AN ARGUS SPECIALIST PUBLICATION
AUGUST 1984

Hobby Electronics

Project Electronics For Everyone

90p

CIRKIT PROJECTS

Three tried and tested electronic devices to build, specially designed for Hobby Electronics by Cirkit

- Infra-Red Link
- Audio Function Generator
- Temperature Controlled Switch

SOFT OPTIONS

Continues inside...

COMPUTER GAMES
IF YOU CAN'T BEAT THEM, SHOULD YOU JOIN IN?

WIDGIT SOFTWARE
REFRESHING ANSWERS TO QUESTIONS THE OTHERS HAVEN'T YET ASKED

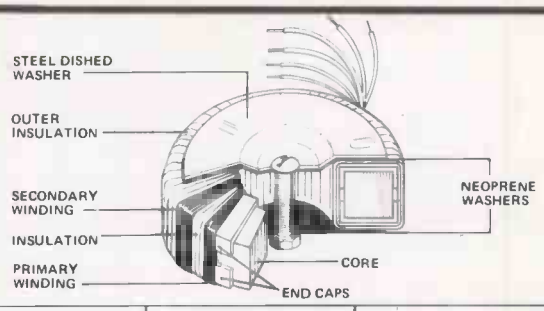
PLUS

NEWS, VIEWS AND REVIEWS FOR ALL AGES

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 14 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
[illegible]	6-6	1·25
[illegible]	9-9	0·83
[illegible]2	12-12	0·63
[illegible]3	15-15	0·50
1X0[illegible]4	18-18	0·42
1X0[illegible]5	22-22	0·34
1X016	25-25	0·30
1X017	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. 2
Graham Bell House, Roper Close,
Canterbury, Kent. CT2 7EP
Tel: (0227) 54778 Telex: 965780

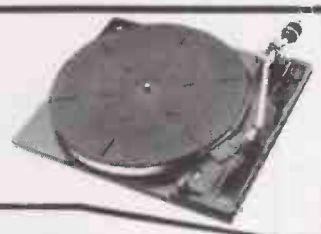
Access VISA

ILP ELECTRONICS LTD.

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.

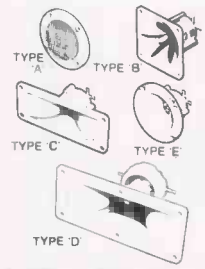
Price £33.60 each £2.50 P&P.



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 + 40p P&P.**

TYPE 'B' (KSN1005A) 3½" super horn. For general purpose speakers, disco and P.A. systems etc. **Price £4.99 each + 40p P&P.**

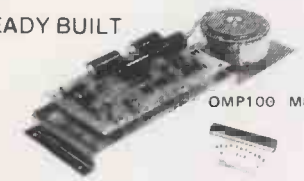
TYPE 'C' (KSN6016A) 2" × 5" wide dispersion horn. For quality Hi-fi systems and quality discos etc. **Price £5.99 each + 40p P&P.**

TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. **Price £7.99 each + 40p P&P**

TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-fi monitor systems etc. **Price £4.99 each + 40p P&P.**

OMP POWER AMPLIFIER MODULE

READY BUILT



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 × 115 × 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 × 123mm × 60mm **Price: £39.99 + £2.50 P&P.**
200 Watt 300mm × 150mm × 100mm **Price: £62.99 + £3.50 P&P.**
300 Watt 330mm × 147mm × 102mm **Price: £79.99 + £4.50 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: £26.00 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

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 × 46 × 14mm (9 volt) **Price; £8.62 + 75p P&P.**

3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled, professional performance. Range up to 3 miles 35 × 84 × 12mm (12 volt) **Price: £13.74 + 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 × 70 × 22mm (9/12 volt). Price: £17.82. Transmitter 80 × 50 × 15mm (9/12 volt). **Price: £11.27 P&P + 75p each. S.A.E. for complete list.**

3 watt FM Transmitter

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

Access **B. K. ELECTRONICS** VISA

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

Hobby Electronics

AUGUST 1984
Vol. 6 No. 8

PROJECTS

★ DIGITAL TEST SET 19
All the functions you need at your fingertips
★ CIRKIT: INFRA RED LINK 44
Nothing passes undetected
★ CIRKIT: TEMPERATURE CONTROLLED SWITCH .. 48
Tune in, heat up, turn on.
★ CIRKIT: SIGNAL GENERATOR 50
Makin' waves
★ DUAL PSU 14
Proven but not pricy
★ SHORT CIRCUITS 60
Another selection of reader circuits

FEATURES

★ AMSTRAD MICROCOMPUTER 58
The monitor comes too.
★ ALL ABOUT BATTERIES PART 2 53
Nicads: A higher charge

SPECIAL

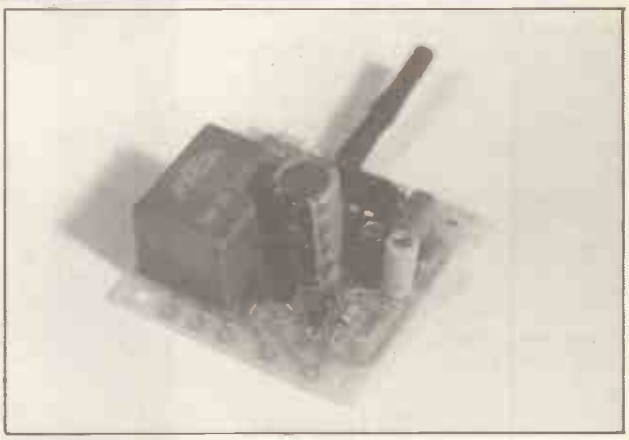
★ SOFT OPTIONS 27
We meet Widgit Software and take a look at the role of computer games: mindless or mind-stretching? As well as news and reviews on the best of educational software.

REGULARS

Monitor 4
What's On Next 18
Buylines 26
HE Backnumbers 43
Points Of View 24
HE PCB Service 64
HE PCB Page 62
HE JULY '84 PCB Page (re-run) 63

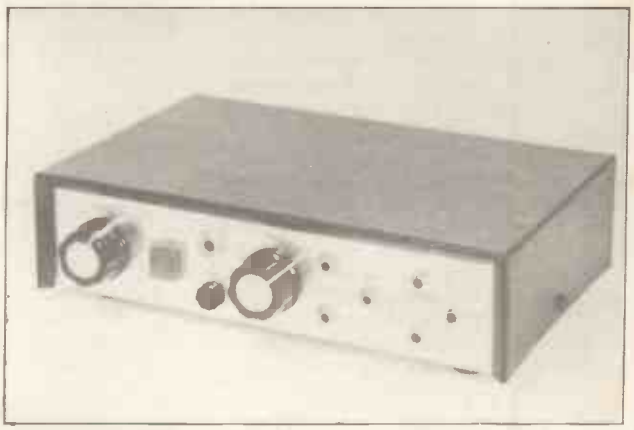
Editor: Ron Keeley
Deputy Editor: Helen P. Armstrong BA
Technical Editorial Assistant: Terry Johnson
Technical Illustrator: Jerry Fowler
Advertising Manager: Joanne James
Copy Control: Lynn Collis
Managing Editor: *Ron Harris BSc*
Chief Executive: T. J. Connell

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



Cirkit: Signal Generator — page 44

Soft Options: Widgit Software — page 27



Digital Test Set — page 19

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.

MONITOR

A Plug

Not just a plug, The Plug: **Power International's protective anti-mains-spike plug** has moved into a Mk II version. In addition to the original transient suppression and RFI filter, the new version has a solid state clamping device with greater power handling ability to remove spikes.

The Plug is somewhat larger than the normal 13A plug, and holds all the circuitry for power protection for microcomputers, test equipment and other interference-vulnerable equipment.

The Plug Mk II costs £17.75 (inc. VAT) and provides a working alternative to bulky and costly bench power protection devices.

Enquiries to **Power International Ltd., 2a Isambard Brunel Rd., Portsmouth, Hants PO1 2DU. Tel: (0705) 756715.**

B.A.E.C. Exhibition

The **British Amateur Electronics Club's** Amateur Electronics **Exhibition** will take place between July 14th and July 28th on Saturday and Sunday between 2pm and 5pm, and from 7.15pm, and Wednesdays and Fridays from 7.30pm only. Monday, Tuesday and Thursday it is not open at all.

The exhibition will be held at the Shelter, The Esplanade, Penarth, S. Glamorgan. Details of the exhibition, and about the BAEC, from **Cyril Bogod, "Dickens", 26 Forrest Rd., Penarth, S. Glamorgan.**

Catalogue

STC Electronic Services have published their "1984 Tool Book", a seventy-two page, A4 **catalogue** showing the complete range of soldering equipment, tools, batteries, wiring and service aids, including a range of **Electrolube** lubricants and computer clearning products.

The tools and aids are primarily professional standard (eg. cable conduit) but nevertheless provide a source for the serious amateur. The battery range has been extended to include lithium memory protection cells from Varta. Copies are available free of charge from **STC Electronic Services, Edinburgh Way, Harlow, Essex CM20 2DF. Tel: (0279) 26777.**

Acorn On Show

Congratulations to **Acorn Computers** who (not entirely to our surprise) won the Queen's Award For Technological Achievement for the BBC Micro and its attandant systems and "many innovative features".

Features that Acorn are particularly proud of include the use of custom ICs, the powerful operating system, built-in local area networking, and their

programming langauge "which has become an educational standard", BBC BASIC.

Apropos of this, the second **Acorn User Exhibition** runs at London's *Olympia 2* from 16-21 August. Acorn and their major suppliers and dealers will be exhibiting all their new products, including second processors, software and robotics. Tickets will be £3.00 for adults and £2.00 for under-sixteens, but advance tickets at £2.00 for adults and £1.00 for under-sixteens can be obtained from the organisers, **Computer Marketplace (Exhibitions) Ltd., 20 Orange St., London WC2H 7ED. Tel: 01 930 1612.**

Computer Show

The **Personal Computer World Show** is moving in 1984 to Olympia 2, and will be held on September 19-24. The show will be one of the first at *Olympia 2* in West London, which is to be opened just a few weeks earlier.

By The Book

Wilmslow Audio have been appointed agents for **Peerless** loudspeaker drive units, as well as the *Peerless Manual for Loudspeaker Constructors*, which contains details of a wide new range including four polypropylene coned bass units newly released to the DIY market. Sizes available are 5in, 6½in, 8in and 10in.

There are seven new DIY speaker systems, including two designs which are specifically designed for digital audio. Active crossover modules are available for three of the designs.

The manual is available to anyone sending a 12x9in stamped addressed envelope to **Wilmslow Audio Ltd., 36-39 Church St., Wilmslow, Cheshire SK9 1AS. Tel: (0625) 529599.**

Cable Catalogue

STC Electronic Services have recently issued their cable and wire **catalogue**, called, not inappropriately, the Cable & Wire Book 1984.

STC claim that the 56-page catalogue carries details of the widest ex-stock range of electronic cables and wires available from a single outlet anywhere in Europe.

Included for the first time are low-toxic equipment wires, heat-resisting VX grade equipment wires, and a range of armoured cable. Good for using as a cooking element in a war zone?

Full technical information is given about the products in the catalogue, which is available from **STC Electronic Services, Edinburgh Way, Harlow, Essex. Tel: (0279) 26811.**

New Disc Format

A one-megabyte version of the 3in **Compact Floppy Disc** format has been announced by the partnership of Hitachi Ltd., their magnetic recording media

subsidiary Hitachi Maxell Ltd., and Matsushita Electric Industrial Co. Ltd.

The new format gives 500kB of unformated recording capacity per side with a track density of 200 tracks per inch, and is compatible with 5.25in drives with a dual sided 1MB capacity. The new magnetic disc designed to meet the highly accurate head positioning requirements of the new format has been developed by Hitachi Maxell.

More information from **Hitachi Sales (UK) Ltd., Hitachi House, Station Rd., Hayes, Middx. Tel: 01-848 8787.**

On The Lead

Pullway Ltd. have produced a pragmatic gadget of the kind that is due to become more and more necessary as the multi-media household gets underway. This is a self-contained pull-out wind-up reel (with carrying handle) of 75R co-axial (television aerial) cable.

The dispenser, which has an integral handle (as well as a moulded plug on the other end of the cable) holds either thirty or forty-five feet of cable, which enables a video recorder, for instance, to be connected up to a television set in the kitchen or the bedroom without moving the VCR. Likewise, a portable television can be moved around the house, or out into the garden (or the garden shed, for the Cup Finals) without extra aerial outlets being fitted.

The dispenser, known appropriately as the "Reeler" can also be used to connect up the TV to a computer, so that games players, or any other user, can hook up their own micro at whatever distance from the screen they please without being hampered by an inadequate length of aerial lead.

Campers and boaters should find this particularly useful for fixing up their TVs in temporary locations, as the cable can be pulled out/re-wound to the exact length required.

Thought: what happens if your bedroom/kitchen is more than forty-five feet from the video recorder? You could drill a hole in the floor . . . or you could get two Reelers. At £7.95, that isn't too serious. Reeler is available from such places as W. H. Smith, Sainsbury's Homebase, Saracentre, etc.

In case of difficulty, further enquiries to **Pullway Ltd., Venn House, 11 Clayton Rd., Hayes, Middx. Tel: 01 848 7747.**

Antique News

The **Antique Wireless Newsheet** has arrived again from the **Vintage Wireless Co.** in Bristol after a longer-than-usual layoff. The accent in the latest issue (No. 97) is on valves — Vintage predict that "the next big valve-related hobby in the UK is going to be audio amplifiers". Accordingly there is the second part of a feature about valves, and an extra insert detailing valves and valve equipment wanted by the Company,

The Newsheet is £4.00 for twelve issues in the UK and Eire, £5.00 airmail elsewhere, from the **Vintage Wireless Co., Tudor House, Cossham St., Mangotsfield, Bristol BS17 3EN. Tel: (0272) 565472.**

Sticks Re-Stuck

It seems as if some games players are hurling themselves physically into the fray. At least, this might be one explanation of the popularity of a fast joystick repair service recently set up by **Computer Supplies** of Boston, Lincs.

CS say that they will repair and return faulty joysticks within twenty four hours. The service is available for most models at a flat rate of £2.95 plus 50p p&p per joystick.

Strong replacement handle inserts are available for the Commodore 1311 joysticks, with simple fitting instructions (ie you don't have to send them the joystick to fit the new insert) for £2.75 per pair, post free.

Contact **Computer Supplies, 146 Church Rd., Boston, Lincs PE21 0JX. Tel: (0205) 50239.**

Buildable Breadboard

Bradley Marshall Ltd. of the Edgware Road, London are stocking a new **breadboard** system from **Wish** of Japan. The boards come in various sizes which can be clipped together in the normal way to make a larger constructional area, and there are aluminium base plates in five sizes complete with two, three or four binding posts.

The breadboard strips come in two basic formats, the "distribution strip" which connects along its length, with 100 sockets, and the "terminal strip" which connects across the width of five sockets in two strips. These are in white plastic, printed with co-ordinate numbers and red and blue guide lines in the case of the distribution strips. The sockets are said to be designed for over 5,000 insertions, and accept 0.3mm to 0.8mm wire and all DIP size components.

Wish also say the the boards are ideal for high frequency and high speed/low noise circuits. The base boards are a protection against static.

The board modules vary from £2.30 to £66.90 (ex. VAT), and a leaflet and full price list is available from **Bradley Marshall Ltd., 325 Edgeware Rd., London W2 1BN. Tel: 01 723 4242.**

MONITOR

Acorn Sprouts

Printers, joysticks and ROM cartridges can be plugged into the **Acorn Electron** via the PLUS-1 **expansion unit** now available from **Acorn**.

The PLUS-1 actually provides a Centronics-type printer interface, an analogue joystick port, and two slots for Acorn's ROM cartridge software.

Cartridge software has the advantage that there is no need for a cassette recorder, and no waiting period while the program loads. The cartridge slots will also be used for future hardware expansions, including an RS423 serial interface for serial printers, modems and possibly other micros.

The unit is a compact piece of matching hardware which plugs securely into the back of the Electron. It comes complete with a user guide which includes tips on how to write a program to use its facilities to the full.

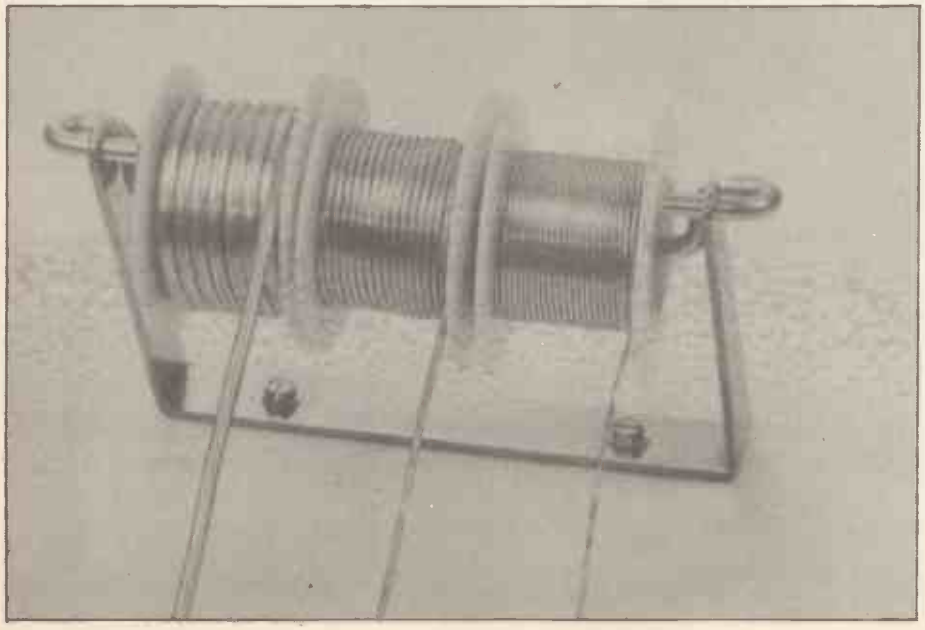
The PLUS-1 draws on the Electron's power supply. The centronics interface is a twenty-six way IDC connector, and the joystick port an 8-bit, four channel AD, both fully compatible with BBC BASIC. The Unit costs £59.90 (inc. VAT) from Acorn dealers and by mail order from **Vector Marketing, London Rd., Denington Estate, Wellingborough, Northants NN8 2RL.**

The first six ROM cartridges available are "Snapper", "Starship Command", "Hopper" and "Countdown To Doom", along with the educational "Tree Of Knowledge" and the artificial intelligence programming languages LISP. The cartridges are £14.95 (inc VAT) except for LISP which is £39.95, including a user guide and demo tape.

Another new on from **Acorn** is a **viewdata interface** to link the BBC Micro to Prestel and electronic mail services.

The adapter connects the micro directly to the telephone network, turning it into a two-way computer terminal. The system can then dial up an access remote computers, including the Prestel and Telecom Gold services. This gives access to Prestel services such as teleshopping, Micronet 800 and Viewfax, giving the computer more of the facilities of a business computer. Telephone numbers stored by the computer can be used, which, along with the autodial facility, makes access to frequently-used numbers more efficient. The adaptor contains software to download telesoftware from the Micronet 800 database. It operates under full computer control, and can be programmed to automatically access and capture data from an information service without a signal from the keyboard.

The Prestel Adaptor comes in a matching style to the BBC Micro, and plugs into the RS423 port and to the Type 600 BT telephone socket (which are much better than the old kind, so if you haven't got them yet, get some fitted). The unit operates in dual duplex mode, baud rate 1200 (receive) and 75 (transmit), and conforms to the CCITT V23 specification. The price is £113.85 (inc. VAT) and comes complete with a viewdata telecomms ROM (which plugs into one of the BBC's sideways ROM sockets) and user guide. The Prestel Adaptor is *only* available mail order, from **Vector**, address above.

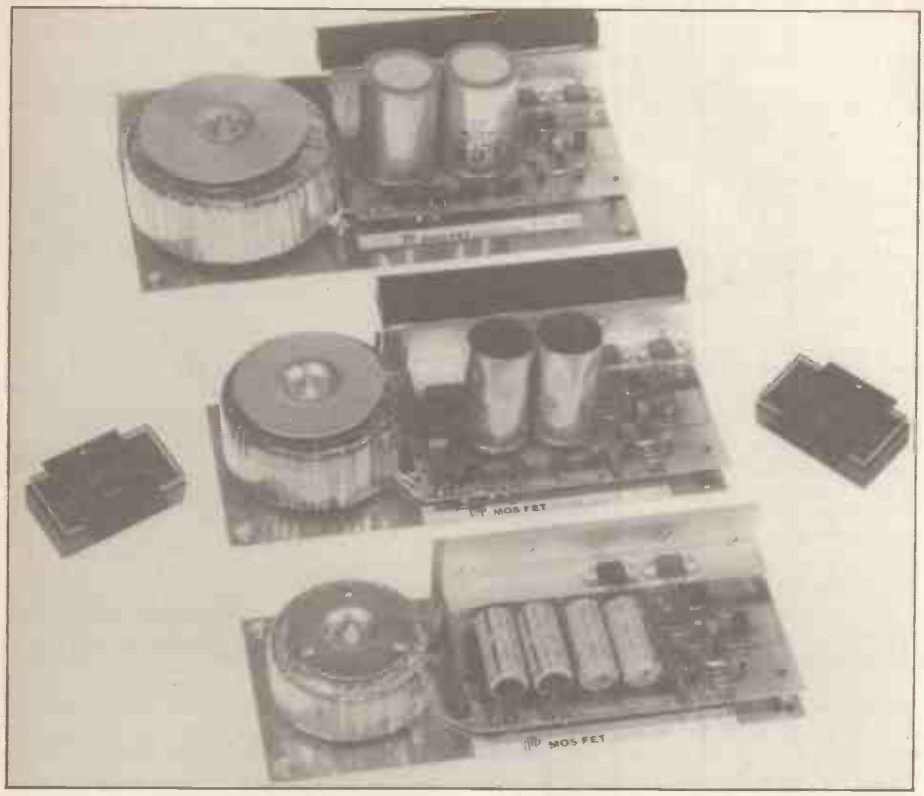


A Quick Plug

A useful device, which will be familiar to some of Hobby's readers, but probably not familiar enough to others,is now being stocked by **OK Industries.** This is the "Quicktest" plugless lead **connector**. The insulated lid is raised to expose three insulated connectors. Stripped wire ends can be inserted to the appropriate live, neutral and earth connections, and are only connected up to the power supply when the lid is closed again. A neon lights up when the power is connected. The unit can be used as a trailing connector, or mounted on a bench or wall.

Another useful tool for a large workshop or laboratory is a solder **spool holder**. The SH-1 spool holder takes spools up to 7in in diameter and 4½in wide, and can be mounted on or under a workbench as a handy dispenser. Come to think of it, it looks as if it would make a perfectly good bogroll holder, as well. All those still using old bits of twisted co-ax for both functions, please take note.

Further information from **OK Industries UK Ltd., Dutton Lane, Eastleigh, Hants SO5 4AA. Tel: (0703) 601944**



Walsall College Of Technology, St. Paul's St., Walsall WS1 1XN (Tel: Aldridge 52706) tell us that they are running a "course of instruction appropriate to the City and Guilds Examination No. 765", or as the rest of us know it, the RAE (Radio Amateurs Examination) for about twenty four weeks at a cost of about £22. Enrolment is on September 4th, 6th and 10th. More details from the college.

Paddington College, 25 Paddington Green, London W2 1NB (Tel: 01 402 6221) is also running an RAE course. Paddington College has an active club station (G4UWU) operated by tutors and past students, and are offering an extended course with the use of their Electrical Engineering Department facilities.

Paddington want attendance twice a week during term time between the end of September and the exam in May. This means slightly higher course fees (with discounts for some categories of student), but claim a 90% pass rate over the last few years.

Considering how many amateurs pass their RAE and go on the air, only to find that they don't know enough about radio to extend the scope of their activities into the interesting areas offered by amateur radio, we think it is well worth paying a bit more and putting in more work in a good college department to get the best out of your hobby.

Enrolment is on the 10th, 11th and 12th September between 1-4pm and 6-8pm or, they say, just turn up on the night. If you are keen we recommend that you enrol sooner rather than later, as courses do sometimes fill up.

For Further information, contact **David Peace G4KKM** on **01 402 6221 Ex. 54**.

Those of you in other parts of the country who want to locate your nearest RAE course should contact the largest local authority library you can get you hands on, and ask their enquiries section. If they don't know, ask to be referred to a library which does. Usually, there will be no problem.

All-Round Amps

B K Electronics have launched their new high specification "Mos-Fet" **amplifier module** under the brand name of OMP. The amplifiers, aimed at hobbyists, and professional amplification manufacturers alike, are rated at 100, 200 and 300W RMS.

The amplifiers are constructed with glass fibre PCBs, aluminium chassis/heat sinks, and power supplies including rectification, smoothing capacitors and torodial mains transformers. On-board drive circuits are provided to power an eleven-segment LED Vu meter as an optional extra.

The specification includes sensitivity for a maximum output of 500mV, bandwidth 1Hz-100kHz, slew rate 45V/us, S/N ratio 125dB, harmonic distortion 0.002% at full power (typical 0.001%), and power output as stated above into 4 ohms.

The boards very in size from 300x123x60mm for the 100W, 300x150x100mm for the 200W to 330x147x102mm for the 300W. Prices are £34.79 plus VAT and £2.50 p&p, £54.80 plus VAT and £3.50 p&p and £69.59 plus VAT and £4.50 p&p respectively, and £7.39 plus VAT and 50p p&p for the Vu meter. Amps with 0.77mV input sensitivities are available as well as models with reduced upper frequency bandwidths.

Enquiries and orders to **B K Electronics, Unit 5, Comet Way, Southend-On-Sea, Essex SS2 6TR. Tel: (0702) 527572.** B K take Barclaycard and Access orders by phone.

Around The House

A tough, remotely controlled rotating **aerial mount** suitable for use with CB FM and TV aerials and security cameras is available from **Semiconductor Supplies Ltd.** The mount, known as the 200 XL, can carry equipment up to 45kg (100lb) in weight and can be rotated by mains power over 360 degrees at a speed of one revolution per 65 seconds (if they's got that five seconds faster it could have been one RPM, couldn't it?).

Movement is controlled by resetting the pointer on the control unit, which, say Semiconductor, is solidly built and, by implication, will not slide around the tabletop like a Trimphone when you try to operate it. A following arrow on the control box indicates the actual position of the mounting as it rotates.

The all-weather motor case is made from cast metal parts, and measures around 290x120x150mm. The clamps atop the rotator will take tubular aerials masts or spigot mountings for cameras etc. There are tube clamps below the rotator, as well, so that it can be mounted on top of another section of mast.

The complete unit costs £49.45 all inclusive by mail order from **Semiconductor Supplies International Ltd., Dawson House, 128/130 Carshalton Rd., Sutton, Surrey SM1 4RS. Tel: 01 643 1126.**

MONITOR

Zoom Control

Commotion are marketing an unusual peripheral at a reasonable price. The EV-1 electronic vision system ("otherwise known as 'Snap') is a small high-resolution electronic camera which connects to a computer. The camera has a resolution of 128 x 256, captures frames in 1/2øth second and plugs into a computer's user port. It uses a specially developed optic RAM chip and a Pentax 18mm f2.8 lens.

The EV-1 comes with a software package which covers imaging, outlining, vectorising, area and perimeter calculation, and object recognition. The manual covers present and future applications of the vision system, including robotics, data capture, security, and entertainment! It contains listings for the software, and details of its operation.

The system was originally designed for the BBC Model B micro, and Commotion advise that they should be contacted regarding use with other computers. The camera can be operated with Commotion's Beasty (no relation) robot arm system by using a simple signal splitter cable.

The EV-1 is designed and manufactured by the Cambridge firm Micro-Robotics. Zoom and Close Up lenses are also available. The system costs £129 (inc. VAT). Enquiries to **Commotion, 241 Green St., Enfield, Middx. Tel: 01 804 1378.**

Get A Load of Lead

Technical artists, people designing electronic circuits, and persons (like students) who hate having to stop and sharpen their pencils tend to appreciate **clicker-style pencils** — the ones where the end clicks in like a biro and ejects an extra millimetre or so of lead from the other end (or several inches of lead, if you hold it the wrong way.) .

Berol, makers of educational art materials and more recently purveyors of good quality British-made writing and drawing equipment to the public, have produced their own click action pencil, and at the very reasonable price of 99p.

The Techwriter's main claim to fame is that it has a built-in shock absorber which helps eliminate lead snapping by allowing the lead to retreat back into the pencil if the writer presses too hard at a normal writing angle (actually it works perfectly well at any angle) until the pressure is off, when it re-emerges. Don't you wish you were that fortunate?

The pencil has a rubber under the push-button, a cleaning wire in case the barrel gets clogged, and two spare leads stored in the barrel. Berol say that the pencil will take any 0.5mm lead whether graphite, filmograph or polymer. The pencils come in four colours, which, as our technical department pointed out, is very useful if you wish to use a range of coloured leads for technical drawing, etc.

User reports vary more in their attitude than their opinion of the pencils. A certain author says that his colleague who snaps 0.9mm leads with regularity is usually thwarted by his Techwriter, while our technical department managed to snap his lead several times, we haven't yet managed to find out how, but he normally uses treetrunk-sized HBs with blunt leads; your editor curled his lip and carried out some tests in which he was pleasantly surprised — the lead can be fully retracted by holding in the push-button and pushing the lead back in if you accidentally over-extrude it; it reacts and re-emerges when necessary; the lead doesn't shoot across the room no matter how hard you shake the pencil; it's a comfortable shape and size to work with. He graciously accepted a sample. Your news editor feels that she can work with nothing except a hand-sharpened Chinese softwood pencil, but is happy to fall back on a Techwriter if the Chinese are low on stocks.

Techwriter costs 99p and comes from **Berol Ltd., Oldmedow Rd., King's Lynn, Norfolk PE30 4JR. Tel: (0553) 61221.** Berol products are stocked in most major stationers.

BBC Drive Interface

General Northern Microcomputers (Gnomic) have produced a **disc drive interface** for the **BBC Micro**, both filling a market gap and extending their present disc drive interfaces for other micros.

The drive is Acorn compatible, allowing up to 256 files and 800K of storage on a single disc. It comes complete with QFS, a disc filing system written by Gnomic's software specialists, which supports single or double density with automatic density recognition, and forty or eighty tracks.

The package costs £95 (ex. VAT) and is a available now from **General Northern Microcomputers Ltd., 2 Whitworth Rd., South West Industrial Estate, Peterlee, Co. Durham SR8 2JJ. Tel: (0783) 860314.**

Comment

A colleague called in last week and, after the course of business, made a mournful aside that her disc drives had suddenly ceased functioning for no apparent reason. Your editor remarked idly, mind elsewhere (you can't service disc drives by telephone) that there was probably a cat hair in them somewhere.

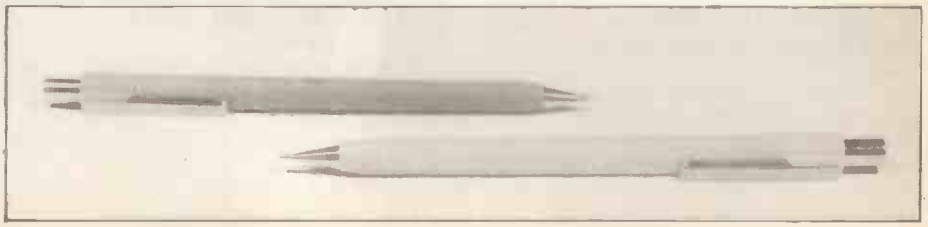
Be that as it may, this remark was followed by a long silence. The awaited rebuke did not materialise, however. Instead, the silence was followed by a squawk, which was followed by the information that a friend had been in the for the weekend, accompanied by two cats. Which means that, of a certainty, the disc drives have cat hairs in them.

A little research in the office revealed that a) the warmer a disc drive becomes, the more desirable it is as a cat couch and b) if the cat wants to sit on the drives it will, even if the doors are kept shut.

If disc drives are to become part of our computer household heritage, which we are assured they are, very shortly, then never mind bringing the prices down, never mind the robust construction, never mind compact size. The first company to make a cat-proof disc drive is going to corner the market.

Delicate Aerial . . .

Mitsubishi recently finished assembling a huge, 64-meter-diameter antenna for observation of Halley's Comet. When completed in late October it will be Japan's largest, and one of the world's largest, deep space probing antennas.



Mitsubishi Electric is building the antenna for the Japanese Education Ministry's Institute of Space and Astronautical Science, which is in charge of the PLANET-A Project to observe Halley's Comet approaching the sun in 1986. It will be installed in Usuda Town for communications with the PLANET-A, a Halley's Comet probe. The comet comes close to the sun every seventy-six years.

The 70-metre-high antenna, weighing approximately 1,900 tons, can rotate horizontally, carried by six platform cars on rails, and can change its vertical angle to be trained in any direction.

To track the deep space probe 180 million km away, receive its very weak, 5W radio waves and telemetric data, and give instuctions to the probe, Mitsubishi introduced various new technologies, including homology designing to hold the parabola's shear, resulting from its huge weight, down to 1.5 millimeters (or less) from an ideal parabola; the world's first beam transmission system that reduces noise and enables the use of various frequencies; a master collimator which ensures directional accuracy of 0.003 degree, and special shapes for the main and auxiliary reflectors for a high gain and improved wide directional characteristics.

The antenna will also be used for probing the moon and planets, and astronomical experiment programs in cooperation with overseas deep space probe stations in the future.

Soldering Station

Tele-Production Tools have brought in a **soldering station** consisting of a temperature contolled pencil soldering iron, and a 240/24V power supply.

The soldering iron is controlled by zero voltage switching and is fully adjustable between 200 and 400°C. It is rated at 50W and conforms to CEE 11 and BS 3456 safety standards. A range of long-life tips are available.

The power supply includes a double-insulated Class II 240/24V, 50VA transformer. The unit includes iron holder, sponge and an illuminated rocker switch. The system is earthed from tip to mains cord, and costs around £35 (ex. VAT).

Enquiries to **Tele-Products** x

Enquiries to **Tele-Production Tools Ltd., Stiron House, Electric Avenue, Westcliffe-On-Sea, Essex SS0 9NW. Tel: (0702) 352719.**

Superer Cat

The second issue of the **Supercat Electronics Catalogue** is now available. This Summer issue contains test and measuring instruments, kits, connectors, leads and accessories and is still free to all applicants within the British Isles.

To obtain your free copy, if you are not already on the mailing list, write to **Supercat Electronics Ltd., PO Box 201, St. Albans AL1 4EN,** giving your full name and address plus postcode, or telephone **(0727) 62171.**

New entries in the Summer issue include Thandar with a full range of instruments and accessories,

Supercat offers a range of test and measuring instruments, and gives a choice of price, specification and ergonomics for all applications. For the first time, a special offer is included that will be expanded for the Xmas issue, due out in November.

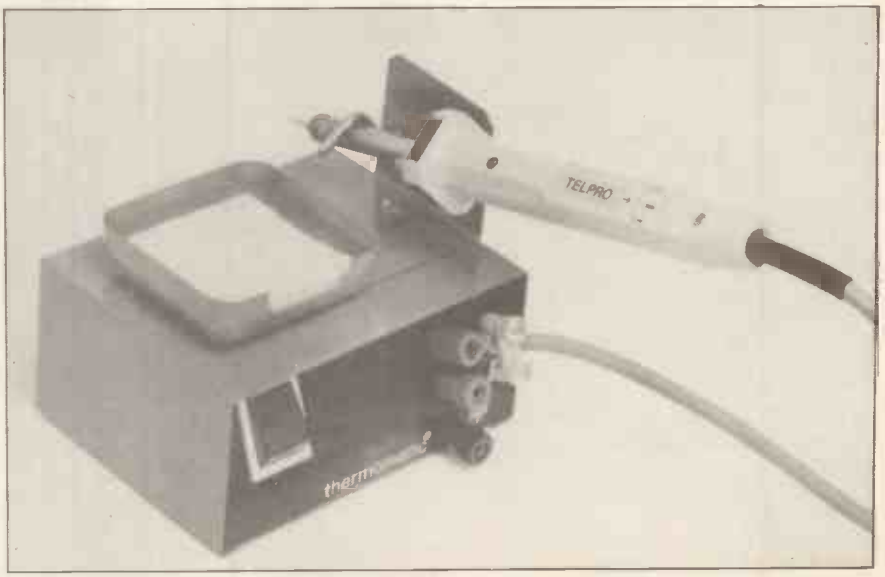
Night Light

CRS International Business Development Service tell us that they have an **automatic photosensitive light switch socket,** which can be fitted in a matter of minutes to bring house lights on as the daylight goes.

The socket fits into the existing light socket, and the bulb then plugs into a bulb fitting on the attachment. The unit is weatherproofed (indeed, it would possibly be more useful as an outdoor light than for indoor, for various reasons) and is fitted with a Cd-S Photocell. CSR recommend that only bulbs up to 60W are used, presumably because the bulb's own illumination will interfere with the photocell if the light is too strong.

CSR also recommend the fitting for use when the house is unoccupied to deter break-ins. Whether the sight of a single, or even several light bulbs on all night long several days in a row would be sufficient to deter a burglar is doubtful — a timing device to switch the light off again at a reasonable hour of the night would probably be more effective, and no more expensive.

However, CSR say that they will give a full money-back guarantee to anyone who is not completely delighted. So if a shiny night is your delight the **TSAS Automatic Switch Bulb** unit costs £15 inclusive from **CSR (Dept. MO) Suite 26, 4th Floor, Morley House, 320 Regent St., London W1. Tel: 01 636 8444.**



MONITOR

Handy Tandy

Tandy have produced a new, comprehensive colour catalogue of Tandy computers and add-ons. The catalogue is free, and is available from Tandy stores and dealers.

The forty-seven page catalogue includes concise information on Tandy's desk top business micros, portable and transportable micros, and micros designed for home and for educational use. It also features printers, accessories, educational systems and a variety of computer centre training sessions. Each section defines the user area, specifications, price and a summary of the special points.

Most of the equipment can normally be seen in any of Tandy's own high street shops, and a limited range in other outlets. Copies of the catalogue can be had from the **Tandy Corporation, Marketing Dept., Tameway Tower, Bridge St., Walsall, W. Midlands WS1 1LA. Tel: (0922) 64181.**

Registration with British Telecom's electronic mail service, Telecom Gold, is available at a special price to individual customers who buy computer equipment from Tandy. As well as the usual Telecom Gold services, this will enable Tandy users to communicate directly with Tandy computer centres and the Tandy central customer service group.

Registration will cost £19.95, and if wished half days training sessions are available from Tandy at their computer centres to help customers make the most of the service.

Amp Chip

The SSM 2015 is a monolithic ultra low noise audio preamplifier IC particularly to microphone preamplification. Gains from ten to over two thousand can be selected with wide bandwidth and low distortion over the full gain range. A very low voltage noise performance is enhanced by a programmable input stage which allows overall noise to be optimised for source impedance up to 4KR.

The circuit has a bandwidth of 700KHz at a gain of one hundred with symmetric slew rate of 6V/uS and distortion of 0.007%. True differential outputs and a high common mode rejection of 100dB provide easy interfacing to flotation transducers such as balanced microphone outputs, tape heads and single ended devices.

The SSM 2015 operates as a true differential amplifier with feedback returned directly to the emitters of the input stage transistors through a resistance. This system produces both optimum noise and common mode rejection while retaining a very high input impedance.

An internal feedback loop maintains the input stage current at a value controlled by an external bias resistor. This provides a programmability function which allows noise to be optimised for a wide range of source impedances up to 4KR and is within 1dB of the theoretical minimum value between 500R and 2K5. The chip is specified within commercial temperature ranges, and costs £9.48 one-off.

Enquiries to **CMS (Distribution) Ltd., 26 Pamber Heath Rd., Pamber Heath, Basingstoke, Hants RG26 6TG. Tel: (0734) 700453.**

New Catalogue

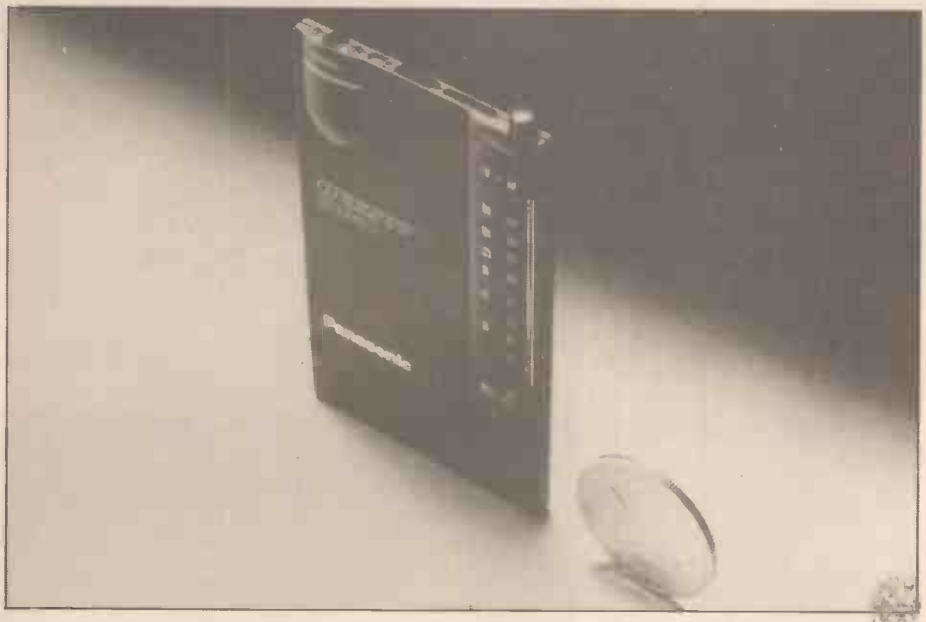
The new 160-page **Toolmail** catalogue contains over 3,500 items illustrated in colour with technical details, prices and application information.

Included in the catalogue is a large range of products for electrical and electronic work together with the biggest range, we are told, of hand and power tools contained in any mail order tool catalogue.

Each catalogue costs £1.50 including postage, but includes £5 worth of discount vouchers which can be used with purchases in excess of £20. Toolmail's policy is to sell top quality tools, and most items in the catalogue come from established British and European manufacturers.

Toolmail hold most lines in stock and can usually despatch orders within forty-eight hours of receipt. There is no charge for postage and packing on orders over £30. Toolmail offer a no-quibble guarantee on all items.

Orders to **Toolmail, 7 London Rd., Sevenoaks, Kent TN13 1AH. Tel: (0732) 455252.**



Give Us A Wave

Thander Electronics have introduced a family of three new full-featured **function generators** which will satisfy the majority of function/sweep/pulse requirements to 5MHz. All three models in the TG500 family offer sine, square, triangle, ramp, pulse and haverwave from 50R variable 20V output.

In addition, the TG502 Function/Sweep Generator has an internal 1000:1 lin or 10,000:1 log sweep generator with marker, and the TG503 Function/Pulse Generator has a variable width and delay pulse section capable of 10MHz in double-pulse mode.

The TG501 Function Generator has free-run, triggered or gated modes, variable start/stop phase and a 19:1 symmetry range enabling ramp, pulse and haverwave waveforms to be produced in addition to the usual sine, square and triangle outputs.

Overall frequency range is .005Hz to 5MHz with a 1000:1 sweep within each range on the dial or via the external sweep input. The main 50R output is capable of 20V peak-to-peak and has a variable DC offset; a TTL output is also provided.

The same main generator features are also offered on both the TG502 and TG503. In addition, the TG502 Sweep/Function Generator has an internal sweep section of 1000:1 linear or 10,000:1 log sweeps.

Sweep limits are set by the main dial and stored digitally to eliminate drift. Both sweep rate and marker duration are variable and there is a single sweep mode, sweep reset and hold, and sweep and pen-lift outputs.

The TC503 Function/Pulse generator additionally offers normal, double or delayed pulse modes with a 10MHz capability in double-pulse mode. Pulse width is variable from 50ns to 50ms and delay from 100ns to 50ms.

The main output can be normal or complement and can be symmetrical, positive-going or negative-going with respect to a constant baseline adjustable by the DC offset control.

Further information from **Thander Electronics Ltd., London Rd., St. Ives, Huntingdon, Cambs PE17 4HJ. Tel: (0480) 64646.**

My Radio Just Fell Between Your Floorboards

Matsushita Electronics — known to us in the UK as **Panasonic** — have developed the world's thinnest stereo radio.

The RF-07 is — as you can see from the photograph — only 3.5mm deep, 92mm high and 55mm wide, around the size of a credit card. Can this be the advent of the Musical Wallet? It receives FM and AM, will play for five hours on its internal, rechargeable NiCad battery (which must then be recharged for another five hours), and weighs only 38g, including battery.

Many new components, and "RHD" (Radio High Density) circuits have been developed for this radio, to a thickness of less than 2.8mm. The FM front end (VHF HF amp, local oscillation and frequency mixer circuits), FM/AM/IF amp, AM AGC circuits and the stereo low frequency amplifier circuits all use the RHD design. The board — a PWB (print wired board) has been built as part of the rear panel of the set, and the slightly raised patches of the case contain the FM/AM band selector, FM mode, power switch and volume control.

Accessories include a battery recharger, stereo headphones and a carrying case, and the whole thing will be launched later this year.

How long before the first one gets wedged inside an automatic cash dispenser, we wonder?

Transformers Must Be Kept On The Lead

Clairtronic have introduced a new economy range of low voltage **isolating transformers** with wound-in flying leads. The cable connections provide extra safety by eliminating mains voltage terminals on the transformer and ensure that international safety standards for creepage and clearance distances are easily maintained.

The integral cables also make the transformer cheaper and easier to connect up.

The transformers come in four sizes of 2, 4, 10 and 18VA each with a choice of four centre-tapped voltage outputs: 6-0-6, 9-0-9, 12-0-12 and 15-0-15V.

Primary voltages are 220V and 240V. All transformers are constructed on double sc section bobbins to provide 4kV of insulation between the primary and the secondary windings.

Prices are from £1.38 to £2.98 inc. p&p. Further information from **Clairtronic Ltd., Churchfield Rd., Chalfont St. Peter, Bucks SL9 9EP. Tel: (0753) 887227.**

Posting Pack

Specialist **mailing packs** for floppy discs are now available in micro disc (3in) size. The 'FloppiPak' protects the disc with foil-laminated card and bubble pack cushioning, and is available in the microdisc, 5¼ and 8in sizes from **Costerwise Ltd., 16 Rabbit Row, London W8. Tel: 01 221 0666.**

Oxfam Want Software

Oxfam are an organisation famous for their small shops selling second hand ball gowns, freshly laundered shirts and used paperbacks. One item which has not yet figured large in their repertoire is software. They are now jumping smartly into the 1980s by launching a drive, centred in London, to get more software into their shops.

They are particularly keen to receive games software, and would like manufacturers' remainders and discarded review copies, unsold overstocks etc, in fact anything which can be spared.

else saleable) can be taken in to any of the organisation's shops countrywide. However, the focus for software is on London shops, or contact the London office at **Oxfam, 172 Archway Rd., London N6 5BB. Tel: 01 348 4255.**

HE

Dual PSU

A versatile bench power supply, fully regulated, limited and metered, and able to provide from zero to 25 volts.

J. E. Aman

HOBBY ELECTRONICS heralds the experimenter's answer to the continued buying of batteries. We needed a dual power supply for testing op-amps etc, and one which could be varied from 0V to say 25V and would supply enough current to suit even the most complex circuits.

To make it truly versatile each supply should be fully regulated and have current limiting and metering for both voltage and current. The resulting circuit is both simple and very reliable, and has proved itself time and again since it was first constructed.

Circuit Description

The diagram of **Figure 1** shows the circuit of the power supply and includes both positive and negative supplies.

For the following description we shall refer to one supply only. The second supply is identical in description but of course has opposite polarity and the currents flow in the opposite direction.

The 20V secondary of the transformer is rectified by the bridge rectifier BR1 and smoothed by the large capacitor C1. The unregulated 28V or so is used to drive the remainder of the circuitry. A highly stable reference voltage is produced by Q1 and associated components.

Constant Current

Together with R1, ZD3 and R3, Q1 produces a constant current which flows through R1. By the action of the transistor, this constant current also flows through ZD1.

This type of circuit allows very little variation in voltage as the Zener has the asset of a virtually zero temperature coefficient. This simply means that the voltage remains constant over a very wide range of temperatures.

The 5V6 reference voltage produced is applied via RV1 to the non-inverting input of IC1. The op-amp has a gain of

Parts List

RESISTORS
All ¼W 5% carbon except where stated.
R1, 2 ..... 1k
R3, 4 ..... 4k7
R5, 6 ..... 2k2
R7, 8, 9, 11 ..... 470R
R10, 12 ..... OR47 2W wirewound
R13, 16 ..... 8k2
R14, 15 ..... 1k8
R17, 18 ..... 25k 2% metal oxide
R19, 21 ..... 1R 2W wirewound
R20, 22 ..... OR1 2W wirewound

POTENTIOMETERS
RV1, 2 ..... 10k linear potentiometer

CAPACITORS
C1, 2 ..... 4700u 50V tag ended electro
C3-6 ..... 10u 25V axial electro
C7, 8 ..... 470u 40V axial electro

SEMICONDUCTORS
BR1, 2 ..... SO4 2A 400V bridge rectifier
Q1, 8 ..... ZTX500 PNP silicon
Q2, 5 ..... ZTX300 NPN silicon
Q3 ..... TTP31A NPN silicon
Q4 ..... TIP3055 NPN silicon
Q6 ..... TIP32A PNP silicon
Q7 ..... TIP2955 PNP silicon
IC1 ..... CA3140 op-amp
IC2 ..... LF351 op-amp
D1-4 ..... 1N4002 silicon rectifier
ZD1-4 ..... BZY88C5V6 5V6 400mW Zener diode

MISCELLANEOUS
M1, 2 ..... 1mA panel meter
SW1 ..... DPDT standard toggle
SW2 ..... 4 pole 3 way rotary switch
NE1 ..... mains panel neon 240V red
T1 ..... 0-20, 0-20 1A chassis mounting transformer
SK1-5 ..... 4mm terminals two red, two black, one green
FS1 ..... 1A fuse with panel mounting holder
Veroboard; three control knobs; metal case 280 x 195 x 90mm; mains cable, BA hardware; mica insulating kits for transistors; connecting wire, solder etc.

BUYLINES ..... **page 26**

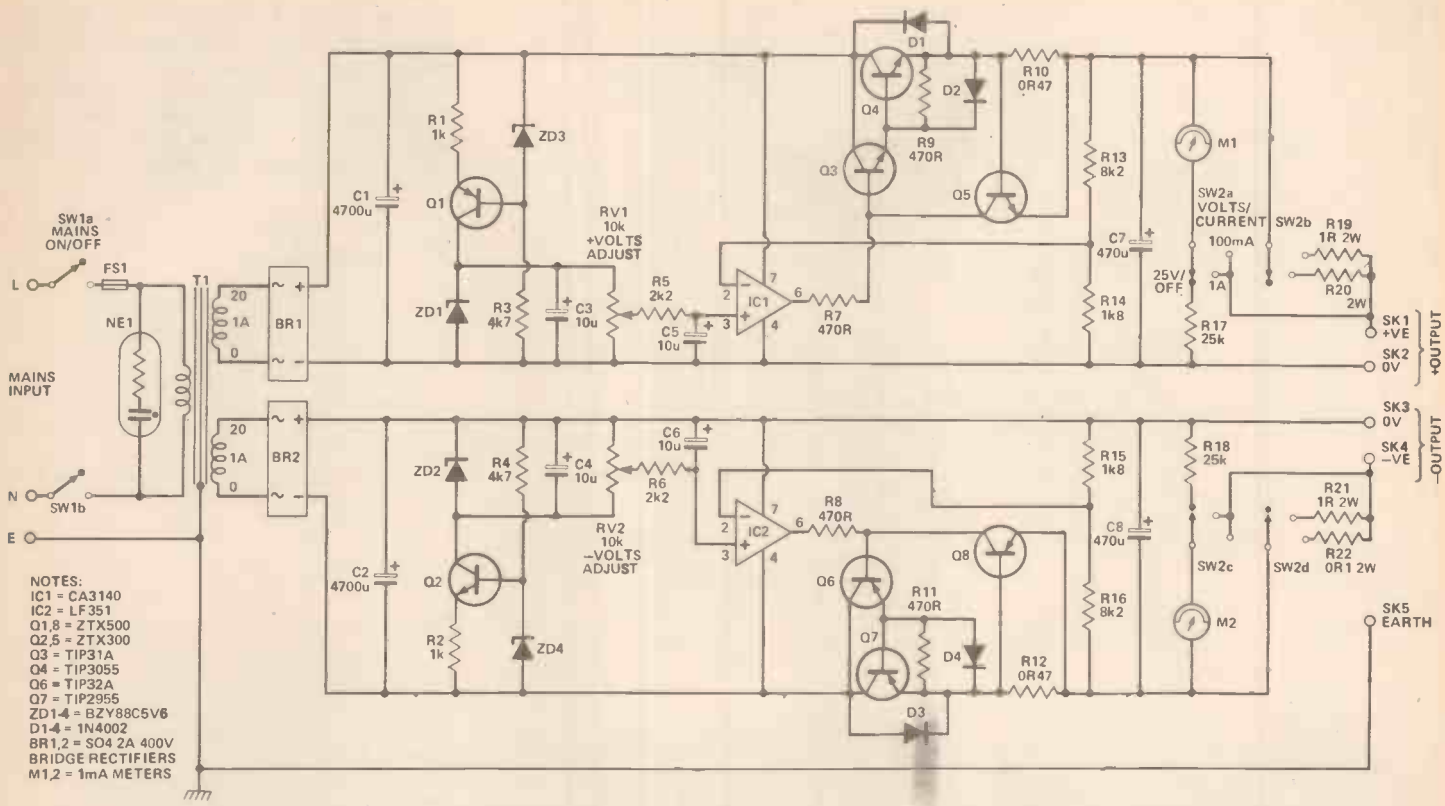


Figure 1. The Circuit, showing both positive and negative supplies.

about five which is necessary to give the 28V or so required by the circuit.

Regulation

The regulating action operates as follows.

Assume for the moment that there is no load connected to the circuit. The variable resistor taps off a reference voltage of between zero and 5V6 and applies this to pin 3 of the IC. By means of the potential divider R13/14 a certain proportion of the output voltage is tapped off and applied to pin 2 of the IC.

Assuming that the voltage applied to pin 2 is lower than that on pin 3, the operation of the op-amp is to cause its output to increase thus driving the Darlington pair Q3/4 harder on. This causes the output voltage to rise and in consequence increases the voltage on pin 2.

This sequence continues until the voltages on both the input pins are equal. At this point the output stops increasing and assumes a steady state.

Connecting A Load

Now, any load connected to the circuit which increases the current drawn from the circuit also reduces the voltage. This reduces the voltage tapped off by the voltage divider and thus lowers the voltage on pin 2 of the IC.

The output of the IC thus begins to increase to compensate for the voltage drop until the voltages on both input pins are once more the same. Since we are holding one pin of the IC at a constant voltage, this means that the regulating action of the IC will always bring the output voltage back to the same level — a level set by the potentiometer times the voltage gain of the op-amp.

Assuming now that the load draws less current, this will cause a corresponding increase in voltage. Once again part of this output voltage is tapped off by the potential divider and applied to pin 2 of the IC. This time the voltage on this pin is greater than that on pin 3. To maintain the balance, the op-amp now reduces its output thus decreasing the drive to the transistors. These transistors turn off, reducing the output voltage. This action continues until balance at both pins of the op-amp is achieved once again.

All this increasing and decreasing happens so fast that to all intent and purposes the output remains stable.

Current Limit

If a short circuit happened across the supply lines of a simple un-protected supply the resulting large current will almost certainly destroy the output pass transistors and probably very much more besides! For this reason, a simple current limit circuit has been incorporated into the supply to offer a degree of protection.

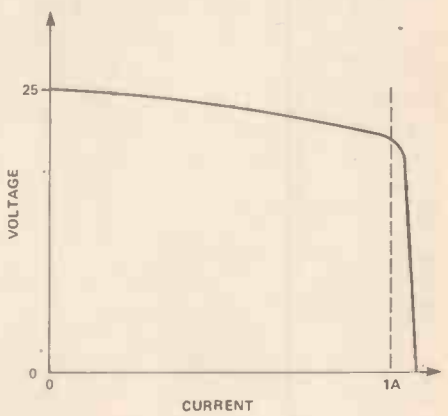


Figure 2. A graph showing the action of the current limiting circuit.

The protection offered by this circuit is not total and as such it should be remembered that if a short circuit did occur, it would be wise to remove it as soon as possible. The operation is as follows.

At fairly low currents, say 100mA the voltage drop across R10 is not sufficient to turn on Q5. The circuit thus plays no part in the normal action of the supply.

At currents near or greater than 1A, the voltage drop across R10 rises sufficiently to turn Q5 on. In doing so, Q5 diverts much of the drive current away from the Darlington pair via the load. This action turns off Q3/4 thus reducing the output voltage. Even with a complete short circuit across the supply lines, the output voltage will be reduced to zero, and the current to not much more than 1A.

A typical curve of this action is shown in **Figure 2**.

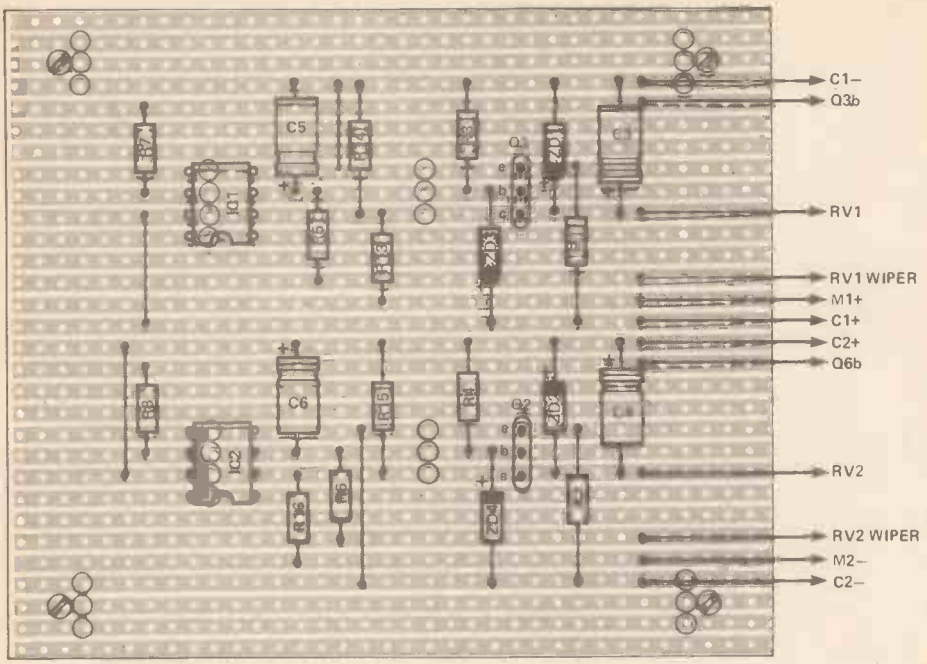


Figure 3. The Vero layout. As usual, pay attention to the orientation of capacitors, diodes etc. For convenience when mounting in the case, make the leads in different coloured wire. There is a fair bit of 'knitting' in connecting up all the leads!

Protection

Further simple protection to the output transistors is provided by resistors R9/11. These drain away any leakage current from Q3 and Q6 which would otherwise cause thermal runaway in transistors Q4 and Q7.

Diodes D1-4 further protect Q4/7 from high reverse voltages which may occur if a highly inductive circuit (lots of coils!) should be connected to the power supply.

Metering

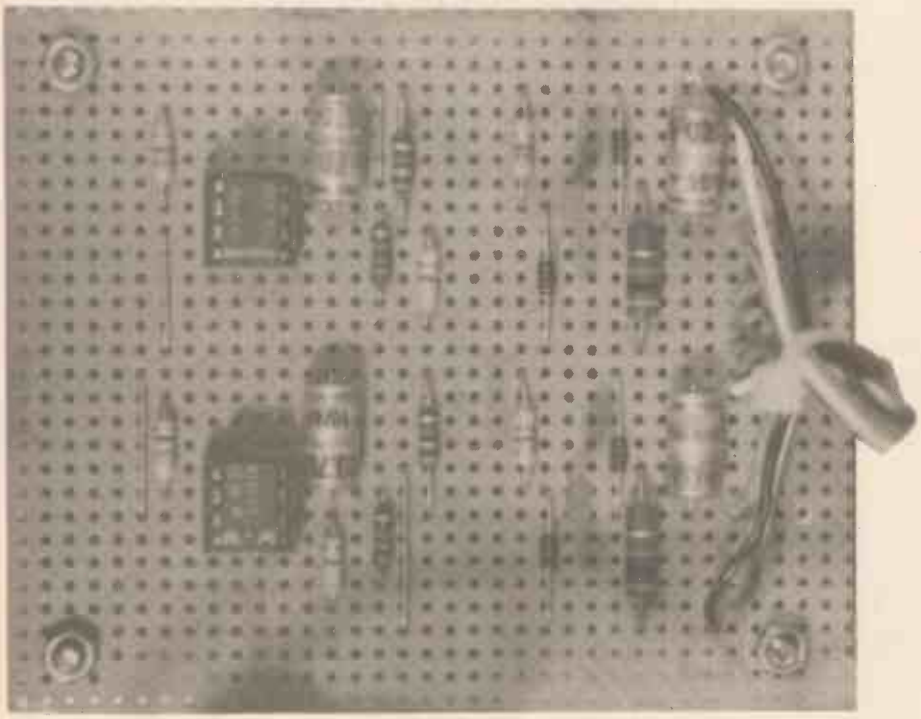
Simple output metering is done by M1 and SW2. The meter can be switched to read voltage or current drawn by the load. Two ranges are provided, either 100mA or 1A full scale deflection. SW2 also enables the two supplies to be turned off while at the same time measuring the output voltage.

Construction

Construction is not too difficult, but care is needed particularly when wiring up large numbers of interconnecting wires.

The general layout of the components can be seen from the photographs, and apart from the positioning of the Veroboard and mains transformers this layout should be followed closely.

The case we used had dimensions 280 x 195 x 90mm, and this size proved to be more than adequate to take all the components comfortably.



Veroboard

Construction can conveniently begin with the Veroboard layout. This is shown in **Figure 3**. Follow the layout carefully, remember to fit the wire links and observe the correct polarity of the capacitors, diodes etc.

Connect the flying leads at this point in time and make them about 8in long. Use different coloured wires if at all possible as this will make it easier to identify one later. Put the board to one side while working on the case.

The details (left) show the connection of various components to SW2 (far left) and Q3/4/6/7 (near left) as shown also in Figures 4 and 5.

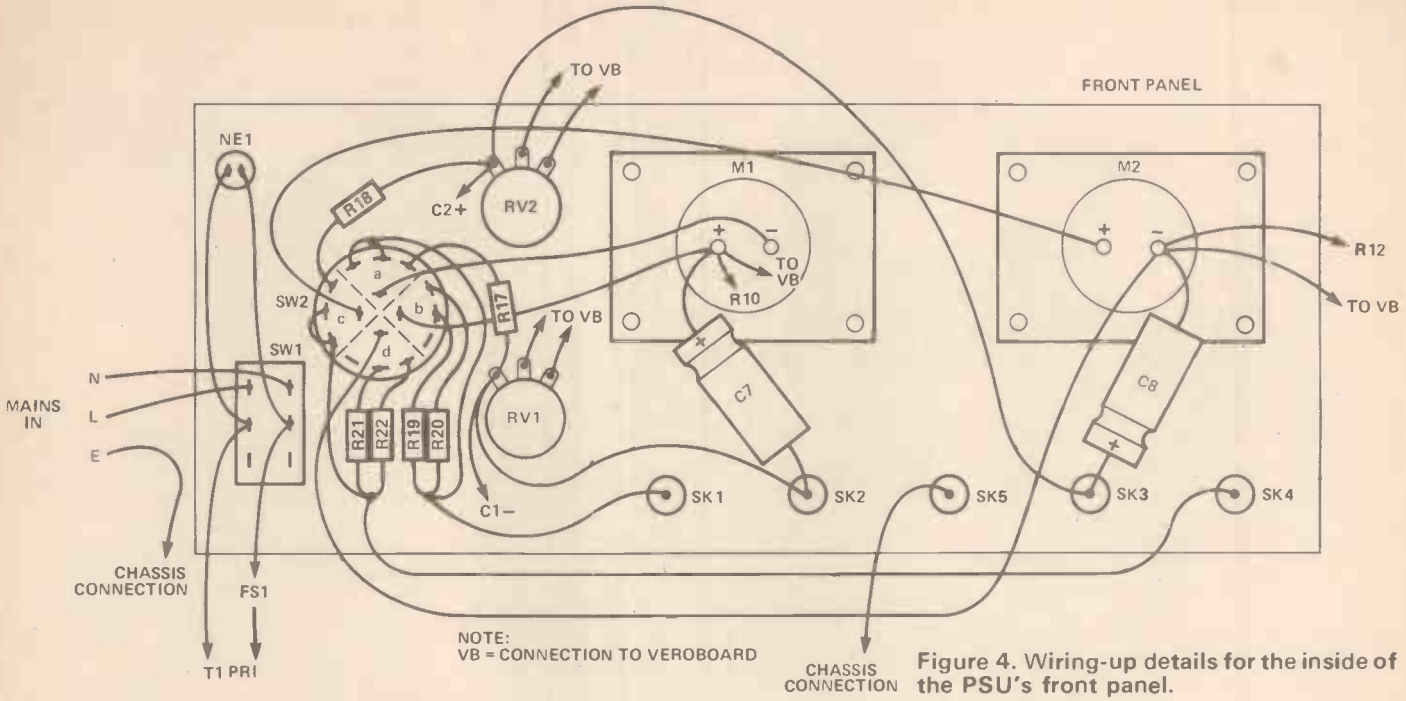


Figure 4. Wiring-up details for the inside of the PSU's front panel.

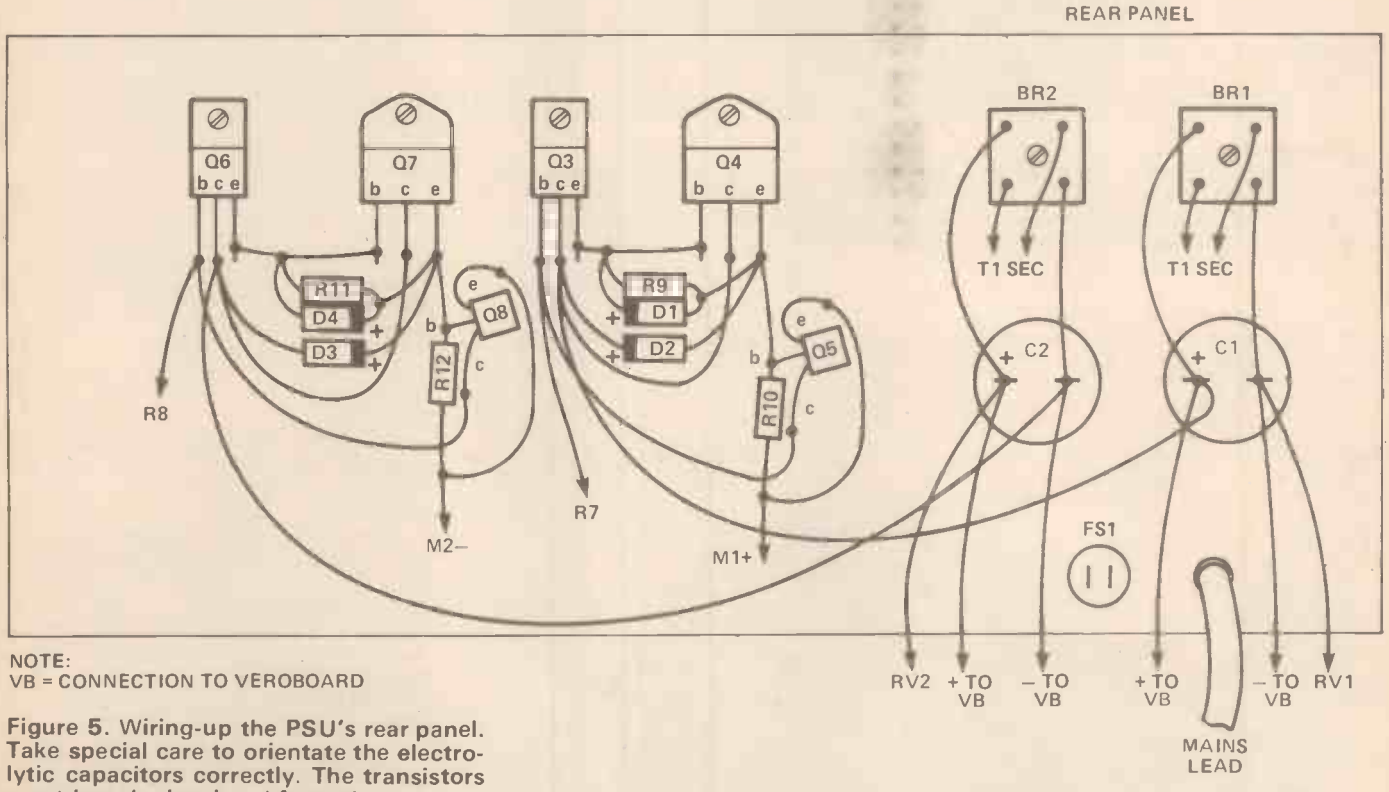


Figure 5. Wiring-up the PSU's rear panel. Take special care to orientate the electrolytic capacitors correctly. The transistors must here be insulated from the case.

Case

No drilling dimensions for the case have been given as these will depend on the size of the components used. The general layout of the components can be seen from the photographs, and **Figure 4** and **5** provide a little more detail.

Before mounting the front panel components it is better to letter the front panel as seen in the photographs. A finishing touch would be to relabel the meter scales to read 0—25 volts.

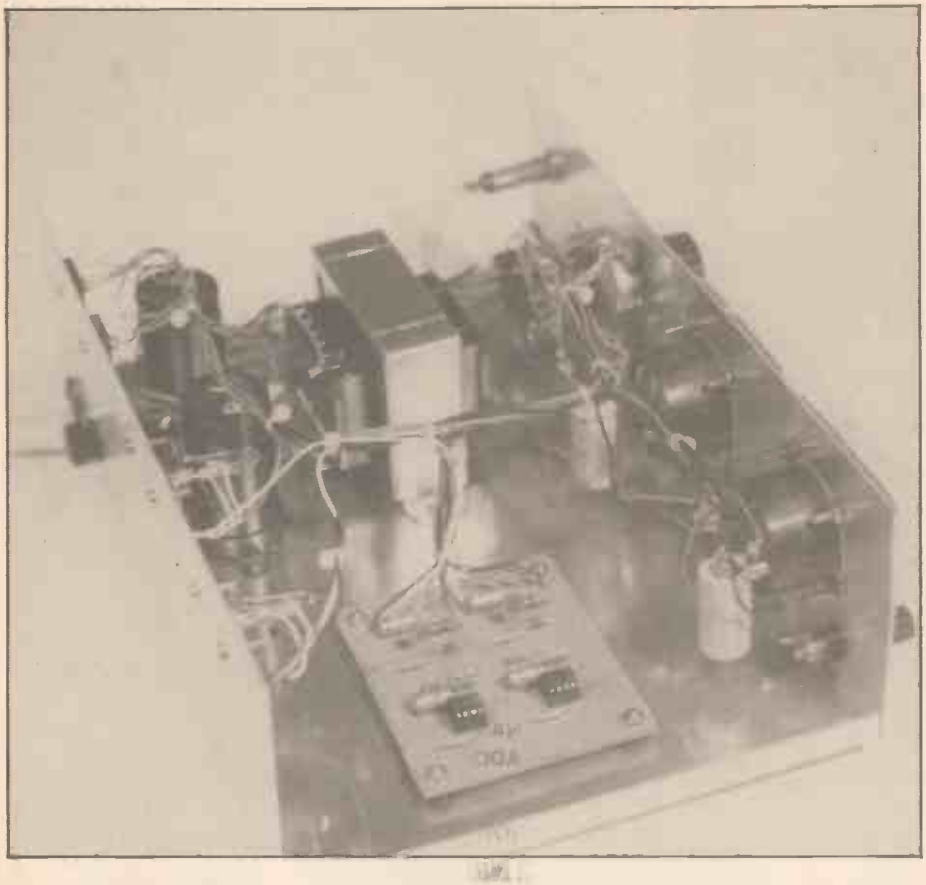
When mounting the transistors on the rear panel be sure to use mica washers and insulating bushes, and check afterwards that there is no short circuit between the metal tabs of the transistors and the case. A smear of heatsink compound on both sides of the mica washer will provide good thermal conduction between transistors and case.

When mounting the two bridge rectifiers do not overtighten the screws as there is a possibility that the moulding may break.

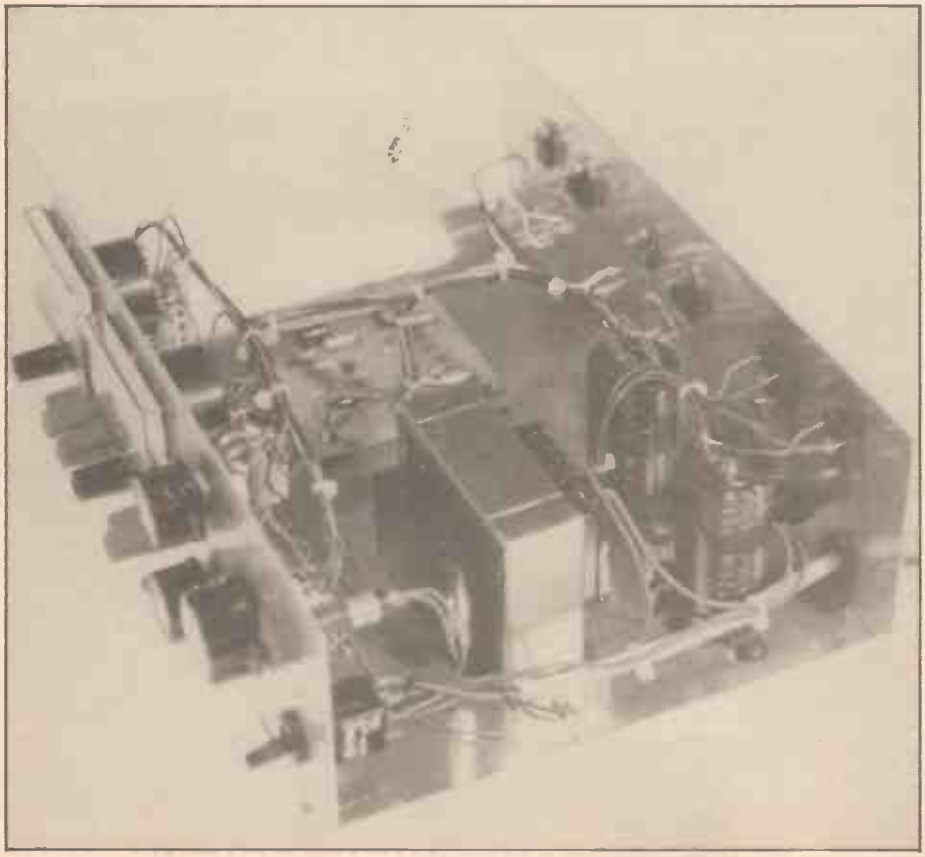
Interwiring

Take the Veroboard and mains transformer and mark and drill the positions of the holes in a suitable position on the bottom of the case. Mount the Veroboard but not the transformer at this stage.

Continue by wiring the output transistors as shown in **Figure 4**. Take care not here not to allow the leads of the transistors to touch the rear panel.



Our arrangements include the Dual PSU – two 'live' views. Because of the large number of small components and trailing wires, it's important to pay a lot of attention to insulating components where necessary (as described in the text) and clipping up the wires neatly to avoid a rat's nest.



Front Panel

Refering now to **Figure 5** the front panel components to be wired up. Do not connect the flying leads, as these are the leads which come from the rear panel, and also the Veroboard.

Finally, connect the flying leads from the rear panel components to the front panel components and from the Veroboard to front and rear.

The mains transformer can now be bolted into position and wired up according to **Figures 4** and **5**.

Testing

Before applying any mains power to the power supply, check all wiring thoroughly and in particular recheck that none of the transistors are short circuited to the rear panel.

If all seems well, set SW2 to OFF and switch on the mains supply. Allow two or three minutes to pass while checking that no component gets warm (or even hot!), and slowly rotate RV1. A reading of some sort should appear on the corresponding meter. Connect a voltmeter on its 25V range and check that both meters read the same voltage.

If the power supply meter does not show the full 25V output, switch off quickly as there is sure to be a fault. Rectify the fault before continuing. If all is well, the other supply can be checked in a similar manner.

It may be found that the supply does not give exactly 25V, but may be a couple of volts lower. This will be due to component tolerances and can be corrected by lowering the values of R14 and/or R16.

In Use

The operation of the power supply is quite straightforward and really needs no explanation, however there are a few points to note.

Firstly, the power supply output transistors do run warm. This is more noticeable when using the supply at low output voltages when the transistors have a large voltage drop across them and consequently have to dissipate a fair amount of heat. This should not cause concern, as the transistors are operating well within their maximum ratings.

Secondly, in the event of a complete short circuit across the supply, although there will be no voltage output, a substantial current will flow in the circuit. For this reason when a short does occur it should be removed quickly to prevent long term damage to the supply.

Finally, to connect the two supplies in series or for use as a ± supply, simply connect the 0V terminals together. The supply can then be used as a 50V 1A supply by connecting the load across the negative and positive terminals, or as a ± supply by connecting the 0V to terminals to the ground point in the circuit under test.

HE

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 .....

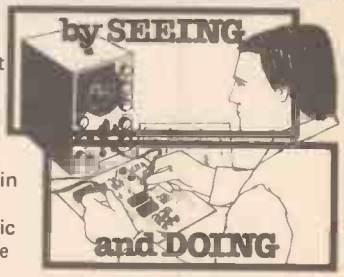
ADDRESS .....

.....

..... HE

MASTER ELECTRONICS NOW!

The PRACTICAL way!



You will do the following:

- Build a modern oscilloscope
- Recognise and handle current electronic components
- Read, draw and understand circuit diagrams
- Carry out 40 experiments on basic electronic circuits used in modern equipment
- Build and use digital electronic circuits and current solid state 'chips'
- Learn how to test and service every type of electronic device used in industry and commerce today. Servicing of Radio, T.V., Hi-Fi and microprocessor/computer equipment.

New Job? New Career? New Hobby? Get into Electronics Now!

FREE! COLOUR BROCHURE

Please send your brochure without any obligation to

NAME .....

ADDRESS .....

.....

HE/8/822 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
- ☐ LOGIC COURSE
- ☐ OTHER SUBJECTS

Please mention HE when replying to advertisers

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 HC-6010 & HC-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: 200μA to 10A
- ★ AC Voltage: 200mV to 750V
- ★ DC Voltage: 200mV to 1000V
- ★ Resistance: 200Ω to 20MΩ
- ★ Input Impedance: 10MΩ
- ★ 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, Heron House, 109 Wembley Hill Road, Wembley, Middlesex HA9 8AG
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.

COMING SOON TO . . .

Hobby Electronics

CIRKIT PROJECTS

Three more complete projects, designed for Hobby Electronics by Cirkit.

Moisture Alarm

If your cat is not smart enough to come in out of the rain, perhaps this easily built gadget will help you keep it dry!

Three Note Doorbell

Ding Dong Dink go the chimes. As well as operating as a doorbell, this simple unit can be triggered to indicate any condition requiring an audio warning signal (for instance, the Moisture Alarm).

Audio Signal Tracer

A useful item for your workshop.

FEATURES

Telecine

If you've ever wondered how last year's feature film appeared on television (or on videocassette) last weekend, this special feature will reveal the secrets of film-to-video transfer.

All About Alarm Circuits

A survey of tricks and techniques for protecting your home and possessions from tea leafs and other undesirables.

SOFT OPTIONS

WOMEN IN COMPUTING — FACT OR FANTASY?

On the track of an endangered species, Soft Options takes account of women in computing. We talk to a systems analyst, an educational software designer, a member of ICL's software support team, and any number of others — all of whom have two things in common: they're good and they're female — and we canvass their views on the role and prospects for women in computing.

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

Hobby Electronics

for

Name . . . . . .

Address . . . . . .

. . . . . .

. . . . . .

Hobby Electronics

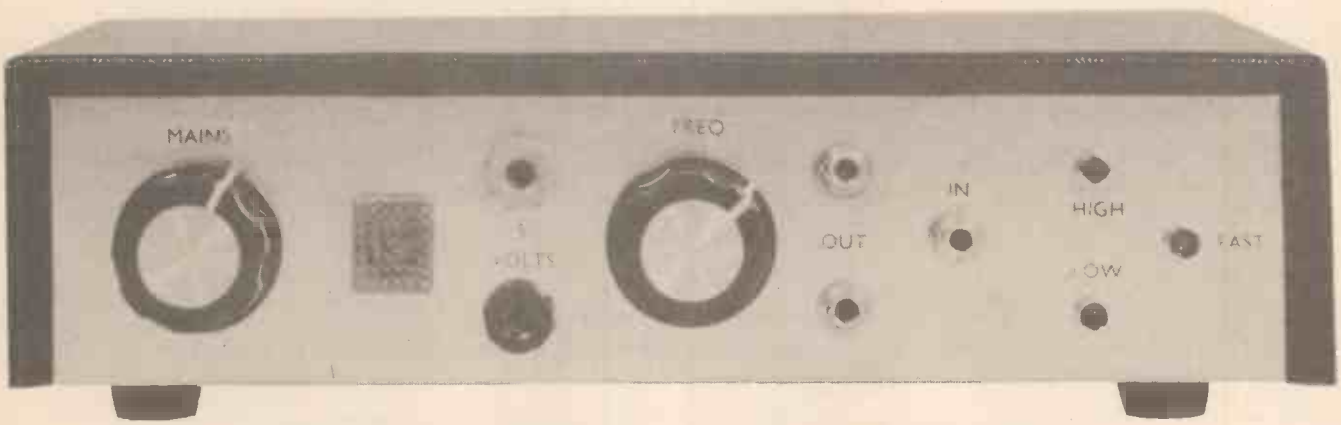
September issue on sale from 10th August.

Place your order now!

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

Digital Test Set

R. A. Penfold



For digital electronics, you need digital test equipment. Our digital test set will do most of the testing you need within one unit

EQUIPMENT for testing and debugging digital equipment can be extremely complex and expensive, but for most amateur electronics enthusiasts such things as multi-channel logic analysers and sophisticated pulse generators are not essential.

Most testing can be achieved with the aid of just two or three simple pieces of equipment, and this piece of test gear includes these basic circuits.

There are really three separate sections to the unit, as follows:

1 5V 500mA power supply supply
2 Pulser with six output frequencies
3 Logic level indicator

Power Supply

The power supply is the most straightforward, and is a simple five volt stabilised circuit which can give output currents of up to 500mA. milliamps.

Although at one time a current rating of about 2A was considered to be quite modest for a power supply of this type, these days there is widespread use of low power logic devices such as the 745LS** series and CMOS devices, and current consumptions are consequently appreciably lower for a given type of circuit.

A maximum output current of 500mA should therefore be adequate for normal requirements.

Pulser

The pulser has six switched output frequencies of approximately 10Hz, 100Hz, 1kHz, 100KHz, and 1Mz. There are antiphase outputs at standard 74LS TTL levels, and the unit can therefore be used to provide a two phase clock signal where necessary.

The main use of a pulser is to provide a slow clock signal for the equipment under test so that the operation of the circuit can be examined more easily, and any malfunction will, hopefully, be more obvious.

Of course, slowness is relative, and in electrical terms it could mean using a clock frequency of a few kilohertz rather than a few hertz, but the wide frequency range should cover most eventualities. If required, the ouput frequencies can easily be altered to suit your particular requirements.

Logic Checker

The logic state checker provides indication of three states: high, low, and pulsing. The main use for a device of this type is checking for the presence or absence of pulses.

For example, if an interface device in a computer add-on is not functioning properly, the first check would be to determine whether or not it is receiving chip enable pulses from the address decoder at the appropriate times.

The logic state checker could be used to monitor the chip select input of the interface device while the computer is used to read from or write to the periphal circuit. If present, the chip select pulse is likely to be very short at typically only about one microsecond, but the tester includes a "pulse stretcher" that gives an output of around a tenth of a second.

The "stretched" output pulse is used to drive an LED indicator, and it provides a clearly visible flash of light if an input pulse is detected.

Block Diagram

Figure 1, shows the block diagram for the unit, and as already explained, the circuit consists of three largely independent sections.

Logic Tester

The logic tester uses two inverters connected in series, with each one driving an LED indicator. Therefore, only one of the outputs can be high at any one time, and depending on whether the input is taken low or high, one or other of the LEDs will be switched on to indicate the input stage present.

The second inverter drives the monostable multivibrator which provides the pulse "stretching" and drives the third LED. The monostable is triggered by positive input transitions incidentally.

Pulser

The pulser uses an inverter in a simple CR oscillator circuit, and six switched capacitors provide the unit with the six output frequencies. The output of the oscillator is fed to an inverter/buffer stage, and then to a second inverter which provides an anti-phase output.

In other words, when output 1 is high, output 2 is low, and vice versa.

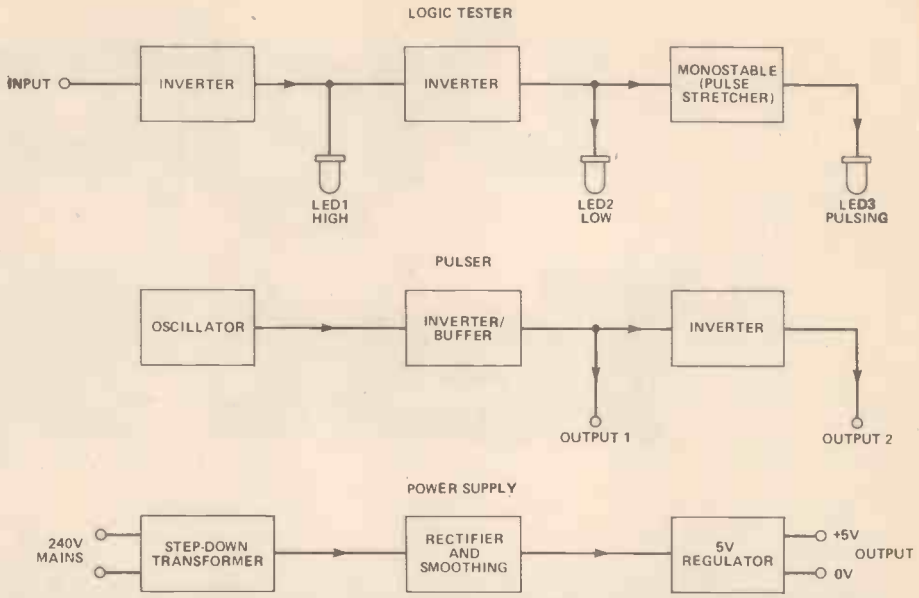


Figure 1. A block diagram of the three sections contained in the Test Set.

Power Supply

A conventional power supply circuit is used, with a mains transformer providing a voltage step-down and giving isolation from the mains supply.

A fullwave rectifier and smoothing circuit is used to give a smoothed DC supply which is then led to a 5V regulator circuit.

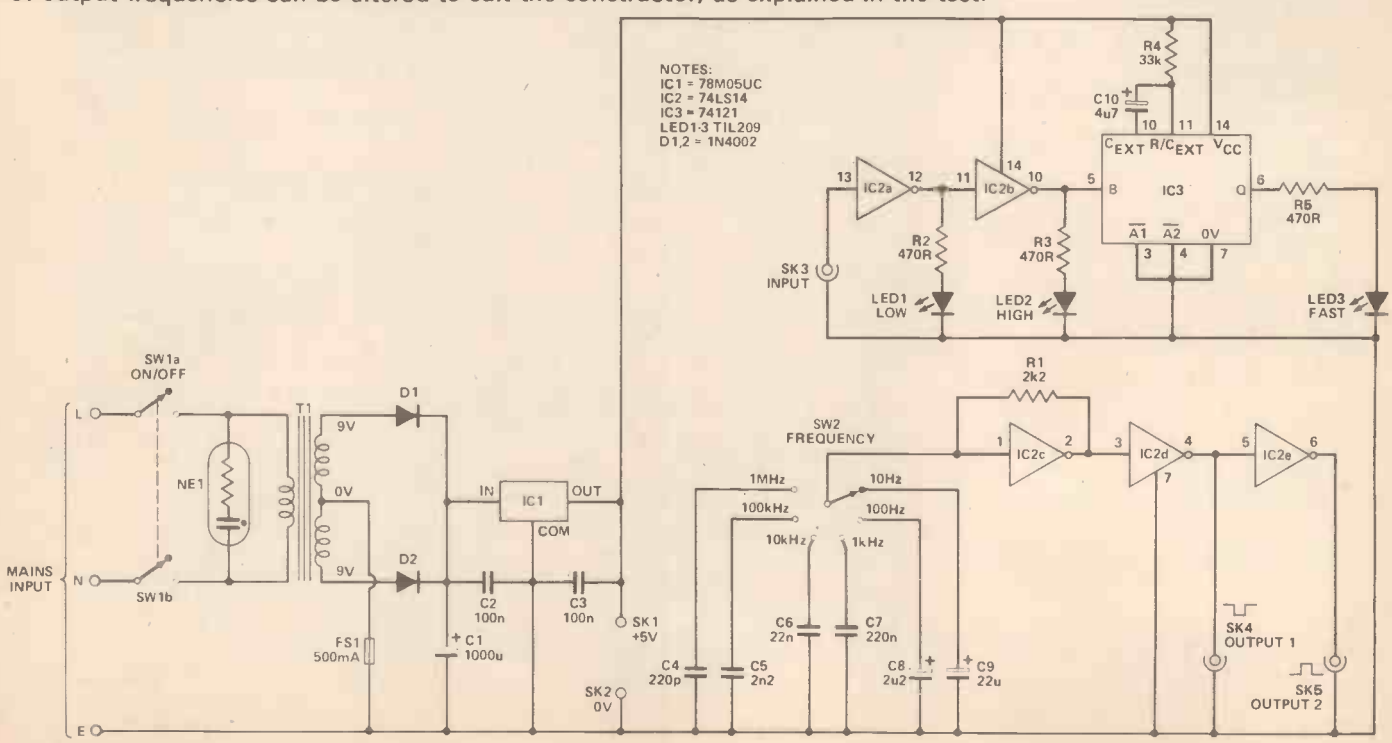
The Circuit In Detail

The full circuit diagram of the unit appears in Figure 2.

Starting with the power supply section this time, T1 is the step-down transformer and D1 plus D2 provides fullwave (push-pull) rectification, with C1 as the smoothing capacitor, regulation being provided by monolithic voltage regulator IC1. This gives an extremely well smoothed and regulated output which is considerably more than adequate in both respects for use with digital circuits.

The IC includes output current limiting which prevents any of the components in the circuit from being damaged if a short circuit or other overload on the output occurs.

Figure 2. The Circuit, again showing the three sections clearly. C4 to C9 gives the six output frequencies available. The range of output frequencies can be altered to suit the constructor, as explained in the test.



The capacitor then starts to charge again, and the circuit oscillates continuously in this fashion.

Antiphase Outputs

This gives a roughly squarewave output from IC2c, although the output does not have a precise one to one mark-space ratio due to a lack of symmetry in output of IC2c stage. However, the output waveform does have very short rise and fall times, and is suitable for most logic testing purposes.

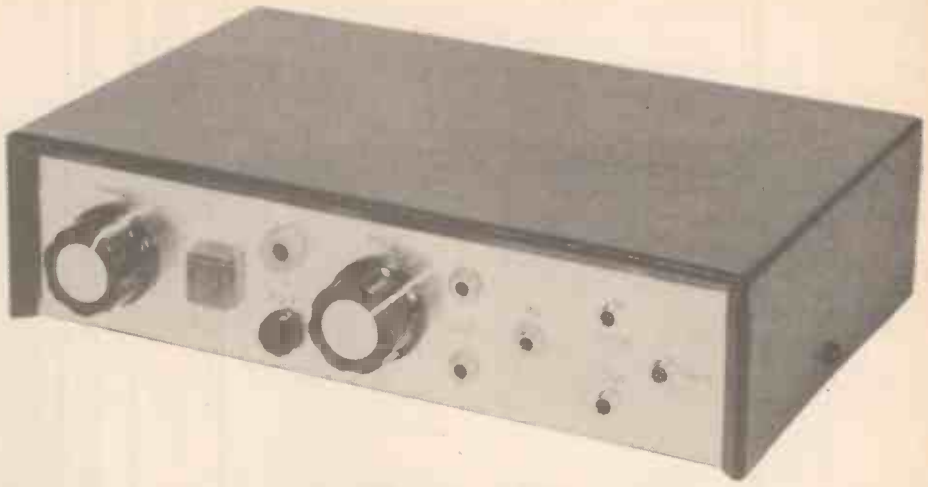
The six switched capacitors give the unit its six switched output frequencies, with C4 giving the highest frequency and C9 the lowest. The output frequencies can easily be altered if desired, and changes in capacitance give an inversely proportional change in frequency. For instance, changing C9 from 22u to 47u would reduce the lowest output frequency from about 10Hz to around 5Hz.

Inverters IC2d and IC2e are used to buffer and invert the output of IC2c to give antiphase outputs.

Construction

The prototype is housed in an inexpensive metal instrument case which has approximate outside dimensions of 203 x 127 x 51mm, but any similar case should be equally suitable. As this project is mains powered, for reasons of safety it is strongly recommended that the case should be of all metal construction and earthed to the mains earth lead. It must be a case where the lid or cover has screw fixing, and does not simply clip on and off so that there would be easy access to the dangerous mains wiring.

The general layout of the unit can be seen by refering to the photographs, and while it is not essential to follow this layout precisely, it is probably best not to use



Parts List

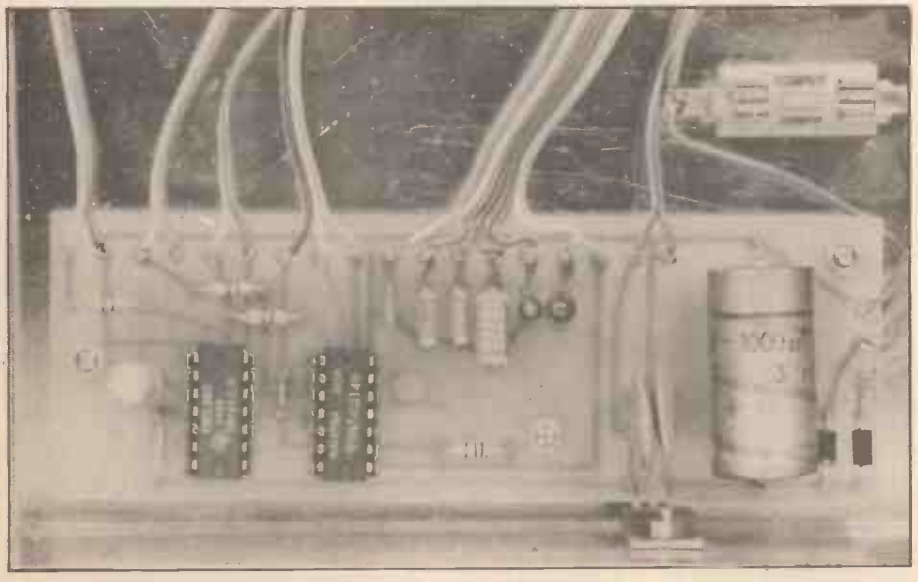
RESISTORS
(All ¼ watt 5% carbon)
R1 ..... 2k2
R2, 3, 5 ..... 470R
R4 ..... 33k

CAPACITORS
C1 ..... 1000u 16V axial electro
C2, 3 ..... 100n ceramic
C4 ..... 220p ceramic plate
C5 ..... 2n2 carbonate
C6 ..... 22n carbonate
C7 ..... 220n carbonate
C8 ..... 2u2 tantalum bead
C9 ..... 22u 16V tantalum bead
C10 ..... 4u7 63V radial electro

SEMICONDUCTORS
D1, 2 ..... 1N4002 1A rectifier
LED1-3 ..... TIL209 or similar
IC1 ..... 78M05UC 5V regulator
IC2 ..... 74LS14 hex inverter
IC3 ..... 74121 monostable

MISCELLANEOUS
SW1 ..... DPDT rotary mains switch
SW2 ..... 2 pole 6 way rotary switch
SK1, 2 ..... 4mm sockets one red one black
SK3, 4, 5 ..... 3.5mm jack sockets
T1 ..... 9-0-9V 500mA mains transformer
NE1 ..... mains panel neon
FS1 ..... 500mA antisurge fuse
Metal instrument case 203 x 127 x 51mm; printed circuit board; two control knobs; two 14 pin DIL IC sockets; panel holders for LED1-3; 20mm chasis mounting fuseholder; mains cable; test leads; wire; 6BA fixings; etc.

BUYLINES ..... page 26



a radically different arrangement. Fit a soldertag on one mounting bolt of T1 to provide a convenient chassis connection point for the mains earth lead.

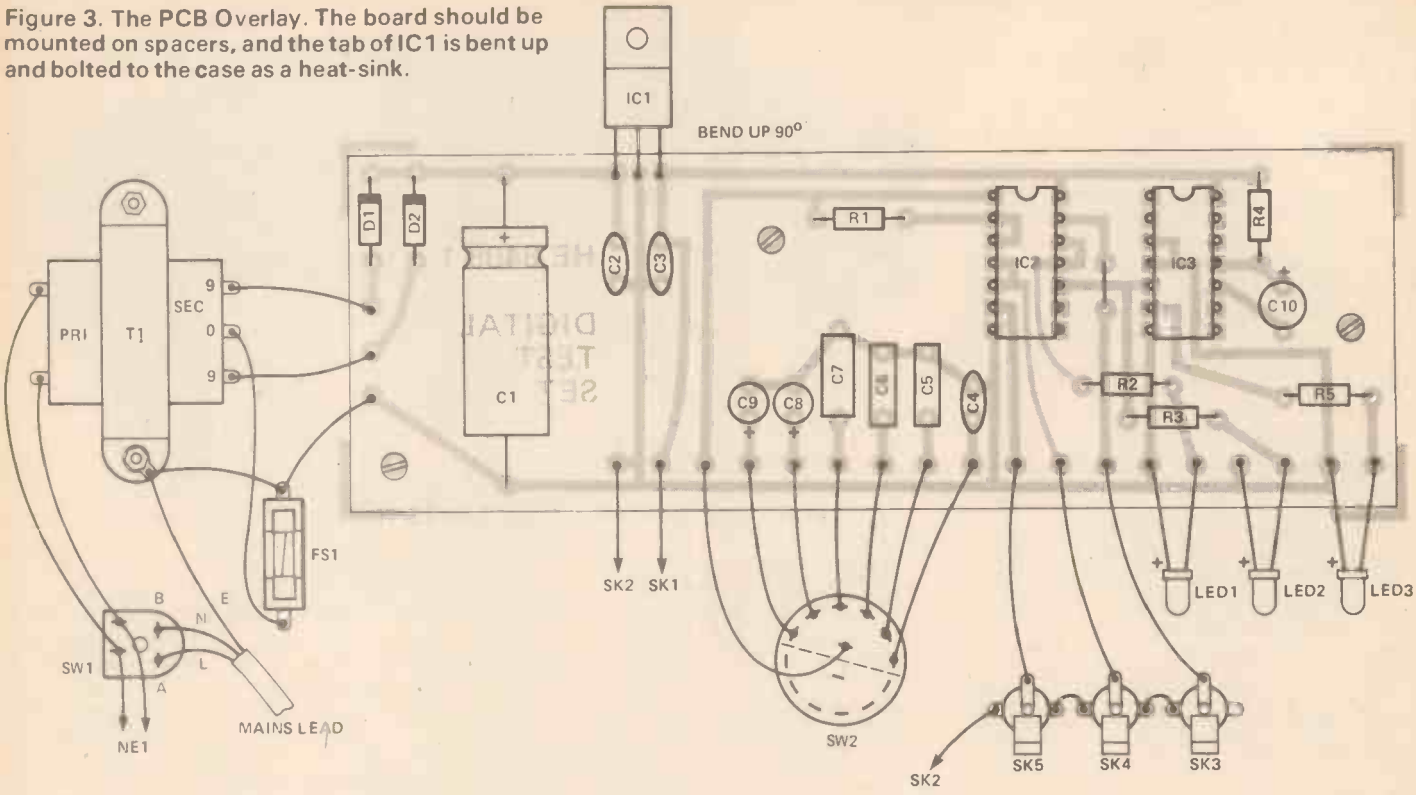
A hole for the mains lead is drilled in the rear panel of the case, and this should be fitted with a grommet for the protection of the cable. Note that NE1 must be a neon lamp that incorporates a series resistor for 240V mains use, and not a simple neon bulb.

FS1 should be an antisurge fuse, and not the more common quick-blow type, or the surge of current as C1 takes up its initial charge will probably "blow" a standard fuse.

On the prototype LED1-3 are types having a chrome bezel mounting and these give a very neat finish, but ordinary 3mm or 5mm diameter LEDs in plastic panel clips will suffice.

Construction of the printed circuit

Figure 3. The PCB Overlay. The board should be mounted on spacers, and the tab of IC1 is bent up and bolted to the case as a heat-sink.



board should not present any real difficulties provided the specified type of capacitor are used.

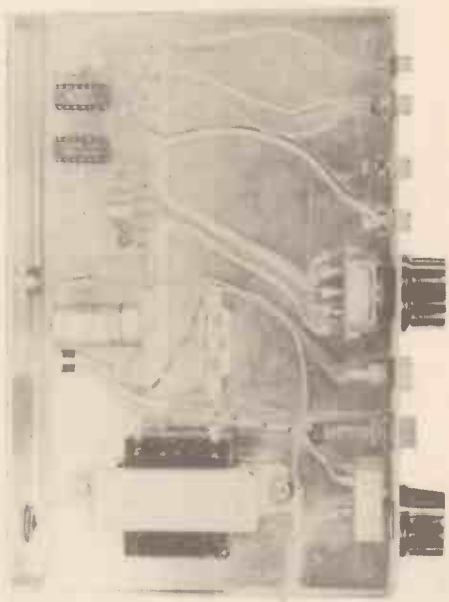
Details of the printed circuit board and wiring are shown in **Figure 3**. Veropins are fitted to the board at all points where off-board connectors will be made. Although IC1 is shown as being mounted horizontally in **Figure 3**, it is in fact only fitted this way initially. The leadout wires are bent at right angles such that IC1 is in a vertical position outside the perimeter of the board. This is done so that with the board mounted well towards the rear of the case, IC1 can be bolted to the rear panel of the case, which then acts as a heatsink.

This arrangement can be seen from the accompanying photographs. Of course, spacers must be used when mounting the board so that the connections on its underside are kept away from the metal case. It is probably best to mount the board first, then mark the positions of the mounting hole on the rear panel using IC1 itself as a sort of template, and the temporarily remove the board so that the mounting hole can be drilled. There is no need to insulate IC1 from the case as, like the case, its heat-tab is at earth potential.

Laidback Current

In fact IC1 has "foldback" current limiting, which means that a heavy overload on the output actually results in the output current being reduced, with a short circuit current of about 300mA rather than something over 500mA being produced.

This gives better protection to the power supply circuit itself, and also to any circuit which is powered from the unit.



The power supply section is used to supply power to the pulser and logic tester circuits so that there is no need to tap off power from any circuit under test. This does not significantly reduce the output current available for external circuits.

Schmitt Trigger

A 74LS14 hex inverting Schmitt trigger, IC2 is used as the basis of both the pulser and logic tester circuits, but only five gates of this device are utilized in this circuit. No connections are made to the unused gate of IC2.

Two inverters, IC2a and IC2b are used in the logic tester circuit, and the fact that IC2 is a Schmitt trigger rather than a straightforward inverter is not relevant in this case.

If the input is taken low, the output of IC2a goes high and LED1 is switched on, but the output of IC2b goes low and LED2 is not activated. If the input is taken high, the output of IC2a goes low while that of IC2b goes high, resulting in LED1 being switched off and LED2 being switched on. LED1 and LED2 thus indicate low and high states respectively. Incidentally, the input takes up a high state in the absence of an input signal.

Pulse Stretcher

A 74121 monostable, IC3 is driven from the output of IC2b, and IC3 is connected so that it is triggered by low to high input transmissions. Components, R4 and C10 are the timing network and these give an approximate output pulse duration of one tenth of a second, which is quite long enough to give a clearly visible flash from LED3.

Oscillator

The oscillator has IC2c operating in a simple relaxation oscillator circuit. The action of an inverting Schmitt trigger is to have the output trigger from high to low at some point if the input voltage is gradually increased from 0V to 1V. Taking the input voltage back the other way causes the output to trigger from low to high at a certain input voltage. However, this second

voltage is lower than the original (high to low trigger potential.

In this circuit the capacitor selected using SW2 is initially uncharged, and therefore takes the input of IC2c low, sending the output high. The capacitor therefore charges via R1 until the high to low threshold voltage is reached. With the output then triggered to the low state the capacitor discharges through R1 until the low to high trigger voltage is reached, whereupon the output goes to the high state.

Hardware, such as M3 or 6BA fixings are suitable for both IC1 and the printed circuit board.

To complete the unit the wiring is detailed as in **Figure 3**. The use of ribbon cable can help to keep this wiring neat and tidy, but ordinary multistrand connecting wire is perfectly adequate.

In Use

When the unit is switched on LED2 should light up but the other two should be switched off, apart perhaps, from a brief flash from LED3 as the unit is turned on.

A quick way of testing the unit is to set SW2 for the lowest output frequency, and then couple the output from SK4 or SK5 to SK3. LED1 and LED2 should then switch on and off fairly rapidly, but at a perceptible rate, with one LED switching on as the other switches off. LED3 should also flash on and off. If SW2 is set for a higher operating frequency both LED1 and LED2 will appear to be switched on simultaneously, but they are in fact just pulsing too fast for the human eye to properly preceive what is happening.

Probably LED3 will also seem to light continuously, and this is due to the monostable being retriggered almost immediately each time LED3 switches off, so that the off time is too short to be perceptible.

You will probably notice that LED1 and LED2 do not have equal brightness. This is because the mark-space ratio of the pulser's output is not precisely one to one. If LED1 is the brighter of the two LEDs the space (low time) is greater than the mark time, or vice versa if LED2 is the brighter. This feature can sometimes be useful when using the unit. For example, if a line should provide one microsecond positive pulses at a frequency of 10kHz, the line is low for the majority of the time. Therefore, LED1 should light brightly, LED2 should light dimly, possibly too dimly to be seen, and LED3 should light up to indicate that pulses are present. If LED3 lights up to indicate the presence of pulses, but LED2 lights up brightly, this would indicate a fault with the pulses either being too long or at too high a frequency.

The tester should work well with any circuit that uses TTL or TTL compatible devices, but remember that it loads the circuit under test by one LS TTL input.

The unit cannot be guaranteed to operate properly with CMOS circuits where the high/low logic voltage limits are slightly different.

Clocking A Pulse

When using a pulser to provide a clock frequency for a piece of equipment, remember that the output of the pulser cannot simply be connected to the output of the built-in clock circuit.

First some means of disabling the internal clock circuit must be found, and this might just entail unplugging an integrated circuit, but in some cases it could be necessary to cut a printed circuit track or something of this nature.

The pulser provides an output voltage of almost five volts peak to peak, and it should therefore operate well with most CMOS circuits as well as TTL types.

HE

If an advertisement is wrong we're here to put it right.

If you see an advertisement in the press, in print, on posters or in the cinema which you find unacceptable, write to us at the address below.

The Advertising Standards Authority.

ASA Ltd, Dept 3 Brook House, Torrington Place, London WC1E 7HN

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 INSTALL-ATIONS/CONTRACTING	☐
AUTO MECHANICS	☐	C & G BASIC MECHAN-ICAL ENGINEERING	☐

Name _____

Address _____

P.Code _____

ICS Division of National Education Corporation

Dept EAS84
ICS School of Electronics
160 Stewarts Road
London SW8 4UJ

01-622 9911 (all hours)

CACC

POINTS OF VIEW

Feel like sounding off?
Then write to the Editor stating your Point of View!

More Metal

Dear Editor,
I have pleasure in enclosing a letter and current literature for you to pass on to Mr. Richard Turner, the author of The Art And Science Of Metal Detection *article (HE May '84).*

One of our items contained in your listing is out of date: the CM6DB quoted was discontinued some time ago. The top-of-the-range model is currently the Coinmaster (CM) 6000 Series 3, which is for the hobby market. It is a TR system, and the sensor size is 20cm. It has a VDI (Visual Discrimination Indicator) meter and Nicad batteries are standard. There is no hipmount version available at the present time. The weight is 2kg, and the accessories include a headset, stand, cardboard presentation case, and a waterproof case cover.

I am enclosing a complete set of our current literature for your own perusal.
Yours faithfully,
G. A. McRae,
White's Electronics (UK) Ltd.,
Inverness.

Thanks to Mr. McRae for this advice and update. Looking at his price lists, I will add that the CM 6000i Series 3 costs £399.95 inc VAT, so it's for the serious investor! But there are many models on White's list which are far less costly.

We will of course forward the information, and any other enquiries, to Mr. Turner, who has unfortunately been in hospital lately, but we hope that he is out and about again now, and wonder if he found any further tales to tell about medical metal detectors while he was in there!

Happy Talk

Dear Mr. Keeley,
I am writing to express my delight and satisfaction at the standard and content of the magazine. As an educationalist, involved in Further Education, publications like yours are a very valuable educational resource.

Your recent series on basic knowledge about electronics was one of the best I have ever seen – lucid explanations accompanied by first rate graphics.

Many of the articles you produce, such as the robot conversion project, are valuable to educationalists and, I suspect, also to industrial trainers and retrainers.

Indeed you may well be interested in considering providing an off-prints service on selected project articles. This might appeal to many technical colleges, retraining facilities, etc.

Once again may I express warm support and praise for the very high standard achieved by your magazine. Keep up the good work.
Yours sincerely,
John Bonington,
Kirkalday,
Fife.

It looks as though one or two of our readers took to heart our comments about only ever hearing the nice bits when there was a nasty bit to report. Are we tempted to blush at this untrammelled praise? Like fun we are! We'll do what all modest persons do, and leave the blushes for the naughty bits!

Seriously however, we are particularly happy when someone in education (or who is being educated) writes to say that HE is helpful, because we see the assisting of people of any age who are learning about electronics, especially beginners, as our main aim. All credit to author Keith Brindley (himself an ex-HE man) and artist Jerry Fowler for the popular series *All About Electronics*, and we hope we will have another back-to-basics series lined up shortly.

In some respects, we do already provide an offprints service, both through the agency of our Backnumbers/Photocopies service (the master index for 1978 to 1983 is available in the March 1984 issue) and through the bimonthly magazine *Electronics Digest*, which prints selections mainly from *Electronics Today International*, but does from time to time reprint projects and articles from HE. This is available from most newagents who stock HE and ETI, and is useful for readers who are not regular subscribers to either magazine.

All Para And Qrrect

Dear Sir,
Could you please tell me if there were any errors in the constructional article Para-Q, The Professional Audio Processor, *as published in HE November '83, page 13?*
Thank you,
E. Reece,
Abbeywood,
London SE2.

We are happy to be able to report that the Para-Q lived up to its specification and that there are no known errors in the article, although we personally know of several built, tested and happily operating units. Proceed!

In Search Of A Detector

Dear Editor,
I have just come back from France with your paper in my luggage. I was very happy to discover for the first time an extended look at Metal Detection.

That is why I am writing to you. For me it is impossible to find the old HE speaking of the Metal Detector project which was mentioned in the article.

So I am wondering if it is possible for you to send me a copy of that article only? I am interested in the Diana Detector, especially the "coil", they are very difficult to build.

Also I read with a lot of interest the part of this article speaking about IB and TR techniques. Then if you have got more about this, I would like you to send me more about those. On reference about books about this, for instance.

In the hope of your answer I send you congratulations about this article which interested me a lot.
Stephane Dujardin,
Counbevoie,
France.

PS. Also can you tell me where to find your paper in Paris.

The "Diana" metal detector was published in the September '81 issue of Hobby. You can obtain a copy of the article by sending £1.50 (sterling) to use here at **No. 1 Golden Square, London W1R 3AB** and saying which article and which issue you need.

We don't have any further information about metal detection — the article was written by Mr. Richard Turner, and we haven't featured any material on metal detection for a long time, apart from the "Diana" project, that is. But I will pass your enquiry along to Mr. Turner, who may be able to tell you about boois, and possibly put you in touch with a metal detection club.

As for where you can get Hobby in Paris, we cannot name individual newsagents, but you should lok firstly for any shop dealing in electronic components, or a book shop dealing in books on electronics, or any

magazine, French or English, which writes about electronics or, specifically, metal detection. Are there any clubs for metal detectors in France? You may find a newsagent who carries English magazines in Paris, although I doubt there are many. If there is a directory of shops, or of clubs, in Paris, I suggest you start looking there.

Alternatively, write to our subscription department here and find out what a subscription would cost. We are very good (of course) but as I warned you, we rarely write about metal detection, so if this is your main interest, look for a specialist magazine, instead of a general one lke like HE.

Mystery Numbers

Dear Clever Dick,
I wonder if you could tell me an equivalent for a ZTX 300 and a ZTX 500. I have tried everywhere, but nobody here has them. And lastly, are the numbers CIL475, SG118, CIL462 and EC462 real numbers of real components?
Yours desperately,
Christopher Teh,
Selangor,
Malaysia.

The nearest equivalent to the ZTX 300 is BC338. This has similar parameters, but has a different package outline. The ZTX 500 is the complementary PNP type to the NPN ZTX 300, and so a BC328 would again be the suitable equivalent.

As for the others, we've never heard of them. Has old Dick been pulling your leg? Never accept component numbers from globetrotting geniuses — you don't know where he's been.

Fish Thermometer

Dear Sir,
As a longstanding reader of HE there is a project I would like to see. That is a Tropical Fish Aquarium Thermostat, with an adjustable range of, say, 70°F to 80°F, and with, if possible, a sensor that could be put into the aquarium water and the adjustment being outside the tank. An electronic thermostat like this has got to beat the normal out of date bi-metal strip type.

Looking forward to such a project in the future, keep up the good work.
Yours faithfully,
J. Murphy,
Mitcham,
Surrey.

A useful idea, and one which we will look into as time goes on. I especially like the novel idea about having the controls on the outside of the tank — but what happens if the fish want to adjust the temperature to suit themselves? How about dual controls? Actually, I need something similar myself to keep the home-brew warm.

A Small Cell

Dear Sirs,
I do not know whether this is within your sphere of services, but I am looking for a supplier of solar cells with small output to supply current to various projects. I am building, in the region of 3 to 5mA, either in units or capable of being built up to voltages of 3, 6 and 9.

The only ones I have across are from 50mA to 3A, whcih is well in excess of what I want, and much too dear to be built up to the voltages that I want.
Yours faithfully,
F. E. Griffen
Crank,
St. Helens,
Lancs.

We have checked our sources, which include **Tandy, RS** and **Maplin.** Maplin have a 3mA cell O/N BL23A (Solar Cell MS4A) for £2.95. Contact Maplin on (0702) 552911, for more information, or to order. These seem to be the only small ones available. Some years ago, a company called Rheinbergs Sciences Ltd. of Tonbridge Kent stocked a variety of small solar cells from an American source. Unfortunately, this concern has closed down and we do not know who, if anybody, has taken over their catalogue. We do know that our readers have had difficulty in the past in obtaining solar cells for various uses.

So, if anyone reading this has any further information about suppliers of solar cells, we would like to hear from them.

Out Of Print

Dear Sir,
I am writing to enquire if your "Hobbyprint" etch-resistant transfers are still avilable, and if so, how much are they?

The Hobbyprint sheet I am interested in is the sheet for December 1980, on which are the transfers for the HE Digital Speedo and Display, and the HE Power Meter.
Yours sincerely,
Colin Barnes,
Ainsdale,
Southport.

We don't produce Hobbyprints anymore. It was a good idea at the time — but our readers preferred either to opt for buying a ready-made-up PCB from the PCB Service, or else using their own tried-and-trusted method. So we had to give it up.

If you have a steady hand, one direct method of transferring a PCB mask to a board is to mark the pin-holes through the paper mask with a punch or compass-end, and then divide the master into, say, a 1cm grid with fine pencil lines. Draw a corresponding grid on the copper board (making sure you get the lines in the same relation to the holes!) and use this as a guide to drawing the tracks freehand with an etch-resist pen.

As anyone who has used this method for copying maps will know, it's simpler than it sounds, providing you are careful.

'Scope Seeker

Dear Sir,
I am interested in building the Digital Oscilloscope as described in Digital & Micro Electronics, *but unfortunately do not possess the magazine in which the first part appeared (in Issue No. 1, Autumn 1983). Could you please let me know if its possible to buy either a copy of the magazine or just the one article?*
Yours sincerely,
Martin Henery,
Salford,
Manchester.

It appears that we cannot supply backnumbers of D&ME as yet, but photocopies of articles can be obtained from our address here (see Contents Page) for £1.50 per article. We'll let everyone know as soon as we can supply backnumbers of D&ME, but it looks as though Issue No. 1 is out of print anyway.

The PCBs for the Digital Oscilloscope should appear in **D&ME No. 5** (the August/September) edition, with the casing and reminder of the construction in the following issue.

Relay Request

Dear Sir,
In your March 1983 HE you published a Signal Powered Loudspeaker Protector. *Can you please give me the stock number for the 12V-PCB-mounting relay you mentioned that we could get from MS Components, or give us the specification of the relay, ie the impedance of the coil, etc. please!!*
C. Castle,
Upminster,
Essex.

We've had a look for this one, and it seems as if MS Components don't stock that exact model any more.

In this case, any relay rated at 12V, 400R or more, with a single pole, 10A contact will do the job.

You could try the type YX97F from **Maplin.** This will work alright, but will not fit the PCB design exactly. It will fit onto the board, but you will have to connect lengths of wire from the copper tracks to the relay pins. This should not impair performance, however.

HE

BUYLINES

Digitest

Approximate cost for this project is £9, excluding the case, LED holders and the PCB. There should be no problem in buying the components, as all are fairly standard.

The choice of LED holders is up to you. The plastic clips are of course the cheapest, but the more expensive metal holders give a more pleasing appearance.

The printed circuit board is simple to make, and could if you are so inclined be done with a Dalo etch resist pen. As a point of interest, the front panel lettering can be done with rub-down transfers such as Letraset, Chartpak etc or similar.

For obvious reasons, all the front panel lettering and markings should be done with all the components removed. A thin coat of artist's varnish will prevent the lettering from rubbing off.

Dual Power Supply

A rather expensive project, but is well worth the effort in buying good quality components as the result is an invaluable piece of workshop equipment.

We estimate the cost to be £13. But to this figure has to be added the cost of the transformer, approx £8-10. The two panel meters £10. And the case, around £6. These prices are only estimates and could vary quite widely, so it's best to shop around for these items.

Adding all these prices together should bring the final total to approximately £37. Do not attempt to save money by buying secondhand or dubious components, as the small saving is hardly worth the effort.

Remember to buy the transformer before buying the case. It's easy to fit a small transformer into a large case but not a large transformer in a small case!

Note that some components are not too critical. For example, the meter range resistors are quoted as being 1R 2W. If these types cannot be obtained, then wirewound resistors of say 1R 5W can be used instead. Similarly with the capacitors. One rated at say 470u 50V is perfectly acceptable but one rated at 470u 16V is not.

Other transformers can be used. For example, a 2 x 12V 1A type could be used giving an output of 0-15V at 1A. This could be useful to remember if you really are short of money! Do not use any transformer rated over 30V 1A.

Catalogues

Our plea for catalogues in the June issue seems to have paid (small) dividends. One of the first respondants was A. **Marshall (London) Ltd**, who happen to send four (!) catalogues. Thank you. And a reminder that any catalogue sent will have a mention (if only briefly) on this page.

The catalogue costs £1 post paid (75p to callers at Glasgow), and for that you get 56 glossy pages. The catalogue contains an unusually varied range of components with particular emphasis on semiconductors — transistors and diodes being outstanding. A comprehensive cat and one worth buying.

A **Marshall (London) Ltd**, 85, West Regent Street, Glasgow, G2 2QD Scotland. Tel: 041 332 4133/5.

Infra-Red Link Temperature Sensor Signal Generator

We have grouped these projects together as they are all rather similar in nature as far as Buylines goes.

All the information required to construct the projects are given in the articles. However, for those constructors who do not wish to shop around for all the parts or make their own PCB's, complete kits are available; all use top quality components and professionally made circuit boards.

The prices are as follows:

Infra-Red Link (4101300)	£11.66
Temperature Sensor (4101303)	£7.73
Signal Genertor (4101302)	£31.65

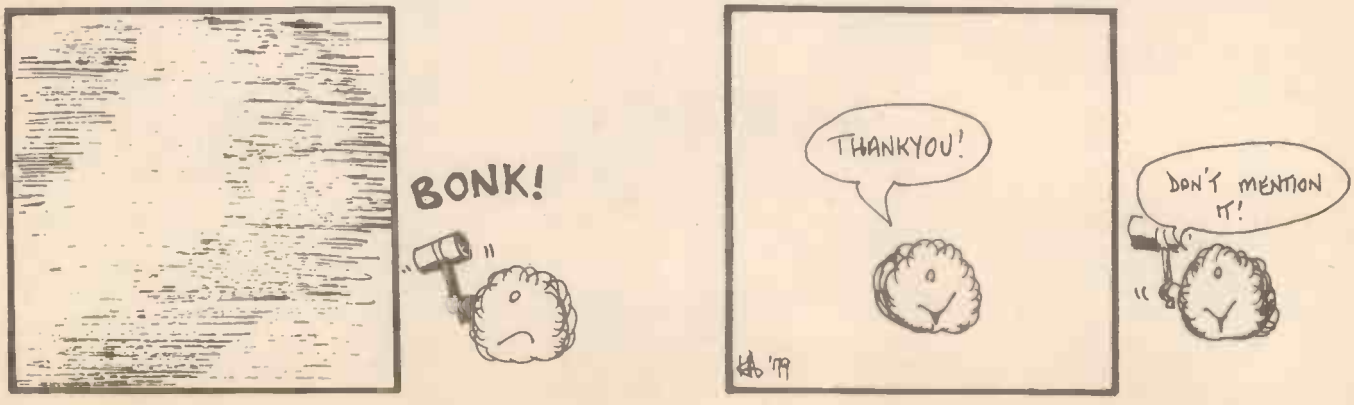
All these prices include VAT and UK postage and can be obtained from: **Cirkit**, Park Lane, Broxbourne, Herts. NE10 7NQ. Quote the order codes (in brackets) when ordering.

Oh No No, Say It Ain't So

But it is. Everybody, from the office cat upwards, denies responsibility and offers evidence to prove it. Be that as it may, the PCB Page foils last month (HE July '84) are ALL THE WRONG SIZE. We are reprinting them, this month, on page 63. The two projects involved are the **Hifi Control Amplifier** and the **Maplight Dimmer**.

Sorry, Mr. Armstrong. The boards were the right size when we built them. They were the right size when we sent the masters up to Hobbyboard. The foils, however, are six-per-cent too small (we measured them — all — a dozen times). How? We wish we knew.

BEASTIES BY AH



SOFT OPTIONS

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

Editorial

One of the major problems bedevelling the new technology is communication, which is ironic when one realises that the whole business of micro-computing is rooted in new and more efficient ways of communicating with, and relating to, the physical world.

The machines themselves communicate quite well: watch a computer-controlled robot working out, and, whilst you may not understand the principles of the thing, you can certainly gain some idea of what it is up to, especially if it's performing a vaudeville routine at an American Computer show!

Tap a key on your home micro, and the software will usually throw up some reaction to your efforts.

Talk to a real, live enthusiast, professional or amateur, and you will quickly realise that, as a race, human being still have a lot to learn about simple words and how to make new ideas accessible.

It is hardly surprising that the community as a whole has been slow to react to computer technology. Television, said to make knowledge not only immediate but assimilable, gives programmes on computing themes to presenters entirely at home with their own innovative expertise, and entirely incapable of explaining it.

Writers of basic handbooks for novice users of micro-computers omit vital information on the grounds since it's obvious to them that it doesn't need to be said.

And there has to be Someone or Other's Law which states that the degree of incomprehensible jargon expounded by any given pundit is in inverse ratio to his actual experience.

It is probable that, had the technology itself not been so inherently fascinating and provided the motivation to learn from within, as it were, the whole revolution would have been rolled into the ground by those who number themselves among its disciples.

As it is, lack of communication has certainly been responsible for delaying matters.

Perhaps that is no bad thing. Perhaps it has allowed the majority of us a breathing space, something which the sheer speed and potential power of the computer explosion has left us in crying need of.

It is a truism that the hardware available is already light years ahead of the software support, and that the gap is widening.

"Technology in search of an application" is a chiche already well-work in an industry barely off the drawing board, so obscurantism may have given us the opportunity to think, hopefully to some purpose.

Perhaps, when we have decided on how to exploit the technology efficiently, at least in ways that most of us can comprehend, we will also have learned how to communicate our knowledge to future generations, clearly and unambiguously.

Hard News 2
New developments in hardware and software for education.

Soft Talk 4
Program reviews this month of Facemaker from ASK, Survival from MacMillan, Early Punctuation from Blackboard Software, Mr. T. Tells The Time from Ebury Software, and a round-up of teach-yourself French programs.

Programmed For Success 10
Soft Options looks at the creative side of computer games: how to design your own, with the help of "designer software".

Big Questions, Small Answers 12
Widgit Software operate from home, but sell through the country's top distributors. They are building their success on clear ideas and a professional approach.

SOFT OPTION

Soft Ice Cream

We thought we were dreaming when we received a package from **Birds Eye Wall's Ltd.**, the ice cream and frozen pea people. But there was nothing edible in the package — just a letter to tell us that Wall's Ice Cream is supporting the Government drive to get a micro into every school (it's a start) with the "biggest-ever schools **micro competition**". The competition also marks the launch of Wall's own **software** for young users.

Competition entries must be in by 28th July 1984, and details will be found — for those of you who have not yet tried them — on the wrappers of Wall's new ice lollies, aptly known as Megabytes. There will also be found details of another competition in which individuals can win an Acorn Electron.

Cool man!

Another source of details is **Paragon Communications Ltd. 66/67 WElls St., London W1. Tel: 01 631 1008.** Ask for **Mr. John Rawlins**. However, entries must be accompanied by Megabyte wrappers, so potential entrants must locate someone who likes a combination of banana or toffee and chocolate and get down to the freezer centre right away.

At the same time, we came into possession of this little card — number 8 in a series of 20 with Wall's "Starship 4" ices. The theme is: School in the year 2004. And here is the news: "Many school lessons will come from computers, on a special visual display screen. But if you think it'll be like watching television all day, think again; if your work's not good enough, they'll give you extra homework!"

In 1984, a computer in every school; in 2004, a computer for every pupil? Can we achieve that in only twenty years? That would be something to break out the Cornettoes about.

Now They Come In Threes

Ever since the Victorians dreamed up the idea of the three volume novel, works in 'trilogy' form have had a peculiar attraction, and since the rise to popular acclaim of *The Lord Of The Rings*, the 'trilogy' has become part of the fantasy novel convention to such an extent that author Stephen Donaldson presented his "Thomas Covenant" saga in *three* trilogies.

So it is not entirely astonishing that a software company writing fantasy **adventure games** also chooses to present them as a trilogy. Should it even be a trilogy? Should it be a trinumery, perhaps? Be that as it may, the aptly-named **Incentive Software** Ltd. have recently released Part 2 of their "Ket Trilogy" titled the *Temple Of Vran*, for the 48K Spectrum. Part 1, the *Mountains Of Ket*, is already available, and the so-far-unnamed Part 3 is projected for later in the summer.

The built-in 'incentive' is that the first person to reach 100% on all three games will win a video recorder up to the value of £400 — a bit of a must for adventure game nuts. The indications are that, adventure games are gaining in popularity over arcade games, fuelled partly by a respectability conferred by the fact that they are regarded by adults as vaguely 'educational' and seem to require a concentration and ability to think through a problem which arcade games do not demand.

While software companies are not pushing an overtly educational image for adventure games, the format which assumes the use of logic, educated guesswork, long periods of thinking, and a great deal of patience, has attracted the attention of some software writers who see it as a possible vehicle for educational programs, for age groups from very young up to teenagers. Adults also play adventure games, of course, but presumably for enjoyment only.

Either way, Incentive's tapes all cost £5.50, with orders and enquiries to **Incentive Software Ltd., 54 London St., Reading RG1 4SQ. Tel: (0734) 591678.** And for collectors of trivia, *The Lord Of The Rings,* upon which the entire fantasy trilogy tradition was based, is not, in fact, a trilogy, but a tale in six books which was published in three volumes purely by chance. Such is the power of packaging.

Interactive Video

A series of interactive Video workshops, organised by **P. D. Whitaker Associates** with support from the **Educational Television Association**, was held in Birmingham in May. The workshop sessions were each of two days duration and offered concentrated "hands-on" experience of the materials and methods of Interactive Video.

The participants included not only teachers and lecturers, but also industrial designers, training and staff-development managers and interested parties from the Forces and the Police.

The workshops are intended to survey the advantages of interactive video over other forms of groups and individual learning and to explain the learning strategies available with IV techniques. The work covered was essentially practical in nature and involved small groups of people working with tutors on case-study material.

Opportunities were provided for participants to discuss their own needs and problems and advice was given on the various steps involved in producing IV materials, their costing and their implementation.

Details of all the currently available IV systems were provided, and a variety of IV stations were available for use over the two days, with Philips and Panasonic disc-IV hardware in predominance, and with Felix Learning Systems carrying the banner for Sony and tape-IV.

HARD NEWS

Memotech

April 5th saw the Minister of Information and Technology, Kenneth Baker, in Oxfordshire to confer on the Department of Trade and Industry' seal of approval on **Memotech's** modern factory. The Witney firm's HRX addition to their MTX modular system particularly captured his attention, as well it might.

The neat black box comes complete with its own video camera and is essentially a powerful picture storage and manipulation facility, with fascinating potential for graphic design . It would be an asset in any classroom, too, but at £11,000 for the complete system, it's unlikely to be appearing there soon!

From Memotech's factory, Mr. Baker went to Oxford to open a conference between the Oxford Delegacy, Memotech and SCAMPS, the Schools Computing and Administration Project, the conference being designed to examine how the MTX system can be used to facilitate administration in schools. Memotech say that their system is ideal for those with limited funds, since each unit can be bought separately,

If the firm is having to work hard to educate the this country into appreciating low profile, high quality microcomputing, it has encountered few problems abroad. The Americans have made their opinion plain, with FCC approval being granted as soon as the MTX was submitted, and the first allocations having been taken up even before the official American launch in April was underway.

It seems that some dealers were so impressed by the design of the computer casing that they painted existing non-Memotech stock black and red Timex/Sinclair's experience in the States is clearly not typical for all British manufacturers.

Europe, too, is buying in quantity. Scandinavia and Germany, in particular, have been seduced by the international character sets which can be selected by the user. The more insular home market refuses as yet to recognise the need to communicate with other countries in any language other than English. Memotech are, however, content to learn the language of success, in which it seems they are making a promising start.

Learning By Games

Longman Software (and here is another prestigeous educational book publisher producing its own software for young learners) have recently issued another four early **learning games.**

The new programs are *3D Hypermaths,* using a "Space Odyssey" format to teach maths to 8-year-olds upwards; *BMX Number Jump,* teaching numbers to 6-10-year-olds with a BMX biking game; *Word Wobbler,* an invaders-type game teaching spelling to 8-year-olds and over, and *Snap-It-Up,* a jungle game teaching "matching and sorting" to 4-8-year-olds.

Longman's will also be producing a range of CSE/'O' level revision tapes.

Enquiries to **Longman Group Ltd., Longman House, Burnt Mill, Harlow, Essex CM20 2JE.**

QL ASAP

After putting back their delivery dates on the new **QL micro** more than once, while their developers wrestled with internal software problems, **Sinclair** are now delivering the first batches of the new computer, their follow-up to the Spectrum.

The standing orders are around 13,000. The problem which has been holding them up since the QL's January launch concerns the computer's control software, which Sinclair wanted on a single microchip. Eventually, they intend to achieve this aim, but for the time being an extra IC is being incorporated into the design.

Although the first deliveries are only a fraction of the total, now that Sinclair have decided on an alternative to their original design, they are free to get on with fulfilling their orders.

Now In Soft Cover

William Shakespeare is in the top ten again. This time it's the Spectrum software top ten, which has been featuring titles from **Penguin Software's** Study Software series of Shakespeare **study aids.** The **Times Educational Supplement** made the comment that "while books really do have an awful lot going for them . . . (the Shakespeare study aids) will actually turn many Grade Cs into Grade As this summer."

If, as seems likely, software packaging can make more unfamiliar subjects more approachable to school-children and students, it can only be a good thing. It might help to open the gateways of understanding to the large number of exam entrants who wrestle with their subject but never really get to grips with it to the extent of wanting to read a bit further for their own pleasure. It could also be a way of encouraging active reading skill.

The managing director of the **Webster Group** was reported as in **The Bookseller** as saying "books and software sell very similarly". As Websters have had all their fingers on the pulse of the book trade for a very long time, and have reportedly done extremely well with **Websters Software** since its inception in early 1983, they are in a privileged position to make such a comment.

This could be seen not merely as a comment on marketing strategies, but as an indication that print and software will develop an interdependent relationship in education which will make us wonder how we ever coped before software came along. See also Mr. Palmer's comments on indexing in last month's lead feature, and bear in mind that the first place where computers and microfilm brushed up against public life, in many cases, was in the indexing section of the local public library. At least, for those of us who wanted books. . . .

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.

Facemaker

(A.S.K.)
BBC Model B
Acorn Electron

For ages 5 to 12 years
(Young children will need help to read the text.)

£9.95

Reviewed by **Roger Sternad**

This is a program designed to help and encourage young readers to enlarge their vocabularies and polish their reading skills.

Such is the nature of the tape that it should also play a real part in motivating children to **enjoy** their reading, which is a definite bonus. It is much harder to help children read more fluently if they have never enjoyed reading.

The program is also sufficiently flexible for its use to be expanded into areas such as creative writing, and it is also valuable for stimulating discussion among a group of children.

A twelve page booklet is supplied with the tape, and gives clear and comprehensive instruction on the aims of the program, what to do if you encounter difficulties in loading, details on how to run the tape and educational notes as well.

The program loads in five parts, taking 4 minutes and 35 seconds in all, but the loading time is displayed from the start, so you know how long you will have to wait. The tape loaded, reliably every time, giving no hint of trouble.

Instructions in the program itself are also clear and helpful, and incorporate a very good system of error trapping and prompting, which makes it easy to use.

For example, at various stages of the program, you have to press the SPACE bar to continue. At these times, a finger is shown on screen over the SPACE bar.

If you make a typing error, a question mark with a face in it appears, prompting you to press the SPACE bar to remove the mistake before you can continue.

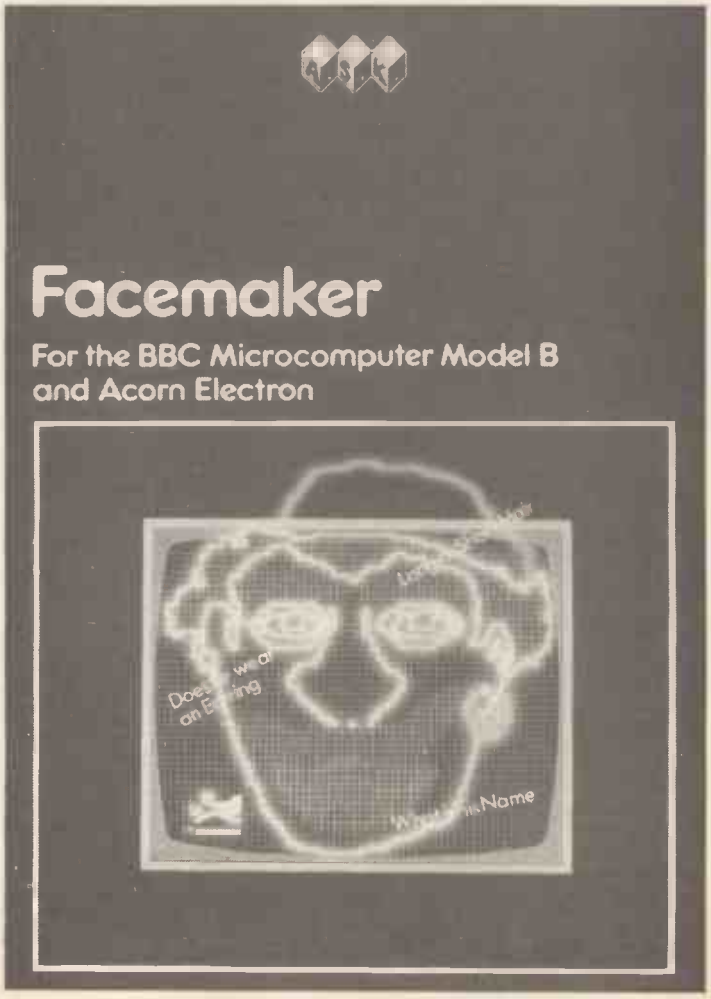
The program involves constructing a face from a built-in store of eyes, mouths, ears etc, much in the manner of a police identikit picture, and a wide range of different faces can be built with varying expressions and colouring.

When you start the tape, you are asked for your name, and a pleasing routine ensures that input is in lower case letters, except for the initial letter of a name, no matter how you have entered it.

A nice touch, this, and with the advantage of ensuring that the computer will not be confused even if you inadvertently put the CAPS lock on.

After entering your own name, you are asked for the name of the person whose face you wish to construct.

Item by item, you are questioned about type, colour and features of the face, and at this stage it is a good idea to have a dictionary nearby, since the program uses words such as "stubbly", "beret" and "bulbous".



It is necessary to read the questions carefully, since the input required differs: sometimes a one word response is required, sometimes two, and sometimes a "yes" or "no". This is another indication of the care which has gone into planning this program.

After you have answered questions regarding a particular facial feature, you are shown your choice, and in this way the face is built up one bit at a time.

Periodically, you are asked if you would like to change any detail, and if you say yes, you are asked which feature you wish to change and are then led through that specific part of the program again.

Some amusing touches emerge as you work through the tape. If, for example, you opt for to construct a masculine face, you are asked if the face is to have a beard and/or moustache, but the question is not asked if you're making a feminine face. More evidence of careful thought!

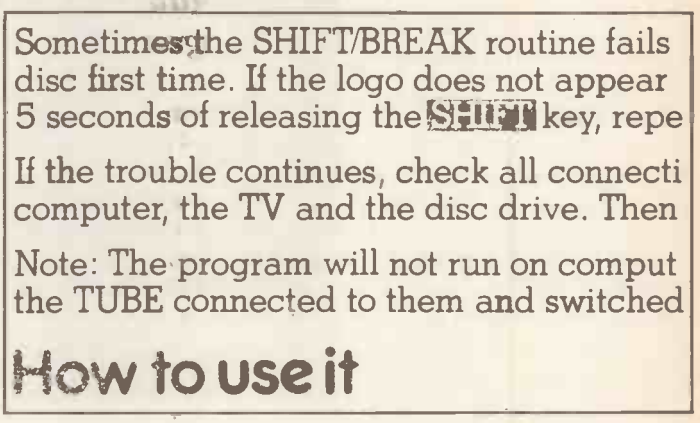
When you have finished one face, you have the option of building another, and at any point, the program can be re-run by processing ESCAPE. The program is not sophisticated enough to produce resemblences to real faces, of course, and this point is made rather well in the instructions, but part of the fun is the amusement when the children view each other's attempts to create the faces of classmates. It proved, indeed, a highly motivating factor, with even the slower readers conscientiously reading through quite lengthy text and looking up unfamiliar words in their dictionaries in their eagerness to finish a face to show their friends!

A useful refinement to this program would be a printout facility, because often the results are worth preserving.

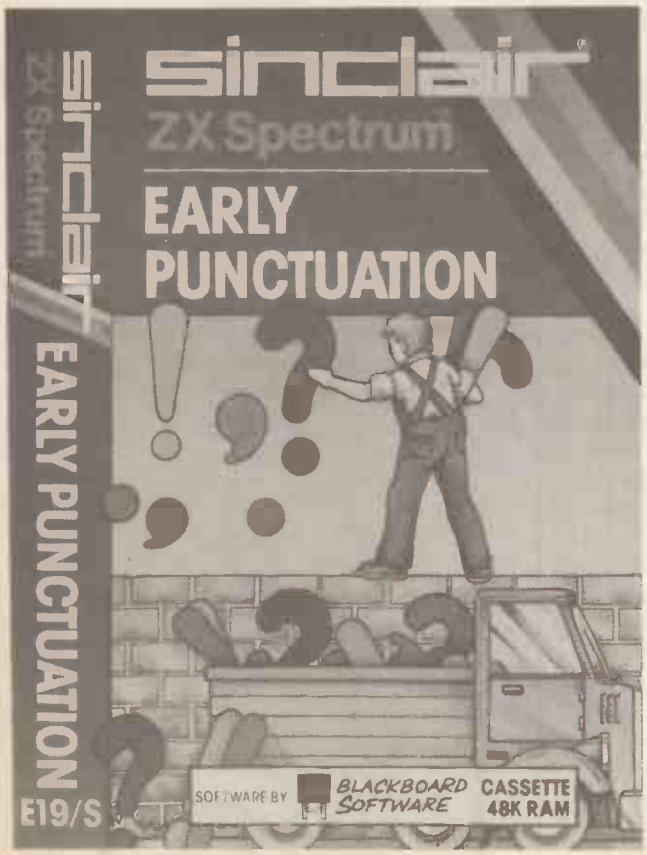
There is no doubt, in my opinion, that this program is good value for money. Anything which makes children laugh *and* prompts them to enjoy reading has to be a winner.

A.S.K. programs are available from Acornsoft outlets, or by mail order from A.S.K. Software, London House, 68 Richmond Rd., London SW15.

A French Face, by Facemaker.



Nice to see the instructions, intended to be read by youngsters, printed in an easily legible size and style, as shown by this full size reproduction from the Facemaker booklet.



Early Punctuation

(Blackboard Software/ Sinclair Research)

For Spectrum 48K

Ages 5 to 8 years

£7.95

Reviewed by **Gerald Cross**

This delightful program affords practice in the use of the full stop, comma, question mark and exclamation mark, and is very easy to use.

After a brief introduction which enables the student to find , ! ? and . on the keyboard, a sentence is displayed with one of the necessary punctuation marks missing.

When the relevant key is pressed at the right time, the appropriate mark is dropped into place by a little man who patrols backwards and forwards above the sentence. Shift keys are not needed.

Ten sentences, selected at random from a file of twenty are presented in sequence, and as successes are scored, a red brick wall is built up.

On top of the wall coloured bottles appear, and the finished construction is a fairground game, to be played as a relaxation after completing the punctuation exercises.

After shooting the bottles off the wall, the student is presented with a certificate, recording his name (which was requested at the beginning of the program), his score for punctuation, with an assessment — for example, "not so good!" — and the score for bottle shooting. The certificate can be printed out.

During the punctuation game, mistakes are patiently dealt with. After five misses, the student is advised to pause and think: the right answer is only disclosed after ten errors.

This is especially useful, since the game involves two skills. On the one hand, it is necessary to decide on the type and position of the punctuation mark required, and on the other, to time the release of the chosen mark properly.

The player might think he is mistiming the drop, when in fact he is attempting to use the wrong punctuation mark.

This, of course, makes the exercise twice as interesting.

Perhaps of most value to the teacher and also affording most fun for the more advanced learner, is the option of editing the sentences and storing the modified program. Given that the same punctuation mark must be preserved, each sentence can be completely customised. "What did you say?" can be replaced by "Where's Ron?"; "Run!" by "Eat your greens!" and so on.

The save and verify operations require no knowledge on the part of the user, who simply has to follow prompts.

This is an excellent program, both for classroom and home use. In the classroom, it would be especially appreciated, because there is so little time wasted when using it.

It loads in 118 seconds, requires few instructions to run and moves along quickly, all of which makes it ideal for use with a group of children eager for their turn.

At home it offers entertainment and education without imposing technical demands. The documentation is concise and informative, and at £7.95 this is an attractive and worthwhile purchase.

Sinclair programs are stocked by most major High Street shops, eg W. H. Smith, Boots, Menzies, Greens at Debenhams, Dixons.

Survival

(MacMillan/Sinclair)

One of the Science Horizons series.

For Spectrum 48K

Ages: 8 to 13 years

£9.95

Reviewed by **David Porter**

The program is essentially a colour, graphics-based game, designed with the specifically educational aim of giving the user and introduction to the principles of interdependence of living creatures and their environment.

The user plays the part of a creature, chosen from a group of six, and by using a set of eight keys on the keyboard the creature is moved around the globe in search of food and water. At the same time, it must avoid being killed by predators.

There are some other control features available on other keys, but these do not significantly affect the basic principles of the game.

With the exception of the loading routine, the program is written entirely in machine code, and cannot be modified or developed.

Unfortunately, it can be erased from memory by pressing SYMBOL SHIFT and A simultaneously. You are then faced with a three minute wait whilst the program is reloaded. The mechanism used to restart the game at any time is pressing CAPS SHIFT and A together, and so it is possible to clear the program by error as well.

This restarting instruction was not included with the main documentation, but was printed on a separate slip of paper. Apart from that, the instructions and advice were perfectly adequate, and in fact, I found the booklet rather more educational than the program itself.

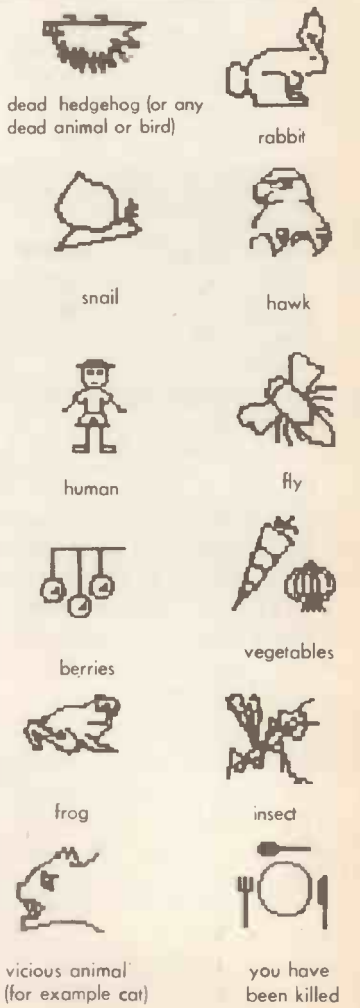
Having spent several hours familiarising myself with, and then playing, *Survival*, I have to conclude that it falls short of the claims made for it as a model of animal ecology.

The first drawback is that it is essentially designed to be used with a joystick, although this is not emphasised in the instructions. The speed of response which can be achieved using the keyboard alone is inadequate for satisfactory playing of the game.

I found the quality of the graphics disappointing, and in particular, I thought the display of the globe poor. I felt that the starting grid should have given the overall map, instead of being blank.

I also felt that the representation of animal, predator and food as A, X and 0 respectively could have been improved.

At each restarting of the game, it is necessary to go through the animal selection process. This becomes irritating, and



I would have preferred the initial selection to be retained until a change is instigated by the user.

Sound is minimal, and even given that sound on the Spectrum is limited, I think better use could have been made of it. What noise there is can be turned off, however.

The game does not seek to develop computing skills, and since its main aim is so complex, this is probably a good thing. On the other hand, I don't think it achieves its declared aims either!

The degree of success of a player is measured by the lifespan he achieves for his selected animal, and this is displayed at the end of each game.

It is not played in real time, and it is difficult to relate activity on the screen to days and weeks passing, so it would have been more helpful if the elapsing of the life span had been displayed continuously.

Since the game demands a lot of patience before you can get a respectable score, I think that for the purpose of learning about survival, the time would be better spent reading a book on the subject.

If considered purely as a game, the program does not provide sufficient entertainment to sustain interest.

The documentation does not specify the age group at which it is aimed.

My own children are under nine, and although they have attempted to play the game, with minimal success, they certainly show no signs of having understood the lesson it purports to teach.

Sinclair programs are available at most High Street shops, eg Boots, W. H. Smith, Menzies, Greens at Debenhams and Dixons.

Left: A selection of animals, predators and foods, from the booklet.

Mr. T Tells The Time

(Written by Edbury Software, published by Good Housekeeping)

BBC Model B
Price £12.95

Recommended ages: 3 to 6/7

Reviewed by **Margaret Curtis.**

This is another in the Mr. T Early Learning series, and consists of four games designed to assist in teaching a young child to tell the time.

Game 1, working clock: A standard clock face is shown with the hands moving, with chimes produced on the hour. The clock is stopped and started using the SPACE bar and each time the bar is pressed, the clock hands will move on one hour, sounding the appropriate chimes.

The computer waits for instruction between moves so that there is plenty of time for discussion and explanation.

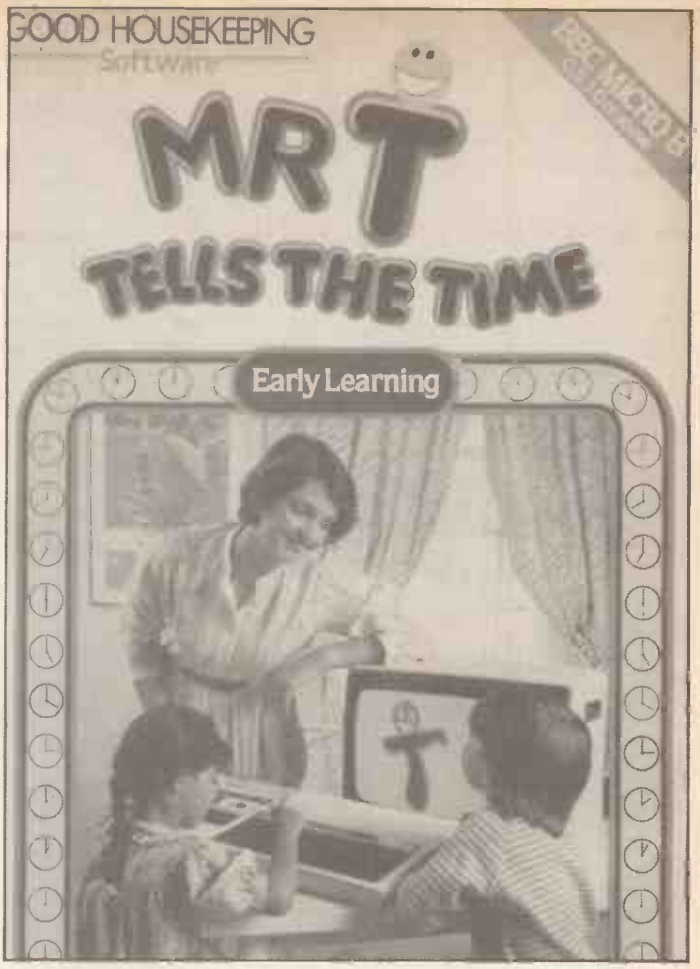
Game 2, matching hours: This activity aims to promote understanding of the relationship between the hour and the minute hands. Two clock faces appear with hands but no numbers. On one clock the hands are stationary while the hands of the other clock change position.

When the hands on both clocks are in similar positions, the SPACE bar is pressed and Mr. T, ever present, is set in motion.

There is a strawberry on the right of the screen, and Mr. T rocks a few steps towards it with each correct match achieved. After twelve answers, Mr. T eats the strawberry, much to the delight of the onlooker.

As with all these programs, the graphics are attractive and amusing.

There are three levels of difficulty, which can either be preselected by a parent, or gone through automatically as performance improves.



At the first level, clock hands point to the hours in clockwise sequence, but at the second level they point in random order. The third level of the game introduces half and quarter hours.

Games 3, clock numbers: This helps relate the numbers on the clock face to their positions and, incidentally, reinforces understanding of the value and order of numbers from one to twelve.

A clock face is displayed with five numbers blanked out at random, by coloured squares, one of which is flashing.

The missing numbers appear *beside* the clock and Mr. T points to each one in turn.

Again the SPACE bar is pressed to match the relevant number, which then travels across the screen to take its rightful place on the clock face.

There are three levels to this game, too.

Game 4, O'clock: The object of this is to teach the child to tell the time when the hands show the hour.

There are some preliminary, non-computing activities suggested in the excellent handbook, designed to relate the hours on the clock to activities during the day, and the computer program is used to reinforce this preparation.

Pressing the SPACE bar moves the hands on the displayed clock face from 1 to 2 o'clock and writes "2 o'clock" at the bottom of the display. At the second level, the player matches the time shown on the clock to the changing number shown under the clock.

The reward is once more by Mr. T, but here he has taken to a parachute in order to reach his strawberry, which gives rise to a genuine case of suspended animation between answers!

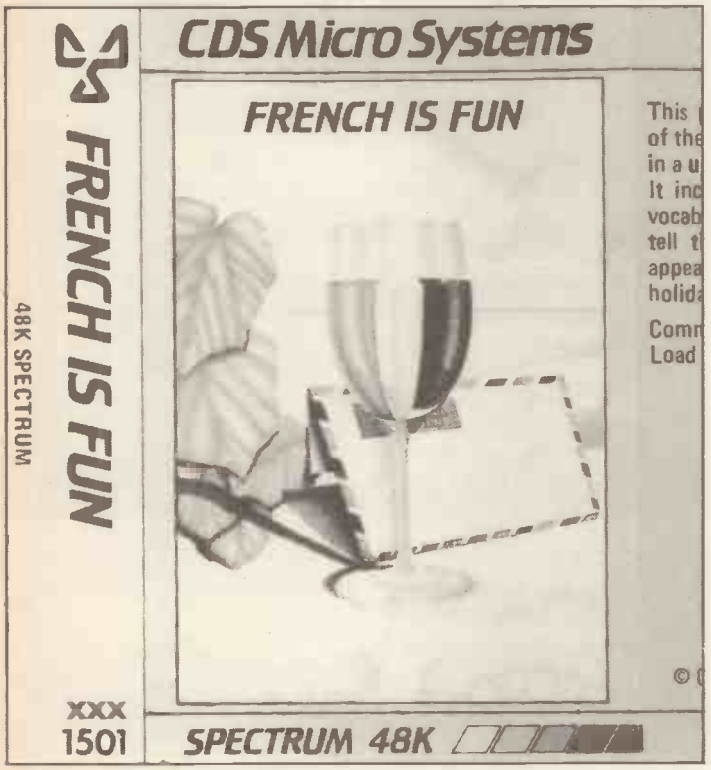
The third level is similar to the second, but this time the written time stays the same and the clock hands move.

This suite of programs is written to a high standard and will help teach a child the basic concept of telling the time.

However, there is no introduction to minutes, which must restrict the use of the program to the very young. This becomes a matter of some moment, as it were, when you are being asked to pay £12.95 for Mr. T's undeniably entertaining help.

What price charm?

Good Housekeeping programs are to be found at branches of W. H. Smith and leading High Street stores. 48K Spectrum versions are available for £9.95.



French Is Fun
(CDS Micro Systems)
Price: £5.95

Tense French
(Sulis Software)
Price £9.95

French Vocabulary
(Rose Software)
Price: £6.95

All for 48K Spectrum
(Tense French is also available for the BBC Computer)
All for O-level/CSE

Reviewed by **Rosemarie Lees**

French is fun claims the software house, and yes, the program is fun. The graphics are excellent, the vocabulary testing is helpful to a newcomer to the language, and the accompanying phrases would be useful to a CSE or O-Level candidate, or to an adult embarking on a French holiday.

The volcabulary can be first viewed and then tested, either from French to English or vice-versa. The score is shown at the end of each test and can be stored to give a total score. The phrases are given in English and the French equivalent is obtained by pressing the appropriate key.

But in the selections on Numbers and Time, I found the screen cluttered and I felt that a simultaneous display of numbers from 1 to 20 would be more relevent than a metric conversion chart.

Sulis Software Limited

Unfortunately, the text is poor. Firstly, it is small and difficult to read. Secondly, is contains glaring inaccuracies, including one major grammatical error, and thirdly, the program has no facility for showing commonly used alternatives. These factors mar a potentially good and entertaining program.

French Vocabulary by Rose Software has six programs on one tape. I found the "Three Topics" programs of most interest. They cover such areas as "Home" and "Shopping" and give the user the choice of keying in the answers either from French to English or the other way round.

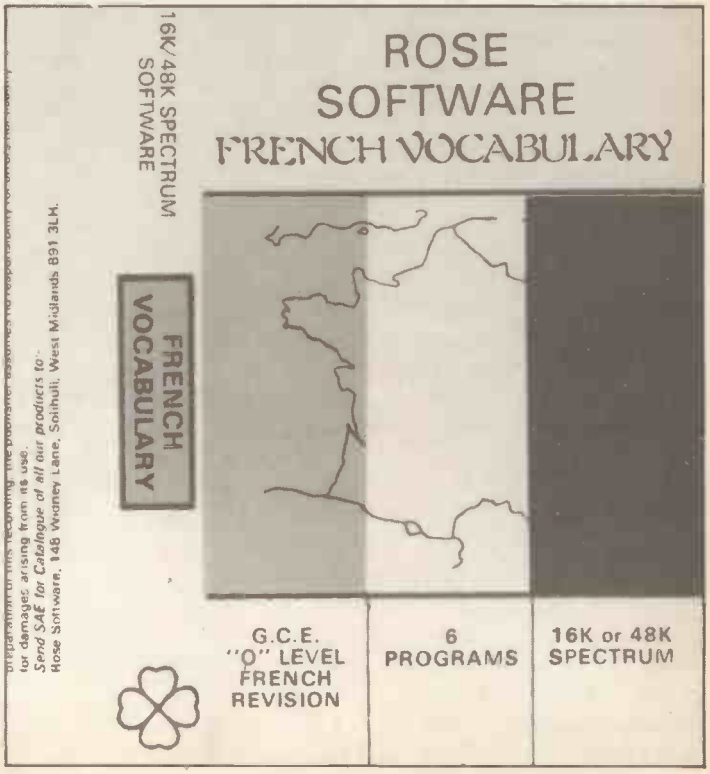
My chief criticism is that there are only twenty phrases for each subject, but I liked the reward incentive in Topics 1 and 2. The correct answer is given when mistakes are made, the phrase is repeated to allow a second attempt.

After each five phrases, the score is given and there is the option of continuing or returning to the menu.

Program 4 allows the user to key in his own vocabulary and save it for future use, while Program 5 offers a chance for self-testing on 120 commonly used words or phrases. Program 6 deals with irregular verbs, but as only one English equivalent is given for each tense, this program could well have been omitted.

The tape has clearly been prepared by someone with a thorough knowledge of French, and has also been carefully checked. There were no spelling errors and only one or two phrases with which I would disagree.

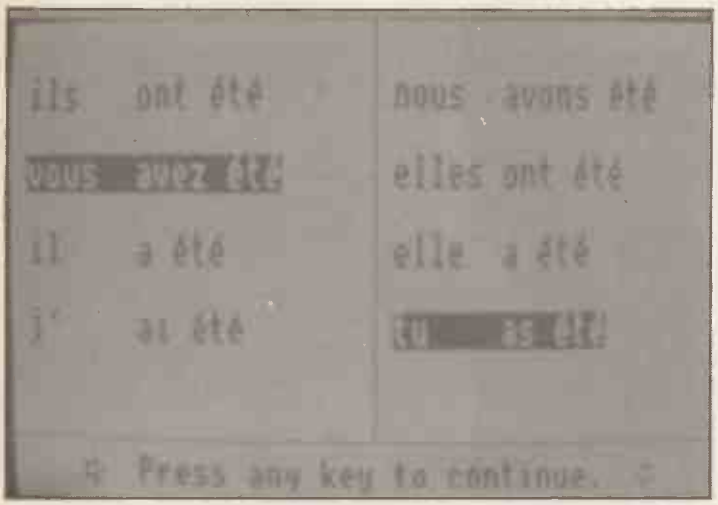
But its usefulness is severely limited because the computer has been programmed to accept only one specific answer to a question, totally ignoring the fact that there are often equally correct alter-



natives. It is nonsense to accept "a quarter to three" for "trios heures moins le quart" but reject "quarter to three". This is likely to discourage, if not thoroughly confuse, any pupil using the tape.

Tense French is helpful, but unlikely to solve all a pupil's problems. It is not possible to view all the tenses of any one verb without returning to the menu after any one tense, and the meanings given are infinitives only, whereas many pupils' problems arise because of their failure to understand that most French tenses have several equivalents in English.

In the testing section the score appears on the screen after each question, and corrections are shown immediately. At the end of each test it is possible to review all 20 answers, and it becomes obvious that the random selection has been poorly programmed in that, on several occasions, the same form of the same verb



appeared twice in any one test.

I found all three tapes easy to use, although when using accent keys in *Tense French* I needed to refer back to the instructions, whereas the Rose Software programs clearly displayed the instructions on the screen. All three programs suffered from not having the facility for displaying and accepting alternatives.

Footnote: *We approached CDS on the matter of inaccuracies in the "French is Fun" tape, and we are assured that the program has now been corrected, and that the current edition of it should be accurate. It is worth mentioning that CDS also do a "German is Fun" tape which is identical in all but vocabulary to the French version. Both tapes are intended for adult use as well as student use, and there are plans for issuing versions for other home micros.*

Another tape from Sulis Software, called "Just A Mot', is designed to teach a French vocabulary of 500 words.

SOFTWARE FROM FLITE:

CARTESIAN

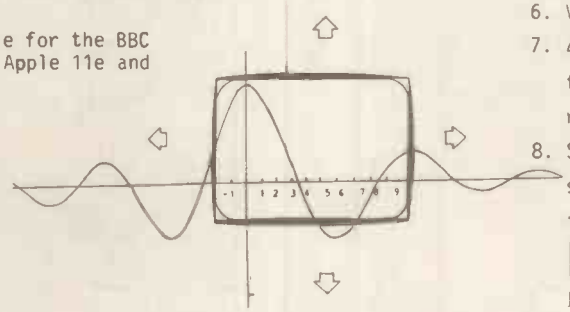
can graph the simplest of functions

Or the most complicated. It then goes on to do an awful lot more. Like drawing the differential curve and finding the definite integral. Like extracting roots wherever they exist, even when the function has multiple roots. Like solving complex equations. Like allowing for many graphs to be overlaid one on the other. Like letting the user animate the scales and axes in order to reach any part of the curve, and to magnify segments.

Naturally if CARTESIAN can handle the functions above, then it can also take care of quadratics, cubics, trig. functions, polynomials, circles and elipses.

CARTESIAN is available for the BBC 'B', Acorn Electron, Apple 11e and Apple Europlus.

PRICE:
Cassette: £24.90
Disc: £27.75



Cartesian is fun to use, which should go a long way towards ensuring that it *is* used, and it is both powerful and flexible enough to be of real benefit to any serious student of mathematics.

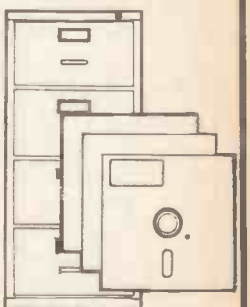
-Hobby Electronics

FILE BASE

YOUR BBC OR ELECTRON DISC DRIVE NOW HAS A WORTHY CARD INDEX DATABASE AT AN EVEN WORTHIER PRICE.

Use it in the home, club, office or school. It's very versatile.

1. Records are designed by the user.
2. May be used with one disc drive.
3. Allows selective label/envelope addressing or full record recall.
4. Search using ANY field.
5. Random access for fast operation.
6. Very user friendly.
7. 40 or 80 track versions. A 40 track disc will hold up to 400 records depending on size.
8. Sort, amend, recall, print-supports professional standard features.



price:£15.90

Disc only. Please specify whether 40 or 80 track.

ACCESS, Barclaycard(VISA) and official orders welcome.

FLITE software

Findrum, Convoy, Co. Donegal
Ireland. Telephone (074) 47227
Mail Order (074) 22286 & (074) 22025

Programmed For Success?

Computer Games are ever with us. If you can't beat them, should you join them, using the various games writing packages available? Or are they a new way to waste more time? Soft Options examines two of the contenders.

Phillip Harvey

Where would we be without computer games? A lot of us wouldn't be anywhere at all, much. There would be far less computers (and computer salesmen), many programmers would be seeking other employment, and there would be a lot of authors and journalists in the queue with them!

Games have certainly been responsible for much of the boom in computers and they have helped people get interested in computers who probably wouldn't have bothered if zapping Aliens From Beyond The Tube hadn't been part of the fun.

The next step from playing games is to write your own, but not everyone has the time or will make the effort to learn the tricks of machine code programming, or even of BASIC.

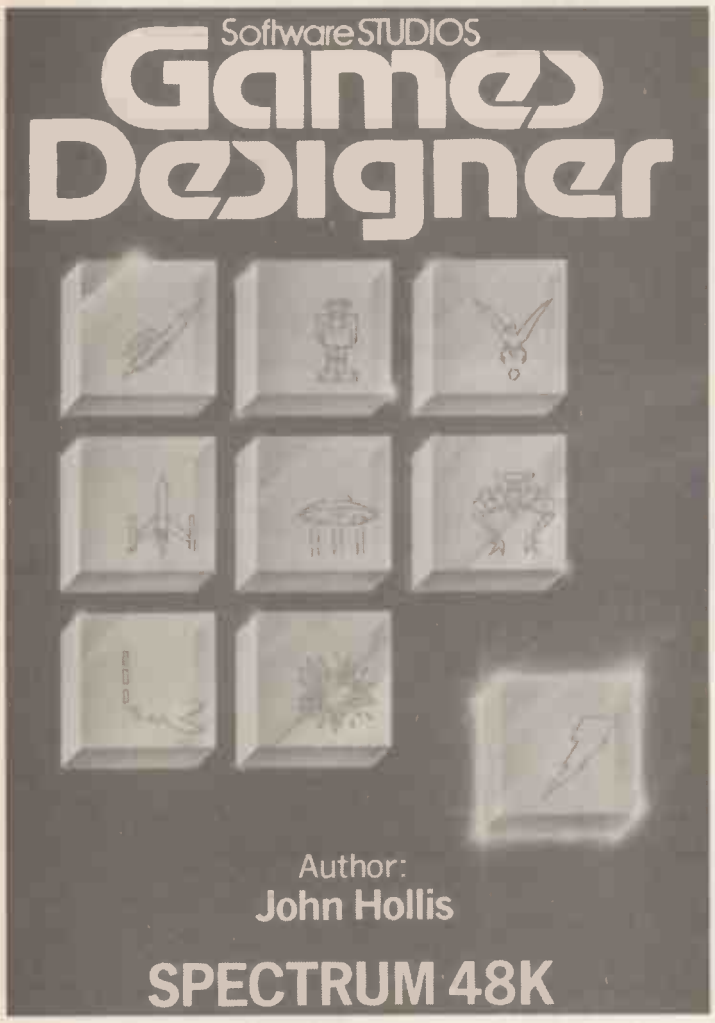
But you don't need to know anything about programming to write a game if you use one of themany games designers packages now available. They won't teach you programming but they do let you work out a game using a high level "games design" langauge. - And if, in the process, you learn something about the logic behind the program, then so much the better.

H.U.R.G. (High level User friendly Real time Games designer) is the latest package for the would-be programmer and comes from Melbourne House. Quicksilva's *Games Designer* has been around since last year, so it was interesting to see how the two compare, and whether either was relevant to genuine programming.

Almost all the input into H.U.R.G. can be achieved using a joystick. Using the keyboard is possible, but only in the joystick format, that is UP/DOWN/LEFT/ RIGHT/FIRE.

Input into **Games Designer** is by using the keyboard normally and prompts guide you through the program, telling you which keys to press and what operation each of the keys performs.

I found using the keyboard for H.U.R.G. very uncomfortable. It was easier when I used a Quickshot joystick but I



occasionally found myself overshooting the option I wanted to select, and when it came to designing shapes I found it virtually impossible. I had to revert to the discomforts of the keyboard for that particular function.

On the other hand, I quite liked the format of *Games Designer* and found it much easier to use.

The 36 page *H.U.R.G.* manual emphasises the versatility of the program. There are few restrictions on the type of game you can create, but you have only one background screen, and it cannot be changed by *H.U.R.G.*

This very serious restriction means that the cost of the package is automatically increased, either in time or money, since the solution is to write a program to draw your screen, or else buy a drawing program to do it for you!

The handbook discreetly suggests Melbourne House's own program, *draw*, as a candidate.

Many commercial games now make use of many different screen layouts, which change as you make progress with the game. The background limitations of *H.U.R.G.* means that any change involves writing virtually and entirely new game each time.

As for *Games Designer*, this deliberately restricts the format of the games you can create to one of the types which are pre-programmed. These include Invaders, Galaxians, Defender, Scramble, Asteroids and Berserk.

No background is possible, except that you have the option of decorating your screen with stars.

H.U.R.G. includes three games as examples of what can be done with the program. Each has a very different format, emphasising the versatility quoted in the handbook.

The first game is similar to Manic Miner, while the second and third resemble Jet Pac and Pac Man respectively.

When these games are played, it becomes obvious that the shapes move only one character at a time, which makes movement jerky and uninspiring.

There is also a complete absence of sound. Although sound from the Spectrum's speaker is poor, nevertheless it does add to a game's appeal, and the lack of it is a definite flaw in *H.U.R.G.*

Games Designer comes with eight ready made games, which was perhaps a mistake, since they underline the restrictions imposed by the program.

All of them follow the format of arcade games such as Defender and Invaders, but are redeemed from complete tedium by good animation and smooth movement.

All the programmed games and your own variations can have sound effects and the finished result is almost of arcade standard, at least as far as technique is concerned.

H.U.R.G. is very user friendly and is a useful tool for the non-programmer to test ideas, but not to create playable games.

Games Designer, on the other hand, allows a novice user to create moderately entertaining games within a very restricted area of design.

What neither program will do is give the user any insight into or knowledge of, programming.

These types of packages are rather like frozen pastry, bought from a supermarket. You can put in a filling and cook them in the ovem to produce an edible result, but you won't be able to compete with a Cordon Bleu chef.

After all, if it was that easy to mers at the Job Centres! standards, there would be a lot of software house programmers at the Job Centre!

Big Questions, Little Answers.

Soft Options meets a software author who started out by writing for the most demanding customers of all - small children. Now she feels that her methods may be the best way of teaching many adults as well, at least so far as understanding computers is concerned.

Helen Armstrong

Widgit: a small object or device which plays an essential part in the operation of a larger device, but whose exact function is not widely understood. Or it could describe a little pottery object which makes an excellent present and later becomes an heirloom.

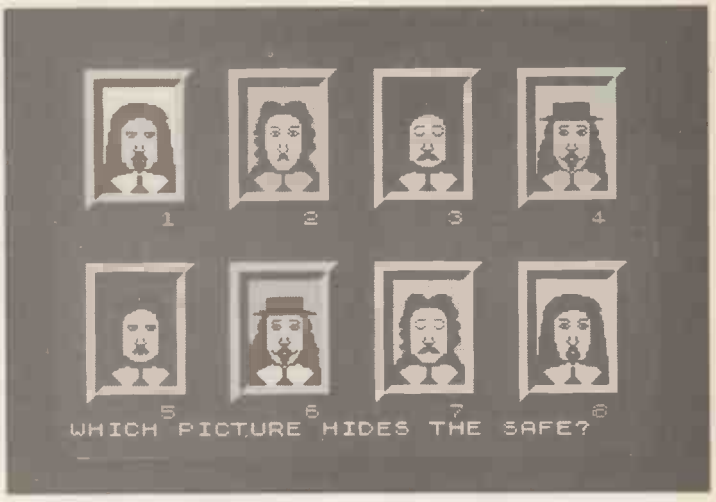
Which, oddly enough, was what Tina Detheridge was making before she became a writer of educational software for pre-school children and laid the foundation of Widgit Software.

Tina, and her co-author husband Mike, are people with the knack of turning a leisure-time activity into a business.

Both teachers by profession, they ran their pottery business in the evenings, and Tina began writing programs in her spare time in order to teach her two young children to use the family's Apple II microcomputer. Friends saw the simple programs Tina and Mike had written, and suggested that, if these programs were available commercially, they would buy them. So Widgit was born.

Mike was the first to take up computing, writing administration programs for the school where he worked. Faced with an Apple II installed in the kitchen, Mike and Tina had to decide between forbidding the children to touch the machine, and allowing them to play with it.

They unreservedly opted for the latter, which left them with the challenge of making the computer accessible to two bright, but pre-school-aged children. Their solution was a short program which displayed a picture when a single key — instead of the usual combination of keys — was pressed.



"Children don't ill treat computers" says Tina "although they will start pounding at the keys if they can't produce any result. They become frustrated". So it is very important to produce programs which very young children can operate without adult assistance.

Adult vigilance, on the other hand, is taken for granted. Tina believes that children should not be left alone to cope with the computer by themselves. An adult is needed to keep an eye open in case the child gets stuck, or is confronted with a computer malfunction — or simply has a question to ask.

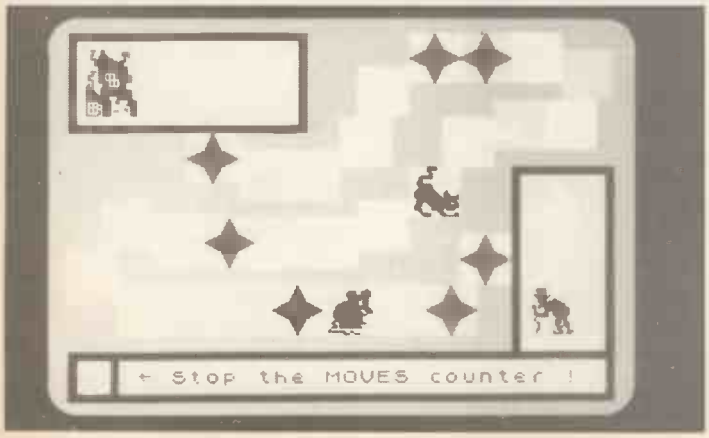
Widgit write their program instructions for parents to follow, to the extent of providing a commentary for the parents to read where there is no speech synthesiser.

They have received criticism in the past over this policy, but Tina believes that guidance and encouragement from parents and partental approval when the right answers are achieved, are one important part of the program's purpose.

They avoid giving scores on their early learning programs, preferring to set a definite goal which is either achieved or not achieved by the player.

Although there is often a big achievement gap between parents and their teenagers — the teenager being computer-ate and the parents otherwise — with very young children, there is an opportunity for child and parent to start together at the same level and learn together — the child learns from the program, and the adult learns by operating the program.

As long as the operating skills needed for a program are not too complex, by the time children are five or six they have learned to load and operate the tapes themselves,



following the instructions in the program.

"For the children's education" has long been one of the standard excuses for buying a first computer.

Naturally the question hs arisen as to whether this intention has been fulfilled in very many cases. Mike and Tina, having begun by marketing educational software to the public by special demand, through major distributors, are in an unrivalled position to assess the true situation.

The buying of micros ostensibly for education covers a very broad social range, says Tina.

It's not a middle-class phenomenon as people often assume; indeed, the "middle-classes" contain a considerable and increasing "television resistant" sub-class who avoid allowing broadcast television to infect their home lives, and tend to lump computers together under the heading of mindless prepackaged entertainment which can only rot the minds of themselves and their children. "I am in the same class myself" she admits.

This view has been reinforced by the lack of useful educational software for children of any age.

The assumption has been that it is teenagers who would benefit most from computerised education, but pre-school children are at their most

receptive, given a suitable lead, and can learn from the computer, and about the computer, simultaneously.

At the time when Mike and Tina bought their first computer, cheap, versatile home computers like the Spectrum had not yet arrived. They chose the Apple because of its excellent graphics.

Tina herself taught art and, although at the time she had no idea that she would soon be writing commerical software, they were both well aware that if the computer were to capture the interest of their children at an early age, good graphics would be essential.

A combination of circumstances — royalties from a text book that Mike had written, plus the arrival of their first offspring, Simon (now five) — gave Mike the excuse he needed for bringing the computer into the family (and, unlike hifi or television, which are regarded by most families as necessities of life, an excuse

still seemed to be a prerequisite for buying even a modest computer).

Tina did not start programming until their second child, Katy, was born a year later. She utilised the time while she was feeding Katy in studying the computer's manual, and set herself small progamming projects in the evenings.

Once they had decided that this was not too early to introduce the children to the computer, Mike and Tina devised very simple programs involving counting, the alphabet and letter recognition.

Then came the favourable reaction from friends with small children, and the move to produce programs for sale.

The first four programs which were produced under the Widgit name were Counting, Shape Sorter, Adding and Subtracting, and Alphabet.

The programs do not only use bold, colourful graphics to

make their point, but use an elementary of 'storyline' to hold the child's attention.

For instance, in one of the programs in Addition and Subtraction, instead of the rows of apples and oranges usually associated with simple arithmetic, a dockyard crane loads and unloads crates from a steamer.

Then the Spectrum arrived. Adamant that their programs should be for use at home by the whole family, Mike and Tina did not want them to end up only in schools.

The Spectrum was a happy solution. Not only was it proving extemely popular, but it was an excellent machine for the programs they were working on.

The Spectrum has received its share of abuse from computer purists, in particular for being a "Mickey Mouse" machine only fit for beginners and games, but Tina, hardly a beginner or an amateur, could not be more enthusiastic about it.

"It's a super machine" she says. "It's easy to program both in BASIC and machine code — we don't use much machine code, because we aren't writing fast games, but we still need to be able to use it when necessary — the graphics are excellent and simple to handle, and there is plenty of easily accessible memory."

The original programs were converted for the Spectrum as soon as possible, and all their subsequent programs have been written for the Spectrum.

Another fact which began to emerge from Widgit's experiences was that people were gradually becoming willing to buy a computer for use by very young children — now that they could buy appropriate programs.

Perhaps the children are partly a pretext: a family may buy a computer on such a pretext, but will they then buy educational software on the same pretext?

It seems that some people, at any rate, are prepared to believe that very young children can benefit from having a machine.

One of Widgit's educational programs takes about a month to write. A month at the computer, that is. First comes around three months of planning — and playing — on paper.

Flow charts are drawn up and the sub-routines charted.

A good educational program seems to have the combined attractions of a book, a game and a television program. Katy, aged three, applies serious thought to a Shape Sorter problem . . .

Then the working "shell" of the program is written onto the computer. Only when the rest of the program is right are the graphics written.

"The graphics are essential" says Tina "but they are an embellishment. The rest of the program has to be right first, and then the graphics go in.

Big, bold full-screen pictures fascinate small children. Tina's pictures are often peopled by beautifully animated little men who trot round the screen performing various tasks. There are no 'token pictures' — each scene has a character of its own.

Widgit have not gone for the hard sell. They decided to be cautious with their advertising and not to allow demand to outstrip what they could supply themselves. This policy has done them no harm.

They began by taking small advertisements in Spectrum-oriented magazines, rotating the advertising between magazines. They supplied schools directly by requisition, and supplied tapes to some retail shops and distributors.

They then found that custom came to them. The next move was to send samples to W. H. Smith's.

At this time, Widgit were the only people writing commercially for the under-eight age group. "A number of people thought we were mad" says Tina.

W. H. Smith clearly did not think they were mad, and test-marketed the programs. Within a couple of months, the tapes were selling well and were accepted as part of Smith's regular software roster.

They have since then been accepted without hesitation by various other distributors, putting them into Boots and other major outlets.

Particularly exciting for Tina is their association with the Daily Mirror's software publishing company, Mirrorsoft.

"Their quality standard is very high" she says. "They try for games which involve all of the family, not just one person games. They are picking up on small software houses, and publishing good quality tapes from all over the place. Also, they credit the programmers, although they are publishing under the Mirrorsoft name. They deliberately hunt for new talent and bring on people who haven't got their own resources. We don't need them to establish the business, as we're growing as fast as we want to already. But we like them."

The association with Mirrorsoft allows Widgit to write software using the "Mr. Men" characters, the rights to which (whom?) are owned by Mirrorsoft.

Tina is planning a series of tapes using the different shapes and sizes of the Men to teach opposite words.

Widgit are not allowing their work for Mirrorsoft to take over, however: first and foremost they want to establish their own brand name.

Mike and Tina are not now the only programmers for Widgit. They plan most of their own material but, commission the actual programming out to hand-picked programmers. Some are still at school.

One is a primary school teacher from Cheshire, who contacted them out of the blue with his own program ideas, as many programmers do, and now works with them.

Tina says of herself that she is "not the world's tidiest programmer", but as Widgit sets very high store by having programs which are entirely crashproof — a small child cannot, after all, be left to sort out a malfunction on a tape — this could be simply a comparative judgement!

Although they do not write games programs *per se*, some of their programs or sequences within programs are laid out like popular arcade games such as maze games.

For instance, a mental arithmetic game, *Quick Thinking*, involves destroying robots. But in order to do this the player has to make quick numerical calculations, and hit the right keys.

Yet they say they have been criticised for the 'violence' in the game, extraordinarily petty when so many games involve shooting at humans or animals, and some are overtly gory.

"Children want to play 'space invaders'" says Tina. "It excites them, and that motivates them. At least with this one they have to think, not just react."

This latter games is one of Widgit's newer programs aimed at eleven to fourteen year olds. "We might settle at that age for a while" says Tina. "There is virtually nothing else there at the moment."

A major project is an adventure-style game which can be adapted for older or younger children, tentatively titled *Castle Of Dreams*.

The adventure game format primarily involves working out puzzles, finding objects, and locating places.

Widgit have adapted the format, firstly, by breaking the adventure down into a series of sequences, each one involving a different set of skills or calculations, which build up into a complete 'quest' to find the wizard's staff, after which the correct route must be swiftly retraced if the player is to escape from

. . . while Simon, aged five, works on Adding and Subtracting. A by-product of using the computer is that it can provide an incentive to develop reading skills.

the castle before it burns down!

In true adventure tradition, various artefacts are needed to complete the quest at different stages, and only two can be carried at any one time.

Tina and Mike have rationalised the format by removing such chronic irritations as sudden and random death, or removal from the game for trivial errors or arbitrary factors.

The player must not ask the computer for 'help' unless seriously stuck, and they may then be sent back to the beginning to start again.

But here, previous achievements will be taken into account in the player's progress, and the game will adapt itself to a player's skill level if failure is repeated.

The adventure contains six separate games, and there will be a complete booklet explaining the games and how to operate them — the screen instructions will only be reminders.

"We aim to cater for a range of skills" says Tina. "Some children are very observant, some are logical, and so on. We are making the game simplier for the younger children by making the games separate from the adventure, because small kids haven't got the patience and the stamina to work through the whole sequence at one go."

Care is taken to see that the operating techniques for the games are easily understood and easy to put into practice.

"It must be obvious what is required — they should be able to guess what is going on."

The number of key strokes needed, for instance, is kept to two in programs for very young children.
"Although we don't write for schools as such" says Tina, " our programs must be educationally sound, and approved by teachers. Many of them are bought by schools."

A selection of Widgit's programs.

The games can easily be played by small groups of children, "co-operative rather than competitive. One has to be very careful with competitive games in an educational context."

"I don't think competition is a bad thing, but it must be for a purpose. Our games work towards results rather than scores. Inter-child competition in schools is not such a good thing. Different children have different things to develop."

Software written specifically for schools — "there isn't very much of it" — is usually written on disc.

As they want their software in homes, Mike and Tina are not yet writing for disc (they use Sinclair Microdrives for writing, for their speed and convenience, with a cassette backup), but Tina sees educational computing becoming far more interactive as time goes by, "especially for older children, once discs become standard."

"They give infinite memory and very fast access. Disc is becoming cheaper all the time, and besides, most users have only been in computing for six months or a year. Their expectations will change. They will expect to spend more on computing, as well."

Apart from the shift to disc-based programs, Tina believes that both children and adults will be starting on simple programming, and that this will lead to more interest in interfacing and control.

"It's not difficult to program, and it offers a lot of possibilities. We may have whole houses wired up for computer control before long."

Coming from somebody who knows well what programming involves, this has the ring of reality rather than science fiction about it.

Having written most of their programs on the Spectrum, Widgit are now going to be writing for the Commodore 64 as well, a computer which Tina likes but has found less easy to work with then the Sinclair machine.

They had intended, as well, to program for the BBC Micro if demand became sufficient, but Tina is now adamant that they are unlikely to do so, because the graphics require too large a slice of the computer's memory.

However, the future holds all kinds of prospects for diversification, many as yet unthought-of. Widgit have now expanded to the point where they are self supporting, and Mike — who loves teaching — is planning to take a year out of his job to see how the future develops.

One thing is certain: Mike and Tina will never want for an occupation. And as one of that (reportedly) rare breed, a professional lady programmer, Tina has shown that programming does not require a hermit-like dedication, or severance from the interests of everyday life. Tina herself is a little perplexed by the role of women in computing.

There are a *lot* of women in computing" she points out "but not many as programmers. They are evaluating and buying programs, but not actually writing them."

Computing in the home, too, is still generally male-led. "It's still the fathers who tend to pick up an interest in computers first. The mothers, and families as a unit, are a bit slow at it. Educational awareness has been a spin-off of this interest in computers, not the cause of it."

As education should be one of the computer's major roles, if not the major role, educational awareness gained by whatever means can only be to the good, and Widgit Software look all set to do more than their share of contributing.

Talking Back

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

MONEY AND THE MARKET

Edware Warr is a freelance computer journalist and ex-teacher, who spent several years becoming progressively afforded to teachers concerned with the future of micro-computing in education. Since embarking on his new career, he says, regretfully, he has had little reason to rethink his pessimism.

It is perhaps no surprise that, having exploited the home micro-market so successfully, both the hard and software companies are looking to what they see as the potentially highly lucrative educational field for their next major source of income.

In order to get the best out of this one, it's probably advias about the future of children, and, in the short term, about the difficulties faced by in-service teachers landed with the job of dragging the school system in this country, sulky and obstructive, into the 1980s.

Why then, are some software houses marketing educational programs so bad as to lay themselves open to the derision of any moderately computerate individual? And why have companies been known to launch computers intended to take their place in the Educational market without adequate software back-up? A computer without software is as much use to teachers and parents as a car without petrol to a rally driver. This is one of Sinclair's great strengths. He doesn't launch hardware without the necessary back-up and if there are doubts as to the robustness of his machines for classroom use, there can be none about the quality and availability of his software.

But what of RML, the one firm which has, if anyone has, tapped into this small goldmine which commerce is so sure exists in educational establishments. Why does RML take two weeks to repair the one and only cassette recorder (a model recommended by them for use with the RML computer and still under guarantee) belonging to a primary school less than 20 miles from their doorstep?

Why did the school have to take it to the RML and then chase up the equipment by 'phone only to be told that it hadn't even been looked at after a week and a half? Computing in the school continued courtesy of Spectrum and a ZX81 owned by members of staff. The £800 480Z system gathered dust in a corner.

It is time, and more than time, that the communication gap between the teaching profession and the manufacturers was bridged, and that those who attempt to makemoney from the market ensure that they deliver the kind of back-up that is vital to the successful exploitation of the micro in the classroom.

The opinions expressed here are not necessarily those of the editor or the publisher of Soft Options. The editor reserves the right to alter any submission for reasons of length or legality.

SOFT OPTIONS COMPUTING DIRECTORY

ED-SOFTWARE

Ed.SOFT
EDUCATIONAL SOFTWARE

76 Woodville Road, Exmouth EX8 1SW
Tel: (0395) 275741

Cassette based Educational Software for BBC micro. Suitable for all from 7 to 18. Programs from £4.95 include: Whatsit (20 questions type game). Wordflash (to aid in the increase of reading ages). MMaths/Placeval (add, subtract, divide, multiply and check place values). Progo (£9.95 LOG style includes DRAWN, MOVE, TURN and a manual). Also TRANSformation goemetry. ANAGRAM and BASICALLY BBC BASIC Booklet (£1) & others.

ECONOMICS ON THE BBC MODEL B

Educational packages to complement economics courses (O & A Level). Extensive graphics simulations. Fully interactive, for class or individual use. Manual included.

Beacon Educational Software (Ref AB) 16 Kingrove Avenue, Beeston, Nottingham NG9 4DQ.

COURSES

HOLIDAY COURSES FOR CHILDREN — Now Booking!
£46 for 5 mornings.
Adult Courses as usual
Ring: **COMPUTER WORKSHOP on 01-318 5488**
4 Lee High Road (Dept H.E.), Lewisham, London SE13 5LQ

COMPUTER REPAIR SERVICES

SP ELECTRONICS

Specialists in BBC Computers, Disc Drives, Printers and extensive range of software.
Full after sales service.

48 Limby Road, Huckwall, Notts. Tel: (0602) 640377

CLASSIFIED ADVERTISEMENT — ORDER FORM

1.	2.	3.
4.	5.	6.
7.	8.	9.
10.	11.	12.
13.	14.	15.

30p per word (min 15 words)

Please place my advert in soft options for weeks. Please indicate number of insertions required.

CLASSIFIED DEPT., HOBBY ELECTRONICS,
1 Golden Square, London W1.
Tel: 01-437 0699

Name .....

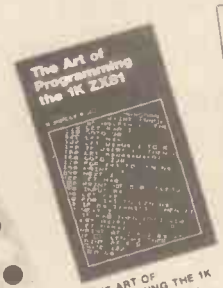
Address .....

42

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 ☐

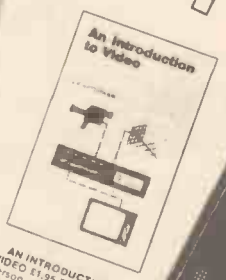
A Z80 WORKSHOP MANUAL £2.75 This book is intended for people who wish to progress beyond the stage of Basic programming to topics such as machine-code and assembly-language programming or need hardware details of the Z-80 based computer ☐

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 ☐

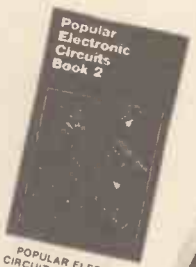


AN INTRODUCTION TO VIDEO £1.95 For the person who has just or is just about to buy or rent some video equipment but is not sure what it is all about ☐

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 130 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 ☐ 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

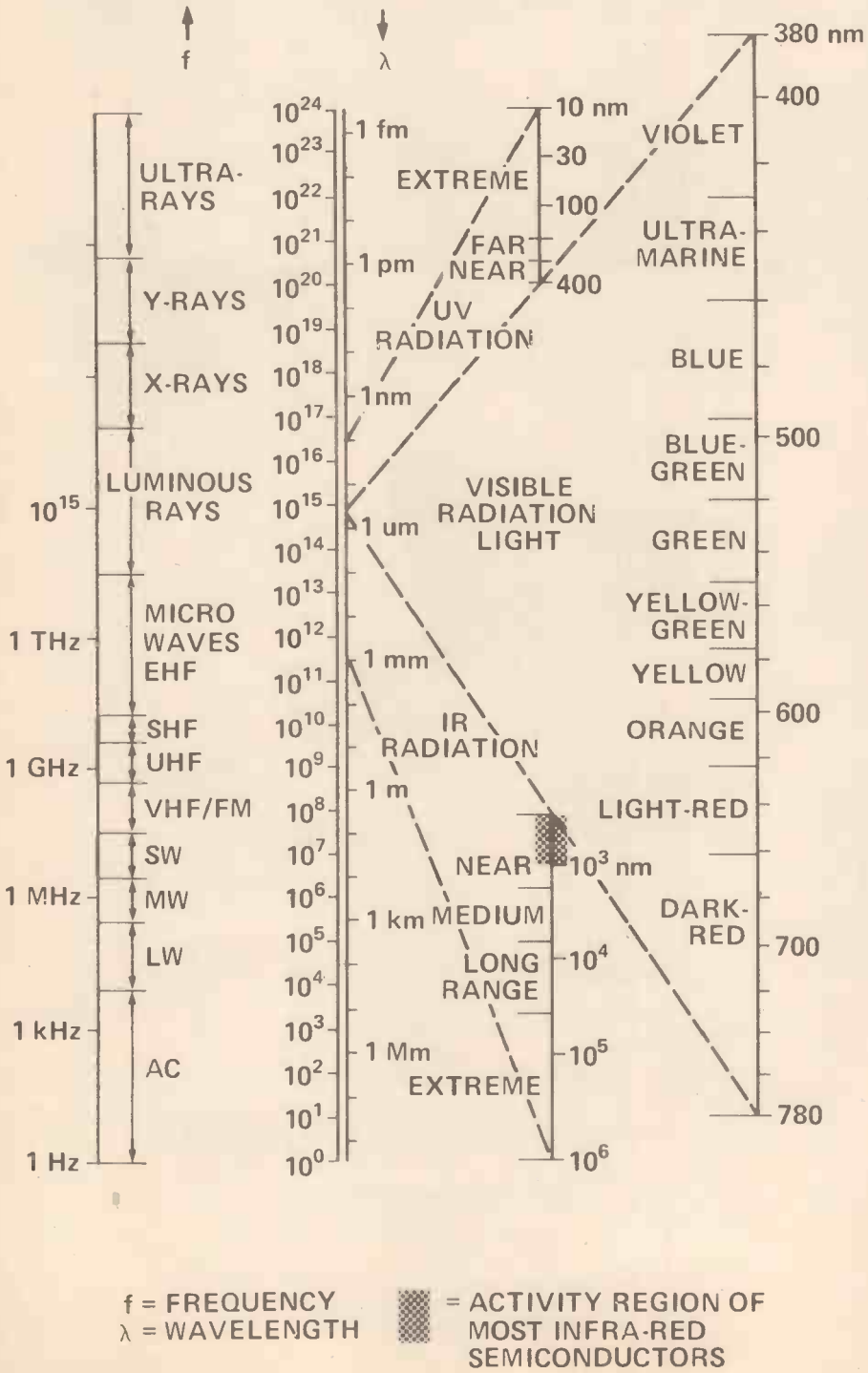
TOTAL PAYMENT £.....

Infra Red Link

Build a better mousetrap? Or any one of 1001 other gadgets or experiments with this simple infra red transmitter and receiver.

J. C. Burchell

Cirkit



f = FREQUENCY
λ = WAVELENGTH

= ACTIVITY REGION OF MOST INFRA-RED SEMICONDUCTORS

MOST people by now are familiar with the concept of infra-red remote control, either owning or having seen some of the many television sets, video recorders and hi-fi sets which are equipped with infra red handsets to allow remote control of their functions from the armchair.

All of these devices, like the infra red control link described in this article rely on the properties of a small group of semiconductors to either convert electrical energy into infra red light, or to reverse the procedure and convert the light energy of an infra red beam into a change in electrical potential.

Spectrum

Figure 1 shows the electromagnetic spectrum, and as can be seen infra red is a band of radiation just below visible light. All glowing objects tend to emit infra red, the largest infra red transmitter being the Sun.

Most infra red links use a special form of light emitting diode as the transmitting device, which emits infra red light when it is forward biased by a suitable current.

Figure 2 shows a typical PN junction diode.

When a forward current flows through the junction, electrons are injected into the P region and holes will recombine. When this happens energy band theory requires that the electrons jump from the high energy conduction band to the lower energy valance band. The surplus energy of the electron is converted to electromagnetic radiation.

Most infra red diodes consist of Galium Arsenide material (GaAs), and emit light in the 800 to 1000nm range. The receiver in most infra-red links is also based upon a special form of diode, and as the effect described above is reversible, a semiconductor junction exposed to

Figure 1. The electromagnetic spectrum, which includes all light, heat and nuclear radiations. The infra red band lies just below visible red.

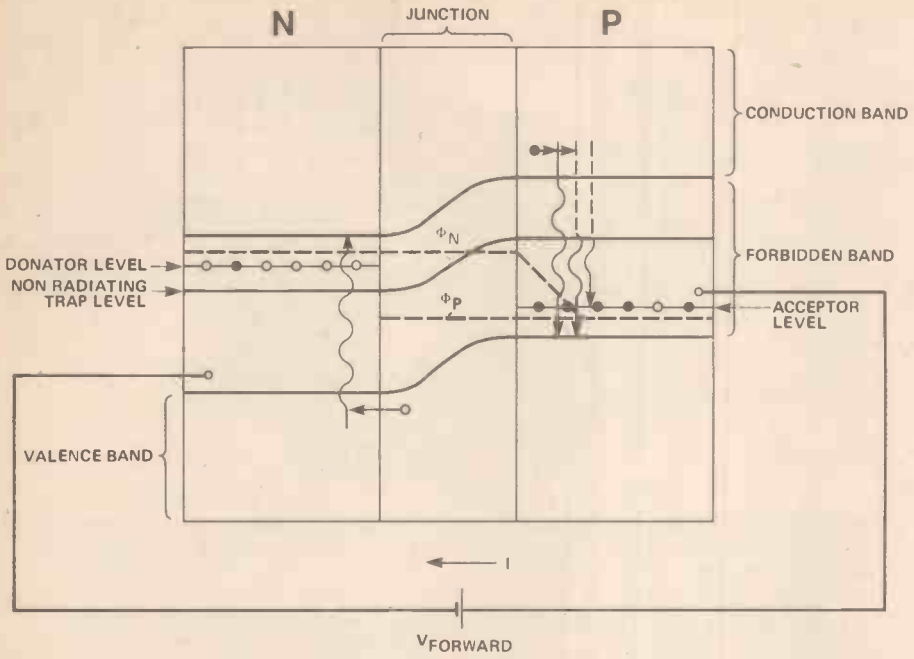


Figure 2. The PN junction of a Light Emitting Diode. When electrons jump from the conduction band to the valance band, their excess energy is converted into photons of light.

light will generate a photo-electric current, by virtue of photons hitting the material and liberating charge carrier pairs.

The Infra-red Link provides a low cost short range control system, capable of detecting the interruption of an invisible beam of infra red light. The link comprises two parts, the transmitter, and a receiver which energises a relay upon detection of the transmitted signal.

The relay is suitable for controlling loads of up to five amps at mains voltage, enabling the link to be used for a variety of projects from home security, through to object counting and clandestine photography.

A number of uses are given at the end of this article.

Block Diagram

Figure 3 is a block diagram of the infra-red link, as can be seen it consists of a transmitter emmitting a beam of infra-red light and a receiver detecting the transmitted signal and operating a relay. If the beam is broken or turned off then the receiver will detect this and release the relay.

Thus any external circuit connected to the relay will be turned on when the transmitted beam is present and off when it is not present.

The Circuit

Figure 4 shows the actual circuit diagram of the transmitter.

It is based upon an NE555 timer configured as an astable multivibrator. This means that the infra-red emitter, LED1 is pulsed on and off many times a second — for the values shown, the frequency of oscillation is around 5KHz.

Using a pulsed beam has a number of advantages over a continuous transmission. Firstly it encodes the beam in a manner which can be recognised by the transmitter, and used to differentiate the signal from the effects of other emitters, such as electric lights in the immediate surrounds. Secondly by picking a high frequency we can AC couple the transmitter circuit and make it immune to slowly changing ambient light levels, eg. going from daylight to night-time. Finally a power saving is achieved by pulsing the transmitter, which is useful when the transmitter is to be battery powered.

Preset potentiometer RV1 allows the transmitted frequency to be altered, allowing a degree of tuning up to take place according to the actual physical location of transmitter and receiver.

Receiver

Figure 5 shows the circuit of the receiver. LED 1 is the infra-red receiver diode which is reversed biased by R1. Infra-red light hitting the diode cause an increase in the minority carriers and a corresponding increase in the diode conduction. This will will cause a voltage drop at the junction of R1 and LED1.

The signal is then AC coupled to the op-amp by C1. This helps to give the receiver a high degree of immunity to ambient light level changes and the effects of electric light bulbs and fluorescent tubes.

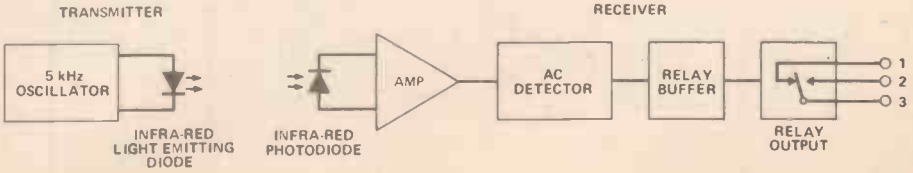
The op-amp, C1 is connected as a non-inverting AC amplifier, R2 and R3 bias the input to mid-rail. The gain of the amplifier is set by the combination of R4, R5 and C2.

At low frequencies the gain of the amplifier is close to unity, however as the frequency of the input signal rises the impedance of C2 lowers, thus increasing the overall gain of the amplifier, so that at the 5KHz or so of the transmitted signal the amplifier has a gain of several thousand.

Thus when the transmitted signal is being received by the receiver, the output of IC1 will be an AC signal of approximately 5KHz. This output signal is then AC coupled by C3 to the voltage doubler network of D1, D2, thus charging up the reservoir capacitor C4, sufficiently to turn Q1 and the relay on.

If the transmitted signal is removed or interrupted, then C4 discharges via R7, and the relay turns off. Resistors

Figure 3. The Block Diagram of the infra red transmitter/receiver link. Any object intervening between the two units will break the IR beam, switching the relay and anything connected to it.



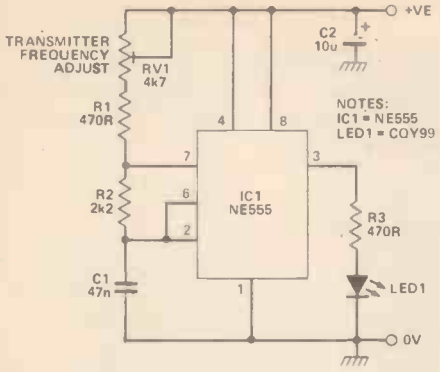


Figure 4. The Circuit of the transmitter stage.

R6 and C5 provide additional power supply decoupling to the amplifier, removing any spikes which might be caused by the relay turning on and off.

Diode D3 provides back EMF protection for Q1.

Construction

Both the transmitter and receiver are constructed or small printed circuit boards. The overlay and foil pattern for the transmitter is show in Figure 6, and that of the receiver is shown in Figure 7.

Pay particular attention to the orientation of the small electrolytic capacitors and the infra-red diodes. Note also that the two diodes are rather similar. The transmitter diode will either have two green dots or be purple in colour, whereas the receiver diode has only one green dot and will be transparent.

Leave the leads on the diodes fairly long and not mounted close to board. Use PP3 battery connectors for the supply take off points.

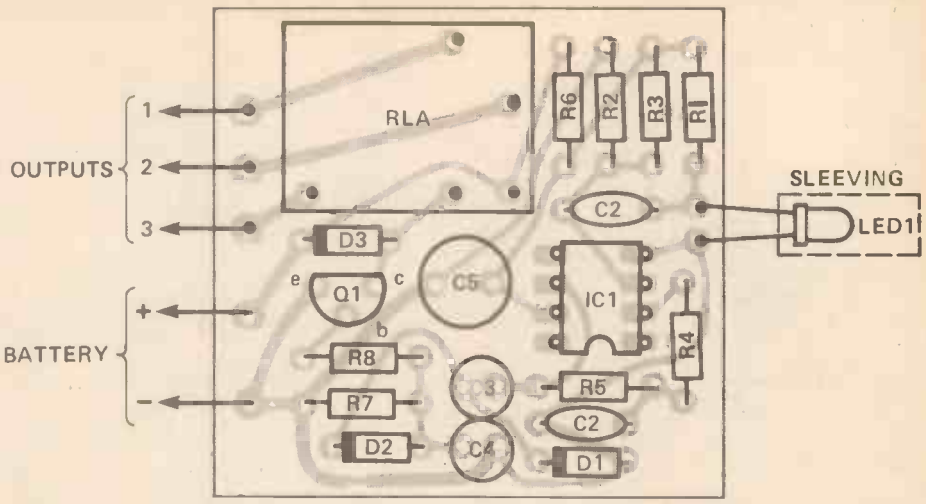


Figure 6. The PCB Overlay for the transmitter stage. Take care to orientate the electrolytics, and the IR diodes correctly, and not to mix up the transmitter and the receiver diodes.

Because the two circuits are fairly simple, the other forms of construction such as Veroboard may be used if desired.

Testing and Setting Up

The transmitter may be powered by any voltage source of eight to nine volts. When powered up you will not be able to see anything being emitted as infra-red is invisible to the human eye, however checking pin 3 of the NE555, with either a high impedance earphone or t
earphone or an oscilloscope should confirm the presence of a high frequency oscillation.

The receiver is best checked by powering up, and then bringing the transmitter close to LED1 at which point the relay should operate. If it does not then double check everything, it is possible to make further checks on the circuit by looking for the signal at the output of IC1, dabbing a wet finger on the junction of R2 and R3 will inject sufficient mains hum into the circuit to operate the relay if all is well. Capacitor C2, should be bridged with a 10u capacitor during this test.

In use, the reciever diode should be covered with a light guide, thus making it more directional and less sensitive to stray pick up. A small piece of rubber sleeving is ideal for this.

An operational range of upto 3.5m is possible, the only adjustment required is to alter RV1 for the best operation. The relay is provided with one set of changeover contacts

Figure 5. The Circuit of the receiver stage. The AC coupling to the op-amp gives a high degree of protection against interference from other light sources.

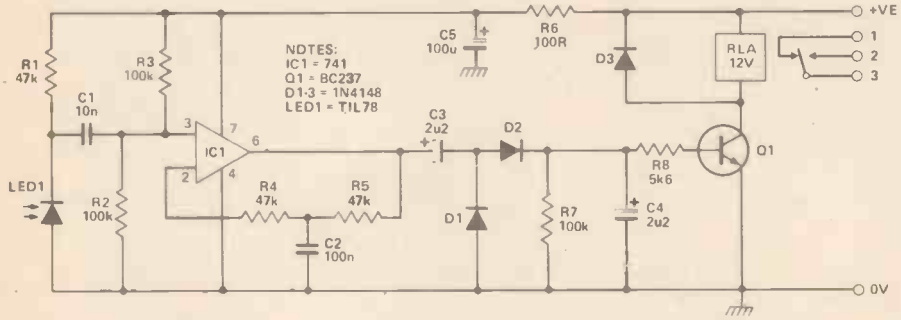
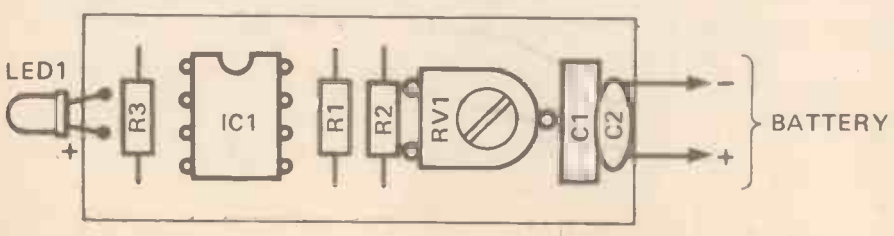
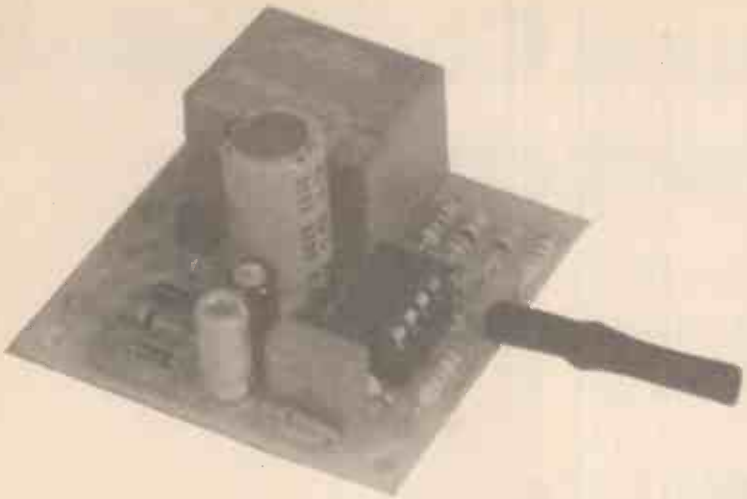


Figure 7. The PCB Overlay for the receiver stage. Look out for the receiver photodiode, which will be transparent and marked with a single green dot.





and these should be connected to the device under control, the use of changeover contacts allows you to select operation of the controlled device as a result of the beam being broken or made.

Uses

There are many possible uses for the infra red link. Just three by way of suggestion are detailed below.

1) As a burglar alarm.

The transmitter is placed on one side of a doorway and the receiver the other. As long as the beam is unbroken, eg no-one is walking through it the relay will be operated, however as soon as an object breaks the beam the relay will open and the alarm will sound.

2) Night photography of animals etc.

The beam is set up across the area of interest, and the relay output is taken to an electronic flash gun. The camera is left with the shutter open. When the beam is broken the flash will fire and a picture will be taken.

3) Computer experiments with gravity.

The computer is programmed to release the ball bearing from the electromagnet, then the computer can time the time taken for the ball to fall a known distance and break the beam, so that the acceleration due to gravity can be found.

Parts List

TRANSMITTER

RESISTORS
All ¼W carbon
R1, 3 ..... 470R
R2 ..... 2k2

POTENTIOMETERS
RV1 ..... 4k7 horiz preset

CAPACITORS
C1 ..... 47n ceramic
C2 ..... 10u 16V tant

SEMICONDUCTORS
IC1 ..... NE555 timer
LED1 ..... CQY99 infra-red emitter

MISCELLANEOUS
Printed circuit board; PP3 battery conector; solder etc.

RECEIVER

RESISTORS
All ¼W carbon
R1, 4, 5 ..... 47k
R2, 3, 7 ..... 100k
R6 ..... 100R
R8 ..... 5k6

CAPACITORS
C1 ..... 10n ceramic
C2 ..... 100n ceramic
C3, 4 ..... 2u2 16V tant
C5 ..... 100u 16V tant

SEMICONDUCTORS
IC1 ..... 741 op-amp
Q1 ..... BC237 NPN silicon
D1-3 ..... 1N4148 silicon diode
LED1 ..... TIL78 infra-red detector

MISCELLANEOUS
RLA ..... 12V relay with one change-over contact
Printed circuit board; battery connector; solder etc.

BUYLINES ..... page 26

Figure 8. One possible application for the IR link: as a burglar detector. Placed on the inside of the door, the opening door will break the beam before an intruder has time the alarm system.

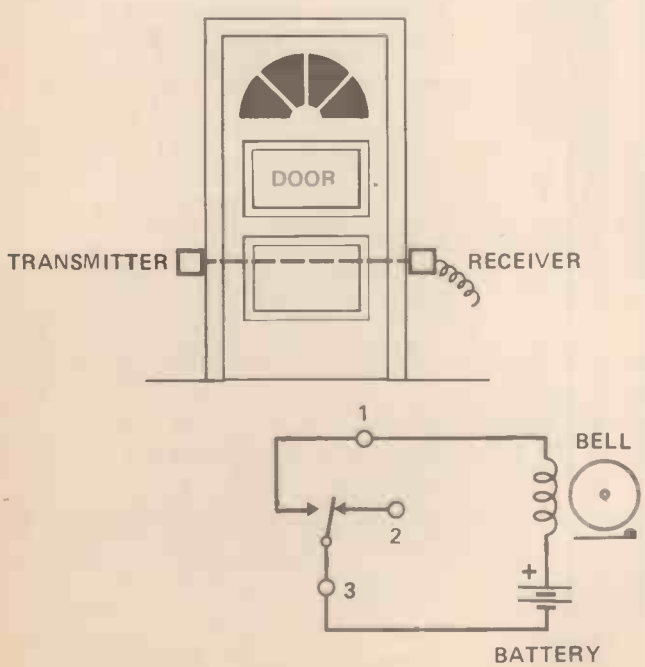
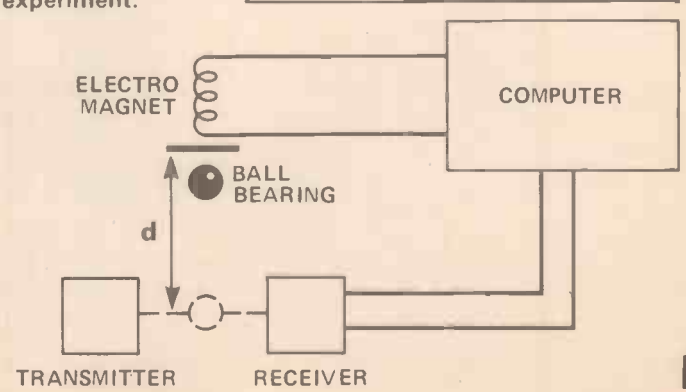


Figure 9. Another application: as a movement detector for a computer experiment.

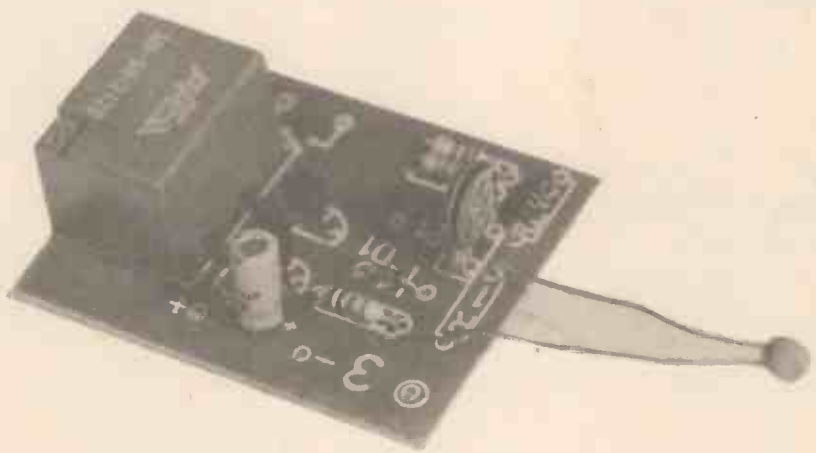


Temperature Controlled Switch

This thermistor-based temperature switch can be set for one of two temperature ranges.

J. C. Burchell

Cirkit



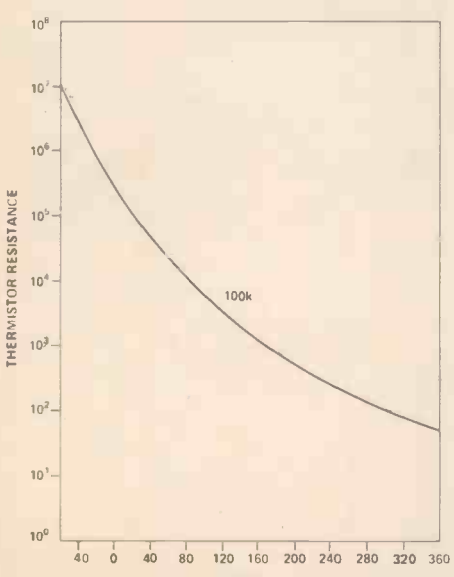
THIS simple temperature controlled switch allows the switching on and off of any electrical device when a preset temperature is reached in the range -10 degrees at 100 degrees centigrade is reached.

Temperature Zone

Obviously for the circuit to operate we need an electronic device whose properties vary with temperature. There are two main classes of devices which exibit suitable properties — semiconductor junctions and thermistors, we have chosen to use a thermistor in this circuit.

Thermistors are special forms of resistors manufactured from heavy metal oxides and designed to have strongly varying resistance versus temperature characteristics.

Figure 1. A graph showing the resitance/temperature characteristics of a typical thermistor.



It is possible to obtain thermistors whose resistance either increases, positive temperature coefficient or decreases, negative temperature coefficient with rising temperature. For a typical negative temperature coefficient resistor, the charge in resistance with temperature is betwen thee and six per cent per degree Kelvin rise.

Figure 1 shows the resistance temperature characteristics of a typical NTC thermistor, as might be expected the characteristic is far from linear, however, in a simple circuit such as this, there is no need to compensate for the lack of linearity.

Circuit Description

Figure 2 shows the circuit of the temperature sensor, which despite its simplicity is capable of giving accurate and stable results over a wide range of temperatures.

The preset, RV1 allows the operating temperature to be set, and is adjusted so that below the desired trip point, the voltage on the base of Q2 is sufficient to keep it switched on. As the thermistor heats up the voltage on the base of Q1, which is derived from the potential divider chain of R1, R2, RV1 and TH1, will drop, eventually allowing Q1 to switch off. As soon as Q1 switches off the voltage on the base of Q2 rises and the relay is switched on. The diode, D1 provides temperature compensation for the two transistors, and C1 acts as a back EMF absorber for the relay.

As shown, the range of the circuit will be for temperatures between 35 to 100 degrees centigrade. If R1 is replaced by a 10k resistor then a range centred on zero degrees will result.

When the relay is inoperative the consumption of the circuit is very small in the order of 2 to 3mA, it may thus be powered from either batteries, or a small DC power unit.

Construction And Testing

A simple circuit such as this may be built onto a small PCB and a suitable layout together with overlay is shown in **Figure 3**.

Once built, the circuit should be double checked for correct orientation of diodes, transistors and capacitors,

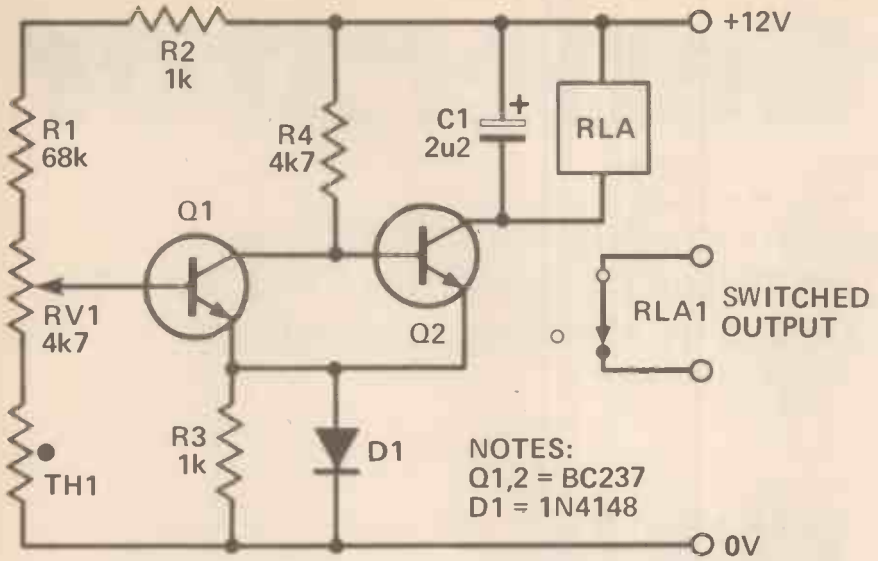


Figure 2. The Circuit. With R1 at 68k, switch will operate for temperatures between 35 and 100°C, with R1 at 10k, it will operate over a range centred on 0°. The exact temperate at which the switch should operate is set by RV1.

Parts List

RESISTORS
All ¼W 5% carbon
R1 ..... 68k
R2,3 ..... 1k
R4 ..... 4k7

POTENTIOMETER
RV1 ..... 4k7 vertical preset

CAPACITOR
C1 ..... 2u2 40V tant

SEMICONDUCTORS
Q1, 2 ..... BC237 NPN silicon
D1 ..... 1N4148 silicon diode

MISCELLANEOUS
TH1 ..... NTC thermistor
RLA ..... 12V PCB relay
Printed circuit board; connecting wire; solder etc.

BUYLINES ..... page 26

and then powered up. The thermistors have no intrinsic polarity, and may thus be wired in without regard to orientation.

Set the preset RV1 to approximately mid-range, and then warm the thermistor up by some means of indirect heating, eg bring a light bulb, or ga
or fan heater close to it. After a short while the relay should be heard to operate and any external circuit connected to it will be turned on. If the source of heat is now removed the thermistor will cool down and the relay will open.

If in use the thermistor is to be immersed in liquid then it will be necessary to further encapsulate it by covering the thermistor and its leads with a suitable epoxy resin.

Once operation is established, the correct operating point of RV1 should be set by reference to a thermometer.

Uses

The relay output can be taken to either an alarm unit, or some form of heating, or cooling device. When selecting a suitable site for the temperature sensor, be careful to avoid placing it in a position where it will be subjected to extraneous external factors, such as draughts, or hot water pipes etc.

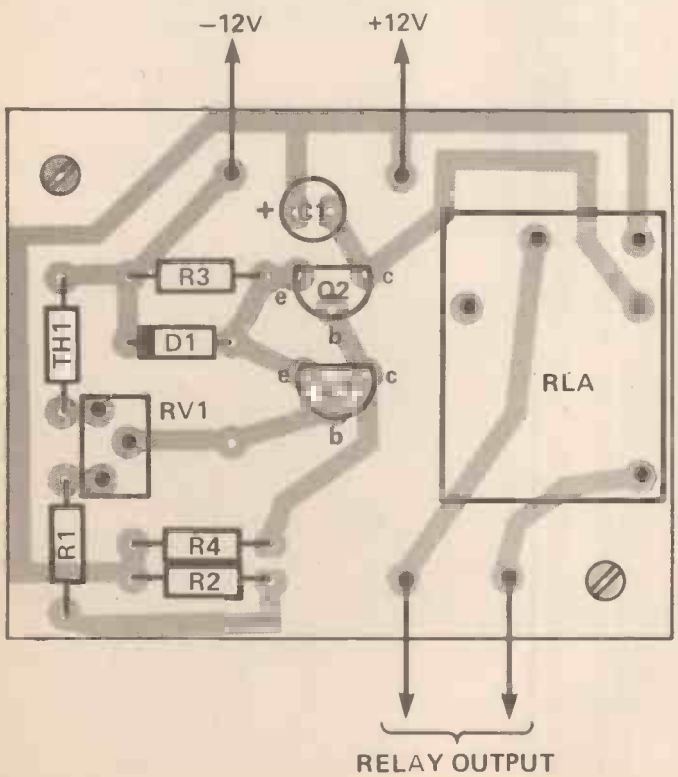
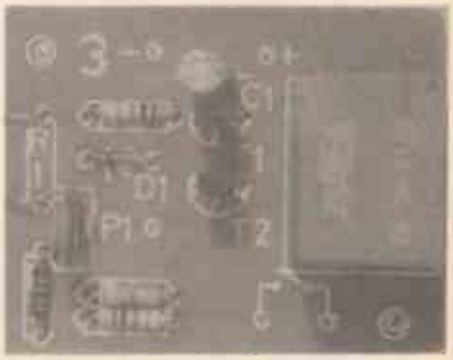


Figure 3. The PCB Overlay. Check the circuit for orientation of diodes, etc. The orientation of the thermistors, on the other hand, is not important.



Signal Generator

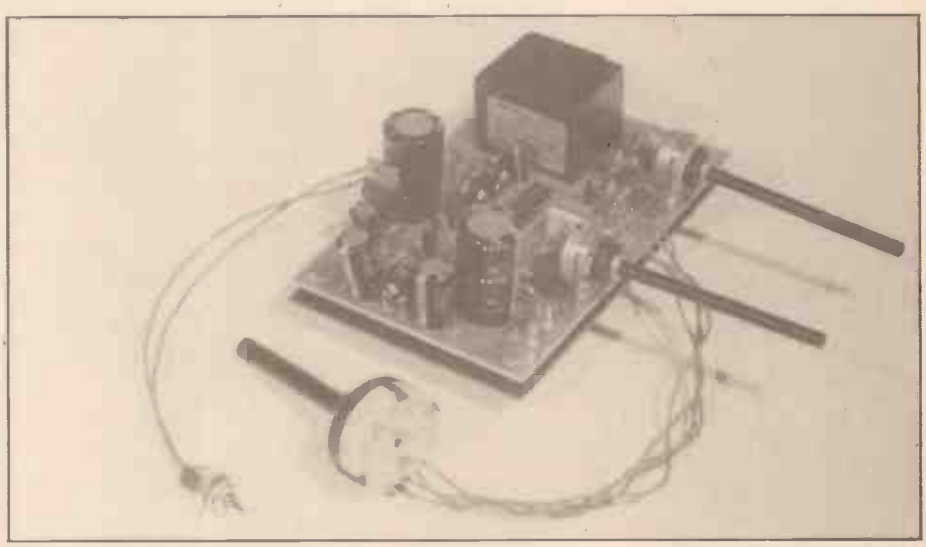
All the components of this versatile three-function signal generator fit onto one PCB, so that it can be cased by itself or with other equipment.

J. C. Burchell

Cirkit

THIS versatile signal generator produces sine, triangle and square waves over the range 1Hz to 1MHz making it invaluable in the workshop for setting up and testing a wide range of equipment both analogue and digital.

The construction is extremely compact as all components and a mains power supply are assembled onto one PCB, enabling the finished generator to be either housed in a standard case or fitted into a piece of existing test gear.



Circuit Diagram

The audio signal generator, **Figure 1** is based around the XR2206 monolithic function generator, an internal block diagram of which is shown in **Figure 2**.

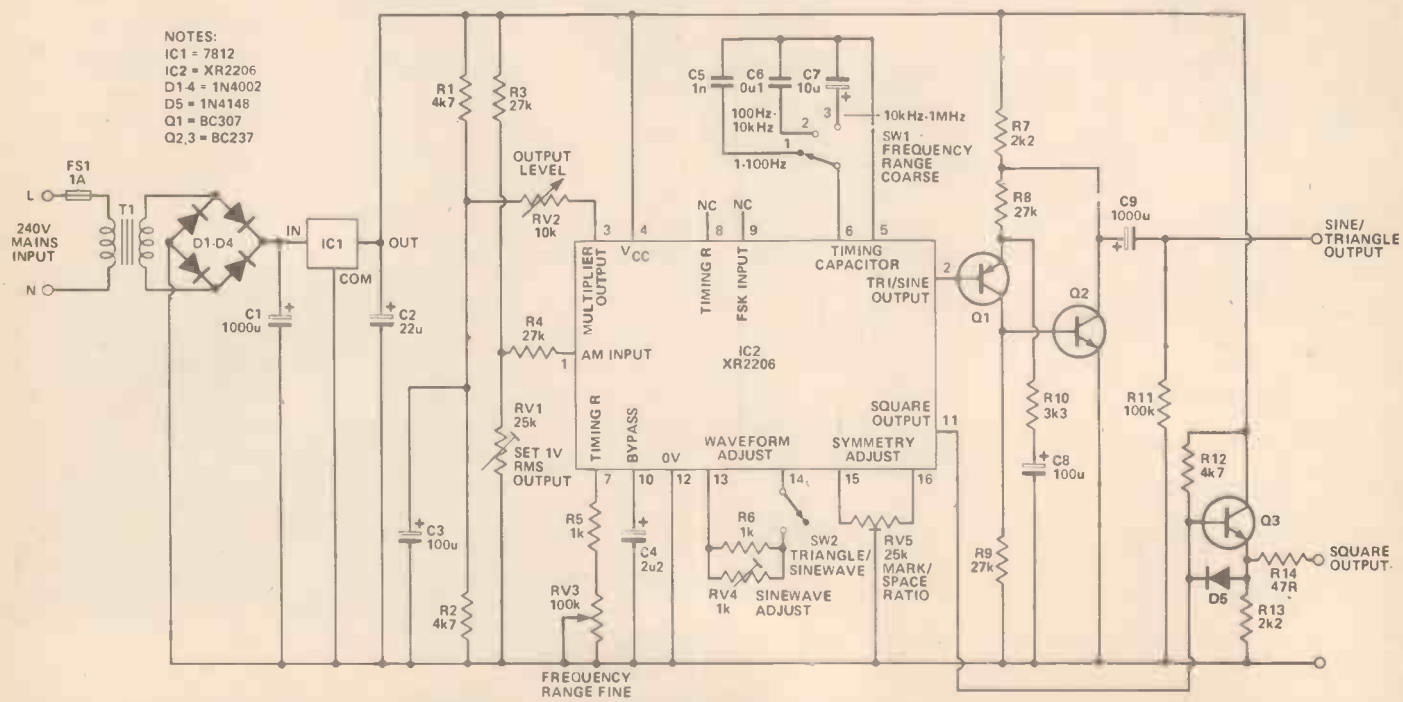


Figure 1. The Circuit. The single XR2206 function generator chip produces square and sine or triangle waves.

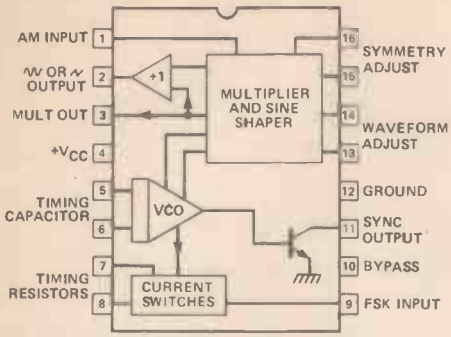


Figure 2. An internal block diagram of the XR22L6 function generator chip.

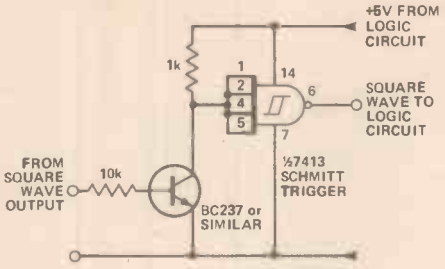


Figure 3. A simple buffer for connecting 12V square wave to a standard 5V logic circuit.

SPECIFICATION

Frequency range	1Hz to 1MHz
Output level: Sinewave	one volt RMS
: Squarewave	12 volts peak to peak
Sinewave distortion	0.5 percent typical
Outputs: Squarewave	12V fixed P-P
: Sinewave	
: Triangle	variable upto one volt RMS
External controls	range
	fine frequency
	output level
	sine/triangle select
Supply	self contained, 240V mains input

The 2206 contains four building blocks for a function generator, most importantly is the Voltage Controlled Oscillator, whose frequency is set by the combination of a capacitor across pins five and six and the timing resistor connected to pins seven and eight. The VCO provides two outputs, the first used as a sync or square wave output, whilst the second is taken to a waveform generator and shaper block. By altering the resistance between pins fourteen and thirteen it is possible to select either a triangle or sine wave output.

The waveform from the multiplier and shaper block is then further buffered so as to offer a low impedance to any following circuit.

Thus the single integrated circuit is capable of simultaneously producing square waves, and either sine or triangle wave outputs.

The sine/triangle wave output can be both frequency and amplitude modulated if desired.

Range selection is made via a three way switch which alters the value of the timing capacitor connected between pins five and six. The frequency of output is then varied by RV3, which alters the value of the timing resistance connected to pin seven.

Potentiometer RV2 adjusts the gain of the multiplier, and RV1 is set up so that with RV2 fully clockwise a standard output of one volt RMS is obtained.

Preset RV5 allows adjustment of the waveform symmetry, whilst the selection of sine or triangle is effected by the combination of SW1 and preset RV4.

The sine/triangle output is passed through a simple buffer amplifier consisting of Q1 and Q2, before being finally decoupled to the output by C9. The square wave output is buffered by Q3, note that this signal is approximately 12 volts peak to peak and so cannot be directly coupled to standard five volt logic circuits, without futher voltage conversion. A simple buffer circuit is shown in **Figure 3**.

A simple power supply consisting of IC1 and associated components provide the required 12 volts for the circuit.

Construction

A circuit of this complexity is best constructed on a PCB, and a suitable layout together with a component overlay is detailed in **Figure 4**.

When constructing the circuit take care to fit all of the active components with the correct orientation as it is possible to destroy them if they are incorrectly placed. As the mains transformer is mounted directly onto the PCB it is important to take additional care in the construction, also note that on the topside of the PCB the fuse is live, and extra care should be taken around this area.

It is a good idea to mount underneath the PCB on spacers, an additional plastic cover, thus helping to prevent accidental bridging of the PCB tracks.

The choice of housing depends on the preference of the constructor, but

Parts List

RESISTORS
All ¼ carbon 5%
R1, 2, 12 ..... 4k7
R3, 4, 8, 9 ..... 27k
R5, 6 ..... 1k
R7, 13 ..... 2k2
R10 ..... 3k3
R11 ..... 100k
R14 ..... 47R

POTENTIOMETERS
RV1, 5 ..... 25k horiz preset
RV2 ..... 10k linear
RV3 ..... 100k log
RV4 ..... 1k horiz preset

CAPACITORS
C1, 9 ..... 1000u 25V radial electro
C2 ..... 22u 25V radial electro
C3, 8 ..... 100u 25V radial electro
C4 ..... 2u2 25V radial electro
C5 ..... 1n carbonate
C6 ..... 0u1 carbonate
C7 ..... 10u 25V radial electro

SEMICONDUCTORS
IC1 ..... 7812 12V 1A regulator
IC2 ..... XR2206 waveform generator
Q1 ..... BC307 PNP silicon
Q2, 3 ..... BC237 NPN silicon
D1-4 ..... 1N4002 silicon rectifier
D5 ..... 1N4148 silicon diode

MISCELLANEOUS
T1 ..... 15V 120mA mains transformer
FS1 ..... 1A PCB mounting
SW1 ..... 1 pole 3 way rotary
SW2 ..... SPST min toggle
Printed circuit board; plastic insulating base; connecting wire; solder etc.

BUYLINES ..... page 26

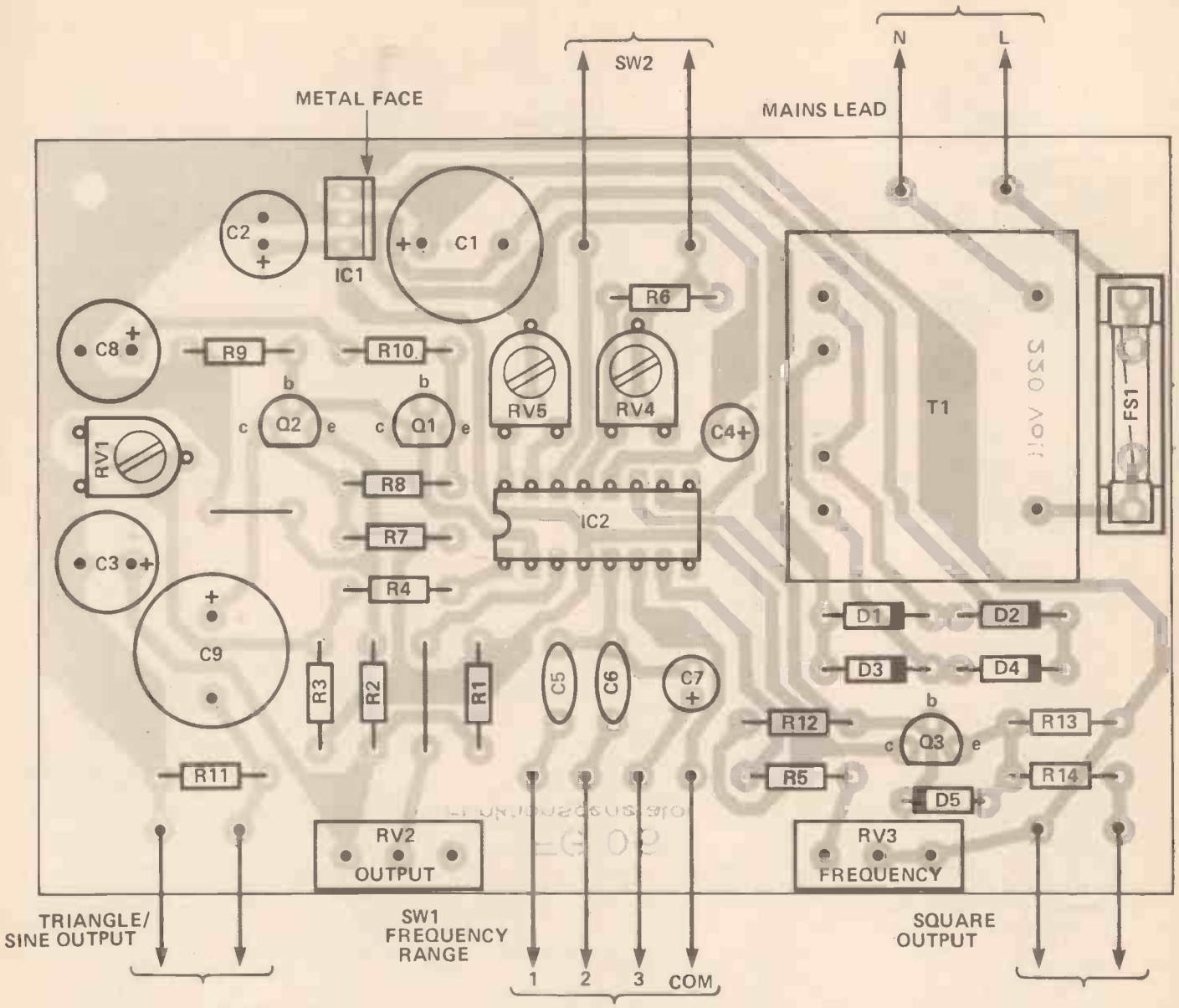


Figure 4. The PCB overlay. The fuse is live on the top surface of the board, so extra care should be taken with construction to ensure safe and accurate operation. Check component orientations carefully.

a metal case should be employed for reasons of safety. The choice of output sockets also depends on how the unit is to be used, but 4mm terminals seem to be the more versatile types to use.

Finally, remember to use a socket for IC2 as this is an expensive device.

Adjustment

Having checked that the PCB is free from solder splashes etc, and all seems well the unit may be connected to the mains. Remember that the area around T1 is potentially dangerous from mains voltages and great care should be taken when adjusting the various presets.

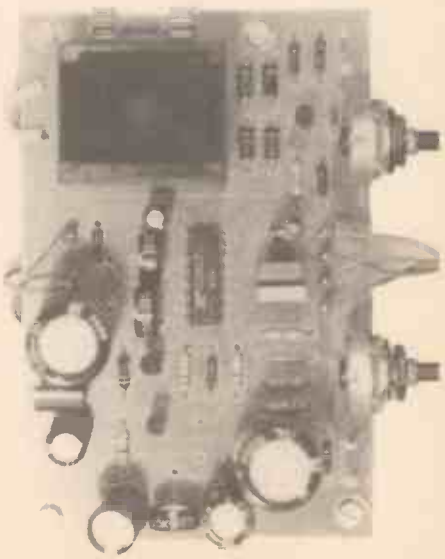
Set SW1 to position two, 100Hz-10kHz, and RV3 to about mid-position. If an oscilloscope is available connect it to the positive end of C9. Switch SW2 should be closed, ie in the sinewave position. Set RV5 to mid-position and adjust RV4 for the best possible waveform. Next adjust RV5 for the best waveform without clipping occuring. Repeat the above procedure until no further improvement can be obtained.

Finally, set RV2 fully clockwise and adjust RV1 to give a one volt RMS output. If no oscilloscope is available then the presets can be left at about mid-position as this setting seems to give a reasonable waveform.

In Use

The use of the signal generator is fairly self explanatory. Because of the extended frequency range, up to 1MHz it is possible to use the generator in both digital and analogue circuits. A typical use here would be in the testing of long wave and medium wave radios, and in particular testing of IF amplifiers and the like.

The square wave output could equally well be used to provide the "external clock" signal to digital circuits, but remember that the output is at 12V and thus the buffer of **Figure 3** must be used to interface to TTL circuits.



All About Batteries

This month, the second part of our look at, and inside, batteries continues with a round-up of rechargeable batteries: expensive, but an investment.

Keith Brindley

THE CELLS we looked at last month — zinc carbon, alkaline manganese mercury, silver, zinc air, and lithium cells — were all classed as *primary* cells. That is, when their store of chemical energy has been changed into electrical energy, and used up, they are no longer useful as sources of power. Other types of cells exist, however, known as *secondary* cells which may be recharged i.e, the chemical reaction which supplies the electrical energy is reversible. Using secondary cells, it is therefore possible to use the cells as a power source, as and when required, until discharged, when the cells may then be recharged for further use.

Secondary cells are more expensive than the equivalent primary cells in terms of initial outlay, particularly because it is usually necessary to buy recharging equipment too, but it may be that the long term cost of secondary cells are lower. Obviously, it is the consumer's choice as to which type of cell is used, but in this second part of our HE battery survey we aim to give an idea of the comparative costs of popular secondary and primary cells.

Lead Acid

One of the most popular types of secondary cells is the lead-acid cell which is the usual cell found in car batteries. Typical cell make-up is shown in **Figure 1**, and is seen to consist of interlaced cathode and anode electrode plates in a sulphuric acid electrolyte solution. The interlaced plates allow large surface area contact between each electode and the electrolyte, while keeping overall cell size (volume) as low as possible. The greater the surface area contact between plates and electrolyte, the greater the possible chemical action and the lower the cell's internal resistance, so naturally a great deal of research has gone into ways of increasing surface area contact. A common method is to use very thin plates separated, as shown, by porous insulators which prevent electrical contact.

The anode electrode is generally constructed of pure, soft lead, whereas the cathode is generally a lead/lead peroxide mixture. As electrical energy is taken from the cell so that it discharges, lead atoms from the anode ionize as positively charged ions into the electrolyte, leaving electrons to enter the connected circuit, as shown in Figure 2.

At the cathode, the lead peroxide ionizes into a strongly positively charged lead ion and also negatively charged ions. The strongly positively charged lead ions take electrons from the connected circuit, and thus become positively charged lead ions of the same type as at the anode, and leaving the circuit at the cathode form a current through the circuit.

Lead ions from both electrodes react with the sulphuric acid electrolyte, forming lead sulphate (which forms as a white deposit on both electrodes) and hydrogen (which combines with the oxygen ions produced from the cathode — forming water).

We can write a formula for the whole chemical process:

$$PbO_2 + Pb + 2H_2SO_4 \rightleftharpoons 2PbSO_4 + 2H_2O$$

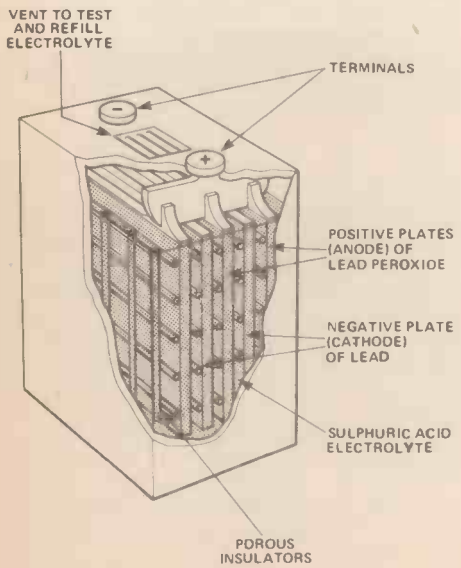


Figure 1. Cell make-up of a typical lead-acid cell. Interlaced anode and cathode electrode plates allow a large surface area contact between plates.

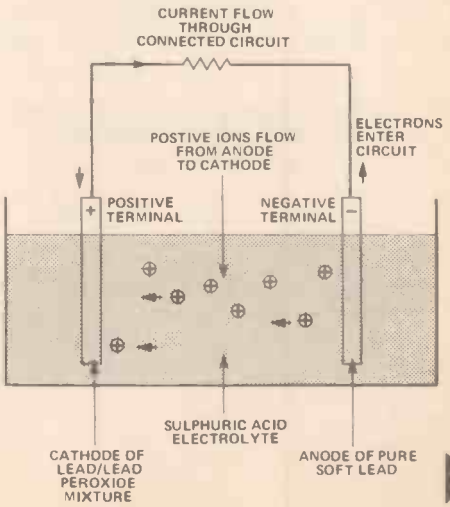


Figure 2. Positive lead ions leave the anode into the electrolyte. Electrons are thus free to enter the connected circuit, effectively forming a current from cathode to anode.

which shows (by the two way arrow) that the chemical reaction is reversible, so that we can recharge the cell by connecting a circuit to the cell which forces electrons into the anode and from the cathode — we'll look at such a circuit, soon.

The formula also shows that the electrolyte solution will be diluted by the manufactured water molecules, as the cell is discharged. This provides us with a useful method of testing the charge/discharge state of the cell. We can — by measuring the specific gravity of the electrolyte — tell that a cell is nearing its discharged state, and thus recharge it. Typical specific gravity of a fully charged cell is about 1.25 and typical discharged specific gravity is about 1.2. A hydrometer is the measuring instrument used. Nominal cell voltage is 2V.

The lead acid cell has been around in one form or another now for a long time. Recent improvements, however, have given it a new lease of life. For example, sealed batteries with a solid electrolyte are available which are entirely maintenance-free and may be used in any position. This can make them a useful alternative to ordinary, dry primary cells in portable equipment, with the advantage that they are rechargeable. Typical cell structure in a three-cell (i.e., 6V) battery is shown in **Figure 3.**

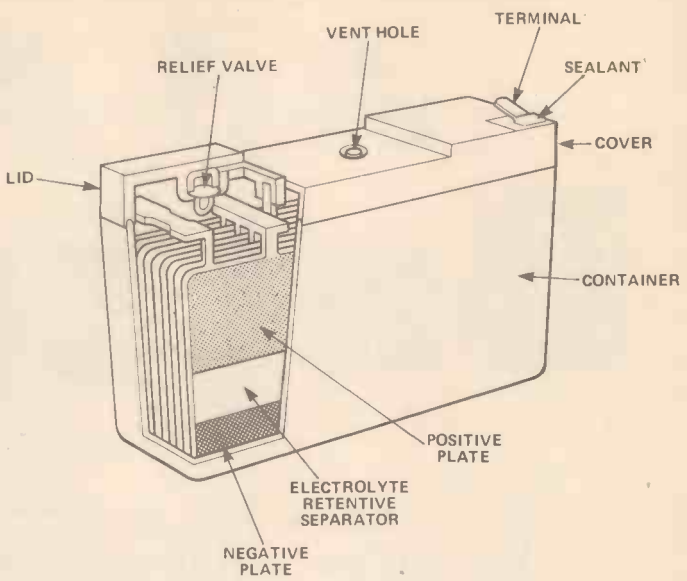


Figure 3. Cell structure of a typical sealed lead-acid battery. Such a battery may be used in any position without spilling electrolyte, and is useful in portable equipment.

Putting It Back

Recharging the lead acid cell is a relatively simple job of applying a reverse current, forcing the chemical reaction (from right to left in the formula) which charges the lead sulphate back to lead and sulphuric acid. The easiest way of producing such a current is to connect the cathode (ie the positive terminal) and the anode (ie the negative terminal) to the positive and negative terminals of the DC voltage source. The voltage supplied by this source may be anything from about 1.1 to 1.25 times the total battery nominal voltage. So, a single cell of nominal voltage 2V may be charged at anything between 2.2V to 2.5V. An ideal example is the car battery again (nominal voltage 12V ie six cells) which is charged by the alternator or generator/regulator combination, at a constant voltage of about 14V.

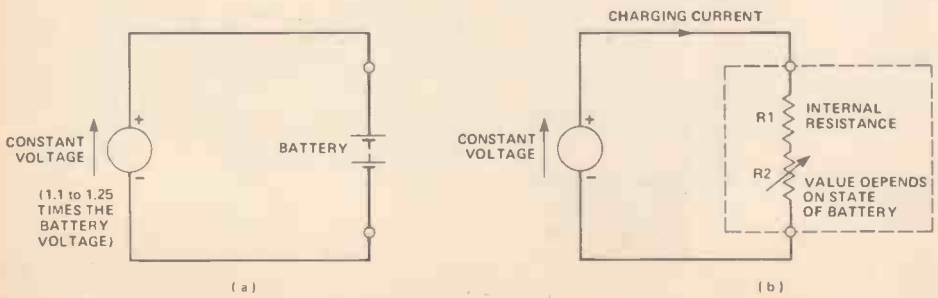
Obviously, the applied reverse current value depends very much on the applied voltage and also on the state of discharge of the cell. The higher the applied voltage and the more the cell is discharged, the higher the recharge current. If the cell is used in a cyclic fashion (ie, from fully charged to fully discharged then recharged again), a high recharge current should be used. But if the cell is to be kept 'topped up' with charge, say, as a car battery would be, then a lower recharge current should be used. This, of course, is the reason why a car battery of 12V is only charged with a voltage of about 14V — about 1.17 times the battery voltage.

A circuit which may be used to charge a lead acid battery is shown in **Figure 4a** where a constant voltage is shown connected to the battery. An equivalent circuit is shown in **Figure 4b** where we can see that the battery may be considered to be a combination of two resistors. Resistor R1 is the battery's internal resistance, which is present in the battery whether it is charging or discharging. Resistor R2 is variable and is defined by the discharge state of the battery. When the battery is fully discharged, the resistance is low, and so the charging current is high. However, when the battery is near or fully recharged, resistor R2 value is high and so the charging current is low.

It is this fact which enables us to be able to check the charge state of a battery simply by observing the value of the charging current. Note that this is strictly only true if the charging voltage is constant, ie from a regulated and stabilised power supply. The ordinary car battery-type of battery charger does not supply a constant voltage and an accurate measure of battery charge state is not therefore possible using such a battery charger.

A reasonably fast recharge of these batteries will be possible, using a constant recharging voltage of 1.25 times nominal battery voltage, if the recharging current is observed and the recharge terminated when the current falls to the final recharge current which will be specified by the manufacturer. Under these measured conditions a full recharge (ie, from when the battery is completely discharged to when it is completely recharged) can take place in about five hours. If a perfectly constant recharging voltage is not available then it is not advisable to recharge at such a fast rate because irreparable damage could occur to the cells. In this case a trickle recharge voltage of about 1.1 to 1.2 times the nominal battery voltage is best used — with a recharge time in excess of twenty hours or so.

Figure 4a. Charging a lead-acid battery. A constant voltage of 1.1 to 1.25 times the nominal battery voltage should be applied. 4b. An equivalent circuit of the charging circuit of 4a.



Nickel Cadmium

The other main type of secondary rechargeable cell is the nickel cadmium (nicad) cell. Sometimes nicad cells have been called DEAC cells, after the company which produced them in the 40s and 50s — Deutsche Edison Akkulumulatoren Company — in Germany.

The positive electrode of a nicad cell is a nickel hydrate, and the negative electrode is a cadmium hydroxide. Electrolyte is a potassium hydroxide solution. As with the lead acid cell we may represent and summarise the

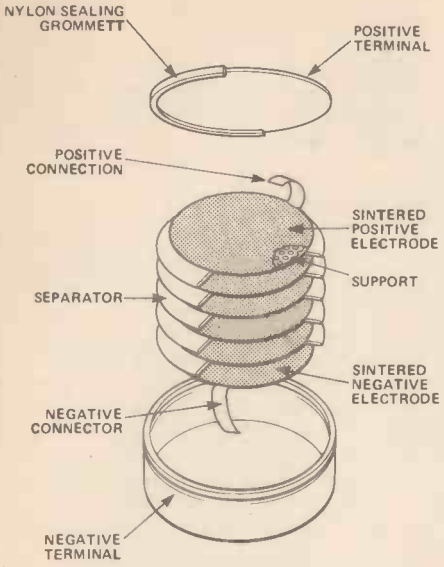


Figure 5. Make-up of a nicad button cell. Sintered electrodes allow a large surface area contact and rapid oxygen migration between positive and negative electrodes.

charge/discharge chemical reaction with a formula:

$$Cd + 2NiOOH + 2H_2O \rightleftharpoons Cd(OH)_2 + 2Ni(OH)_2$$

where the fully recharged state is on the left and the discharged state is on the right. In a fully recharged cell the negative electrode is pure cadmium, which oxidises during discharge. The positive electrode goes from a high to a lower level of oxidation during discharge.

During recharge, the main positive electrode reaction is accompanied by another, side reaction, which produces oxygen. By constructing the cell so that the oxygen can migrate rapidly from the positive electrode to the negative electrode where it recombines, the oxygen build-up is not normally a problem.

A similar side reaction at the negative electrode, producing hydrogen occurs when the negative electrode is in a fully recharged state. By making sure there is a greater quantity of negative electrode than positive we can ensure that this release of hydrogen does not occur.

We can see that when a cell is fully recharged, therefore, all the current passing into the cell is then used to produce oxygen at the positive electrode, which passes to the negative electrode, for recombination. It is essential that cells are constructed to aid this recombination because if it does not occur the oxygen build-up may cause irreparable damage. Construction of a typical nicad button cell is shown in **Figure 5** where we can see that the use of a sintered plate construction allows the plates to be very porous, aiding oxygen migration from positive to negative electrodes. Sintered plates also give the added advantage that the effective surface area of each electrode is greatly increased. If such a button cell is overcharged, with a current which causes excessive oxygen build-up, it will literally explode, so great care must be taken when recharging. An added problem occurs because the recombination reaction of the oxygen and the negative electrode is exothermic and will cause the cell temperature to rise — which may also damage the cell.

Problems

The first problem, of cell explosion, is successfully alleviated by the use of a cylindrical nicad cell, the typical construction of which is shown in **Figure 6.** Here, we can see that sintered positive and negative electrodes are again used, but this time in a cylindrical spiral. A safety vent is featured in the cell lid which releases oxygen at pressures over about ninety pounds per square inch. Therefore if the cell is overcharged with too high a current the oxygen build-up is relieved — the cell is said to have "vented" if this occurs — and the cell will not explode. However, once lost the oxygen cannot be replaced, a factor which prevents the cell from string as much energy as it was orginally capable of.

Cylindrical cells are capable of storing much more energy than button cells of equivalent sizes, and also will provide much greater currents (they have a lower internal resistance). The key to the success of the cylindrical cell is the micro-porous pure nickel mesh used to form grids onto which nickel hydroxide and cadmium hydroxide may be precipitated to form the positive and negative electrodes. Nickel strips are welded to the electrodes and make

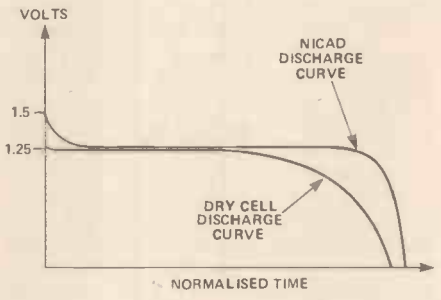


Figure 7. Graph of cell voltage against time, comparing a dry cell and a nicad cell, with a constant discharge current.

contact with the plated-steel battery casing and top.

One of the advantages of this type of cell construction is that cells may be made in virtually any of the commonly available primary cell sizes, AAA, AA, C, D, and even PP3-size, as well as others. This means that nicad cells may often be used as a power source in ordinary home-type battery-powered equipment such as radios, cassette players, torches etc. Nominal voltage of a nicad cell is about 1.25V, which, when compared with the nominal voltage of a typical dry-cell — about 1.5V — might lead us to the conclusion that a lot of equipment may not function properly if we simply

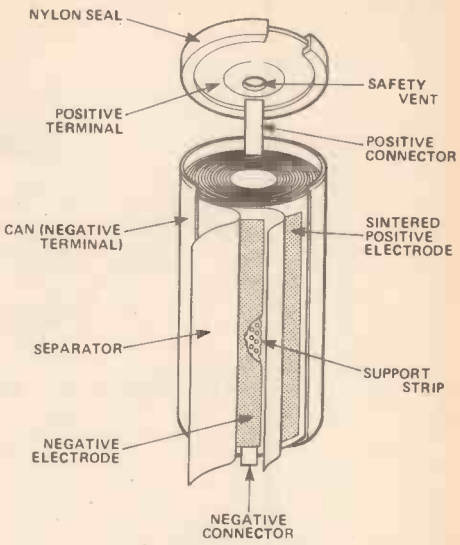


Figure 6. Make-up of a nicad cylindrical cell. The sealed vent in the cell opens at high pressures, prevent explosion due to overcharge.

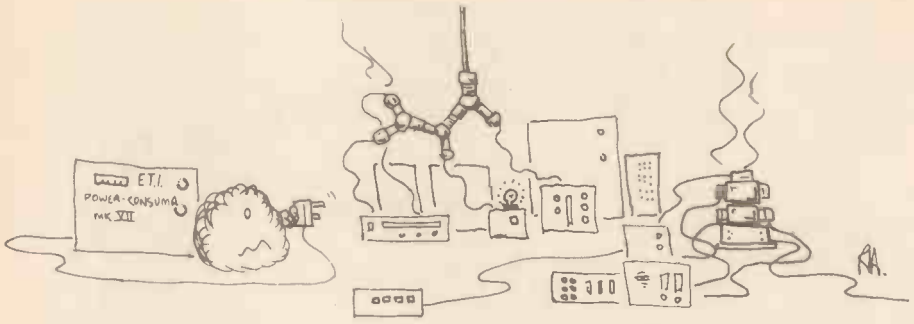
replace existing dry-cells with their equivalent nicad counterparts. On the whole this is not true because of two factors:

1) The dry-cell voltage is a no-load voltage, which will inevitably fall slightly when a load draws current. In the last part of **All About Batteries** we saw this was due to the internal resistance of a cell. With many cells, the actual voltage will be as low as about 1V (or even less) when in use. The extremely low internal resistance of a nicad cell means that its actual voltage remains at 1.25V. In many applications, therefore, the seemingly low nominal voltage of nicad cells will actually give better performance from the equipment they are used in.

2) Dry-cell voltage varies considerably with time. If we were to plot a graph of a dry-cell's voltage against time and compare it with a similar nicad cell graph (**Figure 7**) we can see that although the dry-cell voltage may be higher than the nicad cell voltage at commencement of the plot, as it discharges it will eventually become lower than the nicad cell voltage. In fact, the nicad cell output voltage is so constant and the final discharge point ie, the time when the cell may be thought of as fully discharged, occurs so rapidly that equipment powered by nicad cells may be operating satisfactorily one second and then stop the next, as the final discharge point is reached.

Hence The Price

Assembly of nicad cells is carried out under rigidly controlled conditions and the materials used, along with the elaborate techniques, obviously make them very expensive to purchase. They are, in fact, about 2½ times the price of



Mains Power isn't always the ideal solution!

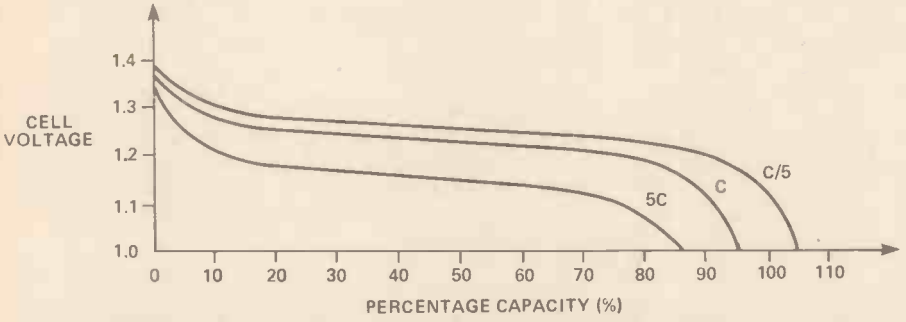


Figure 8. Showing how nicad cell capacity varies within discharge rate.

equivalent sized alkaline manganese cells and only about a quarter the energy capacity. On first sight it would appear that they may not be worth the cost, until we remember that nicad cells are rechargeable and may be used many times over — unlike primary cells such as alkaline manganese. To find out whether nicad secondary cells are more cost effective than primary cells we need to look at how they mey be recharged.

In order that a nicad cell may be successfully recharged without damage, but fully charged, we need to know its capacity. A nicad cell's capacity is the total amount of electrical energy which it is possible to obtain from it when it is fully charged. It is expressed as a number of amp-hours, or milliamp-hours. As with any cell, however, the actual figure varies depending on the discharge current, so it is usual to define the discharge conditions when specifying the capacity. Manufacturers state the capacity and discharge conditions on the packing — or at least they should! A list of typical capacities and cell sizes is given in **Table 1** with nominal capacities.

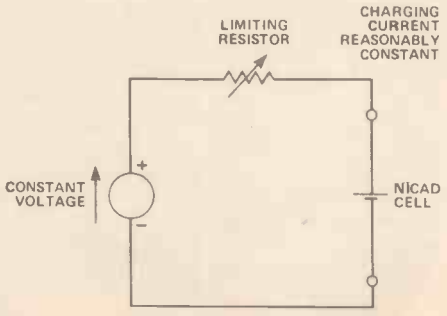
A cylindrical cell's nominal capacity is also known as the "five-hour capacity", because it is the amount of electrical energy the cell gives out when it is discharged in five hours. The "one-hour rate" (ie, the discharge current) would discharge the cell in one hour and is given the symbol 'C'. Similarly, the five-hour rate (C/5) is the current which would discharge the cell in five hours, etc. Cells are considered fully discharged when their voltage has fallen to 1V. **Figure 8** shows how capacities of typical nicad cells vary with three different discharge rates. From this, we can see that slightly higher capacities will be obtained if the discharge rate is lower, and reduced capacities will be the result of higher discharge rates.

Button cell capacities, on the other hand, are expressed as the "ten-hour capacity", and the "ten-hour discharge rate" (C/10) will bring their voltage down to 1.1V, at which point they are considered fully discharged.

Unlike the lead-acid type of secondary cell, the nicad cell must *not* be recharged with a constant voltage source. This is because their very low internal resistance may allow excessive charge currents to occur which may damage the cells. Instead, a constant current source (or at the very least, a source which only supplies a known and safe maximum current) should be used.

The simplest way of obtaining a reasonably constant current is shown in the circuit of **Figure 9** where a constant voltage source provides current to charge the nicad cell, via a limiting resistor. The value of the resistor is chosen so that the recharging current into the cell cannot exceed the maximum safe value for the cell. Generally, such a circuit must be used very carefully and under controlled conditions. Using it cells may be recharged in three main ways.

Figure 9. A simple way of obtaining a reasonably constant recharging current, to recharge a nicad cell.



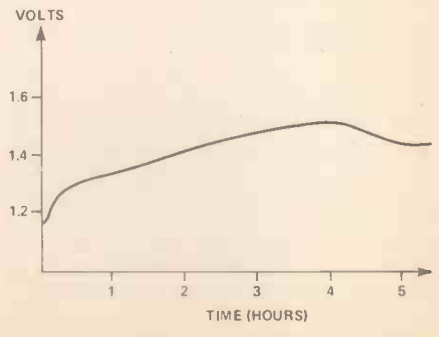
Trickle Recharge

If the current in the circuit is maintained at a C/10 rate a fully discharged cell can be recharged in ten hours — actually just over ten hours, say, twelve to fourteen hours to allow for losses. A trickle recharge at this rate is ideal as an overnight recharge. Another advantage of recharging cells at this rate is that, even when fully recharged, the cells need not be removed — further recharge will not cause damage, because all the oxygen generated at the positive electrode is recombining at the negative electrode. This method of recharging is the only method which allows an indefinite recharge, without cell damage.

Fast Recharge

A nicad cell may be recharged at a much higher rate — say C/3 to C5 — as long as some provision is made to terminate the charge when the cell is fully recharged. This can be done automatically with the use of a voltage sensing circuit which switches off the recharging current when the cell voltage rises above a present level. **Figure 10** shows how cell voltage varies with time at a charge rate of C/4. Obviously this method can only be used if the voltage can be accurately and sensitively measured and the recharge current switched off before damage occurs. The problem with this method (and the next) is that if the high recharge current is not switched off exactly at the same time as the cell is fully recharged, too much oxygen will be given off from the positive electrode, it will not be able to recombine at the negative electrode in sufficient quantities, pressure will rapidly build up and the cell will vent ie, the sealing vent opens and releases the oxygen together with some electrolyte. Unfortunately once electrolyte has been lost by venting it cannot be replaced and so the capacity of the cell is permanently reduced.

Figure 10. Showing how nicad cell voltage varies with time, when recharged (after being completely discharged) with a current rate of C/4.



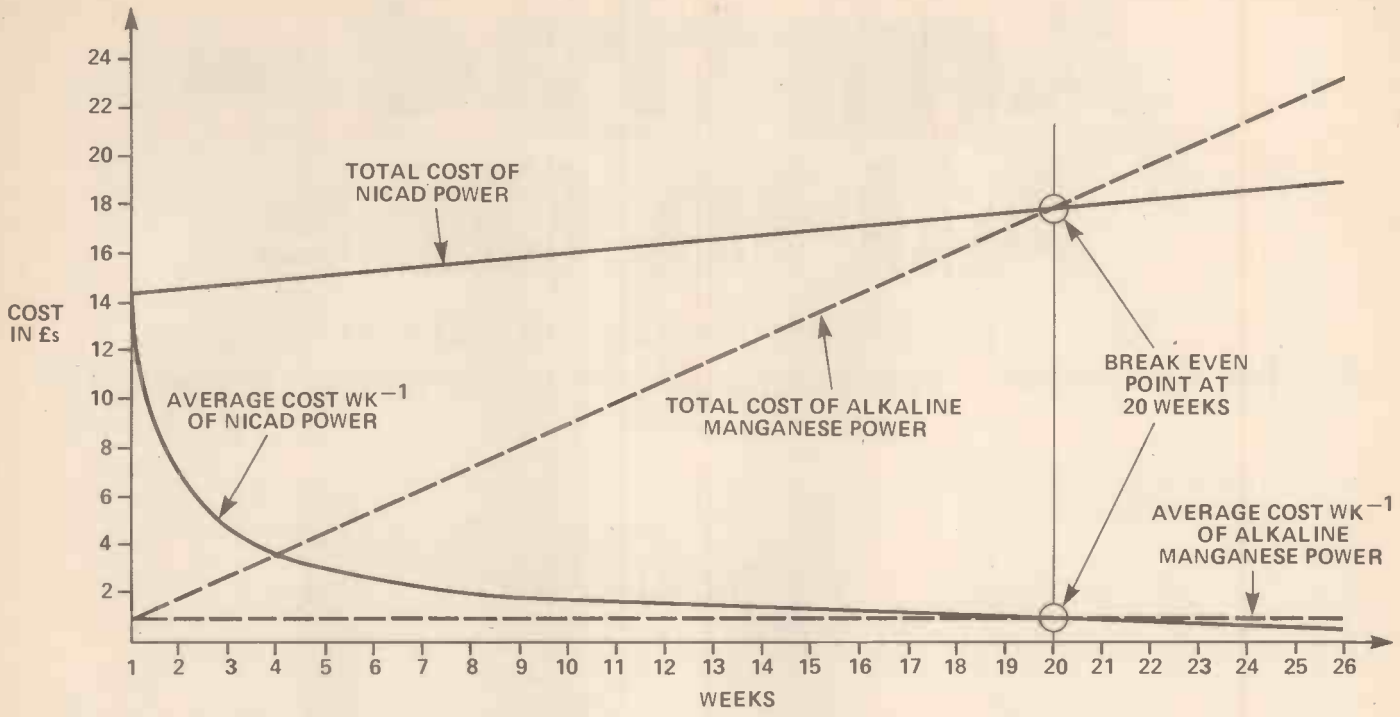


Figure 11. Comparing costs of alkaline manganese and nicad cells on a total and an average basis. Although such a comparison can only be approximate it does prove that nicad cells may be cheaper to use in the long run.

Super-Fast Recharging

There are cases when a user may wish to be able to recharge cells in only a few minutes. For instance, modellers flying their battery-powered aero-models need to rapidly recharge discharged cells in order that they can get the models back in the air again as soon as possible.

It is possible to super-fast recharge cells with recharge rates as high as 4C or so by the method outlined above, measuring the cell voltage and turning off the recharge current when the voltage reaches a set value. However, there is a cheaper method, which is just as accurate. It relies on the fact that the cell is absolutely discharged before any attempt is made to recharge it. Then a fixed value recharge current is applied for the length of time required. Thus, after discharge, a recharge current of say, 3C is applied for twenty minutes. Or a recharge current of 5C is applied for twelve minutes and so on. Although this method is ideal, for example, for the modeller whose only power source in the field is a car battery, it must be stressed that an overcharge of only a few seconds may cause serious venting. To summarise, the cells must be fully discharged, and a known recharge current must be applied for the correct amount of time.

Table 1
Nicad cell sizes with typical nominal capacities

Cell size	Nominal Capacity
½AA	240 mAh
AA	500mAh
C	2000mAh
D	4000 mAh
PP3	110 mAh

Button Cells

Because button cells are not vented, it is very important they should not be overcharged in any way, or the danger of explosion exists. It is wise to limit the recharge current to a low value, say C/30, and simply accept the fact that recharge will take about a day and a half although at this recharge rate an indefinite recharge may be maintained.

However nicad cells are recharged they will last a very long time. Even with the fastest discharge and recharge cycles ie, with the largest currents, they will do their job efficiently for many hundreds of cycles. With small recharge currents, ie trickle recharge, we may expect nicad cells to last, possibly, into the thousands of recharge cycles.

So, how do nicad cells perform in comparison to primary cells, say, of the alkaline manganese type? Well, the comparison is not, unfortunately, straightforward. It depends on a number of factors: number of cells used; cost of recharger; size and cost of cells and usage. However, we may still make a successful comparison based on some arbitrary figures.

Let's say that we have some electrical equipment — a personal hifi, for example — which takes to AA-sized cells. It is used for ten hours per week at a current of 200mA and supply voltage of about 2V to 3V. The two cells must therefore be in series and have a discharge current of 200mA.

If we take as approximate costs, that a nicad recharger is £12 (some are cheaper), AA-sized nicad cells are £1, and AA-sized alkaline manganese cells are 40p, we can now begin to make our cost comparison.

Two alkaline manganese cells (capacity: 1800mA hours) will power the personal hifi for nine hours at 200mA. Two nicad cells (capacity: 500mA hours) will power it for 2.5 hours. So 1.11 sets of alkaline manganese cells are required every week at a cost of about 90p per week. Similarly, four recharges of nicad cells are required (at a cost of, say, 5p per charge — a very high estimate!) at 20p per week.

Figure 11 shows a graph comparing a) the total costs of the two cell types on a week by week basis, and b) costs of the two cell types per week as a running average. All costs of nicad cells have been included — cells, recharger, and recharges. From the figure we can see that although initial outlay of nicad cells is higher than that of alkaline manganese cells, they 'break even' after twenty weeks usage. From that time they are in fact cheaper — both in terms of total outlay and on an average basis.

This result is based on the conditions we stated earlier. If, however the personal hifi is used more often, the break even point will occur sooner. If, also, a greater number of cells is used, perhaps if two personal hifis are used to listen in quadrophonic (*I think this is a joke – Ed.*), the same recharger may be used and the break even point will be even sooner. In fact, the greater usage you have for cells, the more wise it is to use nicad cells — even though the initial outlay may be high — because the break even point will occur all the more rapidly. This result makes you realise why cell manufacturers don't 'push' their nicad products more — they would ruin the lucrative business and profits they make on primary cells!

HE

Amstrad — All In One

The micro scene is changing all the time. Is the next move towards complete computer packages?

A. Parsons

AMSTRAD, who are best known as the makers of workaday, value-for-money hifi systems, have changed their tack and entered the home micro market. Who isn't, these days? The difference here is that Amstrad's contribution is a complete computer station — computer centre? — complete with monitor and integral cassette recorder, for £229.

The package, known as the CPC 464, actually comes in four alternative packages, each of increasing sophistication and price. More of that later; Amstrad's plan is to have 200,000 of these on the market and into homes by Christmas, an impressive aim, and, if they achieve it, an impressive record.

The fact that the monitor is integral to the computer is give point by the fact that the computer's power supply is housed in the monitor itself, while the computer hardware and the cassette recorder are housed with the keypad. The two units are joined via a curly cable, and the whole package is powered by a single mains lead.

The Amstrad CPC464 comes complete with an integral data recorder, and a choice of monitors. The two are not available separately.

Capable Of Resolution

Supplying the monitor with the computer is one solution to arguments about who is next going to use the family TV. More important, it gives a high resolution compatible with the machine's capabilities, including the 80-column text mode. There are two types of monitor available, one the full colour Amstrad CTM640 monitor, the other a monochrome 'green screen' monitor, the GT64.

The monitor/peripheral combinations in which the CPC 464 is to be marketed have been formally designated as Systems 1, 2, 3 and 4. System 1, at £229 includes the computer with a green monitor, System 2, at £329, includes the computer and colour monitor, System 3 at £429, is as System 1 but with the addition of a Hitachi 3in microfloppy disc drive plus CP/M and LOGO, a System 4, at £525, is as System 3 but with colour monitor (or as System 2 plus disc drive and extra languages, if you prefer).

The monitors will not, according to present plans, be sold separately, which means that you will have to opt for one System or the other at the time you purchase the computer. However, Amstrad do plan to market their own colour modulator so that Systems 1 and 3 can be used with an ordinary colour television.

Tough Cassette

The cassette recorder, incorporated under the name of 'datacoder', is for all its nomenclature a common or garden cassette recorder which will quite happily use common or garden cassette tape, although Amstrad stress that they have built it with a bit of extra toughness so that it can stand up to the semi-portable treatment often meterd out even to quite bulky home micros. Data recording speed is a relatively high 2000 Baud.

The keyboard is a feature which I particularly like, with its extra-size, extra colour special function keys and in particular the large ENTER key, which strikes a nice balance between a familiar and conventional typewriter-type keyboard and a specially-designed computer keyboard. There are also cursor control keys, and a numeric calculator-style keypad, all within the keyboard layout.

The computer's integral loudspeaker gives mono sound, and the computer's sound facility is stereo via an audio socket which allows it to be connected up to a hifi system. The sound chip itself gives three voices and seven octaves, along with envelope shaping and white noise.

Amstrad themselves are looking forward to supplying extra peripherals such as a modem, serial interface, extra RAM and sideways ROM in the as yet unscheduled future. The computer's bus expansion port, where the disc drives connect, all account for these, and in addition there is a Centronics printer port and a joystick port. Amstrad will be offering joysticks as extras, and the port will run two joysticks — good move, Amstrad. The Amstrad monitor runs from a normal

RGB output (which is why, presumably, the computer has no composite video output and therefore will need a colour modulator to operate via an ordinary television) which can doubtless feed other RGB monitors if so required — all this in addition to the audio output mentioned further back.

Out of the 64K of the CPC 464's RAM, more than 42K is available for programming in BASIC. This is achieved by using memory paging to connect or disconnect the 32K of standard ROM so that very little of the RAM is permanently tied up. The computer's operating system and BASIC are at the top of the memory map, and Amstrad's BASIC is fast, almost, as fast as we can tell at the moment, as fast as the BBC's. In addition Hisoft Pascal compiler, which is twenty times faster than the computer's BASIC, will be available on tape.

Software is already written and available for the CPC 464. At the launch itself, in addition to the Pascal cassette, Digital Reseach's LOGO was there, and the NEWSTAR word processor package, with another word processor on cassette promised by Amstrad's own software division, Amsoft, set up specially to ensure that their new protege was well supported. This will be just one of fifty or so programs which Amsoft intend to be able to supply by the middle of the year.

On the educational side, Bourne Educational Software, who wrote the introductory tape which comes with the computer (appropriately called "Welcome") have already written a number of early learning programs, indicating that Amstrad have taken serious note of the interest now being shown in the value of home micros as an educational medium, especially for the very young. And whaddya know — there were arcade games as well. Something for everybody.

New Attitude

HE has not yet been able to test the CPC 464, but the signs are that Amstrad are going to deliver as promised, so we may be working on one by the time you read this, and Amstrad's hope to have sold thousands by the end of the year does not seem unrealistic.

The appearance of a reasonably-priced microcomputer with its own monitor and data recorder, from a company which is already accustomed to selling modular hi-tech to home users, marks a small but important shift in attitude towards the home computer and its user. Once the computer becomes independent of the family television it is, like a business computer, a unit in its own right, free for use at all times, and not just a module to be hooked up to the telly whenever the telly isn't otherwise employed.

However, Amstrad are not only challenging the established low-cost micros like the Spectrum and Commodore 64, but the new MSX standard machines coming from Japan. From the sidelines, this is a contest which will make fascinating viewing.

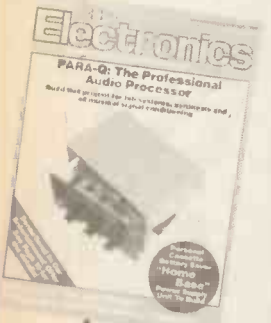
Amstrad's Chairman, Alan Sugar, pictured with the new micro — if you look carefully you can catch a glimpse of curly cable! No spaghetti here.

Specification

Processor	Z80A running at 4MHz.
Memory	64K RAM (42K available from BASIC). 32K ROM holding BASIC and operating system. Memory extension system of sideways ROMS and sequentially addressed RAM.
Keyboard	75-key keyboard, auto repeat, keypad, user defined keys, graphic symbols.
Screen	6845 CRT and associated ULA. Three screen modes: Normal — 40 col X 25 rows (320 x 200 pixels) 4 colours. Multicolour — 20col x 25 rows (160 x 200 pixels) 16 colours. Hi-Res mode — 80col x 25rows (640 x 200 pixels) 2 colours. Up to eight text windows. Border surrounds pixel area.
Sound	AY-3-8912 3-channel sound chip, polyphonic on internal speaker, stereo when put through to hifi output.
Mass Storage	Integral cassette 2000 Baud, motor under computer control, Amstrad 3in micro floppy SSDD, provision for 5.25in drives.
Sockets	Centronics-standard printer port, 9-pin socket for one or two joysticks, 6-pin socket for RGB video, 3.5mm stereo sound, CPU bus for peripherals.

HE

BACKNUMBERS



February 1983
Incremental Timer, Pop Amp 4 & 5, Power Supply for digital applications, the Birth of Broadcasting, Random Access Memories, A Directory of Electronic Kits and Modules, Book Guide.

March 1983
HE EPROM Programmer, Pop Amps 6 & 7, Signal Powered Loudspeaker Protector, Overvoltage Cut-Out, ROMs & EPROMs, the Arrival of Television, Car Computer Review, Radio Rules — Propagation and Aerials, Finishing Touches, Famous Names.

April 1983
Auto Power Down, EPROM Programmer Part 2, Stereo Voice Over, Tools and Test Equipment Survey, Components and Hardware Directory, Tools For The Trade, Components For Computing — Interrupts, Radio Rules — RF Interference and Measurements, Radio Controlled Gerbil.

May 1983
Car Security Cutout, Demister/Aerial Convesion, HE Auto Tester, BBC Micro/HEBOT Interface, Careers In Electronics Part 1, Radio Rules — the RAE, Aces High, DIY Loudspeakers Review, The Micro Age, Famous Names.

June 1983
ZX Sound Board, Car Battery Warning Device, Pop Amps 8, CB Push-To-Talk Switcher, Traffic Light Toy, Digital Displays, Careers — Technical Writing, Electronics In The Home, Book Reviews, Famous Names.

July 1983
Soft Fuzz, ZX81 High Resolution Graphics Board, Simple Tremolo, Stereo Image Expander, Pop Amps 9, All About Electronics Part 1, Oric 1, Review, Careers — British Telecom, Famous Names.

August 1983
Programmable Joystick Controller, Whistle Switch, Expanding the ACE, Car Aerial Winder, Enlarger Timer, Electromagnets and Ohm's Law, Careers — TV and Radio Transmission, Famous Names.

September 1983
Sound Pressure Level Meter, Tremoleko, Power Supply Unit, HE Gripometer, Cable & Satellite TV, Careers — TV and Radio Studio Engineering, Resistance and Capacitance.

October 1983
Audio Level Meter, Hi-Voltage Meter, Jupiter A[Out Of Print] Interface Card, Ultras[Out Of Print] Intruder Alarm, FX[Out Of Print]puter review, Careers[Out Of Print] Customer Service Engine[Out Of Print]g, Introduction to Semiconductors, Eight-page Circuit Supplement.

November 1983
HE Parametric Equ[Out Of Print]liser, Car Interior Light D[Out Of Print]ay, Windscreen Wiper [Out Of Print]ay, Simple Stereo Pre[Out Of Print], Dual Purpose Power S[Out Of Print]y, Short Circuits, Digital [Out Of Print]ircuits, Careers — Microcomputers.

December 1983
General Purpose Light Meter, HE Bassman, Moisture Gauge, Simple Continuity Tester, A Zener Diode Primer, Logic Gates, I Almost Met, Junction FETs.

January 1984
Slot Car Lap Counter, HE Quizmaster, Transatlantic Power Reducer, Mainframe pop Group, Careers — the Army, Op-Amps, 1982/1983 Indexes.

February 1984
Infra Red Camer[Out Of Print] Control, Audio Power S[Out Of Print], Module, Car Timing [Out Of Print]e, CB Field Strength M[Out Of Print], Careers — The Navy, [Out Of Print]tory of Electronic Compo[Out Of Print]nts and Hardware Suppliers 1984.

All issues for 1983 and 1984 are available unless specifically marked as out of print.

Backnumbers of Hobby Electronics are available for the current year and the previous year, at the current price of £1.40. For issues from prior to this, or for current issues which are now sold out, we do a photocopying service. Each article costs £1.50, and information as to its title and publication date should be given. Please allow up to 28 days for delivery.

HOBBY ELECTRONICS BACKNUMBER ORDER FORM TO:

Hobby Electronics
Backnumbers
Hobby Electronics
Infonet Ltd.
Times House
179 The Marlowes
Hemel Hempstead
Herts HP1 1BB

Please send me the following items:

NAME .....

ADDRESS .....

.....

.....

.....

Back issues .....at £1.40 each

I enclose £.....

Cheques and Postal Orders should be made payable to ASP Ltd.

HOBBY ELECTRONICS PHOTOCOPY ORDER FORM TO:

Hobby Electronics
Photocopies
Hobby Electronics
ASP Ltd.
No. 1 Golden Square
London W1R 3AB

Please send me the following items:

NAME .....

ADDRESS .....

.....

.....

Photocopies of .....in the

..... issue at £1.50 each

I enclose £.....

Cheques and Postal Orders should be made payable to ASP Ltd.

SHORT CIRCUITS

Circuit ideas from Hobby Electronics readers.

Hobby Electronics cannot undertake to answer queries on Short Circuits.

Audio Signal Injector

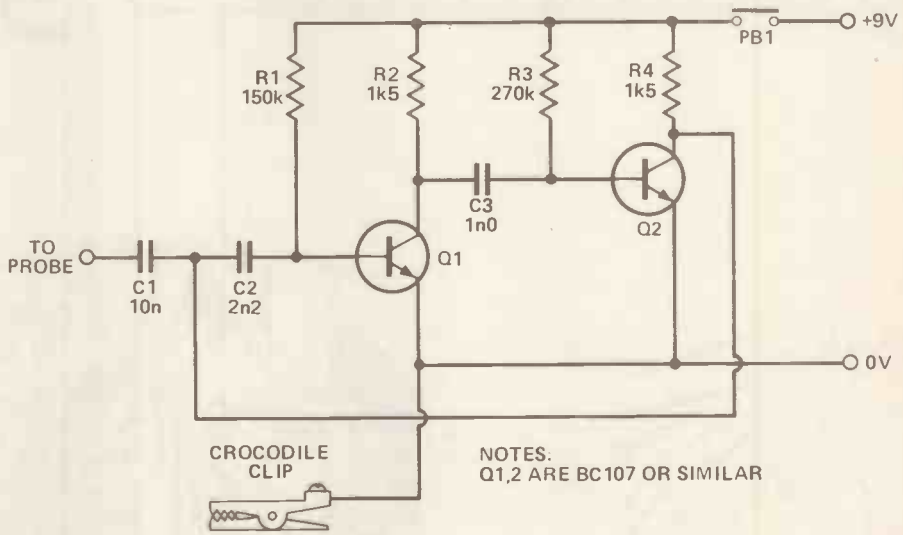
THIS circuit is based on quite a simple basic circuit, only we have drawn it slightly different to the way it is normally seen in magazines or books. It is of course, if you have not recognised it yet, the multivibrator.

The operation is fairly complex but it is sufficient to say that each transistor switches on and off alternately at a rate determined by the time constants of the capacitors and base resistors.

With this type of circuit the output is very rich in harmonics and the signal can extend up to 30MHz and in some cases beyond. It thus makes it suitable for normal audio testing and for use in the RF stages of radios etc. The construction is quite straightforward and Veroboard layout is just one example.

The probe can a short length of 6BA studding or similar as required.

A. Vaughan,
Stirling,
Scotland.

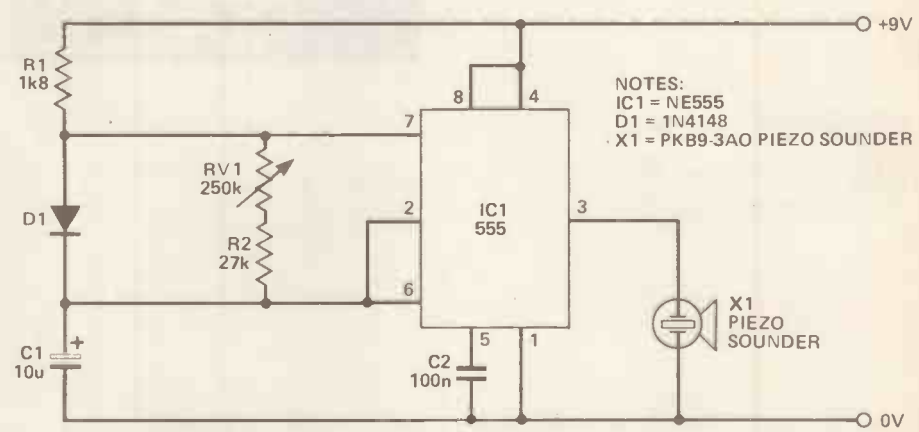


Metronome

THIS metronome was devised to assist a young musician in improving his timing and note values.

It was thought that a very short burst of tone would effectively simulate the characterised metronome sound and this is the basis of the design. A piezo sounder is turned on by a 555 timer, the on time is preset but the off or delay time is variable by the front panel control.

At switch on, C1 will be discharged, the 555 output will be high and the sounder will sound for a short as C1 charges via R1 and D1. When the voltage on C1 reaches the 555 trigger point the output will go low and the sound will stop. The delay before the next burst of tone is determined by the C1 discharge path, This comprises R2 and RV1. Thus we can adjust the delay to give the required repetition rate. This is between about 30 and 220 beats per minute.

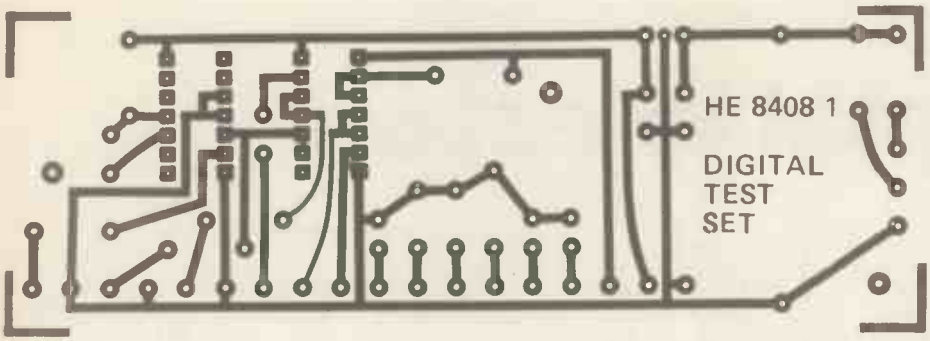


Any convenient method of construction can be used, the prototype was made using a small piece of Veroboard and a plastic box. The sounder used was a PKB9-3AO from Ambit but any similar type should be just as suitable.

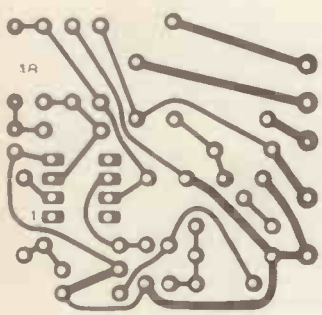
Calibration can be any method convenient to the constructor.

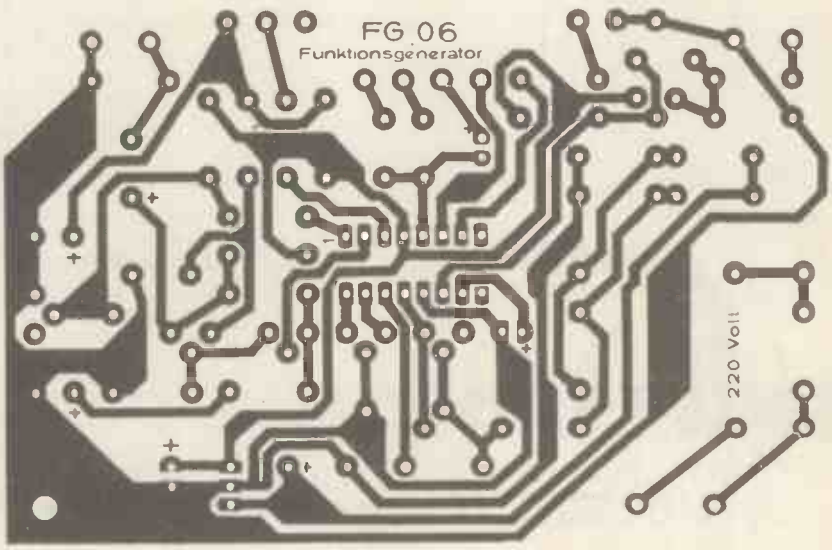
G. J. Hall, Leeds.

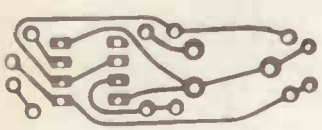
PCB FOIL PATTERNS

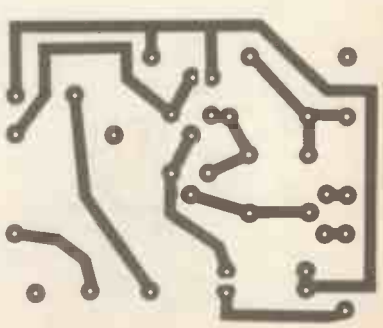


The foil pattern for the Digital Test Set. This board may easily be made using PCB transfers.





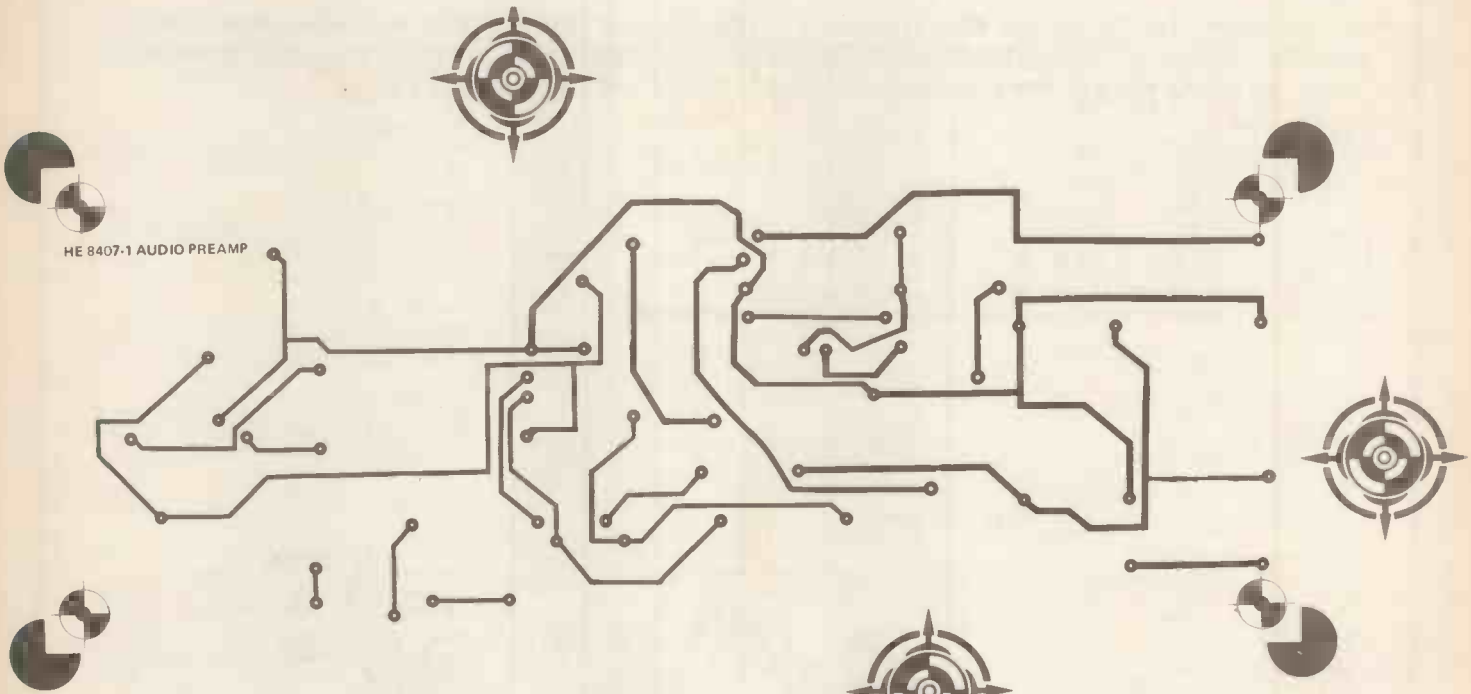


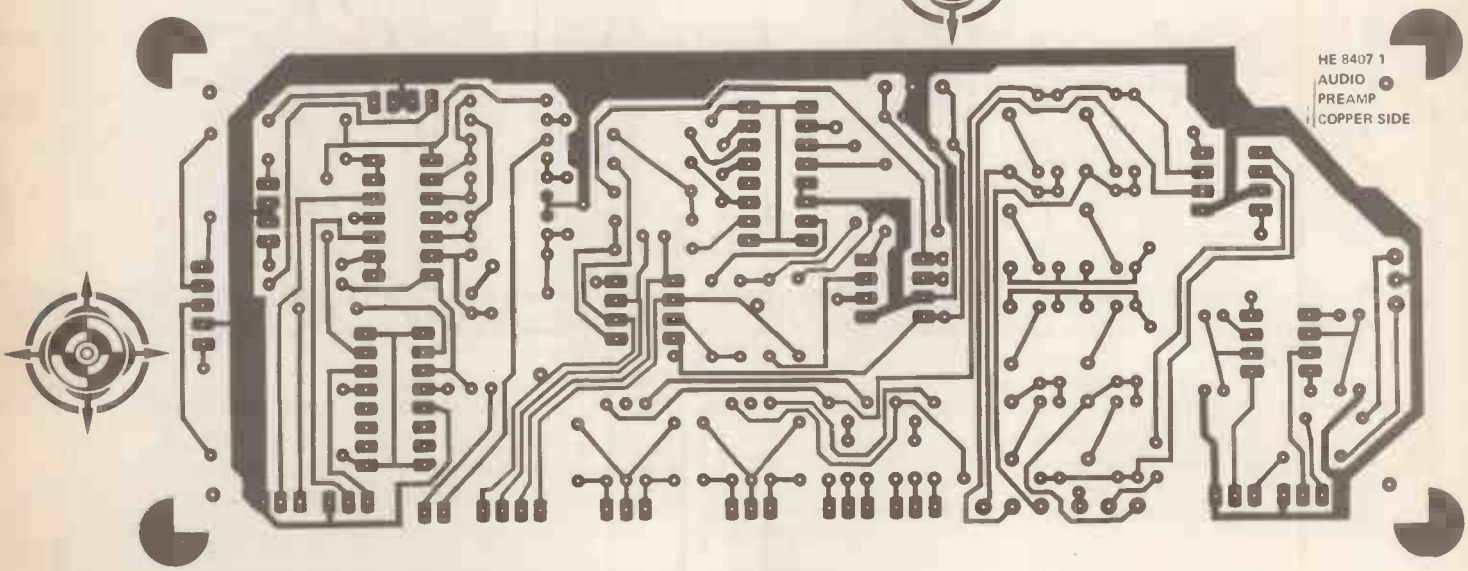


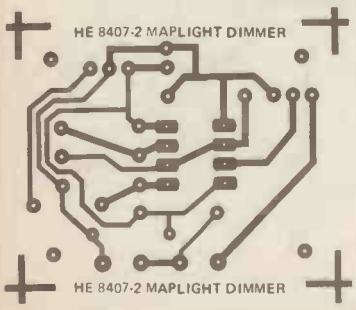
The remaining four foil patterns this month are for the following: above right is the pattern for the Signal Generator. Above are the two foils for the Infra-red Link. And lastly, opposite is the pattern for the Temperature Sensor. Note these boards will not be available from our PCB services as they are copyright **Cirkit**. There will be no problems however if the boards are made for private use and not for resale. Professionally made boards will be available as part of kits — see Buylines, page 26.

PCB Foils for HE July '84

Last month's PCB foils were printed to the wrong sizing. Consequently we are re-running the foils to the correct size, so that when you build the projects, your ICs actually fit in their sockets. Anyone who has had problems with wrong-sized boards, get in touch with us. The PCB SERVICE is not affected by this mistake, which was purely a printing error.







PCB foils for HE July '84:

Above: The two sides of the double-sided Hifi Control Amp PCB, as marked. The compass-marks aid registration, but are not important.

Left: The Maplight Dimmer PCB foil.

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.

June 82		
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	BBC 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	Double sided touch plate	£5.49
June 84		
HE/8406/1	ZX81 Tape	£3.81
HE/8406/2	Mains Intercom	£3.78
HE/8406/3	Millivoltmeter	£3.33
July 84		
HE/8407/1	Audio Preamplifier	£7.20
HE/8407/2	Map Light Dimmer	£2.12
August 84		
HE/8408/1	Digitester	£3.59

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 £	

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
ALARM CONTROL PANEL
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

YOUR OWN ALARM SYSTEM IN 10 MINUTES

A leading UK Alarm System Company now offers components and complete systems for DIY.

★ Self contained *full feature* system — just 10 minutes to set up for full protection.
Supplied fully fitted in a superb teak finish cabinet — blends unobtrusively into any decor.
Can be expanded to cover many points.
Only **£74.50** inc VAT and delivery.
OVER 20000 UNITS SOLD

★ Components to build your own systems.
Ultrasonic detectors to BSS spec.
Latest design with filtering and crystal control. **£24.50** inc VAT.

All products guaranteed. Top quality. Competitive prices. Immediate delivery.

Send for full details:
Dept. T1, Nortek Systems Ltd., 4 Birchanger Road, London SE25 5BB
Tel: 01-771 1657

WHO CAN PUT A PRICE ON PEACE OF MIND! . .
Home security is now available at trade prices
Professional Equipment at Low! Low! Prices!
● No Gimmicks ● Immediate Despatch ● Control panels
● All Prices Include VAT ● Complete with Full Four Colour Instructions & Two Year Guarantee
● Free Technical Advice
Advanced Security Products Ltd
2 Ealing Road, Aintree, Liverpool L9 0HU, Merseyside
Tel: 051 525 3440
Do it now before it's too late! . .

MISCELLANEOUS

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.

LEARN ELECTRONICS WITHOUT SOLDER
Build electronic circuits without solder on a Roden S-Dec. This has built-in contacts and holes into which you plug your components. Suitable for all ages. Can be used time after time. Ideal gift for students or experimenters. Full instructions and 2 circuit diagrams with each S-Dec. Send cheque or P.O. to:- **Roden Products**, Dept HE High March, Daventry, Northants. NN11 4RZ
£4.99 including p & p

'SPACE FOR SALE!'
Tel: 01-437-0699

COMPONENTS

BRITISH TELECOM plug sockets and leads, etc. Tel: C.W.A.S (0274) 731532. Or visit our showroom opposite Odsal Stadium, Bradford.

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 sensor sirens, bells, buzzers all at competitive prices. Write or phone for details. Shudehill Supply Co. Ltd., 53 Shudehill, Manchester M4 4AW. 061-834 1449.

HOBBY SHOP

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

EQUIPMENT

AERIAL AMPLIFIERS Improve weak television reception. Price £6.70. S.A.E. for leaflets. Electronic Mailorder, Ramsbottom, Lancashire BL0 9AGH.

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

STEREOAMPS 120 Watt (60+60) . . . Case — D.I.N. sockets and controls . . . 9-40v/ Smoothing . . . protected outputs 3/15 -O.H.M. tested and diagrams £10/inc . . . KIA-8 Cunliffe Rd., Ilkley.

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

BOOKS & PUBLICATIONS

PARAPHYSICS JOURNAL (Russian translations). Psychotronics, Kirlianography, heliphonic music telekinetics. Computer software. SAE 4 x 9":— Paralab, Downton Wilts.

CONVERT any TV into large screen oscilloscope. External unit plugs into aerial socket of TV. Circuit and plans £3.00 or S.A.E. details: J. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

ELECTRONICS TODAY INTERNATIONAL

CLASSIFIED ADVERTISEMENT — ORDER FORM

If you have something to sell now's your chance! Don't turn the page — turn to us!

Rates of charge: 35p per word per issue (minimum of 15 words).

and post to **Electronics Today International, Classified Dept., 1 Golden Square, London W1.**

Please place my advert in **Electronics Today International** for ..... issues commencing as soon as possible.

I am enclosing my Cheque/Postal Order/International Money Order for: (delete as necessary) £..... (Made payable to A.S.P. Ltd)

VISA OR Debit my Access/Barclaycard (Delete as necessary)

We welcome Access

All classified advertisements must be paid for in advance.

Please use BLOCK CAPITALS and include post codes.

Classification .....

Name (Mr/Mrs/Miss/Ms) ..... (delete accordingly)

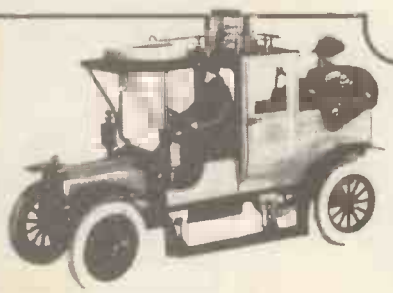
Address .....

.....

Signature.....**Date**.....

Daytime Tel. No. .....

LIMITED EDITION



Vintage Model Cars
Complete or Kits 1/13 th Scale

Landaulette BENZ

These vehicles are unique and quickly become collectors' items. Produced on the same tools and presses used at the turn of the century in the style of Georges Carette. Accurate and authentic designs bring you Model T Fords, Limousine Benz, Double Decker Buses, Fire Engines at superb prices.

Send SAE for brochure and prices to:

Limited Edition, Hadleigh Road Industrial Estate, Ipswich, Suffolk. Telephone: (0473) 59175.

ADVERTISERS INDEX HOBBY ELECTRONICS AUGUST 1984

Armon Electronics **17**
Bi-pak ..... **OBC**
B.K. Electronics ..... **IFC**
B.N.O.S. ..... **IBC**
B.N.R. & E.S. **17**
Brian J. Reed ..... **IBC**
ICS **26**
ILP ..... **IFC**
John Wise Ltd **17**
Sparkrite **17**
Tomorrows World **66**
Vangelder U.K. Ltd ..... **IBC**
Filte Software ..... **Soft Options**

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
I.T.T. Mercury Wetted relay 20-60 VDC Coil. SPCO. 2A. 79p or 10 for £7
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 SL403 3 Watt amp. From bankrupt source, hence sold as untested, 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

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

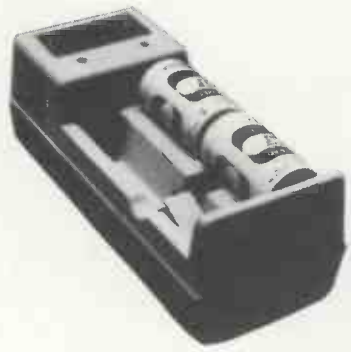
Barclaycard and Access accepted. Please quote number.
Credit Card Hotline — Telephone (0702) 548681

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.

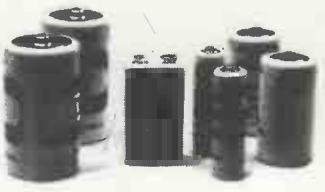
ALL THESE PRODUCTS CARRY A FULL YEAR'S GUARANTEE



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
½AA*	0.10	18.0	14.3	1.58	1.50	1.44
½AA*	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

BARCLAYCARD VISA

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

BI-PAK BARGAINS

HIGH QUALITY MODULES FOR STEREO, MONO & OTHER AUDIO EQUIPMENT

Audio Amplifiers

O/No.	POWER O/P R.M.S.	MAX SUP. VOLTAGE	PRICE
AL 30A	10 Watts	30V	£4.95
AL 60	25 Watts	30-50V	£5.92
AL 80	35 Watts	40-60V	£8.75
AL 120	50 Watts	50-70V	£15.22
AL 250	125 Watts	50-80V	£20.60

Stabilised Power Supplies — Output current 2.5 Amps

O/No.	AC Input Price	
SPM 120/45	40-48V	£8.05
SPM 120/55	50-55V	£8.05
SPM 120/65	60-65V	£8.05

Stereo Pre-Amplifier

O/No.	Supply Vtg.	Price
PA 100	30/55V	£18.50

Mono Pre-Amplifiers – Operating Vtg. 40-65V

O/No.		Price
MM 100	Suitable for Disco Mixer	£14.75
MM 100G	Suitable for Guitar Pre-Amp Mixer	£14.75

Magnetic Cartridge Pre-Amplifier
O/No. MPA30. Sup Vtg. 20-30V. Price £4.29

Monographic Equaliser
GE 100 MKII 10 Channel
OUR PRICE ONLY £20.00
Full Specifications and Data available on request. Please send self-addressed envelope.

AL 250

GE 100 MKIII

PRECISION MORSE KEYS

Well designed beginners key. Fully adjustable. Dims: Base 82mm × 45mm. O/No. VP 122. **£1.85**

ANTENNA SWITCH 2 and 3 WAY

Co-axial switch for one transceiver to two antennae or one antenna to two transceivers. Dims: 86 × 55 × 32mm (Body).
O/No. VP 113 **£4.50**
As above but 3-way.
O.No. VP 114 **£4.75**

HIGH PASS FILTER/SUPRESSOR

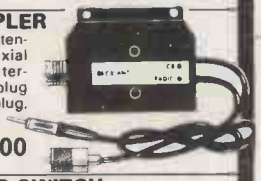
CB/TV. High pass filter. Reduces unwanted signals picked up by antenna. Dims: 45 × 25 × 17mm.
O/No. VP 115 **45p**

LOW PASS FILTER

Designed to reduce harmonics on the VHS and TV band.
Cut-off frequency: 30MHz.
V.S.W.R.: Less than 1.2 to 1.
Insertion loss: –0.2dB @ 27MHz
Impedance: 50ohms.
Dims: 80 × 55 × 40mm.
O/No. VP 116 **£2.75**

ANTENNA COUPLER

Transceiver/car radio antenna coupler. With co-axial cables. One co-axial terminates in antenna plug and the other in PL259 plug.
Dims: 67 × 46 × 30mm.
O/No. VP 117 **£2.00**



TAPE RECORDER SWITCH

Unit to control motor of tape recorder. 1.8m cord and 2.5mm plug attached. On/Off switch. Dims: 55 × 20 × 20mm.
O/No. VP 127 **£1.00**

DC-DC POWER SUPPLY

DC to DC adaptor. Plugs into car cigar lighter aperture. Output 3, 4.5, 6, 7.5, 9, 12V @ 800mA. Has universal output spider plug, also 9V battery snap and polarity reversing facility.
O/No. VP 119 **£2.45**

SPEAKER PROTECTOR

Limits voltage to speaker or to the permissible max., by automatically introducing a resistor in series with speakers. When excessive voltage is reduced the unit resets itself. Electronic voltage-sensing relay circuit. Spring terminals. Cut-off level adjustable from 10W-120W. Full instructions included. Dims: 85 × 74 × 25mm.
O/No. VP 118 **£9.95**

ELECT & PIEZO BUZZERS

PIEZO
Miniature round piezo-electronic buzzer White plastic Low consumption
Frequency 4kHz approx
Output: 70dB (A) @ 1. typ
Power. 12Vd c 4mA
Dims: 22 (dia) × 11 5mm
Fixing Centres: 26.5mm
O/No VP 107 **95p**

PIEZO
Piezo buzzer. White plastic 90mm leads For use on a c mains
Frequency: 3.5kHz approx
Output 85dB (A) @ 1m typ
Power. 240Va c 5mA
Dims: 32 (dia) × 14mm
Fixing centres: 38mm
O/No. VP 108 **£1.15**

ELECTRONIC
Miniature electronic buzzers. Solid state. Ivory plastic 150 leads Frequency: 500 Hz approx.
Dims: 22 × 16 × 15mm
Output: 82dB (A) @ 1m typ
Fixing centres 26mm
3V 25mA: O/No VP 82 6V 25mA: VP 83
9V 25mA. O/No VP 84 12V 25mA: VP 86
80p each

SUB-BOX

A neat swivelling disc provides close tolerance substitution resistors of 36 preferred values from 5ohms to 1Kohm. Simply fix clips into circuit and swivel until optimum result is achieved.
O/No. VP 112 **£4.75**

MINIATURE VICE

Miniature plastic and metal vice with strong suction base for portability. Single action to secure or release suction. Plastic jaws with rubber pads 20mm wide, open out to 40mm. Dims: 85 × 65 × 60mm approx.
FANTASTIC VALUE
O/No. VP 95 **ONLY £1.60**

LEARN A LINGO!
PILLOW SPEAKER

Slim under pillow unit. 8ohms 2" speaker. 1.5m lead with 3.5mm mono jack plug. Black. Dims: 65 (dia.) ×17mm.
O/No. VP 88 **£1.25**

METRIC & BRITISH MEASURES

Steel tapes in sturdy ABs plastic case Silk wrist strap These yellow coated convex tapes have inch and metric graduations. Automatic push-button return.
2m long × 13mm wide O/No. VP 89 **£1.00**
3m long × 13mm wide. O/No. VP 90 **£1.50**
5m long × 16mm wide. O/No. VP 91 **£2.00**

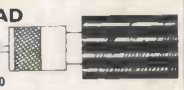
BATTERY TESTER

Tests all types of battery including standard, NICAD, Alkaline etc. Takes all standard sizes including 6V lantern batteries and watch/hearing aid cells Also tests fuses and lamps by means of internal 9V (PP3) battery Can also be used to recharge NICAD batteries by means of external 3-12Vd c power supply (not included).
Full instructions provided Dims: 185 × 103 × 30mm (approx.)
O/No. VP 101 **£7.00**

FM MONITOR

FM monitor for 2 metre band All metal Attached earphone PL259/SO239 connectors 144MHz 10W maximum Dims (Body) 55 × 30 × 23mm
O/No. VP 120 **£4.20**

DUMMY LOAD



50 ohms. 30W UHF co-axial plug fitting (PL259)
O/No VP 121 **£5.20**

PICK-UP COIL

Large telephone pick-up coil for high sensitivity Suction pad to stick to telephone. 90cm lead to 3.5 jack plug. Connects direct to cassette recorder. Dims: 32 (dia) × 17mm (body) 36mm (dia.) sucker
O/No. VP 87 **£1.00**

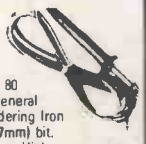
VALUE PACKS

Pak No.	Qty	Description	Price
VP1	300	Assorted Resistors Mixed Types	£1.00
VP2	300	CarbonR esistors ¼ Watt Pre-Formed	£1.00
VP3	200		£1.00
VP4	150	¼ Watt Resistors 100 ohm-1M Mixed	£1.00
VP5	200	Assorted Capacitors All Types	£1.00
VP6	200	Ceramic Caps Miniature - Mixed	£1.00
VP7	100	Mixed Ceramics Disc 1pf - 56pf	£1.00
VP8	100	Mixed Ceramic Disc 68pf - 015pf	£1.00
VP9	100	Assorted Polyester/Polystyrene Caps	£1.00
VP10	60	C280 Type Caps Metal Foil Mixed	£1.00
VP11	100	Electrolytics - All Sorts	£1.00
VP12	60	Bead Type Polystyrene Min Caps	£1.00
VP13	50	Silver Mica Caps Ass 5.6pf - 150pf	£1.00
VP14	50	Silver Mica Caps Ass 180pf - 4700pf	£1.00
VP15	50	High Voltage Disc Ceramic 750v - 8Kv Mixed	£1.00
VP16	50	Wirewound Res 9W (avg) Ass 1 ohm - 12K	£1.00
VP17	50	Metres PVC Covered Single Strand Wire Mixed Colours	£1.00
VP18	30	Metres PVC Covered Multi Strand Wire Mixed Colours	£1.00
VP19	40	Metres PVC Single/Multi Strand Hook-Up Wire Mixed	£1.00
VP20	6	Rocker Switches 5 Amp 240v	£1.00
VP21	20	Pcs 1 2 & 4 mm Plugs & Sockets Matching Sizes	£1.00
VP22	200	Sq Inches Total Copper Clad Board Mixed Sizes	£1.00
VP23	20	Assorted Slider Pots Mixed Values	£1.00
VP24	10	Slider Pots 40 mm 22K 5 - Log 5 - Lin	£1.00
VP25	10	Slider Pots 40 mm 47K 5 - Log 5 - Lin	£1.00
VP26	20	Small 125" Red LED'S	£1.00
VP27	20	Large 2" Red LED'S	£1.00
VP28	10	Rectangular 2" Green LED'S	£1.00
VP29	30	Ass Zener Diodes 250mW 2W Mixed Vlts Coded	£1.00
VP30	10	Ass 10W Zener Diodes Mixed Vlts Coded	£1.00
VP31	10	5 Amp SCR's TO-66 50-400v Coded	£1.00
VP32	20	3 Amp SCR's TO-66 Up To 400v Uncoded	£1.00
VP33	200	Sil Diodes Switching Like IN4148 DO-35	£1.00
VP34	200	Sil Diodes Gen Purpose Like OA200/BAX13/16	£1.00
VP35	50	1 Amp IN4000 Series Sil Diodes Uncoded All Good	£1.00
VP36	8	Bridge Rects 4 - 1 Amp 4 × 2 Amp Mixed Vlts Coded	£1.00
VP37	8	Black Instrument Type Knobs With Pointer ¼" Std	£1.00
VP42	10	Black Heatsinks To Fit TO-3 TO-220 Ready Drilled	£1.00
VP43	4	Power-Fin Heatsinks 2 - TO-3 2 × TO 66 Size	£1.00

TRANSISTOR CLEARANCE

100 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 **£1.00**

BI-PAK SOLDER — DESOLDER KIT



Kit comprises: O/No. VP 80
1 High Quality 25 Watt General Purpose Lightweight Soldering Iron 240v mains incl. 3/16" (4.7mm) bit.
1 Quality Desoldering Pump High Suction with automatic ejection
Knurled anti-corrosive casing and Teflon nozzle 1.5 metres of De-Soldering braid on plastic dispenser.
2 yds (1.83m) Resin Cored Solder on Card
1 Heat Shunt too tweezer Type
Total Retail Value over £12.00
OUR SPECIAL KIT PRICE £9.95

BI-PAK PCB ETCHANT AND DRILL KIT

Complete PCB Kit comprises
1 Expo Mini Drill 10,000RPM 12Vd.c. incl. 3 collets & 3 × Twist Bits
1 Sheet PCB Transfers 210mm × 150mm
1 Etch Resist Pen
1 ½lb pack FERRIC CHLORIDE crystals
3 sheets copped clad board
2 sheets Figreglass copper clad board
Full instructions for making your own PCB boards
Retail Value over £15.00
OUR BI-PAK SPECIAL KIT PRICE £9.95
ORDER NO. VP 81

TECASBOTY

THE ELECTRONIC COMPONENTS AND SEMICONDUCTOR BARGAIN OF THE YEAR!

This collection of Components and 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 0920-3182/3442 and order with your Barclaycard or Access Card – 24hr Answerphone Service NOW. Order No. VP 85.
just £6.50

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:-

BI-PAK

Send your orders to Dept HE8 BI-PAK PO BOX 6 WARE, HERTS
SHOP AT 3 BALOCK 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 order.
Total Postage add 75p per Total order.