electronics today INTERNATIONAL

MARCH 1979

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.

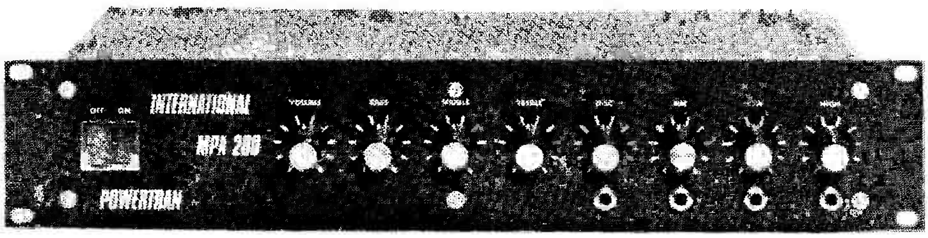
COMPLETE KIT ONLY £49.50 + VAT!

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

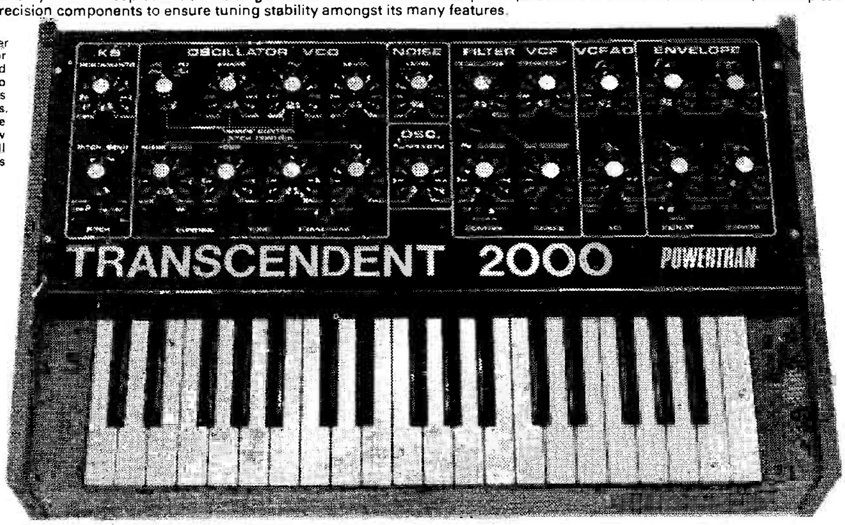
SINGLE BOARD SYNTHESIZER

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 ½% 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 contruction 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!



Cabinet size 24.8" x 15.7" x 4.8" (rear) 3.4" (front)

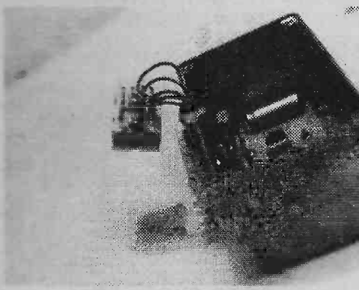
Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more elaborate than a multi-meter and a pair of ears!

POWERTRAN

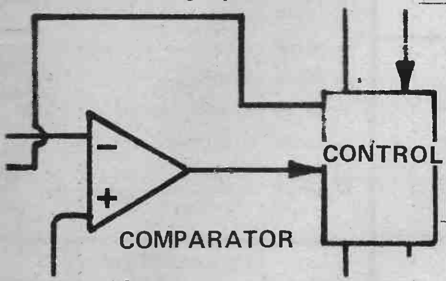
ORDERING INFORMATION AND MORE KITS ON PAGE 6

electronics today

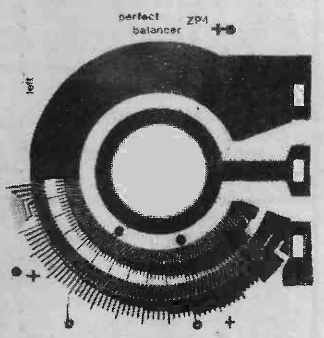
MARCH 1979 VOL 8 NO 3 INTERNATIONAL



Strike a Light p27



p14



Gold in them hills p75

FEATURES

PROJECTS

INFORMATION

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

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

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	74118	£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	7442	£0.38	7484	£0.82	74141	£0.50	74182	£0.55
7410	£0.09	7443	£0.68	7485	£0.65	74145	£0.54	74184	£1.00
7411	£0.15	7444	£0.68	7486	£0.22	74150	£0.65	74190	£0.68
7412	£0.14	7445	£0.64	7489	£1.60	74151	£0.45	74191	£0.68
7413	£0.22	7446	£0.60	7490	£0.30	74153	£0.45	74192	£0.65
7414	£0.45	7447	£0.45	7491	£0.60	74154	£0.80	74193	£0.60
7416	£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	£0.45	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	£0.65	CD4031	£1.60	CD4055	£1.00
CD4001	£0.13	CD4018	£0.70	CD4035	£0.90	CC4056	£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	Engineers & Machinists Reference Tables	~~£0.50~~	£0.45
BP14	Second Book of Transistor Equivalents & Substitutes	~~£1.10~~	£0.99
BP22	79 Electronic Novelty Circuits	~~£0.75~~	£0.68
BP24	52 Projects Using IC741 for equivalents	~~£0.95~~	£0.86
BP26	Radio Antenna Handbook for Long Distance Reception & Transmission	~~£0.85~~	£0.77
BP27	Giant Chart of Radio Electronic Semi-conductor and Logic Symbols	~~£0.60~~	£0.54
BP32	How to Build Your Own Metal & Treasure Locators	~~£1.00~~	£0.90
BP34	Practical Repair & Renovation of Colour TV's	~~£0.95~~	£0.86
BP35	Handbook of IC Audio Preamplifier & Power amplifier construction	~~£0.95~~	£0.86
BP36	50 Circuits Using Germanium, Silicon & Zener Diodes	~~£0.75~~	£0.68
BP37	50 Projects Using Relays SCR's and Triacs	~~£1.10~~	£0.99
BP39	50(FET) Field Effect Transistor Projects	~~£1.25~~	£1.13
BP40	Digital IC Equivalents & Pin Connections	~~£2.50~~	£2.25
BP41	Linear IC Equivalents & Pin Connections	~~£2.75~~	£2.48
BP42	50 Simple LED Circuits	~~£0.75~~	£0.68
BP43	How to make Walkie-Talkie	~~£1.25~~	£1.13
BP44	IC 555 Timer Projects	~~£1.45~~	£1.31
BP45	Projects on Opto-Electronics	~~£1.45~~	£1.31
BP46	Radio Circuits using IC's	~~£1.35~~	£1.22
BP47	Mobile Discotheque Handbook	~~£1.35~~	£1.22
BP48	Electronic Projects for Beginners	~~£1.35~~	£1.22
BP49	Popular Electronic Projects	~~£1.35~~	£1.22
BP50	IC LM3900 Projects	~~£1.35~~	£1.22
BP55	Radio Stations Guide	~~£1.45~~	£1.31
BP160	Coil Design & Construction Manual	~~£0.75~~	£0.68
BP202	Handbook of Integrated Circuits (ICs) Equivalents & Substitutes	~~£1.00~~	£0.90
BP205	First Book of Hi-Fi Loudspeaker Enclosures	~~£0.75~~	£0.68
BP213	Electronic Circuits for Model Railways	~~£0.85~~	£0.77
BP215	Shortwave Circuits & Gear for Experimenters and Radio Hams	~~£0.85~~	£0.77
BP216	Electronic Gadgets & Games	~~£0.85~~	£0.77
BP217	Solid State Power Supply Handbook	~~£0.85~~	£0.77
BP221	28 Tested Transistor Projects	~~£0.95~~	£0.86
BP222	Solid State Short Wave Receivers for Beginners	~~£0.95~~	£0.86
BP223	50 Projects Using IC CA3130	~~£0.95~~	£0.86
BP224	50 CMOS IC Projects	~~£0.95~~	£0.86
BP225	A Practical Introduction to Digital ICs	~~£0.95~~	£0.86
BP226	How to Build Advanced Short Wave Receivers	~~£1.20~~	£1.08
BP227	Beginners Guide to Building Electronic Projects	~~£1.25~~	£1.13
BP228	Essential Theory for the Electronics Hobbyist	~~£1.25~~	£1.13
RCC	Resistor Colour Code Disc Calculator	~~£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 £s — 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″×3½″ approx. 2 pcs
£0.60

THYRISTORS

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

TRIAC

S84 8 Amp. 400 volt TO220 Plastic **80p**

DIACS

1TT	V413 equt	**12p**
BR100	D32	**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	60¼W.	100 ohm — 820 ohm
16214	60¼W.	1K — 8.2K
16215	60¼W.	10K — 82K
16216	60¼W	100K — 820K

All 4 at SPECIAL PRICE of £1.60

16217	40½W.	100 ohm — 820 ohm
16218	40½W.	1W — 8.2K
16219	40½W.	1K — 8.2K
16220	40½W.	100K — 820K

All 4 at SPECIAL PRICE of £1.60

VOLTAGE REGULATORS

Positive

No. MVR7805	μA7805	TO220	**55p**
No. MVR7812	μA7812	TO220	**55p**
No. MVR7815	μA7815	TO220	**55p**
No. MVR7818	μA7818	TO220	**55p**
No. MVR7824	μA7824	TO220	**55p**

Negative

No. MVR7905	μA7905	TO220	**75p**
No. MVR7912	μA7912	TO220	**75p**
No. MVR7915	μA7915	TO220	**75p**
No. MVR7918	μA7918	TO220	**75p**
No. MVR7924	μA7924	TO220	**75p**

μA723C TO99 **38p** 72723 14 pin Dil **38p**
LM309K TO3 **£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	**40p***
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 TO39	**40p**
No. 16140	25 PNP trans. like 2N2905 TO39	**40p**
No. 16141	30 NPN trans. like 2N706 TO18	**40p**
No. 16143	30 NPN Plastic trans. like 2N3906	**40p***
No. 16144	30 PNP Plastic trans. like 2N3905	**40p***
No. 16145	30 PNP Germ. trans. like OC71	**40p**
No. 16147	10 NPN TO3 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 at **£0.60***

PROGRAMMABLE UNIJUNCTION

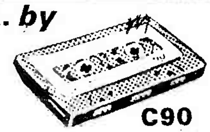
2N6027 supplied with Data **£0.24**

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 **C90**

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

UNIJUNCTION TRANSISTORS

UT46 TIS43 **20p**

FET's

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

2 AMP. BRIDGE RECTIFIERS

Metal Stud Mounting

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

SILICON BRIDGE RECTS.

S99 Mixed Pak 2 — 5 Amp 50-600v. All coded. 4 for **£1.00***

SIMILAR IN 4000 SERIES

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

SALE T-T-TIME again!

SPECIAL OFFER!

COMPONENT PAKS

Order No.	Quantity	
[illegible]	5 pieces Assorted Ferrite rods	40p
[illegible]	2 pieces Tuning gangs MW/LW	40p
[illegible]	50 metres Single strand wire assorted wire	40p
[illegible]	10 Reed switches	40p
[illegible]	3 Micro switches	40p
[illegible]	20 Assorted electrolytics Trans types	40p
[illegible]	1 pack Assorted Hardware nuts/bolts, etc.	40p
[illegible]	30 Assorted tag strips and panels	40p
[illegible]	15 Assorted control knobs	40p
[illegible]	15 Assorted Fuses 100mA 5 amp	40p
[illegible]	60 ½W resistors mixed values	40p
[illegible]	30 metres stranded wire assorted colours	40p
S100	120 ¼ watt resistors, Pre-formed 1978 Prod. Our mix	60p*
S101	120 ½ watt resistors, Pre-formed 1978 Prod. Mixed values	60p*
S102	250 ⅛ watt resistors. Range 100 ohms-10 meg.	£2.00*
S103	220 ½ watt resistors. Range 100 ohms 10 meg.	£2.00*
S104	60 Low ohms ¼ watt resistors 10-100 ohms	60p*
S105	40 Low ohms ½ watt resistors 10-0ohms	60p*
S106	25 Mixed wirewound resistors	60p*
S107	20 Tantalum bead caps 0.22-100mF. 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 Now.			
16191	6 x 470 Ohm	LIN Single	40p*
S24	6 x 1K	LIN Single	40p*
S25	6 x 5 K	LIN Single	40p*
16193	6 x 22 K	LIN Single	40p*
16195	6 x 47 K	LOG Single	40p*
16194	6 x 47 K	LIN Single	40p*
S27	6 x 100 K	LIN Single	40p*
S28	6 x 100 K	LOG Single	40p*
S29	6 x 500 K	LOG Single	40p*

Slider 60mm TRAVEL

S30	6 x 2.5 K	LOG Single	40p*
S32	6 x 50 K	LIN Single	40p*
S34	4 x 5 K	LOG Dual	40p*
S36	4 x 100 K	LOG Dual	40p*
S37	4 x 1.3 MEG	LOG Dual	40p*
S94	6 x 220 K	LIN Single	40p*
S95	6 x 100 K	LOG Single	40p*
S96	6 x 500 K	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 rapng. Mixed—useful values; 5 for **£1.00***

CARBON TYPES

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

DUAL POTS P.C. MOUNTING

6mm Shaft

S92 4 x 100 K Lin. **£1.00***
S93 4 x 100 K 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	BD371 2 Amp 1.2w. 60Vceo Hfe 40-400. Case TO92 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 GP91/1SC Special Offer **£1.00**

Nickel Cadnium Rechargeable Batteries, 1.25v

S128. 3500D Cell size=U2 **£2.50**
S129. 900C Cell size=½U11 **£0.90**
S130. Complete kit of parts to build nickel cadnium charger **£3.50**

Super Save Pak

S124. 6×741P **£1.00**
S125. 5×555 **£1.00**

S138. Surplus/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.	2×12v Relays, plastic case	£0.70
S132.	2×24v Relays, plastic case	£0.60
S133.	1 Switch bank, 5-way, incl. silver knob	£0.75
S134.	2× 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. 3lbs 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. 0235 240v primary 0-55v at 2Amp secondary. **£4.50*+£1.00 p&p.**
S142. 0349 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×AL60 — 1×PA100 — 1×SPM80 — 1×2034 transformer — 2×coupling capacitors. **£37.70 inc. V.A.T.+85p p&p.**

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

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

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

STA125. 125 watts per channel amplifier kit. CONSISTS: 2×AL250 — 1×PA200 — 2×SPM120/65 — 2×2041 transformers — 1×reservoir capacitors — 2×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	2N1B93	28p
AC128	16p	BC182	*9p	BF197	*12p	TIP41A	34p	2N2218	15p
AC128K	24p	BC1B2L	*9p	BF200	25p	TIP41B	35p	2N2218A	18p
AC176	16p	BC183	*9p	BFX29	22p	TIP41C	36p	2N2219	15p
AC176K	24p	BC1B3L	*9p	BFX84	18p	TIP42A	36p	2N2219A	18p
AC187	16p	BC184	*9p	BFY50	12p	TIP42B	37p	2N2221	15p
AC187K	26p	BC184L	*9p	BFY51	12p	TIP42C	38p	2N2221A	16p
AC188	16p	BC212	*10p	BFY52	12p	TIP2955	65p	2N2222	15p
AC188K	26p	BC212L	*10p			TIP3055	42p	2N2222A	16p
AD161/		BC213	*10p	MPSA05	*22p	ZTX107	*6p	2N2369	10p
162 MP	80p	BC213L	*10p	MPSA06	*22p	ZTX108	*6p	2N2904	14p
AF139	30p	BC214	*10p	MPSA55	*22p	ZTX109	*7p	2N2904A	15p
AF239	30p	BC214L	*10p	MPSA56	*22p	ZTX300	*7p	2N2905	14p
BC107	6p	BC251	*10p			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	38p	2N70B	8p	2N3702	*7p
BC159	*9p	BF1B0	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	BYZ10	32p	OA70	5p	IN34	5p	IN5404	13p
BA173	10p	BYZ11	32p	OA79	7p	IN60	6p	IN5406	16p
BAX13/		BYZ12	32p	OA81	7p	IN914	4p	IN5407	17p
OA200	5p	BYZ13	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	SL414A	£1.80

ZN 414 RADIO CHIP 75*

DISPLAYS

No. 1510. 707 LED Display **£0.70**
No. 1511. 747 LED Display **£1.50**
No. 1512. 727 Dual LED Display **£1.55**

LED's

No. S120	.125 Bright Red	£0.09
No. S121	.2 Bright Red	£0.09
No. 1502	.125 Green	£0.12
No. 1505	.2 Green	£0.12
No. 1503	.125 Yellow	£0.12
No. 1506	.2 Yellow	£0.12
No. S82	Clear .2 Illuminating Red	£0.10

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

D84—50 2 ??? round single pin fixing **30p**

OPTOELECTRONICS

2ND QUALITY LED PAKS

No. 1507. 10 Assorted Colours & Sizes **£0.75**
No. S122. 10×.125 Red **£0.60**
No. S123. 10×.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. S83 5 NIXIE Tubes ITT 5870 ST **£2.00** (including Data)
No. S77 Neon Indicator Lamps 230 AC State Colour (Red, Amber and Green) **25p** each

MAMMOTH I.C. PAK

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

POWER SUPPLY STABILIZER BOARD

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

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. INSERTION 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.

GMT ELECTRONICS

(A DIVISION OF GOTHIC ELECTRONIC COMPONENTS LTD)
PO Box 290
8 Hampton Street
Birmingham B19 3JR

TELEPHONE: 021·233·2400

MAIL ORDER ONLY

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

CAPACITORS

Electrolytic Axial Leads — -10% to +50% Tol — Order Code Cap 015 + µF + V d.c.

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			8	9
10		7		9
15	7		8	10
22		7		12
33	7		8	
47		7	10	12
68	8			
100		8	12	
150	8	9		29
220	12		24	34
330			28	37
470		21	30	44
680	19	28	36	50
1000	23	28	55	
1500	32	36		
2200	39			

Tantalum Bead — ±20% Tol — Order Code Cap PR + µF + Volts

µF \ V d.c.	3.15	6.3	10	16	25	35
0.1						9
0.15						9
0.22						9
0.33						9
0.47						9
0.68						9
1						9
1.5						10
2.2				9		11
3.3				9	11	14
4.7				10	14	15
6.8		9		11	15	.6
10		10	11	14	16	20
15		11	14	15	20	
22	11	14		16		
33		15	16	20		
47		16	20			
68	16	20				
100	20					

Electrolytic Can Type — High Ripple, IEC Grade 1, Low E.S.R. Supplied complete with Vertical Fixing Clip — Order Code Cap HR + µF + Volts

µF	V	Ripple 1A @ 85°C	1.4A @ 50°C	Price
2200 µF	16V	2.6A	3.6A	166
4700 µF	16V	5.8A	8.1A	184
10000 µF	16V	9.8A	13.7A	222
22000 µF	16V	1.3A	1.8A	346
2200 µF	25V	4.6A	6.4A	175
4700 µF	25V	8.0A	11.2A	201
10000 µF	25V	12.8A	17.9A	264
22000 µF	25V	0.9A	1.2A	438
1000 µF	40V	2.4A	3.3A	168
2200 µF	40V	5.6A	7.8A	188
4700 µF	40V	9.2A	12.8A	231
10000 µF	40V	1.8A	2.5A	367
1000 µF	70V	4.0A	5.6A	190
2200 µF	70V	7.5A	10.5A	235
4700 µF	70V	4.0A	5.6A	376
1000 µF	100V	7.8A	10.9A	222
2200 µF	100V			346

Electrolytic Radial Leads — -10% to +50% Tol. — Order Code Cap 034 + µF + Volts

µF \ V d.c.	6.3	10	16	25	35	40	50	63
.47								6
.68								6
1.0								6
1.5								6
2.2								6
3.3								6
4.7						6		7
6.8				6			7	8
10			6			7		8
15			6	7			8	10
22		6	7			8	10	
33			7	8		10		
47		7	8		10			
68			8	10				
100		8	10					
150		10						
220	10							

Trimmers — 250V D.C. Wkg. Film Dielectric, Miniature

Range	Price	Order Code
1.4 – 4.1pF	19	Cap 808 A
2 - 8pF	19	Cap 808 B
2 - 20pF	21	Cap 808 C
5.5 – 59.5pF	29	Cap 808 D

500V D.C. Wkg. C004 EA Tubular Type

Range	Price	Order Code
.8 – 3.8pF	46	Cap 802 3
.8 – 6.8pF	48	Cap 802 6
1 – 13pF	61	Cap 802 12
1.7 – 19.7	62	Cap 802 18

Miniature Low Value — Order Code
- Polystyrene, Axial, ±1% Tol., > 63V D.C. Wkg — Cap 424
- Ceramic Plate, Radial, Low K, 1.8pF–8.2pF ±.25pF Tol, 10-330pF ±2% Tol, 100V D C Wkg — Cap 632
- Ceramic Plate, Radial, Med K, ±10% Tol, 100V D.C. Wkg — Cap 630
- Ceramic Plate, Radial, High K, -20% to +80% Tol, 63V D.C. Wkg — Cap 629
- + Value

pF	424	632	630	629
1				
1.2				
1.5				
1.8		6		
2.2		5		
2.7		5		
3.3		5		
3.9		5		
4.7		5		
5.6		5		
6.8		5		
8.2		5		
10		5		
12		5		
15		5		
18		5		
22		5		
27		5		
33		5		
39		5		
47		5		
56		6		
68		6		
82		6		

pF	424	632	630	629
100	16	6		
120	16	8		
150	16	8		
180	16	6		
220	16	6		
270	18	8		
330	18	8		
390	18		5	
470	18		5	
560	16		5	
680	16		5	
820	16		5	
1000	16		5	5
1200	16		5	
1500	18		6	
1800	18		6	
2200	18		6	6
2700	18		6	
3300	18		6	
3900	18		6	
4700	23		7	6
5600	23			
6800	23			
8200	23			

nF	424	632	630	629
10	25			6
12	26			
15	26			
18	27			
22	28			8
27	38			
33	41			
39	43			

Polyester Radial Leads — Order Code
- Dipped Type, ±20% Tol, ±250V D.C Wkg. C280/352 Style — Cap 352
- Moulded Type, ±10% Tol, ±100V D.C Wkg. 10.2mm Pitch Centres — Cap 360
- Moulded Type, ±10% Tol, ±100V D.C. Wkg. 7.6mm Pitch Centres — Cap PHE280
- + Value

µF	352	360	PHE280
.001		5	6
.0015		5	6
.0022	5	5	7
.0033	5	5	7
.0047	5	6	7
.0068	5	6	7
.01	5	6	7
.015	5	7	8
.022	5	7	8
.033	5	7	8
.047	5	7	8
.068	6	8	9

µF	352	360	PHE280
.1	6	8	9
.15	7	9	
.22	8	10	
.33	10		
.47	12		
.68	15		
1.0	19		
1.5	27		
2.2	32		

CASES

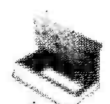
Small Desk Console — Boss Industrial Mouldings
Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
W161, D96, H39 (57)	186	Case BIM1005 OR
W215, D130, H47 (73)	268	Case BIM1006 OR

Plastic Boxes — Boss Industrial Mouldings
Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
L112 W62 D31	87	Case BIM2003 OR
L150 W80 D50	115	Case BIM2005 OR
L190 W110 D60	195	Case BIM2006 OR

Instrument Case — Boss Industrial Mouldings
Covers Manufactured from 14SWG Aluminium
Chassis Manufactured from 18SWG Mild Steel
Covers Finished Orange
Chassis Finished Matt Black



		Order Code
W250 D167.5 H 68.5 (Chassis 153mm Deep)	1480	Case BIM3000 OR

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

		Order Code
L85 W56 D29	97	Case BIM4003 OR
L111 W71 D42	130	Case BIM4004 OR
L161 W96 D53	182	Case BIM4005 OR

Diecast Boxes — Boss Industrial Mouldings
Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

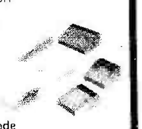
		Order Code
L113 W63 D31	104	Case BIM5003 NA
L152 W82 D50	181	Case BIM5005 NA
L192 W113 D61	280	Case BIM5006 NA

Professional Components for the Amateur

Small Desk Consoles — Boss Industrial Mouldings
Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey
Vantilation Slots In Base

		Order Code
W105 D143 H32 (56)	206	Case BIM6005 OR
W170 D143 H32 (56)	271	Case BIM6006 OR
W170 D214 H32 (82)	375	Case BIM6007 OR

All Metal Desk Consoles — Boss Industrial Mouldings
Slope Front Console, Recessed Top
Two Piece All Aluminium Construction
Ventilation Slots In Rear and Base
Choice of 15° or 30° Sloping Front
Off White Top Panel, Blue Base



		Order Code
W102 D140 H28 (51) 15° slope	1018	Case BIM7151A
W165 D211 H33 (76) 15° slope	1350	Case BIM7154A
W254 D287 H33 (76) 15° slope	1572	Case BIM7156A
W356 D287 H33 (76) 15° slope	1823	Case BIM7158A
W102 D140 H28 (76) 30° slope	1018	Case BIM7301A
W165 D183 H28 (102) 30° slope	1202	Case BIM7303A
W254 D259 H28 (102) 30° slope	1572	Case BIM7306A
W356 D259 H28 (102) 30° slope	1823	Case BIM7308A

Eurocard Size Desk Console — Boss Industrial Mouldings
Slope Front Console
ABS Case, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel, Finished Grey

		Order Code
W169 D127 H45 (70)	375	Case BIM8006 OR

HARDWARE

D.I.L. Sockets

		Order Code
8 Pin Low Profile Socket Tin	11	DIL SKT 8
14 Pin Low Profile Socket Tin	13	DIL SKT 14
16 Pin Low Profile Socket Tin	14	DIL SKT 16
24 Pin Low Profile Socket Gold	66	DIL SKT 24
28 Pin Low Profile Socket Gold	78	DIL SKT 28
40 Pin Low Profile Socket Gold	127	DIL SKT 40

Heatsinks

Individual Type for 1 x T05 50°C/W	10	Sink 5F
Individual Type for 1 x T066 10.5°C/W	26	Sink TV2
Individual Type for 1 x T03 7.2°C/W	24	Sink TV3
Individual Type for 1 x T0126 17°C/W	23	Sink TV4
Individual Type for 1 x T0220 17°C/W	23	Sink TV5

P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying	92	Pen 33PC
Single Sided P.C.B. Pins .040" Diam 100 pcs	55/Pack	SS Pin 040
Double Sided P.C.B. Pins .040" Diam. 100 pcs	55/Pack	DS Pin 040

Fuseholders
Suit 20mm x 5mm fuses.

P.C.B. Mounting, Open Type	[illegible]	Fuse H20B
Chassis Mounting, Open Type	[illegible]	Fuse H20C
Panel Mounting, Screwdriver Slot	[illegible]	Fuse H20PT
Panel Mounting, Finger Release	[illegible]	Fuse H20P

Fuses
20mm x 5mm Glass.

Quick Blow, Range 100mA–5A	5	Fuse 20
Slow Blow, Range 250mA–5A	22	A/S Fuse 20

+ Rating

Lampholders, Panel Mounting
Similar In Style to Fuse H20P
Low Voltage Type Suits LES and M/F Bulbs.

Low Voltage, Red, Amber or Green	75	Lamp LV
Internal Neon 200 240V Red or Amber	95	Lamp N

+ Colour

Bulbs, Low Voltage, L.E.S.

6V, 0.36W, 6.5V, 1W, 14V, 0.75W	22	Bulb LES

+ Voltage

RESISTORS

Carbon Film, Fixed

				Order Code
0.25W, E24 Values IRO-10M, 5% Tol.	1.5 ea.	90p/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD¼
0.5W, E12 Values IRO-4M7, 10% Tol.	2 ea.	1.25p/100 (Mult 10/Value)	£10.10/1000 (Mult 100/Value)	Res RD½

+ Value

Metal Film, Fixed

0.5W, E24 Values, SRI-IM, 2% Tol.	6 ea.	3.80/100 (Mult 10/Value)	£32.40/1000 (Mult 100/Value)	Res MR30
2.5W, E12 Values 10R-27K, 5% Tol.	13 ea.	7.90/100 (Mult 10/Value)		Res PR52

+ Value

Metal Glaze, Fixed

0.5W, E24 Values, IM-33M, 5% Tol.	10 ea.	5.40/100 (Mult 10/Value)	Res VR37

+ Value

Skeleton Presets, Miniature

		Order Code
0.1W, E3 Values, 100R-1M, Lin Vertical Mounting	7	Min Preset V
0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting	7	Min Preset H

+ Value

Skeleton Presets, Standard

0.3W, E3 Values, 100R-4M7, Lin Vertical Mounting	10	Std Preset V
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting	10	Std Preset H

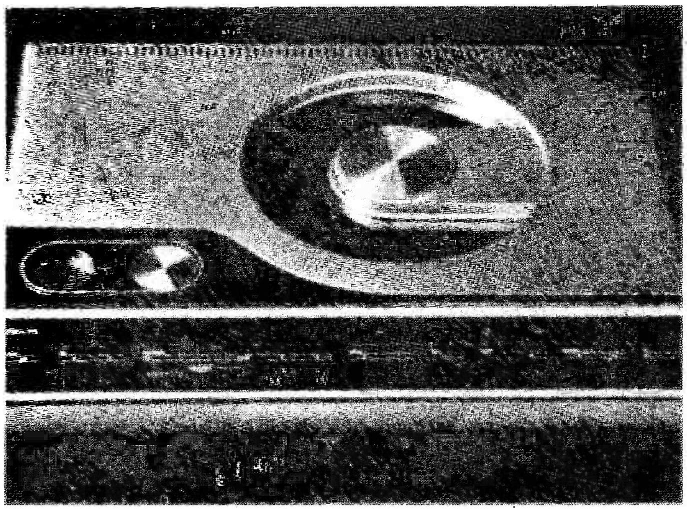
+ Value

Potentiometer, Rotary

0.5W, E3 Values, 1K-2M2 Lin.	34	Pot Lin
0.25W, E3 Values, 4K7-2M2 Log.	34	Pot Log

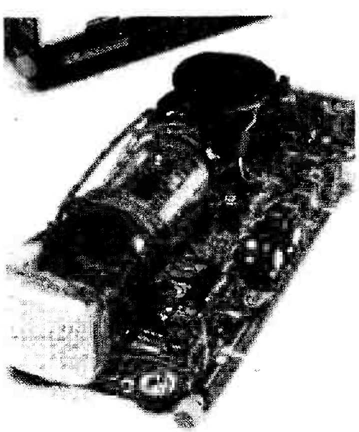
+ Value

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 compatability 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.

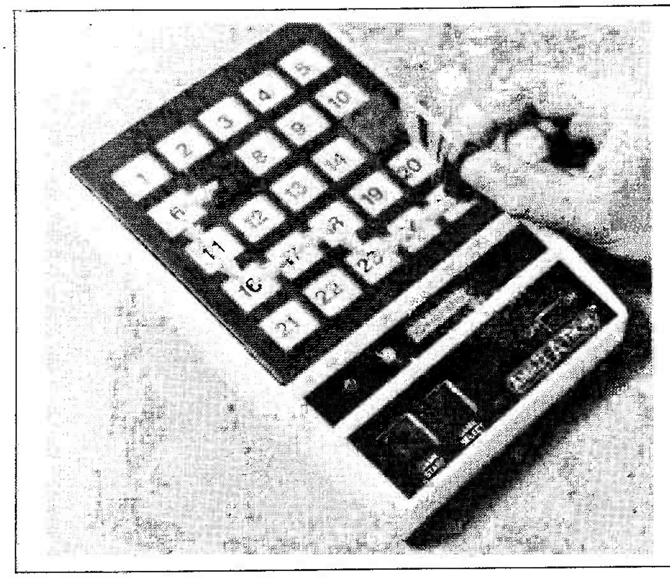
STRIKE A BLOW

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.

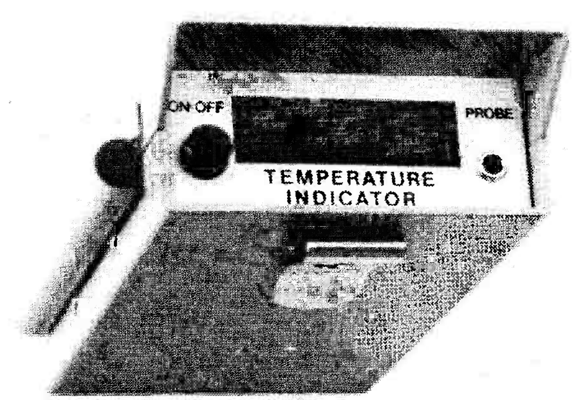
Ron Harris
Editor

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 Rototherm Co Ltd for further details at Kenfig Industrial Estate, Margam, Port Talbot, West Glam. SA13 2PW (South Wales).

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 ve attractive too!

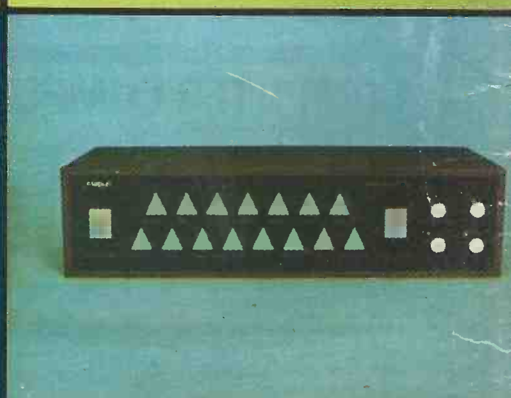
Mobile amateur radio, TV and FM aerials plus lots of accessories are described in our catalogue

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 detai

dd-on bass pedal unit for organs. Has excellent bass guitar stop for guitarists ccompaniment. 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. (Leaf 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 £8.4 (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 ______________________

____

........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 includes 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.

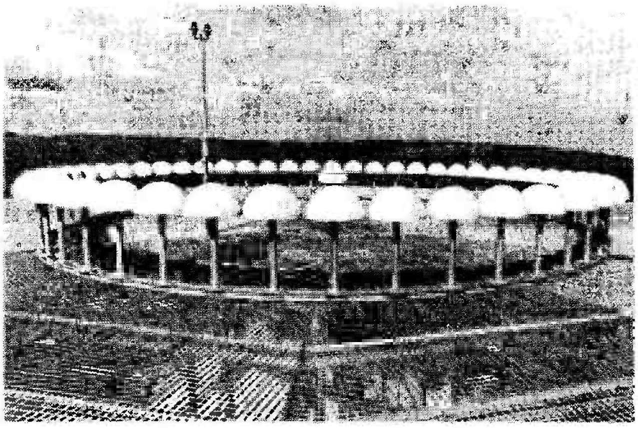
ORIENTAL TELETEXT

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.

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



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

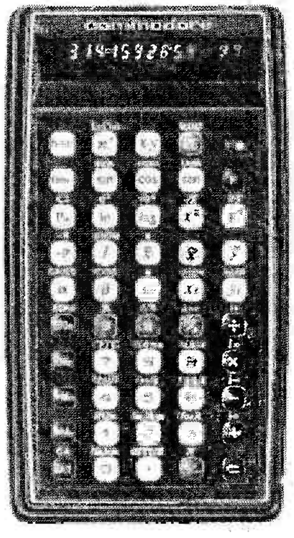
LCD POCKET TV

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 loch.

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.

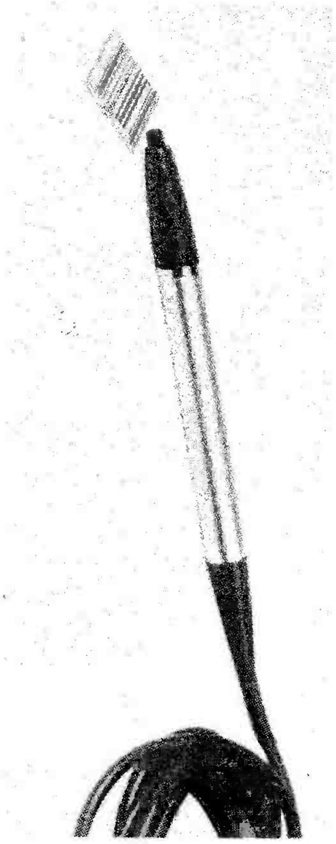
NEW CASES FROM VERO

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.

........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 drawback is 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 your that way inclined, and you can see the good bits over and over again, Cor.

BREADBOARD '79

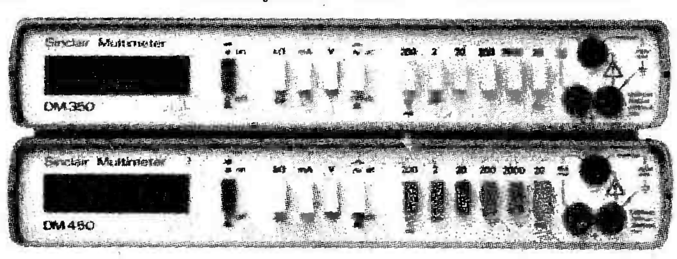
What! already. Well this year there are two dates to put into your Letts Electronic diaries. The Midlands show will be at Bingley Hall, Birmingham, on May 23rd-26th, and the London show is at the Royal Horticultural Hall, Westminster, December 4th-8th. Figures show over 10 000 people attended the first 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 Kirkpatrik a memorial fund has been established for the benefit of his family. Those wishing to make a donation should send this to: John Miller Kirkpatrik 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 (4½ digit 5 function) and DM350 (3½ digit, 34! ranges). They both have good technical specifications and accessories. See the Microvision article for Sinclair's address.



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 descrete 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.

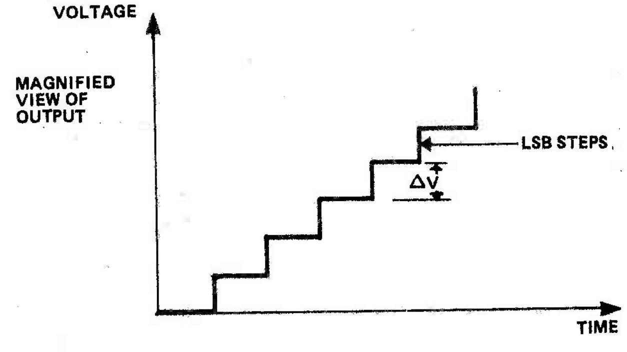
Digital to Analogue Conversion.

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 descrete 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 1/256th 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 I C) 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 descrete ▶



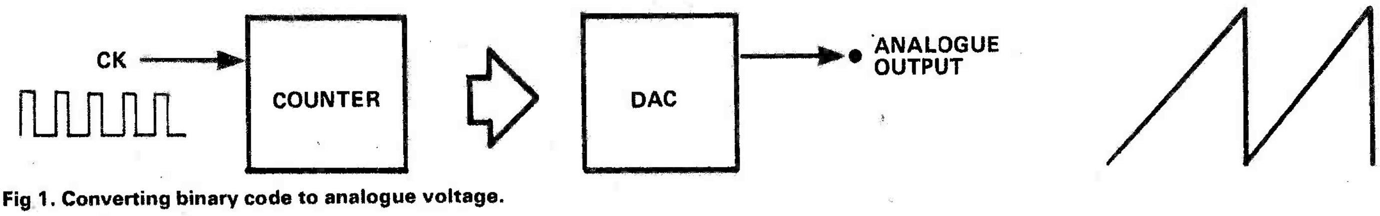


Fig 1. Converting binary code to analogue voltage.

WORDLENGTH n	RESOLUTION 1 PART IN 2n	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 μV 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 descrete 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 abberations in the system. These digital abberations 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 descrete output levels. Now 2^6 is 64 and so the overall resistor tolerance should be ± 1 part in 2 x 64, which comes out at ± 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%.

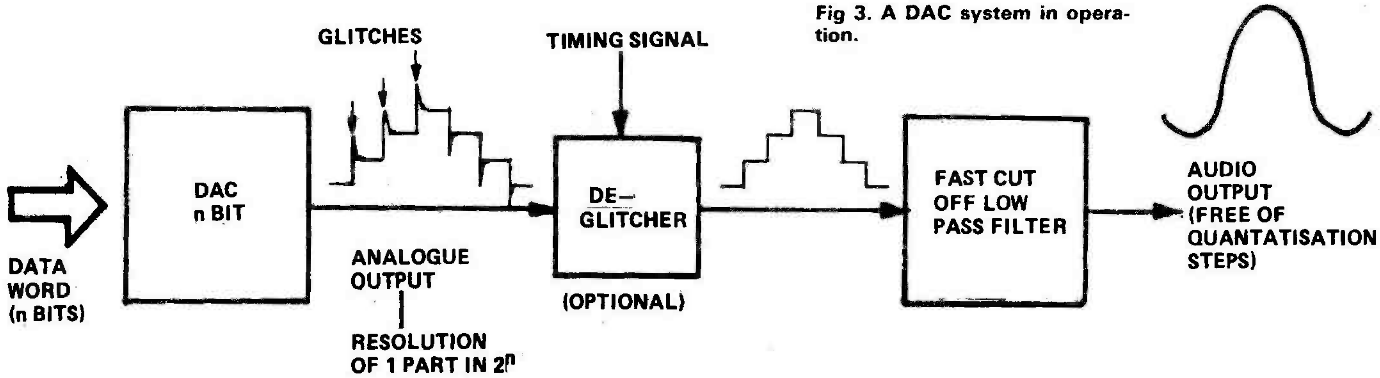


Fig 3. A DAC system in operation.

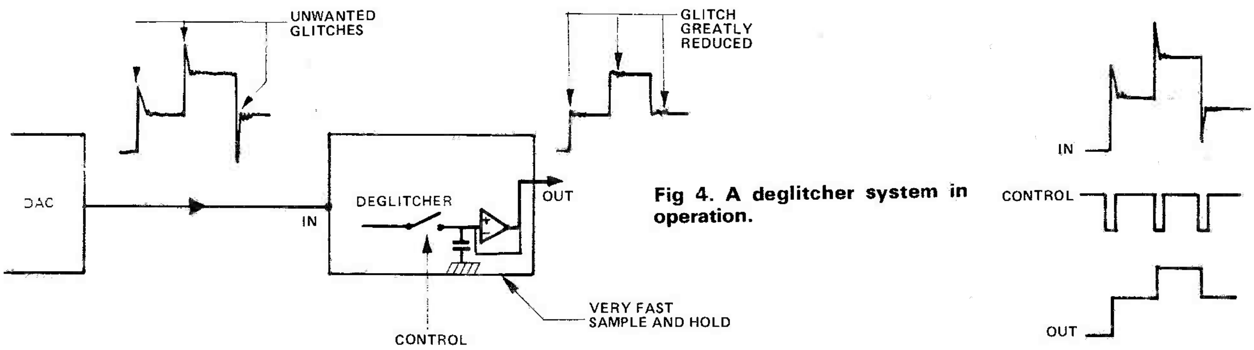


Fig 4. A deglitcher system in operation.

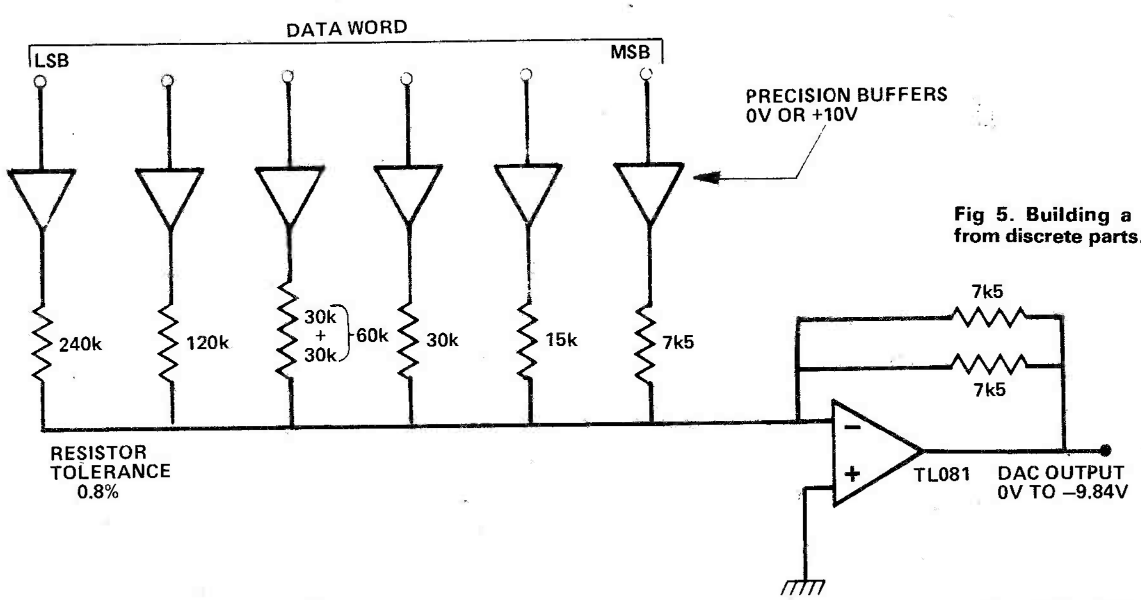


Fig 5. Building a DAC circuit from discrete parts.

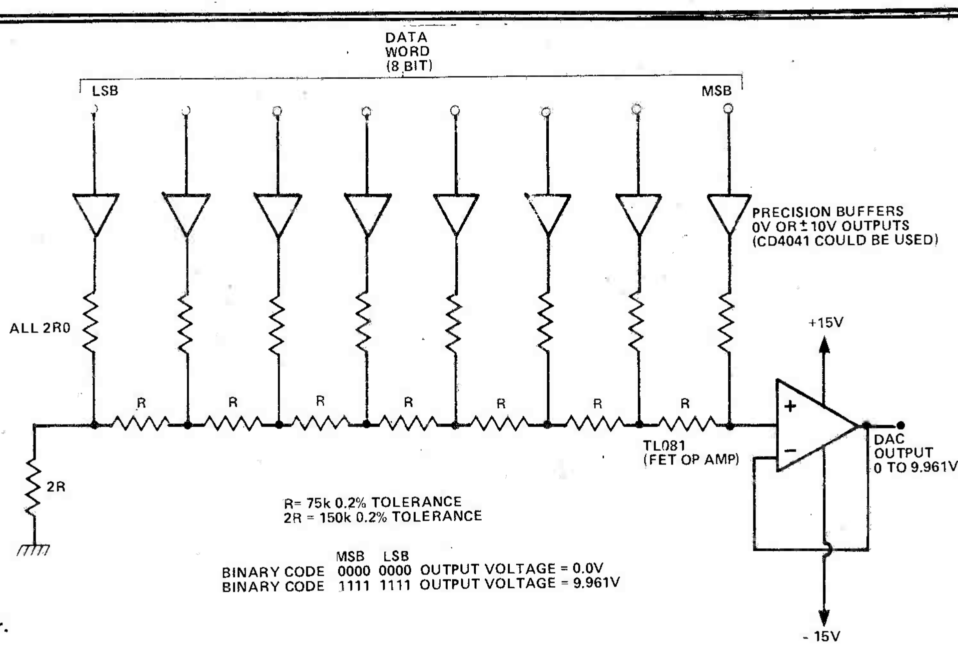


Fig 6. An R-2R ladder.

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).

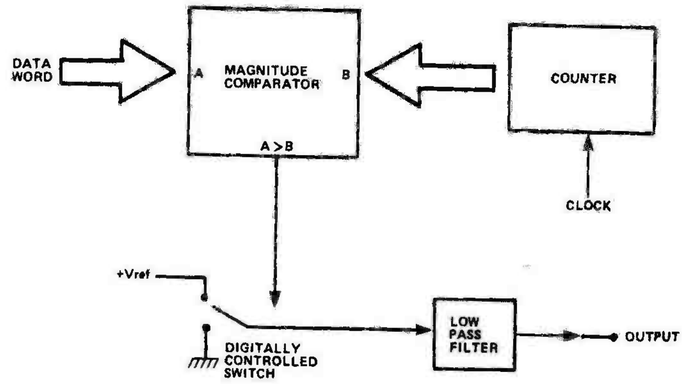
Counting On This

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.

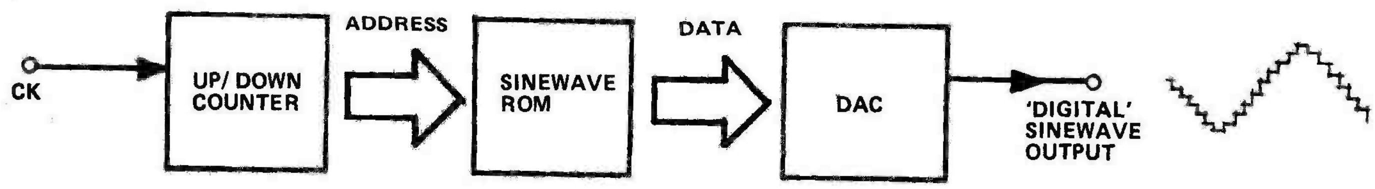
2) When the DAC output exceeds the level of the analog input the comparator output goes low, the counter stops. This is the end of the conversion, and the data that is held on the counters output is the data output. It would then be transferred to some latches, and held there until the next conversion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

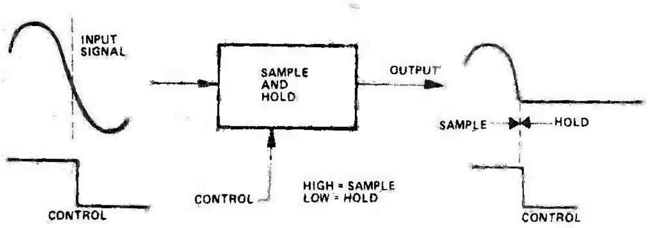


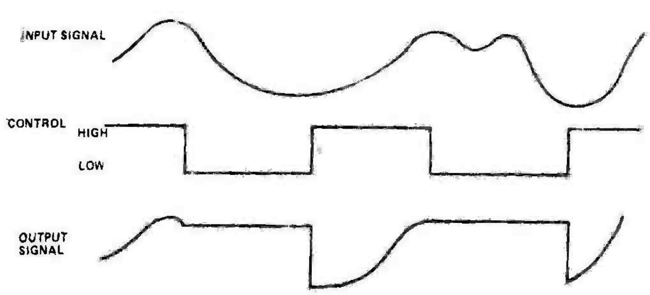
then the longest conversion time will be 1024 counts at 2μSec per count which is 2.048mSec, this means that the conversion rate will be less than 500 per second.

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.



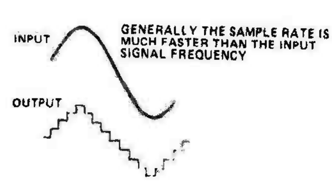


Data Lining

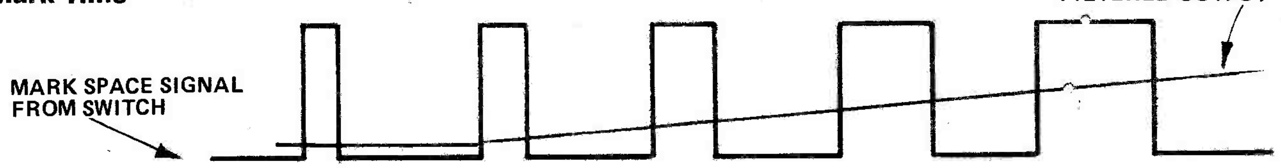
Another method of generating data is to convert analogue information into digital words. The signal must first be passed through a low pass filter, the cut off frequency of which must be less than half of the conversion frequency. The signal is then "held" in a sample and hold unit so that the ADC can 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.

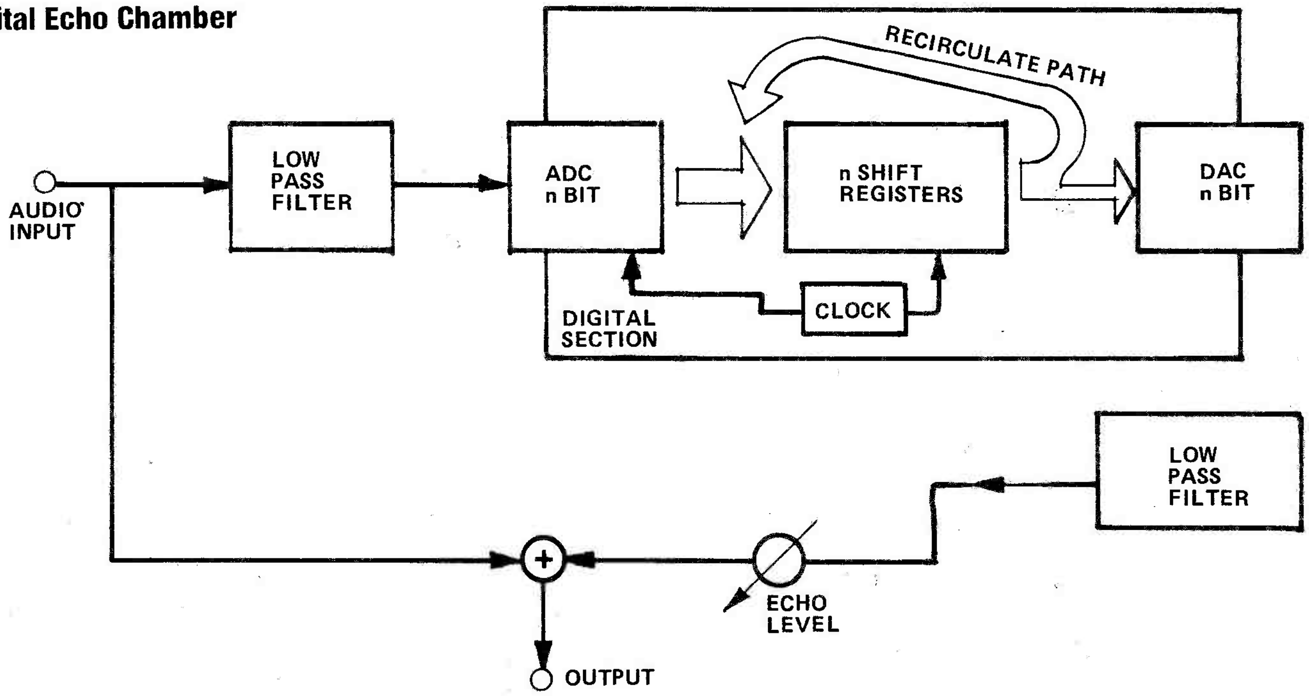


Mark Time



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



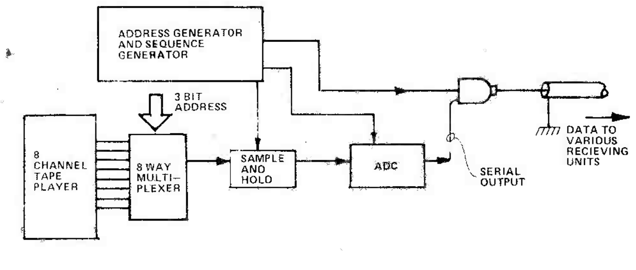
There are several professional echo chambers that are all digital. The audio input is converted into a digital word and then put into a parallel set of shift registers. A 10 bit system would use 10 sets of registers. The clock that starts the ADC conversion also shifts the data along the shift registers. 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 10×25,000 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.

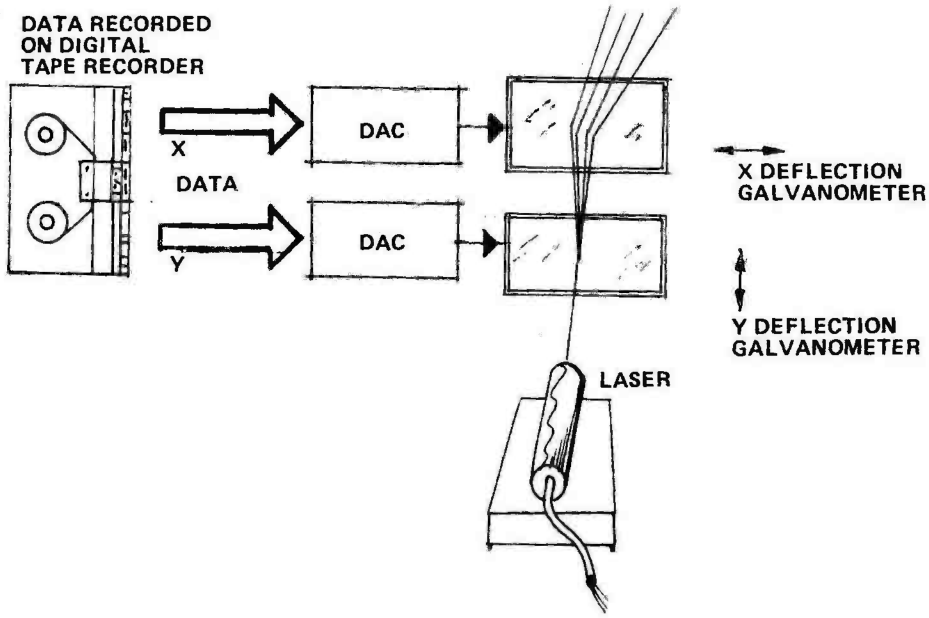
Multiplexed Sound System

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.



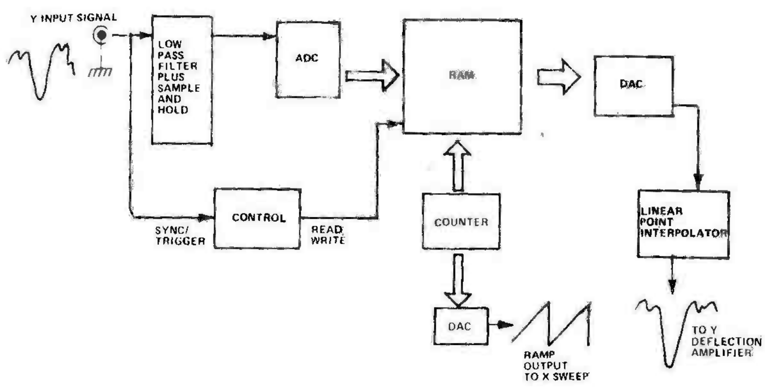
Laser Light Show.

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.

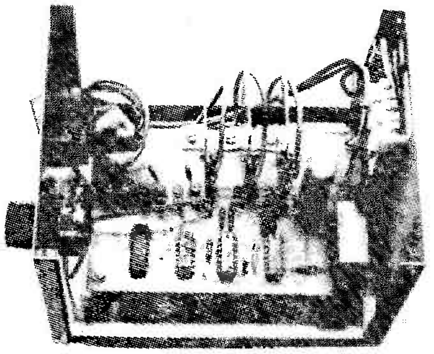
There are several products on the market that enable an ordinary oscilloscope to store waveform information. This is particularly useful if you are trying to capture non-repeating events. The system is very similar to the digital echo unit, there is an ADC, a memory and a DAC. Also there is a trigger circuit so that one shot events can be captured and a ramp generator to produce the Xsweep. 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.



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

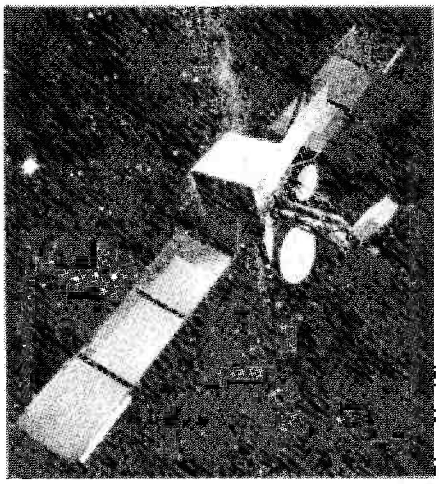
dB

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

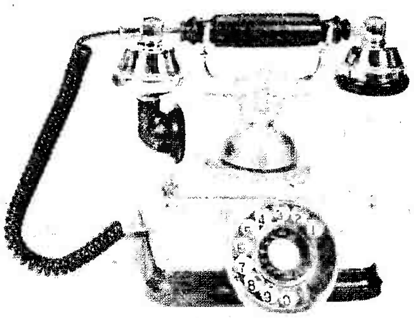
A project for those of you who do more than click the shutter. Our unit is in the mains lead to your enlarger (although battery operated) and allows you to set exposure times between 0.9 and 100 seconds in two infinitely variable ranges.

Communications Satellites



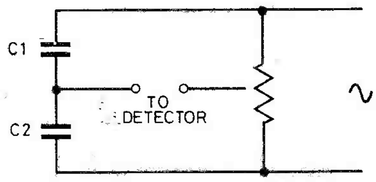
Speak to someone on the 'phone outside Europe and the chances are that your voice will spring out into space for thousands of miles on the way. The commercial ends of the space programme are described.

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.

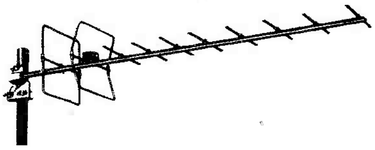
Experimenters Power Supply

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

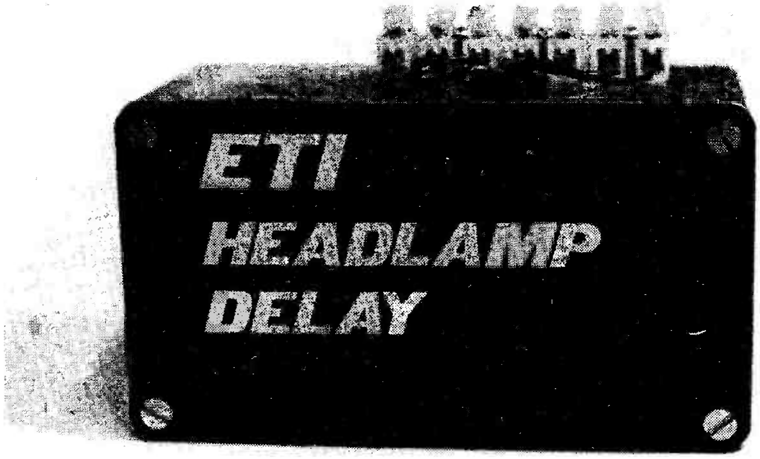
The items mentioned here are those planned for the next issue but circumstances may affect the actual content.

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.



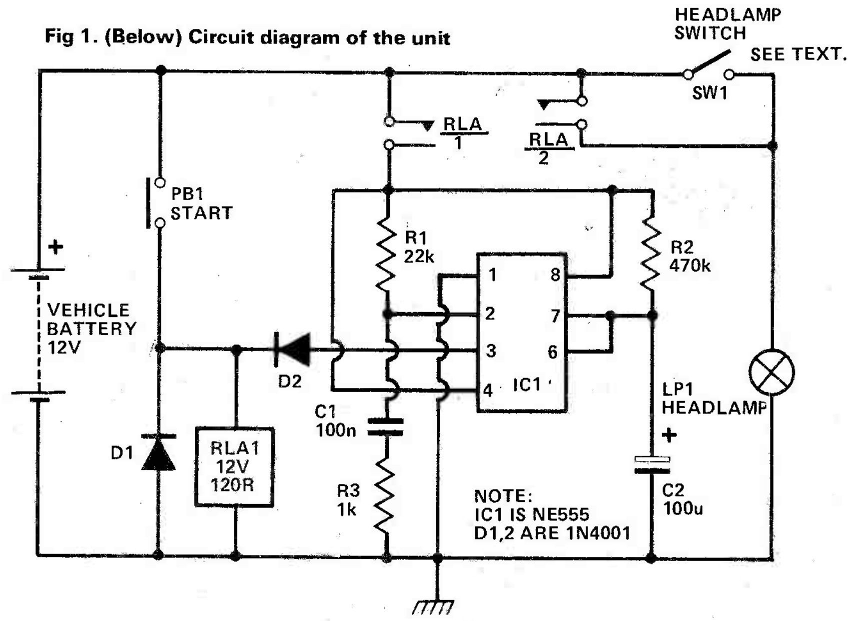
Construction and Use

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 he 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-day 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 vehicles 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. ▶

Fig 1. (Below) Circuit diagram of the unit



BUYLINES

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

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.

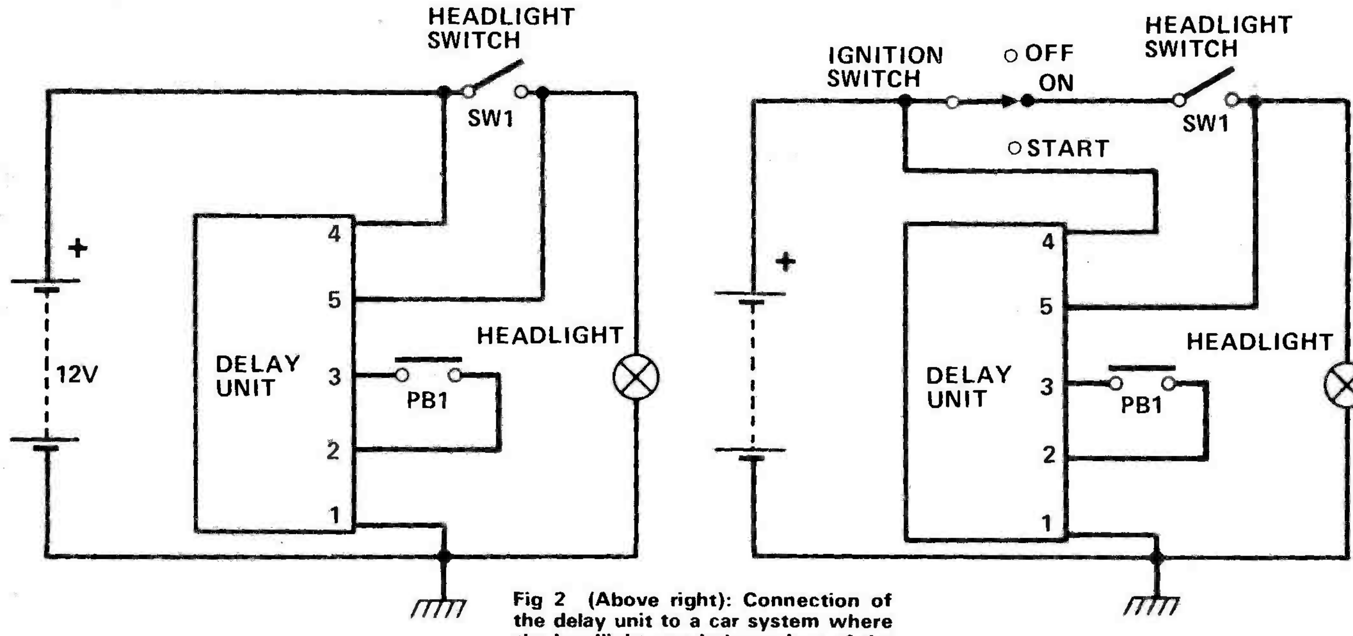


Fig 2 (Above right): Connection of the delay unit to a car system where the headlights are independent of the ignition switch.

(Above Left): Connection to all other systems!

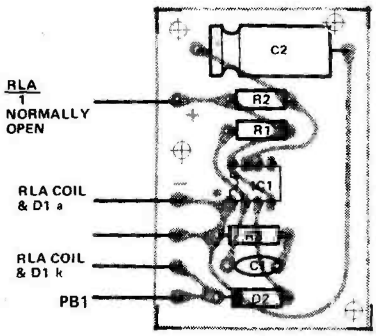
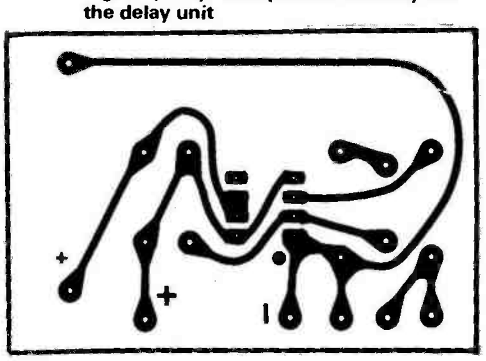


Fig 3. (Left): Component overlay for the delay unit



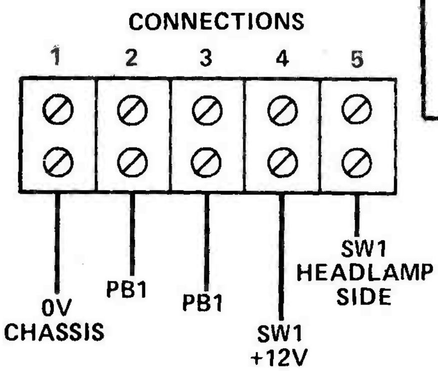


Fig 4. (Left): Wiring of the delay unit to a 5 terminal connection block

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

Fig 6. (Below right): The relay and D1 wiring.

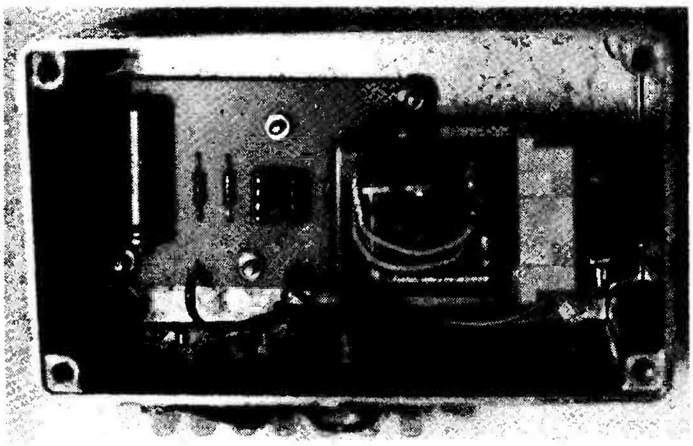
PARTS LIST

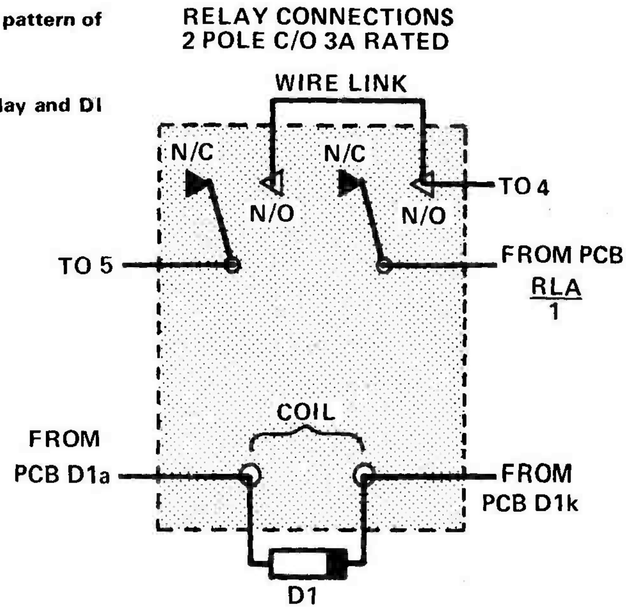
RESISTORS
R1, 22k
R2, 470k
R3, 1k

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.





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

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	.70	5.77	BEGHL
Dec. 77	*Freezer Alarm	608	.65	7.07	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	*Compander	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
Nov. 77	*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	BEL
Nov. 76	541 Train Controller	T001	.80	15.86	BEHL
Jan. 77	444 5 watt Stereo (2 pcbs)	T002	2.15	26.47	BEGK
Feb. 77	448 Disco Mixer	T003	1.75	16.36	BEJ
Dec. 77	Clock B.	T004	2.30	13.61	BE
Jan. 78	House Alarm A.	T005	2.20	25.68	BEHM
	House Alarm B.	T006	.95	3.99	BE
Feb. 78	Metal Locator Mk. II	T007	1.05	19.10	BEHL
March 78	Frequency Shift P.S.U.	T008	.75	4.89	BE
	Frequency Shifter	T009	1.65	21.04	BEL
	L.C.D. Meter	T010	1.10	25.72	BEG
	Light Dimmer	T011	.65	7.17	BEH
Apr. 78	Gas Monitor	T012	.90	13.96	BEHL
May 78	Star Trek Radio	T013	.95	7.97	BFH
	Stars & Dots	T014	2.00	22.28	BEHL
June 78	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
Aug. 78	Etiwet Plant Waterer	T020	1.00	5.03	BEH
Sept. 78	Cross Hatch Generator	T021	1.40	12.64	BEGHL
	Stac Timer	T022	2.30	23.26	BEJL
	Wheel of Fortune	T023	1.35	8.36	BEHL
Oct. 78	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
Oct. 78	Proximity Switch	T028	1.95	13.11	BEGH
Feb. 78	Ultra Sonic Receiver	T029	.70	9.03	BEH
Feb. 78	Ultra Sonic Transmitter	T030	.55	4.57	BEH
Nov. 78	Cuts Cassette Interface	T031	2.25	12.76	BEH
	Audio Oscillator (2 pcbs)	T032	2.90	33.74	BEHL
Dec. 78	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	BE
Jan. 78	Car Tachometer	T038	1.75	10.00	BF
	Digital Module A & B (2 pcbs)	T039	1.80	18.77	BE
	Digital Dial (Excl. T039)	T040	1.25	7.60	BE
	Log Converter	T041	3.50	23.66	BE
Feb. 79	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

SOLDERING IRONS & ACCESSORIES

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

"IDEAL FOR THE HOME CONSTRUCTOR"

ADDITIONAL PRINTED CIRCUIT BOARDS

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

1976 Mar	Audio Level Meter	1.20
May	Audio Exp./Compressor	3.95
Sep.	560 ABC VDU (Set 3)	5.60
	710 2m Power Amp	1.00
Oct.	241 Double Dice	1.50
	252 1-2 Hour Timer	.60
	152AB TV Pattern Gen (Set 2)	3.15
Nov.	543AB STD Timer (Set 2)	2.20
Dec.	544 Heart Rate Monitor	1.10
	447 Audio Phaser	1.60
	446 Audio Limiter	1.35
1977 Jan	570 Reaction Tester	1.60
	549 Metal Locator I	.95
	Patch Detector	.60
	Heads or Tails	.60
Feb.	448A Headphone Amp	.60
	449 Balanced Pre-Amp	.75
	449A VU Meter	1.10
	Door Bell	.75
Mar.	155 ABCD Digital Voltmeter (Set 4)	4.30
	Drill Controller	.70
	Function Generator	.95
	Temperature Alarm (Set 2)	1.40
Apr	Fuzz	.60
	630 Hex Display	.70
	P.S.U.	.60
	804 TV Game	1.70
May	Metronome (Simple)	.60
	Inject Tracer	.80
June	Digital Freq. Meter (Set 4)	3.40
	Bass Enhancer	2.70
Jul	081 Tachometer	.60
	Micro Amplifier	.55
	Alarm Alarm	.60
Aug	Moisture Indicator	.75
	Bongas	.75
	Egg Timer	.70
Sep	Loud Hailer	.70
	Continuity Tester	.60
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
To-morrow	132 Experimenters P.5	1.00
	555 Timer pcb	.70
1978 Jan	Hammer Throw (Set 3)	5.25
	Race Track	1.35
Feb.	Acc. Beat Metronome	.75
	Porch Light	.80
	586 Shutter Timer	1.30
Mar	RMS Meter	1.10
	Line Follower	.70
Apr.	Rain Alarm	1.10
May	Electronic Ignition	1.05
	Helping Hand (Set 2)	2.20
1979 Jan.	Digital Module A	1.10
	Digital Module B	.70
	Digital Module C	.75
Feb	VCT	1.55
	Twonky	2.45

SYSTEM 68

631	2.75
Mainframe PSU	1.00
VDU A	3.00
VDU B	2.95
CPU	2.90
TTY	2.25
Cuts & 4K Ram	245

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.

Prince 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. Dil 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 facia.
- 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 × ½W 1k resistors 30p
4 × NE 555 £1.00

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

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.

Kits can be supplied excluding pcb and/or case. Send sae 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.
32 Market Place
Great Bridge, Tipton
West Midlands

Telephone or Letter

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×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.

NEW **BRISTLE DARTBOARD**
Only **£9.95** + £1.00 P&P

LOOK!!!

4 Digit Alarm Clock chip and display GI CK3000 I.C + Plasma Display **£4.90**

Babani Books sae for list

All prices include P&P & VAT unless shown otherwise

Illustrated List of Chess Sets and Boards Send 15p

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 ▶

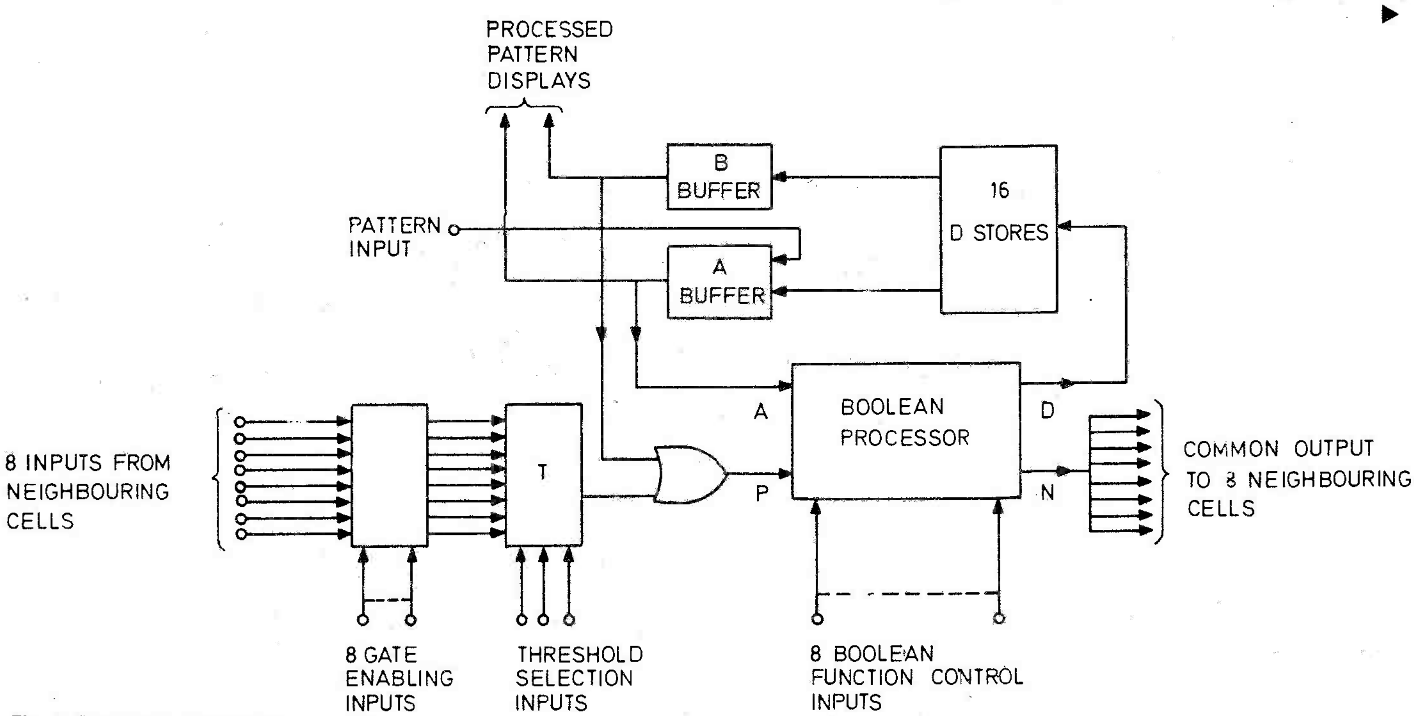


Fig. 1: The block diagram of one of the processors.

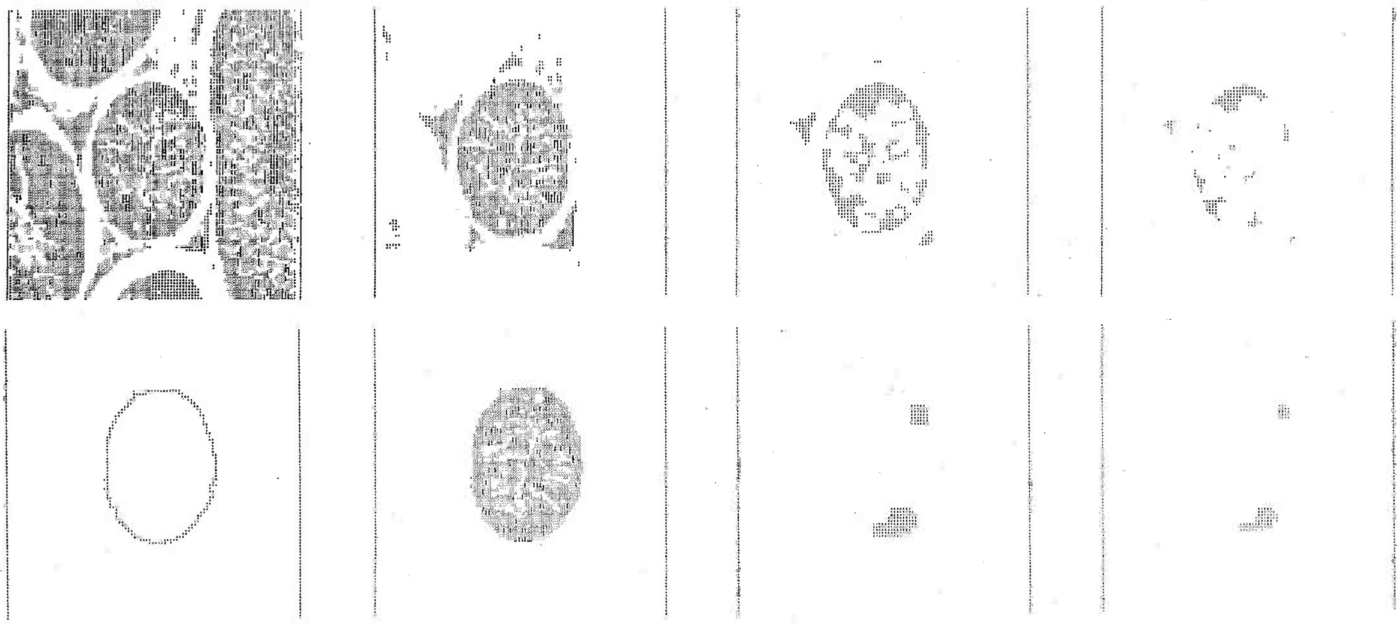


Fig. 2: Stages in the processing of a microscope picture of part of a rat's anatomy.

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 propogation 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 propogating 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 and 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!

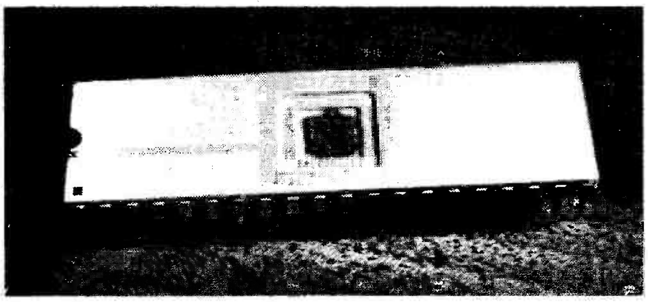
The input signal is from a TV camera (only part of the picture is used — 96 lines x 96 points). This is encoded either as a black and white picture with no grey or as a grey-scale image. CLIP can handle grey-scale pictures, performing processes such as smoothing.

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 0,0,0,0,0,0,0,0
90 DATA 0,1,1,1,1,1,1,0
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 propogate 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

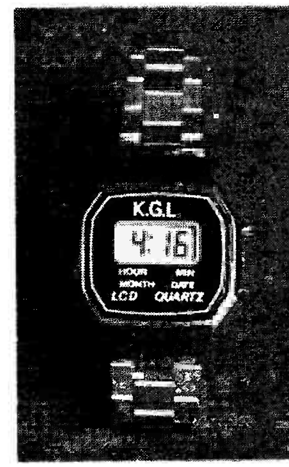
All prices INCLUDE VAT

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 gentlemans 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 . . . .

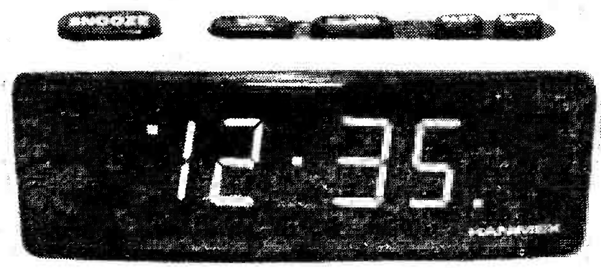
Address . . . .

. . . .

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 ....

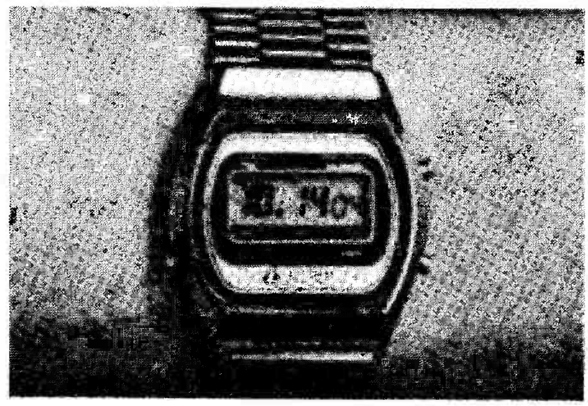
Adress ....

....

....

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 ....

....

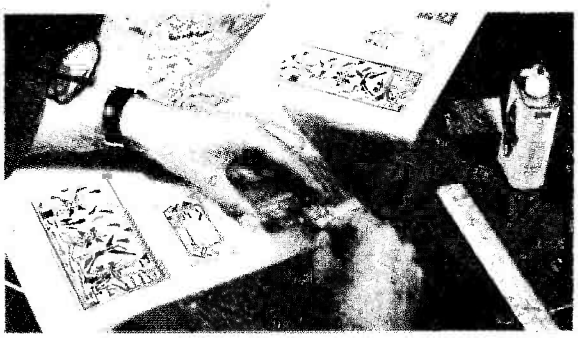
....

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.

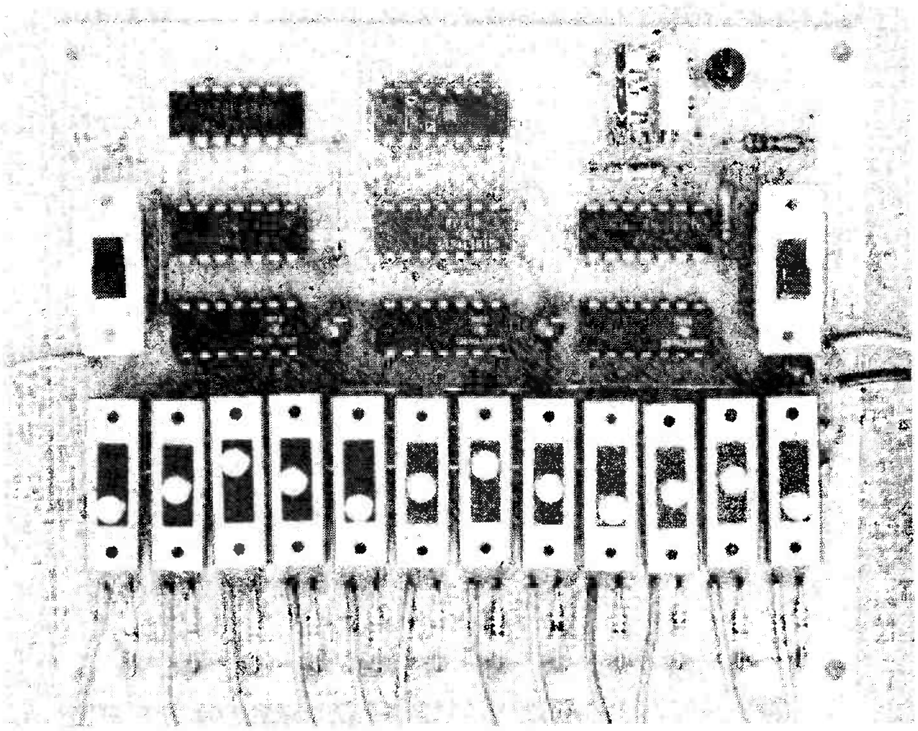
003	Race Track Game	Jan 78
	Hammer Throw	Jan 78
	Freezer Alarm	Dec 77
004	Metal Locator Mk II	Feb 78
	Ultrasonic Tx/Rx	Feb 78
	5 Watt Stereo Amp (modified)	Jan 77
	Metronome	Feb 78
	Shutter Time	Feb 78
005	Op-Amp Supply	
	Frequency Shifter	Mar 78
	LCD Panelmeter	
	Light Dimmer (3 times)	
006	CMOS Switched Preamp	
	From Experimenters	"Electronics
	P.S.U	Tomorrow"
	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	
	Helping Hand	May 78
009	AM/FM Radio	
	Bridge Oscillator	June 78
	CMOS Stars & Dots	
010	Bench Amplifier	
	Freezer Alarm	Project
	Marker Generator	Book
	LED Dice	Six
	Watchdog (2 PCBs)	
	Stars & Dots PSU	
011	Noise Generator	
	General Preamp	Project
	Flash Trigger	Book
	Compander	Six
	Active Crossover (2 PCBs)	
012	Disco Lightshow	Project
	Stereo Simulator	Book
	Digital Thermometer	Six
013	Amplifier Module	
	Amplifier PSU	Project
	Equaliser	Book
	Equaliser PSU	Six
014	Skeet Game	
	Sweep Oscillator	Project
	Burglar Alarm	Book
	GSR Monitor	Six
015	UFO Detector	July 78
	Torch Finder (twice)	July 78
	Etiwet (twice)	Aug 78
016	Stac Timer	
	Xhatch Gen	Sept 78
	Wheel of Fortune	
017	Complex Sound Gen	
	Tele Bell Extender	Oct 78
	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 see n.



SPECIFICATION

Modes	Asynchronous or synchronous
No. of inputs	12 address, 1 clock
Loading	
address	0.4 UL (TTL)
clock	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 requriement	+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 ▶

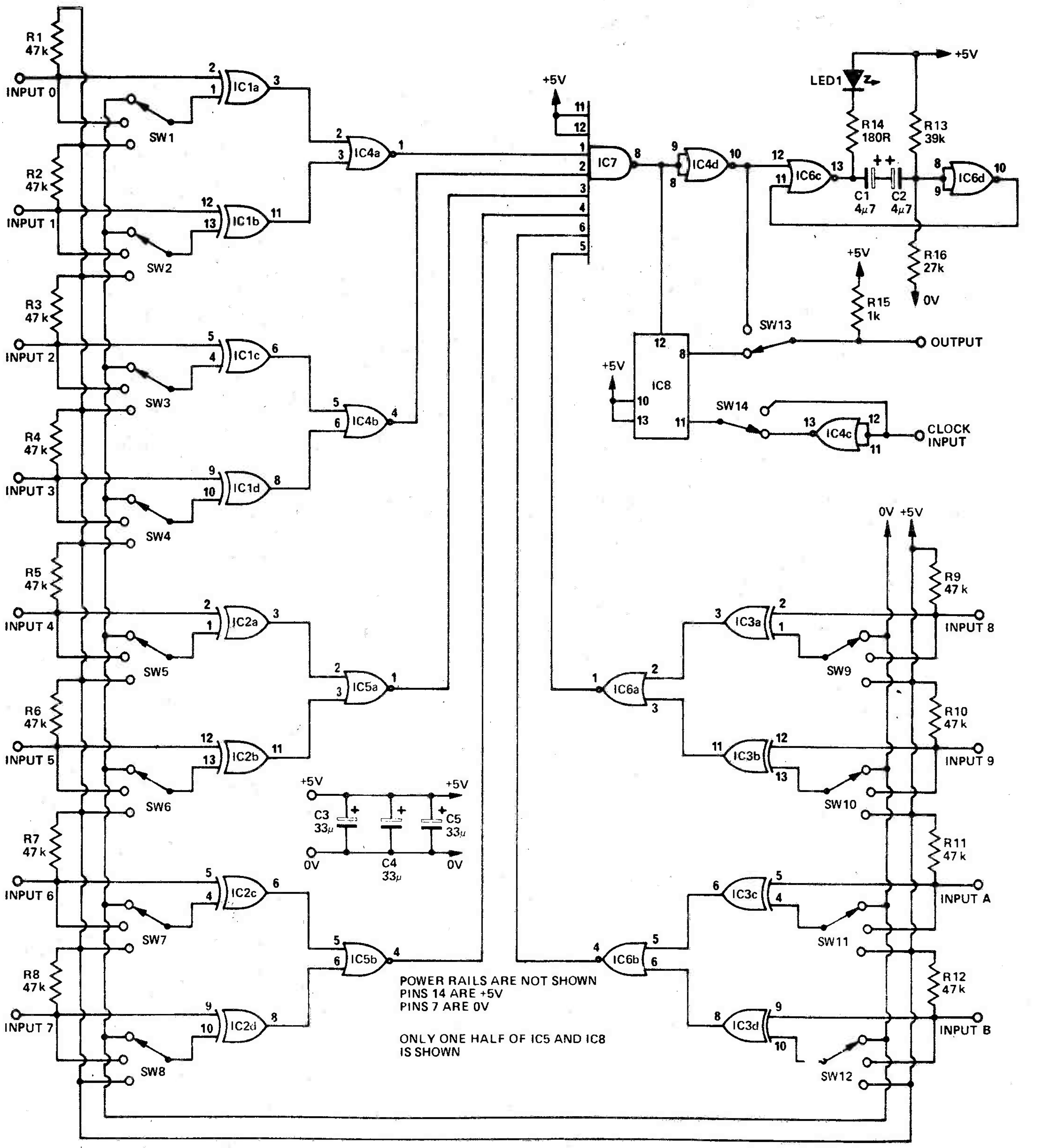


Fig 1. Full circuit diagram of the logic unit.

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	

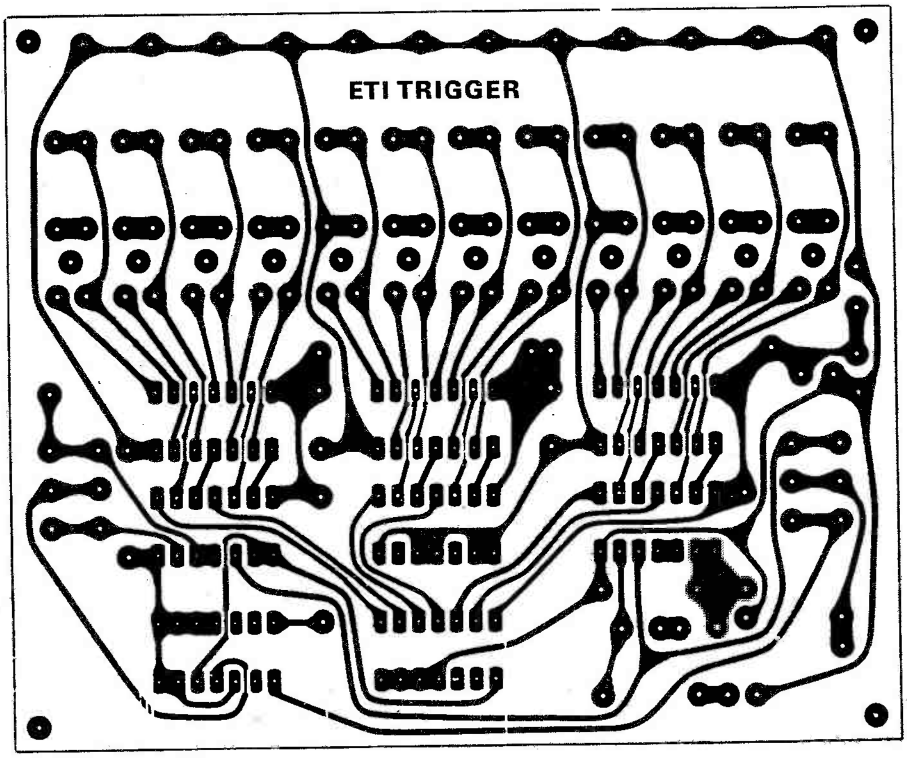


Fig 2 (right): Foil pattern shown full size.

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.

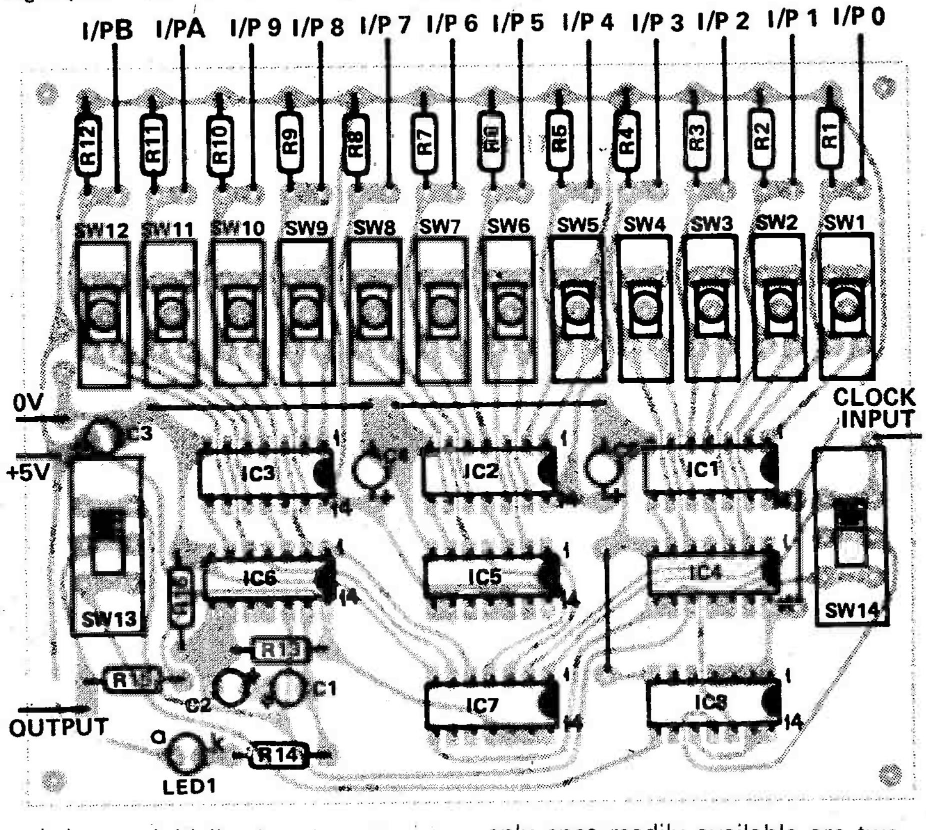
The outputs from the exclusive OR gates are combined in pairs by the NOR gates IC4-IC6. If the 12 input signals match the preset selection, the output of all 6 NOR gates will be high. If any one is not in agreement with the selection one or more of the NOR gates will have a low output.

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 indicationg 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.

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



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.O. 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. govt. depts.. etc can telephone their orders for immediate despatch on account.)

CMOS

These cut prices for Amateur sers and Export. Note: industrial users — quantity prices available.
Mostly Motorola, RCA

4000	15p	4051	72p	40109	£1.02	4517	£3.82
4001	17p	4052	72p	40181	£3.39	4518	£1.02
4002	17p	4053	72p	40182	£1.40	4519	51p
4006	£1.05	4054	£1.10	40192	£1.40	4520	£1.08
4007	18p	4055	£1.28	40193	£1.40	4521	£1.88
4008	87p	4056	£1.34	40194	£1.18	4522	£1.08
4009	50p	4057	£25.70	40257	£1.48	4524	N/S
4010	50p	4059	£4.80	4160	£1.08	4526	£1.08
4011	18p	4060	£1.15	4161	£1.08	4527	£1.52
4012	18p	4061	£15.67	4162	£1.08	4528	99p
4013	42p	4062T	£10.00	4163	£1.08	4529	£1.14
4014	86p	4063	£1.09	4174	£1.08	4530	85p
4015	89p	4064	N/S	4175	99p	4531	£1.45
4016	45p	4065	N/S	4194	£1.08	4532	£1.27
4017	89p	4066	57p	4408	£6.59	4534	£5.13
4018	89p	4067	£3.80	4409	£6.59	4536	£3.69
4019	48p	4068	22p	4410	£5.73	4537L	£13.23
4020	99p	4069	20p	4411	£9.58	4538	£1.25
4021	91p	4070	23p	4412VP	£8.18	4539	91p
4022	86p	4071	21p	4415V	£7.50	4541	£1.14
4023	20p	4072	21p	4415F	N/S	4543	£1.59
4024	66p	4073	21p	4419	£2.68	4549	£3.69
4025	19p	4075	23p	4422	£5.00	4552	£10.55
4026	£1.80	4076	85p	4431	TBA	4553	£3.87
4027	45p	4077	23p	4433	£11.32	4554	£1.19
4028	81p	4078	21p	4435	£7.93	4555	78p
4029	99p	4081	20p	4440L	£11.58	4556	78p
4030	58p	4082	21p	4450	£2.67	4557	£3.86
4031	£2.05	4085	74p	4451	£2.67	4558	£1.14
4032	£1.00	4086	73p	4452	TBA	4559	£3.69
4033	£1.45	4089	£1.50	4461	£2.18	4560	£1.84
4034	£1.96	4093	63p	4462	£2.42	4561	65p
4035	£1.11	4094	£1.90	4490FP	£6.54	4562	£5.33
4036	£2.45	4095	£1.05	4490VP	£4.92	4566	£1.59
4037	£1.00	4096	£1.05	4500	£5.56	4568	£2.38
4038	£1.08	4097	£3.72	4501	17p	4569	£2.57
4039	£2.45	4098	£1.10	4502	91p	4572	25p
4040	£1.05	4099	£1.45	4503	69p	4580	£5.74
4041	80p	40061	N/S	4505	£5.71	4581	£2.62
4042	75p	40100	£2.50	4506	51p	4582	98p
4043	94p	40101	£1.61	4507	55p	4583	76p
4044	90p	40102	£2.12	4508	£2.48	4584	43p
4045	£1.45	40103	£2.12	4510	99p	4585	£1.01
4046	£1.28	40104	£1.09	4511	£1.38	4599	£2.06
4047	87p	40105	£1.06	4512	81p	4700	£1.75
4048	58p	40106	61p	4514	£2.65		
4049	48p	40107	68p	4515	£2.99		
4050	48p	40108	£5.36	4516	£1.08		

74C

74C00	24p	74C90	85p	74C200	£6.78	74C918	£1.06
74C02	24p	74C93	85p	74C221	£1.36	74C921	£11.83
74C04	24p	74C95	£1.04	74C373	£1.73	74C922	£3.66
74C08	24p	74C107	£1.22	74C374	£1.73	74C923	£3.73
74C10	24p	74C150	£4.12	74C901	54p	74C924	TBA
74C14	£1.41	74C151	£2.46	74C902	54p	74C925	£4.84
74C20	24p	74C154	£3.67	74C903	54p	74C926	£4.84
74C30	24p	74C157	£2.20	74C904	54p	74C927	£4.84
74C32	24p	74C160	£1.10	74C905	£7.26	74C928	£4.84
74C42	92p	74C161	£1.10	74C906	54p	74C929	£11.93
74C48	£1.38	74C162	£1.10	74C907	54p	74C948	TBA
74C73	54p	74C163	£1.10	74C908	96p	80C95	54p
74C74	56p	74C164	£1.04	74C909	£1.63	80C96	61p
74C76	54p	74C165	£1.04	74C910	£6.78	80C97	54p
74C63	£1.29	74C173	90p	74C911	£7.13	80C98	61p
74C85	£1.29	74C174	£1.51	74C912	£7.13	82C19	£4.13
74C86	64p	74C175	90p	74C914	£1.41	88C29	£1.93
74C89	£4.38	74C192	£1.10	74C915	£1.10	88C30	£1.93
		74C193	£1.10				
		74C195	£1.04				

VIDEO

UM1111E36 UHF Ch.36 Vision Modulator £2.50 (+12½% VAT)
UM1231 UHF Ch.36 Vision Modulator wide bandwidth (for computers etc.) £4.70 (+8% VAT)

QUARTZ

32.768 KHz (Watch)	£3.23
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	£3.23
3.579545 MHz	£1.95
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
7.86432 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
10.700 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
20.1134 MHz	£3.23
21.1134 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

2½"×1" (pack of 5)	59p
2½"×3¾"	41p
2½"×5"	49p
2½"×17"	£1.52
3¾"×3¾"	49p
3¾"×5"	56p
3¾"×17"	£1.95
4.7"×17.9"	£2.52

0.1" Plainboard (no strips)

3¾"×2½"	28p
3¾"×5"	45p
3¾"×17.9"	£1.28
Terminal pins	£1.50/500
V-Q DIP board	98p
DIP breadboard	£2.42
Spot face cutter	82p
Pin insertion tool	99p

SOLDERCON PINS

100 50p 1000 £4.00

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 3130E	84p
CA 3140E	35p
UA 741 (Texas)	22p
6×741 (Texas)	£1.00

SPECIAL

NSB 3881 Multiplexed 4×0.3" common cathode prime quality £2.95

LED DISPLAYS

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

LIQUID CRYSTAL DISPLAY

4×0.5" Digits 40 pin DIL £8.95

CLOCK CHIPS

AY-5-1224A	£2.60
MK 50253	£5.50
MK 50362/50366	£6.50
MC 14440/(LCD)	£9.95

SIX DECADE COUNTERS

MK 50395/6/7	£8.75
MK 50398/9	£6.20

TIMEBOX. Digital Clock Case. 56×131×71.5 mm with red acrylic window. Case colour white £2.50

MICROPROCESSORS

KEMITRON COMPUTER BOARDS

114 x 203 mm fibreglass, with gold plated edge connector. Designed for a range of MPU's Z80. SC/MP II etc.

SC/MP Protoboard	£5.95
Z80 CPU card	£4.95
VDU 'A' } set of three	£4.95
VDU 'B' } set of three	£4.95
VDU 'G' } set of three	£5.95
EPROM Programmer (2708's)	£5.95
4k PROM board (5204's)	£5.95
8k PROM board (2708's)	£5.95
2k RAM board (2102's)	£5.95
8k RAM board (2114's)	£5.95
TAPE interface	£4.95
PSU 5v. +12v. −12v board	£4.95
PSU 5v. −12v board	£4.95

Further details on request (Others to be announced)

Z80

Z80 CPU (2½ MHz)	£11.95
Z80-4 CPU (4MHz)	£17.95
Z80-CTC	£7.95
Z80-P10	£7.95

SC/MP II, RAM I/O

SC/MP II (4MHz)	£7.95
INS 8154 RAM I/O	£7.50

6800

6800 MPU	£5.95
6802 MPU	£9.95
68A10 (128 × 8 RAM)	£3.10
6820, 6821 PIO	£4.25
6850 ACIA	£6.74

6502

6502 £12.00

CMOS

COSMAC 1802	£13.95
MC14500B ICU	£5.56

COMPUTER KITS

(Check stock before ordering)
Science of Cambridge MK14 £39.95
NASCOM 1 £197.50
Service for MK14 (no fix, no fee) £3.00

MOSTEK VDU BOARD

TYPE VAB-II 16 line x 64 characters, cursor, upper/lower case. needs 20mA interface, keyboard, power supply, and TV monitor £125.00

CRT Controller; UARTs

Thompson CSF SF.F96364E	£11.50
AY-5-1013 UART	£3.80
AY-3-1015 UART	£5.60

BUGS

ETIBUG 1	£19.95
ETIBUG 2	£19.95
KITBUG	£14.95
MIKBUG 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 8678 CAB/BWF/CAH	£12.95
AY-5-2376	£9.75

BASICS

4K NIBL for SC/MPII in 8 ROMS: ISP-8F/351 £50.25
Ditto in 2 ROMS: ISP-8F/352 £46.90
8K LLL BASIC for 8080/Z80 (Check availability before ordering) in 1 ROM: INS 8298 £67.27

UV ERASEABLES

5204 ½K x 8	£7.50
2708 1K x 8	£7.50
2716 2K x 8	£28.28
68708 1K x 8	£9.25

STATICS (Mostly 450nS)

2101—256 x 4	£2.25
21L02—1K x 1	£1.20
2111—256 x 4	£1.75
2112—256 x 4	£2.25
68A10 128 x 8	£3.10
2114—1K x 4	£11.95
4118—1K x 8 (check stock)	£16.50

INTERFACE

81LS95/6/7/8	£1.25
75491 LED driver	50p
ZN425	£3.95

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 McMOS Databook (Motorola)	£3.50
CMOS Databook (National)	£2.30
MC 14500B ICU Handbook (Motorola)	£2.25
'Understanding Microprocessors' (Motorola)	£2.75
M6800 Microprocessor Applications Manual (Motorola)	£9.95
'A Guide to SC/MP Programming' (Kemitron)	£3.50
'A Guide to Kitbug' (Kemitron)	75p
SC/MP Technical Description (National)	£2.76
SC/MP Microprocessor Applications Handbook (National)	£3.45
SC/MP Programming + Assembler Manual (National)	£3.00
NIBL Reference Manual (National)	£3.45
16-page data for IMS 8154 (ISP-8A/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.
c90-page Z80 CPU Technical Manual
c10-page Z80-CTC Product Specification
c25-page Z80-P10 Technical Manual
c200-page Z80 Programming Manual
c25-page Z80 Micro Reference Manual

74LS

		74LS27	28p	74LS76	40p	74LS125	60p	74LS163	£1.18	74LS240	£2.36	74LS283	£1.92	74LS375	£1.60
		74LS28	48p	74LS78	40p	74LS126	60p	74LS164	£1.14	74LS241	£2.32	74LS290	£1.28	74LS377	£2.12
74LS00	14p	74LS30	22p	74LS83	£1.15	74LS132	95p	74LS165	75p	74LS242	£2.32	74LS293	£1.28	74LS378	£1.84
74LS01	14p	74LS32	27p	74LS85	£1.18	74LS136	55p	74LS166	£2.26	74LS243	£2.32	74LS295	£1.85	74LS379	£2.15
74LS02	16p	74LS33	39p	74LS86	43p	74LS138	85p	74LS170	£2.88	74LS244	£1.70	74LS298	£1.68	74LS384	86p
74LS03	16p	74LS37	39p	74LS90	60p	74LS139	85p	74LS173	£1.05	74LS245	£2.70	74LS324	£2.40	74LS386	86p
74LS04	16p	74LS38	39p	74LS91	£1.04	74LS145	£1.08	74LS174	£1.06	74LS247	£1.90	74LS325	£2.90	74LS390	£2.30
74LS05	20p	74LS40	28p	74LS92	89p	74LS147	£1.70	74LS175	£1.10	74LS248	£1.90	74LS326	£2.94	74LS393	£2.30
74LS08	22p	74LS42	98p	74LS93	89p	74LS148	£1.73	74LS181	£3.98	74LS249	£1.90	74LS327	£2.86	74LS395	£2.18
74LS09	22p	74LS47	90p	74LS95	£1.16	74LS151	96p	74LS183	£2.98	74LS251	£1.34	74LS347	£1.48	74LS396	£2.15
74LS10	20p	74LS48	£1.20	74LS96	£1.16	74LS153	76p	74LS190	£1.40	74LS253	£1.42	74LS348	£1.86	74LS398	£2.76
74LS11	22p	74LS49	£1.20	74LS107	44p	74LS154	£1.70	74LS191	£1.40	74LS257	£1.10	74LS352	£2.28	74LS399	£2.30
74LS12	23p	74LS51	24p	74LS109	55p	74LS155	96p	74LS192	£1.30	74LS258	£1.46	74LS353	£2.28	74LS445	£1.50
74LS13	38p	74LS54	28p	74LS112	55p	74LS156	96p	74LS193	£1.30	74LS259	£1.60	74LS365	65p	74LS447	£1.44
74LS14	75p	74LS55	30p	74LS113	50p	74LS157	76p	74LS194	£1.66	74LS261	£4.50	74LS366	65p	74LS490	£1.80
74LS15	30p	74LS63	£1.50	74LS114	50p	74LS158	96p	74LS195	£1.36	74LS266	52p	74LS367	65p	74LS668	£1.82
74LS20	20p	74LS73	46p	74LS122	70p	74LS160	£1.28	74LS196	£1.00	74LS273	£2.44	74LS368	66p	74LS669	£1.82
74LS21	22p	74LS74	41p	74LS123	70p	74LS161	98p	74LS197	£1.40	74LS275	£2.50	74LS373	£1.80	74LS670	£2.48
74LS26	48p	74LS75	48p	74LS124	£1.80	74LS162	£1.38	74LS221	96p	74LS279	66p	74LS374	£1.95		

PET CORNER

Lotus now carry an exciting range of products for your CBM PET.

Memory Expansion

- ★ Mounts inside PET
- ★ Runs from PET's own power supply
- ★ Takes 10 minutes to fit
- ★ Includes memory test program
- ★ 6 month warranty

16k £276 + VAT
24k £337 + VAT
32k £394 + VAT

DUAL DRIVE MINIFLOPPY

- ★ Dual minifloppy with 100K per disk side — 200K online.
- ★ DISKMON in ROM on controller board, plugs into Expandapet.
- ★ DISKMON automatically reorganizes free space after SAVE or ERASE.
- ★ Full disc software support.
- ★ FORTRAN & PLM compilers in February.
- ★ 90-day warranty on hardware.
- ★ Initial quantities limited.
- ★ Available early January.
- ★ Phone or write for full details.
- ★ Needs minimum 16K Expandapet expansion memory.

DKH641 Dual Minifloppy System
£916.00 plus 8% VAT

MUSIC BOX

Turns your PET into a programmable musical instrument. You can record and play up to 90 pages, 16 notes per page, change tempo, key, etc.
£37.50 inc. VAT & P&P

T.I.S. WORKBOOKS

A set of 5 workbooks to give you a full understanding of all the ins and outs of your PET more fully than any previous manuals.
£15.95 per set. inc. P&P

Dustcover £17.95 inc. VAT & P&P

Lots of software and other goodies.
Send large SAE.

LOTUS

Tel: 01-981 3993
Telex: 261426
Atn. Lotus Sound

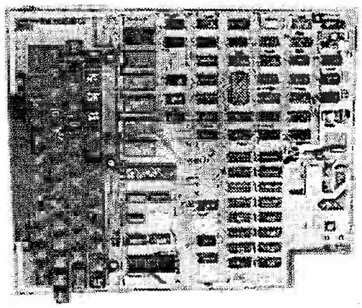
The Age of Affordable Personal Computing Has Finally Arrived

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 computesr.
- 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.

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.

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)

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

....

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

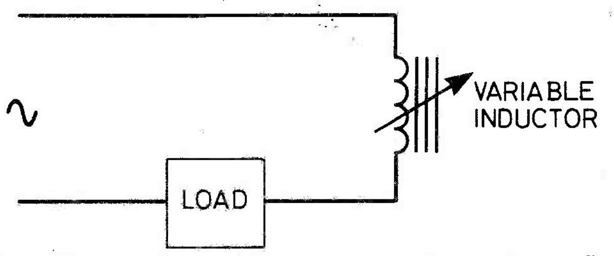


Fig. 1. Control of a load using a variable inductor, this configuration has very little power lost as heat, unlike a resistive controller.

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 ▶

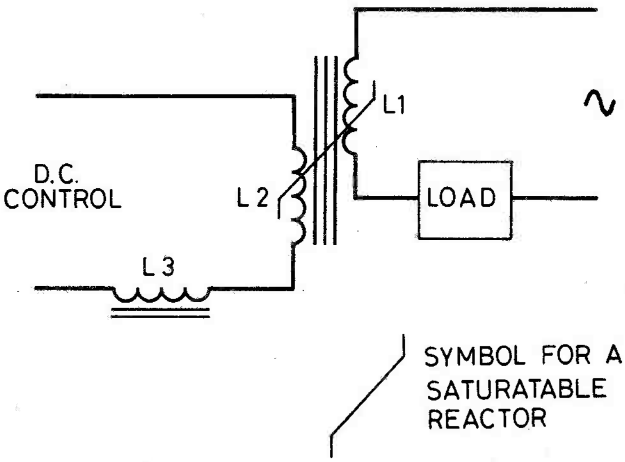


Fig. 2. Simple magnetic amplifier circuit, showing DC control winding.

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 impedence 10/.05=200 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 lead 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.

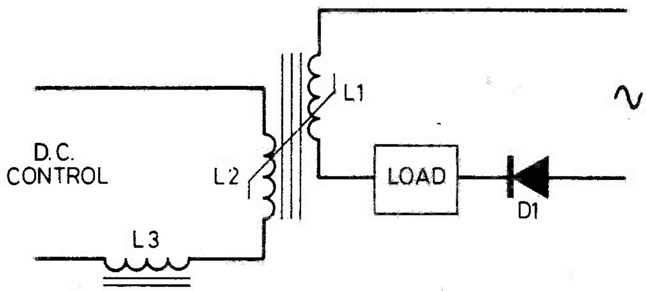


Fig. 3. Half-wave control using self-saturation.

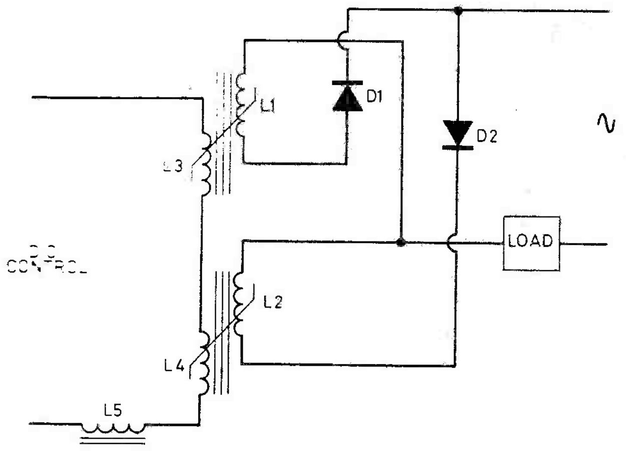


Fig. 4. Full-wave amplification with self saturation, by positive feedback.

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

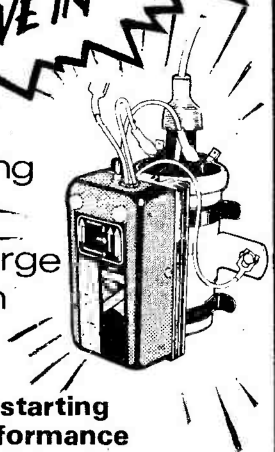
DC amplification? Simple enough, just rectify the output of the magnetic amplifier — the self-saturating full wave type already has two rectifiers included in the circuit and only two more are needed. More sensitivity? Add another winding to pass DC bias current, and the sensitivity increases because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

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 pittec 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. ETI 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 REQ'D.
X4 KIT £16.65 inc. VAT	
TACHO PULSE SLAVE UNIT £3.85 inc. VAT	

Send SAE if brochure only required.

I enclose cheque/PO's for

£ ....

Cheque No.

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.

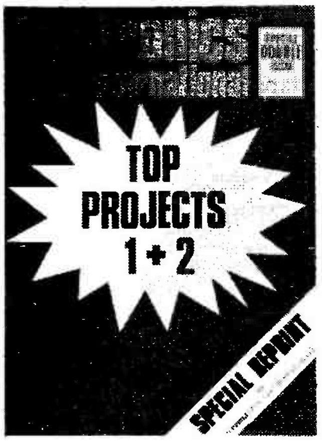
Please send me full colour leaflet and prices on whole ICE range including accessories.

Name ....

Address ....

ETI

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!

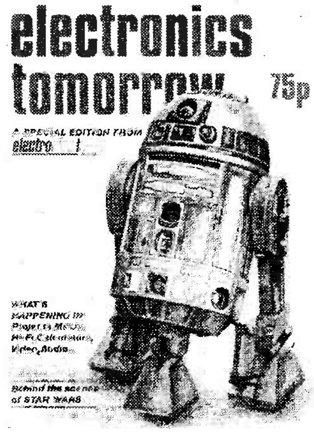
Book 4: £1.00 + 25p P&P.
Sweet sixteen stereo amp., waa-waa, audio level meter, expander/compressor, car theft alarm, headlamp reminder, dual-tracking power supply, audio millivoltmeter, temperature meter, intruder alarm, touch switch, push-button dimmer, exposure meter, photo timer, electronic dice, 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 . . .

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.

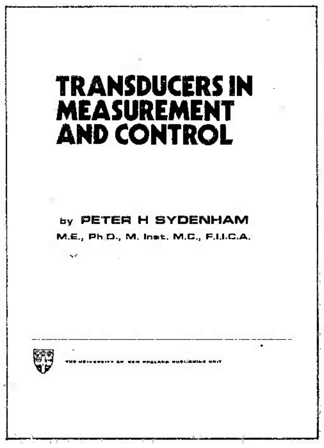
ETI CIRCUITS
Books 1 & 2.
Each volume contains over 150 circuits, mainly drawn from the best of our Tech-Tips. The circuits are indexed for rapid selection and an additional section is included which gives transistor specs, and plenty of other useful data. Sales of this publication have been phenomenal — hardly surprising when the circuits cost under 1p each!
£1.50 + 25p P&P each.

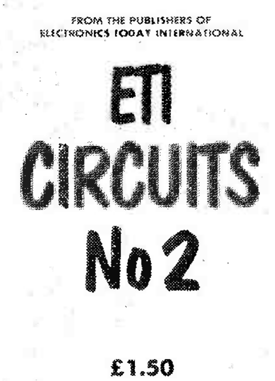


TRANSDUCERS IN MEASUREMENT AND CONTROL

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 re-published the series splendidly for use as a standard textbook. Written by Peter Sydenham, M.E., Ph.D., M.Inst.M.C., F.I.I.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.

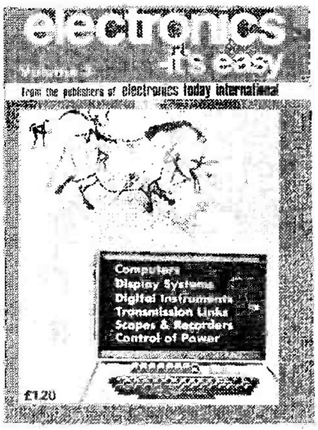




ELECTRONICS — IT'S EASY
Books 1, 2 & 3.

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.

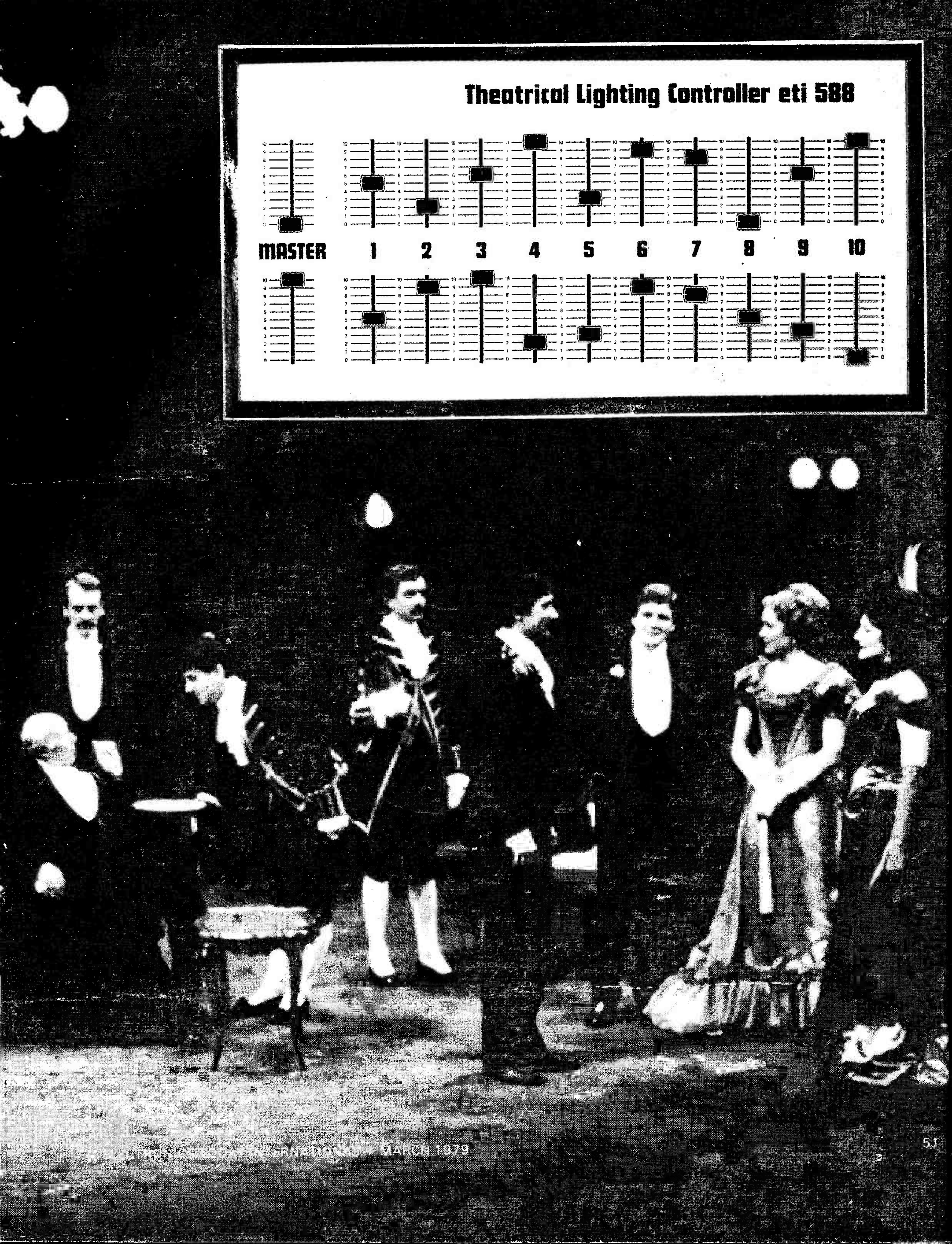
from ETI

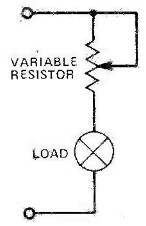
STAGE DIMMER

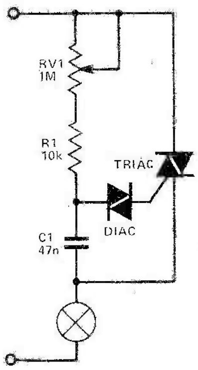
A comprehensive unit designed to handle up to 20A per channel with emphasis upon ease of construction and versatility in operation

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, effectively 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
MASTER
1
2
3
4
5
6
7
8
9
10





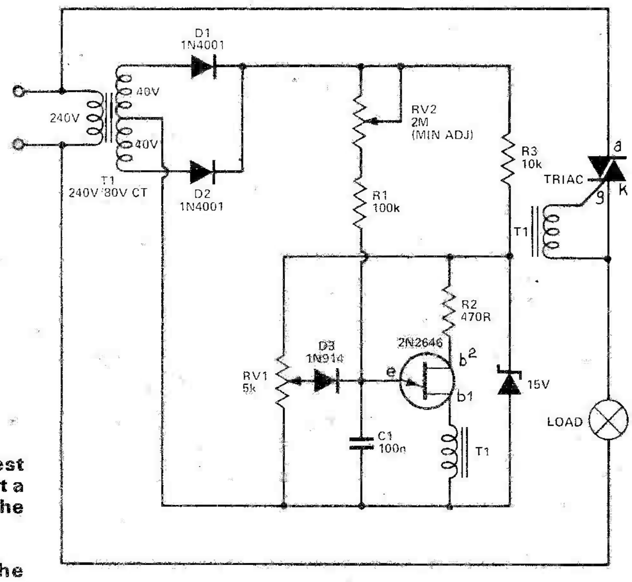


Fig 1. (Far left). The earliest type of dimmer employing just a variable resistor controlling the load.

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

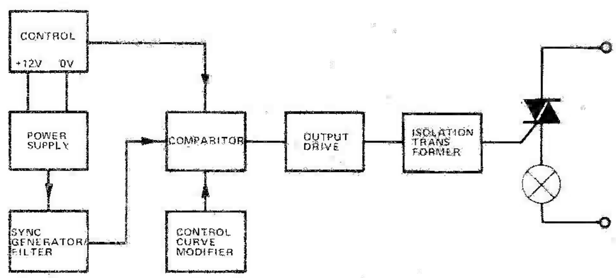
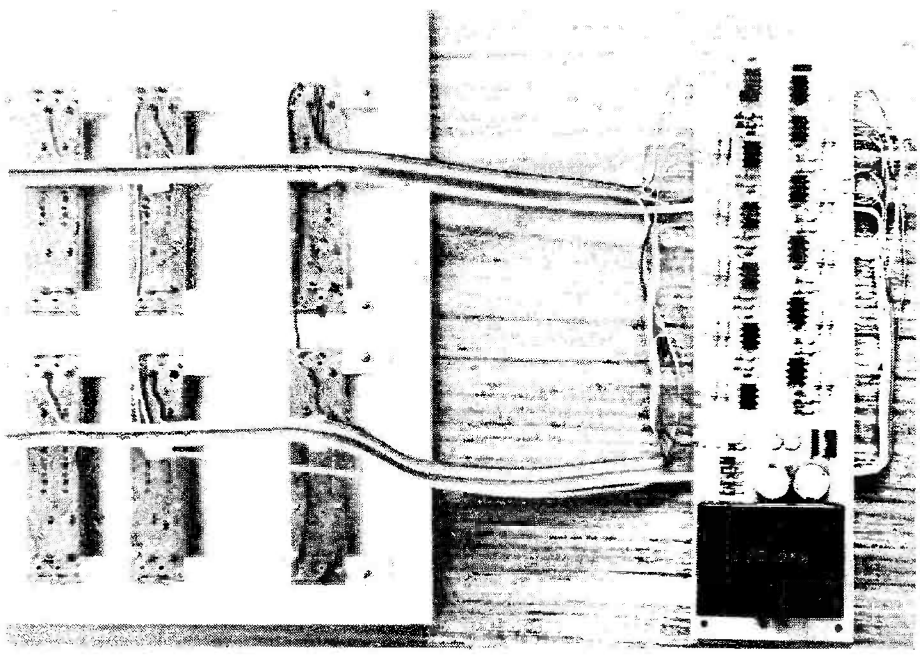


Fig 3. (Right). A more refined realisation of the art, which at least has the control isolated!



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 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 ▶

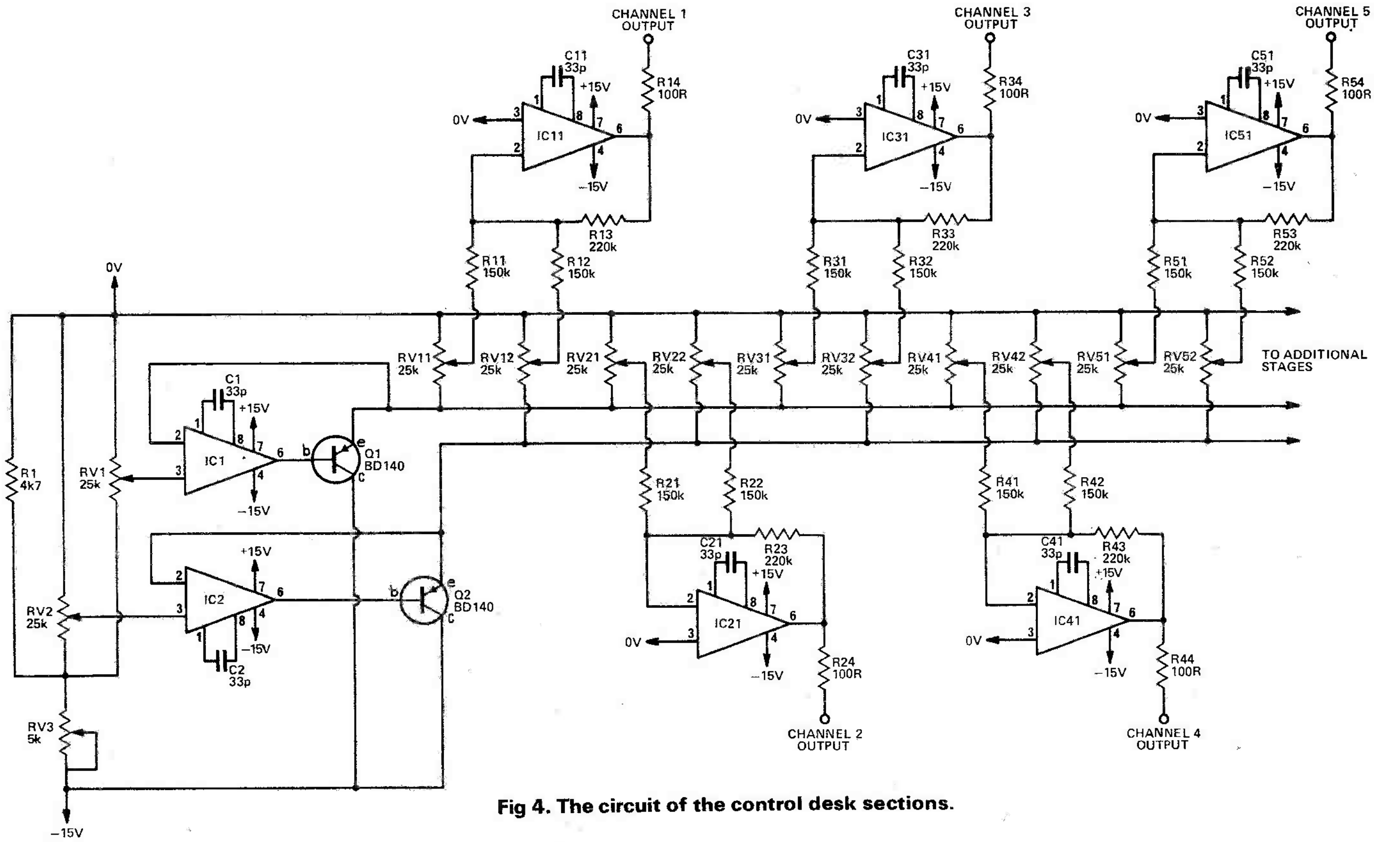


Fig 4. The circuit of the control desk sections.

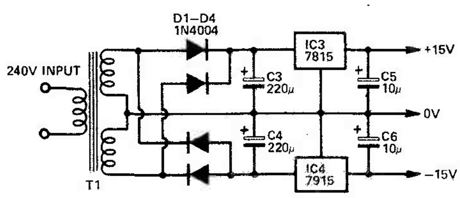


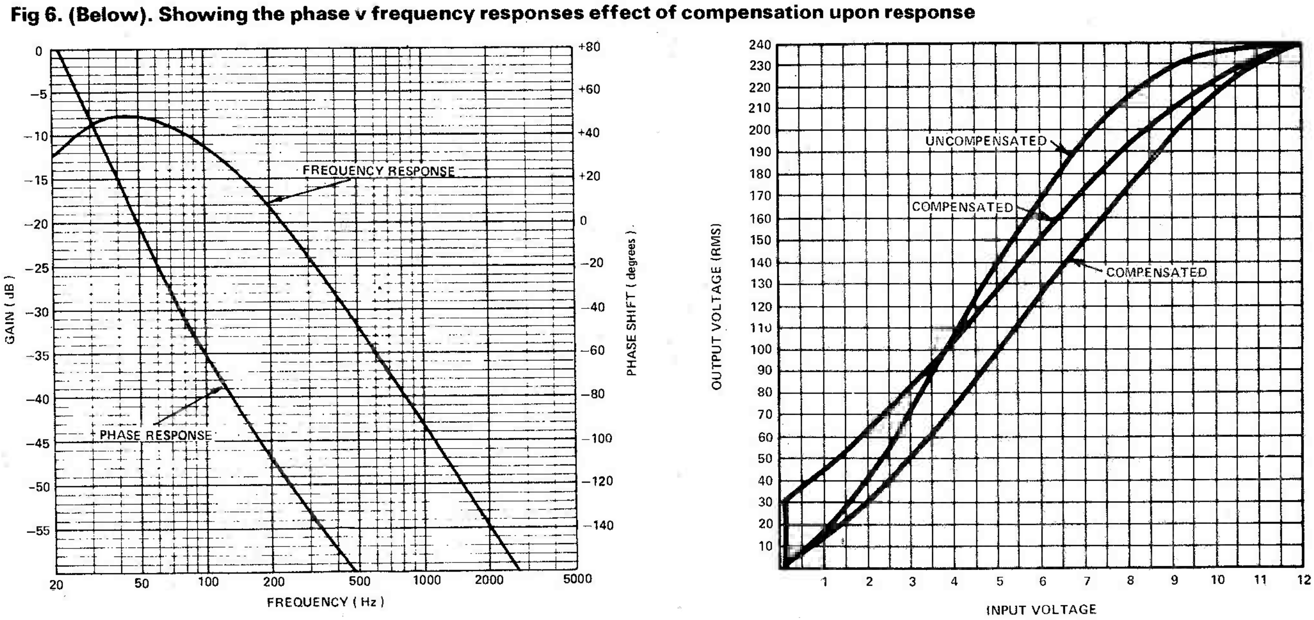
Fig 5. Power supply circuit

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 ½W 5%	
R1	4k7
R11,12,21,22,31 32,41,42,51,52, 61,62,71,72 81,82,91,92,101,102	150k
R13,23,33,43,53 63,73,83,93,103	220k
R14,24,34,44,54, 64,74,84,94,104	100R
POTENTIOMETERS	
22 off	25k 1in. 60mm slide
RV3	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 51,61,71,81 91,101	301A
Q1,2	BD140
D1-D4	1N4001
MISCELLANEOUS	
Transformer	30V
Box and front panel	5W
Knobs to suit	

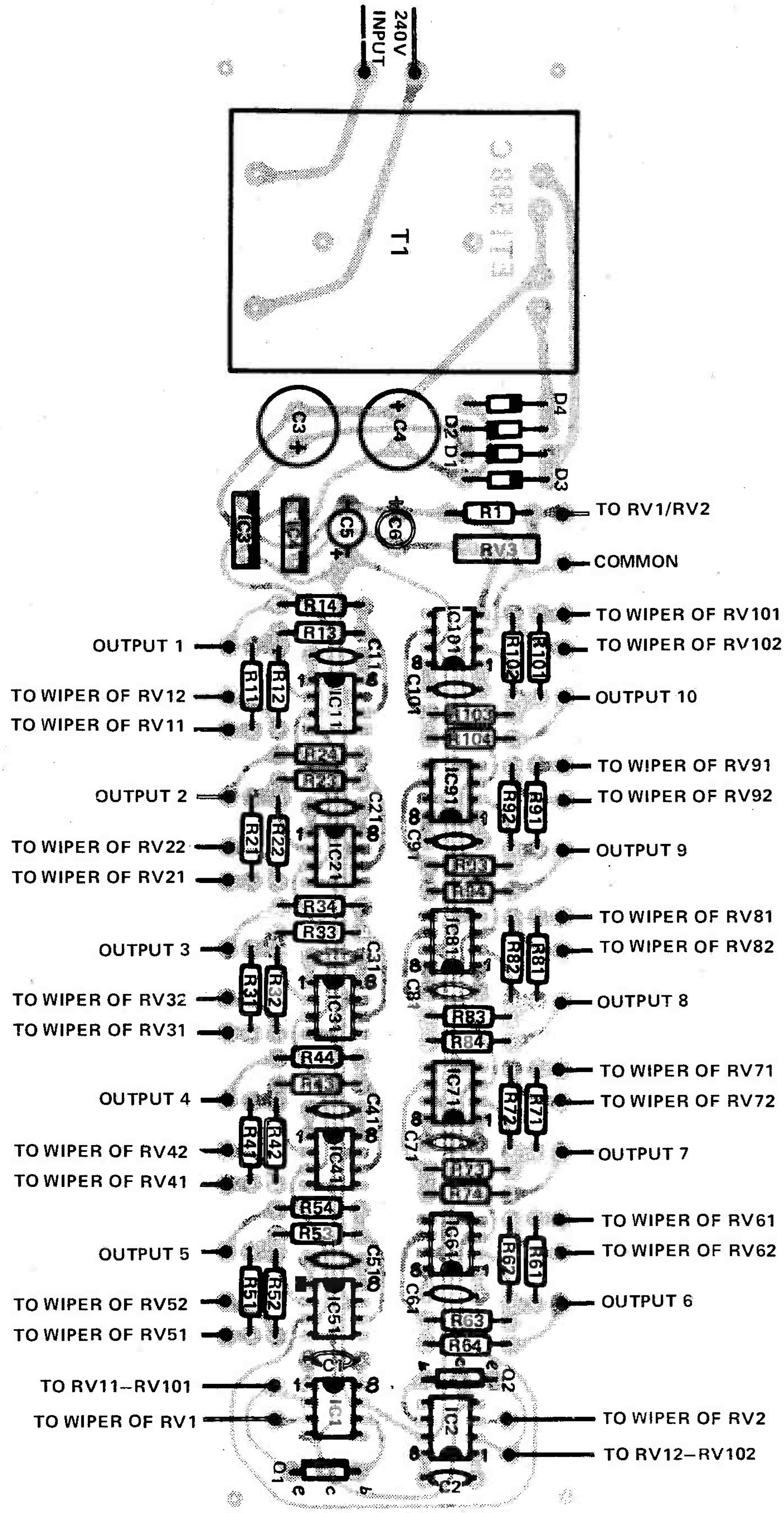


Fig 7. (Right): Component Overlay for the Controller Module.

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.

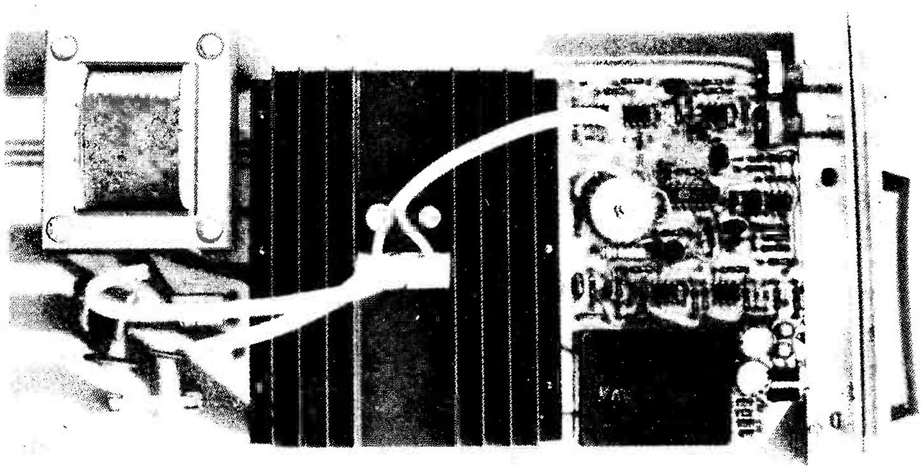
Setting up

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 ¼ 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

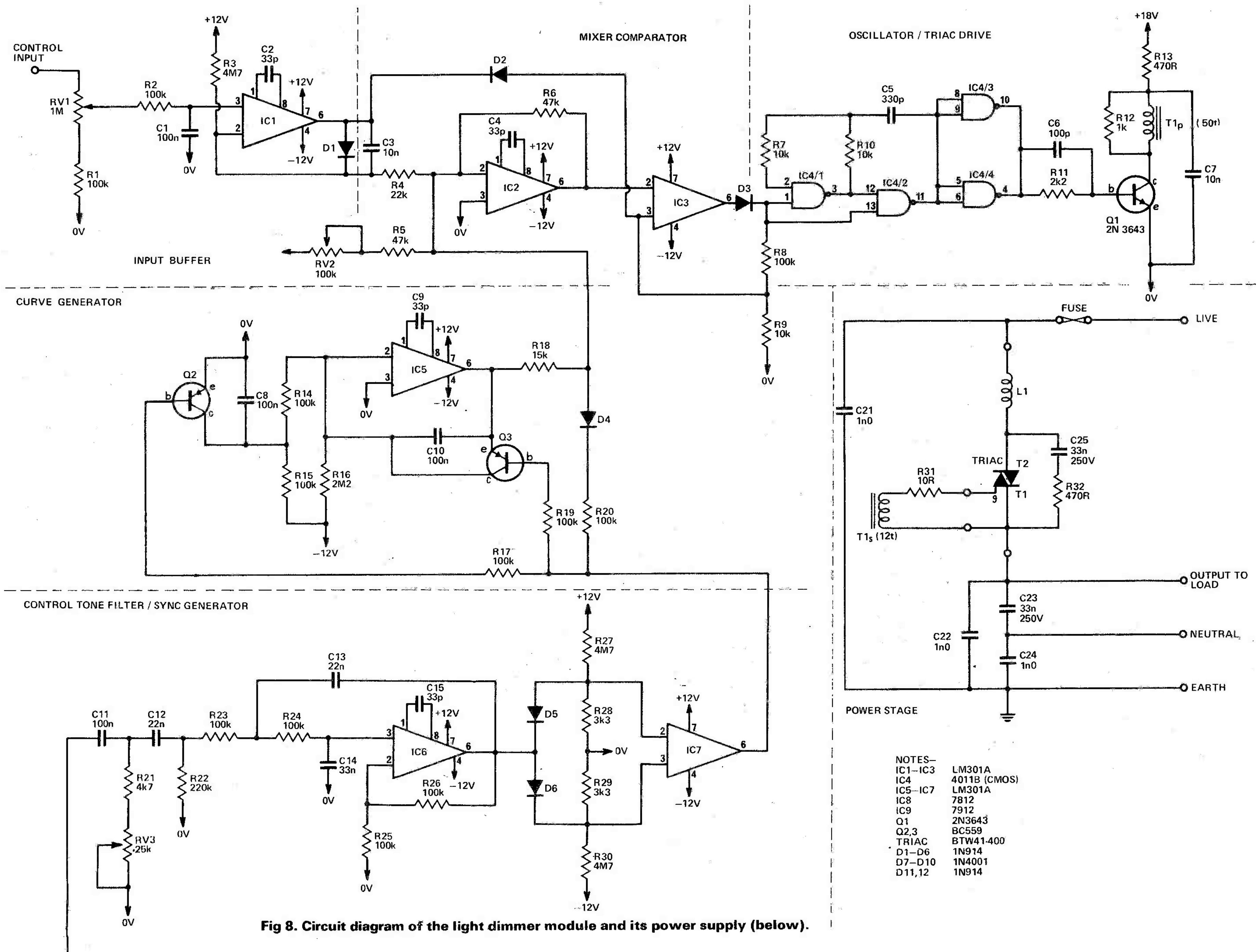


Fig 8. Circuit diagram of the light dimmer module and its power supply (below).

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 μs 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.

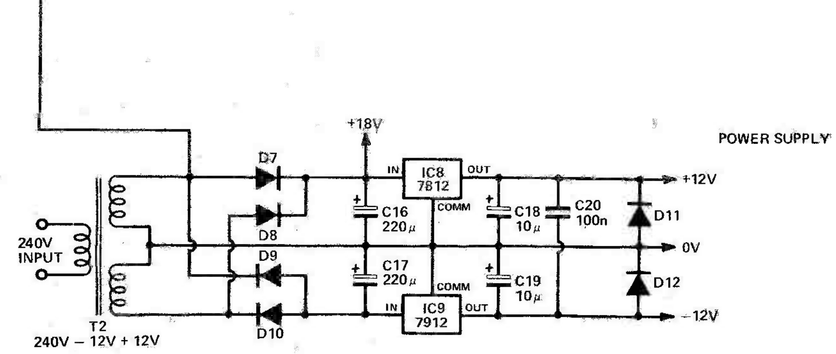
4. Input buffer
This serves two purposes; firstly, it allows a megohm input impedance and secondly it detects when the input voltage falls below 0.1 volt and turns the dimmer output completely off. This allows the minimum light control to be turned up to give a better control range, ie with the filaments 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.



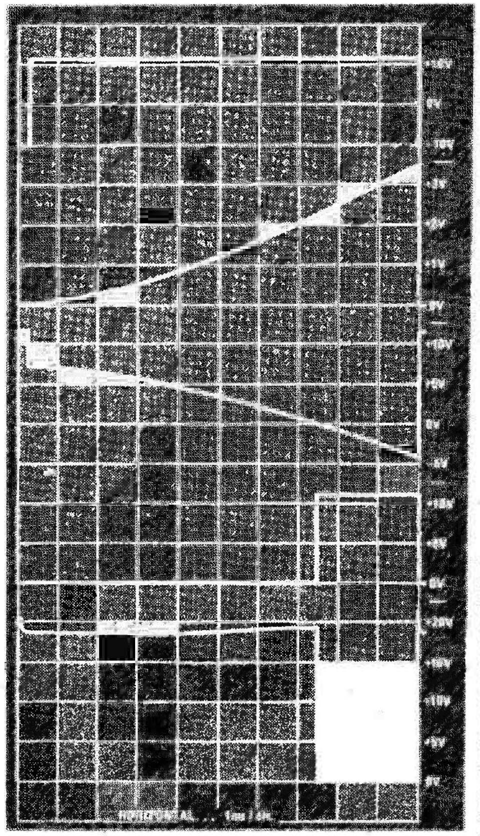


Fig 9. Waveforms shown are: Sync pulse (output IC7), curve generator (output IC5), mixer output (output IC2), oscillator output (IC4), transformer drive (Q1).

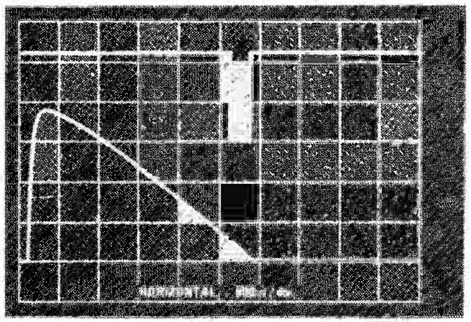


Fig 10. Relationship between the end of half cycle and the sync pulse.

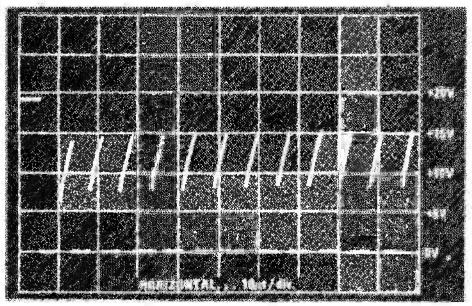


Fig 11. An expanded view of the drive waveform showing Q1 collector voltage.

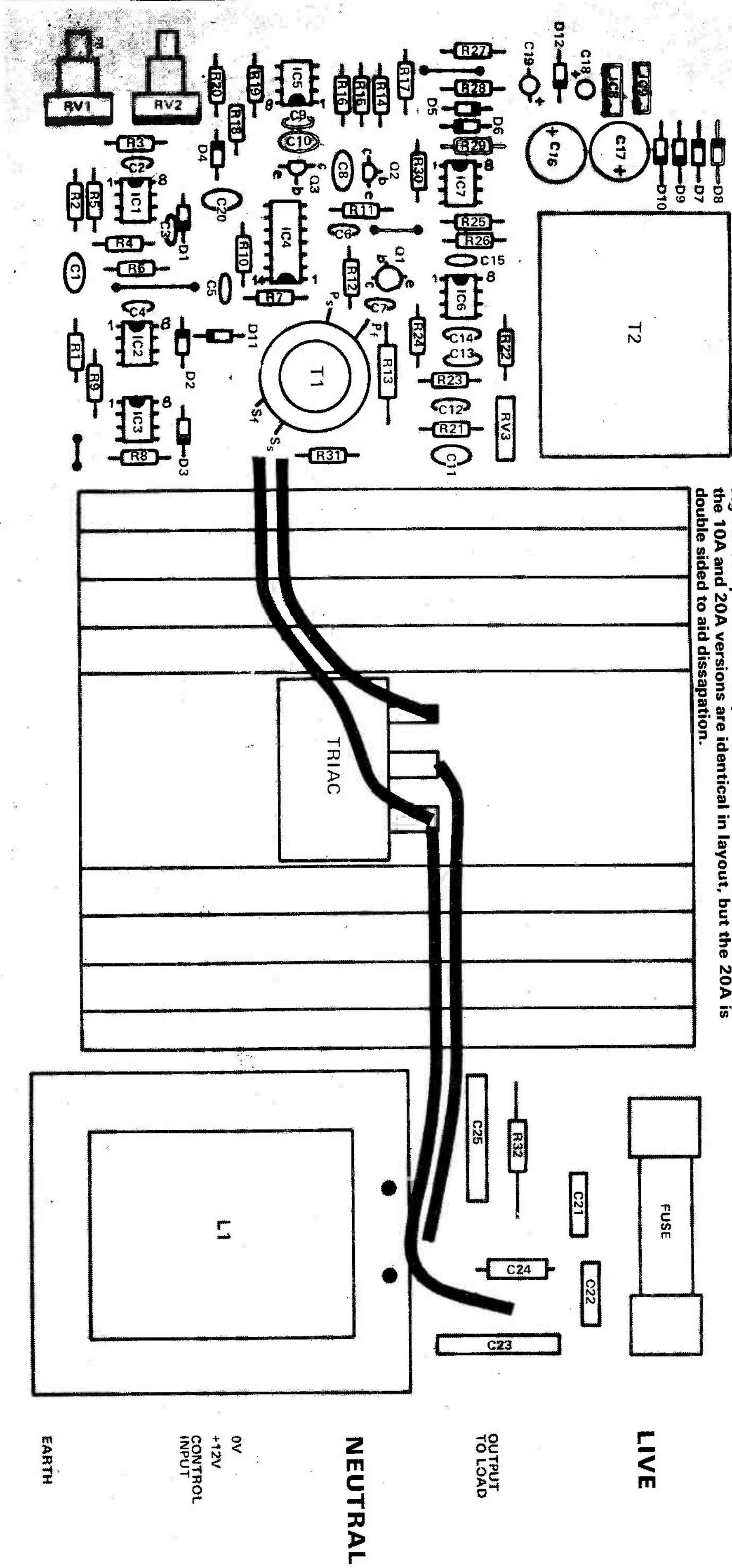


Fig 12. Component Overlay for the dimmer module board. Both the 10A and 20A versions are identical in layout, but the 20A is double sided to aid dissapation.

PARTS LIST

RESISTORS all ¼W 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 IW
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

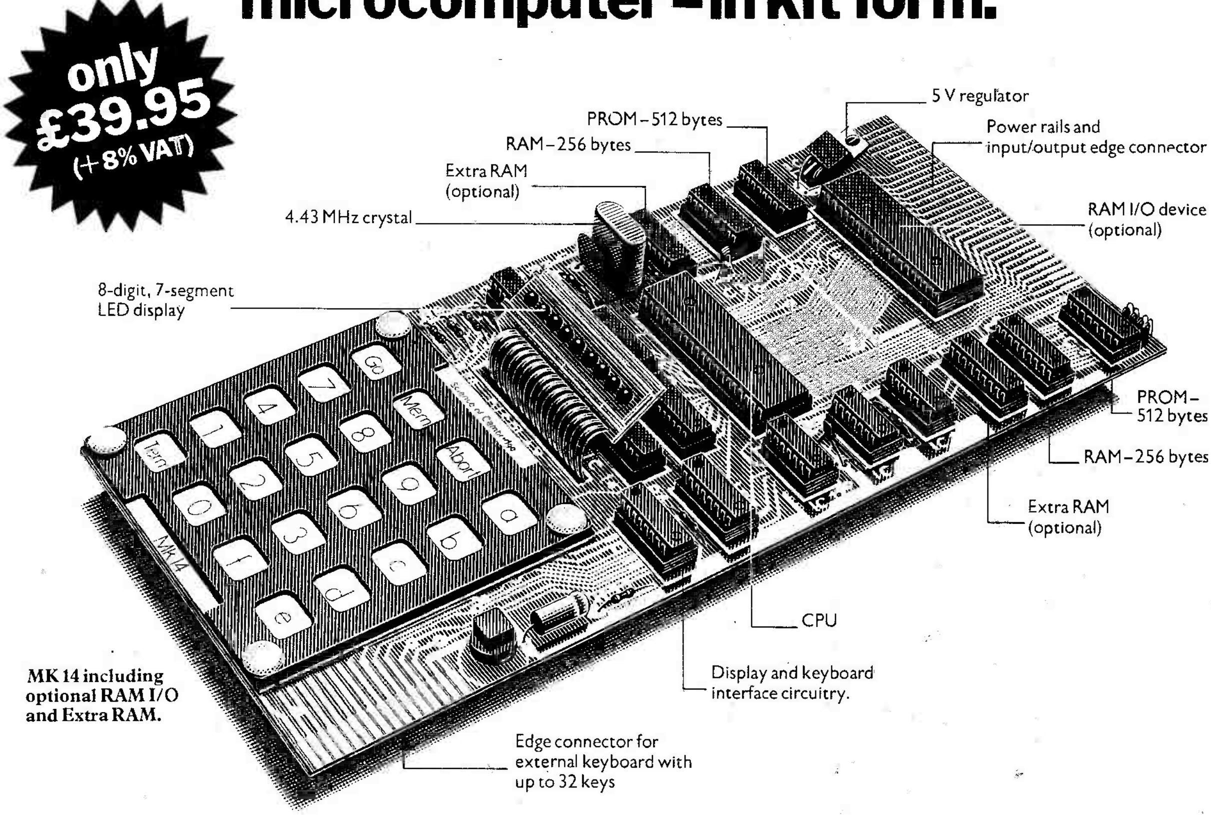
MISCELLANEOUS

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

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 an 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.



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. ETI 1, 56 FORTIS GREEN ROAD
MUSWELL HILL, LONDON N10 3HN
TELEPHONE: 01-883 3705

LOW POWER SCHOTTKY and TTL

	N	LS
7400	.13*	.19*
7401	.13*	.19*
7402	.15*	.19*
7403	.15*	.19*
7404	.16*	.21*
7405	.16*	.21*
7406	.26*	—
7407	.26*	—
7408	.17*	.19*
7409	.17*	.19*
7410	.15*	.19*
7411	.25*	.19*
7412	.18*	.19*
7413	.27*	.40*
7414	.71*	.79*
7415	—	.19*
7416	.25*	—
7417	.34*	—
7420	.16*	.19*
7421	—	.19*
7422	—	.19*
7423	.25*	—
7425	.25*	—
7426	.25*	.19*
7427	.39*	.19*
7428	.38*	.21*
7430	.16*	.19*
7432	.25*	.25*
7433	—	.28*
7437	.25*	.25*
7438	.25*	.25*
7440	.17*	.19*
7441	.70*	—
7443	.50*	.55*
7445	.60*	—
7446	.60*	—
7447	.60*	.87*
7448	.16*	.87*
7449	—	.87*
7450	.16*	—
7451	.16*	.19*
7453	.16*	—
7454	—	.19*
7455	—	.19*
7460	.16*	—
7470	.27*	—
7472	.23*	—
7473	.28*	.29*
7474	.28*	.29*
7475	.44*	.43*

	N	LS
7476	.30*	.29*
7478	—	.29*
7482	.73*	—
7483	—	.75*
7485	1.18*	.88*
7486	.25*	.29*
7489	2.60*	—
7490	.34*	.62*
7491	.73*	1.05*
7492	.46*	.75*
7493	.34*	.65*
7495	.54*	.88*
7496	.67*	1.85*
74107	.27*	.35*
74109	.44*	.35*
74112	—	.35*
74113	—	.35*
74114	—	.35*
74121	.27*	—
74122	.50*	.75*
74123	.60*	.78*
74124	—	1.25*
74125	.51*	.39*
74126	.51*	.39*
74132	.78*	.65*
74133	—	.19*
74136	—	.39*
74138	—	.55*
74139	—	.55*
74141	.76*	—
74145	.75*	1.05*
74147	1.59*	—
74149	1.38*	—
74150	1.08*	—
74151	.67*	.88*
74153	.67*	.48*
74154	1.31*	1.35*
74155	.67*	.78*
74156	.67*	.78*
74157	.67*	.55*
74158	—	.52*
74160	1.21*	.99*
74161	1.21*	.65*
74162	1.21*	1.85*
74163	1.21*	.66*
74164	1.08*	1.15*
74165	—	.78*
74166	1.02*	—
74168	—	1.85*
74169	—	1.85*

	N	LS
74170	1.85*	1.65*
74173	1.41*	.88*
74174	1.01*	1.05*
74175	.81*	1.05*
74176	1.01*	—
74177	1.01*	—
74180	1.01*	—
74181	2.21*	2.99*
74182	.81*	—
74184	1.81*	—
74185	1.62*	—
74188	2.97*	—
74189	3.17*	2.25*
74190	1.21*	.75*
74191	1.21*	.75*
74192	1.21*	1.85*
74193	1.21*	1.85*
74194	1.21*	—
74195	1.01*	1.05*
74196	1.18*	1.05*
74197	1.18*	1.05*
74198	1.81*	—
74199	1.81*	—
74221	—	.99*
74240	—	.25*
74241	—	2.25*
74242	—	2.25*
74243	—	2.25*
74247	—	.95*
74248	—	.95*
74249	—	.95*
74251	—	.83*
74253	—	.99*
74257	—	.99*
74258	—	.99*
74259	—	1.50*
74266	—	.35*
74273	—	2.25*
74279	—	.48*
74283	—	.99*
74290	—	.83*
74293	—	.83*
74395	—	1.05*
74298	—	1.25*
74365	—	.51*
74366	—	.51*
74367	—	.51*
74368	—	.51*
74386	—	.39*
74670	—	1.85*

CMOS

4000	.15*	4077	.21*
4001	.16*	4081	.21*
4002	.16*	4082	.21*
4006	.92*	4085	.92*
4007	.18*	4086	.92*
4008	.92*	4093	.81*
4009	.54*	4099	1.81*
4010	.54*	4502	.92*
4011	.18*	4508	2.46*
4012	.18*	4510	1.07*
4013	.48*	4511	.95*
4014	.92*	4514	2.70*
4015	.92	4515	2.70*
4016	.43*	4516	1.07*
4017	.81*	4517	4.10*
4018	.92*	4518	.95*
4019	.56*	4521	2.54*
4020	.92*	4522	1.89*
4021	.92*	4526	1.89*
4022	.92*	4528	.92*
4023	.18*	4534	7.12*
4024	.65*	4536	3.74*
4025	.18*	4543	1.62*
4026	1.84*	4553	4.53*
4027	.51*	4566	1.51*
4028	.70*	4583	1.02*
4029	1.18*	4585	1.07*
4030	.56*		
4032	1.08*		
4034	1.89*		
4035	1.06*		
4040	.82*		
4042	.70*		
4043	.81*		
4046	1.06*		
4049	.43*		
4050	.43*		
4051	.81*		
4052	.81*		
4053	.81*		
4054	1.29*		
4056	1.46*		
4059	5.18*		
4060	1.24*		
4066	.48*		
4068	.21*		
4069	.21*		
4070	.21*		
4071	.21*		
4072	.21*		

I.C. SOCKETS DIL (Texas)

8pin	.10*
14pin	.12*
16pin	.13*
18pin	.18*
20pin	.20*
22pin	.24*
24pin	.26*
28pin	.30*
40pin	.44*

Wire Wrap

8pin	.23*
14pin	.34*
16pin	.37*
18pin	.43*
20pin	.55*
24pin	.60*
28pin	.65*
36pin	.95*
40pin	1.05*

BITS and PIECES

Static RAM's	1+	17-63	64+
2102A (350ns)	1.05*	.95*	.88*
2102A-2 (650ns)	1.29*	1.15*	1.08*
2111A-1 (500ns)	2.46*	2.19*	2.05*
2112A-2 (250ns)	2.14*	1.90*	1.78*
21L02 (350ns)	1.07*	.96*	.86*
MM5257 (TMS4044)	8.10*	7.19*	6.75*
2114 (450ns)	8.10*	7.19*	6.75*
6810	3.50*	2.97*	2.52*

Dynamic RAM	
4116	12.75*
CPU's	
8080	5.95*
6800	8.99*
9900	42.50*
E-Prom's UV	
1702AQ	5.75*
2708Q	7.87*
TriState Buffers	
81LS95	.75*
81LS96	.75*
81LS97	.75*
81LS98	.75*
74365	.75*
74366	.75*
74367	.75*
74368	.75*
Buffers	
8T26P	1.65*
8T28P	1.65*
8T95P	1.49*
8T96P	1.49*
8T97P	1.49*
8T98P	1.49*
Interface	
8212	2.21*
8216	2.35*
8224	3.59*
8228	5.51*
8251	5.97*
8253	8.10*
8255	5.51*

Regulators

78L series +(POS) 100mA
5v, 6v, 8v, 12v & 15v
All **30p** each

78M series +(POS) 500mA
5v, 6v, 8v, 12v, 15v, 20v & 24v
All **60p** each

79M series —(NEG) 500mA
5v, 6v, 8v, 12v, 15v, 20v & 24v
All **85p** each

78 series +(POS) 1A
5v, 8v, 12v, 15v, 18v & 24v
All **85p** each

79 series —(NEG) 1A
5v, 8v, 12v, 15v, 18v & 24v
All **£1.00** each

uA723 (DIL)	.40*
L200	1.99*
LM304H	2.40*
LM323K	6.25*
LM325N	2.60*
LM326N	2.60*
LM345K	8.10*
L129/30/31	.85*

I.C's

CA3080	.75
CA3130E	.90
CA3140E	.37
LM301AN	.30
LM324N	.73*
LM348N	.99
LM380N	.97
LM381N	1.73
LM382N	1.33
LM3900N	.65
LM3909N	.70*
SN76001N	1.02
SN76003N	2.32
SN76013N	1.55
SN76023N	1.55
TBA810AS	.90
TCA940	1.75
ZN414	.90
ZN424E	1.35
ZN425E	3.78*
ZN459CT	3.54
ZN1034E	2.03*
ZN1040E	8.43*
ZNA116E	6.75*

The items shown in this advert are just a small selection taken from our new 78/79 Catalogue which is now available. It contains everything from Resistors to the latest in Micro-processors. Don't delay order your copy today. The price is only 40p (inc 45p vouchers)

OPTO

.125	1+	10+	50+	100+
TIL209 Red X	.15*	.10*	.10*	.09*
TIL212 Yel X	.20*	.18*	.16*	.14*
TIL216 Red X	.20*	.18*	.16*	.14*
TIL232 Gre X	.20*	.18*	.16*	.14*

X = High Brightness

.2"	1+	10+	50+	100+
TIL220	.16*	.125*	.125*	.11*
TIL224 Yel X	.23*	.21*	.195*	.17*
TIL228 Red X	.23*	.21*	.195*	.17*
TIL234 Gre X	.23*	.21*	.195*	.17*

DL747 4 for £6.00* | **uA741** 5 for £1.00 | **NE555** 4 for £1.00* | **TIL209** 10 for £1.00* | **TIL220** 8 for £1.00*

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 a.m.-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)

Access — Buy it with Access | BARCLAYCARD welcome here

QUALITY STUFF AT KNOCK-DOWN PRICES

TRANSISTORS

AC126	17p	BC213	10p	BFX30	32p	2N3054	44p
AC127	16p	BC214	10p	BFX85	20p	2N3055	44p
AC128	14p	BC237	12p	BFX86	27p	2N3702	8p
Matched 128/176	35p	BC238	14p	BFX87	20p	2N3703	8p
AC141	24p	BC301	30p	BFY50	15p	2N3704	8p
AC142	18p	BC303	30p	BFY51	12p	2N3706	8p
AC151	22p	BC328	13p	BFY53	17p	2N3707	8p
AC152	22p	BC338	13p	BSX19	20p	2N3710	8p
AC153	25p	BC547	11p	BSX20	18p	2N3711	8p
AC176	16p	BC548	11p	BU205	130p	2N3772	172p
AC187	23p	BC549	11p	BU208	150p	2N3773	275p
AC188	20p	BC557	11p	OC25	76p	2N3866	54p
AD149	65p	BCY30	60p	OC28	87p	2N3904	8p
AD161	35p	BCY34	66p	OC35	76p	2N4061	12p
AD162	35p	BCY59	24p	OC71	16p	2N4062	12p
AF114	23p	BCY70	14p	OC72	26p		
AF118	30p	BCY71	14p	OC84	42p		
AF125	25p	BD115	30p	TIP29	37p		
AF126	25p	BD121	70p	TIP30	35p		
AF127	25p	BD123	60p	TIP31	45p		
AF139	32p	BD124	77p	TIP32	45p		
AF186	54p	BD131	35p	TIP33	58p		
AF239	40p	BD132	35p	TIP34	64p		
ASY53	33p	BD135	30p	TIP35A	168p		
ASY54	33p	BD136	30p	TIP36A	165p		
ASY55	33p	BD137	30p	TIP41A	54p		
BC107	7p	BD138	30p	TIP42A	60p		
BC108	7p	BD139	30p	TIP2955	65p		
BC109	7p	BD140	30p	TIP3055	55p		
BC113	12p	BF115	25p	ZTX108	12p		
BC117	15p	BF167	25p	ZTX109	12p		
BC119	25p	BF173	20p	ZTX300	14p		
BC140	27p	BF178	25p	ZTX500	16p		
BC142	20p	BF179	25p	2N706	10p		
BC143	24p	BF180	20p	2N1131	20p		
BC147	7p	BF181	20p	2N1132	20p		
BC149	7p	BF182	20p	2N1302	20p		
BC157	7p	BF183	20p	2N1304	20p		
BC158	7p	BF184	20p	2N1305	20p		
BC159	7p	BF185	20p	2N1306	27p		
BC168	7p	BF194	7p	2N1308	33p		
BC170	7p	BF196	7p	2N1613	18p		
BC171	7p	BF197	7p	2N1711	20p		
BC172	7p	BF198	7p	2N1893	25p		
BC173	7p	BF200	33p	2N2217	24p		
BC182	9p	BF224	16p	2N2219	21p		
BC183	9p	BF257	16p	2N2369	15p		
BC184	9p	BF258	28p	2N2483	26p		
BC186	19p	BF259	28p	2N2484	18p		
BC187	19p	BFR39	18p	2N2905	19p		
BC207	10p	BFR40	18p	2N2906	19p		
BC212	10p	BFR79	18p	2N2907	20p		
		BFR80	27p	2N2926	10p		
		BFX29	20p	2N3053	15p		

TTL

7400	10p	7451	12p	74177	50p
7401	10p	7453	12p	74180	80p
7402	10p	7454	12p	74181	130p
7403	10p	7460	14p	74182	50p
7404	12p	7470	24p	74190	70p
7405	12p	7472	24p	74191	70p
7406	24p	7473	25p	74192	60p
7407	24p	7474	25p	74193	60p
7408	12p	7475	25p	74194	55p
7409	12p	7476	25p	74195	50p
7410	12p	7480	40p	74196	50p
7411	15p	7485	60p	74197	50p
7412	15p	7486	24p	74198	100p
7413	25p	7490	25p	74199	100p
7414	45p	7491	40p		
7416	24p	7492	35p		
7417	24p	7493	30p		
7420	12p	7494	51p		
7421	20p	7495	45p		
7422	15p	7496	45p		
7427	22p	7497	120p		
7428	25p	74100	80p		
7430	12p	74105	40p		
7432	20p	74107	25p		
7433	24p	74109	30p		
7437	20p	74110	46p		
7438	20p	74118	75p		
7440	12p	74121	25p		
7441	46p	74122	33p		
7442	40p	74123	40p		
7443	60p	74125	35p		
7444	60p	74126	35p		
7445	64p	74132	45p		
7446	50p	74141	50p		
7447	50p	74142	180p		
7448	50p	74145	55p		
7450	12p	74150	65p		
		74151	45p		
		74153	45p		
		74154	70p		
		74155	45p		
		74156	45p		
		74157	45p		
		74160	55p		
		74161	55p		
		74162	55p		
		74163	55p		
		74164	60p		
		74165	60p		
		74166	75p		
		74173	80p		
		74174	60p		
		74175	60p		
		74176	50p		

CMOS

4000	12p	4070	12p
4001	12p	4071	12p
4002	12p	4072	12p
4006	68p	4073	16p
4007	14p	4081	14p
4008	64p	4082	14p
4009	30p	4086	59p
4010	35p	4510	60p
4011	12p	4511	70p
4012	12p	4516	64p
4013	30p	4518	65p
4014	60p	4520	65p
4015	50p	4528	55p
4016	30p		
4017	50p		
4018	55p		
4019	40p		
4020	50p		
4021	60p		
4022	50p		
4023	12p		
4024	45p		
4025	12p		
4027	30p		
4028	45p		
4029	50p		
4030	30p		
4035	60p		
4041	57p		
4042	54p		
4043	54p		
4044	50p		
4047	80p		
4048	50p		
4049	25p		
4050	25p		
4066	35p		
4069	12p		

LINEARS

710CN	40p
741-8	22p
747C-14	50p
748C-8	30p
CA3011	80p
CA3018	80p
CA3028A	85p
CA3035	140p
CA3036	120p
CA3046	75p
CA3054	110p
CA3080	70p
CA3140E	51p
LM301AN	28p
LM308N	64p
LM380N	61p
LM381N	120p
NE555	25p
NE556	60p
TBA641	143p
TBA800	70p
TBA810	100p

DIODES

BY127	16p
OA47	10p
OA91	15p
OA200	6p
OA202	9p
1N4148	4p
1N916	5p
1N4001	4p
1N4002	4p
1N4003	5p
1N4004	6p
1N4005	7p
1N4006	8p
1N4007	9p
1N5400	13p
1N5401	14p
1N5402	15p
1N5404	20p

BRIDGE RECTIFIERS

1A/50V	22p
1A/100V	24p
1A/200V	27p
1A/400V	30p
2A/50V	34p
2A/100V	36p
2A/200V	38p
2A/400V	40p

OPTO/DISPLAY

2N5777	50p
OCP71	70p
ORP12	70p
DL704	100p
DL707	100p
.125" & .2" LEDs	
Red	9p
Green	13p
Yellow	13p
Clip	3p

DIL SOCKETS

8 pin	10p
14 pin	12p
16 pin	13p
22 pin	22p
24 pin	24p
28 pin	28p
40 pin	40p

VOLTAGE REGULATORS

7805	60p	7912	80p
7812	60p	7915	80p
7815	60p	7918	80p
7818	60p	7924	80p
7824	60p		
7905	80p		

ZENER DIODES 400mW
2.7V to 33V — 8p

VERO BOARDS .1" copper
2.5" × 5" — 51p
3.75" × 5" — 60p

CERAMIC CAP 50V
22pF to 50,000pF — 3p

POLYESTER CAP 250V
.01, .015, .022, .033, .047, .068, .1 uF — 5p
.15, .22, .33 uF — 6p
.47, .68 uF — 12p
1 uF — 15p
2.2 uF — 25p

ELECTROLYTIC CAP 25V
1 uF to 47 uF — 6p
68 uF, 100 uF — 7p
150 uF — 8p
220 uF — 9p
330 uF — 11p
470 uF — 14p
1000 uF — 22p

RESISTORS
10 ohms to 1 Mohm — 1p

POTENTIOMETERS
1 Kohm to 2 Mohms log linear — 22p
5 Kohm to 1 Mohm log with switch — 50p

PRESETS horizontal
100 ohm to 1 Mohm — 5p

Please add 25p for p&p.

DELTA TECH & CO.
62 NAYLOR ROAD, LONDON, N20 0HN

electronics today international

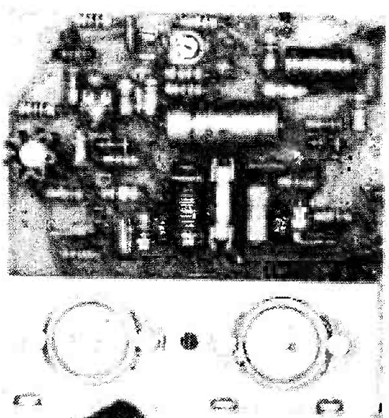
What to look for in the April issue: On sale March 2nd

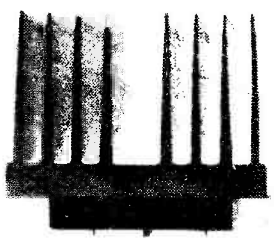
Amp Survey

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.





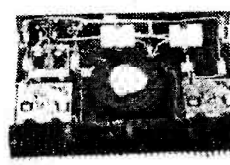
MAINS SEEKER

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

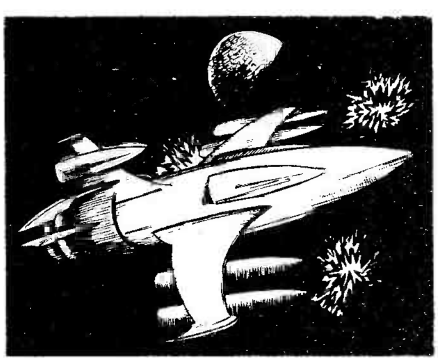


A superb little circuit to add that instant 'jump' to guitar playing. Operated by a footswitch the effect has a unique sound all its own — not to be missed — no strings attached to this one.

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 everday 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 afforementioned 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

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
BYTE (12 per year)	£21.00	£21.00
Creative Computing (12 per year)	£16.00	£16.50
Calcuators 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 . . . When I speak in BASIC	£2.75
Basic BASIC	£6.50
Advanced BASIC	£6.00
Introduction to PASCAL	£4.00

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 — All Orders must be Prepaid
Indicate Payment Method: — 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.

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.

Abacus Computers Limited
62 New Cavendish Street
London W1 Tel: 01-580 8841

Mutek
Quarry Hill, Box Corsham
Wiltshire SN14 9HT
Tel: 0225-743289

Thames Personal Computers
13 Wilmot Way Camberley
Surrey Tel: 0276-27860

Linn Products
235 Drakemire Drive
Castlemilk Glasgow
G45 9SZ 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 whats 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:

$$P = E1$$

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 ϕ=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 capaitor. 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

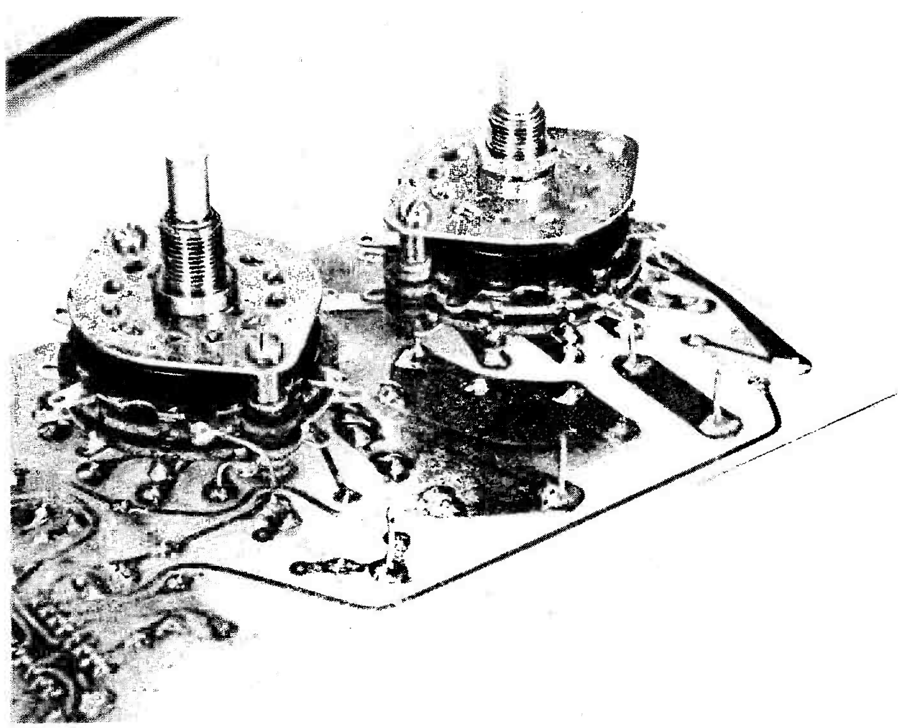
To use the meter we must measure both voltage and current. There must be a common point for these measurements. The current connection can be in either of two ways as shown in the drawings below. One measures the power out of the supply and the second the power into the load. The difference? The current 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 overvoltaged 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 ▶



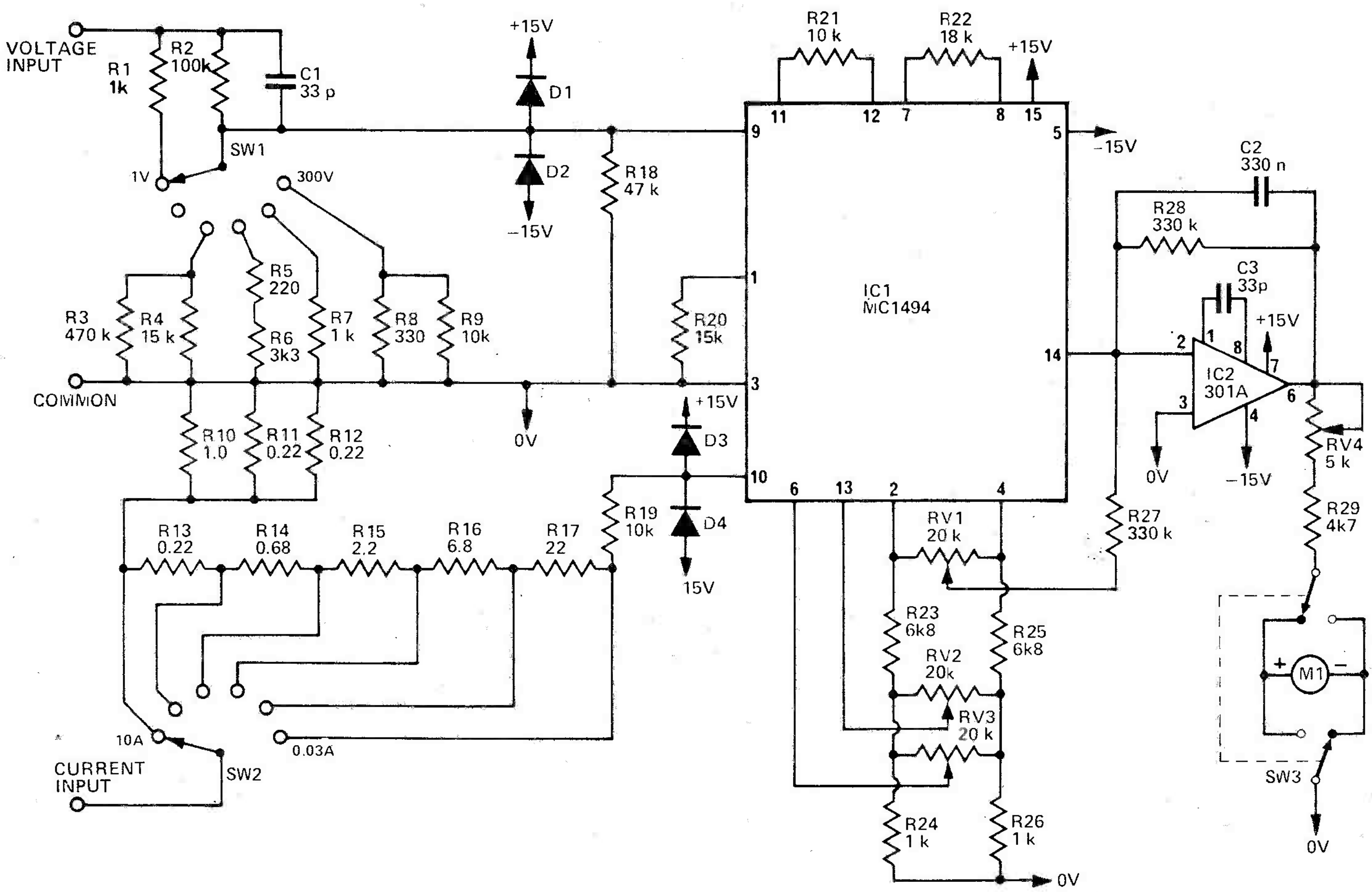


Fig. 1. The circuit diagram of the audio power meter.

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 ∓20V DC which is then regulated to the ∓15 V 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 ∓4 V reference in IC1. Range switching is done by SW1 and SW2. Protection against overvoltaging the IC is provided by D1 — D4.

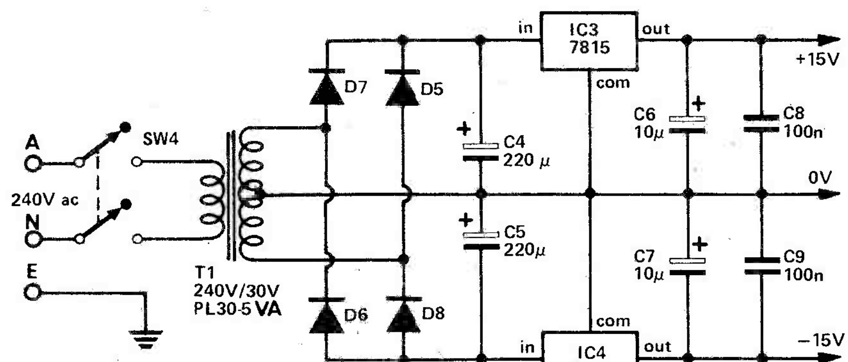
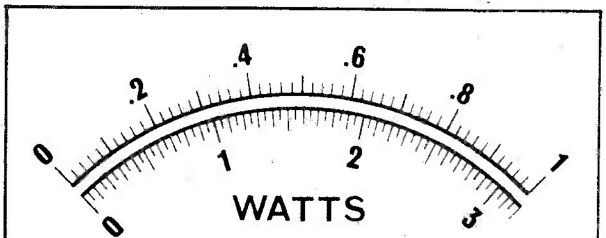


Fig. 2. Power Supply Circuit.

Right: meter scale designed for a 1mA FSD meter. These scales may need to be altered for differing meter units.



Power range is the product of the voltage and current ranges.

1 mA FSD

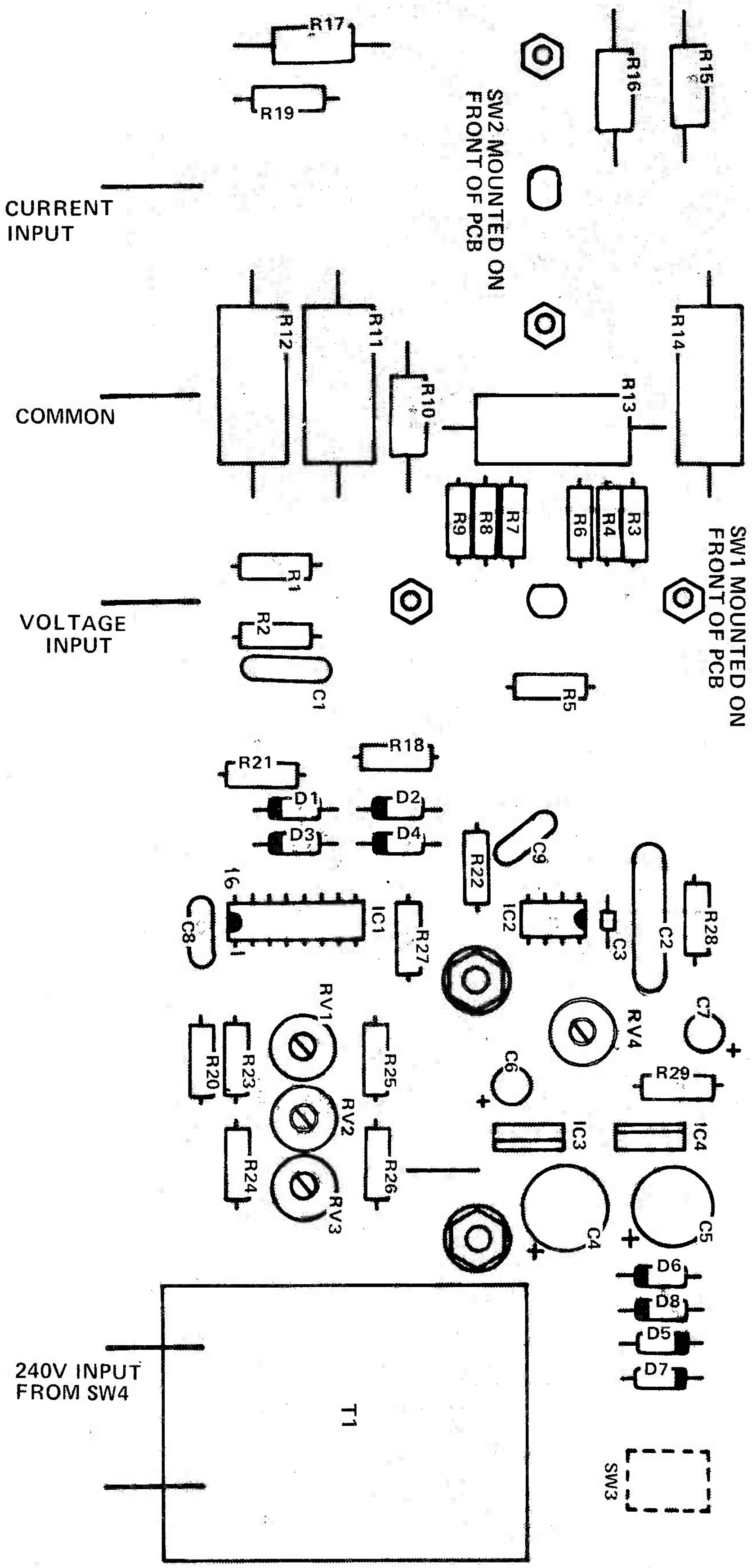


Fig. 3. Overlay for the Power Meter.

PARTS LIST

Resistors all 5% ½W 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	0R22 5W
R14	0R68 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!

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 reistors 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 ▶

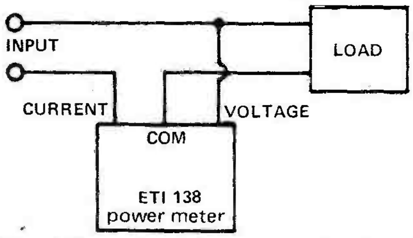


Fig. 4. This connection measures the power into the load.

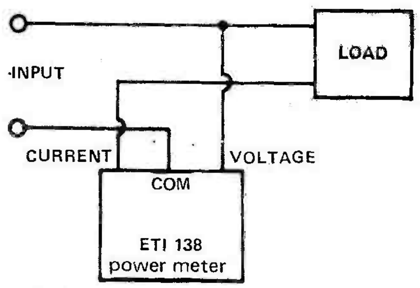


Fig. 5. This connection measures the power out of the supply.

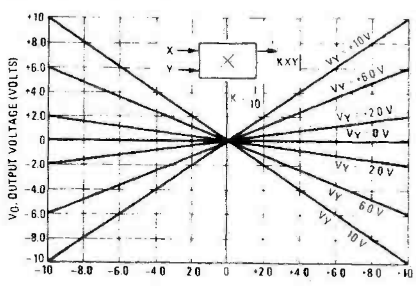


Fig. 6. Transfer characteristics of the IC.

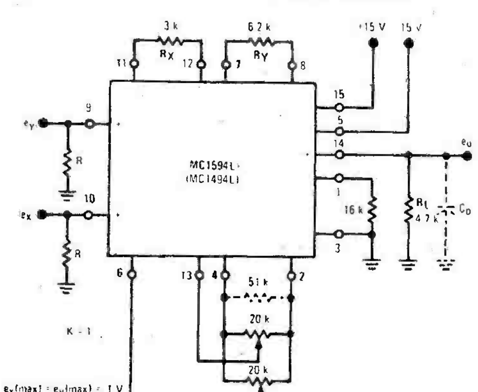


Fig. 7. Typical connections for a wide band multiplier or balanced modulator.

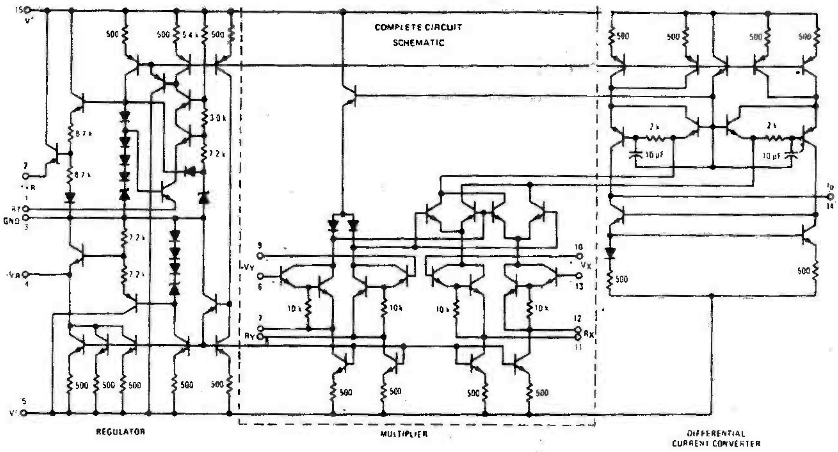


Fig. 8. The internal circuit diagram of the IC.

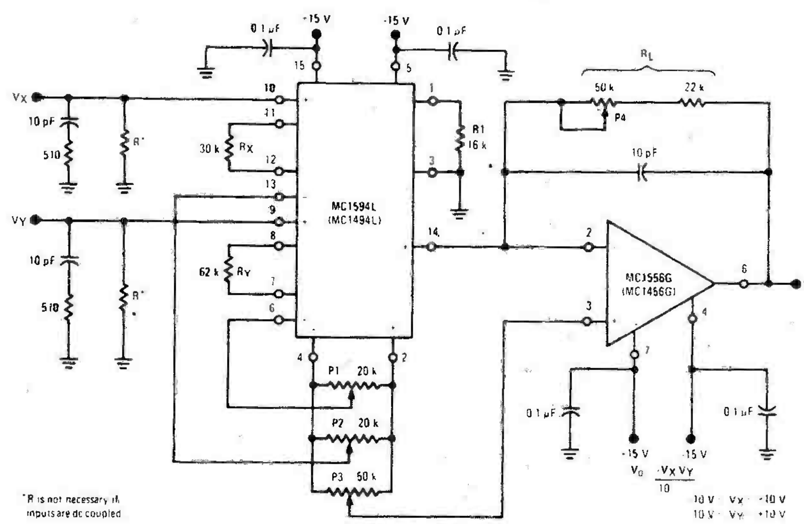


Fig. 9. Typical connection of a low frequency multiplier. For a squaring circuit simply parallel the two inputs. In this case pin 6 can be connected to 0V and P1 deleted.

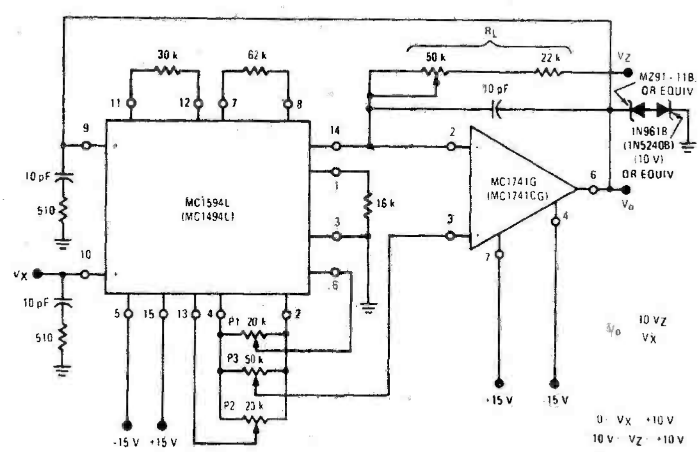
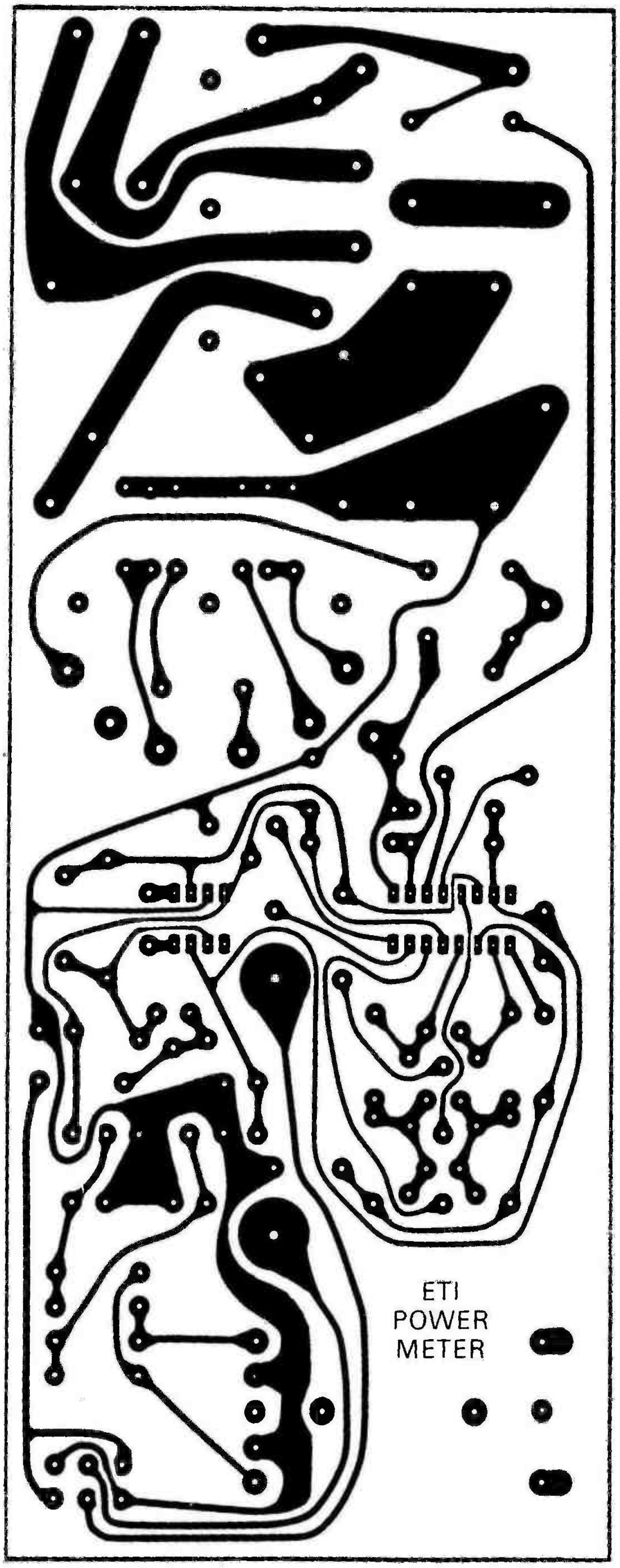


Fig. 10. Typical connection of a divide circuit. For the square root joins pin 9 and 10. Like the squaring circuits pin-6 can be connected to 0V and P1 deleted.

Full size foil pattern for the power meter.



allowance for either the cermet (VTP) or the normal carbon trim pontentiometer.

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 1V 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 ⩾3x peak input voltage(X) expressed in k ohms.

3 The value of Ry (pin 7 to pin 8) should be ⩾6x peak input voltage(Y) expressed in k ohms.

4 Choose the scaling factory required ie Vout = K.Vx.Vy.

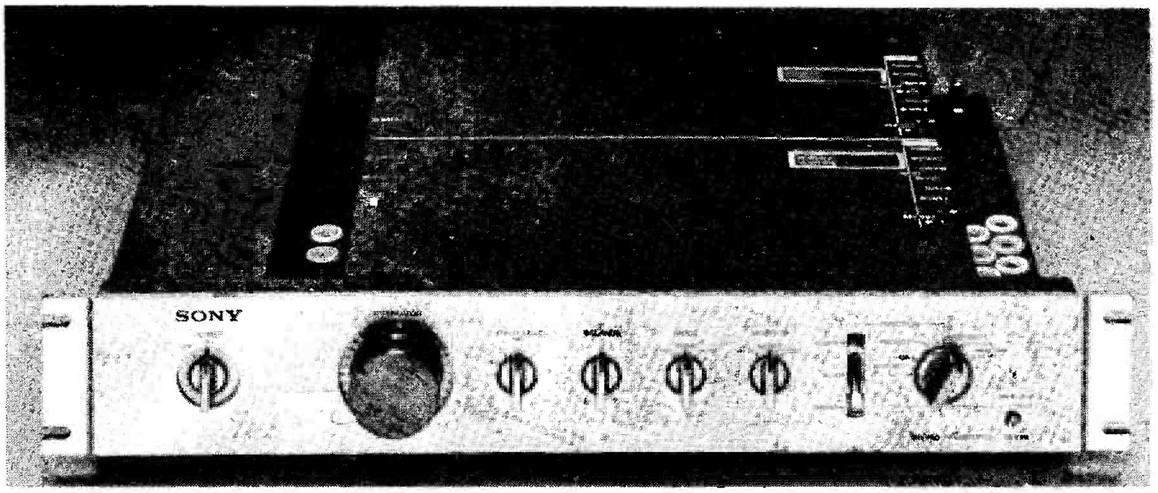
5 Load resistance (pin 14 to 0V) can be calculated by RL = (K.Rx.Ry.)I1) / 2

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

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.

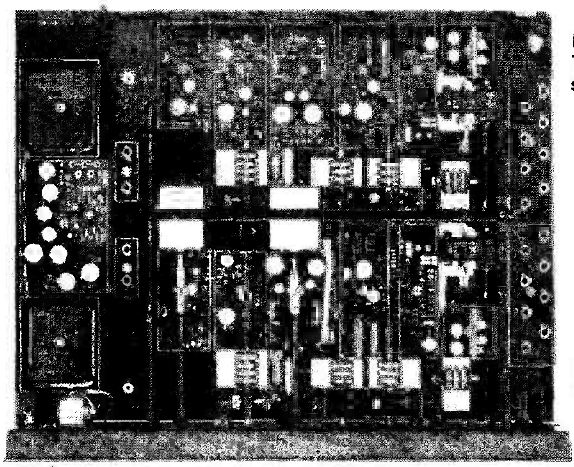
Shifting Load

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.

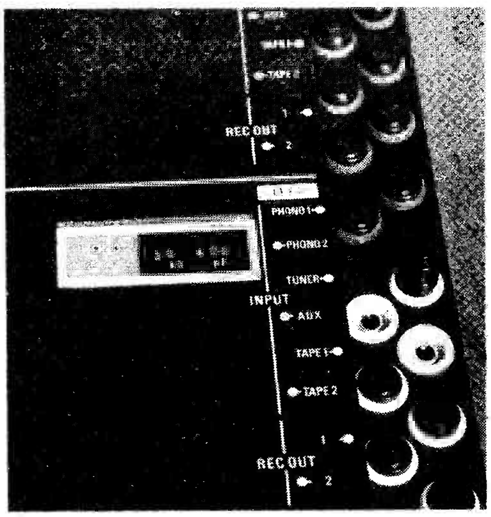
The head amp incorporated is a version of Sony marketed HA55, one of the best mains powered units on the market, and has two possible input impedances.

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.

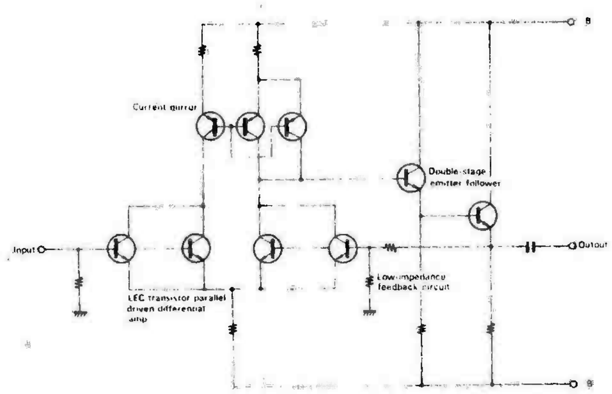
Left: a close up of the cartridge load switching and gold input sockets!

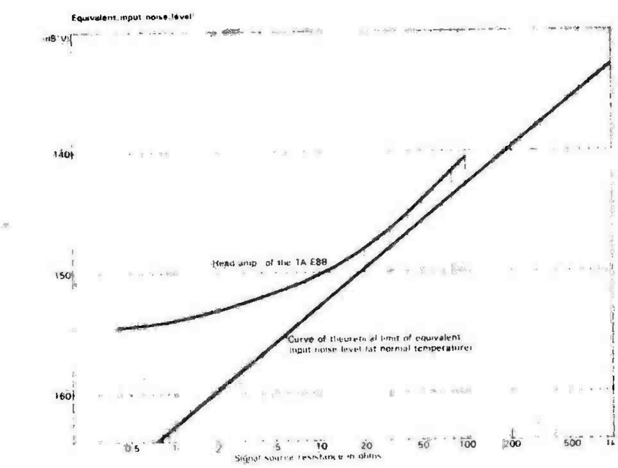


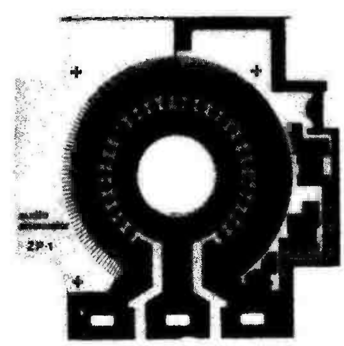
Head Start

As shown below, the moving coil amp consists of a differential pair with current minor 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!

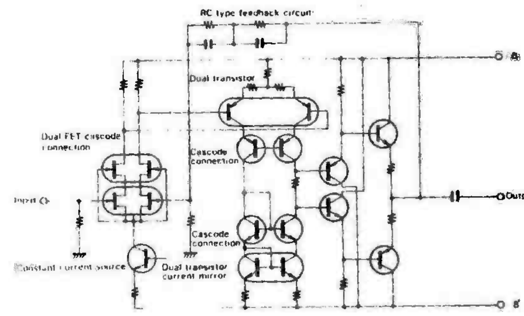
Magnetic Charm

For more normal pickups the TA88 employs dual FET inputs (in cascode mode) and more conventional RC feedback equalisation circitry. The FETs used were developed specially for the amplifier, when your 'Sony' of course you can get these things done.

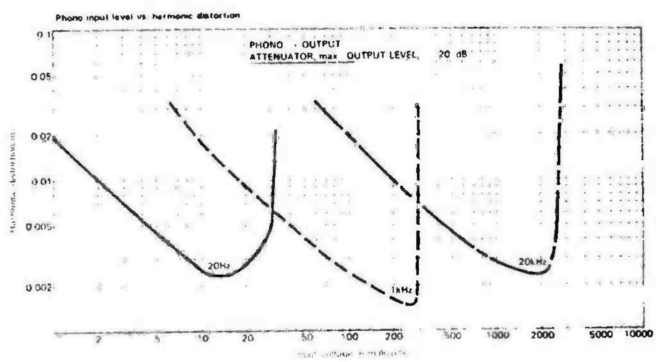
The second stage is a differential amplifier also, to further stabilise and give the overall circuit greater immunity from current source drift. Dual transistors are used in both the second differential amplifier and in the constant current stages of the circuit.

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%.

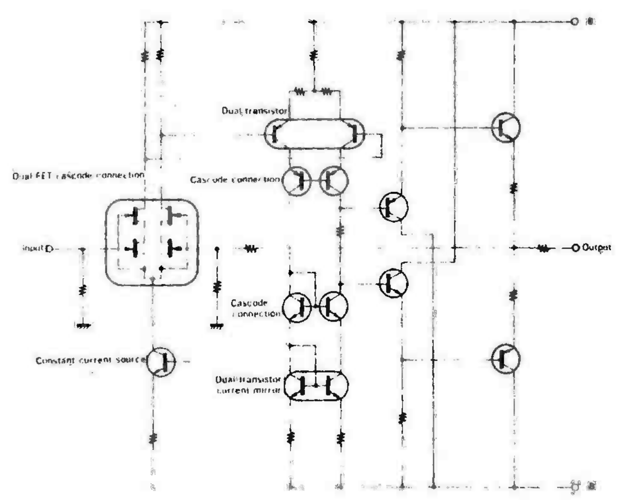


Magnetic cartridge input board.

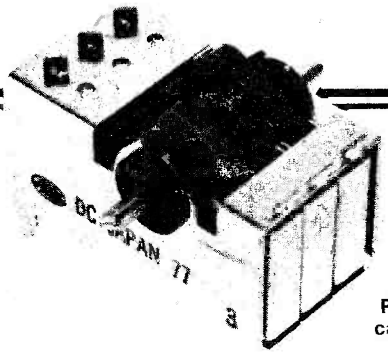


Standing At The Buffers

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.



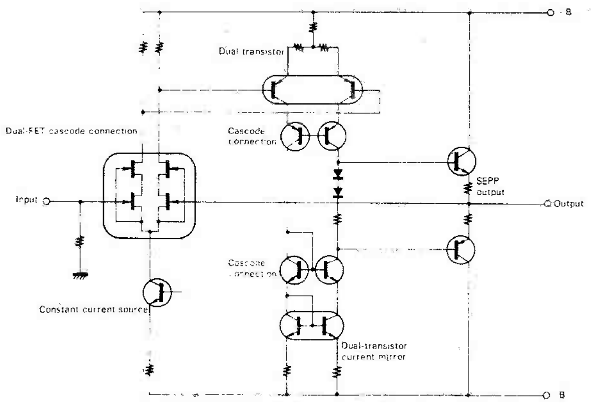
Buffer amplifier circuitry.



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 response, a design closely akin to a power amplifier configuration has been adopted.



Output buffer circuit.

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.

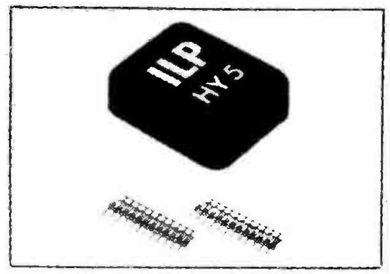
At first the TAE88 sounds very impressive with a particularly good bass end. The treble is a little thin, but nothing to comment adversely on. After a while though I came to suspect that maybe the unit wasn't as good as I thought at first, and perhaps adds a certain metallic quality to the sound.

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 nontheless and if Sony can pull down the price (exit gold?) one which would have received a wholehearted recommendation. ETI

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.

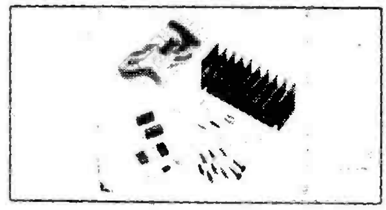
FEATURES: Complete pre-amplifier in single pack — Multi-function equalization — Low noise — Low distortion — High overload — two simply combined for stereo

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 47kΩ 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 ± 16-50V

Price £6.27 + 78p VAT. P&P free.
HY5 mounting board B1 48p + 6p VAT P&P free

HY30
15 Watts into 8Ω



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

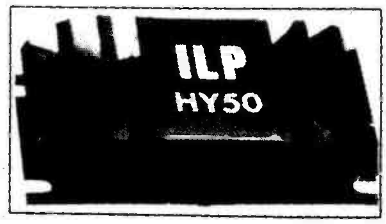
FEATURES: Complete kit — Low Distortion — Short, Open and Thermal Protection — Easy to Build

APPLICATIONS: Updating audio equipment — Guitar practice amplifier — Test amplifier — Audio oscillator

SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω; DISTORTION 0.1% at 15W
INPUT SENSITIVITY 500mV; FREQUENCY RESPONSE 10Hz-16kHz — 3dB
SUPPLY VOLTAGE ± 18V

Price £6.27 + 78p VAT. P&P free.

HY50
25 Watts into 8Ω



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

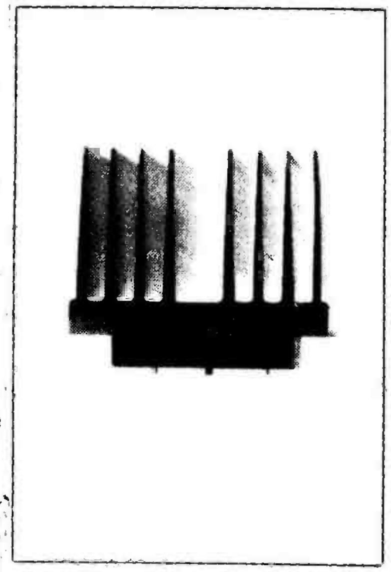
FEATURES: Low Distortion — Integral Heatsink — Only five connections — 7 Amp output transistors — No external components

APPLICATIONS: Medium Power Hi-Fi systems — Low power disco — Guitar amplifier

SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS in 8Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB; FREQUENCY RESPONSE 10Hz-45kHz — 3dB
SUPPLY VOLTAGE ± 25V; SIZE 105.50.25mm

Price £8.18 + £1.02 VAT. P&P free.

HY120
60 Watts into 8Ω



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

FEATURES: Very low distortion — Integral Heatsink — Load line protection — Thermal protection — Five connections — No external components

APPLICATIONS: Hi-Fi — High quality disco — Public address — Monitor amplifier — Guitar and organ

SPECIFICATIONS:
INPUT SENSITIVITY 500mV
OUTPUT POWER 60W RMS into 8Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.04% at 60W at 1 kHz
SIGNAL/NOISE RATIO 90dB; FREQUENCY RESPONSE 10Hz-45kHz — 3dB; SUPPLY VOLTAGE ± 35V
Size 114 x 50 x 85mm

Price £19.01 + £1.52 VAT. P&P free.

HY200
120 Watts into 8Ω

The HY200, now improved to give an output of 120 Watts, has been designed to stand the most rugged conditions, such as disco or group while still retaining true Hi-Fi performance.

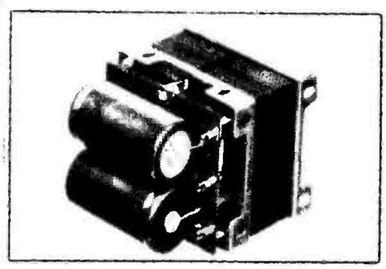
FEATURES: Thermal shutdown — Very low distortion — Load line protection — Integral Heatsink — No external components

APPLICATIONS: Hi-Fi — Disco — Monitor — Power Slave — Industrial — Public address

SPECIFICATIONS:
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.05% at 100W at 1kHz
SIGNAL/NOISE RATIO 96dB; FREQUENCY RESPONSE 10Hz-45kHz — 3dB; SUPPLY VOLTAGE ± 45V
SIZE 114 x 100 x 85mm

Price £27.99 + £2.24 VAT. P&P free.

HY400
240 Watts into 4Ω



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

FEATURES: Thermal shutdown — Very low distortion — Load line protection — No external components

APPLICATIONS: Public address — Disco — Power slave — Industrial

SPECIFICATIONS:
OUTPUT POWER 240W RMS into 4Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.1% at 240W at 1 kHz
SIGNAL/NOISE RATIO 94dB; FREQUENCY RESPONSE 10Hz-45kHz — 3dB; SUPPLY VOLTAGE ± 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.

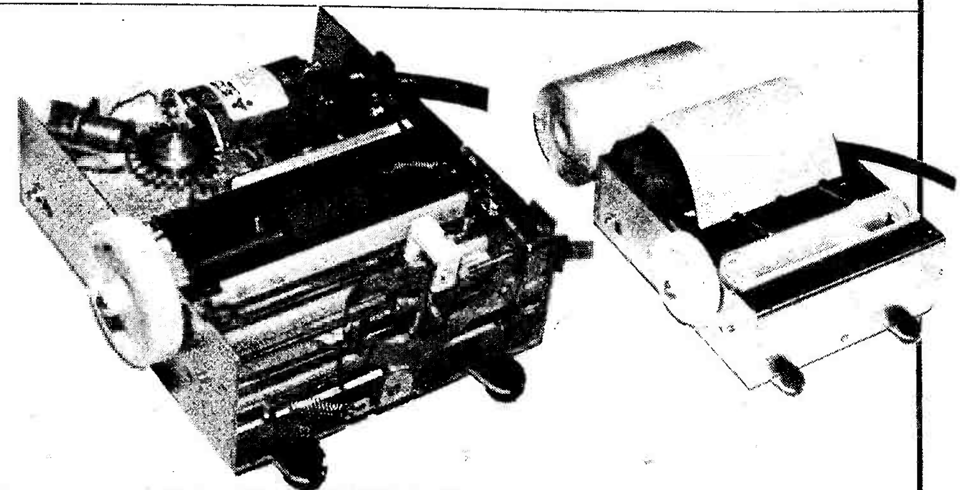
TANGERINE-ONE BOARD VDU

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.

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.



MICRO-BIOLOGY

Continuing the series with an almost indecently intimate look at the good old 6800 MPU.

SOFTSPOT

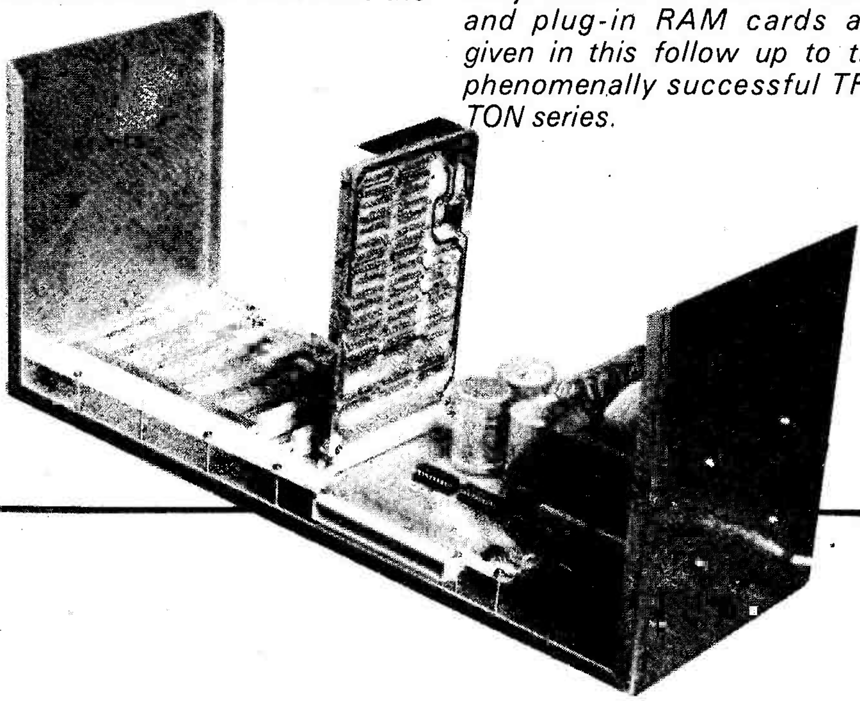
This very popular feature continues to bring you the very latest in new programs, and compiles (groan) all the most up-to-date programming ideas and techniques.

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.

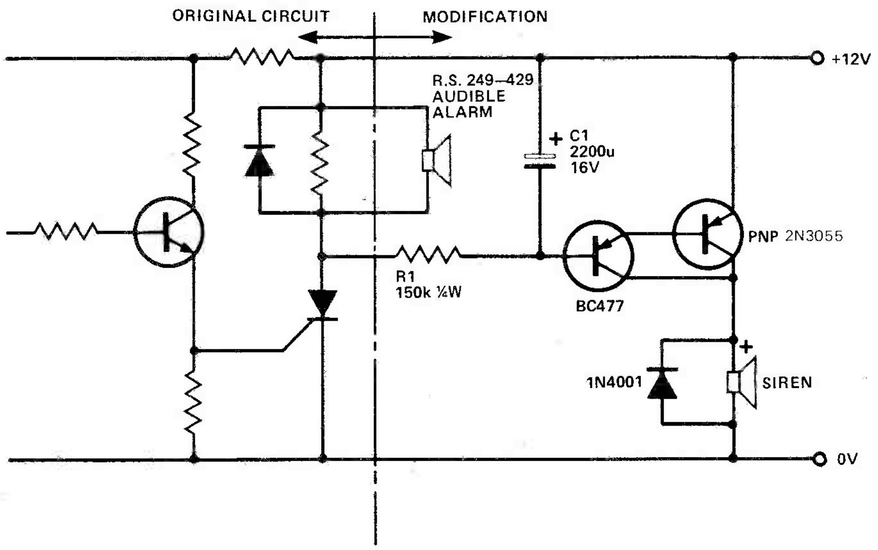
TRITON EXPANSION

Add another 8K of RAM to your TRITON and it will now have the capacity to thank you personally. Details of mother board and plug-in RAM cards are given in this follow up to the phenomenally successful TRITON series.



STOMPER

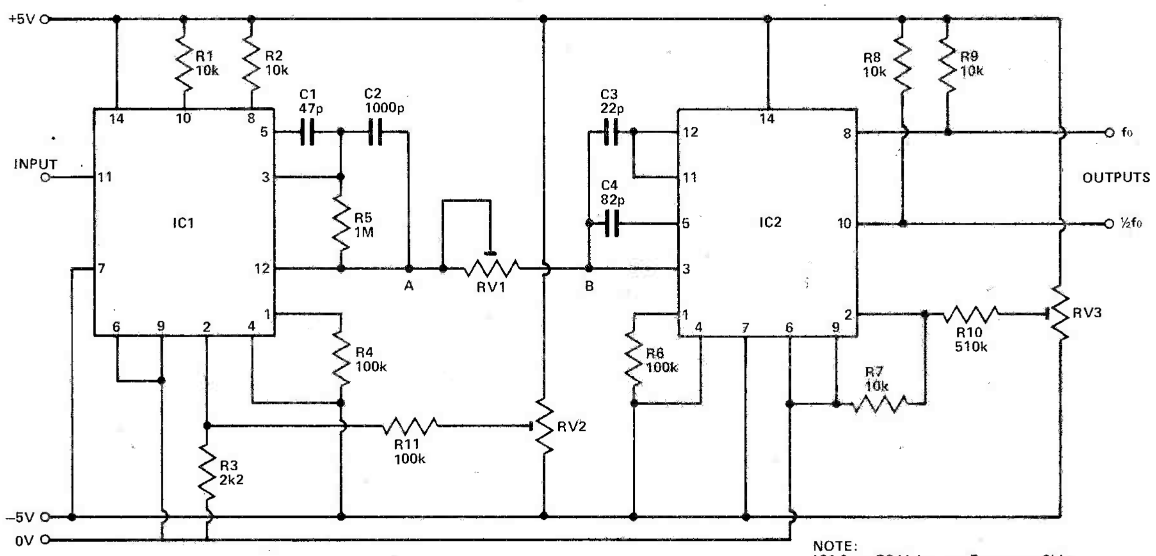
Do you dislike insects? Are you a conservationist? Well this program allows you to stamp on insects without damaging the environment, they even give a satisfying SPLAT when you crush them. Good fun for software Arachniphobiacs.



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 RI and CI.



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 soldiered 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

$$V = F_{in} \times 10^{-3}$$

(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

$$F_{in} = F\ out$$

(NB This is a gross over simplifcation 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.

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
01	0	91
02	1	81
03	F	21
04	M+	84
05	7	61
06	MR	52
07	0	91
08	+	84
09	pi	45
10	=	95
11	y^x	34
12	5	72
13	=	95
14	F	21
15	Frac	51
16	M	51
17	0	91
18	X	74
19	MR	52
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
52	SKIP	15
53	GO TO	14
54	5	72
55	7	61
56	±	94
57	F	21
58	M+	84
59	2	82
60	5	72
61	—	85
62	MR	52
63	2	82
64	=	95
65	F	21
66	M+	84
67	8	62
68	STOP	13
69	GO TO	14
70	0	91
71	2	82

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.

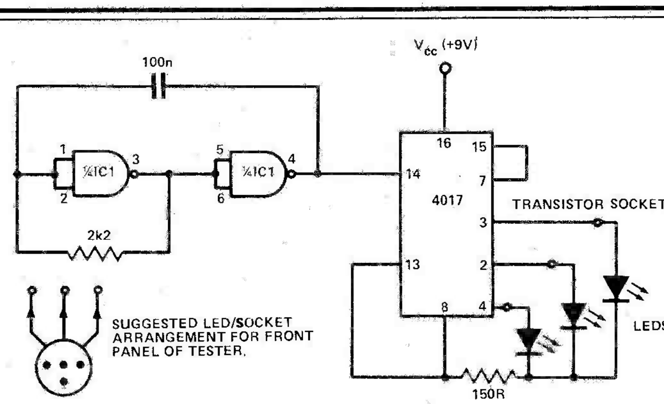
USEFUL HINTS

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.

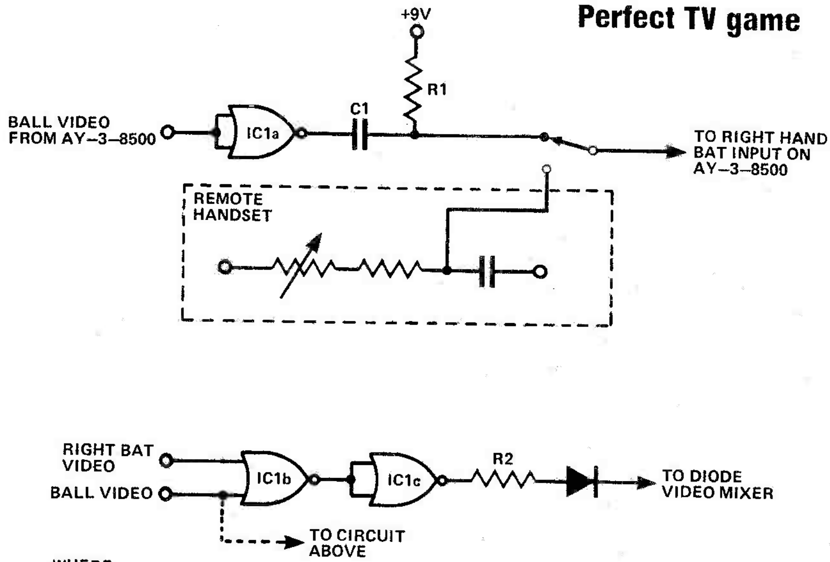
b) NPN one of the LEDs will go out.

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 anobe 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.

Perfect TV game

B. Harvey



WHERE:
IC1 IS 4002
R1 IS 82k
R2 IS 1k
C1 IS 68n

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.

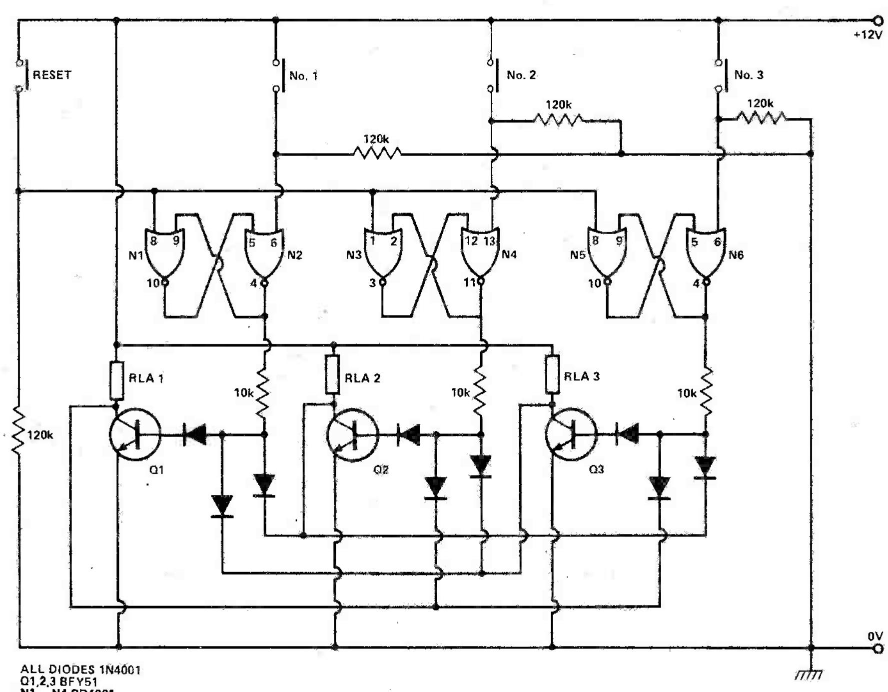
Sequence Switch

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. DI 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 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.



ALL DIODES 1N4001
Q1,2,3 BFY51
N1 – N4 CD4001
N5, N6 ½CD4001
RELAYS 120R OR ABOVE

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	400p	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	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
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	382p		
4052	65p	4518	103p		
4053	65p	4519	57p		
4054	120p	4520	109p		
4055	135p	4521	236p		

Micromarket PRICES SLASHED

6800 series					
6800P	6.50	8216	1.95	2114	£10
6820P	£6	8224	3.50	2708	£10.55
6850P	2.75	8228	4.78	**Development**	
6810P	£4	8251	6.25	MEK6800	£220
6852	3.65	8255	5.40	TK80	£306
8080 series		**MEMORIES**		AMI, Signetics, TI, Intersil, Harris etc. DA	
8080	6.30	2102	£1.70		
8212	2.30	2112	£3.40		
		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 ½A	all 90p
78LCP series TO92 100mA	all 35p
L200 up to 3A/adjustable V&A	195p
78MGT2C ½amp adjustable volts	175p
79MGT2C ½amp 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 dil	36p
CA3160T	99p	710HC to5	65p
Op amps		710PC dil	59p
LM301AH	67p	723CN	65p
LM301AN	30p	741CH to5	66p
LM308H	121p	741CN 8dil	27p
LM308N	97p	747CN	70p
LM318H	279p	748CN	36p
LM318N	224p	NE531T	120p
		NE531N	105p

OPTO 7 seg displays

0.43" High Efficiency HP:

5082- 7650	red CA	233p
5082- 7653	red CC	
5082- 7660	yellow CA	
5082- 7663	yellow CC	
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

TERMS: CWO pse., 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.

TTL : Standard AND LP Schottky

	'N'	'LSN'
7400	13	20
7401	13	20
7402	14	20
7403	14	20
7404	14	24
7405	18	26
7406	38	
7407	38	
7408	17	24
7409	17	24
7410	15	24
7411	20	24
7412	17	24
7413	30	52
7414	51	130
7415		24
7416	30	
7417	30	
7420	16	24
7421	29	24
7422	24	24
7423	27	
7425	27	
7426	36	27
7427	27	29
7428	35	32
7430	17	24
7432	25	24
7433	40	32
7437	40	24
7438	33	24
7440	17	24
7441	74	
7442	70	99
7443	115	
7444	112	
7445	94	
7446	94	
7447	82	
7448	56	99
7449		99
7450	17	
7451	17	24
7453	17	
7454	17	24

	'N'	'LSN'
7455	35	24
7460	17	
7463		
7470	28	
7472	28	
7473	32	
7474	27	38
7475	38	40
7476	37	
7478		
7480	48	
7481	86	
7482	69	
7483A		
7484	97	
7485	104	99
7486		40
7489	205	
7490	33	90
7491	76	110
7492	38	78
7493	32	99
7494	78	
7495A	65	99
7496	58	120
7497	185	
74100	119	
74104	63	
74105	62	
74107	32	38
74109	63	38
74110	54	
74111	68	
74112	88	
74113		38
74114		38
74116	198	
74118	83	
74119	119	
74120	115	
74121	25	
74122	46	
74123	48	
74124		
74125	38	44

	'N'	'LSN'
74126	57	44
74128	74	
74132	73	78
74133		29
74136		40
74138		60
74139		60
74141	56	
74142	265	
74143	312	
74144	312	
74145	65	
74147	175	
74148	109	
74150	99	
74151	64	84
74153	64	54
74154	96	
74155	54	110
74156	80	110
74157	67	55
74158		60
74159	210	
74160	82	130
74161	92	78
74162	92	130
74163	92	78
74164	104	
74165	105	
74166		
74167	20	
74168		
74169		200
74170	230	200
74172	625	
74173	170	
74174	87	120
74175	87	110
74176	75	
74177	78	
74180	85	
74181	165	350
74182	160	
74183		210
74184	135	

	'N'	'LSN'
74185	134	
74188	275	
74190	115	92
74191		
74192	105	180
74193	105	180
74194	105	187
74195	95	137
74196	99	110
74197	85	110
74198	150	
74199	160	
74248		90
74249		93
74251		90
74253		105
74257		108
74258		153
74259		420
74260		153
74261		353
74266		40
74273		124
74275		312
74279		52
74283		120
74290		90
74293		95
74295		120
74298		100
74324		157
74325		242
74326		247
74327		237
74352		100
74353		100
74362		715
74365		49
74366		49
74367		43
74368		49
74373		77
74374		77
74375		60

	LSN
74377	124
74378	93
74379	130
74386	37
74390	140
74395	139
74396	133
74398	180
74399	150
74445	92
74447	90
74490	140
74668	110
74670	249

MISCELLENY

NE555	30p
NE556	78p
NE558	180p
ICM7217	950p
ICM7208	1495p
ICL7106CP - LCD DVM IC	955p
LCD DVM KIT	2480p
3½ digit LCD display	1150p
ICL7107 LED DVM kit	2065p
ICM7216 - 8 digit 10MHz DFM/timer (for LED C.Cath)	£19.82

SCALAR ICs

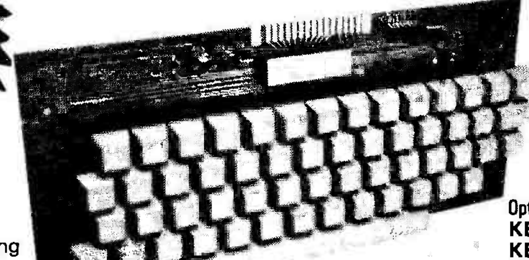
8629 150MHz divide by 100	420p
95H90DC	780p
11C90DC	1400p
8618 -new-divide by 100 or 10 for 120/60MHz	450p

The ICL7216BIPI 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 6amp 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 advertisement 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)

KB756MF including metal mounting frame for extra rigidity,

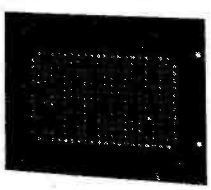
***ONLY* £55.00** (mail order total £61.02)

SELF-SCAN ALPHANUMERIC PANEL DISPLAY

16/18 position display with 64 character repertoire, 5×7 dot matrix. Input 6-bit BCD-code, power requirements +5v, -12v. Character size 0.40" × 0.28" Overall dimensions 8¼" × 2¼" × 1¼". Supplied with full technical data. Price **£55.00** + 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

SEALECTRO PATCH BOARDS



Programme boards for switching and interconnecting input/output circuits. 11 × 20 XY matrix. Interconnection is by means of shorting, skip and component holding pins (not supplied). Dimensions: 7½" × 5¾" × 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

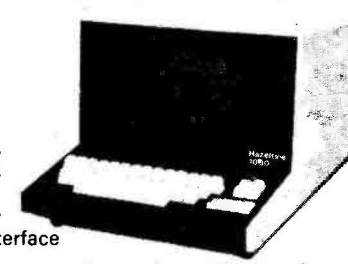
PRICE: £15.00

(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
* 5×7 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.

A copy of trading conditions supplied on request

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.

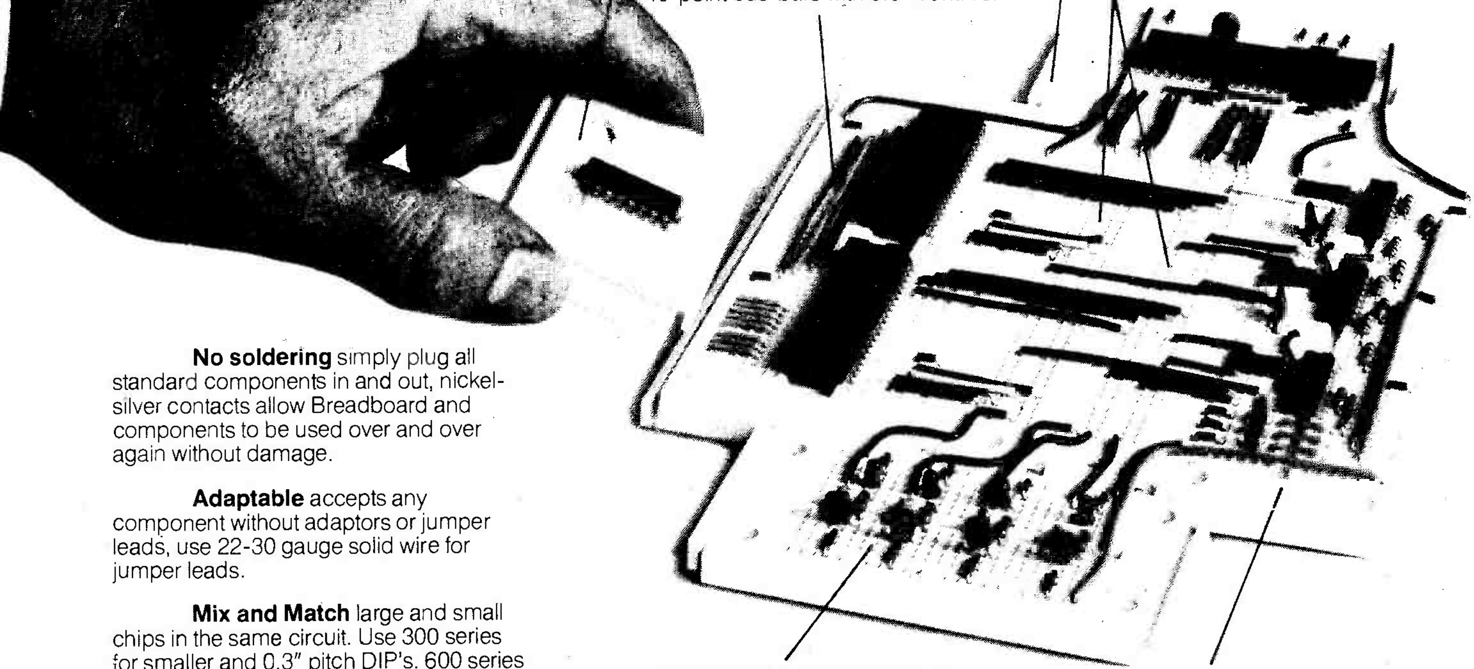
A breadboard as big as your ideas.

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.

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.

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.

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

CSC

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

MINI-ADS & CLASSIFIED

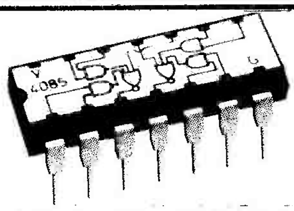
LOW COST RAM

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/l 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 BLAKELOW 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**
4.8v 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

E.T.I. P.C.B'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, 4¾" x 6½", 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.

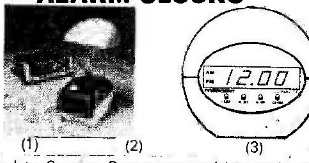
New — signal invert control, integral square wave generator. **Plus** — full details for testing your audio system for transient distortion, crosstalk etc.

Complete Kit only £19·95 **Luxury cabinet and 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

Compuer on a board - 8K basic in Rom keyboard, graphics, cassette interface, 2K monitor, British T.V. interface, expandable.

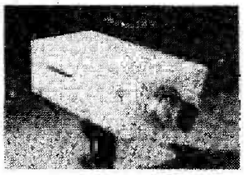
4K RAM £275 8K RAM £315

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 LOCMOS, 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.



CCTV CAMERA

£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.

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, 1.8Ω, 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. ETI3 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.

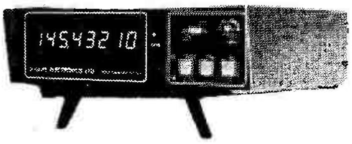
TRANSAM/ETI TRITON COMPUTER P.C.B. for sale, unused, unwanted due to purchase of TR80. £37.50. Write to Burgess 12 Upton Crescent, Oakridge Basingstoke

NASCOM 1 COMPUTER with T2 Nasburg, improved television modulation, P.S.U. and full documentation (including programming manual). Offers £240+. Ring Slough 47353 (evenings).

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

HF60 **£91.20**
HF600 **£106.48** Excluding VAT

Trade enquiries welcome

Send S.A.E. for further details

REF NO 1384670

crael UK LTD. ELECTRONIC DEALERS IMPORT-EXPORT AGENTS

7 HUGHENDEN ROAD - HASTINGS SUSSEX TN34 3TG - England
Telephone: (0424) 428131

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 techiques 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

SPRING SUPER SALES OFFERS

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 our of your computer. You can OBTAIN and EXCHANGE programs and other software – many now available.

SAVE £30

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.

Only **£197.50** + 8% VAT (includes p & p + insurance)

Manuals seperately	2.95
Z80 programming Manual	6.90
Z80 Technical Manual	2.95
PIO Technical Manual	2.95
(All prices add 8% VAT)	

Power supply suitable for NASCOM **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 Joy Stick Kit **£14.90**

Nascom Music Box Kit **£9.90**
(write your own tunes and play them on your Nascom. Complete with full documentation).

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, screeching 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**

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**
Suitable 8K Static RAM Memory ~~£125~~ £110 (fully assembled tested and guaranteed)

Buy both and get 2K Tiny Basic On cassette FREE.

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.

~~£289.00~~ **£249.00** + VAT

Send £10 to reserve one – pay balance on delivery.

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

16K UP GRADE KIT

Half Radio Shack Price **£99** + VAT

Simple to fit – only a screw-driver is required.

LIFETIME GUARANTEE

MODULATORS UHF Channel 36

Standard 6 meg band width **£2.25**
High Quality 8 meg band width £4.90

TRS 80 SOFTWARE *NEW*

100 MIXED PROGRAMMES on cassette **£49.00**

BULK PURCHASE VDU MONITORS

~~£99~~ **£69** + VAT

CASED AND GUARANTEED *12"*