The Truth About the Job Market

Audio PSU Design

All About Diodes

Decoding IC Numbers

Audio, Computing, Music, Radio, Robotics
Powertran's "Hebot II" and "MicroGrasp" kits offer unrivalled value for money to colleges, schools and individual enthusiasts. Put the kit together, plug into your micro and off you go! Hebot II can perform a bewildering variety of actions under the control of a simple BASIC program. Features include independent control of two wheels, flashing "eyes", two-tone hooter and a retractable pen.

Complete kit £85 + VAT
Universal computer interface board kit £11 + VAT

MicroGrasp is a fully programmable electric robot arm with closed loop feedback for positive positioning. The robot can be driven from virtually all micros.

Robot kit with power supply £215 + VAT
Universal interface board kit £60 + VAT

Powertran kits are complete down to the last nut and bolt, with easy-to-follow assembly instructions.

TOP KITS FROM POWERTRAN

MPA 200 100 watt mixer-amplifier. Complete kit £79.50 + VAT
SP2 200 2-channel 100 watt amplifier. Complete kit £85 + VAT
Chromatheque 5000 5-channel light show controller. Complete kit £79.50 + VAT
Digital Delay Line Studio quality effects up to 1.6s delay. £149 + VAT
Patchbay 16 pairs of jacks – for studio or stage. £35 + VAT

MCS-1 MIDI-controlled sampling unit – doubles as a high quality effects unit. Complete kit £599 + VAT

Our Doppler Radar Alarm can detect intruders early enough (and loud enough) to offer your home real protection. Standard kit including two transmitters £119 + VAT
Pair of extra transmitters £39 + VAT
Special offer: extended kit including four transmitters £139.50 + VAT

Send for demonstration tape to sample some of the sounds available £2.50 + VAT

To Powertran Cybernetics Limited, Portway Industrial Estate, Andover, Hampshire SP10 3ET

Please send me the following kits
I enclose Cheque/Postal Order, value £ (Don't forget to add VAT.)
Name ____________________________ Address ____________________________

Please allow 21 days for delivery. Offers subject to availability. Prices are exclusive of VAT and correct at time of going to press. Overseas customers please contact our Export Department.

Access/VISA cardholders – save time – order by phone: 0264 64455.
DIGEST .............................. 7  
TOBIE or not TOBIE, that's the question. The answer is on page 7.

READ/WRITE ..................... 16  
A little electronic mail.

THE REAL COMPONENTS ...... 18  
John Linsley Hood conducts a guided tour of certain one-way paths.

NOISE ABOUT NOISE ......... 23  
Neil Munro has been listening carefully to his power supply.

SECOND PROCESSOR FOR THE ELECTRON ............... 43  
John Wilke concludes his description of this useful add-on and includes a full software listing.

PRINTS BUFFER ................. 33  
Ever wanted to disguise your creaky old printer as an ultra-high speed model? This project may not fool the world but it will certainly fool your computer.

NOISE GATE ..................... 38  
An open and shut case for better stage performance.

REVIEWS ......................... 57  
We try out the Microprofessor MPF-1/88 and some versatile multimeters.

FIRST PROCESSOR FOR THE ELECTRON ............... 43  
John Wilke concludes his description of this useful add-on and includes a full software listing.

UNIVERSAL EPROM PROGRAMMER MKII ............... 48  
Mike Bedford continues his description with a discussion of the software requirements.

OPEN CHANNEL ................... 59  
Keith Brindley wonders whether satellite television is really necessary.

TRAIN OF THOUGHT ............ 60  
Track down your trains.

SCRATCH PAD ..................... 61  
Flea Byte gets under the surface of a few more news stories.

We regret that, once again, we have been unable to find room for the promised EPROM emulator article. We will do our best to make good the omission next month.

INFORMATION

READERS' SERVICES ............. 27  
NEXT MONTH'S ETI ............. 32  
PCB SERVICE ..................... 56  
CLASSIFIED ADS ............... 62  
FOIL PATTERNS ................. 54  
ADVERTISERS' INDEX ............ 66
MAIL ORDERS:
Unit 1, Hill Farm Industrial Estate,
Buxted, Uckfield, East Sussex TN22 9RJ.
Tel: Orders: Buxted (0208) 36412.
Telex: 987756.

ACCESS AND BARCLAYCARD WELCOME

ORDERING INFO: All components brand new and to full spec. All prices exclude VAT. Please add to total order. Please add 7% for carriage (under £200) or 3% (over £200). Order over £500 gets free carriage. All orders welcome: Please add £5 carriage. Payment accepted by: Credit Card, Cheque, Postal Order. VAT Number: GB 066792401. All orders are subject to price changes. All descriptions are given in good faith but errors or omissions are possible. All goods remain the property of the supplier until payment is received. Acceptance of goods by buyer signifies agreement to the above conditions. E & OE JULY 1985
Epson Introduces New Printers

Epson have launched the first two models in a range of ink-jet printers which, they claim, offer the speed of dot matrix machines and quality comparable with that of daisy wheels but without the noisiness of either.

They say they have avoided the problems usually associated with ink-jet printers by using a specially formulated ink, a cap which automatically seals the printing head when the machine is not in use, and an instant head cleaning system available at the touch of a button.

The SQ-2000 is at the top of the range and offers 105 CPS in letter-quality mode and 176 CPS in draft mode. The head uses 24 nozzles and a wide range of typefaces are included. Further typefaces and a range of slot-in interface boards can be added.

The HS-80 is a brief-case sized A4 printer which has a nine nozzle head and offers 160 CPS (not including line throws). It should be available in the Autumn.

Epson (UK) Ltd, Dorland House, 338 High Road, Wembley, Middlesex HA9 6UH, tel 01-902 8892.
COLOUR MONITOR SPECIALS

A Major company's over production problems, and a special BULK PURCHASE enable TWO outstanding offers.

COLOUR MONITOR SPECIALS

'SYSTEM ALPHA' 14" Multi Input Monitor.
Made in the UK by the famous REDIFFUSION Co. for their own professional control rooms, this monitor has all the features to suit the most rigorous of monitor requirements. Two video inputs, RGB and PAL Composite Video, allow direct connection to most makes of micro computers. An internal speaker and audio amplifier may be connected to your system's output or direct to the monitor itself, giving superior colour and sound quality. Many other features include PIL TUBE, Matched DECCA chassis and front panel, Separate Contrast and Brightness - even in RGB mode, Two types of audio input separately adjustable for PAL and RGB, and controls for Composite or RGB input, 15 way 'O' plug for RGB input, modular construction etc. etc.

This must be ONE OF THE YEAR'S BEST BUILDS!!!!

SOLD TO DATE

DECCA RGB 80-100 Monitor.
Little or hardly used manufacturer's surplus enables us to offer this special converted DECCA RGB Colour Video TV Monitor at a super low price of only £99.00, a price for a colour monitor as yet unheard of. An excellent quality, surface modification and special 15" high definition PIL tube, combined with the tried and tested DECCA 80/100 chassis to give 80 column definition and picture.
Rural Radio Payphone

Pressley Radio System has developed a stand alone, rural payphone system which could put a telephone in the Third World, and in the telephone. The roadside telephone needs no conventional wires for communications because it is powered by solar or wind power, or a combination of both, charge an in-built battery system which in turn powers the radio and payphone. The payphone, which is of the type extensively used by British Telecom in the UK, is equipped with ringing facilities, tariff signalling and a liquid crystal readout of coin values. It is housed in a vandal proof case.

In operation, speech is carried through an integral transmitter to the nearest exchange or junction to gain access to the country's trunk network, enabling the caller to have full national or international telephone facilities. The payphone is also able to act as a direct local link, on a point to point basis, so that remote villages can communicate with each other. The radio is available on 450MHz and 1.5GHz.

The payphone is able to recognise 24 different currencies and an inbuilt cash management system reports when the coin box is 75 per cent full. For simple installation a metal plate at the foot of the payphone pole is dropped into a concrete base. An adaption of the payphone configuration has already been installed in Turkey where a completely mobile post office with full service facilities is bringing a new communications technology to villages and seaside resorts. Early discussions are now taking place with a South American country.

Active Loudspeaker Stands

Takmg a novel approach to the problem of getting more bass from small loudspeakers, Asscom have come up with a hollow stand which couples to a speaker to increase its effective volume. The stands come in kit form and are designed for the Wharfdale Diamond, but the manufacturers say they can easily be adapted to suit other small loudspeakers.

The stands are made of wood and incorporate a tapered column which is tuned to boost low frequencies. The loudspeaker attaches to the front of the stand and an acoustic coupling is achieved by means of a hole in the front face of the stand and the hole in the back of the loudspeaker which normally carries the connector panel. In the case of the Wharfdale Diamond, this hole is about 3" in diameter. Once the panel has been removed, the loudspeaker can be screwed to the stand using the connector plate fixing positions and the wiring extended to a new connector plate position on the back of the stand.

Asscom claim that the active stands extend the response of the Diamonds downwards by about 30Hz and do so without affecting the upper base and midrange. They say that the effect is to add weight to the sound without introducing any of the artificial boominess often associated with cheap loudspeakers which attempt to imitate an extended bass response by emphasising the upper bass region.

The kits include pre-cut panels, battens, screws, pins, wadding, damping, woodgrain-effect vinyl covering material, etc. Asscom will consider producing a ready-built version if the demand warrants it. The kit costs £29.95 per pair plus £4.95 post and packing, and an instruction manual containing the plans and details of some other modifications is available for £4.95.

Asscom, Unit A, Mossedge Industrial Estate, Linwood, Renfrewshire PA3 3HR, tel 0505 - 35974.
### BEGINNERS GUIDE
- Beginner's Guide to Basic Programming £5.85
- Beginner's Guide to Digital Electronics £5.85
- Beginner's Guide to Electronics £5.85
- Beginner's Guide to Integrated Circuits £5.85
- Beginner's Guide to Computers £5.85
- Beginner's Guide to Microprocessors £5.85
- Beginner's Guide to Microcomputing £5.85

### COOKBOOKS
- Microprocessor Cookbook Book M. Hordeski £10.65
- TTL Cookbook Lancaster £15.50
- TV Typewriter Cookbook Lancaster £14.05
- CMOS Cookbook Lancaster £12.50
- TTL Cookbook Lancaster £13.95
- TTL Cookbook Lancaster £12.95
- Micro Cookbook Vol.1 Lancaster £15.30
- MC 6809 Cookbook £7.25

### ELECTRONICS
- Principles of Transistor Circuits Amos £9.00
- Electronic Devices & Circuit Theory Boylesrad £15.95
- Principles of Electronic Instrumentation De Sa £11.45
- Giant Handbook of Computer Software £12.95
- Giant Handbook of Electronic Circuits £22.95
- Giant Handbook of Electronic Projects £13.60
- Electronic Logic Circuits Gibson £6.45
- Analysis and Design of Analogue Integrated Circuits Gray £42.50
- Basic Electronics Grob £13.00
- Lasers, The Light Fantastic Hallmark £10.90
- Introduction to Digital Electronics & Logic Joyson £8.25
- Electronic Testing and Fault Diagnosis Loveday £7.85
- Electronic Fault Diagnosis Loveday £6.25
- Essential Electronics A-Z Guide Loveday £7.50
- Microelectronics Digital & Analogue circuits and Systems Millman £12.25
- Power FETs and their application Oxford £41.00
- Electronic Drafting and Design Raskhodoff £26.85
- Electronic Fault Diagnosis Sinclair £4.50
- Physics of Semiconductor Devices Sze £16.90
- Digital Circuits and Microprocessors Taub £25.25
- Active Filter Handbook £13.30
- Digital Systems: Principles and Applications Tocci £14.95
- Master Handbook of Telephone Trilater £12.50

### COMPUTERS & MICROCOMPUTERS
- From BASIC to PASCAL Anderson £11.30
- UNIX - The Book Banham £9.00
- Z80 Microcomputer Handbook Barden £15.05
- Digital Computer Fundamentals Banham £11.75
- Microprocessor Interfacing Carr £28.50
- Microcomputer Interfacing Handbook A/D & D/A Carr £12.50
- Microprocessors/Microcomputers - An Intro Gloone £36.50
- Troubleshooting Microprocessors and Digital Logic Goodman £12.80
- Let your BBC Micro Teach you to program Hartnell £7.95
- Programming your ZX Spectrum Hartnell £8.50
- How to Design, Build and Program your own working System Haylland £12.80
- BASIC Principles and Practice of Microprocessors £8.00
- Microcomputer Builders' Bible Johnson £14.75
- Digital Circuits and Microcomputers Johnson £16.95
- PASCAL for Students Kemp £6.95
- The C - Programming Language Kerrigan £24.45
- Guide to Good Programming Practice Meech £29.50
- Principles of Interactive Computer Graphics Newman £13.75
- Theory and Practice of Microprocessors Nicholas £11.45
- Microprocessor Circuitry Vol.1. Fundamentals and Microcontrollers Nicholls £9.30
- Microcomputer Based Design Peatman £11.75
- Digital Hardware Design Peatman £10.75
- BBC Micro Revealed Russon £9.45
- Easy Programming for the ZX Spectrum Stewart £7.45
- Microprocessor Applications Handbook Strocchi £46.45
- Handbook of Microprocessor Design and Applications Strocchi £46.45

### ELECTRONIC HARDWARE
- Programming the PET/CBM West £16.40
- Computer Peripherals that you can build Wolfe £14.75

### REFERENCE BOOKS
- Electronic Engineers' Handbook Fink £66.60
- Electronic Designers' Handbook Giaccio £77.75
- Handbook for Electronic Engineering Technicians Kaufman £40.50
- Handbook of Electronic Calculations Kaufman £42.25
- Modern Electronic Circuit Reference Manual Marcus £57.45
- Handbook of Microcircuit Design & Applications Stout & Kaufman £49.95
- International Transistor Selector Towers £14.50
- International Microprocessor Selector Towers £16.00
- International MOS Power and other FET Selector £19.95
- International Digital IC Selector Towers £10.95
- International Op Amp Linear IC Selector Towers £9.50
- Illustrated Dictionary of Electronics Turner £18.75

### VIDEO
- Servicing Home Video Cassette Recorders Hobbs £19.05
- Complete Handbook of Videocassette Recorders Kybett £10.50
- Theory and Servicing of Videocassette Recorders McGinty £15.45
- Beginner's Guide to Video Matthewson £5.85
- Video Recording: Theory and Practice Robinson £10.50
- Video Handbook Van Wezel £24.00
- Video Technique White £16.25

### NEW TITLES
- Electronic Devices and Circuits Bell £13.50
- CP/M - The Software Bus: A programmers guide Clarke/Eaton & Powers-Lybe £10.45
- Electronic Instrumentation and Measurement Techniques 2nd Ed. Cooper £14.95
- Graphics on the BBC Microcomputer Cryer £8.45
- The BBC Microcomputer for Beginners Dunn/Morgan £8.45
- Engineering approach to Digital Design Fletcher £17.95
- A UNIX Primer Lumo £15.55
- Understanding Digital Logic Circuits Middleton £7.90
- CP/M Primer Murtha/Waite £16.40
- Introducing Computers Peley £14.95
- Dictionary of Computers/Data Processing and Telecommunications Rosenberg £19.00
- Computer Networks Tennenbaum £18.95
- UNIX Primer Plus Weaite/Martin & Prata £18.95
- Introduction to PASCAL Welsh/Elder £9.45

### ELECTRONIC DATA BOOKS
- THT 83/84 Data dictionary and comparison table £9.50
- TVT A-Z Transistor equivalent book £5.00
- TVT 2N Transistor equivalent book £5.30
- DAT 1 Part 1 of compendium covering transistors A-B £8.40
- DAT 2 Part 2 covering C-Z transistors £10.50
- DAT 3 Part 3 covering 2N21-2N6775 £9.30
- DAT 4 Part 4 covering 2SA,2SB,2SC,2SD,2SJ £11.40
- LIN 1 Linear operational amplifiers data and comparison tables £6.50
- LIN 2 Linear voltage stabilizers, data and comparison tables £6.50
- TTL TTL digital data and equivalent book £7.80
- DDV1 Part 1 European diode data equivalent book £7.90
- DDV2 Part 2 American and Japanese diode data and equivalent book £7.90

---

Please send me the books indicated. I enclose cheque/postal order for £_________________________. Prices include postage and packing.

I wish to pay by Access/Barclaycard. Please debit my account.

[Signature]

Address
**Containerised TV Station**

Incomtel have developed a powerful television transmitter station which is totally self-sufficient within multiple 20' long steel containers and can begin broadcasting within days of arriving on site, anywhere from a remote jungle clearing to an isolated desert range.

Incomtel claim that this is the fastest way to introduce a TV service to a region, and the savings for the customer will be in time and money since no permanent buildings will be needed and relocation fast and simple. Other customers, with established TV networks, have also shown interest in a containerised station to back their permanent installation, ensuring broadcasting continuity around the clock in the event of an emergency or breakdown. The only civil engineering works required are mast foundations and concrete bases for the main containers and the diesel generating set.

In this first station three of the containers have been designed to accommodate two 10kW Band III TV transmitters, together with two high voltage power transformers, two programme input racks and test equipment. The UHF link receiver rack, notch diplexer, aurial and visual dummy loads with changeover switches together with the pressurisation system for the antenna coaxial cable and UHF waveguide are all installed within the three container 'heart' of complex.

Each of the steel fully insulated ribbed ISO containers are air conditioned and special precautions have been taken to inhibit the ingress of fine dust and sand. A specially designed sun roof canopy will protect the entire complex in countries with extreme temperature conditions and each station will be totally independent with its own water, power and fuel supplies.

A custom-designed Rolls Royce 125kW generating set complete with bulk fuel tank fits into a single container which has been sound-proofed to a high standard. Also provided within the complex are reception, staff accommodation and recreation areas, office and stores. To complete the package there is a 150 metre mast fitted with a 12 panel double high power transmitters, together with the pressurisation system for the antenna coaxial cable and UHF waveguide are all installed within the three container 'heart' of complex.

**RS232C Optical Fibre Link**

Belling Lee Intec have introduced a full duplex optical fibre transceiver which plugs directly into the standard 'D' type connector used for RS232C interfaces. They claim that it allows high performance transmission of data over an extended distance without the need for data cables. The L2840 can be used with fibre optic cables of 100 microns and upwards and is fitted with 9mm SMA-style fibre optic connectors. Data rates from DC to 64k baud can be accommodated and a special feature is the ability to be configured internally as either a data terminal equipment (DTE) or data communications equipment (DCE). The supply voltage is 9V connected via a miniature jack plug from an external mains adaptor.

A data sheet describing the L2840 is available from the manufacturer, Belling Lee Intec Ltd, 540 Great Cambridge Road, Enfield, Middlesex EN1 3QW, tel 01 - 367 0080.

**Soldering Iron Thermometer**

Designed for use in applications where soldering iron tip temperature must be precisely controlled, West Sussex Instruments have introduced a digital electronic thermometer which will provide readings of tip temperature in seconds.

The WSI 500 has an integral sensor mounted on the front panel and will measure temperatures from -50 C to +500 C. It has a resolution of 1 C and an accuracy of 0.5% ± 1 digit plus the deviation of the thermocouple. The liquid crystal display has 12.5mm high digits and the meter will operate for approximately 1000 hours from a 9V alkaline battery.

In operation, the soldering iron is simply pressed against the sensor and a reading is obtained within seconds. An area of sponge surrounds the sensor so that the bit can easily be cleaned.

The WSI 500 costs £39.50 plus carriage and VAT and is available from West Sussex Instruments Ltd, 12A Coronation Buildings, Brougham Road, Worthing, West Sussex BN11 2NW, tel 0903 - 212303.

---

*We have received a lot of requests for cut-price back-numbers following our offer in these pages last month. We have sold out of many of the issues listed but still have copies of November 1982, January 1983, May 1983 and December 1983 going for 50p each. If you want a copy of any of these issues, just send us a cheque or postal order for the appropriate amount and, to save us time, enclose your name and address on a gummed label or at least on a piece of plain paper which we can paste down.*

*ETI JULY 1985*
Introducing...

**Serpent SCARA assembly robot**

On show at
Training & Development NEC 9 – 11th July

AND To be featured as a constructional project in Practical Electronics September issue.

---

**AUDIO ELECTRONICS**

**SCOPES**
- (UK C/P 6lms)
- £15.00
- (UK C/P 6lms)

**DIGITAL MULTIMETERS**
- (UK C/P 6lms) with Case
- £29.80
- (UK C/P 6lms) with Case
- £32.00
- (UK C/P 6lms) with Case
- £45.50
- (UK C/P 6lms) with Case
- £48.70
- (UK C/P 6lms) with Case
- £51.90
- (UK C/P 6lms) with Case
- £55.10

**DIGITAL CAPACITANCE METER**
- (UK C/P 6lms) Large LCD display 8 ranges
- 0.1pf to 2.000nuf
- £69.50

---

**LOGIC PROBES**
- (UK C/P 50p)
- £24.95

**DC POWER SUPPLIES**
- 240/250/AC/DC (UK C/P 10.00)
- £12.95
- 240/250/AC/DC (UK C/P 10.00)
- £15.95
- 240/250/AC/DC (UK C/P 10.00)
- £21.95

---

**FREE 44 PAGE PRICED AND ILLUSTRATED CATALOGUE ON REQUEST**
- Over 6000 items stocked

---

**You can depend on**

**ELECTROVALUE**

- To supply the fine range of test & measurement gear by

---

**ROBOTS**

**NEPTUNE I & NEPTUNE II**
- For clean hydraulic power — it's hydraulic fluid!
- Kit from £1250
- Kit from £1725

---

**MENTOR**
- Kit from £345

---

Please phone for brochure: 0264 50093.

---

**BRITAINS FOREMOST QUALITY COMPONENT SUPPLIERS**

For Education, Training and Industry

---

**ETI JULY 1985**
Events Diary

Unix Training Course - June 11-12th
Plessey Microsystems Training Centre, Towcester. Training in Unix system 111 or V, including hands-on experience using a Plessey System 68. Aimed at data managers and software staff interested in multi-user computer techniques. Contact Plessey Microsystems, Sales Office, Water Lane, Towcester, Northamptonshire NN12 7JN, tel 0327 - 50312.

Computer Graphics Course - June 11-14th
Cafe Royal, Regent Street, London. A comprehensive overview which moves from fundamental concepts to the selection and effective use of top-flight workstations and software. The cost is £585.00 plus VAT and details are available from ICS at the address below.

European Unix User Show - June 12-14th
Olympia 2, London. For details see June issue or ’phone 01 - 837 3699.

Computers In Manufacturing Show - June 24-27th
Olympia 2, London. For details see June issue or ’phone 01 - 891 3426.

Networks - June 25-27th
Wembley Conference Centre, Wembley, Middlesex. Exhibition and conference covering Local Area Networks, electronic mail and other data exchange networks. The full conference programme costs £595.00 + VAT, exhibition entrance costs £5.00 and the organisers expect about eighty exhibitors. Contact Online at the address below.

Condition Monitoring In Hostile Environments - June 26th
Regent Crest Hotel, London. For details see June issue or ’phone 0372 - 374151.

Living With Quality Demands BS5750 - June 27th
PERA, Melton Mowbray. One day seminar organised by the Production Engineering Research Association and designed to help production and quality control staff understand and implement the requirements of BS5750. Cost is £125 + VAT with a discount for PERA members. PERA, Melton Mowbray, Leicestershire LE13 0PB, tel 0664 - 501329.

Personal Robotics Conference & Exhibition - July 2-4th
West Port Centre Hotel, London, Sponsored by a number of bodies including the IEE, the event includes a conference attended by speakers from the USA and Europe, specialist workshops and the UK finals of the Micromouse competition. The cost is £525.00 + VAT which includes all refreshments, etc. Ovey Scientific & Technical Services Ltd, Third Floor, Bath House, 56 Holborn Viaduct, London EC1A 2EX, tel 01 - 236 4080.

Programming In C: A Hands-On Workshop - July 2-5th
Cafe Royal, Regent Street, London. Each participant is given access to a Unix system with a C compiler and instructed in the writing and execution of C programmes. The cost is £635.00 + VAT and details are available from ICS at the address below.

Leeds Electronics Show - July 3-5th
University of Leeds. See June issue for details or ’phone 0799 - 26699.

Cable - July 9-11th
Metropole Hotel, Brighton. Conference and exhibition expected to attract 60-70 exhibitors. Conference topics include technology now and in the future, teleshopping and other interactive services and the question of subsidy versus investment. Exhibition entrance costs £10.00, full conference programme costs £330.00 + VAT and details are available from Online at the address below.

Personal Computer World Show - September 4-8th
Olympia, London. The main exhibition covers home and educational computing while a separate exhibition in Olympia 2 caters for business and professional users. For details contact Montbuild Ltd, 11 Manchester Square, London W1M 5AB, tel 01 - 486 1951.

Addresses:
ICS Publishing Company (UK) Ltd, 3 Swan Court, Leatherhead, Surrey KT22 8AD, tel 0372 379211.
Online International Ltd, Pinner Green House, Ash Hill Drive, Pinner, Middlesex HA5 2AE, tel 01 - 868 4466.

Fresh Orange
Castle Associates have introduced the latest version of their 'Electronic Orange', a noise monitoring system intended for use in places of entertainment. The new model has been designed specifically for use in discotheques and removes the mains supply to the sound console if the noise level exceeds the threshold and the DJ ignores warnings to reduce the volume. The Mk1V Electronic Orange consists of a microphone, a control unit and the distinctive orange warning lamp. The microphone should be mounted in the main dance area and its output is fed to the control unit. A sound level circuit built to the requirements of BS 5969 Type 2 compares the incoming signal with a preset level and illuminates the warning lamp if it is excessively high. If the DJ does not respond to the warning by reducing the sound level, the unit will allow a short delay and then briefly interrupt the supply to the disco console. This short period of silence provides an effective deterrent and ensures that the volume is generally maintained at a reasonable level.

Castle Associates point out that complaints about high noise levels from places of entertainment feature regularly in the Environmental Officer's league table of complaints and that the recent Local Government (Miscellaneous Provisions) Act 1982 gives Local Authorities the power to prescribe conditions and restrictions before licensing a place of entertainment. The complete Electronic Orange system costs £350.00 plus VAT and comes with comprehensive installation instructions.

Castle Associates Ltd, Slater Road, Cayton Low Road Industrial Estate, Scarborough, North Yorkshire Y011 3UZ, tel 0723 - 584250.

BBC Headphone Protector
The BBC's Engineering Designs Department has developed a compact limiter which protects headphone listeners against excessively high sound levels. The device introduces no distortion until the limiting level is reached, draws its power from the signal so that no other power source is required, and the design is now available to UK firms for manufacture under licence.

The protector is smaller than a matchbox and is wired into the lead between the amplifier and the headphones. The limiting level is set during assembly to a value in the range 95 to 110 dBA and an averaging network prevents the limiter operating on short duration peaks. To allow for the dynamic range of the signal, the operation of the averaging circuit is such that the mean programme level must be about 5 to 8 dB below the limiting level if it is not to be clipped. A weighting network is included to prevent the limiter acting on the less harmful low frequencies.

The BBC say that some form of protection is essential where headphones could inadvertently be connected to the loudspeaker output of an amplifier, and that there is also a need because listeners often use headphones at high volume levels, especially where there is ambient noise.

The Engineering Information Department, BBC, Broadcasting House, London W1A 1AA, tel 01 - 927 5432.

BBC
**UV ERASERS**

- All erasers with built-in safety switch and mains indicator.
- UV11 as above but with a timer.
- UV14 as above but with a timer.
- UV140 uses up to 14 erasures at a time.
- UV141 as above but with a timer.

**ACORN COMPUTER SYSTEMS**

- BBC Model B Special Offer: £305 (a)
- BBC Model B + Acornet: £335 (a)
- BBC Model B + DFS: £346 (a)
- BBC Model B + DFS + Acornet: £399 (a)

**UPGRADE KITS**

- A to B Upgrade Kit: £65 (d)
- CPC Kit: £70 (d)
- Acornet: £95 (d)
- Speech Kit: £47 (d)

**ACORN ADD-ON PRODUCTS**

- Z80 2nd Processor: £346 (a)
- 8602 Processor: £175 (b)
- Textel Adaptor: £210 (b)
- IEEE Interface: £282 (b)
- Pretile Adaptor: £39 (b)
- PC Lite: £38.50 (b)

**CONNECTION SYSTEMS**

**DISC DRIVES**

These are fully tested and wired drives with slamline mechanisms of high quality, Shuggart A400 standard interface. Drives supplied with cables and formatting discs suitable for the BBC computer. All 80 track drives are supplied with 40/80 track switching as standard. All drives can operate in single or dual density format.

- 1 x 100K 40/80 TS T555A £88.00
- PS200 with 3rd party £125.00
- 1 x 40K 40/80 T555F £135.00
- PS400 with 3rd party £145.00
- Dual 80K 40/80 T555S £165.00
- 2 x 40K 40/80 DS T55DS £295.00
- Dual 80K 40/80 with 3rd party £315.00

**MONITORS**

**ACORN**

- **KAGA TAXAN**
  - BBC Parallel Lead £7 (d) Serial Lead £7 (d)
  - RX/FX80 Dust Cover £4.50 (d)
  - EPSON RS232 with 2K Butter £65 (c) Ribbon £2.50 (d)
  - EPSON KP810/910 Ribbon £6.00 (d)
  - RS232 with 2K Butter £85 (c)
  - 8143 £28 (c)
  - 8148 with 2K £59 (c)
  - Serial Interface: 8143 £28 (c); 8148 with 2K £59 (c)
  - RX/FX80 Tractor Attachment £37 (c)

**MONITORS**

**ACORN**

- **COMMUNICATION ROM**
  - ULTRACALC spreadsheet ROM £345 (c)
  - Printmaster (FX80)/Graphics ROM £399 (c)
  - EXMON/TOOL KIT ROM £47 (c)
  - Disc Doctor/Gremlin Debug ROM £29 (d)
  - BCPL ROM/Disc Doctor £59.00 (b)

**INSTALLATION**

- **COMMUNICATIONS**
  - MODEMS
    - **ACCESSORIES**
      - 32K Internal Buffer £99 (b)
      - Parallel £99 (b)
      - 2K Butter £65 (c) Ribbon £2.50 (d)
  - **ACCESSORIES**
    - 32K Internal Buffer Parallel £39 (b)
    - Parallel £99 (b)
    - 2K Butter £65 (c) Ribbon £2.50 (d)

**ACCESSORIES**

- **COMMUNICATIONS**
  - MODEMS
    - **ACCESSORIES**
      - 32K Internal Buffer Parallel £39 (b)
      - Parallel £99 (b)
      - 2K Butter £65 (c) Ribbon £2.50 (d)

**DISC DRIVES**

These are fully tested and wired drives with slamline mechanisms of high quality, Shuggart A400 standard interface. Drives supplied with cables and formatting discs suitable for the BBC computer. All 80 track drives are supplied with 40/80 track switching as standard. All drives can operate in single or dual density format.

- 1 x 100K 40/80 TS T555A £88.00
- PS200 with 3rd party £125.00
- 1 x 40K 40/80 T555F £135.00
- PS400 with 3rd party £145.00
- Dual 80K 40/80 T555S £165.00
- 2 x 40K 40/80 DS T55DS £295.00
- Dual 80K 40/80 with 3rd party £315.00

**MONITORS**

**ACORN**

- **KAGA TAXAN**
  - BBC Parallel Lead £7 (d) Serial Lead £7 (d)
  - RX/FX80 Dust Cover £4.50 (d)
  - EPSON RS232 with 2K Butter £65 (c) Ribbon £2.50 (d)
  - EPSON KP810/910 Ribbon £6.00 (d)
  - RS232 with 2K Butter £85 (c) Ribbon £5.00 (d)
  - 8143 £28 (c)
  - 8148 with 2K £59 (c)
  - Serial Interface: 8143 £28 (c); 8148 with 2K £59 (c)
  - RX/FX80 Tractor Attachment £37 (c)

**MONITORS**

**ACORN**

- **COMMUNICATION ROM**
  - ULTRACALC spreadsheet ROM £345 (c)
  - Printmaster (FX80)/Graphics ROM £399 (c)
  - EXMON/TOOL KIT ROM £47 (c)
  - Disc Doctor/Gremlin Debug ROM £29 (d)
  - BCPL ROM/Disc Doctor £59.00 (b)

**INSTALLATION**

- **COMMUNICATIONS**
  - MODEMS
    - **ACCESSORIES**
      - 32K Internal Buffer Parallel £39 (b)
      - Parallel £99 (b)
      - 2K Butter £65 (c) Ribbon £2.50 (d)

**ACCESSORIES**

- **COMMUNICATIONS**
  - MODEMS
    - **ACCESSORIES**
      - 32K Internal Buffer Parallel £39 (b)
      - Parallel £99 (b)
      - 2K Butter £65 (c) Ribbon £2.50 (d)
### Linear ICs

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>74LS00</td>
<td>NAND gate</td>
<td>1000</td>
</tr>
<tr>
<td>74LS02</td>
<td>NOR gate</td>
<td>900</td>
</tr>
<tr>
<td>74LS03</td>
<td>3-input NAND gate</td>
<td>700</td>
</tr>
<tr>
<td>74LS04</td>
<td>4-input NAND gate</td>
<td>600</td>
</tr>
<tr>
<td>74LS05</td>
<td>3-input NAND gate</td>
<td>500</td>
</tr>
<tr>
<td>74LS06</td>
<td>4-input NAND gate</td>
<td>400</td>
</tr>
<tr>
<td>74LS07</td>
<td>3-input NAND gate</td>
<td>300</td>
</tr>
<tr>
<td>74LS08</td>
<td>4-input NAND gate</td>
<td>200</td>
</tr>
<tr>
<td>74LS09</td>
<td>3-input NAND gate</td>
<td>100</td>
</tr>
<tr>
<td>74LS10</td>
<td>4-input NAND gate</td>
<td>100</td>
</tr>
</tbody>
</table>

### Computer Components

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>74HC00</td>
<td>NAND gate</td>
<td>100</td>
</tr>
<tr>
<td>74HC02</td>
<td>NOR gate</td>
<td>90</td>
</tr>
<tr>
<td>74HC03</td>
<td>3-input NAND gate</td>
<td>80</td>
</tr>
<tr>
<td>74HC04</td>
<td>4-input NAND gate</td>
<td>70</td>
</tr>
<tr>
<td>74HC05</td>
<td>3-input NAND gate</td>
<td>60</td>
</tr>
<tr>
<td>74HC06</td>
<td>4-input NAND gate</td>
<td>50</td>
</tr>
<tr>
<td>74HC07</td>
<td>3-input NAND gate</td>
<td>40</td>
</tr>
<tr>
<td>74HC08</td>
<td>4-input NAND gate</td>
<td>30</td>
</tr>
<tr>
<td>74HC09</td>
<td>3-input NAND gate</td>
<td>20</td>
</tr>
<tr>
<td>74HC10</td>
<td>4-input NAND gate</td>
<td>20</td>
</tr>
</tbody>
</table>

### Voltage Regulators

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7805</td>
<td>5V regulator</td>
<td>1000</td>
</tr>
<tr>
<td>7905</td>
<td>5V regulator</td>
<td>900</td>
</tr>
<tr>
<td>7812</td>
<td>12V regulator</td>
<td>800</td>
</tr>
<tr>
<td>7912</td>
<td>12V regulator</td>
<td>700</td>
</tr>
<tr>
<td>7815</td>
<td>15V regulator</td>
<td>600</td>
</tr>
<tr>
<td>7915</td>
<td>15V regulator</td>
<td>500</td>
</tr>
<tr>
<td>7806</td>
<td>6V regulator</td>
<td>400</td>
</tr>
<tr>
<td>7906</td>
<td>6V regulator</td>
<td>300</td>
</tr>
<tr>
<td>7809</td>
<td>9V regulator</td>
<td>200</td>
</tr>
<tr>
<td>7909</td>
<td>9V regulator</td>
<td>100</td>
</tr>
</tbody>
</table>

### Other Regulators

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>78L05</td>
<td>Low dropout regulator</td>
<td>100</td>
</tr>
<tr>
<td>79L05</td>
<td>Low dropout regulator</td>
<td>90</td>
</tr>
<tr>
<td>78L12</td>
<td>Low dropout regulator</td>
<td>80</td>
</tr>
<tr>
<td>79L12</td>
<td>Low dropout regulator</td>
<td>70</td>
</tr>
<tr>
<td>78L15</td>
<td>Low dropout regulator</td>
<td>60</td>
</tr>
<tr>
<td>79L15</td>
<td>Low dropout regulator</td>
<td>50</td>
</tr>
<tr>
<td>78L06</td>
<td>Low dropout regulator</td>
<td>40</td>
</tr>
<tr>
<td>79L06</td>
<td>Low dropout regulator</td>
<td>30</td>
</tr>
<tr>
<td>78L09</td>
<td>Low dropout regulator</td>
<td>20</td>
</tr>
<tr>
<td>79L09</td>
<td>Low dropout regulator</td>
<td>10</td>
</tr>
</tbody>
</table>

### Turned Per Low Profile Sockets

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>74540</td>
<td>Turned per low profile socket</td>
<td>100</td>
</tr>
<tr>
<td>74541</td>
<td>Turned per low profile socket</td>
<td>90</td>
</tr>
<tr>
<td>74542</td>
<td>Turned per low profile socket</td>
<td>80</td>
</tr>
<tr>
<td>74543</td>
<td>Turned per low profile socket</td>
<td>70</td>
</tr>
<tr>
<td>74544</td>
<td>Turned per low profile socket</td>
<td>60</td>
</tr>
<tr>
<td>74545</td>
<td>Turned per low profile socket</td>
<td>50</td>
</tr>
<tr>
<td>74546</td>
<td>Turned per low profile socket</td>
<td>40</td>
</tr>
<tr>
<td>74547</td>
<td>Turned per low profile socket</td>
<td>30</td>
</tr>
<tr>
<td>74548</td>
<td>Turned per low profile socket</td>
<td>20</td>
</tr>
</tbody>
</table>

### Transistors

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2N2222</td>
<td>PNP transistor</td>
<td>100</td>
</tr>
<tr>
<td>2N2221</td>
<td>NPN transistor</td>
<td>90</td>
</tr>
<tr>
<td>2N2220</td>
<td>PNP transistor</td>
<td>80</td>
</tr>
<tr>
<td>2N2219</td>
<td>NPN transistor</td>
<td>70</td>
</tr>
<tr>
<td>2N2218</td>
<td>PNP transistor</td>
<td>60</td>
</tr>
<tr>
<td>2N2217</td>
<td>NPN transistor</td>
<td>50</td>
</tr>
<tr>
<td>2N2216</td>
<td>PNP transistor</td>
<td>40</td>
</tr>
<tr>
<td>2N2215</td>
<td>NPN transistor</td>
<td>30</td>
</tr>
<tr>
<td>2N2214</td>
<td>PNP transistor</td>
<td>20</td>
</tr>
<tr>
<td>2N2213</td>
<td>NPN transistor</td>
<td>10</td>
</tr>
</tbody>
</table>

Please add 50p p&p & 15% VAT (Export: no VAT, p&p at cost)

Orders from Government Dept. & Colleges etc welcome.

Detailed price list on request.

Stock items are normally by return of post.
Dear Sir,

I thought technical people were logical thinkers — but I'm afraid the letter from Mr. Wakeham (ETI, May 1985) didn't appear too well hung together to me. Judging from the Editor's little piece, it would appear he thought it was a bit too coherent to me. Judging from the Editor's little piece, it would appear he thought it was a bit too coherent to him.

Of course, the usual paranoia about 'communism' was seen. Yet there are a large number of 'communist' philosophies — Christian communism, Libertarian communism (I'm sympathetic to that), etc. I suspect Mr. Wakeham means the corrupt old business said to be based on a few things that a certain Karl Marx went on about. Then we read all about being phone-tapped — with bated breath! (By our democratic State! — Britain — land of the free — shame on you Mr. Wakeham . . .) Yet we read a 'curse on both your houses' — Communism and Capitalism.

I wonder if Mr. Wakeham realises that FREEDOM is the name of the Anarchist newspaper (started by a scientist, Peter Kropotkin, last century — and circulation said to be rising quite quickly at the moment)!)

Now we come to the 'objectives'. Well, yes, there has been talk about pressing a button to vote via the media, but someone has shown that it would be extremely easy for hackers of some genre or another to juggle the figures by underground input — to their heart's content. Next, Big Brother is watching you . . . and 'the legislation is just and unambiguous', see, comrade no. 63 — or if you don't you it's Room 101 for you! (By the way, I'll control your mind — don't you argue with me — I'm a technician, and I've ceased to be meek!)

Now (to which we come at last) here's a thing. We must 'discover' those who are 'fit' and who can be 'trusted with power'. Who will do this programming? Why those who already have the power — and those with a drive or a thirst for it? Mr. Wakeham's near-religious faith in 'the technical fix' is touching, but hasn't he come across the ease with which you can twist any of that knowledge to say nearly anything you like! (Alas, just look at some of the fiascos of technology in recent times . . .)

Yet this is not to say that technical projects etc. are not fascinating and action packed. But from the power point of view there is some nice work in existence showing a tendency for the growth of what might be called 'Techno-fascism'. There is no space to go into that here, but an eye should certainly be kept on it.

No, I'm afraid old Lord Acton was right when he said 'Power corrupts, and Absolute Power corrupts absolutely.' Any technicians tempted to follow the absolutist path might like to try reading that excruciating book by Jacques Ellul called 'The Technological Society', and also that by Dr. Alex Comfort called 'Power and Delinquency in the Modern State', which has a whole lot of medical argument to illustrate the peculiar state of mind of anyone who is driven to seek political, or other, power over . . . No mention is made in these analyses to the effect that a God-like absolute truth can be found in any computer, IT processor, TV set, or Technician for that matter . . .

Yours sincerely,
Ken Smith
University of Kent
Canterbury.

I'm not sure I like that reference to my little piece, but it does strike me that the idea of technicians being qualified for power by virtue of their technical expertise is about as stupid as the idea that an actor might be fit to become President of the United States by virtue of his acting ability — Ed.

Write/Read

Dear Sir,

I have recently started to read (and hopefully teach myself) about electronics. I have bought a number of the publications on the subject and find that yours is by far the best. However, I am having difficulties and I hope that you may be able to help me.

My main interests are amplification and microcomputers. I would therefore be grateful if you could recommend any worthwhile reading on these subjects. The libraries in my area do not have any appropriate books, and of the books on the market I am stuck for choice. A typical question that you have probably heard before is this: is it worthwhile my investing in an electronics course, either by correspondence or in my local ITc?

Yours,

J. Birch
St. Helens
Merseyside.

Advising on electronics books is difficult because I don't know what level you've reached or what your special needs are. I can only suggest you find a good college or university bookshop and browse, until you find the book or books that seems readable and addresses itself to what you want to know. I can, of course, also recommend that you read our review pages which regularly feature new textbooks. This might give you some idea of what's available. In general, practical experience is probably vital in order to develop an understanding of electronics. We hope our projects may be of some use, but undertaking a course of some sort is undoubtedly a good idea. I would recommend a college or an ITc (if it's a good one), if only because the on-the-spot assistance you would get is invaluable — Ed.

What A Bind!

Dear Sir,

I refer to the cover photo of the March 1985 issue, pretty impressive circuit board for a home constructor, but unless I'm mistaken (which I'm not) the board shown is resting (in peace) gathering dust on the top of my wardrobe, bought for a few pounds from a surplus store as a video game.

The probability that this is a genuine mistake is 9245804:1 (this is also my phone number). Now that's improbable.

Yours,

CHEAT.

I refer to the cover photo of the March 1985 issue, pretty impressive circuit board for a home constructor, but unless I'm mistaken (which I'm not) the board shown is resting (in peace) gathering dust on the top of my wardrobe, bought for a few pounds from a surplus store as a video game.

The probability that this is a genuine mistake is 9245804:1 (this is also my phone number). Now that's improbable.

Yours,

CHEAT.

I refer to the cover photo of the March 1985 issue, pretty impressive circuit board for a home constructor, but unless I'm mistaken (which I'm not) the board shown is resting (in peace) gathering dust on the top of my wardrobe, bought for a few pounds from a surplus store as a video game.

The probability that this is a genuine mistake is 9245804:1 (this is also my phone number). Now that's improbable.

Yours,

CHEAT.
Seriously though, keep up the good work and how about a reward for spotting the deliberate error or a bribe to keep quite.

Yours hopefully,
A. J. Moore,
Liverpool.

(PS: I believe you are looking for good homes for binders).

Dear A. J., you're not wrong. We were going to offer you the bribe, but we blew it.

Mixing with JLH

Dear Sir,

Reference JLH's mixer of June edition 1985. I take the point that JLH is not aiming at 'ultimate fi' but would like to point out that the Gramophone input circuit as published strays by almost 5dBs in the upper bass region from the RIAA playback curve. This is easily remedied by changing the value of C34 from 49nF to 29.2nF (from 27nF and 22nF in parallel to 27nF and 2n2F in parallel), this, by chance, makes the values in the feedback very nearly those used by QUAD in the infamous '33'; can't be bad!

I would also like to recommend that an extra capacitor be added in parallel with the 'mixer pot' (RV12 as drawn), on the RIAA input stage. This will help the response at the higher frequencies where the attenuation of the series feedback arrangement tails off, the response will then be more like that of a 'shunt feedback' layout almost mentioned by JLH. In addition to the accuracy gained to the RIAA curve, this extra C helps particularly with scratches and other record noise. The value my 'BBC' and I recommend is 8n2F and is not significantly affected in the audio band by the setting of RV12.

Yours faithfully,
J. R. Charlesworth
Pickering
N. Yorks.

Help-line

Dear Sir,

I feel I must reply to the letter on page 15 of your May issue, from Mr. R. Leslie. Firstly, may I commend him on his action in taking his hobby further, but more importantly, I must warn him of the dangers of what he requests. In supplying equipment, a company should undertake to provide a service, that is to say the use of shorter than 40mm sliders provides no benefit, they are more difficult to adjust and more importantly if he has them made to order, then a customer with his machine may find that in a few years it is impossible to obtain a replacement if, for example, Mr. Leslie's company has dropped that product. So, in conclusion, by all means use custom knobs, but please don't add to the confusion of special spares available only from the manufacturer (or not at all). In my own work I have often had to scrap customer's equipment due to lack of availability of special spares.

Yours sincerely,
David McIntyre
Kirkcaldy.

Please send letters of Help-line queries or contributions to Read/Write, ETI, ASP Ltd., 1 Golden Square, London W1R 3AB. Any letter we receive may be published unless marked 'Not for publication', and we reserve the right to edit letters for reasons of space. We have received a note addressed to Help-line detailing a commercial service. Please note that the place for commercial services to advertise is in the classified section of ETI.
Prepare to be LED along even stranger paths as John Linsley Hood tunnels his way into the eerie world of diodes.

I looked, when I was describing how transistors evolved, at the basic P-N junction (Fig. 1). These are created by taking a rod, some 2-4 inches in diameter, of very highly purified silicon or other semiconductor material in single crystal form, and cutting it into slices with a diamond edged circular saw. The very thin discs so formed are cleaned and polished, and finally heated in a vacuum oven with a carefully chosen atmosphere so that selected impurities will diffuse into the semiconductor material to a precisely controlled depth.

Silicon is tetravalent, which is to say that the atomic structure is such that there are four surplus valency electrons present in the outermost electron shell within the atom. If one diffuses in a trace quantity (one or two parts per million) of an impurity such as arsenic which is pentavalent (it has five outer orbital electrons), the net result will be that there are some ‘spare’ electrons floating around in the crystal structure.

We call such a material an N doped silicon, or simply N type. If the material is heavily doped, we call it N+, if it is lightly doped we call it N− and so on.

Similarly, if we diffuse in boron which is trivalent (it has only three outer valency electrons), the result will be a number of holes where electrons should be, but are not. These holes behave like positive electrons, but are a bit more sluggish. This is because their movement takes place only as a result of an electron coming from somewhere else to fill the gap, leaving another hole where it had been, and so on. I like to think of this as a kind of electronic leap-frog.

When a P and an N doped semiconductor material are in contact, usually as a result of deliberately contrived impurity zones within the single crystal slice, there occurs a diffusion of these ‘spare’ electrons and holes across the junction. This leaves a depletion zone on either side of the notional junction region which is completely stripped of both holes and electrons, as shown in Fig. 1.

This depletion region is, therefore, effectively a non-conductor, so even in the conducting direction of the diode it is necessary to apply a certain forward voltage before any current will flow, to give the electrons enough kinetic energy to traverse the potential gap.
The effect of this is to make the depletion zone appear to decrease in width, to the point at which it disappears when the forward conduction potential for the junction is reached. The converse is true for a reverse biased junction.

This results in the voltage/current graph shown in Fig.2a. A very important characteristic to note is that the forward voltage drop, \( V_f \), for a diode connected in its forward biased mode is one of pure conduction and is therefore not very noisy, whereas operation in the reverse conduction mode is very noisy indeed.

So, when you need a voltage drop in low noise circuitry, use a string of forward diodes or an ‘amplified diode‘ as shown in Fig.3 rather than a zener diode, in which the conduction occurs as a result of reverse breakdown.

A consequence of the greater mobility of electrons and holes as a result of thermal excitation is that the forward voltage drop of a PN diode decreases with temperature. This seems to contradict the concept that the depletion region arises as the holes and electrons migrate across the junction, so that greater mobility of these should cause a wider depletion zone, but in reality the increased carrier mobility simply acts to lessen the forward bias which needs to be applied before conduction occurs.

However, an important feature of doped regions is that the width of the depletion zone at the junction decreases as the impurity concentration, and the consequent number of holes and electrons, is increased. This phenomenon is used in tailoring device characteristics, as shown later.

**Small Signal Diodes**

There are three different types in general use:-

*Germanium point-contact diodes*, useful for very low level signals in radio applications, but otherwise tending to become obsolescent.

*Germanium diffused junction diodes*, similar in characteristics to silicon ones, but with a lower forward voltage drop (0.15V typically, as compared with 0.55V for silicon), worse reverse leakage current (by a factor of about 1500x), and worse temperature coefficient and maximum working temperature.

*Silicon diffused junction diodes*, such as the 1N4148. These are inexpensive and very reliable (if from a good manufacturer), and can be used as low power rectifiers up to about 30V RMS and 50mA. Their four nanosecond recovery time (the length of time which it takes for the electrons and holes generated by current flow to recombine, so that the diode would be non-conducting in the reverse biased direction) limits their use to about 100MHz. For higher frequency use more suitable diode types are available.

**Power Rectifier Diodes**

These are basically similar to the small signal diode. However, the power handling capability of the diode is determined by the maximum junction temperature, which, in turn depends on the conducting resistance of the diode which determines the power dissipation for any given current and the ease with which the heat generated in the junction can diffuse away. These will usually have a large junction area to minimise the conduction resistance, in good thermal contact with a metal plate or stud whereby the heat can be taken to some kind of heat sink.

Also, such diodes must be able to withstand a high reverse voltage. This is achieved partly by their junction geometry, as shown in Fig.4. In early designs of rectifier diode, it was noted that failure almost always took place at the edge of the junction area. If the sides of the chip are etched away at an angle, the electrical stress at the edge of the junction can be reduced so that this kind of breakdown is prevented.

The other technique employed is to keep the doping impurity levels relatively low, so that the depletion region is wider and the stress, per unit thickness, is consequently less. This, unfortunately, increases the resistance of the silicon per unit area with a consequent higher forward voltage drop - hence more thermal dissipation for a given current. In lower voltage rectifier diodes relatively high doping levels will be employed, simply to reduce the forward conduction power losses.

**Avalanche Diodes**

A further technique which is used in power rectifiers is to tailor the diffusion process and the doping levels of the P and N regions on either side of the junction so that the depletion region is very uniform in thickness. Then, provided that the doping levels are not too high, any carrier (electron or hole) entering the depletion region under conditions of reverse bias will be so accelerated that impacts with atoms will generate further electron-hole pairs. These, in turn, will be accelerated by the applied electric field and will collide with other atoms, giving rise to a situation very
sloping hillside. The purpose of the avalanche diode approach is to avoid destructive damage to the rectifier occurring as a result of very short duration high voltage spikes. These arise all too frequently on power lines. A straightforward rectifier diode could break down under these conditions, and the very high temperatures generated by even small local current flow at high reverse voltages could fuse portions of the junction, leading to a short-circuit.

A typical voltage/current graph for an avalanche diode is shown in Fig. 5. In a well designed device, the reverse turn on is very abrupt and conduction will be distributed uniformly across the whole of the junction area. Although a maximum static thermal dissipation of some tens of watts might be permitted for such a diode, this could well absorb a spike energy equivalent to tens of kilowatts for a duration of only a few microseconds without any harm.

Zener Diodes

These are very heavily doped diodes, with, in consequence, a very thin depletion region between the PN junction. The reverse bias electrical stress across this causes ionisation of the semiconductor material in the depletion zone, and consequent current flow. Beyond about 7V, zener diodes are not used. All of the so-called zeners above this voltage will, in fact, be avalanche diodes. As mentioned above, reverse leakage current is noisy, and a zener diode will make quite a good wide-band noise source.

The fact that zeners are all very highly doped tends to give them a low and fairly sharp turn-on characteristic in the forward direction, which can be useful.

High Frequency Diodes

The major requirements in this application are high carrier mobility and low junction capacitance. These requirements are met fairly well by the old point contact or gold-bonded Germanium diodes, but the most commonly employed type nowadays is the Schottky diode, shown in Fig.6a. This relies only on majority carrier action (electron flow), and is, in consequence, fast in action. The snag is that there are sharp corners where the metal inlay abuts on the N type silicon slice, and the electrical stress at these points leads to a low reverse breakdown voltage which can be as little as 5V. The advantages of this construction are that the forward voltage drop is reduced to some 180-220mV, and that the operating frequency can be as high as 18-20GHz.

The electrical stress at the edges of the metallic layer in a Schottky diode can be lessened by the inclusion of an annular ring of P-type silicon under the edge, as shown in Fig. 6b. However, although it can increase the reverse breakdown voltage to 60-70V, the maximum operating frequency is reduced to about 4GHz. These are sometimes called hybrid Schottky diodes.

Depending on the construction employed, the junction capacitance can be as low as 1pF - compared with 5-50pF for a standard small-signal silicon junction diode and 500-5000pF for a rectifier diode.

An important characteristic of diode behaviour, which influences pulse and switching performance in addition to RF behaviour, is the transient response of the diode junction. This is determined by a variety of phenomena such as:-

Fig. 7 Carrier storage following a reversal of the applied voltage in a PN junction diode.

Carrier storage, due to the minority carriers (holes) still left uncombined at the conclusion of a forward conduction period. This causes conduction to continue for a short period following a reversal of potential, as shown in Fig. 7a. The stored charge can be expressed in pico-coulombs (1 coulomb is the charge stored in a 1 farad capacitor at an EMF of 1 volt), and typical values are 100-10,000pC.

Turn-on transient, due to the time taken for conduction to settle down to a steady value. Typically 10-100ns for a small-signal silicon junction diode.

Voltage dependence of junction capacitance is a characteristic which is exploited in varicap diodes, but occurs in all reverse-biased PN junctions and has some of the characteristics of inductance.

Varicap Diodes

The capacitance of a reverse biased PN junction is, roughly, inversely proportional to the square of the voltage in a PN junction diode.

Fig. 8 The use of varicap diodes to provide remote voltage controlled tuning.
Every diode appears to consist of voltage across it. Such a diode is a semiconductor slice of two conducting regions separated by the depletion layer between them, which acts as a dielectric. Typical devices have capacitance values in the range 3-50pF, depending on device and applied voltage.

The way in which they can be used as a remote voltage-controlled tuning element is shown in Fig. 8. Back-to-back connection is frequently employed where large signal levels are likely, to prevent the signal voltage itself from modulating the capacitance.

A similar type of construction is employed in the varactor diode, in which the diode is connected across an oscillator coil and the dependence of the capacitance on instantaneous voltage is used to generate harmonics of the signal.

**Step Recovery Diode**

This is a device which is designed, by geometry and doping levels, to have a very abrupt switching characteristic when the applied potential is reversed. It can be used to shock excite a coil into oscillation at a much higher frequency (up to the sixth harmonic) than the input voltage. This is useful for microwave signal generation, as is the impatt diode.

**Impatt Diode**

This is a device whose design is deliberately contrived to give a very wide depletion layer, assisted by the inclusion of a layer of intrinsic (un-doped) silicon, in the form shown in Fig. 9a. When this is used in the type of circuit shown in Fig. 9b, quite useful amounts of microwave power (up to 1W CW at 50GHz, or 50W pulsed) can be generated. The trepatt diode is a structural modification of this to cause bunching of the electrons, which allows some increase in power levels.

**Gunn Diode**

In spite of its name, this isn't really a true diode at all. Made from N-type gallium arsenide, it is what is known as a two-valley semiconductor in which the conduction band (that energy level in which the electrons can move as in a normal conductor) has two different levels, with different mobilities.

When current is caused to flow through a slice of this material between two ohmic contacts, the fast electrons overtake the slow electrons to form a bunch which travels through the slice. The result of this is an accumulation of charge at the cathode, until it neutralises the field due to the applied voltage at the contact. Charge accumulation then stops, and the charge domain then travels through the semiconductor slice in the form of a sharp spike of current at a speed determined by the applied voltage. This process then repeats to generate a rapid series of such spikes.

Such devices are often used as the microwave power sources in such things as microwave Doppler intruder and fire alarms.

**Tunnel Diodes**

A decade or so ago, these devices were seen as the bright new hope for simple RF oscillator circuits. Unfortunately, their price never became low enough for them to achieve popularity, and they may soon become just a historical curiosity. They are based on the use of a very highly doped junction, with a consequent very thin depletion layer.

**Light Emitting Diodes**

Apart from the ubiquitous transistor, this is, I think, the bit of modern semiconductor technology which has made the biggest impact on the public at large, as a long-life replacement for filament indicator bulbs.

These work because radiation is emitted by an atom when an electron, having been excited into a higher energy level by some input of energy such as a current, falls back into its original rest level; a similar mechanism operates when an excited electron falls into a hole. The process is known as electroluminescence.

Since the light is emitted from the junction, the diode must be designed so that the light can escape, and usually they are encapsulated in a plastic moulding so designed that it acts as a magnifying glass with

---

**Fig. 9** The construction of an impatt diode and b) a microwave power oscillator using the device.

**Fig. 10** Voltage/current characteristics of a typical tunnel diode.

At very low reverse bias levels, the thermal energy of the electrons in the semiconductor is high enough for them to 'tunnel' through this depletion layer, and the junction conducts. However, as the reverse voltage is increased the thickness of the depletion layer increases, so the tunneling effect, even with an increased potential difference, begins to lose ground. The current then begins to fall as the potential is increased, giving what is known as a negative resistance characteristic.

In due course, the leakage current begins to increase once more leading to the type of reverse voltage/current graph shown in Fig 10. If this is connected in series with a coil as shown in Fig. 11, a simple HF oscillator circuit with a stable output voltage is produced. However, tunnel diodes are quite easily damaged by excessive currents.
the junction at its focus. In order to get radiation emitted in the visible part of the spectrum, it is necessary to have a material with a large energy band gap, such as gallium arsenide (red), gallium arsenide phosphide (amber and yellow), gallium phosphide, (yellow or green, depending on doping).

Early LEDs were not very efficient in terms of the light output for current input, efficiencies of the order of 0.005% being not unusual. However, more modern ‘high-brightness’ LEDs can reach 3% efficiency, especially in the red colours where they are beginning to compete with filament bulbs. Also, by tailoring the geometry of the device, semiconductor lasers are possible and these are used as the ‘reading’ device in compact disc players.

Care must be taken not to reverse bias an LED (light is emitted when current flows in the forward direction) since reverse breakdown will damage the device. An LED can be used on an AC source if it is shunted by an ordinary silicon diode as shown in Fig. 12.

Reverse Leakage

This is one of the major problems with semiconductor diodes, apart from reverse breakdown, and is strongly dependent on temperature. Such leakage currents increase by 10% for each 1°C rise in temperature, which means that the leakage current will double every 8°C. This sets an upper limit for the use of germanium diodes at about 70°C and for silicon at about 160°C.

Although diodes do not appear to have a lot to do with ICs, most microcircuits are made on a substrate of silicon with all the bits of circuitry isolated from the substrate simply because they are sitting on top of a reverse-biased diode junction.

As I mentioned above, such leakage currents are noisy, and this was (and to a lesser extent, still is) the reason why low noise circuits built up from discrete semiconductors would often be better than their op-amp equivalents. However, technology improvements have lessened this penalty, and nowadays, for most practical purposes, if an IC is available to do the job it is not sensible to do it any other way.

Having said that, I propose to have a look next month at the world of the linear IC, with particular reference to the operational amplifier.

---

**TURN YOUR BBC MICRO INTO A PROFESSIONAL MICROPROCESSOR DEVELOPMENT SYSTEM**

**THE OPERATING SYSTEM**
- FLEX — The Professional Operating System
- Versatile, Flexible & Powerful, the ideal operating system for industrial control
- Provides the power, sophistication and ease of development, previously only offered by larger, more expensive systems

**THE HARDWARE**
- 6809 Advanced 16 Bit Processor
- Choice of Industrial Interfaces for Target Applications:
  - High Resolution Colour Graphics
  - Industrial input/output boards
  - IEEE communications
  - and many more

**THE TOOLS**
- PL9 — A fast, efficient control language
- CMS FORTH Interpreter & Compiler
- Cross Assemblers for most 8 bit & 16 bit micros
- "C", BCPL, PASCAL

**THE SUPPORT**
- Top rate after sales technical support
- Systems / Hardware Design

---

Fig. 11 (left) A simple HF oscillator circuit using a tunnel diode and Fig. 12 (right), driving an LED from an AC supply.
In this personal view, hi-fi designer Neil Munro sounds off about power supplies, capacitors and hi-fi designers with audible results.

I had always thought that the only real differences in pre-amps were down to hiss and the facilities offered, once adequate specifications had been achieved. But then, in between repairing and designing various small bits of hi-fi, studio and PA equipment for others, I knocked together a disc pre-amp for myself. I brought it to the shop where I was working at the time and one of the sales staff set it up for a comparison with a newly introduced, expensive commercial design. I sat down, closed my eyes and listened. To my amazement, my pre-amp gave a noticeably clearer and less cluttered performance. I could hear the difference.

Since both pre-amps used broadly similar circuitry (based on the NE5534 and TL072 op-amp chips), both had less than 0.01% distortion at normal levels and both had similarly accurate EQ, I had no idea why they should sound so different. I set about developing the design, replacing the moving magnet input with one for a moving coil cartridge. After playing with several ideas, I found the familiar LM394/NE5534 hybrid configuration worked well. Unlike a similar circuit by Barry Porter, published in ETI, December 1983, I filtered the supply to the LM394 input ‘pair’ and was rewarded with perfect stability and a sensible slew rate. This MC circuit was predictably noisier than my original pre-amp but it sounded even clearer. I could easily tell if three or four voices were singing or if a guitar was nylon or steel strung.

This didn’t seem to me to be entirely due to cartridge variations, since a very expensive commercial MM pre-amp was just as clear. I was puzzled. What was behind all these evident differences?

I checked for marginal stability in the 5534 circuit, but it was fine. I considered power supply rejection in the 5534 stage. The MC circuit used a 5534 stage and it performed very well. In fact, the 5534 has a stated power supply rejection ratio (PSRR) of 100μV/V and a stated common mode rejection ratio (CMRR) of 100dB. But this started me thinking. The figures are referred to input and should be reduced by whatever gain follows. They’re also quoted at DC. And then there was the fact that the MC circuit’s gain comes mostly from the LM394 input ‘pair’ while the 5534’s inverting and non-inverting inputs are fed from equal impedances - so that it should have an easy job.

I felt that I needed to check the real wideband PSRR referred to output, in order to get a true idea of what would happen when you actually listened to some music. I rigged up a power supply with a modulating input (Fig. 1), injected 1V p-p on both the positive and negative supply rails and checked the output of the MM circuit. The modulation appeared at —30dB to —40dB. Taking into account an assumed figure — 70dBV for main supply noise, the modulation noise would drop to —100dB to —110dB when referred to a nominal 1V output from the pre-amp.

This was good news. But when I came to replace the 330 ohm dummy load at the input to the pre-amp with a real MM cartridge (typically 500 R + 1200mH), my jaw dropped slightly. In the 5-20kHz region, the modulated supply noise increased to —10dB. With the power supply back to normal and the cartridge still in place, I found that high frequency input signals gave up to 3mV or — 50dBV of rubbish, which could appear at the output at a worrying —60dB. On the other hand, when I came to test the MC circuit I found that it fared well with a real cartridge in place (these are predominantly resistive at between 3R5 and 30R. It was even acceptable open circuited: —30dB to —40dB except at 20Hz (and this was cured by enlarging the input coupling capacitor and using an active filter for the LM394 stage). The trouble with that capacitor was that low frequency reactance caused an impedance mismatch which ruined the PSRR and CMRR figures for the MM circuit (Fig. 2).

![Fig. 1 Injecting modulation into power supply.](image)

![Fig. 2 PSRR test circuit with MM cartridge.](image)
The Heart of Noise

These things were all curable, yet they didn’t reach to the heart of the problem - the power supply noise in an actual circuit. Clearly, the first place to look for noise in a regulated power supply is the regulation itself. I was using 78/79 types and, as luck would have it, their quiescent noise (20-20kHz hum and hiss) was -70 to -80dBV. Later, I bought a batch for evaluation and found that some showed as much as -40dBV and often came complete with nasty splutterings.

But that’s only part of the story. In operation, active circuitry tends to draw varying current. In Class A amplifiers, this is in step with the signal, but in Class B it becomes half-wave rectified as the positive and negative sections of the audio signal are driven into low impedance loads. The output impedance of the supply and the impedance of intervening wires and connectors become important, introducing modulation on the IC terminals. From this point-of-view, the quality of the power supply is irrelevant. What matters is the modulation.

The all-too-common practice of decoupling with a filter (typically composed of a 10Ω resistor and 10μF capacitor) can actually make things worse because it assumes that the local signal common is 0V. But conventionally, the 0V rail is also signal common and should be treated as a signal path. You wouldn’t connect capacitors from the supplies to the actual signal path, because they will inject noise and modulation rubbish into it which, because of the practical finite impedance of the signal path, will produce a potential that adds to the signal output.

A 10μF capacitor also has an impedance of 800Ω at 20kHz, so signal modulation will be worse. Using a larger capacitor, say 470μF, will help - but at the cost of injecting noise more efficiently (Fig. 3). The only really effective approach - if an expensive one - to ensuring stability on the signal common is to use local active regulation. Even here, care must be taken to avoid injecting DC or other noise into signal common.

Another problem resulting from the finite impedance of signal common is that heavy load currents will generate errors. This is usually inoffensive from an acoustical point-of-view, but with disc input stages the feedback current is the pre-emphasised version of the signal with high frequencies boosted. The result can be nasty harsh noise when added to the equalised output. There are several methods for avoiding this - the use of true independent supplies in different stages, differential sensing of output, shunt feedback or 0V regulation. I chose the last of these as it kills two birds with one stone (Fig. 4). The feedback is handled by a local op-amp that transfers it to the opposite supply line instead of signal common - effectively reducing signal common impedance to the output impedance of the op-amp (for

![Fig. 3 PSU noise resulting from impedance of leads and signal common corruption in class AB out-put stage.](image)

![Fig. 4 Constant current series feedback giving 0V regulation.](image)

![Fig. 5 Suggested PSU regulation circuit.](image)

78/79s are perfectly good general purpose regulators, but they’re not intended for precision supplies. The computer-optimised LM340 series (for example, the LM34OT-15) are consistently better, though the complementary LM320 series is rather expensive for negative supply regulation. The LM337 series are better value, especially if TL072s are used, since their negative supply input is very noise sensitive. The 5534 is an excellent line processing block when driven from lowish kilohms with clean supplies. The power supply circuit shown (Fig.5) has noise in the 20-20kHz range better than -80dBV with 100mA drawn and an output impedance of around 0R3 at 100kHz thanks to the 470μF output capacitors.
On the general topic of power supply decoupling, the use of separate filters for each channel is not recommended. It would be rather like isolating two people with the same contagious disease - it doesn't cure either of them. It's actually useful to have two channels sharing the same supply at each stage, since one can be driven with a signal and the other used to detect any noise generated in the process.

A Couple of Points

And now to capacitors. A 1958 Radio & Electronics handbook that I unearthed has an excellent section on power supply topography and mentions that paralleling a 220μF electrolytic with a 100nF film type overcomes some of the problems connected with the equivalent series resistance (ESR) and leakage of the electrolytic. I was giving my mother hell for bringing me into the world when that was written and it still applies if you’re talking about the stability of wideband amplifiers - as long as the bypass capacitor is placed close to the circuitry not the power supply. But anyone who believes that such bypassing has a significant effect in the audio band either hasn’t bothered to look into the characteristics of modern electrolytics or is still using 27 year old ones!

For example, the 220μF/16V cap used in my power amp feedback decoupling has an ESR of 0.3 to 0.4 ohms at 20kHz and 15°C (it was winter!). A 470nF polyprop/polyester/polyanything has impedance of 17ohms under the same conditions - so what’s bypassing what? It’s only when you get above the 500kHz range that inductive reactance starts taking over and the impedance of electrolytic and film cap begin to match. Bypassing at ICs can be important because inductive supplies in the MHz region can easily cause instability, but 10-47nF is quite adequate, cheaper and lessens noise injection into signal common.

And then you should be asking yourselves, why the pursuit of pure capacitance in coupling components? Ideally, a coupling component should block DC and have zero or constant impedance from at least 20Hz up to 20kHz. A perfect capacitor would do the former but would have 1000:1 variation in impedance over the audio band. Admittedly, in dB terms this variation is miniscule, but the point still stands. Now, a large electrolytic can approach the second requirement for a coupling component. The variation of impedance with frequency in an electrolytic is not simple and there is a 'break' frequency at which the slope flattens out. The electrolytic can be chosen so that this frequency is very low and in the critical mid to high frequency area ESR is practically constant. Inductive reactance is negligible below about 500kHz in any reputable make of capacitor in the sub 1000μF range.

So why do electrolytics sometimes sound odd? I’ve found that ESR can vary, particularly with temperature, by up to 0.1ohms. In conjunction with a 10R resistor - as in all too many MC inputs (Fig.6) - the variation can amount to -40dB. With considerably higher resistances (above 1 kilohm), this figure drops to -80dB or so.

Voltage modulation can also affect the performance of coupling electrolytics. In a competently designed circuit an electrolytic is operated well above its break frequency so that the voltage drop across it is a small fraction of the applied voltage - at most hundreds of millivolts. I have found no evidence of acoustic effects at this level. Even these slight reverse voltages can be eliminated by using predictable offsets to polarise the electrolytics to the peak expected reverse voltage. We have done this with our design, and while I’m not convinced that it has any significant impact, it certainly does no harm (Fig. 7 and 8).

Elie July 1985

Fig. 6 ESR variation in electrolytics - typical configurations.

Electrolytics may also suffer from microphony - a feature used to positive advantage in capacitor microphones. At 200μV sensitivity, microphony in input and feedback capacitors in an MC input stage is hardly surprising, although it varies with type and make. Generally, tantalums produce a boing while aluminium electrolytics give a duller dump - which may explain why tantalums are out of favour. In both cases, mounting in a dollop of silicon rubber helps enormously, damping the resonance due to vibration of the body relative to the leads. Incidentally, other components can suffer from
microphony — particularly FETs. It can be helpful to gently tap all components with a plastic pen to test them.

When it comes to power amp main capacitors, bysspassing becomes even sillier. To achieve 100 millihms at 20KHz would require 80uF of pure capacitance (can I speak to the bank manager, please?). There is no substitute for low ESR electrolytics, now widely available thanks to their development for switch-mode power supplies. Sprague, Mullard, STC and RIFA all do 10,000uF 63V types with a specified maximum of 26 millihms at 10KHz. In most cases a few inches of wiring is enough to equal that.

**Stiff and Nonsense**

When getting obsessed with basic power supply impedance, it’s useful to stop and ask, ‘why does it matter?’. In a sense, the only power supply to an amplifier is the mains, conditioned as required for the sake of convenience so that an input voltage can control this.
Enquiries

We receive a very large number of enquiries. Would prospective enquirers please note the following points:

- We undertake to do our best to answer en-
quirers relating to difficulties with ETI projects, in particular non-working projects, difficulties in ob-
taining components, and errors that you think we
may have made. We do not have the resources to
adapt or design projects for readers (other than for
publication), nor can we predict the outcome if our
projects are used beyond their specifications;
- Where a project has apparently been construc-
ted correctly but does not work, we will need a des-
cRIPTION of its behaviour and some sensible test
readings and drawings of oscillograms if appropri-
ate. With a bit of luck, by taking these measure-
ments you'll discover what's wrong. yourself. Please
do not send us any hardware (except as a gift);
- Other than through our letters page, Read/
Write, we will not reply to enquirers relating to other
articles. We may make some excep-
tions where the enquire is very straightforward or
where it is important to electronics as a whole;
- We receive a large number of letters asking if we
have published projects for particular items of
equipment. Whilst some of these can be answered
simply and quickly, others would seem to demand
the compiling of a long and detailed list of past pro-
jects. To help both you and us, we have made a full
INDEX of past ETI projects and features available
(see under Backnumbers, below) and we trust that,
where possible, readers will refer to this before
given in any direct answer;
- We will not reply to queries that are not accom-
panied by a stamped addressed envelope (or inter-
ational reply coupon), as we enjoy reading your opinions on world affairs,
the state of the electronics industry, and so on, it
does not seem sensible to plough through several pages to find
exactly what information you want.

Subscriptions

The prices of ETI subscriptions are as follows:

- UK: £16.30
- Overseas: £24.00 Surface Mail
  £43.30 Air Mail
Send your order and money to: ETI Subscriptions Department,
Infonet Ltd, Times House, 179 The Marlowes, Hemel Hemp-
stead, Hertfordshire, HP1 1BB. Cheques, postal orders, etc should
be made payable to ASP Ltd. Note that we run special offers on
subscriptions from time to time (though usually only for UK sub-
scriptions, sorry).

ETI are held available through newswagents, and
if readers have difficulty in obtaining issues, we'd
like to hear about it.

Backnumbers

Backnumbers of ETI are held for one year only from the
date of issue. The cost of each is the current
cover price of ETI plus 50p, and orders should be
sent to: ETI Backnumbers Department, Infonet Ltd,
Times House, 179 The Marlowes, Hemel Hemp-
stead, Hertfordshire, HP1 1BB. Cheques, postal orders,
etc should be made payable to ASP Ltd.
We suggest that you telephone first to make sure there
are still stocks of the issue you require: the number is
0442 123435. Please allow 28 days for delivery.
We would normally expect to have ample stocks of
each of the last twelve issues, but obviously, we
cannot guarantee this. Where a backnumber pro-
vess is no longer available, or where the issue you require
appeared more than a year ago, photocopies of

individual articles can be ordered instead. These
cost £1.50 (UK or overseas surface mail), irrespec-
tive of article length, but note that where an arti-
cle appeared in several parts each part will be
charged as one article. Your request should state
clearly the title of the article you require and the
month and year in which it appeared. Where an arti-
cle appeared in several parts you should list these
individually. An index listing projects only from
1972 to September 1984 was published in the
October 1984 issue and can be ordered in the same
way as any other photocopy. If you are interested in
features as well as projects you will have to order an
index covering the period you require only. A full
index for the period from 1972 to March 1977 was
published in the April 1977 issue, an index for April-
1977 to September 1977 was published in the
December 1978 issue, the index for 1979 was
published in January 1980, the 1980/81 index in
January 1982, the 1982 index in December 1982,
the 1983 index in January 1984 and the 1984 index
in January 1985. Photocopies should be ordered
from: ETI Photocopies, Argus Specialist Publica-
tions Ltd, 1 London W1R 3AB. Cheques, postal orders, etc should be made pay-
able to ASP Ltd.

Write For ETI

We are always looking for new contributors to the
magazine, and we pay a competitive page rate.
If you have built a project or you would like to write a
feature on a topic that would interest ETI readers, let
us have a design or proposal. We'll try to help you
get back to you to say whether or not we're interested
and give you all the boring details. (Don't forget to
give us your telephone number).

Trouble With Advertisers

So far as we know, all our advertisers work hard to
provide a good service to our readers. However,
problems can occur, and in this event you should:
1. Write to the supplier, stating your complaint and
asking for a reply. Quote any reference number you
may have (in the case of unsatisfactory or incom-
plete fulfilment) and give full details of the
order you sent and when you sent it.
2. Keep a copy of all correspondence.
3. Check your bank statement to see if the cheque
you sent has been cashed.
4. If you don't receive a satisfactory reply from the
supplier within, say, two weeks, write again, sending
your letter recorded delivery or telephone, and ask
what they are doing about your complaint.
If you exhaust the above procedure and still do not
obtain a satisfactory response from the supplier,
then please drop us a line. We are not able to help
directly, because basically the dispute is between
you and the supplier, but a letter from us can some-
times help to get the matter sorted out. But please,
don't write to us until you have taken all reasonable
steps yourself to sort out the problem.
We are a member of a legal protection scheme, and this means that, subject to certain con-
ditions, if a supplier goes bankrupt or into liquida-
tion, there may be compensation. From time
to time, we publish details of the scheme near our
classified ads, and you should look there for
further details.

OOPS!

Corrections to projects are listed below and normally
appear in the penultimate paragraph. Corrections are
published just once, after which a note will be inser-
ted to say that a correction exists and that copies
can be obtained by sending in an SAE.

ISSUE 27

Digital Control Port (November 1984)
The second sentence in the "Testing" section on
page 30 should include the words 'without any ICs'
in place of the second paragraph of that section, the
check for +5V should be made on pin 3 of IC101,
not IC1. At the bottom of the first column on page
31, the last sentence should finish with B3 = 0.

Video Vandal (November 1984)
In Fig 8 on page 54, R16 and R17 should be shown
connected to the base of Q4, and C12 and SW2
should be in the D output line rather than the QV
line. It may also be beneficial to add a diode across
R3 with its anode connected to the slider of RV1. In
Fig 10, R52 and LED2 are shown connected across
the +12 supply but it is better to place them across
the -12 supply so as to even-up the dissipation in
the ICs.

Electron Speech Board (November 1984)
In the parts list on page 58, IC3 should be listed as
a 74LS273.

Digital Delay Line (December 1984 - January 1985)
In Fig 6, on page 21 of the December issue, C19 and
C20 are both 100uF. In Fig 6, page 62 of the
January issue, C3 should be marked 33p. On the
overlay diagram, R9, p.64, R37 is missing and
should be connected between pin 3 of IC9 and the
OV line; R20 is missing and should be located in
the holes immediately to the left of R18, R30 is missing
and should be connected between pins 1 & 2 of
IC14. Some components on the overlay have also
been wrongly numbered: C20 should be marked
C19 and C21 should be marked C20; R12 (between
ICs 5 & 6) should be marked R22; R48 should be
R44, R49 should be R45, R57 should be R46, R51
should be R47, R50 should be R48, and R47 should
be R49. The unmarked capacitor directly above
what is now C19 is an un-numbered 100n ceramic.
C30 does not appear on any diagram or parts list
and this is correct.

“Sonneti” Combo (March 1985)
The foil pattern on the overlay diagram has been
shown as though from the copper rather than the
component side. The foil is correctly shown on the
Foil Patterns page from the copper side.

VCD0 (March 1985)
The foil pattern on the overlay diagram has been
shown as though from the copper rather than the
component side. The foil is correctly shown on the
Foil Patterns page from the copper side.

Single Board Controller (March 1985)
There were a number of errors in the parts list. RP2
is listed as a 10k S1L, but is actually four separate
resistors, and the same applies to RP3. RP4 is also
listed as a S1L pack but should consist of seven com-
moned resistors. R13 is always required, not just when
a cassette interface is used as stated.

Heat Pen (June 1985)
The corrections appear in the penultimate paragraph on
page 49 should read “… adjust RV2 for 2.73V …”.
not 2.32V as stated.
Gerry Kelly and Ted Wood investigate the claims and counter-claims about the growth of the British electronics industry and the jobs it will create, concentrating on Scotland in this article.

Scotland's growing microelectronics industry put another feather in its cap on 17 April this year. At a press reception held at the Scottish New Towns London Office, it was announced that EKC Technology Inc., which operates six manufacturing and distribution facilities in California's Silicon Valley, is to set up a plant in East Kilbride. East Kilbride is a growing new town and part of Scotland's attempt to be the California of Europe ('Silicon Glen' its promoters call it). Along with other Scottish new towns it has already attracted large amounts of foreign investment.

At the reception we were treated to a slide show and talk on the success story of East Kilbride, glossy brochures outlining its attractions to prospective investors, large amounts of food and drink and much heavy glad-handing from John Housley, EKC's Vice-President Marketing. On the way out we got an armful of freebies, including a miniature bottle of Spirit of East Kilbride's Scotch.

The setting up of EKC's plant is undoubtedly important to both East Kilbride and the semiconductor industry in Scotland. The photoresist strippers they produce will contribute substantially to the infrastructure of the industry, as J. Allan Denholm, Chairman of East Kilbride Development Corporation, puts it: 'The decision by EKC to locate here confirms our role as Scotland's leading centre for overseas investment and adds a new dimension to our growing contribution to a Scottish production chain that goes all the way from raw silicon production to wafer fabrication, contract assembly, test and packing and printed board assembly.'

The rub is that EKC's investment, an initial £1 million plus government grants (the amount of which John Housley was very reluctant to reveal) will produce only 25 jobs over two years, 'dependent on the market'. That seems to fit in with a general pattern of the British electronics industry. While seeing increased investment and output, it seems to be failing to create jobs on anything like the scale needed to replace those lost through the decline of traditional industries.

Awkward Questions

A week before the EKC reception a report was published which not only highlighted this problem but also asked some rather awkward questions about the electronics industry. The mention of its name at the Scottish New Town's London Office was about as welcome as Princess Michael's father at a Buckingham Palace garden party. The Scottish Development Agency was moved to issue a statement criticising it as ill-informed and misleading.

Published by Scottish Education and Action For Development, the report - entitled 'Electronics And Development: Scotland And Malaysia In The International Electronics Industry' - has little doubt that, in Scotland at least, 'the electronics industry cannot be expected to make a major contribution to meeting (the) future need for jobs.'

Scotland's electronics industry now employs around 4,300 people. In 1949 there were only 5,000. But as Scotland has lost 200,000 jobs in manufacturing and mining in the last decade, employment provided by the electronics industry will obviously not fill this massive gap. The SEAD report states that 'some experts believe that the industry will do well to increase its labour force by 7-8,000 by the end of the decade.'

The conclusion seems to be that the electronics industry, as it becomes more capital intensive and automated, will provide only a small increase in jobs. On a larger scale than EKC, National Semiconductor proposed a £100 million investment in Greenock, another of the 'Silicon Glen' towns. This has been postponed, but in any case would have created only 1,000 jobs. Motorola, the 'jewel in the crown' of East Kilbride, are investing £60 million in an automated assembly plant which will provide only 800 jobs.

This is all part of the general trend in British electronics. In a paper published in 1983 - entitled 'Policy for the UK Information Technology Industry' - the NEDC Information Technology Sector Working Party admitted that 'the UK employment implications of current trends in Information Technology are not encouraging. The overall decline in employment levels' said the paper, 'is unlikely to be arrested.' The Sector Working Party's best hope was that the industry might contribute indirectly to the creation of new jobs in service industries.
**Boon And Gloom**

This gloomy prognosis is backed up by Luc Soete in the third volume of Gower Publishing’s ‘Technological Trends and Employment’ series, *Electronics and Communications*.

‘Despite the UK electronics industry’s remarkable output growth pattern pointing directly to the significant of the sector as a “motor” for the economic recovery, first estimates of employment suggest that this boom has been accompanied with little employment creation.’

While Soete concludes that the potential for job creation is still considerable, taking the ‘optimistic scenario’, the growth in electronics employment does not compensate for the loss of jobs in the rest of engineering. The respective figures are +70,000 and —81,000. The ‘pessimistic scenario’ sees employment in the rest of engineering as declining by more than 350,000 by 1990, while the compensation in increased electronics jobs is only 15,000. The NEDC Sector Working Party’s paper agrees with a pessimistic forecast of a decline in employment in the UK IT manufacturing industry.

Any estimate has to assume an ability on the part of the electronics industry in Britain to combat foreign competition. According to Luc Soete, ‘it is still debatable how far import penetration or fiercer competition on the UK export markets could curb the UK Industry’s growth potential and press towards a speedier introduction of labour saving rationalisation investment.’ The NEDC paper says that although the UK IT industry has strengths, ‘these strengths in isolation are not however sufficient; they need to be brought together not least by industry itself into a national policy if the industry is to prosper.’

In the IT sector, UK companies have a minority share in most of the UK’s markets while foreign-owned multinationals have the majority. The British companies are structurally weak in comparison with their foreign competitors and there seems little chance that their performance will improve drastically. According to the NEDC SWP, the target for the UK IT industry, as part of a national policy, should be to break even on balance of trade by 1990. A modest enough goal.

In Scotland, the Scottish Development Agency’s own reckoning, Scottish owned firms account for only 16.5% of employment in the electronics industry. The semiconductor industry is wholly foreign-owned, with five US firms providing 90% of the jobs and one Japanese company supplying the other 10%. Leading US firms also figure prominently in the information systems sector in Scotland (including IBM, DEC, Honeywell, Burroughs and Wang) though new Scottish-based firms have emerged here. Meanwhile, Scottish Education and Action for Development argue that the ‘complete dependence of Scotland’s semiconductor industry on a small number of companies... has prompted fears for the long term future of the industry in Scotland.’

**All Work And No Pay?**

But whatever the arguments about the long term prospects for employment creation in electronics, in the short term jobs themselves don’t seem to be the priority. One of the attractions East Kilbride offers investors is wage rates significantly lower than in the rest of Scotland (see Table). Where comparatively good rates operate, this is due to the fact along with biggest union in the town is the Amalgamated Union Of Engineering Workers. (Note that assemblers are mainly women). The Scottish New Towns as a whole boast of a low level of unionisation and generally ‘trouble free’ factories.

Many of the US companies in Scotland have a record of anti-unionism. Having resisted unions’ attempts to organise in ‘Silicon Valley’, they are hardly likely to welcome them in ‘Silicon Glen’.

When asked about this, John Housley of EKC commented that, although company policy was anti-union, EKC in the States is non-union because ‘none of our employees have expressed the desire to join.’ He followed this with the ambiguous assertion that companies who got the union in, generally deserved it. Significantly union membership is also particularly low among electronics workers in the London-Bristol corridor.

While some would argue that any employment is good employment, the quality and conditions of work should also matter. More often than not these things are determined by the presence of trade union organisation. This, at least, is the view held by Scottish Education for Action and Development.

‘In the most practical terms the absence of trade unions leaves the workers vulnerable to company pressure to fit in with changes in working practices, such as new shift arrangements or short-term contracts. It may make them frightened to speak up on health hazards for fear of losing their jobs. In periods of recession it leaves them dangerously exposed to the company’s need to adjust it’s costs.’ For some, however, such considerations are secondary. ‘Speaking personally,' said Alistair Dalziel, of the East Kilbride Development Corporation, ‘I don’t think it matters'. He was replying to our question about the amount of employment the Scottish electronics industry is creating. ‘It’s the investment that matters.’

**FEATURE**

---

**Table:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVO 8 Mk V, for only £5.50</td>
<td></td>
</tr>
<tr>
<td>Complete with Batteries &amp; Leads</td>
<td></td>
</tr>
<tr>
<td>AVO Test Set No. 1 (Similar to Avo8 Mk3). Complete with batteries, leads &amp; Carrying Case</td>
<td>£50</td>
</tr>
<tr>
<td>AVO Model 73, Pocket Multimeter (Analogue) 30 ranges. Complete with Batteries &amp; Leads</td>
<td>£25</td>
</tr>
<tr>
<td>AVO 72 — Similar to above but no AC Current range. With Batteries &amp; Leads</td>
<td>£15</td>
</tr>
<tr>
<td>HAMEG OSCILLOSCOPES 600, Dual Trace 60MHz Delay Sweep. Component Tester</td>
<td>£195</td>
</tr>
<tr>
<td>HAMEG OSCILLOSCOPES 203, Dual Trace 20MHz Component Tester</td>
<td>£270</td>
</tr>
<tr>
<td>TELEQUIPMENT S43. Dual Trace 25MHZ. Solid State. Portable. 8 x 10cm display With manual</td>
<td>£110</td>
</tr>
<tr>
<td>TELEQUIPMENT D43. Dual Trace 25MHZ. Solid State. With manual</td>
<td>£110</td>
</tr>
<tr>
<td>TELEQUIPMENT CT436. Dual Beam 6MHZ. 10 x 16ins. With manual</td>
<td>£110</td>
</tr>
<tr>
<td>NEW EQUIPMENT</td>
<td></td>
</tr>
<tr>
<td>PHILIPS MM-25177. 4 digit. Auto ranging. Complete with batteries &amp; leads (Un-used)</td>
<td>£295</td>
</tr>
<tr>
<td>PHILIPS MM-25178. 4 digit. Auto ranging. Complete with batteries &amp; leads (Un-used)</td>
<td>£295</td>
</tr>
<tr>
<td>ADVANCE AM/FM Sig Gen type SQA 3.7 250 MHZ.</td>
<td>£75</td>
</tr>
<tr>
<td>ADVANCE AM/FM Sig Gen type SQA 100 220MHz</td>
<td>£35</td>
</tr>
<tr>
<td>HAMEG MM-25179. 4 digit. Auto ranging. Complete with batteries &amp; leads (Un-used)</td>
<td>£295</td>
</tr>
<tr>
<td>LABGEAR CROSSHATCH GENERATOR</td>
<td></td>
</tr>
<tr>
<td>LABGEAR COLOUR BAR GENERATOR</td>
<td></td>
</tr>
<tr>
<td>LABGEAR CROSSHATCH GENERATOR CM-0001</td>
<td>£15</td>
</tr>
<tr>
<td>LABGEAR CROSSHATCH GENERATOR CM-0004</td>
<td>£15</td>
</tr>
<tr>
<td>LABGEAR CROSSHATCH GENERATOR CM-0006</td>
<td>£15</td>
</tr>
<tr>
<td>MULTIMETERS</td>
<td></td>
</tr>
<tr>
<td>UNBELIEVABLE</td>
<td></td>
</tr>
<tr>
<td>AVO 72 — Similar to above but no AC Current range. With Batteries &amp; Leads</td>
<td>£15</td>
</tr>
<tr>
<td>ADVANCE AM/FM Sig Gen type SQA 3.7 250 MHZ.</td>
<td>£75</td>
</tr>
<tr>
<td>ADVANCE AM/FM Sig Gen type SQA 100 220MHz</td>
<td>£35</td>
</tr>
<tr>
<td>HAMEG MM-25179. 4 digit. Auto ranging. Complete with batteries &amp; leads (Un-used)</td>
<td>£295</td>
</tr>
<tr>
<td>LABGEAR CROSSHATCH GENERATOR CM-0001</td>
<td>£15</td>
</tr>
<tr>
<td>LABGEAR CROSSHATCH GENERATOR CM-0004</td>
<td>£15</td>
</tr>
<tr>
<td>LABGEAR CROSSHATCH GENERATOR CM-0006</td>
<td>£15</td>
</tr>
<tr>
<td>NEW EQUIPMENT</td>
<td></td>
</tr>
<tr>
<td>PHILIPS WOBBULATOR GM877S. 5-220MHZ &amp; 440-880MHZ</td>
<td>£65</td>
</tr>
<tr>
<td>LABGEAR COLOUR BAR GENERATOR Type GM030</td>
<td>£65</td>
</tr>
<tr>
<td>NOW ONLY £12</td>
<td></td>
</tr>
<tr>
<td>PEP C3</td>
<td></td>
</tr>
<tr>
<td>AVO TRANSISTOR TESTER</td>
<td></td>
</tr>
<tr>
<td>TT110</td>
<td></td>
</tr>
<tr>
<td>Handheld. GOOD/NOGO for in-Situ Testing. Complete with Batteries, leads &amp; instructions</td>
<td>£15</td>
</tr>
<tr>
<td>MAINS ADAPTOR. New. 240V input 9V DC 800mA Output. Plug directly into 13A Socket. Carriage at cost. VAT to be added to Total of Goods &amp; Carriage</td>
<td>£75</td>
</tr>
</tbody>
</table>

**STEWART OF READING**

110 WYKEHAM ROAD, READING, BERKS RG6 1PL

Telephone: 0734 68041

Callers welcome 9am to 5.30pm Monday to Saturday inclusive
A lot of people have written to us asking for an explanation of the numbering systems used on ICs and other semiconductors. John Linsley Hood, something of an expert on components as his continuing series proves, has put together the following guide.

Integrated circuits are the easy route to circuit design, since many clever engineers have thought out neat ways of achieving the desired end, in conveniently packaged and often quite inexpensive circuit blocks. However, there are two main snags. The first of these is knowing which is the right IC to use, and the second, when this problem has been solved, is to decide which version of the IC in question is the device one wants.

The circuit diagram may show a 741, but the catalogue lists a whole range of these from MC1741SCG to LM1741CJ-14. What does this mean? And the problem doesn't stop there, there are all the digital ICs too.

Well, to start with, the first two letters in the specification refer to the maker of the device. MC, for example, refers to Motorola, μA to Fairchild, and so on. The letters at the end of the specification refer to the packaging, the temperature range for permitted operation, or the reliability guarantee. Here C stands for commercial (0°C to 70°C) and M for military (-55°C to +125°C), which will be a whole lot more expensive. Say £15 for the military version, as compared with 40p for the plastic encapsulated commercial device.

Transistor type designations are a good bit simpler since they do not usually have a prefix identifying the maker or a suffix specifying one of a range of package forms. The package is usually implied by the actual type number of the transistor. Unless they are very popular devices, like a BC109 or a BC212, a particular transistor will only be available from one or maybe two manufacturers.

The BC type designation is, incidentally, a European Pro Electron designation, which actually gives a description of the general type of the device in its letters. The USA JEDEC listing, 1N-, 2N- and 3N-, only refers to the time at which that particular device was registered with the US military authorities, so a 2N5068 is a much more recent device than a 2N697.

There is, however, a small measure of type identification in that 1N- means diodes, 2N- means bipolar or junction field-effect transistors and 3N- means MOSFETS. United States sourced transistors (and ICs) are usually second-sourced (which means that there are at least two manufacturers), whereas the Pro Electron devices may come from one manufacturer alone. This is awkward if some inconsiderate designer (like me) specifies a favourite device such as a Motorola BC449 which is probably not stocked by Bloggs Radio just round the corner, though they could have supplied a BF257 which might, at a pinch, have done the same job.

The letters at the end of the transistor type number, for small signal devices, usually denote the...
current gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.

In fixed gain range or the pin configuration.
In digital ICs, the device classification, if it isn't
digital TTL or CMOS, is tucked into the middle
of the part number. The LS in 74LS68 indicates a low
power Schottky device, for example, while the HC in
74HC160 stands for high speed CMOS.

As a general rule, plastic encapsulations are
cheaper than metal can or ceramic dual-in-line pac-

family type | description | propagation delay (per gate) | power (per gate)
--- | --- | --- | ---
74 ALS | Advanced | 3-4ns | 1-2mW
74 LS | Low-power Schottky | 10ns | 2mW
74 S | Standard TTL | 10ns | 10mW
74 C or CD | Low-power TTL | 33ns | 1mW

Table 4 The letter codes used in the middle of 7400 series TTL type numbers to indicate the technology used.
ETI “Sorcerer” String Synthesiser

Those readers who say we publish too few music projects should get knotted, or better still, get tied up in the construction of this excellent design. The Sorcerer features full chorus, tremolo and various depth stop settings and can be built either with a low-cost touch keyboard or interfaced to a standard keyboard for stage use. The basic unit covers two octaves but this can easily be increased by adding extra modules. Build the Sorcerer and unravel your creativity.

EX42 Interface For The BBC

In October 1983 we described an interface to allow the relatively cheap Silver Reed EX42 daisy-wheel typewriter to be used as a computer printer. The original design was intended for use with the Micricon 65, and we were promptly inundated with requests for a modified version for use with other computers. In an attempt to pacify at least some of our readers, we will be describing the most frequently requested version, an interface to allow the EX42 to be used with the BBC micro.

Data Encryption Using The Intel 8294

The ability to transfer computer data over telephone lines has revolutionised the way in which governments, companies and even individuals handle information. But with increased mobility of data has come a new problem — the vulnerability of the system to ‘hackers’. Anyone with a telephone, a computer and a modem can break into the system if they can only find the correct passwords, and once inside they can examine or modify personal records, industrial secrets or even, perhaps, highly sensitive military information. We will be taking a look at the problems involved in protecting data from hackers and at the Intel 8294, an IC which offers protection in accordance with the US Data Encryption Standard.

A Fresh Look At RCL Bridges

RCL bridges might seem a little old hat in these days of autoranging digital capacitance meters, precision resistance ranges on DMMs and the rest, but for sheer versatility they are hard to beat. In this informative article, L. Boullart describes the theory and operation of RCL bridges before going on to present a practical design which should cope with just about every resistor, capacitor and inductor you are ever likely to meet.

ROM Board For The Spectrum

A useful facility on some microcomputers is the provision of ‘sideways’ ROM sockets, allowing the existing ROM to be exchanged at will for an alternative operating system, language or whatever. This board allows such a facility to be added to the ZX Spectrum and can accommodate the popular 2716 and 27256 EPROMs as well as all the sizes in between.

A-D And D-A Conversion

We have published numerous designs for various converters, from single channel to sixteen channel and for use with a wide range of micro-computers, but we have never taken a detailed look at the process involved. This article looks at the operation of both A-D and D-A converters, explaining the different techniques used and discussing the advantages and disadvantages of each type.

The Real Components

John Linsley Hood continues his look at the ins and outs of components with an examination of the not-so-humble operational amplifier.

Plus . . .

Tech Tips, News Digest, Open Channel, Read/Write, Scratch Pad, Trains Of Thought and book and equipment reviews. It’s all in next month’s ETI.
Have you ever waited twenty minutes for your computer to print the program listing for your latest hyper-space mega-adventure game? This project won’t make the printer run any faster, but it will stop the computer being tied up for the whole time and let you get on with your programming. Design by Nick Sawyer.

The printer buffer is designed to appear to the computer as an ultra high speed printer, with up to 48K of memory and capable of accepting data at a rate of several kilobytes per second. This data is then passed on to the printer at the much slower rate required, about several tens of bytes per second. As the unit appears to the micro as a printer with a standard Centronics interface, it is not specific to any one type of computer, and can be used with any system having a Centronics-type facility.

The buffer has been designed to be flexible in the amount of memory that can be fitted. It can contain either 16, 32 or 48K of memory, so you can start with 16K and upgrade at any stage simply by plugging in more dynamic RAM chips. The software contained in a pre-programmed 2176 EPROM looks after the complicated aspects, and if you feel that you need more than 48K of memory then merely put two or more complete units in series. Remember though, that 48K is about 15 A4 pages of BASIC listing, which should be more than enough for home use.

The buffer features a comprehensive push-button initiated self and RAM test, with printed results. An abort button is also provided for completely re-setting the buffer and its memory.

What is a Centronics-type interface? It is basically a method for transferring data in seven or eight bit wide chunks from one device to another, and includes a ‘handshake’ mechanism to control the speed of transfer. The sequence of events is shown in Fig.1.

Valid data is set up on the parallel data lines and the STROBE line is then pulled low by the transmitting device (computer). The receiving device (printer) responds by pulling the BUSY line high for as long as is necessary to process the data received. The BUSY line is then pulled back low and a short ‘active low’ pulse is output on the ACK line to indicate that the transfer is complete and the next data byte may be transmitted. The busy period may be anything up to one second during carriage return on a slow printer, and the transmitting computer is normally idle during this time.

Construction

The printer buffer is built on a double sided board without plated through holes for reasons of cost. This means that where tracks are joined to components on both sides of the PCB, they will need to be soldered to the component on each side of the board. This presents no problem so long as it is remembered to leave components, IC sockets in particular, standing slightly proud so as to allow access for a thin-tipped soldering iron. In addition there are several connections which will need to be made through the board using either pins or bits of wire, again soldered on each side.

Sockets should be used for the microprocessor IC1, the EPROM IC5, and the six dynamic RAM chips IC9-14. All remaining ICs and the other components may be soldered straight in, taking care not to overheat them.

---

Fig. 1 Timing signals for a Centronics-type interface.
Fig. 2 The circuit diagram of the printer buffer.
Fig. 3 Component overlay for the printer buffer PCB. Note the cut-out in the top, right hand corner which allows room for the transformer.

**PARTS LIST**

<table>
<thead>
<tr>
<th>RESISTORS (1/4W, 5% unless otherwise stated)</th>
<th>RESISTORS (1/4W, 5% unless otherwise stated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 4k7</td>
<td>Q1 BC557</td>
</tr>
<tr>
<td>R2, 3, 9, 10, 12, 13 1k0</td>
<td>D1 1N4148</td>
</tr>
<tr>
<td>R4 47k</td>
<td>D2, 3 1N4001</td>
</tr>
<tr>
<td>R5 22 R 1/2W</td>
<td>LED1, 2 0.2&quot; Red LED with panel-mounting holder</td>
</tr>
<tr>
<td>R6, 7 470 R</td>
<td>MISCELLANEOUS</td>
</tr>
<tr>
<td>R8, 11 10k</td>
<td>SK1 36 way right angle Centronics-type PCB mounting socket</td>
</tr>
<tr>
<td>RP1 1k0 x 8 SIL resistor pack</td>
<td>SK2 26 way IDC plug momentary action push-to-make switches, panel mounting</td>
</tr>
<tr>
<td>CAPACITORS</td>
<td>SW1, 2</td>
</tr>
<tr>
<td>C1, 10 47u, 16V electrolytic</td>
<td>T1 6-0-6V, 6VA chassis mounting transformer</td>
</tr>
<tr>
<td>C2 10n ceramic</td>
<td>XTAL1 2MHz crystal</td>
</tr>
<tr>
<td>C3-9 100n ceramic</td>
<td></td>
</tr>
<tr>
<td>C11 2200u, 16V electrolytic</td>
<td></td>
</tr>
<tr>
<td>SEMICONDUCTORS</td>
<td></td>
</tr>
<tr>
<td>IC1 Z80</td>
<td>PCB; 26 way ribbon cable; DIL IC sockets, 6 off 18 pin, 1 off 24 pin and 1 off 40 pin; plastic case 250 x 140 x 75mm; nuts bolts, wire etc.</td>
</tr>
<tr>
<td>IC2 74LS368</td>
<td></td>
</tr>
<tr>
<td>IC3 74LS74</td>
<td></td>
</tr>
<tr>
<td>IC4 74LS02</td>
<td></td>
</tr>
<tr>
<td>IC5 2716</td>
<td></td>
</tr>
<tr>
<td>IC6 74LS139</td>
<td></td>
</tr>
<tr>
<td>IC7, 8 74LS157</td>
<td></td>
</tr>
<tr>
<td>IC9-14 74LS157</td>
<td></td>
</tr>
<tr>
<td>IC15, 16 74LS374</td>
<td></td>
</tr>
<tr>
<td>IC17 7805</td>
<td></td>
</tr>
</tbody>
</table>

**BUYLINES**

All of the semiconductors and the other general components are widely available from companies advertising in these pages. The box in which the prototype is housed is a Verocase, number 202 - 21035, and is available from Electrovalue, Maplin and TK Electronics among others. The right-angle 36 way Centronics connector is an RS Components part, catalogue number 470-639. RS will only handle orders from trade and professional customers, but if you are unable to use them because of this you can obtain the part through Crewe Allan & Co of 51 Scrutton Street, London EC2 on payment of a small handling charge. A pre-programmed EPROM is available from Tronik Designs, 68A Broomfield Avenue, Palmers Green, London N13 4JP, and costs £7.85 inclusive. Please allow 10 days for delivery. A double-sided PCB is available from the same address for £10.75 and 28 days should be allowed for delivery. Please note that the PCB will not be available through our own PCB Service.
At the heart of the circuit is a Z80 microprocessor (IC1) running at 2MHz. The single phase 2MHz clock is provided by a simple crystal controlled oscillator using three LSTTL inverters (part of IC2), and a pull up transistor to provide the non-standard clock levels required by the Z80. Power-on reset for the microprocessor is provided via an RC network with a time constant of around 200 ms. The diode D1 is provided to ensure a reset occurs should the power supply fail momentarily.

The two function switches, test and abort are connected to the two active-low interrupt inputs of the Z80, INT and NMI respectively. The inputs are normally connected to 5 volts via a resistor and are grounded if a switch is pressed, causing an interrupt which is processed by the software. The software itself is carried in a 2716 EPROM (IC5) which is a 2Kx8 device requiring eleven address lines. An active-low decode from the address decoder is connected to the chip select line of the 2716, and this is used in conjunction with the RD line to gate data from the EPROM onto the data bus for addresses 0000 to 0FFF Hex. In fact only addresses up to 07FFh are used as these are sufficient to decode 2KBytes.

Address decoding is performed by two halves of a 74LS139 dual two to four line decoder, IC6a&b. IC6a decodes address lines A14 and A15 to give four segments of 16K each. The lowest of these segments is further decoded using address lines A12 and A13 to give four segments of 4K each. This therefore gives the addressing capability shown in the memory map.

The possible 48K of RAM is made up from six TMS4416 dynamic RAM IC’s, each of which is organised as 16Kx4 bits. This means that two devices are needed to make each 16K segment. In common with most types of dynamic RAM, the required fourteen address bits have to be multiplexed onto eight lines. This is done to keep the package size down. Eight address bits are strobed into the IC’s by a falling edge on RAS (Row Address Strobe), and the remaining six bits are strobed in by a falling edge on CAS (Column Address Strobe).

These strobe signals are generated by a combination of the signals MREQ, RFSH, and the 2MHz clock signal. The signal MREQ is connected directly to the RAS lines of all the RAM chips, so that an address is strobed in each time MREQ goes low. This will occur on two occasions, when the micro is requesting data from memory and when an automatic refresh cycle is being performed by the Z80. These refresh cycles are necessary for proper operation of the dynamic RAMs. When the micro is requesting data from the memory, the RFSH line will be high and a delayed version of MREQ will be clocked into the flip-flop IC6a by the clock signal. The Q output of the flip-flop is used to switch the two adress multiplexer chips, IC7&8, and also to enable the address decoder IC6a. The NOR gates, IC4, are present to provide some delay for this signal and also ensure that it goes back high at the same time as the MREQ. The signal used for CAS is the appropriate output of the address decoder and this will latch the second half of the device address into the DRAMs. In case of a refresh cycle, the signal RFSH will go low and prevent the signal MREQ being clocked into IC6a, so preventing the above procedure but ensuring that the refresh requirement of the dynamic RAMs is met.

The two 74LS374s hold the information for transfer to and from the outside world. Data is presented from the computer at the D inputs of IC15. When the STB line from the computer goes low it causes the Q output of the flip-flop IC3b to go high. This is connected to the clock line of IC15 and so data is strobed into its latches. The Q bar output of IC3b is also fed back to the Z80 via a tri-state buffer IC2d, and this informs the software that data has been received. This line is also fed back to the transmitting computer via an inverter IC2e thus serving as the BUSY signal. The state of this line is shown by LED1, which will illuminate when the line is low to indicate buffer ready.

When the Z80 reads the latches in IC15, the read strobe generated is also used to clear IC3b thus removing the BUSY signal, and is also fed back to the transmitting computer to serve as the ACK signal. The above procedure is repeated until the transmitting computer has no more data or the buffer runs out of space, in which case the buffer will keep the computer waiting until space becomes available as data is output to the printer.

Data to be output to the printer is written by the Z80 into the ocial latch IC16, the outputs of this latch being fed to the data inputs of the printer. The Z80 monitors the BUSY line of the printer by enabling, with IORQ, the tri-state buffer IC2f, and when it discovers that the printer is no longer busy the STB line is pulled low for a few microseconds. This strobes data into the printer which will then go BUSY again. This sequence is repeated until the buffer has been emptied. It should be mentioned that the input and output processes take place simultaneously, the software being in control at all times. The state of the printer busy line is also shown by LED2, which will illuminate when the printer BUSY line is low to show that the printer is ready.

The power supply is quite straightforward, consisting of a centre-tapped transformer whose output is rectified and smoothed by D2 & 3 and C11. The resulting DC is fed to the voltage regulator IC17, which maintains a constant output of 5 volts. Capacitor C10 is provided for further smoothing, and capacitors 3 to 9 are for de-coupling.

Testing. Connection and use of the printer buffer will be described in a concluding article which we hope to publish next month, along with a complete listing for those diehards who prefer to program their own EPROMS!
There are those who say they can't tell the difference between the music and the noise these days, but Ian Coughlan's versatile unit is not so easily fooled. And when it's not opening up the way to noise-free music, you can use it as an envelope shaper.

Every musician knows the problems caused by noisy leads and effect-units: whenever you stop playing, the snaps, crackles and pops are still there. This state of affairs is acceptable when practising, but is a major headache when recording or playing live. One solution is a noise-gate, the electronic equivalent of pulling the jack-plugs out every time you stop playing. Needless to say, the noise-gate does it so unobtrusively that you'd never know it was there, which is the whole idea!

Important parameters of a good noise-gate are:

Threshold: this is the input signal level required to open the gate, and is adjustable from -35dBm down to -65dBm approximately. Normally it will be set just above the noise-floor, so that when playing begins, the increase in signal level is sufficient to open the gate. Response time: this is the time taken for the noise-gate to begin opening once the threshold has been crossed (some manufacturers of noise-gates call this the attack-time, which is not strictly correct. Ideally it should be instantaneous, and in practice should be less than a millisecond and not adjustable.

Attack-time: this is the time the gate takes to go from fully closed to fully open. Most noise-gates open instantly, which is what is usually required. This design will do so if you want it to, but can also be adjusted to take up to 100ms to open.

Hold-time: this is the period for which the noise-gate remains fully open after playing has stopped. It is adjustable between 100ms and 2s.

Decay-time: this is the time the gate takes to go from fully open to fully closed after the Hold-time has elapsed. Most noise-gates open instantly, which is what is usually required. This design will do so if you want it to, but can also be set to take up to 100ms to open.

As well as being triggered by the incoming signal, the noise-gate may also be opened by another signal connected to the EXT KEY socket, by a logic level on the REM socket, by a switch contact (also on the REM socket), or by the built-in footswitch. Whichever triggering method is used, the attack, hold, and decay controls still function. Because the envelope shape is completely adjustable and the unit can be controlled by a variety of inputs, it can be used as an envelope shaper in its own right.

Construction

Before soldering anything into place, check that your PCB has a hole under PR1 and, if not, carefully drill a 1/4" hole there. This will allow the preset to be adjusted from the underside of the board when the unit is assembled into its case. When the bare board is ready, commence assembly by installing the wire link, the four

The gate is IC2, a transconductance amplifier whose gain is controlled by the current flowing into pin 5. The two halves of IC1 are connected as unity gain buffers, one before and one after the transconductance amplifier. The gain of the transconductance amplifier is adjusted to unity by PR1, so the overall gain of the audio path is unity when the gate is open.

The threshold detector consists of IC3d and the two halves of IC4. The input is taken either from the main audio path, immediately after the buffer stage IC1a, or from the EXT. KEY socket. R15 and C9 form a low-pass filter which removes RF noise and the signal is then passed to the amplifier stage IC4a whose gain is set by the sensitivity control. This is followed by a fixed gain stage, IC4b, which ensures that sufficient level is available to reach the threshold of the comparator.

The window comparator is based around IC4d and is slightly unusual in using only one op-amp. When the output from IC4b is of sufficient amplitude, it will push pin 2 of IC3d higher than pin 3 via D5, or pull pin 3 lower than pin 2 via D4. Provided the gate is not in the bypass mode, pin 5 of the NAND Schmitt trigger IC5a will be at a logic high level and the stream of negative going pulses from the output
of IC5d will produce positive going pulses on pin 4 of the Schmitt. As long as these pulses are present, diodes D6 and D7 will conduct and hold the two ends of C16 at the same potential, preventing it from charging. IC5b and IC5d both have one input connected to the positive supply and IC5b and IC5d both have one input potential, preventing it from charging. When the pulses at the output of IC5a cease, D6 and D7 will no longer conduct and C16 will begin to charge via the Schmitt inverter IC5c. This will cause IC5a pin 4 to remain high, whereupon D6 and D7 will conduct, IC5b pin 1 will be held high via R30 causing its output to stay low, and this low appearing on pin 12 of IC5d will force its output going high and this pin will then stay high for as long as the unit is in the bypass mode. This high level drives the GATE OPEN LED via Q3 and R31, R32 and also provides a voltage into pin 12 of IC3c. This voltage is held down to 4.3V by ZD2 and R14. IC3c is a unity gain buffer stage which, on receiving an input voltage, charges C8 via R13 and RV2. The time taken to charge C8 is the attack time and is adjusted by RV2. The voltage on this capacitor corresponds to the envelope shape voltage to the gain-determining pin of the transconductance amplifier IC2. PR1 allows the overall gain of the audio path to be adjusted back to unity. The complete circuit operates as follows. When the input signal exceeds the threshold, pulses will be produced at pin 1 of IC5d in the manner previously described. Just one of these pulses is sufficient to send IC5d pin 11 high with no apparent delay and this in turn produces 4.3V at pin 14 of IC3c. IC3b pin 8 will also rise to 4.3V but will do so exponentially because of the action of C8, R13 and RV2. C7 is much larger than C8 but it will charge at the same rate because it is fed from the low resistance source provided by the emitter follower Q2. As the voltage on this capacitor rises, so will the current flowing into pin 5 of IC2 and so the gain will increase.

When the input signal falls below the threshold, the pulses on IC3d pin will cease and pin 11 of IC5d will go low after a period of time determined by the setting of RV4. The output of IC3c will then also go low and C8 will discharge through R13 and D1. C7 will also discharge but at a rate determined by the setting of RV1. This falling voltage will reduce the current flowing into pin 5 of IC2 and hence the gain of the audio path will fall.

Most of the circuit operates directly from the 0V and +9V supply, but some parts of it require a centre tap to provide something approximating dual-rail operation. This intermediate voltage is provided by ZD1 and Q1.
Fig. 3 The component overlay for the noise gate PCB. Note the use of insulated wire links across the board and that the capacitors at the socket end are laid flat to prevent their interfering with the potentiometers when the case is assembled.

**PARTS LIST**

<table>
<thead>
<tr>
<th>RESISTORS (all 1/4W, 5% unless otherwise stated)</th>
<th>SEMICONDUCTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 6k</td>
<td>IC1 TL072</td>
</tr>
<tr>
<td>R2 470k</td>
<td>IC2 LM3080</td>
</tr>
<tr>
<td>R3, 7, 30, 33 10k</td>
<td>IC3 LM324</td>
</tr>
<tr>
<td>R4 39k</td>
<td>IC4 TL062</td>
</tr>
<tr>
<td>R5, 6, 9 510R</td>
<td>IC5 4093</td>
</tr>
<tr>
<td>R8, 11, 29, 34 100k</td>
<td>Q1-3 ZTX300</td>
</tr>
<tr>
<td>R10 910R</td>
<td>D1-11 1N4148</td>
</tr>
<tr>
<td>R12 1k</td>
<td>ZD1, 2 BY88-4V3</td>
</tr>
<tr>
<td>R13, 14 22k</td>
<td>LED1 red LED</td>
</tr>
<tr>
<td>R15 12k</td>
<td>with mounting</td>
</tr>
<tr>
<td>R16, 19 1M0</td>
<td>bezel</td>
</tr>
<tr>
<td>R17, 24, 27 220k 2%</td>
<td>SK1 3.5mm</td>
</tr>
<tr>
<td>R18 3k3 2%</td>
<td>jack socket, PC</td>
</tr>
<tr>
<td>R20 330k</td>
<td>mounting, with</td>
</tr>
<tr>
<td>R21 10k</td>
<td>switch</td>
</tr>
<tr>
<td>R22, 23, 25, 26 200k 2%</td>
<td>SK2 1/4”</td>
</tr>
<tr>
<td>R28 51k</td>
<td>mono jack socket, PC</td>
</tr>
<tr>
<td>R31 47k</td>
<td>mounting, with switch</td>
</tr>
<tr>
<td>R32 3k9</td>
<td>SK3 1/4”</td>
</tr>
<tr>
<td>RV1, 2, 4 2M2 logarithmic</td>
<td>SK4 3.5mm</td>
</tr>
<tr>
<td>RV3 470k logarithmic</td>
<td>jack socket, panel</td>
</tr>
<tr>
<td>PR1 10k horizontal skeleton preset</td>
<td>mounting, with switch</td>
</tr>
<tr>
<td>CAPACITORS</td>
<td>SK5 1/4”</td>
</tr>
<tr>
<td>C1, 3 100u 16V radial electrolytic</td>
<td>mono jack socket, PC</td>
</tr>
<tr>
<td>C2, 5, 6, 11, 13 10u 16V radial electrolytic</td>
<td>mounting, with switch</td>
</tr>
<tr>
<td>C4 1u 16V radial electrolytic</td>
<td>SW1 alternate action push switch, panel mounting</td>
</tr>
<tr>
<td>C7, 16 1u 35V tantalum bead</td>
<td>PCB, case; knobs, 4 off; battery connector; 1/4” (20mm) high mounting pillars, 2 off and screws or bolts to suit; 14-pin DIL IC sockets, 2 off; thin foam rubber; 9V battery, PP3 or similar.</td>
</tr>
<tr>
<td>C8 47n multi-layer</td>
<td></td>
</tr>
<tr>
<td>C9 680p polystyrene</td>
<td></td>
</tr>
<tr>
<td>C10, 12 100n multi-layer</td>
<td></td>
</tr>
<tr>
<td>C14 15p polystyrene</td>
<td></td>
</tr>
<tr>
<td>C15 22n multi-layer</td>
<td></td>
</tr>
</tbody>
</table>

**BUYLINES**

The 1/4” jack sockets used in the prototype are made by Cliff and are designed for PCB mounting. They are not readily available in small quantities but their pin spacing is the same as that of Cliff's panel mounting 1/4” jack sockets which are available from Electrovalue. The panel mounting type is solder tags with eyelets rather than pins, but it is a simple matter to cut away one side of the eyelet so as to leave a pin narrow enough to suit the holes in the PCB. Other makes of jack socket available from other suppliers may also be suitable if so modified but we have not tried this.

The potentiometers used are also supplied by Electrovalue and are from their P20 range. RS components stock a suitable switch (Catalogue number 339-241) and a 15mm button for it (catalogue number 339-279 for a pack of three) but they do not stock a shroud as used on the prototype. A switch with a shroud is available from Electromatch for £4.15 including post and packing. The part numbers are MPA106D for the switch, C23 for the button and G13 for the shroud and you can contact them on 0403 - 814111 to obtain up-to-date ordering information. The box is made by STC and is type number 73399B. It costs £1.97 plus VAT but inclusive of post and packing from STC Electronic Services Ltd, Edinburgh Way, Harlow, Essex CM20 2DF. All of the other components are available from our regular advertisers and the PCB is available from our PCB Service.
PROJECT: Noise Gate

Drill all the holes as accurately as you can, clean the box thoroughly with steel wool soap pads to remove any traces of grease or dirt, then paint it. When the paint is dry, the legends can be applied using rub-down lettering and a coat of clear varnish sprayed on to protect them. A piece of thin foam rubber should be glued to the inside of the box to prevent the battery from rattling around.

It is important to use the recommended potentiometers, switch and EXT. KEY socket or difficulty may be encountered in getting everything to fit within the space available. Mount the LED, the socket and the potentiometers through their respective holes in the front panel and connect them up to the PCB, taking care not to use greater lengths of wiring than is necessary. Solder the battery connector leads to the board and place one fibre washer on each of the three larger jack sockets. Mount the switch through its hole in the front panel but do not tighten it up.

Offer the PCB up to the case, guiding the jack sockets into their holes and aligning the switch pins with the pads provided. A little bit of force may be necessary, but any serious opposition should be investigated lest anything be damaged. When the PCB has settled into place, solder the switch pins onto their pads, tighten the switch mounting from the front panel and secure the large jack sockets with the nuts provided. Construction is then complete.

Setting Up And Use

Connect up a 9V battery, switch on, and apply a signal of about 2V peak-to-peak to the input. The LED should light up. Monitor the output with an oscilloscope or an AC millivoltmeter and adjust PR1 until the output level is of the same amplitude as the input level. This is the only adjustment necessary and if all is well the base can be screwed into place and the unit is ready for use.

In use, the noise-gate should come between any effects and the amplifier or tape-recorder. Connection should be by a screened cable as short as is practical. The unit is switched on by connecting a (mono) jack to the input socket.

When setting the noise-gate up initially, turn the sensitivity control...
fully clockwise and the attack, hold and decay fully anticlockwise. The LED should be off; if it isn’t, press the footswitch. If using any effects, switch them on to produce all the noises you’re trying to get rid of, and rotate the threshold control anticlockwise (thus lowering the threshold) until the LED lights (at this stage you should be able to hear the noise getting through to your amplifier). Turn the threshold control slightly clockwise, raising the threshold just above the noise-floor. The LED should go off, and the noise should stop.

As you play your instrument, the gate should open, and should close when you stop. Remember that the other controls are still at a minimum, and should now be set to suit. Normally the attack will be left at a minimum, giving a short rise-time, with the hold and decay at about a second or so.

Pressing the footswitch will open the noise-gate regardless of input level, and is very useful when tuning-up. A remote footswitch can be connected to the REM socket, disconnecting the unit’s own switch.

The noise-gate can also be used as an envelope shaper with the attack-hold-decay cycle being triggered in a number of ways. An audio signal can be connected via the EXT. KEY socket and will trigger the envelope shaper but still allow the threshold control to be used. Alternatively, the EXT. KEY should be shorted with a miniature jack plug and the unit triggered from the REM socket either by making and breaking a mechanical contact or by applying a logic signal. Closing the REM contacts or applying a -5V level will close the gate while opening the contacts or applying a 0V level will open it.
It doesn’t take ESP to know that we’re dealing with the software for John Wike’s Electron add-on.

Having described the hardware for this project last month, it is now time to consider the software. When RUN the program creates a 2K machine code file on tape or disc called E2PCODE. This latter is what must be "RUN" to operate the second processor. Alternatively, if you have a disc it can be renamed as !BOOT and run using shift-break.

The listing given in this article has been produced using a formatting program to line it up nicely. If you intend to enter it yourself you must leave out all the spaces (except those after the '.' labels) or it will not fit into memory.

The beauty of the Acorn machines is that in order to intercept the input/output operations of any language it is only necessary to modify eleven well-documented operating systems (OS) routines. Detailed descriptions of these can be found in 'The Acorn Electron Advanced User Guide' by Holmes and Dickens, and 'The Advanced User Guide for the BBC Micro' by Bray, Dickens, Holmes. The operating system calls are the same for both machines and while one book also covers the special hardware in the Electron, the other is more readily available in the shops.

**Memory Usage**

In this article the Electron processor will be referred to as the I/O processor because that is its main function in the new environment. The second processor will be called 2P for short.

The E2PCODE program loads into addresses 2800 h to 2FFF h in the I/O memory, as shown in the memory map. This is below the highest resolution screen. It uses memory (again I/O) at 0 to 70 h and 400 h to 40B h so it is important that no user programs corrupt these three areas of I/O memory.

The main program is in three sections. Lines 190 to 4880 run where they are in I/O memory. Lines 5930 to 7250 are copies to the 256 byte sideways ROM area and exist at 8000 h in I/O memory and FFOO h in 2P memory. Finally, lines 7300 to 11100 are passed to 2P memory at F800 h to FAFF h.

**Communication**

The processors communicate with each other by way of various locations in 2P RAM which are used as status and data registers. Their functions are listed in Table 1 and, together with the 28byte Oswrch buffer, they overwrite the 2P reset routine in lines 6020 to 6230. As there is no hard reset that routine is not needed again anyway. With all the registers, except the buffer pointers, a zero value indicates that the message data has been received and acted on.

**Facilities**

This implementation has the ability to reset into the I/O processor by pressing B-break, i.e. hold down the B key while pressing BREAK. Programs can then be developed in the I/O memory without switching off. In I/O HIMEM is set to 2800 h to protect the program. In 2P HIMEM is 8000 h and PAGE is 800 h.

If you execute "HELP" while in 2P you will get the message "E2P 0.1". This does not appear if you are in the I/O.

Just one word of warning. Do not use any EVENT handlers in 2P that call OS routines. If you do the system will most probably hang up.

You will have to find out by trial and error which programs will work with a second processor. Anything that accesses screen memory or hardware directly will not work, since this can only be done by OS commands across the interface.

<table>
<thead>
<tr>
<th>Address I/O(2P)</th>
<th>Function</th>
<th>Possible Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>800D(FF0D) h</td>
<td>Pass Instruction to 2P</td>
<td>8 h Start memory read(0)</td>
</tr>
<tr>
<td>8013(FF13) h</td>
<td>Pass OS call to I/O</td>
<td>9 h Start memory write(1)</td>
</tr>
<tr>
<td>8019(FF19) h</td>
<td>Status for I/O to 2P data at 801A(FF1A) h</td>
<td>C h Run program(4)</td>
</tr>
<tr>
<td>8018(FF18) h</td>
<td>Status for 2P to I/O data at 801C(FF1C) h</td>
<td>28 h Stop memory read/write</td>
</tr>
<tr>
<td>801E(FF1E) h</td>
<td>Oswrch buffer insert pointer</td>
<td>40 h Handle Event code</td>
</tr>
<tr>
<td>801F(FF1F) h</td>
<td>Oswrch buffer remove pointer</td>
<td>80 h Pass BRK error message</td>
</tr>
<tr>
<td>8014(FF14) h</td>
<td>Flush Oswrch buffer flag</td>
<td>C0 h Set/Reset Escape flag</td>
</tr>
</tbody>
</table>

Table 1. Communication protocols.
HOW IT WORKS

I/O OPERATION

When the program is run the I/O processor enters the cold start routine at line 1250. At lines 1350 to 1630 it checks each RAM number from 7 down to 0 for a block of RAM of 256 bytes or less. If it finds one it assumes that it is the E2P card and stores the ROM number in location this ROM, if not it returns to the language ROM and prints the error query, E7.

If the ROM is not logged in already (1640-1670), it then cycles through the RAM (1690-1720), loads the RAM (1740-1770) and clears the 2P reset (1780). The RAM is then cycled to refresh it (1800-1820) until the 2P signals that it is ready (1830-1840). It then initiates a 2P memory write and transfers the 2P operating system routines over (1860-2040) before soft resetting itself (2050).

During I/O reset the operating system calls the sideways ROM service call at line 210 (3230-3320). This issues an operation reset (3410-3430) at line 3340. The operating system will then enter the sideways ROM location 400h. This has two purposes.

1. The 2P Osbyte routine checks for the Tube presence flag, if it is set then the language will be started up in the memory clear facility. Lines 2590-3000 to set HIMEM and inhibit the 2P memory refresh (2480-2570) to allow the new routine to enter with their file number plus C0h in the accumulator and waiting for the carry flag to be set. They release the interface using 80h plus the file number. The read/write function is performed by modifying the appropriate action taken. The last few bytes of the routine contain 6170-6230 which modify the calling routine to run the other 128 bytes next time round (6170-6190) and check the status register at 800D(FFFD) h to see if an instruction need to be executed.

Normally the NMI routine (6400-6420) will call the cycle routine (6350-6380) to perform the refresh. However while the I/O is writing or reading 2P memory via the data register at FC5E(FFEE)h the 2P memory will respond quickly to the IRQ line. So the NMI is disabled and the 2P goes into the loop (6680-6700) where it is continually cycling to do the refresh. The read/write function is performed by modifying the three locations at Ivec (6270h) in the irq routine (6250-6330) to read or write the specified start address (6470-6550). If it is a read the first location is read by a software interrupt (6610-6620).

The other instructions are looked for in the test routines (7460-8310) and the appropriate action taken.

The 2P OS routines (8330-9720) interact with their I/O counterparts (450-1230) via the register at 8013(F13)h. Some routines need to pass data over the processor A,X and Y registers. Some need to pass text and some need block data. These are handled by the routines at lines 4700-5360, 6730-6780, and 9740-10320.

The Osvword routines transfer different amounts of different size blocks. The tables at 10480-10910 are used to determine how much to send.

The 2P Osbyte routine checks for the memory functions 82h to 84h (8420-8540) to check if the main high order address (FFFF h for I/O, 0000 h for 2P, PAGE, HIMEM, and Osvword in other Modes, in that order. It also checks (8560-8640) to see if the Owsqrt buffer is being flushed (Osbyte DA h, 000) and sets the flag at 8014(FF14)h.

2P OPERATION

When the 2P reset is cleared it jumps via its reset vector at FFFC h (7240) to line 6020. Here it loads a 128 byte RAM refresh routine twice into FB80h to FBFFh. This consists of initialize accumulator immediate instructions (C9h), which are two bytes long and take two cycles to execute. Thus it will access 128 bytes in 128 cycles, or 64 microseconds. The main loop routine (5540-5880) maintains the rotating Owsqrt buffer remove pointer at 801D(F1FD)h. If the buffer is not empty its contents are printed. If it is empty the status register 8013(F13)h is examined and an OS call is executed if desired.
PROJECT: Processor

The PC8 described last month and the software are available from the author at 9, Lon-y-Gwar, Caerphilly, Mid Glamorgan. The price of the PC8 is £12, software on tape is £3.50, and on your disc £2.00, inclusive of postage. If you send a disc please state whether you wish to have the '800' file put on.

Master

Electronics Microprocessors

New! The Practical Way!

- Electronics – Microprocessors
- Computer Technology is the career and hobby of the future. We can train you at home in a simple, practical and interesting way.

- Recognise and handle all current electronic components and 'chips'.

- Carry out full programme of experimental work on electronic computer circuits including modern digital technology.

- Build an oscilloscope and master circuit diagram.


New Job? New Career? New Hobby?
SEND THIS COUPON NOW

For FREE Catalogue, Colour Brochure, Telephone Orders, Accessory Card and capped pen.

FREE Telephone Orders, Accessory Card AND CAPPED PEN.

Robert Stこういう 13-11 London SW3

ORDERING INFORMATION. All prices are exclusive of Postage. British Radio & Electronics is a free press and is not responsible for errors, omissions or misprints. It is the owner, unless otherwise stated. We reserve the right to make alterations without notice. All prices include sales tax. For further details ask your newsagent.
In which Gordon Bennett jumps to all the right subroutines so that you can blow your EPROMs and blow your minds with the software for Mike Bedford’s better programmer.

When the original articles for the Universal Eprom programmer were published, I was in the process of looking for a new Eprom blower, as the one I was using was horrendously slow. It was a much modified serial driven device originally published in the December 1978 'Computing Today', when this was still a supplement given away in ETI.

However, it was several months before I embarked on the construction of the Universal Eprom Programmer board. It then became apparent that the control software was somewhat unwieldy in its form of both a machine code and BASIC program and that something easier to load and use was required. This prompted me to write a suitable control Eprom for use in the spare slot at E800h in the Microtan memory map.

This Eprom eventually found its way into the hands of Mike Bedford and led to a phone call in which he asked if I would be interested in writing the software for a new enhanced version of the programmer that was under development. The new programmer was to be capable of supporting the interactive programming algorithms which allow the larger devices to be programmed in much reduced times, a 27128 in about 2 minutes and a 27512 in 7 minutes.

The resulting program is described in this article. An idea of the Eproms supported can be gained from Table 1, which also gives a list of those that have actually been programmed using the new hardware and software.

The 27513 is selectable in four 16K banks, each of which is programmed as if it were a 16K Eprom in its own right. Although the programmer software will handle 16K Eproms there is no ability built into it to allow to allow the bank selection mechanism to operate.

The software does not support this as it stands but would need minimal changes to allow the use of this device.

Table 1  EPROMs supported by the programmer.

<table>
<thead>
<tr>
<th>EPROM TYPE</th>
<th>SOFTWARE SUPPORTED</th>
<th>ALGORITHM FAST/SLOW</th>
<th>WHETHER PROGRAMED</th>
</tr>
</thead>
<tbody>
<tr>
<td>2758</td>
<td>YES</td>
<td>$</td>
<td>NO</td>
</tr>
<tr>
<td>2716</td>
<td>YES</td>
<td>$</td>
<td>YES</td>
</tr>
<tr>
<td>2516</td>
<td>YES</td>
<td>$</td>
<td>NO</td>
</tr>
<tr>
<td>2732</td>
<td>YES</td>
<td>$</td>
<td>YES</td>
</tr>
<tr>
<td>2732A</td>
<td>YES</td>
<td>$</td>
<td>NO</td>
</tr>
<tr>
<td>2532</td>
<td>YES</td>
<td>$</td>
<td>YES</td>
</tr>
<tr>
<td>68732</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2764</td>
<td>YES</td>
<td>F/S</td>
<td>YES</td>
</tr>
<tr>
<td>2764A</td>
<td>YES</td>
<td>F/S</td>
<td>NO</td>
</tr>
<tr>
<td>2564</td>
<td>YES</td>
<td>F/S</td>
<td>NO</td>
</tr>
<tr>
<td>68764</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27128</td>
<td>YES</td>
<td>F/S</td>
<td>YES</td>
</tr>
<tr>
<td>27128A</td>
<td>YES</td>
<td>F/S</td>
<td>NO</td>
</tr>
<tr>
<td>27256</td>
<td>YES</td>
<td>F/S</td>
<td>YES</td>
</tr>
<tr>
<td>27512</td>
<td>YES</td>
<td>F/S</td>
<td>NO</td>
</tr>
<tr>
<td>27513*</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2816**</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2864</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The 27513 is selectable in four 16K banks, each of which is programmed as if it were a 16K Eprom in its own right. Although the programmer software will handle 16K Eproms there is no ability built into it to allow to allow the bank selection mechanism to operate.

** The 2816 Eprom requires only a short pulse to initiate the internal programming cycle followed by a delay of 10ms to allow completion. The software does not support this as it stands but would need minimal changes to allow the use of this device.
control programs. It often means making two passes when programming.

Ease of use is of prime importance in a package of this type and to this end it has been made as simple as possible to move back and forth between Eprom programmer software and Tanbug monitor. The programmer software has both a cold and warm start vector, the cold start is at E800h and the warm start is at E803h.

The software should always be entered the first time at E800h as this performs the initialisation of the PIOs. If it becomes necessary to leave the programmer, when developing software with an assembler or using the Tanbug monitor facilities, then re-entry is via E803h.

The provision of memory modify all list commands was not necessary. The ease of movement in and out of the program makes it simple to use the Tanbug and X- bug monitor commands for modification, listing and disassembly. There is one command, however, that is useful for displaying the contents of memory, both on the screen and on a printer: the Dump command. It was developed as an aid to give hexadecimal printer dumps of areas of memory, during Eprom development.

The software actually implements three different Fast programming algorithms depending on the type of Eprom being programmed. For the 2764 and 27128 this flowchart is similar to the one featured in the original article (ETI, August 1983). The 27256 and 27512 are slightly different and this is reflected in the flowcharts of the algorithms for these two Eproms (Figs. 1 and 2). The method used by the 27512 should be quicker than that for the 27256, and approximate times for those Eproms programmed so far are shown in Table 2.

Points Of Note
The present package (EP3V75) will support the new hardware for both fast and slow methods of programming. It will not support the original hardware as I/O bits are assigned to the PIO ports in a different way. Whilst the package will work with Tanbug V2.3 and V3.1 it will not work with V1.0, because of the way in which the system routine calls are vectored through the jump table at the beginning of Tanbug.

In a 2K package such as this it is not possible to include all desir-

---

**Table 2 Approximate programming speeds.**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SIZE</th>
<th>PROGRAM</th>
<th>SLOW</th>
<th>FAST</th>
<th>TEST</th>
<th>VERIFY</th>
</tr>
</thead>
<tbody>
<tr>
<td>2716</td>
<td>2K</td>
<td>1.75m</td>
<td>—</td>
<td>1.25s</td>
<td>1.25s</td>
<td></td>
</tr>
<tr>
<td>2732</td>
<td>4K</td>
<td>3.5m</td>
<td>—</td>
<td>2.5s</td>
<td>2.5s</td>
<td></td>
</tr>
<tr>
<td>2532</td>
<td>4K</td>
<td>3.5m</td>
<td>—</td>
<td>2.5s</td>
<td>2.5s</td>
<td></td>
</tr>
<tr>
<td>2764</td>
<td>8K</td>
<td>7.5m</td>
<td>1m</td>
<td>5s</td>
<td>5s</td>
<td></td>
</tr>
<tr>
<td>27128</td>
<td>16K</td>
<td>15.5m</td>
<td>2m</td>
<td>10s</td>
<td>10s</td>
<td></td>
</tr>
<tr>
<td>27256</td>
<td>32K</td>
<td>30m</td>
<td>4m</td>
<td>20s</td>
<td>20s</td>
<td></td>
</tr>
<tr>
<td>2758</td>
<td>1K</td>
<td>0.8m</td>
<td>—</td>
<td>0.6s</td>
<td>0.6s</td>
<td></td>
</tr>
<tr>
<td>27512</td>
<td>64K</td>
<td>60m</td>
<td>7m</td>
<td>41s</td>
<td>41s</td>
<td></td>
</tr>
</tbody>
</table>

---

**Fig. 1 Flowchart for 27256 programming routine.**

**Fig. 2 Flowchart for 27512 programming routine.**

---

able features — particularly totally comprehensive error checking. Providing a sensible approach, the error checking should be adequate. Entering only the command letter when parameters are required will cause the command action to operate on the first byte at the present Base. Entering parameters in the wrong order will be trapped and a 'P' displayed.

Testing a 27512 Eprom must be done in two 32K parts, and will produce two 'EPROM ERASED OK' messages, approximately 20 seconds apart. This is not an error — honest!

**Hardware Configuration**

The program assumes that the Eprom Programmer board is based at address BC20h. The original Microtan screen is assumed for obtaining parameters, and in the clear screen routine. Locations in zero page from 45h to 5Fh, are used. The Eprom programming software re-initialises the locations it needs when entry is made at E800h. If other user programs are in memory at the same time occupying any of these locations the contents will be overwritten.

**Menu And Commands**

The program us started from the Tanbug monitor by typing CCE800<CR>. You are then asked to enter the type of Eprom that you wish to program and the base address at which your object code resides in memory. You should then see a display of current Eprom type, current base address and the menu of available commands.

This screen display is shown below. It can be obtained at any time, when not actually executing a command, by pressing the 'H' key.
The command input format uses the capital initial letter of the command, as shown on the help menu. Some commands — ‘Help’, ‘Quit’ and ‘Test’ — execute immediately. Others, like ‘New type’ and ‘Base’, prompt for a further input. The rest require a parameter range. The normal format is:

X,ssss,fff
(X is the start address in hex and ffff is the finish address in hex).
The delineator can be any non alphanumeric.

Unlike the old version of the software the range parameters do not require leading zeros. All of the following are valid commands:

- R,0,7FF or R,0000,7FF reads 0 to 7FF.
- S,801,802 slow programs 801 and 802.
- F,FFF,FFF fast programs location FFF.
- D/0/2FF and D—100,1FF both dump to the screen.

All commands that act on the Eprom socket also turn off the green LED and, in case of a programming command, turn on the red LED.

If the range of the parameters entered is too big for the Eprom type, the message ‘EPROM SIZE EXCEEDED’ will be displayed.

120 Command Description

An explanation of the commands may be useful since there are many new features.

HELP:- gives a display of the current Eprom type, base address and the commands available, exactly as it you had just entered the program from Tanbug.
QUIT: - takes you back into the Tanbug monitor and resets the stack, after making the PIO outputs safe.

TEST: - examines the Eprom to see if all locations contain FFh. If they do, you should get a message ‘EPROM ERASED OK’. Otherwise you will get a display of the addresses and contents. If there are more than fourteen locations not containing FFh, the program waits for you to press ‘CR’ before displaying the next lines. To abandon the display press SPACE BAR and you will be returned to the menu.

READ: - reads into memory the contents of an Eprom currently in the programming socket. Requires a parameter range.

VERIFY: - verifies that the Eprom holds the same code as the object code in memory at the current base address. If not, the code in both the Eprom and the memory will be displayed. Like the errors reported in the Test mode, this will be shown fourteen lines at a time, ‘CR’ will show the next screen full and the SPACE BAR will return you to the menu. Successful verification will produce the message, ‘EPROM VERIFIED OK’. Requires a parameter range.

FAST PROG.: - invokes the fast programming mode for Eproms of 8k and larger. With a smaller Eprom currently in the programming socket, it will automatically default to the slow mode to avoid damage. After successful programming there is an automatic verify of the whole range programmed, indicated by the message ‘EPROM PROGRAMMED, VERIFYING’, which gives way to the ‘EPROM VERIFIED OK’ report on completion. Lights red LED. Requires a parameter range.

SLOW PROG.: - the mode for programming Eproms smaller than 8K. With an Eprom of 8K or larger, selection of this mode allows programming in the standard way. This allows a certain degree of flexibility, since you can program Eproms of uncertain size with a tried and tested method. The messages used are the same as for the Fast mode. Lights red LED. Requires a parameter range.

DUMP: - gives a hex dump to the screen and printer in the following format: the absolute address in memory followed by the relative address from the start of the dump, then sixteen hexadecimal bytes of data and finally a two byte check sum computed from the previous sixteen data bytes. To get printer output, enter the command and parameters then press CTRL-P before the carriage return. Don’t forget to turn off printer control afterwards, with another CTRL-P, or the program will appear to ‘hang’ for 10 seconds. With the print output routine times out. Requires a parameter range.

NEW TYPE: - the command to change the type of Eprom you are working with.

BASE: - the means of changing the start address in the memory to that of any new object code.

Way Out

A common feature of all the commands that require parameters, is that the command sequence can be aborted at any time before pressing carriage return by use of the SPACE BAR.

Without using the ‘QUIT’ command, the program can be left by pressing either the ‘ESC’ key or the ‘RESET’ button. Neither is recommended, since they both interrupt commands at indeterminate points. The ‘ESC’ key is particularly bad as it will leave the programming socket with power and signals present. If ‘RESET’ is used it will be necessary to restart the programmer software via the cold start vector. The reset is also issued to the PIO’s, setting the ports to a safe state. They will then need to be re-initialised before they can be used again. It should be obvious when the socket is unsafe, because the green LED will not be lit.

The best method of exit is the ‘QUIT’ command which can only be issued when the programmer is in a safe state and which allows faster re-entry via the warm start vector at E803h.

If you should chance to use ‘ESC’ or ‘RESET’, re-entry to the program will re-initialise the PIO ports and set the socket to a safe state.

Waveform Diagrams

The outputs of the programmer hardware during fast programming change rapidly compared to those resulting from the 50ms pulses of the slow programming mode.

Figures 3, 4 and 5 show the programming voltage VPP, the
supply voltage VCC and the actual program pulse, NPGM (Not PGM), as they appear on an oscilloscope for a number of different Eproms in fast mode.

Figure 3 shows the waveforms for the 2764 and 27128. The 2764A and 27128A are the same, except that VPP is only 12.5 volts.

Figure 4 is the diagram for the 27256 and shows the effect of having chip enable (CE) on the same pin as the programming pulse.

Figure 5 shows the waveforms for the 27512, in which output enable is on the same pin as the programming voltage, and as with the 27256, CE and PGM share a pin.

Future Developments

The author's system includes a TUG Eprom Storage Card (ECS) and he is currently developing a 4K software package with enhanced error checking and additional routines for use with this. Features planned include support for other devices, new utilities, such as memory fill and relocation, and access to programs on the ESC and disc.

Currently being developed is a hardware interface to connect the programmer to a BBC Microcomputer and a sideways rom to allow its use. The hardware has actually been finished and tested. The sideways rom is in mid development. (Keep watching ETI — Ed.).

HOW IT WORKS

On entry through the cold start the PIOs are initialised to the correct inputs and outputs and then zeroed to a safe state. The header message is displayed and the type of Eprom to be operated on is requested along with the base address in memory where the object code resides. Then the help menu is displayed and the software waits for an input.

The program runs a background loop (GETCMD) waiting for characters typed at the keyboard. When an input is received the character is checked against a list of valid commands. On finding one, a jump is made to the corresponding subroutine, otherwise the program simply returns to the background loop.

Entry through the warm start vector does not initialise the PIOs or ask for Eprom type and address, as these are assumed. Instead, the menu is displayed and control passes directly into the background loop. This is intended for a quick return to the program after using the Tugbug monitor facilities. If a program has been run, such as a two pass assembler, which might have corrupted zero page locations used by the Eprom programmer software, it would be wise to return through the cold start vector.

Immediately after the two vectors (at E800h and E803h) in the Eprom there are the tables used for setting up the PIO ports in the configurations required for the functions and Eproms supported. To add other Eprom types to the software these tables would have to be extended and further entries made in the type and length parameters stored from E861h and E8C9h. This is not easy without a full disassembled listing and the use of a two pass assembler. There is no further space available in the current Eprom, so something would have to be removed, which should be no great problem as all subroutines are modular.

The screen clear routine (CLRSCN) is only called twice, from the header at E9CF h and by the help routine at EA23 h. It will not work with 80 column boards. It is the last subroutine in the Eprom at EFEC h.

BUYLINES

For those not wishing to type in the code from the hex dump, a ready programmed Eprom complete with assembler listing is available for £10.00, from G. J. Bennett, 35 Fowler Road, Cove, Farnborough, Hants. Alternatively, the source code (for use with the TUG two pass assembler/editor) and object code on tape are available for £5.00 from the same address. Please allow 28 days for delivery.

The hex dump and full disassembled listing will appear in ETI next month.

ETI JULY 1985
Frequency Fine Tuning for ETI Distortion Meter

Walter Wirth
Sri Lanka

In the text of his Distortion Meter project (ETI, February 1985), John Linsley Hood bemoans the lack of low resistance dual gang pots for fine tuning the frequency of the notch filter. However, high resistance dual pots are available. Instead of using a low value dual pot, the same result can be obtained by using a high value dual pot in parallel.

The diagram shows the relevant circuitry from the original design with the additional components attached by dashed lines. A 500k linear dual pot (designated RVa, b) in series with 4k7 resistors (to prevent too low a minimum resistance) is wired across notch frequency control RV2a, b and associated resistors R5 and R6.

Note that R5 and R6 are given the same value of 560Ω. RV3 in the original circuit is deleted being replaced by the 500k dual pot which will give the necessary non-interactive fine tuning capability mentioned in the original article.

Pulse Group Generator

Paul Cuthbertson
Inverurie
Aberdeen

The idea for this circuit arose when I needed to modulate a transmitter with a burst of 1 kHz about 100mS long every second. The circuit costs less than a pound and has the following advantages:

a) less complex than the usual two 555s in series;

b) low power consumption at about 800μA (not including output stage);

c) guaranteed known number of pulses in each group or burst, all the same width (no glitches due to non synchronised gating);

d) extremely flexible, with pulse grouping depending only on diode configuration. (The only restriction on this is that each burst or burst of bursts contains 2^n pulses where n is a whole number between 1 and 12);

e) duty cycles and pulse arrangements do not vary with frequency;

f) frequency is easily varied by altering the resistors on pin 10 or by chopping an existing pulse train injected at pin 11;

g) maximum attainable frequency typically 8MHz, minimum operating voltage theoretically 1V, but not at the same time.

The circuit works by dividing the square wave on pin 9. Various counter outputs are available to do the gating. In the example shown, only when 8, 9 and 10 are all high will pulses be output. R1, R2 and C1 set the operating frequency using the 4060's internal clock circuitry. R3 prevents the O outputs conflicting with pin 9. There are residual pulses remaining when the O outputs are low, and R4 and R5 form a divider which prevents the output transistor, Q1, turning on with these 0.7V pulses. (A forward-biased diode in the base of the transistor often serves the same purpose.)

On a more speculative note:

a) use the 4040 or 4020 'sister chips' (ouch, that Hertz!) which have different sets of outputs available (but no built-in clock circuitry);

b) turn the diodes round (all of them, note) to get a 'disabled high' with different patterns;

c) some of these chips have Schmitt inputs - inject a sine wave;

d) use another transistor to invert a set of diode outputs, summing the result of this back into the system to get bursts of pulses other than 2^n in number;

e) feed one of the Qs back to reset input;

f) use a series of changeover/centre off switches to switch diodes out of circuit, or to an inverter or the normal matrix;

g) use the gate signal itself as an output giving precise control over duty cycle at varying frequencies of input.

NOTE: SEE ETI, FEBRUARY 1985, p38 FOR ORIGINAL CIRCUIT. R5 IS CHANGED, AND RV3 REMOVED FROM ORIGINAL.

IC1 = 4060
D1 = 3N3054 OR EQUIVALENT
D13 = 1N4148 SEE TEXT
R1,2,4,9,10 CORRESPOND TO BASIC FREQUENCY OF ABOUT 1kHz
OUTPUT IN THIS CONFIGURATION CONSISTS OF GROUPS OF 128 PULSES INTERSPERSED BY GROUPS OF 896 'MISSING' PULSES TRANSITOR STAGE INVERTS

NOTE: IC1 = 4060
D1 = 3N3054 OR EQUIVALENT
D13 = 1N4148 SEE TEXT
R1,2,4,9,10 CORRESPOND TO BASIC FREQUENCY OF ABOUT 1kHz
OUTPUT IN THIS CONFIGURATION CONSISTS OF GROUPS OF 128 PULSES INTERSPERSED BY GROUPS OF 896 'MISSING' PULSES TRANSITOR STAGE INVERTS

52 ETI JULY 1985
Simple CMOS Frequency-Window Discriminator

Thomas Schaerer
Switzerland

If you have to convert any environmental signal (temperature, pressure or humidity, for example) using a voltage-to-frequency converter, and you have to pay attention to an allowed range of signal values, then you should use the following very simple circuit. The circuitry consists of two CMOS ICs, two transistors and associated passive components. It requires a clean pulse wave input, so if your signal is noisy or irregular you should add a Schmitt-trigger stage at the front end of the circuit. The supply voltage can be between +5V and +15V — although this will affect the precise pulse widths involved, which should therefore be independently measured for accurate calibration. With a low Vcc, R4 can be as low as 470R. If Vcc is 15V, however, R4 should be a minimum of 1K5.

IC1 is a dual, retriggerable monostable.

IC1a detects the input frequency. A positive-going input pulse will trigger an output pulse of width given by R1xC1. If another pulse appears on the input before the output pulse finishes, the output will be retriggered. So, if the frequency of the input exceeds a given limit, fmax (equal to 1/R1xC1), the output on pin 6 will be high for the duration of the input signal (and for a short time thereafter until IC1a resets itself). The signal on pin 12 (the input of IC1b) will therefore go high and stay there, so that the output on pin 10 will be a single pulse of width given by the time constant R2xC2.

If the frequency of the input is below the limit fmax, the output on pin 6 will be a pulse wave of frequency equal to the input but of pulse width equal to R1xC1. Now, if this frequency is higher than fmin (equal to 1/R2xC2) the output of IC1b will be continuously retriggered giving a high on pin 10 for the duration of the input signal (and for a short time thereafter until IC1b resets itself). If the frequency is lower than fmin, the output of IC1b will be a pulse wave of frequency equal to the input but of pulse width equal to R2xC2.

In short, an input frequency above fmax will result in a single pulse of width R2xC2 on pin 10 of IC1; an input frequency below fmin will result in a train of R2xC2 pulses on pin 10; and an input frequency between fmax and fmin will result in a high level output on pin 10. The RC network on pin 10 should have component values which ensure that R2xC2 pulses do not reach logic high on the input to IC2a, a Schmitt-triggered NAND gate wired as an inverter. R3 and C3 should have a time constant at least three times greater than R2xC2. R4 should be considerably lower than R3 (between 470R and 1K5R, depending on Vcc). Along with the steering diode, D1, R4 ensures a rapid discharge of C3, while R3 is designed to charge it slowly. With suitable values, pin 1 and 2 of IC2 will be low except when the input signal frequency lies between fmax and fmin.

This low will enable IC2c,d to transmit a 10Hz signal provided by the simple oscillator formed by IC2b, R5 and C4. This signal is directly available on pin 4 of IC2 and is also fed to the LED via a constant current source comprising transistors Q1 and Q2 and associated components. The constant current source ensures that LED brightness does not vary with supply voltage. It should be noted that R1 and R2 must both be greater than 5K, although there is no limit on C1 and C2. The maximum input frequency in this circuit can be in excess of 100kHz, although the accuracy of the circuit at this end of the range and even more so, at the low end of the range when using large-value electrolytics, may be uncertain. For adjustment of ranges and calibration, it would be possible to replace R1 and R2 by suitable pots in series with fixed resistors of 5k or more.
The foil pattern for the Heat Pen, held over from last month.

The top and bottom foils for the Printer Buffer.
The foil pattern for the Noise Gate PCB.
ETI PCB SERVICE

In order to ensure that you get the correct board, you must quote the reference code when ordering. The code can also be used to identify the year and month in which a particular project appeared: the first two numbers are the year, the third and fourth are the month and the number after the hyphen indicates the particular project.

Note that these are all the boards that are available — if it isn’t listed, we don’t have it.

Our terms are strictly cash with order — we do not accept official orders. However, we can provide a pro-forma invoice for you to raise a cheque against, but we must stress that the goods will not be dispatched until after we receive payment.

**PLEASE ALLOW 28 DAYS FOR DELIVERY**

How to order: indicate the boards required by ticking the boxes and send this page, together with your payment, to ETI PCB Service, Argus Specialist Publications Ltd, 1 Golden Square, London W1 R 3AB. Make cheques payable to ETI PCB Service. Payment in sterling only please. Prices subject to change without notice.

Total for boards £ ......... ..............................
Add 45p p&p £ ..............................
Total enclosed £ ..............................

Signed ................................................................
Name ................................................................
Address ................................................................

ETI JULY 1985
REVIWWS

528T Multitester
Hardware
Semiconductor Supplies International Ltd.
Dawson House
128/130 Carshalton Road
Sutton
Surrey SM1 4RS
price: £31 plus VAT

DM30 Multitester
Hardware
Selectronix
Tower House
Lower Kings Road
Berkhamsted
Herts HP4 2AB
price: £39 plus VAT

There seems to be a smallish flood of low price digital multimeters incorporating transistor testers coming to the market right now. The two reviewed here are typical of most cheaper DMMs. The inclusion of the transistor test facility, however, makes them definitely attractive to the home constructor.

Understandably, there is a certain amount of resistance to the idea of using DMMs. As with digital watches, the display is nowhere near as immediate as the scale on an analogue meter. Personally, I find the lack of a calibration feature also annoying — I can never quite trust the reading I get, even though the accuracy is clearly high and the DMM circuitry undeniably reliable.

The manufacturers of the DM30 claim an accuracy of 0.5% on the DC voltage scales, while the 528T's manufacturers claim 0.8% on the same scales. There was a distinct difference in their readings under test, although in both cases the accuracy was clearly better than 1% and the differences were barely significant. In that respect these meters were both undeniably useful instruments, despite my prejudices.

Both meters originate in Taiwan, the DM30 coming via a Swedish distributor. The 528T, although cheaper, is the most attractive of the two and includes an integral stand, an idiot proof socket for transistors under test and standard ¼ inch probe sockets. Unfortunately, it only boasts 14 ranges (including the Hz measurements scale for testing transistors).

Both meters incorporate readable 3½ character, ½ inch LCD displays, but the DM30 has 29 ranges (if you include NPN and PNP transistor testers, a battery tester, a diode tester and continuity buzzer setting). The DM30 allows AC current measurement and a wider range of AC voltage measurement than the 528T. There is a 10A DC current range, too. It also gives an indication of a low battery condition when the meter's internal PP3 battery runs down to less than 1V.

Major disadvantages of the DM30 are the price (£46.57 including VAT and post and packing), the somewhat confusing and non-standard probe sockets and the rotary range setter which could lead to problems with NPN and PNP transistors being tested for HFE and with AC and DC ranges. The meter does seem to be well-protected, but this leads me to one other problem with the DM30.

In the course of reaching these shores, it seems to have acquired the title 'DM30' from nowhere. That's why you should never be without the FREE CRICKLEWOOD ELECTRONIC, from the UK's number one 100% component shop. No gimmicks, no gadgets or computers, just components, millions of them, all easily available by mail order. Calling or credit card telephone orders. Just a card to get your FREE copy now. (No SAE required). You have nothing to lose.

Gary Herman
**REVIEWS**

**MICRO PROFESSOR MPF-1/88**

**Hardware**

*Flight Electronics*  
*Flight House*  
*Quayside Road*  
*Birdham Mar*  
*Southampton*  
*Hampshire SO2 4AD*

price: £325 plus VAT

With so many cheap microcomputers around, it's a legitimate and often asked question as to why anyone should want to pay well over the odds for an evaluation/development system — little more than a microprocessor, some operating system ROMs and a few K's worth of RAM. The system under review, for example, contains one 27128 ROM and two 6116 static RAMs along with the 8088 MPU and associated bits and pieces. That's 20K of memory for a price of £300 odd — not, at first sight, a bargain.

Of course, the MPF-1/88 — like its 280-based predecessor, the MPF-1-P is not intended to be direct competition for a microcomputer — home, office or otherwise — and that's where the answer to the question comes in. The system is a development tool, to be sure, but its major use will undoubtably be as an educational aid. To understand its appeal and to evaluate its worth, then, it's important to bear in mind where the MPF-1/88 will end up: not in a bedroom plugged into a spare television set, nor on the desk of a busy secretary or tired executive, but on workshop benches in colleges, ITeCs and even, perhaps, schools.

The original Microprocessor MPF-1-P was notable for a number of features. It was a single board system sold in a large book-style plastic binder. Based on the Z80, it had a small rubbery keyboard and a four character LED display, by means of which the programmer could directly access, read and alter the contents of memory. The firmware included a fairly basic machine code monitor and a very basic BASIC (which was practically unusable and which has, thankfully, been discarded from the MPF-1/88). What was exceptional about the Microprofessor was the documentation. Despite occasional lapses into Taiwanese English (the MPF-1-P and the MFPI/88 are both produced in Taiwan by the Multitech Industrial Corporation), the manuals were a model of clarity and comprehensiveness.

The importance of documentation in the microprocessor field cannot be overstated. There are really two reasons: by any ordinary micro is not of much use when it comes to learning about MPU's: the first is the typical lack of monitor or assembler facilities (often combined with the complexity of system firmware which makes it difficult to get to grips with the heart of the machine); the second — most crucial — is the abysmally low standard of documentation for micros, especially on the hardware and system firmware level. The MPF-1-P overcame both of these problems by offering a simple monitor and useful input-output devices and documentation which was — relatively speaking — a joy to use.

With the MPF-1/88, Multitech and their UK agents (Flight Electronics) have moved on to higher ground. The 8088 is clearly a compromise MPU, but an effective one in the IBM PC, while the 8086 can be found in the majority of true 16-bit machines.

The differences between the 8086 and the 8088 are subtle but significant. The 8 uses an 8-bit data bus, allowing for downward compatibility with much hardware developed for the 8080 and Z80. The 8086, while the 8088 is a bit data bus with the advantage of increased execution times. From a software point-of-view, both processors are identical — the '8 being designed to fetch or write 16 bits in two consecutive bus cycles, while the '6 performs the same operation in only one cycle. Both devices can also directly address up to 1M bytes of memory by means of a 20-bit address bus.

The MPF-1/88 makes good use of the 8088. On the one hand, it's compatible with many IBM add-on cards and can also read and write data in IBM tape format. On the other hand, a fairly simple modification enables many Z80 boards devised for the original Microprofessor to be used. In fact, Flight are supplying an interface which accepts up to three IBM-style cards and also reconfigures the bus to accept Z80 peripherals: an EPRM programmer, printer, sound generator and speech synthesizer. IBM-style cards available from Flight include an RS232C interface and a video board.

The basic system is attractive even without these add-ons. Unlike the original Microprofessor, the MPF-1/88 is properly cased and includes a full QWERTY keyboard (of adequate quality). The visual display has also been improved, by use of a two line by 20 character LCD screen. There are actually 24 'logical' screen lines which can be scrolled by use of the 'ALT' key on the keyboard.

The board itself is easily accessible and you can get to the two spare ROM sockets and the one spare RAM socket. Each of the three ROM sockets can take 8K or 16K ROMs while the RAM sockets can take 2K or 8K chips. Also accessible is the expansion bus — 2x11 hole rows arranged to take an H-connector and taken out to a 64-pin card-edge connector at the back of the machine. On the back, there is also a Centronics compatible printer port, tape in and out sockets and the PSU socket.

The upgraded features like the keyboard and the LCD display have been made available, I'm sure, because of the added complexity of the 8088. The MPF-1/88 incorporates a machine-code monitor and what the manufacturers describe as a 'line assembler', which is a straightforward and fairly comprehensive assembler/dissembler. The assembler, in particular, is easy to use and powerful — the more so because the operating system includes a number of subroutines called by using the 8088 software interrupt.

As a relative newcomer to 8086/8088 operations, I have to say that they are both lucid and powerful. It is worth considering getting hold of an MPF-1/88 to teach yourself 8088/8086 code, if only because these chips are so well thought out.

The documentation was only slightly disappointing. Regrettably, it is provided in three booklets — the User Manual, the Reference Manual and the Monitor Program Listing — and this means you may find yourself chasing a piece of information across acres of paper. The situation is worsened by the lack of any sort of index.

All the necessary information is available, if you're prepared to look for it, and the standard of the translation has actually improved since the days of the MPF-1-P. All the same, I found it annoying to have to turn to the user manual for the 8088 pin-outs and instruction set when the reference manual contains circuit diagrams and an appendix entitled 'Introduction to 8086 Assembly Language'. Logical presentation is not a strong point.

In one other respect the MPF/I/88 documentation is less adequate than that provided with its predecessor. The earlier system manuals came complete with a useful number of well-explained model programs. There is no better way of learning programming languages — high or low level — than by entering someone else's program and seeing how it works. Unfortunately, the MPF-I/88 documentation pays scant attention to this aspect of the learning process.

A more general question remains. Why spend time and money learning about 16-bit or pseudo 16-bit microprocessors when we have far from exploited all the possibilities of the familiar 8-bits? There really is no adequate answer to that, except to invoke the virtues of knowledge for its own sake and, by the way, to say again that the 8088/8086 are more powerful and, in some ways, more logically designed MPUs than the best-known of the 8-bits. If you're starting out with microprocessors, I'd seriously suggest you consider starting out with an 8088. If you're an old hand, well the 8088 should come easy. In either case, the MPF-I/88 will give you every opportunity to learn what the thing can do and to do a great deal of it.

Gary Herman

ETI JULY 1985
It appears there is more to this satellite TV thing than first meets the eye. I reported, last month, the position of the Club of 21 (the consortium which is to operate Britain's DBS television services), which does not feel inclined to accept the deal arranged by satellite supplier, Unisat. The price for Unisat's satellite services, says the consortium, is much too high. They would prefer to accept tenders from other organisations first, then choose the most desirable. The Government, however, does not see the situation in the same light, apparently preferring the Unisat solution.

The Government also holds the cards with another area of the satellite TV game: that of satellite master antenna television (SMATV) systems. SMATV refers to the type of satellite reception system which deliver a selection of television channels, in cable form to a number of users, from a single parabolic receiving aerial. It's anticipated that such systems will be used initially in hotels, council housing estates, sheltered old peoples' homes, hospitals and blocks of flats - much like existing terrestrial based community aerial television systems. It is not unreasonable to assume that individual householders may also take advantage of SMATV.

And it's this last fact which is worrying not only to the existing cable television operators, but also the Club of 21 with its proposed DBS television services, because both cable and DBS services would be undermined if individuals sidestep them and buy their own SMATV receivers.

Channel choice

Thom EMI is one of the biggest organisations looking to SMATV for future television services. It already owns and runs three SMATV television channels: the pop video channel Music Box, the film channel Premiere and the kiddies' Children's Channel. Apart from operating three of the proposed six or seven SMATV channels though, Thom EMI is also hoping to provide much of the necessary receiving equipment - parabolic aerials, converters etc - to franchises around the country. They, in turn, will lease the equipment to SMATV users. The other existing SMATV channels are: Ten - The Movie Channel (a direct competitor of Premiere), the general entertainment Sky Channel and Screen Sport. The other channel in the pipeline (or should I say in the air) is Cable News Network.

You pays your money...

Knowing this, it's easy to see why the Club of 21 may be worried about individuals using SMATV: the programme content of the SMATV channels is of a very high entertainment level. Of the six DBS channels, on the other hand, four must be the existing BBC and IBA channels. Only two channels of DBS transmissions, therefore, are free for new entertainment channels - even if the Government allows their use for such. The Club of 21, with its legal obligation to relay four old-hat channels, must be feeling pretty down and worried about its commercial viability. Potential users of satellite television services may view the high entertainment content of SMATV channels as being worth the one-off initial outlay of SMATV receiving equipment. Particularly so bearing in mind that the four BBC and IBA channels are already receivable 'off-air', anyway, and that DBS receiving equipment is not going to be cheap.

So the Government has soon to put its cards on the table and decide how best to optimise the possible services. The decision is not easy, and becomes more difficult as time creeps by. Ideally, the decision should have been reached years ago. We might all have had improved television services now if it had.

Meanwhile, one of the main reasons for even considering satellite television systems over ordinary terrestrial television - that of stereo sound - appears to have been knocked down by BBC engineers.

Using a digital coding system, a stereo signal may be transmitted alongside the existing signal so that television receivers equipped with suitable decoding circuitry can provide high quality stereo sound. The system is fully compatible with existing mono television receivers and the BBC says that stereo transmissions could begin as early as 1987.

Do we really need cable or satellite television systems?

Keith Brindley
If you have ever visited a signalbox (or as they call them in North America) you may well have been impressed by the mimic diagrams in which white lights indicate routes that have been set up for approaching trains; these then change automatically to red as the train enters the section of track being represented. Many railway modellers have been captivated and not a few now employ these on their own layouts.

The white lights pose few problems. The real difficulty is how to obtain reliable information as to the present whereabouts of the train, and also, by virtue of its dependence on 'dead' sections of track, not to lose control when the white lights to red.

Traditionally railway modellers have resorted to non-electronic techniques such as the use of relays. One method is to isolate a very short length of rail at the entry to a section and arrange that when train wheels bridge the gaps they complete the circuit of a latching relay. At the start of the next section a similar arrangement applies and the latching of the second relay cancels the first. Spare relay contacts abound for mimic diagrams, automatic signalling and accessory operation. All very straightforward but costly and also, by virtue of its dependence on 'dead' sections of track, it is not conducive to the smooth running of trains.

Two electronic methods of train detection are now rival claimants for the attention of railway modellers — and neither conflicts with smooth running.

Method number 1 is an electronic counterpart to the latching relay. Each section uses a bistable latch. Each latch may consist of a pair of TTL NAND gates or even as with one layout I visited recently, pairs of BFY51 transistors with oodles of collector current capability. Inputs to these bistables are most often from track-mounted reed switches activated by trainborne magnets, less often from 'dead' rail lengths (as with the relay system) or from LDRs shaded by passing trains.

This kind of system suffers from three major shortcomings. (1) Trains are always are of necessity an electrically noisy environment and unless great care is taken any bistable is likely to suffer from spurious setting and resetting. (2) At switch-on the latch may settle in the untrue state. (3) The system in its simplest form only works for one-way traffic; it can be modified for two-way traffic by doubling the number of detectors.

Method number 2 emulates the practice of track circuiting on British Rail by monitoring the electrical continuity of a section of line. Practice is to monitor the current flowing into the section from the controller (throttle) but leaving a trickle from an auxiliary supply to keep the detector going when the controller is off or at a stop. Most often the detector takes the form of a pair of small-signal NPN transistors in reverse parallel monitoring the voltage drop across a reverse parallel pair of rectifiers and transistors by using small power transistors such as the BD437 (see figure).

A fascinating aspect of this bit of circuitry is that it uses the transistor as a 'fractional-gain amplifier', since the base bias may be as high as 1A while collector current is less than 1mA! Numerous variations on this theme are in use and generally the system gives consistently accurate train detection without any problems other than a 0.7V 'diode drop' between controller and train. On my own layout the track circuit units monitor the live and return rails alternately with 'overlap zones' between sections to allow for the length of the train — since only the locomotives are detected.

This kind of reliable bidirectional train detection system with its TTL-compatible output opens the door to exciting possibilities ranging from simple TTL-based automatic signalling to mind-boggling computer-linked train control systems — of which more in later issues.

Roger Amos

Mos-fet Amplifiers

&

MFA100 SFA100

Specification:

<table>
<thead>
<tr>
<th>Power Output</th>
<th>125 Watts into 4 ohms.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output load</td>
<td>8 ohms to 4 ohms.</td>
</tr>
<tr>
<td>Input Sensitivity</td>
<td>0.775 volt (full output).</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>47k ohms.</td>
</tr>
<tr>
<td>Distortion T.M.D.</td>
<td>0.05% @ 1KHz typical.</td>
</tr>
<tr>
<td>Distortion I.M.D.</td>
<td>0.05% @ 80Hz/7KHz.</td>
</tr>
<tr>
<td>Slew rate</td>
<td>50 v/us.</td>
</tr>
<tr>
<td>S/N ratio</td>
<td>100dB below 125 watts.</td>
</tr>
<tr>
<td>Frequency response</td>
<td>10Hz - 100KHz (~3dB).</td>
</tr>
<tr>
<td>Damping factor</td>
<td>&gt; 400.</td>
</tr>
<tr>
<td>Protection</td>
<td>Handle reactive loads. Open circuit, Mismatch, Short circuit, No thermal runaway.</td>
</tr>
<tr>
<td>Case</td>
<td>Matt black texture finish 1mm thick mild steel case with strong leather handle, with plenty of ventilation.</td>
</tr>
<tr>
<td>Models</td>
<td>MFA100 mono 100w power slave. SFA100 stereo 100w + 100w power slave.</td>
</tr>
<tr>
<td>Compare the MFA100 &amp; SFA100 performance with the top range of amplifiers, “then make the right choice”.</td>
<td></td>
</tr>
<tr>
<td>Guarantee 2 years parts and labour.</td>
<td></td>
</tr>
</tbody>
</table>

MFA100 £98 inc. 
SFA100 £140 inc.

Send to: TECHNOCROWN LTD
42 Fallowfield, Luton, Bedfordshire LU3 1PX
Tel: 0582-598167
Mail order only
Postal charges per order £1. Welcome Schools, Colleges, and Trade. Securicor £10.00 delivery.

ETI JULY 1985
SCRATCH PAD

by Flea-Byte

I note with apprehension that video versions of the new Francis Ford Coppola megaflick, 'The Cotton Club', will be issued with an anti-piracy system built-in. The so-called spoiler signal has long been the holy grail of the record industry - the Beatles once even paid a certain Alex Mardas a lot of money partly because he claimed to have invented a device which would prevent home taping of the video signal with noise. The so-called spoiler signal has long been the holy grail of the record industry - the Beatles once even paid a certain Alex Mardas a lot of money partly because he claimed to have invented a device which would prevent home taping of the video signal with noise. The so-called spoiler signal has long been the holy grail of the record industry - the Beatles once even paid a certain Alex Mardas a lot of money partly because he claimed to have invented a device which would prevent home taping of the video signal with noise. The so-called spoiler signal has long been the holy grail of the record industry - the Beatles once even paid a certain Alex Mardas a lot of money partly because he claimed to have invented a device which would prevent home taping of the video signal with noise.

The so-called spoiler signal has long been the holy grail of the record industry - the Beatles once even paid a certain Alex Mardas a lot of money partly because he claimed to have invented a device which would prevent home taping of the video signal with noise. The so-called spoiler signal has long been the holy grail of the record industry - the Beatles once even paid a certain Alex Mardas a lot of money partly because he claimed to have invented a device which would prevent home taping of the video signal with noise. The so-called spoiler signal has long been the holy grail of the record industry - the Beatles once even paid a certain Alex Mardas a lot of money partly because he claimed to have invented a device which would prevent home taping of the video signal with noise.
PRINTED CIRCUITS Make your own simply, cheaply and quickly! Golden Fotolac light-sensitive lacquer - now greatly improved and very much faster. Aerosol cans with full instructions, £2.50. Developer 35p. Ferric Chloride 50p. Clear acetate sheet for master 15p. Copper-clad fibreglass board, approx. 1mm thick 2£0.00 sq. ft. Post/packing 75p.Tranistor electronics, Castle Drive, Pra Sands, Penzance, Cornwall.

J. Linsley Hood Designs Distortion Analyzer kit £25.00 (p&p £1) Multinohmeter kit £12.35 (p&p £5) Case & Panel for above £12.00 (p&p £1.50) ETL Model P.A. kit £3.10 (p&p £1.50) Audio Signal Gen. (022) £28.50 (p&p £1.50) Audio Signal Gen. (902A) £38.50 (p&p £2.00) Fixed frequency Gen. £17.00 (p&p £5) Ref. P.S.U. 1.5/3.5 volts from £12.80 (p&p 75p) SAE for full instructions Teleradio Electronics 225 Forre St., London N19 0PE Tel: 01-807 3719

MINIATURE TRANSMITTER, transmits all voices and sounds to any VHF/FM radio up to 5 miles away, size 2in x 1½in, tunable 70-150 MHz complete kit, including sensitive microphone, £4.95 sent cash/cheque/PO: Technician, 22 Lambardes N.A.G., Nr. Dartford, Kent DA3 8HX. Tel: 01-607 3719

PRINTED CIRCUIT BOARDS and other parts being ready drilled boards £2.85 p&p 50p. Send to: Chataignes Product, Ledbury HR8 2AA. Tel: 01-807 3719

MINIATURE FM TRANSMITTERS, Frequency 60-145 MHz, range 1/2 mile S.G.F. – P.C.B. All components. Full instructions 9-12v operation, broadcast reception. Super sensitive microphone. Pick-up on FM radio. £6.95 inc; or ready built £8.95: Same day des- cation. Super sensitive microphone. £4.95 send away, size 2in x 1/2in, tunable 70-150 MHz complete kit, including sensitive microphone, £4.95 send cash/cheque/PO: Tectroniks, 22 Lambardes N.A.G., Nr. Dartford, Kent DA3 8HX. Tel: 01-607 3719

JBA ELECTRONICS Specialists in manufacturer and design of: Microprocessor, Telemetry, and Audio-based systems. UNIT 1, BRECON INDUSTRIAL ESTATE, BRECQH, POYWES, S. WALES Tel: (0874) 8844

SCOPEs Repaired & recalibrated, all makes, all models. Scopex, Safern, Older TEK TO MENDASCOPE LTD Otter House Western Underwood, Olney Bucks MK46 5JS Tel: (0283) 712445

P.C.B. DESIGN & LAYOUT, manually taped artwork professionally produced at competitive prices. James Gedrich, Tel: 01-674-8511.

POWER SUPPLIES CLAIRTRONIC 3-Pin Plug AC Power Units 400/12V at 400 mA rms. 2-Metre Jack Lead, In-built Thermal Fuse. Price £3.85. P&P & VAT included. CLAIRTRONIC LTD, Churchfield Road, Chalfont St. Peter, Bucks. SL9 9EP.

POWER SUPPLY REPAIRS. We offer a fast repair service on most power supplies. Access'Visa. NHS Amplification, 269 Heswall Road, Hull.


FREE PROTOTYPE of the finest quality with every P.C.B. artwork designed by us. Competitive hourly rates, and high standard of work. Halstead Designs Limited. Tel halstead (0767) 477408.

JBA ELECTRONICS Specialists in manufacturer and design of: Microprocessor, Telemetry, and Audio-based systems. UNIT 1, BRECON INDUSTRIAL ESTATE, BRECQH, POYWES, S. WALES Tel: (0874) 8844

SCOPES Repaired & recalibrated, all makes, all models. Scopex, Safern, Older TEK TO MENDASCOPE LTD Otter House Western Underwood, Olney Bucks MK46 5JS Tel: (0283) 712445

P.C.B. DESIGN & LAYOUT, manually taped artwork professionally produced at competitive prices. James Gedrich, Tel: 01-674-8511.

POWER SUPPLIES CLAIRTRONIC 3-Pin Plug AC Power Units 400/12V at 400 mA rms. 2-Metre Jack Lead, In-built Thermal Fuse. Price £3.85. P&P & VAT included. CLAIRTRONIC LTD, Churchfield Road, Chalfont St. Peter, Bucks. SL9 9EP.

POWER SUPPLY REPAIRS. We offer a fast repair service on most power supplies. Access'Visa. NHS Amplification, 269 Heswall Road, Hull.

YOU ARE UNDER STARTERS ORDERS!

For the BIGGEST Mobile Rally in the South Of England on JULY 14th 10 a.m. to 5 p.m. at the Brighton Race Ground...

THE SUSSEX MOBILE RALLY

Huge "Bring & Buy Stall", 20,000 sq. ft under cover exhibition area, plus attractions for the YXL and children, restaurant facilities. The Rally which caters for the whole family. Talk IN S22 and 3.5 Mhz. Admission £1 children free if accompanied by an adult. For further details ring:

07918 - 5103
If you have something to sell now's your chance! Don't turn the page — turn to us!

**Rates of charge:** 40p per word per issue + 15% VAT (minimum of 15 words).

and post to **Electronics Today International, Classified Dept., 1 Golden Square, London W1.**

Please place my advert in **Electronics Today International** for ....... issues commencing as soon as possible.

---

**Classified advertisements under £10 must be paid for in advance.**

Please use BLOCK CAPITALS and include post codes.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name (Mr/Mrs/Miss/Ms)</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
<th>Daytime Tel. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I am enclosing my Cheque/Postal Order/International Money Order for (delete as necessary) £.... (Made payable to A.S.P. Ltd)

---

**ATTENTION: ALL CLASSIFIED ADVERTISEMENTS MUST NOW CARRY 15% VAT**

---

**MAILORDERADVERTISING**

**British Code of Advertising Practice**

ADVERTISEMENTS IN THIS PUBLICATION ARE REQUIRED TO CONFORM TO THE BRITISH CODE OF ADVERTISING PRACTICE. IN RESPECT OF MAIL ORDER ADVERTISEMENTS WHERE MONEY IS PAID IN ADVANCE, THE CODE Requires ADVERTISERS TO FULFIL ORDERS WITHIN 28 DAYS. UNLESS A LONGER DELIVERY PERIOD IS STATED. WHERE GOODS ARE RETURNED UNDAMAGED WITHIN SEVEN DAYS, THE PURCHASER'S MONEY MUST BE REFUNDED. PLEASE RETAIN PROOF OF POSTAGE/DESPATCH, AS THIS MAY BE NEEDED.

**Mail Order Protection Scheme**

If you order goods from Mail Order advertisements in this magazine and pay by post in advance of delivery, will consider you for compensation if the Advertiser should become insolvent or bankrupt, provided:

1. You have not received the goods or had your money returned; and
2. You write to the Publisher of this publication summarising the situation within 28 days from the day you sent your order and not later than two months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has been declared bankrupt or insolvent (up to a limit of £2,000 per annum for any one Advertiser so affected and up to £6,000 per annum in respect of all insolvent Advertisers. Claims may be paid for higher amounts, or when the above procedure has not been complied with, at the discretion of the Advertiser, but we do not guarantee to do so in view of the need to set some limit to this commitment and to learn quickly of readers' difficulties.)

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine (not, for example, payment made in response to catalogues etc. received as a result of answering such advertisements! Classified advertisements are excluded.)

---

**It's easy to complain about an advertisement. Once you know how.**

One of the ways we keep a check on the advertising that appears in the press, on posters and in the cinema is by responding to consumers' complaints.

Any complaint sent to us is considered carefully and, if there's a case to answer, a full investigation is made.

If you think you've got good reason to complain about an advertisement, send off for a copy of our free leaflet.

The Advertising Standards Authority. 

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

ASA Ltd, Dept 1 Brook House, Torrington Place, London WC1E 7HN

This space is donated in the interests of high standards of advertising
OMP POWER AMPLIFIER MODULES

Now enjoy a wide world-wide reputation for quality, reliability and performance at a realistic price. Four models available to suit the needs of the professional and hobby market, i.e. Industry, Leisure, Instrumental and Hi-Fi, etc. When comparing prices, NOTE all models include Teradial power supply, Integral heatsink, Glass fibre P.C.B., and Drive circuits to power compatible Vu meter. Open and short circuit tested. Supplied ready built and tested.

OMP 100 Mi A Amp Module. 110w R.M.S. 4ohms, I/P Sens 500mV X 10K. Size: 300 X 115 X 12mm. Price: £32.95 + (2.60 P&P).
OMP:MF200 Mos Fet. Very high spec. 200w R.M.S. 4ohms, I/P Sens. 500mV X 10K. Size: 300 X 150 X 100mm. Price: £52.95 + £5.50 P&P.
OMP:MF300 Mos Fet. Very high spec. 300w R.M.S. 4ohms I/P Sens. 500mV X 10K. Size: 300 X 143 X 102mm. Price: £79.95 + £4.50 P&P.

Vu Meter. 11 LED’s. Plastic Case Size: 84 X 72 X 48mm. Price: £8.50 + 50p P&P.

Full specifications available on request.

NOTE: Mos-Fets are supplied as standard (100kHz bandwidth & Input Sensitivity 500mV). If required.

OMP POWER AMPLIFIER MODULES

PEizo ELECTRIC TWEETERS - MOTOROLA

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

TYPE 'A' (KSN2038A) 3", round with white dome tweeter mesh, ideal for bookshelf and medium sized Hi-Fi speakers. Price £4.90 each + 40p P&P. TYPE 'B' (KSN1001A) 3", super horn. For general purpose loudspeaker systems, disco and P.A. systems etc. Price £5.99 each + 40p P&P. TYPE 'C' (KSN1015A) 2", 3", 6" wide dispersion horn. For quality Hi-Fi systems and quality disco etc. Price £6.99 each + 40p P&P. TYPE 'D' (KSN1038A) 3", 4", 6" wide dispersion horn. Upper frequency response retained extending to mid range (2KHz). Suitable for high quality Hi-Fi systems and quality disco etc. Price £9.99 each + 40p P&P.

LOUDSPEAKERS

Cabinet fixing kit included for each tweeter. For full details, please contact us on 01-7243564 Ext. 3500 P&P ea.

POWER RANGE

50 WATT R.M.S. Hi-Fi/Disco
20 ohm, magnet: 151mm; -20 dB re 1W. Ground ally fixing escutcheon. D/cast chassis. 19" width. £11.99 + 2.50 P&P ea.
100 WATT R.M.S. Hi-Fi/Disco
20 ohm, magnet: 151mm; -20 dB re 1W. Ground ally fixing escutcheon. D/cast chassis. 19" width. £24.99 + 5.00 P&P ea.
200 WATT R.M.S. Hi-Fi/Disco
8 ohm, magnet: 225mm; -20 dB re 1W. Ground ally fixing escutcheon. D/cast chassis. £60.99 + 10.00 P&P ea.
600 WATT R.M.S. Hi-Fi/Disco
8 ohm, magnet: 225mm; -20 dB re 1W. Ground ally fixing escutcheon. D/cast chassis. £290.99 + 20.00 P&P ea.
1200 WATT R.M.S. Hi-Fi/Disco
8 ohm, magnet: 225mm; -20 dB re 1W. Ground ally fixing escutcheon. D/cast chassis. £590.99 + 30.00 P&P ea.

FM MICROTRANSMITTER (BUG) 40-1055kHz with very sensitive microphone. Range 100/300 metres. 5.7 x 6.2 x 114mm (9 volt) Price: £9.62 + 75p P&P.
3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled professional performance. Range up to 3 miles 35 X 84 x 12mm (12 volt) Price: £13.74 + 75p P&P.
3 watt FM Transmitter Price: £13.99 + 3.00 P&P.

POSTAL CHARGES PER ORDER £1.00 minimum.

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

B. K. ELECTRONICS

Audio Electronics...12/66
BK Electronics...66
BNRES...27
Cambridge Microprocessor Systems...22
Cricklewood...57
Cybernetic Applications...12
Display...26
Electrovalue...26
ETI Book Service...10
Flight Electronics...IBC
Greenbank...60
Henry's Audio...12
ICS...57
ILP...27
Maplin...OBC
Microprocessor Eng. Ltd...59
Newrad...59
Powertran...IFIC
Rapid...6
SME...66
Stewarts of Reading...29
Technocrown...60
TK Electronics...27
Watford Electronics...4/5

ETI Advertisers Index
July 1985

Audio Electronics...12/66
BK Electronics...66
BNRES...27
Cambridge Microprocessor Systems...22
Cricklewood...57
Cybernetic Applications...12
Display...26
Electrovalue...26
ETI Book Service...10
Flight Electronics...IBC
Greenbank...60
Henry's Audio...12
ICS...57
ILP...27
Maplin...OBC
Microprocessor Eng. Ltd...59
Newrad...59
Powertran...IFIC
Rapid...6
SME...66
Stewarts of Reading...29
Technocrown...60
TK Electronics...27
Watford Electronics...4/5

SME precision pick-up arms

Please call or write:
SME Limited, Steyning, Sussex, BN4 3GY
Telephone: 0903 814321 Telex: 877808 G

ETI JULY 1985
The NEW educational product range from Flight Electronics Ltd, all of which may also be used as low cost development systems for engineers working on low budgets.

1 DT-01 Digital Trainer
For breadboarding, digital circuits, flip-flops and monostable multivibrators, counters, encoders, decoders, multiplexers, demultiplexers and sequencers, registers, LED and 7 SEGMENTS LED displays, memory devices, etc.

SPECIFICATION
AC ADAPTOR JACK: I/P DC +12V, 800mA
POWER SW: AC ADAPTOR
BATTERY: 1.5V x 4
PULSE SW: Two bounce-free pushbuttons
LOGIC SW: Eight logic level switches in DIP type
DC O/P: DC +5V, 750mA for user.
B-023 BREADBOARD: Solderless breadboard with 1580 interconnected tie points.
CLIP TERMINAL: Logic probe clip terminal.
BATTERY HOLDER: 1.5V x 4
LED DISPLAY: Eight LED buffered logic level indicators.
BNC JACKS:
SELECT SW: Clock range selection
LOW: 10 - 40 Hz
HIGH: 1K - 20K Hz
BANANA JACKS:
CLOCK ADJ: Fine adj. of clock frequency
includes Logic Probe.

2 MPF-1/88

3 MPF-1/65

4 MPF-1P

5 MPF-1B

FLIGHT ELECTRONICS LTD
Flight House, Quayside Road, Bitterne Manor, Southampton, Hampshire SO2 4AD.
Telephone (0703) 34003/27721. Telex 477793 KEMPSA G.
More This Month of Maplin

256K D-RAM 41256 - 15ns ONLY £9.95
(0Y74K)

256K EPROM 27256 - 250ns ONLY £18.95
(0Y75S)

Right-angle pcb mounting rotary switches:
1P12W - FT56L, 2P6W - FT57M, 3P4W - FT58N, 4P3W - FT59P. All £2.95 each
Driver chip for motor. SAA1027 ONLY £3.75

*SAVE* 1 Kit containing everything you need motor, SAA1027, data sheet and passives
ONLY £13.35 (LK76H)

Sounds Terrific

Professional Quality
High Power Loudspeakers
featuring:
• Virtually indestructible high-temperature
voice-coil reinforced with glass-fibre.
• 100% heat overload tolerance.
• Advanced technology magnet system.
• Rigid cast alloy chassis
• Linen or Plastiflex elostomee surrounds.
• 5-year guarantee (in addition to statutory
rights).
Prices from £17.97.

Send SAE for our free leaflet XH62S

Top Ten Kits

<table>
<thead>
<tr>
<th>MONTH</th>
<th>DESCRIPTION</th>
<th>CODE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Light Wire Detector</td>
<td>L63T</td>
<td>£2.75</td>
</tr>
<tr>
<td>2</td>
<td>256K D-RAM 41256</td>
<td>L43T</td>
<td>£15.95</td>
</tr>
<tr>
<td>3</td>
<td>Purple</td>
<td>L47T</td>
<td>£19.95</td>
</tr>
<tr>
<td>4</td>
<td>256K EPROM 27256</td>
<td>L48T</td>
<td>£23.95</td>
</tr>
<tr>
<td>5</td>
<td>1P12W Rotary Switch</td>
<td>L49T</td>
<td>£2.95</td>
</tr>
<tr>
<td>6</td>
<td>2P6W</td>
<td>L50T</td>
<td>£4.95</td>
</tr>
<tr>
<td>7</td>
<td>3P4W</td>
<td>L51T</td>
<td>£7.95</td>
</tr>
<tr>
<td>8</td>
<td>4P3W</td>
<td>L52T</td>
<td>£10.95</td>
</tr>
<tr>
<td>9</td>
<td>Line Drum Synth</td>
<td>L53T</td>
<td>£12.95</td>
</tr>
<tr>
<td>10</td>
<td>J187 Amplifier</td>
<td>L54T</td>
<td>£14.95</td>
</tr>
</tbody>
</table>

Over 100 other kits also available. All kits supplied with instructions. The descriptions above are necessarily short. Please ensure you know exactly what the kit is and what it comprises before ordering, by checking the appropriate Project Book mentioned in the list above.

The Zero 2 Robot is the first truly micro robotic system available and remarkably it costs less than £80. Complete kit (only mechanical construction required) £79.95 (LK66W).

Full details of power supply and simple interfacing for BBC, Commodore 64 and Spectrum, in Maplin Magazine price 75p (XA158).

A new range of very high quality multimeters offering truly amazing quality at the price.

Pocket Multimeter , 16 ranges, 2,000V DC/AC £6.95 (YJO6G)

M-1026Z with continuity buzzer, battery tester and 10A DC range, 23 ranges, 20,000V DC £14.95 (YJO7H)

M-2025S with transistor, diode and LED tester and 10A DC range, 27 ranges, 20,000V DC £19.95 (YJO8H)

M-5050E Electronic Multimeter with very high impedance FET input, 53 ranges, including peak-to-peak AC, centre-zero and 12A AC/DC ranges £34.95 (YJO9K)

M-5010 Digital Multimeter with 31 ranges including 20µV and 20µA DC/AC FSD ranges, continuity buzzer, diode test, and gold-plated pcb for long-term reliability and consistent high accuracy (0.25% +1 digit DCV) £42.50 (YJO10L)

The Maplin Service

All in-stock goods despatched some day for all orders received before 2:00-pm.
All our prices include VAT and carriage (first class up to 750g).
A 50p handling charge must be added if your total order is less than £5.00 on mail-order (except catalogue).

Phone before 2:00 p.m. for same day despatch.