

# electronics today

ISSN. 0142-7229

INTERNATIONAL

OCTOBER 1980 60p

## FM RADIO CONTROL

FULL Details Inside



SPECIAL  
COMPUTER  
INTERFACE  
FLASH TRIGGER  
SUSTAIN PEDAL  
SIX PAGES  
OF TRIED AND  
TESTED CIRCUITS TO BUILD  
RELATIVITY EXPLAINED!

GREAT NEWS FOR  
**SPACE FANS**  
INSIDE!



...NEW... PROJECTS... MICROPROCESSORS... AUDIO...



### 8K ON BOARD MEMORY!

5K RAM, 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

### 2 KEYBOARDS!

56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

### GRAPHICS!

64 character graphics option — includes transistor symbols! Only £18.20 extra!

### MEMORY MAPPED

high resolution VDU circuitry using discrete TTL for extra flexibility. Has its own 2K memory to give 32 lines for 64 characters.

### KANSAS CITY

low error rate tape interface.

### PSI comp 80

Z80 Based powerful scientific computer design as published in WIRELESS WORLD



### 2 MICROPROCESSORS

Z80 the powerful CPU with 158 instructions, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, -, /, squares, roots, logs, exponentials, trig functions, inverses etc. Range 10<sup>-99</sup> to 9 x 19<sup>99</sup> to 8 figures plus 2 exponent digits.

### EFFICIENT OPERATION

Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

### RESIDENT BASIC

with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

### 1K MONITOR

resident in EPROM.

### SINGLE BOARD DESIGN

Even keyboards and power supply circuitry on the superb quality double sided plated through-hole PCB.

**COMPLETE KIT  
NOW ONLY  
£225 + VAT**

Cabinet size 19.0" x 15.7" x 3.3"  
Television not included in price.

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete. Included in the PSICOMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board. 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer. 2K Basic and 1K monitor in EPROMs and, of course, wire, nuts, bolts, etc.

### KIT ALSO AVAILABLE AS SEPARATE PACKS

For those customers who wish to spread their purchase or build a personalised system the kit is available as separate packs eg. PCB (16" x 12.5") £43.20. Pair of keyboards £34.80. Firmware in EPROMs £30.00. Toroidal transformer and power supply components £17.60. Cabinet (very rugged, made from steel, really beautifully finished) £26.50. P.S. Will greatly enhance any other single board computer including OHIO SUPERBOARD for which it can be readily modified. Other packs listed in our FREE CATALOGUE.

### PSI COMP 80 Memory Expansion System

Expansion up to 32K all inside the computer's own cabinet!

By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computer's transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

#### Mother board:

Fibre glass double sided plated through hole PCB 8 7" x 3 0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug  
£39.90

#### 8K Static RAM board

Fibre glass double sided plated through hole PCB 5 6" x 4 8" £12.50  
Set of components including IC sockets, plug and socket but excluding RAMs £11.20  
2114L RAM (16 required) £5.00  
Complete set of board components 16 RAMs £89.50

#### 8K ROM board

Fibre glass double sided plated through hole PCB 5 6" x 4 8" £12.40  
Set of components including IC sockets, plug and socket but excluding ROMs £10.70  
2708 ROM (8 required) £8.00  
Complete set of board components 8 ROMs £78.50

BEING FEATURED  
IN THIS ISSUE

## ★ ETI VOCODER ★



Panel size 19.0" x 5.25". Depth 12.2"

**14 CHANNELS!  
NOISE GENERATOR!  
LED PPM METERS!  
SLEW RATE CONTROL!**

**2 OSCILLATORS!  
VOICED/UNVOICED  
DETECTOR!**

**COMPLETE KIT ONLY £195 + VAT**

Kit includes FREE foot control and test oscillator!

Like all our kits the ETI VOCODER really is complete — fully finished metal work, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc. — even a 13A plug!

# POWERTRAN

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!  
**POWERTRAN ELECTRONICS**

PORTWAY INDUSTRIAL ESTATE  
ANDOVER, HANTS SP10 3NM

ANDOVER  
(STD 0264) 64455

**PRICE STABILITY:** Order with confidence. Irrespective of any price changes we will honour all prices in this advertisement until November 30, 1980, if this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.  
**EXPORT ORDERS:** No VAT. Postage charged at actual cost plus £1 handling and documentation.

**U.K. ORDERS:** Subject to 15% surcharge for VAT. No charge is made for carriage, or at current rate if changed.

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

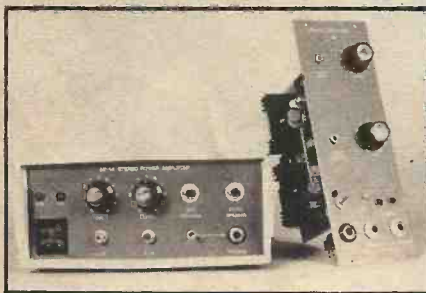
**SALES COUNTER:** If you prefer to collect kit from the factory, call at Sales Counter. Open 9 a.m. - 12 noon, 1-4.30 p.m. Monday-Thursday.

**MANY MORE KITS ON PAGE 8**

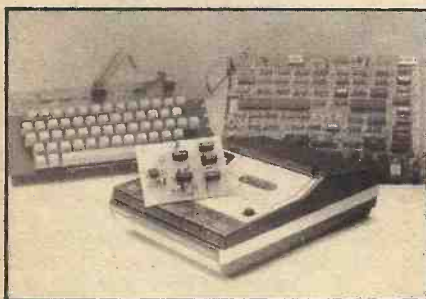




Single chip control system. p.15



Sounds for Project 80. p.79



From micro to tape in a flash. p.63



For photo special effects. p.30

# electronics today

OCTOBER 1980 VOL 9 NO 10

## FEATURES

- DIGEST 7 You read it first here.
- SPOT DESIGNS 22 Six page circuits special.
- SPECIAL RELATIVITY 35  $E=mc^2$  and all that . . . . .
- AUDIOPHILE 48 News from the top deck.
- TECH TIPS 59 Pages of your own designs.
- HEAD AMPLIFIER DESIGN 69 Match-making in your home.
- DESIGNER'S NOTEBOOK 73 Hot sensations on the test bench.
- ASTROLOGUE 84 A dialogue in astronautics.
- MICROBASICS 87 The anatomy of a micro.
- ELECTRONICS TOMORROW 92 From mechanics to chips.

## PROJECTS

- FM RADIO CONTROL 15 One chip remote control.
- FLASH TRIGGER 30 Economical special effects.
- VOCODER 40 Orchestration par excellence!
- FUZZ/SUSTAIN BOX 53 Guitar sounds you must have.
- CASSETTE INTERFACE 63 Extra-fast micro data transfer.
- MONITOR AMPLIFIER 79 Hear what Project 80 has to say.
- FOIL PATTERNS 108 PCBs in black and white.

## INFORMATION

- NEXT MONTH'S ETI 21 Remember, remember ETI November.
- NEXT MONTH'S HE 33 The Hobby Electronics to come.
- SUBSCRIPTIONS 39 Getting it the easy way.
- BREADBOARD 80 95 Making an exhibition of ourselves.
- BOOKS 103 ETI's technical book service.
- COME AND JOIN US 110 Want to work for ETI?
- ETIPRINTS 111 Print a pattern on copper.

**EDITORIAL AND ADVERTISEMENT OFFICE**  
 145 Charing Cross Road, London WC2H 0EE. Telephone 01-437 1002/3/4/5

Non Harris B.Sc. Editor  
 Ian Graham B.Sc. Assistant Editor  
 Tina Boylan Editorial Assistant  
 Paul Wilson-Patterson Group Art Editor  
 Paul Edwards Drawing Office Manager  
 Ray Marston Project Editor  
 Christopher Surgenor Group Advertisement Manager  
 Steven Rowe Advertisement Manager  
 Roy Parrymen Advertisement Representative  
 T.J. Connell Managing Director

OVERSEAS EDITIONS and their EDITORS  
 AUSTRALIA - Roger Harrison  
 CANADA - Halvor Moorshead  
 GERMANY - Udo Wittig  
 HOLLAND - Anton Kriegsman



Member of the  
 Audit Bureau  
 of Circulation



PUBLISHED BY Modmags Ltd, 145 Charing Cross Road, WC2  
 DISTRIBUTED BY Argus Distribution Ltd (British Isles)  
 12-18 Paul Street, London  
 Gordon & Gotch Ltd (Overseas)  
 PRINTED BY QB Limited, Colchester

Electronics Today is normally published on the first Friday in the month preceding cover date. ©MODMAGS LTD 1980. All material is subject to worldwide copyright protection. All reasonable care is taken in the preparation of the magazine contents, but the publishers cannot be held legally responsible for errors. Where mistakes do occur, a correction will normally be published as soon as possible afterwards. All prices and data contained in advertisements are accepted by us in good faith as correct at time of going to press. Neither the advertisers nor the publishers can be held responsible, however, for any variations affecting price or availability which may occur after the publication has closed for press. Subscription Rates: UK £10 including postage. Airmail and other rates upon application to ETI Subscriptions Service, PO Box 35, Bridge Street, Hemel Hempstead, Herts



# Britain's first com computer kit.

## The Sinclair ZX80.

# £79.95

Price breakdown  
ZX80 and manual: £69.52  
VAT: £10.43  
Post and packing FREE

Please note: many kit makers quote VAT-exclusive prices.

You've seen the reviews... you've heard the excitement... now make the kit!

This is the ZX80. 'Personal Computer World' gave it 5 stars for 'excellent value.' Benchmark tests say it's faster than all previous personal computers. And the response from kit enthusiasts has been tremendous.

To help you appreciate its value, the price is shown above with and without VAT. This is so you can compare the ZX80 with competitive kits that don't appear with inclusive prices.

### 'Excellent value' indeed!

For just £79.95 (including VAT and p&p) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or colour); *everything!*

Yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The ZX80 is programmed in BASIC, the world's most popular computer language for beginners and experts alike.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done; connect it to your TV... link it to an appropriate power source\*... and you're ready to go.

#### Your ZX80 kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs - all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be **SAVEd** and **LOADed** on to a portable cassette recorder.)
- FREE course in BASIC programming and user manual.

#### Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately - see coupon).
- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available - see coupon).

\*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

### The unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability - takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions. USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols
- All characters printable in reverse under program control.
- Lines of unlimited length.

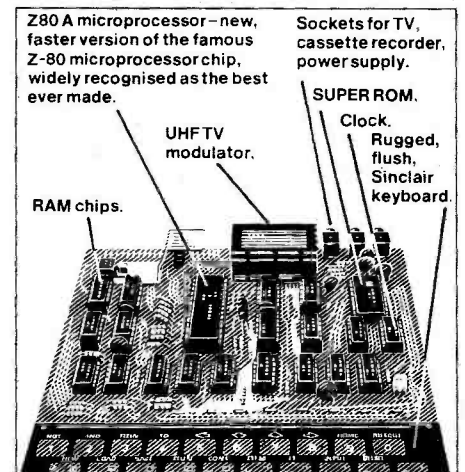
### Fewer chips, compact design, volume production - more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer - typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the ZX80 is faster than all other personal computers.

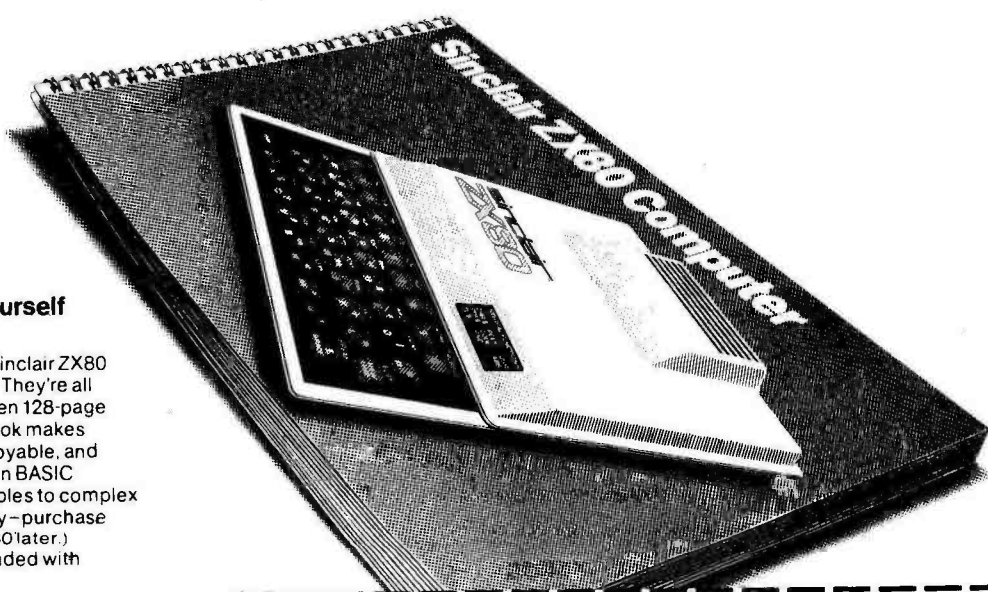
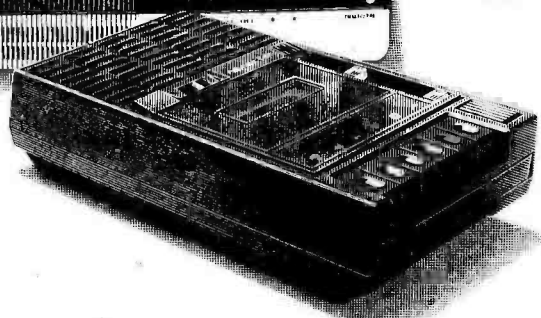
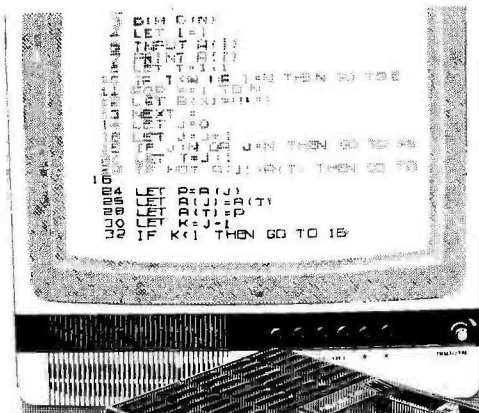
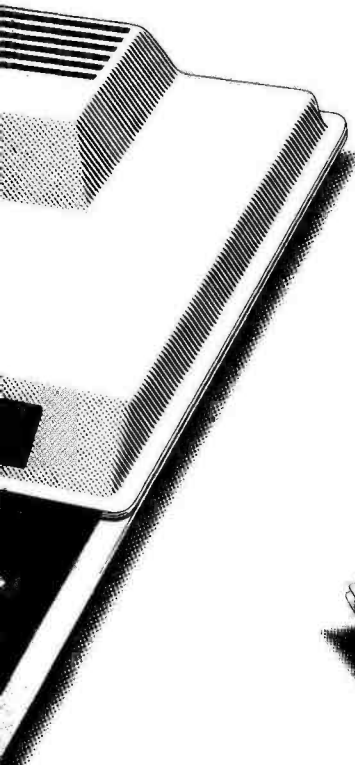
No other personal computer offers this unique combination of high capability and low price.



ETI OCTOBER 1980



# plete



## ZX80 software – now available!

See advertisements in Personal Computer World, Electronics Today International, and other journals.

New dedicated software – developed independently of Science of Cambridge – reflects the enormous interest in the ZX80. More software available soon – from leading consultancies and software houses.

### The Sinclair teach-yourself BASIC manual.

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book free with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.) A hardware manual is also included with every kit.

### The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

The ZX80 kit costs a mere £79.95. Can't wait to have a ZX80 up and running? No problem! It's also available, ready assembled and complete with mains adaptor, for only £99.95.

Demand for the ZX80 is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

**sinclair**  
**ZX80**  
Science of Cambridge Ltd  
6 Kings Parade, Cambridge, Cambs., CB2 1SN.  
Tel: 0223 311488.  
ETI OCTOBER 1980

**ORDER FORM** To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.  
Remember: all prices shown include VAT, postage and packing. No hidden extras.  
Please send me:

Quantity	Item	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor	£79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor	£99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated)	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes)	12.00	
	RAM Memory chips – standard 1K bytes capacity	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer)	5.00	
		<b>TOTAL</b>	<b>£</b>

NB. Your Sinclair ZX80 may qualify as a business expense.

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ \_\_\_\_\_  
Please print  
Name: Mr/Mrs/Miss \_\_\_\_\_  
Address \_\_\_\_\_

ETI/10/80



TTLs by TEXAS	74290	150p	4020	100p	
7400	11p	74293	150p	4021	110p
7401	60p	74298	200p	4022	100p
7402	12p	74365	100p	4023	27p
7403	14p	74366	100p	4024	50p
7404	14p	74367	100p	4025	20p
7405	18p	74368	100p	4026	130p
7406	38p	74390	200p	4027	50p
7407	38p	74393	200p	4028	84p
7408	17p	74490	225p	4029	100p
7409	19p	74LS00	14p	4030	55p
7410	15p	74LS02	18p	4031	200p
7411	24p	74LS03	18p	4033	180p
7412	20p	74LS04	18p	4034	200p
7413	30p	74LS05	25p	4035	110p
7414	40p	74LS08	22p	4036	295p
7415	40p	74LS10	22p	4037	115p
7416	27p	74LS11	40p	4038	120p
7417	27p	74LS13	40p	4039	295p
7420	17p	74LS14	80p	4040	100p
7421	40p	74LS15	45p	4041	80p
7422	22p	74LS20	20p	4042	80p
7423	34p	74LS21	40p	4043	90p
7425	30p	74LS27	38p	4044	90p
7426	40p	74LS30	20p	4046	110p
7427	34p	74LS32	27p	4047	100p
7428	38p	74LS37	30p	4048	55p
7430	17p	74LS38	38p	4049	50p
7432	30p	74LS42	70p	4050	48p
7433	40p	74LS47	75p	4051	80p
7437	35p	74LS51	24p	4052	80p
7438	35p	74LS55	30p	4053	80p
7440	17p	74LS73	50p	4054	150p
7441	70p	74LS74	27p	4055	125p
7442A	60p	74LS75	38p	4056	135p
7443	112p	74LS76	45p	4059	600p
7444	112p	74LS83	70p	4060	115p
7445	100p	74LS85	80p	4063	120p
7446A	93p	74LS86	40p	4066	55p
7447A	75p	74LS90	40p	4067	450p
7448	80p	74LS92	70p	4068	27p
7450	17p	74LS93	80p	4069	20p
7451	17p	74LS96	110p	4070	30p
7453	17p	74LS107	45p	4071	25p
7454	17p	74LS109	80p	4072	25p
7460	17p	74LS112	40p	4073	25p
7470	38p	74LS113	90p	4076	107p
7472	30p	74LS114	45p	4081	27p
7473	34p	74LS122	80p	4082	27p
7474	30p	74LS123	80p	4086	72p
7475	38p	74LS124	180p	4089	138p
7476	32p	74LS125	50p	4093	80p
7480	50p	74LS126	80p	4094	250p
7481	100p	74LS132	60p	4095	95p
7482	84p	74LS133	30p	4096	95p
7483A	90p	74LS136	55p	4097	340p
7484	100p	74LS138	75p	4098	120p
7485	110p	74LS139	75p	4099	200p
7486	34p	74LS145	120p	4100	220p
7489	210p	74LS147	220p	4101	132p
7490A	30p	74LS148	175p	4102	180p
7491	80p	74LS151	80p	4103	250p
7492A	46p	74LS153	60p	4104	99p
7493A	36p	74LS154	200p	4105	99p
7494	84p	74LS155	80p	4106	90p
7495A	70p	74LS156	90p	4107	60p
7496	85p	74LS157	80p	4108	470p
7497	180p	74LS158	60p	4109	100p
74100	130p	74LS160	90p	4110	300p
74107	34p	74LS161	75p	4114	250p
74109	55p	74LS162	140p	4502	120p
74116	200p	74LS163	100p	4503	70p
74118	130p	74LS164	90p	4507	55p
74119	210p	74LS165	140p	4508	290p
74120	110p	74LS166	180p	4510	98p
74121	34p	74LS173	110p	4511	150p
74122	48p	74LS174	100p	4512	80p
74123	60p	74LS175	100p	4514	285p
74125	75p	74LS181	320p	4515	300p
74126	60p	74LS190	100p	4516	110p
74128	75p	74LS191	100p	4520	100p
74132	75p	74LS192	100p	4521	250p
74136	75p	74LS193	100p	4526	108p
74137	50p	74LS195	140p	4527	150p
74141	50p	74LS196	120p	4528	120p
74142	200p	74LS197	90p	4532	140p
74145	90p	74LS221	120p	4534	550p
74147	190p	74LS240	175p	4538	120p
74148	150p	74LS241	175p	4543	180p
74150	130p	74LS242	170p	4553	450p
74151A	70p	74LS243	170p	4556	72p
74153	70p	74LS244	150p	4560	250p
74154	120p	74LS245	250p	4569	250p
74155	90p	74LS247	140p	4572	40p
74156	90p	74LS251	140p	4583	110p
74157	70p	74LS253	90p	4584	90p
74159	190p	74LS257	90p	4585	150p
74160	100p	74LS258	180p	4724	250p
74161	100p	74LS259	180p	40097	90p
74162	100p	74LS266	100p	14411	1100p
74163	100p	74LS273	170p	14412	1100p
74164	120p	74LS279	90p	14433	1100p
74165	130p	74LS283	90p	14500	700p
74166	120p	74LS298	180p	14599	290p
74167	200p	74LS324	200p		
74170	240p	74LS348	200p		
74172	450p	74LS365	48p	DM8123	175p
74173	120p	74LS367	70p	DM8131	375p
74174	90p	74LS368	100p	DP8304	450p
74175	85p	74LS373	150p	DS8835	250p
74176	90p	74LS374	150p	DS8836	150p
74177	90p	74LS375	120p	DS8838	225p
74178	180p	74LS377	180p	MC1488	75p
74180	93p	74LS378	140p	MC1489	75p
74181	180p	74LS390	160p	25510	350p
74182	90p	74LS393	160p	75107	160p
74184A	150p	74LS445	140p	75110	325p
74185	160p	74LS668	100p	75150	175p
74186	500p	74LS669	100p	75154	175p
74188	325p	74LS670	400p	75182	230p
74190	120p	4000 SERIES		75322	300p
74191	120p	4000	15p	75324	375p
74192	100p	4001	22p	75325	375p
74193	100p	4002	22p	75361	300p
74194	120p	4006	95p	75363	400p
74195	95p	4007	20p	75365	250p
74196	95p	4008	80p	75451/2	72p
74197	80p	4009	40p	75491/2	96p
74198	150p	4010	50p	8726	160p
74199	150p	4011	22p	8728	250p
74221	160p	4012	25p	8795	200p
74251	140p	4013	50p	8797	160p
74259	250p	4014	84p	81LS95	120p
74278	290p	4015	84p	81LS96	140p
74279	110p	4016	84p	81LS97	120p
74283	160p	4017	80p	81LS98	140p
74284	380p	4018	85p	9601	110p
74285	380p	4019	45p	9602	220p

93 SERIES	74S SERIES			
9301	74S00	60p	74S114	120p
9302	74S04	60p	74S124	300p
9308	74S05	75p	74S132	180p
9310	74S08	75p	74S133	75p
9311	74S10	60p	74S138	225p
9312	74S20	60p	74S139	225p
9314	74S30	60p	74S157	250p
9316	74S32	90p	74S174	250p
9321	74S37	90p	74S175	320p
9322	74S64	60p	74S194	350p
9334	74S74	90p	74S241	450p
9368	74S85	300p	74S260	70p
9370	74S86	180p	74S373	500p
9374	74S112	120p	74S374	500p

LINEAR I.C.s	MC3340P		
AY1-0212	600p	MC3340P	120p
AY1-1313	668p	MK50398	750p
AY1-1320	320p	ML920	775p
AY1-5050	140p	MM57160	620p
AY3-1270	840p	NE531	150p
AY5-1224A	240p	NE555	22p
AY5-1315	800p	NE556	70p
AY5-1317A	775p	NE562B	425p
AY5-4007D	620p	NE564	420p
CA3019	80p	NE565	130p
CA3046	70p	NE566	155p
CA3048	225p	NE567	140p
CA3080E	72p	NE571	425p
CA3086	48p	NE573A	250p
CA3089E	225p	RC4151	400p
CA3090AQ	375p	S5668	270p
CA3130E	90p	SAB3209	POA
CA3140E	50p	SAD1024A	1250p
CA3160E	100p	SFF96364	1100p
CA3161E	140p	SL490	400p
CA3162E	450p	SN76003N	250p
CA3189E	300p	SN76013N	140p
CA3280	180p	SN76013ND	120p
DAC1408-B	200p	SN76023N	140p
FX209	750p	SN76023ND	120p
ICL7106	850p	SN76477	175p
ICL8038	300p	SP8515	750p
ICM7555	80p	TAA621	275p
LF356P	95p	TBA641B11	225p
LM10C	425p	TBA651	200p
LM301A	30p	TBA800	90p
LM311	70p	TBA810	100p
LM318	200p	TBA820	90p
LM319	225p	TBA950	300p
LM324	45p	TCA210	250p
LM339	75p	TCA220	350p
LM348	95p	TCA940	175p
LM377	175p	TDA1004	300p
LM380	75p	TDA1008	320p
LM381AN	180p	TDA1010	225p
LM386	95p	TDA1022	570p
LM393	100p	TDA1024	120p
LM709	36p	TDA1034B	250p
LM710	50p	TDA1170	300p
LM725	350p	TDA2002V	325p
LM733	100p	TDA2020	320p
LM741	18p	TL071/81	45p
LM747	70p	TL072/82	75p
LM748	35p	TL074	130p
LM2917	250p	TL084	110p
LM3900	70p	TL170	50p
LM3909	70p	UAA170	175p
LM3911	130p	UDN6118	320p
LM3914	225p	UDN6184	320p
LM3915	225p	ULN2003	100p
LM4136	120p	XR2202	300p
LM13600	125p	XR2207	400p
MC1310P	150p	ZN414	90p
MC1458	48p	ZN419C	225p
MC1495L	350p	ZN424E	135p
MC1496	100p	ZN425E	400p
		ZN427E	750p

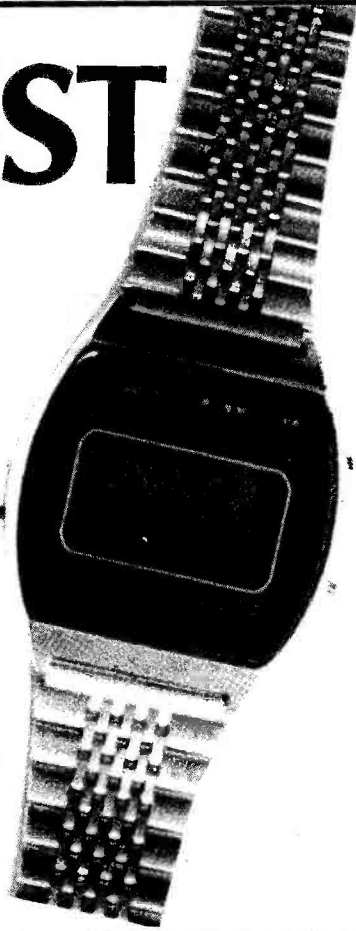
VOLTAGE REGULATORS	OTHER REGULATORS		
Fixed Plastic TO-220	78HGKC	600p	
1A	78H05KC	600p	
+ve	78H05KC	600p	
5V	78H05KC	600p	
12V	78H05KC	600p	
15V	78H05KC	600p	
18V	78H05KC	600p	
24V	78H05KC	600p	
100mA	78H05KC	600p	
5V	78H05KC	600p	
12V	78H05KC	600p	
15V	78H05KC	600p	
78L05	30p	79L05	70p
78L12	30p	79L12	70p
78L15	30p		



# DIGEST

## Watch Out

For under £44.95 you too can own a new Casio watch with continuous time readout, date display, full month, calendar information, professional grade stopwatch, plus alarm and time signal functions with a choice of tone pitch. What more can you ask for? And it's all in the 79CS51B Casio Stopwatch. A conventional LCD readout shows hour, minute, second, am/pm and date. Push a button to display year, month date and day. Press again for full calendar and cycle the display through earlier and later months if so desired. The automatic calendar is programmed from 1901 to 2099. As a stopwatch the 79CS51B has a running time of 12 hours and a measurement unit of one-tenth second. It handles normal start-stop timing, net timing, lap timing and first-second place timing. The watch will also sound an alarm at any preset time and/or signal every hour. One lithium battery will last about 15 months average use. For further information contact Casio Electronics Co Ltd, 28 Scrutton Street, London EC2A 4TY.



## This Is A Recording

The Combur 385 is a new telephone answering machine from Agovox. It is a compact module which sits neatly under a conventional telephone. The facilities available include a remote control electronic decoder which enables the machine to be telephoned from anywhere in the world and instructed to play back over the telephone any messages received from previous callers. The machine is also capable of recording both sides of a conversation and can be linked

to a standard recorder for retaining permanent records of calls. It is also fully compatible with existing dictating machines which utilise mini-cassettes and has a foot switch and head set available. Message lengths can be limited and a call counter enables easy location and logging of messages. The 385 is available for rent at between £3.72 and £6.46 depending on the type of rental contract or £750 for outright purchase. For further information contact The Sales Office, Agovox Limited, 4 Sydenham Road, London SE26 5QY.

## EMP — The Answer

All our inquiries addressed to the Prime Minister, the Home Secretary and the Secretary of State for Defence on the Government's plans to cope with the Electromagnetic Pulse effect (EMP) in wartime eventually found their way to the same office somewhere in the depths of the Home Office. This is what HM Government has to say: 'Her Majesty's Government is aware of the phenomenon of EMP and its possible effects on communications systems. We take it into account in the design of civil and defence systems but cannot, of course, comment on the details of all the forms of EMP protection used.'

The Home Office has given guidance to local authorities and other essential services concerned with the planning of communications systems for war, on the effects of EMP and about certain precautions that can be taken to reduce the risk of EMP damage to communications equipment.

The requirements for home defence communications are currently being reviewed and possible measures to protect them against the effects of EMP will be considered in the course of the review.'

So, it seems the Government and local authorities know all about EMP, but they aren't going to tell the likes of us.

In a statement to the Commons on August 7th, the Home Secretary (William Whitelaw) outlined

developments in Britain's civil defence programme. The UK warning and monitoring organisation is to improve its communications. Improvements are also to be made to the wartime broadcasting service to ensure the continuation of public broadcasting even after a large-scale attack (but no mention of EMP).

After a lengthy pronouncement on Central/Local Government co-operation in wartime, increased expenditure on equipment and services, greater involvement in civil defence by Central Government departments and finishing up with news of the refurbishment of our stocks of emergency fire appliances (Green Goddesses!), Mr. Eric Heffer's immediate reaction was, 'The right hon. Gentleman must be joking'.

We'll keep you posted on any further developments. Keep your letters coming. These given here are representative of those we have received so far. This article has stimulated a greater reader response than anything previously published in ETI. Most of our correspondents have understood the need for caution in our approach to publication.

The letter from Mr Keightley is particularly interesting and we are contacting Mr J. Pawsey MP to gather his views on the subject. In addition investigations are under way to find out exactly what that "guidance to local authorities" referred to in the Home Office reply consists of and of how much use it has

proved to be. We hope to be able to report back next issue on the results of that investigation.

In the meanwhile keep your letters coming to us and why not follow Mr Keightley's example and write to your local MP? Maybe together we can overcome the vast governmental inertia and raise the heads above the sand just a little.

Dear Sir,

I think you should visit the inside of a NATO USA or British Radar Command Station.

We have in the UK high gain very large units operating on all bands ie: VLF to UHF by a switching unit thus making jamming very hard because the unit sends out piano type signal and only receives back the same. All are sent out through banks of pure mechanical harmonic filters, that also process the received signal. The Front end is in liquid He and of the thermocouple type. Most of the units have a large valve content of the ECC82 size.

All cable passing through the 14g sheet steel building shield have 80 to 120 db RFI filters even the power cable. The building is bonded every four feet against RFI.

You will find that you can get an electric shock from nylon rigging seven miles out from the radar station such is the power.

Thank you for bringing your statement to the public and that many items are covered up, it would seem that the designers took into account EMP in the design of the radar system and my part was commissioning the 3000 kW cooling system.

P.S. Do you think I have time to scrap my T151 III which is very limited and purchase and use a T159 before EMP!

M.G. Wadlow  
Project Engineer

Dear Sir,

Congratulations on a most interesting article ("EMP"; ETI August 1980). The text was crisp and informative.

In view of the potential devastating effect of EMP, I feel that more people, both the public and industrialists should be made aware of this aspect of, perhaps, an inevitable nuclear war.

For my part, I have been largely unaware of EMP but feel that I may be able to at least inform engineers and managers in telecommunications.

Yours sincerely,  
S.F. Gately  
Senior Electronics Engineer  
Plessey Telecommunications

Dear Sir,

Thanks to ETI for an informative article on EMP.

I have drawn this article to the attention of Mr Jim Pawsey, the Member of Parliament for Rugby, who is also the secretary of the Civil Defence Committee in the House of Commons.

He informs me that he has tabled a question in the House on this matter after reading your feature.

As you may know, a major statement on Civil Defence by the Home Secretary has been promised before the House rises on August 8th.

Incidentally, a range of devices which offer protection from EMP are being marketed by Suhner. These incorporate a Cerberus gas discharge tube in a coaxial (50R) line.

Yours faithfully,  
M.R. Keightley, B.Sc., G8BLK  
Bilton, Rugby,  
Warwickshire

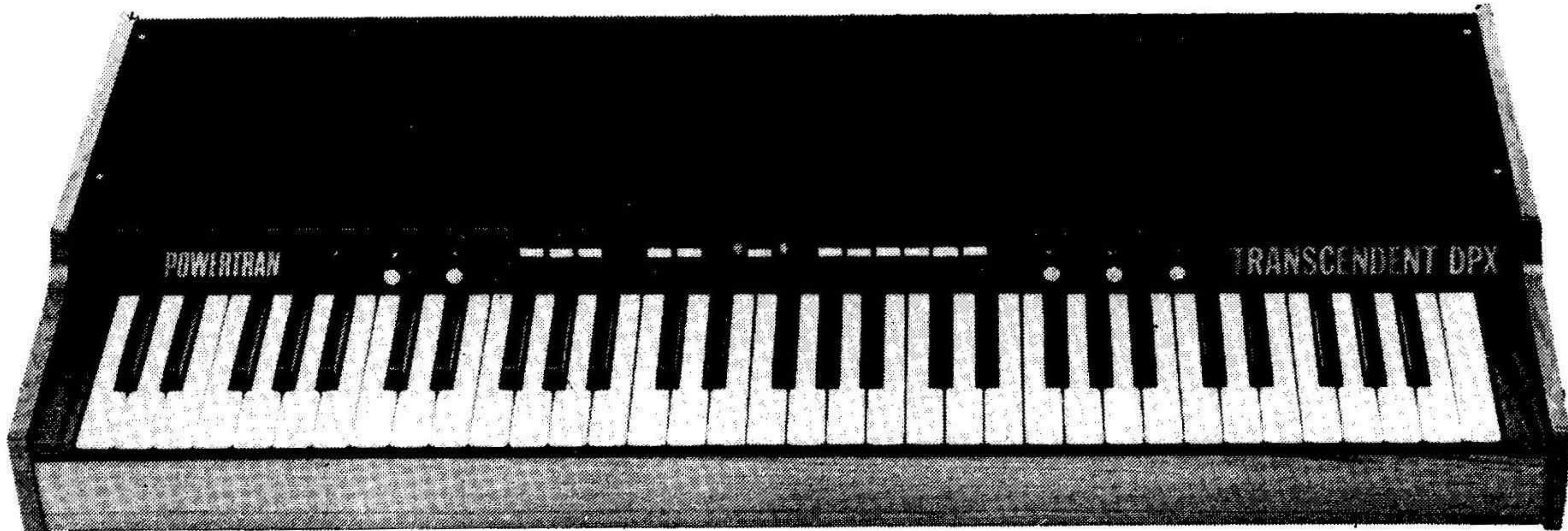


# TRANSCENDENT DPX

**DIGITALLY CONTROLLED, TOUCH SENSITIVE, POLYPHONIC, MULTI-VOICE SYNTHESIZER**

**Another superb design by synthesizer expert Tim Orr — published in Electronics Today International**

The Transcendent DPX is a really versatile new 5 octave keyboard instrument. There are two audio outputs which can be used simultaneously. On the first there is a beautiful harpsichord or reed sound — fully polyphonic, i.e. you can play chords with as many notes as you like. On the second output there is a wide range of different voices, still fully polyphonic. It can be a straightforward piano or a honky tonk piano or even a mixture of the two! Alternatively you can play strings over the whole range of the keyboard or brass over the whole range of the keyboard or should you prefer — strings on the top of the keyboard and brass at the lower end (the keyboard is electronically split after the first two octaves) or vice versa or even a combination of strings and brass sounds simultaneously. And on all voices you can switch in circuitry to make the keyboard touch sensitive! The harder you press down a key the louder it sounds — just like an acoustic piano. The digitally controlled multiplexed system makes practical touch sensitivity with the complex dynamics law necessary for a high degree of realism. There is a master volume and tone control, a separate control for the brass sounds and also a vibrato circuit with variable depth control together with a variable delay control so that the vibrato comes in only after waiting a short time after the note is struck for even more realistic strong sounds.



Cabinet size 36.3" x 15.0" x 5.0" (rear) 3.3" (front)

**COMPLETE KIT ONLY £299 +VAT**

To add interest to the sounds and make them more natural there is a chorus / ensemble unit which is a complex phasing system using CCD (charge coupled device) analogue delay lines. The overall effect of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with either strong or mild effects. As the system is based on digital circuitry digital data can be easily taken to and from a computer (for storing and playing back accompaniments with or without pitch or key change, computer composing, etc., etc.)

Although the DPX is an advanced design using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry and the panel circuitry from the main circuitry in the cabinet. The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc., even a 13A plug!

## POWERTRAN

**MANY MORE KITS ON PAGE 116. MORE KITS AND ORDERING INFORMATION ON INSIDE FRONT COVER**

## TRANSCENDENT 2000

**SINGLE BOARD SYNTHESIZER**

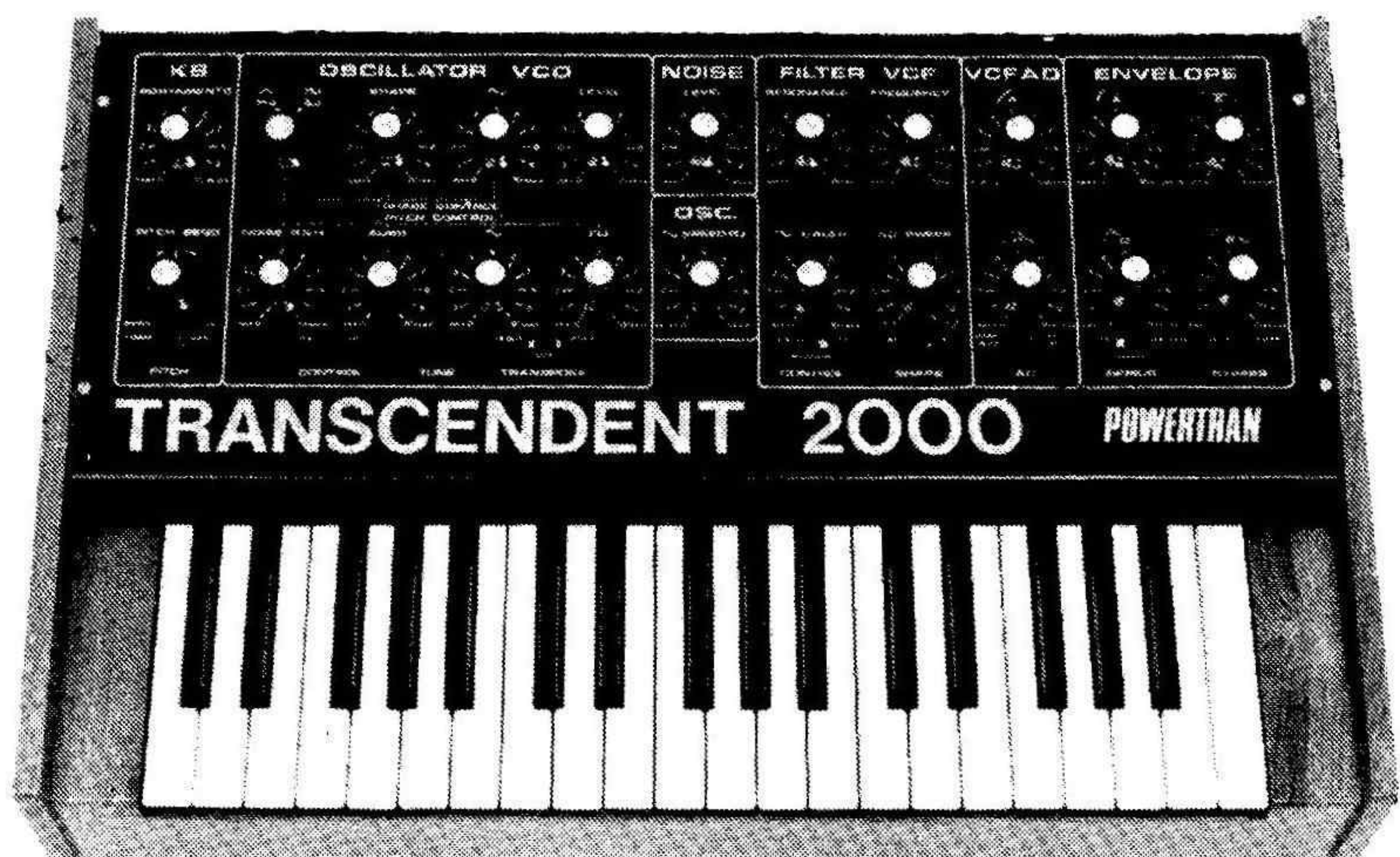
**LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.**

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

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

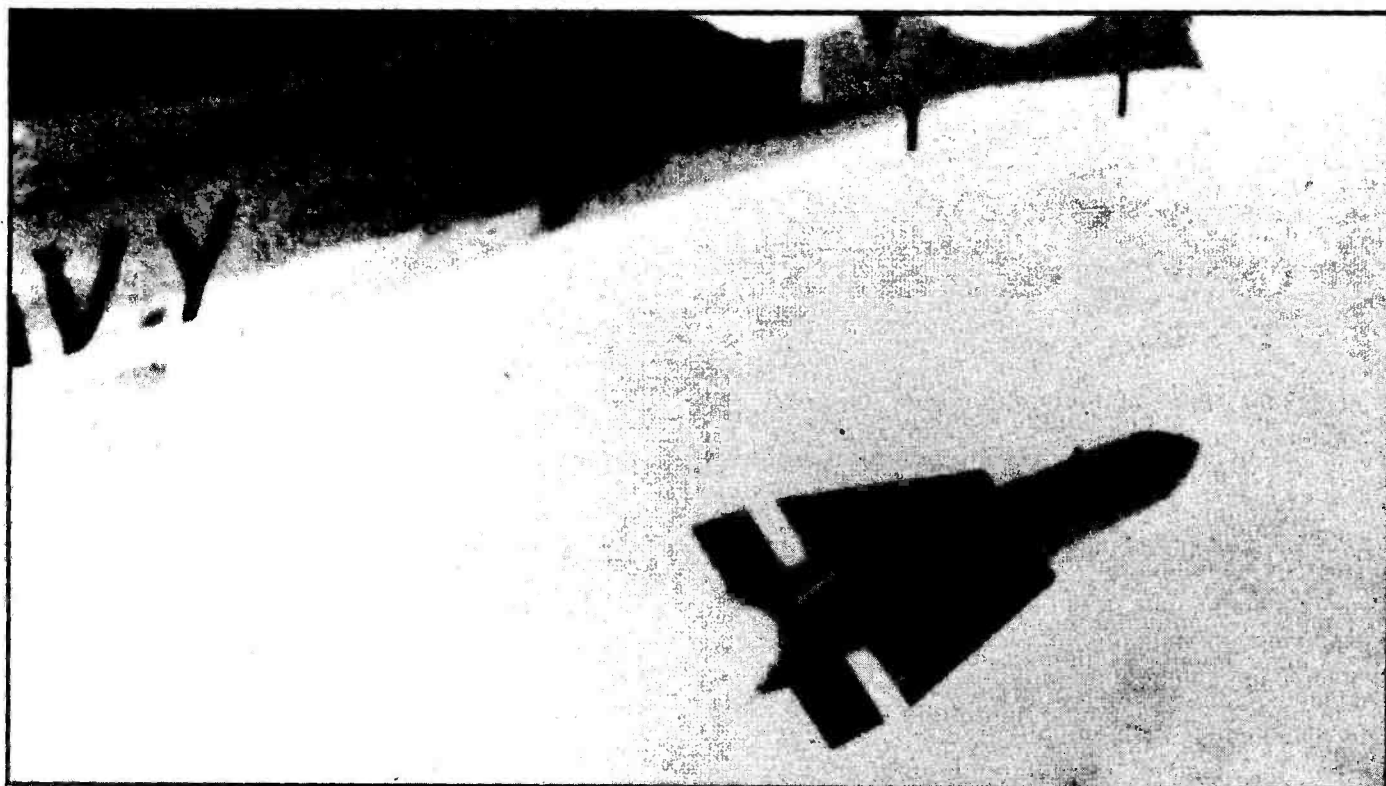
**COMPLETE KIT  
ONLY  
£168.50 +VAT!**

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



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





An F-14 wing-tip camera catches a glimpse of the first airborne launch of the new upgraded version of the Phoenix air-to-air missile.

## On Target

How does Wasp find its targets? Two sensors are under evaluation — infra-red and millimetre radar. Millimetre radar has three main advantages over infra-red. Its high resolution enables tanks to be distinguished from trees and buildings, it uses very small antennae and it is relatively unaffected by adverse weather conditions.

If a group of the missiles are fired at a number of targets, they will each attack a different target. If they can find only one target, it suffers a severe case of overkill. Wasp has a range of six miles when fired from an aircraft with a ground speed of 500 MPH. Two rival versions are under development by Boeing and Hughes.

## AIM To Kill

Earlier this year the US Navy's new AIM-54C Phoenix air-to-air missile was successfully launched from an airborne F-14. It intercepted a drone aircraft target, passing well within the 'kill' range, if the missile had been armed. The Hughes AIM-54C, an improved version of the AIM-54A, carries a new digital electronics unit which is more flexible and reliable than the analogue unit it replaces. It also has a more effective target detector.

This first successful interception was achieved over a greater range than was possible with its predecessors. The F-14 launching aircraft travelled subsonically head-on towards the supersonic QF-4 fighter drone. In this launch, the Phoenix was guided on to the target by radar returns from the F-14's weapon control system. Closer to the target, it can switch to its own active radar system.

The upgraded Phoenix will become the US Navy's primary long-range air defence weapon in the 1990s.

---

## SHORTS

---

A spacesuit was destroyed by fire at the Johnson Space Centre in April. Fortunately there was no-one in the suit at the time, although a technician was badly burned. To avoid a recurrence, a review board has recommended several modifications to the high pressure oxygen system and seals.

---

GEOS-D, the latest in a series of Geostationary Operational Environmental Satellites, is due to join its two companions in Earth orbit as we go to press. The 12 feet high by seven feet in diameter spacecraft will be launched from Cape Canaveral on September 9th by a three stage Delta 3914 booster. Next month I hope to bring you an in-depth report on this latest weather satellite and the GEOS system.

---

In July's Digest we brought you the sad news that the Viking Lander 2's batteries had run out of juice. The latest news on the Viking population of Mars is that Viking Orbiter 1 has now reached the end of its supply of attitude control gas. Viking Lander 1 is the only member of the foursome that is still functional.

---

We now know that the first Space Shuttle launch has been postponed from November this year until at least March next year. Next month Astrologue will look into the political, financial and technical problems that have beset the Space Shuttle from the start.



## Something Bugging You?

With the increase in telephone tapping and boardroom bugging, Audiotel International have developed a simple to use, yet sophisticated successor to their Scanlock radio surveillance receiver. It is called the Scanlock Mark V8 and is a fast, easy means of detecting and locating an eavesdropping transmitter as well as being capable of routine 'sweep' searches of high level meetings rooms. Carried in a vehicle it can also locate any bleeper bug used for 'trailing'.

The Scanlock is not limited to the conventional radio receiver's range of 88-108 MHz. It covers the wider frequency spectrum of 10-1800 MHz and its automatic 'sweep' mode scans this range four times a minute. Finally all that is necessary is to press the 'Locate' button and use the hand-held wand to guide you to where the bug is located. The kit is the size of a small briefcase, weighing 6.3 Kg, complete with spare battery pack. There is also provision for mains usage. For further information contact Audiotel International Ltd at Saddlers Court, Yately, Surrey, GU17 7RX.

## Video Pirates

Victor Company of Japan (JVC), who developed the popular VHS system, are concerned with the increasing number of unlicensed "pirate" VHS blank cassettes that are being imported into the UK. In response, they have issued the following statement to their dealers.

1. JVC hold an exclusive patent of the design, construction and appearance of VHS cassettes in the UK.
2. JVC will protect their rights.
3. JVC is concerned about the importation of unlicensed VHS cassettes into the UK because of their inferior quality as well as their illegality.

## Show Time

Virtually every major electronic manufacturer I spoke to at this year's American Summer Consumer Electronics Show claims to be perfecting speech capable products, whilst only a handful are available.

The leader in voice technology manufacturing is Texas Instruments. Two years ago the firm unveiled the industry's first speech capable product, Speak 'n' Spell, and the consumer electronics world hasn't stopped talking about it since. This year, TI introduced two other talking 'electronic learning aids' and is also predicting a bright future for its talking translator. The \$300 unit offers approximately 500 spoken and displayed words.

If you don't know what type of video tape system you should be using, brace yourself because more befuddlement is brewing. Early next year in the States two manufacturers, perhaps even three, mutually incompatible video disc players will be each shouting the virtues of their products whilst cleverly knocking the others.

Pictures that I have seen from the newest Pioneer, Magnavox, JVC and RCA players are all amazingly detailed and noise-free. The Magnavox and Pioneer machines play compatible twelve inch discs by bouncing a focused laser beam from a spiral track of microscopic pits etched onto the disc's reflective surface. A clear plastic coating makes the disc immune to dust and smudges from handling.

RCA's Selecta Vision video disc player has been completely over-

hauled since it was introduced and field tested several years ago. The basic playback principle is unchanged; a stylus electrode replaced every two or three years, senses a TV signal as electrical capacitance variations in disc grooves spinning at 450 rpm. Playing time was boosted to one hour per twelve inch disc side by doubling disc grooves to just under ten thousand per inch. Home tests show that dust and other groove contamination from handling messed up pictures. So RCA's improved Selecta Vision has a sealed disc caddy.

JVC have illustrated a system that combines the low cost aspects of selectavision with the operating options of free flowing slow motion etc. of optical machines. Not only that JVC included options for a super hi-fi audio disc. It calls the whole package its VHD/AHD System (Video/Audio High Density).

Signals are stored as capacitance variations from minute pits in the conductive plastic. The stylus rests over central spiral tracks distributing pressure and minimising wear. (Stylus life is 2,000 hours, roughly 10 times RCA's).

Sony's newest addition to its Beta family of accessories is the Beta stack model AG300. The unit automatically ejects and loads up to 4 Beta Max video cassettes with record, playback and re-wind capabilities; this accessory can be used with the current Beta Max models SL5400 and SL5600 or with the programmable SL5600. When used with the regular Beta Max models it offers a maximum of 20 hours recording time. With a programmable unit the change allows a user to record separate programmes on separate cassettes: up to 4 events on different

channels and different days within a two week period.

A new company, Activision, has released four new cartridges to work with the Atari video computer system; they are dragster, chequers, boxing and fishing derby. The general opinion is that these cartridges have a far higher resolution and superior game content than any of the Atari manufactured units; is this why Atari is suing them for \$20 million? Anyway these cartridges will certainly be available in the UK via at least one well-known mail order house.

Good news for all you home computer owners. At last you can connect with the real world. Yes, the BSR System X10 is going to be available in January 1981. In case you are unfamiliar with the system here is a brief run-down. Just plug in the command console and various modules into the household supply outlets and you're ready to take control. No special wiring is needed. From one convenient location you can control a bedroom light, hall light, television, radio, stereo, porch light, back door light as well as lights in the dining room. The command console comes in two versions, either with or without a cordless controller. The lamp module receives signals from a command console to turn on, off, dim or brighten any incandescent lamp up to 300 W. The wall switch receives signals from the command console to turn on or off or brighten any light or lamp normally operated by a wall switch up to 500 W and the appliance module receives signals from the command console to turn an appliance on or off.

Gerald Chevin

## Fly The Flag

The familiar terminals in British Airways reservations offices are getting a bit long in the tooth. They're ten years old. A British company, Videcom, has won the £500,000 contract for terminal replacement, against competition from three other contenders — one British and two American. Videcom supplied a substantial number of the existing BA terminals.

The 280 new keyboard VDUs

are to be installed at 69 sites throughout 15 European countries. Installation started in July in Berlin and should be completed by the end of 1981.

The type 101 VDUs to be supplied were designed specifically for airline operations. They use Hall-effect, contactless, solid state keys for maximum reliability and life expectancy. The VDU is part of an integrated terminal system including cluster control units and terminal drive units, which can support up to 128 terminals.

## Eagle Sounds

Eagle International have just introduced their new consumer catalogue for 1980/81. Although it's only 20 pages long it covers a lot of ground — hi-fi separates and rack systems, portable radios, in-car entertainment systems, etc.

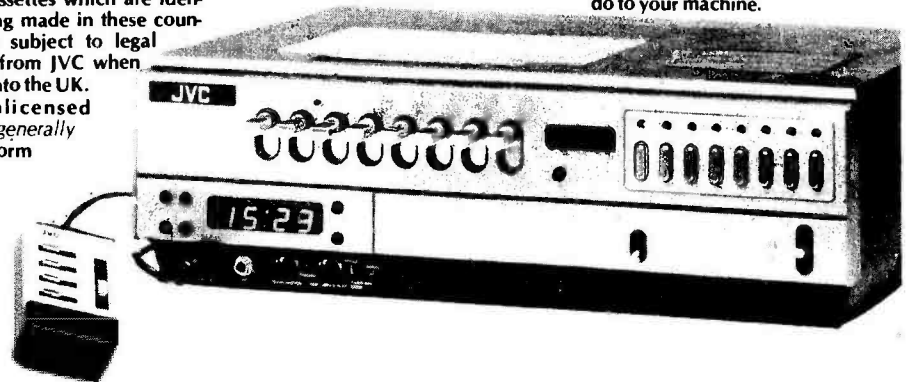
You can get hold of a free copy of this full colour guide to Eagle's wares by writing to Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU.

4. These illegal cassettes originate from Taiwan, Singapore and Hong Kong — there are no VHS cassette making licensees in these countries, thus VHS cassettes which are identified as being made in these countries will be subject to legal proceedings from JVC when imported into the UK.
5. These unlicensed products generally do not conform to VHS

standard dimension, construction, mechanical operation and electrical performance. This may affect the overall performance and operation

of VHS recorders for which JVC are otherwise responsible.

So, you've been warned. Beware of cheap tapes and what they might do to your machine.





# WATFORD ELECTRONICS

33/35 CARDIFF ROAD, WATFORD, HERTS, ENGLAND  
MAIL ORDER, CALLERS WELCOME  
Tel. Watford (0923) 40588/9

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P&P ADD 40p TO ALL ORDERS UNDER £10. OVERSEAS ORDERS POSTAGE AT COST. AIR/SURFACE. ACCESS ORDERS WELCOME.

**VAT** Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 15% to all prices.

We stock thousands more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday. Ample Free Car Parking space available.

**ELECTRONIC CAPACITORS:** (Values are in  $\mu$ F) 500V: 10 50p; 47 78p; 250V: 100 65p; 63V: 0.47, 1.0, 1.5, 2.2, 3.3, 4.7, 6.8, 8p; 10, 15, 22, 11p; 32, 47, 50, 12p; 63, 100, 27p; 50V: 50, 100, 220, 25p; 470, 32p; 1000, 60p; 40V: 2, 3.3, 8p; 100, 12p; 2200, 3300, 85p; 4700, 98p; 35V: 10, 33, 7p; 330, 470, 32p; 25V: 10, 22, 47, 100 8p; 160, 220, 250, 15p; 470 25p; 640, 1000, 35p; 1500, 40p; 2200, 45p; 3300, 77p; 4700 85p; 18V: 10, 47, 7p; 100, 125, 8p; 220, 330, 14p; 470, 20p; 1000, 1500, 30p; 2200 36p; 10V: 100, 7p; 640, 12p; 1000, 16p.  
**TAG-END TYPE:** 450V: 100 $\mu$ F 180p; 70V: 4700, 165p; 64V: 3300 150p; 2500 110p; 50V: 4700, 150p; 3300 135p; 2200 99p; 40V: 4700 130p; 4000 92p; 3300 98p; 2500 90p; 30V: 4700 110p; 25V: 15000 195p; 6400 120p; 4700 100p; 3300 85p; 2200 60p.

**POLYESTER CAPACITORS:** Axial lead type.  
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n 9p; 18n 10p; 22n, 33n 11p; 47n, 68n 14p; 100n 17p;  
150V: 22n 24p; 330n, 470n 41p; 680n 48p; 1 $\mu$ F 64p; 2 $\mu$ F 82p.  
180V: 10nF, 12n, 39n, 100n, 150n, 220n 11p; 330n, 470n 19p; 680n, 1 $\mu$ F 22p; 2.2 $\mu$ F 32p; 4.7 $\mu$ F 36p.  
1000V: 10n, 15n 20p; 22n 22p; 47n 26p; 100n 38p; 470n 80p; 1 $\mu$ F 175p.

**POLYESTER RADIAL LEAD CAPACITORS: 250V:**  
10n, 15n, 22n, 27n 5p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 330n 13p; 470n 17p; 680n 19p; 1 $\mu$  22p; 2 $\mu$  30p; 5 $\mu$  30p; 10 $\mu$  34p.

**TANTALUM BEAD CAPACITORS:**  
35V: 0.1 $\mu$ F, 0.22, 0.33, 0.47, 0.68, 1.0 $\mu$ , 2.2 $\mu$ F, 3.3, 4.7, 25V: 10, 20V: 6 $\mu$ 8, 16V: 2 $\mu$ 2, 4 $\mu$ 7, 10 15p.  
18V: 22 $\mu$  28p, 47, 100 50p, 220 80p;  
10V: 15 $\mu$ , 22 $\mu$ , 33, 24p; 100 $\mu$  35p;  
6V: 47 $\mu$ , 68, 100 28p; 3V: 100 20p.

**MYLAR FILM CAPACITORS:**  
100V: 0.001, 0.002, 0.005, 0.01 $\mu$ F 6p  
0.015, 0.02, 0.04, 0.05, 0.056 $\mu$ F 7p  
0.1 $\mu$ F, 9p, 50V: 0.47 $\mu$ F 12p

**CERAMIC CAPACITORS 50V:**  
Range: 0.5pF to 10,000pF 4p  
0.015 $\mu$ F, 0.022 $\mu$ F, 0.033 $\mu$ F 5p  
0.047 $\mu$ F 5p; 0.1 $\mu$ F, 0.2 $\mu$ F 7p

**SILVER MICA (Values in pF):** 3.3, 4.7, 6.8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220 11p each  
250, 270, 300, 330, 360, 390, 470, 600, 800, 820 16p each  
1000, 1200, 1800, 2000 26p each

**POLYSTYRENE CAPACITORS:**  
10pF to 1nF 8p; 1.5nF to 47nF 10p

**MINIATURE TYPE TRIMMERS:**  
2.5-8pF: 3-10pF: 10-40pF 22p  
5-25pF: 5-45pF: 60pF: 88pF 30p

**COMPRESSION TRIMMERS:**  
3-40pF: 10-80pF: 25-190pF 30p  
100-500pF 45p 400-1250pF 58p

**GAS & SMOKE DETECTORS:**  
TGS 812 & 813 415p; Socket 30p

**JACKSONS VARIABLE CAPACITORS:**  
DILICON 100/300pF 205p motion Drive 450p  
500pF 250p 0 0 208/176 350p  
6:1 Ball Drive with slow motion drive 410p  
4511/DAF 145p C804-5pF: 10, 15:  
Dial Drive 4103 25: 50pF 250p  
1.6/36:1 775p 100, 150pF 335p  
Drum 54mm 55p L' 3x310pF 725p  
0.1-365pF 325p 00-3x25pF 550p

**RF CHOKES:**  
1 $\mu$ H, 4.7, 10, 22, 33, 47, 100, 200, 470  
750, 1mH, 2.5, 5, 10 30p each  
43mH, 100 60p each

**VEROBOARD:** 0.1 0.15 0.1 (copper clad) (plain)  
2 1/2 x 3 1/2" 58p 51p 42p  
2 1/2 x 5" 68p 62p  
3 1/2 x 3 1/2" 58p  
3 1/2 x 5" 77p 86p 65p  
2 1/2 x 17" 204p  
3 1/2 x 17" 284p 229p  
4 1/2 x 17" 345p  
Pkt. of 38 pins 22p. VQ Board 120p  
Pin insertion tool 140p. DIP Board 290p  
Spot face cutter 105p. Veroblock 324p

**PER WIRING:** PEN + Spool 350 Spare Spool 85 Combs 7  
**DALO ETCH RESIST PEN:** + Spare tip 90

**FERRIC CHLORIDE:** 1 lb bag Anhydrous 225p + 40p P&P  
**ULTRASONIC TRANSDUCER:** 40KHz 350p pr

**COPPER CLAD BOARDS:**  
Fibre Single-sided Double-sided SRBP  
Glass sided 9.5" x 8.5"  
6" x 6" 90p 110p 95p  
6" x 12" 150p 195p

**DIL PLUGS (Headers):** 14 pin 35p; 16 pin 40p; 24 pin 85p; 40 pin 295p  
**Ribbon Cable:** 10 way & 20 way available  
Soldercon pins: 100 60p; 500 275p.

**DIL SOCKETS (TEXAS) Low Wire Prof. Wrap:**  
8pin 10p 25p  
14pin 12p 35p  
16pin 13p 46p  
18pin 16p 52p  
20pin 22p 65p  
22pin 25p 70p  
24pin 30p 78p  
28pin 35p 85p  
36pin 40p 105p  
40pin 40p 109p

**EDGE CONNECTORS:** (Double type)  
2x10 way 85p  
2x15 way 99p  
2x18 way 115p 120p  
2x22 way 130p 135p  
2x25 way 149p 160p  
2x30 way 170p  
2x36 way 194p  
2x40 way 210p  
2x43 way 232p

**DIAC:** ST2 20

**75 SERIES:**  
75108 350  
75150 140  
75150 140  
75154 150  
75450 80  
75451 75  
75454 224  
75491 88  
75492 94

## TRANSISTORS

AC125 35	BC182L 10	BF179 38	MPF103 36	TIS45 45	2N2221A 23	2N4921 40
AC126 25	BC183L 10	BF180 38	MPF104 36	TIS46 45	2N2222A 20	2N4922 55
AC127 22	BC184L 10	BF181 25	MPF105 36	TIS59 47	2N2297 45	2N5102 125
AC128 20	BC187 25	BF182 25	MPF106 40	TIS74 47	2N2303 45	2N5135 21
AC141 27	BC212 9	BF194 11	MPSA05 22	TIS88 50	2N2368 17	2N5136 21
AC142 28	BC212L 9	BF195 12	MPSA06 24	TIS90 30	2N2369A 21	2N5138 28
AC143 28	BC213 9	BF196 12	MPSA12 29	TIS91 32	2N2476 120	2N5172 25
AC176 25	BC213L 9	BF197 12	MPSA55 29	UC734 65	2N2483 28	2N5179 60
AC187 26	BC214 9	BF198 16	MPSA56 29	ZTX107 11	2N2484 30	2N5180 38
AC188 26	BC214L 9	BF199 21	MPSU02 58	ZTX108 11	2N2492 50	2N5191 75
AC189 26	BC237 14	BF200 40	MPSU05 50	ZTX109 11	2N2497 50	2N5305 20
AC197 60	BC238 15	BF224A 28	MPSU06 50	ZTX300 13	2N2646 48	2N5308 20
AC198 60	BC307B 14	BF245 30	MPSU52 65	ZTX301 16	2N2784 55	2N5457 35
AC199 60	BC308 15	BF256A 50	MPSU55 55	ZTX302 20	2N2904 26	2N5458 35
AC200 53	BC308L 16	BF256B 50	MPSU56 60	ZTX303 25	2N2905A 26	2N5459 35
AC210 60	BC327 12	BF257 35	MPU131 45	ZTX304 17	2N2906 22	2N5485 40
AC222 60	BC328 15	BF258 35	OC26 170	ZTX314 24	2N2907 22	2N5777 45
AC228 60	BC337 12	BF259 35	OC28 120	ZTX326 45	2N2907A 22	2N5879 140
AC239 39	BC338 12	BF274 42	OC35 125	ZTX341 28	2N2926G 10	2N6027 44
AD149 75	BC441 30	BF275 42	OC36 130	ZTX500 15	2N3011 24	2N6388 126
AD161 42	BC461 30	BF280 40	OC41 125	ZTX501 15	2N3020 33	2SD234 50
AD162 42	BC477 35	BF281 40	OC42 48	ZTX502 17	2N3053 24	3N128 112
AF114 75	BC516 35	BF282 40	OC43 55	ZTX503 15	2N3054 55	3N140 112
AF115 60	BC517 35	BF283 40	OC44 55	ZTX504 25	2N3055 48	
AF116 75	BC547 10	BF284 40	OC45 40	ZTX531 25	2N3108 32	<b>SPECIAL OFFER</b>
AF117 95	BC548 10	BF285 40	OC70 40	ZTX550 25	2N3252 36	2114-450n 250p
AF118 95	BC549C 15	BF286 40	OC71 35	40311 60	2N3302 26	2114-300n 325p
AF119 95	BC556 15	BF287 40	OC72 40	40313 125	2N3441 140	2708 445p
AF139 40	BC557 10	BF288 40	OC73 40	40315 68	2N3442 140	2716-5V 750p
AF178 75	BC558 15	BF289 40	OC74 50	40316 85	2N3663 17	IM6402 350p
AF186 50	BC559 15	BF290 40	OC75 45	40317 85	2N3702 10	MM1702AQ 295p
AF239 42	BCY30 80	BF291 40	OC76 45	40320 70	2N3703 10	
ASZ21 60	BCY34 75	BF292 40	OC77 76	40324 91	2N3704 10	
BC107 12	BCY35 50	BF293 40	OC81 35	40326 52	2N3705 10	
BC108 12	BCY39 78	BF294 40	OC83 48	40327 62	2N3706 12	
BC109 12	BCY40 48	BF295 40	OC84 45	40347 80	2N3707 12	
BC108B 12	BCY42 14	BF296 40	OC140 110	40348 105	2N3708 11	
BC108C 12	BCY45 50	BF297 40	OC170 85	40368 43	2N3709 11	
BC109 12	BCY70 18	BF298 40	OC171 45	40361 50	2N3710 10	
BC109B 12	BCY71 14	BF299 40	OC200 48	40362 50	2N3711 12	
BC109C 12	BCY72 20	BF300 40	TIP29 38	40467A 95	2N3713 140	
BC114 20	BCY78 19	BF301 40	TIP29A 36	40468 60	2N3717 179	
BC115 20	BD112 95	BF302 40	TIP29B 56	40468A 70	2N3772 195	
BC117 20	BD124 115	BF303 40	TIP29C 60	40408 95	2N3773 288	
BC118 18	BD131 42	BF304 40	TIP30 40	40411 280	2N3819 20	
BC119 28	BD132 42	BF305 40	TIP30A 48	40594 98	2N3820 45	
BC123 10	BD133 50	BF306 40	TIP30B 50	40595 98	2N3822 130	
BC238 10	BD135 40	BF307 40	TIP30C 58	40603 67	2N3823 70	
BC239 10	BD136 40	BF308 40	TIP31A 45	40636 130	2N3824 70	
BC240 28	BD137 40	BF309 40	TIP31B 53	40673 95	2N3866 90	
BC142 28	BD138 40	BF310 40	TIP31C 55	2N697 25	2N3879 160	
BC143 28	BD139 40	BF311 40	TIP32A 48	2N698 40	2N3903 18	
BC147 9	BD140 40	BF312 40	TIP32B 48	2N699 30	2N3904 18	
BC147B 10	BD141 40	BF313 40	TIP32C 60	2N706A 19	2N3905 18	
BC148 8	BD144 198	BF314 40	TIP32A 65	2N708 33	2N3906 17	
BC148B 10	BD145 175	BF315 40	TIP32B 65	2N918 33	2N4037 58	
BC149 9	BD158 60	BF316 40	TIP32C 78	2N1131 26	2N4041 40	
BC149C 10	BD205 110	BF317 40	TIP33A 74	2N1132 28	2N4058 15	
BC153 20	BD206 110	BF318 40	TIP34A 88	2N1302 35	2N4061 17	
BC154 13	BD222 65	BF319 40	TIP35A 180	2N1303 50	2N4062 17	
BC157 10	BD245 50	BF320 40	TIP35C 185	2N1304 50	2N4064 115	
BC158 10	BD378 70	BF321 40	TIP36A 170	2N1305 35	2N4220 60	
BC159 11	BD434 32	BF322 40	TIP36C 199	2N1306 40	2N4234 38	
BC160 28	BD517 70	BF323 40	TIP41A 55	2N1307 45	2N4236 45	
BC167A 11	BD695A 85	BF324 40	TIP41B 60	2N1308 50	2N4264 24	
BC168C 10	BD696A 85	BF325 40	TIP42A 82	2N1613 23	2N4286 18	
BC169C 10	BDY56 170	BF326 40	TIP42B 82	2N1670 150	2N4289 18	
BC170 15	BDY60 140	BF327 40	TIP120 90	2N1671B 120	2N4314 61	
BC172 11	BF115 26	BF328 40	TIP121 99	2N2160 350	2N4400 20	
BC177 15	BF154 29	BF329 40	TIP142 125	2N2217 43	2N4427 80	
BC178 14	BF158 30	BF330 40	TIP147 125	2N2218A 34	2N4859 85	
BC179 15	BF167 28	BF331 40	TIP295 60	2N2219A 22	2N4871 55	
BC182 10	BF173 24	BF332 40	TIP305 60	TIS43 30	2N4898 135	
BC183 10	BF177 25	BF333 40	TIS44 30	TIS43 30	2N4901 160	
BC184 10	BF178 26	BF334 40	TIS44 30	TIS43 30		
CA3019 70	MC1304P 260	BX or BX11 250	7437 35	74153 75	74L 78	LS76 45
CA3020 186	MC1310P 150	TBA651 190	7438 30	74154 140	74L00 78	LS78 45
CA3023 191	MC1312PQ 195	TBA800 90	7440 20	74155 75	L30 80	LS83 105
CA3028A 80	MC1458 45	TBA810 95	7441 74	74156 80	L47 75	LS85 105
CA3035 235	MC1494 595	TBA820 70	7442 71	74157 75	L75 395	LS86 45
CA3036 115	MC1495 350	TBA920Q 260	7443 120	74159 185	L75 220	LS90 50
CA3043 275	MC1496L 92	TBA990Q 270	7444 116	74160 99	L85 360	LS91 125
CA3045 365	MC1596 225	TCA270Q 220	7445 132	74162 99	L121 195	LS92 75
CA3046 71	MC1710 79	TCA965 120	7446 132	74162 99	L123 340	LS93 75
CA3048 214	MC3302 150	TDA1004 290	7447 99	74163 99		LS95 115
CA3059 175	MC3340P 120	TDA1008 310	7448 89	74164 120		LS96 180
CA3075 213	MC3360P 120	TDA1022 575	7450 20	74165 120		LS107 45
CA3080E 65	MC3401 52	TDA1024 105	7451 20	74166 155	74S00 60	LS109 75
CA3081 190	MC3403 135	TDA				



# MITRAD

The premier mail order house  
specialising in quality products and  
superior after-sales care.

## SEIKO QUARTZ LCD MEMORY-BANK CALENDAR WATCH

**SPECIAL PRICE ONLY £49.95**  
plus 85p p&p. Usually £89 or over.

- Displays hour, minute, second, month, day of the week and date in 12 hour indication – or 24 hour at the touch of a button.
- Button touch also displays month and year and dates for a designated month with Sunday dates flashing.
- Stores dates in memory up to 11 ahead, flashes 'MEMO' on designated dates.
- Illuminated time and calendar display.
- Display flashes when battery nears life end.
- Stainless steel case and wrist strap (adjustable).

In presentation case with instructions.

### A LIFETIME WATCH AT A BARGAIN-OF-A- LIFETIME PRICE

Full refund if not  
completely satisfied.

Mitrad, 68-70 High Street,  
Kettering, Northants.  
Tel: 0536 522024

This is a representative selection from the collection of guaranteed leading make and own brand watches offered through Mitrad's 48 hour distribution system and backed by Mitrad's own service organisation. For complete product range, ring or write for catalogue. Trade price list available for bulk orders.



To Mitrad, 68-70 High Street, Kettering, Northants.  
Please send me:

- |   |   |
|---|---|
| <input type="checkbox"/> Seiko Quartz watch(es) at £50.80 inc p&p | <input type="checkbox"/> LM62 watch(es) at £14.80 inc p&p |
| <input type="checkbox"/> LM75 watch(es) at £6.80 inc p&p          | <input type="checkbox"/> LM73 watch(es) at £18.80 inc p&p |
| <input type="checkbox"/> LM105 watch(es) at £7.80 inc p&p         | <input type="checkbox"/> LM39 watch(es) at £11.10 inc p&p |
| <input type="checkbox"/> LM40 watch(es) at £10.80 inc p&p         | <input type="checkbox"/> Pen watch(es) at £12.00 inc p&p  |

Total value of my order £ \_\_\_\_\_



I enclose cheque/PO or debit my Access/Barclaycard No. \_\_\_\_\_

Name \_\_\_\_\_ Signature \_\_\_\_\_

Address \_\_\_\_\_ (block letters please)

☎ Credit Card holders may telephone (0536) 522024 24 hours a day stating Card Number for immediate attention. All orders despatched within 48 hours. Delivery subject to availability. Full refund if not completely satisfied.  
Mitrad. Registered in England No. 1500613. ETI





Seiko Quartz

LM75

LM62

LM39

Panter Quartz Pen Watch

**MITRAD LM105** Five function LCD ladies watch. Continuous display of hours and minutes with pulsating seconds. Selectable month, date, seconds. Auto calendar. Fully adjustable closely woven stainless steel strap. Case thickness 7mm. In silver only. **£6.95 + 85p p&p.**

**MITRAD LM73** Gentleman's memory calendar alarm chrono. Programmed to year 2009. Continuous display of hours, minutes and seconds with optional display modes of hours, minutes and date, or calendar and month with flashing Sunday flags. Selectable month. Alarm mode indicated by flashing bill; settable anywhere in 24 hour period; activated for full 60 seconds; provided with 10 minute snooze facility. Chronograph has 12 hour capacity with split and lap mode facilities: first 30 minutes run as minutes, seconds and 1/100 seconds, thereafter hours, minutes and

seconds. Back light. Adjustable stainless steel strap. Case thickness 11mm. **£17.95 + 85p p&p.**

**MITRAD LM40** Four button gentleman's alarm. Continuous display of hours, minutes and seconds plus selectable month, date, day. PM flag. Alarm, settable anywhere in 24 hour period, is activated for full 60 seconds. Back light. Closely woven adjustable stainless steel strap. Case thickness 10mm. **£9.95 + 85p p&p.**

**MITRAD LM75** Five function LCD gentleman's watch with quality chrono look. Continuous display of hours and minutes plus selectable month, date, seconds. Auto calendar. Back light. Stainless steel strap. Case thickness 8mm. **£5.95 + 85p p&p.**

**MITRAD LM62** Gentleman's dual time alarm chrono. Incorporates leading made module. Continuous display of hours, minutes and

seconds with a number coded day, AM/PM, alarm setting and the secondary time indication. Chronograph ('running horse') to 1/10 sec. Freeze, split and lap modes. Alarm, settable anywhere in 24 hour period, is activated for full 60 seconds. Dual timing facility. Fully adjustable closely woven stainless steel strap. Case thickness 10mm. **£13.95 + 85p p&p.**

**MITRAD LM39** Ladies auto LCD dress watch. Continuous display of hours, minutes and (pulsating) seconds. Month and date with auto calendar. Back light. Integral watch and strap with sugar frosted finish in gold or silver. Spring clip clasp for comfortable fit. Case thickness 8mm. **£10.25 + 85p p&p.**

**PANTER QUARTZ PEN WATCH** Five function LCD pen watch showing hours, minutes, seconds, month and date. Computerised four year date memory. Ball point pen. Stainless steel case. **£12.00 inc. p&p.**





## C300/ES200

high performance electronic ignition, to add power, economy, reliability, sustained smooth peak performance, instant all weather starting, to your car.

**Surefire** has sold in its thousands in ready made form from big name accessory firms, but it is now available in quality kit form to fit all vehicles with coil ignition up to 8 cylinders.

**ES200.** A high performance inductive discharge ignition incorporating a power integrated circuit (special selection): electronic variable dwell circuit (maximises spark energy at all speeds): pulse processor (overcomes contact breaker problems). Coil governor (protects coil). Long burn output. Negative earth only. Compatible with all rev. counters.

**C300.** In it's ready built form (C3000) it came top of all systems tested by an independent national authority July '79. A high energy capacitive discharge ignition incorporating a high output short circuit proof inverter, top grade Swedish output capacitor, pulse processor circuit, transient overload protection. Fast rise bidirectional output ideal for fuel injection, sports carburation, oily engines. Compatible with most rev. counters. (Low cost adaptors available for rare cases. Application list enclosed with each kit. Note: Vehicles with Smiths/Jaeger rev. counters code RVI on dial will require adaptor type TCI).

**What's in the kits.** Surefire's own precision anodised aluminium extruded case. P.C. mounted security changeover switch, static timing light. Special selection Motorola semi-conductors. Capacitors, resistors etc. selected after 5 years experience. Glass fibre pcb, solder, complete down to last washer. Fully illustrated comprehensive instructions and full technical back up service.

# SUREFIRE ELECTRONIC IGNITION

Suretron Systems (UK) Ltd. Dept. ET17  
Bayer Buildings, Lower Bristol Road, Bath, BA2 3EF. Tel: Bath (0225) 332317

Name \_\_\_\_\_  
Address \_\_\_\_\_

Phone order with Access Barclaycard Quantity required  
VAT and P & P inc

ES200: Neg	£13.95	£11.95	
C300: Pos	£17.95	£15.95	
C300: Neg	£17.95	£15.95	
Tacho Adapt. TCI		£3.90	

Enclose chq/PO's  
£  
Chq No

## ASCII CODED KEYBOARD KB060 £47.15

Designed for ease and accuracy of use, with 60 keys arranged in stepped rows, auto repeat and 2-key rollover. UC and LC ASCII coding. S.a.e. for details

## THE ZX80 MAGIC BOOK £4.75

15 plus programs including Hammurabi, Animals and Othello. Programming tips. Hardware notes. Memory extension circuit.

## 16K RAM + I/O FOR THE ZX80

MZ160 16K RAM board built and tested	£79.50
MZ161 16K RAM + 24 I/O lines, built and tested	£89.75
MZ162 Bare PCB for MZ161, with circuit & ZX80 conn.	£25.00
CN046 23+23 way I/O connector	£3.00
PZ100 Stabilised power supply, for MZ160/1 + ZX80	£29.30

All prices include UK delivery & 15% VAT

## TIMEDATA Ltd.

57 Swallowdale, Basildon, Essex

## QUALITY REEL TO REEL & CASSETTE TAPE HEADS + MECHANISMS

### POPULAR UNIVERSAL CASSETTE TAPE HEADS

B12-01 Mono Playback	£1.89	C42RPH04 Stereo GLASS FERRITE R/P	£11.80
B12-02 Mono Record/Playback	£4.02	C42RPS18 Stereo TWIN GAP R+P	£25.21
B24-01 Stereo Playback	£3.30	E12-09 Mono/stereo erase	£ 1.85
B24-02 Stereo Record/Pbk	£6.66	B22-02 Twin 1/2 track R/P	£ 5.97
B24-07 Stereo R/P, (Dolby Stm)	£7.87	C44RPH03 Quad 1/4 track R/P	£13.17
C42RPH20 Stereo SENDUST R/P	£9.28	C44RP2ES01 Quad 1/4 track combined R/P + Erase	£26.45
C42RP1ES01 Stereo combined R/P + Erase	£10.93	C22ES02 Twin half track erase	£ 4.72

SEND FOR OUR FULL CATALOGUE 50p including P. & P.

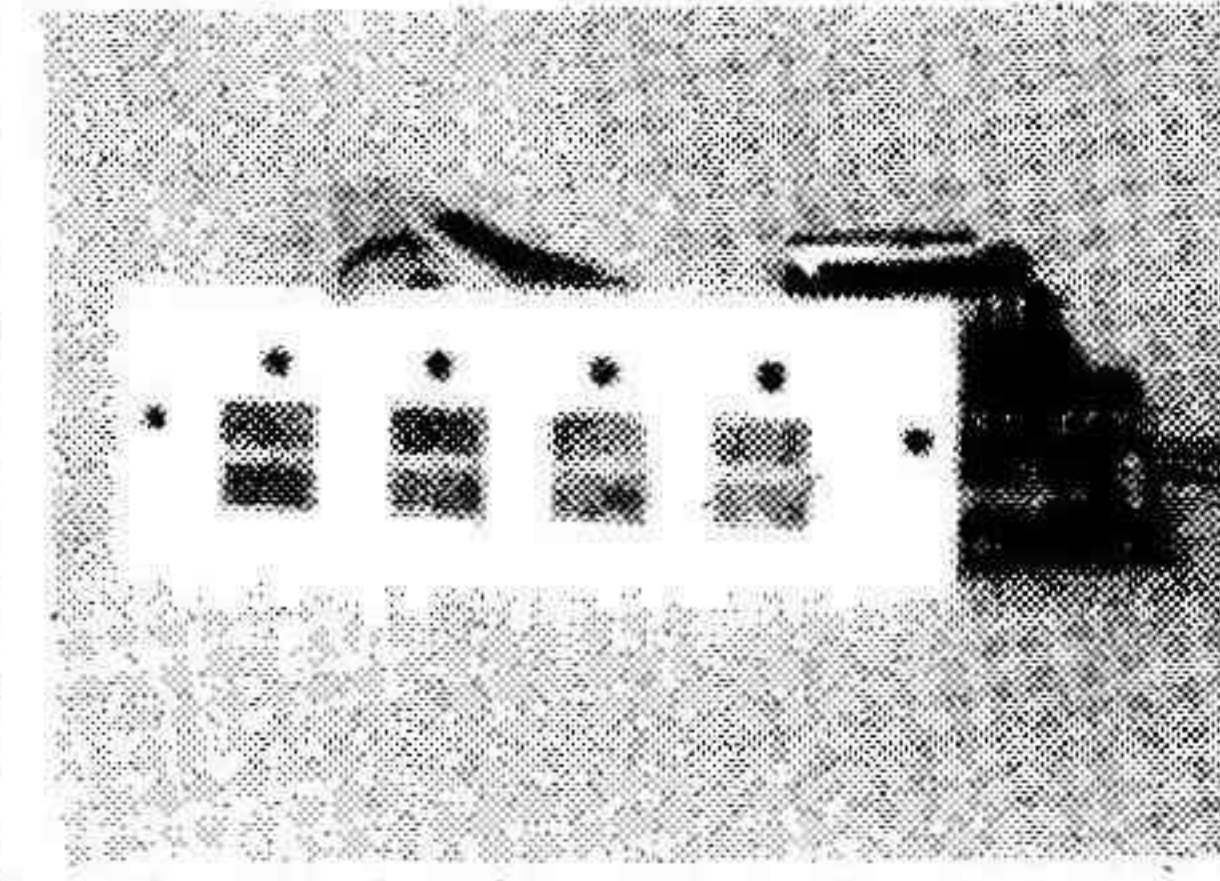
## MONOLITH

THE MONOLITH ELECTRONICS CO. LTD.  
5/7 CHURCH ST., CREWKERNE, SOMERSET, ENGLAND. (0460) 74321

PLEASE ENCLOSE 30p P&P WITH ORDER

ALL PRICES INCLUDE VAT

## HAWK Interlocking Touch Switch Systems



Here is the 4 channel system complete; showing the front panel, the circuitry, and the ribbon cable connecting the two.

Have you ever made a quality project, for which you needed interlocking switches, but all that was available was an unreliable, unsightly and electrically noisy mechanical switch?

You can now get an **electronic switch, touch-operated**, with L.E.D. displays to indicate which channel has been selected, and incorporating totally reliable solid state relays to perform the switching.

There are three options available: 2 channel; 4 channel; and 6 channel. On each channel there are 2 sets of relay contacts acting in parallel, so that stereo signals may be switched — for example, when selecting between the tuner, deck, tape, or auxiliary inputs to an amplifier using the 4 channel unit.

The units are supplied as easy to assemble kits, every kit containing:—

- ★ ALL the necessary components, including a high quality p.c.b. and I.C. sockets
  - ★ An attractive ready assembled front panel — comprising wipe clean stainless steel touch plates on a heat resistant white plastic base, which is pre-drilled for easy mounting on the front panel of your project; complete with ...
  - ★ LEDs above each switch plate to indicate which channel has been selected (the brightness of these may be adjusted)
  - ★ Complete easy to follow assembly instructions
  - ★ Full technical information
- Some of the special features are:—
- ★ Operation from a single supply rail, from 3V-18V
  - ★ Current consumption only 20mA
  - ★ It is IMPOSSIBLE to switch on more than one channel at a time — if more than one switch plate is touched either none or only one channel will be selected
  - ★ EXTREMELY long life — far longer than that of mechanical switches
  - ★ The HAWKTM range are the ONLY interlocking touch switch systems that the home enthusiast can buy as complete systems

Please note: the solid state relays used are C.M.O.S. 4016 and the limits of these devices must be observed.

Please send to M \_\_\_\_\_ at (address) \_\_\_\_\_

Number ..... 2 channel units @ £3.99 ea Add 25p  
Number ..... 4 channel units @ £5.99 ea P/P per  
Number ..... 6 channel units @ £7.99 ea order

Total remittance enclosed \_\_\_\_\_ Cheque/P.O. No. \_\_\_\_\_

OR Please send me the technical information only (enclose s.a.e.)  tick box

## DOVE ELECTRONICS TEL: BRISTOL (0272) 48401

4A Harcourt Road, Redland, Bristol BS6 7RG



# ETI BOOK SERVICE

How to order: Make cheques payable to ETI Book Service. Payment in sterling only please. Orders should be sent to: ETI Book Service, Modmags Sales Office, 145 Charing Cross Road, London WC2. All prices include P&P. Prices may be subject to change without notice.

## BEGINNERS

Beginners Guide to **Electronics** Squires £3.75  
Beginners Guide to **Transistors** Reddihough £3.75  
Beginners Guide to **Integrated Circuits** Sinclair £3.75  
**Understanding Electronic Circuits** Sinclair £4.60  
**Understanding Electronic Components** Sinclair £4.60  
Beginners Guide to **Radio** King £3.75  
Beginners Guide to **Audio** Sinclair £3.75

## COOKBOOKS

**TV Typewriters Cookbook** £7.75  
**CMOS Cookbook** £8.20  
**Active Filters** £11.30  
**IC Timer Cookbook** £7.50  
**IC Op-Amp Cookbook** £10.00  
**Video Cookbook** £7.00  
**TTL Cookbook** £7.55  
**The Basic Cook** £4.00 inc. p/p  
**IC Converter Cookbook** £9.50

## APPLICATIONS

**Fire and Theft Security Systems** B. Weis £2.15  
**How to Build Electronic Kits** Capel £2.65  
**110 Electronic Alarm Projects** R. M. Marston £4.45  
**110 Semiconductor Projects for the Home Constructor** R. M. Marston £4.45  
**110 Integrated Circuit Projects for the Home Constructor** R. M. Marston £4.45  
**110 Thyristor Projects Using SCRs** R. M. Marston £4.45  
**110 Wave Form Generator Projects** R. M. Marston £4.45

## COMPUTING & MICROPROCESSORS

**What is a Microprocessor?** 2 cassette tapes plus a 72-page book £12.00  
**Beginners Guide to Computers and Microprocessors with Projects** C. Adams £6.05  
**Basic Computer Games** Ahl £6.05.  
**Basic for Home Computers** A self-teaching guide. B. Albrecht £6.15.  
**Illustrating Basic** D. Alcock £3.75  
**Intro to Microprocessors** Aspinall £6.55  
**Z-80 Microcomputer Handbook** W. Barden £7.75  
**How to Program Microcomputers** W. Barden £7.25  
**Introduction to Microcomputers and Microprocessors** A. Barna £8.60  
**Microprocessors in Instruments and Control** R. J. Bibbero £13.00  
**Basic Basic** J. S. Coan £7.80  
**Advanced Basic** J. S. Coan £7.30  
**Getting Acquainted with Microprocessors** L. Frenzel £7.25  
**Beginners Guide to Microprocessors** C. M. Gilmore £4.90  
**Beginners Guide to Home Computers** Grossworth £4.50  
**Beginning Basic** R. E. Gosling £4.75  
**Microprocessor Programming for Computer Hobbyists** N. Graham £7.15  
**Miniprocessors from Calculators to Computers** Heiserman £5.00  
**Microcomputers, Microprocessors, Hardware, Software and Applications** J. L. Hilburn £17.40  
**Basic Programming** J. G. Kemeny £7.25  
**Microprocessor Systems Design** E. Klingman £17.00  
**Intro to Microprocessors** Leventhal £17.00  
**Microprocessors — Technology, Architecture & Applications** D. R. McGlynn £10.55  
**Interactive Computing with Basic** Monro £4.25  
**Basic with Style** P. Nagin £4.25  
**Software Design for Microcomputers** Ogden £7.20  
**Microcomputer Design** Ogden £7.25  
**Microcomputer Base Design** Peatman £5.70  
**Hands on Basic with a PET** Peckham £9.55  
**Basic — A hands on method** Peckham £6.95  
**6800 Software Gourmet Guide and Cookbook** Scelbi £8.90  
**8080 Software Gourmet Guide and Cookbook** £8.90  
**The 8080A Bugbook: Microcomputer Interfacing & Programming** P. H. Rony £8.35  
**8080/8085 Software Design** Titus £7.60  
**57 Practical Programs & Games in Basic** Tracton £6.65  
**Microcomputer Primer** M. Waite £6.50  
**Your Own Compqer** Waite £1.60  
**Microprocessor/Microprogramming Handbook** Ward £6.20

## LOGIC

**Logic Design Projects Using Standard ICs** J. Wakerly £7.15  
**Practical Digital Design Using ICs** J. Greenfield £16.00  
**Designing With TTL Integrated Circuits** Texas Instruments £9.35  
**How To Use IC Circuit Logic Elements** J. Streater £3.80  
**110 COSMOS Digital IC Projects for the Home Constructor** R. M. Marston £4.45  
**Understanding CMOS Integrated Circuits** R. Melen £4.15  
**Digital Electronic Circuits and Systems** R. M. Morris £4.50  
**MOS Digital ICs** G. Flynn £5.25

## TEST INSTRUMENTS

**The Oscilloscope In Use** Sinclair £3.50  
**Working with the Oscilloscope** A. Saunders £4.25  
**Servicing with the Oscilloscope** A. King £6.65  
**Radio Television and Audio Test Instruments** King £7.00

## OP-AMPS

**Applications of Operational Amplifiers** Graeme (Burr Brown) £8.45  
**110 Operational Amplifier Projects for the Home Constructor** R. M. Marston £4.45  
**Designing With Operational Amplifiers** Burr Brown £19.00  
**Operational Amplifiers Design and Applications** G. Tobery (Burr Brown) £7.55

## COMMUNICATIONS

**Communication Systems Intro To Signals & Noise** B. Carlson £7.65  
**Digital Signal Processing Theory & Applications** L. R. Rabiner £24.40  
**Electronic Communication Systems** G. Kennedy £8.75  
**Frequency Synthesis. Theory & Design** Mannassewitsch £25.00  
**Principles of Communication Systems** H. Taub £8.40

## THEORY

**Introduction to Digital Filtering** Bogner £10.60  
**Transistor Circuit Design** Texas Instruments £9.75  
**Foundations of Wireless Electronics** M. G. Scroggie £5.60

## REFERENCE

**Electronic Engineers Reference Book (Ed. 4)** L. W. Turner £34.50  
**Electronic Components** M. A. Colwell £2.90  
**Electronic Diagrams** M. A. Colwell £2.90  
**International Transistor Selector** T. D. Towers New update £10.20  
**International FET Selector** T. D. Towers £4.35  
**International Op-Amp Linear IC Selector** Towers £7.65  
**Radio Valve and Semiconductor Data** A. M. Bell £4.00  
**Radio, TV and Audio Technical Reference** Amos £30.40

## MISCELLANEOUS

**Electronic Fault Diagnosis** Sinclair £3.55  
**Integrated Electronics** J. Milman £8.20  
**Practical Solid State DC Supplies** T. D. Towers £6.40  
**Practical Triac/SCR Projects for the Experimenter** R. Fox £2.35  
**Printed Circuit Assembly** Hughes & Colwell £2.90

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



# GREENWELD

443A Millbrook Road Southampton SO1 0HX

All prices include VAT @ 15% — just add 40p post

## SLIDER POT SCOOP!!!

Made by Pihler, types PL40CP & PL60C. Silly prices for superb goods!!  
 PL40CP — 69x16x9mm, 40mm slide length, 220R, 2k2 or 10k lin only. Prices (any mix): 1-24 20p; 25-99 17p; 100+ 14p.  
 PL60C — 84x10x7mm, 60mm slide length, 5k, 10k, 22k and 100k log. only. Prices (any mix) 1-24 25p; 25-99 22p; 100+ 17p.

## BUZZERS, MOTORS & RELAYS

Z401 Powerful 6V DC buzzer, all metal construction. 50mm dia x 20mm 70p.  
 Z402 Miniature type buzzer, 6, 9 or 12V, only 22x15x16mm. Very neat 53p  
 Z450 Miniature 6V DC motor, high quality type 32mm dia x 25mm high, with 12mm spindle. Only 11p.  
 A372 Audible Warning device — solid state circuit drives high efficiency transducer to give high output. Voltage reqd 4-18V. Can also be driven direct from TTL or CMOS. Module size 45x21x12mm. Comprehensive data supplied £1.50  
 W892 Heavy Duty 12V relay, ideal for car use — single 15A make contact. Coil 25R in sealed metal can with mounting bracket 85p.  
 W890 DIL Reed relay SPCO 2.4-10V, 200R coil. Only £2.20.  
 FSRA60 relay, 2 x 10A contacts, 1M, 1B. Coil is 250R, and rated 60V ac, but works on 12-24 DC. Solid Encapsulation with screw terminals makes it ideal for car use. £1.20.

## REGULATED PSU PANEL

Exclusive Greenweld design — better spec. than anything on the market being offered at the price. Panel 110x82x33mm high contains all components including bridge rectifier and smoothing capacitor. Ready built and tested — just add a 30V 2A transformer and two pots for a fully variable voltage and current supply.  
 SPEC: 1/2 Output voltage 0-28V  
 1/2 Output current 20mA-2A  
 1/2 Source Impedance OR1  
 Open circuit ripple 10mV

Send SAE for full details of the many ways this useful module can be used, together with price list of parts for various options. Only £6.75

## TRANSISTOR PACK K516

Take advantage of this unbelievable offer!! Small signal NPN/PNP transistors in plastic package at an incredibly low, low price!! Almost all are marked with type number — almost all are full spec. devices. Some have bent leads. Over 30 different types have been found by us including BC184/212/238/307/328, BF196/7, ZTX107/8/9/342/450/550, etc. Only available as a mixed pack at £3 per 100; £7 per 250; £25 per 1000.

## P.C. ETCHING KIT Mk IV

The best value in etching kits on the market — contains 100 sq ins copper clad board, 1lb Ferric Chloride, Etch resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions. All for £4.95.

## 1981 CATALOGUE

Now in the process of compilation, available NOV. 75p will reserve you a copy, sent as soon as printed.

## BULK SUPPLIES

All new full spec. devices. Prices are for a minimum of 100 of any one device and exclude VAT, which must be added at 15%. Minimum order value from this section is £10+VAT+post. VAT receipt on request.

### RESISTORS

Min. 1/4W 5% carbon film 1R-10M (10% over 1M), all £6.00/1,000.  
 The following values only at £3.50/1,000; per value 4R7, 8R2, 18R, 39R 56R, 220R, 1k, 4k7, 18k, 33k, 39k, 47k, 220k, 390k, 560k, 680k, 820k.

### MIN. PRESETS

0.1W miniature type, open construction. All values from 100R to 1M, vertical or horizontal mounting. All at .042.  
 The following values only at .03: 470RV, 470RH, 500RH, 1kH, 1k5H, 2kV, 2k2H, 2k5H, 4k7H.  
 Also some Pihler enclosed type at .042: 150RV, 200RH, 2kV.

### POTS

5k lin; 100k lin; 220k lin; 500k log; 1M lin. All with std. bush and spindle. .14.

### ELECTROLYTIC CAPS

2.2/25 R	.028	47/63 R	.045
2.2/63 A	.032	100/6.3 A	.020
4.7/10 R	.022	100/35 R PC	.035
4.7/25 R	.028	220/16 A	.055
4.7/50 R	.034	220/25 R	.065
10/16 R	.030	220/70 A	.075
10/25 R	.032	330/50 A	.075
10/25 R PC	.022	330/100 A	.085
10/25 A	.035	470/16 R	.080
10/50 A	.040	470/100 RC	.150
10/100 R	.042	1000/40 A	.230
15/40 A	.030	1000/63 A	.280
22/10 R	.021	2200/10 A	.080
22/25 A	.025	2200/25 A	.280
22/25 R	.027	2200/40 RC	.350
22/63 A	.040	3300/10 A	.090
33/16 A	.022	3300/25 A	.180
47/6 A	.015	4700/10 A	.100
47/25 A	.032	4700/25 RC	.250
47/35 R	.038	4700/40 RC	.35
47/40 A	.045	10000/15 RC	.250

R=radial leads  
 A=axial leads  
 RC=tag ended can  
 R PC=short radial leads for PC mounting

## BUY A COMPLETE RANGE OF COMPONENTS AND THESE PACKS WILL HELP YOU

ALL PACKS CONTAIN FULL SPEC. BRAND NEW MARKED DEVICES — SENT BY RETURN OF POST, VAT INCLUSIVE PRICES.

- K001** 50V ceramic plate capacitors, 5%, 10 of each value 22pF to 1,000pF, total 210. £3.89.
- K002** Extended range 22pF to 0.1µF, 330 values £5.53.
- K003** Polyester capacitors, 10 each of these values: 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1, 0.15, 0.22, 0.33, 0.47µ, 110 altogether for £5.07.
- K004** Mylar capacitors, min 100V type 10 each all values from 1,000pF to 10,000pF. Total 130 for £4.06.
- K007** Electrolytic capacitors 25V working small physical size, 10 each of these popular values 1, 2.2, 4.7, 10, 22, 47, 100µF. Total 70 for £3.58.
- K008** Extended range, as above, also including 220, 470 and 1000µF. Total of 100 for £6.06.
- K021** Miniature carbon film 5% resistors CR25 or similar, 10 of each value from 10R to 1M, E12 series. Total 610 resistors £6.15.
- K022** Extended range. Total 850 resistors from 1R to 10M £8.50.
- K041** Zener diodes 400mW 5% BZY88, etc. 10 of each value from 2.7V to 36V, E24 series. Total 280 for £16.37.

## TM4030 RAM

4096 bit dynamic RAM with 300ns access time; 470ns cycle time; single low capacitance high level clock  $\uparrow$ /p; fully TTL compatible, low power dissipation. Supplied with data £2.75.

## COMPONENT PANELS

Z525 Contains 11 800mA 60V 2N5061 SCRs, 11 6V8 zeners, 11 1N4004 diodes plus Rs, Cs, etc. Only £1.  
 74 Series ICs — Gates and complex logic, 20 asstd ICs on panels £1; 100 ICs £4.  
 Z527 2x6V reed relays, 6x2S030 or 2S230, 6x400V recls, plus Rs. Only 50p.  
 Z531 Trimpot Pack — Ex-computer panels with 20 mixed value multi-turn types £1.00.

## TTL, LINEAR, OPTO

All new full spec — Fairchild/SGS.  
**TTL:** 5400, 5401, 5402, 5403, 5404, 5405, 5410, 5421, 5430, 5450, 5451, 5453, 5460 — All 12p ea. 5470, 5472, 5474, 5475, 5476, 5480, 5486, 5490, 54107, 54121, 54122 — all 20p ea. 5482, 54126 — 40p ea. Others (74S, H) on B/L 12 (SAE please).  
**LINEAR:** 9665 or 9666, 7 x 50V Darlingtons in 16 DIL 60p; 75452 or 4 dual periph driver 70p; XK1444 7 CMOS P-channel buffers, 15V 16 DIL 24p.  
**OPTO:** Isolators, FCD831 60p; TIL115/118 60p; FPE100/106 Infra red LED £2.50; FND847 7 seg 0.8" CA £2.00; FND850 CC £2.00. (Data on request for linear & opto devices)

## VEROBLOC BREADBOARD

New from Vero, this versatile aid for building and testing circuits can accommodate any size of IC. Blocs can be joined together. Bus strips on X & Y axis — total 360 connexion points for just £4.15.

### POLYESTER CAPS

01	400V	C296	.025
.015	250V	C280	.025
.022	400V	C280	.025
.068	250V	Advance	.025
.22	250V	C280	.035
.22	250V	Advance	.035
.22	100V	Minibox	.035
.47	250V	C280	.05
.47	160V	C296	.04
1.0	250V	C280	.065
1.5	63V	Filmcap	.065
2.2	160V	Filmcap	.096
3.3	100V	Wima MKS	.15
4.7	100V	C281	.195
4.7	100V	Wima MKS	.235
6.8	100V	Wima MKS	.285

### POLYSTYRENE CAPS

22pF	125V	5%	£8/1000	1.5/35	.06
27pF	125V	5%	£8/1000	3.3/25	.08
1500pF	125V	10%	£14/1000	10/25	.15
8200pF	125V	10%	£14/1000		

### MINIATURE CERAMIC CAPS

Thompson/CSF miniature type in the following values:  
 3.9pF, 4.7pF, 22pF, 33pF, 47pF, 47pF, 68pF, 82pF, 100pF, 560pF, 2700pF. All 5% except 10%, 120%.  
 Prices: up to 82pF £7/1000  
 100pF £9/1000  
 560pF £5/1000  
 2700pF £9/1000  
 Samples on request (see please).  
 Mullard min. ceramics:  
 33pF 5% 100V £7/1000  
 330pF 2% 100V £8/1000  
 3300pF 10% 100V £13/1000  
 Stettner min. ceramics:  
 330pF 5% 63V £7/1000  
 .022µF 63V £14/1000  
 Lemco .047µF 63V £16/1000

### SEMICONDUCTORS

741 .12, 555 .19, 7401 .08, 7405 .09, 74L74 .21, 4001 .17, 4011 .17: S1 signal diodes like IN4148 by TI on bandoliered reels of 10k £80 (1k £10); IN4002 £25/k; IN4006 £34/k; IN4007 £36/k; Ge signal diode DK14 £20/k; SCRs: 2P4M (C106D) 4A 400V .26; 2N5060 .8A 30V .15; CR201 1A 200V .18.  
 See July's advt. for transistors; send see for latest bulk buyers list.

# MICRO-PRINT LTD

TANGERINE — British Computer Kits — TUSCAN

- Microtan 65 Kit ..... £69.00
- Tanex (min. confg.) ... £43.00
- Tanex expanded kit .. £106.50
- Key pad/full ASCII keyboard, P.S.
- Mother board, cabinets etc.

Single Bd. incl. Video, kit £235.00  
 Also available, full ASCII keyboard, P.S., cabinet, mini floppies etc. Ref.

- 212. Crash Course in Micros ..... £10.65
- 167. How to make money with your Microcomputer £5.75
- 36. Instant Basic
- 216. Intro. to Micros for Ham Shack ..... £3.95
- 184. Little Bk. of Basic Style ..... £5.75
- 161. More Basic Comptr. Games ..... £5.50
- 24. TTL Cookbook .... £7.15
- 224. Basic Cookbook ... £3.95
- 226. Beginners Guide to Computers and Micros. £5.00
- 237. How to design and build your own working computer system ..... £5.75
- 243. Microprocessor Cookbook ..... £4.65
- 246. Modern Digital communications ..... £5.95
- 247. Modern Guide to Digital Logic ..... £5.75
- 65. Basic Computer Games .. £5.50
- 195. The Basic Handbook £11.00
- 171 Basic & the Personal Compt. .... £9.75
- 62. The Best of Byte .. £8.75
- 203. Best of Micro Vol. 11 (6502) ..... £5.50
- 204. Best of Micro Vol. 2 (6502) ..... £6.50
- Single Bd. excl. Video, kit .... £195.00

Ref. **BOOKS**  
 200. Prog. the Z80 — Zaks. £8.95  
 60. Prog. the 6502 — Zaks. .... £7.95  
 40. Basic Basic—Coan ..... £6.50  
 159. Z80 Ass. Lang. Leventhal ..... £8.15  
 233. Computer Technician Hndbk. .... £7.25  
 150. Computer Progs. that work in Basic ..... £3.95  
 168. Microsoft Basic ... £6.75  
 187. 6502 Ass. Lan. Leventhal ..... £8.25

V.A.T. extra (where applicable).  
 Post and Packing extra

# MICRO-PRINT LTD

21 Bankhouse Rd., Hanford, Stoke-on-Trent. 0782-657893  
 Note: New retail premises from 1st October  
 59 Church Street, Stoke-on-Trent. 0782 48348

## HAND HELD GAMES

- Supersonic Mastermind ..... £21.00
- Galaxy Invaders ..... £22.95
- Mattel Soccer ..... £21.50
- ENTERPRISE 4 in 1 ..... £24.95
- 3 Games and calculator in one
- \*Electronic Mastermind ..... £12.90
- U.F.O. Master Blaster ..... £24.95
- Amaze-A-Tron maze game ..... £18.95
- Touch Me by ATARI (like Simon) £26.95
- Football (two players) ..... £24.95
- ZAP missile game ..... £11.95
- \*DIGITS (like Mastermind) ..... £14.95

ALL GAMES HAVE SOUND EFFECTS EXCEPT

## ATARI video computer £129

- Sargon 2.5 Chess ..... £278.00
- Super System 3 Chess ..... £149.95
- SPACE INVADERS CART ..... £29.95
- STAR CHESS T.V. Game ..... £63.35
- DATABASE Prog. T.V. Game ..... NEW £89.95
- CHESSMATE 8 Level ..... NEW £59.95
- CHESS CHALLENGER 7 ..... £84.00
- CHESS CHALLENGER 10 ..... £155.00
- VOICE CHALLENGER ..... £219.00
- CHECKER CHALLENGER 2 ..... £54.00
- CHECKER CHALLENGER 4 ..... £90.00
- ZODIAC Astrol Computer ..... NEW £29.95
- Snooze Alarm ..... £14.90
- EL-MAC 5MHz Scope ..... £139.90
- EL-MAC 3" 5MHz Scope ..... £115.00
- RADAT 10MHz Scope ..... £169.00
- PDM35 ..... £36.50
- PFM ..... £52.30

## PINBALL WIZARD

The latest from the U.S.A.  
 ★ Still available ★  
 Featured in Nov. issue of E.T.I.  
 Home TV Game — B/W Kit  
 Basic Kit £28.90  
 Contains everything except box and controls  
 Box & Controls — £6.50. Mains Adaptor — £3.90  
 Play 7 games with 4 options on each game  
 4-Pinball games 2-Basket, 1-Breakout  
 Versatile car alarm kit £18.90  
 See review in Hobby Electronics November  
 CHROMA CHIME 24 tune door chimes kit £10.75 Built £15.95  
 C.B. Aerials and Accessories

## COMPUTERS — Home, Business etc.

- PET 8K ..... £458.85
- PET 16K ..... £573.85
- SORCERER 16K ..... £861.35
- SORCERER 32K ..... £918.85
- SUPERBOARD II 4K ..... £180.00
- UK 101 Kit 4K ..... £226.85
- Built 4K ..... £286.35
- TRS80 Level 2 16K ..... £409.40
- 5 1/4" Floppy Drive ..... £271.40
- Dual Drive ..... £506.00
- NASCOM 2 Kit ..... £339.25
- HEATH WH89 ..... £1,805.00
- HEATH WH14 Printer ..... £586.50
- Softy Kit ..... £115.00
- Softy Built ..... £138.00
- Intelligent EPROM Programmer
- Sharp Software

PRINTERS : FLOPPY DISCS : BOOKS

S.a.e. Enquiries. Please allow up to 21 days for delivery. All prices inc. of VAT.



**N.I.C.**  
 61 BROAD LANE, LONDON N.15 4DJ  
 Day 01-808 0377; Eve 01-889 9736



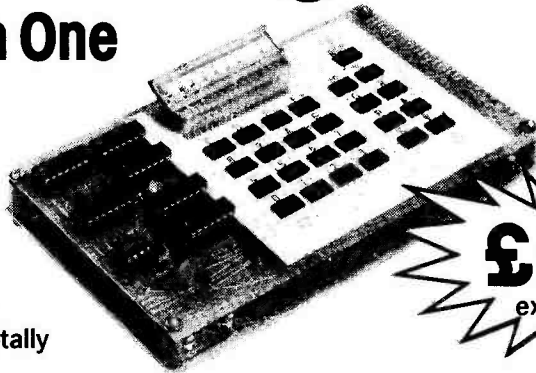
# The Acorn modular system

A range and price unmatched by any other manufacturer in the world.  
Designed and produced in Britain.

## For the absolute beginner...

### System One

A compact stand-alone microcomputer based on standard Eurocard modules, and employing the highly popular 6502 MPU (as used in APPLE, PET, KIM, etc). Throughout, the design philosophy has been to provide full expandability, versatility and economy. Many thousands have already been sold throughout the world.



**£65** in kit form  
excluding VAT

System One is complemented by a range of totally compatible eurocards including:

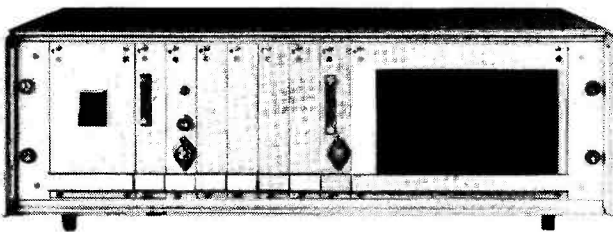
- |   |      |  |        |
|---|------|--|--------|
| ● 8K+8K Static RAM and EPROM                        | £95  | ● Laboratory Interface (isolated inputs, high current outputs) | £122   |
| ● Colour Prestel Compatible VDU Interface           | £88  | ● 6809 CPU Card  | £98    |
| ● Versatile (serial, parallel, RS232 etc) Interface | £69  | ● Professional Keyboard (parallel ASCII encoded)               | £96    |
| ● Dual Mini-floppy Controller                       | £120 | ● AIM 65 Bus Interface adaptor                                 | £33    |
| ● PROM/EPROM Programmer (Bipolar and UV erasable)   | £55  | ● PAL Encoder  | £22.50 |
| ● A to D, and D to A Interface (12 bit, high speed) | £132 |  |        |
| ● Printer Interface (for 12 data 3 strobe)          | £60  |  |        |
- All prices exclude VAT**

#### Available soon:

- 80 x 24 character VDU Interface
  - 32K Dynamic RAM Card
  - 5V/12V Switched mode power supply (1" deep)
  - In circuit emulator (block relocating)
  - IEEE Bus Interface (Full implementation)
  - Real time clock with CMOS RAM
- All these cards utilise 'state of the art' devices and represent an elegant and long lasting solution to today's requirements.

## ...and the absolute professional

### System Three



System 3, contains the 6502 CPU, 16K RAM with DOS and BASIC, VDU Interface, Disc controller and 5" drive, Printer Interface, backplane and power supplies. The entire unit costs about £1,000 and can be added to or reformatted as required.

If you need the facilities of the 6809 processor this can be substituted for the 6502 CPU (all other hardware remains unchanged.)

Acorn's fast BASIC combined with what is probably the most efficient disc operating system available may be linked with a control oriented ONLI BASIC addition for laboratory control, or an accounts/stock control package for small businesses.

A twin disc System Four is available if two drives and several peripheral interfaces are required in one case. Full service and software facilities available.

For more information and order form ring or write to



**ACORN  
COMPUTER**  
Acorn Computer Limited,  
4a Market Hill,  
Cambridge, CB2 3NJ  
Cambridge (0223) 312772

Please send me further information of Acorn products.

My application concerns \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_

Acorn Computer Limited, 4a Market Hill, Cambridge, Cambs. Cambridge (0223) 312772

ETI/10/80



# Greenbank

Greenbank Electronics  
(Dept T10E) 92 New Chester Road, New Ferry  
Wirral, Merseyside L62 5AG  
(Tel: 051-645 3391)



**TERMS, VAT, CWO.** Cheques etc payable to Greenbank Electronics and crossed. Add VAT to all prices at 15% except where stated otherwise. Post etc: [UK 35p + 5p VAT = 40p] per order. Export: NO VAT but add 35p (Euro), 75p (Europe) and £2.50 elsewhere. Access, Barclaycard, Visa, telephoned orders accepted. (Polys, universities, govt depts, etc can telephone their orders for immediate despatch on account.)

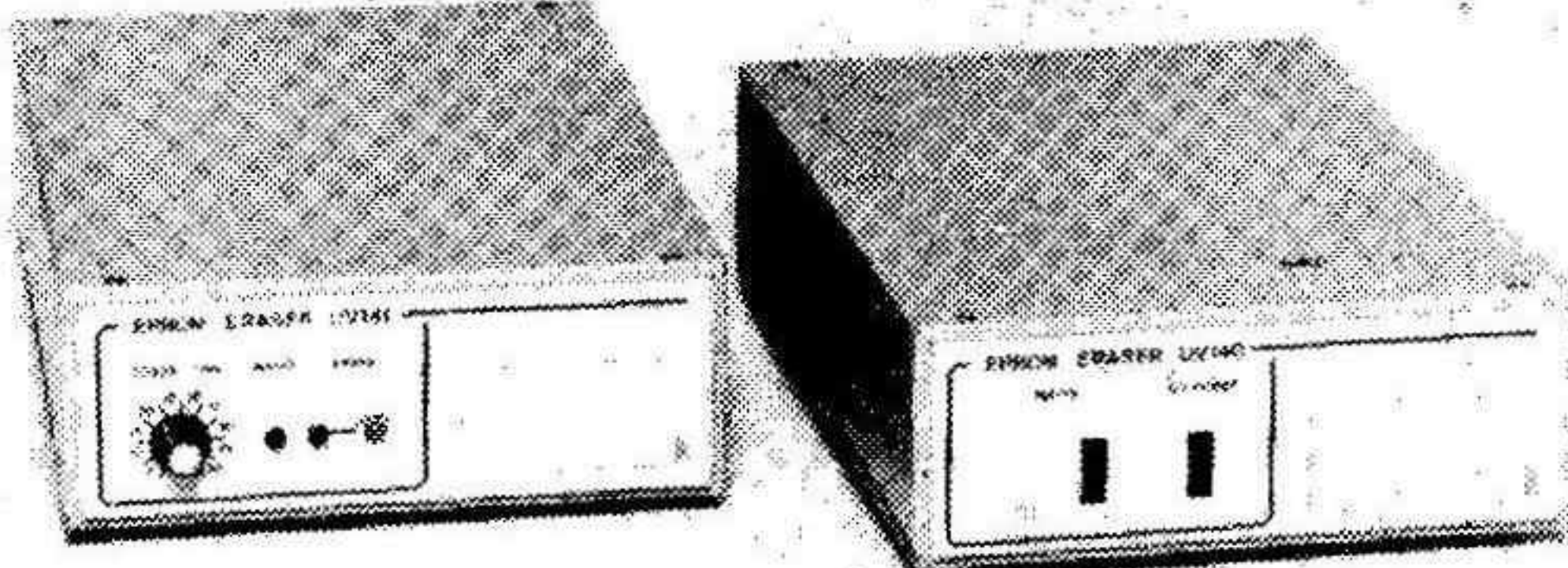


## QUARTZ

32.768KHz (Watch)	£3.23	VEROBOARD 0.1" Pitch with copper strips	2 1/2" x 1" (pack of 5)	74p
60 KHz	£3.95		2 1/2" x 3"	53p
100.0 KHz	£3.62		2 1/2" x 5"	62p
200.0 KHz	£3.92		2 1/2" x 7"	£1.06
204.8 KHz	£3.92		3" x 5"	62p
262.144 KHz	£3.92		3" x 7"	£2.40
307.2 KHz	£3.92		4.7" x 17.9"	£3.14
312.5 KHz	£3.92	0.1" Plainboard (no strips)		
455.0 KHz	£4.95	3" x 2 1/2"		38p
1.000 MHz	£3.62	3" x 5"		58p
1.008 MHz	£3.92	3" x 7"		£1.56
1.280 MHz	£3.92	Terminal pins		£1.50/500
1.8 MHz	£4.25	V-Q DIP board		£1.17
1.8432 MHz	£3.62	DIP breadboard		£2.91
2.000 MHz	£3.62	Spel lace cutter		93p
2.097152 MHz	£3.23	Pin insertion tool		£1.28
2.4576 MHz	£3.92			
2.500 MHz	£3.92			
2.56250 MHz	£3.62			
3.000 MHz	£3.62			
3.2768 MHz	£3.23			
3.579545 MHz	£1.95			
3.83216 MHz	£3.92			
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			
4.9152 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			
7.85432 MHz	£3.23			
8.000 MHz	£3.23			
8.38800 MHz	£3.23			
8.867237 MHz	£3.23			
9.375 MHz	£3.92			
9.800 MHz	£3.92			
10.000 MHz	£3.23			
10.245 MHz	£3.23			
10.700 MHz	£3.23			
10.92 MHz	£3.92			
11.000 MHz	£3.92			
12.000 MHz	£3.92			
14.0 MHz	£3.92			
14.31818 MHz	£3.23			
16.000 MHz	£3.92			
16.000 MHz	£3.23			
18.432 MHz	£3.23			
20.000 MHz	£3.62			
20.1134 MHz	£3.23			
26.690 MHz	£2.10			
27.0 MHz	£3.92			
27.145 MHz	£2.10			
27.648 MHz	£3.92			
38.6866 MHz	£3.23			
48.000 MHz	£3.23			
100.000 MHz	£3.23			
116.000 MHz	£3.23			

## UV EPROM ERASERS

### UV 140, UV 141



Two easy to use units designed for both the professional and amateur UV-prom user

#### Features

- Can erase up to 14 proms.
- Special short wave ultraviolet tube.
- Erase time variable between 5 and 50 minutes in 5 minute steps (preventing over exposure which may shorten prom life).
- Sliding tray carries proms on conductive foam.
- Safety interlock switch prevents the timing circuit from operating and switching on the tube with the tray open.
- "Mains On" and "Tube On" indicators.
- Smart textured case.
- Complete instructions supplied.

Supplied complete with mains plug and flex

Model UV141. Price £77.70

Also available without timer as

Model UV140: Price £61.20

## Tex Microsystems "EPROMPT" UV ERASER



A low cost alternative to the above erasers (UV 140/141) claimed by the manufacturer to erase up to 32 chips in 15-30 mins. This is the cheapest eraser we have seen. The unit has no timer, power switch or safety interlock switch. The user places up to 32 chips into loose conducting foam in the erasure tray (16 along the base, 8 on each side). The chips are held in place by the UV tube which sits in the tray. (Unlike the UV 140/141, no special precautions have been taken to prevent the seepage of UV light, but the manufacturers state that "Incident light from this device is quite safe at distances above 12 inches".)

(Dimensions — 325 x 64 x 38mm)

EPROMPT ERASER: Price £33.56

5204/2708 PROGRAMMING SERVICE: £7.50 each prom. (Price does not include prom, we accept handwritten / typed source code — must be hexadecimal).

PROM WASHING SERVICE: 50p each prom

## NEW COMPUTER BOARDS

The following computer boards have been added to the range for use with the Z80 (114 x 203mm fibreglass with gold plated edge connector).

- IP2 8 line opto isolated input board **£9.40**
- OP2 8 line relay output board **£9.40**
- SIO RS232 serial interface board **£9.40**
- MXD2 16K dynamic ram board **£9.40**

## SPECIAL OFFER

(Subject to stocks)

No monthly accounts for these prices:

	each	per 8
2114 (450nS) — 1K x 4	£2.99	£22.40
2708 (450nS) — 1K x 8	£5.25	£39.60
2516/2716 (450nS) — 2K x 8 single 5v	£12.00	£88.00
4116 (250nS) — 16K x 1 Dynamic	£3.99	£30.40

## CMOS

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

4000 18p	4042 80p	4095 £1.97	4410 £8.55	4531 £1.45
4001 25p	4043 90p	4096 £1.97	4411 £10.72	4532 £1.30
4002 25p	4044 90p	4097 £5.98	4412VP £14.93	4534 £5.60
4006 95p	4045 £2.63	4098 £1.92	4415V £5.24	4536 £3.89
4007 18p	4046 £1.10	4099 £2.00	4422 £5.66	4537L £26.10
4008 80p	4047 £1.71	40100 £1.92	4433 £12.30	4538 £1.20
4009 40p	4048 77p	40101 £1.69	4435V £5.40	4539 97p
4010 50p	4049 45p	40102 £3.67	4450 £3.81	4541 £1.19
4011 25p	4050 49p	40103 £3.67	4451 £3.81	4543 £1.80
4012 18p	4051 80p	40104 £1.85	4461 £3.93	4549 £4.38
4013 50p	4052 80p	40105 £1.85	4462 £4.41	4552 £14.85
4014 84p	4053 80p	40106 92p	4490FP £4.20	4553 £4.50
4015 84p	4054 £2.18	40107 £1.28	4490VP £3.14	4554 £1.38
4016 45p	4055 £2.55	40108 £7.54	4500 £6.95	4555 78p
4017 80p	4056 £2.55	40109 £1.28	4501 29p	4556 72p
4018 89p	4059 £9.23	40110 £3.00	4502 £1.20	4557 £3.86
4019 45p	4060 £2.10	40114 £1.77	4503 70p	4558 £1.25
4020 99p	4062 £10.00	40160 £1.54	4505 £3.71	4559 £4.38
4021 £1.10	4063 £1.90	40161 £1.54	4506 50p	4560 £2.50
4022 £1.00	4066 55p	40162 £1.54	4507 55p	4561 81p
4023 27p	4067 £7.21	40163 £1.54	4508 £2.90	4562 £5.60
4024 78p	4068 27p	40174 £1.54	4510 99p	4566 £1.59
4025 27p	4069 27p	40181 £5.03	4511 £1.50	4568 £2.38
4026 £3.25	4070 30p	40182 £1.90	4512 80p	4569 £2.50
4027 50p	4071 25p	40192 £2.41	4514 £2.65	4572 40p
4028 84p	4072 25p	40193 £2.41	4515 £3.00	4580 £4.77
4029 99p	4073 25p	40194 £3.27	4516 £1.10	4581 £2.62
4030 74p	4075 25p	40208 £7.54	4517 £4.46	4582 £1.14
4031 £4.31	4076 £1.07	40257 £2.31	4518 £1.00	4583 90p
4032 £1.31	4077 29p	4160 98p	4519 80p	4584 90p
4033 £2.63	4078 29p	4161 98p	4520 £1.00	4585 £1.27
4034 £2.00	4081 27p	4162 98p	4521 £2.50	4597 £2.44
4035 £1.10	4082 27p	4163 98p	4522 £1.11	4598 £2.98
4037 £1.99	4085 £1.35	4174 90p	4526 £1.08	4599 £6.95
4038 £1.20	4086 £1.35	4175 £1.15	4527 £1.50	4700 £1.75
4039 £2.78	4089 £2.91	4194 £1.16	4528 £1.20	
4040 £1.00	4093 80p	4408 £9.37	4529 £1.30	
4041 £1.59	4094 £2.50	4409 £9.37	4530 70p	

## 74C

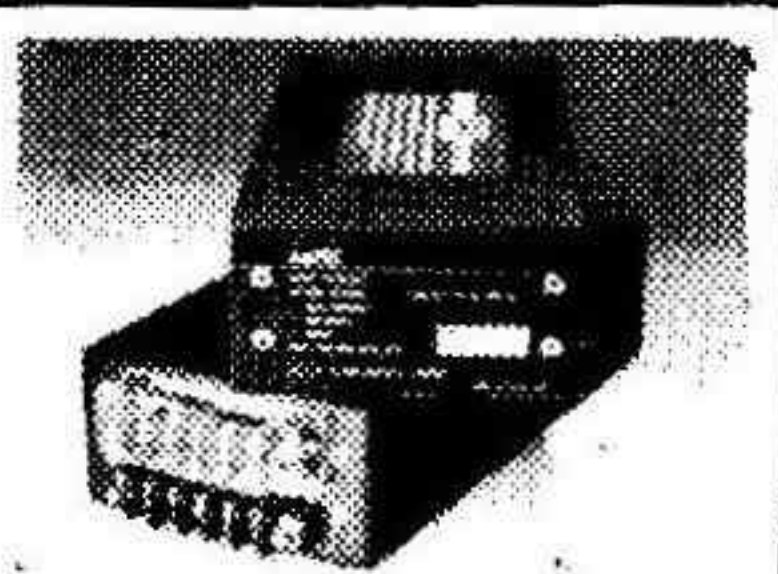
74C00 28p	74C76 57p	74C163 £1.15	74C903 57p	74C925 £5.01
74C02 28p	74C83 £1.34	74C164 £1.08	74C904 57p	74C926 £5.01
74C04 28p	74C85 £1.34	74C165 £1.08	74C905 £7.53	74C927 £5.01
74C08 28p	74C86 67p	74C173 93p	74C906 57p	74C928 £5.01
74C10 28p	74C89 £4.62	74C174 93p	74C907 57p	74C929 £17.90
74C14 90p	74C90 89p	74C175 93p	74C908 £1.00	74C930 £17.90
74C20 28p	74C93 89p	74C192 £1.15	74C909 £1.69	
74C30 28p	74C95 £1.08	74C193 £1.15	74C910 £7.45	80C95 85p
74C32 28p	74C107 £1.27	74C195 £1.08	74C911 £7.39	80C96 92p
74C42 95p	74C150 £3.81	74C200 £7.46	74C912 £7.39	80C97 85p
74C48 £1.43	74C151 £2.55	74C221 £1.41	74C914 £1.46	80C98 92p
	74C154 £3.81	74C245 £2.98	74C915 £1.15	82C19 £6.20
	74C157 £2.29	74C373 £1.79	74C918 £1.10	88C29 £2.90
	74C160 £1.49	74C374 £1.79	74C921 £17.07	88C30 £2.90
	74C161 £1.15	74C901 57p	74C922 £3.78	
	74C162 £1.15	74C902 79p	74C923 £3.86	

## MODULATORS

UM1111 E36 UHF Ch.36 Vision Modulator	£2.50
UM1231 UHF Ch.36 Vision Modulator wide bandwidth (for computers etc.)	£4.70
UM1263 FM Sound Sub-carrier Modulator	£2.50

## SWITCH MODE PSUs

AC 5221S 5V/10A	£69.90
AC 9221S 5V/5A, 12V/1A, -12V/1A, -5V/0.1A	£86.80
AC 5421S 5V/20A	£99.20
AC 9421S 5V/10A, 12V/2A, -12V/2A, -5V/0.1A	£126.50



## MICROPROCESSORS

<b>COMPUTER BOARDS</b>	<b>6800</b>	<b>6502</b>	<b>CMOS</b>	<b>STATICS (Mostly 450nS)</b>	<b>DYNAMICS</b>	<b>UV ERASABLES</b>
114 x 203 mm fibreglass, gold plated edge connector, Buffered SC/MP CPU £9.40	6800 MPU £6.95	6502 PIA £7.95	COSMAC CDP 1802CE £6.50	2101-256 x 4 £2.25	MK 4116 16K 250nS £4.95	5204 (512 x 8) £11.50
SC/MP Protoboard £9.40	6810 (128 x 8 RAM) £3.25	6520 PIA £6.22	COSMAC CDP 1802E £10.85	2102-1K x 1 £1.20	MK 4816 2K x 8 £30.52	2708 1K x 8 £6.75
Z80 CPU card £9.40	6810 (128 x 8 RAM) £3.75	6522 £7.95	CDP 1864 £7.25	2111-256 x 4 £1.95		2716/2516 2K x 8 single 5v £17.95
VDU 'A' set £8.90	6820, 6821 PIA £3.95			2112-256 x 4 £2.25		.2532 4K x 8 (5v) £47.00
VDU 'B' set £8.90	6850 ACIA £4.85			2114/4045-1K x 4 £4.39		PROMWASHING each Prom 50p (+30p+VAT)
VDU 'C' 3ires £9.40	MC6880 £2.64			8 x 2114 £28.00		
EPROM Programmer (2708s) £9.40				2114L-1K x 4 £5.50		
4k PROM board (5204s) £9.40				4118-1K x 8 £15.50		
8k PROM board (2708s) £9.40						
2k RAM board (2102s) 1k £9.40						
2k £9.40						
8k RAM board (2114s) 1k £9.40						
8k £9.40						
Tape interface £8.90						
Keyboard interface £8.90						
PSU 5v, +12v, -12v board £8.90						
PSU 5v, -12v board £5.50						
ISBUS 1.1 13 slot back						



# THIS WAY YOUR ELECTROVALUE CATALOGUE IS IS ALWAYS UP TO DATE

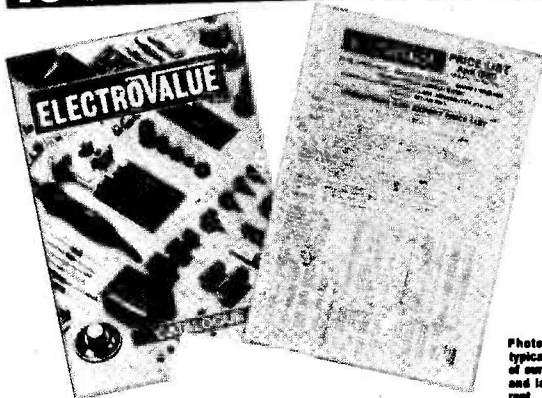


Photo shows a typical example of our price list, and is not current.

It's Electrovalue's quarterly price list published to keep you up-to-date on price and item variations in our 128 page catalogue (FREE ON REQUEST). If you are not yet a customer on our regular mailing list, we will send you our current price list FREE on request and a catalogue (No. 10) with it as well if you wish.

## OUR MINI-SELECTION POINTS THE WAY!

### EXAMPLE ONE - SOLDERING IRONS

Onyz 50	£12.08 net	Antex X25	£4.83 net
Isotip	£25.90 net	Desolder tool SR3A	£7.48 net
Antex C	£4.83 net	500 gm reel solder	£7.59 net

### EXAMPLE TWO - PRINTED CIRCUIT MATERIALS

PCB's 300 x 150 mm		Etch Resist Pen	£1.21
5SHBP S/S	£1.38	Breadboards	
F/Glass S/S	£2.19	Bimboard 12	£9.23
Positive resist 75cc	£1.67	Eurobreadboard	£6.56 net
Ferric Chloride 500g	£3.45	T-DeC	£5.18

### EXAMPLE THREE - SWITCHES

13A time switch adaptors		Smiths TS 100	£14.43 net
Chrome toggle		Wavechange, Lorlin, 1P12W, 2P6W	
Std. SPST	89p	3P4W, 4P3W	46p each
Min. SPDT	82p		

### EXAMPLE FOUR - CAPACITORS BY SIEMENS

Polyester 7.5mm PCM  
1, 1.5, 2.2, 3.3, 4.7nf, 10, 15, 22, 33, 47nf 8p each. 0.1µ 12p, 0.15µ 15p, 0.22µ 18p, 0.33µ 21p, 0.47µ 27p, 0.68µ 34p, 10mm PCM 1µ 37p.

Electrolytic axial (µF/V)  
1/40 15p, 1/100 12p, 2.2/25 15p, 2.2/63 12p, 4.7/16 15p, 4.7/40 12p, 10/25 12p, 10/40 13p, 22/25 13p, 22/40 13p, 22/63 19p, 47/10 13p, 47/25 16p, 47/40 19p, 47/63 20p, up to 1000/16V 32p, Then 1000/25V 44p, etc.

Also full supporting ranges of other ceramic, plastic and electrolytic caps.

### EXAMPLE FIVE-POTENTIOMETERS BY RADIOHM

Single gang lin or log	34p	(Twin types stereo matched)	
Twin gang lin or log	93p	Slider knobs	10p each
Mono slider lin or log	83p	Presets lin, horiz. or vert.	12p
Twin slider lin or log	136p		

### EXAMPLE SIX - RESISTORS

1/8, 1/4W 2.3p 1W 6p. Wirewound from 23p

### AND AS FOR SEMI CONDUCTORS . . . THIS LIST IS BUT A FRACTION OF WHAT WE CARRY

1N914	8p	40673	99p	E1110	92p	TIP31A	52p
1N4007	9p	555	34p	E1210	92p	TIP32A	52p
1N4148	5p	556	38p	LM301AN	35p	TIP41A	69p
1N5402	19p	AC128	36p	LM374N	67p	TIP41C	74p
2N1599	£1.01	AC176	67p	LM380N	£1.14	TIP42A	69p
2N2369A	24p	AD136	£4.25	LM3900N	78p	TIP42C	74p
2N3055	81p	AD149	£1.01	MJE2955	£1.13	TIP2955	69p
2N3102, 11	11p	AD161	40p	MJE3055	£1.00	TIP3055	69p
2N4443	£1.78	AD162	£2	MPSA12	42p	TIS43	40p
2N4444	£2.28	AF127	43p	MPSA63	44p	W02	35p
2N4991	72p	AL102	£1.84	OA47	14p	ZN425E	£4.48
2N5457, 9	45p	BA379	29p	OA90	8p	ZTX107-9	14p
40HF40	£2.25	BB103	43p	OA91	8p	ZTX300	14p
40361	45p	BB104	70p	OA202	16p	ZTX500	16p
40362	45p	BB105	37p	OC29	£1.23		
40636	£1.69	C10601	52p	OC36	£1.18		
		CA140F	46p	T2800D			

**INFORMATION:** To show everything we supply would take about seven pages of tightly packed type in this journal, the range is enormous including not only opto devices and very advanced sophisticated items, but all the everyday things you need as well down to nuts and washers! IT'S ALL IN CATALOGUE 10. OUR 120 PAGE CATALOGUE FREE FOR THE ASKING. PRICES AND V.A.T.: All prices quoted here include V.A.T. for U.K. orders. Overseas buyers deduct 13% when ordering.

**POSTAGE:** For orders up to £5.75 value (U.K.) please add 40p for p/p. If over, orders sent post free in U.K. Overseas orders sent at cost (Min. 40p).

**DISCOUNTS:** 5% allowed on non-net items if order value exceeds £11.50. 10% if order value exceeds £29. Quantity discount prices on most components.

**ELECTROVALUE LTD., DEPT. ET110, 28 St. Judea Road, Englefield Green, Egham, Surrey TW20 0HS. Phone Egham 33603 (STD 0784. London 87). Telex 284475.**

Northern Branch (Personal Shoppers only), 680 Burnage Lane, Burnage, Manchester M19 1NA. Phone (061) 432 4945.

# TRAIN FOR SUCCESS

in Radio, Television & Electronics

ICS have helped thousands of ambitious people to move up into higher paid more secure jobs in the field of electronics - now it can be your turn. Whether you are a newcomer to the field or already working in the industry. ICS can provide you with the specialised training so essential to success.

### Personal Tuition and Guaranteed Success

The expert and personal guidance by fully qualified tutors, backed by the ICS guarantee of tuition until successful, is the key to our outstanding record in the technical training field. You study at the time and pace that suits you best and in your own home. In the words of one of our many successful students: "Since starting my course, my salary has trebled and I am expecting a further increase when my course is completed."

### City and Guilds Certificates

Excellent job prospects await those who hold one of these recognised certificates. ICS can coach you for:

- Telecommunications Technicians
- Radio, T.V. Electronics Technicians
- Radio Amateurs
- Electrical Installation Work

### Diploma Courses

- Colour T.V. Servicing
- CCTV Engineering
- Electronic Engineering & Maintenance
- Computer Engineering and Programming
- Radio, T.V. and Audio, Engineering & Servicing
- Electrical Engineering, Installations & Contracting

### Other Career Courses

A wide range of other technical and professional courses are available including GCE.

**FREE BOOK**

Post this coupon or 'phone today for free ICS careers guide in Electronics

Name \_\_\_\_\_

Address \_\_\_\_\_

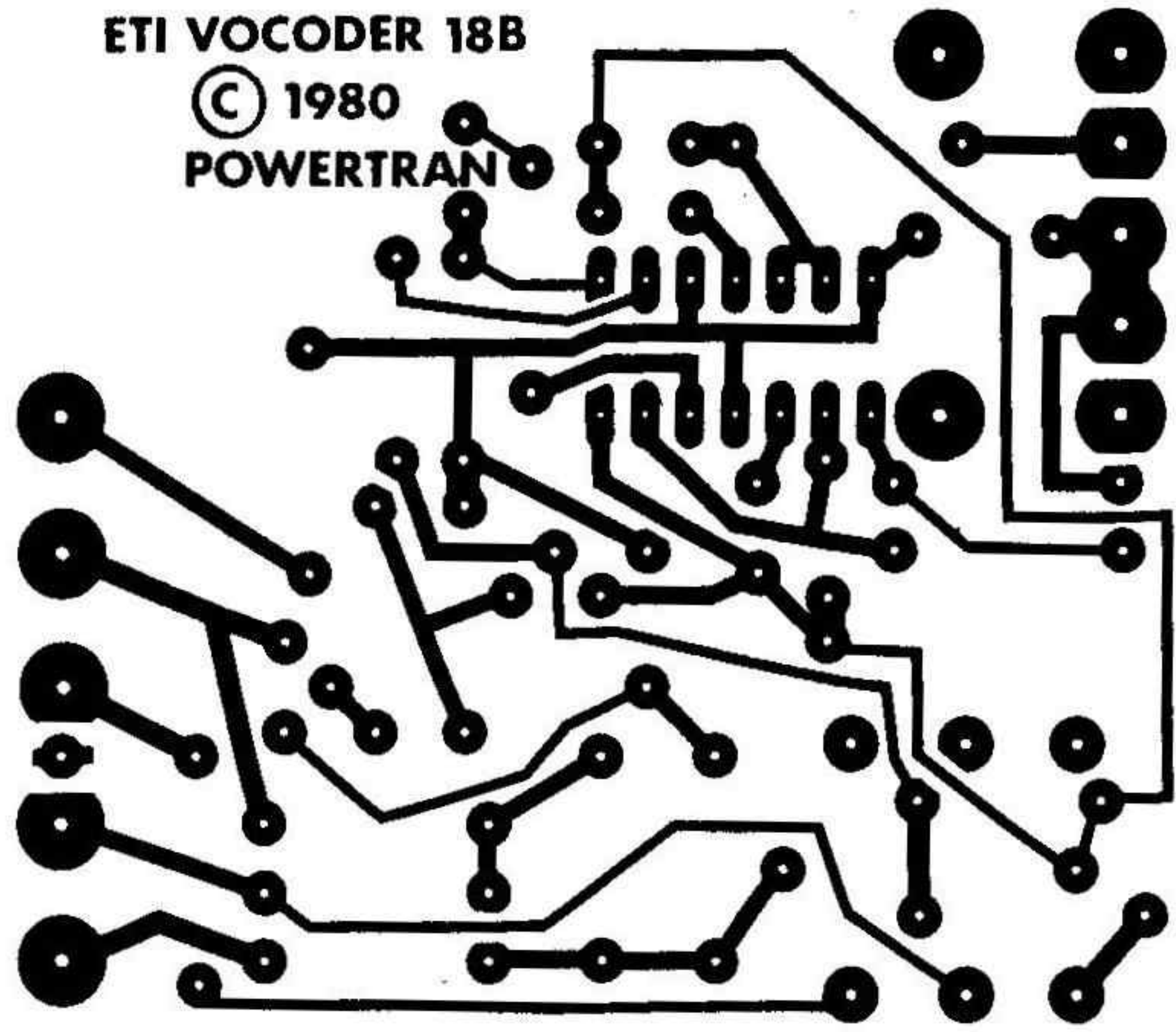
Age \_\_\_\_\_

**ICS**

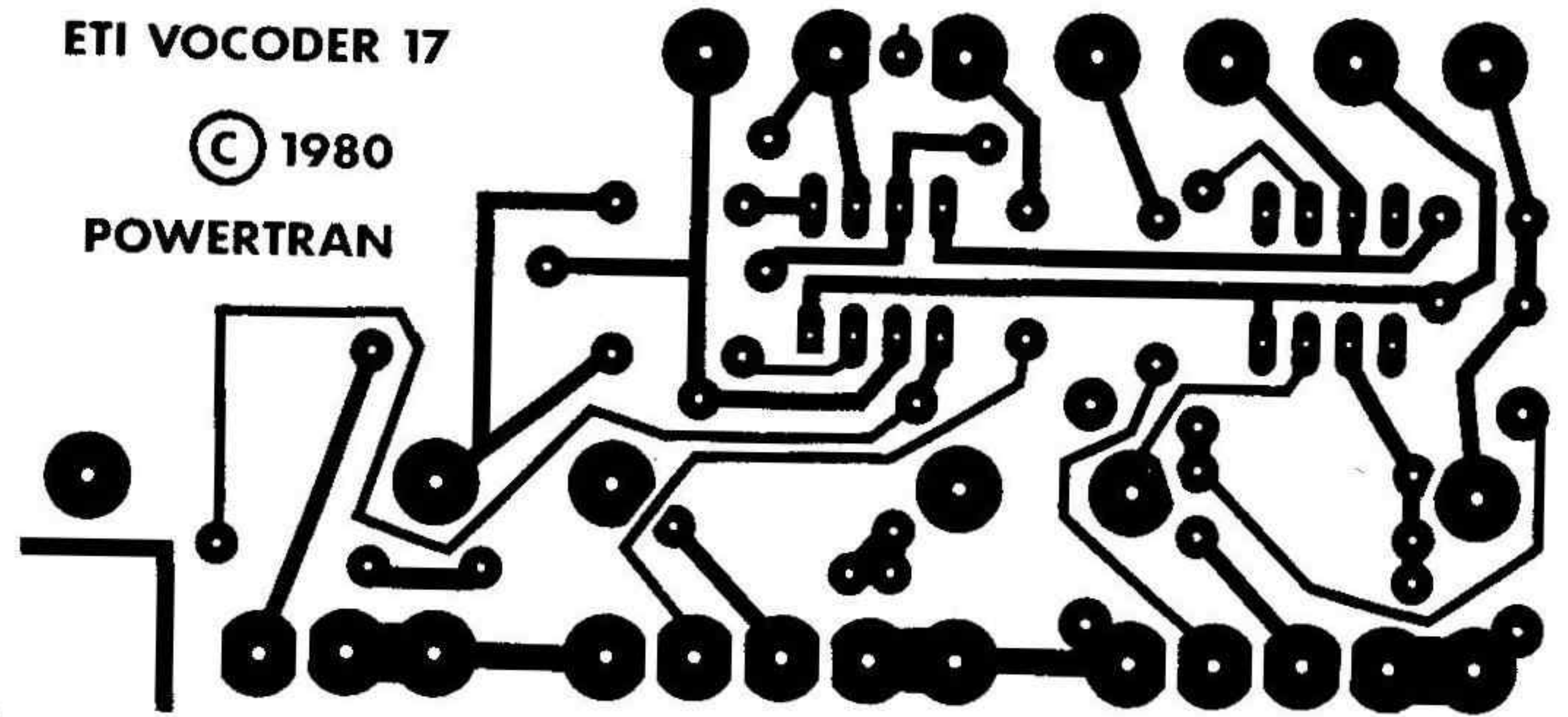
To ICS, Dept. Z265; Intertext House, London SW8 4UJ or telephone 01-622 9911 (all hours)



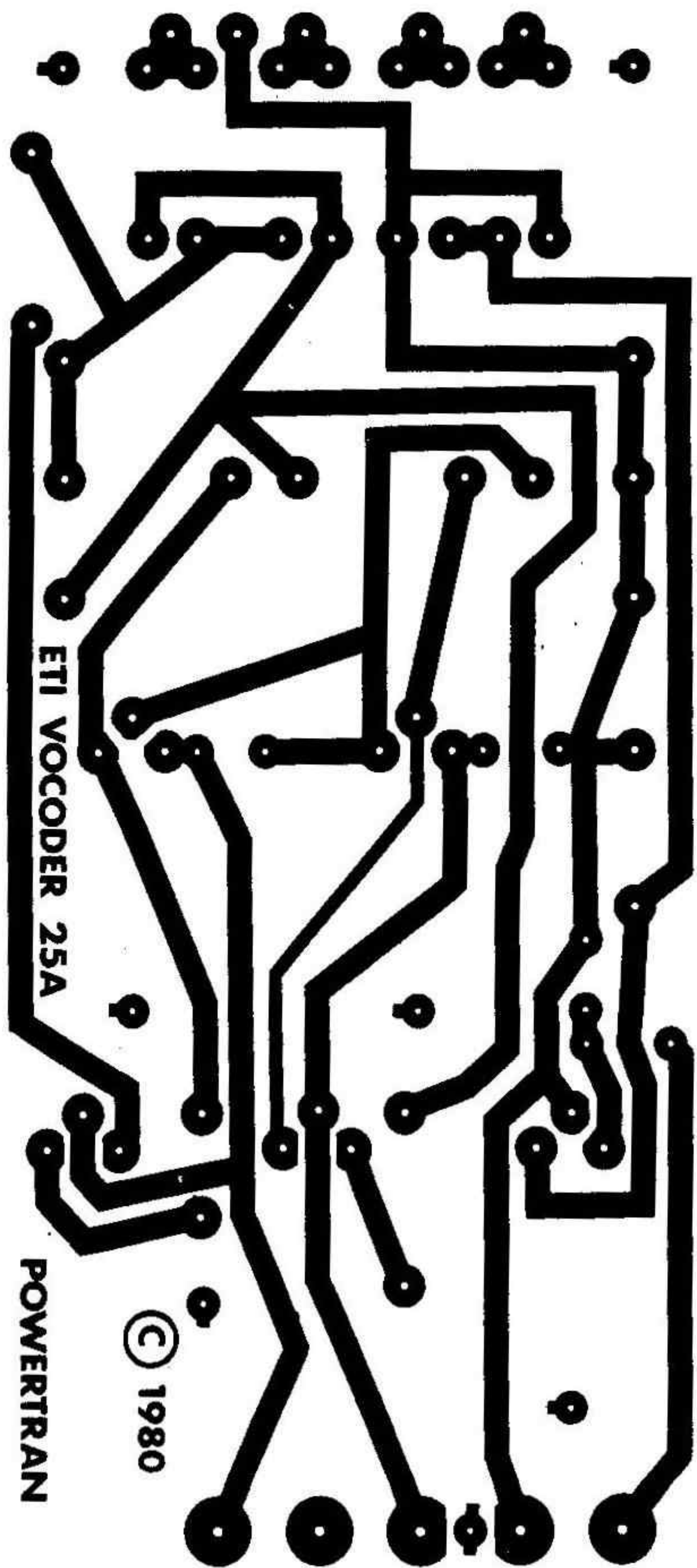
# PCB FOIL PATTERNS



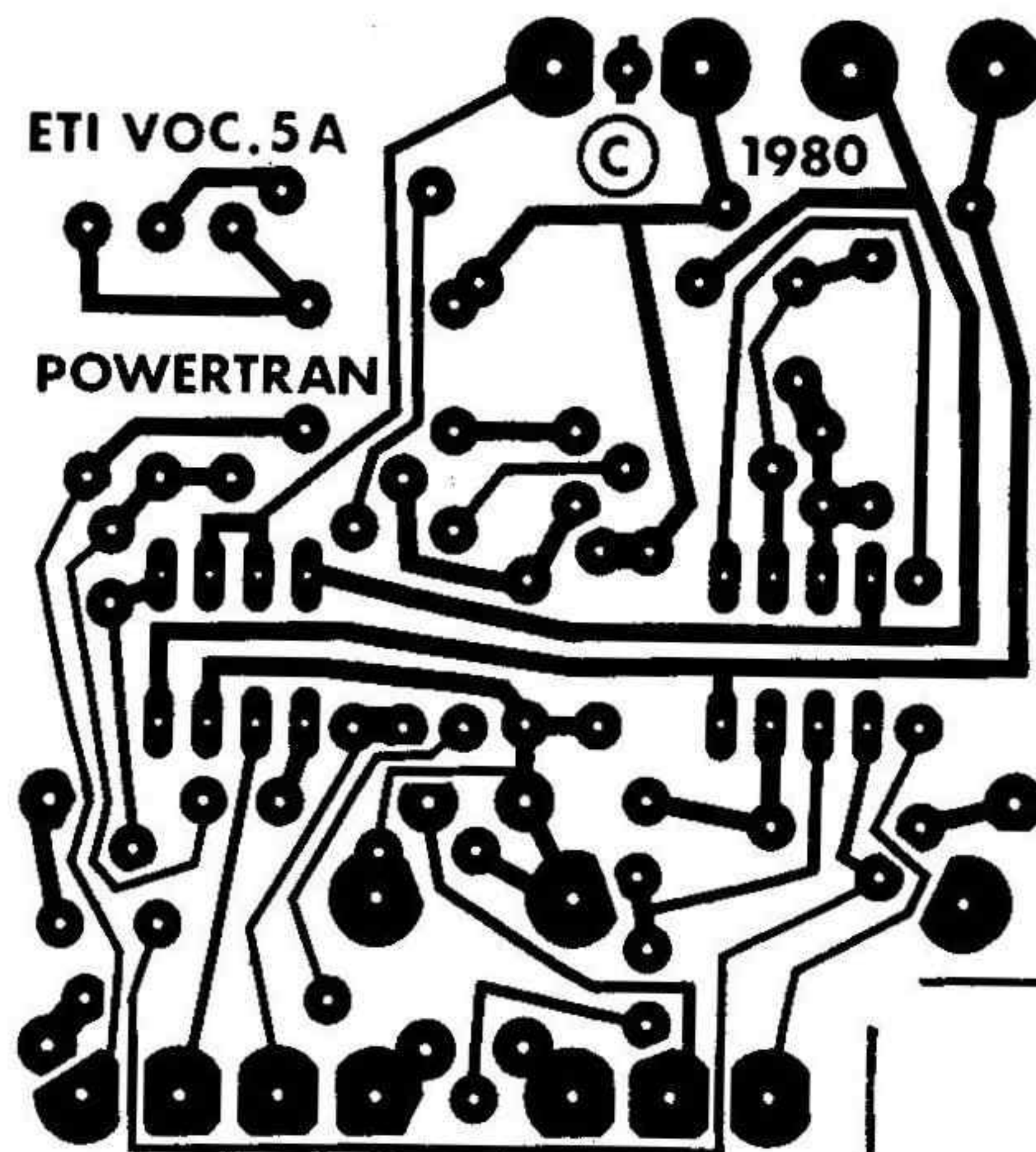
Vocoder Slew Rate Control Board



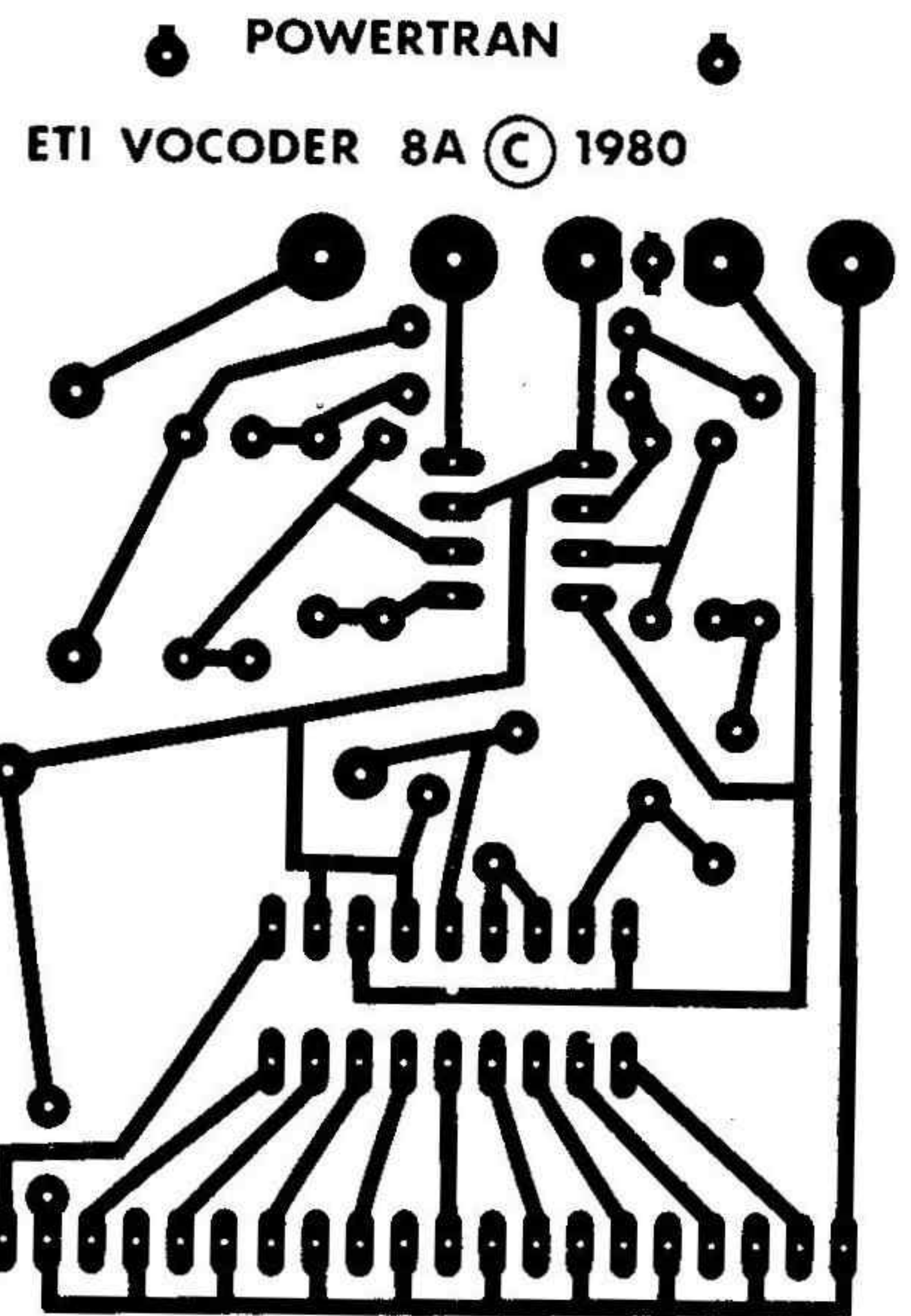
Vocoder Output Amplifier Board



Vocoder Power Supply Board

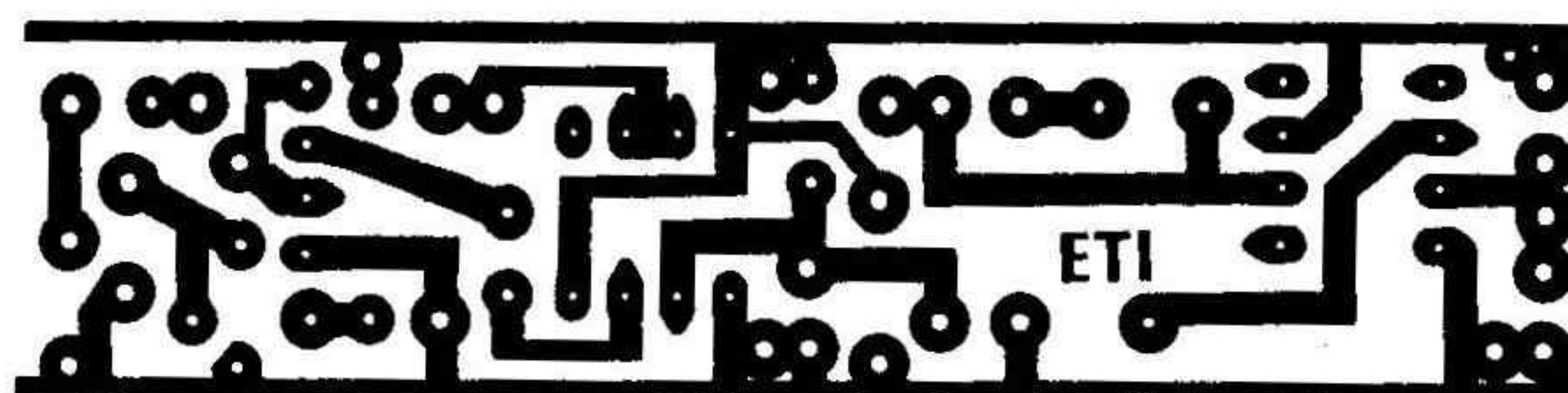


Vocoder Input Amplifier Board

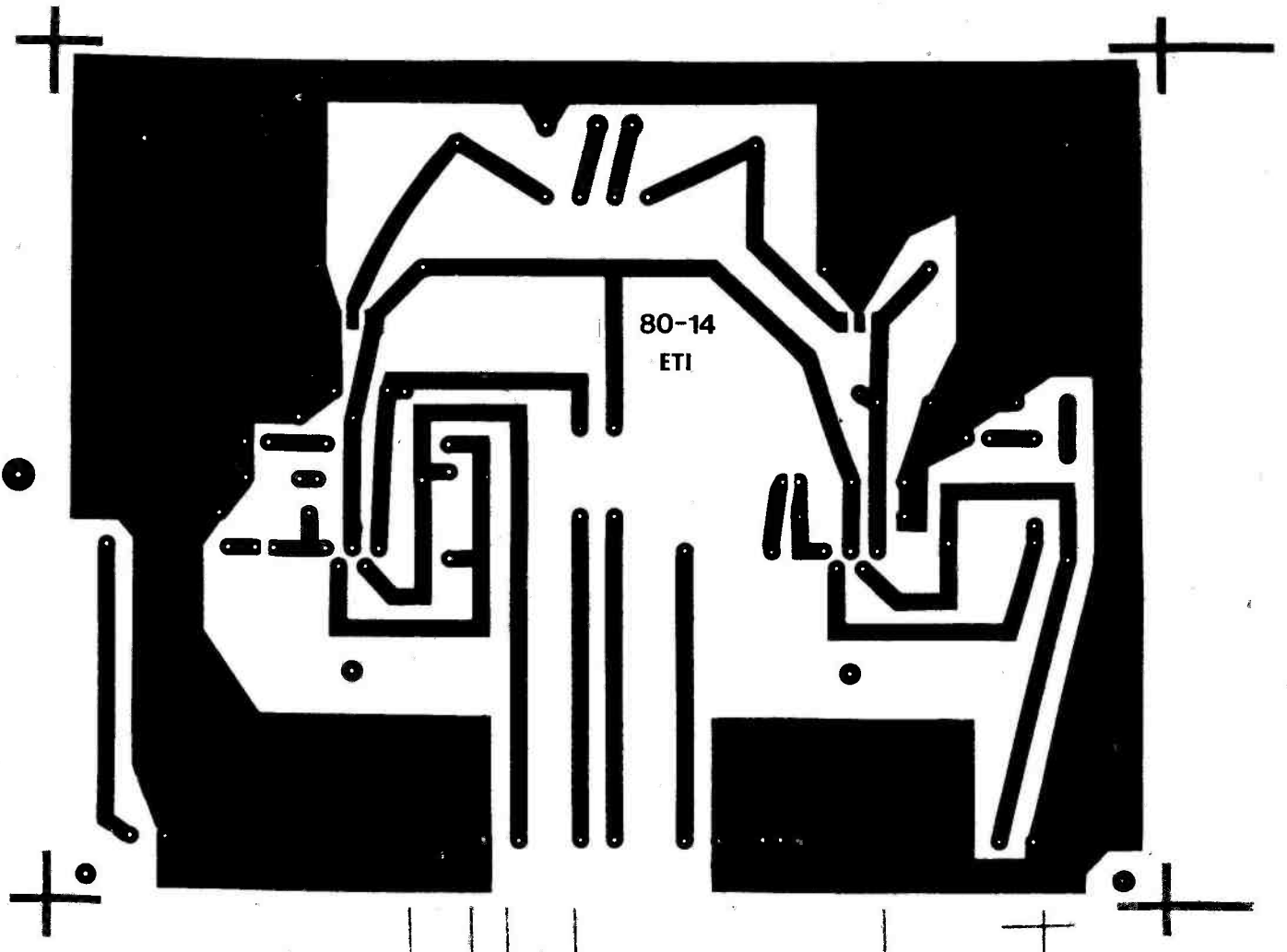


Vocoder LED PPM Display Board

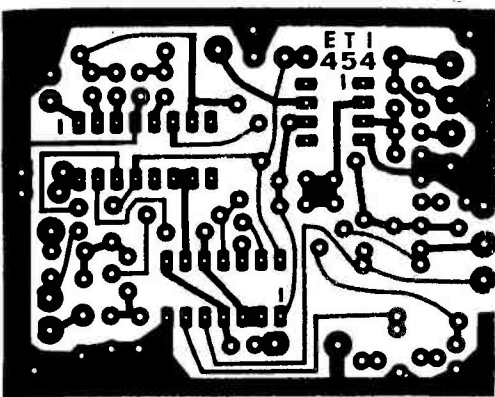
(Below) Flash Trigger



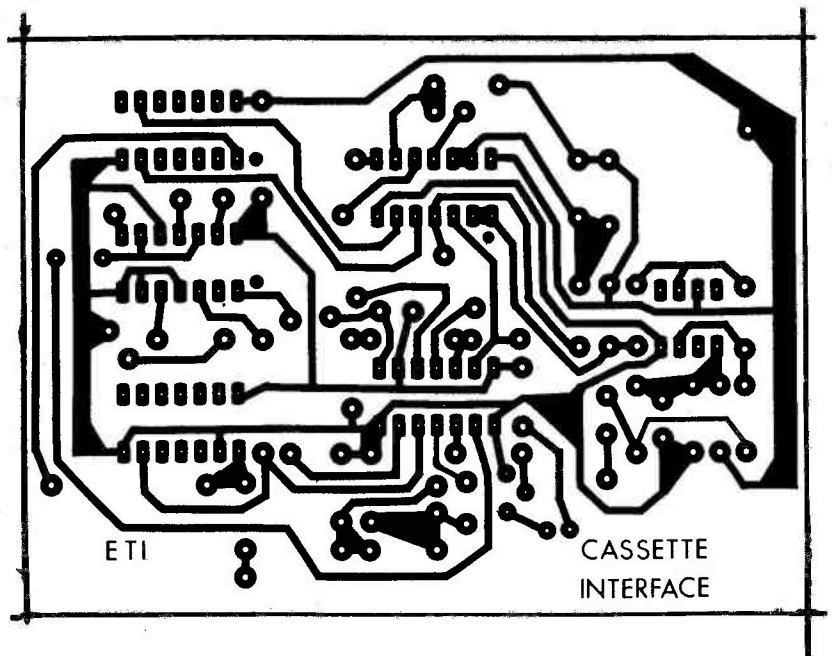




(Above) Monitor amplifier



(Above) Sustain/Fuzz board





WATFORD ELECTRONICS

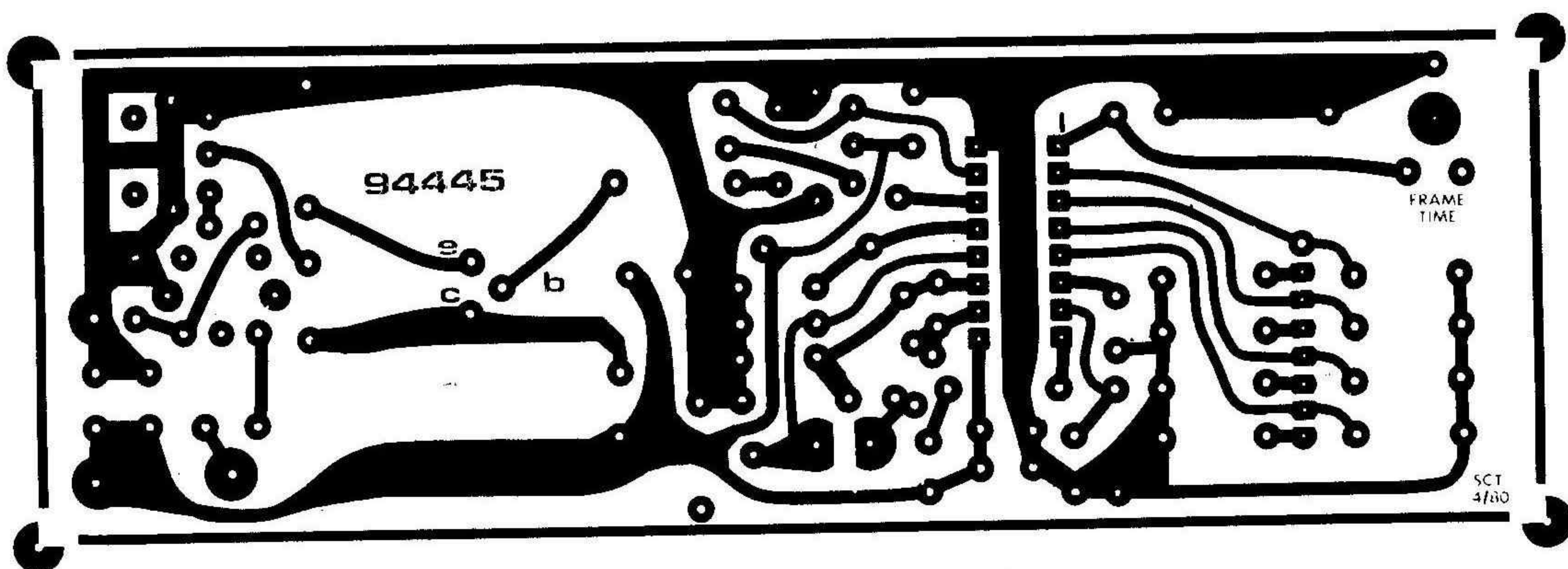
COMPUTER CORNER

- **SUPERBOARD II** Ready-built and tested **Only £150**
- **PSU 5V/3A** (for above incl. RF Modulator) **£25**
- **610 Expansion Board** (BK RAM) expandable to 24K **£150**
- **CHALLENGER 1P** (Superboard cased with PSU) **£200**
- **Extra 4K RAM** (8x2114) **£28**
- **Plastic Case** Black, fits UK101 Superboard, NASCOM II etc **£20**
- **SUPERPRINT 800**, 80 column High Performance Impact Printer. Ideal for PET, NASCOM, UK101, Superboard, TRS80 etc. **only £349**
- **VIDEO GENIE** based on TRS80. Utilises Z80, 12K level II Basic 16K RAM incl. Cassette Deck **£325**
- **STRINGY FLOPPY**. Combines economy of Cassette with speed & reliability of DISC (incl. 20 wafers) **£169**
- **SOFTY**. Intelligent SPROM Programmer. Connects directly to TV. Develop. copy. Burn EPROMS Kit **£99**
- **Ready-built and tested PSU for above (Built)** **£120**
- **UHF Modulators 6MHz** **280p**
- **UHF Modulators 8MHz** **450p**
- **KEYPADS 4 x 4 matrix** **350p**
- **Full ASCII coded 56 Key Keyboard Mod.** **75¢** **£40**
- **10x C12 Cassettes in Rack** (P&P is extra on all items) Call in at our shop for Demo or write in for leaflets **590p**

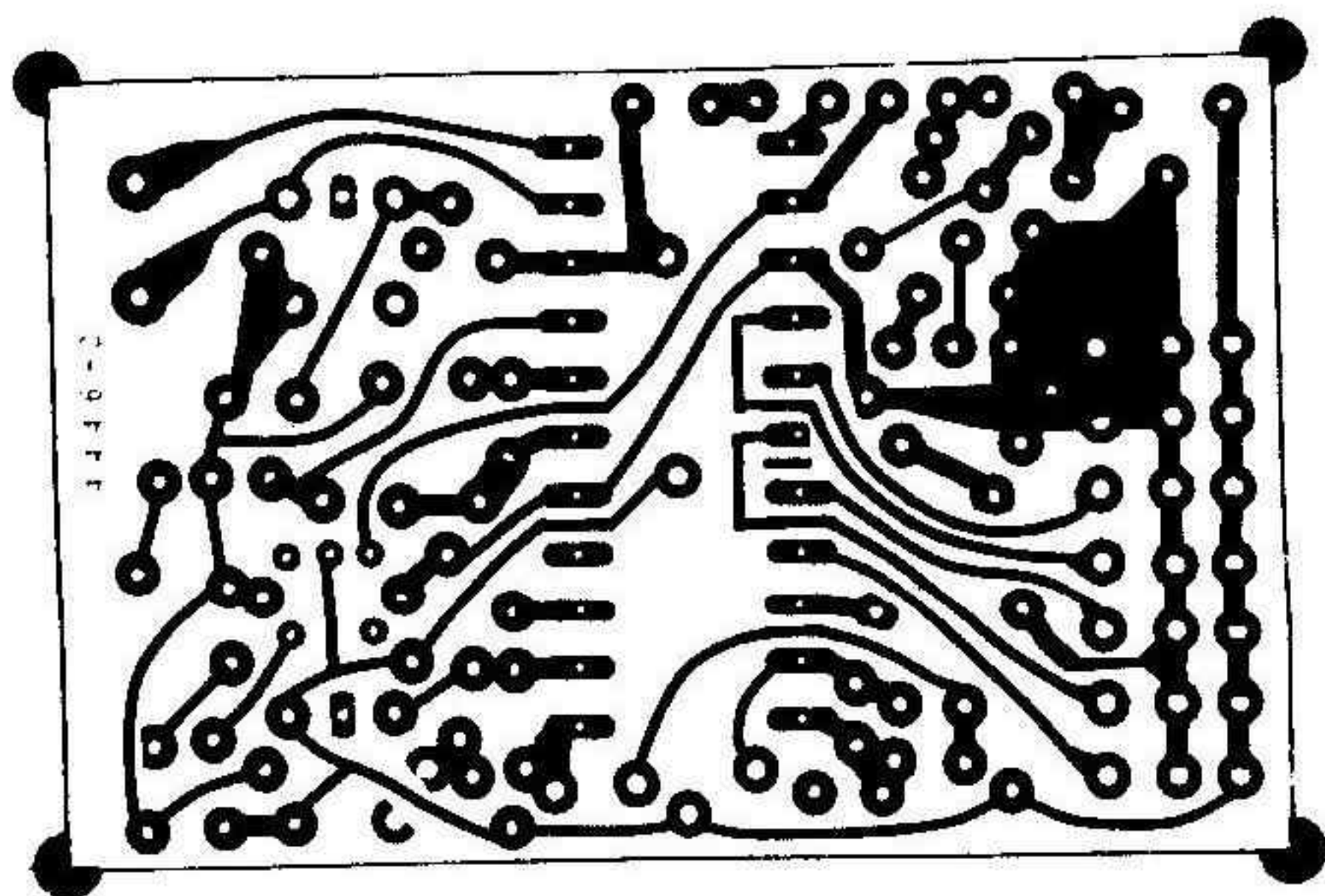
- SWITCHES**
- TOGGLE: 2A, 250V, **28p**
- SPST **34p**
- DPST **34p**
- DPDT **38p**
- 4 pole on/off **54p**
- SLIDE 250V:**
- 1A DPDT **14p**
- 1A DPDT c/over **15p**
- 1/2A DPDT **13p**
- 4 pole 2-way **24p**
- PUSH BUTTON**
- DPDT Black Body **90p**
- Red, Blue, Green, Yellow **40p**
- SRL Latching **125p**
- SRM Momentary **125p**
- MINI Non Locking**
- Push to Make **25p**
- Push Break **25p**
- DIL SWITCHES (SPST)**
- 4 way **85p**, 6 way **95p**, 8 way **115p**
- ROTARY: Make your own multiway Switch.**
- Adjustable Stop Shafting Assembly. Accommodate up to 6 Waters **90p**
- Mains Switch DPST to fit **40p**
- Break Before Make Wafers. 1 pole/12 way **2p/6 way**, 3p/4 way, 4p/3 way, 6p/2 way **8p**
- Spacer and Screen **5p**
- ROTARY: (Adjustable Stop)**
- 1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way **43p**
- ROTARY: Mains 250V AC, 4 Amp** **52p**

- CRYSTALS**
- 100KHz **323**
- 455KHz **383**
- 1MHz **323**
- 1.0038M **385**
- 1.28MHz **382**
- 1.6MHz **323**
- 1.8MHz **323**
- 1.8432MHz **362**
- 2.4576MHz **362**
- 3.2768M **323**
- 3.57954M **185**
- 4.000MHz **290**
- 4.032MHz **323**
- 4.433619M **136**
- 5.0MHz **385**
- 5.1854M **323**
- 5.24288M **425**
- 6.0MHz **323**
- 6.5536M **200**
- 7.680M **323**
- 8.0MHz **392**
- 8.08333M **362**
- 8.867237M **362**
- 9.376M **323**
- 10.0MHz **323**
- 10.7MHz **323**
- 12MHz **392**
- 14.31818M **323**
- 14.8MHz **323**
- 18.432M **323**
- 20.0MHz **323**
- 27.848M **323**
- 38.6667M **380**
- 48.0MHz **323**
- 100.0MHz **323**
- VOLTAGE REGULATORS**
- 1A TO3 +ve -ve **220p**
- 5V 7805 **145p** 7912 **220p**
- 12V 7812 **145p** 7912 **220p**
- 15V 7815 **145p**
- 18V 7818 **145p**
- 20V 7820 **145p**
- 24V 7824 **145p**
- 100mA TO92 Plastic Casing
- 5V 78L05 **65p** 79L05 **65p**
- 6V 78L12 **30p**
- 8V 78L12 **30p**
- 12V 78L12 **30p** 79L12 **65p**
- 15V 78L15 **30p** 79L15 **65p**
- ALUM. BOXES WITH LID**
- 3x2x1" **55**
- 2 1/2x5 1/2x1 1/2" **75**
- 4x4 1 1/2" **75**
- 4x2 1/2x1 1/2" **75**
- 4x5 1/2x1 1/2" **100**
- 4x2 1/2x2" **80**
- 5x4x2" **107**
- 6x4x2" **110**
- 7x5 1/2x2" **185**
- 8x6x3" **185**
- 10x7x3" **240**
- 10x4 1/2x3" **228**
- 12x5x3" **230**
- 12x8x3" **278**
- PANEL METERS**
- FSD
- 60x46x35mm **445p each**
- 0-50uA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
- 0-50mA **4x3x3 1/2"**
- 0-100mA **4x3x3 1/2"**
- 0-500mA **4x3x3 1/2"**
- 0-1A **4x3x3 1/2"**
- 0-2A **4x3x3 1/2"**
- 0-25V **4x3x3 1/2"**
- 0-50V AC **4x3x3 1/2"**
- 0-300V AC **4x3x3 1/2"**
- 0-5V **4x3x3 1/2"**
- 0-10V **4x3x3 1/2"**
- 0-100V **4x3x3 1/2"**
- 0-500V **4x3x3 1/2"**
- 0-1000V **4x3x3 1/2"**
- 0-500pA **4x3x3 1/2"**
- 0-100uA **4x3x3 1/2"**
- 0-500uA **4x3x3 1/2"**
- 0-1mA **4x3x3 1/2"**
- 0-10mA **4x3x3 1/2"**
-

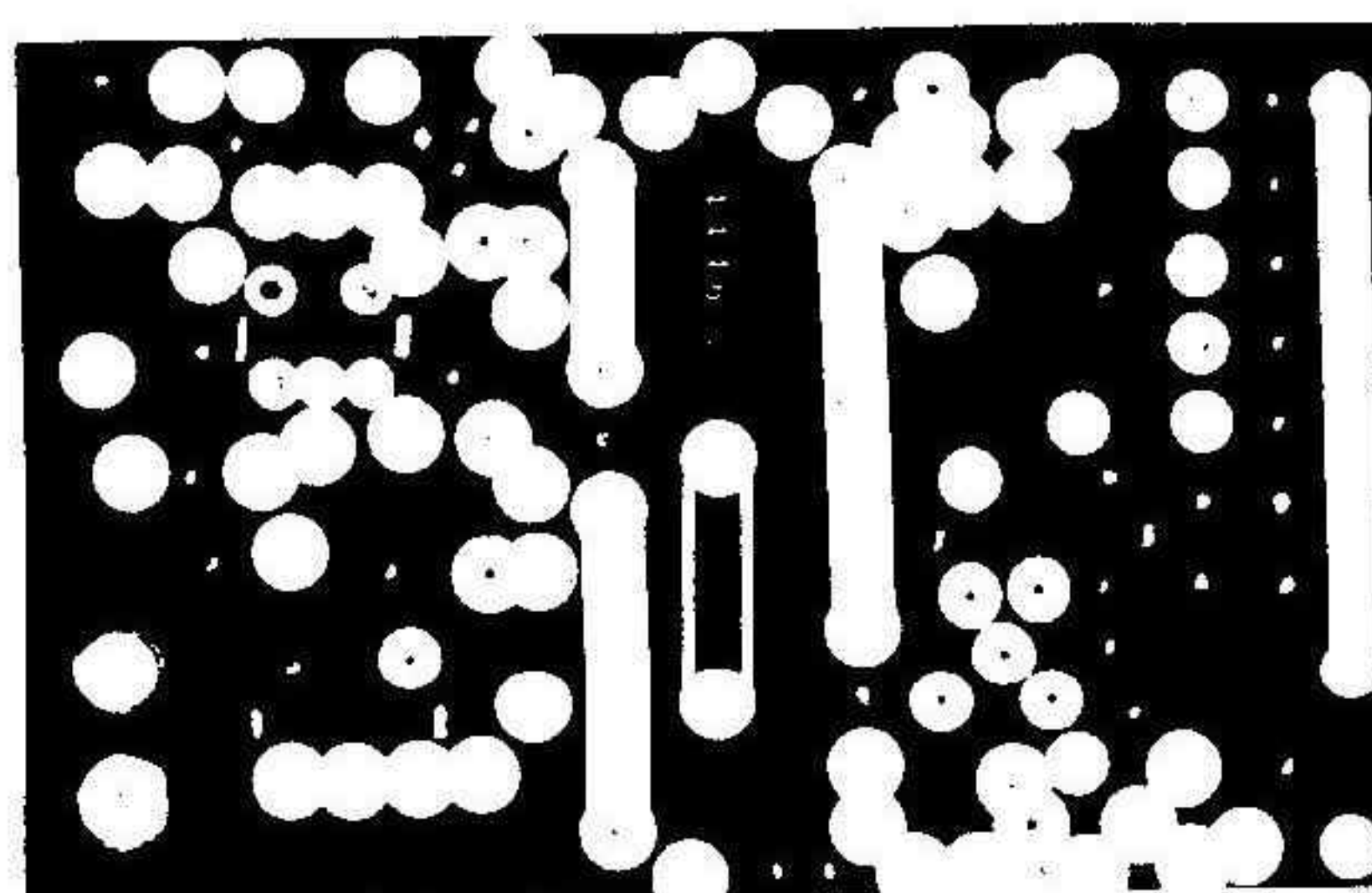




FM Radio Control transmitter board



FM Radio Control receiver board (topside)



FM Radio Control receiver board (bottom side)

# Bind it

It's so easy and tidy with the Easibind binder to file your copies away. Each binder is designed to hold approximately twelve issues and is attractively bound and blocked with the ELECTRONICS TODAY INTERNATIONAL logo.

Price U.K. £3.95 including postage, packing and V.A.T., overseas orders add 30p. Why not place your order now and send the completed coupon with remittance to:-

EASIBIND LTD., 4 UXBRIDGE STREET,  
LONDON W8 7SZ. Tel: 01-727 0686  
Please allow 3/4 weeks for fulfillment of order.

*it's easy* **EASIBIND**  
*with*

Easibind Ltd., 4 Uxbridge St., London, W8 7SZ.  
Nat. Giro No. 5157552.

## Order Form

ELECTRONICS TODAY INTERNATIONAL

I enclose p.o./cheque value .....

for ..... binders

Years required .....

**BLOCK LETTERS PLEASE**

Name .....

Address .....

.....

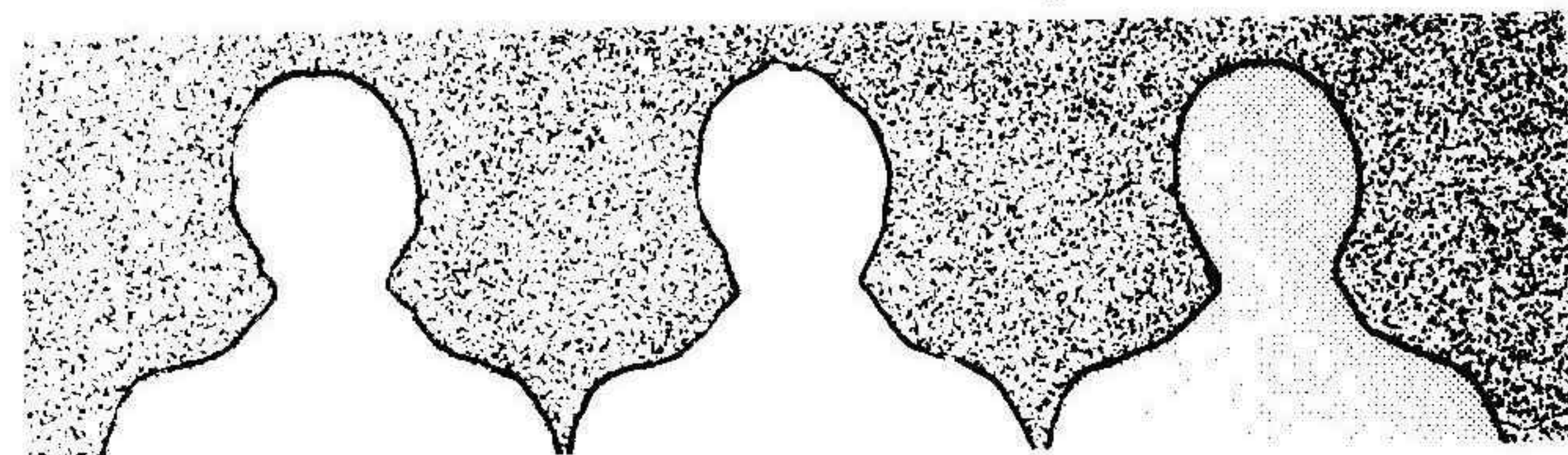
.....

Date .....

Registration No. 307469



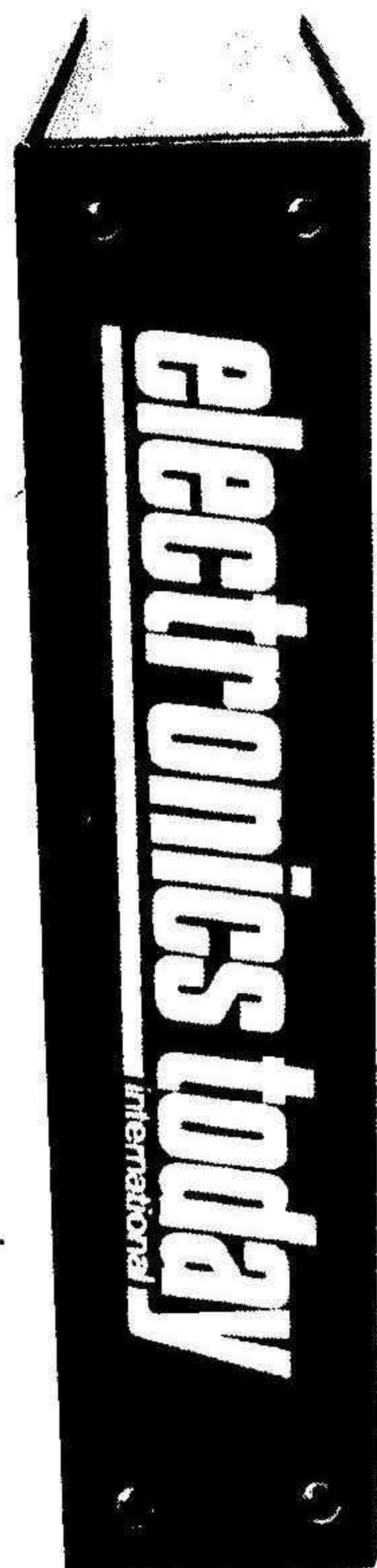
# HELP! ETI NEEDS YOU!



Could you be a Project Engineer for ETI? — the person who fills this position will be able to design and build up projects to the standard of finish ETI readers are used to seeing in their magazine. This calls for someone with a good knowledge of circuit design and with the patience to carry the design through to a finished state. Existing staff are available to assist in all aspects of design work. The easiest part of the job will be writing up the project once it is completed. None of the present ETI technical staff were journalists previous to joining, and no-one has found the writing a difficult task.

We have no preconceived notions of age required. Applications should reach us as soon as possible with C.V.

Apply in writing to:  
The Editor,  
Electronics Today International  
145 Charing Cross Road,  
London WC2H 0EE





# ETIPRINTS

Shown below is the listing for the last year's 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).

## PARTS LIST

<b>038</b>	Buffer Moving Coil Preamp Process Controller	Jan 80	<b>040B</b>	ETI 80 - PSU Tuning Fork Filter Coin Toss	Feb 80	<b>042B</b>	Touch Dimmer, Battery Charger RC Guardian (Top,Bottom)1&2	Apr 80
<b>039A</b>	Hum Filter Logic Probe	Dec 79	<b>041A</b>	ETI Audiophile ETI VCA Signal Trace ETI HC Electromyogram	Mar 80	<b>043</b>	IR60 preamp, Receiver, PSU, Servo Tester, VU-PPM	May 80
<b>039B</b>	Long Period Timer Rain Alarm Touch Switch Flash Trigger Pseudo Random Noise Gen	Dec 79	<b>041B</b>	VCM Heater Controller	Mar 80	<b>044A</b>	IR60 Function Board (Top & underside) Control Circuit, Line Transmitter, Tape Response Meter Ohmmeter	June 80
<b>039C</b>	Function Generator	Dec 79	<b>042A</b>	300W Amp Module	Apr 80	<b>044B</b>	FM receiver PSU & Monitor Amp Drum Synth (function board)	June 80
<b>040A</b>	ETI 80 - VCO and VCLFO	Feb 80	<b>033</b>	Fuel Level Monitor, Alarm, Screen Controller Dynamic Noise Reducer	Sep 79			

## 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!

### BUY LINES

ORDER TODAY

Send a cheque or PO (payable to ETI Magazine) to

ETI PRINT, ETI MAGAZINE 145 Charing Cross Road,  
London WC2H 0EE.

Price £1.20p.

# ETIPRINTS

**SPECIAL OFFER YOU MUST NOT MISS £127 + VAT**

**SAFGAN OFFERS ST-45** single trace Oscilloscope

at only **£127 + VAT** P&P Free till 10th Oct. (1980)

10mv/div . . . 5MHz . . . 4" crt . . . 1 yr. Guarantee . . . British

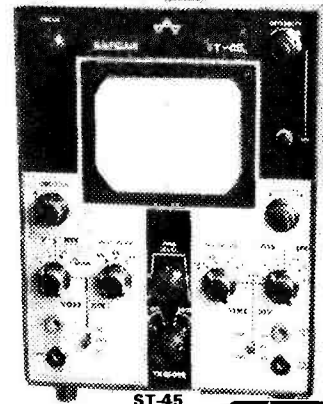
### SPECIFICATION

- ★ 10mv/div - 5v/div in 9 Cal Steps
- ★ BANDWIDTH greater from 5MHz
- ★ TIME BASE 1µs/div - 50ms/div in 15 CAL STEPS
- X5 EXPANSION TO 200ns/div
- X5 MULTIPLIER TO 250ms/div
- ★ TRIGGER LEVEL, ± SLOPE, BRIGHT LINE AUTO

- ★ SENSITIVITY: 0.5div int, 100mv Ext
- ★ GRATICULE BLUE RULED 8x10div (6.4x8cm<sup>2</sup>)
- ★ SIZE H 215mm, W 165mm, D 280mm WEIGHT 4kg.

### ACCESSORIES

- PROBE (X1-REF-X10) £11.50 + VAT
- ADAPTOR BNC to 4mm SOCET £2.95 + VAT



Order to: **SAFGAN ELECTRONICS LTD.**

**56 BISHOPS WOOD, ST. JOHNS, WOKING, SURREY GU21 3QB, Tel: WOKING 66836 or WOKING 69569**

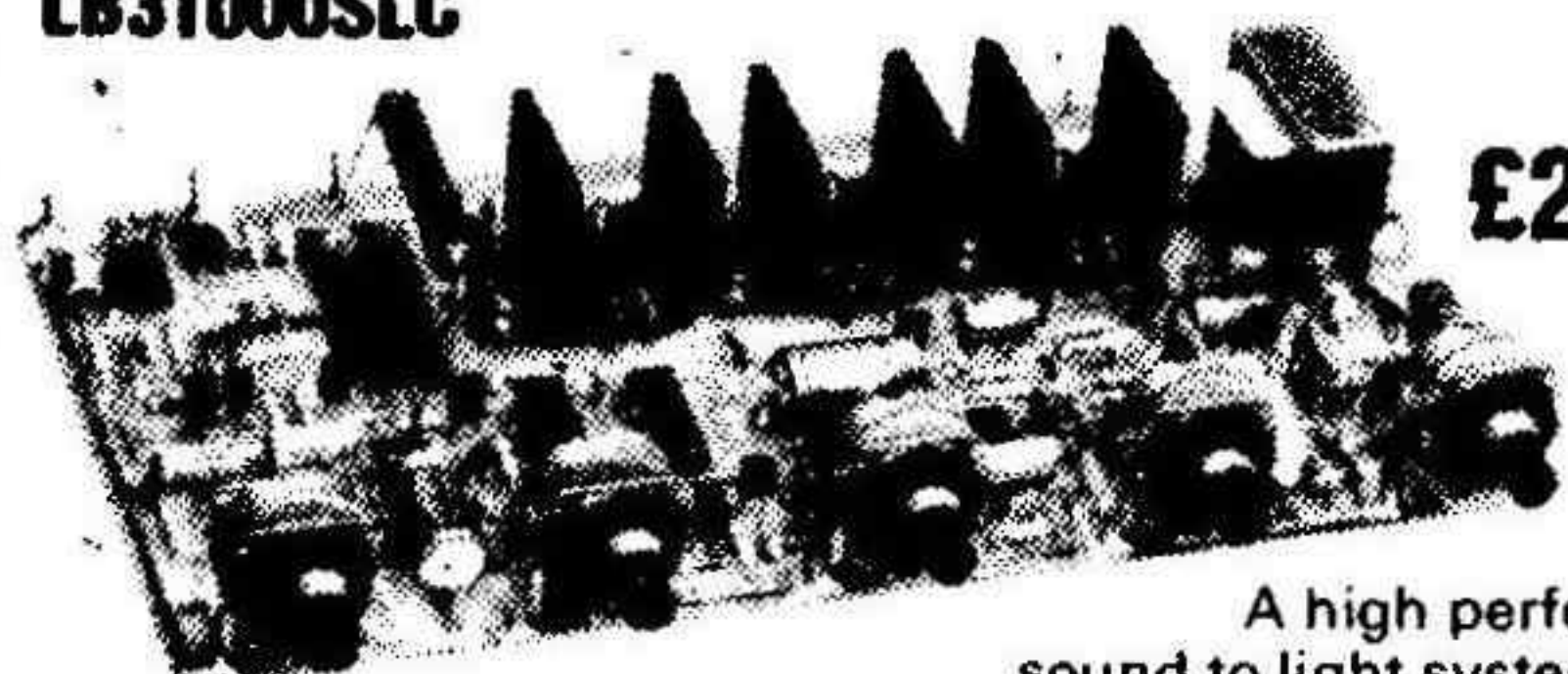
OFFICIAL GOVERNMENT AND EDUCATIONAL ORDERS ACCEPTED





### 3 CHANNEL SOUND/LIGHT CHASER

LB31000SLC

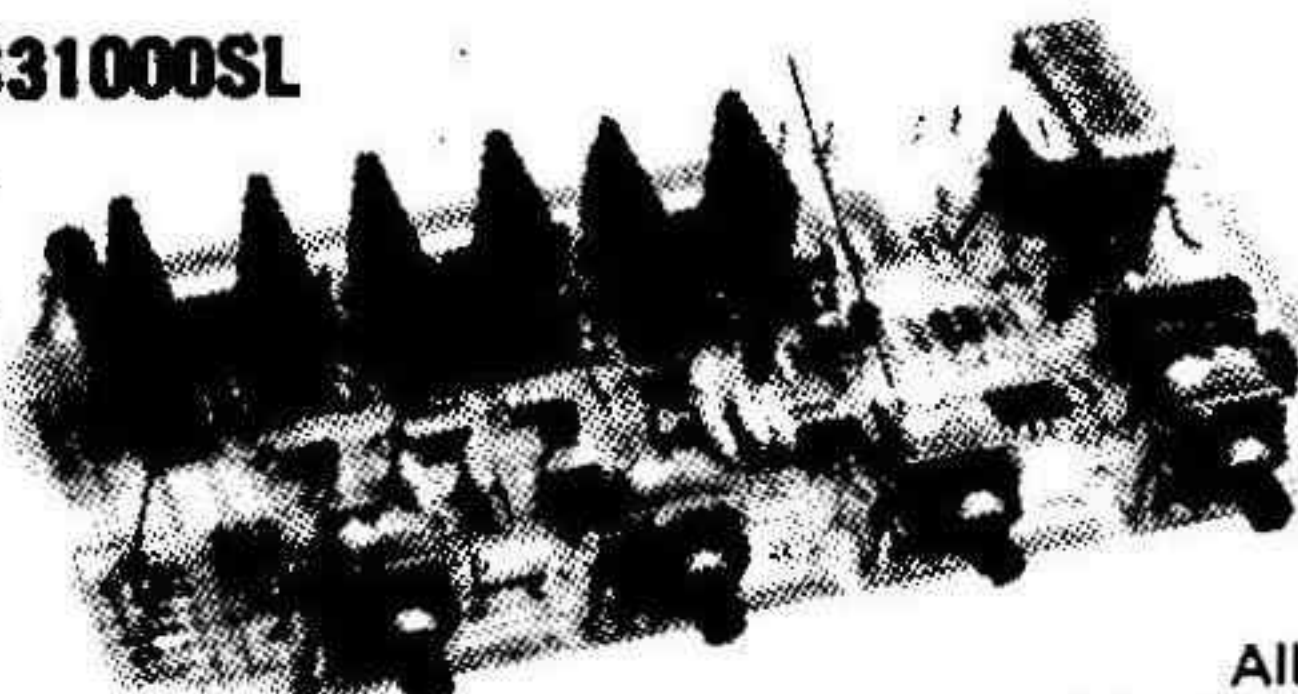


£29.90

A high performance sound to light system which automatically switches to a chase when the music ceases. Super sensitive with an anti interference circuit, the unit will operate from practically any amp and control up to 1,000W/channel, 5Hz to 70K. Controls: bass/mid/treble/master-sensitivity/chase speed.

### 3 CHANNEL SOUND/LIGHT

LB31000SL

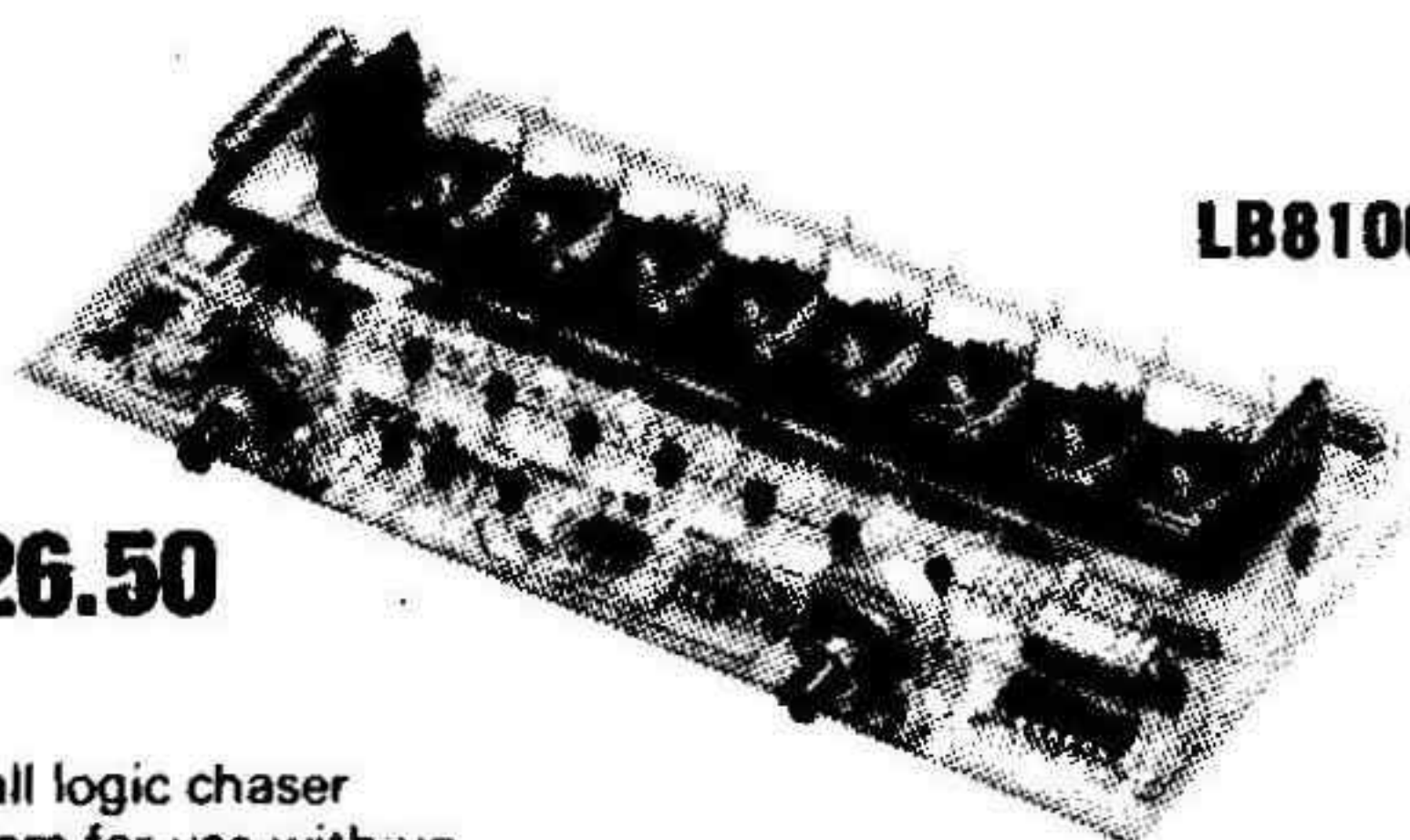


£21.40

All the advantages of the SLC without chase. Controls: bass/mid/treble/master sensitivity. Excellent performance

### 2/4/8 CHANNEL CHASER

LB81000LC

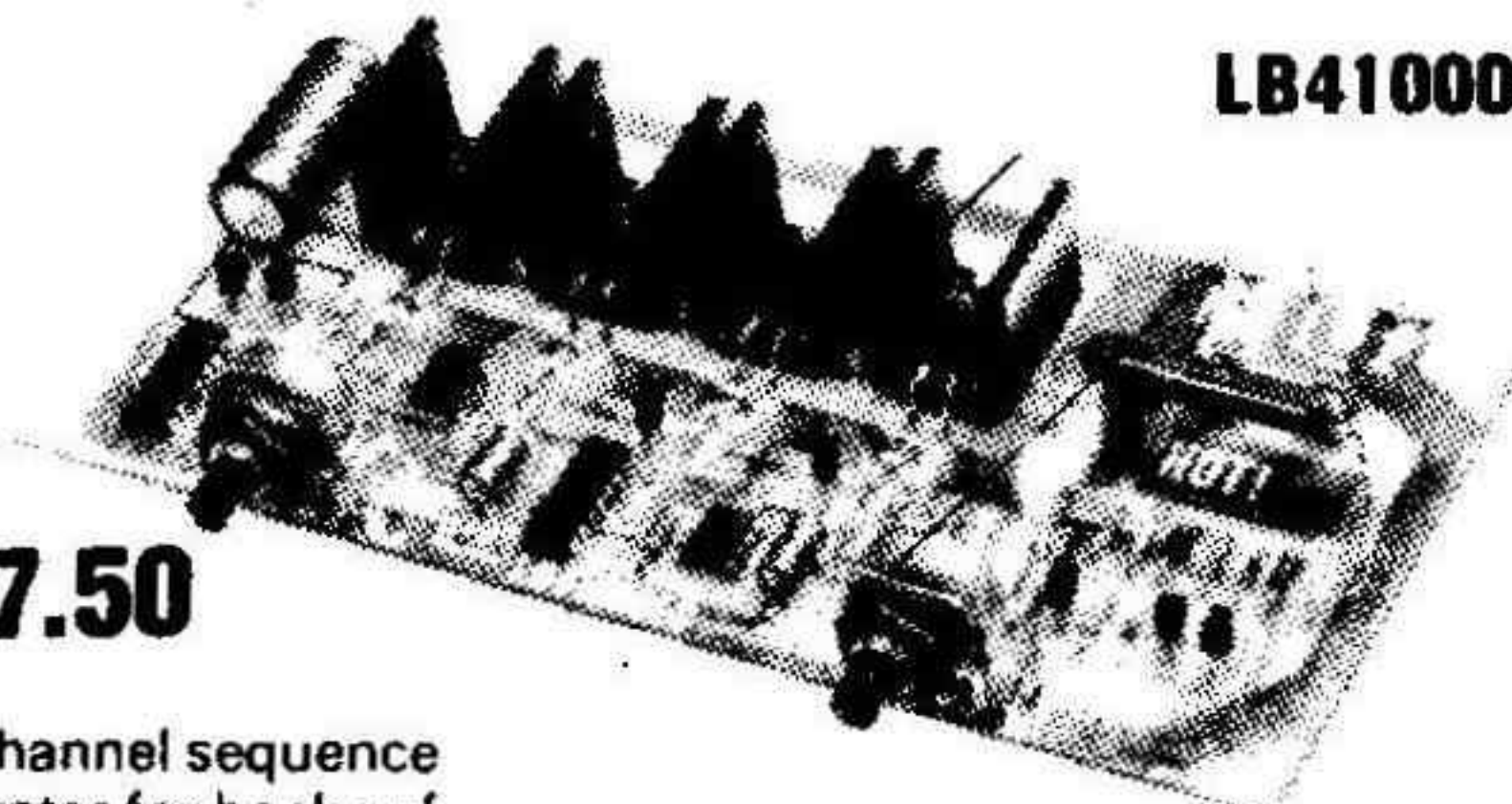


£26.50

An all logic chaser system for use with up to 8 channels at 1,000 watts each. Facilities include footswitch trigger and module cascading (16, 24, 32 channel, etc.), chase speed and re-cycle delay.

### 4 CHANNEL SEQUENCER

LB41000LS

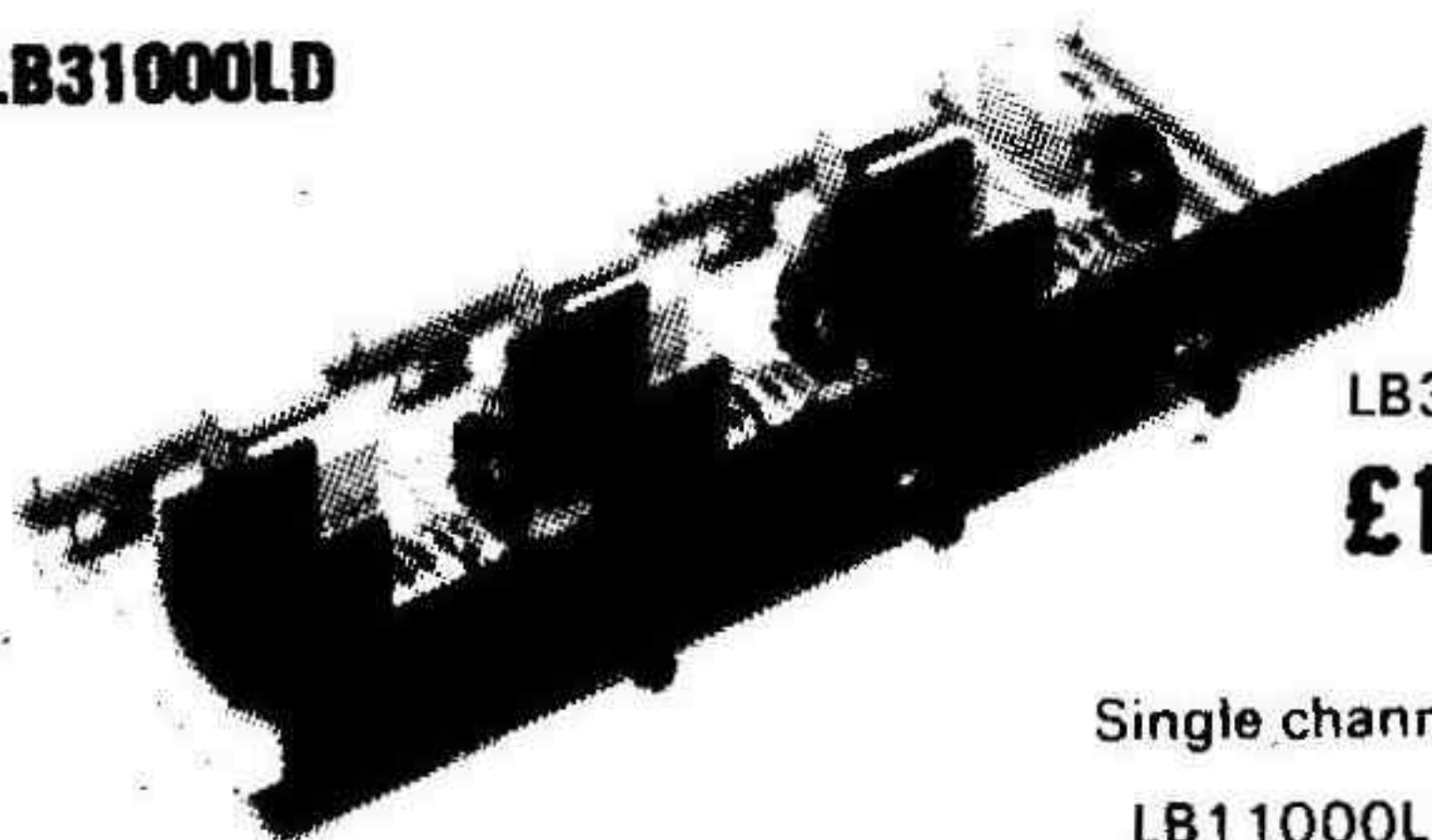


£17.50

A 4 channel sequence generator for banks of lamps up to 1,000W per channel. Two speed controls, cross effect to provide settings between seconds and rapid burst.

### 1 AND 3 CHANNEL DIMMERS

LB31000LD



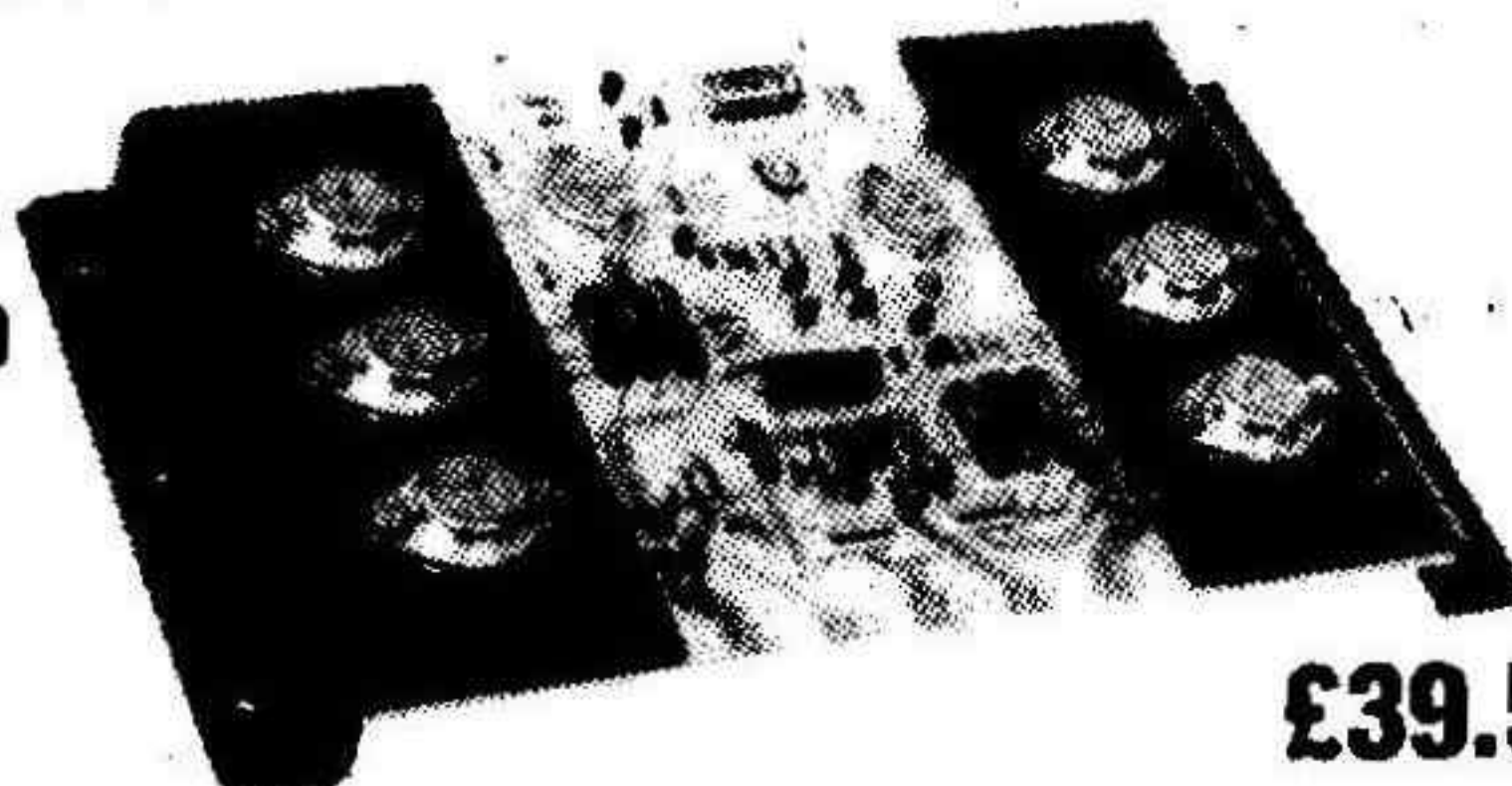
LB31000LD  
£14.70

Single channel version  
LB11000LD £6.70

Power dimmer units for theatre/stage applications up to 1,000W per channel, with on board suppressing. The unit is also available without rotary pots, for use with sliders —

LB31000LD (no pots) £13.50 Sliders 75p each.

LB250

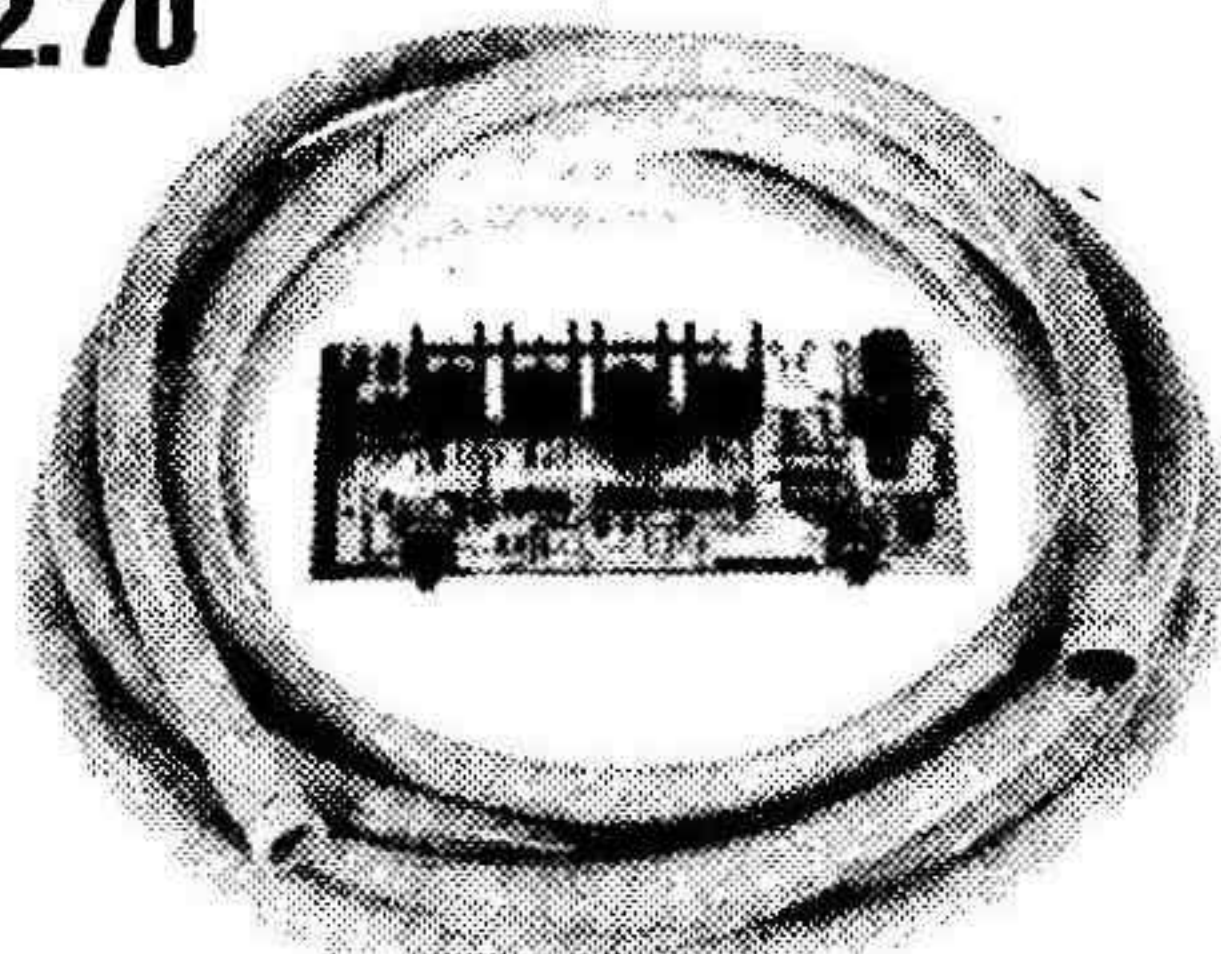


£39.50

### ROPE LIGHTS/DRIVER

LB41000LC-S

£22.70



24 feet ropes  
Red/Yellow  
Blue/Green

ROPE LIGHTS

20% off R.R.P.

£41.40

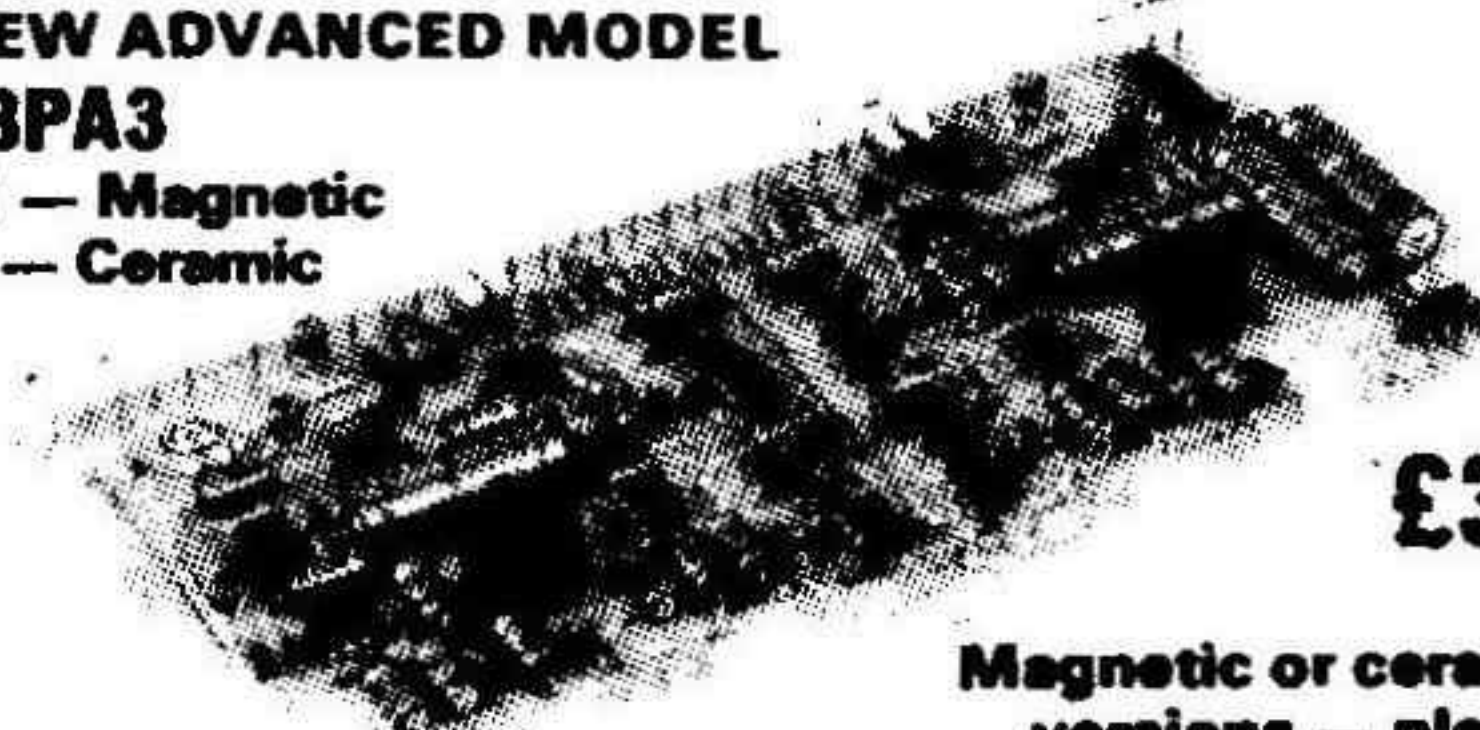
A four channel chaser up to 1,000W per channel, with a sound trigger facility. The music input signal modulates the speed of the chase giving an excellent sound/light effect. The unit will control up to 10 ropes with chase speed and trigger level control.

### STEREO DISCO MIXER/PREAMP

NEW ADVANCED MODEL

LBPA3

M — Magnetic  
C — Ceramic



Still an amazing  
£30.70

Magnetic or ceramic deck versions — please state

All the requirements of a stereo disco preamp on one board, left and right deck mixers/ tone controls/ mic. mixer/ tones/ mic. auto fade over decks/ and P.F.L. The unit can be used with either LB100/150/250 and respective supplies.

Full set of pots — £8.63 Sliders — £11.21 (Six stereo, three mono).

LBPA2

£17.20

A four channel mixer and tone stage for mics, guitars, etc. Can be used with any LB amps. Set of pots £2.74, sliders £5.23.

LBPA1

£19.50

A stereo hi-fi preamp and tone stage for mag. p.u./tape/tuner, etc. Outstanding quality. Set of pots £3.27, sliders £4.49.

### 3-WAY ACTIVE CROSSOVER

LBACO1

£17.90

LBPSU1

£6.20

Bass/mid/treble active crossover with stage booster! Available with crossover points of 200Hz or 300Hz, and 2K or 3KHz (please specify) LBPSU1 supply for LBACO1 (1 or 2).

LBRLD1

£5.70

A de-thump unit for use with any LB power amps. Simply connects between amp and speaker.

PIEZO HORNS

£5.75

P/P 50p

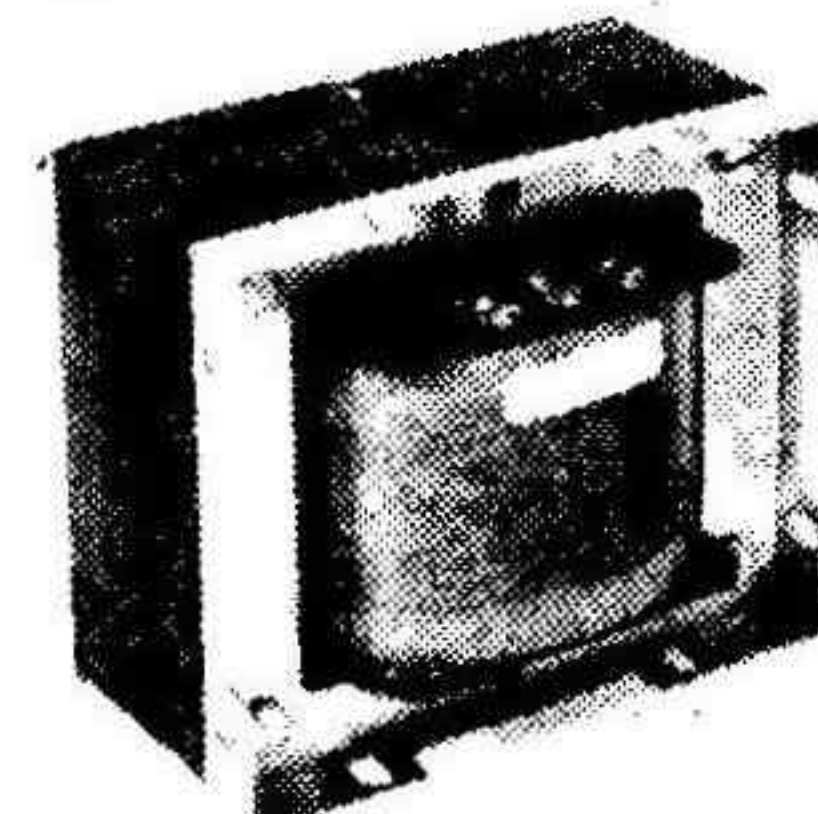
### CELESTION LOUDSPEAKERS

(8ohms)

G12-65 (12 inch 65W)	G12-100 (12 inch 100W)	G12-125 (12 inch 125W)
£20.70 P/P £1.70	£26.45 P/P £1.70	£46.00 P/P £2.00

### POWER SUPPLIES

A range of rugged power supply units to complement our amps.



LB250PS

LB25PS  
£11.20  
P/P £1.20

LB100PS  
£14.70  
P/P £1.40

LB150PS  
£18.00  
P/P £1.40

LB250PS  
£24.50  
P/P £1.70

# L & B

PROFESSIONAL ENGINEERING BY PROFESSIONALS

## ELECTRONIC MODULES

45 Wortley Road, West Croydon, Surrey  
CRO 3EB. Tel. 01-689 4138

- 1) You need a module
- 2) It must be reliable
- 3) It must be competitive
- 4) Its performance must be simply excellent
- 5) Its finish must be outstanding
- 6) You require a connection and circuit diagram
- 7) You require L & B

Each module is manufactured from the highest quality components, and fully tested and guaranteed for 12 months.

All prices shown are VAT inclusive. Please include 50p post/packing except where individually stated. To mail order send cheque/P.O./registered cash/Barclaycard or Access number. C.O.D. service £1 extra. For the new Autumn catalogue send 50p.

### NEW — MINI MODULES — NEW

Ingeniously designed mini pre-amplifier 'building blocks' for use in music and P.A. applications. You choose the type and number of units you require for your particular system and mount each module via its control direct onto your panel.

LBMM1 Pre-amp for mics, guitars etc.  
LBMM2 Mixer for up to 6 LBMM1/2/3/4/5  
LBMM3 Bass/boost/cut for either LBMM1/2/3/4/5  
LBMM4 Mid-boost/cut for either LBMM1/2/3/4/5  
LBMM5 Treble boost/cut for either LBMM1/2/3/4/5  
LBPSU1 ± 15V supply for up to 8 models  
LBPSU ± 15V regulated for up to 50 modules  
MM1 £4.50; MM2 £5.20; MM3 £5.70; MM4 £5.70;  
MM5 £5.70; PSU1 £6.20; RPSU £14.50.

### POWER AMPLIFIERS

Tough dealing power amps for use in sound systems. Open/short circuit protection and fused. Heavy gauge heatsinks and rugged o/p devices (all operate down to 4 ohms).

25W R.M.S. 20Hz to 60K 0.07% THD 9608 S/N LB25	100W R.M.S. 5Hz to 25K 0.1% THD 11008 S/N LB100	150W R.M.S. 5Hz to 25K 0.1% THD 11008 S/N LB150	250W R.M.S. 5Hz to 25K 0.1% THD 11008 S/N LB250
£11.20	£18.20	£26.50	£39.50

Note all models are available with either 500mV or 775mV sensitivity. Please state when ordering.



## DISCO LIGHTING KITS!!!

First class constructional projects, c/w glass fibre P.C.B.'s & full instructions. No extra components needed to make a top rate working unit.

**LK1** 3 channel sound-to-light.  
**£9.90** 300 w/channel 1v - 100w input

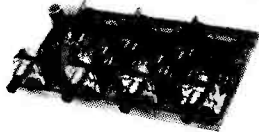
**LK3** 2kW slider dimmer  
**£5.50** suitable for clubs/pubs.  
A professional unit c/w face plate.

**LK2** 3 channel 3kW  
**£17.90** zero voltage firing  
200mV - 100 watts input.

**LK4** 4 channel 4kW  
**£16.50** audio - forward/reverse  
auto - two speed ranges.

Suitable case for  
LK 1/2/4 **£3.50**  
100w spots ES or BC  
**£1.50**.  
Coloured pigmy lamps  
65p.  
8m rope lights  
**£40**

ALL KITS C/W  
Facia panel.  
circuit, comprehensive  
instructions & full  
parts guarantee



Carriage on above 70p

## UNREPEATABLE HI-FI BARGAIN

### 3 WAY LOUDSPEAKER KIT C/W BAFFLE (pre-cut)

Comprises:  
★ 6 1/2" linen surround bass unit  
★ 5" mid-range unit  
★ 3" tweeter  
★ 3 way crossover, fixing screws & baffle  
★ 20 watts handling capability.  
Full instructions provided  
Must be heard to be believed!!

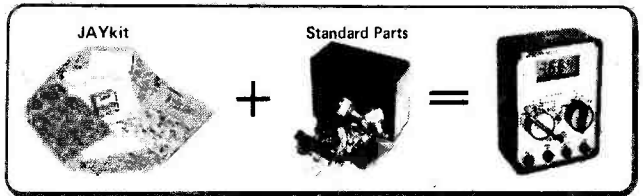
**£9.95** + £1 carr. or two kits for £20 carr. free.

## SAXON ENTERTAINMENTS (ETI)

327-333 Whitehorse Rd., Croydon, Surrey CR0 2HS.

(01) 684 0098.

Order by phone - Access/Barclaycard/C.O.D.  
Open Mon. - Sat. 9am - 5pm.



DM-2



DIGITAL  
MULTIMETER

- ★ DC Volts ..... 1mV to 1000V
- AC Volts ..... 1V to 500V
- DC Current ..... 0.1mA to 0.2A
- Resistance ..... 1Ω to 20MΩ
- ★ 3 1/2 digit LCD
- ★ Auto Low Battery indication
- ★ Auto Polarity & Zero
- ★ 1% accuracy (DC volts)
- ★ Designed around Intersil 7106 IC
- ★ Total cost around £30 (incl. case)

FG-1a



FUNCTION GENERATOR

- ★ 30mV to 10V pk-pk
- ★ 1Hz to 100kHz
- ★ DC coupled
- ★ Sine, Square & Triangle
- ★ Separate TTL output
- ★ Designed around Intersil 8038 IC
- ★ Total cost around £30 (incl. case)

Provided in a JAYkit is a Printed Circuit Board, a punched and lettered Front Panel overlay, a Circuit Diagram and Instruction Sheet and a comprehensive and up to date Component List showing suppliers and current prices. Difficult to obtain pieces of hardware are supplied with the kit.

Jayen Developments, 21 Gladeside, Bar Hill, Cambridge CB3 8DY

To: JAYEN Developments  
21 Gladeside, Bar Hill,  
Cambridge CB3 8DY  
Tel: (0954) 80285

Name \_\_\_\_\_

Address \_\_\_\_\_

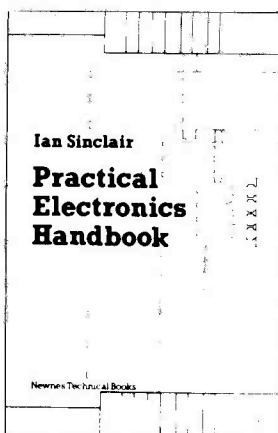
Please send:

- DM-2 @ £5.45  
 FG-1a @ £4.95  
(incl. VAT and P&P)

Money to be refunded if the kit  
is returned within 10 days.

# JAYkits

## New from Newnes Technical Books



Return to Philip Chapman

**Newnes Technical Books**  
Borough Green, Sevenoaks, Kent TN15 8PH

### Practical Electronics Handbook

Ian Sinclair

A useful and carefully selected collection of standard circuits, rules-of-thumb and design data.

Covers passive and active components, discrete component circuits and linear and digital i.c.s.

Describes the operation and function of typical circuits whilst keeping mathematics to a minimum.

208 pages      216 x 138mm      £3.95      US\$9.00

Please send me Practical Electronics Handbook by  
Ian Sinclair 0 408 00447 9. Find £..... enclosed

Name .....

Address .....

.....

.....

ETI 880



# STEVENSON

### REGULATORS

78L05	33p
78L12	33p
78L15	33p
7805	70p
7812	70p
7815	70p
7905	85p
7912	85p
7915	85p
TIC246 16A 400V Triac	115p
C106D 4A 400V 50 SCR	45p

### SPEAKERS

64mm 8 Ω	110p
64mm 64 Ω	110p
70mm 8 Ω	140p
70mm 80 Ω	170p
56mm 8 Ω	100p
Pair of ultrasonic transducers	380p
Magnetic earphone + 3.5mm plug	17p
Crystal earphone + 3.5mm plug	48p

### POTENTIOMETERS

Preset var. or hor.	8p
Rotary 5K-1M Log or Lin	33p
Rotary 5K-1M stereo	110p
Slide 60mm travel 5K-500K log or Lin, single	65p

Suitable knobs for above with coloured caps in red, blue, green, grey, yellow and black. Rotary 16p. Slide 12p each.

### CONNECTORS

DIN	Plug	Chassis Socket	Line Socket
2 pin	9p	8p	12p
3 pin	12p	10p	12p
5 pin 180	13p	11p	16p
JACK	Plug	Scr. plug	Socket
2.5mm	10p	16p	9p
3.5mm	11p	18p	9p
std.	17p	30p	22p
Stereo	25p	39p	25p

### MISC.

8mm stranded conn. cable	30p
Min. mains cable per metre	25p
PP3 battery clips	6p
Crocodile clips	6p
AA rechargeable cells	145p
PP3 rechargeable cells	495p
Red or black terminals	30p
3 lead TO18 socket	15p
Red or amber neon indicator	42p
Subminiature SPST toggle	65p
Standard SPST toggle	40p
Miniature slide switches	16p

IP12W rotary switches	52p
Push to make switches	16p
TO5 heatsinks	12p
20mm panel fuseholders	22p
ORP12 LDR	70p
3.75 x 5 0.1 veroboard	99p
2.5 x 1 0.1 veroboard	21p
3 x 2 x 1 aluminium box	82p
6 x 4 x 2 aluminium box	99p
Miniature 606, 909 transformer	110p
TIL111 optoisolator	80p
4 self adhesive feet	20p
SRB Soldering iron	430p
Desoldering tool	550p

### TRANSISTORS

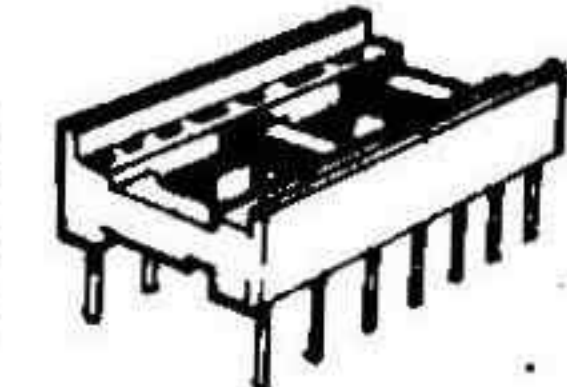
AC127	25p	BC547	8p	TIP30C	70p
AC128	25p	BCY71	18p	TIP2955	65p
AD161	40p	BD131	35p	TIP3055	60p
AD162	40p	BD132	35p	ZTX107	12p
BC107	10p	BD139	35p	ZTX108	12p
BC108	10p	BD140	35p	ZTX109	12p
BC109	10p	BFX29	25p	ZTX300	14p
BC147	9p	BFX84	26p	ZTX500	15p
BC178	16p	BFY50	23p	2N3053	25p
BC182	10p	BFY51	23p	2N3055	55p
BC182L	10p	MJ2955	98p	2N3702	9p
BC184	10p	TIP29C	60p	2N3703	9p
BC184L	10p			2N3704	9p
BC212	10p			2N3819	22p
BC212L	10p			2N3905	10p
BC214	10p			2N5777	50p
BC214L	10p				

### CMOS

4001	25p	4025	25p	4072	25p
4002	25p	4026	150p	4081	30p
4006	95p	4027	50p	4082	30p
4007	25p	4028	90p	4085	85p
4011	30p	4029	110p	4093	80p
4013	45p	4040	110p	4095	110p
4015	85p	4042	85p	4510	90p
4016	48p	4046	110p	4511	100p
4017	80p	4048	60p	4518	90p
4018	90p	4049	50p	4520	110p
4020	110p	4050	50p	4527	165p
4022	100p	4052	80p	4528	100p
4023	25p	4060	120p	4532	125p
4024	60p	4066	63p	4543	170p
		4068	25p	4583	80p
		4069	25p	4585	115p
		4070	25p		
		4071	25p		

### SKTS

Low Profile Texas	
8 pin	9p
14 pin	11p
16 pin	12p
18 pin	16p
20 pin	18p
22 pin	20p
24 pin	22p
28 pin	26p
40 pin	38p



### OPTO

Red	0.125in.	TIL209	TIL220	10p
Green	0.2in.	TIL211	TIL221	16p
Yellow		TIL213	TIL223	16p
Clips				3p
DL704	0.3in CC			130p
DL707	0.3in CA			130p
FND500	0.5in CC			100p



### CAPACITORS

0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 and 2.2uF @ 35V	12p
4.7, 6.8, 10uF @ 25V	20p
22 @ 16V, 47 @ 6V, 100 @ 3V	26p
POLYESTER (Mullard C280 series)	
0.01, 0.015, 0.022, 0.033, 0.047, 0.1	6p
0.15, 0.22	8p
0.33, 0.47	12p

### RADIAL LEAD ELECTROLYTICS

V	10	22	33	47	7p
63V	0.47	1.0	2.2	4.7	10
25V	10	22	33	47	7p
100					9p
1000			470		20p
					32p

### LINEAR

LM324	52p	MM57160	650p
LM339	55p	NE531	140p
LM348	100p	NE555	23p
LM377	170p	NE556	60p
LM378	230p	NE667	120p
LM380	80p	RC4136	100p
LM381	140p	SN76477	230p
LM382	120p	TBA800	80p
LM386	90p	TBA810	110p
LM387	120p	TDA1022	630p
LM1458	40p	TL081	45p
LM1830	180p	TL082	85p
LM3900	60p	TL084	125p
LM3909	72p	XR2206	390p
LM3911	120p	ZN414	80p
LM3914	320p	ZN425E	475p
LM3915	320p		

### PACKS

Specially designed packs intended for development work at a considerable saving.

1/4w resistors. 10 of each value 4.7ohm to 1 Mohm. a total of 650 resistors. 530p each.

1/2w resistors. 10 of each value 4.7ohm to 1 Mohm. a total of 650 resistors. 875p each.

Presets. Pack of 5 of each value from 100ohms to 1 Megohm. a total of 65 presets. 390p each.

LED's. Pack containing 10 of each colour LED 0.2 size. Total of 30 Led's + clips. 450p each.

Zeners. Pack of 5 of each value from 2V7 to 33V A total of 130 zeners. 880p each.

Our new catalogue is now available. It contains 100 illustrated pages detailing over 3000 line items. Send 50p for your copy! You will receive: • A reply paid envelope. • A Mail Order form to facilitate rapid despatch. • A 50p Discount voucher.

All prices include VAT.

Please add 50p carriage on all orders below £15.00.

Access & Barclaycard welcome  
Sales office: 01-464 5770.



## 76 College Road, Bromley, Kent BR1 1DE.

### AND NOW A DIMMER THAT MAKES TOUCH DIMMERS OBSOLETE

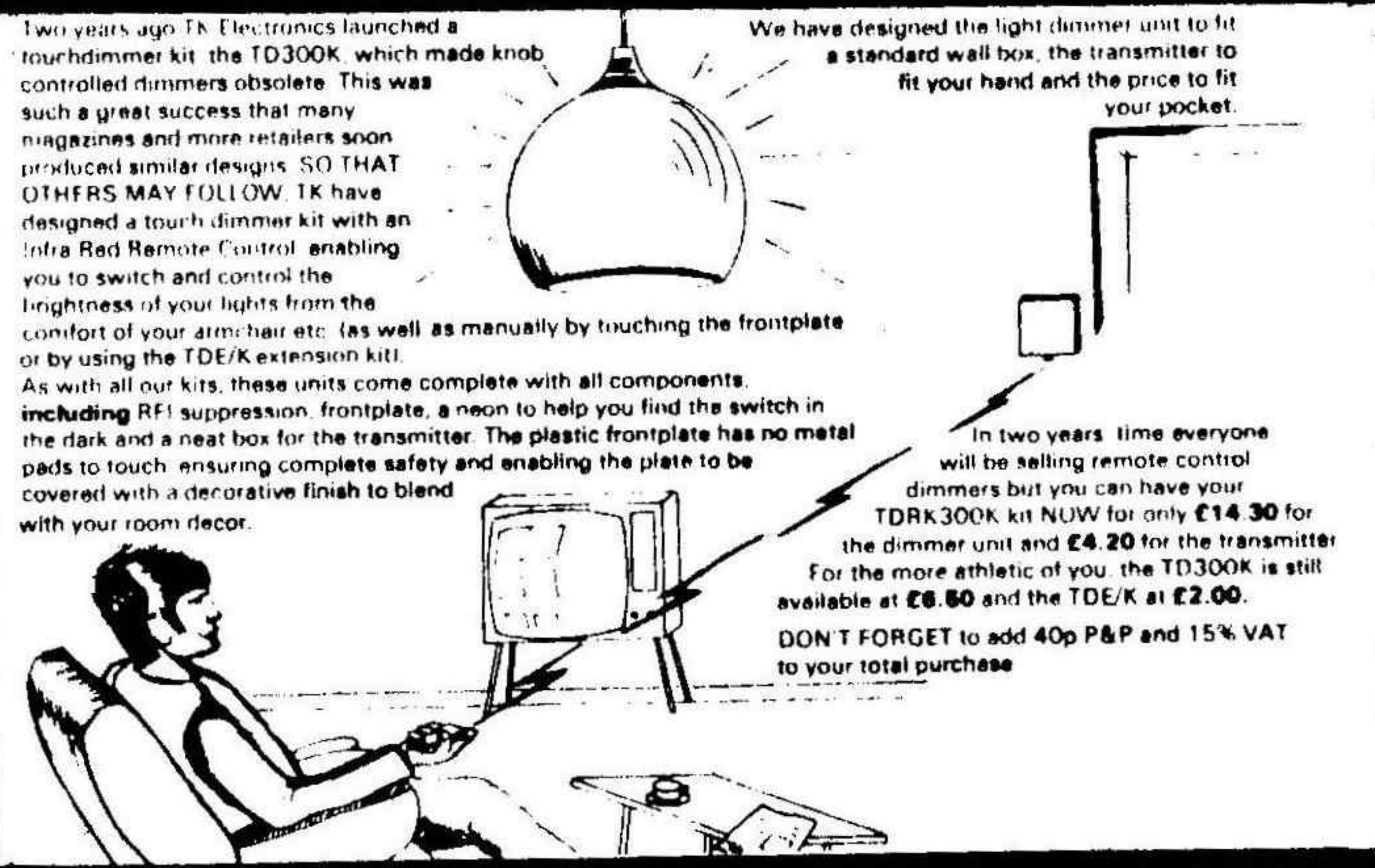
Two years ago TK Electronics launched a touchdimmer kit the TD300K which made knob controlled dimmers obsolete. This was such a great success that many magazines and more retailers soon produced similar designs. SO THAT OTHERS MAY FOLLOW, TK have designed a touch dimmer kit with an Infra Red Remote Control enabling you to switch and control the brightness of your lights from the comfort of your arm-chair etc. (as well as manually by touching the frontplate or by using the TDE/K extension kit).

As with all our kits, these units come complete with all components, including RFI suppression, frontplate, a neon to help you find the switch in the dark and a neat box for the transmitter. The plastic frontplate has no metal pads to touch ensuring complete safety and enabling the plate to be covered with a decorative finish to blend with your room decor.

We have designed the light dimmer unit to fit a standard wall box, the transmitter to fit your hand and the price to fit your pocket.

In two years time everyone will be selling remote control dimmers but you can have your TDRK300K kit NOW for only £14.30 for the dimmer unit and £4.20 for the transmitter. For the more athletic of you, the TD300K is still available at £8.80 and the TDE/K at £2.00.

DON'T FORGET to add 40p P&P and 15% VAT to your total purchase



### REMOTE CONTROL COMPONENTS

LD271 IR Emitting Diode	36p
SFH205 Photodiode Detector	95p
SL480 IC Pulse Amp	£1.70
SL490 32 command encoder/transmitter	£2.40
ML922 10 channel receiver + 3 analogue outputs	£4.20
ML926 16 channel receiver 4 momentary binary o/p	£1.40
ML928 16 channel receiver 4 latched binary o/p	£1.40
ML929 16 channel receiver 4 latched binary o/p	£1.40
Data Sheets per device	10p

These ICs can be used with infra red, ultrasonic or radio links, depending on range, cost and speed of operation.

### RC500K KIT

If you do not require a sophisticated multi-channel remote control, we have developed a simple single-channel on/off infra red transmitter and receiver kit. The transmitter unit comes complete with a hand-held box and requires a PP3 (9V) battery. The receiver includes a triac capable of switching up to 500W at 240V a.c. and comprises a pre-amplifier bistable latch and a mains power supply, making the unit completely self contained. The small size of the receiver enables the unit to be "built into" all kinds of equipment from lamps to tape recorders. Range approximately 20ft.

£12.50

ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION. ADD VAT AT CURRENT RATE TO ABOVE PRICES. 40p P&P MAIL ORDER - CALLERS WELCOME BY APPOINTMENT

## TK Electronics

(ETI), 106 STUDLEY GRANGE ROAD LONDON W7 2LX. TEL. 01-579 9794



### TRIACS

400V Plastic Case (Texas)	
3A	49p
8A	58p
12A	85p
6A with trigger	80p
8A isolated tab	65p
Diac	18p
16A	95p
25A	190p

### TK's SPECIAL OFFERS OF THE MONTH

Orders must be received by 31.10.80

### SPECIAL OFFERS

AY-5-1224 Clock IC	£2.20
LM3915 Bar / Dot Driver	£2.10
2 x DL304 0.3" cc Display	£1.35
2 x DL307 0.3" ca Display	£1.35
2 x 2N3442, 10 off each 0.2" LEDs	£1.80
Red, Green, Yellow	£2.90

### MINI KITS

These kits form useful subsystems which may be incorporated into larger designs or used alone. Kits include PCB, short instructions and all components.

#### MK1 TEMPERATURE CONTROLLER / THERMOSTAT

Uses LM3911 IC to sense temperature (80°C max) and triac to switch heater. 1KW £4.00

#### MK2 SOLID STATE RELAY

Ideal for switching motors, lights, heaters, etc. from logic. Opto-isolated with zero voltage switching. Supplied without triac. Select the required triac from our range. £2.80

#### MK3 BAR / DOT DISPLAY

Displays an analogue voltage on a linear 10-element LED display as a bar or single dot. Ideal for thermometers, level indicators, etc. May be stacked to obtain 20 to 100-element displays. Requires 5-20V supply. £4.75

#### MK4 PROPORTIONAL TEMPERATURE CONTROLLER

Based on the TDA1024 Zero voltage switch, this kit may be wired to form a "burst fire" power controller or a "proportional temperature" controller enabling the temperature of an enclosure to be maintained to within 0.5°C. 3KW £5.55

#### MK5 MAINS TIMER

Based on the ZN1034E Timer IC this kit will switch a mains load on (or off) for a preset time from 20 minutes to 35 hours. Longer or shorter periods may be realised by minor component changes. Maximum load 1KW. £4.50

### DISPLAY LIGHTING KITS

Each unit has 4 channels (rated at 1KW at 240V per channel) which switch lamps to provide sequencing effects, controlled manually or by an optional opto-isolated audio input.

#### DL1000K

This kit features a bi-directional sequence, speed of sequence and frequency of direction change being variable by means of potentiometers. Incorporates master dimming control. £14.80

#### DL21000L

A lower cost version of the above, featuring unidirectional channel sequence with speed variable by means of a preset pot. Outputs switched only at mains zero crossing points to reduce radio interference to minimum. £8.00

Optional Opto Input DLA1 60p

### MINI TRANSFORMERS

Standard mains primaries 240V a.c	
100mA secondaries	
6.0 6V	80p
9.0 9V	85p
12.0 12V	90p

### D.I.L. I.C. SOCKETS

8 pin	8p	18 pin	17p
14 pin	12p	28 pin	24p
16 pin	14p	40 pin	36p

### INTEGRATED CIRCUITS

555 Timer	21p
741 Op. Amp.	19p
AY-5-1224 Clock	£2.80
AY-5-1230/2 Clock/Timer	£4.50
AY-3-1270 Thermometer	£8.20
ICL7106 DVM (LCD drive)	£7.00
LM377 Dual 2 W Amp	£1.45
LM379S Dual 6W Amp	£3.50
LM380 2W Audio Amp	80p
LM382 Dual/low noise Preamp	£1.00
LM386 250mW low voltage Amp	75p
LM1830 Fluid Level Detector	£1.50
LM2907 f-v Converter (8 pin)	£1.40
LM2917 f-v Converter (14 pin)	£1.60
LM3909 LED Flasher/Oscillator	60p
LM3911 Thermometer	£1.20
LM3914 Dot / Bar Driver	£2.10
MM74C911 4 digit display controller	£6.50
MM74C915 7 segment-BCD converter	96p
MM74C926 4 digit counter with 7 seg. o/p	£4.50
S566B Touchdimmer	£2.50
S9263 Touchswitch 16-way	£4.88
SN76477 Complex Sound Generator	£2.52
TBA800 5W Audio Amp	88p
TBA810AS 7W Audio Amp	£1.00
TDA1024 Zero Voltage Switch	£1.20
TDA2020 20W Audio Amp	£2.85
ZN1034E Timer	£1.80

All ICs supplied with data sheets  
Data Sheets only 10p each device.



# Codespeed Electronics

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

**SOUND EFFECTS PCB** brand new, made for spaceman robot toy. Gives 5 spaceman sounds with flashing LED's (speaker not supplied). Entertain the kids for only **85p**. **FLUORESCENT REJECT CALCULATORS** modern, ten function calculators with full memory. Most repairable but no guarantees. **£2.50** each. **ALARM CLOCK CHIP** MM5316 digital alarm clock I.C. With data. **£2.35** each. **GIANT LED CLOCK DISPLAY** non-multiplexed, common cathode display panel. With data **£3.95** each. **WRISTWATCH LED DISPLAY** tiny, bright displays for LED watches. **Note** display is housed in 'legless flatpack' package and required fairly firm soldering. Supplied with data. **95p** each or 2 for **£1.50**. **DIGITAL MULTIMETER CHIP** to build an Auto-polarity, 4½ digit multimeter (requires additional circuitry). With data sheet. **£3.55**. **8 DIGIT CALCULATOR DISPLAY** common cathode, multiplexed, 0.1" digits. With data, **99p** each. **PLASTIC POLARIZING FILTER** 0.006" thick plastic film. Any size cut from 1 square inch up to a maximum size of 19 inches x 250 feet. Only **3p** per square inch. **SUPER QUALITY JACK SOCKETS** gold plated contacts for high reliability. Mono **25p**. Stereo **30p** each. **CALCULATOR KEYBOARDS** excellent value, 2 for **99p**. **LM555 TIMER I.C.** suitable for most timer applications, and is supplied with application booklet. **25p** each. **CALCULATOR CHIP NORTEC 4204**, four function and constant. With data and diagram. **80p** each. **PUSH-BUTTON SWITCHES** with 1 n.o. contact (momentary action). With red button, **15p** each. **MINIATURE SLIDER SWITCHES** wit 2 pole change-over contacts. **16p** each. **STATIC RAMS** 2102 memories, with data, only **99p** each. **REJECT LED CALCULATORS** some repairable but excellent value for spares. Yields lots of parts. **£2.50** each. **LIQUID CRYSTAL CLOCK DISPLAY** nice style display gives black digits on grey background, could also be used for freq. meters, dvm's etc. With data **£5.25**. **PROFESSIONAL QUALITY, CONTROL KNOBS** rotary knobs satin finish black nylon knobs to fit standard ¼" 'D' shaped shafts. Coloured snap-in caps also have position indicator line. Cap colours available, black, white, grey, red, green, blue and yellow. Knob and coloured cap **20p** (state cap colour required). **Skirted rotary knobs**. As above but has 'flared' nut cover around base of knob. **27p** each. (state cap colour required). **Slider Control Knobs** fits 5mm or 8mm shafts. Available in black, white, grey, red, green, blue and yellow. **14p** each (state colour required). **QUALITY REED SWITCHES** tiny but sensitive reed switches, ideal for burglar alarms etc. Only **39p** each. **RECTANGULAR BAR MAGNETS** small but powerful. Purchased for use with above reed switches. **59p** each. **REED RELAYS** 12v d.c. coil, one — n.o. contact. Small enough for PCB mounting. **79p** each. **POWER RELAYS** 12v d.c. coil. Two change-over contacts, each rated at 10 amps. Contacts solid silver for high reliability. Only **£2.55** each. Relay bases for above relays are **35p** each. **TRANSISTOR RADIO I.F. TRANSFORMERS** all brand new. May include several types. Ten transformers for **55p**. **NYLON CABLE TIES** 25 for **35p** (ties are 4" long). **SHRINK TUBE** available in 3 bore sizes. Shrinks by approx 50% when heated. 2.4mm bore **15p** per metre, 4.8mm bore **16p** per metre. 12.7mm bore **23p** per metre. **TEN UNTESTED LED DISPLAYS** Gambler — Try these. Ten 0.1" common cathode displays for **99p**. You to test.

**SALES FACTION GUARANTEED ON ALL ITEMS OR FULL CASH REFUNDED. NEW CATALOGUE (No. 8) NOW AVAILABLE — JUST SEND MEDIUM-SIZED S.A.E. P&P PLEASE ADD 40p (OVERSEAS ORDER ADD £1)**

**V.A.T. ADD 15% TO THE TOTAL COST OF YOUR ORDER (INCLUDING POST AND PACKING)**



# Wilmslow Audio

**THE firm for speakers!**

**SEND 50P FOR THE WORLD'S BEST CATALOGUE OF SPEAKERS, DRIVE UNITS, KITS, CROSSOVERS ETC, AND DISCOUNT PRICE LIST.**

AUDAX - AUDIOMASTER - BAKER - BOWERS & WILKINS  
CASTLE - CELESTION - CHARTWELL - COLES - DALESFORD  
DECCA - EAGLE - ELAC - EMI - FANE - GAUSS - GOODMAN'S  
HARBETH - ISOPHON - I.M.F. - JORDON - JORDAN WATTS  
KEF - LOWTHER - McKENZIE - MISSION - MONITOR AUDIO  
MOTOROLA - PEERLESS - RADFORD - RAM - ROGERS  
RICHARD ALLAN - SEAS - SHACKMAN - STAG - TANNON  
VIDEOTONE - WHARFEDALE.

## WILMSLOW AUDIO

**SWAN WORKS, BANK SQUARE  
WILMSLOW, CHESHIRE SK9 1HF**

**Tel. 0625-529599 FOR MAIL ORDER AND EXPORT OF  
DRIVE UNITS, KITS, ETC.**

**Tel. 0625-526213 (SWIFT OF WILMSLOW) FOR HI-FI  
AND COMPLETE SPEAKERS.**



**A. Marshall (London) Ltd., Kingsgate House,  
Kingsgate Place, London NW6 4TA  
Industrial Sales: 01-328 1009  
Mail Order: 01-624 8582**  
Also retail shops: 325 Edgware Road, London W2.  
40 Cricklewood Broadway, London NW2. 85 West Regent St., Glasgow.  
108A Stokes Croft, Bristol.

### CAPACITORS:

Mullard Ceramic 63v range  
1pF to 10,000pF E 24 range  
all at £0.06 each  
Siemens Ceramic 63v B37448/9  
.01: .022: .033: .047mF @ £0.06  
.068: .1mF @ £0.08: .22mF @  
£0.11

CSF High Voltage Ceramic Discs  
Prices £0.07 to £0.18 Range  
100pF to 10,000pF

Voltage range up to 6Kv.  
See catalogue for details.  
Comprehensive range Siemens  
Layer Polyester Caps: .001 to  
3.3mF  
Prices £0.07 to £0.63.

See catalogue for details.  
Large range of Mullard/Siemens  
Electrolytic Axial/Radial  
Capacitance values 1.0mF to  
10,000mF  
Voltage ranges 25v: 40v: 63v:  
100v:

Prices and types as catalogue  
Also Mullard C280; Siemens  
B32231/4 and B32110. All prices  
net + VAT and postage/packaging.

### TOOLS BAHCO

Side Cutter with Bezel.  
Side Cutter without Bezel.  
End Cutter without Bezel.

Vero Metal Shears.  
Other items as catalogue.



### BOXES & CASES

See catalogue for full range.  
Aluminium boxes 13 sizes.  
Rexine Covered boxes 7 sizes.  
**NEW RANGE TMEC CASES**  
Send S.A.E. for details & types  
Price range, £14.04 to £17.00  
**ABS PLASTIC BOXES**

3" x 2¼" x 1 3/8" Prices as  
3¾" x 2¾" x 1 3/8" catalogue  
4½" x 3¾" x 1 3/8"

8" x 4¾" x 3"  
**BAZELLI INSTRUMENT CASES**  
5 sizes.

Miscellaneous hardware  
including  
Vero Board: Superstrips:  
Vero Breadboard.  
Vero boxes (see catalogue for  
full range).



Card Frames: Flitop boxes:  
etc etc.

### 1980 CATALOGUE

U.K.: 65p post paid  
Europe 85p post paid  
Rest of World £1.25  
post paid

Mail order: 01-624 8582



### TTL see catalogue for full range

SN7400N	£0.14	SN7451AN	£0.54
SN7401N	£0.14	SN7452N	£0.31
SN7402N	£0.14	SN7453N	£0.32
SN7403N	£0.14	SN7454N	£0.80
SN7404N	£0.14	SN7455N	£0.55
SN7405N	£0.15	SN7456N	£0.34
SN7406N	£0.34	SN7457N	£1.60
SN7407N	£0.26	SN74100N	£1.10
SN7408N	£0.15	SN74101N	£0.21
SN7409N	£0.16	SN74118N	£0.76
SN7410	£0.15	SN74119N	£1.20
SN7411N	£0.15	SN74121N	£0.25
SN7412N	£0.20	SN74122N	£0.48
SN7413N	£0.28	SN74123N	£0.42
SN7414N	£0.47	SN74124N	£0.53
SN7416N	£0.22	SN74125N	£0.40
SN7417N	£0.22	SN74141N	£0.50
SN7420N	£0.15	SN74145N	£0.64
SN7423N	£0.18	SN74148N	£1.05
SN7425N	£0.19	SN74150N	£0.79
SN7426N	£0.19	SN74151N	£0.55
SN7427N	£0.19	SN74153N	£0.55
SN7430N	£0.15	SN74154N	£0.90
SN7432N	£0.17	SN74155N	£0.60
SN7437N	£0.21	SN74157N	£0.59
SN7438N	£0.21	SN74160AN	£0.70
SN7440N	£0.15	SN74161AN	£0.70
SN7441AN	£0.52	SN74162AN	£0.70
SN7442N	£0.40	SN74163AN	£0.70
SN7445N	£0.66	SN74164AN	£0.80
SN7446AN	£0.48	SN74165N	£0.80
SN7447AN	£0.48	SN74167N	£1.20
SN7448N	£0.45	SN74174N	£0.80
SN7450N	£0.15	SN74175N	£0.63
SN7451N	£0.15	SN74176N	£0.74
SN7453N	£0.15	SN74177N	£0.73
SN7454N	£0.15	SN74180N	£0.70
SN7460N	£0.15	SN74181N	£1.65
SN7470N	£0.26	SN74182N	£0.83
SN7472N	£0.24	SN74184N	£1.29
SN7473N	£0.25	SN74185AN	£1.10
SN7474N	£0.25	SN74186N	£1.35
SN7475N	£0.31	SN74187AN	£1.64
SN7476N	£0.26	SN74189N	£2.26
SN7480N	£0.39	SN74190N	£0.74
SN7481N	£0.71	SN74191N	£0.79
SN7482N	£0.65	SN74192N	£0.79
SN7483N	£0.60	SN74193N	£0.79
SN7484N	£0.95	SN74196N	£0.74
SN7485N	£0.70	SN74197N	£0.74
SN7486N	£0.15	SN74198N	£1.09
SN7489N	£1.66	SN74199N	£1.09
SN7490AN	£0.33		

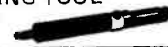
### KNOBS & SWITCHES

Big selection as catalogue -  
Also Resistors; Presets; Pots;  
Opto; Semiconductors etc.

### SOLDERING EQUIPMENT

**IRONS-ANTEX**  
15 watt C15 £3.95  
15 watt CCN £4.20  
17 watt CX17 £4.20  
25 watt X25 £4.20  
Stand £1.50

**DESOLDERING TOOL**  
Solder £6.50



### SINCLAIR INSTRUMENTS

Digital Multimeter  
" PDM35 £ 34.50  
" " DM235 £ 52.50  
" " DM350 £ 72.50  
" " DM450 £ 99.00

Digital Frequency Meter  
PFM200 £ 49.80  
Low Power Oscilloscope  
SC110 £139.00

### CRIMSON ELEKTRIK HI FI MODULES

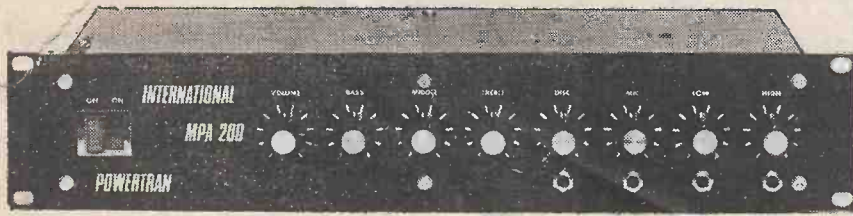
CE608 Power Amp £18.26  
CE1004 " " £21.30  
CE1008 " " £23.91  
CE1704 " " £30.43  
CE1708 " " £30.43  
CPS1 Power Unit £16.96  
CPS3 " " £20.43  
CPS6 " " £26.09  
CPR1 Pre Amp £29.57  
CPR1S Pre Amp £38.70  
All prices + VAT + postage/  
packaging



## MPA 200 100 WATT (rms into 8Ω) MIXER / AMPLIFIER

Featured as a constructional article in ETI, the MPA 200 is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features an adaptable input mixer which accepts a wide range of sources such as a microphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 200 is simplicity itself with minimal wiring needed making construction very straightforward.

The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — complete down to the last nut and bolt.



Panel size 19.0" x 3.5". Depth 7.3"

**COMPLETE KIT  
ONLY  
£49.90 + VAT!**

**MATCHES THE  
CHROMATHEQUE 5000  
PERFECTLY!**

## CHROMATHEQUE 5000 5 CHANNEL LIGHTING EFFECTS SYSTEM

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.

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



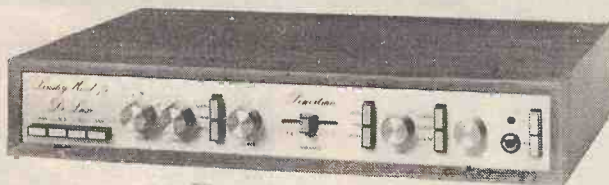
Panel size 19.0" x 3.5". Depth 7.3"

**COMPLETE KIT  
ONLY  
£49.50 + VAT!**

## POWERTRAN

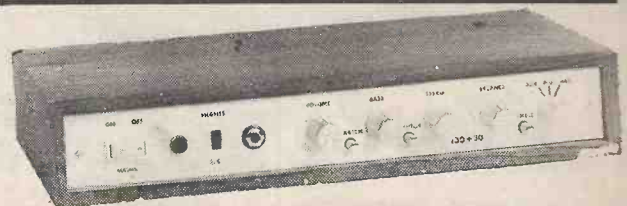
**SYNTHESIZER KITS ON PAGE 8. MORE KITS AND ORDERING INFORMATION ON INSIDE FRONT COVER.**

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



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

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



### T20 + 20 20W STEREO AMPLIFIER £33.10 + VAT

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

MATCHING TUNERS — See our FREE CATALOGUE!

Above 2 kits are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet, cable, nuts, bolts, etc. and full instructions — in fact everything!

## BLACK HOLE

**MUSIC EFFECTS DEVICE — AS FEATURED IN ELECTRONICS TODAY INTERNATIONAL!**

The BLACK HOLE designed by Tim Orr, is a powerful new musical effects device for processing both natural and electronic instruments, offering genuine VIBRATO (pitch modulation) and a CHORUS mode which gives a "spacey" feel to the sound achieved by delaying the input signal and mixing it back with the original. Notches (HOLES), introduced in the frequency response, move up and down as the time delay is modulated by the chorus sweep generator. An optional double chorus mode allows exciting antiphase effects to be added. The device is floor standing with foot switch controls, LED effect selection indicators, has variable sensitivity, has high signal/noise ratio obtained by an audio compander and is mains powered — no batteries to change! Like all our kits everything is provided including a highly superior, rugged steel, beautifully finished enclosure.

**COMPLETE KIT ONLY £49.80 + VAT (single delay line system)**  
De Luxe version (dual delay line system) also available for **£59.80 + VAT**

Cabinet size 10.0" x 8.5" x 2.5" (rear) 1.8" (front)



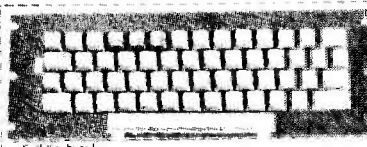


**nascom-2 MICRO-COMPUTER**  
**FREE 16k B RAM Board**  
**FREE POWER SUPPLY**



Ex-stock  
**only £335**  
 + VAT  
 Full after sales service

**COMPUTER KEYBOARDS**



Full Keyboard

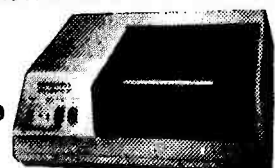
**STAR DEVICES MK III 71** keytouch sensitive keyboard. With numeric pad. All ASCII characters including control keys. Auto key repeat. Parallel output with strobe. Shift lock with indicator LED. Built in 'beeper' with level control. 5V DC at 300mA 15" x 7" x 1.25". Grey case with white keys on blue. **£48.50 plus VAT**

**CARTER 57** key ASCII keyboard. Conventional keyboard. 128 ASCII characters including control keys. Parallel output with strobe. Shift lock. + 5 V and -12 V DC. 12" x 5.5" x 1.5". Black keys with white legends. **£9.34 + VAT.**

**FERRANTI - "SIZE 14 x 6 x 3" SLOPING FRONT"** 55 Key ASCII Coded in steel case. Complete with Plug and Cable with circuit to convert to T.T.L. levels. **£43.00 plus VAT**

In good condition at only **£26 + VAT, P/P £2.50**

**CENTRONICS QUICK PRINTER**



List Price **£459** incl. VAT

**OUR PRICE plus VAT**

**EXCLUSIVE TO HENRY'S** **£195**  
**50% OFF MAKER'S PRICE**

for: Software selectable 20, 40 and 80 column using 120mm aluminium-issued paper. 1 roll supplied. 160 lines per minute.

**TANDY, PET, NASCOM** Centronics parallel data interface for Nascom, Tandy, etc.

240 volt mains input. ASCII character set Paper feed, and on/off select switches 'BELL' signal. Weight 10lbs  
 Size: 13" x 10 1/2" x 4 1/2"

New, boxed and fully guaranteed  
**POST PAID Price £195.00 + VAT**  
 See **COMPUTING TODAY** Recommendations MARCH/MAY ISSUES

**MICROPROCESSOR BOARD (NASCOM 2)**  
 4MHz Z80 CPU; TV or Video + 1200 baud Kansas City + Serial RS 232 printer Interfaces; Keyboard; 128 character ASCII plus 128 Graphics in 2 x 2K ROM; free 16-way parallel port; 8K BASIC; NAS SYS operating monitor. £280 built and tested.

**Firmware & MOS ICs**  
 Zeap Assembler (4, 1Kx8 EPROMS) **£50**  
 Nes Pen text editor (2, 1Kx8 EPROMS) **£30**

**Expansion boards (in kit form)**  
 18K RAM **£127.50** • 32K RAM **£175.00**  
 48K RAM **£220.00**  
 High Resolution Programmable Graphics **£90**  
 Colour Board Kit **£140**  
 High Resolution Colour add on **£37.50**

**TANGERINE LONDON STOCKISTS**

Microtan 65 Kit, incl. VAT **£79.35**  
 Microtan 65 Assembled, **£90.85**

Full ASCII keyboard built **£48.00 plus VAT**  
 The ASCII keyboard includes a numeric keypad and ribbon cable connector. Cabinet available at **£28.00 plus VAT.**

We have produced a mini-track which accepts MICROtan 65 and TANGERINE. It has an integral power supply, just plug it into the mains and away you go! Finished in Black/Tangerine/Brushed aluminium. It gives your mini-system the professional finish. **£43.00 plus VAT**

**SEND FOR COMPLETE BROCHURE TO ADDRESS BELOW**

Tanex (info. card) incl. VAT **£48.00**  
 Tanex Assembled incl. VAT **£38.00**  
 Lower case pack, incl. VAT **£18.00**  
 20 way keypad, incl. VAT **£7.50**  
 Mini-motor board, incl. VAT **£9.95**  
 Complete Tangerine range available

**STEREO CASSETTE TAPE HEAD.**  
 High quality replacement for most machines record/erase with magnetic bracket. **£2.95**

**XJMS (X2ANP118)** 1/4 track Rec./Play medium impedance **£3.25**  
**XJMS (X2ANP38)** 1/4 track Record/Play low impedance **£4.00**

**XE811 (X2AE311)** 1/4 track W/M for LP tapes **£1.25**  
**EX/MP/63** 1/4 track Record/Play Head (black/red) **£2.25**  
**EX12E343** 1/4 track Erase Head for above **£1.25**  
**EX11 E308** Erase 675 ohms 2mA **£9.95**  
**EX12 E307** Erase 675 ohms 2mA **£9.95**  
**EX29 E302** Erase 90 ohms 2mA **£9.95**

**Microflex Tape Heads (1/4 Track)**  
**ER8** Erase **£2.25**  
**KMG-T** with No-metal screen **£2.50**  
**WQ-T** with No-metal screen **£2.50**  
**LFB** Erase Head **95p**  
**R/MP 1/3** Record/Play 1/4 track head **£9.95**

**HR-8P** Single track Record/Play head. 0.2W at 1 kc/s. 60 KHz impedance at 50 kc/s. Bias current 200mA **£9.95**

**LP1171 & LP1179 MODULES by MULLARD**

**LP1157 & LP1186**

LP1171 and LP1179 tuning heart and IF modules which form the basis of a quality AM/FM tuner. Full medium long wave and VHF coverage. May be used as the basis of a quality portable or tuner. Supply 6V at 15mA output 70mV at 20K.  
 Pair **£6.75**

**SUPPLIED COMPLETE WITH DATA**  
 LP1157 Medium & Long Wave tuner module-heart **£2.50**  
 LP1186 Varicap **£5.00**

**DRYFIT RE-CHARGEABLE BATTERY.** 6 volt 4.5 amp/h. Size 6 1/2" x 3 1/2" x 1 1/2" at half price. Brand new **£7.60**, post 50p.

**MIN. EDGE INDICATORS WITH LAMP**  
**0-100 MICRO AMP**  
 6 for **£6.50**

**INDICATOR METERS**  
 200 Micro  
 1 1/2" x 1 1/2" x 1 1/2"  
 6 for **£5**


**TRANS. AMPLIFIERS**  
 Contains a Foster type moving coil, mikes / earphones, V/C & switches as used on aircraft for passenger listening.  
 £1.50 P.P. 25p  
 10 for **£12.50**

**SANGAMO HOUR METER**  
 9999.9 non reset  
**£4.50**  
 1 1/2" sq 2" deep

**MAINS TRANSFORMERS** all 200/250V IN

Type	Current	Size	Price
12V	100m/s	1 1/2 x 1 1/2 x 1 1/2	<b>£0.95</b>
12V	500m/s	1 3/4	<b>1 1/4 x 1 3/4</b>
6-0V	300m/s	s 2x2x2	<b>£1.50</b>
12V	2 amps	3x2 1/2 x 2 1/2	<b>£2.95</b>
8-20V	1 amp		<b>£2.50</b>
12E20V	1 amp		<b>£2.50</b>
14-0-14V	1.5 amp		<b>£2.50</b>
12V	1 amp		<b>£2.50</b>

Size 6x5x5mm Postage 50p each



**RE-CHARGEABLE DRYFIT LEAD-ACID BATTERIES** 6V 4.7 amps **£7.60** PP 50p

**2W MIN. W/W VOL. CONTROLS** 10R-47K 10 for **£6**

**10 TURN POTS** 47R-100K 10 for **£17.50**

**EDGE CONNECTORS** 85p **£1**  
 54 way 1  
 64 way 1

**BELLING-LEE B.N.C. SOCKETS** 10 for **£6**  
 L1647/J5  
 L1647/CSS  
 L1647/50FS  
 L1647/50J  
 L1647/FS

**DIGITAL 24 HOUR CLOCK**

● SILENT RUNNING  
 ● LARGE ILLUMINATED NUMERALS

AS USED IN **BRAUN** DIGITAL CLOCKS

**MECHANISM WITH ALARM**

● AC MAINS  
 ● SIZE 6 3/4" x 2 3/8" x 2 3/4"

Your receipt is a 2-year guarantee



**£5.00**  
**THREE FOR £13.50**

**J.V.C. BELT DRIVEN TURNTABLE**  
 WITH STEREO MAGNETIC CARTRIDGE



**LIST PRICE OVER £50**

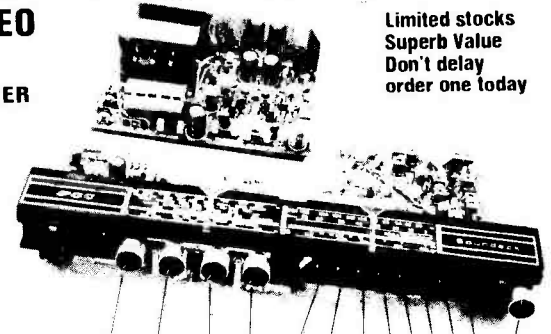
J.V.C. Turntable supplied complete with Audio Technica AT10 stereo magnetic cartridge.

● BELT DRIVEN  
 S-shaped tone arm. Modern design. Full size 12" platter. Calibrated counter-balance weight (0.3 grams). Anti-skate (bias) device. Size - 12" x 15" (approx.)

AT ONLY **£25.99**  
 LIMITED STOCKS  
 PLUS VAT **£3.89** Post 1.2 50

**GEC HIGH QUALITY STEREO**  
**10 + 10 watt AMPLIFIER WITH AM/FM STEREO TUNER IDEAL FOR THE HOME**

A cancelled export order brings you this offer



AM/FM stereo Tuner Amplifier. Ready built. comprising of a tuner/pre-amp. board and separate power supply/power amp. board with wiring diagram.

Rotary Controls: Tuning on/off volume balance, treble, bass. Stereo Beacon indicator. Push-button Controls: Mono. Tape. Disc. A.F.C. F.M. (VHF). LW. MW. SW.

Power Output: 7 watts 6MS per channel, at better than 2% THD into 8 ohms. 10 watts speech and music.

Frequency Response: 60Hz-20KHz within ± 3dB. 300 mV for rated output.

Tape Sensitivity: Output - typically 150 mV Input - 300 mV for rated output.

Disc Sensitivity: 100 mV (ceramic cartridge)

Radio: FM (VHF) 87.5MHz-108MHz. Long Wave 145KHz-265KHz. Medium Wave 520KHz-1620KHz. Short Wave 5.8KHz-16MHz.

Size: Tuner - 2 in. x 1 1/2 in x 7 in. Power Amp - 2 in. x 7 in. x 4 in.

ON/OFF BALANCE. TREBLE. BASS. MONO TAPE Phono AFC FM LW MW SW Tuning Volume

**Fully Guaranteed Ex-Stock**

**SUITABLE SPEAKERS IN CABINETS PAIR 10 WATTS** **£19.95** INC. VAT POST **£2.50** Pair

**ONLY £19.95** + VAT £2.99 CARRIAGE 1.2 50

**EX-MOTOROLA CAR STEREO CASSETTE MECHANISM**

★ Front loading 12 volt transistorised  
 ★ Speed & Voltage control  
 ★ Ex equipment -- Tested O.K.  
 ★ Takes standard C60 cassette

**ONLY £7.50** INC. VAT POST 80p

**5 + 5 Watt Car Stereo Amplifier**

● WITH pre-amplifier and M. & Long wave assembly  
 ● Supplied as two built and tested units.  
 ● R.F. and I.F. stereo preamplifier and radio 4 x 2 x 1 1/2"  
 ● 5 + 5 watt stereo amplifier 12/14 volt 4 x 2 x 1 1/2"  
 ● Complete with circuit, data and connection diagrams.  
 ● Limited quantity available. ex-stock.

**Only £5 + VAT** + VAT Post 50p

**EX-MOTOROLA**

**HENRY'S**

Phone (01) 723 1008/9  
 404 Edgware Road, London W2, England I.E.D.

**PRO M25** Professional capacitor boom-arm microphone by Eagle. A graceful 60 cm boom arm capacitor studio microphone using a cartridge capsule. A high standard of finish for in vision use and yet robust enough to withstand long periods between maintenance. Supplied complete with 1 red and 1 black windshield and 6 metres of twin screened cable terminating at the microphone end in an XLR connector.

Impedance: 600 ohms (floating). Response: 20 18,000 Hz. Sensitivity: -70 dBV. Cable: 6 metres two conductor shielded Connector: XLR 3 1/2C Battery type: HP7.

LIST PRICE **£37.40**  
**OUR PRICE £19.95** INC. VAT POST 1.1 50



# CLASSIFIEDS

**RATES**  
 1-3 insertions £7 per scc  
 4-11 insertions £6.50 per scc  
 12 insertions £6 per scc  
 24p per word (min. 15 words)  
 Box No. of application

All advertisements in this section must be pre-paid  
 Closing Date:- 1st Fri. month preceding publication

Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request).

SEND TO:- ETI CLASSIFIED, 145, CHARING CROSS ROAD, LONDON WC2H 0EE. TEL: 01-437 1002 Ext. 26



**MICROTYPE**

READY CUT CASE FOR SUPERBOARD, UK 101, NASCOM 2. (ALSO AVAILABLE WITH BLANK KEYBOARD FOR HOMEBREW, NASCOM 1, ETC.)

PRODUCED IN BLACK ABS PLASTIC, COMPLETE WITH SCREWS AND INSTRUCTIONS. SPACE FOR EXPANSION, FORCE FEED FAN, NUMERIC PAD AND ADDITIONAL KEYS. ONLY £24.50 + £1.50 P&P + VAT. SEND CHEQUES OR P.O.'S FOR £29.90 TO MICROTYPE, P.O. BOX 104, HEMEL HEMPSTEAD, HERTS. HP2 7DZ. SAE FOR DETAILS. DEALER & OEM ENQUIRIES WELCOME.

**Required: WORKSHOP ENGINEER**

familiar with repairing microprocessor control system. Experience welcome, but not necessary. Please write to:

**VIDEO GAMES SALES**  
 24 Langroyd Road  
 Tooting, SW17

**DIGITAL WATCH BATTERY REPLACEMENT KIT**



These watches all require battery (power cell) replacement at regular intervals. This kit provides the means. We supply eyeglass, non-magnetic tweezers, watch screwdriver, case knife and screwback case opener. Also one doz. assort. push pieces, full instructions and battery identification chart. We then supply replacement batteries — you fit them. Begin now. Send £9 for complete kit and get into a fast-growing business. Prompt despatch.

**BOLSTER INSTRUMENT CO. (ET17)**  
 11 Percy Avenue, Ashford, Middx. TW15 2PB

**LARGEST STOCKS ANYWHERE** sheets and manuals. Service sheets only £1 + s.e. Sole suppliers of the famous TV Repair Systems. Complete Diagram Collection. Mono TV/Washing Machines/Col. TV/etc., in huge binders, only £13.50 each. SAE brings newsletter bargain offers, quotes: G.T., 76 Church Street, Larkhall, Lanarkshire (0698) 883334.

**ZX80 PROGRAMS** on tape, many with graphics. Includes Hangman, Catch the Sub and Arithmetic Practice. — Send s.a.e. to Cadsoft, 24 St. James' Street, Cheltenham, Glos.

**ELECTRONIC IGNITION.** Inductive. Tested. Unboxed. Otherwise complete cars, m/cs, £3.50 + 30p P & p. — Storrington 4830 after 6.30.

**ADAM HALL**

Cabinet & Flightcase Fittings, fretcloths, coverings, handles, castors etc., Jacks & sockets, Cannons, Bulgins, reverb trays, Emilar compression drivers, AKG mics, Celestion speakers, ASS glasfibre horns.

Send 30p postal order for illustrated catalogues to:  
**ADAM HALL (E T SUPPLIES)**  
 Unit B, Charlton Court  
 Grainger Road, Southend-on-Sea  
 Essex S52 5BZ

**SPECIAL OFFER:** XR4136CP Quad 741 75p. CA3080AS 55p. 709 14 pin 25p. SU536T FET input op amp 198p. LM340 K 5V 1A reg TO3 95p. 78M06 ½ A6V reg 60p. 1702A Eprom 425p. SL610C 200p. SL680C 150p. SL613C, SL640C, SL301A 175p ea. Data available on request. Unused and guaranteed. No extras except for orders less than £5 please add 30p post. Send to: Wirral Semiconductors, 177 Brookdale Avenue, Greasby, Wirral, Merseyside, L49 1SR.

**CENTURION ALARMS**

**BURGLAR ALARM EQUIPMENT AT UNBEATABLE VALUE JUST LOOK!**

Order No.

100 ALARM TRIGGER MODULE. 100% Solid State. Battery operation. Pos. & Neg. Rings. N/C for 4-wire contacts. N/O for Mats. etc. One Amp Switching Capacity. Only £9.95

210 Quality White Flush fitting 4-wire MAGNETIC REED CONTACT+matching magnet £1.10

220 Surface 4-wire MAGNETIC REED CONTACT £1.50

240 PRESSURE MAT. Standard size 4-wire 30"x15" £2.20

250 PRESSURE MAT. Stair size 4-wire 23"x6 ½" £1.73

280 VIBRATION DETECTOR. Pendulum type in Ivory Case with contacted Lid+self-adhesive backing. Adjustable sensitivity £3.50

380 SIX INCH UNDER DOME BELL £9.95

390 BEST QUALITY BELL HOUSING. PVC coated metal, not to be confused with the cheaper decoy covers. Fully signwritten with our Centurion insignia £9.50

400 DECOY P.V.C. BELL COVER £9.90

Note: All equipment operates on 12 Volts DC.

710 SCOOP Offer SMOKE ALARMS. Self-contained ionisation type (1.5% obscuration) with low battery warning at the UNREPEATABLE PRICE of only £8.76 While Stocks Last!!!

Terms: Add 15% VAT to Prices + 40p Postage & Packing.

No Minimum Order. Access telephone orders welcome on: 0484-35527 or send S.A.E. for Full List to:

**CENTURION ALARMS & ELECTRONIC SALES, Dept. ME, 206 Wakefield Road, Huddersfield, W. Yorks HD5 8BE.**



**TRANSCENDENT 2000 SYNTHESISER.** Fully working, excellent condition, hardly used and with built-in 6W amplifier. £200. Telephone Bewdley 403286 evenings.

**REMOTE CONTROL.** 32-channel ultrasonic infra-red transmitter I.C. (SL490) £2.85 each. 32 channel receiver IC.s (ML928+ML929) £3.60 pair. Complete data/projects booklet add 50p. P&P 25p. Dataplus Developments, 81 Cholmeley Road, Reading, Berks.

★ 2716 ★ 2716 ★ 2716 ★ 2716 ★  
 ★ SINGLE RAIL ★ FULL SPECIFICATION ★  
 ★ £11.00 EACH INC. V.A.T. — POST FREE ★

**BENNETT & MCKAY LTD.**  
 94 Southbridge Road, Croydon, CRO1AF

**RECHARGEABLE BATTERIES**

TRADE ENQUIRIES WELCOME

FULL RANGE AVAILABLE. S.A.E. FOR LISTS. £1.45 for Booklet, "Nickel Cadmium Power" plus Catalogue. Write or call: Sandwell Plant Ltd., 2 Union Drive, BOLDMERE, SUTTON COLDFIELD, WEST MIDLANDS. 021-354 9764, or see them at TLC, 32 Craven Street, Charing Cross, London, W.C.2.

**THE MK14 BOOK.** Published by Macmillan, this big book covers every aspect of MK14 programming in 17 chapters. S.A.E. for full details. Also details of 1½K memory expansion. £5.95 + 35p p+p. — Redditch Electronics, 21 Ferneyhill Avenue, Redditch, Worcs., B97 4RU.

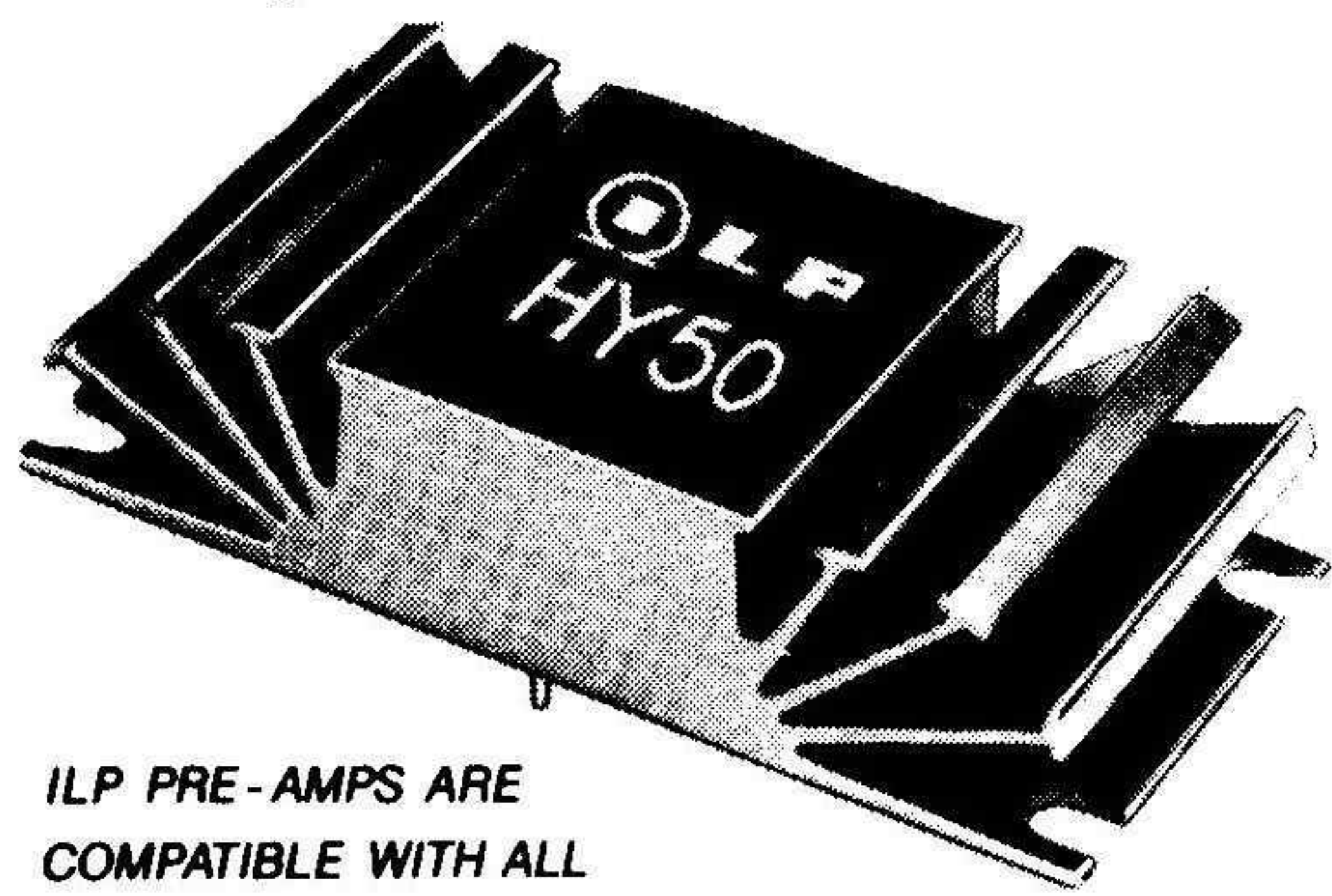
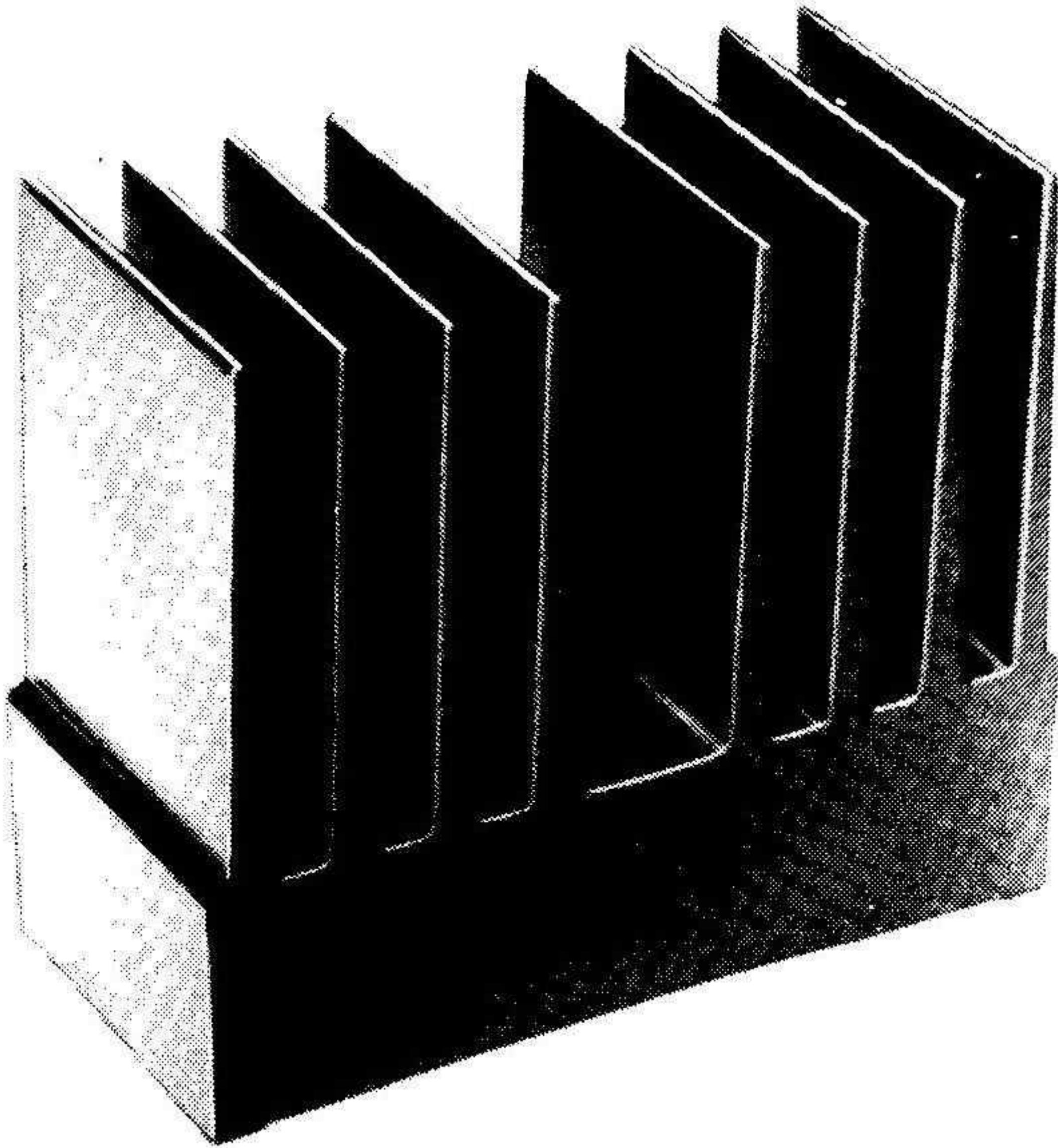
**DIGISCOPE DS2 LOGIC MONITORS,** 16-channel, CMOS/TTL, £27.40. Free leaflet. — J. E. Sinclare and Co., 82 Plumstead Common Road, SE18 3RE.

**200 COMPONENTS £4.** 100 diodes 85p. 150 caps £1.50. 100 resistors 85p. All mixed. Lists 15p. Sole Electronics (ETI), 37 Stanley Street, Ormskirk, Lancs. L39 2DH.

**PLEASE MENTION ETI WHEN REPLYING TO ADVERTS**



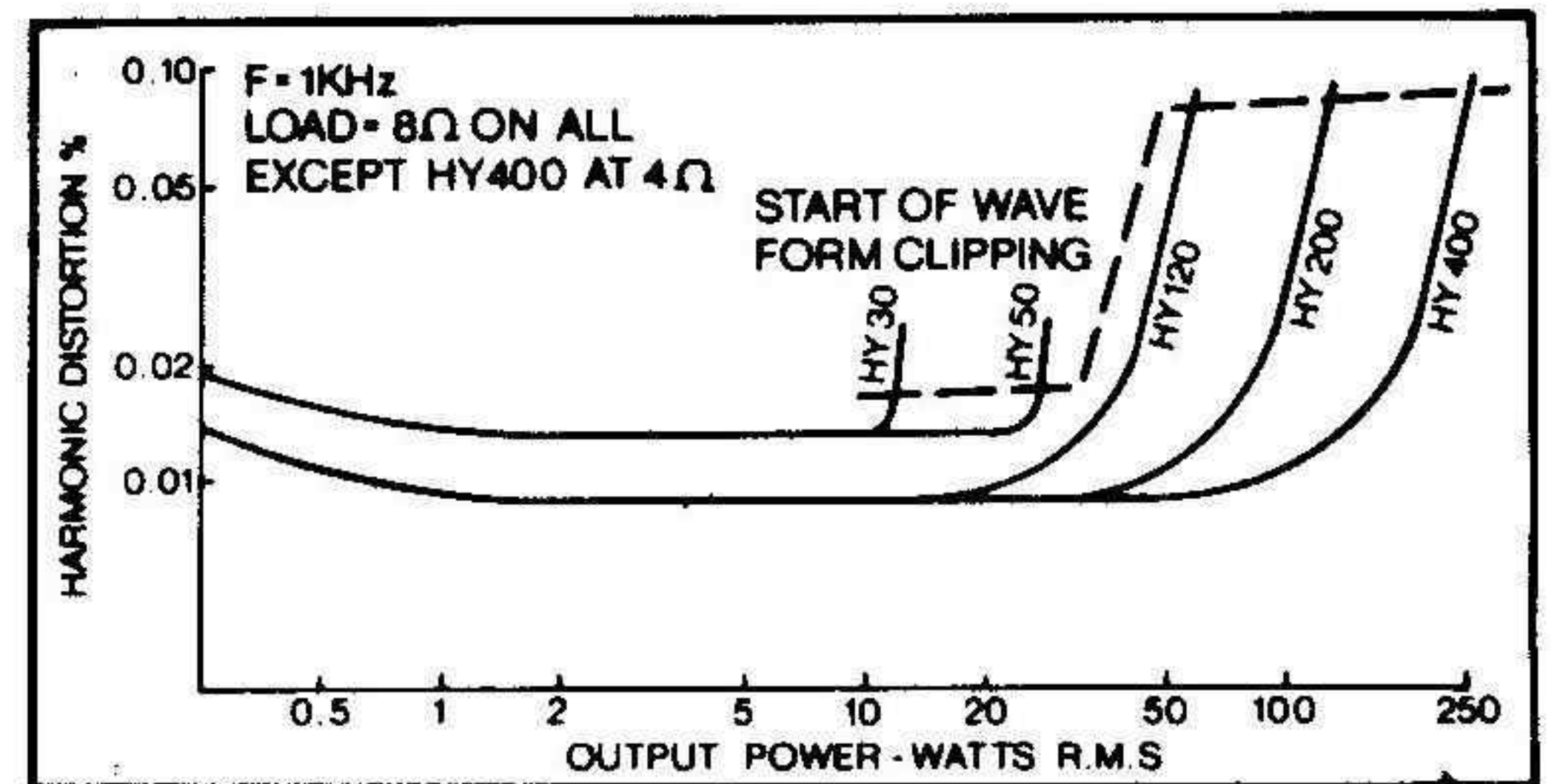
# Simply ahead...



ILP PRE-AMPS ARE  
COMPATIBLE WITH ALL  
ILP POWER AMPS AND PSUs

## POWER AMPLIFIERS

ILP Power Amplifiers are encapsulated within heatsinks designed to meet total heat dissipation needs. They are rugged and made to last a lifetime. Advanced circuitry ensures their suitability for use with the finest loudspeakers, pickups, tuners, etc. using digital or analogue sound sources.



Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 $\Omega$	0.02%	100 dB	-20 -0- +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 $\Omega$	0.02%	100 dB	-25 -0- +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 $\Omega$	0.01%	100 dB	-35 -0- +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 $\Omega$	0.01%	100 dB	-45 -0- +45	114x50x85	575	£18.44 + £2.77
HY400	240 W into 4 $\Omega$	0.01%	100 dB	-45 -0- +45	114x100x85	1.15Kg	£27.68 + £4.15

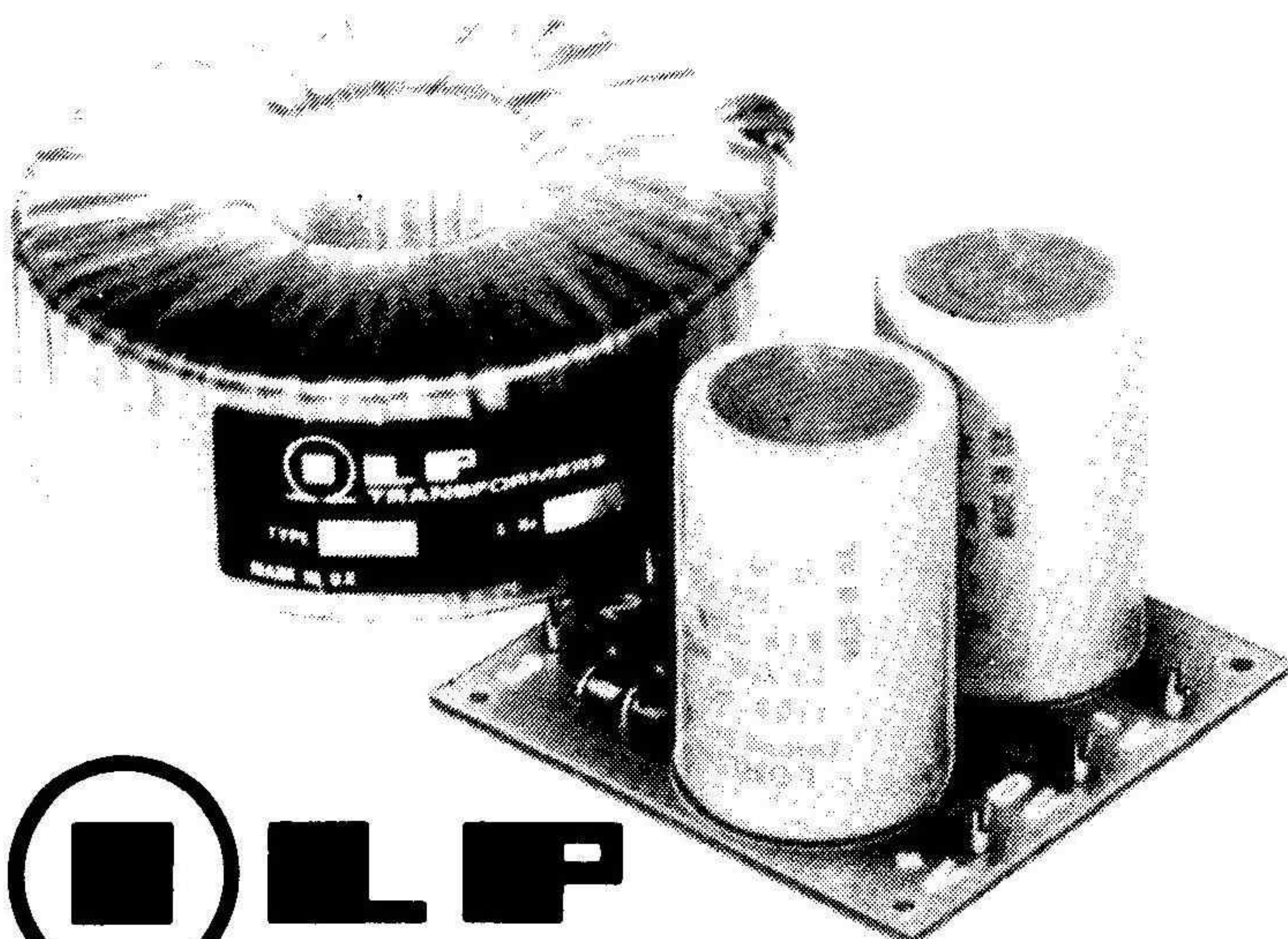
Load impedance - all models 4  $\Omega$  -  $\infty$

Input sensitivity - all models 500 mV

Input impedance - all models 100K  $\Omega$

Frequency response - all models 10Hz - 45 KHz - 3dB

## POWER SUPPLY UNITS



ILP Power Supply Units with transformers made in our own factory are designed specifically for use with ILP power amplifiers and are in two basic forms — one with circuit panel mounted on conventionally styled laminated transformer, for PSU 30 and 36 — in the other, for larger PSUs, ILP toroidal transformers are used which are half the size and weight of laminated equivalents, are more efficient and have greatly reduced radiation.

**PSU 30**  $\pm 15V$  at 100mA to drive up to 12xHY6 or 6xHY66 **£4.50 + £0.68 VAT**

THE FOLLOWING WILL ALSO DRIVE ILP PRE-AMPS

**PSU 36** for 1 or 2 HY30s **£8.10 + £1.22 VAT**

**PSU 50** with toroidal transformer for 1 and 2 HY50s **£9.75 + £1.46 VAT**

**PSU 60** with toroidal transformer for 1 HY120 **£9.75 + £1.46 VAT**

**PSU 70** with toroidal transformer for 1 or 2 HY120s **£13.61 + £2.04 VAT**

**PSU 90** with toroidal transformer for 1 HY200 **£13.61 + £2.04 VAT**

**PSU 180** with toroidal transformer for 1 HY400 or 2xHY200 **£23.02 + £3.45 VAT**



AVAILABLE ALSO FROM WATFORD ELECTRONICS, MARSHALLS AND CERTAIN OTHER SELECTED STOCKISTS.





CAMERA  
CCTV

**£110.00** + P/P £3.45 (inc. VAT)  
+ VAT (£16.50) Optional extra manual  
£6 Total £129.95

**BEST OFFER EVER**  
**Camera Kit, Lens,  
Vidicon & Modulator**

**CROFTON**

Tel: 01-891 1923 For full details

**THE BRITISH AMATEUR ELECTRONICS CLUB** for all interested in electronics. Four Newsletters a year. Library of technical books and magazines. Help for members by experts. U.K. and Eire £4.50, Europe £6, Airmail £7.50. Sterling per year. Details from Hon. Sec., J. G. Margetts, 3 Bishopstone Close, Golden Valley, Cheltenham.

**2708/2716 (triple rail) FAST ERASING/PROGRAMMING SERVICE.** 2708 £3. 2716 £5. From your Hex (or copy your eprom). New 2708 £6 each. — Petron Electronics, 1 Courtlands Road, Newton Abbot, Devon, TQ12 2JA.

**BOOKS BOOKS BOOKS** — Large range of electronics books in stock. Send s.a.e. for list. Servio Radio, Dept ET1 10, 156-8 Merton Road, Wimbledon SW19 1EG.

**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.

**INTENSIVE COURSES IN  
BASIC  
AND  
PASCAL**

including hands on mini-computer operation

These intensive courses are intended to instruct from minimal knowledge to an operational capability of computer programming. Courses are fully residential, allowing maximum time for instruction and programming.

**BASIC** — Weekends from Friday Evening to Sunday Afternoon.

**PASCAL** — Weekdays Monday Morning to Friday Afternoon inclusive.

For further details, dates available, fees  
Phone (0401) 43139, or write  
**CLEVELAND BUSINESS SERVICES**  
(Dept. ET1-2), Cleveland House  
Routh, North Humberside HU17 9SR

**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)

Afca range of etch resist transfers, and other drawing materials for p.c. boards

Send 15p for catalogue.

**RAMAR CONSTRUCTOR  
SERVICES**  
MASON'S ROAD  
STRATFORD-ON-AVON  
WARWICKS. Tel. 4879

**EXACT TIME?**

**MSF CLOCK** is ALWAYS CORRECT — never gains or loses, self-setting at switch-on, 8 digits show Date, Hours, Minutes and Seconds, larger digit Hours and Minutes for easy QUICK-GLANCE time, auto. GMT/BST and Leap year, also parallel BCD output for computer and audio to record and show time on playback, receives Rugby atomic time signals, 1000Km range, ABSOLUTE TIME, **£54.80.**  
**60KHZ RUGBY RECEIVER**, as in MSF Clock, serial data output, built-in antenna, **£15.70.**

*Each fun-to-build kit includes all parts, printed circuit, case, instructions, postage, etc., money-back assurance, so SEND off NOW.*

**CAMBRIDGE KITS**  
45 (TK) Old School Lane, Milton, Cambridge

**NEW QUALITY STEREOAMP CHASSIS.** 60w (RMS) protected 3Ω min. 0.03% THD 12/30V. Working. 20 transistors, Din sockets, controls, selector, v/c, etc. Boxed, data, £11.95 (inclusive). — Klifco Electronics, 1 Regent Road, Ilkley, West Yorkshire, LS29 9EA. Problems: Why not write to us? S.a.e. please.

**TRANSFORMERS MANUFACTURED** to specification, many popular types ex-stock. Fast turn around on volume production. Send enquiries to Louth Transformers, Queen Street, Louth, Lincs. Tel: (0507) 606436.

**NEW WORLDS FIRST  
SHARP POCKET COMPUTER PC-1211**

Complete with Cassette Interface CE-121 as reviewed in E.T.I. (Aug.), Practical Computing (July). Ideal Christmas Gift. Send **£115** incl. VAT and P. & P. to:  
**ELKAN ELECTRONICS**  
28 Bury New Road  
Prestwich, Manchester, M25 8LD

If it's a case of making your project look good, then use one of ours.

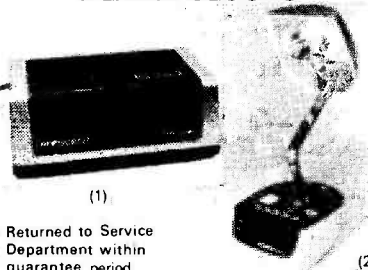
Simply send a S.A.E. for Details and prices.



TRADE ENQUIRIES INVITED.

**H. M. ELECTRONICS**  
271a/275a Fulwood Road.  
Broomhill  
Sheffield S10 3BD

**BARGAINS FOR THE ELECTRONIC HANDYMAN  
BRANDED L.E.D. 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, or 3 for **£9.95**, inc. VAT.
2. With luxury lamp and repeat alarm. S.P.S.P. £31.00. Offered at **£7.95** inc. VAT each, or 3 for **£19.95** inc. VAT.

These will be sold as received from our customers with the existing fault(s) and without guarantee.  
U.K. only  
Discounts available on large bulk purchase.

**PRESCOTT CLOCK & WATCH CO.  
LTD.**  
PRESCOTT HOUSE, HUMBER ROAD, LONDON  
NW2 6ER

**ZX80 MUSIC.** Tunes to tape like saving programs, no hardware mods. £1. Sketching program, poking to Memory Mapped Screen £1. Hex loader/display for machine code programming £1. Inclusive prices for program listing and details. — K. Macdonald, 26 Spiers Close, Knowle, Solihull B93 9ES.

**OSCILLOSCOPE £12.** Easy-build converter plugs into TV aerial socket and converts to large screen oscilloscope. (Components cost under £12). Circuit and plans £3. — Kerr, 27 Coles Road, Milton, Cambridge, CB4 4BL. (Callers by appointment.)

**ZX-80 & TRS-80 CASSETTE PROGRAMMES.** E.g. automatic calculator or metric converter £2.40 each including P&P. SAE for list. Toth, 46 First Avenue, Grimsby DN33 1DA.

**PLUG-IN RAM CARDS, SUIT ZX-80**  
1K—£20; 2K—£30; 3K—£40, send order to Quick-silver, 56 Bedford Place, Southampton, Hants. Or S.A.E. for Data.

**ZX80 GAMES.** Mastercode (Number Mastermind). Runs on Basic ZX80. Extra memory not necessary on cassette. Send £2.50 or s.a.e. details/list. — Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.



**TRS 80  
SOFTWARE  
NOW  
AVAILABLE**

**CROFTON  
ELECTRONICS  
LIMITED**

35 GROSVENOR ROAD, TWICKENHAM  
MIDDLESEX TW1 4AD Tel: 01-891 1923



**Wings Appeal**



During September  
Give for those who Gave

**ETI POWERFET AMP**

Build it at our prices

Hitachi powerFETs 2SK134 / 2SJ49 — £4.75 pair, 2SK133 — £1.95 each.

LM 381AN ultra low-noise stereo preamp — £0.99 each.

10,000uF / 40V caps — £0.95.

Custom Toroidal Transformers 4B-30-0-30-48V 230VA secondary + 20-0-20V preamp winding — £15.50.

Many other bargains — send for list prices — include V.A.T. P. & P. on components 25p, on transformers £2.

**T.D. COMPONENTS**  
F.C.F. Unit  
Havelock Street, Ravensthorpe  
Dewsbury, W. Yorks.

**50Hz SUPERBOARDS  
BRITISH MODEL  
NOW FROM £159.95**

+ VAT + P&P

Fully built, set up and tested  
Accessories, software metal cases, etc.

**AUTHORISED dealer back-up  
C.T.S., 31-33 Church Street  
Littleborough, Lancs.  
Tel. 0706 74342 any time**

**SPEED — VERSATILITY — ECONOMY**



Designed originally for logic wiring applications, it is now accepted and used extensively throughout industry, education and research. ROADRUNNER is used by hobbyists, students, technicians, designers and engineers, to carry out work on:—

**"P.C.B. REPAIRS" "ANALOGUE BREADBOARDING" "SIMPLE LOGIC WIRING" "COMPLEX INTERCONNECTING OF MICROS AND MEMORIES."**

EURO INTROKIT £14.84. PROJECT INTROKIT £5.27. PENCIL WITH LOADED BOBBIN £2.44. WIRE DISTRIBUTION STRIPS:— GLUE FIX 20/pkt 6" LONG £2.80. ADHESIVE 0-38/TUBE. PRESS FIX 20/pkt 2" LONG £2.82. SINGLE EUROCARD HIGH DENSITY 3 PLANE (36x16 PIN DILS) £4.50. DOUBLE EUROCARD, WITH CAPACITY OF 84x16 PIN DILS £7.26. PROJECT CARD HIGH DENSITY S-SIDED 20x14 PIN DILS £2.65. BOBBINS - BLUE 4/pkt £2.12 GREEN 4/pkt £2.12 PINK 4/pkt £2.12 GOLD 4/pkt £2.12. 1 OF EACH COL. £2.20. TINNED COPPER WIRE 4/pkt £2.12. RECOMMENDED SOLDERING IRON FOR ROADRUNNER HOBBYIST £4.50.

Please add 40p for p&p + 15% VAT to all orders.

**FOR FURTHER INFORMATION  
ON ROADRUNNER PRODUCTS  
SEND LARGE S.A.E. TO:—**

**T.J. BRINE ASSOCIATES,**  
116 Blackdown Rural Industries  
Haste Hill, Haslemere, Surrey

**NEW COMPONENTS**

Pack No.

A10 10 PP3 battery leads. 50p  
A30 10 Red or black crocodile clips. 45p  
A60 10 Red or black phono plugs. 80p  
A61 10 single phono sockets. 70p  
A70 10 2.5mm uncreened jack plugs. 80p  
A72 10 3.5mm uncreened jack plugs. 80p  
A73 10 3.5mm chassis sockets. 80p  
A74 10 Standard mono jack plugs. 130p  
A75 10 Standard switched jack sockets. 170p  
A84 10 5 pin 180° DIN plugs. 120p  
A85 10 5 pin 180° DIN chassis sockets. 100p  
C10 5 Standard toggle switches SPST. 190p  
C20 10 Miniature DPDT slide switches. 130p  
C30 10 Miniature push to make switches. 130p  
C31 10 Miniature push to break switches. 170p  
C40 Pair of ultrasonic transducers. 350p  
C50 20 Texas 8 pin sockets. 170p  
C51 20 Texas 14 pin sockets. 200p  
C52 20 Texas 16 pin sockets. 220p  
E10 Resistor kit 10 each value 4.7Ω to 1M. ½W type. Total of 650 resistors. 480p  
¼W 5% carbon resistors. 18p for 20 Multiples of 20 per value only  
10 4.7u 50V radial electrolytics. 60p  
10 10u 25V radial electrolytics. 60p  
10 100u 25V radial electrolytics. 75p  
10 1u 35V tantalum capacitors. 100p  
10 0.1u Mullard C280 polyester. 50p  
E54 10 0.1 Mullard C280 polyester. 50p  
F11 10 BC108 transistors. 90p  
F15 10 BC184L transistors. 90p  
F17 10 BC214L transistors. 90p  
F25 10 2N3702 transistors. 90p  
F26 10 2N3704 transistors. 80p  
F27 10 2N3819 19 transistors. 190p  
F29 10 2N3905 transistors. 90p  
F41 4 2N3055 transistors. 200p  
F46 5 7085 1A 5V regulators. 300p  
H10 20 1N4002 rectifier diodes. 75p  
H50 20 OA91 signal diodes. 140p  
H60 100 1N4148 signal diodes. 180p  
H70 5 C106D 4A 400V thyristors. 200p  
H75 5 TIC246D 16A 400V triacs. 520p  
J15 20 0.2in red LEDs. 170p  
J16 50 0.2in red LEDs. 400p  
J20 100 0.2in red LEDs. 750p  
J30 20 0.2in green LEDs. 280p  
J50 20 0.2in yellow LEDs. 280p  
J60 4 FN500 displays. 35p  
K5 5 741 operational amps. 8 pin. 80p  
K25 5 LM301A operational amps. 8 pin. 140p  
K30 1 LM324 operational amplifiers. 50p  
K80 5 CA3140 operational amps. 225p  
K80 5 NE555 timers. 110p  
M10 8 2114LP memories. 2800p  
N5 1 Dalo printed circuit board pen. 80p

All prices include VAT. Please add 50p carriage on all orders below £10. Send SAE for our keahled list. Mail order only.

**RAPID ELECTRONICS**  
Hillocroft House, Station Road, Eynford, Kent

**ADVERTISEMENT INDEX**

ACORN COMPUTERS .....	105	L8 ELECTRONICS .....	94
AJD DIRECT SUPPLIES .....	67	L & B ELECTRONICS .....	112
ALTEK INSTRUMENTS .....	38	MACLIN-ZAND .....	14
AMBIT INTERNATIONAL .....	71	MAPLIN .....	124
AUDIO ELECTRONICS .....	32 & 38	MARSHALLS .....	115
B. BAMBER .....	62	METAC .....	28 & 29
BAYDIS .....	46	MICRO-CIRCUITS .....	20
BI-PAK SEMICONDUCTORS .....	52	MICRO-PRINT LTD. .....	104
BK ELECTRONICS .....	72	MITRAD .....	100 & 101
B.N.R.S. .....	31	MONOLITH .....	102
BUTTERWORTHS .....	113	MOUNTAINDENE .....	51
CALCULATOR SALES & SERVICE .....	75	E. R. NICHOLLS .....	121
CAMBRIDGE LEARNING .....	61	NIC MODELS .....	104
CHILTMHEAD .....	68	PARNDON ELECTRONICS .....	117
CHROMASONICS .....	97	T. POWELL .....	117
CHROMATRONICS .....	68	POWERTRAN .....	2, 8 & 116
CLEF PRODUCTS .....	62	PROGRESSIVE RADIO .....	58
CODESPEED .....	115	PROTON ELECTRONICS .....	117
COMP, COMP, COMP .....	122 & 123	QUANTUM ELECTRONICS .....	82
CRIMSON COMPONENTS .....	34	RAPID ELECTRONICS .....	121
CRIMSON ELEKTRIK .....	98	J. W. RIMMER .....	38
CROFTON ELECTRONICS .....	37	RISCOMP LTD. .....	37
C.S.C. .....	39, 62 & 75	R.T.V.C. .....	46
CYBER ELECTRONICS .....	46	RUSHMOOR ELECTRONICS .....	86
DELTA TECH & CO. .....	37	SAFGAN ELECTRONICS .....	111
DIGISOUND .....	86	SAXON ENTERTAINMENTS .....	113
DISPLAY ELECTRONICS .....	83	SCIENCE OF CAMBRIDGE .....	4 & 5
DONDENE LTD. .....	94	SILICA SHOP .....	67
DORAM ELECTRONICS .....	78	C. N. STEVENSON .....	114
DOVE ELECTRONICS .....	102	SURETRON SYSTEMS .....	102
ELECTROVALVE .....	107	SWANLEY ELECTRONICS .....	90
GMT ELECTRONICS .....	96	TANGERINE LTD. .....	56 & 57
GREENBANK .....	106	TARGET ELECTRONICS .....	58
GREENWELD .....	104	TECHNOMATIC .....	6
HAMEG LTD. .....	82	TEMPUS .....	98
HAPPY MEMORIES .....	96	TIMEDATA LTD. .....	102
HEATH ELECTRONICS .....	117	TK ELECTRONICS .....	114
HENRY'S RADIO .....	118	TRANSAM .....	91
I.C.S. .....	107	T & T ELECTRONICS .....	90
I.L.P. .....	12, 13 & 86	VIDEOTONE .....	99
JAVEN DEVELOPMENTS .....	113	WATFORD ELECTRONICS .....	10 & 11
KEELMOOR LTD. .....	76 & 77	WEST HYDE DEVELOPMENTS .....	68
KODE SERVICES .....	96	WILLIAM STUART SYSTEMS .....	90
KRAMER & CO .....	46	WILMSLOW AUDIO .....	115
LASCAR ELECTRONICS .....	33		

**ETCH RESIST TRANSFER  
KIT SIZE 1:1**

Complete kit 13 sheets 6in x 4½in **£3.00** with all symbols for direct application to P.C. board. Individual sheets 30p each.

(1) Mixed Symbols (2) Lines 0.05 (3) Pads (4) Fish Plates and Connectors (5) 4 Lead and 3 Lead and Pads (6) DILS (7) BENDS 90° and 130° (8) 8—10—12 T.O.5. Cans (9) Edge Connectors 0.15 (10) Edge Connectors 0.1 (11) Lines 0.02 (12) Bends 0.02 (13) Quad, in Line.

**FRONT AND REAR PANEL TRANSFER SIGNS**

All standard symbols and wording. Over 250 symbols, signs and words. Also available in reverse for perspex, etc. Choice of colours, red, blue, black, or white. Size of sheet 12in x 9in. Price **£1.20.**

**GRAPHIC TRANSFERS WITH SPACER ACCESSORIES**

Available also in reverse lettering, colours red, blue, black or white. Each sheet 12in x 9in contains capitals, lower case and numerals ½in kit or ¼in kit. **£1.20** complete. State size.

**All orders dispatched promptly.**

**All post paid**

Shop and Trade enquiries welcome  
Special Transfers made to order

**E. R. NICHOLLS  
P.C.B. TRANSFERS**  
DEPT. ET110  
46 LOWFIELD ROAD  
STOCKPORT, CHES. 061-480 2179



## BITS & BYTES

8MHz Super Quality Modulators	£4.90
6MHz Standard Modulators	£2.90
C12 Computer Grade Cassettes	10 for £4.00
Anadex Printer Paper — 2000 sheets	£25.00
Floppy Discs 5¼" Hard and Soft Sector	£3.50
Floppy Disc Library Case 5¼"	£3.50
Verocases for Nascom 1 & 2 etc.	£24.90
Keyboard Cases	£9.90

## MEMORY UPGRADES

16K (8 x 4116)	£29.90 + VAT
4K Compukit (8 x 2114)	£29.90 + VAT

EPROM 2716 £12.50 + VAT

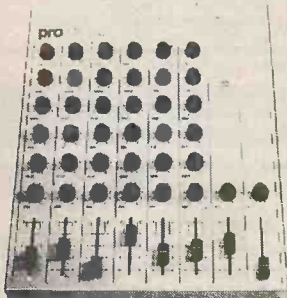
## COMP PRO MIXER

Professional audio mixer that you can build yourself and save over £100.

6 into 2 with full equalization and echo, cue and pan controls.

All you need for your own recording studio is a stereo tape or cassette recorder.

This superb mixer kit has slider faders, level meters and additional auxilliary inputs.



Only £99.90 plus VAT for complete kit

Plus FREE power supply valued at £25.00

Ideal for DISCOS STAGE MIXING HOME STUDIOS AND MANY OTHER APPLICATIONS

## NEC SPINWRITER

only £1490 + VAT



NEC's high quality printer uses a print "thimble" that has less diameter and inertia than a daisy wheel, giving a quieter, faster, more reliable printer that can cope with plotting and printing (128 ASCII characters) with up to five copies, friction or tractor fed. The ribbon and thimble can be changed in seconds. 55 characters per second bidirectional printing — with red/black, bold, subscript, superscript, proportional spacing, tabbing, and much, much more.

EXTENDED WARRANTY BY COMPUKARE



## HITACHI PROFESSIONAL MONITORS

9" — £129  
12" — £199

- **Reliability** Solid state circuitry using an IC and silicon transistors ensures high reliability.
- **500 lines horizontal resolution** Horizontal resolution in excess of 500 lines is achieved in picture center.
- **Stable picture** Even played back pictures of VTR can be displayed without jittering.
- **Looping video input** Video input can be looped through with built-in termination switch.
- **External sync operation** (available as option for U and C types)
- **Compact construction** Two monitors are mountable side by side in a standard 19-inch rack.

RRP £540



only £399 + VAT

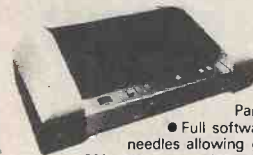
## ANADEX DP800

Super Quality — Low cost printer Tractor Feed with full 96 ASCII character set. Accepts RS232C at baud rates between 100 and 9600 and Parallel Bit data. Attaches either directly or through interlaces to Pet, Apple, TRS80, Sorcerer, Nascom, Compukit etc

EXTENDED WARRANTY BY COMPUKARE

## THE NEW ANADEX DP9501

### A PROFESSIONAL PRINTER



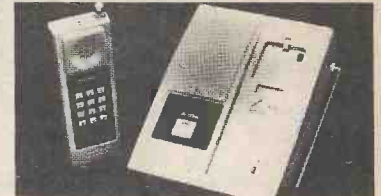
- Bi-directional printing
- Up to 220 chars/line with 4 print densities
- 500 char buffer
- RS232C and Centronics

- Full software control of matrix needles allowing graphics capability
- 200 chars/sec ● Adjustable width tractor feed.

All this for only £895 + VAT.

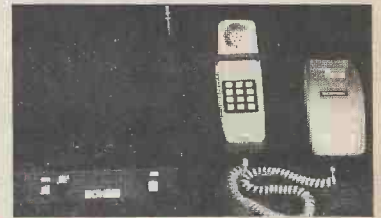
## COMPUPHONES

YOU NEED NEVER MISS AN IMPORTANT CALL AGAIN TWO CORDLESS TELEPHONE SYSTEMS — DIRECT FROM USA



THE ALCOM only £147 + VAT

Base station connects to your telephone line. Remote handset clips to your belt and gives you push-button dialling — Bleeps when call arriving — Nicad rechargeable batteries. Charger in base unit.



THE BOHSEI only £125 + VAT

Base station connects to your telephone line. Remote handset stylishly designed in red — Push button dialling comes complete with charger unit for batteries in handset.



LOW COST TELEPHONE ANSWERING MACHINE only £99.95 + VAT

Microprocessor controlled answering machine. Plug into your phone line. Records any phone call messages. Remote bleeper enables you to listen to your messages from anywhere in the world. Uses standard cassettes. Comes complete with mains adaptor, microphone, remote bleeper, base unit, cassette with 30 sample pre-recorded messages.

## COMMERCIAL • EXPANDABLE • COMPLETE TRS 80 - MODEL II

EXTENDED WARRANTY BY COMPUKARE



This new unit from the world's most successful micro company is now available immediately with software.

The basic unit comes complete with 64 thousand characters (bytes) of Memory. The built in 8" Floppy disc adds another ½ million extra characters including the disc operating system. More disc expansion is now available.

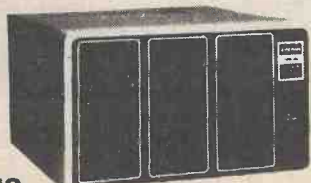
The Model II is a complete unit with a full keyboard including a numeric pad and 12" screen which gives 24 lines of 80 characters. The computer is supplied with both the disc operating system and the Level III Basic.

A full self test routine is written into the power up procedure to eliminate incorrect operation. Both serial and parallel expansion sockets are standard. A printer is a plug-in operation.

Both hardware and software necessary to talk to a mainframe are included. Terminal usage is very possible. With the addition of CPM2 you can operate with COBOL, FORTRAN, MBASIC, CBASIC in which languages are many other applications packages i.e. accounting, payroll stock etc.

COMING SOON

26 megabyte Hard Disc multi-user DOS



WE USE THIS MACHINE IN OUR BUSINESS

64K 1-Disk Model II £1995.00 + VAT  
RRP £2250.00

## 1 DISK EXPANSION Room for 3

500K per Drive gives total of 1.5M Byte — 1 Drive plus Cabinet £799 - VAT

CP/M2	£95.00
CIS COBOL	£400.00
C BASIC	£75.00
M BASIC	£155.00
FORTRAN	£220.00
WORDSTAR	£255.00



JUST COMPARE OUR CASH AND CARRY PRICES!



EUROPE'S FASTEST SELLING ONE BOARD COMPUTER  
**COMPUKIT UK101**

★ 6502 based system — best value for money on the market. ★ Powerful 8K Basic — Fastest around ★ Full Qwerty Keyboard ★ 4K RAM Expandable to 8K on board. ★ Power supply and RF Modulator on board. ★ No Extras needed — Plug-in and go. ★ Kansas City Tape Interface on board. ★ Free Sampler Tape including powerful Disassembler and Monitor with each Kit. ★ If you want to learn about Micros, but didn't know which machine to buy then **this is the machine for you.**

- 40 pin Expansion Jumper Cable for CompuKit expansion **£8.50 + VAT**
- Build, Understand and Program your own Computer for only a small outlay
- KIT ONLY £179 + VAT NO EXTRAS NEEDED**
- Available ready assembled, tested & ready to go **£229 + VAT**

**NEW MONITOR FOR COMPUKIT UK101**  
 ● In 2K Eprom 2716 ● Allows screen editing ● Saves data on tape ● Flashing cursor ● Text scrolls down **£22.00 + VAT**

**FOR THE COMPUKIT**

Assembler/Editor	<b>£14.90</b>	Game Packs	Space Invaders	<b>£5.00</b>
Screen Editor Tape	<b>£5.90</b>	1. Four Games	Chequers	<b>£3.00</b>
		2. Four Games	Real Time Clock	<b>£3.00</b>
		3. Three Games 8K only	Case for CompuKit	<b>£29.50</b>

All Prices exclusive VAT



**only £349 + VAT**  
**TRS80 LEVEL 2 16K**  
 Fully converted to UK T.V. Standard. Comes complete with easy to follow manuals. UK Power Supply — Cassette Leads — Sample tapes. Special box to enable you to plug into your own TV. Recommended for first time-buyers. Just plug in and go. Full Range of Software Available.  
 Interface to Centronics Parallel for TRS80 **£75.00 + VAT**

**only £295 + VAT**  
 Expand your TRS80 by 32K. 32K Memory on board. Centronics parallel port. Disk controller card. Real time clock. Requires Level II Basic. Interface for 2 cassette decks complete with power supply.  
**32K TRS80 EXPANSION INTERFACE**



**video 100**  
 12" BLACK & WHITE LOW COST VIDEO MONITOR  
**only £79 + VAT**  
 ● Ideal for home, personal and business computer systems  
 ● 12" diagonal video monitor ● Composite video input  
 ● Composite video input ● Compatible with many computer systems ● Solid-state circuitry for a stable & sharp picture ● Video bandwidth - 12MHz + 3DB ● Input impedance - 75 Ohms ● Resolution - 650 lines Minimum In Central 80% of CRT; 550 Lines Minimum beyond central 80%.

**NEW SUPER 80 COLUMN PET 32K**  
**£7.95 ex stock**

**We still stock Atari TV game products**

**SPECIAL—ONCE IN A LIFETIME OFFER!**

16K **£399**  
 32K **£449**  
 48K **£499**  
 + VAT  
**EXIDY SORCERER**  
 For Personal or Business Use.  
 32K or 48K memory. 8K Microsoft Basic in ROM. Dual Cassette I/O. RS232 I/O. Parallel I/O (Centronics). Expansion available through optional extra S100 Motherboard. 69 Key keyboard including 16 key numeric pad.

**SPECIAL OFFER**  
 We will part exchange your Sinclair ZX80 for any of our products.  
 Refurbished ZX80's—fully guaranteed **£69.90** + VAT  
 (Supply dependant upon stocks).

**NEW TV GAME BREAK OUT**  
 Has got to be one of the world's greatest TV games. You really get hooked. As featured in ETI. Has also 4 other pinball games and lots of options. Good kit for up-grading old amusement games.  
**MINI KIT** — PCB, sound & vision modulator, memory chip and de-code chip. Very simple to construct. **£14.90 + VAT**  
**OR PCB £2.90 MAIN LSI £8.50** Both plus VAT



We have one of the largest collections of Computer Books under one roof, along with racks of software for the PET and TRS80. **Come and see for yourself.**

**WE ARE NOW STOCKING THE APPLE II EUROPLUS AT REDUCED PRICES**

16K	<b>£599</b>
32K	<b>£649</b>
48K	<b>£690</b>

+ VAT

**Getting Started** APPLE II is faster, smaller, and more powerful than its predecessors. And it's more fun to use too because of built-in features like:  
 ● BASIC — The Language that Makes Programming Fun.  
 ● High-Resolution Graphics (in a 54,000-Point Array) for Finely-Detailed Displays. ● Sound Capability that Brings Programs to Life. ● Hand Controls for Games and Other Human-Input Applications. ● Internal Memory Capacity of 48K Bytes of RAM, 12K Bytes of ROM; for Big-System Performance in a Small Package. ● Eight Accessory Expansion Slots to let the System Grow With Your Needs.  
 You don't need to be an expert to enjoy APPLE II. It is a complete, ready-to-run computer. Just connect it to a video display and start using programs (or writing your own) the first day. You'll find that its tutorial manuals help you make it your own personal problem solver.

**EXTENDED WARRANTY BY COMPUKARE**  
 We give a full one year's warranty on all our products.  
 We now have in stock demonstration models of the Atari 800 and Texas 99/4. **Come and see them**

**EXATRON STRINGY FLOPPY FOR TRS80**  
 (Expansion interface not needed)  
**only £169 + VAT**  
 High Speed storage medium that is cheap and reliable. Includes: 20 wafers - M/C monitor - BUS EXPN cable. **£169**

**NASCOM-2**  
 WITH FREE POWER SUPPLY & 16K RAM B BOARD  
**only £305 + VAT**  
 Subject to Availability

**EXTENDED WARRANTY BY COMPUKARE**  
**NASCOM 2 DISC DRIVES**  
 Add a powerful, double density, mini floppy disc to your Nascom system.  
 ● Disc Controller Card (includes Nasbus 6 S100 interface)  
 ● Will control 4 Drives.  
 ● CPM operating system.  
 ● Extended Disc Basic Compiler.  
 ● Power supply included  
 One Disc System — **£499 + VAT**  
 Additional Disc Unit — **£299 + VAT**

**NEW REDUCED PRICES**

8K	<b>£399</b>
16K	<b>£499</b>
32K	<b>£599</b>

+ VAT  
 RRP £795 for 32K

**The PEDIGREE PETS** Very popular for home & business use. 8K Microsoft Basic in ROM. 8K Pet 32K & 16K with new improved keyboard. All with green screen. Cassette Deck **£55** extra. Full range of software available. Interface PET IEEE — Centronics Parallel. Not decoded **£49.00 + VAT** Decoded **£77.00 + VAT**

**EXTENDED WARRANTY BY COMPUKARE**  
**SPECIAL SCOOP GET YOURSELF A PRINTER FOR YOUR PET AND SAVE A FORTUNE**  
**only £349 + VAT**  
 Full Pet Graphics including cables. Ready to go.  
**EX-STOCK.**



Please add VAT to all prices — including delivery. Please make cheques and postal orders payable to **COMP SHOP LTD.**, or phone your order quoting **BARCLAYCARD, ACCESS, DINERS CLUB** or **AMERICAN EXPRESS** number. **CREDIT FACILITIES ARRANGED** — send S.A.E. for application form.  
 14 Station Road, New Barnet, Hertfordshire, EN5 1QW Telex: 298755 TELCOM G  
 Telephone: 01-441 2922 (Sales) 01-449 6596  
 OPEN - 10 am - 7 pm — Monday to Saturday  
 Close to New Barnet BR Station — Moorgate Line.  
 ★ **NOW IN IRELAND** at: 80 Marlborough St., Dublin 1, Tel: Dublin 749933  
 ★ **COMP SHOP USA**, 1348 East Edinger, Santa Ana, California, Zip code 92705.  
 Telephone: 0101 714 5472526





# MAPLIN

## announce the opening of their new LONDON shop

259-261  
King St.  
Hammersmith  
London W6  
01-748 0926



- \* Excellent metered parking
- \* Close to Hammersmith Underground Station for Piccadilly, District & Metropolitan Lines
- \* Bus no's 260·266·704·27·91 267·290 stop outside



### Opens Tuesday 16th September, 1980

Opening Hours 9.45 am to 5.30 pm Tuesday to Saturday (Closed Monday)

Maplin mail-order –  
Now better than ever!

- \* Up to 8% discount for use with next order
- \* All prices include VAT
- \* Same day service on in-stock lines
- \* Over 95% of our stock lines in stock
- \* Large range of all the most useful components
- \* First class reply paid envelope with every order
- \* Quality components – no rejects – no re-marks
- \* Competitive prices
- \* Your money is safe with a reputable Company

On price, service, stock, quality and security, it makes sense now more than ever to make **Maplin** – your first choice for components every time!

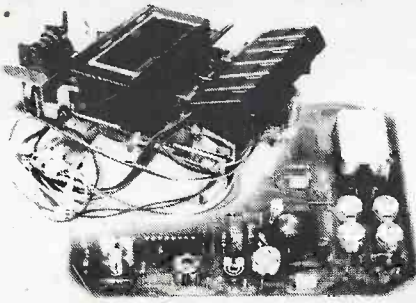
Post this coupon now for your copy of our 1979-80 Catalogue price 70p  
Please send me a copy of your 280 page catalogue. I enclose 70p (plus 46 p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the U.K. send £1.35 or ten International Reply Coupons. I enclose £1.16.

Name \_\_\_\_\_

Address \_\_\_\_\_

ETI 1080

### Stereo Cassette Tape Deck



Utilising the superb JVC deck made for Tandberg and a ready-made pre-aligned, tested and guaranteed module, this cassette deck has a superb sound and a high quality specification. We've got everything you need (except cabinet) including full instruction leaflet for only £39.95. Order as XY36P (Cassette Recorder Kit)

### Space Invaders

Fight the space invaders, be a polaris captain or a spaceship commander. Full colour action on your own TV set and over 450 games to play.

Basic console with Combat cartridge (AC00A) £99.50 + £2.50 carriage

All cartridges available including:

Space Invaders (AC26D)	£29.95	Adventure (AC22Y)	£23.95
Indy 500 (AC24B)	£34.50	Skydiver (AC13P)	£16.95
Chess (8levels) (AC28F)	£34.50	Breakout (AC05F)	£16.95
Golf (9holes) (AC18U)	£16.95	Slot Racers (AC19V)	£16.95
Air Sea Battle (AC01B)	£16.95	Programming (AC27E)	£34.50
Space War (AC02C)	£16.95	Olympics (AC04E)	£16.95
Brain Games (AC16S)	£16.95	Street Racer (AC14Q)	£16.95
Outlaw (AC03D)	£16.95	Keyboards per pair (AC29G)	£11.95

All prices include VAT and carriage except where shown.

# MAPLIN

Maplin Electronic Supplies Ltd

All mail to:- P.O. Box 3, Rayleigh, Essex SS6 8LR.  
Telephone: Southend (0702) 554155.

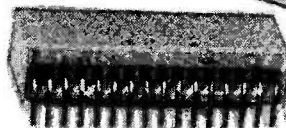
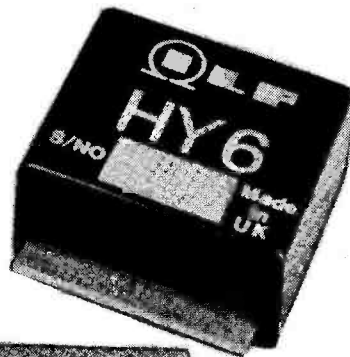
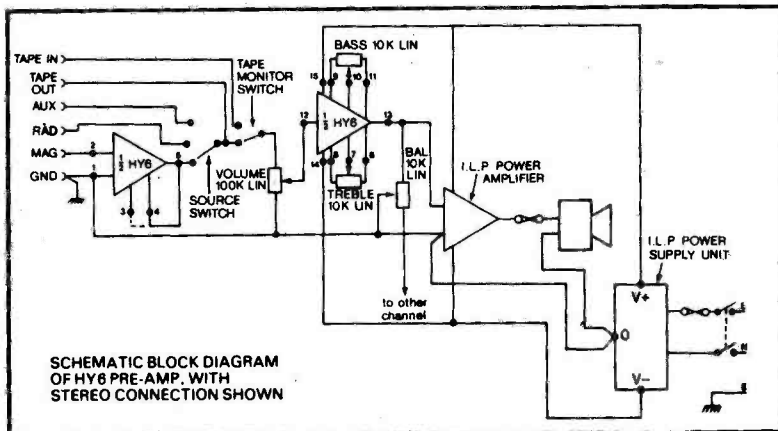
Shop: 284 London Road, Westcliff-on-Sea,  
Essex. (Closed on Monday)  
Telephone: Southend (0702) 554000.



Catalogue now available in all branches of WHSMITH Price £1.00



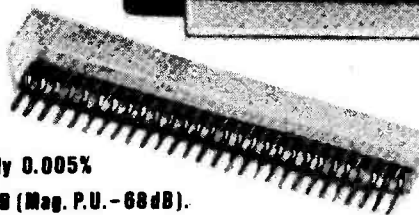
# this time with two new pre - amps



## HY6 mono HY66 stereo

When ILP add a new design to their audio-module range, there have to be very special reasons for doing so. You expect even better results. We have achieved this with two new pre-amplifiers - HY6 for mono operation, HY66 for stereo. We have simplified connections, and improved performance figures all round. Our new pre-amps are short-circuit and polarity protected; mounting boards are available to simplify construction.

Sizes - HY6 - 45 x 20 x 40 mm | HY66 90 x 20 x 40 mm. Active Tone Control circuits provide  $\pm 12$ dB cut and boost. Inputs Sensitivity - Mag. PU - 3mV; Mic - selectable 1-12mV; All others 100mV; Tape O/P - 100mV; Main O/P - 500mV; Frequency response - D.C. to 100KHz - 3dB.



### HY6 mono

£5.60

+ VAT 84p

### HY66 stereo

£10.60

+ VAT 84p

Connectors included

B6 Mounting Board

78p + 12p VAT

B66 Mounting Board

99p + 15p VAT

- LOW DISTORTION - Typically 0.005%
- S/N RATIO - Typically 90dB (Mag. P.U. - 68dB).
- HIGH OVERLOAD FACTOR - 38dB on Mag. P.U.
- LATEST DESIGN HIGH QUALITY CONNECTORS.
- REQUIRE ONLY POTS, SWITCHES, PLUGS AND SOCKETS.
- COMPATIBLE WITH ALL ILP POWER AMPS AND PSUs.
- NEEDS ONLY UNREGULATED POWER SUPPLY  $\pm 15V$  to  $\pm 50V$ .

NO QUIBBLE  
5 YEAR GUARANTEE  
7 DAY DESPATCH ON ALL ORDERS  
BRITISH DESIGN AND MANUFACTURE  
FREEPOST SERVICE see below

★ ALL U.K. ORDERS DESPATCHED POST PAID  
HOW TO ORDER, USING FREEPOST SYSTEM

Simply fill in order coupon with payment or credit card instructions. Post to address as below but do not stamp envelope - we pay postage on all letters sent to us by readers of this journal.



FREEPOST 6 Graham Bell House, Roper Close,  
Canterbury, Kent CT2 7EP.  
Telephone (0227) 54778 Telex 965780

Please supply .....

..... Total purchase price £.....

I enclose Cheque  Postal Orders  International Money Order

Please debit my Access/Barclaycard Account No. ....

NAME .....

ADDRESS .....

Signature .....



FM Radio Control

Page 15 missing



# HOW IT WORKS

The KB4445 is an I<sup>2</sup>L bipolar IC, comprising a 4 channel multiplexer encoder, RF oscillator with FM modulator (switch type) with a 30 mW RF output.

It is also provided with an undervoltage warning system using a flashing LED when the supply voltage drops below 4V4 from a nominal supply of 6 V.

The encoder section consists of a string of cascaded RC monostable time constants, determining the pulse width according to the position of the external control potentiometers.

Channel and frame times are similarly externally programmable.

### Specification

Item	Min	Typ	Max	Comments
Power supply (V DC)	4	6	12	LED flashes at 4V4
Consumption (mA)		20		Oscillator stopped
Output power (mW)		30		
Dissipation (mW)			450	4.5 mW/°C
Operation temp (°C)	-10		+60	
Storage temp (°C)	-55		+125	
Encoder pulse width (µs)		200		
Channel pulse width (mS)		1.5		
Frame pulse width (mS)		20		
Frequency deviation (kHz)	2	4		F <sub>o</sub> + F <sub>dev</sub> when modulated
Crystal frequency (MHz)	8	27	50	Crystal f = f <sub>out</sub> /2

The KB4445 adopts one of the most universal encoder formats and is thus widely compatible with existing FM systems. The 'on-board' RF section is intended to be used as a driver for an external output stage and where sufficient supply voltage is available, a single power MOSFET may be used to achieve power levels in excess of 2 W.

The external circuit shown on the applications diagram delivers approx 400 mW RF to the antenna, which is sufficient for reliable control over 200 m with the KB4446 at the receiver.

Pin 12 of the KB4445 is the switching point of the modulator and it should be noted that the modulation action is achieved by switching an external capacitor in series with the crystal. Thus the level of deviation (more accurately termed modulation 'on' offset) may be controlled by a trimmable value at this point in the circuit. The capacitors across pins 10 and 11 form the feedback of a Colpitts oscillator and thus also affect the order specification of the transmit crystal in conjunction with the capacitor selected at pin 12.

Adjustment of the capacitor at pin 12 is an essentially iterative adjustment, altering the output frequency at the same time as the deviation

level, so care must be taken when setting up initial values in this part of the circuit.

Pin 13 of the KB4445 offers access to the modulator switch filter and may thus be tailored to provide optimum bandwidth by selection of an external value.

### KB4446 Receiver IC

#### Specification

Item	Min	Typ	Max	Remarks
Supply voltage (V DC)	2.1	3.0	4.0	LED flashes at 2V2
Supply current (mA)	15	20	25	at 3V
Receiver sensitivity (dBu)		26		20db S/N
Limiting sensitivity (dBu)		40		
Detector output (8) (mV)		300		60dBu input
S/N at 60 dBu in (dB)		40		
LED drive current (mA)		5		At V <sub>cc</sub> 2V2.
Std pulse width (µs)		200		
Channel (mS)		1.5		
Frame (mS)		20		
Output source current (µA)		100		Decoder outputs
Output sink current (mA)		2.0		Int. 20k

The KB4446 receiver IC uses a third overtone (30pF parallel load) crystal in the local oscillator circuit, selected to be either 455 kHz high or low of the incoming transmitter frequency. Oscillator low is usually preferred.

The mixer output will match either L/C IF filtering or ceramic filter systems in much the same way as the MC3357P. A tuned IFT is however recommended at this point in the circuit, since most ceramic filters will offer little or no attenuation to the local oscillator present at this pin.

The detector uses a standard form of quadrature at pin 2 of the IC — a Q of approx 80 will give results in the above table, although other values may be used if provision is left to include a damping resistor. The choice of the coil will determine the output for a given deviation — in this case 2 kHz is used as the reference (ie 4 kHz total displacement.)

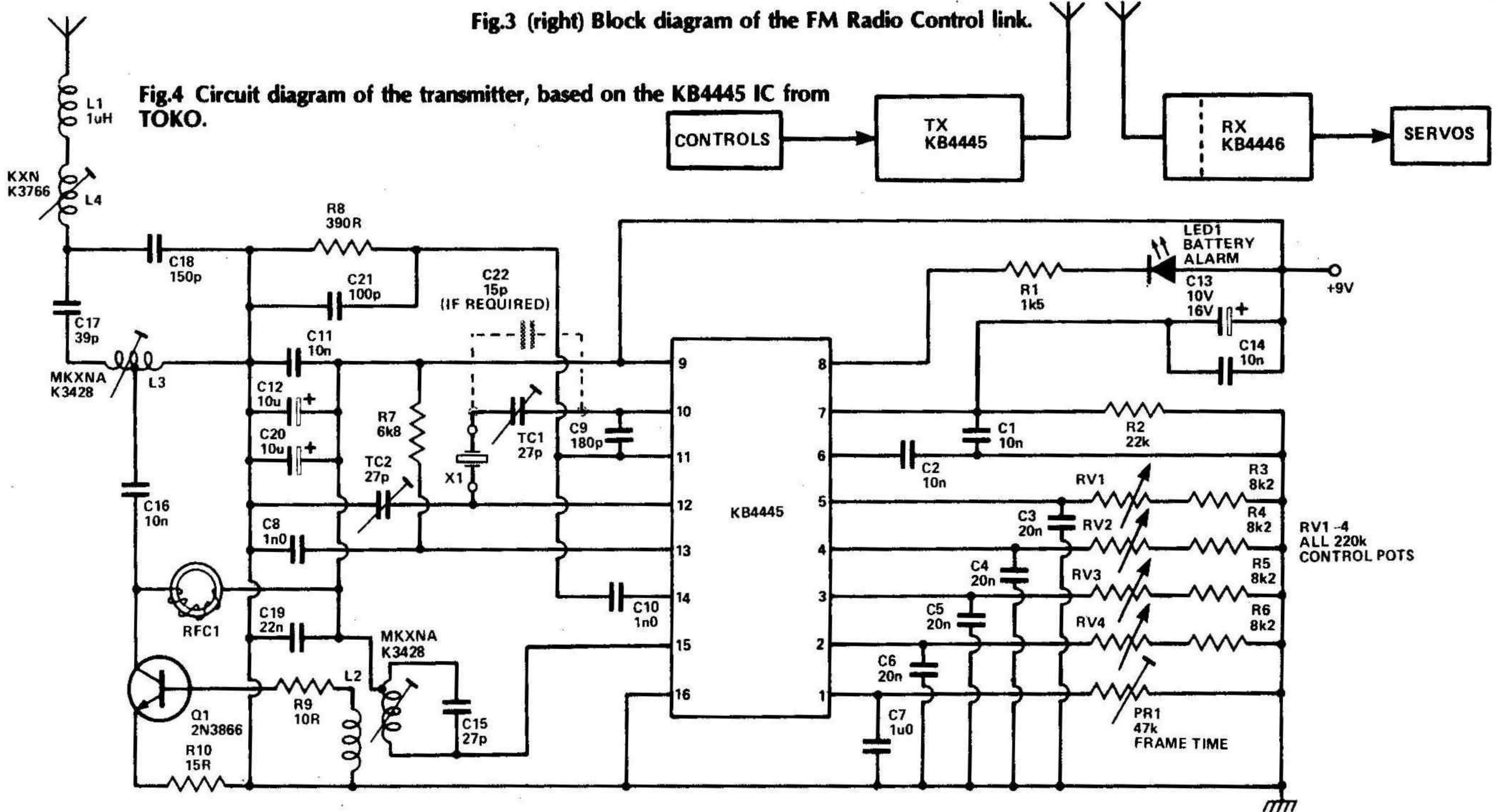
The detector output is fed to a comparator at the decoder input, which provides immunity to noise effects present on the detected signal. The values selected for the inputs at pins 21 and 22 will reject most HF noise and are based on the frame and pulse timing stated here. Other values may be used with non-standard forms of timing sequence.

A good quality capacitor should be used at pin 20 since this is the reset timing capacitor, setting the frame at approximately 20 mS total with the values shown.

Fig.3 (right) Block diagram of the FM Radio Control link.



Fig.4 Circuit diagram of the transmitter, based on the KB4445 IC from TOKO.





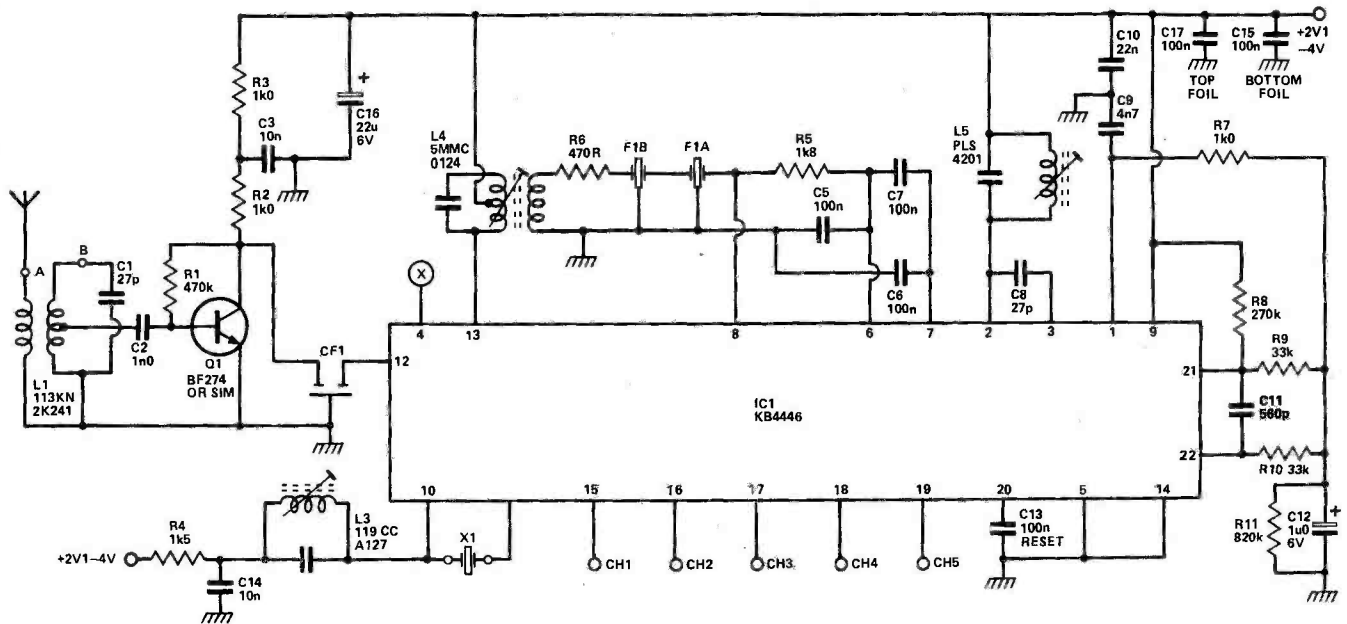


Fig.5 Circuit diagram of the receiver, built round the KB4446 IC, also from TOKO.

## Supply And Demand

The KB4446 is designed to work on the exceptionally low voltage supplies (from 2V1 to 4V) to be precise. This is because the standard servo supply rail of 4V8 is subject to a lot of fluctuation and noise from the effects of the DC motors continually stopping and starting. Despite NiCad batteries being a very low impedance power source, there is nearly always some effect on the supply voltage when the start and stall current of average servos are being drawn, but the difference between 4V8 and the nominal 3V0 of the KB4446 is quite enough to permit stabilisation via a pass transistor.

Both ICs contain an under voltage LED indicator to let you know when the power is approaching a dangerously low level. The indicator need not necessarily be a LED, as the output is available to drive a variety of alternative warning devices. A high efficiency piezo-ceramic resonator may be a more satisfactory system for outdoors applications where the light of a LED is easily flooded by sunlight. A suitable circuit is shown in Fig. 6.

## Construction

The PCB and layout (Fig. 7) of the receiver reveals very little, apart from the fact that you will need a steady hand and a fine point on your soldering iron. The receiver was designed to fit into a standard plastic case with the facility to easily swap crystals and servo connections, so some aspects of the layout are not perhaps as ideal as the RF purist would have chosen. Nevertheless, it works.

The transmitter PCB is a straightforward device, since it is not necessary to apply the same size constraints. The board is designed to slot into a standard case made by Micron radio control.

## Testing And Setting Up

The first thing to do is to ascertain that the transmitter is working. Those with access to an oscilloscope can check the data frame shape and size. Reference back to the internal

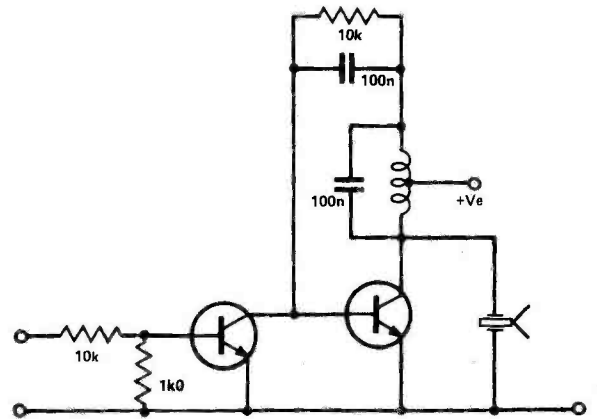


Fig.6 This piezo-electric resonator can be used as a low power alarm instead of a LED.

layout of the KB4445 (Fig.4) shows that the modulating waveform is available at pin 12 of the IC.

Carry out such tests with the crystal removed, since the close proximity of a strong RF field will tend to distort the readings of better (wide bandwidth) oscilloscopes. The frame signal should be set to 20 mS using the preset on pin 1 of the KB4445. If you do not have the necessary equipment to check this, set the 50k preset approximately halfway. The control sticks should similarly be set halfway.

The crystal may now be plugged in and attempts be made to set up the RF output. The best way to do this is with a spectrum analyser (and who hasn't got one these days ??). The next best thing is an absorption wavemeter, which is easily made by using a standard frequency coil and a small meter (Fig. 9).

This is standard procedure in many RC transmitters, although you must be careful where to dangle the pickup section, since it is possible to get misleading results due to localized RF fields that have very little in common with what's actually being transmitted by the antenna. By placing the pickup close by the output of the KB4445 at pin 15, it should be possible to get a reading without too much trouble. If not, the best thing to do is find someone with a known working 27 MHz transmitter and adjust your wavemeter for peak reading with this. →



## PARTS LIST

### TRANSMITTER

Resistors 1/4 W, 5%

R1	1k5
R2	22k
R3,4,5,6	8k2
R7	6k8
R8	390R
R9	10R
R10	15R

### Potentiometers

RV1-4	220k linear
PR1	47k preset

### Capacitors

C1,2,11,14,16	10n ceramic
C3-6	20n ceramic
C7	1u0 35V tantalum
C8,10	1n0 ceramic
C9	180p ceramic
C12,13,20	10u 16V electrolytic
C15	27p ceramic
C17	39p ceramic
C18	150p ceramic
C19	22n ceramic
C21	100p ceramic
TC1,2	27p trimmer

### Inductors

RFC1	10 turns 32/36 SWG enamelled copper wire on ferrite
L1	1uH
L2,3	MKXNA K3428
L4	KXN K3766

### Semiconductors

IC1	KB4445
Q1	2N3866 or 2N4427
LED1	any LED

### Miscellaneous

X1	13.5740 MHz
PCB, Q1 heatsink, joystick pots (x2), telescopic antenna, case to suit	

### RECEIVER

Resistors 1/4 W, 5%

R1	470k
R2,3,7	1k0
R4	1k5
R5	1k8

R6	470R
R8	270k
R9,10	33k
R11	820k

### Capacitors

C1	27p ceramic
C2	1n0 ceramic
C3,4,14	10n ceramic
C5,6,7,13,15	100n miniature ceramic
C8	27p ceramic
C9	4n7 ceramic
C10	22n polyester
C11	560p ceramic
C12	1u0 6V tantalum
C16	22u 6V tantalum

### Inductors

L1	113KN 2K241
L3	199CC A127
L4	5MMC 0124
L5	PCS 4201

### Semiconductors

IC1	KB4446
Q1	BF274 or similar

### Miscellaneous

CF1	SFE27MA
F1A	CFM2 455D
F1B	NTK LFC6
X1	26.640 MHz 3rd order T type
7 way servo connector block, PCB, case to suit.	

### WAVE METER

Potentiometers	
PR1	47k preset

### Capacitors

C1	22p (if required)
C2	10n
C3	27p trimmer

### Semiconductors

D1	any Germanium diode
----	---------------------

### Miscellaneous

M1	100-500 uA
L1	MKXNA K3428

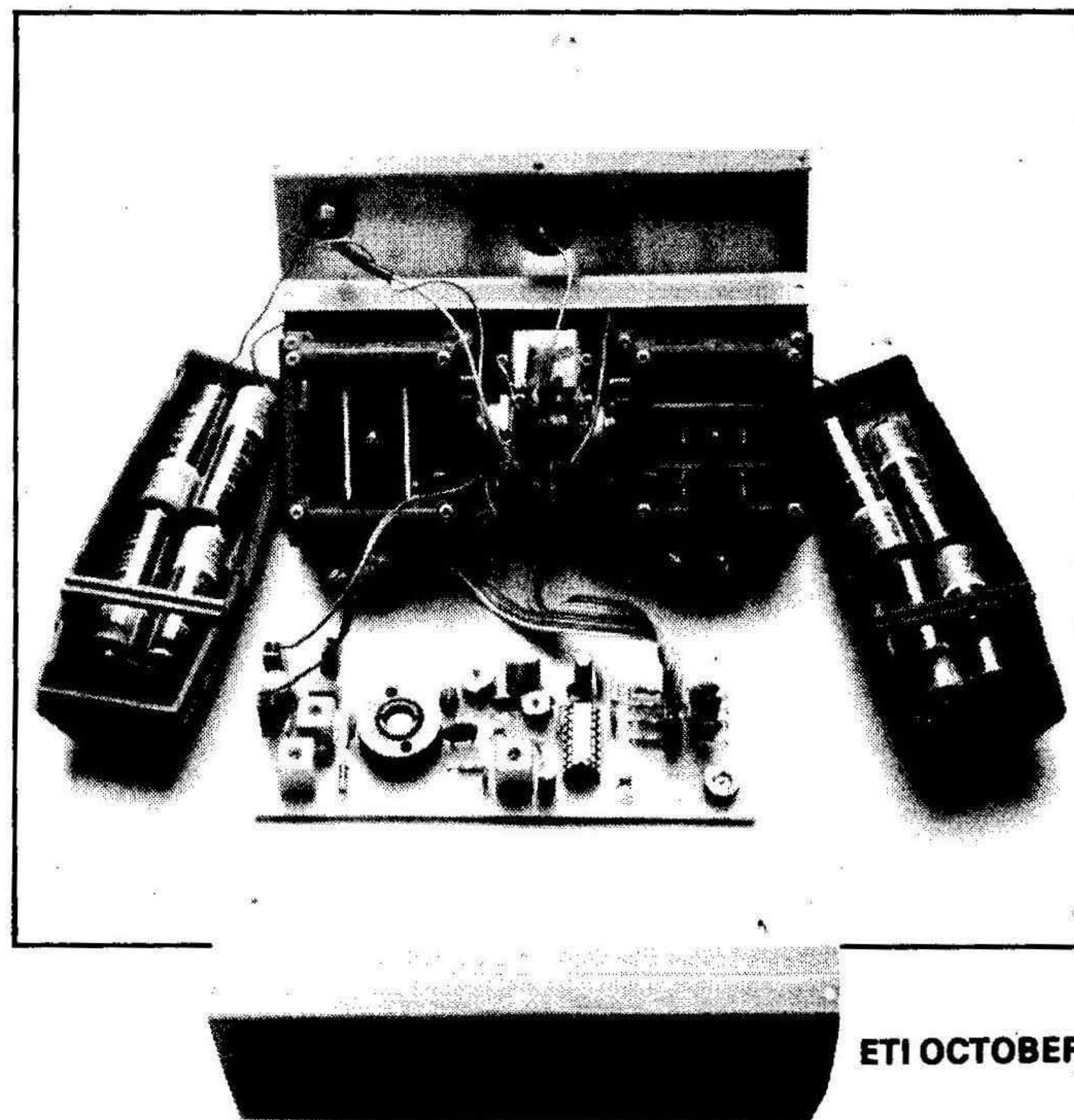
The antenna is a vital part of the output tuned circuit. It is an electrically 'short' transmission antenna, which creates a number of problems for the RF designer, the major one being that it is an integral consideration of the output tuning and so any adjustments really need to be made with the antenna in its finally intended form.

As soon as the first coil peaks, the current drawn by the transmitter should go up fairly dramatically as the output stage begins to warm up. Keep dabbing a finger on the PA stage to check that it does not get too hot. Using the absorption wavemeter placed by the antenna about halfway up and as far away as possible whilst still getting a reading (about 1m should be feasible), peak the coils in the transmitter.

## The Receiver

If you have access to a working FM transmitter, use it for setting up the receiver (remember to use the correct crystal pair).

An audio amplifier with high input impedance can be used to monitor the detector of the KB4446 on pin 1, so you can





## BUYLINES

Ambit International can supply a kit of parts for the transmitter unit for £6.80 + VAT. The case hardware and crystal are extra. A complete kit of parts for the receiver is also available for £8.00 + VAT. The crystal is extra.  
Ambit International, 200 North Service Road, Brentwood, Essex.

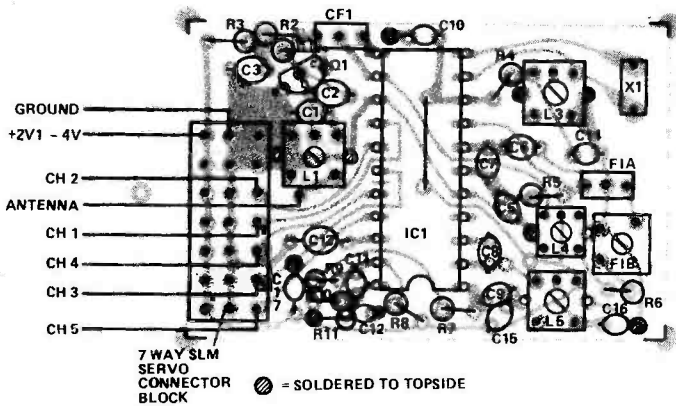
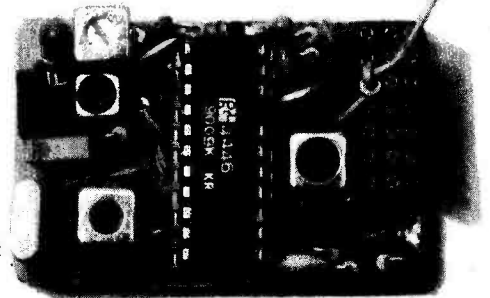


Fig.7 Component overlay of the receiver board (double sided).



(Right) The receiver circuit board (double sided). It's a bit of a squeeze, but it does all fit in.

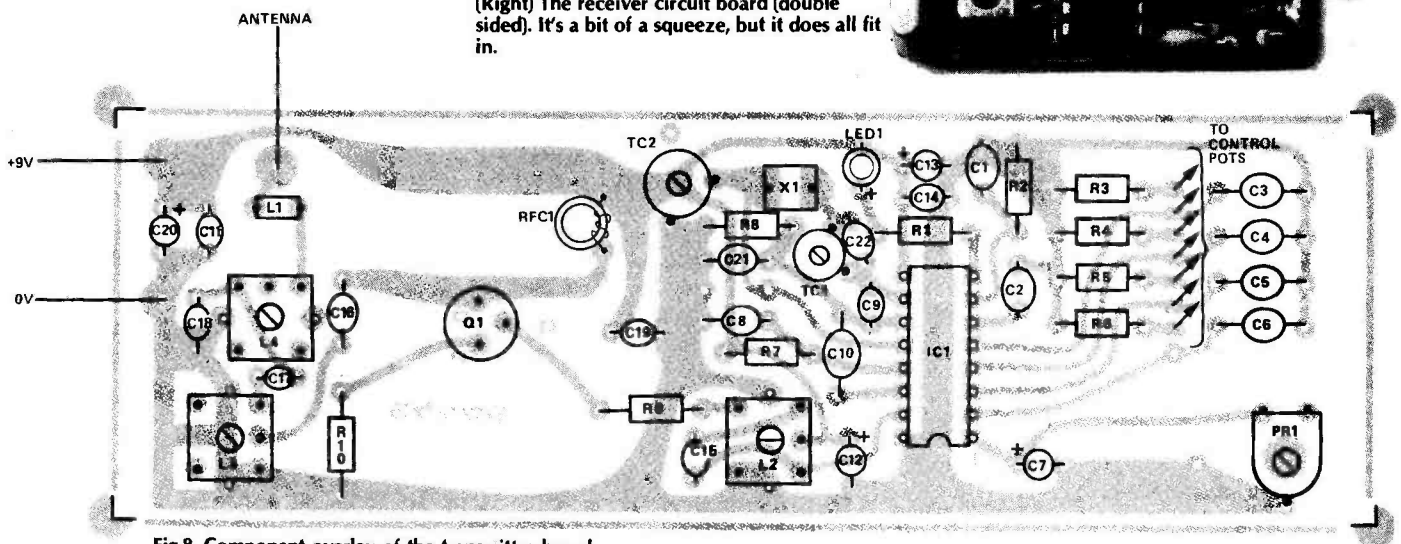


Fig.8 Component overlay of the transmitter board.

hear what is going on whilst tuning up. An oscilloscope at this point will display the detected control 'frame' It should be the same as that appearing at pin 12 of the KB4445 transmitter IC.

By starting with the transmitter and receiver in close proximity, you should have no trouble in getting a signal with which to commence the alignment process. By progressively reducing this input signal and peaking the coils, you will reach an optimum that corresponds to about 2 uV input for a correctly assembled unit. The setting of the crystal oscillator coil (at pin 10 of the KB4446) is critical and may need retrimming as the alignment proceeds to make certain the receiver and transmitter are correctly aligned co-channel. One of the few drawbacks of the FM system is the need for a more carefully matched Rx/Tx frequency than with AM. Stick to one particular make of crystals so that the loading requirements are the same.

Connect a servo to one of the output pins. It should work in response to adjusting the transmitter control. At least one commercial servo is a must, as this can then be used as a reference for the 1.5 mS channel pulse, ie with the controls at centre, the trimming should be adjusted so that the servo is at mid travel. If this is not possible, then a further preset may be needed in series with the control stick pots to bring them in range. If nothing at all happens with the servo connected, then it may be necessary to fit an external pull-up resistor on the output of the KB4446 (10k) to the supply rail of the servo amplifier IC.

Repeat the check on each channel and carry the transmitter down the garden whilst someone monitors the receiver and servos to ensure that adequate range can be achieved.

## Finally

Under no circumstances should any home-made RC equipment be fixed into a model aircraft and flown. Apart from rules preventing flying in parks, the dangers of propelling a few pounds of balsa and metal about at 40-60 MPH demand that a much more cautious approach be adopted. The home made RC can be checked and verified in cars, boats and similar ground-based systems first, or you can have it professionally 'certified'. A licence is required and some experience and training in flying is essential.

ETI

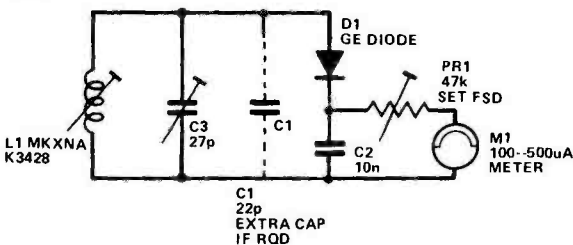


Fig.9 This absorption wavemeter can be used to set up the RF output.



# PRIME COMPONENTS LOW PRICES

All our micro chips are at micro prices. Don't be fooled by low prices. We do not offer for sale, surplus, sub-spec or rebranded devices. All our parts are guaranteed new, first quality, factory prime, full spec devices. It is also our policy to offer you the best of new devices that become available and these are featured regularly. Prices are exclusive of p&p and VAT — please refer to "Ordering Information" before ordering. Official orders from Schools, Colleges, Universities and Gov. Authorities accepted.

### DTL

930	55p
935	65p
937	55p
944	65p
946	55p
957	55p
962	55p
9099	90p

### 7400

7400	11p
7401	12p
7402	12p
7403	13p
7404	17p
7409	18p
7410	16p
7412	18p
7413	28p
7420	16p
7430	18p
7432	25p
7440	16p
7442	68p
7448	75p
7473	32p
7474	32p
7475	40p
7476	40p
7490	35p
7492	50p
7493	50p
7496	45p
74121	35p
74123	45p
74154	90p
74157	55p
74122	45p
74125	50p
74195	100p
74196	100p
74283	140p
74290	120p
74365	90p
74366	90p

### 74LS

74LS00	18p
74LS01	12p
74LS04	15p
74LS08	20p
74LS10	19p
74LS11	30p
74LS12	30p
74LS14	60p
74LS15	38p
74LS20	19p
74LS30	19p
74LS32	25p
74LS40	26p
74LS42	56p
74LS47	78p
74LS48	85p
74LS49	99p
74LS73	30p
74LS74	30p
74LS75	39p
74LS86	39p
74LS90	40p
74LS107	40p
74LS123	89p
74LS125	89p
74LS132	79p
74LS138	69p
74LS151	75p
74LS153	75p
74LS155	65p
74LS161	78p
74LS163	90p
74LS164	90p
74LS168	90p
74LS174	99p
74LS175	99p
74LS195	87p
74LS221	110p
74LS244	175p
74LS245	325p
74LS251	120p
74LS257	110p
74LS290	95p
74LS293	120p
74LS366	57p
74LS373	170p
74LS374	170p
74LS375	140p
74LS377	188p
74LS393	135p
74LS490	140p
74LS670	260p

### 74C

74C20	30p
74C76	60p
74C85	145p
74C97	125p
74C98	125p
74C107	100p
74C160	110p
74C161	145p
74C162	145p
74C163	145p
74C192	175p
74C193	175p
74C194	175p
74C195	175p
74C903	45p

### CMOS

4001	18p
4002	18p
4006	75p
4007	19p
4008	80p
4009	35p
4010	45p
4011	20p
4012	24p
4013	38p
4014	70p
4015	75p
4016	35p
4017	60p
4018	76p
4019	42p
4020	88p
4021	100p
4022	88p
4023	22p
4024	50p
4025	20p
4026	130p
4027	45p
4028	75p
4029	80p
4030	50p
4031	195p
4033	145p
4035	104p
4036	290p
4037	105p
4038	110p
4039	290p

### MEMORIES

2114 300NS	275p
4116 200NS	300p
4116 150NS	395p
4315 (4Kx1) CMOS	
450NS	995p
6514 4K (1Kx4) CMOS	
RAM450NS	795p

### EPROMS

1702A	450p
2708 450 NS	425p
2716 5V 450 NS	850p
2532 32K 450 NS	2995p

### UARTS

AY-5-1013A	325p
AY-3-1015D	398p
IM6402	425p

### CHARACTER GENERATOR

RO-3-2513 UC	450p
--------------	------

### KEYBOARD ENCODER

AY-5-2376	795p
-----------	------

### FLOPPY DISK CONTROLLERS

FD1771 B-01 S/D Inverted Bas	2995p
FD1791 B-01 D/D Inverted Bas	4995p
FD1792 B-01 S/D Inverted Bas	3495p
FD1793 B-01 D/D True Bas	3495p
FD1794 B-01 S/D True Bas	3495p
FD1795 B D/D Inverted Bas	5995p
side select	5995p
FD1797 B D/D True Bas	5995p
side select	5995p

### SUPPORT DEVICES

6520	495p
6522	795p
6532	895p
6551	1095p
6810	375p
6820	425p
6821	425p
6850	425p
6852	425p
8212	395p
8214	450p
8216	395p
8224	395p
8228	395p
8251	495p
8253	1125p
8255	495p
8257	1050p
8259	1325p
MC14412VL	797p
Z80 PIO	595p
Z80 CTC	595p
Z80A PIO	695p
Z80A CTC	695p
Z80 DMA	1995p
Z80A DMA	2495p
Z80 SIO 0	2995p
Z80A SIO 0	3495p
Z80 SIO 1	2995p
Z80A SIO 1	3495p
Z80 SIO 2	2995p
Z80A SIO 2	3495p

### 74C

74C20	30p
74C76	60p
74C85	145p
74C97	125p
74C98	125p
74C107	100p
74C160	110p
74C161	145p
74C162	145p
74C163	145p
74C192	175p
74C193	175p
74C194	175p
74C195	175p
74C903	45p

### LINEAR IC'S

AY 3 1350	695p
AY 3 8910	850p
709	30p
723	33p
741	18p
ICL 7106	595p
ICL 7107	695p
ICL 8038	295p
ICM 7216A	1875p
ICM 7216B	1675p
ICM 7555	80p
LM301AN	30p
LM311	50p
LM318	75p
LM324	45p
LM339	45p
LM380	65p
LM1496	65p
LM1871	550p
LM1872	550p
LM3900	50p
LM3914	225p
LM3915	225p
LM13600	125p
NE555	18p
NE556	50p
RC4136	85p
SN 76477N	175p
TBA810DAS	85p
TL071	55p
TL074	130p
TL082	75p
TL084	110p
TL490	175p
XR2206	325p
XR2207	375p

### DIL SWITCHES

4 pole	99p
6 pole	115p
8 pole	140p
10 pole	175p

### LOW PROFILE SOCKETS BY TEXAS

8 pin	7p
14 pin	9p
16 pin	10p
18 pin	15p
20 pin	18p
22 pin	22p
24 pin	22p
28 pin	25p
32 pin	28p
40 pin	28p

### CPU'S

6502	795p
6504	795p
6505	795p
6800	695p
6802	695p
8080A	525p
8085A	1095p
Z80	795p
Z80A	995p
Z8001	12500p
Z8002	9500p
WD9000B	19900p

### VOLTA GE REGULATORS

7805 / 7812	55p
7905 / 7912	65p
78H05SC	575p
78HGKC	625p

### BIPOLAR PROMS

93448 512 x 8 40 NS	p.o.a.
93453 1k x 4 40 NS	p.o.a.
93451 1k x 8 45 NS	p.o.a.
93511 2k x 8 50 NS	p.o.a.

### KEYBOARD ENCODER

AY-5-2376	795p
-----------	------

### FLOPPY DISK CONTROLLERS

FD1771 B-01 S/D Inverted Bas	2995p
FD1791 B-01 D/D Inverted Bas	4995p
FD1792 B-01 S/D Inverted Bas	3495p
FD1793 B-01 D/D True Bas	3495p
FD1794 B-01 S/D True Bas	3495p
FD1795 B D/D Inverted Bas	5995p
side select	5995p
FD1797 B D/D True Bas	5995p
side select	5995p

### SUPPORT DEVICES

6520	495p
6522	795p
6532	895p
6551	1095p
6810	375p
6820	425p
6821	425p
6850	425p
6852	425p
8212	395p
8214	450p
8216	395p
8224	395p
8228	395p
8251	495p
8253	1125p
8255	495p
8257	1050p
8259	1325p
MC14412VL	797p
Z80 PIO	595p
Z80 CTC	595p
Z80A PIO	695p
Z80A CTC	695p
Z80 DMA	1995p
Z80A DMA	2495p
Z80 SIO 0	2995p
Z80A SIO 0	3495p
Z80 SIO 1	2995p
Z80A SIO 1	3495p
Z80 SIO 2	2995p
Z80A SIO 2	3495p

### LINEAR IC'S

AY 3 1350	695p
AY 3 8910	850p
709	30p
723	33p
741	18p
ICL 7106	595p
ICL 7107	695p
ICL 8038	295p
ICM 7216A	1875p
ICM 7216B	1675p
ICM 7555	80p
LM301AN	30p
LM311	50p
LM318	75p
LM324	45p
LM339	45p
LM380	65p
LM1496	65p
LM1871	550p
LM1872	550p
LM3900	50p
LM3914	225p
LM3915	225p
LM13600	125p
NE555	18p
NE556	50p
RC4136	85p
SN 76477N	175p
TBA810DAS	85p
TL071	55p
TL074	130p
TL082	75p
TL084	110p
TL490	175p
XR2206	325p
XR2207	375p

### DIL SWITCHES

4 pole	99p
6 pole	115p
8 pole	140p
10 pole	175p

### LOW PROFILE SOCKETS BY TEXAS

8 pin	7p
14 pin	9p
16 pin	10p
18 pin	15p
20 pin	18p
22 pin	22p
24 pin	22p
28 pin	25p
32 pin	28p
40 pin	28p

### KEYBOARD ENCODER

AY-5-2376	795p
-----------	------

### FLOPPY DISK CONTROLLERS

FD1771 B-01 S/D Inverted Bas	2995p
FD1791 B-01 D/D Inverted Bas	4995p
FD1792 B-01 S/D Inverted Bas	3495p
FD1793 B-01 D/D True Bas	3495p
FD1794 B-01 S/D True Bas	3495p
FD1795 B D/D Inverted Bas	5995p
side select	5995p
FD1797 B D/D True Bas	5995p
side select	5995p

### SUPPORT DEVICES

6520	495p
6522	795p
6532	895p
6551	1095p
6810	375p
6820	425p
6821	425p
6850	425p
6852	425p
8212	395p
8214	450p
8216	395p
8224	395p
8228	395p
8251	495p
8253	1125p
8255	495p
8257	1050p
8259	1325p
MC14412VL	797p
Z80 PIO	595p
Z80 CTC	595p
Z80A PIO	695p
Z80A CTC	695p
Z80 DMA	1995p
Z80A DMA	2495p
Z80 SIO 0	2995p
Z80A SIO 0	3495p
Z80 SIO 1	2995p
Z80A SIO 1	3495p
Z80 SIO 2	2995p
Z80A SIO 2	3495p

## NEW SPECIAL OFFER! 4K CMOS RAM (1K x 4) 450 NS ONLY £6.95! (8 for £45)

The TC 5514P from Toshiba, CMOS equivalent of the 2114!

- Low Power Dissipation
- 10pW/BIT (TYP) @ 3.0V (STANDBY)
- 10uW/BIT (TYP) @ 5.0V (OPERATING)
- Data Retention Voltage 2V to 5.5V
- Single 5V Power Supply
- 18 PIN Plastic Package
- Full Static Operation
- Three State Output
- Input/Output TTL Compatible
- Fast Access Time 450NS

Toshiba's TC5514P (industry type 6514) is a full static read write memory organised as 1024 words by 4 bits using CMOS technology. Ultra low power dissipation means it can be used as battery-operated portable memory system and also as a non-volatile memory with battery back-up. Operates from a single 5V power supply with static operation, hence no refresh periods and a much simplified power supply circuit design. Three state outputs simplify memory expansion for minimum data retention voltage is 2V, the battery back-up systems needs only simple circuit. Toshiba's original CMOS technology also means wide operating and noise margins. The TC5514P is moulded in a dual-in-line 18 pin plastic package 0.3 inch in width.

## NEW STEREO! S100 SOUND COMPUTER BOARD!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY-3-8910 NMOS Computer sound ICs. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE etc.

**KIT FEATURES**



**NEXT  
MONTH**

# **electronics today**

INTERNATIONAL

**Look out for the November issue —  
on sale October 3rd.**



## **SPACE INVADERS**

In the past few months we've seen all manner of Space Invaders games — from enormous pub machines to programs on tape cassette for home computers. We've spent many a long hour researching the game in pubs and clubs from Land's End (Watford) to John O' Groats. Next month we present the ETI Space Invaders game for you to build.  Plug the lead into the back of your telly and sit back with the box of tricks on your lap. Off you go — blasting aliens out of existence (with full sound effects, of course).  World War III's OK, but there's nothing like the real thing — ETI Space Invaders — a computer game with a trick or two up its sleeve, as you'll find out next month.



Photos courtesy of Twentieth Century Fox.

## **FREE PCB**

As we finish printing each issue of ETI with our John Bull set, we're sticking a free, gratis, no-more-to-pay printed circuit board on the cover. It has a million and one uses — you can prop up a wobbly coffee table, make a shower for the budgie . . . OR build the five projects we've designed for your free PCB. There's an RIAA equalised preamp, a 2 W amplifier, a touch doorbell, a light switch and a metronome.  We give you the PCB; we give you the project designs . . . it couldn't be easier.

## **RADIOACTIVITY**

Know your alpha, beta, gammas? If it's all just radiation to you, you could learn a thing or two from A.S. Lipson's excursion into that fantastic, frazzling, phenomenon of modern physics — Radioactivity. What makes something radioactive? What exactly is radioactivity? All will be revealed next month.

## **EVEN MORE PROJECTS**

Not satisfied with bringing you our amazing Space Invaders game and FIVE projects for your free board, we've also got a doorbell with a difference (it plays tunes) and a straightforward, no frills Bench Amplifier for your test bench. It's all in ETI November.

## **AND THAT'S NOT ALL**

Data Sheet puts in an appearance with all you need to know about a family of monolithic switched capacitor filter chips and a speech generator chip (a very clever little block of plastic).  Talking of blocks of plastic, voltage regulators this time — we look at a very simple discrete component regulator design (for when you don't have the necessary chip to hand then and there).  We know now that the Space Shuttle launch has definitely been postponed until at least next March. Astrologue explains why.

Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.



# SPOT DESIGNS



Six pages of Spot Designs — a bumper bundle of tried and tested circuits with the ETI stamp of approval.

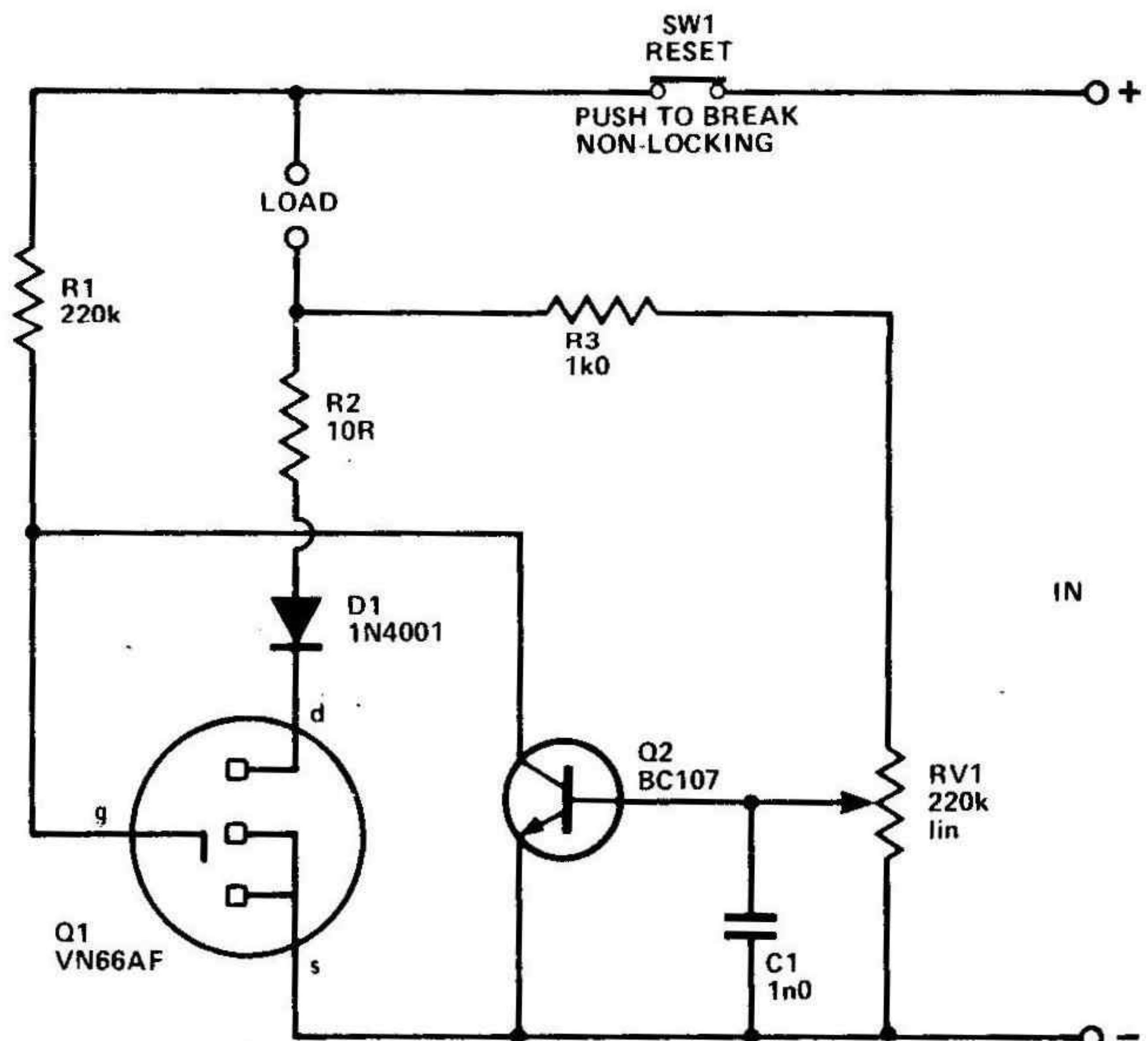
## Overload Current Trip

Most power supplies incorporate some form of protection circuitry so that an excessive output current cannot flow in the event of an overload. However, these protection circuits are often designed merely to prevent the supply circuitry from sustaining damage, and in the event of an overload permit a level of current flow that is sufficient to damage the circuit being powered. This overload current trip can be used between the powered equipment and the power supply and will cut off the supply almost instantly if a preset threshold current is exceeded. The trip current can be varied from just a few to a few hundred milliamps. The unit will work with supply voltages of 5-40 V.

When power is first applied to the circuit, power FET Q1 will be biased hard into conduction by bias resistor R1. Power is, therefore, supplied to the load via Q1, D1 and R2. There will be a voltage drop across these components, and to some extent this varies with changes in the supply current. At low output currents there is likely to be a voltage drop of something in the region of 0V7, but this increases to a volt or so at high currents.

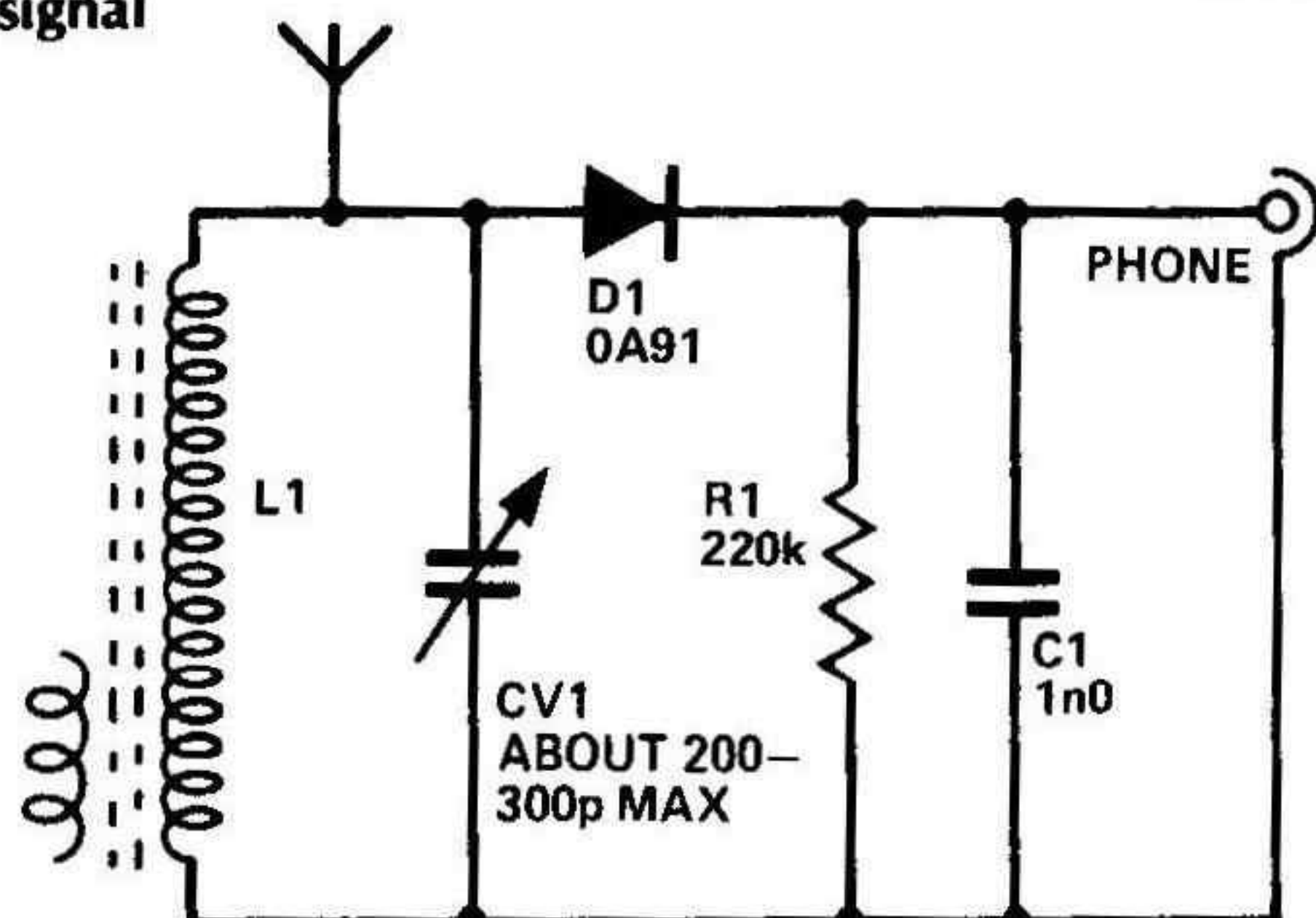
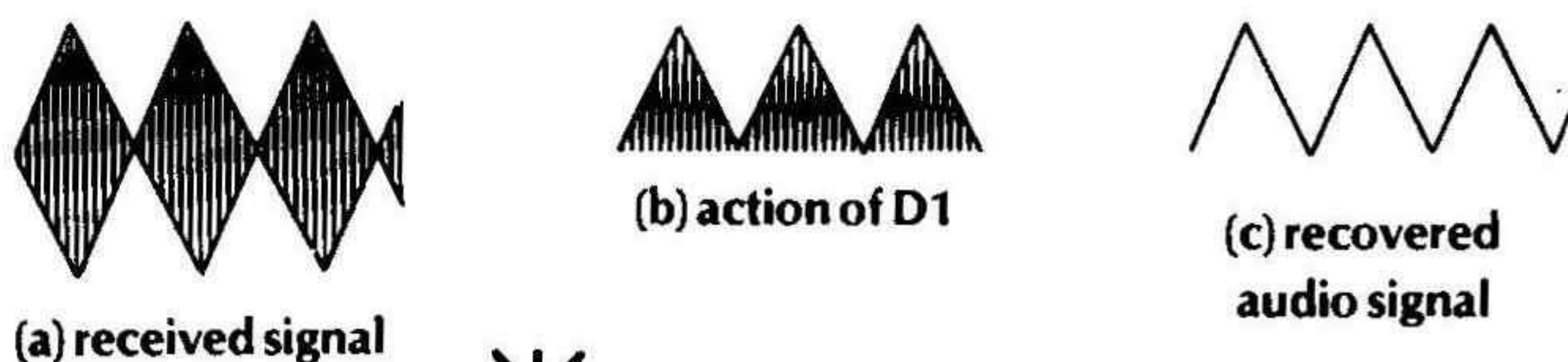
RV1 is adjusted so that at output currents below the required threshold level the proportion of the voltage dropped across Q1, D1 and R2 (and fed to Q2's base terminal) is not sufficient to switch on Q2. If the threshold current is exceeded, the voltage fed to Q2's base is then adequate to switch the device on and it diverts the bias current that formerly went to Q1's gate terminal. Q1 then switches off and cuts the supply to the load. Q2 remains switched on as it receives a strong base bias from the positive supply through the load, current limiting resistor R3 and RV1. Once tripped, the circuit thus latches in the "off" state. It can be returned to the "on" state by clearing the overload and then briefly operating SW1 so that the supply is momentarily disconnected from the unit. When the supply is restored it then starts at the "on" state once again. C1 ensures that the circuit does always initially assume the correct state and it also helps to prevent spurious triggering of the unit.

When using the unit it should be kept in mind that about 1 V is lost through the device and the output voltage from the supply must be adjusted to compensate for this. The current trip inevitably causes some loss of regulation efficiency, but this is only marginal. If the unit is to have a trip current of about 100 mA or more, R2 can be reduced to about 1R8 in order to maintain the low voltage drop and marginal degradation of regulation efficiency.



## Crystal Set

The most simple form of radio for receiving broadcast stations is the crystal set, or more precisely, a modern equivalent using a semiconductor diode to provide detection. This simple set covers the normal medium wave broadcast band, has an output for a crystal earpiece and, in most areas, should give reception of Radios 1, 2 and



NOTE:  
L1 IS DENCO MW5FR FERRITE  
AERIAL OR SIMILAR.

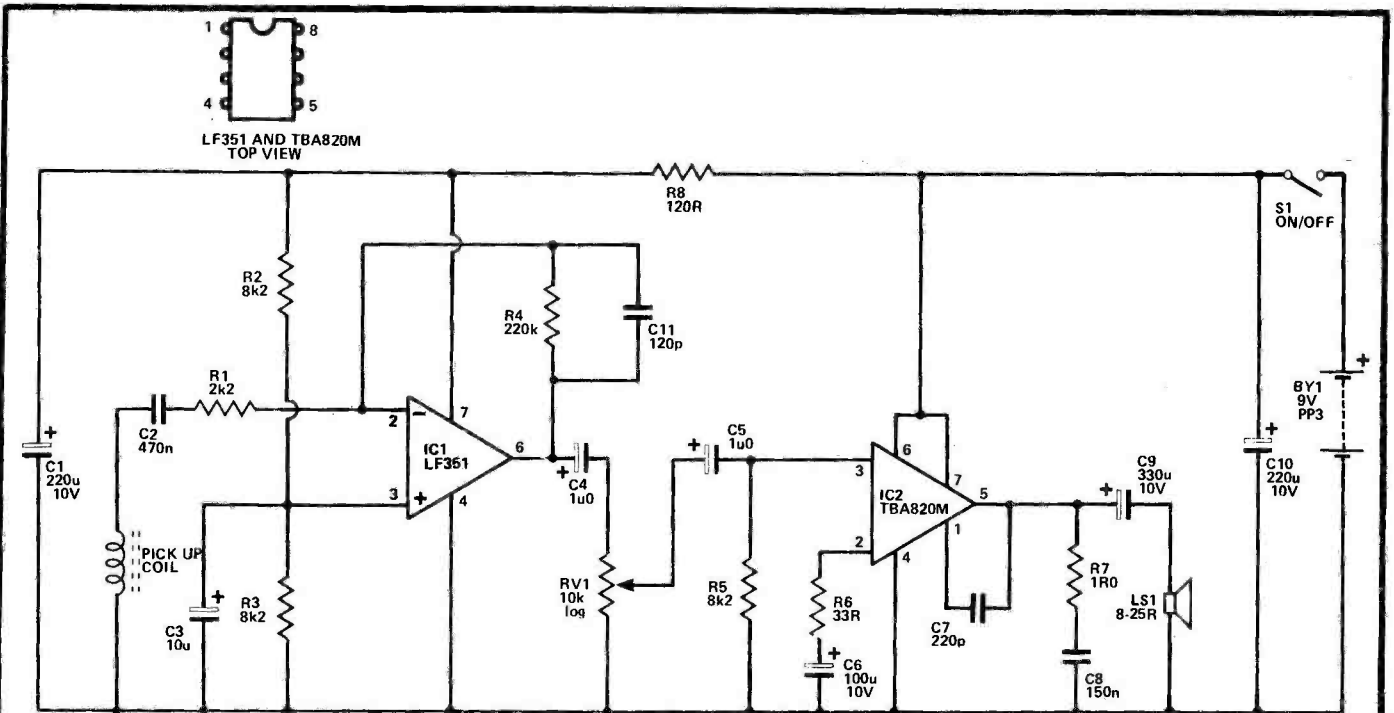
3 at reasonable volume (plus any local radio stations where these are in operation on the medium waveband). It requires no battery or other form of power source since energy derived from the received transmission is used to drive the earpiece. However, this does bring the disadvantage of needing an external longwire aerial to operate the set, as an ordinary ferrite aerial does not give sufficient pick up.

The tuned circuit is formed by L1 and CV1. This selects the desired transmission and rejects other stations. CV1 permits full coverage of the normal medium wave broadcast band to be achieved. In order to obtain good volume from the unit it is necessary to directly couple the aerial to the tuned circuit. For the same reason it is necessary to take the output to the detector direct from the tuned circuit. This inevitably gives the set rather poor selectivity, but it should still be adequate in this respect.

The form of modulation used on the medium wave band is AM (amplitude modulation). This consists of varying the strength of the RF signal in sympathy with the amplitude of the modulating audio signal. D1 half wave rectifies the RF signal to leave only the positive half cycles. R1 and C1 are used to smooth the RF half cycles, but their time constant is too short to produce a steady DC output. Instead the output rises and falls in sympathy with the mean RF signal level, so that the original audio signal is recovered at the output and fed to the earpiece.

The only adjustment the finished unit requires is to slide the aerial coil (L1) along the ferrite rod to find a position that permits full coverage of the medium wave band. The coil is then taped or glued in this position. The smaller winding of the ferrite aerial is not required and is either removed or just ignored. The aerial should preferably be an outdoor type about 10m or so long, but a few metres of hook-up wire fixed around the walls of a room or in a loft should give reasonable results.





## Telephone Amplifier

A telephone amplifier enables more than one person to follow a telephone conversation. The unit described here, in common with all normal units of this type, requires no direct connection to the telephone. Instead, the special pick-up coil has a built-in rubber suction cup that enables it to be easily attached to the telephone base. This produces only a very weak signal from the magnetic field radiated by an inductive component inside the telephone, but satisfactory results can be obtained if it is fed to low noise, high gain amplifier. It would of course be possible to use a much simpler circuit if a direct connection to the telephone were to be made, but this would make installation more difficult and it is ILLEGAL to make a direct connection to a Post Office telephone anyway.

The preamplifier stage of the unit is based on IC1 which is a low noise op amp having a FET input stage. This is used in the conventional inverting audio amplifier mode and the negative feedback network, R1,4, sets the voltage gain at about 40 dB. (100 times). C11

reduces the gain slightly at high frequencies in order to obtain an improved signal to noise ratio.

C4 couples the output from the preamplifier to volume control, RV1, and from here the signal is coupled to the power amplifier by C5. The output stage uses the TBA820M. This is a class B amplifier which will give an output power of a few hundred milliwatts RMS. The closed loop voltage gain of the device is determined by the value of R6, about 25 dB. (180 times) with the specified value. This gives the required very high overall gain in conjunction with the preamplifier's gain. C7, R7 and C8 are needed in order to maintain stability.

The quiescent current consumption of the unit is only about 5 mA, but this rises to as much as 50 mA or so at high volume levels. The best position for the pick-up coil on the telephone base (not the handset) can be located with a little experimentation. Be careful not to place the handset near the amplifier's loudspeaker or advance the volume control too far as this will cause a howling sound due to acoustic feedback.

## D.M.M. To Stopclock Converter

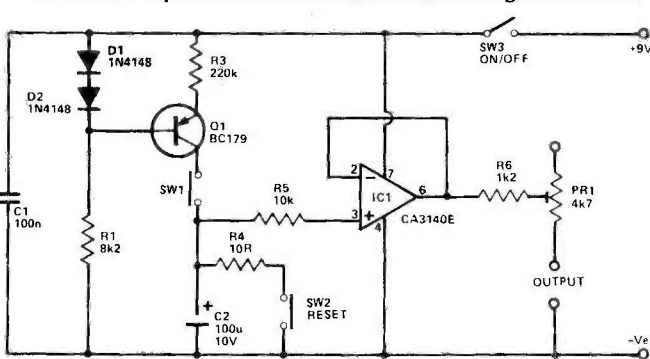
This simple add-on circuit can be used with a DMM switched to the 1 mA range to give a stopclock having a range of 0.99 S (or 0.199 S for a 3 1/2 digit instrument). It can also be used with an ordinary analogue multimeter or panel meter, giving a range of 0-100 S, but the resolution will be lower than with a digital instrument.

The unit relies on the fact that a linear rise in voltage is produced across a capacitor if it is fed with a constant charge current. The

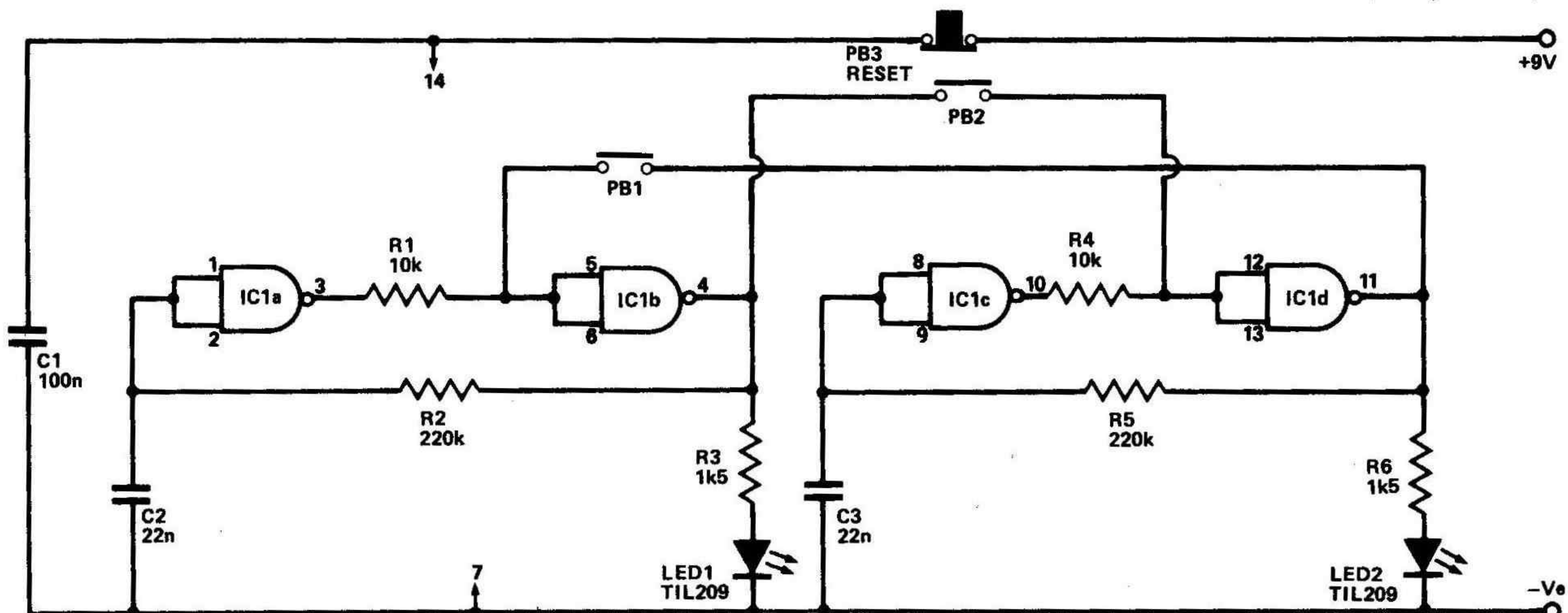
capacitor (C2) must be a high quality type. The use of a tantalum bead component is, therefore, recommended. C2 cannot simply be charged from the supply lines via a resistor, since the voltage across the resistor would drop as the voltage across C2 increases. This would give a decreasing charge current as C2 charges exponentially and the required linear voltage slope would not be produced. C2 is, therefore, charged from a conventional constant current source which is based on Q1. D1, D2, and R1 form a simple shunt regulator circuit which bias the base of Q1 approximately 1V3 below the positive supply potential. There is a voltage drop of about 0V65 across the base emitter terminals of Q1, giving about 0V65 across emitter resistor R3. This gives an emitter current of roughly 3 uA and, as the collector and emitter currents of a high gain device (such as the BC179 used in the Q1 position) are virtually identical, a constant charge current of about 3 uA is fed to C2 when SW1 is operated. This low charge current together with the fairly high value of C2 produces a suitably long time constant.

It is essential that the voltmeter circuit takes no significant current from C2 as this would affect accuracy and would result in a decaying reading at the end of a timing run. Operational amplifier IC1 is, therefore, used as a unity gain buffer stage which gives an input impedance of about 1.5 million megohms and ensures that there is no significant loading on C2. PR1 enables the sensitivity of the voltmeter circuit to be adjusted to the correct level. In practice, SW1 is depressed for (say) 90 S and then PR1 is adjusted for the appropriate reading on the DMM.

SW2 is a reset switch and this discharges C2 (via current limiting resistor R4) if it is briefly operated. SW3 is an ordinary on/off switch. The current consumption of the circuit is only about 4.5 mA.







## Quiz Monitor

This circuit is useful when playing "snap" or TV quizzes where the first person to have an opportunity of answering the question is the first to operate their push button switch. Operating it causes an indicator light to switch on and prevents the opponent's switch and indicator light from working. Thus, there is no doubt as to which push button switch was operated first.

The circuit is based on a CMOS 4001 quad two input NOR gate, but all of the gates have their two inputs connected together so that they, in fact, operate as simple inverters. The circuit has two identical sections, one for each player, each using two of the gates.

If we consider gates 1 and 2, at switch on C2 is in a discharged state and, therefore, takes the input of gate 1 low. This causes the output of gate 1 to go high, taking the input of gate 2 to the same state due to the coupling through R1. The output of gate 2 then goes low and feedback through R2 holds the input of gate 1 in its original low state, thus latching the circuit in this condition. LED 1 is driven from the output of gate 2 via current limiting resistor R3. At first it

will obviously be switched off. So will LED 2 which is the indicator light for the other player. It is driven from an identical arrangement.

If PB1 is activated, the input of gate 2 is taken low, since it will be taken to the low output of gate 4. This sends the output of gate 2 high, the input of gate 1 high (due to the feedback through R2) and the output of gate 1 low. The circuit will hold itself in this state even if PB1 is released. Operating PB2 will have no effect now, since this will merely connect the high output of gate 2 to the high input of gate 4, producing no changes in logic state. Thus the required blocking is obtained. Of course, if PB2 was operated first, LED2 would switch on and PB1/LED1 would be disabled, with the basic circuit action being the same as described above. The operating speed of the circuit is extremely fast and even with a very small gap between the two switches being operated, the unit is capable of determining which was operated first and there is no danger of both LEDs switching on.

The circuit is reset by briefly operating PB3 so that power is removed from the circuit and it starts once again from the beginning when PB3 is released. No on/off switch is required as the unit has a negligible quiescent current consumption.

## Simple Preamplifier

This preamplifier has two inputs; one for a magnetic cartridge and the other is an "Aux" input for a tuner, tape deck, etc. Although the circuit is very simple, it uses an IC which is specifically designed for this application and provides low levels of noise and distortion. The unit is suitable for stereo operation and both the required amplifiers are contained within a single LM382 IC.

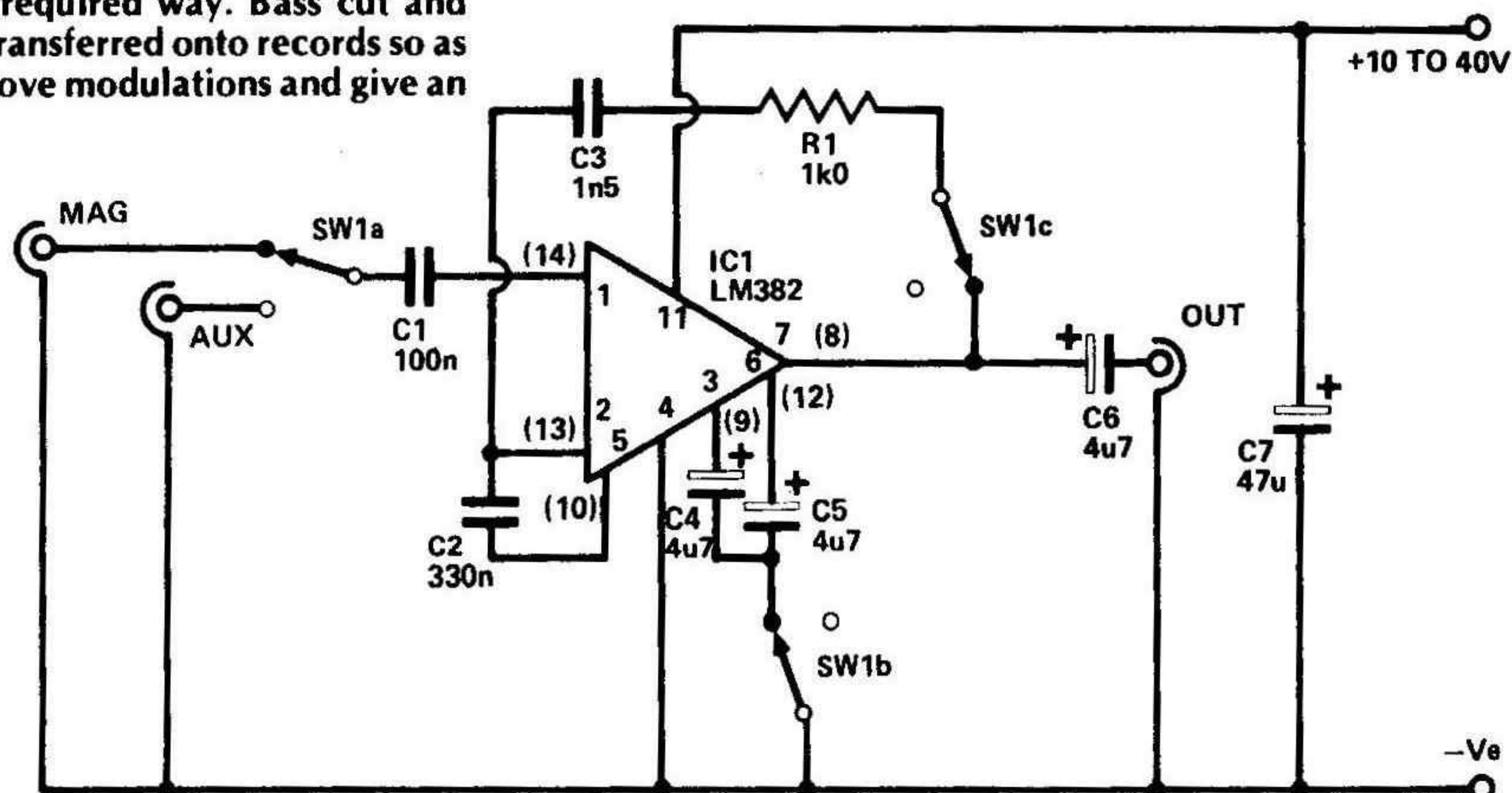
The circuit diagram is for one channel only, but apart from the IC pin connections the other channel is identical. The numbers in brackets show the pin connections for the other channel. The supply connections of IC1 are common to both channels.

The LM382 has an internal biasing circuit which sets the quiescent output voltage at approximately 6 V and no discrete biasing components are required. C6 provides DC blocking at the output. When switched to the "Mag" mode, external feedback components are required in order to shape the frequency response characteristic of the amplifier in the required way. Bass cut and treble boost are applied to the signals transferred onto records so as to prevent excessive low frequency groove modulations and give an

improved signal to noise ratio. The preamplifier must give corresponding bass boost and treble cut in order to give a flat overall frequency response to the system. C2, C3 and R1 are the discrete feedback components and the LM382 itself contains some feedback resistors. C4 and C5 provide DC blocking for two shunt resistors in the feedback network.

When switched to the "Aux" mode, most of the feedback components are not required and are switched out of circuit by SW1a and SW1c. C2 is left in circuit, but is superfluous. In this mode the circuit has a voltage gain of only about four and is really just operating as a buffer stage. SW1a connects the input of the amplifier to the appropriate input socket and C1 provides DC blocking at the input. Of course the input wiring must all be screened to prevent stray pick-up of mains hum, etc.

The current consumption of the circuit is about 12.5 mA. Due to the high supply ripple rejection of the LM382, it is not necessary to have a highly smoothed and decoupled supply.







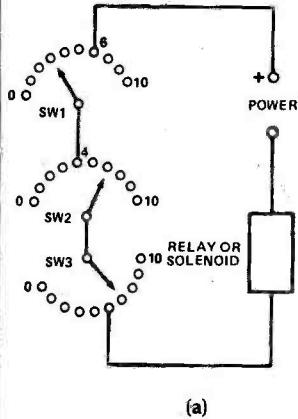
## Combination Lock

Most combination locks are based on the simple arrangement shown in (a). This merely consists of three ten way rotary switches wired in such a way that they will connect power to the relay or solenoid if the correct combination is set on them (6-4-5 in this case). This basic circuit is not often used in practice since it does not take very long to quickly adjust the switches through all the 1,000 possible combinations (0-0-0 to 9-9-9 inclusive) if it is done in a logical manner.

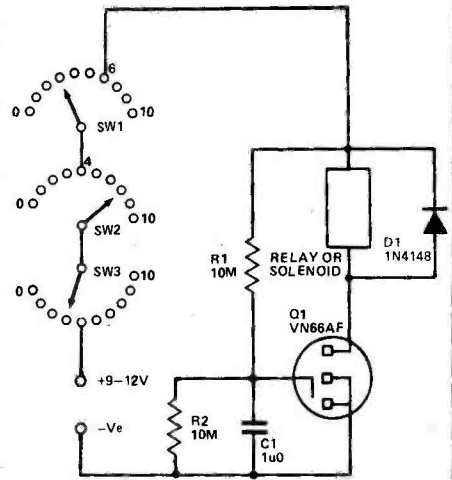
One of the simplest and best methods of overcoming this problem is simply to build a delay circuit into the unit so that power is not supplied to the solenoid or relay until the correct combination is set on them for a few seconds. Quickly running through all the possible combinations is then ineffective at "cracking" the unit, as the delay circuit will prevent the unit from responding when the correct combination is briefly present. Anyone trying to "crack" the unit is very unlikely to succeed unless they know of the delay circuit and are prepared to devote a good deal of time to finding the correct combination.

Circuit (b) has an additional time delay circuit which is based on VMOS device Q1. When the correct combination is set on SW1 to SW3 and power is supplied to the circuit, C1 will be uncharged, giving zero gate bias to Q1. Q1 is, therefore, switched off and no significant current is supplied to the relay or solenoid which forms its drain load. C1 slowly charges via R1 and after about 4 S the charge voltage on C1 will be large enough to bias Q1 into conduction and switch on the relay or solenoid.

R2 discharges C1 when the unit is reset, so that it is quickly ready to operate properly once again. R2 limits the maximum gate voltage of Q1 to only about half the supply voltage, but this is more than adequate to bias the device hard into conduction and is of no practical consequence. D1 suppresses the high back EMF produced across the relay or solenoid when it switches off and prevents possible damage to Q1.



(a)



(b)

## Reverberation Unit

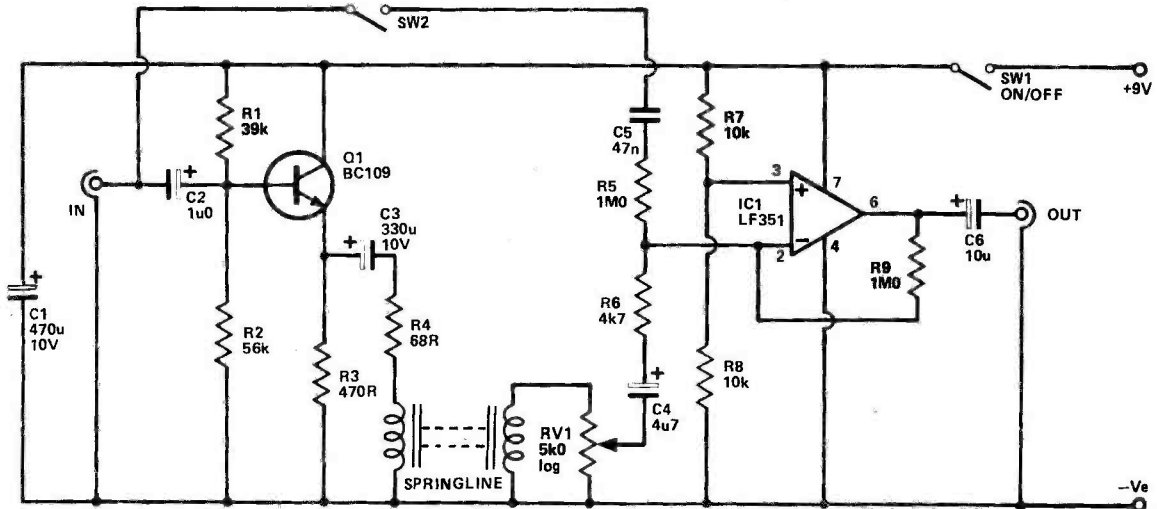
This unit simulates the long reverberation time of a large hall (usually around 2 S or so) and can be employed as a musical effects unit or to improve certain types of home-recording. Reverberation is caused by sounds being reflected around the interior of a room and in the case of a large hall the sounds are usually reflected many times before losing sufficient energy to render them inaudible. This, coupled with the fairly long distances covered by the sound waves between reflections, gives the long reverberation time and reverberant sound of a large hall.

There are several ways of simulating reverberation, but the simplest and most commonly used is probably the springline based system. A springline consists of two transducers linked by one or two long springs. If a signal is fed into one transducer it produces a corresponding audio signal which is transmitted down the spring to the second transducer. Here it is reconverted into an electrical signal again. However, the sound signal travels down the spring relatively slowly, and the signal is reflected backwards and forwards

along the spring many times before it decays to an insignificant level. Thus, the output from the second transducer is a good simulation of natural reverberation.

In this circuit the input signal is fed to the low impedance input transducer of a short springline via an emitter follower which gives a reasonably high input impedance of about 10k or so. This uses Q1 in a conventional configuration. The output of the springline unit is fed to one input of a mixer circuit. This is based on IC1 and again uses a conventional and well known arrangement. There are substantial losses through the springline and so the mixer is designed to boost the output of the springline by over 46 dB (200 times). The other input of the mixer is fed with the input signal, but the high value of R5 gives only about unity voltage gain at this input, so that the main signal does not overwhelm the reverberation signal.

RV1 enables the amount of reverberation signal mixed into the main signal to be controlled. It can be reduced right down to zero by fully backing off RV1. SW2 can be used to cut out the main signal so that only the reverberation signal appears at the output, if desired. The only other control is on/off switch SW1. The current consumption of the unit is approximately 10 mA.





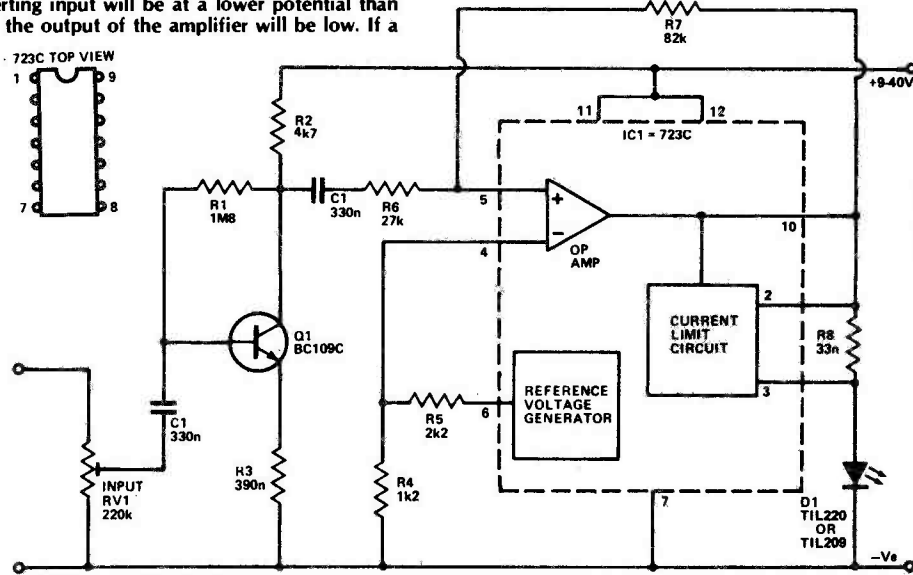
## Peak Level Indicator

Peak audio level indicators can be used in tape recorders, amplifiers, mixers, and other radio equipment to provide a visual overload warning, and unlike slower responding VU meters, they produce a proper response to fast transients. This circuit is based on the inexpensive 723C device which, although primarily intended for use as a voltage regulator, can be adapted to work well in many other applications.

The 723C has a highly stable 7 V (nominal) reference voltage available at pin 6. This is coupled to the inverting input of an operational amplifier (which is also part of the 723C device) via an attenuator, R4,5. This gives a stable reference potential of a little over 2 V at the inverting input. The input signal is coupled by way of sensitivity control RV1 to a common emitter amplifier based on Q1 and fed to the non-inverting input of the operational amplifier by C2 and R6. Under quiescent conditions or with a negative going signal at Q1 collector, the non-inverting input will be at a lower potential than the inverting one, and the output of the amplifier will be low. If a

positive going signal reaches a high enough amplitude, though, the non-inverting input will reach a higher potential than the inverting one causing the output to go high. D1 is then switched on with a current that is determined by the output of the amplifier and which is largely independent of the supply voltage. Discrete resistor R8 actually sets the output current. The specified value gives a nominal 20 mA LED current. R7 provides positive feedback which ensures that D1 is either fully on or off. It also tends to hold D1 in the on state for slightly longer than would otherwise be the case, thus giving a clearer indication of a brief overload.

The unit can be adjusted to respond to input levels down to about 100 mV RMS, which should be more than adequate for all normal requirements. RV1 is adjusted for the lowest sensitivity that causes D1 to come on with an input signal level equal to the lowest overload level. Quiescent current consumption is only about 4 mA.



## I.F. Alignment Oscillator

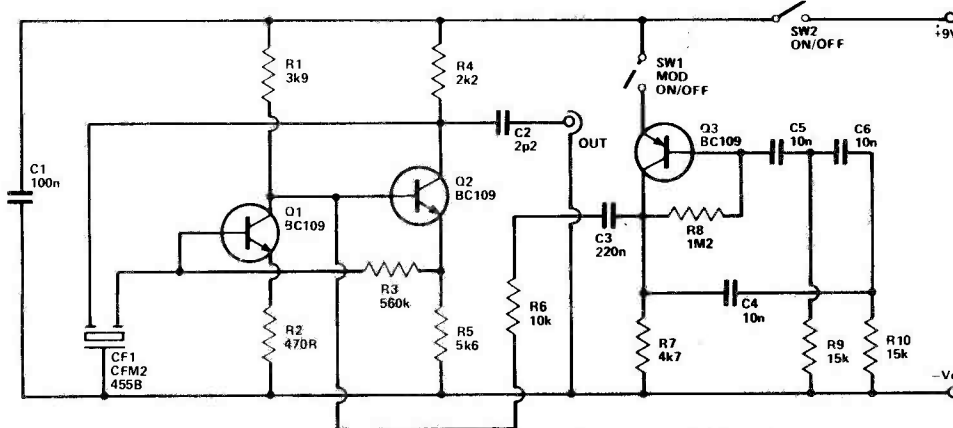
This simple piece of test equipment can be very helpful when aligning or realigning an AM superhet receiver. It provides an output at 455 kHz, which can be modulated by an audio tone if the set is being adjusted for maximum AF output. The modulation can be switched off if the IF transformers are to be adjusted for maximum AGC voltage.

The circuit consists of two oscillators, Q1 and Q2 being used in the one which generates the 455 kHz signal and Q3 in the one which provides the modulation signal. Q1,2 are connected in a straightforward two stage, direct coupled, common emitter configuration. However, neither of the emitter resistors are bypassed in this case as only a low voltage gain is required. The input and output are in phase and positive feedback between the two is provided by ceramic filter CF1 (available from Ambit Interna-

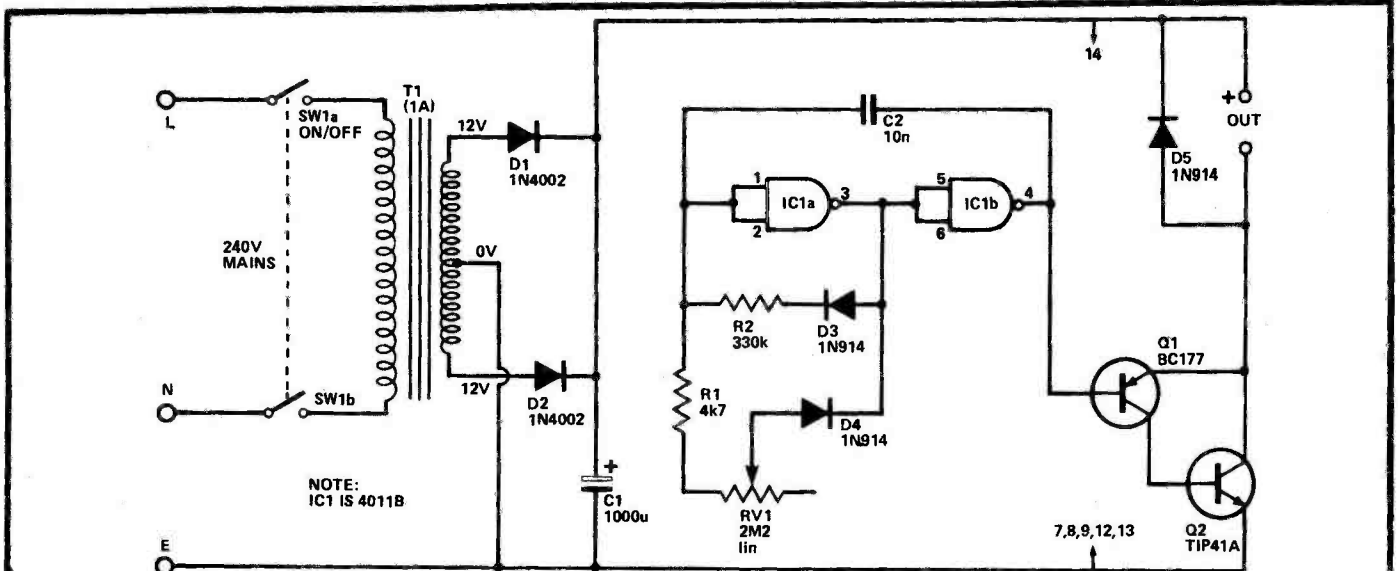
tional). A significant amount of feedback is only provided at the 455 kHz operating frequency of the filter and so the circuit oscillates at this frequency.

A ceramic filter gives good frequency stability, requires no adjustment in order to produce the correct output frequency and is cheaper than using a crystal. C2 provides DC blocking at the output, although it should normally only be necessary to connect the "hot" output to the receiver, no chassis connection being necessary.

A straightforward phase shift oscillator is used to provide the modulation signal and the specified C-R values give an operating frequency of about 500 Hz. C3 and R6 couple this signal to the base of Q2 where it amplitude modulates the 455 kHz signal. SW1 can be used to cut the supply to Q3 and thus remove the modulation. Current consumption is about 2.5 mA with the modulation switched on and approximately 1.7 mA switched off.







## 12V DC Motor Speed Controller

This motor speed controller is of the type where the motor is fed with a series of pulses of fixed duration and the power fed to the motor is varied by altering the frequency of the pulses. The higher the frequency, the greater the power fed to the motor, up to the point where there is virtually no gap between the pulses and the motor is operating at full speed. A useful characteristic of this type of controller is that it gives relatively good results at low speeds and wastes little power with consequent low dissipation in the circuit. This circuit is for 12 V DC motors having a maximum current consumption of up to 1 A (or 2 A if the secondary current rating of T1 is raised accordingly).

T1, D1, D2 and C1 form a simple DC supply which gives a loaded voltage of just over 12 V (just over 17 V unloaded). This is used to drive a CMOS astable multivibrator which is based on two of the gates in a 4011B device. The two gates that are used each have their

two inputs connected together so that they act as inverters and are connected in what is basically just the standard CMOS astable circuit.

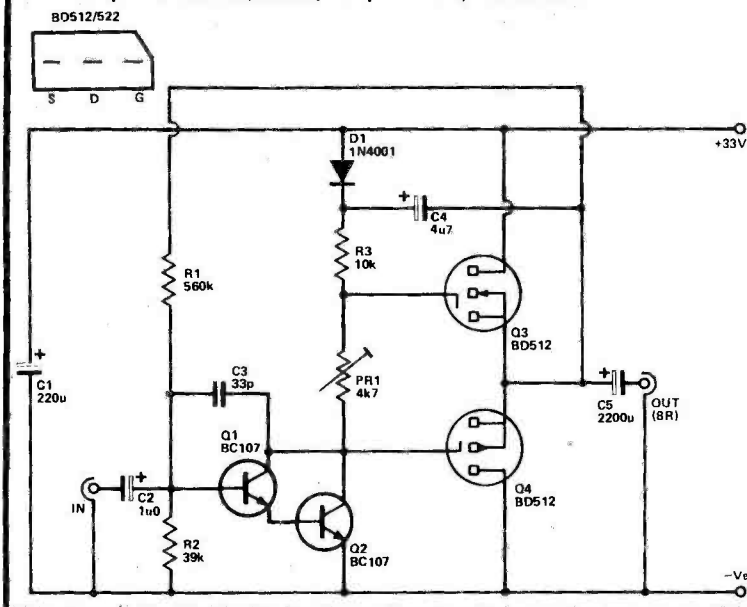
The circuit differs from the standard configuration in that there are two timing resistances; one formed by R2 and the other by the series resistance of R1 plus RV1. D3 and D4 are steering diodes. In effect, R2 forms the timing resistance when the output of the astable is high and gives an output pulse of fixed duration. RV1 and R1 act as the timing resistance when the astable's output is low and the duration between output pulses can, therefore, be varied using RV1.

With RV1 at minimum resistance there is a negligible gap between the output pulses, giving maximum speed from the motor. Increasing the resistance of RV1 increases the duration between the pulses, giving decreased average output power or no significant output power at all with RV1 at maximum resistance.

Since the astable has only a low output current capability, the motor must be driven via a buffer amplifier. This uses Q1 and Q2 in the common emitter mode, with 100% overall negative feedback so that unity voltage gain (but a high current gain) is obtained.

## VMOS 10 Watt Amplifier.

At first sight this circuit may seem to be a straight forward Class B design having an emitter follower, complementary output pair and Darlington Pair common emitter driver stage. However, the output devices are, in fact, complementary VMOS transistors used



in the source follower mode (the FET equivalent of the emitter follower). In most other respects the design is quite conventional.

R1 and R2 are used to bias the unit to give the optimum quiescent output potential and they provide overall negative feedback, which improves the quality of reproduction. D1 and C4 are bootstrapping components, enabling the gate drive voltage to Q3 to go above the positive supply potential, giving improved efficiency to the circuit. R3 is the main collector load for Q2 and PR1 is used to give a standing bias on the output transistors that gives a quiescent current consumption of about 25 mA. The thermal compensation circuitry normally used is totally unnecessary in this circuit, since VMOS devices do not suffer from thermal runaway. In fact the quiescent bias current will drop slightly as the output devices heat up, but not sufficiently to give rise to significant cross-over distortion.

C2 and C5 provide DC blocking at the input and output respectively, while C1 is a supply decoupling component. C3 gives a degree of high frequency attenuation and aids the stability of the circuit.

Although the current in the driver stage, only about 1 mA, may seem to be totally inadequate, it is in fact more than sufficient since the VMOS devices have extremely high input impedances and consume no significant input current. This is one of their main advantages over bipolar devices. One disadvantage in this particular application is lower efficiency due to the higher threshold voltages and on resistance of VMOS transistors in comparison to bipolar devices. However, the circuit will give an output of 10 W RMS using a supply voltage of about 33 V or so (with a current drain of up to about 600 mA). An input of about 500 mV RMS is needed for maximum output.

Note: The output devices do not have internal zener protection diodes and the appropriate handling precautions should be taken. These devices are available from J.W. Rimmer, 367 Green Lanes, Harringay, London, N4 1DY.



# Metac

## ELECTRONICS & TIME CENTRES

### QUARTZ LCD 11 Function Slim Chronograph

12:30<sup>pm</sup> 45

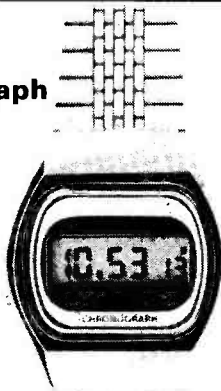
Hours mins secs

8 14<sup>TH</sup>

Month date day

0:00<sup>00</sup>

Min secs 1/10 1/100



Price only  
**£8.95**

Also available:  
SOLAR CHRONOGRAPH  
M9 Price £11.95

6 digit, 11 functions, Hours, mins., secs., day, date, day of week, 1/100th, 1/10th, secs., 10X secs., mins. Split and lap modes. Back-light, auto calendar. Only 8mm thick. Stainless steel bracelet and back. Adjustable bracelet.

SAME DAY DESPATCH.  
M3 Price includes POST & PACKING

### QUARTZ LCD ALARM with Snooze Alarm

12:30<sup>pm</sup> 45

Hours mins secs

8 14<sup>TH</sup>

Month date day

7:30<sup>A</sup>

Alarm



Price only  
**£9.95**

6 functions plus Alarm. Conference signal, 5 minute snooze alarm, Conference signal sounds 4 secs. before main alarm to give advance warning and an option to cancel. Snooze sounds 5 mins. after main alarm and is always preceded by the conference signal.

SAME DAY DESPATCH.  
M4 Price includes POST & PACKING

### QUARTZ LCD ALARM CHRONOGRAPH with 12/24 display

12:30<sup>pm</sup> 45

Hours mins secs

8 14<sup>TH</sup>

Month date day

0:00<sup>0</sup>

Min sec 1/10th



Price only  
**£13.95**

Also available:  
SOLAR ALARM CHRONO  
M7 Price £17.95

Alarm Hours, mins, secs, day of week. Month, date, day of week, alarm, hour, mins., a.m./p.m. 24 or 12 hour display mode. Alarm test. Chronograph, lap time, stop watch 1/10 secs.

M64 Price includes POST & PACKING

### QUARTZ LCD Ladies Day Watch

Hours, mins., secs., day, date, back light, auto calendar.

12:30

Hours mins

8 14

Month date

:45

Secs



Price only  
**£7.95**

Fully adjustable bracelet. Only 25 x 20mm and 6mm thick. Silver or Gold.

M15 SAME DAY DESPATCH. P.&P. included

### QUARTZ LCD Ladies Cocktail Watch

Beautifully designed with a very thin bracelet.

12:30

Hours mins

8 14

Month date

:45

Secs



Price only  
**£14.95**

Hours., mins., secs., day, date, backlight and autocalendar. Bracelet fully adjustable to suit slim wrists. State Gold or Silver finish. Only 25 x 20 x 6mm.

M18 SAME DAY DESPATCH. P.&P. included

### HANIMEX Electronic LED Alarm Clock

Features and Specification:

Hour, minute display. Large LED display with p.m. and alarm on indicator. 24 Hours alarm with on/off control. Display flashing for power loss indication. Repeatable 9-minute snooze. Display bright/dim modes control. Size: 5.15" x 3.93" x 2.36" (131mm x 11mm x 60mm). Weight: 1.43 lbs (0.65 kg).



M13

Price only  
**£10.20** Thousands sold!

Mains operated.

### QUARTZ LCD 5 Function GENTS/BOYS

Hours, mins., secs., month, date, auto calendar, back light, quality metal bracelet. 6mm thick.

12:30

Hours mins

8 14

Month date

:45

Secs



Price only

M1 SAME DAY DESPATCH. **£6.95** P.&P. included

### METAC GUARANTEE

All METAC products carry 12 months guarantee and we also refund your money if not satisfied with our goods or service in the first 10 days.

METAC's well equipped service centre minimises service delays. Please note, we do not delay your order to clear cheques.

Telephone your order using  
Barclaycard/Access

Number on on

**03272 -  
76545**



24 hour answering service  
OR COMPLETE THE  
COUPON

### WHOLESALE MAIL ORDER

Send for our trade price list and order details. Sell our products to your friends and earn yourself

**£££'s**



**NEW 24 HOUR  
DESPATCH SERVICE**

METAC have opened a new even faster Mail Order and Service Centre at DAVENTRY. Orders received before 3.30 p.m. will be despatched same day.

**VISIT OUR ELECTRONIC TIME CENTRES AND SEE ONE OF THE MOST IMPRESSIVE QUARTZ WATCH RANGES IN BRITAIN**

**QUARTZ MELODY  
Alarm Chronograph**

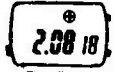
**INCREDIBLE WATCH 34 Functions**



Count-down Timer



Alarm



Time Zone



Chronograph



5 independent working modes, day of week in English, French or German. (Just select the one you like). Hours, mins., secs., day, date, countdown alarm, dual time zone, 1/100th sec., stopwatch. Lap/split time, 1st and 2nd place times. Melody test function.

Price only  
**£17.95**

Price includes  
POST &  
PACKING

**M30 SAME DAY DESPATCH.**

**SEIKO ALARM  
CHRONOGRAPH**

With WEEKLY Alarm, Hours, mins., secs., month, date, day, am/pm. Weekly alarm — can be set for every day at designated time, e.g. 6.30 am on Monday, Wednesday and Friday. Alarm set time displayed above time of day. Full stopwatch functions, laptime, split etc.

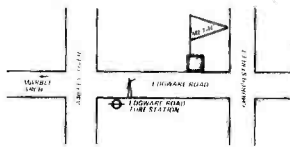


Price only  
**£79.95**

**SAME DAY  
DESPATCH.  
M10**

including POST & PACKING.

**METAC IN  
LONDON**  
327 EDGWARE ROAD, LONDON, W2  
01-723 4753

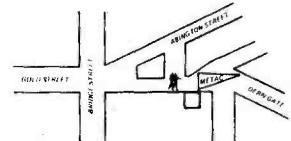


**58 QUEENSWAY, LONDON, W2**  
Opposite Bayswater Tube Station  
Shop open 12 hours / day, 7 days / week

Situated in the heart of London's fast-moving electronics area. A very large selection of watches and consumer electronics products. Also many bargain discount / sale items.

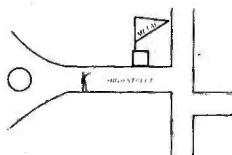
2nd only to Oxford Street, this is London's round-the-clock international tourist area. An excellent selection of expensive famous watches, plus all the popular models.

**METAC IN  
NORTHAMPTON**  
11 ST. GILES SQUARE, NORTHAMPTON  
Tel: (0504) 39550



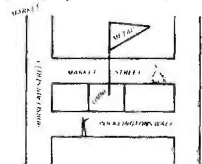
An excellent selection of watches and electronics. This shop also has televisions and video recorders to rent or buy.

**METAC IN  
DAVENTRY**  
67 HIGH STREET, DAVENTRY



Situated in the middle of Daventry, only a short walk from Metac's Mail Order Centre, the shop stocks a wide range of watches and consumer electronic products. You may also rent or buy televisions and video recorders here.

**METAC IN  
LEICESTER**  
OMNI SHOPPING CENTRE, 27 MARKET STREET  
LEICESTER



Situated in the Omni walk-round shopping centre. Metac at Omni stocks an excellent range of quality watches at very attractive prices.

**ALSO IN STOCK**

NEW SEIKO	Digital-Analogue Alarm Chrono	<b>£73</b>
SEIKO	James Bond Memory Bank	<b>£39</b>
BEL-TIME	Now only Pico-Quartz 50 Function All Singing, all Dancing Wrist Computer	<b>£29.95</b>
BEL-TIME	Alarm	<b>£12.95</b>
BEL-TIME	Chronograph	<b>£10.95</b>
BULER	Swiss Digital and Quartz-Analogue Collection	
CASIO	Alarm Chrono. Lowest price anywhere. Send for details.	
OTRON	Korean Waterproof Ladies' and Gent's Solar Alarm Chronographs, etc.	
TRAFALGAR	Digital-Analogue Alarm Chronograph	<b>£29.95</b>

Also large selection of popular Dual-time, Alarm, Countdown, Musical, Ladies' and Gent's Watches.

**WANT TO KNOW HOW  
THEY WORK?**

Send £1 and we will send you the 40-page Watch Report. A technical survey which describes in detail the function and operation of electronic watches in a completely unbiased and objective way.

**MAIL ORDER**

Mail Order is a safe and simple way to purchase goods. You are well protected by the consumer mail order laws and at Metac we combine a fast service with a genuine 10-day home approval scheme. You may examine any merchandise purchased through our mail order division, in your own home for 10 days at no cost to yourself. All postal charges are pre-paid by Metac. For more information on Metac mail order products send for our free literature, brochure and watch-care leaflets, to: **METAC ELECTRONICS LITERATURE, 47 HIGH STREET, DAVENTRY, NORTHANTS.**

POST COUPON TO: **METAC (24 hour despatch centre), FREEPOST, 47a High Street, Daventry, Northants.**

PLEASE COMPLETE BOTH COUPONS

Please send me .....

I enclose P.O./Cheque value .....

Barclaycard/Access No. ....

Name .....

Address .....

FROM:

**METAC ELECTRONICS & TIME CENTRE, (ETI),  
67 HIGH STREET, DAVENTRY, NORTHANTS.**

Name .....

Address .....

POST, PACKING AND VAT INCLUDED IN PRICE.



# FLASH TRIGGER

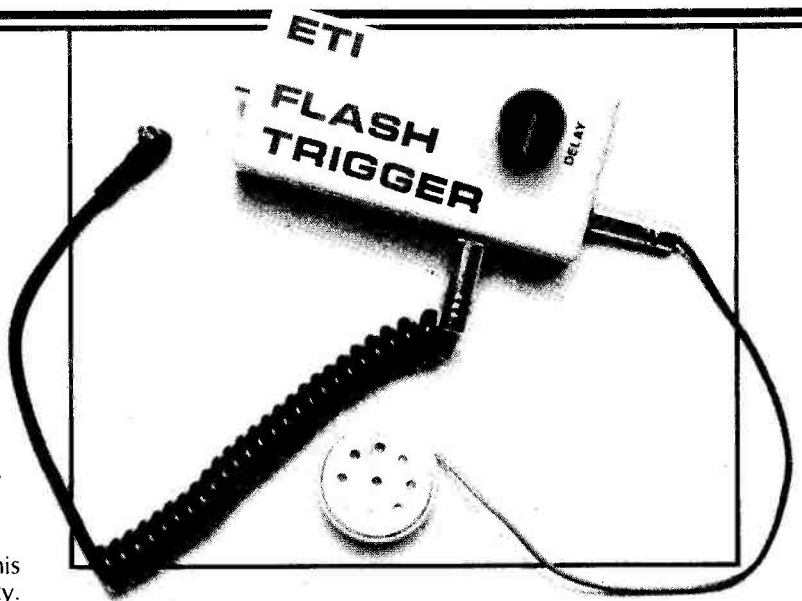
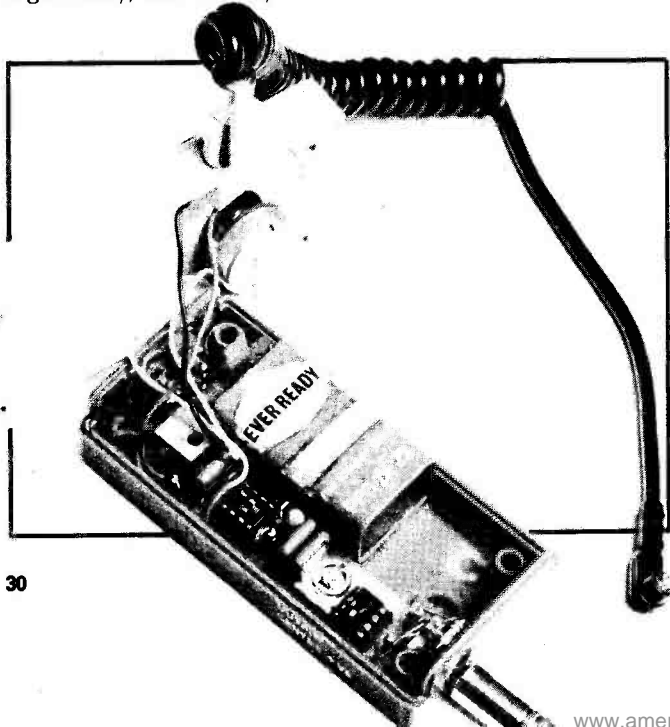
This versatile unit fits in your pocket — ready for use in a flash.

Flash triggers have been with us for a few years now. This design offers all the usual features plus pocketability. Only a couple of cheap chips are used with a careful (check the photos) of other components. Using the specified component values, the unit may be employed either as a direct slave or may introduce a delay variable between 10 mS and 200 mS. Other delay times may be achieved by a single component change.

A number of devices may be used to trigger the unit. Operation as a sound operated flash requires only one extra component, a crystal insert or microphone.

## Construction

Our PCB design will enable you to build the unit into a compact case. A preset component was used for PR1, though a standard potentiometer can be substituted if you have room and require adjustable sensitivity. If you do use our PCB then construction will be straightforward. Just follow our drawings and PCB overlay. As usual, insert the low-profile components first taking care to orient the semiconductors correctly. If you do not have a BC184L, almost any other small NPN silicon transistor can be substituted. However, note the TO92A pin configuration which differs from that of many popular transistor types. We included a power 'on' LED indicator in our design next to the input socket. A word of warning: remember that the trigger leads of many flash guns may have a potential of up to 200 V across them. This is usually low current but may give the clumsy constructor a tingle. This versatile unit should find a place in every photographer's grab-bag, so if you are going to delay, do it our way!



## HOW IT WORKS

The flash gun is discharged by short circuiting its trigger contacts. This is usually achieved by a mechanical contact closure operating synchronously with the camera shutter release. In this design, the camera contacts are replaced by an electronic switch, thyristor Q2. This device is turned on, simulating a contact closure, by application of a positive-going pulse to the gate.

With SW1 in the 'direct' position, the thyristor will be triggered from the output of IC1, a 741 op-amp configured in the variable gain non-inverting mode. The use of C1 gives the amplifier a high available AC gain while minimising the effects of amplifier offsets. Gain is preset to the desired level by adjustment of PR1. For a straightforward sound operated flash, the input to IC1 may consist of a simple crystal insert connected between the junction of R1, 2 and ground. Any device capable of producing a small pulse may be employed at the input. Note that the unit will trigger from positive going edges in the 'direct' mode and from negative edges when switched to 'delay'.

A negative going output from IC1 will trigger the 555 timer, IC2. The delay introduced by this chip is variable between about 10 mS and 200 mS by adjustment of RV1. Other delays may be achieved by changing the value of C4. As the delayed trailing edge output from IC2 is of the wrong sense, it is inverted by Q1 to provide a suitable trigger pulse for Q2. Capacitor C3 provides overall decoupling.

There isn't a lot of space to spare inside the case. Make sure you leave a corner free for the potentiometer body, or the case won't close properly.

## PARTS LIST

Resistors all 1/4W 5%	
R1,2,3,4	39k
R5,6	100k
R7	10k
Potentiometers	
PR1	100k horizontal preset
RV1	2M0
Capacitors	
C1,2,4	100n polyester
C3	4u7 tantalum
C5	10n polyester
Semiconductors	
IC1	741
IC2	555
Q1	BC184L
Q2	C106D
D1	1N4148



NOTE:  
 Q1 IS BC184L  
 Q2 IS C106D  
 IC1 IS 741  
 IC2 IS 555  
 D1 IS 1N4148

Fig.1 Circuit diagram. Any device capable of producing a small pulse can be used at the input.

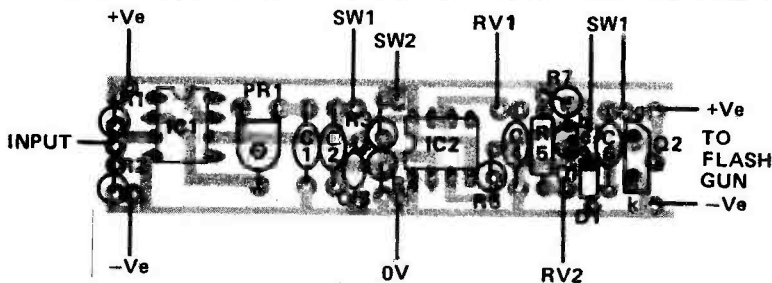
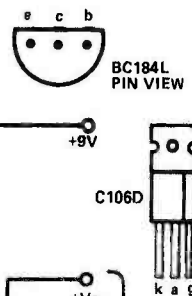
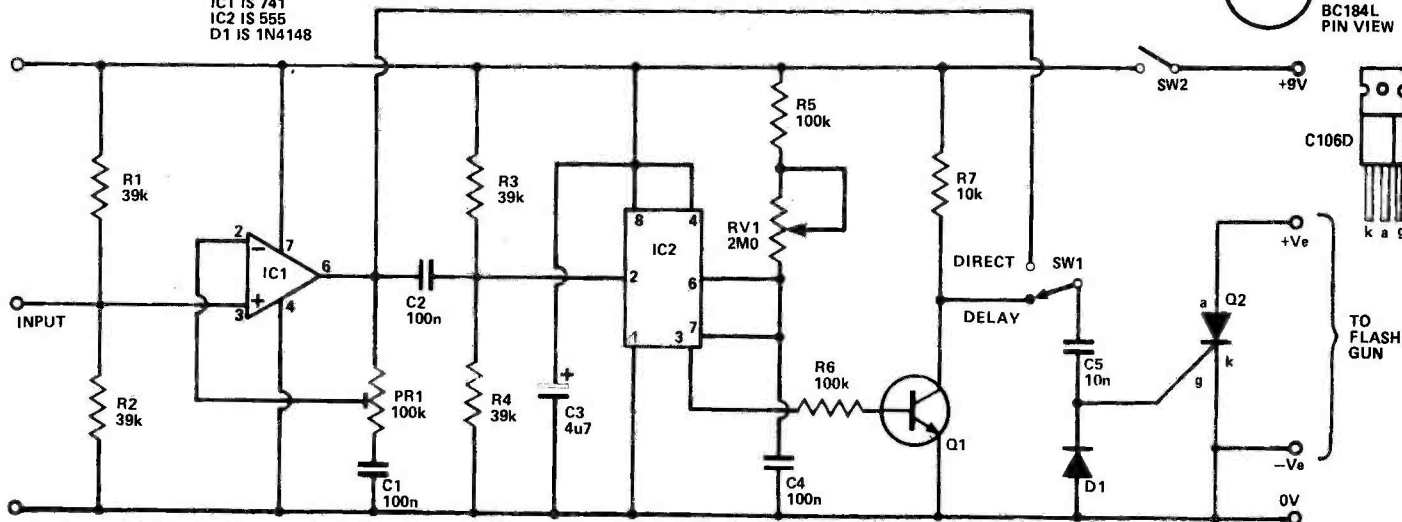


Fig.2 Component overlay.

**BUYLINES**

All the electronic components should be readily available from your usual supplier or see the adverts in this issue. The Vero plastic box we used is their stock number 202-21027E.

ETI

# Conquer the chip.

Be it a career, hobby or interest, like it or not the Silicon Chip will revolutionise every human activity over the next ten years.

Knowledge of its operation and its use is vital. Knowledge you can attain, through us, in simple, easy to understand stages.

Learn the technology of the future today in your own home.

## MASTER ELECTRONICS LEARN THE PRACTICAL WAY BY SEEING AND DOING

- Building an oscilloscope. ● Recognition of components.
- Understanding circuit diagrams. ● Handling all types Solid State 'Chips'.
- Carry out over 40 experiments on basic circuits and on digital electronics.
- Testing and servicing of Radio, T.V., Hi-Fi and all types of modern computerised equipment.

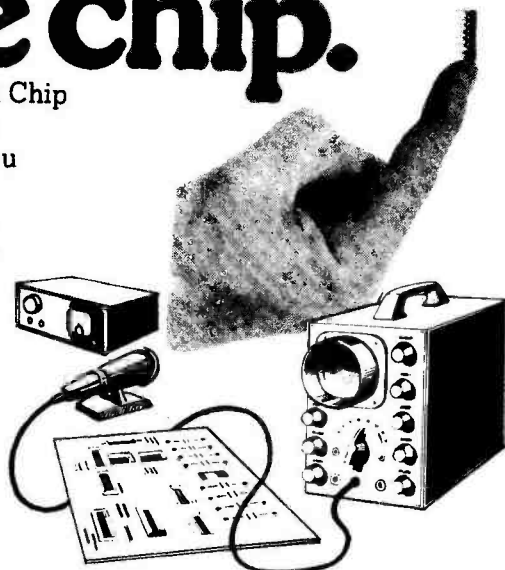
## MASTER COMPUTERS

LEARN HOW TO REALLY UNDERSTAND COMPUTERS, HOW THEY WORK - THEIR 'LANGUAGE' AND HOW TO DO PROGRAMS.

- Complete Home Study library. ● Special educational Mini-Computer supplied ready for use. ● Self Test program exercise.
- Services of skilled tutor available.

## MASTER THE REST

- Radio Amateurs Licence. ● Logic/Digital techniques.
- Examination courses (City & Guilds etc.) in electronics.
- Semi-conductor technology.
- Kits for Signal Generators - Digital Meters etc.



Please send your FREE brochure without obligation to -

Name: \_\_\_\_\_

Address: \_\_\_\_\_

BLOCK CAPS PLEASE

I am interested in -

PRACTICAL ELECTRONICS \_\_\_\_\_

COMPUTER TECHNOLOGY \_\_\_\_\_

OTHER SUBJECTS \_\_\_\_\_ (please state your interest)

BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL  
 4 CLEVELAND ROAD, JERSEY, CHANNEL ISLANDS. ETI/10/813



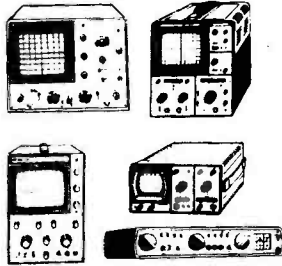
- ORDER BY POST OR TELEPHONE WITH BARCLAYCARD/ACCESS
- ELECTRONIC TEST EQUIPMENT SPECIALISTS
- ALL PRICES INCLUDE VAT

# AUDIO ELECTRONICS

- ALL MODELS ON DISPLAY
- RETAIL - MAIL ORDER EXPORT INDUSTRIAL
- OPEN SIX DAYS A WEEK
- CALL IN AND SEE FOR YOURSELF

## SCOPES

A range of Scopes in stock from 5mHZ Single Trace to 50mHZ Dualtrace. Mains and Battery/Mains portables. Many on demonstration.



### SINGLE TRACE (UK c/p etc £2.50)

Hm 307-3 10mHZ, 5mV, 6 x 7cm display plus component test	£170.00
CO1303D 5mHZ, 10mHZ, 7 x 7cm display	£109.25
SC110 10mHZ Battery portable, 10mV 3.2 x 2.6cm display (Optional case £8.80, Nicads £7.95, Mains unit £4.00)	£152.50
LB0512A 10mHZ, 10mV, 5" display (plus FREE probe)	£195.50
CS1559A 10mHZ, 10mV, 5" display	£198.50

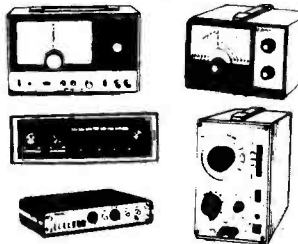
### OPTIONAL PROBES (ALL MODELS)

X1 £6.50, X10 £8.50, X100 £12.95, X1-X10 £10.95

### DUAL TRACE (UK c/p etc £3.50)

CS1562A 10mHZ, 10mV, 5" display	£244.95
Hm312-8 20mHZ, 5mV, 8 x 10cm display	£287.50
CS1565A 20mHZ, 5mV, 5" display	£323.15
CS1352 15mHZ, 2mV, 7.5cm display, battery/mains portable (Nicads pack £29.90)	£346.15
Hm412-4 20mHZ, 5mV, 8 x 10cm display plus Sweep Delay	£399.50
CS1577A 30mHZ, 2mV, 5" display	£465.40
CS1572 30mHZ, 5mV, 5" display plus Video Delay	£472.65
CS1830 30mHZ, 2mV, 5" display plus sweep delay	£507.15
Hm512-8 50mHZ, 5mV, 10x 8cm display, Delay Sweep	£667.00
CS1572 30mHZ, 5mV, 5" display plus video delay	£472.65
LB0514 10mHZ, 1mV (5mV) 5" display (plus 2 FREE probes)	£294.00

## GENERATORS (UK c/p £1.75)



### RF

SG402 100KHZ - 30mHZ with AM modulation	£64.40
LSG16 100KHZ (300mHZ on Harmonics)	£58.50
SG2030 250KHZ - 100mHZ low cost range	£46.95
ARF 300 18HZ-200mHZ low cost range	£76.95

### PULSE

2001 1HZ-100KHZ	£86.00
TG105 5HZ-5mHZ	£97.75
4001 0.5HZ-5mHZ	£105.00

A range of Signal Generators to cover Audio, RF and Pulsing. Mains operated (TG series Battery).

### AUDIO (All sine/square)

AG202A 20HZ-200KHZ	£65.55
LAG26 20HZ-200KHZ	£69.00
AG203 10HZ-1mHZ sine/square	£120.75
LAG120A 10HZ-1mHZ	£137.00

### LEVELL ('M' with Meter)

152 SERIES 3HZ - 300KHZ Sine/Square	£92.00
200 SERIES 1HZ-1mHZ Sine/Square	£92.00
TG152D	£113.85
TG152DM	£124.20
TG200D	£149.50
TG200DM	£155.25

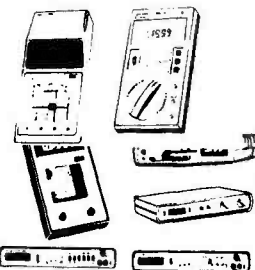
## SWR/FS AND POWER METERS



Range in stock covering up to 150mHZ and up to 1 K watt power. PL259 sockets. Also 250 UHZ Grid Dipmeter. SWR/FS SWR/Power 3-3-150mHZ £3.50. SWR/FS SWR/Power meter 3/2-150mHZ 0-1000 watts £13.95. 110 SWR/Power 1/2-144mHZ 0/70/100 watts £11.50. 171 As 110 Twin meter plus F/S £14.90. Plus large range of BNC/PL259/etc leads/plugs/adaptors/connectors always in stock. 176 SWR/Power/FS 1/2-144mHZ, 5-50 watt. Plus 25-40mHZ AC match £16.00. KDM4 Grid Dip 1/2-250mHZ £26.50.

## DIGITAL MULTIMETERS

A range of LED and LCD Bench and Hand DMM's history operated with optional Mains Adaptors - some with optional Nicads. All supplied with batteries and leads.



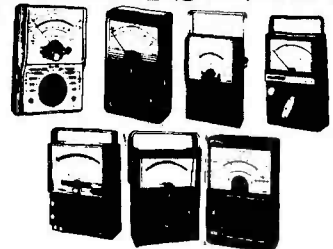
### HAND HELD (UK post etc. 85p)

TM352 3 1/2 Digit LCD plus 10 ADC and Hfe checker	£55.95
PDM35 3 1/2 Digit 16 range LED (no AC current)	£32.95
ME502 3 1/2 Digit LED plus 10A DC and Hfe checker	£43.95
LM2001 3 1/2 Digit LCD 2 amp AC/DC 0.1%	£51.70
6200 3 1/2 Digit LCD 0.2A AC/DC, Auto range	£39.95
6220 As 6200 plus 10A AC/DC	£49.95
6100 As 6200 plus Cont. test/range hold	£64.95
6110 As 6100 plus 10A AC/DC	£74.95

### BENCH PORTABLES (UK c/p £1.00)

DM235 3 1/2 Digit LED 21 ranges, 0.5% AC/DC 2A	£56.50
DM350 3 1/2 Digit LED 34 ranges AC/DC 10A	£78.50
TM353 3 1/2 Digit LCD AC/DC 2 amp	£86.50
TM351 3 1/2 Digit LCD AC/DC 10 amp	£112.50
LM100 3 1/2 Digit LCD AC/DC 2 amp	£86.50
DM450 4 1/2 Digit LED 34 ranges AC/DC 10 amp (DM series options, Carry case £8.80, Nicads £7.95, Mains adaptor £4.00).	£107.95

## MULTIMETERS (UK post etc 75p)



KRT101 1K/Volt 10 range pocket	£4.50
ATM1/LT1 1K/Volt 12 range pocket	£5.95
NH55 2K/Volt 10 range pocket	£6.95
AT1 2K/Volt 12 range pocket de luxe	£7.95
NH56 20K/Volt 22 range pocket	£10.95
YN360TR 20K/Volt 19 range pocket plus hfe test	£13.95
AT1020 20K/Volt 19 range de luxe plus hfe test	£16.95
7081 50K/Volt 36 range plus 10 amp DC	£19.95
TMK500 30K/Volt 23 range plus 12A DC/Cont. test	£21.50
AT20 20K/Volt 21 range de luxe plus 10A DC and 5KV DC	£21.95
AT205 50K/Volt 21 range de luxe plus 10A DC	£24.95
7080 20K/Volt 26 range large scale, 10A DC plus 5KV AC/DC	£26.95
AT2050 50K/Volt 18 range de luxe plus hfe test	£28.50
AT210 100K/Volt 21 range de luxe plus 12A AC/DC	£29.95
360TR 100K/Volt 23 range plus hfe checker and AC/DC 10 amps	£34.95

CHOOSE FROM THE UK'S LARGEST SELECTION

## FREQUENCY COUNTERS



Portable and Bench LCD and LED Counters up to 600mHZ. Prices include batteries and leads.



### HAND HELD (UK post etc 85p)

PFM200 20HZ to 200mHZ 8 Digit LED	£54.50
MAX50 100HZ to 50mHZ 6 Digit LED	£61.00
MAX550 30KHZ to 550mHZ 6 Digit LED	£106.00



### BENCH PORTABLES (UK c/p £1.00)

MAX100 8 Digit LED 5HZ to 100mHZ	£89.00
TF200 8 Digit LCD 10HZ to 200mHZ	£166.75
7010A 9 Digit LED 10HZ to 600mHZ	£175.00

### LOGIC PROBES

#### MONITORS

Logic probes indicating high/low etc states that scopes can miss. all circuit powered for all IC's.

LP3 50 mHZ logic probe	£85.95
LP1 10 mHZ logic probe	£35.50
LP2 1 1/2 mHZ logic probe	£18.95
LM1 Logic monitor	£33.00

Also in stock range of Proto-board kits and breadboards.

### MINI DRILLS AND KITS

(8-12 Volt 1/8" chucks)

Small Drill plus 3 collets	£7.25
Medium Drill plus 3 collets	£10.50
Small Drill plus 20 tools	£14.95
Medium Drill plus 20 tools	£17.95
Mains Drill	£13.95
Mains Drill plus 20 tools	£21.50

Stockists of electronic equipment, speakers/kits, PA equipment plus huge range of accessories ● UK carriage/packing as indicated ● Export - prices on request ● All prices correct at E & OE ● All prices include VAT.

# AUDIO ELECTRONICS Limited

301 EDGWARE ROAD, LONDON, W2 1BN, ENGLAND. TELEPHONE 01 724 3564

OPEN SIX DAYS A WEEK



FREE CATALOGUE!

Send large SAE (17 1/2p UK) Schools, Companies, etc. free on request.



# Hobby Electronics

## Next Month

ON SALE SEPTEMBER 12th

### Kitchen Timer

This handy little gadget will soon take pride-of-place on the kitchen shelves. It'll accurately indicate periods of up to six and a half minutes in thirty second steps. All the components are easy to obtain and it shouldn't take more than a couple of hours to build.

### Freezer Alarm

Still in the kitchen, we've cooked up another winner for you with this little freezer alarm circuit. Should the temperature rise above a pre-determined level then the alarm will sound. Anyone who has ever seen a freezer full of unfrozen food will know how valuable this little project could be!

### Light Dimmer

Here's one for those afraid of bright lights. This all new dimmer circuit will fit into the standard light switch socket. It'll let you control your lighting from a harsh glare to a warm seductive glow, just right for those long winter evenings in front of the telly. It might even save a few bob on the electricity bill too!

### Doorbell

Just in case you've fallen asleep, safe in the knowledge your freezer's OK, the lights are low (courtesy the HE Light Dimmer), the meal was perfect (thanks to the HE Kitchen Timer), you'll be glad to know that the HE Nobell Doorbell will wake you up. This novel little circuit faithfully re-creates the sound of a mechanical door-knocker. No prizes for guessing why we called it the Nobell.

### Temperature Controlled Soldering Iron

If we've tempted you into building any of these projects then you should know about our Temperature Controlled Soldering Iron project next month. You'll be able to build all of the projects without worrying about burnt out bits anymore.

### Home Electronics

To round it all off we will be taking a look at some of the benefits electronics has brought to the home. The homely Tina Boylan looks at some of the gadgets on sale today and some of the labour saving devices we can expect in the next few years.

The items mentioned here are those planned but unforeseen circumstances may affect the actual contents.

## 3½ DIGIT LCD MULTI-METER KIT

# NEW

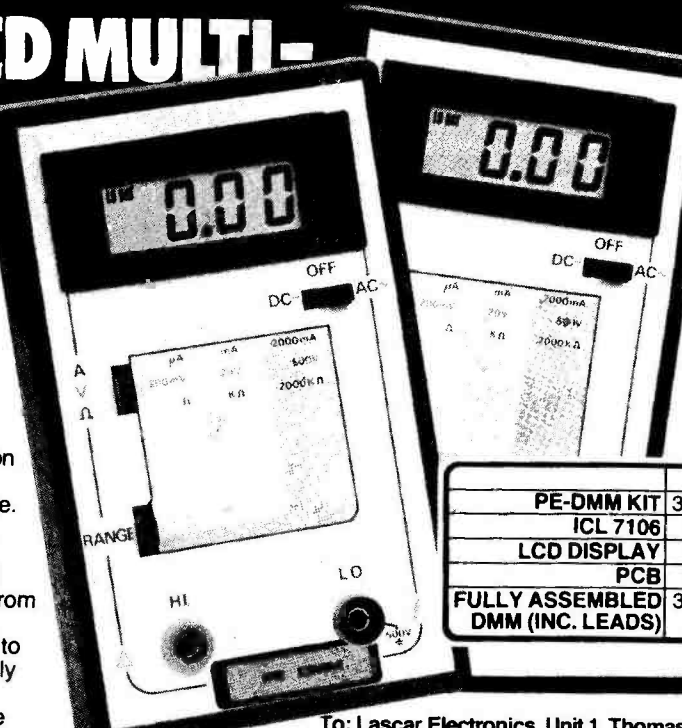
Build the Practical Electronics handheld DMM. This superb product offers professional precision with extended battery life. Five function operation (AC and DC VOLTS, AC and DC CURRENT, RESISTANCE) with ability to check diodes. 0.5" LCD display with 'Battery Low' warning. Auto-polarity, Auto-zero. Full protection against transients and overloads with ability to withstand mains on any range. 0.5% basic DC accuracy and 15 different ranges. It measures AC/DC voltages from 0.1mV to 500V. AC/DC current from 0.1µA to 2A. Resistance from 0.1Ω to 2MΩ. 200 hour battery life.

The Kit contains all parts needed to construct the multimeter plus assembly instructions, battery and test leads.

We also offer a calibration service (£5.00 + VAT) and a trouble-shooting and calibration service (£7.50 + VAT). Various other component parts are also available as listed.

The multimeter is also available fully assembled and calibrated at a cost of £39.70 + P&P + VAT.

Lascar Electronics Ltd., Unit 1, Thomasin Road, Basildon, Essex. Telephone No: Basildon (0268) 727383.



**FEATURED  
ASA  
PROJECT IN  
PRACTICAL  
ELECTRONICS**

	£	P & P	VAT	TOTAL
PE-DMM KIT	32.95	1.00	5.09	39.04
ICL 7106	8.95	0.50	1.42	10.87
LCD DISPLAY	7.95	0.50	1.27	9.72
PCB	4.95	0.50	0.82	6.27
FULLY ASSEMBLED DMM (INC. LEADS)	39.70	1.25	6.14	47.09

To: Lascar Electronics, Unit 1, Thomasin Road, Basildon, Essex.

Please send me Data  FULLY ASSEMBLED DMM (INC. LEADS) £47.09   
PE-DMM KIT £39.04  ICL 7106 £10.87  LCD DISPLAY £9.72  PCB £6.27

Name \_\_\_\_\_

Address \_\_\_\_\_

Tel. No \_\_\_\_\_

I enclose cheque/P.O. value \_\_\_\_\_



### CAPACITORS

Ceramic PCM 5mm - Auto Insertion Types

1 10- 2p	4 33 1p	7 100 1p	10 1K5 1p	12 0.2 2p	15 27 2p	18 0.2 2p	21 100 2p
2 15 2p	5 47 1p	8 330 1p	11 3K3 1p	13 12 2p	16 30 2p	19 120 2p	22 220 2p
3 22 2p	6 68 1p	9 1K 1p		14 18 2p	17 56 2p	20 150 2p	23 270 2p

### CAPACITORS

ELECTROLYTIC TOL. - 10% + 50% IN MFDs ALL 5mm PCM

AXIAL TUBULAR	ALL 3W	PLUG IN	LEADS 7 x 5mm
24 1 13 x 6 0p	29 10 19 x 7 0p	34 2.2/63v 11 x 5 2p	
25 2.2 13 x 6 0p	30 22 19 x 9 12p	35 4.7/63v 11 x 6 2p	
26 3.3 13 x 6 0p	31 47 19 x 10 15p	36 10/63v 12 x 8 2p	
27 4.7 13 x 6 0p	32 100 31 x 13 20p	37 22/35v 13 x 8 4p	
28 6.8 13 x 7 0p	33 220 31 x 13 25p	38 47/35v 12 x 10 4p	
		39 100/25v 13 x 10 5p	
		40 220/35v 17 x 10 7p	
		41 470/63v 20 x 10 9p	

BY ELNA MULLARD  
RUBYCON, PLESSEY SPRAGUE

### BRIDGES

42 W005 10p
43 W02 20p
44 W04 24p

By G1 ME

### CAPACITORS

POLYESTER PLUG IN RECT BOX STYLE

TOL 10% IN MFDs BY EVOX MULL PLESSEY ROBERTSON SIEMENS

PCM	50 1/100	15 20p
46 .001/400v 10 2p	52 .047/100v 10 2p	60 1.5/100 22 20p
47 .0022/400v 10 2p	53 .056/100v 10 2p	61 2.2/100 22 25p
48 .0033/400v 10 2p	54 1/250v 10 2p	62 3.3/100 22 50p
49 .0047/400v 10 2p	55 22/250v 15 5p	63 4.7/100 27 50p
50 .01/250v 10 3p	56 33/100v 15 7p	
51 .022/250v 10 3p	57 47/250v 22 10p	
52 .033/150v 10 3p	58 68/100v 15 15p	

- 64 Also in Axial Supp/en Type KC1853 21p

### CAPACITORS

TANT BEAD 20%

65 2.2/20v 10p	66 4.7/25v 15p
----------------	----------------

### DISPLAYS

LED 7 SEGMENT

67 MSD161C Numeric 05p
------------------------

### DIODES

BY ITT, MULL, SECOSEEN, TEXAS, ETC.

ITEM	3V3	4V7	5V1	5V6	6V8	9V1	10	15	18	4p
80 AX119 35mA 45v 0p	76 BY255 3A 1300V 10p	84 W4004 1A 400V 3p								
81 BA182 100mA 35v 20p	77 DA47 45mA 30v 8p	85 W4148 75mA 75V 1p								
79 BA133 75mA 50v 2p	79 DA90 10mA 30v 10p	86 W4151 150mA 75V 4p								
78 BA116 200mA 150v 4p	79 DA91 50mA 115v 15p	87 W4504 3A 400V 10p								
72 BA138 115mA 50v 4p	80 DA200 80mA 50 2p	88 W4507 3A 800V 12p								
73 BA126 1A 550v 10p	81 W4114 75mA 100V 2p	89 IS923 20mA 200V 0p								
74 BY127 2A 1250v 15p	82 W4016 75mA 100V 2p									
75 BY206 400mA 350v 20p	83 W4002 1A 100v 2p									

### LEDS

2mm TIL 209C

80 GR 13p	91 RED 0p	92 YEL 15p
-----------	-----------	------------

### DIODES

ZENER BY MULLARD SECOSEEN

ITEM	102	103	104	105	106	107	108	109	110	0p
B2X79/B2Y84C 400mA 5%	3V3	4V7	5V1	5V6	6V8	9V1	10	15	18	4p
	53	64	95	96	97	98	99	100	101	

ITEM	102	103	104	105	106	107	108	109	110	0p
B2X81/B5C 1W 3.5%	6V8	9V1	10	12	16	18	20	22	24	0p

### ICs

MISC PINNING SHOWN ALL ON-N

111 301 (8) 30p	112 380 (14) 50p	113 555 (8) 25p	114 709 (8) 40p	115 723 (14) 30p	116 741 (8) 20p	117 CA3130 (8) 70p
-----------------	------------------	-----------------	-----------------	------------------	-----------------	--------------------

DUALS 118 556 (14) 00p	and 119 747 (14) 40p	QUADS 120 324 (14) E3.00
------------------------	----------------------	--------------------------

### ICs

C-MOS / MROLA NATIONAL RCA AND TEXAS

19p	57p	85p	50p	75p	E1
121 00	145 27		160 00	184 40	
122 01	146	28	161 01	185	41
123 02	147		162 02	186	
124	148 30		163 03	187	42
125 07	149 06	35	164 04	188	45
126	150	41	165 05	189	46
127 09	151	42	166 06	190	48
128 10	152	43	167 07	191 50	
129 11	153	44	168 08	192 51	
130 12	154	45	169 09	193 53	
131 13	155	47	170 10	194 54	60
132 14	156 49		171 11	195	70
133 15	157 50		172 13	196	
134			173 14	197 73	73
135			174	198	
136 16	158 W0287L E1		175 17	199 76	
137 17	159 TA550C 9p		176 20	200	
138 18			177 23	201	
139 19			178 25	202 86	
140 20			179 27	203	
141 23	21		180 30	204	
142			181 32	205	
143 25	24 22		182 37	206	
144			183 38	207	

ALSO 158 W0287L E1  
159 TA550C 9p

SPEEDFAST DELIVERIES

### ICs

TTL / FORD NATIONAL SIGNETICS

15p	25p	15p	25p	50p	E1
209 01	210 02	209 01	210 02	209 01	210 02
211 03	212 04	211 03	212 04	211 03	212 04
213 05	214 06	213 05	214 06	213 05	214 06
215 07	216 08	215 07	216 08	215 07	216 08
217 09	218 10	217 09	218 10	217 09	218 10
219 11	220 12	219 11	220 12	219 11	220 12
221 13	222 14	221 13	222 14	221 13	222 14
223 15	224 16	223 15	224 16	223 15	224 16
225 17	226 18	225 17	226 18	225 17	226 18
227 19	228 20	227 19	228 20	227 19	228 20

LOW PRICED IC HOLDERS

224 14 PW 9p
225 16 PW 9p
226 24 PW 27p

### RESISTORS

E12 M Ohms, 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82  
Carbon Film 1/4W 5% 1/2W 5% 1W 5% 10W 5% E12  
Metal Film 1/4W 2% 1/2W 2% 1W 2% 10W 2% E12  
227 When ordering resistors state qty., item no and resistance value.

BY KOA  
Electrosil  
Welwyn

228 RT106 700 1	3.5	5	00p	231 2N444 600 5	2.5	6	00p
229 C1060 400 2.4	.8	.2	40p	232 2N5061 60 25	1.2	35	15p
230 TC1060 400 5		.2	30p	233 2N5082 100 25	1.2	35	20p

### SCRs

228 RT106 700 1	3.5	5	00p
229 C1060 400 2.4	.8	.2	40p
230 TC1060 400 5		.2	30p

### TRANSISTORS

all at 6p each

Case	VC	IC Max	P Tot	FT Min
234 BC134 T0106	E0	45	N 200	200
235 BC147 S0725	45	N 200	350	150
236 BC148 S0725	30	N 200	350	150
237 BC149 S0725	30	N 200	350	150
238 BC157A S0725	45	P 200	350	130
239 BC158A S0725	30	P 200	350	100
240 BC159A S0725	30	P 200	350	100
241 BC1718 T092	45	N 200	300	100
242 BC1728 T092	25	N 200	300	100
243 BC182A T092	50	N 200	300	150
244 BC184 T092	30	N 200	300	150
245 BC184 T092	30	N 200	300	150
246 BC2128 T092	50	P 200	300	200
247 BC2138 T092	30	P 200	300	200
248 BC2148 T092	30	P 200	300	200
249 BC237A T092	45	N 100	825	150
250 BC237 T092	45	N 100	825	80
251 BC447 T092	80	N 800	625	100
252 BC393 T092	300	N 500	625	50
253 T1590 T092	40	N 800	625	100
254 T1591 T092	40	P 800	625	100
255 2N3702 T092	25	P 200	300	100
256 2N3704 T092	30	N 800	360	100
257 2N3706 T092	20	N 800	325	100
258 2N3711 T092	30	N 30	875	100

all at 19p each

25 L	Case	VC	IC Max	P Tot	FT Min
300	2N696	T05	40	N	500
310	2N698	T05	60	N	500
311	2N699	T018	45	N	300
312	2N1613	T05	50	N	600
313	2N1711	T05	50	N	600
314	2N1890	T05	60	N	600
315	2N2218	T05	30	N	800
316	2N2219	T05	30	N	800
317	2N2221	T018	30	N	800
318	2N2222	T018	30	N	800
319	2N2205	T05	40	P	600
320	2N2906	T018	40	P	800
321	2N2907	T018	40	P	800
322	2N3011	T018	12	N	200
323	2N3053	T05	40	N	700
324	2N3638	T0105	25	P	500
325	2N3947	T018	40	N	200
326	2N5550	T092	140	N	600

all at 29p each

327	AC153K	T05	18	P	2A	1W	1
328	AC178	T05	30	P	500	250	1
329	AC272	T05	15	P	500	250	1
330	AF139	T072	15	P	100	60	275
331	BD115	T039	180	N	150	6W	80
332	BD116	T05	60	N	3A	10W	80
333	BD131	T0126	60	N	3A	11W	80
334	BD132	T0126	45	P	3A	11W	80
335	BD178	T0126	45	P	3A	30W	3
336	BD232	T0126	300	N	150	11W	10
337	BD236	T0126	60	P	2A	25W	3
338	BD238	T0126	100	N	2A	25W	3
339	BF459	T0126	100	N	2A	25W	3
340	BSX29	T018	12	P	200	300	40
341	CC45	T0220	15	P	10	83	4
342	TP41A	T0220	60	N	6A	65W	3
343	TP42A	T0220	60	N	6A	65W	3
344	TP3055	TOP3	60	N	3A	100W	100
345	2N3019	T03	80	N	2A	1W	50
346	2N5320	T039	75	N	2A	1W	50
347	2N5322	T039	75	N	2A	1W	50

all at 39p each

348	AC177	T05	32	P	500	260	1
349	AD181	S055	20	N	1A	4W	1
350	AD182	S055	20	N	1A	9W	1
351	AS277	T05	15	P	200	150	8
352	BCY33	T05	25	P	100	250	2



# SPECIAL RELATIVITY

Einstein ranks as one of the giants of physics. A.S. Lipson looks behind the equations and tells the story of the special theory of relativity.

In 1905, Einstein published three papers. It was the third of these which was concerned with special relativity. In this paper — "On the Electrodynamics of Moving Bodies" — he set out by making two apparently innocent assumptions; that the velocity of light as measured by some inertial observer does not depend on the velocity with which this observer is moving, but will only be affected if the observer is accelerating or decelerating (an inertial observer is one who travels with constant velocity, without accelerations or decelerations) and that the laws of physics as measured by the observer are also independent of his velocity. From these assumptions, Einstein produced — using the most beautifully simple arguments — conclusions that rocked common sense and upset people's basic ideas about space and time.

If the laws of physics, *all* laws of physics, are the same, no matter what the velocity of the observer measuring those laws is, then there is no way in which that observer can tell with what velocity he is moving, or even if he is moving at all, just by performing an experiment in his own reference system, which is moving along with him.

## Relative Motion

If, for instance, you are in a smoothly-running train, with all the windows covered over, and without noises from outside, such as the sounds of the wheels on the tracks, then you cannot tell by any means whether the train is in uniform motion, or standing still. However, should one of the windows be uncovered, so that you can see outside, you can then tell whether or not the train is moving by whether or not the buildings outside appear to be passing you at high speed.

Even so, information from the outside world can be very difficult to interpret sometimes. If your train is in a station, with another train on the line just next to it, then when your train pulls out, it can be very difficult to decide whether the motion you observe is due to the other train travelling slowly in one direction, or your own train travelling slowly the other way.

## Ether It's There Or It Isn't

Since Newton, there had been a running debate among physicists as to whether light consisted of a wave or a beam of particles. These days, it is believed that it actually consists of a sort of cross between the two, which is virtually impossible to visualise, but is extremely useful for explaining various phenomena. However, by the second half of the nineteenth century, everyone was pretty certain that it was a wave. Maxwell had predicted the theoretical speed of electromagnetic waves and it had turned out to be pretty nearly the same as the experimentally measured speed of light and that was that — light was probably an electromagnetic wave. The one problem was that all other known waves travelled through a medium of some kind; sound waves through air, water waves

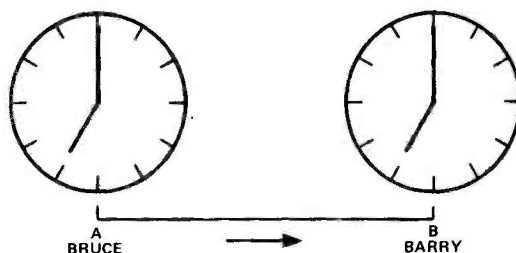


Fig.1 To Bruce it appears that Barry's timescale is 'running slow'. To Barry it appears that it is Bruce's timescale that is slow.

(obviously) through water, and so on. Light seemed to travel through a vacuum — for instance, from the Sun to the Earth. It didn't seem to need a medium. So they invented one; the ether.

The ether supposedly filled all space, acting as a medium for light, but not interacting with matter. (So, for instance, it didn't slow down the Earth in its orbit around the Sun.) The fact that there was no experimental evidence for this ether did nothing to change physicists' minds.

Now we can see why Einstein's ideas were so radical and unpalatable to scientists of the time. He, a mere patent clerk at the time, was daring to challenge the scientific principles laid down by Isaac Newton, acknowledged as the greatest scientist of all time. What Einstein was saying was that there was no need for an 'absolute' reference system — or even for the concept of the 'ether'. In order to make these statements logically consistent, though, he had also to abolish the concept of absolute time.

## Time

Time, according to the special theory of relativity, is dependent on velocity. This is best explained by giving an example. Consider two inertial observers, moving rapidly towards each other. For the sake of argument we can call them Bruce and Barry. Let us imagine that Bruce and Barry are approaching each other with a velocity  $v$ , and that each of them has a very accurate clock, which they carry along with them. Now according to relativity, if Bruce looks at Barry's clock and compares it with his own, it will appear to him that Barry's clock is running fractionally slower. Not only that; Barry himself will also be 'running slower' — his breathing, pulse rate, and so on will all have slowed down by just the same amount. In fact, it will appear to Bruce that Barry's time scale has slowed down! Well, if this is so, then it follows that it appears to Barry that Bruce's clock will be running fast. Or does it? Unfortunately not. If Barry looks at Bruce's clock, he will observe the same effect — that Bruce's clock is running slower; in fact, that Bruce himself will be running slower. Each of the two observers appears to the other to have a slower timescale. →



## And That's Not All

Time wasn't the only thing that took a bashing from Einstein, though; he had something to say about space, as well. If you are travelling at high speeds, the way you perceive objects will also change. Originally, it was thought that relativity theory stated that objects appeared shorter at high speeds. In fact, this is not quite accurate. If objects moving at high speeds are looked at, then they actually appear rotated, rather than contracted in length. If the objects are measured, however, allowing for the travel time of light, then they do appear to be contracted. This decrease in length at high speeds is known as the 'Lorentz Contraction', after a scientist who suggested it (although for different reasons than those of Einstein) shortly before Einstein's paper, in 1895.

We can calculate the apparent length of an object and draw out a table of it against velocity. If  $l_0$  is the length of the object measured at rest, and  $l$  is the length measured at some velocity  $v$ , then  $l = l_0 \sqrt{1 - v^2/c^2}$ , where  $c$  is the velocity of light. In the table below,  $v$  is expressed as a fraction of  $c$ , and  $l$  as a fraction of  $l_0$ .

Velocity(v)	$l/l_0$	Velocity(v)	$l/l_0$
0	1.0	0.9c	0.4359
0.4c	0.9165	0.95c	0.3122
0.8c	0.6	0.99c	0.1411

You can see that, as  $v$  gets close to  $c$ , the apparent length of an object drops dramatically, although at low speeds, less than 0.4c, the effect is fairly small. In fact, this is why we don't notice relativistic effects in normal life and why it took a mind like Einstein's to point them out. Even the fastest speeds that we normally come across are such small fractions of the velocity of light that the relativistic effects are too small to be measured.

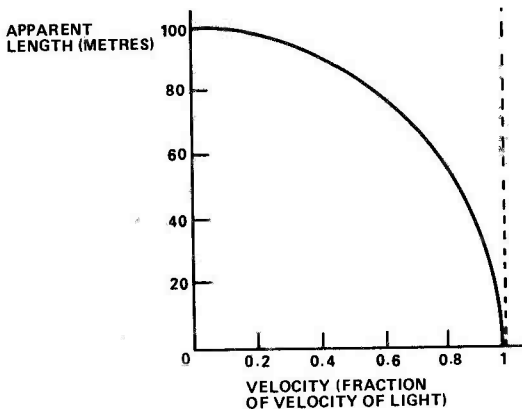


Fig.2 Objects appear to grow shorter at high speeds.

## Time Dilation

The same arguments apply to the peculiar 'time dilation' effects we looked at earlier. At the sorts of velocities we are used to, the effects are too small to notice. Timescales, in fact, are related by exactly the same formulae as are lengths. Going back to Bruce and Barry, if  $t$  is the time Barry measures by his own clock, then  $t' = t \sqrt{1 - v^2/c^2}$ .

At this stage, it might appear, looking at the equations, as though, if we could reach the velocity of light; that is, if  $v$  was equal to  $c$ , then time would appear to stop altogether and objects would appear to be so shortened as to be totally flat. In fact, this does not happen, and for a simple reason — the speed of light cannot be reached.

## Weight A Minute

Physics is concerned mainly with the study of four quantities and the interactions between them. These four quantities are distance, time, electric charge and mass. So far, we've seen that distance and time are both affected by high velocities. What about the other two? Well, electric charge doesn't seem to be changed, however fast you move it, but mass, on the other hand, can be very significantly changed.

The change that occurs is very similar to those with distance and time. If we measure the mass of something when it is at rest with respect to us as  $m_0$  — the 'rest mass', as it is called — then when it is travelling relative to us with a velocity  $v$ , we will find its mass to be given by  $m = m_0 / \sqrt{1 - v^2/c^2}$  and, hardly surprisingly, we see that this equation is strikingly similar to those giving time dilation and Lorentz contractions. The only difference being that  $m_0$  is divided by  $\sqrt{1 - v^2/c^2}$  whereas  $l_0$  and  $t$  were multiplied by it.

The acceleration (that is, the rate of increase of velocity) of an object is given by the force applied to it, divided by its mass. Hence, as velocity increases, so does mass, and for a set applied force, acceleration becomes smaller. As  $v$  gets close to  $c$ , mass gets very close to infinity and the force needed to accelerate the body also gets higher and higher. To accelerate a body to the velocity of light would require an infinite force applied over a finite time, and hence would take infinite energy. Such an acceleration, then, is not possible. Although we can, in theory, get as close as we like to the velocity of light, we can never actually reach it.

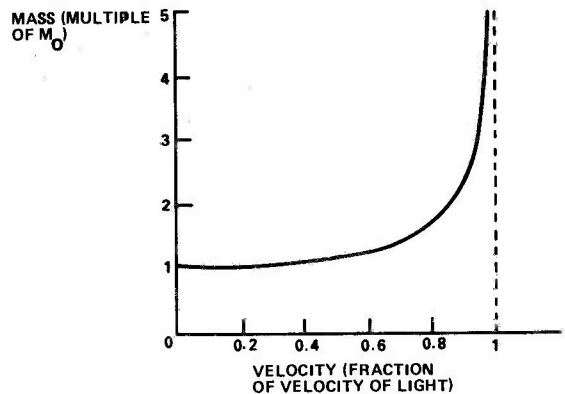


Fig.3 Mass increases at high velocities.

## So Where Does It All Come From?

All right. So an object's mass increases as it travels faster (Fig.3). Where does all this mass come from, though? Well, it originates in the energy that we put into the object while accelerating it and this is where what is possibly the best known equation in physics comes in:

$$E = mc^2$$

Energy equals mass times the square of the velocity of light. The extra mass actually is all the energy that was put into the acceleration. Because of this, when we slow the object down again, it loses all the excess mass, because in decelerating it, we extract all the energy again.

Unfortunately, the equivalence of mass and energy has another application. It is the conversion of mass to energy that forms the basis of operation of the atom bomb. And because  $c$  is so large, it requires only a little mass to make an incredibly large quantity of energy. A match-head if totally converted into energy, could keep a 100 W bulb shining for about 500 years!

ETI



# MONITORS MONITORS MONITORS



Uncased from 3" to 12"  
Cased from 5" to 20".

Semi professional or professional available from stock.

Monitor PCB's including Transformers and Tubes also in stock.

TRS8-80 Software available.

Send for details.

## CROFTON ELECTRONICS

Crofton Electronics Limited  
35 Grosvenor Road, Twickenham, Middx.  
Tel: 01 891 1513

## DIGITAL VOLTMETER MODULE



Fully built and tested, ONLY

£11.95 VAT

- \* Reads positive and negative voltages with a sensitivity of 0 - .999mV and 0 - .99mV
- \* Requires only single supply between 7 & 12 volts (220mA)
- \* High accuracy +0.1% +1 digit
- \* Large bright 0.43" high efficiency displays
- \* 4 readings per second sampling rate
- \* Size only 41 x 95 x 10mm
- \* Supplied with full data & applications information

This brand new, quality module manufactured by Autona Limited (who are one of the U.K.'s largest module manufacturers) means you can build accurate test equipment, multi-meters, thermometers, etc. easily and at a fraction of the cost of ready-made equipment. Full details are provided showing how to measure A.C. voltage, current, resistance and temperature.

Send your cheque or P.O. (£11.95 + £1.79 V.A.T. + 50pp. & p. = £14.24) now to:-

Dept. ETI 1  
RISCOMP LIMITED  
21 Duke Street  
Princes Risborough  
Bucks. HP17 0AT

BUCKINGHAMSHIRE'S NEW  
ELECTRONICS CENTRE  
8 miles off the M40  
50 minutes from London  
Telephone: (084 44) 6326

MAIL ORDER ONLY

### DELTA TECH & CO.

62 NAYLOR ROAD, LONDON, N20 0HN

Please add 25% P&P

<b>CERAMIC CAP (50V)</b> 33 pF to 4700 pF	4p
<b>POLYSTYRENE CAP (50V)</b> 10 pF to 1000 pF	5p
<b>POLYESTER CAP (100V)</b> 1 nF to 68 nF 6p; 100 nF 15p nF 8p; 220 nF 9p; 330 nF 10p; 470 nF 11p; 680 nF 12p; 1uF 14p; 1.5 uF 16p; 2.2 uF 20p; 3.3uF 15p*; 4.7uF: 15p*	
<b>ELECTROLYTIC CAP (uF/V)</b> 1/25 to 47/25 6p; 68/25 7p; 100/35, 150/25 8p; 160/25 5p*; 200/12: 6p; 250/12 7p; 220/25 10p; 470/25, 500/30 10p*; 470/40 mini 15p; 640/16: 8p; 1000/10 8p*; 1000/25 20p; 1500/25: 24p*; 2200/6.3 10p*	
<b>ZENER DIODES (400mW)</b> 5V6 5p* 9V1 6p* 2V7 to 33V 8p	
<b>VEROBOARDS (.1" copper)</b> 2.5" x 5" 60p 3.75" x 5" 70p	
<b>RESISTORS (5% E12)</b> 10 Ohms to 10Mohms	1.5p
<b>PRESETS (.15W HORIZONTAL)</b> 100 Ohms to 2 Mohms	7p
<b>POTENTIOMETERS (1/4W)</b> Linear & Log Scales 4K7 to 2M2	33p
<b>LINEAR CIRCUITS</b>	
709-8	28p
710-14	35p
741-8	20p
747-14	50p
748-8	35p
CA301B	70p
CA302BA	85p
CA3046	50p
CA3054	40p
CA3080E	75p
CA3130E	90p
CA3140E	40p
CA3090AQ	*200p
LF351N	44p
IF356N	85p
LM301AN	30p
LM308N	55p
LM318N	120p
LM324N	120p
LM339N	52p
LM348N	90p
LM377N	175p
LM380N	90p
LM381N	*120p
LM382N	*90p
LM1310N	115p
LM1458N	*40p
LM3900N	*50p
LM3909N	75p
MC1496P	80p
NE531	110p

NE555	22p
NE556	*45p
NE566	140p
SN76115N	*80p
TBA641B	200p
TBA800	75p
TBA 810S	110p
ZN414	90p
ZN1034E	220p
<b>DIODES</b>	
BY127	12p
OA47	8p
OA91	*6p
OA200	6p
OA202	9p
1N916	5p
1N4148	4p
1N4001/2	4p
1N4003	5p
1N4004/5	6p
1N4006/7	8p
1N5400	13p
1N5401	14p
1N5402	15p
1N5404	16p
<b>BRIDGE RECTIFIERS</b>	
W02M	20p
W06M	30p
1A/50V	22p
1A/100V	27p
1A/200V	32p
1A/400V	34p
2A/50V	40p
2A/100V	42p
2A/200V	48p
2A/400V	55p
<b>DIL SOCKETS</b>	
8 pin	*8p
14 pin	*9p
16 pin	*10p
18 pin	16p
22 pin	20p
24 pin	21p
28 pin	25p
40 pin	35p

<b>OPTO/ELECTRONIC</b>	4041 85p	7473 *18p	AC151 17p	BD121/3 75p	TIP36A 200p
2N5777	55p	7474 *25p	AC153 25p	BD124 81p	TIP36B 210p
4043/4	99p	7475 *25p	AC176 22p	BD131/2 35p	TIP41A 60p
4047	105p	7476 20p	AC187/8 22p	BD135 to 8D140 35p	TIP42A 60p
4048	60p	7480 32p	AC187K 30p	BF178 30p	TIP2955 *30p
4049	50p	7485 80p	AD149 *50p	BF179 19p	TIP3055 12p
4050B	50p	7486 18p	AD161/2 40p	BF180 34p	ZTX107/8 23p
4066	60p	7490 *25p	AF114 30p	BF181 8p	ZTX109 12p
4068/9	22p	7491 57p	AF124 35p	BF183 34p	ZTX300/1 14p
4070B/1	22p	7492/3 30p	AF125/6 35p	BF184/5 25p	ZTX302/3 18p
4072/3	22p	7494 50p	AF127 35p	BF194/5 12p	ZTX304 23p
4081/2	26p	7495 40p	AF139 40p	BF196/7 12p	ZTX311 18p
4086	80p	7496 37p	AF239 44p	BF198 10p	ZTX300/1 15p
4510	100p	7497 200p	BC107/8 10p	BF200 23p	ZTX502 20p
4511B	90p	74100 60p	BC109 10p	BF2248 14p	ZTX503 17p
4516/8	105p	74105 43p	BC117 23p	BF2448 45p	ZTX504 24p
4520/8	105p	74107 22p	BC140 20p	BF258 28p	ZTX508/7 20p
<b>LEDs: 0.125" &amp; 0.2"</b>		74109 34p	BC142/3 30p	BF259 40p	2N698/7 20p
Red 10p		74110 40p	BC147/8 10p	BFR39 30p	2N706 14p
Green 13p		74118 84p	BC149 10p	BFR40 20p	2N914 20p
Yellow 13p		74121 25p	BC157/8 12p	BFR79 32p	2N918 35p
0.125" Clip 3p		74122 30p	BC159 12p	BFR90 20p	2N1302/3 35p
0.2" Clip 4p		74123 50p	BC167 14p	BFX29 25p	2N1304 35p
<b>VOLTAGE REGULATORS</b>		74125/6 42p	BC169C 13p	BFX84 25p	2N1306 30p
79L05 30p		74126/7 65p	BC171 10p	BFX85/6 20p	2N1308 35p
79L24 30p		74141/5 46p	BC173 8p	BFX87/8 25p	2N1613 25p
7805 65p		74150 85p	BC177/8 16p	BFX88 25p	2N1711 13p
7812/15 65p		74151 65p	BC179 16p	BFX98 20p	2N1893 25p
7818/24 65p		74153 43p	BC182B 10p	BFY52 22p	2N2219 18p
7905 75p		74154 66p	BC182L *8p	BRY39 50p	2N2222A 23p
7912/15 75p		74155 46p	BC183B 10p	BSX19 12p	2N2369 17p
7918/24 75p		74156 42p	BC184 25p	BSX20 22p	2N2646 46p
<b>THYRISTOR C106D (4A/4000V)</b> 40p		74157 38p	BC186 25p	BU205 150p	2N2904/5 21p
7413 21p		74160 57p	BC187 15p	BU208 210p	2N2906/7 21p
7414 45p		74161 55p	BC207/9 13p	MJ2955 110p	2N2926 10p
7416 20p		74162/3 60p	BC212 10p	MJE340 52p	2N3053 20p
7417 25p		74164/5 56p	BC213L 10p	MJE2955 110p	2N3054 40p
7418 14p		74166 95p	BC214 10p	MJE3055 80p	2N3055 45p
7419 110p		74176/7 70p	BC238 18p	MPF102 45p	2N3442 140p
74174/5 55p		74177 70p	BC214L *8p	MPF104/5 40p	2N3702 to 2N3711 11p
74180 35p		74180 13p	BC261B 23p	MPF106 45p	2N3772 *80p
74181 80p		74181 80p	BC301/3 32p	MPSA06 26p	2N3773 250p
74182 45p		74182 45p	BC328 17p	MPSU06 60p	2N3819 21p
74190 50p		74190 50p	BC338 17p	OC28/35 92p	2N3820 40p
74191 90p		74191 90p	BC467 35p	TIP29 40p	2N3823 70p
74192/3 50p		74192/3 50p	BC478 20p	TIP29B 42p	2N3866 65p
74194 70p		74194 70p	BC479 23p	TIP30 40p	2N3903/4 15p
74195 68p		74195 68p	BC479 23p	TIP30B 42p	2N9007 15p
74196 78p		74196 78p	BC547/8 12p	TIP31A *30p	2N9037 45p
74197 45p		74197 45p	BC549 12p	TIP32 40p	2N5457/B 40p
74198 120p		74198 120p	BC557/8 14p	TIP33 65p	2N5459 40p
74199 90p		74199 90p	BC559 14p	TIP33C 70p	2N6027 30p
<b>TRANSISTORS</b>		74200 20p	BCY70 18p	TIP34A 75p	3N128 50p
AC126/7 22p		7421 19p	BCY71/2 18p	TIP35B 200p	
AC128 20p			BD115 58p		

SAE FOR TRADE PRICE LIST

Telephone 01-445 8224

\*SPECIAL OFFERS THIS MONTH



# QUALITY DOES NOT HAVE TO COST VERY MUCH!

ALL PRICES INCLUDE VAT

## GEC STEREO TUNER/AMPLIFIER

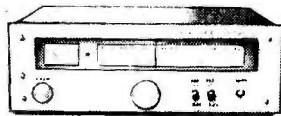
4 wave-band stereo tuner amplifier by GEC

- \* MW/LW/SW/Stereo FM radio
- \* 10+10 watt stereo amplifier
- \* Inputs for PU, tape in/out

Supplied as two assembled units as illustrated — easy to connect. On demonstration for callers.



£21.95 (UK Post etc. £1.25)



## SCOTT T516 STEREO FM/AM TUNER

HIGH QUALITY STEREO FM/AM TUNER BY SCOTT OF USA.

Overall size 5" x 14 1/4" x 12". Brand new and tatty guaranteed at a special low price. On demonstration for callers. (C/P £1.55)

£38.95

1000's SOLD

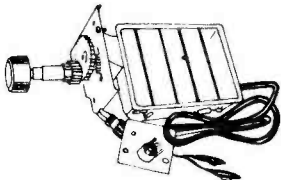


## JVC BELT DRIVE TURNTABLE

JVC TURNTABLE WITH FREE AUDIO TECHNICA AT100 STEREO CARTRIDGE.

- \* S shaped tone arm
  - \* Belt drive
  - \* 12" Platter \* Calibrated counter-balance weight
  - \* Anti-static device
- Size 12 3/4" x 15 1/4" (C/P £1.55)

£29.95



## TV SOUND FROM YOUR HI-FI

High quality TV sound converter plugs into aerial socket of your FM tuner. 9 volt battery operated (battery not supplied). Nothing to look at... but just listen! (UK Post etc. 50p)

On Demonstration for callers. (As reviewed in 'Popular Hi-Fi' July 1979) £8.50



## SEAS SPEAKER KITS



Professional sound hi-fi speaker kits with high sensitivity (80-92dB). Extended frequency response (223 50-20kHz, 253 35-25kHz). Designed and made in Scandinavia to the highest quality. All supplied with complete cabinet plans, tweeters/crossovers/leads etc. \* On Demonstration to callers.

- \* HI-FI 223. 30/45 watt 3 speaker 8" system £43.50 pair
- \* HI-FI 253. 50/100 watt 3 speaker 8" system £34.50 each
- \* HI-FI 403. 50/100 watt 3 speaker 10" system £44.50 each
- \* HI-FI 603. 80/150 watt 3 speaker 8" system £64.50 each

(UK C/P £2.50) COMPLETE RANGE OF SEAS CHASSIS SPEAKERS ETC ALWAYS IN STOCK ALSO STOCKISTS FOR AUDAX, GOODMANS, KEF, PEERLESS ETC.

## PIEZO TWEETERS



Clean sound, very low distortion tweeters. No crossover required. Suitable up to 100 watts — more in series.

- 1 Mid-range horn for disco/pa/groups £9.50
  - 2 Tweeter horn for hi-fi/disco/pa £6.50
  - 3 Popular hi-fi and disco £4.95
  - 4 Flat type hi-fi £3.95
- On Demonstration to callers.

## STEREO ACCESSORIES

- \* GE1305 Hi-fi frequency equaliser £62.95
- \* 1987 Economy version £49.95
- \* APW 200 Peak programme meter (twin scale) £39.95
- \* MS3219 Twin Scale audio output meter £12.95
- \* MC350 Tape echo chamber £58.95

## FREE CATALOGUE

Large range of speakers/stereophones/microphones/mixers/PA equipment etc — and much more! Plus huge range of test equipment. ALL PRICES INCLUDE VAT SEND LARGE 17p SAE ALL PRICES CORRECT AT 1/9/80

# AUDIO ELECTRONICS Limited

301 EDGWARE ROAD, LONDON, W2 1BN, ENGLAND. TELEPHONE 01-724 3564 OPEN 9-6 Mon-Sat

ORDER BY POST OR TELEPHONE WITH BARCLAYCARD/ACCESS OR CALL IN AND SEE FOR YOURSELF



## BUILD YOUR OWN METAL DETECTOR VLF/TR VCO/TR IB/TR BFO...

Pre-aligned search heads — test equipment not required. Literature available in return for SAE. Manuals and parts sold separately; write or phone for price. Export welcome; write for quote.



**Shadow VLF/TR.** Full specification discriminator, not just ferrous/nonferrous indication. It works by measuring the conductivity of the target; now you can reject nails bottle caps even aluminium foil and nail pull tabs! Full ground effect exclusion over normal or high permeability soils.

The head is thermally and capacitively shielded. 4 modes: deepseeking VLF plus 3 TR discriminating rangers. Push button 'memory' tuning. Performance equals commercial detectors costing £200! As described in ETI. Complete kit now only £87.87 inc. VAT & post!

**Shadow TR/1B**

**Individual parts:** Search head £21.33 PCB £6.80 Case £5.33 Adjustable shaft assy £5 10. LM393 £1 12. Manual (gives more info. than ETI article — and extra function) £1 12. All inc. VAT & post! (Other parts also available separately)

**Shadow TR/1B** (illustrated). A true transmit receive/induction balance detector at a budget price for anyone who doesn't need discrimination. Waterproof and thermally insulated search head. Good sensitivity. Built-in speaker and headset jack. Complete kit £33.60 inc. VAT and Post.

**Shadow TR/VCO.** An advanced version of the TR/1B. Use as a sensitive 1B machine or switch to VCO mode when the sound changes to a varying pitch, allowing easier use over mineralised ground and enabling detection of negative, high permeability anomalies. Kit price £38.87 inc VAT and Post.

Matching stereo headphones for all Shadow models £5.85 inc. VAT and Post.

**Shell Kit.** Consists of the (hard to find) hardware items, for detectors of your own design. Fully adjustable shaft with handle, search head mouldings (int. diam. 185mm) with hinge assembly, special clips to mount your own control housing (any box is suitable). Completely non-metallic and undrilled. With assembly instructions £14.46 inc. VAT and Post.

## ALTEK (ETI), 1 Green Lane Walton-on-Thames Surrey

Order by post or phone (24 hours). Access & Visa Cards quote number. Callers by appointment only please. Phone (083 22) 44110 anytime!

## POWERFET AMPLIFIERS

Some day all power amps will be made this way!

Very high quality 80 watt and 120 watt designs (by Hitachi) offering wide bandwidths and very low distortions. Both are conservatively rated and can be used with supplies up to ± 65V. One P.C.B. serves both designs, and an 80 watt unit can be upgraded by the simple addition of components.

All units come with substantial heatsink/mounting brackets

### PFA80

80w into 8Ω (Vs = ± 50V)  
THD < 0.008%  
S/N 120dB

KIT £11.95. BUILT £13.95

↑ from 1W to rated output at all audio frequencies. PFA120. recommended for 4Ω loads.

### PFA120

120W into 8Ω (Vs = ± 55V)  
THD < 0.005%  
S/N 120dB

KIT £19.85. BUILT £21.85

CHAN	VDS max V	ID max A	PDISS max W	Price	
BD512	P 60	1.5	10	85p	CA3080E TLO87 29p
BD522	N 60	1.5	10	80p	CA3140E 2102 80p
VMP4	N 60	2.0	25	1250p	DAC08EN 4001B 17p
VN10KM	N 60	0.5	1.0	55p	DM2502 4011B 17p
VN64GA	N 60	12.5	80	750p	DM2502 4013B 40p
VN67AF	N 60	2.0	15	75p	LM3900 43p 709 15p
2SJ49	P 140	7.0	100	340p	MC3401 30p 710 25p
2SK134	N 140	7.0	100	340p	NE529 145p 733 50p
					NE555 25p 741 18p
					SAD1024 78L05 29p
					1050p 78L12 29p

†/p protected. †our selection VN/VM, 96-page Design Cat. 20p. Heat clips/sink T0202 12p. T092 8p. T03 35p.

### HI-FI ON TWO CHIPS

HA12017 (Preamp 0.001% distortion 83dB S/N in phono application) 80p. HA1397 (Poweramp 20 watts in 8Ω. 0.02% distortion (typ) 195p.

Both with data and circuits.

**VCA** High quality design offers attenuation from 0dB to -90dB S/N 90dB. THD 0.01%. B.W. DC to 100KHz. Complete component set and circuit £2.50.

1C Sockets (low prof.)  
8 pin 10p, 14 pin 12p, 16 pin 13p.  
Low noise Resistor set 10 off each £12. value from 10R to 10M 730.  
1/4W 5% CF resistors 650p.

### SCOPE TRACE DOUBLER P.C.B.

Built C/W shift, chan select, choprate controls and instructions. Useful display from DC to 10MHz. Runs from 9v battery £9.95.

2µS ADC chip set (DAC08, DM2502, NE529) with data £9. HA388 (Bridge amp. 18w from car battery) With data 195p. HA1388 (Bridge amp. 18w from car battery) With data 195p.

30p post and packing. Mail order only to

## J. W. RIMMER

148 Quarry Street  
Liverpool L25 6HQ  
Tel. 051-428 2651

Technical enquiries to 367 Green Lanes, London N4 1DY Telephone: 01-800 6667



# SUBSCRIPTIONS

This year we present a new twelve-part, fiction series — ETI 1980. . . . . available from your newsagent every month.

Forget to buy it this month, or is your newsagent sold out?

Why worry when ETI gets to the shop? Sit back and wait for it to come to you. Take out an ETI Subscription. For only £10.00 we'll send you twelve issues of ETI PLUS A free copy of ETI 1999, a chronicle of future times including the first report of World War III. You've never seen anything like it before.

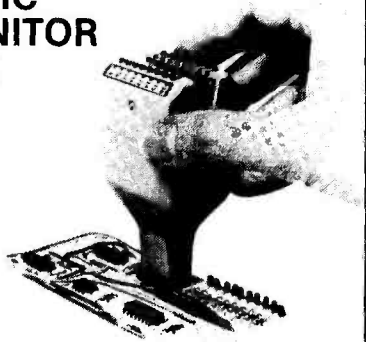
To claim your FREE ETI 1999 (and a years' supply of ETI, of course) send your PO or cheque direct to



ETI Subscriptions  
MAP Publications  
PO Box 35  
Bridge Street  
Hemel Hempstead  
Herts.

## Faster than a scope safer than a voltmeter

LOGIC  
MONITOR  
LM-1



**Instant — simultaneous monitoring of the logic state of all IC nodes**

Just clip it over your IC

LM-1 Instantly and accurately shows both static and dynamic logic states on a bright 16 LED display.

LM-1 finds its own power.

LM-1 cuts out guesswork, saves time, and eliminates the risk of short circuits.

LM-1 is suitable for all dual-in-line logic ICs LED on = logic state 1 (high), LED off = logic state 0 (low), and each LED is clearly numbered 1 to 16 in the conventional IC pattern.

**ONLY £28.70** (Excluding P&P and VAT)  
Total £34.44 including box and instruction manual.

CONTINENTAL SPECIALTIES CORPORATION



C.S.C. (UK) Limited, Dept. 9S  
Unit 1, Shire Hill Industrial Estate,  
Saffron Walden, Essex CB11 3AQ.  
Tel: Saffron Walden (0799) 21682  
Telex: 817477

C.S.C. (UK) Limited, Dept. 9S, Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

LM-1 £34.44 (incl. P&P and 15% VAT) Qty. Req'd.  For FREE Catalogue tick box

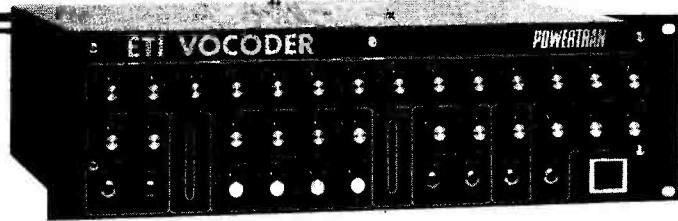
Name ..... Address .....

I enclose PO/cheque for £..... or debit my  
Barclaycard, Access, American Express No. ....  
exp. date .....

**FOR IMMEDIATE ACTION** — The C.S.C. 24 hour, 5 day a week service, Telephone: (0799) 21682, and give us your Barclaycard, Access, American Express number and your order will be in the post immediately.



# VOCODER



In the concluding part of the ETI Vocoder, Richard Becker deals with construction and setting up

Start construction with the power supply PCB and bolt this onto the rear panel with mica washers between the panel and transistors, which are on the underside of the board. Silicone grease will keep the washers in place during fitting. Wire up and check all is well when operating into 1k0 resistors as temporary loads.

Build up the rest of the boards. Use insulation on any links which touch the leads of components. On the LED PPM boards, fit the connector pins for the connector to the component side of the board for the excitation meter and the non-component side for the speech meter. Where there are jack sockets, solder short lengths of bare wire to the boards and fit both board and socket to the front panel before soldering the wires to the sockets, which then become firmly attached parts of the board assemblies. On the internal excitation board of the three controls with mounting frames fit to the underside of the board. The other four controls fit on the top side of the board. To get the correct spacing between the top and bottom controls the top ones are soldered to pins such that the tags just touch the top of the board.

## Split Supply

The analysis/synthesis board is split in two halves to simplify manufacture. When the two halves are completed, fit the boards to the panel by means of the controls. Fit wire links between the boards and solder the two halves together by use of a bared length of wire along the joint. Fit the spacers to the back of the board and drop it into the chassis so that it can sit

## PARTS LIST • Slew Rate Control

### Resistors all 2% metal oxide

R1, 2	15k
R3, 6, 8	2k2
R4, 5, 7	10k
R9, 10	47R
R11	220R
R12	470R
R13	1k0

### Potentiometer

RV1	1M0 log with mounting frame
-----	-----------------------------

### Capacitors

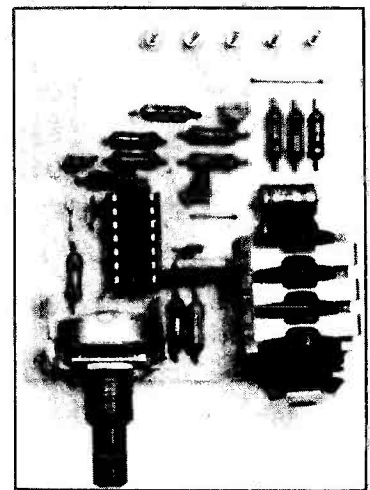
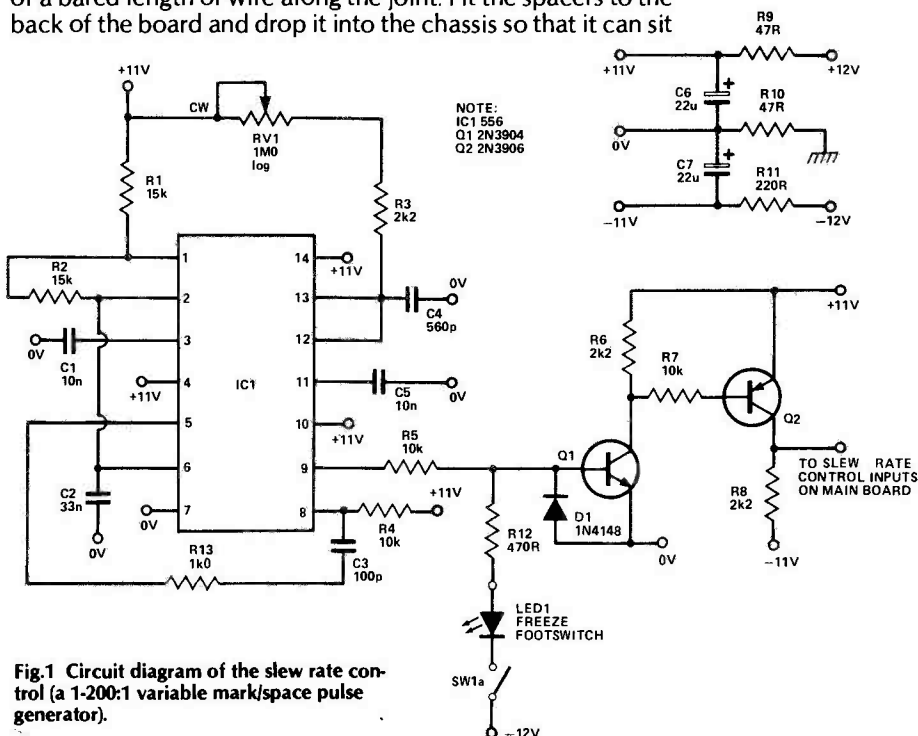
C1, 5	10n ceramic
C2,	33n polyester
C3	100p ceramic
C4	560p ceramic
C6, 7	22u 25V

### Semiconductors

IC1	556
Q1	2N3904
Q2	2N3906
D1	1N4148
LED1	TIL220

### Miscellaneous

Footswitch, Footswitch box, stereo jack plug and socket, 5 way connector, IC socket



Slew rate control board.

Fig.1 Circuit diagram of the slew rate control (a 1-200:1 variable mark/space pulse generator).



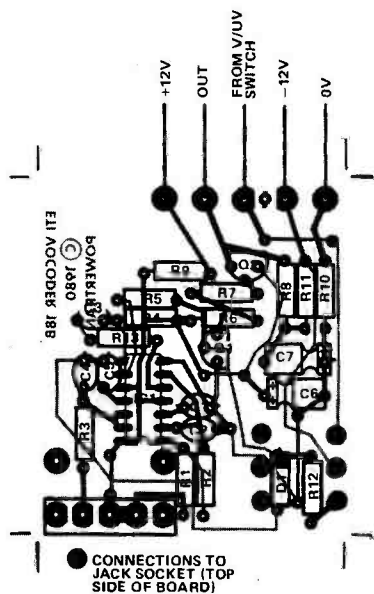


Fig.2 Component overlay of the slew rate control board.

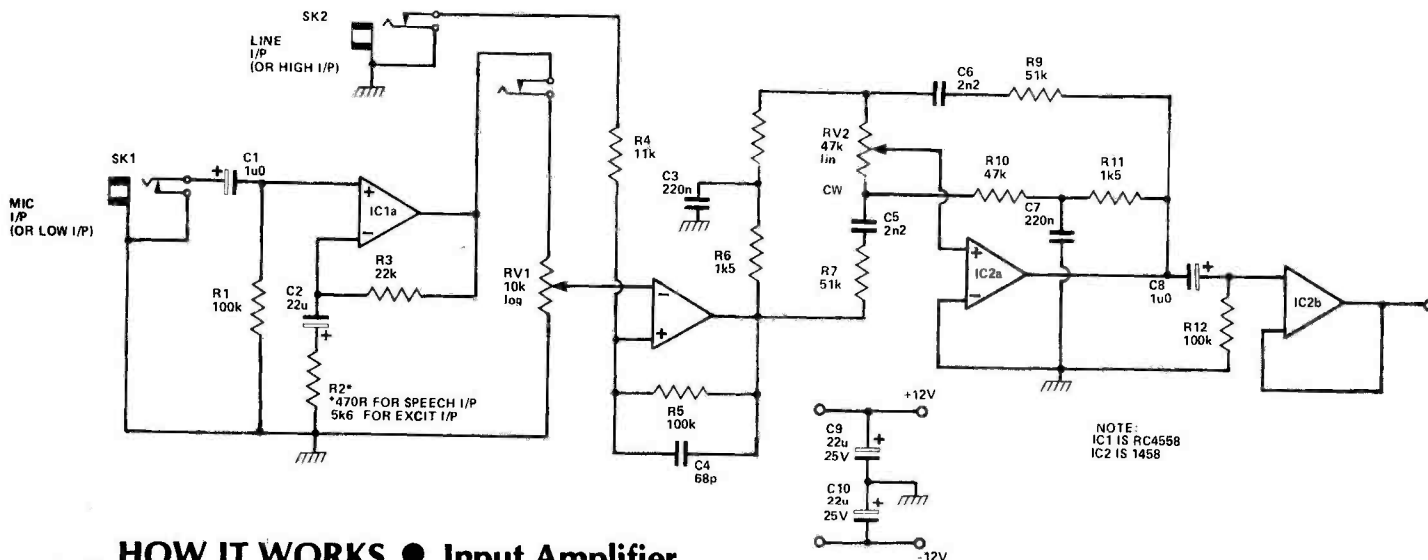
on its back edge whilst wiring up and setting up. Link together with a stretched length of wire on the back of the board all the excitation input pins and also the other inputs and outputs (a total of seven rails).

Make up the wiring loom and connect up all the boards.

### HOW IT WORKS • Slew Rate Control

This is a pulse generator of variable mark/space ratio. IC1 is a 556 which is a dual timer. Pins 1-6 form a 1 kHz 2:1 mark/space ratio pulse generator, its frequency being determined by R1, R2, C2. Its output is used to trigger via C3 and a monostable built round pins 8-13. The width of the output pulse is determined by C4, resistors R3, RV1. The output is buffered by Q1. Q2 is the output driver, switching from +11 V to -11 V. The freeze switch forces the output to -11 V thereby turning off all the FETs of the analysis/synthesis section. To isolate the heavy switching surges on the power rails from the rest of the machine the rails are decoupled by R9, 10, 11 and C6, 7.

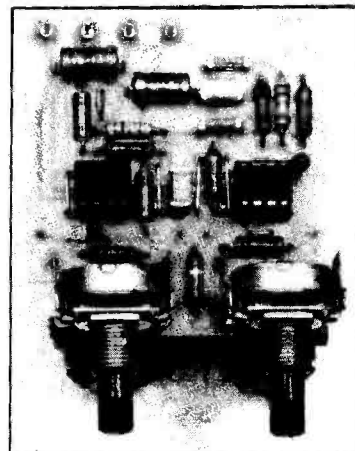
Fig.3 Circuit diagram of the input amplifier



### HOW IT WORKS • Input Amplifier

The preamplifier uses an RC4558, which is a low noise version of the 1458, for IC1. The overall gain of the stage is dependent on which input is used, being unity for SK2 and for SK1 it is 500 (speech) or 50 (excitation). The gain is distributed between IC1a and IC1b. If SK1 is used and SK2 is not, then amplified signal from IC1a is connected to RV1 via the switched contact SK2. Also R4 is connected to ground, through the other switched contact of SK2, giving IC1b a voltage gain of ten. If SK2 is used then IC1a is isolated and R4 is disconnected from ground making IC1b now have unity gain.

IC2 is a rather complex tone control stage giving, with a single control knob, treble boost with bass cut or bass boost with treble cut. R7, C5 and R9, C6 form high pass filters whilst R6, C3 and R11, C7 form low pass filters. When the wiper is clockwise the input of IC2 is connected to the input of the stage via C5, R7 whilst RV2 is in series with the feedback thereby boosting the gain at high frequencies. At the same time, bass from feedback path R11, C7, R10 is dominant over bass from the input, which has to pass through RV2. Therefore, the bass is cut. The opposite occurs when the wiper is anticlockwise.



Input amplifier board.



## Setting Up

Check the power lines are still correct when all the boards are connected, set all presets to the centre of their travel and apply a sinusoidal signal to the speech line input. (If no oscillator is available use the cheap little circuit shown.) Set the level to where the sixth LED up just flickers, corresponding to 400 mV. Measure the AC voltage on pin 6 of IC1 channel 2. Adjust the frequency until the voltage reaches a peak, turn PR1 fully clockwise and turn it back slowly until 4 V RMS is measured at the resonant peak of the filter. Repeat this for the other analysis filters.

Connect a 56R resistor between the bias rail and +12 V, turn the slewing rate control fully clockwise, check the pulse generator is operating by listening for a whistle when the input

jack of an amplifier is placed near the slew rate control board, switch off the unvoiced detector, plug the oscillator into the external excitation HIGH input and set up channel 2 excitation filter as for the analysis filters (except that now the point to measure is pin 1 of IC7 and the potentiometer to adjust is PR5). With RV1 fully clockwise adjust PR2 so that 4 V RMS is also at the output of the OTA buffer (IC6 pin 8). Repeat this for the other filters including channels 1, 14 where there is only PR2 to adjust.

Plug the vocoder into an amplifier, turn up all channel volume controls and the vocoder output control. Turn down the speech and the excitation inputs. Turn up one of the oscillators and adjust RV5 or RV6, as appropriate, so that the signal is heard to just disappear when the width control is anticlockwise. Repeat for the other oscillator.

## PARTS LIST • Input Amplifier

### Resistors all 1/4 W 5%

R1, 5, 12	100k
R2 (speech)	470R
R2 (excitation)	5k6
R3	22k
R4	11k
R6, 11	1k5
R7, 9	1k
R8, 10	47k

### Potentiometers

RV1	10k log with mounting frame
RV2	47k lin with mounting frame

### Capacitors

C1, 8	1u0 16V tantalum
C2	22u 16V tantalum
C3, 7	220n polycarbonate
C4	68p ceramic
C5, 6	2n2 polycarbonate
C9, 10	22u 25V electrolytic

### Semiconductors

IC1	RC4558
IC2	1458

### Miscellaneous

5 way connector, connector pins, IC sockets, jack sockets.

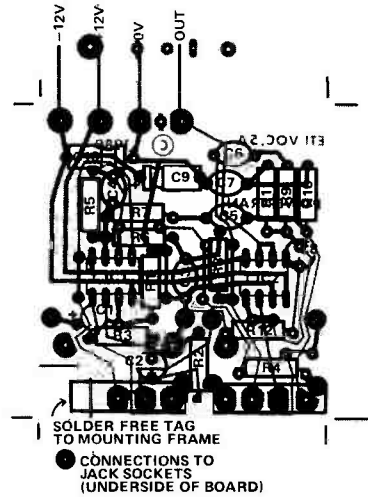


Fig.4 Component overlay of the input amplifier board.

Fig.5 (below) Component overlay of the output amplifier board.

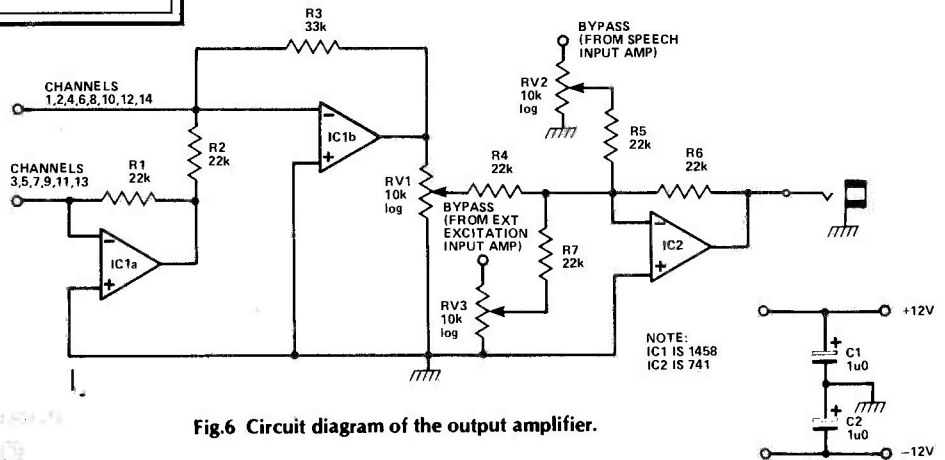
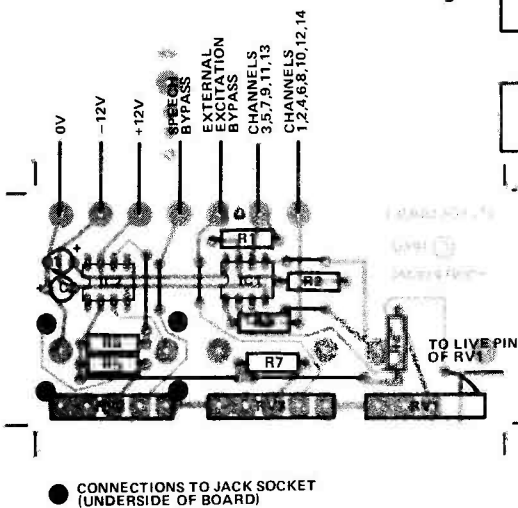


Fig.6 Circuit diagram of the output amplifier.

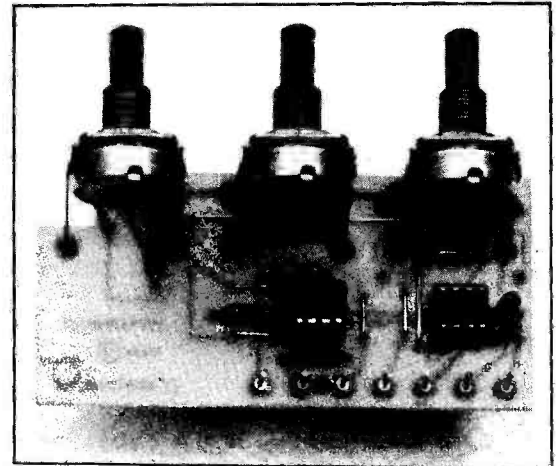
## HOW IT WORKS • Output Amplifier

Outputs from channels 3, 5, 7, 9, 11, 13 are mixed by IC1a and the inverted output mixed with the outputs of channels 1, 2, 4, 6, 8, 10, 12, 14, by IC1b. The output of this is then mixed with the speech and external excitation signals by IC2.



**PARTS LIST • Output Amplifier**

<b>Resistors 1/4W 5%</b>	
R1, 2, 4, 5, 6	22k
R3	33k
<b>Potentiometers</b>	
RV1, 2, 3	10k log with mounting frames
<b>Capacitors</b>	
C1, 2	1u0 16V tantalum
<b>Semiconductors</b>	
IC1	1458
IC2	741
<b>Miscellaneous</b>	
Jack socket, 7 way connector, connector pins, IC sockets.	



Output amplifier board.

Fig.7 Circuit diagram of the LED PPM display.

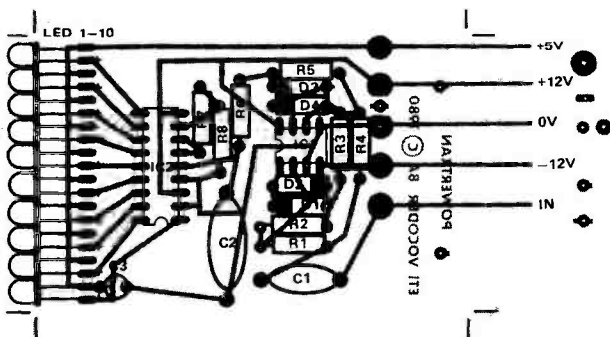
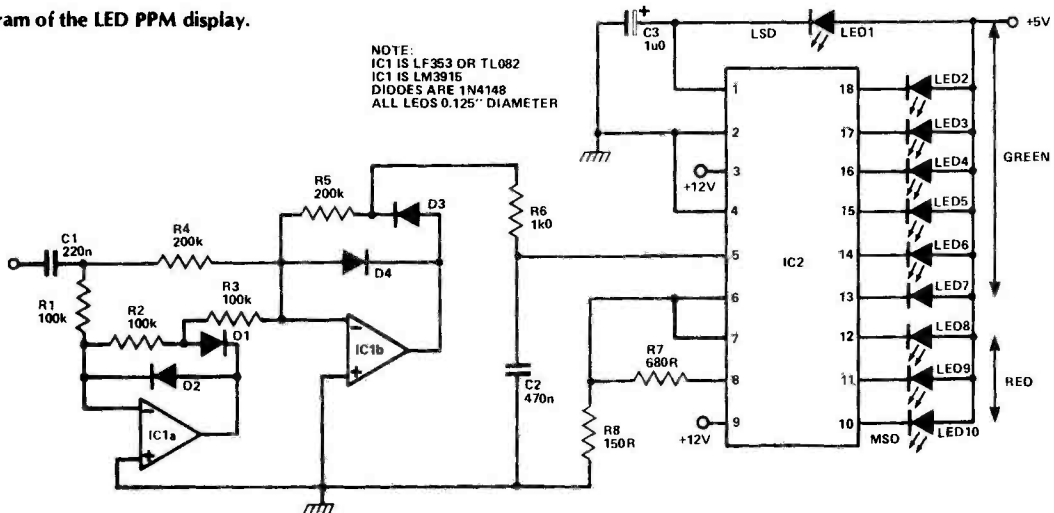


Fig.8 Component overlay of the LED PPM display board.

**HOW IT WORKS • LED PPM Display**

IC1 is a full wave rectifier with peak detector charging C2 to the peak voltage of the input signal. IC1 is a logarithmic display driver, the sensitivity of which is determined by R7, 8. The LEDs are at 3 dB spacing. The red LEDs illuminate when the filters overload. The LEDs have their own power supply.

**PARTS LIST • LED PPM Display**

<b>Resistors 1/4W 5%</b>	
R1, 2, 3	100k
R4, 5	200k
R6	1k
R7	680R
R8	150R
<b>Capacitors</b>	
C1	220n polyester
C2	470n polyester
C3	1u0 16V tantalum
<b>Semiconductors</b>	
IC1	TL082 or LF353
IC2	LM3915
D1-4	1N4148
LED 1-7	T1L211 (green)
LED 8-10	T1L209 (red)
<b>Miscellaneous</b>	
5 way connector, connector pins, IC sockets.	





## Noise Abatement

Remove the 56R resistor, turn down all the channel volume controls and the oscillators. Turn up the noise level to maximum, turn up channel 1 and adjust PR3 to the point just before the noise disappears. Repeat this for the other channels.

Disconnect the excitation and speech inputs from the analysis/synthesis board and temporarily connect the excitation to the speech input of the board so that noise can be applied to the analysis section. Turn up channel 1 and the noise control. Adjust PR4 for minimum breakthrough of the control

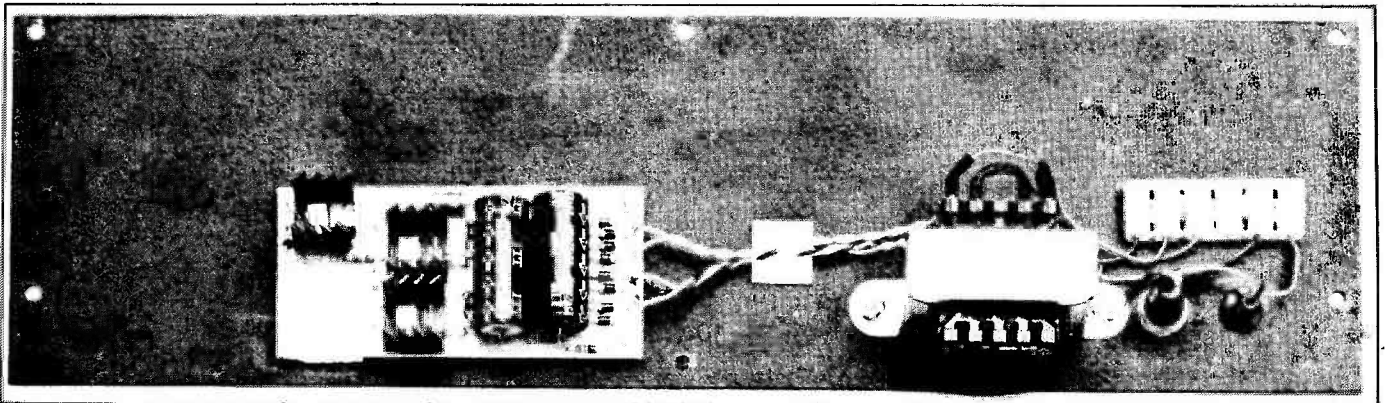
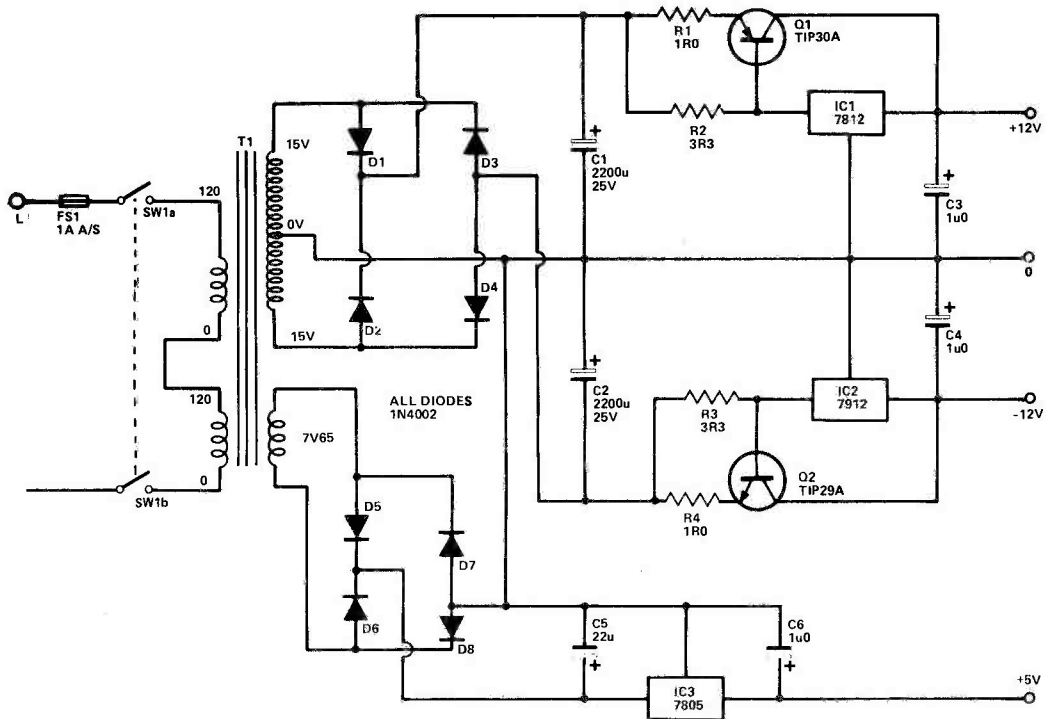
signal which will be heard as a low rumble. Repeat this for the other channels and then re-connect the inputs.

Turn on the voiced/unvoiced detector, apply a high frequency signal to the speech input and the V/UV LED will light up. Turn up all the channel volume controls and the noise control and noise will be heard. Adjust PR2 to halfway between the points where the noise is heard to start limiting. Turn down the noise control and adjust PR1 to the point where noise is just heard to disappear. Turn up the noise again and alter the frequency of the test oscillator. Adjust PR3 to where the noise level drops by about 6 dB, as indicated on the LED PPM, when the V/UV LED is illuminated.

## HOW IT WORKS • Power Supply

Raw positive DC is regulated by IC1. To reduce heat dissipation the current is shared with Q1 roughly in the proportion of R2 to R1. The negative supply is similar. The LEDs of the PPM meters have their own supply. This can be very raw indeed and smoothing capacitor C5 is very small. IC3 is used simply to limit the voltage and not regulate it.

Fig.9 Circuit diagram of the power supply unit.



The power supply unit mounted on the rear panel.





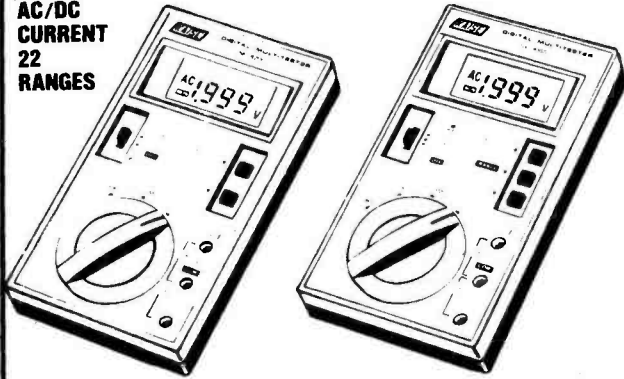


# SPECIAL PURCHASE



## OF TOP QUALITY LCD MULTIMETERS

AC/DC  
CURRENT  
22  
RANGES



6100

6200

### CHOOSE FROM FOUR MODELS

- ★ 3½ digit autoranging (volts / ohms)
- ★ 200 hours battery life (2 pencils)
- ★ 10 amp AC/DC (6220 & 6110) ★ 1000v DC 600v AC
- ★ 200mA AC/DC (6200 & 6100)
- ★ Range hold facility (6100 & 6110)
- ★ Unit and range sign (6110 & 6220)
- ★ Continuity buzzer (6100 & 6110)

#### RESOLUTION

100 µVDC, 1 mVAC  
10 µA AC/DC 0.1 ohm  
10 mA on 10A, AC/DC

#### OTHER FEATURES (ALL MODELS)

Low power OHms Range  
Zero Adjust key  
Battery Warning  
In circuit resistance test  
Size 155 x 85 x 28mm, 250g.

6200 £39.95  
6220 £49.95

#### ACCURACY

6100/6110  
0.5% DC Volts  
1% DC Current  
1.2% AC Current  
0.5% Resistance

#### 6200/6220

0.8% DC Volts  
1.3% DC Current  
1.4% AC Current  
0.8% Resistance

6100 £64.95  
6110 £74.95

★ All prices include batteries / leads and UK VAT (UK c/p 65p)  
★ Order by Post or Telephone with Barclay or Access

### OR CALL IN AND SEE FOR YOURSELF

Cubegate Limited OPEN 9-6 SIX DAYS A WEEK

## AUDIO ELECTRONICS

301 EDGWARE ROAD, LONDON, W2 1BN  
TELEPHONE 01 724 3564

FREE CATALOGUE!

Send large SAE (17½p UK)  
Schools, Companies,  
etc. free on request.

From Mr/Mrs/Miss  
(Block capitals please)

Ref. ETI

Please supply

QTY Model(s)

I/We enclose (incl. 65p post)

Chq/PO value

Or debit Barclay / Access No.

# TRANSFORMERS

Panel Meters, Bridge Rectifiers, Power Supply Units  
Multimeters - Semi Conductors - Timers - Safeloc

#### Minimum & Sub Miniature

Volts	Mini-amps	Ref. No.	Price £	P&P
3-0.3	200	238	2.55	.65
0.6-0.6	1A 1A	212	2.95	.70
9-0.9	100	13	2.25	.65
0.9-0.9	330 330	235	2.10	.65
0.8-9, 0.8-9	500 500	207	2.70	.70
0.8-9, 0.8-9	1A 1A	208	3.80	.70
0-15, 0-15	200 200	236	2.10	.65
0-20, 0-20	300 300	214	2.70	.85
20-12-0-12-20	700(DC)	221	3.45	.85
0-15-20, 0-15-20	1A 1A	206	4.55	1.00
0-15-27, 0-15-27	500 500	203	4.00	.85
0-15-27, 0-15-27	1A, 1A	204	6.05	1.00

#### 12 AND/OR 24 VOLT

12v	24V	Amps	Ref. No.	Price £	P&P
0.5	0.25	111		2.25	.70
1.0	0.5	213		2.70	.85
2	1	71		3.20	.85
4	2	18		4.00	.85
6	3	70		5.55	.90
8	4	108		7.40	1.15
10	5	72		8.20	1.15
12	6	116		8.80	1.15
16	8	17		10.80	1.25
20	10	115		13.80	1.45
30	15	187		16.80	1.45
60	30	226		33.30	1.75

#### 30 VOLT (Pri: 220-240V)

Amps	Ref. No.	Price £	P&P
0.5	112	2.80	.85
1.0	79	3.55	.85
2.0	3	5.55	1.00
3.0	20	6.25	1.15
4.0	21	6.55	1.15
5.0	51	9.55	1.15
6.0	117	11.05	1.15
8.0	88	14.30	1.45
10.0	89	16.55	1.45

#### 50 VOLT (Pri: 220-240V)

Amps	Ref. No.	Price £	P&P
0.5	102	3.55	.85
1.0	103	4.65	1.00
2.0	104	7.25	1.15
3.0	105	8.55	1.15
4.0	106	10.80	1.25
6.0	107	15.05	1.45
8.0	118	20.15	1.65
10.0	119	24.05	2.15

#### 60 VOLT (Pri: 220-240V)

Amps	Ref. No.	Price £	P&P
0.5	124	3.80	.85
1.0	126	5.55	1.00
2.0	127	7.50	1.15
3.0	125	11.05	1.25
4.0	123	12.30	1.45
5.0	40	14.10	1.55
6.0	120	17.55	1.55

#### AUTO TRANSFORMERS

VA (Watts)	Ref. No.	Price £	P&P
150	4	5.55	1.00
20	113	2.60	.85
75	64	4.05	.85
150	4	5.55	1.00

#### Input/Output Tapped

VA (Watts)	Ref. No.	Price £	P&P
300	53	10.05	1.15
500	67	10.80	1.45
1000	84	18.55	1.55

#### Also 1500/2000/3000VA

#### MAINS ISOLATING (Centre Tapped & Screened)

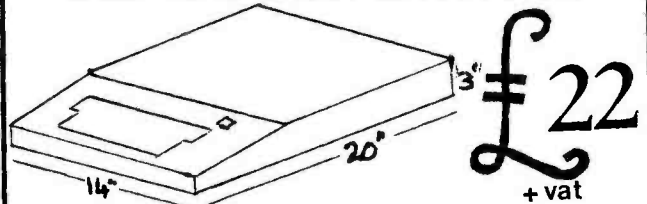
VA (Watts)	Ref. No.	Price £	P&P
60	149	6.55	1.00
100	150	7.55	1.25
200	151	11.05	1.25
250	152	13.25	1.45
350	153	16.25	1.55
1000	156	37.05	3.15

Please add VAT at 15%  
Barclaycard and Access facilities available  
Trade and Education Welcome

**BAYDIS**

7a William Street  
Herne Bay, Kent  
Herne Bay SA45 8E

# NASCOM OWNERS



16 Gauge Aluminium Console, will support Portable TV or Monitor. Enough space inside for 3A PSU, CPU Board and Two Expansion Boards.

PRICE INCLUDES Keyboard Cut-out, Rubber Feet, Carry Handle  
Send cheques or P.O.s for £25.30 to:

## CYBER ELECTRONICS CO. LTD.

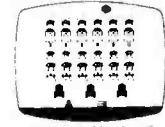
Pavement Square, Addiscombe, Croydon CR0 6RD  
Tel: 01-651 0388 any time



#### ATARI BASIC PROGRAMMING

Basics of computer language and programming. What to say. How to say it... £33.50  
ATARI mains units... £90.50

Keyboard controller... £11.95



#### SPACE INVADERS

Game Program, 112 game variations in-

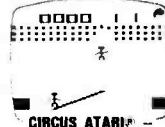
cluding Moving Shields, Zigzagging Laser Bombs, Fast Laser Bombs, Invisible Invaders and 1 & 2 Player Games! £28.00 inc.

Atari with Space Invaders, call for special price.



#### HUMAN CANNONBALL

Shoot your man out of the cannon and into the water tower. Calculate the position of the cannon. The speed (in miles per hour) and the degree of the angle are indicated on your screen. It's all part of Human Cannonball with 8 different games to choose from. £16.20.



#### CIRCUS ATARI

Multi-colored balloons and clowns collide under Atari's Big Top.

You must try to pop the balloons by bouncing the clown from the teeter-totter up to the rows of balloons. Red, white and blue balloons have different point values. The more difficult the 'pop', the higher the score. £16.20.

Golf, Slot Racers & Adventure available P.O.A. Never undersold, all of the ATARI cartridges sold. Chess Challenger 7, Super Systems 3, Sensory 8, all available P.O.A.

Kramer & Co., Dept. ETI 3, 9 October Place, London NW4, Tel: 01-203 2473. Telex: 888941 Attn K7. Visa, Access. Open Mon-Fri. (Sunday by appointment only).



# NEW

## PRACTICAL ELECTRONICS PROJECT 125 WATT POWER AMP KIT

### SPECIFICATIONS

Max. Output power 125 watt RMS  
 Operating voltage (DC) 50-80 Max.  
 Loads 4-16 ohms  
 Frequency response Measured at 100 watts 25Hz-20kHz  
 Sensitivity for 100 watts 400mV @ 47K  
 Typical T.H.D. @ 50 watts 4 ohms load 0.1 %  
 Dimensions 205 x 90 and 190 x 36 mm

The P. E. power amp kit is a module for high power applications—disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, the

output stage uses four 115 watt transistors normally only two would be used, result, a high powered rugged unit. The PC Board is backprinted, etched and ready to drill for ease of construction, and the aluminium chassis is preformed and ready to use, supplied with all parts and circuit diagrams.

125 watt power amp kit **£9.50** plus £1.00 p&p

**ACCESSORIES** Suitable L.S. coupling electrolytic **£1.00** plus 20p p&p

Suitable Mains Power Supply Unit sufficient for one power amp **£7.50** plus £2.75 p&p

ACCESSORIES available only when purchasing packs.



AS FEATURED IN PRACTICAL ELECTRONICS OCTOBER ISSUE

## DIY STEREO BARGAIN PACKS FEATURING FAMOUS BUILT MULLARD PREAMP MODULES

### MULLARD STEREO PREAMP MODULES AND TWO 12 WATT POWER AMP KITS.

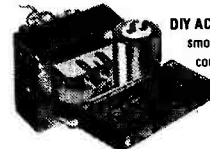
In easy to build form P.C.B.s backprinted, etched and drilled ready to use.

### BUILD A 12 WATTS PER CHANNEL STEREO AMPLIFIER ACCESSORIES AND L.S. KIT EXTRA (not available separately) **£6.00**

**DIY PACK 1** 2 x power amp kits LP1182/ preamp module, suitable for ceramic and auxiliary inputs. **£6.00** plus £1.10 p&p

**DIY PACK 2** 2 x power amp kits LP1184 preamp module suitable for magnetic ceramic and auxiliary inputs. **£8.50** plus £1.15 p&p

**DIY SPEAKER KIT** Two 8" x 5" approx. 4 ohm bass **£3.50** plus £1.70 p&p



**DIY ACCESSORIES** Mains transformer smoothing capacitor rectifier 4 x slider controls, for base, treble and volume.

**£3.00** plus £1.60 p&p

ACCESSORIES: Available only at time of purchase of Bargain Packs

### 12 + 12 WATT AMPLIFIER KIT

NOTE: for use with 4 to 8 ohms speakers

With up-to-the-minute features. To complete you just supply screws, connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs—tape, speakers and headphones. By the press of a button it transforms into a 24 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus 2 power amplifier assembly kits and mains power supply. Also featured 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia panel with matching knobs. Easy to assemble teak simulate cabinet and ready made metal work. For further information instructions are available price 50p. Free with kit. Size 9 1/4" x 8 3/4" x 4" approx.

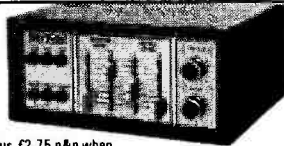
**£13.95** plus £2.55 p&p

NOTE: for use with 4 to 8 ohms speakers.

BSR chassis record player deck with manual set down and return, complete with stereo ceramic cartridge. **£8.50** plus £2.75 p&p when purchased with amplifier available separately **£10.50** plus £2.75 p&p.

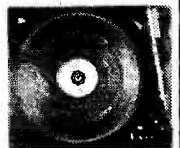
**TWO WAY SPEAKER KIT.** 2 Phillips 8" approx speakers **£4.75** per stereo pair plus £1.50 p&p when purchased with amplifier available separately **£6.75** plus £1.50 p&p.

**ALSO AVAILABLE** Stereo magnetic pre-amp conversion kit all components including P.C.B. to convert your ceramic input on the 12 + 12 amp to magnetic. **£2.00** when purchased with kit featured above. **£4.00** separately inc. p&p.



BSR Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or disco use.

**£12.25** OUR PRICE plus £2.75 p&p



Size approx 13" x 11"

### PHILLIPS RECORD PLAYER DECK GC037

Size approx 15 1/4" x 12 1/4"



Hi Fi record player deck, 2 speed, damped cueing, auto shut-off, belt drive with floating sub chassis to minimise acoustic feedback. Complete with GP401 stereo magnetic cartridge—LIMITED STOCK. UNBEATABLE OFFER AT

**£27.50** complete plus £2.75 p&p

**OFFER!** SAVE MONEY by purchasing 12 + 12 amp kit, BSR record deck and speaker kit together for only **£25.50** p&p £4.50.

### PRACTICAL ELECTRONICS CAR RADIO KIT (Constructors pack 7) **£10.50** plus £1.75 p&p



- \* Easy to build \* 5 push button tuning
- \* Modern styling design \* All new unused components
- \* 6 watt output \* Ready etched & punched P.C.B.
- \* Incorporates suppression circuits \* Now with tape input socket

All the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue. Features: Pre-set tuning with five push button options, black illuminated tuning scale, with matching rotary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia. The P.E. Traveller has a 6 watts output, neg ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The radio fits easily in or under dashboards.

Complete with instructions.

#### CONSTRUCTORS PACK 7A

Suitable stainless steel fully retractable locking aerial and speaker (approx. 6" x 4") is available as a kit complete **£1.95** p&p £1.00

PACK 7A may only be purchased at the same time as Pack 7.

NOTE: Constructor's pack 7A sold complete with radio kit **£15.20** including p&p.

FEATURED PROJECT IN PRACTICAL ELECTRONICS.



### 30 + 30 WATT STEREO AMPLIFIER BUILT AND TESTED

Viscount IV unit in teak simulate cabinet silver finished rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30 + 30 watts. RMS 60 + 60 watts peak for use with 4 to 8 ohm speakers. Size 14 1/4" x 10" approx.

READY TO PLAY **£32.90** plus £3.30 p&p



323 EDWARE ROAD, LONDON W2 21E, HIGH STREET, ACTON W3 6NG

ACTON: Mail Order only. No callers  
**ALL PRICES INCLUDE VAT AT 15%**  
 All items subject to availability. Price correct at 8.8.80 and subject to change without notice

For further information send for our instruction booklet 20p plus stamped addressed envelope.

NOTE: Persons under 16 years not served without parent's authorisation.

### BARGAIN OFFER!!



#### ARISTON PICK UP

Ariston pick-up arm manufactured in Japan. Complete with headshell. **£11.95** plus £2.50 p&p

#### 100 WATT MONO DISCO AMPLIFIER

Brushed aluminium fascia and rotary controls. Size approx 14 1/4" x 4" x 10 1/2". Five vertical slide controls, master volume, tape lever, mic level, deck level, PLUS INTER-DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PRL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak. **£76.00** plus £4.00 p&p

#### 50 WATT MONO DISCO AMPLIFIER

Size approx 13 1/4" x 5 1/4" x 6 3/4". 50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges; tape input and microphone input; Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

**£30.60** plus £3.20 p&p



Personal Shoppers EDWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am-5.30pm. Closed all day Thursday ACTON: Mail Order only. No callers GOODS DESPATCHED TO MAINLAND AND N. IRELAND ONLY



# AUDIOPHILE

Ron Harris returns to his roots — well almost — for a look at a very promising new Thorens TD 160S turntable and has a severe shock in store for headphone owners!

**A**shes to ashes. Dust to dust. Thorens to Thorens. Having launched off down the path to hi-fi many years ago in the august company of a TD 150 II turntable, it brought a whiff or two of nostalgia drifting back to lay hands on this new TD160S.

Thorens have received an indifferent press of late, mainly because some of their decks have failed to match the very high standards set in earlier days, by the 150 and 125 machines.

The standard 160 has been enthusiastically received, however, even by the usually isolationist 'cult' press. There was, though, a lot that could still be done to improve things and after some years of watching other people make money doing them, Thorens have decided enough is enough — and the TD160S is born.

## Vive La Difference

Compared to a standard 160, the 'special' is more solidly constructed all around, has a massively heavy chipboard base, a better bearing system, thoroughly damped sub-chassis and improved suspension. The arm-board is also much heavier, but we'll come to that again later.

The standard Thorens mat has been dumped overboard and a much more sensible specimen is fitted in its place. The emphasis of the work has been upon suppression of resonance and isolation from feedback. I think the changes made show a clear enough improvement in the final sound to be immediately obvious in an A - B test, even in a crowded dealer's. Taking this into account, therefore, one is forced to consider the 160S in a higher league entirely — so it was with the greatest of expectations that I approached the packing case...

## Set Up By The Setting Up

The deck employs the (by now) well known Thorens three point spring suspension. This method of 'floating' a sub chassis away from the base on springs has been employed by Thorens for many years, long before either the Linn or the Ariston arose to dazzle the eyes of belt-driven enthusiasts. The intent is to isolate the turntable and arm assembly from the rest of the known universe. And very effective it is too, I may say.

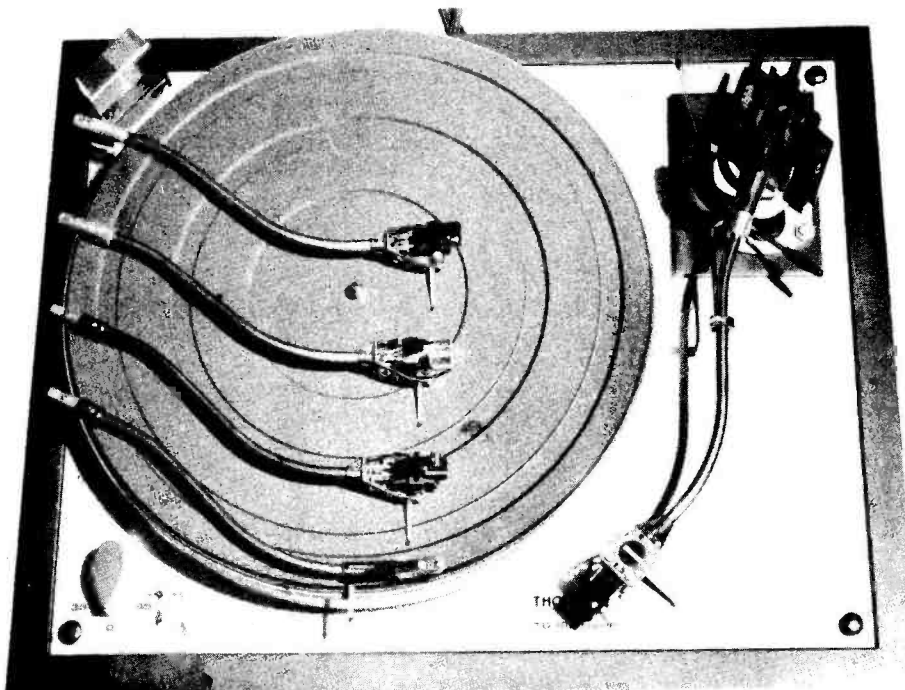
However, this apparently ultimate solution is not without some practical drawbacks. Once the chosen arm is fitted, the whole assembly must be levelled by adjustment of the three springs, which are situated beneath the deck. Which means at every step:- removing the outer turntable, upending the deck, removing the base, replacing the outer turntable and checking with a spirit level. If it is *still* not right, then it's remove the outer turntable, upend the deck... and so on and on ad frustratum maximum.

Once this has been achieved, the arm leads must be arranged within the plinth so that they do not re-couple the sub-chassis to the base, thus negating a large portion of the benefit gleaned from the spring suspension. This is fairly straightforward at least, but with an SME the leads are very stiff indeed, making the adjustment critical. Naturally though, SME can supply a flexible link if your patience falls short of the task.

## Things That Go Bump In The Night

Mention of the magnificent SME brings me onto the subject of fitting said arm to this deck.

'Difficult' sums it up nicely.

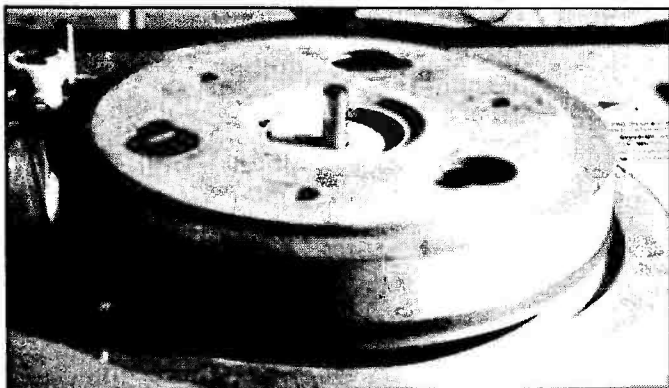


Left: The 160S with SME/V15 IV installed. Note the improved turntable mat and relatively small arm-board. The base is much more massive than the standard version and the base-plate is of thick chipboard. A slot will need to be cut through this to clear an SME lead, however. The two small openings Thorens provide are simply not big enough!

Arranged across the deck are some of the pickups used in evaluating the 160S. Top to bottom these are: Goldring G900 IGC, Coral MC81, Empire 600LAC and the elegant Ortofon/SME 30H. The variation in type of sound between these units was most helpful in identifying which effects were caused solely by the 160S!

ETI OCTOBER 1980





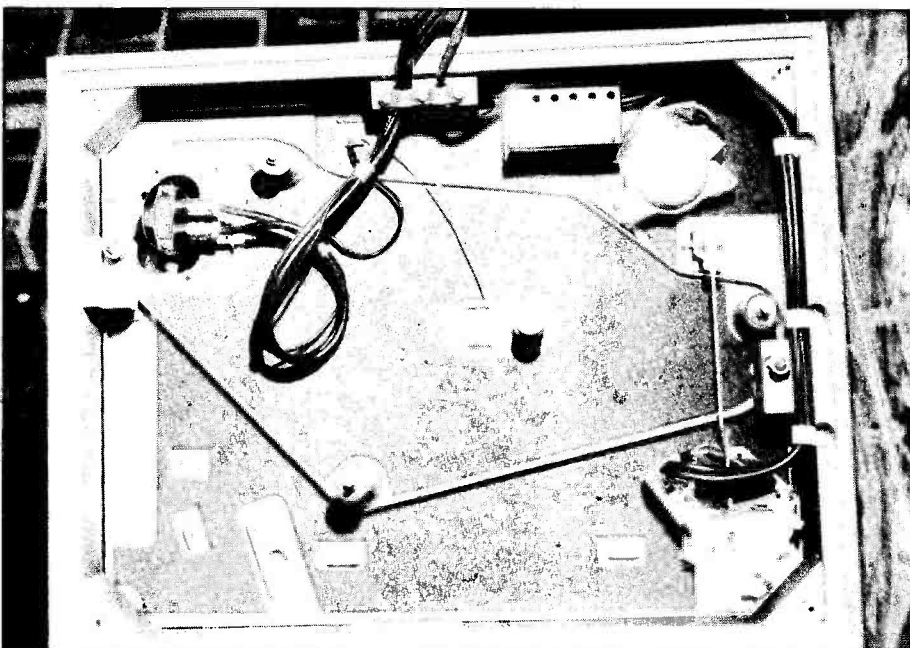
Above: The Thorens sub-chassis with outer turntable removed. Note the position of the drive belt.

The 'new improved' arm-board fitted here — and the sub-chassis — have barely enough room to accept the SME III. Barely in this case means slightly less than 1/10th of a gnat's whisker. I would strongly advise any prospective owners of this combination to shell out the required sum of £8.62 and let SME send you a fully cut board. I assure you it is a miserly sum indeed, when weighed against the blood, sweat and tears you will expend trying to be a DIY hero. You have been warned.

Come to think of it, how about supplying the SME board with the 160S, eh Thorens? All else is but dross anyway!

Failure to line up the arm *exactly* will result in the pillar not clearing the sub-chassis cut-out, which is every bit as generous as the pickup board, or just as musically, bumping away at the base every time someone breathes on the turntable.

All in all then, an enthusiast's — or a dealer's — task. Patience is the order of the day and if you fancy a TD 160S, but don't fancy setting it up, then your friendly neighbourhood dealer *should* do it for you. If he doesn't, simply find another (more) friendly neighbourhood dealer.



Above: The TD160S revealed. The dark areas are damping compound, not applied to the standard 160. Top right is the drive motor and below that the speed change mechanism. Note the loop in the arm lead to keep the sub-chassis decoupled.

## Down To Earth

Earthing the sub-chassis and arm means linking the earth of this to the base earth point beneath the turntable, from where a lead can be run to the amplifier — a point not well explained in the literature, I feel.

I earthed my Decca cleaning arm to the same point to keep down the number of wires trailing around. I have heard it said that use of these 'in-play' brush cleaners re-couples the turntable in the same manner as a badly arranged output lead beneath the base. Frankly, I don't go along with that at all. If the tracking brush is set up properly to a very small down force, then I cannot see that it will affect matters significantly. During listening tests I tried to identify any audible effect produced by employing the brush — and found only that it removed the dust! Really exciting that, huh?

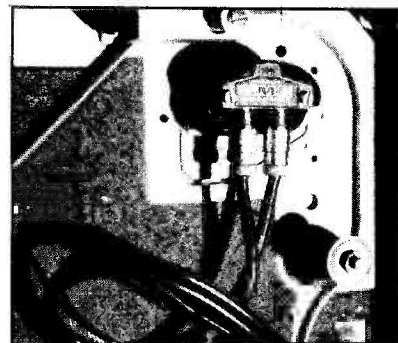
## All Hands On Deck

Listening to the TD 160S was carried out with an SME III on the arm-board, and a variety of cartridges, including a Goldring C9001GC and a Coral MC81. Also a Shure V15 IV was used on most comparisons as was an Ortofon/SME 30H. Regular readers will have seen this little lot before!

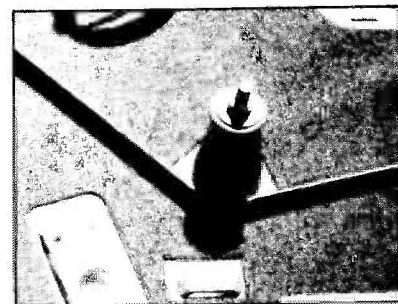
Incidentally I have had some letters questioning my continued use of an SME III as a reference, when as one reader put it, "there are stacks of better arms around."

The answer to all these people lies in the fact that I personally don't think there are ANY better arms around.

The SME is an excellently engineered, universal pick-up arm, which is as neutral as any on the market and a damn sight easier to use than most. Don't be fooled into equating tedious setting up with final quality. It does not automatically follow. The SME is a *dream* to use and offers facilities that allow for useful optimisation of the pickup cartridge in use.



Close-up of the arm pillar. There is not a great deal of room here so if you are fitting your own pickup — beware.



Above: The fixing of the sub-chassis suspension springs. The foam plugs have been sensibly removed on this model.



A small number of top-end pick-ups have been specifically designed for arms other than the SME and will thus operate better in the designed-for carrier.

However, for universal application and sheer engineering excellence, I don't think anyone has gotten near SME yet!

So there.

Back to the plot. After the setting-up was finally concluded and the cartridges aligned I could gratefully sink into the armchair — brandy in hand — and, wiping the sweat from the editorial brow, settle down to some music.

The biggest surprise was the mid-range. With all the cartridges the 160S produced a cleaner and clearer sound than I had heard from them before. Bass was firm and well-controlled, albeit with a nagging doubt concerning the extension. Treble was unimpeachable.

Continued listening has largely removed that doubt over the bass extension and I realised on a direct A-B it was the reference deck that had a slight upper bass prominence compared to the Thorens, which set me onto the thought in the first place! Instructive things comparisons. Learn something new every time.

## A Right Little Belter

This comparison was set up with two SME III arms and two Shure V15 IV cartridges — and my warmest thanks to both firms for helping out at short notice so graciously — on the Thorens and the reference.

Even after several hours of this switching back and forth between decks I am left with nothing to be able to criticise in the TD 160S sound! It comes very, very close to being the best turntable I've ever heard and even changing the mat for a GA Audio Soundisc failed to make any improvement. If anything it muddled up the mid-range detail. Some may find it a little bland methinks — but look ye to your references gentlemen!

Taking price into account, the 160S is an excellent buy. It offers superb performance for its £140 price tag and should make prospective purchasers of decks twice the price stop and think very carefully indeed. To its price must be added, however, the need for precise setting up and a new arm-board! Still, with a good dealer neither should deter a single true audiophile.

An important addition to the ranks of hi-fi then, and I urge you to go and hear for yourself.



The reference cartridge for the comparisons was a Shure V15/IV.



Above: Close-up on the MDR-7 drive unit. The fine film driver is behind the mesh protection and can be clearly seen here. The foam earpads clip around the whole assembly and a spare set is provided.

## Big Brother Is Here!

Perhaps the best-selling headphones so far in 1980 have been the Sony MDR-3s. And quite right too, many of you will say. Good value for money, they certainly are, and up to the 21st of last month I would have said the best value under £50. Alas this is true no longer. There is now a unit on the market whose performance far surpasses the MDR-3, adding to it a wealth of bass extension and clarity, sufficient by far to justify an asking price of around £30. These new phones are little larger than the MDR-3 and not noticeably heavier. The fit is comfortable and the sound dynamic. Their name? Why the MDR-7 of course! What else?

Since they fell into my hands I have been using them in preference to my own Koss ESP-10 electrostatics a lot of the time — and there is no better recommendation than that.

Comparing against the ESP-10s shows the MDR-7s to have a better bass extension than the Koss and to be able to accept higher levels without distress. Their mid-range is coloured with a slight warmth that can add a 'weight' to some music that is simply not there. The treble is smooth and goes a long way past your powers of hearing.

Overall, the sound is lively and detailed without being intrusive. It is easy to listen through them to the music and the comfortable fitting greatly assists matters here.

The MDR-7 will be widely available in this country from September 1st. At the same time an MDR-5 is being released which fills in the considerable gap in price between the three and the seven. I haven't heard them, but on the strength of those on both sides of them, the MDR-5s should not disappoint.

Sony apparently have no plans to bring out an MDR-9. At least not yet. At least that is what they tell me now. I can just see Audiophile in a year's time...

## Conclusions

A nice production yet again. Well built and well presented. A spare set of earpads are included in the price — for when you forget to wash your ears — or just want a change of colour! Selling tag will lie around £30-35 and no doubt the MDR-7 will quickly repeat the sweeping success of its little brother. It deserves to do so, no doubt about it.





Above: The MDR-7 in use. Only one earpiece is adjustable, the other being fixed to a swivel joint to better align with the user's head. Cable entry is side-on and much more convenient than on the MDR-3 where it hangs awkwardly, stethoscope-like, behind the ear pieces.

The MDR-7 is very comfortable in action, but must be precisely aligned with the ear for best performance.

## Odds And . . . Pieces Of Turf

Next month I hope to be able to offer you a complete — cassette based — stereo system at a ludicrously low price. Negotiations continue to bring about an offer on the launch of a new range of budget hi-fi from regions east of Suez! The importers are Videotone and a pair of their excellent GB2 loudspeakers will provide the voice for the system. Everything else — amp, tuner and cassette deck bear a name you will not have heard before, Seoum, and offers 30 W RMS per channel, with good transient delivery, M/C input, FM/AM with good sensitivity, LED level metering on tape and input power and best of all a good sound quality.

Price will be under £300 complete, so if you're looking for equipment in this price area hold on a little — you could save yourself some money!

Also next month I'll be starting to run some of your letters to Audiophile as a regular feature, be they queries or just communications! So if you've anything to say on matters even vaguely hi-fi let's hear from you.

The Audiophile enquiry service will still operate for anyone with a hi-fi problem. Don't forget to give details of the full system you're using and to mark the envelope for 'Audiophile'. ETI

# CALCULATORS, SCIENTIFIC

**\* SPECIAL OFFER**  
TEXAS T159 together with PC100C  
(Complete as manufacturer's specifications)  
**£305.00**

TEXAS/HP Accessories available

*TEXAS T159 (Card prog 960 prog steps of 100 mem)	<b>£156.50</b>
*TEXAS T158 (Key prog 480 steps of 60 mem)	<b>£60.00</b>
*TEXAS PC100C (Printing Unit for T158/159)	<b>£165.00</b>
*TEXAS T157 (Key Prog 8 mem. 150 Keystrokes / 50 Prog Steps)	<b>£26.00</b>

For your Texas T158/59 Calculator  
**ELECTRICAL ENG. MODULE**  
**LEISURE (GAMES) MODULE**  
**STRUCTURAL ENG. MODULE**  
**NOW AVAILABLE**

*TEXAS TI PROGRAMMER (Hexadecimal Oct)	<b>£46.50</b>
*TEXAS T151 /iii (10 mem 32 Prog Steps Stat/Sci)	<b>£28.50</b>
TEXAS T150 LCD (Sci/Stat. 2 Con Mem)	<b>£23.00</b>
TEXAS T125 LCD (Sci/Stats)	<b>£17.00</b>
TEXAS T53 (Sci. 32 Prog Steps-Coa Mem + 80 Prog List Applications book)	<b>£25.00</b>

**Make more of your Texas T158/59 Calculator MATH/UTILITIES MODULE**

If you write your own programs this library is for you! Most programs in this library are designed to be used either on their own or as subroutines of your programs. Applications range from utility programs such as printer formatting and large-scale plotting to advanced mathematical routines.

Module includes:  
**Prompter. Alpha Messages. Printer Formatting. Superplotter. Sorting. Data Arrays. Data Packing. Prime Factors. Hyperbolic Functions. Gamma / Factorial. Random Numbers. Normal Distribution. Interpolation. Roots of a Function. Minimax. Romberg Integration. Differential Equations. Discrete Fourier Series. Calculator Status. Variable Arithmetic. Module Check.**

*TEXAS T158 with Maths/Utilities	<b>£90.00</b>
*TEXAS T159 with Maths/Utilities	<b>£186.50</b>
*TEXAS T158 with Applied Statistics	<b>£80.00</b>
*TEXAS T159 with PC100C & Applied Statistics	<b>£325.00</b>

### AUTUMN SALE

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

### NEW TEXAS T158C\*

\*Continuous program facility on all 480 Program steps/60 mem even when calculator switched off  
\*TEXAS T158C (complete plus Applied Stats, Module) **£99.00**  
\*TEXAS T158C + PC100C **£228.00**

**FREE** while stocks last with every purchase of HP 32E or HP 33E  
**BATTERY HOLDER WITH RECHARGEABLE BATTERY.** Normally costs £10.38.

*HP33E (8 mem. Pro Sci /Sta)	<b>£52.00</b>
*HP33C (as above but con. mem)	<b>£60.50</b>
*HP32E (Advanced Sci with Statistics)	<b>£38.50</b>

*HP34C (Sci Prog 20 Mem)	<b>£83.00</b>
*HP67A (K Prog 224 Steps 26 Mem)	<b>£173.00</b>
*HP97A (Fully prog with Printer)	<b>£384.35</b>
HP41C (the newest calculator from HP)	<b>£167.43</b>
HP41C Card Reader/Printer etc. Modules	<b>Now in stock</b>
CASIO FX501P (Sci. LCD Prog. 128 Steps 11 Mem)	<b>£47.50</b>
CASIO FX502P (Sci. LCD Prog 256 Steps. 22 Mem)	<b>£65.00</b>

### LEXICON LANGUAGE TRANSLATOR

(With 6 Lang. Module — French / Italian / German / Spanish etc) **£115.00**  
Ring Translator **£115.00**

### NOW IT'S YOU AGAINST 'COMPUTERS'

**CHESS CHALLENGER "7"** (7 Levels of game) **£76.50**  
**CHESS CHALLENGER "VOICE"** (10 Levels — beginner to Master Plus) The strongest Prog yet in this series — twice as fast as the other challengers. A microprocessor with 128,000 to 160,000 bits of read only Mem. Over 8000 bits of Random Access Mem. Teaches opening & end game solutions. Plays against itself. Solves book problems etc — and in addition IT SPEAKS. Complete with Deluxe keyboard, hand carved mahogany base plus Deluxe carry case **£170.00**  
**SARGON** The most advanced chess game yet with add on module availability for other games (Our price inc. **FREE** rechargeable battery pack) **£234.70**  
Super System 3 (as recommended by ETI) **£134.75**

### ATARI TV GAMES £98.50 inc. VAT. Philips G7000 P.O.A.

### LEARNING AIDS

TEXAS DATAMAN (Number Games-Table learning etc. 5/10 yrs)	<b>£18.00</b>
TEXAS SPELLING B (Spelling Games ideal 5/10 years)	<b>£22.50</b>
TEXAS SPEAK AND SPELL (for older children 8/13 years)	<b>£39.95</b>

### IDEAL FOR STUDENTS

ALL WITH LCD DISPLAY	
TEXAS T120 (Jun Sci + Con Mem)	<b>£13.00</b>
TEXAS T135 (Sci/Stat C Mem)	<b>£17.00</b>
TEXAS T138 (Sci/Con Mem-Pola Rec Cony Dec Deg conv/ Deg Min Sec)	<b>£19.95</b>

GOODS FULLY GUARANTEED PRICES EXCLUDE VAT (ADD 15%)

Company/ Hospital and Government orders accepted by phone

Barclaycard/Visa/ Access accepted by phone

Export orders welcome. Air Freight/ Air Post Delivery. Quotations on request

**TEL. 01-455 9823**

**SENSORY CHALLENGER 'B'**. The latest Chess Computer from America now in stock. Prices on application.

**MOUNTAINDENE**

22 Cowper St., London, EC2



## FUSE HOLDERS AND FUSES

Description	No.	Price
20mm x 5mm chassis mounting	506	£0.18
1/4in. x 1/4in. chassis mounting	507	£0.14
1/4in. car inline type	508	£0.18
Panel mounting 1 1/4in	509	£0.23
QUICK BLOW 20mm	510	£0.37

Type	No.	Type	No.	Type	No.	Price		
150mA	711	7p	1A	615	6p	3A	619	8p
250mA	612	6p	1.5A	616	7p	4A	620	10p
550mA	613	6p	2A	617	6p	5A	621	6p
800mA	614	8p	2.5A	618	7p			

Type	No.	Type	No.	Type	No.	Price
100mA	622	1A	625	2.5A	628	
250mA	623	2A	626	3.15A	629	
500mA	624	1.6A	627	5A	630	

Type	No.	Type	No.	Type	No.	Price
150mA	631	500mA	632	800mA	634	

Type	No.	Type	No.	Type	No.	Price
1A	635	2.5A	638	4A	641	
2A	637	3A	639	5A	642	

## NUTS AND BOLTS

**BA BOLTS** — packs of BA threaded cadmium plated screws slotted cheese head. Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in. OBA	839	£1.38	1/2in. 4BA	846	£0.37
1in. OBA	840	£0.86	1/2in. 4BA	847	£0.29
1in. 2BA	842	£0.75	1in. 6BA	848	£0.48
1in. 2BA	843	£0.52	1in. 6BA	849	£0.24
1/2in. 2BA	844	£0.80	1/2in. 6BA	850	£0.20
1in. 4BA	845	£0.51			

**BA NUTS** — packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	855	£0.83	4BA	857	£0.35
2BA	856	£0.55	6BA	858	£0.28

**BA WASHERS** — flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	859	£0.16	4BA	861	£0.14
OBA	860	£0.14	6BA	862	£0.14

**SOLDER TAGS** — Hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	851	£0.48	4BA	853	£0.25
2BA	852	£0.32	6BA	854	£0.25

## TRANSFORMERS

**MINIATURE MAINS** Primary 240V

No.	Secondary	Price
2021	6V-0.6V 100mA	£1.04
2022	9V-0.9V 100mA	£1.04
2023	12V-0.12V 100mA	£1.29

**MINIATURE MAINS** Primary 240V with two independent secondary windings

No.	Type	Price
2024	MT 280 D-6V 0.6V RMS	£1.84
2025	MT 150-0-12V 0.12V RMS	£1.84

**1 AMP MAINS** Primary 240V

No.	Secondary	Price
2026	6V-0.6V 1 amp	£2.88 P & P 45p
2027	9V-0.9V 1 amp	£2.30 P & P 45p
2028	12V-0.12V 1 amp	£2.00 P & P 55p
2029	15V-0.15V 1 amp	£3.18 P & P 66p
2030	30V-0.30V 1 amp	£3.97 P & P 86p

**STANDARD MAINS** Primary 240V  
Multi-tapped secondary mains transformers available in 1/2 amp, 1 amp and 2 amp current rating. Secondary taps are 0.19-25-33-40-50V. Voltages available by use of taps.

No.	Rating	Price
2031	1/2 amp	£3.81 P & P 85p
2032	1 amp	£5.06 P & P 85p
2033	2 amp	£6.27 P & P £1
2035	240V Primary 0-55V @ 2A Secondary	£7.30 P & P £1

## SPECIAL OFFER

2042 240V Primary 0.20V @ 2A Secondary. By removing 5 turns for each volt from the secondary winding any voltage up to 20V @ 2A is easily obtainable. Ideal for the experimenter.  
£1.50 P & P 86p

## SPECIAL OFFERS

**MINIDRILL** 12V hand held battery-operated mini drill. 7.500 r.p.m. Collet chuck. Ideal for drilling printed circuits or model making. No. 1402  
£7.70

**TRANSFORMER** 240V Primary 0.20V @ 2A Secondary. By removing 5 turns for each volt from the secondary winding, any voltage up to 20V @ 2A is obtainable. Ideal for the experimenter. No. 2042  
£1.50 + 86p P & P

**ANTEX MLX** Soldering Iron. Sturdy 25 watt iron complete with: 4 1/2 metres of 2-core cable. Works off a 12 volt battery. Ideal for Car. Boat Caravan. No. 1724  
£5.29

## TANTALUM CAPACITORS

3137	1MFD 35V	£0.13	3157	3.3MFD 25V	£0.21
3138	22MFD 35V	£0.13	3143	10MFD 35V	£0.25
3139	47MFD 35V	£0.13	3144	22MFD 16V	£0.25
3141	1.0MFD 35V	£0.13	3145	47MFD 6.3V	
3141	2.2MFD 35V	£0.14	3156	33MFD 35V	£0.13
3142	4.7MFD 35V	£0.21			

## ELECTROLYTIC CAPACITORS

3185	1.000uF 25V	£0.32	3190	4700uF 25V	£0.82
3186	1.000uF 50V	£1.27	3191	4700uF 35V	£2.42
3187	2200uF 25V	£0.69	3192	2200uF 100V	£2.68
3188	2200uF 40V	£0.69	3196	100uF 100V	£0.09
3189	3300uF 100V	£3.61			

## POTENTIOMETERS

**CARBON POTS (Linear Track)**  
Single gang with wire and terminations 6mm x 50mm plastic shaft 10mm bushes supplied with shake proof washer and nut. Tolerance 20% of resistance

1831 1k ohms	1835 22k ohms	1839 470k ohms
1832 2k ohms	1836 47k ohms	1840 1 Meg
1833 4k7 ohms	1837 100k ohms	1841 2Meg
1834 10k ohms	1838 220k ohms	All at 30p each

**CARBON POTS (Log Track)**  
1842 4k7 ohms 1846 100k ohms 1850 wM2  
1843 10k ohms 1847 220k ohms All at  
1844 22k ohms 1848 470k ohms 30p each  
1845 47k ohms 1849 1 Meg

Designed to fit 2.54mm pitch board. All tracks are linear law VC7

1816 100 ohms	1822 10k ohms	1828 1 Meg ohms
1817 220 ohms	1823 22k ohms	1829 2M2 ohms
1818 470 ohms	1824 47k ohms	1830 4M7 ohms
1819 1k ohms	1825 100k ohms	All at
1820 2k2 ohms	1826 220k ohms	10p each
1821 4k7 ohms	1827 470k ohms	

**DUAL CARBON POTS (Log Law)**  
1860 4k7 ohms 1864 100k ohms 1868 2M2  
1861 10k ohms 1865 220k ohms All at  
1862 22k ohms 1866 470k ohms 99p each  
1863 47k ohms 1867 1 Meg

**SINGLE GANG SWITCHED (Lin Law)**  
These potentiometers are fitted with double pole on-off switches. The switch is incorporated within the rotary action of the pot. Specification of pot is as VC1. Switch rating 1.5 amps at 250V AC

1870 4k7 ohms	1874 100k ohms	1878 2M2
1871 10k ohms	1875 220k ohms	All at
1872 22k ohms	1876 470k ohms	75p each
1873 47k ohms	1877 1 Meg	

**DUAL GANG LOG-ANTI-LOG POT**  
1888 Track specification as dual gang pots VC3, but tracks mounted to log-anti-log action 100k ohms £0.86.

**SPECIAL VOLUME CONTROLS**  
A miniature 16mm type replacement volume control, incorporating single pole on-off switch. Resistance value 5k ohms. Tolerance 20% 1/2 watt rating.

1889 £0.31 VCB  
**MINIATURE ROTARY VOLUME CONTROL**  
5k ohms log law with on-off switch. 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement.

1890 £0.62 VC9  
**WIRE WOUND POTS**  
A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shakeproof washer and nut

VC6  
1891 10 ohms 1895 220 ohms 1899 4k7 ohms  
1892 22 ohms 1896 470 ohms All at  
1893 47 ohms 1897 1k ohms 92p each  
1894 20 ohms 1898 2k2 ohms

**SWITCHED POT (Log Track)**  
Specification as VC2 but track having [log] law

1879 4k7 ohms	1883 100k ohms	1887 2M2
1880 10k ohms	1884 220k ohms	All at
1881 22k ohms	1886 470k ohms	75p each
1882 47k ohms	1888 1 Meg	

**PRE-SET POTS HORIZONTAL MOUNTING**  
Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screwdriver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2.54mm. All tracks are linear law VC7

1801 100 ohms	1807 10k ohms	1813 1M ohms
1802 220 ohms	1808 22k ohms	1814 2M2 ohms
1803 470 ohms	1809 47k ohms	1815 4M7 ohms
1804 1k ohms	1810 100k ohms	All at
1805 2k2 ohms	1811 220k ohms	10p each
1806 4k7 ohms	1812 470k ohms	

**PRE-SET POTS VERTICAL MOUNTING**  
Miniature type for transistor circuits. Wiper adjustment is made by a screwdriver slot

## ANTEX IRONS

1943 15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32" bit. £4.83

1947 Replacement element for 1943 iron. £2.19

1944 Iron coated bit 3/32" for 1943 iron. £0.53

1945 Iron coated bit 1/4" for 1943 iron. £0.53

1946 Iron coated bit 3/16" for 1943 iron. £0.53

1948 General purpose 18 watt iron fitted with iron coated bit. £4.54

1952 Replacement element for 1948 iron. £2.19

1949 Iron coated bit 3/32" for 1948 iron. £0.53

1950 Iron coated bit 1/4" for 1948 iron. £0.53

1951 Iron coated bit 3/16" for 1948 iron. £0.53

1931 Highly popular x25.25 watt quality soldering iron ceramic shafts to provide near perfect insulation breakdown voltage of 1500 volts AC and a leakage current of only 3-5uA and another shaft of stainless steel to ensure strength. £4.83

1935 Replacement element for 1931 iron. £1.84

1932 Iron coated bit 1/4" for 1931 iron. £0.58

1933 Iron coated bit 3/16" for 1931 iron. £0.58

1934 Iron coated bit 3/32" for 1931 iron. £0.58

1953 SK1 soldering kit — This kit contains 15 watt soldering iron fitted with a 3/16" bit plus two spare bits, a reel of solder, heat-sink and a booklet 'How to solder' in presentation display box. £6.38

1939 ST3 soldering iron stand. Stand made from high grade bakelite material chromium plated strong steel spring suitable for all models, includes accommodation for six spare bits and two sponges which serve to keep the soldering iron bits clean. £1.73

## BIB HI-FI ACCESSORIES

O/No	Ref	Price
806	J	Compact tape head cleaning kit £1.22
810	23	Tape Editing kit £2.65
811	24	Cassette Tape editing and joining kit £2.76
813	29A	Salvage cassette £0.51
814	31	Cassette Head cleaning tape £0.71
817	36A	Record & Stylus cleaning kit £0.46
818		Bit track Cartridge tape head cleaner £1.24
819	42	Groove Kleen' automatic, metal, record cleaner £2.65
826	52A	Cassette storage tray (holds 10) £0.82
827	53	Hi-Fi stereo test cassette £3.17
829	60	Chrome finish 'Groove Kleen' (plastic) £2.12
833	65	Anti-static Hi-Fi cleaning liquid £0.35
838	78	Cassette test hand-tape-winder £1.50

## VEROBOARD

2201 2.5"x5" 1 Copper	£0.71	2211 2.5"x3.75" 15 Copper	£0.53
2202 2.5"x3.75" 1 Copper	£0.61	2212 3.75"x1.7" 15 Copper	£2.39
2203 2.5"x1.7" 1 Copper	£2.14	2213 3.75"x5" 15 Copper	£0.90
2204 3.75"x3.75" 1 Copper	£0.71	2214 3.75"x1.9" 1 Plain	£1.79
2205 3.75"x1.7" 1 Copper	£2.76	2215 3.75"x2.5" 1 Plain	£0.44
2207 4.75"x1.7" 9" 1 Copper	£3.81	2216 3.75"x3.75" 1 Plain	£0.88
2208 2.5"x5" 15 in pack	£0.85	2217 2.5"x5" 15 Plain	£0.37
2204 3.75"x5" 1 Copper	£0.79	2218 3.75"x3.75" 1 Plain	£0.56
2210 2.5"x5" 15 Copper	£0.64		

## CASES AND BOXES

**INSTRUMENT CASES** in two sections vinyl covered top and sides, aluminium base, front and back.

No.	Length	Width	Height	Price
155	8in.	5 1/2in.	2in.	£1.72
156	11in.	6in.	3in.	£2.92
157	6in.	4 1/4in.	1 1/2in.	£1.79
158	9in.	5 1/2in.	2 1/2in.	£2.43

**ALUMINIUM BOXES** made from bright mild, folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5 1/4in.	2 1/4in.	1 1/2in.	£0.85
160	4in.	4in.	1 1/2in.	£0.85
161	4in.	2 1/4in.	1 1/2in.	£0.85
162	5 1/4in.	4in.	1 1/2in.	£0.97
163	4in.	2 1/2in.	2in.	£0.87
164	3in.	2in.	1in.	£0.60
165	7in.	5in.	2 1/2in.	£1.43
166	8in.	6in.	2in.	£1.82
167	6in.	4in.	2in.	£1.18

**SLOPE front aluminium boxes with black vinyl base and sides and aluminium back and top front — strong construction easily accessible.**

169	2 1/2in.	5 1/2in.	2 1/4in.	1 2in.	3 1/2in.	8in.	£5.45
168	2 1/2in.	7 1/4in.	4in.	1 6in.	4 1/2in.	1 1in.	£8.21

**VERO plastic case box.** These boxes consist of top and bottom sections which include fixings points for horizontal mounting PC boards/chassis plates, the two sections are held together by four screws which enter through the base and are concealed by plastic feet.

No.	Length	Width	Height	Price
170	140mm	40mm	205mm	£4.14
171	140mm	75mm	205mm	£4.62
172	140mm	110mm	205mm	£6.00

## AUDIO LEADS

No.	Type	Price
107	FM indoor Ribbon Aerial	£0.68
113	3.5mm Jack plug to 3.5mm Jack plug length 1.5mm	£0.88
114	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5 length 1.5m	£0.98
115	5 pin DIN plug to 3.5mm Jack connected to pins 1 & 4 length 1.5mm	£0.98
116	Car aerial extension screened insulated lead. Fitted plug and socket	£1.44
117	AC mains connecting lead for cassette recorders and radios 2 metres	£0.78
118	5 pin DIN phono plug to stereo headphone. Jack socket	£1.21
119	2 + 2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0.2m	£1.04



# SUSTAIN FUZZ BOX

For that raunchy sound beloved of electric guitarists the world over, this simple little project is just the thing.

**F**uzz-tone is to guitar what salt is to meat — it adds flavour and body. The ETI Fuzz Unit has an added bonus in an in-built sustain circuit, adding a bit of extra spice to the idea. The device offers three distinctive sounds, in addition to the 'straight through' option: sustain, fuzz with sustain or fuzz without sustain.

## How We Did It

To explain how these sounds are realised, we have to consider the circuit diagram.

The input amplifier, IC1, gives the system some overall gain to boost the treble response and present the correct load impedance to the instrument. The mid-range gain is set to five, allowing 1 V peak-to-peak input signals before distortion and producing the largest possible dynamic range. The frequency response is flat from 20 Hz to about 2 kHz, after which an 8 dB step provides a gentle treble boost up to 20 kHz, where the response is rolled off.

Following the input stage is IC2a, one half of an NE571 compander IC configured as a conventional compressor with a fixed compression ratio of 2:1. This compression effectively halves the dynamic range of the incoming signal by attenuating high level signals and boosting low level ones; thus the signal hangs on — "sustains" — for much longer than it otherwise would. The compression also provides a constant level drive to the clipping stage, making the fuzz sound independent of the instrument output level.

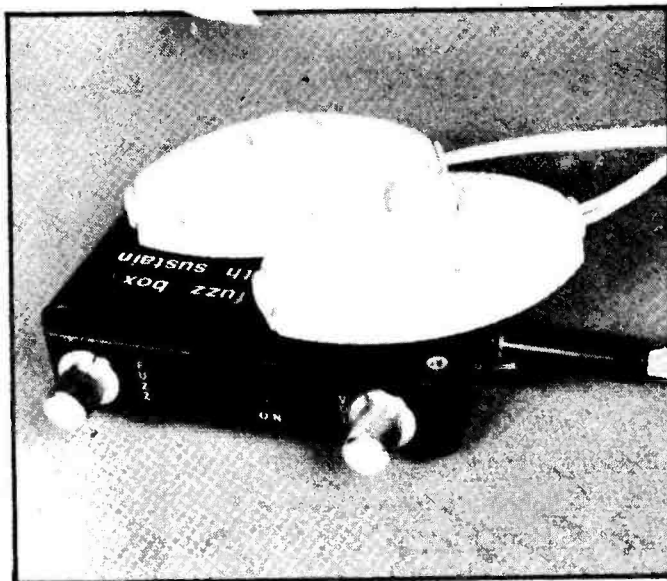
The fuzz stage, Q1, is a high gain amplifier stage. Because of the high, constant drive from the compressor it is always driven into hard clipping, resulting in an output which is substantially a squarewave. The output of the fuzz stage is fed through a tone control which varies the quality of the sound by rolling-off the high frequencies — one of the reasons for the treble boost at the input stage was to ensure that there would be some high frequencies to roll-off at this point!

## Following Envelopes

The by now well-and-truly fuzzed signal is fed to the signal input of IC2b, the second half of the NE571 compander. This time the device is set-up as an envelope follower with a signal input and a control input; the output of IC2b is whatever frequencies are applied to the signal input but with the amplitude envelope of the signal fed to the control input. It is this envelope follower, plus some simple switching, which makes the Fuzz Unit so versatile — of which more shortly!

A deliberate modification to the envelope follower ensures that IC2b shuts-off completely when the signal on the control input falls below a certain level. This is a simple 'noise gate' function which prevents the amplification of low-level signals and noise, eliminating the hisses and buzzes of unwanted sounds and the squeals and howls of unexpected feedback! This function operates only when Fuzz function is selected.

The Fuzz Unit is capable of producing either sustain, fuzz with sustain, or fuzz without sustain. These variations are



achieved by selecting the appropriate output and the appropriate drive to the control input of the envelope follower.

The switching system is entirely electronic, so the guitar signal never leaves the box even if the footswitches themselves are a dozen yards away. The signal is not required to travel long lengths of cable and so is not attenuated or subject to interference. Also, single-pole non-audio type switches may be used, allowing a larger choice of switch types.

Two switch lines are used to control four electronic switches operating as two sets of change-over switches. One line controls A and B, (sustain on/off), the other controls C and D (fuzz on/off).

If neither fuzz nor sustain is selected, A and C are closed while B and D are open; the output of the unit is derived from the input pre-amplifier (so it will be a little louder and a little brighter than the guitar itself) via A and C.

If sustain is selected A and B change over and the output is from IC2a.

## Selective Switching

Selecting fuzz closes D and opens C. Whether it is fuzz with sustain or fuzz without sustain now depends on the position of the sustain select switch. If sustain is selected the drive to the control input of the envelope follower is the compressed signal from IC2a; compression followed by expansion restores the amplitude envelope of the signal, so the output will have the dynamic characteristics of the original guitar sound, but will sustain for longer than usual. If sustain is not selected, the envelope follower control input is from the pre-amp. Therefore, the output of IC2b is the original signal expanded. Because of the value chosen for C7 and C16, the Fuzz Unit will produce a rather long 'delayed attack' effect when in



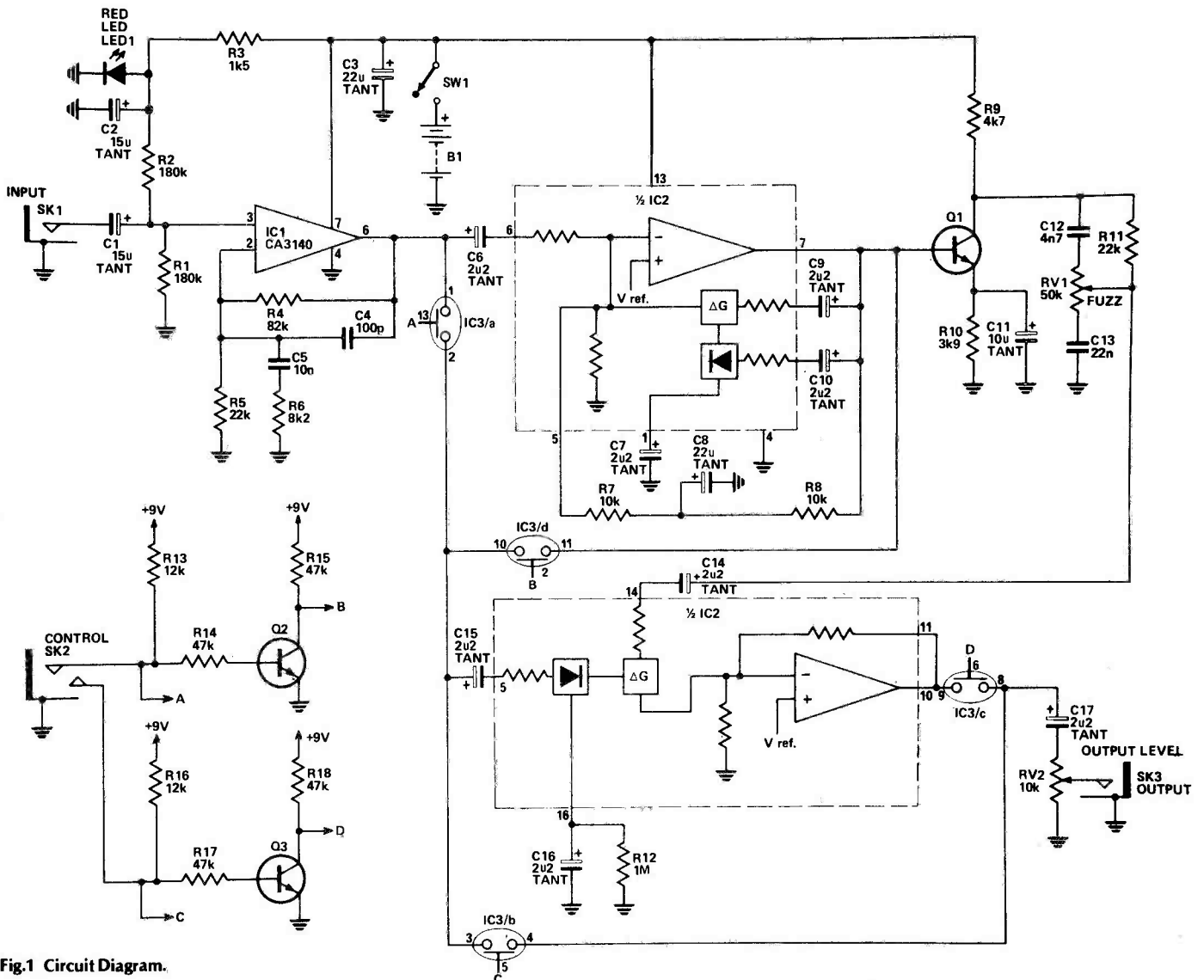


Fig.1 Circuit Diagram.

this mode. If a shorter attack is wanted, C7 and C16 should be reduced; this will give a faster attack in 'fuzz without sustain', and enhanced attack in 'fuzz with sustain'.

Once the box has been drilled, the PCB should be assembled according to the circuit and component overlay. Be sure that polarised components are correctly installed. The ICs should be put in last. Finally, make the control interconnections using the shortest possible lengths of wire.

Use insulated wire, and make sure that nothing is shorting to the box; the battery is best restrained by using a piece of double-sided tape.

After carefully checking that all connections are as they should be, apply power and you've got 'The Fuzz'.

Best results are obtained with the guitar output as high as it will go without causing distortion on loud notes when The Fuzz is switched to sustain only.

## BUYLINES

Components for the ETI Fuzz/Sustain Box are readily obtainable from suppliers advertising in this issue.

## HOW IT WORKS

The input amplifier (IC1) is a CA3140, chosen for its low noise. The input impedance of the device is quite high, so the effective value is determined by the parallel combination of R1, R2; the values used give end impedance of 90k. R1 and R2 can be as low as 10k or as high as 1M, as long as they are the same and within this range.

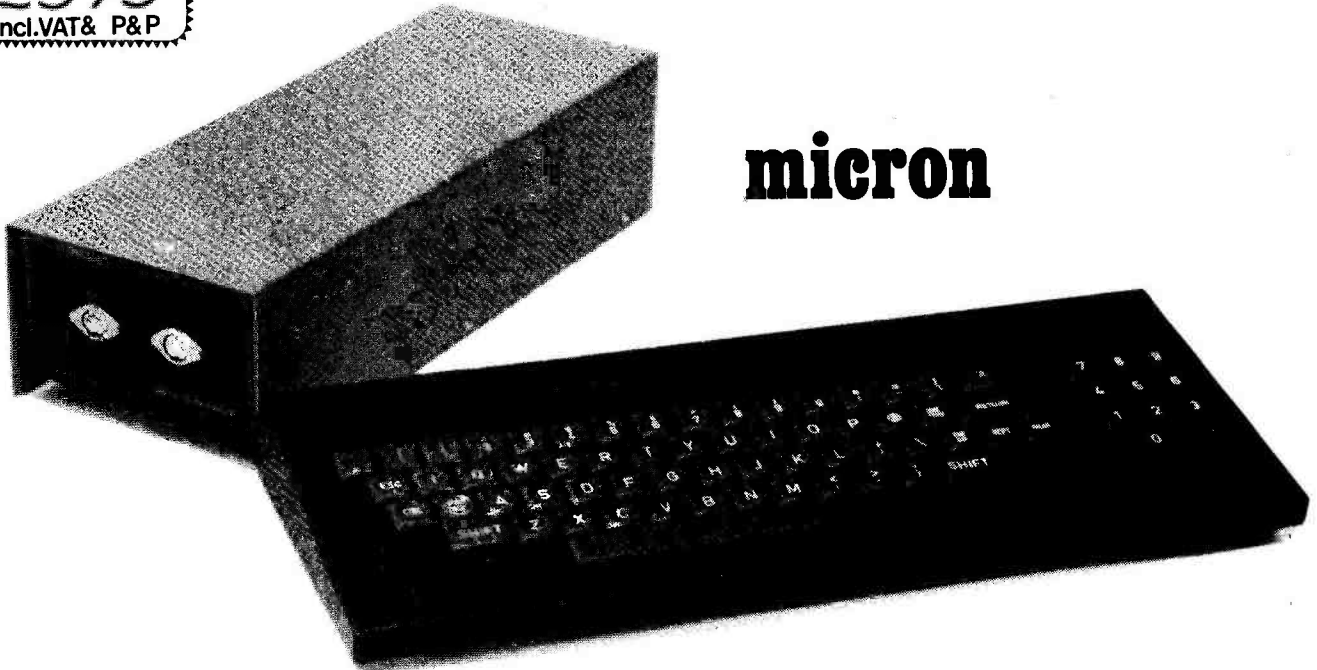
The bias for the CA3140 is filtered and regulated by R3, C2 and LED1; the LED also acts as a 'power on' indicator! The LED must be red as other colours have a different forward voltage. The stage gain of five is set by the ratio of R4 and R5, while C4, C5 and R6 tailor the frequency response.

IC2 is a dual gain control IC, NE571, which may be set-up to implement a number of signal processing functions. Each half of the IC consists of a full wave rectifier acting on the control input, a variable gain cell (signal input), an operational amplifier and a bias system. The blocks may be set-up as, for example, a compressor, an expander, a limiter or an envelope follower. The compression/expansion ratio is internally set at 2:1 while the attack and release times are determined by an external timing capacitor and an internal resistor, the attack-to-decay time ratio is internally set at 1:5.

It is possible to vary both the compression ratio and the attack/decay ratio by the use of complex external circuitry. However, the internally set values are adequate for the purpose of this gadget.



**£395**  
incl.VAT& P&P



'MICRON' may sound small - but we all know that it's much larger than an atom!

The un-beatable features of Microtan 65 and Tanex have been brought together to give you **Micron**, a ready built and tested computer of outstanding value. Fully supported by comprehensive documentation, **Micron** represents an ideal starting point in personal computing. We've taken a full O.E.M. licence for Microsoft Basic, which means that you'll have the support of the most popular Basic available, (as used on PET, APPLE, TANDY etc.). If you want to expand **Micron** there's no problem, just move into the system rack and choose from the range of Microtan modules. Read the information, study what the magazines have to say about us and compare what we have to offer with other systems, then we feel sure that you'll be convinced that we've produced an excellent product.

- FULLY BUILT, TESTED AND CASED.
- 6502 BASED MICROCOMPUTER.
- VDU ALPHA NUMERIC DISPLAY.
- 8K RAM.
- 32 PARALLEL I/O LINES.
- 2 TTL SERIAL I/O LINES.
- 1 SERIAL I/O PORT WITH RS232/20mA LOOP, AND 16 PROGRAMMABLE BAUD RATES.
- 300 / 2400 BAUD FILENAMED CASS. INTERFACE.
- DATA BUS BUFFERING.
- MEMORY MAPPING CONTROL.
- 71 KEY ASCII KEYBOARD, INCLUDING NUMERIC KEYPAD.
- POWER SUPPLY INCLUDED.

#### SOFTWARE

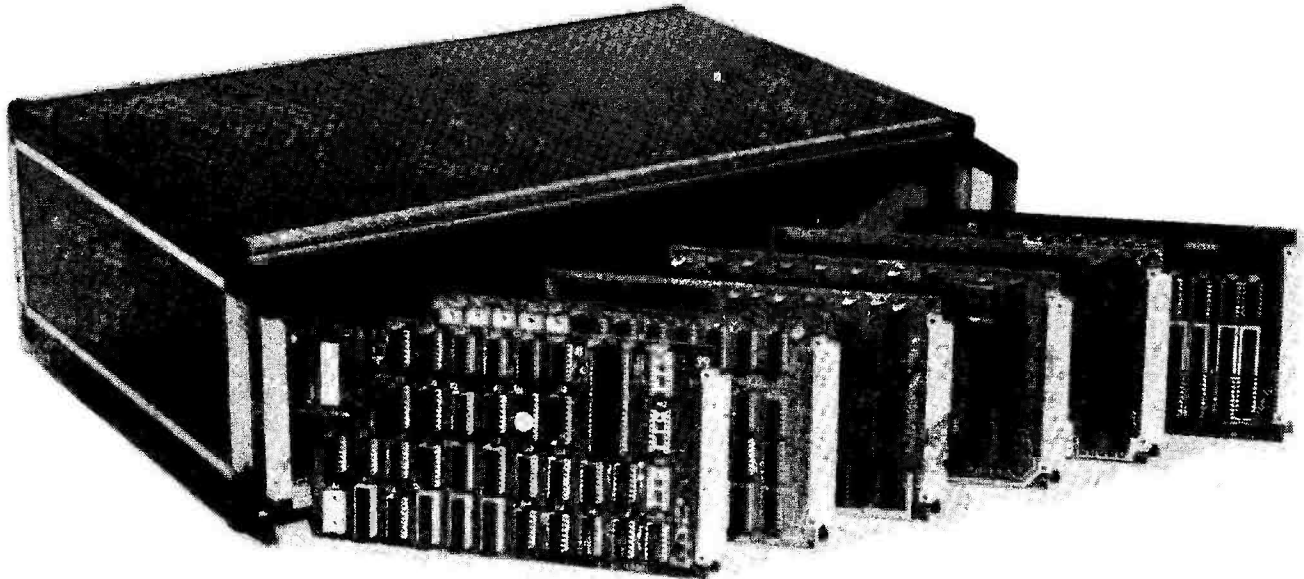
- 10K EXTENDED MICROSOFT BASIC.
- ALL THE USUAL BASIC COMMANDS.
- INTEGER AND REAL NUMBERS.
- INTEGER AND REAL ARRAYS.
- INTRINSIC FUNCTIONS: ABS, INT, RND, SGN, SIN, SQR, TAB, USR, ATN, COS, EXP, LOG, TAN.
- USER DEFINED FUNCTIONS.
- READ AND DATA STATEMENTS.
- DUMP AND LOAD PROGRAMS.
- PROGRAM EDITING COMMAND.
- STRING FUNCTION FOR TEXT I/O.
- BASIC CAN CALL MACHINE CODE SUB-ROUTINE.
- USER MACHINE CODE INTERRUPT HANDLER INTERFACES WITH BASIC.
- XBUG.
- DATA CASSETTE FILE HANDLING IN BASIC

**TANGERINE**  
COMPUTER SYSTEMS LIMITED

Forehill Works  
Forehill Ely Cambs England Tel: (0353)3633



# microtan 65



The **Microtan** system is rapidly becoming accepted as the ultimate approach to personal computing. Start with **Microtan 65**, a 6502 based single board computer, and expand to a powerful system in simple and in-expensive stages. The **Microtan** system is a concept and not an afterthought, this means expansion is easy and very efficient! Unlike many other systems, you'll find it difficult to outgrow **Microtan**, and you won't be wasting your money on a product that will only last you a few months! When you are ready to expand, **Tanex** is waiting. The features offered by **Tanex** are tremendous, and you can start into them for just £49.45! Cassette interface, 16 I/O lines, two 16 bit counter timers, data bus buffering, memory mapping and a further 1K of RAM are standard. From thereon expansion is simple, just plug in extra integrated circuits to get yourself 8K of RAM, a further 16 I/O lines and two more counter timers a serial I/O line with RS232/20mA loop and full modem control, **XBUG** - a firmware package containing cassette file handling routines, plus a line-by-line assembler (translator) and dis-assembler, **PLUS 10K EXTENDED MICROSOFT BASIC**, a suped-up version of the Basic as used by major manufacturers such as Apple, Tandy and Nascom, **NO OTHER LOW COST MICROCOMPUTER OFFERS YOU THIS SUPERB PACKAGE**. O.K. so you want more memory, try **Tanram** for size! Upto 40K bytes on one board starting for as little as £50.60. RAM freaks will be pleased to hear that our system mother board offers page memory logic which will support 277K Bytes, satisfied? To house these beautiful modules you can choose between our mini-rack (as used on **Micron**), which accepts **Microtan** and **Tanex**, or our system rack pictured above. The system rack will support 12 modules. What are these extra modules? Well for starters there's a couple of I/O modules, parallel and serial offering upto 128 I/O lines organised as 16 8 bit ports and 8 serial I/O ports respectively. Shortly we'll be introducing high definition (256x256) colour graphics, A to D and D to A modules, IEEE 488 Bus interface, a PROM programmer, disc controller and **TANDOS** - a 6502 CPM system. So there's plenty to keep you busy. Send for more details, and find out how you can get started for just £79.35!

**ALL PRICES QUOTED INCLUDE V.A.T.**

## **AIM 65, KIM 1, SIM 1 USERS- READ ON!**

We have produced a T.V. interface module which simply connects to the expansion socket of your computer and produces a display of 16 rows by 40 characters! Of even more interest will be our Buffer module, which allows you to expand into our system rack, giving you access to the full range of **Microtan** modules.

Please underline the information required.

AIM T.V. INTERFACE.      MICROTAN SYSTEM.

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PLEASE ENCLOSE 12p STAMP. THANK YOU.





Official orders welcomed, Govt./Educational Dept., etc.

## Panel Meters



Dims:- 50 x 45 x 33mm. Require 38mm dia. cut out

cat.	F.S.D.	
MU90	0-50 U/A	£3.20 + 15% VAT P&P 35p, 10 plus 10% Discount
MU100	0-100 U/A	
MU1	0-1 MA	
MUVU	"VU"	

Dims:- 60 x 47 x 33mm. Require 38mm dia. cut out

FINE QUALITY - JAPANESE MANUFACTURER		
T21	0-50 U/A	£3.75 + 15% VAT. P&P 35p, 10 plus 10% Discount
T22	0-100 U/A	
T23	0-500 U/A	
T24	0-1 MA	
T25	0-5 MA	
T26	0-10 MA	
T27	0-50 MA	
T28	0-100 MA	
T29	0-100 MA	
T30	0-1 AMP	
T31	0-2 AMP	
T32	0-25 Volts	
T33	0-50V AC	
T34	0-300V AC	
T35	"VU"	
T36	"VU"	
T40	50-0-50 U/A	
T41	100-0-100 U/A	
T42	500-0-500 U/A	
T43	0-30V DC	

Dims:- 110 x 82 x 35mm. Require 58mm dia. cut out

FINE QUALITY - JAPANESE MANUFACTURER		
O43	0-30 U/A	£4.75 + 15% VAT. P&P 35p, 10 plus 10% Discount
O45	0-50 U/A	
O410	0-100 U/A	
O420	0-200 U/A	
O450	0-500 U/A	

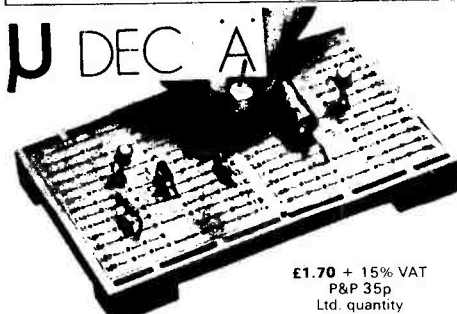
Illuminating kit for meters. T21-T43/O43-O450.

IK2	60p + 15% VAT.
-----	----------------



Dims:- 52 x 52 x 33mm. Require 45mm dia. cut out

cat.	F.S.D.	
MS50	0-50 U/A	£2.88 + 15% P&P 35. 10 plus 10% Discount
MS100	0-100 U/A	
MS1	0-1 MA	
MSVU	"VU"	



£1.70 + 15% VAT  
P&P 35p  
Ltd. quantity

This board is designed solely for the use of discrete components and is particularly useful for basic educational purposes. (No. of contacts: 208)

## ALUMINIUM CHASSIS

6''x3''x2 1/2''	£0.58
6''x4''x2 1/2''	£0.60
8''x3''x2 1/2''	£0.60
10''x7''x2 1/2''	£0.80
12''x3''x2 1/2''	£0.65
12''x5''x2 1/2''	£0.80
12''x8''x2 1/2''	£0.90
14''x3''x2 1/2''	£0.70
14''x7''x2 1/2''	£0.87
14''x9''x2 1/2''	£0.96
16''x6''x2 1/2''	£0.87
16''x10''x2 1/2''	£1.17

ALL PRICES PLUS VAT  
CALLERS ONLY

CARRIAGE ON LARGE  
QTY'S. ARRANGED

<p><b>MOTORS.</b> 1.5V Model motors 22F. Sub. min. big tick 115V DC 3 rpm motor 32p. Replacement 8 track 12V DC motors 55p. General motor 2 1/2 rpm. 75p. 115V AC 4 rpm motor 95p. Cassette motors. 5-8V DC ex. supply. 70p. 8V DC Cassette motors 90p. 6V Cassette motors. New standard 5p. type £1.25.</p>	<p><b>RECORDING TAPE.</b> Low noise mylar. supplied unboxed. 7" 1200' £1.00. 7" 1800' £1.75. 10" 3500' £5.00. JACKSONS CD04 50 PF variable tuning condensers. Standard 1/4" spindle 50p each.</p>	<p><b>FLUORESCENT LAMPS.</b> For caravans, boats, etc. white fitting, paraxip, diffuser. 12V DC. 8 watts. no. of switch £4.95.</p>	<p><b>MOTOROLA PIEZO ELECTRIC TWEETERS.</b> 3" direct radiating type £3.65</p>	<p><b>TRANSFORMERS.</b> All 240V DC primary (postage per transformer is shown in brackets after price). MINATURE RANGE 0-0.6V 100ma. 9-0.9V 75ma. 12-0-12V 50ma all 15p each (15p). 12V 200ma 75p (15p). 0-5-0.5 200ma £1.20 (20p). 6V 500ma £1.10 (22p). 12V 2A £2.35 (45p). 12V 4A £2.85 (45p). 15-0-15V 1A £2.25 (45p). 30-0-30V 1A £2.85 (54p). 20-0-20V 2A £3.65 (54p). 0-12-15-20-30V 2A £4.75 (54p). 20V 2.5A £2.35 (54p).</p>	<p><b>TRIAC XENON PULSE TRANSFORMERS.</b> 11 (GPO style) 32p. 11 plus 1 sub. mm pcb mounting 65p.</p>
<p><b>BUZZERS.</b> Miniature solid state type. 33x17x15mm. 70db at 3 feet 15ma drain. operates 4-15V DC 75p each. LOUD 12 volt buzzer 50x30mm 55p. Carriers 12V DC. Miniature alarm alarm. £1.85. 12V DC SIREN. all metal rotary type. high pitched wail. £8.50. Rotary alarm alarm. 12V DC. red plastic unit with mounting bracket. 86x75mm. £4.50.</p>	<p><b>TOOLS. SOLDER Sucker.</b> good suction. Jeton nozzle. £4.99. Side cutters 5" £1.45. Pliers 5" £1.45. NEON DRIVER 6" LONG 50p. MIYAMA 16 pin IC test clip £1.85. 5 PIECE practice screwdriver set. In. divided handles. £1.05. JUMPER TEST. LEAD SETS 10 pairs of leads with insulated crocs each end 90p. CRIMPING TOOL. a combination type for crimping red, blue and yellow terminations also incorporates a wire stripper (6 gauges) and wire cutter. Insulated handles. only £2.30.</p>	<p><b>COPPER LAMINATED PRINTED CIRCUIT BOARD.</b> Fibreglass single sided type (approx. 2mm thick) 150x150mm 40p. 200x90mm 55p. Double-sided Fibreglass 1mm thick. 180x135mm 45p. PAXOLIN BASED TYPE: (2mm thick). 180x135mm 40p. 200x200mm 50p.</p>	<p><b>PIEZO TWEETERS.</b> require no crossover and can be used with systems up to 100 watts. Frequency response 3.8 to 20KHz.</p>	<p><b>PROJECT BOXES.</b> Sturdy ABS black plastic boxes with brass inserts and lid. 75x56x35mm 65p. 95x77x35mm 75p. 115x99x37mm 87p.</p>	<p><b>VERO HAND HELD BOX.</b> White ABS. 24in x 3.7 in tapered, with screws 65p each.</p>
<p><b>RELAYS.</b> 2 types both operate on 12V DC. sealed plastic cased types. -350 ohm with 2 make 5 amp contacts 75p. 2-1,000 ohm with 2 changeover 1 amp contacts 75p.</p>	<p><b>MICROPHONES.</b> Min. Tie pin. Dnt. uses dead air battery (supplied) £4.95. Low cost condenser ECM105 Dntel. 600ohms. on/off switch standard jack plug £2.95. EM507 Condenser. onl. 600ohms. 30-18kHz. highly polished metal body. £7.95. DYNAMIC stick microphone dual imp. 500ohms or 20k. 70-15kHz. attractive black metal body. £7.75. EM506 Condenser. cardiod. onl. 600ohms or 50k. heavy chromed copper case. £12.95. DYNAMIC P.A. Mike. mobile radio etc. thumb switch 50k imp. £3.75. CASSETTE replacement microphones with 2.5-3.5 plugs £1.25. INSERT crystal replacement 35x10mm 40p. GRUNDIG Electrical inserts. built in FET preamp 3-6V DC. £1.00.</p>	<p><b>TAPE HEADS.</b> Mono cassette. £1.75. Stereo cassette £3.90. Standard 8 track stereo £1.95. 8SH MM 1330 1/2 track 50p. BSR SRP90 1/4 track 12.10. T010 dual head standard 2 heads both 1/2 track R/P with built in erase £1.25.</p>	<p><b>MULTI-SOUND HORN SYSTEMS.</b> ideal disco use. 6 controls. will give 81 various sounds, suitable with P.A. horn, speaker. operates on 12V DC £19.50.</p>	<p><b>VERO POTTING PLASTIC Boxes</b> with lid and screws 70x50x20mm. black. 43p each.</p>	<p><b>VERO HAND HELD BOX.</b> White ABS. 24in x 3.7 in tapered, with screws 65p each.</p>
<p><b>SPECIAL OFFER SEMICONDUCTORS.</b> 2N2002 50c. 10p. 8T504 opto isolator 25p. CA3130 95p. CA3020 45p. TDA1151 25p. 741 22p. 723 35p. NE555 24p. NE555 50p. CD4069 15p. M40005 10 for 35p. 80238 20p. 80438 20p. 7415 35p. 2N414 75p. TL308 10p. LED display 65p. Min. LED. LED 0.2" CLEAR 15p. GREEN 12p. RED 10p. Infra-red clear LED 30p. MPU311 PUTs. 40V. 200ma. 375mW 15p. 2N3773 £1.70. Texas TI038 (T03) Power Trans. 50p. TAG4443 82p. 50p.</p>	<p><b>SWITCHES.</b> Sub. min. Toggle. SPT 8x5x7mm. 42p. DPDT (8x7x7) 55p. DPDT Centre off (12x11x9mm) 77p.</p>	<p><b>PUSH SWITCHES</b> (16x6mm). red top. push in make 15p each. push on break version black vinyl 17p each.</p>	<p><b>RANK ARENA</b> stereo cartridge pre-amplifier modules. suitable for magnetic cartridges. now supplied with connection details. £1.95.</p>	<p><b>FINNED HEATSINKS.</b> Supplied undrilled 4mm thick. 27mm high. 75x124mm 80p. 150x124mm 95p. Smaller version 2.7mm thick. 75x108mm 48p. TRANSISTOR SOCKETS T05 or T08 9p each. T03 type 15p each.</p>	<p><b>CLIFF CLICKTEST.</b> 13 amp mains controller. ideal for workbench, etc. provides rapid and safe mains connection. tough moulded case and lid with neon indicator and fuse £5.15.</p>
<p><b>NEW STOCK ITEM</b> - We are now stocking Expo mini hand-held drills. these are a precision British-made tool. ideal for P.C. board drilling, model makers etc. They operate on 12V DC. Drill kit supplied in plastic hinged case, with drill and 21 accessories, drills, sanders, reamers, buffers, etc. complete kit only £14.25. Drill only £7.25. Drill stand to suit vertical drill press £12.95 (postage 8p).</p>	<p><b>LED VU METERS.</b> Ultra sophisticated logic control circuit with adjustable rise and decay times via external capacitor. Spec: Response -20Hz to 100KHz. Tolerance with 10% operation on 12-15V DC. 62mm high. 54mm high. MONO VERSION £6.95 STEREO VERSION £10.95</p>	<p><b>SLIDE SWITCHES</b> all DPDT 15x8x12mm 13p. 16x11x9mm 13p. 22x13x8mm 13p. 22x13x8 centre off 14p. Multipole slider double echan (12 tags) 29x9x9x1mm 25p.</p>	<p><b>ALUMINIUM PROJECT BOXES.</b> 18 S.W.G. with fitted lid and screws. AB1 3x2x1 52p. AB2 4x3x1 5m 62p. AB3 4x3x2 2in 66p. AB4 6x4x2 2in 74p. AB5 6x4x3 3in 82p. AB6 8x6x2 2in £1.05. AB7 8x6x3 3in £1.25.</p>	<p><b>YIN 360 M/METER.</b> 20,000 opv. 1KV AC/DC Volts. 250ma DC. 4 resistance ranges to 20 Meg. also has built-in transistor tester with leakage and gain ranges £12.50.</p>	<p><b>POWER SUPPLIES.</b> Switched type plugs into a 13 amp socket has 3.4, 5.6, 7.5 and 9 volts 0 c out at either 100 or 400ma. switchable £3.45. HC244R stabilised power supply 3-6-7.5-9V DC at 400ma. has polarity reversing and on off switch and is fully regulated to give exact voltage from no load to maximum current £5.50.</p>
<p><b>ROTARY SWITCHES</b> (water) 3P4W. 4P3W. 2P5W and 1P12W all 35p each.</p>	<p><b>16 pin D.I.L. SWITCHES</b> only 42p each.</p>	<p><b>RIBBON CABLE</b> 8-way single core miniature 22p per metre.</p>	<p><b>ANTEX SOLDERING IRONS.</b> All 240V AC. Model C 15 watts £3.95. Model CX 17 watts £3.95. Model X25 25 watts £3.95. ST3 SOLDERING IRON STAND. suits all Antex irons £1.65.</p>	<p><b>TRANSDUCERS, REC/SENER</b> 40KHZ £3.50 pair.</p>	<p><b>TMK 500 M/METER.</b> 30,000 opv. 1KV AC/DC Volts. DC current to 12 amps. Resistance to 60 meg in 4 ranges. also has built-in buzzer for continuity testing. £20.95.</p>

Terms. Cash with order (official orders welcomed from colleges etc) 30p postage please unless otherwise shown. VAT inclusive prices. S.A.E. for illustrated lists.

**PROGRESSIVE RADIO**  
31 CHEAPSIDE, LIVERPOOL L2 2JD  
ALL ORDERS DESPATCHED BY RETURN POST



# CAMBRIDGE LEARNING

# SELF-INSTRUCTION COURSES

*It's faster and more thorough than classroom learning: you pace yourself and answer questions on each new aspect as you go. This gives rare satisfaction - you know that you are really learning and without mindless drudgery. With a good self-instruction course you become your own best teacher.*

## Understand Digital Electronics

In the years ahead digital electronics will play an increasing part in your life. Calculators and digital watches mushroomed in the 1970's - soon we will have digital car instrumentation, cash cards, TV messages from friends and electronic mail.

After completing these books you will have broadened your career prospects and increased your knowledge of the fast-changing world around you.

### DIGITAL COMPUTER LOGIC AND ELECTRONICS £7.00

This course is designed as an introduction to digital electronics and is written at a pace that suits the raw beginner. No mathematical knowledge is assumed other than the use of simple arithmetic and decimals and no electronic knowledge is expected at all. The course moves painstakingly through all the basic concepts of digital electronics in a simple and concise fashion: questions and answers on every page make sure that the points are understood.

Everyone can learn from it - students, engineers, hobbyists, housewives, scientists. Its four A4 volumes consist of:

**Book 1** Binary, octal and decimal number systems; conversion between number systems; conversion of fractions; octal-decimal conversion tables.

**Book 2** AND, OR gates; inverters; NOR and NAND gates; truth tables; introduction to Boolean algebra.

**Book 3** Positive ECL; De Morgans Laws; designing logic circuits using NOR gates; dual-input gates.

**Book 4** Introduction to pulse driven circuits; R-S and J-K flip flops; binary counters; shift registers; half-adders.

### DESIGN OF DIGITAL SYSTEMS £12.50

This course takes the reader to real proficiency. Written in a similar question and answer style to Digital Computer Logic and Electronics, this course moves at a much faster pace and goes into the subject in greater depth. Ideally suited for scientists or engineers wanting to know more about digital electronics, its six A4 volumes lead step by step through number systems and Boolean algebra to memories, counters and arithmetic circuits and finally to an understanding of calculator and computer design.

**Book 1** Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems; binary multiplication and division.

**Book 2** OR and AND functions; logic gates; NOT, exclusive-OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; karnaugh mapping; three state and wired logic.

**Book 3** Half adders and full adders; subtractors; serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.

**Book 4** Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive-OR feedback counters; random access memories (RAMs) and read only memories (ROMs).

**Book 5** Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction decoding; control programme structure.

**Book 6** Central processing unit (CPU); memory organization; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; computers; executive programs; operating systems and time sharing.

## Flow Charts and Algorithms

are the essential logical procedures used in all computer programming and mastering them is the key to success here as well as being a priceless tool in all administrative areas - presenting safety regulations, government legislation, office procedures etc.

### THE ALGORITHM WRITER'S GUIDE £4.00

explains how to define questions, put them in the best order and draw the flow chart, with numerous examples.

### GUARANTEE No risk to you.

If you are not completely satisfied, your money will be refunded upon return of the books in good condition.

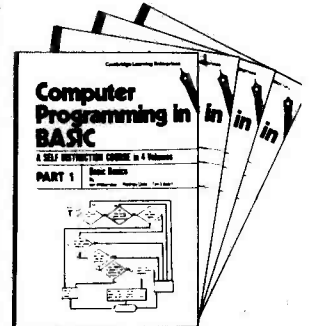
**CAMBRIDGE LEARNING LIMITED, UNIT 15  
RIVERMILL SITE, FREEPOST, ST. IVES, HUNTINGDON,  
CAMBS., PE17 4BR, ENGLAND.  
TELEPHONE: ST. IVES (0480) 67446**

All prices include worldwide postage (airmail is extra - please ask for prepayment invoice).

Please allow 28 days for delivery in U.K.

## Microcomputers are coming - ride the wave! Learn to program.

Millions of jobs are threatened but millions more will be created. Learn BASIC - the language of the small computer and the most easy-to-learn computer language in widespread use. Teach yourself with a course which takes you from complete ignorance step-by-step to real proficiency with a unique style of graded hints. In 60 straightforward lessons you will learn the five essentials of programming: problem definition, flowcharting, coding the program, debugging, clear documentation. Harder problems are provided with a series of hints so you never sit glassy-eyed with your mind a blank. You soon learn to tackle really tough tasks such as programs for graphs, cost estimates, compound interest and computer games.



### COMPUTER PROGRAMMING IN BASIC £9.00

**Book 1** Computers and what they do well; READ, DATA, PRINT, powers, brackets, variable names; LET; errors; coding simple programs.

**Book 2** High and low level languages; flowcharting; functions; REM and documentation; INPUT, IF...THEN, GO TO; limitations of computers; problem definition.

**Book 3** Compilers and interpreters; loops, FOR...NEXT, RESTORE; debugging; arrays; bubble sorting; TAB.

**Book 4** Advanced BASIC; subroutines; string variables; files; complex programming; examples; glossary.

### THE BASIC HANDBOOK £11.50

This best-selling American title usefully supplements our BASIC course with an alphabetical guide to the many variations that occur in BASIC terminology. The dozens of BASIC 'dialects' in use today mean programmers often need to translate instructions so that they can be RUN on their system. The BASIC Handbook is clear, easy to use and should save hours of your time and computer time. A must for all users of BASIC throughout the world.

### A.N.S. COBOL £4.40

The indispensable guide to the world's No. 1 business language. After 25 hours with this course, one beginner took a consulting job, documenting oil company programs and did invaluable work from the first day. Need we say more?

## ORDER FORM

Please send me the following books:-

..... Digital Computer Logic & Electronics @ £7.00

..... Design of Digital Systems @ £12.50

..... Algorithm Writer's Guide @ £4.00

..... Computer Programming in BASIC @ £9.00

..... BASIC Handbook @ £11.50

..... ANS COBOL @ £4.40

..... Your Booklist (Free)

I enclose a \*cheque/PO payable to Cambridge Learning Ltd.

for £..... (\*delete where applicable)

Please charge my:

\*Access/American Express/Barclaycard/Diners Club/Eurocard/Visa/  
Mastercharge/Trustcard

Credit Card No.....

Signature .....

Telephone orders from credit card holders accepted on 0480 67446 (Ansafo).

Overseas customers (incl. Eire) should send a bank draft in sterling drawn on a London bank, or quote credit card number.

Name .....

Address .....

Cambridge Learning Limited, Unit 15, Rivermill Site  
FREEPOST, St. Ives, Huntingdon, Cambs PE17 4BR, England.  
(Registered in England, No. 1328762)

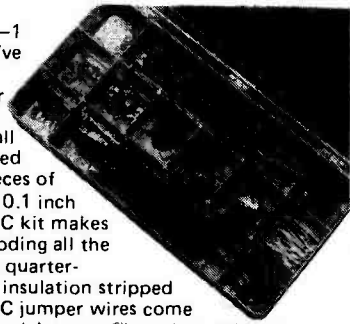






# JUMP TO IT!

Climb aboard the breadboarding bandwagon with CSC's new WK-1 wire jumper kit — just what you've always wanted to make breadboarding easier and quicker than ever before. Here, in one neatly compartmented box, are all those different lengths of insulated hook-up wire you need — 25 pieces of each, in 14 lengths ranging from 0.1 inch to 4 inches. What's more, the CSC kit makes your job even easier by colour-coding all the different lengths and providing a quarter-inch length at each end with the insulation stripped off and bent through 90°. So CSC jumper wires come ready to plug straight into your quick-test sockets, bus strips or breadboard system. No more fiddling around with wire cutters, strippers or pliers — everything you need in one box. Take the plunge right now by filling in the CSC coupon.



CSC (UK) Ltd. Dept. 9RR, Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ. Telephone: (0799) 21682. Telex: 817477.

WK-1 Jumper Kit £5.00 Nett. Unit price inc. P&P 15% VAT £6.90 Only Read

Please deduct £1 postage from each additional order.

I enclose cheque/PO for £ .....  
 or debit my Barclaycard, Access, American Express card  
 No ..... Exp. date .....  
 or Tel: (0799) 21682 with your card number and your order  
 will be in the post immediately.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CONTINENTAL SPECIALTIES CORPORATION



FREE catalogue tick box

Continental Specialties Corporation (UK) Limited, Dept. 9RR  
 Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

## TOMORROW'S TOOLS TODAY

# CLEF KITS



## NEW — ELECTRONIC ROTOR

Two-speed organ rotor simulator plus a three-phase chorus generator on a single PCB (8" x 5"). Kit includes all components — IC sockets throughout — mains operation and stereo headphone driver PCB. Easily integrated with existing organ. Component kit **£89.00**.

## KEYBOARDS

We believe that we have located the best manufacturer of square front Keyboards, as used in our Kits, and can also supply Keyswitch hardware including the industry standard soft plated contact springs

49 NOTE C-C **£23.80**  
 73 NOTE F-F **£37.00**  
 88 NOTE A-C **£45.00**

All Keyboards are easily cut to provide your required length and compass. Quantity enquiries welcome.

## BUILDING SERVICE

We are specialists in Electronic Piano Manufacture and can build your Piano for you — see lists.

## INFORMATION

Please send S.A.E. quoting items of interest. Telephone BARCLAYCARD orders can be accepted, all prices include V.A.T., carriage & Insurance.

## VISITS

Are welcome by appointment, otherwise Mail Order Only.

## EXPORT

Enquiries welcome — in Australia please contact JAYCAR (Sydney).

High Quality Electronic Musical Instruments under the personal supervision of Specialist Designer A. J. BOOTHMAN.

## JOANNA 72 & 88 PIANOS

Six and 7 1/4 Octave Electronic Pianos with unique Touch Sensitive Action as used in the P. E. JOANNA, which electronically simulates piano key inertia — a feature not available in any other design. Build this widely acclaimed professional instrument, for either Domestic or Stage use, from our top quality Component kits

SIX OCTAVES — **£207**  
 7 1/4 OCTAVES — **£232**

## P.E. STRING ENSEMBLE

The versatile String Synthesizer with a fantastic sound at an economic price. Split Keyboard facility with a range of impressive voices.

COMPONENT KIT — **£169**

Back up TELEPHONE advice is available from the designer to supplement the clear instructions included with the above Kits.

## P.A.'s — SPEAKERS — CABINETS

Units can be supplied to add to the Component Kits, including Domestic or Stage Cabinets and portable tubular legs.

## CLEF PRODUCTS (ELECTRONICS) LIMITED (Dept. E.T.I.)

16 Mayfield Road, Bramhall, Cheshire SK7 1JU. 061 439 3297

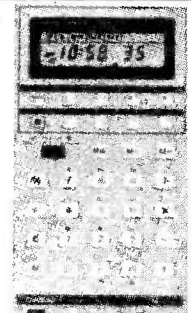
# Star Buys ★★★★★ FROM CASIO

## 12 MELODIES CASIO ML-90

## MELODY MAKER

(RRP £21.95)

ONLY **£19.45**



Clock, hourly chimes, calendar to 1999. Alarm 1: 7 different melodies changing daily, a fixed melody or buzzer. Alarm 2: a fixed melody or buzzer. Date memory 1: "Happy Birthday". Date memory 2: "Wedding March" or "Drinking Song". On December 24/25 plays "Jingle Bells". Calculator with 11-note keyboard, full access memory, square roots, %, 7/32 x 2 1/4 x 4 1/2 inches. Wallet. 1 year batteries.

## Mini SUPERCALC!

## FX-7100

1 YEAR BATTERIES. 30 scientific functions. As FX-8100 but 8 digits, without hyperbolics, fractions and calendar. Only 1 countdown alarm timer (repeat) or stopwatch function. Alarm and hourly chimes. 9/16" x 2 1/4" x 3 1/4". Leatherette wallet. (RRP £27.95)

**£24.45**



FX81 £12.45 FX-330 £16.45 FX510 £19.45 FX-2600 £19.45 FX-3200 £21.45 FX501P £52.45 FX502P £72.45 FA-1 £18.45

## Finger-touch keyboard

## CASIO C-801

Watch Calculator Stopwatch Dual time

(RRP £34.95)

ONLY **£29.45**



## CALCULATOR WATCH

Hours, minutes, seconds, am/pm and day. Day, date, month, calendar pre-programmed to 2009. Professional 24-hour stopwatch measuring net, lap, 1st & 2nd place times to 1/100 sec. Dual time (24 hour). 8 digit calculator. Backlight. Water resistant chrome plated case with stainless steel bracelet.

C-80 Black resin cased version **£24.45**

## OTHER CASIO WATCHES

- F8C Black resin case **£8.45**
- F80 Alarm Chronograph **£19.45**
- 83QS41B Alarm Chrono **£24.45**
- 83QS41B A/C gold plated **£29.45**
- 81QS40B Alarm Chrono **£24.45**
- 59CS33B S/S Dress Alarm **£32.45**
- 56QS50B Digital/Analogue **£34.45**

## LADIES CASIO WATCHES from £12.45

Send 20p for full details of all Casio watches and calculators

## EXECUTIVE ALARM CHRONOGRAPHS

## NEW 79CS-51B

Stainless steel

(RRP £44.95)

ONLY **£39.45**



Hours, minutes, seconds, am/pm and date. Calendar display. Day, date, month and year. Monthly calendar from the year 1901 to 2099. 1/10 sec. stopwatch to 12hrs. Net. lap, 1st & 2nd, 24-hour alarm with 10 step tone control. Hourly chimes, backlight, lithium battery

8.6mm thick. Mineral glass, water resistant.

## 81QS-35B ALARM CHRONOGRAPH

Stainless steel, mineral glass. Water resistant. 5-YEAR BATTERY. Hours, minutes, seconds, day and date, month and year. 12 or 24-hour display. 24-hour alarm, hourly chimes. Stopwatch from 1/100 second to 7 hours; net, lap and 1st and 2nd place times.

(£34.95) **£29.45**



TERMS OF BUSINESS: Please note all Casio items PRICE INCLUDES VAT P&P and insurance. Please send cheques or P.O.s or quote Barclaycard or Access No. to: B. BAMBER ELECTRONICS, 24 HOUR PHONE SERVICE. (0353) 880185 Callers welcome Tues. - Sat. 9.00 am - 5.30 pm.



# B. BAMBER ELECTRONICS

DEPT: ETI, 5 STATION ROAD LITTLEPORT CAMBS CB6 10E





# CASSETTE INTERFACE

Use ETI's supersonic interface to store and retrieve digital data at an incredible 4800 bits per second. Design by Hugh Koanantakool.

**M**oderate-speed cassette systems running at speeds up to 1200 baud have been with us for some time, but unfortunately the standard setters seem to prefer a slower 300-baud Kansas City standard. 300-baud can be too slow if you have a lot of data to manipulate and is suitable only for software distribution. That is, once the original chunk of a software package has been implemented in a system, the user or owner could then make a copy of that piece of software for his (or her) normal use. This working copy should be running at the highest data-transfer rate that the owner can afford. In case of a failure in the fast working copy, the user can always fall back on the original master copy running at the slow rate. This design enables you to store and retrieve digital data using an unmodified cassette recorder at 4800 bits per second. The prototype proved to be as reliable as any 300-1200 baud systems.

## Dropout

One reason for cassette load/save failures is tape dropout — momentary loss of playback signal due to the absence of, or damage to, the ferromagnetic coating somewhere on an imperfect tape; or due to bad contact between the tape and the tape head. In audio cassettes, the tape runs at 1.875 inches a second. Thus, for a 300-baud KC (Kansas City) tape, a bit of data occupies approximately 0.00625 inches — how tiny! Any dropouts which are larger than that size will cause one or more bits of errors. The only practical solution is to use high quality cassettes which are certified or known to be originally free from dropouts. This applies to both 300-baud and the fast 4800-baud systems. From experience most tapes which are error-free at 300 baud can cope well at 4800 baud, but in the latter case, cassettes having good high-frequency specifications are preferred.

## How Good?

This design aims to surpass all existing cassette interfaces in both speed and reliability, given that it should require no more hardware than other systems to build one. It should run

well with an average tape recorder and cassette tapes which can cope with the KC standard or CUTS 1200-baud standard. There will be no timing adjustments. The system can be implemented on any existing serial, asynchronous communication channel and thus can be readily added to most home computers. If it becomes impossible to run the system at 4800 baud due to any reasons including those in my list of observations then you might have to slow down the data rate to, say, 2400 baud.

To do so you only have to slow down your UART (Universal Asynchronous Receiver and Transmitter) clock frequency. There is nothing else to adjust, thanks to the all-digital timing.

## Phase Encoding

There is nothing new or magic about the phase encoding format for data storage on magnetic tapes. Figure 1 illustrates how it works. A logic one is represented by the 5 V level and the zero by 0 V (Fig.1b). Most tape recorders cannot record and playback slowly varying signals or DC. Therefore, a long series of ones or zeros will just come out the same if we attempt to connect the data signal (also called NRZ or Non-Return to Zero) directly to the recorder. This is because the data signal in NRZ format contains important information which is extended down to the very low-frequencies, beyond the frequency range of tape recorders.

Figure 1a shows a carrier wave oscillating at, in this case, 4800 Hz. The carrier is modulated by the data signal of Fig.1b by the following rules:

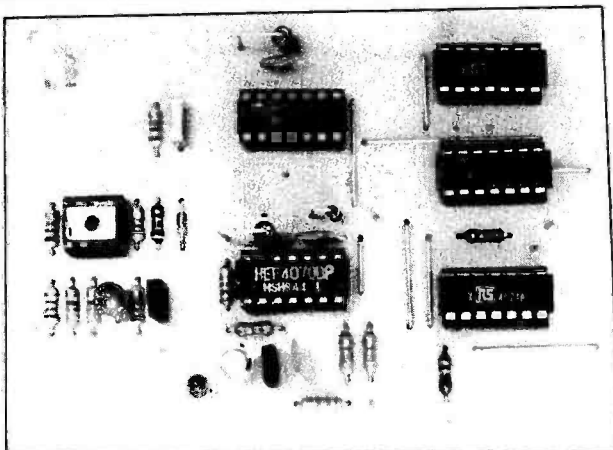
- The data signal is assumed to be synchronised to the carrier. This means their transitions (edges) are perfectly in alignment.
- The carrier wave is inverted if data is a one and normal ie non-inverted if data is a zero. The resulting modulated carrier is shown in Fig.1c.

The phase encoded signal in Fig.1c is known to contain very little energy at low frequencies and can be recorded and played back with little distortion.

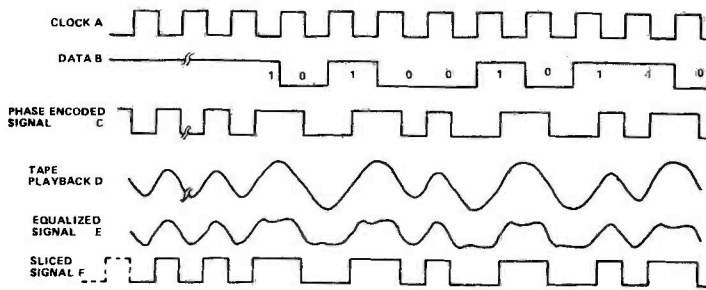
## Demodulation

Figure 1d shows the typical replay signal from the tape recording. Notice the rounding of all sharp edges — this is due to the high-frequency cut-off of the tape recorder. Also the high-frequency components of the signal will suffer from more attenuation than the low frequency components. By using some form of equalisation circuit, we can easily improve the signal into that shown in Fig.1e, which is now good enough for a slicer circuit to decide whether it is high or low. The sliced signal in Fig.1f is very similar to that of Fig.1c but it may or may not be inverted by the playback amplifier inside your recorder;

Construction of the board (left) should not pose any problems. The LED is on if there is no input or during normal data transfer and off if data transfer is about to take place or has just concluded.







**Fig.1 Timing diagram.** The signal output is attenuated to about 100 mV (RMS), suitable for the mic input of most cassette recorders. A high pass filter is included to pre-compensate any loss in high frequency in the cassette. You may not need pre-emphasis capacitor C2 if you use a hi-fi deck.

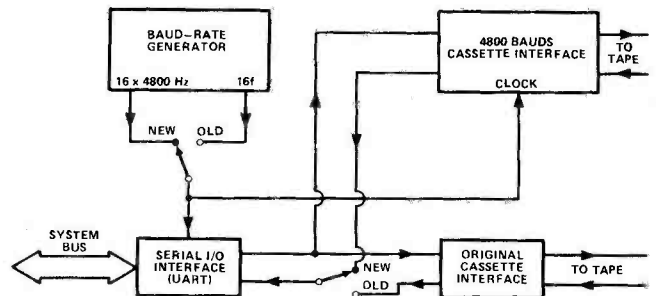
pulse transitions may not be so precisely timed as in Fig.1c due to tape-speed fluctuations and it is more or less independent of the playback volume control setting. We then feed the signal of Fig.1f to a digital circuit (a demodulator), which recovers the data signal (Fig.1b) from the sliced signal (Fig.1f) and presents it to the UART receiver section.

## Implementation

You will probably need a "double standard" approach at least in the beginning so that tapes can be converted from the original slow rate to 4800 baud. The interface circuitry can be connected to your computer system using five wires:

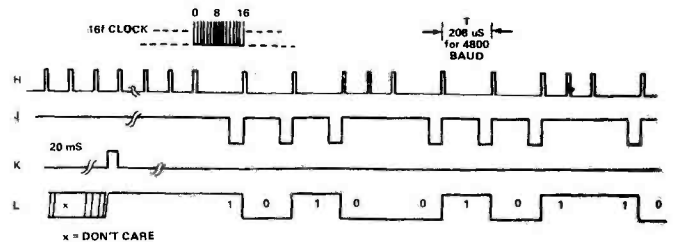
- two power lines (common earth and the 5V supply),
- two serial data lines (one for transmit (dump), one for receive (load)),
- one clock line running at 16x the baud-rate, i.e. 76,800 Hz at 4800 baud.

The only assumption made is that your computer software could handle the UART at 4800 baud. Some systems may not cope with a fast transfer rate. The serial I/O by program control instead of using a dedicated UART could be too slow, or maybe the VDU or TTY is not fast enough to dump some characters, eg filenames, in real-time. However, if you are using a memory-mapped VDU (PET, Superboard II, UK101, NASCOM, etc) or your system monitor buffers the load time messages in RAM, there is no problem, since no major hardware modifications are to be made and no software or data



**Fig.3 Adding the fast cassette interface to your system.**

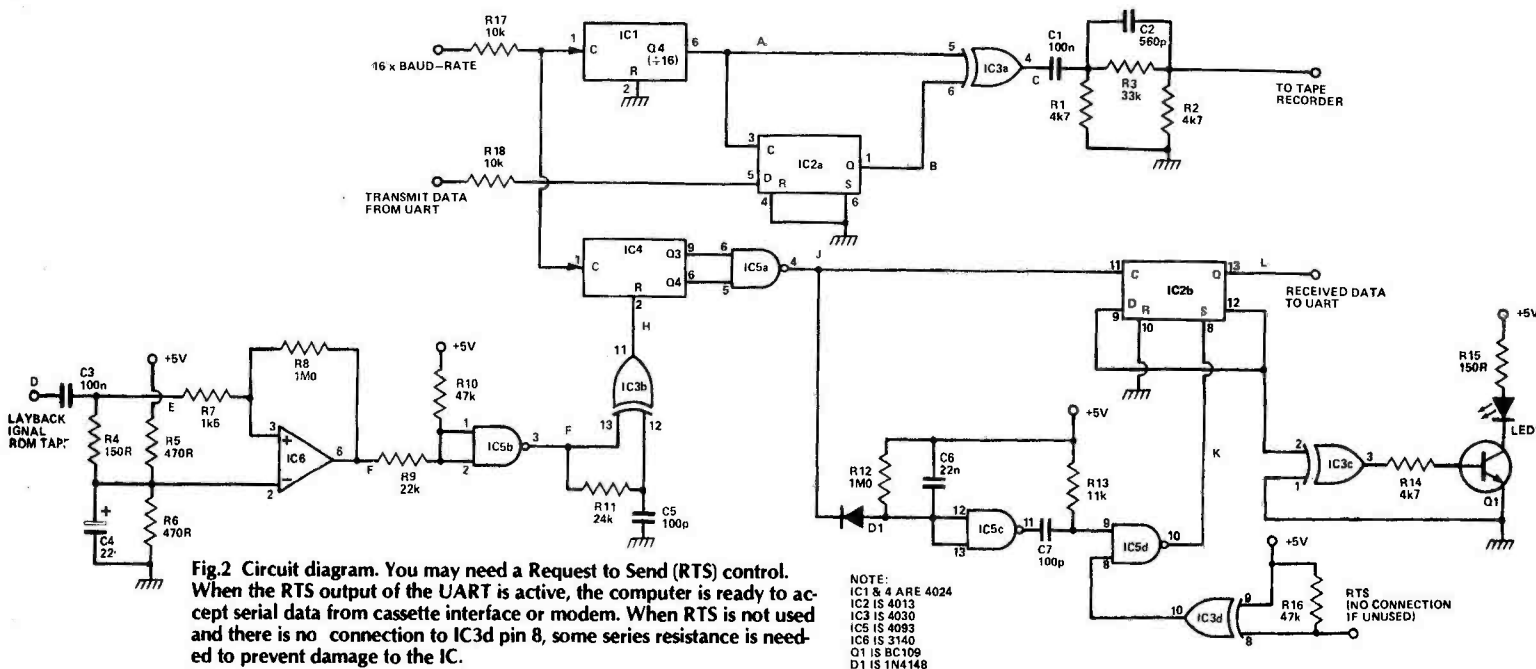
format to be changed. The fast system has been in use since March 1979, accumulating the bit error rate to better than 1 in 10. The tape conversion process is fairly straightforward; switch your system to the original interface, load the original tape to computer, switch to 4800 baud and record the same software onto a new cassette.



**Fig.4 Timing diagram.**

## Postscript

After experimenting with various kinds of tape recorders it is sad to say that some cassette recorders just cannot cope with the 4800-baud system. These recorders don't work with 300-1200 baud systems anyway, (or work with persistent troubles) and they can't even play back a continuous tone steadily! That is, if you record a tone and playback, it sounds so wobbly that anyone can detect its poor speed regulation.



**Fig.2 Circuit diagram.** You may need a Request to Send (RTS) control. When the RTS output of the UART is active, the computer is ready to accept serial data from cassette interface or modem. When RTS is not used and there is no connection to IC3d pin 8, some series resistance is needed to prevent damage to the IC.



## HOW IT WORKS

The upper part of Fig.2 is the phase encoder. IC1 divides the UART clock signal by 16 to 1x baud-rate. The UART data signal is then brought to synchronism to our local clock (carrier) by means of a D-type flip-flop (IC2a). This synchronisation circuit makes sure that data transitions at IC2a always take place at the rising edge of the local clock (at A). However, if the computer data and the local clock happen to be in synchronism already, (a random choice of 1/16), this D-type flip-flop might be in trouble. In reality, this "perfect" chance of trouble never occurs, since the UART's internal  $\div 16$  clock divider circuit works much faster than IC1, even though both are triggered by the same falling edges of the 16x clock. Thus it is sure to achieve perfect synchronisation.

The lower part of Fig.2 shows the receiver/demodulator section of the system. First the signal from the recorder's ear-phone plug is fed to IC6 via C3. The values of C3 and R4 are such that any drop in level of the high frequency signal from an average cassette recorder is equalised. IC6 then slices through the average level of the equalised signal (Fig.1e). IC6 is wired as a Schmitt trigger circuit in order to suppress the background noise during playback. The output of IC6 is further buffered by IC5b. R9 and R10 make sure that the op-amp signal is well within the input range of the CMOS gate, IC5a.

The sliced tape signal is then passed through IC3b, which is configured as a one-shot triggered by both positive and negative-going transients. Its function is to generate a short pulse at point H whenever there is a level of transition at pin 10 of IC5b. The timing diagram is continued in Fig.4 for the sake of explanation of the demodulation process. Pulses at H should be made as narrow as possible: anything shorter than 10  $\mu$ S will be suitable. The pulse duration at H is proportional to the product of R11 and C5. The narrow H pulses reset the binary counter IC4, which is again clocked at 16x baud-rate. The counter outputs Q3 and Q4 are NANDed so as to enable us to detect whether its count reaches 12 or more (1100 to 1111 in binary notation). In other words, as long as the H pulses are no more than 0.75T apart, where T is the duration of one bit, the output of IC5a at J will always be a one. This is because the counter is always reset to zero before it counts to 12. At 4800 baud, T is 208  $\mu$ S. Theoretically the H pulses are either 0.5T or T apart, corresponding to 8 and 16 counts respectively. Thus, discriminating the spacing interval by the threshold of 12 counts seems to be most logical, allowing some  $\pm 20\%$  tape speed fluctuation. In the other case, if the H pulses are more than 0.75T apart, we will get a negative-going pulse at point J. If there are no pulses at H at all, as in the absence of the playback signal from the tape, the signal at J will be pulsed regularly at the baud-rate frequency with the mark-space ratio of 12:4.

From the timing diagrams (Figs.1 and 4), we may conclude that a "change" of the carrier phase corresponds to a change in the original data stream. This change in turn corresponds to the larger separation between successive H pulses, equal to T. Subsequently, long separation of H pulses is detected as a J pulse. We can, therefore, recover the original data signal from the J pulses by using IC2b, connected as a toggle flip-flop. It inverts its state upon receiving a J pulse. All seems to go well but we might still run into trouble if we happen to start IC2b wrongly and get all the data bits inverted, yet still obeying the change conditions discussed. Care must, therefore, be taken to ensure that the logic state of IC2b is always properly defined before data transfer can take place.

Fortunately, the asynchronous serial data transmission convention is such that on a UART getting ready to transmit, it always sends a series of marks (logic one). This means that we always have a steady tone recorded prior to the actual data signal. Therefore, we can preset IC2b to logic one before any transfer process commences. This function is carried out by means of IC5c and d. If the carrier is detected continuously for longer than 20 mS, the circuit will assume that this is a series of marks or logic one. It then resets IC2b accordingly. All subsequent data bits will then be demodulated with the correct polarity.

These properties are usually associated with cheap recorders. Users must avoid recorders with peak speed-fluctuations well over  $\pm 20\%$ , our required tolerance. Poor speed-regulation of a new recorder is associated with the lack of motor-regulator circuit, but it can also happen to a more costly recorder if the pinch-roller has been deformed, eg by leaving the machine off in the play position for a long time.

To sum up, the 4800-baud system may not work with all recorders due to the following reasons, in order of seriousness:

- (a) recorder transport mechanics — you need a recorder that can at least reproduce clean steady tone,
- (b) tape quality : use tapes which are better than just a "low-noise one, eg "Super Dynamic", "High Frequen-

- (c) cy", etc, recorder bandwidth — you tend to get more bandwidth from a radio-cassette than a hand-held recorder.

If your system has an RTS line and you are using it to control the cassette's motor, then you may also use it to control the received data line of this interface as well. When there is no input signal from the recorder, the idling sequence at point L (Fig.2) is 1010101, which is a series of the valid ASCII 'U' characters causing over-run error in the UART. This error is normally reset by the tape loader routine before the data transfer takes place. A normal way of tape loading is to type into the computer, specifying a tape load command, start playing the cassette recorder until you hear the header tone (continuous 4800 Hz) then type RETURN to start loading. The presence of the continuous tone is also indicated by the LED going off temporarily. However, if you happen to get a monitor which does not reset the UART (eg the UK101), then you need to get rid of the 1010101... pattern by means of the RTS line. With RTS line low (no request for data transfer) the LED is also off and the data output line is kept high and no longer causes overrun errors.

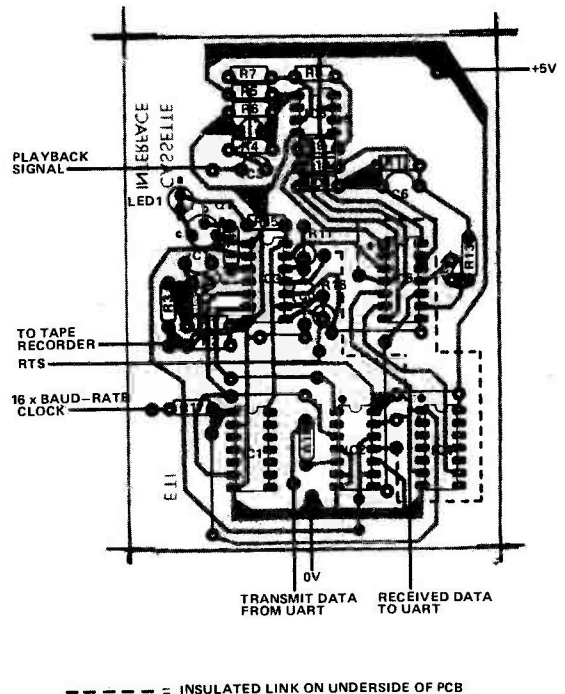


Fig.5 Component overlay.

## PARTS LIST

Resistors 1/4W, 5%	C2	560p ceramic	
R1,2,14	4k7	C4	22u 25V tantalum
R3	33k	C5,7	100p ceramic
R4,15	150R	C6	22n polycarbonate
R5,6	470R		
R7	1k5	Semiconductors	
R8,12	1M0	IC1,4	4024B
R9	22k	IC2	4013B
R10,16	47k	IC3	4030B
R11	24k	IC5	4093B
R13	11k	IC6	3140
R17,18	10k	Q1	BC109
Capacitors	LED1	D1	1N4148
C1,3	100n ceramic		TIL209



**LEAR SIEGLER model 310 Ballistic printer.** Save £400. **OUR PRICE ONLY £950** or make us an offer.  
**DEC VT52.** Used but clean **£650.**  
**TERMINET 30 PRINTER WITH TWIN CASSETTE.** 30 cps. Standard 232. **£700 or offer.**  
**NEWBURY VDU** with Keyboard Model 24-80 **£350 or offer.**  
**CIPHER VDU** with separate Keyboard (No case). Printer, port; reverse video / flashing etc **£375 each or offer.**  
**CALCOMP 564 BARREL PRINTER.** MUST GO. **£650.**  
**CIL PLOTTER on STAND.** Ex-Ministry VGC. **£850.**  
**FACTIT 4001 READER** with 2 spoolers 4015. **£475** the set. Please make an offer we can accept.  
**FACTIT PUNCH** with 5107 CONTROLLER **£250.**  
**DICOM Disk Drive 8"** Ex-Ministry Clean **£120 each.**  
**TELETYPE PUNCH** in Silent Case **£45 each.**  
**ARCTURUS A18D.** 16 bit mint. With Data. Another gift **£425.**  
**COMPUTER AUTOMATION ALPHA 16** with TTL Input Interface. Massive Documentation & quantity of paper tapes. And again a gift at **£390.**  
**HEWLETT PACKARD 2114A COMPUTER.** No Interface. No data. HENCE **£475.**  
**TELETYPES ASR 33** with 20ma Loop **£350 each**, 232 available at extra cost. KSR as above **£225 each.**  
**TWIN SHUGART** Floppy Drives a **£450 gift.**  
**A FEW OLIVETTI PRINTERS & KEYBOARD** Type Te300 still available — please enquire.

**STEPPING MOTORS**  
 200 Steps — 20-oz/in. torque, 12/24 volt input 4-wire.  
**£12 each. P&P £1.50**

**STEPPING MOTORS**  
 200 Steps. 20 oz./in. torque. 120 volt operating 3-wire.  
**£4 each. P&P £1.50**

BC172	5p	BC212B	5p	74C20	25p	2N5449	5p	BC251	5p
BZY884V7	10p	SN76550	5p	74C08	25p	2N3053	15p	BC171A	5p
BZY8813V	10p	IC7451	10p	74C10	20p	TIS92	10p	BF760	5p
2N3006	5p	MC4001	15p	MC4049	35p	TIS93	10p	4013	30p
1N4305	5p	MC4012	15p	2N3704	8p	BC337	8p		
BX279C12	10p	MC4020	75p	2N5447	5p	BC327	8p		

MONSANTO DISPLAY type MAN 101A 0.3" display. **£1 each.**  
 REGULATORS — all at **45p each.**  
 MC7805; 7812; 7815; 7912.  
 MC1496L 70p. TIS 50 — **10p each.** MC4016 — **25p each.** 74100N — **75p each.**  
 Miniature 4.7K PRESET. 10 for **25p.** 100 for **£2.**  
 16 pin DIL Socket **10p.** 14 pin SIL Socket **8p.**  
 LED type TIL 209 Red with holder **10p each.**  
 SLOTTED OPT SWITCH supplied with data — normally over **£2.** OUR PRICE **75p each.**  
 ROCKER SWITCHES 2 pole c/o — **15p each.**  
 Spring Action TERMINALS — normally over **30p ea.** OUR PRICE **15p each.**  
 TOROIDAL TRANSFORMER 0-11.5V-230V Input; 13.5V-0-13.5V rated 8VA output **£1.70 each.** P&P 75p.  
 Sub-min TRANSFORMER 0-120-240V Input. 12V-0-12V rated 4VA. Output **75p each.** P&P 50p.  
 L.E.D.s Standard White **12p;** Standard Yellow **15p;** Small White **8p.**

**709 DIL 14-PIN OPERATIONAL AMPLIFIERS**  
 at **8p each**  
 100 off 25% discount.

**MINIATURE KEYBOARD**

Push contacts, marked 0-9 and A-F and 3 optional function keys. **£1.75 each.** P&P 65p.

**MAGNETOS**

— Brand New. Boxed Ex-Ministry  
 Originally for Ministry aircraft, therefore finest quality — very reliable.  
 Ridiculous **£4.75 each**

**STEPPING MOTORS**

North American Phillips. 5 volt 3.3 Amp operation. 2 wire PPS 0-200 revs per min 0-250 used. Tested **£16 each.** P&P **£1.50**

**MUST CLEAR POLAR DISPERSION ANALYSER**

5" Display. These are supplied with STU 2 plug-in. 1 to 45 GHZ.  
**£95 each**

**TRANSISTOR INVERTOR**

115V AC 1.7 Amp Input. Switching is at 20KHz. Output windings from Pot Core. Can be rewound to suit own purpose or unit can be broken for host of components. Circuits supplied. **£1.25 each.** P&P **£2.**

**CONVERT THIS UNIT TO A SUPER BATTERY CHARGER**

Attractive green ministry quality case with removable top and bottom plates — heavy duty power switches — high powered resistors to control current — good quality centre mounted amp meter — strip of wing nut terminals on front panel which can be used for connecting leads. ALL THIS FOR **£3.50.** P&P **£2.** Four Units **£12.** Carriage **£5.**

**STEPPING MOTORS**

6/12 position with additional where the rotor is coils. Device can be used as a tachometer. Diagram supplied. Will actually work on 5 volts, 12/24 recommended.  
**£1.50 each** P&P 75p or 5 for **£5** P&P **£1.50.**

**INFRA RED IMAGE CONVERTER type 9606 (CV 144)**

1 1/4" diameter. Requires single low current 3KV to 6KV supply. Individually boxed. With data.  
**£12.50 each** P&P 75p  
 Infra Red Lamps also advertised

**KEYBOARD PAD**

Size 3x2 1/2x2" high with 12 Alma Reed Switches. Blue keys marked in green 0-9 and a star with one blank.  
**£4 each.** P&P **£1.** or 5 for **£15** P&P **£2.**

**EDDYSTONE RXS**  
 770R used tested **£95 each**  
 730/10 used tested **£77.50 each**  
 940 24V inverter version. Special Government Quality vgc  
**£165 each**

**TANTALUM BEAD CAPACITORS.** 4.7uf 25V. 10 off **£1;** 100 off **£7.50.** 330uf 6.3V 15p

**TEXAS Low Profile 40pin IC Sockets 45p ea.**

**SMALL TRANSFORMER.** 240V Input. Output 2 windings 12V and 24V 1 amp. **£2 each.**

**SO SIMPLE SO SAFE.**

Fit a push button **CIRCUIT BREAKER** Small, compact. 3 ratings 0.8; 1.8 and 10Amp. State which one when ordering. **75p each.**

**AMP METER** 2 1/2" dia. Scaled 0-60. Basic 75MV FSD. Complete with external 60 Amp Shunt. **£2.50 ea.** P&P **£1.50.**

**DIODES**  
 All new full spec. devices IN3063 BAX 13; 1S44; 1N4148; 1N3470; 1N4151.  
 100 off **£1.50** — 1,000 off **£10.**

**MUST CLEAR LARGE QUANTITY OF PHOTO MULTIPLIERS**

all with information. British. Approx. 2" window **£2 each.** British. Approx. 5" window **£3.50 each.** American. Approx. 2" window **£4 each.** Special American version by RCA **£6 each.** P&P all photomultipliers **£1.50 each.**

**BLUE THERMAL PAPER**  
 430ft roll 8 1/2" wide  
**£2 per roll P&P £1.75**

MARCONI Signal Generator type TF144H	£225
R&S UHF Signal Generator 280-940MHz USVD	£85ea
R&S ATTENUATOR 0-100db 50 ohm. DPR BN18042/50	£85ea
R&S Power Signal Generator D.1-30MHz SMLR BN41001	£85ea
R&S Direct Capacitance Meter KKH BN5201	£120
MARCONI voltmeter TF1041C	£30
MARCONI Signal Generator TF144H/4 Light front No Case	£175
R&S Z Graph type ZDD BN3562	£85
EHT UNIT 230V 50cs 25VA 7.5KV	£22.50ea
R&S SWOB BN4244/2/50; POLYSCOPE 1 As New	£375
STODDART Radio Interference & Field Intensity Meter complete with Power supply 375-1000MHz. No linking cable	£450
R&K Signal Generator type 365A. AM/FM 1-320MHz	£175ea
R&K Automatic Freq. Response Recorder type 3302 (Beat freq. Osc type 1014 with Recorder type 2304)	£350
MARCONI Signal Generator TF801B/1/S	£120ea
MARCONI Signal Generator TF801B	£80
MARCONI UNIVERSAL BRIDGE TF1313 1/4%	£250ea
MARCONI AM/FM Signal Generator TF95A/2	£130
MARCONI Carrier Deviation Meter TF791C	£130
ADVANCE 1 Meter type T2	£45
OSCILLOSCOPES — wide range from	£40ea

The above is a very small fraction of the test gear we have available. The prices we believe are fair — you persuade us they should be less. We will at least have the courtesy to listen. Call and see but please phone to make sure the items are still available.

**LEEX ROTARY SOLENOIDS.** 115V DC. No switch assembly. 15p ea.  
**DIAMOND H CONTROLS ROTARY SWITCH.** Single pole 10-way. Printed Circuit Mount. New 10p ea. 100 off **£7.**  
**DELAY LINE.** 50 nanoseconds. 3 connections — ground-in-out. Size 2" x 7 1/8" x 5 1/8". New 25p ea.  
**PULSE TRANSFORMER.** Sub min. size 1/2 x 5/16 x 1/4". Secondary centre tapped. New 20p ea.  
**MOTOR** by Inland Motor Corp. DC High Torque Reversible. Usable torque at 5V. Max voltage 24V **£2.50 ea.** P&P **£2.**  
**REMCO TV TYPE MULTIPLIER.** Two high voltage outputs and focus. **£1 each.**  
**DON'T TAKE CHANCES.** Use the proper EHT CABLE. 10p per metre or **£7.50 per 100 metre/drum.** P&P **£2.**  
**PHOTOGRAPHIC LAMPS.** Pearl 230V 500 watt. Screw cap 75p ea. Box of 12 **£5.50.** P&P **£1.50.**  
**RAPID DISCHARGE capacitors** 8mid 4kV **£5 each.** P&P **£2.**  
**MYSTERY IC PACK.** Some 40 pin — good mixture — all new devices. 25 ICs for **£1.** P&P 50p. You find out what they are and we will buy the information from you.  
**VACUUM PUMPS — TRAPS, ETC.** Send for list.  
**DECOUPLING CAPACITORS**  
 0.05mid. 10V. 0.01mid. 0.047mid. 250V. 33k. 330pf. All values 100 for **£1.50.**  
**E.H.T. Capacitor 600pf 8KV 20p each.**  
**10-way MULTI COLOUR RIBBON CABLE.** New 40p per metre. 10 metres for **£3.**  
**GEC UHF 4-button tuner.** **£1.50 each.**  
**CENTAUR 115V FANS** 4 1/4 x 4 x 1 1/2" **£4.50 ea.**  
**EX-USED equipment.** tested. **50p each.**  
**CONTACTORS.** Heavy Duty 24V DC 5 make **£1 each.**  
**GEC UHF/VHF 6-button tuner.** **£2 each.**  
**DIGITAL 24-HOUR CLOCK** with built-in alarm as used in Braun Digital clocks. Silent running. Large illuminated numerals. AC mains. Size 6 1/2 x 2 1/2 x 2 1/2". **ONLY £3.75 each.**  
**931A PHOTO MULTIPLIER** in stainless steel container with window and built-in resistor network. **£2 each.** P&P **£1.**  
**RANCO 250V 18A THERMOSTATS** with Control knobs calibrated 50-200 degree C. **£2.50 each.**  
**SOLID STATE UHF TUNERS.** 30 sets **£1 each.**  
**BRAND REK** blue wire wraps. 30 metres for **£1.** P&P 25p.  
**SLIDER CONTROL 500K Log.** Single track. Complete with knob. Length 3 1/2". **25p each.**  
**TRANSFORMERS**  
**AUTO 240V input** 115V. 1 Amp output **£1.25 each.** P&P **£1.25.**  
**240V input.** Soc. 6V. 1.86A. Size 2 1/2 x 2 x 2". Good quality. **£1.50 each.** P&P **£1.**  
**240V input.** Soc. 12V 0.92A. Size 2 1/2 x 2 x 2". Good quality. **£1.50 each.** P&P **£1.**  
**240V input** 12V 100MA. Size 60 x 40 x 42mm. **50p each.**  
**240V input.** Soc. 12-0-12V 50MA. Size 53 x 45 x 40mm. **£1.15p input.** Soc. 5V 250MA. Size 1 1/16 x 1.5 x 1 1/4". 2 for **50p.**

**SEMICONDUCTORS** 1N4005 — 6p; 1N4002 — 3p. At 5p each:  
 BC147, BC157, BC158, BC237, BF197, OA90, OA81, BC148B, BA154, BA243.  
 At 25p each:  
 TIP31, TIP41A, 2N296, AF139, 2TX341, BY127 10p, BF181 20p, BD239 40p, BD241 40p, MA343AT 45p, BD228 50p, BD233 & BD234 Comp Pair 25W — 80p per pair at 50p each.  
**REGULATOR TBA625.** 8 to 20V in — 5V out 100MA TO5 Con. 50p each BF256C 20p.  
**TV AMPLIFIER TBA 120 20p each.**  
**Integrated Circuits**  

7453	5p	74H74	12p	75325	£1
7451	5p	74H51	7p	SN15862	4p
7402	12p	74538	10p	MC4028	85p
7416	20p	74502	12p	7417	14p
7495	35p	74154	70p	7441	40p
74122	12p	74C02	16p	74C86	50p
74C00	17p	74C04	18p	74C161	24p

**MOTOROLA DUAL** in Line 6 pin Opto Coupler **30p each.** Gold plate tester version **50p each.**  
**EPROMS 2708 £1.50 each.**  
**SMITHS** encapsulated transistorised AUDIBLE WARNING DEVICES 4V-12V. Can be driven from TTL **85p each.**  
**ELECTROSTATIC VOLTMETERS.** 7.5KV **£8 each.** P&P **£1.50**  
 Other ranges available. Please enquire.  
**TRIMMERS.** Sub-min 0.25 to 1.25 pf. 1 to 4 5pf. 7 to 45pf. All at 6p each.  
**HONEYWELL** humidity controllers **50p each.**  
**THYRISTOR TIMER.** Solid State. 15 secs adjustable (reset) in plastic relay case. Standard 7 pin base. Series delay **50p each.**  
**MINIATURE PC MOUNT SLIDE SWITCH.** Single pole 3-way **10p each.**

**LARGE EX-MINISTRY SPEAKERS.** OUTSIDE 15 ohm or 500 ohm. Tested. **£25 each** or 5 for **£100**

Some EHT Transformers and Capacitors available. Please enquire.  
**TELEPHONE 706** style black; grey or blue **£5.50 ea.**; 746 style black or grey **£7.80.** Older style black **£2.50 each.** Discoupled grey 706 **£4 ea.** P&P **£1.50** per telephone. INSERT can be used as Microphone/Earpieces (like used as insert in telephone but superior quality Ex-Min. Brand new wrapped **75p each** or 10 for **£8.**  
**DC SERVO MOTOR 110V 2.5Amp** continuous. Double shaft. Brand new. 4 wire. 4 brush **£25 ea.** Plus carriage.  
**PC Mount POTS.** Wire wound with knob 200 ohm & 10ohm. **10p**  
**CAPACITORS** at 5p ea. — 0.1 uF 400V Small rec. block PC Mount German Class 3300pf; 220nF 250V.  
 Capacitor 0.1mid 250V AC — **10p ea.**  
**4 DIGIT 7 SEGMENT** per digit plus a figure one to the left plus a centre minus sign to the left of the figure one with decimal places between digits. Good brilliance at 1.5V 15 connections **£2.50**

**VARIACS** Ex-Equipment. Good condition 8 Amps **£25 ea.**  
 20 AMPS **£35 ea.**  
 Some 3 phase available. Please enquire.

**CRYSTALS** 50p each.  
 Flat metal case — 19.2KHZ, 844.8KHZ, B7G — 10MHZ

**LOUD HAILERS.** Transistorised hand-held. no leads. Standard internal batteries supplied. **£20 ea.** P&P **£2**  
**INFRA RED QUARTZ LAMP.** 230V 620 Watts. Size 1 3/8" x 1/4" dia. **£1.50.**  
**BRIDGE RECTIFIER.** 2 Amp **80p ea.**  
**PHOTOODE DETECTOR 4"** fly leads. **25p ea.**  
**AMPHENOL.** 17-way chassis mount edge connectors 0.1 spacing. **15p ea.**  
**I.E.C. Standard MAINS LEAD.** Moulded (3 vertical flat pins centre offset) **60p ea.**  
**FANS.** 115V 13 Watts. Size 3 1/4 x 3 1/4 x 1 1/2" BRAND NEW. **£4.50 ea.** Secondhand **£2.50 ea.**  
**Miniature MOTORS** 12V with geared wheel (8 teeth 3/16" dia) Size 1 1/4 x 1/4" dia. New **30p ea.**  
**MOTOR** 12V DC with pulley and integral semiconductor. Speed Control. New **£1 ea.**

MINIMUM ORDER **£3** VALUE OF GOODS. MINIMUM P&P **£1** — where P&P not stated please use own discretion — excess refunded. CARRIAGE ALL UNITS. **£5** P&P or CARRIAGE and VAT at 15% on total MUST BE ADDED TO ALL ORDERS.  
 CALLERS VERY WELCOME STRICTLY BETWEEN 9am-1pm and 2-5pm Monday to Saturday inc.  
 BARCLAYCARD (VISA) and ACCESS taken. Official orders welcome.

**CHILTMHEAD LTD**  
**NORWOOD ROAD, READING** **TELEPHONE NO. READING 669656**  
 (2nd turning left past Reading Technical College in King's Road then first right. — look on right for door with "Spoked Wheel")



**WE HAVE ALL THE NEW ATARI®  
VIDEO GAME PROGRAM™  
CARTRIDGES.**

**ATARI £86 + VAT**

**SILICA SHOP**

**ELECTRONIC GAMES**

**ATARI**



SPECIAL PRICE

**£86 + VAT**

**INTELLIVISION MATTEL**



Available August 1980  
This is the most advanced TV game in the world. Expandable next year into a full microcomputer. COLOUR CATALOGUE AVAILABLE WITH DETAILS ON ALL THE CARTRIDGES

£173.87 + VAT

**CHESS COMPUTERS**



NEW RANGE AVAILABLE AUGUST 1980  
We specialise in computer chess machines & stock over 13 different models from £20 to £300

Send for further details.

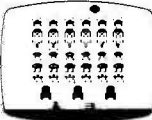
**TELETEXT**



RADOFIN TELETEXT Add on Adaptor

**£199 + VAT**

**SPACE INVADERS**




HAND HELDS + CARTRIDGES  
ATARI - ACETRONIC  
PRINZTRONIC  
RADOFIN - DATABASE etc.  
We keep a full range!  
Send for cartridge lists stating which machine you own.

**BRIDGE COMPUTER**



- ★ Plays 1/2/3 or 4 Hands
- ★ Problem Mode
- ★ Audio Feedback
- ★ Instant Response
- ★ Auto scorekeeping

**BACKGAMMON COMPUTERS**



OMAR 1  
OMAR 2  
CHALLENGER  
GAMMONMASTER

From £38 to £108. Send for further details.

**27 TUNE DOOR BELL**



**£17.13 + VAT**

**DRAUGHTS COMPUTER**



- ★ Solves Problems
- ★ Rejects illegal moves
- 2 level machine £43 + VAT
- 4 level machine £77.78 + VAT

**LEISURE**

- ★ CHEAP TV GAMES
- ★ TELEPHONE ANSWERING MACHINES
- ★ AUTO DIALERS
- ★ CALCULATORS
- ★ DIGITAL WATCHES
- ★ PRESTEL
- ★ HAND HELD GAMES

**FREE CATALOGUE**  
For a free copy of our 32 page catalogue, send a 12p stamp to Silica Shop Ltd or Telephone 01-301 1111

**SILICA SHOP**  
SILICA SHOP LTD., Dept. ET1 10  
102 Bellegrove Road  
Welling, Kent DA16 3QF  
Tel: 01-301 1111

MAIL ORDER SERVICE - Free postage & Packing  
TELEPHONE & MAIL ORDERS - accepted on Access ★ Barclaycard ★ American Express ★ Diners Club  
CALLERS WELCOME - at our shop in Welling - Demonstrations daily  
Open from 9am-5pm Mon-Sat (9am-1pm Wed)  
GUARANTEE - Full 12 months + After Sales Support!  
We have comprehensive brochures on all products. Please let us know what you are interested in and we will send you detailed brochures AND our own 32 page catalogue covering most games on the market





# MUSICAL MICRO 24 TUNE DOOR BELL

## BUILD THE WORLD FAMOUS CHROMA-CHIME

Give your friends a warm welcome. Yes, think how delighted and amazed they will be to hear the musical Chroma-Chime play when they press your button!

The Chroma-Chime uses a microcomputer to play 24 well-known tunes. The kit is simplicity itself for ease of construction. Absolutely everything needed is supplied, including:

- ★ Resistors, Capacitors, Diodes, Transistors, I.C. Socket and all hardware
- ★ Texas Instruments TMS 1000 microcomputer
- ★ Comprehensive kit manual with full circuit details
- ★ Ready drilled and legended PCB included

**ONLY  
£11.95  
+ 75p p&p  
UK ONLY**

Plays 24 well-known tunes including:

Star Spangled Banner, William Tell Overture, Greensleeves, Rule Britannia, Colonel Bogey, Oh come all ye faithful, plus many other popular tunes.

- ★ No previous microcomputer experience necessary
- ★ All programming retained is on chip ROM
- ★ Fully guaranteed
- ★ Ideal present any time

### TMS 1000N



—MP0027A Micro-computer chip available separately if required. Full 24 tune spec device fully guaranteed.

This unique chip is designed only for electronic doorbells. Full 24 tune spec device fully guaranteed. Includes all other parts required. Musical Boxes, Car Horns, Musical Boxes, Alarms, Amusement Machines, Public Address etc

**£4.95**

ALL CHROMATRONICS PRODUCTS SUPPLIED WITH MONEY BACK GUARANTEE

Please send me: ETI.10.80

TO: CHROMATRONICS, RIVER WAY, HARLOW, ESSEX  
Telephone (0279)418611

NAME  
ADDRESS

I enclose cheque/PO value £  
or debit my ACCESS/BARCLAYCARD account no.

Signature

# CHROMATRONICS

# Multimeters. what price excellence?

... certainly less than you think. By incorporating a custom made LSI chip, these fully auto-ranging 3½ digit multimeters are available at prices from under £50.00.

SK-6110  
(illustrated)

**£67.17**

+ VAT

SK-6220

**£45.43**

+ VAT



Supplied complete with batteries, test leads, spare fuse and instruction manual.

#### SK-6110 and SK-6220

- Full auto-ranging on both voltage and resistance
- Current measurement up to 10A DC and AC
- Unit and range automatically displayed
- Auto polarity and auto zero
- Only 5mW dissipation—200 hours continuous use
- Zero adjust key to correct for test leads on low value measurements
- High impact ABS case
- Low battery indication

#### SK-6110

- Audible continuity test function
- Range hold function
- Audible over-range indication

Telephone orders welcome for Access and Barclaycard and all account customers. All prices inc. P.&P.



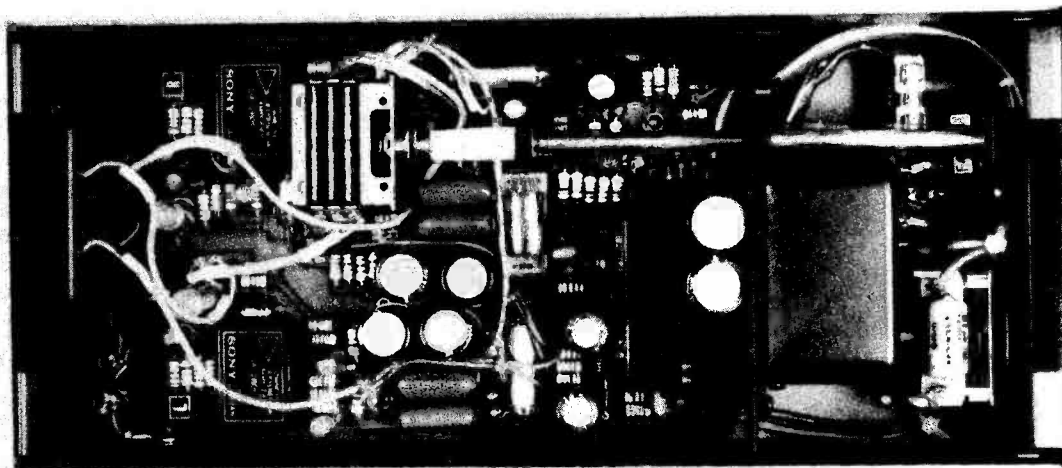
## WEST HYDE

West Hyde Developments Limited,  
Unit 9, Park Street Industrial Estate, Aylesbury, Bucks. HP20 1ET.  
Telephone: Aylesbury (0926) 20441/5.



# HEAD AMP DESIGN

Videotone's Andy Sykes rounds off his head amp design guide with a few words on the dreaded mains hum.



The head amplifier design published in ETI in January is a good example of a differential input stage (Fig.1), which also makes use of a symmetrical output stage. A different approach is shown in Fig.2, that of the Videotone H300 amplifier. This is a refined version of the circuit in Fig 6 (last month) and is based on a simple parallel transistor pair.

Eight transistors are used for Q1 and two for Q2 and a bootstrap capacitor is employed to increase the open loop gain and so keep the distortion well below the noise level.

## Trickle Charge

The design also features switchable gain and input capacitance to allow many different cartridges to be catered for. The commercial unit is powered by a rechargeable battery which is put on trickle charge when the head amp is switched off. This neatly removes both the need for a sophisticated mains power supply and the tedium of changing batteries.

## De-Thumper

Any output spikes produced on power up or down, so prevalent in other designs, are also eliminated by the use of a darlington pair to slowly raise and lower the supply rail when the power switch is operated. The time constant of this rise and fall is far greater than any others in the circuit and so the unit switches on and off without damaging your precious speaker cones if you inadvertently leave the volume turned up.

Another advantage of this particular configuration is that the feedback resistor provides the bias for the first stage so

that potentially noisy input bias resistors are not required. The common emitter second stage gives a low output impedance, which enables relatively long signal leads to be used and renders variations in main amplifier input impedances unimportant. The frequency response extends well up into the MHz region to reduce susceptibility to RF pickup and note also the use of an inductor in the supply line. It also sounds good, though perhaps I am a little biased.

## Mains Hum

The final point to be discussed is the bane of any audiophile's life, the dreaded mains hum. Oh for the DC supplies of yester-year. As with any other piece of sensitive electronics great care with screening and earthing arrangements must be taken to keep the hum gremlins at bay. The ideal case would be made of Mu metal, an alloy with particularly good screening properties, but this is not very cosmetic. If your head amp is to stand any chance of holding its own against the acres of brushed aluminium which enclose the average Hi-Fi, a smart but substantial aluminium or steel case is the next best thing.

## Earth Loops

Connections to and from the head amp should be such that earth loops are avoided. Figure 3 illustrates one possible way of doing this, the turntable earth being separated from the signal earth to avoid hum pickup from the motor. It may also be necessary to tie the amplifier chassis down to a good earth





Fig.1. For full details of the ETI Moving Coil Preamp, see ETI January 1980.

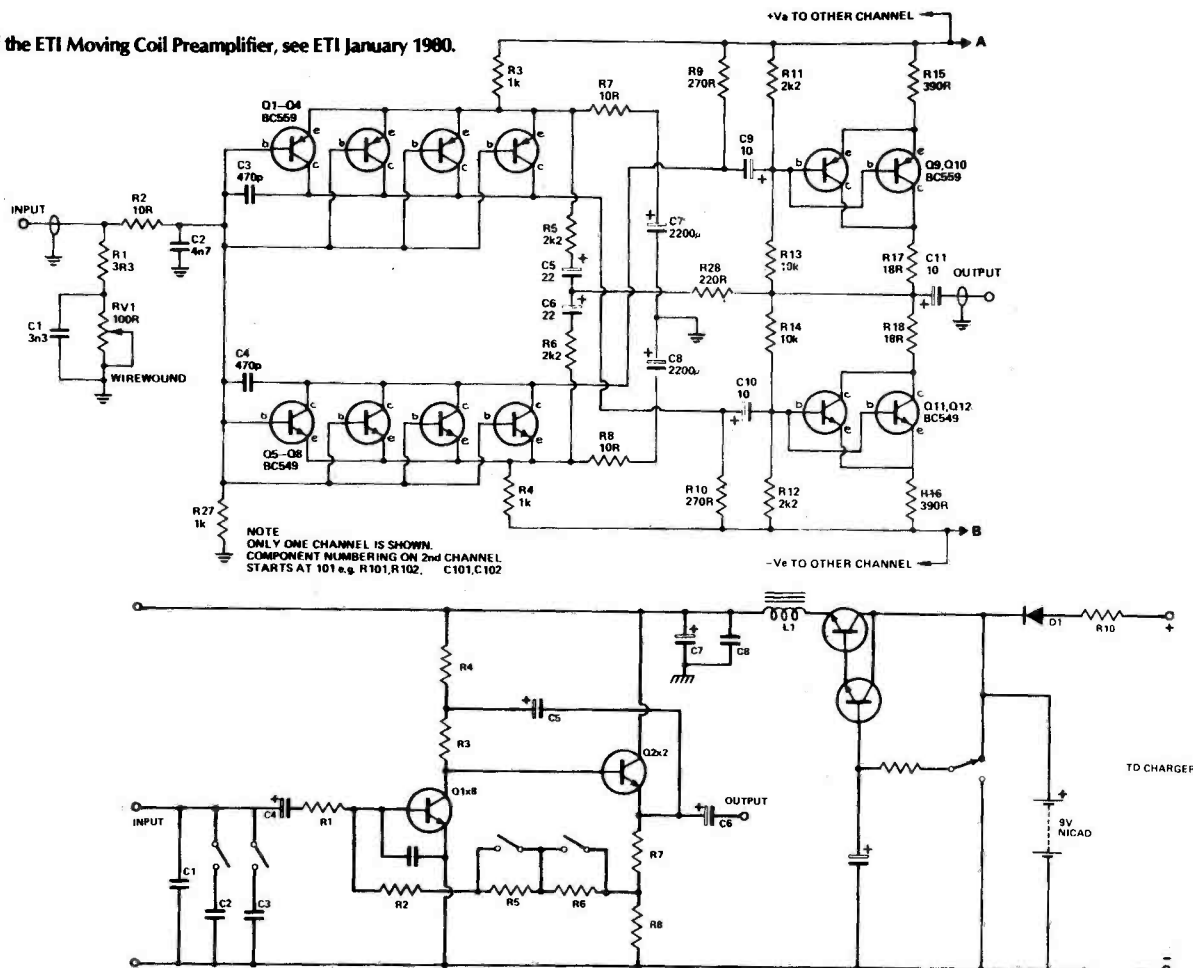


Fig.2. The Videotone H300 uses a different approach from the ETI design.

if it follows the modern trend of possessing a two-core mains cable. If your house wiring earth is not good enough, a passing water (not gas) pipe should be pressed into service, or even a length of copper pipe sunk into the back garden.

There is a case of a house with such bad earthing arrangements that the GPO telephone engineers not only resorted to sinking a rod in the garden, but instructed the occupants to water it before making a call in order to keep the telephone line from fading away.

## Mains-Shy

A certain amount of experimentation may be necessary to obtain the best position to site the Head Amplifier. Keep it and all signal leads away from potential sources of electromagnetic radiation such as mains cables, amplifier transformers and electric motors. I know that all this is pretty boring stuff which all good Hi-Fi buffs have known since they were knee high to a volume control, but introducing a Head Amp to your Hi-Fi does increase the system gain by a further factor of 30 and so precautions against hum pickup must be correspondingly greater.

If you do plump for a mains powered design, a separate case away from the amplifier circuit will almost certainly be required. This supply should be as well regulated and decoupled as possible (the use of the various IC voltage regulators here is highly recommended). Long supply leads are a potential source of RF pickup so remember to decouple at high frequencies as well on the supply line as near to the amplifier circuit as possible. Again the use of an inductor in the supply lines is recommended.

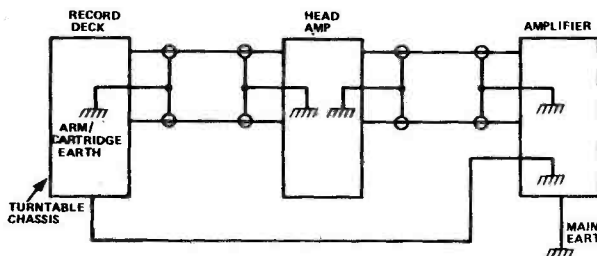


Fig.3. One possible way of avoiding earth loops.

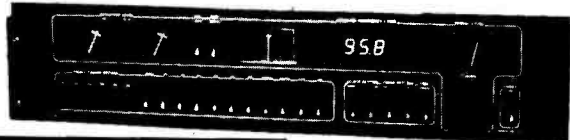
## Memories are Made of This

So there we have it, an albeit potted guide to Head Amplifier design, but it should point budding designers in the right direction, avoiding the more obvious pitfalls. It is well worth the time and effort expended on producing a head amp because, although the sound extracted from the record groove by a good moving coil cartridge is not startling when compared to a moving magnet of similar price, it is the subtleties of reproduction that are conspicuous by their absence; once heard, always hankered after. Even my wife can tell the difference and her normal assessment of any piece of Hi-Fi I bring home is based upon its ability to collect dust or support a plant pot. I am winning, though, slowly... very slowly.

ETI



## Complete Audio/Tuner Kits



### Mk III FM Tuner series

Carriage for Mk III tuner £3 inc

The Mark III series FM tuner has been updated, and now includes a centre zero tuning meter as standard. The instruction manual has been meticulously revised, enabling easy assembly by constructors of various levels of experience - a preview copy may be purchased for £1.00.

Mark III A series 'Reference series' tuner modules .....£171.35 inc.

Mark III B series 'Hyperfi' modules, with switched IF BW, pilot cancel decoder .....£198.95 inc.

A matching synthesiser unit will be made available later this year, and can be retrofitted to either version. All versions include digital frequency readout/clock, VU deviation meters, 6 preset stations, 10 turn pot manual tuning, toroidal PSU, output level adjustment, 110/240v AC input. Full alignment service available.

### Power Amplifier

Style and performance - with a real 'belt and braces' PSU design.

After a couple of preview comments, it seems that many of you are waiting to hear about the matching HMDSFET power amplifier for the Mk III tuner. Well, it's out at last - complete with twin toroidal PSUs for comfortable 80W RMS per channel, over 100W peak, but limited by thermal shutdown of the HMDS. 10W-100W log LED output peak indicator, DC offset protection and switch-on pause relay. AC or DC input coupling, direct or relay protected output terminals. The works. Only one version of this item: Complete kit .....£178.25 inc. Carr. £5.

### Preamplifier

More features and facilities, thanks to DC switching and control design

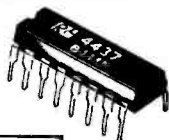
Previewing the most comprehensive audio preamplifier yet..... DC switching of 7 inputs, plus two tape in/out. 2 low pass, 2 high pass active filters, genuine volume related loudness, 1dB channel matching, with DC volume, balance, bass and treble controls. Suitable for bus/remote control, tape dubbing, switched monitor etc. 80dB S/N+, THD -75dB or better. Pluggable PU equalization boards, tone control override. Price for complete unit about £149 ex VAT.

## Semiconductors

### Radio/Communications ICs

FOR COMPLETE LISTINGS - SEE OUR NEW PRICELIST

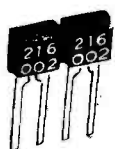
CA3089E	2.11	HA1197	1.61	SD6000	4.31
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38
HA11225	2.47	TBA651	2.53	MC1350P	1.38
HA12412	2.81	TDA1090	3.51	KB4412	2.24
KB4420	1.95	TDA1220	1.61	KB4413	2.24
TBA120S	1.15	TDA1083	2.24	KB4417	2.53
KB4406	0.80	TDA1062	2.24	MC3357P	3.16



### VARIACAP DIODES.....

A section from our PL:

BA102	0.35	16:1 ratio AM tuning	
BB204	0.41	KV1215 9v triple	2.93
BB105	0.41	KV1211 9v dual	2.01
BB109	0.31	KV1225 25v triple	3.16
MVAM2	1.93	BB212 9v dual	2.25



### POWER MOSFETS

100W PA's made simple

Since pioneering the 100W complementary MOSFET technique - Hitachi have developed a range of output devices and drivers that ought to revolutionise opinions and attitudes towards the design of all LF amplification systems. We have a new 48 page application note (£1.50 inc) and complete sets of parts, modules and now the new complete PA system (see above).

25K133 120v N-ch 100W MOSFET £6.33 2SJ48 Pch complement £6.33  
25K135 160v N-ch 100W MOSFET £7.29 2SJ50 Pch complement £7.39  
PA101B Kit for 100W MOSFET PA less Heatsink £16.10, (£23 inc heatsink/bkt)

### ULTRA LOW NOISE PU PREAMPLIFIER

The HA12017 is the last word in PU preamps, and general low noise audio design. It is an SIL IC, with 86dB S/N in RIAA configuration, 10v RMS output capability, 0.002% typ THD at 10v RMS output (imagine the overload margin !!). It comfortably supercedes discrete circuit designs in terms of price/performance, and takes the art beyond the TDA1042's capabilities. (Replaces HA1457) £1.80 each - or an RIAA applications PCB with two ICs for £5.75. Complete with Rs&Cs £9.95.

### Radio Control ICs

We have various RC ICs, including NE544 NE5044, and two new ones from OKI

KB4445 - 4 channel dig. prop. FM TX IC. 30mW out (amplifiable) -£2.30 inc  
KB4446 - 4/5 ch. dig. prop FM RX IC. Suits KB4445 or RCME syst. £2.65.  
KB4445/6 pair: £4.75. New 8 page data sheet 35p + SAE. More RC ICs in list

### CMOS, LPSNTTL, TTL, MPU: Listings in the new pricelist.

Most CMOS is available in low volume - also LPSN. Standard linears and TTL OK.

Things like ICM7216B, ICL8038, 8080A, 6800P, 2708, NE555, NE556, etc

Coming Soon..... Contain yourselves, RF fans ! Not yet ready for a full launch until autumn, but previewed here..

### SSB transceiver system : 10kHz to 1000MHz !!

A modular VLF to UHF SSB TX/RX system at last. With the correct first mixer, the basic PCB covers 10kHz to 1000MHz - using LO fed from ext. source (Our 2 IC Mullard synth for instance) and RF PA for TX. OP. 0.2uV basic sensitivity in HF. Typ cost for HF synth SSB RX will be less than £200. Add an RF PA for full TRX for another £50. See one in our foyer, and marvel.

CATALOGUES 60p ea, all three for £1.60  
PRICES SHOWN HERE INCLUDE VAT  
POST/PACKAGE CHARGE NOW 50p

Please send an SAE with all enquiries.  
Phone orders by ACCESS - but minimum £5  
Callers welcome

**ambit**  
INTERNATIONAL

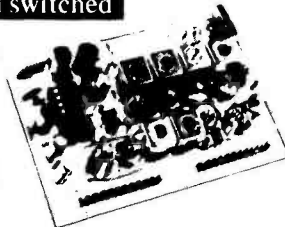
**200 North Service Road, Brentwood, Essex**

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

## Radio/Audio/Communications Modules

### LW-MW-SW-DC tuned and switched

91072- All switching of bands by a single pin to gnd. Varicap tuned, with LO output for synth. MW/LW version or MW/LW plus 1 or 2 SW bands MW/LW: £15.58 +1SW £16.73



### VHF Tunerheads

Europe's largest stock range for broadcast and communications. Probably also the world's - details in the catalogues and PL. Specials are also supplied in the region 30-220MHz.

### Pilot Cancel PLL Stereo decoders

Again, Europe's widest range of stereo decoders including pilot cancel PLL types. The pic shows the 944378 - pilot cancel including post decoder 26/38kHz filtering and muting preamp output



944378-2  
£26.45

### Switched bandwidth FM IF strips

Broadcast FM IF strips for all occasions, including the new 911225 - with diode switched narrow filter option, ultra linear phase ceramic filters, 84dB S/N, and 0.04% THD (40kHz deviation). Plus usual things like AGC, AFC, dev. mute, level meter drive. £23.95 (supplied in screen can with 0.1 edge connection system) Also the 7230 hyperfi series - as the 911225, but with slope controlled AFC that operates in conjunction with signal level - and an extra IF amp stage for DXing.

### Various digital frequency displays

The World's largest range of receiver DFM's is now joined by the DFM7 (shown) - and L shaped version of the DFM3 with remote display mount connector possibility. 1kHz SW resolution with 455kHz or 10.7MHz offsets, 100Hz res up to 3.9999MHz, and VHF to 299.99 MHz in 10kHz steps : £41.75



## Components

### Crystal Filters

Most popular types are available - ex-stock, and in quantity.

10.7MHz	25kHz Channel spacing	8pole	£16.67
	12½kHz	..	£17.82
	2.4kHz SSB	..	£19.78
	Monolithic dual roofing filter		£2.30
34.5MHz	1.3dB loss, 80dB stopband HF	first filter in synth. RX	£36.80
RC XTALS	FM pairs (no spits)		£3.74
	AM pairs		£3.57
USB/LSB	Xtals for 10.7SSB filter		£2.88 ea



### Piezo Sounders

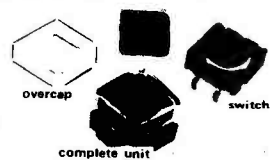
The most efficient warning sounders yet

The latest thing in electro-acoustic efficiency. 1mA of drive from CMOS will give an SPL of 83dB - 10v RMS drive from CMOS uses 3mA for 100dB SPL at 4.8kHz (88dB at 1.66kHz)  
The data sheets shows various drive circuits, and give full specifications with regard to broadband responses and power consumption etc. 1 off 44p inc. 100 off 28.75p (25p ex vat)



### Keyboard switches and caps

From the world's most widely used switch manufacturers - ALPS - come the biggest and best range of keyswitches, and data entry keyboard switches. The SCMB1101 is shown here, with the KT5 2-part cap (with clear top, to enable easy fitting of your chosen legend. Other types are available with built in LED, 90° mounting etc. SCMB1101 : 17p, KT5 : 16p - or 29p/pair



### LCD CLOCKS

Clocks use 1.5v at 15uA only. DVM 9v/1mA

### LCD DVM

CM161: 7mm LCD 12/24hr, alarms etc £11.44 each  
CM172: 13mm, 12hr, alarms, timer etc £14.32 each  
CM174: 13mm, 12hr, min/sec stopwatch £14.32 ea  
DVM 176: ICM7106 based LCD 3½digit £22.36 each



## WHAT'S NEW at AMBIT

### NEW PRICELIST/SHORTFORM: 28 pages, FOC with A5 SAE pse

Bigger print than our recent one page list - and vastly extended

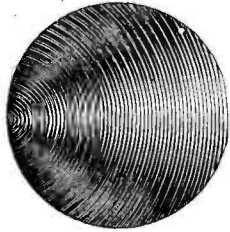
If you still need convincing to invest £1.60 in the cats, be mean and get this first.

### POWER MOSFET APPLICATIONS HANDBOOK by HITACHI

£1.50 each - or free with pairs of HMOS and the PA101B.

Everything you should know about HMOSFET devices theory and applications.



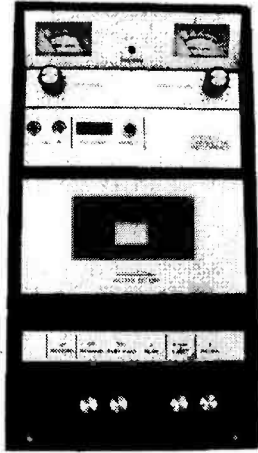


# B.K. ELECTRONICS

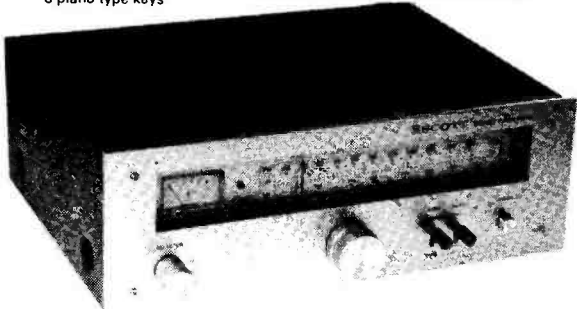
## A SOUND CHOICE

★ PROMPT DELIVERY ★ PRICES INCLUDE V.A.T. ★ AMPLE STOCKS  
A PERSONAL SERVICE FROM A SMALL EXPANDING COMPANY

**STEREO CASSETTE TAPE DECK ASSEMBLY.** Comprising of a top panel assembly and tape mechanism coupled to a record/play back printed board assembly. For horizontal installation into cabinet or console of own choice. Brand new, ready built and tested. **Features:** Pause control, auto stop, 3 digit tape counter, illuminated twin VU meters with individual level controls, twin mic, input sockets, AC erase system, LED record indicator. (Separate power amplifier required.) **Input Sensitivity:** 6 MV (with level control set at max). **Input Impedance:** 47 kOhms. **Output Level:** To both left and right hand channels 150 MV. **Output impedance:** < 10k. **Signal to noise ratio:** 45 dB nominal. **Power Supply Requirements:** 12V AC at 300M/A. **Connections:** All connections to the unit are via a wander lead terminated with a nine pin plug (socket provided). **Dimensions:** Top panel — 11 1/2 in x 6 1/2 in. Mechanism fits through a cut out 5 1/4 in x 10 1/2 in. Clearance required under top panel 2 1/4 in. Supplied complete with circuit diagram etc. **Price £30.50** plus £2.50 postage and packing. Suitable mains 12-volt transformer, **£3.00.**



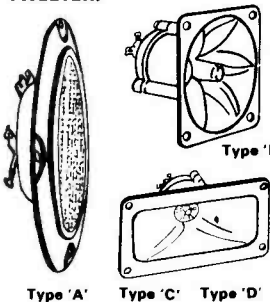
6 piano type keys



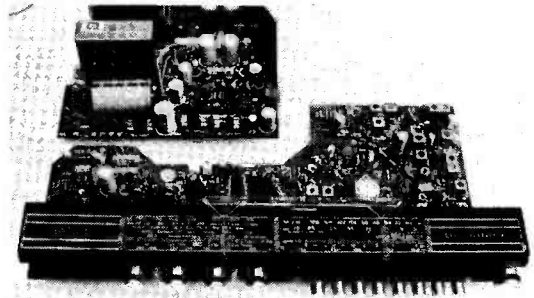
**SCOTT AM/FM STEREO TUNER MODEL 516.** This Scott tuner is one of the top American makes and is offered at a very realistic price. **Features:** ★ FM tuning range 87.5 to 108 MZ ★ AM tuning range 535 to 1605 kHz ★ Usable FM sensitivity 6.2dB 2.2µV ★ 300 ohm & 75 ohm Aerial inputs for FM ★ Signal strength tuning meter ★ Stereo beacon indicator ★ Ferrite aerial for AM ★ Mute switch, 10 diodes, 9 transistors and 3 ICs. **Size:** Height 5in, Width 14 1/2 in, Depth 12in. Silver front panel. Black body. Modern stacking format. Suitable for 240-volt 50Hz AC operation. **Price £40.50** plus £2.50 postage and packing.

### PIEZO ELECTRIC TWEETERS — MOTOROLA

Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). **FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.**

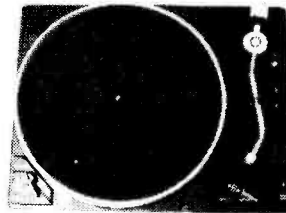


**Type 'A'** 3in round with removable wire mesh. Ideal for bookshelf hi-fi speakers. **Price (Type 'A') £3.75 each;**  
**Type 'B'** 3 1/2 in super horn. For general purpose speakers disco and PA systems, etc. **Price £4.60 each.**  
**Type 'C'** 2in x 5in wide dispersion horn. For hi-fi systems and quality disco etc. **Price £6.20 each.**  
**Type 'D'** 2in x 6in wide dispersion horn. Frequency response extending down to mid-range (2000 c/s) suitable for hi-fi systems and quality disco. **Price £9 each.**  
Post and Packing, all types, 15p each (or SAE for Piezo leaflets).



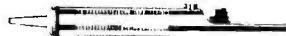
**GEC AM/FM STEREO TUNER AMPLIFIER CHASSIS.** Originally designed for installation into a music centre. Supplied as two separate built and tested units which are easily wired together. **Note:** Circuit diagram and interconnecting wiring diagrams supplied. **Rotary Controls:** Tuning, on/off volume, balance, treble, bass. **Push-button controls:** Mono, Tape, Disc., AFC, FM (VHF), LW, MW, SW. **Power Output:** 7 watts RMS per channel, at better than 2% THD into 8 ohms, 10 watts speech and music. **Frequency Response:** 60Hz-20kHz within ± 3dB.

**Tape Sensitivity:** Output — typically 150 mV. Input — 300 mV for rated output. **Disc Sensitivity:** 100mV (ceramic cartridge). **Radio:** FM (VHF), 87.5MHz — 108MHz. Long wave 145kHz — 108kHz. Medium wave. 520kHz — 1620kHz. Short wave. 5.8MHz — 16MHz. **Size:** Tuner — 2 3/4 in x 15 in x 7 1/2 in approx. Power amplifier — 2 in x 7 1/2 in x 4 1/2 in approx. 240V AC operation. Supplied complete with fuses, knobs and pushbuttons, and LED stereo beacon indicator. **Price £21.50** plus £2.50 postage and packing.



**JVC TURNTABLE.** JVC Turntable supplied complete with an Audio Technica AT110 stereo magnetic cartridge. ★ 'S' shaped tone arm. ★ Belt driven. ★ Full size 12in platter. ★ Precision calibrated counterbalance weight (0-3 grms.) ★ Anti-skate (bias) device. Nylon thread weight. ★ Damped cueing lever. ★ 240V AC operation, (50Hz). ★ Cut-out template supplied. **Size — 12 1/4 in x 15 1/4 in (approx).** **Price £29** plus £2.50 postage and packing.

### DE-SOLDERING PUMP



This de-soldering pump made to a very exacting specification is ideal for the removal of small components from printed circuit boards, etc. Comes complete with spare PTFE tip. **£5.30** post free.

### FIRE ALARM CENTRAL CONTROL UNIT (S.T.C.)

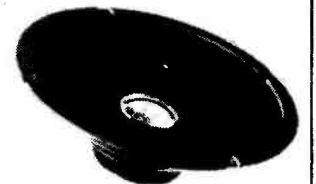
Ideal for Fire or Burglar Alarm Systems

- ★ Responds to normally open or closed switches (or smoke detectors etc.)
  - ★ Complete with an internal EXIDE lead acid accumulator (dry charged) as a back-up for mains failure. This is trickle charged
  - ★ 6v-2 amp output for Fire/Burglar alarm, etc.
  - ★ Re-set button for silencing Fire/Burglar alarm.
  - ★ Internal buzzer which sounds if re-set button if pressed until initiating switch is cleared.
  - ★ Wall mounting, complete with red case, approx. 11" x 7 1/2" x 4".
  - ★ 240v AC operation.
- Price £18.50** + £3 postage and packing.



### LOUDSPEAKER

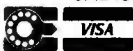
High quality full range 8" loudspeaker. 10 watts RMS. 80HM. Rolled surround with aluminium centre dome. **Price £3.75 each** + 75p Postage and Packing each.



# B.K. ELECTRONICS

37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY

★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam. Callers welcome by prior appointment, please phone 0702-527572.





# DESIGNER'S NOTEBOOK

Ray Marston devotes this month's 'Notebook' to a discussion of practical temperature-sensing switches, alarms and metering circuits.

Temperature-sensitive circuits such as thermo-switches, alarms and electronic thermometers are amongst the most popular and common of all projects published in the technical Press. Such projects may use thermostats, thermistors or semiconductor devices as their basic temperature-sensing elements: each of these types of device has its own advantages and disadvantages and presents the electronics engineer with particular design problems. This month's 'Notebook' is devoted to a discussion of some of these problems.

## Thermostats

The easiest way to implement a thermo-switch project is to use a commercially available thermostat of the type used in central heating systems, for instance, as the switching element. These devices usually take the form of a bimetal strip that closes a pair of contacts when the temperature falls below a preset 'trip' level, the level usually being variable over a limited range via a calibrated control.

The trip levels of these thermostats are usually accurate to within a degree or two and the devices give an adequate performance in most practical applications. They are simply wired in series with the switched load, as shown in Fig.1a, so that power is fed to the load when the temperature falls below the trip level.

You can reverse the action of a standard thermostat, so that power is fed to the load when the temperature rises above the trip level (contacts open) by using the simple circuit of Fig.1b. Here, when the contacts are closed the output of the inverting CMOS gate is driven low, so Q1 and the relay are off and zero power is fed to the load via the RLA/1 contacts. The circuit consumes a standby current (via R1) of only a microamp or so under this condition. When the thermostat contacts open, the input of the gate is pulled low via R1, so Q1 and RLA are driven on and power is connected to the load via the RLA/1 contacts.

## Thermistor Circuits

Thermistors are simply resistive elements that are subject to fairly large changes in resistive value with small changes in temperature. They are ideally suited to use in sensitive or 'precision' thermal switching applications. The devices come in a variety of styles, but we'll concern ourselves here with inexpensive negative temperature coefficient (NTC) carbon-rod types only; a quick scan of component suppliers catalogues will show that these devices are readily available with a variety of resistance values at a variety of temperatures.

Figure 2 shows how you can use an NTC thermistor to make a precision under-temperature or 'frost' switch. Here, TH1 PR1 and R1-R2 are wired in the form of a bridge that is

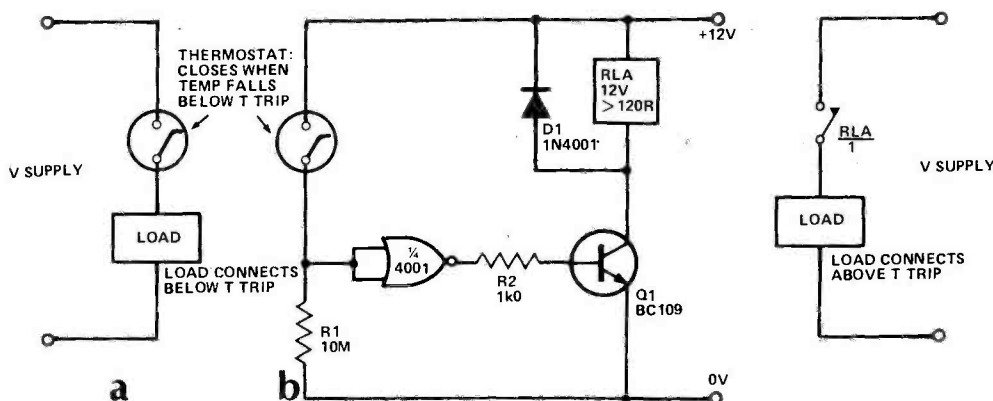


Fig.1 The effective switching action of a thermostat (a) can be reversed by using the circuit shown in (b).



almost balanced (via PR1) at the required trip temperature and the op-amp is wired as a voltage comparator with its output driving the relay via Q1. At temperatures below the trip level the pin 3 voltage of the op-amp output is driven to negative saturation and Q1 and the relay are driven on. At temperatures above the trip level the reverse action is obtained and the op-amp output is driven to positive saturation and Q1 and the relay are cut off.

The action of the Fig.2 circuit can be reversed, so that the circuit acts as an over-temperature switch, either by transposing the pin-2 and pin-3 connections of the op-amp or, as in the case shown in Fig.3, by transposing the TH1 and PR1 positions.

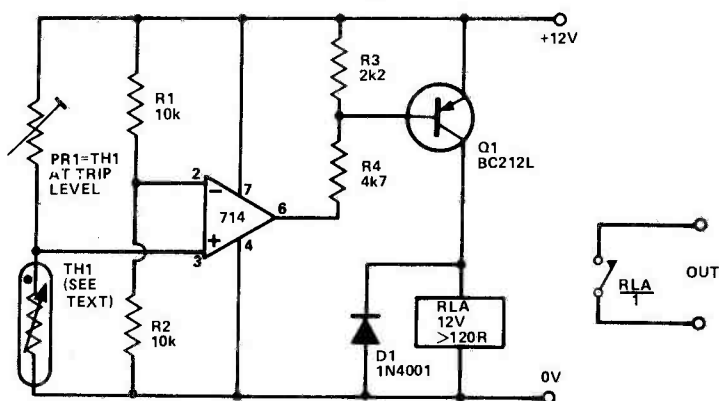


Fig.3 Precision over-temperature switch using thermistor sensor.

preset via PR1. The op-amp is wired as a conventional astable (with its output boosted by Q1-Q2), except that PR1-TH1 act as a potential divider between the output and pin-2 input of the op-amp and prevents the circuit from oscillating when the resistance of TH1 is below that of PR1. The action of the circuit can be reversed, so that it acts as an over-temperature alarm, by simply transposing TH1 and PR1. In either case, TH1 can be any NTC type that has a value in the range 2k0 to 2M0 at the required trigger temperature: the operating frequency of the astable can be changed by altering the C1 value.

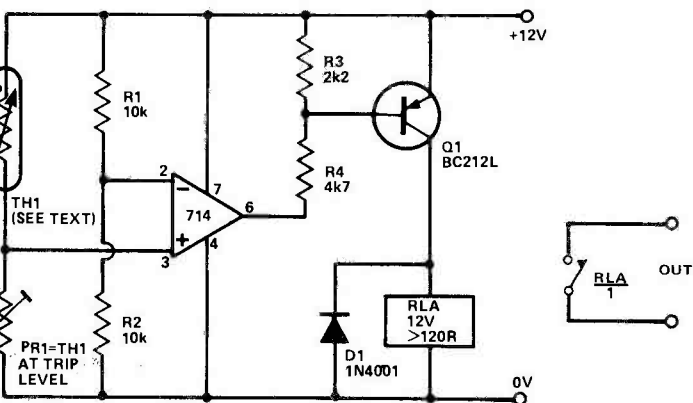


Fig.2 Precision under-temperature or 'frost' switch using thermistor sensor.

## Diode Sensors

Ordinary silicon diodes have junction temperature coefficients of about  $-2 \text{ mV}/^\circ\text{C}$  when forward biased and can thus usefully be employed as temperature sensing devices. Major advantages of such diodes are that they give readily repeatable and consistent results and, because of their small masses, have fairly rapid thermal response times. A major

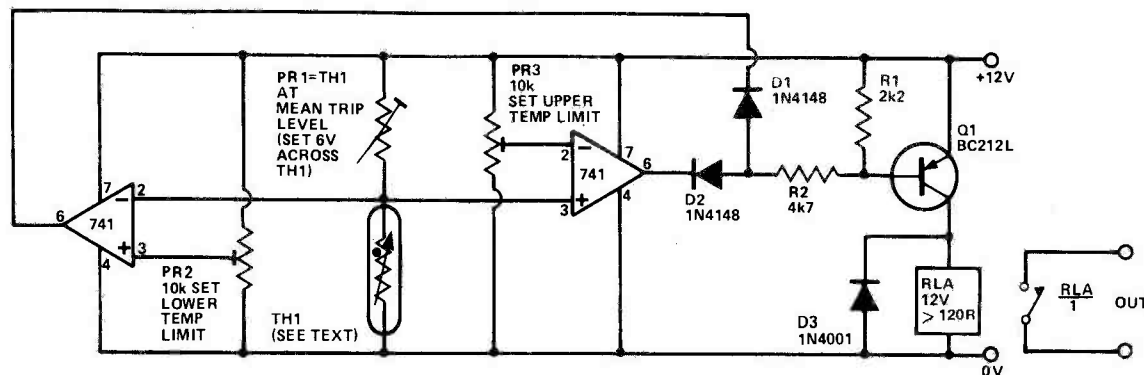
## Two Into One

Figure 4 shows how the above two circuits can be used together to make a combined over/under-temperature switch in which the relay turns on if the temperature (of TH1) goes above a limit set by PR3 or below a limit set by PR2.

Note in the above three circuits that TH1 can be any NTC thermistor that exhibits a resistance in the approximate range 500R to 9k0 at the desired mean 'trip' temperature.

Finally, Fig.5 shows how an NTC thermistor can be used to make a direct-output alarm-call generator that produces a powerful fixed tone if the TH1 temperature falls below a level

Fig.4 Method of combining the Fig.2 and 3 circuits to make a precision over/under temperature switch with independently adjustable upper and lower trip levels.





disadvantage is that their forward voltages are normally large compared to normal temperature-change values and are highly dependent on forward current: Typically,  $V_f$  values may be 630 mV at 1 mA and 660 mV at 2 mA, giving a nominal 3 mV  $V_f$  change (equal to a 1.5°C error) with a 10% change of forward current.

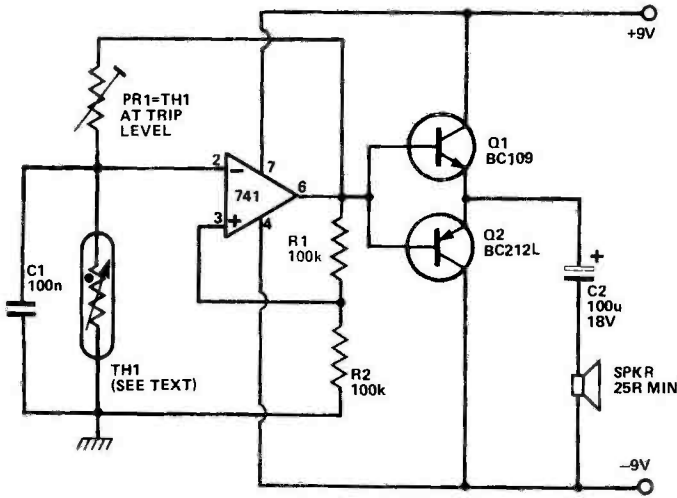


Fig. 5 Direct output under-temperature alarm produces a powerful tone signal when temperature falls below a value preset by PR1. The circuit can be converted to an over-temperature alarm by transposing TH1 and PR1.

Figure 6 shows how a pair of 1N4148 (or similar) diodes can be used to make a differential temperature switch in which the relay turns on when the D1 temperature rises above that of D2. The circuit is responsive to the relative, rather than the absolute, temperatures of the two diodes. PR1 enables the differential trip levels to be varied over a limited range.

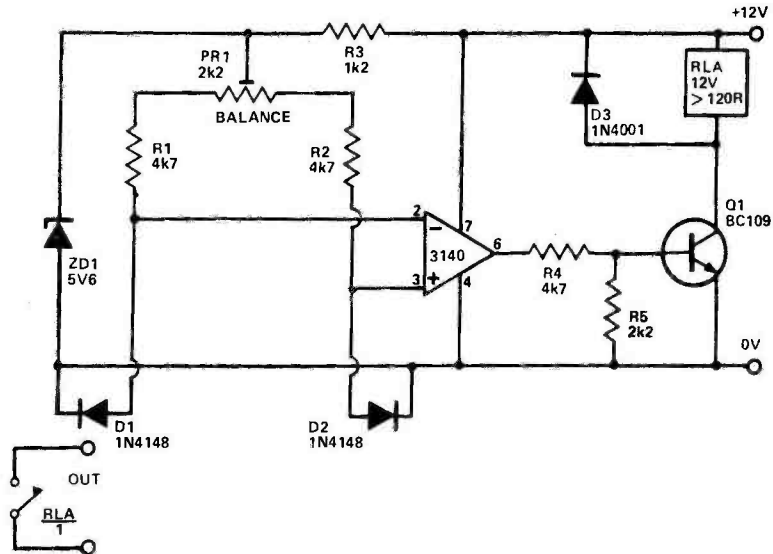


Fig. 6 This differential temperature switch uses diode sensors and turns RLA on when the D1 temperature rises above that of D2.

ETI

## CALCULATORS

ALL EQUIPMENT FULLY GUARANTEED  
so order with confidence and PAY NO MORE

### PROGRAMMABLE CALCULATORS

FX 501P 10 + 2 digit, 128 step, 11 memories	£43.43
FX 502P 10 + 2 digit, 256 step, 22 memories	£60.83
FA1 Adaptor cassette interface	£17.35
MASTERPACK 150 + programmes on tape with manual	
FX301P + FA1 + Masterpack	
FX502P + FA1 + Masterpack	
*TEXAS TI51-111 32 step 10 memory	£25.17
*TEXAS TI53 Lcd 32 step constant memory	£22.57
*TEXAS TI57 50 step 8 memory	£23.44
*TEXAS TI58 480 step 60 memory	£58.23
*TEXAS TI58C as above with prog retention	£73.87
*TEXAS TI59 960 step 100 memory mag card	£150.39
*TEXAS PC100C Printer for 58/58C/59	£136.48
*TEXAS PC100C IF ORDERED WITH 58/58C/59	£130.39

### PROGRAMME LIBRARIES FOR TI58/58C/59

MATHS/UTILITIES, APPLIED STATS, ELECTRICAL ENGINEERING	£22.57
LEISURE	£33.00
SURVEYING, STRUCTURAL ENGINEERING	£54.74
PC 100C PAPER ROLLS 10 OFF	£19.09
BATTERY PACKS state model or BP number	£6.04

### SCIENTIFICS 8 DIGIT Lcd

CASIO FX68	£16.48	CASIO FX100	£13.00
CASIO FX81	£11.26	CASIO FX510	£18.48
CASIO FX330	£13.87	CASIO FX3200	£18.22
CASIO FX2600	£16.48	CASIO FX5000 10 MEM	£24.30
CASIO FX7100	£20.83	SHARP EL5806 (8+2)	£15.61
SHARP EL503	£11.26	SHARP EL5808 (8+2)	£13.87
TEXAS TI25 or TI35	£16.48	SHARP EL5812	£16.48
TEXAS TI50	£19.98	NATIONAL NS108	£15.61
*TEXAS TI42 M.B.A. 32 step 12 memory finance/Stats	£35.61		
*TEXAS TI PROGRAMMER	£43.43		
TEXAS TI44 Lcd constant memory statistical	£25.17		
TEXAS LITTLE PROFESSOR	£11.26		
TEXAS DATAMAN	£17.35		
TEXAS SPEAK AND SPELL	£38.22		

### CLOCK CALCULATORS

CASIO MQ6 micro card watch in leather case	£17.35
CASIO PW81 hourly chime / alarm	£13.00
CASIO ML71 card version of ML81 with 1 alarm	£19.09
CASIO AQ1500 day/date/stopwatch	£13.87
CASIO AQ2200 hourly chime / alarm / calendar / stopwatch	£17.35
CASIO MQ12 card version of above	£17.35
CASIO L90 new 12 pre-programmed tunes	£17.35
TELEPHONE ANSWERING MACHINES twin cassette	£147.78

PRICES EXCLUDE V.A.T. PLEASE ADD 15% POST & PACKING FREE

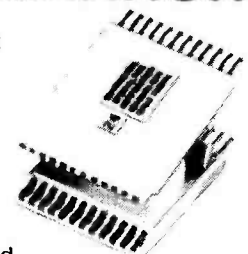
### CALCULATOR SALES & SERVICE

Arrow Works, Arrow Road, Redditch B98 8NN  
Tel. Redditch (0527) 43169



## NEEDS NO EXAMINATION

You don't need to look too closely at the CSC Proto-Clip range of IC test clips to see that they provide instant connection to dual-inline packaged components. Use them on ICs, networks or relays to provide a high-integrity interface for 'hands-off' testing with oscilloscopes, signal sources, logic analysers and other instruments. Contact spacings designed to suit all standard IC packages, CSC Proto-Clips feature a moulded webbing construction, non-corroding nickel-silver contacts, and clip notches to prevent slippage during testing. Make contact with CSC Proto-Clips right away by filling in the coupon.



CSC (UK) Ltd. Dept. 90Q, Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ. Telephone: (0799) 21682. Telex: 817477.

14 PIN PC14 (£2.60 Net) £3.85	16 PIN PC16 (£2.75 Net) £4.02	24 PIN PC24 (£4.80 Net) £6.48	40 PIN PC40 (£7.90 Net) £10.23
----------------------------------	----------------------------------	----------------------------------	-----------------------------------

Bold prices include P & P and 15% VAT. Please deduct £1 postage from each additional order.

I enclose cheque/PO for £ .....  
or debit my Barclaycard, Access, American Express card .....  
No ..... Exp. date .....  
or Tel: (0799) 21682 with your card number and your order will be in the post immediately.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CONTINENTAL SPECIALTIES CORPORATION



FREE catalogue tick box

Continental Specialties Corporation (UK) Limited, Dept. 90Q  
Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

## TOMORROW'S TOOLS TODAY



# KEELMOOR Quality..

Keelmoor Ltd is a company which has been established for a long time – we supply the products you have often bought from other companies. Our precision watches and electrical goods are renowned for their superb quality and reliability. We differ from other companies in that we import direct world-wide – that difference is passed on to you at unbeatable prices. You receive the goods faster and we provide a service and no catch guarantee of which we are justly proud. We employ experts world-wide whose job it is to seek out products of the highest quality at the lowest possible prices. Illustrated here is just a tiny selection of our comprehensive range. Just compare these items with those seen elsewhere – we are confident the prices will amaze you. You can save ££££'s.

## GENTS 5 FUNCTION LCD



This is the foundation of our range and is ideal for the man requiring the basic functions of hours, minutes and seconds, with month and date. A backlight is included and the stainless steel strap provided is fully adjusted to suit any size of wrist. Guaranteed for one year, this watch represents fantastic value at only

**£4.95p**

ILLUSTRATED BELOW IS THE LADIES 5 FUNCTION LCD. This watch has the same time and auto calendar functions as the basic gents model described above, together with backlight and adjustable strap to suit the daintiest of wrists. It's compact, pleasing appearance makes it a very practical day watch and it is also often used for boys and girls. Available in black or white face.

These are just a few of our fantastic offers remember. A free colour catalogue is posted with every order.

**£5.95p**



## GENTS LCD ALARM WATCH

This model represents fantastic, incredible value for money. The 6 digit display continuously shows hours, minutes and seconds, or may be changed at will to hours, minutes and date. Its effective alarm is extremely useful and may be set to any time within a 24 hr. period. In addition, there is an alarm indicator, 4 year calendar and snooze repeater.

**£8.95p**

### FULLY GUARANTEED

We must emphasize all these items are fully guaranteed for one year. All electronic goods come complete with demonstration batteries which cannot be guaranteed. New batteries are available for only 60p.

**BARCLAYCARD AND ACCESS CARD WELCOME. SEE COUPON.**

## HERE IS THE AMAZING 12/24 HOUR ALARM/CHRONOGRAPH



Along with the usual time and date displays, this multi-functional timepiece has a 24 hour alarm and a  $\frac{1}{2}$  second stopwatch. The time may be set to operate in 12 or 24 hour mode and the date can be in English or American format. The day of the week is continuously indicated and the stopwatch display may, on command, be frozen to show split/laptime while the stopwatch continues to run. Stopwatch operation does not effect normal time keeping. £12.95 only for this model. Also available with solar energy panel to conserve energy during daylight hours for £14.95

FROM **£12.95p**

From Watches to Clocks, from Calculators to Radios, from Binoculars to Tool Kits – KEELMOOR is the name for the right quality at the right price. Your personal catalogue will tell you more – free with every order.

## LADIES QUARTZ LCD DRESS WATCH

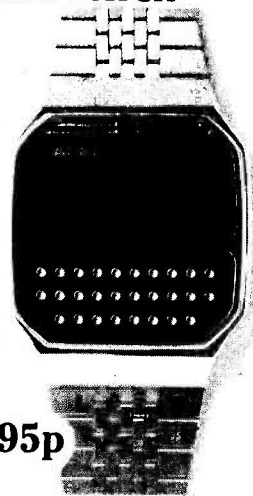
This attractive ladies model with the standard 5 functions of hours, minutes and seconds, month and date has literally sold in tens of thousands. Available in gold or silver colours with 'sugar coated' finish. Please state first and second choice of square, round or oval design.

**£8.95p**

## THE ULTIMATE GENTS LCD CALCULATOR/ALARM WATCH

If you want a watch from the top end of the market this is the one for you. Full calculator functions plus memory and percentage are combined with time and alarm functions to make this item an outstanding buy. Manufactured in Japan at the same factory that produces models for probably the most famous name in the watch business, this device represents sheer quality at an unbelievable price. Comes complete with backlight and button operating tool carried in the strap clasp. We advise you to order quickly whilst stocks last.

**£39.95p**



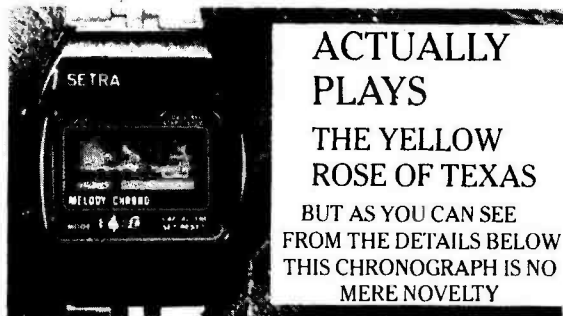


# at Keener Prices

**FREE**  
With every order  
Big colourful  
**Keelmoor** catalogue  
featuring hundreds of  
products at bargain  
prices.

We don't think you'll find items of this quality anywhere else at the price we offer. Order now, Christmas is round the corner and this is the way to make gift buying easier – and cheaper too.

**WE ARE PROUD TO INTRODUCE THE AMAZING MELODY ALARM CHRONOGRAPH**



**ACTUALLY  
PLAYS  
THE YELLOW  
ROSE OF TEXAS**  
BUT AS YOU CAN SEE  
FROM THE DETAILS BELOW  
THIS CHRONOGRAPH IS NO  
MERE NOVELTY

Today's technology has produced this fine watch which incorporates a musical alarm which plays a complete verse of 'The Yellow Rose of Texas.' Other functions included are as for model number 1.

**£14.95p**

**NEW TO OUR RANGE, WE COMBINE PRECISION AND STYLE IN THIS—THE SUPER SLIM GENTS 5 FUNCTION CHRONOGRAPH**



JUST TO GIVE YOU AN IDEA OF THE ULTRA SLIMNESS OF THESE WATCHES WE HAVE ILLUSTRATED A SIDE VIEW OF THE SUPERSLIM DIGITAL. BELOW, WE HAVE ELABORATED ON SOME OF THE TECHNICALITIES:—

These watches need no special functions to make them stand out in a crowd—their slimness serves that purpose. If you've been put off digital quartz watches in the past because you require an ultra-slim design, now is the time to change. Is equipped with standard 5 functions and backlight.

**£9.95p**

**MAINS DIGITAL ALARM CLOCK**



A very practically sized mains operated digital alarm clock – this item is extremely well finished and looks equally at home by the bedside or in the living room. With snooze/repeater alarm you could not even buy the components to build your own for this price. Available at the amazingly low price of only

**£8.95p**

**AND FINALLY, WHAT MUST BE THE ULTIMATE IN SQUEEZING A QUART INTO A HALF PINT POT! THE INCREDIBLE MINIATURE LCD TRAVEL/ALARM CLOCK**



As you can see from the photograph above this device is tiny and yet it continuously displays hours and minutes with auto calendar and night light. Invaluable for the busy traveller or simply for use in the modern home, it comes complete with its own travelling case and can easily be carried in top pocket or the smallest of handbags. It has even got a stand for upright position on table, shelf or sleeping compartment. An unusual gift to yourself or others at only £10.95.

Every order dispatched by return, and is sent by recorded delivery. That is **Keelmoor's Promise To You.**

**THE KEELMOOR PROMISE**

Keelmoor have a tremendous reputation to uphold, both in the retail and wholesale trades and so, with every product sold, we automatically give the Keelmoor Promise. This includes—

● **NO RISK GUARANTEE.**

Try any of these items for 15 days and if you are not completely satisfied with the quality and value simply return it for a complete refund.

● **ONE YEAR'S FULL**

**GUARANTEE** on all products

● **BACK UP SERVICE** second to none

**15 DAY TRIAL COUPON.**

To Keelmoor Ltd, 78 Castle Street, Melbourne, Derby DE7 1DY  
Please send me the items indicated in the boxes below. I understand that if I am not completely satisfied, I may return the goods undamaged within 15 days and my money will be refunded in full.

A	B	C	D	E	F	G	H	I	J	Just indicate with a tick. Item required if more than one required tick plus number - i.e. 3
										TOTAL AMOUNT = £

NAME Mrs, Miss, Ms, Mr  
ADDRESS

POST CODE

Enclose a cheque - PO to KEELMOOR LTD  
Or charge my Access  or BARCLAYCARD  (tick as applicable)

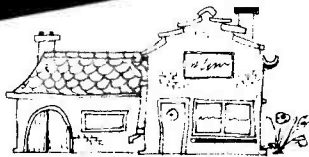
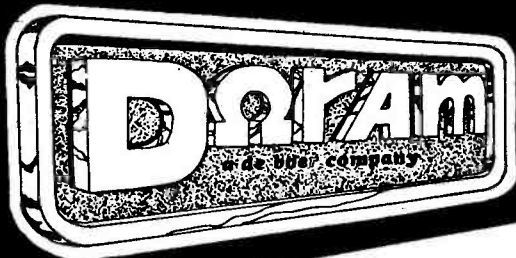
No

TOTAL - £

The advertisements to watch for quality precision at the right price. All goods dispatched by return.

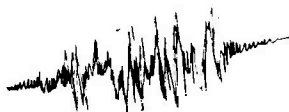
ETI





## HOME

- Steam train and whistle (80019). Simulates the sound on steam and whistle **£6.50**  
 Clap switch (79026). You clap your hands and the light comes on **£6.60**  
 Elekdoorbell (79095). Program your own signature **£22.00**  
 Touch dimmer (78065). Room lighting controlled by single touch **£6.80**  
 TV sound modulator (9925) **£3.75**  
 Simple sound effects (79077) **£5.70**  
 Electronic nuisance (80016) **£3.85**  
 Ultrasonic transmitter (audio) (79510) **£7.65**  
 Ultrasonic receiver (audio) (79511) **£9.65**  
 DJ killer (79505) **£8.80**  
 Quiz master (79033) **£6.50**  
 Variable fuzz-box (9984) **£6.55**  
 Ioniser (9823). Produces a high concentration of negative ions **£9.55**  
 Oscillographics (9979). Random displays patterns on your oscilloscope **£11.25**  
 Cackling egg timer (9985). Times your egg, then clucks like a hen! **£7.20**  
 Pools forecaster (79053). Weighs up the odds and could win you a fortune **£8.15**  
 Loudspeaking telephone amplifier (9987). Amplifies signal without direct connection **£11.50**  
 Sensitive lightmeter (9886). Light measurement using silicon photodiode **£12.55**  
 Nicad charger (79024). Automatically prevents over charge of cells **£15.20**  
 Proximity detector (9974). Detects movement in a room (electric field change) **£9.80**  
 Central alarm (9950). Master station slave station **£10.85**  
 Alarm unit **£3.10**  
 Touch tuning FM preselect unit (79519). With digital display **£17.50**  
 Talk funny (80052). Deliberate electronic distortion of speech and music signals using a single IC, the 2206 **£9.60**  
 Colour generator (80027). Using coloured light for an effective display **£19.70**  
 Pools predictor (79053) **£8.15**



## HIGH FREQUENCIES

- Aerial amplifier (80022). Improves the sensitivity of an existing receiver specify VHF/UHF **£5.45**  
 UHF/VHF modulator (9976). Generates a carrier for TV signals **£6.25**  
 Mini shortwave receiver (9920). Interesting introduction to SW radio **£8.95**  
 FM IF strip (78087). Using the CA 3189 limiter demodulator IC **£13.05**  
 Stereo decoder (79082). Compatible with the FM IF strip **£15.10**  
 Digital tuning scale (80021). A sophisticated digital frequency indication **£46.30**  
 Ohm aerial (80076 1 + 2). A practical shortwave aerial for 1, 8-30MHz **£10.30**

Buying one of our PROJECT PACKS will save you the frustration of tracking down those evasive components that hold up the completion of your project. Our packs include Printed Circuit Board, all the components listed in the article together with sockets and solder. Cases, knobs, etc., can be supplied as extra items if required. Ask for more information . . . !

## MUSIC

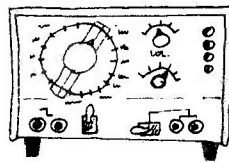
- Chorosynth (80060). A cheap mini-synthesizer **£67.90**  
 Elektor vocoder (80060). The first vocoder designed to be built from a kit with excellent features. It has 10 channels **£162.50**  
 Front panels for vocoder per channel **£1.25**  
 Analog reverberation unit (9973). Kit with 1 SAD 1024 **£27.70**  
 Piano. Excellent kit of an electronic piano with three voices.  
 Master tone oscillator/generator **£37.00**  
 Octave PCB (9914) **£18.75**  
 Filter PCB (9981) **£16.50**  
 Power supply (9979) **£19.05**  
 Digital reverberation unit main board **£67.20**  
 Extension boards **£46.30**

## NEW - NEW

- \* **Transistor Ignition (80084)**. A system which combines the most significant advantages of other systems **£20.45**
- \* **Digital Heart Beat Monitor (80071)**. Displays the heart rate on an LED display with audible monitoring through a loudspeaker **£37.20**
- \* **Transistor Tester (80077)**. Not only checks that the device is functional, but also displays the HFE group **£15.54**
- \* **Digibook**. An ideal form of tuition for first-time users of digital ICs. Electronic experimental PCB and components plus an instruction manual giving over 30 experiments and exercises **£13.50**
- \* **Post Poster (80130)**. An electronic insect repellent. Confuses mosquitos with high pitched tone **£2.35**
- \* **Battery Voltage Indicator (80101)**. Only a few components are needed to display the state of your car battery. LED display shows when you are in the danger zone **£6.85**
- \* **Active Car Aerial (80018)**. A signal booster designed for car radios. Works on both AM and FM bands to make a significant improvement to radio reception **£13.65**
- \* **Morse Trainer (80072)**. Can be preset to generate the morse alphabet for tuition purposes. Morse key required **£11.00**
- \* **Car Battery protection (80109)**. Automatically switches off your lights if you forget **£5.15**

## NEW CATALOGUE

Send 40p for our new catalogue giving details of our project packs and component range.



## MEASURING

- Digital thermometer (80045)  
 LCD display (supplied without relay) **£28.95**  
 LED display (supplied without relay) **£23.20**  
 Relay (two pole changeover) **£2.45**  
 AC millivoltmeter (79035). FET input meter circuit and audio generator **£6.30**  
 Universal digital meter (79005). Digital replacement for pointer instruments **£14.65**  
 Precision timebase (9448). Generates a precision 1 Hertz pulse **£13.10**  
 Power supply for timebase **£5.40**  
 Universal timebase (78100). Crystal controlled timebase **£18.70**  
 1/4 GHz counter (9887 1 + 2 + 3 + 4). Excellent kit count up to 250 MHz **£98.15**  
 Minicounter (9927). 1KNz 4 digit display **£27.70**  
 Audio analyser (9932). An analyser which can point the deficiencies in a particular audio chain or environment **£14.80**  
 Spot sinewave generator (9948). Programmable sinewaves with less than 0.0025% THD **£12.95**  
 Simple function generator (9453). Sine, square and sawtooth outputs **£27.70**  
 Sinewave generator (79019). Always sinewaves when you need them **£8.90**  
 TV scope basic version (9968 1/5). Produces display up to 1 KHz on TV **£34.50**  
 TV scope advanced version (9969 1/3). Converts basic scope to 100KHz bandwidth **£48.25**  
 Digiscope (9926) **£32.35**  
 Digifarad (79088). A digital capacitance meter with a wide range **£25.10**  
 Gate dipper (79514). Checks the resonant frequency of a circuit **£16.00**

## AUDIO

- Equaliser (9832). Single channel audio equaliser with slidepots **£17.70**  
 with turnpots **£15.60**  
 with preset pots **£13.95**  
 UAA180 LED meter (9817). A two-channel display meter with LEDs **£13.00**  
 Peak programme meter (9860). For use with UAA180 LED meter to give stereo audio display **£13.00**  
 Luminant (9949 1 + 2 + 3). A novel LED audio level indicator **£20.70**  
 Parametric equaliser (9897)  
 filter section (9897-1) **£6.45**  
 Tone control section (9897-2) **£5.20**  
 Audio analyser (9932). An analyser which can pinpoint the deficiencies in a particular audio chain or environment **£14.80**  
 Preconsonant (9954). A high-performance amplifier **£5.75**  
 Consonant (9945). A complete audio control preamplifier **£34.65**  
 Toppreamp (80031). Mini preamplifier for Topamp or any other Hi-Fi poweramp **£34.30**  
 Topamp (80023). Hybrid audio power amplifier with OM 931 (output 30 watt) **£18.50**  
 with OM 961 (output 60 watt) **£33.40**  
 Stentor (79070). A portable amplifier ideally suited for PA **£30.00**  
 Assistantor (79071). A preamp for use with Stentor **£7.00**  
 Elektornado (9874). A 2 x 50 watt or single 100-watt power amplifier **£19.50**  
 Electret microphone preamp (9866). Compact design that fits into the mike **£4.85**

## HOW TO ORDER:



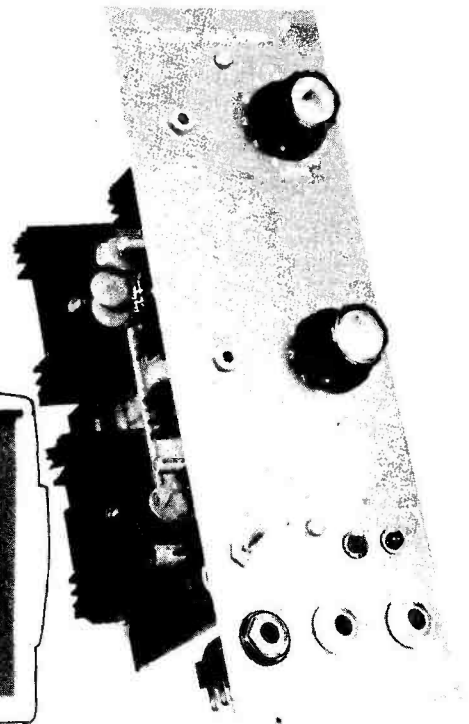
Send a cheque or postal order to **DORAM ELECTRONICS LTD., Fitzroy House, Market Place, Swaffham, Norfolk, PE37 7QH**. All our prices include V.A.T. Please add 40p for postage and packing.

Office hours: Monday-Friday, 9 a.m. to 5 p.m.  
 Telephone Swaffham (0760) 21627. Telex 817912.





# MONITOR AMPLIFIER



## Sound out your collection of Project 80 synthesiser modules with this 10 W per channel stereo power amplifier. Design by Charles Blakey

The 80-14 Stereo Power Amplifier is designed to be used in conjunction with the Project 80 synthesiser but with a few component changes it may also be used as a compact general purpose amplifier. The amplifier has an input impedance of 100k and an output of 10 W per channel into 8 $\Omega$  with a maximum distortion of 0.5% (typically 0.1%). For use with the synthesiser the input sensitivity is 1V<sub>RMS</sub> for the rated output and for the general purpose version the sensitivity is 250 mV<sub>RMS</sub>. A switched headphone output is incorporated, suitable for use with low impedance headphones.

The design is based on the TDA2030 which is a Class B amplifier with low harmonic and cross-over distortion. It incorporates power limiting circuitry, giving short-circuit protection, in addition to a conventional thermal shut down system. The choice is based on experience with the TDA2030, the fact that 10 W per channel is adequate for domestic or monitoring use, the need to keep heat generation to an acceptable level and, not least, to provide a compact module.

### Power Regulations

To obtain the 10 W per channel output it is necessary to use a 30 V supply; the maximum rating of the device is 36V. Furthermore, synthesiser applications in particular can generate peak current demands and these factors dictated the use of a regulated +15 V supply and DC coupling of the speakers. The components for rectifying, smoothing and regulating the power supply have been incorporated on the same PCB as the amplifier. When used with the synthesiser this allows the same mains switch to be used as for the +15 V module supply (Project 80-1) and for the fuse and

transformer for the amplifier to be housed in the keyboard case. A miniature three pole connector may then be used to couple the 15-0-15 V unregulated supply to the module housing allowing the module to be rapidly removed from the case when required. Also by having the capacitors on the PCB the ground returns from the speakers are kept short.

### All Change

The component values shown in the circuit diagram are for the synthesiser version. For the general purpose amplifier the following component changes are required.

R3,8	wire links
R4,6,11,13	100k
R5,12	3k3
C6,11	4u7 PCB electrolytic

### Construction

The module will fit onto the standard 9 x 3 inch panel and it can also be installed in a Teka Alba A23G case but as with the panel version the transformer will have to be external to the case. For the self-contained amplifier a case with minimum internal dimensions of width 220 mm, length 250 mm and height 90 mm is required.

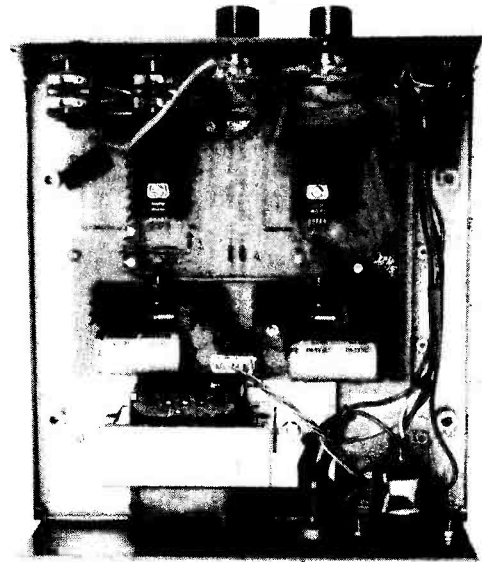
Construction should be carried out in the following sequence. Make the one wire link with insulated wire then solder in the resistors, capacitors and the bridge rectifier. Next install the TDA2030s. Slide the heatsink under the TDA2030 and, after checking that the pins are still in place, bolt the IC and the heatsink to the PCB. Do not move the





heatsink once the IC has been soldered since this will stress the pins. The voltage regulators are now bolted to their heatsinks (the pins should protrude from the side having the greatest distance from mounting hole to edge) and the combined heatsink and IC held firmly against the PCB while the regulator is soldered in place. There is no need to isolate any of the ICs from their heatsinks, but it should be noted that the heatsinks for the negative regulator and the TDA2030s will be at negative potential. A small amount of heatsink compound between the IC and their respective heatsinks is desirable.

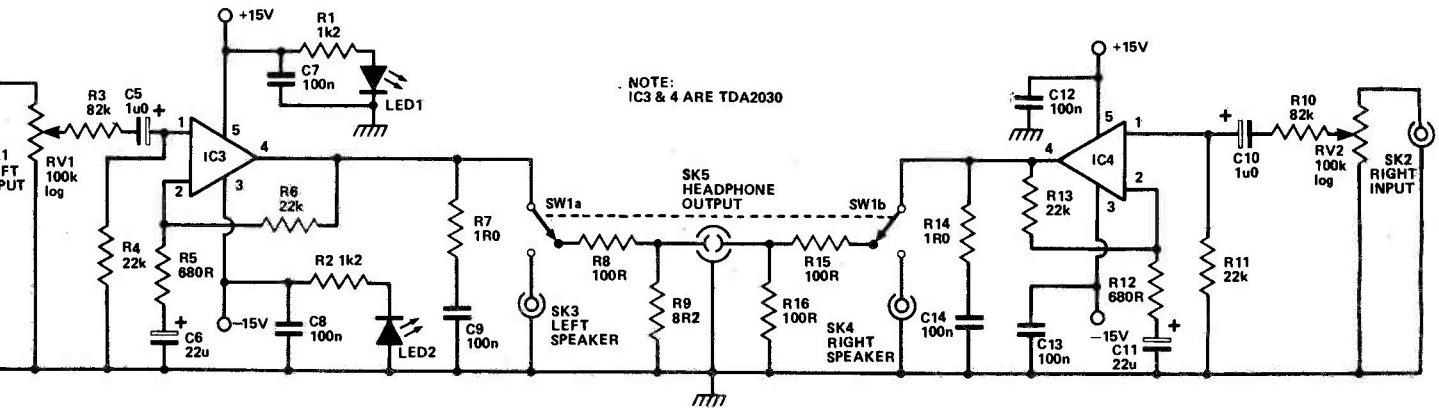
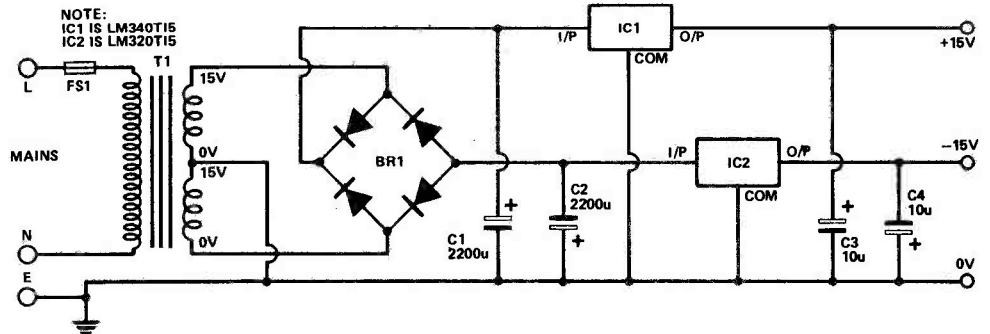
Next wire the PCB to the panel components. Screened wire should be used for the input leads which go from the input jack sockets to the rotary potentiometers and from the latter to the PCB. Do not common ground connections at the panel (except for the LEDs), but take them back to the appropriate connection hole on the PCB. Keep wiring as short and neat as possible. For the speaker leads it is preferable to use wire of at least equivalent to 16/0.2 mm. R8 and 15 can be soldered direct to the switch and a lead taken from the other end to the headphone socket while R9 and 16 should be soldered direct to the headphone socket. Remember to take a ground return from this socket to the PCB.



Inside the Project 80 Monitor Amplifier. Straightforward design and PCB layout makes for simple construction.

Fig. 1 (right) Circuit diagram of the power supply. BR1 is a 2 A bridge rectifier.

Fig. 2 (below) Circuit diagram of the stereo Monitor Amplifier (synthesiser version). See text for alterations necessary to make a general purpose amplifier.



## HOW IT WORKS

The TDA2030 power amplifiers (IC3 and IC4) require few external components and the function of the latter for the left input is described. C5 AC couples the amplifier while R3 and R4 form an attenuating network to reduce the sensitivity for use with the Project 80 synthesiser and, in the absence of RV1, determine the input impedance. RV1 provides manual adjustment of attenuation. R5 and R6 set the closed loop gain and for the general purpose version (R4 = 100k; R6 = 100k; R5 = 3k3) the voltage gain is approximately 30 dB. C6 is for DC decoupling of the inverting input and adjusts the low frequency cut-off. R7 and C9 increase frequency stability while C3, C4 (power supply) together with C7 and C8 are bypass capacitors which

also reduce the risk of oscillation.

SW1 allows selection of speaker or headphone outputs and for the latter R8 and R9 attenuate the output to a level suitable for low impedance headphones.

The power supply is a conventional regulated supply with a nominal +15V and 1A5 per rail which is sufficient for 8R speakers at peak output of the amplifiers (about 13W with 10% distortion). The regulators will also cope with 4R speakers in combination with a suitable transformer. R1, R2 together with LED 1,2 give a visual indication of supply voltage to the amplifiers.



# PROJECT: Monitor Amplifier

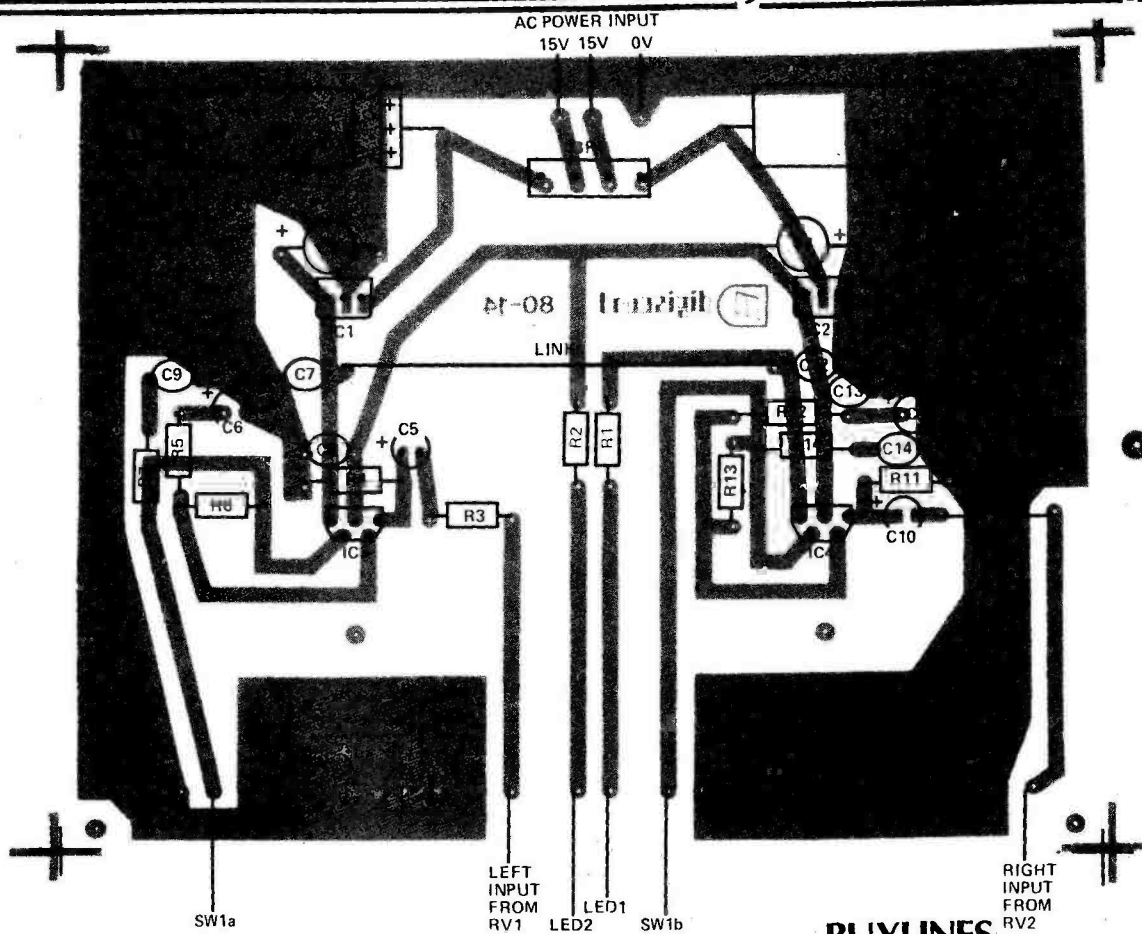


Fig.3 Component overlay.

A kit for the stereo amplifier is available from Digisound Limited, 13 The Brooklands, Wrea Green, Preston, Lancs PR4 2NQ for £22.20 inclusive of postage and VAT. The kit includes the PCB and all listed components except transformer and case/panel. Please specify synthesiser or general purpose version.

## PARTS LIST

(Synthesiser version, 8R speakers)	
Resistors ¼ W carbon except where stated	
R1,2	1k2
R3,10	82k
R4,6,11,13	22k
R5,12	68R
R7,14	1R0, ½ W
R8,15	100R, ½ W
R9,16	8R2, 2W5 wirewound
Potentiometers	
RV1,2	100k logarithmic
Capacitors	
C1,2	2200u 40 V electrolytic
C3,4	10u 25 V electrolytic
C5,10	1u0 100 V PCB electrolytic
C6,11	22u 25 V PCB electrolytic
C7,8,9,12,13,14	100n disc ceramic
Semiconductors	
IC1	LM340T-15
IC2	LM320T-15
IC3,4	TDA2030H
LED1,2	Red LED
B1	2 A bridge rectifier
Miscellaneous	
SW1	DPDT subminiature switch
SK1,2	3.5 mm jack sockets (phono sockets for GP version)
SK3,4	0.25 inch mono jack sockets
SK5	0.25 inch stereo jack socket
T1	50 VA transformer, dual 15 V secondaries in series or 15-0-15 V type.
FS1	Chassis fuse holder with 1 A fuse.
Heatsinks for IC1,2,3, and 4	

## Ironing

A final point to note is that comparatively heavy currents will flow through many of the connections and it is essential that they are properly soldered. The connections requiring most care are those to ground where the large foil area acts as a heatsink. This is eased by using a tinned PCB but even then it is necessary to place the soldering iron adjacent (not touching) to the lead to be soldered and allow the area to heat up sufficiently prior to heating the lead and applying solder to it.

After construction connect the transformer and switch on. Gently touch each IC in turn. These should remain cool, since the TDA2030 quiescent current to each is only of the order of 50 mA. The LEDs will indicate whether the power supply is functioning. If any of the ICs run hot at this stage check the component placement and condition of soldered joints. Next connect the speakers and if any hum is evident check the wiring from PCB to panel components. Finally connect the amplifier to an audio source to determine that the module is functioning correctly.

Conventional Hi-Fi speakers should not be used in conjunction with a synthesiser since single frequency tone of more than a few watts can damage treble speakers. For most purposes full range speakers with a nominal impedance of 8R and a rating of 15 W will prove adequate.

ETI



# Quantum Electronics



## PRE-AMP: KIT £85.50, BUILT £92.50

The most cost-effective pre-amplifier available. It provides a perfect match for any cartridge, moving coil or magnetic and also accepts auxiliary and 2- or 3-head tape machine with outstanding technical performance from an elegant circuit configuration. The kit requires **no soldering** and takes only about 15 minutes. The module is available separately at £51.75. We also have separate mains supplies for the pre-amplifier in kit form and ready-built, and modules/hardware for moving coil head amps.

## POWER AMPS: KITS FROM £100.50 BUILT £151.00

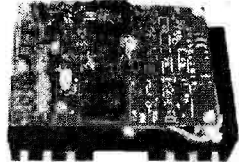
There are two stereo and four mono 'domestic' power amplifiers from 45W to 200W/8 ohms, ready built or in kit form. The kits use built and tested printed circuit boards and require only simple assembly and point-to-point wiring.

Exemplary specification includes (h.d. less than .01% at 1kHz, slew rate greater than 30V/μs, noise greater than 110dB, fully protected against overload, unconditionally stable.

**45W channel: kit, P2, £100.50; built, 202D £151.00**  
**110W/channel: kit, P4, £126.00; built, 204D £185.00**

## POWER AMP MODULES AND SUPPLIES

QE 1708, 1704, £31.96  
 QE 1004, £20.69



M1504, 1508, £35.79    M2603, £50.28  
 M854, £26.00            M2308, £53.96

We offer a wide range of power amplifier modules to suit virtually any application with a performance that is unbeatable at the price. Using circuitry basically identical to our widely acclaimed amplifiers above, they are available in both the popular 'L' bracket versions for 60 to 170W 'module rating' for medium duty use and also in high dissipation formats using separate heatsinks for ultimate reliability at up to 260W r.m.s. Matching power supplies using toroidal transformers (available separately up to 500VA) are available.

## ★ EXCELLENT TRADE PRICES ★

We also build rack mounting power amplifiers, sub-assemblies and special modules to individual specifications. Please telephone with your enquiry.

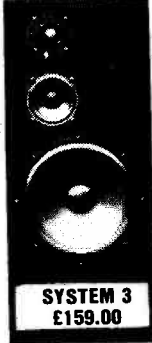
## NEW DELUXE SPEAKER KITS



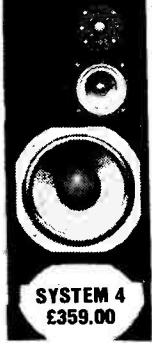
SYSTEM 1  
£69.00



SYSTEM 2  
£89.00



SYSTEM 3  
£159.00



SYSTEM 4  
£359.00

PRICES PER PAIR INC. BAFFLES

Have you wondered why the existing sources of speaker kits offer a bewildering choice of systems, particularly combinations of 200mm bass unit and tweeter? Don't they know which ones are best? If so, why bother with the rest! Well we have sorted out these super kits so you can order in confidence, knowing you get our full endorsement of their performance and value. The kits incorporate professionally finished front baffles with the drive units already mounted so all the fiddly work is done for you. All that is left to do is to make a simple box. Crossover networks, foam and terminals are included. Systems 1 and 2 use a 200mm bass and 25mm dome tweeter from Son Audax. System 2 being a reflex design that we enthusiastically recommend. System 3 is a competitive 3-way I.B. using Seas bass and mid with a Son Audax tweeter, cleverly incorporating a stand at the bottom of the enclosure, as does System 4, undoubtedly the best kit on the market, using a Volt 250mm bass driver with a 250mm ABR on the rear baffle (also supplied), a modified Peerless mid and Son Audax tweeter. We will also be retailing selected drive units at competitive prices, e.g. Son Audax 200mm bass, 20B25J4 £13.60; 25mm tweeter, HD100D25, £9.00.

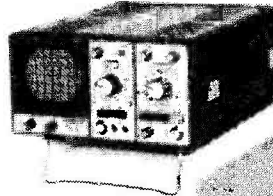
All our prices include V.A.T. and delivery. Export no problem — please send for a specific quote by return. All equipment can be wired for 110V mains. Please send a large S.A.E. or dollar bill for our full information and review reprints.

**PLEASE NOTE THE ADDRESS OF  
 OUR NEW LARGER PREMISES:  
 8 ALBION STREET, LEICESTER  
 Tel: (0533) 546198**

# HAMEG

## OSCILLOSCOPES

TOP PERFORMANCE,  
 QUALITY AND VALUE



HM 307 ..... £149  
 Single Trace DC-10MHz  
 Plus Built-in Component  
 Tester

HM 312 ..... £250

Dual Trace DC-20MHz  
 5mV/cm, Full X-Y, 30MHz  
 Trigger, plus TV Trigger

HM 412 ..... £350

Dual Trace DC-20MHz  
 5mV/cm, X-Y, 40MHz Trigger  
 plus Sweep Delay

HM 512 ..... £580

Dual Trace DC-50MHz  
 5mV/cm, X-Y, 70MHz  
 Trigger Sweep Delay, plus Single  
 Shot, Sweep Delay and After  
 Delay Trigger



HM 812 ..... £1,458

Dual Trace as per HM 512 plus  
 Storage, Automatic Storage and  
 Variable Persistence

Prices U.K.  
 List Ex. VAT

For  
 FULL DETAILS and  
 DISTRIBUTOR LIST  
 contact:

**HAMEG LTD.**  
 74-78 Collingdon St.  
 Luton, Beds LU1 1RX  
 Tel: (0582) 413174



# ASTROLOGUE

Over the years ETI has covered almost every aspect of spaceflight. Now in the new regular series Ian Graham keeps you up to date with what's happening in the world of aerospace.

One aspect of the European space programme suffered a serious setback in May this year, when the Ariane launch vehicle ended up in the Atlantic Ocean two minutes after embarking on its second test flight.

Ariane is the key to Europe's future independence from America and Russia in placing satellites in Earth orbit. It will vie with the American Space Shuttle for business. Although the European Space Agency (ESA) is supporting the development and testing programme, once the hardware is proven Ariane will have to pay its own way by charging customers to carry their payloads into orbit.

The 200 tonne, three stage rocket first took to the air in December 1979 at the fourth attempt. The first hold-up was caused by excessive pressure readings in one of the four first stage Viking 2 engines. In fact the engines were OK. The fault was in the pressure sensor.

During the second attempted launch a fault appeared in the on-board batteries. Again, a sensor was found to be responsible. Unfortunately, this malfunction caused further delay by damaging one of the third stage subsystems (helium pressurisation). When Ariane finally got off the ground, its performance exceeded the designers' predictions, to the relief of all concerned. Ariane was a success.

## Test Launch

The second test rocket blasted off from the Guiana Space Centre in French Guiana on May 23rd. Within a few seconds of lift-off, pressure in one of the four first stage engines began to fluctuate. Two of the remaining engines suffered the same rapid pressure variations, which set up vibration in the structure itself. Eventually, the rocket broke up and blew itself to pieces.

The wreckage has now been recovered from the Atlantic mud and investigators have found a small metal identification tag in a fuel injector in one of the engines, although it isn't known if the tag was lodged in the injector at launch or during the break-up. The investigators are also looking at several other possible causes. The next test flight, originally scheduled for November, has been postponed until the beginning of next year.

## Hughes' News

This is the first chance we've had to look at the new Hughes Aircraft Company Wasp anti-armour missile. It is one of a new generation of 'fire and forget' missiles; that is, once fired from an aircraft, the missile can carry on to its target without any guidance from the mother aircraft.

Of its predecessors, Maverick had to be targeted by the aircraft and could only be fired singly. Wasp can be fired either singly or in swarms of ten or more, but its over-riding advantage is that the aircrew do not have to identify a target before launch. The missile looks after all that itself. So, the aircrew can send a dozen Wasps on their way against a formation of enemy tanks and make for home without contacting the air defences. For that reason I'd guess Wasp will be a popular missile with the aircrew who will operate it.



In this artist's impression, a swarm of Wasps has been launched in the general direction of a formation of enemy tanks. The aircrew are already making for home. Each missile then seeks out a target and attacks.

The Hughes Aircraft Company's Wasp air-to-surface anti-armour missile. When the five feet long missile is launched, the wings flip out into the flying position.



# RUSHMOOR ELECTRONICS LTD

43 Queens Road, Farnborough, Hants.  
Farnborough (0252) 515373

- ★ Prices include VAT
- ★ Unless stated post/packing 35p
- ★ All items full spec. and guaranteed
- ★ Cash/Cheque/P.O. with order

## TRANSISTORS

BC108.....	12p
BC182/3.....	11p
BC212/3.....	14p
OC42.....	35p
TIP31A.....	35p
TIP32a.....	35p
TIP41A.....	45p
TIP42A.....	45p
TIP3055.....	45p
TIS90 (2N3704).....	5p

## DIODES

IN4148.....	4p
General Purpose Silicon	
.....	50p per 100

## LINEAR I/C

741-8.....	21p
741-14.....	40p
NE555.....	30p
LM308N.....	55p
LM311N.....	60p
LM709-14.....	40p
LM710CN-14.....	50p
LM723CN.....	50p
LM3900.....	55p
SN75188N.....	125p
SN75189N.....	135p
SN76477N.....	250p

## REGULATORS

LM309KC.....	120p
LM320K-12.....	280p

## OPTO

TIL209 - Red.....	12p
TIL220 - Red.....	13p
TIL306 - 7-Seg Display and Decoder - Red.....	650p
TIL321A - 7-Seg Display C/A. 5".....	100p
NSB3881 - LED Display. 3" Cathode Multiplexed.....	389p

## INTERFACE I/C

DS75491N - 4-Seg LED Driver.....	60p
DS75492N - 6-Digit LED Driver.....	60p
DS8640N - Quad NOR Unified Bus Receiver.....	70p

## COMPUTER I/C

TMS2516JL.....	1600p
TMS2708JL.....	762p
TMS2532JL.....	4800p

## SPECIAL OFFERS

- ★ MM 5378N. Digital clock I/C. Crystal controlled. LED outputs ..... 380p
- ★ 8Ω Speaker - 2" dia ..... 80p
- ★ SPDT Rocker Switch..... 40p
- ★ Slide Switch - Centre Off ..... 30p
- ★ 20mm Panel Mounting Fuseholder ..... 40p
- ★ 20mm PCB Mounting Fuseholder - (Strip of 12) ..... 35p
- ★ PP3 Battery Clip ..... 15p
- ★ PP9 Battery Clip ... 10p per pair
- ★ Dynamic Hand Microphone - 200z Impedance..... 175p
- ★ Experimenters Boards (Undrilled).... 150p per set of 6
- ★ 250V Reversible Brushed Motor - 15000 r.p.m. .... 200p + 75p post/packing

# DIGISOUND LIMITED

—providing a service to all who are interested in electronic music

## NEW PRODUCTS

Two new custom I.C.s from Solid State Micro Technology which have general applications but are particularly well suited to polyphonic synthesizers.

**SSM 2044.** 4-pole voltage controlled filter for 24dB/octave low pass filtering. A novel filtering technique provides extended control range, low noise and high control rejection. On chip control of resonance. Differential inputs for two voice arrangements. ± 5V to ± 15V supplies. **£3.20 each** (excl. postage and V.A.T.).

**SSM 2055.** Voltage Controlled Transient Generator. Similar features to the SSM 2050 but improved offset and control feedthrough. Ability to gang controls together when two or more devices being used. **£3.65 each** (excl. postage and V.A.T.). Add 30p P. & P. and then 15% V.A.T. to total value.

Data sheets on above (or other specialised I.C.s stocked) available for 10p per device, plus 15p postage unless ordered with price list or components.

**NEW PRICE LIST.** 15p post paid. Some price increases have become necessary for ETI 80 MODULAR SYNTHESISER kits published earlier in the year. As a special offer we will accept orders for complete kits at the original price stated in ETI or in our April 1980 price list. This offer closes on September 30, 1980.



**DIGISOUND LIMITED,**  
13 THE BROOKLANDS, WREA GREEN,  
PRESTON, LANCS. PR4 2NQ  
Tel.: 0772 683138 (MAIL ORDER ONLY)

# Toroidal Transformers



We use advanced winding technology to make our toroidal transformers. They have only half the weight and height of their laminated equivalents within the range and are appreciably more efficient. Our toroids cost virtually the same as their now outdated laminated equivalents and hum is down to a negligible tenth of what it used to be. Each I.I.P. toroidal transformer is supplied with rigid mounting kit comprising centre bolt, two neoprene and one steel washer. Now available in a range of 37 sizes.

TYPE	VA	SECONDARY RMS VOLTS	SECONDARY RMS CURRENT	DIMENSIONS OIA-HT	WEIGHT KG	PRICE
2X010 2X011 2X012 2X013 2X014 2X015 2X016	50	6+6 9+9 12+12 15+15 18+18 22+22 25+25	4.16 2.77 2.08 1.66 1.38 1.13 1.00	80 x 45mm	0.9	EACH <b>£5.40</b> + £1.10 P&P + £0.98 VAT
3X010 3X011 3X012 3X013 3X014 3X015 3X016 3X028 3X029 3X030	80	6+6 9+9 12+12 15+15 18+18 22+22 25+25 110V 220V 240V	6.64 4.44 3.33 2.66 2.22 1.81 1.60 0.72 0.36 0.33	90 x 30mm	1.0	EACH <b>£5.70</b> + £1.20 P&P + £1.04 VAT
4X010 4X011 4X012 4X013 4X014 4X015 4X016 4X028 4X029 4X030	120	6+6 9+9 12+12 15+15 18+18 22+22 25+25 110V 220V 240V	10.00 6.66 5.00 4.00 3.33 2.72 2.40 1.09 0.54 0.50	90 x 40mm	1.2	EACH <b>£6.72</b> + £1.30 P&P + £1.20 VAT
5X016 5X017 5X028 5X029 5X030	160	25+25 30+30 110V 220V 240V	3.20 2.66 1.45 0.72 0.66	110 x 40mm	1.8	EACH <b>£8.88</b> + £1.40 P&P + £1.54 VAT
6X016 6X017 6X018 6X026 6X025 6X028 6X029 6X030	300	25+25 30+30 35+35 40+40 45+45 110V 220V 240V	6.00 5.00 4.28 3.75 3.33 2.72 1.36 1.25	110 x 50mm	2.6	EACH <b>£12.27</b> + £1.50 P&P + £2.07 VAT

## CHOICE OF 3 PRIMARY INPUTS

I.I.P. Toroidal Transformers are available in choice of 110V., 220V., or 240V., coded as follows.  
For 110V Primary insert 0 in place of "X" in type number.  
For 220V Primary insert 1 in place of "X" in type number.  
For 240V Primary insert 2 in place of "X" in type number.

Example - 120VA 240V 15 + 15V. 4A = 42013.

\* TYPES TO CUSTOMER'S SPECIFICATION CAN BE SUPPLIED TO ORDER IN QUANTITY, ENQUIRIES INVITED.

## FREEPOST facility.

We pay postage on U.K. enquiries and orders! Simply address envelope to FREEPOST T4 to address below. NO STAMP REQUIRED.

## TO ORDER

Enclose cheque / Postal Order / Money Order or quote your ACCESS or BARCLAYCARD account No.



**I.I.P. TRANSFORMERS** — a division of

IIP Electronics Ltd. Graham Bell House, Roper Close, Canterbury CT2 7EP.  
Phone (0227) 54778. Telex 965780



# MICROBASICS

In the second part of our new series, Henry Budgett takes the mystique out of the inner workings of modern man's best friend and contemplates the bits and pieces necessary to make it all work.

Having introduced the various component parts of a computer system in last month's episode I shall now move onto the actual microprocessor itself. Just as we divided the computer up into a number of parts so we may dissect the microprocessor. It is important to understand at this early stage that the much-vaunted micro is merely a very complex piece of electronic logic and is totally useless on its own without the ranks of qualified engineers, programmers and other allied trades, the supposedly mighty micro is an incomprehensible lump of high technology!

## Architectural Heritage

The average, general purpose computer can be divided into a number of discrete elements as we saw last month. One of these components is the Central Processing Unit or CPU and this can be sub-divided still further. The microprocessor is really a totally integrated central processing unit; it still needs all the other bits and pieces to make it perform as a computer. Some of the later designs do incorporate internal memory

areas and one or two even have self-contained programs, the new SC/MP chip from National Semi with the NIBL BASIC built in being a prime example.

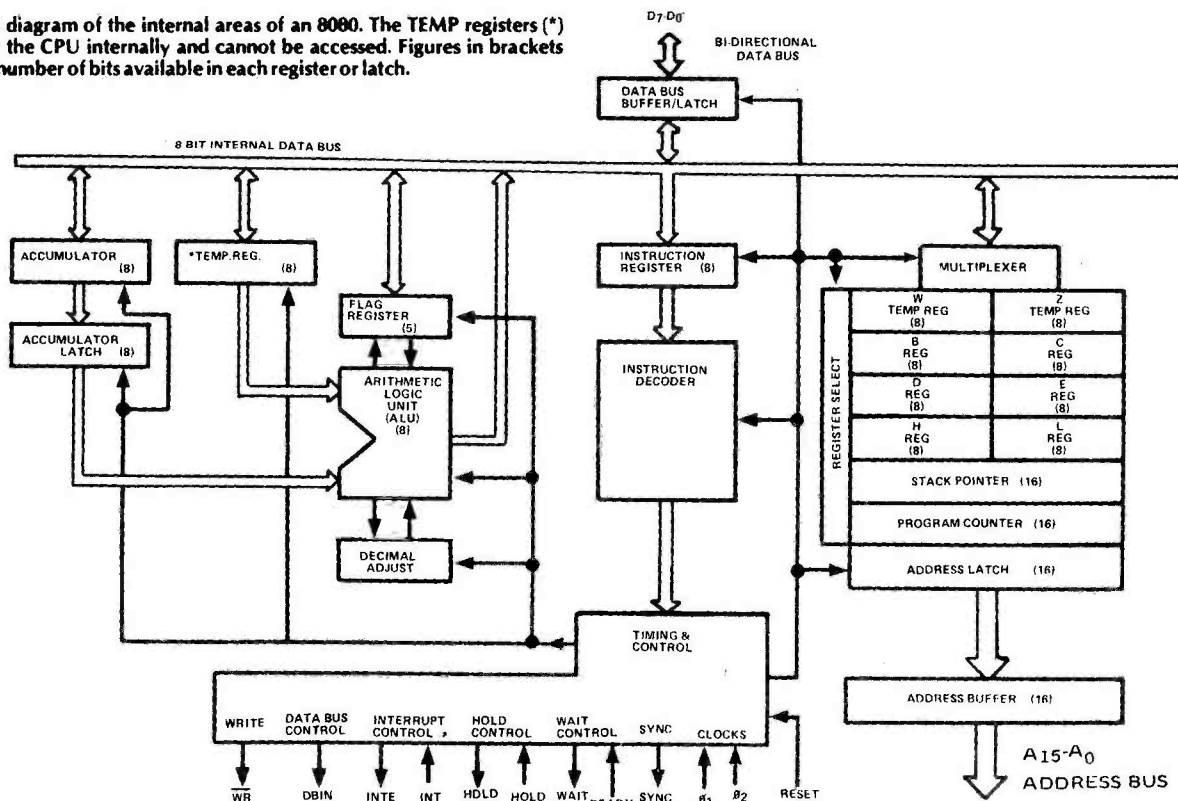
The three main sections of the CPU are the registers, the ALU and the control circuitry.

Taking them in order we find that the registers are a group of storage units within the CPU. Some of these are available to the programmer, others are used solely by the processor as counters or storage locations. The most important of these is the Accumulator. This register is used to store the data to be processed by the ALU, a typical instruction being to add the contents of some memory location to the Accumulator and to hold the result in the Accumulator for further processing. Many of the current families have other general purpose registers for data storage — the 8080 has six for example.

## Flagging Already?

Closely associated with the Accumulator are a number of special registers called the flags. These are used to indicate the

Fig.1 Block diagram of the internal areas of an 8080. The TEMP registers (\*) are used by the CPU internally and cannot be accessed. Figures in brackets refer to the number of bits available in each register or latch.





status of the ALU after an operation. Typical flags are 'carry' showing that an arithmetical carry has occurred, 'overflow' which simply shows that the number has exceeded the word length of the Accumulator and a number of bits which indicate the sign of the result in the Accumulator. There is also one other register connected with the Accumulator and ALU and that is the index register. This holds any offsets used in addressing or indexing and its inclusion is machine dependent.

The processor also requires a number of special registers, the instruction register and the program counter being two typical examples. These both have a 'double word' capacity, that is they can hold a full sixteen bit address. The contents of the program counter are always one in front of the address currently being used. This is in order to allow subroutines to re-join the program at the right place. When multiple subroutines are used, these addresses are held in a LIFO memory area called the stack. Some processors have a built-in stack which allows only a certain number of subroutines, whereas others use a dedicated area of memory, which can be, in theory, as large as you like.

All the stored information in memory is, until decoded, garbage. The instruction register performs two tasks in that it not only holds the currently selected address contents but also decodes them to see if they are valid instructions or data. This is usually done by a mask programmed ROM (Read Only Memory) which has all the valid instructions stored in it. The reason for coding the instruction set into a 'microprogram' are twofold. Firstly, it makes the control circuitry much simpler and, secondly, one can, in theory at least, change the instruction set of one's processor. As an example of this there are some 20 extra codes built into the Z80 CPU that are not mentioned in the manuals. Apparently they are not all guaranteed to work on all Z80s. Anyone know what they are and what they do?

## Cycling Around

All the processes of control are under the charge of a central clock which synchronises the various happenings within the CPU. Some processors require a two phase clock, others a single phase, but in almost all cases the clock must be crystal

controlled. The reason for the accuracy needed is that, if one is to expand the system further than the basic CPU and its associated support circuitry, the clock must remain stable under variations of temperature and varying loads. Computer buses are fairly capacitive and can, over reasonable transmission distances, turn a nice square wave into a very unpleasant object indeed. The fundamental speed of the CPU is governed by the clock frequency. The original 8080 ran at 1 MHz and the 8080A, because of improved internal circuitry, runs at 2 MHz and will, therefore, process at twice the speed. However, and this is a common misconception, the actual CPU doesn't process at these speeds because of a number of reasons.

The most obvious reason is that the ALU is a serial device, that is it takes one bit at a time rather than processing the entire word. The second reason, which I will elaborate on in a minute, is that one has to perform a number of discrete operations within the chip just to get the information in a place where it can be processed and this takes time. All these operations are performed in cycles, the fundamental unit of time taken to fetch and execute a single instruction. On inspection of a data sheet on your chosen micro you will find this time quoted in terms of the number of clock cycles taken. All other instructions are then specified in the number of cycles that they take.

## State Visit

To further explain this concept of instruction cycles let's take a look at the various types. The basic FETCH cycle, also known as the M1 cycle, is made up of four states. During the first three, the processor fetches the instruction from the memory location indicated by the program counter. The counter is at this point showing the current location and has not been incremented. The fourth cycle is taken up by decoding the instruction. An example of this is the instruction to add the contents of a register to the Accumulator. If we wish to access a memory location rather than a register, we will have to perform a memory read, which requires an extra machine cycle. Say we wish to add the contents of a given memory location to the contents of the Accumulator. The sequence of operations is as follows: the processor extracts the

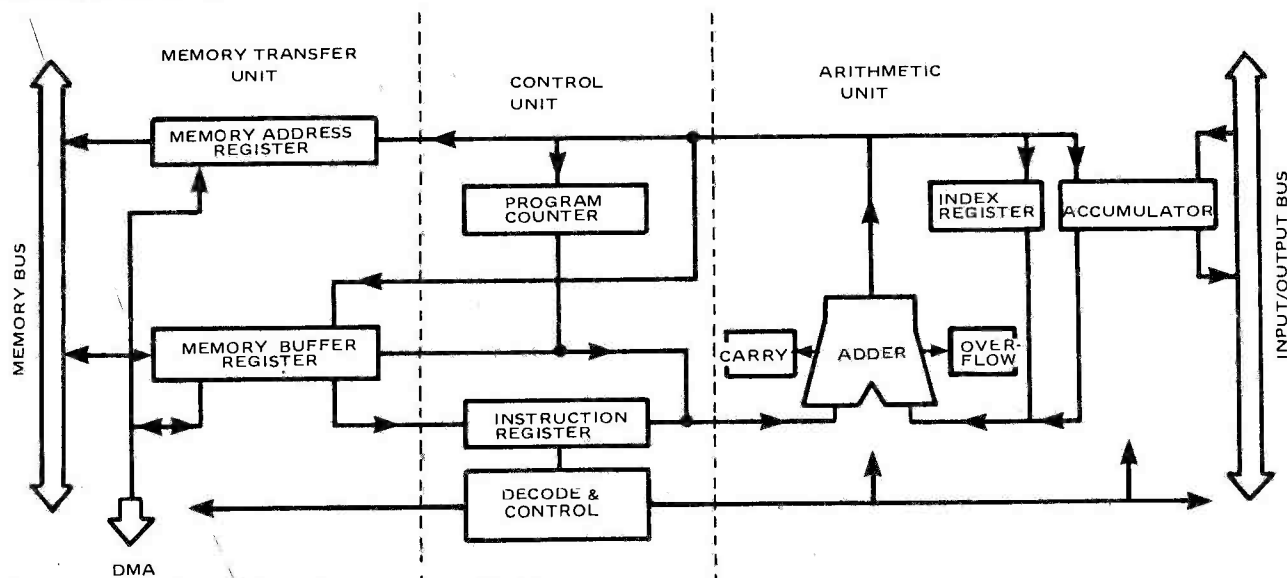


Fig.2 Functional block diagram of a CPU. This represents the minimal configuration you would expect to find. You could implement this (for fun) in discrete logic elements and see how it worked. It makes a good demonstration piece for schools and colleges.



single byte instruction from the memory location given in the program counter; this takes three states. This is decoded and the processor sends, as an address, the contents of its H and L registers. The data word returned during this cycle is held in a temporary register inside the CPU and we have now used six states. The final act of adding the temporary register contents to the Accumulator takes a further state making seven in all, or two cycles. The longest operation of all, in 8080 code, takes 16 states or five machine cycles.

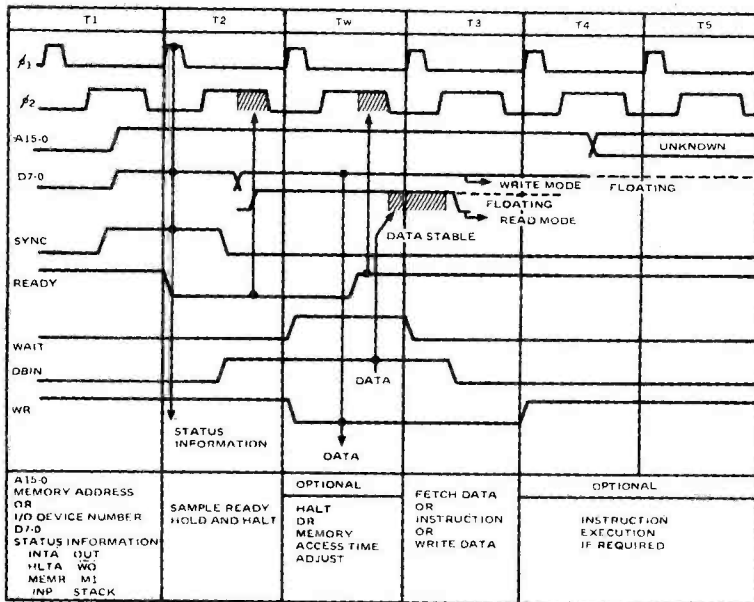


Fig.3 Timing diagram showing the various states that can make up a machine cycle: The vertical arrowed lines indicate information access states.

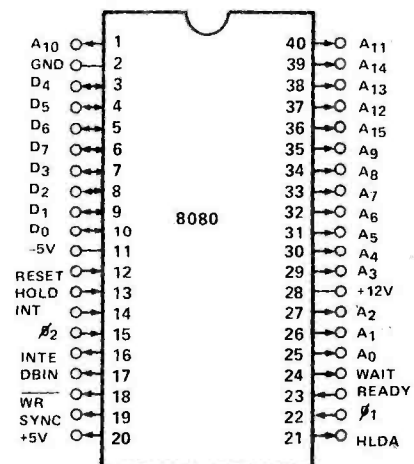
transfer. WAIT is an indication that the CPU has entered a WAIT state, triggered by pulling the READY line low before the second state time. This causes extra states to be added to the cycle time for as long as the READY line is held low. The process is often used in situations where the memory or device currently being accessed is slower than the processor.

Our next signal, WR, is provided for the synchronisation of external transfers. These include memory and I/O operations and it is the converse of DBIN. There now follows a group of controls, which are concerned with things called interrupts. An interrupt is the computer equivalent of a tap on the shoulder and is used by peripheral devices to tell the processor that they are ready to be looked at. The INT line must be set high to tap the computer on its shoulder, but this will only work if the INTE line has been enabled previously. Inside the CPU, the interrupt is signalled by a status bit being set and the external device must put its instruction onto the bus in order for any action to be taken. The HOLD line is concerned with direct memory access and as such we shall not dwell on this until next month. The HLDA is merely an indication that the CPU is in a HOLD state. Finally we have the RESET line which, as its name implies, does. The signal will restore the CPU to the first state of a machine cycle and it also clears the program counter. It is essential to start all the power up sequences with this signal otherwise you never know what you may find yourself doing! It is also worth noting for all those sceptics among you that pressing RESET does *not* destroy all your registers, it merely sets you back to the beginning without destroying your program *unless* the person who programmed the monitor on your system clears the memory as the first operation. Whoever said that programmers were logical anyway.

## The Ins And Outs

The final section of our look at the internals of a CPU is the connections you can make with the outside world. Generally, the CPU is housed inside a DIL package with some 40 legs. Under normal circumstances, assuming the standard eight bit CPU, we will have 16 pins for the address bus, eight pins for the data bus and 16 pins left to play with. Just what you do with them depends on the kind of CPU you have, but let's take a close look at the pins on an 8080.

Having already mentioned the address and data bus, we only need to say that the data bus is a bi-directional system and is capable of tri-state operation. It can assume a high impedance state, which is neither a logic zero nor one and this is used under some special circumstances, which will be mentioned next month. Four further legs can be allocated to power; the device needs  $\pm 5$  V, +12 V and ground. Yet two more legs can be allocated to the required two phase clock, leaving us ten possible control signals to communicate the state of the device to the outside world. These are SYNC, DBIN, WAIT, HLDA, INTE, READY, HOLD, INT and RESET. Taking these in order, the SYNC indicates the first state of each machine cycle, thus acting as a synchronisation signal, hence the name. The DBIN signal tells the outside world that the CPU can accept data. It should be used to externally enable the



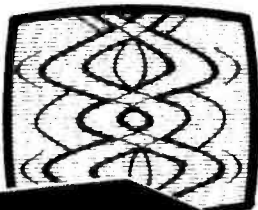
Pin designations of the 8080. Developed by Intel, fathers of the micro, it is still regarded as the workhorse of eight bit processing. It also spawned the Z80, probably the most powerful eight bit chip using current technology.

## Coming Soon

Next month's slice of bits will investigate the thorny topic of memory devices and show you the way in the ROM-RAM jungle as well as telling you how to ignore your CPU altogether and really make things work fast.



# VIDEO MUSIC



The amazing Videograph, as featured recently in Electronics Today International, links your Hi-Fi with any Colour TV to produce a Fantasia of hypnotic visual effects. The system displays stereo music as brilliantly coloured waveforms against an ever changing background. For the technically-minded, a square-wave signal generator is built-in, permitting advanced demonstrations of transient response etc. Truly the ultimate accessory for any Hi-Fi system!

**DIY KIT ONLY £33.95**

Case & Controls £15.95  
or READY BUILT £69.95

All prices include VAT and postage

**WILLIAM STUART SYSTEMS Ltd**

Dower House, Billericay Road, Herongate, Brentwood, Essex CM13 3SD. Telephone: Brentwood (0277) 810244



# BOMB PROOF POWER!



The WINTON is still the **OUTSTANDING KIT ACHIEVEMENT** of the decade. Using POWER MOS-FETs in the OUTPUT STAGE it provides 50 + 50 WATTS at less than 0.1% distortion over the **whole** audio band.

The Power MOS-FETs we use are practically 'Bomb Proof' without the need for distortion introducing protection devices, or as some coyly name them "Thermal Overload Cutouts." Our MOS-FETs don't suffer from thermal runaway or secondary breakdown as ordinary transistors do.

Requiring around twenty hours to build you finish up with an amplifier which is equal to, or better than ready-built designs costing upwards of £600, and you have the enormous satisfaction of having built it yourself.

A 12p stamp will bring you the full details or better still, send your cheque for the best amplifier kit around. POWER MOS-FETs RULE, O.K.

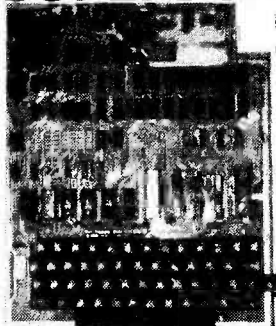
**COMPLETE KIT** of all parts necessary to build the P.W. WINTON ..... **£133.50**

Order with complete confidence (C.W.O. only please) from:

**T. & T. ELECTRONICS (Dept. E)**  
Green Hayes, Surlingham Lane, Rockland St. Mary  
Norwich NR14 7HH. Telephone 05088 632

**PRICE INCLUSIVE OF V.A.T. & CARRIAGE**  
Callers by appointment only

# OHIO SCIENTIFIC SUPERBOARD 2

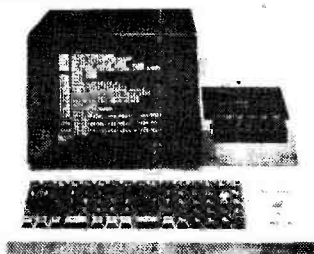


**50ZH BLACK AND WHITE VERSION £159.95 + 15% VAT POST FREE**  
**50ZH COLOUR VERSION £205 + 15% VAT.**

## THIS UNIQUE SPECIAL OFFER

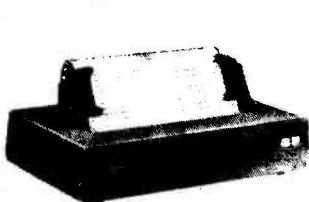
If bought with superbord or colourboard these items are at the reduced prices shown first. Also sold separately at the bracketed prices. Add 15% vat. Modulator and power supply kit £7.95 (£11), 4K extra ram £20 (£24). Display expansion kit approx 30 lines x 54 characters £15 (£20). Case £23 (£26). Colour conversion board fully assembled £45 (£45). Cassette recorder £13 (£15). Extended monitor £20 (£20). Assembler/Editor £25 (£25). 610 Expansion Board £160 (£160).

## SHARP MZ-80K



The brilliant new Japanese computer which is beating the hell out of PET. 20K ram expandable to 48K. Built in VDU screen, music function and cassette. Displays 40 characters x 25 lines and 80 x 50 graphics. £485 + 15% VAT.

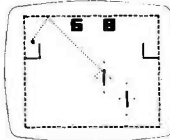
## SUPER PRINT 800MST



The ideal impact matrix printer for Superboard. UK101, pet, apple, trs80, mz-80k, 60 lines/minute. 72, 80, 96, 120, and 132 chr/line. Tractor and friction feed. Graphics and user definable chr sets. RS232, 20ma, IEEE488, and centronics I/O. **SPECIAL OFFER.** Supplied with free word processor, program and interface components **£359 + 15% VAT.**

## TV GAMES

AY-3-8550 chip £3.00, kit £5.26  
Stunt cycle AY-3-8765 chip £9.14, kit £6.95  
10 game paddle 2 AY-3-8600 chip £5.95, kit £7.03.  
Modified shoot kit £5.28  
Colour generator kit £9.95



## MAINS TRANSFORMER

6.0-6v 100ma 80p, 1 1/2a £2.60 9.0-9v 75ma 80p, la £2.40, 2a £3.94, 12.0-12v 100ma 99p, la £2.90, 15.0-15v la £3.15.

## JC12 AND JC20

Integrated circuit audio amplifier chips with data and printed circuits. JC12 6 watts £2.08 JC20 10 watts £3.54.

## CONTINENTAL SPECIALITIES PRODUCTS

EXP300 £6.61, EXP350 £3.62, EXP325 £1.84, EXP650 £4.14, EXP48 £2.64.

## STABILIZED POWER KITS

TTL computer supplies 5v 2a £7.44, 5v 4a £12.60, 8-way types 3 1/2v/6v/7 1/2v/9v/12v/15v/18v 100 ma £2.60, la £6.50, 2a £9.84. Variable voltage models 2-18v 100ma £2.60, 1-30v la £6.75, 130v 2a £12.10.

## PRINTED CIRCUIT MATERIALS

PC etching kits: - economy £2.42, standard £4.76, 40 sq ins pcb 45p, 1 lb FeCl1 £1.50 Etch resist pens: - economy 50p, daio 84p, Drill bits 1/32" or 1mm 34p, Etching dish 82p, Laminate cutter £1.20.

## BI-PAK AUDIO MODULES

AL30A £4.53, PA12 £9.31, PS12 £1.75, T538 £2.70, S450 £27.90, Al60 £5.62, PA100 £19.24, SPM80 £5.26, BMT80 £6.06, Stereo 30 £23.94, AL80 £8.56.

## COMPUTER GAMES

New Sensory Chess Challenger 8 £109 Chess Challenger 7 £75, Chess Champion 6 £49.95, Checker Challenger 2 £33, Star Chess £62, Atari Video computer £129, Cartridges £14.85 (except chess £43.95, backgammon £33.95 and space invaders £27.50). Special offer: - Video computer plus space invaders £146.

## S-DECS AND T-DECS

S-Dec £3.79, T-Dec £4.59, 16 dil adaptor £2.31.

## COMPONENTS

1N4148 0.9p, 1N4002 3.1p, 2114 memory chips low current 300ns £3.45, 723 14 dil 33p, NE555 8 dil 24p, 741 8 dil 18p, bc547, bc549, bc182, bc184, bc212, bc214 5.5p, tip 32c 36p, tip41c 40p, bd132 27p, Fuses 20mm x 5mm cartridge 15, 25, 5, 1, 2, 3, 5a quickblow 2p, Resistors 5% 1/4W E12 10R to 10M 1p, 0.8p for 50+ of one value, Polyester capacitors 160v .015, .068mf 2.6p, .047, 1mf 4p, .01mf 3p, .022, .033mf 3.3p, .15, .22, .33mf 4.9p, 47mf 6p, Polystyrene capacitors E12 63v 10 to 1000pf 3p, 1n2 to 10n 4p, Ceramic capacitors 50v E6 22pf to 47n 2.5p, Electrolytic capacitors 50v .5, 1, 2mf 6p, 25v 5p, 10mf 6p, 16v 22p, 33mf 6p, 47, 68mf 5p, 100mf 7p, 330, 470mf 9p, 1000 mf 11p, zeners 400mW E24 2v7 to 33v 7p, Preset pots subminiature 0.1W horiz or vert 100 to 2M2 7p, Potentiometers 1/4W 4K to 2M2 single 25p, dual 71p, 1/8 red LEDs 9.7p, IC sockets 8 dil 8.7p, 14 dil 10.1p, 16 dil 12p.

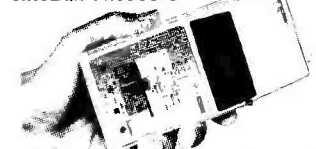
## BATTERY ELIMINATORS

3-way types with switched output and 4 way multi jack: - 3 1/2v/6v 100ma £2.67, 6v/7 1/2v/300ma £3.14, 100ma radio types with press-stud connectors 9v £3.77, 6v £3.77, 4 1/2v £3.77, 9v 9v £4.99, 6v 6v £2.99, 4 1/2v 4 1/2v £4.99, Cassette recorder mains unit 7 1/2v 100ma with 5 pin din plug £3.77, Fully stabilized type 3 1/2v/7 1/2v/9v 400ma £8.50, Car converters 12v dc input, output 7 1/2v 300ma £1.19, output 3 1/2v/6v/7 1/2v/9v/12v 800ma £2.76.

## BATTERY ELIMINATOR KITS

100ma radio types with press-stud connectors 4 1/2v £1.49, 6v £1.49, 9v £1.49, 4 1/2v 4 1/2v £1.92, 6-v £1.92, 9v 9v £1.92, Cassette type 7 1/2v 100ma with din plug £1.49, Heavy duty 13-way types 4 1/2v/6v/7 1/2v/11v/13v/14v/17v/21v/28v/34v/42v la £5.52, 2a £8.80, Car converter input 12v dc, output 6v/7 1/2v la stabilized £1.35.

## SINCLAIR PRODUCTS



SC110 10MHz oscilloscope £144.95, PFM200 £51.95, case £2.07, adaptor £4.20, connector kit £13.95, Microvision TV £89, adaptor £6.88, PDM35 £34.23, adaptor £4.20, case £2.07, DM350 £76.70, DM450 £102.17, DM235 £55.55, Accessories for all 3 models: - rechargeable batteries £7.99, mains adaptor/charger £4.20, case £8.90, Enterprise prog calculator £19.95, TG105 £87, TF200 £150.

# SWANLEY ELECTRONICS

Dept. ETI, 32 Goldsai Rd., Swanley, Kent BR8 8EZ.

Mail order only. Please add 35p postage. Prices include VAT unless stated. Lists 27p post free. Overseas customers deduct 13%. Official credit orders welcome.



# ELECTRONICS TOMORROW

**A spanner's not much help when your computerised fuel injection system dies. Dave Raven of Metac Electronics reports on the quality control that keeps your chips up to scratch, with a footnote on hand-held games.**

**W**hile we must welcome the arrival of new electronic circuitry in everyday products (cars, sewing machines, food mixers, etc), electronic failures always seem much worse and more difficult to put right. The difficulty now in making temporary repairs to an item, which has been transformed into a solid block of plastic containing a thick-film circuit, is underlined to the stranded motorist when he is out in the pouring rain.

My own recent experience of this occurred miles out in the countryside. I was directed with my faulty alternator to a small holding, miles from anywhere. The gentleman who attended to me was clearly an expert, despite outward appearances and disused cars littering his yard. A small workshop/caravan was crammed with used starter motors and dynamos. With the precision of a brain surgeon, he diagnosed my faulty alternator (a diode in yer alternator) and immediately commenced stripping it down and replacing the faulty component. With an elaborate piece of home made test equipment, which put Heath Robinson to shame, he tested the alternator on the bench under full load. While watching this rustic genius I felt assured that, even with the advent of microprocessors this man will survive. But what of all the other indispensable backyard mechanics who are willing to be called out on breakdowns at 9am on a Sunday morning? If you happen to be equipped with an elaborate computer-controlled fuel injection system, then just try and sort that out mate.

## Quality Control

The whole elaborate procedure for the quality control of precision electronic equipment is now becoming of vital importance. If electronic products are to achieve the same reputation as earlier mechanical products, which appear to go on forever, it is necessary that they are produced to the same high standards. Electronic products properly tested can achieve very high levels of quality and reliability as any airline pilot or astronaut will testify. The term quality is used to express our level of satisfaction with either goods or a particular service which we use. The notion of quality becomes more ambiguous when we must express our satisfaction with a particular instrument after we have used it through several months. Even if the qualities noticed during the first few months have deteriorated, the product must remain within the specification during its useful life. The measurement of the deterioration of quality of a batch of instruments is when we start to examine the probability of failure or its reliability. A

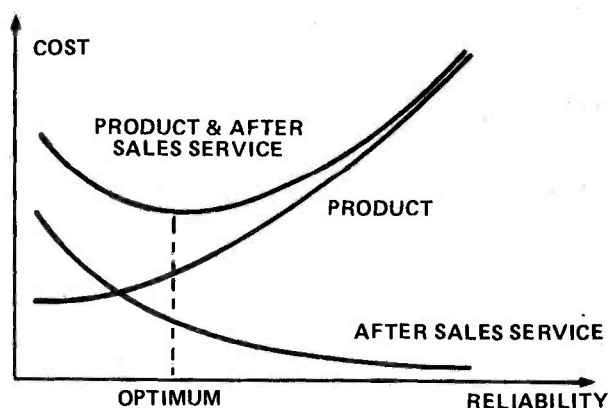


Fig.1. The optimum reliability, considering the cost of the product and the cost of repair during the after-sales service period.

reliable instrument is one which maintains its performance throughout its useful life. A product's reliability can be defined within exact limits by the manufacturer and, naturally, the higher the product's reliability, the higher the price is. The reliability of an instrument is in the mathematical sense of the term — the probability of good functioning within clearly defined performances, in a given time period, under conditions of normal use. This reliability, in the form of probability, is expressed by the quotient of the number of instruments still working at the time of the test divided by the number of instruments initially put into service, when this latter tends towards infinity. The following formula can be used to calculate reliability:-

Reliability = No. of instruments working correctly at time of test/No. of instruments initially put into service.

## Failure Rate

The other factor which is linked closely with reliability is the rate of failure. This parameter represents the speed with which the products cease to work correctly. The rate of failure in terms of time can be expressed graphically as a (bathtub) curve, which can be divided into three parts. The first part involves early failures which arise during the first few months. The second part involves random failures, with a constant rate of failure. No physical or chemical procedure can eliminate them and this is of prime importance to electronic products. The last part involves failures due to wear, signifying the end of a product's lifetime.



## Image Projection

The failures which occur during the first few months are particularly unwelcome, since they do much to tarnish a supplier's image. They are also very expensive to deal with. The reliability tests which a watch would need to undergo if we are to meet the requirements of the Swiss Industry Standards are divided into two categories:-

1. Performance and quality tests.
2. Accelerated life tests simulating wear.

## Testing Time

The example below is the type of performance that electronic watches must undergo if they are to reach an acceptable level of quality for the Swiss (and, indeed, Metac): Control for good functioning of all external controls accessible to the wearer, such as time setting, second stop, rapid corrector, etc; measurement of trimmer adjustment range in positive and negative areas; measurement of supply voltage at which the watch ceases to function correctly; measurement of current consumption and calculations of performance in terms of type of battery used; measurement of the performance deviation of the watch, expressed in seconds per day as a function of the supply voltage variation; determine the effects of temperature variation on the quartz crystal and the integrated circuit; measurement of the watch's resistance to thermal shocks and determination of the watch's resistance to magnetic fields.

Note: a watch can be termed anti-magnetic if it withstands without damage three passages in a magnetic field of 60 Oersted. A watch can be termed anti-shock if it withstands without damage two shocks corresponding to a fall from a height of one metre on a hard wood floor; the intensity of such a shock is around 5,000 g (1 g = unit of gravity acceleration).

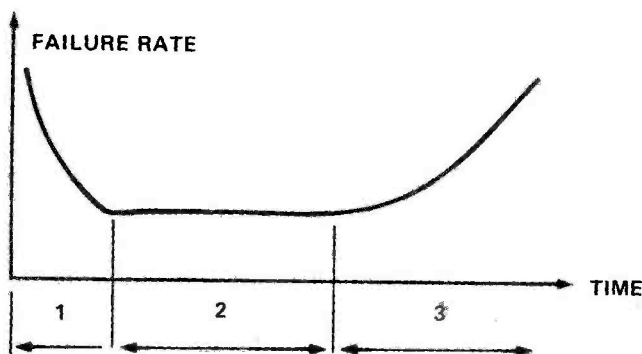


Fig.2. The bathtub curve shows the rate of failure of a product in terms of time.  
1. Early rate of failure; 2. Random failures, with a constant rate of failure;  
3. Failures due to wear.

## Hand-held Games

Electronic games have been with us now for the last three years and are continually growing in their sophistication. The early TV game chip with its four simple games proved to quickly become a bore and probably ended up in the bottom of the toy cupboard the day after boxing day. Space Invaders and the other microprocessor based games, which until now were only to be seen at fun-fairs and in the local pub, are soon to emerge as portable hand-held games, which will easily fit into the Christmas stocking. The only viable way to produce really high technology microprocessor chips is in large volume. Once all the production problems are solved, the manufacturer starts to crank the handle and out spew millions of chips. Since rockets, machine tools, etc cannot consume very many chips in peace-time, the industry requires a volume product, which will soak up all this excess production.

## Software In Hand

Now that chip shortages (which probably held back this product last year) have been overcome, the relatively simple task of assembling hand-held games will ensure their success this Christmas in a big way. Over 500 different hand-held games are being produced. However, reports from the Far East indicate that only a small number are up to standard and will be acceptable to the UK market. Finding a suitable game, which does not quickly become a bore, is a major headache for designers. The chip manufacturers are Texas Instruments, AMI and General Instruments in the main and these companies expend a considerable effort in writing software for hand-held game microprocessors. It still remains a very high risk business, however, and manufacturers and importers will try hard to ensure that they do not have large stocks remaining after Christmas.

## Moving Pictures

Trends in hand-held games are in the direction of more LCD games than the LED type. These will last 20 to 30 hours compared to only three to five for LED ones. The use of fluorescent tube and larger memories are also expected developments. The drawback with LCD hand-held games is that they must have a combination of driver and LCD display. Companies in Hong Kong are working on this to produce the combination of chip and driver which makes players move on the display. The final touch will be a single chip direct drive microprocessor for LCD games. The standard type of LCD display has between 128 and 256 dots and the players and balls are mere blips on the screen. It is, however, hoped soon to produce a program of more than 600 dots and the LCD microprocessor will have drive capability with good resolution. Hand-held game trends are also moving towards devices that produce sounds. An example of this is sound producing microprocessors, which produce musical sounds in toys and screeching wheels and engine sounds for toy cars.



TTL  
CMOS  
74LS  
LEDS

# LB ELECTRONICS

LINEAR  
RAMS  
EPROMS  
SURPLUS

TELEPHONE:  
UXBRIDGE 55399

**PCB OFFERS**  
(1A) 100 bit shift register PCB, 115mm x 94mm containing 9 x 7491, 6 x 7496 and 1 x 7441. Terrific bargain 85p, p&p 30p.  
(1C) PCB 215mm x 290mm 12 x TMS 312J (for sim.) Hex 32-bit Shift Reg. + 39 ICs. £2 + 50p p&p (limited stocks).

**MPU CORNER**  
2122 (200ns), £3. 2114 (450ns) £4.50.  
Texas Instruments, 27lb single rail. Brand new. Full spec. £9.95 each p&p 25p. 2708 (400ns) £4.50. 74125 for £1 + p&p 25p. MK 1002P (dual 128 bit Shift Reg) 35p.  
LM711CH (Voltage Comparator) 30p.

(All Full Spec)  
2526 Character Generator (64 x 9 x 9) £2.95 + data & p&p 25p  
**International rectifier SOLID STATE RELAY** type A2402 Output 240 VAC 2.5 amps input 90-240 VAC/45-200 VDC £6.00 p/p 25p.

**O TYPE CONNECTORS**  
15 Way: wirewrap plugs only 75p.  
25 Way: ribbon plugs PCB mounting £1.40.  
25 Way: sockets (solder) £1.40.  
50 Way: skt (wirewrap) £1.65.  
50 Way: skt £1.45, p&p 25p.

**COVERS**  
25 Way: 75p (plastic), p&p 25p.  
37 Way: 90p (plastic), p&p 25p.

**DISPLAYS**  
HP 5082 4 digit DIL display full spec £1.50 each, p&p 25p. Large quantities POA.  
MAN 727 seg CC £1.25, p&p 25p. Burroughs Panaplex 9 Dig. + skt and bezel £1.00, p&p 25p.  
LED 3 Digit DIL 55p, p&p 25p.  
Bowmar 9 digit .1 in LED with red bezel. (As used in calculators). £1.00 + 25p p&p.

**SUPERSAVER**  
Ribbon Cable Headers 16 OIL Jermy, gold plated, with cover 45p, p&p 25p.

**SUPERSAVER 2**  
Tantalum Capacitors 25 volt 4.7 uF, 14 for £1.00, p&p 25p

**SUPERSAVER 3**  
**PRICE SMASH FND 500** .5in. LED displays. Full spec 50p each, p&p 25p, large quantities POA.

**SUPERSAVER 4**  
HYBRID SYSTEMS DAC 371-8 Bit. DIL packaged, ideal MPU users with data. £2.95, p&p 25p

**SUPERSAVER 5**  
**Battery eliminator 6VDC 200MA 240V AC input ideal for calculators, radio, etc., give away price 95p each. Large quantities P.O.A.**

**SUPERSAVER 6**  
RS 338-383 Miniature Decade Thumbwheelswitch. £1.65, p&p 25p

**SUPERSAVER 7**  
SN74116 Dual 4 Bit latch 75p, p&p 25p  
SN7418 Arithmetic Logic Unit. 80p, p&p 25p  
SN74194 4 Bit Register. 50p p&p 25p  
SN74198 8 Bit Shift Register. 75p p&p 25p

**SUPERSAVER 8**  
**ITT 4cx 250b brand new full spec £7.50 each p&p 25p**

**SUPERSAVER 9**  
5 digit 7 segment DIL LED .11" displays 4 for £1.50 p/p 25p.

**SUPERSAVER 10**  
9 way male/female connector. ELCO 8129. 0.1 inch pitch, gold-plated PCB mounting, ideal for bussing two PCBs together. Superb value, 35p, p&p 25p

**SUPERSAVER 11**  
74LS266 50p. 74LS245 £2.40. 74LS240 £1.00. 74S260 35p. P&p on all above 25p.

**SUPERSAVER 12**  
TMS 3128NC Static shift register. £1.50, p&p 25p.

**SUPERSAVER 13**  
PL259 (UHF) Elbow Connectors. 50p each, p&p 25p.

**SUPERSAVER 14**  
Recording Designs Ltd digital cassette deck. 50-100 Baud RS232C 240V input. A professional superb deck. £68.00, p&p £2.00.

**SUPERSAVER 15**  
5K multivolt trimpos. PCB mounting, per box of 14 £2.50, p&p 25p.

**SUPERSAVER 16**  
**Yet another star bargain.** Astec UM111E36 modulator 65p each, p&p 25p

**LEDs (Full spec.)**  
TIL209, red 10p. 0.2in, red 12p. 0.2in green 28p. 0.2in, yellow 28p.  
RL54 red axial lead. 15p.  
P&p on all above 25p.

**VERNITRON** Ceramic filters type FM4 10yMHz 45p, p&p 25p  
**TRANSISTORS**, BD236 40p, BC183L 10p, BF195 10p, SGS 2N3055 30p, p&p on all 25p.  
TBA 810S, with data, 85p, 4-way DIL switches. 75p. MC1303 Dual Stereo preamp with data, £1.25. 7in Nylon cable ties 100 for £1.50. All p&p 25p.

**NEW SN76477** (Yes, back in stock). Sound Generator IC (Train, plane, explosion, laser gun, etc.) with data £3.25, p&p 25p.

**PCB KEYBOARD**, 65mm x 82mm, 18 key Clickers less Key tops, ideal Hexadecimal use 35p, p&p 25p.

**CAPACITOR SCOOP**, 1.600uF at 10v, 160uF at 25v. Axial lead. 2 dozen for £1 + 25p p&p

**MINI FANS** 80mm x 80mm approx. 115v. Brand new. £4.50 + £1.00 p&p  
IEC mains chassis plug 75p suitable socket 35p, p&p 25p

**GIVEAWAY**  
22 pin low profile dip socket, gold plated. 12p EACH p&p 25p

**Just arrived. ITT 2082 Data Modem.** Brand new and boxed, with manual. 600/1200 Baud. Data Modem to CC ITT. V24/RS 232C. Channel centre frequencies 1300 and 1700Hz (600 Baud) or 1300 and 2100Hz (1200 Baud). Synchronous or asynchronous operation over 2 or 4 wire, switch or dedicated lines, built in self and lines test functions. Some of the best equipment we have ever obtained. £115.00 each, p&p £3.00. (Fraction of original cost).

**IC HOLDERS (Low-profile)**  
8 DIL 12p 14 DIL 15p  
16 DIL 17p 18 DIL 20p  
22 DIL 28p 24 DIL 35p  
28 DIL 45p All p&p 35p

**WE STOCK** a vast range of TTL, CMOS, some 74LS, MINIATURE TOGGLES, etc.  
**PSUs.** We have a large stock of power supplies at very realistic prices (callers).

**RELAYS**  
ITT 700 ohm Single pole changeover. 45p. Banor resettable double pole changeover 12V £1. Both p&p 25p

**CIRCUIT BREAKERS**  
4450v AC 65v DC 0.5A 50p; ditto 7A 80p, p&p 25p.  
**ALLEN KEYS**, 7/16in 5p; 12 for 50p; p&p 25p.  
**ASR33** (with tape punch reader), generally overhauled. £185.00 inc. of VAT.

Centronics secondhand printers, various types (o/h), phone for your requirements

**CENTRONICS 101A Dot Matrix printer.** Fully overhauled. 165 char/sec. £450.00 inc. VAT. Carriage at cost. As above dual headed 300 char/sec £650 inc. VAT.

**MEMOREX 651** dual disk drives complete with power supplies and format electronics (sorry, no data as yet). £350 each inc. of VAT.

Recordcall telephone answering machines (GPO line matching transformer removed) sold as is from £2 to £10 depending on condition. Fitted with very nice standard cassette deck. With circuit diagrams. SORRY BUT FOR CALLERS ONLY.  
Terms cash with order (official orders welcomed from colleges, etc.) All enquiries s.a.e. please. All prices inclusive of VAT, unless otherwise stated. Postage as shown per item.

**FOR THE PROFESSIONAL USER.** CP Clare Keyboard switches with buttons (blank) 65p each p&p 25p.

**BURROUGHS keyboard, 96 key station.** On-board crystal and TTL. Brand new and boxed. 500mm x 190mm. At the time of advert no date. No keytops. Read all Clare ponder. Read switches. Bargain £12.00 each, p&p £1.00.

**PLEASE DO NOT ORDER GOODS FROM OLD ADVERTS. PHONE BEFORE ORDERING.**

**SURPLUS STOCKS PURCHASED FOR CASH**

**LB ELECTRONICS**  
11 HERCIES ROAD  
HILLINGDON, MIDDLESEX  
UB10 9LS, ENGLAND

All enquiries s.a.e. please  
New retail premises, now open Mon, Thurs, Fri, and Sat, 9.30-6.00 Lunch 1-2.15 weekdays. Closed all day Wednesday. We are situated just off the A40 opposite Master Brewer.

ALL PRICES INCLUSIVE OF VAT

**UXBRIDGE 55399**

All components full spec.

## DANGER from RADIATION Be prepared WITH OUR RADIATION DETECTOR

Recommended for: Civil Defence, Fire, Police, Hospital & Medical use

### General Information:

Pocket dosimeters provide an accurate, reliable and immediate method of measuring the integrated dose of radiation received by those exposed to ionising radiation. The dose may be read at any time and in any place, providing a source of light is available.

### Principle:

The dosimeter is an ionisation chamber type using a quartz fibre electroscopie as the indicating element. A microscope is used to project the image of the moving quartz fibre element on to a graticule scale. The quartz fibre is mounted on a wire electrode, which in turn is supported by a high quality insulator. When the instrument is charged, positive charges distribute themselves over the wire electrode and quartz fibre causing the fibre to bend away from the electrode. The fibre will take up a position depending on the amount of charge on the system.

When the surrounding air in the ionisation chamber is ionised negative ions will be attracted to the positively charged electrode thereby reducing its charge. The resulting fibre movement will be related directly to the quantity of radiation producing the ionisation. The fibre movement can thus be calibrated directly in roentgen units and the rate of movement of the fibre will be proportional to the roentgens received per unit time.

### Construction:

The microscope, electroscopie and ionisation chamber are housed in an outer skin which may be of brass or aluminium. At one end of the tubular case is fixed a charging assembly, and at the other an eye-piece window. These two assemblies are soldered into the outer cage to ensure a hermetic seal.

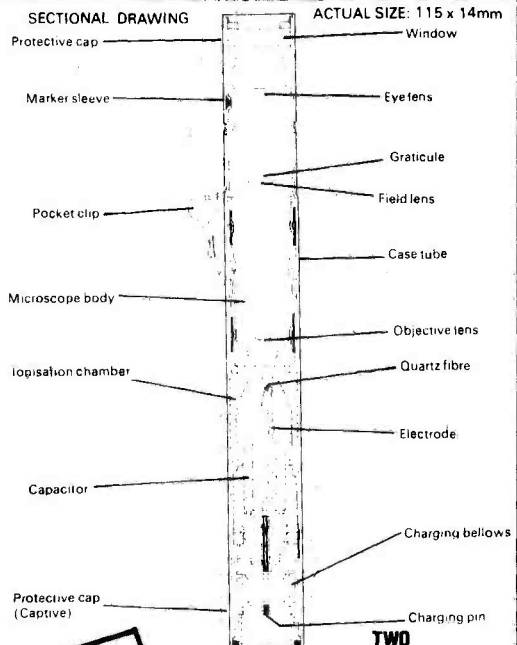
Each dosimeter is provided with protective end cap translucent window so that the cap need not be removed for reading.

Dosimeters meet vibration, drop, salt spray, humidity, water immersion and temperature tests

● BE PREPARED, EVERY HOME SHOULD HAVE ONE ●

### Features:

- These units will read automatically the amount of radiation in the air
- This instrument is only a little larger than a fountain pen
- Clips on to your top pocket
- Weight less than 3 oz.
- Contains three lenses
- Fully charged, tested and guaranteed. Refurbished by us
- British design and manufacture, rugged construction
- Manufacturer's list price of similar model is over £25
- Buy now whilst stocks available. Delivery by return post



**SAVE £15**

ALL YOURS FOR ONLY **£10.95** incl. post paid

**TWO FREE RE-CHARGE VOUCHERS WITH EVERY DETECTOR**

Manufacturer's current list price similar model is over £25



## DONDENE LTD.

Phone (01) 723 1008/9  
404 Edgware Road, London W2, England I.E.D.



Supplied complete with Data and Information on radiation and detectors.

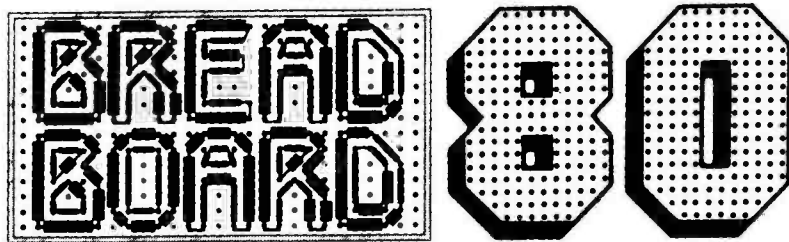
All units are checked and tested just prior to despatch by first-class mail in proper protective packing.

VIEW THRU LENS





COMPUTERS AUDIO RADIO MUSIC LOGIC TESTGEAR CB GAMES KITS



COMPONENTS DEMONSTRATIONS SPECIAL OFFERS MAGAZINES BOOKS



## It's all at Breadboard '80

This is **the** exhibition for the electronics enthusiast. From November 26 -30 there is only one place in the universe for the electronics enthusiast to be — Breadboard '80, at the Royal Horticultural Hall in London. The majority of leading companies will be exhibiting, including all the top monthly magazines in the field. There will be demonstrations on most stands and many feature special offers that are EXCLUSIVE to Breadboard!

All aspects of this fascinating field are catered for, from CB to home computing, so whether you want to buy a soldering iron or a synthesiser — or just keep up to date with your hobby — don't miss Breadboard '80.



With every order of FOUR or more advance tickets we will send you a FREE copy of ETI, 1989 (£1.50 normally)

**Royal Horticultural Halls  
Elverton Street  
Westminster London SW1  
November 26-30 1980**

26th Nov — WEDNESDAY — 10am-6pm  
27th Nov — THURSDAY — 10am-8pm  
28th Nov — FRIDAY — 10am-6pm  
29th Nov — SATURDAY — 10am-6pm  
30th Nov — SUNDAY — 10am-4pm

Send to: **AVOID QUEUES - GET ADVANCE TICKETS**  
Advance Tickets, Midlands Ltd, 145 Charing Cross, London WC2N 6DL  
Please send: tickets @ £1.00 (Student/Child/OAP)  
TO: \_\_\_\_\_  
Enclose P.O. / Cheque for £ \_\_\_\_\_





**Freeport A**  
**Birmingham**  
**B19 1BR**  
**021-233-2400**

- FREEPOST ON ORDERS
- VAT INCLUSIVE PRICES
- ADD 30p P&P
- 24 HR PHONE ANSWERING SERVICE
- ACCESS
- VISA
- CASH
- CHEQUE

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

C-MOS (BUFFERED)			LINEAR			SEMICONDUCTORS					
HEF4003	22	HEF4044	105	HEF4512	136	CA3046	84	IN914	5	BC182L	12
HEF4001	22	HEF4046	133	HEF4516	127	CA3080E	77	IN4001	5	BC184	11
HEF4002	22	HEF4047	109	HEF4517	478	CA3130E	99	IN4002	5	BC184L	12
HEF4006	119	HEF4049	57	HEF4518	118	CA3140E	48	IN4004	7	BC212	11
HEF4007	22	HEF4050	87	HEF4519	69	CA3190E	293	IN4007	9	BC212L	12
HEF4008	100	HEF4051	87	HEF4520	118	LM321AN	34	IN4148	4	BC214	11
HEF4011	22	HEF4052	90	HEF4521	235	LM339N	78	IN5402	15	BC214L	12
HEF4012	22	HEF4053	90	HEF4528	124	LM380N	104	2N2369	21	BC547	13
HEF4013	57	HEF4056	62	HEF4532	150	LM381AN	198	2N2646	46	BC548	11
HEF4014	100	HEF4057	475	HEF4534	638	LM3900N	75	2N2826G	13	BC549	12
HEF4015	100	HEF4058	22	HEF4539	138	MC3403P	156	2N3053	19	BC557	15
HEF4016	57	HEF4059	22	HEF4585	122	NE531	131	2N3054	55	BC558	15
HEF4017	100	HEF4070	22	HEF4724	214	NE536	258	2N3055	55	BCV70	15
HEF4018	100	HEF4071	23	HEF4907	113	NE550	78	2N3072	9	BCV71	15
HEF4019	58	HEF4072	23	HEF4908	92	NE556N	62	2N3704	9	BD131	39
HEF4020	112	HEF4073	23	HEF4106	78	NE568N	171	2N3705	10	BD132	39
HEF4021	107	HEF4075	23	HEF4160	149	NE570N	485	2N3773	297	BD138	39
HEF4022	182	HEF4076	130	HEF4192	149	NE871N	505	2N3789	22	BD140	39
HEF4023	22	HEF4077	22			RC4136	146	2N3820	39	BF800	333
HEF4024	76	HEF4078	23			T8A1205	88	2N3904	9	BF805	29
HEF4025	22	HEF4081	23			TDA1022	713	2N5457	39	BFV50	17
HEF4026	244	HEF4082	23			TD1024B	238	2N5459	35	BCV51	17
HEF4027	57	HEF4085	80			TL081CP	84	40673	88	BRV39	50
HEF4028	89	HEF4086	80			TL084CN	158	BC107	14	BSX20	21
HEF4029	113	HEF4093	63			UA7805CU	78	UA741CN	20	CL8960	2850
HEF4030	56	HEF4094	219			UA7812CU	78	UA741CT	47	TP131	15
HEF4031	290	HEF4104	208			UA7815CU	97	Zener	BC109	TP132	54
HEF4035	138	HEF4502	114			UA7819CU	97	Diodes	BC109B	TP141C	76
HEF4040	107	HEF4505	714			UA7915CU	97	400mV CAV7-C33	BC109C	TP142C	76
HEF4041	94	HEF4508	230			UA7919CS	38	BZY88/BZX79	BC158	TP195S	76
HEF4042	83	HEF4510	135			UA78L12CS	38		BC158	TP3055	60
HEF4043	100	HEF4511	157			UA78L15CS	38	+ Voltage	BC177	TP543	36

# Happy Memories

**4116 200ns £3.75**      **4116 150ns £5.50**  
**2114 450ns £2.95**      **2114 200ns £3.45**  
**2708 450ns £4.95**      **2716 5 volt £10.95**

**MEMOREX SOFT-SECTORED MINI-DISCS** for  
 PET, TRS-80, etc. Supplied in **Free Library Case**  
**£19.95 per 10**

**Low Profile I.C. Sockets by Texas**  
 Pins ..... 8 14 16 18 20 22 24 28 40  
 Pence ..... 10 11 12 16 17 20 21 28 37

**Memory Upgrade Kits** for Apple, 2020, TRS-80,  
 etc. .... **from £30** please phone

Quantity prices available on request, Government  
 and Educational Orders welcome. Trade accounts  
 opened.

ALL PRICES INCLUDE V.A.T. POSTAGE FREE ON  
 ORDERS OVER £10, OTHERWISE ADD 30p.

Access and Barclaycard Welcome

**HAPPY MEMORIES**  
 Dept. ET1  
 Gladestry, Kington  
 Herefordshire HR5 3NY  
 Telephone (054422) 618

## GMT SELL P.A. EQPT.

CAPACITORS		Polyester Radial Leads		Electrolytic Radial Leads	
<b>Electrolytic Axial</b>	Order Code	Dipped Type, C280/352 Style	Order Code	-10% to +50% Tol.	Order Code
-10% to +50% Tol.	Cap 018 + µF	Moulded Type, 10mm Pitch	Cap 352	µF V 16 25 36 40 50 63	Cap 350
1.0	8		+ Value	47	7
1.8	9			68	7
2.2	9	001	382 380	10	7
3.3	9	0015	7 15	15	7
4.7	9	0022	7 22	22	7
6.8	8	0033	6 33	33	7
10	10	0047	6 47	47	7
15	8	0068	6 68	68	8
22	8	01	6 1	100	8
33	8	015	6 15	150	11
47	8	022	6 22		
68	9	033	6 33		
100	9	047	6 47		
150	9	068	6 68		
220	13				
330	30				
470	33				
680	21				
1000	26				
1500	35				
2200	42				

RESISTORS		Skeleton Presets, Miniature	
<b>Carbon Film, Fixed</b>	Order Code	0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting	Order Code
0.25W, E24 Values 10R-10M, 5% Tol.	2 each Res RD%	0.1W, E3 Values, 100R-1M, Lin. Horizontal Mount	8 Min. Preset V
100/100 (Multi 10/Value)	+ Value	0.2W, E3 Values, 100R-4M7, Lin. Vertical Mounting	11 Std. Preset H
0.5W, E12 Values 10R-4M7, 10% Tol.	3 each Res RD%	0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mount	+ Value
+ Value	+ Value	Potentiometer, Rotary	
<b>Metal Film, Fixed</b>	Order Code	0.5W, E3 Values, 1K-2M2 Lin.	39 Ro Pot Lin
0.5W, E24 Values, SR-I-M, 2% Tol.	8 each Res MR30	0.25W, E3 Values, 4K7-2M2 Log.	39 Ro Pot Log
2.5W, E12 Values, 10R-27K, 5% Tol.	16 each Res PR52	Potentiometer, Slider	
+ Value	+ Value	0.5W, E3 Values, 2K2-47K Lin.	45 Si Pot Lin
<b>Metal Glaze, Fixed</b>	Order Code	0.25W, E3 Values, 1K0-1M0 Log.	45 Si Pot Log
0.5W, E24 Values, 1M-33M, 5% Tol.	16 each Res VR37		+ Value
+ Value	+ Value		

## SEND A LARGE S.A.E. FOR OUR 'FLOG LIST' & OTHER INFO.

MAINS TRANSFORMERS		Plastic Boxes - Boss Industrial Mouldings	
Secondaries may be connected in series or parallel to give wide voltage range	Order Code	Moulded Box and Close Fitting Flanged Lid	Order Code
Primaries 0.220, 240V		ABS Box, C/W Brass Bushes, and Lid in Orange	
6VA - Clamp Type Construction	235 each	L112 W82 D31	99
Approx. 18% Regulation F.C. 54, H36, W35		L150 W80 D50	131
0.4.5V, 0.4.5V Secondaries	Trans 6VA	L190 W110 D80	223
0.3V, 0.6V		Plastic Boxes with Metal Lids	
0.12V, 0.12V		ABS Base, C/W Brass Bushes, in Orange	Order Code
0.15V, 0.15V		1mm Aluminium Top Panel Finish Gray	
0.20V, 0.20V		L85 W56 D28	112
20VA - Clamp Type Construction	360 each	L111 W71 D42	150
Approx. 18% Regulation F.C. 70, H48, W46		L181 W96 D53	208
0.4.5V, 0.4.5V Secondaries	Trans 20VA	Diecast Boxes	
0.6V, 0.6V		Diecast Box and Flanged Lid	Order Code
0.15V, 0.12V		Aluminium Box and Lid in Natural Finish	
0.15V, 0.15V		L113 W83 D31	124
0.17.5V, 0.17.5V		L152 W82 D50	215
0.20V, 0.20V		L192 W113 D81	334
		SWITCHES	
		Miniature Toggle - Honeywell	Order Code
		SPDT	67 SW 8A1011
		SPDT C/OFF	81 SW 8A1021
		SPDT Double Bias To Centre	90 SW 8A1041
		DPDT	99 SW 8A2011
		DPDT C/OFF	111 SW 8A2021
		Miniature Push - C & K	
		SP Push To Make, Momentary	62 SW 8531
		SP Push To Break, Momentary	62 SW 8533

G.M.T. ELECTRONICS KITS		P.E.T. POWER AMPLIFIER OUTPUT MODULE KIT	
FULL TELETEXT KIT	£199-90	ONE AMP POWER SUPPLY MODULE KIT - FIVE VOLTS	£ 6-00
(Free-standing unit - no internal connection to T.V.)		ONE AMP POWER SUPPLY MODULE KIT - TWELVE VOLTS	£ 7-50
TELETEXT DECODER + REMOTE CONTROL KIT	£135-90	MODEL INERTIA CONTROLLER MK I - SLOT RACER	£ 30-00
(For wiring into existing television)		MODEL INERTIA CONTROLLER MK II - TRAIN (HAND UNIT)	£ 25-00
PAL ENCODER/MODULATOR KIT	£ 22-90	MODEL INERTIA CONTROLLER MK III - TRAIN (CONSOLE UNIT)	£ 25-00
DOPPLER RADAR ALARM KIT	£ 44-90		

# QUESTION?

1. Is your hobby home computing or electronics?
2. Do you understand the application of IC's, Transistors, Diodes, etc?
3. Have you used or applied analogue or digital techniques?
4. Are you applying TTL Logic to your home computer?
5. Are you programming your home computer using simple software techniques?

If the answer is YES to any of these questions then why not consider turning your hobby into a career - applying your knowledge to servicing electronic equipment ranging from basic terminals and data processing machines through to advanced micro-processor systems.

We will train you through to advanced technology at the company training school, fitting the individual in at their own level.

We have vacancies over the whole of the U.K. especially in the London area, with the successful applicants working from home, usually in a radius of no more than 60-70 miles.

We supply all tools and test equipment, plus a company car which is available for private use.

If you are interested, then why not contact **Mr. C. Marklew** on **0249 813771** to discuss your own career opportunities in confidence, or write to:

**KODE SERVICES LIMITED**  
 Station Road, Calne, Wiltshire



# CHROMASONIC electronics

56 FORTIS GREEN ROAD, MUSWELL HILL, LONDON N10 3HN  
 TELEPHONE 01-883 3705, 01-883 2289

**YOUR SOUNDEST CONNECTION IN THE WORLD OF COMPONENTS**

## PETS

(8K RAM)  
**£399**

16N (16K RAM) **£499**

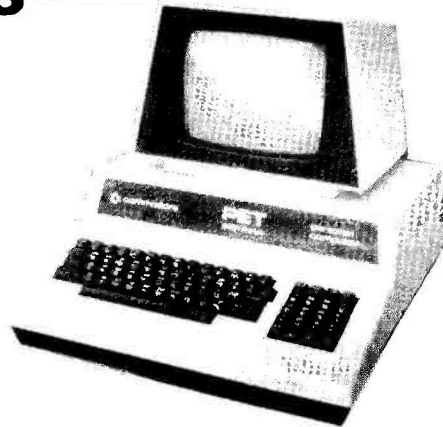
32N (32K RAM) **£599**

**ALL WITH NEW KEYBOARD  
 AND GREEN SCREEN  
 PERIPHERALS**

Service & Assistance available.  
 Interfaces available are:

X-Y Plotters, Analogues to Digital Converter, 16 channel interfaces, Bi-directional interfaces etc.

EXTERNAL CASSETTE DECK SUITABLE FOR ALL PETS **£55**



## MEMORY

D. RAMS	£	p
4027	2.75	
4050 (350NS)	2.35	
4060 (300NS)	2.39	
4116	4.35	

S. RAMS	
2102A	1.09
2102A2	1.09
2112A	2.25
21L02	.98
2114-4045	2.95
4035	1.07
4044-5257	6.93

BULK PURCHASE	
8x2114	22.50
8x4116	29.95
8x21L02	7.00

BULK PURCHASE	
16x2114	39.95
16x21L02	13.00
32x21L02	25.00
64x21L02	45.00

## UK101

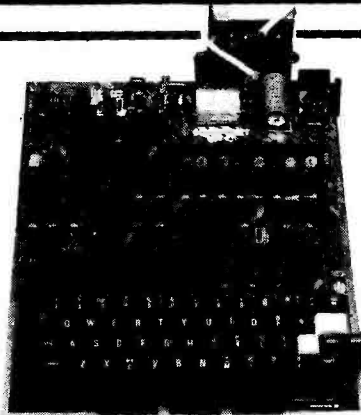
**NEW LOW PRICE**

**£179** IN KIT FORM  
**£229** READY BUILT & TESTED  
**£249** COMPLETE IN CASE

- No extras required 8x2114 **£22.50**
- ★ Free sampler tape
  - ★ Full Qwerty keyboard
  - ★ 8K basic
  - ★ Ram expandable to 8K on board (4K inc)
  - ★ Kansas City tape interface

**ASSEMBLER  
 EDITOR  
 TAPE  
 £14.95**

★ NEW MONITOR ALLOWS FULL EDITING & CURSOR CONTROL **£22.00**



## EPROMS

2708	4.95
2716 (5v)	13.95
2532	39.95

## ROMS

2513 (UC)	5.95
2513 (LC)	5.95

## CPUS

6502	9.50
8080	4.75
9900	25.95
6800	5.90
Z80	8.95

## LATEST STOP PRESS AND PRICE LIST

Send see or phone for up-to-date **PRICES** of all our range of items stocked

### CASES

Available for  
 U.K. 101, Superboard  
 Nascom,  
 Appx. DIM. 17" x 15"  
 435 x 384 mm

**PRICE £24.50**

P. packing £1.50.

### TAPES

Unique stackable tape  
 storage unit. Interlocking  
 drawers.  
 Each drawer containing 2  
 C12 tapes

10 drawers **£9.50**  
 5 drawers **£5.25**  
 Single drawer **£1.10**

### MEMORY EXPANSION KIT

Suitable for UK101, Superboard  
 expansion using 2114's each board  
 has 16K ram capacity kit contains:

- ★ On board power supply
- ★ 4K Eprom expansion
- ★ Fully buffered for easy expansion  
 via 40 pin socket **£99.95**
- ★ 8K kit **£139.90**
- ★ 16K kit

## BUFFERS

81LS95	1.25
81LS96	1.25
81LS97	1.25
81LS98	1.25
SN74365	.52
SN74366	.52
SN74367	.52
SN74368	.52
8T26	1.75
8T28	1.75
8T95	1.57
8T96	1.57
8T97	1.50
8T98	1.57

## BAUD RATE GENS

MC14411	8.75
MM5307	8.75

## UARTS

AY-5-1013	3.45
AY-3-1015	3.98
MM5503	4.75
6011	3.55

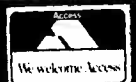
## PRINTERS

**TX-80 £375**

**EPSON TX-80 £375**  
 Dot-matrix printer with Pet  
 graphics Interface: Cen-  
 tronics parallel, options: PET,  
 Apple and serial.



Please add VAT 15% to all prices. Postage on computers, printers and cassette decks charged at cost. all other items P&P 30p. Place your order using your Access or Barclaycard. (Min. tel order £5). Trade and export enquiries welcome. credit facilities arranged.





Is  
this

# THE ULTIMATE WATCH from Seiko?

## JET 010 ANALOGUE/DIGITAL ALARM CHRONOGRAPH

A superbly styled analogue watch only 7.5mm thick (approx.) with a multifunctional digital display.

### ANALOGUE

Independent, hours, minutes and sweep second hand.

### DIGITAL

**Time:** Independent, 6-digit display of hours, minutes and seconds, with a.m./p.m. indication (12-hour system) or 24-hour readout.

**Calendar:** Alpha day and date with automatic adjustment.

**Alarm:** The 24-hour alarm sounds for 60 seconds. 12- or 24-hour readout with alarm set symbol continuously displayed.

**Chimes:** The hourly signal, with symbol, can be switched on or off.

**Stopwatch:** Measures net times from 1/100 second to 1 hour.

**Dual time, count down and accumulation function availability.** Stainless steel case and bracelet. Hardlex glass, shock and water resistant. Anti-magnetic. Approx. 2-year battery life.

This state-of-the-art watch is destined to become a classic.

**ONLY £62.50**



JET 010

## SPECIAL SUMMERTIME OFFERS

Excluding new models illustrated

ALL our normal discount prices

A further



A further



ALL our normal discount prices for ALARM, ALARM CHRONOGRAPH and CALCULATOR watches.

**OFFER CLOSES SEPTEMBER 30th, 1980  
SUBJECT TO AVAILABILITY**

Send 25p for our illustrated catalogue and save £££s!

## SEIKO'S NEW SOLAR ALARM CHRONOGRAPHS



Water resistant case withstands splashing, etc.

**£52.50**

**Interval countdown alarm timer.  
Weekly programmable alarm.**

Comprehensive display of hours, minutes, seconds, day, date and month. The 24-hour alarm can be programmed to ring on any day or days of the week. The hourly chimes can be switched on or off. The interval alarm timer can be set for a period of time up to 16 hours and is repetitive until switched off.

The stopwatch measures net, lap and 1st and 2nd place times from 1/100 second to 20 minutes, then in seconds to 12 hours, the upper display indicating lap times and the lower display total time. Stainless steel case and bracelet. Hardlex glass. Approximately 7-year battery life. 6 solar panels. 12 month world-wide guarantee.



100m water resistant. Suitable for swimming, etc.

**£69.95**

Price includes VAT, P&P. Send your company order, cheque or P.O. or telephone your Access or Barclaycard number to:

# TEMPUS

Tempus (Dept. ET1)  
FREEPOST, 164-167 East Road  
Cambridge CB1 1BR. Tel. 0223 312866

## The finest amplification from Crimson Elektrik LATEST DEVELOPMENTS

CRIMSON ELEKTRIK Power amplifiers are the most sophisticated on the market today. Yet now with the latest Issue 5 innovations THEY ARE EVEN BETTER! We have included sonic improvements and developed a unique electronic protection circuit which obviates the need for output fuses. In fact, such fuses can seriously degrade the performance of an amplifier. They can blow under heavy drive conditions — even with non faulty loads (due to thermal fatigue), they can be a time consuming nuisance and even dangerous to replace, but more importantly they are responsible for "envelope distortion" i.e. dynamic compression of the signal, even fuses in the feedback loop suffer from the first two disadvantages, and the latter to a lesser extent.



CP3000 POWER AMP MODULE 300 WRMS 4Ω

### BEST VALUE

CRIMSON have an enviable reputation for supplying the best value amplifier kits. You can prove this to yourself by checking out the competition in the following crucial areas: ★ Professional grade phono sockets for ALL signal connections ★ Silver/Gold plated switch contacts ★ Adequate heatsinking for full rated output ★ Available from stock ★ Manufactured by a specialist company with a reputation for friendly and helpful service before and AFTER sale ★ Forms the basis for high quality active loudspeaker systems. Considering the advantages of CRIMSON Kits. Why choose anything else?

### SOUND ADVICE

Crimson Amplifiers are versatile and dependable. The new CP3000 will give up to 300 watts into 4 ohms at 0.03% THD and is the obvious choice for P.A. and Disco's requiring the best performance. For Hi-Fi we produce the ever popular pre- and power amp hardware kits which enable our advanced modules to be housed in attractive metalwork and include everything down to the last nut and bolt.

Our Pre-amplifier can be fitted with the moving coil module allowing it to be used with the latest M.C. cartridge (which can now be bought for as little as £30). Write for details, specifications and full price list or send 50p cheque/p.o. for our comprehensive application/users manual.

Space precludes us from publishing all our products and prices, below are just a few examples.

- ★ Power Amp Modules (single channel)
  - CE 608 (60 WRMS/8 ohms) £23.10
  - CE 1708 — (170 WRMS/8 ohms) £38.50
  - CP 3000 — (300 WRMS/4 ohms) £58.00
- ★ 60 + 60 watt stereo pre and power amplifier complete kit £208.86
- ★ Stereo Moving Coil Pre-Pre Amplifier Module MC1 £28.50
- ★ 3 Way Active Crossover (single channel) £32.60

Don't forget, Crimson modules are available throughout the country from all branches of Marshalls and Mail order from Badger Sound Services and, of course Crimson Elektrik.

Prices include V.A.T. and post to anywhere in the U.K.



## Crimson Elektrik

1A Stamford Street, Leicester LE1 6NL

Telephone (0533) 563508



## Image Projection

The failures which occur during the first few months are particularly unwelcome, since they do much to tarnish a supplier's image. They are also very expensive to deal with. The reliability tests which a watch would need to undergo if we are to meet the requirements of the Swiss Industry Standards are divided into two categories:-

1. Performance and quality tests.
2. Accelerated life tests simulating wear.

## Testing Time

The example below is the type of performance that electronic watches must undergo if they are to reach an acceptable level of quality for the Swiss (and, indeed, Metac): Control for good functioning of all external controls accessible to the wearer, such as time setting, second stop, rapid corrector, etc; measurement of trimmer adjustment range in positive and negative areas; measurement of supply voltage at which the watch ceases to function correctly; measurement of current consumption and calculations of performance in terms of type of battery used; measurement of the performance deviation of the watch, expressed in seconds per day as a function of the supply voltage variation; determine the effects of temperature variation on the quartz crystal and the integrated circuit; measurement of the watch's resistance to thermal shocks and determination of the watch's resistance to magnetic fields.

Note: a watch can be termed anti-magnetic if it withstands without damage three passages in a magnetic field of 60 Oersted. A watch can be termed anti-shock if it withstands without damage two shocks corresponding to a fall from a height of one metre on a hard wood floor; the intensity of such a shock is around 5,000 g (1 g = unit of gravity acceleration).

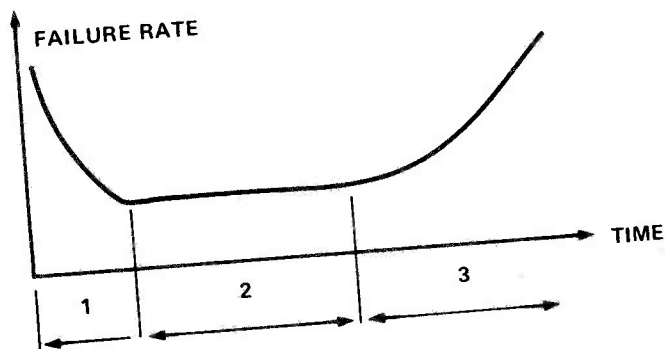


Fig.2. The bathtub curve shows the rate of failure of a product in terms of time.  
1. Early rate of failure; 2. Random failures, with a constant rate of failure;  
3. Failures due to wear.

## Hand-held Games

Electronic games have been with us now for the last three years and are continually growing in their sophistication. The early TV game chip with its four simple games proved to quickly become a bore and probably ended up in the bottom of the toy cupboard the day after boxing day. Space Invaders and the other microprocessor based games, which until now were only to be seen at fun-fairs and in the local pub, are soon to emerge as portable hand-held games, which will easily fit into the Christmas stocking. The only viable way to produce really high technology microprocessor chips is in large volume. Once all the production problems are solved, the manufacturer starts to crank the handle and out spew millions of chips. Since rockets, machine tools, etc cannot consume very many chips in peace-time, the industry requires a volume product, which will soak up all this excess production.

## Software In Hand

Now that chip shortages (which probably held back this product last year) have been overcome, the relatively simple task of assembling hand-held games will ensure their success this Christmas in a big way. Over 500 different hand-held games are being produced. However, reports from the Far East indicate that only a small number are up to standard and will be acceptable to the UK market. Finding a suitable game, which does not quickly become a bore, is a major headache for designers. The chip manufacturers are Texas Instruments, AMI and General Instruments in the main and these companies expend a considerable effort in writing software for hand-held game microprocessors. It still remains a very high risk business, however, and manufacturers and importers will try hard to ensure that they do not have large stocks remaining after Christmas.

## Moving Pictures

Trends in hand-held games are in the direction of more LCD games than the LED type. These will last 20 to 30 hours compared to only three to five for LED ones. The use of fluorescent tube and larger memories are also expected developments. The drawback with LCD hand-held games is that they must have a combination of driver and LCD display. Companies in Hong Kong are working on this to produce the combination of chip and driver which makes players move the display. The final touch will be a single chip direct drive microprocessor for LCD games. The standard type of LCD display has between 128 and 256 dots and the players' balls are mere blips on the screen. It is, however, hoped soon to produce a program of more than 600 dots and the LCD microprocessor will have drive capability with good resolution. Hand-held game trends are also moving towards devices that produce sounds. An example of this is sound producing microprocessors, which produce musical sounds in toys such as screeching wheels and engine sounds for toy cars.



COMPUTERS AUDIO RADIO MUSIC LOGIC TEST GEAR CB GAMES KITS

# BREADBOARD '80

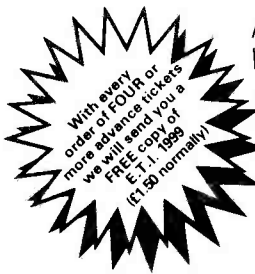
COMPONENTS DEMONSTRATIONS SPECIAL OFFERS MAGAZINES BOOKS



## It's all at Breadboard '80

This is **the** exhibition for the electronics enthusiast. From November 26-30 there is only one place in the universe for the electronics enthusiast to be — Breadboard '80, at the Royal Horticultural Hall in London. The majority of leading companies will be exhibiting, including all the top monthly magazines in the field. There will be demonstrations on most stands and many feature special offers that are **EXCLUSIVE** to Breadboard!

All aspects of this fascinating field are catered for, from CB to home computing, so whether you want to buy a soldering iron or a synthesiser — or just keep up to date with your hobby — don't miss Breadboard '80.



With every order of FOUR or more advance tickets we will send you a FREE copy of ETI, 1989 (£1.50 normally)

**Royal Horticultural Halls**  
**Elverton Street**  
**Westminster London SW1**  
**November 26-30 1980**

26th Nov — **WEDNESDAY** — 10am-6pm  
 27th Nov — **THURSDAY** — 10am-8pm  
 28th Nov — **FRIDAY** — 10am-6pm  
 29th Nov — **SATURDAY** — 10am-6pm  
 30th Nov — **SUNDAY** — 10am-4pm

Send to **AVOID QUEUES — GET ADVANCE TICKETS**  
 Advance Tickets, Merchants Ltd, 185 Chancery Lane, London WC2H 9LT  
 Please send: **tickets @ £1.50 (Student/Child/OAP)**  
 TO: \_\_\_\_\_  
 Enclose P.O. / Cheque for £ \_\_\_\_\_



The NEW

# VIDEOTONE

YOU CANNOT BUY CHEAPER - YOU CAN ONLY GET LESS FOR YOUR MONEY!

## Introduces DIRECT SELLING - the Ultimate Discount!!!



### LOUDSPEAKERS

The complete fully reviewed range of Videotone Speakers which dominate within their class. Now at lowest ever prices.

- D 100 £38
- Minimax 11 £44
- GB3 £50
- GB2 £60
- GBS £207
- D 93 £40

DISCOUNT SELLING PRICE  
**£50.00**

### CORAL CARTRIDGES

Fast becoming one of the top names

#### MOVING COIL

- UK's No. 1 Cartridge
- MC 81 £48.87
  - 777EX £35
  - 777E £25

#### MOVING MAGNET

- 555SX £7.28
- 555E £14.22
- 666E £32.48



#### HEAD AMP

- H300 £51.75
- T100 £24.75

#### HEADSHELLS

- S100 £6
- S101 £7
- S200 £4

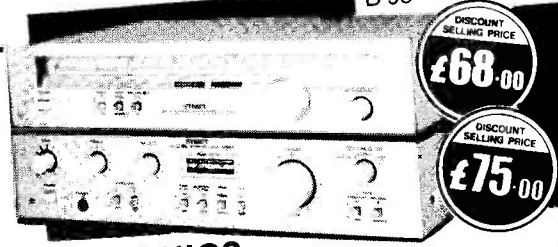


### MICROPHONES

- MU 105-22 £29.30
- MU 105-12 £22.25
- MU 25 C £17.39

### TURNTABLES

- Sansui SR222 Mk2 £69.00
- JVC LA 11 £64.00
- JVC SLQ 3 £140.00



### ELECTRONICS

This new range of Electronics from Videotone redefines the words quality and value for money to a new high.

- 30 watt amp MC input SA4130 £75.00
- Stereo Tuner ST4120 £68.00
- Cassette full features SC3200 £98.00
- 50 Watt amplifier WA7700 £77.00
- 20 Watt amplifier LA2020 £58.00

DISCOUNT SELLING PRICE  
**£68.00**

DISCOUNT SELLING PRICE  
**£75.00**

## A MESSAGE FROM VIDEOTONE

*Dear Customer*

You will find that the products advertised on this page are the best possible value for money. They are only low in price because we have eliminated large amounts of selling costs that other brands have to suffer. These savings are passed directly on to you. We have full brochures on any specific item you may be interested in and a competent realistic staff of engineers at our London Showrooms to help you in your choice. Our consumer protection packages are comprehensive and we offer every form of financing you may require. We carry out our own servicing and are dedicated to giving Value for Money. We are confident our products are unbeatable. You may purchase with confidence because our Engineers have specially selected them from competitive sources throughout the world and we import them directly ourselves. Remember, you have 21 days trial period on all products. That is the measure of our confidence.

*Bill Hardcastle*  
Managing Director



### HEADPHONES

- HP 90 Headphone £12.65
- HP 80 Headphone £9.69

Superbly made with top flight performance.

DISCOUNT SELLING PRICE  
**£9.69**

### SEND FOR OUR LATEST FREE BROCHURE AND DETAIL LIST OF LOCAL SALES OUTLETS IN THE U.K.



VIDEOTONE  
98 CROFTON PARK ROAD,  
CROFTON PARK, LONDON SE4  
Tel: 01-690 8511/2

Please send me your Direct Selling Brochure and list of sales outlets.

Name \_\_\_\_\_  
Address \_\_\_\_\_



ALL PRODUCTS ON DISPLAY & CONTINUOUS DEMONSTRATIONS

ALL PRICES INCLUDE VAT

ETI OCTOBER 1980

E.T.I. 10/80





# COMPUTER WAREHOUSE

**NOW OPEN**  
MONDAY-SATURDAY  
9.30-5.30

In stock now test equipment, microprocessors, teletypes, transformers, power supplies, scopes, sig. gen's, motors, peripheral equipment, I.C.'s, tools, components, variacs, keyboards, transistors, microswitches, V.D.U.'s sub-assemblies + thousands of other stock lines. Just a mere fraction of our vast range, is displayed below. 100's of bargains for callers.

## SCOOP PRINTER PURCHASE

PROFESSIONAL EQUIPMENT AT HOBBYIST PRICES  
SO LOW EVEN OUR COMPETITORS GASP!

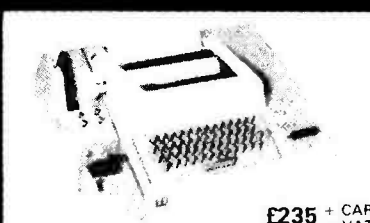
### DATA DYNAMICS 390 ASCII PRINTERS



ONLY  
**£135 + CAR + VAT**

Printer only version of the world famous Teletype KSR33 but with the additional bonus of being housed in a special attractive sound proof case which cuts down any mechanical noise to a minimum. Also fitted is a unique data detect circuit which automatically turns the machine on and off on receipt/end of data from the computer. Standard features such as ASCII, 110 baud, and RS232 interface enable direct connection to most micros. Supplied in good condition and in working order.

### TELETYPE ASR33 I/O TERMINALS



**£235 + CAR + VAT**

Fully fledged industry standard ASR33 data terminal. Many features including: ASCII keyboard and printer for data I/O, auto data detect circuitry, RS232 serial interface, 110 baud, 8 bit paper tape punch and ready for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order. Options: Floor stand £12.50 + VAT  
Sound proof enclosure **£25.00 + VAT**

### ICL TERMIPRINTER 300 BAUD TERMINALS



**£325 + CAR + VAT**

Made under licence from the world famous GE Co. The ICL Termiprinter is a small attractive unit with so many features it is impossible to list them in the space available! Brief spec. as follows: RS232 serial interface, switchable baud rates 110, 150, 300, (30 cps), upper and lower case correspondence type face, standard paper, almost silent running, form feed, electronic tab settings, suited for word processor applications plus many more features. Supplied in good condition and in working order. Limited quantity.

### HOW TO GET HERE

Victoria, London  
Bridge or Holborn  
Viaduct to  
Thornton Heath.  
1 minute from  
Thornton Heath  
Station.

**SPECIAL OFFERS**  
**HORIZON NORTH STAR**  
56k ram, quad floppys  
guaranteed **£1795 + VAT**

**HEWLETT PACKARD**  
HP programmable calc.  
**£140 + VAT**

**BEARCAT 210**  
Scanning receiver  
- 40.512 Mhz  
**£140 + VAT**

### THE CHIPS ARE DOWN MOSTEK, INTEL, NEC, MOTOROLA I.C. PRICES SLASHED!

A massive purchase of brand new "state of the art" data processing equipment enables us to offer the following chips at never, and we mean never to be repeated prices.

8085A	Central Processor	£11.99
8155C	256x8 Static Ram	£8.95
8253C	Programmable Interval Timer	£8.95
8255A	Programmable Peripheral Interface	£9.95
8259A-8	Programmable Interrupt Control	£4.75
8755A	2Kx8 Eprom 16 1/0 Lines	£34.50
MC6850P	ACAI	£3.75
2652	MPCC Comms. Controller	£24.00
2102 1K	Static 650ns Rams 8 for	£5.25
1702	256x8 Eprom	£3.75
5101L-1	256x4 Static Ram 450ns	£4.95

And Remember All Chip Prices Include V.A.T.

All above I.C.s are brand new or removed from new unused socketed P.C.B.'s. Eproms supplied washed.

All full spec. and guaranteed

### SEMICONDUCTOR 'GRAB BAGS'

Amazing value mixed semiconductors, include transistors, digital, linear I.C.'s, triacs, diodes, bridge recs. etc. etc. All devices guaranteed brand new, full spec. with manufacturers markings, fully guaranteed.  
50 + BAG £2.95 100 + BAGS £5.15

### MUFFIN FANS

Keep your equipment Cool and Reliable with our tested ex-equipment "Muffin Fans" almost silent running and easily mounted. Available in two voltages. 110 V.A.C. £5.05 + pp 65p OR 240v A.C. £6.15 + pp 65p DIMENSIONS 4 1/2" x 4 1/2" x 1 1/2"

ELECTRONIC  
COMPONENTS  
& EQUIPMENT

**66%**  
DISCOUNT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains, we have thousands of I.C.'s, Transistors, Relays, Cap's., P.C.B.'s, Sub-assemblies, Switches, etc. etc. surplus to our requirements. Because we don't have sufficient stocks of any one item to include in our ads., we are packing all these items into the "BARGAIN PARCEL OF A LIFETIME" Thousands of components at giveaway prices! Guaranteed to be worth at least 3 times what you pay plus we always include something from our ads. for unbeatable value!! Sold by weight

2.5kts £ 4.75 + pp £1.25 5kts £ 6.75 + pp £1.80  
10kts £11.75 + pp £2.25 20 kts £19.99 + pp £4.75

★ **SHUGART SA800** ★  
8" Floppy Disk Drives  
as new **£225.00 + VAT**

### ★ RAM AND EPROM STAR OFFERS ★

2716 Single 5v rail EPROMS **£10.25**  
2716 Three rail EPROMS **£ 8.50**  
4116 16k x 1 200 n s RAMS 8 for **£28.50**

### 64K x 8 DYNAMIC/STATIC RAM CARDS

A masterpiece of electronic engineering and our own advantageous buying enables us to bring you a complete memory system at a giveaway price. Originally made for a large processor the RAM card has many features, including on board refresh, internal parity generation and checking. Standard TTL inputs/outputs, +5, +12, -15v supply rails and its effective STATIC capability make it useable with many CPU's. A fast cycle time of approximately 400ns make this a snip at only **£125.00 + £3pp**. Supplied complete with circuits.

### ★ DISPLAY I.C. AND TRANSISTOR BARGAINS NEVER CHEAPER ★

All I.C.'s and Transistors by well known manufacturers and fully guaranteed. No fall outs. Comprehensive data on I.C.'s 15p per type.  
2N4351 N channel MOS FET  
2N4352 P channel MOS FET  
60p each £1.00 per pair.  
HIGH VOLTAGE NPN POWER SWITCHING transistors BVcbo 600v BVceo 500v BVVebo 15v Ic 5 amps Pc 125 watts HFE 60 typ ft 2.5 mhz ideal invertors. etc TO3 £1.60 each 4 for £5.40  
BF258 NPN 250v @ 200ma 45p each 3 for £1.08  
1.R. BS801 2.5 amp 100v bridge rec P.C. mount long leads 35p each 4 for £1.08  
1N4998 4 amp 100v P.C. mount diodes long leads 14p each 10 for £1.10  
LM309K + 5v 1.2 amp regulator £1.10 each 6 for £5.35  
AGFA C10 computer grade cassettes complete with library cases 68p each, 10 for £5.50  
1N4004 SD4 1 amp 400v diodes 7p each 18 for £1.00.  
1.R. 12 amp BRIDGE RECS. 400 volt £1.25 each.

POWER DARLINGTON SCOOP!  
MJ1000 NPN 60v 90w 8 amps 103 95p each  
2N5365 NPN 80v 100w 10 amps 103 £1.25 each  
MJ4030 NPN 60v 150w 16 amps 103 £2.25 each

### S.C.R.'s

2N3001 30v 350 ma TO18 22p each 6 for £1.00  
2N5061 60v 800ma TO18 27p each 4 for £1.00  
2N4441 50v 8 amps TO220 45p each 10 for £4.00  
C10601 400v 5 amps TO202 55p each 10 for £5.00

### TRIACS

G.E. 12 amp 600v TO220AB 95p each 10 for £8.75  
A.E.I. 10 amp 400v ready mounted on 2; + 2; heatsink £1.00 each 4 for £3.75

### LOW PROFILE I.C. SOCKETS

8 D.I.L. 10p each 12 for £1.00  
14 D.I.L. 14p each 8 for £1.00  
16 D.I.L. Gold Plated mdl. grade 22p each 6 for £1.00  
22 D.I.L. 27p each 5 for £1.00  
24 D.I.L. 25p each 3 for £1.00  
40 D.I.L. 80p each 2 for £1.00

### OTHER GOODIES

2N3055 IR C.A.1 65p each  
2N5943 RF output 40 volts, 1 watt up to 1000MHZ TO 55p each 10 for £5.00  
2N4304 W/720 P E.T. transistor 37p each 3 for £1.00  
LM3800/SL605 14 D.I.L. 2 watt A.F. amp 80p each 8 for £6.00  
CA3028B DC 120 MHZ differential-cascade amp £1.00 each 3 for £2.50  
CA3011 20 MHZ wideband amp TO99 case 65p each 2 for £1.00  
TMS3114 DUAL MOS 128 bit static shift reg. DC 25 MHZ £1.50 each 4 for £4.25  
GE424 zero voltage switch, triac SCR relay driver TO5 can £1.10 each 7 for £6.50  
LM384 5 Watt audio I.C.s £1.50 each 10 for £11.00  
FPO3725 4 NPN 50v 500ma transistors in 14 D.I.L. pack 70p each 2 for £1.00

**SUPERVALUE P.C.B. SPECIAL**  
Another great buy. Board contents include 62 Digital I.C.'s all located in 14 pin D.I.L. sockets. Original cost over £90, our price only **£4.95 + pp 65p**

### POWER SUPPLY UNITS

Building a system? Then your P.S.U. requirements stop here! Removed from brand new fire damaged front end processors originally costing several thousands of pounds each, these supplies feature 1980's technology including switching regulators. Fully smoothed and regulated continuous outputs of: +5v @ 15 amps, +12v @ 3 amps, and -12v @ 3 amps all on a P.C.B./heatsink measuring only 12" x 7.5" x 2.5". Supplied complete with circuit, transformer and easily removed smoke marks! **£34.95 + £2.50 car.**

### KEYBOARDS

★ LOW PRICE CHASSIS ★



A special bulk purchase enables us to offer the above keyboard at a lowest ever price. 49 coded keys encoded into a direct TTL compatible 7 bit output. Features such as delayed strobe, 5 volt D.C. single rail operation and rollover protection make this an absolute must for the MPU constructor! Supplied complete with connection diagram and edge connector, at a secondhand

"no time to test" price of only **£20.00 + P.P. £1.60**

**SUPER CASED VERSION** Same as above spec. but housed in attractive two tone moulded, free standing case. Unit also includes an all TTL parallel to serial converter (no details) etc.

**£27.50 + P.P. £1.85**

### TOROIDAL TRANSFORMERS

PR 240v pri. sec. 15 0 15 @ 2 amps dimensions 3" x 2 1/2" £4.95 + p.p. 99p.  
TM 240v/110v pri. sec. 15 0 15 8vA dimensions 2 1/2" x 1" £1.95 + p.p. 30p.  
All voltages measured off load.

Plugs, Sockets & Connectors Cannon 'D' Range

Ways	Plug	Socket
9	£1.03	£1.26
15	£1.17	£2.01
25	£1.72	£2.58
37	£2.35	£4.14
50	£2.90	£5.48

25 way ex-equip. plug or socket £1.25

Edge connectors, gold plated  
0.1 DS 85 way **£3.99**  
0.1 DS 45 way **£2.45**  
0.15 DS 58 way **£3.25**  
0.156 DS 36 way **£2.00**  
All connectors easily cut to size  
1000's of other connectors ex stock

### BARGAINS GALORE!

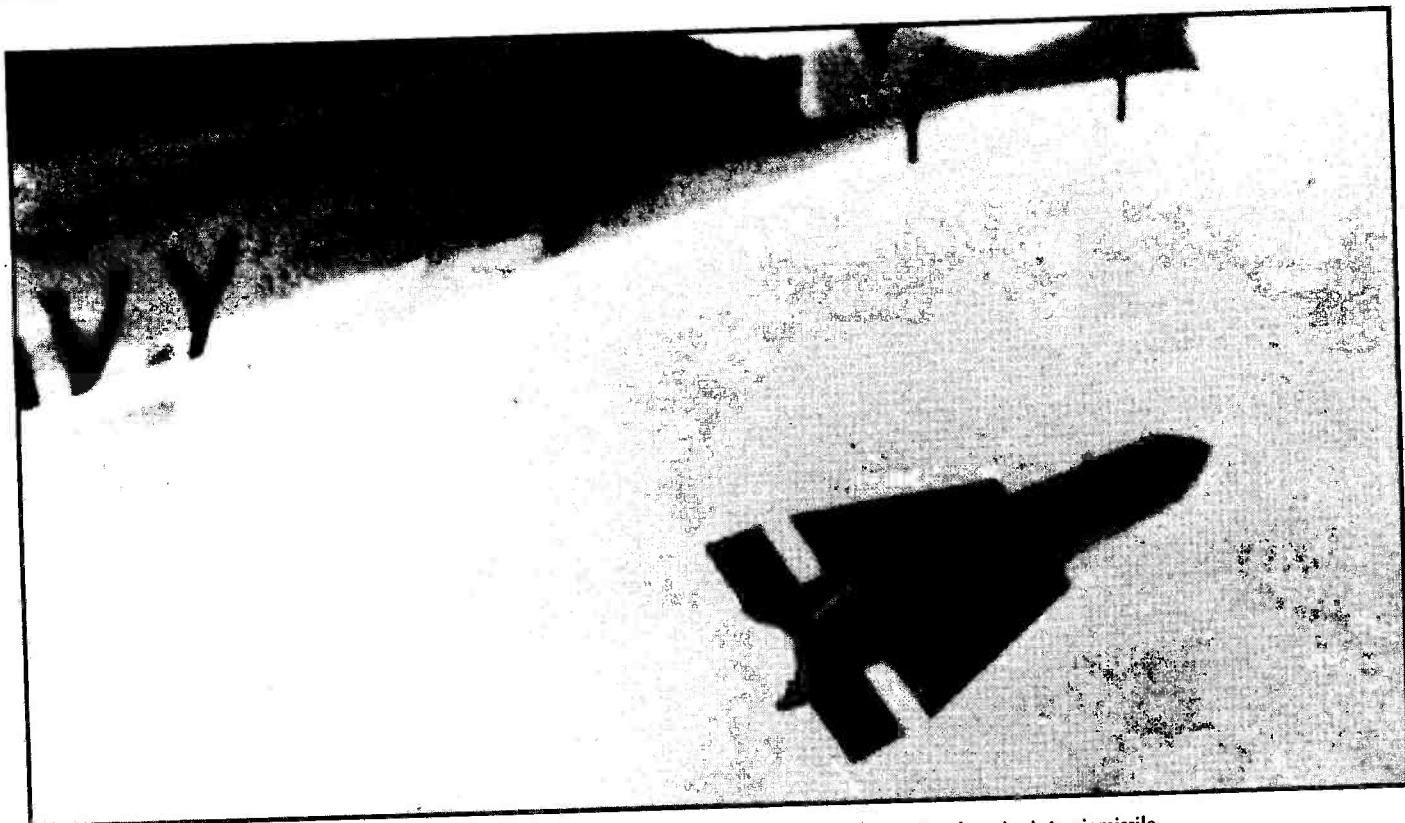
In our walk round Warehouse  
NOW open Monday to Saturday 9.30-5.30



Dept. E.T.I. 64-66 Melfort Rd., Thornton Heath, Surrey  
Telephone 01-689 7702 or 01-689 6800

MAIL ORDER INFORMATION  
Unless otherwise stated all prices inclusive of VAT. Cash with order. Minimum order value £2.00. Prices and Postage quoted for UK only. Where post and packing not indicated please add 40p per order. Bona Fide account orders minimum £10.00. Export and trade enquiries welcome. Orders despatched same day where possible. Access and Barclaycard Visa welcome.





An F-14 wing-tip camera catches a glimpse of the first airborne launch of the new upgraded version of the Phoenix air-to-air missile.

## On Target

How does Wasp find its targets? Two sensors are under evaluation — infra-red and millimetre radar. Millimetre radar has three main advantages over infra-red. Its high resolution enables tanks to be distinguished from trees and buildings, it uses very small antennae and it is relatively unaffected by adverse weather conditions.

If a group of the missiles are fired at a number of targets, they will each attack a different target. If they can find only one target, it suffers a severe case of overkill. Wasp has a range of six miles when fired from an aircraft with a ground speed of 500 MPH. Two rival versions are under development by Boeing and Hughes.

## AIM To Kill

Earlier this year the US Navy's new AIM-54C Phoenix air-to-air missile was successfully launched from an airborne F-14. It intercepted a drone aircraft target, passing well within the 'kill' range, if the missile had been armed. The Hughes AIM-54C, an improved version of the AIM-54A, carries a new digital electronics unit which is more flexible and reliable than the analogue unit it replaces. It also has a more effective target detector.

This first successful interception was achieved over a greater range than was possible with its predecessors. The F-14 launching aircraft travelled subsonically head-on towards the supersonic QF-4 fighter drone. In this launch, the Phoenix was guided on to the target by radar returns from the F-14's weapon control system. Closer to the target, it can switch to its own active radar system.

The upgraded Phoenix will become the US Navy's primary long-range air defence weapon in the 1990s.

ETI OCTOBER 1980

## SHORTS

A spacesuit was destroyed by fire at the Johnson Space Centre in April. Fortunately there was no-one in the suit at the time, although a technician was badly burned. To avoid a recurrence, a review board has recommended several modifications to the high pressure oxygen system and seals.

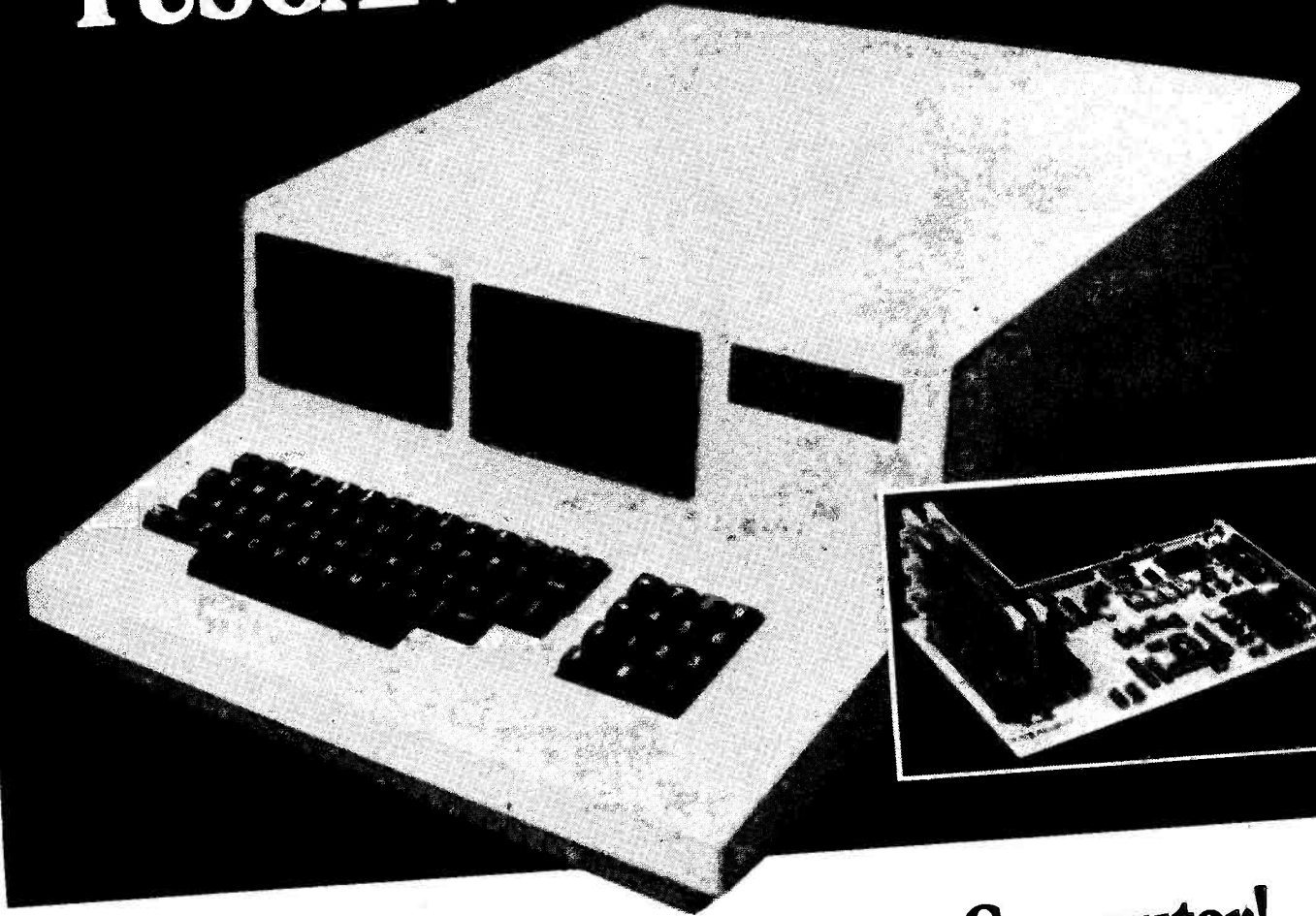
GEOS-D, the latest in a series of Geostationary Operational Environmental Satellites, is due to join its two companions in Earth orbit as we go to press. The 12 feet high by seven feet in diameter spacecraft will be launched from Cape Canaveral on September 9th by a three stage Delta 3914 booster. Next month I hope to bring you an in-depth report on this latest weather satellite and the GEOS system.

In July's Digest we brought you the sad news that the Viking Lander 2's batteries had run out of juice. The latest news on the Viking population of Mars is that Viking Orbiter 1 has now reached the end of its supply of attitude control gas. Viking Lander 1 is the only member of the foursome that is still functional.

We now know that the first Space Shuttle launch has been postponed from November this year until at least March next year. Next month Astrologue will look into the political, financial and technical problems that have beset the Space Shuttle from the start.



# 'TUSCAN' FROM TRANSAM



## Take a step up to your next Computer!

### THE CONCEPT

How many ways are there to build an S100 system? Not many, and all expensive. TUSCAN changes all that.

Five S100 boards on one single board—just for starters. Plus five extra slots for future expansion.

What a combination! Z80 and S100 with the TRANSAM total package of system and applications software.

How do we do it? Our prices start at £195 and you can build up in easy stages to a fully CP/M compatible disc based system. Something to think about!

### THE HARDWARE

The first Z80 single board computer with integral S100 expansion. British designed to the new IEEE (8 BIT) S100 specification, the TUSCAN offers total system flexibility. A flexibility available now.

The board holds the equivalent of a Z80 cpu card, 8k ram, 8k rom video and I/O cards with 5 spare S100 expansion slots and offers a price/performance ratio which is hard to beat.

Just compare our price with a commercial S100 ten slot motherboard with this specification.

### THE SOFTWARE

TUSCAN offers the user the choice of system monitor, editor, resident 8k basic, resident Pascal compiler or full CP/M disk operating system. All options are upwards

compatible and fully supported with applications software. Both 5¼" and 8" drives are supported in double density.

### THE PACKAGE

TUSCAN is available in kit form or assembled. With several hardware and software options to suit your requirements and budget. Attractive desk top case also available holds 2 x 5¼" Drives.

# TRANSAM

## NOBODY DOES IT BETTER!

Send to Transam Components Ltd., 59/61 Theobald's Road, London WC1.

I am interested in the TUSCAN Z80 based single board computer with S100 expansion and enclose a S.A.E. for further details.

Name \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_

ETI OCTOBER 1980

TRANSAM COMPONENTS LTD., 59/61 THEOBALD'S ROAD, LONDON WC1. TEL: 01-405 5240/2113



single byte instruction from the memory location given in the program counter; this takes three states. This is decoded and the processor sends, as an address, the contents of its H and L registers. The data word returned during this cycle is held in a temporary register inside the CPU and we have now used six states. The final act of adding the temporary register contents to the Accumulator takes a further state making seven in all, or two cycles. The longest operation of all, in 8080 code, takes 16 states or five machine cycles.

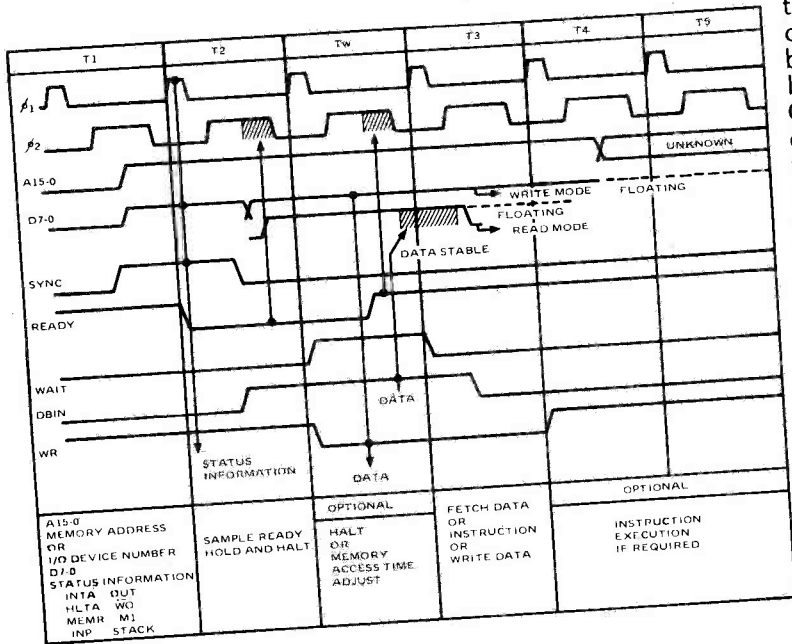


Fig.3 Timing diagram showing the various states that can make up a machine cycle: The vertical arrowed lines indicate information access states.

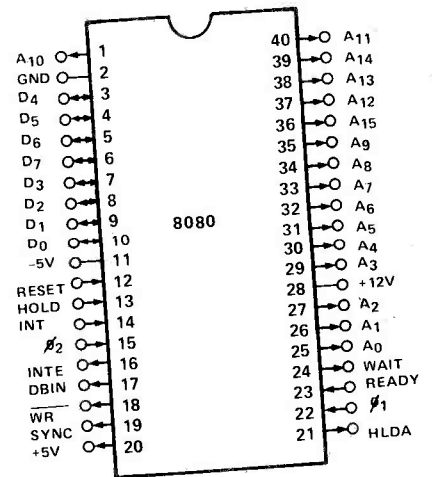
## The Ins And Outs

The final section of our look at the internals of a CPU is the connections you can make with the outside world. Generally, the CPU is housed inside a DIL package with some 40 legs. Under normal circumstances, assuming the standard eight bit CPU, we will have 16 pins for the address bus, eight pins for the data bus and 16 pins left to play with. Just what you do with them depends on the kind of CPU you have, but let's take a close look at the pins on an 8080.

Having already mentioned the address and data bus, we only need to say that the data bus is a bi-directional system and is capable of tri-state operation. It can assume a high impedance state, which is neither a logic zero nor one and this is used under some special circumstances, which will be mentioned next month. Four further legs can be allocated to power; the device needs  $\pm 5$  V, +12 V and ground. Yet two more legs can be allocated to the required two phase clock, leaving us ten possible control signals to communicate the state of the device to the outside world. These are SYNC, DBIN, WAIT, HLDA, INTE, READY, HOLD, INT and RESET. Taking these in order, the SYNC indicates the first state of each machine cycle, thus acting as a synchronisation signal, hence the name. The DBIN signal tells the outside world that the CPU can accept data. It should be used to externally enable the

transfer. WAIT is an indication that the CPU has entered a WAIT state, triggered by pulling the READY line low before the second state time. This causes extra states to be added to the cycle time for as long as the READY line is held low. The process is often used in situations where the memory or device currently being accessed is slower than the processor.

Our next signal, WR, is provided for the synchronisation of external transfers. These include memory and I/O operations and it is the converse of DBIN. There now follows a group of controls, which are concerned with things called interrupts. An interrupt is the computer equivalent of a tap on the shoulder and is used by peripheral devices to tell the processor that they are ready to be looked at. The INT line must be set high to tap the computer on its shoulder, but this will only work if the INTE line has been enabled previously. Inside the CPU, the interrupt is signalled by a status bit being set and the external device must put its instruction onto the bus in order for any action to be taken. The HOLD line is concerned with direct memory access and as such we shall not dwell on this until next month. The HLDA is merely an indication that the CPU is in a HOLD state. Finally we have the RESET line which, as its name implies, does. The signal will restore the CPU to the first state of a machine cycle and it also clears the program counter. It is essential to start all the power up sequences with this signal otherwise you never know what you may find yourself doing! It is also worth noting for all those sceptics among you that pressing RESET does not destroy all your registers, it merely sets you back to the beginning without destroying your program unless the person who programmed the monitor on your system clears the memory as the first operation. Whoever said that programmers were logical anyway.



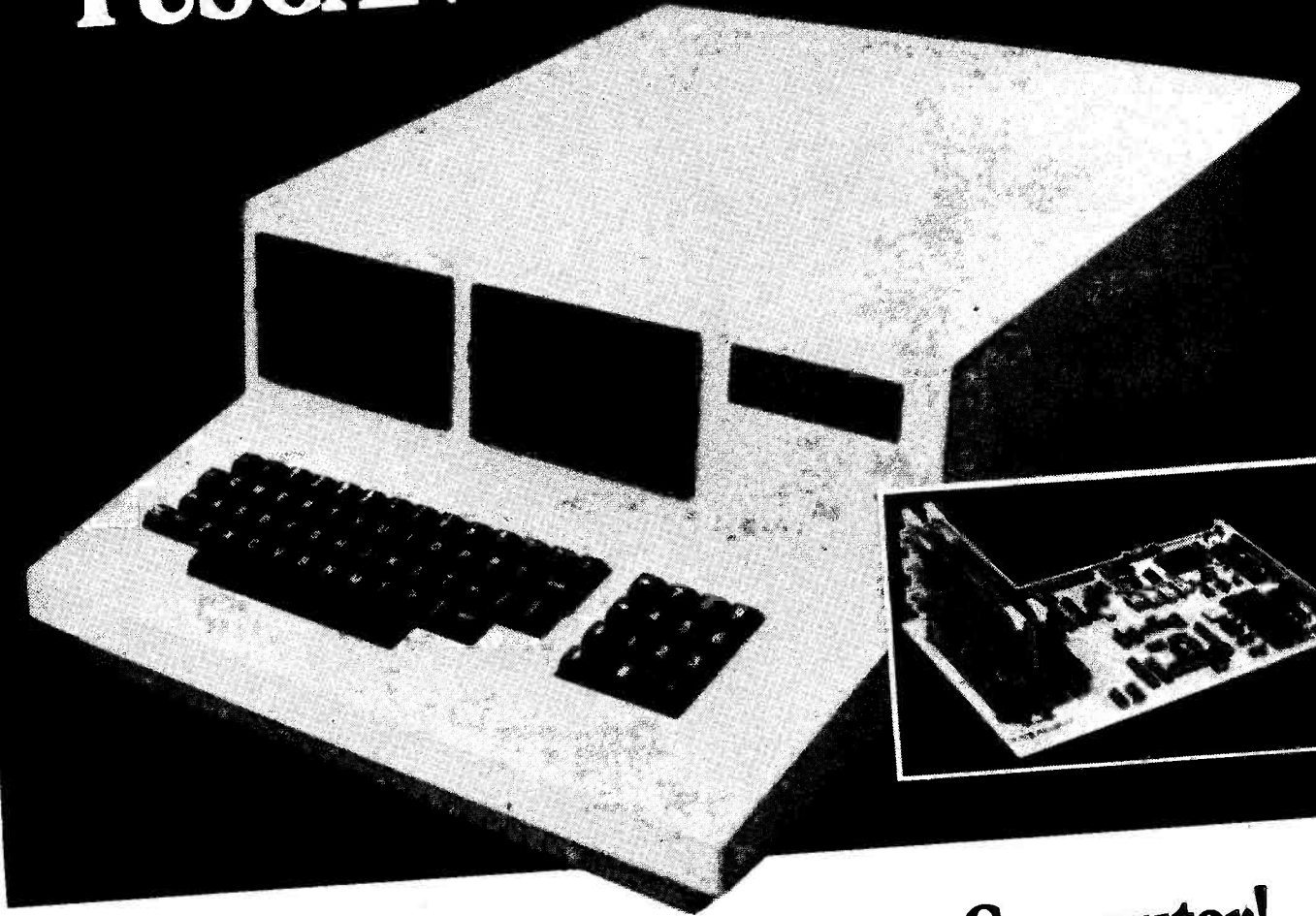
Pin designations of the 8080. Developed by Intel, fathers of the micro, it is regarded as the workhorse of eight bit processing. It also spawned the Z80, probably the most powerful eight bit chip using current technology.

## Coming Soon

Next month's slice of bits will investigate the thorny topic of memory devices and show you the way in the ROM-RAM jungle as well as telling you how to ignore your CPU altogether and really make things work fast.



# 'TUSCAN' FROM TRANSAM



## Take a step up to your next Computer!

### THE CONCEPT

How many ways are there to build an S100 system? Not many, and all expensive. TUSCAN changes all that.

Five S100 boards on one single board—just for starters. Plus five extra slots for future expansion.

What a combination! Z80 and S100 with the TRANSAM total package of system and applications software.

How do we do it? Our prices start at £195 and you can build up in easy stages to a fully CP/M compatible disc based system. Something to think about!

### THE HARDWARE

The first Z80 single board computer with integral S100 expansion. British designed to the new IEEE (8 BIT) S100 specification, the TUSCAN offers total system flexibility. A flexibility available now.

The board holds the equivalent of a Z80 cpu card, 8k ram, 8k rom video and I/O cards with 5 spare S100 expansion slots and offers a price/performance ratio which is hard to beat.

Just compare our price with a commercial S100 ten slot motherboard with this specification.

### THE SOFTWARE

TUSCAN offers the user the choice of system monitor, editor, resident 8k basic, resident Pascal compiler or full CP/M disk operating system. All options are upwards

compatible and fully supported with applications software. Both 5¼" and 8" drives are supported in double density.

### THE PACKAGE

TUSCAN is available in kit form or assembled. With several hardware and software options to suit your requirements and budget. Attractive desk top case also available holds 2 x 5¼" Drives.

# TRANSAM

## NOBODY DOES IT BETTER!

Send to Transam Components Ltd., 59/61 Theobald's Road, London WC1.

I am interested in the TUSCAN Z80 based single board computer with S100 expansion and enclose a S.A.E. for further details.

Name \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_

ETI OCTOBER 1980

TRANSAM COMPONENTS LTD., 59/61 THEOBALD'S ROAD, LONDON WC1. TEL: 01-405 5240/2113

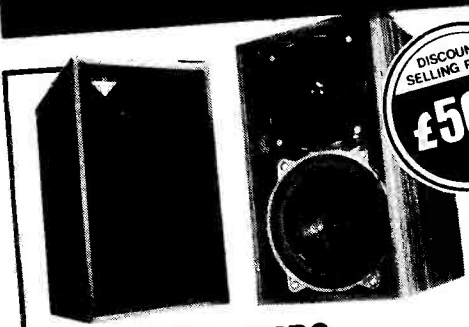


The NEW

# VIDEOTONE

YOU CANNOT BUY CHEAPER - YOU CAN ONLY GET LESS FOR YOUR MONEY!

## Introduces DIRECT SELLING - the Ultimate Discount!!!



### LOUDSPEAKERS

The complete fully reviewed range of Videotone Speakers which dominate within their class. Now at lowest ever prices.

- D 100 £38
- Minimax 11 £44
- GB3 £50
- GB2 £60
- GBS £207
- D 93 £40

DISCOUNT SELLING PRICE  
**£50.00**

### CORAL CARTRIDGES

Fast becoming one of the top names

#### MOVING COIL

- UK's No. 1 Cartridge
- MC 81 £48.87
  - 777EX £35
  - 777E £25

#### MOVING MAGNET

- 555SX £7.28
- 555E £14.22
- 666E £32.48



#### HEAD AMP

- H300 £51.75
- T100 £24.75

#### HEADSHELLS

- S100 £6
- S101 £7
- S200 £4

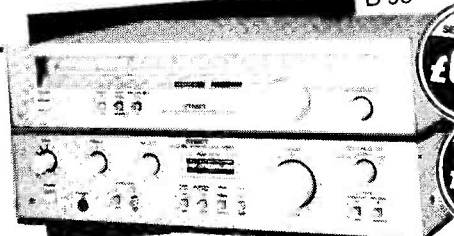


### MICROPHONES

- MU 105-22 £29.30
- MU 105-12 £22.25
- MU 25 C £17.39

### TURNTABLES

- Sansui SR222 Mk2 £69.00
- JVC LA 11 £64.00
- JVC SLQ 3 £140.00



### ELECTRONICS

This new range of Electronics from Videotone redefines the words quality and value for money to a new high.

- 30 watt amp MC input SA4130 £75.00
- Stereo Tuner ST4120 £68.00
- Cassette full features SC3200 £98.00
- 50 Watt amplifier WA7700 £77.00
- 20 Watt amplifier LA2020 £58.00

DISCOUNT SELLING PRICE  
**£68.00**

DISCOUNT SELLING PRICE  
**£75.00**

## A MESSAGE FROM VIDEOTONE

*Dear Customer*

You will find that the products advertised on this page are the best possible value for money. They are only low in price because we have eliminated large amounts of selling costs that other brands have to suffer. These savings are passed directly on to you. We have full brochures on any specific item you may be interested in and a competent realistic staff of engineers at our London Showrooms to help you in your choice. Our consumer protection packages are comprehensive and we offer every form of financing you may require. We carry out our own servicing and are dedicated to giving Value for Money. We are confident our products are unbeatable. You may purchase with confidence because our Engineers have specially selected them from competitive sources throughout the world and we import them directly ourselves. Remember, you have 21 days trial period on all products. That is the measure of our confidence.

*Bill Hardcastle*  
Managing Director



### HEADPHONES

- HP 90 Headphone £12.65
- HP 80 Headphone £9.69

Superbly made with top flight performance.

DISCOUNT SELLING PRICE  
**£9.69**

SEND FOR OUR LATEST FREE BROCHURE AND DETAIL LIST OF LOCAL SALES OUTLETS IN THE U.K.



VIDEOTONE  
98 CROFTON PARK ROAD,  
CROFTON PARK, LONDON SE4  
Tel: 01-690 8511/2

Please send me your Direct Selling Brochure and list of sales outlets.

Name \_\_\_\_\_  
Address \_\_\_\_\_

E.T.I. 10/80



ALL PRODUCTS ON DISPLAY & CONTINUOUS DEMONSTRATIONS

ALL PRICES INCLUDE VAT

ETI OCTOBER 1980