique connection slot for orbit prism revolvers. Only **£65.00 + VAT** attachments extra



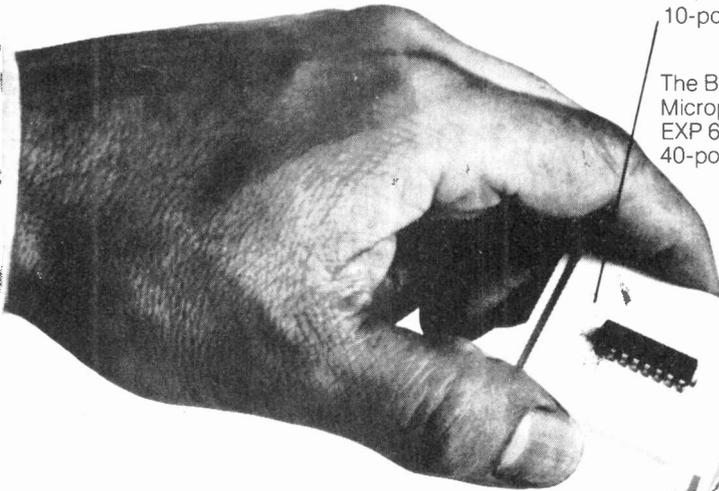
PLUS MANY DISCO ACCESSORIES
All Roger Squire's shops have a service department which carries large stocks of DISCO SPARES & ACCESSORIES. For example: Fane and H. H. Disco Speakers 12" and 15" BSR and Garrard decks at discount prices

Roger Squire's DISCO GEAR

Personal callers: ROGER SQUIRE'S DISCO CENTRES
LONDON: 175 Junction Road, Turnell Park N19 5QJ. 01-272 7474
BRISTOL: 125 Church Road, Redfield, Bristol BS5 9JR. 0272-550550
MANCHESTER: 251 Deansgate M3 4EN. 061-831 7676
GLASGOW: 1 Queen Margaret Road (off Queen Margaret Drive), Kelvinside, Glasgow G20 6BP. 041-946 3303

Open from 10-5 Tues-Sat
10-8 Weds.
Closed Mondays.

A breadboard as big as your ideas.



EXPERIMENTOR 325 £2.54

The ideal Breadboard for 1 chip circuits. Accepts 8, 14, 16 and up to 22 pin IC's. Has 130 contact points including two 10-point bus-bars.

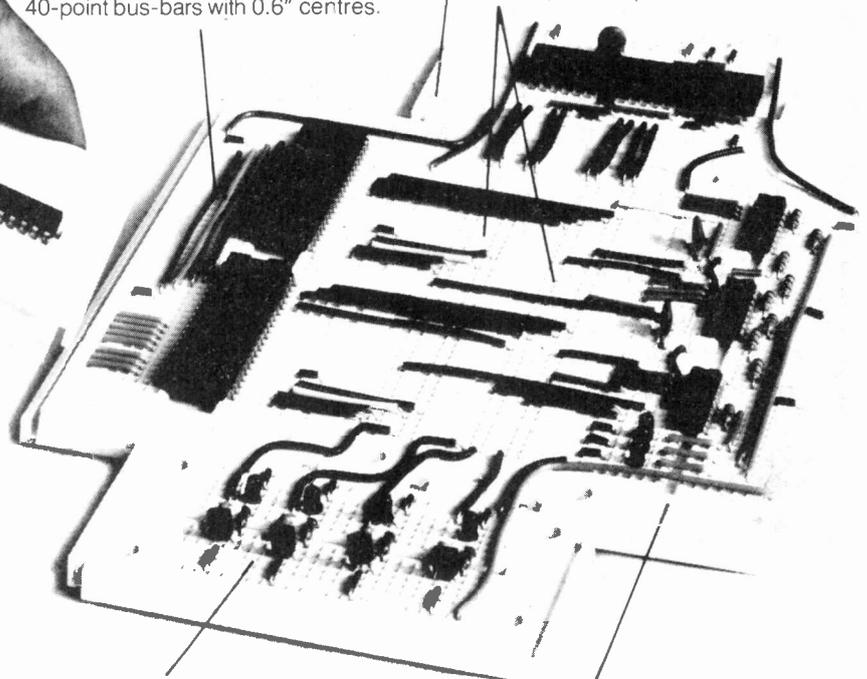
EXPERIMENTOR 600 £7.88

The Breadboard for quick construction of Microprocessors and other circuits. EXP 600 has 550 contacts including two 40-point bus-bars with 0.6" centres.

EXPERIMENTOR 650 £4.70

Perfect for checking out Microprocessors. EXP 650 has 270 contacts including two 20-point bus-bars with 0.6" centres.

EXPERIMENTOR QUAD BUS STRIP £3.29 Need more bus-bars, clip on an EXP 4B and you have four 40-point bus-strips with 8-, 12- and 16-line address, create data-buses by combining EXP 4B, Bus Strips.



No soldering simply plug all standard components in and out, nickel-silver contacts allow Breadboard and components to be used over and over again without damage.

Adaptable accepts any component without adaptors or jumper leads, use 22-30 gauge solid wire for jumper leads.

Mix and Match large and small chips in the same circuit. Use 300 series for smaller and 0.3" pitch DIP's. 600 series for Microprocessors with 0.6" centre channel for full fan-out with larger chips.

Smallest to Biggest, remember CSC's Breadboards "snap-lock" together so you can start with a small idea and expand your ideas to as Big a Breadboarding area as you like.

Easy Permanent Mounting, using four screws from front or six self-tappers from rear. Vinyl-insulated backing lets you fasten to any surface.

Pick any project that you want to build, or any part of a project that you want to test or modify. Count up the number of IC's you need for the project.

Then simply look up in the box opposite the Breadboard you require.

If you need more than two bus-bars simply add the correct number of Quad-Bus Strips. **GET STARTED NOW FOR AS LITTLE AS £2.54.**

EXPERIMENTOR 350 £4.21

EXP 350, specifically designed for the hobbyist working with up to 3 x 14 DIP IC's. With 270 contact points including two 20-point bus-bars the EXP 350 accepts any size DIP with 0.3" spacing.

Marked Contact Points transfer component by component from letter/number position on Breadboard to finished P.C. Board or Wiring Table.

Ruggedly built of abrasion-resistant materials that withstand 100°C.

EXPERIMENTOR 300 £7.29

The hobbyists ideal Breadboard, accepts 6 x 14 DIP or 5 x 16 DIP, has 550 contact points including two 40-point bus-bars, accepts any size DIP with 0.3" spacing.

Tailor-Made Breadboards e.g. a project requires up to 5 x 14 DIP chips and needs up to six bus-bars. Which to buy? Easy from the table below select an EXP 300 plus an EXP 4B, total cost £10.58.

MODEL NO	NUMBER OF CONTACT HOLES	IC CAPACITY (14-pin DIP's)	UNIT PRICE (includes Post & VAT)
EXP 300	550	6	£7.29
EXP 600	550	use with 0.6" PITCH DIP's	£7.88
EXP 350	270	3	£4.21
EXP 650	270	use with 0.6" PITCH DIP's	£4.70
EXP 325	130	1	£2.54
EXP 4B	FOUR 40-point Bus-Bars	—	£2.30

How to order Telephone 0799 21682 and give your Access, American Express or Barclaycard number and your order will be in the post that night. Or send your order, enclosing cheque, postal order, or stating credit card number and expiry date. For full catalogue showing all CSC products for the engineer and hobbyist send large S A E.

CONTINENTAL SPECIALTIES CORPORATION



Europe, Africa, Mid-East: **CSC UK LTD.**
Shire Hill Industrial Estate, Units 1 and 2
Saffron Walden, Essex CB 11 3AQ Dept. 9K
Telephone Number: SAFFRON WALDEN 21682
TLX 817477

**TO ALL TRADERS, MAIL ORDER HOUSES
CONTACT MRS TINA KNIGHT FOR "PROFIT-PACKAGE" DETAILS**

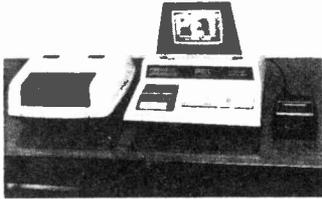
PETALECT

ELECTRONIC SERVICING LTD.

WANTED

Good Homes for Intelligent Pets
THE

PET 2001 Computer
£643.52 plus VAT



This unbelievably versatile, compact, portable and self-contained unit has many varied applications and offers tremendous benefits in the worlds of

● **BUSINESS and COMMERCE:**

Can be used efficiently for Trend Analysis · Stock Control · Payroll · Invoicing · Inventory Control, etc.

● **SCIENCE and INDUSTRY:**

The 'PET' has a comprehensive set of scientific functions useful to scientists, engineers and industry.

● **EDUCATION:** An ideal tool for

teaching and it can be used to keep records, exam results, attendance figures, etc.

● **ENTERTAINMENT:** Games including Backgammon, Noughts and Crosses, Pontoon, Black Jack and Moon Landing

Possesses all usual alphanumerics PLUS 64 graphic characters for plots, artwork, etc., a printer, 2nd cassette deck and software available AND IN THE NEAR FUTURE 'Floppy Disc' data and programme storage system.

We have six years' experience in servicing electronic calculators, mini-computers in S.E. England. 24-hour service contract available at £69.50 per annum. Credit and leasing terms available.

For full details and demonstration contact Peter Watts . . . Now!

PETALECT

ELECTRONIC SERVICING LTD

(Authorised Commodore Pet Dealer) Specialists in Electronic Servicing, Programming, Electronic Design and Prototype Manufacture

33 PORTUGAL ROAD, WOKING, SURREY GU21 5JE.

Tel: Woking (04862) 69032/68497

AT LAST!

The new Strathand Security Division catalogue is here. Full details of alarm circuit principals and practice.

How the professionals keep burglars at bay.

Including diagrams of how to wire up doors, windows, etc.

Full price list and order form included.

£1.00 inc. P&P
(Refunded on orders over £10)

Telephone your Access / Barclaycard number for fast delivery.

STRATHAND SECURITY

44 St. Andrew's Square

Glasgow, G1

Tel. 041-552 6731 / 2

Callers Welcome



SINCLAIR PRODUCTS*

Microvision TV UK model £89.95. PDM35 £27.25. Mains adaptor £3.24. Case £3.25. 30kv probe £18.95. DM350 £67.80. DM450 £86.50. DM235 £49.45. Rechargeable batteries £7.50. Mains adaptor/charger £3.70. Case £8.50. 30kv probe £18.95. Enterprise prog calculator complete with accessories £21.95. Cambridge prog calculator £13.13. Prog library £3.45. Mains adaptor £3.20.

S-DECS AND T-DECS*

S-Dec £3.17. T-Dec £4.02. u-DeCA £4.40. u-DeCB £6.73. 16dil or 10T05 adaptors with sockets £2.14.

CONTINENTAL SPECIALITIES

PRODUCTS*

EXP300 £6.21. EXP350 £3.40. EXP600 £6.80. EXP650 £3.89. EXP4B £2.48. PB6 £9.94. PB100 £12.74. LM1 £30.99. LP1 £33.48. LP2 £19.44. MAX100 £75.40.

TV GAMES

Send s a e for data. AY-3-8500 chip £4.95. Economy kit £4. Stunt cycle AY-3-8760 chip £6.90. Economy kit £4. 10 game paddle 2 AY-3-8600 chip £5.90. Economy kit £6.80. Racing car AY-3-8603 chip + economy kit £17.90. Wipeout / breakout AY-3-8606 chip + economy kit £17.90. Modified shoot kit £4.98. Rifle kit £4.95. Colour generator kit £7.50. Joystick 220K £1.69.

MAINS TRANSFORMERS

6-0.6V 100ma 74p. 1 1/2 £2.35. 6 3V 1 1/2 £1.89. 9-0.9V 75ma 74p. 1a £1.99. 2a £2.60. 12 0-12V 50ma 74p. 100ma 90p. 1a £2.49. 13V 1/2 95p. 15 0-15V 1a £2.79. 30-0-30V 1a £3.59.

JC12 AND JC20 AMPLIFIERS

Integrated circuit audio amplifier chips supplied with free data and printed circuits. JC12 6 watts £1.60. JC20 10 watts £2.95. Send s a e for free data on our range of matching power and preamp kits

FERRANTI ZN414

IC radio chip £1.05. Extra parts and pcb for radio £3.85. Case £1. Send s a e for free data

PRINTED CIRCUIT MATERIALS

PC etching kits. Economy £1.85. Standard £3.99. 60 sq ins pcb 55p. 1 lb F&C1 £1.05. Etch resist pens Economy 45p. dalo 73p. Small drill bits 1/32 in or 1mm 20p each. Etching Dish 68p. Laminate cutter 75p.

BATTERY ELIMINATORS

3-way types with switched output and 4-way multi-jack 3/4 1/2 6v 100ma £2.71. 6/7 1/2 9v 300ma £2.95. 100ma radio types with press-stud connectors 9v £3.35. 6v £3.35. 4 1/2 9v £3.35. 9+9v £4.50. 6+6v £4.50. 4 1/2+4 1/2 £4.50. Cassette recorder mains unit 7 1/2 100ma with 5 pin din plug £3.35. Fully stabilised type 3/6 7 1/2 9v 400ma £6.40. Car converters 12v dc input output 9v 300ma £1.50. output 7 1/2 300ma £1.50. Output 3/4 1/2 6/7 1/2 9 12v 800ma £2.50.

BATTERY ELIMINATOR KITS

Send s a e for data 100ma radio types with press-stud connectors 4 1/2 9v £1.40. 6v £1.40. 9v £1.40. 4 1/2+4 1/2 £1.80. 6+6v £1.80. 9+9v £1.80. Cassette type 7 1/2 100ma with din plug £1.40. Heavy duty 13 way types 4 1/2 6 7 1/2 9 11 13 14 17 21 25 28 34 42v 1A £4.65. 2A £7.25. Transistor stabilised 8-way types for low hum 3 4 1/2 6 7 1/2 9 12 15 18v 100ma £2.80. 1 Amp £6.40. Variable voltage stabilised models 2-18v 100ma £3.60. 2-30v 1A £6.95. 2-30v 2A £10.95. Car converter 12v dc input output 9 7 1/2 6v 1A stabilised £1.35.

BI-PAK AUDIO MODULES

Send s a e for data S450 £23.51. AL60 £4.86. pa100 £15.58. spm 80 £4.47. bmt80 £5.95. mk80 £38.74. stereo 30 £20.12.

COMPONENTS

1N4148 1.4p. 1N4002 2.9p. 741 8 dil 15p. 723 14 dil 29p. NE555 8 dil 23p. bc182b bc183b bc184b bc212b bc213b bc214c bc547 bc548 bc549. bc550 4.5p. tp31c tp32c 34p. tp41c. tp42c 45p. bd131 bd132 31p. Plastic equvs bc107. bc109 4.8p. Fuses 20mm x 5mm cartridge 15 25 5 1 2 3 5Amp quickblow 1p. anti surge 3.4p. Resistors 5% 1/4W E12 10R to 10M 1p. 0.8p for 50+ for one value Polyester capacitors 250V 015 068 1mf 1.5p. 01 033 33mf 2.7p. 022 047mf 3.2p. 22 47mf 4.8p. Polystyrene capacitors E12 63v. 10 to 10000pf 3p. Ceramic capacitors 50v E12 22 to 1000pf 1.7p. E6 1n5 to 47n 2p. Electrolytic capacitors 50v 5 1 2mf 5p. 25v 5 10mf 5p. 33mf 4p. 16v 22mf 5p. 100mf 6p. 220mf 4.1p. 330mf 9p. 470mf 11p. 1000mf 10p. 1500mf (PC) 3.4p. 10v 1000mf 5.1p. 2200mf 6p. 2mf 1.7p. Zeners 400mW E24 2v 7 to 33v 7p. Preset pots sub-miniature 0 1 horiz or vert 100 to 4k7 6.8p. Potentiometers 1/4W 4K7 to 2M2 log or 1n single 26p. dual 76p.

SWANLEY ELECTRONICS

DEPT. ETI, 32 GOLDSSEL RD., SWANLEY, KENT BR8 8EZ

Mail order only. Please add 30p to the total cost of order for postage. Prices include VAT. Overseas customers deduct 7% on items marked * and 11% on others. Official credit orders welcome.

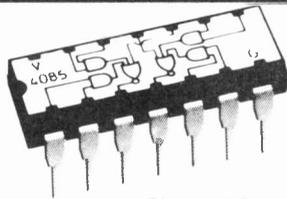
MINI-ADS & CLASSIFIED

LOW COST RAM

21L02 (450ns)
1-15 @ 89p
16-63 @ 86p
64+ @ 83p

Ring for latest quantity discount prices
0243 42554

J. M. Evans
"Kimlas"
School Lane
Nutbourne
Chichester
Sussex



LIVING LOGIC!

STICKIES are printed self-adhesive labels that stick to the top of ICs. They make dull, anonymous plastic blocks into diagrams that come ALIVE! See at-a-glance where to place your test probe or soldering iron — take the hassle out of ICs.

STICKIES are great for building and debugging prototypes, faultfinding, experimenting, teaching — even designing PCB layouts.

STICKIES come in packs for 7400- or 4000-series ICs. Each pack contains a sensible mix of more than 60 different IC types.

120-label pack — 80p, 480-label pack — £2.80, or 2-10 packs at £2.50 each, 11-plus £2.20 each.

Prices include VAT and first-class postage. Official orders welcome. Please state whether TTL or CMOS required.

For your STICKIES by return of post
CONCEPT ELECTRONICS, 8 Bayham Road
Sevenoaks, Kent TN13 3XA
Phone: 0293 514110

BRITISH MOTOROLA 6800 SYSTEMS

6800S: 16K Dynamic RAM, 1K Mikbug compatible monitor, room for 8K BASIC in ROM, VDU with u/I case and graphics, CUTS and Hi Speed tape interfaces. Single pcb with power supply components. Price of kit from £275 without kbd or £299 with keyboard.

Mini 6800.1K monitor, 1K user RAM, CUTS, VDU. Kit without keyboard from £120, with keyboard from £145.

NCU Board. This number cruncher using the MM57109 is supplied with our own Basic style program on tape (3K bytes) that will outperform any of the 8K Basics as a programmable calculator. Suitable for any 6800 system with Mikbug. Kit price £32.

8K RAM (2114) and 5 or 10K PROM board. This pcb is bus compatible with the above systems and has all the buffering and decoding that you need. PCB only, £13.

all prices without VAT and post
PLEASE SEND SAE FOR LEAFLETS

HEWART MICROELECTRONICS
95 BLAKEWOOD ROAD
MACCLESFIELD, CHESHIRE

SOUTH WALES

FOR
TTL, CMOS, LINEARS
DISCRETES, PASSIVES
HARDWARE, TOOLS
CASES, TRANSFORMERS, ETC.

DIGITAL WATCHES AND
CLOCKS

SEND 20p FOR CATALOGUE

Mail and Official Orders accepted

Come to:
STEVE'S ELECTRONICS
15/17 THE BALCONY
CASTLE ARCADE
CARDIFF CF1 2BU
TEL: (0222) 41905

1.2V
NICADS

Prices include VAT

RECHARGEABLE BATTERIES

BUTTON CELLS

	Dia	Hgt	Price
225mAh	25.0	7.5	0.60
500mAh	34.5	9.5	1.15
4-Bv Pack (centre tap available)			
225mAh			2.40
500mAh The original "Deac"			4.60

CYLINDRICAL CELLS

("Vented" for fast charge)

0.5Ah*	HP7 or	Size AA	1.10
1.2Ah*	22.5 or	49.0	1.40
1.8Ah*	HP11 or	Size C	1.95
4.0Ah*	HP2 or	Size D	2.75
6.0V Pack 5x1.2Ah nicads 7.50			

*Tags available at extra 10p per cell
Charger — Suitable for any of the above nicads — charges up to twelve cells in series at either 25mA, 50mA, 120mA, 200mA or 400mA rate **£11.95**
Charger for 1 to 4 HP7 or 0.5Ah nicads **Only £5.95**

UK POST AND PACKING
50p PER ORDER

Sizes approx.
in mm.

V + F SMALLCRAFT (POPLAR) LTD.
38 Stoneleigh Road, Clayhall
Ilford, Essex
01-550 6642

ETI PCB's

Buy it with Access

BARCLAYCARD

Available for all ETI projects from day one of ETI, 'phone your order

SPECIAL OFFER — Single sided Pax PCB mat, four off, 4 3/4" x 6 1/2", 99p all up

CROFTON ELECTRONICS LIMITED

35 GROSVENOR ROAD, TWICKENHAM
MIDDLESEX TW1 4AD · Tel: 01-891 1923

MICROBITS

EXIDY SORCERER
HORIZON
SOL
CROMENCO
77-68
PANDA
PERIPHERALS
SOFTWARE
CONSULTANCY
BOOKS

34B London Road
Blackwater
Camberley
SURREY
Tel: 0276 34044

PRINTED CIRCUITS and HARDWARE

Comprehensive range Constructors' Hardware and accessories.

Selected range of popular components Full range of HE printed circuit boards, normally ex-stock, same day despatch at competitive prices.

P.C. Boards to individual designs Resist-coated epoxy glass laminate for the d.i.y. man with full processing instructions (no unusual chemicals required).

Alfac range of etch resist transfers, and other drawing materials for p.c. boards.

Send 15p for catalogue.

RAMAR CONSTRUCTOR SERVICES
MASONS ROAD
STRATFORD-ON-AVON
WARWICKS. Tel. 4879

VIDEO MUSIC



Videograph II links to the aerial socket of your tv and provides a full colour GIANT oscilloscope display. A must for hi-fi, home entertainment, discos, organs etc.

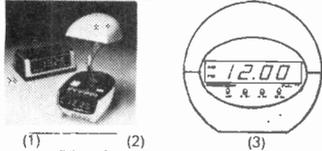
New — signal invert control, integral square wave generator. Plus — full details for testing your audio system for transient distortion, crosstalk etc

Complete **£19.95** Luxury cabinet and Kit only **£9.95** controls. **£9.95**

READY BUILT UNIT £39.95 + £1.00 P&P

WILLIAM STUART SYSTEMS LTD
Dower House, Billericay Road
Herongate, Brentwood
Essex CM13 3SD
Telephone: Brentwood (0277) 810244

**BARGAINS FOR THE
ELECTRONIC HANDYMAN
BRANDED LED DIGITAL
ALARM CLOCKS**



Returned to Service Department within guarantee period.

- (1) With alarm repeat — S R S P. of £17 00 offered at £3.95 inc VAT
- (2) With luxury lamp and repeat alarm as featured in most major U.K. Mail Order catalogues. S R S P £31.00 — offered at £6.95 inc VAT
- (3) With integral luxury light and repeat alarm also as featured in most major U.K. Mail Order catalogues. S R S P of £32 00 — offered at £6.95 inc VAT

These will be sold as received from our customers with the existing fault(s) and without guarantee.

Discounts available on large bulk purchases

**PRESCOTT CLOCK AND
WATCH COMPANY LIMITED**
Prescott House, Humber Road, London NW2 6ER

OHIO SUPERBOARD

Computer on a board - 8K bank in Rom keyboard, graphics, cassette interface. 2K monitor. British TV interface, expandable

4K RAM £275 8K RAM £315

C.T.S.

1 HIGHER CALDERBROOK
LITTLEBOROUGH, LANCS.

TEL. LITTLEBOROUGH (0706) 79332/73840
ANY TIME

VMOS POWERFET VN67AF 99p. Latest price cuts, LM741C 18p, LF13741N (JFET 741) 33p. Also, CA3140E 40p, 78L05 (T092) 29p, 709 15p, 308 25p, 1458 (House Numbered) 30p. Quad Nortons, MC3401P 40p, LM3900N 45p. FET (equiv. 2N3823) 14p. Fast LOC MOS, 4017B (16MHz @ 10v) 65p, 4013B 35p, 4016B 40p, 4020B 80p, 4001B/07/11B/69 16p. 10% Discount over £5. P&P 20p. SAE for informative lists to: J. W. RIMMER, 367 GREEN LANES, LONDON N4 1DY.

TIRRO's new mail order price list of electronic components now available on receipt of SAE. TIRRO Electronics, Grenfell Place, Maidenhead, Berks.

MINI FLOPPY DISCS, £3.50 each + 15p. postage, 4 up — post free, 10 up — free case. State Disc drive. TL081CP op-amps 45p. OVOID, 26 Bentley Road, Liverpool L8 0SZ. Tel. 051-728 7639.



**C
C
T
V

C
A
M
E
R
A**

£99.99 Total £110.64 inc. p/p & VAT
BEST OFFER EVER
**Camera Kit, Lens,
Vidicon & Modulator**

CROFTON

Tel: 01-891 1923 For full details

NASCOM 1 Z80 Microcomputer with power supply and keyboard. Just built and fully working. Must sell. Asking £235 cost of parts. Nottingham (0602) 877037 Steve.

CIRCUIT DESIGN, Prototype construction, Analogue or Digital, Single Circuits or Complete Instruments/Systems. Write A. J. ATTWOOD, C.Eng., MIERE, Heathercote, Heatherton Park, Taunton, Somerset, TA4 1ET or Phone Bradford-on-Tone (082-346) 536.

TVH7 TELEVISION SOUND. For high clarity Hi-Fi listening and recording of television programmes. Supplied built and tested on a single board measuring 105x52mm, for TV internal fitment. £9.80 inclusive, with wiring and comprehensive instructions. EVE Products, 7 Adel Green, Leeds 16.

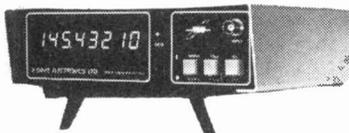
STEPPING MOTOR DRIVE. Reversing, V.F. Oscillator or external pulses, TTL inputs, 48V/0.5A per phase max., 4-phase, IDEAL MICROPROCESSOR USE. £17.00. Suitable motor £15.00. SAE details F.H., 24 Belvoir Ave., Trentham, Stoke-on-Trent.

NEW QUALITY STEREO 60w(RMS) CHASSIS. Mag P.U./Mike(3Mv) + tuner + aux, 24 trans. 2 I.C. Thd .07% 1kH @ 35v. Fr 20Hz-300kHz, Stab'd PSU 2N3055 output, din socks, controls vol. select, etc. Boxed, data, £11.95 (or 240v AC £19.95 inc.). K. Lawrence, 1 Regent Road, Ilkley, W. Yorks.

HIGH FREQUENCY COUNTER

Types HFC60, HFC600 and HFC60-OV, HFC 600-OV

- Bright 8 digit 0.5" LED display
- Excellent sensitivity and trigger from square and sine inputs 10Hz-600MHz
- Compact, all inclusive specification
- Mains power 100-240v AC 40-60Hz
- DC power input 9-16 volts for mobile use
- Switched 1/0/0 1 sec time base
- Switched range 60MHz or 600MHz
- Decimal points automatically placed with time base or range switching



—OV Series provide a special Xtal in a proportionally controlled oven giving exceptional performance. The oven unit is also available as an 'add on' later addition if required

HFC60 £91.20 Excluding VAT
HFC600 £108.48

Trade enquiries welcome

Send S A E for further details

REF NO 1384670

**7 HUGHENDEN ROAD - HASTINGS
SUSSEX TN34 3TG - England
Telephone: (0424) 428131**

craeL UK
LTD.
ELECTRONIC DEALERS
IMPORT-EXPORT AGENTS

robbed?

kit
£56.80 inc Don't be...

Construct and Install the new **HOMEWATCH** electronic alarm system and protect your home.

Complete kit includes:- P.C.B. keyswitch-operated control unit, all pcb components(5 i.c.'s), psu, 6 l.e.d.'s, internal alarm, external bell (in weatherproof box), 5 magnetic sensors, relay, manual, etc.

DATAPLUS DEVELOPMENTS
81, Cholmeley rd, Reading, Berkshire.
sae brings further details.

KSR-33 TELETYPE. 10 chars/sec, friction feed, with servicing manuals. Mechanically in good condition and working. £250 o.n.o. — Phone C. Bowden, 828-8695 (London).

CONSTRUCTOR PLANS — Hundreds Sold! Pulse Induction Metal Detector, advanced economical switched CMOS. £1.56. Radio Telescope 5-Metre £2. R & E Publications, Highlands, Needham Market, Suffolk.

CAR BATTERY GIVING TROUBLE — try our all electronic battery voltmeter IC and PCB £2.75 inc. SAE for details. — TRITECH ELECTRONICS, 190 Roding Road, Loughton, Essex.

FULL SPECIFICATION DISPLAYS
DL701, DL704, DL707 £1.25; DL747 £2.15; DL727 £3.20; Prices inclusive. R.S. (Doram) rotary switches/wafers, BCD/decimal thumbwheel and keyswitches/caps. SAE with enquiries. — COMPUTEK 10, Marlhurst, Edenbridge, Kent.

RESISTORS (5% carbon film), 25 of each value: 10Ω, 12Ω, 18Ω, 47Ω, 82Ω, 180Ω, 220Ω, 270Ω, 330Ω, 390Ω, 470Ω, 1kΩ, 1.8kΩ, 3.3kΩ, 3.9kΩ, 4.7kΩ, 8.2kΩ, 10kΩ, 12kΩ, 15kΩ, 22kΩ, 27kΩ, 33kΩ, 47kΩ, 56kΩ, 68kΩ, 82kΩ, 100kΩ, 180kΩ, 270kΩ, 470kΩ, 680kΩ. (800 resistors), only £4 post paid. D. Johnston, 12 Balgillo Road, Dundee DD5 3LU.

MAINS BORNE INTERFERENCE FILTERS for HiFi, and computing. Hunts 3 amp high performance six element professional quality, meeting BS613. £3.25 inclusive. LTE, 80 Lime Grove, Ruislip, Middx.

A FAST INTRODUCTION TO COMPUTING. This excellent book explains programming clearly and concisely. £3.95 from your local bookshop, or post free from: Industrial Training Press, Dept. ET13, 3 Ringwood Way, Winchmore Hill, London, N21 2RA.

110 INTEGRATED CIRCUIT PROJECTS FOR THE HOME CONSTRUCTOR. Order your 120 page copy today only £2.95 PP45p. Bacca Electronics, 34 Keats Close, Wootton Bassett, Wiltshire. Mail order only.

TRANSAM/ETI TRITON COMPUTER P.C.B. for sale, unused, unwanted due to purchase of TR80. £37.50. Write to Burgess, 12 Upton Crescent, Oakridge, Basingstoke.

NASCOM 1 COMPUTER with T2 Nasburq, improved television modulation. P.S.U. and full documentation (including programming manual). Offers £240+. Ring Slough 47353 (evenings).

SITUATIONS VACANT

Audio Engineer

The above vacancy has arisen with the Electronics Department of The Decca Record Company in New Malden, Surrey.

The work of the department is concerned with the design and maintenance of electronic audio equipment used by the Quality Control Department in testing of long-playing records.

Applicants, male or female, should be aged over 20 and must have audio experience. Preference will be given to those with a relevant City and Guilds or O.N.C. qualification.

The position carries a competitive salary and excellent general conditions of employment. Additional benefits include subsidised lunches, discounts on Company Products and Sports and Social Club.

Write or phone the Personnel Officer, The Decca Record Company Limited, Burlington House, Burlington Road, New Malden, Surrey. Telephone: 01-942 2464.

DECCA



The Queen's Award for
Export Achievement
to Decca Ltd 1976

THE ROYAL FREE HOSPITAL, Hampstead. Medical Physics Technicians (Electronics) Grades III and IV. Two electronics technicians are required for the Electronics Workshop of this major teaching Hospital to assist with the development and maintenance of electronic circuits and equipment. Applicants (male or female) for the Grade III post should hold the City and Guilds Full Technological Certificate in appropriate subjects or an equivalent qualification and have good practical experience in the design of electronic circuits using state-of-the-art techniques. Similar qualifications are required for the Grade IV post. A working knowledge of analogue and digital circuit techniques and an ability to service electronic equipment would be an advantage. Salaries for these posts are on scales: £4,098-£5,142 p.a. (Grade III) and £3,423-£4,488 p.a. (Grade IV), including all allowances. The Grade and starting salary will depend on qualifications and experience. Application forms (to be returned by 15th March, 1979) and Job Description available from the Personnel Department, The Royal Free Hospital, Pond Street, Hampstead, London, NW3 2QG. Tel: 01-794 0500, Ext. 4286. Please quote ref: Grade III 0758 and Grade IV 0761. Camden and Islington Area Health Authority. (T).

LABORATORY ENGINEER required to work in Research & Development Department for a company based at Willesden, to be trained to design standard. Knowledge of digital techniques essential. Starting salary approx. £80 per week according to experience. Hours: 9.30 a.m.-5.30 p.m., 5-day week. Apply Mr. D. Morgan/Mr. J. Brown 459 2236/9.

LABORATORY ENGINEERS required to fix video game logic boards in North West London. Some digital knowledge essential. TV knowledge an advantage. Starting salary £70-£80 per week according to experience. Hours 9.30 a.m.-5.30 p.m., 5-day week. Apply Mr. D. Morgan, 459 2236/9.

AD INDEX

ABACUS COMPUTING	66
ALTEK	30
AMBIT	86 & 87
ASTRA-PAK	29
AUDIO ELECTRONICS	73
BAMBER	30
BI-PAK	4 & 5
CAMBRIDGE LEARNING	64
CATRONICS	36
CHILTMead	74
CODESPEED	13
COMMUNICATIONS MEAS	80
COMP, COMP,	32, 98 & 99
CONTINENTAL	
SPECIALISTS	93
CRAEL U.K.	96
CRIMSON ELECTRIK	29
CROMASONICS	60
DELTA TECH	60
E.D.A.	48
ELECTRONIC BROKERS	48 & 87
ELECTROVALUE	82
E.S.E.	86

GMT ELECTRONICS	6 & 7
GREENBANK	42
GREENWELD	82
HENRY'S	13, 17, 47, 73 & 92
H & S ELECTRONICS	88
IBEK SYSTEMS	88
ILP ELECTRONICS	78
JEFF WAYNE MUSIC	84
KRAMER	47, 80 & 88
L. B. ELECTRONICS	80
LEKTROKIT	16
LOTUS SOUND	42 & 43
L.P. ENTERPRISES	65
MAGNUM AUDIO	15
MAPLIN	100
MARSHALLS	89
METAC	26
MICRODIGITAL	91
MINIKITS	18
MOUNTAINDENE	18
NICHOLLS	88
NIC MODELS	32
NORMAN INSKIP	44

PETALECT	94
POWELL	84
POWERTRAN	2 & 8
PROGRESSIVE RADIO	18
RACE ELECTRONICS	88
ROGER SQUIRES	92
R.T.V.C.	90
SCIENCE OF	
CAMBRIDGE	59
SCOPEX	77
SINTEL	17
STEVENSON	14
STRATHAND	94
SWANLEY	94
TAMTRONIK	32
TARGET ELECTRONICS	15
TECHNOMATIC	12
TIMETRON	24
T.K. ELECTRONICS	15
TRIDENT EXHIBITIONS	73
VERO	15
VIDEOTIME	92
WATFORD	10 & 11
WILMSLOW	92

INTERESTED IN HOME COMPUTING?

FREE B BUG valued at £23.00 plus 10 x C12 cassettes valued at £4.00 plus Standard Modulator valued at £2.25 **WITH EVERY NASCOM**

Start now and don't get left behind **THE NASCOM 1** is here Ex-stock with full technical services

Plus the opportunity to join the fastest moving club of personal computer users enabling you to get the most out of your computer. You can OBTAIN and EXCHANGE programs and other software - many now available.

The Powerful Z80 Microprocessor
Professional Keyboard
1 Kbyte Monitor in EPROM
2 Kbyte RAM (expandable)
Audio Cassette interface
Plugs into your domestic TV
Easy construction from straightforward instructions
- no drilling or special tools
- Just neat soldering required.



SAVE £30

Only **£197.50 + 8% VAT** (includes p & p + insurance)

Manuals seperately	2.95	
Z80 programming Manual	6.90	
Z80 Technical Manual	2.95	
P10 Technical Manual	2.95	Power supply suitable for NASCOM
(All prices add 8% VAT)		19.90

NASCOM AD ONS - Nascom improved monitor B Bug (2K) featuring - *Four times tape speed *Direct text entry without ASCII *Extended keyboard facility *Additional useful subroutines **£23.00**

Nascom Vero Case **£22.50** Nascom Music Box Kit* **£9.90**
(write your own tunes and play them on your Nascom.)

Nascom Joy Stick Kit **£14.90** Complete with full documentation.

NASCOM IMMEDIATE EXPANSION S100 from COMP - strongly recommended

The only available S100 motherboard kit (fully buffered) that plugs directly into your Nascom. Designed for the insertion of S100 boards (e.g. Static RAM, EPROM and discs etc.).

S100 Motherboard/Buffer (Complete kit + documentation)	£47.50	Buy both and get 2K Tiny Basic On cassette FREE.
Suitable 8K Static RAM Memory (fully assembled tested and guaranteed)	£110	

NASCOM LOW COST EXPANSION

Uses dynamic RAM and NASBUS (please note this expansion does not support S100 memory)

Tiny Basic in EPROM	£25.00	} All plus VAT
8K Dynamic RAM board (in kit only)	£85.00	
Motherboard (in kit only)	£12.50	
Buffer board (in kit only)	£25.00	

ATTENTION! TRS 80 USERS

SAVE £90

Simple to fit - only a screw-driver is required.

16K UP GRADE KIT	Half Radio Shack Price	£99 + VAT	LIFETIME GUARANTEE
-------------------------	------------------------	------------------	---------------------------

TRS 80 SOFTWARE NEW
100 MIXED PROGRAMMES on cassette **£49.00**

PET COSTS LESS AT COMP and it's a pedigree

RRP **£695**

The No. 1 Personal Computer in the U.K.
Affordable **£590** **SAVE £100** for the first time user and the professional check out the PET, the world's most popular personal computer.



THE ATARI video computer system

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty great Game Program™ cartridges!

Have fun while you sharpen your mental and physical coordination. You can play rousing, challenging, sophisticated video games, the games that made Atari famous.

You'll have thrill after thrill, whether you're in the thick of a dogfight, screaming around a racetrack, or dodging asteroids in an alien galaxy. With crisp bright color (on color TV) and incredible, true-to-life sound effects. With special circuits to protect your TV.

Cartridges now available
Basic Maths, Airsea Battle, Black Jack, Breakout, Surround, Spacewar, Video Olympics, Outlaw, Basketball, All at **£13.90 each.**



Years and years of fun and satisfaction are assured

SAVE £30

~~£169~~ **£139.00**

OHIO SUPERBOARD II NEW

For electronic buffs. Fully assembled and tested. Requires +5V at 3 Amps and a video monitor or TV with RF converter to be up and running.

STANDARD FEATURES

Uses the ultra powerful 6502 microprocessor
8K Microsoft BASIC-in-ROM
Full feature BASIC runs faster than currently available personal computers and all 8080-based business computers.
4K static RAM on board expandable to 8K
Full 53-keyboard with upper/lower case and user programmability
Kansas City standard audio cassette interface for high reliability
Full machine code monitor and I/O utilities in ROM

Direct access video display has 1K of dedicated memory (besides 4K user memory), features upper case, lower case, graphics and gaming characters for an effective screen resolution of up to 256 by 256 points. Normal TV's with overscan display about 24 rows of 24 characters; without overscan up to 30 x 30 characters.

EXTRAS

Available expander board features 24K static RAM (additional), dual mini-floppy interface, port adapter for printer and modem and an OSI 48 line expansion interface.
Assembler/editor and extended machine code monitor available.

~~£280.00~~ **£249.00 + VAT** *Send £10 to reserve one - pay balance on delivery.*

MODULATORS UHF Channel 36

Standard 6 meg band width **£2.25**
High Quality 8 meg band width **£4.90**

BULK PURCHASE VDU MONITORS ~~£99~~ **£69 + VAT**
CASED AND GUARANTEED **12"**





A quality range of British made electrical accessories plus a "How to" book. Do your own home electrical work with complete confidence. See cat. pages 129 to 134



This superb organ — build the first working section for just over £100. Full specification in our catalogue.



A range of highly attractive knobs is described in our catalogue. Our prices are very attractive too!



Mobile amateur radio, TV and FM aerials plus lots of accessories are described in our catalogue.



A pulse width train controller for smooth slow running plus inertia braking and acceleration. Full construction details in our catalogue.



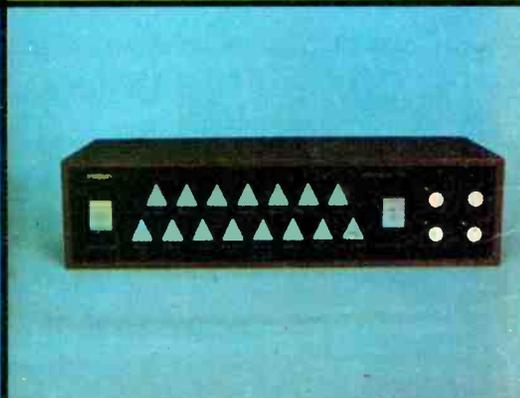
A wide range of disco accessories at marvellous prices. Our catalogue has all the details.



Add on bass pedal unit for organs. Has excellent bass guitar stop for guitarists accompaniment. Specification in our catalogue.



The 3800 synthesiser, build it yourself at a fraction of the cost of one ready-made with this specification. Full details in our catalogues.



Touch operated rhythm generator, the "Drumsette". Construction details 25p. (Leaflet MES49). Specification in our catalogue.

MAPLIN

ELECTRONIC SUPPLIES LTD

All mail to:-
 P.O. Box 3, Rayleigh, Essex SS6 8LR.
 Telephone: Southend (0702) 554155.
 Shop: 284 London Road,
 Westcliff-on-Sea, Essex.
 (Closed on Monday).
 Telephone: Southend (0702) 554155.



A superb technical bookshop in your home! All you need is our catalogue. Post the coupon now!



An attractive mains alarm clock with radio switching function and battery back up! Complete kit with case only £13.88 (incl. VAT & p&p) MA1023 module only £B.42 (incl. VAT)



A massive new catalogue from Maplin that's even bigger and better than before. If you ever buy electronic components this is the one catalogue you must not be without. Over 280 pages - some in full colour - it's a comprehensive guide to electronic components with hundreds of photographs and illustrations and page after page of invaluable data.

Our bi-monthly newsletter contains guaranteed prices, special offers and all the latest news from Maplin.



A 63-key ASCII keyboard with 625-line TV interface, 4 page memory and microprocessor interface. Details in our catalogue.

Post this coupon now for your copy of our 1979-80 catalogue price 75p.

Please send me a copy of your 280 page catalogue as soon as it is published (8th Jan 1979). I enclose 75p but understand that if I am not completely satisfied I may return the catalogue to you within 14 days and have my 75p refunded immediately. If you live outside U.K. send £1 or ten International Reply Coupons.

NAME _____

ADDRESS _____