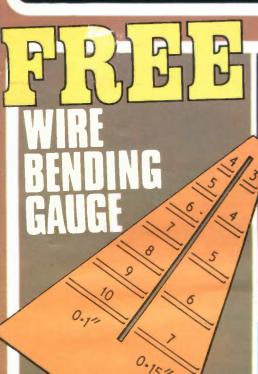
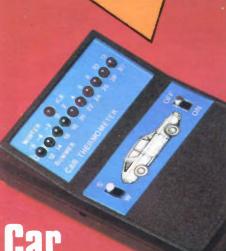
Easy to build projects for everyone

# Everyday MARCH 83 80p ELECTRONICS



TACIN



Car Thermometer

# TEST GEAR 83 DUAL POWER SUPPLY



# **EXPANDED KEYBOARD for the ZX81**



# **MULTI-STATION INTERCOM**



electrorize

# **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

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

PROTECT
YOUR CAR
WITH AN
ELECTRONIZE
ELECTRONIC ALARM



Y an electronic key - a

- ★ 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 atc.

Don't Wait Until Its too Late ~ Fit one NOW!

- ★ 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.)

ASSEMBLED AND TESTED £ 37.95

Prices include VAT

VISA

Access and Visa Welcome Write or Phone Quoting Number ELECTRONIZE DESIGN

Dept. C · Magnus Rd · Wilnecote Tamworth · B77 5BY tel: 0827 281000

# Everyday ELECTRONICS

# VOL. 12 NO. 3 MARCH 1983

PROJECTS . . . THEORY . . . NEWS . . . COMMENT . . . POPULAR FEATURES . . .





© IPC Magazines Limited 1983. Copyright in all drawings, photographs and articles published in EVERYDAY ELECTRONICS is fully protected, and reproduction or imitations in whole or in part are expressly forbidden.

	n			01	ro
۲	n	0	J	L	rs

MULTI-STATION INTERCOM by T. Rule Keep in touch around the home	138
CAR THERMOMETER by M. Plant Monitor the outside air temperature	150
<b>BUZZ OFF!</b> by T. R. de Vaux-Balbirnie A game for a steady hand	154
TEST GEAR 83—DUAL POWER SUPPLY by J. R. W. Barnes Variable output: 0 to 20V. Fixed output: 5V 1A for powering TTL	159
EXPANDED ADD-ON KEYBOARD FOR THE ZX81 by J. M. Stejskal For speedier program entry	170
EPROM PROGRAMMER FOR THE ACORN ATOM by D. C. Grindrod Part 2: Construction and software	178

# **SERIES**

INTRODUCING ELECTRONICS by George Hylton	146
Part 6: Digital Electronics	
THE ELECTRONICS OF INFORMATION	166
TECHNOLOGY by T. Ivall	
Part 5: Information Units	

# **FEATURES**

137
145
156
158
165
173
174
176
182

# FREE WITH THIS ISSUE

The Electronics Epoch; Crystal-Ball Gazing

**EE WIRE BENDING GAUGE** (cover mounted)

Our April 1983 issue will be published on Friday, March 18. See page 157 for details.

Readers Services • Editorial and Advertisement Departments

137



# "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:

(a) 2 × 3V motors, linked by a magnetic clutch, thus enabling turning of the vehicle:

(b) A gearbox contained within the black ABS housing reducing the final drive speed to approx. 50rpm.

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 straight ahead.

### SIMON GAME

... is back again. Another supply of ready built PCB's for this flashing light/pulsating tone computerised game is now with us. Supplied tessed and working with speaker & instructions, £4.95.

# REED RELAYS

Manufacturers rejects – DIL and other PCB mounting types. SP, DP and 4P – make, break & c/o contacts. Not tested, may be only partially working or o/c etc, so very low price -pack of 10 assorted £1; 25 £2.00; 100 £7.00

IN4148 - BEST PRICE EVER Supplied in packs of 100, by Toshiba £2 per pack; 3 packs £5.50; 10 packs £15; 25 packs £32; 100 packs £115.

# **FERRIC CHLORIDE**

New supplies just arrived – 250mg bags of granules, easily dissolved in 500ml of water. Only £1.15. Also abrasive polishing block 95p.



# LIE DETECTOR

Not a toy, this precision instrument was originally part of an "Open University" course, used nairy 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 44V batts. Overall size 155×100×100mm. Only 4.9.95—worth that for the case and meter alone!!

AA NI-CADS - 10 for £9.95
Brand new nickel cadmium batteries by GE, standard 1.2V @ 450mA/H. Professional quality with solder tags both ends. Special price, £1.40 ea; 10 for £9.95; Box of 80 £65. Ni-cad Charger: Charges up to 4 AA, C or D cells + PP3. Only £7.95.

# **BRAND NEW VEROBLOC KIT!!!**

Just published by Babani, Mr. R. A. Penfolds new book, "30 SOLDERLESS BREADBOARD PROJECTS" – this book features 30 different projects for assembly on a Verobloc, and the kit contains all parts necessary to make:

oricans all parts necessary to make Audio Amplifiers Light & Dark Activated Switches & Alarms Timers Metronome Oscillators & Tone Generators Washing Door Ruzzer

Oscillators & Tone Generators
Warbling Door Buzzer
Two-tone Train Horn
Touch Switch
Reaction Game
Sound Activated Switch
Radio Receivers
Fuzz Unit . . . + lots more!!
The introduction shows all the different components and explains how to use the breadboard. The Verobloc layout is shown for every project together with the circuit diagram and an explanation of how it works. Ideal for beginners in electronics, but also suitable for more advanced students.

more advanced students.
The complete lift is contained in an attractive plastic case, which can be divided up into 15 compartments in which your components may

Complete Kit, including book, Verobloc & all parts £24.95; Book only £2.25; Kit without Verobloc £28.45 obloc £20.45.



NOW REDUCED TO £3.95

ELECTRO-DIAL
Electrical combination lock-for maximum security-pick proof. I million combinations!!
Dall 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 ×60mm deep. Only £3.95.

# STABILIZED PSU PANEL

A 199 A versatile stabilized power supply with both voltage (0-30V) and current (20mA-2A) fully variable. Plany uses inc. bench PSU, Ni-cad charger, gen purpose testing. Panel ready bulk, tested and calibrated. 47.75. Suitable transformer and pots. 46.00. Full data supplied.

443D MILLBROOK ROAD, SOUTHAMPTON SOI 0HX All prices include VAT - just add 50p post. Tel. (0703) 772501

# TWO FABULOUS OFFERS FROM

SUPER 20 20k $\Omega$ /V a.c. & d.c.

A SUPER **PROTECTED** UNIVERSAL **MULTIMETER** 

Undestructible, with automatic protection on allog ranges but 10A.

# **ONLY £33.50**

inc. VAT, P&P, complete with carrying case, leads and instructions.

This special offers is a wonderful opportunity to acquire an essential piece of test gear with a saving of nearly £20.00.

d.c. ranges and  $\Omega$  2% a.c. 3% (of f.s.d.) Accuracy:

d.c. V 100mV, 1·0V, 3·0V, 10V, 30V, 100V, 300V, 1000V. 39 ranges: d.c. I 50µA, 100µA, 300µA, 1.0µmA,3mA, 10mA, 30mA,

super 20

100mA, 1A, 10A a.c. V 10V, 30V, 100V, 300V, 1000V. a.c. I 3mA, 10mA, 30mA, 100mA, 1.0A, 10A.

 $\Omega$  0-5.0k $\Omega$ , 0-50k $\Omega$ , 0-500k $\Omega$ , 5M $\Omega$ , 50M $\Omega$ . dB from -10 to +61 in 5 ranges.

Dimensions:  $105 \times 130 \times 40$ mm.

# **TESTER 50 39 ranges**

 $50k\Omega$  V a.c. and d.c. With protective diodes and quick-acting 1.25A fuse. THE **PROFESSIONAL** SOLUTION TO GENERAL MEASUREMENT **PROBLEMS** 

> ONLY £36:30 incl. VAT, P&P, complete with carrying case, leads and instructions.
> Goods normally by return of post.

The best instrument for the workshop, school, toolbox, TV shop and

anywhere accurate measurement is needed quickly and simply.

Accuracy: d.c. ranges and Ω 2% a.c. 3% (off.s.d)

39 ranges: d.c. V 150mV, 1V, 3V, 10V, 30V, 100V, 300V, 1000V; d.c. I 20μΑ, 100μΑ,300μΑ, 1-0mA, 3mA, 10mA, 30mA,

100mA, 1A, 3A.

a.c. V 10V, 30V, 100V, 300V, 1000V; a.c. I 3mA, 10mA, 30mA, 100mA, 1A, 3A. Ohms 5kΩ, 50kΩ, 500kΩ, 5MΩ, 50MΩ.

dB from -10 to +61 in 5 ranges.

Dimensions: 105 × 130 × 40mm.

For details of these and the many other instruments in the Alcon range, including multimeters, components measuring, automotive and electronic instruments, please write or telephone:



Instruments Ltd.

19 MULBERRY WALK - LONDON SW3 6DZ - TEL: 01-352 1897 - TELEX: 918867

SUPERIOR QUALITY CARBON FILM RESISTORS, HI STAB Betteries:	1RANSISTORS 2M5401 Probably the 2M5415	35p 8C212 1 10 8C212A	10p 8F 457 12p 8F 458	CRICKLEWOOD ELECTRONICS LTD.
LOW NOISE GUARANTEED WINDING 5% E24 2p minimum 500 charges 10 10 10 10 10 10 10 10 10 10 10 10 10	targest retail 2N5416 variety in UIC 2N5447 If you don't 2N5448	1.54 BC212B 16p BC212L 19p BC212LA	15p 8f 459 10p 8f 469 13p 8f 470 14p 8f 839	40 Cncklewood Broadway, London NW2 3ET tel 01-452 0161 tlx 914977
METAL OXIDE /FILM  METAL OXIDE /FILM  MP11(1 2AH)	want please 2N5450 s phone or write 2N5451 as this is not 2N5457	23p 8C213A 25p 8C213A 28p 8C213B	10p BFR40 11p BFR41 12p BFR79	259' This is a small list from our vast stocks. Full orice list free on request. You may order by phone quoting Access. Visa or American Express no, or by nominal mail.
Very high thermal & electrical stability. Extremely low noise 0.4W 10Ω 1MΩ 2% E24 for Adjustable to 8	2N404 1 5C 2N5459 2N914 20c 2N5460 2N916 39e 2N5543	250 8C213L 729 8C213LA 5 00 8C213LA	13p 8FR80 13p 8FR81 13p 8FR90 13p 8FS26	250 Order: Aniells Wichigher Aniel Stock Rem (197% et stock) go out some day Please 250 and 15% VAT & 70p p8p Govt Depts, schools, etc., orders welchem Overseas 310 orders no VAT but allow extra note Overseas 215 ALL STOCK BRAND NEW FRANCHISED ORIGIN
LOW DHMIC VALUE RESISTORS PP3 55 50	2N917 65p 2N918 33c 2N6082 2N929 36p 2N6121 2N929 45p 2N6122	37p BC213LC 11.99 BC214 54p BC214B 54p BC214B	14p BFS61 10p BFS98 12p BFX29 13p BFX30	CRICKLEWOOD—STOCKING PARTS OTHER STORES CANNOT REACH
0 2261 8 2Ω 812 11p WIREWOUND RESISTORS 5% 2 3W 0 2261 330Ω 612 28p GRAPHIC	2N930 20p 2N6123 2N930A 30p 2N6124 2N1893 30c 2N6125 2N1974 1 50 2N6126	59p BC214L 56p BC214LB 59p BC214LC 71p BC237	13p BF V50 13p BF V51 14p BF V52	216 VM46AF BM RECTIFIERS LM1889 3.77 4000 10p 7400 101p 74LS00 11p 22p VM66AF BSp (IPIV shown in LM2907N 2.75 4001 10p 7401 11p 74LS01 11p 22p 2TR107 10p breckets1 LM2907N8 2.80 4002 11p 7402 11p 74LS02 11p
4 7W 0 4711 6K8 E12 130 PROCESSORS 10 11W 1 012 13K E12 176 E79366 E44	1N2060 7 14 2N6129 1N2102 38p 7N6130 1N217 38p 2N6131 1N2217 38p 2N6131	79p 8C237A 93p 8C237B 98p 8C237C 83p 8C237C	16p 85X19 17p 85X20 18p 85X21	246 ZTX109 196 W01 (100) 206 M2917N 1.88 4007 156 7404 126 74L504 126 21X300 136 W02 (200) 266 NE543N 2.50 4009 246 247 247 257 247 257 257 257 257 257 257 257 257 257 25
ROTARY POTS E3 Series 4 7K 2M Lin 32p 4 K 2M Log 32p 10 Tother good makes may be sent only	1N2218A 25p 2N6133 1N2219 27p 2N6134 1N2219A 28p 2N6253	1 14 BC238A 1 36 BC238B 1 45 BC238C 1 55 BC239	15p BU104 15p BU105 16p BU109 17p BU126	2.22 21 8302 139 W08 (800) 40p 1907 20p 124510 12p 170 21 71 331 3 p 2 mp 1 yee
As above with DP switch 80p ARIALS Beautiful ufd V Beautiful	2N2221 22p 2SC 130 2N2221A 23p 2SC 144 2N2222 24p 2SC 201	6 95p BC239A 4 2.50 BC239B 8 1.70 EC239C	16p BU204 17p BU205 18p BU206	2 2 2 273.31 32p 501 (1001 37p 10000 3.5 d014 66p 74.11 16p 74.534 30p 175 273.312 35p 502 (2001 400) NE555 1.5 100 175 273.313 35p 504 (4001 40p 105661 49 105 105 105 105 105 105 105 105 105 105
Switch  90p   47   100   90   Low Volta    MICRO MINI   47   350   30p   Matsushita only   100V CERAMIC   63   8p   uFd   V	8 2N2223 2.80 2SK 134 2N2223A 4.15 3N128	3.98 EC300 3.98 EC301 1.12 BC302 3.50 BC303	44p BU326S 43p BU406 47p BU407	2 35 27 33 0 35p
PLATE CAPS 1 1000 9p 10 16 5% or better 1 500 40p 22 10 E12 Series 2 2 25 8p 22 16 1pF 10nF 7p 2 2 63 9p 47 10	2N2303 38p 3N139 6p 2N2368 25p 3N139 6p 2N2369 18p 3N140 7p 2N2369A 18p 3N143 7n 2N2646 45p 3N152	3.30 8C327 2.37 8C328 2.85 8C337 3.00 8C338	14p BU500 14p BU500 15p BUV20 15p BUV20	1 25 ZTX501 14p PW02 (200) 78p PLI03 A 12,75 w021 45p 7421 20p 741532 13p 1100 ZTX501 41p PW02 (200) 78p 6(4136 5 5p 4023 12p 423 78p 741532 13p 1100 ZTX503 11p PW06 (600) 80p 6(4136 5 5p 4023 12p 1423 78p 741532 14p 1100 ZTX503 11p PW06 (600) 80p 6(4136 5 5p 4023 12p 1423 78p 741532 14p
DISCOUNTS ON 2 2 100 11p 47 16 QUANTITY 2 2 350 00p 100 10 PLEASE PHONE 3 3 25 10p 100 16 1	7p 2N2646 45p 3N152 8p 2N2647 90p 3N153 3P 2N29044 27p 3N154 3P 2N2905 28p 3N200 3N201 3N201	2 47 2 56 6 93 8 C441 8 C460	32p BUV23 33p BUV24 32p BUV25	10. 90 27 18510 340 25 amp type St.450 3.47 4025 120 7426 280 741.534 150 1210 27 18530 340 Metal clad with TBA500 3.11 4027 200 742.54 150 274.545 280 150 150 27 18530 326 Metal clad with TBA500 3.11 4027 200 742.54 280 741.542 280 7
POLY C 3 3 63 12p 220 16 1 5% 7 5mm 250V 4 7 16 8p 470 10 1 CAPACITORS 4 7 25 3p 470 16 1	2p 1N2906 25p 40360 2p 2N2906A 30p 40361 3p 2N2907 25p 40362	60p 8C516 67p 8C517 67p 8C517	33c 8UX20 40c 8UY18S 40c E430 13c J300	5.60 1NB21 70p K02 (200) 2.80 TBA520 2.57 4030 14p 7433 22p 74L554 14p
1nF 68nF 10p 47 63 12p 1000 16 2 82nF 150nF 16p 47 100 14p 2200 10 1 10 25 8p 2200 16 4	Op         2N2907A         26p         40363           Ip         2N2920         3 47         40406           Ap         7N2923         25p         40407           Ap         2N2924         15p         40408	2 22 BC547A 1 39 BC547B 75p BC548 1 50 BC548A	14p J310 14p MJ802 12p MJ900	53p 14914 08p T8A530Q 2.78 4033 1.20 7440 15p 74L574 18p 1.35p 141576 20p 141
5% 7 8mm 100V   10   40   12p     Grade One   CAPACITORS   10   51   14p   Grade One   Glass PC8   100n F 180n F 12p   22   25   RCA   185   Single Sided   220n F 270n F 15p   Z   40   14p   178   240nm   270n F 15p   Z   270	2N2925 15p 40410 2N2926 10p 40411 2N3019 50p 40412 2N3053 27p 40673	2 86 BC548B 2 86 BC54BC 592 BC549	13p MJ901 14p MJ1000 15p MJ1001 13p MJ1800	2.50 1N4002 4 p 880C3700 1 80 T8A5500 3.27 4037 1 30 7444 50 74L580 1.20 3.00 1N4003 5 p 8Y154 550 T8A560C 3.27 4039 90 7465 50 74L583 380 23.00 1N4004 5 p 8Y179 20 T8A560 2 37 4039 2 80 7445 50 74L583 380 2 74L583 400 2 74L585 400 2 74L58
220nF 270nF15e 22 40 14p 130nF 390nF20e 22 63 14p 470nF 560nF27e 22 100 21p 660nF 12n 47 25 14p	5c 2N3054 56p 40822 40871	1 80 8 C 5 4 9 8 80 8 C 5 4 9 C 80 8 C 5 5 0 35 9 8 C 5 5 7	14p VIJ2500 15p VIJ2501 30p VIJ2955 33p VIJ3000	2.79   1M4005   6g  2ENLER DIDDES   76,85700   2 48   4040   46c   7447   40p   741,586   16p   1.25   1M4004   6g  2ENLER DIDDES   7C,9390   2.19   4041   406   7448   46e   741,590   246   1.00   1M4007   7g   400,500mW   TC,9340   1.68   4042   390   7450   15p   741,593   246   2750
1µF (10mm) 35p 47 40 17p 420 249mm Complete range 47 63 25p 11 of other voltages 47 100 28p Ferric Chlorid	5c 2N3108 62p AC126 2N3109 48p AC127 2N3232 1 50 AC128	25p BC557A 25p BC557B 25p BC558	15p VIJ3001 16p VIJ3701 16p VIJ4502 14p MJ15003	2 55   NA148   Sp   2 4 47 V   Sp   TOA1003   3.94   444   179   7453   15p   44.597   386   256   NA1450   18p   TOA1004   287   4046   44p   7453   14p   741.586   806   3.99   NA448   22p   1.3 West   TOA1005   3.94   4046   44p   7460   7461   745.510   741.510
5 spacings in 50 25 189 60 % Solution 510ct Please phone 100 16 149 100 25 169 TANTALUM 100 40 22p FTCM RESIST	2N3251 360 AC151 2N3439 98p AC152 2N3440 80p AC153	51p BC558B 45p BC558C	15p MJ15004 16p MJ15015 17p MJ15016 15p MJE340	5.55 1N5172 30p 3 3.82V 15p TDA1072 4.55 1N5172 30p 13 3.82V 15p TDA1072 4.55 1N5176 30p 7472 25p 74LS112 22p 75L073 1N5176 30p 74LS113 22p 74LS113 22
1/35V 14p 100 63 25p TRANSFERS 22/35V 14p 100 100 30p 1 Train inns 32/35V 14p 220 10 16p 2 Thick lines	2N3442 1 35 AC176 2N3442RCA185 AC176 2N3444 1 70 AC187	27p 8C559B 37p 8C559C 8C560	16p MJE350 17p MJE2955 32p MJE3055 34n MPSA05	1.50 1.50522 14e) 7.5 75V 1.10 1.0AA170 1.50 4052 406 7476 286 741.5123 386 4051 4052 4051 4052 4052 4052 4052 4052 4052 4052 4052
47/35V 14p 220 25 22p 3 Thin bends 68/35V 14p 220 25 22p 4 Thick be 1.0/35V 14p 220 63 30p 6 Transistor	2N3447 5.72 AC188H 2N3448 6.56 ACY17	25p BCY70 40p BCY71 70p BCY72	16p MPSA06 16p MPSA10 190 MPSA12	Product   Prod
2.2/35V 22p 330 16 19p 7 Dots - hole 3.3/35V 22p 330 25 22p 8 0 1 edge co	ns 293632 230 AF2798	1 24 8D132 1 00 8D135 75p 8D135	44p MPSA13 44p MPSA14 40p MPSA16 40p MPSA18	30p 1N5625 60p V vellow ZN1034 1 99 4066 22p 7489 2 20 74LS145 70p 30p 1N5626 62p Large diffusest ZN1040 6 69 4067 2 40 7490 20p 74LS147 1 57
6.8/25V 26p 470 25 28p Any sheet above 30p 10/16V 25p 470 63 43p C10 3 sheet above 30p 10/16V 25p 470 63 43p C10 07 13 sheet above 30p 25p 470 63 43p C10 07 100 100 100 100 100 100 100 100 10	2N3638A 370 AL 102	750 BD137 3 40 BD137 2 20 BD138 2 30 BD139 100 BD140	30p MPSA42 30p MPSA42 30p MPSA43 30p MPSA55	1544   100   180
10/35V 34p 470 100 60p PHOTO 15/16V 30p 1000 25 38p 15/26V 32p 1000 40 46p Glass For Dec 15/26V 32p 1000 40 40 46p Glass For Dec 15/26V 32p 1000 40 46p Glass For Dec 15/26V 32p 1000 40 40 40 40 40 40 40 40 40 40 40 40	2N3703 10p 8C107A CB 2N3704 10p 8C107B 11y 2N3705 10p 8C108	12p 80 237 12p 80 238 10p 80 239A	MPSA56 MPSA65 MPSA66 MPSA66 MPSA70	30p 8A138 30p 8ZO 80 6p 650 11.89 4073 13p 7496 40p 74LS156 35p 45p 8A142 20p GZO 12p 10p 6800 2.74 4076 45p 74100 80p 74LS156 35p 650 2.74 4076 45p 74100 80p 74LS158 28p
22/6.3V 26p 1000 63 86p results to 22/16V 32p 2200 16 40p spraying Exp 33/10V 38p 2200 25 83p to UV	2N3707 10p BC108B 2N3708 10p BC108C 2N3709 10p BC109	12p BO240A 14p BO240C 10p BO241A	550 MPSA92 730 MPSA93 610 MPSL01 670 MPSL51	300 8A15A 350 A10 250 Z20 8050 3.48 4081 120 74105 550 7415161 350 220 8050 10 80 4081 120 74107 220 7415161 350 4081 84 4081 820 74107 220 7415162 350 8050 10 80 4082 120 74107 20 74107 350 350 8050 10 80 4082 120 74109 80 7415163 350
Feedthrough 4700 16 750 100 - 160 1 1700 - 160 1 1700 - 160 1 1700 - 160 1 1700 - 1700	56 2N3711 100 8C109C 90 2N3712 200 8C109C 85 2N3713 138 8C141	12p 80242A 12p 80242A 80242C 25p 80243A 37p 80243C	70n MPSU04 72p MPSU05	1.32 8A182 40p 85C 12p 10p 8900 57.76 4089 1.50 74116 50p 7415165 59p 800 57.76 4089 1.50 74118 59p 7415169 80p 55p 8A202 28p 75C 17p 13p 9900 21.00 4093 20p 74119 80p 7415169 86p
Fully enclosed Pitter Pre-sets Pitter Pre-sets Polid Hook up 100 - 160 100 - 220 2	2N3715 3.31 BC142 66 2N3716 3.60 BC143 15 2N3819 210 BC147	34p BO244A 10p BO244C 10p BO245A	82p MP5U07 1 00 MPSU51 1 14 MPSU55	739 8A317 250 Large 1100 LOGIC LCS 4095 Mb 74121 35 74LS173 550 880 A318 30 LOGIC LCS 4096 500 1413
	21 2N3820 Mp 8C1478 56 2N3821 1.84 8C147C 2N3822 Sop 8C148	10p 80245C 20p 80246A 90246C 10p 80249A	1 30 MPSU56 1 20 MPSU57 1 50 OC20 2.00 OC22	500 BAV19 150 GSU 42p 34p COMPUTER 4098 74p 74125 350 74LS181 99p 1.20 8AV70 150 VAL 42p 34p SUPPORT 4099 900 74125 350 74LS183 179
Mini Horiz 14p Twin 1 amp 14p use Sodium 17p 3 Core 25 amp Nydroidel	2N3860 31p BC148C 2N3866 BC149C 2N3877A BC149C	130 130 100 100 100 100 100 100 100 100	2.31 OC23 2.11 OC25 2.44 OC28 0C29	2.50 BAX16 11p RGV8 83p 78p AV5.2376 5.80 4507 33c 74136 33p 74L5192 38p 1.70 BAY127 27p LINEARIC. ICM7555 80p 4508 119 74L5
Thumbwheel or 3 Core 13 amp OALD ETCH RESIST PEN Standard Pro	2N3902 6 66 BC149C 2N3903 15p BC152 2N3904 15p BC153 0p 2N3906 15p BC153	13p BD438 35p BD439 23p BD440	88p OC29 88p OC35 90p DC41 91p OC43 91p OC44	2.36 8Y182 1.24 AY1.5050 95p NS1771 20 00 4511 460 74144 2 10 7415197 480 760 8Y188A 450 AY3.8915 5.39 R02513LC 4.80 4512 380 74145 500 7415197 480 74
Solid Multicore 4 Core 330 C280 or Equiv Polyester Caps 12 Core 460 1100NS	2N3906 2N4030 2N4031 2N4031 55p BC157A BC157B	270 80442 110 80529 120 80529 130 80530 100 80535	83p OC70 1 20 OC71 1 30 OC72 75p OC82	560 87227 3 1.56 3 00 5AA5010 7.10 4518 360 74150 680 7415241 350 680 87297 45 20 20 20 20 20 20 20 20 20 20 20 20 20
Rediel Long	99 2N4037 43p BC158B 66 2N4239 1 00 BC158	12p 80536 13p 80537 11p 80538	75p OC82D 80p OC83 80p TIP29A TIP29C	70p 0A10 70p CA3069 2 80 SAA5040 15 00 4521 990 74156 400 7415245 70p CA3060 4 08 SAA5041 18.00 4526 590 74156 400 7415247 50p
47nF 68nF 100nF 9p Mini Single 12p 125 Element 2 150nF 220nF 4 Core 4 Screens 8its C240	2N4400 15p BC160	13p BD539C 18p BD540C 42p BD540C 48p BD540C	1.10 TIP30A SEp TIP30C 1.20 TIP31A 72p TIP31C	DA91   100   CA31307   180   TMS6011   3 66   4532   600   74159   760   7415255   306   306   0A200   0A200   200   CA31407   806   81726   1.38   4534   4.28   74151   450   7415255   306   306   0A200   200   CA31407   806   81728   1.35   4536   2.380   74162   460   7415255   350   360
330nF 470nF14p 4 Core 1 Screen No.3 (Med) 680nF 1µF 24p 54p No.6 (Lge) 1 5µF 2 7µF 44p 8 Core 61p Bits 3(25)	6p 2N4402 30p BC167 6p 2N4403 30p BC167A 2N4409 36p BC167B	10p BD676 10p BD677 13p BD678	77p TIP32A 78p TIP32C 83p TIP33A 1.32 TIP33C	Sp ST2 25p LC7130 3.20 81LS96 1.20 4553 2.3 74166 480 74LS266 18p
Copper Cled	50 2N4440 12 50 8C1686 50 2N4870 800 8C168C	10p BD712 10p BDX14 10p BDX18	1.32 TIP34A 1.30 TIP34C 1.58 TIP35A	746 THYRISTORS LF353 S2p RNLS98 120 6556 Ne 7472 275 74LS275 2.25 Ne 74 120 4566 140 7472 275 74LS275 2.25 Ne 74 120 4566 140 74713 60p 74LS279 160 160 160 160 160 160 160 160 160 160
3 75 + 5 83e 75Ω UHF 36e 22 swq 3 25 + 17 2 50 75Ω VHF 28e VALVES 3 75 - 17 3 30 300Ω Fiel 14e	2N4888 92p 8C169C 2N4898 129 8C169C 2N4901 169 8C177A	10p BDX32 10p BUY54 16p BYD55 25p BDY56	3.47 TIP35C 1.70 TIP36A 1.75 TIP36C 1.80 TIP41A 5.25 TIP41C	1.28 B 200V LM348N 62p 8154 142 4584 38p 74175 45p 7415283 40p 1.38 C 300V LM348N 62p 8155 38t 4584 38p 74176 32p 7415289 4.70 1.38 C 300V LM349N 11 280ACYC 2 8 4585 78e 74177 465p 7415290 46p
VQ Board 1 50 Dip Board 3 25 Reinbow ECC82 1 Track Cutter 1 15 Ribbon Cable ECC83 1	12 2N4903 3 24 BC178 12 2N4904 2 75 BC178A 12 2N4905 3 25 BC178B	26p 80Y57 16p 80Y58 24p 8F194 25p 8F195	12p TIP42C	56p TiC106A 46p LM380N4 150 280APMA 10.00 2101 4.00 74180 40p 7418298 85p 86p TiC106B 470 LM380N8 150 2402AL2 1.35 74181 1.15 7418299 2.50
100 Pins 50 24 Way 186p EF86 1 Verobloc 3 70 40 Way 270p EL84 2	00 2N4907 3.20 BC179A 19 2N4908 3.70 BC1978 60 2N4909 2.90 BC179C	28p 8 f 196 28p 8 f 197 28p 8 f 198 27p 8 f 198	12p TIP50 12p TIP53 15p TIP54	1.40 4A TIC1060 959 (M381N 1.40 M82N 112 T14 (200ms)00 14184 906 74L5374 1.46 M82N 12 T157 T1C1060M 96 M82N 12 T157 T1C10
Spare Spool 72s	75 2N4918 95p 8C182 80 2N4919 1 28 8C182A 86 2N4920 1 34 8C182B 90 2N4921 56p 8C1828	10p BF200 12p BF224J 13p BF225J 10p BF240	1 48 TIP112 32p TIP115	11C116A 660 LM386N1 880 78L05A 300 4027 3 000 74191 480 78L53A 7850 110 8A 71C116C 710 LM386N4 120 78L12A 300 4044 7 00 74192 480 74L53A8 1.00 4060 880 880 880 880 74L53A8 1.00 4060 880 880 880 880 74L53A8 1.00 4060 880 880 880 880 880 880 880 880 880
(Posting prices   amps and   PCC85   3   Towers   Transistor   nearest above   PCF86   2   Transistor   Tra	10 2N4922 69p BC182LA 19 2N4923 99p BC182LB 10 2N5086 36p BC182LB 10 2N5087 39p BC183	13p BF241 14p BF244A 10p BF244B	38p TIP120 38p TIP122 35p TIP125 30p TIP127	73p LM391N80 1 53 1 Amp T0220 4118 3 3 74195 40 74LS362 7.25
10 50 slow 17p PCF801 2 TTL Data 3 95 1-2.5 amps PCF802 2 Quick 10p PCL82 1	7 2N5088 37P BC183B 11 2N5089 37P BC183B 00 2N5190 MB BC183C	12p BF245B 13p BF246 10p BF246A	30p TIP130 51p TIP132 52p TIP135 30p TIP137	150 T1C1260 775 M22SCN 2.19 76241 386 25004 7.50)74198 330 743.5367 259 1460 T1C1260 775 M22SCN 2.19 76241 386 6116 4.00 74199 330 743.5368 259 1460 T1C12660 956 LM733 650 Negative 614 3.30 74221 559 744.5378 580 150 150 150 150 150 150 150 150 150 15
Volt Reg Data 20 mm quick 10p PCL86 2 PCL805 2 PCL805 2 PO510 4	70 2N5193 90 8C183L8 0 2N5194 730 8C183LC 05 2N5209 240 8C184	13p 8F2468 13p 8F247A 14p 8F247B 10p 8F254	53p TIP140 54p TIP142 96p TIP145 38p TIP147	1 04 T9:as 400 LM741CN 156 79105 586 7489 173 74417f1 7415386 114 1741CN14 806 79112 586 7489 420 744101 145 7415390 450 118 174504 145 7415390 450 744101 145 7
Memory applic 4 95 Microtest 80 PL508 2 PL508 2 PL519 7	11 2N5246 40p BC184C 16 2N5247 45p BC184L 15 2N5248 46p BC194LB	12p 8F255 13p 8F256A 10p 8F256B 13p 8F256C	42p T1P2955 35p T1P3055 45p T1S43 62p T1S45	776 ILC22010A1 / Ph
Special function C22 00 PY88 1 handbook 3 95 Pocket size 6L6 2	77 2N5249 48p BC184LC 22 2N5266 2 88 BC186 33 2N5293 38p BC187 4 2N5294 1 28	14p BF257 24p BF258 24p BF259	30p T1546 32p T1547 35p T1588A	1.22   M.1307N 2.75   ZERD   2.26   49p 714430 1.45   741.540   2.20
Book in stock send for free list Multimeter 6527 506 21	9 2N5295 1 37	BC207 BC209	190	TIC2630(25A) M1871 4.39 2s pn 4.99 (PPD7/C OFF /14/51 1.75 /415860 1.89 (PD7/C 2.11 LM1872 4.39 (40 pn 5.30 40 pn 2.11 4.50 1.45 1.45 1.45 1.45 1.45 1.45 1.45 1.45

MINI-MULTI TESTER Deluxe packet size precision mov-Ing coil Instrument, Jewelled bearings - 2000 o.p.v, mirrored scale.

11 Instant range measures: DC volts 10, 50, 250, 1000.

AC volts 10, 50, 250, 1000.

OC amps 0 - 100 mA.



Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well Unbelievable value at only £6.75 + 60p post and insurance.

and insurance. FREE Amps range kit to enable you to read DC current from 0 - 10 scale, It's free if you purchase quickly, but if you already own Mini-Tester and would like one, send £2.50.

### SUPER HI-FI SPEAKER CABINETS

LABINE I S
Made for an expensive Hi-Fi outfit
— will suit any becor. Resonance
free, Cut-outs for 6%" woofer and
2%" tweeter. The front material is
Dacron. The completed unit is most
pleasing. Supplied in pairs, price
£6.90 per pair (this is probably less
than the original cost of one
cabinet) carriage £3.00 the pair.



6%" 8 ohm 25 watt £4.50, 2%" 8 ohm tweeter, £2.50. No extra for postage if ordered with cabinets. Xover £1,50,

OITTO but for 8" speaker and 4" tweeter. £7,50 + £3,50.





### VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95. These are without case but we can supply These are without case but we can supp a plastic base £1.75 or metal case £2.95. Also available is adaptor kit to convert this into a normal 24 hr, time switch but with the added advantage of up to 12 on/offs per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30,

### THERMOSTAT ASSORTMENT

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi metal types and 3 liquid types. 
There are the current stafts which will open the switch to protect 
devices against overload, short circuits, etc., or when fitted say 
in front of the element of a blow heater, the heat would trip 
the staft if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which 
could include 0 – 100°C. There is also a thermostatic poid which 
can be immersed, an oven stat, a calibrated boiler staft, finally an 
ice staft which, fitted to our waterproof heater element, up in the 
loft could protect your pipes from freezing. Separately, these 
thermostats could cost around £15,00 - however, you can have 
the parcel for £2,50.

# **50 THINGS YOU CAN MAKE**

Things you can make include Multi range meter, Low ohms tester, A.C. amps meter, Alarm clock, Soldering iron minder, Two way stelephone, Memory jogger, Live line tester, Continuity checker, etc., etc., and you will still have hundreds of garts for future projects. Our 10Kg parcel contains not less than 1,000 items - panel meters, timers, thermal trips, relays, switches, motors, drills, sand diss, tools, thermostats, coils, condensers, resistors, neose, serphone/microphones, nicad charger, power unit, multi-turn pots and date on the 50 projects.

YOURS FOR ONLY £11.50 plus £3.00 post

## **EXTRACTOR FANS**

EXTRACTION 1 A...

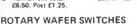
Mains operated — ex-computer,

4" x 4" Muffin 115v,

5" — £5.75, Post £1.25 
6" — £5.95, Post £1.25 
4" x 4" Muffin 230v,

£5.75, Post 75p,

£5.75, Post 75p,



Samp silver plated contacts, 'A' shaft, 1'' dia, wafer.
Single wafer types, 299 sech. as follows:
1 pole 12 way 2 pole 6 way 3 pol
4 pole 3 way 6 pole 2 way 4 pol
Two wafer type, 59p sech, as follows 4 pole 3 way 4 pole 6 way 12 pole 2 way 2 pole 12 way 6 pole 2 way 4 pole 5 way 8 pole 3 way

6 pole 2 way 3 wafer types 99p each, 9 pole 4 way 5 pole 5 way 12p 3 way 6 pole 6 way

# **EXTRA POWERFUL 12v MOTOR**

Made to work battery lawnmower, this probably develops up to ¼ h.p., so it could be used to power a go-kart or to drive a compressor, etc. etc. 69 of \$41.50 post. (This is easily reversible with our reversing switch - Price £1.15).

MINI MONO AMP on p.c.b., size 4"x 2" approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price £1.15 each, or 10 for £10,00.



# **POPULAR PROVEN PROJECTS**

MULTI-CHANNEL or ROBOT CONTROLLER

This is two kits. The 8 channel transmitter kit and the 8 channel receiver kit. Each kit comes with diagrams and notes, but no circuit boards, the component layout being left to you. The data shows how to drive, reverse and steer two or more s. With spare channels to perform other functions, Price £9.50 for both kits.

### 3 CHANNEL SOUND TO LIGHT KIT



Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by W. sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form or £25.00 assembled and tested. Case & metal Chassis No. Fully punched and

# WHY BE COLD - Build a tangential blower heater.

# TANGENTIAL BLOW HEATER

2.5 Kw quiet, efficient instant heating from 230/240 volt nains. Kit consists illustrated 2.5 Kw



# CAR STARTER AND CHARGER KIT

In an emergency you can start car off mains or bring your bettery up to full charge in a couple of hours. The kit comprises: 250 watt mains transformer, 40 amp bridge rectifier, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever sults you best. Price £12.50 + £3.00 post.

# TRANSMITTER SURVEILLANCE

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox — all electronic parts and circuit, £2.30,(not licenceable in the U.K.).

### **RADIO MIKE**

Ideal for discos and garden parties, allows complete freedom of movement, Play through FM radio or tuner amp. £6.90 complete kit. (not licenceable in the U,K.)

# FM RECEIVER

Made up and working, complete with scale and pointer needs only headphones, ideal for use with our surveillance transmitter or radio mike. £5.85. or kit of parts £3.95.

# 3 - 30v VARIABLE VOLTAGE POWER UNIT

With 1 amp DC output, for use on the bench, students, inventors, service engineers, etc. Automatic short circuit and overload protection. In case with a volt meter on the front panel. Complete kit £13.80

# INTERRUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra red or ordinary light is broken. Main components — relay, photo transistor, resistors and capacitors, etc. Circuit diagram but no case, Price £2:30.

# IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder — complet mains operated kit, case included. £11.95 plus £2.00 post.

# RADIO STETHOSCOPE

Easy to fault find — start at the aerial and work towards the speaker — when signal stops you have found the fault, Complete kit £4.95.

## INVISIBLE AND SILENT SENTINEL

Ultra-sonic beam when broken could warn you of visitor — two kits — transmitter & receiver. To operate light or bell, £9.50.

# BURGLAR ALARM

Complete kit includes 6" extrenal alarm bell, mains power unit, control box with keyswitch, 10 window/door switches, 100 yards of wire. With instructions. £29.50,

# 12v MOTOR BY SMITHS

Made for use in cars, these are series wound and they become more powerful as load Increases. Size 3%" long by 3" die. These have a good length of %" spindle — price £3.45. Ditto, but double ended £4.25.

Ditto, but permanent magnet, £3.75.

WATERPROOF HEATING WIRE

60 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses — around water pipes, under grow boxes in gloves and socks. 23p a metre.

# J. BULL (Electrical) Ltd. (Dept. EE), 34 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 300.

MAIL ORDER TERMS: Cash P.O. or cheque with order. Orders under MAIL DRUBK TERMS: Cash, F.O. or cheeged with order. Overs under \$10 add 60p service charge. Monthly account orders accepted from schools and public companies. Access & 8/card orders accepted day or night. Haywards Heath (6444) 454563, Bulk orders: write for quote. Delivery by return. Shop open 9.00 — 5.30, mon to Fri, not Saturday.

# SCHOOLS-LABS-STORES-WORKSHOPS-FACTORIES-

Your chance to re-stock at less than cost prices!!!

Your chance to re-stock at less than cost price:	5111
5mm flat twim per 100 metres   1.5mm flat 3 core & E per 100 metres   1.5mm flat 3 core & E per 100 metres   1.5mm flat 3 core per 100 metres   1.5mm flat 3 core per 100 metres   1.5mm flat bris & E per 100 metres   1.5mm flat bris	£2,00 £3,50 £5,50 £3,00 £7,50
15 core per 200 metres £1	60.00 40.00
THERMOSTATS & HEAT SWITCHES	
Thermostat: 3 level contact type. 10 amp appliance type thermoster. Spindle adjust Contact type with changeover, 10 amp switches, 0 - 100°C Wall mounting, metal case, c/o contacts low voltage	.30 .40 .58 £2.30
TIMERS & CLOCKSWITCHES	
Cooker clock switch, Smiths 12 hour	£2.30 £5.50 £1.00
Clockwoek operated switches: 15 amp, 230v. On time up to: 10 minutes £1.37 120 minutes	£1.37 £1.37
30 minutes . £1.37 360 minutes	€3.50
BLEEPERS - SIRENS - BELLS - BUZZERS	
Siren/Hooter - Delta 6 or 12v DC or 24v AC	.37
Open type buzzer, ex GPO, 10 - 20V Underdome bell, 4v - 9v Fire alarm bell, 12" gong, heavy cast fron construction	.85 £12.00
COUNTERS	12.00
6 digit counter, Mains operated, Not resettable	.60 .50 £1.00
SWITCHES - ROCKER, TOGGLE, ETC.	
Rocker switches: white push into hole 1" x 7/16". All rated 10 amp, AC 250 volt. on/off	.12
10 amp, AC 250 volt. on/off changeover centre off	
on/off with neon  push to make spring return	.20
push to break spring return Larger two circuit one on one with mounting plate	.20
13 amp rocker switch, Car Fastener (DoT)	.15
Interlocking switch: blow heater, 3 rockers, 10 amp	.30
changeover centre off on/off with nean push to make spring return push to break spring return push to break spring return Larger two circuit one on one with mounting plate 13 amp rocker switch. Car Fastener (DoT)	.20 _25
10 amp off/on	.15
Lever operated add	.10
Lever with roller operation add Miniature types: Burgess V4T6 c/o	.15
Two mounted with roller operator	.65
flat multi stackable 60 watt	.50
Glass reed switches: 60 watt 10p. 40 watt 5p. flat multi stackable 60 watt .  Operating colls for reed switch multi voltage 3, 6, 9, or 12 Ceramic magnets Mullard	.50
Mini Magnet	.15
MISCELLANEOUS ITEMS	
Neon Mains indicators. Standard	.15
Sench Isolation mains in 230/240v output, 250 Watts	£4.50
Light operated switch 12 volt. Encapsulated Insulating board, srbp etc. Approx 10 tons. Sheet size 4'x 4'	.20 £1,25
or larger, Various thicknesses, price per lb	.50 £2.00
Of larger, Various micknesses, price per lb.  Ditto, Tufnol, price per lb.  Aerosol can ICI Fluon lubricant  Varicap P.B. TV tuner	.35
Varicap P.B. TV tuner Battery holder takes 6 U2 batteries, snap connector Car Battery clips, as for charger, + and — per pair	.50 .25 .10
MAINS TRANSFORMERS	
6 volt 1 amp	£2.00
6.3 volt 2 amp £1.00 38 volt 2½ amp	£2.50 £4.00
12 volt 4 amp £2.00 50 volt 2 amp	£2,00
12 volt 1 amp £1.00 12 · 0 · 12, 2 amp	£2.50

# 8.5 - 0 - 8.5 1 amp £1.00 18 volt 1 amp £1.50 25 volt 1½ amp £1.50 12 - 0 - 12, 1 amp . 100W auto 115v o/p

# **MOTORS - MAINS & BATTERY**

3 - 6 volt battery motor, very small			.15
3 - 12 volt battery motor, very low current			.20
Mains motor with gear box 5 rev minute		4	£2,25
80 rev per minute			
110 rev minute			£2.00
200 rev minute			
Mains motor, double ended fan motor			£1.20
Ditto single ended fan motor			£1.00
Fan blade for above			.50
Mains motor, double ended, very powerful 1%" stac	k		£1,50
Mains instrument motors 1 ray 24 hours .			£1.50
with gear box: 1 rev 1 hour			
16 rev minute			
4 rev minute , .			
2 rev minute			£1.50
1 rev minute			£1.50
Motor clackwork, set up to 1 hour			.38
Motor, clockwork set up to 1 hour with ringer .			.75
Mains motor % h.p. 1425 revs, ex-computer			€4.25
Vent opening motor with end stop switches			£12.50
12 volt motors, Smiths, single ended 1/11 spindle			
12 volt motors, Smiths, double ended "" spindle			£2,00
			£1,75
1% h.p. motor 3450 rpm 100 volt. 50Hz. New .			€5.00

SPECIAL TERMS. For items in this column. Order no less than 10 of any item. Then add VAT at 15%, and 20% for carriage in the case of transformers and electric motors. All other items in this column are free post & packing.

# ectronics

**MAIL ORDERS:** Unit 3, Hill Farm Industrial Estate, Boxted, Colchester, Essex CO4 5RD. **TELEPHONE ORDERS:** Colchester (0206) 36412.



S55CMOS   80   ICL7106   556CMOS   150   ICL7611   1709	LM339 LM348 LM358 790 LM377 995 PLM380 180 PLM381 180 PLM381 180 LM382 295 LM384 65 LM393 465 LM393 465 LM701 360 LM725 360 LM725 360 LM725 360 LM725 360 LM7458 40 LM7458 40 LM3907 120 LM3907 120 LM3907 120 LM3907 120 LM3907	45 LM3911 60 LM3916 50 LM3916 170 LM13606 65 MC1496 120 PMF10C* 130 ML922 150 ML924 120 ML925 65 ML924 120 ML925 60 ML926 60 ML926 61 ML926 61 ML926 62 ML927 62 ML927 63 ML927 63 ML927 64 ML926 64 ML926 65 ML927 75 MM5387 76 ME531 76 NE555 76 NE555	175 P 195 P 105 P	#E566 140 PNE567 100 PNE567 3070 #E571 370 #E568 60 #E468 60 #E46	TL064 96 TL071 30 TL072 95 TL074 95 TL082 95 TL170 50 UL1700 95 TL1710 50 UL170003 85 TL170 50 UL170004 90 XR2206 290 XR2206 290 XR2206 290 XR2206 330 XR2726 530 ZN4276 650 ZN428 480 ZN428 480 ZN428 480 ZN428 480 ZN428 480
TRANSISTORS  AC125 35 BC149 9 AC126 25 BC157 8	BC548 10	BFR40 23 1 BFR80 23 1 BFR81 20 1	TIP29A 3 TIP29B 5 TIP29C 3	60 ZTX108 80 ZTX109 55 ZTX300 87 ZTX301	8 2N3055 50 12 2N3442 120 14 ▶ 2N3702 6 16 2N3703 9 15 ▶ 2N3704 6

▶CA324	IOE 11	0 LM33	52		LM3909		E565	110	TL06			V1034E	200
E-30		NAME OF TAXABLE PARTY.		BC517	40	BF337	40	MPSU56	60	ZTX108	8	2N3055	50
TRAI	USIST	ORS		8C547	7	BFR40	,23	TIP29A	30	ZTX109	12	2N3442	120
				BC548	10	BFR80	23	TIP298	55	ZTX300	14	▶ 2N370	
AC125	35	BC149	9	BC549	10	▶BFR81		TIP29C	37	ZTX301	16	2N3703	9
AC126	25	8C157	8	BC558	10	BFX29	25	TIP30A	35	ZTX302	15	▶2N370	
AC127	25	BC158	10	BCY70	18	BPX84	25	TIP30B	50	ZTX304	17	2N3705	9
► AC128		BC159	8	BCY71	18	BF X85	26	TIP30C	37	ZTX341	30	2N3706	9
AC176	25	BC160	45	BCY72	18	BFX86	28	TIP31A	35	ZTX500	15	2N3707	10
AC187	22	BC168C	10	BD115	55	BFX87	25	TIP31C	37	ZTX501	15	2N3708	10
AC188	22	BC169C	10	BD131	35	<b>BFX8</b> 8	25	TIP32A	35	2TX502	15	2N3709	10
AD142	120	BC170	8	8D132	35	8F Y50	23	TIP32C	37	ZTX503	18	2N3772	170
AD149	80	BC171	10	8D133	50	BFY51	20	TIP33A	50	ZTX504	25	▶2N377	3 195
AD161	40	BC172	8	BD135	40	BFY52	23	TIP33C	75	2N697	20	▶ 2N381	9 18
AD162	40	BC177	18	8D136	30	BFY53	32	TIP34A	60	2N698	40	2N3820	40
AF124	60	BC178	1.8	BD137	30	BFY55	32	TIP34C	86	2N706A	20	2N3823	65
AF126	50	8C179	18	80138	30	BFY56	32	TIP36A	105	2N708	20	2N3866	90
AF139	40	BC182	10	▶BD13	9 35	8RY39	40	TIP35C	125	2N918	35	2N3903	10
AF186	70	▶BC1821	. 8	▶BD14	0 35	BSX20	20	TIP36A	125	2N1132	22	2N3904	10
AF239	75	BC183	10	BD204	110	8SX29	35	TIP36C	135	2N1613	30	2N3905	6
BC107	10	8C183L	10	BD206	110	8SY95A	25	TIP41A	45	2N2218A	45	2N3906	10
BC107B	12	BC184	10	BD222	85	BU205	160	TIP42A	45	2N2219A		2N4037	45
▶BC108	9	BC1841	. 7	BF180	35	BU206	180	TIP120	90	2N2221A	25	2N4058	10
BC108B	12	BC212	10	BF 182	35	BU208	170	TIP121	90	2N2222A	20	2N4060	10
BC108C	12	BC212L	10	BF184	25	MJ2955	99	TIP122	90	2N2368	25	2N4061	10
▶BC109	9	BC213	10	BF 185	25	<b>MJE340</b>	50	TIP141	98	2N2369	16	204062	10
BC109C	12	BC213L	10	8F194	12	MJE520	65	TIP142	98	2N2484	25	2N6487	36
BC114	18	BC214	10	BF 195	12	MJE521	95	TIP147	110	2N2646	45	2N5458	36
BC115	22	▶BC2141	L B	BF 196	12	MJE3056		TIP2955	60	2N7904	20	2N5459	30
BC117	18	BC237	8	BF 197	12	MPF102	40	T1P3055	55	2N2904A	20	2N5485	36
BC119	35	BC238	14	BF198	10	MPF104	40	TIS43	40	2N2905	22	2N5777	45
BC137	40	BC308	12	BF199	18	MPSA05	22	TIS44	45	2N2905A		2N6027	30
BC139	40	BC327	14	BF200	30	MPSA06	25	TIS90	30	2N2908	25	40360	40
8C140	28	BC328	14	▶BF24		MPSA12	30	TIS91	30	2N2906A	25	40361	50
BC141	30	BC337	14	BF245	30	MPSA65	30	VN10KN		2N2907	25	40362	50
BC142	25	BC338	14	BF 256		MPSA56	30	VN46AF		2N2907A	25	40408	70
BC143	25	8C477	30	BF 257	32	MPSU05	55	VN66AF		2N2926	9		
BC147	8	BC478	30	8F258	25	MPSU06	55	VN88AF		▶2N3053			311743
BC148	8	BC479	30	BF 259	35	MPSUS5	60	2TX107	8	2N3054	55		97.4
50,140	9	5-15		J. 200	30	WIF 2000	90	2.74107	0	E1470.24	55	100	

	MICR BEST PRICES ANYWH	27 25 27 41 61	32 32 16 P20 16-P3 150nS	205 Z80/ 340 Z80/ 340 Z80/ 70 Z80/	A CPU 29 A P10 26 A CTC 26 A S10 90 A DMA 115 A DART 50 895 8	0 81L 0 148 0 148 0 Epsi 0 Con	\$97 8	lievs wo	100K 1MH 1.843 2.0M 2.453	27 32M 20 22 76M 20 9M 9	5 4.431 5 6.0M 00 7.0M 25 8.0M	140 150
Total Statement of the last of	4001 1 4002 1 4006 5 4007 1 4008 3 4009 2 4010 2 4011 1 4012 1 4013 2 4014 4	4016 4017 4018 0 4019 0 4020 2 4021 00 4022 4 4023 36 4024 4 4025 4 4026 4 4026 4 4026 5 4028 9 4029 15 4030 10 4031	30 45 42 40 445 416 33 412 40 40 40 40 415 414 416 416 416 416 416 416 416 416 416	4034 140 4036 249 4039 280 6040 40 4041 40 4042 38 4044 40 4046 40 4046 40 4046 40 4046 40 4046 21 4050 21 4052 48 4052 48	4055 4059 4060 4063 4066 4067 4068 4069 4070 4071 4072 4073 4075 4076	78 80 430 42 80 22 225 14 13 13 13 13 13 13	4081 4082 4085 4086 4089 4093 4094 4095 4097 4098 4099 40106 40163 40173 40173	18 68 65 290 70 70 40 110 60 100	40193 4502 4503 4507 4507 4510 4511 4512 4514 4515 4516 4518 4521 4521 4521	60 32 35 110 45 40 40 115 115 55 40 50	4528 4529 4532 4534 4538 4549 4549 4553 4555 4556 4559 4560 4584 4724	45 150 60 400 60 50 360 215 35 390 140 35 60 140
The second secon	LS04 1 LS05 1 LS08 1 LS09 1 LS10 1 LS11 1 LS12 1 LS13 1 LS14 3	1 LS27 1 LS30 2 LS32 2 LS37 2 LS38 2 LS40 2 LS42 2 LS47 2 LS45 2 LS51 9 LS55	12 12 14 12 12 13 14 15 13 14 15 14 14 14 14 18 18 18 18 18 18 18 18 18 18 18 18 18	LS75 20 LS76 17 LS78 17 LS83 35 LS85 48 LS85 48 LS90 24 LS92 25 LS93 24 LS95 38 LS95 38 LS96 95 LS107 40 LS109 21 LS113 21 LS113 21 LS113 21 LS114 22 LS114 22 LS114 22 LS114 22 LS112 35	LS123 LS125 LS126 LS132 LS138 LS138 LS139 LS147 LS147 LS148 LS151 LS153 LS155 LS156 LS155 LS156 LS155	34 24 25 35 26 30 70 150 75 38 38 75 33 36 26 29	LS160 LS161 LS162 LS163 LS164 LS165 LS166 LS170 LS173 LS174 LS175 LS199 LS199 LS199 LS199 LS199 LS1995 LS1996	35 35 35 35 40 55 60 75 60 45 45 35 35 35 35 45	LS197 LS221 LS240 LS241 LS242 LS243 LS244 LS245 LS257 LS257 LS258 LS259 LS268 LS279 LS263	45 50 60 55 55 55 55 70 48 28 32 32 32 55 20 58 30 38	LS353 LS365 LS366 LS367 LS368 LS373 LS374 LS375 LS377 LS378 LS390 LS399 LS399 LS541 LS670	60 28 28 28 29 58 60 43 60 57 45 40 156 78 135
NAME AND ADDRESS OF TAXABLE PARTY AND ADDRESS OF TAXABLE PARTY.	7404 1 7405 1 7406 1 7407 1 7408 1 7409 1 7410 1	1 7420 1 7421 2 7422 2 7427 4 7428 9 7430 9 7432 3 7433 3 7437 3 7438 5 7440	23 7 19 7 19 7 14 7 19 7 19 7 18 7 25 7 20 7 20 7 21 7 22 7 23 7	444 85 446 58 447 36 448 43 450 14 451 14 453 14 460 14 460 14 472 22 473 24 474 19 475 26 480 45 480 45	7483 7485 7486 7489 7490 7491 7492 7493 7494 7495 7496 7497 74100 74107 74109	30 60 19 180 19 34 24 24 33 33 33 38 86 78 22 24 24	74122 74123 74125 74126 74126 74131 74147 74147 74147 74150 74153 74154 74155 74156 74157	38 38 33 30 54 48 75 60 48 36 36 28 56	74161 74162 74163 74164 74165 74167 74170 74173 74175 74176 74177 74177 74180 74181 74182	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
	CAPAG	TORS		POT	ENTIOME	TERS		то	OLS			

# SWITCHES

Submin toggle: SPST 55p, SPDT 60p, DPDT 65p, Miniature toggle: SPDT 80p. SPDT centre off 90p. DPDT 90p. DPDT centre off 100p. DPD1 sup. DPD1 centre off 100p. Standard toggle: SPST 35p, DPDT48p Miniature DPDT slide 12p. Push to make 12p. Push to break 22p. Rotary type adjustable stop. 1912W, 2PSW, 3P4W all 55p each. DII swifthers. DIL switches: 4SPST 80p 6 SPST 80p, 8SPST

VERO					
VEROBLOC	⋖			,	350
Size 0.1 matr	in:				
2.5 x 1 .					22
2.5 x 3.75					75
2.5 x 5 .					85
3.75 x 5 .					95
VQ board					160
Veropins per	10	0:			
Single sided					50
Double sided					60
Spot face cut					105
Pin insertion	toc	ılc			162
Wiring pen an	od a	mo	οI		310

apare spe	ACI FUID	COITIUS	. 0
DIOD	ES		
BY127	12	▶1N4001	3
OA47	10	1N4002	5
OA90	8	1N4006	7
OA91	7	1N4007	7
OA200	8	1N5401	12
OA202	8	1N5404	16
1N914	4	1N5406	17
▶1N414	8 2	400mWzen	6

CABLES	ı
20 metre pack	

20 metre pack single ing cable ten differe			
Speaker cable .			10p/m
Standard screened			16p/m
Twin screened .			24p/m
2.5A 3 core mains			23p/m
10 way rainbow rib	bor	1	65p/m
20 way rainbow rib	bor	1	120p/m

# TRANSFORMERS

Please add carriage charges

Miniature mains: 606V, 909V, 12012V all @ 100mA 100p each.

PCB mounting, Ministure: 3VA 0-6, 0-6 @ 0,25A; 0-9, 0-9 @ 0.15A; 0-12, 0-12 @ 0,12A 200p each. 6VA 0-6, 0-6 @ 0.5A; 0-9, 0-9 @ 0.3A; 0-12, 0.12 @ 0.25A 270p each.

6VA 046, 04 € 0.5A; 0 \$, 05 € 0.3A; 0-12, 0.12 € 0.25A 270p each. High qualifity. Solit bobbin construction 6VA 046, 04 € 0.5A; 0-3, 0-3 € 0.4A; 0-12, 0-12 € 0.5A; 0-15, 0-15 € 0.4A 295p (plus 40p carriage). 40.4A 295p (plus 50p carriage). 40.4A 295p (plus 75p carriage).

# HARDWARE

PP3 battery clips	
Black pointer control knob	. 15
Pr Ultrasonic transducers	35
▶6V Electronic buzzer	6
▶12V Electronic buzzer	6
▶PB2720 Piezo transducer	7
▶64mm 64 ohm speaker	70
▶64mm 8 ohm speaker	71
20mm panel fuseholder	2

BOXES	Aluminium
Plastic with	3x2x1" 70
lid + screws	4x3x1%" 85
3x2x1" 55	
	88 6×4×2" 120
7×4×2 16	50 6x4x3" 150
	▶ C106D 30
SCRs	400 V BA 70
	400 V 12A 95

l	00	_	400 V 12A	95
	BRIDGE RECTIFI	ERS	2A 200V 2A 400V 6A 100V	40 45 80
Į	1A 50V 1A 400V	20 35	6A 400V 95 VM18 DIL 0. 200V	-

# CONNECTORS

			2.5mm	10p	100
	120				
3 pin		10p	3.5mm	9p	9p
5 pin	13p	11p	Standar	d16p	20p
			Stereo		
1mm	12p	13p	4mm	18p	17p
UHF (	CB) (	Conn	ectors:		
PL259	Plug	40p.	Reduc	er 14	p.
SO239 square chassis skt 38p.					
SO239S round chassis akt 40p.					
IEC 3 p	oin 2	50 V	6A.		
Plug ch	assis	mou	nting .		38p
Socket	free	hang	ing .		60p
Socket	with	2m	lead .		120p
_	_	_	_		_

## MULTIMETERS

HT-120 4,000 opv
A smart looking 11 range pocket sized multimeter with an impressive spec. Complete with battery, etc. Spec. Complete with dattery, etc. 650p each. HT-320 20,000 opv. Highly sensitive 19 range multi-meter including transistor tester. Overload protection. DC volts = 1000, AC volts = 1000; DC current 0,25A, 4 resistance ranges, Complete with batteries, leads, etc. 1395p

NEW CATALOGUE . NEW CATALOGUE!!!!!!!! Our latest catalogue has just been released containing over 2000 stock lines all at extremely competitive prices backed by Rapid's return of post service. Stocks include Denco coils, tools, Verocases, data sheets etc. etc. Send 45p for your copy now (sent free of charge with all orders over £10)

CAPACH DISC Polyester, radial isade, 250v. C280 type: 0.01, 0.015, 0.022, 0.033 -50; 0.047, 0.058, 0.1 -70; 0.15, 0.022 -90; 0.33, 0.47 -139; 0.68 -20s; 1u - 22s Electrolyter, radial or axial leeds: 0.4763V, 1/63V, 2/2/63V, 4/763V, 0/25V - 79; 220/25V, 140; 470/25V - 252; 22/25V, 4775V - 80; 100/25V - 99; 220/25V, 140; 470/25V - 252; 1000/25V - 30s; 2200/25V - 50s. Tog end power supply electroly tics: 2200/40V - 110s; 4700/40V - 150s, 2200/63V - 140s; 4700/40V - 150s, 2200/63V - 140s; 4700/63V - 230s, 2200/63V - 140s; 4700/40V - 150s, 10, 721, 233, 476, 568, 100, 156; 10, 721, 233, 476, 568, 100, 156; 150n, 11p; 220n, 13p; 330n, 20s; 470n 26p; 680n, 29s; 1u 33p; 2u 2, 50s.

470n 28p; 680n, 29p; 1u 33p; 2u2, 500.
Tentalium bead:
0.1, 0.22, 0.33, 0.47, 1.0 @ 35V - 12p; 2.2, 4.7, 10 @ 25V - 20p; 15/16V - 30p; 22/16V - 27p; 33/16V - 45p; 47/6V - 27p; 47/16V - 70p; 68/6V - 40p; 100/10V - 90p. Car. disc. 22p - 0.0 tu 50V, 3p each. Mullard ministure caramic plate:
1.8oF to 100pF 6p each.
Polystyrene, 55 tol: 10p-1000p, 6p; 1500-4700, 8p; 6800 0.012u, 10p. Trimmers, Mullard B08 sersis: 2-10 pF, 22p; 2-22pF, 30p; 5:5-65pF, 35p

# RESISTORS

\( \text{\text{W} 5\text{\text{Carbon film E12 series 4.7}} \)
\( \text{ohm - 1M}, \quad \text{1 p each}, \)
\( \text{\text{\text{W} 5\text{\text{\text{Carbon film E12 series 4.7}}} \)
\( \text{ohm to 4M7}, \quad \text{2 p each}, \)
\( \text{\text{\text{W} 1\text{\text{\text{\text{\text{\text{W} 1\text{\texiex{\text{\text{\text{\text{\text{\texiex{\text{\ti}\text{\text{\text{

SOCKETS	Low	Wire
	profite	wrap
8 pin	6р	25p
14 pin	80	350
16 pin	9p	42p
18 pin	12p	52p
20 pm	13p	60p
22 pin	16p	700
24 pin	18p	700
28 ppn	23n	80p
40 pin	250	980
Soldercon pini	60P/100	

Rotary, Carbon track Log or Lin 1K - 2M2, Single 32p, Stereo 85p, Single switched 80p, Slide 60mm travel single Log or Lin 5K - 500K 63p each. Preset submin, hor, 100 ohms -1M

# REGULATORS

SOLDERINGIRONS			
LM323K	350	1₽5V .	550
LM317T	120	78H05 5A	
LM317K	270	LM33BK	475
LM309K	130	LM723	35
7818	35	7915	40
7812	35	7912	40
7805	35	7905	40
78L15	30	79L16	65
78L12	30	79L12	65
78 LOE	30	79L05	65

# Antex CS 17W Soldming and 2.3 and 4.7mm birs to suit CS 17W iron 450, element CS 17W iron 450, element Solder pump desided ring to Spare nozale for above 10 metros 22mm belook in 10 metros 22mm be

# PCB MATERIALS

Alfac transfer sheets - please s	<b>Itute</b>
type (e.g. DIL pads etc.) .	45
Dela etch resist pen	100
Fibre glass board 3.75"x8"	80
Ferric chloride 250ml bottle.	100
	_

Small trimming tool .		22
Small pocket screwdriver		16
Large pocket screwdriver		13
8 piece precision screwdring	rer	set
in plastic case		170
Low cost side cutters .		160
High quality side cutters		650
Low cost pliers		160
Minh overlies where		CEO

Small trimming tool

1 / 0				
160				
650				
160				
650				
120				
695				
1025				
1200				
Reduced shank drill bits for				
60				

# OPTO

▶ 3mm red 7	▶5mm red 7			
▶ 3mm green 10	▶ 5mm green 10			
▶3mm yellow10	▶ 5mm yellow10			
Clips to suit - 3p a	each,			
Rectangular	TIL32 40			
▶red 12	TIL78 40			
green 17	▶TIL111 60			
yellow 17	ORP12 85			
▶TIL3B 40	TIL100 90			
2N5777 45	Dual colour 60			
Seven segment displays:				
Com cathode	Com anode			
DL704 0.3" 95	DL707 0.3" 95			
▶FND500	FND607			
0.5" 100	0.5" 100			
TIL313 0.3"115	TIL3120.3"115			
TiL3220.5°115	TIL3210.5"115			
LCD: 3% digit 58	Op. 4 digit 620p.			

400 V BA 400 V 16 A	
0	25
•	00

# COMPONENT KITS

An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greetly reduced prices. XW 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total 4.60) actions to 1.00 of each value from 4.7 ohms to 1.00 of each value from 4.7 of each value fro 480 370 575 of 650 resistors). Ceramic Cap. kit, 5 of each value - 22p to 0.01u (136 caps). Polyester Cap. kit, 5 of each value from 0.01 to 1uF (65 caps). Preset kit, Contains 5 of each value from 100 ohms to 1M (total 65 presets
Nut and Bolt kit (total 300 items): 180p
25 68A %" bolts
25 68A %" bolts
50 68A nuts
25 68A %" bolts
50 68A nuts 425

# I he 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/ 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 Saturday

# FPAK BARGAIN



# 5121 SCREWDRIVER SET

6 precision screwdrivers in hinded plastic casa Sizes 08 1 4 2 2 4 2 9 and 3 8mm £1.75

# 5131 NUT DRIVER SET

5 precision nut drivers in hinged plastic case With furning rod Sizes = 3 3 5 4 4 5 and 5mm £1.75

# 5T41 TOOL SET

5 precision instruments in tonged diastic case Crosspoint (Phillips) screwdrivers H O and H 1 Hex key wrenches 1 5 2 and 2 5mm £1.75

# SIST WRENCH SET

5 precision wrenches in hinged plastic case Sizes - 4 4 5 5 5 5 and 6mm £1.75

BUY ALL FOUR SETS 1121 1151 and ge HEX KEY SET FREE

HEX KEY SET ON RING Sizes 152 253

5 5 5 and 6mm Made of hargened steel HX 1 £1.25



# "IRRESISTARIF

AE	919	ON BANGAINS	
Pak No.	On.º	Description	Price
SX10	400	Mixed "All Type" Resistors	£1
SX11	400	Pre-formed % % watt Carbo	on
		Resistors	£1
SX12	200	s watt Carbon Resistors	£1
SX13	200	watt Carbon Resistors	£1
SX14	150	h walt Resistors 22 ohm-	
		2m2 Mixed	6.1
SX15	100	1 and 2 watt Resistors 22	
		ohm 2m2 Mixed	El
Paks SX1	2.15 con	tain a range of Carbon Film Ri	esistars

of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor paks and have a full range to

cover your projects.
"Quantities approximate, count by weight

# GUARANTEED TO SAVE YOU

MUNET	
SX27A 60 Assorted Polystyrene Bead Capa	citors
Type 9500 Series PPD	£1.00
SX28A 50 Assorted Silver Mica Caps	
5.6pF-150pF	£1.00
SX29A 50 Assorted Silver Mica Caps	
180pF-4700pF	£1.00
SX30A 50 High Voltage Disc Ceramics 750V	min
up to 8KV. Assorted useful values	£1.00
SX31A 50 Wirewound 9 watt (arg) Resistor	S.

AUTO SCREWDRIVERIDRILL Automatic spiral ratchet. Complete with 2 screwdriver blades, 5 & 65mm. 1 screwdriver cross point No. 1 & three drills – 2, 2.8 and 35mm. 1.65mm - A MUST FOR ALL HOBBY-BUILDERS & CONSTRUCTORS, Order No. ASD/1 £3.**50** each

# "CAPABLE

	UAF	AUTTONTANO	
Pak No.	Ott.	Description	Price
SILE	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature	2
		Mixed	£1
SX18	100	Mixed Ceramics Lpf 56pf	El
SX19	100	Mixed Ceramics 6Bpf- 0.5ml	13
SI 20	100	Assorted Polyester/Polystyrer	ne
		Capacitors	£1
SX21	60	Mixed C280 type capacitors	
		metal foil	£1
SIZZ	100	Electrolytics all sorts	£1
SX23	50	Quality Electrolytics	13

\*Quantities approximate count by weight

# RARGAINS

	BAITGAILL	
SX91	20 x Large .2" REO LEO	£1
SX42	20 small 125 Red LEO's	61
S143	10 Rectangular Green LEO's 2	£1
S146	30 Assorted Zener Orodes	
	250mw-2 walt mixed voltages.	
	all coded. New	£1
SX47	4 Black Instrument	
	Knobs-winged with pointer !"	
	Standard screw Fit size 29 x	
	20mm	50p
S149	20 Assorted Slider Knobs	
	Black/Chrome, etc	C1
SKBO	12 Neons and Filament Lamps. Lo	
	voltage and mains - various types	
	and colours - some panel mounti	ng El

# BRAND NEW LCD DISPLAY MULTITESTER.

LCD 10 MEGOHM INPUT IMPEDANCE

3 % digit 16 ranges plus hFE test facility for PNP and NPN transistors "Auto zero, auto polarity 'Single handed pushbutton operation \*Over range indication \* 12 5mm inch) large LCD readout \*Dioue check \*Fust circuit protection \* Test leads battery

and instructions included 1993 0: - 1999 Max indication

Polarity indication. Negative only Positive readings appear without - sign

10 Megohms Input impedance Zero adjust Automatic 250 miliiseconds Sampling time - 5°C to 50°C

Temperature range 1 x PP3 or equivalent 94 Power Supply battery

20mW 155 x 88 x 31mm SIZE RANGES

DC Voltage 0 200mV 0.2.20.200-1000V Acr 0.8% AC Voltage 0 200 1000V

Acc | 2 DC Current 0 290uA 0.2.20.200mA 0-10 A Acc. 1.2% Resistance 0. 2. 20-200K ohms

0 2 Megohms Acc BI PAK VERY LOWEST POSS PRICE

# . 9600 £35 00 each

# SIREN ALARM MODULE

American Police type screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security urposes, 5 watt. 12v max



f3.85 Order No BP124

# The Third and

.... you always need but have never got until now.
This helpful unit with Rod mounted horizontally on Heavy Base. Crocodile clips attached to rod ends. Six ball & socket joints give infinite variation and positions through 60° also available attached to Rod a 21/ dia magnifier giving 2.5 x magnification. Helping hand unit available with or without magnifier Our Price with magnifier as illustrated DRDER NO T402 €5.50 Without magnifier ORDER NO T480 €4.75

# Fourth Hand...



5157 6 Black Heatsink will fit TO 3 and TO 220 Ready drilled Half price 61 value

1 Power finned Heatsink This heatsink 5153 gives the greatest possible heat dissipation in the smallest space owing to its unique staggered fin design pre-drilled 10 3 Size 45mm squarer 20mm high 40p 10.66 size 35 mm x 30 mm x 12 mm

5155 L Heat Efficiency Power Finned Heatsink 90mm + 30mm + 35mm High Dulled to take up to 4 1

£1.50 each

# SINGLE SIDED FIBREGLASS

	B	IOARD		
Order No.	Pieces	Size	Sq.Ins.	Price
B1	4	9 = 2%"	100	£1,50
B2	3	11 = 3"	100	£1.50
B3	4	13 x 3"	156	\$2.00
DOU	BLE SIC	ED FIBR	EGLAS	S

BOARD

### SILICON POWER TRANSISTORS - 703

NPN like 2N3055 - but not full spec 100 watts 50V min. 10 for E1.50 — Very Good Value 100s of uses — no duds Order No. SX90

### **BI-PAK SOLDER DESOLDER KIT**

ORDER NO SX80 Kit comprises 1 High Quality 40 watt General Purpose Lightweight Soldering iron 240v mains inc (4.7mm) bit

1 Quality Desoldering pump. High Suction with automatic ejection. Knurled anti corrosivo casing and tellon nozzle

1.5 metres of De soldering braid on piastic dispenser vds (1 83m) Resin Cored Solder on Card

Heat Shunt tool tweezer Type Total Retail Value over £12.00 DUR SPECIAL KIT PRICE CB.95

### BI-PAK PCB ETCHANT AND DRILL KIT

omptete PCB Kill comprise Expo Mini Drill 10 000RPM 12v DC incl 3 pilets & 1 x 1mm Twist bit

Sheet PCB Transfers 210mm + 150r Etch Resist Pen

IND DACK FERRIC CHLORIDE Crystais sheets copper clad board

sheets Fibregiass copper clad board ull instructions for making your own PCB poards

DRDER NO. SX81

Retail Value (iver £15.00 OUR BI PAK SPECIAL KIT PRICE £9.75

# ROGRAMMARI E LINLUINCTION TRANSISTOR

PUT case 10106 plastic MEU: 2N6027 /6028 PNPN Silicon Price 1-9 10-49 50-99 100\* Each 20p 18p 15p 13p

SX33A 6 small (min (SDST/SPDT Toggle Switches 240v Samp £1.00 SX35A 6 small (min) Rocker Switches 240v Samp \$1.00 SX35A 240v SAMP \$1.00 SAMP \$1

£1.00

A mixed bundle of Copper clad Board Fibre glass and paper Single and double sided. A tantastic bargain SX72 £1.00 REGULATED VARIABLE Stabilised POWER SUPPLY

m 2 30 volts and 0 2 Amps. Krt includes VPS30 Module, 1 — 25 volt 2 amp transformer, 0 50v 2" Panel Meter, 1 — 0-2 amp 2" Panel Meter, 470 phm wirewound potentiometer, 1 - 4K7 phm wirebound potentiometer, Wiring Diagram included, Order No. VPS30 KIT

# MINIATURE FM TRANSMITTER Freq: 95-106MHz. Range: 1 mile Size: 45 × 20mm. Add: 9v bett.

Not licenced in U.K. Ideal for: 007-MI5-FBI-CIA-KGB etc.

# **TECASBOTY**

The Efectronic Components and Semiconductor Bargain of the Year. A host of Electronic components including potentiometers — rotary and slider presets — horizontal and vertical Resistors of mixed values 22ohms to 2M2 -- 1 8 to 2 Walt. A comprehensive range of capacitors including electrolytic and polyester types plus disc ceramics elcetera Audio plugs and sockets of various types plus switches, fuses, heafsinks, wire, nuts 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 we ver £25 00 Our Fight Against Inflation

Beat the Budget JUST £6.50. Down with Depression

SX3R 100 Silicon NPN Transistors-£3.00

100 Silicon NPN Transistors—all perfect Coded mixed types with data and eqvt sheet. No rejects Real value 100 Silicon PNP Transistors—all perfect. Coded mixed types with data and eqvt sheet. No rejects Fantastic value.

The best known Power Transistors in the World — 2N3055 NPN 115w Our BI-PAK Special Offer Price 10 off 50 off 1 £16.00 £3.50 £30.00

**8D312** COMPLIMENTARY PNP POWER TRANSISTORS: TO 2N3055
Equivalent MJ2955 — BD312 — TO3 /
SPECIAL PRICE E0.70 each



# **MORE BARGAINS!**

60 metres PVC covered Hook-up \$151 vire single and stranded. Mixed £1 25 Assorted TTL Gates 7400 ues 7401.7460 £1 10 Assorted flip Flops and MSI £1 SX60 20 Assorted Slider Potentiometers 40 Assorted Pre-Sets Hor/Yert £1

£1

£1

10 Reed Switches — glass type 3 Micro Switches — with lever

Sand your orders to Dept EE3 BI-PAX-PO BOX 6 WARE HERTS. SUPP AT 3 BALDOCK ST WARE HERTS. THINS: CASH WITH ORDER SAME DAY DESPATCH. ACCESS. BARCLAYCARD ALSO ACCEPTED TE! (0800) 3182 GIRO 388 7008 ADD 15%-VAT ANDL\$5 PER GROEP POSTAGE AND PACKING



Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail ber you must add VAT at 15% to your orde

Total Postage add 75p per fotal orde

# -PAK BARGAII

# TRIACS - PLASTIC

4 AMP - 400v - T0202 - TAG 136G 50 OFF £17.50 £3.75 40p 8 AMP 400v T0220 - TAG 425

### SLIDER **POTENTIOMETERS**

ALL AT 50p PER PAK

SX63 5 x 470 ohms Lin SX67 5 x 47k Lin SX68 5 x 47k Log SX69 5 x 100 Lin SX70 5 x 1 meg Lin SX65 5 x 22k Lin SX66 5 x 22k Log

\$140 250 Silicon Diodes-Switching like 230 Silicon Diodes—General Purpose like 0A200/202 BAX13:16 Uncoded 30-100+200mA DO 7 £1 25

SX44 10 5A SCR's TD64 3 x 50v 3 x 100v 2 s 200v 2 x 400v Super value less than 1 price £
10 5A SCR s T066 2 x 50v 2 x 100v 4 x



# **MINIATURE TOOLS FOR HOBBYISTS**

insulated handles 4-linch length. Order

handles 5-inch length Order No YO44 handles 5 inch length Order No YD45

4 jinch length Order No YO45 0

PLASTIC

SIZE . I

3

**EXPERIMENTOR** BOXES - ALUMINIUM -

ALUMINIUM BOXES

Made with Bright Aluminium folded

2% 11/2

construction with deep lid and screws

fure snipe nose pliers with side cutter and serrated jaws — insulated handles Sinch length Order No Y042. All with insulated handles

### ELEVEY DRIVER

ALL AT

1.25

langth 8 inch Order No FS-1 Flat blade 4mm FS-2 Cross point no 1 £1.75 and



SO-2 Cross point no 0 850 sech INEXPENSIVE TOOLS OF IMMENSE VALUE

terminals for crimping Order No WS2 Our low price £1.20 an

**Plastic Boxes** 

Flanged Lid, fixing screws into brass bushes

Plastic as above but with aluminium top pa 4 2% 1 146 €1.

slope

1 1/2 148

Order No

141

144

Price

£1.00

£1.30

61.50

£1.40

22.14

oloured Black Close fitting

4% 2½ 1½ 6 3% 2

Plastic sloping front

Set of 5 BA spanner shafts plus universal handle in roll-up wallet Sizes DBA 24-6-8BA Order no: T192 £2 75 set

# NEON SCREWDRIVER

71in blade order no NS1 g0 85e se 54m blade order no NS2 £0 50m sach

Guarantee Satisfaction or your money back has always been BI-PAK's GUARANTEE and it still is All these Sale items are in stock in quantity and we will despatch the same day as your order is received

# IC SOCKETS The lowest price ever.

The more you have the cheaner they come! 10 att 50 att 100 att



# **VOLTAGE REGULATORS**

Positive + Negative + 7805 - 50p 7912 - 55p 7912 - 55p

# BI-PAK'S OPTO 83 SPECIAL

A selection of Large & Small size LED's in Red Green, Yellow and Clear, plus shaped devices of different types. 7 Segment displays, photo transistors, emitters and detectors

Types like MEL11, FPT100 etc. Plus Cadmium Cell ORP12 and germ. photo transistor OCP71. TOTAL OF 25 pieces.



# SEMICONDUCTORS FROM AROUND THE WORLD

Order No 159

161

164

167

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

83p

83p

670

21.12

All measurements for boxes are shown in inches. L = Length. W = Width. H = Height



# MW398 NI-CAD CHARGER

Universal Ni-Cad battery charger. All plastic case with lift up lid. Charge/Test switch. LEO indicators at each of the five charging points

Charges -PP3 (QV) 220 240V AC U12(15V penlite) 0ims -1111(15V C) 210 x 100 x 50mm U2 (1 5V D ) €6.95

# POWER SUPPLY OUR PRICE £3.25

Power supply fits directly into 13 amp socket Fused for safety Polarity reversing socket Voltage switch Lead with multi-plug Input = 240V AC 50HZ Output = 3 4 5 6

# 1 Amp SILICON RECTIFIERS

Glass Type similar IN4000 SERIES IN4001-IN400 50 — 500v — uncod.J — you select for VLTS ALL perfect devices — NO duds Min 50v 50 for £1.00 — worth double ORDER NO SX76

Silicon General Purpose NPN Transitors TO-18 Case Lock fil leads — coded CV7644 Similar to 8C147 BC107 - ZT89 ALL NEW! VCE 70v IC500mA Htte 75-250 PRICE \$2.00 £3.80 £17.50 £30.00 \$

| Siticon General Purpose PNP Transistors T0-5 Case | Lock Int leads coded CV9507 similar 2N2905A to LBFX30 VC 60 IC 600mA | Min Inte 50 ALL NEW! | 50 off | 1000 off PRICE \$2.50 \$4.00 \$19.00 \$35.00

# Silicon NPN'L' TypeTransitors

TO-92 Plastic centre collector Like BC182L — 183L — 184L VCBO 45 VCEO 30 IC200mA His 100-400 ALL perfect devices - uncoded OROER AS SX183L

50 off 100 off 500 off 1000 off £1.50 £2.50 £10.00 £17.00

PNP SILICON TRANSISTORS:

Similar ZTX500 — ZTX214 — E-Line VCEO 40 VCBO 35 ic 300mA Hfe 50-400

Brand New — Uncoded — Pefect Devices 50 of 100 of 500 of 1000 of **£2.00 £3.50 £15.00 £25.00** 

DIGITAL VOLT METER MODULE 3 x 7 segment displays Basic Circuit Instructions extend voltage & Operating voltage 9/12v. Typ. Power Consumption 50mA 0/NO:SX99 Once only price

£9.95 ELECTRONIC SIREN 12v DC

Dur Price:- £5.50

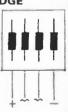
### SILICON BRIDGE RECTIFIERS

Comprising 4 × 13 amp rectifiers mounted on PCB.

VRM - 150 vlts IFM - 1.5 Amps Size: 1 inch square

10 off £1 00 50 off £4.50 100 off £7.50

Order No. As:4RI BRect



# **MULTITESTERS**



1.000 opy Including test leads & Battery AC volts - 0-15-150-500-1,000 DC volts - 0-15-150-500-1,000 DC currents - 0-1ma-150ma Resistance - 0-25 K ohms 100 K ohms

O/No.1322.OUR PRICE £6.50 ONLY

# DOME TWEETER

Dome Tweeter for systems up to 50w. Impedence 8 ohms. Frequency Response 2000-20000Hz, Oims 98mm dia x 31mm deep. OUR PRICE £2.95, 0/No. 0MT200

Dims - 90 x 61 x 30mm

30,000 opy Including test leads and case

AC volts - 0.2 5-10-25-100-250-500-1,000 DC volis - 0-0 25-1-2 5-10-25-100-250-1,000 DC current - 0-50ua 0-5ma-50ma 0-12amps Resistance - 0-6K ohms-70K ohms-6meg ohms 60meg ohms

Decibels - - 20db to plus 56db Short test - Internal buzzer Dims - 160 x 110 x 50mm

O/No. 1315. OUR PRICE **ONLY F24 75** 



s provided to current ranges

# SPECIAL OFFER OF STEREO AUDIO MODULES

A COMPLETE SET TO GIVE YOU 70 WATTS TOTAL 35 WATTS (rms) PER CHANNEL 56 POWER SUPPLY

Kit comprises: er Amplifiers

1 x SPM120/55 Power Supply 1 x PA200 Stereo Pre-Amplifier

X Front Panel – Black with White lettering
 X Black Knobs with White Pointers
 X Coupling Capacitors & 1 Reservoir

Capacitor, Full hook-up chart

# NORMAL RETAIL PRICE £52, COMPLETE SAVING £14 **Our SPECIAL OFFER Price For 1 MONTH ONLY**

Order by phone NOW with your Credit Card — Ring: Sue on 0920 3442/3182 for immediate despatch (Order as: SX70 watt AUDIO KIT)

£38 COMPLETE

Send your orders to Dept. EE3 B1-PAK PO BOX 6 WARE HERTS SHOP AT 3 BALDDOX 5T. WARE HERTS TERMS: CASH WITH ORDER IS AME OAY DESPATCH. ACCESS BARCLAYCARD ALSO ACCEPTED. TEL (0220) 3182 GIRO 399 7006 DO 15% VAT AND 159 PER ORDER POSTAGE AND PACKING



Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail Remember you must add VAT at 15% to your order Total Postage add 50p per Total order.

# TV SOUND TU **BUILT AND**



In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping 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 common 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 81/2" x 31/4".

E.T.I. kit version of above without chassis, case and hardware, £12.95 plus £1.50 p&p.

# **PRACTICAL ELECTRONICS** STEREO CASSETTE



£32.95 + £2.75 p&p

NOISE REDUCTION SYSTEM • AUTO STOP • TAPE COUNTER • SWITCHABLE E.Q. • INDEPENDENT LEVEL CONTROLS • TWIN V.U. METER • WOW & FLUTTER 0.1% • RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING • FULLY VARIABLE RECORDING BIAS FOR ACCURATE MATCHING OF ALL TAPES. Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts. i.e. semiconductors, resistors capacitors, hardware top cover, printed scale and mains transformer. You only supply solder and hook-up wire.

Featured in April issue P.E. Reprint 50p, Free with kit. Self assembly simulated wood cabinet - £4,50 + £1.50 p&p.

SPECIAL OFFER! £31.00 plus £2.75 p&p

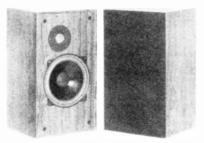
# **BSR RECORD DECK**

Menual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or

disco. 13"x 11" approx. £12.95 +£1,75 p&p.

SPECIAL OFFER! Replacement stereo cassette tape heads £1.80 es. Mono £1.50 es. Erase 70p es. Add 50p p&p to order.

# Special Offer! AUDAX 45 WATT TWO WAY SPEAKERS £36.95 a pair



Originally made to sell for over £70, Unit comprises 8" bass/ mid range and 4" soft dome tweeter and a 6 element crossover. Mirror image. Finished in rosewood. Size: 470mm high x 264mm wide x 225mm deep. Empty cabinets available separately if required. £9.95 pair + £4.75 p&p.

All mail to:

# 21A HIGH STREET, ACTON W3 6NG.

Note: Goods despatched to U.K. postal addresses only. All items subject to availability. Prices correct at 30/10/82 and subject to change without notice. Please allow 7 working days from receipt of order for despatch. RTVC Limited reserve the right to up-

# PERSONAL LS AMP KIT

Amplifier for your personal stereo cassette player as featured in January issue of Everyday Electronics, Turn your personal stereo into a mains powered home unit.



Parts: Stereo power amp PC8 with all components, £3.50 + 75p p&p. Power supply unit, £1.95 + £1.50 p&p. Pair of 4½" eliptical speakers, £1.50 the pair, + £1.00 p&p. Input & output sockets & plugs, £1.50. Recommended case (for the power supply and amp only). £2.95 + 80p p&p. P&P inclusive price of £1.75 for two or more articles

# P.E. STEREO TUNER



This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July '81 issue)

For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System. FEATURES: VHF, MW, LW Bands, interstation 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. Stabalised power supply with "C core mains transformer. All components supplied are to P.E. strict specifications." ion, Front scale size: 10%" x 2%" approx. Complete with diagram and instructions.

£17.95 Plus £2.50 p&p. Self assembly simulated wood cabinet sleeve to suit tuner only Finish size: 11%"x 8%"x 3%", £3.50 Plus £1.50 p&p.

# SPEAKER KIT

**2 WAY 10 WATT** 

8" bass/mid range and 3%" tweeter. Complete with screws. wire, crossover components and cabinet. All wood precut - no cutting required. Finish - chipboard covered wood simulate, size 14½"x 8%"x 4". PAIR for ONLY £12.50 plus £1.75 p&p.



# 125W HIGH POWER AMP RILLET

£10.50 + £1.15 p&p

£14.25

+£1.15 p&p The power amp kit is a module for high power applications

 disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open cirout condition. A large safety margin exists by use of gener-ously rated components, result, a high powered rugged unit. The PC board is back printed, etched and 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: Suitable mains power supply kit with transformer: £8.50 plus £2.00 p&p.
Suitable LS coupling electrolytic: £1.00 plus 25p p&p.



SPECIFICATIONS:

Max. output power (RMS): 125W.
Operating voltage (DC): 50 - 80 max.
Loads: 4 - 16 ohms.
Frequency response measured @ 100 watts: 25Hz - 20KHz.

Sensitivity for 100 watts: 400m V @ 47K Typical T.H.D. @ 50 watts, 4 ohms: 0,1%. Dimensions: 205 x 90 and 190 x 36 mm.

Model No. GP-397 HI. Specification: Output - 2mV. Separation - 22dB. Stylus 0.6mm diameter. Useful replacement cartridge for Audio Technica AT10, ADC QLM 30, Goldring G850/G800, Shure M3D, M708, Tenorel T200 ID.

\$\frac{\text{£3.95}}{\text{eq}} \text{each} \text{Plus 60p p&p.} \text{\$\text{Plus 60p p&p.}}

# HI-FI SPEAKER BARGAINS

35 WATT MICRO 2-WAY SPEAKER SYSTEM

Unit comprises one 50w (4"app.) Audax soft dome tweeter HD100, And one 5" Audax bass/midrange 35w driver HIFILISM Complete with 2 element crossover. Total impedance of system 4 ohms.

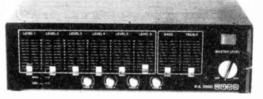
£8.95 PER-SET + £2.70 p&p.



# **MONO MIXER AMP**

Ideal for Church halls & Club houses

50 WATT Six individually mixed inputs for two pick ups (Cer. or mag.), two moving coil microphones and two auxiliary for tape tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic. and aux. inputs. Size: 13%"x6%"x3%" app: Power output 50 watts R.M.S. (cont.) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs, Ready to use



Matching AKG Microphone to suit (with speech and music filter). Complete with lead, ONLY £9,95 plus 75p p&p,

ALL CALLERS TO: 323 EDGWARE ROAD.

date their products without notice. All enquiries send

LONDON W2. Telephone: 01-723 8432. (5 minutes walk from Edgware Road Tube Station) Now open 6 days a week 9 - 6. Prices include VAT.





# VOL. 12 NO. 3 MARCH 1983

Editor F. E. BENNETT

Assistant Editor B. W. TERRELL B.Sc.

**Production and News Editor** D. G. BARRINGTON

Projects Editor G. P. HODGSON

Art Editor R. F. PALMER

**Assistant Art Editor** P. A. LOATES

**Technical Illustrator** D. J. GOODING Tech. (CEI)

Secretary JACQUELINE DOIDGE

Editorial Offices
KING'S REACH TOWER STAMFORD STREET LONDON SE1 9LS Phone: 01-261 6873

Advertisement Manager Phone: 01-261 6671

Representative R. WILLETT Phone: 01-261 6865

**Classified Supervisor** 8. 8LAKE Phone: 01-261 5897

Make-Up and Copy Department Phone: 01-261 6615

Advertisement Offices KING'S REACH TOWER STAMFORD STREET **LONDON SET 9LS** 

### **TEST GEAR 83**

T was as far back as 1974 that we published a comprehensive set of test instruments under the title *EE Test Gear Five*. This series proved to be very popular and instruments built to these designs will have been giving good service in workshops and dens up and down the country over the last nine years or so. Equipment of this kind generally has a long life. The devoted constructor or experimenter treats his equipment with respect and it is not likely to suffer misuse in the hands of others.

Electronic technology has of course been developing over these nine years and some different needs have arisen in regard to test equipment used in pursuance of our hobby. Such needs have been recognised and covered by individual items of equipment presented in our pages from time to time. Now the time seems right to present a new set of instruments. There is another reason also, that is to satisfy the needs of a new generation of readers. Over a period most hobbyists will acquire or build individual items of test gear, but acquisition on this casual basis is not the most ideal arrangement. Far better to have a set of co-ordinated units planned to give comprehensive facilities.

With the introduction of Test Gear  $8\bar{3}$  constructors now have the opportunity to build a set of matching instruments designed to meet practically all requirements of the average hobbyist in the light of the present state of the art. The first instrument is covered in this issue and the remaining instruments will be published one per month in the following issues of EE.

The completed instruments will add distinction to the hobbyist's workshop and provide lasting evidence of their builder's skill. But far more important, this collection of test gear will be of incalculable value in the years ahead. Test Gear 83 will prove a sound investment of time and money.

# A GIFT FOR CONSTRUCTORS

Despite its simple appearance, the tool attached to our front cover will be an important accessory for the constructor's work bench. Anyone who assembles circuits will quickly discover how useful this wire bending gauge is in forming resistor and capacitor leads to suit horizontal or vertical mounting of these components and with a spacing to suit a selected number of holes on an 0.1 inch matrix board.

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

We cannot undertake to engage in discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

Back Issues

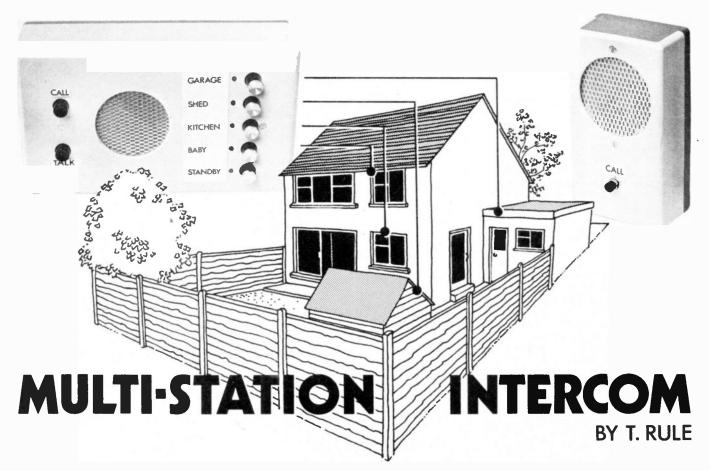
Certain back issues of EVERYDAY ELECTRONICS are available worldwide price £1.00 inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 OPF. In the event of non-availability remittances will be returned.

heal bennett

Binders to hold one volume (12 issues) are available from the above address for £4.60 inclusive of postage and packing worldwide. Please state which Volume.

Subscriptions

Annual subscription for delivery direct to any address in the UK: £12-00. Overseas: £13:00. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.



The unit to be described can be built to connect to any number of slave units via a two-wire interconnecting lead. Designed to provide private intercommunication between the master unit and any slave, it can also be used as a baby alarm or a general security system, and provides a means of listening into the slave units. For example, if a slave unit is mounted outside somewhere in the grounds of the property, it is possible to listen in on that unit for any intruders who may be nearby.

The basic unit described here has been built to supply four slave units and operate from a PP3 battery, and be used for simple intercom purposes. If it is intended for use as a baby alarm or security system a simple mains power supply should be used instead of the battery, but with a suitable switch to change over in the event of mains supply failure. A circuit for this is suggested.

# **DESCRIPTION OF SYSTEM**

The unit is simple to construct and all parts are available from a number of advertisers. Fig. 1 shows a block diagram of the basic circuit. One speaker (LS2) is connected to the amplifier input via the PRESS TO TALK switch S1, and the other

speaker LS1 is connected to the amplifier output. Pressing the switch to change over the two speakers enables communication from one to the other, depending on which one is used as the microphone at any time. The PRESS TO TALK switch is mounted on the master unit. In the standby position the slave speaker is used as a microphone and can be listened into by the master unit.

With a intercom system it is important to be able to "call" a selected slave or conversely for a slave to be able to "call" the master unit. This is made possible here by connecting some of the output back to the input via a phase-shift

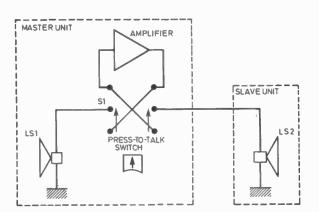


Fig. 1. Block schematic of the basic intercom circuit.

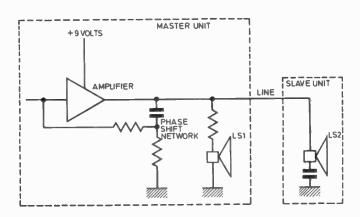


Fig. 2. Basic circuit when the master "calls".

network, so that oscillation at a suitable frequency takes place. Fig. 2 shows the basic arrangement when the master unit makes a call (no switching is shown).

When the slave unit calls, the circuit is slightly different and this is shown in Fig. 3. Closing the CALL switch on the slave connects the positive supply to the basic amplifier via the speaker voice coil and the diode rectifier. This enables the unit to oscillate as before and as the speaker is in series with the supply under calling conditions there is enough output for the calling tone to be heard at the slave position.

Once a call has been made in either direction the switching changes the circuit back to the basic arrangement shown in Fig. 1.

# **IDENTIFICATION OF CALLER**

With a multi-slave intercom system some means of identification is needed so that the particular slave calling can be selected. This is achieved by the use of thyristors, the gates of which are connected to the lines so that when a slave unit calls and the positive supply is connected it also connects to the thyristor and turns it "on". An l.e.d. in its anode will then light and indicate which slave has called.

If a call is already in progress and another slave calls, the l.e.d. for that line will light indicating that a call is waiting, and it will stay alight until the line is selected. These additional calls do not interrupt the conversation already taking place, further, it is impossible for any slave to listen in on other lines.

# THE COMPLETE CIRCUIT

The complete circuit is shown in Fig. 4 and at first glance may seem complicated. However much of the circuit is repeated from each slave line used. The number of lines which can be used is only limited by the amount of switching available and the size of the case used.

The circuit of Fig. 4 shows four slave units and this was felt to be the most which the average household would require. The switches are shown in the "standby" position (S3 depressed) and in this position the supply is disconnected.

# COMPONENTS \*\*\*

### Resistors

H1	1 K\$2	RIB	TOKSZ	
R2	68kΩ	R19	10kΩ	
R3	100kΩ	R20	10kΩ	
R4	4.7kΩ	R21	10kΩ	
R5	390kΩ	R22	2.7kΩ	
R6	47Ω	R23	2.7kΩ	
R7	47kΩ	R24	2.7kΩ	
R8	4.7kΩ	R25	2.7kΩ	
R9	100kΩ			
R10	39kΩ			
R11	$22\Omega$			
R12	$820\Omega$			
R13	2·7kΩ	3	ee	
R14	$820\Omega$	•		-
R15	820Ω	•	ono	
R16	820Ω			

# **Potentiometer**

R17 820Ω

VR1 10kΩ skeleton preset

All 1W carbon film ±5%

# Capacitors

CT	U-22μF polyester
C2	0.047μF polyester
C3	330pF polystyrene
C4	0-1µF 16V elect.
C5	22µF 16V elect.
C6	2.2µF 16V elect.
C7	100μF 16V elect.
C8	100µF polyester
C9	0.01μF 16V elect.
C10	100µF polyester
C11	100μF 16V elect.
All electr	olytics are the small
	ided p.c.b. type
	C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 All electr

# Semiconductors

TR1	BC414, BC109 or
104	similar npn transistor
IC1	LM380 a.f. amplifier, 2W
D1-5	output 8Ω TIL209 I.e.d. (5 off)
D6-9	1N4148 diode (4 off)
CSR1-4	C103YY thyristor, gate
	current 0.2mA (4 off)

# Loudspeakers

LS1,2 miniature,  $8\Omega$ , 70mm dia. approx. (2 off)

# Sockets

SK1-5	jack socket, miniature
	(RS type 478-497)
	(5 off)
PL1-5	jack plug, miniature
	screened (RS type
	478-380) (5 off)

### **Switches**

S1,2	d.p.d.t. miniature push- button, momentary
	action (RS type
	339-235) (2 off)
S3-7	d.p.c.o. push-button,
	break-before-make (RS
	type 388-434) (5 off)
	5-switch latching
	assembly for
	interlocking operation
	(see text) (RS type
	388-614). Push-button
	knobs (7 off) (RS type
	339–263)
S8	s.p. miniature push-
	button, momentary make (RS type 337–914)

### Miscellaneous

B1 PP3 battery
Printed circuit board; support
pillars (2 off) (RS type 543–737);
terminal pins; master unit case
188 x 110 x 60mm (RS type
509–585); slave unit case 120 x
65 x 40mm (RS type 509–579);
plastic feet (for spacing sub-panel
from case) (4 off) 12-7mm (RS
type 543–327); connecting wire
7/0-2mm p.v.c. covered; screws;
nuts; washers; solder tag;
speaker mounting clips; battery
connector.

£28 includes only one Slave

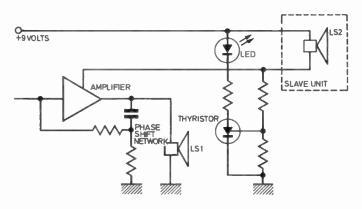


Fig. 3. Basic circuit when the slave "calls".



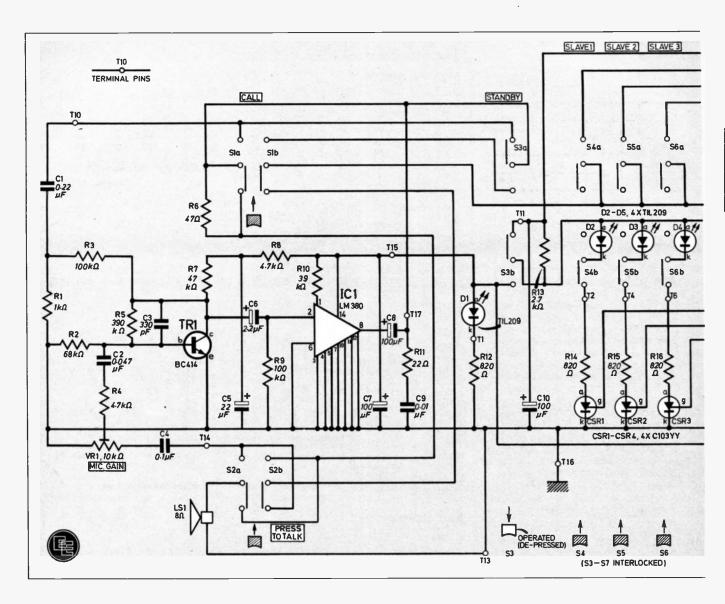


Fig. 4. Complete circuit diagram for the Multi-Station Intercom. All switches are shown in the standby position. The circuit for the slave unit is shown in the panel on the far right.

Switches S3 to S7 are interlocked push-button types and only one can be depressed at a time. Depressing a button automatically releases any other that may have been depressed.

The basic amplifier uses the LM380 integrated circuit IC1 but as this has a fixed gain an extra transistor stage TR1 has been added to improve the sensitivity.

If a slave is selected (assuming Slave 1) the speaker unit on that line will act as a microphone and is connected via S4a, S1b, and S2b to the input of TR1. The output of IC1 connects to the master speaker via S1a and S2a.

When S2 is pressed to change over the connections the two speaker systems are reversed and the master speaker becomes the microphone and the slave the speaker.

# CALLING A SLAVE

A slave is selected by pressing S4, S5, S6 or S7. The slave is then called by

pressing switch S1. The power supply is then connected via S3b (now in the lower position) and some of the output of IC1 is connected to its input via C7, S1a, C1, R1, R2, C5, causing the amplifier to oscillate. At the same time the slave speaker is connected to the output of IC1 via S1b and S3a (now in its lower position). The master speaker is also connected to the output but via a limiting resistor R3 to reduce the volume of the calling tone.

Releasing S1 reverts the circuit back to its normal mode and two-way communication can take place. The PRESS TO TALK switch S2 MUST be pressed each time the master speaks in order that its speaker becomes the microphone and the slave the loudspeaker.

# SLAVE TO MASTER

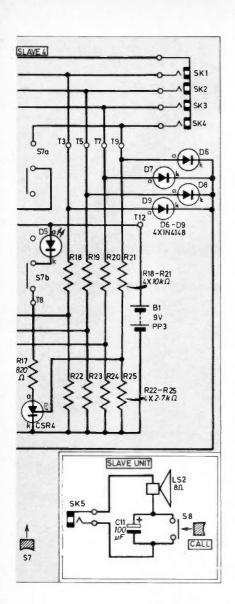
With all switches in the standby position, if a slave calls the positive supply is connected to the amplifier IC1 via the

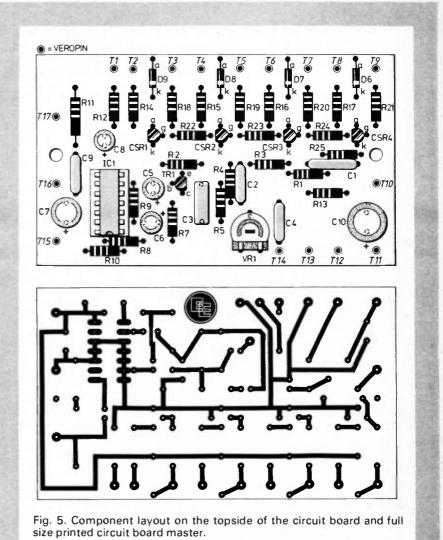
slave speaker voice coil, and D9 (assuming Slave 1 is calling). The supply is also connected to the gate of CSR1 via R18 turning it "on" and so lighting up D2.

As some of the output from IC1 is connected to its input via S3a in the "standby" position the circuit will oscillate and put a tone onto the master unit speaker. This tone will also be heard at the slave due to its speaker being in series with the supply to IC1.

The master unit then selects the line calling and the circuit again reverts back as shown in Fig. 1.

Selecting the calling line also disconnects the supply to the thyristor CSR1 via S4b and switches off the l.e.d. indicator D2. An l.e.d. indicator D1 is also connected to the IC1 supply and indicates when the unit is "on". To check that the whole system is "off" with no calls waiting it is only necessary to check that all the l.e.d.s are extinguished.





# SENSITIVITY CONTROL

A preset potentiometer VR1 is provided so that the sensitivity can be adjusted to a suitable level, however this control will normally be used in its maximum position if monitoring of a slave is desired.

The actual audio frequency of the calling tone will be dependent on a number of things, for example, the type of speakers used, state of the battery voltage, etc. The frequency can be modified by changing the values of C1 and/or R1. In any event the tone produced when called by a slave will be lower in pitch than when the master unit calls and C1 and/or R1 may need adjusting for the most suitable sound.

Note that R13 is shorted out when in the "standby" position. This enables the full supply voltage to be applied to IC1 (for calling) via the line and slave unit. When the line is selected this resistor maintains voltage on the line to operate the thyristors should another line call, but allows an "audio earth" via C10 for the slave speaker/microphone. If the audio earth was via the supply line, instability would result.

# CONSTRUCTION

One printed circuit board is used and this carries the bulk of the components. The full-size pattern appears in Fig. 5. Be careful to maintain the correct polarity of all electrolytics and diodes and also check the position of pin 1 of the LM380 before soldering it into place or plugging into a socket.

# WIRING

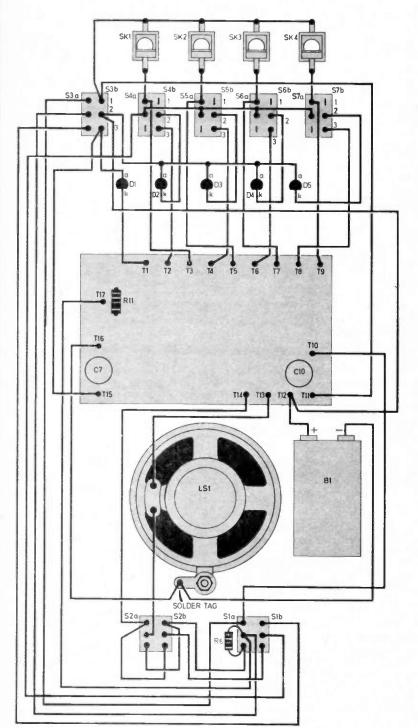
There is a considerable amount of hard wiring on this project and, although the actual layout is not critical, care should be taken regarding connections to the various switches. It is suggested that suitable coloured leads be wired to the switches first and then the p.c.b. placed into position and its terminal pins connected up. Leave the leads long enough so that the board can be lifted clear for any servicing that may be required at a later date. The full interwiring is shown in Fig. 6.

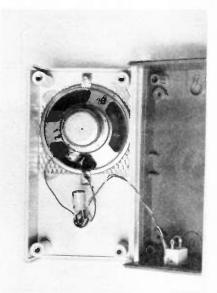
# SUB-PANEL

All components are mounted on a subpanel as shown in Fig. 7. Mark out the aluminium accurately but only pilot drill in the first instance with a 1mm drill. By doing this the sub-panel can be used as a marking template for the front panel of the case, thus ensuring exact register of the two sets of holes.

Note that certain holes are NOT required in the front panel, these are holes lettered "A" and "E".

# **MULTI-STATION INTERCOM**





Wiring and component layout inside the completed slave unit.

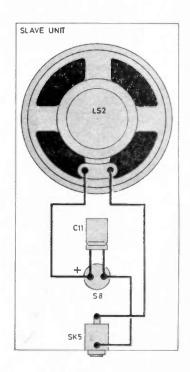
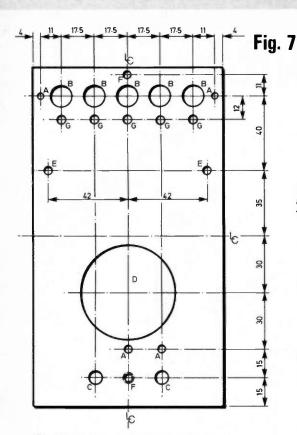
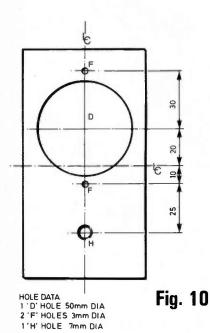


Fig. 6. Interwiring details for the master control and one slave unit. The case mounted components have been laid "flat" for clarity of wiring.



HOLE	Α	8	С	D	Ε	F	G
SUB PANEL	3	11	6-5	50	4	3	SEE TEXT
FRONT OF CASE	-	11	11	50	-		TO SUIT LED SEE TEXT

NOTES: DRILL ALL HOLES Imm DIA & USE AS FRONT PANEL TEMPLATE BEFORE MAKING FULL SIZE HOLES 'G' TO FRONT PANEL ONLY



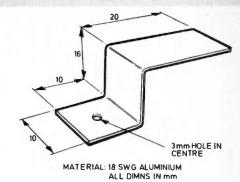


Fig. 8

Fig. 7. Measurement and drilling details for

the sub-panel.

Fig. 8. Details of the battery bracket.

Fig. 9. Drilling details for the end panel of the master unit case.

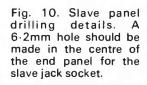


Fig. 11. Suggested sub-assembly for the five indicator l.e.d.s.

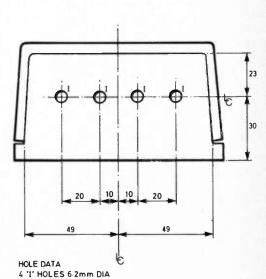
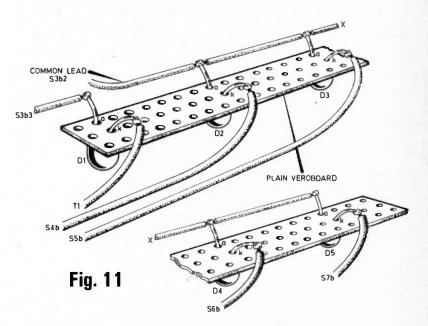


Fig. 9



1 JACK (SK5) HOLE 6-2mm DIA (IN CENTRE OF END PANEL)

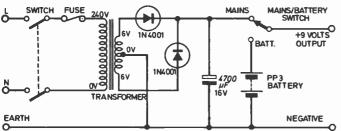


Fig. 12. Suggested circuit diagram for a mains/battery power supply.

TO +9 VOLTS
(COMMON LINE)

TO ONE OF THE LINE OF FROM THE MASTER UNI

MULTI-WAY SWITCH TO SELECT MONITORING POINTS

TO +9 VOLTS

(COMMON LINE)

Fig. 13. One method of wiring extra monitoring points for security.

Four plastic feet are fitted to the inside of the case to maintain the correct distance between the sub-panel and case. Two 6BA screws with nuts for spacers are also used to hold the sub-panel in position.

A small metal bracket holds the PP3 battery in place and this is made as shown in Fig. 8. This bracket is not required if a mains power supply is used.

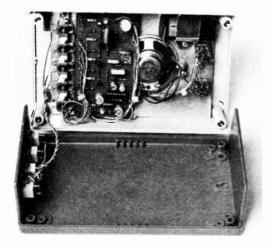
# CASE DRILLING

Fig. 9 shows the holes required in the end of the case for the miniature jack sockets and Fig. 10 shows the drilling required for the slave units. When cutting the 50mm hole in the cases a "Q" Max cutter can be used but warm the case to about 20°C before cutting (warm the cutter as well); this will enable the plastics case to be cut cleanly without splitting. If cutting is attempted with the plastic very cold it will split.

# LED ASSEMBLY

The l.e.d.s are held in place by first mounting onto a strip of plain perforated board, Fig. 11, and a strip of foam mounted along its back. This sub-assembly is then sandwiched between the case and sub-panel. Using a 0·lin. board the l.e.d.s will be spaced every seven holes, that is, six holes between each l.e.d. In any event the l.e.d.s should be a firm fit into the holes in the case, but the use of this extra

Completed prototype of the master unit. The plain perforated board has been replaced by a printed circuit board.



mounting strip makes for easy handling during wiring and assembly, or when servicing, as the five l.e.d.s can be handled as a single assembly.

The loudspeaker apertures are covered with a suitable fret before final assembly and this may be either a metal or cloth type. Metal is preferred as it will provide greater protection for the speaker units. The fret is held in place by the use of white Bostik (the writer uses Bostik 4 multi-tile adhesive).

The cases specified have special mouldings in the backs which can be knocked out to provide holes for fixing the units to a wall. Depending on the labelling, the units can be mounted either way round.

# MOUNTING THE SUB-PANEL

When mounting the five-way pushbutton unit onto the sub-panel, space it away from the panel approximately 7mm, by using 6BA screws with nuts as spacers. This ensures the actual buttons will be at the same height as the "call" and "PT" buttons. To ensure smooth operation of the buttons it is important that all burrs are removed from the holes in both the sub-panel and case.

# **INSTALLATION**

No problems should be encountered here as the "lines" are low impedance and only passing a very low current, few а milliamps. Standard type bell wire may be used for indoor wiring but if cable runs are made outdoors bell wire will be unsuitable as it is not weather-proof. For outdoor cable runs p.v.c. covered cable should be used. On NO account must any direct connection be made between these and the "lines" mains or telephone wires, they may however be laid alongside such cables if this is unavoidable. In this event some mains borne interference may be heard on the intercom system. Each end of a "line" should be terminated with a 3.5mm miniature jack plug which is then plugged into the slave unit.

TO OTHER

UNITS

# **OPERATION**

Select the line required, sounds should be heard from the slave unit (assuming that someone is there). Press the CALL button, a tone should be heard at both ends of the line. When the slave answers, press the PRESS TO TALK button before speaking and release it to listen.

When on standby, a "slave" may be called by pressing the CALL button. Again a tone should be heard at both ends. Select the line that is calling and press the PRESS TO TALK button to answer, release to listen again.

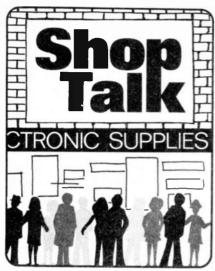
As each slave calls, the appropriate l.e.d. should indicate which line has called. If a conversation is in progress and another slave calls, the l.e.d. will indicate that a call is waiting, and this can be answered by selecting that line and either dealing with the call or asking them to wait until you can call back. If a conversation is already in progress, no tone will be heard if additional lines call in.

# MAINS POWER SUPPLY

If several slave units are being used, it would be wise to operate the system from the mains. A suggested circuit for this is shown in Fig. 12. An extra jack socket should be fitted to the master unit and the battery connections taken to this with a suitable lead then going to the power supply.

# **USE AS A SECURITY UNIT**

By using the circuit shown in Fig. 13 any number of extra "microphones" can be selected so that it is possible to listen in to a number of positions. It is not possible for these to call the master, although the master can call them if required and engage in normal two-way communication. This facility could also be useful where, for example, a number of children's rooms need to be monitored. Other uses will no doubt come to mind.



By Dave Barrington

# **Screened Plastic Boxes**

The complete BIM2000 range of plastic multi-purpose cases from Boss are now available internally coated with 0.05mm thick, black EMI/RFI conductive shielding.

Having all the normal electrical screening protection facilities associated with steel or diecast aluminium enclosures, it is claimed that these ABS boxes also have the added advantage of light weight and easy drilling.

Available initially in black only, the deep profile lids are firmly secured to the base by screws running into brass hank bushes which not only ensure a good electrical connection for total screening but also provide protection against the ingress of moisture.

The cases are moulded in seven sizes ranging from  $100 \times 50 \times 25$ mm to  $190 \times 110 \times 90$ mm. For further details of the complete range contact: Boss Industrial Mouldings Ltd., Dept EE, James Carter Road, Mildenhall Suffolk IP28 7DE.

# Catalogue

A new shortform hobbyist catalogue featuring a wide range of products for the electronics enthusiast has just been issued by the Retail Division of BICC-Vero.

Products covered in the 6-page colour catalogue include circuit boards, solderless breadboards, boxes, tools and a wide range of accessories.

Copies of the "The Hobby Herald" catalogue are available Free from BICC-Vero Packaging, Dept EE, Retail Department, Industrial Estate, Chandlers Ford, Eastleigh, Hants SO5 3ZR. A large stamped addressed envelope would be appreciated.

# Coloured Knobs

A new range of control knobs, with coloured caps and "skirts", are now being stocked by Ambit International.

These knobs are from the well-known Ritel of Switzerland range and at present consist of matt black bodies with a selection of different coloured caps, pointers, skirts and dials. They also feature push-fit brass collet fixing.

Another ten finishes are available to special order. For more details of the complete range contact: Ambit International.

# CONSTRUCTIONAL PROJECTS

### Car Thermometer

The most expensive item in the Car Thermometer is the temperature sensing device and could cause purchasing problems.

The case of this device is stamped with the type number 590kH and as far as we have been able to establish is only stocked by RS Components (order code 308-809). This is an expensive item.

We would point out that RS Components will only supply to bona fide traders and readers will have to order through their local component supplier. If any readers are able to "throw" any further light on a source of supply, or equivalent, for the temperature sensor we will be pleased to hear from them.

This project has been specially designed to fit into a small hand-held case with sloping display panel. This case is available from Lascar Electronics Ltd., Dept EE, Module House, Whiteparish, Salisbury. It is also available from Verospeed, Dept EE, Boyatt Wood, Eastleight, Hants SO5 4ZY, and is listed as a hand-held case for digital panel meter (stock no. 89-25463J).

# **Dual Power Supply**

The mains transformer used in the prototype *Dual Power Supply* was custom-made by Samson's (Electronics) Ltd., Dept EE, 9 Chapel Street, London NW1. A similar mains transformer with 24V 1.5A and 9V 1.5A secondaries could be used but, because of physical size, may require altering the layout within the case.

The heatsink and meter were purchased from Ambit International and the Sifram front panel knobs are stocked by Electrovalue and Marshall's.

It is quite in order to use  $0.47\Omega$  3W wire-wound resistors for R1 and R8.

### **Multi-Station Intercom**

The two-tone moulded plastics cases called for in the *Multi-Station Intercom* are Verobox types and should be available from most component suppliers. Stockists include Bi-Pak, Maplin, Magenta, Electrovalue, and Verospeed.

The sockets SK1 to SK5 are 3.5mm miniature types with normal closed contacts. All the interlocking switches (S3 to S7), mounting plate and knobs are available from Maplin.

The thyristors (CSR1 to CSR4), type C103YY, appear to be only available from RS Components.

# Expanded Add-On Keyboard for the ZX81

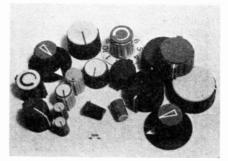
It is quite possible that many of the add-on keyboards now on the market could benefit from the Expanded Add-On Keyboard for the ZX81 project, however, these have not been investigated by us. The keyboard used in the prototype was obtained from Redditch Electronics (Dept. EE), 21 Ferney Hill Avenue, Redditch, Worcs B97 4RU.

The additional keyboard switches and switch "tops" are available from Redditch or Maplin. The Verostrip is available from Vero Electronics.

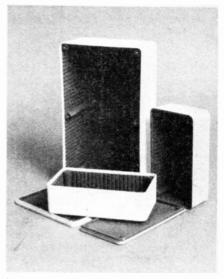
# **Buzz Off**

The 12V audible warning device used in the prototype of the *Buzz Off?* model was obtained from RS Components, stock number 248-808. However, most of the solid-state buzzers on the market are rated from 6V to 20V operation and could be used.

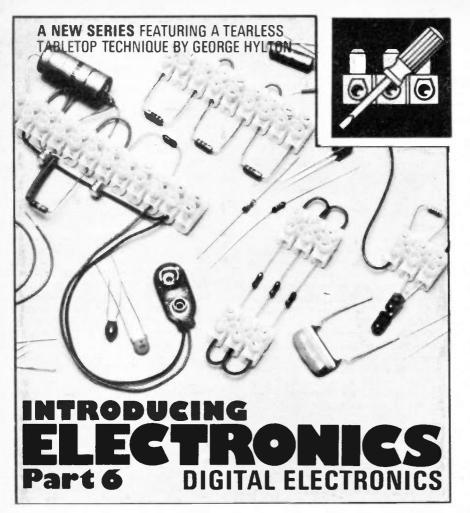
These devices appear to be about half the price of the RS item. Stockists of these buzzers include Electrovalue, Maplin, Magenta, TK Electronics and Ambit.



Selection of control knobs from Ambit International.



New range of "screened" plastic cases from Boss Industrial Mouldings Ltd.



N THIS, the last of the present series, we'll take a quick look at digital electronics. Since this topic includes practically the whole of computing and much of modern communications, it will have to be a rather superficial look. However, interested readers can obtain more detailed knowledge, in a painless way, by following The Electronics of Information Technology now running in this magazine.

# DIGITS: WE ALL KNOW THEM

There's nothing strange about digits. We have five on each hand. Most of us learn to count on them, thereby gaining our first practice in digital computing! We are also familiar with the idea of sending messages in Morse Code, an early form of digital communication.

# **BACON AND BINARY**

It all started long before the electrical age. When the Spanish Armada appeared in the Channel, warning beacons were lit on hilltops to send the message across the country. A beacon is either lit or not. This on-or-off feature is characteristic of digital communications.

Of course, you can light one beacon

for an early warning, two for a more urgent one and three for imminent danger -but the on-off nature of the individual fire remains.

This is in distinction from analogue signals, where the intensity of the signal is varied in step with the information to be conveyed, as in a.m. radio where the strength of the transmitter is made to change in step with the sounds at the studio microphone.

The trouble with analogue signals is that they are very susceptible to interference. Imagine how difficult it would have been to signal with beacons by varying their brightness in an analogue way. Even if it could have been accomplished at the transmitting end, how difficult it would have been for a watcher many miles away to read the variations, perhaps through mist or haze, even though he had no doubt that a beacon was lit.

# SIMPLER WITH DIGITS

The "all-or-nothing" nature of digital signals makes the problem so much simpler.

Morse Code is only partly digital. The lengths of the digits vary (dots or dashes) and this is an analogue feature. True digital codes, with all the elements or

"bits" the same length, are used in machine telegraph systems like teletype, but in fact the basic five-bit code of early teleprinters and teletypes pre-dates the electrical age by several centuries. It was invented by Shakespeare's contemporary, Francis Bacon, for use as a diplomatic code.

Bacon showed how a code message could be hidden in a plain language message. The example he gives shows how the sentence:

# STAY TILL I COME TO YOU

can be made to conceal the very different

### FLY!

The trick is to modify the letters of the plain message in some unobtrusive way; for example, to write some a tiny bit above the line and others a tiny bit below. Each letter can then have one of two positions, high or low. The intended reader then groups the letters of the plain message into lots of five and rewrites them as "highs" (H) or "lows" (L). So STAY TILL I COME TO YOU may become, say, HHLLH LHHLL LLLHH LLL.

The LLL at the end are spares, because the first three groups are all that are needed. The decoder looks up his code book and finds that HHLLH means LHHLL = "L", and LLLHH = "Y". Message read, he packs his bags and leaves!

# DIGITAL ELECTRONIC CODES

Bacon's code is a true binary code, with the essential "all-or-nothing" character of the individual elements. In transistor terms, we may agree to say that there is a "high" (H) when a transistor collector goes positive and a "low" (L) when it falls to zero.

These two states, which in practice correspond to, say, transistor off, and passing no current, and transistor hard on, passing so much current that all the supply voltage is dropped across a collector load resistance, can also be designated "1" and "0". So HHLLH could be written 11001. This looks like a number and can indeed be treated as one. Thus, doing subtraction, we could say that 11110-01110=10000.

We have now arrived at a strange state of affairs where 0's and 1's can signify either letters or numbers, and having turned letters into numbers we can then add or subtract them! In fact, anything that can be turned into an electrical signal can be "digitised" and the digits

manipulated.

If you watch TV, then practically every day you see some of the tricks which can be performed by digitising the TV picture then manipulating the digits as numbers. The picture can be made to expand, contract, change shape, split into several identical pictures, even fold over like the page of a book or wrap itself round a cylinder. All done by digits.

# PULSE CODE MODULATION

In the communications field, an important development is the now widespread use of digitised speech. Many years ago, long before the transistor, a British engineer worked out the basic principles. Last month we noted how in an a.m. radio receiver the detector in effect produces a string of samples of the original programme. So long as there are enough samples, the gaps can be filled in and the original programme waveforms recreated.

In Pulse Code Modulation the speech is sampled at a high rate (at least 8000 times a second). This gives a sequence of samples whose size depends on the intensity of the speech at the instant of sampling (Fig. 6.1). Instead of transmitting these as variable-amplitude analogue signals, each sample is digitised, that is turned into a string of 0's and 1's. This is transmitted (with the usual advantages of a binary system) and turned back into analogue signals at the receiver.

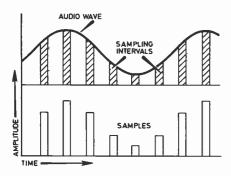


Fig. 6.1. Sampling an audio signal.

If the sampling time is short (say one microsecond), then the gap in time which comes before the next sample is due can be filled with samples of other speech waveforms. In this way a number of different conversations can be interleaved

in time. At the receiving end, accurate timing circuits sort them out again.

In this way, many speech channels can be interleaved in time, transmitted over the same cable, and sorted out again. In the new telephone exchanges, all the speakers' voices will travel along the same "highway". To connect two speakers together, timing "gates" will be opened just long enough to let through the samples of their voices, then closed to exclude every body else's.

# NOT, OR, AND, NAND, NOR

The basic digital circuits are rather boring. They are either the equivalent of switches which open to let signals pass (Fig. 6.2) or "inverters" which turn 1's into 0's, and vice-versa.

A single npn transistor with a collector load resistance can act as an inverter. A large positive input to its base causes the collector voltage to fall from a positive value (= "1", say) to zero (= "0", say).

In computer jargon, a "1" at the input

In computer jargon, a "1" at the input becomes a "not 1" at the output. An inverter is often called a NOT circuit.

Fig. 6.2a is an OR gate because signals are passed on if switch A or B or C is closed. Fig. 6.2c is an AND gate because no signal is passed on unless A and B and C are closed.

The common transistor equivalents such as (b) and (d) also invert, so they are NOT OR (= NOR) gates and NOT AND (= NAND) gates. In this example they are 3-input gates but other numbers of inputs can be catered for.

Gates in integrated circuits are more complicated but their function is the same. Combinations of these simple circuits are all that is needed to form the hardware of computers, capable, when programmed, of adding and subtracting binary numbers. Multiplication and division can be performed by repeated addition or subtraction.

It may be inexpressibly tedious for a human being to work out  $7 \times 3$  as 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 = 21, but a computer never complains. Of course, there is no such thing as 3 in binary codes. But combinations of 1's and 0's can be made to stand for any number. Thus 3 becomes 11 in binary. It looks complicated, but that's merely because of unfamiliarity.

# FLIP-FLOPS AND THINGS

Let's look at some slightly less boring binary circuits. In Fig. 6.3, provided the resistances are correct, TR1 is turned hard on when S1 is in position 1, and off in position 2. The l.e.d. lights or not, accordingly.

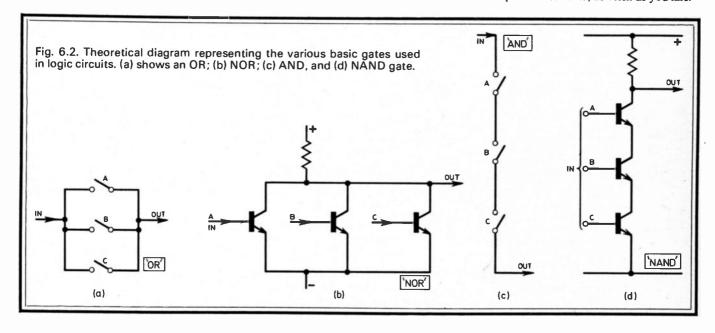
In real life binary circuits, the transistors are controlled mostly by voltages or currents from other circuits rather than by switches. The next circuit (Fig. 6.4)

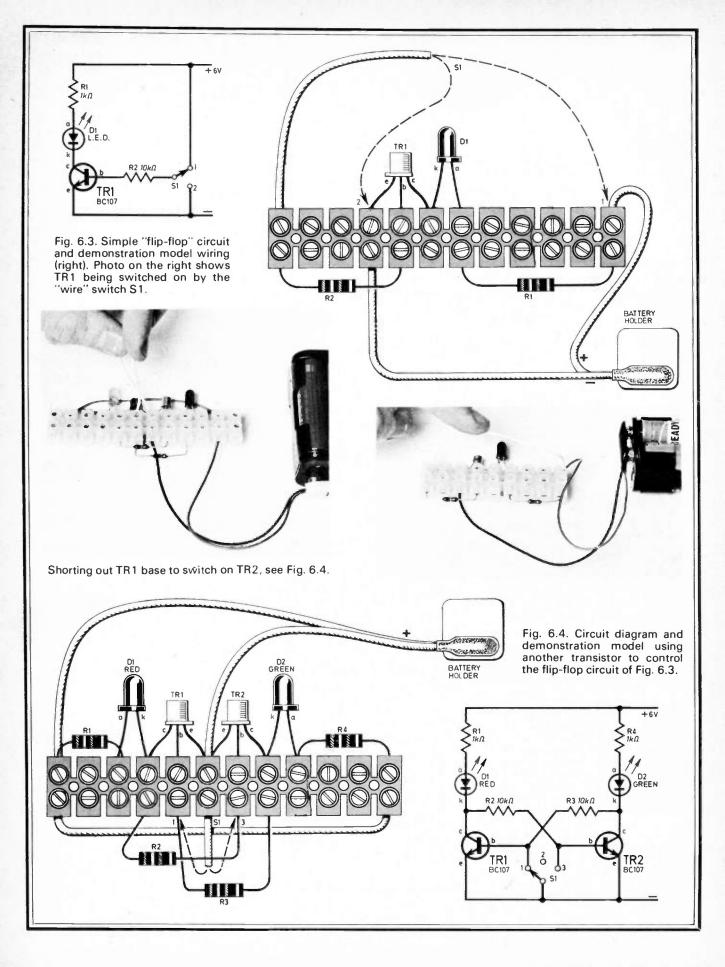
illustrates the point.

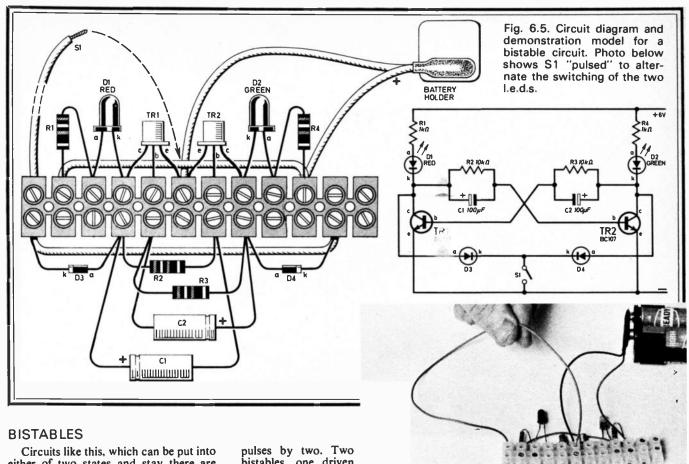
Here, each transistor is controlled by the collector voltage of the other. If TR1 is on, its collector voltage is low so there is no voltage to drive current through R2 to turn on TR2. This in turn means that TR2 collector voltage is high, which is just what is needed to turn on TR1.

Unless you do something about it, the circuit will stay in this state for ever. What you do is move the bit of wire which serves as S1 from its central, neutral position to position 1. This shorts out TR1 base current, turning TR1 off. Its collector voltage goes high and this turns TR2 on. The circuit has "changed state". It stays that way when S1 is returned to neutral (2). This is memory, of a sort. The circuit remembers what state it has been put into.

To reverse the state, move \$1 to 3. And so on. You can also reverse the state by touching your switch wire on to the collector of whichever transistor is NOT conducting. In these ways the circuit can be made to "flip" out of one state and "flop" into the other, as often as you like.







either of two states and stay there are called *bi-stable* circuits, or just *bistables* for short. There is obviously something very binary about them, and they become

of use for computing when modified so that they change state every time an input pulse is applied, even though it is applied simultaneously to both transistors.

You can do the trick by adding two capacitors and two diodes (Fig. 6.5). A diode allows current to pass only in the direction of its "arrowhead" triangle. With SI open, whichever way current tries to flow it is blocked by one diode. But when SI is closed, current can flow through both diodes, to the negative line. In effect, this connects the collectors to negative and turns off both transistors.

But with S1 open, one collector is "high". Its associated capacitor charges.

It takes time to discharge a capacitor, as you know. If S1 is given just a quick flip, some charge remains, and it is always of the correct polarity to reverse the state of the circuit. So, by repeatedly flipping S1 the state can be changed again and again. In a real-life circuit S1's job might be performed by another transistor, turned on by pulses to its base. These pulses could be derived from one of the collectors of another bistable.

Note that any one transistor, say TR2, changes state every alternate time S1 is closed. If output pulses are taken from TR2, there are only half as many output pulses as operations of S1. If S1 is replaced by a pulse-driven transistor, the bistable divides the number of input

pulses by two. Two bistables, one driven from the other, divide by 4. Three divide by 8... and so on. Chains of bistables like this form counters.

Such is the art of i.c. manufacture that a chain of 14 bistable or "flip-flops", each in fact containing several transistors, can be bought for about 50 pence. The i.c. also contains a circuit which resets the whole thing to zero when required. A four-stage counter, which is capable of counting up to 16, is often arranged to reset every time it reaches 10. This makes it into a decade counter.

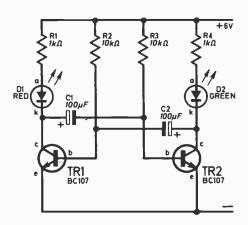


Fig. 6.6. Circuit diagram for an "astable" oscillator which can be built from components from Fig. 6.5.

Bistables can also be connected in such a way that they act as stores or registers which remember a string of digits. The string can be moved along the chain, to emerge eventually at the other end. This is a shift register, or moving store. Bistables can also be used as static stores or memories. Most pocket calculators nowadays have such memories. Computers have very large ones capable of storing thousands of digits.

# WINKER

If you want to experiment with computer i.c.s you will be well advised to buy one of the many excellent multi-socket "breadboards" now available for the purpose. I.C.s and components can be plugged in at will and linked up with pushed-in wires. For about £8 you can get a breadboard big enough for nearly all the projects you'll want to try out.

I hope you have enjoyed this series. If so, keep reading, because there are plans for some follow-up articles using the terminal-block solderless technique.

As a final experiment you might like to convert your bistable into an astable, that is an oscillator (Fig. 6.6). I'll leave you to work out the changes in connections from the earlier circuit!



TODAY'S driver could well profit from a knowledge of the air temperature around the car, especially if used to provide a warning of possible ice formation on the road surface.

So, what kind of thermometer would be suitable for use in a car to meet this need and yet also have sufficient range to measure anticipated maximum summer temperatures?

# ANALOGUE OR DIGITAL?

To keep the thermometer small and rugged, a digital circuit design using l.e.d. or l.c.d. displays is called for, since a moving coil meter for an analogue display would make a bulkier and less durable thermometer. Digital design also makes the inclusion of an alarm function easier.

However, 7-segment displays are expensive, and one solution is to use discrete l.e.d.s in a bargraph display of the type used for VU meters. Such a display of, say, ten l.e.d.s in a horizontal format functions as an analogue display but they light in discrete steps.

# BARGRAPH

The 3914 i.c. is purpose-designed to drive a ten l.e.d. bargraph to give an analogue display of the voltage it senses. It is housed in an 18-pin package and the l.e.d.s are normally mounted in-line to give a bar or moving dot display. Its principal advantages compared with a con-

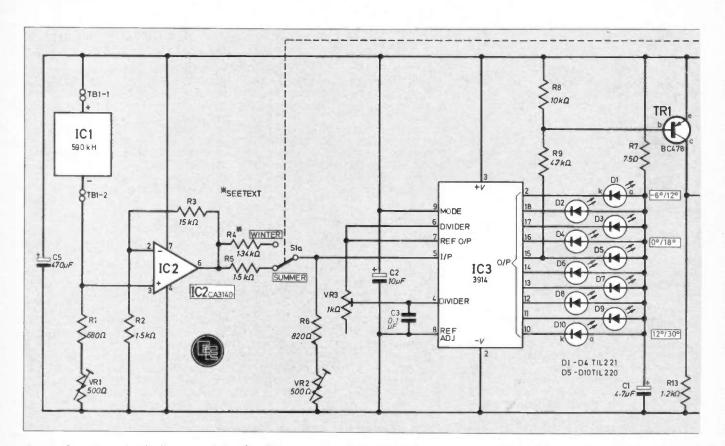


Fig. 1. Complete circuit diagram of the Car Thermometer. Note that the temperature sensor, IC1, is connected to the terminal

ventional moving coil meter are: it can be used in any position; it can be seen in the dark; it has a fast response; and it is unaffected by knocks and vibrations.

The device contains a precision voltage reference and internal logic which enables the user to choose bar or moving dot display operation. The 3914 also contains current limit resistors for the l.e.d.s.

# **VOLTAGE COMPARATORS**

There are ten voltage comparators. The non-inverting input of each comparator is taken to a precision voltage divider chain made up of ten one kilohm resistors connected in series. All the inverting inputs of these comparators are connected together and taken to the output of the buffer stage which receives the input signal.

By using the internal voltage reference, a stabilised voltage can be set across the voltage divider chain so that an increasing step voltage is set on the non-inverting inputs of the comparators, from the lower one to the upper one. As the output voltage from the buffer stage increases in response to an analogue input voltage, the voltage on the commoned inverting inputs increases.

When the voltage on the inverting input of a comparator exceeds the voltage on its non-inverting input, its output voltage goes low and the l.e.d. connected to this output lights. Each of the ten outputs can sink a current of 30mA and this

IC4 pin14 S1b R10 IC4a 10kQ ON/ OFF IC4b TB1 R11 \$ IC4c IC4<sub>4093</sub> R12 100kΩ D11 IC4, pin 7, 8,9 AL ARM TIL 220 TB1-3

block by up to three metres of wire.

current is programmed by an external resistor.

# CIRCUIT DESCRIPTION

Four i.c.s are utilised in the design of the Car Thermometer circuit shown in Fig. 1. The CMOS op-amp, IC2, is wired as a non-inverting voltage amplifier with a voltage gain of about 11, that is, the ratio of resistor values (R3 + R2) to R2.

The temperature sensor IC1, acts as a high impedance current source which passes about 1µA per Kelvin (1 Kelvin equals 1°C), through resistors R1 and VR1 when it is supplied with a voltage between 4V and 30V d.c. across it. Due to its high impedance, the sensor current is virtually insensitive to voltage drops which might occur on long cables connecting it to the amplifier.

R1 and VR1 are adjusted so that a voltage varying by about 0.91mV per Kelvin occurs at pin 3 of IC2. This variation is set so that, after amplification, the voltage at pin 6 varies by 0.1V/K. This condition makes it easy to calibrate the thermometer, since voltage at this point may be read directly as Kelvin. For example, a voltage of 2.67V occurs when the temperature of the sensor is 267K, or -6°C (273K corresponds to 0°C).

Thus, over the full range of temperature measured by the thermometer, the voltage changes from 267mV to 303mV (30°C). Note that a temperature of x degrees Celsius is equivalent to a temperature of 273 + x degrees absolute or Kelvin.

The total variation in voltage at pin 6 of IC2 is, therefore, 0·18V. A fraction of this voltage is applied to the input of IC3, pin 5, via the voltage dividers R5 (or R4) and R6 + VR2. The internal reference voltage of 3914 is available at pin 7 and is nominally equal to 1·2V. Pin 6 is connected to pin 7 so that the voltage at the "top" end of the internal voltage divider is 1·2V.

The voltage at the "bottom" end of the voltage divider is set on pin 4 by VR3 which selects a fraction of the internal reference voltage. Thus a stable voltage is set across the internal voltage divider which enables an accurate expanded scale thermometer to be designed using the 3914.

Capacitors C1, C2 and C3 are required to ensure that the 3914 is stable in operation. Resistor R7 is connected in series with the anodes of the ten l.e.d.s to reduce the power dissipation inside the 3914 by bringing its output transistors further into saturation.

# **ALARM CIRCUIT**

The logic circuit which operates the flashing l.e.d. when the temperature of the sensor is below 2°C is centred on the CMOS device, IC4. Three of the four 2-input Schmitt NAND gates are used.

When the temperature is 2°C or above, D5 connected to pin 15 of IC3 is on and the voltage drop across it lowers

the voltage at pin 15. TR1, in association with the voltage divider R8 and R9, inverts this low and places a logic high on pin 12 of IC4a. Since the voltage on pin 13 is also high, the output at pin 11 is low. This low applied to pin 6 of IC4b ensures that its output stays high and TR2 holds off the alarm D11.

If D5 goes off, the voltage at pin 15 of IC3 goes high and transistor TR1 switches off which places a logic low on pin 13, IC4. Thus, the output of this gate is now high and this high is placed on pin 6 of IC4b.

# SCHMITT OSCILLATOR

Pin 5 of IC4b is connected to the output of a simple Schmitt oscillator designed around IC4c using C4 and R12. Thus pin 5 of IC4b receives square-wave pulses at a frequency of about 1Hz.

Every time pin 5 receives a low from the oscillator, pin 4 goes from low to high. Thus pin 4 of IC4b passes a series of pulses to transistor TR2 which drives D11 on and off at the oscillator frequency.

To avoid the alarm operating at temperatures below 20°C when the selector switch S1a is on SUMMER, S1b holds the base of TR2 high hence preventing D11 from flashing.



flashing l.e.d. at temperatures below 2°C.

Sensor: Semiconductor

Power

supply:

temperature sensor with nominal temperature coefficient of 1µA/°C

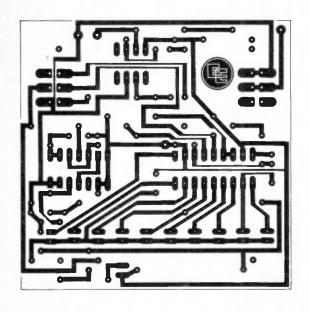
Suitable for in-car use since Thermometer

operates over a 7V to 16V range without affecting calibration

Max. 150mA at 12V supply current: voltage with all

l.e.d.s on

# Car Thermometer



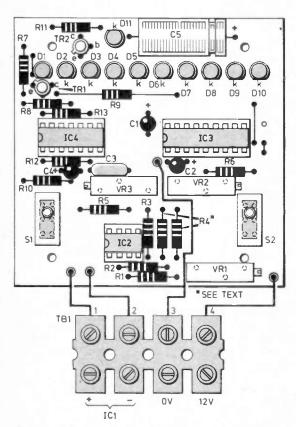


Fig. 2. Full size p.c.b. artwork and component layout. All the l.e.d.s are soldered into the board at the same height of approximately 20mm (to the top of the lens).

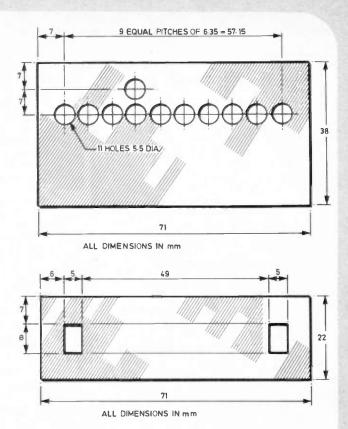
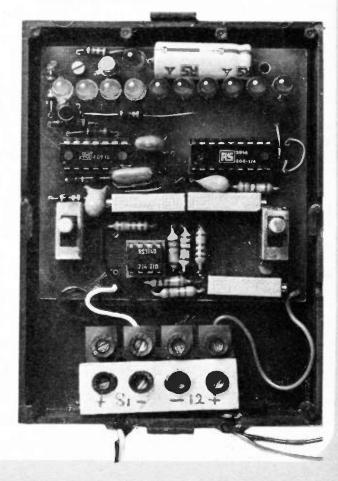


Fig. 3. Drilling details for the display panel and switch label. Both are specifically designed for the Lascar hand-held case.





# CIRCUIT BOARD

The p.c.b. layout shown in Fig. 2 makes circuit assembly of the thermometer straightforward. This board is designed to fit inside the lower half of the hand-held case. The l.e.d.s are soldered direct to the p.c.b., the height being chosen so that they just pass through holes drilled into the display plate when the unit is assembled.

The ice warning l.e.d. is mounted by the side of the 0°C l.e.d. The first four l.e.d.s which indicate below freezing on the WINTER scale are green and the rest red.

All the components except the temperature sensor are mounted on the p.c.b. There are a few problems which might arise in using the 3914 and these were anticipated in the component layout. One problem is that the l.e.d. currents sum at the 0V terminal (pin 2) of this i.c. and any resistance between pin 2 and the battery terminal will cause voltage drops which can make the 3914 oscillate.

Oscillation in the 3914 is usually manifested by a slow turning on and off of the display. Thus the battery negative lead is taken direct to pin 2 and C4 decouples the power supply close to the 3914. Similarly, C1 between the l.e.d. anode common and pin 2 has a decoupling role and reduces the possibility of oscillation due to any resistance between pin 3 and anode common.

Resistor R4 has a calculated value of 1.34 kilohms, and is made up from two resistors connected in series, nominal values of 510 ohms and 820 ohms. The precise value of this resistor is determined by the value of the internal reference voltage of the 3914 and corresponds to the internal reference voltage of 1.26V. The resistors were selected using a digital

ohmmeter.

Constructors are advised to select a value close to 1.34 kilohms assuming

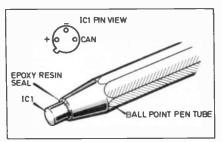


Fig. 4. Method of mounting the temperature sensor, IC1, in a plastic ball point pen tube.

their 3914 has the same internal reference voltage. Should, in subsequent use after calibration, the scale be inaccurate, a change to one of the two resistors making up R4 can be made.

The four external connections to the unit (to power supply and sensor) are made via a four-way terminal block, TB1. It is important to check that correct polarities are observed to the sensor. A pair of leads two or three metres long, if necessary, can be used to connect the sensor to the terminal block and care should be taken to ensure that the soldered joints close to the sensor are insulated from each other, and from any exposure to external water.

The sensor should be glued with epoxy resin into the end of a plastic ball point pen tube for protection as shown in Fig 4. Note that pin 3 (case) of IC1 is not used and should be cut off close to the case.

# CALIBRATION

This exercise necessitates the adjustment of VR1, VR2 and VR3 with a possible change to the value of R4 or R5. However, the procedure is quite straightforward and you only need some glasses of water at 12°C and 30°C, measured using an accurate thermometer, and some melting ice in another glass.

Connect the unit to a 9V, PP7 battery or to a 12V d.c. power supply and put the sensor in the water at 12°C, using the thermometer to keep the water well stirred. Switch on the unit and select the SUMMER range. Use a digital voltmeter (if available) to measure the voltage at pin 6 of IC2 and adjust VR1 until a reading of 285mV is obtained. This reading corresponds to an absolute temperature of 285K (12°C). Move the sensor to water at 30°C and you should find that the voltmeter now reads 303mV. VR1 should not now be touched again.

Note that the sensor, amplifier and digital voltmeter constitute a digital thermometer whose scale is linear and reads in degrees absolute (Kelvin).

Adjust VR2 until all the l.e.d.s are on making sure that D10 just comes on. Put the sensor in water at 12°C again, and adjust VR3 so that D1 just comes on. Move the sensor back to water at 30°C and once again check that D10 is just on. No further adjustment to VR2 and VR3 should be necessary. They have set the scale of the thermometer to a 18°C span.

Switch S1 to WINTER and put the sensor in melting ice at 0°C. The first four (green) l.e.d.s should be on, and the ice alarm D11 should begin to flash on and off. Remove the sensor from the melting ice and allow it to warm up. As it does so D5 will light and the alarm will go off.

Place the sensor in the water at 12°C and the last l.e.d. in the scale will just come on. If it does not, a change to one of the resistors R4 or R5 is necessary. Select another resistor to correct the error using the fact that reducing the value of R4 (or R5) causes the scale to over-read and increasing the value causes the scale to under-read.

# **COMPONENTS**

### Resistors

 $680\Omega \pm 2\%$ R 1 R2.5 1.5k $\Omega \pm 2\%$  (2 off) R3  $15k\Omega \pm 2\%$ **R4** 1-34kΩ (see text) 820Ω ±2% See R6 R7  $7.5\Omega$ R8.10 10kΩ (2 off) R9 4.7kΩ R11 470Ω 100kΩ **R12** R13 1 ⋅ 2kΩ

All ±2% resistors are metal oxide, all other types are ±5% carbon

# Capacitors

C1 4·7μF 25V tantalum bead C2,4 10μF 25V tantalum bead (2 off) C3 0·1μF polyester

C5 470µF 25V elect.

# **Semiconductors**

D1-4 TIL221 0-2in. green l.e.d. (4 off)

D5-11 TIL220 0-2in. red l.e.d. (7 off)

TR1,2 BC478 silicon npn (2 off) IC1 590kH temperature

sensor TO-5 package IC2 CA3140 cmos op-amp

IC3 3914 linear bargraph display driver IC4 4093 cmos quad 2-input

### Miscellaneous

S1,2 d.p.d.t. sub-miniature slide switch with chrome tang (2 off) VR1,2  $500\Omega$  multiturn preset (2 off)

NAND Schmitt trigger

VR3 1kΩ multiturn preset TB1 4-way terminal block Hand-held instrument case; single sided p.c.b. 70 × 70mm; 18-pin d.i.l. holder; 8-pin d.i.l. holder; 7/0-2mm wire; used ball point pen tube; epoxy resin adhesive.

Approx. cost Guidance only

£16

# **INSTALLATION**

The thermometer is now ready to use in the car. Connect the unit to the car battery via the ignition switch, carefully observing to polarity, and mount the unit in a position not illuminated by direct sunlight otherwise the scale will be difficult to read.

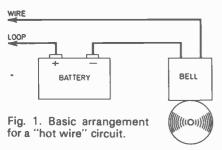
The sensor should be located away from engine or exhaust heat but able to sense the ambient air temperature without being directly exposed to the airstream; or to rain and road spray. A good position for the sensor is behind the front bumper guard but fit the sensor inside a short length of tube open at one end and mounted with its open end pointing earthwards.



At village fêtes up and down the country you will see this time-honoured game. No-one seems to know what it is really called but the idea is simple enough. If you can guide the hand-held loop around a bent wire obstacle course without touching it, you win. If you touch the wire with the loop a bell rings and you lose!

# ORIGINAL SYSTEM

The circuit normally used is extremely simple—just a battery and bell connected in series, Fig. 1. The bent wire and handheld loop form a "switch" so that the circuit is completed when the two touch.



Although satisfactory, this system suffers from two defects. Firstly, if the player touches the wire momentarily then the bell might fail to ring due to its rather slow response time. Secondly, since the current required to operate the bell flows through the wire and loop, poor contact between the two will prevent the circuit from working. It is therefore necessary to keep the wire and loop very clean to avoid erratic operation.

# RAPID RESPONSE

The author examined the basic circuit and improved it while still preserving the traditional form of the game.

The first improvement was to ensure that the device would sound for a definite time even after *momentary* contact between wire and loop. This avoids disputes

as to whether the player actually touched the wire or not. The second improvement makes sure that the circuit works reliably even where very poor contact exists.

In the prototype, the bell was replaced by an audible warning device. This consumes less current than a bell, is cheaper, more reliable and gives a louder sound. Experiments with the prototype were unsuccessful when an ordinary bell or buzzer was used.

# CIRCUIT DESCRIPTION

The circuit diagram for the Buzz Off! is shown in Fig. 2.

The main part of the circuit consists of the ever popular 555 timer i.c. This is connected as a monostable—that means it remains off until triggered whereupon it switches on for a predetermined time then reverts to its original state. The *trigger* referred to is provided by contact between the wire and hand-held loop.

The time during which the circuit is on depends on the values of R1 and C1. Using the component values suggested this time will be about half a second and

this was thought appropriate. For a longer time, R1 could be increased and for a shorter time reduced.

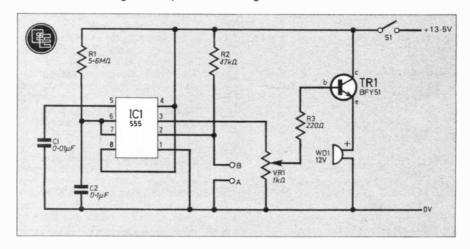
The output of the i.c. is obtained at pin 3 and is connected to the base of TR1 which does the actual job of operating the audible warning device. VR1 matches the output from the i.c. to the transistor.

For the prototype, three type 1289 4.5V batteries were connected in series, Fig. 3, and these gave excellent results. The suggested audio-warning device does not perform well on less than a 12-volt supply although a 9V battery will do for testing. The current requirement is about 10mA on standby and 100mA whilst actually sounding.

# **COMPONENTS** Resistors R1 5-6MΩ R2 47kΩ 220Ω R3 All JW carbon ±5% Capacitors C1 C2 0.01µF polyester 0-1μF polyester Semiconductors TR1 BFY51 npn silicon IC1 NE555 timer Miscellaneous VR1 1kΩ miniature horizontal preset s.p.s.t. miniature toggle 12V buzzer (see text) WD1 **R1** 13½V (see text) 0.1 inch matrix stripboard 9 strips by 22 holes; plastics case 115 x 95 x 37mm (ABS box MB3); 8pin d.i.l. i.c. socket; chipboard: 460 x 110 x 15mm; 100mm tinned copper wire 16 s.w.g.; 800mm flexible wire; connecting wire; wire coat hanger. Approx. cost

**Guidance only** 

Fig. 2. Complete circuit diagram for the Buzz Off!



# starts here

# CIRCUIT BOARD

The circuit is built on a small piece of 0·1 inch matrix stripboard 9 strips by 22 holes in size. Use an 8-pin i.c. socket and do not insert the i.c. until all assembly work is completed. Cut the copper tracks in the places indicated on the underside diagram, Fig. 4, especially not forgetting the row between the pins of the i.c. socket.

Although any small plastics box may be used to house the project, the suggested one has convenient slots for easy mounting of the circuit panel.

# **POWER SUPPLY**

The audio-warning device may be placed inside the box with only the top part protruding through a hole cut in the lid. If this is made a tight fit then no further support will be needed. Holes need to be drilled in the case for \$1, external battery leads, and for connections to the loop and wire. If the box is large enough, the batteries may be placed inside, but a better plan is to use external batteries especially where heavy use is anticipated.

# WARNING DEVICE

The alternative audible warning device will operate from a 9-volt supply. It may be mounted on top of the case using small nuts and bolts. Although much smaller it is also quieter in operation so, for loudest results, the recommended audio-warning device should be used. Whichever device is chosen, it is essential to observe the The recommended audiopolarity. warning device has spade type connectors marked "+" and "-". The alternative has flying leads—red for positive and black for negative. Soldered connections may be made to spade connectors so long as they are made quickly. On the other hand, the proper connectors are cheap and may be obtained from a motor accessory shop.

The switch \$1 is mounted in the hole in the lid and wired into the positive battery lead. Some connections need to be made to the copper strip side of the circuit panel. These should be made with great care to avoid short circuits.

# LOOP HANDLE

The hand-held loop consists of a piece of thick (16 s.w.g.) copper wire bent around a wooded dowel and twisted tightly around it using pliers or a vice. The diameter of the loop is left to the constructor since it is this which determines the difficulty of the game.

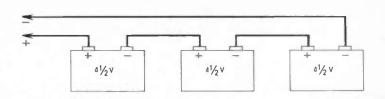
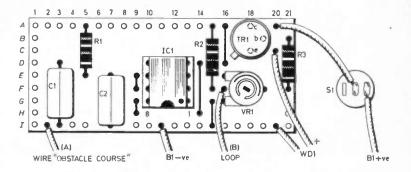


Fig. 3. Connecting three batteries in series to power the Buzz Off! circuit.



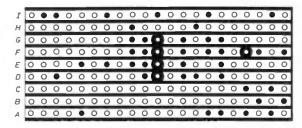
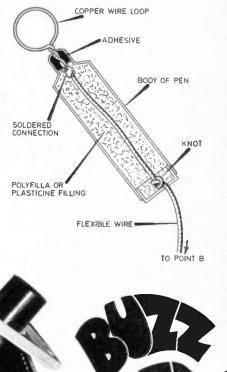


Fig. 4 (Above). Component layout, interwiring details and underside of the stripboard showing breaks (5 off) in the copper strips. Note that there should be 22 holes not 21 as shown.

Fig. 5 (Right). Suggested method of construction for the hand-held loop.

Completed prototype of the Buzz Off! The siren protrudes through a cut-out in the case lid. The circuit board slides into slots in the side of the case.



The handle consists of an old felt tip pen. After dismantling this and washing it out, the copper loop has a length of flexible wire soldered to it and adhesive used to secure the parts together, see Fig. 5. The wire is knotted and passed through a hole drilled in the base of the pen body. This knot will protect the soldered connection from the rough service which the loop is likely to receive.

The best wire to use is the "extra flexible" variety. This resists bending very well. If it is not available, ordinary stranded wire will give reasonable service. When the project has been finally tested, the body of the pen may be filled with Plasticine to give a pleasant feel to the handle. The free end of the wire is taken to point B on the circuit panel and soldered into position.

# **COAT HANGER**

The wire obstacle course is made from

an old wire coat hanger mounted on a chipboard base. The baseboard used for the prototype was made from 15mm thick chipboard about 460mm long by 110mm wide. After untwisting the coat hanger and bending the wire into a suitable shape, the hand-held loop is threaded onto it.

The ends of the wire are then secured through holes in the baseboard. If BA taps and dies are available, the ends of the wire may be threaded and secured using two nuts and washers at each end. A solder tag may be used at one end to make the connection to point A. The wire may also be secured in the holes by using epoxy resin adhesive. A soldered or tightly twisted connection may then be used for connection to point A.

If sharp ends of wire protrude through the baseboard, rubber feet may be used to keep it clear of the table. Finally, a spring clip on the baseboard may be used to keep the hand-held loop tidy while the game is not being used.

# **CIRCUIT TEST**

Testing may be carried out using a 9V battery. Set VR1 to approximately midtravel, keep the loop clear of the wire and switch on. The audio-warning device may give a single "bleep" which may be ignored. Now touch the loop against the wire for an instant. There should be a short bleep. Some adjustment to VR1 may be needed for best results. If the circuit tends to trigger falsely—to bleep even when the loop and wire have not touched—then R2 may need to be altered in value.

If the length of the bleep is too short, R1 may be increased in value and viceversa.

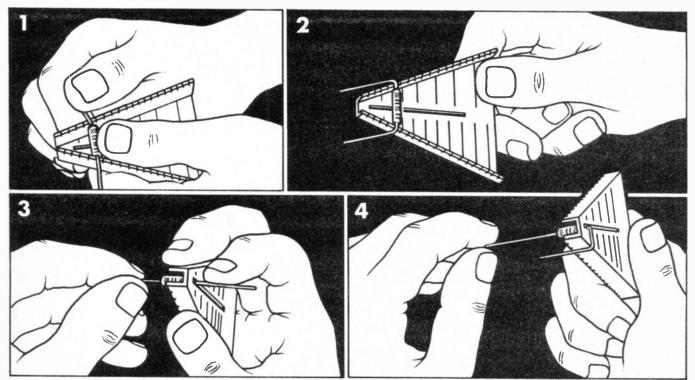
This game is certainly good for fundraising. You are sure to be in demand when word gets around!

# **HOW TO USE YOUR**

# BENDING GAUGE

The Wire Bending Gauge given free with this issue is intended to be used for bending the leads on small components such as resistors and axial lead capacitors. It provides a quick, accurate and safe means of bending the leads to span an exact number of holes on perforated circuit boards. There are guides for both horizontal and vertically mounted components on 0-1 and 0-15 inch pitch boards. The numbers represent the number of holes to be spanned, including mounting holes.

Horizontal mounting. (1) Place the component in the notches to span the requisite number of holes for the appropriate pitch. Hold component body and bend one lead at a time to make the leads parallel; (2) ready for insertion. Vertical mounting. (3) Place component in slot and bend protruding lead through 90 degrees. Slide component along slot to required span guide lines and bend once again through 90 degrees over gauge edge as shown in (4). Move component to tip of gauge to remove.





APRIL 1983 ISSUE ON SALE FRIDAY, MARCH 18

ISSII

# GO TO WORK ON THESE

PROJECTS

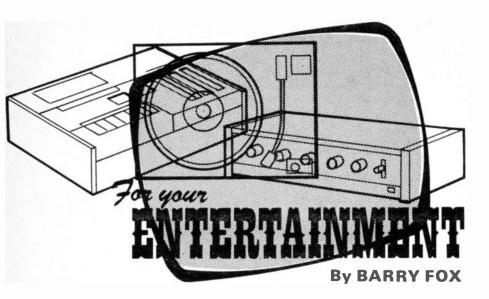
EGG TIMER

CAR RADIO LS BOOSTER

ZX SPECTRUM AMPLIFIER

FUNCTIONS

FLANGER SOUND EFFECT



# Why Markets Are Lost

Over the last 15 years I've watched the British consumer electronics industry be decimated by Far Eastern competition. But I'm sorry to say that many firms, now out of business, have reaped no more than they deserved. They didn't plan ahead, they didn't keep in touch with what their customers wanted and they didn't keep up to date with technology, production efficiency and quality control. So they went out of business when better, cheaper and more reliable products from Japan started to flood in. Now exactly the same thing is beginning to happen to the motor industry.

Recently, partly out of national loyalty, I bought British when I needed a new car. I chose an MG Metro because I admired some of its elegant design features. Like, for instance, the way the driver's switch panel has a blanked off socket into which the owner can push-fit Leyland switches to add optional extras, such as front fog lamps. As the switch pushes home it mates with contacts on the edge of a printed circuit board which is connected to the main wiring loom. As the Leyland circuit diagram for the car shows, it is then only necessary to connect a relay and fog lights at the free end of the wire, near the front radiator.

# The Missing Wire

Thinking to myself, at last we're learning from the Japanese, I bought and fitted the necessary switch, relay and fog lights. But then I found that, although the switch mated with the p.c.b., the fog lamp wire shown on the circuit diagram wasn't anywhere to be seen. The dealer who had sold me the car was puzzled and suggested I contact the service division of British Leyland. Two months later I had still not solved the problem but I'd learned an awful lot about the problems Leyland must face in the future. What I found out could also, incidentally, be very useful for anyone else who has recently bought a Metro car, and for dealers who are selling them.

The Supercover guarantee department of British Leyland referred my query to the BL Customer Service Department. Unfortunately they couldn't read a circuit diagram, and told me that the wire was missing because it was shown in the circuit diagram only as a dotted line, meaning that it was optional. In fact, it's clearly shown in Leyland's own circuit as a hard wire. I persisted and my query was then passed to another customer relations person at British Leyland. He ducked the issue altogether. "Your best course of action will be to consult your local dealer". So I wrote back again explaining that it was only because the dealer was puzzled that I had written to British Leyland for advice in the first place.

# Do It Yourself

I heard nothing, so phoned British Leyland Customer Relations to try and sort things out once and for all. At first they tried to tell me that the wire was there but I couldn't see it. Then they finally owned up. The wire which makes it easy for Metro owners to fit their own fog lights has been omitted from the wiring loom to save money. Dealers hadn't been told and the circuit diagram hadn't been changed. "It is necessary to supply and fit the necessary wiring yourself," wrote Leyland, enclosing a scrappy Xeroxed sheet showing where the missing wire should be fitted to the p.c.b.

My mind boggling, I asked the British Leyland Press Office how much money the company was saving by omitting one metre of low current wire at the production stage, and leaving the customer to rebuild it into the car after purchase. The press officer came back to me (or more accurately waited until I got impatient and phoned her), to tell me that she had been assured by BL's electrical engineers and product planners that the wire wasn't missing after all!

After yet more phone calls and letters I finally got something approaching the full story. The wire in question was in all the original Metro range, but is now being omitted. With curious logic it's been omitted first from the most expensive cars, the MG Metro and the Van den Plas. No-one could say for sure who had made the decision.

# Incomprehensible

So, if you want to fit fog lamps to a new Metro car by using the standard switches that interface with the p.c.b., then don't doubt your sanity if you can't find the wire that is shown on the circuit diagram.

Meanwhile, British Leyland is getting £990 million of public money over two years. That's nearly £10 million a week. This money is intended to help the company fight off Japanese competition. When I was in Japan recently, at a trade seminar, I told the story of the missing Metro wire. The Japanese press and businessmen present looked at me as if I was mad. The idea of treating a customer that way is totally alien to Japanese industry. And that's why they are winning the trade war.

# Buying A Home Computer

The national press carried a report of boom sales in home computers in the last Christmas shopping rush. This is doubtless because home computers are now cheaper than a computer controlled home TV game.

Despite all the fancy talk about home computers making domestic life and business more efficient, there's no doubt that most people who buy them end up using them mainly to play games. A friend in America recently told me that although many businessmen now feel obliged to buy and install a computer system in their office, to look "on the ball", most of them only use their impressive installations to play exotic TV games.

I also heard recently of problems some users are having with their home computer disc drives. It's easy to forget that although the microprocessor inside a computer is a wonder of modern technology, and can in

theory last forever, the same is certainly not true of disc drives.

These are complicated mechanical beasts, that will eventually go wrong or wear out. In some cases they may only last a few months, and if the drive is built into the main computer housing, then you'll have to return the whole system for repair. The cost of the strip down and replacement of a drive can be well over

Don't rely on the guarantee to help you. Often you'll find it offers only three month's free parts and labour. You may be able to contest this under the British consumer laws, but you could well end up with a fight on your hands.

So, before buying a computer ask yourself three questions. Do I really want one; how easy will it be to repair or replace a disc drive; and am I getting a good guarantee.

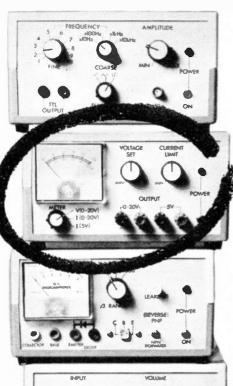
# I POWIE SUPPI

**UNIT ONE** 

BY J. R. W. BARNES

# THE TEST GEAR 83 SERIES CONSISTS OF:

### DUAL POWER SUPPLY ● FUNCTION GENERATOR ● TRANSISTOR TESTER FREQUENCY METER **PULSE GENERATOR** LABORATORY AMPLIFIER









1974 EVERYDAY ELECTRONICS published a series of articles, E.E. Test Gear Five specially designed for the constructor.

Since 1974 there have been many major advances in the world of electronics and we now introduce a new series of six instruments, under the title Test Gear 83.

# **TEST GEAR 83**

This new generation of test equipment reflects the upward trend in technology. Of the original five, two have been kept, the Power Supply and the Transistor Tester, both being new and considerably updated designs. The A.F. Oscillator has been abandoned in favour of a Function Generator, and the R.F. Generator has gone completely. In addition, there is a Laboratory Amplifier, a Pulse Generator and Digital Frequency Meter.

The reasons for building your own test equipment, however, remain the same. Electronics is a craft, and with widely available integrated circuits, sometimes likened to building blocks, most of the old terrors of electronics have disappeared. The average man (or woman) in the street can be as happily engaged in building and experimenting, as the technically trained expert. It is the nature of electronics that allows useful and satisfying involvement at all levels.

Throughout the design of the Test Gear 83 projects, emphasis has been placed on two main areas; firstly, the price/performance ratio while at the same time designing units that will provide a sufficiently high specification, so they will be of use for many years. The other area of concern is on ease of construction.

All the units will be built on printed

circuit boards, whilst this adds to the construction time it has been the authors experience that constructional errors are less likely to occur, and the project works first time.

# **DUAL POWER SUPPLY**

A power supply is a key component in any electronic system. Although batteries may be used to supply the finished project they are not flexible enough for development work. Also, with batteries becoming increasingly more expensive the idea of running projects from the mains becomes attractive. This unit has been designed to supply the essential requirements of a home constructor's workshop at a reasonable cost. It provides two stable, well regulated outputs, with low ripple.

The main output provides 0 to 20V and has constant current overload protection which can be set in the range 0 to 1-2A.

The second output provides a fixed 5V output and is primarily intended for experimenting with TTL logic. The maximum current available is fixed at 1A.

A meter is provided for measuring the output voltage, current on the main output and the current drawn from the 5V output. Both supplies are short-circuit protected.

# CIRCUIT DESCRIPTION

The circuit diagram of the unit is shown in Fig. 1. The circuit can be split into sections, the main output and the secondary output. The secondary output will be considered first.

The circuit is very conventional in the fact that all the work is done by the three terminal regulator integrated circuit, IC1.

### **SPECIFICATION**

# Variable output 0 to 20V d.c.

Range: Max. current:

Ripple:

1.2A

10mV peak-to-peak (supplying 15V at 1A) 0.08% (measured at

Load regulation: Line regulation:

20V between 0 and 1A) 0.0065% (input voltage varied between 230V and

250V

# **Fixed output**

5V d.c. Output: Max. current: 1A

8mV (supplying 1A) Ripple: Load 1.5% (between 0 regulation: and 1A)

General

3 ranges V(0-20V). Meter: /(0-20V), /(5V) Terminals: 4mm banana sockets



The a.c. input is provided by the transformer and is rectified and smoothed by the bridge rectifier D1-D4, and capacitor C1, respectively. The low value resistor R1 is used to sense the output current for the meter.

With an output current of 1A, half a volt is developed across R1. R2 is chosen to make the meter 0.625V full scale. The

capacitors C2 and C10 are to prevent high frequency oscillations.

The main output is more complex, rather than use another monolithic regulator i.c. the higher stability of a LM723 was sought. The reason for this is because in a simple series regulated supply, a large amount of power is dissipated in the output transistor causing it to run hot. In a monolithic regulator this raises the temperature of the voltage reference and causes it to drift.

# **EXTERNAL AMPLIFIER**

In a design using a discrete output transistor, the transistor and the reference are in thermal isolation. A very stable reference is provided by IC2. Readers familiar with the LM723 regulator will know of its inability to regulate at low output voltages, that is less than two volts. This limitation arises from the error amplifier, so in this design an external amplifier is used, a CA3140, IC3.

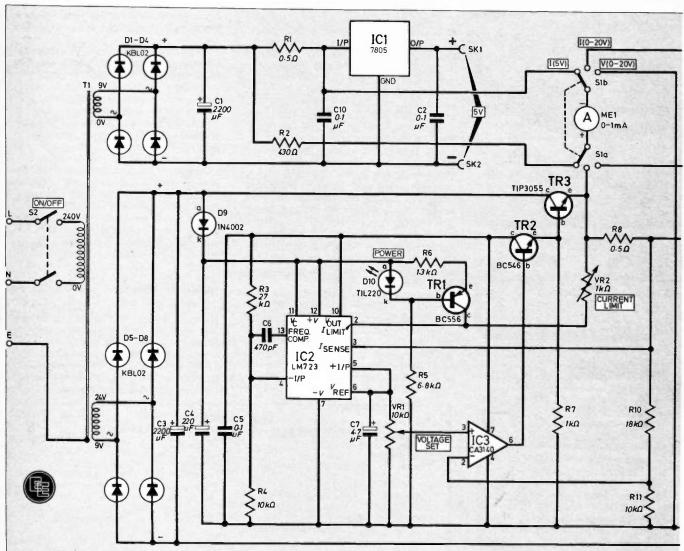
This amplifier will work with its input close to 0V. The voltage reference from pin 6, IC2 is fed via the voltage control potentiometer VR1 to the non-inverting input of IC3. A portion of the output voltage is fedback to the inverting input via the potential divider R10, R11. This feedback loop keeps the output voltage constant. The output of IC3 is used to drive the series pass Darlington pair made of transistors TR2 and TR3.

# **CURRENT LIMITING**

The error amplifier in IC2 and its associated output transistor are used to limit the supply to IC3 to a maximum of 27V. The output current is sensed by resistor R8, when the current flowing through this is 1·2A, 0·625V is developed across it. If this were directly connected to pins 2 and 3 of IC2 this would result in the supply to the op-amp being reduced thus keeping the output current constant.

The current limit circuit is biased by

Fig. 1. Complete circuit diagram for Unit One, the Dual Power Supply. The main output provides 0 to 20V with constant current overload protection within range 0 to 1-2A. The second output provides a fixed 5V 1A supply specifically for experimenting with TTL logic.



driving a constant current of 0.75mA from the current source TR1 and its associated components, through VR2. The voltage across VR2 is added to that across the sense resistor, increasing the current limits sensitivity.

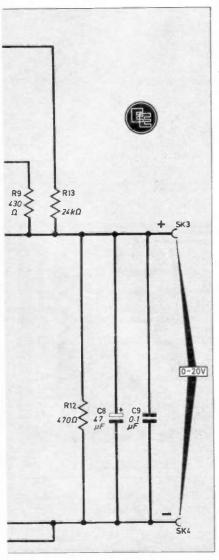
The sense resistor is also used by the metering circuit to display output current.

The d.c. is provided by the 24V secondary from T1, bridge rectifier D5-D8 and capacitor C3.

# Starts here

# CIRCUIT BOARDS

The prototype was housed in a Vero case type 202-21036C. This case will be used throughout the *Test Gear 83* series





# COMPONENTS Resistors R1,8 0.5 $\Omega$ (2 off) 3W wire-wound R6 1.3k $\Omega$ R2,9 430 $\Omega$ (2 off) R7 1k $\Omega$

All  $\frac{1}{4}$ W carbon  $\pm 5\%$  unless otherwise stated

Capacitors

 $\begin{array}{cccc} C1 & 2200\mu F \ 25V \ elect. \\ C2,5,10 & 0\cdot 1\mu F \ 160V \ Siemens \ (3 \ off) \\ C3 & 2200\mu F \ 40V \ elect. \\ C4 & 220\mu F \ 40V \ elect. \\ C6 & 470pF \ disc \ ceramic \\ C7 & 4\cdot 7\mu F \ 10V \ tantalum \ bead \\ C8 & 47\mu F \ 25V \ elect. \\ C9 & 0\cdot 1\mu F \ ceramic \\ \end{array}$ 

Shop Talk page 145

Semiconductors

D1—4 KBLO2 200V, 4A bridge rectifier D5—8 KBLO2 200V, 4A bridge rectifier D9 1N4002 TIL220 red l.e.d.

TR1 BC556 pnp silicon
TR2 BC546 npn silicon
TR3 TIP3055 npn silicon

TR3 TIP3055 npn silicon plastic power 7805 5V, 1A regulator LM723 adjustable voltage regulator

IC3 CA3140 MOSFET op-amp

approximate cost £35

# Miscellaneous

T1 mains transformer with 24V, 1.5A and 9V, 1.5V secondaries ME1 1mA f.s.d. panel meter with  $120\Omega$  coil (type ML52)

ME1 1mA f.s.d. panel meter with 120Ω coil (type ML52) S1 2-pole, 6-way midget rotary with adjustable stop

S2 d.p.d.t. miniature mains toggle VR1  $10k\Omega$  control potentiometer VR2  $1k\Omega$  control potentiometer SK1,3 insulated terminal post red SK2,4 insulated terminal post black

SK2,4 insulated terminal post black Verocase type 202-21036C; single-sided p.c.b. size 120  $\times$  85mm and 85  $\times$  75mm; heatsink size 89  $\times$  75  $\times$  51mm rated at 1-5°C/W; control knob (3 off); l.e.d. holder; Veropins; 7/0-2mm wire; 14/0-2mm wire; mains cable; grommet; P-clip; 14-pin d.i.l. holder; 8-pin d.i.l. holder; mounting hardware (M2-5 or 6BA).

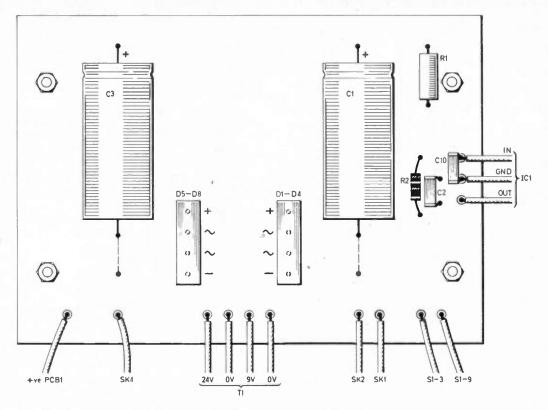
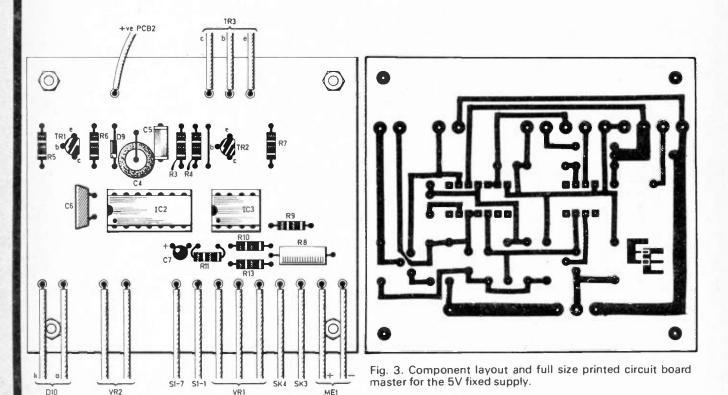
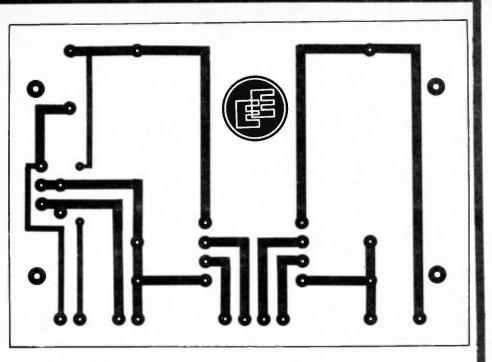


Fig. 2. Component layout and full size printed circuit board master (opposite page) for the 0-20V variable supply.





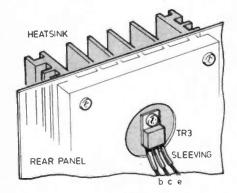
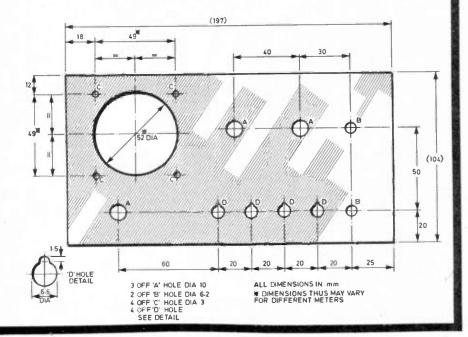


Fig. 5 (Left). Mounting details for transistor TR3. Note that no insulating kit is used on this transistor so the rear panel and the heatsink are connected to the collector and should not be "earthed".

Fig. 4 (Below). Drilling details for the front aluminium panel.



and should be available through the normal Vero distributors.

Begin construction with the circuit boards. If you are making the boards yourself pay special attention to their external dimensions. The prototype boards were laid out with etch resistant dry transfers. The p.c.b. artworks and component layout diagrams are shown in Fig. 2 and Fig. 3.

Solder the components to the board in the normal manner beginning with the passive components and the wire link, working through to the transistors and the diode. It will be found helpful if Veropins are inserted in the board where the flying leads leave it. Note that additional holes have been provided to allow for different sizes of capacitors, particularly C1 and C3 the smoothing capacitors.

#### CASE

Once the circuit boards are complete, the case can be prepared. Remove the four screws at the corners of the base, allowing the two halves to be separated. Remove the front and rear panels. To assist in marking out and to protect the panels from scratches it is advisable to fasten a piece of graph paper with double-sided tape. Mark the centre of the holes according to the dimensions given in Fig. 4 and then lightly centre-punch them. Without removing the protective paper, drill the holes. For the large holes it is better to drill a small hole (about 3mm) first and then drill the hole to the right size.

The large circular hole for the meter can be made two ways: either drill a series of small holes round the circumference and punch out the middle, then finish with a file; or use an Abra file in a hacksaw frame.

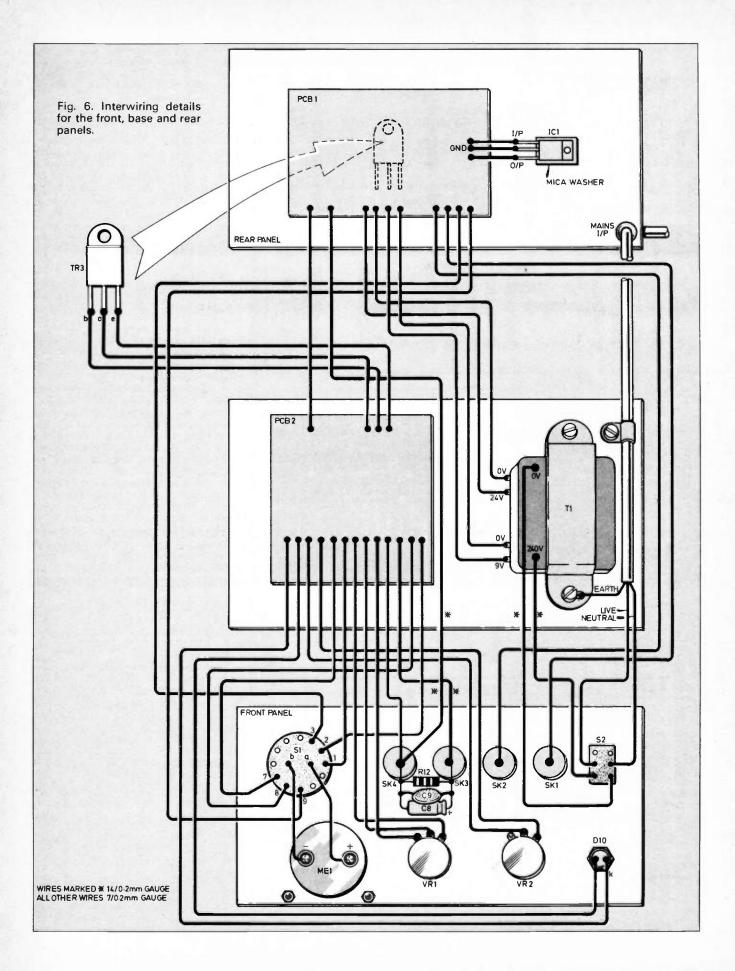
#### **REAR PANEL**

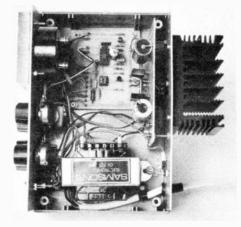
The rear panel holds the heatsink. The heatsink used on the prototype is available from Ambit International, Part 21-08030.

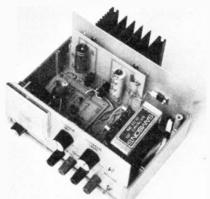
A 30mm diameter hole was cut to be the centre of the heatsink in the rear panel to allow the transistor TR3 to be mounted, see Fig. 5. Note that no insulating kit is used on this transistor so the rear panel and the heatsink are connected to the collector of the transistor and should not be earthed. The 5V regulator is mounted with a mica washer and an insulating bush. To aid heat transfer, a thin smear of heatsink compound should be applied to both sides of the washer and the power transistor.

Solder three wires to the leads of TR3, before mounting the rear p.c.b. on standoffs over the transistor. The rear panel assembly can now be replaced in the lower half of the case.

Screw all the front panel components in place having first cut to size the spindles on the potentiometers and the switch. At this stage it is best to attach wires to the panel mounting components, paying







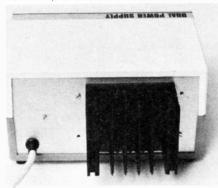


Front panel layout and lettering.

(Left). Positioning of mains transformer, and circuit boards within the case. The boards are held "proud" by their mounting nuts and bolts.

(Bottom left). Circuit board and TR3 on the rear panel.

The heatsink mounted on the exterior of the rear panel.



attention to the two thick wires, see Fig. 6. These wires must be thick or poor regulation will result. Once this has been done the panel can be slid into its mounting slots and the other ends of the wires be soldered.

#### IN USE

The power supply can be used to replace the power supply of a circuit under test. Turn the METER switch to voltage V (0–20V) and with no load connected and the current control turned up set the required voltage. Switch to the current setting I (0–20V) and turn the current control to zero. The load can now be connected and the CURRENT LIMIT control can now be increased. When the current stops rising the power supply is then operating in the constant voltage mode.

Should the load try and draw more current than the threshold, the supply will limit the current by reducing the voltage, that is, go into the constant current mode. The supply may be used in the constant current mode for recharging Ni-Cad batteries, take care though, not to exceed the manufacturers rated current.

manufacturers rated current.

When the supply is delivering a small

output, a large voltage is developed across the series transistor and it will dissipate a lot of power. To avoid overheating the supply should not be operated in this condition for excessive lengths of time. The prototype was short circuited for a quarter of an hour with no ill-effects, although this is not recommended!

## COUNTER INTELLIGENCE

#### Computer Holiday

Earlier this year I found myself, probably like the rest of you, bombarded with alluring holiday literature. There was no escaping it, the newspapers, the radio, the television, all combined to part you from your money in exchange for a fortnight's sunshine.

Unable to withstand the pressure I went to see my bank manager and tried to lull him into a sense of false security with talks of luxury cruises. "Yes, Young, I agree with you in principal, but I think I would be a lot happier if you went for a row round the Serpentine, it would be more in keeping with your present financial status."

Encouraged by his friendly remarks I had another look at the brochures and the following caught my eye. It was a picture of a young man and a young woman sunbathing, and the caption below said, "Don't just lie there, do something". It was an advertisement for a holiday on the shores of the Mediterranean, and thrown in at no extra cost was a course on computer programming. The idea being that when you were bored stiff with doing nothing you

could learn something useful. Alas, the nearest I shall get to it is lying under my Solarium with my minicomputer, and trying to persuade my friends I have been away on one of these specials.

#### **Paranormal**

I think most readers will know I have a slight interest in the paranormal. I don't dabble in it but when a story comes along that has a slight electronic flavour about it, I unhesitatingly pass it on to my readers. Such an opportunity occurred recently and I seized it with both hands.

A short time ago I watched a programme on television. It concerned an old Inn situated in Wales. It had been there since before the Norman Conquest. Many people who had lived there testified that it was haunted, voices and footsteps, and even an organ had been heard playing.

An electronics expert became interested and examined the building, particularly the stone it was made of. It was a coarse local stone, but it had thin streaks running through it which he decided were metal or silicon.

Would it be possible, he thought, for these stones to act as a tape-recorder, and would it be possible to drive out the sound by applying a high voltage to the wall? With the permission of the Inn keeper, he and friend drove long nails into the wall and arranged a time switch to apply a high voltage at 2.30am. A tape-recorder was left running to record the results.

At this point in the programme the commentator said, "I will now play you the tape". For the next few seconds there was silence and then a babel of strange voices and an organ playing weird music. It was really eerie and quite uncanny to listen to.

I thought I would try this experiment myself. I was just about to drive a six-inch nail into the wall when my better half said, "I shouldn't do that if I were you". I expostulated that I was interested in science and wanted to hear these strange voices and language. My spouse came back, "If you knock that nail in you will hear some unusual language without any voltage being applied."

Oh well, perhaps she is right; anyway, one shouldn't dabble in this kind of thing—there may be something in it.

### THE ELECTRONICS OF



## INFORMATION TECHNOLOGY

PART FIVE

BY T.E. IVALL C.Eng., M.I.E.R.E.

We encounter information as a measurable quantity most straightforwardly in storage systems. Their storage capacities are specified in units called bits (short for binary digits, to be explained below). A small random access memory, for example, might have a capacity of 1,024 bits. A magnetic disc store might have a capacity of 10 megabytes (where 1 byte is a group of 8 bits).

Another type of hardware for which a measure of information is used is data transmission equipment. Here, of course, we are concerned with a rate of flow of information from one terminal to another and this rate is measured in bits per second. British Telecom's Prestel service, for example, sends information over telephone circuits at 1,200 bits/second in one direction and at 75 bits/second in the other direction. A much faster system used by British Telecom, for data and other information, works at 2,048 kilobits/second.

#### UNIT OF INFORMATION

The need for a universally accepted unit of information is as important as the need for universally accepted units of length, mass, time, electric current and the many others derived from them.

Without agreement on these units throughout the world—even though conversions between different systems of units may sometimes be necessary-not only science and engineering but the practical affairs of everyday life would come to a messy halt.

In a telecommunications system, for example, to make sure that a physical channel like a coaxial cable will actually convey information at the rate you wish to supply it from a given type of terminal, you must be able to measure the transmission capacity of the channel and the generating capacity of the terminal in the same units.

#### ORIGIN OF BINARY CODE

But why have we chosen the bit, or binary digit, as the unit for measuring information?

Just as the foot as a unit of length originally came from the adult human foot, so there is an historical background to the newer unit as well. The whole history of signalling, whether by light, sound, mechanical movement or electricity, shows that methods using two opposing states have been both practical and effective. They are simple and unambiguous.

We have used light/darkness in lamps and heliographs, sound/silence in sirens and foghorns, left/right positions of galvanometer needles in telegraph instruments, hole/no-hole in punched paper tape and on/off in various electrical systems.

Samuel Morse devised his now famous code with its two symbols, long and short, to make use of the two positions of the armature, and the resulting black/white inked pattern, in his electromagnetic telegraph. In turn, the code was utilised in later signalling systems. In modern communications and electronics, of course, there are various techniques for providing the two states-for example, two different voltage levels of two different frequencies.

So the development over the years of a useful technology for sending information in terms of two states has been a strong incentive for us to consider information as being reducible to this simple binary form. But apart from the practical considerations there is also a good theoretical basis for the binary digit as a unit of information.

#### SELECTION OF SIGNS

The communication of information is fundamentally a selection of signs from a fixed and agreed set of signs. This is so whether we are concerned with selecting sounds from a vocabulary, letters from an alphabet or words from a dictionary.

When we write in English we successively select letters from a set limited to 26. In another language the total number in the set might well be different. One might invent a written language with an alphabet of only 12 characters, or 7, or 4—or only two, say ■ and △. It would be



Optical fibre cable (left) that will replace the old style metal conductor and metal sheathed coaxial cable (right) in modern telecommunications networks are shown for comparison in this British Telecom picture. Optical fibres have a much greater transmission capacity than traditional coaxial cables. Pulse rates in excess of 140 million per second have been achieved over distances of 100km without intermediate amplification.

perfectly feasible to provide enough combinations of s and s to signify all the meanings we wanted (though most of the words would have large numbers of these

signs).

Two signs are, of course, the smallest possible "alphabet". Below that no choice is available. Thus a selection from two possible signs—a binary choice—is the elemental choice. In the numeration of binary arithmetic the two signs are conventionally written as 1 and 0, but the actual characters used are quite unimportant.

So, if the binary choice is the basic element of selection it is also the basic element of information, on the principle of selecting from a set discussed above. When we make a choice of one sign in a binary system of notation we are automatically implying "one out of two". For historical reasons the two written numerals of binary arithmetic have become well established, so it is now conventional to describe the choice as being one out of two digits. Hence the binary digit, or bit.

A store designed to hold binary information is a group of two-state elements (electronic devices or magnetic cells), one for each binary digit. The capacity of the store is simply the number of two-state elements available to hold the digits. But what about information that is not already in binary digital form, such as

sound or vision signals?

#### SUCCESSIVE BINARY CHOICES

By making a succession of binary choices we can make selections from much larger sets than just two signs—as large as we want, in fact. Fig. 5.1 shows how a selection can be made of one sign (the letter F) from an eight-character

alphabet by a series of three binary choices. Therefore the number of bits of information contained in the knowledge that one letter has been selected from an alphabet of eight\* is 3. If this whole selection were made in, say, a tenth of a second the information rate would be 30 bits per second.

Now let us see how this principle can be applied to information in electrical signals. First, in place of the eight letters write a set of eight voltages on a scale. Then add a horizontal time scale to allow a signal to be represented as a voltage/time graph. The result is Fig. 5.2.

We can now select by a series of binary choices any one voltage from a group of eight voltages, and the information contained in the knowledge that this particular voltage has been selected is 3 bits. This signal is not actually drawn as a continuous voltage/time graph but is defined approximately by an invisible line passing through the points marked at the different voltage levels.

If we doubled the number of voltages in the set to 16 the signal would be defined more accurately by more points, as shown in Fig. 5.3, but because more binary choices would be required to allow this, the information content of any one point on the graph would become 4 bits.

In theory, to define any signal perfectly would require an infinite number of voltage level points, infinitely close together (see Part 1 on "Representing information electrically"). In practice, it does not have to be all that great; for example, a good quality television signal calls for a minimum of eight binary choices (8 bits) which means selections from a set of 256 voltage levels.

#### INFORMATION RATE

The information *rate* of the signal in Fig. 5.2 is determined by the time intervals between the voltage points defining the graph. This varies between 60 milliseconds (giving 16.6 bits/second) and 360 milliseconds (giving 2.8 bits/second).

In practice we have to allow for the highest information rate necessary for the class of signal we are dealing with. A television signal, for example, calls for a maximum information rate of about 11 million bits/second, while a telephone voice signal requires a maximum rate of about 8,000 bits/second.

#### INFORMATION CHANNELS

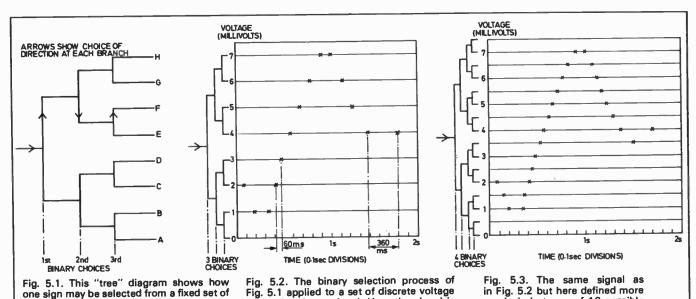
A channel is a means of transmitting an individual, recognisable signal or train of information—say a voice signal or telex message—from one place to another. Usually this transmission is in one direction only, but sometimes the term "channel" implies bi-directional transmission. The physical means of transmission ranges from a simple pair of wires, as used for the domestic telephone line, to coaxial cables, radio links, waveguides and optical fibres.

By using carriers (Part 3) or timesharing methods (Part 4) we can accommodate a whole group of channels within a single transmission system such as a coaxial cable, without the individual trains of information interfering with each other. This is multi-channel transmission.

What mainly matters in information technology is the capacity of a channel to convey information—the maximum flow rate in bits per second that it will handle. This depends on a number of physical quantities in the transmission system. One is the electrical power in the signal; another is the electrical power in the noise (unwanted random fluctuations) introduced by the transmission system itself.

precisely in terms of 16 possible

voltage levels.



values forming a signal. Here the signal is

defined by selections from a set of eight

possible voltage levels.

sign from a set of eight.

signs by making a series of binary choices

(of direction at the branching points). Three binary choices are required to select any

<sup>\*</sup>The generalised formula is: number of bits =  $log_2N$ , where N is the number of signs in the set.

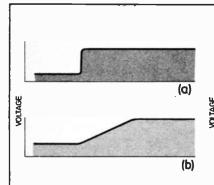


Fig. 5.4. Parts of two signals, illustrating different rates of change of voltage with

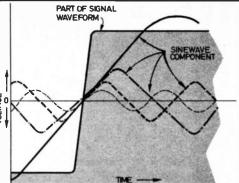


Fig. 5.5. How a signal waveform may be analysed into a set of sine-wave components (Fourier analysis). Not all of the components that make up this signal waveform are shown here.

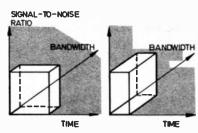


Fig. 5.6. Three-dimensional analogy in which the box is a quantity of information (bits). In transmitting a given quantity of information (the volume of the box), the time taken, bandwidth and signal-to-noise ratio may be exchanged with each other. These two examples illustrate an exchange of time and bandwidth (signal-to-noise ratio remaining constant).

#### SIGNAL-TO-NOISE RATIO

The presence of noise sets a limit to the number of distinct levels in a signal waveform that can be detected, Fig. 5.2 and Fig. 5.3). Sufficient power in the signal will make the effect of this noise insignificant, but there are practical limits to the amount of power that can be transmitted. The relationship of these two (average) powers—the signal-to-noise ratio—is therefore important in determining the accuracy of the information received at the end of the channel.

Another factor determining the accuracy of signal transmission is the ability of the channel to convey the variations of the electrical quantity (Part 1) that represent information—more specifically, the rate of change of these variations. For example, Fig. 5.4 shows parts of two signal waveforms, each of which is a transition between two steady voltages. In (a) the rate of change of voltage with time is higher than the corresponding rate of change in (b).

In a channel using, say, a wire cable as a transmission medium, the resistance and reactance of the wire together limit the rate of change of an electrical quantity that can be sent along it. Consequently, if the signal waveform at the input of the channel contains higher rates of change than the medium can transmit, the waveform received at the end will be distorted and hence the information will contain errors.

For example, the transition at (a) in Fig. 5.4 could be considered as part of a signal fed to the input of a channel. If the channel were incapable of transmitting this rate of change the transition as received at the end of the channel would be something like (b).

#### **BANDWIDTH**

The ability of a channel to convey such rates of change is determined by its bandwidth, measured in hertz (Hz). This term may require some explanation. Any signal waveform can be analysed into a number of sine-wave components of

different magnitudes, frequencies and phases.\* This is illustrated in Fig. 5.5 which shows some, but by no means all, of the sine-wave components which, when added together, constitute the signal waveform shown.

Each component has a maximum rate of change. A channel will convey a limited range of these sine-wave components, and the bandwidth of the channel is the extent of the continuous range, in Hz, over which the channel transmits a specified proportion of the original signal power. The bandwidth of a typical telephone voice channel, for example, is about 4,000Hz.

The channel's bandwidth therefore indicates the rates of change that can be transmitted and, as a result, the number of independent levels of a waveform that can be conveyed by it in a given time. It is therefore a factor in determining the maximum information rate in bits/second.

#### THREE QUANTITIES

So signal power, noise power and bandwidth together determine the highest rate at which a channel can convey information. The exact relationship of the three quantities to this maximum rate is given by an expression\* which enables the channel to be matched to a given source of information, or vice-versa.

In some IT systems it is possible to adjust the rate at which information is generated at the source—to alter the length of time available to convey a given number of bits. This enables us to alter

the bandwidth and/or signal-to-noise ratio required. A graphical analogy of this inter-dependence is given by the "box" diagrams in Fig. 5.6.

The volume of the box, the triple product of time, bandwidth and signal-to-noise ratio, is proportional to a given number of bits of information. Obviously it is possible, as shown by the two examples, to change the time available, the bandwidth and the signal-to-noise ratio (actually it is log<sub>2</sub>), in various ways that will maintain constant the volume representing the quantity of information.

A good example of this, known to some experimenters, is slow-scan television. If you increase the length of time available to send a given quantity of information in a picture, you can transmit the picture in a channel of smaller bandwidth than would otherwise be possible.

To be continued



Mathematically inclined readers will know this as Fourier analysis. The sine-wave components are expressible mathematically as the terms of a Fourier series (named after the French mathematician and physicist J. P. J. Fourier).

<sup>\*</sup> Derived by C. E. Shannon.  $C = W \log_2(1 + S/N)$ , where C = maximum capacity of channel in bits/second, W = bandwidth in hertz, S = mean signal power in watts, and N = mean noise power in watts.

I.Cs - DIGITAL & ANALOGUE

74LS165 74LS173 74LS173 74LS173 74LS193 74LS193 74LS193 74LS195 74LS240 74LS24

- 24 HOUR NORMAL DESPATCH TIME
- ESTABLISHED 1965
- ALL GOODS GUARANTEED BRAND NEW AND TO SPECIFICATION
- APPOINTED SIEMENS DISTRIBUTORS

п					
	4072 13 4081 13 4082 13 4093 20 4510 45 4511 45 4516 53 4516 53 4518 40 4520 50 4543 75	LM382N 115 LM3900N 50 LM3914N 200 LM3915N 200 NE555V 23 NE556A 104 RC4151NB 80 S041E 290 S041P 121 S042E 364	TAB1041K 187 TBA120AS 62 TBA120U 75 TBA800 75 TBA10S 75 TBB1458 62 TBB14588 40 TCA105 120 TCA105B 108 TCA105B 108 TCA105D 185	0.032768 102	4 433 4 915 5 000 5 026 6 000 6 144 6 5536 8 000 10 000 18 432
	All above prices are NET and shown in pence	\$89 11.23 \$1788 31.00 \$187 13.29 \$5668 214 \$576A 235	TCA205K 200 TCA335A 66 TCA345A 109 TCA345W 177 TCA671 131	ZENER E 400mW/2.7-30V 1-3W/3.3-100V 20W/7.5-75V	DIODE
	ANALOGUE 709C14 49 709C14 36 723C14 36 741C5 57 741C8 16 741C8/S 16 741C8/S 56 741C8 35 741C8 35 741C8 45 745C14 40 7106 450 7107 500N 7555 80N 7555 10N 7555 10N 7555 45 CA3048 70N CA3130E 80N CA3130E 80N	S576B 235 S576C 235 S576D 255 S576D 255 S576D 255 S488209 458 S488209 429 S483210 311 S483210 311 S483210 311 S483210 311 S483210 311 S483210 312 S483210 312 S4	TCA780 211 TCA871 114 TCA955 228 TCA965 136 TCA965 136 TCA965 136 TCA965K 170 TCA971 92 TCA991 80 TCA991 100 TDA2002 126 TDA2003 126 TDA2030 126 TDA2030 126 TDA2030 126 TDA2030 126 TDA2030 127 TDA400 184 TDA4700A 548 TDA4713A 435 TFA1001W 252 TL071CP 45 TL071CR 120 TL081CP 46 HBA170 165	DIN AUDIO Pins plug 2 8p 3 140 4 17p 5 (180   17p 5 (180   17p 6 18p JACK PLUGS SKTS MONO 1 chrome P1 53p 34p plastic P2 32p 14p STEREO	20p Plugs Socke

TCA910 TCA980 TCA980 TCA955 TCA955 TCA955 TCA955 TCA951 TCA991 TCA991 TDA2000 TDA2000

ZE	_	DIODE	S
194	128	18 432	188
000	102	10 000	157
1579	128	8 867	128
2768	188	9.000	1.88
4576	268	6 5535	128

	. 0.0000	
00mW/2.7-3	OV 7p	
-3W/3 3 100	V 15p	
OW 75-75V	£1.98	
CC	NNECTORS	
IN AUDIO	IDC Connectors	
ins plug	skt DIL	
8p	8p 14 way	
140	8p 16 way	

		00.					
DIN AUC				IDC Con	necio	115	- 1
Pins	ph	ag	skt	DIL			102-
2	8	P	8р	14 way			103p
3	14	P	8 p	16 way			117p
4	17	P	14p	24 way			170a
5 4180 1	17	P	11p	40 way			265p
5 1240 1	20	)p	8p	PARALL	EL TY	/PE	
6	18	D	20p			olug	skt
1	15	io o	30p	16 way		10	1 30
				20 way	- 1	25	1.45
JACK PL		SKTS		26 WAY	1	50	1.70
MONO 1				34 way	1	.65	1 95
chrome				40 WHY	1	85	2 10
plastic F	2 :	32p 14 <sub>l</sub>	20p	Plugs	have	refai	ners
STEREO				Sockets	havi	strate	n re
1				Tol			
chrome	P3 1	11p	52p	IC SOCK	CYC		
plants. I	P4	60p 15p	20p	P ns	Em		15 101
MONO				B	E 111		120N
1 5mm		18p	14 p				160N
Stereo		23p	42p	14			180N
				16			
0 SER				18	11		220N
		ing skt		20	12		240N
9		р 104 р		22	14		280N
15		p 140p	96p		15		300N
25		p 205p		28	18		360N
37	199	թ 298 թ	122p	40	25	3	500N
REGULA	TOR	S		7918	40	79+8	50
7805	40	7905	50	7824	40	7924	50
7806	40	7906	50	781.05	32	791.05	
7808	40	7908	50	781.12	32	79112	50
7812	40	7912	50	781.15	32	79115	50
7815	40	7915	50	781.74	32	79t 24	50

#### CAPACITORS

	ELECT	TR(	DLYTICS	3
13p 17p	1/63 2.2/25 2.2/63 4.7/63 4.7/100 6.8/40 10/6 10/25 10/40 10/63 10/100	9 13 9 9 14 9 13 10 11 12 15	1000/10 1000/16 1000/25 1000/40 1000/63 2200/6 2200/16 2200/25 2200/40 4700/16 4700/25	19 26 36 44 76 9 44 60 73 72
5p	22/10 22/25	11	TANTALUI	VI
100 NON NON NON NON NON NON NON NON NON N	22/40 22/100 47/3 47/10 47/10 47/10 47/10 47/10 47/10 100/10 100/10 100/10 100/10 100/10 20/10 220/10 220/10 220/10 470/10 470/10 470/10 470/10 470/10 470/10 470/10 470/10	14 15 11 15 15 11 15 15 16 17 17 17 17 17 17 17 17 17 17 17 17 17	BEADS 0 1/35 0 22/35 0 22/35 0 22/35 0 22/35 0 22/35 0 22/35 0 22/35 0 22/35 0 22/35 0 22/25 0	13 13 13 13 16 16 18 16 24 16 18 18 30 30 24 30 66
		-		

SOLDERING IRONS

**SWITCHES** 

Also large stocks of bits, desoldering devices, accessories, etc.
ANTEX C 240V £4.60N; X.25-240V
£4.70N; CSBP £5.45N; XSBP £5.56N;
ST4 Stand £1.70N
DRYX 50 watt temp controlled
£15.50N
SOUDER 500gm/18SWG £7.60N; Desolder braid 1.5m 54p

Type CK -19-12 way, 2P-6 way, 3P-4 way, 4P-3 way 48p: Mm Toggles = \$7101 SPDT 57p; \$7201 DPDT 60p; \$7201 APDT 61p; \$7201 APDT

DUAL IN LINE ENG colour coded 0.3" = 0.1" format. On IOH single throw 2P SDS2 54p; 4P SDS4 95; 6P SDS6 £1.38; 8P SDS8 £1.87; 10P SDS0 £2.10. Low cost D I L 4P DNS04 66p; DNS08 £1.00 LATEST PRICE LIST

includes many new additions to items in our catalogue. Large S.A.E. brings price list FREE. CATALOGUE incl 70p refundable voucher, 70p post free U.K. with price list.

#### **BOXES**

DIGITAL

\*4LS02\*
\*4LS08\*
\*4LS08\*
\*4LS108\*
\*4LS108\*
\*4LS11\*
\*4LS14\*
\*4LS28\*
\*4LS31\*
\*4LS32\*
\*4LS37\*
\*74LS38\*
\*74LS37\*
\*74

High quality Black ABS plastic or die-

7400 7400 7401

High quality black Abs prastic of decast plain or stove grey

L W 0 ABS Plain Stove Grey

50 50 25 5001P 500 5001 123p

100 60 25 5001P 500 5001 123p

113 63 17 200 180p 5001P 145p 5002 154p

114 66 40 2004 115p 5004P 152p 5004 210p

152 82 50 2005 134p 5005P 218p 5005 288p

192 113 61 2006 235p 5006P 314p 5006 401p



VERD RANGE pastic boxes L W D 72 47 25 21024 54p 120 50 35 21390 87p 180 110 55 21391 160p Cases 134 90 44 21089 £7.68 224 140 64 21090 £11.62 302 170 84 21091 £15.78

#### **VEROBOX CASES**

finish to a much valued project. ABS, light grey top, dark grey bottom + 2 anodised par

-	,,	9.01		9 0 7 00 11 1	-
	Ł	D	н	TYPE	PRICE
	205	140	40	21034	£4.52
	205	140	75	21035	£5.02
	205	140	110	21036	£6:54
	180	120	39	21037	£4.11
	180	120	65	2103B	£4.40
	180	120	90	21039	€4.69
	155	85	39	21040	€3.31
	155	85	60	21041	€3.31
	155	85	80	21042	£4.30
	125	65	30	21047	£2.48
	125	65	39	21048	£3.15
	125	65	50	21049	£3.56



125	65	50	210	<sup>49</sup> £3.56			1	BC41
CENT	COL	DUCT	'nΓ	00			30N 15N	BC47 BC54
<b>DEMI</b>	UUI	<b>NDUCT</b>				B1906	38	BC54
1N914	0.3 (	2N3819	22	AA118	14	BA379	25	BC54
1N914B	10	2N3820	40	AA119	13	BAS40-03	36	BC54
1N916	52N	3823	60	AC126	25	BAS70 03	41	BC55
1N4007	06	2N3904	15	AC127	25	BAT14 036	41	BC55
1N4148	03	2N3906	15	AC128	25		1.75	BC55
1N5402	14	2N4036	46	AC151R	56	BB409	33	BC55
1N5407	10	2N4058-62	09	AC153K	20	BC107A.B	16	8 C55
2N697	23	ZN4124	25	AC176	25	BC108A.B.C		BC56
2N706	18	2N4126	25	ACY17	156	BC109B.C	18	BC87
2N930	20	2N4284	30	ACY18	120		30N	BC88
2N1132	23	2N4286	18	ACY19	99		100	BCY3
2N1302	110	ZN4289	23	ACY20	90	BC125	20	BCYS
2N1303	58	2N4291	24	ACY21	85	BC125	20	BCY7
2N1304	62	2N4292	21	ACY39	170	BC140	25.	BCY
2N1305	62	2N4991	62	ACY41	10	BC141	30	BCYZ
2N1306	90	2N5062	322	AD136	530	BC147A	10	BD13
2N1307	67	2N5192	110	AD142	90	BC149	10	BO13
2N1308	147	2N5195	106	AD149	88	BC154	75	BD13
2N1309	99	2N5457	32	AD161	36	BC160	25	8013
2N1599	100	2N5458	32	AD162	35	8C161	30	8013
2N1613	25	2N5459	- 36	AF114	37	BC167A	09	BD13
2N1711	25	2N6050	380	AF115	37	BC167B	09	BD14
2N1893	32	2N6057	376	AF116	57	BC168A	09	BD64
2N2218A	31	6F40	152	AF117	110	8C168B	09	BD67
2N2219A	25	16F40	165	AF124 AF		BC169B	09	8D68
2N2222A	25	40HF40	225	AF126	37	BC169C	09	BF11
2N2369A	21	40361DIS		AF127	37	BC177B	16	BF16
2N2484	25	40362	65	AF200	10	BC178B	16	BF17
ZN2646	45	40406	71	AF239	114	8C179B	18	BF17
2N2904	28	40408	95	AF279	30	BC182	09	BF17
2N2904A	25	40412	106	AFY12	204N	BC182L .	09	BF24
2N2905A	25	40430	100	AFY16	327N	8C183	09	BF25
2N3053	23	40594 40595	123	AFY180	310N	BC183L	09	BF25
ZN3054	56		123	AFY18E6		BC184	09	BF42
2N3055	48	40636 40673	147	AFY42	461N	BC184L	09	BF42
2N3405	64	A9903	146	AU106	240	BC202Y	120	BF45
2N3663	15	A9903	13	AU111 AU1161	luse	BC212	09	BF45
3702-11		AA116	9		10 05	BC212L	09	BF45
2N3771	180	AA117	13	AUY22 BD140	10.95 25N	BC213	08	BF59
2N3794	21	A-11/	13	80140	2014	BC213L	09	BFR3

ANALOGUE
709C5 49
709C14 44
723C14 36
741C5 57
741C8 57
741C8 56
741C614 46
741C614 46
741C614 46
741C614 46
741C614 40
7

METERS Large range of types in stock, also probes Paris accessories, etc.

PANEL MOUNTING in 50, 100, 500 µA, 1, 5, 10, 50, 100, 500 mA, 1A either model.

SAS580 198 SAS590 15.55 TAA761 104 TAA765A 62 TAA865 103 TAA865A 62 TAA861 103 TAA865A 72 TAA2761A 72 TAA4761A 113 TAA4765A 120







#### MULTIMETERS

NH56A NEW 20Kft/V AC/DC/ RES/dB in 23 ranges. 130 × 88 37mm £11.20N



YN360TR
20KD V
AC/DC/R
dB (Transis
tor Test
in 21
ranges.
i45 - 96 -
45mm
£18,45N

			6.10.	- 0	
00004	00	BFR39-41	23	E1210	76
BC214	09		23	E2506	154
8C214L	09	BFR79-81			
BC238C	09	BFT65	119	EB383	20
BC239C	09	BFT66	192	MJ2955	90
BC2589	09	BFX29	24	MJE340	56
BC2678	16	BFX84	24	MJE2955	95
BC300	32	BFX85	24	MJE3055	70
BC301	24	BFX87	28	MPF102	40
BC303	30	BEX88	26	MPS6531	40
BC327	16	BFY50	24	MPS6534	42
				MPSA12	36
BC328	11	BFY51	24		
BC337	14	BFY52	24	MPSA63	38
BC338	11	BFY90	143	NAS206S5	81
BC413	09	BR34	70	OA47	12
BC414	09	BR64	110	OA90	10
BC477	24	BRY39	45	OA91	10
BC546	10	BSX20	22	OA95	DIS
BC547	09	BSX26	22	OA202	14
BC548	09	BSX63	769N	OC28	75
	09	BT106	147	OC29	75
BC549			136	OC35	75
BC550	10	BT108			90
BC556	10	BU105	170	OC36	
BC557	09	BU124	85	OC84	25
BC558	09	8U208	180	PM7A2	373
8 C559	09	BUX26	350N	PN70	10
BC560	10	BUX28	546	PN72	05
BC879	38	BUX81	744	Q4006LT	104
BC880	43	BUX85	249	Q4010LT	115
BCY31A	157	BUZ10A	478	Q4025H	450
BCY58	18	BUZ15	12.27	T2700D	189
BCY70	18	BUZZO	523	T2800D	104
			787	TAG3-400	100
BCY71	18	BUZZ3			
BCY72	18	BUZ24	12.50	TAG209-40	
BD130	46N	BUZ32	6.25	TAG209 60	
BD131	48	BUZ33	844		130
BD132	48	BUZ41A	637	TIC106D	48
BD135	27	BUZ44A	9.67	TIC106M	56
BD136	27	BUZ45	12.76	T1C1260	64
BD139	30	BUZ48	18.94	TIC206D	54
BD140	32	BUZ50A	763	TIC226D	61
BD644	42N	BUZ54A	21.43	TIC236D	96
80679	62	BUZ80	739	TIC246D	105
				TIP31A	36
BD680	64	BUZ83	11.29		
BF115	36	BUZB3A	11.95	TIP32A	36
BF167	25	BUZ84A	12.75	TIP41A	45
BF173	25	BY164	48	TIP41C	60
BF177	26	C106D1	46	TIP42A	45
BF178	25	C0326	460N4	TIP42C	60
BF244B	40	C0340	490N4	TIP150	75
BF254	14	C407	17	TIP2955	56
		C0546	126N1	TIP3055	56
BF255	14	C762	40	TIS43	50
BF420	31	C1406	77	U763	50
BF421	34			VN10KM	56
BF457	36	D4 clip			9.1
BF458	35	C1406	and	VN46AF	
BF459	35	E2506	10	VN66AF	105
BF597	12N	D1046	86	VN88AF	123
BFR34A	84	E1110	76	W02	25
- A 110 mm	91	_	_		_

RF CHOKES 1, 1.5, 2.2 etc to 33µH ea. 30p 47, 68, 100 etc to 680µH ea. 33p 1000. 1500 e1c to 4700<sub>M</sub>H ea. 35p

DISPLAYS

DAMEL LAMPS

KNOBS

PAREL LAMES	7-segment
LED chrome,	Common
red 54	anode
LED yellow or	MAN72A red 75
green 70	MAN82A vellow
(high efficiency)	110
Filement in red.	MANS2A green
amber, green or	110
clear,	Common
6 V 60 mA 48	cathode
14V 40 mA 54	MAN74 A red 85
	MAN84A vellow
	110
LED's	MAN54A green
5mm red 10	110
	5V filement
	3015F 8 mA 256
green 16	
Mountings, B65	3015F 15 mA
20,	250

DIACK PLASTIC	K3 pointer 15
K1 skirted	K7 19mm
with spot 16	knurled 23
K2 as K1,	K8 as K7 +
35mm 21	skirt 23
RECHARGEABLE	CHARGERS
RECHARGEABLE CELLS	CHARGERS NC756 £5.59N
CELLS	NC756 £5.59N

Carbon Rotary (P20) 100ohms 4M7 lin 220ohms 2M2 log 32p each w switch 87p. Dual gang (JP20) 4K7 1M2 lin or log 95p w switch £1.50

SLIDERS
58mm, low cost 10K 1M log only 29p. Std
58mm rhono 4K7 1M lini or log 74p
stereo matched £1 25. Graduated bezels 34p PRESET

PRESET
Min. 10mm did. Hris. or Vert. 1000hms.
1M 130
Preset Cermet recteinear type 89P 1000hm.
Int 1.06 each
Preset Cermet 10mm did. Horiz. or Vert.
1000hm. 29p
Pressetvi. MPW. T. moulded carbon. 47 ohms.
2M2 59p each

1 4 1 3 1 2, 3 4 wott all 2p each, 10 of one value 15p 2% Multiard metal film 5 1 ohms 300K 5p each, 10 of one value 40p 5% were wound 3W or 7W most E12 values 1 2ohms to BK2 9p each 10 for 70pN PP3 charger 410p **POTENTIOMETERS** 

RESISTORS



VAT additionel at 15% on all UK orders FREE POSTAGE and packing on UK CW D orders value £5 75 inc VAT1 and upwards Under £5 75 add 40p linc VAT1 DISCOUNTS on orders over £23 00 5% £657 50 10%

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

PLEASE MENTION THIS JOUR-NAL WHEN ORDERING OR WRITING IN TO US

#### ELECTROVALUE LTD Head Office, Mail Order Dept and Shop

28D St. Judes Road, Englefield (Geen, Egham, Surrey TW20 OH8 Telephone Egham (STD 0784; London 87) 33603; Telex 264475 Also in Manchester for personal shoppers at 680 Burnage Lane, Burnage, Manchester M19 1NA Telephone 061-432 4946

EV Computing Shop 700 Burnage Lane, Menchester Telephone 061-431 4866

## EXPANDED ADD-ON KEYBOARD for the ZX81



BY J.M. STEJSKAL

THIS project describes the circuitry and its construction for extending the ZX81 add-on keyboard to provide a number of single stroke entry functions. These functions would normally be entered using SHIFT with another key. For example, to enter TO, SHIFT is held down while 4 is pressed.

The add-on keyboard seen here is that available from Redditch Electronics. We expect that the additions described here will be suitable for use with keyboards from other suppliers. We have not tried these, however.

Since the ZX81 user is no longer obliged to hold down the SHIFT key for much of the time, the typing becomes more comfortable and speedier with these additions.

#### ZX81 KEYBOARD

The relevant section of the ZX81 keyboard circuit is shown in Fig. 1. The 40 key-switch positions are arranged on a  $5 \times 8$  grid. There is no contact between column and row until the key at their intersection is pressed. When doing this

the information on the column line is transferred to the appropriate row line(s).

The ZX81 keyboard routine uses the upper half of the CPU address bus to repeatedly shift a logic 0 along address lines A8 to A15. This strobing happens very rapidly. The information appearing on the KBD bus (0 to 4) when a key is pressed tells the system which key has been pressed. If no key has been pressed, all logic 1's are on the bus resulting from the  $10k\Omega$  pull-up resistors to +5V.

the  $10k\Omega$  pull-up resistors to +5V. If, say, the "1" key is pressed, then when A11 next goes low, KBD0 will also go low with the remainder of this bus staying high. This information is read into ICA by a scanning routine and the

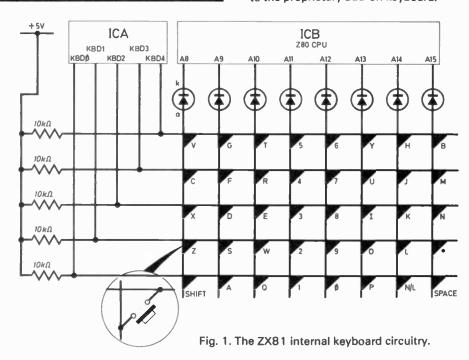
pressed key determined.

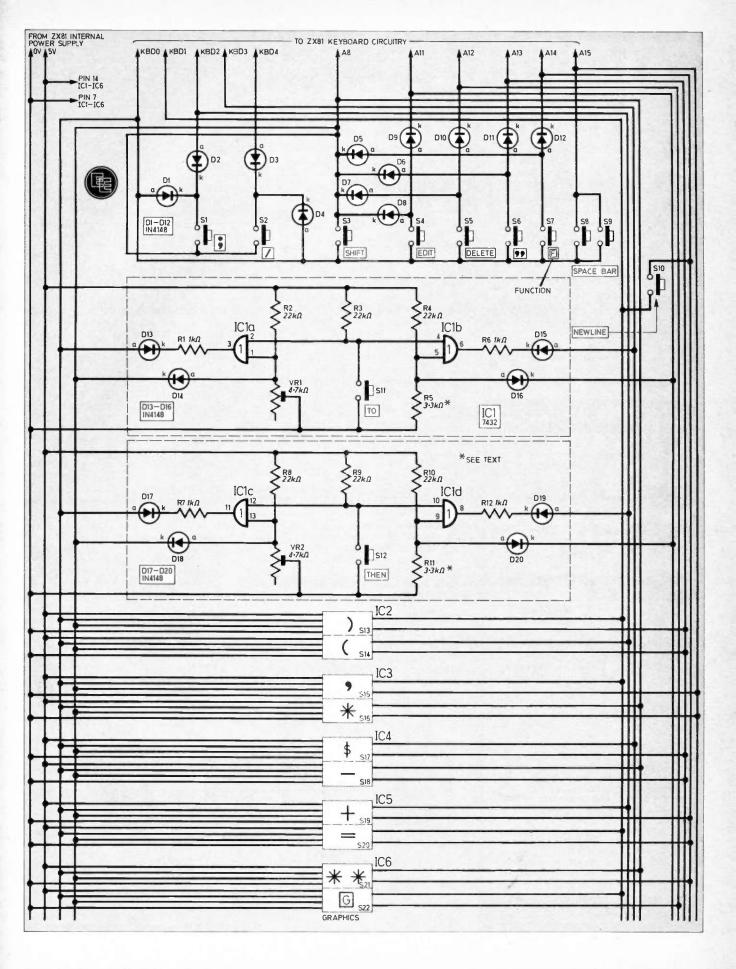
How the low gets on the KBD line happens in the following way. When the address line goes low, and the key makes contact, a series circuit across the +5V and logic 0 is made with one of the  $10k\Omega$  resistors and the diode. It is the junction of these two components which is read on the KBD line. Since the forward drop across a diode such as those in the ZX81 is about 0.7V, it is below the logic 1 threshold and is thus read as a 0 as required.

#### CIRCUIT DESCRIPTION

The complete circuit diagram for the Expanded Add-On Keyboard for ZX81 is shown in Fig. 2. There are three different circuit configurations according to the position of the switch on the keyboard matrix, see Fig. 1. The add-on keyboard is in parallel with this using KBD0 to KBD4 and A8 to A15.

Fig. 2 (opposite). The complete circuit diagram for the extra keys to be fitted to the proprietary add-on keyboard.





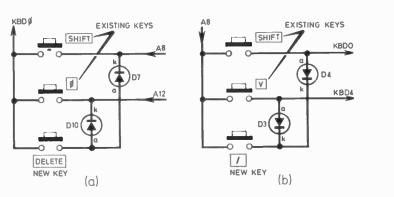


Fig. 3. Two of the three different switch-circuits used in the design, re-drawn for clarity.

The operation of two of these three different circuit arrangements is best explained by means of the re-drawn sections in Fig. 3.

The circuit in Fig. 3a is for use with any, or all, characters on line KBD0 which connects them to the SHIFT key, but where their address lines are different.

#### **COMPONENTS**

#### Resistors

R1,R6,R7, R12

R2,R3,R4, R8,R9,R10}  $1k\Omega$  (6 off each)  $22k\Omega$  (6 off each)

R5 R11  $3.3k\Omega$  (6 off each) All  $\frac{1}{4}$ W or  $\frac{1}{8}$ W carbon  $\pm 5\%$ 

#### **Potentiometers**

VR1,VR2

4.7kΩ subminiature vertical skeleton presets (6 off each)

#### **Semiconductors**

D1-D12

1N4148, 1N914 or similar switching

D13-D20

diodes (12 off) 1N4148 or similar (12 off each)

1C1-IC6 7432 TL Quad 2-input OR gates (6 off)

#### Miscellaneous

S1-S22

p.c.b. mounting momentary action push-to-make keyboard switch (22 off)

Verostrip: 64 strips, 36 strips (2 off); fibre glass board (un-coppered, for board D) size 207 x 30mm; top caps for above switches: single (18 off), double (2 off), treble (1 off, or separate space bar, see text); 14-pin d.i.l. i.c. sockets (6 off); lightweight stranded p.v.c. covered wire—selection of colours; metal for brackets and fixing hardware as required,

Approx. cost Guidance only £17.50

The characters that can be used with this circuit are: A,Q,1,0,P,NEWLINE, SPACE. The following are used here: 1(EDIT),  $\theta$ (RUBOUT), P("), NEWLINE(FUNCTION). As an example, Fig. 3a shows the circuit for the DELETE key. Both switches, SHIFT and 0, work independently as before, the two diodes D7 and D10 preventing any interconnections between the two. When the commoning key DELETE (RUBOUT) is pressed, then the logic levels on A8 and A12 are successively passed to KBD0, thus producing the same effect as a "SHIFTed 1", that is, DELETE.

As already mentioned, only the fre-

As already mentioned, only the frequently used characters have been selected here: EDIT, DELETE, ", FUNCTION (F). Although there is no special arrangement for any delay, the SHIFT always comes on first, without fail, making the circuit reliable and cheap.

The other circuit, in Fig. 3b, is suitable for keys: Z(:), X(;), C(?) and V(/). Two of these have been selected here: X(;) and V(/). The example shown is for the division sign "/".

The circuit in Fig. 3(b) is similar to that in (a) but this time it is the address line which is common to two keyboard lines: A8 is commoneed with SHIFT and V to realise /. If when / is pressed, a logic low is placed on A8 it will be transferred to both KBD0 and KBD4 which is the required condition for SHIFTed V.

Three of the extra key-switches are connected in parallel with existing keys, moving them to more convenient positions. Like all other extra keys, they can still be used in their original position. They are: SHIFT on the right-hand side of the keyboard, SPACE on a long spacebar and NEWLINE at the bottom left-hand corner. The space-bar shown here is from an old ASCII keyboard and is fitted with a key-switch at each end.

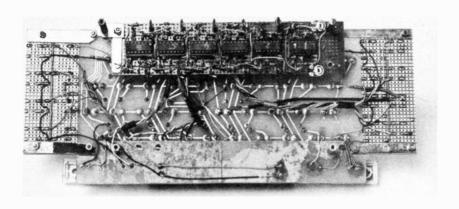
Although the remaining 28 keyswitches do not have a common line with SHIFT key, all or any may be connected for single shifted-key operation by using a pair of logic gates for each function. Twelve keys were selected to appear on the prototype keyboard, any of which may be substituted by those of the constructor's choice. The twelve are: 4(TO), 3(THEN), 0()), I((), .(,), B(\*), U(), J(-), K(+), L(=), H(\*\*) 9 (GRAPHICS) G.

Two separate sections to produce TO and THEN are shown in detail in Fig 2. Each is made up from two OR gates and are seen to be identical.

The components in the other circuits are identical, the only difference being that the b and d gates in each pair of gates might be connected to a different KBD-line and/or A-line. One gate in every pair operates the SHIFT. VR1 and R5 arrange the delay required for SHIFT to operate first.

With S11 not pressed, a logic high (1) reaches one input of each of the two or gates IC1a and IC1b causing each output to be at logic 1. The other input to each gate is held at logic 0 by the potential divide effect of R2/VR1 and R4/R5. When S11 is pressed the outputs of IC1a and IC1b drop to logic 0.

• Now each keyboard line is strapped to +5V by its own resistor (in the ZX81). The ZX81 internal circuitry looks for a logic 0 appearing on one of the lines at the appropriate time when being strobed by A8 to A15 outputs. When the output of IC1 goes low, a low is read in on KBD0. This, together with the low logic reaching A8 from pin 1, simulates SHIFT being pressed. IC1b goes low also at the same time, with a logic 0 being placed on KBD3 and A11. The values of VR1 and R5 are chosen so that SHIFT acts before 3, giving SHIFTed 3. This is TO, the required result. (To be continued)



## CIRCUIT

This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised.

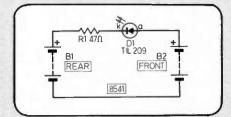
Payment is made for all circuits published in this feature.

Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.

#### REAR-LIGHT FAILURE INDICATOR

THE question of whether or not the rear light is working is a constant worry for cyclists riding at night.

This simple circuit lights an l.e.d. if the rear-light battery is flat. The circuit uses the front-light battery as the power source for the l.e.d., and the l.e.d. is mounted on the steering column of the cycle. If the rear-light battery is flat there is a potential difference across the l.e.d. and it will



glow, informing the cyclist of the urgent need to change the battery.

Andrew Marshall, Old Basford, Nottingham.

#### QUICK POLARITY TESTER

The prototype of the Quick Polarity Tester the connections to the battery were for negative earth vehicles, as shown in the circuit diagram, but for positive earth vehicles the connections to the battery must be reversed.

To test this, connect up the battery terminals to the car cigarette lighter (+ to pin, — to chassis). It was found best to use "Christmas Tree" bulbs as these were small, although other bulbs could be used.

Alexis Landa, Ilfracombe, Devon.

#### SPEED CHESS AND DRAUGHTS TIMER

Stimulated by the Lightning Chess Buzzer featured in an earlier issue of *EE*, I have designed another timer based on the 4017 CMOs chip.

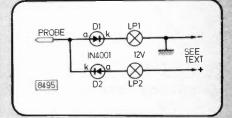
A NAND gate oscillator formed by IC1a and IC1b feeds the clock of the decade counter IC2. This causes the line of l.e.d.s D1 to D10 to light in sequence unless the reset switch S1 is operated.

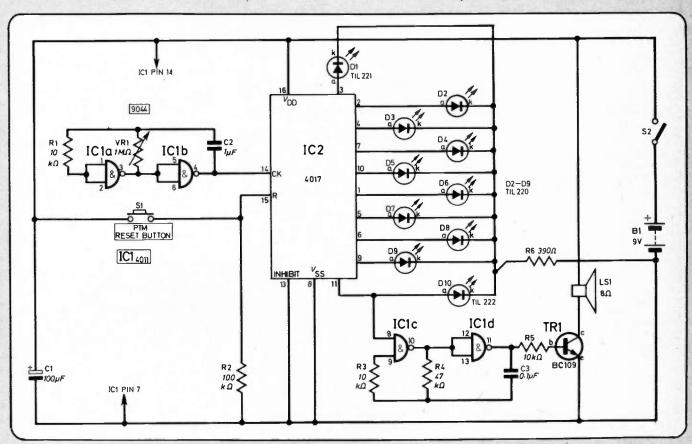
If a player fails to complete his move within the time set by potentiometer VR1

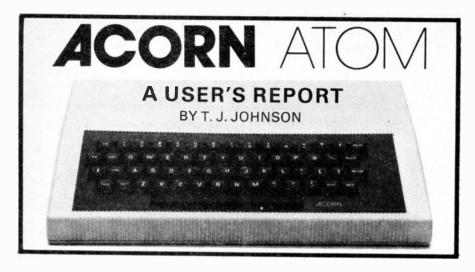
then the yellow l.e.d. D10 will light and an alarm will sound. This alarm is triggered by the oscillator IC1c/IC1d and indicates a time fault.

As shown, the maximum time is adjustable up to 15 seconds, by increasing the value of C2 the time maximum may be increased in proportion.

Andrew Knight, Langley, Southampton.







THERE are two basic versions of the Acorn Atom home computer and both are available as kits or ready made. The first, commonly referred to as the "minimum" system, has 8K of ROM and 2K of RAM. The second, often called the "expanded" system, has 12K of ROM and 12K of RAM. The one point to note is that the expanded system has the optional floating point ROM fitted—a most valuable addition.

I purchased the minimum system in kit form for really only one reason, and that was to save money. I found that there was nothing particularly instructive about constructing the kit, so unless you have very shallow pockets it is better to purchase the assembled and tested version.

#### THE KIT

The Atom kit comes complete with concise and very compact assembly instructions, and was obviously written with the more experienced constructor in mind. Although the kit is remarkably easy to construct, it is definitely not recommended for beginners who lack experience in soldering.

I experienced no great difficulties in assembling the kit, and found that the Atom was complete and ready for use in a little over three hours. The one frustrating moment came when fitting the keyboard.

The construction of the keyboard is such that you have to insert the fine gold-plated contact wires (over 100!) into the large diameter p.c.b. holes. This may sound easy but it can prove frustrating, especially when you think you have the keyboard fitted and are just about to solder the wires to the p.c.b., then you discover that a single contact wire has become trapped under the keyboard, with the result that you have to remove it and start all over again. This is the one major criticism I have with the kit.

A short lead also needs to be made which connects the Atom cassette interface socket with your recorder. The manual shows the required connections for the Atom end. For the recorder end

you should either refer to its manual and/ or solve the connections by trial and error.

When trying out the Atom for the first time, be sure to check each key, and every key, in turn. I found when power was first applied that, whichever key I pressed the figure "8" appeared on the VDU. After much fault-tracing it turned out to be the "8" key at fault with a permanent short across it. The fault was cleared, of course, but it does illustrate the point earlier about the difficulty of fitting the keyboard.

#### **EXPANSION**

The expandability of the Atom is perhaps one of its major assets. The minimum system can be expanded in a variety of ways. For example: by adding extra RAM—here 10K may be fitted on the board with a further 64K as an additional "card"; a colour encorder card and extra ROM in the form of two further i.c.s. All these additions may be mounted inside the case of the Atom.

The usual printer and floppy discs may also be connected to the Atom by way of the various expansion sockets on the rear. These expansion sockets also carry the Address, Data and Control lines of the CPU as well as various control signals which may be used for further expansion, for example, extra RAM and ROM.

[The Atom is also equipped with latched ports. These have been employed in the design of an Eprom Programmer, see page 178].

#### CASSETTE FILING

The cassette operating system of the Atom is exceptionally good, despite its very slow transfer rate of 300 bits per second, when compared with other machines. I use a Ferguson model 3240 recorder of some 10 years vintage and well-worn heads, and apart from the initial troubles when first setting the system up, have experienced no difficulties in saving or loading programs on tape.

The cassette operating system is very tolerant of input/output levels from the

recorder and thus probably makes it one of the better systems available.

#### THE LANGUAGE

The language used on the Acorn Atom is of course Basic—with a few variations on the "standard" Basic.

It would be impracticable in a short report such as this to list all the variations, and in the long run it would be of no practical use, unless you intend to translate one form of Basic program to another. If you have some sort of electronics background or a logical mind you should have no trouble in getting to grips with the language. I will confess that before I bought the Atom I had no previous knowledge of Basic apart from the many programs I had seen in magazines. Providing you have had a similar experience it will not be difficult to progress through the Basic manual supplied with the unit.

Possibly one area of programming which is difficult to understand is Assembler Programming using mnemonics. The Atom manual gives an introduction to assembler programming, but from my point of view is very lacking in detailed explanations of the various instructions.

#### **GRAPHICS**

Most home computers have some form of graphics capabilities, either black and white and/or colour. The Atom has both, providing the colour encoder card is used. In its lowest graphics mode the resolution is  $64 \times 48$  pixels and in the highest mode is  $256 \times 192$  pixels (slightly lower when colour is used).

I found the graphics quite difficult to grasp at first, particularly the fifteen PLOT commands, and also when incorporating these instructions in a games program. The graphics are, however, very good and should not prove difficult after a certain amount of practice.

It is worthwhile to point out that the VDU is memory mapped, that is, each of the 512 points on the screen may be POKED with any desired character, thus providing an additional graphics mode.

#### CONCLUSIONS

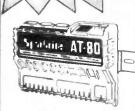
Obviously, since this is the first and only home computer I am likely to buy, I am slightly biased in favour of the Atom.

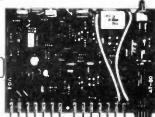
Since owning the Atom for some 12 months, I have had the opportunity to try several other machines, both "home" types and "commercial" types of computer. In nearly every case, I prefer the Atom for its simplicity and ease of use.

I believe the computing power of the Atom is somewhat under-estimated and consider the Atom a most worthwhile investment. It is very simple to use, its language is easy to learn, and it is very easily expandable. For a relatively small outlay I have a very powerful computing machine that I do not consider will be obsolete in ten years' time.

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 KIT FORM**





#### 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 or Large Turminigh 400ft-L triudrescent 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 A real challenge for the electronics enthusiast!







#### SX1000 **Electronic Ignition**

- Inductive Discharge Extended coil energy storage circuit
- Contact breaker driven
- Three position changeover switch
- Over 65 components to assemble
- Patented clip-to-coil fitting Fits all 12v neg. earth vehicles

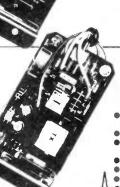


TX1002

 Extended coil energy storage circuit
 Inductive Discharge Three position changeover switch Distributor triggerhead adaptors included 

Die cast weatherproof case ● Clip-to-coil orremote mounting facility ● Fits majority of 4 & 6 cyl. 12V. neg. earth vehicles ● Over 145 components to assemble.







#### **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

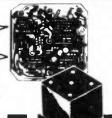
 The ultimate system ● Switchable contactless. • Three position switch with Auxiliary back-up inductive circuit. Reactive Discharge. Combined capacitive and inductive • Extended coil energy storage circuit • Magnetic contactless distributor triggerhead • Distributor triggerhead adaptors included

 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

All SPARKRITE products and designs are fully covered by one or more World Patents

#### SPECIAL OFFER

REE" MAGIDICE KIT WITH 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 P77 battery

  Over 100 components to assemble

SPARKRITE 82 Bath Street, Walsall, West Midlands, WS1 3DE England

Tel: (0922) 614791 Allow 28 days for deliver,

	SELF ASSEMBLY KIT
\$X 1000	£12.95
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 **ADDRESS** 

> I ENCLOSE CHEQUE(S)/POSTAL ORDERS FOR KIT REF

CHEQUE NO

BARCLAYCARD VISA

CUT OUT THE COUPON NOW!

PHONE YOUR ORDER WITH SEND ONLY SAE IF BROCHURE IS REQUIRED

## Everyday News

#### PERSONAL PAYPHONE

Many small businesses would like to provide their customers or staff with a payphone service, but the current wall-mounted model may not suit their particular situation. Now, British Telecom have introduced a push-button payphone only nine inches square and seven inches high and weighing less than 7lb that also doubles as a private phone.

Called the Payphone 100, it can be left permanently coin-operated or, at the turn of a key, switched from a payphone to an ordinary phone and back again. When used as a payphone it accepts 2p, 5p, 10p and 50p coins and will refund unused coins at the end of a call.

The table-top payphone is particularly useful for small businesses who want to provide their customers or visitors with the use of a phone but who do not want to give away free calls. Typical users will be hairdressers, pubs, clubs, wine bars, garages, surgeries and shops. Another possibility could be for the person who has a "friendly neighbour".

Designed for use with the new socket system, it is ideal for those businesses who have only one telephone line. A single payphone allows this line to be used for both private and customer use.

When operating in the payphone mode, local trunk and international calls can be made but calls to or via the operator, except for 999 emergency calls, are not possible. When switched to "private" use all services are available

The annual Leeds Electronics Show will take place from 5 to 7 July in the Departments of Electrical and Electronic Engineering, University of Leeds.

#### Training for the Micro

An advanced microprocessor training course, that can be used for "distance learning", has been developed at the IBA's Harman Engineering Training College, Seaton, Devon. The initial requirement was to provide theoretical and practical training for field engineers maintaining the microprocessor-based transmission equipment used in the new Regional Operations Centres and Channel 4 transmitting installations, including control and telemetry systems.

The programme is broken down into three stages: Microprocessor basics using a modified version of the M6800 D2 kit. Digital diagnostics for broadcast systems, including signature analysis. High-level language programming, using the Apple II microcomputer.

Renters of the Payphone 100 will be billed for calls at the normal rate but people using the phone will have to insert coins at the higher coinbox rate. The renter retains the extra cash.

The user is warned of "credit expiry" by a flashing l.e.d. and a warning tone. A cash-box full sensor helps to prevent jammed coin slots.



#### Inventer's Workshop

In a bid to attract local inventers with new ideas into the field of microelectronics, the Microelectronics Applications Research Institute (MARI), Newcastle upon Tyne, has set up a Microelectronics Innova-

The innovation centre supports the use of the workshop and individuals are closely supervised by MARI staff. It is claimed that this facility is unique in that individuals receive assistance at the early stages of the invention which, at present, no other organisation provides. People can experiment and test their ideas without having to set up their own expensive production facilities, and at the same time attract customers or backers.

#### Japanese Buy British

Logic analysers made by British instrumentation specialists, Than-

dar Electronics, are being exported to Japan.

The initial order, worth £100,000, is claimed to represent a classic "reverse technology coup" for the St Ives, Huntingdon-based company which exports over 50 per cent of its output.



#### SHIP-SHAPE

A contract to provide a combined radar and electro-optic weapons control system, to be in-stalled in one of the Royal New Zealand Navy's Leander Class Frigates, has been awarded to RCA Missile and Surface Radar.

This contract is part of plans to modernise and improve the Royal New Zealand Navy ships capabilities.

In addition to weapons control, the radar can be used for navigation, surveillance, aircrast con-trol, drone control, and in search and rescue missions

#### **CLUB SPOT**

The ACC National Prestel Committee, acting in its role as the national body representing the computer hobbyist, has linked up with Micronet 800 to create Club Spot 800, a new service to involve ordinary computer enthusiasts in Prestel

Club Spot 800 will contain news and ideas about micros and micro clubs, plus programs, sales and wants, and general views.

To introduce the new service a conference is being held on February 26, starting at 2pm, at the Institute of Grocery Distribution, Grange Lane, Letchmore Heath, Watford, Registration is free in advance or £5 for those turning up on the day (subject to space being available).

For more details contact: R. Steele, ACC National Prestel Committee Secretary, St John's College, Oxford OX1 3JP.

 The Pontefract & District Amateur The Ponterract & District Amateur Radio Society is holding its annual "Component Fair" on Sunday, March 13, at the Carleton Grange Community Centre, Carleton, Pontefract. Time: 11am to 4.30pm (10.30am for the disabled).

For more information contact: Mr

P. N. Butterfield, G4AAQ, Pontefract & District ARS, 43 Lynwood Crescent, Pontefract WF8 3QT.

#### . . . from the World of Electronics



#### -ANALYSIS-

#### **BELTS AND BRACES**

When the first experimental communications satellites, *Telstar* and *Relay*, flew into orbit in 1962 many experts forecasted that the days of submarine cable in international traffic were numbered. When, three years later, *Early Bird* was launched into geostationary orbit 23,000 miles out in space earlier fears seemed confirmed. The submarine cable was doomed.

What a pity, we thought, so soon after the big technological breakthrough in 1956, the year when repeater technology had improved to the point when it was possible to use telephony by cable across the Atlantic Ocean, 90 years after the laying of the first successful transatlantic telegraph cable.

And yet here we are in 1983, two decades after *Telstar*, with more submarine cables than ever and new ones being laid on the ocean beds every year. What the experts didn't see was that a mature technology was still capable of "stretch". Or that new, however exciting at first sight, is not necessarily better or even cheaper.

Two main developments saved the submarine cable from extinction. One was the development of solid-state wide-band repeaters which enabled many more simultaneous telephone conversations. Thus, in a single decade, cost per telephone channel fell by a factor of 20. The other was the phenomenal growth of world telecommunications traffic now shared by both cable and satellite.

A political factor, not to be ignored, is that communications satellites are vulnerable to destruction by killer satellites which, for all we know, may already be deployed ready for action. Safety lies in both belts and braces to keep our communications trousers up, with terrestrial h.f. radio as an emergency piece of string in our pocket should belts and braces be shot away.

While cable has not only miraculously survived but actually flourished it is to have a change of character. Next year a UK-Netherlands cable will be completed at a cost of £85 million. It will carry 4200 simultaneous telephone conversations to bring the southern North Sea network to a total capacity of some 14,000 circuits. It will be the most up-to-date in the world.

But it is also expected to be the last of its type to find a land-fall in the UK, using analogue speech over wires. All subsequent submarine cables, say British Telecom, are being planned to use digital speech transmitted through optical fibre. This doesn't mean a threat to satellites. Both systems are needed and can live happily side-by-side, belted and braced in mutual support.

Brian G. Peck

#### **INFORMATION DEGREE**

British Telecom is to help two Universities produce information technology experts who will run the advanced telecommunications systems of tomorrow.

In partnership with the Universities of Aston and York, British Telecom will develop new degree courses for training 60 students to become electronic engineers with skills in telecommunications and computing.

British Telecom will pay the Universities £100,000 a year for new equipment and additional teaching staff. This support will be guaranteed for five years.

Most of the places on the

Most of the places on the courses will go to school-leavers with good "A" level grades, but some may be given to suitably qualified technicians already in Telecom's employment. The new courses will begin in 1984.

#### Lord of the Spectrum

The Hobbit, a full-colour adventure simulation based on J. R. R. Tolkien's fantasy land, is amongst new software for the ZX Spectrum and ZX81 personal computers announced by Sinclair Research.

The player assumes the role of Bilbo and undertakes a series of adventures in which he will meet and interact with all the novel's other leading characters.

Depending on his decisions each game will develop differently.

Compiled by Melbourne House to use the full potential of the 48K Spectrum, features include original artist-designed graphics and a built-in 500 word "inglish" vocabulary to instruct the computer. The package, price £14.95, comes complete with a copy of the novel.

#### JUST THE TICKET

Government approval of British Rail's plans to invest £21 million in new ticket issuing machines will soon bring BR's ticket offices into the micro age. Up to £17 million of the investment is for a new all-purpose ticket issuing system and the remaining £4 million is for PORTIS, a portable version of the main system for use by guards on pay trains.

Subject to satisfactory evaluation of the prototypes, the new machines should come into operation in mid-1984 and be fully established by the middle of 1986.

#### **ORIC GOES INTO PRODUCTION**

A new computer named Oric I has just gone into mass production. Over 250,000 of these machines are expected to be sold in its first year. Its market will be that at present enjoyed by the ZX Spectrum and will be the first competitor to a Sinclair computer.

Based on our impressions of a pre-production model we received, the company responsible for the Oric, Oric Products International Ltd. have a machine to be proud of in both appearance and performance.

The computer is equipped with a unique type of keyboard with space bar forming one of the 57 positive action keys on a querty arrangement, extensive colour, music and sound effects capabilities.

There is an r.g.b. output as well as u.h.f. The cassette tape in/out runs at 2400 Baud (!!!). There is access to the bus at the rear of the computer and an output suitable for driving a Centronics-type interface. Available with 16K and 48K RAM. A Technical Review of Oric I will appear shortly in EE.



## — EPROM—— PROGRAMMER FOR THE ACORN ATOM



**PART TWO** 

BY D. C. GRINDROD

THE second and final part of this project deals with the construction, software and testing.

#### CIRCUIT BOARDS

Two circuit boards are used in the construction of the Eprom Programmer, one to hold the power supply components and the other for the EPROM socket and d.i.l. connection sockets for connecting to the Atom.

Begin with the power supply board, this is shown in Fig. 3. The layout of the components on the topside is shown together with the breaks to be made on the underside. The prototype used a p.c.b. mounting type transformer. If this is not available, a chassis mounting type may be used, suitably positioned on the case with its leads connected to T1 fixing location as shown.

Make the required breaks in the copper strips and then solder the components in place as shown in Fig. 3. The leads on the i.c.s need to be formed to fit the board.

A small piece of adhesive paper stuck to the board should be used to identify the pins on *PL6*. If the voltages become transposed, then the EPROM would become permanently damaged.

When you are satisfied that all components are correctly wired up the power supply board may be tested. Temporarily connect a mains cable and plug across the primary of T1. Set VR2 to its midway position.

Fix a length of 4-way ribbon cable to SK5. Label the positions of the individual sockets in SK5: 0V, 5V, 25V and B as appropriate. Plug into PL6 on the board and with a voltmeter, check that the +5V supply is present. It may vary a little from +5V but should never exceed 5.25V else the EPROM will become damaged.

The 25V supply at this time should read between 15 and 30 volts. Adjust VR2 until the reading is 25 volts, exactly. Next adjust VR1 until the voltage at B is about 22 volts with respect to the 0V rail. It may be trimmed in later.

Since the 7805 regulator incurrs a 20V drop it will get hot. If the Eprom Programmer is expected to be in use for prolonged periods at a time the use of a heatsink is recommended or use a reduced secondary tapping such as 9V.

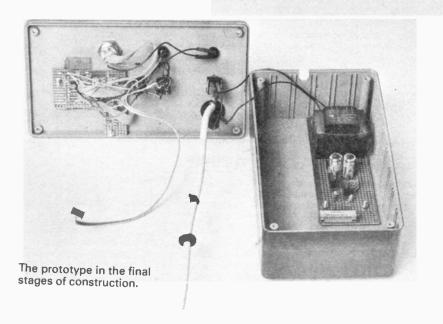
The topboard connects ports A, B and C to the EPROM socket and control switches.

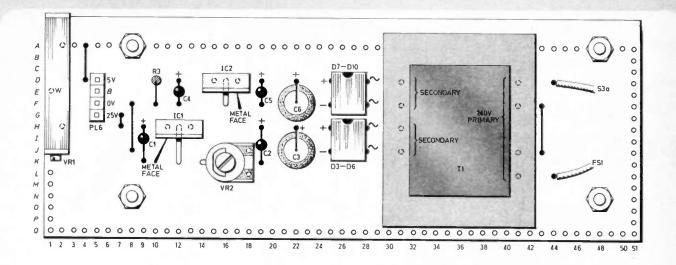
Dual-in-line sockets were used for ports A and B due to their cheapness and reliability. A standard 5-way 270° DIN socket was used for port C. There is no reason why a different connector system could not be used.

The topboard is shown in Fig. 4. It has been drawn as in the prototype but a square piece of stripboard could be used.

In the prototype the SK5 was a 24-pin Zero Insertion Force (z.i.f.) socket. As its name implies it exerts no force on the pins of the EPROM being programmed or read. It drops into holes in the socket and moving the lever to a horizontal position causes the socket contacts to grip the EPROM pins. Move the lever to a vertical position to release the grip and allow the EPROM to be removed.

The z.i.f. socket was plugged into a low profile 24-pin socket soldered to the board, but it may be soldered to the board direct if desired.





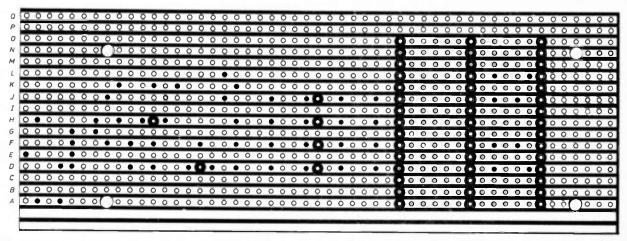
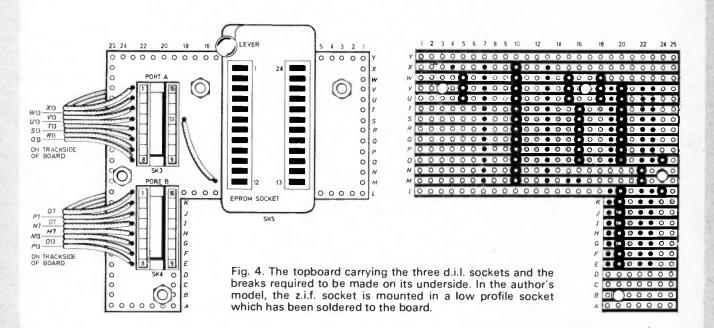


Fig. 3. The layout of the components for the power supply section of the Eprom Programmer and the breaks to be made on the copper side of the board, with drilling details.



(0)(0) Di 881 R2 €X13 DAA SI 52 0 240V A.C. MAINS 2K REAL 6 LAA (0)TOP CIRCUIT (0) **(**0) BOARD SK6

Fig. 5. Complete interwiring details and suggested component layout on the lid of the case.

**PROGRAM A** 

1 REM BASIC CONTROL PROGRAM-D.C. GRINDROD 1982 2bIN. "2K OR 4K EPROM"Z;@=1

3 IF Z=2 U=224;X=192;Y=2048;G.d

4 IF Z=4 U=192;X=224;Y=4096;G.d

5 G.b

6d?£B80C=X;?£B802=255;?£B803=255

7 P.\$12, "SET SWITCHES TO PROGRAM AND "Z"K" '

10aIN. "RAM START ADDRESS"C,"RAM END ADDRESS"D

15 IF D-C+1>Y P. "PROGRAM EXCEEDS "Z"K.START AGAIN"; G.a

16 P. "PROGRAM LENGTH IS "D-C+1"BYTES"

20cIN. "EPROM START ADDRESS"E

25 IF E+D-C+1>Y P. "PROGRAM WILL NOT FIT IN EPROM" ';G.c

26 P. "EPROM END ADDRESS" E+D-C

30 F=E&£FF;G=E&£FFFF/256

35 ?£B002=G

39 P. "PROGRAMMING STARTED"

40 F.A=C TO D

50 ?£B801=f;?£B800=?A

53 ?£B80C=U;F.B=0 TO 109;N.;?£B80C=X

55 F=F+1

60 IF F=256 G=G+1;F=0;?£B002=G

70 N.

P.\$11,"PROGRAMMING COMPLETE".

\$7,\$7',"SET MODE SWITCH TO READ"

90 E.

#### PROGRAM B

1 DIM LL4

2 F.D=0 to 4;LLD=-1;N

5 F.X=1 TO 2

10 P=£2890

201/FULLY RELOCATABLE M/C D.C. GRINDROD 1982

30:LL4 LDX @192; LDY @0; LDA @255

40 STX £B80C;STY £B802;STA £B803

50 LDX £33D;LDY £33E;STX £8002

60 STY £81;STX £83

70 LDX £322;LDY £323

80 LDA @0;STA £80

90:LLO STX £B801

100 LDA £B800;STA (£80),Y

110 LDA £33F;CMP £83;BNE LL1;CPX £324;BEQ LL2

120:LL1 INX;INY;CPX @0;BNE LL3; INC £B002;INC £83

130:LL3 CPY @0;BNE LL0;INC £81

140 CLC:BCC LLO

150:LL2 RTS

160);N.

170 E.

Grey ribbon cable (Speedbloc cable) was used in preference to the "rainbow type as it is lighter and more pliable.

#### TOP PANEL

First of all prepare the lid of the chosen case to accept the case mounted components. Make the cut-out to accommodate the z.i.f. socket. Fix all the components in place. Fit the board fixing screws to the case lid and hold in position with full nuts. These also act as spacers. Position and solder the sockets to the board, make the link wire connection on the board topside and then attach 120mm lengths of 8-way ribbon cable to the non-copper side as shown.

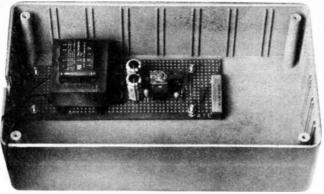
Now fit this board in place and secure. The remainder of the wiring to this board is soldered directly to the copper trackside of the board. The complete wiring of the panel mounted components is shown in Fig. 5. The wiring should all be carried out with p.v.c. covered lightweight wire. Note that R1 is directly wired between SK2 and S2, and R2 directly to the leg of D2. Sleeve all mains input connections for reasons of safety.

Do not attach the ribbon cable from the topside of the board to the underside until last. Carefully check all wiring and make sure there are no bridges across adjacent copper tracks. Attach SK6, check and label its connections.

#### LEAD SET

A set of leads need to be made up to connect the Eprom Programmer to the Atom. One will be terminated at one end with a 64-way (a+b) DIN indirect connector, with the other end fitted with two separate 14-pin d.i.l. header plugs.

The second lead will have a 7-way DIN plug at one end (Atom cassette port) and a 5-way DIN plug at the other to



code program written in Atom Assembler form to read the EPROM. Any number prefixed by "£" is in hexadecimal.

match with the socket on the Programmer. Full pinning details are provided in Fig. 2 to allow these leads to be constructed.

#### SETTING UP

The power supply board will not at this stage be mounted in the case. After all interconnections have been made check that there are no solder bridges between adjacent tracks on the upper circuit board.

Next check for continuity between the EPROM socket SK5 and the input sockets, SK2, SK3 and SK4. Check the routes for both positions of S1. Check also for continuity of the supply lines from SK6 to the SK5 positions pin 12, 21 and 24, for all combinations of S1 and S2. Remember that All floats for 2K EPROMS and that CB2 is on pin 18 for 2K types and pin 20 for 4K types.

Plug SK6 into PL6, plug the unit into the mains and switch on. The power on l.e.d. D2 should light up. The bi-coloured l.e.d. should be lit either red or green according to the setting of S2. Operate S2 and adjust VRI until both green and red are of equal brightness. Check that the +5V rail is still within limits as VR1 does lift its level by 0.1V or so. If all is well, switch off at the mains and secure in the

case.

Switch on again and check the power supply pins on SK5. You should read 5V (5.25V max.) between pins 24 and 12, and 25V between pins 21 and 12 for S2 in PROG mode and 5V when in the READ mode.

A final check should be made using an ohmmeter between adjacent pins on SK5. Shorted tracks on the data or address busses could cause the 6522 (VIA) or 8255 to source too much current and possibly become damaged.

It is good practice to leave the MODE switch in the READ position until the program wants it changed. This prevents any accidental programming by erroneous port values before they are initialised.

#### SOFTWARE

The software for the Eprom Programmer is in two parts: Program A, the control program in Basic for programming the EPROM; and Program B, a machine

Characters in lower-case represent inverse video characters.

#### **TESTING**

Connect the Eprom Programmer to the Atom and switch on the latter. The computer should function normally. Turn

on the Programmer.

First of all load the byte £AA into RAM at say £8200, then enter the Basic control program, Program A. Set mode switch to PROG and run the program without an EPROM in place. When asked for EPROM start and end address, type in 00F. After "PROGRAMMING COM-PLETE" message is received, measure address bus and data bus voltage levels at SK5. The voltage level from D0 to D7 should alternatively read 0V and 5V or very near these values. A0 to A3 should read 5V and the remaining address lines, OV. If not, find out why not before proceeding.

With the Programmer turned off, insert an EPROM. Set \$2 to READ \$1 to appro-

priate size and then switch on.

Load a small program into RAM at say £8200 then enter Program A. Now run the program and follow the instructions. On completion, remember to set mode switch to READ. Enter Program B and run it to get the program assembled.

As mentioned earlier the variables are passed to the machine code routine via the integer variables A, B and C.

A = EPROM start address

B = RAM start address

C = EPROM end address

If we want to load the EPROM contents into RAM at say £8200 then we type:

A=0;B£8200;C=end address of eprom\*; LINK £2890

followed by return. This address is given by the Basic control program.

The cursor will reappear almost instantly. (The execution times are 45µs (2K) 165µs (4K).) To check this set TOP (?18=£82) and type E.; RUN. If all is well then save the machine code on tape thus:

\*SAVE "EPROM READ" 2890 28DF

(Left). Early stage of assembly. Power supply board in position in base of case. (Above). The completed unit.

A2	CO	A0	00	A9	FF	8E	0C
88	8C	02	88	8D	03	88	ΑE
3D	03	AC	3E	03	8E	02	BO
84	81	86	83	ΑE	22	03	AC
23	03	A9	00	85	80	8E	01
B8	AD	00	88	91	80	AD	3F
03	C5	83	D0	05	EC	24	03
F0	14	E8	C8	EO	00	D0	05
EE	02	BO	E6	83	CO	00	D0
DD	E6	81	18	90	D8	60	

Hex dump of the program.

Table 2: Allocation of ports

	ADDRESS	USE
PORT A	£8800	ADDRESS LINES
		A0 TO A7
PORT 8	£B801	DATA BUS TO/
		FROM EPROM
PORT C	EB002	ADDRESS LINES
		A8 TO A11

#### CONCLUSION

This article has outlined the essentials of programming EPROMS and reading their contents. If more serious applications are required the machine code routine could be modified to be called by the burning program, and compare memory and EPROM for verification by changing the STA instruction in line 100 to a CMP instruction and writing an error routine for mismatch of contents.

Erasure of the EPROM is achieved by exposure to ultraviolet light of wavelength 2537°A with minimum integrated dose of 15W/sec/cm<sup>-2</sup>.

The author found an 8W Sylvania germicidal lamp at 2cm a suitable eraser. Erasure takes about 15 minutes. In the erased state each EPROM location contains 255.

## RADIO WORLD

#### By Pat Hawker, G3VA

#### The Electronics Epoch

The development of radio and electronics over the past 100 years has had a profound effect on everyday life, though I am not sure that I go along with those who say that information technology will prove to be the coming of the second industrial revolution.

Despite the impact of electronics on our whole way of life—for better or for worse—the subject has not been very well served by the historians. There are few books that treat the subject analytically and dispassionately and too many that are concerned with claiming credit for particular persons and countries.

Baird did not "invent" television. Marconi, although he himself invented very little, still has the best claim to have developed radio communication despite the, in some ways, valid claims on behalf of Popov, Loomis, Tesla, Hughes, Jackson and others.

Watson-Watt certainly developed radar in the UK, but there were others working on similar lines in other countries, and it can be argued that the greatest British contribution was the 1940 development at the University of Birmingham by H. A. H. Boot and J. T. Randall of the cavity magnetron as a high-power generator of centimetric waves.

However, even this device owed something to the arrival in England, in May 1940, of the French scientist Maurice Ponte who brought across the Channel his resonating segment magnetrons which the British team recognised as having saved them six months of work.

#### International Help

The need for international co-operation on the writing of scientific and technical history has been brought home to me by receiving a much-appreciated copy of the magnificently-produced book "The Electronic Epoch". This has been written by the talented Elizabeth Antebi, a writer and producer with French broadcasting, supported by an impressive international team of scientific advisers. The UK is represented by Dr William Gosling, formerly Professor at Bath University and now research director of Plessey.

This large, heavily-illustrated book, printed in Japan, with the English-language version published by the Van Nostrand Reinhold Company, must be the first time that a serious attempt has been made to produce an international synthesis of the whole electronic epoch in both words and pictures. Subjects covered include communications, television, consumer elec-

tronics, medical electronics, radar and radio navigation.

Elizabeth Antebi has gone to enormous trouble to collect a vast number of historical photographs and to ensure that the text comes at least as close to historical truth as is possible in an industry where "not invented here" is still too often a reason for condemning new technology.

#### **Electronic Umpiring**

This year has seen the first live television transmission of a Test Match direct from Australia though once again the midnight start emphasised the unsolvable problem of large time differences. But the recent Test series also underlined the problem presented by instant slow-motion replay on television where the audience can see all-tooclearly that umpires sometimes make mistakes.

Clearly the ability of television to undermine confidence in umpiring decisions is something that needs to be considered

seriously. In tennis one has seen the growing tendency to question the judgement of linesmen, although this has not been entirely solved by introducing a degree of electronic instrumentation. Yet for horseracing few would dispute the value of the camera for close finishes—and the value of the special television recordings when objections are raised.

#### **Action Replay**

There would seem little logical reason why in cricket, the umpire in cases of doubt should not ask a clubhouse "referee" to advise him on the basis of an action replay, using perhaps a pocket radio. To prevent too many hold-ups to the game some rules would have to be worked out on how often, or just when, this facility could be used, otherwise we might have more attempts to intimidate umpires by players! But it seems absurd if the television audience can see so clearly that decisions made in good faith by the umpires are wrong.

#### Crystal-Ball Gazing

If at times historians get things wrong so do those who attempt to predict the future of developing technology. I have been amused to discover from various compilations (including R. L. Weber's "A random walk in science", published by The Institute of Physics) some predictions that the experts concerned must have come to wish they had never made:

"There is no plea which will justify the use of high-tension and alternating currents, either in a scientific or a commercial sense . . . I can see no justification for the introduction of a system which has no element of permanency and every element of danger to life and property"—Thomas Edison, 1889, in advocating d.c. mains.

"As far as sinking a ship with a bomb is concerned, you just can't do it"—US Rear-Admiral Clark Woodward (1939) on bombing from aircraft.

"Wireless is totally unsuited for war; the enemy could either hear all conversations, or could jam transmissions so nothing can be heard"—an earlier American rear-admiral in 1903.

"That is the biggest fool thing we have ever done. The bomb will never go off, and I speak as an expert on explosives"—yet another US admiral: William Leahy to President Truman, 1945, on the atomic bomb.

When in 1913, Lee de Forest, who first put a grid into a diode valve, was charged with fraudulently using the US mail to persuade the public to invest in his company, the District Attorney claimed: "De Forest has said...it would be possible to transmit the human voice across the Atlantic before many years. Based on these absurd and deliberately misleading statements, the misguided public has been persuaded to buy stock". It was only two years later, 1915, that the first radio transmission of speech across the Atlantic was accomplished!

On the other hand, it is easy to be a little over-confident. The French engineer Edouard Belin, in January 1926, said: "I am certain that before the end of 1926 an orator speaking into the microphone will have both his voice and his image transmitted simultaneously all over the globe". He was roughly 40 years out—the first genuine world programme by satellite on television was in 1965.

The Chinese have a proverb that the fish are the last to discover water; and Nicholas Butler once said: "An expert is one who knows more and more about less and less".

For a detailed booklet on remote control — send us 30p and S.A.E.  $(6'' \times 9'')$  today.

#### **HOME LIGHTING KITS**

These kits contain all necessary components and full instructions is are designed to replace a standard wall switch and control up to 300w. of lighting. TDR300K Remote Control £14.30 Dimmer Transmitter for above £ 4.20 TD300K Touchdimmer £ 7.00 Extension kit for 2-way switching for TD300K £ 2.00 TDE/K



#### DVM/ULTRA SENSITIVE THERMOMETER KIT



This new design is based on the ICL7126 (a lower power version of the ICL7106 chip) and a 372 digit liquid crystal display. This kit will form the basis of a digital multi-meter (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 polarity indication and an ultra low power requirement—quiring a 2 year typical battery life from a standard 9V PP3 when used 8 hours a day, 7 days a week

Price £15.50

#### 3-NOTE DOOR CHIME

Based on the SAB0600 IC the kit is supplied with all based on the SABUGUU IC the Kit is supplied with all components, including loudspeaker, printed circuit board, a pre-drilled box (95 × 71 × 35mm) and full instructions. Requires only a PP3 9V battery and push-switch to complete. AN IDEAL PROJECT FOR BEGINNERS. Order as XK102

#### XK113 MW RADIO KIT

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

#### **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 1μF/250V –

5 per value £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

#### **MINI KITS**

AK1 TEMPERATURE CONTROLLER/THERMOSTAT Uses LM3911 IC to sense term ture (80°C max.) and triac to s heeter. 1KW MK2 Solid State Relay

Ideal for switching motors, lights, heaters, etc. from logic. Opto-isolated with zero voltage switching. Supplied without triac £2.50 Supplied without triec MICE BAR/DOT DISPLAY

MICI SAR/DOT DISPLAY
Displays an analogue voltage on a
linear to element LED display as a
ber or single dot, ideal for thermometers, level Indicators, etc. May be
stacked to obtain 20 to 100 element
displays. Requires 5-20V supply.

24.50

displays. Requires 5-20V supply.

MK4 PROPORTIONAL 24.50
TEMPERATURE CONTROLLER
Based on the SL441 zero voltage
switch, this kit may be wired to form
a "burst fire" power controller,
enabling the temperature of an enclosure to be maintained to within
0,5°C. Max. load 3KW 25.55
MKS MAMNS TIMER
Besed on the ZN 1034E Timer IC this
kit will switch a mains load on (or off)

kit will switch a mains load on (or off) for a preset time from 20 mins. to 35 hrs. Longer or shorter periods may be realised by minor component changes. Max. load 1KW. £4.50

#### LCD 31/2 DIGIT MULTIMETER

It 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 impedence 10M, Size 155:086-31 mm, Requires PP3 9v bettery. Test leads included

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

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

Electric lock mechanisms for use with letch locks and above kit £13.50

**DISCO LIGHTING KITS** 

bi-directional

#### 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 It's packed with details of all our NTS plus large range of Scientific Orlocking 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.

Add 55p postage & packing +15% VAT to total Oversess Customers;

d £2.50 (Europe), £6.00 (elsewhere) for pås Send S.A.E. for further STOCK DETAILS, Goods by return muhicat

OPEN Sem to 5pm (Mon to Fri)
10em to 4pm (Set)

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

Answering service evngs & weekends

> PRICES EXCLUDE VAT

#### incorporates a master dimming control £14.60 DLZ100K

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.

Optional opto input DLA1 Allowing audio ("beat") -light response.

value-for-money

sequence, speed of sequence and frequency of direction change, being variable by means of potentiometers and

Only £8.00

features

This 3 channel sound to light kit features zero voltage switching, automatic level control & built in mic. No connections to speaker or amp required. No knobs to adjust - simply connect to mains supply & Ismps. Only £11.95

#### FAST SERVICE · TOP QUALITY · LOW LOW PRICES

No circuit is complete without a call to

11 Boston Road London W7 3SJ





TEL: 01-567 8910 ORDERS 01-579 9794 ENQUIRIES 01-579 2842 TECHNICAL AFTER 3PM



#### Do you know anybody who can build a Digital Pulser for only £18.00?



#### The answer is yes — its YOU!

With GSC's new DPK-1 kit, you can build a sophisticated portable test instrument for stimulus/response testing. It automatically delivers just the right signal for whichever logic family you're using - and it's equally suited to single pulses or pulse trains at a frequency of 100 per second. The fully featured DPK-1 kit includes all components, leads, circuit board and case - and is supplied complete with detailed assembly instructions and an operating manual.

Get rid of your digital hang-ups; send off for a DPK-1 straight away.

Easy to follow Instruction Manual with every Kit



#### GLOBAL SPECIALTIES CORPORATION



G.S.C. (UK) LIMITED UNIT 1, SHIRE HILL INDUSTRIAL ESTATE SAFFRON WALDEN, ESSEX CB11 3AQ Telephone: Saffron Walden (0799) 21682 Telex: 817477

#### GLOBAL SPECIALTIES CORPORATION (UK) LIMITED, DEPT. 4X

Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ

DIGITAL PULSER KIT DPK-1	'£22.42 (inc. P & P & 15% VAT)	Quantity Reqd.	For FREE catalogue tick box
Name	Address		
I enclose PO/Cheque for	2		or debit my
Barclavcard/Access/Ame	rican Express. No	ex	p date

## Sinclair ZX Spectr

16K or 48K RAM...
full-size movingkey keyboard...
colour and sound...
high-resolution
graphics...

## From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

#### Professional powerpersonal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

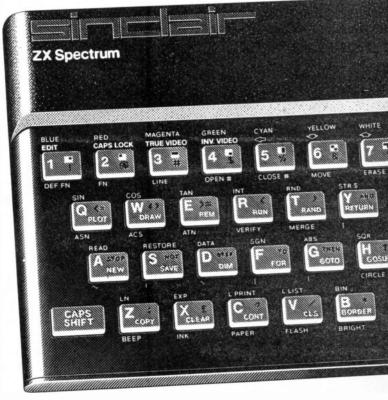
You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.



#### Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232/network interface board.



#### Key features of the Sinclair ZX Spectrum

- Full colour 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound BEEP command with variable pitch and duration.
- Massive RAM 16K or 48K.
- Full-size moving-key keyboard all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution 256 dots horizontally x 192 vertically, each individually addressable for true highresolution graphics.
- ASCII character set with upper- and lower-case characters.
- Teletext-compatible user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

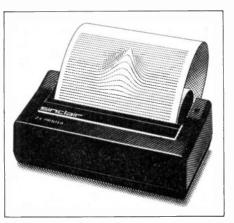


#### The ZX Printeravailable now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set - including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.



#### The ZX Microdrive coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing by providing mass on-line storage.

Each Microdrive can hold up to 100K bytes using a single interchangeable storage medium.

The transfer rate is 16K bytes per second, with an average access time of 3.5 seconds. And you'll be able to connect up to 8 Microdrives to your Spectrum via the ZX Expansion Module.

A remarkable breakthrough at a remarkable price. The Microdrives will be available in the early part of 1983 for around £50.



#### ZX Spectrum software on cassettes-available now

The Spectrum software library is growing every day. Subjects include games, education, and business/ household management, Flight Simulation...Chess...Planetoids. History...Inventions...VU-CALC...VU-3D ...Club Record Controller...there is something for everyone. And they all make full use of the Spectrum's colour, sound, and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

#### ZX Expansion Module

This module incorporates the three functions of Microdrive controller, local area network, and RS232 interface. Connect it to your Spectrum and you can control up to eight Microdrives, communicate with other computers, and drive a wide range of printers.

The potential is enormous, and the module will be available in the early part of 1983 for around £30.



Sinciair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS. Tel: Camberley (0276) 685311.

#### How to order your ZX Spectrum

BY PHONE-Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day, BY FREEPOST-use the no-stamp needed coupon below. You can pay by cheque, postal order, Access,

Barclaycard or Trustcard.

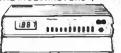
EITHER WAY-please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt-and we have no doubt that you will be.

Qty	Item	Code	Item Price	Total £
	Sinclair ZX Spectrum - 16K RAM version	100	125.00	
	Sinclair ZX Spectrum - 48K RAM version	101	175.00	_
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
			= 1.10	
*I enc	e tick if you require a VAT receipt   lose a cheque/postal order payable to Sinclai se charge to my Access/Barclaycard/Trustca			
*I enci *Pleas *Pleas			rch Ltd for £_	
*I encl *Pleas *Pleas as app	lose a cheque/postal order payable to Sinclai se charge to my Access/Barclaycard/Trustcal se delete/complete               blicable		rch Ltd for £_	
*I encl *Pleas *Pleas as app Signa	lose a cheque/postal order payable to Sinclai se charge to my Access/Barclaycard/Trustcal se delete/complete               blicable		rch Ltd for £_	
*I encl *Pleas *Pleas as app Signa PLEAS	lose a cheque/postal order payable to Sinclai se charge to my Access/Barclaycard/Trustcal se delete/complete               blicable		rch Ltd for £_	
*I encl *Pleas *Pleas as app Signa PLEAS	lose a cheque/postal order payable to Sinclai se charge to my Access/Barclaycard/Trustcal se delete/complete		rch Ltd for £_	
*I encl *Pleas *Pleas as app Signa PLEAS	lose a cheque/postal order payable to Sinclai se charge to my Access/Barclaycard/Trustcal se delete/complete		rch Ltd for £_	



RETAIL . MAIL DROER . EXPORT . INDUSTRIAL . EDUCATIONAL

#### OIGITAL MULTIMETERS (UKC/P Free)



HAND HELD K 025C\*13 range 0.2A 0C 2 meg ohm K 030C\*26 range 1A AC/0C 20 meg ohm K 035C\*28 range 1DA AC/0C 20 meg ohm 6010+22 range 1DA AC/0C 20 meg ohm £24.95 £34.95 £39.95 £34.40 7030+ As 6010 but 0.1% basic. £41.30 188M 16 range 10A OC. 2 meg plus Hie tester £39.95 189M 30 range 10A AC/DC. 20 meg plus Hie

MANO HELD AUTO RANGE OM2350=21 rangs 10A AC/DC 20 meg ohm

| Miniature | E | Miniature | Miniature | E | Miniature | E | Miniature | Mini £49.95 £41.95 £44.50 £58.95

#### FREQUENCY COUNTERS



PFM200A 200 MHZ hand held pocket 8 digit | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 Optional carry case £6.84 rescalers - Extended range of most counters

Prescalers - E TP600 600 MHZ £43.00 TP1000 1 SHZ £74.00

#### **ELECTRONIC INSULATION TESTER** YF 501 500 V/0-100m with carry case £63.00

MULTIMETERS (UK C/P 650) Y7206 20K/V 19 range pocket meter SPECIAL PRICE C7081 50K/V 21 ranges Range doubler 10A DC SPECIAL PRICE

ETC5000/5001 21 ranges, 50K/V. Range doubler, 10A 0C. £16.50 TMK500 23 ranges 30K/V. 12A 0C plus cont buzzer £23.95 NH56R 20K/V. 22 range pocket £10.95

EU102 14 range 2K/V pocket €5.95 830A 26 range 30K/V, IDA AC/DC overtoad £23.95 360 TR 23 range 100K/V. Large scale £36.95

10A AC/OC plus Hie AT1020 18 range 20K/V. Detuxe plus Hie £17.50 £16.95 tester ST303TR 21 range 20K/V plus Hie tester

#### **VARIABLE POWER** SUPPLIES

PP241 0/12/24V, 0/1A. £35.00 PP243 3 amp version £59.95

ILIK C/P £1.001



ther mocouple. AC CLAMPMETER

\$7300 0/300A: 0/600 VAC. 0/1 Kohm 9 ranges With carry case [UK C/P 65p] £28.50

404/406 EDGWARE ROAD, LONDON W2

**LOGIC PROBES** 

ALSO AT HENRYS RADIO.





TRANSISTOR TESTER Direct reading PNP: NPN, etc. IUK C/P 65pl

AUDIO ELECTRONICS Cubegate 301 EDGWARE ROAD, LONDON W2 1BN. TEL: 01-724 3564



BENCH MODELS (3% digit unless stated)

TM353 • 27 range LCO 2A AC/OC TM355 • 29 range LED 10A AC/OC TM351 • 29 range LCO 10A AC/OC £86.25 £86.25 £113.85 TM351-29 range LCD 10A AC/OC £113.85
2001 28 range LCD 10A AC/OC plus 5 range
Cap. Meter with case £10-8.00
185034 4½ dight LCD every facility (0.02%) £171.00
18034 4½ dight LCD every facility (0.05%) £171.00
180348 0.03% basic version of above £189.00
40ptional carry case £6.84

EDUCATIONAL DISCOUNTS AVAILABLE FOR ALL STOCKS - PLEASE ENQUIRE

#### SIGNAL GENERATORS





FUNCTION: All sine/square/triangle/TTL, etc TG1001HZ - 100KHZ TG10202HZ - 2MHZ £1 £90.00 £166.75

PULSE TG105 Various lacilities 5 HZ - 5 MHZ £97.75 AUDIO: Multiband Sine/Square LAG27 10 H7 to 1 MH7

SG402 100 KHZ to 30 MHZ £59.95 £71.00 LSG17 100 KHZ to 150 MHZ

#### AUDIO . RF . FUNCTION . PULSE **OSCILLOSCOPES**





£276.00

Full specification any model on request, SAE by post,

'HM' Series HAMEG: 'SC' THANDAR: 'CS' Series TRIO: '3' Series CRDTECH

SINGLE TRACE 3030 15 MHZ 5mV, 95mm tube plus component tester C/P £3.00 £1 SC110A •, Miniature 10 MHZ battery portable

£171 00

Post free £1

HM 103 15 MHZ 2mV, 6 x 7 display plus
component tester C/P £3.00 £1

e Optional carry case £6.84 AC adaptor £6.69
Nicads £12.50 £177.00 **OUAL TRACE (UK C/P £4.00)** 

HM 203/4 Qual 20 MHZ plus component

CS 1566A Dual 20 MHZ All facilities HM204 Dual 20 MHZ plus component tester £419.75 OPTIONAL PROBE KITS

£7.95 £10.50 X1 X1 - X10 X10 X100 £16.95 STOCKISTS FOR TRIO: HAMEG: CROTECH: SAFGAN 'SCOPES. MOST MODELS IN STOCK.

#### HIGH VOLTAGE METER

Direct reading 0/40 KV. 20K/Volt. [UK C/P 65p] £18.40

**OIGITAL CAPACITANCE** 0.1 pt to 2000 mld LCO 8 ranges 0 MG013 £57.95 (Carry case £2.95)

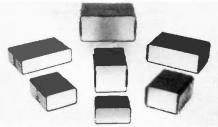




#### PLASTIC CASES



beige cases offer choice of **EXTERNAL** PRICE EACH front panels; grey plastic (P), silver plastic (M) and DIMENSIONS M 0.99 10  $85 \times 60 \times 40$ 1.16 1.22 aluminium (A). PCB slots and 110 × 75 × 50 155 × 95 × 60 1.20 1.72 20 1.49 30 2.51 2.74 10° tilt vertically or desk style. 2-10



BLACK CASES WITH BLACK AND SILVER END PANELS. PCB BDSSES. TOP

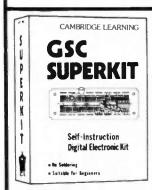
		2CHEAA2	IN ROLLOW.		
TYPE	EXT DIMS	EACH	TYPE	EXT DIMS	EACH
110	115 × 74 × 6	1 2.47	220	220 × 140 × 64	4.81
115	115 x 140 x 6	1 2.85	221	220 × 140 × 84	6.53
116	115 × 140 × 8	4 4.52	222	220 × 140 × 114	7.68
117	115 × 140 × 11	4 5.38			

Mail Order only. All prices include VAT and P&P. Send large SAE for Catalogue of boxes, knobs, power supplies (from 5A to 150A), controllers and more.



DEPT. EE3, 2 THE WILLOWS, HERSTMONCEUX, East Sussex, BN27 4LE. Tel. 0323 832571.

#### A PRACTICAL DIGITAL ECTRONIC KIT FOR ESS THAN £20



#### SUITABLE FOR **BEGINNERS**

#### NO SOLDERING!

Learn the wonders of digital electronics and see how quickly your аге designing circuits. The kit contains: seven LS TTL integrated circuits,

breadboard, LEDs, and all the

switches, resistors, capacitors, and other components to DII. build interesting digital circuits; plus verv clear and thoroughly tested instruction manual (also available separately). All this comes in a pocket size plastic wallet for inc VAT and p&p. £19-90p This course is for true beginners - the only extra you need is a 42V battery.

needs no soldering iron. asks plenty of questions, but never leaves you stuck and

helpless. teaches you about fault-finding, improvisation.

s course teaches boolean logic, gating, R-S and J-K This flipflops, shift registers, ripple counters, and half-adders. Cheque with order to:-

Cambridge Learning Limited, Unit 34 Rivermill Site, FREEPOST, St Ives, Huntingdon, Cambs. PE17 4BR, England.

or tel 0480 67446 with credit card details

#### E.E. PROJECT KITS

**TRANSISTORS CAPACITORS** 

TOOLS RESISTORS HARDWARE

#### CASES MAGENTA KITS

Make us your No. 1 SUPPLIER OF KITS and COMPONENTS for E.E. Projects. We supply carefully selected sets of parts to enable you to construct E.E. projects. Kits include ALL THE ELECTRONICS AND HARDWARE NEEDED, Printed circuit boards (fully etchad, drilled and roller tinned) or Veroboard are, of course, included as specified in the original article, we even include nuts, screws and i.C. sockets. PRICES INCLUDE CASES unless otherwise stated. BATTERIES ARE NOT INCLUDED. COMPONENT SHEET INCLUDED. If you do not have the issue of E.E. which includes the project—you will need to order the instruction reprint at an extra 45p each.

Reprints available separately 45p each + p. & p. 45p.

DOUBLE DICE Jan. 83. £10-82 ELECTRONIC V/I METER Dec. £11-38 ZX TAPE CONTROL Nov 82. £6 48 PHOTO FINISH Nov 82. €5-98 PHOTO FINSH NOV 82. 55.98
SINE WAVE GEN Oct. 82. 614.65
G. P. PRE-AMP Oct. 82. 62.96
LIGHTS ON ALERT Oct. 82. 64.25
CONTINUITY CHECKER Sept 82. 64.37
SOUND SPLITTER Sept 82. 63.70
SOUND RECOMBINER Sept 82. 63.70 SOUND RECOMBINER Sept 82. £3-70
SCREEN WASH DELAY Sept 82. £4-48
INSTRUMENT PRE AMP AUG. 82.
ET-02
TWO TONE DOORBELL ALARM AUG
82, less case and bell transformer. £8-82.
CB ROGER BLEEPER AUG 82.
ET-02
BRAKE LIGHT RELAY July 82. £4-40.
2-WAY INTERCOM July 82. £4-11
ELEC FRONIC PITCH PIPE July 82.
E4-94 £4-91 REFLEX TESTER July 82. £1-97 SEAT BELT REMINDER June 82. £1-87 EGG TIMER June 82. £1-87 TWO TONE TRAIN HORN WITH REMOTE TRIGGER OPTION May 82. CAR LED VOLTMETER less case. May 82. £2.89 May 82. LIGHTNING CHESS BUZZER. May 82 £6-20 V.C.O. SOUND EFFECTS UNIT Apr CAMERA OR FLASH GUN TRIGGER Mar 82. £12-41 less tripod bushes. POCKET TIMER Mar 82. £3-71, GUITAR TUNER Mar 82. £15-63, CAROVERHEATING ALARM, Feb. 82. STABILISED POWER SUPPLY, Jan. 82, £24-58
MINI EGG TIMER, Jan. 82, £3-94
SIREN MODULE, Jan. 82, less speaker, MODEL TRAIN CHUFFER. Jan. 82. E8-27.
SQUARE SIX. Dec. 81, £4-70,
GUITAR ADAPTOR. Dec. 81, £3-,76
REACTION METER. Dec. 81, £17-55,
ŁŁECTRONIC IGNITION. Nov. 8 ELECTRONIC IGNITION. Nov. 81. 625-98.

SIMPLE INFRA RED REMOTE CONTROL. Nov. 81. 61-98.

PRESSURE MAT TRIGGER ALARM. Nov. 81. 61-27 less mats.

EXPERIMENTER CRYSTAL SET. Nov. 81. 61-27 less mats.

EXPERIMENTER CRYSTAL SET. Nov. 81. 62-27 less mats.

EXPERIMENTER CRYSTAL SET. Nov. 81. 62-25 less mats.

EXPERIMENTER CRYSTAL SET. Nov. 81. 62-25 less mats.

EXPERIMENTER CRYSTAL SET. Nov. 81. 62-25 less mats.

PHODO FLASH SLAVE. 62-36.

EXPERIMENTER CRYSTAL SET. 98 less mats.

EXPERIMENTER CRYSTAL SET. 99 less mats.

EXPERIMENTER.

EXPERIMENTER CRYSTAL SET. 99 less mats.

EXPERIMENTER.

EXP 625-98. SIMPLE INFRA RED REMOTE CON-

TESTERS. Mar. 81. Ohmeter version £2:02. Led version £2:73 MINI SIREN, Mar, 81, £8-04, LED DICE, Mar, 81, £8-44, LED FLASHER, Mar, 81, £4-29, MODULATED TONE DOORBELL. BENCH POWER SUPPLY, Mar. 81, £53-47.
THREE CHANNEL STEREO MIXER.
Feb. 81, £18-69. SIGNAL TRACER, Feb. 81, £8-17 Jess NI-Cd BATTERY CHARGER, Feb. 81. ULTRASONIC INTRUDER DETECTOR, Jan. 81 less case, £53-47, 2 NOTE OOOR CHIME, Dec. 80, £18-32. LIVE WIRE GAME, Dec. 80. £11-78 GUITAR PRACTICE A PLIFIER. Nov. 80. £12-£2 less case. Standard case £3-68. High quality case £6-33. SOUND TO LIGHT. Nov. 80. 3 channel, 621-34. TRANSISTOR TESTER, Nov. 80, £11-83 inc. test leads.
AUDIO EFFECTS UNIT FOR WEIRD SOUNDS: Oct. 80. £13-11. BICYCLE ALARM. Oct. 80. £18-35 less mounting brackets.
IRON HEAT CONTROL. Oct. 80. £5-86. TTL LOGIC PROBE. Sept. 80. £5-18.
ZENER DIODE TESTER. June 80. £6-66.

BATTERY VOLTAGE MONITOR. May 80. £5-18. CABLE & PIPE LOCATOR, Mar. 80. £4-11 less coll former, KITCHEN TIMER, Mar. 80 £14-85 MICRO MUSIC BOX. Feb. 80. £16-26. Grey Case £3-99 extra.

4 STATION RADIO, May 80, £18-29 less Case. LIGHTS WARNING SYSTEM, May 80. £4:68.

SIMPLE SHORT WAVE RECEIVER. Feb. 80, £25 Ms. Headphones £2 Ms. SLIDE/TAPE SYNCHRONISER. Feb. MORSE PRACTICE OSCILLATOR. Feb. 80, £4-62.

SPRING LINE REVERB. UNIT, Jan. 80. UNIBOARD BURGLAR ALARM. Dec.

BABY ALARM, Nov. 79, £9-66 CHASER LIGHTS. Sept. 79, £23-40. SIMPLE TRANSISTOR TESTER. Sept. 79, £7-30.

DARKROOM TIMER, July 79, £2-89, ELECTRONIC CANARY, June 79, £5-80, MICROCHIME DOORBELL, Feb. 79, THYRISTOR TESTER, Feb. 79, £3-78.

FUSE CHECKER, Oct. 78, £2-31, SOUND TO LIGHT, Sept. 78, £8-42. CAR BATTERY STATE INDICATOR. Sept. 78. Less case, £2-49, R.F. SIGNAL GENERATOR, Sept. 78. £26-72.

IN SITU TRANSISTOR TESTER.
June 78. £6-77. WEIRD SOUND EFFECTS GENERA-TOR, Mar. 78, £5-58.

TOR. Mar. 78. £5-58. AUDIO VISUAL METRONOME, Jan. 78 ELECTRONIC TOUCH SWITCH. Jan.

ELEG I KUNIC TOUCH SWITCH, Jan. 78, £2:73 less case.
RAPID DIODE CHECK, Jan. 78, £2:76, PHONE/DOORBELL REPEATER, July 77, £7:46. ELECTRONIC DICE. Mar. 77. £5 68.

#### MORE KITS AND COMPONENTS IN OUR LISTS

FREE PRICE LIST
Price list included with orders or send sae (9 x 4)
CONTAINS LOTS MORE KITS, PCBs & COMPONENTS

#### 1982 ELECTRONICS CATALOGUE

Illustrations, product descriptions, circuits all included. Up-to-date price list enclosed. All products are stock lines for fast delivery. Send 80p in stamps or add 80p to order.

MORE E.E. KITS PLUS H.E. and E.T.I. PRO-JECT KITS IN THE PRICE LIST,

MAGENTA gives you FAST DELIVERY OF QUALITY COMPONENTS & KITS.
All products are stock lines and are new & full specification. We give personal service &
quelity products to all our customers—HAVE YOU TRIED US?

#### MAGENTA ELECTRONICS LTD. EH48, 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. PRICES INC. VAT





Normal despatch by return of pos OFFICIAL ORDERS WELCOME OVERSEAS. Payment must be in sterling, IRISH REPUBLIC and BFPO: UK PRICES. EUROPE: UK PRICES plus 10%. ELSEWHERE: Write for quote.

#### **SOLDERING/TOOLS**

ANTEX X5 SOLDERING IRON	
25W	£5-48
SOLDERING IRON STAND	£1-98
SPARE BITS. Small, standard,	
large, 65p each. For X5 + X25	
SOLDER. Handy size	99p
	£1 .84
DESOLDER BRAID	69p
HEAT SINK TWEEZERS	29 p
	£6.48
HOW TO SOLDER LEAFLET	12p
LOW COST CUTTERS	
LOW COST LONG NOSE	~ 1 03
PLIERS	24.60
WIRE STRIPPERS &	2.1 00
CUTTERS	00.00
COTTERS	F.5.03



MULTIMETER TYPE 2. (YN360TR) 20K o.p.v. with transistor tester. HELPING HANDS JIG £6.30 £14.75 Heavy base. Six ball and socket joints

allow infinite variation of clips through 360°. Has 2½° diameter (2.5 × magnifier attached), used and recommended by VERO SPOT FACE CUTTER ... £1-49
PIN INSERTION TOOL ... £1-89
VEROPINS (pk of 100) 0-1" ... 52p
MULTIMETER TYPE 1 (1,000 ppy) £5-48 SET. 10 loads with 20 clips .
RESISTOR COLOUR CODE CALCULATOR CONNECTING WIRE PACK TYPE ED. 11 colours

ILLUMINATED MAGNIFIERS Small 2" dia. (5 x mag.) £1:14 Large 3" dia. (4x mag.) £2-46 CAST IRON VICE ........... £2:96 SCREWDRIVER SET............ £1-96 POCKET TOOL SET ...... **DENTISTS INSPECTION MIRROR** £2-85 JEWELLERS EYEGLASS ...... £1-50 PLASTIC TWEEZERS .... PAIR OF PROBES WITH LEADS

All top quality components as specified by Everyday Electronics. Our kit comes complete with FREE COMPONENT IDENTIFICATION SMEET. Follow this educational series and learn about electronics LIST 1 and LIST 2 together £27-98. LIST 3 £5-98.

\* \* \* SPECIAL OFFER \* \*
LISTS 1, 2 and 3 all bought together £33-48.

WOODEN CASE KIT also available £11-98--wood, formica, glue, screws etc. Cut to size. 12 part series, reprints available of previously published parts. 45p cach.

LISTS 1, 2, AND 3 ALL AVAILABLE NOW. ALSO WOODEN CASE KIT.

SEMICONDUCTOR ELECTRONIC PROJECTS FOR HOME ELECT. PROJECTS IN PHOTOGRAPH 110 ELECT. ALARM PROJECTS MODEL RAILWAY PROJECTS BASIC ELECTRONICS. Theory

practice £7:50
BEGINNERS GUIDE TO BUILDING ELECT. PROJECTS £1:50

#### ADVENTURES WITH MICROELECTRONICS

Similar to 'Electronics' Uses I.C.s. Includes dice, electronic organ, doorbell, reaction timer, radio etc. Based on Bimboard 1 bread board.

Adventures with Microelectronics £2.55

Component pack £29-64 less battery.

#### ADVENTURES WITH ELECTRONICS BUTTON

An easy to follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-Dec breadboard. Gives clear instructions with lots of pictures. 16 projects-including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec breadboard and all the components for the projects.

Adventures with Electronics £2-40. Component pack £18-98 less battery.

#### ADVENTURES WITH DIGITAL ELECTONICS

New book by Tom Duncan in the popular 'Adventures' series. This book of entertaining and instructive projects is designed for hobbyists and students. It provides a stepping stone to the microprocessor.

The first part deals with the properties of some basic ICs used in digital electronics.

The second part gives details of how to build eight devicesshooting gallery, 2-way traffic lights, electronic adder, computer space invaders game, etc.

For each project there is an explanation of 'how it works' and also suggestions for 'things to try'.

No soldering-all circuits built on 2 Bimboard 1 breadboards.

Adventures with Digital Electronics book £3-25. Component pack £42-50, ref. EEDC. All the components needed including 2 breadboards and hexadecimal keyboard. Available less breadboards £29.98, ref. EEDF. Both less battery.

# IMASTER 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!

FREE	Please send your brochure without any obligation to	I am interested in:  COURSE IN ELECTRONICS
COLOUR BROCHURE	NAME	as described above
	ADDRESS	RADIO AMATEUR LICENCE MICROPROCESSORS LOGIC COURSE
ER ELLTHONICS		OTHER SUBJECTS
POST NOW TO:	BLOCK CAPS PLEASE	EE/3/820
Dwitigh Motion	nol Dodio falllocknowicz Cohool	Dooding Dowler DOLLDD

**British National Radio&Electronics School** Reading, Berks. RG11BR.

THE MOST COMPREHENSIVE RANGE OF COMPONENTS, KITS AND MODULES IN THE WORLD & THERE'S ONLY ROOM FOR A FRACTION HERE, GET THE CATALOGUE AND FIND THE REST.

STOCK CODE WHEN ORDERING PLEASE.

	-	ALN	VAYS	USE	STO	DCK C	ODE V	VHE	٨
400	00 CM0	2	Type		Price		Stock No.	Price	ı
			74(\$27	31 07422		7401740			ı
: ppe		Price	744528	31 07428	0.10				ı
400008	22 04000	8.11	74(530	31 07430	8.14	7401920			Ł
4001	23 04001	6.11	74(\$32	31 07432	0.14	7461930	40 183CM		ı
400.2	23 04002	8.12	74(53)	31 07433	0.14	7401950	40195CM		ı
4007	23.04007		74L537	31 07437	0.18	74C200	29 74200	0.50	ł.
4008	23 04008		741.538	31 07438	814	740221	29 74221	1.95	ı
400948	22 04009		74LS40	37 07440	0.18	74C9Q1	29 74901	0.95	ı
4011		0.11	741542	31 07427	0.10	74C9G2	29 3490.	0.65	Ł
4011UB		8.11		31011647	0.75	746903	29 74903	0.55	ì.
4512	23 04312	0.14	744.548	31 07448	8 40	740904	29 74904	0.55	ł.
4013	23 04013			3107449	0.80	740905	29 74905	0.61	ı
4015	23 04015	8.58	74L\$51	31 07451	0.14	740906	29 74906	0.95	Ł
4016	23 04016	0.22	741554	31 07454	8.14	740907	29 74907	0.55	Ł
4017	23 04017	8.48	741555	31 07455	0.14	740906	29 74906	0.76	Ł
4070	23 04020	8 55	74L574	31 07474	8.21	740909	29 74909	2.18	ı
4021	23.04021	8.55	34LS75		8.21	740910	29 74910	5.00	ı
4022	23.04022	0.55	741576	31 07476	6.25	740914	28 74914	1.10	ı
4023	23 04023	0.15	74LS78	31 07478	0.19	74C918	29 74918	1.30	ı
4024		0.33	34(58)		6.33	740925	29 74925	0.00	ı
4025	23 04025	0.15	741585	31 02485	0.44	740928	29 74926	6.11	Ł
4027		8.28	74LS86		0.15	740927	29 74927	8.00	ı
4028	23 04028	8.50			0.24	-	-	_	ı
4029		8.55	741.591			1	THEXX	-	ı
4035		0.87	741592			74HCDG	30 07400	0.50	ı
4040		6.69	74(\$93			74HC02	30 07400	9.56	ı
4042		0.50	741.595			74HC04	30 07404	8.61	ı
		8.60	74LS107			74HC10	30 07410	0.54	ı
4D44	23/04044	0.68	7415109			74HC20	30 07420	0.54	ı.
6946		0.61	7415112			74HC86	30 07420	0.74	ı
4049UB		0.24	744.5113			74HC132	30 74132	1:24	ı
4050	23 04050	8.24	74,5114			74HC786	30 74756	0.01	ı
4051	23 04051	8.55	1415122			74HC4002	30 04002	0.54	ı
4052	23 04052	0.55	74(\$123			74HC4002	30 04075	0.54	ı
4053	23 04053	0.55	74LS125	31 74125	8.27	74MC 8075		1.00	ı

JALSKX

6.C.182.292 60.0227

2 Part 27-86
2 Par \$8 00016 58 14237 58 14238 58 14245 58 14429 58 14475 58 14679 58 16811 58 16811 58 03056 58 03056 58 13008 8.65 2,78 16.58 46.80 18.58 1.28 4.99 6.58 10.24 9.95 6.45 1.28

783800 56 73800 1.26

\$\$\text{SMAIL}\$ \text{SIGNAIL}\$ \text{EE} \text{\$\ wi756 9F980 NF961 8F963 J310 J176 7SF55 2SE168 3SE45 3SE60 3SE60 3SE80 40873 40822 40823 3SE112 80 03823 80 03823 8.65 ODES

6.17 6.25 8.81 8.87 8.16 6.75 8.46 6.20 8.64 8.87 8.87 8.87 8.85 6.18 6.42 VARICAPS

SMALL SIGNAL AUDIO

8ATG2 8A121 981058 981098 982048 98212 977210 MYAME WYAME RY1210 KW1211 KW1225 KW1236 KW1236 KW1236 KW1236 KW1236 2.45

SCRS TRIACS

88755 100 52 53700 6.56

C10801 52 00126 8.78

C12201 52 00427 1.45

27860734 56 08073 9.88

0.29 0.31 0.44 0.40 0.30 0.41 0.35 0.35 0.80 0.80 0.80 3.10 4.25 3.10 4.25 3.10 4.25 80140 80185 80166 80179 80180 11P318 11P328

2012055 258720 250780 25,469 25,463 25,463 25,4134 25,1135 25,4227 25,753

| Table | Part | \$\frac{\text{SWA14}}{\text{SWA14}} \frac{\text{SWA14}}{\text{SWA14}} \frac{\text{SWA14}}{\text{SWA14}} \frac{\text{RV}}{\text{SWA14}} \frac{\text{SWA14}}{\text{SWA14}} \frac{\t

L149 ZNA234 U2970 U2470 U2470 U2470 U2578 U2578 U2578 U3074 LM300A LM300A LM300A LM300A LM303A LM303A LM303A LM300A LM300A LM300A LM303A LM30A LM30A

ALWAYS USE STOCK CODE WHEN ORDERING PLEASE. RETAIL SHOP OPENING HOURS

Monday to Thursday 9.00-6.00 Friday 9.00-7.00 Saturday 9.00-5.30



ALL PRICES SHOWN EXCLUDE VAT. P&P 60p per order.

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM144SG

AMBIT INTERNATIONAL DEPT. 200 North Service Road, Brentwood, Essex

#### **RESISTOR FILE**

#### Std E12 VALUES Iw CARBON FILM 10 $\Omega$ to 10M $\Omega$

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

SUPER FILE. AS ABOVE BUT WITH 100 RESISTORS IN EACH **ENVELOPE** £55.00



CHEQUES & P.O's PAYABLE TO: POPS COMPONENTS PRICES ARE INCLUSIVE BUT ADD 60p P&P TO EACH ORDER

REFILL ENVELOPES CONTAINING 10×1w RESISTORS ANY E12 VALUE FROM 10Ω TO 10MEGΩ 15p EACH CONTAINING 100×1 RESISTORS ANY E12 £1.20 EACH

POPS COMPONENTS CALLERS WELCOME @

38/40 LOWER ADDISCOMBE RD CROYDON, SURREY CRO 6AA TEL: 688 2950



NEW AMBIT CATALOGUE – SPRING ISSUE No.5 – AVAILABLE MARCH – ORDER YOUR COPY NOW 75p1

#### Constructor Series Speakers

IT'S SO EASY

Have fun, save money, building a Kef design with a Wilmslow Audio

CS Total kit No electronic or woodworking knowledge necessary and

the end result is a proven topquality design

that you'll be proud of

Each kit contains all cabinet components, accurately machined for easy assembly, speaker drive units, crossovers, wadding, grille fabric, terminals, nuts, bolts, etc

The cabinets can be painted or stained or finished with iron-on veneer or self adhesive woodgrain vynil.

Easy foolproof assembly instructions supplied. Set of constructor leaflets sent free on receipt of large S.A.E.

Prices: CS1 (As 101)

CS3 (as 103.2)

CS5 (as Carlton II) CS7 (as Cantata)

£110 pr. inc. VAT, plus carr./ins. £ 5.50 CS1A (simplified LS3/5A) £103 pr. inc. VAT, plus carr./ins. £ 5.50 £129 pr. inc. VAT, plus carr./ins. £10.00

£192 pr. inc. VAT, plus carr./ins. £15.00 £250 pr. inc. VAT, plus carr./ins. £18.00



8 0625 529599

35/39 Church Street, Wilmslow, Cheshire SK9 1AS



Catalogue -- £1.50 post free Lightning service on telephoned credit card orders! Please allow 7 days for delivery.



#### **Receivers & Components**

#### **NEW SURPLUS RELEASE**

Ex GOVT LEAO ACIO ACCUMULATORS. Brand new 10V 5ah famous manufacture. Easily tapped in 2v stages. Size only 7"×5"×2". Ideal for emergency lighting and power supplies. Burglar alarms etc. Must have cost Govt. over £20 each. Our price £5.50 each, carriage £2.50. 2 for £10 carriage £3.50 4 for £18 carriage £6, 8 for £32 carriage £10. All despatched unfilled. Robust wooden tray with carrying handles. Holds 8 accumula-

tors £5.
CORDLESS INQUCTIVE LOOP HEAOPHONES. Self powered. Input via loop or external min BNC socket. Contains transistor-ised high gain amplifier. Operates from internal batteries Noise excluding muffs. Switch on when placed on head. Special offer white stocks last £6 p.p. £2. 2 pairs for £12 post

free. LIGHTWEIGHT HEADSETS (Govt. release). Brand new 600 ohms impedance. A bargain at £3.50 p.p. £1. 2 pairs for £7 post

RIDICULOUS RESISTOR SALE. Brand new 1 watt carbon film RIDICULOUS RESISTOR SALE. Brand new 1 watt carbon film resistors. 5% tol. High quality resistors made to exacting specifications by automatic machines. E12 Range IRO to 10M in lots of 1000 025 per valuel. Only £8 per 1000. Lots of 5000 for 255. 1 RO to 10M. 1000 PCB type resistors £2.50. Bulk purchase enables us to offer 1000 mixed pre-formed carbon film resistors. 5% tol. for PCB mounting. Huge range preferred values. £2.50 per 1000. 4000 for £8. Postage 15p in £1. GENUINE AFV TANK HEADSETS AND MIKE £3.50 per pair. p.p. £1. 2 pairs £7 post free. All headphones fitted with Exministry plug. Standard jack plugs available 25p each 2 for 40p. Headphone extension sockets available at 25p each. 2 for 40p. Impedance of first two items 600 ohms. All headphones in good condition.

SCOOP PURCHASE PYE POCKET PHONE RECEIVERS Type PF1 normal freo 450mHz. Supplied in used condition less battery. £4.50 each. Carriage £1. 2 pairs £9.00 post free. 4 pairs £16.00 post free. THE GOVT. SURPLUS WIRELESS EQUIPMENT HANDBOOK. Gives detailed information and circuit diagrams for British and American Government Surplus Receivers Transmitters and Test Equipment etc. Also suggested modification details and improvements for surplus equipment. Incorporated is a Surplus/Commercial cross referenced valve and transistors guide. The standard reference work in this field. Only £7.50 p.p. £150. No VAT on books.

New release of MODERN DYNAMIC MOVING COIL MICRO-New release of WOUGHN O'THAMIC WOUTHO CUIL WILDU-PHONES. 200 ohms impedance. Switch incorporated. Most with lead and DIN plug. Used but nice condition. 3 designs of case housing. Price one mike our choice £2 plus 50p p.p Bargain offer all 3 mikes £4.50 p.p. £1 GENUINE EX-GOVT COLLAPSIBLE AERIALS. A fully adjustable

highly efficient whip aerial in 5 sections. Length 1) mic Closed 300 m/m. Copper plated sections. As used on Ex Manpacks, Brand new in makers boxes £2.50 each, p.p. 75p. 2

for £5 post free. HAVE YOU SEEN THE GREEN CAT.  $1000 \times$  of new compo nents, radio, electronic, audio at unbelievably low prices. Send 50p and receive catalogue and FREE RECORO SPEED INDICATOR.

MINI JUMBO PACK (£20 worth)

for £5 p.p. £1.50.
PLEASE ADD 15% VAT to all orders including carriage and p.p.



Dept EE1, 12/14 Harper Street, Leeds LS2 7EA. Leeds 452045. retail premises at above address (opposite Corals), s welcome 9 to 5 Mon to Sat. Sunday 10 to 1 by Callers welcome appointment. GOVT, SURPLUS ITEMS ALWAYS IN STOCK

Reach effectively and economically to-days enthusiasts anxious to know of your products and services through our semi-display and classified pages. Semi-display spaces may be booked at £7.24 per single column centimetre (minimum 2.5cm). The prepaid rate for classified advertisements is 31 pence per word (minimum 12 words), box number 60p extra. All cheques, postal orders,

#### **Receivers & Components**

ELECTRONIC COMPONENTS MERSEYSIDE, Myca Electronics, 2 Victoria Place, Seasombe Ferry, Wallasey, L44 6NR. Mail order. Send 50p for price list refundable off first order. 051-638 8647.

AERIAL BOOSTERS trebles incoming signal, price £7.00. SAE leaflets. VELCO ELECTRONICS, Ramsbottom, Lancashire BL0 9AG

#### **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 – guaranteed at least 1000 items, minimum weight 10lbs. ONLY £8.50 inc.

**ELECTRONICS WORLD** 1d Dews Road, Salisbury, Wilts, SP2 7SN (Prop: Westbrough Ltd)

VERO BOARD 0.1 PITCH, 95×292mm £3.50 each, 112×177mm £2.95 each. Prices inclusive of VAT, p&p 30p. Send cheque or PO with order to: Coxon Electronics, 47 Steepturnpike, Matlock, Derbyshire, DE4 3DP.

TURN YOUR SURPLUS capacitors, transistors etc., into cash. Contact Coles Harding & Co., 103 South Brink Wisbech, Cambs. 0945-584188. Immediate settlement.

#### Service Sheets

**BELL'S TELEVISION SERVICE** for service sheets on Radio, TV etc. £1.25 plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Rd., Harrogate, N. Yorkshire. Tel: 0423 55885.

ANY PUBLISHED, FULL-SIZE SERVICE SHEET by return £2 + LSAE, CTV/music centres £3. Repair data with all circuits, layouts, etc. your named TV or Video £8.50. Free 50p mag. All orders, queries—T.I.S. (E.E.), 76 Churches, Larkhall, Lanarkshire.

#### Miscellaneous

ELECTRONICS WITSOLDER	THOUT
Build electronic circuits without solder on a Roden S-Dec. This has built-in contacts and holes into which you plug your components. Suitable for all ages. Can be used time after time. Ideal gift for students or experimenters. Full instructions and 2 circuit diagrams with each S-Dec. Send cheque or P.O. to:  Redde Preducts, Dep EE High March, Durwink, NRI 11 40E	including p & p

O	RD	ER	F	OR	KM	PLEASE	WRITE	IN	BLOCK	CAPITA	LS
---	----	----	---	----	----	--------	-------	----	-------	--------	----

Please insert the advertisement below in the next available issue of <b>Everyday Electronics</b> for						
NAME			EVERYDAY ELECTRONICS			

**EVERYDAY ELECTRONICS** 

Classified Advertisement Dept., Room 2612, King's Reach Tower, Stamford Street, London SE1 9LS Telephone 01-261 5942

31p per word, minimum 12 words, Box No. 60p extra.

Company registered in England, Registered No. 53626, Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.

3/83

#### AT YOUR SERVICE

etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Department, Everyday Electronics, Room 2612, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5942).

#### Miscellaneous Cont.

THE SCIENTIFIC								
WIRE COMPANY								
PO Box 30, London E.4, 01 531 1568								
	ELLED CO							
SWG	1 lb	8 oz	4 oz	2 oz				
8 to 34		1.90		0.80				
35 to 39		2.10		0.85				
40 to 43		2.65		1.46				
44 to 47		5.32		2,50				
48 to 49	15.96	9.58	6.38	3,69				
	PLATED (							
14 to 30	7.09	4,20	2.43	1.72				
TINE	IED COP							
14 to 30	3.97	2.41	1,39	0,94				
FLUXCORE								
SOLDER		3.16						
Prices include P & P vat. Orders under £2 add 20p.								
SAE for list of cor enquiries welcome		resistan	ce wire.	Dealer				

DIGITAL WATCH REPLACEMENT PARTS. Batteries, displays, backlights, etc. Also reports, publications, charts. SAE for full list, PROFORDS, Copners Drive, Holmer Green, Bucks HP15 6SGA.

#### CATALOGUE OF BURGLAR EQUIPMENT TOP QUALITY D.I.Y. SYSTEMS AND PARTS AT TRADE PRICES SEND S.A.E. OR PHONE: C-TEC SECURITY, Dept. EE, **60, MARKET ST, WIGAN** (0942) 42444

INGERSOLL PERSONAL STEREO FM/AM receiver features - individual volume controls, stereo beacon, fingertip tuning, feather-weight headphones, requires PP3 battery £12.95 p&p 80p. RADIO WATCH – normal size quartz L.C.D. watch combining AM radio complete with featherweight head-phones, only £11.95 p&p 45p. TAITS MAIL ORDER, 31 Lime Grove, Addlestone, Surrey.

#### SILVER OXIDE BATTERIES

Save pounds on silver oxide and alkaline button cells. Fully guaranteed. e.g.: LR44 for Pentax ME Super camera only 42p each post free. For FREE EQUIVALENTS CHART and price list send s.a.e. to:

H. M. WHEELER & CO., (Unit 1), 15 Hawthorn Crescent, Bewdley, Worcs. DY12 2JE.

#### Courses

CONOUER THE CHIP-master modern electronics the practical way by seeing and doing in your own home. Write for your free colour brochure now to BRITISH NATIONAL RADIO & ELECTRON-ICS SCHOOL, Dept C3, Reading, Berks RG1 1BR.

## **HOW DARE**

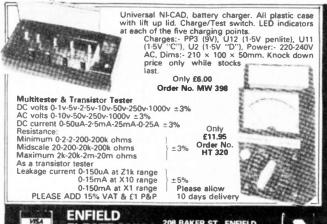
If you see an advertisement in the press, in print, on posters or a cinema commercial which makes you angry, write to us at the address below. (TV and radio commercials are dealt with by the I.B.A.)

The Advertising Standards Authority.
vertisement is wrong, we're here to put it right.

ASA Ltd., Brook House, Torrington Place, London WCIE 7HN.

#### INDEX TO ADVEDTICEDS

Alcon         130           Ambit         189           Audio Electronics         186           Bi-Pak         134, 135           B.K. Electronics         Cover III           B.N.R. & E.S.         188           Bull J.         132           C-Tec Security         191           Cambridge Learning         186           Cricklewood Electronics         131           Dziubas M.         192           Electrains         186           Electronics World         190           Electronize Design         Cover II           Electronize Design         Cover III           Electronize Design         Cover II           G.S.C.         183           Greenweld Electronics         130           H. M. Wheeler         191           I.C.S.         192           Magenta Electronics         187           Maplin Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         189           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191	ADVER 119EK9	)
B.K. Electronics         Cover III           B.N.R. & E.S.         188           Bull J.         132           C-Tec Security         191           Cambridge Learning         186           Cricklewood Electronics         131           Dziubas M.         192           Electrains         186           Electronics World         190           Electronize Design         Cover II           Electrovalue         169           Enfield Electronics         191           G.S.C.         183           Greenweld Electronics         130           H. M. Wheeler         191           I.C.S.         192           Magenta Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         189           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191           Sinclair Products         184, 185           Sparkrite         175           Titan Transformers         191           T.K. Electronics         183	Ambit	189
Cambridge Learning         186           Cricklewood Electronics         131           Dziubas M.         192           Electrains         186           Electronics World         190           Electronize Design         Cover II           Electrovalue         169           Enfield Electronics         191           G.S.C.         183           Greenweld Electronics         130           H. M. Wheeler         191           I.C.S.         192           Magenta Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         189           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191           Sinclair Products         184, 185           Sparkrite         175           Titan Transformers         191           T.K. Electronics         183	B.K. Electronics Cover B.N.R. & E.S.	r III 188
Electrains         186           Electronics World         190           Electronize Design         Cover II           Electrovalue         169           Enfield Electronics         191           G.S.C.         183           Greenweld Electronics         130           H. M. Wheeler         191           I.C.S.         192           Magenta Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         189           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191           Sinclair Products         184, 185           Sparkrite         175           Titan Transformers         191           T.K. Electronics         183	Cambridge Learning Cricklewood Electronics	186
Electronics World         190           Electronize Design         Cover II           Electrovalue         169           Enfield Electronics         191           G.S.C.         183           Greenweld Electronics         130           H. M. Wheeler         191           I.C.S.         192           Magenta Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         189           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191           Sinclair Products         184, 185           Sparkrite         175           Titan Transformers         191           T.K. Electronics         183		192
Greenweld Electronics         130           H. M. Wheeler         191           I.C.S.         192           Magenta Electronics         187           Maplin Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         188           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191           Sinclair Products         184, 185           Sparkrite         175           Titan Transformers         191           T.K. Electronics         183	Electronics World	190 er II 169
I.C.S.       192         Magenta Electronics       187         Maplin Electronics       Cover IV         Myers Electronics Devices       190         Pops Components       189         R & TVC       136         Rapid Electronics       133         Roden Products       190         Scientific Wire Co.       191         Sinclair Products       184, 185         Sparkrite       175         Titan Transformers       191         T.K. Electronics       183	G.S.C	
Magenta Electronics         187           Maplin Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         189           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191           Sinclair Products         184, 185           Sparkrite         175           Titan Transformers         191           T.K. Electronics         183	H. M. Wheeler	191
Maplin Electronics         Cover IV           Myers Electronics Devices         190           Pops Components         188           R & TVC         136           Rapid Electronics         133           Roden Products         190           Scientific Wire Co         191           Sinclair Products         184, 185           Sparkrite         175           Titan Transformers         191           T.K. Electronics         183	I.C.S	192
R & TVC       136         Rapid Electronics       133         Roden Products       190         Scientific Wire Co.       191         Sinclair Products       184, 185         Sparkrite       175         Titan Transformers       191         T.K. Electronics       183		er IV
Rapid Electronics       133         Roden Products       190         Scientific Wire Co.       191         Sinclair Products       184, 185         Sparkrite       175         Titan Transformers       191         T.K. Electronics       183	Pops Components	189
Sinclair Products       184, 185         Sparkrite       175         Titan Transformers       191         T.K. Electronics       183	Rapid Electronics	133
T.K. Electronics 183	Sinclair Products 184,	185
Wilmslow Audio 189		
	Wilmslow Audio	189





ELECTRONICS 208 BAKER ST., ENFIELD, MIDDX. Tel: 01-366 1873

#### TITAN TRANSFORMERS **DUNCOMBE STREET, GRIMSBY** SOUTH HUMBERSIDE DN32 7EG.

#### **INVERTERS**

12/24 volt DC input from car battery to 240 volt AC output at 100, 250, 500 and 1000 VA.

Plus, powerlift, autocharger, powersaver, powermonitor, autochangeover and battery isolator as optional extras.

#### **TRANSFORMERS**

12/24 volt) 30/60 volt Range

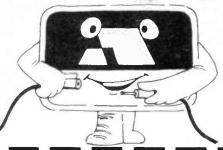
Autotransformers, safety isolating equipment P.C.B's etc.

**BATTERY CHARGERS** - 2 volt. **ADAPTORS** 

6 volt to 7.5 volt to 9 volt switchable. 300MA regulated 6 volt to 7.5 volt to 9 volt switchable. 250MA unregulated

Send SAE for prices and info. by return. Mail Order Prompt Service

#### Make the connection with Access



and receive a regular postal delivery of Everyday Electronics. It's easy, it's straightforward and it's quick. Just use the subscription order form to get your Access card account charged with the price of a subscription or order your subscription through Access on the phone: (01) 886 6433. If you pay by cheque or postal order, use the subscription order form in the usual way.

#### SUBSCRIPTION ORDER FORM

wish to become a subscribe	r to <b>Everyday Elect</b> i	ronics for one year and enclose cheque
oostal order value	no	made payable to IPC Magazines L
Complete this portion if you a my Access card account with		card account. I authorise you to debit
My Access no. is		
Block letters please)		
Name		
Address		
Signature		
aryriature		

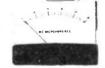
#### **Subscription Rates:**

UK, Isle of Man, Channel Islands and Irish Republic £11

Overseas £12

Unless you are phoning your order, complete and post this order form to:

**Everyday Electronics,** 2613 King's Reach Tower, Stamford Street, London SE1 9LS.



METERS: 110 × 82 × 35mm 50 μA, 100 μA. £5·90. 30 uA. Post 50p.

METERS: 45 × 50 × 34mm 50μA, 100μA, 1mA, 5mA, 10mA, 25v, 1A, 2A, 5A 25V. £2.90. Post 30p.

METERS: 60 × 47 × 33mm 50µA, 100µA, 1mA, 5mA, 10mA, 50v, 100mA, 1A, 2A, 25v, 50 50-0-50μA, 100-0-100μA, £4·76. VU meters. £5.32. Post on above meters 30p

Silicone grease 50g £1-32 Post 14p.

#### NI-CAD BATTERY CHARGER

Led indicators charge-test switch. For PP3, HP7, HP11 & HP2 size batteries

Price £5.85 Post 94p.

20,000 ohm/volt DC Volts: 0·1, 0·5, 2·5, 10-150— 250-1,000v. AC Volts: 10-50, 250-1,000 RESISTANCE

**MULTI-METER** 

360 T R

7 N

RANGES X1, X10, X1K, X10K £14-10 P.&P. 87p



#### TRANSFORMERS 240v Primary

3-0-3V	IUUIIIA	04 0	
6-0-6v	100mA	87p	
6-0-6v	250mA £1.22		
12-0-12v	50m A	92 p	
12-0-12v	100m A	£1 · 15	
Post on al	ove transform	ners 48p.	
9-0-9v	1A	£1 · 80	
12-0-12v	1A	£2-40	
15-0-15c	1A	£2.60	
6 · 3v	11A	£1 · 80	
6-0-6v	11A	£2-10	
	-		

Post on above transformers 87p.

All above prices include V.A.T. Send 80p for new 1982 fully illustrated catalogue, S.A.E. with all enquiries. Special prices for quantity quoted on request.

All goods despatched within 3 days from receipt of the order.

#### M. DZIUBAS

158 Bradshawgate, Bolton Lancs. BL2 1BA

#### FREE CAREER BOOKLET

#### Train for success, for a better job, better pay

Enjoy all the advantages of an ICS Diploma Course, training you ready for a new, higher paid, more exciting career.

Learn in your own home, in your own time, at your own pace, through ICS home study, used by over 8 million already!

Look at the wide range of opportunities awaiting you. Whatever your interest or skill, there's an ICS Diploma Course there for you to use.

Send for your FREE CAREER BOOKLET today—at no cost or obligation at all.

TICK THE FREE BOOKLET YOU WANT

ELECTRONICS ENGINEERING	TV & AUDIO SERVICING
ELECTRICAL ENGINEERING	RUNNING YOUR OWN BUSINESS
Name	 
Address	 
Division of National London SWI Education Corporation I	01-622 9911 (all hours)

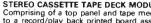
Published approximately the third Friday of each month by IPC Magazines Ltd., Kings Reach Tower, Stamford St., London SE1 9LS. Printed in England by Chapel River Press. Andover, Hants. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Subscriptions: Inland £12.00, Overseas £13.00 per annum payable to IPC Services. Oakfield House, Pettymount Road, Haywards Heath, Sussex. Everyday Electronics is sold subject to the following conditions namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.



## thorough A SOUND CHOICE STOCKIST A SOUND CHOICE



#### **★ PROMPT DELIVERY ★ PRICES INCLUDE V.A.T. ★ AMPLE STOCKS** A PERSONAL SERVICE FROM A SMALL EXPANDING COMPANY



STEREO CASSETTE TAPE DECK MODULE
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,
reach built and tested.

net 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 level: 400mV to both left and right hand channels. Output Impedance: 10K. Signal to noise ratio: 45dB. Wow and flutter: 0.1%. Power Supply requirements: 18V DC at 300mA. Connections: The left and right hand stereo inputs and outputs are via individual screened leads, all terminated with phono plugs (phono sockets provided). Dimensions: Top panel 5\(\frac{1}{2}\)in. Supplied complete with circuit diagram and connecting diagram. Attractive black and silver finish.

Silver firms.

Price £26.70 + £2.50 postage and packing.

Supplementary parts for 18V D.C. power supply (transformer, bridge rectifier and smoothing capacitor) £3.50.



#### 1 K-WATT SLIDE DIMMER

\* Controls loads up to 1KW.

- Compact Size 47" × 11/2" × 23".
- Easy snap in fixing through panel/cabinet cut out.

Insulated plastic case

Full wave control using 8 amp triac.

Conforms to BS800.

Suitable for both resistance and inductive loads. Innumerable applications in industry, the home, and disco's/theatres, etc. Price £11.70 each + 50p P&P. (Any quantity.)

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. 57 × 46 × 14mm (9 volt). Price: £6.58.
DIGITAL THERMOMETER. -9.9°C to +99.9°C. LED display. Complete with sensor. 70 × 70mm

DIGITAL THERMOMETER. –9.9°C to +99.9°C. LED display. Complete similar (9 volt). Price: £22.94.

(9 volt). Price: £22.94.

3 WATT FM TRANSMITTER. 3 watt. 85/115MHz varicap controlled. Professional performance. Range up to 3 miles. 35 × 84 × 12mm (12 volt), Price: £10.64.

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

8.5.8. P.232 TURNTABLE

P232 Turntable \* 'S' shaped tone arm

#### LOUDSPEAKERS

6 piano type keys

15" 100 watt R.M.S. (HI-FI, P.A., BASS GUITAR), Die cast chassis, 2" aluminium voice coil, white cone with aluminium centre dome. 8 ohm imp., Res. Freq. 20Hz., Freq. Resp. to 2.5KHz., Sens. 97dB. (As photograph). Price: £32,00 + £3.00 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 + £3.00 carriage.

8" 50 watt R.M.S. (HI-FI, P.A.). 11" 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.

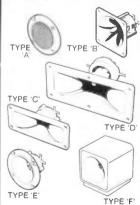
12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO). 2" aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 6.5KHz., Sens. 98dB. Price: £22.00 + £3.00 carriage.

12" 85 watt 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: £22.00 + £3.00

15" 150 watt 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: £47.00 + £4.00 carriage

#### 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 speakers systems of up to 100 watts (more if 2 put in series). FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.



TYPE 'A' (KSN1036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-Fi speakers. Price £3.45 each.

TYPE 'B' (KSN1005A) 3\\\^" super horn. For general purpose speakers, disco and P.A. systems, etc. Price £4.35 each

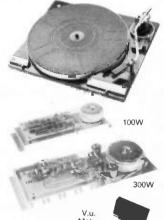
TYPE 'C' (KSN6016A) 2" × 5" wide dispersion horn. For Hi-Fi systems and quality discos, etc. Price £5.45 each.

TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response re-tained extending down to mid range (2,000 c/s). Suitable for Hi-Fi systems and quality discos. Price £6.90 each.

TYPE 'E' (KSN1038A) 32" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems, etc. Price £4.35 each.

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

U.K. post free (or SAF for Piezo leaflets)



#### **MULLARD SPEAKER** KITS



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 frequency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8 ohm. Attractive blue cone with aluminium centre dome. Price: £17.99 each + £3.00 P & P.

P232 Turntable ★ 'S' shaped tone arm
★ Belt driven ★ Aluminium platter
★ Cueing lever ★ 240 volt AC op Cueing lever ★ 240 volt AC operation

Cut-out template supplied

Used as standard by Hi-Fi and Disco manufacturers

Fitted with either a magnetic or ceramic cartridge, please state cartridge required

Price: £22.50 + £2.50 P & P.

POWER AMPLIFIER MODULES 100 WATT R.M.S. AND 300 WATT R.M.S. MODULES

Power Amplifier Modules with integral toroirower Amplifier Modules with Integral foroidal transformer power supply, and heat sink. Supplied as one complete built and tested unit. Can be fitted in minutes. An LED Vumeter is available as an optional extra.

SPECIFICATION

Max Output Power: 110 watts R.M.S. (OMP 100) 310 watts R.M.S. (OMP 300)

Loads: Open and short circuit proof. 4-16

Frequency Response: 20Hz-25KHz ±3dB. Sensitivity for Max. Output:
500mV at 10K (OMP 100) 1V at 10K (OMP 300)

T.H.D: Less than 0.1%

I.H.D: Less than 0.1%.

Supply: 240V 50Hz

Sizes: OMP 100 360 × 115 × 72mm

OMP 300 460 × 153 × 66mm

Prices: OMP 100 £31.50 each + £2.00 P&P

OMP 300 £89.00 each + £3.00 P&P

Vu Meter £6.50 each + 50p P&P

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 woofer (8' or 5") with foam surround and aluminium voice 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 in polystyrene packs complete with instructions. 8" 40W system—recommended cabinet size 240 × 216 × 445mm. Price: £14.90 each + £2.00 P&P. 5" 30 W system—recommended cabinet size 160 × 175 × 295mm. Price: £13.90 each + £1.50 P&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.

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



B.K. ELECTRONICS DEPT E.E.

37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY ★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam. Callers welcome by **Prior** appointment, please phone 0702-527572.

## = - - -R ZX81 an

#### Now your computer can talk!

- \* Allophone (extended phoneme) system gives unlimited vocabulary.
- ★Can be used with unexpanded VIC20 or ZX81 does not require large areas of memory.
- ★In VIC20 version, speech output is direct to TV speaker with no additional amplification needed.
- \*Allows speech to be easily included in programs.

Complete kit only £24.95.

Order As LK00A (VIC20 Talk-Back). LK01B (ZX81 Talk-Back).

Full construction details in Maplin Projects Book 6. Price 70p. Order As XA06G (Maplin Mag Vol. 2 No. 6).



#### KEYBOARD WITH ELECTRONICS



- \* Full size, full travel keyboard that's simple to add to your ZX81 (no soldering in ZX81).
- \*Complete with electronics to make "Shift Lock", "Function" and "Graphics 2" single key selections.
- \*Powered (with adaptor supplied) from ZX81's own standard power supply.

Full details in Project Book 3 (XAO3D) Price 60p. Complete kit (excl. case) £19.95. Order As LW72P. Case £4.95 Order As XG17T. Ready built-in case £29.95. Order As XG22Y.

#### OTHER KITS FOR ZX81

3-Channel Sounds Generator (Details in Book 5). Order As LW96E. Price £10.95.

ZX81 Sound On Your TV Set (Details in Book 6). Order As LKO2C. Price £19.95

ZX81 I/O Port gives two bi-directional 8-bit ports (Details in Book 4)

Order As LW76H. Price £9.25

ZX81 Extendiboard will accept 16K RAM and 3 other plug-in modules.

Order As GB08J. Price £2.32. PCB: Edge Connectors (4 needed):

Order As RK35Q. Price £2.39

#### HOME SECURITY

Six independent channels - 2 or 4 wire operation. External horn. High degree of protection and long term reliability. Full details in Projects Book 2. (XA02C) Price 60p



#### 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) £1.99.

#### STEREO MOSFET AMPLIFIER



- ★ Over 26W/channel into 8Ωat 1kHz both channels driven
- \* Frequency response 20Hz to 40kHz ± 1dB.
- \*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 and mains lead terminations).
- \* Complete kit contains everything you need including pre-drilled and printed chassis and wooden cabinet. Full details in Projects Book 3. Price 60p (XAO3D). Complete kit only £49.95 incl. VAT and carriage (LW71N).

#### BUY IT WITH MAPCARE

Send now for an application form - then buy it with MAPCARD. MAPCARD gives you real spending power up to 24 times your monthly payments,



#### MAPLIN'S FANTASTIC PROJECTS

Full details in our project books. Issues 1 to 5: 60p each. Issue 6: 70p. 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 Keyboard with electronics Stereo 25W MOSFET Amplifier Doppler Radar Intruder Detector • Remote Control for Train Controller.

In Book 4 (XAO4E) Telephone Exchange for 16 exten sions 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 & VIC20 Module to Bridge two of our MOSFET Amps to make a 350W Amp • ZX81 Sound on your TV • ZX81 Interface for Modem Scratch Filter Doorbell for Deaf Simple FM Tuner Damp Meter.

Projects for Book 6 were in an advanced state at the time of writing, but contents may change prior to publication (due 11th February 1983).

#### 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 of WHSMITH Price £1.25



All prices include VAT & carriage. Please add 50p handling charge to orders under £5 total value

#### 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 U.K. send £1.90 or 10 International Reply Coupons. Despatched by return of post.

Name

Address

MAPLIN ELECTRONIC SUPPLIES LTD

P.O. Box 3, Rayleigh, Essex SS6 8LR Telephone: Sales (0702) 552911 General (0702) 554155

159 King St., Hammersmith, London W6. Telephone: 01-748 0926 284 London Rd., Westcliff-on-Sea, Essex. Telephone: (0702) 554000 Lynton Square, Perry Barr, Birmingham. Telephone: (021) 356 7292