

Star sounds \* \* Star quality \* \*

SECURICOR DELIVERY on all orders over £100 (UK mainland only) Add just £2.50 on lower price orders

DJ90 Stereo Mixer — this is a really versatile new mixer that enables the constructor DJ to produce a professional performance every time. There are two stereo inputs for magnetic carridges, a stereo auxiliary input and mike input. Other 'plus' features are autopanning for fast or slow slider controls.

multi-mixing, ducking, interrupt, input modulation, in short everything ... the whole works — AND — under £100 complete! Complete kit £97.50 + VAT

Star features \*\*

TRANSCENDENT 2000 — Although only a 3 octave keyboard the '2000' features the same design ingenuity, careful engineering and quality components of its larger brethren. The kit is well within the scope of the first time builder - buy it, build it play it! You will know you have made the right

Complete kit £165.00 + VAT

Free Soldering

Practise Kit on

request with your

first kit - useful

tips, well

illustrated.

BIG NEWS ABOUT OUR LATEST **ADVANCES IN ROBOTICS** SEE INSIDE BACK COVER



SALES COUNTER Collect your order from the factory. Open 9-12/1-4.30 Mon-Thurs. Easy parking, no wa ting

This versatile modular mixer, featured as a constructional article in Practical Electronics can be built up to a maximum of 24 inputs, 4 outputs and an auxiliary channel. Each input channel has Mic and Line inputs, variable gain, bass and treble controls and a parametric middle frequency equalizer. There are send and return jacks, auxiliary, part and fader controls and output and group switching. The output channels have PPM displays and record and studio outputs. The auxiliary channel also has a PPM display and there is a headphone monitor jack and a built-in talk-back microphone. The mixer modules plug into base units each of which takes up to 6 channels. To eliminate hum, the power supply is in a separate cabinet.

KIT PRICES

Input channel Output channel Auxiliary channel Blank Panel

£19.90 Base unit and wooden front Pair of malfogany end cheeks £18.50 Power Supply and cabinet €19.50 £22.50 £3.00

£27.50 £12.50

All prices are VAT exclusive

TRANSCENDENT POLYSYNTH — A four octave polyphonic synthesiser with outstanding design characteristics and versatility and performance to match. Complete kit £275.00 plus VAT (single voice

E>tra voice (up to three more) £42.00 plus VA

secs. Many powerful effects including phasing, flangine, A.D.T., chorus, echo &



Digital Delay Line — With its ability to give

delay times from 1.6 mSecs to up to 1.6

vibrato are obtained. The basic kit is extended in 400 mS steps up to 1.6 secs. Simply by adding more parts to the PCB. Compare with units costing over £1,000! Complete kit (400 mS delay)

£130 + VAT

Parts for extra 400 mS delay £9.50 + VAT

MPA 200 — is a low price high power 100W amplifier its smart styling, profes-sional appearance and per-

each channel can handle up to 500W mamal wring is needed with our unique ebberd design. Complete kit £49.50 + VAT

s asts. Complete kit £175.00 + VAT

Seast Complete Air £173.00 + VAT
SP2 200 twice the power with two of the reliable, durable and economic amps from the MPA 200, fed by saparate power supplies from a common toroidal tormer. Superb finish and quality components through up to (even over) the standard of high prices factory-bit Complete kit £64.90 + VAT



WORLD **LEADERS** IN **ELECTRONIC** KIT DESIGN AND SUPPLY

PORTWAY INDUSTRIAL ESTATE ANDOVER, HANTS SA10 3NM. PISA **ORDER BY PHONE (0264) 64455** 

Simply request your chosen kit and quote your Access or Barclaycard Number.





Dave Bradshaw: Editor Peter Green: Deputy Editor Phil Walker: Project Editor Jerry Fowler: Technical Illustrator

Gary Price: Divisional Advertisement Manager

Ron Harris B.Sc: Managing Editor T.J. Connell: Managing Director

PUBLISHED BY

Argus Specialist Publications Ltd. 145 Charing Cross Road, London WC2H 0EE DISTRIBUTED BY:

Argus Press Sales & Distribution Ltd. 12-18 Paul Street, London EC2A 4JS (British Isles) PRINTED BY QB Limited, Colchester

COVERS PRINTED BY: Alabaster Passmore

OVERSEAS EDITIONS and their **EDITORS** 

AUSTRALIA — Roger Harrison CANADA — Halvor Moorshead GERMANY — Udo Wittig HOLLAND — Anton Kriegsman



Member of the Audit Bureau of Circulation

Electronics Today is normally published on the first Friday in the month preceding cover date. The contents of this publication including all articles, designs, plans, drawings and programs and all copyright and other intellectual property rights therein belong to Argus Specialist Publications Limited. All rights conferred by the Law of Copyright and other intellectual property rights and by virtue of international copyright conventions are specifically reserved to Argus Specialist Publications Limited and any reproduction requires the prior written consent of the Company. 9 1983 Argus Specialist Publications to the Company. 1983 Argus Specialist Publications to 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 arterwards. 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. Electronics Today is normally published on the first Fri-

☐ Subscription Rates. UK £13.15 including postage. Airmail and other rates upon application to ETI Subscriptions Department, 513 London Road, Thornton Heath, Surrey

CR4 6AR

#### EDITORIAL AND ADVERTISEMENT OFFICE

145 Charing Cross Road, London WC2H 0EE. Telephone 01-437 1002/3/4/5. Telex 8811896.

#### **FEATURES**

Our monthly and occasionally irreverent look at what's new and interesting in the field of electronics. Would you believe a piranha-proof microcomputer . . .

CONFIGURATIONS . . . . . . . . . . . . . 59 In his penultimate discourse on electronics, Ian Sinclair sheds some light on the field of opto-electronics.

LABORATORIES ON A CHIP. . . . . 29 Silicon engineering is coming of age and revolutionising technology. Now mechanical as well as electrical structures can be etched into chips.

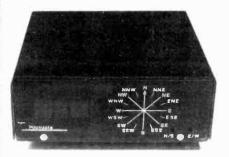
dedicated to the chips at the heart of the ETI 'Victory' organ, the M108/208 single chip organs.

BUYER'S GUIDE TO TEST GEAR . 42 More types of digital multimeter than you ever dreamed existed - all neatly tabulated to take the tedium from selecting the one you want.

Three more readers amaze you with their ingenuity as we offer some more circuit submissions.

#### **PROJECTS**

Novel circuitry and novel theory all go to make up this intriguing and innovative project,



SWITCHED MODE POWER SUPPLY.35 You've read the theory, you've tried the maths; now build the project. Part 1 describes the circuit details.

PSEUDOROM .....52 Find all the faults in your software before you burn it into an EPROM with this amazing little project. Clumsy constructors should look elsewhere, though.



Keep your tropical fish happy, keep warm, make beer or make yoghurt; but not all at the same time! A nifty computer, the Acorn Atom, and it can be even niftier if you speed up your data entry with this add-on numeric keypad. PCB FOIL PATTERNS.....92

IMMERSIBLE HEATER......65

#### **INFORMATION**

NEXT MONTH'S ETI	ELECTRONICS DIGEST	
BIRMINGHAM HOME	BOOK SERVICE	8
COMPUTER EXHIBITION 40	PCB SERVICE	9:

33/34 CARDIFF ROAD, WATFORD, HERTS, ENGLAND MAIL ORDER, CALLERS WELCOME Tel. Watford (0923) 40588. Telex: 8956095

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.OS OR BANKERS DRAFT WITH DRDER OR ACCESS. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT ENQUIRY WELCOME. P&P ADD 50p TO ALL CASH ORDERS. 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% tot he total cost including P6-P. We stock thousands more Items. It pays to visit us. We are altrusted behind Wetford Footbell Ground. Nearest Underground/R8 Station: Wetford High Street.

Open Monday to Saturday: 9.00sm to 8.00pm. Ample Free Car Parking space available.

ELECTROLYTIC CAPACITORS: (Values in uF) 500v: 10uF 52p: 47 78p; 63v: 0.47, 1.0, 1.5, 2.2, 3.3, 4.7 8p; 10 10p; 15, 22 12p; 33 15p; 47 12p; 68 20p; 100 19p; 220 28p; 1000 70p; 2200 90p; 50v: 68 20p; 100 17p; 220 28p; 1000 70p; 2200 90p; 50v: 68 20p; 100 17p; 220 24p; 40v: 6.8 15p; 22 9p; 33 12p; 330, 470 32p; 1000 48p; 2200 90p; 250v: 15, 47, 10, 22, 47 8p; 100 11p; 150 12p; 220 50p; 2200 50p; 2300 76p; 4700 92p; 150 12p; 220 50p; 2200 50p; 2300 76p; 4700 92p;

16V: 47, 68, 100 9p; 125 12p; 330 18p; 470 20p; 680 34p; 1000 27p; 1500 31p; 2200 36p; 4700 79p.

TAG.END CAPACITORS: 64V: 2200 139p; 3300 198p; 4/00 245p; 50V: 2200 110p; 3300 164p; 40V: 4700 180p; 25V: 2200 80p; 3300 88p; 4000, 4700 88p; 10,000 320p; 15,000 346p; 18V: 22,000 350p

POLYESTER CAPACITORS: Axiel Lead Type
400V: InF; In5; 2n2; 3n3, 4n7, 6n8 11p; 10n, 15n, 18n, 22n 12p; 33n, 47n, 68n
16p; 150n 20p; 220n 30p; 330n 42p; 470n 52p; 680n 1uF 88p; 2u2 82p.
180V: 10nF 12n, 39n, 100n 11p; 150n, 220n 17p; 330n, 470n 30p; 680n 38p; 1uF
42p; 1u5 45p; 2u2 48p; 4u7 58p.
1000V: InF 17p; 10nF 30p; 15n 40p; 22n 35p; 33n 42p; 47n, 100n 42p.

POLYESTER RADIAL LEAD CAPACITORS: 250V FEED-THHOUGH CAPACITORS 10p; 330n, 470n 13p; 680n 19p; 1u 23p; 1u5 40p; 2u2 48p. 1000pF /450V 8p

POTENTI METERS: Rotary, Carbon,

IANTIALUM BEAD CAPACITORS 38V: 01 uF 0.22 0.33 15p; 0.47, 0.68 1.0, 1.5 16p; 2.2, 3.3 18p; 4.7, 6.8 22p; 10 28p; 18V; 2.2, 3.3 18p; 4.7, 6.8 22p; 10 18p; 15, 38p; 2.2 30p; 33, 47 40p; 100 18p; 15, 38p; 22 30p; 33, 47 40p; 100 18p; 15V; 15, 22, 28p; 33, 47 35p; 100 65p; 6V: 100 42p. MYLAR FILM CAPACITORS 100V: 1nF, 2, 4, 4nF, 10 8p; 15nF, 22n, 30n, 40n, 47n 7p; 56n, 100n, 20on 9p; 50V: 470nF 12p.

TANTALUM BEAD CAPACITORS

CERAMIC CAPACITORS 50V:
Range: 0.5pF to 10nF 4p. 15nF. 22nF.
33nF: 47nF 6p. 100nF/30V 7p.
200nF/6V 8b.

POLYSTYRENE CAPACITORS: 10pF to 1nF 8p; 1.5nF to 12nF 10p SILVER MICA (Values in pF)
2, 3-3, 4-7, 6.8, 8-2, 10, 12, 15, 18,
22, 27, 33, 39, 47, 50, 56, 68, 75, 82,
20, 27, 20, 50, 180 pf, 15p, each
200, 27, 20, 20, 20, 20, 30, 30, 30, ach
100, 1,200, 1800, 220, 30p, each
100, 1200, 1800, 220, 30p, each
100, 1200, 1800, 220, 25pf, 50, 50 pF, 30p, 10, 88 pF, 36 pc, 20, 25 pF, 50 p

type not mixed.

DIODES

RESISTORS Carbon Film Hi-Stab. 5%

Type Miniature poly Capacitors 250V

POTENTI METENS: Notary, Carbon, Track 0.2, 4, 10.0g Et Lin values.
5000, 1KG & 2KG (Linear orly) Single Gang, 5KG:2MD Single Gang Log & Lin 50, 5KD:2MD Single Gang D / P Switch 5KD:2MD Double Gang 899

SIEMENS och

ACCESS

SLIDER POTENTIOMETERS 0-25W log and linear values 60mm 5KΩ-500KΩ single gang 10KΩ-500KΩ dual gang Salt Stick Graduated Bezal

RAM

FOR

MICRO 4816AP 100ns : 225p

PRESET POTENTIOMETERS
0.1W 500 5M0 Miniature
Vertical & Horizontal
0.25W 1000 3.3M0 horiz, larger
0.25W 2000 4.7M0 vert.

2764 425 3242 590 4116-150n 80 4116-200n 80 4116-200n 425 4134-3 - CM0 425 4134-3 - CM0 425 4532-3 325 4532-3 325 4532-3 325 5101-450 220 5116-150n 360 5116-150n 360 5116-150n 360 6502-CPU 325 6502-4 450 6504-250 560 6504-250 560 6504-250 560 6505-250 640 6522VIA 256 6532 271 6532RRIOT 570 6532RRIOT 570 65545RT 899 Type not mixed.

RESISTORS NETWORK S.I.L.
7 Commoned (8 pins) 1000, 6800, 1K 2k2, 4K7, 10K, 47K 100K

25e
8 Commoned (9 pins) 1500, 1800, 2700, 3300, 1K, 2k2, 4K7, 6K1 0K, 2K7 K4 100K

25e
24c2 4K7, 6K6, 10K, 2K7 K4 100K

25e
3 Commoned 1 K, 2k7, 10K, 47K 8 100K

25e
3 Commoned 1 K, 2k7, 10K, 47K 8 100K

25e
3 Commoned 1 K, 2k7, 10K, 47K 8 100K

4 8p each 15 Range. 3V3 to 16 33V 1.3W 17 16p each

3A 200 V 3A 400 V 8A 100 V 8A 800 V 12A 100 V 12A 400 V 12A 800 V 16A 100 V 16A 800 V 25 V 500 V 25 A 800 D 54 56 60 69 115 78 82 135 103 105 220 220 296 120 NOISE Noic Diode 196p VARICAPS 8A102 50 8B1058 40 8B106 40 8B1098 46 MVAM2 166 BA102 BB105B BB106 BB109B MVAM2

TRIACS

5117-100n 6502CPU 6502A 6504 250 6505 5520PIA 6522VIA 6530 RESTANCIA 6545RTC 6551ACIA 6592PC 6800 6802 6803 6804 6805 6805 6809 6810 6820 18 75 SERIES 34 75107/8 96 40 75110 90 46 75121/2 130 83 75154 125 75154 125 75154 125 75154 125 75159 125 75182/3 98 75188/3 98 751 75107/8 75110 751114/5 75121/2 75150 75154 75159 75182/3 75188/9 75322 75324 75361/3 75365 75450 75451/2 75454 76491/2 96 90 150 130 125 125 125 99 56 140 360 150 150 150 86 62 70 65 6821 68854 6840 6843 6843 6845 6845 6850 3856 68821 6875 8880 74C922 8080A 8085A 8086 8118:10 8123 8155 81159 81159 81159 811599 811599 811599 811599 811599 811599 811599 SCR
THYRISTORS
5A/40V
5A 400V
5A 400V
5A 400V
12A 400V
12 32 40 48 80 90 78 96 188 150 180 36 24 29 36 32 38 130

SCR

550 99 MC1495 99 MC1495 MC1596 C 300 MC1648 150 MC3360 P MC3300 P MC3300 P MC3300 P MC3401 S MC3401 MC3403 MC3401 MC3403 MC340 MC ICL7204
ICL7610
ICL7610
ICL7610
ICL7610
ICL7610
ICL7610
ICL7610
ICM7215
ICM7216
ICM7216
ICM7216
ICM7216
ICM7217
ICM7214
ICM7214
ICM7224
ICM7216
ICM7216
ICM7216
ICM7217
ICM7224
ICM7216
ICM7217
ICM7216
ICM7217
ICM721 

**TRANSISTORS** 

35 | BC212L 30 | BC213L 32 | BC214L 35 | BC214L 175 | BC237/8 | BC214L 175 | BC237/8 | BC214L 175 | BC237/8 | BC307B 79 | BC307B 42 | BC337/8 | BC347/8 | TO BC549/7 | BC549/8 | BC558/7 | 10 BC558/7 | 10 BC558/7 | BC558/7 | 10 BC558/7 | BC77/2 | BC77/8 | BC77/2 | BC77/8 | BC77/8 | BC77/2 | BC77/8 | BC77/3 | BC77/8 | BC77/3 | BC77/8 | BC77/3 | BC77/8 | BC77

BD133 70 BD135 45 BD136/37 40 BD136/37 40 BD138/39 40 BD140 40 BD144/45 198 BD158 66 BD205/6 110 BD245 48 BD245 48 BD245 48 BD245 48 BD245 48 BD245 48 BD517 75 BD645 80 BD695A 125 BB115 125

BD696A BF115 BF154/8 BF184/5 BF194/5 BF198/9 BF200 BF224A BF224B BF245

AC126/7 AC141/2 AC176 AC187 AC188 ACY19/21 ACY22/41 AD142 AD149 AD161 AD162 AF115/6 AF118 AF124/26

AF118 80
AF124/260
AF139 40
AF139 75
AF186 75
AF186 75
AF186 76
BC107 12
BC108 12
BC108 12
BC109 12
BC117/8 20
BC147/8 9
BC142/3 10
BC167 A 10
BC168 10
BC167 A 10
BC168 10
BC167 A 10
BC169 10

8F256A BF256B BF257/8 BF257/8 BF336/7 BF594/5 BFR39/40 BFR41/79 BF494/5 BFA41/79 BFA80/81 BFR80/81 BFR88 BFX29 BFX81 BFX84 BFX85/6 RFY55/51

10 BF256B
10 BF256B
10 BF256B
10 BF257B
10 BF259
10 BF259
10 BF259
10 BF3347
11 BF834179
15 BF834179
16 BF834179
16 BF834179
17 BF83576
18 BF9347
18 BF9347
19 BSX20
19 BF9347
10 BU208
10 BW1690
11 BW169

TDA1022 TDA1024 TDA1034 TDA1034 TDA1034 TDA2002 TDA2000 TDA2000 TDA2000 TDB0701 TL170 TL081CP TL094CP TL094CP TL074CP TL074CP TL074CP TL074CP TL084CP TL084CP

36 MPSA56
46 MPSA56
46 MPSA70
36 MPSU02
36 MPSU03
36 MPSU03
37 MPSU03
38 MPSU06
30 MPSU06
30 MPSU06
31 MPSU66
32 MPSU66
33 MPSU66
34 MPSU66
35 MPSU66
36 MPSU66
36 MPSU66
36 MPSU66
36 MPSU66
37 MPSU66
38 MPSU66
38 MPSU66
39 MPSU66
30 MPS

175 90 160 160 125 296 190 275 396 159 TAD100 TBA120S TBA540Q TBA550Q TBA550Q TBA641BX or 8X11 TBA651 TBA800 TBA910 TBA920Q TBA920Q TBA990Q TBA990Q TBA540 290 190 80 96 TC9109 TCA220 TCA270Q TCA280A TCA940 775

TCA965 TDA1004 TDA1008

350 240 125

ULN2003 ULN2004 ULN2283 UPCS75 UPC1025H UPC1025H UPC1156 UPC1156H UPC1156H UPC1156H UPC1366 XR2206 XR2206 XR2206 XR2206 XR2211 XR2216 XR2211 XR2216 ZN424 ZN419E ZN424 ZN419E ZN425 ZN426 ZN426 ZN426 ZN427 ZN427 ZN428 Z TTL74 7400 7401

552999550046618181818185642620252548201070207223535359988055202535557050580023535353733228557205540445540403808884044444488815025540540468880

74C

74C244 195 74C245 195 74C373 240 74C374 245 74C922 420 74C923 500

74500

\$158 \$188 \$189 \$194 \$195 \$201 \$225 \$241 \$244 \$251 \$257 \$262 \$287 \$288 \$289

2N3708/9 10 2SC2078 2SC2091 2S | VK1011 | 85 | 2N3708/9 | VM10KM | 65 | 2N3713 | VM66AF | 85 | 2N37713 | VM66AF | 85 | 2N3772 | VM68AF | 86 | 2N3772 | VM68AF | 86 | 2N3773 | VM89AF | 96 | 2N3819 | ZTX1079 | 12 | 2N38220 | ZTX1079 | 12 | 2N3820 | ZTX1079 | 13 | 2N3903/4 | ZTX300 | 13 | 2N3903/4 | ZTX300 | 13 | 2N3903/4 | ZTX300 | 15 | 2N3903/4 | ZTX300 | 17 | 2N4264 | ZTX326 | 30 | 2N4266 | ZTX304 | 17 | 2N4264 | ZTX305 | 14 | 2N4400 | ZTX307 | 23 | 2N4365 | ZTX351 | 25 | 2N5138 | ZTX550 | 2N5139 | ZTX550 | 2N5139 | ZTX550 | 2N5139 | ZTX550 | ZTX551 | 2N5139 | ZTX550 | ZTX551 | ZTX550 | ZTX551 | ZTX551 | ZTX550 | ZTX551 | ZTX550 | ZTX551 | ZTX550 | ZTX550 | ZTX551 | ZTX550 | ZT

CHOKES Minieture PCB type 1uH, 2u2, 4u7, 10u, 22u, 33u, 47u, 100u, 220u, 330u, 470u 85 100u, 140 330u, 180 50 1mH, 225 2m2, 90 10mH 90 22m, 140 43m 85 100m

LS20 LS21 LS22 LS LS254 LS26 LS27 LS245 LS247 LS248 LS251 LS253 LS257 LS258 LS259

SWITCHES TOGGLE: 2A. 250V SPST 33p DPDT 44b SUB-MIN TOGGLE SPST on/off 54p SPDT c/over 60p SPDT centre off 65p SPDT biased both ways DPDT centre off 85p DPDT biased both ways DPDT centre off 85p DPDT biased both ways SIDBE 250V: DPDT 1A 14p DPDT 1A 13p DPDT 1A 14p DPDT 1A 13p DPDT 1A 15p DPDT 1A 1	way 85p; 45p. 212 > 212	334 100p 5 115p 30p 98p 17 390p 98p 17 390p 98p 100 pnrs 55p 100 pnrs	Double S.R.B.P	CONNECTORS	PANEL METERS FSD 60 × 46 × 35mm 0-50µA 0-100µA 0-500µA 0-500µA 0-500µA 0-500µA 0-500µA 0-500µA 0-24 0-250 0-3000 AC	RELAYS  Miniature, enclosed, PCB mount. SINGLE POLE Changeover RL-91 2050 Coil; 12V DC, 10V5 to 19.5V1. 10A at 30V DC or 250V AC RL6-1050V AC RL6-100 530 Coil, 6V DC (5V4 to 9V9 1909) RL6-111 2050 Coil, 6V DC (10V7 to 19V5) RL6-114 7400 Coil, 2V DC (22V to 37V)  AMPHENOL PLUGS IEEE 24 Way Centronics Parallel 36 Way solder 530 Centronics Parallel 36 Way IDC 456 Centronics 36 Way IDC Female 520p  BUZZERS, miniature, solid-state 6V: 9V & 17V PPEZOITANASDUCERS
We stock most of the parts finches 145p 185   Double ended DIP (Header P 16   Combined The parts 12   Combined The parts 12   Combined The parts 12   Combined The parts 145p 185p 205   Combined The parts 145p 205    Combined The parts 145p 205   Combined The parts 145p 205    Combined The parts 145p 205    Combined The parts 145p 205    Combined The parts 145p 205    Combined The parts 145p 205    Combined The parts 145p 205    Combined The parts 145p 205    Combined The parts 145p 205    Combined The parts 145	POT 386 6 × 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	12" 150p  SOCKETS  Low Wire Prof Wrap 9 25p 10p 35p 10p 42p 10	475p   510p   65p   0.1" prich   210p   20 way   65p   166p   65p   166p   16	DIL PLUG (Heeder) Solder IDC 14pin 90p 99p 24pin 88p 105p 24pin 88p 178p 30CKETS 24 pin 820p 24 pin 87p 24 pin 87p 36 pin 97p 36 pin 97p 36 pin 97p 37p 38p 38p 38p 38p 38p 38p 38p 38p 38p 38	455KH 3770 1MHz 376 1 008M 275 1 008M 200 2 04M 200 2 04S76M 200 3 278M 200 4 0322MHz 200 4 0322MHz 200 4 194304 200 4 194304 200 5 185MHz 200 6 008Hz 200 7 168MHz 160 8 08333M 385 8 08723M 175 10 024MHz 150 10 00MHz 175 12 00MHz 150 10 00MHz 175 12 00MHz 175 12 00MHz 170 1	PB2720  LOUDSPEAKERS Ministure, 0.3W: 80 2in, 3in, 2in, 3in 0 2jin 400, 640 or 800  ASTEC UHF MOOULATORS Standard 6MHz Wideband 8MHz  WEMON' New Version WATFORD'S Ultimate Monitor IC A 4K Monitor chip specially designed to produce the best from your: Superboard Series I 6 III, Enhanced Series III, Enhanced Superboard Series I 6 III, Enhanced Superboard Series I 6 III, Enhanced Series
\$\frac{\text{SOVA}}{2} \times \frac{\text{V} \times \text{V}}{2} \times \text{V} \time	LM323K 460p 5A	MX80FT 80 columbra standar graphic: 500 shee MX100 features  SEIKOS and heig Printer C SOFTY Accepts	2 8×6×3° 210p 10 x4×3° 240p 10 x4×3° 240p 10 x4×3° 256p 12 x8×3° 256p 12	1+ 50+ 2764 450p 395p  I CORNER  10° & Friction feed, 9 x 9 matrix idirectional, Centronics Interface 0 (BS232, Hi-Res, Bit Image script, Underlining facility plus fazirpt, Underlining facility fazirpt, Column, 15° carriage, plus all the IEE 500 sheets of Paper.  Only £425 + carr.  CPS, Normal and Double width intronix Intri- standard £240 (£7 car) d BBC £12 om Programmer and Emulator.	27.145M 190 38.66667M 175 48.0MHz 170 100.0MHz 285 116.0MHz 250  NEC PC8  MICROL 80 column, 1 seeking Tract true decende line  ORIC M 16K and 48K  MONITORS  MICROVITEC	Complete Upgrade Kit from Model A to Mod. B £43 We supply complete range of BBC Plugs, Sockets, Leads, Peripherals, Software etc. Send SAE for list BO23BE-C PRINTER E320 £7 car) LINE-82A PRINTER 20 CPS bidirectional, Logic or & Friction feed. 9x9 matrix, rs, 40.66,80 or 136 colms per £325 ICROCOMPUTERS versions available.
4023 13 4175 105 4582 98 4024 32 4194 105 4583 98 90 4025 13 4409 790 4584 40 4026 80 4409 790 4585 90 4027 20 4410 725 4597 330 4028 39 4411 675 4599 280 4029 46 4412 775 4085 90 4030 15 4415 480 4099 4099 45 4599 280 4030 15 4415 480 4099 4099 45 4010 15 4010	Red, Green or Yell   18   Triangular LEDs   Red   18   Green or Yellow   22   LD271 Infra Red   46   SFH205 Detector   11.03   11.07   12.08   12.09	RS 232:  TEX EPF TEX EPF TEX EPF TIMER  ELECTR to abov overcook SPARE POWER Output, 6 MULTIR Micros. T C12 CON	rronics 1/P & 0/P. (and carronics routines and centronics routines IOM ERASER Erases upon ERASER with a sar ROM ERASER plus ONIC TIMER, Solid stee Erasers. Protects ing. Our timer pays for "UV" Lamp bulb.  SUPPLY. Regulated viv to 15V at 4A. Profes AIL POWER SUPPLY ested output: +5V/5A	Noting to Display, NS-232, Noting the Noting to Standard. PSU included. £169 to 32 ICs in 15-30 minutes. £33 to year switch. £35 our Solid State ELECTRONIC £44 ate, 15-30 min. Connects directly your expensive Chips from tself in no time. £15 with Overload protection. Variable sionally finished £38.  Y KIT.Especially designed for ; +12V; +25V; -12V of 1A £37 tettes in library cases. 40p to sheets). £7 + 150p carr	BMC BM1401     ZENITH 12' Gre     Carraige on all N     CASET     Similine Portab- made for Micro  WEROM     A highly sophistic straight into float Gives many uniq Tape INterface. disassembler, Men breakpoints: Basic RESTORE: Full BA Find line & delete;	n BBC prog.) . £250  14" Colour Monitor, RGB input £235  pen Monitor, Hi-Res £80  Aonitors is £7 (Securicor)  TTE RECORDERS  or MICROS  TO ACORN ATOM  cated Acorn Utility ROM. Plugs ing point Atom's Utility Socket.  use BASIC Extensions: Hi-speed  2 Key rollover Keyboard, Full  pour dump modify, Machine code error trapping; READ, DATA & SIC Keyboard scanner (BBC like); Auto line numbering; Plus Chain, Loopaborting; Eaisly extendible  pplied.
4050 25 4513 199 40192 75 4051 45 4516 40193 70 4052 60 4515 115 40193 70 4053 50 4516 56 40195 75 4054 66 6 4519 30 40245 196 4057 1916 4520 50 40373 160 4059 436 4520 50 40373 160 4050 46 4510 50 4057 195 4520 50 4520	DL/07.3° CA 99 FN0357 Red 120 FN0500 115 .3° Green CA 150 .6° Green CA 216 .3° ± 1 Green CA 150 DVM176 22 LCD3 DyM176 52 LCD 4 Digits 530 LCD 6 Digits 530 LCD 6 Digits 525 PIN DIODE 504478-002 010p REFLECTIVE Optical Switch type TiL139 170p SLOTTED Optical Switch similar to RS Comp.'s 1889	FD50A -     CS50A -     CD50A -     CD50E -     CD50F -     CD50F -     MITSUB sity One access ti     Drive Ca     10 Verba     10 Verba     10 Verba	- Uncased Single, 40 tr - Single Cased with PSL - Twin Cased with PSU Single Cased with PSL - Twin Cased with PSL - Twin Cased with PSL - Stwin Line: Unca	EAC (BBC Compatible)  ack, 5½", S/S, 100K	WATFORD'S MICRO EXPA for interfacing DRAGON, PE INE, SPECT VIDEO GENIE High Spec. A Electronics st 1982.	OUTIMUM  own most versatile NSION SYSTEM. Ideal g with APPLE, ATOM, IT, RESEARCH MACH- RUM, SUPERBOARD, , ZX81, etc. Low Cost, is published in Practical carting from November  SAE for details.

# ₹Rapid ₹Electronics

MAIL ORDERS: Unit 1, Hill Farm Industrial Estate, Boxted, Colchester, Essex CO4 5RD, **TELEPHONE ORDERS:** Colchester (0206) 36412.





**ACCESS AND BARCLAYCARD** WELCOME

	-		-488	1	100	Description of	Sec.		tend		
LINEAR	1			LM339 LM348	45 60	LM3911 LM3914	120 175	NE566 ▶NE567	140	TL064 TL071	96 30
555CMOS	80	101 7400	700	LM358	50	LM3915	195	NE570	370	TL072	50
556CMOS	150	ICL7106	790	LM377	170	LM13600	105	NE571	370	TL074	95
709	25	ICL7611	95	►LM380	65	MC1496	68	▶RC4136	55	▶TL081	25
▶741		ICL7621	180	▶LM381	120	MC3340	135	▶RC4558	60	TL082	45
	14	ICL7622	180	LM382	120	► MF10CN		SL480	170	TL084	95
748	35	ICL8038	295	LM384	130	ML922	400	SL490	250	TL170	50
9400CJ	350	ICL8211A	200	LM386	65	ML924	195	SL76018	150	UA2240	120
AY-3-1270	720	ICM7224	785	LM387	120	ML925	210	▶SN76477	380	ULN2003	85
	370	ICM7555	80	LM393	100	ML926	140	SP8629	250	ULN2004	90
	540	▶LF351	45	LM709	25	ML927	140	T8A120S	70	XR2206	290
CA3046	60	LF353	85	LM711	60	ML928	140	T8A800	75	ZN414	100
▶CA3080	65	LF356	90	LM725	350	ML929	140	TBA810	96	ZN423	135
CA3089	190	LM10	360	LM733	75	MM5387A	465	TBA820	70	ZN424	135
CA3090AO	375	LM301A	25	LM741	14	NE529	225	TBA950	220	ZN425E	350
CA3130E	85	LM311	70	LM747	60	NE531	150	TDA1008	320	ZN426E	330
▶CA3140E	36	LM318	120	LM1458	40	NE544	205	▶TDA102		ZN427E	650
CA3161E	100	LM324	40	LM2917	200	▶NE555	16	TDA1024	125	ZN428E	480
CA3189	290	L M334Z	100	LM3900	45	▶NE556	45	TL061	40	ZN459	285
	110	LM335Z	125			NE565	110			ZN1034E	
P 0/-0240E		C.,,,000E	0	▶LM3909	70	ME 202	110	TL062	60	ZN 1034E	200
			BC51	7 40	BF337	40 M	PSU56	60 2TY	100	R 2N3055	50

1	30	CABL	ES	
2	50	20 metre	nack si	nale
4	95	ing cable		
81	25	Speaker o		
2	45	Standard		á
4	95	Twin scre		
0	50	2.5A 3 cc		
40	120	10 way ra		
003	85	20 way ra		
004	90	10 way ge		
06	290	20 way g		
4	100	20 way g	eA LIDE	rom.
3	135		_	
4	135	REGUL	ATO	28
5E	350			ш.
		78L05	30	
6 <b>E</b>	330	7000		79
6 <b>Ŀ</b> 7E	650	78L12	30	79 79

LM309K LM317K LM317T LM323K

BY127 OA47

DIODES

OPTO

BLES

	e connect-	
ent co	lours.65p	
	10p/m	E
	16p/m	F
	24p/m	!!
	23 p/m	
pbon	65p/m	
obon	120p/m	1
١	38p/m	1
١	80p/m	Ľ

79L05 79L12 79L15 7905 7912 7915

130 LM723 35 270 SPECIAL OFFERI 120 78PO5 10A +5V 350 only 390p each.

▶1N4001 1N4002 1N4006 1N4007 1N5401 1N5404 1N5406 400mWzen

 ▶ 3mm red
 7
 ▶ 5mm red
 7

 ▶ 3mm green
 10
 ▶ 5mm green
 10

 ▶ 3mm yellow10
 ▶ 5mm yellow10

| \$\bar{\text{Parm}}\$ vellow10 | \$\bar{\text{Psimm}}\$ vellow10 | \$\text{Cips to sujt} - 3p each | \$\text{Psimm}\$ vellow10 | \$\text{Cips to sujt} - 3p each | \$\text{Psimm}\$ vellow10 | \$\text{TL32} = 40 | \$\text{Psimm}\$ vellow1 | \$\text{Psimm}\$ vellow1 | \$\text{Psimm}\$ vellow2 | \$\text{Psimm}\$ ve

►FND500 FND507 0.5" 100 0.5" 100 TIL313 0.3"115 TIL3120.3"115 TIL3220.5"115 TIL3210.5"115 LCD: 3½ digit 580p. 4 digit 620p.

HARDWARE	
PP3 battery clips	
Red or black crocodile clips	
Black pointer control knob	
Pr Ultrasonic transducers	3
▶6V Electronic buzzer .	- 1
▶12V Electronic buzzer .	- 1
▶PB2720 Piezo transducer .	
▶64mm 64 ohm speaker .	
▶64mm 8 ohm speaker .	
20mm panel fuseholder	

POTENTIOMETERS

Rotary. Carbon track Log or Lin 1K - 2M2. Single 32p. Stereo 85p. Single switched 80p. Side 60mm travel single Log or Lin 5K - 500K 63p each. Preset submin. hor. 100 ohms -1M 7p each. Cermet precision multiturn, 0.75W %" 100 ohms to 100K - 88p each.

	CAPACITOR
	olyester, radial lea
t	ype: 0.01, 0.015,
6	p: 0.047, 0.068, 0

ds. 250v. C280 0.022, 0.033 -Polyester, radial leads. 250V. CZ80 type: 0.01, 0.015, 0.022, 0.033 - 6b; 0.047, 0.068, 0.1 - 7b; 0.15, 0.22 - 9b; 0.33, 0.47 - 13p; 0.68 - 20p; 1u - 23p. Electrolytic, radial or axial leads: 0.47/63V, 1/63V, 2.2/63V, 4.7/63V, 10/25V - 7b; 22705V, 4.7/25V - 8p; 100/25V - 7b; 2270/25V - 14p; 100/25V - 50p; 2200/25V - 14p; 2200/25V - 14p; 2200/63V - 14p; 4700/40V - 160p; 2200/63V - 14p; 4700/63V - 230p Polyester, miniature Siemens PCB: 1u, 2n2, 3n3, 4n7, 68n, 8p; 100n, 9p; 150n, 11p; 220n, 33n, 475, 68n, 8p; 100n, 9p; 470n, 26p; 680n, 29p; 1u, 33p, 2u2, 55p.

	_	
BRIDGE		2A 200V 40
RECTIF	FDE	2A 400V 45
RECTIF	Ens	6A 100V 80
		6A 400V 95
1A 50V	20	VM18 DIL 0.9A
1A 400V	35	200 V 50

	umper	prugr j	(LIEST CHEL	IG DIF
	465	300	205	185
BRIDGE	490	315	215	195

6 ins. 185 205 300 465 12 ins. 195 215 315 490 24 ins. 210 235 345 540 36ins. 230 250 375 595 25 way D Connector jumpers 18ins. long single ended male 495p. 18ins.long single ended f/male 525p

#### EPSON PRINTERS

Latest generation printers from Epson. Logic seeking, bl-directional bit image printing, 9 x 9 Matrix, Auto underline, Centonix 8 Bit Parallel Interface as standard.

RX80 100 CPS 80 column

FX80 160 CPS 80 column Tractor Feed . . .



2200.00	
£398 00	Carriage £7 per printer.

►CA324	0E 110	LM33			M3900 LM3909	45 70	NE565 NE565	110	TL06			N459 N1034E	285
				BC517	40	BF337	40	MPSU56	60	ZTX108	8	2N3055	
TRAN	SISTO	RS:		BC547	7	BFR40 BFR80	23	TIP29A	30	ZTX109	12	2N3442 ▶ 2N370	120
			0	BC548 BC549	10 10	▶BFR8	23	TIP29B TIP29C	55 37	ZT X300	14	2N3703	
AC125		C149 C157	9	BC558	10	8FX29	25	TIP29C	35	ZTX301	16	≥2N3703 ▶2N370	9
AC126		C158	10	BCY70	18	BFX84	25	TIP30A	50	ZTX302 ZTX304	15 17	2N3705	9
AC127		C159	8	BCY71	18	BFX85	25	TIP300	37	ZTX341	30	2N3705	9
► AC128		IC160	45	BCY72	18	8FX86	28	TIP31A	35	ZTX500	15	2N3700	10
AC176		C168C	10	BD115	55	BF X87	25	TIP31C	37	ZTX500	15	2N3708	10
AC187 AC188		C169C	10	8D131	35	8FX88	25	TIP32A	35	ZTX502	15	2N3709	10
		C170	8	8D132	35	8FY50	23	TIP32C	37	ZTX503	18	2N3772	170
AD142		C171	10	8D133	50	BFY51	20	TIP33A	50	ZTX504	25	▶2N377	
AD161		C172	8	BD135	40	BFY52	23	TIP33C	75	2N697	20	▶ 2N381	
AD162		C177	18	BD136	30	BFY53	32	TIP34A	60	2N698	40	2N3820	
AF124		C178	18	BD137	30	BFY55	32	TIP34C	85	2N706A	20	2N3823	65
AF126		C179	18	8D138	30	BFY56	32	TIP35A	105	2N708	20	2N3866	
AF139		C182	10	▶BD13	9 35	8RY39	40	TIP35C	125	2N918	35	2N3903	10
AF186		BC182L	. в	▶BD14	0 35	BSX20	20	TIP36A	125	2N1132	22	2N3904	10
AF 239		3C183	10	BD204	110	BSX29	35	TIP36C	135	2N1613	30	2N3905	6
BC107	10 E	C183L	10	BD 206	110	BSY95		TIP41A	45	2N2218A		2N3906	10
BC107B		3C184	10	8D222	85	8U205	160	TIP42A	45	2N2219A		2N4037	45
▶BC108	10	BC184L		BF 180	35	BU206	180	TIP120	90	2N2221A		2N4058	10
BC1088		3C212	10	BF 182	35	BU208	170	TIP121	90	2N2222A		2N4060	
BC108C		3C212L	10	BF184	25	MJ2955		TIP122	90	2N2368	25	2N4061 2N4062	10
▶BC109		3C213	10	BF 185	25	MJE340		TIP141	98	2N2369	16	2N4062 2N5457	10 36
BC109C		3C213L	10	BF194	12	MJE520		TIP142 TIP147	98 110	2N 2484	25 45	2N5457 2N5458	
BC114		3C214 ►BC214l	10 . 8	BF195 BF196	12 12	MJE521 MJE305		TIP2955		2N2646 2N2904	20	2N5459	
BC115 BC117		BC2140	. 8	BF 196	12	MPF10		TIP3055		2N2904 2N2904A		2N5485	
BC117		3C237	14	BF198	10	MPF 10		TIS43	40	2N 2904A	22	2N5777	
BC137		BC308	12	BF199	18	MPSAO		T1S44	45	2N2905A		2N6027	
BC139		3C327	14	BF200	30	MPSAO		T1S90	30	2N2906	25	40360	40
BC140		3C328	14	▶BF24		MPSA1		TIS91	30	2N2906A		40361	50
BC140		BC337	14	BF245	30	MPSA5		VN10KN		2N2907	25	40362	50
BC142		BC338	14	BF 256		MPSA5		VN46AF	75	2N2907A		40408	70
BC143		BC477	30	BF257	32	MPSUO		VN66AF	85	2N2926	9		
BC147		BC478	30	BF258	25	MPSUO		VN88AF	95	▶2N3053	23		
BC148	8	BC479	30	BF 259	35	MPSU5	5 60	ZTX107	8	2N3054	55		
					-	-							100
MIN.	D CO	NNECT	ORS	3			4	TO S	SOL	DERING	iR	ONS	

# 25 way 37 way 125p 170p 240p 350p 195p 290p 290p 440p 100p 110p

VOICE SYNTHESISER!

Now your computer can talk. The GI SP0256 speech processor is able through stored program to synthesize speech. Allophone (extended phoneme) system gives unlimited voabulary. Easily interfaced with any digital system; ten TTL compatible signals are used to select the allophones.

770p, Data: 50p.

SCRs

SOLDE	RING	IRONS

VERO

VEROBLOC ◀

Size 0.1 matrix 2.5 x 3 2.5 x 3 2.5 x 5 3.75 x 5 VQ board

Single sided
Double sided
Spot face cutter
Pin insertion too

Wiring pen and spool Space spool 75p

8228 8251 8253 8255 8259 MC1488 MC1489 Z80A CPU Z80A PIO Z80A CTC Z80A SIO Z80A DMA

Antex CS 17W Soldering iron	460
2.3 and 4.7mm bits to suit .	65
CS 17W iron: 450, element:	210
Antex XS 25W	480
3.3 and 4.7mm bits to suit .	65
Solder pump desoldering tool.	480
Spare nozzle for above	70
10 metres 22swg solder .	100

350

R	ESI	STOR	S	
%W	5%	Carbon	film	ı

WW 5% Carbon film E12 series 4.	/
ohm - 1M 1p each.	
1/2W 5% Carbon film E12 series 4.	7
ohm to 4M7 2p each.	
1/2 1% metal film E24 series 10	
ohm - 1M 6p each.	

PCB MATERIALS	
Alfac transfer sheets - please	state
type (e.g. DIL pads etc.)	45
Dalo etch resistant pen	100
Fibre glass board 3.75 x 8"	80
Fibre glass board 8 x 12"	200
Ferric Chloride crystals	100

Plasti & scr 3 x 2 4½ x	x 1" 3 x 1%"	3 d 4 55 6 88 7	luminiur x 2 x 1" x 2% x 1 x 2% x 2 x 4.x 2" x 5 x 2% x 6 x 3"	65 %" 95 " 95 120
12 12 48 50 125 18 68 65 290 70 40 110	40193 4502 4503 4507 4508 4510 4511 4512 4514 4515 4516 4518 4520	65 60 32 35 110 45 40 40 115 115 55 40	4528 4529 4532 4534 4538 4543 4543 4553 4555 4556 4559 4560 4585	45 150 60 400 50 360 215 35 35 390 140 35
60 100 <b>75</b>	4521 4526 4527	130 60 50	4724	60 140

LS353 LS365

CM0 1000 1001 1002 1006 1007 1008 1009 1010 1011 1012 1013	10 10 12 50 14 36 24 24 10 15	4016 4017 4018 4019 4020 4021 4022 4023 4024 4025 4026 4027 4028 4029	20 30 45 25 42 40 45 16 33 12 75 20 45	4034 4036 4039 4040 4041 4042 4043 4044 4046 4047 4048 4049 4050 4051	140 249 280 40 40 38 40 40 40 35 38 21 21	4054 4055 4059 4060 4063 4066 4067 4068 4069 4070 4071 4072 4073 4075	78 80 430 42 80 22 225 14 13 13 13 13	4081 4082 4085 4086 4089 4093 4094 4095 4097 4098 4099 40106 40109 40163	12 12 48 50 125 18 68 65 290 70 70 40 110
013 014 015	45 40	4030 <b>403</b> 1	14 125	4051 4052 4053	48 48	4076 4077	45 14	40173 40175	60 100 75
LS T	TL	LS20 LS21	12	LS75 LS76 LS78	20 17 17	LS123 LS125 LS126	34 24 25	LS160 LS161 LS162	35 35 35
.500 .501 .502 .503 .504 .505 .508 .509	11 11 12 12 12 12 12 12	LS22 LS26 LS27 LS30 LS32 LS37 LS38 LS40 LS42 LS47	12 14 12 13 14 15 13 28 35	LS83 LS85 LS86 LS90 LS92 LS93 LS95 LS96 LS107	35 48 16 24 25 24 38 95 40	LS126 LS132 LS136 LS138 LS139 LS145 LS147 LS148 LS151 LS153	25 35 26 30 30 70 150 75 38 38	LS163 LS164 LS165 LS166 LS170 LS173 LS174 LS175 LS190	35 40 55 60 75 60 45 45 35

5	LS00 LS01 LS02 LS03 LS04 LS05 LS08 LS09 LS10 LS11 LS11 LS12 LS13 LS14 LS15	11 11 12 12 12 12 12 12 12 12 12 12 12 1	LS22 LS26 LS27 LS30 LS32 LS37 LS38 LS40 LS42 LS47 LS48 LS51 LS55 LS73 LS74	12 14 12 13 14 15 13 28 35 45 14 14 18	LS 78 LS 83 LS 85 LS 86 LS 90 LS 92 LS 93 LS 95 LS 96 LS 107 LS 112 LS 113 LS 114 LS 122	17 35 48 16 24 25 24 38 95 40 21 21 21 22 35	LS126 LS132 LS136 LS138 LS139 LS147 LS147 LS148 LS151 LS153 LS154 LS155 LS156 LS156 LS157 LS158	25 35 26 30 30 70 150 75 38 38 75 33 36 26 29	LS162 LS164 LS165 LS166 LS170 LS173 LS174 LS175 LS190 LS191 LS192 LS193 LS195 LS196	35 40 55 60 75 60 45 35 35 35 36 32 45	LS240 LS241 LS243 LS244 LS245 LS247 LS257 LS257 LS258 LS259 LS259 LS273 LS279 LS283	60 55 55 55 55 70 48 28 32 55 20 58 30 38	LS366 LS367 LS368 LS373 LS374 LS375 LS377 LS378 LS390 LS393 LS399 LS541 LS670	28 28 29 58 60 43 60 57 45 40 156 78
0) 0) 55	7400 7401 7402 7403 7404 7405 7406 7407 7408 7409 7410 7411 7412	11 11 11 12 12 14 19 19 13 13 13 15	7413 7414 7416 7417 7420 7421 7422 7427 7428 7430 7432 7433 7437 7438 7440 7442	17 23 18 19 19 14 19 18 25 13 20 20 23 24 14 30	7444 7446 7447 7448 7450 7451 7453 7454 7460 7472 7473 7474 7475 7476 7480 7482	85 58 36 43 14 14 14 14 12 24 19 26 25 46	7483 7485 7486 7489 7490 7491 7492 7493 7494 7495 7496 7497 74100 74107 74109 74121	30 60 19 180 19 34 24 24 33 33 38 86 78 22 24 24	74122 74123 74125 74126 74132 74141 74145 74147 74150 74153 74154 74155 74156 74157 74160	38 33 33 30 54 48 75 60 48 38 47 36 36 28 55	74161 74162 74163 74164 74165 74167 74170 74173 74174 74175 74177 74179 74180 74181	46 46 46 46 150 115 58 53 45 35 42 75 38 100 55	74190 74191 74192 74193 74194 74195 74196 74197 74198 74199	40 40 40 40 40 40 40 80 80

#### CONNECTORS

DIN	Plug	Skt	Jac k	Plug	Skt
2 pin	9p	9p	2.5mm	10p	10p
3 pin	12p	10p	3.5mm	9p	9p
			Standar		
Phono	10p	12p	Stereo	24p	25p
			4mm	18p	17p
UHF (	CB) (	Conn	ectors:		
			. Reduc		
			nassis ski		
			hassis sk	t 40p	
IEC 3					
Plug cl					38p
Socker					60g
Socke	t with	2m	lead .	_	1200

#### SWITCHES

SOCKETS

COMMON STATE

ubmin toggle: PST 55p, SPDT 60p, DPDT 65p. SPST 356, SPDT 609, DPDT 659.
Miniature toggle:
SPDT 80p. SPDT centre off 90p.
DPDT 90p, DPDT centre off 100p
Standard toggle:
SPST 359, DPDT48p
Miniature DPDT slide 12p. Push to make 14p. Push to break 22p Rotary type adjustable stop.

1P12W, 2P6W, 3P4W all 5top each.

DIL switches:

4SPST 80p 6 SPST 80p. 83PST

# 6116P3 320 6502CPU 225 6502CPU 225 6502CPU 225 6502CPU 250 6801CPU 250 6802CPU 250 6802CPU 550 6803CPU 550 6803CPU 550 6803CPU 620 6803CPU 620 6803CPU 620 6803CPU 620 6803CPU 620 6803CPU 620 2114L2 75 2716 205 2532 290 2732 290 2764 540 4116P20 70 5101L-1 220 COMPONENT KITS

CATALOG CO.	2 2 2		
An ideal opportunity	for the beginner or the	experienced construct	tor
to obtain a wide rang	e of components at grea	tly reduced prices, 1/4	W 5%
Resistor kit Contains	10 of each value from	4.7 ohms to 1M (tota	ıl
of 650 resistors) .			530
	f each value - 22p to 0.0	1u (135 caps)	370
Polyester Cap, kit. 5	of each value from 0.01	to 1uF (65 caps)	575
Preset kit Contains f	of each value from 100	ohms to 1M (total	
65 presets			425
Nut and Bolt kit (tot	al 300 items): 180o		
25 6BA ¼" bolts	50 68A washers	50 68A nuts	
25 68A %" bolts	25 4BA ¼" bolts	50 6BA washers	
50 6BA nuts	25 68A 1/2" bolts.	OU CO Trasilors	
DO ODA IIGG	20 COM /2 DOIG		

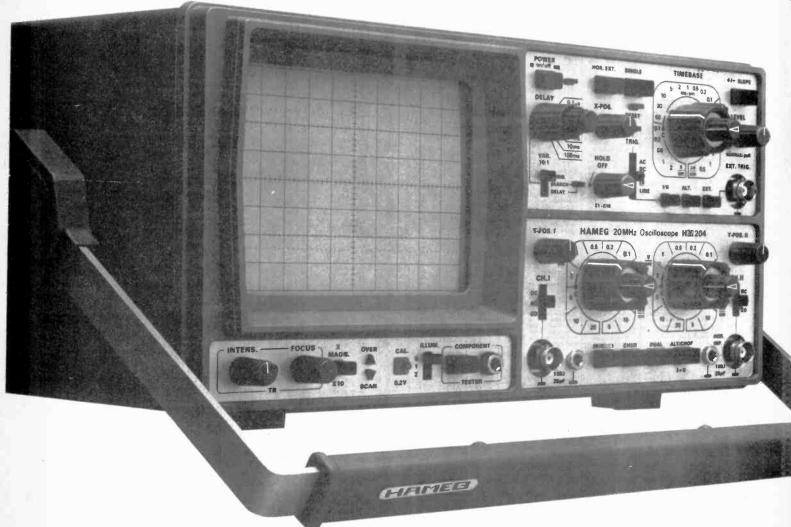
6852 6875 6880 81LS95 81LS96 81LS97 8080A 8085AC 8156 8212 8216 8224

# The Rapid Guarantee

★ Same day despatch ★ Competitive prices ★ Top quality components ★ In-depth stocks

ORDERING INFO. All components brand new and full specification. All prices exclude VAT Please add to total order, Please add 50p carriage to all orders under £15 in value. Send cheque/ Presse add to total order. Tease and odd partiage to all orders when the 175 m value. Send therefore, P.O. or Access/Visa number with order. Our detailed catalogue costs 45p (free with orders over £10). Callers most welcome. Telephone orders welcome with Access or Visa. Official orders accepted from colleges, Schools, etc. . . Callers most welcome, we are open Monday to Friday.

# INTERNATIONAL TO THE STATE OF T



Portable Induction Loop

Following the degree of interest that our feature on Induction Loops aroused, Vivian Capel has designed a practical system. Now there's no excuse for the hard-of-hearing to be left out of things anymore.

Tech Tips Special

Eight pages of ingenious, novel, and money-saving designs from one of the country's largest design teams — yourselves.

Microcomputer Output Driver

Don't let your micro just sit there, contentedly passing information back and forth inside itself — get it busy working for you, with this 16-channel output driver.

TV Storage Scope

This little unit will enable you to utilise your TV screen to display oscilloscope waveforms. It's always seemed illogical

that you have to use two CRTs for different jobs, hasn't it — now you can use just the one. Not only that, but the unit will store waveforms too, all for under £100.

Oscilloscope Survey

Just in case you're too lazy to build the TV Scope, we're taking a look at the options open if you want to buy one. And if you're too poor to afford a new scope, we'll be examining the state of the second-hand market too. If you're on the look-out for test equipment, don't miss the July issue of ETI.

LOOK OUT FOR THE JULY ISSUE ON SALE JUNE 3rd

Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

# 

40 C	RICKLE	WOOD BI	ROADWA	AY, LONI	OON	NW2 3ET.	Tel: 01-	- <b>452 0161</b> .	. TELEX:	914977	CRIKEL G		
WW 10Ω 10MΩ	ORS, HI STAB MOISE % E24 2p % E24 2p % E12 8p % E12 8p KIDE/FILM STORE STORE FILM FILM FILM FILM FILM FILM FILM FILM	Veroboard 0.1*  2 5 - 2 3 75 900  2 75 - 2 3 75 900  2 75 - 3 75 900  2 75 - 5 900  2 75 - 7 103	Grade One Glass PCB Single Sided 178 - 240nm 199 420 - 195mm 1 30p 420 - 245mm 420 -	2NA714   120 2NA71	N1990 2 N1990 3 N1990 2 N1990 3 N1990	30° 2NS219 30° 2NS219 150° 2NS220 150° 2NS221 150° 2NS221 150° 2NS221 150° 2NS221 150° 2NS221 150° 2NS221 150° 2NS223 150° 2NS223 150° 2NS223 150° 2NS223 160° 2NS223 160° 2NS224 160° 2NS246 170° 2NS	755  40625  40625  40625  506312  5063	1. 500 3. 201 3.	BCATTS   BC416	300 BOY10 300 BOY11 300 BOY11 300 BOY11 300 BOY17 3120 BOY23 3130 BF153 3140 BF153 3150	2.80   85Y39   85Y39   85Y31   85Y35   85Y35	78c	pos
SILVER MICA CAPS 11% 360V Cement coated Extremely rebole 2 2pF 3 3nf 2 2pG 12	Chamble   E	may be seet unity supply difficulty!    Beautiful     Mini Radial     Low Voltage     Marsushija unity     Mini Radial     Low Voltage     Marsushija unity     Mini Radial     Low Voltage     Marsushija unity     Mini Radial     Mini Radi	TRANSISTORS Probably the largest retail variety in UK If you that you are what you are fill is 1 200 201 201 201 201 201 201 201 201 20	2Ni-68.8 36, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20	2N3969 2N59510 2N59011 2N5903 2N59035 2N59035 2N59036 2N59086 2N5988 2N598 2	2 75 2N6253 3 25 2N6254 3 42 2SC1306 3 20 2SC1307	1.45   6C1/23   6C1/25   95p   6C1/2	82	249 80159 80160 80	55p BF-55c BF-55	MJ400	2.96 OC71 1.00 OC72 1.69 OC82 1.72 OC82 1.73 OC82 1.74 OC82 1.75 O	50p 50p 50p 50p 50p 50p 78p 78p 78p 78p 22p 22p 23p 33p 34p 34p 74p 33p 1.28 88p 1.28 88p 1.28 1.28 1.28 1.28 1.28 1.28 1.28 1.28

## CRICKLEWOOD — STOCKING PARTS OTHER STORES CANNOT REACH!

Items not fully covered on this list include: OPTO 7 seg LEDs, LCDs bezelled LEDs, Lamps, Lampholders, FUSES: 20mm 1½ inch, slow or quick blow. Fuseholders. CONNECTORS: DIL DIN Phono, 1mm, 2mm, 4mm. Bulgin USA. I.E.C. KNOBS: Plastic, Aluminium, Anodised, Collet, Pointer, SWITCHES: Toggle, Biased, Rocker, Rotary, Side, Dil, Push. METERS: LCD, Andogue. Test and Panel. TOOLS: Piers, Cutters, Strippers, Trimmers, Cable Cutters. And much, much more. All in stock items (that's 95%) posted same day. OFFICIAL ORDERS FROM SCHOOLS. GOVT DEPTS ETC WELCOME. OVERSEAS ORDERS WELCOME ICWO + ADEQUATE POSTAGE. QUANTITY DISCOUNTS BY NEGOTIATION. CRICKLEWOOD ELECTRONICS LTD., 40 CRICKLEWOOD BROADWAY, LONDON NW2 3ET. TEL: 01-452 0161, Telex 914977

★ THE LAZY WAY Phone your order through on Access, Barclaycard, Visa or American Express for immediate service; no extra charge, no minimum order.
★ THE TRADITIONAL WAY Send cheque, PO or credit card number. Cash not encouraged but accepted (no coins please). All in stock items shipped same day.
★ THE IDEAL WAY Call in and collect. We are on the main Edgware Rd (A5) just 1} miles from Staples Corner and approx 3 miles from Marble Arch.
VAT Please add VAT at the current rate to all orders except books. VAT not chargeable abroad. POST; PACKING & INSURANCE Standard small order charge is 70p (more for heavier goods). Export orders minimum £1.50.

# 

#### SPECIALIST ELECTRONIC COMPONENT DISTRIBUTORS

325 EDGWARE ROAD, LONDON W2 1BN Tel: 723-4242

ALL THE POWER SUPPLIES TO DRIVE THESE MODULES PS. THESE KITS AND MODULES ARE **EXCLUSIVE OF VAT** 

#### **CRIMSON ELEKTRIK**

No 2580 2581 2582 2583 2584 2585	Modules CE 608 CE1004 CE1008 CE1704 CE1708 CE3004	40W Mono 100W 4 Mono 100W 8 Mono 170W 4 Mono 170 W 8 Mono	Price 18.26 21.30 23.90 30.43 30.43
2585a 2585b 2585c 2608	FE 908 FE1704 BD1 CPR 1X	300W 4 Mono 90W FET. Mono 170W FET Mono Bridge Unit for Modules Pre-Amp Module	42.60 25.65 33.48 7.13 41.70

## WE ALSO STOCK

No			Price
2615	Complete Pre-Amp Kit	CK1010	£80.00
2616	Complete 40W Stereo Amp Kit	CK1040	£105.00
2616a	Complete 80W Stereo Amp Kit	CK1080	£116.00
2617	Complete 100W Stereo Amp Kit	CK1100	£131.00
2618	Add on Moving Coil Kit	MC12K	€21.74
2619	Pre-Amp Power Supply Kit	PSK	£17.39
TS70 70	Thermal Switch		
HS50 5	Omm Heatsink		
HS100	100mm Heatsink		
14.95 1	50mm Heatsink		

JOIN THE PROFESSIONALS

PLEASE NOTE ALL CRIMSON MODULES ARE GUARANTEED FOR 2 YEARS.

WE STOCK A WIDE RANGE OF BOXES TO HOUSE THESE KITS IN. FROM VERY SMALL TO VERY LARGE 19" MAXIMUM PS. ALL KITS INCLUDE VAT

#### **VELLEMAN KITS**

No	Description	Price
K610	Mono UU using LEDS.	10.05
K1798	Stereo UU using LEDS	18.77
K1874	Running Light Kit	14.95
K2571	Light Computer with EPROM	36.23
K2569	Three Tone Chime	8.57
K2575	Microprocessor Doorbell 25 tunes	15.53
K2544	Complex Sound Generator	10.26
K2032	Digital Panel Meter	16:61
K2557	Digital Thermometer	26.57
K2545	50Hz Crystal Time Base	12.00
K615	High Precision Stopwatch	50.29
	Description	Price

#### Some are easy some are hard

No	To the temples	11.16
K2543	Transistor Ignition	- 1
K2555	Digital Freq Counter for Receivers	45.40
K2566	3 Channel Coloured Light Organ	19.19
K2572	Universal Stereo Pre-Amplifier	6.56
K2574	Universal 4 Digit U/D counter with memory	44.72
K2577	Electric Motor Speed Control	11.17
K2579	Universal Start/Stop Timer	7.45
		81.45
K2583	Heating Controller	
K1682	Microprocessor Universal Timer (no case)	61.72
K2580	Electronic Power Switch Dimmer	12.37
K2551	Central Alarm Unit	15.48

#### **TELETEXT KIT**

This unit will make your TV fully remote control (infra-red) and bring you closer to the amazing world of teletext. The kit can also be updated to incorporate full Prestel, and with a keyboard this can give you full message facilities for ordering foods or sending and receiving messages (E.G.) Booking your Holidays!

With a microcomputer as an alternative keyboard the world is even greater adding bulk updating to viewdata computers an receiving telesoftware for implementation to any

Even without the Prestel option, Telesoftware from the Teletext pages free!
The full features of Teletext, including subtitles are all included in the basic kit. An attractive stylish case is available to complement the finished kit.

> Basic Teletext Kit (no box) £130 + VAT P/P £2.50 with box £144.95 + VAT P/P £3.00 box by itself £14.95 + VAT P/P 75p

#### PRESTEL ADAPTOR



A Prestel micro computer adaptor to give full autodialing to your micro computer. All the usual Prestel facilities are added via this unit, plus many more, and, can operate to any viewdata computer.

You can shop from home, bank transmitt messages and receive software which means that the uses your micro can be put to are limitless.

The unit is not restricted to just the UK, for at least 28 countries use the Prestel viewdata format, so you can also mail-order from anywhere. The Prestel unit is suitable for most micro computers even the ZX-81, so at the push of a button, the technology of tomorrow is in your home today.

#### **ANTEX**

Soldering Irons		
X25	25W	5.30+
CX	17W	5.30+
C "iron"	15W	4.80+
CCN "ceramic"	15W	5.30+
Wide range of bits	and el	ements in
stock now		

Soldering iron stand 2.40 We stock multicore solder for normal use or fine

#### **ORYX**

Iso-tip Cordless Iron	31-90+
Miniature low voltage	
soldering station	13.95+
Oryx50 50W temp control	lled 15.50
Oryx super 30	5.90+
All irons are 240V mai	ns. Earth
Leakage current is less that	an 3 ua.
The temperature controlle	d iron can
be controlled within ± 2%	tempera-
ture range from 200°C to 4	

#### COMPONENTS | EDGE CONNECTORS

Device	Price	ZX81 E.C. 2.98
Z 80A	3.20	Spectrum E.C. 3.7,8
Z80A PIO	3.20	VIC 20 E.C. 3.78
Z80A CTC	3.20	50 Way E.C. 3.30
6800	6.50	18 Way E.C. 2.80
6810	3.00	64 Way E.C.Plug 2.50
6821	4.25	64 Way E.C. Socket 4.80
6502CPU	7.50	31 Way E. C. Plug 2.00
2114(200ns)	1.80	31 Way E. C. Socket 2.10
2708	3.00	
2716	3.20	We stock a very wide range of
2732	7.50	opto-devices, from Infra-Red to
2532	3.50	LED's to Opto-Couplers.
2764 (200ns)	11.00	Check us out for competitive
ADC0816 (8 bit)	14.90	prices and helpful service.

We also stock 74 series 74LS, C mos, transistors, capacitors, resistors, LED's, zeners, diodes, jack plugs, mains plugs XLR plugs, can-non plugs, arrow switches BNC connectors, reducers, photolak, developer, PC board, sensitive & normal, boxes, wire cutters, strippers, Edge connectors, pots, batteries, digital pulsers, logic probes, proto-boards, vero board

This is just a small sample of what we stock, if you like to see more send £1.00 to us for our NEW 1983 CATALOGUE

#### **BOOKS**

\*New Books

Please Note. Books are VAT exempt but add £1.00 to cover P/P

The 9900 Family Data Book The Opto-Electronics Data Book The Bipolar Microcomputer Databook The Interface Circuits Data Book The TTL Data Book MDS Memory Data Book The Linear Control Circuits Data Book The Voltage Regulator Data Book The Power-semiconductor Data Book *TTI Data Book Volume I *TTI Data Book Volume II	10.00 4.00 4.50 7.00 8.50 3.95 4.00 4.50 9.00 8.00
301 Circuits Towers Transistor Equivalent Towers Digital Selector Towers Linear 10 Selector	5.00 9.50 9.95 7.50

Why not try our mail order service, it's fast and efficient. We take Barclay, Access, Am Exp, Diners or Cheque, Cheques made payable to Bradley Marshall Ltd.

PLEASE REMEMBER TO ADD VAT AT 15% + 70p P&P

# DIGEST

## Compressor/ Limiter Tips

an Martin, designer of the Compressor/Limiter project we ran last month, has written suggesting some setting up hints. He thinks it would be wise to check the operation of the DC side chain before inserting the VCA chips IC2, 5 and 7: if there was a fault in the side chain which resulted in no curent being passed into the control pins on IC7 (pins 1 and 16), it's possible that the output of IC2 and IC5 could swing to the positive or negative supply rail and damage the LM13600 which follows. For this reason we suggest that these ICs are removed and the input currents to pins 1 and 16 of IC7 are measured. These should be in the region of 66 uA (V<sub>MIN</sub>/7k5), and V<sub>MIN</sub> should be 0V5. Both these measurements should be made with no input signal present.

## **New From ILP!**

15 VA transformers — all fully encased in ABS plastic shells with easy fixing by an M4 bush at the base. ILP are planning to extend this facility throughout the year to cover transformers up to 120VA. ILP Electronics, Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP.

## Two-way Tapping

C omplete two-way 'live' telephone conversations can be recorded with the Ansafone 600. This microprocessor controlled unit switches from its usual role as a telephone answering machine to a two-way conversation recorder in less than a second. Ansafone, Lyon Way, Frimley Road, Camberley, Surrey.

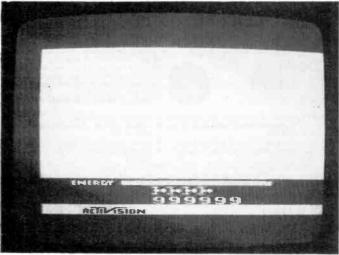
The Sinclair That Never Forgets

R OM-81 is a memory expansion unit for the ZX81 personal computer which enables the user to read useful routines and commonly used information, stored in U.V. erasable, programmable Read Only Memory. The unit is supplied without EPROMs as these are normally programmed and provided by the user.

Two 24 pin sockets allow either 2716 or 2732 EPROMs to be used. They can provide up to 8K of memory in 2K increments. The sockets are decoded to lie between 8K and 16K in the ZX81 memory map, which is just below the BASIC area. Separate 2K and 4 k decoding is link selectable to make it possible to vacate locations occupied by other peripheral cards.

ROM-81 has additional circuits to allow the use of slow EPROMs. The most popular EPROMs have a maximum access time of 450 nS. This is too slow for the ZX81. A special Wait State circuit in ROM-81 automatically requests the CPU in the ZX81 to wait until data has been read. Wait States do very slightly decrease the speed of operation of the computer and affect precise calculations of delay loops. The key device has therefore been socketed. Removing it will prevent implementation of Wait States.

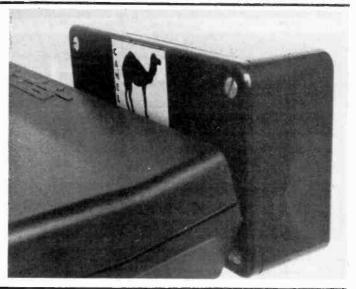
ROM-81 comes in a black ABS case with a screwed down cover for quick accessibility without vulnerability. It plugs on to the ZX81 with an adaptor at the rear of the box for further expansions. It is supplied with easy to follow User Notes which give the programs for data retrieval. (But what is the camel for? — Ed).

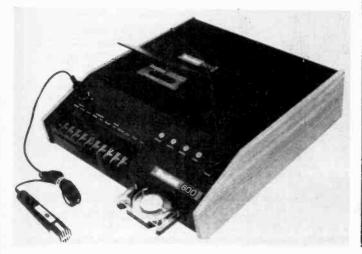


## Megamania Mangled

We did it! We penetrated the deep mysteries of what lies beyond the magic million of Megamania (new readers will not be aware that this is the best game in the Universe). After a finger-mangling fight with the Atari joystick during a game that

dragged on for an hour and a quarter, Peter "I'll beat it if it kills me" Green finally got to 999,999 with four spare lives, as evidenced by this photograph. The result was something of an anticlimax, as the game simply latches up. No fanfare, no screen message of congratulations, no dancing girls—the game just dies, its little software counter overloaded. Pity, that—now we can only score it 9½ instead of 10.





### New Catalogue From Toolmail

The new 1983 Toolmail 128-page full colour catalogue is now on sale, offering better value than ever before. With 600 new items and over 2,000 tools illustrated, the product range available must be larger than any specialist tool shop. Prices are still really competitive and all items are available for immediate delivery through Toolmail's efficient nationwide mail order service.

In addition, there are many new features in the 1983 Toolmail

catalogue. Of particular interest are the three £1 vouchers to be found on page 128. Valid until July 31, 1983 they are each redeemable on any order in excess of £10.

A further Toolmail venture for 1983 is the opening of the Sevenoaks Tool Room in March. Many of the tools in catalogue will be available there. Others may be ordered there through the regular Toolmail service for delivery by post. Customers may also redeem their Toolmail vouchers at the Sevenoaks Tool Room.

The catalogue is available in all major newsagents price £1. Copies are also available direct from Toolmail (1982) Limited, PO Box 46, Maidstone, Kent ME15 BEQ.

# DULES FOR SECURITY & DETECTION



This exciting new module offers all the possible features likely to be required when building an treatures interly to be required when building an intruder alarm system. Whether used with only 1 or 2 magnetic switches or in conjunction with several ultrasonic alarm modules or infra-red units, a really effective system can be constructed at a fraction of the cost of comparable ready-made units. Supplied with a fully explanatory Data Sheet that makes installation straight forward, the module is fully tested and quaranteed.

\*available in kit form £16.95 plus VAT.

- Built-in electronic siren drives 2 loud speakers. Provides exit and entrance delays together with fixed alarm time
- Battery back-up with trickle charging facility Operates with magnetic switches, u/sonic or
- Anti-tamper and panic facility

ALARM

US 4012

Fully built

Et tested

MODULE

ULTRASONIC

- Stabilised output voltage
- 2 operating modes full alarm/anti-tamper and panic facility
  Screw connections for ease of installation
- Separate relay contacts for switching external

Adjustable range

from 5ft. to 25ft.

effective fully built

module containing both

ultrasonic transmitter and receiver and circuitry for providing false alarm suppression. This module,

hardware is available (see right).

together with a suitable 12V power supply and relay unit as shown, forms an effective though inexpensive intruder alarm. Supplied with comprehensive Data Sheet, it is easily mounted in a

wide range of enclosures. A ready-drilled case and necessary

Test loop facility

## INFRA-RED **SYSTEM** IR 1470

Fully built & tested

- Range up to 50°12V operation
- Supplied with full instruction
- Easily installed





Now available, a really effective infra-red system built to the high standards demanded by the security Now available, a really effective infra-red system built to the high standards demanded by the security industry, and yet offered at this low price. The system consists of a transmitter and receiver which provide an invisible beam over distances from 1-50 ft. or more. When the beam is interrupted, a relay is energised in the receiver unit. The use of a modulated beam combined with the infra-red filters, prevent interference from artificial or sunlight, whilst LED indicators ensure easy alignment of the beam. Both units are housed in attractive black moulded enclosures which are easily mounted. Supplied with full instructions. the unit is ideal for use in conjunction with the Control Unit CA 1250 or as an independent unit.

#### Power Supply & Relay Units PS 4012 £4.25 + VAT

Provides a stabilised 12V output and relay with 3A contacts. The unit is designed to operate one or two of the ultrasonic units. Fully built and tested.

#### Siren Module £2.95 + VAT **SL 157**

Produces a loud and penetrating sliding tone operating from 9-15V. Capable of driving 2 off 8 ohm speakers to SPL of 110db at 2M. Contains an inhibit facility for use with shop lifting loops or other break to activate circuits.

Add VAT & 50p post and packing to all orders.

Shop hours 9.00 - 5.30 p.m. (Wad. 9.00 - 1.00 p.m.) Units on demonstration - callers welcome. S.A.E. with all enquiries.



Telephone orders welcome

#### Hardware Kit HW 4012

£4.25 + VAT

A suitable ready-drilled case with the various mounting pillars, mains switch socket and nuts and bolts.

Designed to house the ultrasonic alarm module together with its power supply. Size: 153mm x 120mm x 45mm

#### **★** ACCESSORIES

3-position Key Switch for use with CA 1250, supplied with 2 keys Magnetic switch (with magnet)

£3.43 £4.95

5" Horn speaker for use with CA1250 and SL157

#### RISCOMP LIMITED

Dept ETI/17 Princes Risborough, Bucks

Princes Risborough (084 44) 6326

Please allow 7 days for delivery

#### DIGITAL VOLTMETER MODULE DVM 314

Fully built & tested



# COMTECH ELECTRONICS

	BD132	480	MJE521	650	2N3708	on l	LM747	50p	5mm red	7p		VOLTA		EGLATORS	1	CAPACITORS		
TRANSISTORS	BD135	30p	MJE3055	65p	2N3771 17	Op	LM748	35p	3mm green	9p			1A TO			Electrolytic, radial.		Value/Volta Price
3C1078	12p BD136	30p	MPSA05	180	2N3772 17 2N3773 19		LM1458 LM1496	36p 70p	5mm green 3mm yellow	100	7805 7812	33p	33p	7905 7912	40p 50p	Value/Volts 1uF/63	Price 8p	Value/Volts Price 220uF/25 15p
3C108C 3C109C	12p BD137 13p BD138	30p	MPSA06 MPSA12	18p		Op	LM3900	47p	5mm yellow	10p	7815		33p	7915	50p	2.2uF/63	6p	470uF/25 23p
3C113/4	15p BD139	35p	MPSA13	20p	2N3866 9		MC1455	15p	retangular stackable	- 1			100m# 30ø	79L05	50p	4.7uF/63	6р	1000uF/25 32p
3C115/6	16p BD140	35p	MPSA14 MPSA42			Op	MC1458 MC1496	36p 70p	RED	10p	78L05 78L12		30p	79L12	50p	10uF/63 100uF363	7p 20p	10uF/63 6p 22uF/16 6p
3C117 3C119	18p BD204 19p BD206	64p	MPSA43	23p	2N3905 1	00	MC3302	72p	GREEN	14p	7BL15	30p		79L15	50p	4.7uF/25	60	47uF/16 60
3C139	30p BD222	56p	MPSA55	18p	2N3906 1	Op	MC3401 MC3403	65p 60p	YELLOW	15p	78H05 5V	1 at 5.6			540p	10uF/25 22uF/ <b>2</b> 5	6p 6p	100uF/16 9p 220uF/16 12p
3C140 3C142/3	28p BD239A 27p BD239C	40p 45p	MPSA63 MPSA64	220	2N4030 3 2N4033 3	Op	MC3456	43p	SOCKETS	70	LM309K 5	SV al 1A			120p	47uF/25	9p	470uF/16 1Bp
3C160	28p BD240A	42p	MPSA92	24p	2N4037 3	Op	NE529	220p	14 pin	80	LM317K A	Adi/15A			240p	100uF/25	10p	1000uF/10 19P
3C161	32p BD240C	48p	MPSA93 TIP29A	24p			NE532 NE544	80p 200p	16 pin 18 pin	9p	LM317T A	ldy1A			98p 200p		6р	220uF/10 35p
3C169C 3C170	9p BD241A 9p BD242A	50p	TIP298	30p	2N4062 1	001	NE550	170p	20 pin	140	LM723CN	Adj.			35p	Value/Volts		Value/Volts Price
3C171	9p 80243A	50p	TIP29C	36p			NE555	15p	22 pm	14p	CMOS			1082	12p	0 1uF/35 0.22uF/35	12p	6.8uF/25 20p 10uF/16 20p
3C172 3C173	9p BD234C 9p BD244A	65p 60p	TIP30A TIP30B	30p 30p	2N4401 1 2N4402 1		NE556 NE558	43p	24 pin 28 pin	180	4000		10p 4	1093	22p	0.33uF/35	120	10uF/16 20p
3C177	160 BD244C	76p	TIP31A	330	2N4403 1	40	NE564	430p	40 pin	20p	4001			1098	72p 46p		12p	15uF/16 28p
3C178C	16p BF 180	38p	TIP31B	330		8p	NE565 NE566	140p	BRIDG				50p	1510 1511	44p		12p	22uF/16 35p 33uF/10 36p
3C 179 3C 182	16p BF181 8p BF182	30p	TIP31C TIP32A	370	2N5458 2		NE567	120p	RECTIFIE	18n	4007		15p 4	1512	420	1uF/35	12p	47 uF/10 60p
3C182L	8p BF183	30p	TIP328	330	2N5459 2		NE570 NE571	370p 350p	1A/100V	20p	4011 4012			1514 1516	110p 56p		18p 20p	68uF/6.3 60p 100uF/6.3 80p
3C184 3C184L	8p BF184 8p BF185C	30p 29p	TIP32C TIP47	37p			NE594	220p	1A/200V 1A/400V	240	4013		20p /	1520	50p	4.7uF/25	20p	100uF/3 40p
3C212	8p BF194	120	TIP1 10	350	2N5551 1	8p	NE644	380p	1A/600V	28p	4014		46p 4	1528 1555	58r	Cermaic, miniatrus	e plate.	
9C212L	8p BF195		TIP110 TIP115	350			NE645 SL490	270p 300p	1A/800V 3A/50V	400	4015 4016		20p		36p 36p			d 47N do each
9C213 9C213L	8p 8F196 8p 8F197	12p		35p	LINEAR ICS	-	SN76018	135p	3A/50V 3A/100V	42p	4017		35p .	1584	34p		1014, 221	4,4714 Ap each.
BC214	8p BF198	10p	TIP121	60p	555		SN76115	95p	3A/200V	44p	4020		42p 40p	4585	56p			
BC214L	8p BF 199	9p 20p	TIP1222 TIP126	69p		3p	SN76660 TBA120S	90p 70p	6A/50V 6A/100V		4022		44p	RESISTORS	F04			11 RE0:100
BC237 BC238/9	6p . BF244C 10p BF245	20p	TIP27	60p	747C	iOp	TBA800	70p	6A/200V	68p	4023			W Carbon life one value.	n E 24 serie	es 5% tolerance, 10 ol	nms to 15	/ 1peach. 85p/100
BC251	10p BF256C	25p	TIP2955	70p		15p	TB810 TBA820	90p	6A/400V	94p	4024		35p	2W Carbon file	n E 12 serie	s 5% tolerance, 10 oh	ms to 1M	2peach. 140p/100
BC300 BC301/2	40p BF257 36p BF258	30p	TIP3055	70p		XOp	TDA1022	550p	DIODES AA119	90	4026		78p	ne value.	E24 - ovi or	s 1% tolerance, 10 oh	ne to 1M	40 each 250o 100
BC303/4	36p 8F259	35p	TIS90	24 p	CA3140E 4	10p	TDA1024	120p	OA47	9p				ne value	EZ4 Selles	s 1-6 tolerance, room	112 10 1141	чрваси, 250р 100
mC307	10p BF336 12p BF337	36p 39p	TIS92 2N1613	20p 30p		Юρ 55p	TDA2002 TDA2003	98p	OA90	7p	40.29		45p	BDERING: A	il compo	nents top quality an	d luil sp	ac. Please add 30p
WC327 WC328	12p BF337 12p BF338	39p	2N1711	30p	CA3189E 24	15p	TDA2020	240p	OA91 OA95	7p 8p			15p	PAP to all o	rders belo	ow £5 and VAT to	total, C	iovernment orders
III IIC337	12p BF457	30p	2N1893	28p		0p	TDA2030 TL061	200p 40p	OA200	7p	4041		40p	veicome, Irac	ie please	enquire. Send chequ ronics. All orders d	ue or pos espetche	tal order made pay- ed same day. Send
BC338 BC413C	12p BF 458 10p BF 459	32p 36o	2N2218A 2N2219A	25p	LF351 LF353	30p	TL081	40p	A202 BAX13	UP.	3043		40p	arge SAE for	full price	list.	o o p a com	
IIC414C	10p BFX29	28p	2N2221A	200	LF355	35p	SCRs	28p	BAX16	80	4046 4048		44p	COMPONENT	PACKS			FREE!
IIIC415C	10p BF X30	28p 28p		18p		35p 38p	C106D C116D	70p	1544	op.	Idodo		20p	CP2 10 BC18	2 & 10 BC2	212 Transistors 12		
BC416C	10p BF X84 23p BF X85	280		23p	LM301 :	25p	C126	90p	1S921 1N914	/p	4050 4051		20p	CP3 10 BC54	8 10 BC5	559 Transistors 12 ng diodes 100V 24		WITH
IIIC478	22p BF x86	28p		15p		54p	2N4444 2N5061	120p	1N916	30	MOSS					ng diodes 100V 30	Op	ALL
BC479 BC546	23p BF X87 10p BF X88		2N2484 2N2904	24p		200	2N5062	290	1N414B 1N4149	2p 3p	4069		14p	CP9 30 1N40	02 1A/100		0p	ORDERS
#C547B	9p BFY50	23p	2N2904A	220	LM324	4Op	2N5064	32p	1N4001	3p			12p	CP10 100 1N	4148 SWIK	thing diodes 15 tic capacitors 38		OVER
<b>8</b> C548B	8p BFY51		2N2905 2N2905A	22p		16p	THYRISTORS:	55p	1N4002	4p	4072		120	CP17 4 LF35	JFET Op	Amps (low noise) 17	Op	
#C549C #C550C	9p BFY52 9p BFY53		2N2906	20p	LM358	45p	C225D	60p	1N4003 1N4004/5	4p 5p						Amps (wide band) 30	Οp 5p	£6
9C556	10p BSY95A	23p	2N2906A	22p	LM376	88p	C226D C236D	70p 90p	1N4006/7	6p				CP21 20 Red CP28 10 C10			0p	10
9C557B	9p BU205 8p BU208		2N2907 2N2907A	23p		20p		30p	1N5401	110	4078		14p	CP29 25 5mm	Red Leds	with clips 19	5p	BC182's
9C558B BC559C	9p BU208	140p	2N3053	23p	LM384 1	25p	ZENERS		1N5402 1N5402/4	12p 13p			12p	CP30 25 3mm	Hea Leds	s with Clips 17	Op	
■ SC559C	9p MJ2955	98p		56p	LM386	85p 30p	2V7-36V	6p	1N5405/6	14p								
BC560C BCY70	9p MJE340 17p MJE350	48p 70p		50p	LM388 1	вор	1.3W		1N5407/8	15p								
BCY71	18p MJE371	84p	2N3442	120p	LM389 1	50p	3V9-51V	12p	6A/100V 6A/200V	28p 30p								
BCY72	15p MJE520 50p MJE521	60p 65p				70p	Chps	30	6A/400V	32p								L 3-15 15 15 15 15 15 15 15 15 15 15 15 15 1
BD115 BD131	50p MJE521 45p MJE2955	80p		9p		14p	3mm red	60	6A/600V	35p	E							
					I .		1		1		Color of							

\* FAST RELIABLE SERVICE \*

★ VERY COMPETITIVE \*

COMTECH ELECTRONICS

MAIL ORDERS 205 STURDEE ROAD. LEICESTER LE2 9FY Telephone: (0533) 779578

## **NEWS:NEWS:NEWS:NEWS:NEWS:NEWS**

Centronics Interface For Spectrum

If you're frustrated with the limitations of the ZX printer or would like to utilize your Spectrum for business use you can now link your Spectrum to Centronics type printers with the use of a Kempston Centronics Interface.

A major feature is the recognition of LLIST and LPRINT by the interface. This allows programs to be listed directly from your Spectrum and also allows you to print-out direct from listings (BASIC only) without the need of special user calls. It is also possible to send out control codes to the printer giving the facility of different characters, i.e., condensed, expanded, etc. The interface is supplied cased and ready to use by simply plugging directly into a Centronics type printer, eg all Epsons including MX-80 F/T III, Seikosha 100 A, OKI Microline 80 etc, and also includes driving



software which allows up to 128 characters per line (depending on printer type)

There is also a range of business software from Hilderbay Ltd which can be used in conjunction with Centronics type printers, i.e., accounts, stock control, etc. The interface complete with connecting lead will be priced at £45 including VAT (mail order £1 p&p) which includes a 12 month guarantee. Kempston (Micro) Electronics are at 180a Bedford Park, Kempston, Bedford MK42 8BL.



## Look, Mum, No Keys!

C asio's latest miniature calculator SL80 has no keys in the conventional sense. Instead it has flat, sensor-touch pads

which respond to finger pressure. The keyboard itself, forming part of an integrated protective wallet, is as large as the whole of a normal credit card calculator, so individual keypads are generously proportioned and well spaced making the calculator much easier to operate.

SL80 has no batteries either, saving the consumer the expense and inconvenience of having to replace a battery. Power comes from built-in solar cells, needing light intensity of only 50 lux. For the untrained 50 lux is the equivalent of a dull light for normal reading!

This tough, maintenance-free little instrument is coming into the shops at a recommended retail price of only £10.95. Casio Electronics Co Ltd, Unit 6, 1000 North Circular Road, London,

NW2 7JD.

# Bite A Computer!

usky, the world's first portable microcomputer, will be on show at this year's Hanover Fair, April 13-20, where it will be demonstrating its indestructible computing power to a deadly Amazonian piranha, immersed in a tank of water at UCSL Microsystems' stand (B5604) in CeBIT Hall 1 (but don't try typing anything in while it's there!).

Husky is now in use for data capture and portable data processing applications by scientific,

commercial and military users in Europe, the United States and other countries.

Husky's applications range from guided missile support to brewery stock-taking. Husky's large memory — up to 144K — allows it to be used independently for long periods. Husky is the first portable microcomputer to offer IBM's 2780 synchronous package, allowing direct communication with mainframe computers.

Husky is designed and manufactured in Britain by DVW Microelectronics, a member of the AIDCOM International group of companies.

#### **Shorts**

● The latest catalogue from Stotron Ltd has arrived in our offices; rather curiously it's dated 1982, but never mind, it's full of goodies. You can obtain your copy from Stotron Ltd, Haywood Way, Ivyhouse Lane, Hastings, East Sussex, TN35 4PL, telephone 0424 442160.

 Since MAC has been chosen as the UK's system for future direct satellite broadcasting (see ETI March 83), it's reassuring to know that it's been successfully demonstrated in Germany. About 100 telecommunications Multiplex engineers saw Analogue Component pictures which had been sent from the IBA Engineering Centre near Win-chester, England, via the European Orbiting Test Satellite stationed 36,000 km above West Africa. The demonstrations in-cluded a direct comparison with conventional PAL-encoded colour signals.

• Gould Power Supplies UK, of Raynham Road, Bishop's Stortford, Herts, have expanded their Econoflex range of switch-mode power supplies with the addition of the EX24/5. Not surprisingly, this is a 24 V, 5 A output unit. The power output is floating and fully regulated to within 0.2%, protection circuitry is incorporated, and

the input can be 110 or 220 V AC.

• Hardly a month goes by without some new information from those busy chaps at OK Industries UK Ltd. This time they've produced a new brochure describing their range of PacTec enclosures, which are moulded from impact-resistant ABS in a range of sizes from small to medium. Various colours and accessories are available. Copies of the 22-page catalogue are available from OK at Dutton Lane, Eastleigh, Hants, SO5 4AA (telephone 0703 610944).

• Remember manufacture in-car microprocessor equipment and we've mentioned their products before in Digest. Anyway, the US parent company has bought out the UK operation in order to do their own marketing: the good news is that this move will result in a hefty 30% cut in prices, as well as a further financial investment in service facilities. Zemco UK's office is at 66 Earlsdon Street, Coventry CV5 6EJ (telephone 0203 79969), and readers interested in cruise controls and in-car computers are directed thence.

• Accelerate your Apple with the Accelerator II from Pete & Pam Computers, New Hall Hey Road, Rossendale, Lancs, BB4 6JG (telephone 0706 227011). For £299 you get a plug-in board con-

taining a 6502C processor and 64K of memory which will boost the speed of the Apple II Plus from 1 MHz to 3.58 MHz. It can run all native Apple II software.

Calling all radiologists,

• Calling all radiologists, radiographers and clinicians — the second London Course in Whole Body Tomography (whatever that is:) will be held from 7-10 June 1983. Further information may be obtained from one of the organisers, Dr Janet Husband, CT Scanning Unit, Royal Marsden Hospital, Downs Road, Sutton, Surrey SM2 5PT (telephone 01-642 6011 ext. 496). The course is approved under HM67/27 for study leave purposes.

of A 50-page two colour catalogue is now available from STC Meridian, West Road, Harlow, Essex CM20 2BP. The range of products includes such components as picture tubes and microphones, buzzers, sounders, re-entrant horns, counters, timers and relays, as well as vacuum fluorescent displays, DC-to-DC converters, display drivers, infrared diodes, phototransistors, LED and LCD displays, and printers.

• Flexible Switch Technology Ltd.

 Flexible Switch Technology Ltd can now offer a low-profile QWERTY keyboard with an overall thickness of less than 2 mm. The keyboard is fully sealed and comes complete with connectors on two flexible tails. All you have to do is plug them in to a suitable drive board. Two types are available: flat membrane switches or FST's new 'click' effect tactile buttons. You can have any colour you like as long as it's blue, black or white. Flexible Switch Technology are at Unit 31, Middlefield Industrial Estate, Sunderland Road, Sandy, Beds SG19 1RB (telephone 0767 80332).

• Sharp PC-1251 owners can now buy a spreadsheet program which allows as many as 26 columns, 100 rows, and over 200 'cells' on the sheet. You can either use it as a tool for solving the "what if" type of question, or as a mini-database with up to 100 names and telephone numbers. The program, called Easi-calc 1251, requires the CE125 printer-recorder and costs £14.95 including VAT from Elkan Electronics, 11 Bury New Road, Prestwich, Manchester M25 8JZ (telephone 061-798 7613).

● Two new books have been added to the successful 'Understanding . . .' series from Texas Instruments. The titles are 'Understanding Electronic Control of Energy Systems' and 'Understanding Telephone Electronics', and each costs £3.95 plus £1.50 postage and packing from Texas Instruments Ltd, PO Box 50, Market Harborough, Leicestershire.



#### **MULLARD SPEAKER KITS**

Purposefully designed 40 watt R.M.S. and 30 watt R.M.S. 8 ohm speaker systems recently developed by MULLARD'S specialist team in Belgium. Kits comprise Mullard woote (8" or 5") with foam surround and aluminium voice coil. Mullard 3" high power domed tweeter. B.K.E. built and tested crossover based on Mullard circuit, combining low loss components, glass fibre board and recessed loudspeaker terminals. SUPERB SOUNDS AT LOW COST. Kits supplied to polysthera packs complete with instructions. polystyrene packs complete with instructions.

40W system — recommended cabinet size 240 445mm

Price £14.90 each + £2.00 P & P 30W system — re 0 × 175 × 295mm recommended cabinet size

Price £13.90 each + £1.50 P 8 P.

Designer approved flat pack cabinet kits, including grill fabric. Can be finished with iron on veneer or self adhesive vinyl etc.

8" system cabinet kit £8.00 each + £2.50 P'& P. 5" system cabinet kit £7.00 each + £2.00 P & P.



Comprising of a top panel and tape mechanism coupled to a record/play back printed board assembly. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready

one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready built and tested. Features: Three digit tape counter. Autostop, Six piano type keys, record, rewind, fast forward, play, stop and eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. Input Sensitivity: 100mV to 2V. Input Impedance: 68K. Output Impedance: 68K. Supplied and the sensitivity: 100mV to 2V. Input Impedance: 68K. Suput Input Input



LOUDSPEAKERS
15" 100 watt R.M.S. (HI-FI, P.A., DISCO, BASS GUITAR) Die cast chassis, 2" aluminim voice coil, white cone with aluminium centre dome. 8 ohm imp., Res. Freq. 20Hz., Freq. Resp. to 2.5KHz., Sens. 97d8 (As photograph). Price: £32.00 + £3 carriage.

£3 carriage.

12" 100 watt R.M.S. (HI-FI) Die cast chassis. 2" aluminium voice coil. Black cone. 8 ohm imp. Res. Freq. 20Hz., Freq. Resp. to 4.5KHz. Sens. 95dB. (As photograph). Price: £23.50 + £3 carriage.

8" 50 watt R.M.S. (HI-FI, P.A.) 1 "" aluminium voice coil. White cone. 8 ohm imp. Res. Freq. 40Hz., Freq. Resp. to 6KHz. Sens. 92dB. Also available with black cone fitted with black metal protective grille. (As photograph). Price: White Cone £8.90, Black cone/grille £9.50 P&P£1.25.

12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2" aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq. 45Hz., Freq.

aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 6.5KHz., Sens. 98dB. Price: £22.00 + £3 carriage.

Hesp. to 6.5M12., Sens. Soots. Price: \$2.200 + L3 carriage:
12" 85 wart R.M.S. McKENZIE C1285TC (P.A., DISCO) 2" aluminium voice coil. Twin cone. 8 ohm imp., Res. Freq. 45HZ, Freq. Resp. to 14KHz. Price £22 + £3 carriage.
15" 150 wart R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil. Die cast chassis. 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. Price: £47 + £4

#### 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 'D'

TYPE 'A' (KSN2036A) 3" round with prowire mesh, ideal for bookshelf and medium sized Hi-fi speakers. Price £4.29 each. TYPE 'B' (KSN1005A) 3 ½" super horn. For general purpose speakers, disco and P.A. systems etc. Price £4.99 each.

TYPE 'C' (KSN6016A) 2" × 5" wide dispersion horn. For quality Hi-fi systems and quality discosletc. Price £5.99 each.

TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. Price £7.99 each.

TYPE 'E' (KSN1038A) 3%" horn tweeter with attractive silver finish trim. Suitable for I monitor systems etc. Price £4,99 each.

TYPE 'F' (KSN1057A) Cased version of type
'E' Free standing satellite tweeter: Perfect 'E'. Free standing satellite tweeter: Perfect add on tweeter for conventional loudspeaker Price £10.75 each

P&P 20p ea. (or SAE for Piezo leafiets).



#### NO 80 LOUDSPEAKER

The very best in quality and value.

Ported tuned cabinet in hard-wearing black vynide with protective corners and carry handle. Built and tested, employing 10in British driver and Piezo tweeter. Spec: 80 watts RMS; 8 ohms; 45Hz-20Hz; Size: 20in x 15in x 12in; Weight: 30 pounds

Price: £49.00 each Carriage: £5 each £7 per pair

#### **BK ELECTRONICS**

Prompt Deliveries **VAT** inclusive prices **Audio Equipment** Test Equipment by Thandar

and

Leader

HOBBY KITS. Proven designs including glass fibre printed circuit board and high quality components complete with instructions.

FM MICROTRANSMITTER (BUG) 90/105MHz with very sensitive microphone. Range 100/300 metres. 5 x 46 x 14mm (9 volt) Price: £6.58.

DIGITAL THERMOMETER -9.9 C to +99.9 C. LED display. Com-

plete with sensor, 70 x 70 mm (9 volt) Price: £22.94
3 WATT FM TRANSMITTER / WATT 85/115MHz varicap controlled, professional performance. Range up to 3 miles 35 x 84 x 12 mm (12 volt) Price: £10.64

SINGLE CHANNEL RADIO CONTROLLED TRANSMITTER/ RECEIVER 27MHZ Range up to 500 metres. Double coded modulation. Receiver output operates relay with 2amp/240 voll contacts. Ideal for many applications. Receiver 90 x 70 x 22 mm 9/ 12 volt) Price: £14.38. Transmitter 80 x 50 x 15 mm (9/12 volt) Price £9.15, P&P All Kits +50p, S.A.E. for complete list.



Transmitter



#### **BSR P256 TURNTABLE**

P256 turntable chassis • S shaped tone arm • Belt driven • Aluminium platter • Precision calibrated counter balance • Anti-skate (bias device) • Damped cueing lever skate (bias device) 

Damper cueling lever

240 volt AC operation (Hz)

Cut out
template supplied 

Completely manual arm

This deck has a completely manual arm and is
designed primarily for disco and studio use
where all the advantages of a manual arm are required

Price £31.35 each, £2.50 P&P



#### **POWER AMPLIFIER** MODULE



New model. Improved specification NEW OMP100 Mk.II POWER AMPLIFIER MODULE Power Amplifier Module complete with integral heat sink, toroidal transformer power supply and glass fibre p.c.b. assembly, incorporates drive circuit to power a compatible LED Vu meter. New improved specification makes this amplifier ideal for P.A., Instrumental and Hi-Fi applications. and Hi-Fi applications.
SPECIFICATION

SPECIFICATION
Output Power: — 110 watts R.M.S. Loads: — Open and short circuit proof 4/16
ohms. ohms.
Frequency Response:—15Hz - 80KHz -3dB.
T.H.D.—0.01%.
S.M.R. (Unweighted):—-118dB - 3.5dB.
Sensitivity for Max. Output—500mV © 10K.
Frice:—231.99 + 22.00 P8P.
Vu Meter Price:—£7.00 +P&P.

## HOME PROTECTION SYSTEM

Better to be 'Alarmed' then terrified. Thandar's famous 'Minder' Burglar Alarm System Superior microwave principle. Supplied as three units complete with interconnection cable. FULLY

Superior microwave principle. Supplied as three units, complete with interconnection cable FULLY GUARANTEED. Control Unit — Houses microwave radar unit, range up to 15 metres adjustable by sensitivity control. Three position, key operated facia switch — off — test—armed 30 second exit and entry delay. Indoor alarm — Electronic swept freq. siren, 104dB output. Outdoor Alarm — Electronic swept freq. siren, 98dB output. Housed in a tamper-proof heavy duty metal case.

the control unit and outdoor alarm contain re Born the Control unit and outgot airam contain re-chargeable batteries which provide full protection during mains failure. Power requirement 2007/260 Volt AC 50/60Hz. Expandable with door sensors, panic buttons etc. Complete with instructions. SAVE OVER £100 Usual price £228.85 — B.K.E.'s BARGAIN PRICE £128.00 + £5.00 P&P. S.AE. for colour brochure.

12 80 watt R.M.S. loudspeaker A superb general purpose twin cone loud speaker. 50 oz. magnet. 2 aluminium voice coil. Rolled surround. Resonant fre quency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8ohm. Attractive blue cone with aluminium Price £18.49 each + £3.00 P&P





UNIT 5, COMET WAY, SOUTHEND-ON-SEA, ESSEX, SS2 6TR

★ 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



TYPE 'C

TYPE 'E'

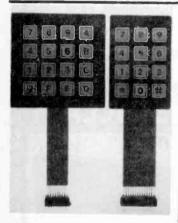
## NEWS:NEWS:NEWS:NEWS:NEWS:NEWS

# **ZX81** Music Board

We've just discovered (since the prototype was tested using a Memotech RAMpack) that it isn't possible to plug peripherals into the back of Sinclair's RAMpack. Have no fear, you can still use the Music Board: all the completed boards and kits sold by Petron Electronics will be modified so that the Sinclair memory can be plugged in behind the Music Board. Problem solved.

#### **ORIC** Overload

T angerine Users Group (TUG) have asked us to bring to the attention of ORIC-1 owners that they are receiving several thousand enquiries per month, thereby creating an overload condition in the organisation. Although they are making every effort to respond as quickly as possible, delays of up to 14 days are inevitable, during this period of reorganisation.



## Membrane Keypads From Velleman

V elleman have introduced a new range of membrane keypads, available with 12 keys (type KB12) or 16 keys (type KB16). Both versions are offered with standard legend or with blank keys to enable customer to print their own legend.

These multi-layer keyboards are manufactured by Velleman using high quality materials with the top layer being polycarbonate film which resists scratching, dust and water. Termination is by insulated flat cable and a suitable PCB connector with 2.54mm (0.1 inch) spacing is supplied. Ratings are 24 V and 25 mA maximum.

A data sheet with full

A data sheet with full technical specification is available upon request. Price including VAT and postage is £8.44 for both versions (1 off quantity) with discounts available for larger quantities. Velleman (UK) Limited, PO Box 30, St Leonards on Sea, East Sussex, TN37 7NL.



New Crimson Factory

D ue to successful and increasing trading Crimson Elektrik has opened a new factory to handle sales and production of all modules, kits and industrial amplifiers. From the same date the Leicester factory will only be handling production and sales of the prestigious 600 series hifi amplifiers, available only through specialist retailers. All enquiries other than for the 600 series should now be addressed to: Crimson Elektrik, 500 King Street, Longton, Stoke-on-Trent ST3 1EZ.

High-Tech Pager

A new version of an economical radio paging system for on-site or wide-area use has been launched by Multitone Electronics, using technology currently unique to the company.

The system, called 'Readout', is a single or dual-format encoder (control unit) that can operate both analogue and digital pagers. This means that users with analogue equipment can protect past investment in their existing receivers and still upgrade their system to take advantage of the latest high-speed digital technology.

Up to 500 digital pagers can be added to an existing system without any need to replace the transmitter, aerial and associated wiring

One of the key new features on FM systems is 'receiver out of range'. This prevents pager wearers from being out of contact without being aware of it. When taken out of range of the transmitter, a pager emits a low-frequency buzz warning.

Another new feature is transmitted steering, developed to enable users to add a new digital system to an analogue system on another radio frequency. The dual-format 'Readout' can steer calls for the analogue receivers to the existing AM transmitter and calls for the new digital receivers to a new FM transmitter. Multitone is the only manufacturer that can supply an encoder to provide this facility.

For further information contact: Multitone Communications Systems Ltd, 6-28 Underwood Street, London N1 7JT. Tel: 01-253 7611.



SX16 SX17

SX18 SX19 SX20

**SX21** 

SX24

200

190

60

100 50

20

### "IRRESISTABLE

RE	RESISTOR BARGAINS"								
Pak No.	Oh.*	Description	Price						
SX10	400	Mixed "All Type" Resistors	£1						
SX11	400	Pre-formed 4-5 watt Carbo	n						
		<ul> <li>Resistors</li> </ul>	£1						
SX12	200	watt Carbon Resistors	£1						
SX13	200	4 watt Carbon Resistors	£1						
SX14	150	ש watt Resistors 22 ohm-							
		2m2 Mixed	£1						
SX 15	190	1 and 2 watt Resistors 22							
		ahm 2m2 Mused	61						

ohm:2m2 Mixed £1
Paks SX12-15 contain a range of Carbon Film Resistors
of assorted values from 22 ohms to 2? meg. Save
pounds on these resistor paks and have a full range to

6 Black Heatsink will lit 10-3 and

10 220 Ready drilled Half price

1 Power finned Heatsink. This heatsink

gives the greatest passible heatidissipation

TO 3 Size 45 mm squarex 20 mm high 40 p TO 66 size 35 mm x 30 mm x 12 mm 35 p

1 Heat Efficiency Fower Finned Heatsink 90mm x 80mm x John Migh. Drilled to

in the smallest space owing to its unique

staggered fin design, pre-drilled

take up to 4 x

TO-3 devices

£1.50 each

Quantities approximate, count by weight SX52

SX53

#### antities approximate, count by weight BARGAINS

"CAPABLE

**CAPACITOR PAKS''** 

Description
Capacitors Mixed Types
Ceramic Capacitors Miniature

Mixed Ceramics 1 of - 56 of

Mixed Ceramics 191-3001 Mixed Ceramics 68pf- 0.5mr Assorted Polyester/Polystyrene

Capacitors Mixed C280 type capacitors

metal foil Electrolytics, all sorts Quality Electrolytics

50-1000 mf Tantalum Beads, mixed

£١

20 small 125 Red LED s	£1
10 Rectangular Green LED's 2	£1
30 Assorted Zener Diodes	
250mw-2 watt mixed voltages.	
alf coded. New	£1
4 Black Instrument	
Knobs-winged with pointer 14"	
Standard screw. Fit size 29 x	
20mm	50p
20 Assorted Slider Knobs	
Black/Chrome, etc	£1
12 Neons and Filament Lamps, Lo	w
voltage and mains - various types	
	10 Rectangular Green LED s 2 30 Assorted Zener Diodes 250mw. 2 wart mixed voltages, all coded New 4 Black Instrument Knob5—winged with pointer <sup>1</sup> 4 Standard screw Fit size 29 x 20mm 20 Assorted Slider Knobs

#### SEMICONDUCTORS FROM AROUND THE WORLD

£١

A Collection of Transistors, Diodes, Rectifiers, Bridges, SCR's, 100 Triacs, IC's both Logic and Linear plus Opto's all of which are current everyday usable devices





#### BI-PAK'S OPTO BARGAIN OF THE YEAR!



AND we guarantee your money back if you are not

completely satisfied. FULL data etc included Order No. 8X57.

#### **TECASBOTY**

The Electronic Components and Semiconductor Bargain of the Year. A host of Electronic components including potentiometers. I rotary and slider presets. Individual and vertical Resistors of mixed values 220hms to 2M2 — 1,8 to 2 Wath A comprehensive range of capacitors including electrolytic and polyester types plus disc ceramics electera. Audio plugs and sockets of various types plus switches, fuses, heatsinks, wire, nuls bolts gromets, cable clips and tyes, knobs, and P.C. Board. Then add to that 100 Semiconductors to include transistors, diodes, SCR's opto's, all of which are current everyday usable, devices In all a Fantastic Parcel. No rubbish all identifiable and valued in current catalogues at well over £25 00. Our Fight Against Inflation

- Beat the Budget Down with Depression JUST £6.50.

Send your orders to Dept EE6, BI-PAK PO BOX 6, WARE, HERTS. SHOP AT 3 BALDOCK ST,



Use your credit card. Ring us on Ware 3182 NOW and ber you must add VAT at 15% to your order

## CATALOGUE

#### BI-PAKS NEW 1983 CATALOGUE IS OUT!

Presented with a Professional Approach and Appeal to ALL who require Quality Electronic Components, Semiconductors and other Accessories ALL at realistic prices

There are no wasted pages of useless information so often included in Catalogues published nowadays. Just solid facts i.e. price, description and individual features of what we have available. But remember, BI-PAK's policy has always been to sell quality components at competitive prices and THAT WE STILL DO.



We hold vast Stocks "in stock" for fast immediate delivery, all items in our Catalogue are available ex

The Catalogue is designed for use with our 24 hours "ansaphone" service and the Visa/ Access credit cards, which we accept over the telephone.

To receive your NEW 1983 BI-PAK Catalogue, send 75p PLUS 25p p&p to:

# OUND with SINCLAIR

MAKE AMAZING SOUND EFFECTS WITH YOUR ZX 81.

TIMEX Sinclair 1000 or SPECTRUM

THE ZON X81

£25.95 incl p&p & VA1



ZONXBI



- The ZON SOUND UNIT is completely self-contained and especially designed for use with the ZX-81\_TIMEX Sinclair 1000 and Spectrum Computers. It just plugs in a no dismantling or soldering.
- No power pack, batteries leads or other extras.
- Manual Volume Control on panel ample volume from built-in loud-speaker 16K Rampack or printer can be plugged into Standard Sinclair
- ZON X Sound Unit without affecting normal computer operation
- Huge range of possible sounds for Games, Music, Helicopters, Sci-Fi, Space Invaders, Explosions, Gun-shots, Drums, Planes, Lasers, Organs, Bells, Tunes, Chords, etc., or whatever you devise!
- 8 full octaves. Uses 3-Channel sound chip giving programme control of pitch, volume of tones and noise all with envelope control.
- Easily added to existing games or programmes using a few simple "BASIC" lines or machine code.
- No memory addresses used 10 mapped.

FULL instructions with many examples of how to obtain effects and the programmes, supplied. Fully guaranteed. British Made.

\*Except with Spectrum, you need the Spectrum Extension Board Order No. SE1 - PRICE £6.80 inc. VAT.

Payment may be made by Cheque, P.O. Giro. No. 388, 7006. Postal Order or Credit Card.

Export orders:- Bank Cheque, International Money Order, U.S. \* or f





## **NEWS:NEWS:NEWS:NEWS:NEWS:NEWS**



## Yet More Speakers From Wilmslow

New from Wilmslow Audio, PROKITS provide a range of speakers for the home constructor which are ideal for small venue discos, public address, parties, etc. Combining Wharfedale's design expertise with Wilmslow Audio's kit knowhow, they offer true hi-fi quality sound together with high sensitivity to make optimum use of the amplifier power available.

The kits contain everything required for the construction of the speakers except adhesives. Only a

few simple tools are required. Six models are offered: E50PRO (100 watts), E70PRO (150 watts), E90PRO (200 watts), E50PRO SUPER (150 watts), E70PRO SUPER (175 watts), E70PRO SUPER (300 watts). The PRO SUPER range is fitted with special hand-built bass units and the crossover networks are fitted with thermal overload protection for the treble units and for the complete system. The photograph shows the E50PRO and the E90PRO.

Prices range from £218.95 per pair for the E50PRO to £425 per pair for the E90PRO SUPER. Details from Wilmslow Audio Ltd, 35/39 Church Street, Wilmslow, Cheshire SK9 1AS. Telephone 0625 529599.

#### A New Name

Renema Associates is a newly formed O.E.M. company now launching a comprehensive range of products for the Oric-1 computer. Included in this range is a 'Multipurpose/Personnel Records File'. This powerful software permits the mass storage and file handling of confidential information on personnel or products. The package is priced at £15.00.

Also supporting the range is an 'Oric-1 Keyboard Trainer' software package and a growing number of games, books, and accessories for the Oric-1 owner including Oric-1 American T-Shirts. Kenema Associates Ltd, 1 Marlborough Drive, Worle, Avon BS22 ODQ.

# Large Format Clock/Counter

new range of digital counters and clocks using high brightness 3½ inch vacuum fluorescent character display tubes is now available from Greatech Electronics Limited. The digital counters, two, three and four digits accept BCD input with optional blanking and remote display data input control.

The clock model is available in a twelve or twenty-four hour ver-

sion with a mains frequency locked crystal controlled oscillator powered by a battery (rechargeable) during mains failure. (One of these may even be enough to help the Editor of a certain sister electronics magazine get to work on time!)

The display tube's brightness is adjustable and available in white, green, red and yellow. A variety of other colours can be provided by filtering and contrast enhancement provided to suit particular applications. Greatech Electronics Ltd, Hay Lane, Braintree, Essex.



ETI

# **OPTO ELECTRONICS**

#### LEDS

3mm, 5mm, Rectangular Diffuse Gravestone:

Red - 8p

Orange - 8p (not Gravestone)

Yellow - 10p

Green - 10p 3mm Red Battery Status - 20p

5mm Red Flasher - 40p

5mm Bi Colour Red/Green - 50p

3+5mm Red Constant Current - 20p

3 or 5mm Mounting Clips - 2.5p

#### INFRA RED EMITTERS

3mm TIL32 Type - 40p

5mm TIL38 Type - 40p

IRL60 Mini Radial - 30p

IRL80 Side Looker - 40p

#### **INFRA RED SENSORS**

3mm TIL78 Type - 40p

5mm BP103B (Trans) - 45p

Pin Diode (Side Looker) - 85p

NORP12 (Resistor) - 75p

LPT100 (Transistor) -40p

#### DISPLAYS

DL304/307 - 75p

DL704 - 90p

DL500/507 - 85p

DL527/528 - £1.50

DL0727 (Orange) - £2.00

DL0747 (Orange) - £1.00

DL6304/307 (Green) - 80p

RB61000 - £1.60

4 Digit 0.5" Clock - £2.00

9 Digit Calculator - 50p

DL1414 Intellegent - £12.50

#### **OPTICAL ISOLATORS**

IL74 (6 pin) - 60p

ILD74 (8 pin) - 99p ILQ74 (16 pin) - £2.25

4N26 (6 pin) - 53p

#### STARTER KIT

5 each, 4 colours, 3,5mm, Rectangular Gravestone Leds

2 each, TIL38, 78, Photo Diode/2 each, ILD74 ISOL

2 each, DL307, 704, 500/1 x 9 Digit Calculator Stick

£10

For full details of our extensive Opto range a 52 page catalogue is available at £1.25 including P&P & VAT or free with order £10 or over in value.



DICKEN HOUSE, ORCHARD LANE, HARROLD, BEDFORD TELEPHONE: (0234) 720575 TELEX: 825744

**TERMS** — All prices exclusive of VAT and are subject to availability plus 60p P&P.



#### **HOME LIGHTING KITS**

These kits contain all necessary components and full instructions & are designed to replace a standard wall switch and control up to 300w. of lighting.

TDR300K Remote Control £14.30 Dimmer
MK6 Transmitter for above £4.20 Touchdimmer £ 7.00 TD300K

Extension kit for 2-way switching for TD300K £ 2.00

LD300K Rotary Controlled £ 3.50



#### HOME CONTROL CENTRE

This kit enables you to control up to 16 different appliances anywhere in the house from the comfort of your armchair. The transmitter appliance addressed. The transmitter also includes a COMPUTER interface so you can proincludes a COMPUTER interface so you can programme your favourite micro (e.g. ZX81) to switch lights, heating, electric blanket, make your morning coffee, etc., automatically without rewiring your house. JUST THINK OF THE POSSIBILITIES. The kit includes all PCBs and components for one transmitter and two receivers, plus a pre-drilled box for the transmitter. Order as XK112. £42.00

Additional Receivers XK111 £10.00

#### "OPEN-SESAME"

"OPEN-SESAME"

The XX103 is a general purpose infra-red transmitter/receiver with one momentary (normally open) relay contact and two latched transistor output. Designed primarily for controlling motorised garage doors and two auxillary outputs for drive/garage lights at a range of up to 40 ft. The unit also has numerous applications in the home for switching lights, TV, closing curtains, etc. Ideal for aged or disabled persons.

Curreins, etc. local pressors.

The King prises a mains powered receiver, a fine futton transmitter, complete with prescribed by a complete complet

**ONLY £23.75** 

#### 3-NOTE DOOR CHIME

Based on the SAB0600 IC the kit is supplied with all components, including loudspeaker printed circuit board, a pre-drilled box (95 x 71 x 35mm) and full instructions.

Requires only a PP3-9V battery and push-

switch to complete.
AN IDEAL PROJECT FOR BEGINNERS. Order as XK102

FEATURES INCLUDE

£5.00

THE MULTI-PURPOSE TIMER HAS ARRIVED

Now you can run your central heating, lighting, hi-fi system and lots more with just one programmable timer. At your selection it is designed to control four mains outputs independently, switching on and off at pre-set times over a 7 day cycle, e.g. to control your central heating (including different switching times for weekends), just connect it to your system programme and set it and forget it—the clock will do the rest.

Have you got our FREE ORANGE CATALOGUE yet?

NO?! Send S.A.E. 6" × 9" TODAY!!

It's packed with details of all our KITS plus large range of SEMICONDUCTORS including CMOS, LS TTL, linear, microprocessors and memories; full range of LEDs, capacitors, resistors, hardware, relays, switches etc. We also stock VERO and Antex products as well as books from Texas Instruments, Babani and Elektor.

ALL AT VERY COMPETITIVE PRICES.

ORDERING IS EVEN EASIER — JUST RING THE NUMBER YOU CAN'T FORGET FOR PRICES YOU CAN'T RESIST.

5-6-7 8-9-10

and give us your Access or Barclaycard No. or write enclosing cheque or nostal order. Official orders accepted from schools, etc.

cheque or postal order. Official orders accepted from schools, etc.

service evngs

& weekends

#### **REMOTE CONTROL KITS**

FOR A DETAILED BOOKLET ON REMOTE CONTROL — send 30p + 6"×9" S.A.E

MK6 SIMPLE INFRA RED TRANSMITTER Supplied with hand-held plastic box. Requires 9V (PP3) battery

Mains powered with triac output to switch up to 500W at 240V ac. Range approx 20 ft. on/off or momentary control. 62.00 MK0 24.00 kg. Range approx 20 ft. on/off or momentary control. 62.00 KC 500K - special price for MK6/MK7 F12.50 MK94 WAY KEYBOARD F12.50 MK10 16 WAY KEYBOARD F12.50 MK10 16 WAY KEYBOARD F12.50 MK10 16 WAY KEYBOARD F12.50 KK10 16 WAY KEYBOARD F12.

MK11 10 channel +3 analogue o/p receives

A mains powered LR receiver providing control signals to 10 on/off and 3 analogue circuits. May be used for controlling the volume of an amplifier, brightness of a lamp, etc.

£12.00 MK1216 CHANNEL LR RECEIVER
A mains powered LR Receiver providing up to 16 outputs for switching.

NOW available in stock

# MICROCOMPUTER

uses FORTH which executes about 10 times faster and requires less program memory than a comparable program using basic. Features 8k ROM, 3k RAM, built in speaker, 40 key keyboard and a 32 × 24 line-flicker free display on TV. Comes supplied complete with leads, mains adaptor, a comprehensive easy-to-follow manual on Forth programming + FREE cassette containing 5 sample programs.

**ONLY £75.00** 

(+ £2.00 carriage + VAT)

JUPITER ACE SOFTWARE

JUPITER ACE SOFTWARE

J3 SPACE INVADERS £3.90 J5 DOT MAN

J4 SWAMP MONSTERS £3.90 J7 ZAP 'EM (ASTEROIDS) DUCK
SHOOT & MINEFIELD (3 programs) £5.20

WHY NOT COME IN AND SEE IT FOR YOURSELF!

#### **COMPONENT PACKS**

PACK 1 650 Resistors 47 ohm to 10 Mohm --10 per value £4.00

PACK 2 40 × 16V Electrolytic Capacitors 10µF to 1000µF - 5 per value £3.25

PACK 3 60 Polyester Capacitors 0.01 to  $1\mu F/250V = |5 \text{ per value } \textbf{£5.55}$ 

PACK 4 45 Sub-miniature Presets 100 ohm to 1 Mohm — 5 per value £2.90

PACK 5 30 Low Profile IC Sockets 8, 14 and 16 — pin — 10 of each £2.40 PACK 6 25 Red LEDs (5mm dia.) £1.25

#### **ELECTRONIC LOCK KIT XK101**

This KIT contains a purpose designed lock IC, 10-way keyboard, PCBs and all components to construct a Digital Lock, requiring a 4-key equence to open and providing over 5000 different combinations. The open sequence may be easily changed by means of a prewired plug. Size: 7 x 6 x 3 cms. Supply: 5V to 15 V d.c. at 40uA. Ouput: 750mA max. Hundreds of uses for doors and garages, car anti-theft device, electronic equipment, etc. Will drive most relays direct. Full instructions **DNLY £10.50** 

Electric lock mechanism for use with latch

ocks and above kit £13.50

#### XK113 MW RADIO KIT

Based on ZN414 IC, kit includes PCB, wound aerial and crystal earpiece and all components to make a sensitive m niature radio. Size:  $5.5 \times 2.7 \times 2$ cms. Requires PP3 9V battery. IDEAL FOR BEGINNERS £5.00

#### **DVM/ULTRA SENSITIVE** THERMOMETER KIT

This new design is based on the ICL7126 (a lower power version of the ICL7106 chip) and a 31/2 digit liquid crystal display. This kit will form the



basis of a digital multimeter (only a few additional resistors and switches (only a few additional resistors and switches are required—details supplied), or a sensitive digital thermometer (-50°C to +150°C) reading to 0.1°C. The basic kit has a sensitivity of 200mV for a full scale reading, automatic polerity indication and an ultra low power requirement—giving a 2 year typical battery life from a standard 9V PP3 when used 8 hours a day, 7 days a week.

Price £15.50

#### **DISCO LIGHTING KITS**

DL 1000K
This value for-money kit features a bi-directronal sequence, speed of sequence
and frequency of direction
change, being variable by means of potentiometers and incorporates a master dim-Varia. ming control

£14.60

DL2100K
A lower cost version of the above, featuring undirectional channel sequence with speed variable by means of a pre-set pot. Outputs switched only at mains zero crossing points to reduce radio Interference to a minimum.

Only £8.00

Optional opto input DLA1
Allowing audio ("beat") — light 60D

Disology
This 3 channel sound to light kit features zero voltage switching, automatic level control and built in mic. No connections to speaker or amp required. No knobs to adjust — simply connect to mains supply and lamps. (1Kw channel)

Only £11.95

#### MINI KITS

MK1 ELECTRONIC THERMOSTAT Uses LM3911 IC to sense temperature (80°C max) and triac to switch heater (1KW). Mains powered.

Uses LW39111C to sense temperature (80°C may) and tract to switch heater (1KW1, Mains powered MK2 SOLID STATE RELAY Switches 240V ac motors, lights, heaters from logic/computer circuits. Zero voltage switching, opto-isolated. Supplied without triac 22.60 MK4 PROPORTION (150 MK4 PROPORT

remote control kiss. See femote control kiss. NEW MK19 DC CONTROLLED AUDIO AMPLIFIER May be used with virtually any stereo audio amplifier to control bass, volume, treble and balance remotely aither using a wire link or the interior to the control bass. woutine, replie and balance remotely either using a wire link or the MK11 ntra red receiver. A 1 of 10 decoder with LEDS is also included for remote nput selection/display. (See remote control kits.)

#### 24 HOUR CLOCK/APPLIANCE TIMER KIT

Switches any appliance up to 1kW on and off at present times once per day. Kit contains: AY-5-1230 IC, 0.5" LED display, mains supply, display drivers, switches, LEDs triacs, PCBs and full instructions

CT1000K Basic Kit CT1000K with white box (56/131 x 71mm) (Ready Built)

For a detailed booklet on

\*\*EATURES INCLUDE: 0.5" LED 12 hour display.

Day of week, am/pm and output status indicators.

4 zero voltage switched meins outputs.

50/60Hz meins operation.

Battery backup saves stored programmes and continues time keeping during power failures. (Battery not supplied).

Display blanking during power failure to conserve battery properties.

18 programme time sets.

Powerful "Everyday" function enabling output to switch every day but use only one time set.

Useful "sleep" function—turns on output for one hour.

Direct switch control enabling output to be turned on immediately or after a specified time interval.

20 function keypad for programme entry.

Programme verification at the touch of a button.

Kit includes all components. PCB. assembly (Kit includes all components, PCB, assembly and programming instructions). ORDER AS CT5000

remote control — send us 30p

ALL **PRICES** and S.A.E.  $(6'' \times 9'')$  today. **EXCLUDE VAT** 

No circuit is complete without a call to

NOW E39 WITH SO MANY EXTRA FEATURES.

OPTIONAL BLACK

PLASTIC CASE. READY DRILLED £2.50

LCD 31/2 DIGIT MULTIMETER

of ranges including DC voltage (200 mv-1000 v) and AC voltage, DC current (200 mA-10 A) and resistance (0-2 M) + NPN & PNP transistor gain and diode check. Input impedance 10M. Size 155x88x31 mm. Requires PP3 9v battery. PP3 9v battery. ONLY £29.00

Add 65p postage & packing + 15% VAT to total Overseas Customers; Add £2.50 (Europe), £6.00 (elsewhere) for p&p Send S. A. E. for further STOCK DETAILS. Goods by return subject to availability.

OPEN 9am to 5pm (Mon to Fri) 10am to 4pm (Sat)

CLOCK TOWER

IRCULAR RD

UXBRIDGE ROAD







01-579 9794 ENQUIRIES 01-579 2842 TECHNICAL AFTER 3PM

SERVICE - TOP QUALITY - LOW LOW PRICES

ETI



TEL: 01-567 8910 ORDERS



is an alternative to AUTOMATIC TEST EQUIPMENT which can be very expensive. MICRODOCTOR is perfectly adequate for diagnosing faults in microprocessor boards or computers in the REPAIR SHOP or on the PRODUCTION LINE. Reports are PRINTED on the integral thermal primer. Tests supported are CHECKSUM, RAMTEST, WAIT, READ, WRITE, I/O READ, I/O WRITE, DUMP IN HEX, DUMP IN ASCII, TEST DATA LINES (for shorts between data, address and rails), SEARCH (for two specified bytes), MAP (print a memory map of ROM, RAM, I/O and EMPTY SPACE). Supports both multiplexed and non-multiplexed address/data. Standard software will also DISASSEMBLE in ZBO mnemonics—other disassemblers, cost extra. Programs for board-testing can be written in MINUTES—and retained for MONTHS even if the power is switched off (CMOS RAM is backed-up with rechargeable battery). Capacity is 15 different programs of 12 tests each. Included are two PROBE CONFIGURATION CARDS (One ZBO, other uncommitted), PROBE with 24 inch cable and 40-pin DIL plug—and POWER SUPPLY.

- alla FOWER SOFFET.	
OPTIONAL EXTRAS	
6502 Disassembler Card	£35.00
6800 Disassembler Card	£35.00
8085 Disassembler Card	£35.00
Clip-over PROBE (only needed if uP is soldered-in)	£35.00
Thermal Paper (10 Rolls)	€9.00
Spare configuration cards	£6.50



uses the MOST POWERFUL LANGUAGE OF ALL — direct ASSEMBLER MNEMONICS.

MENTA has VISUAL AIDS to program development which the big systems lack: a TV display of PROGRAM, REGISTERS and STACK, single-step operation (watch the cursor move from instruction to instruction, see the register-contents change, observe stack operations, etc.) BUGS can be fixed immediately without reassembling. Full speed operation is supported too — with or without BREAKPOINTS. Designed originally for the Schools' Council to teach microprocessing. MENTA is a complex CONTROLLER in its own right, like any other Z80 system, with practical, commercial applications in ROBOTICS. Features include CASSETTE INTERFACE, ASSEMBLER/EDITOR, serial DISASSEMBLER

24 bits of I/O — also TV FLYLEAD, POWER SUPPLY and COMPREHENSIVE MANUAL with SOURCE-CODE LISTING.

MODULES AVAILABLE

MODULES AVAILABLE

MODULES AVAILABLE

Liniversal input/Output Device £21.00

Analogue to Digital Converter £18.00

Digital to Analogue Converter £14.00

D.C. Motor and Current Buffer. £12.00

Switching Input Module Analogue/Digital £10.00

Pupil Reader £2.50

Teacher's Guide £2.50



Dataman Designs Retrofit for 7.42080

Gives R.S. 232 output facility for printed STATE and TIMING diagrams. Also DISASSEMBLES in Z 80, 6502 or 6800 mnemonics on-screen or to printer.

Olivetti Typewriter Interfaces

for ET121 and ET221 machines which permit the typewriter to be used as a DAISY WHEEL PRINTER for computers implementing the RS232, IEEE 488 (PET) or CENTRONICS PARALLEL busses, almost all computers in fact. Great for word processing and letter writing! Same price, fitting free if requested (you pay carriage or typewriter if we fit). £195.00

Ultra-Violet Eprom Erasers from

£33.00



# Softy Eprom Programmer/Emulator

SOFTY has functions equal, at least, to equipment which sells for over £500. SOFTY EMULATES AND PROGRAMS 2716, 2732, 2532 EPROMS. (The type is selected by a personality switch. SOFTY will copy any of these EPROMS to any other). SOFTY has a HEX KEYPAD, a fast CASSETTE INTERFACE, a MEMORY MAP TV DISPLAY with powerful editing — such as INSERT, DELETE, SHIFT-BLOCK and many other facilities — too many to list here. R5232 SERIAL and CENTRONICS PARALLEL routines for INPUT and OUTPUT are standard. The price includes TV FLYLEAD, POWER SUPPLY and ROM EMULATOR CABLE WITH 24 PIN DIL PLUG. SOFTY is used as a DEVELOPMENT SYSTEM for new products or just as a STAND-ALONE EPROM PROGRAMMER.

Adequate performance prices at sensible prices

LOMBARD HOUSE, CORNWALL ROAD, DORCHESTER, DORSET DT1 1RX. Telephone: Dorchester (0305) 68066 Telex 418442 DATAMAN

Prepaid orders normally shipped by return. Prices include first-class recorded post in UK. Securicor. Red Star. etc. at extra cost. VAT should be added at current rates.

Carriage Free on Orders in excess of £50.00 Add,£2.50 if less

# **AUTOCOMPASS**

Don't say we aren't good to you! Not only is this a unique and cheap-to-build project featuring some unusual techniques, but it also gives an insight into a little-known area of binary numbers. Design by Nigel Collier.

his novel project describes the operation and construction of an electronic compass specifically designed for use in automobiles. The unit can distinguish 16 different headings, and uses a dot matrix LED display to register the car's heading in nautical point and quarterpoint notation - for landlubbers this means N, NNE, NE, ENE and so on. The display dims automatically as the ambient light level drops.

The whole assembly, which is simply compensated for accurate readings inside the metal body of the car, is housed in an elegant matt black box, complete with a fixing bracket which enables it to be positioned almost anywhere in the

car.

Finally, the sensor itself is designed using an apparently newlydiscovered set of binary numbers!

#### The Circuit

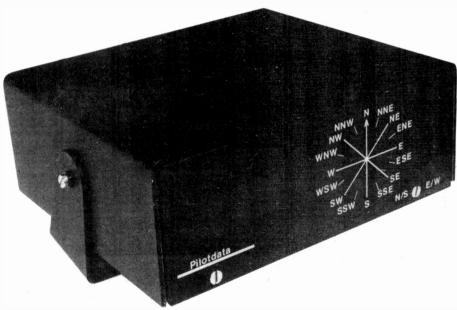
The unusual sensor, details of which are given later, generates a four-bit code, with each of the 16 possible numbers corresponding to a different heading. The remainder of the logic circuitry is based around a 2716 2K EPROM (at last, a non-computer-orientated use for an

The EPROM contains the data necessary to give meaningful alphabetical displays as the perceived heading is updated. A listing of the data contained in the EPROM can be obtained from us on receipt of an s.a.e., for those amongst you with access to an EPROM programmer. Don't worry if you haven't though; ready-blown EPROMs will be available (see Buylines).

The display consists of two 7 x 5 dot matrix displays type DL5735, manufactured by Litronix. These are arranged to form three adjacent display sections with areas of 5 x 5. 4 x 5 and 5 x 5.

#### Sensor Design

The operation of the sensor can best be described by looking at Fig. 1. The central pillar, topped by the pivot needle, is made from transparent perspex and houses the incandescent light source. Balanced on the pivot needle is the compass



#### PARTS LIST

	VK12 FI21
Resistors (all	1W, 5% except where
stated)	111, 211
	1k0
R2-6,9	4k7
	10k
	not used
11110,01,00	470R
R11-15,	al =
	2k7
R16-29,26-30	15R, 1W
R31,32	13K, 144
Potentiomete	rs
PR1,2	100R miniature horizontal
	preset. 3W rating
l i	
Capacitors	
C1	220nF polyester 470uF 6V3 axial
C2	470uF 6V3 axial
	electrolytic
	47nF polyester
	2n0 polystyrene
C8	2u2 63 V axial electrolytic 1n0 polystyrene
C9	ino polystyrene
Semiconduct	Ore
I IC1	2716 single rail EPROM
II.c.	(+5 V)
IC2	4017B
1C3,4	4001B
IC5	7472
IC6	7475
10.70	74LS367
1C9	7805
11000	ULN2003
	BC212L BC182L
	OP500 phototransistor
Q12-16 DISP1,2	DL5735 dot matrix LED
DISF 1,2	display
11	/
Miscellaneou	ıs
LDR1	ORP12
L1-4	500 turns of 40 swg
	enamelled copper wire on
	1M0 1W resistor (see text)
PCBs (see	Buylines); sensor (see
	se (see Buylines); mounting
I hardware, w	are etc.

#### BUYLINES.

hardware, wire etc.

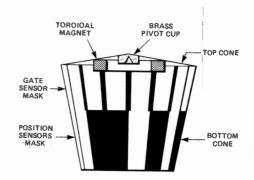
A ready-built sensor, complete with phototransistors, is available for £8. The two double-sided PCBs, both with silkscreened component identification, are available for £6.50 the pair. Customer-supplied EPROMs will be programmed for 40p plus postage. Preprogrammed 2716 EPROMs are available for £3.00. An Autocompass case plus silk-screened perspex front panel is available for £4.00. Finally, a complete kit of parts, down to the last nut and bolt, will be supplied for £35.00 plus £1.50 postage and packing. All the above are available from Pilotdata Ltd, 2 Derwent Close, Wokingham, Berks.

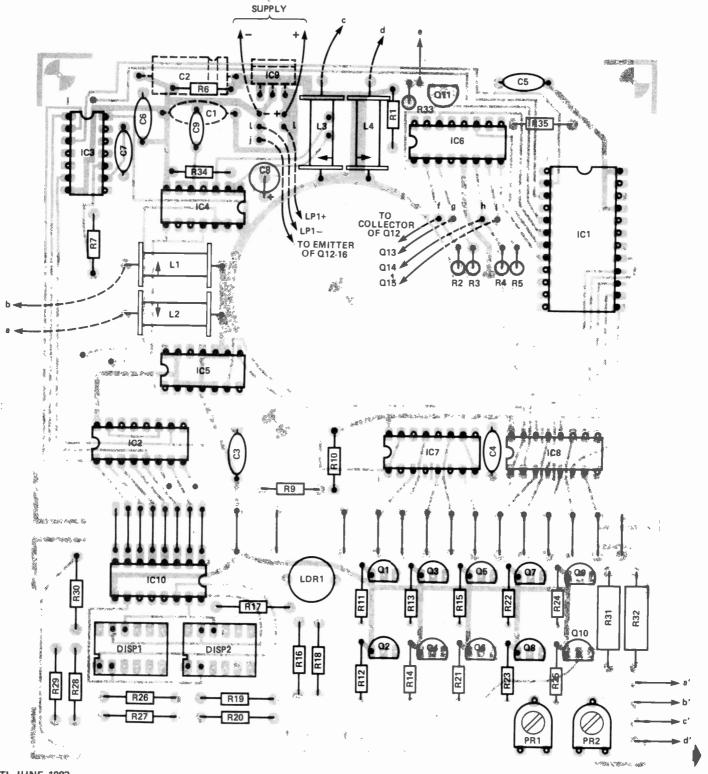
mask — this is free to both rotate and tilt. A toroidal magnet, magnetised through its major diameter, is fixed to the mask. Thus the mask will always orientate itself in the same direction (with respect to the Earth's magnetic field) as the car's heading changes.

The mask pattern is designed such that the four phototransistors arranged around the circumference of the mask can unambiguously encode the sensor heading. For those who are interested in this sort of thing, a full description of the coding method used is given in the box entitled 'Cyclic Binaries'.

This form of coding, rather than a standard four-bit coding for four phototransistors positioned in a vertical line, was necessary to stop

Fig. 1 (Right) The sensor mask. Fig. 2 (Below) Component overlay.





erroneous coding occurring as the mask tilts (as it is inclined to do as the car accelerates or corners). The fifth phototransistor, Q16, reads another part of the mask, and only allows the logic circuitry to update the sensor heading when the four 'position' phototransistors are nicely matched with a mask section.

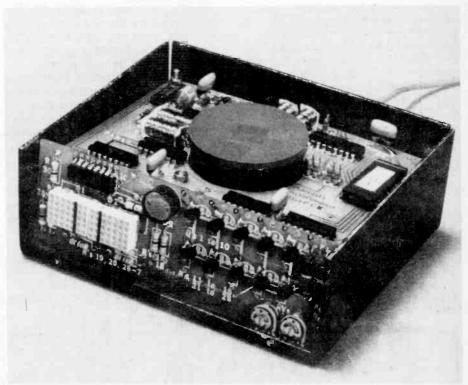
The whole assembly is fluid-damped to stop unnecessary oscillations. A somewhat incongruous loop of silicone tube is fixed onto the side of the housing. This is not a way of getting rid of spare balloons from the Christmas party — it is present to absorb any changes of volume of the damping fluid that occur with changes in temperature.

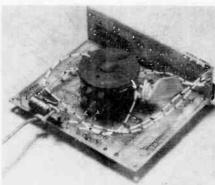
#### Construction

Because of the difficulties involved in the making of the compass mask, it is not recommended that the average home constructor should attempt to build his (or her) own sensor from scratch. Ready-built and tested sensors are available from Pilotdata at the address given in Buylines. We doubt if many of our readers are keen on metal-bashing either, given that Pilotdata can supply the case assemblies ready-screened and painted, but dimensions are available from us if you send a stamped addressed envelope

From an electronic point of view there are few problems posed by the construction — however, you will need a soldering iron with a very fine bit.

The main PCB is double-sided but not plated-through. There are seven points where isolated tracks on opposite sides of the board need to be joined with a linking pinthese are shown with a dot on our overlay and a 'p' on the silkscreened legend on the manufactured boards. Any other component lead or IC pin indicated with a dot should also be soldered both sides. The 10 terminal pins for the off-board connections must be all pushed through from the component side of the PCB. The voltage regulator and its two associated capacitors, C1 and C2, are shown in dotted outline on the overlay and must be soldered onto the underside of the PCB. The leads of the voltage regulator should be carefully pre-bent such that the mounting hole of the regulator is 19 mm below the underside surface of the PCB and flush with the edge of the board when soldered in

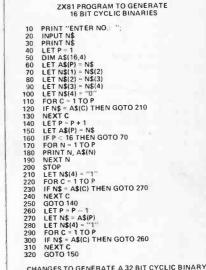




These two internal shots should help with construction.

position. Using an epoxy adhesive, fix a 5/16" 6BA screw into the regulator mounting hole with the screw thread protruding out backwards from the body of the PCB.

The four coils are wound on 1 megohm, 1 W resistors. Each resistor is prepared by glueing onto each end a 9 mm square plastic or cardboard pad to retain the wire.



CHANGES TO GENERATE A 32 BIT CYCLIC BINARY

50 DIM A\$(32,5) 95 LET N\$(4) = N\$(5) 100 LET N\$(5) = "0" 160 IF P < 32 THEN GOTO 70 210 LET N\$(5) = "1"

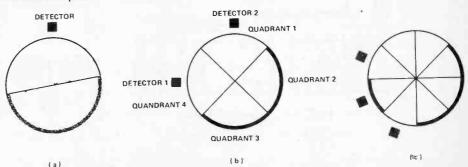


Fig. 3 Using cyclic binaries to detect shaft position.

# **PROJECT: Autocompass**

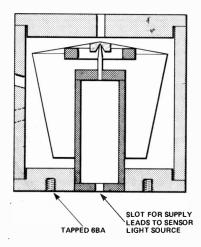


Fig. 4 (Above) A cross-section through the sensor housing.

Fig. 5 (Right) Generating the cyclic binary for Fig. 3c.

100 000 000 100 000 001 101 101 001 <u>001</u> ROUTE (1) 111 100 <u>001</u> 000 ROUTE (2)

CYCLIC BINARIES.

The mask pattern of the compass sensor owes its existence to a group of numbers which the author has called 'cyclic binaries'. So far as we are aware, this intriguing set has so far been ignored by the mathematicians, though if anyone knows otherwise, we would be delighted

to hear from them. Consider a cross-section of a shaft (Fig. 3a) whose circumference is half white and half black. A single detector is sufficient to determine which side of the shaft is nearest the detector, by detec-

ting the local shaft colour.

Using the same shaft, let us now introduce a second similar detector such that the angle subtended by the two detectors at the axis of the shaft is 90° (Fig. 3b). The position of a point on the shaft can now be narrowed down to one of four quadrants. This table gives the truth table for the four possibilities:

Q1	Q2	Quadrant
Black	Biack	1
Black	White	4
White	Black	2
White	White	2

In these examples the detectors are obviously binary detectors: we can call black a 0 and white a 1. Thus in Fig. 3b the shaft's rotational position has been

encoded as a two-bit number.
Can we extend this system to three numbers, so as to encode for eight sectors? We can, but the shaft's pattern now becomes a bit more complex (Fig. 3c). As in the case for one or two detectors, the pattern is unique (ignoring simple rotations and mirror images) in generating a separate three-bit number for each of the eight sectors. Note that the detectors now subtend angles of 45° to their neighbours.

Now the colouring of the three-sensor shaft pattern can be represented by an eight-bit binary number arranged in a circle thus:

I propose to write this number thus:

11100010<sub>c</sub>
The subscript C signifies that the binary is cyclic, ie its end is joined to its start. (Note that it doesn't matter at what point in the number you start, or in what direction you proceed: 10001110c is the same number).

Now for four detectors with 22.5° separation: the arrangement used in the Autocompass. The shaft pattern is now divided into 16 sectors: are there any patterns which yield a unique four-bit number for each of the discernable rotational positions? The answer is obviously yes, since one is used in the compass sensor. In fact there are six such numbers (not counting rotations and reflections), and these six can be split up into three pairs. Each pair consists of a number and its inverse (ie each 1 becomes a 0 and vice versa). The pairs

01101011111000010c and inverse 10000110101111100c and inverse 1000010111101001<sub>c</sub> and inverse

far as we know, perfect cyclic binaries (ie ones that generate unique positional data for each of their sectors) can be found for any number of sensors. For the sake of interest, the table below shows perfect cyclic binaries for five, six and seven sensors.

FIVE BIT. 000001111101110011010110100101001 000000111111011110011101011100011011010011001 0110000101010001001<sub>C</sub>

000000011111110111110011110101111000111011011-

How can perfect cyclic binaries be generated? Consider the case of determining the cyclic binary for three sensors. Figure 5 shows the search tree involved: we have arbitrarily started from '000'. If the shaft rotates one position from right to left, the new number will be '00?'. The least significant digit can be 0 or 1, but if it is 0, we have a repeat of the first number, so it must be a 1. The tree shows the continuation of this process. Every underlined number is a

repeat.
The completed tree shows two routes through all eight numbers and back to the starting number. Selecting the first digit of each number along the routes, we get:

00010111<sub>c</sub> (Route 1) 00011101<sub>c</sub> (Route 2)

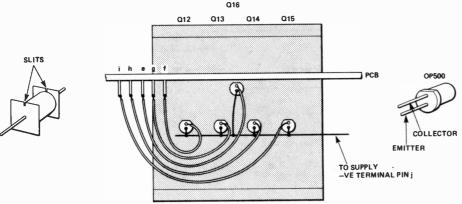
ie both routes yield the same number.

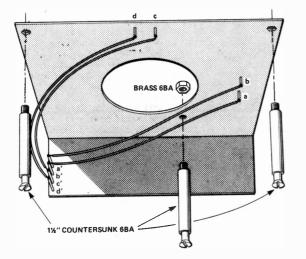
For larger cyclic binaries, drawing the tree out becomes impractical, but the search method is ideally suited to adaptation to a computer program. We've given a program here, in BASIC, which has been written for a ZX81 and will perform a tree search to generate 16-bit cyclic binaries — all you have to do to start it is enter a four-bit number.

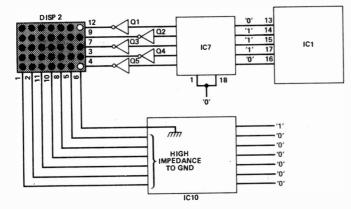
The most obvious drawback of using cyclic binaries for determining the rotational position of a shaft is that an addi-tional gating phototransistor is necessary. This would be superfluous if the cyclic binary was also Gray-coded. Gray-coded binary number sequences are special in that any two adjacent numbers in the sequence only differ by one binary digit. The following table shows a representative Gray coding sequence to illustrate the property:

Do 'super-perfect' Gray-coded cyclic binaries exist? We think not, but this judgement is based on a very limited investigation.

If you wish to search for superperfect cyclic binaries, here are a couple of hints. First, note that the detectors do not need to be adjacent (though any rotationally symmetrical arrangement of detectors will lead nowhere). Second, looking for cyclic Gray-coded sequences will be easier than looking for Gray-coded cyclic binaries (if you get the distinction!). Good luck.







IC6 OUTPUT	<b>VERSUS SE</b>	ENSOR HE	ADING		
SENSOR HEADING	A3 (PIN 1)	A2 (PIN 14)	A1 (PIN 11)	A0 (PIN 8)	DECIMAL
N	1	1	1	0	14
NNE	1	1	1	1	1 <u>5</u>
NE	0	1	1	1	7
ENE	1	0	1	1	11
F	i	1	0	1	13
ESE	Ò	1	1	0	6
SE	Ŏ	0	1	1	3
SSE	ĭ	0	0	1	9
S	Ó	1	0	0	4
SSW	ĭ	Ó	1	0	10
SW	'n	ĭ	0	1	5
WSW	Ŏ	Ò	1	0	2
W	ő	ŏ	Ó	1	1
WNW	0	ŏ	Ö	0	0
NW	1	ŏ	ŏ	0	8
NNW	i	ĭ	ŏ	Ō	12

Fig. 6 (Above) Coil and sensor details.

Fig. 7 (Left) The PCB fixing bolts fit here.

Fig. 8 (Below left) Circuit operation shown frozen at one point in the multiplexing.

Q12-16 are phototransistors attached to the compass sensor. The voltage present at the collector of any one of the phototransistors is pulled up to a logic 1 level by the resistors R2-5 and R33, so long as the phototransistor in question is shaded from the sensor light source by the compass mask. Once exposed to light, a phototransistor will turn on and its collector voltage will drop to a logic 0. 1C6 is a four-bit bistable latch. So long as phototransistor Q16 is shaded.

IC6 is a four-bit bistable latch. So long as phototransistor Q16 is shaded, the latch outputs will present the inverse of the latch inputs. However, once Q16 is exposed to light, the latch will hold the last four-bit input, irrespective of any further changes in input. In other words, IC6 is a memory device, supplying IC1 with information concerning the sensor position at the last positional update. Table 1 shows the output of IC6 with reference to the sensor positions.

The rest of the logic circuit converts the four-bit output of IC6 to an alphanumeric display of the sensor heading. IC3c,d are configured with R7 and C7 as an astable multivibrator. With the values chosen, this generates a

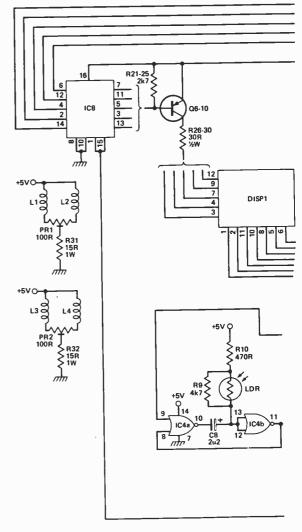


Fig. 9 Autocompass circuit diagram.

#### HOW IT WORKS.

square wave of about 25 kHz, which is

fed to the clock input of IC2.
IC2 is a 4017 counter-divider: only one of the chip's 10 outputs can be high at any one time. Every positive transition of the clock signal advances the high output to the next pin in sequence, from right to left in the circuit diagram. Once pin 6 is driven high it activates the monostable multivibrator configured around IC4a,b. The monostable is, in effect, a pulse stretcher. The output of the monostable (pin 11) is normally low. When pin 9 of IC4a goes high, the output simultaneously goes high. As IC4b pin 11 is connected to the 4017 clock inhibit (pin 13), this immediately stops any

further clocking of the 4017's outputs.
The length of time that IC4b pin 11
remains high is dependent on the
resistance of the LDR. The more light
that falls on the LDR, the lower is its
resistance, the quicker C8 charges, and the shorter is the resultant length of the output pulse. Once pin 11 returns low again, the 4017 is free to continue clocking on the next positive clock signal transition. When IC2 pin 11 goes high, it drives the reset pin (pin 15) high which

starts the whole cycle again by sending pin 3 high. To summarise, the 4017 outputs sweep from pin 3 to pin 5; then there is a delay with all the relevant out-puts of the 4017 low, this delay being dependent on the ambient light level, before the cycle repeats. It can therefore be seen that the delay constitutes a display brightness control.

IC10 is a seven-stage Darlington driver. As each input of IC10 goes high, so the corresponding output is grounded, which in turn grounds the cathodes of the five LEDs in the relevant row of each display matrix. This constitutes one-half of the display multiplexing

IC1 is an EPROM which produces a specific eight-bit output at pins 9-1 13-17 (only the latter five being used) depending on the state of the 11 address input pins. We have seen that pins 5-8 of IC1 depend on the sensor heading, being driven by the outputs of IC6. The remaining seven address lines define the position of the multiplexing cycle.

The two dot matrix displays together have 14 vertical columns: the 4017

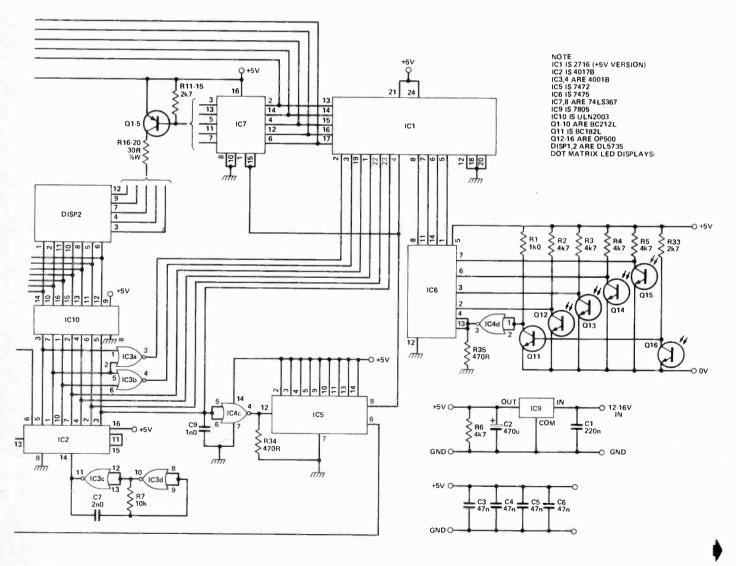
cycles through seven states. Therefore

the multiplexing circuit must service one display at a time. This is organised by olspiay at a time. This is organised by IC5, a flip-flop. Every time the 4017 starts a new cycle by sending pin 3 high, the outputs of IC5 (pins 8,6) change state. Pin 8 is always the inverse of pin 6. IC5 pin 8 addresses pin 4 of the EPROM: thus pin 4 high means 'multiplex display while pin 4 low means 'multiplex display 2'

The remaining six address lines of IC1 are driven by the outputs of IC2. The two NOR gates IC3a,3b compress the information on IC2 pins 10,1, and 5 to

the two lines on pins 2 and 3 of IC1.
IC7 and IC8 are tristate buffers. They
are gated on by the two outputs of IC5 such that only one is on at a time. Both receive the data output from IC1, and each in turn uses the data to supply current to the anodes of the LEDs in its display via the current amplifiers Q1-10.

To help show what is going on, Fig. 8 shows the multiplexing at one instant of time. Note that Q1-10 act as inverters, so a 0 at the output of the EPROM defines an LED which is lit. In this case the display could be showing the last column of, say, "NNE".

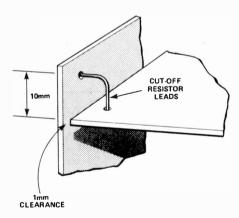


# **PROJECT: Autocompass**

The wire is 40 gauge enamelled copper wire, and 500 turns are needed on each resistor — this won't take you as long as it might seem! Remember to scrape off the insulation from the free ends before attempting to solder them to the resistor leads. Each pair of coils consists of one which has been wound 'right-handed' and one which has been wound 'left-handed'; ie they are not capable of superimposition, one being the mirror-image of the other. Label the two types unambiguously.

The display has four terminal pins but does not require any linking pins: all through-board connections here are made by soldering the necessary component leads on both sides (again indicated by dots). After soldering the terminal pins, which again are inserted from the component side, solder in the LED dot matrix displays. Mount them so that their pins only protrude about 1 mm from the rear of the PCB: this allows sufficient clearance to solder to the tracks on the front of the PCB. Save the clipped leads from the resistors they will be ideal later for joining the two PCBs together.

The boards are mounted so that the main PCB lies 10 mm below the top edge of the display PCB, and 1 mm free of the underside of the display PCB. The diagram shows the



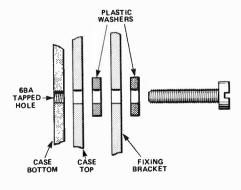


Fig. 10 It goes together like this . . .

method used to join the boards (Fig. 10).

The interwiring of the coils to the display PCB and the sensor to the main PCB is straightforward: just keep the wiring short and neat and remember that all the wiring is taken from the underside of the PCBs. Note that the phototransistors protrude from the sensor towards the back of the instrument.

The assembly of the two PCBs and the sensor fits snugly into the case bottom, being fastened in place with three 1½" screws which have slide-on spacers. Two 6BA x 3/16" countersunk screws fix the sensor housing to the case bottom, and a further two attach the perspex fascia. The case top and fixing bracket are attached using two 6BA x ½" screws, as shown in Fig. 10. Note that the fixing bracket can either be fixed underneath the unit as shown in the photos, for dashboard mounting, or the other way up so that the compass may be hung from the car roof.

#### **Setting Up**

When benchtesting the completed PCB assembly, remember to adequately heatsink the 5 V regulator. The display is multiplexed, and so the DC current through each LED can exceed 100 mA (though for a few microseconds only, of course). But, were the oscillator to be inoperative then it would be perfectly possible to blow up the display. So play it safe temporarily disconnect the 5 V supply to the display PCB by desoldering the ninth board-linking pin from the right-hand side (viewed from the front) and check on an oscilloscope that the waveforms are what they should be (see Fig. 11).

If you don't have an oscilloscope, don't despair: an LED with a 200R resistor in series will suffice. Ground the appropriate end and touch the LED's anode end to the output pins of the 4017 (pins 1, 2, 3, 4, 5, 6, 7, 10). When operating correctly, the LED should glow very dimly (you may need to turn off the lights to detect it). If, on the other hand, one of the channels lights the LED brightly, with the remaining channels off, then you have a fault. However, with reasonable care in construction, the compass should work first time.

The only adjustment required is the setting of the bias coils to null out the car's magnetic field. Using a map (or a second compass outside the car), position the car so that it is pointing north. If the Autocompass

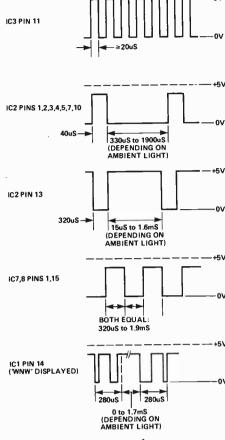


Fig. 11 Some test waveforms.

does not read north, it is because of the car's field component which lies at right angles to the car's long axis. We can nullify this component by rotating the pot labelled 'N/S' until the compass reads north.

Now the car must be positioned to point east. If the compass does not read east, it can only be because of the car's field component which lies parallel to the car's long axis. So adjust the 'E/W' pot to neutralise this component, and the compass is compensated.

#### Installation

The Autocompass has been designed to be easily fixed into a car, but there are a few cautionary points that must be made. First, keep it away from any loudspeakers, as they possess strong magnets which can overcome even the compensation circuits. Second, ensure that the top of the box is as level as possible in its final position - the sensor will tolerate quite a bit of tilt, but if it is level at rest then its operational range will be enhanced. Finally, the display can consume about 800 mA with the display flat out, so an in-line fuse may be ETI desirable.

## MIDWICH COMPUTER COMPANY LIMITED

FAST EX-STOCK DELIVERY OF MICROCOMPUTER COMPONENTS AT UNBEATABLE PRICES

	MEMORIES 2114L-200ns D1 0.80	75451 <b>0.22</b>	ZN429 D1 2.10	4510 0.40	193 <b>0.35</b> 194A <b>0.35</b>
Official <b>BBC</b> Dealer	2708 450ns D2 2.95 2716 450ns D1 2.45	75452 <b>0.22</b> 75453 <b>0.22</b> 75454 <b>0.22</b>	ZN432 D1 13.00 ZN449 D1 2.55	4511	195A 0.35 196 0.45
### 8BC COMPUTERS    Model B + Disc Interface   441.95     (carriage 650 by Securicor)	2716 350ns D1 4.95 — 2716 3 rail D1 7.25 2532 450ns D2 3.45	75468	CRYSTALS 1 M 2.75 1.008 M 2.75	4515 <b>0.96</b> 4516 <b>0.40</b> 4518 <b>0.40</b>	197 <b>0.45</b> 221 <b>0.48</b> 240 <b>0.55</b>
BBC MICRO OISC DRIVES BBC 31 Single 100K Drive Expandable to	2732 450ns <i>D1</i> <b>3.45</b> 2732 350ns <i>D1</i> <b>5.45</b> 2764 300ns <i>D1</i> <b>5.99</b>	AY31015 D2 <b>3.00</b> AY31270 <b>6.47</b> AY38910 D6 <b>4.40</b>	1.8432M 1.92 2.4576M 2.00 3.6864M 1.86	4519 <b>0.27</b> 4520 <b>0.40</b> 4521 <b>0.90</b>	241 0.55 242 0.55 243 0.55
BBC 31 Single Floor Orive Expandable to 229.00 BBC 32 Dual 100K Drives 340.00 BBC 33 100K Upgrade for BBC 31 122.00	4116 150ns D2 0.85 4116 200ns D2 0.80 4118 150ns D1 3.25	AY53600 D2 <b>6.70</b> DP8304 D1 <b>2.50</b> MC1488 D1 <b>0.37</b>	4M 0.64 6M 0.86 8M 0.86	4522 <b>0.52</b> 4526 <b>0.52</b> 4527 <b>0.52</b>	244 0.55 245 0.70 248 0.55
BBC 34 Dual 400K Drives 649.00 All Disk Drives (except BBC 33) are complete with	5516 200ns D2 9.45 -6116 150ns D1 3.30 6116 Low Power	MC1489 D1 0.37 MC3242A 6.30 MC3446 D1 2.50	9.8304 1.68 19.6608 2.48	4528 0.41 4532 0.72 4541 0.50	249 <b>0.55</b> 251 <b>0.30</b> 253 <b>0.35</b>
Manual Utilities Disc, and Connecting Cables  BBC MICRO UPGRADE KITS	150ns D2 <b>4.95</b> 4164 150ns TI	MC3448A D1 3.75 MC3480 D5 7.30	OIL SOCKETS (TEXAS) PINS TIN GDLD WW	4543 0.50 4553 1.57	257A 0.30 258A 0.35
BBCA2B Complete A to B Upgrade 44.75 BBC 1 16K Memory 18.00	D3 4.45 4164 200ns TI D3 3.95	MC3487 D1 2.00 MC14411 D1 7.65 MC14412 9.45	8 7 16 25 14 10 26 35	4555 <b>0.35</b> 4556 <b>0.35</b> 4585 <b>0.75</b>	259 <b>0.55</b> 261 <b>1.00</b> 266 <b>0.20</b>
BBC 2 Printer/User 1/0 Kit 7.50 BBC 3 Disc Interface Kit 95.00 BBC 4 Analogue Input Kit 6.70	4164 150ns Mostek D3 4.45	MC14412 9.45 R032513L <i>D1</i> <b>6.50</b> R032513U <i>D1</i> <b>6.50</b>	16 10 29 40 18 13 33 50 20 15 37 60	4585 0.75 74LS SERIES	273 <b>0.54</b> 279 <b>0.30</b>
BBC 6 BUS Expansion Kit 6.45	4516/4816 100ns D2 <b>2.25</b>	UHF MODULATORS	22 17 38 65 24 21 46 70	00 <b>0.11</b> 01 <b>0.11</b>	283 <b>0.40</b> 290 <b>0.39</b>
All Kits are supplied with full fitting instructions	4532 200ns <i>D2</i> <b>2.95</b>	UM1111 6MHz D1 2.60	28 <b>24 55 80</b> 40 <b>30 76 99</b>	02 0.11 03 0.12	293 <b>0.39</b> 365 <b>0.27</b>
BBC CONNECTORS BBC 21 Printer Cable and Amphenol Plug	6800 FAMILY 6800 D7 2.25 6802 D5 2.50	UM1233 8MHz D1 3.90	ZIF SOCKETS (TEXTOOL)	04 0.12 05 0.12 08 0.12	366 <b>0.27</b> 367 <b>0.27</b> 368 <b>0.27</b>
(not assembled) 13.00 BBC 22 User Port Connector and Cable 36" 2.46 BBC 23 Cassette Lead 3.50	6809 D6 6.30 6810 D1 1.15	BUFFERS 81LS95 0.80	24 pin 5.75 28 pin 8.20	09 <b>0.12</b> 10 <b>0.12</b>	373 <b>0.62</b> 374 <b>0.62</b>
BBC 23 Cassette Lead 3.50 BBC 24 7 Pin DIN Plug 0.60 BBC 25 6 Pin DIN Plug 0.60	6821 D3 1.00 6840 D4 3.75	81LS96 0.80 81LS97 0.80	40 pin <b>9.75</b>	11 0.12 12 0.12	375 <b>0.35</b> 377 <b>0.60</b>
BBC 26 5 Pin DIN Plug BBC 35 Disc I/O Cable 34W IDC to 2x34 way	6845 D5 6.50 6850 D2 1.10	81LS98 0.80 8T26A 0.90	CMOS 4000 4000 0.10	13 0.12 14 0.25	378 <b>0.60</b> 379 <b>0.90</b>
card edge 12.00 BBC 36 Disc Power Cable 6.00	68488 D2 7.30 68800 D7 5.25 68809 D6 12.00	8T28A 0.90 8T95 0.90 8T97A 0.90	4001 <b>0.10</b> 4002 <b>0.12</b> 4006 <b>0.42</b>	15 <b>0.12</b> 20 <b>0.12</b> 21 <b>0.12</b>	386 <b>0.35</b> 390 <b>0.45</b> 393 <b>0.45</b>
BBC 44 Analogue Input Plug and Cover BBC 66 IM Bus Connector + 36" Cable 3.50	68B10 D1 2.26 68B21 D3 2.20	8198 0.90	4007 <b>0.14</b> 4008 <b>0.32</b>	22 <b>0.12</b> 26 <b>0.12</b>	OIL JUMPERS
BBC ACCESSORIES BBC 45 Joysticks (per pair) 11.30	68B40	LINEARS L203 0.65	4009 <b>0.24</b> 4010 <b>0.24</b>	27 <b>0.12</b> 28 <b>0.12</b>	Single Ended 24" 14 PIN 1.45
BBC 67 Eprom Programmer (assembled) 57.95 BBC 71 Teletext Receiver 225.00	<b>ZBC FAMILY</b> Z80 ACPU <i>D2</i> <b>2.99</b>	LF398N 4.75 LM301AN 0.24	4011 0.10 4012 0.16	30 <b>0.12</b> 32 <b>0.12</b>	16 PIN 1.65 24 PIN 2.40
BBC 72 Second Processor (6502) 170.00 BBC 73 Second Processor (780) 170.00	Z80 BCPU D2 9.00 Z80 ACTC D1 2.60	LM308N <b>0.48</b> LM311P <b>0.50</b> LM319N <b>1.99</b>	4013 0.20 4014 0.40 4015 0.36	33 <b>0.12</b> 37 <b>0.12</b> 40 <b>0.12</b>	40 PIN 3.80 Double Ended
ACORNSOFT FOR THE BBC SBE03 Business Games 8.65	Z80 BCTC D1 9.00 Z80 ADART D1 5.50	LM324N 0.30 LM348N 0.60	4016 <b>0.20</b> 4017 <b>0.32</b>	42 <b>0.28</b> 47 <b>0.35</b>	6" 12" 18" 14 PIN <b>1.85 1.98 2.42</b>
SBE04 Tree of Knowledge 8.65 SBE02 Peeko Computer inc Manual 8.65	Z80ADMA D2 6.95 Z80AP10 D1 2.75	NE555P 0.16 NE556CP 0.45	4018 <b>0.36</b> 4019 <b>0.36</b>	48 <b>0.45</b> 49 <b>0.12</b>	16 PIN 2.05 2.15 2.68 24 PIN 3.00 3.15 3.96 40 PIN 4.65 4,90 6.18
SBE01 Algebrail Manipulation Pk 8.65 SBX01 Creative Graphics Cassette 8.65 SBX02 Graphics and Charts Cassette 8.65	Z80 BP10 D1 9.00 Z80 AS10 D4 9.00	TL010 0.39 TL011 0.32	4020 <b>0.36</b> 4021 <b>0.40</b>	51 0.12 54 0.12	25 WAY D-TYPE
SBB01 Desk Diary inc Manual 8.65 SBL02 LISP Cassette 14.65	8080 FAMILY 8085A D4 3.50	TL012 0.34 TL014 0.36 TL021 0.34	4022 0.40 4023 0.13 4024 0.32	55 <b>0.12</b> 73 <b>0.18</b> 74 <b>0.16</b>	CONNECTORS Male-Male
SBL01 FORTH Cassette 14.65 SBG01 Philosophers Quest 8.65	8212 1.10 8216 1.00	TL061 0.29 TL062 0.49	4025 <b>0.13</b> 4026 <b>0.74</b>	75 0.18 76A 0.17	36" cable 12.00 Male-Female
SBG07 Sphinx Adventure 8.65 SBG03 Monsters 8.65	8224 <b>2.10</b> 8228 <b>3.27</b>	TL064 0.98 TL066 0.29	4027 <b>0.20</b> 4028 <b>0.32</b>	78A <b>0.18</b> 83A <b>0.36</b>	36" cable 12.00 Male single ended 18" cable 4.95
SBG04         Snapper         8.65           SBG15         Planetoid         8.65           SBG06         Arcade Action         10.35	8251A D5 2.50 8253 4.00 8255A D5 2.25	TL068 0.32 TL071 0.29	4031 <b>0.94</b> 4033 <b>1.80</b> 4034 <b>0.94</b>	85 <b>0.42</b> 86 <b>0.16</b> 90 <b>0.22</b>	Female single ended 18" cable 3.95
SBG05 Rocket Raid         8.65           SGB13 Meteors         8.65	6500 FAMILY	TL072 <b>0.47</b> TL074 <b>1.00</b> TL081 <b>0.26</b>	4035 <b>0.38</b> 4040 <b>0.36</b>	91 <b>0.80</b> 92 <b>0.32</b>	IOC CONNECTORS
SBG14 Arcadians 8.65 SBG10 Chess 8.65	6502 D3 3.25 6502A D3 5.00	TL082 <b>0.46</b> TL084 <b>1.58</b>	4041 <b>0.36</b> 4042 <b>0.34</b>	93 <b>0.22</b> 958 <b>0.40</b>	Shrouded Headers (with ejectors)
ACORNSOFT BOOKS FOR THE BBC MICRO SBD01 Creative Graphics 7.50	6520 D1 2.50 6520A D1 3.16 6522 D5 3.19	TL091 0.40 TL092 0.58	4043 0.36 4044 0.36 4045 1.35	109A <b>0.27</b> 112A <b>0.20</b>	(Right Angle PCB Mtg) 10 PIN 0.86
SBD02 Graphs and Charts 7.50 SBD04 LISP 7.50	6522A D5 <b>5.50</b> 6532 D2 <b>5.50</b>	TL094 1.34 TL487 0.62 TL489 0.62	4046 0.42 4047 0.70	113A <b>0.20</b> 114A <b>0.22</b> 122 <b>0.28</b>	14 PIN 1.22 16 PIN 1.34
SBD03 FORTH 7.50 Please ring for current delivery on Acornsoft Products	FLOPPY OISC	TL494 1.63 TL496 0.60	4048 <b>0.38</b> 4049 <b>0.23</b>	123 <b>0.34</b> 125A <b>0.24</b>	20 PIN 1.46 26 PIN 1.76 34 PIN 2.06
before ordering. BBC MICRO COMPONENTS	CONTROLLERS 8271 36.00 FD1771 D5 15.00	TL507 <b>1.33</b> 725 <b>1.60</b> 741 <b>0.14</b>	4050 <b>0.23</b> 4051 <b>0.38</b> 4052 <b>0.44</b>	126A <b>0.25</b> 132 <b>0.34</b> 136 <b>0.25</b>	40 PIN 2.32 50 PIN 2.35
4516 100ns <b>2.25</b> 8271 <b>36.00</b> 6522 <b>3.19</b> 20 Way Header <b>1.46</b>	FD1791 D6 22.00 FD1793 D6 23.00	741 <b>0.14</b> 747 <b>0.48</b> 748 <b>0.27</b>	4053 <b>0.44</b> 4054 <b>0.85</b>	138 <b>0.25</b> 139 <b>0.27</b>	60 PIN 3.20
74LS244	FD1795 D6 28.00 FD1797 D6 28.00	REGULATORS	4055 <b>0.85</b> 4060 <b>0.39</b>	145 <b>0.57</b> 148 <b>0.70</b>	Fitted with 36" cable 10 PIN 1.40
DS369IN 4.50 15 Way D Skt 2.15 DS88LS120N 4.50 6 Way DIN Skt 0.90	WD1691 D2 12.00 WD2143-01 D2 6.99	78L05 0.30 78L12 0.30	4063 <b>0.85</b> 4066 <b>0.24</b>	151 0.40 153 0.40	14 PIN 1.82 16 PIN 2.10
UP07002 4.50 5 Way DIN Skt 0.90 BBC SOFTWARE IN EPROM	INTERFACE DEVICES 6402 3.80	78L15 <b>0.30</b> 7805 <b>0.40</b> 7812 <b>0.40</b>	4068 <b>0.14</b> 4069 <b>0.14</b> 4070 <b>0.13</b>	155 <b>0.30</b> 156 <b>0.35</b> 157 <b>0.25</b>	20 PIN 2.46 26 PIN 3.24
Wordprocessor "View" 52.00 1.2 MOS 10.00	75107 <b>0.47</b> 75110 <b>0.56</b>	7815 <b>0.40</b> 7905 <b>0.45</b>	4071 <b>0.13</b> 4072 <b>0.13</b>	158 <b>0.30</b> 160A <b>0.32</b>	34 PIN 3.80 40 PIN 4.90 50 PIN 5.48
	75150 <b>0.64</b> 75154 <b>0.77</b> 75160 <b>2.56</b>	7912 <b>0.45</b> 7915 <b>0.45</b>	4073 0.14 4075 0.13	161A 0.35 162A 0.35	60 PIN 6.38
SPECIAL OATA SHEETS are available on items marked D. Prices are as	75161 <b>2.80</b> 75162 <b>3.95</b>	LM309K 1.20 LM317K 2.40 LM323K 4.50	4076 0.43 4077 0.13 4078 0.15	163A <b>0.35</b> 164 <b>0.40</b> 165A <b>0.50</b>	OATA BOOKS by Texas Instruments
OFFER Inflows:	75172 <b>1.95</b> 75173 <b>1.44</b>	LM338K <b>6.25</b>	4081 0.13 4082 0.13	166A 0.60 173A 0.55	Linear Control Circuits 4.90 Voltage Regulators 4.50
Spectrum 32K   D2 1.00	75174 1.95 75175 1.44 75182 0.50	OATA CONVERTERS UPD7002 D1 4.26	4085 <b>0.50</b> 4086 <b>0.44</b>	174 <b>0.40</b> 175 <b>0.36</b>	MOS Memory 3.95 Interface Circuits 7.00
Upgrade Kit D4 2.00 2.50 D6 3.00	75182 <b>0.50</b> 75183 <b>0.50</b> 75188 <b>0.37</b>	ZN425 D1 3.45 ZN426 D1 3.00 ZN427 D1 5.99	4093 <b>0.20</b> 4502 <b>0.46</b> 4507 <b>0.32</b>	181 <b>0.90</b> 190 <b>0.35</b>	TTL 5th Edition 8.50 Bipolar Micro 4.50
<b>24.95</b>   D6 3.00 4.00	75189 <b>0.37</b>	ZN428 D1 4.75	4507 <b>0.32</b> 4508 <b>0.96</b>	191 <b>0.35</b> 192 <b>0.35</b>	TTL Pocket Guide 3.50 Linear Pocket Guide 2.50

CARRIAGE Orders up to £199 sent by 1st class post and £200+ by

CHARGES 0-£100 = £0.50, £100-199 = £1.25, £200+ = £5.00.

PRICES All prices and carriage charges quoted are exclusive of VAT and are subject to change without notice.

QUANTITY DISCOUNTS Available on most products. Please telephone for details.

phone for details.

OFFICIAL ORDERS are welcome from Educational Establishments,
Government Bodies and Public Companies.



CREDIT ACCOUNTS Are available subject to status. Payment strictly nett 30 days.

CREDIT CARDS Payment by credit cards is accepted on most products with no surcharge. OUT OF STOCK Items out of stock will follow with £0.45 Carriage

charge at our discretion, or a refund will be issued if requested. DELIVERY All stock orders received up to 3.30pm are despatched the

## MIDWICH COMPUTER COMPANY LIMITED

DEPT ETI, RICKINGHALL HOUSE, RICKINGHALL, SUFFOLK IP22 1 HH TELEPHONE (0379) DISS 898751

## THE 'ALADDIN'S' CAVE OF COMPUTER AND ELECTRONIC EQUIPMENT

#### HARD DISK DRIVES

Fully refurbished Diablo/DRE Series 30 2.5 mb hard disk drive for DEC RKO5, NOVA, TEXAS etc. Front load £550.00 – Top load £295.00 PSU type ME3029 for 2 drives £125.00

DRE 44A/4000A/B 10 mb 5+5 all configurations from £995.00 Call sales office for details

#### **AMP MAINS FILTERS**

Cure those unnerving hang ups and data glitches caused by mains interference. Matchbox size – Up to 5 amp 240 v load. As recommended by the ZX81 newsletter. Suppression Devices SD5A £5.95.

The UK's FIRST free of charge, 24 hr. public access data base. Get information on 1000's of stock items and order via your computer and credit card. On line now, 300 baud. CCITT tones, full duplex, fully interactive.

DON'T MISS THOSE BARGAINS CALL NOW, IT'S FREE!

01-683 1133 week 84 hrs.

7 days per per day

#### COMPUTER 'CAB'

All in one quality computer cabinet with integral switched mode-PSU. Mains filtering, and twin fan cooling. Originally made for the famous DEC PDP8 computer originally made to the landous December 24 hours per day the PSU is fully screened and will deliver a massive +5v DC at 17 amps. +15v DC at 1 amp and -15v DC at 5 amps. The complete unit is fully enclosed with removable top lid, filtering, trip switch, 'Power' and 'Run' LEDs mounted on Ali front panel, rear cable entries, etc. LEDs mounted on Ali front panel, rear cable entries, etc. Units are in good but used condition - supplied for 240v operation complete with full circuit and tech. man. Give your system that professional finish for only £49.95 + Carr. Dim. 19" wide 16" deep 10.5" high. Useable area 16" w 10.5"h 11.5"d. Also available LESS PSU with internal dim. 19" w. 16"d. 10.5"h, £19.95". Carriage & insurance £9.50.

COOLING FANS (eep your hot parts COOL and RELIABLE with our range of BRAND NEW professional

with our range of BRAND NEW professional cooling fans
ETRI 99XUOI Dim. 92 x 92 x 25 mm.
Miniature 240 v equipment fan complete with finger guard £9.95.
GOULD JB-3AR Dim. 3" x 3" x 2.5" compact very quiet running 240 v operation. NEW£6,95
BUHLER 69.11.22. 8-16 v DC micro miniature reversible fan. Uses a brushless servo motor for extremely high air flow, almost silent running and guaranteed 10,000 hr life. Measures only 62 x 82 x 22 mm.
Current cost £32.00. OUR PRICE ONLY
£12.95 complete with data.
MUFFIN-CENTAUR standard 4" x 4" x 1.25" fan supplied tested EX EQUIPMENT 240 v at £6.25 or 10 v at £4.95 or BRAND NEW 240 v at £10.50. 1000's of other fans Ex Stock.
Call for Details. Post & Packing on all fans £1.60

# FLOPPY DISK DRIVES



Unbelievable value the DRE 7100 8" floppy disk drives utilise the finest technology to give you 100% bus compatibility with most drives available today. The only difference being our PRICE and the superb manufacturing quality! The 7100 single sided and 7200 double sided drive accept hard or soft sectoring IBM or ANSI standard formats giving a massive 0.8 MB (7100) 1.6 MB (7200) of storage. Absolutely SHUGART, BASF, SIEMANS etc. compatible. Supplied BRAND NEW with user manual and full 90 day warranty. Carriage and insurance £9.75.
7100 Single sided £225.00 + Carr. 7200 Double sided £295 + Carr.

Optional accessories: Full technical manual £20.00 alone. £10.50 with drive. Refund of difference on drive purchase. DC and AC power connector and cable kit £8.45.50 way IDC connector £5.50.50 way ribbon cable £3.20 per metre.

# SUPER DEAL? NO — SUPER STEAL!! The FABULOUS 25CPS TEC Starwriter

Daisy wheel printer at a fraction of its original cost.

BRANDNEW AT ONLY £499+ VAT

Made to the very highest spec the TEC Starwriter FP1500-25 features a heavy duty die cast chassis and DIABLO type chassis and DIABLO type print mechanism giving superb registration and print quality. Micro-processor electronics offer full DIABLO/QUME

command compatability and full control via CPM Wordstar etc. and full control via CPM Wordstar etc.

Many other features include b id directional
printing, switchable 10 or 12 pitch, full width 381 mm paper handling with upto
163 characters per line, friction feed rollers for single sheet or continuous paper,
internal buffer, standard RS232 serial interface with handshake.
Supplied absolutly BRAND NEW with 90 day guarantee and FREE daisy wheel
and dust cover. Order NOW or contact sales office for more information.
Optional extras: RS232 data cable £10.00. Tech manual £7.50. Tractor feed
£120.00. Spare daisy wheel £3.00. Carriage & Ins. (UK Mainland) £10.00.

## TELETYPE ASR33

I/O TERMINALS
FROM £195 + 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 reader 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

KSR33 with 20ma loop interface£125.00 + Sound proof enclosure £25.00 + VAT

#### SOFTY 2

The amazing SOFTY 2. The complete "toolkit" for the open heart software surgeon. Copies, Displays, Emulates ROM, RAM and EPROMS of the 2516, 2532 variety. Many other features include keyboard, UHF modulator. Cassette interface etc Functions exceed capabilities of units costing 7 times the price! Only

£169.00 pp£1.95 Data sheet on request

## RECHARGEABLE BATTERIES

CYCLON type DO01 sealed lead acid maintenance free 2v 2.5 ah. will deliver over 300 amps on short circuit!! Brand new at only £2.95

#### VIDEO MONITORS

12" CASED. Made by the British KGM Co. Designed for continuous use as a data Designed for continuous use as a data display station, unit is totally housed in an attractive brushed aluminium case with ON-OFF, BRIGHTNESS and CONTRAST controls mounted to one side. Much attention was given to construction and reliability of this unit with features such as, internal transformer isolated regulated DC supply, all components mounted on two fibre glass PCB boards – which hinge out for ease of service, many internal controls for linearity eta. The monitor accepts standard 75 ohm composite video signal via SO239 socket on rear panel. Bandwidth of the unit is estimated around 20 Mhz and will display most high def graphics and 132 x 24 lines. Units are secondhand and may have screen burns. However where burns exist they are only apparent when monitor is switched off. Although unguaranteed all monitors are display station, unit is totally housed in an only apparent when monitor is switched off. Although unguaranteed all monitors are tested prior to despatch. Dimensions approx. 14" high x 14" wide by 1.1" deep. Supplied complete with circuit 240 volt AC operation. ONLY EAS.00 PLUS E9.50 CARR.

operation. **ONLY E45.00 PLUS E9.50 CARR.**24" CASED. Again made by the KGM Co with a similar spec as the 12" monitor. Originally used for large screen data display. Very compact unit in lightweight alloy case dim. 19" H x 17" D x 22" W. All silicon electronics and composite video input make an ideal unit for schools, clubs, shops etc. Supplied in a used but working condition.

#### condition. ONLY E55.00 PLUS E9.50 CARR. & INS.

14" COLOUR superb chassis monitor made by a subsidiary of the HITACHI Co. Inputs are TTL RGB with separate sync, and will plug direct into the BBC micro etc. Exceptional bandwidth with good 80 col definition. Brand new and guaranteed. Complete with full data & circuit. 240 v AC working. Dim. 14" x 13" x 13" ONLYE199.00 PLUSE9.50 CARR.

## DATA MODEMS

Join the communications revolution with our range of EXTELECOM data modems. Made to range of EX DELECOM data Indeems Made to most stringent spec and designed to operate for 24 hrs per day. Units are made to the CCITT tone spec. With RS232 i/o levels via a 25 way 'D' skt. Units are sold in a tested and working condition with data. Permission may be required for connection to PO lines. MODEM 13A compact, async, same size as telephone base. Up to 300 baud, full duplex over 2 wires, but call mode only £75.00

MODEM 2B/C Fully fledged, up to 300 baud async, ANSWER & CALL modes, auto answer, auto switching, ideal networks etc. Just 2 wire connection to comms line. £85.00

MODEM 20-1 Compact unit for use with PRESTEL or full duplex 2 wire link 75 baud transmit – 1200 baud receive. Auto answer. £130.00

MODEM 20-2 same as 20-1 but 75 baud receive 1200 baud transmit. £130.00 MODEM 20-3 Made for data rates up to 1200 baud in full duplex mode over 4 wire circuit or half duplex mode over 2 wires. £130.00 Carriage. 13A £4.50. 2B/C & 20 £9.50.

DATA PUMP MODEM compact unit upto 1200 baud full duplex over 4 wires or half duplex over 4 wires or half duplex over 2 wires. BELL specification with data i/o via RS232 25 way D socket, remote test etc. 240 v operation. Supplied complete with data £65.00 carr. £4.50.

For more information or details of other types of ex. stock moderns contact sales office.

#### D.C. POWER SUPPLY SPECIALS

Experimentors PSU Ex-GPO unit all silicon electronics. Outputs give +5v@2 amps. +12v@800 ma. +2v@800 ma. +24v@350 ma.5v@50 ma. floating. Dim 160 x 120 x 350 mm. All outputs fully regulated and short circuit proof. Removed from working equipment, but untested. Complete with circuit. Transformer guaranteed. Only £14.50 +£2.50 pp.

CUSTOM POWER CO55 5v@3 amp. Very compact unit dim. approx60 x 90 x 190 mm. Semi open chassis, full crowbar overvoltage protection. Tested Ex Equipment. £11.95 + pp £1.25

FARNELL 5 Volt 40 amps. Type number G6-40A this miniature switching psu measures only 160 mm wide, 175 mm deep and 90 mm high!! Fully regulated and smoothed with over voltage protection etc. 120 or 240 volts AC input. Supplied BRAND NEW and boxed with circuit and fixing screws at a fraction of the current list price. Only £130.00 + £3.00 carr. & ins.

PERIPHERAL SYSTEM SUPPLY. Fully cased unit supplied in a Brand new or little used condition. Outputs give 5 v @ 11 amps, "+" 15-17 v @ 8 amps. "-" 15-17 v @ 8 amps and "+" 24 v @ 4 amps. All outputs are crowbar protected and the 5 volt output is fully

regulated. Fan cooled Supplied tested, with circuit \$55.00 + £8.50 carr.

MAIN FRAME SUPPLY. A real beety unit designed for MINI or MAINFRAME use outputs give 5 volts @ 50 amps. +12v @ 5 amps. -12v @ 10 amps. All output are fully regulated with crowbar overvoltage protection on the 5v output. Supplied with circuit and tested. Ex-Equip. 110v AC input. Only £49.95 + carr. £10.50

# 66% DISCOUNT COMPONENTS & EQUIPMENT

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 play plus we always include something from our ads, for unbeatable value!! Sold by weight.

2.5kls£4.25 + pp £1.25 10kls£10.25 + pp £2.25

5kls £5.90 + pp £1.80 20kls £17.50 + pp £4.75

#### SEMICONDUCTOR GRAB BAGS

Mixed Semis amazing value contents include transistors, digital, linear, I.C.'s triacs, diodes, bridge recs., etc. etc. All devices guaranteed brand new full spec. with manufacturer's markings, fully guaranteed, 50+£2,5100+£3,15.
TTL 74 Series A gigantic purchase of an "across the board" range of 74 TTL series I.C.'s enables us to offer 100+ mixed "mostly TTL" grab bags at a price which two or three chips in the bag would nnormally cost to buy. Fully guaranteed all I.C.'s full spec. 100+£6.90 200+£12.30 300+£19.50

#### OLIVETTI TE300 REDUCED TO CLEAR

Complete input output terminal with integral 8 hole paper tape punch and reader. Unit operates at 150 baud in standard ASCII. Ideal as a cheap printer for a MICRO etc. 120 columns, Serial data i/o. Supplied complete with data, untested, unquaranteed £45.00 +£11.50 carr.

### ALL PRICES PLUS VAT



All prices quoted are for U.K. Mainland, paid cash with order in Pounds Stirling PLUSVAT. Minimum order value £2.00, Minimum Credit. Card order £10.00. Minimum BONA FIDE account orders from Government depts, Schools, Universities and established companies £20.00. Where post and packing not indicated please ADD 60p + VAT. Warehouse open Mon-Fri 9.30 — 5.30. Sat. 10.15 — 5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export enquiries welcome.

64-66 Melfort Road, Thornton Heath, Near Croydon, Surrey 01-689 7702 - 01-689 6800 Telex 27924



# LABORATORIES ON A CHIP

Silicon is turning out to have more uses than just a conventional chip material. It can be chemically machined to form a wide variety of structures, perhaps even miniature laboratories with built-in computers. Stephen McClelland explains.

hat could be a new era of Lilliputian engineering is quietly unfolding thanks to a different kind of silicon chip development. Now, microscopic mechanical structures, some less than the thickness of a human hair, can be fabricated in silicon just like standard

transistors and integrated circuits.

Silicon has been used for some time to create pressure and strain gauges but present techniques can produce nozzles, valves and sensors of all types. The manufacture of complex 3D mechanics in silicon is now being contemplated. Researchers at Stanford University, California — who dub these operations 'micromachining' — have even been able to place most of a gas chromatograph on a flat silicon wafer 5 cm in diameter. This sort of result indicates that complete electromechanical and electronic systems can be made in silicon less expensively and yet more accurately than conventional techniques would allow. The processing methods so well established in the integrated circuit industry will be capable of producing simultaneously large numbers of components in a silicon wafer with a consequent cost reduction.

All this is possible because of continuous improvement of silicon integrated circuit technology, particularly in the area of pattern definition and photolithography (the generation and transfer of a small enough mechanical pattern onto the silicon to be machined) and etching (the

chemical dissolution of selected areas of silicon).

#### Photolithography And Etching

Photolithography has been propelled forward because of demands made by high density electronic chips which are approaching VLSI (Very Large Scale Integration) complexity. At the moment it is possible to design patterns, 200 x or 500 x larger than life, which will eventually produce a minimum feature size of 2 or 3  $\mu$ m quite routinely. Next generation equipment will allow such features to be cut less than 1  $\mu$ m, making it possible to fabricate, easily, novel optical components such as diffraction gratings in silicon. But the key to micromachining has been the variety of etching techniques that carve detail on the silicon surface.

Some (isotropic) etchants merely dissolve silicon at equal rates in all directions, but some show anisotropic behaviour; that is, they preferentially etch only certain crystal planes of silicon. By etching faster in certain directions than others — and the relative difference in speed can be two orders of magnitude — predictable three-dimensional shapes can be cut.

What is cut depends on both the etchant used and the crystallographic orientation of silicon used. We describe

the crystallography of silicon numerically using Miller indices, which essentially state the orientation of a plane of a silicon atomic lattice by defining its intercepts with a hypothetical set of axes (Fig. 1). From the micromachining point of view the most important planes are the (100), (110) and (111) in the (cubic) silicon lattice. Etchants like potassium hydroxide or an ethylene diamine/pyrocatechol mixture essentially migrate much faster in the (100) direction than they do in the (111) direction because the packing density of silicon atoms is much lower in the 100 direction. The result when etching is that a V-shaped notch is formed in a (100) slice where the sides of the 'V' are the slower-etching (111) planes.

But the groove can be very accurately reproduced and its sidewalls will always make an angle of 54.74° with the surface of the silicon. Moreover the depth of the groove is directly related to the width of the surface opening etched, since etching effectively stops at the (111) planes which intersect the sides of the opening. Wafers are typically of the order of a few tenths of a millimetre thick and so it takes a few hours to etch a deep groove, or, if the surface detail is wide enough, a nozzle-shaped hole right through the

slice.

#### Nozzles, Valves And Beams

Dr. Ernest Bassous' group at IBM has patented a variety of nozzle structures, based essentially on this technique, which are intended for projecting very fine ink sprays in high resolution printers. Although accurate dimensioning can be achieved by simply etching right through the silicon as described above, Bassous has found that better

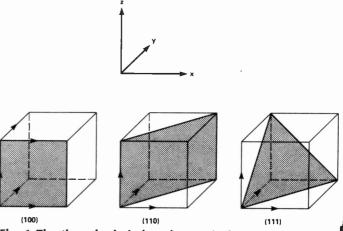


Fig. 1 The three basic index planes of silicon.

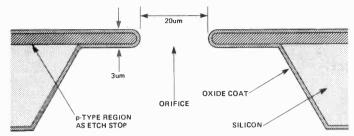


Fig. 2 The smallest nozzle in the world? IBM Research Labs made this silicon nozzle.

nozzles can be made by employing the natural resistance to etching of heavily-doped P-type silicon. A thin layer of this is formed at the back of the wafer, uniform except where orifices are required. The wafer is then etched anisotropically from its upper surface. Etching is terminated only by the thin P-barrier but punctures the slice completely in its unprotected regions. After cleaning and silicon dioxide regrowth the final structure is shown in Fig. 2. It has an orifice typically less than 20  $\mu m$  wide set in a membrane only 3  $\mu m$  thick.

Another IBM researcher, Kurt Petersen, takes membrane manufacture further. He allows the etch to deliberately undercut the overlying silicon dioxide layer and so produces an ultra-thin, springy, 'diving board' structure made entirely of oxide. The 1 mm thick membranes can be easily — but not irreversibly — bent by an electric field and IBM has used them as electronically controlled scanning mirrors to reflect illuminated data from a single character generator on to a ground glass screen for display purposes. IBM also foresees applications for them in high-isolation electromechanical switches.

A flexible structure is also the basis of Dr Lynn Roylance's miniature accelerometer to study heart wall motion. In the Stanford laboratories she made a 3 x 2 x 0.6 mm cantilevered beam unit entirely from etched silicon. The beam bends in response to applied acceleration with considerable sensitivity — it can detect an acceleration from 0,01 g to 50 g, with a 1% accuracy. The actual detecting elements for this kind of transducer are usually of a piezorestive variety. This means that the resistance of a diffused element (usually p-type) changes when it is mechanically stressed. However, these resistive elements are usually quite sensitive to temperature changes, which is why they usually take the form of a Wheatstone Bridge circuit.

#### **Engine-eering**

Silicon transducers, if they're small and light enough, can find their way into a whole spectrum of applications. They have been mounted on heart walls, on turbine components in aircraft and may well be shot into space on planetary probes. But most engineers belive that the traditional benefits of silicon processing (ie mass-produced, low cost, high precision techniques) will only really show when micromachining is adopted by a mass-production industry.

The US car industry could be just such a sponsor. Silicon sensors have been edging their way onto the Detroit production lines in a drive for higher fuel efficiency through better monitoring techniques in automobiles, although not as widely as predicted. William Wolber, a Michigan sensor specialist, describes the place of silicon components in the automobile industry as a 'useful addition' but warns that improvements in processing will continually be required if silicon is to be competitive. At present, the US industry wants to monitor a variety of

### MICROMACHINING SILICON

Standard silicon processing techniques basically involve one or more repeats of an oxidation-etch-diffusion cycle, outlined below:

Oxidation — A layer of silicon dioxide is grown on the silicon wafer by heating it in an oxygen stream. This layer will act as the pattern definition layer for the rest of the process (a).

tern definition layer for the rest of the process (a).
 Etching — The wafer is now coated with photoresist (a light-sensitive compound) which is exposed to light via a master negative glass plate on which are detailed the features to be machined (b).

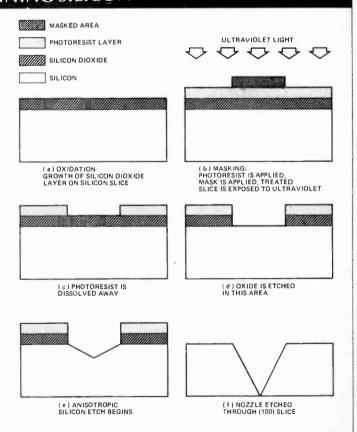
glass plate on which are detailed the features to be machined (b). Unexposed parts of the resist (underlying the negative) are then easily rinsed off, but the exposed, hardened resist remains. This serves to protect the underlying oxide from dissolution when the wafer is treated with hydrofluoric acid. Unprotected oxide is dissolved off leaving bare silicon (c,d).

If the wafer is now treated with an etching solution that dissolves silicon but not oxide, the silicon will be eaten away beneath the oxide window exclusively (e). If the etchant is *isotropic* the rate of etching will be the same in all directions. If the etchant is *anisotropic* it will etch in a preferential direction, eg potassium hydroxide solution will produce a V-groove in (100) orientated silicon and a vertical walled profile in the (110) direction (f).

For many devices, the process ends here or is cycled through again after a complete re-oxidation of silicon, depending on the profiles required. For more complicated structures (eg Dr. Bassous' membrane-nozzle described in the article) and to make electronic devices such as integrated circuits, gaseous impurities (eg boron compounds) are carefully allowed to diffuse into the silicon, through oxide windows like those made previously.

After the micromachining has been fully performed, the silicon wafer is split into individual silicon chips each containing a copy of the micromachined device.

Cross-section of silicon wafer, or slice, showing the procedure for cutting a simple nozzle through the wafer. Dimensions are not to



# -FEATURE: Micromachining

variables in the engine including air and coolant temperatures and fuel metering. The latter is derived from the determination of the manifold absolute pressure by silicon strain gauge techniques.

#### Chromatography On A Wafer

Perhaps the most spectacular development to date, however, has been the fabrication of a gas chromatograph system on a single silicon wafer, by Dr Stephen Terry and his colleagues at Stanford. Gas chromatography, the separation of a mixed sample gas back into its components, can be broken down into three separate stages:

 sample injection from the outside world sample separation in a long thin column

 detection and quantity measurement of each individual component.

The sample gas is injected into the system mixed with a carrier gas, typically nitrogen. Separation occurs in the column and is determined by the relative migration rates of each component in the sample. These in turn, are influenced by both the carrier gas velocity and the relative adsorption/desorption parameters of the components, in a so-called stationary phase, a substance which lines the walls of the column. With a sufficiently long column, the individual components emerge as separate entities ready

to be detected by a suitable transducer.

The Stanford instrument cleverly reduces the largescale complexity required for such an instrument with micromachining. In particular, the separator column (which has to be long to achieve good separation) is coiled into a spiral groove 1.5 m long but only 200  $\mu$ m by 30  $\mu$ m in cross-section. It is sealed after etching with a Pyrex cover slip to make a closed capillary column. Once again, the etching is patterned through a grown silicon dioxide

overcoat to define the spiral.

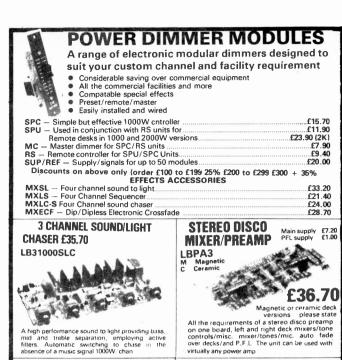
The components are detected by a simple, yet very effective, thermal conductivity sensor. This is essentially a nickel film resistor heated by an electric current. The temperature it actually reaches for a constant current depends on the thermal conductivity of the gas stream

passing through the device.

The results of the chromatograph are impressive, especially when compared to larger laboratory instruments. It has been used so far to analyse hydrocarbon mixtures and does this very efficiently with a fast time constant — which means that sample peaks can be as short as one tenth of a second compared with the width of several seconds realized by standard laboratory instruments. This in turn means the instrument can provide better resolution of the sample.

#### **Material Benefits**

But, of course, one need not be restricted to silicon for micromachining. With slight modification, other materials can be used as long as they are compatible in basic ways with the planar process for making chips. With a little imagination, the number of applications can match the number of different materials. And some are highly exotic. The gas chromatograph discussed above, for example, has been suggested for planetary probes and what are essentially entire chip-based 'laboratories' are now being actively researched. In the space of a few millimetres, such a chip could collect, treat and analyse a sample, even to the extent of heating or micro-refrigerating it through use of the Peltier effects. For ambitious experiments on space probes, the above could be combined with gas detectors, magnetic and electric field detectors and pressure and temperature detectors, all in silicon with the advantage of suitable signal processing electronics fabricated simultaneously.



3 CHANNEL SOUND/LIGHT



£22.70

Controls: bass/mid/treble/master sensitivity

AND MORE!

- \* 4 CHAN S/L AUTO CHASER
- \* 4 CHAN MULTI SOUND CHASER \* 4 CHAN SEQUENCER
- \* 4 CHAN SOUND CHASER
- \* FASCIA PANELS

Active Crossovers £17.90 (supply £7.20) (3-way 300Hz/3kHz)

Don't hesitate to write or phone for immediate information. All prices include VAT. Please include 75p post except power dimmer (£2.75). Cheques/PO/COD/Access all welcome.

Tel: 01-640 6053 (Mon to Fri 9 to 4.30)

L & B ELECTRONIC 34 Oakwood Ave, Mitcham, Surrey CR4 3DP

# **ELECTRONIC**

### **MICROSYNTH**

2½ Octave Music Synthesizer with two O lators, two Sub-Octs, Switched Routing Thumbwheel. A comprehensive instrument o ing the full range of Synth, Music & effects. FULL KIT £129 Also available in 3 parts.





#### BAND-BOX PROGRAMMABLE BACKING TRIO

THREE PIECE BACKING BAND

DRUMS + BASS + KEYBOARDS Over 3,000 chord changes (60 scores) on 132 different chords – extendable to 200 scores. Master Rhythm also required. FULL KIT £235 EXTENSION £72

#### 88/72 NOTE PIANOS **SPECIALISTS SINCE 1972**



The above may also be pur chased in four parts.

DOMESTIC KITS inc. Cabinet, P.A., & Spkr. 88 NOTE £442 72 NOTE £398

STAGE MODEL inc. Cabinet & Stand
72 NOTE £383

ALL PRICES INC. VAT. CARR., & TELEPHONE ADVICE S.A.E. for full Specs & MANF. PRICES. VISA-ACCESS.



#### MASTER **RHYTHM** PROGRAMMABLE DRUMS

TWenty-Four Rhythm programmable Drum Machine with twelve instruments. Eight sections are extended to 24/32 measures for two bar programming. Sequence operation and instrument tone adjust.

COMPLETE KIT

279

STRING ENSEMBLE £197.50 ROTOR-CHORUS £98.00

SQUARE FRONT KEYBOARDS 88 NOTE £60 49 NOTE £29 73 NOTE £50 30 NOTE £19 KEYSWITCH ITEMS ALSO AVAIL-

# 01-452 1500 TECHNOMATIC LTD 01-450 6597

Micro Computer Please phone for availability



BBC Model B £399 including VAT plus £8 carr. Model A to Model B Fitting charge £15 Individual upgrades also available

WORD PROCESSOR 'VIEW' 16K ROM £52

> **TELETEXT ADAPTOR** £195.00

PRESTEL ADAPTOR £90.00

2nd PROCESSOR 6502 £170 2nd PROCESSOR Z80 £290

ACORN SOFT/BBC SOFT/GAMES PADDLES IN STOCK

#### FLOPPY DISC INTERFACE Incl. 1.2 operating system £95 + £20 installation

#### Phone or send for our BBC leaflet

#### **BBC FLOPPY DISC DRIVES**

Single drive 54" 100K £235 + £6 carr. Dual drive 5¼" 800K £799 + £8 carr.

#### BBC COMPATIBLE DRIVES

These are drives with TEAC FD50 mechanism and are complete with power supply SINGLE: 100K £190; 200K £260; 400K £340 DUAL: 200K £360; 400K £490; 800K £610 Drive Cables: Single £8 Dual£12

OFFICIAL POP DEALER

#### CASSETTE RECORDER

**BBC Compatible Cassette Recorder** with Counter and Remote Control £26.50 + £1.50 carr. Cassette Leads £3.50 Computer Grade Cassette £0.50p each £4.50 for 10 + £1 carr.

#### MONITORS

MICROVITEC 1431 14" Colour Monitor	
KAGA 12" RGB Monitor £255 + £8 c	arr.
Lead for KAGA RGB	210
SANYO 12" Hi Res Green Monitor£99 + £6 c	arr.

#### ACORN ATOM

Basic Built £135 Expanded £175 (carr £3 per unit) Atom Disc Pack £299 + £6 carr 3A 5V Regulated PSU £26 + £2 carr. Phone or send for our BBC Atom list.

#### **NEC PC 8023 BE-C**

Features include: 80 cols 100CPS, Bi-Directional, Logic seeking, Proportional Spacing, Forward & Reverse Line Feed, Hi-Res and Block Feed, Hi-Hes and Block Graphics, International and Greek characters, Auto-Underline, Super & Sub Scripts, Friction & Tractor, 2K Buffer, Cartridge Ribbon.



#### **PRINTERS** SEIKOSHA GP 100A

80 Cols 30 CPS Full ASCII e GRAPHICS 10" Wide paper

Now only £180+ £6 carr. Ask for details on GP 250A

Parallel Printer lead for BBC/Atom to most printers £13.50 Variety of interfaces, ribbons in stock 2,000 fan fold sheets 9\frac{1}{2}" \times 11" \mathbb{E}13.50 + \mathbb{E}3 p \mathbb{E}7 p

AMPHENOL CONNECTORS

(centronix type)

(centronix type)

36 way Solder Type Plug

36 way Solder Socket

36 way IDC Plug (centronix type)

24 way Solder Plug

**EPSON RX80 and FX80** 

X80 and FX80

RX80 100CPS 80 Col

Tractor Feed FX80

160CPS 80 Col

F & T Feed

Logic seeking, Bidirectional, Bit image
printing, 9 x 9 Matrix,
Auto Underline, Centronix 8, Bit Parallel
Interface as standard

RX80 £298

FX80 £438

(£8 carr/printer) (£8 carr/printer)

RIBBON

CABLE (Grey)

80p 90p 105p 140p 220p 265p

330n

#### RUGBY ATOMIC CLOCK

This Z80 micro controlled clock/calender receives coded time data from NPL Rugby The clock never needs to be reset. The facilities include 8 independent alarms and for each alarm there is a choice of melody or alternatively these can be used for electrical switching. A separate timer allows recording of up to 240 lap times without interrupting the count. Expansion facilities provided. See July/August ETI for details. Complete Kit £145 + £2.00 p&p

#### **MICROTIMER**

6502 Based Programmeable clock timer with

- 224 switching times/week cycle 24 hour 7 day timer
- 4 independent switch outputs directly interfacing to
- 6 digit 7 seg. displays to indicate real time, ON/OFF and Reset
- Output to drive day of week switch and status LEDS.
   Full details on request. Price for kit £57.00

#### I.D. CONNECTORS

(Speedblock Type) of Header Recep- Edge Plug tacle 90p

Conn
90p 200p
125p 240p
150p 300p
160p 380p
190p 550p
200p 600p 25 way Male 500p Female 550p

15 way 25 way 37 way MALE 90p 130p 160p 250p 160p 230p 265p 425p FEMALE Angled 110p 160p 210p 350p Angled Hood 175p 240p 310p 500p 95p 125p

**D-CONNECTORS** 

JUMP LEADS 4In Ribbon Cable with headers
14 pln 18 pin 24 pin 40 pin
1-and 145p 165p 240p 380p
2 ends 210p 230p 345p 540p 24in Ribbon Cable with sockets
20 pin 26 pin 34 pin 40 pin
1 end 160p 210p 270p 300p
2 ends 290p 385p 490p 540p 24in Ribbon Cable with D

#### RS232 CONNS (25 way D)

24" Single end Male £5.50 24" Single end Female £6.00 £11.00 £10.00 £11.50 24" Female-Female 24" Male-Male 24" Male-Female

#### **DIL HEADERS**

IDC 16 pin 24 pin 40 pir

#### (IEEE type) 24 way Solder Socket 24 way IDC Plug

**CONNECTOR SYSTEMS** 

FURO CONNECTORS

### (Indirect Edge Conn)

DIN STD 41617 21 way 41617 31 way 41612 2 x 32 way Angled 2x32 way 41612 3x32 way Angled 3x32 way

Plug Skt 2x18 way 170p 170p 2x22 way 180p 180p 2x23 way 250p 320p 2x25 way 325p 375p 1x43 way 2x25 way 1x43 way 2x43 way 2x50 way 275p 380p 400p 150p 2x32 way zidc a + c 525p 225p (for 2x32 way specify a + b or a + c) 1x77 way

### CONNECTORS

10 way 14 way 16 way

20 way

26 way

34 way 40 way

50 way 64 way

5**5**0p

550p

500p

500p

0.1in 0.156i - 140p 200p 170p 210p — 225p 220p 260p 396p 700p S100 Coni

#### **MICRODOCTOR**

This is not a logic analyser or an oscilliscope. It tests a microsystem and gives a printed reprint on RAM. ROM and 1/0 - it will print memory map, search for code, check dataline shorts and operates peripherals Microdoctor complete with PSU. Printer, probe cable

and two configuration

boards. £295



UVIB up to 6 Eproms £47.50 £60.00 mains switches and safety

## SOFTY II INTELLIGENT PROGRAMMER

The complete micro processor development system for Engineers and Hobbyists. You can develop programs, debug, verify and commit to EPROMS or use in host computer by using softy as a romulator. Powerful editing facilities permit bytes, blocks of bytes changed, delete or inserted and memory contents can be observed on ordinary TV. Accepts most +5v Eproms.

Softy II complete with PSU, TV Lead and Romulator lead £169

#### SPECIAL **OFFER**

2114L 2716 (+5vl 2532 4116-2 4164-2 6116P-3

#### **UV ERASERS**

**UVIT with Timer** UV140 up to 14 Eproms £61.50 **UV141** with Timer (Carr £2/eraser) All erasers are fitted with

interlocks

#### **WIRELESS** WORLD' **PROJECTS**

Semiconductors inc I.C., Transistors, Displays, Connecors and Sockets for most projects are stocked by us.

#### BOOKS (No VAT p&p £1)

CMOS Cook Book CRT Controller H/Book £7.95 £11.50 Programming the Z80 Z80 Microcomp. handbook £6.95 £10,25 Programming the 6502 £12.10 6502 Assy. Lang. 6502 Applications 6502 Software Design £10.20 69.05 £10.52 6502 Games Large selection of databooks. Inter-facing books, books on BBC, etc in stock. As for our list.

#### PLEASE SEND SAE FOR PRICE LIST

74190 45p 74LS241 55p 4010 24p 14500 700p 14	740C	11	AD7581 1250  LIN8A   180    AD7581 1250  LIN8B   120    AD7581 1250  LINBB   120    AD7581 1250  AD7581   AD7581   AD7581	1985/26   250
74194 40p 7415245 70p 4015 40p 74195	74184 45p 74LS16b 174LS16b 174LS17b 174	\$50p   485268   250p   4885   75p   \$50p   7485260   70p   40014   40p   \$50p   7485261   300p   40085   90p   \$50p   7485261   300p   40085   90p   \$50p   7485261   300p   40102   140p   \$50p   7485373   400p   40102   140p   \$50p   7485371   650p   40106   40108   \$60p   748571   650p   40108   40109   \$60p   748571   650p   40110   \$60p   748571   620p   \$60p   4000   10p   40108   \$60p   4010   40109   40110   \$60p   4010   40109   \$60p   4010   40109   \$60p   4010   40109   \$60p   4010   40109   \$60p   4011   40109   \$60p   40	ORP12 120p TIL32 55p ORP61 120p TIL81 90p ORP61 120p TIL10 70p MCT26 100p TIL111 70p MCS2400 190p TIL113 70p IL074 240p TIL11 70p ORCS2400 150p  LEDS 7 TIL22 G 12p TIL220 Red 10p TIL22 G 12p TIL21 Yel 15p DIJOT Red 140p TIL312 / 310p DIJOT Red 140p TIL312 / 310p DIJOT Red 140p TIL32 / 310p DIJOT Re	BU198

# instruments set the pace

#### TV & FM Test



- Colour Bar Pattern GeneratorsSweep and Marker Generator
- CRT Tester
- Field Level CheckerSignal Level Meter
- High Voltage Metered Probe
- Signal Generators

#### **Audio Test**



- Generators
- **Attenuators**
- System Analyser
- Audio Tester

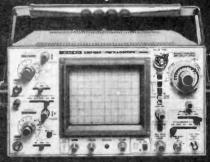
- Distortion Meter
  Equaliser Amp
  Wow and Flutter Meter
  Frequency Response Recorders
- Millivoltmeters
- Log Amplifier
- Speaker Analyser

When you select an instrument from the Leader range, you get more than just sound engineering. That's quaranteed - by rigorous quality assurance at manufacture, and a one year warranty. A broad range that covers most areas of test, measurement and calibration, with advanced features and high specification as standard. Prices that are lower than you'd expect are the bonus. Probes, covers, hoods and pouches are all available to enhance the application potential and ensure that Leader instruments set the pace for others to follow.

thandar

**ELECTRONICS LIMITED** 

### Oscilloscopes



- 4 to 50mHz
- Single, Dual and Quad trace
- Delayed sweep
- Wide bandwidth
- High sensitivity
- High accuracy
- Battery operated

#### **General Test**

- LCR Bridge
- Semiconductor
- Curve Tracer
  Transistor Testers
- Logic Probe



### **Power Supplies**

- Laboratory bench type
- 5 models
  - 500mA to 5A
    - Overload Protected

Thandar Electronics Ltd, London Road, St. Ives, Huntingdon, Cambridgeshire PE17 4HJ England. Tel: (0480) 64646.







# SWITCHED MODE POWER SUPPLY

There's a lot of unnecessary mystique surrounding the design and construction of switched mode power supplies: here's one anybody can build. Design by International Rectifier.

he advantages in using a switched mode power supply instead of a linear power regulator are well-known (if you don't know them, turn to Configurations in the April '83 ETI). However, the simplicity with which a linear regulator may be designed makes this configuration the most popular solution for low power applications.

The availability of low cost switching components (switching regulator ICs, magnetic components and high frequency MOSFET switches) is increasing the tendency for design

engineers to choose switched mode PSUs in their equipment. The design presented here is the work of International Rectifier and shows how such a supply may be designed quite simply by using IR HexFETs with their following desirable properties:

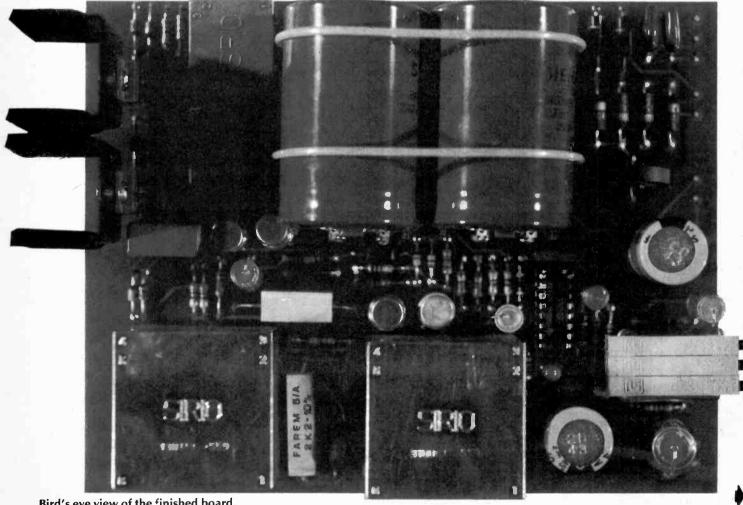
- no secondary breakdown
- high input impedance
- fast switching speed
- no current hogging • no minority storage time

The project is built on a single doublesided PCB with plated-through holes. which carries all the components except the rectifying diodes and the auxiliary power supply for the controller IC.

Acknowledgements are due to Ing. Bernadi, Ing. Cavalleri and the technicians of the D.T. Application Laboratory of Telettra-Vimercate for their contributions to the design of this power supply.

System Description

This power supply uses a halfbridge configuration that can be made to operate from either 120 or 240 V AC (the half-bridge configuration was explained in more detail in the



Bird's eye view of the finished board.

Designer's Notebook feature on page 63 of the April '83 ETI).

The circuit uses two high voltage HexFETs to drive a transformer directly from the rectified mains at a frequency of 75 kHz. The transformer output is rectified and the output voltage is stabilised by changing the duty cycle of the switching waveform with a PWM inverter circuit. This function is performed by the SG3524 (IC1) and its external components.

The power supply for the control circuit (marked on the circuit diagram as the auxiliary voltage) is obtained from the mains using a 12 V, 3 W transformer and a bridge rectifier.

The HexFETs are 400 V devices in a TO-220 package and are driven by transfornmers so as to provide voltage isolation between the primary and secondary circuits — this is necessary because the controller IC is grounded at the load.

The power supply can be divided into four main sections:

- High power voltage stage
- Low voltage power stage
- Driving circuitry
- Control circuitry

Each of these parts will be looked at separately. Figure 1 shows the complete circuit diagram of the switched mode power supply.

High Voltage Power Stage

The mains voltage is rectified by a bridge consisting of diodes D1-4 and is filtered by C3 and C4. C3, C4, and C5, together with the HexFETs Q1 and O2 and the transformer T1 form the halfbridge inverter. The DC voltage across C3 and C4 is applied in alternate directions to the primary of T1 as Q1 and Q2 switch commutatively. The theoretical waveforms (both voltage and current) that appear across each HexFET are indicated in Fig. 2. The full DC voltage appears at the HexFET drain only when the MOSFET is completely cut off. A 400 V HexFET allows a 15% margin in voltage, giving a lower loss during the conduction time due to a lower on resistance.

The current flowing in the transformer primary is a square wave defined by:

$$Ip = Io + I\mu$$

where lo is the output current, N the primary/secondary winding ratio and  $I\mu$  the magnetising current. The working current for each HexFET at maximum loading is about 1 A so the choice of a device with a 400 Vbreakdown voltage and a current capability of 2 A is more than adequate. For this switched mode power supply the IRF722 HexFET is

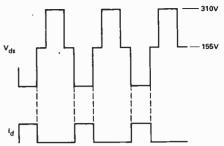


Fig. 2 Theoretical waveforms.

used, which is supplied in a plastic package.

The transformer is constructed using a Siemens pot core. The number of turns on the primary winding is defined by:

$$NP = \frac{Vdc}{4Bm.f.Ae}$$

where Vdc is the peak voltage across C3 or C4, f the frequency of operation, Bm the peak operating flux density in webers/square meter amd Ae is the effective core area in square meters.

The number of turns on the secondary winding is determined by this equation-

$$\frac{Ns}{Np} = \frac{Vs}{Vp}$$

where Vs is the voltage on the secondary including all losses due to

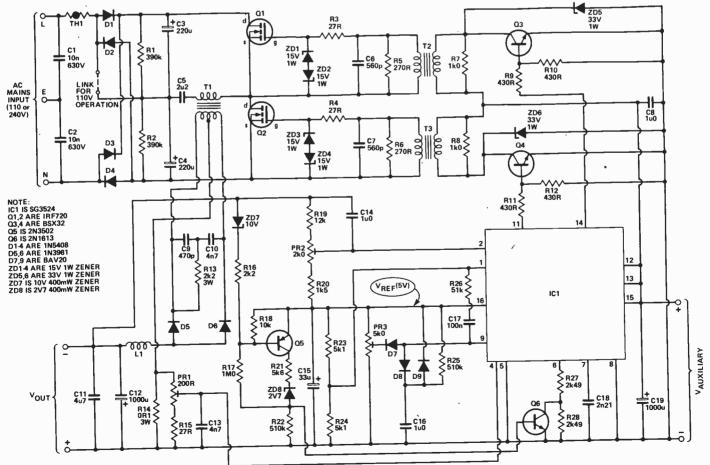


Fig. 1 Circuit diagram.

# PROJECT : Power Supply

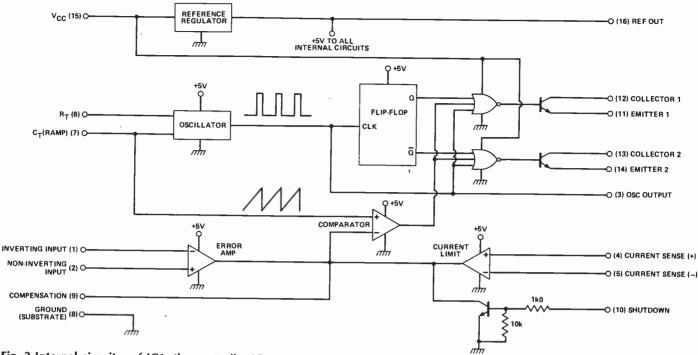


Fig. 3 Internal circuitry of IC1, the controller IC.

diodes, inductor, the current-sensing resistor and the dead time (see later), and Vp is the voltage on the primary when the system is working at the minimum allowable mains voltage and including all losses due to capacitor ripple and the input circuitry.

# Low Voltage Power Stage

The output voltage at the secondary of T1 is rectified by the high speed diodes D5 and D6 and filtered by an LC section (L1, C12). The inductor value, L, must be chosen higher than the critical value so that current circulation will be stopped, ie:

$$L > Lc = \frac{Vo.Toff}{2.lo.min}$$

Vo and lo.min are, respectively, the output voltage and the minimum output current (500 mA in this design). The capacitor value is determined by the following equation:

$$LC = \frac{Vo}{\Delta Vo.8.f^2(\eta - 1)}$$

where  $\Delta Vo$  is the desired variation in output and  $\eta$  is the ratio between the on and off switching times. To give an output with very low dynamic impedance, the value of C12 is chosen several times higher than the calculated value.

The additional components R13, C9, C10 and C11 are included to damp high-frequency ripple.

# **Driving Circuitry**

The HexFETs are driven by the two transformers T2 and T3. The primary of T2 or T3 loads a small switching

transistor Q3 or Q4, which is driven directly by the output of the controller IC. To clamp the over-voltage generated by T2 or T3 during the turn-off of Q3 or Q4, the zener diodes ZD5 and ZD6 are connected in parallel with the transistors on the secondaries of the transformers.

Two zeners are connected back-to-back forming a clamp which limits any gate-to-source voltage spikes to ±15 V. The gate series resistors R3 and R4 damp any unacceptable oscillations.

# **Control Circuitry**

The control circuitry consists of a switching regulator IC (an SG3524) and a few other components. The IC provides all the functions necessary to produce a stabilised DC output voltage with a limited DC output current by controlling the duty cycle of the switching power MOSFETs. The control circuitry may be broken down into the following functions:

- Oscillator
- Dead time
- Soft start
- Short circuit protection
- DC output voltage stabilisation.

## Oscillator

The frequency of the oscillator is set by R27 and C18 at 150 kHz. Figure 4 shows the relationship between resistance, capacitance, and the oscillator period. The timing resistor R27 is connected to ground through R28, which is shunted by transistor Q6. This configuration allows the frequency to be halved by the automatic short-circuit protection, as described later.

# **Dead Time**

To avoid the simultaneous conduction of two HexFETs during the transition time, the IC generates a blanking pulse. The width of this dead time is controlled by the value of the timing resistor CT (C18) as shown in Fig. 5. To adjust this width an external circuit consisting of PR3 and D7 is added.

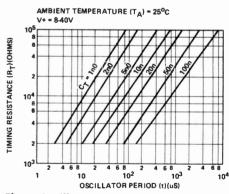


Fig. 4 Oscillator parameters.

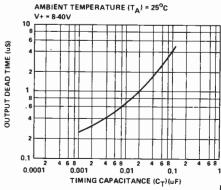
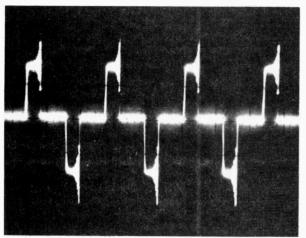
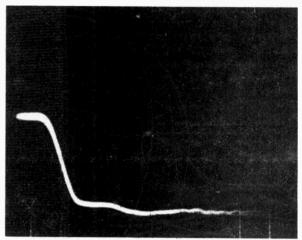


Fig. 5 Setting the dead time.

# **PROJECT: Power Supply**



The drain voltage waveform (50V/div and 5 uS/div).



The drain voltage turn-on waveform (50 V/div and 50 nS/div).

# Soft Start

A few components (C16, D8, D9 and R25) provide a low duty cycle initially so that at start-up, a high current flow into the HexFET and the consequent possibility of saturating the transformer core is avoided.

# Short Circuit Protection

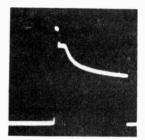
This operation is performed by sensing the current flowing in the load via R14. The voltage developed across the resistor is fed back into the current limit sense amplifier included in the IC. The current limit can be adjusted by means of the preset potentiometer PR1. R14 must be non-inductive to prevent any possiblity of instability.

To protect the switched mode power supply from a short circuit on the secondary, the circuitry built round Q5,6 and some other components is included. The function of this circuit is is to change the value of RT (by adding R28 to R27) and thus halving the frequency of operation. In fact R28 is normally shunted by Q6, but when the output voltage drops lower than 5 V Q6 is switched off. By halving the frequency, the conduction angle is increased to allow a better performance by the IC.

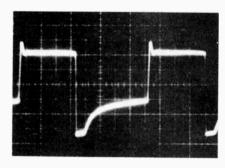
# DC Output Stabilisation

The control circuit is grounded at the load and the voltage sense for the feedback is direct. Through PR2, R19 and R20, a fraction of the output voltage is fed back into the internal error amplifier of the IC. The error amplifier is working in the common mode configuration (Fig. 5) and the gain at open loop is equalised with the network R26 and C17 to compensate for roll-off due to the LC filter on the output.

It's inevitable when travelling a little off the beaten path of circuit design that components will be required which are not readily available. Such is the case for the switched mode power supply and consequently we are arranging for a supplier to stock them. Prices and addresses will be included in next month's article, which deals with the construction of this project.



Signal at the collector of Q3, Q4.



To verify the correct functioning of the unit. check that this waveform is present at the gate of the HexFET.

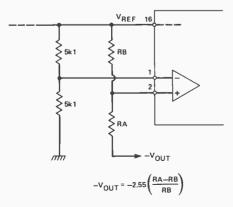


Fig. 6 Error amp operation.

# SPECIFICATIONS\_

Input voltage range:

110 or 220 V ±10%

Output voltage: Output current: 12 V

Line regulation:

100 kHz ripple: 150 kHz ripple: 0.01% at 4 A for +10% -20% line variation

±1% from 500 mA to 4 A Load regulation:

10 mVpp 220 V input 4 A output 20 mVpp 220 V input 4 A output Approximately 80% at full load

Overall efficiency: Short circuit current limit:

# **ECTROVAL**

**CMOS** 

4000 4001

DIGITAL & ANALOGUE I.C. SECTION

74tS161 74tS163 74tS164 74tS165 74tS173 74tS175 74tS175 74tS175 74tS197 74tS197 74tS197 74tS197 74tS197 74tS197 74tS197 74tS242 74tS243 74tS243 74tS243 74tS245 74tS247 74tS24

7400

- 24 HOUR NORMAL DESPATCH TIME
   ESTABLISHED 1005
- ALL GOODS GUARANTEED BRAND NEW AND TO SPECIFICATION
- APPOINTED SIEMENS DISTRIBUTORS

_		_		-		
	4081	13	.LM380NB	80		
- 13	4082	13	LM381N	145	TAA2761A	72
30	4093	20	LM382N	115	TAA4761A	113
	4510	45	LM3900N	50	TAA4765A	120
45	4511	45	LM3914N	200	TA81041K	187
45 45	4514	110	LM3915N	200	TBA120AS	62
	4516	53	NE555V	23	T8A120U	72
45	1518	40	NE556A	45	T8A800	75
78	4520	50	NE567N	104	TBA10S	75
-	4543	75	RC4151NB		T8A820	75
10	4583	90	S041E	290	TBB1458	62
10			S041P	121	TBB1458B	40
12	Many	other	S042E	364	TCA105	120
50	types in si	tock -	S042P	138	TCA105B	108
14	see currer		S89	425	TCA105G	140
32	list.	n price	S178A	16.60	TCA250A	186
24	HST.		S187	13.28	TCA205K	200
24			S556B	214	TCA335A	66
11	All above	prices	S576A	235	TCA345A	109
15 '	are NET	and	S576B	235	TCA345W	177
20	shown in	nence	S576C	235	TCA671	131
16			S576D	225	TCA780	211
10	ANALOG	UE	S1469	468	TCA871	114
20	709C5	49	SAB0600	425	TCA955	228
20	709C14	44	SAB3209	425	TCA965	136
15	723C14	36	SAB3210	311	TCA965K	120
25	741C5	57	SAB3211	168	TCA971	92
12	741C8	16	SAB3271	329	TCA991	80
10	741S	56	SAB4209	497	TCA991K	100
19	741C14	47	SA88256C		TDA2002	120
14	741S	56		35.40	TDA2003	126
12	741C14	65	SDA2007	965	TDA2030	150
13	748C8	35	SDA2008	676	TDA4050B	144
30	1458C5	62	SDA3205	724	TDA4290	169
20	1458C14	40	SDA3206	406	TDA4600	184
19	7106	450N	SAD1024	900	TDA4700A	546
15	7 07	500N	SAJ131	238	TDA4718A	436
15	555	18N	SAJ141	278	TFA1001W	252
10	7555	80	SAJ205	B10	TL071CP	25N
10	556	45	SAS231W	260	TL072CP	45N
10	CA3046	70	SAS251	142	TL074CN 1	00N
10	CA3080E	70N	SAS580	196	TL081CP	25N
16	CA3130E	90	SAS590	196	UAA170	165
23	CA3140E	45	SDA5680A	150	UAA170L	152
23	LM301At			15.55	UAA180	165
15	LM308N	60	TAA761	104	UAA190	141
13	LM317K	295	TAA761A	49		M000
13	LM324N	32	TAA765A	62	ZN414	80N
13	LM348N	66	TAA861	103	ZN424P	99
3	LM380N	66	TAA865A	59	ZN425E	350
-				00		_
	METE	RS La	ge range of t	ypes in	stock; also pro	bes,
	eugs, acces		~ .			

MU Range 50 x 45mm £2.68

MULTIMETERS

NH56A NEW — 20KΩ/V AC/DC/-RES/dB in 23 ranges: 130 × 88 ×

37mm £11.20N

# CRYSTALS CRYST/ (in MHzI 0.032768 0.100000 1.000 1.8432 2.000 2.4576 3.2768 3.579 4.000 4.194 128 157 157 128 157 157 128 1.88 128 157 188 4,433 4,915 5,000 5,026 6,000 6,144 6,5536 453 453 320 268 268 188 128 102 128 8.000 8.867

# **ZENER DIODES** 400mV/2.7-35V 7p; 1.3W/303-100V 15p; 20W/7.5-75V £1.98

REGULATORS
7805, 7806, 7808, 7812, 7815, 7818, 7824 each 40p, 78L05, 78L12, 78L15
78L24 each 32p. 7905, 7906, 7908, 7912, 7915, 7918, 7924, 79L05.
79L12, 79L15, 79L24 each 50p.

### **SOLDERING IRONS**

	Also large stocks of bits, desoldering
	devices, accessories, etc.
ı	ANTEX C 240V £4.60N; X.26-240V
ļ	£4.70N; CSBP £5.45N; XSBP £5.50N;
ì	ST4 Stand £1.70N.
	ORYX 50 watt temp, controlled £15.50N.
ı	SOLDER 500gm/18SWG £7.60N;

### **SWITCHES**

T Range 60 × 45mm £5.95

YN360TR

20KΩ/V: AC/DC/R/ dB/Transis tor Test: in 21

£16:45N

CA3140E LM301AN LM308N LM317K LM324N LM348N !LM380N	45 25 60 295 32 65 66	TAA761 TAA761A TAA765A TAA861 TAA865A	15.55 104 49 62 103 59	UAA170L UAA180 UAA190 XR2206 ZN414 ZN424P ZN425E	152 165 141 300N 80N 99 350	Type CK —1P/12 way, 2P/6 way, 3P/4 way 4P/3 way 4B/9; Min Toggliss—S710 1 SPDT 58p; S7201 DPDT 89p; S7301 3PDT 58,5 S7203 DPDT 89p; S7301 3PDT 58,5 S7203 DPDT 89p; S7301 3PDT 58,5 S7203 DPDT 89p; S7301 BUTON min 8531 make/8533 break 52p; B225 DPDT 51,34.  DUAL IN LINE ERG colour coded 0 3". 0.1"format On/Off single throw 2P SDSQ 0.1"format On/Off single throw 2P SDSQ	22224
METER leads, accesso PANEL MOU 500 mA; 1A ei	ries, e NTINC	tc. ≩ in 50, 100,			14		

# CAPACITORS

Plystyrene, Siemens
5% Tolerance 180V
5% Tolerance 180V
47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 580, 680, 820p-1, 102, 115, 118, 2n2, 2n7, 3n3, 3n9, 4n7, 10p; 5n6, 6n8, 8n2, 10n, 13p.
Ceramic Very Small 1, 8, 22, 2, 7 ctc, up to in 5p each. 1n5, 2n2, 3n3, 4n7, 6n8, 5p; 10n, 22n, 6p; 33n, 47n, 68n, 7p; 100n, 8p.

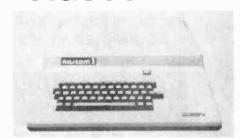
100, 22n, 8p; 33n, 47n, 68n, 7p; 1UUn, 8p.
Plyester, Siemens Layer Type 7.5mm lead spacing 100V
1n, 1n5, 2n2, 3n3m, 4n7, 8p; 4n7, 6n8, 8n2, 10n, 12n, 15n, 18n, 22n, 33n, 47n, 75, 56n, 68n, 7p; 82n, 100n, 9p; 120n, 150n, 11p; 180n, 220n, 12p; 270n, 330n, 330n, 390n, 470n, 15p; 56n, 680n, 24p; 10mm spacing 1Ur 25p; 15mm spacing 10z 25p; 25mm, spacing 1Ur 400V 56p; 3,33UF 100V 69p; in depth stocks.

	ELECTI	ROLYI	rics	
	1/63	9	1000/10	19
	2.2/25	13	1000/16	26
	2.2/63	9	1000/25	36
	4.7/63	ý	1000/40	44
	4.7/100	14	1000/63	76
	6.8/40	9	2200/6	09
	10/6	8	2200/16	44
	10/25	9	2200/25	
	10/40	11	2200/40	73
	10/63	12	4700/16	72
	10/100	15	4700/25	90
	22/10	9		
	22/25	11		
	22/40	12	TANTALU	NI
	22/63	15	BEADS	
	22/100	16	0.1/35	13
	47/3	2	0.22/35	13
	47/10	11	3.47/35	13
ring	47/25	12	1.0/35	13
	47/40	15	2.2/16	13
40V	47/63	17	2.2/35	16
ON;	47/100	18	4 7/16	16
ON.	100/3	2	4.7/35	15
	100/10	12	6.8/16	16
ON;	100/16	12	10/6.3	16
	100/25	12	10/16	18
	100/40	15	10/25	18
	100/63	20	22/6.3	18
	100/100	27	22/16	30
P/4	220/10	16	22/25 33/6.3	24
101	220/16	16		30
301	220/25	16	33/10	30
ush	220/40	20	47/6.3 100/3	30
2p;	220/28	28	100/3	66
-р,	220/100	42		
3" x	470/10	19		nges
)S2	470/16	19		nany
65;	470/25	19	please see	Cat
Low	470/40	27	82 and/or	
	470/63	45	rent price lis	
	470/100	73	rent price is	st.

DID YOU KNOW that for almost 20 years, Electrovalue have been foremost suppliers of components etc. for constructors for items costing from a couple of pennies to computer equipment for hundred of pounds? Our latest price list (free on application) talls at application) tells all.

SO WHY NOT SEND FOR YOUR FREE COPY NO

# lascom



Highly recommended for its versatility and reliability this latest Highly recommended for its versatility and reliability this latest microprocessor from Nascome could be the foundation of a superb professionally styled system of excitingly useful applications and development ... and of course Electrovalue are accredited Nascom suppliers ready to delivery your Nascom 3 (and ancillaries) NOW We do more than just self computers — we understand them so you can buy from us with complete confidence.

derice.	
Nascom 3 Microprocessor to drive a monitor or TV set	£540 + V.A.T.
Monitor for above Nascom Dual Disc Drive SS/DD	£120 + V.A.T.
(standard 514" size)	£685 + V.A.T.
Nascom High Capacity Dual Drive	£949 + V.A.T.

NASCOM 2 in kit form inc. keyboard (but less power supply and RAM) always available £225 + V.A.T.

# WE ARE NASCOM APPROVED STOCKISTS

VAT additional at 15% on all UK orders FREE POSTAGE and packing on UK C.W.O. orders value £5.75 (inc. VAT) and upwards. Under £5.75 add 40p (inc. VAT)	laccepted via Mail Order or Telephone.
DISCOUNTS on orders over £23.00 — 5%	

Not applicable to 'Net' items (shown by 'N' after the price) or to orders paid for by credit cards.

PLEASE DON'T FORGET TO THIS JOURNAL WHEN ORDERING OR WRITING IN TO US

## **ELECTROVALUE LTD**

Head Office, Mail Order Dept and Shop
28E St. Judes Road, Englefield Green. Eghem, Surrey TW20 0HB
Telephone: Epham (STD 0784): London 871 33603; Telex 264475
Also in Manchester for personal shoppers at
888 Burnage Lane, Burnage, Manchester M19 1NA
Telephone 061-432 4946

Computing Shop - 700 Burnage Lane, Manchester Telephone 061-431 4866

# **BOXES**

COMPUTER

**74LS** 

74LS00 74LS02 74LS04 74LS05 74LS08 74LS10 74LS11 74LS14

High quality Black ABS plastic or die

cast	pla	in or	stove	grey.						
L		W	D	A8	S	Plai	n	Stove	e Gr	
5	0	50	25			5001P	90p	5001	123p	
10	00	60	25	2002	<b>96</b> p	5002P	117p	5002	154p	
11	3	63				5003P				
12	1 !	66	40	2004	115p	5004P	162p	5004	210p	
15	52	82	50	2005	134p	5005P	216p	5005	268p	
19	32	113	61	2006	235p	5006P	314p	5006	401p	



VERO RANGE plastic boxes

L W D

72 47 25 21024

120 50 35 21390

180 110 55 21390 G RANGE professional Instrur 21024 21390 21391 Cases 134 90 44 21089 224 140 64 21090 302 170 84 21091

# **VEROBOX CASES**

ish to a much valued

project.
ABS, light grey top; dark grey bottom + 2 anodised panels



L								
	CENAL	COI	IDIIOT	'nΠ			80146 80226	30N 45N
ì	<b>SEIAII</b>	JUI	NDUCT	Un	13		81906	
	1N914	03	2N3819	22	1 AA118	9	8A379	38 25
	1N9148	10	2N3820	40	AA119	9	BAS40-03	25 36
	1N916	15	3823	60	AC126	25	BAS70-03	36 41
	1N4007	υ6	2N3904	15	AC127	25	BB105 B	32
	1N4148	03	/N3906	15	AC128	25	BB 20 4	59
	1N5402	14	2N4036	46	AC151R	56	BB409	33
	1N5407	18	2N4058-62	09	AC153K	20	BC107A.B	16
	2N697	23	2N4124	25	AC176	25	BC108A,B	
	2N706	18	2N4126	25	ACY17	156	BC109B.C	18
	2N930	20	2N4284	30	ACY18	120	BC121W	30N
	2N1132	23	2N4286	18	ACY19	99	BC122Y	100
	2N1302	110	2N4289	23	ACY20	90	BC125	20
	2N1303	58	2N4291	24	ACY21	85	BC125	20
	2N1304	62	2N4292	21	ACY39	170	BC140	25
	2N1305	62	2N4991	62	ACY41	10	BC140	30
	2N1306	90	2N5062	32	AD136	150	BC147A	10
	2N1307	67	2N5192	110	AD142	90	BC149	10
	2N1308	147	2N5195	106	AD149	88	8C154	25
	2N1309	99	2N5457	32	AD161	35	BC160	25
	2N1599	100	2N5458	32	AD162	35	BC161	30
	2N1613	25	2N5459	36	AF114	37	BC167A	09
	2N1711	25	2N6050	380	AF115	37	BC167B	09
	2N1893	32	2N6057	375	AF116	57	BC168A	09
	2N2218A	31	6F40	152	AF117	64	BC168B	09
	2N2219A	25	16F40	165	AF124 AF		BC169B	09
	2N2222A	25	40HF40	225	AF126	37	BC169C	09
	2N2369A	21			AF127	37	BC177B	16
	2N2484	25	40362	85	AF200	10	BC178B	16
	2N2646	45	40406	71	AF239	114	BC179B	18
	2N2904	26	40408	95	AF279	30	BC182	09
	2N2904A	25	40412	108	AFY12	204N	BC182L	09
	2N2905A	25	40430	100	AFY16	327N	BC183	09
	2N3053	23	40594	123	AFY180	310N	BC183L	09
	2N3054	56	40595	123	AFY18E6		BC184	09
	2N3055	48	40636	147	AFY42	461N	BC184L	09
	2N3405	64	40673	145	AU106	240	BC202Y	120
	2N3663	15	A9903	16	AU111	(use	BC212	09
	2N3702-11	00	AA113	13	AU116)		8C212L	09
	2N3771	180	AA116	9	AUY22	10.95	DC212	200

- 1				E 141		
ı	BC214	09	BFR39-41	23	£1210	76
- 1	BC214L	09	BFR79-81	23	E2506	154
	BC238C	-09	BFT65	119	(B383	20
	BC239C	09	BFT66	192	MJ2955	90
-						
- 1	BC258B	09	BFX29	24	MJE340	55
	BC2678	16	BFX84	24	MJE2955	95
4	BC300	32	8FX85	24	MJE3055	70
-1	BC301	24	8FX87	28	MPF102	40
	BC303	30	8FX88	26	MPS6531	40
	BC327	16	8FY50	24	MPS6534	42
	BC328	11	8FY51	24	MPSA12	36
	BC337	14	BFY52	24	MPSA63	38
	BC338	11	BFY90	143	NAS206S5	81
	BC413	09	BR34	70	OA47	12
4	BC414	09	BR64	110	OA202	14
	BC477	24	BRY39	45	OC28	75
	BC546	10	BSX20	22	OC29	75
	BC547	09	BSX26	22	OC35	75
	BC548	09	8SX63	160	OC36	90
- 1		09	BT106	147	OC84	25
	BC549 BC550		BT108	136	PM7A2	373
		10		170	PN70	10
- 1	BC556	10	BU105			
ı	BC557	09	BU124	85	PN72	06
	BC558	09	BU208	180	Q4006LT	104
- 1	8C559	09	BUX26	350N	Q4010LT	115
	BC560	10	BUX28	545	Q4025H	450
	BC879	38	BUX81	744	T2700D	189
	BC880	43	9UX85	130	T2800D	104
	BCY31A	157	BUZ10A	345	TAG3-400	100
	BCY58	18	BUZ15	12.27	TAG209-40	0 85
- 1	BCY70	18	8UZ20	523	TAG209-60	0
	BCY71	18	BUZ23	787		130
	BCY72	18	BUZ24	12.50	TIC106J	48
	BD130	45N	8UZ32	625	TIC106M	55
	BD131	48	BUZ33	844	T1C126D	64
	BD132	48	BUZ41A	637	TIC206D	54
	BD135	27	BUZ44A	9.67	TIC226D	61
- }	BD136	27	BUZ45	12.76	TIC236D	96
	BD139	30	BUZ48	18.94	TIC246D	106
	BD140	32	BUZ50A	763	TIP31A	36
- 1			BUZ54A	12.50	TIP32A	36
- 1	BD644	42N		739	TIP41A	
	BD679	62	BUZ80			45
	BD680	64	BUZ83	11.29	TIP41C	60
- 1	BF115	35	BUZ83A	11.95	TIP42A	45
- 1	BF167	25	BUZ84A	12.75	TIP42C	60
-	BF173	25	BY164	48	TIP150	75
1	BF177	25	C106D1	45	T!P2955	55
1	BF178	25	C0326	460N4	T1P3055	55
1	BF244B	40	C0340	490N4	TIS43	50
	BF254	14	C407	17	U763	50
- 1	BF255	14	C0546	126N1	VN10KM	55
Ì	BF420	31	C762	40	VN46AF	93
ı	BF421	34	C1406	77	VN66AF	105
- 1	8F457	35	D4 clip	for	VN88AF	123
ı	BF458	35	C1406	and	W02	25
- 1	DF458	30	50500	0.10	774000	13



Birminghám

THE
METROPOLE HOTEL
AT THE
NATIONAL
EXHIBITION CENTRE

VISIT THE COMPLETE SHOW FOR THE HOME USER AND SEE:

A COMPLETE cross section of all hardware and software available to the home user.

A **FULL RANGE** of home computers priced from £50 upwards.

A COMPUTER ADVICE CENTRE run by independent experts for the answers to all our questions.

WIN WIN TWO COMPUTERS—one for you one for a school of your choice—to be won at each show: FREE entry form with advance tickets

JUNE SATURDAY 4th (10am-6pm) sunday 5th (10am-4pm)

ADULTS: £2.00 UNDER 8s & OAPs: FREE 25% DISCOUNT for parties of 20 or more.

# SPONSORED JOINTLY BY:

A&B Computing
Computer Today Personal Software
Personal Computing Today
Home Computing Weekly
ZX Computing

ETI

THE MEN WHO INVENTED ME WERE ENOUGH THINK TO MAKE 'FORTH' (IT'S FASTER 10 TIMES AND TIMES MORE COMPACT THAN 'BASIC').

YET THEY'RE DUMB ENOUGH TO SELL ME FOR £89.95!



Richard Altwasser and Steven Vickers are the men who invented the Jupiter Ace.

After years of designing microcomputers that use BASIC (both men played a major role in creating the ZX Spectrum), they abandoned it in favour of FORTH.

FORTH is just as easy to learn as BASIC. Yet it's a faster, more compact and more structured language that educationalists and professional programmers alike prefer.

So the Jupiter Ace is the only microcomputer you can buy that is designed around FORTH.

Using it, there's little fear of accidentally 'crashing' programs halfway through and having to start all over again (a common fault with BASIC). The Jupiter Ace's comprehensive error checking sees to that.

The Jupiter Ace has a full-size keyboard, high resolution graphics, sound, floating point arithmetic, a fast, reliable cassette interface, 3K of RAM and a full 12 month warranty.

You get all that for £89.95. Plus a mains adaptor, all the leads needed to connect most cassette recorders and T.V.'s, a software catalogue (35 cassettes available, soon to be 50), the Jupiter Ace manual and a free demonstration cassette of 5 programs

The Jupiter Ace manual is a complete introduction to personal computing and a simple-to-follow course in FORTH, from first principles to confident programming.

Plug-on 16K and 48K memory expansions are also available, at very competitive prices. (There'll be a plug-on printer interface available soon, too.)

It'll take you no time at all to realise how clever Richard and Steven were to design the Jupiter Ace around FORTH. And even less time to realise what a silly price £89.95 is to charge for it.

# Technical Information

### Hardware

Z80A; 8K ROM; 3K RAM.

### Keyboard

40 moving keys; auto repeat; Caps Lock.

### Screen

Memory mapped 32 col x 24 line flicker- free display upper and lower case ascii characters.

### Graphics

High resolution 256 x 192 pixel user defined characters.

### Sound

Internal loudspeaker may be programmed for entire audio spectrum.

### Cassette

Programs and data in compact dictionary format may be saved, verified, loaded and merged. All tape files are named. Running at 1500 baud.

### **Expansion Port**

Contains D.C. power rails and full Z80 Address, data and control signals. Can connect extra memory peripherals.

### Editor

Allows complete editing and listing of compiled programs.

Please send cheque/postal order to: Jupiter Cantab, 22 Foxhollow, Bar Hill, Cambridge CB3 8EP.

# **Jupiter** ACE

Please send me \_\_\_\_\_ Jupiter Ace microcomputers @ £89.95 (+ £3.95 p. & p.)

Tick here if you require VAT receipt \_\_\_

Name \_\_\_\_

Address \_\_\_\_\_

011 0183

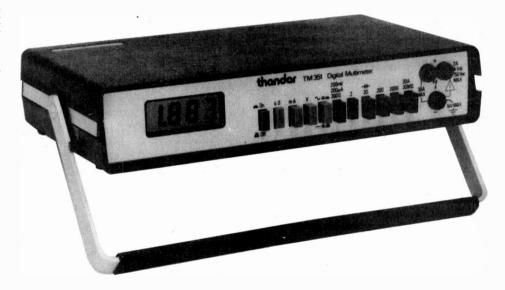
Available for immediate delivery. Allow 14 days for p. & p. U.K. price only (export price on request).

# BUYER'S GUIDE TO

We've been getting testy with test gear, and in particular DMMs. Here are specs on over 30, and info on more besides. You'll find

he price of DMMs has fallen so much that you can now buy a reasonable quality instrument for the same price as a relatively cheap moving coil multimeter. So why doesn't everybody use DMMs and put the moving coil meter manufacturers out of business? First-ly, the cheap end of the market is likely to be dominated by moving coil meters for some time to come because the market is too small (unlike that, for example, of watches) for economics of scale to reduce the prices drastically. Secondly, and to an extent following on from the first reason, most electronics engineers and hobbyists are more familiar with moving coil meters and so have a certain preference towards them. And finally, there are some occasions when a moving coil meter can be far more useful than a digital - for instance, when you're measuring a voltage that's varying by around 10% per second, when you'd find yourself completely bedazzled by the flicker of digits on a DMM. Most engineers prefer to have a choice of the meter

The Thandar TM 351



for the job, so don't throw away your old test meter just because you're going to buy a nice new DMM.

**Multi-tudes Of Meters** 

In the table, we've listed all the test meters we were able to get information on, up to a maximum price of £100 (excluding VAT). Note that we have listed some meters as similar to those in the table. There were rather more meters than we bargained for, and we dread to think how many more leaflets will have arrived between our writing and your reading this! Some comments on the table will be helpful.

All the test meters in the table are 3½ digit types, ie

reading is 1999.

You can obtain meters with more digits, but we did not come across any range, though we did find

in the price range, though we did find some 4½-digit hand-held meters at just over £100. So, for example, a

The HC (well, sometimes) 601 (left) and the MIC-3300A (right): both these meters (and their relatives) turn up at a variety of sources.

200mV voltage range on our meters will have a maximum reading of, in fact 199.9mV, and will be, at best, able to distinguish (or resolve) voltages that are 0.1mV different.

# **Accuracies**

The accuracies quoted in the table are for guidance only. For two reasons we cannot quote exactly



# TEST EQUIPMENT

information on the latest in other types of test gear on page 48 too. Next month, oscilloscopes.

comparable figures for different different manufacturers meters: guote their error specificaitons in different ways, though most use the method we have adopted of quoting a percentage of the reading plus a number of digits (some quote a percentage of full scale as well as or instead of the number of digits); and different ranges of the same quantity may have different errors. For example, Keithley quote an error of 1% plus 1 digit for the 2, 20 and 200mA DC ranges of the 130, yet 2% plus 1 digit for the 2A and 10A ranges. Also, some go further and quote different errors for different frequencies on the AC ranges. So, given the space available we can do no more than give a very broad indication, and we strongly recommend that once you have narrowed down the field to those instruments you are most interested in, you should get full specs from the manufacturers or agents. You should also note that some meters have accuracy guarantees, ie, provided that the meter is used within specified temperature and humidity, and is not abused, then the meter should stay within the specifications for at least a year. Therefore it's likely that these meters will be fairly conservatively specified.



You should decide what accuracy you actually need. It isn't that often that it's necessary to measure quantities to 1%, in fact, for most purposes, 5% is perfectly adequate. However, what you might need to do is to distinguish between quantities that differ by, say, 1%, and this is a relatively straightforward task for virtually any DMM.

Note that for maximum DC and AC voltage ranges, the maximum volts is always less than the maximum reading that the display is capable of. The maximum for AC is specified as volts RMS, very often 700V RMS, which will mean a peak voltage of 1000V for a sinusoidal waveform.

# **Features**

Most of the features are self-explanatory, though you may be a little surprised that feature F, folds for protection, really does mean that the



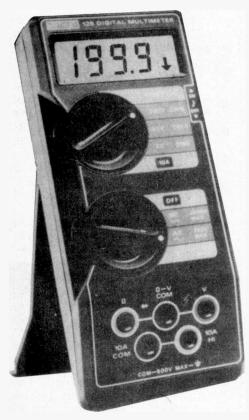
DIGITAL
<b>MULTIMETERS</b>

Voltage Of ranges in DC Volts Ranges in AC Volts (Hz) for Voltage Of ranges in October October

		pracie	00	prac	0/0	0. ki	atel (nu	acked	pract	KerAccio
	Avometer DA211	200mV to 1000V (5) <	0.8+1 ~	200V, 1000V (2) 1	1.2+10	45 to 500 ·	200uA to 10A (5)	1.2+2	-	- 00
	Avometer DA212	200mV to 1000V (5)	0.25+1	200mV to 750V (5)	0.75+3	45 to 500	200uA to 1A (5)	0.75+5	200uA to 1A (5)	1.2+4
	AVO Digminor 2000	2V to 1000V (4)	0.25+1	2V to 1000V (4)	1.0+3	40 to 450	20mA, 2A (2)	1.0+1	20mA, 2A	2.0+3
	Avometer 2001	200mV to 1000V (5)	0.25+1	200mV to 1000V (5)	1.0+3	40 to 1k	200uA to 10A (6)	0.75+1	200uA to 10A (6)	1.5+3
	BBC MA2D	200mV to 650V (5)	1.0+1	200mV to 650V (5)	1.5+3	NS	2mA to 10A* (5)	1.0+1	2mA to 10A* (5)	1.5+3
	BBC MA3D	200mA to 650V (5)	1.0+1	200mV to 650V (5)	1.5+2	15 to 4k	2mA to 10A* (5)	1.0+1	2mA to 10A* (5)	1.5+2
	Beckman T110	200mV to 1000V (5)	0.25+1	200mV to 750V (5)	1.0+3	NS	200uA to 10A (6)	1.0+1	200uA to 10A (6)	1.5+3
	Beckman TECH 310	200mV to 1500V (5)	0.25+1	200mV to 1000V (5)	0.75+3	45 to 2k	200uA to 10A (6)	0.75+1	200uA to 10A (6)	1.5+3
	Eagle TS 500	2V to 1000V (4)	1.0+1	200V, 500V (2)	2.0+1	NS	2mA to 200mA (2)	1.5+1	-	_
(	Eagle TS 750	200mV to 1000V (5) 🔀	0.8+1	200mV to 700V (5) 🕊	1.0+2	NS	200uA to 10A (16) 🕪	1.5+1 🗸	200uA to 10A (6) 🛫	3.0+2
	Eagle TS 3500	200mV to 1000V (5)	1.0+1	200mV+600V (5)	1.0+1	NS	20mA to 1A (3) (+10A with shunt)	1.0+1	20mA to 1A (3) (+10A with shunt)	1.0+1
	Elemic Digital 10	200mV to 1000V (5)	0.2+1	200mV to 1000V (5)	0.5+1	10 to 5k	200uA to 10A* (6)	0.2+1	200uA to 10A*(6)	0.5+1
	Fluke 8022B	200mV to 1000V (5)	0.25+1	200mV to 750 (5)	1.0+3	45 to 450	2mA to 2A (4)	0.75+1	2mA to 2A (4)	2.0+3
	Hansen HD30/B	200mV to 1000V (5) ~	1.35+1	2V to 600V (4)	2.3+1	40 to 500	200mA (1) 🗶	2.0+1	200mA (1)	3.0+1
	Hansen HD31	200mV to 1000V (5)	0.8+1	2V to 750V (4)	1.2+1	40 to 500	200mA, 10A (2) X	1.8+1	200mA, 10A (2)	2.0+1
	HC601	200mV to 1000V (5)	1.0+2	200mV to 750V (5) 😸	2.0+5	45 to 400	200uA to 2A (5) 🗸 🗴	2.0+1	200uA to 2A (5)	2.0+5
	HC703	200mV to 1000V (5)	1.0+2	200mV to 750V (5)	0.6+3	45 to 1k	200uA to 2A (5)	0.25+1	200uA to 2A (5) 🗢	2.0+2
	Keithley 128	2V to 1000V (4)	0.5+1	2V to 750V (4)	1.0+1	45 to 500	10A (1)	1.5+1	10A (1)	2.0+1
	Keithley 130	200mV to 1000V (5)	0.5+1	200mV to 750V (5)	1.0+5	45 to 500	2mA to 10A (5)	2.0+1	2mA to 10A (5)	3.0+5
	Lascar DP2010	2V to 500V (4f) 🗸	1.0+1	2V to 500V(4) ~~	2.0+5	NS	2mA to 2Á (4)	3.0+1	2mA to 2A (4)	4.0+1
	Lascar LMM100	200mV to 1000V (5)	0.1+1	200mV to 1000V (5)	0.75+5	NS	200uA to 2A (5)	0.25+1	200uA to 2A (5)	1.0+5
	MDS D350	200mV to 1000V (5)	0.75+1	2V to 600V (4)	1.0+2	40 to 500	200mA (1) (20A with shunt)		200mA (1) (20A with shunt)	1.25+1
	MIC-3300A	200mV to 1000V (5) ~		200V, 750V (2)		40 to 500	200uA to 10A (6) 🛫	0.8+1	- X	-
_{	MIC-60002	200mV to 1000V (5) ~	Ø.5+1✓	200mV to 750V (5)	1.0+2	40 to 600	200uA to 10A (6) 🛩	0.8+1 🗸	2mA, 200mA, 10A (3).	1.5+1
	Micronta 22-191	200mV to 1000V (5)	1.0+1	2V to 500V (4) ~	1.5+2	45 to 1k	2mA to 200mA (3) 🔾	2.5+1	2mA to 200mA (3) 🔾	2.5+2
	Micronta 22-192	200mV to 1000V (5)	1.5+2	2V to 500V	1.5+2	45 to 1k	200mA (1)	2.5+1	200mA (1)	2.5+2
	Pantec Pan 2001	200mV to 1000V (5)	0.2+1	200mV to 750V (5)	0.5+1	NS	200uA to 10A (6)	0.2+1	200uA to 10A (6)	0.5+1
	Sabtronics 2015A	200mV to 1000V (5)	0.1+1	200mV to 1000V (5)	0.5+1	40 to 40k	200uA to 10A (6)	0.3+3	200uA to 10A (6)	0.5+1
	Sabtronics 2035A	200mV to 1000V (5)	0.1+1	200mV to 1000V (5)	0.3+2	NS	200uA to 2A (5)	0.3+1	200uA to 2A (5)	0.25+1
	Sifam DMM 2200B	2V to 1000V (4)	0.3+2	2V to 1000V (4) 👅	0.4+2	45 to 700	2mA to 2A (4) ~	0.7+2	2mA to 2A (4)	1.0+3
	Sifam DMM 2500	200mV to 1000V (5)	0.3+2	200mV to 1000 (5)	0.4+2	45 to 700	2mA to 2A (4)	0.7+2	2mA to 2A (4)	1.0+3
	Thandar TM 351	200mV to 1000V (5)	0.1+1	200mV to 750V (5)	0.5+2	50 to 1k	200uA to 10A (6)	0.3+1	200uA to 10A (6)	1.0+2
	Thandar TM 354	2V to 1000V (4)	0.75+1	200V, 500V (2)	1.0+2	50 to 500	2mA to 2A (4)	1.0+1	<del></del>	_
	Trio DL-705	2V to 1000V (4)	0.5+2	2V to 1000V (4)	1.0+2	40 to 1k	20mA, 200mA (2)	1.0+2 -		_
44									ETI JUNE	1983

	A		for	en	ohms					, (see
n AC	urren	ange (HZ)	age Bura	in 1891	Ohms es in	ohm <sup>s</sup>	ארצו. ני	e or	امین	lied & NAT
IN ACT	dip 'eu	cy Raiacy um	Aoltage Brie	uge saug	ecy on	U. Gee	KEYMM	dels .so	ories Str.	uding
ding 7	Frequed	CY Range (HZ)  Accuracy  Maximum  on	Voltage Burd Voltage Burd Voltages Ra Int Ohms (number bracker	is) Accu	es in racy on restrict	Ohms Type Ohms	Key) MM/TYP	Access Key)	.:	Avameter DANI
	-	300mV (10A 500mV)	2k to 2M (4) X	1.0+2	BDHMNO	hand	- Sim.	bt	56.50	Avometer DA211
	45 to 1k	250mV (1A 600mV)	200 to 20M (5)	NS	KLMO	hand/LCD	_	bt	79.90	Avometer DA212
,	40 to 2k	500mV	2k to 20M (3)	1.0+1	BCDGMNOS	hand/LCD	_	bkt	69.40	AVO Digiminor 2000
•	40 to 450	500mV	200 to 20M (2)	0.25+1	BCDGMNOS	hand/LCD	Vehicle Test 2002	bkt	85.40	Avometer 2001
	NS	NS	2k to 20M (5)	2.0+1	BKMNO	hand/LCD	MA1D	t	68.00	BBC MA2D
	15 to 4k	NS	2k to 20M (5)	2.0+1	BFKMO	hand/LCD	_	t	99.00	BBC MA3D
	N\$	750mV	200 to 20M	0.5+3	BCKLM	hand/LCD	T100	bt	59.00	Beckman T110
	45 to 400	700mV	200 to 20M	0.5+1	BDKMNS	hand/LCD	_	bt	95.00	Beckman Tech 310
	-	NS	2k to 2M (4)	1.5+1	BGMO	hand/LCD	_	ct	29.95	Eagle TS500
	N\$	NS	200 to 20M (6) 🛫	1.0+1	BKMOS	hand/LCD	_	ct	149.95	Eagle TS750
	NS	NS	2k to 20M (5)	1.0+1	KMPS	hand/LCD	_	cst	74.95	Eagle TS3500
	10 to 5k	200mV	2k to 20M (5)	0.2.1	BDVA	l lico	District o District o	La	92.00	Floria Diaital 10
		250mV (2A900mV)	200 to 20M (6)	0.2+1 2.0+1	BDKMO ABDHMNO	hand/LCD hand/LCD	Digital 8, Digital 9 8021B	bct bt	83.00 99.00	Elemic Digital 10 Fluke 8022B
		NS	200 to 2M (5)	1.35+1	CDKOR	hand/LCD	HD30	bft	38.70	Hansen HD30/B
		NS	200 to 20M (5)	0.8+1	CDKOR	hand/LCD	_	bft	51.26	Hansen HD31
	45 to 400	250mV (2A 700mV)	200 to 20M =	0.6+4	ABDHLMO\$		HC6010	bt (	34.00 ?	HC601
		250mV (2A 700mV)	200 to 20M	0.2+3	ABDHLMOS		HC7030	bt (	(44.00)?	HC703
		300mV	200 to 20M (4)	0.5+1	ABCDKMN	hand/LCD	135A	bt	119.00**	Keithley 128
		300mV (2A 700mV)	200 to 20M (5)	0.5+1	AKMO	hand/LCD	131	t	99.00**	Keithley 130
		NS	2k to 2M (4) ×	1.0+1	BDGMO	hand/LCD	DP2010K	t .	27.40	Lascar DP2010
		NS	200 to 20M (5)	0.2+1	ABHO	bench/LCD	LMM1001	t	75.20	Lascar LMM1000
	40 to 500	300mV (2V with S)	200 to 2M (5)	0.75+3	CHLOR	hand/LCD	_	bcst	69.00	MDS D350
		,,	(0,							
[	-	350mV	200 to 20M (6)	0.8+1	ABDKMNOT	hand/LCD	-	ft (	42.00 ?	MIC-3300A
	NS	350mV . —	200 to 20M (6) $\sim$		ABCDKMNO	hand/LCD	-	ft	46.00	MIC-6000Z)
	NS	NS	200 to 20M (6)	2.0+1	CDKMOS	hand/LCD	· –	t {	47.78) X	Micronta 22-192
	NS	NS	200 to 2M (5)	2.0+1	CDKORS	hand/LCD	-	t	64.95	Micronta 22-192
	NS	NS	200 to 20M (6)	0.5+1	BKMO	hand/LCD	-	t	79.83	Pantec Pan 2001
	NS .	NS	200 to 20M (6)	0.1+1	HLMO	bench/LCD	2010A	t	83.00	Sabtronics 2015 A
	NS	NS	200 to 20M (6)	0.25+1	BHLMO	hand/LCD -	_	t .	62.00	Sabtronics 2035A
	45 to 700	200mV	2k to 20M (5) '>	0.3+2	BKMO		-	bft	43.43	Sifam DMM 2200B
	45 to 700	200mV	200 to 20M (6)	0.3+2	BHMO	bench/LCD		bt	66.04	Sifam DMM 2500
	50 to 1k	NS	200 to 20M (6)	0.2+1	DHMO	bench/LCD	TM353, <b>T</b> M355	bt	99.00	Thandar TM351
	-	300mV (2A 900mV)	2k to 2M (6) 🗶	0.75+1	BDGMO	hand/LCD	-	t	39.95	Thandar TM354
	_	NS	2k to 20M (6)	0.5+2	HO(R)	bench/LED	-	bít	92.00	Trio DL-705
	ETI JUNE	1983								

meter folds in two down the centre. Meters with low power ohms ranges useful for be measuring values with the comresistance ponents still in circuit because the test voltage they apply is 0V5 or less, which is too low to turn on transistor or diode junctions. Not all manufac-



Keithley's 128 — the 135 has an extra digit.

turers specify the maximum test voltage that their meters will apply, so we may have missed some meters that apply less thant 0V5 on all resistance ranges (feature N).

# **Prices**

Note that these do not include VAT. Before ordering, you should check the price with the suppliers it may be possible to get a better price than we've quoted by shopping around.

# Similar Brands

These are brands that share a similar specification, with differences from the meter in the table as detailed below:

AVO Vehicle Test 2002 (£97.00): limited basic ranges, but wide selection of special accessories specially for automotive testing;

BBC MA1D (£54.00): same ranges as MA2D (except no 10A current ranges), lower accuracy;

Beckman T100 (£49.00): same ranges T110 (except no continuity buzzer), lower accuracy;

Elemic Digital 9 (£58.95): same ranges as Digital 10, lower accuracy; Digital 8 (£52.50): as Digital 9 but no 10A ranges;

Hansen HD30 (£36.48): as HD30B but no continuity buzzer;

HC6010 (£37), HC7030 (£47): as HC601, HC703 but with 10A ranges; Keithley 135 (£225): similar to 128 but with  $4\frac{1}{2}$  digits and higher accurancy;

Keithley 131 (£139): similar to 130 but with higher accuracy;

Lascar DP2010K (£19.95 special offer): kit version of DP2010;

(£79.95): LMM1001 Lascar MM100 but with higher accuracy; **Sabtronics 2010A** (£71.00): as 2015A

but with LED display;

Thandar TM353 (£75.00): similar to TM351, but lower accuracy, no 10A range and rotary switch range selection;

Thandar TM355 (£75.00): similar to TM351, but lower accuracy and LED display.

# **Key to DMM Features**

A = accuracy guarantee

B = single battery operation

C = continuity beeper D = diode test facility

F = folds for protection

G = slider switch range/mode selection

H = push-button range/modeselection

K = rotary switch range/mode selection

L = low power ohms range

M = manual ranging

N = low power ohms on all ranges

O = overload protection

R = autoranging

S = stand

T = transistor test facility

# Key to accessories supplied

b = battery

c = carry case
f = sapre fuse

k = test clips

s = high-current shunt

t = test leads

\* = 20A for limited period

\*\* = likely to be discounted

NS = not specified

# Addresses

Thorn EMI Instruments Limited. Archcliffe Road, Dover, Kent CT17 9EN

# **BBC**

available through: John Minster Instruments Ltd,

137/139 Sandgate Road, Folkestone, Kent CT20 2DE; and: House of Instruments Ltd, Clifton Chambers, 62 High Street, Saffron Walden, Essex, CB10 1EE

**Beckman** 

available through:

Farnell Electronic Components Ltd, Canal Road, Leeds, LS12 2TU; and, Audio Electronics, Cubegate Ltd, 301 Edgware Road, London W2 1BN

Precision Centre, Heather Park Eagle International Drive, Wembley, HA0 1SU

Elemic

available through:

Black Star Ltd, 9A Crown Street, St Ives, Huntingdon, Cambs PE17 4EB

Fluke (GB) Ltd

Colonial Way, Watford, Herts WD2 4TT

Hansen

available through:

Audio Electronics, Cubegate Ltd HC601, HC703, etc

These are available through a number of suppliers, and are often sold as 'own brands', with or without the HC prefix. However, you should check that the specs are the same as those we quote which are for the House of Instruments Ltd

**Keithley Instruments Ltd** 1 Boulton Road, Reading, Berkshire RG2 ONL

**Lascar Electronics Ltd** Module House, Whiteparish, Salisbury, Wiltshire SP5 2SJ

Micro-Data Systems, Coach Mews, St Ives, Huntingdon, Cambs PE17 4BN

MIC -6000 Z available from:

House of Instruments Ltd Micronta

available through Tandy high street shops.

Pantec Pan

available through: Audio Electronics, Cubegate Ltd.

Sabtronics

available through: Black Star Ltd; and, Stotron Ltd, Haywood Way, Ivy House Lane, Hastings, East Sussex TN35 4PL. (Stotron also sell the Taisei DM2350, which bears a remarkable similarity to the MDS D350, though the specs are slightly lower, for £48.00).

Sifam Limited

Woodland Road, Torquay, Devon

**Thandar Electronics Limited** London Road, St Ives, Huntingdon, Cambs PE17 4HJ

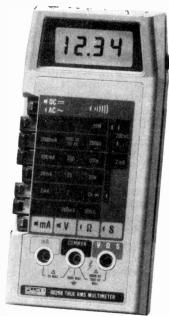
Trio

available from:

House of Instruments Ltd

# **EQUIPMENT NEWS...EQUIPMENT NEWS..**

# Fluke Hand-held True RMS DMM.



Fluke has expanded its best-selling range of 3½ digit hand-held digital multimeters with the the introduction of a version with true RMS measurement capability. Fluke pioneered true RMS measurement on hand-held DMMs with their recently launched 4½ digit family and have now introduced this useful facility to their 3½ digit range.

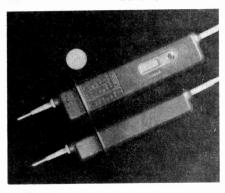
Called the 8026B, this new model provides all the facilities and performance of the 8020B series models such as 0.1% basic DC accuracy, high speed continuity bleeping for open/short continuity testing, and conductance which allows high resistance measurements from 20 Mohms to 10,000 Mohms to be made.

True RMS capability is most useful when measuring nonsinusoidal waveforms as in digital equipment, e.g. modems, terminals and monitors as well as in motor and thyristor circuits, noise measurement etc. Conventional meters using only averaging techniques can introduce errors of up to 30% or more in such applications.

Other features of the 8026A, which is priced at £180 + VAT, include a heavy duty 600V dual-fuse system to protect against high-energy input signals, a very rugged design, non-skid rubber feet and a tilt bail for ease of use in the field. The new instrument comes with a two-year guarantee and labour warranty and a one-year calibration cycle. For further information, contact Fluke Way, Colonial (GB) Limited, WD2 4TT. Watford, Herts. Tel: 0923 40511.

**New Source for Digicheck** 

The Steinel Digi-Check, a voltmeter and ohmmeter of a rather novel design, is now available from Electronic and Computer Workshop Ltd, 171 Broomfield Road, Chelmsford, Essex CM1 1RY.



Temperature Measurement From Your DMM



A nyone who has access to a digital multimeter can now use it as a versatile wide range temperature measuring instrument using standard type K thermo-couples, by adding the DVM/TC Interface Unit, which costs £36 (+ £1.35 p&p + VAT) from the makers.

This new device, at considerably lower cost than a dedicated instrument, has a temperature range of — 50C to 1100°C and incorporates junction cold automatic compensation. Thermocouples are attached through a miniature compensated socket. basic Α thermocouple and mating plug are supplied as standard with the instrument. The output of 1mV per degree centigrade is via a 0.75 metre coiled lead fitted with 4mm plugs. Long term stability is claimed to be excellent and the low battery drain allows it to be used for continuous monitoring if necessary

Full details are available from the manufacturers Graham Bell Instrumentation, PO Box 230, 39 Derbyshire Lane, Sheffield, S8 0TH. Tel: 0742 582370.

# **Enhanced Logic Analyzer**

Two optional enhancements for their Model 632 Logic Analyzer announced by Zicon Instruments of Norwich.

The Model 632 is designed as a high performance, low cost instrument for use in trouble-shooting synchronous logic systems. It has sixteen data channels, two qualifiers and a clock input which, coupled with its integral hexadecimal display, allows it to be used "free-standing" in the analysis of microprocessor systems. The unit also provides oscilloscope outputs which are used to generate the familiar timing diagram.

In its standard form, the Model

In its standard form, the Model 632 is capable of capturing 128 16-bit words at speeds up to 4MHz with 64 words pre-trigger.

Data can be recorded using either edge of the external clock; and a clock qualifier allows (for example) only-memory reads or only-data outputs to be recorded. The trigger word is set by four thumbwheel switches in hexadecimal code with disable/enable selection for each switch. A 1-X-0 trigger qualifier expands the trigger word to 17 bits or it may function as an external trigger.

can The stored data examimed in one of two ways. The integral 4-digit hexadecimal display shows one word at a time with its position in memory relative to the trigger word indicated by a 2-digit cursor display extending from -64 to +63. A timing diagram output is also which provided generates 16-channel display on any general purpose oscilloscope with trigger and cursor position markers.

An optional 12 MHz memory speed (Option 11) is now available on this model. As a further enhancement (Option 12), Zicon Instruments have designed and produced a dedicated IEEE-488 bus data pod for use with Model 632. This probe connects directly to the bus and permits the monitoring of bus activity in either state or timing format with 8 input lines switchable between handshake and management lines or flying leads for user connection.

Current prices are: Model 632 £1095; Option 11 £295; Option 12 £295. Zicon Analyzers are distributed by STC Instruments Ltd of Harlow and Elex Systems of Bracknell. Zicon Instruments Ltd, 23 Meteor Close, Airport Industrial Estate, Norwich NR8 6HQ. Tel: Norwich (0603) 400083.

# EQUIPMENT NEWS . . . EQUIPMENT NEWS . . .

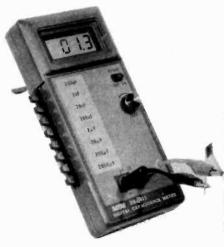
# High-Current Clamps For Beckman Multimeters

A range of three current clamps is now available to extend the AC and DC current ranges of all Beckman Instruments' multimeters. The ranges are 10 to 150A RMS AC (model CT-231, £19.00 inc. VAT), 10 to 1000A RMS AC (model CT-232, £98.50 inc. VAT) and 0 to 600A AC and DC (model CT-233, £69.00 inc.

VAT, available June).

With the multimeter in the 200mA AC position, the CT-231 displays the current directly in amperes. With the CT-232, the multimeter is set in the 2A AC position and the current reading is multiplied by 1000. Depending on DC or AC measurement, the multimeter using the CT-232 is set to either 200mV or 2V DC or AC position, the readings being directly in amperes and amperes/1000 respectively. (The clamps should be usable with other brands of DMM — Ed.). Beckman Instruments Ltd, Mylen House, 11 Wagon Lane, Sheldon, Birmingham B26 3DU. Tel: 021-742 7761.

# Low Cost Capacitance Meter



portable LCD digital capacitance meter costing £49.50 plus VAT marketed by Semiconductor Supplies, Sutton, has a 0.1 pF to 2000 uF range covering virtually all electronics engineering applications. A 3½ digit display is provided.

The DM 6013 is supplied with an instruction manual, alligator test leads and a spare 0.2A fuse. For further information contact Semiconductor Supplies International, Dawson House, 128/130 Carshalton Road, Sutton, Surrey SM1 4RS. Tel: 01-643 1126.

# **National Agreement**

Wessex Electronics Ltd of Bristol has been appointed by National Panasonic (UK) Ltd to market National measuring and

testing equipment.

Among the products Wessex will be distributing is a 20 MHz, 32 channel logic analyser. The VP-3620A is a dedicated unit catering to a wide range of industrial needs. It contains a logic state analysing self-contained function for microprocessor operation analysis and a logic timing function for the evaluation of peripheral operations. With its multifunction capability, National's logic analyser is also able to display the traced data in disassembled mnemonic mode mnemonic corresponding to each microprocessor in use.

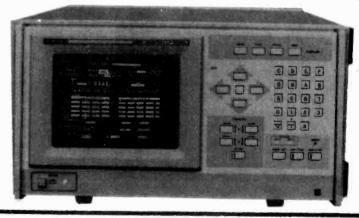
The National Panasacope will also be available from Wessex. The new oscilloscope (VP-5512A) offers DC to 100 MHz with an alternate sweep function. There is four channel, eight trace capability so that a large number of signals can be simultaneously observed. The Panascope features an advanced dome-meshed CRT and an auto-fix circuit for easy triggering. Ideal for field or lab use, the Panascope has a tv sync separation circuit for video

signals and variable hold off function for trigger stabilisation.

Advanced technology utilised in the Panascope, such as reduced number of parts for greater reliability and epoxy circuit boards for heat and shock resistance are also featured in the logic control series oscilloscopes (VP-5520B and VP-5530B) manufactured by National and to be marketed by Wessex. Both the VP-5520B and the VP-5530B offer multi-trace capability and facilitate accurate signal measurement up to 200 MHz and 300 MHz respectively.

Making up complement of National products to be marketed by Wessex Electronics is a new generation A4 digital graphic plotter. Offering six colour graphics plotting speeds up 400mm/sec, the plotter (VP-6801A) allows great versatility in the creation of graphs and line definitions. The VP-6801A features a high level of intelligence to simplify the external programming required to generate complex graphs, shapes alphanumerics. Computer interfaces available include both GP-IB and RS-232C, thus allowing the VP-6801A to be used as a computer graphics device as well as for instrumentation graphics. Wessex Electronics Limited. 114-116 North Street, Downend, Bristol, BS16 5SE. Tel: 0272 571404.

National's VP-3620A Logic Analyser



# Platinum Digital Thermometer

pocket-sized, digital thermometer, with +/- 0.1 degrees C accuracy over an extended temperature range from -200 to +800 degrees C, is announced by Ancom Ltd. The Ancom BLR-800 offers a one degree C resolution, very good repeatability and a stability figure of 0.01 degrees C per degree C, with a wide range of standard platinum RTD temperature sensor probes. These include models for measurement of air temperature, liquid immersion, surface

temperature, hypodermic insertion and fast response types. The sensors are available with conformity to British and DIN standards in grades A, B, C, D and E and are simply connected to the instrument by a three-way plug/socket.

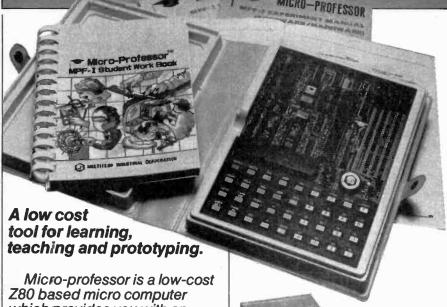
The BLR-800 uses a low power 3½ digit LCD for data display, which also

displays a low battery sign.

Calibration is very simply carried out by the user, using boiling water and melting ice references.

For further information please contact Ancom Limited, Devonshire Street, Cheltenham GL50 3LT, Tel: 0242 513861.

# THE COMPLETE PACKAGE! MICROPROFESSOR PLUSTHE **VORK BOOK**



which provides you with an interesting and inexpensive way to understand the world of microprocessors.

Micro-Professor is a complete hardware and software system and is a superb learning tool for students, hobbyists and microprocessor enthusiasts, as well as an excellent teaching aid for instructors of electrical engineering and computer science courses.

Micro-Professor **£99** 

Now with the Student Work Book available Flight offer you the complete package. An easy to follow manual that will help further your understanding of microprocessors.

Student Work £16.00

Micro-Professor is a trade mark of Multitech Industrial Corporation. Z80 is a trade mark of Zilog Inc.

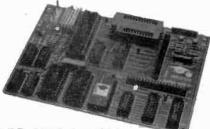
Manual play, Auto replay. Auto rhythm -6 different rhythms, Sound Synthesizer and Hi-fi speaker.

SGB-MPF

Generation

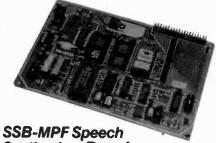
Sound

**Board** 



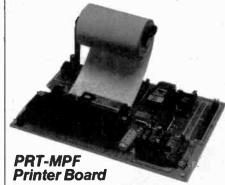
**EPB-MPF EPROM Programming Board** 

For all + 5V 1KB/2KB/4KB EPROMS Read/Copy/List/VerifyCapability.



Synthesizer Board

A vocabulary of up to 400 words based on the TMS 5200 chip.



Memory dump utility. BASIC program listing. Z80 disassembler.

Please send me	Qty
Micro-Professor	£99.50
	(+£4.00 p&p)
Student Work Book	£16.00
SGB-MPF board	£79.50
EPB-MPF board	£99.50
SSB-MPF board	£99.50
EPB-MPF board SSB-MPF board PRT-MPF board	£86.25
Lenclose cheque/P	O for £

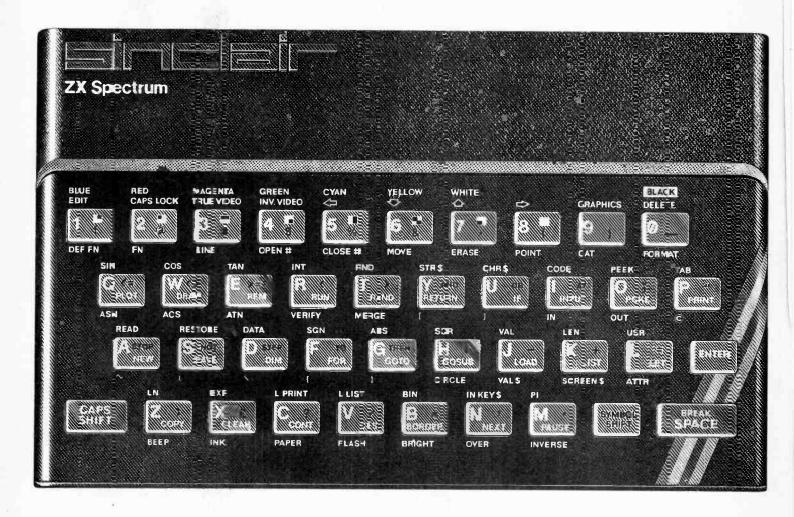
1 Name ....... I Address ....

Mail Order only Prices include VAT. Please allow 28 days for delivery.



FLIGHT ELECTRONICS LTD. Quayside Rd. Southampton, Hants SO24AD. Telex. 477793. Tel.(0703)34003/27721.

# Sinclair ZX Spect



# The growing range of Spectrum Software



You'll know already that the Spectrum has generated an enormous range of peripherals and independent software. Our own range is growing very fast and is shown in the Sinclair Software Catalogue – free with every ZX Spectrum.

# rum-news!

# 16K now f99-95 Previously £125.

# 48K now Previously £175.

At last, a 16K colour computer with graphics for under £100!

Why have we done it? Partly because the sheer volume of Spectrums sold (over 300,000 so far) has brought down unit production costs.

And partly, of course, because we hope you'll buy a Sinclair computer - and not some competitor's promise! We've all heard about colour computers breaking the £100 barrier. Here's the computer that's done it. A colour computer with advanced graphics that's fully supported, and widely available.

Right now, you can order a Sinclair Spectrum at these prices direct from Sinclair on the order form below. And to make it even easier to handle high-level computing at the

lowest possible price, we've cut the cost of the printer, too. At £39.95, it's almost unbelievable!

At prices like these, there's really no reason to wait.



**ZX Printer now** £39.95

Previously £59.95

How to order your ZX Spectrum

Access, Barclaycard or Trustcard holders -call 01-200 0200 24 hours a day, every day. By FREEPOST - use the coupon below. Please allow up to 28 days for delivery, 14-day money-back option.

# ZX Spectrum

Sinclair Research Ltd., Stanhope Road, Camberley, Surrey, GU15 3PS.

Tel: 0276 685311. Reg. no: 1135105.

Qty	Item		Code	Item Price £	Total £
	Sinclair ZX Spectrum - 16K RA	M version	3000	99.95	
	Sinclair ZX Spectrum - 48K RA	AM version	3002	129.95	
	Sinclair ZX Printer		1014	39.95	
	Printer paper (pack of 5 rolls)		1008	11.95	
	Postage and packing: orders	under £90	0028	2.95	
	orders	over £90	0029	4.95	
	se a cheque/postal order payable charge to my Access/Barclaycard			JI 40	
Please d	elete/complete as applicable.				
Signatu	ıre				PLEASE PRIN
Name:	Mr/Mrs/Miss				
Addres	s   <u>             </u>				
		11			<u>  _  ETI 906</u>
		,			

# **PSEUDOROM**

EPROMs never forget but they're a damned nuisance to reprogram. RAMs are easy to overwrite but they lose their contents on power-down. ETI, naturally, has combined the best of both worlds. Design by Phil Walker.

he ETI PseudoROM now offers the home constructor a device having the capacity of the larger ROM and EPROM chips, but with the programmability of RAM, which can be inserted into the existing ROM socket of your microcomputer. This makes it possible to develop large and complex operating software in one module which only occupies the same physical board area as the eventual ROM or EPROM (if used).

Another advantage is that the access time of the module is only 50 nS or so slower than the memories it contains (if you're using both the 74HC32 and the 74HC138). This will be somewhat less than the normal 450 nS spec of

Joshiha TMM2016P 2.053

Here's a fine, upstanding project . . .

many EPROM devices advertised, and could enable you to run your system at a higher clock frequency (processor permitting), so increasing throughput.

# The Circuit

The circuit used in this project is essentially very straightforward and consists of four 2K by 8 bit CMOS RAM chips, connected to an address decoder to make an effective 8K by 8 bit memory. By means of a small battery and some extra circuitry this sizeable chunk of memory will retain its data even when unplugged from its socket. To make it even more useful the unit is constructed such that it can be used as four areas of 2K by 8 read/write memory or alternatively four sections of 2K, two sections of 4K or a single section of 8K by 8 read-only memory. All these modes are selectable by the integral switches, except that 8K by 8 is only available when inserted into a 28 pin socket.

The point of this versatility is that the unit can be programmed in an existing RAM socket (or one can be provided) at any time and then transferred to an EPROM or ROM socket without losing data (as long as the write protect switch is used). This means that quite large sections of operating systems or special software can be modified and tested without the delays of erasing and reprogramming EPROMs or losing data in system crashes.

### 2-4-8K

The only difference between the 4K and 8K versions of this unit lie in the type of DIL plug used, the size of socket into which it is plugged and the numbering of the input/output pins on the circuit diagram. For memory simulation up to 4K only 24 pins are needed, while for 8K all 28 pins are required. The easiest way of inserting the unit correctly is to identify the 0 V pin and make sure it goes into the 0 V pin position in

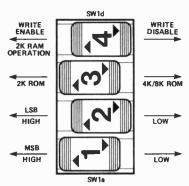
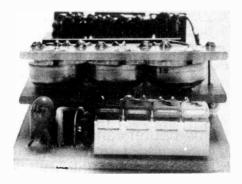


Fig. 1 Switch operations for the PseudoROM.

the socket used. For 24 pin sockets this is pin 12, for 28 pin sockets it is pin 14. Note that for 28 pin plugs and sockets the equivalent functions will occur on pin numbers having a value of 2 greater than those of 24 pin sockets, with the exception of +5 V on pin 28 and A12 on pin 2 (this latter address line goes to the connection marked (2\*) on the circuit diagram).



View from the top.

# **\_BUYLINES\_**

The 74HC series logic ICs which are required for this project are fairly new to the hobbyist scene and appear so far only to be stocked by Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG. The DIL switch shouldn't cause any problems but if you do have difficulty Maplin stock a suitable type. The mercury cells should be obtainable from most high street chemists and photographic shops, while the PCBs are available using our PCB Service order form on page 95.

# HOW IT WORKS.

The essential part of the circuit consists of IC1-4. These are 6116 CMOS 2K x 8 RAMs, which have the property of consuming very little power when not in use. However, for this to happen pin 18 (CS) of each device must be at a logic high level and preferably within a few per cent of the supply voltage. Also, the remaining device pins should be held close to either supply rail. R1-19 hold the address and data pins of the RAMs close to 0 V (via R29) when the unit is unplugged, or to the positive supply rail when in position.

ZD1, R28,30,31 and Q1 sense the presence of a suitable external power supply. When this is found the inputs to IC5a go low which causes its output to go low also. This then enables IC5b, IC5c and IC6 to operate. IC5c acts as a IC5c and IC5 to operate. Ic5c and IC5 to Operate. Ic5c and IC5 to Operate. Ic5c and IC5b buffers the WE function (normally IC5b buffers the WE function (normally IC5c) and both to buffer the C5 pin 21). IC6 is used both to buffer the C input and to use the two most significant address lines to select which RAM device is to be activated. SW1a and SW1b with their associated resistors provide default addresses to IC6 when direct inputs are not available. SW1d selects either ROM or RAM type operation whilse SW1c selects 2K or 4K/8K ROM simulation.

D1 isolates the memory power supply from that of the host machine when the main power is off and is a ger-manium device for minimum voltage drop. Likewise, D2 isolates the backup in the RAMs for a long time.

# Construction

Examine the overlay diagram and photographs very carefully . The unit consists of three PCBs mounted one on top of another. These must be assembled correctly and put together in the right order as there may be no second chance. We suggest that you follow the procedure here so that it goes together correctly, but read it carefully before starting.

Start with the smallest PCB: this is the battery connector. Take three thin brass shims about 0.1" (2.5 mm) wide by 0.6" (15 mm) long and solder each to the central bar of each pattern on the PCB such that they overlap one edge by 0.4" (10 mm) or so. Bend the overlapping length round the edge of the PCB so that it lies near the non-track side. This will form the positive contact for each cell. Alternatively, any springy material to hand may be soldered into the centre hole to do the job. In fact we used contacts from a piece of edge connector.

Next solder six lengths of 20 swg copper (or paper clip) wire into the holes nearest the free end of the battery connector described above. These wires will connect to the next board down and complete the battery holder.

The middle-sized PCB should be assembled next: this will form the middle of the sandwich. Be very careful to get the right value resistors in the right holes. There are nineteen 47k resistors and one 1k0 resistor on the board, all of which mount vertically. Insert them into their holes and solder into position as close as possible to the board. DO NOT CUT ANY OF THE LEADS OFF.

Using two 2½" (60 mm) lengths of 22 swg wire, connect the free ends of each line of resistors together and pass the remainder of the wire through the hole shown on the overlay; solder into position but

0.10

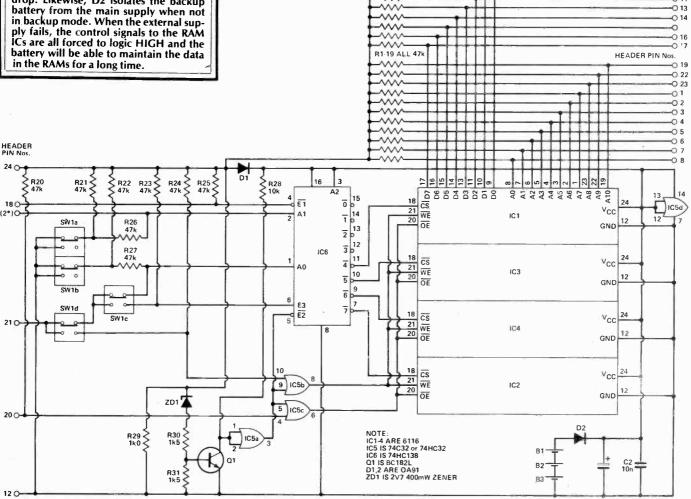


Fig. 2 Complete circuit diagram for the PseudoROM. All the header pin numbers refer to the 24-pin version: add two to all the numbers for the 28-pin version except for the pin marked (2\*). This is left unconnected on the 24-pin version.

DO NOT CUT OFF. There are seven more links to be made to the lower board which should consist of 1" (25 mm) lengths of 22 swg wire. A useful tip - squeeze the end of the wire with pliers to help it stay in the hole when soldering. Now mount D2 on the PCB making sure that the polarity is correct.

The next step is to assemble the battery connector onto this board. First insert some 22 swg tinned copper wire into the three holes in the middle PCB which lie in the centre of the cell positions. Solder them into position and crop off close to the track side and to about  $\frac{1}{4}$ " (6 mm) on the component side. Bend this short wire towards the edge of the PCB and flatten it (. . . GENTLY . . .). These form the negative battery contacts. Now take the small PCB and insert the six wires from it into the corresponding holes in the medium-sized PCB. Put three of the specified mercury cells in position and adjust the two PCBs until the cells are held reasonably firmly in their correct positions. Solder the link wires into position and crop them close to the PCB: then remove the cells.

Solder 12 1" (12 mm) lengths of 22 swg wire (14 lengths for a 28-pin plug) into the row of holes on the edge of the PCB (starting at the R29 end) such that the wire projects on the component side. Now carefully insert the two memory devices into the PCB and solder them into position. MAKE ABSOLUTELY SURE THEY ARE THE RIGHT WAY ROUND and TAKE FULL PRECAUTIONS AGAINST STATIC DAMAGE. Crop the IC leads close

to the foil side.

The largest PCB can now be assembled. First insert all the

# PARTS LIST.

Resistors (all ‡W, 5%) R1-27 47k **R28** 10k **R29** 1 k0 R30,31 1k5

Capacitors

4u7 16 V tantalum C<sub>2</sub> 10nF disc ceramic

Semiconductors IC1-4 6116 IC5

74C32 or 74HC32 74HC138 IC<sub>6</sub> BC182L 01 D1,2

**OA91** 2V7 400 mW zener

Miscellaneous

quad SPDT DIL switch PX675 mercury cell SW<sub>1</sub> PCBs (see Buylines); 24 pin (or 28 pin) DIL header plug; wire, thin brass shim or other contact material.

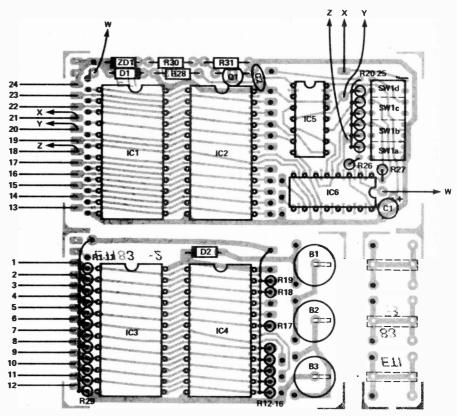


Fig. 3 Component overlay for the PseudoROM. Remember to separate the three boards before soldering!

resistors, diodes, capacitors and transistor. Note that six of the resistors (all 47k) are mounted vertically as before with their free ends connected together and to a hole in the PCB. This time, however, the leads can be cropped close to the PCB. Next fit the DIL switch SW1, the two 74 series CMOS devices, and the remaining two memories. REMEMBER THAT ALL THE ICs ARE SENSITIVE TO STATIC. Make sure that they are the correct way round before soldering them in. Finally on this PCB, use four lengths of THIN insulated wire to make the long links shown on the overlay (W-W, X-X, Y-Y, Z-Z).

Having reached this stage it would be advisable to recheck all the solder joints on all the boards with a magnifying glass for accidental blobs, splashes or other faults.

From now on it will be virtually impossible to rectify any constructional errors. So check again!

Take the smaller PCB assembly and crop the wires projecting on the foil side so that the three links nearest the battery holder are virtually full length but the longest is at the edge and the shortest is farthest from it. Next crop the two lines of resistor leads and links so that the longest are about \(\frac{3}{2}\)' (18

mm) and the shortest are about ½" (12 mm), graded evenly across the board width. This is done to make the next operation easier.

Now the tricky bit. With great care feed the wires from the smaller PCB assembly into the corresponding holes in the larger PCB. Make sure that the wires are straight when you do this and don't allow the long links to cross each other on top of the memories. It should be possible to get the two PCBs down to about ½" (6 mm) apart. If you can't do this it may be that the transistor or capacitor is in the way. Rectify this before carrying on. The transistor must be very close to the board. If this is not the problem one of the links may be bent. This is a fault, as when properly assembled all the links between boards are straight.

When this stage has been reached successfully, solder all the inter-board links and crop off the excess wire.

The end is now in sight. Examine the connector end of the assembly you have made and offer up the 24 or 28 pin plug you wish to use. It may be necessary to file a little material off one of the PCBs so that the plug will lie square against the two PCBs when the pins are soldered in position. Do this now if necessary.

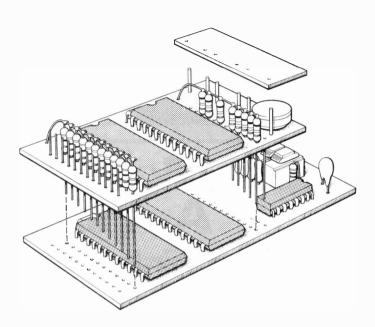
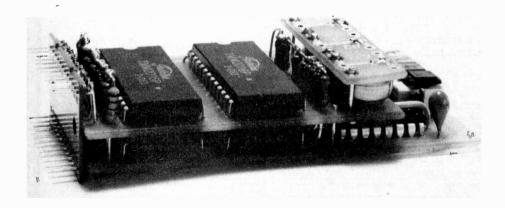


Fig. 4 An exploded view to help you through the traumas of construction. Compare with the photo below.

If there is a large blob of solder on any of the three pads where the links have been soldered already, remove some of it with a solder sucker or piece of fluxed braid. This is to allow the plug pins to seat down onto the PCB foil. Align the tags of the plug labelled with pins 13 to 24 (or 15 to 28 for the larger plug) against the pads along the edge of the largest PCB in the assembly. Solder them carefully to the pads such that pin 24 connects to the innermost of the three joined pads (or pin 28 joins to the outermost in a 28 pin plug). This should cause the remaining pins to be forced against the link wires coming from the middle PCB. With

any luck they will be in the right place to be soldered but check first. Pin 12 (or 14 on 28-way plug) should lie next to R29 (1k0). If all is correct then solder them into position and crop off any excess wire.

The assembly should now be complete and after inserting the mercury cells is ready for use. These cells should be inserted with the flat or outer part of the case nearest to the small PCB. This is the POSITIVE terminal. The rounded stud is negative and goes to the middle PCB. Make sure the batteries are pushed well in so that they locate against the pairs of supporting struts and do not touch each other.



The assembled project is neat and compact — at least it should be if you've done things correctly.

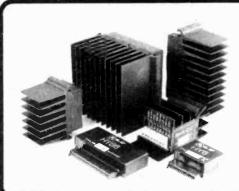
Otherwise one battery will be shorted out.

# Using the PseudoROM

It is recommended that the unit is only inserted or removed from its socket when the equipment using it is switched off. To make use of the unit the data must first be written into it in 2K blocks. For this a 24 pin socket must be provided with a R/W signal on pin 21 and other signals as for a standard 2K EPROM. SW1d should be set to connect the pin 21 input through to IC5b and SW1a and SW1b set to select the 2K segment to be used. Data can now be entered into the unit. Change the SW1a and SW1b settings to load up the other segments as required, remembering that SW1a is the MSB and SW1b the LSB of the address.

When placed in a suitable 24 or 28 pin ROM socket, SW1d should be set so that pin 21 (23) is no longer connected to IC5b: this prevents accidental overwriting of the data. SW1c can now be used to select either 2K ROM simulation (connecting to IC6 pin 6) or 4K in a 24 pin socket and 8K in a 28 pin socket (connecting to IC6 pin 1). Whichever mode is selected, the segment select addresses selected by SW1a and SW1b will be overridden by the relevant external address lines. This saves much extra switching but anomalies may occur if the 2K ROM mode is selected in a 28 pin socket.

Note that this module is only suitable for use in EPROM sockets with single rail power supplies and the CE or CS signal on pin 18 (20 for a 28 pin socket) and the OE signal on pin 20 (22 for a 28 pin socket). Pin 21 (23 for a 28 pin socket) must be logic high level: All address or WE as appropriate for the mode used. Unfortunately this rules out some devices such as the three-rail TMS2716, the TMS2532, and under some circumstances the TMS2516. If in doubt, consult the data sheets for your particular device and circuit. Warning: DO NOT TRY TO PROGRAM THIS UNIT IN AN EPROM PROGRAMMER — the high voltage will damage it permanently. And take care when handling the device out of its socket - once assembled it's unlikely that any of the CMOS chips will be blown by static, but if it should happen, your guess is as good as ours how to replace them.





# Modular Modular **Amplifiers** the third generation

Due to continous improvements in components and design ILP now launch the largest and most advanced generation of modules ever.



# **WE'RE INSTRUMENTAL** IN MAKING A LOT **OF POWER**

In keeping with ILP's tradition of entirely self-contained modules featuring, integral heatsinks, no external components and only 5 connections required, the range has been optimized for efficiency, flexibility, reliability, easy usage, outstanding performance, value for money.

With over 10 years experience in audio amplifier technology ILP are recognised as world leaders.



### BIPOLAR MODULES

Module	Output	Load		ORTION	Supply	Size	WT	Price	
Number	Power Watts rms	Impedance	T.H.D. Typ at 1KHz	1,M,D. 60Hz/ 7KHz 4:1	Voltage Typ	mm	gms	VAT	
HY30	15	4-8	0.015%	< 0.006%	± 18	76 × 68 × 40	240	L8.40	
HY60	30	4-8	0.015%	< 0.006%	± 25	76 x 68 x 40	240	£9.55	
HY6060	30 + 30	4.8	0.015%	< 0.006%	± 25	120 x 78 x 40	420	£18.69	
HY124	60	4	0.01%	< 0.006%	± 26	120 x 78 x 40	410	£20.75	
HY128	60	8	0.01%	< 0.006%	± 35	120 x 78 x 40	410	£20,75	
HY244	120	4	0.01%	< 0.006%	± 35	120 x 78 x 50	520	€25.47	
HY248	120	8	0.01%	< 0.006%	± 50	120 x 78 x 50	520	£25.47	
HY364	180	4	0.01%	< 0.006%	± 45	120 x 78 x 100	1030	£38.41	
HY368	180	8	0.01%	< 0.006%	± 60	120 x 78 x 100	1030	€38.41	

Protection: Full load line. Slew Rate: 15v/µs, Risetime: 5µs. S/N ratio: 100db. Frequency response  $\{-3dB\}$  15Hz = 50KHz, Input sensitivity: 500mV rms, Input Impedance:  $100K\,\Omega$ , Damping factor:  $400Hz\!>\!400$ ,

# DDE AMD EVETEME

Module Number	Module	Functions	Current Required	Price inc.
нү6	Mono pre amp	Mic/Mag. Cartridge/Tuner/Tape/ Aux + Voi/Bass/Treble	10mA	£7.60
нү66	Stereo pre amp	Mic/Mag, Cartridge/Tuner/Tape/ Aux + Vol/Bass/Treble/Balance	20mA	£14.32
HY73	Guitar pre amp	Two Guitar (Bass Lead) and Mic + separate Volume Bass Treble + Mix	20mA	£15.36
HY78	Stereo pre amp		20mA	£14.20

Most pre-amp modules can be driven by the PSU driving the main power amp. A separate PSU 30 is available purely for pre-amp modules if required for £5.47 (inc., VAT). Pre-amp and mixing modules in 18 different variations. Please send for details.

Mounting Boards
For ease of construction we recommend the B6-for modules HY6-HY13 £1.05 (inc., VAT) and the B66 for modules HY68-HY78 £1.29 (inc., VAT).

Module	Output	Load	DISTO	RTION	Supply	Size	WT	Price	
Number	Power Watts rms	Impedance	T.H.D. Typ at 1KHz	1.M.D. 60Hz/ 7KHz 4.1	Voltage Typ	mm	gms	vat	
MOS 128	60	4-8	< 0.005%	<0.006%	1.45	120 x 78 x 40	420	130.41	
MOS 248	120	4-8	<0.005%	< 0.006%	1.55	120 x 78 x 80	850	1 315,886	
MOS 364	180	4	<0.005%	<0.006%	1.55	120 x 78 x 100	110,45	1.45,53	

Protection: Able to cope with complex loads without the need for very special protection circuitry (fuses will suffice).

Slew rate: 20v/js. Rise time: 3ps. S/N ratio 100db

Frequency response t—38BL 15Hz - 100kHz. Input sensitivity. 500mV rms
Input impedance: 100K  $\Omega$ . Damping factor: 100Hz > 400.

### 'NEW to ILP' In Car Entertainments

C15
Mono Power Booster Amptifier to increase the output of your existing car radio or cassette player to a nominal 15 watts rms.

Very easy to use.

MOSFET MODULES

Robust construction,

£9,14 (inc. VAT)

Mounts anywhere in car.

Output power maximum 22w peak into 4 $\Omega$ . Frequency response (—3d8) 15Hz to 30KHz, T.H.D. 0.1% at 10w 1KHz S/N ratio (DIN AUDIO) 80d8, Load Impedance 3 $\Omega$ . Input Sensitivity and impedance (selectable) 700mV rms into 15K $\Omega$  3V rms into 8 $\Omega$ . Size 95 x 48 x 50mm, Weight 256 gms.

C1515

Stereo version of C15. Size 95 x 40 x 80. Weight 410 gms. £17.19 (inc. VAT)

POWER SUPPLY LINITS. Uncorporating our own toroidal transformers

Model Number	For Use With	Price inc
PSU 21X	1 or 2 HY30	£11.93
PSU 41X	1 or 2 HY60, 1 x HY6060, 1 x HY124	£13.83
PSU 42X	1 x HY128	£15.90
PSU 43X	1 x MOS128	£16.70
PSU 51X	2 x HY 128, 1 x HY 244	£17.07

Model Number	For Use With	Price inc
PSU 52X	2 x HY124	£17.07
PSU 53X	2 x MOS128	£17.86
PSU 54 X	1 x HY248	£17,86
PSU 55X	1 x MOS248	£19,52
PSU 71X	2 x HY244	£21.75

Model Number	For Use With	Price inc. VAT
PSU 72X	2 x H / 248	1.22,54
PSU 73X	1 x = 7364	£22,54
PSU 74X	1 x H < 368	£24,27
PSU 75X	2 x MOS248, 1 x MOS368	124.2%

Please note: X in part no, indicates primary voltage. Please insert "O" in place of X for 110V, "1" in place of X for 220V, and "2" In place of X for 240V

# WITH A LOT OF ELP FROM

PROFESSIONAL HI-FI THAT EVERY ENTHUSIAST

CAN HANDLE...

# Unicase

Over the years ILP has been aware of the need for a complete packaging system for it's products, it has now developed a unique system which meets all the requirements for ease of assembly, adaptability, ruggedness, modern styling and above

Each Unicase kit contains all the hardware required down to the last nut and bolt to build a complete unit without the need for any special tools.

Because of ILP's modular approach, "open plan" construction is used and final assembly of the unit parts forms a compact aesthetic unit. By this method construction can be achieved in under two hours with little experience of electronic wiring and mechanical assembly.

# **Hi Fi Separates**

UC1 PRE AMP UNIT: Incorporates the HY78 to provide a "no frills", low distortion, (< 0.01%), stereo control unit, providing inputs for magnetic cartridge, tuner, and tape/ monitor facilities. This unit provides the heart of the hi fi system and can be used in conjunction with any of the UP Unicase series of power amps. For ultimate hum rejection the UC1 draws its power from the power amp unit.

POWER AMPS: The UP series feature a clean line front panel incorporating on/off switch and concealed indicator. They are designed to compliment the style of the UC1 pre-amp. Performance for each unit which includes the appropriate power supply, is as specified on the facing page.

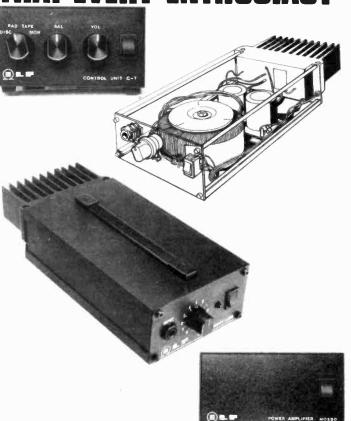
# **Power Slaves**

Our power slaves, which have numerous uses i.e. instrument, discotheque, sound reinforcement, feature in addition to the hi fi series, front panel input jack, level control, and a carrying handle. Providing the smallest, lowest cost, slave on the market in this format.

## UNICASES

HIFI Sep	HIFI Separates										
UC1	Preamp				£29.95						
UP1X	$30 + 30W/4 - 8\Omega$	Bipolar	Stereo	H <sub>i</sub> E <sub>1</sub>	£54.95						
UP2X	60W/4 <b>Ω</b>	Bipolar	Mono	HiF;	£54,95						
UP3X	60W/8 <b>\Oldot</b>	Bipolar	Monu	HiFi	£54.95						
UP4X	120W/4 <b>Ω</b>	Bipolar	Mono	HiFi	£74.95						
UP5X	120W/8 <b>Ω</b>	Bipolar	Mono	HiFi	£74.95						
UP6x	60W/48 <b>Ω</b>	MOS .	Mono	Hilli	£64.95						
UP7X	120W/48 <b>Ω</b>	MUS	Mono	HiFi	£84.95						
Power SI.	aves										
US1X	60W/4 <b>\O</b>	Bipolar	Power	Slave	£59.95						
U\$2X	120W/4 Ω	Bipolar	Power	Slave	£79.95						
US3X	$60W/4-8\Omega$	M()S	Power	Slave	£69.96						
US4X	120W/4 8 <b>Ω</b>	MOS	Fower	Slave	£89.95						

ease note X in part number denotes mains voltage. Please insert "O" in place of for 110V, "1" in place of X for 220V (Europe), and "2" in place of X for 240V (U.K.) All units except UC1 incorporate our own toroidal transformers,



### TO ORDER USING OUR FREEPOST FACILITY

TO ORDER USING OUR FREEPOST FACILITY

Fill in the coupon as shown, or write details on a separate sheet of paper, quoting the name and date of this journal. By sending your order to our address as shown at the bottom of the page opposite, with FREEPOST clearly shown on the envelope, you need not stamp it. We pay postage for you. Cheques and money orders must be crossed and made payable to I.L.P. Electronics Ltd. if sending cash, it must be by registered post. To pay C.O.D. please add £1 to TOTAL value of order.

PAYMENT MAY BE MADE BY ACCESS OR BARCLAYCARD IF

Post to: ILP Electronics Ltd., Freepost 4, Graham Bell House, Roper Close, Canterbuy CT2 7EP, Kent, Englar Telephone: (0227) 54778. Telchnical: (0227) 64723. Telex; 965780.	id.
Please send me the following	
Total purchase price	
l enclose Cheque Postal Orders Int. Money Order	
Please debit my Access/Barclaycard No	
Name	
Address	
Signature	

electror/ize

# **AUTO-ELECTRONIC PRODUCTS**

KITS OR READY BUILT

# ELECTRONIC IGNITION



YOUR CAR
AS GOOD AS IT COULD BE?

- ★ Is it EASY TO START in the cold and the damp? Total Energy Discharge will give the most powerful spark and maintain full output even with a near flat battery.
- ★ Is it ECONOMICAL or does it "go off" between services as the ignition performance deteriorates? Total Energy Discharge gives much more output and maintains it from service to service.
- ★ Has it PEAK PERFORMANCE or is it flat at high and low revs. where the ignition output is marginal? Total Energy Discharge gives a more powerful spark from idle to the engines max. (even with 8 cylinders).
- ★ Do the PLUGS and POINTS always need changing to bring the engine back to its best. Total Energy Discharge eliminates contact arcing and erosion by removing the heavy electrical load. The timing stays "spot on" and the contact condition doesn't affect the performance either. Larger plug gaps can be used, even wet or badly fouled plugs can be fired with this system.

Is the PERFORMANCE SMOOTH. The more powerful spark of Total Energy Discharge eliminates the 'near misfires' whilst an electronic filter smooths out the effects of contact bounce etc.

Most NEW CARS already have ELECTRONIC IGNITION. Update YOUR CAR with the most powerful system on the market - 3½ times more spark power than inductive systems - 3½ times the spark energy of ordinary capacitive systems, 3 times the spark duration.

Total Energy Discharge also features:

EASY FITTING, STANDARD/ELECTRONIC CHANGEOVER SWITCH, LED STATIC TIMING LIGHT, LOW RADIO INTERFERENCE, CORRECT SPARK POLARITY and DESIGNED IN RELIABILITY.

★ IN KIT FORM it provides a top performance system at less than half the price of competing ready built units. The kit includes: pre-drilled fibreglass PCB, pre-wound and varnished ferrite transformer, high quality 2µF discharge capacitor, case, easy to follow instructions, solder and everything needed to build and fit to your car. All you need is a soldering iron and a few basic tools.

FITS ALL NEGATIVE EARTH VEHICLES 6 or 12 volt, with or without ballast.

**OPERATES ALL VOLTAGE IMPULSE TACHOMETERS:** (Older current impulse types need an adaptor).

STANDARD CAR KIT £15.90 Assembled and Tested £26.70

PLUS P. & P. £1 (U.K.)

TWIN OUTPUT KIT £24-55

For Motor Cycles and Cars with twin ignition systems

Assembled and Tested £36-45

Prices include VAT

# PROTECT YOUR CAR WITH AN ELECTRONIZE ELECTRONIC ALARM



Don't Wait Until Its too Late ~ Fit one NOW!

- ★ 2000 COMBINATIONS provided by an electronic key a minature jack plug containing components which must match each individual alarm system. (Not limited to a few hundred keys or a four bit code).
- ★ 60 SECOND ALARM PERIOD flashes headlights and sounds horn, then resets ready to operate again if needed.
- ★ 10 SECOND ENTRY DELAY allows owner to dis-arm the system, by inserting the key plug into a dashboard mounted socket, before the alarm sounds. (No holes in external bodywork, fiddly code systems or hidden switches). Reclosing the door will not cancel the alarm, before or after it sounds, the key plug must be used.
- ★ INSTANT ALARM OPERATION triggered by accessories or bonnet/boot opening.
- ★ 30 SECOND DELAY when system is armed allows owner to lock doors etc.

- ★ DISABLES IGNITION SYSTEM when alarm is armed.
- ★ IN KIT FORM it provides a high level of protection at a really low cost. The kit includes everything needed, the case, fibreglass PCB, CMOS IC's, random selection resistors to set the combination, in fact everything down to the last nut and washer plus easy to follow instructions.

FITS ALL 12 VOLT NEGATIVE EARTH VEHICLES.
SUPPLIED COMPLETE WITH ALL NECESSARY LEADS
AND CONNECTORS PLUS TWO KEY PLUGS

CAR ALARM KIT

£24.95

PLUS P. & P. £1 (U.K.) Prices

**ASSEMBLED AND TESTED** £ 37.95

include



Access and Visa Welcome. Write or Phone Quoting Number

# ELECTRONIZE DESIGN

Dept. D · Magnus Rd · Wilnecote Tamworth · B77 5BY tel: 0827 281000

# CONFIGURATIONS

Ian Sinclair has seen the light! Now he wants to illuminate the rest of us. In case you hadn't already guessed, this month's topic is opto-electronics.

pto-electronics is a word that hadn't been thought of a few years ago, but which is now used to describe a set of devices that are important enough to merit a part of this series all to themselves. An opto-electronic device is one which makes use of light as part of its electronic function, so this label includes all varieties of devices that convert light signals into electrical signals or

the other way round.

The simplest opto-electronic devices of the electricity-to-light type are the familiar LEDs. Familiar they may be, but even experienced engineers are not always aware of their eccentricities. Like any other diode the LED has an anode and a cathode, and passes current in the forward bias direction; this is when the light is emitted. What is not nearly so well known is that the peak reverse voltage of these diodes is very low; if you get an LED the wrong way round in a circuit, it's usually curtains for the LED when the voltage is switched on. A typical value of peak reverse voltage is 3 V, so practically any circuit that will operate the LED when it is connected the right way round (Fig. 1) will blow it up if it happens to be the wrong way round.

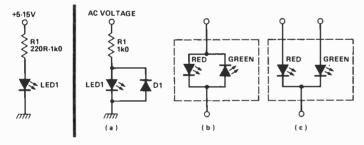


Fig. 1 (Right) The basic LED operating circuit. A currentlimiting resistor must always be used unless the output resistance of the driving circuit is high.

Fig. 2 (Left) LED operation. (a) For use with AC, a silicon diode must be connected across the LED terminals as shown. (b) The two-colour LED uses two LED junctions connected in opposite directions. (c) The tri-colour LED uses separate LEDs with a common cathode connection.

In addition, the forward voltage across the LED is very much higher than the 0V6 that we merrily assume for a silicon diode. For gallium arsenide, the material used for many types of LEDs, the forward voltage is more like 2V1 to 2V4, so that LEDs are of little use in very low-voltage circuits — they won't, for example, work from a 1V5 cell.

# **Current Affairs**

One of the major snags about LEDs is that they consume a surprising amount of current. Manufacturers quote 'adequate' light output for red LEDs with 5 to 25 mA, and for the green/yellow varieties with 10 to 40 mA. This wouldn't be missed in a circuit operating at 5 V, 2.5 amps, but it can be quite a drain on battery equipment, often considerably more than all the CMOS ICs in a circuit intended for battery operation.

LEDs can be used with AC supplies providing there is a diode connected in reverse across each LED (to prevent excessive reverse voltage) as well as the usual current limiting resistor (Fig. 2a). Bi-colour LEDs consist of a package of two LEDs in one casing, connected in inverse parallel so that current in one direction will give a light of one colour, while the other colour is achieved by reversing the current (Fig. 2b). In this circuit, one LED protects the other against reverse voltage. Tri-colour indicators (Fig. 2c) use two diodes with a common cathode connection and separate anode leads, so that three colours can be indicated, one in each lead, plus yellow when both LED sections are activated. Personally, for indicating when mains voltage is on, I much prefer the old-fashioned neon.

# On Display

When it comes to digit displays, LED types have quite a lot of competition. The traditional seven-segment display (Fig. 3) comes as a common anode or a common-cathode type (Fig. 4), and each type needs a separate limiting resistor in each driver lead. The normal method of use is to connect the display to a decoder chip such as the 7448 or 7447, which in turn takes the digital information in as BCD signals — four bits per digit. The snag again is the current consumption, 10-20 mA per segment, which means that displaying a figure '8' uses 7 x 20 mA — 140 mA just to

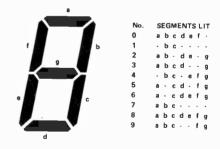


Fig. 3 Layout of the seven-segment display, with segment guide. An eighth segment, the decimal point, is often added.

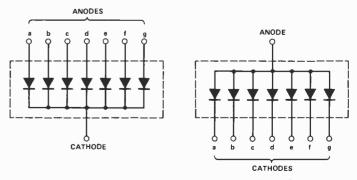


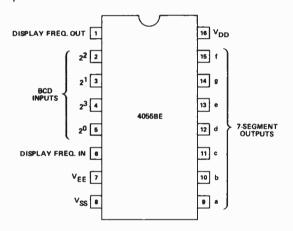
Fig. 4 Internal connections for common anode and common cathode displays. Whichever type is used, there must be a separate limiting resistor for each segment.

display one digit! While mains-powered equipment isn't too upset by this size of current, the LED seven-segment display did not last very long in battery-powered devices, even when multiplexing was used. Multiplexing means that only one digit at a time is activated, the digits being switched on in sequence fast enough to present the appearance of all the digits being illuminated at once.

Oddly enough, the forward voltage for the segments of an LED seven-segment display tends to be lower than for diodes, around 1V3 to 1V7. At temperatures above about 25°C, the maximum current has to be reduced by 0.3 mA per degree to avoid over-dissipation of the junction in

each segment.

One competitive display that seems to be much less well-known is the filament seven-segment display. This can use as little as 5 mA per segment, and looks surprisingly bright — it can be driven by a decoder directly with no limiting resistors, and for many purposes is superior to LED displays. The usual reason for preferring solid-state displays is long life, but the quoted life of more than 100,000 hours for the filament type of display is pretty competitive, and some LED displays are notorious for short life — one frequent candidate for replacement in my experience is the display used in the old KIM microprocessor units.



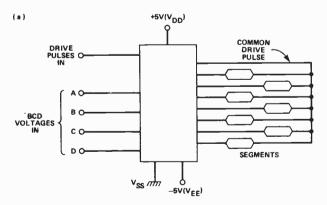




Fig. 5 Driving LCD displays. The common lead of the LCD display must not be earthed; it has to be returned to the driver IC. The waveform (b) applied is AC with no trace of DC.

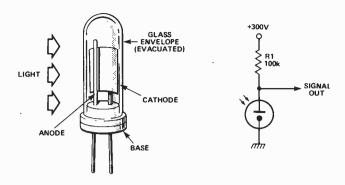


Fig. 6 The vacuum photocell, and a typical circuit arrangement.

# **Oldies But Goodies**

The two older types of displays which are also worth considering are the electron-beam type and the gas-discharge type. The electron beam display uses a miniature cathode wire to emit electrons, which will then be attracted to any positive anode. The anodes are coated with phosphors (similar to the phosphors used in cathode ray tubes), and any anode which is positive to the cathode by a sufficient voltage will glow. A 24-40 V supply is needed, which usually means the use of an inverter when low-voltage batteries are used, as in calculators. The display is easy to read, and uses less current than the LED type — I still prefer a calculator using this type of display to one using the more-common LCD display.

The gas-discharge display is an older type which uses the principle of the neon light — ionisation of a low-pressure gas in an electric field. Like all gas-discharge, this needs a high operating voltage, around 150-250 V, but the operating current is very low: only 0.7 mA per segment in a typical application. The display is very bright, and is worth considering for mains-operated equipment whose display has to be viewed under difficult illumination conditions, such as alternate brightness and darkness. A driver IC is available nowadays — in times past (dare we say the Dark Ages?), the major handicap of using this type of display was the lack of suitable driver transistors.

**Liquid Light** 

Last among the displays, of course, there is the LCD. A good LCD can give a dense black indication against a light grey background, is clearly visible in bright light, and reasonably visible even in low illumination conditions. There's a lot of variation between displays, however, even from the same manufacturer, and some are poor, with low contrast and very slow response to changing digits. Prices also vary considerably — one catalogue I have lists the price of a calculator-size display as being twice as much as I would have to pay for a complete calculator using a similar display!

Operating conditions for these displays are very different from those of other types of displays, because they have to be operated from high-frequency AC supplies. For this reason, displays either come with all the necessary circuitry for generating their driver pulses built in, or they can be used with a standard chip intended for this purpose. It's particularly important not to apply DC to the segments of an LCD display, because this can kill the display very

rapidly.

# On The Receiving End

Moving to the other end of the opto-electronics business, we find the photocells. Vacuum photocells and

# FEATURE: Configurations

photomultipliers are rather specialised, and we'll only touch briefly on these types. They rely on photocathodes, surfaces which emit electrons into a vacuum when they are struck by light. The anode which collects the electrons (Fig. 6) must be at a fairly high voltage (100-500 V), and the currents are small: microamps rather than milliamps. Photomultipliers obtain greater sensitivity and increased output by using secondary multiplication, meaning that the electrons from the cathode (Fig. 7) are accelerated to surfaces, called dynodes, which will release electrons each time an electron strikes the surface. If each of these multipliers releases two to five electrons for each striking electron, spectacular gain can be achieved which, unlike amplification of signals by conventional methods, is practically noise-free.

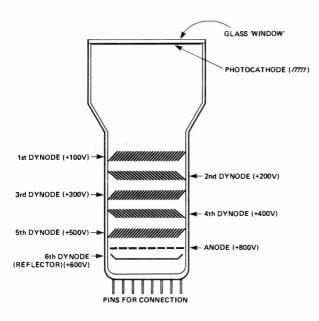


Fig. 7 Cross-section of a photomultiplier, used for detection of very low light levels.

The more familiar solid-state light-to-electrical-signal devices that we use are the solid-state photodetectors, of which the most commonly used is the cadmium sulphide cell. The ORP12 is the standard device of this type, often called an LDR (light dependent resistor). The cell consists of a strip of cadmium sulphide whose resistance decreases as light falls on it. The resistance in the dark is high, up to 10M, and the resistance can fall as low as 100R in bright sunlight. A less well-known aspect of these cells is that they can withstand a fairly high voltage, around 100 V; subject to their dissipation limit of 200 mW, meaning that you might need a limiting resistor connected in series. The cadmium sulphide cell is a slow-acting device, needing about 350 mS for the resistance to fall on exposure to light, and around 75 mS for the resistance to rise again when the light is shut off. The response to different colours is generally similar to that of the human eye, but the cadmium sulphide is much more sensitive to red and infrared, which is why its use in cameras is now less common than it was some 10 years ago.

# **Fun With Photodicdes**

Other light detectors need some degree of amplification. Photodiodes are diodes of fairly conventional construction, with a transparent window over the junction,

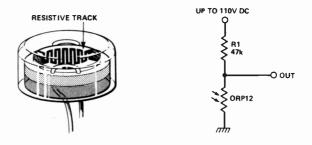


Fig. 8 The photoresistive cell or light-dependent resistor (LDR).

which are used reverse-biased. For such a diode, the reverse leakage current increases as the intensity of light on the junction is increased. This current is small, ranging from around 1 nA in darkness to almost 1 mA in very bright light, so that amplification is usually necessary, as in the circuit of Fig. 9. The response time is about 250 nS, so that the op-amps shown in Fig. 9 would have to be replaced by a transistor circuit, using high-speed switching transistors, if you wanted to use the photodiode for high-speed signals. Combined photodiode/op-amp packages can be bought for medium-speed applications.

The old-style phototransistor, which was a transistor formed with a window above the base-collector junction, is a thing of the past: what is now called a phototransistor is a combination of silicon photodiode and transistor in one package. This combines a sensitivity that is much greater than that of a photodiode alone with a good fast response time, giving typically a 2 MHz bandwidth. This is particularly useful for receiver use in light-beam transmis-

sion systems.

Last in our catalogue for the month come the optoisolators, which consist of a combination of LED and phototransistor in a single package. These components are embedded in clear plastic, which allows light transmission but which is a good electrical insulator. It's easy to achieve isolation to at least 4 kV, with reasonable signal transmission. For an ordinary isolator, the output signal will be about 20 per cent of the amplitude of the input, but when a Darlington phototransistor is used, the output can be three times or more the amplitude of the input. It's just the device I was looking for 25 years ago when I wanted to modulate the grid of a cathode-ray tube which was working at -4 kV!

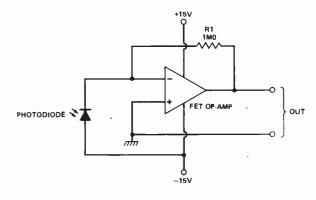


Fig. 9 Using a photodiode in conjunction with a FET op-amp. The FET type is needed because of the very high impedance of the photodiode circuit.

# The Reference Point for Kit Amplifiers from now on . . . .





### HIFI STEREO AMPLIFIER KITS

From one of Britain's leading esoteric amplifier manufacturers comes an exciting new package of stereo amplifier kits, designed to offer all the advantages of true high fidelity but without the usual price penalty

usual price penaity.
These new kits offer the choice of moving magnet or moving coil inputs, 40 to 100 watts per channel, in fact, everything that made the previous models so popular is included but with added style, easier construction and a full two year warranty.

The new range consists of The CK 1010 Stereo Pre Amplifier, The CK 1040 WPC Power Amplifier, The CK 1100 WPC Power Amplifier.

This kit contains all the necessary parts to build a complete pre-amp. The main PCB is ready assembled and tested therefore construction is simply a matter of point to point wiring and mechanical assembly of the connections and controls to the pre punched chassis.

The CK 1010 takes its DC supply from the CK 1040, 1100 or, if using a different power amplifier a PSK power supply kit. Inputs for disc, tuner and tape are provided and an optional add-on moving coil input can be fitted to extend its versatility. (MCPK)

This is a nominal 40 watt per channel power amplifier kit which features our dual power supply and the DC output for the CK 1010. All components such as heatsinks, wire and connectors are included and protection is provided from short circuit outputs.

#### CK 1100

Similar to the CK 1040 this model provides a nominal 100 watts per channel with extra heatsinking and thermal cutouts are provided as standard. When correctly assembled these kits are guaranteed for two years.

It would seem that Crimson have maintained their position at the top of the commercial kit-build field. There is no oriental amplifier I know of that can better the sound of this combination overall at any price and only a few — such as the KA-1000 (£500+) — are of comparable standard. . . . I can say no more than that for £250 it (£K 1010/MC2K/1100) is a bargain and one that becomes the reference point for kit amplifiers from now on."

PRICES CK 1010 - RRP£92.00; CK 1040 - RRP£121.00; CK 1100 - RRP£151.00; MC2K - RRP£25.00; PSK - RRP£20.00 Access accepted, otherwise send C.W.O. Allyprices include P&P to anywhere in the U.K. Export: Write for pro-formal

# SEND FOR FULL DETAILS ON OUR HIFI KIT PRODUCTS BY WRITING TO ADDRESS BELOW



**PHOENIX WORK 500 KINGS STREET** STOKE-ON-TRENT TEL: 0782 330520

5rpm 240V A.C. Mf. by Carter. £6.05 £1 p&p (£8.11 inc. VAT)
71/2rpm Motor approx 30lb in. 110V A.C. complete with Transformer for
240V A.C. £10.75 + £1.50 p&p (total inc. VAT £14.09)

CROWN 42 rpm 110/230V A.C. 50 Hz, 100 lb.in approx. reversible geared Motor. Price £18.15 + £2.50 p&o (total incl. VAT £23.75)
38.3 rpm GEARED MOTOR. Torque 35lb.in. reversible 115V AC inc. start capacitor. Price £11.55 + £2 p&p (total incl. VAT £15.58 N.M.S. Suitable TRANSFORMER 230V A.C. operation. Price £5.00 + £1.00 p&p (total incl. VAT £15.00)

Industrial and Educational purposes. Produces high intensity nable from approx. 1 to 70 f.p.s. Price less case £27 - £2 p&p. EVAT £3.36). Suitable Case and Reflector £12.50 - £2 p&p. VAT £16.68).

HY-VGHT Mk V. Designed for Disco, Theatrical uses, etc. Approy. 4 joules. Adjustable speed. Price 27 - 22 pago. [Total inc. VAT. 233.36]. Case and reflector price £12.50 - 22 pago. [total incl. VAT. £16.68]. Foolscap SAE for further details including Super Hy-Lyght.

Thomas single diaphragm. Max. 20 psi. 1½ cfm., approx. 110V A.C., £16 - £2 p&p (total incl. VAT £20.70), OR, to include Transformer for 230/240V A.C. £26.45 incl. VAT

3 phase A.C. motor 220/250V or 380/440V 1.425 rpm, ½8 h.p. cont, Direct coupled to William Aliday Alcosa carbon vane blower/vacuum pump. 0 9 cfm8hg. £22 - £4 p&p (total incl. VAT £29.90).

500 VOLTS 500 megohms £49.00 p&p £2. (£58.65 inc. VAT & p&p).
1000 VOLTS 1000£ £55.00 p&p £2.00 (£65.55 inc. VAT & p&p).

Type \$4.51 200/250 AC 2 on/2 off every 24 hours. 20 amps contacts with override switch Diameter 4' > 3', price £9.50 p&p £1 (£12.36 inc VAT & p&p). Also available with solar dia R&T. Also available Sangamo Weston 60 amp and AEG 80 amp. Phone

71rpm WYNSCALE motor approx. 10lb inch. A.C. supplied with auto transformer 240V. A.C. operation. £10.75 p&p £1.50 (£14.09 inc. VAT). N.M.S.

N.E.C. GEARED MOTOR, 152 rpm. 200lb.in 230V A.C. 50Hz, Ratio 9.2 to 1. Non reverse, Incl. capacitors, Fraction of maker's price. £41.25 + Carr + VAT. N.M.S.

INDUSTRIAL STROBE KIT

BLOWER/VACUUM PUMP

INSULATION TESTERS NEW

COMPRESSOR

**GEARED MOTORS** 

# Superior Quality Precision Made **NEW POWER RHEOSTATS**

New ceramic construction, heavy duty brush assembly, continuously rated. 25 WATT 5/10/25/50/100/150/250/300/500/1K11 1.5K1123, 10. + 30p p&p (£3.91 inc. VAT). 50 WATT 2501 £5.50 - 50p p&p (£6.90 inc. VAT).

100 WATT 1/5/10/25/50/100/250/500/1k(2/1.5k(1/2.5k(1/3.5k() £7.25 - 75p p&p (£9.20 inc. VAT) Black Silver Skirted Knob calibrated in Nos. 1-9, 11/2in dia. brass bush. Ideal for above Rheostats 30p ea. - VAT.

SOLID STATE E.H.T. UNIT Input 230V A.C. Fully isolated. Approx. 15KV. Built-in 10 sec. Timer. Easily modified for 20 sec. 30 sec. to continuous operation. Size 155.85.450mm. Price £5. 75p.p&p. (Total inc. VAT £6.61).

# 240V A.C. SOLENOID VALVE

body. Manuf. Dewraswitch Asco. Price: £5.50 + £1 p&p (£7.48 inc. VAT). N M.S.

METERS (New) — 90mm DIAMETER
AC Amp. Type 6272: 0, 1A, 0.5A, 0.10A.
AC Volt. -3.30V
DC Amp. Type 6505 0.5A, 0.10A, 0.50A, 0.100A. DC Volt 30V All Types
623.60 e.a. - p&p. 75p. (£5.00 inc. VAT) except 0.50A DC, 0.100A DC, 0.100A DC.
65.00 - 75p.p&p. (£7.76 inc. VAT).

# ULTRA VIOLET BLACK LIGHT

FLUORESCENT TUBES
4h 40 watt £8.70 inc. VAT £10.00 (callers only).
2h 20 watts £6.20. Post £1.25 (£8.57 inc. VAT & p&p)
(For use in standard bit pin fittings).
12n 8 watt £3.00. 45p (£3.97 inc. VAT p&p)

1ε in α watt £3.00. • 45p (£3.97 inc. VAT p&p).
9in 6 watt £2.50. • 45p (£3.39 inc. VAT p&p).
6in 4 watt £2.50. • 45p (£3.39 inc. VAT p&p).
Complete ballast unit for either 6V, 9V or 12V tube 230V AC op. £5.50
Post 55p (£6.96 inc. VAT p&p). Also available for 12V DC £5.50 Post 55p
(£6.96 inc. VAT p&p).

### **BLACK LIGHT BULBS**

Self-ballasted Mercury U.V 175W Bulbs. Available for either B.C. or E.S. fitting Price £11.79 incl. p&p and VAT 400W UV LAMP AND BALLAST complete £38.00 post £3.50 (£47.73 inc. VAT & p&p). 400W UV LAMP AND BALLAST complete £38.00 post £2.00 (£18.40 inc. VAT & p&p).



Quiet smooth-running COOLING or EXTRACTOR FAN Size: 43/4x43/4x11/2. Supplied for 240V A.C. operation. Price £4.75 + £1 pap (total incl. VAT £6.62).

# **VORTEX BLOWER & SUCTION UNIT**

Powerful multi-stage dynamically balanced, totally enclosed. 9" dia. Rotators. 3,500 cpm 1"2 1.D Inlet and outlet. 110V A.C. Price £20,00. Suitable transformer for 240V A.C. £5.00 · £3.00 p&p (total incl. VAT £32.20)

# **VARIABLE VOLTAGE TRANSFORMERS**

INPUT 230/240V a.c. 50/60 OUTPUT 0-260V

200W1 amp inc. a.c. voltage 0.5 KVA (2½ amp MAX) 1 KVA (5 amp MAX) 2 KVA (10 amp MAX) 3 KVA (15 amp MAX) 5 KVA (25 amp MAX) 10 KVA (50 amp MAX) 10 KVA (50 amp MAX)



# 3-PHASE VARIABLE VOLTAGE

TRANSFORMERS
Dual input 200 - 240V or 380-415V. Star connected 3 KVA 5 amp per phase max £113.40

6 KVA 10 amp per phase max 10 KVA 16 amp per phase max £170.10 £345.45

Comprehensive range of L.T., AUTO (110-240V), AND ISOLATION TRANSFORMERS available for immediate delivery. Leaflet on request.

### EPROM ERASURE KIT

OIM EMASUME N.I.
waste money? Build your own EPROM ERASURE for a fracthe price of a made-up unit. Complete kit of parts less case,
tie 12". 8 watt 2537 Angst Tube. Ballast unit, par of b-pin
Neon indicator, safety microswitch, on/off switch and cir-

cuit. LESS CAST, Price: £13.60 · 75p p&p. (Total incl. VAT £16.50). Warning: Tage used in this circuit is highly dangerous to the ey

# FROM STOCK AT PRICES THAT DEFY COMPETITION!

AC GEARED MOTORS DC MOTORS **MICROSWITCHES** RELAYS REED SWITCHES SOLENOIDS A.C. or D.C. PROGRAMME TIMERS C.F. BLOWERS AC CAPACITORS STROBE KITS **FLASHTUBES** CONTACTORS SYNCHRONOUS MOTORS

Phone in your enquiries

Stockists for Finnigans Hammerite paint and Waxoyl products

Ample parking space Showroom open Monday-Friday



# RADING CO

57 BRIDGMAN ROAD, CHISWICK, LONDON W4 5BB, 01-995 1560 ACCOUNT CUSTOMERS MIN. DRDER £10

for details.

Type S288 I on, or 1 timed c/o every 24 hours, day omitting device.

Price £11 - £1 p&p (£13.80 incl VAT) N M.S.

Type S388. As above, plus 36 hours spring reserve. Less perspexioover Price £13.00 - £1 p&p (£16.10 incl VAT) N M.S.

SANGAMO WESTON TIME SWITCH

N.M.S. New Manufacturers' Surplus R&T Reconditioned and Tested.

Personal callers only. Open Saturdays

9 Little Newport Street London WC2H 7JJ Tel: 01-437 0576

# T.V. SOUND TUNER

**BUILT AND TESTED** 

In the cut-throat world of apparently ponder over is "Will anyone notice if we save money by chopp-ing this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are commor



£24.95

and all this is really quite sad, as the TV companies do their best to transmit the highest quality sound. Given this background a compact and independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains-operated.

This TV SOUND TUNER offers full UHF coverage with 5 pre-selected tuning controls. It can also be used in conjunction with your video recorder. Dimensions: 11%"x 8%"x 8%"x 3%" E.T.I. kit version of above without chassis, case and hardware. £12.95 plus £1.50 p&p

PRACTICAL ELECTRONICS SPECIAL OFFERI STEREO CASSETTE RECORDER KIT COMPLETE WITH CASE

ONLA £31.00 plus £2.75 p&p. NOISE REDUCTION SYSTEM. • AUTO STOP. • TAPE COUNTER. • SWITCHABLE E.G. • INDEPENDENT LEVEL CONTROLS • TWIN V.U, METER. • WOW & FLUTTER 0.1%. • RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING. • FULLY

RIABLE RECORDING BIAS FOR YPES

Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts. i.e. semiconductors, resistors, capectors, randware, top cover, printed scale and mains transformer. You only supply solder & hook-up wire. Featured in April P.E. reprint 50p. Free with kit

# Stereo Tuner Kit

This easy to build 3 band stereo AM/ FM tuner kit is designed in conjunction



with P.E. (July '81). For ease of construction and alignment it incorporates three Mullard modules and an System

I.C. IF System. FEATURES: VHF, MW, LW Bands, interstat-ion muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM-ferrite rod, FM-75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front state size 10%" × 24" approx. Complete with diagram and instructions.

SPECIAL OFFER! £13.95 +£2.50 p86

self assembly simulated wood cabinet sleeve to suit tuner only. Finish size: 11 1/2/18 18/2/18 3/2/19 £3.50 Plus £1.50 p&p

# STEREO CASSETTE DECK



lus £2,50 p&p. Just requires mains transform er and input/

output sockets and a volume

plete. Supplied with full connection details

# 125W HIGH POWER AMP MODULES

The power amp kit is a module for high power applications - disco units, guitar amplif power applications - disco units, gottal aniphiers, 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, result, a high powered rugged unit. The PC board is back printed, etched and safety and the second to the safety and the safety a ready to drill for ease of construction and the aluminium chassis is preformed and ready to use. Supplied with all parts, circuit diagrams and instructions.

ACCESSORIES: Stereo/mono mains power supply kit with transformer: £10.50 plus £2.00 c &p.



SPECIFICATIONS:

SPECIFICATIONS:
Max. Dutput power (RMS): 125 W. Operating
voltage (DC): 50 - 80 max. Loads: 4 - 16 ohm.
Frequency response measured @ 100 watts:
25Hz - 20KHz, Sensitivity for 100w: 400mV
@ 47K, Typical T.H.D. @ 50 watts, 4 ohms: 0.1%. Dimensions: 205x90 and 190x36mm

**KIT £10 50** +£1.15 p&p

BUILT **£14 25** +£1.15 p&p

#### **BSR RECORD DECK** SPEAKER BARGAINS

Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cart ridge 2 speeds with 45rpm spindle adaptor ideally d for home or disco £12.95 +£1.75 p&p.



SPECIAL OFFER Replacement Stereo cassette tape heads £1.80 each. Mono: £1.50 each. Erase £0.70 each. Add 50p p&p to order

21E HIGH STREET, ACTON, W3 6NG.

Note: Goods despatched to U.K. postal addresses only All items subject to availability. Prices correct at 31/5/83 and subject to change without notice. Please allow 14 working days from receipt of order for despatch, RTVC Limited reserve the right to update their products without notice. All anguiries seek.

# 2 WAY 10 WATT

SPEAKER KIT

8" bass/mid range and 3% tweeter. Complete with screws. tweeter. Complete with screwire, crossover components and cabinet. All wood precut—fo cutting required. Finish—chipboard covered wood simulate, size 14½"x 8¾"x 4". PAIR for ONLY £12.50 plus £1.75 p&p.

SALLERS TO: 323 EDGWARE ROAD, LONDON-W2\_Telephone: 01-723 8432. (5 minutes walk from Edgware Road Tube Stat Now open 6 days a week 9 – 6. Prices include V



# CALL IN AND SEE FOR YOURSELF

TEST EQUIPMENT CENTRES ALL MODELS ON DISPLAY

RETAIL . MAIL ORDER . EXPORT . INDUSTRIAL . EDUCATIONAL

DIGITAL MULTIMETERS (UKC/P Free) 1887 month i a



HAND HELD -With KD25C=13 range 0.2A OC 2 meg ohm £24.95 K D305 = 16 range 10 A C/2 2 meg ohm
K D30C = 26 range 14 A C/2 2 meg ohm
K D30C = 26 range 14 A C/0C 20 meg ohm
K D55C = 28 range 10 A A C/0C 20 meg ohm
C D55C = 28 range 10 A C/0C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range 10 A C/20C = 20 meg ohm
C D55C = 28 range

£69.95 HAND HELD AUTO RANGE DM2350=21 range IOA AC/OC 20 meg ohm liniaturel

(Miniature)
HD30 16 range 0.2A AC/OC 2 meg ohm
HD30/B As above plus cont. buzzer
HD31 22 range 10 AC/OC 2 meg ohms plus co €44.50 £58.95

+Optional carry case £2.95



BENCH MODELS

TM353• 27 range LCO 2A AC/OC TM355• 29 range LEO 10A AC/OC TM351• 29 range LCO 10A AC/OC 2001 28 range LCO 10A AC/OC plus 5 range £86.25 £113.85

Cap. Meter with case £108.00 TM 451 41, digit LCO every facility [0.02° o] £171.00 1503a 4%, digit LCO every facility [0.05%] 1503h a 0.03% basic version of above •Optional carry case £6.84 €189.00

ALWAYS BARGAINS IN EQUIPMENT FOR CALLERS

# FREQUENCY COUNTERS



PFM200A 200 MHZ hand held pocket 8 digit 8110 A 8 digit LEO bench 2 ranges 100 MHZ 5:
80108 9 digit LEO bench 2 ranges 800 MHZ 5:
80008 9 digit LEO 3 ranges 16 HZ 5:
175040 = 8 digit LEO 40 MHZ 5:
175040 = 8 digit LEO 200 MHZ 5:
17500 = 8 digit LEO 200 MHZ 5

£43.00 £74.00

#### **ELECTRONIC INSULATION TESTER** YF 501 500 V/0-100m with carry case £63.00

MULTIMETERS (UK C/P 65p) C7081 50K/V 21 ran Range doubler 10A OC SPECIAL PRICE

£15.95 ETC5000/5001 21 ranges, 50K/V. Range doubler, 10A 0C. £16.50

TMK 500 23 ranges 30 K/V. 12A DC plus £23 95 NH56R 20K/V, 22 range gocket £10.95 EU102 14 range 2K / V pocket 830A 26 range 30K/V. 10A AC/OC overload

YN 360TR 19 range 20K/V plus Hie tester

protection, etc. 360TR 23 range 100K/V. Large scale 10A AC/OC plus Hfe £23.95 €36.95 10A AC/OC plus Hfe **AT1020** 18 range 20K/V. Deluxe plus Hfe ST303TR 21 range 20K/V plus HIe tester

**VARIABLE POWER** SUPPLIES (UK C/P £1.00) PP241 0/12/24V. 0/1A

€35.00 PP243 3 amp version £59.95 PS 1307S 8/15V 7 amp twin mete



£5.95

£24.95

DIGITAL THERMOMETER TH301 LCO ~50°C to +750° with Thermocouple £68.43

**AC CLAMPMETER** \$**7300** 0/300A: 0/600 VAC. 0/1 Kohm 9 ranges With carry case (UK C/P 65p) £28.50

**LOGIC PROBES** LP10 10 MHZ £28.50 C LDP076 50 MHZ with carry case and accessories £71.30

# SIGNAL GENERATORS



Stein Co. FUNCTION: All sine/square/triangle/TTL.etc TG100 I HZ 100 KHZ TG102 0.2 HZ 2 MHZ £1 **PULSE** 

TG105 Various facilities 5 HZ 5 MH7. £97.75 AUDID: Mulliband Sine/Square LAG27 10 Hz in L MHz AG202A 20 Hz to 200 KHz (List £94.50)

SG402 100 KHz to 30 MHz (Last few) LSG17 100 KHz to 150 MHz £59.95 £79.35

## AUDIO . RF . FUNCTION . PULSE **OSCILLOSCOPES**





Full specification any model on request. SAE by post HM' Series HAMEG: 'SC' THANDAR: CS' Series TRIO: '3' Series CROTECH

LS Series TRIO: 3' Series CROTECH SINGLE TRACE 3030 15 MHZ 5mV 95mm tube plus component lester C/P C3 00 £1 SC110Am. Miniature 10 MHZ battery portable Post free £1 £177.10 £171.00

Postree £171.00
HM 103 15 MHZ 2mV. 6 x 7 display plus
component tester C/P C3.00

© Optional carry case £6.84
Nicads £12.50

DUAL TRACE (UK C/P £4.00)

HM203/4 Dual 20 MHZ plus component tester

£303.60 £269.50 £276.00 CS1562A Qual 10 MHz (List £321.00) 3131 Qual 15 MHZ + component tester CS 1566A Qual 20 MHZ All facilities List £401.35 H M204 Qual 20 MHZ plus component tester

sweep delay.
CS1820 Dual 20 MHz with extra facilities £419.75 [List £508.30] £485.00

OPTIONAL PROBE KITS
X1 £7.95
X1 - X10 £10.50 X10 X100 HIGH VOLTAGE METER

Direct reading 0/40 KV. 20K/Volt. [UK C/P 65p] £23.00

DIGITAL CAPACITANCE METER

0 l pt to 2000 mtd LC0 8 ranges **DM6013** £52.75 [Carry case £2.95]



Direct reading PNP: NPN, etc TC1 £21.95 (UK C/P 65p) AUDIO ELECTRONICS Cubegate



301 EDGWARE ROAO, LONDON W2 1BN, TEL: 01-724 3564 ALSO AT HENRY'S RADIO.

SO AT HENRY'S RADIO. 4/406 EDGWARE ROAD, LONDON W2, TEL: 01-723 1008

# Accurate Digital Multimeters at

6010

5% Accuracy

£29.95

Exceptional Prices

28 RANGES, EACH WITH FULL OVERLOAD

**PROTECTION** 

**NEW ANALOGUE METER WITH CONTINUITY BUZZER AND BATTERY SCALE** 

NEW HM102 BZ Z £13.00

NEW HM 102 BZ **SPECIFICATION** 

DC Voltage: 0-25, 1, 2.5, 10, 25, 100, 250, 1000 volts 20,000 ohms/volt. AC Voltage: 0-10, 25, 100, 250, 1000 volts

10,000 ohms/volt.
Decibels: -20 to +22dB
DC Current: 0-50, 500µA, 0-5, 50, 500mA

DC current: 0-50, 500µA, 0-5, 50, 500mA
Ohmmeter: 0-6 Megohms in 4 ranges.
30 ohms Centre Scale
Power Supply: One 1.5V size 'A' battery (incl)
Size & Weight: 135 x 91 x 39mm, 280gr.

HM 101 POCKET SIZE MULTIMETER SPECIFICATION

DC & AC Voltage: 0-10, 50, 250, 1000 volts, 2000 ohms/volts
Decibels: -10 to +22dB

DC Current

0-1 Megohm in 2 ranges, 60 ohms Centre Scale One 1.5V size 'A' battery (incl) 90 x 60 x 29mm, 92gr. incl. battery Power Supply: \* Size & Weight:

Add 15% to your order for VAT. P&P is free of charge. Payment by Cheque with Order. Access & Barclaycard accepted.

Quantity discount for trade on application.

SPECIFICATION MODELS

Weight: 400g inc. battery. Mode Select: Push Button.

Input Impedance: 10MΩ
Display: 3½ Dîgit 13mm LCD Display: 3½ Digit 13mm LCu O/load Protection: All ranges

OTHER FEATURES: Auto polarity,

auto zero, battery low indicator, ABS plastic case with tilt stand, battery and test leads included, optional carrying

10 amp AC/DC Single 9V drycell. Life: 200 hrs Dimensions: 170 x 89 x 38mm.

AC DC Current: 200µA to 10A
AC Voltage: 200mV to 750V
AC Voltage: 200mV to 1000V
Resistance: 200ΩV to 2MΩ
Input Impedance: 10MΩ

10M

6010 & 7030



ARMON ELECTRONICS LTD.

Cottrell House, 53-63 Wembley Hill Road, Wembley, Middlesex, HA9 8BH, England

Telephone 01-9024321 (3 lines )

TELEX No. 923985

• Price







127-140-1	_	201				-														-	-	-
																DIODE	S					
TRAN'TO	)RS			ļ		1		ł								0A200	5p	747-14 30p			ML922	300p
AC 127		BC214	60	BF196	5р			!	_		40-		10.			0A202	5p	748-8 25p AY-3-1270	LM308N-	450	NE562	300p 100p
AC128	12p	BC214L	6n	BF197	8p		10p	4001B		7407		74121	220	LS48	30p	1N4148 1N4005	4p 4p	500n	LM318H	80n	NE566 NE567	130p
AC 141	15p	BC237	6p	BF198	8p		110	4006B		7408 7409		74122	30p	LS73	15p	1N5402	12n	CA3018H 50p	LM318N	100p	SN76115	
AC142	7p	BC238	4p	BF200	1.5p	2N1132	13n	4007 4008		7410		74125		LS74 LS75	14p			CA3019 60p	LM339N	35p	01170173	50p
AC153		BC261B		BF244C	13p	2N 1304		4009		7412		74126		LS76	15p	I DIL		CA3028AH	LM380N	55p	TBA641B	X1
AC176	15p	(BC478)	00-	BF257	11p	2N1306	16p	4010B	20p	7413		74132	28p	LS78	40.	I SOCKET	S	50p	LM381N	80p		150p
AC187 AC187K	120	BC301 BC338	20p	BF258 BF259	17p	214 1300	20p	4011B	9p	7416		74141	35p	LS86	4.5	I 18 nin	10p	CA3048 200p	LM382N	70p	TBA651	100p
AC188	15p	BC477	150	BFR39	10p	1 2142211	15p	4012		7417		74145	30p	LS90	18p	122 pm	12p	CA3054 40p CA3090AQ	LM1458N	30p	TBA800 TDA1004	60p
AD149	40p	BC547		BFR40	15p		10p	4014	35p	7420 7421		74147		LS95	35p	24 pin 28 pin	16p	70p	MC1310N	1 65n	1DA 1004	250p
AF118	23p	BC549		BFR80	10p		100	4015B	14n	7423		74151		LS122 LS123	22p	40 pin	18n	CA3130E 60p	MC14951	ООР	TDA1008	250p
AF124	30p	BC557		BFX29	25p	2N2484	10p	4010	35p	7425		74153	30p	LS157	28p			CA3160E 80p	1	350p	70111000	250p
AF 125	30p	BC558		BFX86	15p	2N 29 0 4	10p	4021	30p	7426		74155	30p	LS163	30p		ICe	LF356N 60p	MC1496F	60p		
AF139 AF186	40n	BC559 BCY30		BFX87 BFX88	15p		10p	4022		7427		74156	20p.	LS221	400	700.9	16p	LM301AN-14	MK50398	400-	ZN424E	120p
ASY54	100	BCY34			13p		_10p	4025		7428		74157	25p		28p	710-14	15p	18p		400p		- 1
ASY55	10p	BCY59			15p			4027	30p	7432 7433		74161 74162	24p	LS253 LS279	2 OP	7.10			1	_		-
BC107	6p	BCY70	10p	BFY53	8p	2N3055		4028		7437		74163	35n		26p	BOW	ED 6	SUPPLY PCB (	E11 - 2111. I		alicina al ali	- 1
BC108	6p	BCY71			80p	2N3703		4035	40p	7438	8p	74164	35p	OPTO								
BC109C	100	BCY72	10p		15p	2N3705		4041	35p	7440		74165		ELECTRO				ilised and regul				
BC119 BC142	200	BD115 BD121	30p	MPF104 MPF105			5p	4042		7441		74167		ORP12 3mm LED:	50p	cons	tructi	on details suppl	iled		70p	- 1
BC143	20p		30p	MPF106	20p	2N3707 2N3708		4043		7442		74173 74174				MAII	NS TI	RANSFORMER	1: 2A-9V Ro	bust &	3 compact	- 1
BC147	5p	BD131	20p				5p	4044		7443 7444		74175	20-1	Red	7p	by Ai	r Linl	k			290p	- 1
BC148		BD132	20p				5p	4048		7445		74177	20-	Green Yellow	7p 7p	1						- 1
BC149	5p	BD135	20p				e '-	4050B	20p	7446		74180	23p	5mm LED	5 7 1	6V8	7V5 8	10DES (400m) 3V2 9V1 12V 15	V 16V 18V	221/2	3V0 0V2	- 1
BC158 BC159		BD136 BD137	20p	115.900		12N3823	35p	4066		7447A		74181	800	Green	7p						•	- 1
BC167			20p	IIP34A	SSP	2N3866 2N3903	30p	4068		7448		74182 74184	30p	Yellow	7p	2001	ENTI	OMETERS (LC	G VALUES	ONLY	)4K722K	- 1
BC168		BD139	20p	Tip2955	400	2N3903		4069 4070B		7450 7451		74185	80p		1	2206	470	JK 2M2			гэр	- 4
BC170		DD 140	FOD	Z1X10/	6p	2N4058		40708		7453		74190	35p	VOLTA	GE	ROT	ARY	SWITCHES: 2/	A/ 250V DE	ST	150	- 1
BC173		BF167	12p	ZTX108		2N4059		4081		7454		74191	35p	REGULAT	ORS					-		
BC177 BC178		BF173 BF178	12p	ZTX303		2N4060	40	4082		7460		74192	32p	500mA:		TAN	TAL	JM BEAD CAP	2u2/20V		8p	- 1
BC182		BF180	170	ZTX311 ZTX341		2N4061		4516	50p	7470		74193 74194		79M12	15p	POL	VECT	ER CAP (100V	), 4=E to 60	٦		- 1
		BF181	5p	ZTX500	6p	2N5458 2N5459		4518		7472 7473		74194	40p	79M24	15p	100n	E 1	50nF 330nF	50 4705E	30F	4p	- 1
		BF183	24p	7TY501		2N6027	15p	П		7474		74197		1 Amp:		10011	, ,	33011	3p 4/011F	Tur	тио бр	- 1
BC207		BF184	170	7TX503		3N128	100	7401	8p	7475		74198	60p	7812	40p	ELEC	CTRL	YTIC CAP (UF	/V): 1/63	2u2/6	3 4u7/25	- 1
BC212		BF 185	120	2N697	15p			7403	8p	7476		74199	40p	7815	40p	10/2	5 22/	25 33/40 47/2	5 160/25 B	40/16	3 4n	- 1
BC213 BC213L		BF194 BF195	100	2N698	140	CIMI		7405	8p	7480	22p			7818 7905	40p 45p	47/6	3 100	0/25 150/25 22	0/25 500/	30	5p	
BC213L	ob	Dr 195	/ P	2N706	70	4000	5p	7406	пр	7482	40p 30p		1		45p		40 ( /6	mini) 10p 4 7p 1500/40	70/25 8p	100	0/10 10p	1
	OF REAL PROPERTY.	Section 1 Section	and the Owner, where the Persons is not the Persons in the Persons	Company of the last of the las	THE RESERVE	Contract to the Party of	-		ALC: UNKNOWN	7483	SUP	77	L·LS'		+0P	2200	, 0	7P 1000/40	I OD	∠UUU/	10 120	-

# DELTA TECH & CO 62 Naylor Road, London N20 0HN

Phone: 01-445-8224 Mail Order only. Prices include VAT. Add 30p postage. Minimum ACCESS Order £7.

BRIDGE RECTIFIERS W06M 1A/50V 1A/200V 1A/400V 1A/600V 2A/100V 14p 16p 16p 17p

BARGAIN PACKS (useful values only) 100 Ceramic caps: 150p 100 Polystrene caps: 200p 100 Polyster caps: 350p 100 Electrolytic caps: 450p 100 Folyester caps: 350p 100 Electrolytic caps: 450p 100 Carbon Film Resistors 70p 100 Presets 250p

PRESETS (mini horizontal): 100R 220R 470R 1K 2K2 4K7 10K 22K 47K 100K 250K 500K 1M ... 4p 

# IMMERSIBLE HEATER

This simple-to-construct project has done sterling service as a temperature controller in a common fish tank heater but has wide application. Design by Jonathan Scott.

f this project did not run directly on 240 V we would call it a simple project. It contains only one IC, a triac and very little else, yet it is a full zero-crossing switch system capable of controlling up to 1500 W of heating power that may be employed to regulate the temperature of a room, a fish tank or a bowl of yoghurt-in-the-making.

At this point, let us stress that the PCB is operating at live mains potential as the IC is designed to run directly on the mains without transformer isolation, so be careful. You should never touch any of the components while the circuit is plugged in, nor try to adjust the setpoint preset pot.

The triac must be of 400 or more volts rating, and it must be of at least 4 A current rating as the PCB is designed to take the type which comes in a bolt-on package, and these start at 4 A. This overrating, if you are only planning to have around 150 W of heater, as we did, allows you to dispense with a heatsink. There is not reason why you shouldn't have a higher rating still if the thing physically fits in place. With a heatsink, the type we found most common at the suppliers (and used) is rated at 6 A and will thus run up to 1500 W.

The thermistor you use will depend upon how much you wish to pay, how robust a component you need, and how you wish to connect it thermally to the load, as well as the temperature you are going for. We used both a cheap rod type, and a type G23. The latter is a small, but strong, glass bead type with a wide temperature range - but a £5-plus price tag! The G23 is a professional type, but reliable and predictable. As we point out later, a failure of the thermistor is not likely to cause anything but a cooling of the load, so unless you are willing to pay the price and need the reliability, use a cheap type. It is only necessary to have a resistance of 2k0 to 60k at the regulated temperature. We used a type having a resistance of 47k at 25°C, costing only 40p or so.

Once you have obtained the thermistor, it is necessary to select R4 and PR1 to suit. These must together be able to equal the resistance of the thermistor at the temperature you are going for. Now, the G23 has a resistance of 2k0 at 20°C and a temperature coefficient of so many ohms-perdegree. As we were going for 20-25 degrees in that model, we chose 820R for R4 and 5k0 for PR1 ensuring that we could reach 2k0 or a bit less. In general, if the thermistor is a cheap type, you had best measure its resistance while at the temperature you need. If it comes with specifications it will be possible to calculate the resistance at a given temperature.

So, having selected these components, you should assemble them on the PCB in accordance with the overlay diagram. Take care to get the polarity of the IC, capacitor and triac correct. Note that the metal tag of the triac is the MT2 connection, and the lead to the load is taken via a lug on the

bolt holding it to the PCB.

The final piece of constructional detail is the mounting of the thermistor. It is important to have it in close thermal contact with the item you are trying to heat. In our constructional example we are regulating the temperature of the liquid surrounding the tube within which the controller and the heater are immersed. It is thus only possible to regulate the tube temperature, as we cannot put the (live) sensor in the liquid. The sensor was pressed against the tube and seated in a blob of thermal compound of the type used for mounting transistors on their heatsinks. This meant that it was held at the temperature of the outside as much as possible, rather than at the temperature of the heater and controller themselves.

As the design of the housing is largely up to the individual constructor, there is very little to say about the physical makeup of the project. If you are copying the format shown in the pictures.

# .THE ZERO CROSSING SWITCH TECHNIQUE...

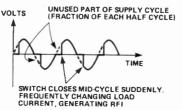
In normal phase control switching the switching element, an SCR or triac, is triggered into conduction at some time during each half cycle. The moment of switching is varied, so that the duration of the applied voltage pulse, which corresponds to the fraction of the cycle left at the point of triggering, is varied. This is a simple and direct method which does vary the applied power fairly smoothly (see Fig. 1). Unfortunately, the sudden application of voltage tends to produce a lot of electromagnetic radia-tion due to the sudden current change in the load circuit. This is responsible for a lot of radio frequency interference, or

In ZCS the switching element is only allowed to change to the conducting

state when the supply voltage is crossing the zero-voltage point — hence the name. This means that there are no sharp voltage transitions across the load, and so no RFI. The penalty paid is that only whole half cycles are applied to the load. The system is thus not readily applicable to lighting applications as the lights flicker badly due to the relatively long periods between conduction and isolation (see Fig. 2).

For applications where the system

has sufficient inertia, such as heating, this system is by far the superior technique. As the required functions are available within a single, relatively cheap IC it is practicable to built a ZCS system with almost the same ease as a proportional system.



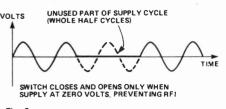


Fig. 2

NOTE:
IC1 IS CA3059
TRI IS TIC226D OR SIMILAR
6A/400V TRIAC

R1 R2 R3 TO LOAD
(HEATER)

R4 820R
AC

PR1 2 G MT1

TH1 7 B 9 10 11

N TR1

assembly is rather straightforward. The only point to note is that you will have to take particular care to see that the tube is sealed against the accidental entry of liquid. Here, Silastic or a similar silicone sealant comes in very useful.

# BUYLINES\_

This simple project uses very few parts, most of which are commonly stocked items. However, to choose a suitable thermistor it will be necessary to check in the mail order companies' catalogues; they don't bother putting these items in their magazine ads. Maplin stock the G23, plus a suitable selection of cheap rod thermistors. We got our fish tank heater in the local pet shop, but if you do this it's advisable to check the various types in the shop, making sure that you can get into it and that there's room for the PCB. The PCB can be obtained from the PCB Service using the order form on page 95.

Fig. 3 The circuit. Simple, what?

It is necessary to set the preset pot before sealing up the immersible tube. This is done be carefully setting the system up with water coming up to the point on the tube above where the sensor is located. Then, allow a couple of hours of undisturbed operation and measure the liquid temperature with a thermometer. Adjust the preset pot (mains unplugged!) and repeat. If you measured the thermistor beforehand, while at the correct temperature, you can adjust the pot/R4 combination to give you that resistance straight away and there should be no need to make a second adjustment of the pot. If at some later stage you wish to change the set point, Silastic is easy to peel away and you can reseal the tube when the adjustment is made and checked.

We do not advise you to leave an access hole to permit adjustment of the pot because, firstly, someone might try and do that with the power on (poof!) or more likely the liquid will find a way of invading the tube and quietly ruin the components.

# HOW IT WORKS

Initially, consider the triac to be turned off. Some current flows into pin 5 of the IC and this is limited by R1-3 and rectified within the IC to provice about 8 V DC for the operation of the circuit. Capacitor C1 smooths this supply. Inside the IC are a number of separate subcircuits centered on a comparator ('ON/OFF SENSING AMP'). Connection of pins 9, 10 and 11 uses internal resistors to establish half supply rail (about 4 V) as one of the levels to be compared. When the voltage on pin 13 exceeds half rail potential the comparator activates a circuit which turns the triac on at the next supply zero, and each subsequent zero until the voltage falls below half rail.

falls below half rail.

Clearly then, PR1/R4 must be selected so that they add up to the resistance of the sensing thermistor at the temperature for which it is desired to regulate. Thus, when the temperature reaches the preset point, the voltage across TH1 corresponds to half rail potential on pin 13.

Pin 14 allows the protection circuit to detect when TH1 goes either open circuit or short circuit by looking at the voltage at the junction of R4 and TH1. If this voltage nears the DC supply rail or the local common (N), there has been a failure, and the firing of the triac is inhibited until the condition is removed.

The supply dropping resistors R1-3 are used instead of a single resistor purely for size considerations. All that is required is that they deliver 10 to 50 milliamps to the IC's rectifier-regulator.

The sensing thermistor must be a negative temperature coefficient type (NTC), as its resistance must drop with increasing temperature in order to reduce the voltage on pin 13 as the temperature is brought towards the setpoint. There is sufficient excess supply current to allow it to draw at least one milliamp if necessary. Thus, any of the common small bead types with a few kilohms of resistance at the setpoint may be used. The total permissable sensor resistance range is 2k0 to 100k.

Most of the functions of this temperature controller are contained inside the IC, so let's take a look at the zero-voltage switch IC first.

Three zero-voltage switches are made by RCA — the CA3058, CA3059 and CA3079. They are all designed to control a thyristor in a variety of AC power switching applications for AC input voltages of 24, 230, 230 and 277 V at 50, 60 and 400 Hz. Each incorporates four functional blocks as follows (refer to the block diagram here):

● Limited-Power Supply — permits operation directly from an AC line.

Directional On/Off Sensing Amplifier

 tests the condition of external sensors
 command signals. Hysteresis or
 proportional-control capability may easily be implemented in this section.

Zero-Crossing Detector — synchronises the output pulses of the circuit at the time when the AC cycle is at zero voltage point; thereby eliminating radiofrequency interference (RFI) when used with resistive loads.

 Triac Gating Circuit — provides highcurrent pulses to the gate of the power controlling therefore.

controlling thyristor.
In addition, the CA3058 and CA3059
provide the following important auxiliary functions:

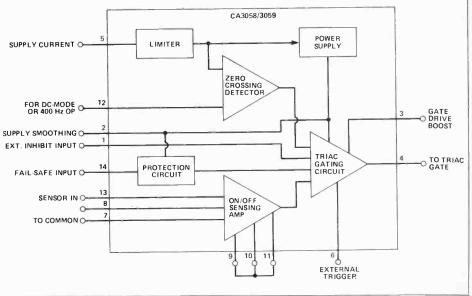
 A built-in protection circuit that may be actuated to remove drive from the triac if the sensor opens or shorts.

 Thyristor firing may be inhibited through the action of an internal diode gate connected to Terminal 1.

High power DC comparator operation is provided by overriding the action of the zero-crossing detector. This is accomplished by connecting pin 12 to pin 7. Gate current to the thyristor is continuous when pin 13 is positive with respect to pin 9.

Because the CA3079 does not incorporate the built-in protection circuit, the CA3058 or CA3059 have been specified for this project. If the project is used to control a fish tank heater, one doesn't want to boil one's finny friends in the event of a thermistor failure!

Now we know what's inside the IC, how is it put to work in the circuit?



# PROJECT: Immersible Heater

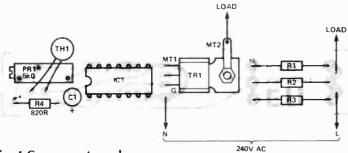


Fig. 4 Component overlay.



Naked and clothed. At top is the naked PCB (approximately life size) to compare with the component overlay. The lower picture shows the completed immersible temperature controller from a common fish tank heater. The arrow shows the positioning of the thermistor sensor.

# PARTS LIST.

Resistors (all ½W, 5% except where

stated)

68k 1 W R1-3 820R (see text) R4

**Potentiometer** 

5k0 multiturn cermet PR1

preset

Capacitor

100μF 16 V tantalum

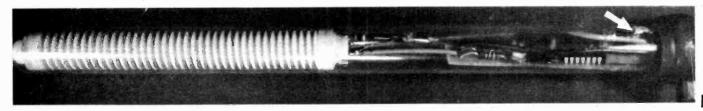
Semiconductors

CA3059 TR1

6 A, 400 V triac eg TIC226D or similar

Miscellaneous
TH1 thermistor to suit application eg G23 glass bead
type (see text)

PCB (see Buylines): solder lug; hookup wire; heating element etc.



EXCLUSIVE of V Postal Order, Ba EducationalIns We are pleased unless accompa delay in despato	AT. Please add inkers Draft or itutes Welcome to receive over inied by Banker h. Overseas tra it detailing full r	60p to o Cash (Pl e. Trade A seas ord 's Draft in de enqu range of	rder to cover P LEASE registe Accounts open Jers (please all In UK Currency iries welcome	&P BEF r) with c edsubji ow adei may be may be vailable	x stock despatch ORE calculating \ Order. Official orde ect to satisfactory quate postage — subject to Bankei for full details. VA = — 30p refundab	VAT. I ers fr statu surpl rs Co T not	Payment by cheq rom Govt. Depts a us — send for deta lus refunded) wh immission and sli applicable to exp	jue, and ails. ich, ght	74LS	Н.	AMILTON HOUSE STEVENAGE H ephone (0438) 72	D. 11 WALKERN F ERTS SG1.3QC	ROAI	D	19
LM334Z LM335Z LM339 4 LM348 5 LM377 16 LM380 6 LM381 12 LM382 11 LM384 13 LM386 12 LM386 12 LM387 12 LM387 12 LM387 12 LM386 12 LM386 12 LM387 LM387 12 LM	0 LM3911 4 LM3915 5 LM3914 4 LM3915 5 LM318600 5 LM13600 6 MC1348 6 MC3340 0 ML924 0 NE529 5 NE556 6 NE556 6 NE565 0 NE5666 0 NE5667 0 NE571 5 RC4136 0 RC4558 0 RC4558 0 RC4558 0 TBA800 5 TBA8120S 0 TBA800 5 TBA8120S 0 TBA800 1 TBA820 1 TBA800 1	70 120 135 10 10 10 10 10 10 10 10 10 10 10 10 10	ZN459 ZN1034E LOGIC ICs AY5-2376 MC1488 MM5303 MM53077 MM558174 TM56011 ULN2003 88795 8811S96 88195 88195 8811S96 881596 881596 881596 881597 811S98 6522 6532 6532 6532 6532 6532 6532 6532	285 200 550 555 625 700 90 90 90 90 80 80 80 80 80 80 80 80 80 80 80 80 80	4000 4001 4002 4007 4008 4011 4012 4013 4016 4016 4016 4017 4020 4021 4022 4023 4024 4025 4024 4025 4028 4024 4025 4029 4035 4040 4051 4050 4068 4068 4068 4078 4078 4078 4078 4078 4078 4078 4078 4082 4093 4093 4093 4090 4500	1111144241140990222993222073354080001222888224333334390222343944422244882243333439223000000000000000000000000000	2650A 1 6502 6800 6802 6809 8035 8060 1 8080A 8085A 280A 8085A 280A 8085A 2101 2114(200ns) 2532 270B 27664 116(200ns) 4118-3 4164 5101(450ns) 5204 6116(150ns) 6514	39 48 90 1055 555 56 660 680 880 400 400 400 400 400 400 400 400 4	LS00 LS01 LS02 LS03 LS03 LS04 LS05 LS08 LS08 LS09 LS10 LS11 LS12 LS27 LS21 LS27 LS21 LS27 LS21 LS27 LS21 LS27 LS21 LS27 LS21 LS21 LS27 LS21 LS27 LS21 LS27 LS21 LS27 LS21 LS27 LS21 LS21 LS27 LS21 LS27 LS21 LS21 LS21 LS21 LS21 LS21 LS33 LS33 LS38 LS42 LS48 LS45 LS48 LS49 LS55 LS51 LS56 LS56 LS57 LS56 LS57 LS57 LS57 LS57 LS57 LS57 LS57 LS57	11 11 11 11 11 12 12 12 12 12 12 12 12 1	LS153 LS155 LS155 LS155 LS156 LS157 LS156 LS157 LS158 LS161 LS161 LS162 LS162 LS163 LS163 LS164 LS168 LS170 LS168 LS173 LS174 LS175 S6 LS181 LS174 LS175 S6 LS181 LS192 LS199 LS199 LS199 LS199 LS199 LS199 LS199 LS194 LS195 LS241 LS195 LS242 LS196 LS243 LS196 LS243 LS196 LS244 LS195 LS259	BEADS 0.1/35 0.22/35 0.22/35 0.33/35 0.47/35 0.68/35 1.0/35 1.0/35 1.5/35 2.2/35 3.3/35 10/25 2.2/16 3.3/16 4.7/16 6.8/16 10/16 10/16 10/16 10/16 15/16 22/16 33/16 47/16 100/16 15/10 22/10 33/16 47/10 100/63 63V MINI MONOLYTHI CERAMIC 100F 22/16 33/16 47/10 100/63 63V MINI MONOLYTHI CERAMIC 100F 22/16 33/16 47/17 100/63 63V MINI MONOLYTHI CERAMIC 100F 22/17 100/63 100/10	11222214667 1111111111111111111111111111111111	ZENER DIODI 2V7-33V 500 M 5V1-75V 1.3W BRIDGE RECTIFIERS 1A/100V 1A/400V 1A/400V 1A/800V 2A/100V 2A/200V 2A/400V 2A/800V 2A/800V	ES W 74 14 20 23 25 33 66 44 40 40 40 40 5 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6

# **POWERFET AMPLIFIERS**

#### **NEW DESIGNS**

With the introduction of four new boards PANTECHNIC have pushed forward the performance and reliability of their powerfet amplifiers. Four key improvements have been incorporated in these second generation modules —

performance and reliability of their povertical eligibilities.

1.) The use of H-PAK powerfets, resulting in improved thermal efficiency and consequently enhanced power output capabilities.

2.) Low COB drivers now in power transistor packages, maintaining the superb HF performance and improving driver reliability.

3.) Separate driver and input supply rails allowing a 10% increase in available output power by increasing output stage efficiency.

4.) Bridge mode input pin allowing instant bridging between any two amplifiers without the need for extra circuitry.

## **PFA100 Specification**

Bandwidth 10Hz-100KHz ± 1dB 0utput Power into 80 100W (Vs = ± 55V) THD (20Hz-20KHz) < 0.008% 1HD (1KHz at 100W) 0.004% typ. 12dB 500 V///6 10Hz-100KHz ± 1dB Slew rate >30 V/uS Gain x 23 Vs max ± 70V

Price

£17.35 (Built & Tested) £15,17 (Kit)



PFA 100 120W into  $8\Omega$  (V<sub>S</sub> =  $\pm$  60V)



# **PFA200 Specification**

Bandwidth 10Hz·100KHz ± 1dB Output power into 8th 150W (Vs ± 60V) THD (20Hz-20KHz < 0.0059 THD (1KHz at 150W) 0.002% typ SNR 120dB Slew rate >30 V/uS Gain × 23 30K ± 70V Vs max

PFA200 180W into 8Ω 300W into  $4\Omega (V_S = \pm 67V)$ 

Price £23.87 (Built & Tested) £21.70 (Kit)

### And for those with a taste for power . . .

- PFA500 Delivers 475W into 4 ohms and 600W into 2 ohms. These highly current

# POWER SUPPLY COMPONENTS

Toroidal Mains Transformers

Voltage	160VA	225 VA	300 VA	500 VA	625 VA
40-0-40	9.71	11.36	12.32	_	-
45-0-45	_	11.36	12.32	16.05	-
50 <b>-0</b> -50	_	_	-	16.05	18.80

Special low flux windings. Carriage included

5A 400PIV Bridge rectifier For the PFA/HV 500VA 70-0-70 10,000uF 80V Electrolytics 30,000uF 75V Electrolytics £4.13 £10.00 10.000uF 100V Electrolytics

Phone or write for advice on selecting the right components for your particular application.

All prices excl. VAT. Carriage 75p. Trade supplied

Ask about our preamps, protection boards and active crossovers

# THE POWERFET SPECIALISTS pantechnic

(incorporating J.W. Rimmer)

Dept ETI/6 148 Quarry Street, Liverpool L25 6HQ

Telephone: 051 428 8485 Technical enquiries Phil Rimmer 01-800 6667



# "BIG TRAK" MOTORIZED GEARBOX

These units are as used in the "Big Trak" computerized vehicle, and offer the experimenter in robotics the opportunity to purchase the electro-mechanical parts required in building remote controlled vehicles. The unit comprises:

al 2 x 3V motors, linked by a magnetic clutch, thus enabling turning of the vehicle; bl A gearbox contained within the black ABS housing reducing the final drive speed to approx  $50\,\mathrm{rpm}$ .

Data is supplied with the unit showing various options on driving the motors, as well as a direction controller circuit, enabling the unit to turn right, left or go straigt ahead.

# AA NI-CADS 10 for £9.95

Brand new nicket cadmium batteries by GE, standard 1.2V at 450mA/H. Professional quality with solder tags both ends. Special price, £1.40 ea; 10 for £9.95; Box of 80 £95. Nicad Charger: Charges up to 4AA, C or D cells + PP3. Only £7.95.



NOW REDUCED TO £3.95

### **ELECTRO DIAL**

Electrical combination lock-for maximum security-pick proof. One million combinations!! Dial is turned to the right to one number, left to a second number, then right again to a third number. Only when this has been completed in the correct sequence will the electrical contacts close. These can be used to operate a relay or solenoid. Overall dia 65mm x 60mm deep. Only £3.96.

### FERRIC CHLORIDE

New supplies just arrived — 250mg bags or granules, easily dissolved in 500ml of water. Only £1.15. Also abrasive polishing block 95p.

# STABILIZED PSU PANEL

A 189 A vesatile stabilised power supply with both voltage (0-30V) and current (20mA-2A) tuly variable. Many uses inc bench PSU, Nicad charger, gen, purpose testing. Panel ready built, tested and calibrated C7.75. Suitable transformer and pots £8.00. Full data supplied.

### **REED RELAYS**

Manufacturers rejects — DIL and other PCB mounting types. SP, DP and 4P — make, break and c/o contacts. Not tested, so may be only partially working or o/c etc, so very low price — pack of 10 assorted £1; 25 £2.00; 100 £7.00.

### **TELESCOPIC AERIALS**

As used in Sinclair microvision, 9 section 100-610mm. Only 95p.

**COMPUTER SOFTWARE** We now sell a range of tapes and books for DRAGON 32, SPECTRUM, ZX81, BBC and VIC20. Send s.a.e. for list stating for which com-puter required, or call in our shop.

### **D-TYPE CONNECTORS**

		1-9	10+
	9way plug	.83	.66
	9way socket	1.17	.94
ŀ	9way hood	1.30	1.04
	15way plug	1.10	.88
	15way socket	1.67	1.34
	25way plug	1.60	1.28
	25way socket	2.52	2.02
	25way hood	1.50	1.20
	Many other types of connectors	in stock	at com-
	petitive prices —		
	DIN Inch IDC Coox etc.		

DIN, Jack, IL SAF for list.

# **COMPUTER BATTLESHIPS**

Probably one of the most popular electronic games on the marker. Unfortunately the design makes it impractical to test the PCB as a working model, aithough it may well function perfectly. Instead we have tested the sound on perfectly. Instead we have tested the sound on perfectly. Instead of or its component value only PCB may be chipped or cracked). SN76477 sound (C. TMS1000 u processor; batt clips, R's, C's etc. Size 160, Y 410m. Only £1.50. Instruction book and circuit 30p extra.

# SIMON GAME

Simon is back again. Another supply of ready built PCB's for this flashing light/pulsating tone computerised game is now with us. Supplied tead and working with speaker and instructions. 24.95.



# LIE DETECTOR

Not a toy, this precision instrument was originally part of an "Open University" course, used to measure a change in emotional balance, or as a lie detector. Full details of how to use it are given, and a circuit diagram. Supplied complete with probes, leads and conductive jelly. Needs 2 41V batts. Overall size 155x100x100mm. Only £3.85 — worth that for the case and meter alone!

# PACKS PACKS PACKS

- worth that for the case and meter alone!

PACKS PACKS PACKS

K601 We have just purchased a large quantity of said are long leaded, brand new and mostly marked. Plastic-free late with the process of the process of the late of the lat

433A MILLBROOK ROAD, SOUTHAMPTON SO1 OHX All prices include VAT — just add 50p post. Tel 772501



# INTELLIGENT VOICE TERMINAL — EASY TO USE SPEECH SYNTHESIS —

- PRONOUNCES ALL ASCII LETTERS, NUMBERS AND USEFUL SYMBOLS
- ALLOPHONE DICTIONARY ALLOWES USER TO SYNTHE-SISE 'ANY' WORD
- RS232C INTERFACE-SELECTABLÉ BAUD RATE
- INTERNAL LINE BUFFER ALLOWS HIGH SPEED DUMP
- CAN BE USED INSTEAD OF A PRINTER
- INTERNAL MEMORY FOR COMMONLY USED WORDS AND PHRASES
- GOMPACT UNIT WITH MAINS SUPPLY OPTION

M.I.M.'s Intelligent Voice Terminal is designed as an easy to use yet sophisticated peripheral for microprocessors and minicomputers. The Terminal is treated as a printer accepting a line of ASCII characters at high speed and then pronouncing them at the correct speed, thus freeing the user from timing considerations. It may be used to add extra realism to games, or other interactive programs, but imposes very little in terms of software or execution time on the host computer.

PRICES Type 1032/5 (5V PSU) — £129

Type 1032/240 (240V PSU) — £149

Please add VAT (15%) and postage (£2) to above prices. Send orders (Cheques, postal orders only) or requests for further information to the following address.

MIM ELECTRONICS LTD BROADWAY DUKINFIELD CHESHIRE SK16 4UU



# FOR HI-FI&ELECTRONICS ENTHUSIASTS! We are the specialists of electronic kits. A catalogue with complete range of products including pre-amp modules, power amp modules, pre-and power amplifier modules, complete kits of amplifiers, equalizers, reverberation amplifiers (with cases), alarm clocks, appliance timers, CB amplifiers, test equipment, control (electronic touch switch, sound activated switch, light activated switch, infra-red remote control), music generators, battery fluorescent light and high quality black anodised amplifier cases. . . etc. with illustrative pictures now available at the cost of 60p including P + P, together with a 10% discount voucher for your first order. **EQUALIZER & REVERBERATION** HI-FI AMPLIFIER MODULES **AMPLIFIER** Equaliser Built £73.50 TA-323A 30W + 30W stereo amplifier £18.95 Kit £23.95 Ass. TA-280 60W + 60W stereo amplifier V stereo amplifier £27.50 Kit £33.50 Ass. Reverbervator Built £79.50 TA-920 70W + 70W stereo amplifier £36.50 Kit £42.50 Ass. All prices include VAT **CONTROL MODULES** PROFESSIONAL RACK **MOUNTING CABINET** TY-7 Electronic touch switch £2.90 Kit £4.50 Ass. TY-11 Light activated TY-11 Light activated switch 22.20 Kit £3.50 Ass. TY-18 Sound activated switch (Clap-switch) £4.50 Kit £5.95 Ass. TY-38 Sound activated switch (voice-switch) Available Soon ■ Wholly made of black anodised aluminium sheets ■ Suitable for high quality amplifiers and many other purposes ■ Top, bottom and rear cover removable for access ■ Different sizes ■ Compatible price ■ Front panel is of brushed aluminium finish TY-38 Sound activated switch (voice-switch) 65.50 Kit £7.50 Ass. TY-41 (nfra-red remote control (Heceiver and transmitter) £17.20 Kit £21.95 Ass. To: Concept Electronics Ltd., 51 Tollington Road, London N7 6PB Mail orders only Please send me the electronic kits catalogue & the 10% discount voucher for my first order. I enclose 60p in stamps/cheque/postal order. Make cheques payable to Concept Electronics Ltd. Name Address Block cans please

# ELECTRONIC COMPONENTS AND TEST EQUIPMENT 35, HIGH BRIDGE, NEWCASTLE UPON TYNE NE1 1EW TEL: 0632 326729



MULTIMETERS

MULTIME I EMS
THANDAR TM351

■ Bench/portable ● 3½-digit 0.5" LCD ● 0.1%
basic accuracy ● 29 ranges. ● Battery life
typically 2000 hrs ● Complete with batteries & Accessories. Carrying case £6.84. Universal test lead set £12.65. Service Manual £3.00.



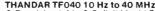
FREQUENCY COUNTERS
THANDAR TF200 10Hz to 200 MHz

● Bench/portable ● 8-digit Liquid Crystal Display. ● Frequency range 10 Hz - 200 MHz ●
Resolution better than 1 ppm ● Sensitivity typically 10mVrms ● Time base accuracy 0.3 ppm. ● Battery life 200 hours ● Frequency, time.average period, totalize & reset; 2 ranges, pate times: external clock facility. ● Complete 5 gate times; external clock facility ● Complete with batteries. £166.75.



THANDAR TM353

Bench/portable ● 3½-digit 0.5" LCD ● 0.25% basic accuracy ● 26 ranges ● Battery life typically 3000 hrs ● Complete with batteries & test leads £86.25. Accessories as TM351.



THANDAR TF040 10 Hz to 40 MHz

● Bench/portable ● 8-digit Liquid Crystal Display. ● Frequency range 10 Hz - 40 MHz

● Resolution 1 Hz. ● Sensitivity 40 mV rms.

● Timebase accuracy 0.5 ppm ● Battery life 80 hours. ● Frequency, totalize & reset: 2 gate times ● Complete with batteries. £126.50.



THANDAR TM354 ● Pocket size. ● 3½-digit 0.5" LCD. ● 0.75% basic accuracy. ● 14 ranges ● Battery life 200 hrs £45.94. Carrying case £3.45. Universal test lead set £12.65. Service Manual £3.00.

ACCESSORIES FOR TF200 & TF040 AC adaptor £7.99, Carrying case £6.48, X1 Probe £8.05, X10 Probe £920, Service manual £3.00. TP600 prescaler £51.75. TP1000 prescaler £74.75.



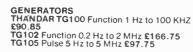
■ Bench/portable ● 4½-digit 0.4" LCD ● 0.03% basic accuracy ● Full auto-ranging or manual ● Sample hold ● Audible continuity test ● Complete with battery and leads £171.35. AC Adaptor £7.99, Universal test leads £12.65. Service Manual £3.00.



■ Bench/portable ● Low power ● 10 MHz bandwidth ● 10mV sensitivity £171.35. Carrying case £6.34. AC Adaptor £7.99. Rechargable battery pack £12.65. X1 probe £8.05. X10 probe £8.20, X1 X10 Switched probe £10.93. Sprung hook trimmer pack £2.88. Manual £3.00.

THANDAR PFM200A 20 Hz to 200 MHz

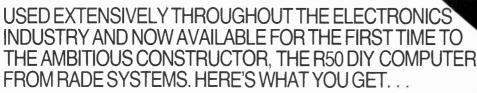
Pocket size ● 8-digit LED display ● Frequency range 20 Hz · 200 MHz. ● Resolution
0.1 Hz. Sensitivity typically 10 mV rms. Timebase accuracy 2 ppm ● Battery life 10 hours. ● Frequeny; 2 ranges, 4 gate times ● BNC input sockets €77.62. Accessories. Carrying case €3.45, AC adaptor €7.99, X1 probe £8.05, X10 probe £9.20, Service Manual £3.00.



Full spec available on all instruments, just phone



Schools, colleges, universities supplied on official orders. Prices include VAT. Please add £1.00 postage to orders under £20.00.



● Z80A BASED PROCESSOR ● FULL 64K OF DYNAMIC RAM ● DUAL SERIAL PORTS ● PARALLEL PRINTER PORT ● UNLIMITED EXPANSION VIA TWO EXPANSION CONNECTORS ● FULL 4MHZ CPU ● FULL CPM SUPPORT VIA ADD-ON FLOPPY OR HARD DISC OPTION BOARDS • USER MANUAL

DOZENS OF APPLICATIONS INCLUDE: 

AUTOMATION DEVICES

- CONTROL APPLICATIONS COMMUNICATIONS EQUIPMENT
- BUSINESS MACHINES WORD PROCESSORS GRAPHICS DISPLAYS
- SCIENTIFIC AND EDUCATIONAL

# PLEASE MAKE CHEQUES/POSTAL ORDERS PAYABLE TO RADE SYSTEMS LTD.

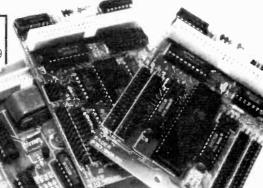
R50 DIY SINGLE BOARD COMPUTER £215 FLOPPY DISC CONTROLLER £80

SPRITE COLOUR GRAPHICS BOARD £99 🗆 R50 TECHNICAL MANUAL £6.50

## OPTION BOARDS INCLUDE: FLOPPY DISK CONTROLLER £80

- SPRITE COLOUR GRAPHICS BOARD £99
- R50 TECHNICAL MANUAL £6.50
- PRICES INCLUDE P+P

ALSO AVAILABLE PIO, SIO, IEEE 488 PORT, REAL TIME CLOCK, PROTOTYPING BOARD, MATHS PROCESSOR USES AMD9511 A TO D CONVERTOR, STEREO SOUND MUSIC BOARD, 192K RAM BOARD, CASSETTE INTERFACE, HARD DISC INTERFACE, CPM 2.2 AND TURBODOS AVAILABLE. INTERFACE KITS FOR ALL LEADING MICROS PRICES ON APPLICATION.



MORE INFORMATION [ AMOUNT ENCLOSED &

NAME ADDRESS.

POST CODE

RADE SYSTEMS LTD. 290A HIGH ROAD, WILLESDEN, LONDON NW102EU



# DATA SHEET

# M108/M208 SINGLE CHIP ORGAN

iven the great popularity of the Victory organ that we've been featuring in ETI since February, it isn't surprising that there have been many enquiries about further information on the SGS-Ates chips that form the heart of the project. This Data Sheet should clear up most of the questions.

The M108/M208 is a single chip featuring solo and/or accompaniment modes. It accepts 61 keys arranged in a 12 × 6 matrix; a scanning cycle takes microseconds and all keys pressed There are accepted. keyboard formats: either 61 keys (solo) or 24 plus 37 (M108), 17 plus 44 (M208) keys (accompaniment and solo) with the possibility of automatic chords of the 'accompaniment' section. There are internal anti-bounce circuits.

A top octave synthesizer is incorporated for the generation of three 'footages'. More than one chip can be employed with synchronisation through the reset input. There are separate analogue outputs (for each foot) for solo, accompaniment and bass sections (square wave of 50% duty cycle) with the average value constant. Each section also has 'key down' and 'trigger' outputs. Sustain is provided for the last keys released in the solo section.

There are several choices of operating mode in the accompaniment section:

- Manual, with or without memorisation of the selected keys (free chords with alternate bass),
- Automatic, with or without memorisation of the selected key (priority to the left for automatic

chords and bass arpeggio). When in automatic mode there are again several possibilities:

- Major or minor third
- With or without seventh.

The chip operates from a standard single supply of +12 V  $\pm 5\%$ , with a low dissipation of less than 600 mW. All inputs are protected from electrostatic discharges.

# **General Characteristics**

The characteristics of the M208 are similar to those of the M108; the only difference is the keyboard split, which is 24+37 for the M108 and 17+44 for the M208 when used in 'accompaniment + solo' mode.

The circuit comprises:

- Two pins for clock input; one for the matrix scanning, the other for the incorporated Top Octave Synthesizer (TOS); by connecting both the clock inputs to the same matrix scanning clock (1000.12 kHz), the three footages generated are 16', 8' and 4'
- Six inputs from the octave bars (keyboard and control scanning).
- Three multiplexed data inputs for addressing the bass selection. These inputs normally come from the outputs of an external memory (negative or positive logic with control inside the chip).
- Eight signal outputs divided by section: three for the solo section (16', 8', 4'), four for the accompaniment section (16' or root, 8' or 3rd, 4' or 5th, 8th/7th according to operating mode), one for the bass.
- Twelve outputs for the matrix scanning.
- Five trigger and key down outputs: KPS (key pressed solo), TDS (trigger decay solo), KPA (key pressed accompaniment), NPA (pitch present in accompaniment outputs), TDB (trigger decay bass) respectively. These outputs, in conjunction with an external time constant, allow the formation of the envelope of the sustain and percussion effects. The duration of the trigger pulses is approximately 9 milliseconds
- One input (reset) to synchronize the device or more than one device (with the same keyboard scanning and using a single contact per key). The reset action, provided by an

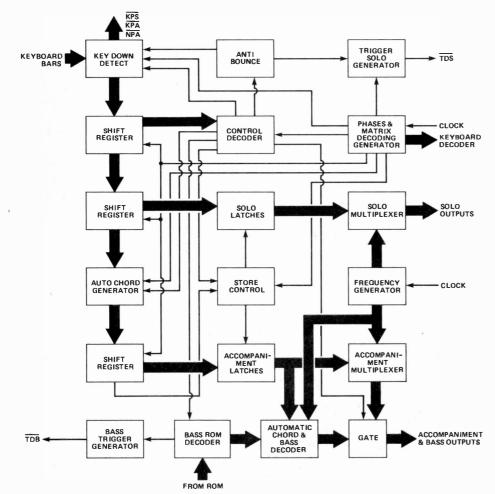


Fig. 1 Block diagram of the IC.

external circuit, is of the power-on reset (high active) type and its duration must be approximately 0.5 milliseconds.

 One TEST pin (in use it must be connected to V<sub>DD</sub>).

Two supply pins.

# **Features**

The main feature of this chip is the possibility of formating the keyboard either with 61 keys (only 'solo' without automatism) or separating it into two sections ('accompaniment + solo') with the possibility of chord and bass automatic in the first section.

● The '61/24 + 37' (17 + 44) control chooses the keyboard operating mode, ie the whole keyboard dedicated to 'solo' or 24 (17) keys dedicated to 'accompaniment' and 37 (44) to 'solo'.

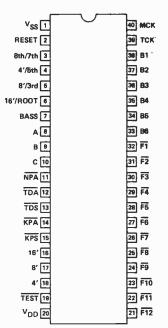
 The 'Man/Auto' control, which operates only in case of 'accompaniment and solo', chooses the manual or the automatic accompaniment.

• The 'Sust OFF/Sust ON' allows the storage of the 'solo' section and handles the whole keyboard or 37 (44) keys depending on the operating mode.

• The 'Latch/Latch' similarly allows the storage of the 'accompaniment'

+ solo' only.

• The '3rd+/3rd-' which operates only in case of 'accompaniment + solo' and 'automatic' changes the automatic chord generated from major to minor or vice versa.



 $\rm v_{SS}$  is the lowest supply voltage  $\rm v_{DD}$  is the highest supply voltage

Fig. 2 Pin connections for the M108/M208.

# MATRIX ORGANISATION (KEYBOARD AND CONTROLS)

M108/208	M108/208 Octave bar inputs								
Matrix outputs	B1	B2	В3	В6 -					
F1	C <sub>1</sub>	C <sub>2</sub>	Ċ3	C <sub>4</sub>	.C²	C <sub>6</sub>			
F2	C <sub>1</sub> #	C₂#	C3#	C₄#	C₅#	7th OFF/7th ON			
F3	D,	$D_{2}$	$D_3$	$D_4$	$D_s$	3rd+/3rd—			
F4	D <sub>1</sub> #	D₂#	D <sub>3</sub> #	D₄#	D₅#	Sust. OFF/Sust. ON			
F5	Ε,	E <sub>2</sub>	E <sub>3</sub>	E <sub>4</sub>	E <sub>s</sub>	Latch/Latch			
F6	F,	$F_{2}$	F <sub>3</sub>	F <sub>4</sub>	F <sub>s</sub>	Man/Auto			
<u>F7</u>	F,#	F <sub>2</sub> #	F <sub>3</sub> #	F₄# .	Fs#	61/24 + 37 (17 + 44)			
F8	G,	$G_2$	G,	G <sub>4</sub>	$G_5$	Antibounce ON/Antibounce OFF			
<del>F</del> 9	G,#	G₂#	G,#	G₄#	G₅#	ROM Low/ROM High			
F10	A,	$A_2$	$A_3$	A <sub>4</sub>	$A_5$				
F11	A1#	A2#	A <sub>3</sub> #	A4#	A <sub>5</sub> #				
F12	В,	В,	В,	B₄	B <sub>s</sub>				

• The '7th OFF/7th ON' adds the seventh to the automatic chord generated.

 The 'Antibounce ON/Antibounce OFF' disables the antibounce circuit

which is usually enabled.

● The 'ROM Low/ROM High' selects between ROMs with return to '1' (Low active) or with return to '0' (High active). Usually the chip is enabled for ROMs with return to '1' (Low active).

# 'Solo' Operation

In this case the chip recognizes the whole keyboard as 'solo' and does not read the controls which concern the 'accompaniment + solo' operation. The chip identifies all the keys pressed and transfers to the outputs of each section the analogue sum of corresponding pitches. The outputs are current generators with average value constant, therefore it is sufficient to connect the pins to one load and send the signals on to the filters.

In the case of 'Sustain OFF' each new key pressed or released is accepted or deleted in a time less than 576 microseconds. In the case of 'Sustain ON' the chip has a different operation according to whether the new key (keys) is pressed or released: each new key pressed is always accepted in a time less than 576 microseconds, whereas each key released is deleted with a delay of 73 milliseconds and only if there are still keys pressed. In fact, if after the 73 milliseconds there are no keys pressed, the last key (or keys) released remains stored until new keys are pressed. In this mode it is possible to have Sustain, with external envelope shaping, for the last keys (or key) released. The pitch

envelope is controlled by a DC signal KPS (any key pressed), and there is also an AC signal TDS (trigger decay solo) which provides a pulse whenever a key is pressed. An antibounce appropriate circuit, inside the chip, solves the problems the associated with keyboard contacts.

# 'Solo + Accompaniment' Operation

In this case the chip identifies the 'accompaniment' on the first 24 (17) keys on the left, and the 'solo' on the remaining 37 (44) keys and reads all the controls which concern the 'accompaniment' section. The 'solo' function is identical to '61 keys' mode, but for the 'accompaniment' section there are two possibilities:

## Manual

The chip identifies which keys are pressed in the 'accompaniment' section, and transfers to the 'accompaniment' outputs the analogue sum of the corresponding pitches. The 'accompaniment' section is fully independent of the 'solo' section and the signals (if there is no 'latch') remain at the output only while the keys are pressed even if there is 'sustain on'.

The 'bass' section gives at the bass output an alternating bass bet-

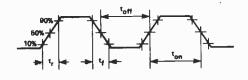


Fig. 3 The input clock waveform.

ween the first on the left and the first on the right of the keys pressed in the 'accompaniment' section; the pitch switching timing is dependent on an external ROM (three bits). The 'accompaniment' control stores the last keys released and the output signals, including the bass output, remain until new keys are pressed. The TDB (trigger decay bass) output gives a pulse corresponding to every output change; there are also two DC signals, KPA (any key pressed accompaniment) and NPA (pitches in output accompaniment) relative only to the 'accompaniment' section. The first of these signals (analogous to KPS) concerns the keyboard and does not consider the 'latch' condition. The second on the contrary concerns the 'accompaniment' output and considers the 'latch' condition.

#### **Automatic**

The chip recognizes in the 'accompaniment' section only the first on the left of the keys pressed and, according to the setting of the following controls, produces a major or minor chord with or without seventh only the 4' footage but with separated outputs for root, third, fifth and eighth (or seventh if the chord is with seventh).

The bass section gives the bass arpeggio among root, third, fourth, fifth, sixth, seventh and eighth with pitch switching dependent on an external ROM (3 bits). In automatic mode the two octaves of the 'accompaniment' section inside the chip are connected in parallel both for the chord and for the bass; therefore by pressing any one of the two keys of the same note the chip generates the same chord.

The 'latch' control stores the major chord and the bass pitches (until new keys are pressed); the modification of the chord stored (from major to minor, addition of seventh) is always possible by operating the proper controls: by releasing these controls the chord becomes major again. It is possible to delete the stored pitches both in manual and in 'automatic' mode by a latch control signal.

Once again there are KPA, NPA, and TDB information; however the TDB pulse, which normally appears at each arrival of the ROM codes, does not appear if there are no pitches in the 'accompaniment' (and bass) outputs or, in the case of alternate bass (in manual mode) if the codes indicate conditions of indifference.

Parar	meter	Test conditions	Min.	Тур.	Max.	Unit
REC	OMMENDED OPERA	TING CONDITIONS			_	
V <sub>DD</sub>	Highest supply voltage		11.4	12	12.6	V

**STATIC ELECTRICAL CHARACTERISTICS** (Positive logic,  $V_{DD} = +10$  to +14 V,  $V_{SS} = 0$  V,  $T_{amb} = 0$  to 50 °C unless otherwise specified)

#### **INPUT SIGNALS**

V <sub>II</sub>	Input high voltage	Note 1	V <sub>DD</sub> —1	V <sub>oo</sub>	٧
		Note 2	4	18	V
		Note 3	V <sub>DD</sub> -2	V <sub>DD</sub>	V _
Vit	Input low voltage	Note 1	Vss	V <sub>ss</sub> + 1	٧
		Note 2	V <sub>ss</sub>	V <sub>ss</sub> + 0.6	V
		Note 3	V <sub>ss</sub>	V <sub>ss</sub> + 2	V
Iu	Input leakage current	V <sub>1</sub> = 14 V T <sub>amb</sub> = 25°C		10	μА

#### **LOGIC SIGNAL OUTPUTS**

R <sub>ON</sub>	Output resistance with			300	500	ohms
	respect to V <sub>ss</sub>					
R <sub>ON</sub>	Output resistance with					
	respect to V <sub>DD</sub>	$V_{OUT} = V_{DD} - 1$		15	25	kilohms
		(driver off)				
V <sub>OH</sub>	Output high voltage		V <sub>DO</sub> -0.4		$V_{DD}$	V
Vol	Output low voltage			V <sub>ss</sub> + 0.2	V <sub>ss</sub> + 0.4	V

#### **POWER DISSIPATION**

	TILK DISSILITION					
I <sub>DD</sub>	Supply current	$T_{amb} = 25$ °C	30	45	mA	

#### ANALOGUE SIGNAL OUTPUTS (the external load must be connected to V<sub>DD</sub>/2)

ОН	Output current with	Outputs loaded with 1k0	35	50	70	μА
	respect to V <sub>DD</sub> /2	resistor versus V <sub>DD</sub> /2			_	
loL	Output current with	Outputs loaded with 1k0	-35	<b>—50</b>	-70	μА
	respect to V <sub>ss</sub>	resistor versus V <sub>DO</sub> /2				ļ
Note	1: Refers only to the clock	inputs				
Note	2: Refers only to the inputs	from the external memory				
Note	3: Refers only to the reset i	nput.				

#### **DYNAMIC ELECTRICAL CHARACTERISTICS**

#### MASTER CLOCK INPUT

fi		Input clock frequency			1000.12		kHz
t,	, t <sub>í</sub>	Input clock rise and fall	1000.12 kHz			40	n\$
		time 10% to 90%	_				
to	n, t <sub>off</sub>	Input clock ON and OFF			-		
		times	1000 kHz	1	500		nS

#### TOP OCTAVE SYNTHESISER CLOCK INPUT

fi	Input clock frequency		100	1000.12	2500	kHz
t, t	Input clock rise and fall	1000.12 kHz			40	nS
	times 10% to 90%					
t <sub>on</sub> , t <sub>o</sub>	# Input clock ON and OFF					
	times	2000 kHz		250		nS

#### **TDS** and **TDB** OUTPUTS

ton	Pulse duration	1000 kHz	9.216	mS
t,, t	Outputs rise and fall times	1000 kHz	100	nS
	10% to 90%			

## FEATURE: Data Sheet

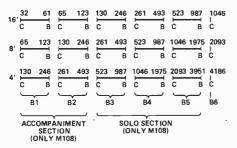


Fig. 4 The frequency range of each octave (16', 8', 4' footages).

#### **ABSOLUTE MAXIMUM RATINGS**

V <sub>DD</sub> Source supply voltage with respect to V <sub>ss</sub> (GND) pin voltage	-0.3  to  +20  V
V, Input voltage with respect to V, loutput current at any pin Top Operating temperature	-0.3 to +20 V 3 mA 0 to 50°C

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other condition above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

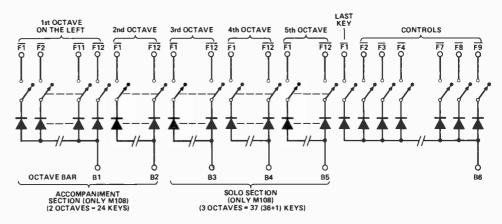


Fig. 5 Connection of the keyboard and control switches.

NOTE: THE SWITCH 'OPEN' CORRESPONDS TO 'KEY NOT PRESSED' OR 'CONTROL IN THE FIRST CONDITION' (SEE THE TABLE 'MATRIX ORGANISATION')

#### **BASS TRUTH TABLES**

External Memory Code			Alternate Bass Outpu (Manual mode)	
С	В	Α	(Automatic mode)	(
1	1	1	No change	No change
i	1	0	Root	1st on the left
1	0	1	3rd	
i	Ō	0	4th	
0	1	1 1	5th	1st on the right
Ō	1	0	6th	
0	0	1	7th	
Ó	0	0	8th	

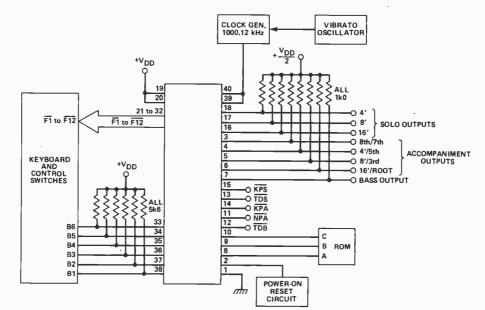


Fig. 6 A typical application.

ETI

## Play the AMBIT numbers game ......

The long awaited implementation of on-line order processing is with us at last, and whilst this means that orders for in-stock items can now be processed more efficiently, it also means that orders should be submitted using stock codes for best results. Our current catalogue (75p) includes all order codes (watch out for the new expanded Spring edition), but here's an abstract from some of the more popular lines to use as a quick reference.

Remember that you can also access our catalogue via REWSHOP on REWTEL, which now includes on-line current price and delivery information. You need a 300 baud MODEM and RS232 terminal, (various suitable configurations based on popular micros have been published in recent past issues of Radio and Electronics World)

Prices shown here exclude VAT, and the P&P charge is currently 60p per order (unless otherwise indicated). Remember that our telesales service operates with human beings (not 'dumb' machines) from 8am to 7pm (and frequently later) Monday to Friday, and 9am to 8pm on Saturdays. REWSHOP operates 24 hours a day, 365 days a year with full price and delivery information.

World).	ALWAYS US	F STOCK NUN	BERS WHEN O	RDERING PLFA		
4000 CMOS Type Stock No. Price	Type Stock No. Price To	ype Stock No. Price	Type Stock No. Price	Type Stock No. Price	Type Stock No. Puce	Type Stack No Price
Type Stock No Price 4704 23 04703 4.48		4C914 29:74914 1.10 4C918 29:74918 1.30	UA758 61 00758 2.35 TBA820M 61 00820 0.78	HA11223 61-11223 2.15 HA11225 61-11225 1.45	2SK134 60 00134 3.10 2SK135 60 00135 4.25	6V8 12 00688 0.10 8V2 12 00828 0.10
4000UB 22 04000 0.11 4705 23 04705 4.24 4001 23 04706 0.11 4706 23 04706 4.50		4C925 29 74925 8.00 4C928 29 74926 4.00	TDA 1028 61-01028 2.11 TDA 1029 61 01029 2.11	HA12002 61-12002 1.22 HA12017 61-12017 0.80	25K227 - 60 00227 3.55 2SD753 - 58-03753 2.34	9V1 12 00918 0.10 10 12 01008 0.10
4002 23 04002 0.12 4720 23 04720 4.00	74LS192 31 74192 0.39 7	2927 29 74927 6.00	ZNA1034 61 01034 2.10	HA12402 61-12402 1.95	SMALL SIGNAL RF	11 12 01108 0.10
4007 23 04007 0.13 4723 23 04723 0.95 4008 23 04008 0.50 4724 23 04724 0.95	74LS193 31 74193 0.39 74LS194 31 74194 0.39	74HCXX	LM1035 61 01034 2.10 TDA1054M 61 01054 1.45	HA12411 61-12411 1.20 HA12412 61-12412 1.55	BFY50 58 06500 0.22	12 12 01208 0.10 15 12 01508 0.10
4009UB 22 04009 0.25 4725 23 04725 2.24 4011 23 04011 0.11 40014 23-40014 0.54		4HC00 30 07400 0.56	TOA1062 61-01062 1.95 TOA1072 61-01072 2.69	LF13741 61 13741 0.33 MK50366 61 50366 3.35	BF241 58 06241 0.1B BF273 58 06273 0.1B	18 12:01808 0.10 22 12:02208 0.10
40110B 23 04011 0.11 40085 23 40085 0.99 4012 23 04012 0.14 40098 23 40098 0.54	7415721 31 74727 0.47	4HC02 30 07402 0.51 4HC04 30 07404 0.88	TDA1074A 61 01074 5.04 TDA1083 61 01083 1.95	MK50375 61-50375 3.85 MM53200 61-53200 3.90	BF274 58 06274 0.20 BF362 58 06362 0.49	27 12:02708 0.10 33 12:03308 0.10
4013 23 04013 0.25 40106 23 40106 0.69	7415240 37.74240 0.60	4HC10 30.03410 0.58 4HC20 30.07420 0.56	TDA 1090 61 01090 3.05 HA1137 61-12411 1.20	PRESCALER	8F440 58 06440 0.21 8F441 58 06441 0.21	
4016 23 04016 0.22 40161 23 40161 1.05	7418242 31 74242 0.55	4HC86 30 07486 0.74 4HC132 30 74132 1.26	HA1196 61-01196 2.00	U264 61-02640 1.27	8f 479 58 06479 0.86 -8f 6795 -58 06679 -0.55	SCRS- TRIACS BRY55-100 52 55 100 0.50
4017 23 04017 0.40 40162 23 40162 1.05 4020 23 04020 0.55 40163 23 40163 1.05	7415243 31 74243 0.55	4HC266 30 74266 0.81 4HC4002 30 04002 0.56	HA1197 61 01197 1.00 TDA1220 61 01220 1.40	U265 61 02650 3.18 U266 61 02660 2.43	-BFR91 58 07091 -1.33	C10601 52 00106 0.70
4021 23.04021 0.55 40174 23.40174 1.05 4022 23.04022 0.55 40175 23.40175 1.05	7415245 3774245 1.00 7.	4HC4075 30 04075 0.56	LM1303 61 01303 0.99 LM1307 61 01307 1.55	11C90DC 61 01190 12.95 MSL2312R 61-02312 3.94	8FT95 58-10095 0.99 8FW92 58-08092 0.60	C122D1 52 00122 1.45 2N6403 52 06403 2.22
4023 23 04023 0.15 40192 23 40192 1.08	741 5253 31 74253 0 36	4HC242 30 74242 2.00 4HC243 30-74243 2.00	MC1310P 61 01310 1.90 MC1330 61 01330 1.20	MSL2318 61-02318 3.64	BFY90 58 09090 0.90 NE21936 58 21936 5.00	2N6073A 58 06073 0.98
4025 23 04025 0.15 40195 23 40195 1.08	74LS258 31 74258 0.36	4HC74 30 07474 0.74 4HC109 30 74109 0.68	MC1350 6101350 1.20	MSM5523 61 05523 11.30 MSM5524 61 05524 11.30	ZTX323 58 06232 0.60 2N2369A 58 02369 0.38	BALANCED MIXERS
4027 23 04027 0.26 4028 23 04028 0.50	74LS260 31 74260 0.26	4HC175 30 74175 1.08 4HC373 30 74373 2.40	HA1370 61 11370 1.90 HA1388 61 01388 2.75	MSM5525 61-05526 7.85 MSM5526 61-05526 7.85	RF POWER	SBL1 12 00003 4.68
4029 23 04029 0.55 74LS00 31-07400 0.11 4035 23 04035 0.67 74LS01 31 07401 0.11	74LS200 31 74200 0.20 7.	4HC374 30 74374 2.40	LM1458N 61-14580 0.45 MC1496P 61-01496 1.25	MSM55271 6155271 9.75 ICM7106CP 6107106 9.55	BFW16A 58 08016 0.65	SBL1-8 12 00013 5.00 SBL1-X 12 00023 6.33
4040 23 04040 0.68 74LS02 31-07402 0.11	7415279 37 74279 0.35	4HC533 30 74533 2.40 4HC534 30 74534 2.40	St 1610 61 01610 1.92 St 1611 61 01611 1.60	ICM7107CP 61-07107 9.55 LC7137 61-07137 7.50	MRF237 58:14237 3.20 MRF238 58:14238 10.50	SRA1 12 00033 10.80 SRA1-1 12 00043 12.77
4043 23 04043 0.60 74LS04 31 07404 0.14	741 5 200 31 74 207 0 40 /4	4HC165 30 74165 1.96 4HC173 30 74173 1.20	SL1612 61-01612 1.60 SL1613 61-01613 2.06	ICM 72168 61-72161 19.50	MRF245 58-14245 40.00 MRF449A 58-14449 16.50	SRA1H 12 00053 16.34
4046 23 04046 0.60 74LS08 31 07408 0.14	74LS298 31 74298 0.54	4HC160 30-74160 1.33 4HC161 30-74161 1.33	SL1620 61-01620 2.50	ICM7216C 61 72162 19.95 ICM7217A 61-07217 9.50	MRF472 58-14472 1.25	SRA3 12:00063 15:35
404908 22 04049 0.24 74LS09 31 07409 0.14 4050 23 04050 0.24 74LS10 31 07410 0.14	74LS366 31 74366 0.40	4HC162 30 74162 1.33 4HC163 30 74163 1.33	SL1621 61:01621 2:50 SL1623 61:01623 2:44	SP8629 61 08629 3.85 SP8647 61 08647 6.00	MRF475 58-14475 4.60 MRF629 58-14629 4.99	TEDS
4051 23 04051 0.55 74LS11 31 07411 0.14 4052 23 04052 0.55 74LS12 31 07412 0.14	74LS367 3174367 0.30 7	4HC4538 30 74538 2.10	SL1625 61 01625 2.50 SL1626 (SL6270)	SP8793 61-08793 7.70 95H90 61-09590 7.80	PT8811 58-18811 9.50 TP2320 58-12320 10.24	3mm round types
4053 23 04053 0.55 74LS13 31-07413 0.32	7418373 31-74373 0.72	4HC85 30 74280 2.95 4HC280 30 74280 2.95	SL1630 61-01630 1,62 SL1640 61-01640 2,25	HD10551 61-10551 2.45 HA12009 61-12009 8.00	VN66AF 60 02066 0.95 2TX3866 58 03866 0.45	CQX25 Red/Ctr 15 20250 0.15 V178P Red 15:01780 0.15
4066 23 04066 0.30 74LS15 31-07415 0.14	74LS375 31 74375 0.31 7	4HC42 30 07442 1.00 4HC138 30 74138 1.08	SL 1641 61 01641 2.25 MC1648 61-01648 3.25	HD44015 61 44015 4.45	2N3866 58-13866 1.20	CQX26 GriCir 15 20260 0.16 V179P Green 15:01790 0.16
4068 23 04068 0.16 74LS20 31 07420 0.14 4069UB 22 04069 0.14 74LS21 31 07421 0.14	741S378 31 74378 0.44	4HC139 30 74139 1.08 4HC4514 30 04514 3.40	TDA2002 61-02002 1.25	HD44752 61 44752 8.00 MC145151P 61-14151 0.00	SMATL SIGNAL FET	CQX27 Yel/Cir 15 20270 0.18 V180P Yellow 15 01800 0.18
4070 23 04070 0.16 74LS22 31 07422 0.14 4071 23 04071 0.16 74LS26 31 07426 0.14	7415379 31:74379 0.44 7.	4HC4543 30 04543 2.75	ULN2240 61-02240 3.25 ULN2242 61-01090 3.05	MC145152P 61-14151 0.60 MC145156P 61-14156 4.60	BF256 59.00256 0.30 BF960 60.06960 0.99	CGX41A Or/Rd 15-20410 0.19
4072 23 04072 0.16 74LS27 31 07427 0.30	74LS386 31 74386 0.27 7	4HC157 30 74157 0.92 4HC158 30 74158 0.90	ULN2283 61.02283 1.00 CA3080 61.03080 0.70	SMALL SIGNAL AUDIO	BF961 60 06961 0.70 BF963 60 06963 0.99	Standard 5mm DIA LEDs CQY4DL Red 15-10400 0.12
4075 23 04075 0.16 74LS30 31 07430 0.14	74LS393 31.74393 0.4B	4HC257 30 74257 0.90	CA3089 61-03089 1.84	BC182 58 00182 0.10	J310 59 02310 0.69	COY72L Green 15-10720 0.15
4076 23 04076 0.55 74LS32 31 07432 0.14 4077 23 04077 0.18 74LS33 31 07433 0.14	74LS398 31 74398 0.80 74LS399 31 74399 0.65	LINEAR ICs	CA3130E 61 31300 0.00	8C212 58 00212 0.18 BC237 58 00237 0.08	J176 59 02176 0.65 25K55 59 01055 0.32	CQY74L Yellow/5-10740 0.15 CQX38A Drird 15-20380 0.20
4078 23.04078 0.18 74LS37 31.07437 0.18 4081 23.04081 0.18 74LS38 31.07438 0.14		M1DCN 61 00010 3.88 4F10 61 00011 5.05	CA3130T 6131301 0.90 CA3140E 6131400 0.46	BC238 58 00238 0.08	2SK168 59 01168 0.37 3SK45 60 04045 0.49	COX398 Otrict 15-20390 0.29 Rectangular 2.5 = 5mm LEDs
4082 23 04082 0.18 74LS40 31 07440 0.18		149 61 00149 1.86 NA234 61 02340 8.50	CA3189E 61-03189 2.20 CA3240E 61-32400 1.27	BC239 58 00239 0.08 BC307 58 00307 0.08	3\$K51 60 04051 0.54 3\$K60 60 04060 0.58	CQX10 Red 15-20100 0.17
4099 23 04099 0.80 74LS47 31 07447 0.15	0.	2378 61-00237 1.28	MC3357 61 03357 2.85 MC3359 (see ULN3859)	BC308 58 00308 0.00 BC309 58 00309 0.00	3SK88 60 04088 0.99	CQX11 Green 15 20110 0.20 CQX12 Yellow 15 20150 0.20
4502 2304502 0.60 74LS49 31-07449 0.80	74C02 29 07402 0.35 U	247B 61 00247 1.28 1257B 61 00257 1.28	ULN3859 61 03859 2.95	8C327 58 00327 0.13 8C337 58 00337 0.13	40673 see 3SK51 40822 see 3SK51	CQX40 Or/Red 15-20400 0.24
4503 23 04503 0.50 74LS51 31.07451 0.14 4506 23 04506 0.70 74LS54 31 07454 0.14	74C0B 29 07408 0.35 U	2678	KM3701 61-03701 85.53 KM3702 61-03702 74.84	BC413 58 00413 0.10	40823 60 03823 0.65 3SK112 60 04112 4.80	Infra-Red LEOs
4507 23 04507 0.37 74LS55 31 07455 0.14 4508 23 04508 1.50 74LS74 31 07474 0.21		M301AN <i>61 03011</i> 0.27 M308H <i>61 03080</i> 0.70	LM3900 61 39000 0.60 LM3909N 61-39090 0.68	BC414 58 00414 0.11 BC415 58 00415 0.10	DIODES	CQY99 Emit 15-10990 0.56 BPW41 Det 15-30410 1.51
4510 23 04510 0.55 74LS75 31 07475 0.21	74C20 29:07420 0.35 LI	M308CN 61-03081 0.65 M324 61-03240 0.45	LM3914N 61-03914 2:80 LM3915N 61-03915 2:80	BC416 58 00416 0.11 8C546 58 00546 0.12	AA112 12 01126 0.25	
4512 23 04512 0.55 74LS78 31.07478 0.19	74C32 29 07432 0.35 LI	M339N 61-03390 0.66 F347 61 00347 1.60	KB4400 61 04400 0.80 KB4412 61 04412 1.95	8C550 58 00550 0.12 8C556 58 00556 0.12	BA379 12-03797 0.35	I R Optocoupler BNY37 15 40370 1.44
4515 23 04515 1.25 74LS85 31-07485 0.44	74C48 29 07448 1.50 LI	M348 <i>61-03480</i> 0.90	KB4413 61 04413 1.95	BC560 58 00560 0.12 BC639 58 00639 0.22	ND4981 7E 12-49817 0.51 0A91 12 00916 0.07	DN137 1340370 1.44
4516 23.04516 0.60 741586 31-07486 0.15 4518 23.04518 0.35 741590 31-07490 0.24	74C74 29 07474 0.75 LF	F351 61 03510 0.49 F353 61 03530 0.76	KB4420B 61 04420 1.09	BC640 58 00640 0.22 MPSA13 58 04013 0.30	0A47 12:00476 0.10 PW02 12:62006 0.75	FLAT DIFFUSED
4520 23.04520 0.60 74LS91 31.07491 0.36 4521 23.04521 1.30 74LS92 31.07492 0.32		M380N 61 00380 1.00 M381 61 00381 1.81	TOA4420 61-14420 2.65 TOA4421 61 14421 2.65	MPSA63 58 04063 0.30	S04 12:24006 0.45 W005 12:10506 0.28	V320 15 03200 0.17 V321 15 03210 0.26
4522 23 04522 0.89 74LS93 31 07493 0.24	74C85 29 07485 1,30 LF	M382 61 00 382 1.81 N419CE 61 00 419 1.98	KB4423 61 04423 2.30 KB4424 61 04424 1.65	ZTX108 58 01108 0.10 ZTX212 58 01212 0.10	1N4001 12 40016 0.08 1N4002 12 40026 0.07	V322 15-03220 0.20 V323 15-03230 0.20
4527 23 04527 0.80 74LS107 31 74107 0.31	74C89 29 07489 3.60 Z	NA423 61 04230 1.00	KB4430 61 04430 2.30 KB4431 61 04431 1.95	2TX653 58 01653 0.20 2TX753 58 01753 0.20	1N4004 12,40046 0.07	V330 15 03300 0.17
4528 23 04528 0.65 74(S109 31 74109 0.25 4529 23 04529 0.70 74(S112 31 74112 0.21	74C93 29 07493 1.05 Zi	N426E/8 61-04260 3.00	KB4432 61 04432 1.95 KB4433 61 04433 1.52	2N2904 58 02904 0.25 2N2905 58 02905 0.25	1N4148 12-41486 0.05 1N5404 12-54046 0.16	V332 15 03320 0.20
4531 23 04531 0.65 74LS113 31 74113 0.21 4532 23 04532 0.80 74LS114 31 74114 0.21		N427EI8 61 04270 6.28 N428EI8 61 04280 4.78	KB4436 61 04436 2.53	2N3905 58 03905 0.10 2S8646A 58 03646 0.30	1N6263 12 62637 0.62	V333 15 03330 0.20 V340 15 03400 0.17
4534 23 04534 4.00 74LS122 31 74122 0.27 4536 23 04536 2.50 74LS123 31 74123 0.36		N429E/8 61 04290 2.10 N432CJ10 61 04320 28.09	KB4437 61 04437 1.75 KB4438 61 04438 2.22	2S8648A 58:03648 0.40	VARICAPS	V341 15:03410 0.26 V342 15:03420 0.20
4538 23 04538 0.85 74LS125 31 74125 0.27	74C157 29 74157 2.10 21	N433CJ10 61 04330 22.59 N440J 61 04400 0.80	K84441 61 04441 1.35 K84445 61 04445 1.29	2S0666A 58 03666 0.30 2S0668A 58 03668 0.40	BA102 12:01025 0.30 BA121 12:01215 0.30	V343 15 03430 0.20 V510 15 05100 0.17
4539 23 04539 0.80 74LS126 31 74126 0.27 4543 23 04543 0.80 74LS132 31 74132 0.27	74C1610 40161CM Z	N450E 61 04500 7.61	KB4446 61 04446 2.75 KB4448 61 04448 1.65	2SA872A 58-02872 0.19 2SA1084E 58 01084 0.25	981058 12.01055 0.30 881098 12.01095 0.27	V511 15 05110 0.26
4549 23 04549 3.50 74LS133 31 74133 0.24 4553 23 04553 2 70 74LS136 31 74136 0.20	74C163D 40163CM N	E542 61:05420 1.20 E544 61:00544 1.80	NESO44 61-05044 2.26	2SA1085E 58 01085 0.25 2SC1775A 58 01775 0.19	BB204B 12 02045 0.36 BB212 12 02125 1.95	V513 15 05130 0.20
4554 23 04554 1.20 74LS138 31 74138 0,30 4555 23 04555 0.35 74LS139 31 74139 0.30		E555N 61 05550 0.20 E556N 61 05560 0.50	MC5229 61 05229 9.60 NE5532 61 55320 1.85	2\$C2546E 58.02546 0.24	1TT210 12 02105 0.30 MVAM115 see KV1236	V520 15 05200 0.17 V521 15 05210 0.26
4556 23.04556 0.40 74.5151 31.74151 0.30 4557 23.04557 2.30 74.5153 31.74153 0.34	74C173 4076C SI	1.560C 61.05600 1.98 1.562 61.00562 4.05	KM5624 61 05624 4.35 SD6000 61 06000 3.75	2SC2547E 58-02547 0.24	MVAM125 see KV1225	V522 15 05220 0.20 V523 15 05230 0.20
4558 23 04558 0.80 74LS155 31 74155 0.30	74C1750 40175CM N	E564 61 00564 4.29 E565 61 00565 1.00	S16270 61-06270 2.03 S16310 61-06310 2.45	AUDIO PDWER 80139 58-15139 0.29	KV1210 12:12105 2.45 KV1211 see XV1236	V530 15 05300 0.17 V531 15 05310 0.28
4559 23 04559 3.50 74LS156 31 74156 0.33 4560 23 04560 2.50 74LS157 31 74157 0.27	74C193D 40193CM N	£566 <i>61 00566</i> <b>1.30</b>	SL6440 61 06440 3.38	BD140 58-15140 0.31 BD165 58-15165 0.46	KV1225 12-12255 2.75 KV1235 12-12355 2.75	V532 15-05320 0.20
4561 23 04561 1.00 74LS158 31 74158 0.27 4562 23 04562 2.50 74LS160 31 74160 0.34	740200 29 74200 6.50 N	IE567 61 00567 1.30 IE570N 61 00570 3.85	\$1,6600 61,06600 3.75 \$A\$5610 61,06610 1.48	B0166 58-15166 0.48	KV1236 12-12365 2.55 KV1310 12-13105 0.40	V540 15-05200 0.17
4566 23 04566 1.20 74LS161 31 74161 0.36 4568 23 04568 1 45 74LS162 31 74162 0.36	74C221 29 74221 1.55 SI	1624 61 00624 3.28 A709HC 61 07090 0.64	SL6640 61 06640 2.75 SL6690 61 06690 3.75	80179 58-15179 0.38 80180 58-15180 0.41	KV1310 12-13205 0.40	V541 15 05410 0.26 V542 15 05420 0.20
4569 23:04569 1.70 74LS163 31:74163 0.36	740902 29 74902 0.55 ui	A709PC 61 07091 0.36 A710HC 61 07100 0.64	SL6700 61 06700 2.75 SAS6710 61 06710 1.48	TIP31A 58-15031 0.35 TIP32A 58 15032 0.35	ŽENER DIDDES	V543 15-05430 0.20 V550 15-05500 0.17
4580 23 04580 3.25 74LS165 31 74165 0.60	74C904 29 74904 0.55 UI	A71DPC 6107101 0.59	LS7225 61 07225 3.65 ICM7555 61 75550 0.80	MJ2955 58 12955 0.68 2N3055 58 13099 0.58	BZYB8C 400mW. 5%. 2V7 IZ 00278 0.10	V551 15-05510 0.26 V552 15-05520 0.20
4581 23 04581 1.40 74 S166 31 74166 0.58 4582 23 04582 0.70 74 S168 31 74168 0.69	74C906 29 74906 0.55 us	A711CN 61:07110 0.85 A733CN 61:07330 0.89	CL8038CC 61 08038 4.50	2S8720 58 15720 0.60 2SD760 58 17800 0.60	3V3 12-00338 0.10 3V9 12-00398 0.10	V553 15 05530 0.20
4583 23.04583 0.80 14LS170 31.74170 0.63 4584 23.04584 0.27 74LS173 31.74173 0.47	740908 29 74908 1 10 ui	A741CH 61074IB 0.66 A741CN 61074II 0.20	MSL9362 61 09362 1.75 MSL9363 61 09363 1.75	2SJ49 60 01049 3.10	497 12 004 78 0.10 5V1 12 005 18 0.10	TRI COLDUR
4585 23 04585 0.45 74LS174 31 74174 0.37 4702 23 04702 4.50 74LS175 31 74175 0.40		A747CN 6102470 0.70 A748CN 6104780 0.30	K10170 61 10170 1.87 TK10321 61 10321 2.75	2SJ83 60 01083 3.55	5V6 12 00568 0.10	V518 15 05180 0.60

#### Ambit international

200 North Service Road Brentwood, Essex CM14 4SG Telecom directory: Consumer 0277-230909 Industrial 0277-231616 Telex 995194 AMBIT G DATEL 0277-232628









TELEPHONE SALES 8 am - 7 pm MON - FRI 9 am - 6 pm SAT

#### E.T.I. KITS

#### ALL KITS INCLUDE PCBs

Full kits include printed circuit boards, components, hardware, 1.C. sockets, cases etc. unless stated (not batteries). If you do not have the issue of E.T.I. which

includes the project — you will need to order the instruction reprint at an extra 45p each. PCBs included. Reprints available separately 45p each + p6rp 45p.

LOGIC PROBE March 83 less case ALARM MODULE March 83	£24.57. WA
ZX ADC Jan 83	
SPECTRACOLUMN Dec 82. Less cas	
***************************************	
PLAYMATE Augu/Sept 82, less of	ptional foot LED
pedal + mains unit	F39 99 Stm
Case extra	£28.42 GUI
DUAL LOGIC PROBE Sept 82	£14.99 DRI
<b>AUTO VOLUME CONTROL Sept 82£4</b>	28 less case   ENC
INSULATION TESTER May 82	£17.57 SOL
AUTORANGING CAPACITANCE	METER
Mar/April 82	
HIGH QUALITY PHONO AMPLIFIE	RS Feb 82. 4IN
Less case	
MOVING COIL STAGE	MU
MOVING MAGNET STAGE	£19.75 ME
DECT CONTROL 5 1 00	£19.66 ULT
PEST CONTROL Feb 82	
GUITAR TUNER Jan 82	
COMPONENT TESTER Dec 81	
CAR ALARM Nov 81	£19.77 £49.

SOUND BENDER Oct 81	£22.84
WATCHDOG SECURITY ALARM Aug 81	
RECHARGEABLE BATTERY extra	
HECHANGEABLE BATTERY EXTRA	£19.96
HANDCLAP SYNTHESISER Aug 81	£32.98
WAH PHASE June 81. Less pedal	£14.78
LED JEWELLERY June 81. Cross	€2.98
GUITAR NOTE EXPANDER April 81	£17.98
DRUM MACHINE April 81	£85.97
ENGINEERS STETHOSCOPE Mar 81	£20.98
SOUND PRESSURE LEVEL METER Feb 8	1
	££43.98
INFRA RED ALARM Feb 81	
4 INPUT MIXER Dec 80	F21.74
MUSICAL DOORBELL Dec 80	£12.77
	FB 58
<b>ULTRASONIC BURGLAR ALARM Aug 80</b>	
CAPACITANCE METER Aug 80	F77 28
	. £11.98
CLICK ELIMINATOR And 79 687 70 Oct	

#### MORE KITS - SIMILAR STYLE TO ETI

Instructions included (separately 45p each)
Please quote ref. no. when ordering

01	SEAT BELT REMINDER	f4 18
02	ZX TAPE CONTROL	£6.93
	3 CHANNEL SOUND TO LIGHT	
	WEIRD SOUND EFFECTS GEN	
		C5.98
Q5	IN SITU TRANSISTOR TESTER	£8.98
0.6	ELECTRONIC DICE	£5.71
Q7	DIGITAL CAPACITANCE METER	£21.82
O8	CABLE TRACKER	£10.43
	SIGNAL TRACER	£4.31
Q10	CONTINUITY CHECKER	£5.96
Q11	FUZZBOX	£11.43

3	Q12 METRONOME	£12.98
3	Q13 ZX INTERFACE BOARD	£11.78
	Q14 DRUM SYNTHESIZER	.C21.82
t	Q15 TELEPHONE BELL REPEATER	13.98
3	Q16 ECHO REVERB	£34.43
3	CASE extra	£3.76
1	Q17 MEMORY BANK-MINI SYNTH	£30.43
	Q18 MASTHEAD AMPLIFIER	.£14.98
3	Q19 GUITAR PRE AMP	£6.98
1	CASE extra	£2.29
3	020 ULTRASOUND BURGLAR ALARM.	€20.43

#### **MAGENTA ELECTRONICS LTD**

EB26, 135 HUNTER ST., BURTON-ON-TRENT, STAFFS DE14 2ST 0283 65435. MON-FRI 9-5. MAIL ORDER ONLY

ADD 45p P&P TO ALL ORDERS

ACCESS and BARCLAYCARD (VISA) ORDERS ACCEPTED BY PHONE OR POST, SAE ALL ENQUIRIES Prices inc. VAT
OFFICIAL ORDERS WELCOME OVERSEAS
Payment must be in sterling, IRISM REPUBLIC
and BFPO — UK PRICES. EUROPE — UK
PRICES + 10%. ELSEWHERE — Write for Quote

## **MONITORS**





## HIGH RESOLUTION ~ AND LOW COST!

Either cased or open frames to OEM's. The specification is right, the price is even better.

Phone or write to our Sales Dept for immediate action and prices.

**CROFTON ELECTRONICS LTD** 

35, Grosvenor Road, Twickenham, Middx, TW1 4AD. Telephone: 01-891 1923/1513 Telex: 295093 CROFTN G

July issue on sale at your newsagent from 10th June Place your order now!



## ZX81 HIGH RESOLUTION GRAPHICS BOARD

User-definable, high resolution graphics for the Sinclair ZX81 computer — without fuss! This is a simple add-on PCB that plugs into the ZX81 ROM socket; no modifications to the computer hardware are needed in this project! The ZX HRG is completely software controlled and allows you to program high resolution graphic characters for, say, a Space Invader game, graph plotting or anything else.

Software control allows the high resolution characters, once set up, to be saved on cassette then loaded and re-used at any time, and switching between either HRG user-graphics or the standard Sinclair character set is easy, under software control. Any single element of an 8x8-pixel character can be individually controlled, giving a screen resolution of 256x176, allowing fine detail graphics programming.

The ZX HRG Board is the first half of a Sinclair Graphics Package. The second project is a user-programmable joystick controller — the first of its kind! Unlike all others it can be instructed to operate with any commercially available games programme, and will appear in the August issue of Hobby Electronics. A slightly different version for the Sinclair Spectrum will also be out shortly.

Although these articles are being prepared for the next issue, circumstances may alter the final content.

## TOROIDALS

The toroidal transformer is now accepted as the standard in industry, overtaking the obsolete laminated type. Industry has been quick to recognise the advantages toroidals offer in size, weight, lower radiated field and, thanks to I.L.P., PRICE.

Our large standard range is complemented by our SPECIAL DESIGN section which can offer a prototype service within 7 DAYS together with a short lead time on quantity orders which can be programmed to your requirements with no price penalty.

\*Gold service available.
21 days manufacture for urgent deliveries.

\*Orders despatched within 7 days of receipt for single or small quantity orders.

\*5 year no quibble guarantee.



ТҮРЕ	SERIES S	ECONDARY Volts	RMS Current	PRICE	TYPE	SERIES :	SECONDARY Volts	RMS Current	PRICE	TYPE	SERIES No	SECONDARY Volts	RMS Current	PRIČE
NEV 15 vA 62 x 34mm 0.35Kg Regulation 19%	0x010 0x011 0x012 0x013 0x014 0x015 0x016 0x017	NEW\\ 6+6 9+9 12+12 15+15 18+18 22+22 25+25 30+30 in AB	1.25 0.83 0.63 0.50 0.42 0.34 0.30 0.25	\$5.12 + pape078 + VATEO 89 TOTAL 26.79 stic)	<b>120</b> VA 90 x 40mm 1.2Kg Regulation 11%	4x010 4x011 4x012 4x013 4x014 4x015 4x016 4x017 4x018 4x028 4x029 4x030	6+6 9+9 12+12 15+15 18+18 22+22 25+25 30+30 35+35 110 220 240	10.00 6.66 5.00 4.00 3.33 2.72 2.40 2.00 1.71 1.09 0.54 0.50	£7.42 + p&p£1.72 + VAT£1.37 TOTAL£10.51	300 VA 110 x 50mm 2.6Kg Regulation 6%	7x015	15+15 18+18 22+22 25+25 30+30 35+35 40+40 45+45 50+50 110 220 240	10.00 8 33 6.82 6.00 5.00 4.28 3.75 3.33 3.00 2.72 1.36 1.25	£10.88 + pā p£ 05 + VATĒL 94 TOTAL £14 87
30 vA 70 x 30mm 0.45Kg Regulation 18% 50 vA 80 x 35mm 0.9Kg	1x010 1x011 1x012 1x013 1x014 1x015 1x016 1x017 2x010 2x011 2x011 2x012	6+6 9+9 12+12 15+15 18+18 22+22 25+25 30+30 6+6 9+9 12+12	2.50 1.66 1.25 1.00 0.83 0.68 0.60 0.50 4.16 2.77 2.08	£5.49 +pape1.10 +VATE0.99 TOTAL £7.58	<b>160</b> VA 110 x 40mm 1.8Kg Regulation 8%	5x013	9+9 12+12 15+15 18+18 22+22 25+25 30+30 35+35 40+40 110 220	8.89 6.66 5.33 4.44 3.63 3.20 2.66 2.28 2.00 1.45 0.72	£8.43 +p&p£1.72 +VAT£1.52 TOTAL£11.67	<b>500</b> VA 140 x 60mm 4Kg Regulation 4%	8x018	25+25 30+30 35+35 40+40 45+45 50+50 55+55 110 220 240	10.00 8.33 7.14 6.25 5.55 5.00 4.54 4.54 2.27 2.08	£14.38 +p8p£240 +VAT£252 TOTAL£1930
Regulation 13% 80 VA 90 x 30mm	2x013 2x014 2x015 2x016 2x017 2x028 2x029 2x030 3x010	15+15 18+18 22+22 25+25 30+30 110 220 240 6+6 9+9	1.66 1.38 1.13 1.00 0.83 0.45 0.22 0.20	£6.13 + p8p£1.35 + VAT£1.12 TOTAL £8.60	<b>225</b> VA 110 x 45mm 2.2Kg Regulation 7%	6x012 6x013 6x013 6x014 6x015 6x016 6x017 6x018	12+12 15+15 18+18 22+22 25+25 30+30 35+35	9.38 7.50 6.25 5.11 4.50 3.75 3.21	£9.81 +p8p£2.05 +VAT£1.78	<b>625</b> VA 140 x 75mm 5Kg Regulation 4%	9x026	30+30 35+35 40+40 45+45 50+50 55+55 110 220 240	10.41 8.92 7.81 6.94 6.25 5.68 5.68 2.84 2.60	£17.12 +p8p£2.55 +VAT£2.95 TOTAL £22.62
1Kg Regulation 12%	3x012	12+12 15+15 18+18 22+22 25+25 30+30 110 220 240	3.33 2.66 2.22 1.81 1.60 1.33 0.72 0.36 0.33	£6.66 + p&p£1.72 + VAT £1.26 TOTAL £9.64		6x026 6x025 6x033 6x028 6x029 6x030	40+40 45+45 50+50 110 220 240	2.81 2.50 2.25 2.04 1.02 0.93	TOTAL £13.64		o to a	LABLE nd includi I to order		√A are

The benefits of ILP toroidal transformers

ILP toroidal transformers are only half the weight and height of their laminated equivalents, and are available with 110V, 220V or 240V primaries coded as follows.

IMPORTANT: Regulation -- Alk voltages quoted are FULL LOAD. Please add regulation figure to secondary voltage to obtain off load voltage.

For 110V primary insert "0" in place of "X" in type number.

For 220V primary (Europe) insert "1" in place of "X" in type number

For 240V primary (UK) insert "2" in place of "X" in type number.

Also available at Electrovalue, Maplin, Technomatic and Barrie Electronics.

For mail order please make your crossed cheques or postal orders payable to ILP Electronics Ltd. Barclaycard/Access welcome. Trade orders standard terms.

Post to ILP Electronics Ltd. Graham Bell House Roper Close Canterbury C12 7EP. Kent. England Telephone (0227) 54778. Telex 965780





(a division of

#### OW COST PROFESSIONAL TEST INSTRUMENTS





- \* FREQUENCY COUNTERS
- \* ANALOGUE METERS
- \* DIGITAL METERS
- \* FUNCTION GEN
- \* OSCILLOSCOPES
- \* POWER SUPPLIES
- \* LOGIC PROBE
- \* SCOPE PROBES



Write or phone for illustrated Test Instrument catalogue and price list.

BLACK STAR LTD.

9A, Crown Street, St. Ives, Huntingdon, Cambs. PE17 4EB.

Tel: (0480) 62440 Telex: 32339





And now for some Atomic fusion. Nothing to do with nuclear reactors (that's still at the breadboarding stage): this is an addon numeric keypad. Design by Patrick Squire.

he addition of a numeric pad to the standard QWERTY keyboard greatly increases the ease of use of a microcomputer, both for programs containing extensive numerical statements and for joystick operations, where the layout of the numeric keys corresponds directly to the direction of movement of an object being controlled on the VDÚ. Anyone accustomed to using machines both with and without numeric pads will appreciate the advantages of the extra keys. An additional drawback of the QWERTY keyboard is that the +, \* and = operations are obtained by shifted keys. This can be very frustrating and lead to errors when entering programs.

For all these reasons it is desirable to be able to add a basic calculator pad, containing the numbers 0-9, the decimal point, equals sign and the four arithmetic operators, to machines not originally supplied with such a facility. Unfortunately such an accessory is not generally available for most micros. This article describes a calculator pad designed specifically for the Acorn Atom, although the general principles employed are capable of straightforward modification to other machines which use a similar system of scanning the key matrix. The whole unit can be constructed for under £20, but it does involve soldering to the masterboard of the Atom, so construction should not be undertaken by the fainthearted.

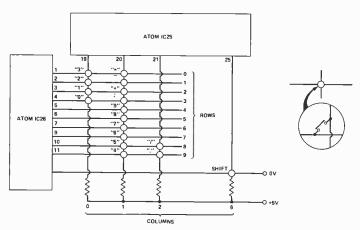


Fig. 1 Part of the Atom keyboard matrix. Each row is connected to one or more columns by a single keyboard switch. The rows are driven by the 3-to-10 decoder IC26. The columns are read by the PIA IC25.

#### **Matrix Scanning**

In order to understand the operation of the unit described here, or in order to modify it for other machines or to incorporate alternative functions, it is essential to understand how the Atom reads a depressed key. Figure 1 shows the appropriate section of the Atom circuit. It can be seen that each character key connects a particular row (numbered 0 to 9) with a particular column (numbered 0 to 6). For example, key '9' connects row 4 with column 1. The SHIFT key works in a slightly different way, so I will first describe the operation of reading an unshifted key.

The Atom operating system includes a machine code routine

that scans the keyboard. Normally all the rows 0-9 are held at logic high. The columns are connected by pull-up resistors to the + 5 V rail, so they are also logic high. In this state the depression of a character key has no effect, since it merely connects two lines both in the same state. When the scan commences, each row is successively driven low by IC26. The routine then interrogates each column to see if it is low. Consider the state when row 4 has been set low. If no key has been pressed the columns will all be high. If key 9 is pressed, however, column 1 will be connected to row 4, which is low. Column 1 will thus be pulled low and the Atom will know from the

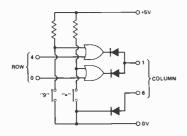


Fig. 2 The principle of the keyboard extension. The unshifted key '9' drives column 1 low when row 4 is also low. The shifted key '=' drives column 1 low when row 1 is low; it also pulls column 6 low to give the shift operation.

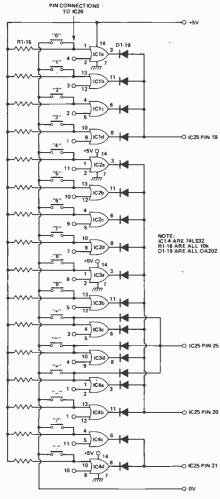


Fig. 3 The complete circuit of the keypad extension.

#### BUYLINES

Nothing at all unusual in this project and most suppliers should have the components in stock. One source for the case we used is BI-PAK Semiconductors, PO Box 6, 63a High Street, Ware, Herts SG12 9AG (telephone 0920 3182/3442): they also stock the semiconductors and resistors. The order number for the case is 148. The PCB can be ordered using our PCB Service order form on page 95.

information stored in ROM that the combination 'row 4 low and column 1 low' means that key '9' has been pressed. A similar process works for all the unshifted keys.

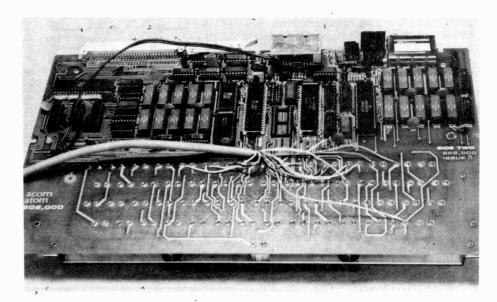
For the shifted keys use is made of column 6. Figure 1 shows that this is normally high, but that if the SHIFT key is pressed it pulls the line low by direct connection to the 0 V line. The key scan routine therefore also interrogates column 6 and, according to its state, decides whether a dual-role key, such as '=/-' is to be interpreted as shifted or unshifted.

#### **Circuit Principles**

The direct way of extending the ATOM keyboard would be to parallel each keyboard switch by a corresponding key on the pad.

However, this would involve having 16 unconnected switches and 32 connecting wires. This would be a very inefficient system and would not be able to cope with shifted characters as single-key operations. The system employed in this design employs an OR gate for each key, and is illustrated in Fig. 2 for two keys, one the unshifted '9', the other the shifted '='.

Consider first the unshifted '9' key. When the Atom drives pin 5 of IC26 low (this corresponds to row 4 — see Fig. 1) one input of the upper OR gate is driven low. So long as key '9' remains open, however, the other input of this gate remains high. The OR action then maintains the output high, so pin 20 of IC25 (column 1) remains high. If, on the other hand, key '9' is closed both



Wiring up to the Atom — the diagram below refers.

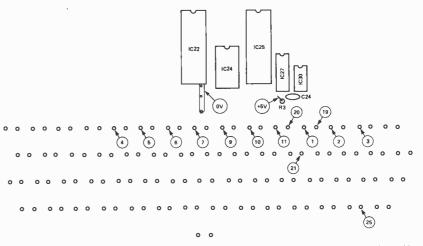


Fig. 4 A diagram of the Atom PCB (rearside of the keyboard) showing take-off points for the wiring. The numbers refer to the pins on IC25 and IC26 (as Fig. 1 shows, this numbering is unambiguous), and correspond to the numbers on the PCB.

#### PARTS LIST\_

Resistors (all 1W, 5%) R1-16 10k

Semiconductors IC1-4 74LS32 D1-19 OA202

Miscellaneous

PCB (see Buylines); 16-switch keypad matrix (see text); } meter 15-core plus screen cable; case to suit.

inputs to the OR gate are low, and the output is low. The fourth possibility (pin 5 of IC26 high, '9' low) also results in a high output, so pressing '9' will not have any effect unless row 4 is also low, as required. The purpose of the diodes is to isolate the outputs of the various OR gates. In the absence of the diodes, when one gate tried to go low it would be pulled up by all the other gates connected to the same line. It would also upset the operation of IC26. The diodes have a similar effect to open-collector outputs. However, open-collector OR gates are not generally available.

Now consider the operation of the shifted '=' key. The logic of the lower OR gate is identical to that just described, but in addition a diode connection to pin 25 of IC25 pulls column 6 low, thus simulating the effect of the combined operation of the SHIFT and '=/-' keys on the Atom keyboard. The complete circuit is shown in Fig. 3. Note that for 16 keys, the 16 OR gates conveniently occupy four quad OR gate ICs (type 74LS32).

#### Construction

The most expensive item is the keyboard itself. It should contain 16 single-poll switches with one side commoned to the 0 V rail. The author used a very cheap but entirely satsifactory unit from Watford Electronics Ltd. Perusal of the advertising columns should reveal a source of a suitable alternative for less than £10. Avoid decoded types, which are connected in a matrix fashion unsuitable for this application. As a last resort you could make your own from the readily available keypad switches.

The circuit should be constructed on a printed circuit board. Veroboard can be used, but is much more difficult to wire up and looks messy with so many connections. We've designed a double-sided PCB for this project — with care this shouldn't cause grave difficulties to home constructors,

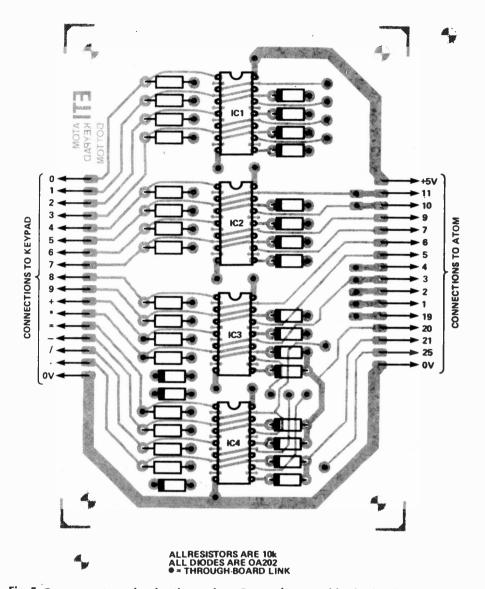


Fig. 5 Component overlay for the project. Remember to solder both sides of the board at each point indicated by a dot.

and finished boards will be on sale through our PCB Service. To avoid the cost of plated-through holes, links between the two sides of the PCB are required: these are shown by dots on the overlay. If the position has a component lead, solder it on both sides of the board — otherwise fit a through-board link.

Now comes the tricky bit. The problem is to find suitable places on the Atom masterboard to pick up connections to the key matrix. After an hour or so of probing with a multimeter we came up with the connection diagram of Fig. 5. We don't need to distinguish between the sets of pins for IC25 and IC26, incidentally, as the two have no numbers in common.

All the keyboard matrix connections can be made to the pins of the existing keyboard

switches. The supply connections are somewhat trickier. The 0 V is taken from a large area near IC22 (it will be necessary to scrape away the green varnish in order to solder the lead), while the +5 V is taken from the top end of R3. The photograph will hopefully make things clear.

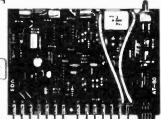
The number of connections required between the Atom and the PCB is 16, including the 0 V and +5 V rails. These are conveniently provided by 15 core and earth cable, of which a length of half a meter is ample. You will have to make a hole in the Atom case to bring the cable through.

The pad is mounted in a sloping fronted Bim case, which conveniently matches the shape of the Atom case, and helps to give a uniform appearance to the finished product.

Step-by-step fully illustrated assembly and fitting instructions are included together with circuit descriptions. Highest quality components are used throughout.

## **BRANDLEADING ELECTRONICS NOW AVAILABLE IN KI**





#### AT-80 **Electronic Car Security System**

- Arms doors, boot, bonnet and has security loop to protect fog/spot lamps, radio/tape, CB equipment
- Programmable personal code entry system Armed and disarmed from outside vehicle using a special magnetic key fob against a windscreen sensor pad adhered to the inside of the screen ● Fits all 12V neg earth vehicles ● Over 250 components to assemble

#### **VOYAGER** Car Drive Computer

● A most sophisticated accessory. ● Utilises a single chip mask programmed microprocessor incorporating a unique programme designed by EDA Sparkrite Ltd. ● Affords 12 functions centred on Fuel, Speed. Distance and Time. ● Visual and Audible alarms warning of Excess Speed, Frost/Ice, Lights-left-on ● Facility to operate LOG and TRIP functions independently or synchronously Large 10mm high 400ft-L fluorescent display with auto ● Large 10mm high 400ft-L fluorescent display with auto intensity. ● Unique speed and fuel transducers giving a programmed accuracy of + or — 1%. ● Large LOG & TRIP memories. 2,000 miles. 180 gallons. 100 hours. ● Full Imperial and Metric calibrations. ● Over 300 components to assemble real challenge for the electronics enthusiast!



**Electronic Ignition** 

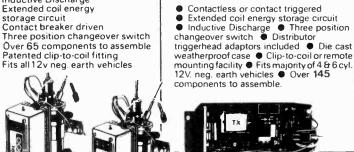
TX1002





#### SX1000 **Electronic Ignition**

- Inductive Discharge Extended coil energy storage circuit
- Contact breaker driven
- Three position changeover switch
- Patented clip-to-coil fitting







#### SX2000 Electronic Ignition

- The brandleading system
- on the market today Unique Reactive Discharge
- Combined Inductive and Capacitive Discharge
- Contact breaker driven
- Three position changeover switch
- Over 130 components to assemble Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles

#### TX2002 **Electronic Ignition**

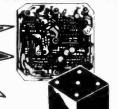
The ultimate system ● Switchable contactless. ● Three position switch with Auxiliary back-up inductive circuit ● Reactive Discharge. Combined capacitive and inductive ● Extended coil energy storage circuit ● Magnetic contactless distributor triggerhead. ● Distributor triggerhead adaptors included. ● Can also be triggered by existing contact breakers. ● Die cast waterproof case with clip-to-coil fitting ● Fits majority of 4 and 6 cylinder 12v neg. earth vehicles. ● Over 150 components to assemble

Over 150 components to assemble

All SPARKRITE products and designs are fully covoled by one or more World Patients



FREE" MAGIDICE KIT WITH L ORDERS OVER £45.00



#### MAGIDICE **Electronic Dice**

- Electronic Dice
  Not an auto item but great fun
  for the family
  Total random selection
  Triggered by waving of hand
  over dice
  Bleeps and flashes during a 4 second
  tumble sequence
  Throw displayed for 10 seconds
  Auto display of last throw 1 second in 5
  Muting and Off switch on base
  Hours of continuous use from P97 battery
  Over 100 components to assemble

SPARKRITE 82 Bath Street, Walsall, West Midlands, WS1 3DE England

Tel (0922) 614791 Allow 28 days for delivery

		SELF	
		ASSEMBLY	KIT
	SX 1000	£12.95	
i	SX 2000	£19.95	
	TX 1002	£22.95	-
	TX 2002	£32.95	
	AT 80	£32.95	
	VOYAGER	£64.95	
	MAGIDICE	£9.95	

PRICES INC. VAT. POSTAGE & PACKING

NAME	ETI/6/83
ADDRESS	
	RITIE
I ENCLOSE CHEQUE(S)/POSTAL ORDERS FOR	JC8
£KIT REF	6011
CHEQUE NO	
	Chil





CUT OUT THE COUPON NOW!

#### Interak 1—

#### THERE'S NO LIMIT TO WHAT A COMPUTER WITH NO CARDS CAN DO!

It's the oldest trick in the book to grab your attention with a stupid title, but in this case there's a grain of truth in the statement above. The Interack 1 Computer System is a 4 MHz Z80A develop-

The Interack 1 Computer System is a 4 MHz Z80A development system, one which you build yourself, perhaps for enthusiastic home use, or more often for industrial or educational purposes.

The fundamental structure is a 3U 19" rack which has space for 13 cards ("International" size, i.e. 4.5" x 8") on 1" pitch, with space for a power supply at one end of the rack. International size — rack mounting: Inter-rack Interak! 13 cards 4.5" by 8" gives a total potential board area of over 400 square nches, enough for a couple of hundred chips or more, there's no real limit on what that could do is there? (It would leave a few of today's marvels a bit in the shade would leave a few of today's marvels a bit in the shade

eh?)
But don't be scared, you don't have to build a Frankenstein's monster until you're ready. The first few cards are pretty straightforward: First the VDU-K, which can be connected to your own TV. (or monitor), then the Z80A-CPU card, the brains; then dynamic RAM, and finally the Keyboard inter face (to any standard parallel ASCII keyboard, and you've got a computer — with the ultimate resource: 9 empty slots for the future. (Perhaps use one of them for a 2400 haut tane interface or later floppy disks.)

2400 baud tape interface or later floppy disks.)

Example prices (excluding VAT), everything is available separately and full after sales service in case you make a mistake: Z80A CPU card £10.95, Manual £1.50, Main Parts £13.41.

40 type-written pages of description, specification, price lists etc. are yours for the asking (a 25p stamp and/or SAE is a help, but not essential), or telephone if you prefer. You'll have to live with your computer for a long time, so make the effort and find out all about interak now; a couple of minutes is all it takes to ask for a leaflet!

#### Greenbank

Greenbank Electronics (Dept. T6E), 92 New Chester Road, New Ferry, Wirral, merseyside L62 5AG Telephone: 051-645 3391 (Dept T5E)

MONITOR in attractive case Non Standard out, With Info £25 each. Carr £7 Matching ACSII ded Querty Keyboard with Numeric Keyyad and Function Keys. £25 each P&P £5 The Pair £40.

Cart C7

12\*MONTOR, Cased Non Standard Input With Infor £20 each. Cart £7. With Matching ASCIL coded Ouerty Keyboard with Numeric Pad and 24 Function Keys. £35 the Pair. Cart £7. POWER UNIT. 240V Input. Outputs +55V/15A. +24V/15A. -24V/3A. £12 each. MSTRUMENT CASE standard 19\* width x 16\* depth x 10\* input. 62 each. Cart £7. LOPPY DISK DRIVE 8\* PW MEMOREX. Connection details £85 each £87. £5.

GEARED MOTOR 117/234 Volt Input 50HZ, 4" dia x 5 ¼" deep, ½" shaft. New £5 each PEP £4 MOTOR 12V DC Input 3" dia x 4¾" deep, ½" shaft. New £5.50 each PEP £3. DC MOTOR 612 Volts Mechanical Constant Speed Control 1¾" dia £1 each. MOTOR 12V DC with pulley £ senii-conductor espeed control £1 each. SYNCHRONOUS MOTOR 2 Phase 9 volt AC 375 RPM. Good torque (needs 30.40 mld capactus Suitable for Robitics/Plotters etc. £1 each.

OTHER SYNCHRONOUS/STEPPING MOTORS AVAILABLE. PLEASE ENQUIRE

GEARED MOTOR 120V 50H7 4 Watt 1 mm 2" dia GEARED MOTOR 120V SONZ, a Watti tpm, z on x 1 j" deep c.1.50 each.
CENTAUR FANS 4 j". Brand new, 100V 20W, 2 speed, 22 each PSP 62.
CENTAUR FANS 4 j". 115V New, £4.50 each.
MUFFIN 115V 41", unused, £3 each PBP £2.
TRANSFORMERS All brand new, all 240 volts

Sec 25.5V 2.5A. Size 31 × 21 × 21". £2.50 each. Sec 115V1A (auto) £1.25 each. Sec 6V 1.66A £1.50

Sec 12V 100MA 50p each. TRANSFORMER 127/220 Volt Input Sec 12V 1A

TRANSFORMER 127./220 Volt Input Sec 12V 1A RMS £1.80 sech TRANSFORMER 120 Volt Input Sec 10 0-10V 1A 750 sech 750 sech 120 120 240V Input. Sec 12 0.12V 4V 750 sech 10 uff £6 TOROIDAL TRANSFORMER 0.120 240V Input. Sec 13.5 0 13.5 V 8VA. £1.30 sech 10 off £170 TOROIDAL TRANSFORMER 0.120 240V Input. Sec 0.12V; 0-12V 10VA per winding. Encapsulated. £4 sech. 10 off £35. Sub Min PULSE TRANSFORMER. Sec centre tap ped. Suitable for Thyristor triggering 20p sech. 10 off £180. RAPID DISCHARGE CAPACITOR 8 mfd 4KV £5 sech P&P £2.

P&P£4.
PUSH BUTTON TELEPHONES for Internal Systems. BRAND NEW. P&P£2 ea.
746 style Two Tone Grey £8 each.
KRONE type FeTAp 731. Beige. £6 ea.
Quantity discount — Please Enquire Minimum Order of Goods £3. Minimum P&P £1.50. VAT at 15% MUST be added to TOTAL OF GOODS & PACKAGING.

TELEPHONES. 706 style black, blue, green, grey, £5.50 each, 10 off £45. TELEPHONES. 706 style black, blue, green, grey, 65.50 each, 10 off £35.
Discoloured £4 each, 10 off £30, 746 style black or grey £7.50 each, På På På 22 each, 4:10 units £7. Over 10 by arrangements.
TOKIN NOISE FILTER VG215FU. 250VAC 15A 50/60HZ. With fixing bracket. New £2 each. VU METER. Scaled 0-5, size 1½ × 7/8", 50p each 10 off £4.

50/60HZ. With fixing bracket. New Lz secn. VU METER, Scaled 0-5, size 1] ± 7/8", 50p sech 10 off £4.

1.T. LOUD SPEAKER. 3 1" dia. 50 ohm 0.2 Watt. New. 75p sech. 10 off £6.50.

E.H.T. CABLE. Overall dia Srim, 10p per metre. 100 metre drum £7.50 P5P £4.

Multi Colour RIBBON CABLE 10 way, 50p per metre, 10 metres £4, 14 way 75p per metre. 10 metres £4, 16 way 75p per metre. 10 metres £4, 100 metres £8, 100 metres £8, 100 metres £4, 14 way 75p per metre. 10 metres £8, 100 metres £8, 100 metres £4, 14 way 75p per metre. 10 metres £8, 100 metres £8, 100 metres £7, 100 metres £8, 100 metres £7, 100 metres £8, 100 metre

EPROM 2/16 Single rail, £1.50 each. Z004 ±e each.

SPECTRAL RELIANCE TEN TURN POT. 100 ohm ± 1%. Brand new, 759 each 10 off £5.

SLIDER POTENTIOMETER. Twin Gang, 200K or 2M, 359 each 10 off £1.

PANEL MOUNTING FUSE HOLDER for 1 ½" fuse, 209 each. 10 off £1.

BELLING LEE CHASSIS MOUNTING FUSE HOLDER for 1 ½" fuse, 209 each. 10 off £1.

I.E.C. MAINS LEAD. 2 metre length, heavy duty, 609 each. 10 off £1.

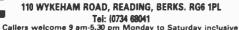
CORE CURLY WIRE extending to 2 metres, 209 each. 10 off £1.

MICROPHONE/EARPIECE INSERTS. Brand new, 759 each. 10 off £8.

EXECUTIVE TELEPHONE-PUSH BUTTON. Functions include 10 number memory; repeat dialing; internal Microphone & Speaker and separate handset etc. Will connect direct to British Telecom System. BRAND NEW. ONLY £25 ea. P&P&.

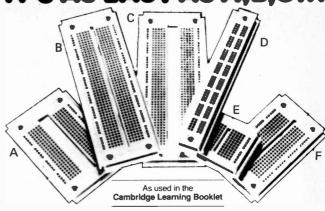
Many more components and test equipment available. S.A.E. or telephone for lists.

#### STEWART OF READING





IT'S AS EASY AS A,B,C...



- A EXP 650 For microprocessor chips, £4.25
- B EXP 300 The most widely sold breadboard in the UK; for the serious hobbyist. £6.00
- EXP 600.6" centre channel makes this the Microprocessor Breadboard. £7.25
- D EXP 4B An extra 4 bus-bars in one unit. £2.50
- E EXP 325 Built in bus-bars accepts 8, 14, 16 and up to 22 pin ICS. £2.00
- EXP 350 270 contact points, ideal for working with up to 3 x 14 pin DIPS. £3.45
- G PB6 Professional breadboard in easily assembled kit form. £11.00 (Not illustrated.)
- PB 100 Kit form breadboard recommended for students and educational uses. £14.25 (Not illustrated.)

#### & IT'S AS EASY AS 1,2,3 with THE EXPERIMENTOR SYSTEM

**SCRATCHBOARD** 

~BREADBOARD

-MATCHBOARD

- 1. EXP 300PC which includes one stem. A matchboard pre-drilled PCB = £1.50
  2. EXP 302 which includes three items. Three 50-sheet scratchboard workpads = £1.75
  3. EXP 303 which includes three items. Two matchboards and an EXP 300 solderless breadboard = £8.00
  4. EXP 304 which includes flour items. Two matchboards and EXP 300 breadboard and a scratchboard workpad = £9.40

The above prices do not include P&P and 15% VAT

#### TOMORROW'S TOOLS TODAY

GLOBAL SPECIALTIES CORPORATION G.S.C. (U.K.) Limited, Dept. 9H Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ. Tel: Saffron Walden (0799) 21682. Telex: 817477.

nclose cheque/P	O for £		
debit my Barcla	ycard, Access, Ame	rican Express car	d
o. <u>'</u>		Exp.dat	
Tel: (0799) 216 st immediately.	82 with your card r	number and your	order will be in
A EXP 650 £5.75	Qnty, Regd.	B EXP 300 £8.05	Qnty, Regd.
C EXP 600 £9.48	Qnty, Regd.	D EXP 48 £3.73	Qnty, Regd.
E EXP 325 £3.16	Qnty, Reqd	F EXP 350 £4.83	Qnty Read
G PB6 £13.80	Qnty, Regd.	H PB 100 £17.53	Qnty, Regd.
Experimentor	System		
1 EXP 300 P	C Qnty, Reqd,	2 EXP 302 £2.87	Qnty . Read.
3 EXP 303 £10,35	Qnty, Reqd.	4 EXP 304 £11.96	Onty, Read.

VISA

CIRCUIT BOARD ELECTRONICS

THE NEW EXCITING

NAME IN PCB'S

FOR THE HOME ENTHUSIAST

**COMPARE OUR PRICES** 

FOR COMPLETE PRICE LIST

WRITE TO
CIRCUIT BOARD COMPONENTS
55 MURDOCK ROAD
BEDFORD
TEL. BEDFORD 214219

### London College



i vi Furniture

## COURSES IN ELECTRONICS FOR THE MUSIC INDUSTRY

T.E.C. DIPLOMA IN MUSICAL INSTRUMENT STUDIES

(2 years full time specialising in Electronics)

### T.E.C. HIGHER DIPLOMA IN MUSICAL INSTRUMENT TECHNOLOGY

(2 years full time specialising in Electronics)

The Electronics option of these T.E.C. courses allow the student to specialise in music industry applications.

Suitable students would be interested in both music and electronics and wish to combine them.

Higher Diploma applicants would normally have an A level or its equivalent in an appropriate subject.

Applications forms and further details are obtainable from the Senior Administrative Office at the College.

Department of Musical Instrument Technology London College of Furniture 41–71 Commercial Road London El ILA 01-247 1953

### WHY USE STRIPBOARD?

Make your own PCB. It's

easy:
"GET YOU STARTED" KIT
12V Mini Drill (takes \( \frac{1}{2} \)A).
1mm Bit.
25 sq ins Copper Clad.

25 sq ins Copper Clad.
PCB Etchant for } Itr.
Tweezers and Dish.
Fine Etch Resist Pen.
Instructions. Only £6.00,
'SUPER'' KIT. As above with: 3

Pens, Fine-Medium-Thick.
75 sq ins Copper Clad.
3 Sheet Transfers — Etch Resist.
Only £8.50.

SIMPLE PCB DRILL.

12V Motor with chuck attached with 3 collets 0.8 to 2.0mm £4.50.

**PCB ETCHANT** 

Double strength to make 1 ltr solution. £0.90.

**ETCH RESIST PENS** 

Set of 3, Fine-Medium-Thick £1.80.

Cheques & P.O.'s payable to POPS Components. Callers welcome to our new shop extension. Five times the size.

### RESISTOR FILE

Std E12 VALUES 4w CARBON FILM 1011 to 10M11

73 PRINTED ENVELOPES EACH CONTAINING 10 FULL SPEC, 5% RESISTORS COVERING THE E12 SERIES FROM 10 $\Omega$  TO 10M $\Omega$  In a smart flip-top file for your work bench

£8.50

CHEQUES & P.O'S PAYABLE TO: POPS COMPONENTS. PRICES ARE INCLUSIVE BUT ADD 60p P&P TO EACH ORDER

,W rog road E1: HESISTORS

SUPER FILE. AS ABOVE BUT WITH 100 RESISTORS IN EACH ENVELOPE £55.00

REFILL ENVELOPES CONTAINING 10×½w RESISTORS ANY E12 VALUE FROM 10Ω TO 10MEGΩ 15p EACH CONTAINING 100×½ RESISTORS ANY E12 £1.20 EACH

Please allow 28 Days Delivery

POPS COMPONENTS CALLERS WELCOME @

38/40 LOWER ADDISCOMBE RD, CROYDDN, SURREY CRO 6AA TEL: 688 2950

### **BIG NEWS**

from



VAST STOCKS OF COMPONENTS AT RIDICULOUSLY LOW PRICES

#### MAIL ORDER

we offer the best component prices in the business, and no order is too small to receive our first class attention.

#### **COMPONENT WAREHOUSE**

we have a huge warehouse full of components, test equipment — in fact virtually everything you will ever need. Come and have a browse around. Open Mon. to Sat. — 9am to 4pm. You will easily find us opposite the John O'Gaunt Hotel on the A45.

SEND A LARGE S.A.E. FOR OUR FREE COMPREHENSIVE CATALOGUE



DEPT 4F HIGH MARCH, DAVENTRY

## **TECH TIPS**

#### Scope Bargraph Unit

Graeme Durant, Selby

This circuit is designed to be used in conjunction with any ordinary oscilloscope which has an X-deflection input, and allows it to be used as a bargraph display. The screen has 10 useable columns, thus making it suitable for use with the ETI Spectrum Analyst published recently.

The heart of the circuit is IC1, an LM3914 bargraph driver. The input to this, pin 5, is connected to a sawtooth generator running at about 1 kHz, formed around Q1. Q1 is a constant current generator supplying 5 mA and charging a 330nF capacitor to create a linear sweep. As the voltage on this capaci-

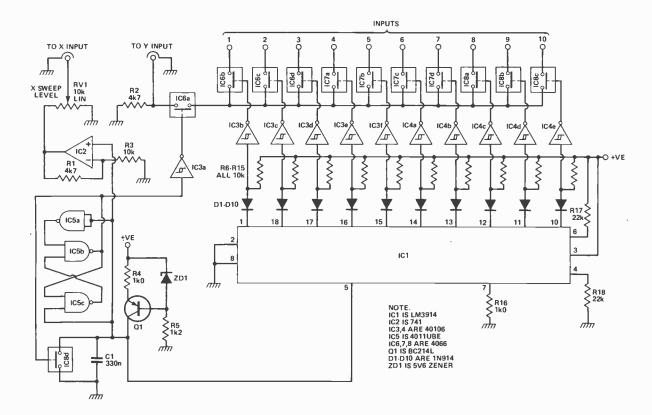
tor reaches the upper CMOS threshold, about two-thirds supply, a latch formed by IC5b and c is triggered by IC5a. This rapidly discharges the capacitor through IC8d. When the voltage has dropped to the lower CMOS level, about one-third supply, the latch is reset and the capacitor starts to charge up again. Thus a linear sawtooth waveform is produced.

This is buffered by IC2 and fed out to drive the X amplifier in the scope. However, as this sweep also drives a bargraph IC which has its upper and lower limits set to be similar to the two CMOS switching levels, the 10 outputs go low, one at a time, in sequence. These outputs are used to drive a multiplexing system: a set of 10 analogue switches (IC6b to IC8c). These are driven via inverting Schmitt triggers, diodes and pullup resistors due to the limited drive cap-

ability of IC1 at logic 1.

The multiplexed output is sent to the scope's Y input via another analogue switch, which is normally on, but cut off while the sweep capacitor discharges so as to blank out the 'flyback'. Alternatively, the 'Z modulation' input of the scope could be used if one is available.

In use, the internal sweep generator in the scope is turned off and the circuit is connected. It is recommended that a regulated supply of 15 V is used so as to provide adequate X output drive. The X sweep level is adjusted until a suitable width of diplay is produced (this being a horizontal line at the present), which should be moved to the bottom of the screen. Now the inputs to the scope may be connected and the Y sensitivity of the scope adjusted to give a good display.



Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items. ITI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for at a competitive rate.

Drawings should be as clear as possible and the text should be typed. Text and drawings must be on separate sheets. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International,

145 Charing Cross Road, London WC2H 0EE.

#### Improving Crossover Performance (Zobel network)

#### J. P. Macauley, Crawley

When designing crossover networks, problems are encountered due to the reactive nature of the speakers. This problem can cause ringing, and more importantly the roll-offs will not occur at the frequency that the normal design calculations would indicate. It is pointless to design a crossover on the assumption that the impedance remains at a constant value throughout the operating range.

In fact a moving coil speaker looks like an inductance and a resistance in series. Because of the inductance the impedance of the speaker increases with frequency. It is not unusual to find that the impedance presented by a nominally 8 ohm speaker is nearer 15 ohms at 3 kHz.

This problem can be overcome by shunting the speakers in the proposed system with a series resistorcapacitor combination. If the values of these components are correctly chosen the speaker will look like a nearly pure resistive load to the crossover. Obviously this ensures that the latter rolls the response of the speakers on and off at the calculated frequencies without problems.

The circuit is shown in Fig. 1, and the component values are determined as follows. Feed the speakers with a sine wave at the desired crossover frequency via a 100R resistor (see Fig. 2). Measure the output voltage at the output of the generator (V<sub>1</sub>) and the voltage across the speaker terminals (V<sub>2</sub>). The impedance of the speaker Z can now be determined by the equation

$$Z = \frac{100 \times V_2}{V_1 - V_2}$$

The DC resistance is now measured across the speaker terminals and R is made equal to this. C can now be determined from the equation

$$C = \frac{Z - R}{2\pi f R^2}$$

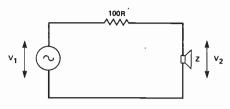


Fig. 1.

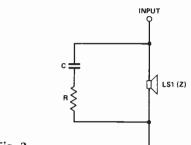


Fig. 2.

where f is the crossover frequency in Hertz and C is given in Farads. The speaker and network now present a resistive load equal to R and the crossover can safely be calculated on this assumption.

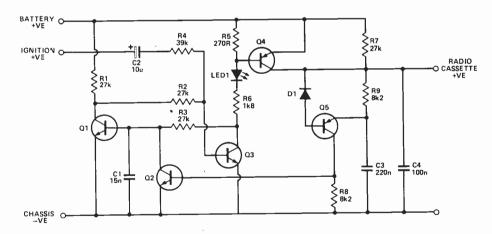
#### Car Radio Latch

#### A. Miller, Loughborough

When fitting a car radio or cassette player into a car, one problem is deciding which side of the ignition to connect the supply lead. If it's connected to the ignition side the keys must be in to use the radio, a potential hazard if children are left listening. On the other hand, if it's connected to the battery side you have to remember to turn off the radio every time you leave the car.

The answer is simple — you connect to both using the circuit shown here. Normally the radio is left switched on and it will go on and off with the ignition. But if the ignition is off, switching the radio off and then on again also turns the radio on.

The circuit consists of a latch using Q1 and Q3, which controls a driver stage Q4. The LED indicates the state of the latch and is optional, but it doesn't consume any extra power since without it, the power would only be dissipated in R6. C2 serves to trigger the latch on and off with the ignition, and R4 prevents false triggering during starting. If the radio goes off after starting R4 should be increased, and if the radio



fails to go on and off with the ignition, R4 should be reduced.

When the latch is in the 'off' state, a small current passes through R7 to the radio. While the radio is on, C3 and C4 will remain discharged, but if the radio is off, C3 and C4 charge to the full battery voltage. If the radio is switched on, C4 rapidly discharges through the radio leaving C3 to discharge via Q5 and D1 and produce a current in R8. This turns on Q2, triggering the latch to supply power to the radio. C1 ensures reliable triggering.

Q1,2,3 and 5 are all general-purpose transistors, such as the BC108/BC158

types, and Q4 is a power Darlington with at least 2 A rated collector current. No heatsink should be necessary for Q4, as it is always either off or in saturation. D1 is a general-purpose diode such as the 1N4148. R4 is the only component with a critical value and may need adjusting as mentioned earlier. All the component values are those used in the prototype and any similar values should work. The quiescent power consumption is either 2 mA or 10 mA depending on the state of the latch, but if the vehicle is to be left standing for longer than a fortnight the unit (or the battery) should be disconnected.

85

#### **MODULAR AUTOMATIC** NEW! TELEPHONE SYSTEM

£24.50 +£1 p&p

Each ready built module is a complete exchange providing up to ten extension lines

Simply connect 'phones and power supply Only two wires to each telephone

Uses ordinary dial or push-button 'phones Complete privacy for conversations Range of several miles

Fully expandable system

Each module allows two 'phones to be used at one time, two modules allows four, etc.

N.B. Module should be available by late May.

RECONDITIONED
TELEPHONES.
Push Button Trimphones £15
+ £180 p&p 2 for £28 + £250
Push Button 746 £975 + £180 2for £18 + £250
Recent Style Dial Phones £4.75 + £180 2 for £9 + £250 5 for £20 + £5
Seconds (in good working order)

Order)
Class 1 £3.50 + £1.80 5 for £15 + £5
Class 2 (discoloured) £2.25 + £1.80 5 for £9 + £5

UNISELECTORS, 50v, 4 Bank Homing Bank, 25 way £3.50

Desk-top Ten Way Manual Ex-change (key & lamp unit) with instructions £8 + £1.80 P&P

Send SAE for free leaflet on telephone systems

TEMPERATURE GUAGE 0-120 C
Remote sensor on 38" capilliary, panel mounting dial 55mm dia Only £2.50

16A 240V RANCO THERMOSTAT

Wide control range (low room temp, to over boiling point). Sensor on 22" capillary, 2.30, including control knob.

BUY ONE EACH OF ABOVE FOR £5.50

GEARED Synchronous motor, 8 r.p.m. 240VA.C. 3 Watt

SOLENOID GAS VALVE. 240V A C. 5 P.S I. suitable for non-corrosive fluids. £2.20

BULGIN 3 pin free plug & panel socket 2A 240V

DIAL-OUT WITH YOUR COMPUTER. PCB.'s convert binary to dialing pulses and enable your computer to dial-out (with suitable interface). Ex-equipment. Tested £12 with explanatory notes.



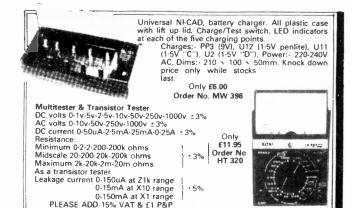
L.E.M. SERVICES 22 Emscote Road, Warwick, Warwickshire Tel: 0926 490740

ADD 50p P&P ORDERS OVER £7.50 POST FREE

unless stated otherwise

Lagrand

ALL ITEMS - MONEY BACK IF NOT DELIGHTED



**ENFIELD** 

ELECTRONICS 208 BAKER ST., ENFIELD MIDDX. Tel: 01-366 1873





#### **HORIZON ELECTRONICS**

(Midands)
Dept H/E Charlotte St. Rugby Tel: 78138
Prime quality. TERRIFIC PRICES. Mail order only Dept H/F Tel: 78138

			_		
REGULATORS (5/ 100mA +ve 1 amp +ve 723 var	12/15VI 28p 33p 28p	THYRISTORS (plast 4 amp 400v 8 amp 400v TRIACS (plastic) 24 amp 400v 8 amp 400v	35p 60p 50p 80p	LINEAR IC's 747 748 ICM 7555 ICM 7556 LF 351	50p 33p 70p 130p 40p
ZENERS (3 3 to 30 500mW 1 3watt DIODES IN 4001 4002	9V) 6p 12p 3p 4p	TOGGLE SWITCHE: Min SPST Min DPDT S Min SPST S Min DPDT	57p 70p 46p 62p	LF 353 LM 301A LM 324 LM 380 LM 3909 NE 567v TDA 202 TDA 2020	70p 24p 27p 50p 66p 85p 185p 285p
4004/6 IN 5401 5404 5406 BRIDGES 1 amp 500	6p 12p 13p 14p	TRANBISTORS BC 107B BC 108B BC 109B BC 140 BC 142 BC 150	9p 9p 10p 25p 22p 35p	SOLDERING IRON: Antex C 15w CCN 15w X25 25w All bits	445p 465p 470p 60p

ABOVE: Just a few exmples Send S.A.E./List ADD: 65p p&p to all orders under £5.00 VAT: add 15% VAT to total order value

### PARNDON ELECTRONICS LTD.

Dept. No. 23, 44 Paddock Mead, Harlow, Essex CM18 7RR. Tel. 0279 32700

RESISTORS: 14 Watt Carbon Film E24 range ± 5% tolerance. High quality resistors made under strictly controlled conditions by automatic machi-

and colour coded
£1-00 per hundred mixed (Min 10) per value) £8-50 per thousand mixed (Min 50 per value)

Special stock pack 60 values 10 off each £5-50

DIODES: IN4148 3p each Min order quantity 15 items £1-60 per hundred

CAPACITORS, REGULATORS, SWITCHES, I.C. TRANSISTORS, DIODES, etc, etc.

**FULL LIST AVAILABLE — SEND S.A.E.** 

DIL SOCKETS: High quality low profile sockets

8 pin - 10p. 14 pin - 11p. 16 pin - 12p. 18 pin - 19p. 20 pin - 21p

22 pin - 23p. 24 pin - 25p. 28 pin - 27p. 40 pin - 42p.

ALL PRICES INCLUDE V.A.T. & POST & PACKING --- NO EXTRAS MIN ORDER - UK LI 00 OVERSEAS LS CASH WITH ORDER PLEASE



Visual Display Units Burroughs MT686 VDUs versatile micro controlled programmable terminals have 3 RCA 1802 CPUs and 64K of memory. 12" Green screen (80 × 25) RS232 106 key detached keyboard. Can also be used as quality video monitor. £149 + £15 carr. WHILE STOCKS LAST

#### CENTRONICS 306 LINE PRINTERS



professional fast compact line-printer. 80 columns, 120 char/sec. Parallel i/f. Quality at a silly price. Vertical format unit. To inc. operations manual. ONLY £149.00. Carriage (England) £17.50. Tech manual (230 pages) £10.00.



#### FLOPPY DISC DRIVES

Fantastic MEMOREX 550 8" discs mounted in attractive case power supply and fan. Shugart standard 50 way interface. Space for second drive. £199 (carr.

#### **MAWSON ASSOCIATES**

124 Lennard Rd, Beckenham, Kent BR3 1QP

WE ALSO BUY COMPUTERS AND COMPUTER PERIPHERALS

01-778 3600

Callers welcome by appointment s/h items sold working but not g'teed

### WRONG TIME?

MSFCLOCK is ALWAYS CORRECT — never gains or loses. SELF SETTING at switch-on, 8 digits show Date, Hours, Minutes and Seconds, auto GMT3BST and leap year, also parallel BCD (including Weekday) output for alarm etc and audio to record and show time on playback, can expand to Years, Months and Milliseconds and STOP-CLOCK, receives Rugby 60KHz atomic time signals, built-in antenna, 1000Km range, GET the RIGHT TIME, £69-60.

60KHZ RUGBY RECIEVER, as in MSF Clock, serial data output, decoding details, Basic listings, £22-20.

Each fun-to-build kit includes all parts, printed circuit, case, instructions, by-return postage etc, money back assurance so GET yours NOW.

**CAMBRIDGE KITS** 44(TT) Old School Lane, Milton Cambridge.

#### ECTRONIC BARGAIN SUPPL

#### **EX-GOVT VALUE and SEMICONDUCTOR EQUIVALENTS GUIDE**

Contains an up to date fully comprehensive cross referenced guide to British and American Service valves and semiconductors. £2.50 plus pp. 30p.

#### VALVE AND PROJECTOR LAMP LIST

Valves from 1925 to 1980. Many obsolete types. Modern TV, radio and transmitting valves. Send 60p. (Refundable on purchase) Or free with Ex-Govt., Valve Guide. We buy and sell valves in any quantity, large or small.

PLEASE ADD 15% VAT to all orders including carriage and P.P.

Devices

Myers Electronic Dept. ETI2 12/14 Harper Street. Leeds LS2 7EA (opposite Corals), 9 to 5. Mon to Sat. Sunday 10 to appointment. Govt. Surplus items always in stock

## Do you think that designing and understanding electronic circuits is beyond you?

The summer edition of Electronics Digest, *Gateway To Circuit Design*, provides a step-by-step introduction for the newcomer to the art of circuit design. Firstly, you'll be introduced to the commoner electronic components — but not in a passive way. Electronics is a practical subject, so *Gateway To Circuit Design* will enable you to build simple circuits for yourself, and take measurements on them (along the way learning how to use a multimeter). Once these introductions are over, *Gateway To Circuit Design* shows you what goes into the design of a wide range of electronic equipment — for audio, computing and electronic music, for instance.

Gateway To Electronics is an occasional popular series in Electronics Digest, published by Argus Specialist Publications. Previous issues in the series have concentrated on projects; now we'd like you to design your own!

At all good newsagents now or available by post from Electronics Digest, 513 London Road, Thornton Heath, Surrey.

## We'd like to show you that you're wrong



## MASTER ELECTRONICS NOW! The PRACTICAL way!

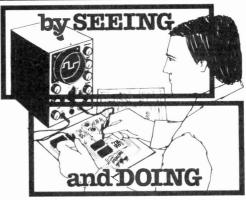
This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

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

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

You will do the following

- Build a modern oscilloscope
- Recognise and handle current electronic components
- Read, draw and understand circuit diagrams
- Carry out 40 experiments on basic electronic circuits used in modern equipment
- Build and use digital electronic circuits and current solid state 'chips'
- Learn how to test and service every type of electronic device used in industry and commerce today. Servicing of radio, T.V., Hi-Fi and microprocessor/computer equipment



## New Job? New Career? New Hobby? Get into **Electronics** Now

PREE!	Please send your brochure without any obligation to NAME	COURSE INTELLIBORICS		ETI/6/82
	ADDRESS	as described above RADIO AMATE UR LICENCE MICROPROCESSORS LOGIC COURSE	OTHER SUBJECTS	
POST NOW T	O:			~

British National Radio & Electronics School Reading, Berks. RG1 1BR

## electronics today international BOOK SERVICE

How to order: indicate the books required by ticking the boxes and send this page, together with your payment, to: ETI Book Service. Argus Specialist Publications Ltd. 145 Charing Cross Road, London WC2 0EE. Make cheques payable to ETI Book Service. Payment in sterling only please. Prices include postage and packing. Prices may be subject to change without notice.

THE RESIDENCE OF THE PARTY OF T	3000	☐ Getting Acquainted with your VIC 20 Hartnell	£8.50
BEGINNERS GUIDES		Getting Acquainted with your ZX81 Hartnell Let your BBC Micro Teach you to program Hartnell	£5.95 £7.90
☐ Beginner's Guide to Basic Programming Stephenson	£4.95	Programming your ZX Spectrum Hartnell	£8.50
Beginner's Guide to Digital Electronics	£4.95	The ZX Spectrum Explored HArtnell	€6.95
☐ Beginner's Guide to Electronics ☐ Beginner's Guide to Integrated Circuits	£4.95 £4.95	How to Design, Build and Program your own working Com	£7.95
Beginner's Guide to Integrated Circuits Beginner's Guide to Computers	£4.95	☐ BASIC Principles and Practice of Microprocessors Heffer	£7.15
☐ Beginner's Guide to Microprocessors	£4.95	Hints and Tips for the ZX81 Hewson	£5.25
сооквоокѕ	G0.46	What to do when you get your hand on a Microcomputer Holtzman	£8.65
COOKBOOKS	14514	☐ 34 More Tested Ready to Run Game Programs in BASIC Horn	£6.60
☐ Master IC Cookbook Hallmark	£8.65	_ initial accompanies and a manufacture and a ma	£10.75 £13.00
Microprocessor Cookbook M. Hordeski	£6,60 £13.15	☐ Digital Circuits and Microcomputers Johnson ☐ PASCAL for STudents Kemp	£7.20
☐ IC Op Amp Cookbook Jung ☐ PLL Synthesiser Cookbook H. Kinley	£6.60	The C — Programming Language KErnighan	£17.20
Active Filter Cookbook Lancaster	£12.00	COBOL Jackson	£7.95 £9.50
TV Typewriter Cookbook Lancaster	£9.95 £10.85	☐ The ZX81 Companion Maunder ☐ Guide to good Programming Practice Meek	£5.70
☐ CMOS Cookbook Lancaster ☐ TTL Cookbook Lancaster	£10.00	Principles of Interactive Computer Graphics Newman	£12.95
☐ Micro Cookbook Vol. 1 Lancaster	£14.00		£11.35 £11.35
BASIC Cookbook K. Tracton	£5.20 £5.95	☐ Exploring the World of the Personal Computer Nilles ☐ Microprocessor Circuits Vol. 1. Fundamentals and	L11.33
MC6809 Cookbook C. Warren	10.50	Microcontrollers Noll	£8.90
ELECTRONICS	4 3 11	Beginner's Guide to Microprocessors Parr	£5.10 £10.50
Principles of Transistor Circuits Amos	€8.50	☐ Microcomputer Based Design Peatman ☐ Digital Hardware Design Peatman	£9.10
Design of Active Filters with experiments Berlin	£10.40	BBC Micro Revealed Ruston	£9.45
1 49 Easy to Build Electronic Projects Brown	£5.20	☐ Handbook of Advanced Robotics Safford	£12.15
Electronic Devices & Circuit Theory Boylestad	£11.95 £3.55	☐ 1001 Things to do with your own personal computer Sawusch ☐ Easy Programming for the ZX Spectrum Stewart	£7.15
☐ How to build Electronic Kits Capel ☐ How to Design and build electronic instrumentation Carr	£3.95	☐ Microprocessor Applications Handbook Stout	£34.40
☐ Introduction to Microcomputers Daglecs	£7.20	Handbook of Microprocessor Design and Applications	£27 60
☐ Electronic Components and Systems Dennis ☐ Principles of Electronic Instrumentation De Sa	£15.00 £11.40	Stout Programming the PET/CBM West	£37.60 £17.80
☐ Principles of Electronic Instrumentation De Sa ☐ Giant Handbook of Computer Software	£11.00	An Introduction to Microcomputer Technology Williamson	£6.20
Giant Handbook of Electronic Circuits	£14.75	Computer Peripherals that you can build Wolfe	£10.50
☐ Giant Handbook of Electronic Projects	£9.95	Microprocessors and Microcomputers for Engineering Stud	£6.60
☐ Electronic Logic Circuits Gibson ☐ Analysis and Design of Analogue Integrated Circuits Gray	£5.55 £26.95	and Technicians Wooland	20.00
Basic Electronics Grob	£10.50	DEFENSE BOOKS	
☐ Lasers — The Light Fantastic Hallmark	£6.60	REFERENCE BOOKS	
Introduction to Digital Electronics & Logic Joynson Electronic Testing and Fault Diagnosis Loveday	£5.25 £6.60	☐ Electronic Engineers' Handbook Fink	£56.45
☐ Electronic Fault Diagnosis Loveday	£5.75	☐ Electronic Designers' Handbook Giacoletto	£59.55
☐ Essential Electronics A-Z Guide Loveday	£7.20	☐ Illustrated Dictionary of Microcomputer Technology Hordeski	£7.25
☐ Microelectronics Digital & Analogue circuits and systems Millman	£11.80	☐ Handbook for Electronic Engineering Technicians Kauffman	
103 Projects for Electronics Experimenters Minis	£7.25	☐ Handbook of Electronic Calculators Kauffman	£34.40
☐ VLSI System Design Muroga	£30.00	☐ Modern Electronic Circuit Reference Manual Marcus ☐ International Transistor Selector Towers	£40.70 £10.70
☐ Power FETs and their application Oxner ☐ Practical Solid State Circuit Design Olesky	£23.00 £8.40	International Microprocessor Selector Towers	£16.00
☐ Practical Solid State Circuit Design Clesky ☐ Master Handbook of IC Circuits Powers	£10.95	International Digital IC Selector Towers	£10.95
Electronic Drafting and Design Raskhodoff	£21.85	☐ International Op Amp Linear IC Selector Towers ☐ Illustrated Dictionary of Electronics Turner	£8.50 £12.95
□ VOM — VTVM Handbook Risse     □ Video and Digital Electronic Displays Sherr	£7.25 £25.40	[] Indistricted Distriction of Electronics Famor	212.00
Understanding Electronic Components Sinclair	£7.50	VIDEO	
☐ Electronic Fault Diagnosis Sinclair	£4.50		
☐ Physics of Semiconductor Devices Sze ☐ Digital Circuits and Microprocessors Taub	£14.50 £32.00	Servicing Home Video CAssette REcorders Hobbs	£11.80
Active Filter Handbook	£6.50	Complete Handbook of Videocassette Recorders Kybett	£7.95
☐ Designing with TTL Integrated Circuits Texas	£14.00	☐ Theory and Servicing of Videocassette Recorders McGinty ☐ Beginner's Guide to Video Matthewson	£11.95 £5.20
☐ Transistor Circuit Design Texas ☐ Digital Systems: Principles and Applications Tocci	£14.00 £11.85	☐ Video Recording: Theory and Practice Robinson	£14.40
☐ Master Handbook of Telephones Traister	£11.85 £8.65	☐ Video Handbook Van Wezel	£21.90
How to build Metal/Treasure Locators Traister	£5.20	☐ Video Techniques White	£12.95
☐ 99 Fun to Make Electronic Projects Tymony ☐ 33 Electronic Music Projects you can build Winston	£7.25 £5.95		
	20.50	Please send me the books indicated. I enclose cheque/postal ord	ler for £
COMPUTERS & MICROCOMPUTERS		Prices include postage and packing.  I wish to pay by Access/Barclaycard. Please debit my a	
BASIC Computer Games Ahl	£6.35	I wish to pay by Access/Darciaycard, Flease debit my a	ccount
From BASIC to PASCAL Anderson	£7.95		
Mastering Machine Code on your ZX81 T. Baker	£6.95	5 2 2 4	
UNIX — The Book Banaham  Z80 Microcomputer Handbook Barden	£7.80 £10.00	3 2 2 7	
☐ Z80 Microcomputer Mandbook Barden ☐ Microcomputer Maths Barden	£10.75		
☐ Digital Computer Fundamentals Barter	£9.20	4 9 2 9	
Visicale Book, APPLE Edition Bell	£14.50 £14.50		
☐ Visicalc Book. ATARI Edition Bell ☐ Introduction to Microprocessors Brunner	£14.50 £22.00	Signed	
Programming your APPLE II Computer Bryan	£7.95	Nome	
☐ Microprocessor Interfacing Carr	£6.60 £8.10	Name	
☐ Microcomputer Interfacing Handbook A/D & D/A Carr ☐ Musical Applications of Microprocessors Chamberlain	£25.50	Address	
30 Computer Programs for the Home Owner in BASIC		Audi 633	*******
D. Chance	£7,95 £7,95		
☐ Microcomputers Dirkson ☐ APPLE Personal Computer for Beginners Dunn	£8.50		,
	10.00		
☐ Microcomputers/Microcomputers — An Intro Gioone ☐ Troubleshooting Microprocessors and Digital Logic Goodn	£10.90		*****

## **HYCONOMISER**

Although not electronic, we believe that Vivian Capel's report on the Hyconomiser will interest ETI readers as it could affect something very near to their hearts — their wallets! After all, the more cash you save, the more you can spend on electronic goodies.

etrol-saving gadgets have abounded over recent years, and even before that when the stuff was much cheaper. Savings were marginal with most, some made no difference and a few actually increased consumption! It was with great scepticism, then, that I greeted the announcement of yet another, especially as it cost the not insignificant sum of £47.50. Even today you can buy quite a few gallons of petrol for that.

The ad claimed savings of up to 20%. That phrase 'up to' of course is the let-out; 5% or even 2% could be said to qualify. However, I was impressed by the fact that all the listed suppliers and fitters were well-known main-agent garages that had reputations to lose. Fitting, incidentally, must be by a trained mechanic, and this is included in the

Still suspicious, I phoned all the garages and questioned the mechanics. All were enthusiastic except a Volkswagen dealer who was having troubles, which I

believe have since been resolved.

So what actually is it and what does it do? Much of the wastage in a petrol engine is due to large drops of fuel which are too big to be fully burnt before they are ejected from the exhaust. Some, because of their size and mass do not move quickly enough to make it around the sharp bends of the inlet ducts, hit the walls and run down the cylinders to dilute the oil. This is aggravated at part-throttle settings by the throttle-plate, which diverts the flow toward the manifold walls. A further factor is the lowpressure region set up under the throttle-plate which tends to deflect the fuel toward the front cylinders, thus giving uneven distribution and power loss. And finally in the fuel saga, uneven atomisation produces regions of uneven mixture in the combustion chambers around the plug tips.

A formidable collection of ills, curable you might think only by completely redesigning the petrol engine! Not so, for the Hyconomiser claims to overcome them all. How?

By sonic pulses.

#### **Blowing In The Wind**

It consists of a plastic cylinder containing three plastic balls. A controlled air flow passes through the cylinder making the balls resonate at three different frequencies from 850 Hz to 2.5 kHz. The pulsed air flow is injected through a tube into the intake manifold below the carburettor. There the highest frequency produces a cone of microturbulence that smashes the fuel droplets into a fine mist with particles smaller than 20 microns.

The mixture still has to be distributed evenly to all cylinders, and evenly within each cylinder. This is the job of the middle and lower frequencies which set up areas of

turbulence throughout the fuel inlet system.

The results are less consumption, more power, smoother running and, of interest to the environmentalists, less exhaust pollution. Engine and plugs also run cleaner. Air/fuel ratio is maintained closely to the optimum 14.6:1 stoichiometric region.

Well, it sounds good but does it work? I decided to take a chance and had one fitted. Beforehand I made a careful check on my consumption in my elderly 1964 Wolseley 16/60, and for mixed town and country travel found it was 23 mpg. After fitting, I repeated the test with the same journeys. In view of the 'up to' phrase I would have been happy with 10% improvement: so I was very pleased to achieve 28 mpg, a 21% increase. Later, on a single long-distance run I did 34 mpg, but had no previous figure for this run to compare with.

I discussed this later with Hyco's managing director Tom Pearse. I learned that performances in excess of 20% were not at all uncommon, and I saw a report by one of the main-agent garages of before-and-after tests on various more recent model cars at several fixed speeds. Some were considerably higher, although this would not be a fair test of everyday motoring. Pressed for a minimum expected figure, Mr Pearse said he would be surprised if a normal production car did not attain 15% improvement.

As to cleaning the engine, I found it does this too. The makers stipulate that cars with old engines should be returned to the fitter after about 150 miles for re-tuning the device. It is in fact individually tuned for resonance with the particular engine it is fitted to. The turbulance breaks up the carbon deposits and thereby enlarges the combustion area, causing the device to de-tune. Once re-tuned the engine remains carbon-free and there is no further need of tuning.

The fitters did not inform me of this, and some thousand miles later my consumption had climbed and the device was completely off tune. Re-tuning restored op-

timum economy once more.

I can also confirm that the performance of my car is more sprightly although I have not pursued this too far, as my driving is definitely economy-orientated.

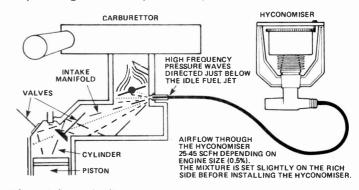


Fig. 1 Schematic diagram showing the operation of the Hyconomiser. By acoustically atomising the petrol, improved combusion and air/fuel ratio results.

## FREE CATALOGUE!

OUR GREAT NEW ILLUSTRATED CATALOGUE IS PACKED WITH INFORMATION ON SUPERB QUALITY, PROFESSIONAL BURGLAR ALARM **EQUIPMENT** 



#### AT UNBEATABLE PRICES!

SENO S.A.E. OR PHONE **NOW** FOR YOUR COPY THIEFCHECK BURGLAR **ALARM D-1-Y SYSTEM** 



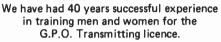
**OISTRIBUTOR** 

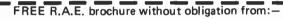
A.D. ELECTRONICS DEPT. ETI 6 217 WARBRECK MOOR AINTREE LIVERPOOL L9 0HU/051 523 8440

#### TALK TO THE WHOLE WORLD

Study now for the

#### RADIO AMATEUR'S EXAMINATION





British National Radio & Electronics School READING, BERKS, RG1 1BR

Name .																		
Address																		

ETI/6/817 BLOCK CAPS PLEASE

#### **MULTIMETERS**

(UK C/P 65p) RANGE DOUBLER 10A DC1 £15.95 ETC 5000/5001 121 Ranges 50K/V Range Doubler 10A DC £16.50 TMK 500 23 Ranges 30K/V 12A ....£23.95 DC Plus cont. buzzer... NH56R 20K/V 22 Range Pocket ...£10.95 360TR 23 Range 100K/V. Large scale 10A AC/DC plus Hfe....£36.95 ATI 020 18 Range 20K/V. DeLuxe plus Hfe Tester ...... £17.50 ST303TR 21 Range 20K/V plus Hfe

#### **SPEAKERS**

(Hi-Fi, P.A., Disco, Bass Guitar) 12" 50W .....£14.95 12" 100W .....£19.95 15" 100W .....£29.95 18" 100W .....£39.95 Postage and Packaging £3 **RETAIL • MAIL ORDER EXPORT • INDUSTRIAL** 

**EDUCATIONAL** 

ALL PRICES CATALOGUE INCLUDE SEND LARGE SAE

(UK 20p)

MUSICRAFT 303 EDGWARE RD, LONDON W.2. TEL: 01-402 9729/2898

..£16.95

#### WHY WRITE TO LONDON

When you can walk to the Midlands largest selection of DIY.

Plugs, sockets, connectors, cable, flex, leads, boxes, Aerials, styli, components, elements, semi-conductors, meters.

Spares and repairs for all electronic, electrical and audio.

H. G. Electronics Co. 1350 Stratford Road, Hall Green, Birmingham B28 9EH Telephone: 021-777 2369



## LB ELECTRONICS

#### DISC DRIVE BONANZA

PERTEC FD650 DSDD 8"

40 Track

£228 + VAT

TEAC FD-55F 1/2 Height DSDD 80 track New Cannon 2/3 drive SSDD Shugart Compatable

£129 + VAT

All 5% drives suitable for BBC MICPC

POWER SUPPLIES for 51/4" disc drives.
5 volts at 1 amp.
12 volts at 1.3 amp. £14.00 + VAT P/P £1.00 .00 + VAT P/F £1.00 £14.00 + VAT p/p £1.00 £1.00 p/p 15p £1.35 p/p 15p £2.00 p/p 30p bllets £4.95 p/p 65p 12 Volts at 1.3 amp.
DC power plug for 5½" drive
DC power plug for PERTEK drive 8"
Amphenol 36way (Centronics) plugs used
Brand new EXPO PCB Drill (12 volts DC) plus collets

The above drives are suitable for the BBC Micro, we can supply full documentation if requested with purchase of the drives only. Also available is a word processing package with is a tape to disc program (i.e. will not run without discdrives.

Offered with Full documentation at £9.80 p&p 50p.

#### **BRAND NEW AND BOXED PLUS DATA P&P AT COST**

Apple controller card for two drives £40.00 + VAT p&p 50p ASC11coded qwerty Keyboard manufactured by Alphanumeric (Woking £40.00 + VAT p&p 50p UK). Model 60K brand new plus data .......£19.95 p&p £1.50 25 WAY 'D' Types, plugs £1.85, sockets £1.85 (solder tail) p&p 30p. Telephone for bulk prices.

(Manuals available £5.00 each)

#### **INTERSCAN ACCOUSTIC COUPLER** 10" × 4" × 5" WITH ELECTRONICS, SOUND TIGHT UNIT, FOR STANDARD GPO HAND SET. NO DATA - £10.00 (INC VAT) P&P £1.75

8" Drive Cabinets complete with power supply (LINEAR) to take two 8" Drives, Brand New £99.95p + VAT 5p (carriage cost) Twin 5" Cabinets with power supply £85.00 + VAT (to arrive shortly) 9" Green Phosphor Monitors Brand New and Cased Composite Video Input 18mhz band width £78 + VAT each (carriage cost)



### LB ELECTRONICS

11 HERCIES ROAD, HILLINGDON, MIDDLESEX UB10 9 LS, ENGLAND TEL: UXBRIDGE 55399



#### MARCO TRADING SPECIAL OFFERS

Translators
BC308A— PNP 30V, 0.2A, 0.3W, 130MHZ. (Similar to: BC178, 205, 213, 252, BC308A— PNP 30V, 0.2A, 0.3W, 130MHZ. (Similar to: BC178, 205, 213, 252, 513, 558)
Price: 10 for 50p; 100 for £3.00; 1000 for £20.00; Larger Qty prices on application)

BC170: NPN 20V, 0.1A, 0.3W, 100MHZ (Similar to: BC108, 183, 208, 238, 383, 10 for 50p; 100 for £3.00; 1000 for £20.00. Larger Qty prices on

Price: 10 for application)

BC250A— PNP 30v, 1.2A, 0.3W, 130MHZ. (similar to: BC178, 213, 252, 308, 513, 558) Price: 10 for 75p; 100 for £6.00; 1000 for £50.00. Larger Qty prices on application)

AU110— PNP 160V, 10A, 30W, (Similar to AU107, 2N5324, 2N5325) Price: 10 for £12.00; 100 for £85.00

Capacitors
470u 16V Radial (25mm x 15mm-4mm lead length) 5p each: £3.00 per 100
1000u 16V Radial (30mm x 15mm-4mm lead length) 8p each: £5.00 per 100
3300u 16V Axial (50mm x 20mm) 25p each: 10 for £2.00; 100 for £15.00

Plastic boxes complete with removable lids (Fixing screws not supplied) Size: 3" x 3" x 1½" Deep. Available in black or red (Please state colour when ordering). Price: 50p each; 10 for £4.00.

Transformers
Good quantity transformers with independent secondaries:
Primary: 240V Secondary 1: 15-0-15V at 1½ A per side, Secondary 2: 9V at 4A (with a bridge gives 12V DC)
Prica: £2.50 each (P&P £1.20 in addition to 35p normal charge).

Multibloc 4-Way Extension Socket
PVC body with internal cable grip fitted with 13A fuse and neon indicator. Max total load 13A 250V; Length 10½; Width 2½.
Price: £4.50 each (P&P 25p in addition to 35p normal charge).

Video TV projection screens Phillips 60" £50 each (P&P £6)

T.V. projection lenses. Fresnel type 9010 £10 per pair. (P&P 50p per pair)

Send 35p NOW for our latest Catalogue. Fantastic value it includes capacitors, diodes, resistors, transistors, LEDs, boxes, cable, prepaid envelopes and much, much more.
Please add 35p postage and packing and 15% VAT to all orders.

Send orders to

#### MARCO TRADING (Dept ET6)



The Maitings, High Street, Wem, Shropshire SY4 5EN Telephone: WEM (0939) 32763

Every order receives our latest special offer lists. Or send SAF All orders despatched by return of mail.

## E.T.I. — JUNE 83 ADVERTISERS INDEX

A.D. Electronics90
Aitken Bros
Ambit Int75
Armon Electronics64
Audio Electronics63
Bi-pak16
BK Electronics14
Black Star77
BNRS87, 90
BRadley Marshall10
Cambridge Kits86
Circuit Board Components83
Clef Products76
Comtech Electronics12
Comquip
Concept Electronics82
Cricklewood Electronics8,9
Crimson Elektrik62
Dataman Design19
Delta Tech64
Display Electronics28
Electronize Design58
Electrovalue39
Emos83
Enfield Electronics91
Flight Electronics49
Greenbank82
Greenweld68
G.S.C
Happy Memories91
H.G. Electronics90
Horizon Electronics91
ICS91
100

#### TECHNICAL TRAINING IN ELECTRONICS, **TELEVISION AND AUDIO**

#### IN YOUR OWN HOME-AT YOUR PACE

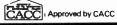
ICS can provide the technical knowledge that is so essential to your success, knowledge that will enable you to take advantage of the many opportunities open to the trained man. You study in your own home, in your own time and at your own pace and if you are studying for an examination ICS guarantee coaching until you are successful

#### City & Guilds Certificates

Radio Amateurs Basic Electronic Engineering (Joint C&G/ICS)

#### Certificate Courses

TV and Audio Servicing Radio & Amplfier Construction Electronic Engineering\* and Maintenance Computer Engineering\* and Programming TV, Radio and Audio Engineering Electrical Engineering,\* Installation and Contracting \*Qualify for IET Associate Membership





Member of ABCC

#### POST OR PHONE TODAY FOR FREE BOOKLET

Please send me your FREE School of Electronics Prospectus.
Subject of Interest
Name
Address



Post to.

Dept H265 ICS School of Electronics 160 Stewarts Road London SW8 4UJ



#### HAPPY MEMORIES

Part Type	1 011	25-99	100 up
4116 200ns	.90	.81	.78
4116 250ns	.70	.63	.60
4816 100ns For BBC comp	2.20	1.95	1.85
4164 200ns	3.99	3.56	3.42
2114 200ns Low power	1.15	1.00	.90
2114 450ns Low power	.95	.85	.80
4118 250ns	3.35	3.00	2.85
6116 150ns CMOS	3.35	3.00	2.85
2708 450ns	2.60	2.25	2.10
2716 450ns 5 volt	2.35	2.10	2.02
2716 450ns three rail	5.75	5.00	4.65
2732 450ns Intel type	3.50	3.15	3.00
2532 450ns Texas type	3.70	3.30	3.00
2764 250ns	4.90	4.35	4.20
			_

Z80A-CPU £3.95 Z80A-PIO £2.99 Z90A-CTC £2.99 6522 PIA £3.70 88LS120 £2.20 7002 A-D £4.60 3691 £2.75 7812 reg 7805 reg .50

Low profile IC sockets: Pins 8 14 16 18 20 22 23 28 40 Pence 9 10 11 14 15 18 19 25 33

Soft-sectored floppy discs per 10 in plastic library case: 5 inch SSSD £17.00 5 inch SSDD £19.25 5 inch DSDD £21.00 5 inch DSQD £26.35 8 inch SSSD £19.25 8 inch SSDD £23.65 8 inch DSDD £25.50

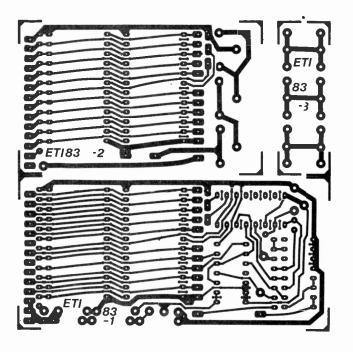
745LS series TTL, large stocks at low prices with DIY discounts starting at a mix of just 25 pieces. Write or 'phone for list.

Please add 50p post & packing to orders under £15 and VAT to total. Access & Visa welcome. 24hr service on (054 422) 618 Government & Educational orders welcome, £15 minimum. Trade accounts operated, 'phone or write for details.

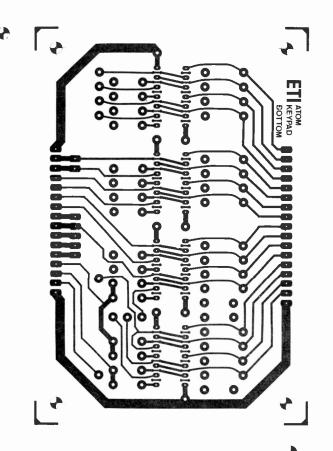
#### Happy Memories (ETI),

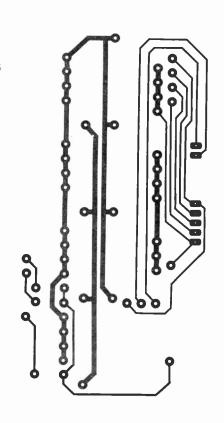
Gladestry, Kington, Herefordshire. HR5 3NY. Tel: (054 422) 618 or 628

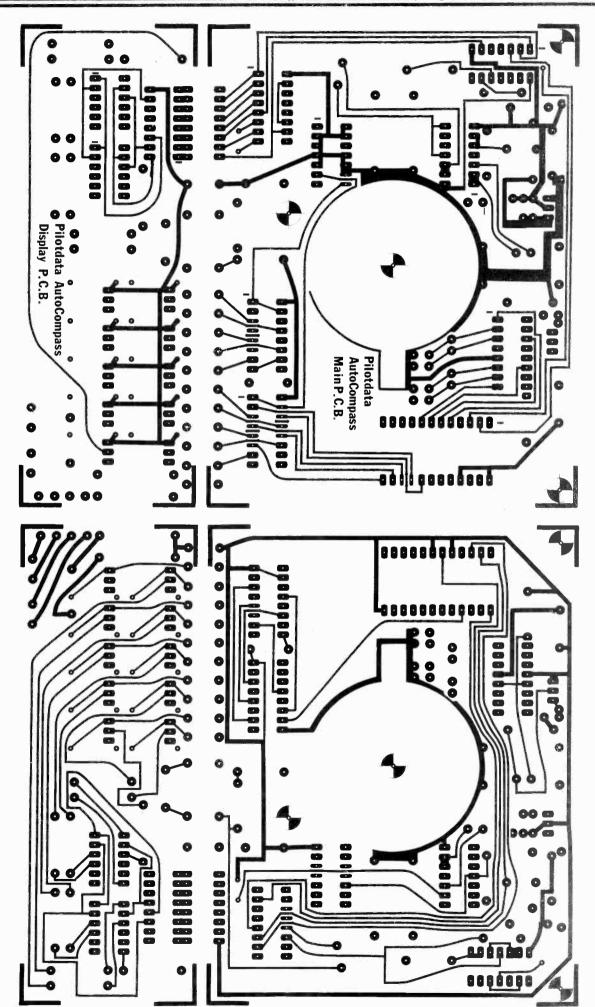
# PCB FOIL PATTERNS











MONTHLY IN **ELECTRONICS TODAY** -YOUR OWN WHERE TO **BUY IT' GUIDE** 

#### AVON

#### **ANNLEY ELECTRO**

190 Bedminster Down Road Bedminster Down, Bristol Tel: 0272 632622 Open: Mon-Sat 9am-6.30 pm Wed 9am-2pm

#### DORSET

**D.J. ELECTRONICS** 64 Ensbury Park Road, Bournemouth. Tel: (0202) 515073.

Open: Mon-Sat 9am-6pm.

#### LANCASHIRE

#### ETESON ELECTRONICS 15B Lower Green,

Poulton-le-Fylde, Blackpool Tel: (0253) 885107

9 30am 12 30 1 30 5 30 Closed Wed & Sun Electronic Component Specialists.

#### **MERSEYSIDE**

#### MYCA ELECTRONICS

2 VICTORIA PL, SEACOMBE FERRY, WALLASEY, L44 6NR. Tel: 051 638 8647

Open Mon-Sat 10am-5.30pm Mail Order price list 50p refundable

LOOKING FOR **COMPONENTS! HARDWARE! CASES! TRY YOUR LOCAL** LISTED STOCKIST

#### PROGRESSIVE RADIO

93 Dale Street. Tel 051 236 0982 47 Whitechapel, Tel 051 236 5489 Liverpool 2 THE ELECTRONICS SPECIALISTS Open: Tues-Sat 9.30-5.30

#### W. MIDLANDS

103 Coventry St., Kidderminster Components, computers, car radios, C.B.'s, amateur radio and all electronic hobby equipment
Open: Mon-Sat 9-6, Sun 10-2 TEL: 0562 2179



#### H. G. ELECTRONICS CO

1350 Stratford Rd., Hall Green Birmingham. Tel: 021-777 2369 Open: Mon-Sat 9-5.30 (Closed Weds) Electrical accessories, plugs, skts, leads, Electronic components, computers, audio. video, tape, disco, hi-fi . . .

#### **NORTHAMPTONSHIRE**

- \* A new company selling electronic components
- Mail order and walk-round supermarket.
- \* Yast stocks and very competitive prices.



High March, Daventry, NNII 4HQ.
Telephone 03272 5523. Teles 311245.
(Off A45 onnosite laborate (Off A45 opposite John O'Gaunt.)

FOR YOUR BUSINESS TO BE INCLUDED, CALL **ELECTROMART ON** 01-437-1002.

#### **STAFFORDSHIRE**



ELECTRONIC SUPPLIES

105 High St., Woistanton, Newcastle

Tel: 0782 636904

Open: Mon-Wed 9-6, Thurs 9-12 & 5-7, Fri & Sat 9-9, Sun 11-2

#### S. WALES

STEVE'S ELECTRONIC SUPPLY CO. LTD. 45 Castle Arcade, Cardiff

TEL: 0222 41905 Open: Mon-Sat 9-5.30 For components to computers

#### WARWICKSHIRE



Charlotte St, Rugby. Tel: Rugby 78138 Open 5 Days 10-6 (closed Wed) Wide range of components and R.S. stockists 1983 Mail Order Catalogue 75p

#### YORKSHIRE



ACE MAILTRONIX LTD. 3A Commercial Street, Batiey. Tel: (0924) 441129

Open: Mon-Fri 9am-5.30pm. (Sat 1pm) Retail and wholesale.

Please include INTERNATION	e my busines NAL:	s details in the nex	t available issue of E	LECTRONICS TODAY
BUSINESS NAM	ИЕ:			
ADDRESS:	***************************************		•••••	
				ON
				£17 CY
	*************	•••••••••••••••••••••••••••••••••••••••	•••••••••••••••••••••••••••••••••••••••	.501
TEL. NO.:		••••••••••••		
OPENING HOU	RS:			
F	RETAIL []	WHOLESALE	MAIL ORDER	(Please tick)
CONTACT: (FOR	OFFICE USE	ONLY)	*****	

## ETIPCB SERVICE

Up until now PCBs were always the hardest component to obtain for a project. Of course you could make your own, but why bother anymore?

Now you can buy your boards straight from the designers — us! As of this issue all (non-copyright) PCBs will be available automatically from the ETI PCB Service. Each board is produced from the same master used to build our prototypes, so you can be sure it's accurate and will be finished to the high standard you would expect from ETI.

In addition to the PCBs for this month's projects, we are making available some of the more popular designs from our recent past. See the list below for details. Please note that NO OTHER BOARDS ARE AVAILABLE. If it's not listed, we please that have it!

ALWAYS QUOTE THE P	CB CODE WHEN	ORDERING PLEASE
--------------------	--------------	-----------------

E/794-1 Guitar Effects Unit	age Probe 1,93 age Panel (2 Boards) 10.70 Generator 5.29 B 2,41 b Interface (2 Boards) 5.87 tracolumn 4.82 Guage 3.00 DC 2,25 mmable PSU 3.00 Board 11.16 Module 3.15 User Graphics 0,93 Probe 2,17 ime Clock 7.60 emeter (2 Boards) . 8.47
□ E/794-1 Guitar Effects Unit       2.64       □ E/8110-1 Enlarger Timer       3.40       □ E/8210-1 Messi         □ E/794-2 Click Eliminator       6.64       □ E/8110-2 Sound Bender       2.65       □ E/8211-4 Pulse         □ E/796-1 Accented Beat Metronome       3.60       □ E/8111-1 Voice Over Unit       3.97       □ E/8212-1 ELCI         □ E/803-1 Signal Tracer       □ E/8111-2 Car Alarm       2.81       □ E/8212-2 Serve         □ E/803-1 Signal Tracer       2.27       □ E/8112-1 Alcohometer (2 boards)       5.21         □ E/808-1 CMOS Logic Tester       2.64       □ E/8112-3 Bodywork Checker       1.75       1983         □ E/8010-1 Cassette Interface       2.93         □ E/8010-2 Fuzz/Sustain Box       3.27       □ E/821-1 Parking Timer       2.20       □ E/831-3 Progra         □ E/8011-6 Audio Test Oscillator       3.13       □ E/821-3 Guitar Tuner (2 boards)       5.55       □ E/833-3 ZX81         □ E/8012-3 Four Input Mixer       2.64       □ E/822-2 Allez Cat Pest Repeller       1.68       □ E/833-4 Logic I         □ E/822-5 Moving Magnet Stage       3.49       □ E/834-2 Therm         □ E/822-6 Moving Coil Stage       3.49       □ E/834-2 Therm	Generator
E/796-1 Accented Beat Metronome 3.60	B
□ E/796-1 Accented Beat Metronome       3.60       □ E/8111-1 Voice Over Unit 3.97       □ E/8212-1 ELCI □ E/8111-2 Car Alarm	D Interface (2 Boards) 5.87 tracolumn 4.82 duage
E/8111-2 Car Alarm   E/8212-2 Served   E/803-1 Signal Tracer	Guage
E/803-1 Signal Tracer	Guage
□ E/803-1 Signal Tracer       2.27       □ E/8112-1 Alcohometer (2 boards)       5.21         □ E/808-1 CMOS Logic Tester       2.64       □ E/8112-3 Bodywork Checker       1.75       1983         □ E/808-3 Uitrasound Burglar Alarm       2.87       □ E/8010-1 Cassette Interface       2.93       □ E/8010-2 Fuzz/Sustain Box       3.27       □ E/8010-2 Fuzz/Sustain Box       3.27       □ E/8011-5 RIAA Preamp       1.93       □ E/821-1 Parking Timer       2.20       □ E/833-1 Sound         □ E/8011-6 Audio Test Oscillator       3.13       □ E/821-3 Guitar Tuner (2 boards)       5.55       □ E/833-2 Alarm         □ E/8012-1 Musical Doorbell       2.80       □ E/822-1 Ripple Monitor       1.92       □ E/833-3 ZX81         □ E/8012-3 Four Input Mixer       2.64       □ E/822-2 Allez Cat Pest Repeller       1.68       □ E/833-4 Logic I         □ E/822-5 Moving Magnet Stage       3.49       □ E/834-1 Real T         □ E/822-6 Moving Coil Stage       3.49       □ E/834-2 Therm	DC
E/808-1 CMOS Logic Tester.       2.64       E/8112-3 Bodywork Checker       1.75       1983         E/808-3 Ultrasound Burglar Alarm       2.87       E/8112-4 Component Tester       1.49       E/831-1 Fuel Green         E/8010-1 Cassette Interface       2.93       E/8010-2 Fuzz/Sustain Box       3.27       E/8011-5 RIAA Preamp       1.93       E/821-1 Parking Timer       2.20       E/833-1 Sound         E/8011-6 Audio Test Oscillator       3.13       E/821-3 Guitar Tuner (2 boards)       5.55       E/833-2 Alarm         E/8012-1 Musical Doorbell       2.80       E/822-1 Ripple Monitor       1.92       E/833-3 ZX81         E/8012-3 Four Input Mixer       2.64       E/822-2 Allez Cat Pest Repeller       1.68       E/833-4 Logic I         E/822-5 Moving Magnet Stage       3.49       E/834-2 Therm         1981       E/822-6 Moving Coil Stage       3.49       E/834-2 Therm	DC
E/808-3 Uitrasound Burglar Alarm       2.87         E/8010-1 Cassette Interface       2.93         E/8010-2 Fuzz/Sustain Box       3.27         E/8011-5 RIAA Preamp       1.93         E/8011-6 Audio Test Oscillator       3.13         E/8012-1 Musical Doorbell       2.80         E/8012-3 Four Input Mixer       2.64         E/802-2 Allez Cat Pest Repeller       1.68         E/823-3 There       E/833-1 Sound         E/821-1 Parking Timer       2.20       E/833-1 Sound         E/821-3 Guitar Tuner (2 boards)       5.55       E/833-2 Alarm         E/8012-3 Four Input Mixer       2.64       E/822-1 Ripple Monitor       1.92       E/833-3 ZX81         E/822-2 Allez Cat Pest Repeller       1.68       E/833-4 Logic I         E/822-5 Moving Magnet Stage       3.49       E/834-1 Real T         E/822-6 Moving Coil Stage       3.49       E/834-2 Therm	DC
□ E/8010-1 Cassette Interface       2.93         □ E/8010-2 Fuzz/Sustain Box       3.27         □ E/8011-5 RIAA Preamp       1.93         □ E/8011-6 Audio Test Oscillator       3.13         □ E/8012-1 Musical Doorbell       2.80         □ E/8012-3 Four Input Mixer       2.64         □ E/8012-3 Moving Magnet Stage       3.49         □ E/831-2 ZX AI         □ E/831-3 Progra         □ E/833-1 Sound         □ E/821-3 Guitar Tuner (2 boards)       5.55         □ E/833-2 Alarm         □ E/822-1 Ripple Monitor       1.92         □ E/833-3 ZX81         □ E/822-2 Allez Cat Pest Repeller       1.68         □ E/833-4 Logic I         □ E/822-5 Moving Magnet Stage       3.49         □ E/834-2 Therm         □ E/822-6 Moving Coil Stage       3.49         □ E/834-2 Therm	mmable PSU
E/8011-5 RIAA Preamp       1.93       E/821-1 Parking Timer       2.20       E/833-1 Sound         E/8011-6 Audio Test Oscillator       3.13       E/821-3 Guitar Tuner (2 boards)       5.55       E/833-2 Alarm         E/8012-1 Musical Doorbell       2.80       E/822-1 Ripple Monitor       1.92       E/833-3 ZX81         E/8012-3 Four Input Mixer       2.64       E/822-2 Allez Cat Pest Repeller       1.68       E/833-4 Logic I         E/822-5 Moving Magnet Stage       3.49       E/834-1 Real T         E/822-6 Moving Coil Stage       3.49       E/834-2 Therm	Board
E/8011-6 Audio Test Oscillator	Module 3.15 User Graphics 0.93 Probe 2.17 ime Clock 7.60
E/8011-8 Addib Test Oscillator	User Graphics 0.93  Probe 2.17 ime Clock 7.60
☐ E/8012-3 Four Input Mixer 2.64 ☐ E/822-2 Allez Cat Pest Repeller 1.68 ☐ E/833-4 Logic I☐ E/822-5 Moving Magnet Stage 3.49 ☐ E/834-1 Real T☐ E/822-6 Moving Coil Stage 3.49 ☐ E/834-2 Therm	Probe 2.17 ime Clock 7.60
E/8012-3 Four input winter	ime Clock 7.60
1981	
1981 □ E/822-6 Moving Coil Stage 3.49 □ E/834-2 Therm	emeter (2 Boards) 8.47
□ = [0.00 ± 0	
E/811-1 LED Tacho	Lighting — Main 11.94
E/611-2 Multi-Option Silen 3.20 E/624-3 Voltage Monitor	Lighting — Display 3.00
☐ E/813-1 Universal Timer 3.31 ☐ E/825-1 DV Meg 2.72 ☐ E/835-1 Compr	ressor/Limiter 5.38
E/812-1 IN Alarm (4 boards) 6.04 E/625-2 Analogue 1 WW	PSU
E/612-5 Fulse Generator	SU
E/613-1 Engineer's Stethoscope 2.03	NDFL Amp 4.70
E/814-2 Drum Machine (2 boards) . 5.60   E/626-4 MOSFET Amp Module: 6.70	ed Input Preamp 2.81
E/814-4 Guitar Note Expander 3.20 E/620-3 Logic Lock	Lighting — Autofade 5.38
☐ E/816-8 Waa-Phase 1.53 ☐ E/826-6 Digital PWM 3.34 ☐ E/835-7 Stage I	3
☐ E/816-9 Alien Attack	Board 4.12
E/817-1 System AS- Input	seudoROM (3 Bds) . 3.15
(WIN OF WC)2.05 = E/02/-7 TV Baigraph Wall4.00 =	sible Heater , 2.00
E/817-2 System A - Preamp 5.17  E/627-3 I V Bargraph Chainlei 2.20  E	Keypad 4.50
E/817-3 Smart Battery Charger 1.37 E/627-4 Hotwire	ned Mode PSU 14.00
E/818-3 Hand Clap Synth 3.97 E/827-5 Bridging Adaptor 2.38	CB Code Means
☐ E/818-5 Watchdog Home Security ☐ E/828-1Playmate (3 Boards)/.20	) signifies that the
(2 boards)	ETI project (as
E/020-0 South Track	Hobby or Ham
(3 boards) 7.35 E/829-1 Auto Volume Control 1.84 Opposed to a	
	numbers give the
year in which	h the project was
STRICLY CASH WITH ORDER – OFFICIAL ORDERS ARE NOT published,	F,
	e or two numbers
	ash give the month
	project was published;
	after the dash
	e project within the
ticking the boxes and send this page, together with month.	
your payment, to: ETI PCB Service, Argus	
Specialist Publications Ltd, 145 Charing Cross Signed Signed	
Road, London WC2H 0EE. Make cheques payable	
to ETI PCB Service. Payment in sterling only please.	
Prices subject to change without notice.  Address	
Total for boards £ PLEASE ALLOW	
Add 45p p & p 0. 45   28 DAYS FOR	
Total enclosed £ DELIVERY	

#### **ELECTRONICS TODAY INTERNATIONAL**

**CLASSIFIED** 

Lineage:

35 p per word (minimum 15 words) Semi Display: (minimum 2 cms)

1- 3 insertions £10.00 per cm 6-11 insertions £ 9.50 per cm

Ring for information on series bookings/discounts

12+ insertions £ 9.00 per cm

All advertisements in this section must be prepaid.

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





01-437 1002 **EXT 204** 

Send your requirements to: Jo James, ASP Ltd., 145 Charing Cross Road, London WC2H 0EF.

#### **COMPONENTS**



UNBEATABLE PRICES for our electronics components. CMOS, TTL, Linear etc. (e.g. NE555 \_\_ 12p, NE556 \_\_ 28p. Texas soundchip SN76 477N \_\_ £1.75). Send S.A.E. For full list Micro Times. 19 Mill Street, Ridoford N.D. S.A.E. Bideford, N.Devon.

**BUILDING A TAPE DECK?** We supply Papst precision tape drive/rewind motors, 120/220 VAC, 12000 RPM, 14W only £4.90 new, (£16.80 elsewhere). Matching capacitor 60p, p&p £1.50 .STEPPING MOTORS ideal for Robotics, any precision cotnrol six-wire, 5.4V, 1.5A DC, torque 45ozin, £4.90 used p&p £1.50. Greymoor Robitcs (EM-AT), 5, Southern Hay, Cavendish Road, Weybridge, Surrey, KT13 0JN.

#### BUMPER BOX OF BITS

WOW! We've got so many components in stock, we can't possibly list them all! — So buy a box. In it you'll find resistors, capacitors, displays, switches, panels with transistors, diodes, IC's etc., coils, pots... and so on. All modern parts — guarenteed at least 1000 items, minimum weight 10lbs, ONLY £8,50 inc.

**ELECTRONICS WORLD** 1e Dews Road, Salisbury, Wilts. SP2 7SN

SURPLUS MANUFAC TURERS REQUIREMENTS. All brand new Tip35A 60p. Tip36A 65p. 2N4405 35p. 2N6287 £1.50. Limited quantities. Mr Howard, 13 Clifton Road, Huntington, Cambs. (0480) 57339.

NOW OPEN IN NEWCASTLE, Waterloo Street, "Marlborough Electronic Components" for the best in electronic components, test equipments etc. Tel 618-377

#### **NEW COMPONENTS** CHEAPEST PRICES

New full spec parts ex stock. Same day despatch SAE or phone for full lists Example prices: 10 uf. 35v radial capacitators 5p each. 100 1/4w resistors 75p (1K, 10K, 100K - other valves available). BC308B 10p each 25IN 4148 for only 45p

**COLCHESTER COMPONENTS** Unit A2

Cowdry Centre, Colchester (0206) 66345

COMPREHENSIVE **FULL** RANGE of IC's, Transistors, Diodes, capacitors, etc. Please send 75p inc. p&p for catalogue, inquiries S.A.E. to Jones Electronics, 267 Rectory Road, Grays, Essex. Or ring Grays Thurrock 33158.

MAIDSTONE ELECTRONIC COMPONENTS shop. Thyronics. Control Systems 8, Sandling Road, Maidstone, Kent, Maidstone 675354.

## £6.50 Post 65p MINI-MULTI TESTER

De-Luxe Range Doubler Model, 50, 000 o.p.v. £18.50 7 x 5 x 2 in Post £1

R.C.S. LOUDSPEAKER BARGAINS 3 ohm 5x3in 7x4in E2.50; 8 ohm 2in 7in E2.00 3in 5in 5x3in 6x4in/x4in E2.50 6/in, 8inx5in E3; 8in E3; 10in E5; 12in E8. 10 ohm 3in 5x3'iin 6x4in 6x2.50, 6/i, 8,6m 6x,5 5 ohm 3in 5x3'iin 6x4in 5in E2.50, 6/i, 8,6m 6x,5 5 ohm 3in 5x3in 7x4in E2.50; 17: 120 ohm 3in die E1.50.

BATTERY ELIMINATOR MAINS to 9 VOLT DC. Stabilised output, 9 volt 400 m a UK made the terminals Overlada cut out 5x3'xx2'xin Transformer Rectifier Unit Suitable Radios Casser tees £4.50. Post 50p

LOW YOUTAGE ELECTROLYTICS 1 2 3 4 8 16 25 30 50 100 200mF 15V 10p. 500mF 12. 15p: 22v 20p: 50V 30p: 1000mF 12V 30p. 250v 30p: 1200mF 76V 80p. 2200mF 52 25V 25V 240V 60p: 2000mF 100V 617 02. 500mF 50V 70p: 3000mF 25V 50p. 50V 50p. 3000mF 63V £1.20; 4700mF 63V £1.20; 2700mF 76V £1. 4700mF 40V 85p: 1000mF 100V £1.

HIGH VOLTAGE ELECTROLYTICS 8 450V 45p 8 + 8 450V 75p 50 - 50 300V 50p 16 35C. 45p 8 + 16 450V 75p 32 + 32 - 32 350V 85p 33 350V 75p 20 - 20 450 / 75p 100 - 100 275V 85p 50 350V 80p 32 - 32 350V 85p 150 - 200 275V 70p 50 450V 85p 32 - 32 50C. 81.80 220 450V 85p

TRIMMERS 2004 Sept 10p 100pf 160pf 15p, 500pf 30p.
COMDENSERS VARIOUS 1pt 100 100pf 15p, 500pf 30p.
COMDENSERS VARIOUS 1pt 100 10mf 350 pf 30p.
COMDENSERS VARIOUS 1pt 100 10mf 350 pf 30p.
COMDENSERS VARIOUS 1pt 100 0mf 350 pf 30p.
COMDENSERS VARIOUS 1pt 100 0mf 350 pf 30p.
COMDENSERS VARIOUS 1pt 100 0mf 350 pf 30p.
CAT 35p 1000 C 1mr 25p; 022mf 30p. 047mf 80p. 175c, 122mf 50p.
CAT 35p 1000 C 1mr 25p; 022mf 30p. 047mf 80p. 175c, 122mf 50p.
CAT 35p 1000 C 1mr 25p; 022mf 30p. 047mf 80p. 175c, 122mf 50p.
CAT 35p 1000 C 1mr 25p; 022mf 30p. 047mf 80p. 175c, 122mf 50p.
CAT 35p 1000 C 1mr 25p; 022mf 30p.
CAT 35p 1000 C 25p; 020mf 30p.
CAT 35p 1000 C 25p; 020mf

THE INSTANT BULK TAPE ERASER OUTSITE OF SERVICES FOR HEAD DEMAGNETISEP PROBE ES OO

£9.50 F. 30



MAINS TRANSFORMERS

#### **RADIO COMPONENT SPECIALISTS**

DEPT 6.337 WHITEHORSE ROAD CROYDON SURREY U.K. TEL 01-684 1665



Post 50p Minimum, Callers Welcome, Closed Wed. Same day despatch Access-Barclay-Visa. Lists 31 p.



#### CONSTRUCTING AN AUDIO MIXER?

To achieve a high quality finish you need commercially produced printed panels - sub-frames - main frames etc designed and manufactured specifically for this purpose.

#### PARTRIDGE **ELECTRONICS**

56 Fleet Road, Benfleet, Essex, SS7 5JN, England.

THE MIXER PEOPLE

(Large S.A.E. please)

#### KITS

DIGITAL WATCH REPLACE-MENT parts, batteries, displays, backlights etc. Also reports publications, charts. S.a.e. for full list Profords Conersdrive, Holmergreen Bucks HP15 6SGD

PRINTED CIRCUITS Make your own simply, cheaply and quickly! Golden Fotolac light-sensitive laquer - now greatly improved and very much faster. Aerosol cans with full instructions, £2.50. Developer 35p. Ferric Chloride 60p. Clear acetate sheet for master 15p. Copper-clad fibreglass board, approx. 1mm thick £2.00 sq. ft. Post/packing 75p. White House Electronics, Castle Drive, Praa Sands, Penzance, Cornwall.

#### **ANYTHING** TO SELL?

Then sell it quickly and cheaply Phone ASP Classified 01-437 1002 ext. 204

#### **SOFTWARE GAMES**

SPY CASSETTE. Amazing cassette will allow you to stop, list or copy any previously un-stoppable tape. Includes two free utilities. State if for ZX81 or \$pectrum. Send just £3. Bolder, 29 Chadderton Drive, Unsworth, Bury, Lancs.

#### **EQUIPMENT**

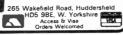
#### CENTURION ALARMS

#### We manufacture, you save £ £ £'s

Send s.a.e. or phone for our Free list of professional D.I.Y. Burglar Alarm Equipment and accessories. Discount up to 20% off list prices, eg. Control Equipment from £15.98, Decoy Bell Boxes from £5.95 inc.

TRADE ENQUIRIES WELCOME





051-228 3483 INTRUDER ALARMS LTD WHOLESALE SUPPLIES MAIL ORDER DEPT

Bell Boxes £6.00
Dummy Boxes £4.50
Bell 6"£7.50
SIRENS
Minimite£4.50
Electronic £7.50
Cable (4 core) £7.00
PRESSURE MATS
Stair
Standard £1.50
CONTROL PANELS
Battery T/E/E £20.00
F.S.N. 20/40 £36.00
CONTACTS
Aluminium £1,85
Surface £0.75
Flush £0.65
Quickfits£0.75
BEAMS
Infra Red£31.50
Ultrasonic comp £36.00
Rec Battery £6.95

Discount on quantity - Please add 15% VAT

FOR ORDERS LESS THAN COO POP 62.00 OVER COO POP FREE A1 ALARMS LTD 86 Derby Lane, Old Swan, Liverpool 13

HIGH POWER MERCURY ION LASER, emits green/red light. Easily built by the amateur constructor. Ideal school project, etc. Comprehensive kit of plans, including source of all materials, £5.25 + 25p P&P. Lasertech, 31 Mill Brow, Chadderton, Lancs.

BURGLAR Alarm Equipment. Please visit our 2,000 sq. ft. showrooms or write or phone for your free catalogue. C.W.A.S. Ltd., 100 Rooley Avenue, Bradford BD6 1DB. Telephone 0274 308920.

COPPER CLAD Double Sided Fibreglass, 12" x 8". 10 sheets £6. 5 sheets £4. Davron, Box No. E.T.I. 202, ASP Ltd., 145 Charing Cross Road London WC2

**AERIAL AMPLIFIERS** Improve weak television reception. Price £6.70, S.A.E. for leaflets. Electronic Mailorder, Ramsbottom, Lancashire BL0 9AGH.

U.V. LIGHT EXPOSER UNIT for use in prep. of photo-resist P.C.B's. Attractive wooden construction with exposer area of 250 x 150 mm. Case 350 x 250 x 95 mm. 240v operation. Only £37.00 p&p Send cheque to V.E.P. Ltd. 5 Hewens Rd. Uxbridge UB10 OFR.

## NEW 1983 EDMUND SCIENTIFIC CATALOGUE NOW AVAILABLE

NOW AVAILABLE
72 pages of
Solar Energy, Lab Equipment.
Photography, Magnifiers.
Health, Astronomy, Motors.
Magnets, Holography, Fibre
Optics, Weather, And More!
Send for FREE copy to
Dept ET10,
Rhenbergs Sciences Ltd,
Sovereign Way, Tonbridge,
Kent TN9 1RN
or phone 0732 357779



HIGH QUALITY 240v inverter transformers with circuit dia-gram, 160va/12v £13, 500va/ 12v £21, 300va/24v £15, 625va/24v £23. Includes VAT and p&p. Tornado Wind Gener-ators, 75 Benslow Lane, Hitchin, Herts.

> Whatever you are selling. Do it quickly and cheaply **Phone ASP** Classified 01-437 1002

#### FOR SALE



CONVERT ZX81 to Eprom rogrammer. ZP4000 unit £55 - ATorSAE details Enterprise echnology Emited. P.O. Box 40, Wigan WN3 6LF. **VERORACKS 19" BRAND NEW**, beautifully made, will take card size 11.5 cms by 20.1 cms it has 40 card slides marked 1-20. Lockable front panels size 11.5 cms by 30.5 cms and 11.5 cms by 13 cms (PSU PANEL) PSU chassis included with plug and socket on back panel. 5 off "D" type cut outs on rack back panel, provision for fixing board sockets on rack. Only £30.00. Custom made fully enclosed case for the above, with carrying handles and back panel cut out for rack connections, colour Blue Only £25.00. RACK WITH CASE FOR £50.00 all prices have VAT and postage included in them. "Q" SERVICES, 29 LAWFORD CRESCENT, YATE-LEY (0252) 871048 CAM-BERLEY, SURREY.

TEN OLIVETTI TE300 Input/ output Terminals integral 8 hole paper tape punch and reader, 110 Baud Standard ASCII. Serial input/output. 120 columns untested, unguaranteed. Buyer to collect. £40 each. Mr Á. J. Stitchman, Chesterfield College of Technology, Infirmary Road, Chesterfield S41 7NG. (0246) 201011 ext. 337.

SHEETMETAL FOLDERS 18" x 18c Steel, 16G Aluminium bench or vice held. Hobby or Light industrial use. £38. 890-7838. Day/evening.

FOR SALE G.S.C. 2001 Function generator: Maxi 100 Frevirtually quency counter unused £80 each 05402 677.

STEREOPOWER 120 WATT £10.85 p..case & controls & sockets & instructions..KIA-8. Cunliffe Road, Ilkley..300 watt slaves £15 E/E.

> Components to sell? Phone ASP Classified on 01-437 1002 ext. 204

#### **BOOKS & PUBLICATIONS**

**PARAPHYSICS** JOURNAL (Russian translation); psychotronics, kirlianography, heliaphonic music, telekinetics. Computer software. S.A.E. 4 x 9", Paralab, Downton, Wiltshire.

AMAZING **ELECTRONICS** PLANS.Lasers, super-powered cutting rifle, pistol, light show, ultrasonic force fields, pocket defence weaponry, giant tesla, satellite TV pyrotechnics, 150 mare projects. Catalogue £1 (refundable) from Plancentre. Brømyard Road Industrial Estate, Ledbury HR8.

#### **AVOID WASTED** RESPONOSE

To fill your vacancy cost effectively and quickly. Reach over 65,000 people in the electronics field. For details: Phone ASP Classified 01-437 1002 Ext. 204

TELETEXT (Oracle/Ceefax) add-on adaptors for any television. Only £147.50 plus £2.45 postage. Also Viewdata (Prestel). Access/Visa. Cytel (ETI). Freepost Bristol BS10 6BR. (0272) 502008 anytime.

ZX81 INVERSEVIDEO MOD-**ULE.** No more eye strain, simple to fit inside computer. Complete with full instructions and change over switch. Only £6.95 inc. p&p. Send cheque to Xerox Electronics, PO Box 2, Loamhead, Midlothian, Scot-

45% of our readers own a home computer.

Reach them through

**ASP Classified** Phone 01-437 1002 ext. 204

#### WANTED

WANTED: **ELECTRONIC** COMPONENTS and test equipment. Factories cleared. Good prices given. Q Services, 29 Lawford Crescent, Yateley, Camberley.

## SOFTWARE APPLICATIONS

HIGH RESOLUTION GRAPH-CS For Sinclair ZX81 1K with out hardware! Tape and in structions only £3.99. Moody, 1, Benson Street, Car bridge CB4 3QJ.

SPY CASSETTE. Amazing cassette will allow you to stop. list or copy any previously un-stoppable tape. Includes two free utilities. State if for ZX81 or Spectrum, Send just £3. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs





## Engineers

#### Satellite Communications

Major expansion of our Space Division has created numerous opportunities for engineers to be involved in some of the most technologically challenging work on meteorological and communications satellites

Qualified Hardware and Software Design Engineers of various levels of experience are required for posts which vary from Engineering Manager/Group Leader to membership of a Design Team. Disciplines include:

Spacecraft Systems **Communications Systems** Microwave Systems and Equipment Radar and Signal Processing **Electronic Circuit Design** Mechanical, Thermal and Dynamics Design **Power Supplies Switch-Mode** 

Salaries and benefits will reflect the importance we attach to the positions and relocation assistance is available if required

Please write or telephone stating your qualifi-cations, recent experience and area of interest to Jack Burnie, Marconi Space & Defence Systems Limited, Browns Lane, The Airport, Portsmouth, Hants. Tel (0705) 674019 Ref: BL 34. (All posts are open to men and women)

### Marconi

Space & Defence Systems



#### **COULD YOU SELL** THIS SPACE

If you are young, enthusiastic, ambitious and hardworking then read on.

We need someone of your calibre to join ASP Classified. The atmosphere's exciting and the career prospects excellent.

Call Sally Collins on 01-437 102 and find out more about this exciting opportunity.

#### WILL THE POSTMAN INTRODUCE YOU TO A NEW APPOINTMENT NEXT WEEK?

He could do \_ if he's deliverying your free weekly copy of Executive Post, the unique executive jobs newspaper published by PER, part of the Manpower Services Commission.

Because each week Executive Post carries:

- an average of 30 pages of UK and overseas job opportunities: technical, professional, scientific, managerial and commercial
- informative editorial on job-hunting and career development
- news on starting your own business, on vocational training and on further education

Contact Kevin Edwards now for your sample copy and next week, the postman could help your jobsearch come to a successful conclusion.

Executive Post, Moorfoot, The Moor, Sheffield S1 4PQ. Tel. Sheffield (0724) 704584.

#### VIDEO ENGINEERS

Redifusion Consumer Manufacturing Ltd is seeking intermediate and senior video engineers with OND, HND or similar qualifications, together with a knowledge of analogue and digital circuits, to join a small team working on a wide variety of projects associated with video cassette recorders, video cameras, disc players, colour TV receivers and monitors.

In addition to analysis of performance and long term reliability factors, assessment reporting is an important part of the team's function and the ability to express oneself verbally and in writing is essential.
Our laboratories are situated at Chessington within

easy communting distance of the Surrey country-

Attractive salaries and the usual big company benefits are offered to suitably qualified and experienced engineers. If you believe you can make an effective contribution to our future video projects please write to or phone:-

Mr. Harry Brearley Rediffusion Consumer Manufacturing Ltd., Fullers Way South, Chessington, Surrey, KT9 1HJ Telephone: 01-397 5411

### CLASSIFIED ADVERTISEMENT — ORDER FORM

10.	11.	12.
13.	14.	15.

Advertise nationally in these columns to over 100,000 readers for only 35p per word (minimum charge 15 words). Simply print your message in the coupon and send with your cheque or postal order made payable to Argus Specialist Publications Ltd to:

CLASSIFIED DEPT., ELECTRONICS TODAY INTERNATIONAL 145 Charing Cross Rd., London WC2H 0EE.

Tel: 01-437 1002

Please indicate classification required.

Tel.No.(Day)

WE TAKE ACCESS AND BARCLAYCARD

Please place my advert in E.T.I. for months. Please indicate number of insertions required.

## Get moving with these new developments in UK Robotics

#### - advanced electrohydraulic designs for education, industry and now available to the home constructor.

Hebot II is a tertle-type robot which takes programming out of the two dimensional world of the VDU into the rea three dimensional world. Given a DC supply of 9-15 V it can perform a bewildering number of inoves under computer control — forwards, backwards left and right — with each wheel independently controlled It has blinking eyes, bleeps with a choice of two tones and has a solenoid operated pen to charrits progress. Touch sensors coupled to its shell return data about its environment, to the computer for it to calculate evasive or experiatory action. Hebot II connects directly to an I/O port or afternatively with the universal interlace board to the expansion bus of a ZX81 or other computer. Robotic experience is becoming as essential a subject as computing. MICROGRASP provides the lowest cost means of acquiring that experience but despite its ultra low price the robot has considerable versatility. There are 5 axes each using a servo motor and there is versatility. There are 5 axes each using a servo motor and there is feedback from each of the aim movements. Control is by any computer with an expansion bus - the ZX81 being particularly suitable. Servoing is achieved with nardware on the interface board to keep programming simple and the robot is operated uncer BASIC commands with no computer specific software required. The interface board is memory mapped using only 64 bytes at any of 1024 switch selectable locations.

MICROGRASP robot kit with power supply Universal computer interface board kit

ZX81 peripheral/RAM Pacx splitter board

£2.50



MICROGRASP, INTERFACE BOARD AND ZX81

HEBOTT I

Up to the nano-second hard, firm and software developments embodied in a complete system. 1 Mega Hertz 16 bit CPU; 64K upwardly compatible DRAM; separate 16K video DRAM and 24K TI Powe Basic with overwrite. Supports up to four Disc drives o mixed type with 16 serial I/O ports. Programmable Baud rate and comprehensive E Bus interface designed to support real world applications.

Top of the range is the Genesis P102 which has dual speed

control, cortinuous servo operation and double acting cylinders for increased torque on the wrist and arm rotation

joints. The microprocessor based control system has additional memory, position interrogation via the RS232C interface increasing the versatility of computer control and inputs

6 axis system READY BUILT £1950.00
Powertran COFFEX 16 bit 64K computer Kit £295.00, READY BUILT £395.00
(Electronics Today Internal onal December issue on CORTEX)

are provided for machine tool interfacing.

Very high resolution graphics gives 3D simulation in 16 colours on 36 prioritised planes of user definable characters Software FORTH coming includes this trendy language along with NOS C/PM

Hardware components available separately with details in Nov, Dec. and Jan issues of ETI. Software features include; Real time clock, full renumber command, buffered I/O to free machine whilst

Example prices and specifications

Genesis S101 Base: 19.5" × 11" × 7.5' Lifting capacity: 1500gm Arm lift: 6.6" Weight: 29Kg

Genesis P101

Complete Systems as shown in Photograph above

Genesis 5101

Genesis 5101 4 axıs system in kil form £681.50 5 axis system in kil form £737.50 5 axis system Ready Built £1450

Genesis P101

GENESIS P102 PROCESSOR BOX, HAND HELD CONTROLLER AND CORTEX COMPUTER

All prices exclusive of VAT

printing, call to machine code routines, hexadecimal support and userfriendly textual error trapping messages.

If computers interest you then the Cortex will expand your understanding infinitely more than off the shelf machines. Use it in business, education, research or just play with the incredible graphics capability. At Powertran we are using these machines in conventional roles, in product control and R & D. We shall coordinate the Cortex user group and distribute software for the TMS 9995 CPU. Complete 16 bit 64K computer kit £295.00 + VAT. Complete 16 bit 64K computer ready built £395.00 + VAT



With prices starting below £1,000 the Genesis range of general purpose robots With prices starting below £1,000 the Genesis range of general purpose robots provide a first rate introduction to robotics for both education and industry. Each has a self-contained hydraulic power source, which enables loads of several pounds to be smoothly handled. The system operated from a single phase 240 or 120V AC supply or a 12V DC supply. The machine can be supplied with up to 6 axes each of which is fully independent but capable of simultaneous operation. Position control is achieved by means of a closed-loop feedback system based around a dedicated microprocessor. Movement sequences can be entered, stored and replayed by use of a hand held control er, alternatively the supplied as a standard RS 232C. systems can also be interfaced to an external computer via a standard RS 232C link.



GENESIS S101 AND GENESIS P101 WITH PROCESSOR BOXES AND HAND-HELD CONTROLLERS

WORLD **LEADERS ELECTRONIC** KIT DESIGN AND SUPPLY

(CYBERNETIC D VISION) PORTWAY NOUSTRIAL ESTATE NDOVER HANTS SP10 3NM Phore Enquiries (0284) 64455 Export Enquiries Powertran International Hollom Down Farm Lopcombe Salisbury Wiltshire SP5 1BP Tel: 0264 781545 TLX: 477407 ZENMON

ALL PARTY OF THE P

Send now for an application form - then buy it with MAPCARD.

MAPCARD gives you real spending power — up to 24 times your monthly payments — instantly!

## **Maplin News**



Computer

**Shopping** 

**Arrives** 

AS FROM June 1st you can

place orders directly with our

computer from your personal

computer. The computer shop-

ping revolution has arrived! To

communicate, you'll need a modem (our RS232 compatible

modem kit is LW99H price

## **Sole UK Agents** for Heathkit

NOW THE world-famous Heathkit range of superb electronic kits is available from Maplin - the newly appointed exclusive UK distributor. Kits range from a simple clock for beginners to a unique Robot (see pic) with which you can learn about robotics.

There is a range of training courses covering electronics and computing topics, many containing constructional projects. For full details, pick up a copy of the latest Maplin magazine or write for a free copy of our Heathkit Order As XH62S. catalogue.



#### **GREAT PROJECTS** FROM E&MM



OUR NEW book "Best of E&MM Projects Vol. 1" brings together 21 fascinating and novel projects from

Projects include Harmony Generator, Guitar Tuner, Hexadrum. Syntom, Auto Swell, Partylite, Car Aerial Booster, MOS-FET Amp and other musical, hi-fi and car projects. ORDER AS XH61R, PRICE £1.

## E&MM's first year.

£39.95) and an interface (our ZX81 interface LK08J price £24.95 is available already with many more for most popular micros coming soon). Just dial us up on 0702 552941

ring now!

and you'll be able to interrogate our stock file then place your order, type in your credit card number and a few minutes after you hang up your order will print out in our warehouse ready for packing. And all without saying

Try out the future way of shopping now! You'll see immediately what stock we've got available and you'll discover how easy it is to ensure your order is exactly right. And you'll see precisely what the current price is for each item and what total amount will be charged to your credit card. It all helps to make buying easier. So give us a

### **Maplin's Fantastic Projects**

FULL DETAILS in our project hooks. Price 70p each.

In Book 1 (XA01B) 120W rms MOSFET Combo-Amplifier • Universal Timer with 18 program times and 4 outputs • Temperature Gauge • Six Vero Projects.

In Book 2 (XA02C) Home Security System • Train Controller for 14 trains on one circuit • Stopwatch with multiple modes Miles-per-Gallon Meter.

In Book 3 (XA03D) ZX81 Kevboard with electronics . Stereo 25W MOSFET Amplifier 

■ Doppler Radar Intruder Detector • Remote Control for Train Con-

In Book 4 (XA04E) Telephone Exchange for 16 extensions • Frequency Counter 10Hz to



600MHz • Ultrasonic Intruder Detector • I/O Port for ZX81 • Car Burglar Alarm • Remote Control for 25W Stereo Amp.

In Book 5 (XA05F) Modem to European standard • 100W 240V AC Inverter 

■ Sounds Generator for ZX81 • Central Heating Controller • Panic Button for Home Security System • Model Train Projects • Timer for External Sounder.

In Book 6 (XA06G) Speech Synthesiser for ZX81 & VIC 20 •

Module to Bridge two of our MOSFET Amps to make a 350W Amp • ZX81 Sound on your TV • Scratch Filter • Damp Meter • Four Simple Projects.

In Book 7 (XA07H) \*Modem Interface for ZX81/VIC20 • Digital Enlarger Timer/Controller • DXe1s Audio Processor • Sweep Oscillator • Minilab Power Supply • Electronic Lock • and others.

\*Projects for Book 7 were in an advanced state at the time of writing, but contents may change prior to publication (due 14th Max

#### 25W Stereo MOSFET Amplifier

- \*Over 26W/channel into 812 at IkHz both channels driven.
- \*Frequency response 20Hz to  $40kHz \pm IdB$ .
- \*Low distortion, low noise and high reliability power MOSFET output stage.
- \*Extremely easy to build. Almost everything fits on main pcb, cutting interwiring to just 7

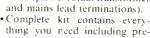
wires (plus toroidal transformer

thing you need including predrilled and printed chassis and wooden cabinet.

Price 70p (XA03D). Complete kit only £55.20 incl. VAT and carriage (LW71N).

#### POST THIS COUPON NOW!

Please send me a copy of your 1983 catalogue. I enclose £1.50 (inc. 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 UK send £1.90 or 10 International Reply Coupons.



Full details in Projects Book 3.

Name Address .....

Post Code .....

### MATINEE ORGAN

EASY-TO-BUILD, superb specification. Comparable with organs selling for up to £1000.

Full construction details in our book (XH55K). Price £2.50. Complete kits available. Electronics (XY91Y) £299.95\*. Cabinet (XY93B) £99.50\*. Demo cassette (XX43W)



#### Maplin's New 1983 Catalogue

Over 390 pages packed with data and pictures and all completely revised and including over 1000 new items.



On sale in all branches WH SMITH. Price £1.25.  MAPLIN ELECTRONIC SUP-PLIES LIMITED, P.O. Box 3, Rayleigh, Essex SS6 8LR. Tele-Sales (0702) 552911 General (0702) 554155.

Shops at: 159 King St., Hammersmith, London W6. Tel: 01-748 0926. 284 London Rd., Westeliffon-Sea, Essex. Tel: (0702) 554000. Lynton Square, Perry Barr, Birmingham. Tel: (021) 356 7292.

Shops closed Mondays.

All prices include VAI & carriage. Please add 50p handling charge to orders under £5 total value