AN ARGUS SPECIALIST PUBLICATION
MAY 1984

Hobby Electronics

Project Electronics For Everyone

90p

SOFT OPTIONS

Commencing in this issue...
A new monthly supplement exploring soft-ware for learning, and the uses of computers at home and in the classroom

METAL DETECTION
In-depth survey of methods, applications and equipment

EASY TO BUILD PROJECTS

- Spring Reverb Unit
- Mains Touch Switch

BI-PAK BARGAINS

MINIATURE TOOLS FOR HOBBYISTS

Miniature round nose side cutters – insulated handles 4½inch length. Order No: Y043.

Miniature long nose pliers – insulated handles 5½inch length. Order No: Y044.

Miniature bend nose pliers – insulated handles 5½inch length. Order No: Y045.

Miniature end nippers – insulated handles 4½inch length. Order No: Y046.

Miniature snipe nose pliers with side cutter and serrated jaws – insulated handles 5inch length. Order No: Y042.

ALL AT £1.25 each

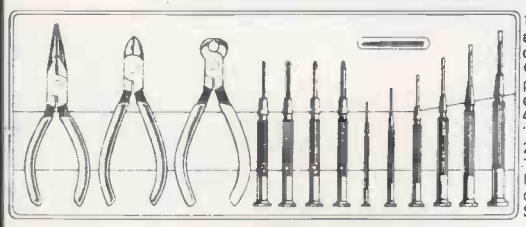
FLEXEY DRIVER

A flexible shaft screwdriver for those awkward to get at screws. Overall length 8½inch. Order No: FS-1 Flat blade 4mm FS-2 Cross point no. 1 **£1.75 each.**

GRIP-DRIVER

8inch long screwdriver with spring loaded grip on end to hold screws in position while reaching into those difficult places. Order No: SD-1 Flat blade 4mm SD-2 Cross point no.0. **£95p each.**

13 PIECE TOOL KIT AND CASE



13-piece tool set housed in attractive moulded plastic case with clear sliding cover ● 1 off 5" snipe nose "radio" pliers with side cutters ● 1 off 4½" side cutters ● 1 off 4½" end cutters ● 2 off hex. "Allen" key drivers 2mm and 2.5mm; 2 off cross-point "Phillips" drivers No. 0 and No. 1 (with tommy bar) ● 6 off precision screwdrivers. Sizes from 1mm to 3.5mm ●

ONLY £7.50 ORDER No. VP102

PRECISION JEWELLERS' TOOLS

Rustproof, Tempered Handles and Blades. Chrome Plated Handles. Swivel Heads for use on Precision Work.

5T21 SCREWDRIVER SET
6 precision screwdrivers in hinged plastic case. Sizes – 0.8, 1.4, 2, 2.4, 2.9 and 3.8mm **£1.75**

5T31 NUT DRIVER SET
5 precision nut drivers in hinged plastic case. With turning rod. Sizes – 3, 3.5, 4, 4.5 and 5mm **£1.75**

5T41 TOOL SET
5 precision instruments in hinged plastic case. Crosspoint (Philips) screwdrivers – H0 and H1 Hex key wrenches. Sizes – 1.5, 2 and 2.5mm **£1.75**

5T51 WRENCH SET
5 precision wrenches in hinged plastic case. Sizes – 4, 4.5, 5, 5.5 and 6mm **£1.75**

MULTITESTER

1,000 opv 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
Dims - 90 × 61 × 30mm.

O/No. 1322 OUR PRICE £6.50 ONLY

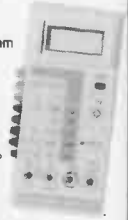
BRAND NEW LCD DISPLAY MULTITESTER

RE 188m

LCD 10 MEGOHM INPUT IMPEDANCE

*3½ 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 (½-inch) large LCD readout *Diode check *Fast circuit protection *Test leads, battery and instructions included.

Max indication	1999 or −1999
Polarity indication	Negative only Positive readings appear without + sign
Input Impedance	10 Megohms
Zero adjust	Automatic
Sampling time	250 milliseconds
Temperature range	−5°C to 50°C
Power Supply	1 x PP3 or equivalent 9V battery
Consumption	20mW
Size	155x88x31mm



RANGES
DC Voltage 0-200mV
0-2-20-200-1000V. Acc. 0.8%
AC Voltage 0-200-1000V
Acc. 1.2% DC Current 0-200uA
0-2-20-200mA, 0-10A. Acc. 1.2%
Resistance 0-2-20-200K ohms
0-2 Megohms. Acc. 1%
BI-PAK VERY LOWEST PRICE

£45.00 each

Leather Case for 188m **£2.50 EACH**

SIGNAL INJECTOR

Simple push button operation. Oscillates at 700 – 1k Hz with harmonics to 30MHz. 1.4V p/p output. Impedance 10kΩ. Ideal for trouble shooting with audio equipment. One "AA" penlight battery supplied. O/No VP96 **£2.50**

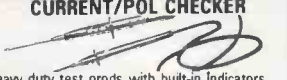
LOGIC PROBE

Automatic levelling. White LED indication. Minimum width of measuring pulse 30 millisecs.Maximum input frequency 10M Hz.

Input impedance:	100kΩ
Power consumption:	40mA maximum
Power supply:	4.5 – 18 V d.c.

ORDER No. VP97 **£10.50**

CURRENT/POL CHECKER



Heavy duty test prods with built-in Indicators for testing polarity: indicates whether a.c. or d.c. 3.5V to 400V. O/No. VP98 **£2.50**

TESTER

Universal tester with ceramic buzzer. Tests diodes, transistors, resistors, capacitors and continuity. One "AA" penlight battery included.

Test current:	Max 2μA
Test voltage:	1.2V
Response range:	100MΩ
Max voltage:	500V
Internal resistance:	390kΩ **£5.00**
Length:	135mm O/No. VP99

CIRCUIT TESTER

D.C. continuity tester for circuit checking on all low voltage equipment and components. Diode checking also possible. Takes two AA batteries. 90cm lead has crocodile clip. Body length 145mm. O/No. VP100 **75p**

ELECTRONIC SIREN 12v DC

Red plastic case with adjustable fixing bracket. Emits high-pitched wailing note of varying pitch - 100 cycles per minute. Dims - 90mm (dia.) 60mm (depth). Power - 12v DC. O/P 90dBA 1m type.

Our Price: £5.50 O/No. VP79

MINIATURE FM TRANSMITTER

Freq: 95-106MHz. Range: ¼ mile
Size: 45 × 20mm. Add: 9v batt.
Not licenced in U.K.
Ideal for: 007-MI5-FBI-CIA-KGB etc.

O/No. VP128 **ONLY £5.50**

POWER SUPPLY OUR PRICE £4.25

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, 7·5, 9 & 12V DC Rating – 300 ma VP109.

RATCHET SCREWDRIVER KIT

Comprises 2 standard screwdriver blades 5 & 7mm size. 2 cross point size 4 & 6. 1 Ratchet handle. 5-in-1 Kit. £1.45 each. O/No 329B

VALUE PACKS

Pak No.	Qty	Description	Price
VP1	300	Assorted Resistors Mixed Types	£1
VP2	300	Carbon Resistors ¼½ Watt Pre-Formed	£1
VP3	200		£1
VP4	150	¼ Watt Resistors 100 ohm-1M Mixed	£1
VP5	200	Assorted Capacitors All Types	£1
VP6	200	Ceramic Caps Miniature – Mixed	£1
VP7	100	Mixed Ceramics Disc. 1pf – 56pf	£1
VP8	100	Mixed Ceramic Disc. 68pf – .015pf	£1
VP9	100	Assorted Polyester/Polystyrene Caps	£1
VP10	60	C280 Type Caps Metal Foil Mixed	£1
VP11	100	Electrolytics – All Sorts	£1
VP12	60	Bead Type Polystyrene Min Caps	£1
VP13	50	Silver Mica Caps Ass. 5.6pf – 150pf	£1
VP14	50	Silver Mica Caps Ass. 180pf – 4700pf	£1
VP15	50	High Voltage Disc. Ceramic 750v – 8Kv Mixed	£1
VP16	50	Wirewound Res. 9W (avg) Ass. 1 ohm – 12K.	£1
VP17	50	Metres PVC Covered Single Strand Wire Mixed Colours	£1
VP18	30	Metres PVC Covered Multi Strand Wire Mixed Colours	£1
VP19	40	Metres PVC Single/Multi Strand Hook-Up Wire Mixed	£1
VP20	6	Rocker Switches 5 Amp 240v	£1
VP21	20	Pcs. 1 – 2 & 4 mm Plugs & Sockets Matching Sizes	£1
VP22	200	Sq. Inches Total, Copper Clad Board Mixed Sizes	£1
VP23	20	Assorted Slider Pots. Mixed Values	£1
VP24	10	Slider Pots. 40 mm 22K 5 × Log. 5 × Lin	£1
VP25	10	Slider Pots. 40 mm 47K 5 × Log. 5 × Lin	£1
VP26	20	Small .125" Red LED'S	£1
VP27	20	Large .2" Red LED'S	£1
VP28	10	Rectangular .2" Green LED'S	£1
VP29	30	Ass. Zener Diodes 250mW – 2W Mixed Vlts. Coded	£1
VP30	10	Ass. 10W Zener Diodes Mixed Vlts. Coded	£1
VP31	10	5 Amp SCR's TO-66 50-400v Coded	£1
VP32	20	3 Amp SCR's TO-66 Up To 400v Uncoded	£1
VP33	200	Sil. Diodes Switching Like IN4148 DO-35	£1
VP34	200	Sil. Diodes Gen. Purpose Like OA200/ BAX13/16	£1
VP35	50	1 Amp IN4000 Series Sil. Diodes Uncoded All Good	£1
VP36	8	Bridge Rects. 4 × 1 Amp 4 × 2 Amp Mixed Vlts. Coded	£1
VP37	8	Black Instrument Type Knobs With Pointer ¼" Std	£1
VP42	10	Black Heatsinks To Fit TO-3, TO-220 Ready Drilled	£1
VP45	50	BC107/8 Type NPN Transistors Good Gen. Purpose Uncoded	£1
VP46	50	BC177/8 Type PNP Transistors Good Gen. Purpose Uncoded	£1
VP47	10	Silicon Power Trans. Similar 2N3055 Uncoded	£1.50

TRANSISTOR CLEARANCE

All Sorts Transistors. A mixed Bag NPN-PNP Silicon & Germ. Mainly Uncoded You To Sort Pack includes Instructions for Making Simple Transistor Tester. Super Value. Order No. VP60 100 for £1

REGULATED VARIABLE *Stabilised* POWER SUPPLY MODULE + KIT

Variable from 2-30 volts and 0-2 Amps. Kits includes –
1 – VPS30 Module. 1 – 25 volt 2 amp transformer.
1 – 0-50v 2" Panel Meter. 1 – 0-2 amp 2" Panel Meter.
1 – 470 ohm potentiometer. 1 – 4K7 ohm potentiometer. Wiring Diagram.
included Order No. VPS30 KIT **£20**

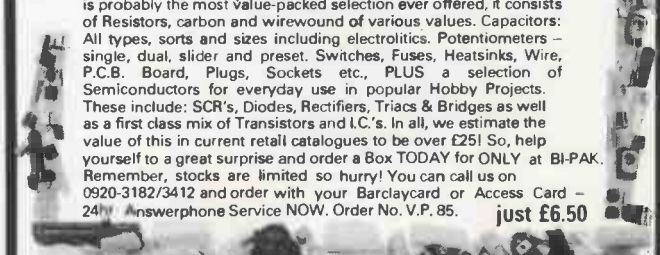
OUR GREAT NEW 1984 CATALOGUE

Presented with a Professional Approach and Appeal to ALL who require Quality Electronic Components, Semiconductors and other Accessories ALL at realistic prices. There are no wasted pages of useless information so often included in Catalogues published nowadays. Just solid facts i.e. price, description and individual features of what we have available. But remember, BI-PAK's policy has always been to sell quality components at competitive prices and THAT WE STILL DO.

We hold vast stocks "in stock" for fast immediate delivery, all items in our Catalogue are available ex stock. The Catalogue is designed for use with our 24 hours "ansaphone" service and the Visa/Access credit cards, which we accept over the telephone.

To receive your NEW 1984 BI-PAK Catalogue, send 75p PLUS 25p p&p to:

TECASBOTY *THE ELECTRONIC COMPONENTS AND SEMICONDUCTOR BARGAIN OF THE YEAR!*



This collection of Components & Semiconductors for the hobbyist is probably the most value-packed selection ever offered, it consists of Resistors, carbon and wirewound of various values. Capacitors: All types, sorts and sizes including electrolitics. Potentiometers – single, dual, slider and preset. Switches, Fuses, Heatsinks, Wire, P.C.B. Board, Plugs, Sockets etc., PLUS a selection of Semiconductors for everyday use in popular Hobby Projects. These include: SCR's, Diodes, Rectifiers, Triacs & Bridges as well as a first class mix of Transistors and I.C.'s. In all, we estimate the value of this in current retail catalogues to be over £25! So, help yourself to a great surprise and order a Box TODAY for ONLY at BI-PAK. Remember, stocks are limited so hurry! You can call us on 0920-3182/3412 and order with your Barclaycard or Access Card – 24hr Answerphone Service NOW. Order No. V.P. 85. **just £6.50**

BI-PAK

Send your orders to Dept HE5 BI-PAK PO BOX 6 WARE, HERTS
SHOP AT 3 BALDOCK ST. WARE, HERTS
TERMS CASH WITH ORDER. SAME DAY DESPATCH. ACCESS. BARCLAYCARD ALSO ACCEPTED. TEL (0920) 3182. GIRO 388 7006
ADD 15% VAT AND 75p 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 Total order.
Postage add 75p per Total order.

MAY 1984
Vol 6 No 5

Hobby Electronics

PROJECTS

FEATURES

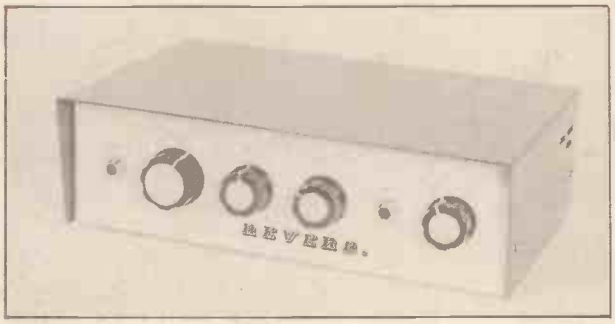
SPECIAL

REGULARS

No Forward Bias this month, – but don't worry. There are no errata for HE April, and if any appear, FB will report them next month.

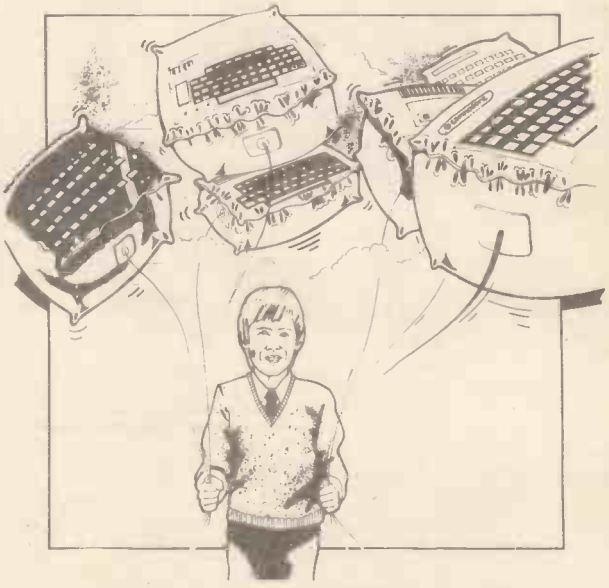
Editor: Ron Keeley
Deputy Editor: Helen P. Armstrong BA
Technical Editorial Assistant: Terry Johnson
Technical Illustrator: Jerry Fowler
Advertising Manager: Joanne James
Copy Control: Lynn Collis
Managing Editor: *Ron Harris BSc*
Chief Executive: T. J. Connell

We are not normally able to deal with technical enquiries by 'phone, so please don't ring. Write to us with an SAE.



Spring Reverb Unit — page 58

The Art And Science Of Metal Detection — page 45



Soft Options — A New Supplement — page 27

Hobby Electronics is normally published on the second Friday of the month prior to the cover date.
Hobby Electronics, No. 1, Golden Square, London W1R 3AB, 01 437 0626. Telex No 8811869. Published by Argus Specialist Publications Ltd.
Origination by Ebony Typesetting, Trion House, 13 Dean Street, Liskeard, Cornwall PL14 4AB.
Distributed by S. M. Distribution Ltd, 16/18 Trinity Gardens, London SW9 8DX.
Printed by The Garden City Press, Letchworth, Herts SG6 1JS. Covers printed by Alabaster Passmore.
Notice: The contents of this publication including all designs, plans, drawings and programs and all copyright and other intellectual property rights therein belong to Argus Specialist Publications Ltd. All rights conferred by the Law of Copyright and other intellectual property rights by virtue of international copyright conventions are specifically reserved to Argus Specialist Publications Limited and any reproduction requires the prior written consent of the Company. All reasonable care is taken in the preparation of the magazine to ensure accuracy, but Argus Specialist Publications Ltd cannot be held responsible legally. ©Copyright 1984 Argus Specialist Publications Ltd. Member of Audit Bureau of Circulation.

EUROPA ELECTRONICS

Mail Order to 160 High Road, Willesden, London NW10 2PB
TEL: 01-907 1659

SEND FOR A FREE LIST OF OUR LARGE RANGE OF ITEMS
ALL DEVICES ARE NEW, FULL SPEC AND GUARANTEED

Post & Packing: Add 30p to all orders under £5.
VAT: All UK orders add 15% to total cost including p&p.

74LS SERIES

74LS00	20p	74LS154	74p
74LS01	20p	74LS155	40p
74LS02	20p	74LS156	40p
74LS03	20p	74LS157	40p
74LS04	20p	74LS158	35p
74LS05	20p	74LS160	50p
74LS08	20p	74LS161	50p
74LS09	20p	74LS162	45p
74LS10	20p	74LS163	45p
74LS11	20p	74LS164	48p
74LS12	20p	74LS165	60p
74LS13	25p	74LS166	90p
74LS14	34p	74LS168	140p
74LS15	20p	74LS169	110p
74LS20	20p	74LS170	100p
74LS21	20p	74LS173	90p
74LS22	20p	74LS174	45p
74LS24	20p	74LS175	45p
74LS27	20p	74LS181	120p
74LS28	20p	74LS183	120p
74LS30	20p	74LS190	60p
74LS32	25p	74LS191	60p
74LS33	20p	74LS192	60p
74LS37	20p	74LS193	60p
74LS38	20p	74LS194	60p
74LS40	20p	74LS195	50p
74LS42	36p	74LS196	60p
74LS47	40p	74LS197	54p
74LS48	60p	74LS221	80p
74LS51	20p	74LS240	70p
74LS54	20p	74LS241	70p
74LS55	20p	74LS242	60p
74LS73	20p	74LS243	60p
74LS74	30p	74LS244	100p
74LS75	30p	74LS245	140p
74LS76	27p	74LS247	70p
74LS83	46p	74LS248	70p
74LS85	60p	74LS249	70p
74LS86	25p	74LS251	45p
74LS90	32p	74LS253	45p
74LS91	60p	74LS256	200p
74LS92	60p	74LS257	45p
74LS93	32p	74LS258	45p
74LS95	50p	74LS259	80p
74LS96	90p	74LS260	35p
74LS107	33p	74LS261	80p
74LS109	33p	74LS266	25p
74LS112	33p	74LS273	100p
74LS113	30p	74LS275	175p
74LS114	32p	74LS279	50p
74LS122	60p	74LS280	80p
74LS123	90p	74LS290	80p
74LS124	150p	74LS293	55p
74LS125	34p	74LS295	50p
74LS126	34p	74LS365	70p
74LS132	42p	74LS363	180p
74LS133	30p	74LS364	180p
74LS136	30p	74LS365	34p
74LS138	42p	74LS366	34p
74LS139	42p	74LS367	34p
74LS145	75p	74LS368	34p
74LS147	120p	74LS373	100p
74LS148	120p	74LS374	100p
74LS151	50p	74LS375	60p
74LS153	50p	74LS390	60p
		74LS393	120p

TRANSISTORS

AD161	42p
AD162	42p
BC107	10p
BC108B	12p
BC109	10p
BC109C	12p
BC177	16p
BC178	16p
BC179	20p
BC182L	10p
BC183L	10p
BC184L	10p
BC212L	10p
BC213L	10p
BC214L	10p
BC547	12p
BC548	12p
BC549C	14p
BC556	18p
BC557	18p
BC558	18p
BC559	15p
BFY50	23p
BFY51	23p
BFY52	23p
TIP29A	32p
TIP30A	35p
TIP31A	38p
TIP32A	38p
TIP33A	65p
TIP34A	74p
TIP41A	80p
TIP42A	88p
TIS43	32p
2N2646	45p
2N2904	28p
2N2905	28p
2N2906	28p
2N2907	28p
2N3053	26p
2N3055	48p
2N3702	10p
2N3703	10p
2N3704	10p
2N3705	10p
2N3706	10p
2N3707	10p
2N3708	10p
2N3709	10p
2N3819	22p
2N3903	18p
2N3904	18p
2N3905	18p
2N3906	18p
2N5457	30p
2N5458	30p
2N5459	30p

COMPUTER CHIPS

Z80A	320p
Z80ACTC	250p
Z80ADART	700p
Z80AP10	250p
Z80S10	910p
6802	225p
6821	100p
6840	375p
6850	110p
6852	250p
6875	500p
8085	450p
8154	850p
8156	350p
8212	100p
8216	100p
8226	270p
8250	850p
8253	390p
8255	255p
8259	400p

MEMORIES

2102-3L	120p
2114-2L	100p
2516	280p
2532	375p
2708	250p
2716	250p
2732	320p
4116-20	100p
4164-15	400p
4816-AP3	280p
8101	210p
8116P-3	350p
745188	190p
745288	180p
745387	228p
745474	400p

CRYSTALS

1MHZ	290p
2MHZ	225p
4MHZ	180p
8MHZ	180p
10MHZ	175p
16MHZ	200p

LINEAR IC's

741	16p
748	36p
CA3019	80p
CA3046	70p
CA3048	220p
CA3059	265p
CA3060	250p
CA3080	72p
CA3086	48p
CA3130E	90p
CA3130T	110p
CA3140C	90p
CA3140E	50p
CA3160E	100p
CA3161E	150p
CA3162E	450p
CA3189E	300p
CA3240E	110p
CA3280G	200p
LF347	150p
LF351	48p
LF353	85p
LF355	85p
LF356	85p
LF357	110p
LM301A	35p
LM310	120p
LM311	70p
LM318	180p
LM319	215p
LM324	30p
LM324Z	90p
LM335Z	140p
LM339	80p
LM348	65p
LM380	75p
LM381N	145p
LM382	115p
LM384	160p
LM386	90p
LM387	120p
LM389	95p
LM393	100p
LM3900	50p
LM3909N	65p
LM3911	125p
LM3914	280p
LM3915	280p
LM3916	280p
LM13600	110p
MC1310P	150p
MC1445	250p
MC1456	36p
MC1495L	350p
MC1496	70p
MC3340P	120p
MC3403	85p
NE531	140p
NE544	150p
NE555	16p
NE556	45p
NE564	420p
NE565	120p
NE566	155p
NE567	140p
NE570	410p
NE571	400p
NE592	80p
NE5534P	110p
TBA810	98p
TBA820	80p
TL061CP	40p
TL062	80p
TL064	95p
TL071/81	28p
TL072/82	45p
TL074	100p
TL084	90p
TL084	200p
TL170	50p
TL430C	70p
ZN414	80p
ZN419C	180p
ZN423E	130p
ZN424E	130p

4000 CMOS

4000	10p
4001	10p
4002	12p
4006	50p
4007	14p
4008	36p
4009	24p
4010	24p
4011	11p
4012	18p
4013	20p
4014	48p
4015	40p
4016	20p
4017	32p
4018	45p
4019	28p
4020	48p
4021	40p
4022	45p
4023	13p
4024	32p
4025	13p
4026	80p
4027	20p
4028	40p
4029	48p
4030	15p
4037	110p
4038	110p
4040	40p
4041	40p
4042	40p
4043	40p
4044	40p
4045	108p
4046	50p
4047	45p
4048	50p
4049	24p
4040	24p
4051	45p
4052	80p
4068	14p
4069	14p
4070	14p
4071	14p
4072	14p
4073	14p
4075	14p
4078	48p
4077	16p
4078	18p
4081	14p
4082	15p
4088	55p
4089	135p
4093	24p
4094	90p
4095	75p
4096	70p
4501	28p
4502	60p
4503	45p
4504	75p
4506	35p
4507	35p
4510	45p
4511	45p
4512	80p
4518	40p
4520	90p
4521	160p
4526	60p
4527	80p
4528	50p
4532	70p
4583	90p
4584	36p
4585	75p
40085	90p
40097	50p
40102	140p
40103	170p
40106	38p
40109	100p
40183	80p
40174	50p
40175	50p
40193	80p

VOLTAGE REGULATORS (PLASTIC) TO220

7805	40p	7905	45p
7812	40p	7912	48p
7815	40p	7915	48p
7818	40p	7918	45p
7824	40p	7924	48p

ISOLATORS

TIL74	130p
TIL74	240p
TIL112	70p
TIL113	70p
TIL116	70p

LED

	mm	mm
	3	5
Red	9p	10p
Yellow	12p	14p
Green	12p	13p

TYRISTORS

5A 400V	40p	C106D	38p
5A 600V	48p	TIC44	24p
8A 600V	90p	TIC45	28p
12A 400V	85p	TIC47	38p
BT106	150p	2N5062	32p
BT116	180p	2N5064	38p

TRIACS

3A/100V	48p	12A/100V	78p
3A/400V	58p	12A/400V	82p
8A/100V	60p	12A/600V	135p
8A/400V	69p	16A/100V	103p
8A/800V	115p	16A/400V	105p

7 SEGMENT DISPLAYS

DL704	90	TIL312	105
DIL707	90	TIL313	105
FND357	120	TIL321	115
FND500	115	TIL322	115

DIODES

OA47	8p
OA90	9p
OA91	9p
OA200	9p
OA202	9p
1N914	4p
1N916	7p
1N4148	4p
1N4001	5p
1N4004	6p
4007	7p

BRIDGE RECTIFIERS

1A50V	19p
1A100V	20p
1A400V	25p
2A100V	30p
2A400V	45p

ZENER DIODES

2·7-33V
400mW 8p

OPTO ELECTRONICS

2N577	40p	TIL78	55p
OCP71	180p	TIL31A	120p
ORP12	120p	TIL32	58p
ORP60	120p	TIL81	90p
ORP61	120p	TIL100	75p

ELECTROLYTIC CAPACITORS

(Axial & Radial) Values in uF
63V: 1, 2.2, 3.3, 4.7, 6.8, 10 6p; 15, 22, 33 8p
40V: 330, 470 45p; 1000 48p; 2200 70p
25V: 47, 100 8p; 220, 330, 12p; 470 25p; 680 1000 34p; 220 90p; 4700 92p
16V: 470 14p; 1000 20p
10V: 1000 15p; 2200 25p

POLYESTER CAPACITORS (Radial) 250V
10n, 15n, 22n, 33n, 47n 6p; 68n, 100n 8p; 150n, 220n, 330n 10p; 470n 15p; 680n 20p; 1000n 25p

MYLAR FILM CAPACITORS (Radial) 100V
1n, 1n5, 2n2, 3n3, 4n7, 6n8, 10n 6p; 15n, 22n, 33n, 47n 8p

CERAMIC CAPACITORS 50V Radial Lead
22pF–47,000pF £12 Values 4p

POTENTIOMETERS

Carbon track, 0·25W log & linear
5K-2M single gang 30p
5K-2M single gang D/P switch 75p
5K-2M dual gang stereo 88p

PRESET POTENTIOMETERS
Horizontal & Vertical
0·1W 100R-1 Meg 7p
0·25W 100R-1 Meg 10p

RESISTORS 5% Carbon Film
E12 values
0·25W 1R-5M1 1p
0·5W 1R-5M1 1·8p

SWITCHES

Slide ST
DPDT 14p
DPDT c/off 15p

Sub-min Toggle
SPST on/off 54p
SP c/over 80p
DPDT 75p
DPDT c/off 88p

Push Button
Push to Make 15p
Push to Break 25p

RIBBON CABLE

Grey/meter

10 way	40p
16 way	60p
20 way	85p
26 way	120p
34 way	160p
40 way	180p
50 way	200p
64 way	280p

DIL SOCKETS

Pin	Low Prof	Wire Wrap
8	8p	25p
14	10p	38p
16	10p	40p
20	22p	50p
24	24p	65p
40	30p	100p

D-CONNECTORS

No of Ways	9	15	25	37
Male				
Solder	80p	105p	160p	250p
Angled	150p	210p	250p	365p
Female				
Solder	105p	180p	200p	335p
Angled	185p	215p	290p	440p
Hoods	90p	85p	90p	100p

EURO CONNECTORS

	Plug	Skt
DIN 41617		
21 way	160p	165p
31 way	170p	170p
DIN 41612		
2x32 way St. Pin	220p	275p
2x32 way Ang. Pin	275p	320p
3x32 way St. Pin	260p	300p
3x32 way Ang. Pin	375p	350p

DIL HEADERS

	Solder type	IDC type
14 pin	40p	100p
16 pin	50p	110p
24 pin	100p	150p
40 pin	200p	275p

TRANSFORMER

Min Split Bobbin
Primary 240V
Second 6-0-6
9-0-9, 12-0-12
PCB Mounting

3VA	200p
6VA	270p
Standard	
6VA	220p
12VA	295p
24VA*	330p

VEROBOARDS

	clad	plain
2½ x 3¾"	73p	52p
2½ x 5"	83p	—
3¾ x 3¾ .83p		
—		
3¾ x 5"	95p	79p
3¾ x 17"	325p	211p
4½ x 18"	425p	—
Pkt of 100 pins		50p
Spot face Cutter		119p
Pin insertion tool		182p

ALUM BOXES

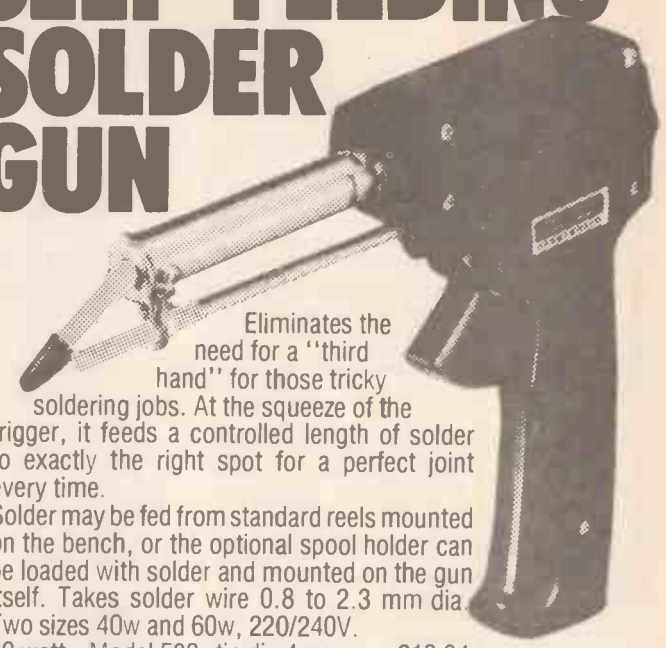
3 x 2 x 1"	65p
4 x 2¼ x 2"	85p
4 x 2¾ x 2½"	103p
4 x 6 x 2"	105p
4 x 4 x 2½"	120p
5 x 4 x 1½"	98p
5 x 6 x 2½"	120p
5 x 2¾ x 1½"	80p
5 x 2¾ x 2½"	130p
6 x 4 x 2"	120p
6 x 4 x 3"	150p
7 x 5 x 3"	180p
8 x 6 x 3"	210p

PLUGS AND SOCKETS

	Plugs	Skts
¼" Mono	220p	200p
¼" Stereo	30p	25p
3·5mm Mono	12p	15p
3·5mm Metal	20p	
2·5mm Mono	12p	15p
2·5mm Metal	20p	
Phon plastic	15p	16p
Metal	20p	

Retail Shop: North Parade Electronics, Mollison Way, Edgware, Middlesex.

SELF-FEEDING SOLDER GUN



Eliminates the need for a "third hand" for those tricky soldering jobs. At the squeeze of the trigger, it feeds a controlled length of solder to exactly the right spot for a perfect joint every time.
Solder may be fed from standard reels mounted on the bench, or the optional spool holder can be loaded with solder and mounted on the gun itself. Takes solder wire 0.8 to 2.3 mm dia.
Two sizes 40w and 60w, 220/240V.

40 watt Model 583 tip dia 4mm — £19.84
60 watt Model 585 tip dia 6mm — £20.29
Spool Holder (fits either model) — £ 3.13

Prices include P&P and 15% VAT. Send order with cheque/PO. Ring for Access/Visa sales, or ask for order forms.

LITESOLD

LIGHT SOLDERING DEVELOPMENTS LTD Dept HE, Spencer Place, 97-99 Gloucester Road, Croydon CR0 2DN. 01-689 0574

19" Rack Mounting Cabinet

Only £15.99

(Including post, packing and VAT)

Make your next project in one of our superb 19" Rack Mounting Cabinets. Your equipment will be totally accessible by way of the removable top, bottom and rear covers. The professional quality cabinet has a heavy duty grey paint finish, and the front panel is of heavy guage 3mm aluminium. The heavy guage chassis mounting plate is pre-drilled, and has four mounting positions to choose from. There are a choice of front panels availble, either brushed aluminium, or matt black finish. A pair of chromed handles are incorporated on the front panel, and for bench mounting, a set of rubber feet are supplied.

DIMENSIONS
MOUNTING PANEL: 480 x 150 mm.
REAR CASE: 425 x 140 x 250 mm.

Send Cheque/Postal Order to:

VAN GELDER (UK) LIMITED
Unit 1, South Road, Southend Airport
Southend-on-Sea, Essex SS2 6YG

Barclaycard and Access accepted. Please quote number.
Credit Card Hotline — Telephone (0702) 548681

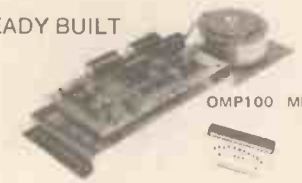
BSR P256 TURNTABLE

P256 turntable chassis ● S shaped tone arm ● Belt driven ● Aluminium platter ● Precision calibrated counter balance ● Anti skate (bias) device) ● Damped cueing lever ● 240 volt AC operation (Hz) ● Cut out template supplied ● Completely manual arm. This deck has a completely manual arm and is designed primarily for disco and studio use where all the advantages of a manual arm are required

Price £32.35 each. £2 50 P&P

OMP POWER AMPLIFIER MODULE

READY BUILT



Vu meter.

New model.
Improved specification

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

SPECIFICATION

Output Power:— 110 watts R.M.S.
Loads:— Open and short circuit proof 4/16 ohms.
Frequency Response:— 15Hz - 30KHz - 3dB
T.H.D.:— 0.01%.
S.N.R. (Unweighted):— - 118dB ± 3.5dB.
Sensitivity for Max Output:— 500mV at 10K.
Size:— 360 X 115 X 72mm. Price:— £31.99 + £2.50 P&P. Vu Meter Price:— £8.50 + 50p P&P.

MOS-FET HIGH SPEC. MODULES

MOS-FET VERSIONS AVAILABLE UP TO 300 W. R.M.S.
100 Watt 300mm X 123mm X 60mm Price: £39.99 + £2.50 P&P.
200 Watt 300mm X 150mm X 100mm Price: £62.99 + £3.50 P&P.
300 Watt 330mm X 147mm X 102mm Price: £79.99 + £4.50 P&P.

PANTEC

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 X 46 X 14mm (9 volt) Price: £7.99 + 75p P&P.

3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled, professional performance. Range up to 3 miles 35 X 84 X 12mm (12 volt) Price: £12.49p + 75p P&P.

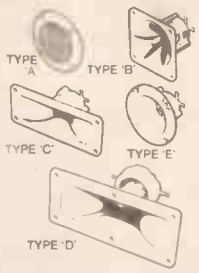
SINGLE CHANNEL RADIO CONTROLLED TRANSMITTER/RECEIVER 27MHZ Range up to 500 metres. Double coded modulation. Receiver output operates relay with 2amp/240 volt contacts. Ideal for many applications. Receiver 90 X 70 X 22mm (9/12 volt). Price: £16.49. Transmitter 80 X 50 X 15mm (9/12 volt). Price: £10.29 P&P + 75p each. S.A.E. for complete list.

3 watt FM Transmitter

PIEZO ELECTRIC TWEETERS — MOTOROLA

Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). **FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.**

LARGE S.A.E. For details of disco mixers, speakers, kits, amp - modules, buglar alarms, turntables, etc.



TYPE 'A' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-fi speakers. Price £4.29 each + 30p P&P.

TYPE 'B' (KSN1005A) 3½" super horn. For general purpose speakers, disco and P.A. systems etc. Price £4.99 each + 30p P&P.

TYPE 'C' (KSN6016A) 2" X 5" wide dispersion horn. For quality Hi-fi systems and quality discos etc. Price £5.99 each + 30p P&P.

TYPE 'D' (KSN1025A) 2" X 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. Price £7.99 each + 30p P&P.

TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-fi monitor systems etc. Price £4.99 each + 30p P&P.

LOUDSPEAKERS POWER RANGE

THREE QUALITY POWER LOUDSPEAKERS (15", 12" and 8" See Photo). Ideal for both Hi-Fi and Disco applications. All units have attractive cast aluminium (ground finish) fixing escutcheons. Specifications and Prices.

15" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 20 Hz. Freq. Resp. to 2.5KHz. Sens. 97dB. Price: £34.00 each + £3.00 P&P

12" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 25Hz. Freq. Resp. to 4 KHz. Sens. 95dB. Price: £24.50 each + £3.00 P&P

8" 50 watt R.M.S. Impedance 8 ohms. 20 oz. magnet. 1½" aluminium voice coil. Res. Freq. 40Hz. Freq. Resp. to 6 KHz. Sens. 92dB. Black Cone. Price: £9.50 each. Also available with black protective grille. Price: £10.50 each. P&P £1.50.

12" 85 watts 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 £24.99 + £3 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 £24.99 + £3 carriage.

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 £49 + £4 carriage. Cabinets fixings in stock S.A.E.

★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Sales Counter. ★

B. K. ELECTRONICS

UNIT 5, COMET WAY, SOUTHEND-ON-SEA, ESSEX. SS2 6TR TEL: 0702-527572

VISA

B.N.O.S. ELECTRONICS

"NiCAD Batteries"

We can supply, from stock, quality batteries from one or more of the following companies: Ever Ready, Saft and Hitachi, at unbelievable prices and a complete range of chargers.

ALL THESE PRODUCTS CARRY A FULL YEAR'S GUARANTEE

NiCAD Batteries

Format	Capacity (AH)	Height (mm)	Diameter (mm)	Prices 1-9	10-24	25-99
AAA	0.18	45.0	10.5	1.34	1.27	1.22
⅓AA*	0.10	18.0	14.3	1.58	1.50	1.44
⅓AA*	0.24	28.1	14.3	1.45	1.37	1.32
AA	0.50	50.2	14.3	0.90	0.85	0.82
AA*	0.50	50.2	14.3	0.96	0.91	0.88
½A*	0.45	28.1	17.3	1.53	1.45	1.38
RR*	1.20	42.1	22.6	1.70	1.61	1.52
C	2.20	49.7	25.9	2.40	2.30	2.20
D (sub)	1.20	60.5	32.9	2.40	2.30	2.20
D	4.00	60.5	32.9	3.50	3.32	3.15
D*	4.00	60.5	32.9	3.59	3.41	3.24
F*	7.00	91.3	32.9	6.85	6.50	6.20
SF*	10.00	91.3	41.7	10.50	9.50	8.90
PP3	0.11	49 × 26.5 × 17.5		4.35	4.10	3.85

* Denotes cell fitted with solder tags

NiCAD Chargers

AC.1 SAFT MAZDA AA charger, charges 1 to 4 AA cells £5.75 PC.3 SAFT MAZDA PP3 charger, charges 1 or 2 PP3 cells £5.75 MC.4 JECKSON MULTICHARGER, charges 2 or 4 AA, C or D cells £7.00 MC.6 SAFT MAZDA MULTICHARGER, charges 1 to 4 AA, C or D cells, or 1 or 2 PP3 cells £8.75

BNOS Electronics (Dept HE) Bigods Hall, Great Dunmow, Essex CM6 3BE
Telephone (0371) 4677

All prices include VAT. Postage is free on all UK orders sent with cash over £5. for UK orders under £5. please add 60p to order total.
Trade enquiries welcomed

BARCLAYCARD VISA

MONITOR

Sound Advice

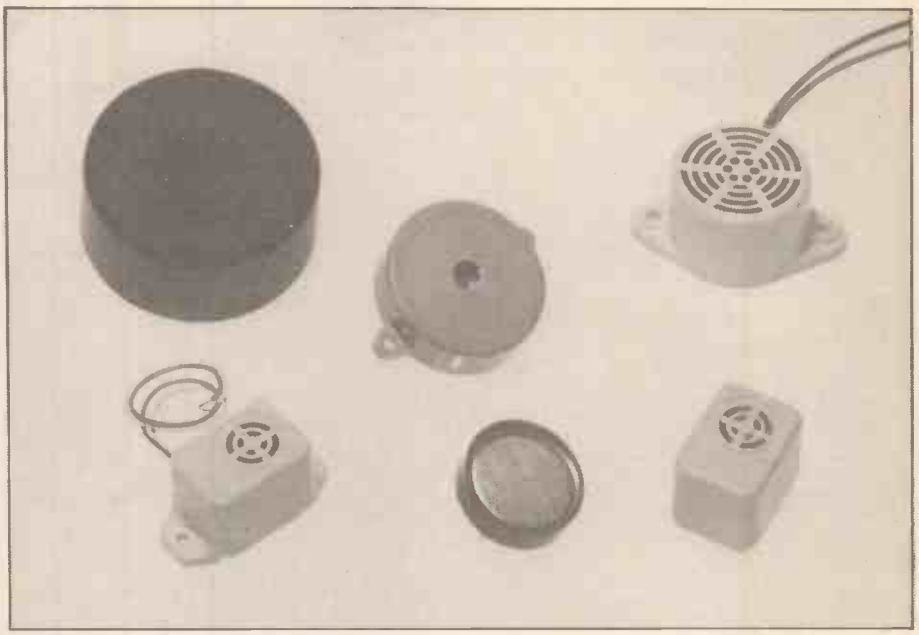
Stotron are now able to supply an improved range of **alarms,** including miniature and subminiature solid state electronic buzzers for direct PCB use or panel mounting and types that can be mounted in a fourteen pin dip socket.

These electronic buzzers are ideal for many applications, such as personal alarms, office and factory equipment or industrial vehicles etc. Even projects, would you believe.

Standard and miniature piezo ceramic alarms are available for PCB, panel or chassis mounting and are capable of producing continuous or intermittent sound, and some types give a cricket or warble **effect.** A small plastic PCB mount retainer can be used to convert certain PCB mounts alarms to panel mounts; this also improves tone and output.

Two ranges of sound transducer are also stocked, offering many different sounds ideal for the reproduction of complex audio signals such as voice or multiple frequencies. The small size and low weight of these facilitate portable and miniature applications.

For further information contact **Stotron Ltd., 72 Blackheath Rd., Greenwich, London SE10 8DA. Tel: 01 691 2031.**



Wide Ranging Tester

Fieldtech Heathrow has recently introduced a **capacitor and inductance tester** designated the LC53. The unit provides the engineer with a range of test functions never previously available in one unit, Fieldtech claim that the unit is unique because it is the only tester on the market which will dynamically test capacitors, coils, SCRs and Triacs and will find an amazing 75% of defective capacitors which value-only meters will miss.

The LC53 is fast with 100% automatic ranging. It tests capacitors for leakage current under full load, with up to 600V applied. It checks capacitor dielectric absorption, and has the capability to reform electrolytics. It will check for all coil defects in or out of circuit, and automatically tests coils for effective Q using a US-patented ringing test. It tests transmission lines for distance to open or short circuits within feet, and it will also test dielectric strength to 600V. It may also be used for hi potential leakage tests up to 600V. The unit is already being successfully used in major electronics companies giving broadcast, TV and video engineers quick reliable results with a unique range of test functions.

For further details please contact **Fieldtech Heathrow Ltd., Huntavia House, 420 Bath Road, Longford, Middx UB7 0LL. Tel: 01 897 6446.**

Upmarket Monitor

Zeal Marketing are now agents for Microvitec **monitors.** The model 1431-MZ is compatible with the ZX Spectrum QL, along with a sound output which allows the bangs and thumps of games programs to be deployed to full advantage, as well as providing a key bleep if required.

The unit costs £299.00 all inclusive.

Enquiries to **Zeal Marketing Ltd., Vanguard Trading Estate, Storforth Lane, Chesterfield, Derbyshire S40 2TZ. Tel: (0246) 208555.**

Graphic Colours

Encountered at an electronics games fair: a computer which analyses your personality by analysing your colour preferences. You pays your money, you fill in a card which contains eight printed colour samples, in the order in which you like the colours you see at the time that you see them. (This is very important: according to the theory, your colour preferences alter according to the mood you are in and in general how you feel.) The figures are fed into the computer, which then produces a neat little printout to tell you what sort of person you are.

Sounds daft? It's not as daft as it sounds: colours, especially primary colours, have been shown to have quite a dramatic effect on the way you feel, and vice versa: your mood can influence the way you respond to certain colours. There is actually something about the structure of the eyeball which causes the colours (red and blue) at the opposite ends of the visible spectrum to have a very different 'feel' to them (most people see red as warm and exciting, blue as cool and quiet), and a host of associations (red with fire, yellow with the sun, dark blue with night time, etc.), which are fairly universal, which cause us to respond to different colours in different ways.

The colour test used by this computer is based on the Luscher colour test, which is now used in the USA for doing quick 'personality tests' on people applying for jobs, etc. (and, incidentally,

MONITOR

on people undergoing psychiatry . . .). The theory is that your preference for one colour as opposed to another tells certain things about your outlook, and also that well-balanced personalities show a consistent preference for the four 'psychological primaries' (so-called by psychologists because most people distinguish them as the 'basic' colours) red, yellow, dark blue, and deep green, with a lower preference for subdued n, the 'mixed' colour violet, dull grey, or black.

The assessment is made not only by the order of preference but by the combinations in which they appear.

Dr. Luscher himself developed a 'long test' for detailed analysis containing 27 colours and many combinations. The eight-colour test is the abridged version for easy use. It used to be a popular party

What you get from the colour computer (unsurprisingly, since it's designed entirely for entertainment) is the abridged version of the abridged version. It is, however, suitably dramatic. Try this: *You are a rare person . . . you can be looked up to and recognized as a leader.* And for my husband: *You enjoy the challenges of life for you know you can conquer any situation and make it a rewarding experience.* That's what I call money's-worth.

There are supposed to be over 43,000 different combinations; we found we had one comment in common out of five apiece, although our preferences weren't very similar.

But what the heck. It's just a game, and it gives you something you can frame. You want to get *into* it, man, read the book*. The system was being distributed by **Computamania, 34 Leicester Lane, Great Bowden, Market Harborough, Leics LE16 7HA. Tel: (0858) 65851**. Meanwhile, I'm going to nip off and appreciate some beauty, work in co-operation with someone and get recognized as a leader. Perhaps by next month I'll be editor . . .

*The book, incidentally, is *The Luscher Colour Test* by Dr. Max Luscher, Pan Books, 1971, Ed. I. Scott.

Speak To Me

Crimson Electrik have appointed **Wimslow Audio Ltd.** as distributors of their well known range of hifi kit amplifiers and amplifier modules.

The range includes two and three way active crossover modules in a choice of fourteen standard frequencies. Modules for non-standard frequencies can be supplied to order within seven days.

Leaflets, price lists and reviews are available free of charge (send a large SAE) from **Wilmslow Audio Ltd., 35-39 Church St., Wilmslow, Cheshire SK9 1AS. Tel: (0625) 529599.**

Portable Oscilloscope

A new general purpose dual trace **oscilloscope** announced by **Bridage Scientific Instruments Ltd.** costs less than £200 (ex VAT). Small and highly portable, the DB242 is suitable for laboratories radio and TV maintenance, hi-fi enthusiasts and radio hams.

Speed and simplicity of use are important features. This is apparent in the display in which a medium persistence phosphor gives good trace readability on the 60 x 50mm display screen on which a calibrated graticule is superimposed. Considerable time savings are achieved using the trace location button which returns over-scanned traces to the screen regardless of the setting of other operating controls and the auto brightline triggering system.

A cheaper single trace version, the Bridage SB121, is also available. The general specification is similar but without the twin channel facilities.

Enquiries to **Bridage Scientific Instruments Ltd., 63-65 High St., Skipton, N. Yorks BD23 1EF. Tel: (0756) 69511.**

Multi Modem

All major World communications standards are supported by the WS2000 **Modem** now available from **Minor Miracles Ltd.** of Ipswich. Switchable to 300 Baud full duplex, 600 half duplex, 1200 half duplex and 1200/75 back-channel (Prestel standard) PLUS both Bell (USA) and CCITT (UK-Euro) standards, WS2000 costs £99.95 plus VAT and carriage.

Special features include reverse 1200/75 Baud operation, so that WS2000 may communicate with dedicated Prestel/Micronet/Viewdata terminals — a capability of considerable interest to dial-in-database operators. With the optional plug-in Auto-Dial/Auto-Answer Board (£39.00 plus VAT) and a special control lead set (£9.50 plus VAT) this modem can be set up to answer the 'phone line, scan the incoming carrier and set itself to that standard before putting the computer on line.

WS2000 is delivered complete with British Telecom modular line cord and plug, and parallel telephone socket on the back panel of the Modem. RS232 interface is standard, plus full in-built self-testing and mains power supply. Case size is 16 x 15 x 7 cms. The

Enquiries to: **Minor Miracles Ltd., PO Box 48, Ipswich IP4 2AB. Tel: (0473) 50304.**

MONITOR

EPROM Services

EPROM Services are a company based in Leeds who offer a series of add-ons and EPROM boards for the ZX Spectrum and ZX81, including PROM programmers, EPROM cartridges, preprogrammed EPROMS, a programming and copying service, I§O cards and various other things.

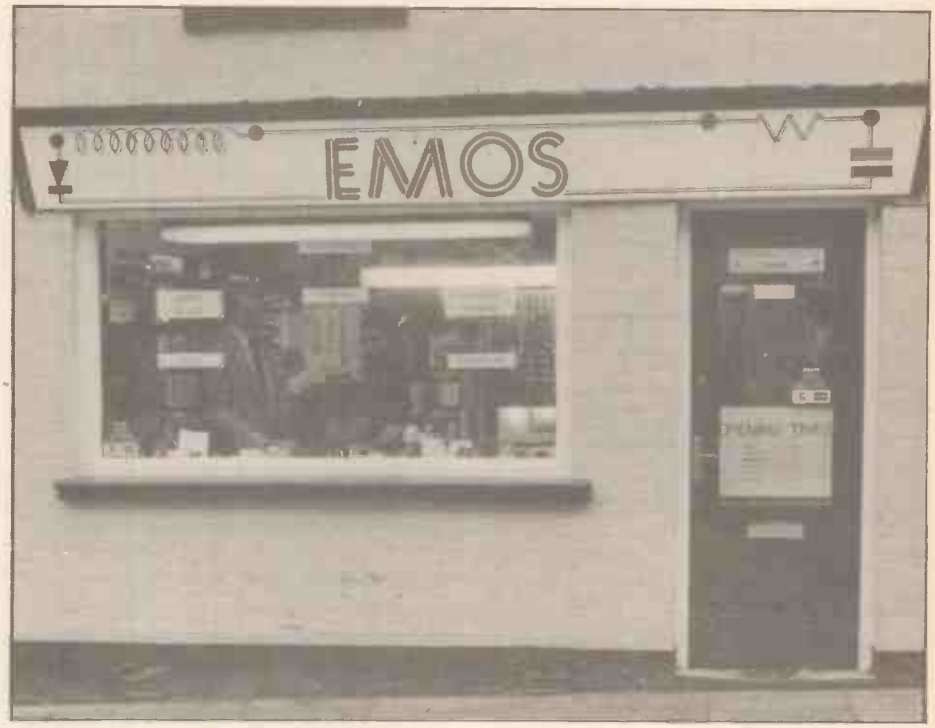
For lists and a price list contact **EPROM Services, 3 Wedgewood Drive, Roundhay, Leeds LS8 1EF. Tel: (0532) 667183.**

New Shop

A new **electronics and computer shop** has opened in Daventry, selling components and accessories. The company, **EMOS**, formerly operated from a warehouse on a local industrial estate, but have found that there is enough demand to support a shop. They intend to stock electronics products from plugs to microcomputers, as well as giving advice.

The EMOS shop will be open from 9am to 5pm every day except Thursdays and Sundays, and they will also run a mail order service.

More information from **David Ashwell, EMOS Ltd., 17 Sheaf St., Daventry, Northants. Tel: (03272) 5524.**



3in Software

Four major software companies have announced plans to release software for the BBC Micro on the new Hitachi 3in disc drive system marketed by Advance Memory Systems.

Gemini Marketing Ltd., 18a Littleham Rd., Exmouth, Devon EX8 2QG will be doing a series of accounting packages, much of which will be available through W. H. Smiths.

Clares Micro Supplies, 98 Middlewich Rd., Exmouth, Devon EX8 2QG will be doing a series of accounting packages, much of which will be available through Boots.

Bourne's Educational Software, Bourne House, The Hundred, Romsey, Hants SO5 8BY will be doing mostly educational software, as will **Beebug Soft, PO Box 109, High Wycombe, Bucks HP11 2TD.**

Amateur Television Club

For anyone in the London area interested in **Amateur Television**, the **Home Counties Amateur Television Group** meet at Richings Park Sports and Social Club, Iver, Bucks at 8.30pm every fourth Wednesday of the month.

Talk-in is provided on 145.200Mhz. The group operates slow and fast scan monochrome and colour TV on HF, plus 70cm, 23cm and 10GHz. Future meetings include a talk on Video Recorders (25th April), a talk on Slow Scan TV (23rd May), an outside activity night on 70cm and 23cm (27th June) and a Slow Scan Operating Evening (25th July).

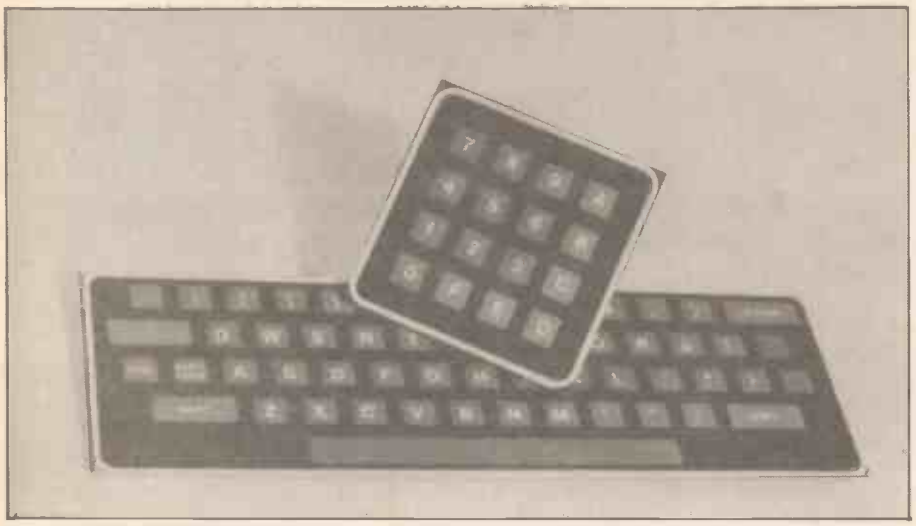
For further information contact **P. W. Andrews G6MNJ, Secretary, The Home Counties Amateur Television Club, 4 Greensward, Kings Court, Ashfield Ave., Bushey, Herts WD2 3HQ.** Like most clubs, the HCATG would probably appreciate an SAE with enquiries.

Maplin Magazine

Maplin have a number of new products in their latest magazine (Electronics — The Maplin Magazine, March-May, 70p), including a battery operated kit called the Easyload, for the ZX Spectrum, which is designed to eliminate difficulties in cassette data loading: an "Extendiport" kit for the Dragon 32 to allow the Dragon's central socket to be moved to a more accessible position, and an interface to connect the Oric 1 to a Maplin modem.

There are also kits and information concerning amateur radio and in-car electronics, Heathkit educational courses price bonanza on Atari software, and a prize reader survey draw.

Enquiries to **The Editor, Doug Simmons, The Maplin Magazine, PO Box 3, Rayleigh, Essex SS6 8LR. Tel: (0702) 554155.**



Membrane Keyboards

Semiconductor Supplies is supplying two membrane keyboards: a 350x100 x2mm QWERTY, and a 16-way 0-9/A-F measuring 100x100x2mm.

The keyboards consist of glass fibre PCBs faced with a tough, colour-printed polycarbonate film, which makes a silver-plated contact when lightly touched. The QWERTY keyboard has a matrix output via a 16-pin DIL socket; the 16-way board connections are via seventeen pins, one common.

The prices for the boards are £17.75 and £7.90 respectively, all-inclusive. Enquiries to **Semiconductor Supplies International Ltd., Dawson House, 128/130 Carshalton Rd., Sutton SM1 4RS. Tel: 01 643 1126.**

Phree-Phlowing Phloops

Users of the BBC Micro attempting to make the choice between cassette and disc storage are now confronted with a third alternative: a **PHLOOPY cartridge.**

The PHLOOPY drive's motor drives **Phi Mag Systems,** claim has most of the features of a floppy disc, plus other advantages, for half the price, is a flat cartridge of about the same depth as an audio cassette, and twice the volume. Instead of containing reeled tape, the cartridge has a continuous tape loop, twelve feet long, which 'snakes' around the inside of the cartridge. This avoids the need for tape lubricant, which can impair the action of the tape heads.

An innovation in this design, as opposed to other tape-loop drives developed in the past is that a special record head, developed by Phi Magnetronics, records nine tracks side-by-side on ¼in instrumentation tape, instead of serially along the length of the tape (a similar breakthrough to that which allowed the practical production of video cassettes). This allows the cartridge to use twelve feet of tape, instead of over one hundred feet.

The PHILOOPY drive's motor drives the tape at 15in per second; PHLOOPY typically takes 3 to 4 seconds to fill a file and load/save it. The transfer rate is 10Kb per second, up to two hundred times faster than for a cassette.

The PHLOOPY drive also has its own microprocessor-controlled error correction system. Extra codes are recorded which allow errors to be picked up and corrected automatically. The machine's on-board microprocessor also copes with file handling, instead of using up space on the BBC, and so uses about half as much of the BBC RAM as many disc systems. The Loop Filing System uses standard BBC Filing System and BASIC program commands, as well as its own utilities.

Phi Mag also claim that there is no risk of data corruption if a cartridge is removed from the drive while it is working, and also say that it is completely compatible with most existing cassette or disc-based programs.

Where's the catch? The catch is that to connect the PHLOOPY, a minor modification — very minor, the disconnection of two resistors — has to be made to the BBC main board. What you feel about that will depend on whether or not you like opening computers and how old your machine is (ie whether or not it is still under the manufacturer's gurantee).

PHLOOPY is expected to be available from around mid-May, priced around £113.85 inc. VAT, with an interface for the BBC which runs up to eight drives, priced around £29.90 inc. VAT. A single PHLOOPY gives 100K of storage.

Enquiries to **Phi Mag Systems Ltd., Tregoniggie Industrial Estate, Falmouth, Cornwall TR11 4RY. Tel: (0326) 76060.**

Jupiter Sighted Again

For those of you who are wondering what will be the fate of their Jupiter ACE micros now that Jupiter Cantab has gone into liquidation.

The beginnings of an answer have arrived from **Boldfield Ltd. Computing, of Sussex House, Hobson St., Cambridge. Tel: (0487) 840740.** Boldwood have bought up the remaining stocks of the ACE and are marketing them at a big discount on the original prices. Better, Boldfield say that they are going to attempt to arrange for better software support, and a range of peripherals for the ailing micro.

The ACE will be available, by mail order only, from Boldfield at the following prices:

ACE plus power supply, manual, demo cassette, leads and twelve month guarantee: £33.35 inc VAT and p&p; 16K RAM pack: £26.45 in VAT and p&p; both together: £54.05 inc VAT and p&p. The software cassettes are £3.00 each — no inclusive price has been quoted for these.

HE

H.E. PROJECT KITS

I.C.s TRANSISTORS CAPACITORS TOOLS RESISTORS HARDWARE CASES KITS PCBs

MAGENTA

Full Kits inc. PCBs, hardware, electronics, cases (unless stated). Less batteries.
If you do have the issue of H.E. which includes the project — you will need to order the Instruction reprint as an extra — 50p each. Reprints available separately 50p each + p&p 50p.

ANALOGUE TEST SET (less speaker) April 1984 £25.89
TIME OUT April 84 £20.79
OFFBEAT METRONOME Mar 84 £12.79
LIGHTNING CHESS TIMER Mar 84 £12.99
INFRA-RED CAMERA CONTROL Feb 84 £17.49
C.B. FIELD STRENGTH METER Feb 84 £14.15
BASSMAN Dec 83 (with PCB) £10.38
CONTINUITY TESTER Dec 83 £5.55
MOISTURE GUAGE Dec 83 £10.98
ULTRASONIC INTRUDER ALARM no case Oct 83 £14.85
WHISTLE SWITCH Aug 83 less mic £19.98
STEREO SPREADER July 83 £6.36
SINCLAIR SOUND BOARD Jun 83 less case £18.98
BAT LIGHT (car battery indicator Jun 83 less case £5.48
TTL LOGIC PROBE June 83 £8.78
AUTO TESTER May 83 £7.35
STALL THIEF May 83 (Inc relay) £12.36
STEREO VOICE OVER UNIT April 83 £19.27
OPTIONAL MIC PRE AMP April 83 (no case) £4.69
PHASE FOUR Dec 82 £20.58
STEREO NOISE GATE Dec 82 £16.88
TAPE/SLIDE SYNCHRONIZER Dec 82 £23.90
ODOMETER Nov 82 £16.48
ZX INTERFACE BOARD Sept 82 inc edge con 3@12.46
AUTO WAH June 82 **20.88** case **£13.51**
AUTO GREENHOUSE SPRINKLER June 82 less pump and power supply £15.82
ECHO REVERB UNIT May 82 Less case £38.48
Economy case WB3 £3.75 extra
DIGITAL THERMOMETER May 82 including case + bezel £18.59
AUDIO SIGNAL GENERATOR May 82 £22.98
CABLE TRACKER May 82 £10.98
DIGITAL CAPACITANCE METER Apr 82 £23.10
SIGNAL TRACER Apr 82 £4.25
BIKE ALARM Apr 82 £13.99
DIGITAL DICE Mar 82 £7.99
NOISELESS FUZZBOX Feb 82 £11.98
MASTHEAD AMPLIFIER Feb 82 £16.10
DRUM SYNTHESIZER Dec 81, Full kit £25.37
GUITAR HEADPHONE AMPLIFIER Dec 81 £4.12
IN CAR CASSETTE POWER SUPPLY Dec 81 £5.25
SCRATCH FILTER Nov 81. Mono £6.48
Stereo £9.80
LED VU METER Nov 81 less case £5.35
SIMPLY STYLUS ORGAN Nov 81 less case £5.48
METRONOME Nov 81 £13.98
TELEPHONE BELL REPEATER Oct 81 £15.15
Med linking wire extra 14p meter
COMBINATION LOCK Oct 81 less case £19.98
'DIANA' METAL LOCATOR Sept 81 £37.50
VARIABLE BENCH POWER SUPPLY Aug 81 £29.48
ULTRASOUND BURGLAR ALARM July 81 £21.98
ELECTRONIC DOOR BUZZER July 81 £6.48
ELECTRONIC METRONOME July 81 £5.48
CONTINUITY CHECKER June 81 £6.60
ENVELOPE GENERATOR June 81 £19.48
PUBLIC ADDRESS AMPLIFIER March 81 £21.48
Extras — horn speakrs **£6.35** each PA MIC **£4.95**
FUZZBOX March 81 £11.98
WINDSCREEN WIPER CONTROL March 81 £8.98
STEAM LOC WHISTLE March 81 £14.38
PHOTOGRAPHIC TIMER March 81 £3.85
HEATBEAT MONITOR Feb 81 £27.50
TWO-TONE TRAIN HORN Feb 81 £6.16 less case
MEDIUM WAVE RADIO Feb 81 £8.98
CHUFFER Jan 81, less case £8.25
BATTERY CHARGE MONITOR Dec 82 £6.34
MEMORY BANK-MINI SYNTHESISER Nov & Dec 80 £36.48
TRANSISTOR TESTER Nov 80 £7.25 inc test leads
GUITAR PRE-AMP Nov 80 £7.25
case extra £2.29
INTRUDER ALARM Oct 80 £23.10
TOUCH SWITCH Sept 80 £2.99 less case & contacts
GUITAR PHAER Sept 80 £17.88
SOUND OPERATED FLASH TRIGGER July 80 no skt £5.83
FOG HORN June 80 £7.30
SPEED CONTROLLER FOR R/C April 80 £19.20 (less case)
DIGITAL FREQUENCY METER April 80 £43.98
GUITAR TUNER Nov 79 £14.10
CAR ALARM Feb 79 £14.20

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

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.
FREE to Schools/Colleges requested on official letterhead.

SOLDERING/TOOLS

ANTEX X5 SOLDERIN IRON 25W £6.29
SOLDERING IRON STAND £2.18
SPARE BITS. Small, standard, large, each. For X5+X25 £1.04
SOLDER. Handy size £1.38
SOLDER CARTON £2.50
DESOLDER BRAID 69p
HEAT SINK TWEEZERS 35p
DESOLDER PUMP £6.48
HOW TO SOLDER LEAFLET 13p
LOW COST CUTTERS £1.69
LOW COST LONG NOSE PLIERS £1.68
WIRE STRIPPERS & CUTTERS £2.88
PRECISION PETITE £12.80
12V PCB DRILL £8.78
DRILL STAND £1.76
VERO SPOT FACE CUTTER £2.52
PIN INSERTION TOOL 65p
VEROPINS (pk of 100 0.1") £5.85
MULTIMETER TYPE 1 (1,000 opv) £2.85
CROCODILE CLIP TEST LEAD SET. 10 leads with 20 clips £1.15
RESISTOR COLOUR CODE CALCULATOR 23p
CONNECTING WIRE PACK TYPE ED. 11 colours 40p
ILLUMINATED MAGNIFIERS
Small 2" dia. (5 x mag) £1.32
Large 3" dia. (4 x mag) £2.52
CORE TRIM TOOL 39p
PRESET TRIM TOOL 60p
FREEZER AEROSOL £1.59
CONTACT CLEANER AEROSOL £1.45
ELECOLIT CONDUCTIVE PAINT £4.99
PVC TAPE (RGB) 3 reels 39p
SCREWDRIVER SET £1.98
POCKET TOOL SET £3.98
DENTISTS INSPECTION MIRROR £2.85
JEWELLERS EYEGLASS £1.50
PLASTIC TWEEZERS £69p
pair of probes with leads (cc). 77p
O MAX PUMPS
3/8" £2.98; 1/2" £3.06; 5/8" £3.17; 3/4" £3.24

MULTIMETER TYPE 2. (YN360TR) 20K o.p.v. with transistor tester. £14.99
AC + DC volts. DC current. 4 very useful resistance ranges. We've used it and we like it.

FUN WITH ELECTRONICS
Enjoyable introduction to electronics. Full of very clear full colour pictures and easy to follow text. Ideal for all beginners — children and adults. Only basic tools needed. 64 full colour pages cover all aspects — soldering — fault finding — components (identification and how they work).
Also full details of how to build 6 projects — burglar alarm, radio, games, etc. Requires soldering — 4 pages clearly show you how.
COMPONENTS SUPPLIED ALLOW ALL PROJECTS TO BE BUILT AND KEPT.
Supplied less batteries & cases.
FUN WITH ELECTRONICS, COMPONENT PACK £16.48
BOOK EXTRA £1.25.
Book available separately.

Speakers Min 8 ohm 87p; 64 ohm 89p, 80 ohm 90p
Crystal earpiece 57p
Magnetic earpiece 19p
Stethoscope attachment 89p
Mono headphones £3.36
Stereo headphones £5.49
Telephone pickup coil 88p
Min buzzer 6V 75p. 12V 72p.
Euro breadboard £6.20
S Dec breadboard £3.98
Bimboard breadboard £6.98
Verobloc breadboard £5.88

PCB etching kit £6.48
ZX81 edge connector £2.25
Ferrite rod 5 inch 59p
PP3 clips 10p. PP9 clips 11p.
2 Station intercomm £10.53
IC Sockets 8 pin 16p; 14 pin 17p; 16 pin 18p.
Traditional Style Bell £1.95
Public Address Mic 50k £4.95
Mic Insert Crystal 45p
Cassette Mic £1.29
Pillow Speaker £1.40
Horn speaker 5½" 8 ohm £6.98
BOOKS: see our price list

MAGENTA ELECTRONICS LTD
HE11, 135 Hunter St., Burton-on-Trent Staffs., DE14 2ST. Mail Order Only.
(0283) 65435 S.A.E. enquiries.
Add 50p p&p to all orders. Prices include VAT. Access & Visa phone/post

24hr Answerphone for orders.
Official school orders welcome.
OVERSEAS: Payment must be in sterling
IRISH REPUBLIC + BFPO – UK PRICES.
EUROPE: UK PRICES + 10%.
ELSEWHERE: WRITE FOR QUOTE.
Goods normally despatched by return of post.

MICROTANIC COMPUTER SYSTEMS LTD.

MICROTAN 65 *NO OTHER COMPUTER IS AS PERSONAL!*

For less than £60 you can start building your own Computer that truly suits your needs and, of course, eventually far more superior to any Computer available off-the-shelf.

MICROTAN 65 comes in kit form, complete with manual, full instructions, board with components, (kit form or fully built) our full back-up service, and your own Microtan World Magazine available on subscription.

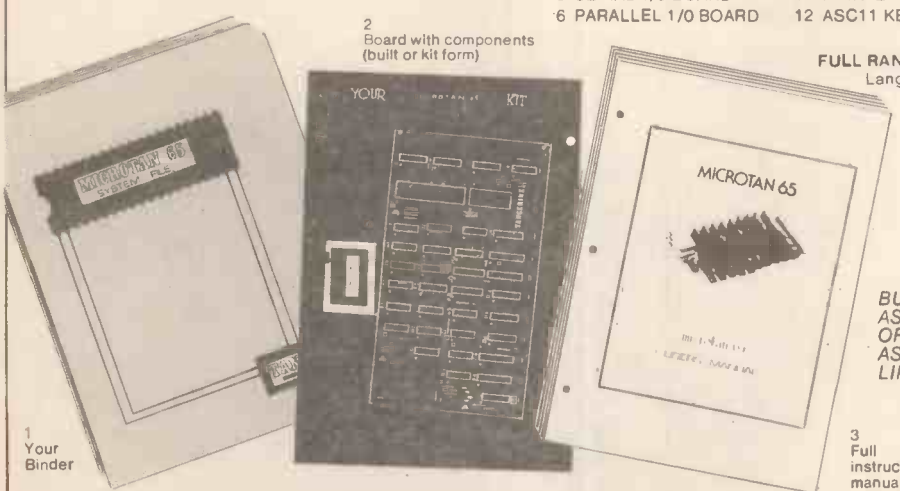
FLEXIBLE & EXPANDABLE SYSTEM — 1K to 256K!

Just look at the options:

1 DISK CONTROLLER
2 REAL TIME CLOCK
3 EPROM PROG. CARD
4 SOUND BOARD
5 SERIAL 1/0 BOARD
6 PARALLEL 1/0 BOARD
7 MASS EPROM STORAGE BOARD
8 INDUSTRIAL CONTROLLER BOARD
9 40K RAM BOARD
10 HIGH RES. GRAPHICS 256x256
11 PRINTER FACE BOARD
12 ASC11 KEYBOARD

Microtan World Magazine

FULL RANGE OF SOFTWARE
Languages available: Machine Code, Assembly, Basic, Forth, and Pilot



1 Your Binder
2 Board with components (built or kit form)
3 Full instructions manual

BUILD AS FAST OR SLOW AS YOU LIKE!

HOW TO ORDER:

Enter details in the coupon below, enclosing your cheque made payable to: Microtanic Computer Systems Ltd. Prices include VAT add £1.50 p&p. Please allow 14 days for delivery.

Post to:
MICROTANIC COMPUTER SYSTEMS LTD
16 UPLAND RD. LONDON SE22
Tel No. 01-693 1137

Please rush me my starter kit: (Please tick)

☐ kit form — I will build myself £59.95
☐ Fully Built £69.95
☐ Complete system wall chart

I enclose my cheque/P.O. for £

Name .....
Company .....
Address .....
.....
.....
Tel (Day) .....
Tel (Eve) .....

MICROTANIC COMPUTER SYSTEMS LTD

SHOWROOM: 16 UPLAND RD
DULWICH, LONDON SE22
TEL: 01-693-1137

MAIL ORDER:
235 FRIERN RD. DULWICH
LONDON SE22

Also available from:
Waltham Forest Computer Centre
889 Lee Bridge Rd.
Nr Whipps Cross, Walthamstow E7
Tel: 01-520 7747

Mains Touch Switch

The HE Mains Touch Switch is designed to avoid both picking up interference from the mains, and generating interference, a common problem with touch switches. This makes it practical for regular use.

Rory Holmes

THIS PROJECT describes a design for a reliable and highly practical mains touch switch suitable for any type of load up to 250 watts (or 500 watts by altering one component). The design overcomes many of the problems that are inherent in previously available circuits rendering them impractical, except as novelty switches.

Before describing the design features provided and their relevance to touch switching, it would be useful to take a look at the shortcomings of standard circuits.

A Finger On The Problem

Several types have employed some type of high input impedance amplifier which picks up signals radiated from a finger to generate a pulse. This pulse then switches a bistable circuit to drive a triac on or off. The problem here is that any spurious interference is very easily picked up and triggers the switch. This interference usually comes down the mains supply in the form of spikes from turning on or off other domestic equipment.

Alternatively, electrical interference from lighting will affect the high impedance electronics. Whatever the case, this sort of spurious triggering is out of the question for a serious application. Nobody wants all his lights and hifi to come on accidentally at four in the morning!

A second major drawback with these types, is the use of phase control in one form or another — either as used in touch controlled dimmers, or simply chopping portions of the mains cycle to provide a local power supply. Phase control generates vast amounts of RFI, (radio interference) due to the instantaneous switching of high voltages, and the simple L/C filters recommended for such circuits are always insufficient.

Phase control also decreases the life of most bulbs due to the step changes in current. Being generally messy and an extremely anti-social electronic pollutant it's worth avoiding if possible!

Pause For Power

By far the biggest drawback, as far as using touch switches to replace wall switches is concerned, is the switch power supply. If the switch requires both the mains, live and neutral for its power, then it can not be wired in as a wall switch, where there are only two wires for a switch in series with the bulb, unless of course you are prepared to rewire all your lighting circuits under the plasterwork to provide a live terminal.

The problem is to derive power for the switch without using phase control, both when the lamp is on and off. Touch plates can also cause problems, especially when they require direct electrical contact (very dangerous!), or even bridging of two contacts by skin resistance. Charge build up or oxidation on the touch plates can often render them inoperative.

The circuit presented here has been designed to avoid all these pitfalls and has the following features:

1. No spurious pulse triggering, the unit switches off after an absence of pulses over a fixed time.
2. Complete elimination of RFI. Triac is switched fully on or off. Bulky inductors and suppressors are eliminated since phase control is not used.
3. Switch-on transients, current surges, and RFI are eliminated by zero crossing turn on, giving longer bulb life and less electricity consumption.
4. Completely solid state — no relays.
5. The touch switch is a true series switch with only two connections. The logic power supply is derived from the mains circuit being switched during both on and off conditions.
6. Touch switch does not utilize the pick-up of external signals such as hum or electric field charges,but acts by capacitive dividing of an internal oscillator. The single touch plate is thus completely isolated from the rest of the circuit.
7. A time constant provides a small switching delay for reliability and elimination of double switching.

In effect the device is a one amp solid-state latching mains relay, with an electrostatically isolated input requiring virtually zero power for switching.

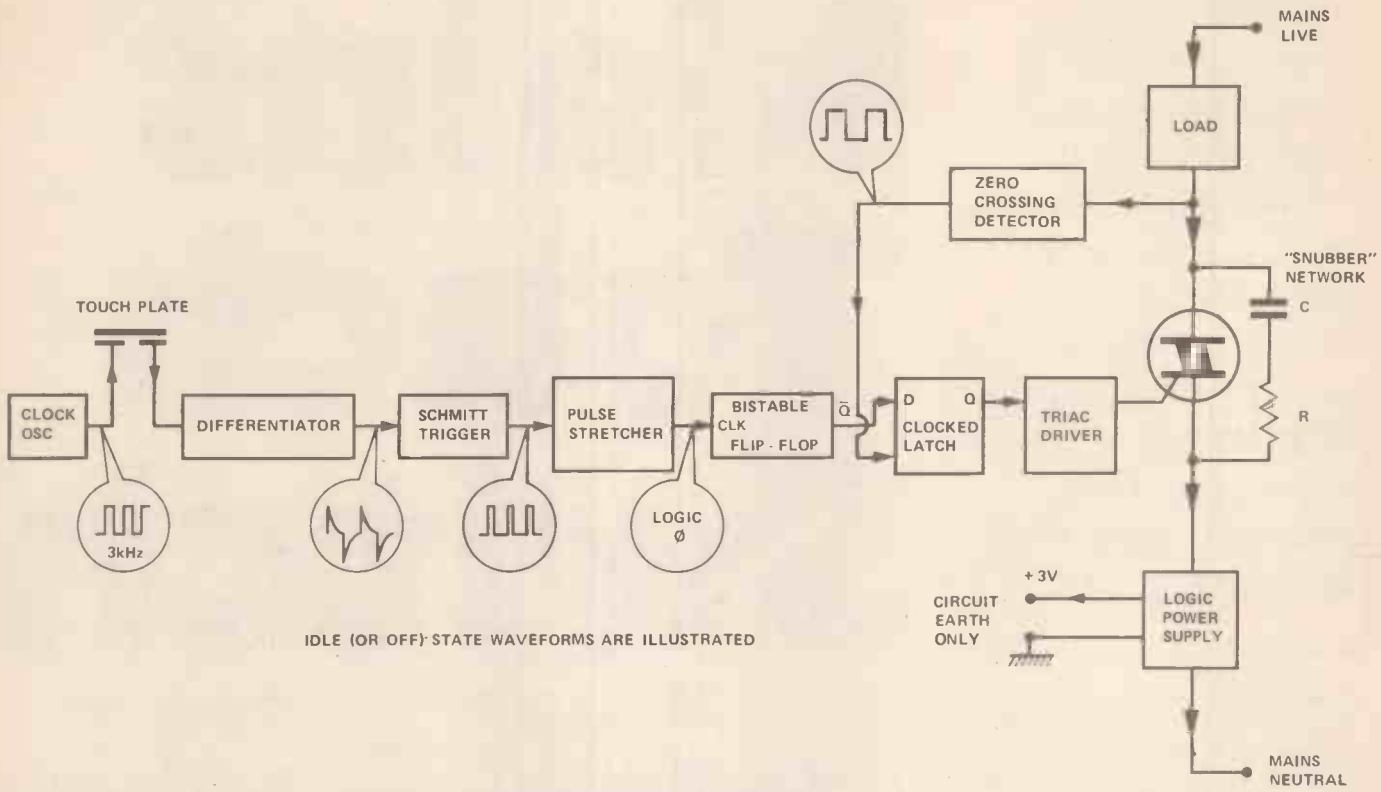


Figure 1. The complex block diagram of the mains touch switch.

Block Diagram

The basic elements making up the touch switch are illustrated in the block diagram of **Figure 1**.

The touch of a finger on the touch plate is detected by means of a capactive dividing action. As the diagram shows, the touch plate is electrically equivalent to two low value capacitors in series, with their common junction being the touch plate. A 3kHz square wave is fed from a clock oscillator to one side of these capacitors and passes through the touch plate to the differentiator. The differentiator produces small spikes on the positive going edges of the received square wave, and since these pass above the threshold of the following Schmitt trigger, a corresponding square wave is generated at its output.

Now, when the plate is touched, the capacitance of the human body relative to the circuit earth will considerably attenuate the received squarewave signal, due to capacitive dividing. The differentiated output spikes are now well below the Schmitt threshold and so the squarewave output ceases. On removing the capacitance from the plate, the square wave restarts, and this action is always the same regardless of the state of the mains bulb.

Clocking A Pulse

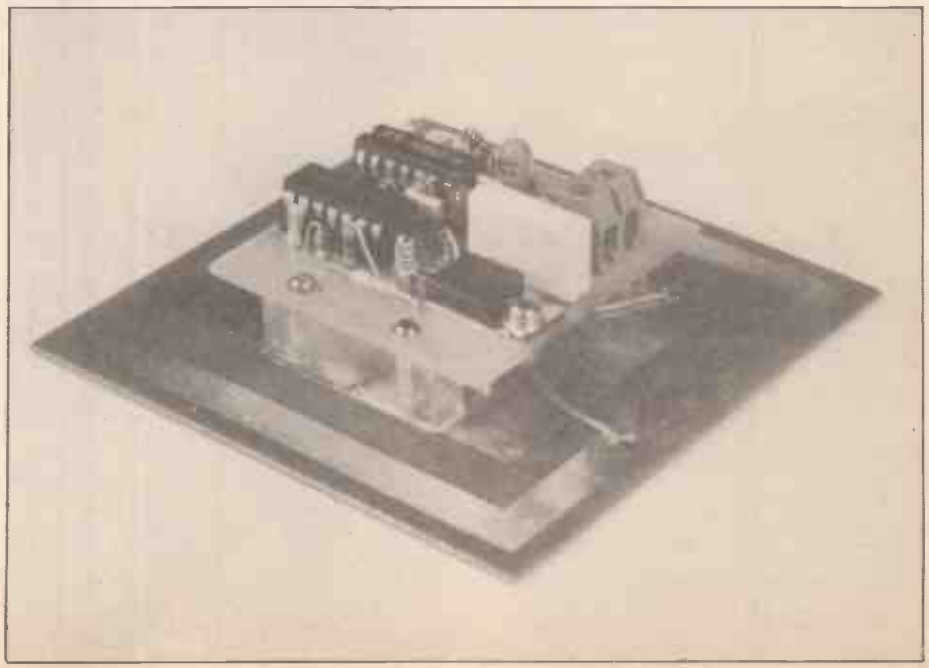
The Schmitt trigger output pulses are then fed into a pulse stretcher which provides a logic zero output as long as the pulses have gone missing for a certain length of time. A time constant is introduced to provide reliable and interference free switching from a single touch.

The positive going logic pulse is used to clock a toggle type flip flop such that its Q output will change state each time the plate is touched. This output essentially determines the state of the bulb. However, before we can actually turn the triac on or off, we need to wait until the mains waveform passes through the zero volt point on its cycle.

Zero Crossing

A zero-crossing detector is used to provide a squarewave whose edges exactly correspond to these zero volt points, and the positive going edges are then used to clock a D type latch. The lamp state signal, Q is fed to the data input on this latch and will thus be transferred to the Q output at the next zero crossing of the mains.

When the Q output goes to logic one, the triac will be turned on using a transistor driver to provide sufficient gate current. With the triac on the



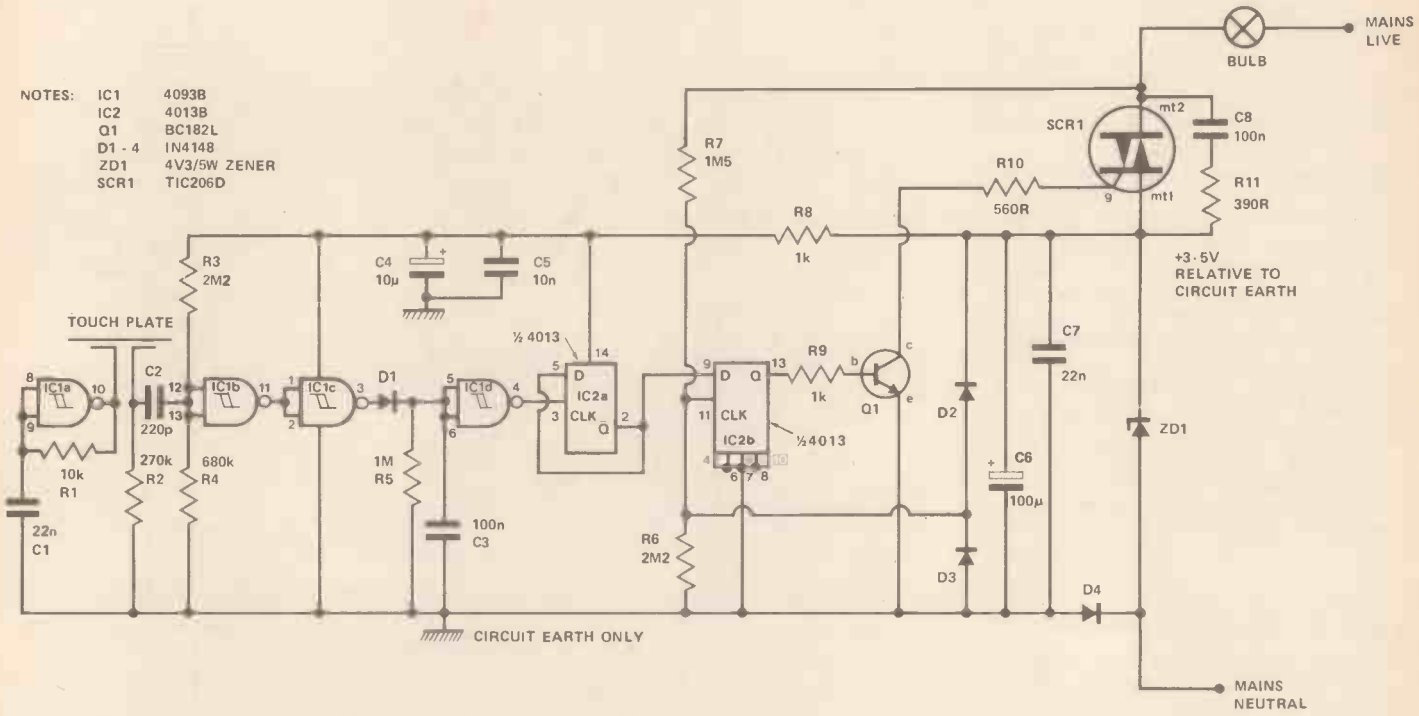


Figure 2. The Circuit. Power in the circuit is kept low to prevent heating.

lamp will also turn on, and everything remains static until the lamp is ready to be switched off.

The most unusual part of the touch switch functioning is the logic power supply. Since the circuit is CMOS it can be powered with as little as three volts and so the power supply has been arranged to be in series with the bulb and triac mains circuit. About four of the total available mains volts are dropped by this circuit which then derives a smooth three volt supply for the logic. The current through the power supply is limited to about one amp and this in turn limits the maximum mains load to 250 watts.

Circuit Description

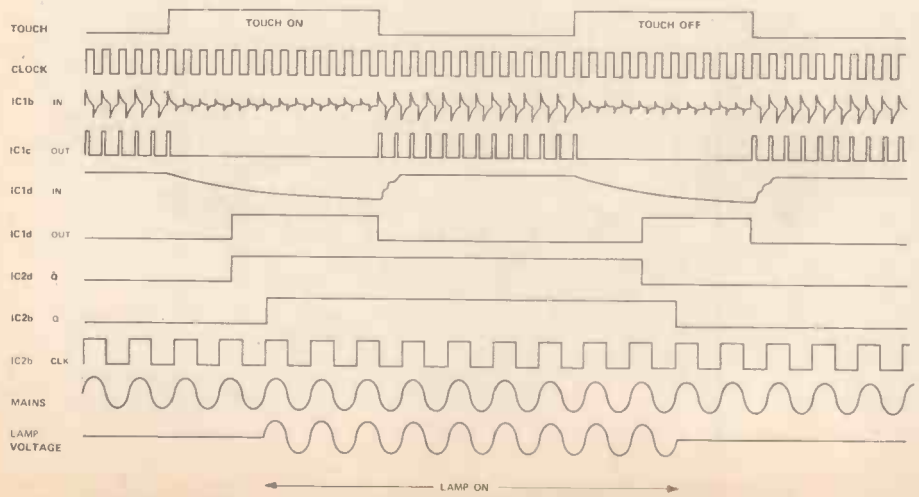
The complete circuit diagram of the touch switch is shown in **Figure 2**. All the logic for the touch detection and on/off sequencing is achieved using two CMOS chips, the 4093 quad NAND Schmitt trigger, and the 4013 dual "D" type latch.

The ICs are powered at their lowest possible supply voltage of about three volts. There are two reasons for this; firstly a low supply voltage is needed to give a proportionally low hysteresis on the switching thresholds of the touch input detector gate IC1b, and secondly it's all that can be squeezed from the circuit power supply without incurring too much heat dissipation!

The touch plate oscillator consists of a standard single Schmitt gate squarewave generator, IC1a and its associated timing components R1 and C1. The resulting squarewave of about 3kHz, available at pin 10 is fed to one side of the touch plate capacitors. The touch plate capacitively couples this signal to the junction of R2 and C2.

At the right-hand end of C2 a differentiated "spike" waveform is produced as illustrated in the timing diagram **Figure 3**. When the plate is not being touched this spike waveform has an amplitude just greater than the Schmitt threshold voltage of IC1, which subsequently produces inverted pulses at pin 11.

Figure 3. The waveforms shown here are idealised — the mains cycles are not in the same timescale as the clock.



Schmitt Threshold

The switching threshold of the Schmitt gate has been adjusted slightly offcentre from the usual half-way point by resistors R3 and R4. This is done so that when no pulses are available to cross its threshold, which occurs when the plate is touched, the gate output will normally be high. Gate IC1c is then used to invert this signal for driving the pulse stretcher circuit of D1, R5, C3 and IC1d. If the plate is not being touched, positive going pulses passed via D1 will keep capacitor C3 charged up to a logical high level, so that the output of invertor IC1d stays at logic low. When the pulses disappear, the capacitor will discharge through R5, producing

a time delay before the invertor output switches sharply to logic high.

This positive going pulse which occurs whenever the plate is touched is used to clock the latch IC2a, which has been configured as a toggle action flip-flop. The Q output on pin 2 will change logic state for each clock pulse received and essentially determines whether the bulb is on or off. The touch switch part of the circuit ends here and the rest of the circuitry is involved in driving the triac and providing the logic power supply.

Although the command to turn the light on or off has been latched in the circuit, the triac must not be switched until the mains waveform crosses its zero volt point. This technique completely elminates any RF1 or clicks. If mains were applied to the bulb at the moment of reaching its 325 volt peak there would be a very heavy surge current, since the lamp resistance is very low when cold.

Zero Crossing Revisited

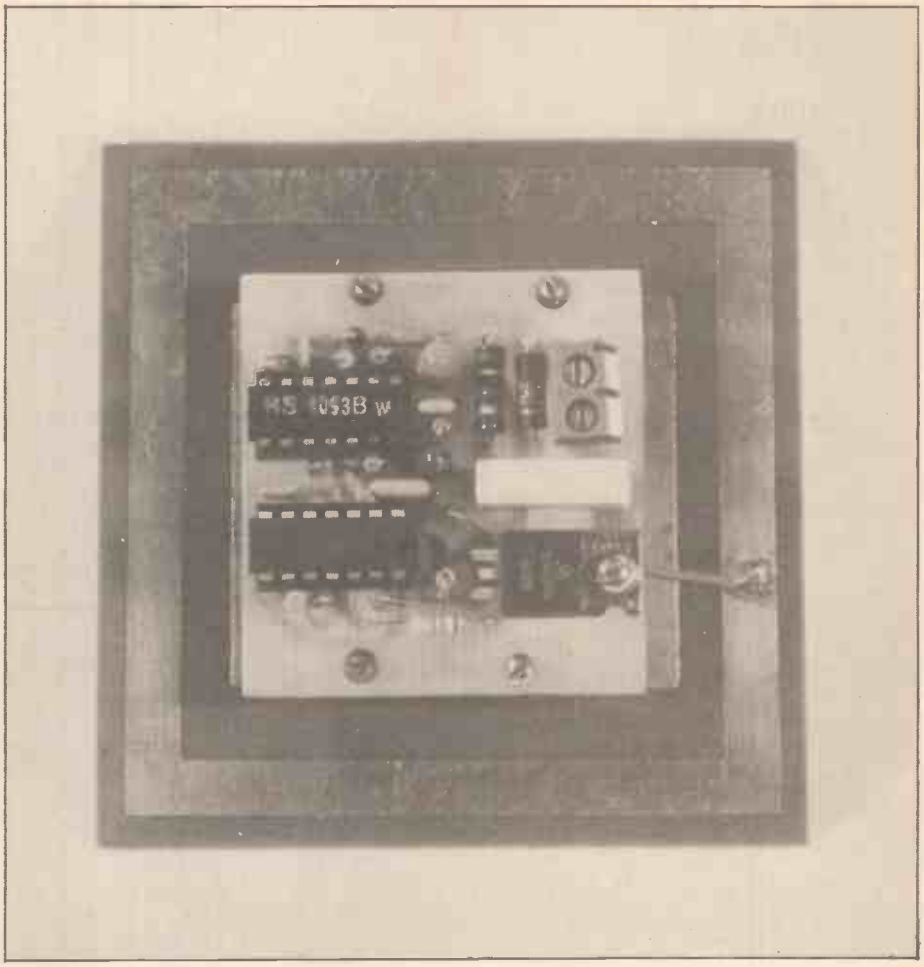
By using zero crossing this surge current is removed, since the bulb filament can warm up slowly as the mains voltage rises, and consequently the bulb life is greatly increased along with a reduced electricity consumption.

It can be deduced from the timing diagram that the latch IC2b plays this all important role in the triac switching. The mains waveform is fed through the potential divider of R6 and R7 to the clock input, pin 11. The mains waveform is clipped and clamped close to the logic circuit supply rail voltage by diodes D2 and D3 so that the clock input is actually a squarewave whose edges correspond to the zero crossing points. The Q output will thus take up the previously latched touch switch state when the mains is at zero.

Triacs can be turned on using either positive or negative gate current. The negative gate current required is about 3mA, and the positive about 5mA. Since it suits the circuit configuration, negative gate control is chosen. Transistor Q1 turns on via R9 when the Q output is at logic one. The required negative gate current how flows through R10, as the collector of Q1 is now at -3V5 relative to the triac terminal mt1.

Power Supply

The logic power supply is derived from the 4V3 5 watt Zener diode ZD1, which is wired in series with the mains bulb circuit. When the triac and hence the bulb are turned on, current for the Zener will be the same as the bulb current, about 400mA. When the triac switches off, a "snubber network" comes into play under the different rules of a "lossless" voltage dropper. Capacitor C8 allows a mains current of 10mA to flow through the bulb and Zener circuit, *but 90 degrees out of phase* with the mains voltage cycle. The mains voltage is thus almost completely dropped across C8 with no power loss. Resistor R11 is provided to limit the charge/discharge currents in C8.



A reasonably stable voltage, just over 4 volts will be continuously available accross the Zener diode. Since it is AC the voltage is rectified and smoothed by D4 and capacitor C6. The power supply is further smoothed by the filter R8 and C4 before supplying the remainder of the circuit. Capacitors C7 and C5 are used to cut out any high frequency noise on the supply lines.

Construction

Construction should start with the assembly of the main printed circuit board. It is strongly recommended that the layout shown is used, since it is fairly critical and includes mains voltages. Veroboard is definitely out for this project — it is not suitable for mains circuits.

The component overlay is illustrated in **Figure 4.** As can be seen the components are packed quite closely with most resistors vertically mounted to keep the size of the unit small enough to fit into an ordinary light switch box. Although care is needed the assembly should be quite straightforward if the following points are observed. There are many polarity components, namely the diodes, tantalum capacitors, ICs, and the Zener diode. The orientation of these components must be thoroughly checked against the overlay before soldering, also observe the pin connections for the L version of the BC182 transistor.

The vertically mounted resistors should have their leads bent firmly over their tops before insertion. Sockets should be used for IC1 and IC2 to allow for easy replacement in case things go wrong. The terminal block required for the mains input is a two way PCB mounting type, since these are not readily available a standard for way type may be used after carefully cutting it in half with a hacksaw.

When soldering in the triac make sure that it is bolted down first through the hole marked on the overlay, use 6BA hardware for this. The triac leads are bent over close to its body, so ensure that there are no shorts before proceeding.

After soldering and closely cropping all components leads the ICs may be plugged in. This completes the main assembly, but remember to check the track side of the board for any solder bridges or shorts.

Finally, its a good idea to thoroughly tin all the large copper tracks carrying mains current insuring that all joints are smooth. Finish by spraying a coat of solder-through lacquer or artist's varnish to the track side of the board.

Parts List

RESISTORS
(All 0.25W 5% carbon, except where stated)

R1	10k
R2	270k
R3, 6	2M2
R4	680k
R5	1M0
R7	1M5
R8, 9	1k0
R10	560R
R11	390R ½W

CAPACITORS

C1, 7	22n monolithic ceramic
C2	220p monolithic ceramic
C3	100n monolithic ceramic
C4	22u 6V3 tantalum
C5	10n monolithic ceramic
C6	100u 6V3 tantalum
C8	100n 250V AC polyester

SEMICONDUCTORS

IC1	4093B quad nand Schmitt trigger
IC2	4013B dual D flip flop
Q1	BC182L NPN transistor
D1-4	1N4148 silicon diode
ZD1	4V3 5W Zener diode
SCR1	TIC206D triac

MISCELLANEOUS
Two printed circuit boards; two way PCB mounting terminal block; perspex mounting blocks, appox 1" x ⅜" x 3/16"; two 14 pin IC sockets: 8BA/6BA hardware; connecting wire, solder etc.

BUYLINES ..... page 26

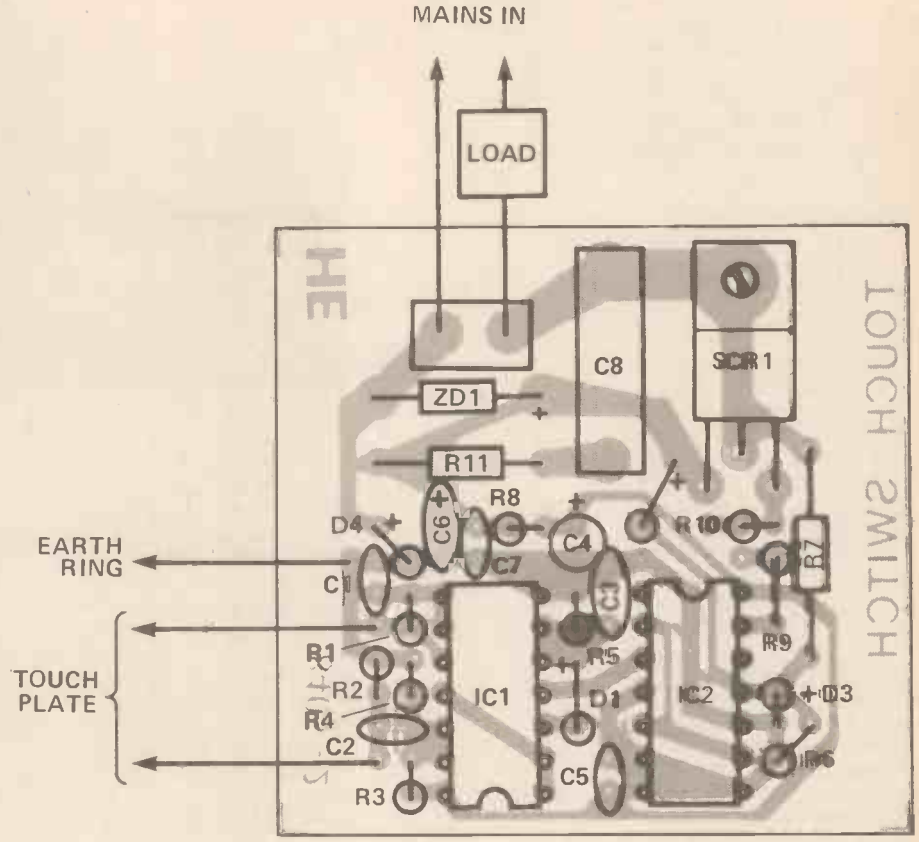


Figure 4. The component layout. There are many polarity components, so component orientation should be double-checked before connection.

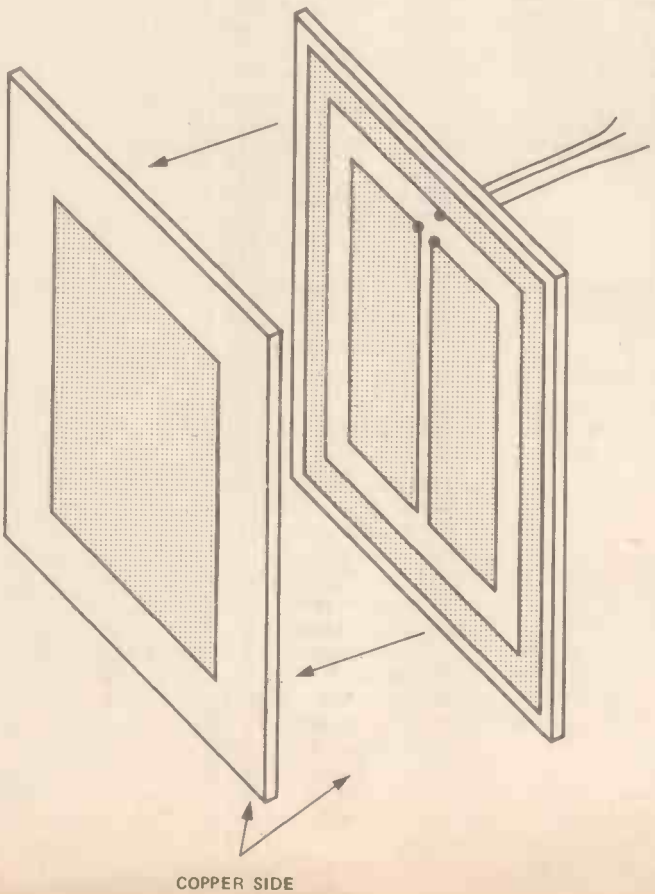


Figure 5. This diagram shows the construction of the Touch Switch from single, as opposed to double-sided PCB. Superglue or Araldite the two boards together as shown; drill small holes to let out the thin connecting wires to the other side of the board where it can be connected up to the circuit.

Touch Plate

The touch plate consists of an 85mm square of double sided PCB. The simple foil pattern is shown in **Figure 5**. It consists of the touch plate on one side, being completely isolated from the rest of the circuit, with two smaller plates directly underneath on the reverse side of the board.

A further ring of copper on the underneath, connected to circuit earth is used to increase the capacitance to earth when touching the plate. It may not always be necessary depending on the amount of mains wiring in the vicinity of your switch point. The size and alignment of the plates is important so the dimensions given should be used. The touch plate could easily equally well be constructed from two pieces of single sided PCB as shown in **Figure 6**.

Mains Touch Switch

Alternatively pieces of aluminium foil may be stuck down to a thin piece of laminated plastic or paxolin, with connections being crimped onto small flaps of the foil. Since the touch plate works by capacitive action, it is not necessary to have a direct electrical contact, and the touch plate may therefore be painted over or even covered by an adhesive plastic film as you wish.

The circuit assembly must be mounted on the reverse side of the touch plate; it can be mounted using PCB spacers or small plastic blocks to ensure that there is a gap of about 1cm between the two boards.

Bolts must not be used through the touch plate board, though they can be used to bolt spacer blocks to the circuit PCB, which can then be superglued to the touch plates. As long as there are no shorts between the plates and the main circuit board any mounting arrangement will be suitable. Before gluing or screwing down the circuit assembly, it must be wired to the touch plates.

Three insulated wires are required and they should be soldered to the track side of the PCB at the points shown in **Figure 6**. When the assembly is secured in place, the wires can be cut as short as possible and soldered to the corresponding plates. PCB lacquer can be used to protect the plates from corrosion and oxidising.

Installation And Testing

The PCB and touch plate have been designed small enough to replace the standard wall mounting light switch, and the unit should easily fit into the existing hole after removal of the old switch.

Installation is simplicity itself, just wire the two existing mains leads into the touch switch terminal block as shown on the PCB overlay diagram. Note that the touch switch cannot be used on the two way type of light switches as used at the top and bottom of staircases. Don't forget to switch off your house lighting circuit at the mains first, and ensure that you get the neutral and live connectors the right way round! A glowing electrician's neon screwdriver can be used to locate the live side. The bulb must be of course be in circuit with the mains power on for this test.

After wiring up, the touch plate can be secured to the wall surround using double sided tape or sticky pads. Do not drill holes in the PCB and use the existing screws.

Now comes the moment of truth. Switch on your mains power and touch the plate, the light should come on and another touch should turn it off again. Remember though that there is a time constant in the circuit that requires a certain duration of touch before switching.

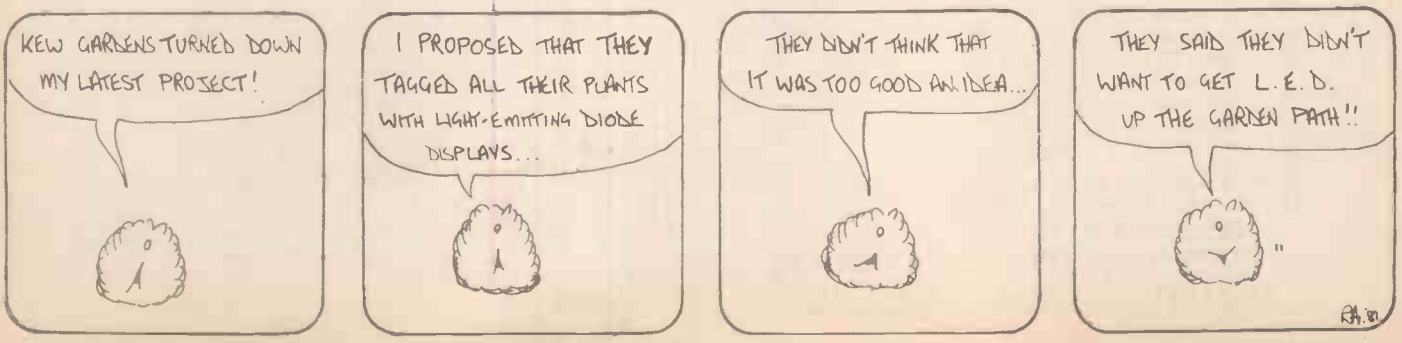
If the sensitivity of the touch plate is insufficient it can be increased by slightly reducing the value of R4 to say 560k.

The touch switch could of course be applied in many different ways. Owing to its small size it could easily be built into existing equipment such as side lamps, or hifis. Alternatively it can be mounted in a stand alone box. Different styles and construction of touch plates are left to your own imagination and construction abilities. Since the switch does not employ phase control to switch the mains waveform it can equally well be used on other types of mains loads up to 250 watts, such as transformers, soldering irons, record decks, televisions etc.

The switch could even be mounted on a bathroom ceiling with a flexible wire soldered to the touch plate in place of the usual pull cord. Since bathrooms are fairly humid places, even up at ceiling level, its a good idea to put the entire PCB assembly in epoxy resin or araldite. A suitable metal weight soldered to the bottom of the wire would then act as the touch plate.

HE

BEASTIES BY RH



COMPEX (UK) LTD

BATTERIES NiCAD rechargeable 1.2v by GE
AA HP7 5AH 65p
C U11 1.6AH £1.85
D U2 4.0AH £2.75
pp3 9v 175 AH £3.64
Ansa Universal Charger for above £8.65
SNAPS pp3 3p

BRIDGES BY164 67p W005/W02/W04 — 26p 5amp/Sq
CONNECTORS
PLUGS Banana red/black 9p
DIN 3/5 pin 13p
Euro 14p
Jack Mono/Ster 19p
Speaker type 477-898 12p
SKTS
DIN 3/5/6 way 13p
Earphone Chassis 5p
Euro Chassis 35p
Jack stereo 21p
Speaker Chassis 17p

£1.40 25amp/Sq £1.88

COILS - PCB TOKO
60p set of 5 types

KNOBS CHROME MATCHED
¼"x1¼" dia ¼" spindle
85p set of 5 types

CAPACITORS
CERAMIC DISC
RADIAL 10% 50V
PCM 2½/5mm
10pF-4K7pF E12
5p ea. £3/100

ELECTROLYTIC
AXIAL PLUG IN RADIAL
8p 5p
£8/100 £4/100
47/63 10/63
10/63 22/25
1.5/63 47/25
2.2/63 10/16
4.7/63 22/25
10/16 47/25
15/16 100/16
22/16 10p
33/16 £8/100
47/16 47/63
8p 10/63
£8/100 22/63
47/63 33/63
10/63 47/63
15/40 100/25
22/40 220/25
33/63 470/16
47/63 1000/10
68/63 15p
100/25 £11/100
120 100/63
£16/100 220/63
150/16 330/63
220/16 470/63
330/16 1000/16
470/16 1500/16
18p 25p
£18/100 £15/100
150/40 1000/25
220/50 2200/16
470/50 SINGLE
1000/16 ENDED
24p TAGS
£18/100 1 - £1.40
680/40 25 - 90p
1000/40 1000/100
2200/16 2200/63
3300/16 4700/40
4700/16 6800/25

POLYESTER AXIAL 10%
5p 11p
£3/100 £9/100
01/250 33/100
022/250 47/250
039/400 68/250
047/250 100/250
1/160 15/100
22/400 22/100

POLYESTER BOXED PLUG IN 10%
All at 7p

£8/100	PCM
001/400v	10
0022/400v	10
0033/400v	10
0047/400v	10
01/250v	10
022/250v	10
033/250v	10
047/250v	10
068/250v	10
1/250v	10
15/250v.	18

All at 8p

£7/100	
22/250v	18
33/250v	18
47/250v	22
68/100v	18

All at 15p

£13/100	
10/250v	18
15/100v	22
22/250v	22
All at 21p	
£17/100	
33/100v	22
47/100v	27

POLYSTYRENE AXIAL 2½% 63v
4p each £3/100 E3/12
10pF — 2K2pF E12

TANT BEAD

RADIAL 20%	100+
1/35 8p	£5
22/25 8p	£6
47/35 9p	£8
10/35 11p	£9
22/20 13p	£11
47/25 15p	£13
10/25 15p	£17
15/25 22p	£18
22/25 32p	£28
33/16 47p	£38
47/16 52p	£48
100/16 80p	£56

DIODES

AA119	17p
AA215	32p
BA158	24p
BA159	33p
BA162	13p
BAW62	4p
BAX13/16	4p
BAW62	17p
BAY38	17p
BAY71	7p
BY122	17p
BY127	7p
BY206	22p
BY210/400	22p
BY225	10p
BYW96	17p
BYW10	23p
BYX38/300R	61p
BZX61/B5 1W	
3v3 to 33v	
BZY88 3v3 to 33v	4p
BZY88C5v6	£1.02
BZY96C8v6	£1.02
GP10R	23p
OA47/90/91	3p
OA200/202	8p
TAA550	22p
UAV30/6	44p
IN270	21p
IN823A	33p
1N914/IN916	3p
IN920	17p
IN957 to IN984	7p
IN2970 to IN3015	£2
IN4001 to IN4004	3p
IN4005 to IN4007	4p
IN4148/IN4151	3p
IN4448	7p
IN4728 to IN4764	21p
IN5334 to IN5377	58p
IN5401 to IN5404	7p
IN5405 to IN5408	9p
IS44	4p
IS131	21p
IS421	54p
IS823	14p
IS030	81p
40HFR10	£1.03

S.C.R.s

BT106	55p
BT151	65p
C106C tabless	12p
C106D	31p
S2060W	28p
TIC206D	38p
TIC226	48p
2N4441	62p
2N5061	17p
232 and	
241TB200JD	
WESTCODE	£9.50

IC's CA/LM/or NE

101AH	£1.23
119J	£1.10
218H	£1.10
224AJ	£6.40
301AH	24p
304H	£1.10
308H	43p
311N	84p
319H	£1.90
339N	£1.30
348N	68p
380N-8	83p
380N-14	86p
381N	£1.37
531N	£2.86
555N	19p
556N	64p
557N	78p
709CN	39p
710CN	39p
723CN	44p
741CN-8	21p
747CN	71p
747CN	36p
748CN	33p
748N	36p
1458N	28p
1488N	54p
1489N	43p
1558M	£1.90
3045N	68p
3075N	£1.36
3085N	85p
3089N	£1.04
3090AQ	£2.78
3123N	£1.82
3140N	£2.86p
3240E-14	£1.11
3900N	52p
3914N	£2.89

74-N

00	26p
01	32p
02	32p
03	32p
04	35p
05	35p
08	35p
09	35p
10	32p
11	35p
12	31p
13	46p
14	56p
15	37p
16	37p
17	37p
18	37p
19	37p
20	32p
21	35p
22	35p
23	35p
24	35p
25	35p
26	35p
27	35p
28	55p
30	32p
32	35p
33	39p
37	39p
38	39p
40	39p
41	£1.17
42	52p
45	91p
46	98p
47	98p
48	98p
50	32p
51	32p
60	28p
70	39p
72	39p
73	39p
74	39p
75	54p
76	54p
80	68p
83	68p
84	£1.27
86	39p
90	48p
92	48p
93	54p
96	64p
107	£1.54
109	48p
110	48p
111	78p
116	£1.78
118	£1.17
121	46p

74H—N

00	50p
01	50p
04	54p
10	50p
30	50p
50	08p
40	50p
74	£1.38p
108	£1.81
183	£3.17

74L—N

04	£1.01
121	£1.51

74LS—N

00	31p
01	31p
02	31p
04	32p
05	32p
08	32p
09	32p
10	31p
11	32p
14	51p
15	31p
20	31p
21	31p
27	31p
30	31p
32	31p
38	32p
42	84p
47	96p
51	31p
73	39p
76	39p
83	43p
85	78p
93	51p
109	43p
112	43p
123	91p
138	80p
139	30p
145	£1.05
157	56p
158	56p
160	85p
161	85p
163	85p
170	£1.51
193	83p
221	£1.13
244	86p
245	£1.35
251	86p
257	56p
259	£1.18
273	£1.30
283	74p
299	£2.80
367	52p
490	£2.43
669	£1.95

74S—N

00	47p
02	47p
04	58p
08	47p
10	47p
11	47p
20	39p
21	47p
30	47p
32	47p
37	47p
38	47p
40	47p
51	47p
64	47p
74	97p
86	£1.27
112	97p
113	97p
114	97p
124	£2.08
133	47p
138	£2.08

40—N

00	30p
01	30p
02	30p
04	30p
08	30p
10	41p
11	68p
19	41p
20	£1.08
21	98p
22	97p
23	30p
25	30p
26	30p
27	53p
28	55p
30	£1.08
32	41p
35	£1.23
40	£1.02
42	83p
43	55p
44	58p
48	92p
48	40pp
50	39p
55	41p
60	£1.14
69	45p
70	45p
71	30p
72	30p
73	30p
74	£1.38
78	17p
81	30p
82	30p
83	84p
93	43p
99	£1.36

45—N

01	77p
02	78p
03	78p
10	59p
11	59p
12	73p
18	89p
19	44p
20	89p
28	94p
30	82p
38	87p
43	£1.45
56	81p
85	£1.06

122	74p
123	82p
125	80p
1.2	84p
141	£1.27
145	87p
147	£1.66
148	£1.07
150	£1.58
151	56p
153	56p
154	£1.82
155	56p
156	56p
157	56p
158	£1.10
159	76p
160	76p
164	76p
165	76p
173	£1.07
174	74p
175	68p
180	87p
184	£2.83
185	£2.83
190	£1.07
191	£1.07
192	84p
194	84p
195	84p
197	93p
221	£1.01
240	£1.01
298	£1.66
393	£1.64

78—N

107	98p
110	£1.36
114	£3.26
182	£1.42
370	£3.54
451	25p
453	27p
454	25p
495	85p
492	79p

CRYSTALS
4.433MHZ £1.48
8.00 MHZ £1.90

IC's NUMERIC MISC

MCM6810	£4.40
TL071	33p
TL072	84p
ZB0CPU	£3.30
ZB0CP10	£5.80
TL081	38p
TL082	66p
TL084	93p
TBA120S	£1.38p
TBA120U	78p
TBA395	£3.20
TBA396	£2.99
2N425E	£4.99
2N428E	£18.18
TDA440	£3.68
TL442CN	£3.31
TBA510	£8.52p
BA511A	£3.41
TBA520	£2.15
BA521	£3.12
TBA560C	£3.48
AD563JD	£2.97
TBA651	£3.92
MC667P	£2.88
MC688P	£2.88
TBA720A	£4.88
TBA810S	83p
TBA820M	£1.78p
MC830P	55p
TCA830	£3.79p
MC846	£1.18p
MC853	89p
TBA950	£2.97p
TDA1001	£1.82
TDA1004A	£3.38
UPC1025H	£8.87
UPC1028H	89p
TDA1035C	£7.41
HA1151	£2.90p
HA1156W	£3.68
TDA1170S	£3.87
UPC1182H	77p
TDA1200	68p
HA1339	£1.25
HA1366W	83p
FD171AO	£27.63
TDA2002	£1.98
UPC2002V	77p
TDA2003	£2.87

TDA2004	£5.30
TDA2020AD	£1.89
TDA2030	£3.27
2101MPC	£1.50
2114N4	£1.37
TDA2190	£3.78
FSA2501	£1.88
DM2502	£2.68
TDA2520	£2.97
TDA2522	£2.97
TDA2532	£8.03p
TDA2540	£3.96
TDA2541A	£1.03p
2708	£4.78p
2716	£2.66
2732	£4.99p
MB3712	89p
4114R330	£1.28
4116N3	81p
4138	89p
6810P	£3.77
ICT106	£7.95
TAT130P	64p
TAT204	53p
TAT205AP	83p
TAT222AP	83p
TAT312	49p
AD7506	£1.47
AD7523	£1.92
AD7530	£2.33p
P8035	£4.03p
P8038	£2.87p
P9090A	£2.68p
P8212	£1.98
P8216	£1.84
P8238	£3.80
P8251	£3.03
P8280	£1.04
F9002	35p
F9003	35p
F9014	83p
F9015	46p
F9016	58p
F9301	£1.00
F9311	£1.82
HA12002	£1.82p
HA12003	£2.88p
40106	74p
40107	67p
M51521L	72p
76110	81p
76477	£2.18

LEDS
125° TIL209

Green	8p
Red	8p
Yellow	7p
CLIPS	2p

3° TIL220

Green	7p
Red	8p
Yellow	8p
CLIPS	2p

METERS VU 40 x 40 mm Scale 0 to 25 blue 85p
OPTO TIL 32 28p TIL 78 28p 2N5777 25p

PRESETS Cermet ¼" RECT 20 turn
All values 10R to 1 Meg 27p
Cermet ¼" sq horiz or vert 1 turn
All values 10R to 1 Meg 19p

RESISTORS E12 ¼w C FILM 5% 1p £3.70/1000
¼w M FILM 2% 3p £8.00/1000
C Film 1R to 10 Meg M FILM 10R to 470R

SOCKETS IC LP 8 pin 6p 14/16 pin 8p
18/20/22 pin 18p 24/28 24p 40/46 pin 28p

TRANSFORMER 12-0-12 1A £1.77

TRANSISTORS

AC107	25p	BC384/C	13p	BU105	£1.20	2N1613	28p
AC116	29p	BC415A	8p	BU113	£1.62	2N1711	28p
AC123K	40p	BC461	31p	BU126	£1.44	2N1890	45p
AC127	23p	BC477	21p	BU205/5	£1.06	2N2218	23p
AC128	26p	BC478	24p	BU208A	99p	2N2219	
AC138	27p	BC548/B	7p	BU326	£1.08	2N2221	21p
AC141B	23p	BC547/B	7p	BU406	£1.02	2N2222A	16p
AC141K	33p	BC546/B	7p	BUY87	£1.82	2N2368A	21p
AC142K	33p	BC549C	7p	MEO404	9p	2N2369A	21p
AC153	30p	BC556	8p	MEO412	9p	2N2646	43p
AC171	27p	BC557	7p	MEO8102	15p	2N2647	96p
AC176	27p	BC558/B	8p	MJ413	£2.30	2N2904	18p
AC178	27p	BC559	8p	MJ423	£3.30	2N2905A	22p
AC181K	48p	BC636	18p	MJ2251	90p	2N2906	18p
AC184	45p	BCX33	22p	MJ2501	£1.20	2N3007	22p
AC185	45p	BCX58	18p	MJ3001	£1.35	2N3012	45p
AC186	45p	BCY42	27p	MJE340	32p	2N3019	46p
AC187K	30p	BCY70/1	19p	MJE520	22p	2N3053	27p
AC188	32p	BCY72/8	15p	MPS404	22p	2N3054	36p
AC193K	32p	BCY91	23p	MPS3640	22p	2N3055	39p
AC194K	33p	BD112	£1.05	MPSA05	22p	2N3440	58p
ACY17	£1.18	BD115	57p	MPSA06	19p	2N3442	£1.08
ACY18	£1.18	BD116	39p	MPSA12	19p	2N3546	97p
ACY22	£1.18	BD131/2	24p	MPSA14	25p	2N3583	78p
ACY44	89p	BD135/6	27p	MPSA42	15p	2N3638	22p
AD140/2	97p	BD139	38p	MPSA43	19p	2N3641/2	30p
AD149	97p	BD140	38p	MPSA56	22p	2N3702/3	8p
AD161/2	36p	BD176	39p	MPSA92	28p	2N3704/5	10p
AF126C	35p	BD232	44p	MPSU04	61p	2N3706/7	9p
AF139	82p	BD235	41p	MPSU10	87p	2N3710/11	7p
ASY27	£1.88	BD371B	25p	OC25	87p	2N3724	45p
AU110	£2.88	BD436	36p	OC28	£1.04	2N3771	£1.44
BC107	9p	BD437	41p	OC29	£1.27	2N3772	£1.44
BC108	7p	BD675	64p	OC45	64p	2N3773	£1.58
BC108c	10p	BD677	64p	OC71	27p	2N3819	35p
BC109	9p	BDY55	£1.75	OC75	33p	2N3820	45p
BC109c	11p	BF180	28p	OC76	27p	2N3903	12p
BC118	10p	BF194	9p	OC205	£2.17	2N3904	10p
BC119	22p	BF195	12p	SE3453	99p	2N3905	12p
BC121B	12p	BF196	12p	TIP29	28p	2N3906	10p
BC134/7	10p	BF197	14p	TIP30	23p	2N3947	£1.08
BC140	22p	BF198	18p	TIP31A	25p	2N4061	12p
BC141	25p	BF199	14p	TIP31C	33p	2N4126	12p
BC142/3	23p	BF224	33p	TIP32A	28p	2N4340	91p
BC147	8p	BF241	18p	TIP32C	33p	2N4907	£1.34
BC148	9p	BF244	26p	TIP33A	87p	2N4358	58p
BC149	9p	BF245	28p	TIP34A	77p	2N4402	18p
BC158	8p	BF255	21p	TIP35A	£1.57	2N4871	66p
BC159	8p	BF256A	43p	TIP36A	£1.87	2N5248	38p
BC160	28p	BF258	36p	TIP41A	24p	2N5308	23p
BC187A	6p	BF259	30p	TIP42A	24p	2N5320/2	38p
BC171	6p	BF274	27p	TIP42B	32p	2N5415	57p
BC172	7p	BF337/8	25p	TIP47	36p	2N5447/8	9p
BC173	6p	BF391	27p	TIP110/2	36p	2N5457/9	38p
BC177	15p	BF459	38p	TIP115	28p	2N5550	18p
BC178	18p	BF478	63p	TIP121	36p	2N5655	90p
BC179	15p	BFR39	21p	TIP126	36p	2N6052	£1.80
BC182	9p	BFR40	18p	TIP127	36p	2N6059	£1.80
BC182L	6p	BFR50	24p	TIP141	99p	2N6107	45p
BC183	9p	BFR51	27p	TIP142	£1.72	2N6385	£1.27
BC183L	6p	BFR81	21p	TIP147	£1.80	2S002	75p
BC184	8p	BFR80/1	29p	TIP2955	39p	2S701	75p
BC184L	6p	BFR86	34p	TIP3055	39p	2SA496	36p
BC205	10p	BFT50	93p	TIS43	36p	2SB495	30p
BC212	9p	BFW11	89p	TIS73	48p	2SC1172	£2.34
BC212L	6p	BFW16	89p	TIS90	18p	2SC1173	29p
BC213	9p	BFX34	90p	TIS91	18p	2SC1213	29p
BC213L	6p	BFX85/8	23p	TIS92	22p	2SC1226	33p
BC214	9p	BFY50	19p	ZTX109	19p	2SC1307	£1.14
BC214L	6p	BFY51/2	22p	ZTX173	28p	2SC1449	33p
BC237/8	6p	BFY90	87p	ZTX300	19p	2SC1674/5	29p
BC238/B	6p	BPX25	£1.51	ZTX500	18p	2SC1678	80p
BC239/B	6p	BRY39	27p	2N696/9	28p	2SC1945	£2.34
BC300	31p	BRY56A	42p	2N706	22p	2SC1971	37p
BC307/B	6p	BSX20	18p	2N918	17p	2SC2028	37p
BC309C	7p	BSX26	36p	2N930	18p	2SJ50	£3.13
BC325	30p	BSX29	33p	2N1132	89p	2SK30	18p
BC327/8	8p	BSX93	45p	2N1303	63p	2SK135	£3.15
BC337/8	11p	BSY79	31p	2N1304	95p		
BC338	9p	BU102	£1.75	2N1305	83p		

V REGs 78L06/12 43p 79L05/12 48p 7805/12/15/24 31p
LM309K £1.29 LM317T 58p LM323K £3.70 7805/12/15/24 36p

add P&P 50p then add VAT 15%

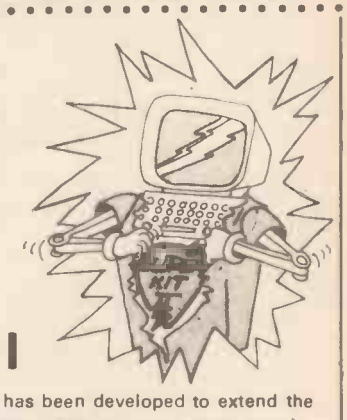
Stock list of over 2000 items Free if requested for on a company letterheading

COMPEX (UK) LTD
66 John F. Kennedy Est.
WASHINGTON, NE38 7AJ.
Tel: 091-4167814 Tx 537681

FIND YOUR WAY THROUGH THE DIGITAL ELECTRONICS MAZE

First there was
SUPERKIT

and now ...
NEW
SUPERKIT II



This practical self-instruction kit has been developed to extend the original beginners' **SUPERKIT**. **SUPERKIT II** includes an instruction manual and many more components, enabling you to design and use adders, subtractors, counters (ripple, up/down, synchronous, decade and Gray code), registers, pattern recognisers and 7-segment displays. You need the board and components from **SUPERKIT** to enable you to build the circuits in **SUPERKIT II**. Together the two kits provide an excellent introduction to digital electronics – what really goes on inside a computer.

SUPERKIT (SUP) £22.00 **SUPERKIT II (SUP II) £16.00**

Special price £35.00 for both (SUP + II) (inc. VAT and p & p)

The **SUPERKIT** series is backed by our theory courses, **DIGITAL COMPUTER LOGIC** (beginners' course), which covers the design of logical circuits, and **DIGITAL COMPUTER DESIGN** (more advanced), which covers the design of digital computers. **MICROPROCESSORS AND MICROELECTRONICS** teaches you what a microprocessor is and what it can do.

DIGITAL COMPUTER LOGIC (DCL) £7.00
DIGITAL COMPUTER DESIGN (DCD) £9.50
MICROPROCESSORS AND MICROELECTRONICS (MIC) £6.50

Please send for full information on these and our other courses.

GUARANTEE If you are not completely satisfied, return the item to us within 28 days for a full refund. All prices include worldwide surface postage (ask for prepayment invoice for airmail). Allow 28 days for delivery in UK. Overseas payment by international credit card or by bank draft drawn on a London bank.

CAMBRIDGE LEARNING LTD, Unit 98, Rivermill Site, FREEPOST, St Ives, Cambs PE17 4BR, England.

Tel: 0480-67446

VAT No 313026022 Transcash No 2789159 Reg No 1328762

Please send me (initial letters used):

.....SUP	@ £22.00	.....DCL	@ £7.00
.....SUPII	@ £16.00	.....DCD	@ £9.50
.....SUP + II	@ £35.00	.....MIC	@ £6.50

I enclose a cheque/PO payable to Cambridge Learning Ltd for £.....

Please charge my ....., credit card,

No ..... Expiry date .....

Telephone orders from credit card holders accepted on 0480 67446 (24 hrs)

Name .....

Address .....

.....

.....

..... Signature.....

CAMBRIDGE LEARNING
Unit 98, Rivermill Site, FREEPOST, St Ives, Cambs PE17 4BR, England.

COMING SOON TO . . .

Hobby Electronics

Soft Options

Video Disc Interactive System For Home Computers

In issue 2 of Soft Options, our special educational computing supplement, we preview a startling development for home computers.
It is a control system for a video disc player, and potentially it will make possible real time, video quality interactive game playing and computer learning on a popular home computer.

Also in Soft Options . . .

The Tandberg TCCR530 Computer Controlled Cassette Recorder is reviewed . . . plus software reviews, news, and comments on educational computing from those most involved.

Top Projects To Build

Mains Intercom

No need to run new wires for this two-station intercom. Instead it makes use of existing house mains cables, with the signal frequency-modulated onto the neutral line. It's perfectly safe, simple to build, and easy to use.

ZX 81 Tape Controller

Fed up with changing the connections between your ZX81 and the cassette? Eliminate this tiresome problem with our ZX81 Tape Controller!

Audio Millivoltmeter

A useful instrument for fault-finding on low-level audio circuits, this test equipment project won't cost much to build.

Conductance Meter

An instrument for measuring resistance in the range 1M to 100M ohms, and handy for checking swarf bridges across Vero tracks, hair line cracks in printed circuit boards etc.
This instrument measures conductance values other meters can't reach!

Please reserve me . . . . . copies of the June issue of

Hobby Electronics

for

Name . . . . . .

Address . . . . . .

. . . . . .

. . . . . .

Hobby Electronics

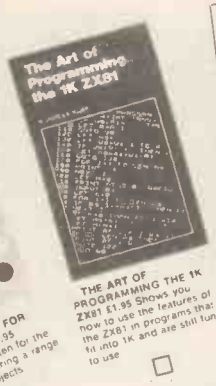
June issue on sale at your newsagent from 11th May. Place your order now!

Although these articles are being prepared for the next issue, circumstances may alter the final content.

BOOKSHELF

THE HE BOOKSHELF is pleased to offer you a range of top quality electronics paperbacks for you to read and enjoy delivered direct to your door!

IC PROJECTS FOR BEGINNERS £1.95 Especially written for the beginner offering a range of simple projects ☐



THE ART OF PROGRAMMING THE 1K ZX81 £1.95 Shows you how to use the features of the ZX81 in programs that fit into 1K and are still fun to use ☐

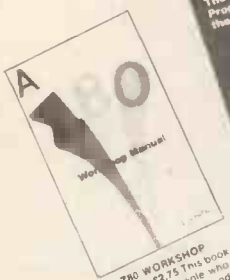
EASY ADD-ON PROJECTS FOR SPECTRUM, ZX81 & ACE £2.25 This book describes how to build a number of electronic projects which you can use with your Spectrum, ZX81 or Jupiter Ace microcomputer ☐

ELECTRONIC PROJECTS FOR CARS AND BOATS £1.95 Fifteen fairly simple projects complete with stripboard layouts ☐

25 SIMPLE AMATEUR BAND AERIALS £1.95 This concise book describes how to build amateur band aerials that are simple and inexpensive to construct and perform well ☐

HOW TO DESIGN YOUR OWN PCBs £1.95 The purpose of this book is to familiarise the reader with both simple and more sophisticated methods of producing printed circuit boards (P C B s) ☐

MODEL RAILWAY PROJECTS £1.95 Build your own controllers, signals and sound effects etc. and add realism to your model railway ☐



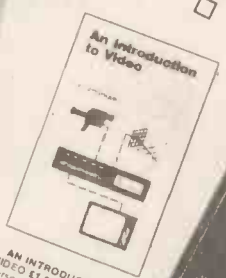
A Z80 WORKSHOP MANUAL £2.75 This book is intended for people who wish to progress beyond the stage of Basic programming to topics such as machine-code and assembly-language programming or need hardware details of the Z-80 based computer ☐

THE ART OF PROGRAMMING THE ZX SPECTRUM £2.50 Simply helps you get the most out of your Spectrum ☐

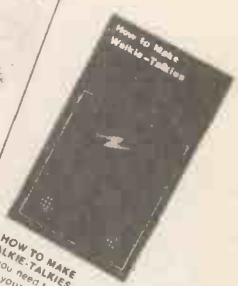
CB PROJECTS £1.95 Shows you how to make a number of useful and interesting CB accessories ☐

THE ART OF PROGRAMMING THE 16K ZX81 £2.50 Concentrates on good programming style and helps you use your 16K RAM pack and ZX printer to the full ☐

POPULAR ELECTRONICS PROJECTS £1.95 An interesting collection of projects which will appeal to most hobbyists ☐



AN INTRODUCTION TO VIDEO £1.95 For the person who has just or is just about to buy or rent some video equipment but is not sure what it is all about ☐

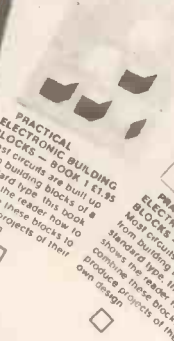


HOW TO MAKE WALKIE-TALKIES £1.95 All you need to know to build your own walkie-talkies ☐

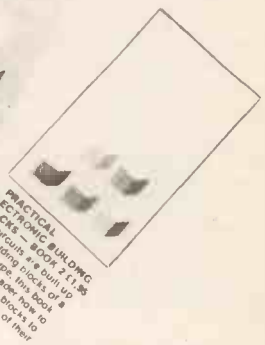
HOW TO USE OP-AMPS £2.25 All you need to know about Op-Amps a source book of circuits and design calculations ☐

POPULAR ELECTRONIC CIRCUITS — BOOK 1 £1.95 Contains over 70 useful and interesting circuits covering a wide range of subjects ☐

POPULAR ELECTRONIC CIRCUITS — BOOK 2 £2.25 Over 140 pages of useful and interesting circuits ☐



PRACTICAL ELECTRONIC BUILDING BLOCKS — BOOK 1 £1.95 Most circuits are built up from building blocks of a standard type. This book shows the reader how to combine these blocks to produce projects of their own design ☐



PRACTICAL ELECTRONIC BUILDING BLOCKS — BOOK 2 £1.95 Most circuits are built up from building blocks of a standard type. This book shows the reader how to combine these blocks to produce projects of their own design ☐

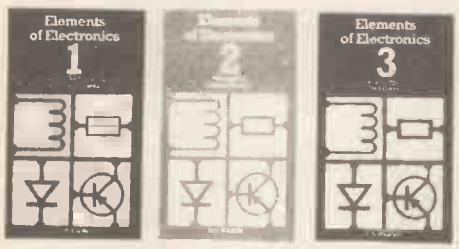
ELEMENTS OF ELECTRONICS — BOOK 1 £2.25 The Simple Electronic Circuits and Components ☐

ELEMENTS OF ELECTRONICS — BOOK 2 £2.25 Alternating Current Theory ☐

ELEMENTS OF ELECTRONICS — BOOK 3 £2.25 Semiconductor Technology ☐

ELEMENTS OF ELECTRONICS — BOOK 4 £2.95 Microprocessing Systems and Circuits ☐

ELEMENTS OF ELECTRONICS — BOOK 5 £2.95 Communication ☐



To receive your books you only need ✓ the I☐ for each title you require and send this page duly completed with your remittance to the address stated.

I enclose my cheque/Postal Order/Money Order (delete as necessary)

for £..... (payable to ASP Ltd)

OR

Debit my Access/Barclaycard (delete as necessary)

VISA

Name (Mr/Mrs/Miss).....

Address.....

.....

.....

Signature

SEND TO:

HE BOOKSHELF, 513 London Road, Thornton Heath, Surrey CR4 6AR

Please use BLOCK CAPITALS and include post codes.

Number of books ordered .....

Total value of books £ .....

Add 75p P&P

TOTAL PAYMENT £.....

ALL ABOUT ELECTRONICS

Our new Beginner's Series tells you all you'd like to know about electronics. From start to finish. All about components and circuits, all the theory you need to get started in the world of electronics.

Keith Brindley

Two months ago (HE March '84) we looked closely at the digital devices of combinational and sequential logic. We saw the simple logic gates (AND, OR, NAND, NOR, NOT) of combinational circuits and concluded that such circuits were unintelligent. They merely act as a group of electronic, high-speed switches so that the combination of inputs applied to these switches at any one time defines the output (or outputs) at that time. A change of inputs leads instantly to a change in output(s).

However, using these very same combinational gates it is possible to construct bistables, which form the basis of semiconductor memories. In building a bistable, the combinational gates undergo a transformation into a sequential circuit: where the output(s) of the circuit depend not only on the input at any one time but also on what has happened before.

Bistables and logic gates can combine in many ways, to form, among other things counters, registers and adders. Such circuits can be used to perform operations on applied binary numbers, such as addition, subtraction, multiplication, division, counting, storage, etc. Often, circuits like these are combined into an arithmetic logic unit (ALU) and used within a computer to perform the necessary mathematical operations on binary numbers.

Of course, an ALU is not the only circuit used within a computer, there are many more. But the principles, using simple combinational logic gates to build complex sequential circuits, and using these sequential circuits to build even more complex circuits, are the same. All the other circuits of a computer which we will later meet can be built from the elementary AND, OR, NAND, NOR, NOT logic.

The Computer

The term "computer" is really a misnomer: it understates the concept of computing. A more accurate term to describe the collection of bits and pieces which fit together to make the machine is a "computer system". No two computer systems are exactly alike — their final forms depend on the uses to which they are put. Even the popular home computer systems (the hardware of which is mass-produced in thousands) are used for thousands of different purposes, with thousands of different software programs.

Nevertheless, it is possible to define a computer system, because all such systems have a minimum quantity of parts which can be illustrated in block diagram form as in **Figure 1**. There are, as you can see, four main blocks forming a computer system:

- central processor
- a memory (or store)
- an input device
- an output device

The heart, brain and soul of a computer system is the central processing unit.

Most "home microcomputers" must be wired up individually to a separate monitor, power supply unit and, as here, a memory device such as a tape cassette recorder.

This functions purely and simply to perform operations of various descriptions (such as add, subtract etc.) on applied binary numbers. A central processing unit (CPU) works in binary, that is, everything it does is controlled by the application of binary numbers for the specific purpose of processing other binary numbers. It is able to communicate directly with all the other three parts.

Input/Output

Input/output (I/O) devices are used for communication between computer system and computer user. A simple input device is a set of switches and a simple output device could be a set of lamps. **Figure 2** shows a possible computer system using four switches as input and four lamps as output devices. Such a computer system could be the basis for a simple calculator if, say, each combination of the four input switches corresponds to either a number from 0 to 9 or a mathematical function, eg add, subtract, multiply etc. Because the switches can only be on or off, ie in one of the two states, we can use a binary coding system for the four switch positions. Four switches allow sixteen possible combinations ($2^4 = 16$) and, defining logic 1 as being an *on* switch, and logic 0 as being *off*, we can use the switch combinations in **Table 1** as the possible input data for our example of **Figure 2**. Similarly, binary information can be displayed on the output lamps of **Figure 2**, giving the results of the input calculations.

More complex I/O devices are used in practical computer systems and a few types will now be considered.

Card Readers And Punches

Data such as programs is stored in the form of punched holes in these cards and the CPU reads the data by passing cards, one at a time, through the card reader. The card reader is thus an input device. Each hole in a card is detected by a photo-electric detector and a card can hold as many as eighty combinations of holes. Each combination of holes defines a character, which can be a letter of the alphabet, a single-digit denary number, or a special character (eg, +, –, /, ").

Obviously few, if any, computer programs have eighty characters or less, so more than one card will be required by the CPU. Card readers have a hopper which can hold many cards in order and the fastest readers can read about thirty cards every second under control of the CPU.

The corresponding output device is a card punch into which blank cards are placed, which are then punched to correspond to data from the CPU.

Table 1

Input data	Meaning
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	. (decimal point)
1011	+
1100	–
1101	x
1110	÷
1111	clear

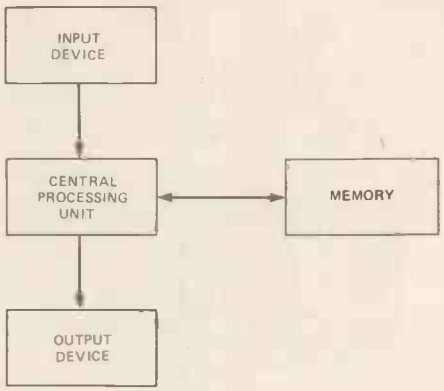


Figure 1. A very simple block diagram which nevertheless represents the basics of all computer systems.

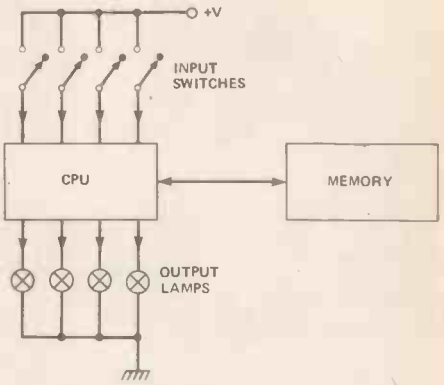


Figure 2. A simple computer system using four switches as input devices and four lamps as output devices.

Paper Tape Readers And Punches

This is a similar form of I/O medium to punched cards in that data is coded in the form of punched holes in the tape, and the data is also read by a similar type of photo-electric detector. About forty characters can be coded on 10cm of paper tape.

Unlike punched cards which only hold about eighty characters each, a reel of tape can be three hundred metres long, containing approximately one hundred and twenty characters — the equivalent of fifteen hundred punched cards. Obviously, a great deal of data (perhaps a complete computer program) can be input to, or output from, a computer with tape reader and writer.

Magnetic Tape

The general principle of magnetic tape I/O is that data is coded (written) onto the metallised surface of a thin plastic tape, as an input operation. The whole I/O procedure is akin to recording and playback of music with a cassette tape recorder — in fact, many of the available home computers use cassette tape as an I/O medium.

Many characters (say twenty million) can be coded on magnetic tape in this fashion and high transfer rates (over one million characters per second) can be achieved with the best of the reel-to-reel type magnetic tape I/O units.

The capacity and rate of the cassette varieties used with home computers are not as good (no more than one hundred thousand characters and about one hundred characters per second) mainly because of the lower quality and lower tape speed of the machines.

Terminals

One of the most popular I/O media is the computer terminal, which provides two-way communication to and from the CPU. Its main advantage is the use of a typewriter-style keyboard (often called a QWERTY keyboard, because the first six keys are lettered, Q, W, E, R, T, and Y) for input and some sort of alphabetical and numerical character representation (eg, printed on paper or on a TV-type screen) for output. Information flow, to and from the computer and user, can therefore be in a more or less easily understood form.

Most home computers and personal computers have an in-built terminal facility, with QWERTY keyboard and a TV-type screen (called a monitor), or at least a connection socket to the user's own TV. Another name for a terminal with a monitor screen is a visual display unit (VDU).

Other I/O Devices

Some I/O devices are not always obviously connected to a computer. If you have a bank account or a building society account, for example, you may also have a cash-card. On one side of the card may be a magnetic strip or something similar on which will be invisibly coded details of your account. When you insert your card into the cash machine at the bank or building society, the machine reads the account details and passes it to a central computer in an output operation. Output, of course, is release of your required cash.

Another input method is used in some large department stores and libraries, where each article for sale, or book for lending has a striped label which contains information relating to

Some of the larger home micros follow the business computer style of a built-in VDU (visual display unit, or monitor) and memory unit (in this case cassette, but more often now, disc).

it. By passing a light pen across the label, the pen picks-up the information which is input to a computer. In the case of the department store, price is automatically registered on the cash-till and the level of stock (held in the computer) reduced by one. In a library system, the book is registered as being borrowed by the borrower who has a library ticket with a similar striped label.

One of the best examples of an output device is a printer, of which there are several varieties, including matrix printers, daisy wheel printers, golf ball printers, line printers, laser printers and thermal printers. Ranging in price (from approximately £200 through to £200,000), the choice of printer for a computer system depends almost totally on the required quality and speed of print.

Memory

A computer system's memory can be simply imagined as a letter rack consisting of many pigeon holes, one for each employee who works in a block. In the morning, after the mail arrives, the secretary sorts out the letters, putting each one into a particular pigeon hole matching the name on the letters. Sometimes during the day each employee (or pigeon) goes to the pigeon hole with her/his name and picks up any mail.

In a computer system's memory each pigeon-hole is called a memory location, and has a unique address (corresponding to the employee's name). The content of the location is a binary number (data). Data is said to be written to a location when it is transferred from the CPU, and is read from the location when it is transferred to the CPU. The computer memory itself is hardware ie, physical components making up part of the system — what is stored in the memory is software ie, numerical information.

In a typical computer system, a certain amount of memory lies within the central hardware of the machine. There are, generally two types of such main storage or main memory classified as read only memory (ROM), in which the system's controlling software is permanently stored and random access memory (RAM) in which user controlled software programs, data etc. can be temporarily stored.

Internal main memory can be manufactured using the circuit devices called bistables, mentioned earlier. So, if you can picture a matrix of literally thousands of semiconductor bistables, each made from gates, each gate made from transistors, then you have pictured a typical computer system's main memory. Other types of main memory exist, the most common in the past being core storage in which tiny rings of a magnetic material are magnetised into one of two states by the direction of currents in wires passing through the rings. The two magnetic states are used to present logic 1 and logic 0, making up a single bit of binary number.

Auxiliary Memory

The other variety of memory is auxiliary memory and is generally used by computer systems for mass storage of data and programs. We have already seen one of the available types of auxiliary memory, but we discussed it then as a variety of I/O device: magnetic tape. Magnetic tape memory falls equally well into both categories, because it performs both functions, I/O and memory.

As a memory device it has a large capacity (a single reel of tape can hold approximately twenty million characters, remember) but is slow. Memory devices have an access time, which is the time taken for the CPU to store or retrieve a particular item of data, and the access time for magnetic tape memory is the average time to find the data — taken to be the time from the middle to the end of the reel. This is difficult to specify because it depends on the machine used and the length of tape, but approximate times are in values of minutes. The slowness of this type of memory can be appreciated if it is compared with the access time of main memory — typically in thousandths of a second.

Tape used is similar to the tape in a domestic-type tape recorder but of better quality. Dimensions are about 1.5cm to 3cm wide and up to one thousand metres long. A diagram of a typical magnetic tape machine is shown in **Figure 3** and a closeup of the recording/playback head in record mode is shown in **Figure 4**. Current in the coil of the head corresponds to the data to be recorded and this produces strong magnetic field in the head. As the tape passes the head, its magnetic surface thus becomes magnetic according to the data to be recorded. On playback, the magnetised surface of the tape creates a small current in the coil as it is drawn past the head. This current is amplified and corresponds to the data which was originally recorded.

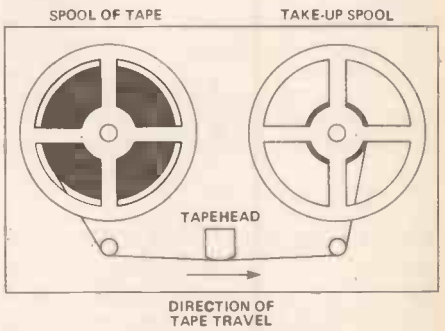


Figure 3. A magnetic memory system. Such an auxiliary memory has a large capacity but a slow access time.

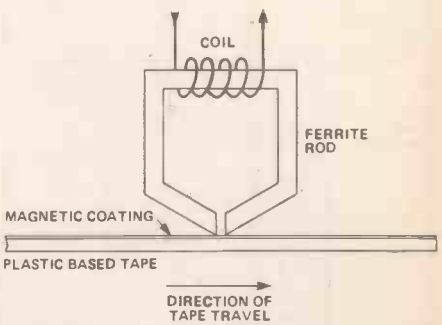


Figure 4. Principle of operation of a magnetic tape memory system. An electric current through the coil produces a magnetic field which is stored on the magnetic surface of the tape. On playback the stored information creates a current through the coil which can be amplified.

Magnetic Disc

A magnetic disc memory system uses the same principle of record and playback of data, onto and from a magnetic surface. However, instead of magnetic tape, the magnetic surface is on a flat disc (**Figure 5**). The record/playback head can move across the disc and data is recorded in tracks of information. Access times of disc systems vary with quality, but are around 100ms.

Different types of disc are available, eg floppy, rigid, and Winchester, and different amounts of data can be stored. The smallest and cheapest systems will store up to around a hundred thousand characters per disc but the largest and most expensive can store over fifty million characters.

The type of auxiliary memory chosen for use in a computer system depends to a large extent on what use is to be made of the system. If huge amounts data are to be stored for a very long time, and a fast access time is not important, then a magnetic tape auxiliary memory is ideal. However, if fast access times are important but large quantities of data are still to be stored then a disc system auxiliary memory is a better choice. Needless to say, memories with fast access are generally more expensive than those with slow access.

Central processors perform their functions at a very high speed, but because memories with fast access (say, disc or internal main memory) are expensive compared with slow access tape memory, most home computer systems are built around a compromise of a large capacity slow access memory, in conjunction with a small capacity fast access internal memory. Disc options are usually provided if required.

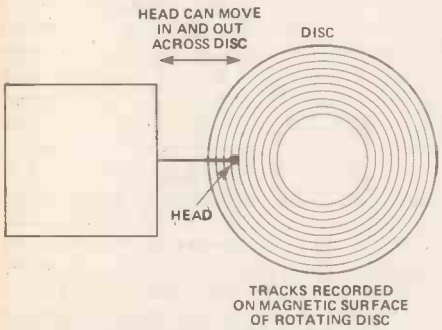


Figure 5. Principle of a magnetic disc memory system. Large capacity systems are possible with a fast access time compared to magnetic tape.

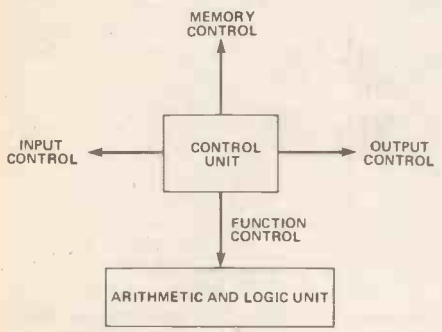


Figure 6. The main sections of a central processing unit (CPU).

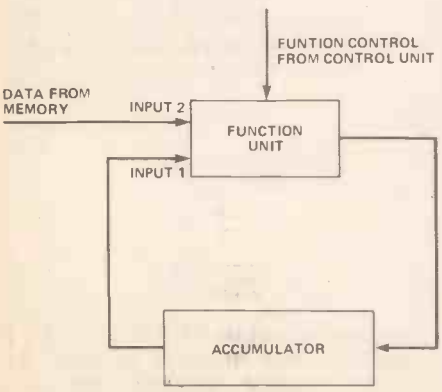


Figure 7. Inside an arithmetic and logic unit (ALU). The accumulator is a single-number store, or register.

Central Processors

The central processor of a computer system — any computer — system — performs two basic functions:

- control of the internal operations of the computer system
- all arithmetic and logic functions eg, add, multiply, AND, OR

These two functions are shown in block diagram form in **Figure 6**. The control unit has a number of jobs to do. First it controls the transfer of data to or from all I/O devices. It also controls the input of data to the main and auxiliary memories (ie, it writes data into memory), and the output of data (ie, reading) from memory. It determines the functions required of the ALU in order to comply with the instructions of the program then, finally, it takes the ALU through each calculation step-by-step. In short, the CPU controls everything that a computer system can do — data bases, word processors, automatic cash registers, 'talking' dashboards in cars etc., are all possible only because of this exceptional controlling power of the CPU.

Now, from this description of a CPU you could be forgiven if you were to think of a CPU as being super-intelligent. Actually, there is nothing further from the truth — a CPU is not intelligent at all. By itself it cannot do a single thing! The seemingly clever things it does are only made possible because of the instructions (in the form of programs) which we supply.

This picture shows a new-style Hitachi disc drive using 3½in discs rather than 5in discs. Disc drives are getting smaller and cheaper as demand increases.

These instructions are step-by-step commands to the control unit, which are stored in the memory of the computer. As each command is carried out the next instruction is taken from the memory ready for carrying out, in a fetch-execute cycle common to all computers. We'll look at this fetch-execute cycle in more detail, soon.

Arithmetic And Logic Unit

An ALU can perform a small number of binary operations on binary numbers. Generally it can

- add
- subtract
- compare
- AND
- OR

binary numbers, so that its output is an addition of a subtraction of a comparison of, etc., two binary numbers. Other mathematical and logical functions can be included in the list of duties an ALU can perform, depending on its internal complexity. Every duty, however, is controlled and requested by signals from the control unit and the ALU can do nothing it is not told to do.

We can look deeper into the ALU and **Figure 7** is a block diagram showing the accumulator, which is an ordinary shift register, which acts as a number-one memory. The first of the two binary numbers to the ALU is stored in the accumulator, ready for application to input 1 of the function unit. The second of the two binary numbers to the ALU is taken from memory, straight to input 2. Acting on commands from the control unit, the function unit performs the arithmetic or logic functions on the two applied numbers and puts the result into the accumulator.

An example of how the accumulator is used in the ALU is shown in *Table 2*,

Table 2

Step	0	1	2	3
Accumulator	—	5	28	36
Data	+5	+23	+8	

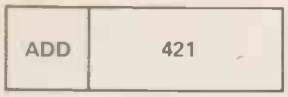


Figure 9. Each instruction in a computer program can be stored ready for use in a computer memory.

where three numbers (5, 23 and 8) are to be added. Initially, the accumulator holds an irrelevant number (possibly the address to the previous calculation) and its contents are shown by a dash. On the first step, however, this irrelevant number is replaced by the first number to be added, so that input 1 to the function unit is the first number (5). Input 2 is the second number (23). On a command from the control unit the two numbers are added and the result (28) put into the accumulator. The process is repeated, adding the third number (8) and putting the final result (36) into the accumulator.

A Complete Central Processing Unit

We are now in a position to look again at the whole central processing unit. But this time we know enough about the internal parts to be able to see how the complete device functions. **Figure 8** shows a block diagram of a CPU, and the control unit, accumulator, function unit and computer memory are shown. Also included in the diagram are two new parts: a program counter and an instruction register. The program counter is a simple counter which holds the memory address of the next program instruction to be carried out. On completion of every program instruction the program counter is incremented by one. The instruction register is used to temporarily hold the program instructions to be carried out.

In our example of a CPU, we shall assume that each instruction in the program consists of two parts (see **Figure 9**). First part of the instruction, the operation, is simply the command which the CPU must follow ("add" in **Figure 9**). Second part is the address of the memory location which contains the number to be operated on (the operand).

If we now define a possible set of simple instructions operations which a CPU could typically follow, we can apply them (with numbers) and show how calculations can take place within a computer. These instructions could be, with the code numbers for simplicity:

1 — add to accumulator
2 — complement accumulator
3 — increment accumulator
4 — read contents of memory into accumulator
5 — write contents of accumulator memory
6 — clear accumulator ie, set accumulator contents to zero.

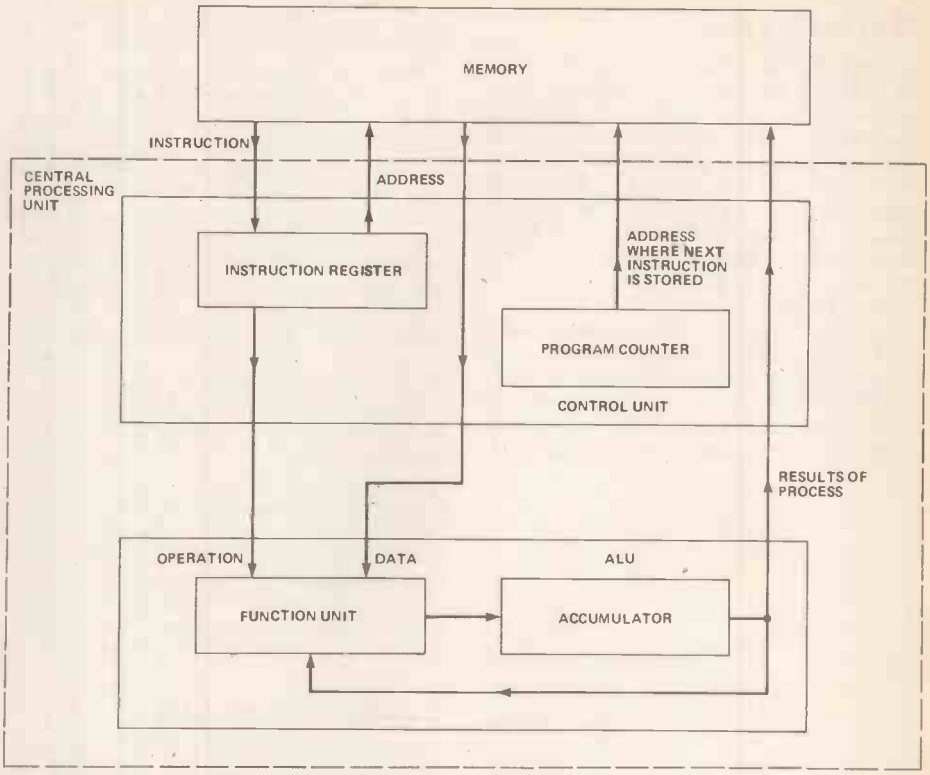


Figure 8. A block diagram of a whole central processing unit, complete with ALU, instruction register and memory.

Initially, we shall assume the contents of the accumulator are zero. Also, the program counter contains the number 1 ie, the address of the first instruction. Now, let's say the program stored in memory is written with the aim of adding together two numbers, say, 45 and 28. The program, stored in consecutive memory locations could be as shown in **Table 3**.

At step 1, the number held in the address indicated by the program counter is fetched from the memory and loaded into the instruction register, where the operation (ie, 4 = read contents of memory into accumulator) is separated from the address part of the instruction. The CPU now starts the execute part of the cycle, in which the operation is carried out — so the contents of memory address 100 (ie, 45) are read from the memory and loaded into the accumulator. The program counter is incremented automatically to point to the next instruction address (ie, 2).

The fetch cycle of step 2 loads the next instruction, 1101 into the instruction register and separates the operation (1 = add to accumulator) from the address (101). Now the execute cycle is commenced; the content of address 101 (28) added to the accumulator and the program counter is incremented.

Finally, in step 3, the operation 5 (write contents of accumulator into memory) is carried out and the contents of the accumulator (73) are moved to memory location 102. The program counter is incremented.

Table 3

Memory Location	Operation	Address
1	4	100
2	1	101
3	5	102
1		
1		
1		
1		
100	45	
101	28	
102	unspecified	

Subtraction

Table 4 lists a program which has been written to subtract two numbers ie, 15 from 26. You should remember that subtraction is carried out in digital circuits by forming the two's complement of the number to be subtracted and *adding* it to the other number. The two's complement of a binary number is obtained by inverting each bit of the number ie, complementing the number and then adding one ie, incrementing.

So the program must function along these lines. First step is given by the instruction contained in memory location 4 (the program counter was left there after the last program, remember). The instruction 6XXX (X means 'don't care', in other words the data is irrelevant) is fetched from memory and loaded into the instruction register. The operation 6 (clear accumulator) is carried out. This is necessary, otherwise the contents already in the accumulator could cause the next program results to be wrong. The program counter is incremented.

In the next step, the instruction 4110 is fetched from memory location 5 and executed. The contents of memory location 110 are read into the accumulator and the program counter is incremented.

The next two steps, complementing and incrementing the contents of the accumulator, are needed to allow subtraction of the number. Again, in each of these two steps, the data is irrelevant.

The instruction in address location 8 is to add the contents of location 111 (26) to the contents of the accumulator (-15), giving the answer, 11.

Finally, the last instruction (5112) is to write the contents of the accumulator into memory address 112. The program counter is incremented and the program is completed.

Table 4

Memory Location	Operation	Address
4	6	XXX
5	4	110
6	2	XXX
7	3	XXX
8	1	111
9	5	112
1		
1		
1		
1		
110	15	
111	26	
112	unspecified	

Summary

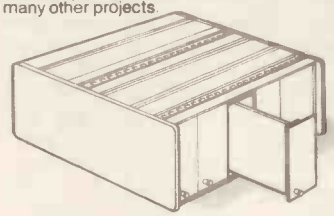
So, with program instructions and operations like these, the central processing unit of a computer can perform calculations. Of course, the calculations performed by the CPU are all in binary and the instructions it receives from the program must also be in binary, as must the numbers to be added, or subtracted etc.

The list of operations which the CPU can perform is very limited in our example. In fact, this instruction set is not sufficient to allow us to do more than just simple arithmetic functions such as add, subtract, multiply, divide etc. But, the basic idea is sound. If we enlarge the instruction set, we obtain a more versatile CPU, which can perform a wider range of processing tasks. This, together with memory, input devices and output devices, forms a computer system.

No Project Is Complete Without The Right Housing . . .

KMT
The unique new modular enclosure.

Suitable for alarm systems, counters, interfaces amplifiers, model control units and many other projects.



Easy to assemble - just 10 screws.

Easy on the pocket - house your projects economically and professionally.

For full size eurocards (100 x 160mm) mounted horizontally in the 35TE front panel kit.

Half size eurocards (100 x 80mm) mounted vertically included as part of all front panel kits (except 35TE), with connector included.

Hand Held Box

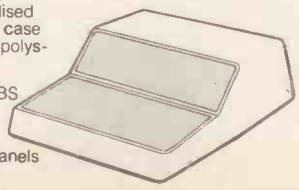
This box is moulded in two sections and has a textured finish. The battery compartment accepts a PP3 or nickel cadmium stack 25 x 45mm long. A circuit board 56 x 105mm may be mounted on three pillars in the base, location being provided by a 3mm spigot. The top moulding will accept a circuit board 71 x107mm.

- Material-Textured ABS
- Colour-Dark brown

Hi-Style Desk Top Case

Designed to house keyboards and displays on two 1,6mm silver anodised aluminium panels. The light brown case is manufactured from high impact polystyrene and has a textured finish.

- Casing-High impact textured ABS
- Colour-Brown, front and base panels 1,6mm satin anodised aluminium



Plastic Boxes
Type A

Plastic boxes consisting of a top and bottom moulding with front and rear aluminium panels, positively retained in the two halves.

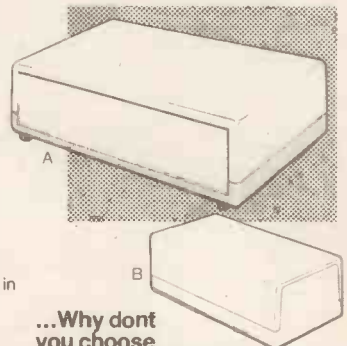
- Top and bottom moulding-High ABS.
- Colour-Light grey top: dark grey base.
- Front and rear panels-Satin anodised aluminium 1,6mm thick.

Type B

Constructed of high impact polystyrene, these handsome two-toned grey boxes are suitable for wall mounting and free standing instruments. The two halves of the box are held together by screws inserted from the base.

- Material-High impact polystyrene
- Colour-Top light grey: base dark grey
- Panels-Satin anodised aluminium

Send 50p for a copy of the catalogue with details of the full range available.



...Why dont you choose BICC-Vero Enclosures. A complete range where quality and economy are combined.

BICC-VERO ELECTRONICS LIMITED
Retail Department, Industrial Estate, Chandlers Ford, Hants SO5 3ZR
Tel (04215) 62829

BICC vero

BUYLINES

Conductance Meter

No buying problems with this project but do shop around for the panel meter. You can try **Watford Electronics** for starters. The one we used is normally referred to in catalogues as a 'T' type. Others such as the much cheaper 'M' types can also be used. Note the maximum size of meter one could use with the recommended case is 60 x 48 x 32mm.

Approximate cost excluding case and materials for probes is £11. There is no PCB for this project.

Spring Reverb

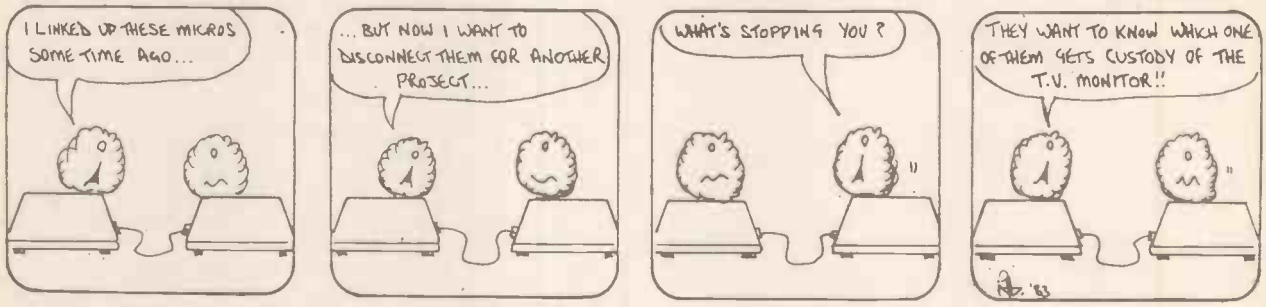
And yet another project with no component problems and not a lot to be said about it! Do make sure that you purchase the spring line before buying the case — for fairly obvious reasons.

The actual spring line used in the prototype was obtained from **Maplin**.

The approximate cost excluding case and PCB is £14.

The PCB can be obtained from our PCB service.

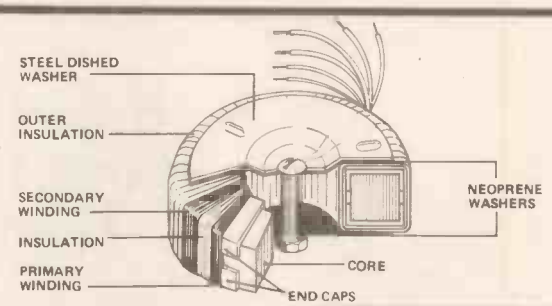
BEASTIES BY AH



TOROIDALS

The toroidal transformer is now accepted as the standard in industry, overtaking the obsolete laminated type. Industry has been quick to recognise the advantages toroidals offer in size, weight, lower radiated field and, thanks to I.L.P., PRICE.

Our large standard range is complemented by our SPECIAL DESIGN section which can offer a prototype service within 7 DAYS together with a short lead time on quantity orders which can be programmed to your requirements with no price penalty.



15 VA
62 x 34mm 0.35Kg
Regulation 19%

SERIES No	SECONDARY Volts	RMS Current
0x010	6+6	1 25
0x011	9+9	0 83
0x012	12+12	0 63
0x013	15+15	0 50
0x014	18+18	0 42
0x015	22+22	0 34
0x016	25+25	0 30
0x017	30+30	0 25

(encased in ABS plastic)

30 VA
70 x 30mm 0.45Kg
Regulation 18%

1x010	6+6	2 50
1x011	9+9	1 66
1x012	12+12	1 25
1x013	15+15	1 00
1x014	18+18	0 83
1x015	22+22	0 68
1x016	25+25	0 60
1x017	30+30	0 50

50 VA
80 x 35mm 0.9Kg
Regulation 13%

2x010	6+6	4 16
2x011	9+9	2 77
2x012	12+12	2 08
2x013	15+15	1 66
2x014	18+18	1 38
2x015	22+22	1 13
2x016	25+25	1 00
2x017	30+30	0 83
2x028	110	0 45
2x029	220	0 22
2x030	240	0 20

80 VA
90 x 30mm 1Kg
Regulation 12%

3x010	6+6	6 64
3x011	9+9	4 44
3x012	12+12	3 33
3x013	15+15	2 66
3x014	18+18	2 22
3x015	22+22	1 81
3x016	25+25	1 60
3x017	30+30	1 33
3x028	110	0 72
3x029	220	0 36
3x030	240	0 33

120 VA
90 x 40mm 1.2Kg
Regulation 11%

4x010	6+6	10 00
4x011	9+9	6 66
4x012	12+12	5 00
4x013	15+15	4 00
4x014	18+18	3 33
4x015	22+22	2 72
4x016	25+25	2 40
4x017	30+30	2 00
4x018	35+35	1 71
4x028	110	1 09
4x029	220	0 54
4x030	240	0 50

160 VA
110 x 40mm 1.8Kg
Regulation 8%

5x011	9+9	8 89
5x012	12+12	6 66
5x013	15+15	5 33
5x014	18+18	4 44
5x015	22+22	3 63
5x016	25+25	3 20
5x017	30+30	2 66
5x018	35+35	2 28
5x026	40+40	2 00
5x028	110	1 45
5x029	220	0 72
5x030	240	0 66

225 VA
110 x 45mm 2.2Kg
Regulation 7%

6x012	12+12	9.38
6x013	15+15	7.50
6x014	18+18	6 25
6x015	22+22	5 11
6x016	25+25	4 50
6x017	30+30	3 75
6x018	35+35	3 21
6x026	40+40	2 81
6x025	45+45	2 50
6x033	50+50	2 25
6x028	110	2 04
6x029	220	1 02
6x030	240	0 93

300 VA
110 x 50mm 2.6Kg
Regulation 6%

7x013	15+15	10 00
7x014	18+18	8 33
7x015	22+22	6 82
7x016	25+25	6 00
7x017	30+30	5 00
7x018	35+35	4 28
7x026	40+40	3 75
7x025	45+45	3 33
7x033	50+50	3 00
7x028	110	2 72
7x029	220	1 36
7x030	240	1 25

500 VA
140 x 60mm 4Kg
Regulation 4%

8x016	25+25	10 00
8x017	30+30	8 33
8x018	35+35	7 14
8x026	40+40	6 25
8x025	45+45	5 55
8x033	50+50	5 00
8x042	55+55	4 54
8x028	110	4 54
8x029	220	2 27
8x030	240	2 08

625 VA
140 x 75mm 5Kg
Regulation 4%

9x017	30+30	10 41
9x018	35+35	8 92
9x026	40+40	7 81
9x025	45+45	6 94
9x033	50+50	6 25
9x042	55+55	5 68
9x028	110	5 68
9x029	220	2 84
9x030	240	2 60

Why a Toroid?
- Smaller size & weight to meet modern 'slimline' requirements.
- Low electrically induced noise demanded by compact equipment.
- High efficiency enabling conservative rating whilst maintaining size advantages.
- Lower operating temperature.

Why ILP?
- Ex-stock delivery for small quantities.
- Gold service available. 21 days manufacture for urgent deliveries.
- 5 year no quibble guarantee.
- Realistic delivery for volume orders.
- No price penalty for call off orders.

Prices including P&P and VAT

VA	Size	£	VA	Size	£
15	0	7.43	160	5	12.90
30	1	8.08	225	6	16.30
50	2	10.10	200	7	18.55
80	3	10.81	500	8	25.73
120	4	11.73	625	9	31.63

For 110V primary insert "0" in place of "X" in type number.
For 220V primary (Europe) insert "1" in place of "X" in type number.
For 240V primary (UK) insert "2" in place of "X" in type number.
IMPORTANT: Regulation - All voltages quoted are FULL LOAD.
Please add regulation figure to secondary voltage to obtain off load voltage.

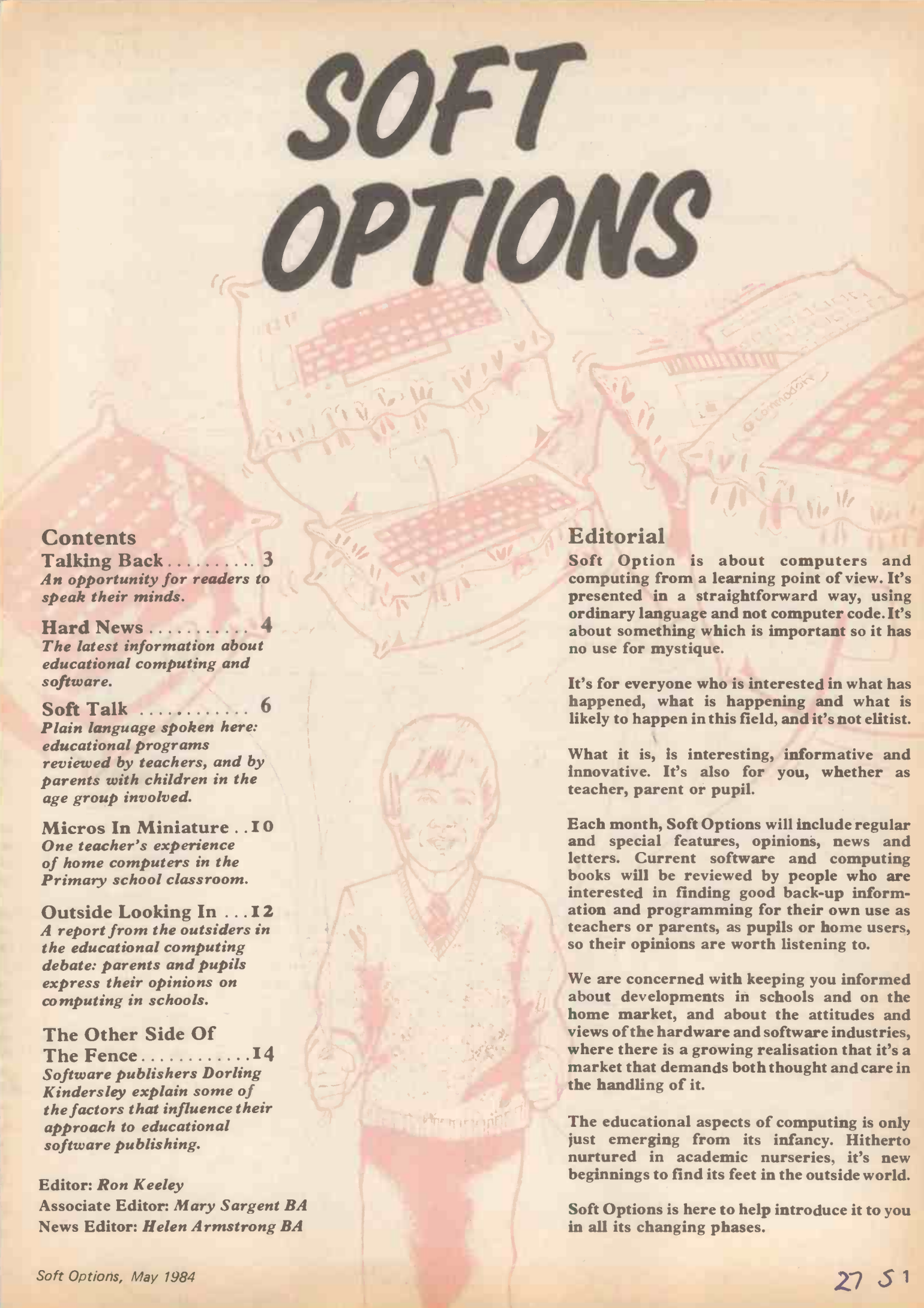
Mail Order — Please make your crossed cheques or postal orders payable to ILP Electronics Ltd.

Trade — We will open your credit account immediately upon receipt of your first order.

Post to: ILP Electronics Ltd., Dept. 5
Graham Bell House, Roper Close,
Canterbury, Kent. CT2 7EP
Tel: (0227) 54778 Telex: 965780

ILP ELECTRONICS LTD.

SOFT OPTIONS



Contents

Editor: *Ron Keeley*
Associate Editor: *Mary Sargent BA*
News Editor: *Helen Armstrong BA*

Editorial

Soft Option is about computers and computing from a learning point of view. It's presented in a straightforward way, using ordinary language and not computer code. It's about something which is important so it has no use for mystique.

It's for everyone who is interested in what has happened, what is happening and what is likely to happen in this field, and it's not elitist.

What it is, is interesting, informative and innovative. It's also for you, whether as teacher, parent or pupil.

Each month, Soft Options will include regular and special features, opinions, news and letters. Current software and computing books will be reviewed by people who are interested in finding good back-up information and programming for their own use as teachers or parents, as pupils or home users, so their opinions are worth listening to.

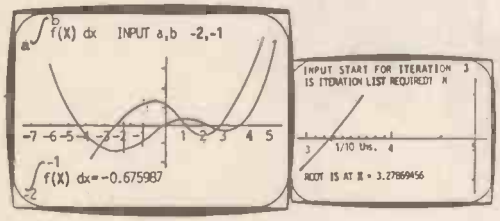
We are concerned with keeping you informed about developments in schools and on the home market, and about the attitudes and views of the hardware and software industries, where there is a growing realisation that it's a market that demands both thought and care in the handling of it.

The educational aspects of computing is only just emerging from its infancy. Hitherto nurtured in academic nurseries, it's new beginnings to find its feet in the outside world.

Soft Options is here to help introduce it to you in all its changing phases.

27 51

NOW A TRUE SPREADSHEET, FUNCTION GRAPHING, EQUATION SOLVING, DIFFERENTIAL PLOTTING, INTEGRAL FINDING, GRAPH MANIPULATING, MATHS TEACHING PACKAGE IS AVAILABLE.



FOR **BBC 'B' & APPLE IIe,**

Cartesian DOES THE FOLLOWING:

- ★ HANDLES TRANSCENDENTAL FUNCTIONS, CIRCLES, ELIPSES, POLYNOMIALS.
- ★ GRAPHS FUNCTION TO EXTREMELY HIGH OR LOW VALUES OF X AXIS.
- ★ PLOTS DIFFERENTIAL CURVE IN CONJUNCTION WITH PRIMARY.
- ★ EXTRACTS ROOTS PRECISELY USING NEWTON RAPHSON METHOD.
- ★ MAGNIFIES CURVES FOR FINE DETAIL EXAMINATION.
- ★ DETERMINES DEFINITE INTEGRAL (area under curve).
- ★ SOLVES COMPLEX EQUATIONS.
- ★ BRINGS WITH IT AN 18 PAGE BOOKLET WHICH IS WELL WRITTEN AND EXPLAINS ALL THE UNDERLYING MATHEMATICAL PRINCIPLES.
- ★ SPREADSHEET FEATURE ALLOWS ALMOST INFINITE TRAVEL UP OR DOWN THE X AXIS.

IT'S CALLED **Cartesian** AND IT'S MORE FUN THAN A GAME. HIGH RESOLUTION GRAPHICS AND EXCELLENT DOCUMENTATION MEAN THAT IN A SHORTTIME YOU SHOULD ABSORB MOST OF THE CONCEPTS RELATING TO CALCULUS AND THE SOLUTION OF POLYNOMIALS.

THEN THE REAL FUN STARTS . . . . .

Price : CASSETTE £24.90. DISK £27.75. INCL. P&P. NO VAT ON UK OR NI ORDERS.

MAIL ORDER TELEPHONE (074) 22286 & (074) 22025

BARCLAYCARD (visa) & ACCESS WELCOME.

FLITE software Findrum, Convoy, Co. Donegal, Ireland.

Dealers who are interested in high quality educational software should write or phone.

NEC SOFTWARE

CROSSWORD PUZZLER

BBC 'B'

A cassette of programs which allow you to create, store and play your own crossword puzzles. Includes three demonstration data files of improving junior and infant spelling, helping with revision facts, foreign language vocabulary etc.

£6.90 inc VAT

ALL FINGERS GO!

BBC 'B'

Ultra fast touch typing course with a completely new approach to learning to type — users follow the computer's moving fingers on the micro's keyboard. Eighteen lessons from beginners' standard to full keyboard typing, including error checking and speed measurement. Superb use of the BBC's colour and graphics.

Set of two cassettes **£14.95** inc VAT
40 or 80 track Disck **£28.75** inc VAT

From bookshops or direct from NEC

NATIONAL EXTENSION COLLEGE
18 Brooklands Avenue
Cambridge CB2 2HN

(prices include post and packing)

Wordmaker

Listmaker

For Spectrum 48 and Commodore 64

- an interactive program to help children develop spelling, reading and vocabulary skills in the context of a simple letters and word game.

Spelling is an essential skill in enabling a child to progress in the educational system.

A major feature of spelling ability is the recognition of possible letter sequences - when people aren't sure of word, they often try writing it down on scrap paper to see if it looks right, i.e. they are using their reading to check on their spelling. This interrelationship has been tapped in the program Wordmaker by giving the child a number of letters to rearrange in order to make words from. By trying out words in this way, they can develop a knowledge of correct sequences of letters and develop appropriate strategies for working out words.

Using columns of letters which can be moved up and down to make words, the child is relieved of the burden of having to learn how to type from a keyboard and the overall process becomes one of discovering words rather than that of rote memorisation which is an unnecessarily laborious and often unpleasant task for most children.

This program can easily use any type of word list and is therefore suitable for many different ages (from 5 years).

Wordmaker may be used for many other purposes such as:
• By foreign students learning English • English students of French or German (French and German versions) • For teaching words in specific subjects such as Biology, Botany, Medicine etc; where there is a list of "connected" words.

Wordmaker - this is the main driver program and when loaded will auto run showing a simple 2 column word list. If required at this stage a new word list may be loaded.

Listmaker - Parents or teachers may use this program to produce their own word list.

Word Files - The program is supplied with 12 progressively difficult word files.

All three programs supplied with complete documentation in a large durable library case. Price £7.50 incl. of P & P. and V.A.T. available from **IMS Software** 143-145 Uxbridge Road, London W13 9AV Telephone orders welcome with ACCESS. Telephone: 01-567 6288

28

S2

Talking Back

These pages are made available to readers of Soft Options, to express their opinions on computers, educational computing and software, or any other related topic.

The Other Half

Hazel Terry is 15 years old and in her fifth year at school. She owns her own micro, a ZX81, and has been interested in computing since she was introduced to it by her younger sister two years ago. She does Computer Studies at school and will be taking her O-levels in that and other subjects this year.

Computer studies is a relatively new subject in the school cirriculum, and there will are still a few problems with the contents of the course and attitudes towards it. I certainly felt that the introductory talk we were given on the subject did not sufficiently stress the importance of computing in a wider number of jobs, nor did it spell out exactly what was involved in the course.

I was also concerned that the school suggested that instead of starting the course in the third year I should take it in the sixth form.

I believe that Computer Studies should be taught for two years as a compulsory subject and then offered as an option course. This would provide everyone with a basic understanding of computing. I also believe a conscious effort should be made by the school staff to encourage a mixed range of children to adopt the subject.

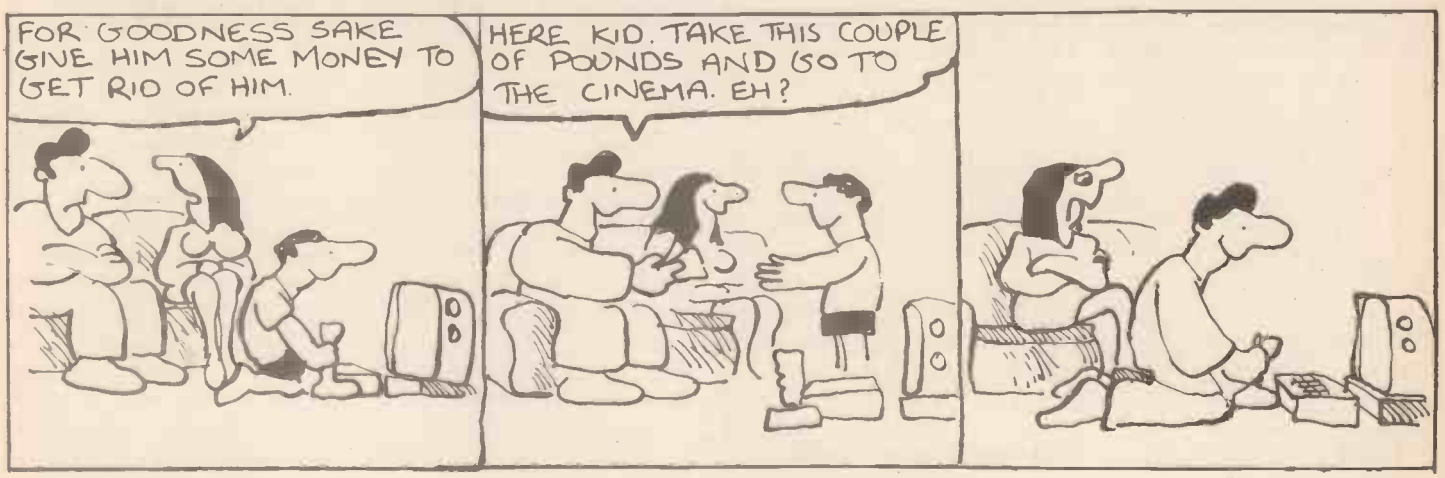
At the moment, the class consists mainly of intelligent boys, and girls who are considering a career in secretarial work. I do not think the importance of computing in such areas as medicine is apparant enough to a large number of girls.

As a subject, the syllabus still has its faults. I feel that there is too little graphic work offered on the course and in some areas it seems far to general. A good example of this concerns applications. Areas such as design are only briefly mentioned, using computers as an aid. To be able to work through a specific example in this area, using the computer through the full range, would be very beneficial to me as a pupil.

Computer Studies could be described as a science. However, this does not mean that it has to be hindered by the teaching problems that science departments experience.

A problem faced by both departments is the attitudes demonstrated between girls and boys. Unfortunately the boys appear to believe that they have a natural domination over the girls. Many of them have been encouraged by their fathers. This is not so often the case for the girls. This masculine attitude often crushes any confidence that the girls may have had.

Earlier I mentioned the lack of awareness of the computer's role in many careers and research. Computing is, after all, a job women can do as well as men. It is a long standing joke that women are by nature illogical. This is of course not true. Women are just as logical as men, but they are encouraged neither at school nor, often, at home to participate in logical activities and subjects. This means they do not have a chance to develop any ability they have in this area. Women must remember that it is a field where they are equal to men. However, I wonder, as the importance of computing grows, will men attempt to be dominant? Could a woman in computing be as unusual as a women in certain scientific fields?



29 S

SOFTOPTION

MTX 500/512 Launched

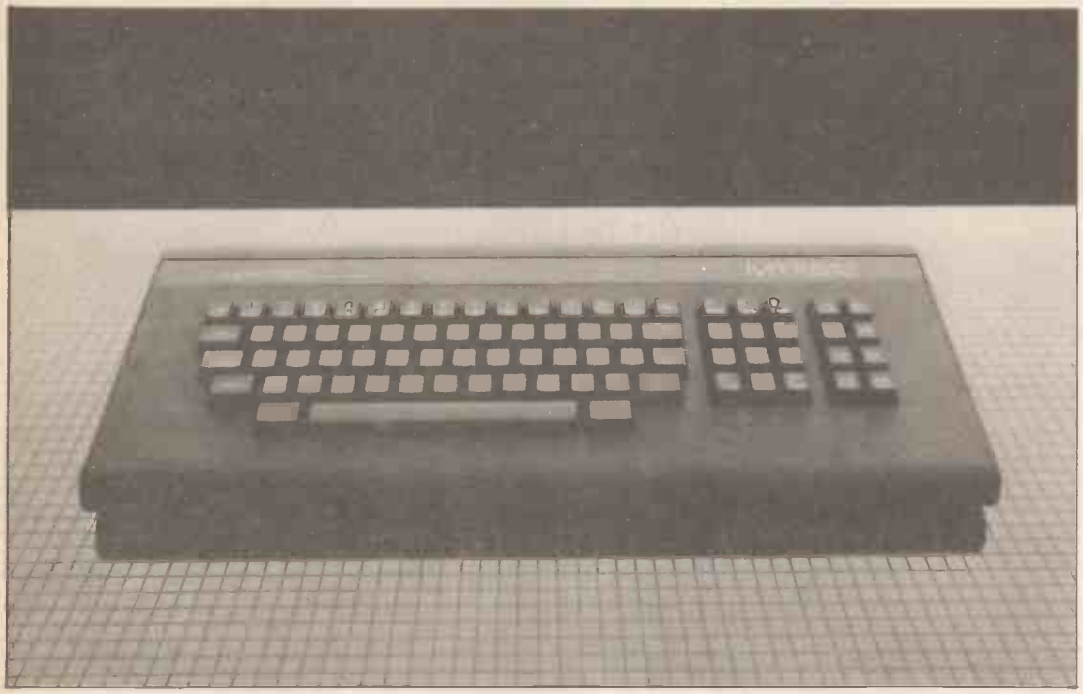
An impressive display of working computers, peripherals and software was provided by **Memotech** at the launch of their **MTX Series computers** at the Cumberland Hotel in London on February 16th.

The theme of "New Technology In The UK", the subject of Sir Campbell Fraser's opening speech, was well illustrated by Memotech's "high-tech" equipment, but most home buyers and, I suspect, a great many schools are likely to be very interested in the MTX 500 & MTX 512 computers, which cost £275 and £315 (inclusive of VAT) respectively.

The MTX has an excellent hardware specification and it is of such a rugged construction that it is difficult to see how, even in constant-use conditions, it could be harmed by ham-fisted users.

Colour graphics and sound are arguably better than those of the Acorn BBC model B and Commodore 64 computers, and the expandability of the MTX is both straightforward and inexpensive. The built-in software caters both for the beginner (with the new language Noddy) and the advanced programmer (with the assembler and Front Panel).

Memotech have their sights firmly fixed on an educational market for their machines and with their new factory in Witney opening in April, they will be in a position to offer the same sort of volume production as Research Machines Ltd. and Acorn. Their Local Area Network is ready, and a network of eight machines was demonstrated at the London launch. The MTX network is fast and, unlike most other networks, can be driven by a standard cassette-based computer. In Memotech's case this is the MTX 512. Up to 255 stations can be accommodated in the Net, and work has already started on fitting these systems into colleges and offices.



Anyone who has ever seen or used a Memotech ZX81 add-on will know that the qualilty of the hardware is high, and since their venture into computers a common question has been "will they manage the software to go with it?"

Since the second function of the London Launch was to hold a seminar on standards of hardware and software in education, and to create a research fellowship to investigate the matter, there can be little doubt now that Memotech are just as concerned over the quality of software for their machines as in the mechanical reliability of them. It was clear from a number of points raised that the intention is to offer programs similar to "the best" of the current Acorn/BBC educational software, but that to emulate the BBC BASIC would not be a worthwhile exercise, the actual language always being secondary to the aims and objectives of the program itself. Users of the BBC computer may like to know though that the tremendously useful 40-column coloured text with high resolution graphics mode *can* be emulated on the MTX, and software to do this will be available shortly. There are also signs that some of the leading software houses are more than interested in providing programs for the Memotech, and the future looks decidely promising.

Soft Options hopes to monitor the progress of this new British computer, assessing the usefulness of the new beginners' language "Noddy" and reviewing its educational software as it becomes available.

Quick Maths

Quicksilva, the "Game Lords" themselves, are turning their attention to more serious matters. They have plans for some **maths tapes**, which are currently being written for them, and there is talk of some Early Learning software from the same stable. The company is also thought to be more than interested in the potential offered by Memotech's MTX series. Watch this space . . .

New Ways With Educational Software

In a startling move, three directors from the Heinemann group of publishers have left to form their own home software publishing company — with the full blessing of Heinemann.

Alan Hill, former Managing Director of Heinemann; Hamish MacGibbon, Chairman of Heinemann Computers in Education Ltd., and Roy Davey, marketing director of Heinemann Educational Books, have formed **Hill, MacGibbon, Ltd.** to publish home software with a strong bias towards educational tapes aimed at school-age users right through from five up to sixteen.

Heinemann, on the other hand, are apparently pulling out of this market, and have sold their successful software packages for primary schools, launched last September, to the new company. The four software packages, developed by Five Ways Software with the Dudley Education authority, were originally commissioned by Roy Davey for Heinemann. It remains to be seen what a small company with such a wealth of experience in the educational market can do with software — the omens must look auspicious.

HARD NEWS

Penguin On Tape

March 29 saw the arrival on the software market of a significant package from a a significant source. The Directors of **Penguin Books** have declared their interest in the computer revolution with the introduction of six Shakespeare **revision tapes,** designed to run on the 48K Spectrum and aimed specifically at the O-level/CSE candidate revising at home. The programs cost £5.95 each, which is good news for those who are tired of having to fork out £10 for the privilege of buying "educational" tapes, and will be available from bookshops and from high street outlets such as W. H. Smith and Sons.

The programs have been written by two Secondary School teachers, who between them have thirty-six years experience of actually teaching, and whose knowledge of their subject cannot be doubted. A refreshing aspect of the launch is that Penguin, who are calling their range Study Software, do not claim to have solved all the problems inherent in producing software for learning. Whilst they are confident that the product is superior to anything currently available, and that the programs have great potential, both they and the authors, John Mahoney and Stewart Martin, are prepared to listen to constructive comment and accommodate it where possible.

At the moment the titles available include: *Macbeth, Romeo and Juliet, Julius Caesar, The Merchant of Venice, Twelfth Night* and *Henry IV Part I* and versions for the BBC and Electron machines will be launched in May.

Penguin, however, see this as only the beginning and are committed to at least twenty titles, all examination set texts, but including novels such as *Catcher In The Rye* and *Lord Of The Flies* as well as Shakespeare's plays. At the same time as expanding the range of titles they also intend to cater for other micros, including the Commodore 64, and both the authors will shortly leave teaching to fulfill their contracts with Penguin as full-time programmers.

Learn The Lingo

French Is Fun and **German Is Fun** are the first two programs of a new educational series planned by **CDS Micro Systems**. The programs use the graphics capabilities of the Spectrum 48K to present French and German in an interesting and stimulating way. They are intended for students or for just brushing up a modest knowledge of the language before going on holiday, and cost £5.95 each.

The programs are similarly structured. A nine point menu is displayed when the program has loaded and the required section is selected by pressing the appropriate number key. A second menu then allows selection of one of four modes.

Mode 1 builds up one of six pictorial scenes featuring house, countryside, seaside, cafe, street or school, and as it does so the corresponding English and French words are displayed.

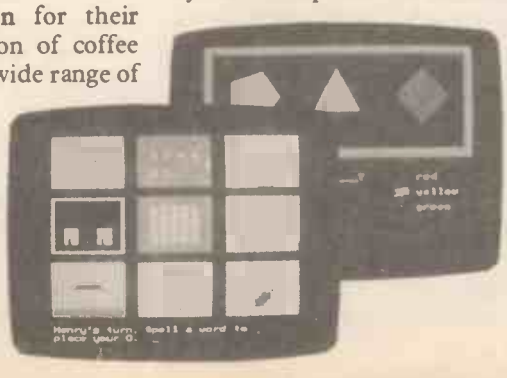
Mode 2 tests spelling and French vocabulary. Wrong letters are reflected in the mistakes counter which can be re-set when the scene is finished. Typing in a ? automatically displays the next letter. Mode 3 runs through fifteen general phrases, and Mode 4 causes Mode 1 and 3 to be run simultaneously.

The main menu includes separate "counting" and "telling the time" selections in addition to an "All Picture" scenes selection.

Software With Advice

News of another publishing house interested in the educational possibilities of the micro comes with the announcement of *Dorling Kindersley's* intention to market two programs by **Goldstar** for primary school users.

Previously known for their glossy presentation of coffee table books on a wide range of subjects such as gardening and photography, the company has now set up Dorling Kindersley Software, which intends to use the same kind of expertise in selling software. *Learn About Words* and *Learn About Shapes* have emerged from the Media Resources Group of Surrey, the first program having been written by the Group and the second being commissioned from one member of the Group.



Both will run on the BBC machine, will cost £9.95 (inc. VAT) each and will be available by mail-order from the end of April.

Included in the package will be a registration form which, when completed and returned, will give the consumer access to Dorling Kindersley's advice and help with the programs.

O LEVEL MATHS/PHYSICS

For 32K BBC Micros & Electrons
Multiple-Choice Revision Programs

- Large database of questions — random selection for each test.
- End of test score, time-report, answer-check.
- Cut-off option, on time-up you're marked on the number of questions completed.

£10.95 per cassette (inc. p&p): Both for **£20**
S.A.E. for further details.

Heliwell Software
157 St. Peters Rd., Reading RG6 1PG

Soft Talk

This month's reviews have been written by primary and secondary teachers, and by parents with children of the ages catered for by the particular programs on test.

Superspy

A modern history simulation

(*Ampalsoft*)
Cheshire Cat Educational Series for Dragon 32 computers.
BBC Model B version available from April 1984.
Price: £14.95

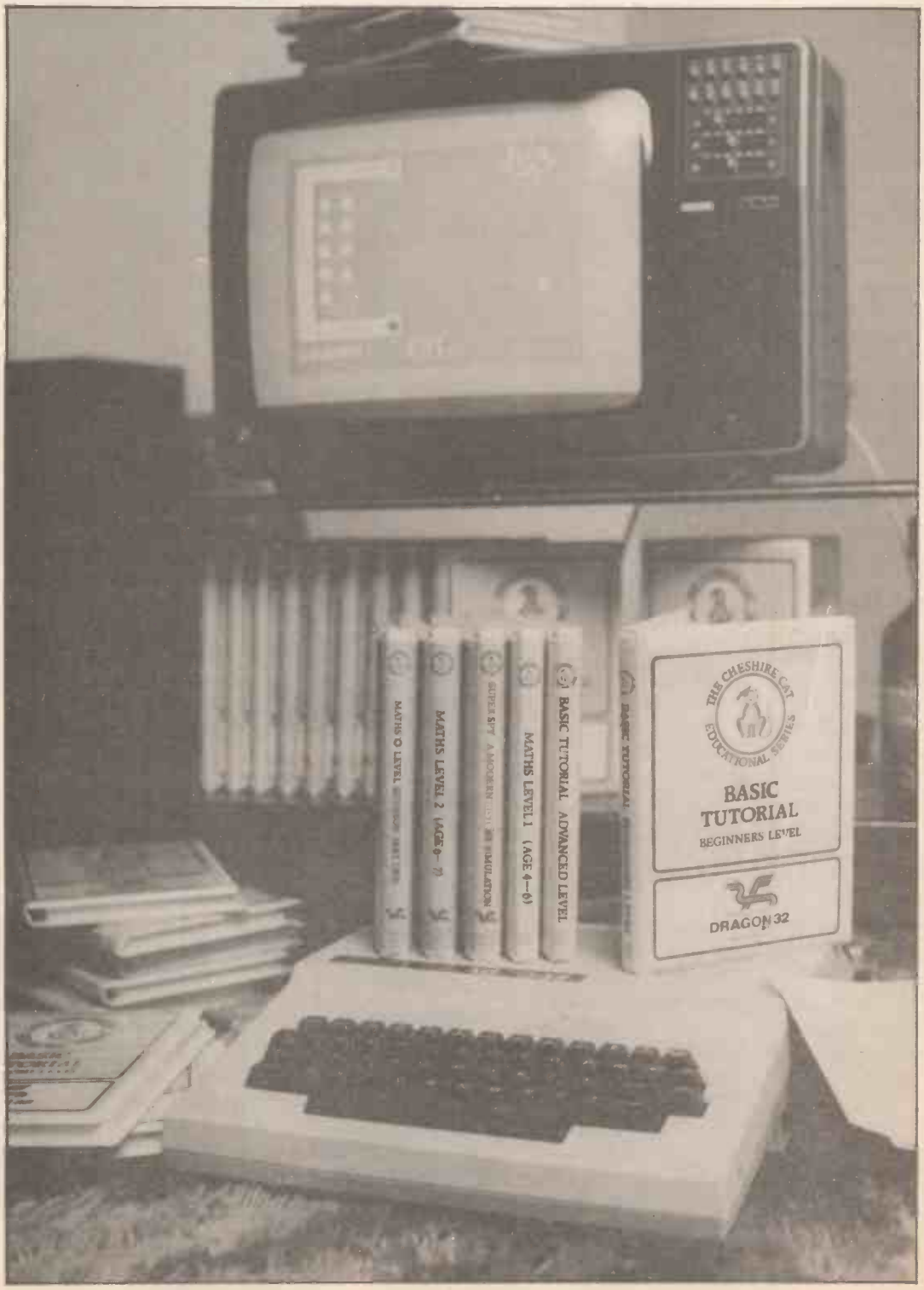
Reviewed by **N. E. Martin.**

Warning
Don't start this program without a couple of hours to spare . . . it's compelling stuff!

Superspy consists of a series of skill tests — an assault course, a parachute drop, code-breaking and shooting — interspersed with briefings on life in Britain during the Second World War. The training leads eventually to a full-scale mission in which you, a German spy, are parachuted into Scotland and have to find your way to London to deliver a vital message.

Your route south is on A-roads selected from a very creditable map of Britain, and it leads you from one town to the next. On reaching a town, you are given a potted geography and are then accosted by a policeman or member of the Home Guard. If you cannot answer his question correctly (remember those briefings!) you get involved in a fight from which only your skill can rescue you.

You then have to contact



Ampalsoft's compulsive "Superspy" modern history game is reviewed here.

another agent whose phone number and password appear briefly on the screen, and have to be memorised. If you make satisfactory contact, you get a night's rest and proceed to the next town on the following day — provided, of course, that the road you want to take is not closed, in which case you may choose to retrace your steps or stay where you are.

Should your limited time run out, you are given the chance to gamble for more. If you eventually reach London, make your contact and pass the correct message, then your success is charmingly acknowledged and you get the opportunity to start another mission.

This program was generally so good that it seems churlish to find fault with the details.

I would have liked the STAY option to have been specified on the route selection screen. It was also tedious to re-read the geographical notes every time you STAYed, especially if you were caught for several days.

Could this option perhaps have thrown up a question on the notes instead?

Finally, it would have been preferable to have had a way out after a successful mission without BREAKING the program.

These, however, are all minor points. Superspy is a well thought out and attractively presented introduction to life in wartime Britain and contains a surprisingly large amount of information which was painlessly absorbed, and later reproduced, by two ten year olds, whose previous knowledge of the subject was practically nil ("Churchill? Who's he?").

Although designed for individual use, it would be great fun for a small group and will appeal to a wide range of ages and abilities.

The Cheshire Cat series is available from Boots computer departments, Dragon Data and selected High Street stores.

Wordmaker/ Listmaker

(IMS Software)
16/48K **Spectrum, Commodore 64**
Price: £7.50

Reviewed by **A. J. Verdin**

The author claims that these programs "help children develop spelling, reading and vocabulary skills".

The idea is to assemble real words from the letters and letter combinations displayed in columns on the screen. The letter column may be moved up and down by use of the P and L keys.

For example, List 1 shows ten three letter words ending in "at". The "at" remains static on the screen while the column containing the 21 consonants can be moved so that each, in turn, can be combined with "at". ENTER is pressed when a real word is recognised.

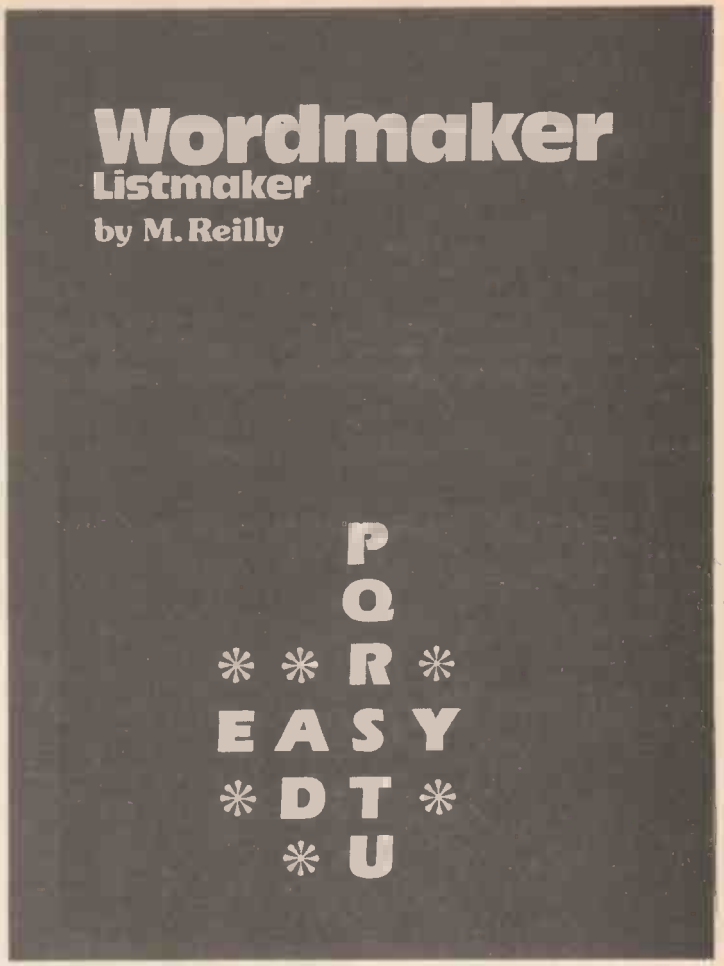
The principle is similar to that of Word Wheels, made by generations of teachers, and it is difficult to see what, if anything, the computer adds to this activity.

The word lists are idiosyncratic and contain many words which are either obscure in spelling or meaning, eg "gat" and "clew", and many others which I, together with the Concise Oxford Dictionary, do not recognise as real words, eg "belter".

Alternatively, words which I do consider real, eg "oh" and "ye", words that appear in early reading books and hymns, are marked wrong, with a cross, and a disconcerting raspberry is sounded.

Exposing children to the combinations of letters which are not real words can only be detrimental and a waste of time, yet the author claims that rote memorisation of correct spelling is unnecessarily laborious!

Moreover, spelling is not just a matter of visual memory, but of learning hand and wrist



"Wordmaker/Listmaker", from IMS Software.

movements, where the actual writing of words reinforces the learning process.

The program claims "to develop early reading skills by encouraging a strategy of sounding out words and leads children to develop a more extensive vocabulary as they encounter words that are new to them".

However, a computer can not listen and correct a child's reading. Recognising a combination of letters as a genuine word is not really learning how to read or spell. In fact, the pupil can only recognise a word to be genuine if he has already read it!

List maker is a program to enable appropriate lists of related words to be complied and then used in the Word Maker program. At first sight this may have some use since the pupil is helped to look for spelling patterns in words, and if the lists are made from books then at least all of the words are 'real'.

However, once the list is compiled on paper its usefulness ends, since setting up the word list on the computer has more to do with manipulating the letters on the screen than learning how to spell. Again, this involves wrong combinations being displayed by the learner.

It is hard to see any merit in these programs, or indeed to see them as anything but a gimmicky and extremely limited use of the computer. Books, together with pencil and paper will do the job better, as these are still the principle tools of a literate society, and should be used to teach literacy.

Wordmaker/Listmaker is available direct from IMS Software.

Since this program was reviewed IMS have improved the software, with the word files now on separate cassettes. In addition the Commodore 64 version offers a choice of either keyboard or joystick control.

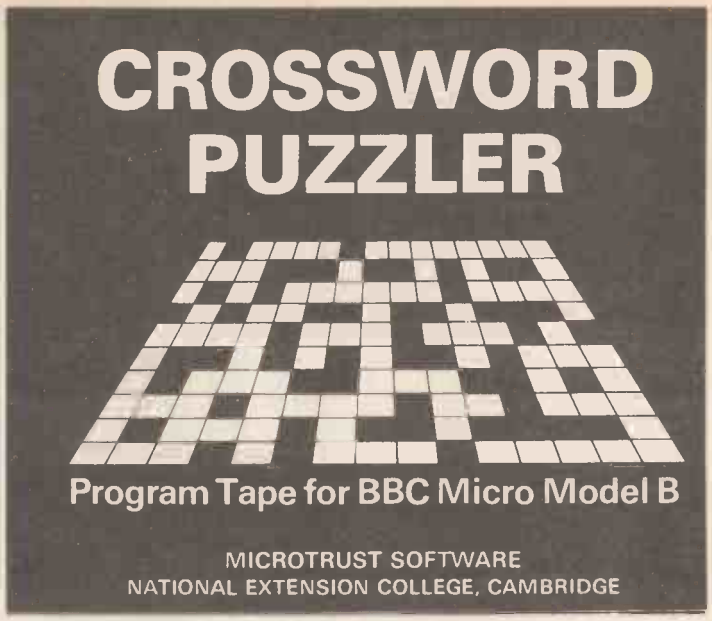
IMS Software,
143-145 Uxbridge Road,
Ealing,
London W13 9AV
01-567 6288

33

Crossword Puzzler

(*Microtrust Software*)
For **BBC Model B** computers. **Spectrum** 16K or 48K version available from July 1984.
Both versions priced at £6.90

Reviewed by **Roger Battley**



Crossword puzzles come into the category of things that you are either addicted to or else have little interest in. With this in mind, I loaded the program with some apathy. Guess which school of thought I belonged to?

The program came in a neat plastic folder with the cassette and instruction booklet inside. The cassette consists of "Word Play" and four ready-made crosswords on side A and "X Word Gen" on the other side. This is for creating your own puzzles. The tape loaded faultlessly every time I tried it.

The first part of the booklet gives a very short introduction to the history of crossword puzzles and outlines what is on the cassette. It then explains how to set up your own crossword using the X Word Gen. On running the program you are asked to name the puzzle being created and whether you have already saved a part-entry for this puzzle. If you are starting afresh it sets the size of the crossword being written.

Once this is done the program asks for the clues you wish to give and the correct answers required. Clearer instructions at this point would help. However once I realised that I should repeat the serial number the computer prints at the start of each clue before entering all the details, all went smoothly.

It is vital to prepare the required crossword as suggested, before you start, otherwise you become hopelessly lost when trying to correctly locate each entry. You are asked to check each clue before committing it to memory, because it cannot be recovered for alteration unless the entire puzzle is re-entered. Finally, you are given a small on-screen display of the letters in their relative positions within the puzzle. You then set the baud rate to either 300 or 1200 and SAVE your masterpiece.

To use this newly created puzzle you must first load WORDPLAY and then follow instructions. The program asks for the puzzle's name and baud rate and proceeds to load it. Nothing much seems to happen for a very long time. Then the crossword appears on the top two-thirds of the screen. The lower third is reserved for communication during the game.

After every input the computer beeps its feelings at you, which I found infuriating after a very short while because there is no way that it can be turned off without major excavation into the program listing. This seems to me to be entirely unreasonable.

After registering the number of the clue you wish to attempt, the program always enquires if you want the answer. It would be better if you were just asked once at the start of the program — if nothing else, it would cut down on those beeps!

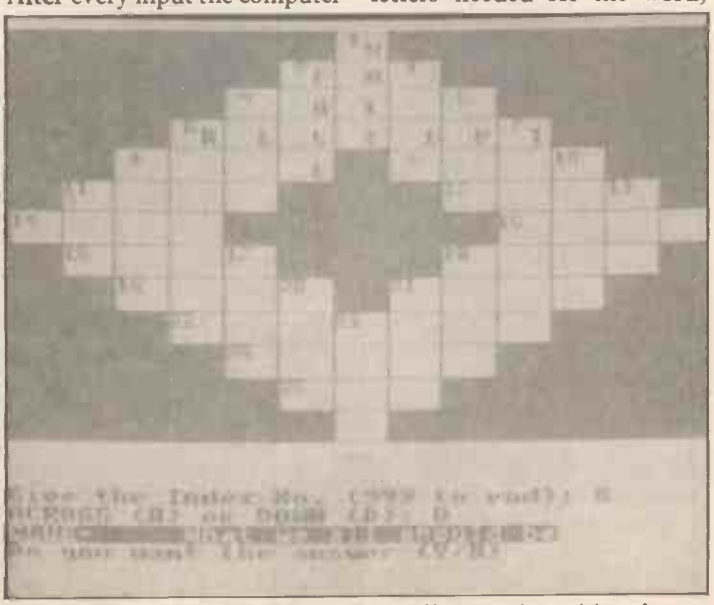
You cannot move on to another clue until an answer of some kind has been supplied, even if it is incorrect. The program insists on your giving the exact number of letters needed for the word, including any correct ones already on the screen.

Correct answers are in upper case, incorrect ones in lower case. Every wrong answer produces the inevitable beep, unnecessarily prolonged. When you have completed the puzzle or given up by entering 999, you are presented with the facts of your game. These include time taken, number of wrong anwers, number of answers supplied by the computer on request and the number of clues attempted out of the total required to complete the puzzle.

This last part tended to slip off the screen and pop up on the other side for all but the shortest puzzles. After this the program "hopes you enjoyed the puzzle", and displays a modest little menu in the bottom left hand corner enquiring what you want to do next. Options include re-running the same game, loading a new game, or quitting.

There was no print-out-facility available, which I would have thought fairly necessary for such a game. The screen layout could have been improved and the ability to turn the sound off seems, to me, essential. The documentation is adequate without being over-clear, and on the last page a method of auto-indexing computer tapes is outlined.

This was devised by a Mr. C Hood, who generously donated the method, possibly because it was too fiddly to hang on to. I certainly felt it was worthwhile sticking to a tape counter. I don't know about you, but I can think of better things to do with £5, and I still don't like crossword puzzles.



A screen display from "Crossword Puzzler". How about rich and famous'?

Crossword Puzzler is available direct from Microtrust Software, or from the Computer departments in W.H. Smith stores.
Microtrust Software,
National Extension College,
18, Brooklands Avenue,
Cambridge,
CB2 2HN
0223 - 316644

Geometry

'O' Level Maths Revision
(*Rose Software*)
Price £5.95

Reviewed by **Francis Glassborrow.**

The first criticism that must be levelled at this maths program from Rose Software is that the documentation is poor. I do not see why the user should not be addressed in clear English: I do not find a cassette insert which starts, "The cassette contains six programs of multiple choice questions using generated numbers" a useful introduction for the target user, that is, an O-Level maths candidate.

Unfortunately, the general tenor of the insert is a pretty good indication of what is to come. But if the introduction stretches the student's resources, the same cannot be said of the program. As far as I can see, the selection of topics for each program was made entirely on the basis of what a CSE computing candidate might be able to cope with, and is therefore inadequate for the needs of O-Level students.

After each section of the tape had been loaded my time was ingeniously wasted by the loading of a Front Page, which displayed the firm's logo. They're clearly proud of this, since a large proportion of the tape was devoted to this screen.

Undismayed, I pressed "any key" to start the program proper, and was treated to yet another screen display, this time accompanied by a burbling sound effect.

Swearing gently, I persevered and finally got to the program. I was given, by way of a diagram, a pair of parallel lines and a transversal — crude, unimaginative and showing nothing that could not be better done on paper.

I was asked a simple question about the proper term to use to describe the relationship between the two angles, and yes, it was multiple choice although only three choices were offered. After I had made my selection I was simply informed whether I was right or wrong. On responding to "press any key" I was given my current total of correct answers and incorrect ones. I had to press again to obtain the next question.

If you think that this was just an easy exercise to get me started, read on. All the questions in the first five programs followed the same general pattern. Occasionally, but rarely, some advice was given. I never did manage to provoke any constructive reaction to wrong answers.

Even when I deliberately set about getting all the answers wrong the programs did nothing to help. I wasn't even advised to consult teacher. Perhaps the thing knew I was cheating . . .

As far as I could ascertain the program contained fewer than a dozen questions each, and these were of a very simple nature. The "generated numbers" do nothing except change the particular numbers in a question.

By the way, the programs don't like to let go too easily — you can't escape merely by saying you don't want any more questions. The program simply starts all over again. Your only salvation is the BREAK key.
There is also a new dimension added to the perennial upper/lower case problem: if you have the CAPS LOCK on and manage to respond to the question "Do you want any more?" the machine will lock up on you. Well, it makes a change from the BREAK key, I suppose.

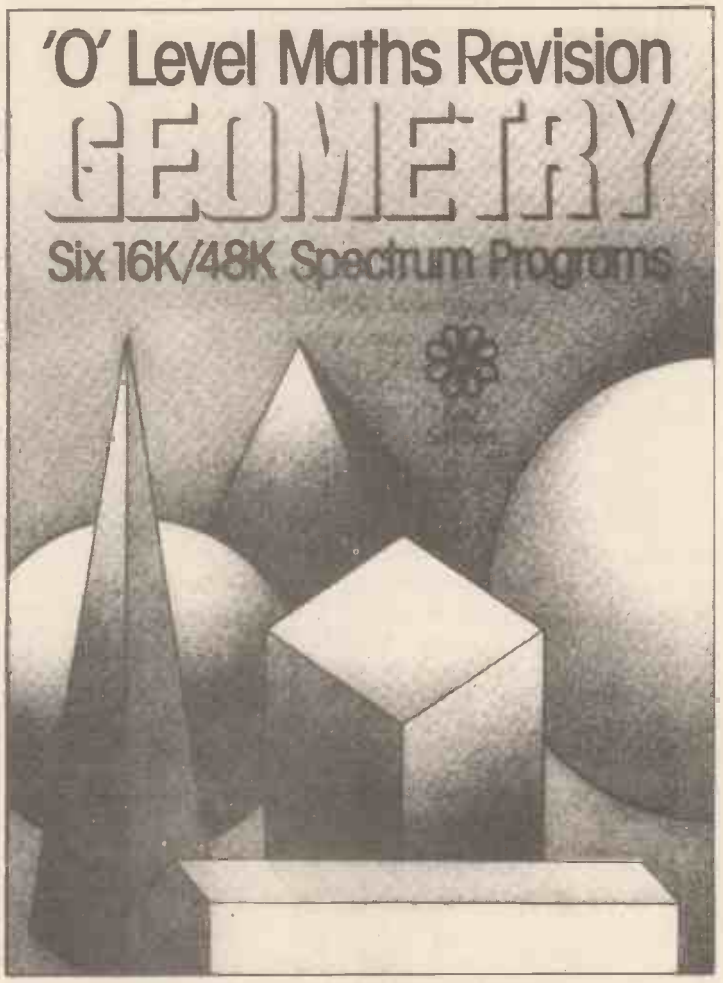
On to the sixth program, which involves "Typical O-Level questions with help facilities". This little gem contains five questions; the last three questions use the same diagram and all but the first concern angle properties. The standard of all questions is about CSE/O-Level short-question level, which is not exactly the demanding end of the subject.

The content of these programs is not in itself trivial, but the handling is. Nowhere has the programmer shown any inkling of the kind of difficulties faced by young people trying to polish up their knowledge for examinations. The tape is boring to use and none of the very great potential of the Spectrum has been tapped.

A good education program demands several hundred hours work by the programmer together with some detailed research. I could find little evidence of these qualities in this tape. It should be noted that an entire Maths revision textbook costs less than this package and any single chapter of such a book will do more good than all six programs.

This offering cannot be said to be thought-provoking or capable of triggering interaction between people. These qualities have, arguably, always been criteria in any meaningful educational system, and there seems to be no good reason why they should not be adopted by the people who wish to market educational software.

Contributions like this to little to enhance commericial standards and are of use to no-one interested in serious applications of the micro computer.



The cover of the booklet accompanying Rose Software's "Geometry" program. The cover is identical, but will be in full colour.

Rose Software tapes are available direct from selected High Street stores.
Rose will be re-presenting their software with full colour boxes and descriptive leaflet, and a price increases to £6.95 is expected when the new packaging becomes available.

Rose Software,
148 Widney Lane,
Solihull,
West Midlands,
B91 3LH
021-705 2895

Micros In Miniature

By Audrey J. Verdin

Unexpectedly positive response to a Sinclair ZX81 in her Primary school classroom led one teacher to think seriously about the need for better software for learning.

Just over two years ago I was introduced to my first microcomputer. It was love at first sight. I found it incredibly fascinating that I could hold a conversation with a keyboard and a television set, and actually make the thing respond, albeit that I had already programmed the reponses into it.

I decided that I wanted to play with one at home, and of course I wanted it immediately! Assistants in likely shops looked blankly at me when I mentioned the word microcomputer, and I soon discovered that the only one I could actually have immediately was a ZX81, from W. H. Smiths.

I took it home to share with my family but met blank incomprehension at my enthusiasm, and nobody willing to play with me. I duly played my myself, and produced an extremely crude program which I thought my six-year-olds might like.

Of course, I knew that the keyboard was too tiny, not positive enough for small fingers, and that the upper case letters were a drawback. It also seemed a very vunerable and fragile toy to have in an infants' classroom, but I thought maybe I would find someone who was as interested as I was. I did . . . several.

I discovered that small fingers actually found it easier to use the keyboard than big ones. I found that the children soon became conversant with the upper case printing (a bonus?), especially the good readers, and they willingly helped the others. After a week I happily left the chidren using it while I had my coffee, and it has never meen mistreated in any way.

Co-operation in the classroom. The girls are just as interested as the boys . . . if not more so! (Photograph of children at Sutton Primary School, Cambridgeshire: courtesy Sinclair Research Limited).

The only drawback was that if the table or wires were moved suddenly there was a momentary interruption in the power supply, and we lost the program. Occasionally I had to put it away because I felt reloading was taking up too much of my time, and I was fed up with the chorus of "Gone again!".

In that first group of children there were a number of boys who were the most enthusiastic, but I was determined not to let them take it over. After all, I am female and I enjoy computing, so I decided it was not to become a male preserve.

I discovered, later, that groups of children vary: gender does not predetermine interest. Recently, I noticed two five year old girls, in my class only three weeks, sitting waiting first thing in the morning at the empty table facing a blank wall where I always put the computer

They were waiting to make sure that they were the first of the day to use it! They started a waiting list similar to that we often keep next to the computer.

This one was a little different. Their own names were written beside numbers one and two, five and six, and nine and ten! At this age, girls *are* interested, and do *not* see this as a male activity.

That first group of boys loved to play 'Othello' against the computer. They were determined to beat "him" (!). I was surprized to find that they were willing to discuss the next move and come to a joint decision. It seemed to foster a genuine spirit of cooperation, which is often absent in a class of mostly egocentric six and seven year olds. They ganged up against "him", and showed unselfish pleasure at other people's brillian ideas. I found this to be one of the most rewarding

aspects of using the computer in the classroom.

After a month, we had a parents' evening. I set up the computer in the corner and invited the parents of those six year old experts to have a go. Not one did! They were glad to see what it was that their children had talked about, but were not willing to experiment themselves, or not while I was there, anyway!

Since those early days (only two years ago) things have changed considerably. We now have a school computer (an RML480 Z), I have a Spectrum as well as the ZX81, and about one third of the children have computers at home, bought over the counter at many different shops, of several makes.

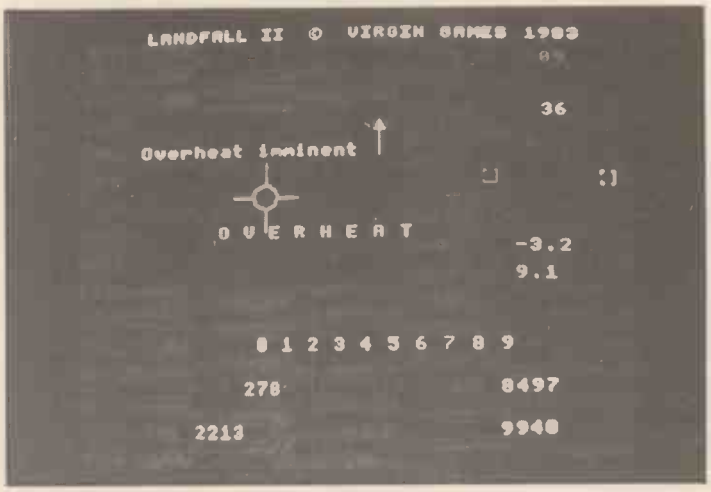
For the 480Z, we are well served with software. We have the M.E.P. primary package, supplemented by several excellent Local Authority programs, and for one week each term that we have it in the classroom we are spoilt for choice. Actually, in a primary school of eight classes, one computer is simply not enough. We need more. However, in my classroom things are a little better.

My own computers are there most days (not all) and they take their place as normal activities.

My greatest problem is finding suitable software for them, because of course, as a school we have had the M.E.P. package, and are not entitled to the same for the Sinclair machines. All of those readily available in the High Street shops, labelled as suitable for young children, are also labelled "educational" These programs are, almost without exception, of the drill and practice type.

The majority of them are arithmatic, with some alphabet programs thrown in. The assumption seems to be that the computer must be used to do the same job as sum books and the more elderly reading schemes. They are enlivened, perhaps, with moving graphics and sometimes (heaven forbid) they involve bombing practice, with the child expected to bomb the correct answer.

There is a vast amount of programming talent going to waste in making sums gimmicky, but whatever the extra incentive in the short run, children are going to realise that they are being conned into doing the same on the computer as they used to do in books. I am not saying that there is no place for "drill and practice" in the Primary school, because of course there is! Children still have to learn the alphabet, learn to count and to add and subtract.



Games, particularly simlation games such as the 'lunar lander' type, have a useful role in educational computing.

I am not even saying that we should not do it with the computer. I think that it is fine for extra practice at a particular stage and, given the innovation, extra enthusiasm is generated, provided that the use of the computer is not limited to this.

What I believe is that we need programs for younger children which will develop talents that traditional schooling can not. We need activities that the computer does *better* than anything else. At the moment these seem to be data handling, simulation, and programs which provide a simplified computer language for children to use, such as LOGO. This should soon be more widely available, and we have high hopes of this developing genuine mathematical thinking and problem solving skills in quite young children.

Simulation programs seem to be lacking for this age group. Why not adventure type games at carefully graded reading levels, and with graphics? These would be very useful, since children could learn how to make choices or develop strategies based on evidence they collect, either from observation of the graphics or from written descriptions.

As with most things for the younger children, the best and most sophisticated programming would be needed, because boredom soon sets in when the computer simply responds "I do not understand", as it did in one so-called adventure game I used (or tried to) recently. Anything to do with prehistoric animals, knights and castles, or space are sure winners with the under eights.

They do *not* all have to fight, be blown up or bombed. We do not need to encourage war, in the classroom, in the aggressive sense, but why not in the sense of games of strategy — outwitting the enemy rather than shooting him?

Another problem is that programs, often costing about £10, have to be bought unseen. No one expects buyers of books to make a purchase over the counter without first dipping in. Book shops are full of browsing customers, and they still sell books. Programs will not be less good because the teacher or parent is able to sample before buying. I assume that manufacturers do not object too strongly, because recently at the ZX Micro Fair I saw hundreds of games being played, and they were still being sold. In fact I bought two programs that I would not have done, had I not seen them first. The titles would not have encouraged me to buy them.

Publishers who are moving into educational software cannot be trusted unfortunately, because they are among the chief offenders in the drill and practice market. In one counting game, for example, each number was related to a particular animal moving in a particular pattern. The one child I have so far who still counts intuitively soon memorised that if it was a group of elephants, it was five — and so on — just as he had already memorised the domino patterns on the playing cards that his parents had tried to use for counting games.

The best set of programs I have (I think) are maze games of varying difficulty. The child can plan where to move without being harried by monsters, and these mazes cannot be memorised because different patterns are generated each time, unless the child wishes to repeat the same problem.

This has a useful spin-off in encouraging sub-skills of reading, such as left-to-right eye movements and scanning ahead, as each creature is moved from the left side of the screen to the right. Other sub-skills that could be developed using a computer are visual discrimination and visual memory.

I hope that, soon, the proven inventiveness of programmers will be applied to the real educational needs of young children today, and that we shall soon see a new generation of programs.

Outside, Looking In

Research and report by **Mary Sargent.**

While academic arguement curdles on the pages of the educational press, we conducted a small poll of the opinions of the outsiders in the Great Debate: parents and their children.

In an article published in the Times Educational Supplement recently, Lucy Warner examined parental attitudes to high technology in American schools.

American parents are largely hooked on the new American Dream, which involves total computer literacy for their children, preferably before Elmer P. Jones on the next block manages it, and this despite considerable reservations among "Educators" as to the amount of time and money computing should consume.

So how do parents in England see the situation here? We approached a few people for their views, concentrating initially on the parents of primary school children, on the grounds that, 1. You have to start somewhere and 2. this is the first generation who might reasonably be expected to be computer literate at the end of their school careers.

Father of two sons, aged 8 plus and 6. State Church school.

My own children are both under 9 but I am keen that they should begin to become familiar with computers as soon as possible, and I am therefore pleased to see equipment being provided to this end at their school.

I think there should be a dual approach to the use of the computer in school for young children. Firstly, it has great potential as a teaching aid and I suspect there is a great deal of software development needed in this area. It is a pity that the writing of educational programs is not as lucrative as writing games for the home micros.

Secondly, children should be given a simplistic understanding of what the computer does and how you make it do it. Obviously, young children cannot understand the complexities of maths in a program, but they are capable of understanding how a computer language can be used in a series of simple program lines and how such things are loaded into memory and stored.

Both aspects can be developed gradually until children reach the stage where they are able to confidently use the computer as a tool for their own purposes.

"I've had to think about it because I'm on the PTA of my son's school and funds have just been spent on a 480Z and some ZX81s. So far, only the older children have had access to them. But my basic feeling is that my children must be capable of using them, because we live in a computer age and they're unlikely to go away, however little I know about them personaly."

Dealer in Computer systems for the home market:

"The parents who come in here are concerned that their children should be given every chance with the new technology, and it's not by any means restricted to professional people. One chap came in the other day and bought a BBC system and as much educational software as I could recommend, for his eleven year old daughter. He was a builder and semi-literate and he was determined that his child was going to be better educated than he was.

Mother of 5 daughters aged 7 to infant. Two children at rural village school:

"I think it helps development of logical thinking. Anything which helps make you more at home with the world as it develops must be a good thing. I believe computers are a large part of the future: how far this is due to my own thinking and how far influenced by what I read, I'm not sure. I don't think they'll ever take over but

I want my children to be competent with them, Computers should never replace the basic teaching of the three Rs and my children are using the school computer for more abstract exercises, which pleases me."

Interestingly, although several of the people who contributed to this article owned micros, only one parent related the question of children's education in computing to the home situation. He was also the only person to give any detailed thought to the software aspect, although that is perhaps the most obvious way to judge a computer if you are unfamiliar with them — through the medium of the programs displayed on their screens. This is what he had to say:

Father, One son, aged ten, and a daughter aged seven. State primary school:

"What do you children do when the neutron bomb store has been blown up for the 100th time, the last arcadian zapped? Does the congratulatory message every say, "Well done, wow, gosh, etc. now you must be bored with this, how about trying something different?"

No, but we were all thinking on those lines after a few days. Its educational roles were never uppermost in our minds when we bought our Spectrum before Christmas.

Having said that, and having got the machine, I see broadly three possible educational roles for it, two of which we have already started to appreciate.

Firstly, it shows what a computer is, the kind of things it is good at and, just as important, the kind of things is is not good at. Early on, we wrote a simple dialogue to ask your name, request permission to call you by a shortened version, ask your age and so on.

My ten year old son was fascinated by the first run of the dialogue and cried, "Now ask it *its* name!", even after participating in the writing of the program. So he quickly learned the limitations of the computer's personality.

Secondly, I see the value in teaching logic by writing programs, the idea that reasoning can be formalised which underlies all computer languages. In this respect the limitations of BASIC haven't worried me. It was useful to discover that sound and text handling are more fun and more appropriate to the children's level than numerical manipulations, which call for mathematical sophistication.

Thirdly, of course, there is the use of the computer as a means to an end with educational software. As yet, I have little experience of this application but I must say I am suspicious.

This is partly because the non-arcade games I have seen advertised often appear fatuous and I can well imagine educational programs would be too, as if playing computerised scrabble or monopoly is an advance on the good old fashioned way. I'm sure the writers of chess programs learn more and expend more time and ingenuity than those who use their product, who must be lonely people indeed.

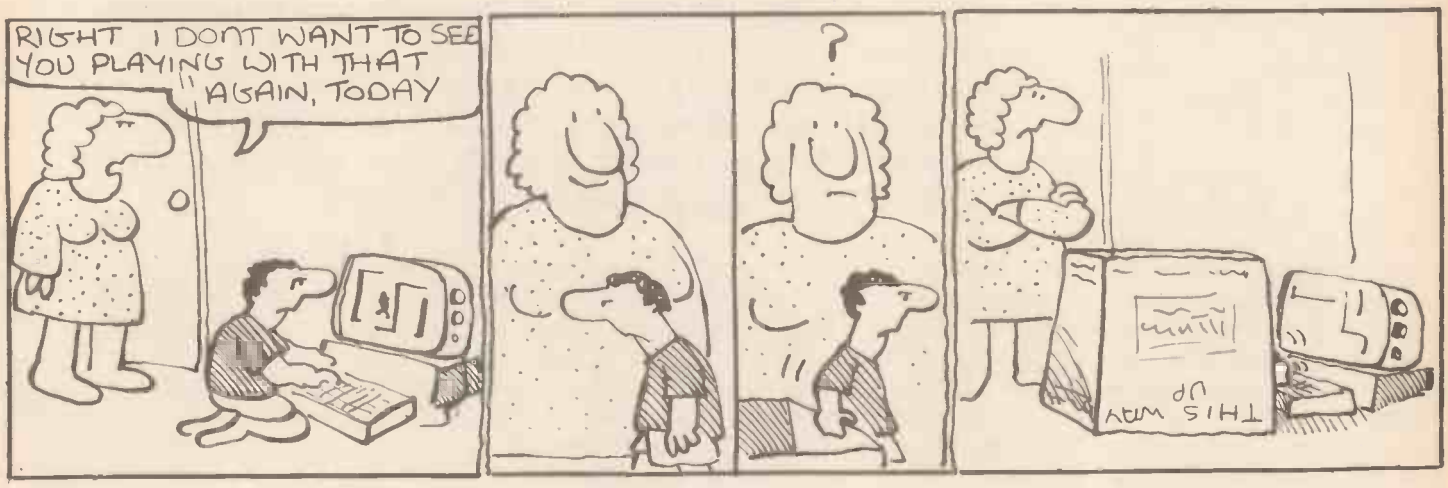
To overcome my prejudice, educational software will not only have to be technically excellent, it will have to convince me that it offers something useful which is not readily available from teachers, books and experiments.

I would hate to see the depth and connections with other materials in a good text-book passed over in favour of a cheap, convenient and seductive electronic surrogate, however high resolution its colour graphics may be."

In the course of gathering these comments, we met up with one or two of the consumers themselves who were quite pleased to record their reactions to the revolution in their midst. They ranged from the deeply reflective to the dismissive:

Neville, aged 10: "My Spectrum, according to my experience with computers, is a very good machine. I don't think much could be done in the way of making it a better one. I like messing about with commands such as FLASH, BEEP, BORDER etc. I really think it is handy that when you press a key it makes a fairly loud clicking sound like say you were typing in a line of program you would know whether what you wanted to type had come out if you were looking at the keyboard, because of the clicking sound.

What I do not really like about it is probably the size of the keyboard, it is rather small, but that does not matter so much, because I put it on a pretty big stand so it looks better. But that is about the only thing I dislike about the Spectrum.



What I like doing with it is the typical things like playing games and writing simple (and difficult) programs. I am in the middle of writing a word adventure game with sound and flashing in it. I also like doing maths with it."

Stephanie, aged 6: "Computers? Great. Can we play games on them?"

Katiana, aged 7: "I like the computer because you can type in games and you can play games like Horace And The Spiders. My brother has got Penetrator but I like Horace And The Spiders best. I like putting Horace in the tap. And I like playing it."

Richard aged 6: "I like one of the games we play at school on the computer because there's a maze and it's full of carrots and the rabbit has to eat all the carrots and you have to get him out of the maze. That's it. I like it very much."

Tracy aged 9: "As well as, or instead of, lessons?" 39

The Other Side Of The Fence

Every month, Soft Options will present an opportunity for educational software houses to speak for themselves. In this issue Henry Budgett, Software Manager, and Amy Carroll, Director of Dorling Kindersley software, explain their approach to this new and rapidly expanding market.

The current range of educational software that's available through High Street outlets can best be described as a curate's egg; good in parts.

The major problem with this rapidly growing sector of the market is that the majority of publishers either have no previous experience in software publishing or have no commercial experience. These deficiencies have tended to polarise the market into one of two main camps.

The biggest of these contains the publishers of books and magazines who have launched themselves into the market without any real consideration for the quality or educational validity of their products. In the main the programs are bought-in or commissioned without any in-house control of content or quality.

The other group consists of very able educational software producers who have no commercial experience and are, therefore, unable to get the distribution and impact that their products will need to sell in sufficient quantities to make the original effort worthwhile.

The educational software business is rapidly expanding to become a viable market, although sales of several thousand units are needed to cover even the development cost of a decent program. As the market grows and the majority of programs are purchased for use at home rather than in the classroom, it is important to take a different approach to the way in which programs are acquired, developed and marketed.

For the younger 'pre- and early-school' age groups, the software will generally be bought by the parent, either at the child's request or under the guidance of a teacher.

It is well established that the majority of home computers purchased for family use are justified on the basis of their educational capabilities, so sales of educational software can reasonably be expected to follow.

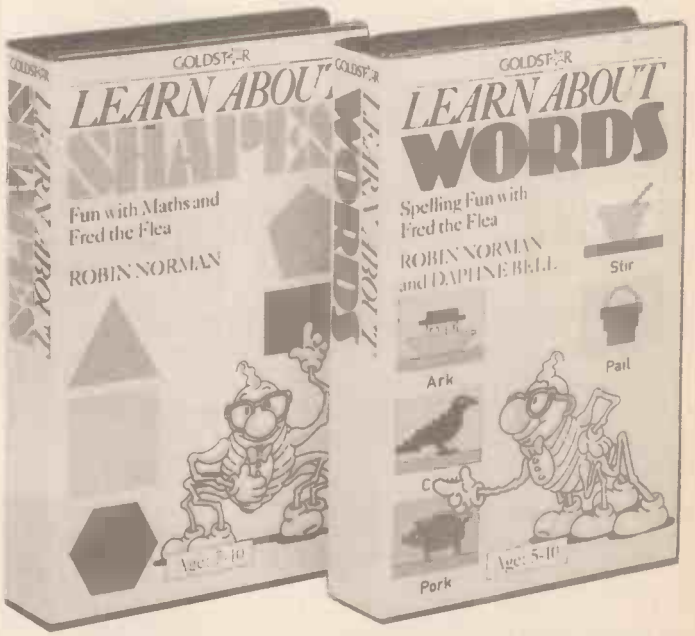
Presentation and design of the packaging as well as the on-screen appearance of the product are essential here. The purchaser, as well as the user, must feel that something of worth has been bought.

It is also vital with this sector of the market that some measure of the child's achievement be provided. Too many "educational" programs are based around familiar arcade-style games and, while there is nothing wrong in using these as the reward for correctly answering questions, they do not stand as learning aids in their own right.

Among the immediate requirements for any piece of software that is expected to be used for education is that the program must involve its user; interaction at a very high level is essential.

The material presented must, as far as is practical, but non-repetitive and maintain a high level of interest from the user. Attractive screen presentation, the effective — but not overpowering use of colour and sound and the ease-of-use of the program all form part of its overall appeal. On innumerable occasions good software concepts have been ruined by loud sound effects, which can't be turned off, and over-bright or complex screen displays.

The intelligent use of the



Goldstar Education programs are attractively packaged in rigid plastic cases, with a good deal of essential information shown on the covers. The programs are tested by teachers and students, educationally sound, and consistent with school syllabi.

keyboard is also important, forcing the user to remember a five-key sequence to select a function tends to detract significantly from the use-ability of any program; it will ruin an educational one!

Preparing and programming the product for the age-group it is aimed at is one thing; providing the support for a parent who will, inevitably, be asked questions about the program by the child is another. As well as providing this material as part of the package, the same documentation can be extended to include work exercises that allow the child to demonstrate that he or she has actually learnt the information presented.

With older age groups the information can be much more tightly presented: learning and rapid assessment of the acquired knowledge are what counts here. Once again, though, the provision of back-up material is essential as the computer screen is not always the ideal medium for the presentation of information.

Complex graphics are attractive but often absorb so much of the computer's capacity that they detract from the real information. By placing the diagrams, where appropriate, in an accompanying booklet the program can concentrate on presenting and assessing the textual information.

The **publication** process of an educational program begins long before the product hits the streets. Whether the software starts life as an idea or a partly programmed example, the editorial control of the content and presentation must rest with the publisher.

Much of the material that comes from the various educational authorities is designed for classroom use with the full-time presence of a teacher. As the main market for this software is in the home environment the first essential is to tailor the program to fit these requirements.

The program should, where necessary, be able to provide any assistance that the student is likely to need during its use; the software is, after all, designed for use at home without the constant supervision of a teacher.

Uncertainties in operation must be eliminated and the programs must be very robust and totally crash-proof. Preliminary screening of the product by potential users, both as individuals and groups, must be undertaken to ensure that the software meets these requirements as well as those of the various educational markets.

It is no use producing a program based on a certain sector of mathematical theory if that information is not required by any of the examination boards!

As the program develops into its final form, the accompanying material must also be prepared. Once again careful editorial control is required and is the publisher's responsibility .

Too many programs have been produced whose documentation bears little or no resemblance to the product and fails, in any case, to provide support. The documentation must be as carefully user-tested as the programs; if necessary, it must be re-written to cover points raised by users and not considered by the programmers.

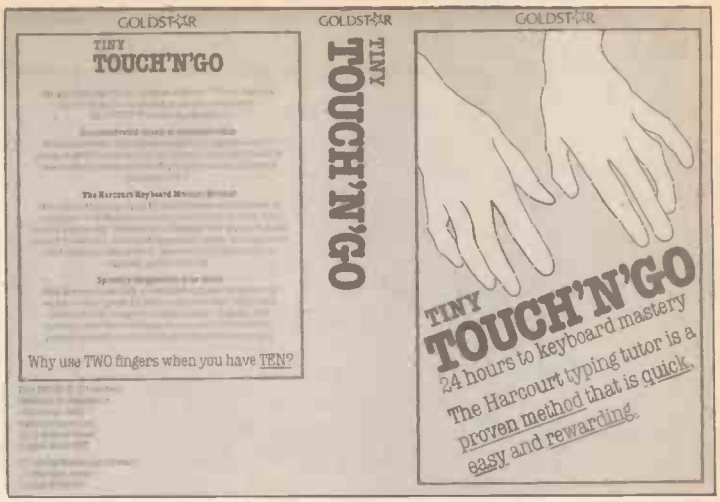
Even when the completed program and its supporting material are available in the shops, the publisher must still monitor the comments and opinions generated by magazine reviewers, educationalists and, most important of all, the general public.

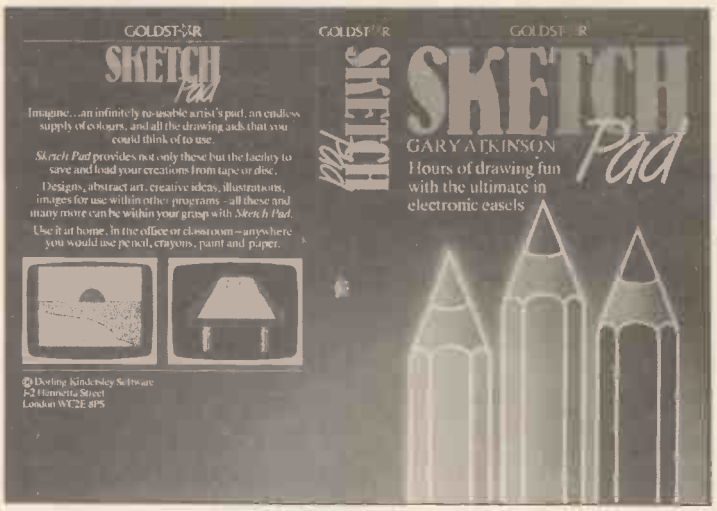
There is no disgrace in producing a better version of a piece of software that incorporates features demanded by the user; sneaking out a patched version which overcomes a bug is another matter.

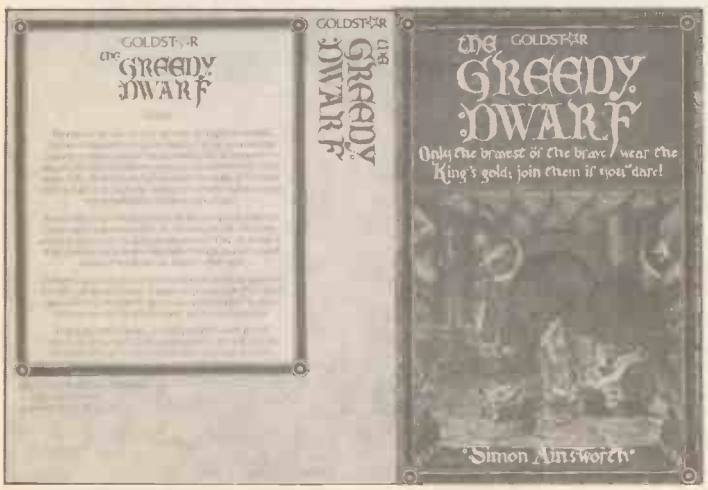
It is almost an education in itself to try to define what is, and what isn't, a piece of educational software. While anything that is directly linked with the processes of formal education can immediately be classified as such, it is a somewhat harder task to define the educational value of a typing tutor or a drawing program.

It could be argued that any program which actively encouraged the use of the computer was educational in the sense that it increased the user's computer literacy!

However, it is our view, and one shared by many software producers, that any program which teaches a skill, such as typing, or provides a means of developing a talent, such as art or photography, can be regarded as educational.







Goldstar Home Reference series (top right and middle) are designed as practical programs which teach useful skills, after helpful advice on a number of topics, or enhance programming skills. Goldstar's demanding adventure games include programs like "The Greedy Dwarf".

The problem is that the more specialised the market, the greater the development costs of the software, yet the smaller the potential number of buyers. Against this, however, is the fact that the more dedicated the user, the more money he or she is prepared to pay for the program and so the status quo is maintained.

A major factor in the way in which a given program is tailored is that of the national market it is intended to serve. While sales of educational software are growing in the UK, these are mainly based around the BBC Microcomputer and the Sinclair ZX Spectrum. With these two machines dominating the classroom computer market the home user will tend to follow suit.

Other systems, like the Dragon 32 and the Commodore 64, while being just as suitable for the home user, tend to find themselves out on a limb. This however, is only true of the UK and dosen't represent the state of the market for Europe as a whole or the USA.

In France, for example, we find that the Oric is doing very well indeed, while Spain is rapidly becoming a major market as central government implements a massive computer literacy project. The computers in use in Scandinavia are different again, and very strict controls are maintained on the software that is allowed into the educational sector.

In general, the European market is some two years behind the UK as far as the penetration of computers into homes is concerned, while on the educational side they are often ahead of us.

America, on the other hand, has no defined policy on the use of computers in schools and the majority of the effort has been left in the hands of local authorities and educational boards.
Computer manufacturers have exploited this, and it is often the case that one area will be totally dominated by Apple, another by Tandy while a third is supplied by Commodore.

Obviously, irrespective of any national language differences, the range of machines is going to be vastly different for each of the potential overseas markets and the investment in preparing new versions may not be worthwhile. Here, however, an established book publishing house can come into its own, as it is highly likely that links will have already been established with overseas publishers.

In cases such as these, it will be possible to sell the rights and let the foreign publisher handle any necessary conversion details.
Overall, then, it must be said that the educational software market in the UK is rapidly coming of age. Programs are at last being marketed as a commercial operation, and because of the potential size of the market, greater efforts are being taken at the outset to ensure that the material is educationally valid, attractively presented and packaged and, possibly above all, supported properly.

As more and more well-established publishing houses start to attack the market the smaller companies that provide the imagination and drive will slowly be absorbed.

This will be of benefit to all, as the big publishers will gain expertise while the smaller organisations will be better promoted and distributed and under the editorial control of a co-ordinated educational policy.

MANAGING THE QUEST

THE ADVENTURER'S VOCABULARY

The game posseses a large vocabulary, over 100 words in all. Much of the fun of an adventure is discovering those words which mean something and those that don't. If the command system cannot understand your instruction it will tell you; just try phrasing the command in another way or use an alternative wording. Many words are included as synonyms; TAKE and GET, for example, have the same meaning as far as the game is concerned. Several examples from the vocabulary have been given below, whether they work or not is for you to discover!
The command language is structured in the usual way. That is, it understands verbs and nouns. To issue a command you need to phrase it in these terms: GET SWORD, DROP LAMP, GO DOOR. While this may seem restricting, it is surprising just how complex your

THE CITY OF 'EHDOLLAH

Once this was the fabled seat of noble kings and great priests. Its loveliness boasted no rivals and its inhabitants, the Toggalids, were envied throughout the universe for the serenity of their lives. They existed only to do good works and to add to the store of beauty in the world. 'EhDollah was famed for the magnificence of its architecture, the vastness of its gardens, and not the least, for the many unparalleled riches it contained.

All programs are well documented and illustrated. This page, from the "City of 'EhDollah" adventure game, is typical. The storyline is interesting and well thought out, while the instructions show the high 'anti-crash' programming standard.

PHILIPS P2000 DAISY WHEEL PRINTER RS232 ..... £375 ea
SHUGART 801 FLOPPY DISK DRIVES 8" ... £100 ea
TRANSTEL DOT MATRIX PRINTER Compact Serial Interface 230V. With info ..... £65 ea
TELETYPE ASR33 (Printer, Keyboard, Punch and Reader) RS232 ..... £50 ea
9" MONITOR Cased Non-Standard. With info ... £20 ea
12" MONITOR Cased Non-Standard. With info £15 ea
AZTEC 20" Black & White MONITOR Video In .... £50 ea
TV Style 20" MONITOR Black & White. Video In £30 ea
GENERAL ELECTRIC TERMINET Printer with Keyboard Upper/Lower case ..... £125 ea
ICL Version of above. No keyboard ..... £95 ea
QWERTY KEYBOARD. Push to make. Uncased £15 ea
P&P £4.
CARRIAGE ALL UNITS £7.

OSCILLOSCOPES
COSSOR CDU150 Dual Trace 35MHZ Delay Sweep £200
S.E. LABS SM111 Dual Trace 20MHZ £200
TEKTRONIX 585A with 82 Plug-in. Dual Trace 85MHZ Dual TB Delay Sweep £200
TEKTRONIX 545B with CA Plug-in. 24MHZ Dual Trace Dual TB £160
SOLARTRON CD1400 Dual Beam 15MHZ £90
Ex-Ministry CT436 Dual Beam 6MHZ £60
ADVANCE Dual Stab DC Power Supply PP3. 0-30V, 0-1A twice. Metered £50
FARNELL Stab Power Supply TSV30/5EC 30V/5A £60
AVO TRANSISTOR TESTER TT169. With leads ... £20
P&P £2.
CARRIAGE ALL UNITS £7.

STEPPING MOTORS
Type 1. 200 Steps 4 Phase (5 wire) 12/24V 25 oz inch. 2¼" dia. £15
Type 2. 6/12 Steps 3 Phase 12/24V. 1¾" dia. £2 ea 5 for £5.70
Type 3. 24 Steps 4 wire 5V 3.3A 0-250rpm 0-200PPs 2¾" dia ..... £10 ea
Type 4. 200 Steps 120V (3 wire) 25 oz inch. 2¾" dia. ..... £4 ea

MOTORS
SYNCHRONOUS 2 Phase 9V AC. 375rpm Cap start. Will DC step. — 8 steps per rev. ..... £1 ea
GEARED 117/234V 50HZ 4" dia ..... £5 ea P&P £4
GEARED 115/230V 1 RPM 2¾" dia .... £4 ea P&P £2
MOTOR 12V DC 3" dia ..... £3.50 ea. P&P £3

TRANSFORMERS
TOROIDAL 13.5-0-13.5V 8VA .... £1.50 ea 10 off £12
TOROIDIAL 0-12V, 0-12V 10VA per winding .... £4 ea 10 off £35 P&P £2
AUTO 240V Input 115V 1A. ..... £1.25 ea
Sub-Min 12-0-12V 4VA ..... 75p ea. 10 off £6. P&P £2
Printed Circuit Mounting 120/240V. Input Sec 15V 0.4A twice ..... £1.50 ea
Chassis Mounting 120/240V:
9V 0.33A twice — £1.50 ea; 20V 0.15A twice — £1.50 ea;
6V 0.5A twice — £1.50 ea; 12V 0.96A twice — £1.50 ea;
7.5V 3.34A twice — £3 ea.
Sub-Min PULSE TRANSFORMER Centre tapped. Suitable Thyristor triggering — 20p ea. 10 off £1.80. Many other transformers available — please enquire.

CAPACITORS
Electrolytic 15,000mfd 25mfd 25V 20p ea. 10 off £1.80
Sprague Compulytic 18,000 mfd 10V Screw terminal ..... £1 ea.
Electrolytic 900mfd 100V Screw terminal ..... 50p ea. 10 off £4
Tantalum Bead 0.1mfd 35V. 10 off £1. 100 off £7.50
De-Coupling — 0.4725V; 0.005 100V; 0.47 12V; 0.001 200V; 133pf. ..... 10 off 30p. 100 off £2

SWITCHES
ILLUMINATED ROCKER 2 pole 250V 8A. Orange ..... 50p ea. 10 off £4
ROCKER 2 pole c/o — 12p each ..... 10 off £1.80
TOGGLE Centre off DPDT .... 20p each 10 off £1.80
SLOTTED OPTO SWITCH with data 50p each 10 off £4
Min MICROSWITCH V3-Button .... 30p ea. 10 off £2.50
I.C. SOCKETS
10 pin-10p; 22 pin-15p; 14 pin-8p 100 off £6
36 pin-15p; 40 pin-25p; 16 pin-8p 100 off £6
RIBBON CABLE
10 way-50p per metre. 10 metres £4
14 way-75p per metre. 10 metres £6
PCB KEYBOARD PAD 19 Push Contacts 0-9; A-F plus 3 optional — £1.50 ea. 10 off £12
KEYBOARD PAD 12 Alma Reed Switches Push to make 0-9"; & Blank ..... £4 ea. 5 off £15 P&P £3
TOKIN NOISE FILTER VG215FU. 250VAC 15A 50/60 HZ With fixing bracket ..... £2 each
BLACK RIBBONS for Teletypes/ Teleprinters ..... 75p ea 6 off £4
I.T.T. LOUDSPEAKER 2¼" 50ohm 0.2W ..... 75p ea 10 off £6.50
FERRANTI PHOTOCELL Type MS15 50p ea 10 off £4
VU METER Scaled 0-5 Size 1½x⅞" .... 50p ea. 10 off £4
I.E.C. MAINS LEAD 2 metre Heavy duty 60p ea 10 off £5
MICROPHONE/EARPIECE INSERTS 75p ea. 10 off £6
CINCH CONNECTOR STRIP 12way. Screw connections ..... 35p ea. 10 off £3.
CABLE TIES White 9cm; Black 12cm ..... 50 for 50p

EXECUTIVE TELEPHONES — PUSH BUTTON
Many functions including 10 number memory; repeat dialing etc. Will connect to GPO system. Brand New. £25 each P&P £4.

SAMPLE OF STOCK — SAE or TELEPHONE for LISTS. Please check availability before ordering. Min order of Goods £4. Min P&P £1.50. VAT at 15% MUST be added to TOTAL of Goods & Packaging.

VISA

STEWART of READING
110 WYKEHAM ROAD, READING, BERKS RG5 1PL.
Tel: 0734 68041
Callers welcome 9am-5.30pm Monday to Saturday Inclusive

KITS FROM £7 ...TO £60

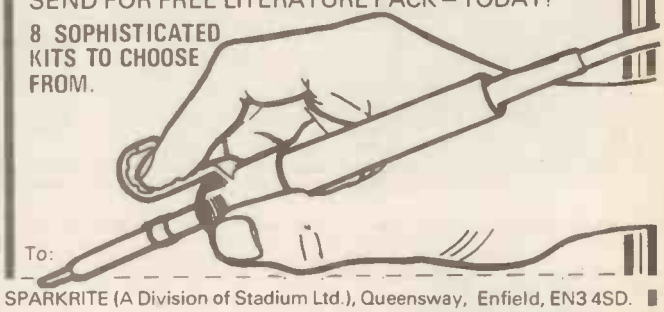
Sparkrite

Buy Sparkrite Brand Leading Auto Electronics in self-assembly kit form – And save pounds!!

- Electronic Ignition systems – contact triggered and contactless
- Electronic Car Security Systems – including a new ultrasonic unit
- Car Drive Computer – with 12 functions

SEND FOR FREE LITERATURE PACK – TODAY!

8 SOPHISTICATED KITS TO CHOOSE FROM.



To:

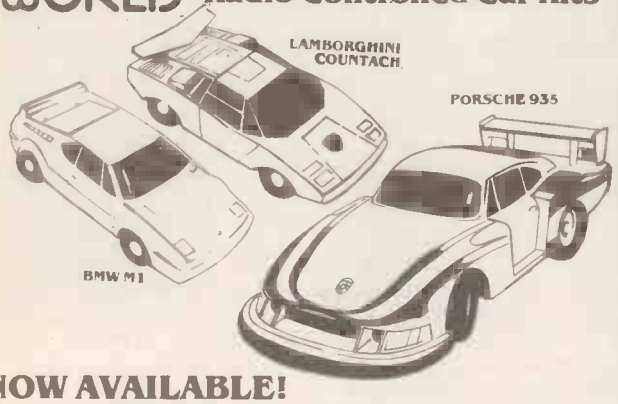
SPARKRITE (A Division of Stadium Ltd.), Queensway, Enfield, EN3 4SD.
Telephone: 01-804 4343

NAME .....

ADDRESS .....

..... HE

Tomorrow's WORLD **Self-Build Radio Controlled Car Kits**



NOW AVAILABLE!

Complete Car Kit and Transmitter Kit
Clear build-up instructions included
only **£9.95** + 50p P&P

Also
Porsche 935 Turbo Kit (2 speed)
Kit includes transmitter and full build-up instructions
only **£17.00** + 50p P&P

Order now from:-
Tomorrow's World
Car Kit Dept.,
Hadleigh Road Ind. Estate,
Hadleigh Road,
Ipswich, Suffolk.
Tel: Ipswich (0473) 59175

Special quantity rate for Schools.

Please send me:-
☐ Lamborghini Kit
☐ BMW M1 Kit
☐ Porsche 935 Kit

Name _____
Address _____

Please allow 14 days delivery in U.K.

LITESOLD

MINIATURE TOOL SETS AT MINIATURE PRICES

Ideal for work on optical and electronic equipment, instruments and models. Japanese made, top quality metric tools in hardened and tempered steel, with fitted plastic cases. Swivel-top, chromium-plated brass handles. Not to be confused with similar cheap non-Japanese sets.

SCREWDRIVER SET 113. 6 plain screwdrivers, blades 0.9, 1.2, 1.8, 2.3, 3.0 and 3.5mm. Price **£2.70.**

SOCKET SET 227. 5 socket spanners, 3.0, 3.5, 4.0, 4.5 and 5.0mm. Price **£2.80.**

CROSSPOINT/HEXAGON SET 305. 2 Japanese crosspoint screwdrivers, sizes 0 and 1. 3 Hex. key wrenches 1.5, 2.0 and 2.5mm. Price **£2.70.**

COMBINATION SET 228. 5 open spanners 4.0, 4.5, 5.0, 5.5 and 6.0mm. 5 socket spanners 3.0, 3.5, 4.0, 4.5 and 5.0mm. 2 crosspoint screwdrivers bit sizes 0 and 1. 3 screwdriver bits 1.5, 2.5 and 3.5mm. 3 Hex. keys 1.5, 2.0 and 2.5mm. 1 scriber. 1 swivel-top driver/holder. Price **£4.83.** All prices include postage and 15% VAT.

Ring for Access/Barclaycard Sales or send remittance to:

Access VISA

Light Soldering Developments Limited, 97-99 Gloucester Road, Croydon, Surrey CR0 2DN. Tel: 01-689 0574.

MASTER ELECTRONICS NOW!
The PRACTICAL way!

YOUR CAREER..YOUR FUTURE..YOUR OWN BUSINESS..YOUR HOBBY

THIS IS THE AGE OF ELECTRONICS!

the world's fastest growth industry...

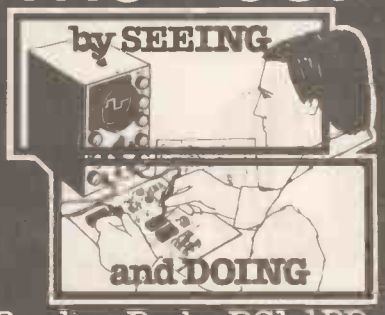
Our new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn by 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 using the oscilloscope
- 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, VCR and microprocessor/computer equipment.



CACC

British National Radio & Electronics School Reading, Berks. RG1 1BR

FREE! COLOUR BROCHURE

Please send your brochure without any obligation to

NAME

ADDRESS

HE/5/842 BLOCK CAPS PLEASE

Post now to: **British National Radio & Electronics School** Reading, Berks. RG1 1BR

I am interested in:

- ☐ COURSE IN ELECTRONICS as described above
- ☐ RADIO AMATEUR LICENCE
- ☐ MICROPROCESSORS
- ☐ OTHER SUBJECTS please state below

CACC

OR TELEPHONE US 0734 51515 OR TELEX 22758 (24 HR SERVICE)

FEEL HEALTHIER WITH ZEPHION

Bring fresh clean air into your home with the Zephion Air Ioniser.

Air free from smoke, dust and other pollutants of modern day living can bring to many the relief of breathing comfortably once again.

We are confident that you will be delighted with the Zephion Air Ioniser, but if you are not entirely satisfied a full money back guarantee is available if items are returned in good condition within 28 days.

BUILD IT YOURSELF! clip the coupon

TO:- Dataplus Developments
81, Cholmeley road
Reading, Berks.
RG1 3LY TEL:- 0734 67027

NAME:-

ADDRESS:-

☐ ZEPHION KITS @ £24.15p *(Kits include all parts)*

☐ ZEPHION AIR TONERS BUILT AND TESTED. @ £34.50p

Money immediately refunded if items returned in good condition.

Prices include VAT & postage; allow 14 days for delivery. DATAPLUS HE

TWO GREAT HOBBIES ...IN ONE GREAT KIT!

The K5000 Metal Detector Kit combines the challenge of DIY electronics assembly with the reward and excitement of discovering Britain's buried past.

As a Metal Detector—the K5000 boasts the proven pedigree of C-Scope, Europe's leading detector manufacturer. As a Kit—simplified assembly techniques require little technical knowledge, and no complex electronic test equipment. All stages of assembly are covered in a finely-detailed 36 page manual.

Detector Features Analytical Discrimination & Ground Exclusion

Ask at your local Hobby/Electronics shop or use the coupon and send with your remittance to:-
C-Scope International Ltd., PO Box 36, Ashford, Kent TN23 2LN

Please send me ..... K5000 Kits @ £119.99(+£3.00 p+p) each.

☐ Please debit my Barclaycard/Access
☐ I enclose Cheque/PO

£

Name .....

Address .....

HE

The Art and Science of

Metal Detection

HE looks at the history, techniques and uses of all kinds of metal detecting, from treasure-hunting to bomb disposal.

Richard Turner

METAL DETECTION is a subject seldom mentioned in electronics journals, but recently it has attracted much attention in the daily press. Detectorists have been featured on many a front page with their finds of explosives or buried treasure, and perhaps even more while assisting the police in searches for weapons in some very controversial murder cases. However, metal detection has been around for about ten decades now and has been used for a very wide range of applications, and thus should be of interest to electronics enthusiasts.

Those of you who may have constructed your own 'Coin Collector', IBs Mark 1 and 2, 'Mains Seeker', 'Shadow' or 'Diana' metal detectors may want to exploit them to the best advantage, and this article will assist you with ideas for applications.

Histories

While for hundreds of years treasure seekers and prospectors have used devices such as divining rods, magnetic needles and a variety of "doodlebugs" to aid their searches, it was not until 1879 that the first practical, scientifically proven instrument was built. The credit for this discovery goes to Professor D. E. Hughes, who demonstrated his 'Induction Balance' to the Royal Society in that year.

The Induction Balance attracted a great deal of interest among the scientists of the day, including the Chief Chemist of the Royal Mint who acquired one of the first units for the assaying of coins. Alexander Graham Bell applied the Induction Balance to the location of an assassin's bullet in the body of American President James Garfield.

This 'electric' metal detection had a good scientific start and it is worth examining in closer detail some of the

Detectorist Turner makes a find. The camping knife is an excellent tool for recovering small objects like coins and rings.

The Art Of Metal Detection

Keeler Optical Instruments

A Roper-Hall bench detector used for medical applications.

many uses of the technology.

In Hughes's Induction Balance a Leyden Jar supplied current to a microphone which was placed in contact with a ticking clock. Alternating current was achieved by a manually activated resonating spring contact assembly feeding two induction coils wound in opposition to each other. The pick up consisted of another pair of identical coils wired as a circuit with a further three coils and a telephone. This arrangement was adjusted for complete silence in the telephone. To 'detect' or 'analyze' metal, the sample was placed on the primary coils, thus disturbing the mutual induction so that sound was heard in the telephone. Then the indicating coil in the secondary circuit was moved along a scale marked in degrees until silence was obtained again. Different samples could be identified against a previously prepared chart. This instrument was sensitive to such a degree that coins of the same denomination, but with varying amounts of wear, could be distinguished from each other.

Another detection principle developed in Victorian days worked on 'Secondary Induction'. This involved a complex set-up but gave a considerable detection range. And indeed, when demonstrated at a Welsh metal mine at the turn of the century it was found that metal ores could be detected up to three hundred yards away.

Briefly, the set-up was as follows: a battery supplied the primary current to a motorized contact breaker which 'chopped' it into a high frequency and fed the primary winding of a transformer, where the voltage was stepped up. The secondary output was fed to a pair of probes placed in the earth. A similar pair of probes placed some distance away fed another transformer to which there was connected a galvanometer. If there was no metal in between probes the input signal would 'scatter' in all directions and the galvanometer would remain at zero. The presence of ores or large metal objects would attract the voltage fed into the ground, producing and indication on the meter.

Electronic Principles

With the advent of electronics, the transmit-receive technique was quite accidentally developed. During World War One the military developed sound ranging and direction finding equipment. It was soon found that large masses of metal such a bridges, railways and ships at sea interfered with the equipment and much re-design was necessary for proper operation. However the 'interference' turned out to be a benefit as this led to the development of metal detectors for sensing enemy submarines and tanks at a considerable distance.

In the post World War One years the transmit-receive technique was used for electrical prospecting, and forms the basis of most metal detectors today. The heterodyne principle found much favour in the late nineteen thirties and was used extensively until about five years ago. A more recent innovation in metal detection technology operates on the DECCO principle which was developed at Oxford Archaeological Research Laboratory in 1966. *Decay of Eddy Currents in Conducting Objects* is now better known as pulse induction, and HE's 'Diana' operates on that principle. Few people are aware of what an important function metal detectors perform for their wellbeing and comfort. Most and possibly all food and pharmaceutical products are passed through metal detectors to ensure there are no nuts, bolts, swarf, pins or other alien items in them. Medicines like pills and powders receive the same treatement. Shoes are tested for unwanted insole tacks and even such products as textiles, carpets and lino are passed through a metal detector before despatch to the customer.

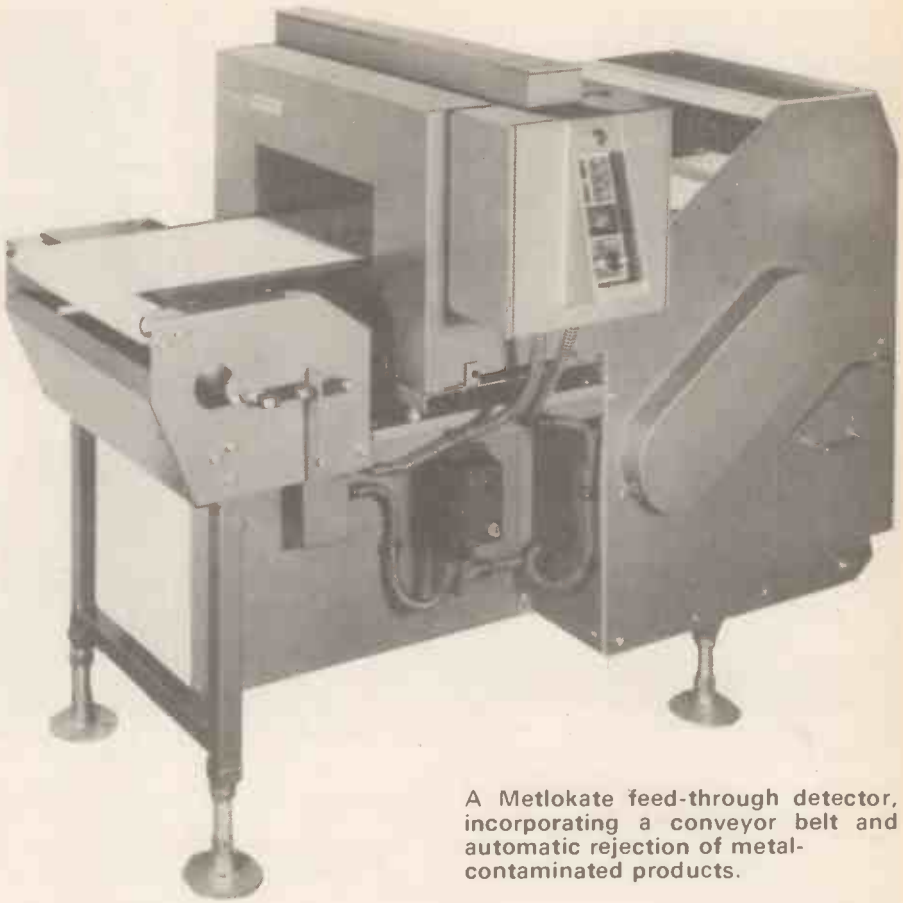
In quarrying and mining industries the burden is checked for tramp metal such as drill rods, dipper teeth, and pick and shovel ends to prevent damage to cutters and diamond tipped grinders. Most of the world's airports are equipped with 'walk through' metal

detectors to combat the carrying of illegal weapons. Accurate location of pipes has to be known when mechanized road or trench digging takes place. Lumber jacks and tree surgeons screen trees to detect bracing tie bars, bolts or nails which may be covered by callus growth and thus prevent a danger to power operated saws. Reclaiming timber is very much a practice with DIY enthusiasts, but why risk damage to your electric plane or sander by nails etc, when a quick scan will save the expense of new plane blades or sanding strips?

Medical Applications

As already mentioned, Bell used the Induction Balance to detect a bullet in a human body, and ever since that time medical metal detection has flourished. In 1885 the Royal Army Medical Corps developed quite a different metal detector for locating bullets and shrapnel in wounded soldiers. During World War Two electronic metal detectors were developed in Britain (Barnato Joel Laboratories), Germany (Siemens Electric) and the USA (Waugh Laboratories). The European detectors used the heterodyne principle at VHF, while the American unit was an electronic version of Induction Balance.

Currently the world's most advanced medical and veterinary detectors are of British manufacture, the Roper-Hall locator for Opthalmic and Medical applications (Keeler Instruments) and Tektamet PI for veterinary use (Goring Kerr PLC). These high technology and patent protected detectors not only distinguish ferrous from non ferrous metals but also indicate which metal is predominant. Thus the surgeon or vet has an instant indication as to what technique to use for extraction. If the metal is non ferrous, a conventional cut and sew method would be employed, but a metal which has ferrous content can be removed by an electromagnetic extraction technique, eliminating surgery.



Goring Kerr PLC

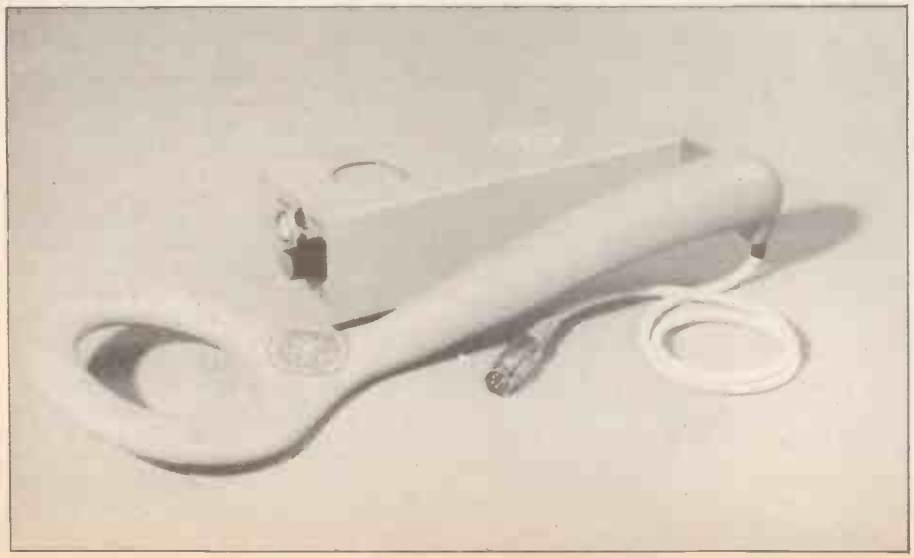
A Metlokate feed-through detector, incorporating a conveyor belt and automatic rejection of metal-contaminated products.

Treasure Seeking

With the Royal Mint using the Induction Balance for the assaying of coins it became apparent that this instrument could be adapted for the location of precious metals. Soon 'Buried Treasure Finders' were very much the fad of Victorian society, and were seen wandering about the countryside with very strange looking devices. However treasure hunting did not reach its peak until the early Twenties, when an Englishman by the name of Williams emigrated to Panama where he got a concession from the government to seek out the treasure concealed before the sacking of Panama City by the notorious pirate Captain Morgan.

Devising a transmit-receive metal detector capable of locating metals up to forty feet beneath the ground, he soon located cellars and secret tunnels packed with precious metals. Williams became very rich and his fame spread far and wide. Being a generous man he gave the plans for his metal detector to anybody who asked for it, and some of those ungrateful individuals even filed patents for it as their own invention. Thus with metal detectors being produced on a large scale, the rich with time on their hands once again took up the seeking of buried treasures. Most of them headed for the Cocos Islands where legend said that much treasure had been concealed by pirates. Franklin D. Roosevelt, a prominent lawyer, was one of the first to land, and even after he had become President of the USA he returned for another try. Malcolm Campbell, Admiral Nicholson and Commander Worlsey also led expeditions to the Cocos Islands.

This portable, belt-carried MD 199 can be used with a variety of probes. The one shown is a hand probe.



Adams Electronics

Detectorists Today

However, pirate and legendary treasures are very much of a myth and today's detectorists take a much more practical view, seeking lost coins, jewellery and the like which has accumulated in the ground over the last two thousand years. Many previously unknown coins and artifacts have enriched our museums after being found in that way. Occasionally large hordes of coins are

The Autopusle hand-probe is used to locate the exact position of a bracing bar before carrying out tree surgery.

found. However, detectorists have also made headlines in the national press by finding wartime bombs and ammunition, which are dealt with by the EOD (Explosive Ordnance Disposal) units of the British Army.

Even wrecked ships can spread danger on the coasts, and an example of this was the wreck of *Aeolian Sky* which discharged its cargo of deadly cyanide canisters. In a situation like this a prompt search and recovery operation is required with metal detectors, as shifting sands and seaweed were quickly concealing the canisters. In this particular instance the Detector Information Group (DIG) organized a search to assist Coastguards and Police, whose resources were stretched to the limit. This operation proved such a success that an annual beach clearance now takes place in May along the South Coast.

This year the National Council for Metal Detecting is organizing this event which will be sponsored by Whites Electronics of Inverness. Support by clubs affiliated to NCMD has been assured and about a thousand detectorists are expected to take part in the search, which will be centered at Brighton. Similar events will simultaniously take place on the North East and North West coasts of England, with EOD units on standby, as much ammunition etc., including mines (frequently netted by trawlers) is likely to be found. Today's detectorists must be commended on their responsible attitude and personal dedication in taking part in searches for weapons or stolen and lost jewellery, and other such activities.

It can be seen that metal detection in its various forms be it industrial, hobby, criminology or security contributes a great deal to the safety and wellbeing of society in general.

In the second half of this article, we shall take a closer look at the technical aspects of various detection techniques and brief specifications of commercial equipment. The block diagrams are in simplified form and show only the basic requirements for such detectors.

But first, some of the legal aspect of metal detection. Although an amendment of 1st January 1981 "Exemption of Low Powered Devices from Licensing", in the Wireless Telegraphy Act of 1948, has revoked the need for a licence, metal detectors are still subject to legal requirements, and some brief excerpts follow:

> "A metal detector shall be used only with emissions at a fundamental frequency within the frequency band 0Hz to 148.5kHz."
>
> "The strength of the electric field of emissions shall not exceed 3000 microvolts per meter measured at a distance of six meters."
>
> "The use of a metal detector shall not cause undue inteference with any Wireless Telegraphy."

Furthermore, when using a metal detector for coin or relic search and recovery one is subject to a code of conduct which has been drawn up by interested parties including the Department of Environment. Briefly, this states:

> "Do not trespass — you have no right to search anywhere except on your own land".
>
> "Always ask permission from the LANDOWNER, not the tenant, and respect the Country Code".
>
> "If you discover any ammunition, bomb or mine DO NOT touch it, but mark the spot and inform the Police and landowner".
>
> "Do not use a metal detector on or near an Ancient Monument or a Scheduled Archaeological Site".

It should be noted that the last mentioned locations are subject to special laws, which carry heavy penalties. It is also worth noting that National Trust land and even car parks and commons are subject to laws which prohibit "Digging or Disturbing Turf". In addition, a detectorist should be familiar with Treasure Trove laws, and all finds

Another kind of tree surgery? A C-Scope hand locator checks out a recycled plank for buried nails before planing.

of precious metal should be handed to the Police who in turn inform the Coroner.

The best way for a novice to enjoy metal detection is to join one of the two hundred clubs which exist in the UK, or to take out a subscription to *Detector User* or *Treasure Hunting* magazines, which regularly update club lists, as well as the legal and moral aspects of this interesting and exciting hobby.

Heterodyne (BFO) Principle

Of all the possible ways of detecting metal the heterodyne principle is perhaps the best known. After all most radios use BFO (Beat Frequency Oscillator), so the system is easily understood even by a layman. The technique is simple, economical and produces very satisfactory results. The detector can be constructed from readily available radio parts; if a search coil of small but intense field is required (for instance, for medical applications) a ready made ferrite rod aerial can be used!.

For larger areas and deeper penetration the search coil is usually wound in multilayers on a circular former although printed circuit coils are also known. On a detector with wide range tuning it is possible to detect metal against a metallic background, for instance, copper pipe embedded in reinforced concrete.

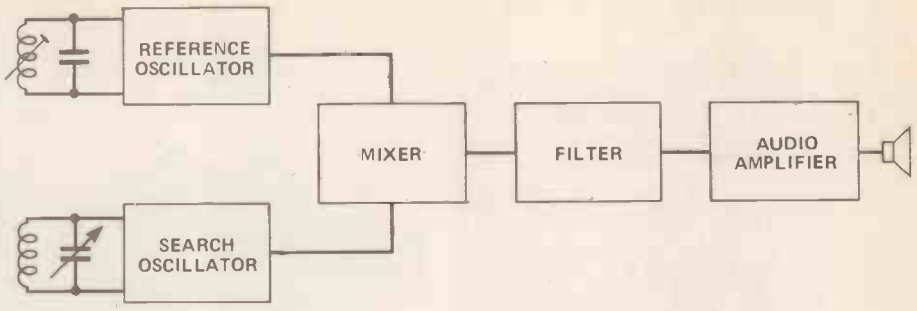


Figure 1. A block diagram for a Heterodyne Principle (BFO) detector, the simplest type for a home constructor to design.

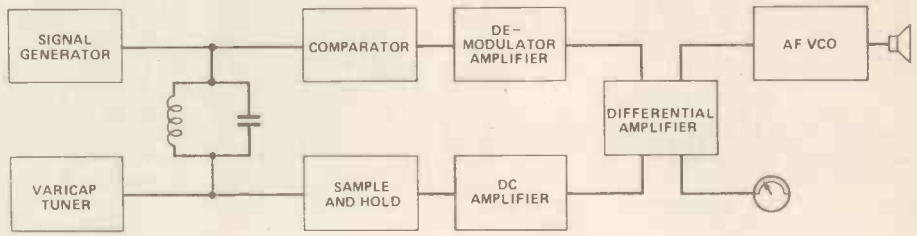


Figure 2. The Off Resonance Descrimination system. Very selective, this method is favoured by "treasure hunters".

Off Resonance Discrimination (ORD)

In this technique the search coil is driven by a frequency which typically differs by about 3dB from the natural resonant frequency of the tuned circuit. This arrangement automatically gives a very selective detection. If for instance a discriminating detector is required for non ferrous metals, the signal generator is driven at a higher frequency, but for ferrous metals at a frequency which is below the natural resonant frequency of the search coil. Thus in "treasure hunting" applications excellent rejection of unwanted objects (nails, bottlecaps etc.) is achieved while retaining good sensitivity to desirable finds of coins, jewellery and the like. The main drawback of the system is thermal instability, for instance, if the detector is kept in boot of a car during hot weather the search coil alters its natural resonance, and the separation between the drive and natural frequency of the tuned circuit drifts so far apart that detection becomes difficult, if not impossible.

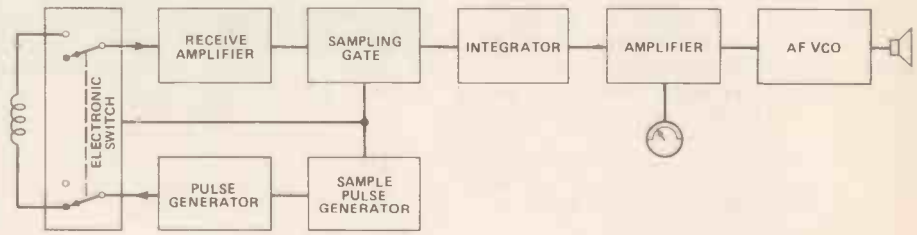


Figure 3. The block diagram of a pulse induction system. This method uses the ability of metal objects to absorb and reflect electromagnetic radiation as eddy currents which can be detected.

Pulse Induction System (P.I.)

This system differs from all the other methods as no oscillators or tuned circuits are required. Detection is achieved by the phenomenon of decaying currents in metal objects (DECCO). Thus a high amplitude short duration pulse is injected into the search coil, which emits electromagnetic radiation within its range. Soft objects such as soil or even aluminium foil allow the energy to penetrate and disperse while solid metals, especially magnetic metals, absorb and reflect this energy in the form of eddy currents which readily produce EMF in the search coil, generating a signal in the receive amplifier.

The main drawback of this principle that Earth's magnetic field renders the detector oversensitive to ferromagnetic metals. Although discriminating-type pulse detectors are now available, these do not provide such a good selection of desirable objects as continious wave discriminators.

Induction Balance Method (IB)

This old and complicated but most sensitive detection principle requires several (or multitapped) search coils, and so is not exploited very much these days. However its sensitivity to precious metals is unsurpassed. As explained earlier in this feature, with a suitable arrangement even worn coins can be distinguished from new ones. This is achieved by phase-anti-phase magnetic fields which can be generated by complex coil arrangements, but energized by simple electronic circuitry with a very modest current consumption.

Balanced Coil Application (BC)

This is a simplified adaptation of the Induction Balance very much favoured by manufacturers of industrial detectors. And indeed the block diagram shows in simplified form an arrangement for a "feedthrough" conveyer type instrument. The search coils are usually of rectangular form wound in single layers, offering very high sensitivity. Typically a one millimetre metal sphere can be detected at a velocity of 40ft per minute through a 12 x 4in aperture.

The oscillator also initiates the pulse generator which is connected in a feedback circuit, thus offering a self checking function and automatically stopping the detector should a fault occur. If unwanted metal is detected, the reject timer allows the product to leave the search head and reach the rejection point where it is removed automatically from the conveyor belt.

Transmit-Receive Radio Technique (T-R)

This technique operates on true radio principles, and it can be seen why metal detectors come under the scope of Wireless Telegraphy Act. In early equipment (as already explained) the transmitter was quite a separate item from the receiver which could be placed a considerable distance away, offering very deep penetration. However in recent times the trend has been to combine both units into one case for compactness and portability. A simple sine wave oscillator drives a tuned circuit of a suitable frequency. A tuned search coil (or coils) feeds an RF

A classic shot: recovering interesting artefacts from the countryside with a ground-searching detector.

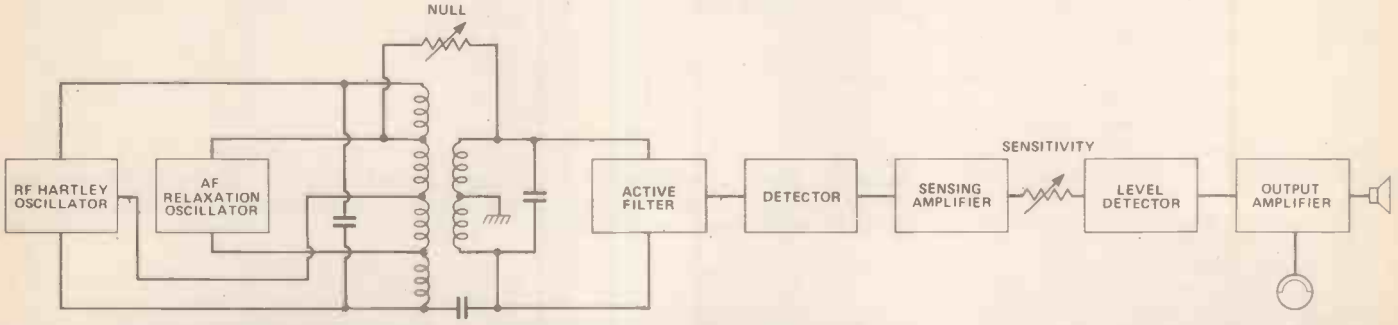


Figure 4. Induction Balance, the oldest and most sensitive method of detection, is now not much used because of its complexity.

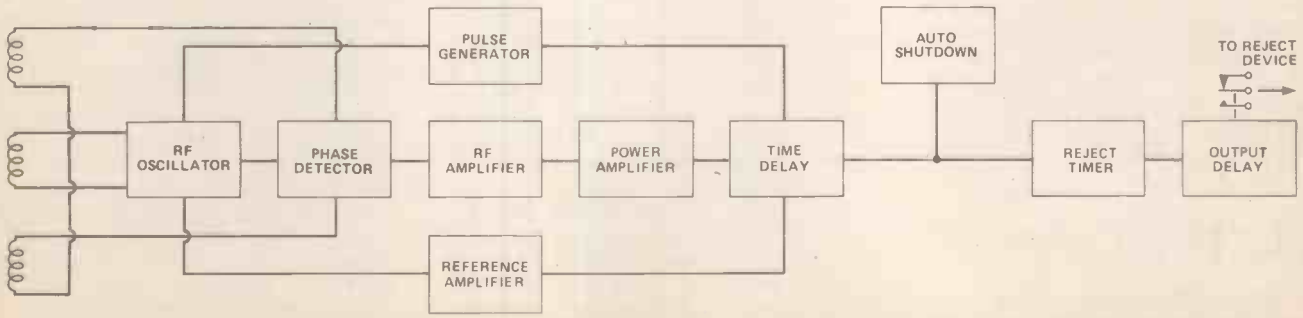


Figure 5. The Balanced Coil method, a simplified version of Induction Balance, favoured for "production line" detectors because it is very sensitive at speed.

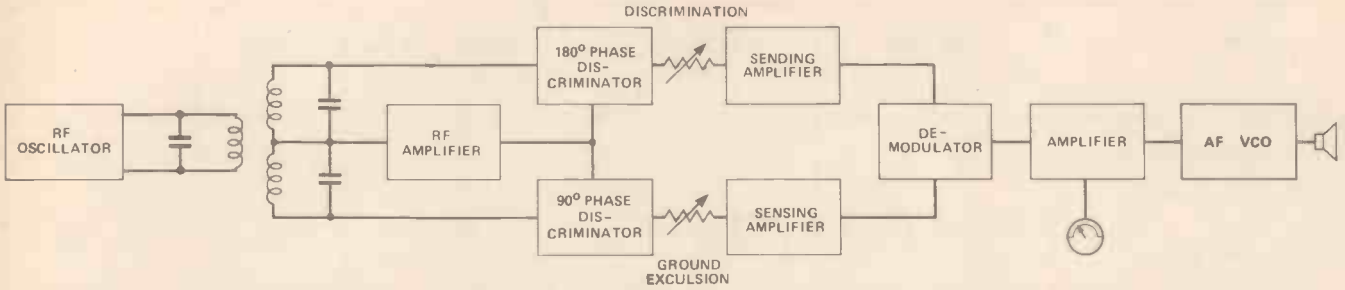
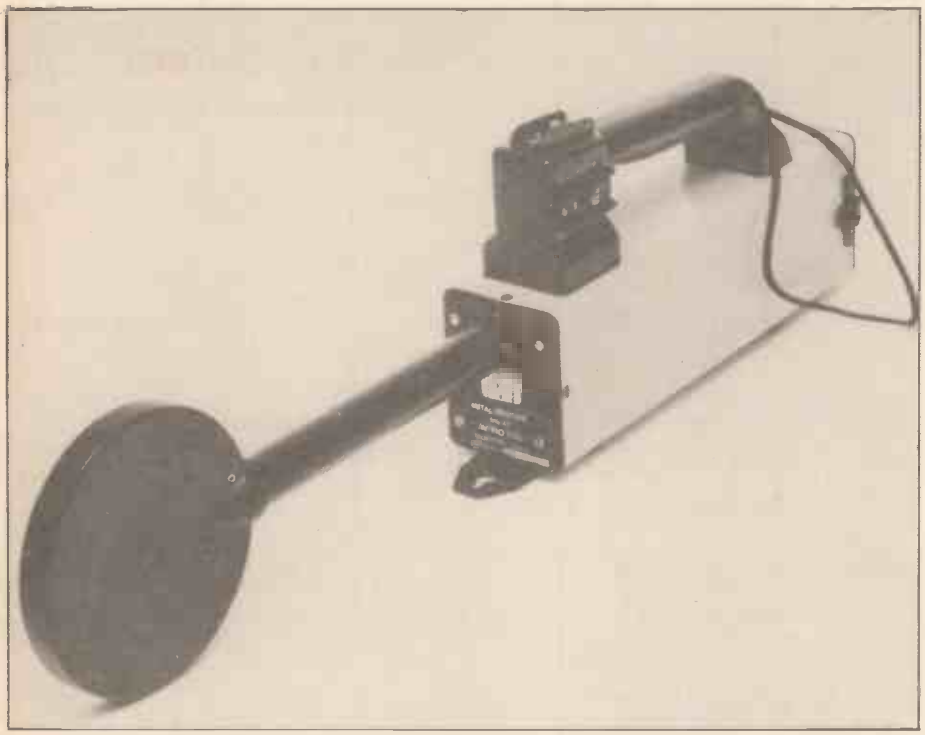


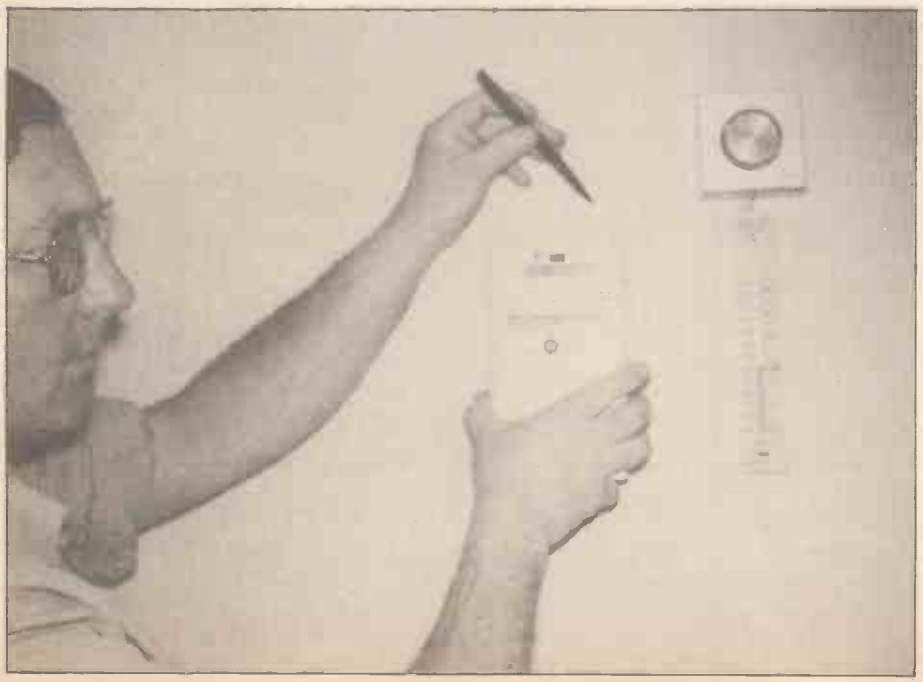
Figure 6. A block diagram for the Transmit-Receive Radio Technique, popular for its simplicity and ability to discriminate between worthless and valuable metals.



United Sci Instruments

The aptly-named "Frisker" detector with a side-mounted search coil specifically for searching live humans.

A project detector built in a Verobox does unglamorous but useful work as a pipe tracer.



amplifier to boost the incoming signal for the purpose of phase discrimination, eliminating unwanted signals from the ground (minerals etc.) and offering discrimination between unwanted objects and precious metals. Straightforward output circuitry is employed. The simplicity of this technique makes it a very attractive proposition to manufacturers of 'hobby' type detectors which usually operate in the VLF spectrum.

Equipment Survey

To conclude this article a survey is included of some commerically manufactured equipment manufactured in the UK. Each company has been limited to a maximum of five entries.

Some explanatory notes are worthy of inclusion as some readers may wonder, for instance, what is the difference between a hand and portable detector? A hand detector is a completely self contained one piece unit whose total length does not usually exceed eighteen inches. However, headphones or earpieces may be supplied as optional extras. Portable units will have a separate search coil (or coils) or probes and electronics case, and can be in a shoulder-slung case or a hip mount design. Usually a range of optional extras are available, as in the case of medical detectors where even a reset foot switch is provided. A bench unit would be usually powered by mains and have a range of search probes for various applications.

Walk Through, as its name suggests, is a weapons type detector and at least one company manufactures such a unit in a 'portable' version which can be folded up and transported in a boot of a car! Hobby detectors are usually of one-piece construction with the search coil for ground searching mounted on an adjustable shaft which may be mounted on an electronics case. Some models are available in hipmount versions. This description also applies to underwater detectors. Conveyer type detectors are limited to industrial applications, and such detectors are available with search coils from about 1in diameter (for pharmaceutical applications) to 50ft for textile industries.

Now turn over for our four-page guide to Metal Detectors in the UK. We haven't quoted prices, as these can change suddenly, but we have included the manufacturers' addresses, so that readers can write for details.

The Art Of Metal Detection

Manufacturer	Model	Type	System	Sensor Size	Meter	Power Supply
Adams Electronics, Felming Way Industrial Centre Crawley, Sussex RH10 2NX.	IPD 2	Hand	—	6in	No	PP3
	IPD 4	Hand	—	4½in	No	PP3
	MD 199	Portable	PI	Various	No	7 x 1V5 AA Cells
	MD 202	Bench	PI	Various	No	110/240V
	ADM 500	Walk through	PI	200cm High	Light Indicator	110/240V
Arado Electronics, 59 Pound Street, Carshalton Surrey SM5 3PG.	IBA 65	Hobby	IB	20cm	No	2 x PP3
	120B	Hobby	IB	20cm	Yes	2 x PP3
C-Scope International Ltd., Wotton Road, Ashford, Kent TN23 2LN.	Industrial	Hand	TR	—	LED	PP3
	Treasureseeker	Hobby	TR	20cm	No	2 x PP3
	Promet	Hobby	TR	20cm	Yes	12 x HP7
	Metadec	Hobby	TR	20cm	Yes	12 x HP7
Diver Detection Devices, Mile Lane, Coventry, West Midlands CV1 2NL.	HD 2001	Hand	—	25cm long	No	Ni-Cads built in
	ML8 000	Walk through	—	350cm high	Yes	110/240V
Electrolocation Ltd., 129 South Liberty Lane, Bristol BS3 2SZ	CAT	Portable	TR	—	No	8 x 1V5 AA Cells
	Genny	Portable	only	—	No	8 x 1V5 AA Cells
	GRP 1/2/3-04	Portable	TR	Ferrite/Aerials	Yes	PP4/P99
Essex Treasure Hunters, 33a South Road, South Ockendon, Essex RM15 6NT.	Coinstalker	Hobby	TR	20cm	No	2 x PP3
	Saxon 3	Hobby	TR	20cm	Yes	3 x PP3

Size	Weight	Accessories	Comments
14in	1lb	Earpiece, headset	Supplied with holster and shoulder strap as standard.
15in	12oz	Earpiece, headset	Moulded high impact resistant ABS plastic case.
9 x 3¼ x 2½in	26oz	Headset, wriststrap	Field Service Capability by non technical personnel.
270 x 165 x 55mm	1050gm	—	All search probes are interchangeable with MD 199.
—	3.2kg each panel	—	Unit can be folded for transportation and carried or installed by one person.
Adjustable shaft	—	—	Thumb operated multiturn tuner incorporated into handle.
Adjustable shaft	4lb 12oz	—	Centre zero discriminator meter mounted in handle, patented circuitry.
16.5 x 9 x 3.2cm	400gm	Headphones	Injection mouled case contains metal and mains detection dual circuitry.
97cm Max 69cm Min	0.8kg	Headphones	No frills, low cost detector.
Section shaft	2kg	Headphones	Built in discriminator meter and four modes of operation.
114cm Max 83cm Min	2.2kg	Headphones	Top of the range model, can be converted to hipmount.
59.5 x 4.2cm	600gm	—	Truncheon type detector with audio and vibratory output; supplied with charger.
—	—	Ni-Cads and charger	Sensor consists of two separate pillars spaced 762mm apart.
750 x 220 x 70cm	3kg	See below	Low cost and very robust pipe and cable detector with trigger type switch.
400 x 330 x 175mm	3kg	—	19kHz transmitter accessory to increase detection range of cable avoiding tool.
Various	Various	Too numerous to mention	Very comprehensive range of pipe and cable locators for professional applications.
105cm Max 57cm Min	1.75kg	Headphones	All metal construction with exception of search head.
105cm Max 74cm Min	2kg	Headphones	All metal construction with exception of search head.

Manufacturer	Model	Type	System	Sensor Size	Meter	Power Supply
Goring Kerr PLC, Vale Road, Windsor, Berkshire SL4 5JX	Tektamet PI	Portable	BC	120 x 110 x 50mm	Yes	Ni-Cads built in
	Metlokate	Conveyor	BC	Various	Yes	240V
Keeler Optical Products Ltd., Clewer Hill Rd., Windsor, Berks SL4 4AA.	Roper-Hall	Portable	BC	Three probes	Yes	Ni-Cads built in
Protovale Instruments Ltd., Unit IISE Industrial Estate Kingston Bagpuize Oxfordshire OX13 5AS.	Aquapulse	Under-water	PI	25cm	Yes	Ni-Cads built in
	Pim Dec 4	Portable	PI	25cm	No	D Size
	Pulsar	Hobby	PI	22cm	No	4 x 1V5 AA cells
	Imp	Portable	PI	22cm	No	4 x 1V5 AA cells
	Totalscan	Portable	PI	22cm	Yes	Ni-Cads built in
Rimatron, 79 Moorgate Street, Blackburn, Lancashire BB2 4NY.	Viking 5DM	Hobby	TR	178mm	Yes	2 x PP3
United Scientific Instruments Ltd., 10 Fitzroy Sq., London W1P 6AB.	Frisker	Hand	PI	100mm	No	PP9
	4C	Portable	IB	28.5 x 10.8cm	No	PP6
Young Electronics, 19 The Broadway, London N14 6PH.	Fieldmaster FX77	Hobby	TR	20cm	Yes	2 x PP3
White Electronics Ltd., 13 Hrbour Road, Inverness IV1 1RY	Coinmaster 6DB	Hobby	TR	20cm	Yes	Ni-Cads built-in
	Treasuremaster	Under-water	PI	11in	LED	6 x 1V5 AA cells
	Beachcomber	Hobby	TR	8 or 6in	Yes/No	9V

Size	Weight	Accessories	Comments
380 x 280 x120mm	3.5kg	—	Patent protected automatic tuning, multitune audio, discriminates metal to 0.5mm.
Up to 50ft for permanent installation	—	—	Comprehensive range of feedthrough detectors for industrial applications.
402 x 259 x 134mm	6.63kg	All supplied as standard	Patent protected specialist detector for medical applications.
Convertible unit	—	38cm or 19cm coils	Professional unit supplied with a range of accessories.
Hipmount	—	50/38/19/12cm coils	Fully automatic with fast zero reset; deepseeking output variable from 14 to 52W.
Adjustable shaft	1.25kg	Headphones	Low cost self contained detector.
Hipmount	400cm	Ni-Cads & Charger	Hand probe or long shaft available for agricultural applications.
Hipmount	—	Headphones	Long shaft of fixed length supplied for pipe tracing etc.
Adjustable shaft	—	Headphones, carrybag	Low cost discriminator with motor, non discriminators also available.
490 x 130 x 55mm	1.25kg	—	Vertical coil specifically designed for security applications.
21.6 x 10.8 x 10.8mm	1.8 + 2.95kg	Wooden transport case etc.	Normal & Pave modes of operation; standard mine detector of many NATO forces.
Adjustable shaft	1.9kg	Headphones	End of range being sold off at reduced prices, check availability first.
Standard or hipmount	4lb 12oz	Headphones	Top of the range model with three modes of operation; other models available.
Adjustable shaft	—	Headphones	Vibrator and visual output for land use if required.
Adjustable shaft	—	Headphones	Several models available in this range.

POINTS OF VIEW

Feel like sounding off?
Then write to the Editor stating your Point of View!

Breaker Broke

Dear Sir,
Could you please help me to contact "Breaker One-Four". It seems that the address that I have is possibly either the wrong one, or they have simply changed their premises. Could you please give me their correct current address.
Yours faithfully,
D. A. Carter,
Johannesburg,
South Africa.

"Breaker One-Four" was a regular feature in Hobby Electronics, written by the then editorial team. As HE moved into a wider area of electronics, it became less of a flagship for CB, and, after being intermittant for some time, "Breaker One-Four" ceased trading in December '81. Rick Maybury moved on to pastures new.

HOWEVER the good news is that CB radio has (for a good while now) its own mag on the premises. Write to Sue Sharp, Editor, CB Radio Today, at the same address as Hobby Electronics.

Odd Numbers

Dear Sir,
On returning to practical electronics after an interval of several decades (I refrain from signing myself R. Van Winkle) I am puzzled by the way capacitors are now marked. Recently I ordered three values and received parts marked as follows (all were for a nominal working voltage of 63V):

Value ordered	*Markings on part supplied*
.001 ufd	*2601*
.01 ufd	*2A102K*
.25 ufd	*274 100K*

I see no consistency here. What's the Boolean bar doing in the first one? If in the third one the actual value is 270,000pf, why don't the others use the same code? Is K a tolerance rating, and if so what is A? And how about the numerals 26, 100 and 102?

Perhaps there is a back number of HE, which I am finding very interesting and instructive, that explains this, in which case please let me know the date, etc.

If you know of an external publication that covers the whole subject of component ratings, markup and classification, I should be very grateful for the details.
Yours faithfully,
C. Powell,
Leatherhead,
Surrey.

If it's any consolation, you are not alone. While charts are occasionally published showing how to read capacitor values, tolerances, etc., it seems to us that there is no real consistency with different manufacturers, adopting different systems, which often include codes for parameters of little practical importance to the home constructor, eg, case style.

But there is nothing new about this problem. The only sure solution is to have on hand a capacitance meter (try the one we published in HE April '82 — it's inexpensive, and works extremely well.).

As it happens an article explaining some of the finer points concerning capacitors appeared in last month's HE. It won't be resolve all the mysterious codes you've cited, but should help to make the general position clearer.

Overseas Correspondent

Dear Clever Dick,
Being one of your regular correspondents (well, I've written to you once before) I'm sure that, in your omnipotence, you'll be able to help me.

I'm quite interested in the HE Bassman project (HE November '83) but, being a bit daft, I'm not too sure how to go about connecting instrument input and output sockets, ie will I need screened cable, which tags should I use on the jack sockets, etc?

Also, while I'm on the subject, how about a full scale "octaver" project with one or two octave steps up as well as down?

Regards from one of your less clever brethren,
Kevin McKeown,
Circencester,
Gloucestershire.

Oh boy. You're not kidding.

The guitar plugs into a standard mono jack socket, which is connected to the Bassman terminals marked "Input". And yes, you should use cable. Similarly, the output terminals should be connected (by screened cable) to an output socket, which goes to your amp.

If you want to know how to wire up the jack plugs and sockets, take my advice . . . go and find someone who knows how to do it, plead with them, and then WATCH THEM VERY CAREFULLY. A picture is worth a thousand words (which is about how long it takes to explain how to wire up a jack socket), and I have to get on with my er technical report on the progress of electronics in the South Sea Islands. Now where did I put the medicinal rum?

Ultra Alarm

Dear Sir,
I have bought the October edition of your magazine, and I am intending to make the Ultrasonic Alarm. I have seen one of the professionally made ones and there are a number of extra features on it. Firstly, the alarm, when it has been triggered, resets itself after about two minutes. It produces a much louder noise than the buzzer would and, as you mentioned, it has a delay of about six to seven seconds before the alarm goes off. I presume that an amplifier could be added, being triggered off by a relay, as the IC could not take the current. I wonder if you could tell me if there is any way to do these other things.

I have just started reading your excellent magazine, and am a beginner at electronics.

I have bought the parts for it and am doing it on a stripboard so the PCB will not have to be altered.
Yours sincerely,
Andrew Clothier,
Barnard Castle School,
Co. Durham.

Yes, these three modifications can be done, but only with considerable changes to the original design. Unfortunately, we are not able to undertake modifications for individual readers, but if you keep reading HE, building and practising you should soon learn enough to be able to carry out the modifications yourself.

By the way of a helpful hint, I feel obliged to point out that a PCB is not the same as a stripboard, and since the original design was for a PCB, you may find that you have problems converting the design for stripboard. Why not build it up as instructed, in the first place, get it working, and redesign it when you know enough about it to do so? You can always recycle the parts.

Reverb Still Going

Dear Sir,
I have recently acquired a copy of Hobby Electronics February '84, and became an instant convert.

After reading various electronics mags I think your magazine has all that I require for my various interests.

I got quite involved with the article concerning the Echo/Reverb and I would like a back issue with the complete circuit diagram and components, as I would enjoy building such a unit. If a back issue cannot be obtained, I would not mind purchasing the circuit diagram.
Yours faithfully,
R. D. Hurley,
Forest Gate,
London E7.

Another reason for re-running errata from time to time — people start building them again!

After a certain amount of tooing and froing, we have now a definite address for the Backnumber Service, and definite guidelines.

In future, only backnumbers for the current year and the previous year (1984 and 1983 in this case) will be available in issue form, and these will cost the current cover price of HE, plus 50p postage and packing. At the present, this is £1.40.

Orders should go to **Hobby Electronics, Infonet Ltd., Times House, 179 The Marlowes, Hemel Hempstead, Herts HP1 1BB.** The HE Book Service will also operate from the same address.

For issues earlier than 1983, photocopies of individual articles only will be available, from our home address **No. 1, Golden Sq., London W1R 3AB, price £1.50 per article.**

The complete guide to HE back issues appears in the form of the Complete Cumulative Index, HE March '84.

Not A Joke

Dear Sir,
I hope you may be able to help me with a problem. It is not a technical query, but a question of frustration. I have in my possession a crystal radio, made up from parts purchased from the Antique Radio store in Bristol.

My trouble is the crystal itself, which has become unfixed from the crystal holder. I have several new crystals available, but cannot trace any vendor of the soft metal which holds it in place. I have written to about twenty advertisers in your magazine, but none seem to stock this material. I have found out from several replies I have had that it is called Woods-Metal. I believe it is a semi-hard material sold in a tube.

I have just received a letter from the antique radio place, and they have told me to try a joke shop for an item called the melting spoon, but I know of no such outlet, let alone a joke shop, and sincerely hope you may be able to help me with a likely source of supply.
Thank you,
A. J. Simmonds,
Welling,
Kent.

For fastening the crystal, you need a soft, malleable, conductive material. Woods Metal is the most often used, so we checked with the radio experts in the office and they said — guess what? — try a joke shop.

The "Melting Spoon", or any similar jape which requires an apparently solid metal object which suddenly wilts when warmed up, depends on the fact that Woods Metal becomes soft at a very low temperature. How to find a source of supply? Most large towns have a joke shop. Try your local yellow pages telephone directory, and if that fails, try a directory for the nearest large town. If you locate an outlet, phone them for advice. If they can't supply a melting spoon or similar artefact, they may be able to tell you who can. If you can't find anyone nearer, Brighton should be a dead cert.

There are alternatives to Woods Metal, but none of them very easy to locate. There used to be a "liquid solder" available from some hardware shops, for repairing damaged pots and pans. There are also various metallic epoxies and paints which you may be able to resort to. The important thing is to establish whether or not they are conductive. A good hardware store should be able to give you some pointers.

The difficulty in getting Woods Metal is a complaint that we hear from time to time from antique radio enthusiasts, and I'm surprised that the Vintage Wireless Company (if it is they that you are corresponding with) don't have a source of supply — but the joke shop does seem to be the normal answer to the problem.

Across The Sea

Dear Sir,
With reference to the **Trans-Atlantic Power Reducer** *Project printed in the January 1984 issue, I have a couple of questions about availability of components.*

In your Buylines column on page 26 you state that all components are readily available from Maplin Electronics, however, in their 1984 catalogue, Maplin do not list a 7W, 22k resistor, nor a C146D 10A triac. They do list a C246D (15A) Triac. Is this a suitable equivalent?

I would be grateful if you could advise me.
Yours sincerely,
M. D. Simpson,
Jeddah,
Saudi Arabia.

Yes, the CD246D 15A triac is a suitable substitute.

The 7W 22k resistor should be available from a number of sources — RS, Farnell, Greenweld Electronics, even surplus shops. If you are stuck, use two 10k 4W resistors in series.

At a pinch, you could use a resistor with a lower dissipation. The one specified is rated with a wide safety margin. However, it would be better to obtain the rating specified if possible, and this should not prove very difficult.

No Scope

Dear Sir,
I am a regular reader of your magazine. I have been looking through the adverts hoping for some information on a kit to build an oscilloscope, but with no luck.

Could you please help by telling me which companies if any do oscilloscope kits, failing that, where I could obtain a Cathode Ray Tube type VCR139A or CV1588.
Yours faithfully,
Alaistair Whyte,
East Kilbride,
Glasgow.

We have had a quick look round and we cannot locate a source of oscilloscope kits, indeed, one place that used to do them now no longer does.

However, **Henry's, at 404-406 Edgware Rd., London W2 1ED, tel: 01 724 0323,** supply a number of oscilloscope parts and oscilloscopes and should be able to assist you.

Does anyone else know of a source of kits for oscilloscopes and other pieces of major test equipment?

Binders Back

Dear Sirs,
Could you please tell me how much the binders are for Hobby Electronics, also how many issues each one holds, and what colours are they. Do you post them, or do we come to Golden Square?
Yours sincerely,
D. M. Blair,
Canvey Island,
Essex.

If this is beginning to sound a bit like a mechandising column, it's because we have been sitting on our backnumbers/binders enquiries until we had the new address and prices.

A Hobby Electronics binder is £5.00, holds twelve issues, and comes in any colour you want, so long as it's blue with gold lettering. We post them, otherwise doubtless readers would be queueing found the block, troubling the local constabulary and costing us a fortune in hot soup and blankets.

The address to contact (it's been said elsewhere, but bears repeating) is **Hobby Electronics (binders), Infonet Ltd., Times House, 179 The Marlowes, Hemel Hempstead, Herts HP1 1BB.**

HE

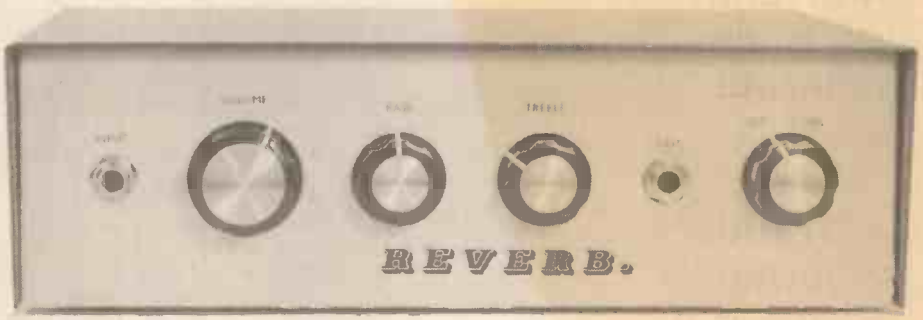
Springline Reverb

The original is the best, so the saying goes. The original reverb effect uses a springline unit, and this is a cheap and simple version of this popular effect.

R. A. Penfold

THERE are a number of methods which can be used to produce a reverberation effect. Natural reverberation is produced by sounds echoing from around the walls, ceiling, etc of a hall, or room, so that short sounds are effectively stretched. In a large hall a reverberation time of several seconds may be produced, with the ceiling, walls, floors, and most of the hall's contents all acting as fairly efficient sound reflectors. The large size of hall also aids a long reverberation time.

On the other hand, a typical room in a house or flat is very much smaller so that sounds must be reflected around the room a great many times in order to give a long reverberation time. This does not usually happen in practice as modern soft furnishings tend to be good sound absorbers, and consequently a reverberation time of just 200 milliseconds or so would be quite normal.



Springline

There are purely electronic ways of processing an audio signal to give it a longer reverberation time and the so called "big hall" sound. However, this tends to be a rather difficult and expensive way of doing things since it involves the use of a long delay line with tappings at irregular intervals. The outputs of the delay line are mixed together, and feedback to the input is used to recycle the signals. The delays are analogous to the different delays produced as signals are reflected from various parts of a room — and therefore travel different distances, while the feedback is the electronic equivalent of sounds being reflected to and fro around a room.

The complexities of using a long delay line can be avoided by using a semi-mechanical means of synthesising the reverberation. By far the most popular method of this type, and probably the simplest and least expensive way of generating a good quality reverberation effect, is to use a springline unit. This is an uncomplicated piece of equipment which consists basically of two transducers and one or two springs which mechanically couple the transducers.

The input signal is applied to one transducer, where it is converted into vibrations which travel down the springs to the second transducer. The vibrations are then converted back into an electrical signal which constitutes the output of the unit.

Of course, the vibrations travel along the spring less than instantly, giving a sort of simple delay line effect. Also, the vibrations are to an extent, reflected backwards and forwards along the springs, giving a good simulation of sounds being bounced around a room. A springline can therefore be used as the basis of a reverberation unit, and practical units can provide reverberation times of around two to seven seconds, depending largely on the length of spring used.

Early springline reverberation units for the home-constructor used springlines built from such things as ceramic pickups and car suspension springs, but these days good quality ready-made springlines are available quite cheaply, and there are no mechanical difficulties in constructing a springline reverberation unit. The specified springline for this project has a delay time of 25 to 35 milliseconds, and a reverberation time of 2.5 to 3 seconds.

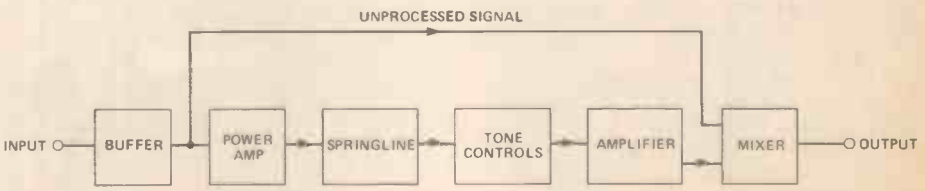
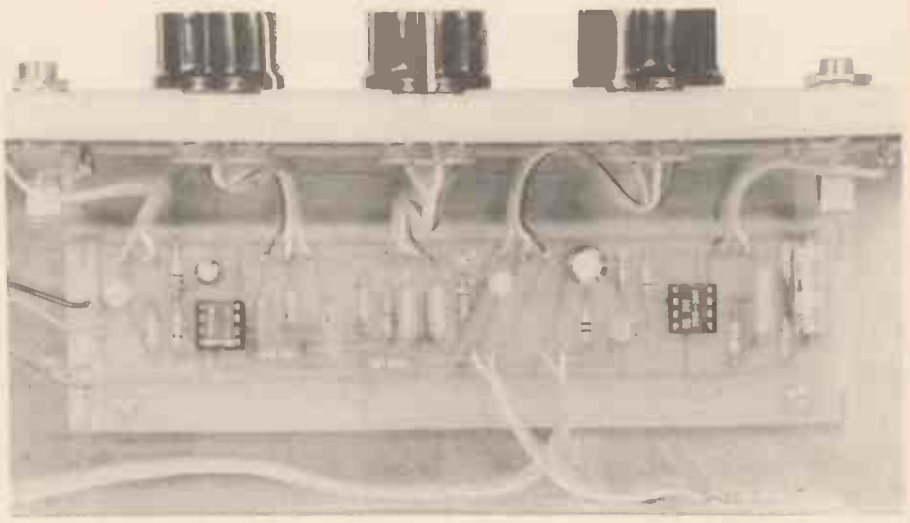


Figure 1. The block diagram showing the Springline in the complete system.

Block Diagram

One problem that can occur with springline units is a "boominess", or other problems with the tone of the reverberation signal. A novel feature of this design which overcomes this is a standard bass and treble tone control circuit to process the reverberation signal. This enables interesting variations in the effect to be obtained.

Figure 1 shows the unit in block diagram form, and this shows the way in which the springline and tone controls fit into the completed system.



Buffer

A buffer stage is used at the input to give the circuit a fairly high input impedance, approximately 100k so that it only lightly loads the piece of equipment used to provide the input signal. The power amplifier is a simple class A type which does not provide a very high output power, but is sufficient to drive the input transducer of the springline. It is advisable to use a reasonably strong drive signal as the output of the springline is otherwise very low. This necessitates the use of a large amount of amplification to bring the output signal up to an acceptable level.

This is not a very good scheme of things in practice as it encourages acoustic feedback and related problems. A high drive power is not acceptable since it would result in a lot of distortion from the springline, and in exteme cases could even result in damage to the input transducer. The drive power therefore has to be a compromise.

Tone Controls

The tone control circuit is placed at the output of the springline unit, and a level control is also included here. The latter enables the reverberation signal to be varied from zero to a level roughly comparable to the straight-through signal.

Note that the tone controls only affect the reverberation signal, and not the straight-through signal. Thus they alter the qualities of the reverberation signal without altering the overall tone of the output signal. An amplifier follows the tone control circuit, and this is needed to compensate for the not inconsiderable losses through the springline. After amplification the reverberation signal is combined with the unprocessed signal using a simple mixer circuit.

The Circuit

Figure 2 shows the full circuit diagram of the unit.

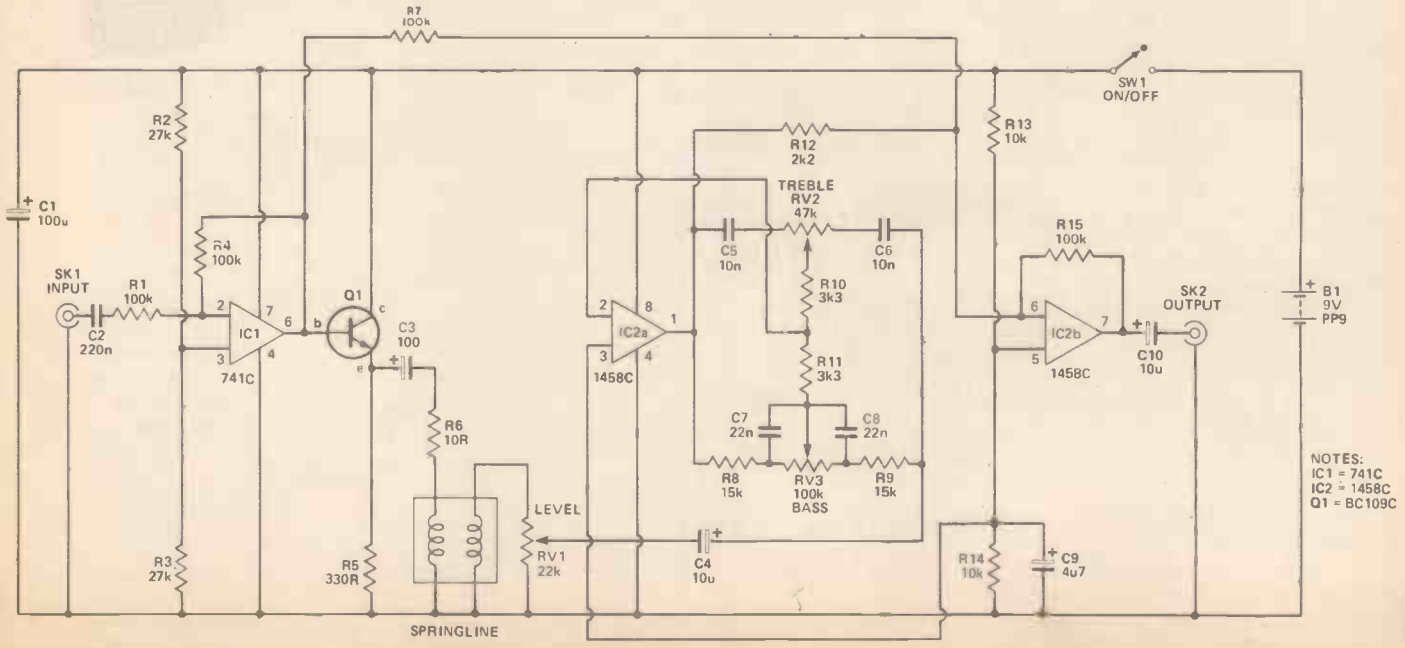
The input buffer stage uses IC1 in the standard operational amplifier inverting mode, with R1 setting the input impedance at 100k, and with R4 giving a voltage gain of unity. Transistor Q1 is used as an emitter follower output stage which drives the input transducer of the springline.

On the output side of the springline unit, RV1 is a volume control style variable attentuator, and it feeds into an active volume/tone control circuit. This has the usual bass, RV3 and treble, RV2 controls. Integrated circuit IC2a is used as the basis of the tone control circuit, and it is used in the inverting mode.

Treble Control

If we consider the operation of the treble control circuit first, C5, RV2, and C6 form a negative feedback

Figure 2. The Circuit. IC2b operates as both amplifier and mixer stage.



network. The voltage gain of the circuit is equal to the impedance of C5 plus the left hand section of RV2's track divided by the impedance of C6 plus the right hand section of RV2's track. Very much the same as for an ordinary operational amplifier inverting mode circuit in fact.

With the slider of RV2 at the centre of its track the two impedances are equal, and unity voltage gain is produced. At high audio frequencies where C5 and C6 have a low impedance relative to RV2, taking the slider of RV2 towards the right hand end of its tracks unbalances the feedback impedance in a way that results in a boost in voltage gain.

Conversely, taking the slider in the opposite direction causes a reduction in gain. At low frequencies C5 and C6 have a value that is high when compared to the full track resistance of RV2, and adjustment of the latter can only marginally alter the gain of the circuit. This gives the required treble boost and cut, with little effect on bass and middle audio frequencies.

Bass Control

The bass control circuit operates in a similar manner, but here it is at low frequencies where the two capacitors C7 and C8 have a high impedance, with potentiometer, RV3 being allowed to exercise a large amount of control over the voltage gain of the circuit. Resistors R8 and R9 are used to "tame" the maximum and minimum responses of the circuit. At high frequencies C7 and C8 have an impedance which is low in relation to the track resistance of RV3, so RV3 is effectively short circuit and adjustment of it has little effect on the voltage gain of the circuit.

Amplifier

Integrated circuit IC2b is used as both the amplifier and mixer stages. It is almost a conventional operational amplifier summing mode mixer circuit, but the value of R12 has been made lower than that of R15 and the other input resistor R7. As a result of this the unprocessed signal from IC1 is fed through to the output of IC2b with approximately unity voltage gain. The signal from the tone control circuit is boosted by a factor of about 45 times, (R15 divided by R12 = 45.45), which adequately compensates for the losses through the springline unit.

The current consumption of the circuit is a little under 20 milliamps, and the circuit should therefore be powered from a fairly high capacity battery such as a PP9 or six HP7 cells connected in series.

Construction

A case of fairly substantial dimensions is needed for this project as the springline unit is over 200 millimetres in length. The case for the prototype measures 250 by 150 by 75 millimetres, and apart from the last dimension, this is about the smallest size that will accommodate all the components.

The front panel layout can be seen by referring to the photographs, and it is advisable to use the same general layout as the wiring up will then be more straightforward. Standard jack sockets are used at the input and output of the unit, but these could obviously be changed for any other desired type of audio connector that would be more convenient in your set-up.

The specified case is supplied with an aluminium chassis, and the springline unit is mounted at the rear of this. It can simply be bolted in place using M3 nuts and screws, or small grommets can be used over the fixing screws to minimise the transmission of sound and vibration to the springs and transducers. Another alternative is to use special rubber couplings to fix the springline unit in place.

Printed Circuit Board

Next the printed circuit board is built, and this is detailed in **Figure 3**. There is nothing particularly unusual about the board, and it is just a matter of taking the usual care to connect the

Parts List

RESISTORS
(All ¼W 5% carbon)
R1, 4, 7, 5 ..... 100k
R2, 3 ..... 27k
R5 ..... 330R
R6 ..... 10R
R8, 9 ..... 15k
R10, 11 ..... 3k3
R12 ..... 2k2
R13, 14 ..... 10k

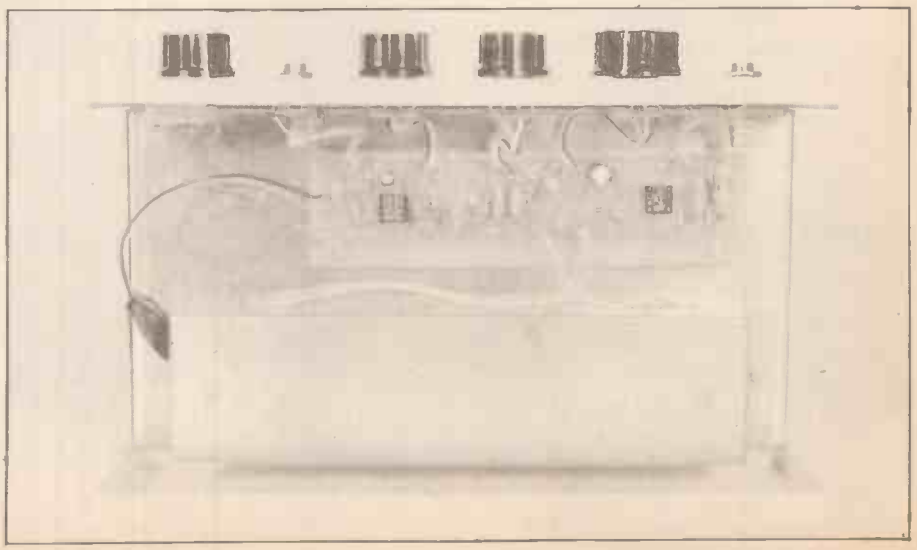
POTENTIOMETERS
RV1 ..... 22k linear
RV2 ..... 47k linear
RV3 ..... 100k linear

CAPACITORS
C1 ..... 100u 10V axial electro
C2 ..... 220n polyester
C3 ..... 100u 10V radial electro
C4, 10 ..... 10u 25V radial electro
C5, 6 ..... 10n polyester
C7, 8 ..... 22n polyester
C9 ..... 4u7 63V radial electro

SEMICONDUCTORS
IC1 ..... 741C op-amp
IC2 ..... 1458C dual op-amp
Q1 ..... BC109C NPN silicon

MISCELLANEOUS
SK1, 2 ..... ¼ inch jack socket
SW1 ..... DPDT rotary mains switch
B1 ..... 9 volt (see text)
Short springline unit; battery connectors; case, 250 x 150 x 75mm; printed circuit board; four control knobs; two 8 pin DIL IC sockets; M3 hardware; Veropins; connecting wire; solder etc.

BUYLINES ..... page 26



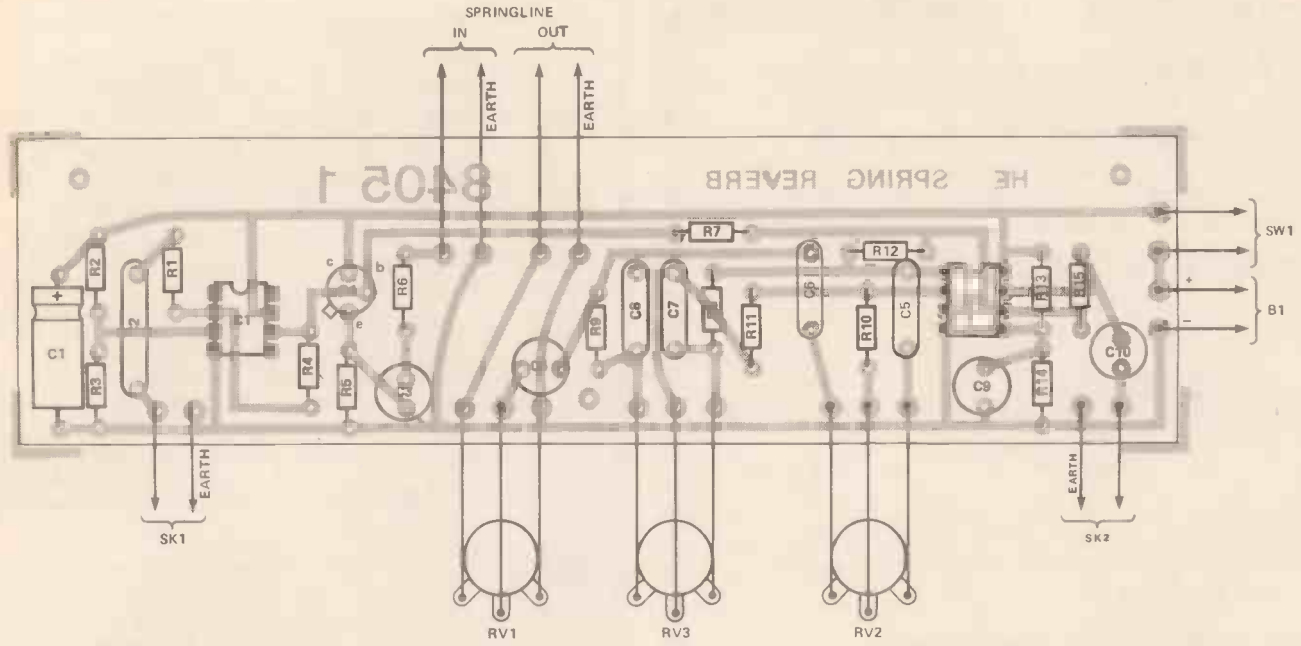


Figure 3. The PCB foil and overlay. The connections at bottom go to the controls, those at the top go to the small springline unit, which occupies more than half the case (see the picture on the previous page).

integrated circuits and electrolytic capacitors the right way around.

Fit Veropins to the board at places where connections will be made to off-board components such as the controls and springline. The completed board is mounted on the chassis just in front of the springline, and towards the left hand side of the unit, using M3 fixings together with 6mm spacers to keep the connections on the underside of the board clear of the metal chassis.

The unit is then completed by adding the point to point wiring. The input and output terminals of the springline are clearly marked as such and there should be no problems here. The connections to the input terminals can be either way round, but one of the output terminals connects to the chassis of the springline. This one, which can clearly be seen to connect to the chassis of the component, must connect to the earth input of the printed circuit board.

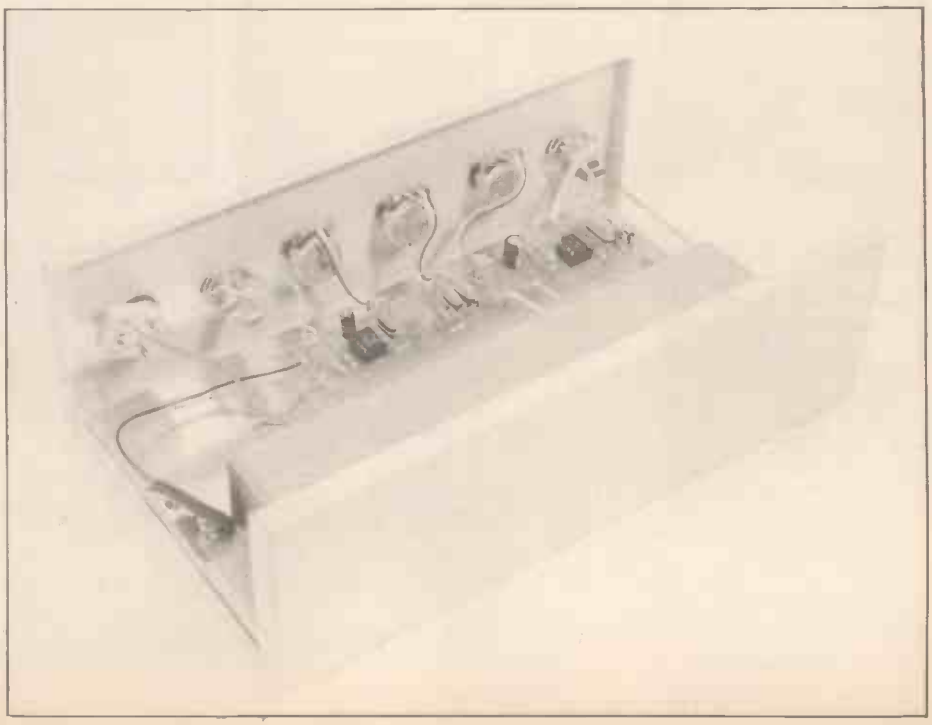
There is plenty of space for the battery to the right of the printed circuit board. If a PP9 type is used this will require the use of the large press-stud battery connectors. If six HP7 cells are used, these should be fitted in a plastic battery holder, and this has small, PP3 type press-stud connectors.

In Use

Ideally the input signal should be a few hundred millivolts RMS, but signals up to about one volt RMS or so can be tolerated. The unit will operate with lower level signals, but problems with noise and/or acoustic feedback are likley to result if a very low level signal, such as that from a microphone, is used. With signals of this type a preamplifier should be used to boost the input to the unit to a more suitable level.

With RV1 fully advanced the reverberation effect should be so strong as to be very evident on practically any type of input signal. The tone controls are simply adjusted to give whatever effect you consider to be the most suitable. The effect can be varied from a very deep "boomy" reverberation with the controls set for full bass and minimum treble, to a shorter "small hall" type reverberation with the tone controls adjusted for full treble and minimum bass.

On the prototype there is no switch to enable the reverberation to be switched out, but if this facility is required it is merely necessary to connect a SPST switch in the lead which carries the output of the springline to RV1. Similarly, a SPST switch in series with R7 could be used to permit the straight-forward signal to be switched out to give only the reverberation signal at the output. HE



hobbyboard

The Complete Printed Circuit Workshop

Computer Cables & Connectors

We now offer an extensive range of computer cables & connectors including a spectrum user port extender cable. Send for complete cable & connector price list.

SPECTRUM EXTENDER

HB/2069 £8.85*

Overcomes those interconnection problems! Six inch double ended extender & male PCB plug. Also available as single ended with 9" of ribbon cable

HB/ 2068 £4.76*

VIC/CBM 64 cassette interface

Operates with most data recorders HB/3000 £12.50*

Full Hobbyboard Catalogue £1.50* (refundable with first order over £10)
*Prices inclusive of VAT, carriage 60p In U.K. Overseas orders please add extra carriage.

hobbyboard

a division of
KELAN ENGINEERING Ltd
Hookstone Park
Harrogate, N. Yorks

complete P.C.B. workshop

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 —no cost or obligation at all.

C & G BASIC ELECTRONICS	☐	ELECTRONIC ENGINEERING	☐
C & G RADIO AMATEUR'S Exam	☐	COMPUTER PROGRAMMING	☐
RADIO & AUDIO ENGINEERING	☐	TV & AUDIO SERVICING	☐
RUNNING YOUR OWN BUSINESS	☐	ELECTRICAL INSTALLATIONS/CONTRACTING	☐
AUTO MECHANICS	☐	C & G BASIC MECHANICAL ENGINEERING	☐

Name _____

Address _____

P.Code _____

ICS Division of National Education Corporation
Dept EA154
ICS School of Electronics
160 Stewarts Road
London SW8 4UJ
01-622 9911 (all hours)
CACC

HORIZON ELECTRONICS

(Midands)
Charlotte St. Rugby Tel: 78138
Prime quality. TERRIFIC PRICES. Mail order only

REGULATORS
(5/12/15v)
100mA type 28p
1 amp type 33p
723 variable 28p

ZENERS
(Z.5 to 30v)
500mW 6p
1 watt 12p

DIODES

1N 4001	3p
1N 400 2	4p
1N 4004	6p
1N 4006	6p
1N 5401	12p
1N 5405	13p
1N 5408	14p

BRIDGE RECTIFIERS

1 amp 50v	20p
2 amp 100v	30p
2 amp 400v	38p
6 amp 100v	45p
6 amp 400v	75p
10 amp 50v	170p
10 amp 200v	195p

THYRISTORS (plastic)

6 amp 400v	35p
8 amp 400v	50p

TRIACS (plastic)

4 amp 400v	50p
8 amp 400v	60p
25 amp 400v	158p

LED's

0.2" Red	7p
0.2" Green	8p
0.2" Yellow	8p

OPTO ISOLATORS

TIL 112	83p
4N 33	117p
MOC 3020	185p

DINPLUGS

5 pin	23p each	118p per 10
5 pin 180	13p each	110p per 10
5 pin 240	14p each	115p per 10
5 pin 360	36p each	180p per 10
6 pin	27p each	190p per 10
7 pin	28p each	190p per 10

CAPACITORS

Radial 63v		Axial 63v	
		1 mfd	7p
1 mfd	7p	2.2 mfd	7p
2.2 mfd	7p	4.7 mfd	8p
4.7 mfd	8p	10 mfd	10p
10 mfd	10p	22 mfd	12p
22 mfd	12p	47 mfd	14p
47 mfd	13p	100 mfd	21p
100 mfd	19p	220 mfd	50p
220 mfd	44p	470 mfd	85p
		1000 mfd	70p

TRANSISTORS

BC107s	9p	BC135	33p
BC108s	9p	BC136	35p
BC109s	10p	BC139	32p
BC140	25p	BC140	33p
BC142	22p	BF178	25p
BC160	35p	BF179	30p
BC182	7p	BF257	30p
BC212	7p	BF258	30p
BC237	8p	BF259	33p
BC300	52p	BFX85	27p
BC301	25p	BFX86	28p
BC302	39p	BFX87	28p
BC303	39p	BFX88	25p
BC301	25p	BFY50	20p
BC302	39p	BFY51	22p
BC303	30p	TIP31s	35p
BC304	40p	TIP32s	38p
BC337	8p	VN1010km	50p
BCY70	15p	VN66af	65p
BCY71	15p	VN88af	95p

LINEAR I.C.s

CA 3240	96p	LM 709	44p
DAC 0800	233p	LM 747	60p
ICL 7811	96p	LM748	35p
ICL 7822	180p	LM 1458	43p
ICM 7555	70p	LM 3900	58p
ICM 7556	130p	LM 3909	88p
LF 347	158p	LM 3914	295p
LF 351	40p	LM 3915	315p
LF 353	70p	NE 531	133p
LM 301	24p	NE 567	95p
LM 324	37p	SN 76013N	271p
LM 339	46p	SN 76023N	272p
LM 348	80p	ZN 414	88p
LM 380	68p	ZN 425	348p

'D' CONNECTORS (mm's)

15 way	— plug	85p
	socket	128p
	cover	99p
25 way	— plug	122p
	socket	122p
	cover	99p
25 way I.D.C.	— plug	435p
	socket	495p
	cover	99p

TOGGLE SWITCHES

Standard 2 amp	— SP ST	38p
	DP DT	49p
Miniature 2 amp	— SP ST	57p
	DP DT	70p
Sub Min 2 amp	— SP ST	46p
	DP DT	62p

ADD: 65p post/packing to all orders under £15
VAT: add 15% VAT to total order value (inc p&p)
*** Comprehensive Catalogue Available: . 85p ***

MODEL COVERS

All sizes catered for with the base of your choice and colour. Let us help you keep your pride and joy in good condition. Trade or Retail enquiries welcome.
6mm rebate base for 3mm clear perspex cover
4" high x 12" long x 6" wide = 12.00p. + pp.

TELEPHONE OR WRITE
ALL ENQUIRIES ANSWERED

John Wise Limited
5 Alpha Road, West Green
Crawley, Sussex RH11 7DH
Tel: Crawley 542889

Affordable Accuracy · Low Cost Multimeters from Armon

SPECIFICATION MODELS 6010 & 7030 DIGITAL
★ 10 amp AC/DC
★ Battery: Single 9V drycell. Life: 200 hrs.
★ Dimensions: 170 x 89 x 38mm
★ Weight: 400g inc. battery
★ Mode Select: Push Button
★ AC DC Current: 200μ A to 10A
★ AC Voltage: 200mV to 750V
★ DC Voltage: 200mV to 1000V
★ Restance: 200Ω to 20MΩ
★ Input Impedance: 100MΩ
★ Display: 3½ Digit 13mm LCD
★ O/load Protection: All ranges

SPECIFICATION HM 102R ANALOGUE
★ DC Voltage: 0-25, 1, 2.5, 10, 25 100, 250, 1000 volts 20,000 ohms/volt.
★ AC Voltage: 0-10, 25, 100, 250, 1000 volts 10,000 ohms/volt.
★ Decibels: −20 to +22dB.
★ DC Current: 0-50,500Ω A, 0-5, 50, 500mA.
★ Ohmmeter: 0-6 Megaohms in 4 ranges. 30 ohms Centre Scale.
★ Power Supply: One 1.5 V Size 'A' battery (Incl)
★ Size & Weight: 135 x 91 x 39mm, 280gr.
HC 102 BZ WITH BUZZER
BATTERY SCALE, 10A DC RANGE

HC102R
£11.00

ARMON ELECTRONICS LTD.
Dept. E, Cottrell House, 53-63 Wembley Hill Road, Wembley, Middlesex HA9 8BH
Telephone 01-902 4321 (3 lines). Telex 923985
Please add 15% to your order for VAT. P&P free of charge. Payment by cheque with order.
Offer applicable to mainland UK only.
Please allow 15 days for delivery.

HE PCB SERVICE

Ready made PCBs For Readers!

PRINTED CIRCUIT BOARDS (PCBs) for HE projects have often represented an obstacle for our readers. Some of you, no doubt, make your own but our PCB Service saves you the trouble.

NOW you can buy your PCBs direct from HE. All (non-copyright) PCBs will be available automatically from the HE PCB Service. Each board is produced from the same master as that used for the published design and so each will be a true copy, finished to a high standard.

Apart from the PCBs for this month's projects, we are making available some of the popular designs from earlier issues. See below for details. *Please note that only boards for projects listed below are available*: if it isn't listed we can't supply it.

HE/8204/2	Dual Engine Driver	£3.76
HE/8204/3	Bike Alarm	£2.82
May 82		
HE/8205/1&2	Digital Thermometer (Set of two)	£5.31
HE/8205/3	Echo-Reverb	£6.47
HE/8205/4	Cable Tracker	£2.13
June 82		
HE/8206/1	Power Supply Design	£2.85
HE/8206/2	Auto-Wah	£3.54
HE/8206/3	Auto Greenhouse Sprinkler	£3.97
HE/8206/4&5	Telephone Timer (Set of two)	£7.48
July 82		
HE/8207/1	Tanover	£2.45
HE/8207/2	TVI Filter	£2.05
HE/8207/3	Computer PSU	£8.83
HE/8207/4	Solar Radio	£2.28
August 82		
HE/8208/1&2	Digital Millivoltmeter (Set of two)	£4.99
HE/8208/3&4	Audio-Analyser (Set of two)	£13.28
September 82		
HE/8209/1&2	Signal lights Main Module	£2.25
	Junction Module	£1.96
HE/8209/3	ZX Interface	£3.84
HE/8209/4	Slot Car Controller	£2.28
October 82		
HE/8210/1	Flash Point Alarm	£2.45
HE/8210/2	Negative Voltage Generator	£1.71
HE/8210/3	Squelch Unit	£2.90
November 82		
HE/8211/1	Pedometer/ Odometer	£2.45
December 82		
HE/8212/1	Phase Four	£3.25
HE/8212/2	Microlog	£4.58
HE/8212/3&4	Tape/Slide (Set of Two)	£6.05
HE/8212/5	TV Amp	£6.56
HE/8212/6	Lofty	£3.00
HE/8212/7	Noise Gate	£4.14
HE/8212/8	Low Cost Alarm	£2.65
January 83		
HE/8301/1	Chip Probe	£2.09
HE/8301/2	Switched Mode Regulator	£2.25
February 83		
HE/8302/1	Incremental Timer	£8.20
HE/8302/2	DigiTester PSU	£7.71
March 83		
HE/8303/1	Loudspeaker Protector	£2.89
HE/8303/2	Overvolt Cutout	£2.59
April 83		
HE/8304/1	6502 EPROMMER	£8.26
HE/8304/2&3	Ducker Main Board	£4.09
	Preamp Board	£2.66
HE/8304/4	Power Down	£2.42
May 83		
HE/8203/1	8BC Interface	£5.54
HE/8305/3	Stall Thief	£2.88
HE/8305/4	Auto-Test	£2.88
June 83		
HE/8306/1	Sinclair Sound Board	£3.22
HE/8306/2	CB Rap Latch	£1.90
HE/8306/3	Bat Light (Car battery monitor)	£2.59
HE/8306/4	Traffic Light Toy	£2.94
July 83		
HE/8307/1	Soft Fuzz	£3.19
August 83		
HE/8308/1	Whistle Switch	£5.06
HE/8308/2	Ace Interface	£4.05
HE/8308/3	Enlarger Timer	£3.36
HE/8308/4	Auto-Winder	£3.43
September 83		
HE/8309/1	Tremoleko	£3.61
HE/8309/2	SPL Meter	£4.85
October 83		
HE/8310/1	Ultrasonic Alarm	£3.67
HE/8310/2	Audio Level Meter	£3.55
HE/8310/3	High Voltage Meter	£3.99
November 83		
HE/8311/1	Wiper Delay	£3.22
HE/8311/2	Light Delay	£3.21
December 83		
HE/8312/1	Damp Meter	£3.32
HE/8312/2	Continuity Tester	£1.39
HE/8312/3	Light Meter	£3.63
HE/8312/4	Bassman	£2.75
January 84		
HE/8401/1	Power Reducer	£3.69
HE/8401/2	Lap Counter	£7.00
HE/8401/3	Quizmaster	£3.23
February 84		
HE/8402/1	Audio PSU	£5.62
HE/8402/2	Field Memory	£3.23
HE/8402/3	Camera Remote Transmitter	£2.67
	Receiver	£3.48
HE/8402/4	Timing Strobe	£3.61
March 84		
HE/8403/1	Offbeat Metronome	£3.46
HE/8403/2	Sinewave Generator	£3.31
HE/8403/3	Lightning Timer	£3.35
April 84		
HE/8404/1	Analogue Test Set	£4.31
HE/8404/2	Time Out	£3.54
May 84		
HE/8405/1	Spring Reverb	£3.70
HE/8405/2	Touch Switch	£3.11
HE/8405/3	Touch Switch (Double sided touch plate)	£5.49

PLACE an order for your PCBs using the form below (or a piece of plain paper if you prefer not to cut the magazine), then simply wait for your PCBs to drop through your letterbox, protected by a Jiffy bag.

HE PCB Service, Argus Specialist Publications Ltd., No. 1, Golden Square, London W1R 3AB.

I enclose a cheque/Postal Order made payable to ASP Ltd, for the amount shown below Price.

OR

I wish to pay by Barclaycard. Please charge my account number

. . . . . VISA

OR

I wish to pay by Access. Please charge to my account number

. . . . . Access

SIGNATURE . . . . . .

NAME . . . . . .
(BLOCK CAPITALS)

ADDRESS . . . . . .
(BLOCK CAPITALS)

. . . . . .

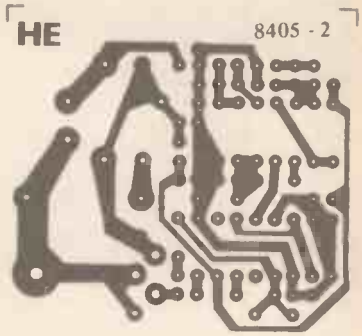
. . . . . .

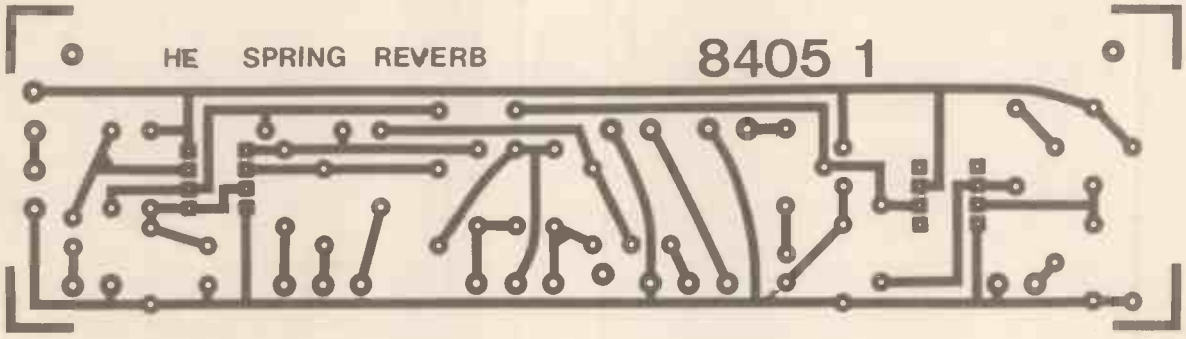
Please allow 21 days for delivery

Boards Required	Price
Add 45p p&p	0.45
Total Enclosed £	

PCB FOIL PATTERNS

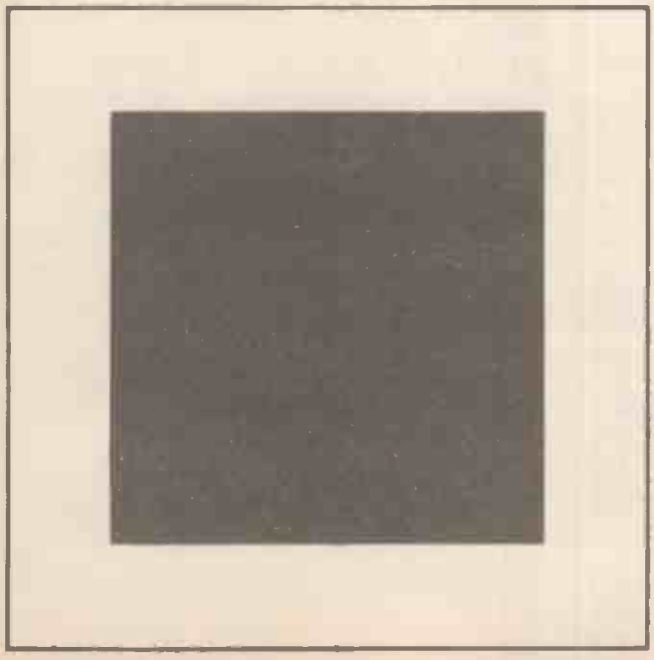
Two PCB foil patterns in very different styles: in each case, the layout is determined by the shape and size of another component in the respective projects.
Right: The Mains Touch Switch, packed into a small area behind the touch plate.
Below: The Spring Reverb, long and thin to lie alongside the springline unit.



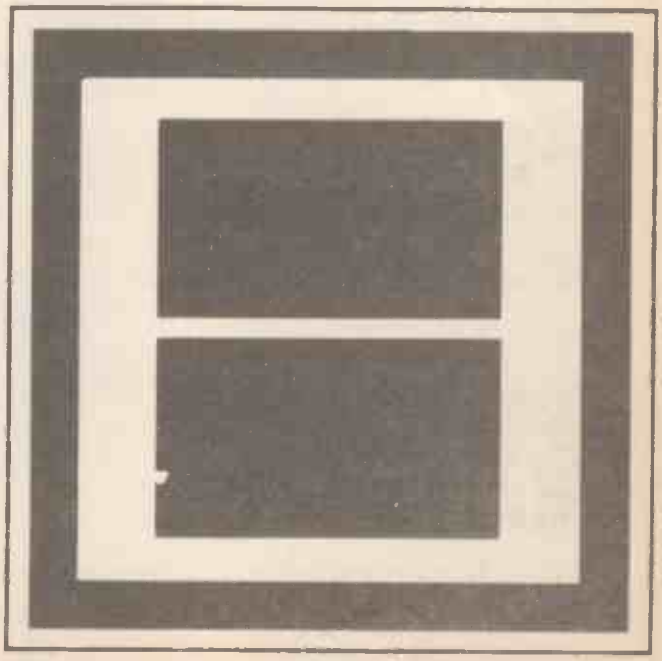


Below: The Foil patterns for the double-sided touch plate as used in the Touch Switch. The same pattern may be used if two single-sided boards are to be glued together.

TOP SIDE



UNDERSIDE



HOBBY ELECTRONICS CLASSIFIED

Lineage:
35p per word (minimum 15 words)
Semi-display £8.20 per single column centimetre
Ring for information on series bookings/discounts

All advertisements in this section must be prepaid.
Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request)

01-437 0699

Send your requirements to:
Debbie Miller
ASP Ltd.,
1 Golden Square,
London W1R 3AB

ALARMS

TIMED ENTRY EXIT CONTROL PANEL
ALARM
MAINS–BATT.
MODEL 9000E
–ONLY–
£29.50 INC
2 ZONE £33–89
■ FULL 2 YEAR GUARANTEE
■ Adjustable entry–exit with buzzer.
■ Regulated power supply (1-2 amp).
■ Latching 24 hour circuit.
■ Visual & audible walk test.
PLEASE SEND FOR FREE CATALOG. OF ALARM EQUIPMENT FROM
SIMPSONS ELECTRONIC ALARMS
70 PRIORY ROAD LIVERPOOL L4 2RZ.
■TRADE SUPPLIED■
051-260-0300

SECURITY Alarm Systems
FREE COMPREHENSIVE CATALOGUE!
● LOWEST DISCOUNT PRICES
● HIGHEST QUALITY EQUIPMENT
● FREE DIY DESIGN GUIDE
● FULLY ILLUSTRATED
● MICROCHIP CIRCUITRY
● QUICK DESPATCH SERVICE
● FULL INSTRUCTIONS
SEND SAE OR PHONE
C-TEC SECURITY, Dept HE
60 Market St, Wigan WN1 1HX
Telephone (0942) 42444
Trade Enquiries Welcome

LARGE STOCK OF BURGLAR ALARM EQUIPMENT: As used in the trade. JN Security Centre, 176 Sydenham Rd., London SE26 5JZ. 01-778 1111. Showrooms open 6 days.

A1 INTRUDER ALARMS
Wholesale Alarm Suppliers
Latest D.I.Y. & Wholesale Published Catalogue
Write off for your copy
86 Derby Lane, Old Swan, Liverpool 13 (Dept HE)
Tel: 051-288 3483
or 051-220 0590

BURGLAR ALAMR equipment. Ring Bradford (0274) 731532 for our catalogue, or call at our large showrooms opposite Odsal Stadium.

LANCASHIRE

E·E· ETESON ELECTRONICS
158 Lower Green
Poulton-le-Fylde Blackpool
Tel: (0253) 885107
Open 9:30 am–12:30, 1:30–5:30
Closed Wed. & Sun.
Electronic Component Specialists

COMPUTERS

CONTROL
Plug-ins for the DRAGON 32
RELAY OUTPUT UNIT
FITTED 2 RELAYS — £16.75
Space for 6 more
FAST A-D CONVERTER WITH APPLICATION SOFTWARE
£29.50
Other units available. Please send A4 S.A.S.E. for the full details.
P.N.P. COMMUNICATIONS
(Dept. H.E.)
62 Lawes Avenue, Newhaven
East Sussex BN9 9SB
Tel: 0273 514465

RADIO SERVICES

VINTAGE WIRELESS COMPANY 1914-1960
Radios, amplifiers, service sheets, valves, vintage components. Books new and used.
Repairs and Restorations.
Mail Order only.
Tudor House, Casoham St., Mangotsfield BS17 3EN
Tel: 565472

EQUIPMENT

AERIAL AMPLIFIERS Improve weak television reception. Price £6.70. S.A.E. for leaflets. Electronic Mailorder, Ramsbottom, Lancashire BL0 9AGH.

RESISTOR PACKS FOR ALL PROJECTS
¼ watt carbon film resistors 5% 1 ohm to 10M E24 series. Packs of 10 each value (1690 resistors £10.00. Your choice of qualities/values 25 for £1.00. VAT and Post Free.
GORDON HALLET
20 Bull Lane, Malden, Newton Dorchester, Dorset DT2 0BQ

KITS

PRINTED CIRCUITS. Make your own simply, cheaply and quickly! Golden Fotolac light-sensitive lacquer — now greatly improved and very much faster. Aerosol cans with full instructions, £2.25. Developer 35p. Ferric chloride 55p. Clear acetate sheet for master 14p. Copper-clad fibreglass board, approx. 1mm thick £1.75 sq. ft. Post/Packing 50p. White House Electronics, Castle Drive, Praa Sands, Penzance, Cornwall.

FOR SALE

100W AMPLIFIER — £9.95 built! or use the same board for 50W, 150W, 200W into 4 or 8 ohms etc., by using alternative output transistors and PSU. SAE for full details to – ESS Amplification, Innovation House, Guildhall Road, Hull.

KIA RETURN AN AD No.14 . . . Any Stereoamp £10.83 + this ad . . . Case, controls & sockets, glass/pcb + heatsinking . . . Tested . . . 10+10/30+30/60+ 60W KIA-8, LS29 9DZ/ Thankyou. 'Happy Easter folks!'.

BOOKS & PUBLICATIONS

PARAPHYSICS JOURNAL (Russian translations). Psychotronics, Kirlianography, heliphonic music telekinetics. Computer software. SAE 4 x 9":— Paralab, Downton Wilts.

COMPONENTS

BRITISH TELECOM plug sockets and leads, etc. Tel: C.W.A.S (0274) 308920. Or visit our showroom opposite Odsal Stadium, Bradford.

FREE! Parcel of L.E.D.'s, switches, components worth £10. Send only 80p postage. Horsley, 113 Clare Rd, Braintree, Essex.

WE SUPPLY a wide range of electronic components and service parts. Also new telephone plugs and sockets, joystick interfaces and leads for most computers. Burglar alarm equipment including censor sirens, bells, buzzers all at competitive prices. Write or phone for details. Shudehill Supply Co. Ltd., 53 Shudehill, Manchester M4 4AW.

BOOKS

Be your own boss with our new published business manuals.
Both with full fault guides and business know how.
Domestic appliance reconditioning and repair for profit.
2 volumes only £12.50 post free.
A guide to professional sewing machine repairs for profit.
2 volumes only £8.50 post free.
Leaflets available.
Mr. Marchant. Dept H.E.
30 Chester Road East, Shotton, Clwyd, N. Wales

PLANS 'N DESIGN

AMAZING electronic plans, lasers, gas, ruby, light shows, high voltage teslas, van de graph, surveillance devices, ultrasonics, pyrotechnics, new solar generator, 150 more projects, catalogue S.A.E., Plancentre, Bromyard Road Industrial Estate, Ledbury HR8

ED - SOFTWARE

TEACHER?
Make life easier USE your SPECTRUM or BBC B computer to put your classlists and marks on cassette.
TEACHING DATA sorts, ranks, grades. It prints lists, graphs and stats **£5.20 to:**
B. Farris, 8 Thompson Road
Bolton BL1 6DF

Bimconsoles — METAL Brown base Beige top

Part No	A	B	C	D	E	
BIM 2601	178	51	210	38.5	70	10.96
BIM 2602	280	51	210	38.5	70	12.19
BIM 2603	381	51	210	38.5	70	14.10
BIM 2604	483	51	210	38.5	70	16.01
BIM 2605	480	51	261	38.5	70	17.85
BIM 2701	178	76	210	38.5	70	11.52
BIM 2702	280	102	210	38.5	70	13.40
BIM 2703	381	102	210	38.5	70	14.86
BIM 2704	483	102	210	38.5	70	16.97

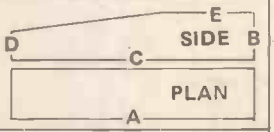
Bimconsoles — ABS Black or Grey base with Grey Aluminium top.

BIM 6005	105	55.5	143	31.5	37.5	2.25
BIM 6006	170	55.5	143	315	37.5	2.80
BIM 6007	170	81.8	21.8	31.5	57.8	3.85

BIMBOARDS

Prototype with plug-in breadboads
Component support brackets supplied with all except Eurobreadboard.

Type	No of Con. Points	
Eurobreadboard	500	6.25
Eurobreadboard PCB	500	0.75
Bimboard 1	550	6.55
Bimbusstrip	80	2.50
Bimboard PCB	630	1.44
Bimboard Layout Pad		0.46
MPUrobreadboard	1422	17.25
Bimboard Designer		77.00



All prices inc VAT. Add 60p per order on Bimboards, £2.50 per order on Bimconsoles for p&p. SAE for full list. Mail Order only.

BIMSALES
Dept HE/5, 48a Station Road, Cheadle Hulme, Cheadle, Cheshire. SK8 7AB. Tel: 061 485 6667.

Please mention HE when replying to advertisers

Hobby Electronics May 1984 Advertisers Index

Send for my CATALOGUE ONLY 75p
(plus 25p post/packing)

My all-inclusive prices quoted in the Catalogue are the lowest. All below normal trade price — some at only one tenth of manufacturers quantity trade.

Millions of components : thousands of different lines

Rechargeable Nickel Cadmium batteries (ex unused equipment)
AA(HP7) 1.25volt 500ma. Set of four £2
Plastic container of ten £5

Clear L.E.D. illuminates Red, Green or Yellow depending upon polarity/current.
Oblong 5 x 2½mm Face 25p or 100 for £23 or 1000 for £200
5mm Red Flashing L.E.D. 25p or 10 for £2.25

Watch/Calculator/Lighter etc, Mercury batteries
RW52(PX675) RW54 Made by Ray-O-VAC
RW56 (DH323,WH8) 31p each or
RW57, RW58 10 for £2.60, 100 for £21

IN4004 or IN4006 Diodes. 300 for £6.48p
TO5 or TO18 Heatsinks 7½p, 100 for £6.50, 1000 for £55
Clipover Heatsink for I/C or TO202 device 21 x 18mm
18p or 100 for £16.50 or 1000 for £155
Heatsink for T03 or Plastic Power 19p, 100/£17.50, 1000/£165
Modern Telephone Handset and lead in white, red, blue, grey, yellow, green or black £2
Plessey SG403. 3 Watt amp. From bankrupt source, hence sold as untested, at 4 for 60p or 10 for £1.20p.

SEND PAYMENT PLUS 16p SAE OR LABEL

Prices you would not believe before inflation!

BRIAN J. REED
TRADE COMPONENTS
ESTABLISHED 27 YEARS
161 St. Johns Hill, Battersea, London SW11 1TQ
Open 11 am till 6.30pm Tues. to Sat. Telephone: 01-223 5016

PARNDON ELECTRONICS LTD.
Dept. 22. 44 Paddock Mead. Harlow, Essex. CM18 7RR. Tel: 0279 32700

RESISTORS: ¼ Watt Carbon Film E24 range ± 5% tolerance
Bandoliered and colour coded. Full Range 1RO-10M.
£1.00 per hundred mixed (Min 10 per value) **£8.50** per thousand mixed (Min 50 per value)
Special stock pack 60 values. 10 of each **£5.50**

RECTIFIERS

	1 Amp	3 Amp
50V	3p	14p
100V	4p	14p
200V	5p	14p
400V	6p	19p
600V	8p	20p
1000V	9p	25p

VOLTAGE REGULATORS – 1 amp/T0220
Positive voltage 5,8,12,15,24V **40p**
Negative voltage 5,12,15V **43p**

CAPACITORS – Mixed special **£2.00** pack. Tant bead: 5 off OR AL. ELEC: 30 off. Our choice of Values/Voltages.

DIL SOCKETS 8 pin – **10p.** 14 pin – **11p.** 16p pin – **12p.** 18p pin – **19p.** 20p pin –**21p** 22 pin – **23p.** 24 pin – **25p.** 28 pin – **27p** 40 pin – **42p.**

DIODES: IN4148 **£1.60** per hundred
ALL PRICES INCLUDE V.A.T. & POST & PACKING — NO EXTRAS
MIN ORDER — UK £1.00 OVERSEAS £5 CASH WITH ORDER PLEASE
X-Stock Items Same Day Despatch

OVERCHARGED FOR YOUR BATTERIES?

RECHARGEABLE BATTERIES
AND CHARGERS

For Use in Your

Personal Stereo	Metal Detector
Transistor	Test Equipment
Torches	Car Kits
Cassette Recorders	Electronic Projects

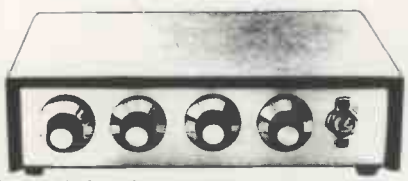
SANDWELL PLANT LTD
656 Chester Road, Erdington, Birmingham
Tel: 021-373 9487 After hours Lichfield 57977
Also at Hitchin, Telephone: Hitchin 733254
Private enquiries welcome. Send SAE for details
Special discounts available for Schools.

PREVIOUSLY ADVERTISED STILL AVAILABLE

Tape punch and reader	£22.50
Bench isolating transformer 250 watt	£7.75
BDAC In-flight stereo unit	£1.50
Drill assortment 4 each 25 sizes between .25mm & 2.5mm	£11.50
Battery condition tester, less box	£1.75
Nicad chargers, mains	£0.75
Flourescent inventor 13 watt from 12v	£3.50
Ten digit stitch pad-pb phone etc.	£1.95
Uniselector 2 pole 25 way	£4.60
Water valve mains operated	£2.50
Counter 6 digit mains operated	£1.15
ditto 12v resettable	£3.45
Double glazing clear PVC sheet, 23½" wide-per running ft.	£0.15
Locking mechanism with 2 keys	£1.15
Magnetic Clutch	£4.50
Mouth operated suck or blow switch	£2.30
Solenoid with slug 8 - 12v battery op.	£1.82
ditto 230v mains	£2.30
Timer Dmron STP NH 110v AC Coil	£6.90
Key switch with 2 keys dp mains	£1.75
Air valve mains operated	£3.75
Latching relay mains operated	£3.50
Dry film lubricant aerosol can	£0.65
Coin op switch, cased with coin tray	£4.60

8 POWERFUL MODEL MOTORS (all different)

for robots, meccanos, drills, remote control planes, boats, etc. £2.95.



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 ¼" 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.

12 volt MOTOR BY SMITHS

Made for use in cars, etc. these are series wound and they become more powerful as load increases. Size 3½" long by 3" dia. They have a good length of ¼" spindle — **Price £3.45.**
Ditto, but double ended £4.25.
Ditto, but permanent magnet **£3.75.**

EXTRA POWERFUL 12v MOTOR

Probably develops up to ¼ h.p. so it could be used to power a go-kart or to drive a compressor, etc. £7.95 + £1.50 post.

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats 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 stat 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 pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat 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.**

MINI MONO AMP on p.c.b., size 4"x 2" (app.)

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 amp. Brand new, perfect condition, offered at the very low price of **£1.15 each, or 10 for £10.00.**

— BARGAIN OF THE YEAR —

The AMSTRAD Stereo Tuner.

This ready assembled unit is the ideal tuner for a music centre or an amplifier, it can also be quickly made into a personal stereo radio — easy to carry about and which will give you superb reception.

Other uses are as a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead.

Some of the features are: long wave band 115 — 270 KHz, medium wave band 525 — 1650KHz, FM band 87 — 108MHz, mono, stereo & AFC switchable, tuning meter to give you spot on stereo tuning, optional LED wave band indicator, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or headphones and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands. All made up on very compact board.

Offered at a fraction of its cost: **only £6.00**
+ £1.50 post + insurance.

THIS MONTH'S SNIP

Hi Fi sound from your Spectrum 1 watt amp — pm speaker & instructions **£2.45**

REVERSIBLE MOTOR with control gear

Made by the famous Framco Company this robust motor is approx 7½" long, 3½" dia. 3/8" shaft. Very powerful, almost impossible to stop. Ideal for operating stage curtains, doors, ventilators, etc. Even garage doors if properly balanced. Offered complete with control gear as follows:

1 Framco motor with gear box
1 manual reversing & on/off switch
1 circuit diag. of connections
1 push to start switch
2 limit stop switches
ONLY **£19.50** + postage **£2.50.**

FOR SOMEONE SPECIAL

Why not make your greeting card play a tune? It could play 'Happy Birthday', 'Merry Christmas', 'Wedding March', etc, or 'Home Sweet Home', etc. Wafer thin 3 part assemblies, for making cards musical. Mini microchip speaker and battery with switch that operates as the card is opened. Please state tune when ordering. Complete, ready to work £1.25.

JOYSTICK

WHY PAY £10 OR MORE — Make yourself a Joystick — full details were given in Dec/Jan 'Sinclair Projects'. We will supply complete kit for **£2.30.** Although designed for the Spectrum or ZX81 it is equally suitable for any home computer.

TELEPHONE ITEMS

Plug and Wall socket — 4 pin or 5 pin	£3.45
Plugs only 4 pin or 5 pin	£1.15
Modern desk telephone	£7.50
Heavy black old type	£5.50
External bell unit	£6.50
Bell ringing power unit	£4.50
Pick up coil	£1.15

STABILISED POWER SUPPLY (Mains Input)

By LAMDA (USA) — Ideal for computer add-ons, d.c. output. Regulated for line volts and load current. Voltage regulation .1% with input variations up to 20% — load regulation 1% from no load to full load — or full load to no load. Complete in heavy duty case — Models available: 5v - 9A £23. 12v - 1.5A £13.25. 15v - 1.2A £13.25. 24v - 2A £23.

PRESTEL UNIT

— brand new and complete except for 7 plug in IC's — Price: **£19.75** + £2.00 p&p.
Note: British Telecom may not connect this equipment as there is no manufacturer to guarantee it, however it is well worth buying for its immense breakdown value — sold originally at over £150.

25A ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you wake — switch on lights to ward off intruders — have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. Independent 60 minute memory jogger. A beautiful unit at £2.50.

BELLS & ALARMS

Hooter/Siren 6v - 12v	69p
Loud, med & soft buzzer	75p
Open buzzer ex G.P.O.	50p
12" Gong cast iron cased ALARM BELL 12v dc	£19.50
6" Gong 12v dc	£7.50
6" Gong mains	£8.50

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 telephone, Memory jogger, Live line tester, Continuity checker, etc. etc., and you will still have hundreds of parts for future projects. Our 10Kg parcel contains not less than 1,000 items - panel meters, timers, thermal trips, relays, switches, motors, drills, taps, and dies, tools, thermostats, coils, condensers, resistors, neons, earphone/microphones, nicad charger, power unit, multi-turn pots and notes on the 50 projects.

YOURS FOR ONLY £11.50 plus £3.00 post.

TELEPHONE & INTERCOM CABLES

15 conductors colour coded 200mt coil **£59.00**
10 conductors colour coded 200mt coil **£39.00**
Flex extension lead twin rubber .5mm ideal grass cutters etc .250mtn coil **£25.00**
50 meter coil **£6.75**

MAINS TRANSFORMERS

4 volt	4 amp	£1.75	24 volt	4 amp	£4.85
6 volt	1 amp	£1.15	25 volt	1 amp	£2.25
12 volt	½ amp	£1.15	35 volt	2 amp	£3.95
12 volt	¾ amp	£1.55	38 volt	2½ amp	£4.95
12 volt	1 amp	£1.75	26 volt	10 amp	£9.95
15 volt	2 amp	£3.45	50 volt	2 amp	£5.50
15 volt	4 amp	£4.60	25.0.25	½ amp	£3.95
18 volt	1 amp	£1.95	12.0.12	2 amp	£4.95
20 volt	1 amp	£2.30	115v 100w auto		£3.95
24 volt	2 amp	£3.45	115v 250w auto		£5.75

J. BULL (Electrical) Ltd.

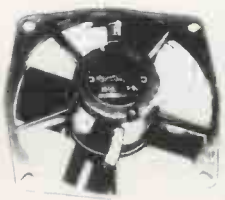
(Dept. HE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU. Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £12 add 60p service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted day or night. Haywards Heath (0444) 454563. Bulk orders: phone for quote. Shop open 9.00 — 5.30, mon to Fri, not Saturday.

STORE CLOSING SALE

All stocks must go from one of our big warehouses. 10,000,000 items, everything from AERIALS to ZENER will be cleared at fantastically low prices - if you are a manufacturer you can save yourself a fortune - send for our Sale List, not for small buyers as minimum order £100.

EXTRACTOR FANS — MAINS OPERATED



Woods extractor.
5" — £5.75, Post £1.25.
6" — £6.95, Post £1.25.
5" Plannair extractor £6.50. Post £1.25.
4"x 4" Muffin 115v. £4.50. Post 75p.
4"x 4" Muffin 230v. £5.75. Post 75p.
All the above ex-computer, those below are unused.
4" x 4" £8.50. Post 75p.
9" American made £11.50. post £2.00.
Tangential Blower 10x3 air outlet, dual speed £4.60. Post £1.50.

LIGHTING & POWER CABLES

Made by Volex to BRITISH STANDARD SPECIFICATIONS

P.V.C. sheathed outer-copper clad conductors

1.5mm flat twin 100	metres	£4.50
1.5mm flat 3 core 8E	metres	£11.00
6mm flat 3 core	metres	£54.00
16mm flat twin 8E	metres	£115.00

MINIATURE WAFER SWITCHES

2 pole, 2 way — 4 pole, 2 way — 3 pole, 3 way — 4 pole, 3 way — 2 pole, 4 way — 3 pole, 4 way — 2 pole, 6 way — 1 pole, 12 way.
All at 25p each or 10 for £2.00

OTHER TYPES IN STOCK — PLEASE ENQUIRE

BLEEP TONE These work off 12v and have an unusual and pleasant bleep. 69p each.

CONNECTING WIRE PACK 96 lengths of connecting wire, each 1 metre long and differently colour coded, a must for those difficult interconnecting jobs. 85p the lot.

RED LEDS 10 for 69p. 100 for £5.75. 1000 for £52.

IN LINE SIMMERSTAT Ideal heat controller for soldering iron and many other hand-held appliances. £2.30. 10 for £17.25.

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 a plastic case - £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.**

IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder — a complete mains operated kit, case included.

£11.95 plus £2.00 post.

OTHER POPULAR PROJECTS

Short Wave Set — covers all the short wave bands using plug-in coils. Kit complete	£14.50
R C Bridge Kit	£9.95
3 Channel Sound to Light — with fully prepared metal case.	£14.95
Ditto — made up	£25.00
Big Ear, listen through walls	£9.50
Robot controller — receiver/transmitter	£9.50
Ignition kit — helps starting, saves petrol, improves performance	£13.95
Silent sentinel Ultra Sonic Transmitter and receiver	£9.50
Car Light 'left on' alarm	£3.50
Secret switch — fools friends and enemies alike	£1.95
3 — 30v Variable Power Supply	£13.80
2 Short & Medium wave Crystal Radio	£3.99
3v to 16v Mains Power Supply Kit	£1.95
Light Chaser — three modes	£17.50
Mullard Unilex HiFi stereo amplifier with speakers	£16.75
Radio stethoscope — fault finding aid	£4.80
Mug stop — emits piercing squark	£2.50
Morse Trainer — complete with key	£2.99
Drill control kit	£3.95
Drill control kit — made up	£6.95
Interrupted beam kit	£2.50
Transmitter surveillance kit	£2.30
Radio Mike	£6.90
FM receiver kit — for surveillance or normal FM	£3.50
Seat Belt reminder	£3.00
Car Starter Charger Kit	£15.50
Soil heater for plants and seeds	£16.50
Insulation Tester — electronic megger	£7.95
Battery shaver or fluorescent from 12v	£6.90
Matchbox Radio — receives Medium Wave	£2.95
Mixer Pre-amp — disco special with case	£16.00
Aerial Rotator — mains operated	£29.50
Aerial direction indicator	£5.50
40 watt amp — hifi 20hz — 20kHz	£9.50
Microvolt multiplier — measure very low currents with ordinary multitester	£3.95
Pure Sine Wave Generator	£5.75
Linear Power output meter	£11.50
115 Watt Amplifier 5Hz 25kHz	£13.50
Power supply for 115 watt amps	£8.50
Stereo Bass Booster, most items	£8.95

ENFIELD ELECTRONICS

208 Baker Street, Enfield, Middlesex. EN1 3JY. Tel: 01-366 1873

TRANSISTORS

AC125	30p	BC183C	12p	MJE2955	110p	ZTX303	20p
AC126	30p	BC183L	12p	MJE3055T	80p	ZTX304	20p
AC127	30p	BC183LB	12p	MPSA06	25p	ZTX330	35p
AC128	30p	BC184	12p	MPSA56	30p	ZTX500	18p
AC132	90p	BC184B	12p	MPSU05	65p	ZTX501	18p
AC141	30p	BC184L	12p	MPSU56	60p	ZTX502	18p
AC142	30p	BC186	30p	OC22	150p	ZTX503	18p
AC176	30p	BC187	30p	OC23	150p	ZTX504	30p
AC187	30p	BC212A	14p	OC26	100p	ZTX531	30p
AC188	30p	BC212L	12p	OC28	200p	ZTX550	30p
AD149	80p	BC213	12p	OC35	220p	2N696	35p
AD161	45p	BC213B	12p	OC41	75p	2N698	45p
AD162	45p	BC213L	12p	OC42	75p	2N699	40p
BC107	12p	BC214	12p	OC70	60p	2N706A	26p
BC107A	14p	BC214B	14p	OC76	60p	2N708	30p
BC107B	14p	BC214L	12p	OC81	60p	BC237	18p
BC108	12p	BF194	14p	OC82	60p	BC238B	18p
BC108A	14p	BF195	14p	OC84	50p	BC307	18p
BC108B	14p	BF198	14p	TIP29	30p	BC308	14p
BC108C	14p	BF199	14p	TIP29A	35p	BC327	16p
BC109	12p	BF200	35p	TIP29B	50p	BC328	16p
BC109B	14p	BF224B	20p	TIP29C	45p	BC337	16p
BC109C	14p	BF244B	35p	TIP30A	40p	BC338	16p
BC140	35p	BF256	35p	TIP30B	50p	BC441	36p
BC141	35p	BF257	35p	TIP30C	45p	BC461	36p
BC142	35p	BF258	35p	TIP31	38p	BC477	40p
BC143	35p	BF259	35p	TIP31A	40p	BC478	40p
BC147	12p	BF594	40p	TIP31B	40p	BC517	45p
BC148	12p	BF595	30p	TIP31C	45p	BC547	15p
BC157	12p	BFR39	20p	TIP32A	40p	BC548	15p
BC158	12p	BFR79	30p	TIP32C	40p	BC549	16p
BC159	12p	BFR80	30p	TIP36C	140p	BC556	20p
BC160	50p	BFX29	30p	TIP41A	50p	BC557	16p
BC161	45p	BFX84	30p	TIP41B	50p	BC558	16p
BC167	15p	BFX85	30p	TIP42A	60p	BC559	16p
BC168	12p	BFX87	30p	TIP42B	65p	BCY70	20p
BC169	12p	BFX88	30p	TIP120	80p	BCY71	20p
BC170	20p	BFY50	28p	TIP121	80p	BCY72	23p
BC171	13p	BFY51	25p	TIP122	120p	BD131	50p
BC172A	12p	BFY52	25p	TIP2955	70p	BD132	50p
BC173	13p	BFY90	80p	TIS43	36p	BD133	60p
BC177	20p	BRY39	40p	TIS44	40p	BD135	50p
BC178	20p	BSX20	30p	TIS90	30p	BD136	40p
BC179	25p	BSX29	35p	TIS91	30p	BD137	40p
BC181	23p	BU105	170p	VN10KMA	75p	BD138	40p
BC182	12p	BU205	200p	VN66AF	95p	BD139	45p
BC182B	14p	BU208A	220p	VN88AF	110p	BD140	45p
BC182L	12p	MJ2955	90p	ZTX107	12p	2N914	36p
BC183	12p	MJE340	50p	ZTX108	12p	2N918	30p
BC183B	12p	MJE371	90p	ZTX109	12p	2N930	30p
				ZTX300	15p	2N1131	30p
				ZTX301	18p	2N1132	30p
				ZTX302	20p	2N1303	80p
						2N1304	80p
						2N1305	80p
						2N1307	70p
						2N1308	80p
						2N1613	36p
						2N2222A	30p
						2N2369A	28p
						2N2646	68p
						2N2904A/5A	30p
						2N2906A	60p
						2N2907A	30p
						2N2926G	12p
						2N2926R	12p
						2N2926Y	12p
						2N3053	30p
						2N3054	75p
						2N3055E	60p
						2N3442	150p
						2N3615	200p
						2N3702	12p
						2N3703	12p
						2N3704	12p
						2N3705	12p
						2N3706	12p
						2N3707	12p
						2N3708	12p
						2N3710	12p
						2N3711	12p
						2N3771	200p
						2N3772	200p
						2N3773	200p
						2N3819	25p
						2N3820	45p
						2N3823	50p
						2N3866	100p
						2N3903	15p
						2N3904	15p
						2N3905	15p
						2N3906	15p
						2N5172	30p
						2N5194	80p
						2N5457	42p
						2N5458	48p
						3N128	85p
						3N140	85p
						3N141	85p
						3N163	110p
						3N201	110p
						3N202	125p
						40406	80p
						40407	80p

TTL

7400	18p	7417	28p	7447	75p	7486	35p	74119	70p	74160	65p	74190	58p
7401	18p	7420	20p	7448	55p	7489	140p	74121	35p	74161	55p	74191	55p
7402	18p	7422	28p	7450	21p	7490	37p	74122	41p	74162	46p	74192	55p
7403	18p	7425	28p	7451	20p	7491	45p	74123	41p	74163	46p	74193	55p
7404	18p	7426	28p	7453	21p	7492	40p	74126	70p	74164	46p	74194	52p
7405	18p	7427	30p	7454	21p	7493	41p	74132	65p	74165	60p	74195	52p
7406	32p	7428	30p	7460	21p	7494	41p	74135	50p	74166	60p	74196	55p
7407	32p	7430	26p	7470	25p	7495	41p	74141	51p	74167	185p	74197	55p
7408	25p	7432	26p	7472	25p	7496	41p	74144	250p	74170	195p	74198	95p
7409	25p	7433	35p	7473	30p	7497	60p	74145	575p	74173	120p	74199	95p
7410	18p	7437	30p	7474	35p	74100	95p	74147	125p	74174	65p	74221	60p
7411	25p	7438	30p	7475	40p	74104	58p	74148	65p	74175	65p	74279	60p
7412	26p	7440	23p	7476	35p	74105	58p	74150	70p	74176	46p	74284	95p
7413	26p	7441	51p	7480	30p	74107	30p	74151	46p	74177	55p	74285	95p
7414	37p	7442	40p	7481	110p	74109	30p	74153	46p	74180	50p	74366	64p
7416	28p	7443	71p	7482	70p	74110	41p	74154	81p	74181	121p	74390	325p
		7444	95p	7483	58p	74111	70p	74155	46p	74182	70p	74393	100p
		7445	71p	7484	81p	74116	70p	74156	46p	74184	105p		
		7446	71p	7485	75p	74118	65p	74157	35p	74185	105p		

LS TTL

74LS00	17p	74LS27	21p	74LS83	51p	74LS138	40p	74LS169	98p	74LS243	81p	74LS293	46p
74LS01	17p	74LS28	21p	74LS85	52p	74LS139	39p	74LS170	86p	74LS244	65p	74LS353	71p
74LS02	17p	74LS30	21p	74LS86	23p	74LS147	121p	74LS173	63p	74LS245	86p	74LS362	110p
74LS04	17p	74LS32	21p	74LS90	39p	74LS148	86p	74LS174	58p	74LS247	65p	74LS365	35p
74LS05	17p	74LS33	21p	74LS93	35p	74LS151	46p	74LS175	52p	74LS248	66p	74LS366	35p
74LS08	18p	74LS37	21p	74LS95	46p	74LS153	52p	74LS181	115p	74LS249	66p	74LS367	35p
74LS09	20p	74LS38	21p	74LS96	109p	74LS154	120p	74LS183	201p	74LS251	40p	74LS368	35p
74LS10	20p	74LS40	21p	74LS107	46p	74LS155	46p	74LS190	58p	74LS253	46p	74LS373	70p
74LS11	20p	74LS42	37p	74LS109	35p	74LS156	46p	74LS191	55p	74LS257	40p	74LS374	70p
74LS12	23p	74LS49	63p	74LS112	32p	74LS157	40p	74LS192	55p	74LS258	43p	74LS375	52p
74LS13	28p	74LS51	21p	74LS113		74LS158	40p	74LS193	55p	74LS259	67p	74LS386	130p
74LS14	32p	74LS54	21p	74LS114	32p	74LS160	40p	74LS194	52p	74LS260	30p	74LS390	55p
74LS15	21p	74LS55	21p	74LS122	46p	74LS161	40p	74LS195	52p	74LS266	32p	74LS393	55p
74LS20	21p	74LS63	138p	74LS123	46p	74LS162	40p	74LS196	52p	74LS273	63p	74LS395	98p
74LS21	21p	74LS73	25p	74LS124	166p	74LS163	43p	74LS197	52p	74LS275	146p	74LS398	310p
74LS22	21p	74LS74	25p	74LS125	37p	74LS164	48p	74LS221	63p	74LS279	40p	74LS541	130p
74LS26	21p	74LS75	28p	74LS126	35p	74LS165	60p	74LS240	81p	74LS280	110p	74LS629	200p
		74LS76	25p	74LS132	41p	74LS166	81p	74LS241	75p	74LS283	46p	74LS669	160p
		74LS78	25p	74LS136	28p	74LS168	97p	74LS242	80p	74LS290	60p	74LS670	120p

CMOS

CD4000	15p	CD4015	46p	CD4035	55p	CD4054	100p	CD4093	40p	CD4503	46p	CD4569	80p
CD4001	15p	CD4016	30p	CD4038	125p	CD4060	80p	CD4099	140p	CD4511	52p	CD4572	80p
CD4002	15p	CD4017	40p	CD4040	50p	CD4066	30p	CD4160	75p	CD4512	60p	CD4581	80p
CD4006	60p	CD4018	52p	CD4041	50p	CD4068	20p	CD4161	75p	CD4514	140p	CD4582	80p
CD4007	16p	CD4019	30p	CD4042	45p	CD4069	20p	CD4162	75p	CD4515	200p	CD4583	60p
CD4008	45p	CD4020	52p	CD4043	46p	CD4070	16p	CD4163	75p	CD4516	65p	CD4584	60p
CD4009	30p	CD4021	46p	CD4044	46p	CD4071	18p	CD4175	75p	CD4518	52p	CD4585	110p
CD4010	35p	CD4022	46p	CD4045	120p	CD4072	18p	CD4402	75p	CD4520	60p	CD40100	200p
CD4011	15p	CD4023	20p	CD4046	55p	CD4075	25p	CD4412	75p	CD4528	81p	CD40106	80p
CD4012	20p	CD4024	40p	CD4047	46p	CD4076	60p	CD4419	75p	CD4538	100p	CD40109	100p
CD4013	25p	CD4025	18p	CD4048	45p	CD4077	30p	CD4445	75p	CD4539	78p	CD40114	200p
CD4014	55p	CD4026	100p	CD4049	30p	CD4078	25p	CD4446	75p	CD4541	100p	CD40174	80p
		CD4027	25p	CD4050	30p	CD4081	25p	CD4449	75p	CD4555	60p		
		CD4028	45p	CD4052	70p	CD4082	25p	CD4501	35p	CD4561	110p		
		CD4029	55p	CD4053	60p	CD4085	72p	CD4502	70p	CD4568	80p		

LINEAR

CA1310E	185p	CA3090	415p	LM339	80p	LM3911	140p	SAA5020		TDA1008	347p	TL074	117p
CA1350E	90p	CA3130	105p	LM348	90p	LM3914	285p	SN76013N	295p	TDA1022	570p	TL081	40p
CA3020	230p	CA3140	52p	LM358	62p	LM3915	285p	TAA621A	290p	TDA1024	120p	TL082	65p
CA3028	110p	CA3240	125p	LM380	85p	LM3916	285p	TAA661B	175p	TDA2002	150p	TL083	92p
CA3035	270p	ICM7555	105p	LM381	170p	MC1458	70p	TBA120B	70p	TDA2003	345p	TL084	65p
CA3043	305p	ICM7556	200p	LM382	130p	MC1488	80p	TBA120S	68p	TDA2020	350p	UA748	40p
CA3035	270p	LF347	200p	LM384	160p	MC1489	90p	TBA120U	98p	TDA2030	340p	ZN414	95p
CA3043	305p	LF351N	55p	LM386	100p	NE555	20p	TBA540Q	161p	TDA2102		ZN424	150p
CA3055	85p	LF353N	100p	LM387	140p	NE556	55p	TBA651		TDA2522		ZN425	400p
CA3065	150p	LM224	150p	ILM389	110p	NE564	405p	TBA800	95p	TDA9400		ZN426	345p
CA3080	80p	LM301	30p	ILM732	55p	NE566	173p	TBA810S	110p	TL061	50p	ZN427	715p
CA3081	225p	LM308	100p	ILM747	75p	NE567	161p	TBA820	81p	TL062	75p	ZN1034	230p
CA3085	145p	LM311N	81p	ILM1458	45p	NE570	391p	TBA920Q	175p	TL064	150p	ZN1040	750p
CA3086	65p	LM318N		ILM3900	70p	NE571	387p	TCA270S	171p	TL071	50p		
CA3089	230p	LM324	50p	ILM3909	92p	SAA5010		TDA1004	345p	TL072	60p		

RIBBON CABLE

(Priced per 33cm)

COLOUR	
WAYS	
10	26p
20	53p
26	76p
34	100p
GREY	
10	18p
20	25p
26	50p
36	60p
40	80p

D CONNECTORS

PLUGS	SOCKETS	COVERS
9 way 90p	125p	110p
15 way 125p	190p	110p
25 way 190p	230p	125p

RECHARGEABLE BATTERIES

HP2, 1.2v, 4.0AH	£3.95
HP2, 1.2v, 1.2AH	£2.60
HP11, 1.2v, 1.2AH	£2.40
HP7, 1.25v, 500mAH	£1.00
AAA, 1.2v, 180mAH	30p
PP3, 8.4v, 110mAH	£4.50

DIODES

AA119	15p	OA200	9p	1N5060	18p
AA215	16p	OA202	9p	1N5062	20p
BAX13	10p	1N823	5p	1N5400	11p
BY100	30p	1N914	5p	1N5401	12p
BY127	18p	1N916	6p	1N5402	14p
BY133	20p	1N4000	5p	1N5403	15p
BY206	30p	1N4001	5p	1N5404	16p
BY207	30p	1N4002	5p	1N5405	17p
BY299	40p	1N4003	6p	1N5406	18p
BYX10	18p	1N4004	6p	1N5407	22p
OA47	10p	1N4005	7p	1N5408	25p
OA90	8p	1N4006	7p	1S44	5p
OA91	8p	1N4007	8p	1S921	7p
OA95	8p	1N4148	5p	1S922	7p
		1N4448	6p	1S923	7p

I.C. SOCKETS

LOW PROFILE		TURNED PIN	
D.I.L Type	Price	D.I.L. Type	Price
8 pin	10p	8 pin	35p
14 pin	12p	14 pin	50p
16 pin	14p	16 pin	60p
18 pin	18p	18 pin	65p
20 pin	24p	22 pin	75p
22 pin	25p	24 pin	80p
24 pin	30p	28 pin	100p
28 pin	32p	40 pin	150p
40 pin	35p		

ZENER DIODES

BZX61C/1.4 watt: 3V3, 3V6, 3V9, 4V7, 5V6, 6V2, 7V5, 8V2, 10V, 11V, 12V, 13V, 15V, 18V, 20V, 22V, 24V, 27V, 30V, 33V, 36V, 39V, 43V, 47V, 56V, 68V, 75V, 82V, 100V, 180V, 200V **16p each**

BZY88C/0.4 watt: 1V3, 2V7, 3V, 3V3, 3V6, 3V9, 4V3, 4V7, 5V1, 5V6, 6V2, 7V5, 8V2, 9V1, 10V, 11V, 12V, 13V, 15V, 16V, 18V, 22V, 24V, 27V, 30V, 33V, 36V **10p each**

LEDs

5mm: Red	10p	113: Red	
Green	13p	Red	20p
Yellow	13p	Green	25p
3mm: Red	10p	Yellow	25p
Green	13p	323: Tri.	
Yellow	13p	Red	20p
COX21: Red		Green	25p
flashing	65p	Yellow	25p
251: Rect/stack		503: Square	
Red	20p	Red	20p
Green	25p	Green	25p
Yellow	25p	Yellow	25p

REGULATORS

LM304H	180p	UA723C	77p	78H12 (3A/5V)	
LM309H	80p	7805A	50p		460p
LM309K	130p	7812A	50p	78L05	35p
LM317K	350p	7812Kc	121p	78L12	35p
LM317T	130p	7815A	50p	78L15	35p
LM320/5	65p	7818A	50p	78L18	35p
LM320/12	65p	7824A	50p	78L24	35p
LM320/15	65p	7905A	55p	78L62	35p
LM320/24	65p	7912A	55p	79L05	45p
LM337T	180p	7915A	55p	79L12	45p
LM1469	324p	7918A	55p	79L15	45p
UA78P (8A/5V)	450p	7924A	55p	79L18	45p
				79L24	45p

ALUMINIUM BOXES

3½" × 1¾" × 9½"	
80 × 50 × 25	80p
100 × 65 × 50	1.20
100 × 70 × 40	1.20
100 × 100 × 40	1.20
135 × 70 × 40	1.20
135 × 105 × 40	1.40
180 × 125 × 65	1.95
205 × 155 × 75	2.50

VERO PLASTIC BOXES

White 71 × 49 × 25	60p
Blk 71 × 49 × 25	60p
Blk 120 × 80 × 35	1.10
Blk 180 × 110 × 55	1.75

VERO BOARDS

127 × 63	1.10
95 × 63	95p
431 × 63	3.17
127 × 95	1.20
95 × 95	1.15
431 × 95	4.20
454 × 119	5.50
63 × 25 pk of 5	1.30

THYRISTORS

BT101	104p	T05 1A/400V	104p	600mA/200V	45p	5A/400V	60p
BT102	104p	2N1599	40p	1A/50V	40p	5A/600V	70p
BT106	104p	2N4441	170p	1A/100V	45p	5A/800V	80p
BT107	132p	2N4444	150p	1A/200V	50p	7A/100V	55p
BT108	143p	2N5060	36p	1A/400V	60p	7A/200V	60p
TIC44	20p	2N5061	33p	1A/600V	75p	7A/400V	70p
TIC106D	40p	2N5062	42p	1A/800V	90p	7A/600V	80p
TIC106M	77p	2N5063	47p	3A/50V	46p	7A/800V	90p
TIC126D	99p	2N5064	47p	3A/100V	53p	10A/50V	55p
TIC2060	80p	600mA/20V	21p	3A/200V	58p	10A/100V	60p
TIC2260	90p	600mA/30V	24p	3A/400V	71p	10A/200V	65p
TIC246D	130p	600mA/100V	30p	3A/600V	79p	10A/400V	70p
				5A/50V	43p	10A/600V	88p
						10A/800V	115p

TRIACS

2A/200V	50p	6A/400V	80p
2A/400V	60p	6A/600V	90p
2A/600V	60p	8A/400V	80p
4A/400V	60p	8A/600V	90p
4A/600V	80p	10A/100V	80p
6A/200V	80p	10A/200V	100p
6A/400V	90p	10A/400V	110p
6A/600V	100p	10A/600P	100p

BRIDGE RECTIFIERS

1A/50V	30p	6A/50V	75p
1A100V	30p	6A/100V	75p
1A/200V	35p	6A/400V	80p
1A/400V	40p	6A/400V	100p
2A/50V	35p	10A/200V	200p
2A/100V	45p	10A/400V	200p
2A/200V	50p	25A/200V	250p
2A/400V	55p	25A/400V	300p

SOLDER

20 swg. 3 core

500g 495p

POTENTIOMETERS

Carbon track, ¼ watt log & linear values:

Range	Price
470R-2.2MR (single track)	40p
4.7K-2.2MR (dual gang)	100p
4.7K-2.2MR (single gang D/P switch)	90p

SLIDER POTS

60mm track, log & linear values:

Range	Price
5K-500K	80p

PRESETS

Pre-set pots ¼ watt

Range	Price
50R-4.7MR (mini vert. & horiz.)	10p

Dalo Etch resist £1.10

RESISTORS

High stability, ¼ watt, 5%

Range	Price (1-99)	(100+)
1R-10MR	2p	1p

High stability, ¼ watt, 5%

Range	Price (1-99)	(100+)
1R-10MR	3p	1.5p

CAPACITORS

CERAMIC 1pF, 2p2, 2p7, 3p3, 3p9, 4p7, 5p6, 6p8, 8p2, 10pF, 12pF, 15pF, 18pF, 22pF, 27pF, 33pF, 39pF, 47pF, 56pF, 68pF, 82pF, 100pF, 120pF, 150pF, 180pF, 220pF, 270pF, 330pF, 470pF, 560pF, 680pF, 820pF, 1000pF, 1n5, 1n8, 2n2, 3n3, 3n9, 4n7, 5n6, 6n8, 8n2, 10nF, 22nF, 47nF, 100nF 6p each

MYLAR: 100V 1nF, 2n2, 3n3, 4n7, 6n8, 10nF 7p each, 15nF, 22nF, 33nF, 47nF 9p each, 68nF, 100nF 11p each, 220nF 15p, 330nF 18p, 470nF, 20p

POLYSTYRENE 22pF, 47pF, 68pF, 82pF, 100pF, 120pF, 150pF, 220pF, 270pF, 330pF, 390pF, 470pF, 680pF, 820pF, 1000pF, 1200pF, 1500pF, 1800pF, 2000pF, 2200pF, 3300pF, 4700pF, 5600pF, 10nF 8p each 300pF 15p each. 330pF, 390pF, 470pF 19p each. 500pF, 560pF, 680pF 22p each. 820pF 24p each. 1000pF 27p, 1500pF 32p, 1800pF 42p, 2200pF 45p 2700pF 48p. 3600pF 55p. 3900pF 68p. 4700pF 83p. 5000pF 98p. 6800pF 115p. 8200pF 120p. 10000pF 125p.

TANTALUM BEAD 3V: 100uF, 150uF, 220uF, 330uF 64p each. 470uF 110p, 680uF 160p. 6V3: 100uF 27p, 150uF 32p, 180uF 42p, 220uF 45p 270uF 48p. 360uF 55p. 390uF 68p. 470uF 6u8, 12p. 10uF 13p. 33uF 33p. 47uF 25p. 100uF, 220uF 77p each. 470uF 160p 10V: 15uF, 22uF 20p 83p. 5000pF 98p. 6800pF 115p. 8200pF 120p. 10000pF 125p.

ELECTROLYTIC Axiel or Radial 16V: 10uF, 22uF, 33uF 10p each. 47uF, 68uF, 100uF 12p each. 125uF, 220uF 14p each, 330uF 18p. 470uF 24p. 680uF 36p. 1000uF 30p. 1500uF 40p. 2200uF 50p. 25V: 1uF, 10uF, 22uF, 47uF 10p each. 100uF 12p. 220uF 20p. 470uF 30p. 1000uF 40p. 2200uF 55p. 4700uF 115p. 35V: 120uF, 250uF 20p each. 40V: 6u8 10p. 470uF 30p. 1000uF 45p. 50V: 0.47uF, 1uF 8p each. 1uF (small) 12p. 220uF 35p. 63V: 1uF, 2u2, 4u7 7p each. 10uF, 22uF 10 each. 47uF 12p. 100uF 20p. 220uF 30p. 100V: 4.7F 48p. 160V: 10MF 32p. 250V: 0.01uF, 0.047uF, 0.1uF 10p each. 0.22uF 11p. 0.47uF 12p. 1uF 18p. 2u2 26p. 10uF 23p. 100uF 35p. 400V: 0.47uF 35p. 600V: 0.022uF, 0.047uF 30p each. 0.22uF, 67p. 1000V: 0.0022uF 27p. 0.022uF, 0.1uF 39p each.

POLYESTER C280 250V .01, 022, 033, 068, 1 8p .15, 22, 33 10p 47 12p, 68 20p, 1uF 26p 2.2 50p.

SILVERED MICA 2p2, 3p3, 5pF, 10pF, 18pF, 20pF, 22pF, 25pF, 27pF 13p each, 30pF, 33pF, 39pF, 47pF, 50pF, 56pF, 68pF, 75pF, 82pF, 100pF, 120pF, 150pF, 180pF; 200pF, 220pF, 250pF, 270pF, 300pF 15p each, 330pF, 390pF, 470pF 19p each. 500pF, 560pF, 680pF 22p each. 820pF 24p each. 1000pF 27p, 1500pF 32p, 1800pF 42p, 2200pF 45p 2700pF 48p. 3600pF 55p. 3900pF 68p. 4700pF 83p. 5000pF 98p. 6800pF 115p. 8200pF 120p. 10000pF 125p.

Prices for TTL Components are changing all the time. Please phone for current prices

NEW ILLUSTRATED CATALOGUE NOW AVAILABLE, £1 including VAT plus P&P

50p P&P ON ALL ORDERS UNDER £10

TELEPHONE ORDERS ACCEPTED WITH ACCESS & BARCLAYCARD. OFFICIAL ORDERS MOST WELCOME FROM SCHOOLS ETC.

WE ARE OPEN MONDAY TO SATURDAY 9-6 PM

All prices include V.A.T. Same day despatch