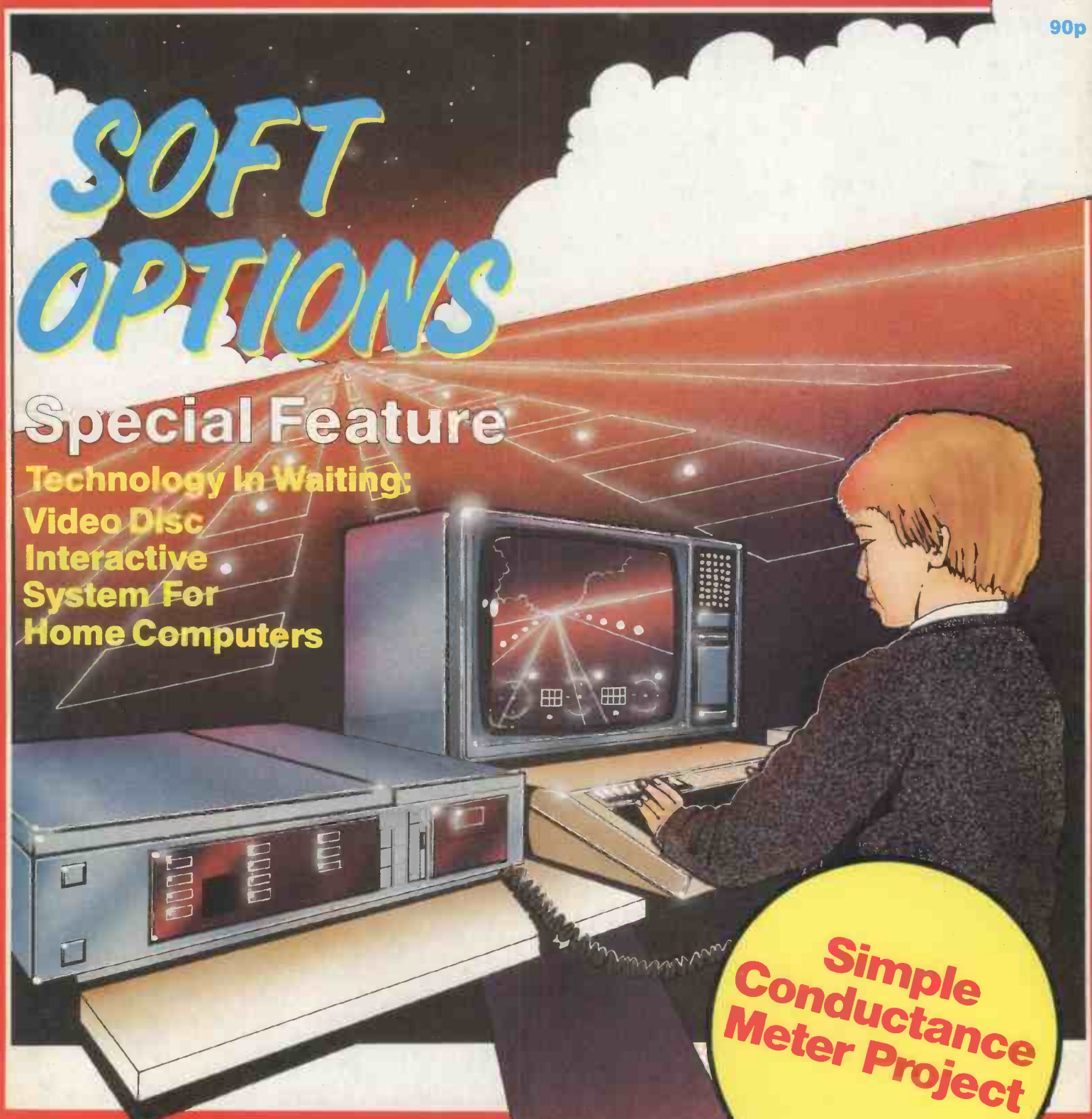
AN ARGUS SPECIALIST PUBLICATION
JUNE 1984

# Hobby Electronics

Project Electronics For Everyone

90p



## SOFT OPTIONS

### Special Feature

Technology In Waiting:
Video Disc
Interactive
System For
Home Computers

Simple Conductance Meter Project

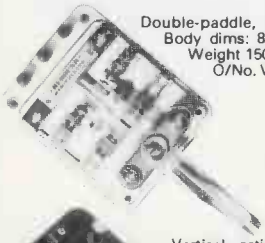
Top Projects To Build...

ZX81 Tape Controller • Mains Intercom

# BI-PAK BARGAINS

## PRECISION MORSE KEYS

Well designed beginners key. Fully adjustable. Dims: Base 82mm x 45mm. O/No. VP 122. **£1.85**



Double-paddle, squeeze action. Body dims: 83 x 65 x 35mm. Weight 150g. O/No. VP 123. **£20.00**

Vertical action. Robust ABS body weighted with heavy metal plate. Screw terminals. Silver contacts. Usual adjustments. Body dims: 150 x 75 x 50mm. Weight 0.5kg. O/No. VP 124

**£21.00**

## ANTENNA SWITCH 2 and 3 WAY

Co-axial switch for one transceiver to two antennae or one antenna to two transceivers. Dims: 86 x 55 x 32mm (Body).
O/No. VP 113 **£4.50**

As above but 3-way.
O.No. VP 114 **£4.75**

## HIGH PASS FILTER/SUPRESSOR

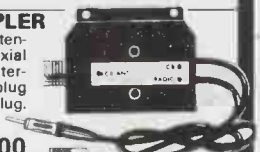
CB/TV. High pass filter. Reduces unwanted signals picked up by antenna. Dims: 45 x 25 x 17mm.
O/No. VP 115 **45p**

## 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 x 55 x 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 x 46 x 30mm.
O/No. VP 117 **£2.00**



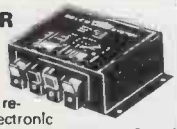
## TAPE RECORDER SWITCH

Unit to control motor of tape recorder. 1.8m cord and 2.5mm plug attached. On/Off switch. Dims: 55 x 20 x 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 x 74 x 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.) x 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.) x 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 x 16 x 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 x 65 x 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.) x17mm.
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 x 13mm wide. O/No. VP 89 **£1.00**
3m long x 13mm wide. O/No. VP 90 **£1.50**
5m long x 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 x 103 x 30mm
O/No. VP 101 **£7.00** (approx.).

## FM MONITOR

FM monitor for 2 metre band. All metal. Attached earphone. PL259/SO239 connectors. 144MHz 10W maximum. Dims: (Body) 55 x 30 x 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.) x 17mm (body) 36mm (dia.) sucker. **£1.00**
O/No. VP 87

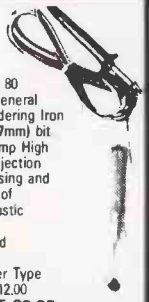
## VALUE PACKS

| 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 | 50 | C280 Type Caps Metal Foil Mixed | £1.00 |
| VP11 | 100 | Electrolytics – All Sorts | £1.00 |
| VP12 | 50 | 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 x Log. 5 x Lin | £1.00 |
| VP25 | 10 | Slider Pots 40 mm 47K 5 x Log 5 x 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 DA200/BAX13/16 | £1.00 |
| VP35 | 50 | 1 Amp IN4000 Series Sil. Diodes Uncoded All Good | £1.00 |
| VP36 | 8 | Bridge Rects. 4 x 1 Amp 4 x 2 Amp Mixed Vlts Coded | £1.00 |
| VP37 | 8 | Black Instrument Type Knobs With Pointer 1" Std | £1.00 |
| VP42 | 10 | Black Heatsinks To Fit TO-3, TO-220 Ready Drilled | £1.00 |
| VP43 | 4 | Power-Fin Heatsinks 2 x TO-3 2 x 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-Solder ing 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 x Twist Bits
1 Sheet PCB Transfers 210mm x 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**
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# Hobby Electronics

JUNE 1984
Vol 6 No 6


## PROJECTS



## FEATURES



## SPECIAL



## REGULARS




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

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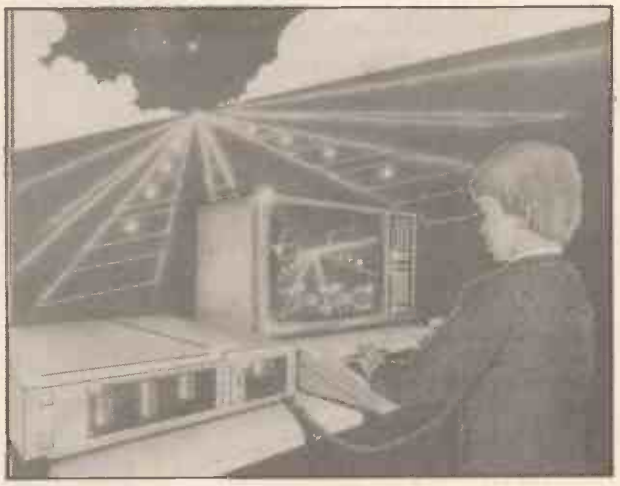

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ZX81 Cassette Tape Controller — page 59


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## Computer Products

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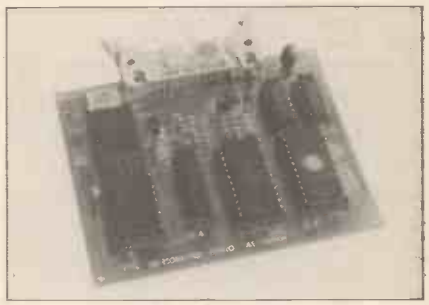


| | | |
|---|---|---|
| C12 Computer Cassette | 21-00012 | 0.55 |
| BBC to Centronics Printer | 03-10019 | 7.25 |
| BBC to 25 way D Male | 03-10021 | 4.50 |
| 25 way D Socket | 10-25200 | 1.90 |
| 25 way D Plug | 10-25100 | 1.30 |
| Cover for 25 way D | 10-25322 | 0.93 |
| 20 up Eprom Eraser | 40-82100 | 31.25 |
| Z80 A Industrial Controller | 40-82000 | 49.95 |
| 6802 Industrial Controller | 40-68020 | 49.95 |
| 6502 Industrial Controller | 40-65020 | 49.95 |
| Z8 Basic/Debug Controller | 41-00904 | 50.00 |

## Nicad Batteries & Chargers

Minimum life 600 (300 PP3 size) full charge/discharge cycles. Batteries must be charged from a constant current source only. All batteries are supplied only with a residual charge and should be charged before used.

| | | | | 1-9 | 10-49 |
|---|---|---|---|---|---|
| AA | 1.2V | 500mAH | 01-12004 | 0.80 | 0.74 |
| 'C' | 1.2V | 2.2AH | 01-12024 | 2.35 | 1.99 |
| 'D' | 1.2V | 4.0AH | 01-12044 | 3.05 | 2.85 |
| PP3 | 8.4V | 110mAH | 01-84054 | 3.70 | 3.50 |
| CH1/22 PP3 Charger 11mA for 16 hours | | | 01-00159 | | 4.30 |
| CH8/RX Multi-purpose Charger | | | 01-02204 | | 9.40 |

Will recharge AA, C, D and PP3 size cells with automatic voltage selection. Will recharge following combination: 6×D, 6×AA, 6×C, 2×PP3, 2×D+2×C, 2×D+2×AA, 2×D+1×PP3, 2×C+2×AA, 2×C+1×PP3, 2×AA+1×PP3.

| | | | |
|---|---|---|---|
| Battery Adaptor | | 01-12001 | 0.96 |

Sold in pairs: one to convert AA size to C size and one to convert C to D size. Both may be used together to convert an AA to D size.

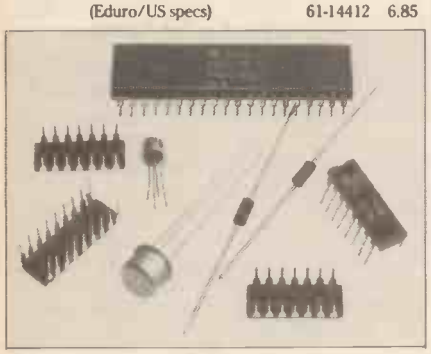
## Semiconductors

### *Linear IC's*

| | | | |
|---|---|---|---|
| LM301AN | DIL version | 61-03011 | 0.44 |
| LM308CN | DIL version | 61-03081 | 0.65 |
| LM311CN | Popular comparator | 61-00311 | 0.46 |
| LM324 | Low power quad op amp | 61-03240 | 0.67 |
| LM339N | Low power quad comparator | 61-03390 | 0.68 |
| LM346 | Programmable quad op amp | 61-00346 | 3.72 |
| LF347 | Quad Bi-FET op amp | 61-00347 | 1.82 |
| LM348 | Quad 741 type op amp | 61-03480 | 1.26 |
| LF351 | Bi-FET op amp | 61-03510 | 0.49 |
| LF353 | Dual version of LF351 | 61-03530 | 0.76 |
| LM380N | 1W AF power amp | 61-00380 | 1.00 |
| NE555N | Multi-purpose low cost timer | 61-05550 | 0.45 |

# for a better service.

| | | | |
|---|---|---|---|
| NE556N | Dual version of the 555 | 61-05560 | 0.50 |
| uA741CN | DIL low cost op amp | 61-07411 | 0.22 |
| uA747CN | Dual 741 op amp | 61-07470 | 0.70 |
| uA748CN | 741 with external frequency comp | 61-04780 | 0.40 |
| HA1388 | 18W PA from 14V | 61-01388 | 2.75 |
| TDA2002 | 8W into 2 ohms power amp | 61-02002 | 1.25 |
| ULN2283 | 1W max. 3-12V power amp | 61-02283 | 1.00 |
| MC3357 | Low power NBFM IF system and detector | 61-03357 | 2.85 |
| ULN3859 | Low current dual conversion NBFM IF and detector | 61-03859 | 2.95 |
| LM3900 | Quad norton amp | 61-39000 | 0.60 |
| LM3909N | 8-pin DIL LED flasher | 61-39090 | 0.68 |
| KB4445 | Radio control 4 channel encoder and RF | 61-04445 | 1.29 |
| KB4446 | Radio control 4 channel receiver and decoder | 61-04446 | 2.75 |
| ICM7555 | Low power CMOS version of timer | 61-75550 | 0.98 |
| ICL8038CC | Versatile AF signal generator with sine/square/triangle OPs | 61-08038 | 4.50 |
| TK10170 | 5 channel version of KB4445 | 61-10170 | 1.87 |
| HA12002 | Protection monitor system for amps, PSUs, TXs etc | 61-12002 | 1.22 |
| HA12017 | 83dB S/N phono preamp 0.001% THD | 61-12017 | 0.80 |
| MC14412 | 300 baud MODEM controller (Eduro/US specs) | 61-14412 | 6.85 |



## *Microprocessor & Memories*

| | | | |
|---|---|---|---|
| Z80A | Popular and powerful 8-bit CPU | 26-18400 | 3.40 |
| Z80AP10 | 2 port parallel input/output | 26-18420 | 2.95 |
| Z80A CTC | 4 channel counter/timer | 26-18430 | 2.90 |
| Z8671 | Z8 Micro comp. and Basic | 26-08671 | 17.50 |
| 6116-3 | 16K (2kx8) CMOS RAM 200nS | 26-36116 | 6.68 |
| Z6132-6 | 32K (4kx8) quasi RAM 350nS | 26-06132 | 15.00 |
| 4116-2 | 16K (16kx1) 150nS | 26-24116 | 1.59 |
| 2764 | 64K (8kx8) 450nS | 26-02764 | 9.50 |
| 2732 | 32K (4kx8) 450nS | 26-02732 | 5.70 |

## *Voltage Regulators*

| | | | |
|---|---|---|---|
| 7805 | 5V 1A positive | 27-78052 | 0.40 |
| 7812 | 12V 1A positive | 27-78122 | 0.40 |
| 7815 | 15V 1A positive | 27-78152 | 0.40 |
| 7905 | 5V 1A negative | 27-79052 | 0.49 |
| 7912 | 12V 1A negative | 27-79122 | 0.49 |
| 7915 | 15V 1A negative | 27-79152 | 0.49 |

## *Transitors*

| | | | |
|---|---|---|---|
| BC182 | General purpose | 58-00182 | 0.10 |
| BC212 | General purpose | 58-00212 | 0.10 |
| BC237 | Plastic BC107 | 58-00237 | 0.08 |
| BC238 | Plastic BC108 | 58-00238 | 0.08 |
| BC239 | Plastic BC109 | 58-00239 | 0.08 |
| BC307 | Complement to BC237 | 58-00307 | 0.08 |
| BC308 | Complement to BC238 | 58-00308 | 0.08 |
| BC309 | Complement to BC239 | 58-00309 | 0.08 |
| BC327 | Driver/power stage | 58-00327 | 0.13 |
| BC337 | Driver/power stage | 58-00337 | 0.13 |
| MPSA13 | NPN Darlington | 58-04013 | 0.30 |
| MPSA63 | PNP Complement to MPSA13 | 58-04063 | 0.30 |
| J310 | JFET for HF-VHF | 59-02310 | 0.69 |
| J176 | JFET analogue switch | 59-02176 | 0.65 |
| 3SK51 | Dual gate MOSFET-VHF amp | 60-04051 | 0.60 |
| 3SK88 | Dual gate MOSFET-Ultra lo noise | 60-04088 | 0.99 |
| TIP31A | Output stage | 58-15031 | 0.35 |
| TIP32A | Complement to TIP31A | 58-15032 | 0.35 |
| VN66AF | VMOS Power FET | 60-02066 | 0.95 |
| ZTX3866 | E-line version 2N3866 | 58-03866 | 0.45 |
| IN4001 | Rectifier diode | 12-40016 | 0.06 |
| IN4002 | Rectifier diode | 12-40026 | 0.07 |
| IN4148 | General purpose silicon | 12-41486 | 0.05 |

## *Silicon Controlled Rectifiers*

| | | | |
|---|---|---|---|
| BRY55-100 | 100V .8A | 52-55100 | 0.50 |
| C106DI | 400V 4.0A | 52-00106 | 0.70 |
| C122DI | 400V 8.0A | 52-00122 | 1.45 |

## *3mm Diameter LEDs*

| | | | |
|---|---|---|---|
| V178P | Red | 15-01780 | 0.15 |
| V179P | Green | 15-01790 | 0.16 |
| V180P | Yellow | 15-01800 | 0.18 |

## *5mm Diameter LEDs*

| | | | |
|---|---|---|---|
| CQY40L | Red | 15-10400 | 0.12 |
| CQY72L | Green | 15-10720 | 0.15 |
| CQY74L | Yellow | 15-10740 | 0.15 |

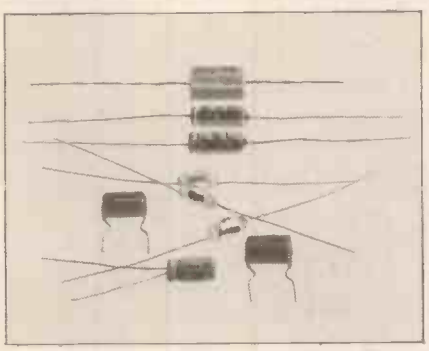
## *Infra-Red LEDs*

| | | | |
|---|---|---|---|
| CQY99 | Emitter | 15-10990 | 0.56 |
| BPW41 | Detector | 15-30410 | 1.51 |

## *Tri Colour LED*

| | | | |
|---|---|---|---|
| V518 | Orange-Green-Yellow | 15-05180 | 0.60 |

## Capacitors



## *Aluminium Electrolytics Radial PCB Mounting*

| | | | Pack of 4 |
|---|---|---|---|
| 10u | 16V | 05-10606 | 0.24 |
| 47u | 16V | 05-47606 | 0.28 |
| 47u | 25V | 05-47607 | 0.28 |
| 470u | 6.3V | 05-47705 | 0.36 |
| 470u | 16V | 05-47706 | 0.48 |

## *Tantalum Beads*

| | | | Each |
|---|---|---|---|
| 1uf | 35V | 05-10501 | 0.18 |
| 10uf | 16V | 05-10601 | 0.28 |
| 47uf | 6.3V | 05-47601 | 0.45 |
| 47uf | 16V | 05-47602 | 0.92 |

## *Monolithic Capacitors*

| | | Pack of 3 |
|---|---|---|
| 1n | 04-10204 | 0.39 |
| 10n | 04-10304 | 0.42 |
| 100n | 04-10404 | 0.45 |

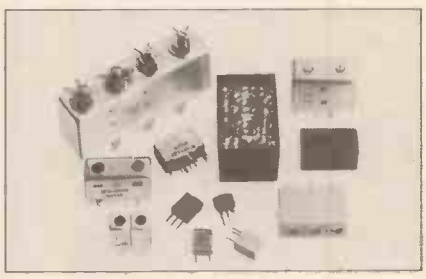
## *Low Voltage Disc Cermaic*

| | | Pack of 5 |
|---|---|---|
| 1n | 04-10203 | 0.20 |
| 10n | 04-10303 | 0.20 |

## *Polyester (C280)*

| | | Pack of 3 |
|---|---|---|
| 10n | 04-10305 | 0.18 |
| 47n | 04-47305 | 0.24 |
| 100n | 04-10405 | 0.24 |
| 470n | 04-47405 | 0.51 |
| 1uF | 04-10505 | 0.66 |

## R F Components



## *Filters*

CFU/LFB CFW/LFH SERIES

Miniature 455kHz filters. I/P and O/P impedance 2K.

| | | -6dBW | -40dBW | | |
|---|---|---|---|---|---|
| LFB6/CFU455H | | 6kHz | 18kHz | 16-45512 | 1.95 |
| LFB12/CFU455F | | 12kHz | 26kHz | 16-45515 | 1.95 |
| LFH6S/ CFW455HT | | 6kHz | 14kHz | 16-45525 | 2.45 |
| LFG12S/ CFW455FT | | 12kHz | 22kHz | 16-45528 | 2.45 |
| CFM2455A Mechanical IF Filters for 455kHz | | | | 19-45530 | 0.77 |

## *Crystal Filters* 2 Pole Types

| | | | |
|---|---|---|---|
| 10M15A | 10.7 Centre Freq. | 20-10152 | 2.10 |
| 10MO8AA | 10.695 Centre Freq. | 20-11152 | 3.49 |

## *Inductors*

We offer the complete Toko range of fixed and variable inductors. Over 500 coils from audio to V.H.F. See catalogue for details.

## Soldering Irons (Antex)

| | | | |
|---|---|---|---|
| CS240 | Iron 240VAC 17 Watts | 54-22300 | 5.20 |
| XS-240 | Iron 25W 240V High heat capacity | 54-22500 | 5.40 |
| SK6 | Presentation pack of one XS-240 with ST4 stand | 54-22510 | 7.20 |
| MLXS | Handy 12V 15W soldering iron complete with crocodile clips and solder | 54-20004 | 5.60 |

Please add 15% VAT to all advertised prices and 60p post and packing. Minimum order value £2 please. We reserve the right to vary prices in accordance with market fluctuation.

# MONITOR

## Soft Swap

**Acornsoft**, the software division of Acorn Computers, are giving their customers an opportunity to **part-exchange software** on cassette for the same software of disc.

To take advantage of the offer, customers should return their cassette, without its outer box, to Acornsoft, plus a remittance for half the cost of the same program on disc (inclusive of VAT), to **Disk Replacement Service, Acornsoft Ltd., c/o Vector Marketing, Denington Industrial Estate, Wellingborough, Northants NN8 2RL.** To find out whether a particular program is available on forty or eighty track discs, check the most recent Acornsoft catalogue, available from Acorn dealers or from **Acornsoft Ltd., 4a Market Hill, Cambridge CB2 3NJ.** Whether or not you think this is good value depends on how badly you want to acquire a disc at the expense of your cassette, but it is certainly an unusual service. One which purveyors of Videodisc and Compact Disc players might in due course consider?

## 6809 Group

A **newsletter and User Group** for users of the 6809 microprocessor has been founded.

The newsletter will come out bimonthly (six times a year), and will feature a software section for 6809 assembly routines and programs, as well as programs in other languages; a 6809 assembly langauge course for those updating from other processors (so far, only 6502 and Z80); a hardware section for circuits relevant to the 6809 or to computers in general; a free advertisement page for members, and a letters page, as well as other incidental articles.

Subscription will be yearly, half yearly or by individual issue, at 70p per issue to begin with, with the price coming down if there is enough support. The group would like contributions of articles and items for the newsletter.

Those interested please contact **Mr. W. Gibbons, 9, St. Thomas Hill, Launceston, Cornwall PL15 8BL.**

## Computer Fair

Europe's biggest personal and small business computer exhibition, **The Computer Fair**, will be once again staged at Earls Court from June 14-17, 1984. This event will feature a 'Business/Trade Only Day' on June 14, to enable trade and business people to visit the show before the crowds converge. The exhibition has also been arranged in two distinct areas — one for home computer enthusiasts, the other for business exhibitors. Attendance at the 1984 Show is expected to match that of the 1983 when nearly 50,000 people attended. Sinclair Research, who chose the 1982 Computer Fair to unveil the Spectrum Microcomputer and in 1983 exhibited new peripherals for this system, are back this year to show their latest computer the Sinclair QL. Commodore will be displaying home and personal computers including the SX-64 portable computer. Acorn will be showing bitstik graphics (computer aided drawing) systems on the BBC Micro.

The Computer Fair will be open from 10.00am — 6.00pm on June 14 (Business/Trade Only Day), June 15 and 16, and from 10.00am - 5.00pm on June 17. For further information on all aspects of the event, contact **the Exhibition Manager, The Computer Fair, Reed Exhibitions, Surrey House, 1 Throwley Way, Sutton, Surrey SM1 4QQ. Tel: 01 643 8040.**


## Don't Overheat

**OK Industries** are now stocking a temperature-controlled **soldering station.** Features of the station are stability within 5% over 100-500°C, power and heater indicators, a temperature indicator, proportional control and a 24V 48W low-leakage iron. The unit is earthed to protect MOS and CMOS chips, and comes in a 115V or 230V model. Various soldering tips are available.

Enquiries to **OK Industries UK Ltd., Dutton Land, Eastleigh, Hants SO5 4AA. Tel: (0703) 619841.**

## Not An Armon A Leg

**Armon Electronics** have supplemented their range of push-button **digital multimeters** with an advanced rotary-switched model, the HC-5010.

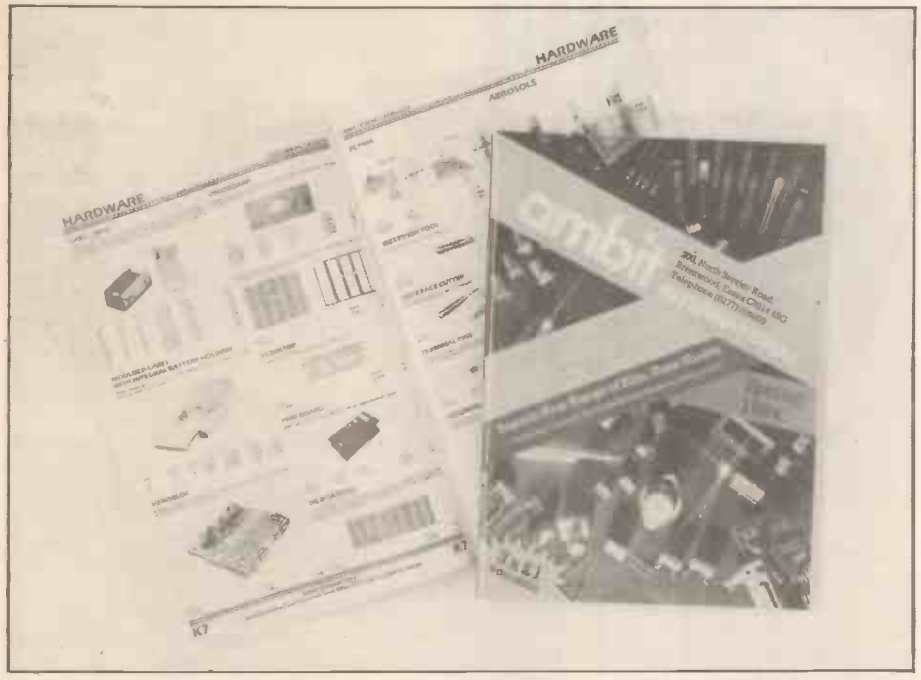
Housed in an ABS cabinet, fitted with recessed input jacks to obviate shock hazard, and a tilt stand for bench use, the meter is supplied with a 9V battery, test leads and a comprehensive instruction manual, and comes in polyfoam packing. A no-quibble guarantee covers the instrument against defects in workmanship and materials for twelve months.

Readings are on a 3½ digital LCD display, which has low battery and polarity indication, with automatic decimal point. A twenty-position rotary switch selects the functions and ranges. Resistance ranges extend from 20R to 20MR, with a resolution of 10mR on the 20R range, and include a diode test position and a continuity buzzer. The amp ranges are also extended — 20uA range, and accuracies of 1 to 3% AC and 0.5 to 3% DC, depending on range selected.

Voltage range is from 200mV to 750V AC or 1,000V DC. Resolution is 10uV on the 200mV ranges, with accuracies of 0.25% DC and 1% AC. All ranges and functions are protected against overload.

The price is £35.95 plus VAT. Further details can be obtained from **Armon Electronics Ltd., Cottrell House, 53/63 Wembley Hill Rd., Wembley, Middlesex, HA9 8BH. Tel: 01 902 4321.**

# MONITOR




## Ambit Out

**Ambit International's** Spring 1984 **catalogue** is now available from newsagents and from Ambit themselves, cover price 80p. The catalogue features components, kits, data sheets, batteries, crystals and electronics books, as well as three £1 discount vouchers. Everything can be obtained mail order, or from Ambit's three retail outlets at **200 North Service Rd., Brentwood, 53 Burrfield Rd., Portsmouth** and **Park Lane, Broxbourne.** Catalogues can be ordered from **Ambit International, 200 North Service Rd., Brentwood, Essex CM14 4SG.** If you can't get them locally.

## Electronics Circuit

The **British Amateur Electronics Club's** Spring journal contains a guide to designing and making PCBs, (copiously illustrated); "The Computer And Its Uses Part 1"; Notes From An Experimenter's Workshop; Electronics A-Z Part 5 — Atomic Structure And Semiconductors; and the usual letters, news, small ads, list of component suppliers offering discounts to members, etc. A very meaty issue, this one. Enquiries about membership to the **Chairman, Mr. C. Bogod, "Dickens", 26 Forrest Rd., Penarth, S. Glamorgan.** The BAEC is a very good thing for anyone learning, or teaching themselves, electronics, with lots of hints and practical information.

## The Prize Is To The Swiftest

$100,00 for the First Prize is the reward being offered by **Video Games International,** and their partners for this year's "Invent A Game" **competition.** We wish they'd given us a bit more warning so that we could let those of our readers who aren't avid readers of the "international specialist press" (which must mean the computer press) but who nevertheless enjoy games and programming, that this competition is happening. Entries close on May 31st, which is about three weeks' time, but anyone who is thinking of entering or who has a new game gleaming in his or her eye is invited to contact Mr. Mark Eliot on (0753) 652711/2 to find out more about the competition. The address, for those of you who trust not in telephones, is **Video Games International, Pinewood Studios, Iver Heath, Bucks SL0 0NH.**

## Take Cover

**John Wise Ltd.,** are a small company who produce various useful articles in acrylic. Of interest to Hobby readers might be **model-type dust covers** and also display cases and stands, made to the customer's requirements. Enquiries to their new address, **John Wise Ltd., 5 Alpha Rd., West Green, Crawley, Sussex RH11 7DH. Tel. (0293) 542889.**

## Page Of Aquarius

A new monthly magazine, **Aquarius User,** has been launched for the owners of the Aquarius micro. The magazine contains news and information about the computer and peripherals, software reviews, hints and listings, and letters pages. At present it is available at a subscription rate of £12 per year.

For information contact **Aquarius User, 66 Wymering Rd., London W9.**

## BBC Data Base

**Clares Micro Supplies** announce what is probably the most powerful **data base** yet available for the BBC Micro. Beta-Base has the facility for 200 fields, fields of up to 254 bytes and records in excess of 2000, with Redefine and Transfer options to make a file more versatile, a powerful sort and search facility, calculations on all mathematical fields and a variety of printing options.

Beta-Base's secret lies in the fact that it has been written as a disc based data base. The total size of any file is purely limited by the size of the disc drives.

Priced at £25 (inc. VAT) Beta-Base comes with a fully comprehensive manual and a demonstration program. Beta Base is available from **Clares Micro Supplies, 98 Middlewich Road, Rudheath, Northwich, Cheshire CW9 7DA. Tel: (0606) 48511,** and selected retail outlets.

## A Fair Copper

As an alternative to printed circuit boards, adhesive **copper strip** sold in rolls can be used. **Copperfoil Enterprises'** Copperfoil tape is a thin pure copper strip backed by an adhesive formulated to withstanding high temperatures and take soldered connections. The tape is suitable for voltages up to 240VAC/DC and a current carrying capacity of 5A, but is not recommended for mains voltage. The tape can be bonded to almost any insulated surface, including paper and plastic.

The tape is available in 4, 4.75, 6 and 8mm widths, in 33 metre rolls. Enquiries to **Copperfoil Enterprises, 141 Lyndhurst .Drive, Hornchurch, Essex RM11 1JP.** We tested a strip and found that it was a little inclined to lift, temporarily, if subjected to prolonged contact with a hot soldering iron but otherwise stayed put and took a good solder contact.

# MONITOR

## Back To Bassics

**Wilmslow Audio**, the **loudspeaker kits** specialists, now have three new models in the **Wharfdale Speakercraft** range.

Designated the L50, L90B and L140, these are two-way systems of 11, 17 and 20 litres respectively. Unlike most previous small Wharfdale speakers, these are all of 8R impedance. This new Speakercraft MANUAL is available free from Wilmslow.

**Volt loudspeakers** have come up with an answer to the problem of adding extra bass units to compact 'speakers. Two new units, the 8in DVC220DS and the 10in DV250 overcome the problem of matching low-sensitivity small speakers with the higher sensitivity of a bass unit in a larger enclosure, by having their sensitivities tailored to match smaller units. They are fitted with dual voice coils, so that the bass output of both channels can be fed via third order networks into a single bass unit.

The 8in speaker is suitable for wall mounting or enclosure mounting, the 10in unit for enclosure mounting only. Computer optimised tuning details can be supplied with either type for the chosen cabinet volume, and with or without grilles fitted.

Full details from **Wilmslow Audio Ltd., 35/39 Church St., Wilmslow, Cheshire SK9 LAS. Please send 12x9in SAE. Tel: (0625) 529599.**

## Electron Add-on

**FBC Systems** have produced what will be one of the first, if not the only (by the time you read this) extension for the Acorn Electron so far: a switched **joystick interface.**

The plug-in cartridge takes all standard Atari-style joysticks, and FBC say that it is considerably quicker to read their interface than it is to read a normal keyboard input or A/D convertor. PCB have been in consultation with various Electron software houses, and intend to demonstrate their product at computer shows round the country during this year.

Enquiries to **Breheny Advertising Ltd., 1 The Channel, Union St., Ashbourne, Derbyshire. Tel: (0335) 43729.**

## Circuit Layout By Apple

For Apple users doing electronic design, come two programs to assist in calculation and layout of electronic circuits.

Avant-Garde Creations's 'Hi-Res Electronic Design" allows the user to create fast and neat electronic schematics and save them as picture files on disc or via a printer, including labelling. A single keytouch chooses from ninety-eight different electronic components, or for choosing shape rotation. Components can be moved around the screen using an ordinary games paddle or joystick.

Korsmeyer's "Electronic Design" gives a menu-driven array of electronic formulae for quick calculation.

Information from the distributors, **Pete & Pam Computers, New Hall Hay Rd., Tawtentstall, Rossendale, Lancs BB4 6JG. Tel: (0706) 212321.** The Avant-Garde program costs £19.95 plus VAT; no price is quoted for the other package.

## Flat Transformer

**Avel-Lindberg** have issued a leaflet on what has been claimed to be the world's thinnest transformer (remember when a transformer was a lump of solid iron requiring a suitcase or at least a small rucksack to transport it?).

Their OB (on-board) PCB-mounting transformers are 10.5mm high, by 57mm by 68mm and conform to high industrial standards. Dual primary windings can be connected in parallel for 120VAC or in series for 240VAC nominal operation at either 50Hz or 60Hz. The transformers are available with a range of secondary winding ratings. Both direct soldering and screw-fixings are provided for.

Information from **Avel-Lindberg Ltd., South Ockendon, Essex, RM15 5TD. Tel: (0708) 853444.**

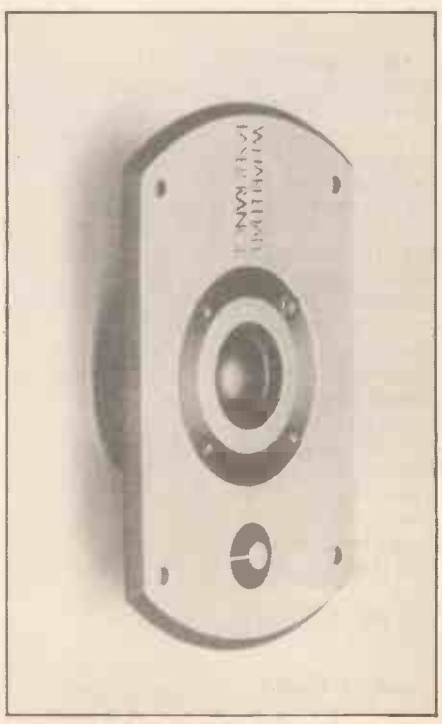
## It's A Draw

**Reekie Technology** (who are based in East Twickenham and not, as you might think, in Edinburgh) has launched a **drafting aid** for BBC Model B micros, with software available on disc or cassette, and software for other micros under development.

Image Plotter allows the micro to reproduce maps, graphs, line drawings etc. to be reproduced with great exactness, from where they can be stored with the help of a printer. The plotter comes ready assembled with a handbook and calibration sheet. Made of aluminium and weighing 350g, the plotter costs £49.45 inc. VAT. Reekie do not specify whether this includes carriage, but they do say that Image Plotter is only available mail order at present.

They are also planning a low-cost X-Y plotter for use with the Image Plotter.

Orders and enquiries to **Reekie Technology Company, Beaufort Rd., Off Richmond Rd., East Twickenham, Middx. TW1 2PH. Tel: 01 892 2877.**



# MONITOR


## Going For Brokers

New pro-standard test equipment from **Electronic Brokers** includes three autoranging **multimeters** and a brace of portable **oscilloscopes**.

The 70 Series digital multimeters by Fluke comprise the basic JF73 with 0.7% accuracy, the JF75 with 0.5% accuracy, manual override and an audible continuity bleeper, and the JF77, with 0.3% accuracy, has a touch-hold facility which allows the user to concentrate on setting the test leads without watching the display. When a stable reading is achieved, a bleeper sounds, and the reading is held until a new test point is selected.

The two oscilloscopes are the Philips PM3254 and PM3256. Both are dual trace, with separate variable control of the main and delayed timebases, variable hold-off, X-Y display facilities, and TTL triggering. The trigger-view function can also be used as a third channel. The PM3254 has a single timebase and the PM3256 a delayed timebase.

Being designed for portability, the two scopes are strongly built around a tubular chassis, with a shoulder strap. Both can be operated from AC or DC power supplies.

For further information contact **Electronic Brokers Ltd., 61/65 Kings Cross Rd., London WC1X 9LN. Tel: 01 278 3461.**

## ZX Projects Go North

Distribution of the popular **ZX81 Hi-Res Graphics Board** (HE July '83) is now being handled by **Kelan/Hobbyboard, Hookstone Park, Harrogate, N. Yorks.** All the orders have been passed across from **Cambridge Computing,** and any queries about orders should be sent to Kelan. The modifications to the **ZX81 Programmable Joystick** to make it compatible with Sinclair Microdrives are being finalised at present, so any reader who is waiting for news about the modified boards should be hearing shortly.

## Marshall Catalogue

**A. Marshall** (London) Ltd. have issued their new, 56-page 1984 catalogue. With over 8,000 items listed, the catalogue costs £1.00 post paid, £1.50 overseas, and 75p to callers at their shop at **85 West Regent St., Glasgow G2 2QD. Tel: 041 332 4133.**

## In The Modem

"Modems . . . what are they? Of what benefit are they to a micro owner/user? What services can be accessed . . .?" enquires a letter from Tandata's PR company. Tandata, of course, are becoming well known for their Tm100 smart modem, and are bringing out another model, the Tm200, with both full and half duplex at various rates.

Now Tandata have issued an information special edition of their Tandata Newsletter describing how modems can be connected and used with different microcomputers. They invite anyone who would like a copy of the leaflet to write to them at **Tandata Marketing Ltd., Albert Rd. North, Malvern, Worcs WR14 2TL.**

## Appliance Brochure

**Superswitch,** makers of small domestic appliances and specialists in products to improve home security, have produced a new range brochure. Available free, it contains details of all the company's latest products, including their dimmers and timers. Amongst the new items featured are a battery driven, passive infra-red intruder alarm, low voltage outdoor lighting, smoke alarms, and the Long-lite rechargeable torch. All these have been introduced by Superswitch during the last few months.

Further information from **Superswitch Electric Appliances Ltd., 7 Station Trading Estate, Camberley, Surrey GU17 9AH. Tel: (0276) 34556.**

## Go Forth And Multitask

Users who want **FORTH** for their **BBC Micros** will now find in on a 16K EPROM type 27128 from **Skywave Software,** going under the name of Multi-FORTH 83. This version of FORTH has been specially written for the BBC.

The EPROM can be plugged into the micro's sideways ROM area so that it has a higher priority than the BASIC ROM. It is multi-tasking, so that the user can have several FORTH programs on the go at once; compatible with the MOS so that the Disc Directory and other DFS commands can be used, and MOS commands can be used from within the FORTH; capable of maintaining files of more than 32K which can be stored on disc alongside non-FORTH files; vectored so that the more powerful features can be user-redefined; extensively documented, and with a number of other special features.

Multi-FORTH 83 costs £40 plus p&p and VAT from **Skywave Software, 73 Curzon Rd., Boscombe, Bournemouth BH1 4PW. Tel: (0202) 302385.**

# MONITOR

## Graphics Stylus

**Computapix Ltd,** has launched the PIXSTIK computer graphics stylus, which comes complete with its own "paintbox" software, and when connected to the VIC 20 or Commodore 64K home computers turns into a multi-purpose drawing instrument.

PIXSTIK offers a choice of sixteen colours to work in, and a range of predetermined shapes can be drawn, in addition to the freehand facility and commands that will among other things finish off the drawing in filled, unfilled or paintbrush style.

The ABC mode enables users to animate what they have drawn, bounce it backwards and forwards on the screen, and even run it cartoon fashion. "The real beauty of the PIXSTIK lies in the ease with which anyone can operate it, whether doodling or drawing seriously, and it even has a built-in eraser" say Computerpix. PIXSTIK comes complete with an instructional manual, software and three computer games, at the price of £29.95, including VAT and p&p.

Orders and enquires to **Computapix Ltd, Gores Road, Kirkby Industrial Estate, Kirkby, Liverpool, L33 7UA. Tel: 051 548 7111.**

## Time Control

An inexpensive Swiss-made 24-hour **timeswitch** that will plug into any 13-amp socket can be set to control burglar repelling lights and radio at up to five separate times during twenty-four hours. Maximum load is 13-amp (3100W at 240V 50Hz). It will also switch on radios or tape recorders to catch sports results or news programmes. Once set, it operates round the clock continuously until switched off or reprogrammed.

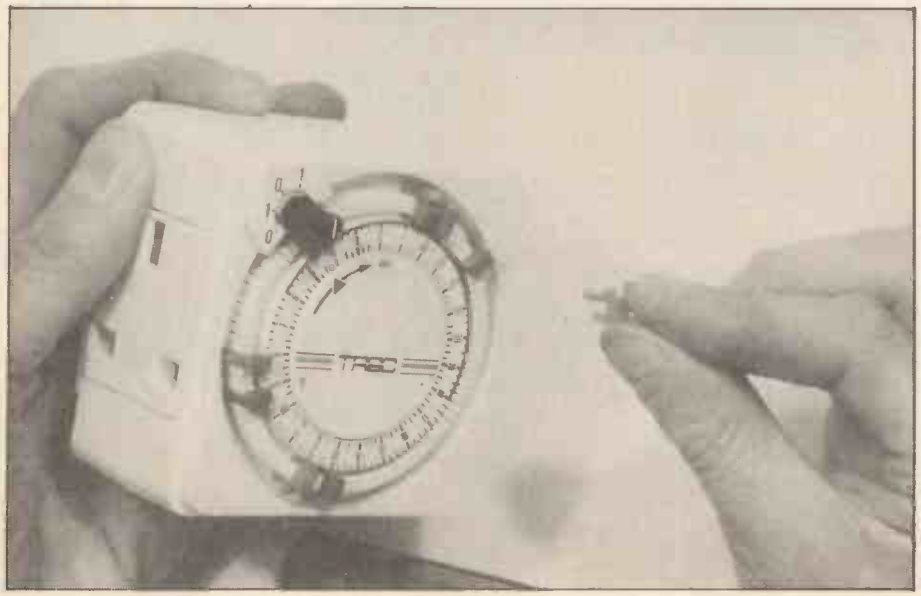
Five pairs of operating pegs are supplied, red for 'on' and blue for 'off'. They are housed in a compartment in the clock until needed, when they are inserted against the times that switching is to take place. Operation is simple and there is an indicator which shows whether the switch is on or off and allows the current or next switching phase to be over-ridden if required. The price is £14.00 including VAT and p&p.

Enquiries to **Semiconductor Supplies Ltd., Dawson House, 128/130 Carshalton Rd., Sutton, Surrey SM1 4RS. Tel: 01 643 1126.**

## Light Work

A **work holder** with a 'quick-release trigger to allow PCBs to be removed and replaced in a matter of seconds is available from **Electronic & Computer Workshop Ltd.** The special attachments which fit to the PCB holding arms can be repositioned to hold such small components as switches etc. during soldering operations.

The MCP-2 Work Holder can hold boards up to 12in long, is multi-positional and can revolve around 360°. The 'quick-release' trigger arm works by spring tension which is adjusted by means of a knurled knob. The heavy die-cast base of the Work Holder incorporates two trays for holding components and other small parts.



A simple but very effective tool is the Telpro **Automatic Wire Stripper** which, with a one squeeze operation strips the insulation from single and stranded wires without damage. Its wide jaws permit fast and accurate stripping without any nicking or scraping of the wire and a gauge is supplied to ensure consistent lengths of stripping.

Two models are available: the AWS-1 will cut five diameters of wire: 1.0, 1.6, 2.0, 2.6, and 3.2mm., while the AWS-2 will cut four diameters, 0.5, 1.2, 1.6, and 2.00mm. It is priced at £5.00 plus £1.00 p&p and VAT.

The versatile Velleman **Light Computer** is available in kit form, priced at £31.50 plus £1.00 p&p and VAT.

The kit has eight programs stored in an EPROM, each of which can be selected by a switch. The largest consists of over one hundred steps, and each program will give a particular lighting effect via seven outputs, to which groups or festoons of lamps may be connected. Various configurations are available: running lights; forward and reverse; flip-flop function and specific advertising sign functions. The circuit can be adapted for use in discos, in educational applications, and to test security systems.

Specifications include a 24-240VDC lamp supply, 2 x 12VAC logic supply and a maximum triac output of 600W. Other features include user selectable programs in EPROM, adjustable speed and buffered outputs (emitter-follower). There is no limit on the number of circuits which may be connected together in cascade and synchronised. Similarly there is no limit on the number of controllable outputs.

For further information please contact: **Electronic & Computer Workshops Ltd., 171 Broomfield Road, Chelmsford, Essex CM1 1RY. Tel: (0245) 262149.**


## Take A Tip

New to the range of production **soldering tools** offered by **Tele-Production Tools** is a temperature controlled pencil iron designated the Thermomatic.

This new iron, which is rated at 24/50W, has a 'closed loop' electronic control system enclosed in the handle and is fully adjustable from 200° to 400°C. The Thermomatic, which may be used with any 24V power supply, has no moving parts and creates no magnetic or electrical interference whatsoever.

Safety features include burn-resistant silicon rubber lead, self-extinguishing polycarbonate handle and low operational voltage. A range of fourteen iron-clad long-life bits are available for use with the Thermomatic, which include screwdriver, chisel and conical shaped tips.

The average price of the Thermomatic is £14.00 exclusive of VAT.

For further details contact **Tele-Production Tools Ltd., Stiron House, Electric Avenue, Westcliffe-on-Sea, Essex SS0 9NW. Tel: (0702) 352719.**

## Microelectronics Off The Shelf

The first packaged range of micro-electronic components to be sold exclusively through high street model and hobby shops have been announced by **Micromate Ltd** of Bedford.

Based on experience on the industrial side, the MicroMate range covers the most commonly used components, at prices from 30p to £5 per pack. The latter price is for a single chip, but many components will be packaged in stock box quantities. The range includes resistors, capacitors, optoelectronics, relays, switches, connectors and small specialist tools. All are packaged in clear plastic packs, so the contents can be clearly seen.

Where the range, which is extensive but basic, does not include some specifically needed component, shop-keepers can order it directly from MicroMate's stocklist of 2,000 components, all bought direct from the manufacturers, for ex-stock delivery. The bespoke service back-up to the off the peg trade also includes free advice from MicroMate, though, since the company intends to deal only through retail outlets, queries will have to be passed to them through the stockists, not sent direct.

At present, MicroMate offer only components but they are planning to develop the product range towards specific project kits, and ultimately may sponsor microelectronics design competitions to foster interest among modellers.


## Glue Gun

A hotmelt **Glue Gun** from **Steinel (UK) Ltd.**, called the Gluemate has been designed and engineered from scratch to overcome problems encountered with trigger operated glue guns.

The trigger action was specifically engineered to give more precise control over the glue feed, and has increased glue feed at the nozzle by up to 38 % over existing trigger operated models. The gun incorporates a valve arrangement in the nozzle which ensures an even and continuous flow of glue, for fine assembly and filling and sealant jobs as well as for insulation, repairs, reinforcement, bonding and encapsulation.

At a RRP of £19.95 (including VAT), the Gluemate is for both hobbyist and professional craftsman.

The gun heats up rapidly, being ready for use in 3 to 4 minutes, and is supplied with a clip-on stand. The heater housing is double insulated and the choice of a self-regulating heater control system has eliminated the need for potentially unreliable mechanical thermostats. The Gluemate will operate off any mains voltage from 100 to 240 volts.

An inexpensive and versatile LED **Voltage Tester**, the Master Check-3, aimed at hobbyist and professional users alike, is now available. It is a two-terminal, hand-held instrument, which will measure AC and DC voltages in the range from 6V to 415V RMS, from an LED array display.

The unit is simple to use, due to its construction, comprising two probes connected by a cable, one of which contains the measurement electronics and display LEDs. This means that users keep their eyes on their hands, rather than looking at a separate meter. Surge rated voltage is 6kV and input impedence is from two to 50kR. PTC controlled, depending on the input voltage.

Applications for the Master Check-3 including battery testing, checking three phase motors, and the testing of domestic equipment and hobby projects. Frequency range is from 0 to 100Hz and peak current is 180mA at 380V.

For further information contact **Steinel (UK) Ltd., 17, Reddicap Trading Estate, Sutton Coldfield, West Midlands B75 7BU Tel: 021 378 2820.**

## Prize Games

Tomy, who make the Robo I robot arm (shortly to be the subject of a control/interface project incorporating the Sinclair Spectrum and other micros in *Digital and Micro Electronics*) have won the 1984 Electronic Games Arcade Award in the USA for their **Tomytronic** 3-D Sky Attack, which is, despite the reference to 'arcade' a hand-held game which uses parallel screens to set its space battle in three dimensions.

Don't be surprised if there is a heavy crop of 3-D games in the near future. HE

# EUROPA ELECTRONICS

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

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

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

**74LS SERIES**

| | | | |
|---|---|---|---|
| 74LS00 | 20p | 74LS154 | 74p |
| 74LS01 | 20p | 74LS155 | 40p |
| 74LS02 | 20p | 74LS156 | 40p |
| 74LS03 | 20p | 74LS157 | 40p |
| 74LS04 | 20p | 74LS158 | 35p |
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| 74LS08 | 20p | 74LS161 | 50p |
| 74LS09 | 20p | 74LS162 | 45p |
| 74LS10 | 20p | 74LS163 | 45p |
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| 74LS14 | 34p | 74LS168 | 140p |
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| 74LS21 | 20p | 74LS173 | 90p |
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| 74LS27 | 20p | 74LS181 | 120p |
| 74LS28 | 20p | 74LS183 | 120p |
| 74LS30 | 20p | 74LS190 | 60p |
| 74LS32 | 25p | 74LS191 | 60p |
| 74LS33 | 20p | 74LS192 | 60p |
| 74LS37 | 20p | 74LS193 | 60p |
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| 74LS40 | 20p | 74LS195 | 50p |
| 74LS42 | 36p | 74LS196 | 60p |
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| 74LS48 | 60p | 74LS221 | 80p |
| 74LS51 | 20p | 74LS240 | 70p |
| 74LS54 | 20p | 74LS241 | 70p |
| 74LS55 | 20p | 74LS242 | 60p |
| 74LS73 | 20p | 74LS243 | 60p |
| 74LS74 | 30p | 74LS244 | 100p |
| 74LS75 | 30p | 74LS245 | 140p |
| 74LS76 | 27p | 74LS247 | 70p |
| 74LS83 | 46p | 74LS248 | 70p |
| 74LS85 | 60p | 74LS249 | 70p |
| 74LS86 | 25p | 74LS251 | 45p |
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| 74LS91 | 60p | 74LS256 | 200p |
| 74LS92 | 60p | 74LS257 | 45p |
| 74LS93 | 32p | 74LS258 | 45p |
| 74LS95 | 50p | 74LS259 | 80p |
| 74LS96 | 90p | 74LS260 | 35p |
| 74LS107 | 33p | 74LS261 | 80p |
| 74LS109 | 33p | 74LS266 | 25p |
| 74LS112 | 33p | 74LS273 | 100p |
| 74LS113 | 30p | 74LS275 | 175p |
| 74LS114 | 32p | 74LS279 | 50p |
| 74LS122 | 60p | 74LS280 | 80p |
| 74LS123 | 90p | 74LS283 | 50p |
| 74LS124 | 150p | 74LS290 | 55p |
| 74LS125 | 34p | 74LS293 | 50p |
| 74LS126 | 34p | 74LS295 | 70p |
| 74LS132 | 42p | 74LS365 | 180p |
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| 74LS136 | 30p | 74LS365 | 34p |
| 74LS138 | 42p | 74LS366 | 34p |
| 74LS139 | 42p | 74LS367 | 34p |
| 74LS145 | 75p | 74LS368 | 34p |
| 74LS147 | 120p | 74LS373 | 100p |
| 74LS148 | 120p | 74LS374 | 100p |
| 74LS151 | 50p | 74LS375 | 60p |
| 74LS153 | 50p | 74LS390 | 60p |
| | | 74LS393 | 120p |

**TRANSISTORS**

| | |
|---|---|
| AD161 | 42p |
| AD162 | 42p |
| BC107 | 10p |
| BC108B | 12p |
| BC109 | 10p |
| BC109C | 12p |
| BC177 | 18p |
| BC178 | 16p |
| BC179 | 20p |
| BC182L | 10p |
| BC183L | 10p |
| BC184L | 10p |
| BC212L | 10p |
| BC213L | 10p |
| BC214L | 10p |
| BC547 | 12p |
| BC548 | 12p |
| BC549C | 14p |
| BC556 | 15p |
| BC557 | 15p |
| BC558 | 15p |
| BC559 | 18p |
| BFY50 | 23p |
| BFY51 | 23p |
| BFY52 | 23p |
| TIP29A | 33p |
| TIP30A | 33p |
| TIP31A | 38p |
| TIP32A | 38p |
| TIP33A | 65p |
| TIP34A | 74p |
| TIP41A | 80p |
| TIP42A | 85p |
| TIS43 | 32p |
| 2N2646 | 45p |
| 2N2904 | 28p |
| 2N2905 | 26p |
| 2N2906 | 28p |
| 2N2907 | 26p |
| 2N3053 | 26p |
| 2N3055 | 48p |
| 2N3702 | 10p |
| 2N3703 | 10p |
| 2N3704 | 10p |
| 2N3705 | 10p |
| 2N3706 | 10p |
| 2N3707 | 10p |
| 2N3708 | 10p |
| 2N3709 | 10p |
| 2N3819 | 22p |
| 2N3903 | 15p |
| 2N3904 | 15p |
| 2N3905 | 18p |
| 2N3906 | 18p |
| 2N5457 | 30p |
| 2N5458 | 30p |
| 2N5459 | 30p |

**COMPUTER CHIPS**

| | |
|---|---|
| Z80A | 320p |
| Z80ACTC | 250p |
| Z80ADART | 700p |
| Z80AP10 | 250p |
| Z80S10 | 810p |
| 6802 | 225p |
| 6821 | 100p |
| 6840 | 375p |
| 6850 | 110p |
| 6852 | 250p |
| 6875 | 500p |
| 6085 | 450p |
| 8154 | 950p |
| 8156 | 350p |
| 8212 | 100p |
| 8216 | 100p |
| 8228 | 270p |
| 8250 | 650p |
| 8253 | 390p |
| 8255 | 285p |
| 8259 | 400p |

**MEMORIES**

| | |
|---|---|
| 2102-3L | 120p |
| 2114-2L | 100p |
| 2516 | 250p |
| 2532 | 375p |
| 2708 | 250p |
| 2716 | 280p |
| 2732 | 320p |
| 4116-20 | 100p |
| 4164-15 | 400p |
| 4816-AP3 | 280p |
| 5101 | 210p |
| 6116P-3 | 380p |
| 745188 | 150p |
| 745288 | 150p |
| 745387 | 225p |
| 745474 | 400p |

**CRYSTALS**

| | |
|---|---|
| 1MHZ | 290p |
| 2MHZ | 228p |
| 4MHZ | 180p |
| 6MHZ | 180p |
| 10MHZ | 175p |
| 16MHZ | 200p |

**LINEAR IC's**

| | |
|---|---|
| 741 | 14p |
| 748 | 38p |
| CA3018 | 80p |
| CA3046 | 70p |
| CA3048 | 220p |
| CA3059 | 285p |
| CA3060 | 250p |
| CA3080 | 72p |
| CA3086 | 48p |
| CA3130E | 90p |
| CA3130T | 110p |
| CA3140E | 90p |
| CA3140E | 50p |
| CA3160E | 100p |
| CA3161E | 150p |
| CA3162E | 450p |
| CA3189E | 300p |
| CA3240E | 110p |
| CA3280G | 200p |
| LF347 | 150p |
| LF351 | 46p |
| LF353 | 85p |
| LF355 | 85p |
| LF356 | 85p |
| LF357 | 110p |
| LM301A | 25p |
| LM310 | 120p |
| LM311 | 70p |
| LM318 | 150p |
| LM319 | 218p |
| LM324 | 30p |
| LM324Z | 90p |
| LM335Z | 140p |
| LM339* | 50p |
| LM348 | 65p |
| LM380 | 75p |
| LM381N | 145p |
| LM382 | 118p |
| LM384 | 160p |
| LM386 | 90p |
| LM387 | 120p |
| LM389 | 95p |
| LM393 | 100p |
| LM3900 | 50p |
| LM3909N | 65p |
| LM3911 | 128p |
| LM3914 | 250p |
| LM3915 | 250p |
| LM3916 | 250p |
| LM13600 | 110p |
| MC1310P | 150p |
| MC1445 | 250p |
| MC1455 | 36p |
| MC1495L | 350p |
| MC1496 | 80p |
| MC3340P | 120p |
| MC3403 | 65p |
| NE531 | 140p |
| NE544 | 150p |
| NE555 | 18p |
| NE556 | 45p |
| NE564 | 420p |
| NE565 | 120p |
| NE566 | 155p |
| NE567 | 140p |
| NE570 | 410p |
| NE571 | 400p |
| NE592 | 80p |
| NE5534P | 110p |
| TBA810 | 95p |
| TBA820 | 80p |
| TL061CP | 40p |
| TL062 | 60p |
| TL064 | 95p |
| TL071/81 | 28p |
| TL072/82 | 45p |
| TL074 | 100p |
| TL084 | 90p |
| TL084 | 200p |
| TL170 | 50p |
| TL430C | 70p |
| ZN414 | 80p |
| ZN419C | 180p |
| ZN423E | 130p |
| ZN424E | 130p |

**4000 CMOS**

| | |
|---|---|
| 4001 | 10p |
| 4002 | 12p |
| 4006 | 50p |
| 4007 | 14p |
| 4008 | 38p |
| 4009 | 24p |
| 4010 | 24p |
| 4011 | 11p |
| 4012 | 18p |
| 4013 | 20p |
| 4014 | 48p |
| 4015 | 40p |
| 4016 | 20p |
| 4017 | 32p |
| 4018 | 48p |
| 4019 | 25p |
| 4020 | 48p |
| 4021 | 40p |
| 4022 | 45p |
| 4023 | 13p |
| 4024 | 32p |
| 4025 | 13p |
| 4026 | 80p |
| 4027 | 20p |
| 4028 | 40p |
| 4029 | 45p |
| 4030 | 18p |
| 4037 | 110p |
| 4038 | 110p |
| 4040 | 40p |
| 4041 | 40p |
| 4042 | 40p |
| 4043 | 40p |
| 4044 | 40p |
| 4045 | 105p |
| 4046 | 50p |
| 4047 | 45p |
| 4048 | 50p |
| 4049 | 24p |
| 4050 | 24p |
| 4051 | 45p |
| 4052 | 50p |
| 4066 | 14p |
| 4069 | 14p |
| 4070 | 14p |
| 4071 | 14p |
| 4072 | 14p |
| 4073 | 14p |
| 4075 | 14p |
| 4076 | 48p |
| 4077 | 18p |
| 4078 | 18p |
| 4081 | 14p |
| 4082 | 15p |
| 4086 | 55p |
| 4089 | 125p |
| 4093 | 24p |
| 4094 | 80p |
| 4095 | 75p |
| 4096 | 70p |
| 4501 | 28p |
| 4502 | 80p |
| 4503 | 45p |
| 4504 | 75p |
| 4506 | 38p |
| 4507 | 38p |
| 4510 | 45p |
| 4511 | 45p |
| 4512 | 88p |
| 4518 | 40p |
| 4520 | 50p |
| 4521 | 80p |
| 4526 | 80p |
| 4527 | 60p |
| 4528 | 50p |
| 4532 | 70p |
| 4583 | 90p |
| 4584 | 38p |
| 4585 | 75p |
| 40085 | 90p |
| 40097 | 50p |
| 40102 | 140p |
| 40103 | 170p |
| 40106 | 38p |
| 40109 | 100p |
| 40163 | 80p |
| 43174 | 50p |
| 4017B | 50p |
| 40193 | 60p |

**VOLTAGE REGULATORS (PLASTIC TO220)**

| | | | |
|---|---|---|---|
| 7805 | 40p | 7908 | 45p |
| 7812 | 40p | 7912 | 45p |
| 7815 | 40p | 7915 | 45p |
| 7818 | 40p | 7918 | 45p |
| 7824 | 40p | 7924 | 45p |

**OPTO ELECTRONICS**

| | | | |
|---|---|---|---|
| 2N577 | 40p | TIL78 | 55p |
| OCP71 | 180p | TIL31A | 120p |
| ORP12 | 120p | TIL32 | 85p |
| ORP60 | 120p | TIL81 | 90p |
| ORP61 | 120p | TIL100 | 75p |

**ISOLATORS**

| | |
|---|---|
| ILD74 | 130p |
| ILQ74 | 240p |
| TIL112 | 70p |
| TIL113 | 70p |
| TIL116 | 70p |

**LED mounting**

| | 3mm | 5mm |
|---|---|---|
| Red | 9p | 10p |
| Yellow | 12p | 14p |
| Green | 12p | 12p |

**THYRISTORS**

| | | | |
|---|---|---|---|
| 5A 400V | 40p | C106D | 38p |
| 5A 600V | 48p | TIC44 | 24p |
| 8A 600V | 90p | TIC45 | 29p |
| 12A 400V | 85p | TIC47 | 35p |
| BT106 | 150p | 2N5062 | 32p |
| BT116 | 180p | 2N5064 | 38p |

**TRIACS**

| | | | |
|---|---|---|---|
| 3A/100V | 48p | 12A/100V | 78p |
| 3A/400V | 56p | 12A/400V | 82p |
| 6A/100V | 80p | 12A/800V | 138p |
| 6A/400V | 89p | 16A/100V | 103p |
| 6A/800V | 115p | 16A/400V | 105p |

**7 SEGMENT DISPLAYS**

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

**DIODES**

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

**BRIDGE RECTIFIERS**

| | | |
|---|---|---|
| 1A/50V | 19p | |
| 1A/100V | 20p | |
| 1A/400V | 25p | |
| 2A/100V | 30p | |
| 2A/400V | 45p | |

**ZENER DIODES**

2.7-33V 9p
400mW

**ELECTROLYTIC CAPACITORS**

(Axial & Radial) Values in uf.
63V: 1, 2.2, 3.3, 4.7, 6.8, 10 6p; 15, 22, 33 8p
40V: 330, 470 45p; 1000 48p; 2200 70p
25V: 47, 100 8p; 220, 330 12p; 470 25p; 680 1000 34p; 2200 50p; 4700 92p
16V: 470 14p; 1000 20p
10V: 1000 15p; 2200 25p

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

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

**CERAMIC CAPACITORS** 50V Radial Lead 22p!–47,000p! E12 Values 4p

**POTENTIOMETERS**

Carbon track, 0.25W log & linear
5K-2M single gang 30p
5K-2M single gang D/P switch 78p
5K-2M dual gang stereo 88p

**PRESET POTENTIOMETERS**

Horizontal & Vertical
0.1W 100R-1 Meg 7p
0.25W 100R-1 Meg 10p

**RESISTORS** 5% Carbon Film
E12 values
0.25W 1R-5M1 1p
0.5W 1R-5M1 1.5p

**SWITCHES**

| | |
|---|---|
| Slide 1A | |
| DPDT | 14p |
| DPDT c/off | 15p |
| Sub-min Toggle | |
| SPST on/off | 54p |
| SP c/over | 60p |
| DPDT | 78p |
| DPDT c/off | 88p |
| Push Button | |
| Push to Make | 18p |
| Push to Break | 25p |

**RIBBON CABLE**

Grey/meter

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

**DIL SOCKETS**

| Pin | Low Prof | Wire Wrap |
|---|---|---|
| 8 | 8p | 25p |
| 14 | 10p | 35p |
| 16 | 10p | 40p |
| 20 | 22p | 50p |
| 24 | 24p | 65p |
| 40 | 30p | 100p |

**D-CONNECTORS**

No of Ways: 9 15 25 37

| | | | |
|---|---|---|---|
| Male | | | |
| Solder | 80p | 105p | 180p 250p |
| Angled | 150p | 210p | 250p 385p |
| Female | | | |
| Solder | 105p | 180p | 200p 335p |
| Angled | 165p | 215p | 290p 440p |
| Hoods | 90p | 85p | 90p 100p |

**EURO CONNECTORS**

| | Plug | Skt |
|---|---|---|
| DIN 41617 | | |
| 21 way | 150p | 165p |
| 31 way | 170p | 170p |
| DIN 41612 | | |
| 2x32 way St. Pin | 220p | 275p |
| 2x32 way Ang. Pin | 275p | 320p |
| 3x32 way St. Pin | 280p | 300p |
| 3x32 way Ang. Pin | 375p | 350p |

**DIL HEADERS**

| | Solder type | IDC type |
|---|---|---|
| 14 pin | 40p | 100p |
| 16 pin | 50p | 110p |
| 24 pin | 100p | 150p |
| 40 pin | 200p | 225p |

**TRANSFORMER**

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

| | |
|---|---|
| 3VA | 200p |
| 6VA | 270p |
| Standard | |
| 6VA | 220p |
| 12V4 | 295p |
| 24VA* | 330p |

* Also 24-0-24

**VEROBOARDS**

| | clad | plain |
|---|---|---|
| 2½ x 3¾" | 73p | 52p |
| 2½ x 5" | 83p | — |
| 3¾ x 3¾ 83p | | |
| 3¾ x 5" | 95p | 79p |
| 3¾ x 17" | 375p | 211p |
| 4½ x 18" | 425p | — |
| Pkt of 100 pins | | 50p |
| Spot face cutter | | 118p |
| Pin insertion tool | | 182p |

**ALUM BOXES**

| | |
|---|---|
| 3 x 2 x 1" | 85p |
| 4 x 2½ x 2" | 85p |
| 4 x 2½ x 2½" | 103p |
| 4 x 4 x 2" | 105p |
| 4 x 4 x 2½" | 120p |
| 5 x 4 x 1½" | 98p |
| 5 x 4 x 2½" | 120p |
| 5 x 2¾ x 1⅝" | 80p |
| 5 x 2¾ x 2¾" | 130p |
| 6 x 4 x 2" | 120p |
| 6 x 4 x 3" | 150p |
| 7 x 5 x 3" | 180p |
| 8 x 6 x 3" | 210p |

**PLUGS AND SOCKETS**

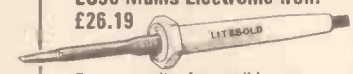
| | Plugs | Skts |
|---|---|---|
| ⅛" Mono | 22p | 20p |
| ⅛" Stereo | 30p | 25p |
| 3.5mm Mono | 12p | 15p |
| 3.5mm Metal | 20p | |
| 2.5mm Mono | 12p | 15p |
| 2.5mm Metal | 20p | |
| Phon plastic | 15p | 16p |
| Metal | 20p | |

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

# JOIN UP WITH LITESOLD

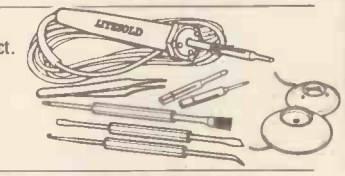
**Professional Soldering Equipment at Special Mail-Order Prices.**

**EC50 Mains Electronic Iron. £26.19**




Features spike-free, solid state proportional electronic temperature control inside the handle. Adjustable 280° to 400°C. Burn-proof 3-wire mains lead. Fitted 3.2mm Long-Life bit. 1.6, 2.4 and 4.7mm available. 240v a.c.

**SK18 Soldering Kit. £15.24**

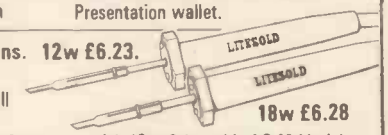



Build or repair any electronic project. LC18 240v 18w iron with 3.2, 2.4, and 1.6mm bits. Pack of 18 swg flux-cored 60/40 solder. Tweezers. 3 soldering aids. Reel of De-Solder braid. In PVC presentation wallet.

**ADAMIN Miniature Iron. £5.97**

Possibly smallest mains iron in the world. Ideal for fine work. Slim nylon handle with finger grip. Interchangeable bits available 1.2, 1.6, 2.4, 3.4 and 4.7mm. Fitted with 2.4mm. 240v 12w (12v available). Presentation wallet.

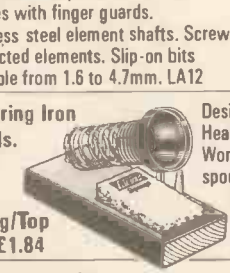
**'L' Series Lightweight Irons. 12w £6.23.**




**18w £6.28**

High efficiency irons for all electronic hobby work. Non-roll handles with finger guards. Stainless steel element shafts. Screw-connected elements. Slip-on bits available from 1.6 to 4.7mm. LA12 model, 12w, 2.4mm bit. LC 18 Model, 18w, 3.2mm bit. 240v Std – 12v available. Presentation wallet.

**Soldering Iron Stands. £5.11**



**Spring/Top only, £1.84**

Designed specially for LITESOLD irons. Heavy, solid-plastic base with non-slip pads. Won't tip over, holds iron safely. With wiping sponge and location for spare (hot) bits. No 5 stand for EC50 iron No 4 stand for ADAMIN miniature Iron No 3 stand for LA12 and LC18 Irons All same price

**Replacement Bits**

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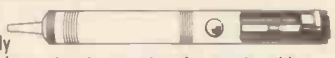

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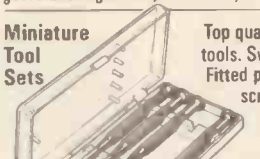

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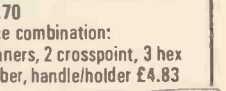

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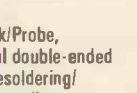

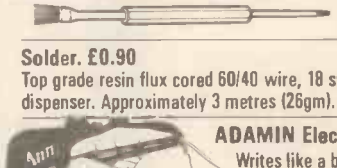

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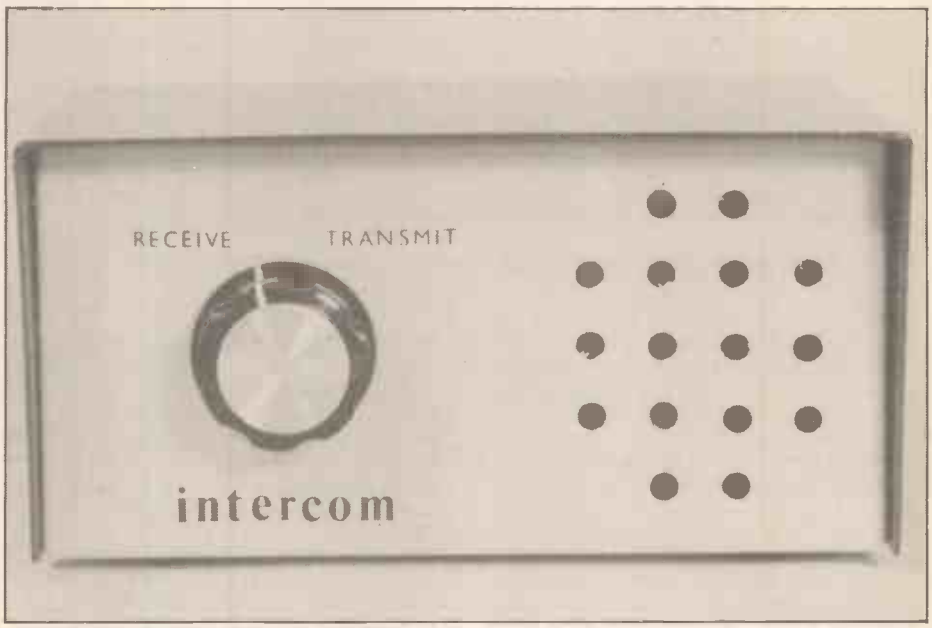
# Mains Intercom

**This two-way intercom system transmits through the mains wiring of the rooms where it is installed, is easy to set up and has no trailing wires between the stations.**

R. A. Penfold




WHILE INTERCOMS using connecting wires between each unit are not yet extinct, over the years there has been a steady trend in favour of so called "wireless" intercoms where the signals are carried from one unit to another through the mains wiring.

Anyone who has installed an ordinary intercom, with two or three way cables trailing around the house, will appreciate the relative ease with which a "wireless" type intecom can be installed. But there are disadvantages in the use of a "wireless" system, the main one being the relatively high cost and complexity of the equipment, though for most users the ease which which this type of intercom can be fitted and used more than compensates for these drawbacks.

This through-mains intercom is a simple two-station system which should provide good results when used between any two rooms of a house or other buildings. However, in common with other intercoms of this general type, it is not likely to give usable results with the two stations in separate buildings, except in the case of (say) a house and a shed or other outbuilding which share the same mains circuit.

This short range is, in fact, an essential feature since the equipment would otherwise almost certainly be illegal to use, and problems with interference from other intercoms would in many areas make the equipment unusable. Of course, for most purposes communications from one room to another, or between an outbuilding and the house, is all that is required from an intercom system.

## System Operation

An ordinary intercom is basically just an amplifier plus two loudspeakers (one at each end of the system). A switch is used to control which loudspeaker is connected to the input of the amplifier (and operates in reverse as a sort of moving coil microphone), and which is fed from the output. This gives two way communications with the send/receive switching at one end of the system.

A simple arrangement of this type is not really suitable for a through-mains intercom. Here the signal is carried by the mains earth lead plus either the "L" or "N" lead. Most wireless intercoms, including this design, use the "N" lead to provide the second connection; it has the advantage of being at virtually the same potential as the earth lead, while with the "L" lead there is the full 240 volts AC mains voltage to contend with.

In the case of the "N" lead things are not totally straightforward since there is a low impedance from this lead to earth, and in most cases there will also be a substantial amount of noise on this line. Simply coupling the output of an amplifier to the earth and "N" leads is not likely to give satisfactory results, and could be dangerous anyway.

The normal approach with this type of intercom is to use a low power frequency modulated carrier signal at about one or two hundred kilohertz. The use of frequency modulation helps to minimise problems with noise pick-up in the mains wiring (plus the inevitable mains "hum"), and enables a relatively loose (and safe) coupling to the mains supply to be utilized. **Figure 1** shows in block diagram form the arrangement used in this intercom. Note that this is only one end of the system, and that two such units are required.

The transmitter is the more simple section of the unit, and this is comprised of a preamplifier, amplifier, and voltage controlled oscillator (VCO). The loudspeaker doubles as

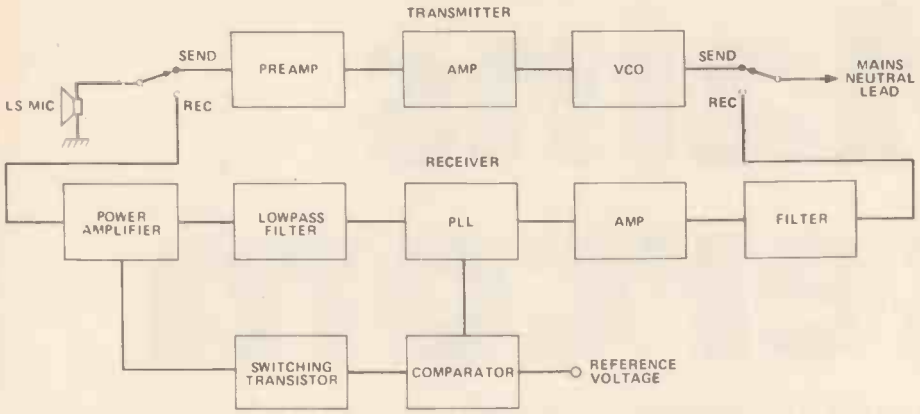



**Figure 1. This block diagram shows the layout of the intercom station. Two of these units are needed.**

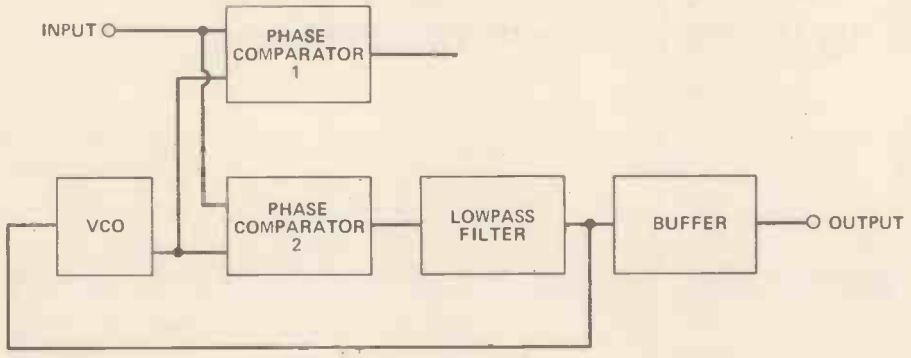



**Figure 2. Block diagram of the phase locked loop which acts as the FM detector.**

the microphone, as in a conventional intercom, and this provides a very low signal level of typically well under 1 millivolt RMS. Two stages of amplification are therefore needed in order to drive the VCO adequately.

The VCO itself is a simple C-R type; at the relatively low frequencies involved here an L-C oscillator is not needed.

The send/receive switch connects the loudspeaker to the transmitter or receiver circuit, as appropriate, and also connects the mains "N" lead to the appropriate section of the unit.

The receiver has an L-C bandpass filter at the input, and this helps to reduce the noise content on the input signal. The output from the filter is at a reasonably high level (typically a few hundred millivolts), and a single stage of amplification is adequate to bring the signal to a high enough level to drive the next stage of the receiver.

This is a phase locked loop (PPL) which is used here primarily as an FM detector. This must convert the rises and falls in input frequency into corresponding variations in output voltage. The phase locked loop actually consists of a number of stages in itself, and the block diagram of **Figure 2** helps to explain the way in which this circuit functions.

If we ignore phase comparator 1 for the moment, the input signal is applied to one input of phase comparator 2. The other input of the comparator is fed from the output of a VCO. The control voltage for the latter is provided by the phase comparator by way of a lowpass filter which smooths out the rapid changes in voltage at the output of the comparator and gives a more suitable control voltage for the VCO.

The output from the phase comparator goes to a high voltage if the VCO frequency is lower than that of the input signal, or even if the VCO is slightly lagging in phase. This high control voltage raises the frequency of the VCO so that is brought in line with the input signal.

Conversely, if the VCO is at a higher frequency than the input signal, the output of the phase comparator goes to a low voltage and reduces the VCO's operating frequency.

Thus the VCO tracks the input signal, staying on the same frequency and in-phase with this signal, provided it remains within the locking range of the circuit and there are no very rapid frequency changes. In this case though, it is not the VCO signal that is of interest, but the control voltage. This rises and falls in sympathy with the input frequency, and provides the demodulated audio signal.

This signal is obtained via a buffer stage which ensures that excessive loading of the control voltage and a consequent malfunction is avoided. This arrangement may seem to be a rather complicated way of providing FM demodulation, but in practice phase locked loops provide excellent results, especially in an application such as this where the input signal is almost certain to be contaminated with a fair amount of noise.

The phase locked loop integrated circuit used in this design is the CMOS 4046BE, and an unusual feature of this device is the inclusion of two phase comparators. When phase comparator 1 is used, under no signal conditions the VCO goes to its centre frequency. With phase comparator 2 the VCO swtiches off in the absense of an input signal. In this application there is no discernable difference in performance provided by the two comparators.

If we return to the block diagram of **Figure 1**, the demodulated output of the PLL is fed to a lowpass filter. This helps to reduce background noise, and the restricted high frequency output of the unit i perfectly adequate for communications purposes. Finally, the signal is fed to a power amplifier and then to the loudspeaker.

Some additional circuitry is needed to provide a squelch action, as the circuit otherwise providesa circuit otherwise provides a very loud noise output in the absence of a

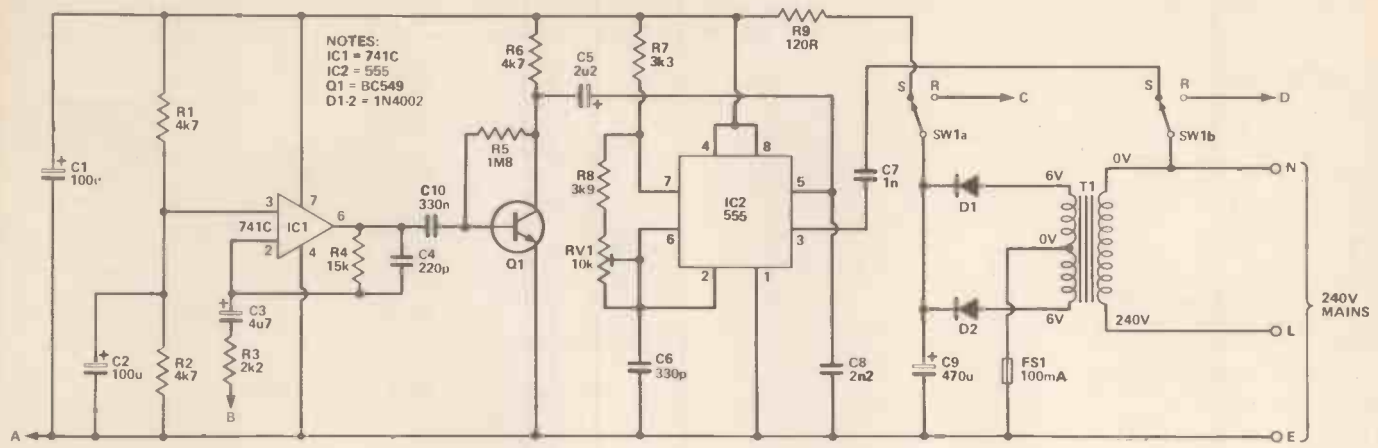



**Figure 3. The circuit of the transmitter section of the intercom stations.**

proper input signal.

The DC output from the PLL rises significantly in the presence of a proper intput signal, and this is detected by a voltage comparator which then turns off a switching transistor. Under stand-by conditions this transistor is used to feed a DC bias to the power amplifier which prevents it from operating properly and blocks the audio (noise) output.

## Transmitter Circuit

Figure 3 shows the circuit diagram for the transmitter section of the unit.

The preamplifier is a simple operational amplifier inverting mode circuit. This has only a modest amount of voltage gain (about seven times), but this can be boosted if necessary by raising the value of R4. However, in general it is best to have slightly too little gain rather than a bit too much, as this gives better intelligibility. Q1 is a common emitter amplifier and this provides most of the circuit's audio gain.

A 555 astable is used as the VCO, as it has the advantage, over most of the alternatives, of low cost and a strong output. The output is loosely coupled to the mains "N" lead by C7. RV1 enables the output frequency to be adjusted to a suitable range from the receiver circuit; the operating frequency is around 200kHZ.

It is quite easy to frequency modulate a 555 astable, and the modulation signal is simply applied to pin 5 of the device. The circuit oscillates by first charging C6 to two thirds of the supply voltage, then discharging it to one third of the supply potential, then charging it again, and so on.

The modulation voltage fed to pin 5 merely modified the two thirds of V+ threshold level. Raising this level results in C6 having to charge and discharge for a longer period of time on each cycle, and reduces the output frequency. Reducing the threshold voltage reduces the charge and discharge times of C6 and gives increased output frequency.

Although this is only a rather crude way of generating an FM signal, it actually works quite well in practice and is more than adequate for this application.

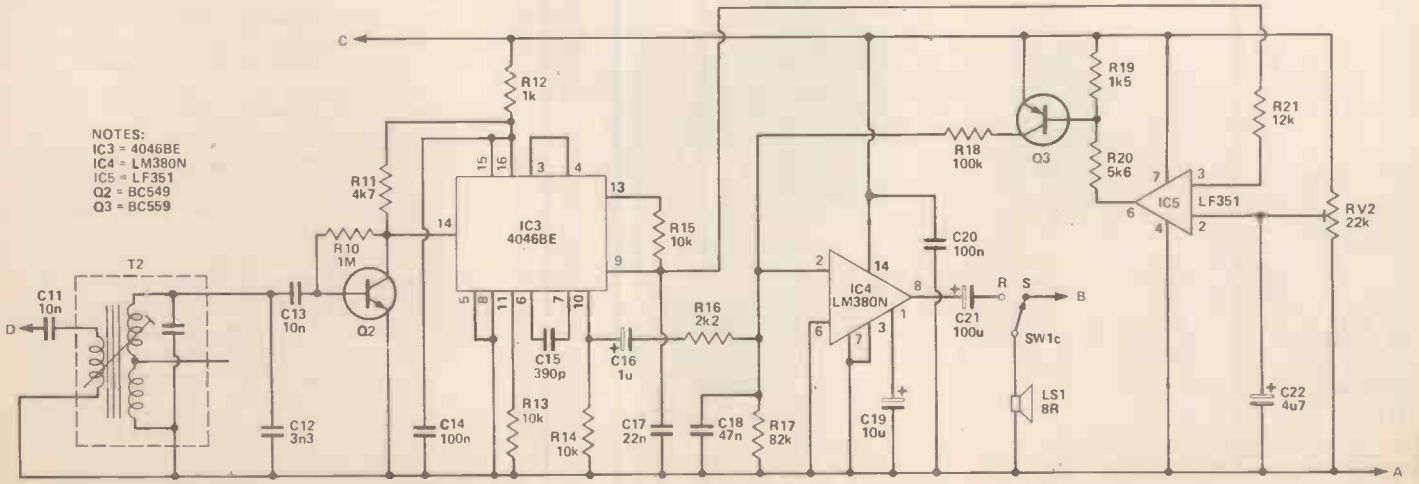
The power supply is a simple non-stabilised type which uses fullwave (push-pull) rectification; it is used to power both the transmitter and receiver circuits. R9 and C1 give additional smoothing to the transmitter supply. SW1a is used to cut off power from the transmitter when the unit is in the "receive" mode, so that the transmitter does not produce interference and reduce the quality of the received signal.

## Receiver Circuit

The receiver circuit appears in Figure 4. C11 couples the signal from the "N" main lines to the primary winding of T2. This is actually a 455kHZ IF transformer used in reverse to act as a step-up transformer and bandpass filter.

C12 shunts the internal tuning capacitor of T2 and reduces the resonant frequency to about 200kHZ. The adjustable core of T2 is used to set the input filter for peak

**Figure 4. The circuit of the receiver station. The coupling to the neutral line is via T2, which acts as a step-up transformer and bandpass filter.**



## Parts List

**RESISTORS**
(All ¼ watt 5%)
R1, 2, 6, 11 ..... 4k7
R3, 16 ..... 2k2
R4 ..... 15k
R5 ..... 1M8
R7 ..... 3k3
R8 ..... 3k9
R9 ..... 120R
R10 ..... 1M
R12 ..... 1k
R13, 14, 15 ..... 10K
R17 ..... 82k
R18 ..... 100k
R19 ..... 1k5
R20 ..... 5k6
R21 ..... 12k

**POTENTIOMETERS**
RV1 ..... 10k 0.1 watt horiz preset
RV2 ..... 22k 0.1 watt horiz preset

**CAPACITORS**
C1, 2, 21 ..... 100u, 10V radial electro
C3, 22 ..... 4u7 63V radial electro
C4 ..... 220p ceramic plate
C5 ..... 2u2 63V radial electro
C6 ..... 330p ceramic plate
C7 ..... 1n carbonate
C8 ..... 2n2 carbonate
C9 ..... 470u 10V radial electro
C10 ..... 330n carbonate
C11, 13 ..... 10n polyester
C12 ..... 3n3 carbonate
C14, 20 ..... 100n ceramic
C15 ..... 390p ceramic plate
C16 ..... 1u 63V radial electro
C17 ..... 22n polyester
C18 ..... 47n carbonate
C19 ..... 10u 25V radial electro

**SEMICONDUCTORS**
IC1 ..... 741C op-amp
IC2 ..... 555 timer
IC3 ..... 4046BE phase locked loop
IC4 ..... LM380N audio power amp
IC5 ..... LF351 bifet op-amp
Q1, 2 ..... BC549 NPN silicon
Q3 ..... BC559 PNP silicon
D1, 2 ..... 1N4002 1A 100V rectifiers

**MISCELLANEOUS**
T1 ..... 6V-0V-6V 100mA mains transformer
T2 ..... Toko YHCS11100 455kHZ last IFT
SW1 ..... 3-way 4-pole rotary with end stop
LS1 ..... 8 ohm 66mm (approx.) loudspeaker
FS1 ..... 20mm 500mA quick blow
Case, about 150 x 100 x 75mm; printed circuit board; control knob; 20mm chassis mounting fuse-holder; mains lead, wire, 6BA fixings, etc.

**Note that the above list is for one unit only.**

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

performance.

The output from T2 is at a fairly high level, being a couple of hundred millivolts RMS or so, but phased locked loop IC3 requires standard 5 volt logic input levels. Q2 is therefore used as a common ommiter amplifier which clips the input signal and provide a suitable signal for IC3.

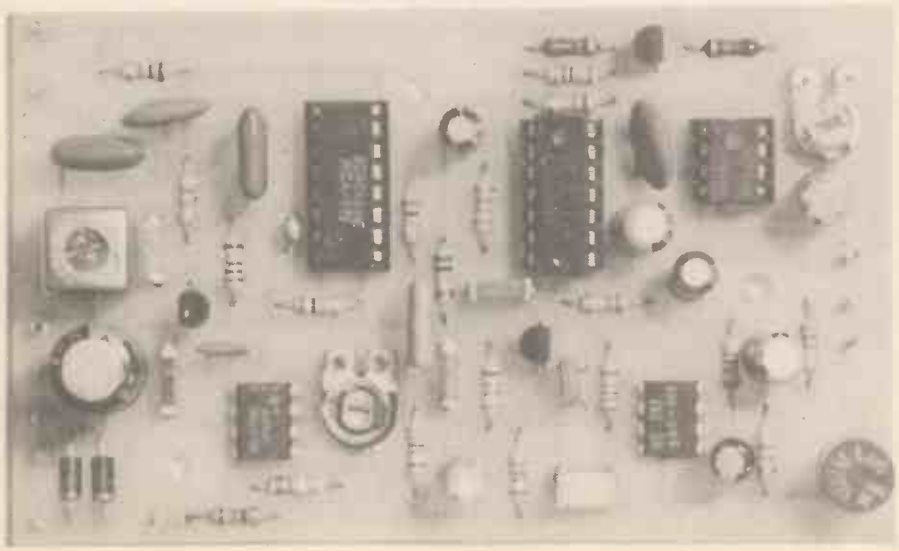
IC3 has a built-in 5.4 volt zener diode, and in conjunction with load resistor R12 this is used to provide a stabilised supply for both Q2 and the phase locked looped circuit.

R13 and C15 are the timing components for IC3's VCO. R15 plus C17 form the lowpass filter, and R14 is the discrete load resistor for the source follower buffer stage at the output of the device.

The audio output is coupled by C16 to the lowpass filter which is comprised of R16 and C18, after which the signal passes to the input of a power amplifier based on the ever-popular LM380. This drives the loudspeaker via DC blocking capacitor C21 and one pole of the send/receive switch (SW1). The squelch circuit uses IC5 as the voltage comparator, and Q5 as the switching transistor.

Q3 is normally switched on so that a strong DC bias is provided to the input of the power amplifier by way of R18. This drives the output of IC4 fully positive and prevents any audio output from being produced.

When a proper input signal is present the voltage at pin 9 of IC3 increases, sending the output of IC5 high, switching off Q3, and permitting the audio amplifier to operate normally. RV2 is adjusted to give a satisfactory reference voltage at the inverting input of IC5.



## Construction

Details of the printed circuit and wiring are provided in **Figure 5.**

In most respects construction of the board is perfectly straightforward, but in order to get all the components to fit onto the board properly it is essential to use the miniature printed circuit mounting capacities specified in the components list.

IC3 is a CMOS device and it should be fitted in a 16 pin DIL IC socket. The other normal antistatic handling precautions should also be observed. Be careful to fit the semiconductors the right way round, especially IC2, which has the opposite orientation to the other four integrated circuits. Veropins are used at points where connections to T1, SW1, and LS1 will be made.

A metal case having approximate

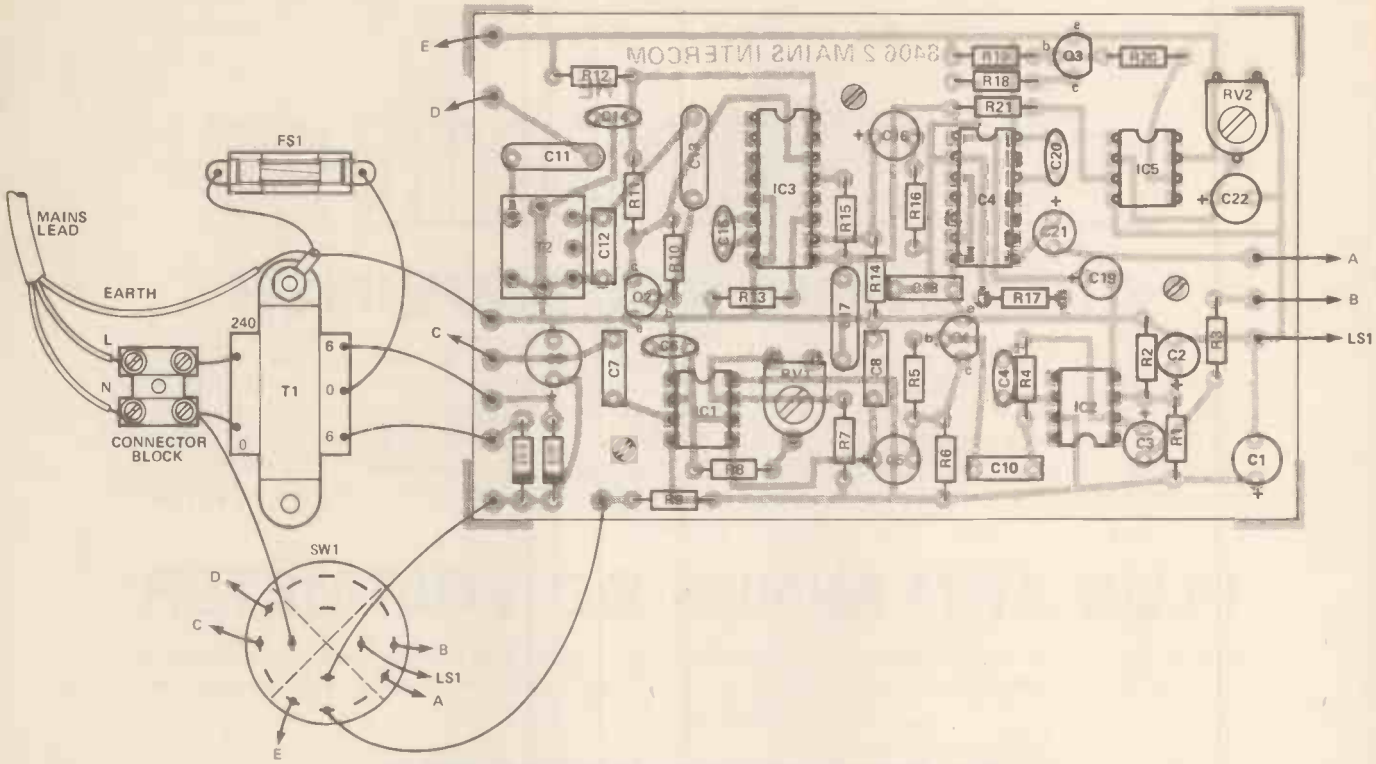



**Figure 5. The component layout. Apart from the normal caution with CMOS devices and component orientation, care should be taken to use the correct miniature circuit-mounting components where specified, or the components will not fit the board.**

dimensions of 150 by 100 by 75mm is just about adequate to accommodate all the components. SW1 is fitted on the left hand section of the front panel, and LS1 is mounted on the extreme right hand end of the panel.

A 4-pole 3-way rotary switch (with the end stop set for 2-way operation) is the least expensive type to use for SW1, but an alternative such as a multipole changeover toggle type can be used if preferred.

A speaker grille is then required, but this can just consist of a matrix of holes about 5mm in diameter drilled in the front panel. With most miniature loudspeakers there is no provision for screw fixing, and LS1 will need to be glued in position on the front panel.

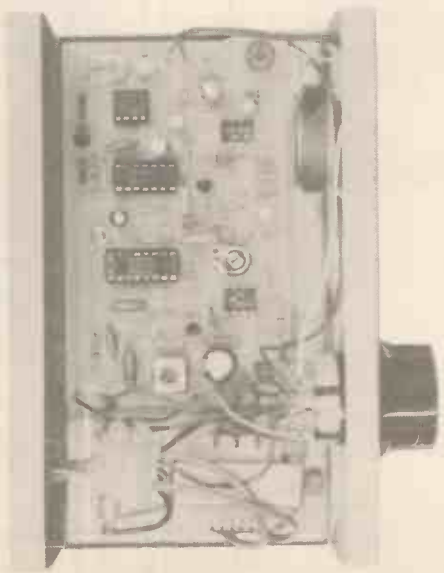
T1 and the holder for FS1 are mounted at the left hand end of the chassis, leaving sufficient space for the component panel on the right hand section of the chassis. A soldertag on one of T1's mounting bolts provides a chassis connection point.

Note that it is essential for T1 and LS1 to be mounted as far apart as possible, since LS1 (when used as a microphone) will otherwise pick-up strong mains "hum" from T1.

The component panel is mounted using 6BA fixings, including spacers about 6mm long to keep the connections on its underside away from the metal chassis. A hole for the mains lead is drilled in the rear panel of the case, and this should be fitted with a grommet to protect the cable.

Finally, the hard wiring is added using ordinary multistrand connecting wire. Most small mains transformers have flying leads rather than tags, and a two-way connector block is then used to connect the mains lead to the primary winding of T1. These are normally sold in twelve way blocks, but a two way section is easily cut from one of these using a sharp knife.

As the mains supply is involved be careful to avoid wiring errors, and thoroughly check the wiring before fitting the mains plug and connecting the unit to the mains supply.



## Adjustment

Start with RV1 and RV2, set with their wipers at roughly the centre of their tracks. With one unit set to transmit and the other set to receive it is likely that the system will provide communications, but if not, adjustment of RV1 at the transmitter should rectify matters.

RV1 and T2 are then adjusted to optimise results, and the setting of T2's core will probably not be critical. Carry out the final adjustment with the units in separate rooms (to avoid "howl around"), and use a helper or (say) a radio set to provide sounds for the transmitter. Of course, this procedure must then be repeated with the roles of the two units reversed.

With one unit set to receive and no proper input signal present, adjusting RV2 well in a clockwise direction should result in loud noise emanating from the loudspeaker. If RV2 is set just far enough in a clockwise direction to eliminate the noise, a good squelch action should be obtained. This adjustment should then be repeated for the second station.

In use SW1 must, of course, be left in the "receive" position on both units. For one station to call the other it is merely necessary for the caller to set his or her unit to "transmit" and speak into the microphone ("Mr Watson, come here. I want you.").

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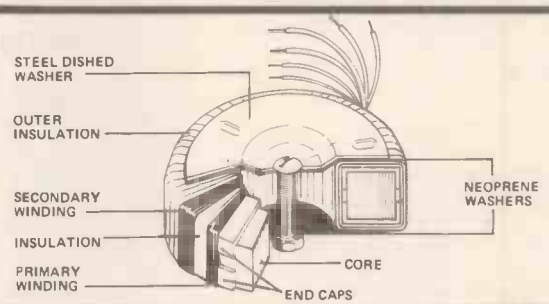


**15 VA** 62 x 34mm 0.35Kg Regulation 19%

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

(encased in ABS plastic)

**30 VA** 70 x 30mm 0.45Kg Regulation 18%

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

**50 VA** 80 x 35mm 0.9Kg Regulation 13%

| | | |
|---|---|---|
| 2x010 | 6+6 | 4.16 |
| 2x011 | 9+9 | 2 77 |
| 2x012 | 12+12 | 2.08 |
| 2x013 | 15+15 | 1.66 |
| 2x014 | 18+18 | 1.38 |
| 2x015 | 22+22 | 1.13 |
| 2x016 | 25+25 | 1.00 |
| 2x017 | 30+30 | 0 83 |
| 2x028 | 110 | 0 45 |
| 2x029 | 220 | 0 22 |
| 2x030 | 240 | 0 20 |

**80 VA** 90 x 30mm 1Kg Regulation 12%

| | | |
|---|---|---|
| 3x010 | 6+6 | 6.64 |
| 3x011 | 9+9 | 4 44 |
| 3x012 | 12+12 | 3.33 |
| 3x013 | 15+15 | 2 66 |
| 3x014 | 18+18 | 2 22 |
| 3x015 | 22+22 | 1 81 |
| 3x016 | 25+25 | 1 60 |
| 3x017 | 30+30 | 1 33 |
| 3x028 | 110 | 0 72 |
| 3x029 | 220 | 0 36 |
| 3x030 | 240 | 0 33 |

**120 VA** 90 x 40mm 1.2Kg Regulation 11%

| | | |
|---|---|---|
| 4x010 | 6+6 | 10.00 |
| 4x011 | 9+9 | 6.66 |
| 4x012 | 12+12 | 5.00 |
| 4x013 | 15+15 | 4.00 |
| 4x014 | 18+18 | 3 33 |
| 4x015 | 22+22 | 2 72 |
| 4x016 | 25+25 | 2.40 |
| 4x017 | 30+30 | 2.00 |
| 4x018 | 35+35 | 1.71 |
| 4x028 | 110 | 1.09 |
| 4x029 | 220 | 0 54 |
| 4x030 | 240 | 0.50 |

**160 VA** 110 x 40mm 1.8Kg Regulation 8%

| | | |
|---|---|---|
| 5x011 | 9+9 | 8.89 |
| 5x012 | 12+12 | 6.66 |
| 5x013 | 15+15 | 5.33 |
| 5x014 | 18+18 | 4.44 |
| 5x015 | 22+22 | 3.63 |
| 5x016 | 25+25 | 3.20 |
| 5x017 | 30+30 | 2.66 |
| 5x018 | 35+35 | 2.28 |
| 5x026 | 40+40 | 2.00 |
| 5x028 | 110 | 1.45 |
| 5x029 | 220 | 0.72 |
| 5x030 | 240 | 0.66 |

**225 VA** 110 x 45mm 2.2Kg Regulation 7%

| | | |
|---|---|---|
| 6x012 | 12+12 | 9 38 |
| 6x013 | 15+15 | 7 50 |
| 6x014 | 18+18 | 6 25 |
| 6x015 | 22+22 | 5 11 |
| 6x016 | 25+25 | 4 50 |
| 6x017 | 30+30 | 3 75 |
| 6x018 | 35+35 | 3 21 |
| 6x026 | 40+40 | 2 81 |
| 6x025 | 45+45 | 2 50 |
| 6x033 | 50+50 | 2 25 |
| 6x028 | 110 | 2 04 |
| 6x029 | 220 | 1 02 |
| 6x030 | 240 | 0 93 |

**300 VA** 110 x 50mm 2.6Kg Regulation 6%

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

**500 VA** 140 x 60mm 4Kg Regulation 4%

| | | |
|---|---|---|
| 8x012 | 12+12 | 16 66 |
| 8x013 | 15+15 | 13 33 |
| 8x014 | 18+18 | 11 11 |
| 8x015 | 22+22 | 9 09 |
| 8x016 | 25+25 | 8 00 |
| 8x017 | 30+30 | 6 66 |
| 8x018 | 35+35 | 5 71 |
| 8x026 | 40+40 | 5 00 |
| 8x025 | 45+45 | 4 44 |
| 8x033 | 50+50 | 4 00 |
| 8x042 | 55+55 | 3 63 |
| 8x028 | 110 | 3 63 |
| 8x029 | 220 | 1 81 |
| 8x030 | 240 | 1 66 |

**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 |

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|---|---|---|---|---|---|
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| 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 |

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# POINTS OF VIEW

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

### Component Confidence

*Dear Editior,*
*I have just received my March issue of HE and I feel I must come to your defence against the criticisms of Mr. Watson of Hull with respect to your cost estimates for projects.*

*My first copy of HE was the 1983 October issue and I too was interested in the Audio Level Meter. I did a quick survey of the adverts and found your estimate was about right. In fact I was holidaying in Colchester so I had a little trip to Rapid Electronics at Boxted.*

*I received a very cordial welcome and was served on a while-you-wait basis by a very competent and helpful staff. My total costs were £6.99 inc. VAT. Had I ordered by post my cost would have been an additional 58p. As a saver I went for separate LEDs and clips.*

*I also received a free catalogue and a good recommendation for a pub lunch. Thank you, Rapid, and please, Mr. Watson, do your homework, you can save pounds.*
*Yours faithfully,*
*Southam,*
*Leamington Spa.*

It's nice to see a vote of confidence for the components suppliers. As for Mr. Watson of Hull, don't be too hard on him — his figures were so way out that we reckon he must have had a case of bad luck. However, it does help to check prices if you are buying from a small, or non-specialist outlet.

### Right Side Of The Law

*Dear Sir,*
*Over the past few years my son and I have made a lot of the projects in your magazine. Some have been better than others but all have been interesting and all have worked, and we've got a lot of satisfaction and enjoyment from them. But there's one exception, the Big Ear (HE December '83).*

*We have tried this twice, with new components, but still can't get it to go; we get crackles and hums but no response through the microphone. From* **Points Of** *View we notice that mistakes do creep into some of the circuits occasionally, and we wonder whether this has happened with the Big Ear? Can you help us?*
*Yours faithfully,*
*D. Beasley,*
*Newbury,*
*Berks.*

There are two immutable Laws which govern this correspondence box, and doubtless those of all technical publications:

1) Very rarely will your readers get around to telling you how good you are, unless they also have a query about an instance in which you aren't.

2) Very rarely will your readers write you an absolute stinker, but if they do, the entire year's allocation will arrive in the same week, leaving you to think of helpful replies which are neither homicidal nor suicidal.

But neither homicide nor suicide is required in this case. There were two misprints in the Big Ear. These were corrected in December '83, and the design improved to get around component tolerance problems, which were causing some of the Big Ears to work badly or not at all. Mr. Beasley has been sent a copy of the corrections.

### Air Turns Blue

*Dear Editor,*
*We are pleased to announce our new range of light-emitting diodes for 1984. As you will see from the enclosed sample, we have made a breakthrough in the manufacture of LEDs and our range now includes the blue variety, which has been a right b****** (He means "bother" – Ed.) to produce commercially.*

*Unlike many companies still experimenting with silicon carbide, we found quite by chance that stained carrot juice doped with particles of liquorice allsorts, give the required spectral resonse. During ionisation tests this was found to be 465nm with a deviation of ±6nm which is well with the "turquoise blue" limits for standard blue LEDs.*

*Blue LEDs must be driven from an AC source, similar to liquid crystal diodes, ie the pins must be driven in antiphase. Kits which enable the home constructor to manufacture his own LEDs are available from most local greengrocers.*
*Yours faithfully,*
*Barney Splatbanger,*
*Bodgitt & Spludge UK,*
*No Fixed Address.*

Some persons obviously have a deviation of rather more than ±6nm, especially those who lay themselves open to being positively identified as Mr. Wakely of Wimbledon among sixty other unopened letters after a year's absence, merely by the typeface on their hairy old typewriter. We've got news for you, mate. April Fool's Day 1984 was also Mothers' Day — so we've passed your suggestions on to your mum. The samples were delicious. Thanks very much.

### Projects In The Air

*Dear Sir/Madam,*
*At the present time a number of student projects are being considered, and I should be very grateful if you would kindly provide me with the following information as soon as possible:*

*i) Details of the Stereo Amplifier (November '76); Intruder Alarm (October '80); Slide-Tape Synchroniser Unit (December '82) and Audio Mixer (December '78), as well as any subsequent errors in these publications.*
*Yours faithfully,*
*S. Gough,*
*Student Engineer Training Centre,*
*Royal Aircraft Establishment,*
*Farnborough,*
*Hants.*

We'll pass this request straight on to our photocopy department.

We get a number of requests from colleges and students who want to use Hobby projects for their course work. We don't often hear, though, how they got on in the end (for the Laws governing this phenomenon, see above). So how about letting us know if a Hobby project has been useful as the basis for study, and letting us have any suggestions for making project articles more informative for students. We can pass suggestions on to our authors.

### Wither Weller?

*Dear Sir,*
*I write in the hope you may assist me in locating the current address of Weller Electronics Ltd., whose old address is listed as Redkiln Way, Horsham, Sussex.*

*I purchased a soldering iron from a local shop and it is defective. Regrettably, the shop has closed down and I am not able to return it to them.*

*I hope you can oblige.*
*Yours faithfully,*
*C. N. Austwick,*
*Potters Bar,*
*Herts.*

The only address we have for Weller with regard to their soldering irons is

that of *Cooper Tools Ltd., Sedling Rd., Wear, Washington, Tyne & Wear NE38 9BZ. Tel. (0632) 466062,* who represent Weller. I suggest you contact Cooper Tools and give them full details of your iron, how you obtained it, and what is wrong with it, and they should be able to advise you.

## Antique Book

*Dear Sir,*
*While recently reading through one of your back issues (January '79 to be exact) I noticed a book advertised on page 20 titled "Transducers In Measurement And Control".*

*As I recently started working for a company which deal exclusively in transducer measuring and control equipment, and as I know almost nothing about transducers, it sounds to me as if this would be a good investment.*

*I would just like to ask if this book is still in print and if so, how much and where I can get it from.*

*I've only recently got back into electronics again after a three year layoff.*

*Any help rendered will be gratefully received.*
*Yours sincerely,*
*Andy Turner,*
*Wokingham,*
*Berks.*

*Transducers In Measurement And Control* was actually published as a series in ETI between May 1972 and September 1973. It was so erudite that various bodies requested that it should be published as a special publication, which it duly was, and was available in that form for a number of years.

However, in due course (another victim of the recession) demand was no longer sufficient to justify a reprint, and the book went out of print.The articles are still available. However, as the standard photocopy charge for a single article is £1.50, this would be prohibitively expensive. Also, the series may now be out of date. I suggest that, if you are still interested, you contact the Editor on ETI, at the same address as HE, tell him about your problem, and see what he can suggest.

## NiCad Knowledge

*Dear Sir,*
*I note that you intend to publish a Battery Eliminator/NiCad charger unit for personal stereos, etc. This prompts me to write and suggest that HE publishes a related feature on NiCads and their uses, care and maintenance.*

*I know a little about this subject, but not enough. For example, I know that for the best performances and maximum life, they should be charged at a constant current of approx. one tenth of their rated amp/hour capacity, eg AA size 500mA/hr cells at 50mA. I do in fact have a home built charger to do this for most sizes of NiCad.*

*I am told that from time to time they should also be 'cycled', ie discharged at a steady rate until totally discharged, then recharged normally, this process to be repeated three times. What I would like to see in HE is a circuit to enable this to be done safely and without the need for constant attention. My charger is an adpatation of an RS design, using a 7805 voltage regulator as a constant current generator.*
*Yours faithfully,*
*M. L. Peake,*
*Bilston,*
*W. Midlands.*

A useful idea backed with practical suggestions. We have been thinking about doing a feature or series on batteries for some time and will be looking into this.

The cycling process you mention is the best procedure to use. The cycling does not have to be repeated three times, and the batteries can be discharged instantly by connecting a wire across them (in which case stand back, as they can give off a great deal of current for a brief moment). However, you risk shortening the life of your NiCads if you take shortcuts, although you are unlikely to actually destroy them.

## Overseas Amp

*Dear Sir,*
*I'm a six form student and I require some help which I thought you could give me.*

*I'm interested in building up an amplifier for my stereo cassette player. The amplifier must be about 40W per channel. Can you send me an illustrated diagram with the parts I would need and the cost for these parts? If these cannot be done, can you please suggest an alternative by which I can find this diagram. Hoping I haven't caused you any trouble, and thanking you in advance for your co-operation.*
*Yours faithfully,*
*Malcolm Micallef,*
*Malta.*

We've had a look through the back indexes of HE and ETI, but there is nothing which would specifically suit your purpose without a lot of alteration.

We suggest you write to **Bernard Babani (publishing) Ltd., The Grampians, Shepherds Bush Rd., London W6 7NF, UK,** and ask for *Audio Amplifier Construction* by **R. A. Penfold,** number BP122; this will give you the basics of amplifier construction from which you can work out your own specification. The book costs £2.25, and please also include enough to cover return postage to your home. It is an ordinary paper-back sized book.

## Out Of Prints

*Dear Sir,*
*Do you still have the PCB aids called Hobbyprints?*

*If so, do have any for the Digital Frequency Meter (HE April '80) and also for the Mini-Synth (HE November '80)? But I have the greatest need for the DFM because I'm building a stylus organ and since I have to adjust the pots for the notes, I need the DFM.*

*If you haven't, can you give me a design as good as your DFM, since it's the best and I haven't found any constructional details of a DFM from anywhere else.*
*Yours sincerely,*
*D. E. Jones,*
*Hackney,*
*London.*

Regrettably we stopped producing Hobbyprints two or three years ago, as most people seemed to be managing without them. However, you can successfully make your own "Hobbyprint" by tracing the PCB foil from the magazine onto a piece of thin tracing paper, or transparent artist's film, with a fine-tipped black pen. This calls for a steady hand, especially where the connections for ICs are concerned, as there is no room for flexibility as there is with other components.

Use an artist's drawing pen, or a very fine felt-tipped pen with indelible ink for preference, or a good, fine fountain pen; in fact, the pen which you wrote your letter with should do the job. You can then use this mask to expose the PCB, and any small faults can be rectified when the PCB is made.

## Etch Resist

*Dear Sir,*
*Please give me information on how to mix ferric chloride to etch my own PCBs. I have tried it three times but was not able to produce a presentable board.*

*I have copper clad boards purchased from Radio Spares. I also have the chemicals but do not know the proportion of the mixture.*

*Please help; I shall be very grateful.*
*Yours faithfully,*
*E. D. Chukwudinma,*
*University Of Jos,*
*Nigeria.*

The first question we asked was: what sort of boards are you using? If you are using normal copper board, then a mixture of about one pound of ferric chloride to a pint-and-a-half of water, plus a few ccs of hydrochloric acid for luck, will work, although some experimentation with the strength of the mixture might be worthwhile.

If, on the other hand, you have boards already coated with etch resist, which some RS board is, the board has to be exposed with ultra violet light and developed in a mild solution of sodium hydroxide, before etching with the ferric chloride in the normal way.

HE

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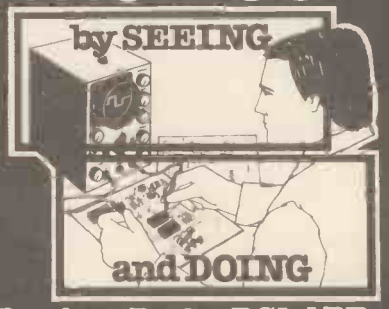


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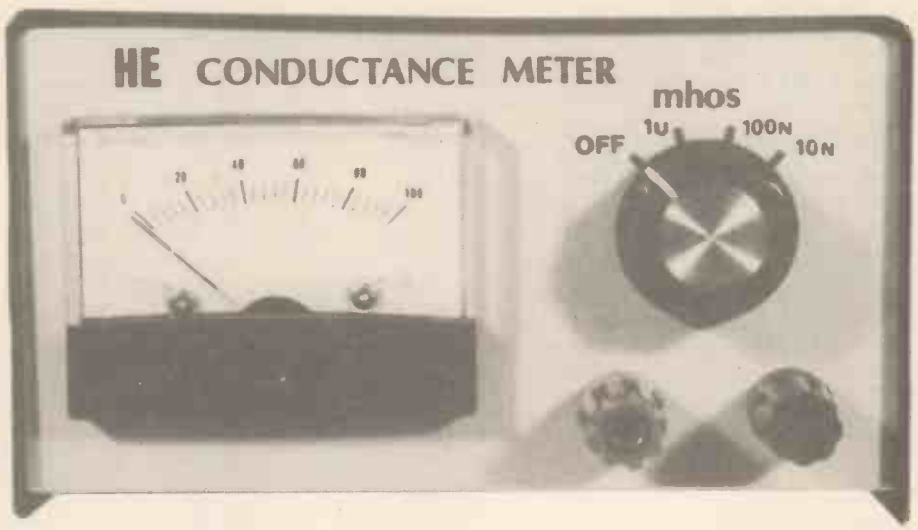
# HE Conductance Meter

## Resistance measures the difficulty of current flow. Conductance measures the ease of current flow. By a coincidence, it's easier to troubleshoot circuits with a conductance meter.

Jim Aman

DURING a period of trouble shooting on a printed circuit board, a need arose by the author for a simple meter or other indicating device which could detect the swarf, solder splashes etc, but most importantly short circuits between the tracks. At the same time the device could be used to give meaningful readings of the impedance of the circuit without causing any semiconductor junctions to become turned on.

As the resistance — more correctly the impedance between the tracks is very large, a simple ohm meter could not be used to give any sort of useful readings. Thus the Conductance Meter was designed to fufil this need and make a troubleshooter's nightmare become a dream.




### Conductance

Some people may wonder why we are measuring the conductance of a circuit rather than the more normal resistance. The main reason why this is so lies behind the definition of conductance.

Beginners are nearly always taught first that resistance opposes the passage of current. The idea of conductance is the *ease* with which a current can be made to flow rather than the *difficulty*.

Conductance is defined as: the number of amps caused to flow by one volt.

Conductance is usually measured in mhos, although Siemans is also quite often used. The symbol for conductance is G or ℧ — an inverted ohms sign, rather appropriate as it is the opposite of ohms!

So I = E x G is an alternative form of I = E ÷ R, where I = current, E = voltage, R = resistance and G = conductance. In other words conductance is the reciprocal of resistance.

To digress for a moment, it is worthwhile considering that it is an advantage to use conductance in calculations — particularly in parallel circuits as: GT = G1 + G2 + . . . + Gn.

### A Conducted Tour Of The Circuit

The full circuit for the unit is shown in **Figure 1**. The non-inverting input (pin 3) of IC1 is connected to a reference voltage of 100mV. As the feedback resistor network (R4-6) is connected between the output and the inverting input of the IC, this will tend to make the output zero. With a circuit connected to the probes, a current will flow through R1. This will cause a current to flow through the feedback network, and the voltage drop across the selected resistor will be directly proportional to the "current conducting" from one probe to another.

This voltage drop is fairly small and so we use IC2 as a high impedance buffer to measure the voltage. The output of IC2 then drives the meter to provide an indication of the circuit

conductance.

As regards the remaining components, RV5 allows the output of IC2 to be zeroed, while RV6 sets the full scale deflection of the unit. Capacitors C1 and C2 provide decoupling of the supply lines and D1 protects the input of IC2 from excessive input voltages.

The variable preset resistor RV1 sets the reference voltage on pin 3, and the two Zener diodes protect the input of IC1 from high voltages. The remaining presets allows for individual adjustment of each range.

Notice we are using two separate supplies for each op-amp. This is necessary because of the very high impedance involved and the fact that the loading effect of IC2 may cause large errors in the operation of IC1.

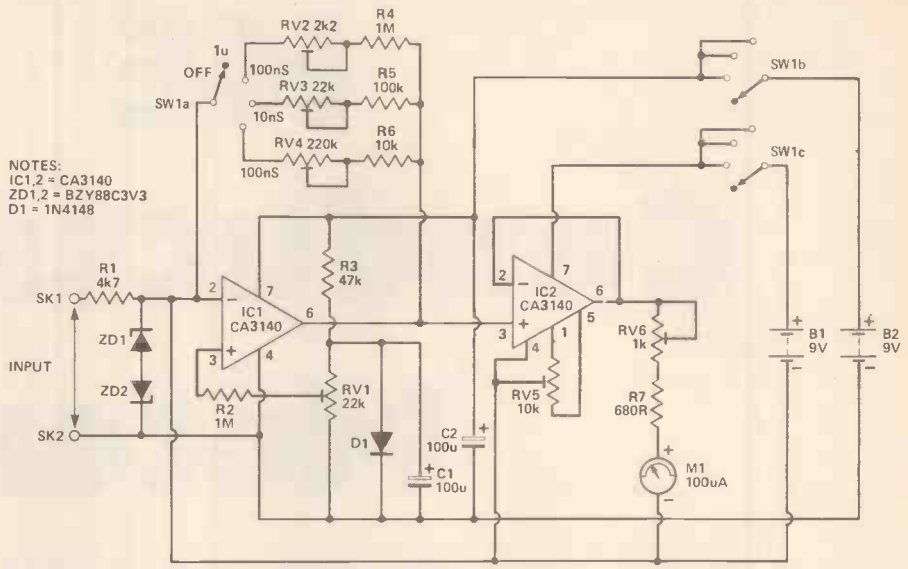



Figure 1. The Circuit. IC2 acts as a high impedance buffer to measure small voltage drops across the appropriate resistor.

## Construction

The construction of the unit is fairly straight forward but care needs to be taken. The circuit can be built on either Veroboard or a PCB — we have used Veroboard. When building the unit take care to keep the probe connections well apart from each other. Also ensure that the Veroboard tracks are clean and free from solder flux. A stiff paint brush or a small wire brush can be used here to clean the tracks. Do not attempt to spray the copper tracks with a flux spray or similar.

Figure 2 shows all the required construction. The size of case you use depends on what you have to hand — ours was 14 x 13 x 7cm approximately. Note the box must be metal. The position of the various front panel controls can be seen in the photographs. The probes can be constructed from short lengths of multi-strand test lead wire fitted at each end with a crocodile clip and a 4mm plug.

## Parts List

**RESISTORS**
(All ¼ W 5% carbon)
R1 ..... 4k7
R2, 4 ..... 1M
R3 ..... 47k
R5 ..... 100k
R6 ..... 10k
R7 ..... 680R

**POTENTIOMETERS**
RV1, 3 ..... 22k horiz preset
RV2 ..... 2k2 horiz preset
RV4 ..... 220k horiz preset
RV5 ..... 10k horiz preset
RV6 ..... 1k horiz preset

**CAPACITORS**
C1, 2 ..... 100u 16V axial electro

**SEMICONDUCTORS**
IC1, 2 ..... CA3140 op-amp
ZD1, 2 ..... BZY88C3V3 3V3 400mW Zener
D1 ..... 1N4148 silicon diode

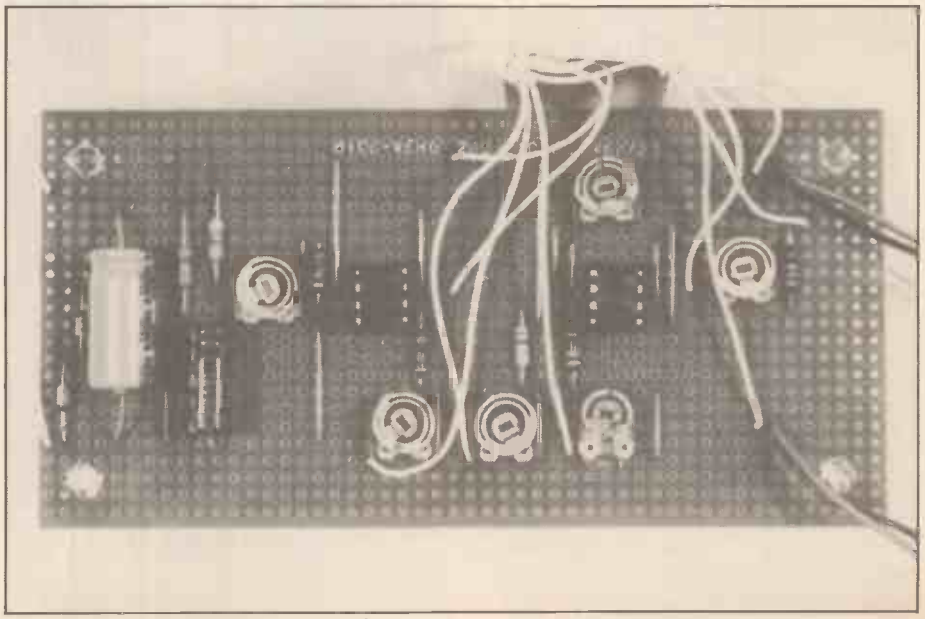
**MISCELLANEOUS**
SW1 ..... 3 pole 4 way rotary switch
M1 ..... 100uA analogue meter
SK1, 2 ..... 4mm sockets
Metal case, 140 x 130 x 70mm; Veroboard; test probes (see text); control knob; two PP3 batteries and clips; connecting wire, solder etc.

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

## Calibration

With the probes not connected adjust RV1 to give 100mV on its wiper. Do this using a high impedance voltmeter preferably a digital type. Next adjust RV5 to give a zero reading on the unit's meter on all ranges. This is especially important on the most sensitive range (10n℧), although you may find that a true zero reading cannot be obtained easily, if this is the case then leave RV5 set at the lowest point possible.

Next connect the probes and set SW1 to the 100n℧ range. Connect a precision 10 M resistor across the probes and adjust RV3 for full scale deflection. The switch to the 1 u℧ range and connect a 1M resistor across the probes. Adjust RV2 for a full scale deflection. Finally a 100M resistor is connected



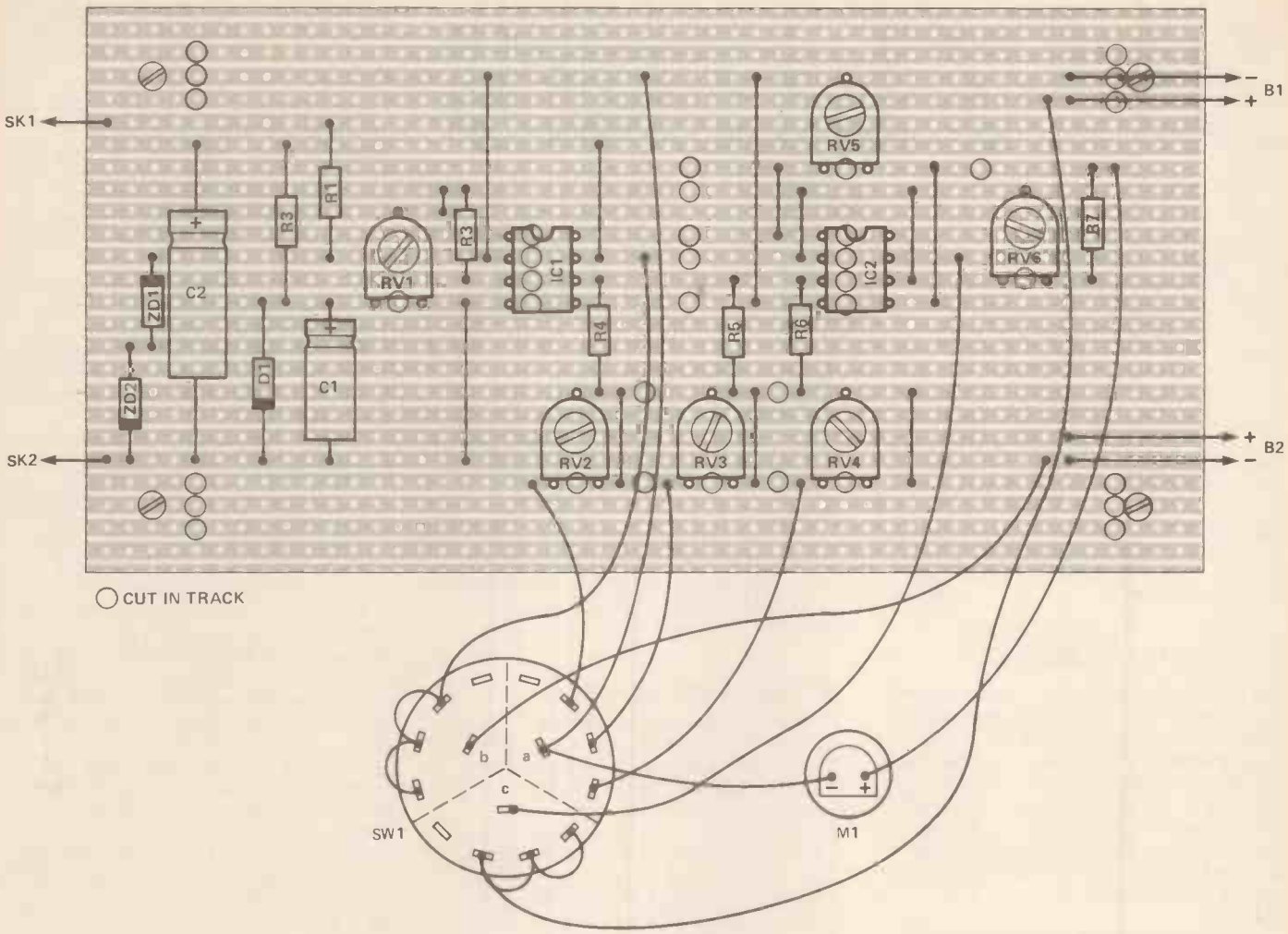
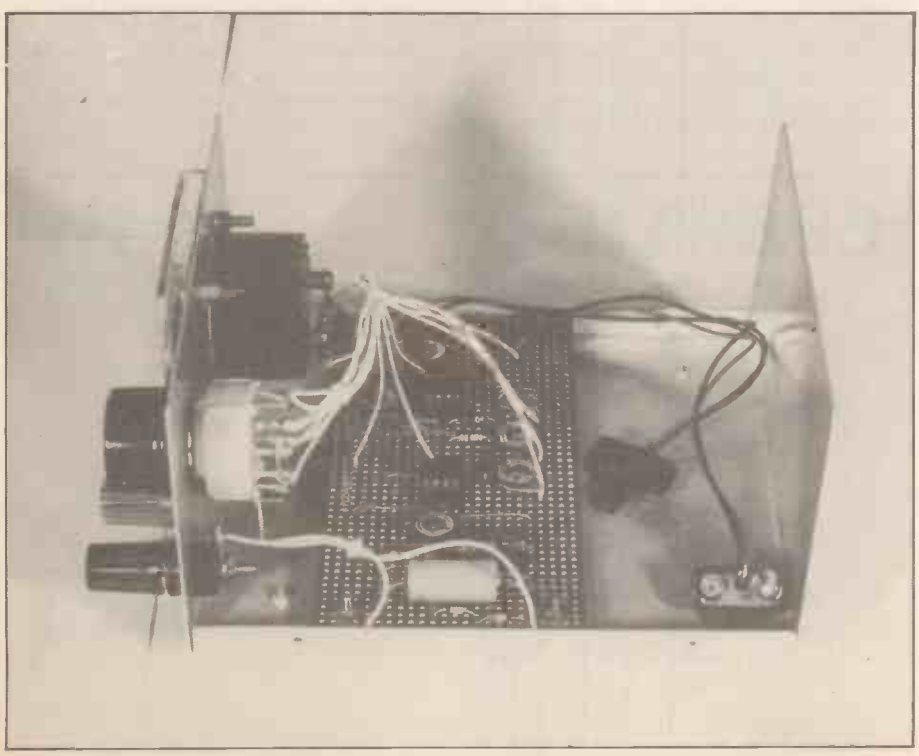



Figure 2. The Vero layout and components. Extra care needs to be taken that there are no solder bridges or short circuits.



across the probes and the 10n℧ range is adjusted using RV4. If no 100M resistor is available then ten series connected 10M resistors can be used.

## In Use

The operation of the unit is quite straight forward. With the circuit under test switched off, the probes are connected across suitable points on the circuit board — across the supply lines would be a suitable starting point. The range switch is then adjusted to give a reading on the meter.

If you wish to translate the readings into resistance then remember that the lower the conductance,then the higher the resistance is. For example, a reading of 5n℧ is noted, this translates to a resistance of 50M.

Conversely note that say, a reading of 0.5u℧ indicates that the current is finding it particularly easy to flow (remember the definition of conductance), which means in simpler language that there is a short of some kind across the circuit!

HE

# BUYLINES

## Oops!

How many of you noticed in last month's Buylines we gave buying information etc. on the Conductance Meter? One Million . . . Two Million . . . Now how many noticed that the article did not appear in that issue? One . . . Two . . . Three . . . Fine.

We all make mistakes but it's nice to be ahead of our schedule for once!

For the benefit of readers we reproduce the Conductance Meter text, together with the correct text which should have gone in last month. This was for the Mains Touch Switch and our apologies to those who missed these words of wisdom.

Now for this month's projects (with the correct text!)

## Conductance Meter

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

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

## Mains Touch Switch

All components for this project are readily available and should present no difficulties. The AC capacitor can be found in the **Maplin** catalogue if no other supplier can be found.

Note that all the components must be miniature types, and here it is better to obtain the PCB before buying the components. The Zener diode ZD1 can be increased to a 10W device to increase the power handling of the unit, typically slow.

Because the PCB carries mains voltages it is very important that all the soldered joints are well made and smooth.

It is worth spending time on the soldering to insure that there is no danger of short circuits etc.

The estimated cost for this project is #4, and this does not include the PCBs, which can be obtained from our PCB service as usual.

## ZX Tape Controller

The estimated cost for this project is £6.75, excluding the edge connector, case and printed circuit board.

As a PCB is used, it is important to use the correct relays as specified in the text, i.e. Maplin YX94C and YX95D.

Other types can of course be tried, but will obviously mean changes to the board.

The PCB is available as usual from our PCB service.

## Audio Millivoltmeter

Not given in the Parts List is the actual size of panel meter used in the prototype. The size is 50x45x30mm. Shop around for the meter as prices vary widely. Try **TK Electronics** for starters.

The estimated cost for this project is £10, and this excludes the cost of the case and printed circuit board, which is of course available from our PCB service.

## Wireless Intercom

A fairly substantial project this! Remember that two units are required for the full intercom facility, and the Parts List gives the components required for just one unit.

The cost for just one unit is estimated at £10. This excludes the case and printed circuit board (available from the PCB service).

Despite the relatively high cost of the project (£20 for a complete system), the advantages of FM are obvious, and this project compares favourable with other "commercial" units costing slightly more.

The case size given *just* takes the PCB and other components comfortably. In view of the varying sizes of transformers some constructors may like to use a case with more substantial dimensions.

Because of the risk from mains voltage it is best to use a metal case for each unit. Also take great care with your construction techniques.

## Prices

There appears in the world, some sort of raw material crisis as regards semiconductor material. This means that semiconductors, particularly 74 and 74LS integrated circuits are in short supply. So don't complain to your supplier, he has problems of his own!

You may also have noticed in many advertisements the polite message "check prices before ordering".

A wise message, and one which you should take note if you want your components in a hurry and all at the same time.

## Catalogues

Will advertisers (and those who don't) note that the HE catalogue library is looking very sparse nowadays. Your latest catalogue and/or price list (retail) would be very welcome.

We think the reason is obvious. We need the catalogues to price up our projects and to help readers look for the best possible prices. If we don't have your catalogue we cannot (and probably won't) recommend you as a source of supply.

And just to prove that some companies already think like this, we have received not a couple of weeks ago, three, yes three, catalogues from **TK Electronics** (11, Boston Road, London. W7 3SJ Tel: 01 579 9794/2842). Thank you gentlemen.

Needless to say, most of the projects this month were priced-up using their catalogues.

The catalogue consists of 28 crammed packed A5 pages, with most components ranging from common or garden resistors through switch cleaners, twist drills to kits of various shapes and sizes. One negative comment. The prices on the page do not include VAT. A slight inconvenience when hurriedly looking through comparing prices.

HE

## BEASTIES BY AH

# SOFT OPTIONS

## Editorial

In a recent edition of the *Financial Times*, Alan Cane wrote an article called "Junk Programs", in which it was reported that Britain's largest teaching union complained that evaluating educational software "had proved especially difficult, with no reference points from which to work".

Fortunately, the NUT spokesman had overcome this problem, and was able to tell Mr. Cane that, "Most educational software is junk. It is unreliable and rubbishy."

So it might be cynically thought, are some of the statements put out by some unions, which ought to know better.

Who has ever successfully evaluated a teacher? When did a book reviewer last dismiss the printing industry because he found it difficult to establish points of reference for his reviews?

Could it possibly be a fear of the unknown, which has provoked such extreme reaction, or do spirits of Captain Ludd disturb the slumbers of the NUT?

There is undoubtedly poor software around. Undeniably, there are overpriced packages which offer inadequate return to the purchaser. Obviously, we haven't yet worked out how to use the home-micro to the full and, yes, it's a adman's paradise at the moment. Of course, the NUT has a duty to comment on all of this.

But does its duty dictate that it should damn the whole software industry with sweeping pronouncements on "rubbish" and "junk"?

Would it not be more in keeping with teaching tradition if it were to guide, advise, comment constructively and ultimately help achieve a reasonable standard of product?

One way of doing this, it is suggested in the same article, is to set up a "central agency" to "evaluate and classify" software for schools use, with parents benefitting from such guidance.

Well, it is 1984, after all, and doubtless Big Brother would have approved.

Whatever happened to commonsense, personal judgement, individual choice? There are as many opinions on what makes a good or worthwhile program as there are types of machine to run them on, and different types of mind will extract different values from each package.

What is really needed, surely, is concerted pressure for a more realistic price structure and a satisfactory method of viewing the stuff before you buy it, and here the NUT might well have a useful role as lobbyist.

There are signs that the software market is improving its standards. Not all houses are cowboys, by a very long way, and some are very good indeed.

It is no more difficult to identify a good program when one emerges than it is to identify a good book. It just calls for a little more practice, a little more intelligence and a little less hysteria than certain bodies of opinion are presently displaying.

## Contents

## Amstrad Ad Astra

Wednesday 11th April saw the launch of the **Amstrad** home computer package, the **CPC 464,** and if production goes according to schedule, you will be able to see this remarkable machine in shops such as Boots, Dixons, Comet and Rumbelows at the beginning of June, and you may even be able to buy one. It will set you back £229, inclusive of VAT, for the "smallest" system.

This price includes a proper typewriter-style keyboard, a built in cassette recorder (which takes standard-size cassettes) and a high-resolution monochrome monitor. The specification of the silicon bits-and-pieces is equally impressive with a screen display which can give eighty columns of text, a palette of twenty-seven colours and resolution to 640 x 200 pixels, stereo sound, and an industry standard BASIC which has a few extra and interesting commands.

If this specification at just over £200 seems impossible, reflect for a moment what Amstrad are attempting to achieve. They judge that in the audio market-place the consumer prefers a package (the Tower System) devoid of separate pieces strung together with a multiplicity of cables and connectors and that it is natural to move into the low-cost-micro arena with a similar package deal. Alan Michael Sugar, the company's chairman, says:

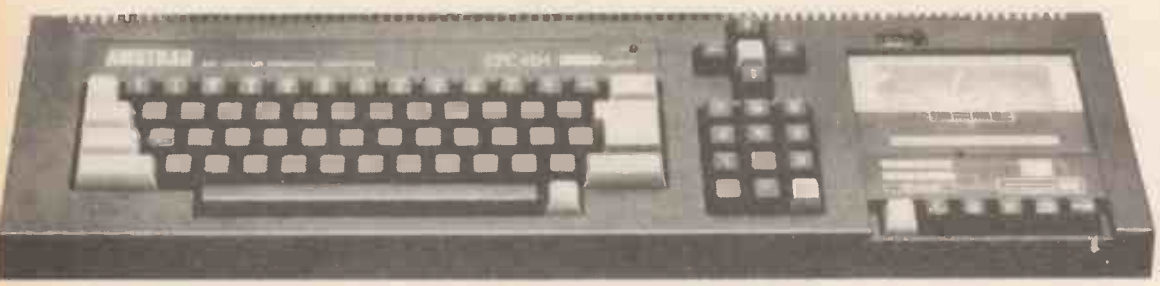
"The CPC 464, with its all-in-one packaging and the £229 price tag, brings the home computer within reach of almost every family in the country. Amstrad, with its agressive marketing style, is committed to winning a large slice of this growing market."

Those of us queueing for a certain 32-bit micro might like to know that Alan Sugar intends to sell 200,000 Amstrad computers between now and Christmas, and that barring typhoons in the China Seas the first shipment of Korean-assembled CPC 464s should be in the High Street stores by the time you're reading this.

At the Amstrad launch, ten CPC 464s, in varying configurations, were all running well and looked to be production models, although the "insides" were never revealed . . . What *was* freely available for scrutiny, however, was a dozen or so pieces of cassette-based and disc-based software, including Hisoft's PASCAL, Digital Research's LOGO and the NEWSTAR wordprocessor.

The usual arcade-games were also in evidence, as were some early-learning educational programs from Bourne Educational Software Ltd. The latter company also wrote the "Welcome" tape which is supplied with every Amstrad computer. To ensue a steady supply of software for their new machine, Amstrad have set up a software division called Amsoft. William Poel, head of Amsoft, is confident that the company will have fifty programs available for sale in June.

Amstrad say that they have designed their computer to provide both newcomers and experienced programmers with a non-idosyncratic BASIC and an operating system (to be fully explained in a separate advanced-user's manual) which will provide a friendly environment in which existing software may be tailored and new software written. The various systems will provide a sound foundation for educational establishments that have hitherto been unable to find the cash to purchase the number of computers, monitors, etc that are required to provide the type of hands-on experience that cannot be achieved with one or two micros amongst a class of thirty.



## Book Trade Set Fair For Software

The 13th **London Book Fair** took place at the Barbican Exhibition Hall, right in the heart of London, between the 10th and the 13th of April, and it was notable for three things.

Not only was it substantially larger than the previous years, with 699 stands, representing a majority of the publishing trade, but it was also open to the public for limited periods. More significant than either of these factors, perhaps, was the deliberate inclusion of software and computer areas, which demonstrated clearly the very serious commitment to computer assisted learning (or CAT, as we shall doubtless, increasingly, see it referred to), which book publishers have made over the last eighteen months.

Names such as **Penguin, Collins, Nelson** and **Hutchinson** are familiar to just about anyone who has ever read a book, and all now are deeply involved in the publishing, not merely of books about computers, but actual software. Their example is being emulated by many less well known, but just as respectable companies, all of whom are sure that there is a need for professionally produced, quality software which they should fulfill.

The first signs are that their instincts about the market are right. All the companies we spoke to were pleased with the interest shown by both dealers and the public in their products, and all were agreed that, whilst it was early days to be talking about profit, the prospects for educational software were healthy.

**Penguin Software**'s academic marketing manager, Andrew Welham, said that sales of the company's new Study Software range were encouraging.

All the retailers who had taken the tapes initially had now reordered, which, since the Shakespeare study aids were launched only in March, is an indication of the interest there has been.

Penguin are also pleased about the reaction they have received from the teaching community, from which they were expecting at least a degree of scepticism — founded only perhaps on the general association of software with 'computer games' rather than more enduring applications such as teaching. Instead, teachers on the whole have welcomed the six tapes currently available, as a step in the direction eductional software should be taking, and Penguin are now considering ways of adapting their pro-

# HARD NEWS

grammes for use in the classroom.

**Shiva** are moving in the other direction. After enthusiastic reaction from teachers who have used the company's eleven numeracy and logic packages in schools, Neville John, director of Shiva, has announced plans to offer the programs for general sale, suitably modified for the home market.

After the advent fifteen months ago of Collins' "Spectrum Starter Packs", which represented a first venture into the software market, the company has expanded its range to incorporate Early Learning programs.

Ken Hills, the Publishing Director of **Collins,** is enthusiastic about the prospects. Reaction from retailers to the new programs has been good, which is not surprising since they feature Paddington Bear, who is now obviously concealing a micro in the famous suitcase.

On a more ambitious level, Collins are also promising a BBC starter pack. This involves fifteen hows of programming for the user, at the end of which marathon, the company confidently predicts total competence in the basics of the subject. In common with an increasing number of publishing houses, Collins are emphatically looking to pastures new.

**Pirates**

**Chalksoft Ltd.** are moving into the arena with educational programs for the BBC Micro, Spectrum and VIC 20. One of their first ventures is an 'adventure educational program' (definitely an emerging trend). "Pirate" takes the player over sea and land, through battles, rocks, reefs, mysteries and shipwrecks and all the paraphernalia of pirate tradition, in the cause of "strategy, planning and mapping"

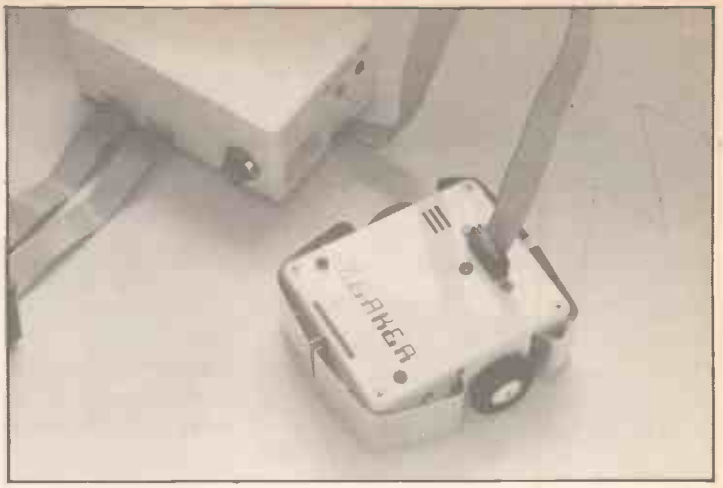
Two programs for the Acorn Electron involve punctuation and grid co-ordinates. 'Puncman", based graphically on Pacman-type games has Puncman retrieving full stops and capitals eaten by Nosher and replacing them in their correct position; "Invisible Man" has a cartoon figure hidden in a grid, which has to be searched by means of choosing the right co-ordinates. These programs are aimed at 7-11-year-olds.


For older students, Chalksoft have Eiffel Tower, a French-learning program for the BBC 32K and Spectrum 48K, with Commodore 64 to follow. Other language programs, in German, Spanish, and English, including a 'Words and Pictures' program for 3-7-year-olds, are in progress.

More information from **Chalksoft Ltd., 37 Willowslea Rd., Worcester WR3 7QP. Tel: (0905) 55192.**

**Robots On The March**

The emerging trend towards a general curiosity about computer control applications is revealing itself in increased robot activity. Now that so many micro owners — including very young micro owners — have familiarised themselves with programming, the question "What next?" arises. Writing games programs is usually the first stage in a developing computerate's self-eduction. The next stage looks as if it is going to be computer control of the outside world.



Robots are an effective means of learning and teaching computer control, quite apart from their entertainment value.

The ZEAKER robot is already familiar to some from its run under licence to Coln Robotics over the last year. Now the rights have reverted to the designer, David Buckley.

Mr. Buckley and colleague Robin Bradbeer have set up the new company **IGR — The Droidsmiths (Inter-Galatic Robots) Ltd.** with a hand-picked team to market personal robots for domestic, educational and leisure use, initially a family of Zeakers.

Following ZEAKER 1 comes ZEAKER II, the "draw-droid", which is being launched at the London Festival of Computing's Computer Fair in April.

ZEAKER II is a turtle robot with a mobile pen, and is designed to interface with LOGO, which is available on some microcomputers and is becoming more commonplace LOGO for the Sinclair Spectrum has been scheduled for release at around the same time.

The ZEAKER III is scheduled for launch later in the year, and will be a buggy-type, expandable by the addition of extra modules, selling in kit form for under £100.

IRG are beginning their career by giving ZEAKER I a substantial price cut on its prefious price of around £200. Further information can be had from **Robin Bradbeer** at **IGR, Unit 208, Highbury Workshop, 22 Highbury Grove, London N5.**

# Interactive Video Disc System

***Video disc systems are the latest in home entertainment, but how long before the industry extends its vision to the eductional horizon? Soft Options examines the potential of a technology in waiting . . .***

by Richard Sargent

**The influence of television** on the people of the Western World is indisputable. It fascinates the viewer with moving images in full colour, attracting and holding attention for more hours than might seem reasonable, but whether educational television has proved a significant resource in the last 20 years is a moot point.

Moreover, the market for videocassette recorders, so ably exploited by the Japanese electronics industry on the one hand, and the TV rental companies on the other, had demonstrated that even relatively expensive systems have found their way into numerous households.

However, both television and video tape suffer from a major drawback so far as eductional material is concerned: they follow the sequential format inherited from cine-film, and once the viewer starts to watch "a programme" he tends to watch without pause until its end.

This is desirable, if not essential, for entertainment and recreational programmes, but it is highly undesirable for most educational purposes.

**Even the best** of contemporary schools and college TV broadcasting can leave dissatisfied customers, both

*Phillips' LaserVision is the favoured technology for interactive video systems, though the Long Play version shown here would not be suitable.*

among teachers and taught.

Programmes, ephemeral by definition, are designed as units of continuous narrative or argument. The viewer cannot pause, reflect or take notes while viewing without losing the thread of the argument.

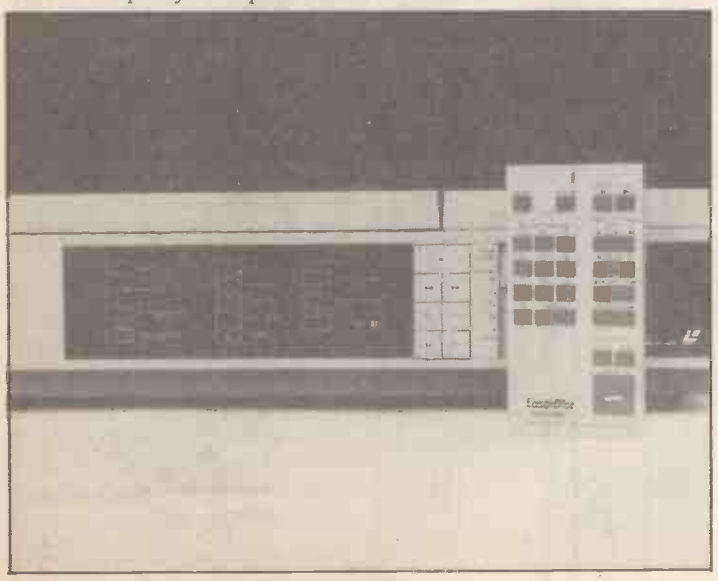
The level, format, structure and language of any given transmission are influenced by the potential audience as conceived by the producer and thus the usefulness of any specific programme for any particular student is rather a matter of chance than design.

The student cannot question the system to clarify his or her understanding, and the tendency is towards passive acceptance by the viewer of the information disseminated.

Advances in video cassette recorders have begun to redress this balance, and the latest machines provide the facility to stop, slow down, or retrace steps during a programme. Although it is possible to extend computer control to these recorders, true random access to the material on the tape is not possible, and still-frame techniques are best avoided due to excessive tape degredation.

Magnetic tape technology has serious limitations, and so it is only now, with the emerging videodisc technology, that the concept of "Interactive Video" is approaching maturity, and when it does arrive a great many old and inefficient methods of learning will be swept aside.

*The Pioneer LaserDisc, with in-built facilities for remote control, has been adapted for computer interactive control.*



**Interactive Video** embodies the immense potential which results from the convergence of technologies: the TV and film industry which can make available documentaries, archivel material and custom-produced programmes, and the computer industry which can make the micros manipulate the video and turn it into a contemporary or historical window looking at the real world but allowing interaction with that window-world with a higher degree of control than would be possible in the real world.

The videodisc has been with us since the 1960s in experimental form, and after many false starts there are now two main contenders for the lucrative home and educational market: the CED Video Disc System (formerly called the RCA Selectavision system) and the Philips' LaserVision system.

Both use double-sided discs, 12 inches in diameter, which sell for between £10 and £20, but there the similarity ends. The systems use totally different principles to extract the video and sound information from the disc surface.

All the indications are that the CED Videodisc will be used for standard sequential viewing and will figure large in the domestic market, whereas the LaserVision will be used in the business and information dissemination fields. Not only are there technical reasons for this, but the pricing structure is likely to reinforce it: at £200 the CED player is at least half the price of the LaserVision player.

It should be said here that the quality of picture obtainable from both systems is superb, and can only be fully appreciated if the video signal is fed into a monitor rather than to a domestic television receiver. The pictures, rock-steady, brilliant and sharp, can only be matched by those found within recording studios.

However, the CED disc is delicate and will, if played excessively, begin to wear and degrade whereas the LaserVision disc is robust and cannot be worn out in normal use, however many times it is played.

*Learning to fly a kite, a hang glider, or a 747 . . . interactive video systems could provide a vivid insight into the machanics of flight.*

**The LaserVision** optical video disc (hereafter simply called the disc) was invented and developed over 10 years by Philips in their Dutch laboratories.

Each disc carries colour television information, two sound tracks and associated control data on a single spiral track which can give about one hour of continuous viewing if it is a Long Play (CLV) disc or 37 minutes if it is an Active Play (CAV) disc.

The programme track is read by a micro-fine laser beam inside the player. Because



3

## Man of Vision

**Michael Grove** is a man "obsessed by the problems of education". A product of a traditional grammar school, whose restless enthusiasms were never satisfactorily catered for by the system, Mr. Grove is an Interior Designer with more than a passing interest in the micro revolution.

During the past three or four years he has conceived and designed a video disc interactive system which, if properly funded and promoted, could, he believes, help change the face of education as we know it.

**The video disc** interactive system he sees as an integral part of the educational revolution. "The beauty of the video disc is that it encompasses every facility that mankind has known up until now to communicate an image, all on one disc.

From the educationalists point of view, Michael Grove says the system has the ability to "tell the user what he's going to see before he sees it, what he is seeing while he is seeing it and what he has seen after he's seen it. Any tool which can give you that kind of potential is a very powerful tool".

Michael Grove took his ideas to Acorn. "I have worked in association with them since they had 25 people — now they have nearly 500." The association has spawned a working system, exhibited by Orbis Computers at several big computing fairs during the last 18 months, but the problems of finance make it unlikely that working systems will find their way into schools in the near future.

Grove is encouraged by the attitude of Government departments, where he has found a small core of people who understand that the future is with the infants of today, and who are therefore anxious to examine the possibilities of developing the systems specifically for the primary market.

**The MEP**, too, has been constructive in its attitudes, but in a sense video disc interactive systems are still of the future.

As Quentin Bell, Acorn's PR company, say, "It is still very much a technology in search of an application".

Michael Grove is philosophical. Ideally, he would like to make a system which is sophisticated, yet imposes few restraints on the user and to do it at a rock bottom price. He recognises that as a designer he has the freedom to think such Utopian thoughts, but that market forces render such things impossible for commerical companies.

Nevertheless he is optimistic and believes the next five to eight years will bring his project to fruition.

One of the applications that he envisages is vocational retraining of the working population, and since the interview with him, the EEPTU (the Electrician's Union) has announced co-operation in just such a scheme.

This country is fortunate in that, despite a history of good ideas pre-empted or given away to foreign markets, it still produces people like Michael Grove, who have the imagination, initiative and energy to get new technologies off the ground.

**Mary Sargent**

there is no stylus and no physical contact between the disc surface the discs do not wear out, and are thought to have an impressively long life.

In the case of the Active Play disc, the programme track is segmented into 54,000 separate frames, each of which is numbered and can be randomly accessed. It is this feature that make the CAV disc quite unlike any other video disc.

There is a microprocessor already fitted in all the current videodisc players, but it is kept busy supervising the precise positioning of the read-head on the track and controlling the speed of the turntable, etc.

On the "industrial/educational" players there is a second micro onboard which gives the machine a certain amount of intelligence, since it can accept instructions from the keyboard or from information encoded on the disc itself. But perhaps more importantly, this micro allows the machine to communicate with an external computer.

Under the control of purpose-written programs, the full potential of the disc player is realised. A search can be made for any one of the 54,000 frames, Teletext data, already interleaved between the frames on some discs, can be extracted and read. The picture can be shown in sequence with sound, or static, as in a slide display. The frames can be strepped through slowly, backwards or forwards, or reviewed at fast speed.

The teletext data or data from the computer's floppy discs can be overlaid on the screen entirely or in boxes. Computer generated graphics can be included in the complete programme.

The equipment already exists, and it is not particularly expensive.

The two current LaserVision players from Philips are very much domestic models and cannot be connected to computer systmems. The

Pioneer LD 1100 laser disc player, on the other hand, although designed for the consumer entertainment market, has features that make it possible to utilize it for a degree of interactive programming, and can be linked to various makes of micro.

Pioneer offer a general purpose interface, and a prototype interface specifically designed to connect to a BBC microcompter has been demonstrated by Orbis Computer Ltd, an Acorn subsidiary.

*Interactive Programming of the First Kind – following the leader.*

**Laser discs** are expensive to produce and it is not surprising that there are, as yet, few titles suitable as the basis of a computer assisted learning program, although most of the big-name companies are waiting in the wings, presumably to see how the sales of domestic machines and entertainment-discs progresses.

Among those interested are Thorn-EMI from the film and disc industry, Longman and Macmillan from the publishing houses, and BBC Enterprises/Open University representing TV Education.

Preparing the master-copy disc from an existing high-quality film costs in the region of £2000, but the cost for an interactive *package* which would including original filming and the software to handle the subject matter is variously estimated to be £30,000 to £100,000.

In view of these costs, it is perhaps a little surprising to find such Active Play disc titles such as David Attenborough's BBC *Videobook of British Garden Birds*, BBC's *Romance of the Indian Railways* and the Open University's *Help your child to read* in the vanguard of educational (in its broadest sense) material.

The entertainment area is rather better catered for with some 400 Long-Play titles currently available for the domestic Philips system.

As with all new technologies, it is easy to pull impressive figures out of the hat which "prove" how wonderful the system is.

Yes, certain optical discs can carry the entire text of *Encyclopedia Brittanica* with room to spare but that might not interest an eight-year-old, or for that matter, his teacher.

But what a group of teachers saw demonstrated in the Summer of '83 left them all asking "When could my school have one of these?". The system they saw was a BBC micro with a single floppy disc and its own black and white monitor linked to a Pioneer disc player with its own colour monitor.

If a picture is worth a thousand words then a video disc under computer control must be worth ten-thousand. Single-stepping the TV frame forwards through the flight of a bird; a wave breaking on the shore-line; a complex chemical reaction — minute detail can be seen by the student, perhaps for the first time ever, and it can be explained and believed because it is real.

**It is likely** that the video disc will first be used in schools as a superior audio-visual aid which will communicate with the teacher and a class group in a set-up which probably won't *look* like any different from today's teaching sessions with a Video Cassette Recorder.

However, the interactive disc system also has its own program language, Microtex-plus in the case of Orbis system, and any Active Play disc can be turned into an individual work station which can tutor the student in a friendly and flexible manner.

It is this arrangement which is likely to find its way into a great many households before the end of the decade, and when that happens, the face of education in Britain will have to change.

*Down-market video disc systems for the consumer may offer potential for computer control in the future.*

# 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 programs on test.***

## Mr. T's Shape Games

*(Good Housekeeping/Edbury Software)*

**48K Spectrum**
**BBC Model B**
**For ages 3-6**
**Price: £12.95**

**Good Housekeeping** are marketing a range of educational programs designed for the home computer, and for children aged 3 to 6.

Each package aims to provide activites for a parent and child together, and is designed to encourage discussion and establish the techniques and vocabulary appropriate to the subject. It moves on to games for one and two players with adult help or on their own, as they wish.

The games use amusing graphics and an animated character called Mr. T. Sound effects and tunes provide necessary stimulation and reward all the children's efforts, which helps maintain their interest. The accompanying sound handbook suggests follow-up activies and gives useful advice, such as "This is a game for a child to play with an adult. You might use it instead of reading a story — but not at bedtime when your child is tired."

**The emphasis** is on making the learning process for both adult and child, an important point since the child's whole attitude to computers and computing can be influenced by these early experiences.

**Children can work** at their own pace, which removes the potential frustration of continuous failure, or the boredom of too much repetition. Different levels of ability and age are catered for, and the adult can select the level of difficulty or leave the program to adjust automatically to increasing ability.

Operation of the program is uniform throughout the range, and even parents new to computing need only a quiet half hour alone with the handbook and the program to ensure a problem free introduction for their child.

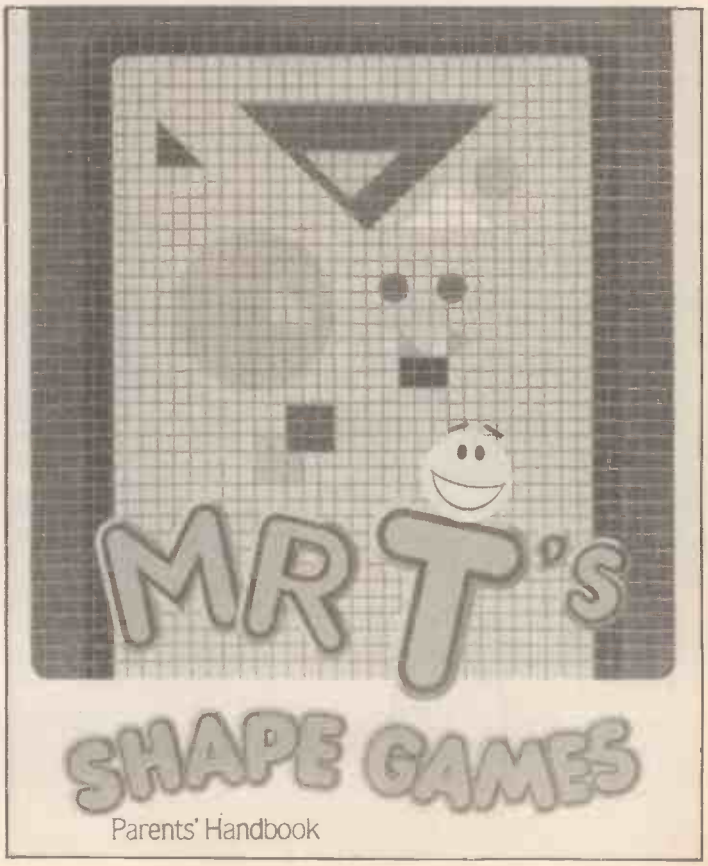
**Each cassette** comes in a glossy book-style box, with the handbook, and costs £12.95. It is a matter for individual choice whether that sort of price for one early learning program is worthwhile, considering the books and toys which are available for this age-group.

Some of the programs have a greater potential for long term use than others. Mr. T's Shape Games has two programs on it: the first is *Jigsaw*, a shape recognition game.

**The game begins** with a pattern made up of two or more shapes on the screen. Once the pattern is complete, a triangle, square, or other shape appears at the top and sides down over the position. The child fits the shape into a matching part on the pattern by pressing the SPACE bar to stop it at the appropriate place, and there is a suitable margin for error to take account of failure to hit the bar at exactly the right instant.

Played with an adult, the game encourages increased perception by the asking of questions — several are suggested in the handbook. This is suitable for teaching three or four year olds about shapes and is an enjoyable game for older children, the increasing levels of difficulty extending its useful life.

**The second program** is called *Shape Maker*, and in this game the player builds up a pattern or picture by choosing different shapes, changing their size, positioning them on screen and colouring them in. It requires continuous help from an adult, because the options at each



stage require extensive explanation.

The game is designed to explore the relationship between various shapes and their symmetry. It is, in fact, laying the foundations for the study of geometry. Some children might find their inability to control the program alone frustrating, but by the age of about seven, they should be able to allow their artistic abilities full rein unaided!

*Good Housekeeping programs are generally available from branches of W. H. Smith and from leading High Street retailers. Versions for 48K Spectrums will be available in May, priced at £9.95.*

## Cartesian

*(Flite Software)*
**BBC Model B**
**Price:** £27.75 (disc) or £24.90 (cassette)
Reviewed by **Robert Newell**

**Cartesian** is a package aimed at promoting an understanding of the value of mathematical functions and determining their roots. The cover notes claim: "High resolution graphics and excellent documentation mean that in a short time you should absorb most of the concepts relating to calculus and the solution of polynomials."

This is ambitious, since it implies that the program and documentation are in themselves sufficient to promote a large measure of self-instruction in a wide area, and I do not feel that the package achieves this.

**The documentation** consists of an 18 page booklet, of which only five pages are devoted to explaining the mathematical principles involved in the very wide field the program deals with, and a supplementary page dealing with fairly significant alterations to the operation of the program.

It is adequte, but not excellent, and successful running of the program will involve some intelligent experimentation with the keyboard beforehand!
Having said that, I believe this program is capable of giving considerable help to a student using it to supplement conventional teaching material. It could also be constructively used as a classroom teaching aid.

**Specifically,** the package permits the following operations: (a) Graphical presentation of a function and its first derivative. Up to six degrees of freedom can be handled and the value of a function over a very wide range of values of x and y can be examined by means of a series of displayed manipulation commands.

(b) Calculating the roots of the equation using the Newton-Rapheson method.

(c) Calculating the definite integral of the function (areas under the curve) using Simpson's Rule.

(d) Solving complex equations. The program will find the roots of quadratic equations not having real solutions.

The program is in two parts which are chained in the usual way. The first part sets up the screen and other parameters, and then loads the main program, which is written in BASIC.

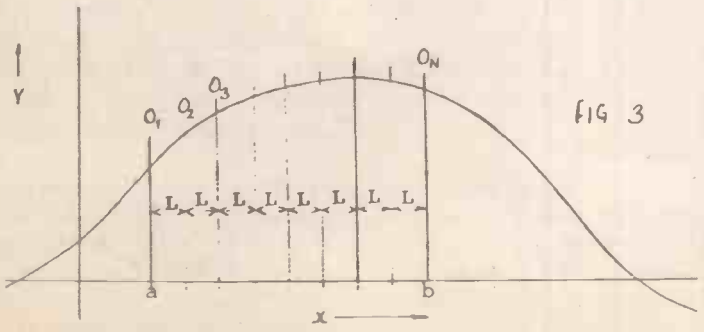
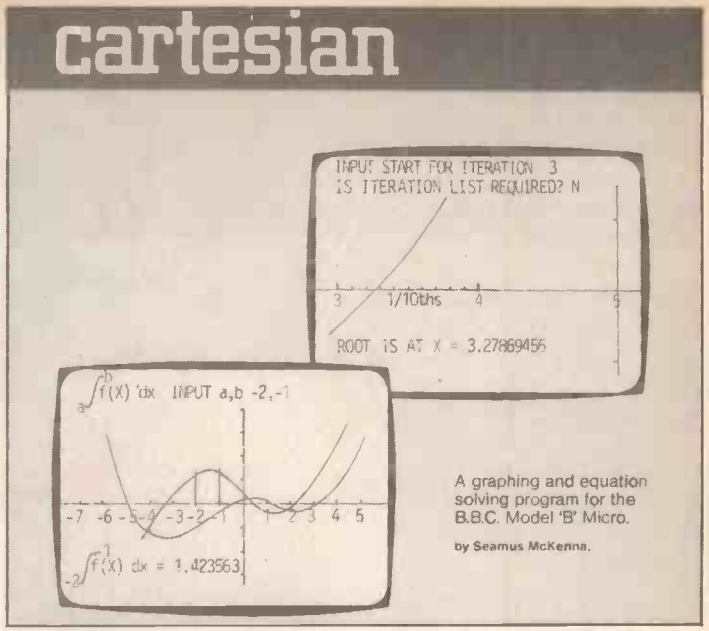


FIG 3



A graphing and equation solving program for the B.B.C. Model 'B' Micro.

by Seamus McKenna.

**It is possible** to escape and examine the code by pressing E. The BREAK key has been redefined to re-run the program, which can be restarted after exiting, provided the display mode has not been changed.

The program itself is fascinating to use ,
The program itself is fascinating to use. Function plotting is fast, and it is great fun to enter different types to see what shaped curves result. Some patience is needed initially in finding the best scale and off-set for the axes for plotting a particular function, but this becomes easier with practice.

**Three example functions** are included in the appendix and are useful for preliminary experiments.

The differential of the curve can be plotted at any time and the screen is only cleared on command so that several functions can be plotted at once, if required. This allows comparison, and the program could be recommended on the basis of this display facility alone. It could not fail to give any student an insight into, and understanding of, the way functions behave.

**The roots** of the equation defined by the function may be discovered by a single key command. The Newton-Rapheson iterative method is used and the program asks for an initial approximation, which may be found by noting the position(s) where the plotted function crosses the x-axis. Computation is fast, too.

**The definite integral** is evaluated using Simpson's Rule. Again, a single key command is required, and the program requests the interval wanted. The method for both routines is fully described in the handbook.

The program will also evaluate the roots of a complex equation, but only for the quadratic case. It does this by explicit calculation using the co-efficient of the expression, which must be typed in. I did not find this capability particularly useful or instructive.

**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.

Only refinement of the screen display and an updating of the handbook, together with the inclusion of a few sample sessions, are needed to turn this very good piece of software into a truly excellent package.

*'Cartesian' is available from Flite Software, Findrum, Convoy, Co. Donegal, Ireland. Telephone 010 353 74 22286 or 010 353 74 22025 for details.*

## Henry IV Part 1

*(Penguin Study Software)*
**48K Spectrum**
**Price: £5.95**
**O-level/CSE standard**

Reviewed by **Francis Josephs**


**This is an interesting program,** simple to use and with a clear screen display, but although Penguin recommend it for use by CSE and O-level students, I would think it rather too difficult for the first group and not complex enough for the O-level students.

I don't think it likely that the program allows "very sophisticated studies" of the text, as is claimed, but a student can benefit from it by following a character or theme of his choice through the play, with a series of intelligent questions, statements and observations.

**Standard explanations** are not given, but although the absence of easy answers is an excellent feature, it might perhaps have provided encouragement and stimulation if, occasionally, a clue were given as to whether the student was on the right track.

Alternatively, a supplementary question, such as "Does this passage suggest a. or b.? If a, then how do you explain c.?" might have been helpful.

A source of confusion might be in the line references, which refer only to the Penguin New Shakespeare text. By the end of a scene, there can be as much as six or seven lines difference between different editions of the play, so it would seem logical to quote the first line of the reference, to avoid misunderstanding.

At the end of the searches I was disappointed to find no overall conclusion, no series of questions for future consideration, not even a suggested critic or book to read.

**A specific option** which I found unsatisfactory was the examination of language. I thought it superficial, since it failed to examine the use of language in any depth at all, and a search of Act IV produced the fatuous statement, "You were searching a part of the play for something that was not there to any significant extent." That would have surprised Shakespeare!

I would also have liked to see two levels of questions, to cater for the different standards of exams and to allow for the increased understanding of specific students.

**This is a useful program** for enabling students to think about and memorise themes and characters, and is especially useful for the less well motivated pupils, who will like the format.

It is valuable because it requires close working with the text, but it is not all that it is claimed to be. There are definable faults and some missed opportunities, but even so I shall keep my review copy for future use.

## Macbeth

*(Penguin Study Software)*
**48K Spectrum**
**Price: £5.95**
**O-level/CSE standard**
Reviewed by **David Cooper**


**Macbeth** offers students the chance to review the major characters and themes in combinations of up to three at a time.

The program indicates other possible cross-references, or informs you that there is no worthwhile point to follow up.

Each reference to the play is from Penguin's successful New Shakespeare texts, and is accompanied by questions or statements that encourage the student to think carefully about the play.

**The screen display** is excellent, with an uncluttered and well-balanced layout that is easy to read and follow. A cursor allows you to choose topics and either follow one topic through the entire play, or through individual acts, or select further topics for comparison.

In theory, then, an excellent program that combines thoroughness with imagination. It was when we turned to investigate one theme that the advantages and the disadvantages became apparent.

There are seven references to the Witches in Act 1; many of them are so short as to be obscure, and one is both confusing and misleading.

**We are told** that "the witches and all they stand for set the tone of the play." Even if it were true, it is vague, and the blank space left on the screen

might suggest that a more thoughtful comment would have been better.

Worse, we are told of the famous line "Fair is foul and foul is fair" that this "inability to see" leads to destruction — a comment that neither I nor my A-level students could understand. In effect, the comments here are rather too enigmatic for most pupils to use on their own.

They could, however, be the basis for excellent class discussion, if any teacher chose to use a lot of class time in this way!

**The merit of this program** lies its ability to place characters and themes in an interesting relationship, even if at times it dismisses as obvious and beneath discussion points that would be worth considering with CSE pupils.

In this context, it is worth mentioning two omissions that, if included, would help all students — line references to quotations used in the comments, and a list of all the references on each topic at the end.

Where do these programs fit in? Revision notes, including Penguin's own new series, are cheaper and allow the student to turn back a page (the computer program does scroll back).

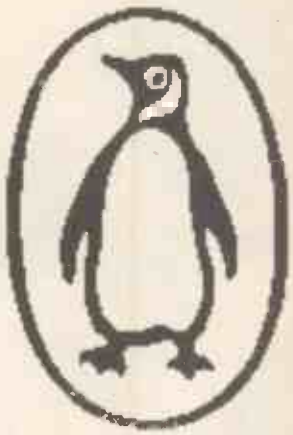
**On the other hand,** used as a revision aid, the program will enable anyone to improve their understanding both of individual scenes and the overall pattern of the play.

I'll buy some of the others in the series, but I look forward to a second edition that chooses its words more carefully, and isn't afraid to go into some detail on each reference chosen.

*Penguin Study Software is available from branches of W. H. Smith, Boots, and all good book shops.*

## Birds In Fresh Waters

PENGUIN STUDY SOFTWARE



**Following a stream** of other distinguished publishing houses, Penguin have not merely waddled to the edge, but have plunged headlong into the perilous soft seas, with six programs designed to launch the Bard on his most innovative voyage since printing was introduced. The first series are designed for the O-level/CSE candidate.

It is a formidable undertaking, and the advertising division of Penguin Books hasn't made it any easier.

"The first truly revolutionary breakthrough in the study of literature since the invention of printing." ". . . such a claim requires a totally original concept — Penguin study software is exactly that." "The Ultimate Blackboard". " . . . gives Total Access." and more moderately, "the best piece of Educational software to be launched in 1984."

**It cannot be said** that the admen haven't done their stuff. On the other hand, such hyperbole might obscure the interesting facts that Penguin's software team has also done its stuff, and not at all badly.

Stripping away, as one must, the adulatory gunk, reveals the workmanlike product which, if it doesn't achieve the dizzy heights constructed for it by the dream factory boys, at least represents hope, and light on the hitherto bleak horizon of software for learning.

**As was to be expected,** Pengin have taken care to use the right tools. Many Educationalists feel that serious software should be designed, if not written, by people with knowledge of the subject as it is taught — in other words, in-service teachers.

So Study Software is written by two in-service teachers of English literature, with thirty years experience between them, and strong views on the need for teachers to be involved in microcomputing.

**Complaints** about obscure instructions and poor mechanics of some programs have also been listened to, and Study Software is a thoroughly efficient and well presented range of programs. Were their rumblings about price? At £5.95 for each cassette, Penguin have placed their products within the range of the finances of the home users for whom they are intended. The reviews printed here were written by two senior English masters at two separate secondary schools. Although Study Software is intended for the student revising at home, professional opinion was obviously relevant, and the more so because Penguin admitted to "expecting some flak" from the teaching profession, on account of daring to try to "teach Shakespeare on the computer".

**Of course** they are not trying to do this, and their apprehensions have not been justified. Reactions seem, rather, to be interest and qualified approval, notwithstanding the earnest young gentleman who enquired of the authors at the press launch as to whether they suffered qualms about Shakespeare's opinion of their enterprise. They were very nice to him.

**They were also very nice** about more serious questions. Neither the authors nor Penguin Software division are claiming to have found all the answers to the problems inherent in educational programs, and they seem genuinely concerned to benefit from constructive comment.

Since Penguin are heavily committed to software, with a promised range of twenty or so titles initially (not all Shakespeare) and John Mahoney and Stewart Martin are now both out of teaching and into full-time programming, it's in everybody's interests that they should be receptive.

**This kind of professionalism** and dedication of resources can only be in the best interests of the educational software market generally. Penguin have proved their value in the publishing world beyond the need for comment. The signs are that they can only be of value to the software industry, too.

## Maths 'O' Level Revision Part One

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

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

**There is** nothing offered by this computer course that could not be done in a book, but given that revision is a boring fact of life, if doing it on your Dragon is more fun then that may be a good and sufficient reason for using a computer, at least while the novelty lasts.

The course comes on two cassettes and all the following topics are covered in depth: Areas and Volumes, Ratios and Percentages, Interest, Averages, Velocity and Acceleration, Equations of lines, Gradients, Differentiation, Turning Points, Integration, Areas and Volumes by Integration, Geometrical Constructs, Lines, Angles, Loci and Examination Techniques.

The topics covered on each side of a cassette are detailed on the fact card provided (although for some reason Ratios are omitted from Arithmetic 1) which also contain clear instructions on how to run the program.

**Each side** of the cassette is menu driven by the major headings, as are most of the sub-sections. It is therefore easy to select a particular topic for revision, and there is no requirement to complete one section before going on to the next. At the end of each screen displayed (apart from the menus themselves) you have the option of returning to the top level menu, continuing to the next page or going back to the previous page.

In general each topic is covered in four parts: a brief explanation; some worked examples; a set of questions for you to attempt; and the answers. At the end of the answer screen you can request details of the working of any or all of the questions.
**This is not** a teaching course and should not be used as such. Its explanations and examples serve only as a reminder of previously absorbed (?) facts. However in both the examples and the questions it sets, the program attempts to show the various ways in which an examiner may approach a subject and you should end up knowing how to apply your knowledge to most questions. It would perhaps be useful to draw students' attention to this point.

The examination techniques given on the last side are all good stuff. Don't ever underrate technique — whatever exam you are taking, it can pick up that vital mark for you! In terms of information per byte, this must be one of the best value programs around and if you are hooked on computing it may help you get your Maths O-Level too.

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

## Advanced BASIC Tutorial

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

Reviwed by **N. E. Martin.**

**This course** assumes that the user already has some knowledge of the BASIC language, although there is a brief revision session included. It could equally well be used by anyone familiar with other high level languages who wished to extend their knowledge to include BASIC.

The course covers three major areas — graphics, music and formatted output — together with a number of smaller but very important topics such as string-handling, subroutines, arrays etc. Details of the areas covered on each side of the two cassettes are contained in the fact card provided, which also gives simple instructions on how to load and run the programs and a recommended order of study.

Each side of the tape is a self-contained section driven by a menu of topics. Each topic is presented as a sequence of screen displays and at the end of each display the user has the option of continuing to the next screen, going back to the previous screen or returning to menu selection. This enables him to control how much or how little of each section he wishes to cover.

**The first side** includes a brief revision session, further PRINT facilities, array and data handling and some notes on using the cassette recorder. In general the presentation of the material was clear, but unnecessarily slow, and more use could have been made of highlighting and flashing to emphasise various points.

There was insufficient user interaction to maintain interest, particularly during explanations of PRINT USING. This was a powerful tool, which would have been enhanced by more specific explanation and lots more interaction.

**The second side** covering variable values, mathematical features, subroutines, functions, strings and sounds/music, proceeded at a better pace, but were two screens of ASCII conversion table really useful? Surely, these would have been printed on the fact card, if needed.

Cheshire Cat Advanced Level Basic Tutorial includes:-
- Drawing Shapes and Moving Pictures
- Music and Noises
- High and Low Resolution Graphics
- Sub-Routines and User Functions
- Manipulating String Variables
- Numbers and Mathematics
- Arrays and Data
- Typing and Testing Programs
- and a complete PRACTICAL session providing Exercises, Examples and Solutions.

The coverage of strings and music, however, gave a good idea of the extensive facilities available, but more interactive work would have improved it.

**Side three** goes into graphics, with details of high and low resolution screens is well explained and the user is given the opportunity to experiment with various settings of SET and RESET in a "controlled environment".

But be warned that a colour screen is essential to gain most benefit from this section.

**Side four** contains exercises covering the earlier material, together with sample programs producing the requisite output. Once again, a colour screen is essential, since the colour graphic exercises could not sensibly be attempted in black and white.

In general, the course contains a lot of good material but does not take sufficient advantage of the facilities a computer offers for user interaction. In particular, a different method of presentation would allow the user to work at his own speed, and more use of question and answer sessions within the tutorial would improve the user's grasp of the facts presented.

On a technical note, BREAK was sometimes disabled for short periods, but worked in general, and on none of the Ampalsoft programs did we manage to upset or break them by a silly input.

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

## Young Learners I

(*Rose Software*)
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Reviewed by **A. J. Verdin**

**The tape contains** four programs of the drill-and-practice kind, so beloved of software houses. This type of program is most easily available to the public, and they are always described as educational.

**ABACUS** is an exercise in addition, up to either 10 or 20, using two horizontal abaci with beads sliding from right to left, one at a time. These enable counting on the first line as they appear, and then on to count on the second line. After the answer has been entered, the same exercise is repeated on the vertical abacus, the computer numbering the beads as they appear.

A picture of a house and garden is built up with each answer that is correct at the first attempt. The colouring of the beads seems to be random and it is unfortunate that, if we have to go through the same process twice, the colours should not appear in the same order each time, so as to appear to be the same beads each time.

The program would have been more useful had there been an option for choosing any total up to 10 been available, since children need to be confident with the lower numbers first. The program is friendly, saying hello and asking for the user's name, although the flashing screens are both annoying and unnecessary.

The building up of the picture was appealing, but the whole process of counting beads twice takes so long that boredom inevitably sets in.

**Time** is perhaps the best of the four programs. The menu comprises four options: 1) on the hour only; 2) plus half hours; 3) plus quarter hours; 4) any time at all.

A clock with two hands pointing to 12 is displayed, and the user is invited to set it to a time specified by the computer. The time is given in two ways, ie '10 to 9' or 8.50. The long hand is moved by using L and ENTER, then the short hand by using S and ENTER. If the set time is incorrect, a clock face showing the correct time is displayed.

This program can give plenty of practice at each stage of telling the time, and seemed to be fun to use.

**SHOPPING** claims to familiarise the user with the eight coins in current use".

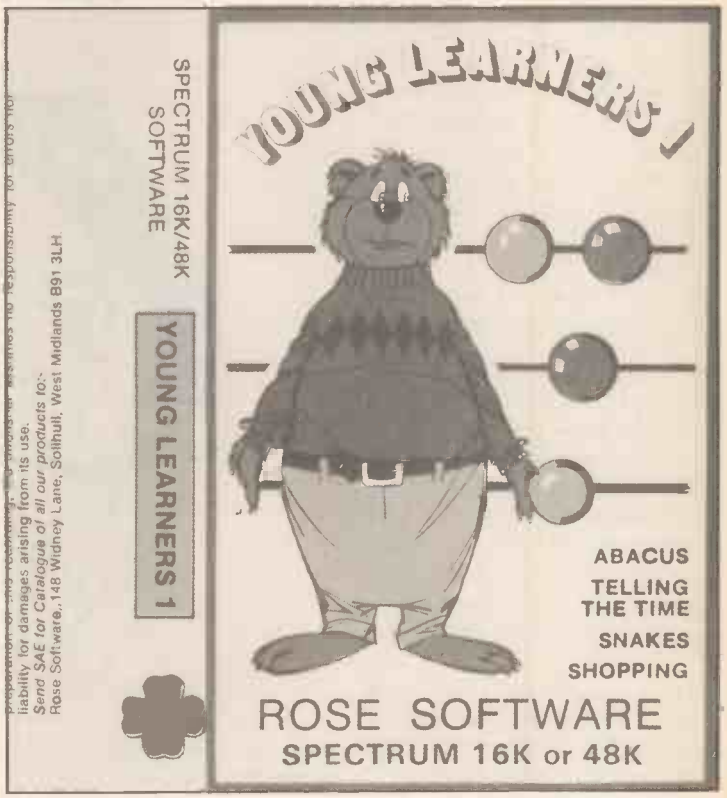
But nothing can familiarise a young child with coins except handling the coins themselves; certainly the crudely labelled outlines which appear on the screen will not do so.

The user is invited to buy items, selecting the correct coins exactly, or to work out the appropriate change from a specified amount, so in effect this program is simply an electronic workbook, and the answer will need to be worked using coins. The only role of the computer is to provide instant feedback.

**Snakes** is a board game, with numbers from 0 to 34 arranged like a Snakes and Ladders board. First the computer throws a dice and then the number of the square where the counter should land has to be entered. If the answer is correct, the counter moves up a ladder, but if incorrect it drops down a snake.

The program gives some practice at using a number line, but the graphics are uninspiring, and the noise irritating. Playing the real game of Snakes and Ladders is more fun.

Although 'Time' is quite a valuable teaching aid, the other programs, owing to their lack of innovation, soon become boring and are ultimately less enjoyable and instructive than the real activities they are meant to replace.




*Rose Software is available either direct or from selected High Street stores.*
*New full colour packaging, to be released shortly, is expected to result in a price increase.*

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# How I Learnt To Stop Worrying And Love The Computer

***An everyday story of a teacher's re-programming as an adept in the world of bits, bytes and bugs.***

by **Barry Birch**

*Barry Birch is head of Geography at South Kilburn High School, and has recently acquired a Diploma in Professional Studies in Education (Computing). He is considering taking the British Computer Society exams, having been granted exemption from Part 1.*

**I teach** in an Inner London comprehensive school, where I am Head of Geography. Among my talents, I number a complete absence of any mathematical ability, a situation which has not altered since my failure to achieve O-level in this most holy of disciplines.

Three years ago I became aware of the micro-electronic revolution when the school acquired its subsidised 380Z and invested in half a dozen or so ZX81s.

Awareness, however, is far from being interest, as all teachers know, too well, and it was not until a year later that an instinct for self-preservation led me to delve deeper.

A group of colleagues already enamoured of The Chip demonstrated to the rest of us a course they had developed for all third year pupils. It involved, among other things, an introduction to programming in BASIC, using the ZX81. It suddenly dawned on me that the pupils whom I taught and loved so well were about to gain an insight into a totally new area of knowledge and would be well placed to score some points off Sir.

It obviously behoved me to acquire, not merely some well timed enthusiasm, but some fairly fireproof knowledge, and that right speedily.

Despite, therefore, my complete indifference to the workings of electronic gadgetry and my studious avoidance of all matters mathematical, I cultivated an intense interest in micro-computing. It's amazing what chidren can inspire one to do!

I began by following the same course designed for the third years, and I enjoyed it! I decided I knew how Columbus felt when discovering the New Worlds. I shall never forget the pride I felt when I wrote my first 10 line program. It flashed my name on and off screen continuously and I'd always yearned to see my name in lights.

**With help** and encouragement from the Head of Computing, I quickly became adept with conversational bits and bytes and bugs, and I also learnt a lot. One of the things I learnt was that my non-existent maths *did not matter* to my growing addiction to computing, since there were plenty of aspects to this new learning where logical thinking and hard work were of far greater importance.

This is an eternal truth which doesn't receive enough publicity, in my opinion. Can it be that mathematicians are in a consipiracy to keep it all to themselves?

In recognition of my services in discovering this fact for mankind, two years ago I was seconded to a course at South Bank Polytechnic to study for a Diploma in Professional Studies in Education, (Computing), which is, I think, the only full-time course available to teachers who wish to retrain to teach Computer Studies to O-level, or whose non-computing colleagues can't stand their enthusiasm during break any longer.

*Extract from* Glib Gloss — *the guide to the real meaning of the jargon of everyday computer folk . . .*

***Word Processor***: *Computer salesman in pursuit of a gullible customer.*

At the time, the Manpower Services were paying LEAs a proportion of the wages of teachers accepted for this type of course, which made it easier for people like me to get secondment. This is, sadly, no longer the case. I don't think my secondment had anything to do with the decision . . .

There were twenty-seven teachers on my course, of several varieties, ranging from the completely ignorant to those who knew it all and wanted a bit of paper to prove it. There were Historians, Georgraphers, French and English teachers and a liberal supply of — guess who — mathematicians.

**Undeterred,** we set to with vim and vigour, causing some heartache to the hapless tutors — teaching teachers is a thankless task. They don't take kindly to it, and it is to the tutor's credit that they tried so hard to reassess the course as we went along.

And as we went along, it became apparent that, just as I and others like me struggled with the maths-based sections, so the mathematicians floundered when it came to computer applications, computer effects on society and teaching methods and resources. Some of my best friends are mathematicians, but it was still nice to watch them suffer.

Back at school, after successfully completing the course, I find a large proportion of my timetable devoted to computing in its various aspects. I still have a lot to learn, but the Head of Computing is still talking to me and is very helpful. I share teaching of O-level Computing studies course in the 6th form, and also inflict upon them a Computer Appreciation class, which originated as part of my course work, and I now teach the third year Technology module in programming that started it all. I'm also involved with a BASIC programming course run for local people by the school; so I don't feel that the LBA wasted it's money.

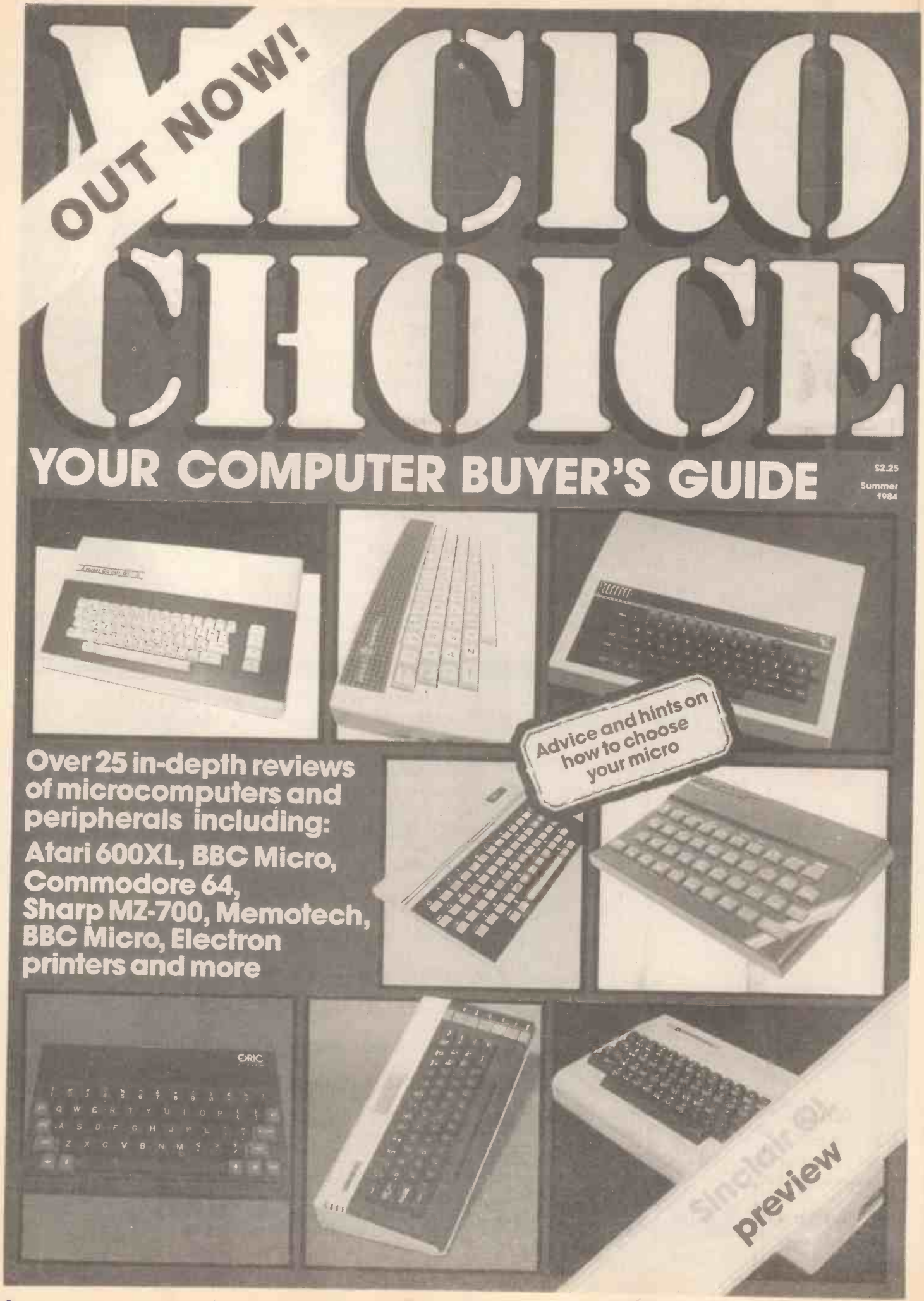
So far as I'm concerned, teaching Computing means being under constant pressure to keep abreast of new developments, new books, new software, not to mention keeping ahead of the third years, and there's no time to relax. It also means a renewed enthusiasm for teaching as a career.

**Computer assisted learning** is now affecting every subject on the curriculum and it is time that certain things were acknowledged. The traditional link between maths and computing should be severed and the micro-computing revolution seen for what it is — an exciting and challenging prospect for Education, and open to teachers of any and every persuasion. As a well-known propagandist might have said, and only just didn't . . .

"Oh Brave New World, that has such people in it; Geographers and all, re-trained for CAL."

*Extract from* Glib Gloss — *the guide to the real meanings of the jargon of everyday computer folk . . .*

***Byte:** Computers do this to hands that feed incorrect information.*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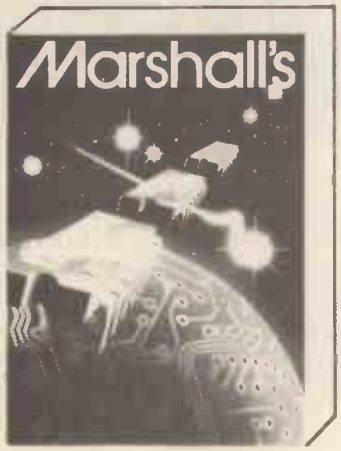


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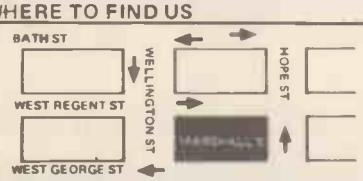


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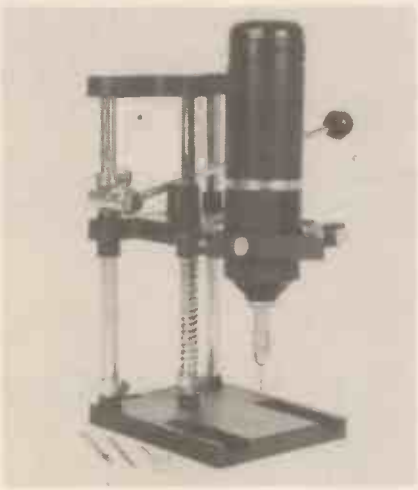

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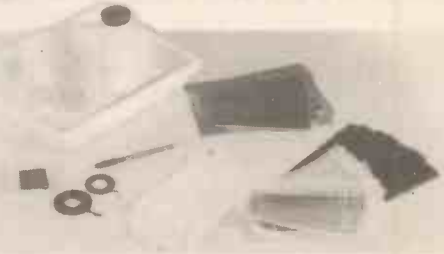

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# ALL ABOUT ELECTRONICS

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Keith Brindley

PART 9 of *All About Electronics*, in the April issue of Hobby Electronics, introduced us to the concept of communications. We saw how a transmission medium, forming a transmission channel between source and receiver, could be used in a number of ways to transmit information of some description.

By dividing up the available resources of the transmission medium we can multiplex many information signals together (from many different sources) at one end of the channel, and demultiplex the signals apart again at the channel's other end.

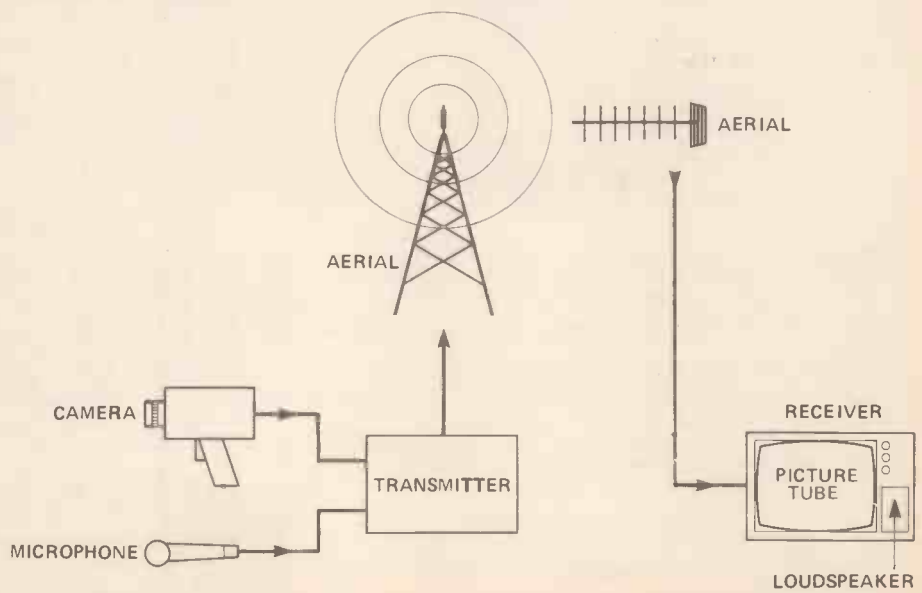
The telecommunications system we looked at quite closely in the April issue was the UK telephone system, which mainly uses cable (either twisted-pair, or coaxial cable) as its transmission medium. Two main types of multiplexing signals onto the cables of the telephone system are used: frequency division multiplexing (FDM) with single sideband amplitude modulation, and time division multiplexing (TDM) with pulse code modulation.

## Transmission Principles

The principles involved in the telephone system with its cable transmission medium are the same principles used in other telecommunications with other media. For example, frequency division multiplexing is the way signals are transmitted in radio systems which use air as the transmission medium. Of course, some of the concepts in radio communications are different to the concepts in telephone communications. Broadcast radio communications are based on the fact that a single radio station transmits signals with a particular carrier frequency over the air, with no single direction. In this way thousands, possibly millions, of people are able to receive the one-way broadcasts if they have a radio receiver. The telephone system in contrast is a point-to-point communications system in which a two-way link is set up between two people. It is important to see the basic difference between the two types of telecommunications systems, because the different purposes which they serve have more or less defined the way each has evolved and also defines how they will evolve in the future.

One of the biggest practical constraints which any system has (whether the system is a telecommunications system, a digital system, or, in fact, a non-electronic system) is cost. If a product is too expensive, that is, more than the customer is prepared to pay, it will not sell. Companies are generally in business to make profits, so a manufacturer will normally make its products with profit in mind — the products must therefore be cheap enough so that the customer is prepared

**Figure 1. A television system, showing a camera and microphone which convert the scene and sound into electric signals which are transmitted as a radio broadcast. The television receiver reconverts the received electric signals back to vision and sound.**



to buy, but also so that the company makes its desired profit. This month we are going to study another classic telecommunications system — television — and we will see how the cost constraints which television faces defines the quality and quantity of the service given to the paying customer.

Television is enormously popular. Nearly every home in the UK has at least one TV set, and a proportion have two or more. This signifies that the price range, within which manufacturers of TVs sell their products, must be acceptable to the majority of people.

Now, TV sets are very complex items of machinery. They are not cheap because they have design, development and production costs, so in order that manufacturers can maintain a reasonable profit margin while pricing their product low enough to allow the customer to buy. TVs are generally made to the minimum acceptable standards. This minimum standard is largely governed by the customer, because it is the customer who has to use the TV. It is the customer who has the choice in the showroom to look at a selection of TV sets and decide whether the better picture, or higher quality sound of one TV set is worth £X more than another.

Once in a while, a leap in quality is made in TV standards, which although due to the customers' desire for higher quality, is largely out of the customers' control. For instance, the change from 405-line to the present 625-line picture standard, occurring about twenty years ago was such a leap. The addition of colour transmissions and colour TV sets (about fifteen years ago) was another. Future ones look set to be satellite TV broadcasting and cable TV systems; we'll have a look at those next month. Again, however, it is the customer who in the end pays for the increased quality.

## TV Standards

So, what is this minimum acceptable standard? To define it, we need to go back to basics and look at how TV sets work, and how the TV signal is broadcast and received.

Television communications generally, consist of radio transmissions in the ultra-high frequency (UHF) band, between about 470MHz and 940MHz. The total band used is divided up into 8MHz slots or "channels" in which a single TV signal may be transmitted. Radio transmissions at these frequencies are not particularly long distance, covering approximately circular areas of no more than about fifty miles' radius, so by careful positioning of TV transmitters and careful frequency allocation the same transmission frequencies may be used by more than one transmitter throughout the land, without interference problems. We'll see how these 8MHz channels contain all the information required for a TV receiver, ie the customers' TV set to form the picture and sound, as we look at the principles of TV.

The television shown in **Figure 1** shows how the microphone converts the audio information from the scene, say the couple's voices, into electrical signals to be transmitted. The microphone acts as a simple audio-electric transducer, providing an output voltage or current which changes as the audio sounds themselves change. The electrical information the microphone provides is simply an analogue representation of the original sound.

It would be nice if the camera shown in **Figure 1** could in the same way provide a simple analogue representation of the visual scene to be transmitted. Unfortunately, this is just not possible, because the visual scene is a far more complex thing than the audio sound association with it. So, the scene has to be broken down by the camera, into smaller parts which *can* be transmitted by an electrical representation. Each part of the scene is transmitted in a series, such that the TV receiver can display the whole scene on the picture tube at the same time as the associated sound analogue electrical signal is converted by the loudspeaker back into sound.

Of course, all of this serial information which represents the visual scene has to be transmitted in a co-ordinated way, to allow the TV receiver to display it all, in the correct position, on the picture tube. This is done by scanning the total scene to be transmitted, dividing it up into an number of lines, and then transmitting the information relating to the amount of light in each line (the luminance signal). The UK television system divides the scene into 625 lines, but other systems use a different number of lines, eg the American television system has 525 lines, the French 819 lines. When each line has been scanned, and the whole scene has been transmitted, the procedure is started again, so that the transmission is a never-ending cycle of scanned lines, each 625-line cycle corresponding to transmission of a complete scene.

At the receiver, these individual lines are each displayed separately on the screen of the picture tube to make up the whole scene again, for the viewer to look at.

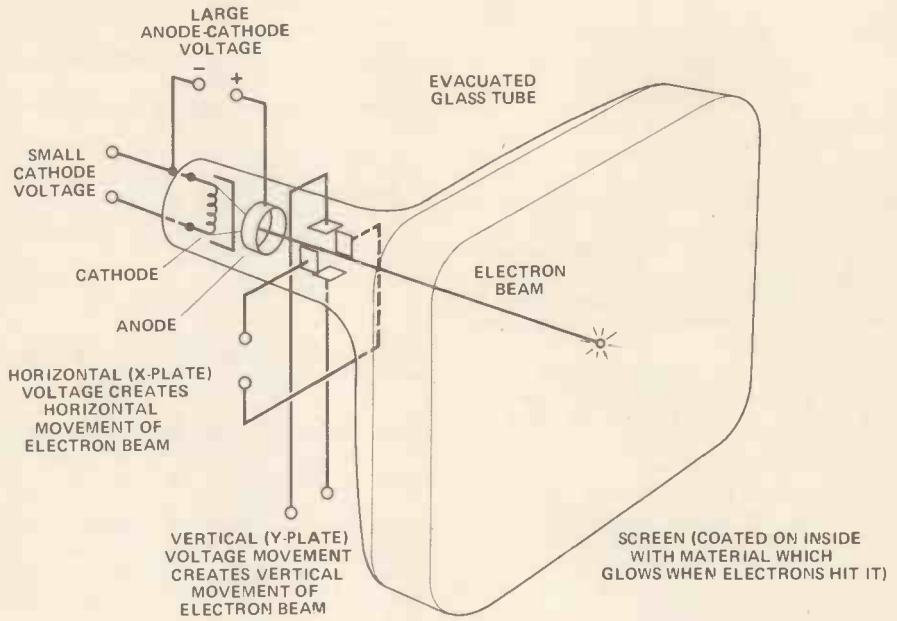



**Figure 2. A cathode ray tube (CRT) which displays television pictures by controlling the brightness of an electron beam as it is scanned over the screen.**

## Only An Illusion

Even from this simple explanation it is obvious that the whole process of transmitting and receiving TV pictures relies on the couple of basic optical illusions:

- The eye cannot focus accurately enough on the displayed picture to see that it is composed of 625 individual lines. This optical illusion is also used quite effectively to print photographs in publications (like Hobby Electronics) where the photograph is divided up before printing into literally thousands of tiny dots. The size of the dots when printed defines which areas of the photograph are dark (large dots) and which areas are light (small dots). As long as the picture is quite acceptable, because the eye cannot detect each line (or dot) individually.

- The eye cannot detect rapid changes between similar scenes. If each scene of 625 lines is displayed for just a small time on the TV picture tube, before being replaced by a new 625-line scene, the eye is unable to detect the fact that separate scenes are being displayed. This effect, known as the "persistence of vision", is also used in the cinema where rapid successions of individual film frames are projected onto the cinema screen.

Knowing these optical illusions, we are now in a position to calculate the minimum standard of picture quality

that can be used by a television communications system to give acceptable quality to the consumer.

First, let's start with the minimum number of lines required. If we remember that, in most cases, a viewer sits at an approximate distance of five times the screen size from the television, then we can use this as a convenient starting point. This 5x rule is, however, only a guideline, and factors such as room size, viewers' vision and even hearing can affect a viewers' subjective position in relation to the television.

A typical TV picture tube size (measured diagonally) is 600mm, so the 5x distance is 3m from the TV. Now at this distance a human eye with 'reasonable' vision (another subjective factor) can just detect between two dark lines separated by a distance of 0.6mm.

Now, a diagonal picture tube size of 600mm means that the tube height is 360mm (measure it yourself if you don't believe it!). So, if a 360mm high picture tube is viewed there must be:

$$\frac{360}{0.6} = 600 \text{ lines}$$

on tube to enable an acceptable picture. With a similarity too close to be coincidental, the UK television system is based on a 625-line picture.

## Flicker

The required repetition rate, or picture frequency, of the scene displayed on the television tube is just as subjective as the required line number. It depends not on the viewer but also on the brightness of the displayed picture — the brighter the picture, the more noticeable the flicker between individually displayed scenes.

Over the brightness range which modern television picture tubes are capable of, flicker is just about noticeable at a frequency of approximately sixty pictures a second. So, it would seem that sixty pictures a second is just about the minimum acceptable number we should use in our television system. But, this leaves us with one problem — the UK mains frequency is 50Hz, which causes interference with the ideal 60Hz picture frequency. The interference would manifest itself as an irritating flashing on the television picture tube at the difference frequency of 10Hz. It is caused because the power supplies generally used within television receivers are not complex circuits and do not produce stabilized (ie level) DC voltages. Instead, quite significant ripple voltages occur naturally at 50Hz on the DC voltages used within the receiving circuits. These ripples, and therefore the interference could be reduced electronically to an insignificant level if more complex, stabilising power supply circuits were used. But, such power supply circuits would be correspondingly more expensive — and this would defeat the aim of producing a television receiver which is as cheap as possible. So, the frequency difference between mains and picture frequencies is reduced instead: and, in fact, the picture frequency in the UK and throughout Europe is equal to the mains frequency — 50Hz. The result of this lowering of standards is that the viewing brightness must be also reduced to maintain a flicker-free picture.

It is interesting to note that the acceptable quality picture brightness of North American television receivers is higher than that of European receivers because, like our system, the picture frequency has been set at mains frequency, but the North American mains frequency is 60Hz!

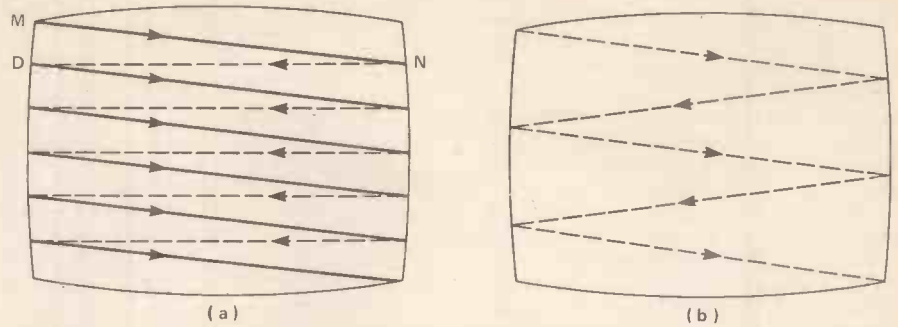



**Figure 3. A possible scanning pattern, known as a raster, of the lines and field of a television system.**

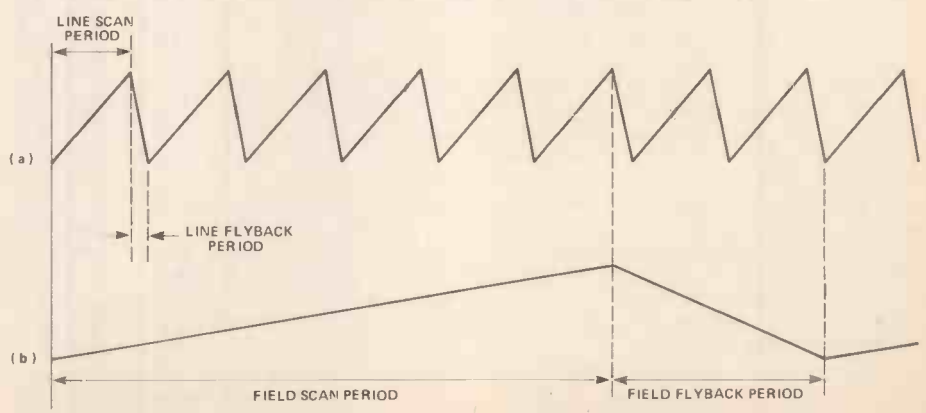
## Cathode Ray Tube

Now that we have defined the minimum acceptable quality picture for a television system, we find that it corresponds closely to the existing UK system, we can begin to look at just exactly how this picture is transmitted, received and displayed. Picture display is straightforward and is undertaken on the screen of a cathode ray tube (CRT). A CRT of a monochromatic television receiver is shown in **Figure 2**. It is formed essentially by an evacuated glass tube. At the narrow end is a cathode, heated by a small voltage, which gives off electrons. The electrons, being negatively charged, are attached to the positively biased anode. As the electrons move towards the anode, their velocity builds up so that they are travelling fast enough to go right through the anode and carry on as an electron beam which hits the CRT screen. The screen is coated with material which gives off light as the electron beam hits it.

Varying the number of electrons allowed through the anode to the screen by, say, varying the anode biasing voltage, varies the amount of light at the screen. So the brightness of the light may be controlled, electronically, by increasing or decreasing the anode bias voltage. Biasing voltages applied to the x- and y-plates of the CRT attract or repel the electron beam to or from the plates — bending the beam in horizontal and vertical directions — so that its position as it hits the screen can be altered. By varying the plate voltages in a logical and controlled manner, the beam can be made to scan the screen, and a possible way is shown in **Figure 3**. Here a pattern of six lines is shown, starting at the top left hand corner. The complete line pattern is known as a raster. If we imagine the raster to be contained within x- and y-axes of a graph then the motion in the x-axis direction (ie, horizontally) is known as the line scan, and the motion in the y-axis direction (ie, vertically) is the field scan. Another way of controlling the beam is with the use of coils which, when energised with an applied voltage, can deflect the beam.

The line scan of the first line, from point M to point N, corresponds to the first line of the picture, and the brightness of line varies in accordance with the received signal of the first scanned line from the camera. The line scan from point N to point O is known as a line flyback. This occurs much more rapidly than the left-to-right scan and, in fact, the display is blanked (with say a low anode voltage) during flyback so

**Figure 4. Line scan and field scan voltages at the x- and y-plates of a CRT.**



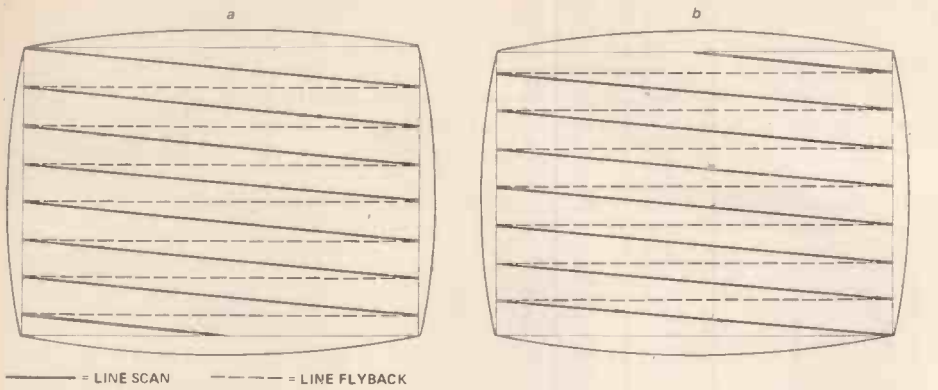



Figure 5a) the odd field of the UK 625-line television system b) the corresponding even field.

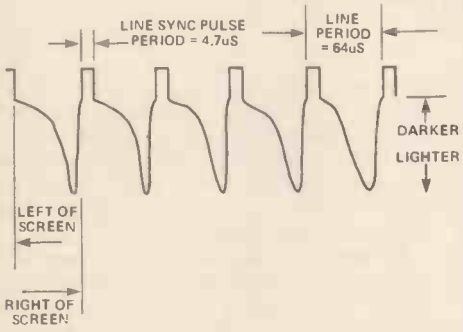



Figure 7.Video waveform showing five line periods, with line sync pulses of 4.7 us duration and varying luminance signals.

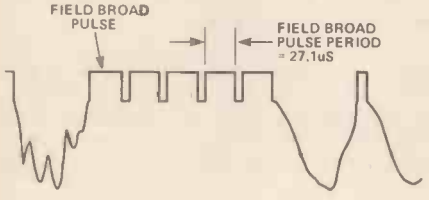



Figure 8. Video waveform showing five field broad pulses of 27.1 us duration, used to reset the field sync.

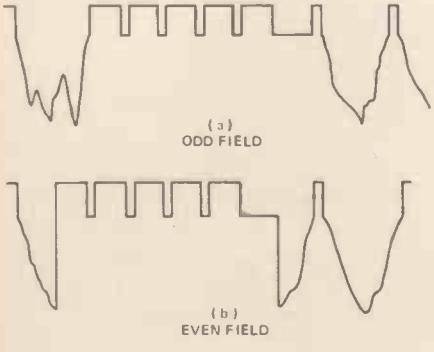



Figure 9. Showing the difference between positioning of field broad pulses in a) the odd field, and b) the even field.

that we cannot see it (this is shown by the broken lines). From then on, lines 2 3, 4, and 5 are scanned, with flyback, until the left-to-right scan of 6 has ended, at point P. The scan now has to return to the beginning of the raster to start again. The field flyback (**Figure 3b**) accomplishes this, during which there are two complete blanked line scans.

**Figure 4** shows the voltages at the horizontal and vertical (x and y) deflection plates of the CRT to produce this raster and you can see the longer left-to-right line scan period than the right-to-left line flyback period (**Figure 4a**). Similarly, the longer field scan period can be seen, compared with the field flyback, in **Figure 4b**.

The complete UK television system raster is, of course, more complex than this example but nevertheless is based on the same idea. **Figure 5** shows the principle of the complete raster. These are, as we know, a total of 625 lines per raster, but these are split into two separate fields of 312.5 lines each. The odd field (lines 1, 3, 5, 7 etc.) is shown in **Figure 5a**, while the even field (lines 2, 4, 6, 8 etc.) is shown in **Figure 5b**. These two fields are interlaced on the CRT screen to produce the single raster, as shown on **Figure 6**. In this way, the UK television system maintains a field frequency of 50Hz but the actual picture frequency (ie, two fields) is 25Hz. Because there are 625 lines per picture the line frequency is 15,625Hz (ie, 625 x 25).

## Everything But The Kitchen Sync

Obviously, the transmission and reception of television picture signals requires that the TV receiver is in time with the transmitter. The first line of the displayed scene (ie, the top line on the picture tube) must be the first line of the transmitted one; likewise the one hundredth line must be the same; and so must the six hundred and twenty-fifth. If this wasn't so the picture would be at best displayed half-on, half-off the tube; at worst it would be an incomprehensible jumble of uncoordinated lines.

This timing and coordination of each line is done by transmitting special synchronising signals with the luminance signal of each line. These sync

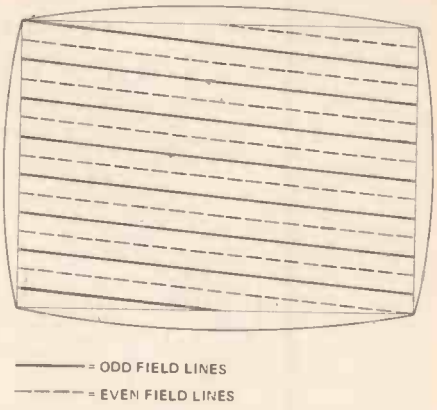



Figure 6. A single raster of lines, used in the UK 625-line television system, composed of two separate fields.

pulses are detected by the TV receiver which 'locks on' to the transmitted signal and displays the correct scene.

Now, to display the line, in sync, so that a correct scene may be made on the CRT screen, the sync pulses have to contain the following information which the receiver decodes and uses to control the electron beam of the CRT:

- when an line starts and ends
- where a field starts and ends
- which field it is

**Figure 7** shows a section of five line periods which illustrates how the luminance signal of each line varies (the lower the luminance signal voltage the brighter the electron beam's spot on the CRT screen). By observing the shape of each line's luminance signal we can see that in this example the left hand half of the screen is darker than the right hand side — at least over five lines shown. In between each line's luminance signal is a line sync pulse which is used within the receiver to set the beginning and end of each of the saw tooth line scans of **Figure 4a**. The dimensions of these line sync pulses are strictly maintained so that if the receiver 'sees' a sync pulse of 4.7us duration, it must be a line sync pulse.

A field sync pulse, however, has a duration of 27.1us, and is generally known as a field broad pulses might be used to synchronise field scanning is shown in **Figure 8**. Because the line signal is blanked during the field flyback, no luminance signal is shown over the five field broad pulses, corresponding to two and a half line periods. When the receiver detects the 2.71 sync pulses, the field scan saw-tooth waveform (**Figure 4b**) is ended, and a new sawtooth is signal is started.

The receiver can differentiate between odd and even fields, by making use of the fact that an odd field starts at the beginning of its first line, while the even field starts half way through a line. The difference in signal waveforms at the end of each field is apparent in **Figure 9**.

The final waveform, actually used in

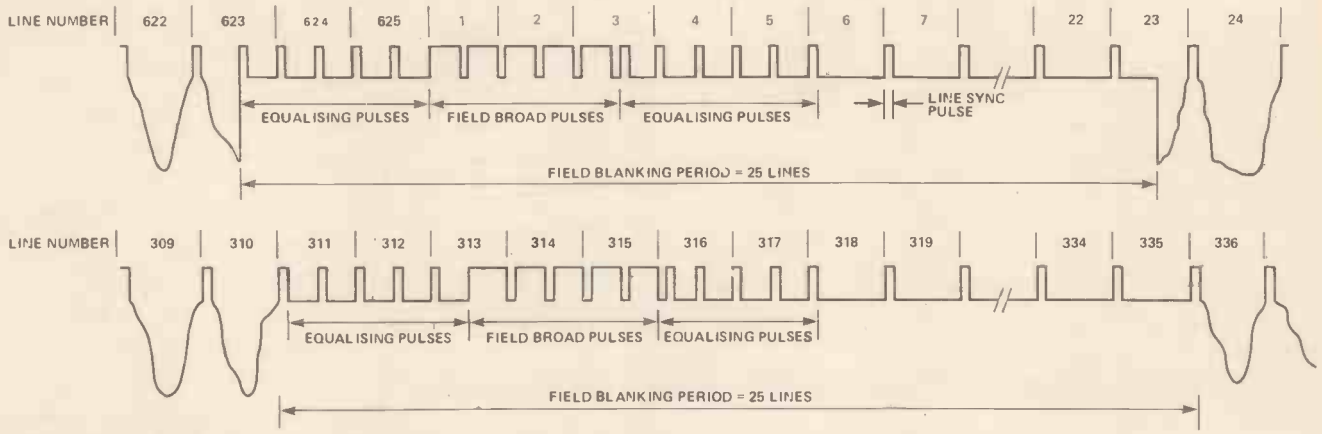



**Figure 10. Video waveform of the UK 625-line television system, showing blanked lines per field.**

the UK television system, is somewhat different to this however, because many more lines, apart from the two and a half periods of the field broad pulses, are blanked. The UK television system in fact allows for up to twenty-five blanked lines out of each field. So, in any one picture, only 575 lines may be active. A set of typical line and field sync pulses is shown in **Figure 10** for both odd and even fields.

## Sound, Lights, Action

We're in a position now to see how the complete television signal sound, luminance and sync, is transmitted over the 8MHz channels. Radio broadcasts are used, which are amplitude modulated for the vision signals (including sync pulses), and frequency modulated for the sound signals. A spectrum of the whole signal is shown in **Figure 11** and it can be seen that the vision signal takes up the majority of the 8MHz channel width (about 7.75MHz); the sound channel takes up only a few kHz, and a guard band, separating each channel, of about 0.25Mhz is included.

The vision signal, although amplitude modulated, is not broadcast using any of the methods we have met previously (double sideband) but another method — vestigal sideband (VSB). **Figure 12** shows a spectrum of a VSB signal in which the broken line indicates how the lower sideband of a complete double sideband signal is made up. VSB is used in television signal broadcasting because a complete double sideband transmission of the vision signal is too wasteful of channel space. A complete double sideband transmission of the required vision signal would require 12MHz of space, but single sideband transmissions, require complex receiver circuits. VSB transmissions however, are not too wasteful of channel space yet simple receiving circuits can demodulate the signal.

A block diagram of all mains parts of a monochrome television receiver is shown in **Figure 13** and possible waveforms at selected points throughout are included. The components involved in each of the blocks and the circuit used are not important, but the functions they perform are.

Finally, we can take a look at the transmission, reception and display of colour television pictures. Colour broadcasts in the UK were first transmitted in comparatively recent times — the USA have had colour television for well over twenty years. The USA colour system does, however, suffer from the problem that the displayed colours do vary with the received signal. The UK, and all European, colour television systems overcame this problem technically and so were worth the wait.

Display of colour picture relies on the fact that the CRT has, not one but three electron beams. Each beam is accurately controlled to fall onto phosphors on the CRT screen which, instead of emitting only white light, emit one of three

**Figure 11. Spectrum of a monochrome broadcast television signal.**

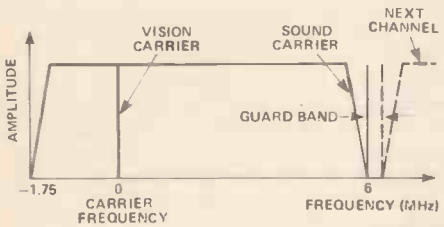



**Figure 12. Spectrum of a vestigial sideband broadcast signal.**

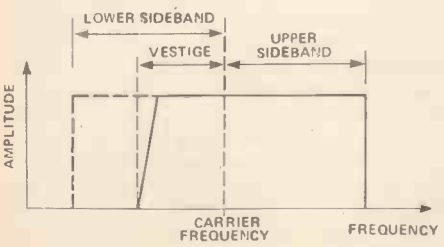
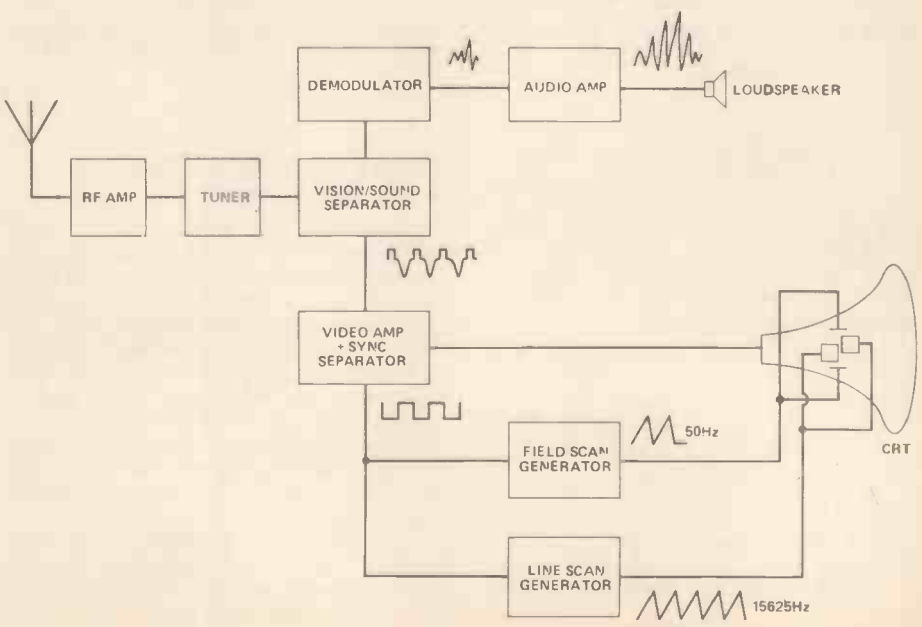



**Figure 13. Block diagram of the main parts of a television receiver.**



different colours. Thus one beam falls only on green parts, one falls only on blue parts and one only on red parts and the three parts will emit coloured light of a strength according to the strength of the three beams.

The phosphors are arranged in strict rotation, ie red, green, blue; red, green, blue, etc., so no one coloured part is adjacent to another part of the same colour.

Red, green and blue are primary colours when emitted from a light source. In combination they can make up any other colour. For example: an equal mixture of red and green produces yellow; an equal mix of red, green and blue produces white. So by controlling the relative strengths of the electron beams hitting the adjacent phosphors on the screen the various colours required can be displayed on the screen.

## Three Parts And One Hole

This whole colour display process, of course, relies totally on the fact that the CRT can be accurately manufactured, with small enough phosphors and controllable electron beams.Generally the groups of three colours, known as triads, are only a millimetre or so across, which gives an idea of the accuracy involved.

To aid correct positioning of each beam onto its coloured part, a metal sheet is positioned inside the CRT, close to the screen. In the sheet are small holes corresponding to the each colour on the triads. As an electron beam is directed at the screen it is allowed to pass only through a single hole in the sheet. Thus only a part of the beam actually passes through to the screen, a "shadow" being formed over the rest of the screen. With accurate positioning of the sheet, and accurate shaping of the holes, each beam can be made to fall only on its allotted colour. The metal sheet is often known as a shadow mask — a usefully descriptive term — and an illustration of a colour CRT is shown in **Figure 14**. In it, the three electron beams, the shadow mask and the triads are clearly seen. The beams from each electron gun is deflected over the screen in the same way as in the monochrome CRT of **Figure 2** ie, with deflecting coils.

To display colour pictures, it is obvious that the control circuitry in a colour television receiver must be correspondingly more complex than that of a monochrome receiver. Not only does a luminance signal (the same as the monochrome luminance signal) have to be generated to control the brightness of the screen (or parts of it) but also chrominance signals which control the various colours on the screen. Transmission of the chrominance signals is no real problem — in the spectrum of **Figure 14** we saw that the vision signal spread from -1.75MHz to +6MHz. Although this is perfectly true, the strength of the vision signal is much lower at high frequencies than at lower frequencies. A more realistic impression of signal powers is shown in **Figure 15**, and you can see the fall in strength above about 3MHz. The UK television system makes use of this fact to broadcast colour chrominance signals, by superimposing them on a second carrier wave, the chrominance subcarrier, which is spaced at a frequency of 4.43MHz above the luminance signal carrier frequency. **Figure 16** shows the possible result of such a combined luminance, chrominance and sound television broadcast signal.

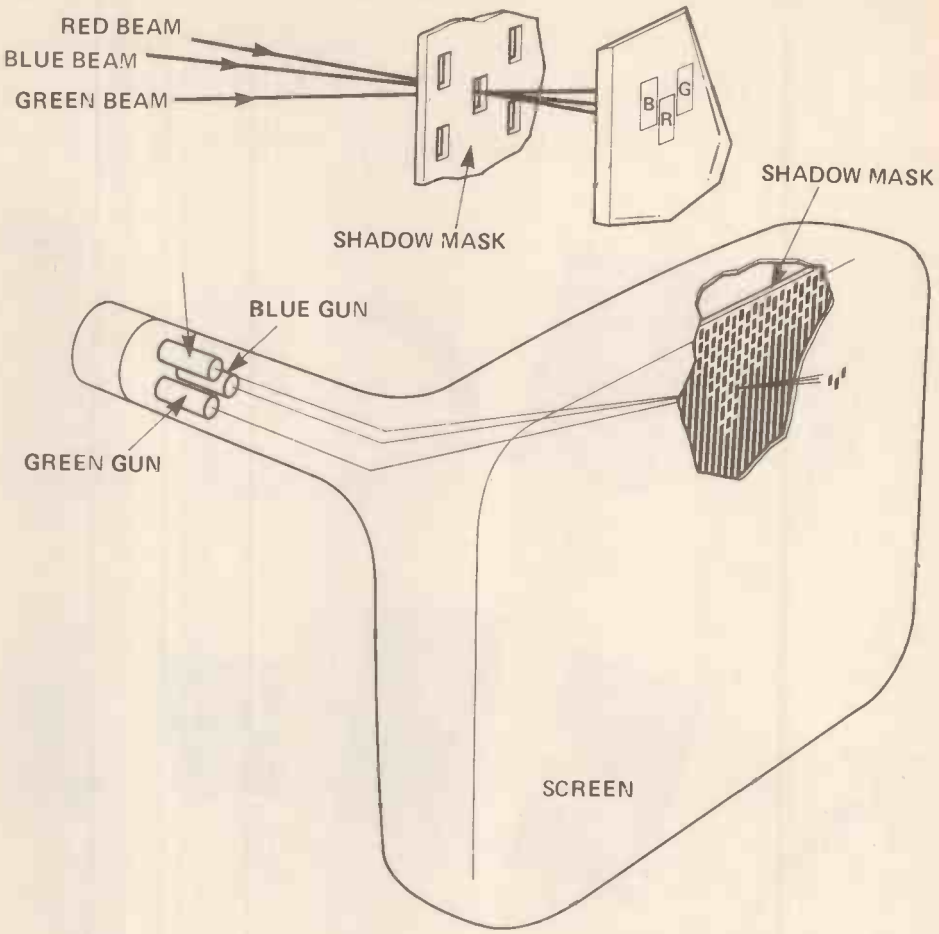
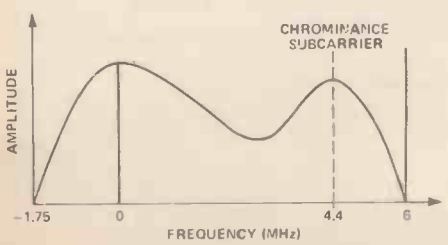



**Figure 14. A colour CRT showing the three electron guns, the shadow mask and the produced triads.**

**Figure 15. A more realistic spectrum of the signal of monochrome television system.**


**Figure 16. A possible spectrum of a colour television system broacast signal, showing luminance, chrominance, and sound carriers.**




## Conclusion

Television systems are not new; they have been with us now, in one form or another, for decades. They have evolved slowly with consumer demands to their present state. What the next step in their evolution is, however, as yet undecided, but will probably be along one or more of three possible directions: cable distribution rather than radio broadcasts; satellite broadcasts; or digital transmissions. We'll take a brief look, among other things, at these next month, in the final part of All About Electronics.

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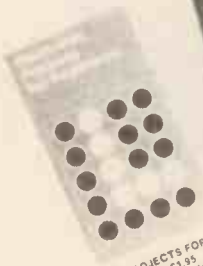

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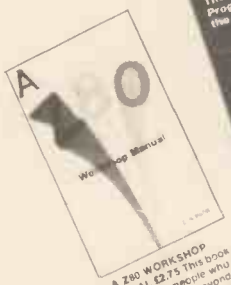


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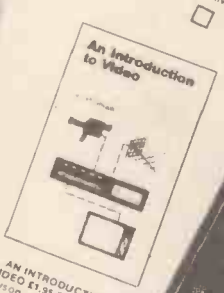


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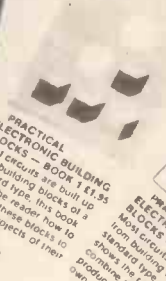

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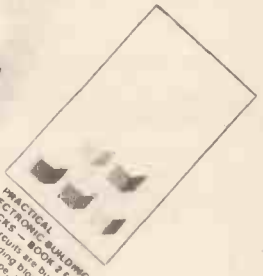

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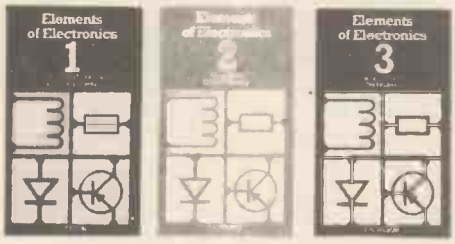



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# Audio Millivoltmeter

**A straightforward millivoltmeter specially well adapted for hobby use, as it is simple to operate, with virtually the same frequency response in each of its three ranges.**

R. A. Penfold

AN audio millivoltmeter is an extremely useful piece of test equipment, especially when used in conjunction with an AF signal generator or function generator, such as the designs featured in recent issues of Hobby Electronics.

An ordinary multimeter switched to a low AC voltage range will often suffice for measurements such as frequency reponse testing and voltage gain measurement, but problems can sometimes arise due to the equipment under test providing an inadequate signal level to give a significant reading on the meter.

This is especially the case when making signal to noise ratio measurements where the noise signal is typically only about two millivolts or less. Also, when testing filters an adequate signal level may be obtained within the passband, but outside the passband the signal may quickly fall to an adequate level, making proper plotting of the filter's response impossible.

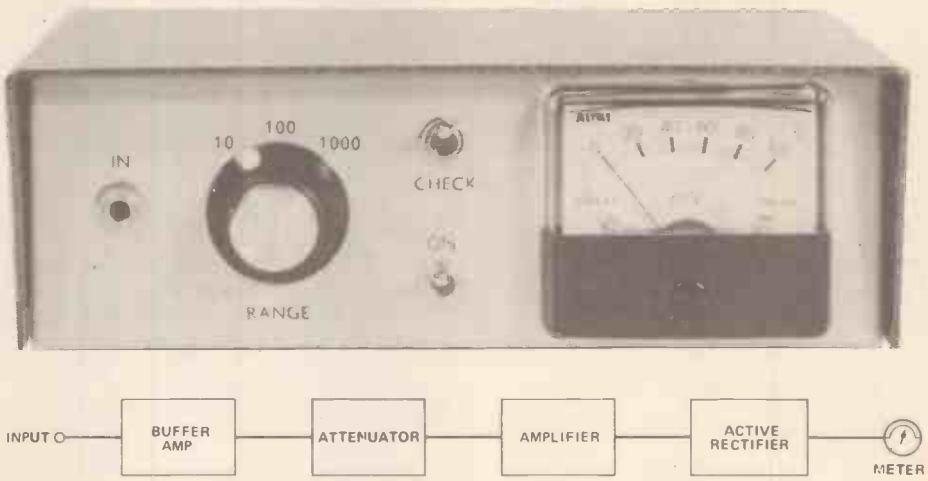



**Figure 1. The block diagram of the Audio Millivoltmeter. This circuit is not quite the simplest form of millivoltmeter available: the circuit has been designed to give first-class performance while avoiding some of the problems associated with simpler circuits.**

## High Sensitivity

An audio millivoltmeter has a much higher level of sensitivity than a multimeter. Whereas the most sensitive AC voltage range of a multimeter is typically about one to five volts for full scale deflection, most millivoltmeters have a full scale sensitivity of only a few millivolts on the lowest range. In fact the more sophisticated instruments have full scale value in the microvolt range, but for amateur use a relatively simple unit such as the one featured here is perfectly adequate.

It has three ranges of 10, 100, and 100 millivolts RMS for full scale deflection, together with a high input impedance of just over one megohm and an upper -3dB point at about 200kHz. The frequency response is virtually flat from 20Hz to 100kHz, and unlike some instruments, there is no significant change in the response from one range to another. The performance figures have been chosen to be adequate for the majority of audio measurements, but by having relatively modest sensitivity and bandwidth figures the circuit is not hyper-critical and prone to instability etc.

## Block Diagram

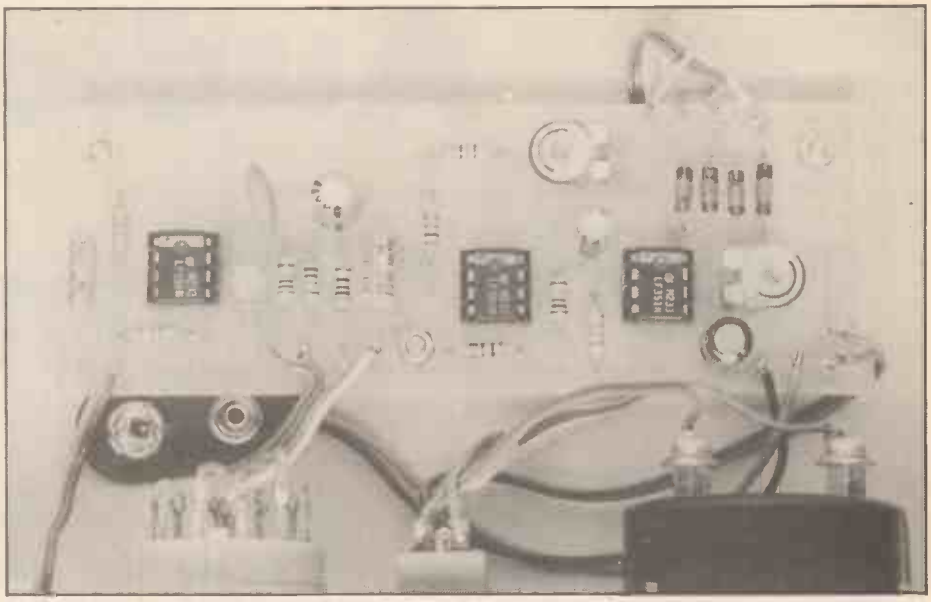
Circuits of this type can be based on a single operational amplifier, but there are disadvantages in such a simple system. One is a reduction in the frequency bandwidth of the circuit, often resulting in an adequate bandwidth when the unit is used on its most sensitive ranges. Circuits of this type are also apt to be relatively unstable and lack good repeatability.

This design uses a slightly more complicated system, but one which gives excellent performance and reliability. **Figure 1** shows the block diagram of the millivolt meter.

## Buffer Amplifier

The buffer amplifier at the input gives the unit its high input impedance. A high input impedance is important as the unit might otherwise significantly load the circuit under test, giving a reduction in the signal level when the meter is connected to the unit, and a misleading reading. The next stage is a three-step attenuator, and this gives the unit its three measuring ranges.

The attenuator is placed in a low impedance part of the circuit so that it does not require any frequency compensation components and setting up. A slight drawback of this system, as opposed to having the attenuator at the input of the unit, is that the input stage has to handle the full input voltage swing. This prevents medium and high voltage ranges from being included, but this is not of great importance since an ordinary multimeter can handle these adequately.

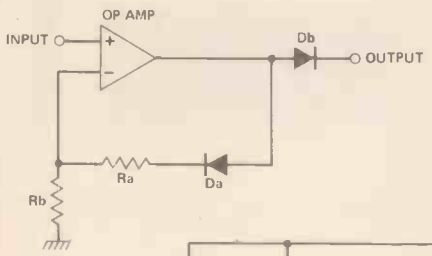


## Voltage Amp

The next stage is a voltage amplifier which brings the signal up to an adequate level to drive the final stage, which is an active rectifier. With most multimeters the meter movement is driven via an ordinary (passive) rectifier circuit, but this is not practical in this application. All practical diodes have severe non-linearity in their forward voltage/current characteristic.

Silicon diodes are the worst offenders, with an extremely high resistance until the forward bias voltage reaches about 0V5 to 0V6. The resistance then rapidly falls to a very low level. This gives non-linear scaling, but with a fairly high full scale deflection voltage sensitivity, the non-linearity is not severe (although it is still severe enough for most multimeters to use separate DC and AC voltage scales).

**Figure 2. The basic half-wave rectifier circuit; the design uses this principle to overcome the non-linearity of the diodes.**




## Active Rectificer

With a full scale deflection sensitivity of only a few millivolts, even allowing for some amplification ahead of the meter, the non-linearity would be extremely pronounced if the most suitable type of diode for this application was to be selected. There are several ways around the problem, but the most practical is to use an active rectifier which utilizes negative feedback to overcome the nonlinearity of the diode

Figure 2 shows the basic circuit of a half wave active rectifier, and this helps to explain the way in which circuits of this general type function.

The circuit is almost a straightforward non-inverting operational amplifier type, and differs from this configuration only in that diode, Da has been included in the negative feedback path, and diode, Db is included in series with the output. With the standard circuit a negative feedback action balances the inverting (–) and non-inverting (+) input voltages.

If, for the sake of this explanation, we assume that Ra and Rb have the same value, in order to maintain the balance, the output of the amplifier must assume a value equal to double the input voltage in order to

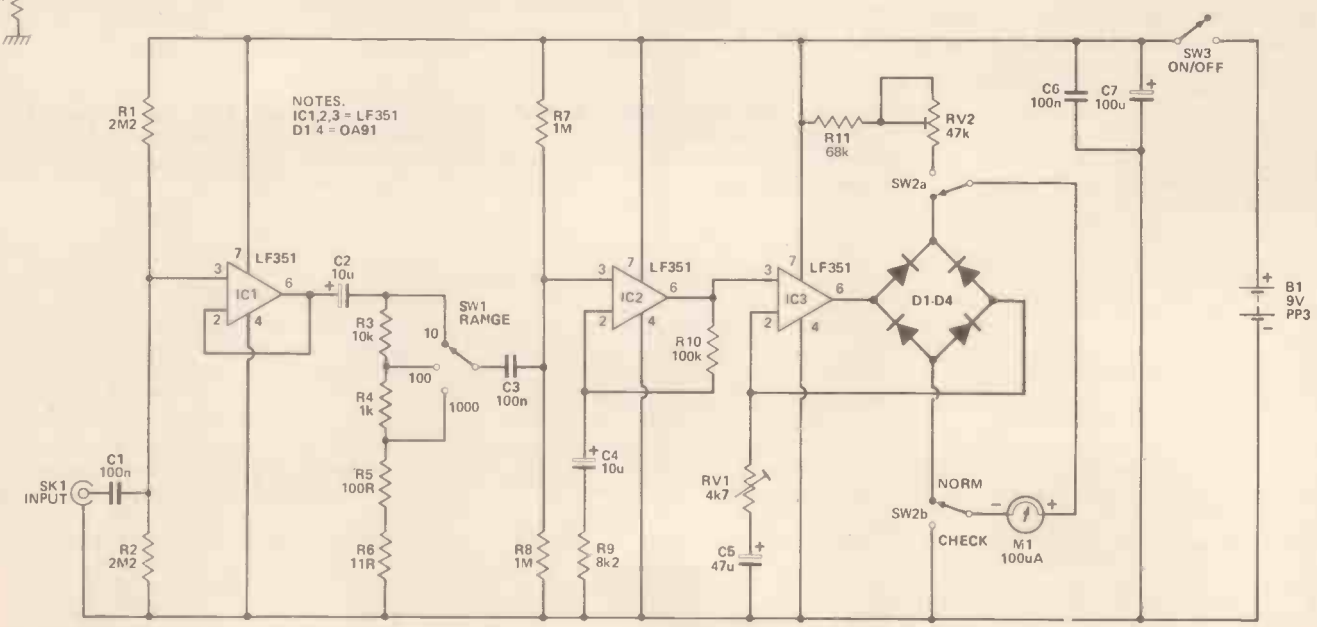



**Figure 3. The circuit of the Audio Millivoltmeter.**

compensate for the voltage drop produced by Ra and Rb.

Things are much the same with the two diodes included in circuit. However, in order to maintain the input voltage balance the output voltage from the operational amplifier has to go to double the input voltage plus the voltage dropped across Da. The output from the circuit as a whole is therefore equal to double the input voltage, plus the voltage drop through Da, minus the voltage drop through Db. In other words, the inclusion of Da boosts the output voltage of the operational amplifier by an amount that compensates for the voltage drop through Db, and effectively eliminates the non-linearity of Db (which provides the rectification).

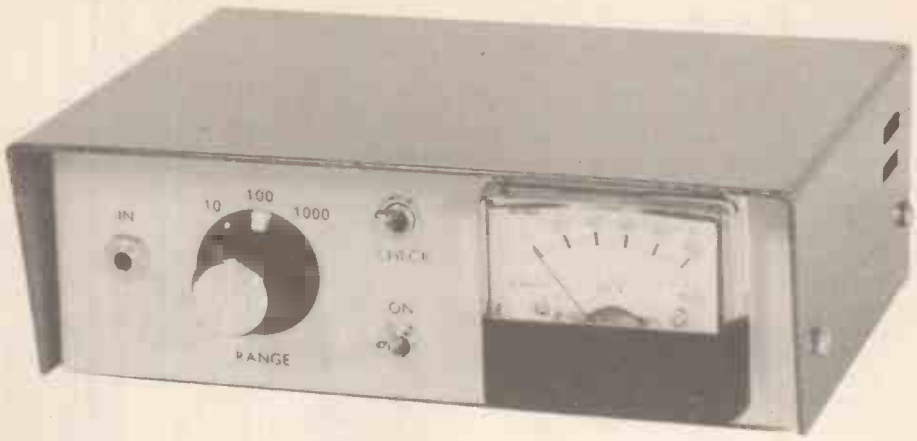
As we shall see shortly, the rectifier circuit used in this circuit is actually somewhat different to the basic half wave type of Figure 2, but it uses the same operating principle.

## Circuit Operation

Figure 3 shows the full circuit diagram of the millivoltmeter. The input buffer stage is a conventional operational amplifier and the non-inverting type.

Resistor R1 plus R2 bias the circuit and have values which give the circuit the required high input impedance. Although at first sight an ordinary 741C operational amplifier may seem adequate for IC1, it must be borne in mind that this stage must be able to handle signals of up to one volt RMS at frequencies of up to about 200kHz or so. The slew rate of the 741C is not adequate for signals having such rapid voltage changes, and a more modern device such as the LF351 therefore has to be used.

Capacitor C2 couples the output of IC1 to a simple three stage decade attenuator. Switch SW1 is used to select the desired output of the attenuator, and this is, of course, the range switch.




The next IC, IC2 is used as the basis of the voltage amplifier, and this is a conventional non-inverting circuit having its voltage gain set at just over 13 times by R9 and R10. Resistors R7 and R8 have been given high values so that the amplifier has a high input impedance, about 500, and does not load the attenuator significantly (which would effectively degrade its accuracy).

## Rectifier Stage

The final IC, IC3 acts as the basis of the active rectifier stage, and this uses the bridge rectifier formed by D1 to D4 to provide full wave rectification for the meter. However, the rectifier is included in the negative feedback circuit of IC3 so that the output voltage of IC3 is modified by an amount that compensates for the voltage drop through the diodes.

Germanium rather than silicon diodes are used in the circuit as germanium types, at the low currents involved here, have a much lower forward voltage drop than silicon types. This does not make much difference to the low frequency performance of the circuit where the amount of negative feedback and slew rate provided by IC3 are more than adequate to cope, but it helps to give improved peformance at high frequencies where these two parameters are barely adequate. The preset RV1 is adjusted to give the circuit the correct sensitivity. The other resistor (Ra in Figure 2) in the negative feedback circuit is the resistance of the meter.

## Power

The circuit has a simple battery check facility, and in the battery check mode, SW2 switches meter M1 across the supply lines via the series resistance of R11 and RV2. Preset, RV2 is adjusted to give the meter a full scale sensitivity of 10V. Power is supplied by a small PP3 size 9 volt battery, and the current consumption of the circuit is only about five milliamps.

## Construction

It is advisable to use a metal case for this project so that the circuit is screened against mains "hum" and other electrical interference. A metal instrument case measuring about 150 x 100 x 50mm is ideal. This assumes that a fairly small meter is used, such

## Parts List

**RESISTORS**
(All ¼ watt 5% unless noted)
R1, 2 ..... 2M2
R3 ..... 10k 0.4 watt 1%
R4 ..... 1k 0.4 watt 1%
R5 ..... 100R 0.4 watt 1%
R5 ..... 100R 0.4 watt 1%
R6 ..... 11R 0.4 watt 1%
R7, 8 ..... 1M
R9 ..... 8k2
R10 ..... 100k
R11 ..... 68k

**POTENTIOMETERS**
RV1 ..... 4k7 0.1W horiz
RV2 ..... 47k 0.1W horiz

**CAPACITORS**
C1, 3 ..... 100n polyester
C2, 4 ..... 10u 25V radial elect
C5 ..... 47u 10V radial elect
C6 ..... 100n ceramic
C7 ..... 100u 10V radial elect

**SEMICONDUCTORS**
IC1, 2, 3 ..... LF351 bifet op amp
D1, 2, 3, 4 ..... 0A91 germanium signal diode

**MISCELLANEOUS**
M1 ..... 100u moving coil panel meter
SW1 ..... 3 way 4 pole rotary switch
SW2 ..... DPDT miniature toggle switch
SW3 ..... SPST miniature toggle switch
SK1 ..... 3.5mm jack socket
B1 ..... 9 volt PP3 size
Metal instrument case 150 x 100 x 50mm; printed circuit board; control knob; battery connector; 6BA or M3 fixings; Veropins; test leads; wire, etc.

BUYLINES ..... page 26

as the 50 x 45 mm type used on the prototype. From the electrical point of view any meter having a full scale sensitivity of 100 microamps should operate properly in the circuit.

The front panel layout can be seen from the photographs, but any sensible layout is suitable. The only awkward point here is the cutout for the meter, and this is 1.5 inches (38mm) in diameter for the usual 60 x 45mm and 50 x 45mm moving coil panel meters.

Assuming that special cutting equipment is not available, probably the easiest way of making the cutout is to clearly mark the perimeter of the required hole on the front panel, and then drill a ring of closely spaced holes of about 3mm to 3.5mm in diameter just inside the marking line. Using a miniature round file the holes are then joined up and the central piece of metal is removed. Then a large half-round file is used to smooth and carefully enlarge the cutout to the correct size. The meter also requires four small diameter mounting holes for its built-in mounting screws. The positions of these on the front panel can easily be marked using the meter itself as a sort of template.

Details of the printed circuit board and wiring are provided in Figure 4.

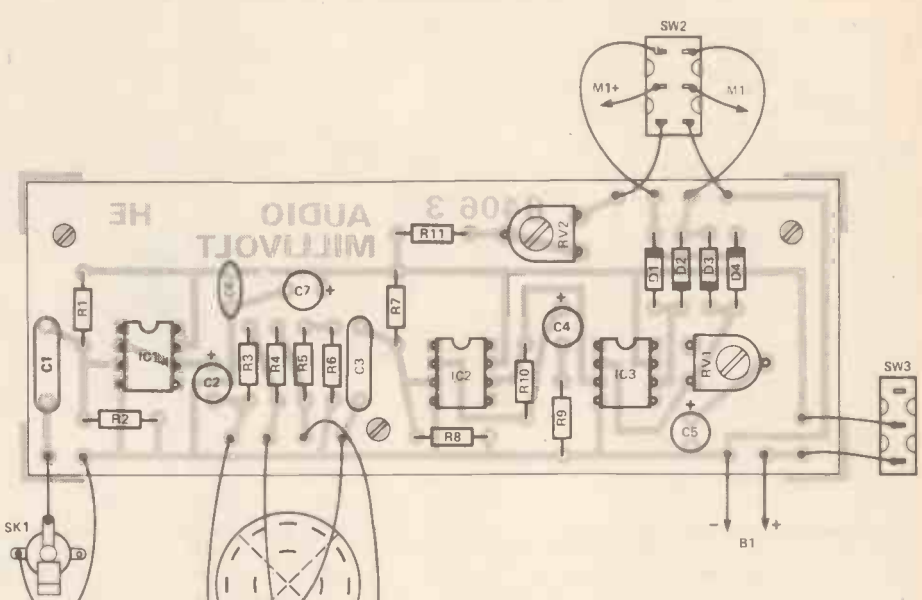
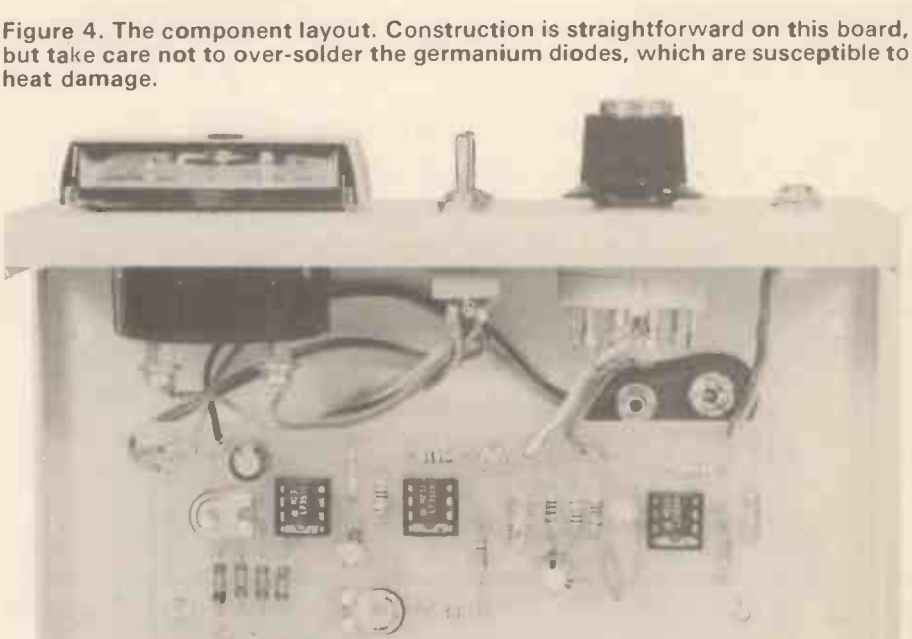



**Figure 4. The component layout. Construction is straightforward on this board, but take care not to over-solder the germanium diodes, which are susceptible to heat damage.**



## Watch Your Soldering

The only special point to note when constructing the board is that D1 to D4 are germanium devices, and that these are more easily damaged by overheating than the more common silicon devices. Therefore, when connecting these to the board take care not to leave the soldering iron on each joint any longer than is absolutely necessary.

Fit Veropins to the board at the positions where connections to SK1 and the controls will be made, and then mount the board on the base panel of the case using 6BA or M3 fixings. These must include spacers about 6mm long to hold the connections on the underside of the board away from the metal case.

To complete the unit, the wiring is added, and this is all completed using ordinary PVC insulated connecting wire. Keep the leads from SK1 to the board reasonably short and direct, and well away from IC2 and IC3.

## Adjustment

Start with RV1 and RV2 both adjusted fully anticlockwise. With SW2 set to the "check" position and the unit switched on there should be a substantial deflection of the meter. Use a multimeter set to a suitable DC voltage to measure the battery voltage, and then adjust RV2 for a corresponding reading on M1. The battery should be replaced when its voltage falls to about 7V5 to 8V.

In order to adjust RV1, first set the unit to the "normal" mode. Incidentally, do not worry if there is a strong but brief deflection of the meter when the unit switch on in the "normal" mode. This is just caused by the capacitors in the circuit taking up their working charges, and nothing in the circuit will come to any harm.

With an audio sinewave input signal of known amplitude and within the measuring range of the unit connected to the input, set SW1 to a suitable range and then adjust RV1 for the correct reading. If only a limited amount of test gear is available it might be difficult to obtain a suitable reference level. The easiest solution to the problem is probably to use an ordinary multimeter set to a low AC voltage range to monitor the output of the signal generator, and adjust the generator for an output of one volt RMS. Most multimeters provide good accuracy at AC voltages of around one volt, and this should give a one volt calibration signal of adequate accuracy.

In use, a set of leads is required, and this consists of a screened lead about one metre long with the inner conductor terminated in a test prod. A second test prod connects to the outer braiding via an ordinary insulated lead about 150mm in length. Of course, the other end of the cable is fitted with a 3.5mm jack plug to match SK1.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# FORWARD BIAS

## Questions, answers and errata from readers and writers.

Only one, very small error to report from HE April '84: on page 17, under the heading "More About Tuned Circuits", in the final column, the sentance "A nanohenry + $10_2{}^9$ henries" should read "A nanohenry = $10^{-9}$ henries". As errata come, you can't get a lot smaller than that . . .

Next, a report and query from a reader:

**Re: Low Power Pilot Light**
**HE September '81**
*Dear Sir/Madam,*
*With regard to the above project, I have found the following errors: 1) In Figure 1 and Figure 2 (overlay) the LED 1 connection annotations are reversed (C and A).*
*2) In Figure 2, C1 positive should go to Veroboard D8, not C8.*
*3) In two of the Pilot Lights constructed did not operate properly. The LED stayed on permanently and did not flash. I found that inserting a 470R resistor in series with the* +9V power line corrected this. Could you explain why?
4) Are there any more errors regarding this project?

Yours faithfully,
J. S. Runacre,
Sittingbourne,
Kent.

Thanks to Mr. Runacre. No, there are no other errata reported for this project; the errata have almost certainly been reprinted at some stage, but as we don't have an index of errata, I can't tell you when. They will be reappear in due course when FB gets to September '81.

The cause of the problem is probably the tolerances of the components in the two models you built adding up to the "wrong direction", causing R3 to malfunction. If you reduce the value of R3 in these models, you should find that the extra 470R resistor becomes unnecessary.

## COLLECTED BOOBS

### Continuing excerpts from the Hobby Electronics Errata Box

### Temperature Controlled Soldering Iron
*(HE October '80)*

In **Figure 2**, ZD1 is shown the wrong way round. If it has been soldered in like this it will almost certainly need replacing.

### Tug Of War
*(HE October '80)*

In **Figure 1** R20 should be 2k2, not 8k2.

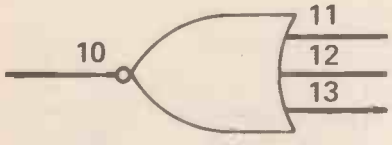
In **Figure 2**, pin 4 of IC3 should be connected to R19. Part of the PCB is missing, and should be replaced with tinned copper wire.

### Kitchen Timer
*(HE October '80)*

In the **Circuit Diagram** and **Parts List**, R17 should be 3k9 and not 82k.

### Double Dice
*(HE November '80)*

In **Figure 2**, the pin numbers for ICs 2c and 4c are wrong. The correct pin-outs are:




The connections on the PCB are correct.

### Guitar Preamp
*(HE November '80)*

In **Figure 1**, C7 should be 22uF tantalum as shown in the Parts List.

In **Figure 2**, there should be a track break at J8.

In **Figure 3**, the screen of the lead from C10/RV3 (volume) should be connected to H14 (the earth track).

### Bench Amplifier
*(HE January '81)*

In **Figure 2**, the power connections to the Veroboard should be reversed, ie + goes via SW1 to Veroboard point 23H, and goes directly to Veroboard point 24F–.

The Q1 connections should be: emitter to Veroboard Point E2, collector to Veroboard point G2 and base to Veroboard point F1, ie the transistor is moved down one hole.

### Sound-Into-Light Module
*(HE January '81)*

In **Figure 5**, the Veroboard track should be broken underneath C5, eg at B25. Pins 6 and 7 of IC1 should be linked together.

### Heartbeat Monitor
*(HE February '81)*

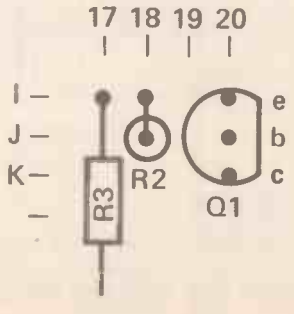
In **Figure 2**, the off-board 100k resistor is incorrect. Instead, with reference to Figure 2, the right-hand signal generator input should be connected to C6 where the 100k resistor is now connected, and a cable link should be made from this point round to the – connection of the battery on the PCB. (This is only for test purposes.)

### Hi-Z Voltmeter
*(HE February '81)*

On **Figure 2**, the three connections (to pin 5) at F10, F11 and F13 should be moved up to the next track (pin 6) (E10, E11 and E13 respectively). There should be a track cut at G16.

### Public Address Amplifier
*(HE March '81)*

In **Figure 2**, R3 (top connection), R2 and Q1 should be moved down one row on the Veroboard, as shown:

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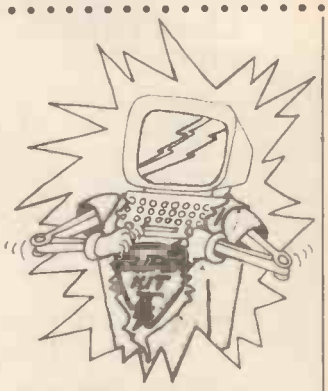

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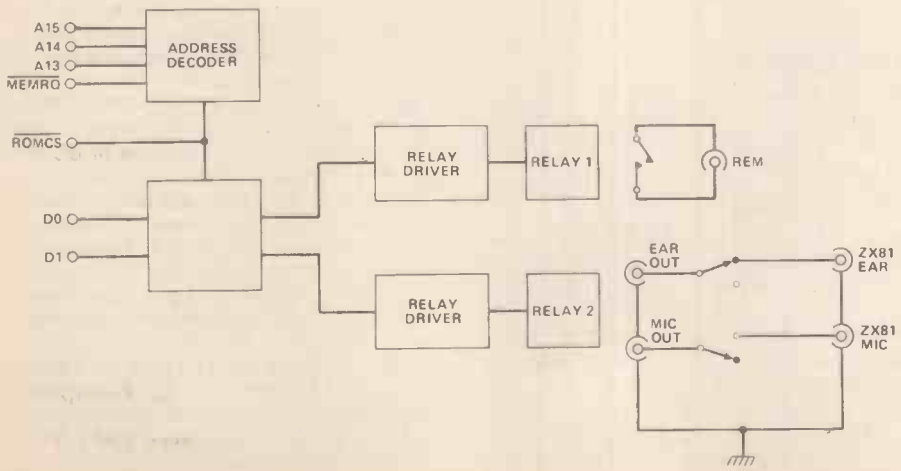
# ZX 81 Microphone Connector

**This twin relay output port for the ZX81 gives the computer more control over a cassette recorder via the cassette interface, and avoids feedback problems in loading and saving data. It has other uses, too.**

R. A. Penfold


Figure 1. The block diagram, showing the twin relays and the connections to the earphone and microphone sockets.




ALTHOUGH the ZX81's cassette interface has received at least its fair share of criticism, if used correctly with a cassette recorder and tape of reasonable quality it provides fairly reliable saving and loading. However, in some respects this interface is quite crude, and it does not provide any form of tape motor control.

Futhermore, with most recorders problems with feedback arise if the equipment is used with both the earphone and microphone leads connected at once. In order to overcome this it is necessary to connect only the lead actually in use. This makes the ZX81 cassette interface a little awkward to use, especially when saving programs, which is when the absence of any automatic motor control is most noticeable.

## Controller Operation

This project is basically just a twin relay output port for the ZX81, and it is primarily intended as an aid to loading and saving, although it can be used in many other ZX81 applications which require a twin relay port. The block diagram of **Figure 1** helps to explain the way in which the system operates.

If we consider the relay switching first, one of the relays has a single make contact which is used to activate the motor of the cassette recorder. The other relay has double pole changeover contacts, and these are arranged so that normally the earphone socket of the recorder is connected through to the "Ear" socket of the ZX81, but the microphone socket of the recorder is disconnected from the "Mic" socket of the ZX81.

In order to load a program it is just a matter of activating relay 1 so that

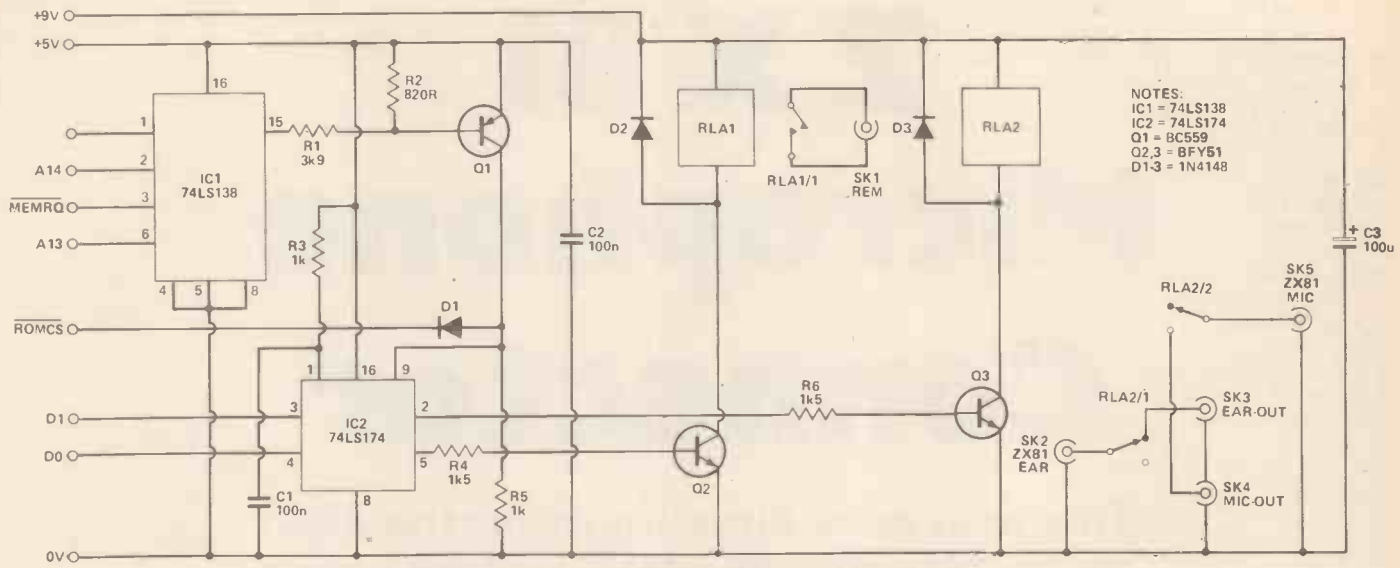



Figure 2. The Circuit Diagram of the ZX81 Tape Controller. Power is supplied by the computer.

## Parts List

**RESISTORS**
(All ¼W 5% carbon)

R1 ..... 3k9
R2 ..... 820R
R3, 5 ..... 1k
R4, 6 ..... 1k5

**CAPACITORS**

C1 ..... 100n polyester
C2 ..... 100n ceramic
C3 ..... 100u 16V radial electro

**SEMICONDUCTORS**

IC1 ..... 74LS138 3-to-8 line decoder
IC2 ..... 74LS174 hex D-type flip/flop
D1, 2, 3 ..... 1N4148 silicon signal diode
Q1 ..... BC559 silicon PNP
Q2, 3 ..... BFY51 silicon NPN

**MISCELLANEOUS**

SK1 ..... 2.5mm jack socket
SK2, 3, 4, 5 ..... 3.5mm jack socket
RLA1 ..... 12 volt 300 ohm coil SPDT contacts
RLA2 ..... 12 volt 300 ohm coil DPDT contacts

Printed circuit board; plastic case, about 150 x 80 x 50mm; ZX81 edge connector and 10-way ribbon cable; two 16-pin DIL IC sockets; Veropins, wire, etc.

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

The relays are:- Maplin YX94C and YX95D.

the motor in the recorder is switched on, and then switching this relay off again once the program has been successfully loaded. In order to save a program both relays must be switched on, and then off again once the program has been saved. No plugging and unplugging of the microphone and earphone leads is needed as this is effectively done by relay 2.

The circuit which drives the relays is a fairly conventional ZX81 2-bit output port. An address decoder circuit decodes only lines A13 to A15, plus the MEMRQ line so that the port is placed in the ZX81's memory map rather than in its input/output map. This is done simply because ZX81 BASIC language does not include IN and OUT instructions, and input/output devices can only be operated from BASIC using PEEK and POKE in conjunction with memory mapping.

The decoded output is used to control two data latches which are fed from lines D0 and D1 of the data bus. The latched outputs drive the relays via conventional single transistor relay drivers. The address decoder is also used to disable the ZX81's ROM which would otherwise interfere with the output port.

## The Circuit

Figure 2 shows the full circuit diagram of the ZX81 Tape Controller Unit. The address decoder is based on IC1, which is a 74LS138 three-to-eight line decoder. In this circuit the three address inputs are fed from lines A15, A14, and MEMREQ, while the positive enable input of the device is used to decode A13. IC1 also has two negative enable inputs, but these are not needed in this circuit and are simply connected to the negative supply rail so that they are permanently enabled.

Only output 0 at pin 15 of IC1 is utilized in this design, and this output goes low when A14, A15, and MEMRQ are low and A13 is high. In other words, when any address in the range 8192 to 16383 is accessed.

If it is a positive pulse that is required to operate both the data latches and the ROMCS line, and Q1 is used as an inverter to convert the output of IC1 to a signal of the correct polarity.

The output of Q1 is used to directly drive the clock pulse input of the data latches, but it drives the ROMCS line via diode D1. The reason for disabling the ZX81's ROM is that only partial address decoding is used in the ZX81, and apart from its base addresses, the ROM appears at various address blocks throughout the 64K address range. Taking the ROMCS line high disables the ROM, so that an address block occupied by one of these "ROM echoes" can be used for other devices.

However, internal circuits of the ZX81 operate the ROMCS line, and must not be prevented from doing so by external circuits, or the computer will "crash". D1 is therefore included in series with the output to the ROMCS line so that Q1 can pull this line high when a suitable address is accessed, but it does not hold it low at other times.

IC2 is the data latch, a 74LS174 device. It is actually a hex D-type flip/flop, but it works well in this application, and the four unused flip/flops are just ignored. R3 and C1 are used to provide a negative reset pulse to the "master reset" terminal at switch-on. This ensures that initially both relays are in the off state.

The relay driver circuits have Q2 and Q3 as standard common emitter switches, with the usual protection diodes (D2 and D3) in their collector circuits. The main circuit is supplied with power by the stabilised 5 volt output of the ZX81. A 5 volt supply is inadequate for most relays, and the non-stabilised 9 volt (nominal) output of the ZX81 is therefore used to

supply the relays and their drivers.

The relay switching circuit is exactly the same as the arrangement outlined in **Figure 1** and described earlier. An important point to note is that neither side of the motor control output (SK1) connects to the earth rail. With most cassette recorders neither of the remote control terminals connect to earth, and connecting either terminal to this rail usually prevents the remote control facility from operating (and could even damage the recovery).

The total current consumption of the circuit is under 100 milliamps, even with both relays switched on, and the ZX81 is readily able to supply a current of this modest magnitude.

## Construction

The plastic case having approximate outside dimensions of 150 by 80 by 50 millimetres is adequate to comfortably accommodate all the components. The suggested front panel layouts can be seen by referring to the photographs.

It is advisable to have the two sockets which connect to the ZX81 well separated from the three which connect to the cassette recorder so that the unit is easily wired into the system without making any errors.

SK1 is a 2.5mm jack, while the other four sockets are 3.5mm jack types. These match the types fitted to the ZX81, and probably those fitted to your recorder as well, but alternative types can of course be fitted if these would be more convenient in use.

As explained previously, neither side of SK1 must be allowed to come into electrical contact with the earth rail. What this means in practice is that either a metal case must not be used, or SK1 must be an insulated type (or insulated from the metal case). In practice it is probably best to use a plastic case and avoid any insulation problems with SK1.

Details of the printed circuit board and the wiring are provided in **Figure 3**. In most respects there are no unusual points when constructing the board, but be very careful to connect the three diodes with the correct polarity, especially D2 and D3. Also make sure that the other semiconductors and C3 are fitted the right way round.

Provided the relays specified in the components list are used, they will plug straight into the printed circuit board without any difficulty. From the electronic point of view any relay that will operate reliably on a supply potential of about 9 volts, has a coil resistance of around 200 ohms or more, and has suitable contacts is perfectly suitable for use in this project.

The problem with alternative relays is that they are almost certain to be physically different from those used in the prototype, and will not fit onto the board properly unless the track layout is suitable modified. They could be mounted off-board, but this is not a very neat solution and could be

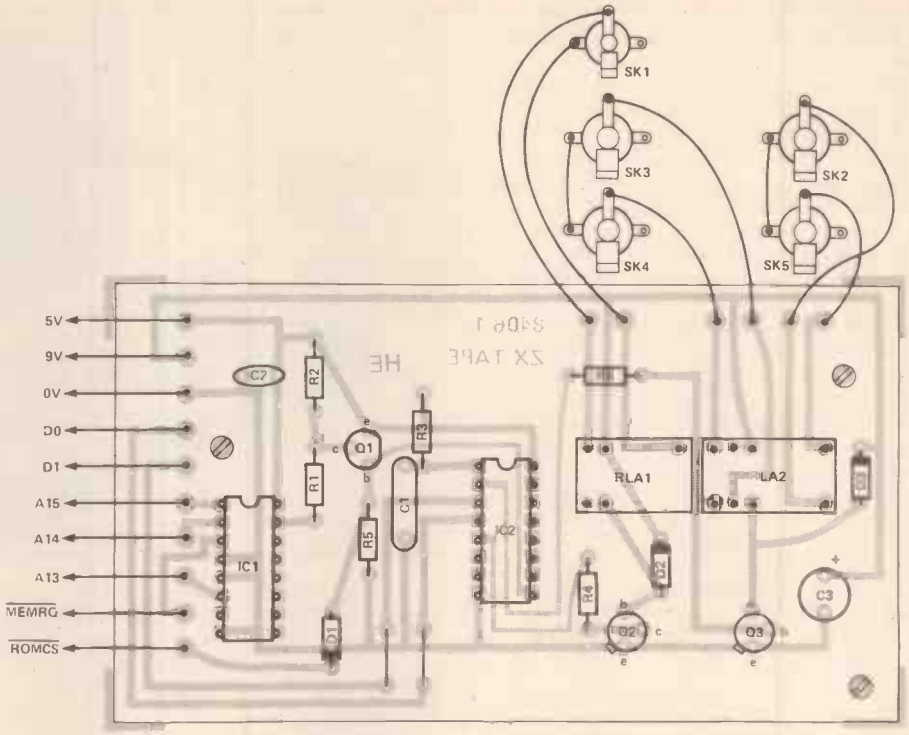



**Figure 3. The component layout. Whereas relays other than those specified will work perfectly well, they may not fit into the layout given. We don't advise using different relays unless you are happy about your ability (and willingness!) to alter the tracks somewhat if necessary.**

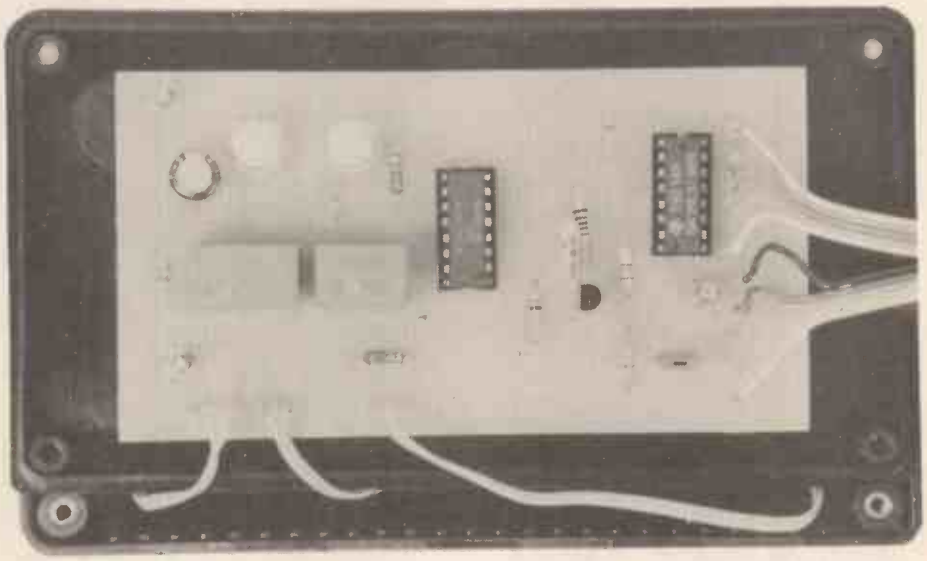
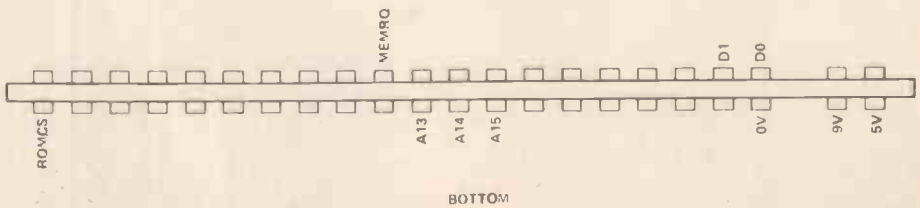


**Figure 4. A close-up of the correct connections from the ten-way ribbon cable to the ZX's edge-connector.**

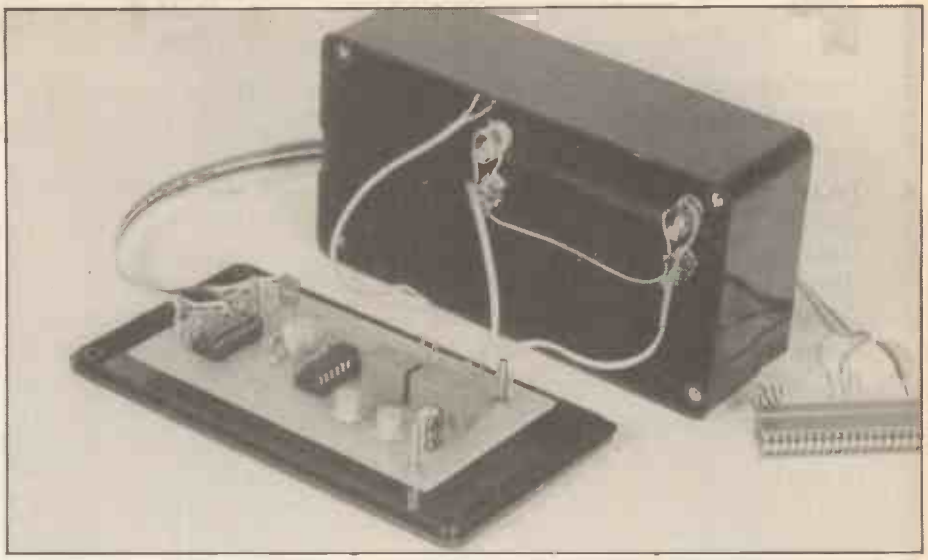


difficult to implement satisfactorily.

For this reason it is much easier to use the specified components, especially for those who have limited experience of electronic project construction.

Fit Veropins to the board at places where connections to the ZX81's edge connector and the sockets will be made. Do not overlook the two link wires just to one side of D1. The completed board is then mounted on the rear panel of the case using M3 or 6BA fixings. The wiring to the sockets is then added using ordinary multi-strand connecting wire.

The connections to the ZX81's edge connector are made using a piece of ten-way ribbon cable about 0.5 metres long and terminated in a ZX81 style 2 by 23 way (plus polarising key) edge connector. Be careful to connect the lead to the edge connector correctly — Figure 4 shows the necessary connections. A cutout for the ribbon cable to pass through is filed in the case at any convenient point.



## In Use

After giving the completed unit a couple of thorough checks, connect it to the ZX81's edge connector and switch on the computer. It should operate normally, and the relays in the controller should not switch on. Typing POKE 9000,3 into the ZX81, then hitting RETURN should result in both relays switching on. Then typing POKE 9000,0 and hitting RETURN should switch them off again.

There should be no difficulty in connecting the unit to the "Ear" and "Mic" sockets of the ZX81, and the leads supplied with the machine can be used. Similarly, the earphone and microphone sockets of the controller connect to the corresponding sockets of the recorder in the same way that the ZX81 originally connected to the recorder.

In order to connect the control output of the controller to the "Control" or "Remote" input of the recorder a lead fitted with two 2.5mm jack plugs will probably be needed. Some cassette recorders use DIN connectors, and you will then need to refer to the handbook for the recorder to determine what type of plug is needed and the correct method of connection.

As the ZX81 cannot have multiple statements, a short program must be used when saving a program (and there must be a small amount of memory left to accommodate this program). The way this is done is to place the tape control program at higher line numbers than the main program.

For instance, if the main program ends at line 3590, the control program could be placed at any lines from 3591 up to the maximum acceptable line number for the ZX81.

The three program lines are shown below (complete with sample line numbers):

```
3600 POKE 9000,3
3700 SAVE "Program Name"
3800 POKE 9000,0
```

The first line switches on the cassette motor and sets the controller to the "save" mode; the next line saves the program; and the last one switches off the motor and sets the controller back to the "load" mode.

To run the control program simply type GOTO followed by the first line number of the control program (ie GOTO 3600) in the above example), and then hit RETURN. This is not quite as cumbersome as it might seem due to the ZX81 keyword system, and it is quite quick and easy in use.

Of course, when the main program is run the control program (which is also saved) is of no consequence as the program never reaches the three line numbers concerned. Remember to have the cassette in the recorder at the point where the program must commence, and to press both the "record" and "play" keys before starting the control program.

When loading a program it is really just a matter of typing:

```
POKE 9000,1
```

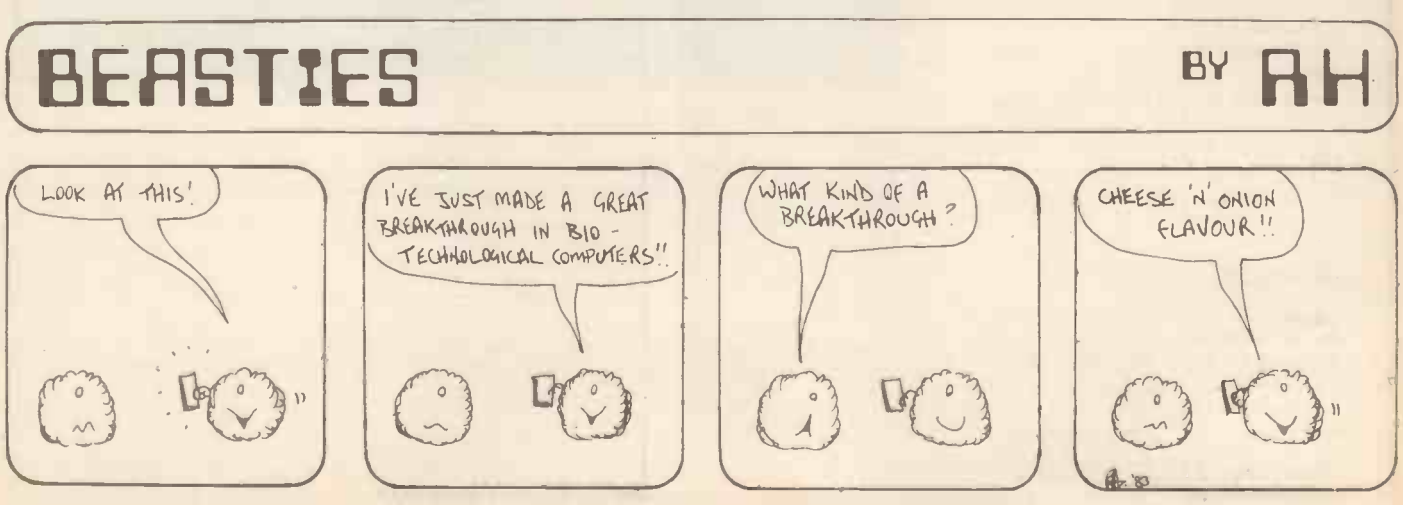
to enable the cassette motor to be switched on, then:

```
LOAD "Program Name"
```

to load the program, followed by

```
POKE 9000,0
```

to switch off the motor once the program has been loaded. A simple control program similar to the one used when saving programs could be used, but the final POKE to switch off the motor would not function, since the loaded program would replace the control one. This is not much of a drawback, as it is really when saving programs that automatic tape control is really useful, and things are much less critical during load operations..



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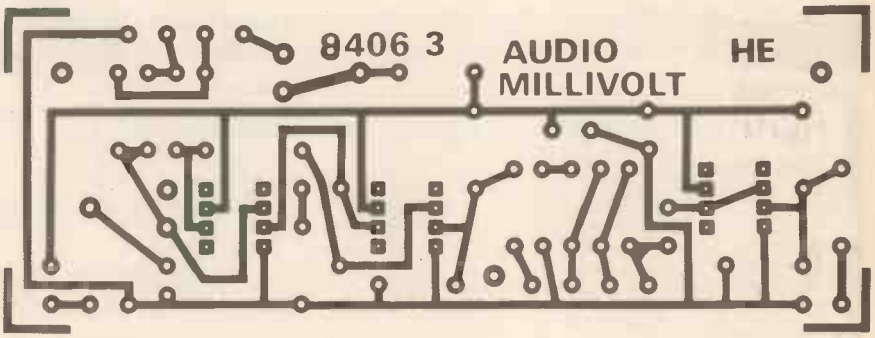
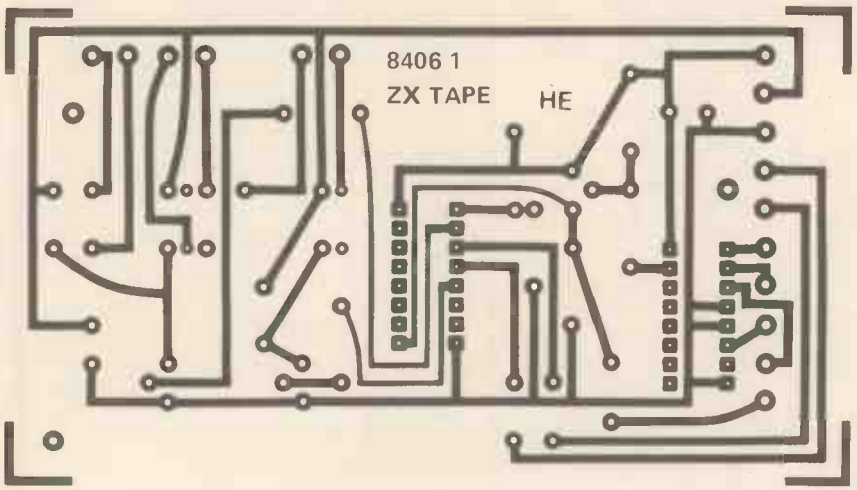
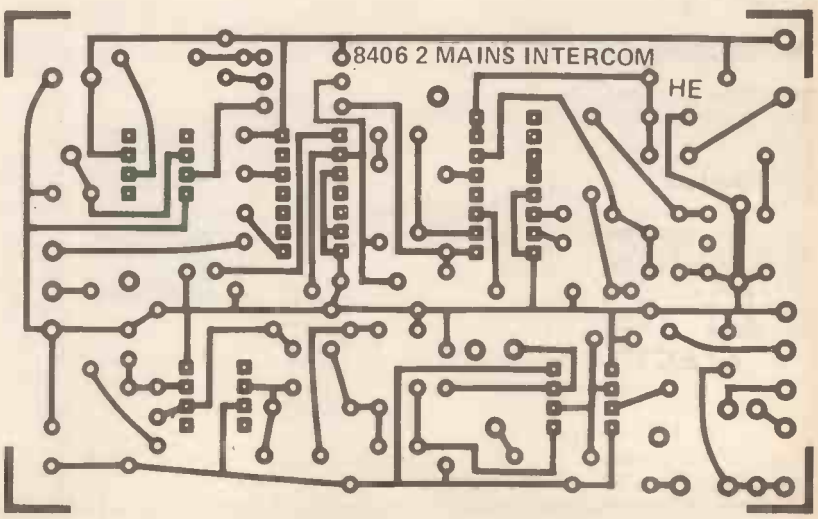



The foil pattern for the Audio Millivoltmeter project. We couldn't get the full title of the project on the board — hence the abbreviated title!




The foil pattern for the ZX tape Controller. This time we had plenty of room — but not the right size lettering!




The most complex pattern this month: The Mains intercomm foil pattern. Because it is fairly complex, it may be a little difficult to do this by home construction methods, so the ready-made board from our service would be the best idea. Board size right — lettering right!

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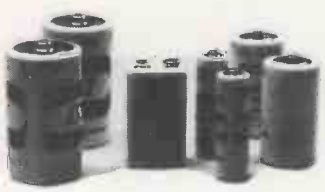

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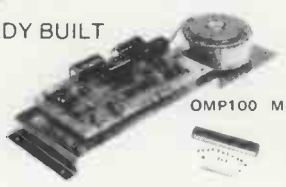


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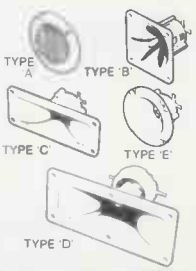


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| 74LS12 | 23p | 74LS42 | 37p | 74LS109 | 35p | 74LS156 | 46p | 74LS191 | 55p | 74LS257 | 40p | 74LS374 | 70p |
| 74LS13 | 28p | 74LS49 | 63p | 74LS112 | 32p | 74LS157 | 40p | 74LS192 | 55p | 74LS258 | 43p | 74LS375 | 52p |
| 74LS14 | 32p | 74LS51 | 21p | 74LS113 | | 74LS158 | 40p | 74LS193 | 55p | 74LS259 | 67p | 74LS386 | 130p |
| 74LS15 | 21p | 74LS54 | 21p | 74LS114 | 32p | 74LS160 | 40p | 74LS194 | 52p | 74LS260 | 30p | 74LS390 | 55p |
| 74LS20 | 21p | 74LS55 | 21p | 74LS122 | 46p | 74LS161 | 40p | 74LS195 | 52p | 74LS266 | 32p | 74LS393 | 55p |
| 74LS21 | 21p | 74LS63 | 138p | 74LS123 | 46p | 74LS162 | 40p | 74LS196 | 52p | 74LS273 | 63p | 74LS395 | 98p |
| 74LS22 | 21p | 74LS73 | 25p | 74LS124 | 166p | 74LS163 | 43p | 74LS197 | 52p | 74LS275 | 145p | 74LS398 | 310p |
| 74LS26 | 21p | 74LS74 | 25p | 74LS125 | 37p | 74LS164 | 48p | 74LS221 | 63p | 74LS279 | 40p | 74LS541 | 130p |
| | | 74LS75 | 28p | 74LS126 | 35p | 74LS165 | 60p | 74LS240 | 81p | 74LS280 | 110p | 74LS629 | 200p |
| | | 74LS76 | 25p | 74LS132 | 41p | 74LS166 | 81p | 74LS241 | 75p | 74LS283 | 46p | 74LS669 | 160p |
| | | 74LS78 | 25p | 74LS136 | 28p | 74LS168 | 97p | 74LS242 | 80p | 74LS290 | 60p | 74LS670 | 120p |

### CMOS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CD4000 | 15p | CD4015 | 46p | CD4035 | 55p | CD4054 | 100p | CD4093 | 40p | CD4503 | 46p | CD4568 | 80p |
| CD4001 | 15p | CD4016 | 30p | CD4038 | 125p | CD4060 | 80p | CD4099 | 140p | CD4511 | 52p | CD4572 | 80p |
| CD4002 | 15p | CD4017 | 40p | CD4040 | 50p | CD4066 | 30p | CD4160 | 75p | CD4512 | 90p | CD4581 | 80p |
| CD4006 | 60p | CD4018 | 52p | CD4041 | 50p | CD4068 | 20p | CD4161 | 75p | CD4514 | 140p | CD4582 | 80p |
| CD4007 | 16p | CD4019 | 30p | CD4042 | 45p | CD4069 | 20p | CD4162 | 75p | CD4515 | 200p | CD4583 | 60p |
| CD4008 | 45p | CD4020 | 52p | CD4043 | 46p | CD4070 | 16p | CD4163 | 75p | CD4516 | 65p | CD4584 | 60p |
| CD4009 | 30p | CD4021 | 46p | CD4044 | 46p | CD4071 | 18p | CD4175 | 75p | CD4518 | 52p | CD4585 | 110p |
| CD4010 | 35p | CD4022 | 46p | CD4045 | 120p | CD4072 | 18p | CD4402 | 75p | CD4520 | 60p | CD40100 | 200p |
| CD4011 | 15p | CD4023 | 20p | CD4046 | 55p | CD4075 | 25p | CD4412 | 75p | CD4528 | 81p | CD40106 | 80p |
| CD4012 | 20p | CD4024 | 40p | CD4047 | 46p | CD4076 | 60p | CD4419 | 75p | CD4538 | 100p | CD40109 | 100p |
| CD4013 | 25p | CD4025 | 18p | CD4048 | 45p | CD4077 | 30p | CD4445 | 75p | CD4539 | 78p | CD40114 | 200p |
| CD4014 | 55p | CD4026 | 100p | CD4049 | 30p | CD4078 | 25p | CD4446 | 75p | CD4541 | 100p | CD40174 | 80p |
| | | CD4027 | 25p | CD4050 | 30p | CD4081 | 25p | CD4449 | 75p | CD4555 | 60p | | |
| | | CD4028 | 45p | CD4052 | 70p | CD4082 | 25p | CD4501 | 35p | CD4561 | 110p | | |
| | | CD4029 | 55p | CD4053 | 60p | CD4085 | 72p | CD4502 | 70p | CD4568 | 80p | | |

### LINEAR

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CA1310E | 185p | CA3090 | 415p | LM339 | 80p | LM3911 | 140p | SAA5020 | | TDA1008 | 347p | TL074 | 117p |
| CA1350E | 90p | CA3130 | 105p | LM348 | 90p | LM3914 | 285p | SN76013N | 295p | TDA1022 | 570p | TL081 | 40p |
| CA3020 | 230p | CA3140 | 52p | LM358 | 62p | LM3915 | 285p | TAA621A | 290p | TDA1024 | 120p | TL082 | 65p |
| CA3028 | 110p | CA3240 | 125p | LM380 | 85p | LM3916 | 285p | TAA661B | 175p | TDA2002 | 150p | TL083 | 92p |
| CA3035 | 270p | ICM7555 | 105p | LM381 | 170p | MC1458 | 70p | TBA120B | 70p | TDA2003 | 345p | TL084 | 65p |
| CA3043 | 305p | ICM7556 | 200p | LM382 | 130p | MC1488 | 80p | TBA120S | 68p | TDA2020 | 350p | UA748 | 40p |
| CA3055 | 85p | LF347 | 200p | LM384 | 160p | MC1489 | 90p | TBA120U | 98p | TDA2030 | 340p | ZN414 | 95p |
| CA3043 | 305p | LF351N | 55p | LM386 | 100p | NE555 | 20p | TBA540Q | 161p | TDA2102 | | ZN424 | 150p |
| CA3055 | 85p | LF353N | 100p | LM387 | 140p | NE556 | 55p | TBA651 | | TDA2522 | | ZN425 | 400p |
| CA3065 | 150p | LM224 | 150p | LM389 | 110p | NE564 | 405p | TBA800 | 95p | TDA9400 | | ZN426 | 345p |
| CA3080 | 80p | LM301 | 30p | LM732 | 55p | NE566 | 173p | TBA810S | 110p | TL061 | 50p | ZN427 | 715p |
| CA3081 | 225p | LM308 | 100p | LM747 | 75p | NE567 | 161p | TBA820 | 81p | TL062 | 75p | ZN1034 | 230p |
| CA3085 | 145p | LM311N | 81p | LM1458 | 45p | NE570 | 391p | TBA920Q | 175p | TL064 | 150p | ZN1040 | 750p |
| CA3086 | 65p | LM318N | | LM3900 | 70p | NE571 | 387p | TCA270S | 171p | TL071 | 50p | | |
| CA3089 | 230p | LM324 | 50p | LM3909 | 92p | SAA5010 | | TDA1004 | 345p | TL072 | 60p | | |

### RIBBON CABLE

(Priced per 33cm)

| WAYS | COLOUR |
|---|---|
| 10 | 26p |
| 20 | 53p |
| 26 | 76p |
| 34 | 100p |
| | GREY |
| 10 | 18p |
| 20 | 25p |
| 26 | 50p |
| 36 | 60p |
| 40 | 80p |

### D CONNECTORS

| PLUGS | SOCKETS | COVERS |
|---|---|---|
| 9 way 90p | 125p | 110p |
| 15 way 125p | 190p | 110p |
| 25 way 190p | 230p | 125p |

### RECHARGEABLE BATTERIES

| | |
|---|---|
| HP2, 1.2v, 4.0AH | £3.95 |
| HP2, 1.2v, 1.2AH | £2.80 |
| HP11, 1.2v, 1.2AH | £2.40 |
| HP7, 1.25v, 500mAH | £1.00 |
| AAA, 1.2v, 180mAH | 30p |
| PP3, 8.4v, 110mAH | £4.50 |

### DIODES

| | | | | | |
|---|---|---|---|---|---|
| AA119 | 13p | OA200 | 9p | 1N5060 | 18p |
| AA215 | 16p | OA202 | 9p | 1N5062 | 20p |
| BAX13 | 10p | 1N823 | 5p | 1N5400 | 11p |
| BY100 | 30p | 1N914 | 5p | 1N5401 | 12p |
| BY127 | 18p | 1N916 | 6p | 1N5402 | 14p |
| BY133 | 20p | 1N4000 | 5p | 1N5403 | 15p |
| BY206 | 30p | 1N4001 | 5p | 1N5404 | 16p |
| BY207 | 30p | 1N4002 | 5p | 1N5405 | 17p |
| BY299 | 40p | 1N4003 | 6p | 1N5406 | 18p |
| BYX10 | 18p | 1N4004 | 6p | 1N5407 | 22p |
| OA47 | 10p | 1N4005 | 7p | 1N5408 | 25p |
| OA90 | 8p | 1N4006 | 7p | 1S44 | 5p |
| OA91 | 8p | 1N4007 | 8p | 1S921 | 7p |
| OA95 | 8p | 1N4148 | 5p | 1S922 | 7p |
| | | 1N4448 | 6p | 1S923 | 7p |

### I.C. SOCKETS

| LOW PROFILE | | TURNED PIN | |
|---|---|---|---|
| D.I.L Type | Price | D.I.L. Type | Price |
| 8 pin | 10p | 8 pin | 35p |
| 14 pin | 12p | 14 pin | 50p |
| 16 pin | 14p | 16 pin | 60p |
| 18 pin | 18p | 18 pin | 65p |
| 20 pin | 24p | 22 pin | 75p |
| 22 pin | 25p | 24 pin | 80p |
| 24 pin | 30p | 28 pin | 100p |
| 28 pin | 32p | 40 pin | 150p |
| 40 pin | 35p | | |

### ZENER DIODES

BZX61C/1.4 watt: 3V3, 3V6, 3V9, 4V7, 5V6, 6V2, 7V5, 8V2, 10V, 11V, 12V, 13V, 15V, 18V, 20V, 22V, 24V, 27V, 30V, 33V, 36V, 39V, 43V, 47V, 56V, 68V, 75V, 82V, 100V, 180V, 200V
16p each

BZY88C/0.4 watt: 1V3, 2V7, 3V, 3V3, 3V6, 3V9, 4V3, 4V7, 5V1, 5V6, 6V2, 7V5, 8V2, 9V1, 10V, 11V, 12V, 13V, 15V, 16V, 18V, 22V, 24V, 27V, 30V, 33V, 36V
10p each

### LEDs

| | | | |
|---|---|---|---|
| 5mm: Red | 10p | 113: Red | |
| Green | 13p | Red | 20p |
| Yellow | 13p | Green | 25p |
| 3mm: Red | 10p | Yellow | 25p |
| Green | 13p | 323: Tri. | |
| Yellow | 13p | Red | 20p |
| COAX21: Red | | Green | 25p |
| flashing | 65p | Yellow | 25p |
| 251: Rect/stack | | 503: Square | |
| Red | 20p | Red | 20p |
| Green | 25p | Green | 25p |
| Yellow | 25p | Yellow | 25p |

### REGULATORS

| | | | | | |
|---|---|---|---|---|---|
| LM304H | 180p | UA723C | 77p | 78H12 (3A/5V) | |
| LM309H | 80p | 7805A | 50p | | 460p |
| LM309K | 130p | 7812A | 50p | 78L05 | 35p |
| LM317K | 350p | 7812Kc | 121p | 78L12 | 35p |
| LM317T | 130p | 7815A | 50p | 78L15 | 35p |
| LM320/5 | 65p | 7818A | 50p | 78L18 | 35p |
| LM320/12 | 65p | 7824A | 50p | 78L24 | 35p |
| LM320/15 | 65p | 7905A | 55p | 78L62 | 35p |
| LM320/24 | 65p | 7912A | 55p | 79L05 | 45p |
| LM337T | 180p | 7915A | 55p | 79L12 | 45p |
| LM1469 | 324p | 7918A | 55p | 79L15 | 45p |
| UA78P (8A/5V) | 450p | 7924A | 55p | 79L18 | 45p |
| | | | | 79L24 | 45p |

### ALUMINIUM BOXES

| | |
|---|---|
| 3⅛" × 1⅝" × 2¼" | 80p |
| 80 × 50 × 25 | |
| 100 × 65 × 50 | 1.20 |
| 100 × 70 × 40 | 1.20 |
| 100 × 100 × 40 | 1.20 |
| 135 × 70 × 40 | 1.20 |
| 135 × 105 × 40 | 1.40 |
| 180 × 125 × 65 | 1.95 |
| 205 × 155 × 75 | 2.50 |

### VERO PLASTIC BOXES

| | |
|---|---|
| White 71 × 49 × 25 | 60p |
| Blk 71 × 49 × 25 | 60p |
| Blk 120 × 80 × 35 | 1.10 |
| Blk 180 × 110 × 55 | 1.75 |

### VERO BOARDS

| | |
|---|---|
| 127 × 63 | 1.10 |
| 95 × 63 | 95p |
| 431 × 63 | 3.17 |
| 127 × 95 | 1.20 |
| 95 × 95 | 1.15 |
| 431 × 95 | 4.20 |
| 454 × 119 | 5.50 |
| 63 × 25 pk of 5 | 1.30 |

### SOLDER

20 swg, 3 core

500g 495p

### THYRISTORS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BT101 | 104p | T05 1A/400V | 104p | 600mA/200V | 45p | 5A/400V | 60p |
| BT102 | 104p | 2N1599 | 40p | 1A/50V | 40p | 5A/600V | 70p |
| BT106 | 104p | 2N4441 | 170p | 1A/200V | 45p | 5A/800V | 80p |
| BT107 | 132p | 2N4444 | 150p | 1A/400V | 50p | 7A/100V | 55p |
| BT108 | 143p | 2N5060 | 36p | 1A/600V | 60p | 7A/400V | 60p |
| TIC44 | 20p | 2N5061 | 33p | 1A/800V | 90p | 7A/600V | 70p |
| TIC106D | 40p | 2N5062 | 42p | 3A/50V | 46p | 7A/800V | 80p |
| TIC106M | 77p | 2N5063 | 47p | 3A/100V | 53p | 7A/800V | 90p |
| TIC126D | 99p | 2N5064 | 47p | 3A/400V | 58p | 10A/50V | 55p |
| TIC206D | 80p | 600mA/20V | 21p | 3A/600V | 71p | 10A/100V | 60p |
| TIC226D | 90p | 600mA/30V | 24p | 3A/800V | 79p | 10A/200V | 65p |
| TIC246D | 130p | 600mA/100V | 30p | 5A/50V | 99p | 10A/400V | 70p |
| | | | | | 43p | 10A/600V | 88p |
| | | | | | | 10A/800V | 115p |

### TRIACS

| | | | |
|---|---|---|---|
| 2A/200V | 50p | 6A/400V | 60p |
| 2A/400V | 60p | 6A/600V | 80p |
| 2A/600V | 60p | 8A/200V | 60p |
| 4A/400V | 60p | 8A/400V | 70p |
| 6A/200V | 80p | 8A/600V | 90p |
| 6A/400V | 90p | 8A/800V | 110p |
| 8A/400V | 80p | 10A/100V | 80p |
| 10A/200V | 100p | 10A/400V | 110p |
| 10A/400P | 100p | | |

### BRIDGE RECTIFIERS

| | | | |
|---|---|---|---|
| 1A/50V | 30p | 6A/50V | 75p |
| 1A/100V | 30p | 6A/100V | 75p |
| 1A/200V | 35p | 6A/200V | 80p |
| 1A/400V | 40p | 6A/400V | 100p |
| 2A/50V | 35p | 10A/200V | 200p |
| 2A/100V | 45p | 10A/400V | 200p |
| 2A/200V | 50p | 25A/200V | 250p |
| 2A/400V | 55p | 25A/400V | 300p |

Dalo Etch resist £1.10

### POTENTIOMETERS

Carbon track, ¼ watt log & linear values:

| Range | Price |
|---|---|
| 470R-2.2MR (single track) | 40p |
| 4.7K-2.2MR (dual gang) | 100p |
| 4.7K-2.2MR (single gang D/P switch) | 90p |

### SLIDER POTS

60mm track, log & linear values:

| Range | Price |
|---|---|
| 5K-500K | 80p |

### PRESETS

Pre-set pots ¼ watt

| Range | Price |
|---|---|
| 50R-4.7MR (mini vert. & horiz.) | 10p |

### RESISTORS

High stability, ¼ watt, 5%

| Range | Price (1-99) | (100+) |
|---|---|---|
| 1R-10MR | 2p | 1p |

High stability, ¼ watt, 5%

| Range | Price (1-99) | (100+) |
|---|---|---|
| 1R-10MR | 3p | 1.5p |

### CAPACITORS

**CERAMIC** 1pF, 2p2, 2p7, 3p3, 3p9, 4p7, 5p6, 6p8, 8p2, 10pF, 12pF, 15pF, 18pF, 22pF, 27pF, 33pF, 39pF, 47pF, 56pF, 68pF, 82pF, 100pF, 120pF, 150pF, 180pF, 220pF, 270pF, 330pF, 470pF, 560pF, 680pF, 820pF, 1000pF, 1n5, 1n8, 2n2, 3n3, 3n9, 4n7, 5n6, 6n8, 8n2, 10nF, 22nF, 47nF, 100nF 6p each

**MYLAR: 100V** 1nF, 2n2, 3n3, 4n7, 6n8, 10nF 7p each. 15nF, 22nF, 33nF, 47nF 9p each. 68nF, 100nF 11p each. 220nF 15p. 330nF 18p. 470nF, 20p.

**POLYSTYRENE** 22pF, 47pF, 68pF, 82pF, 100pF, 120pF, 150pF, 220pF, 270pF, 330pF, 390pF, 470pF, 680pF, 820pF, 1000pF, 1200pF, 1500pF, 1800pF, 2000pF, 2200pF, 3300pF, 4700pF, 5600pF, 10nF 8p each

**TANTALUM BEAD** 3V: 100uF, 150uF, 220uF, 330uF 64p each 470uF 110p. 680uF 160p. 6V3: 6u8, 12p. 10uF 13p. 33uF 33p. 47uF 25p. 100uF, 220uF 77p each. 470uF 160p. 10V: 15uF, 22uF 20p each. 33uF 33p. 47uF 40p. 68uF 63p. 220uF 110p.

16V: 2u2, 3u3 20p each. 4u7, 6u8 25p each. 10uF 32p. 22uF 35p. 16V: 33uF 40p. 47uF 60p. 100uF 95p. 220uF 105p. 25V: 15uF, 22uF 40p each. 47uF, 68uF 60p. 35V: 0.1uF, 0.22uF, 0.47uF 16p each. 1uF, 1u5 18p each. 2u2 25p. 3u3, 4u7 20p each. 6u8 30p. 10uF 40p. 47uF 60p.

**ELECTROLYTIC Axiel or Radial** 16V: 10uF, 22uF, 33uF 10p each. 47uF, 68uF, 100uF 12p each. 125uF, 220uF 14p each. 330uF 18p. 470uF 24p, 680uF 36p. 1000uF 30p. 1500uF 40p. 2200uF 50p. 25V: 1uF, 10uF, 22uF, 47uF 10p each. 100uF 12p. 220uF 20p. 470uF 30p. 1000uF 40p. 2200uF 55p. 4700uF 115p. 35V: 120uF, 250uF 20p each. 40V: 6u8 10p. 470uF 30p. 1000uF 45p. 50V: 0.47uF, 1uF 8p each. 1uF (small) 12p. 220uF 35p. 63V: 1uF, 2u2, 4u7 7p each. 10uF, 22uF 10 each. 47uF 12p. 100uF 20p. 220uF 30p. 100V: 4.7F 48p. 160V: 10MF 32p. 250V: 0.01uF, 0.047uF, 0.1uF 10p each. 0.22uF 11p. 0.47uF 12p. 1uF 18p. 2u2 26p. 10uF 23p. 100uF 35p. 400V: 0.47uF 35p. 600V: 0.022uF, 0.047uF 30p each. 0.22uF, 67p. 1000V: 0.0022uF 27p. 0.022uF, 0.1uF 39p each.

**POLYESTER C280 250V** .01, 022, 033, 068, 1 8p. 15, 22, 33 10p. 47 12p. 68 20p. 1uF 26p. 2.2 50p.

**SILVERED MICA** 2p2, 3p3, 5pF, 10pF, 18pF, 20pF, 22pF, 25pF, 27pF 13p each. 30pF, 33pF, 39pF, 47pF, 50pF, 56pF, 68pF, 75pF, 82pF, 100pF, 120pF, 150pF, 180pF, 200pF, 220pF, 250pF, 270pF, 300pF 15p each. 330pF, 390pF, 470pF 19p each. 500pF, 560pF, 680pF 22p each. 820pF 24p. 1000pF 27p. 1500pF 32p. 1800pF 42p. 2200pF 45p. 2700pF 48p. 3600pF 55p. 3900pF 68p. 4700pF 83p. 5000pF 98p. 6800pF 115p. 8200pF 120p. 10000pF 125p.

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