

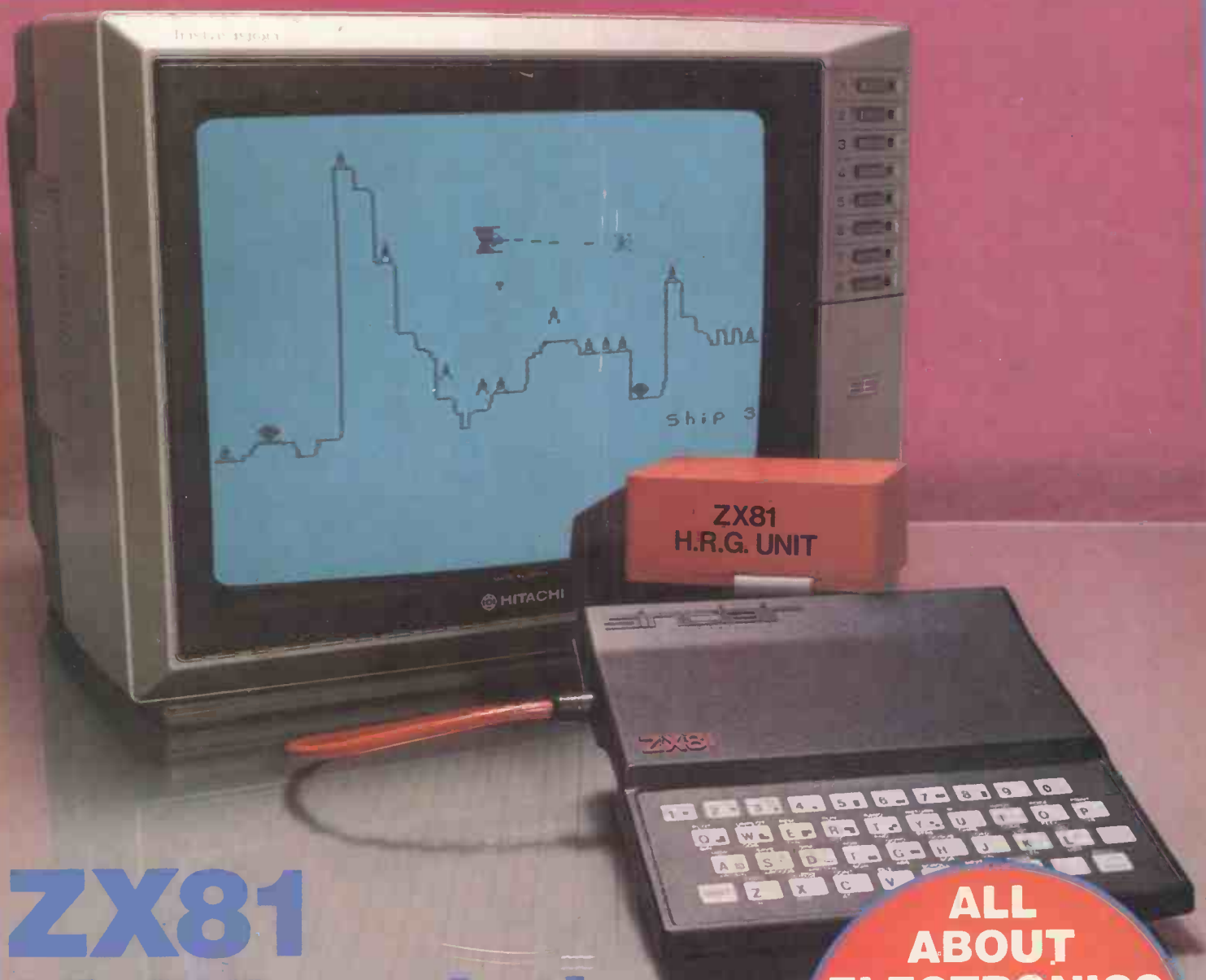
Hobby

AN ARGUS SPECIALIST PUBLICATION

Electronics

Project Electronics For Everyone

85p



ZX81 High Resolution Graphics Project

**ALL
ABOUT
ELECTRONICS**

New Series
From Basics to
Broadcasting

Ins and Outs of the ORIC-1

Simple Audio Projects to Build

Hobby Electronics

JULY 1983
Vol 5 No 7

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THE HOBBY 'SCOPE: Due to circumstances beyond our control, we regret that the second instalment of this project has had to be withdrawn from this issue of Hobby Electronics. The second part of the *Components for Computing* article dealing with computer display techniques has also been cancelled. We apologise for these changes, but would like to assure our readers that both articles will be completed in future issues.

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The Rapid Electronics

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LM741	14	NE529	225
LM747	60	NE531	150
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LM3017	40	RC4558	60
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MONITOR

Have You Heard The One About The Irish Computer Club . . . ?

Dublin computer enthusiasts have formed the **Irish Amateur Computer Club**, and they are looking for micro buffs from all over Ireland to join them.

"The initial response has been excellent, with our membership now exceeding seventy," writes Secretary Nigel Carey. "Although our members are all very enthusiastic and some are experienced programmers, we are lacking in hardware specialists."

(You are not the only one, Mr. Carey. If too many hobbyists follow the trend and concentrate on micros to the exclusion of hardware, they won't even be able to wire up their own plugs in a few year's time! It won't be "no user-servicable parts" any longer, it'll be "no useable parts servicers" . . . but enough of this . . .)

"We are hoping that a mention in your magazine might prompt some of your Irish readers to join the club. The IACC is open to all micro enthusiasts both experts and beginners. We meet at least once each month in **Power's Hotel, 47 Dawson St., Dublin** (on the second Sunday of each month from 10.00am to 2.00pm). Club members receive regular bulletins and newsletter. Demonstrations, market facilities, lectures and social evenings are just a few of our many activities."

The man to contact is **Mr. Nigel Carey, 166 McKee Avenue, Finglas, Dublin 11**. I expect they would appreciate an SAE, too.

Texas Rides Again

Texas Instruments have introduced a compact, low cost computer for professionals. The CC-40 is programmable in enhanced BASIC and can run applications software loaded either from solid state cartridges or small tape cartridges. The system is battery operated and can be carried in a briefcase as well as being fully operational as a desk-top computer.

The CC-40 has 34K bytes of built-in ROM allowing immediate use of BASIC, and the TI BASIC used is compatible with that used in TI's Home Computer family (see *Texas For Starters*).

6K bytes of user-addressable RAM can be expanded to 16K and a module port, provided for up to 128K of application software, can be used to expand the computer's RAM. The CC-40 has a suggested retail price of £169.95 and should be available by the time you read this.

A 'Hex-bus' intelligent peripheral interface connector on the module allows connection of current and future peripherals in the Compact family. An RS232 interface, printer/plotter and 'Wafertape' digital tape drive are planned immediately, and other peripherals such as a bar code reader, modems, printers, and a black and white TV interface for the near future. Each unit will include a 'Hex-bus' port and



interface cable, and will be designed to operate with the TI-99 Basic Computer and with an adapter with the TI-99/4A Family Computer.

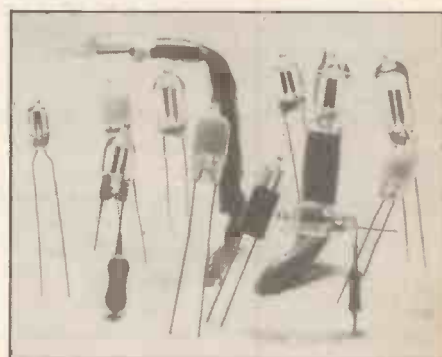
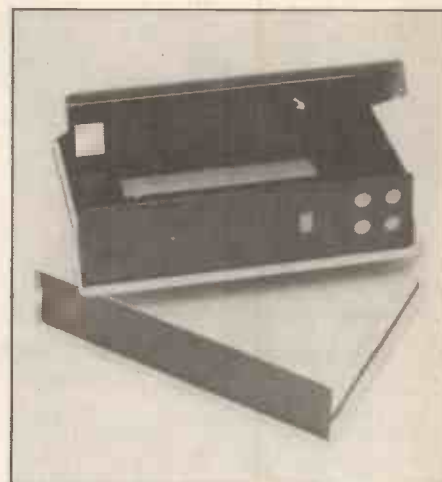
Suggested retail prices are £99.95 for the RS232 interface, £149.95 for the printer/plotter and £119.95 for the 'Wafertape' tape drive.

There will be twenty-two software applications packages available to start with, including Maths, Finance, Perspective Drawing, Advanced Electrical Engineering, Editor/Assembler and games packages on cartridge, and Elementary Dynamics, Photography, Inventory Control and several others on 'Wafertape' cartridges. TI expect to have seventy-five cartridges available by the autumn.

For further information contact **Texas Instruments Ltd., Manton Lane, Bedford, MK41 7PA. Tel: (0234) 67466**.

Light Box

Boss Industrial Mouldings, sole UK distributors for **Phillips** miniature neons, have now introduced blue and green fluorescent neons with AC striking voltages of less than 100V and 94V respectively and a life expectancy of more than 20,000 hours. They are



available as individual components or with a butt welded special film resistor suitable for 110-130V or 220-250V operation at temperature up to 130°C.

They also do customer-specified neon assemblies for bulk/industrial buyers.

Boss have also added another model to their BIM3000 series: this is a metal case available in two similar sizes, 250 x 167.5 x 68.5mm or 250 x 187.5 x 78.5mm with a matt black stoved chassis and red, grey or orange stove enamelled top and bottom covers. The design includes integral brackets, etc., for components, PCBs and other assemblies. Custom cut-outs and punchings are available to bulk buyers.

Contact **Boss Industrial Mouldings, James Carter Rd., Mildenhall, Suffolk IL28 7DE. Tel: (0638) 716101**.

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Hobby Electronics' Monitor pages are our new products, new ideas, and forthcoming events column. The electronics fan has to know you're there before he can take advantage of your services. So please let us know, just as early as you can, when something new is coming up that you want our readers to know about.

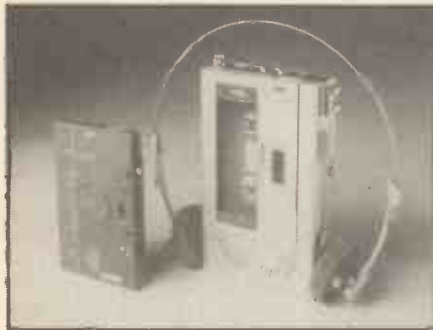
Remember that the Hobby readership is diverse. People of all ages and walks of life, from Primary students to Professors, take advantage of our

emphasis on self-education in every field of electronics. They want to find out what it's all about. Help MONITOR keep them in the picture.

Note: Hobby Electronics is produced up to eight weeks before it hits the newstands, so news never comes too soon.

Send press releases and news items to **MONITOR, Hobby Electronics, Argus Specialist Publications, 145 Charing Cross Road, London WC2H 0EE**.

MONITOR



Back On The Streets

It's enough to bring the Editor out in permanent apoplexy, but the new crop of Personal Stereos have arrived. I notice, however, that no-one has yet taken up our challenge to make one that runs on wind power...

From Heron Electronics comes the Crown CH-10 at around £24.95. This little object boasts headphones of an advanced design to give exceptional clarity, four-track, two-channel stereo, auto stop and cue functions, LED battery indicator, balance control and an output power of 30mW per channel. It measures 94 x 157 x 30mm, weighs 240gm and comes with a shoulder strap. Enquiries to your local hifi store or to Heron Electronics Ltd., Heron House, 19 Marylebone Rd., London NW1 5JL. Tel: 01 486 4477. There is also a Ch-20, at around £38.95, which includes an FM radio with stereo tuner, with a very similar specification.

From Panasonic comes another budget model, the RQ-J75. This will retail for around £33.50, and Panasonic don't mention any special features with this one except good value for money with their usual high standards. Dimensions are 88 x 134 x 35mm. Enquire at your local Panasonic dealer or to National Panasonic (UK) Ltd., 300-318 Bath Rd., Slough, Berks SL1 6JB. Tel: Slough 34522.

A more upmarket portable from JVC has a separate FM radio tuner module, shaped like a cassette tape, which loads into the cassette compartment for use. Not so convenient, perhaps, as a



machine with the tuner permanently built in, but the CQ-F2E boasts advanced features such as an improved tape transport system with anti-rolling device, Dolby B, and metal tape compatibility, as well as the more usual features.

The CQ-F2E costs around £69.90. See your JVC dealer or contact JCV (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestly Way, London NW2 7AF. Tel: 01 450 2621. for more information.

Micro Add-Ons

Kempston (Micro) Electronics' Competition-Pro joystick (featured in Monitor HE May '83) is now available for the VIC-20, and Atari 400 and 800 micros, as well as the Sinclair Spectrum. The Spectrum version costs £25 including interface, and the new editions cost £16.50.

Kempston have also produced an interface to link the Spectrum with Centronics-type printers.

The interface is able to recognise LLIST and LPRINT commands, so that programs can be listed directly from the Spectrum and listings (in BASIC only) can be printed out without special user calls. It is also possible to produce condensed, expanded, etc. characters. The interface comes ready to plug in directly to any Centronics type printer, ie all Epsoms, Seikosha 100A, OK1, Microline 80, etc. and includes driving software for up to 128 characters per line depending on printer type.

There is also a range of business

software from Hilderbray Ltd., including accounts, and stock control, etc., for use with these printers.

The interface costs £45.00 complete (plus £1.00 p&p). Orders and enquiries to Kempston (Micro) Electronics, 180a Bedford Rd., Kempston, Bedford MK42 8BL. Tel: (0234) 852997.

Testing, Testing, Testing

Dawne Instruments and Electronics have announced a string of new test instruments in their range.

Two new digital multimeters, the HC6010 and HC7030, have been produced to supplement the successful HC610 and HC703 models. These are 3½-digit LCD hand-held DMMs with retractable bench stands, and features include automatic zero, polarity and low battery indication, full ranges of DC and AC Volts and Amps, Ohms with switchable hi-voltage for diode testing and lo-voltage for in-circuit resistance tests, overload protection on all ranges, recessed input sockets, and a basic DC accuracy of 0.6% for the 6010 and 0.2% for the 7030. All models carry a year's guarantee and include free test leads, battery and manual. A carrying case is an optional extra at £3.00.

The HC6010 is £37.00 and the HC7030 is £47.00, with the older models slightly cheaper, but prices are quoted here ex-VAT or p&p, so if you want to buy mail-order you will have to send off for a pro-forma or check the price first.

A new 3½-digit multimeter, the 3300A has transistor hFE measurement facilities for both NPN and PNP devices, with an hFE range of 0 to 1,000. It directly indicates the hFE values, with about 10uA of Base current and 2V8 of Vce. Overload protection is 1000VDC and 750V rms AC. Diode test facilities give a maximum of 3V2 o/c and 0mA2 test current. Other functions include VAC and VDC, DC current to 10A and resistance to 20MR, and 800 hours of battery life from one 9V cell. The cost, ex VAT etc., is £42.00.

The Model 5000 is a counter-timer produced by GSC. This is a miniature hand-held battery-operated instrument, which measures pulse width in addition to frequency and period, and uses the



MONITOR

latest developments in high speed CMOS logic circuitry to provide characteristics normally only found in expensive benchtop instruments.

The 5000 has an 8-digit LCD display. It incorporates a wide range of signal-conditioning facilities including attenuation, slope selection, AC or DC coupling and variable trigger control. Signal input for all functions is via a BNC connector with an input impedance of 1M Ω , and attenuation settings of x1, x10 and x100 are available.

In the frequency mode the 5000 can handle inputs from 0Hz to 50MHz; the equivalent for the period and pulse-width modes are 25ns to 10s, and either the high or low part of the signal can be selected, as can gate times of 0.01, 0.1, 1.0 or 10s. Averaging can be carried out over 10, 100 or 1000 cycles.

The unit is powered by six AA NiCad or alkaline batteries, or by an AC adaptor/charger. We don't have a price for this one, nor for the following:

GSC's Model 3002 autoranging capacitance meter also boasts the virtues of a benchtop machine in a handheld model. The direct capacitance readings are from 1pF to 10uF990. There are eight automatically selected ranges, and Dawne claim an accuracy of within 0.2% (\pm one count) up to 199uF, and 1.0% ditto thereafter. As DC charging characteristics are used for measurement, the meter can be used for measurements on switches, cables and other components as well as capacitors. Input connectors are provided for round or flat-leaded devices.

The Model 3002 operates from six AA NiCad or alkaline batteries or from an optional charger.

The Model 6000 low-cost frequency counter provides two front-panel BNC inputs, one from 5Hz to 100MHz with a 1M Ω impedance and the other from 40MHz and 650MHz with a 50 Ω impedance. A switchable low-pass filter gives 3dB/octave rolloff at 60kHz for audio and ultrasonic measurements, and gate times of 0.1, 1.0 and 10s.

Another feature of this new model is a 3MHz 579545 temperature-compensated crystal oscillator with an accuracy of ± 0.1 part in 10^6 .

All enquiries to Dawne Instruments and Electronics, Shields Rd., Bill Quay, Gateshead NE10 0RS. Tel: (0632) 695117.



Tooling Up

Two from Toolmail: a computer service wallet containing twenty-five tools specially chosen for the simple maintenance of microcomputers and similar equipment. Tools include a miniature soldering iron, solder, pliers, tweezers, knife, IC puller, screwdrivers and adjusting tools among other basics. The kit costs £39.50 all inclusive.

Toolmail are also now supplying a range of Sanwa multimeters. Sanwa offer the widest range of multimeters anywhere in the world and supply



industrial and government users. A brochure with their selection is available from Toolmail.

Toolmail's latest catalogue is now available, with 128 pages, cost £1.00. Orders and enquiries to Toolmail, (1982) Ltd., PO Box 46, Maidstone, Kent ME15 8EQ. Tel: (0622) 683861.

Speed Of Light

For the ardent PCB-maker or anyone going into production even on a small scale, Electronic Assistance Ltd. have two UV exposure units at a reasonable price.

The UV-800 uses four 15W actinic UV lamps and is capable of etching more than 800sq cm of pre-sensitised PCBs or labels in less than three minutes, which is appreciably faster than traditional fluorescent tubes can achieve.

The UV-800 uses a very sensitive timer unit based on the ZN 1034E chip which allows repeated exposure to within 0.1% of the set time limit, over a

wide temperature range. This is an integral part of the exposure unit.

Safety and efficient operation features include a flame retardant foam pressure pad designed to avoid displacement of artwork when closing, and a positively interlocked microswitch which prevents UV emission reaching the operator's eyes when the pressure pad is raised.

There is also a more basic unit, of interest to hobbyists, without the timer function but with all the safety features. This is the UV-300, and costs £35.00 plus VAT. The UV-800 costs £85.00 plus VAT.

Enquiries to Electronic Assistance Ltd., Unit 1, Brynberth Industrial Estate, Rhayader, Powys LD6 5EN. Tel: (0597) 810711.

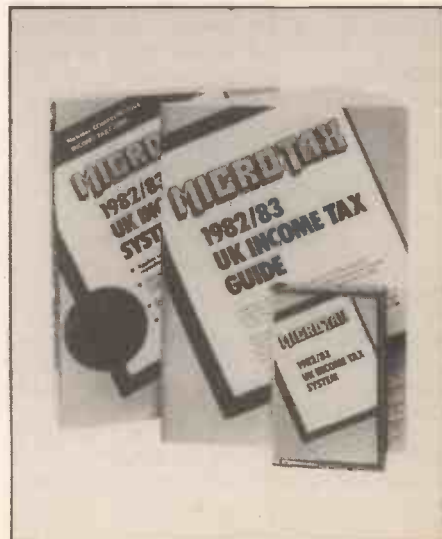
Less Taxing

A revolution in coping with that dreaded income tax return is forecast by the producers of Microtax, a new software system developed for Britain's growing number of home computer users.

Microtax, which consists of a set of programs on tape or disk and supporting manual, is claimed to be the first comprehensive, easy-to-use micro-computer system for completing tax returns.

The first Microtax system is an income tax system for the tax year 1982/1983 (ie for the current tax return) — this announcement is a trifle late for anyone who is not him or herself a trifle late, but the 1983/84 will be out in the autumn of 1983. Also available in 1983 will be complementary systems for dealing in more detail with the taxation of business and professional income, and a third system to cover Capital Gains Tax.

In addition to the calculation of tax liabilities, Microtax provides all the details to be filled in on the tax return, and for those with their own printers, a printout of all the relevant details is provided, which can be attached to the tax return.



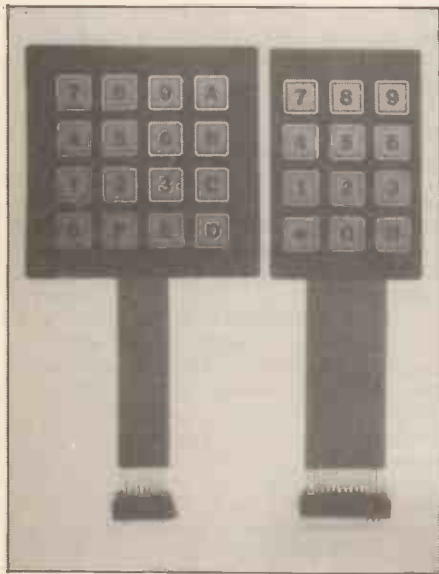
Microtax can currently be used on the 48K Spectrum, Commodore VIC 20 with 16K RAM pack, Commodore 64, Pet 400 Series (disk or tape), Dragon 32 and BBC Model B. Systems are being developed for use on the Sharp M80Z and Newbrain micros — in fact, these will probably be ready by the time you read this.

Microtax was developed by two taxation experts from Tax and Financial Planning Ltd., and took nine months of professional accountancy time and the equivalent of two years of program time to develop for the 1983/4 tax returns. The Microtax package costs £24.94 all inclusive from Microtax Ltd., Barratt House, 7 Chertsey Rd., Woking, Surrey GU21 5AB. Tel: (04862) 20369. Please state which micro you are using when ordering.

Membrane Keyboards

Velleman have announced the introduction of a new range of membrane keyboards available with 12 keys (type KB12) or 16 keys (type KB16). Both versions are offered with standard legend or with blank keys to enable customers to print their own legend.

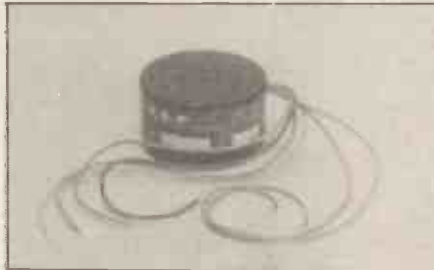
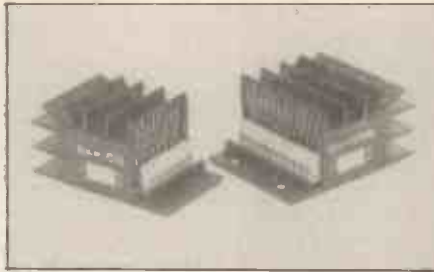
These multi-layer keyboards are manufactured by Velleman using high



quality materials, with the top layer being polycarbonate film which resists scratching, dust and water. Termination is by insulated flat cable and a suitable PBC connector with 2.54mm (0.1in) spacing is supplied. Ratings are 24V and 25mA maximum.

A data sheet with full technical specifications is available upon request. Price including VAT and postage is £8.44 for both versions (1 off quantity), with discounts available for larger quantities. Velleman will also manufacture special keyboards to customers own design.

Contact Velleman (UK) Ltd., PO Box 30, St. Leonards-on-Sea, East Sussex, TN37 7NL. Tel: (0424) 753246.



Help From ILP

ILP Electronics have introduced a 15W (rms) per channel stereo power booster for car radio and cassette players to accompany their 15W mono power booster already on the market.

Both modules, the mono C15 and the stereo C1515, somewhat resemble electronic hedgehogs and are designed to increase the output power of car radio /cassette players without distortion. They come as encapsulated modules with two-hole fixings, screw terminal blocks for easy wiring-up, automatic supply on switch-on, selectable input level facility and output protection circuitry.

Also from ILP comes 15VA transformers fully encased in ABS plastic shells with easy fixing by an M4 bush at the base. ILP are planning more transformers in the encased toroid style up to 120VA.

For information and prices on both components, contact ILP Electronics Ltd., Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP. Tel: (0227) 54778.

Sussex Mobile Rally

The Sussex Mobile Rally is being held at Brighton Racecourse on Sunday July 17th.

Features will include 20,000 square feet of exhibition areas, under cover, free minibus rides between the racecourse and the seafront (about four miles away), trade stands and a huge, popular Bring and Buy stall, and talk-in facilities on S22 and 80m. The rally is designed as a family attraction, not just for diehard fans.

The rally opens at 10.30am and closes at 5pm. Admission is £1.00, free to children and disabled people. There will be free car parking for up to 4,000 cars.

Advance tickets for clubs, and general information, can be obtained from W. Firmager, Flat 2, 23 Chatham Place, Brighton, Sussex.

Turn On The Lites

From Light Soldering Developments comes more soldering equipment and also a piece of gear which isn't anything to do with soldering but certainly utilises their experience with soldering irons.

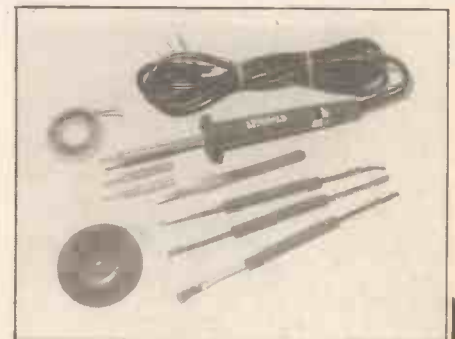
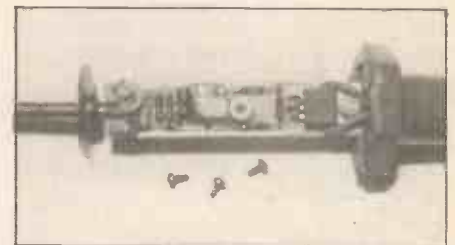
This is the Adamin Electric Stylus, which employs the blocking foil to mark and label a wide range of materials.

The Adamin is about the size of a ballpoint pen and operates from its own 4V5 mains plug and transformer, which fits a 13A socket. The silver-alloy writing tip heats in about 30 seconds to a temperature sufficient to activate the foil to allow writing. The foil comes in a variety of metallic and coloured finishes, and the Adamin is supplied initially with the plug/transformer and nine strips of foil in gold, silver, copper and six colours. The cost is £15.04 all inclusive.

Litesold have modified their LE40 24V electronically controlled iron to incorporate proportional band temperature control. Within this band, power is supplied in regular pulses of equal intervals and of a length which varies according to the actual and 'set' temperature of the iron. At the set temperature, the power-on and power-off periods are equal. Above and below this, they are modified until, at the limits of the proportional bands, the power is either fully on or fully off.

This system provides an improved temperature control, claim Litesold. To endorse their confidence in the iron, the 'set' temperature at manufacture is 370°C, lower than many controlled irons, but possible because of the exceptionally good control response of the iron. The lower working temperatures reduces the risk of damage to components and PBCs and allows longer life to the iron and bits.

The temperature can be user-adjusted anywhere between 280 and 420°C and stability around the point set is typically $\pm 2^\circ\text{C}$.



MONITOR

The PU2450 Power Unit, designed for use with the LE40, now features a LED load indicator which glows when the iron is drawing load current. This provides a constant confirmation of the iron's correct operation and is useful for showing the exact setting point when adjusting the temperature.

Mail order prices for the LE40 are £25.67 all inclusive, for the PU2450 £32.69 and for both together £57.99.

Litesold have recently introduced a complete soldering/desoldering kit for hobbyists. This includes an 18W mains iron fitted with a 3.2mm copper bit, with two alternative bits of 1.6mm and 2.4mm; three metres of 18 swg flux-cored solder, stainless steel tweezers, three double-ended desoldering tools and a reel of desoldering braid. The kit comes in a clear PVC wallet and is available at the mail order price of £14.55 all inclusive.

Orders and enquiries to Light Soldering Developments Ltd., Spencer Place, 97/99 Gloucester Road, Croydon CR0 2DN. Tel: 01 689 0574.

Shorts

For owners of the 16K Sinclair Spectrum, Sinclair are now offering a 32K upgrade, priced at £60 inclusive of all labour and postage costs. Owners who opt for the upgrade are also being offered a free Sinclair 48K cassette of their choice and the chance to buy Sinclair's ZX Printer at the special inclusive price of £39.95 (instead of the normal price some £20 higher).

Sinclair Research Ltd., 25 Willis Rd., Cambridge CB1 2AQ. Tel: (0233) 353204.

A new edition of the RSGB's *A Guide to Amateur Radio* — the 19th edition, to be exact! — by Pat Hawker G3VA has come out. The book is an all-round handbook, covering topics from basic electronics, detailed looks at the different units of amateur radio equipment, the RAE, operating a



station, international radio amateur organisations and appendices. The book is an 160-page paperback costing £2.75, or £3.44 by post, from the RSGB, Alma House, Cranbourne Rd., Potters Bar, Herts EN6 3JW. Tel: Potters Bar 59015.

Ambit International, the component suppliers who specialise in many unusual and imported lines, have released their 1983/84 catalogue, which is available through newsagents priced 75p. In the event of problems, contact Ambit International, 200 North Service Rd., Brentwood, Essex CM14 4SG.

The Leeds Electronics Show takes place from 5th to 7th July at the University of Leeds. This is a professional show, but anyone wanting information should contact Pat Hyatt on (0799) 26699.

A multimeter also from Electronic and Computer Workshop. This is the Steinel Digi-Check, a 3½-digit handheld meter of an unusual design. It consists of two probe tips, each weighing 250gm, which contain the instrumentation (A/D converter on a single CMOS LSI chip), digital display, PSU and battery charger, plus the test lead. The points under investigation can be tested and the display viewed simultaneously, while the scale selected can be changed while the instrument is in use.

Specifications include DCV from 0mV1 to 500V, ACV from 10mV to 500 and resistance from 0R1 to 20MR; pushbutton reading storage ensures that measurements can be made even in hard-to-reach places, and then the display can be brought out to where it can be read.

For more information contact Electronic & Computer Workshop Ltd., 171 Broomfield Rd.,

Chelmsford, Essex CM1 1RY. Tel: (0245) 62149.

Get Off The Line . . .

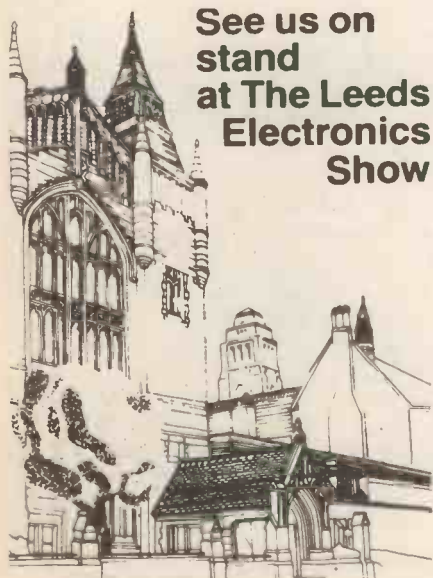
A new creature may be appearing in homes and gardens this summer — Britain's first legal cordless telephone.

This licence-free gadget is made by Fidelity Radio and has a nominal range of one furlong (700 ft), and perhaps double that from a high place with a clean line of sight. The base unit plugs into an ordinary British Telecom phone socket, and will recharge the batteries in the handset overnight.

The mobile handset is said to sound and work just like a conventional fixed phone, but includes automatic recall of the number dialled (useful for repeat attempts to reach an engaged number) and an intercom call-button for conversation between the base unit and the handset.

This is obviously aimed at businesspersons and the Leisure Class at present, but how long will it be before we can all have one on our bikes? Probably not long. This unit costs £169.00, with a twelve month warranty, and the standard socket is installed by British Telecom for £11.50. The makers point out that purchase and installation of a cordless phone roughly equates to installation and six years' rental of a standard pushbutton Trimphone. Cordless phones have been in use in the USA for nearly 15 years and 'listening in' has not proved a problem, we are told, because any one of the 20,000 different electronic signatures used to link the base and handset units is highly unlikely to be repeated within a quarter-mile radius.

Enquiries to Micro Equipment Centre Ltd., 18 Brock St., Bath BA1 2LW. Tel: (0225) 20312.



See us on stand at The Leeds Electronics Show

CALL IN AND SEE FOR YOURSELF

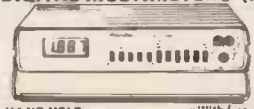
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 - K0615=16 range 10A DC 2 meg plus Hfe tester £39.95
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 - 1503Ha 0.03% basic version of above £189.00
- *Optional carry case £6.84

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- T100 34 range 10A AC/DC 20 meg ohm £56.35
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 - LS617 100 KHz to 150 MHz £79.35

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- ETU102 14 range 2K/v pocket £6.50
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- 360TR 23 range 100K/v. Large scale 10A AC/DC plus Hfe £39.95
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- YN 360TR 19 range 20K/v plus Hfe tester £15.95

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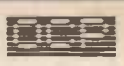
- Direct reading NPN: PNP. etc. TC1 (UK C/P 65p) £21.95

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THIS PROJECT is a subtle variation on an old idea. Fuzz-tone is used either purely for effect — heavy metal power chords would not be the same without it — or to mimic the soft clipping tones of an over-driven valve amplifier.

Depending on the values chosen for R10, 11, 12, 13, 14 and 15 the unit can be constructed to produce anything from a traditional, harsh fuzz sound to a reasonable imitation of a valve amplifier pushed a little too hard. The 'fuzz control' potentiometer allows variations around the basic sound and, according to one user, at moderate settings "it sounds like Jimmy Page reversing uncontrollably into a large greenhouse". That's a recommendation?!

Fuzz On The Circuit

The first stage of the circuit (Figure 1) is a simple preamplifier, designed to accept an input directly from an

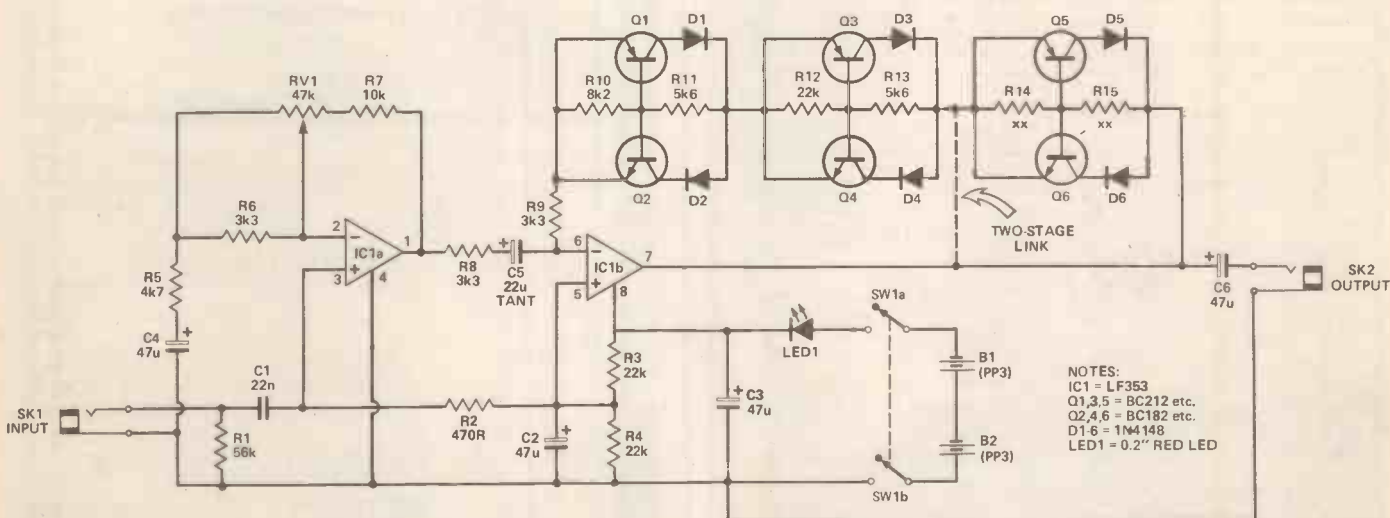
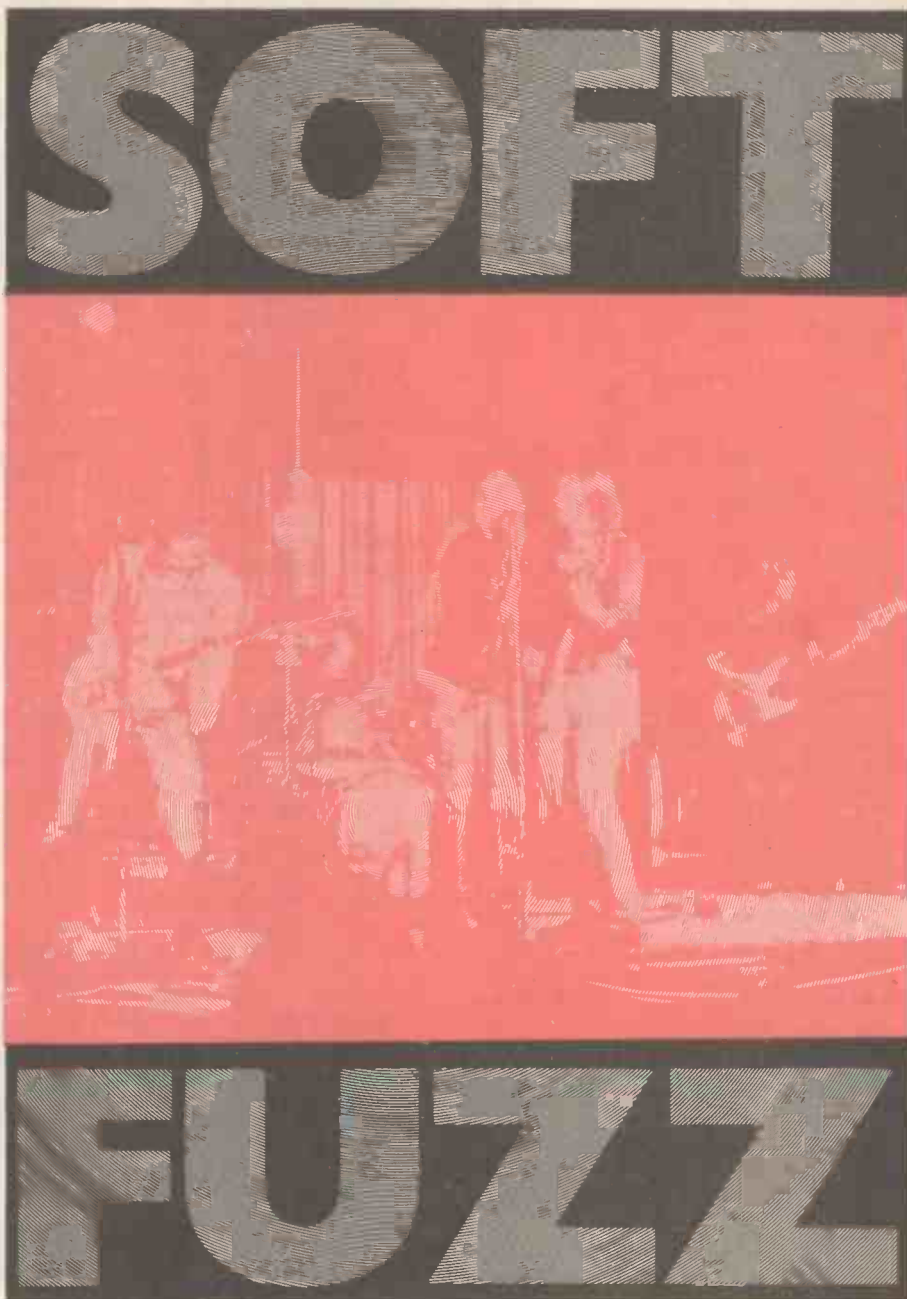


Figure 1. The circuit, with an optional third stage for experimenters. For other constructors, the third-stage is by-passed by a wire link.

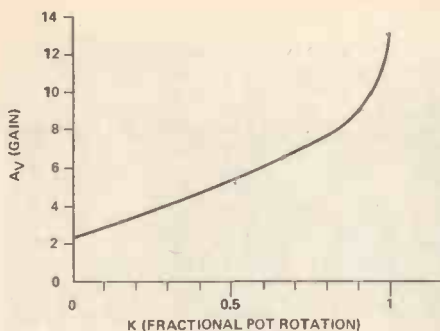


Figure 2. Potentiometer law.

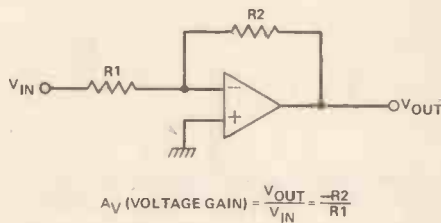


Figure 3. The operation of an op-amp in the inverting mode under normal conditions. In the Soft Fuzz, however, this is modified by a Zener-like network.

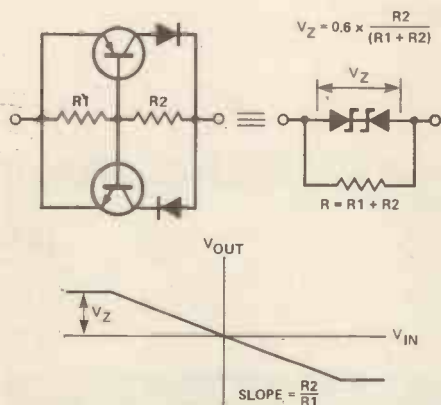


Figure 4. The 'Zener' network and its characteristics.

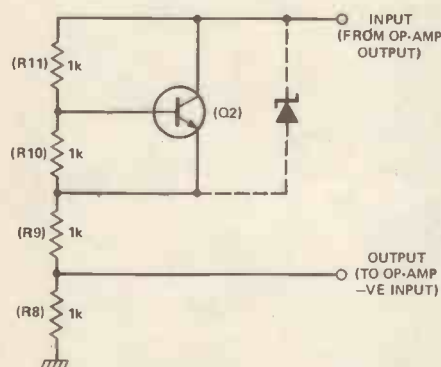


Figure 5. The operation of the 'Zener' network when the input voltage is positive.

electric guitar. The gain is adjustable between about 2.3 and 13 using RV1. Although a linear potentiometer is specified (generally it's possible to get better quality linear pots than logarithmic types, and a Cermet variety would be a good idea here to reduce the noise to a minimum), the variation of amplifier gain with resistance is not, as shown by Figure 2.

The output of the preamp will range up to about 4V RMS and is AC coupled to the next stage to avoid amplifying the DC offset produced by IC1, which is an LF353 dual JFET op-amp. The coupling capacitor C1 should be tantalum bead type, since the polarity of the DC offset voltage may be different from unit to unit, and tantalums can stand up to about 0V3 reverse polarisation.

The second stage is the bit that makes the interesting crunchy sounds. It consists of an op-amp connected as an inverting amplifier, with several complicated looking two-transistor networks in the feedback loop. But to describe all this, we're better off first looking at a simplified circuit.

First though, it ought to be remembered that the gain of an op-amp in the inverting mode is as shown in Figure 3. In the main circuit, however, the feedback resistor has been replaced by a network consisting of two transistors, two diodes and two resistors. These form, in effect, a pair of back-to-back Zener diodes in parallel with a resistor. Up to the operating voltage of the "Zeners", the circuit looks like a pure resistance but above the voltage V_Z the "Zeners" conduct so the resistor is taken out of circuit. The input/output characteristic of this network (Figure 4) shows that it is linear up to the "Zener" voltage, but clips for input voltages higher than that.

Half of the "Zener" network has

been re-drawn in Figure 5; this is the half that is operating when the input voltage is positive (the resistors have been re-numbered to agree with one section of the main circuit but the values have been changed to simplify the explanation).

Zener Diode Lately?

Generally an NPN transistor will begin to conduct when the base is about 0V6 more positive than the emitter. In this case, the base voltage is derived from the input (which is actually from the op-amp output, remember); if the input is say, 1V, then with the resistor values shown the base will be at 0V75 and the emitter at 0V5, so the transistor will be cut off and the output is another 0V25 less than the emitter voltage. But if the input rises to around 2V4, something different happens; the base voltage becomes 1V8 while the emitter voltage is 1V2 and the transistor will begin to conduct.

Now if the input voltage rises to around 4V, say, the transistor is well and truly switched on — however it will only conduct just enough to maintain the base voltage 0V6 higher than the emitter, as described. The circuit is thus acting as a Zener diode, maintaining a fixed voltage of 1V2 across it, and the input voltage less the collector to emitter voltage appears on the emitter.

Another way of describing this is to say that for input voltages above 2V4 only R8 and R9 are left in circuit to oppose the increase in current due to increased input voltage. Hence the current increases twice as much for a given voltage change above the 2V4 level than it does for the same change at voltages below 2V4.

The graph of the transfer (input/output) characteristic of the circuit is shown in Figure 6. The

Parts List

RESISTORS

- (All 1/4 watt 5% carbon)
- R1 56k
- R2 470R
- R3, 4, 12 22k
- R5 4k7
- R6, 8, 9, 14, 15 3k3
- R7 10k
- R10 8k2
- R11, 13 5k6

POTENTIOMETERS

- RV1 47k linear law

CAPACITORS

- (All 25V axial electro except as noted)
- C1 22n disc ceramic
- C2, 3, 6 47u
- C4 47u 25V radial electro

- C5 22u 16V tantalum bead

SEMICONDUCTORS

- IC1 LF353 dual JFET op-amp
- Q1, 3, 5 BC212 etc. PNP general purpose
- Q2, 4, 6 BC182 NPN general purpose
- D1-D6 1N4148
- LED1 0.2" Red

MISCELLANEOUS

- SW1 DPST min. slide or toggle
- SK1, 2 PP3 Case, approx 102 x 102 x 51mm; PP3 battery clips; Veropins; PCB; 4 x M2.5 or 6BA nuts and bolts, wire, solder etc.

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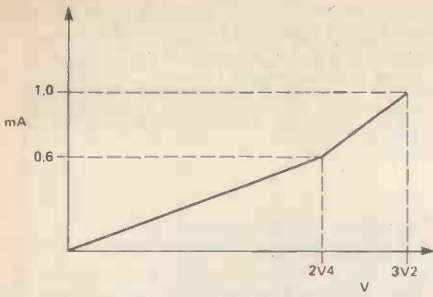


Figure 6. The transfer characteristics of the Soft Fuzz circuit.

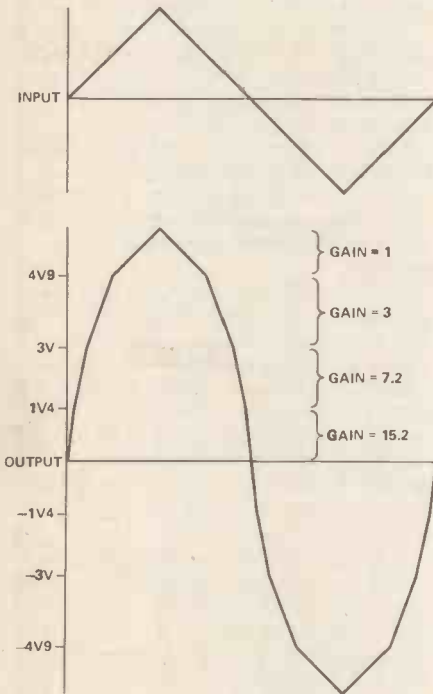


Figure 7. The curve in the lower diagram shows the effect of the Soft Fuzz circuits on a triangular waveform.

resistance of the curve is equal to the slope of the graph, and for the first part it is $2V4/0mA6 = 4kR$, while for the second part it is $0V8/0mA4 = 2kR$, as expected. This apparent resistance, calculated from the change in current resulting from a change in voltage, is called the 'incremental resistance', and if the circuit is used in the feedback loop of an op-amp, it is plain that the gain at any time will be proportional to the incremental resistance.

Of course this simplified circuit illustrates only half of the network, but the PNP transistor performs an identical function when the input (op-amp output) waveform goes negative.

The net effect of placing a network such as this in the feedback path is to reduce the gain as the input signal increases.

By carefully calculating the values of the resistors R10-15, the 'breakpoints' at which the incremental resistance slope changes can be selected to give smooth compression of the signal (clipping is just sudden and hard compression...). Three non-linear elements are used to give three breakpoints, and the overall

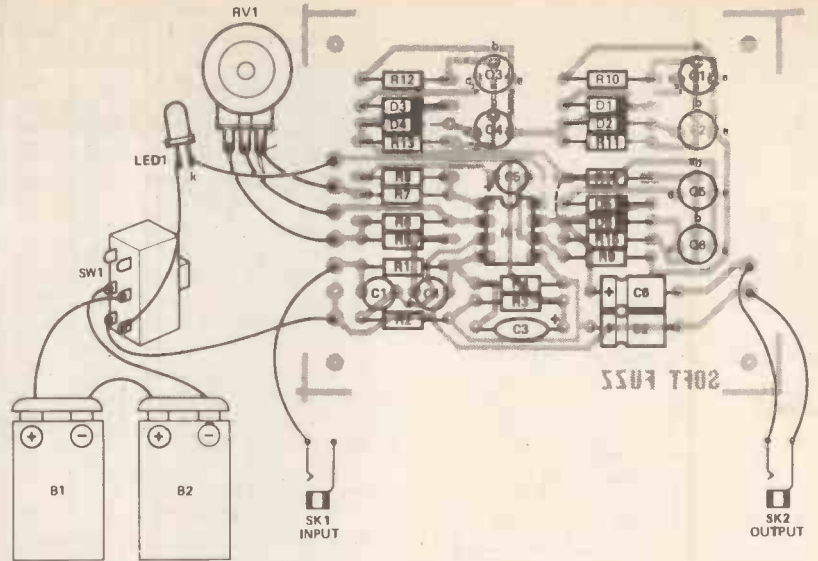


Figure 8. The PCB overlay.

effect of the unit on a triangular waveform is shown in Figure 7. The breakpoints selected for this project produce a gain of 15.5 for inputs (from IC1b) up to 1V4, a gain of 7.2 for inputs from 1V4 to 3V and a gain of 3 for signals from 3V to 4V9; thereafter the gain is one, no matter how large the input signal! Hence the triangle wave is amplified with four separate slopes; one generated by each breakpoint, plus the base gain of one.

Construction

The project is easily assembled with the aid of the component overlay, Figure 8. The third stage of non-linear feedback has been made optional so if you wish to proceed with only two stages, insert a link to join IC1 pin 7 to the junction of R13, D3 and D4. The components used for the third network should then be omitted but they can always be added at a later

stage if desired and the link removed.

Connections to and from the board are best made via PCB-pins; both the input and output leads should be screened cable, and keep the leads to the potentiometer as short as possible. The LED power-on indicator is a bit of 'flash', but as it may prevent the unit from being left on it will probably earn its keep! It should be mounted on the side of the box near the on/off switch. The usual alternative, of course, to use a double-pole jack socket which disconnects the battery when the guitar plug is removed.

An aluminium box is preferred for mounting the PCB, because of its screening property, and the board is easily fixed with four M2.5 or 6BA nuts and bolts.

HE



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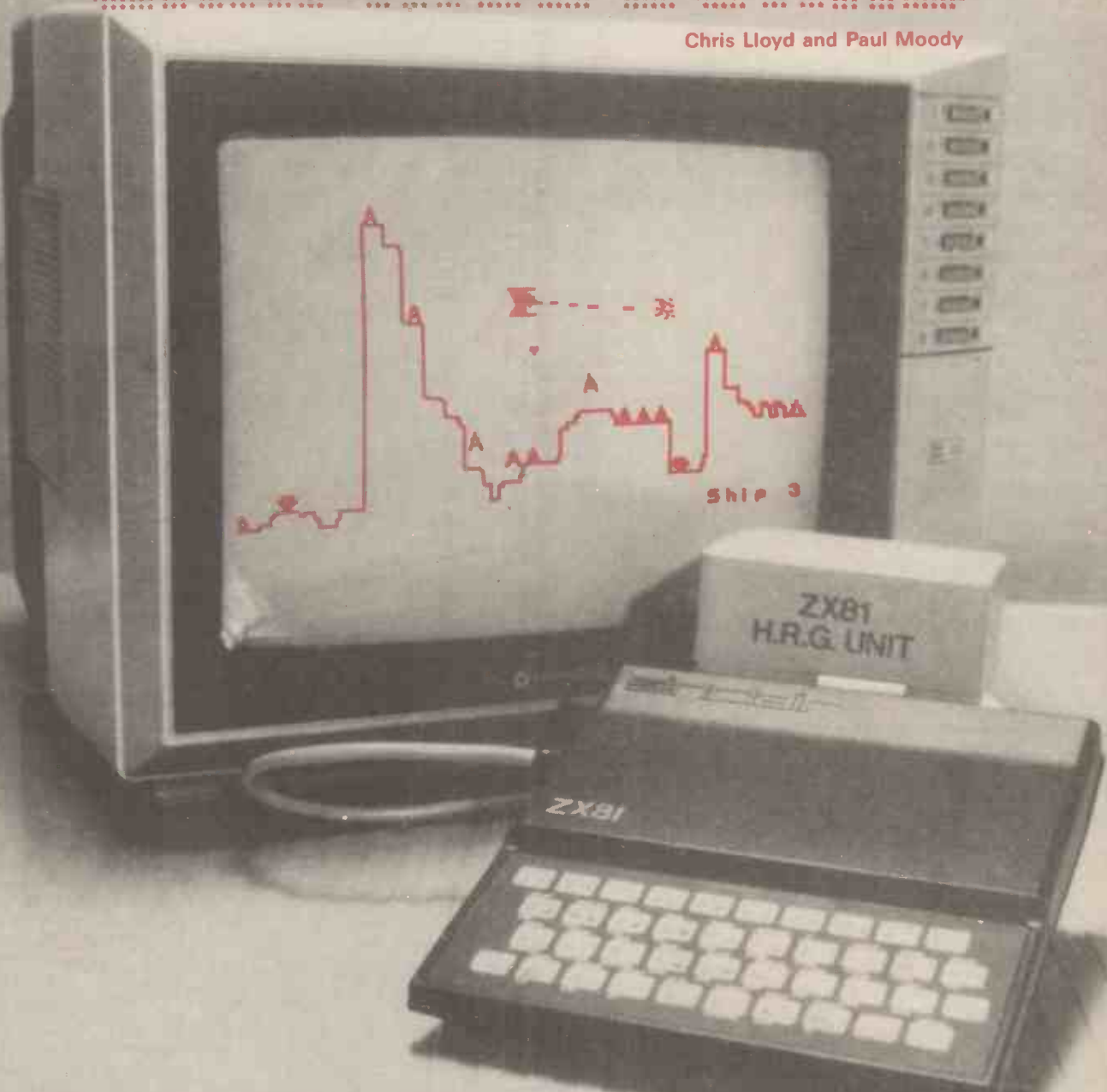
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Chris Lloyd and Paul Moody



Fed up with chunky, block graphics on your ZX81? Then try our High Resolution Graphics board. It allows you to plot at least 512 points (more, with clever programming) and works with either the standard 1K computer or with a 16K RAM pack plugged in.

THE POPULARITY of the Sinclair ZX81 has amply demonstrated the high demand for low priced home computers but, after buying their ZX81 and discovering for the first time the joys of computing, many owners soon wish to improve on the basic Sinclair system. Then they find that extra money or a commercial High Resolution Graphics (HRG) board costs almost as much as the original machine.

But wait! The high resolution graphics system described here is available as a kit for only £17.50 and offers facilities superior to many HRG add-ons. It enables the user to define his own graphics symbols — making it possible to plot accurate graphs and shapes, to play games such as chess or Invaders with realistic figures, or to devise any new character — all with a screen resolution of 256 x 176 pixels. In addition no hardware modifications are required; the unit plugs directly into the ZX81 ROM socket and is completely software controlled.

Sinclair Displays Itself

One of the main reasons for the ZX81's low price is that it uses very little hardware to produce the display. Instead of a dedicated display chip, Sinclair cleverly manages to trick the Z80 CPU into handling the display, making it behave in a way it is not normally intended to work.

The problem of displaying data this way is simply one of speed. To output the characters fast enough, the CPU has to do two things; first it must read the character code in RAM, and second it must find the pattern of dots in ROM that correspond to the required character.

With most processors this is impossible to do at any reasonable speed, but Sinclair has used a special facility of the Z80 CPU — its ability to refresh dynamic memory — to work a neat trick.

Dynamic memory is simply a block of memory cells in which a logic '1' is stored as a charge on a tiny capacitor, which is itself part of the memory IC (*dynamic memory was explained in greater detail in Components For Computing, February 1983 issue of Hobby Electronics*). However the charge leaks away fairly rapidly, so that data must be 'refreshed' from time to time. This capability is built into the Z80 CPU and normally it refreshes dynamic memory about once every microsecond, during the second half of each machine cycle. At these times the top half of the refresh address is equal to the contents of the CPU's I register and always remains the same, while the bottom half is equal to the contents of the R register and is incremented each cycle.

This refresh ability is put to full use by the Sinclair Logic Chip, a Ferranti ULA (Uncommitted Logic Array). Normally in the first half of a machine cycle the CPU fetches the next instruction to be executed. However the Logic Chip periodically tricks the CPU into putting out the address of the next character to be displayed,

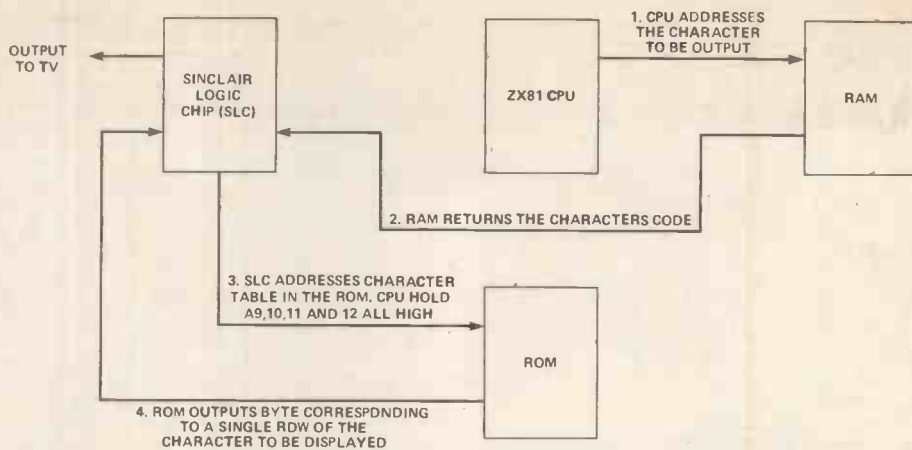


Figure 1. This block diagram shows, in simplified form, how the display is generated.

instead of an instruction, and the RAM returns a character code from the display section of memory. This would be treated as an instruction to be executed, except that the Logic Chip once more fools the CPU by overwriting the data lines, forcing them all 'low' so that the CPU effectively receives a No Operation (NOP) instruction.

Meanwhile the Logic Chip is using the character code data to generate the address in ROM where is located the dot pattern for the selected character. During the second half of the machine cycle — the Refresh cycle — the Sinclair Logic Chip puts out this address on the lower nine address bus lines, overwriting the CPU's lower refresh address bits so that the Logic Chip addresses masquerades as the lower half of the refresh address! The upper bits come, as usual, from the CPU's I register, and together these bits address a memory location in the top 500 bytes of ROM, where the character dot tables are held. The data from the ROM is then sent directly to the display and forms the top row of the displayed character. The Logic Chip address is then changed successively to output the other seven rows of dots.

High Resolution

The ZX HRG board allows the programmer to choose for himself the pattern that will appear on the screen when the Sinclair prints a character. Quite simply, it overwrites that part of ROM which contains the character data — memory locations 7680 to 8191 — by disabling the ROM whenever the address is within that range. So, instead of reading this part of the ROM, the Sinclair is instead directed to the HRG RAM, which has been set up by the programmer to provide the desired high resolution character. For increased flexibility, the HRG system is completely software controlled, allowing rapid selection of either user-defined or normal Sinclair graphics, and of course the two can be combined if the Sinclair ROM data is first transferred to the HRG RAM.

Table 1.

CONTROL NUMBER	HRG FUNCTION
0	HRG OFF.
8	DISPLAY LOWER HALF OF HRG RAM.
10	DISPLAY UPPER HALF OF HRG RAM.
12	LOAD LOWER HALF OF HRG RAM
14	LOAD TOP HALF OF HRG RAM

The Circuit Resolved

The HRG circuit consists of a control section, ICs 1 to 5, the HRG RAM in IC6 and 7, and the Sinclair ROM, which is unplugged from the ZX81 and re-mounted on the HRG board. All the signal lines and the +5V and 0V supply rails are taken from the ZX81 ROM socket to the HRG unit via a length of ribbon cable and a DIP Leader.

The HRG is located in memory at 7679 (one byte below the start of the Sinclair ROM's character data tables) and it is controlled by POKing this address with an appropriate control number — either 0, 8, 10, 12 or 14 — as shown in Table 1.

The address is decoded by the 13-input NAND gate, IC5; 7679 corresponds to address lines A0-A8 and A10-A12 all high so, with A9 inverted by IC3f, IC5's output will go low only when this address is present on the bus. The Sinclair logic chip also recognises the address, which is within the ROM space, so at the same time it takes the ROM Chip Select (ROMCS) line low. This signal is inverted by IC3d and forms one input to the NAND gate IC2c. The other input is from IC5, inverted by IC3e, and since these are both high, pin 8 of IC2 will go low.

The purpose of all this is to store the control number in IC1, a 4-bit latch. But because the ZX81 itself

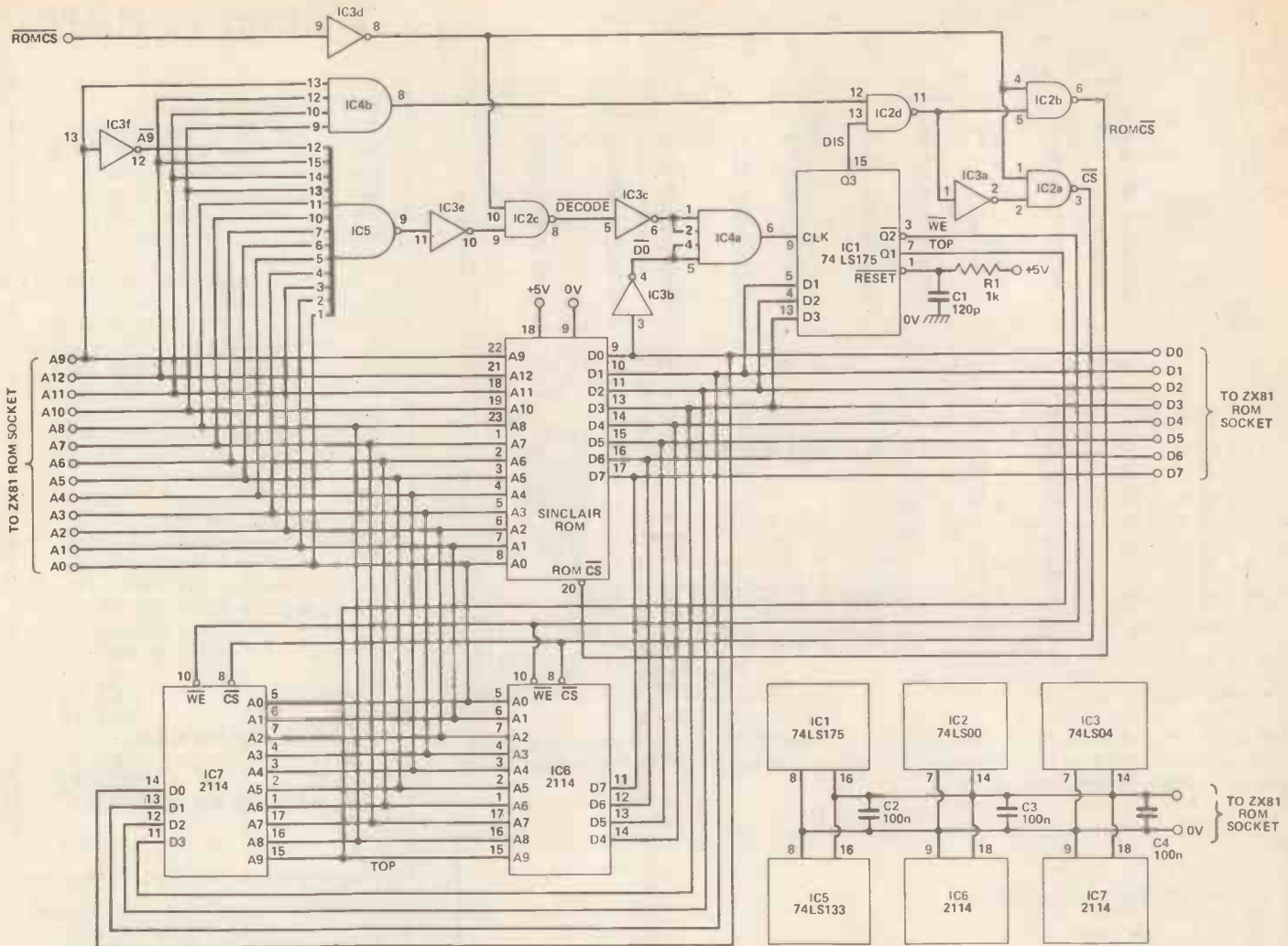


Figure 2. The complete circuit of the High Resolution Graphics Board. The ROMCS signal is also from the ZX81 ROM.

periodically puts into the HRG address, (approximately once every five minutes, when the system variable FRAMES takes on this value — see the ZX81 BASIC manual, page 179), it is necessary to prevent the ZX81 from accidentally activating the HRG board.

This is achieved by using only *even* control numbers so that data bit D0 is always zero when the HRG is being addressed by the user. The data lines are all taken high during the times when FRAMES is active, so the ZX81 cannot accidentally address the HRG.

D0 is inverted by IC3b and together with the inverted DECODE signal produces a high output from AND gate IC4a, which latches D1, D2 and D3 into IC1. The latch outputs, now labelled TOP, WE and DIS, are then used to control the HRG function. Note that TOP follows D1, WE follows D2 and DIS follows D3.

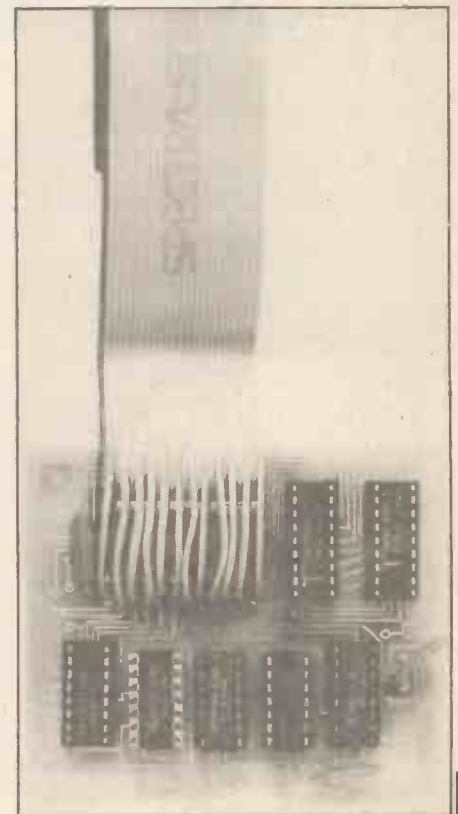
The DIS line is used to select either normal Sinclair graphics or the user-defined characters previously stored in RAM. The output of IC4b goes high whenever address lines A9-A12 are high (ie, whenever the address is in the range 7680-8191), but if the control number 0 has been POKED then DIS will be low and hence IC2d output will be high. The inverted

ROMCS signal will also be high at this time, so the ROMCS signal, the output from IC2b, will be low and the Sinclair ROM will be enabled. At the same time the output from IC2a will go high and since this is connected to the Chip Select (CS) inputs of ICs 6 and 7, the HRG RAM is disabled and normal graphics characters will be displayed.

However if any other control number is POKED the DIS line will be high, ROMCS will go high to disable normal graphics, while CS will go low, allowing the user-defined graphics to be displayed.

When the computer is first switched on it is obviously desirable that normal characters are enabled, so R1 and C1 are connected to the latch's Master Reset input and they produce a brief low-going pulse when power is first switched on, clearing all the latch outputs to zero.

The operation of the other two control lines is quite simple by comparison. That WE line is tied to the RAM Write Enable inputs and whenever the control number equals 12 or 14, WE goes low and this will enable data to be written to the RAM, ICs 6 and 7. Any other control number will keep WE high so that the RAMs can only be read.



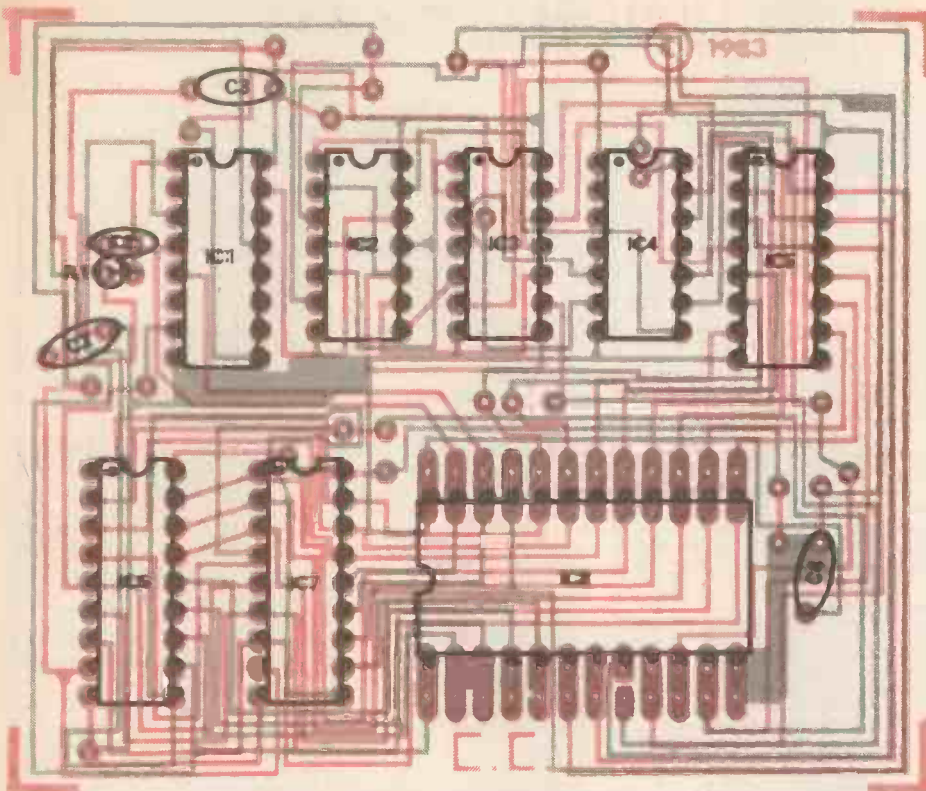


Figure 3. The double-sided, through-hole-plated PCB and component overlay. Readers making up a board themselves will need to wire through-links to connect the two sides of the printed circuit.

Program 0

```

1  REM "X zeroes"
10 PRINT "FIRST ADDRESS"
20 INPUT A
30 PRINT AT 15,0; "";
40 LET X$=""
50 IF X$="" THEN INPUT X$
60 POKE A, 16*CODE X$+CODE X$(2)-476
70 PRINT CHR$ INT (PEEK A/16+28);CHR$ (PEEK A-INT (PEEK A/16)*16+28)
80 LET A=A+1
90 LET X$=X$ (3 TO)
100 SCROLL
110 GOTO 50
    
```

Machine Code Loader routine; enter in the REM statement (Line 1) the number of zeroes specified for the program you wish to use.

However there is a slight complication in writing to the character RAMs. During the second half of each machine cycle the CPU's I register puts out the top half of a refresh address. Normally this is of no consequence, but if the user is attempting to write to RAM then the HRG WE line will be low, so whatever appears on the data bus at these times will over-write the character data. The solution to this problem is carried out in the operating software: before the Write Enable is taken low the contents of the I register are simply changed so that it is no longer addressing the character RAM space!

Finally, the TOP signal is taken directly to the A9 address input of each RAM IC so that taking this line high (control numbers 10 or 14) addresses the top 512 bytes of the HRG RAM; this facility allows two completely different character sets to be created and displayed.

Construction

There should be no particular difficulty in building the HRG project. All components are mounted on the double-sided through-hole-plated printed circuit board and can either be soldered directly or inserted in IC sockets for safety. The ribbon cable which connects to the ZX81 is soldered to the PCB. No special handling precautions are necessary in the construction — but some care is required at the next stage.

Installation

The Sinclair ROM must be removed from the ZX81 and re-mounted on the HRG board, and the DIP header from the project plugged into the ROM socket. This leaves the edge connector free for use with other accessories.

To open the ZX81 first remove all leads and add-ons and peel off the rubber pads on the base of the computer, making sure that the

Writing to RAM

BEFORE loading character-definition information into the HRG RAM, it is first necessary to change the value in the ZX81 CPU's I register as described in the text. This operation can only be performed by a section of machine code program.

The actual operation of writing to the HRG RAM can be carried out either by a BASIC routine, or by machine code. If BASIC is used the m/c program must first be called, then the HRG RAM loaded using POKE commands to the appropriate addresses, then the I register restored to its original value by calling the second section of m/c program. The display will be corrupted while BASIC is loading the RAM data.

The program listing below, in Hex and Decimal, performs the necessary operations on the I register. It must also be used if loading under machine code.

3E00	62,00
ED47	237,71
C9	RETURN TO BASIC 201
3E1E	62,30
ED47	235,71
C9	RETURN TO BASIC 201

adhesive film remains attached to the pads. Next remove the five screws now visible and note their order so they can be correctly replaced. The base can now be removed, exposing the copper side of the PCB. Remove the two screws holding it in place and carefully fold back the board, being very careful not to damage the ribbon cable leading to the keyboard, or its connections on the PCB. DO NOT attempt to remove the cable from the PCB, and take note of the direction of the fold in the cable so that it can be correctly repositioned.

Identify the Sinclair ROM (Figure Z) and note its orientation in the socket; then use a small screwdriver to carefully lever the ROM from its socket; work from both ends and be careful not to bend the pins! Now plug the DIP header into the ROM socket, taking care that it goes in at the right end! It is advisable to gently wipe the header pins with a cloth soaked in alcohol or white spirit before plugging in, and check for loose connections or short circuits.

The ribbon cable is best lead out of a narrow slot filed into the rear of the base. Alternatively it can be taken through the edge connector slot, but it may interfere with some add-ons. In either case it will be necessary to fold the cable through 90° so that it sits flat under the PCB when this is re-mounted.

Re-assemble the ZX81, then plug the ROM into its socket on the HRG board. Mount the board in the case,

Parts List

RESISTORS

R1 1kR
10% 1/4 watt carbon

CAPACITORS

C1 120p
ceramic
C2,3,4 100n
ceramic

SEMICONDUCTORS

IC1 74LS175
TTL Quad D-type latch
IC2 74LS00
TTL Quad 2-in NAND
IC3 74LS04
TTL Hex Inverter
IC4 74LS21
TTL Dual 4-in AND
IC5 74LS133
TTL 13-in NAND
IC6,7 2114
NMOS 1024x4-bit RAM

MISCELLANEOUS

3 x 14-pin, 2 x 16-pin, 2 x 18-pin, 1 x 24-pin DIL sockets; 1 x 24-pin DIL header and approx. 9" x 24 ribbon cable; PCB; case; wire, solder etc.

BUYLINES page 34

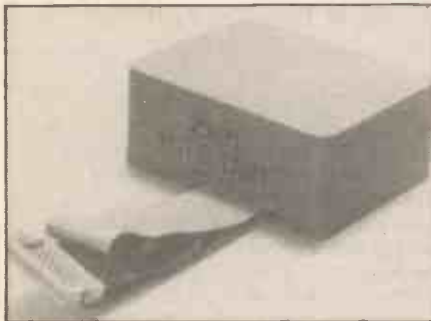
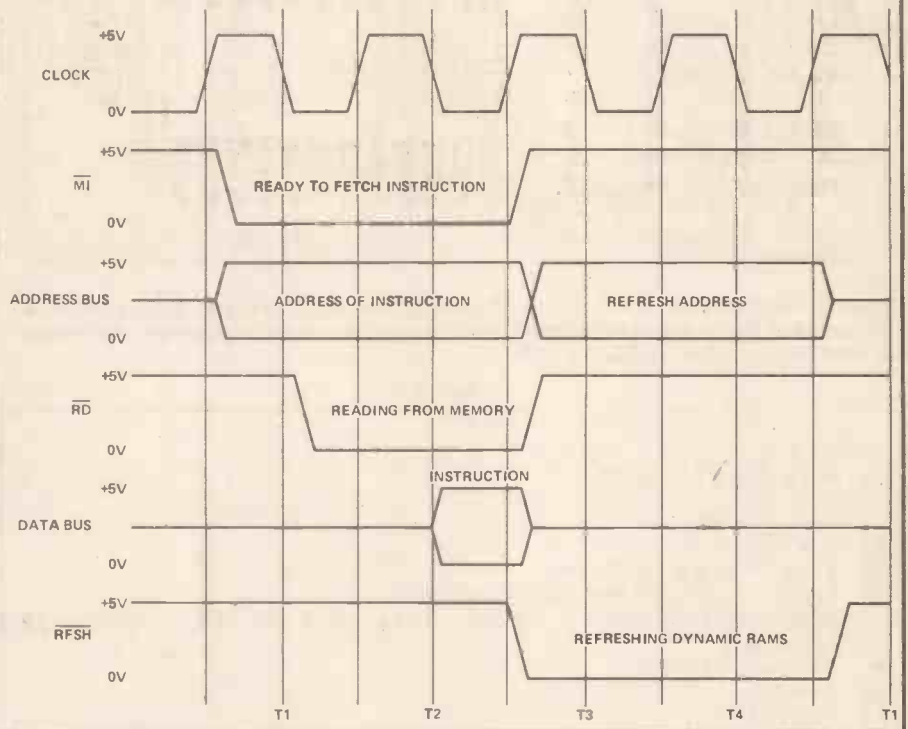
Clocking The Z80

TO ensure that all parts of a micro based system are working together, it is essential that all the activities take place at clearly defined times. To enable this synchronisation the CPU is fed with a clock signal, running at 3.25 MHz in the case of the Sinclair Z80 CPU.

To understand how the CPU uses the clock cycles, consider what happens when it goes to memory to fetch its next instruction (see figure). The top line shows the regular clock frequency and the line below that the \overline{MI} output from the CPU, which signals the beginning of an instruction fetch from memory. During the first two clock cycles the

address of the instruction to be fetched is output on the address lines, along with a low on \overline{RD} indicating a read operation. The memory returns the instruction on the data bus, and in the next two clock cycles, the CPU decodes and executes it, simultaneously putting out a refresh address and sending \overline{RFSH} low.

This group of four clock cycles is called a machine cycle and simple instructions (such as LD A,B) only require one machine cycle for completion. More complicated instructions may require more than one machine cycle.



screw it all together and you're reading for action.

Testing

If a 'K' fails to appear when the power has been switched on, check all the connections from the ribbon cable to the HRG board, and remove the ROM and gently wipe the pins to remove any grease. If these measures fail to restore correct operation the ZX81 will have to be stripped and the DIL header checked again; there is very little that can go wrong on the project board, except for putting the ICs in wrong way around!

Software To Sample

Four programs are provided to allow you to explore the capabilities of the HRG Board. They all use a section of machine code which, at the very least, changes the value in the CPU's I register (for the reason mentioned earlier).

These programs also use m/c to write data to the RAM (see box) and to perform other functions, too. A "machine code loader" program is listed as Program 0 for those who

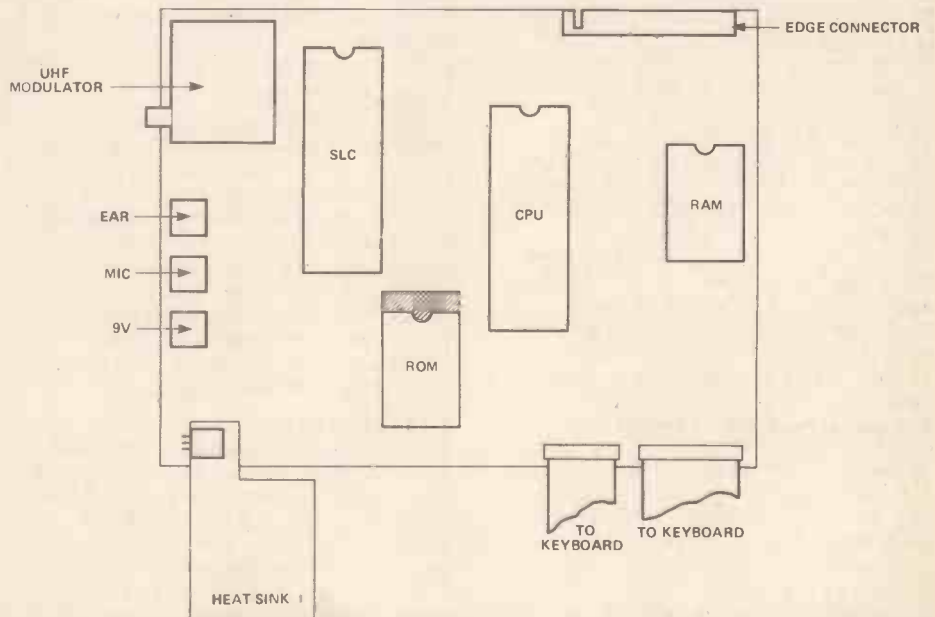


Figure 4. The component layout inside the ZX81. The 24-pin ROM is mounted in a 28-pin socket; the hatched area indicates the unused pins.

don't already have a favourite routine of their own. The m/c is stored in memory on locations reserved by the REM statement of Line 1; eg if the machine code is four bytes long, then this space is reversed by typing

```
1 REM "0000"
```

To load the code, type in the Loader (making sure you have entered the specified number of Os in Line 1) then RUN it. When prompted, enter the starting address of the m/c routine ("FIRST ADDRESS"), then enter the code one line (two, three or four bytes) at a time; the Loader routine will give a prompt ("L") after each NEWLINE.

When all the Loader has been entered, delete lines 10 to 100 — DO NOT remove Line 1, which contains all the m/c you have just labouriously typed in Line 1 of the Loader now becomes the first line of whichever program you now wish to try.

The Programs

Except for Program 4, these are all intended to run in 1K, and with most the display will be limited to an 8x8 character block at the top left corner of the screen. The final listing will only run in 16K, and gives a full screen display.

Program 1 is a simple routine for testing the HRG Board. It's not terribly exciting (it simply displays 32 thin vertical lines in the top two rows of the screen) but if you'd rather be sure that all is in order before typing in a longer program, try this one first!

Load the machine code first, using the Loader program. The first two lines of code change the value of the CPU's I register, and the next few lines enable the HRG for storing data by loading the control number 12 (OC in Hexadecimal) into the control latch. The middle section of code stores new character data in successive memory locations corresponding to the ROM locations of CHR\$ 0-63 (see page 181 of the Sinclair BASIC manual for the "regular" characters that are being replaced!). The last half-dozen lines of m/c turn off the HRG and restore the original value of the I register.

The BASIC program (which is entered after lines 10-110 of the Loader have been removed) first calls the machine code routine in Line 20; this sets up the character RAM as described. The remainder of the program turns on the HRG in Display Lower RAM mode and prints the new characters before pausing, after which the HRG is turned off by POKEing 0 into the latch.

Characters To Order

Program 2 is a general routine that will probably be used continually, if not frequently! It allows the user to define a character using normal ZX81 block graphics, after which the new character is stored in the HRG RAM.

The pattern of dots which make up each character is held in eight consecutive bytes, each representing

one row of the character. The 8 x 8 grid depicted in Figure 5, with each bit equal to a one representing a dot and each bit equal to zero, a blank, will be familiar to most readers.

Program 2 first draws a 8 x 8 block-character grid on the screen, together with a row and column references. The dots which will make up the new pattern are then entered by specifying the row number and the letter corresponding to the column, eg "2C" enters a dot in the second column, third row. Mistakes can be erased by entering the co-ordinates followed by the letter R; eg "2CR" will remove the dot just entered. Entering STOP produces a prompt (L) and the next step is to enter the character-code of the symbol you wish to replace by the new dot-pattern.

The program does all this by storing eight variables, one for each row of the grid, then transferring them to the appropriate eight bytes of the HRG RAM at the address normally occupied by the character being replaced. The character table in the Sinclair ROM starts at location 7680 with Code 0, a blank, and since each character requires eight bytes the next (Code 1) starts at location 7688. In general, the character with Code 'X' starts a location (7680 + 8 * Code 'X'). Thus if the new character shown in Figure 6 was to replace 'E' (Code 42) it would be stored in RAM at

Program Notes

All machine code must be entered using the machine code loader program. The listings commence at the top left and read down the columns. The decimal number at the start of each m/c listing is the "FIRST ADDRESS".

Program 1

```
1 REM "44 zeroes"
20 RAND USR 16514
30 POKE 7679,8
40 FOR N=0 TO63
50 Print CHR$ N;
60 NEXT N
70 PAUSE 500
80 POKE 7679,0
```

16514	ED42
3E01	2803
ED47	03
21FF1D	18F3
OEOC	21FF1D
71	OEOO
01001E	71
21FF1F	3E1E
02	ED47
C600	C9

A simple test routine for checking the operation of the HRG Board project.

Program 2

```
1 REM "90 zeroes"
20 FOR N=0 TO 7
30 PRINT AT 7,1; "12345678"; AT 8+N,0; CHR$ (N+38)
40 POKE 16514+N,0
50 NEXT N
60 POKE 16566,0
70 INPUT X$
80 GOTO 150
80 IF LEN X$=3 THEN POKE 16566,1
100 POKE 16563,CODE X$(2)
110 POKE 16565,8-VAL X$(1)
120 RAND USR 16567
130 PRINT AT CODE X$(2)-30, VAL X$(1); CHR$ (384-LEN X$*128)
140 GOTO 70
150 IF X$(1)="S" THEN GOTO 180
160 IF CODE X$(2)=45 THEN GOTO 70
170 GOTO 90
180 INPUT X
190 POKE 16522,X
200 RAND USR 16524
```

16514	2A8940	C9	47
00	29	00	3AB540
00	29	00	FE01
00	29	00	2804
00	01001E	00	7E
00	09	2AB340	B0
00	010800	015C40	77
00	54	09	C9
00	5D	3AB540	3EFF
00	218240	3C	A8
00	EDB0	47	46
3E00	21FF1D	3E01	A0
ED47	3608	CB27	77
21FF1D	3E1E	10FC	C9
360C	ED47	IF	

The listing for Program 2, which can be used to define any new character on an 8x8 grid.

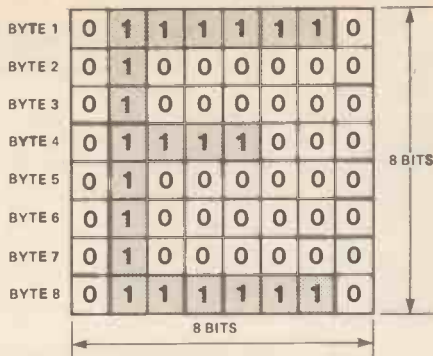


Figure 5. Character information is stored in memory as a sequence of eight bytes. Bits set to 'one' produce a dot, while bits left at 'zero' are not displayed.

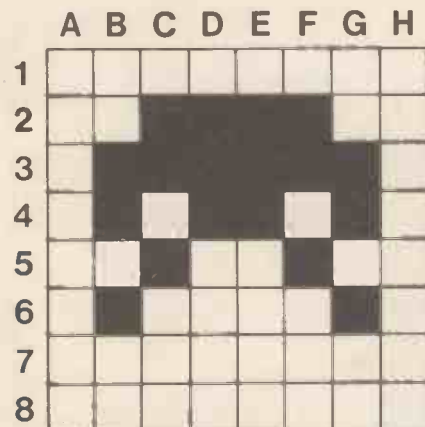


Figure 6. Program 2 allows new characters to be defined and displayed. This figure shows the set-up for defining new characters; in use, the new character 'shrinks' to normal size.

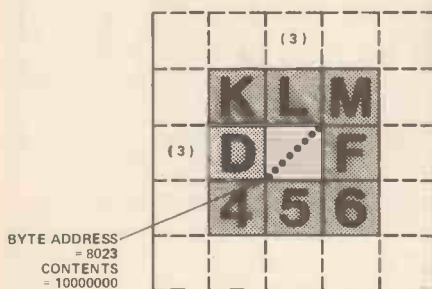


Figure 7. Illustrating the display method for graph plotting. The character ('E' in this example) is replaced by a dot pattern corresponding to the line segment to be plotted. Extended plots can be formed by joining line segments.

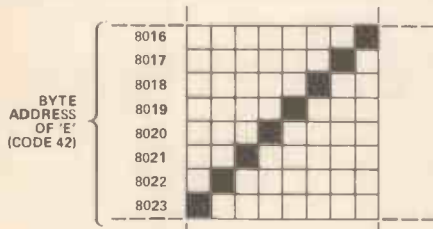


Figure 8. Detail of the line segment shown in Figure 7. The memory location of each byte can be calculated as described in the text.

Program 3

```

1  REM "169 zeroes"
10  RAND USR 16514
20  FOR X=0 TO 63
30  LET Y=X
40  IF Y>63 THEN GOTO 90
50  IF Y<0 THEN GO TO 90
60  POKE 16507,X
70  POKE 16508,Y
80  RAND USR 16556
90  NEXT X
100 POKE 7679,8
110 FOR C=0 TO 7
120 FOR N=0 TO 7
130 PRINT AT C,N; CHR$(56+N-
C*8)
140 NEXT N
150 NEXT C
160 IF INKEY$="" THEN GOTO
160
170 CLS
180 POKE 7679,0

16514      90
D3FD      47
3E00      3E07
ED47      90
21FF1D    47
0E0C      CB24
71         CB24
01001E    CB24
21FF1F    7C
02         81
C600      8F
ED42      2600
2803      29
03         29
18F3      29
21FF1D    48
0E00      0600
71         09
3E1E      01001E
ED47      09
D3FE      E5
C9         0605
00         21FF1D
3A7B40    0E08
47         71
CB38      10F8
CB38      E1
CB38      B2
48         E5
CB20      57
CB20      D3FD
CB20      3E00
90         ED47
47         0605
3E07      21FF1D
90         0E0C
1601      71
2805      10F8
CB22      E17A
3D         7A
20FB      77
3A7C40    0605
47         21FF1D
CB38      0E00
CB38      71
CB38      10F8
60         3E1E
CB20      ED47
CB20      D3FE
CB20      C9
    
```

The small-screen graph plotter program; to plot any other graph just change the function in Line 30; eg to LET Y= SIN X to plot a sine curve.

location (8 * 42 + 7680) = 8016. Then every time that the HRG unit was turned on by POKEing 7679 with 8, the new symbol would be printed on the screen whenever the program would normally have printed 'E'.

Graph Plotting

Programs 3 and 4 are essentially the same — both plot a high resolution graph — except that Program 3 runs in 1K and uses only a portion of the screen while Program 4 needs 16K and displays over the whole screen. The resolution is the same for both.

Since they are so similar, we will briefly describe only Program 3. It works by consecutively printing a block of the first 64 characters from the ZX81 set in an 8 x 8 grid at the top left of the screen, so that each character has a specific screen location (actually these 'characters' are printed as blanks, but each corresponds to a specific character-code, so the effect is as described).

Then the blanks are filled in with dots corresponding to the points to be plotted. This is done by calculating the location in memory of each of the eight bytes defining a character, then storing a new byte there depending on whether or not there are points to be plotted.

For example, the character 'E' (Code 42) will be 'located' on the screen at a position three rows down and three rows across. The bottom row of dots making up this character is located in memory at

$$7680 + 8 * 42 + 7 = 8023.$$

Now if a single dot is required to be plotted at a position corresponding to the first dot on the left, all that is required is for the byte 10000000 to be stored at location 8023, and the required point will be plotted.

The difference between the 1K and the 16K programs is that instead of arranging all 64 Sinclair characters in a grid, it first calculates the screen position where the point is to be plotted. A 'blank' character is then printed at that position, and the appropriate byte filled in to produce a single dot at the required co-ordinates.

All 64 characters are used, so that when the 64th has been printed on the screen, no more points can be plotted — easily, that is. It is possible to re-use characters, eg to create a line drawing such as the one on the cover of this issue by joining line sections together. However this is not the place to explore these possibilities — the technique requires fairly clever programming, however — something that will keep HRG owners busy for some time!

STOP PRESS: Owners of late-model ZX81s may find that the ROM is soldered directly into the PCB, rather than plugged into a socket. A different method of connecting the HRG board must be used with such computers — turn to Buylines, page 34, for further instructions.

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ALL ELECTRONICS relies on electricity being controlled, and anything which we call electronic controls electricity; so, the best introduction to a series such as this must be to explain what electricity is. This is essential so that we can understand just how it *can* be controlled.

To make things as simple as possible let's think of electricity as being a 'flow' of 'something' through metal. It's just like water through a pipe really, like the pipe shown in Figure 1.

Water is flowing through the pipe from left to right in the Figure, but it could run equally well from right to left

— it all depends on whether the pressure of water is higher on the right (in which case the water flows from right to left) or on the left (when flow will be as in the Figure). Water will always flow from wherever the pressure is high to where the pressure is low. In a water system this pressure normally comes from the effects of gravity (Figure 2).

In Figure 2 is a water tank similar to the one in your home. At a distance 'h' below this is a tap; when the tap is open, water will flow from the area of high pressure (the tank) to the area of low pressure (the tap). This pressure difference depends largely on the

height, *h*. A good example of this can be seen in the rate of water flow between an upstairs water tap and a downstairs water tap in a house. Generally speaking the greater the distance *h*, the greater the flow rate of water out of the tap, because the greater is the pressure difference.

Another method of creating a pressure difference in a water system is to use a pump. A pump can make a pressure difference occur in a level system (Figure 3) or even uphill i.e. against gravity (Figure 4).

The pump in a central heating system does just this, forcing hot water around

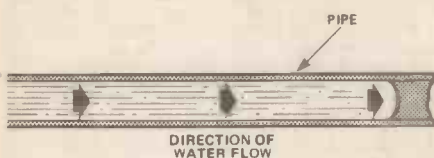


Figure 1. Water flowing along a pipe.

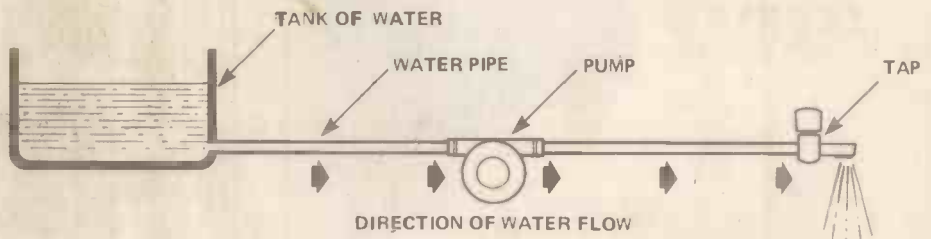


Figure 3. How a water pump can be used to create a pressure difference and cause water to flow along a pipe.

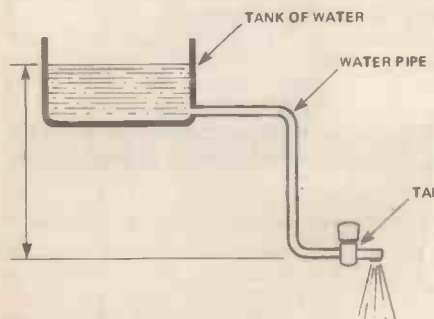


Figure 2. Simple domestic water system. The water tank is at a height, *h*, above the tap.

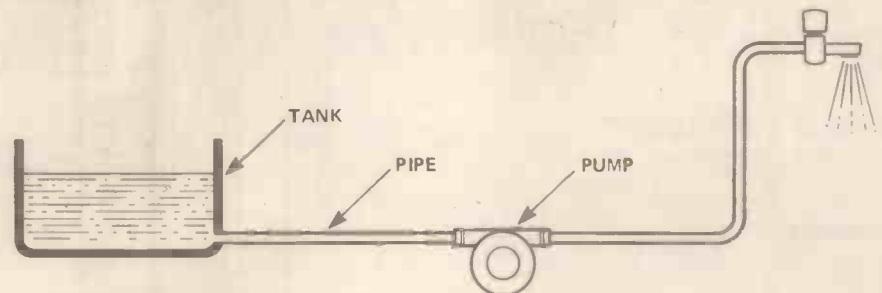


Figure 4. A water pump can also make water flow upwards, against gravity.

all the radiators in the system. In Figure 3 and 4 of course, the pressure difference now largely depends on the strength of the pump and has little to do with the distance between pump and tap.

Things are very, very similar in an electric system. A simple one is shown in Figure 5 with a battery and bulb along with connecting wires. If you remember, I said earlier on that electricity is simply a flow of 'something' through metal. Well, the connecting wires of the circuit are metal, and they are equivalent to the pipes in a water system. The battery is a source of electricity — in the same way that the tank in Figure 2 is a source of water. The bulb is just an indicator to prove that there actually is something flowing through metal in our simple electrical system, just like the tap showed water flow. Of course the bulb should light — try it if you don't believe me — but why? What is actually flowing through the wire which can make the bulb light up?

Particularities

To find out the answer to this question we have to look at the structure of metal itself and of the individual atoms of the metal. Any atom — not just an atom of metal — has a central 'nucleus' containing a number of particles called neutrons and protons. Neutrons (as their name suggests) are electrically neutral; protons, however, each have a single positive (abbreviated to '+ve') electric charge. Now, I'm sure you'll have heard the saying "opposites attract". Well, it is true of atomic particles too. Associated with every positively charged proton in the nucleus is a negatively charged particle. These are much smaller and weigh much less (only about 1/2000th) than a proton, but each particle holds an equal and opposite charge. These particles are called electrons, and they fly around the nucleus much like satellites orbit the earth. The feature which makes a metal atom different to most other atoms is the fact that metal electrons are relatively free to move — a metal nucleus doesn't mind giving up one or more of its orbiting electrons to the next nucleus as long as its place can be taken by another electron. So, by making a 'pressure' difference between one end of a row of metal atoms and the other end, we can create a 'flow' of electrons along the row in exactly the same way that water can be made to flow along a pipe. This pressure difference, in electrical terms, is known as electromotive force (abbreviated EMF), ie a force which makes electrons move. Get it? The EMF in the circuit of Figure 5 is provided, of course, by the battery, and EMF is commonly referred to as voltage, or sometimes potential difference when referring to the difference between two voltages.

Nuclei of other materials, eg wood, plastic, glass, hold on tightly to their electrons and so, even with a large applied EMF, electricity can't easily flow through those materials. We say that

metals conduct electricity and those other materials are non-conductors of electricity.

Sizing It Up

Just to give a rough idea of the size of the particles we're talking about, it is worth noting their weight. Believe it or not, one proton weighs:

$$0.0000000000000000-0000000001672 \text{ kg.}$$

That is, 1.672×10^{-27} kg. That's not a lot! A neutron weighs the same, but an electron weighs only 0.00056 of that, or 9×10^{-31} kg.

Little wonder we can't 'see' electricity if it consists of a movement of electrons. We can only see its effects — for example the lighted bulb in the circuit of Figure 5.

An EMF-atic Force

Electromotive force can be derived in a number of ways, the usual methods being:

- i Chemical — dissimilar metals, immersed in a chemical solution eg, lead-acid car batteries, dry cells.
- ii Thermo-electric — dissimilar metals are placed in contact and the junction is heated; the size of the EMF is dependent on the temperature of the junction.

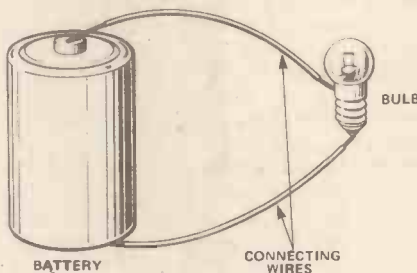


Figure 5. A simple electric system. A source of electricity (the battery) is connected to an indicator of electricity flow (the bulb) with metal connecting wires.

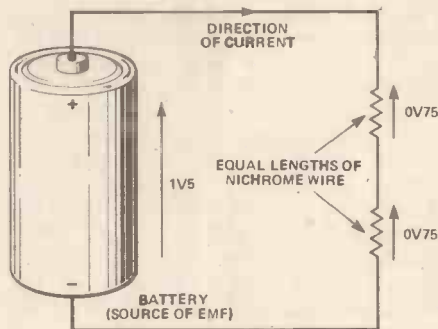


Figure 6. The battery, as a source of EMF, creates a current which in turn causes potential differences to occur across the two lengths of nichrome wire.

iii Electrostatic — friction can create free electric charges on the surface of a non-conductor, eg the old trick of rubbing a plastic ruler with a piece of cloth for a few seconds and then picking up small bits of paper with the electrostatically charged ruler.

iv Electromagnetic — when a conductor is placed in a changing magnetic field we say an EMF is induced in the conductor, eg a dynamo.

The term "electromotive force" is normally only used when we talk about the sources of electricity, such as a battery or dynamo. Where an electricity flow causes different voltages in a circuit then we call this voltage a potential difference (abbreviated PD). The general order of things then, is that an EMF creates an electric flow (more commonly called a current) which later on in a circuit produces a PD between different points in the circuit; an example is shown in Figure 6.

The EMF source is a dry-cell battery which has an EMF of 1.5 Volts (abbreviated 1V5). The battery has a positive (+ve) terminal and a negative (-ve) terminal. The voltage of 1V5 is shown diagrammatically with an arrow — we will show voltages between points in the circuit by arrows across the points, with the actual value of the voltage at the side and the arrow-head indicating which point is at a more positive potential.

There is another arrow-head in the figure — it indicates the direction of the electric current. But does it mean that the electrons are flowing from the positive battery terminal to the negative battery terminal? Think about it! Electrons are negatively charged, remember so no, it certainly does not mean this. Electrons must come from the negative battery terminal and go to the positive terminal (opposites attracting!) so, why do we show current flow as being in the other direction? The answer is that, long ago, when the effects of electricity were first observed, nobody knew the cause so they could not know the true direction of the current. Scientists of the time took an educated guess, defined positive and negative sides of an EMF and decided that it would be logical to presume that electricity flows from a more positive potential to a lower, more negative potential. They were wrong!

Electron flow is from negative to positive but, by convention, current flow is from positive to negative. It sound tricky, and sometimes causes problems, but you'll get the hang of it soon enough.

Back to Figure 6 now, and you will see that there are two new things in the circuits, ie the two equal lengths of nichrome wire. Nichrome is an alloy of two metals, nickel and chromium, which displays an odd property — it doesn't conduct electricity as well as most metals. But there again, it is not a non-conductor. It's somewhere in between the two extremes, so that we say that it resists the flow of electricity.

Resistance

Because the two lengths of nichrome wire are equal, then the amounts of resistance to current flow in each length are also equal. We'll learn a lot more about resistance later on, but all we need to know about it now is that it is the property of part of an electrical circuit, which changes current back to PD in the general order of circuits which I've already told you about ie,

EMF → current → PD

Remembering that if two resistances in our circuit are equal, we can say that the PD created by the current flowing *through* each length of nichrome wire will also be equal *across* each length, and so we have 0V75 across each length of nichrome wire.

There are four important points which I'll stress before going any further, which are all illustrated by Figure 6.

- 1) Current flows *through* things, voltages (PD or EMF) are *across* things — don't get mixed up!
- 2) PDs in a circuit always add up to the EMF at the input of the circuit.
- 3) Current flow through a resistor causes a voltage to occur across the resistor.

Also, generally speaking, inputs to a circuit should be drawn on the left of any diagram of that circuit; outputs (or the effects of the inputs) should be drawn on the right.

Now let's take a closer look at the three new things we've learned about so far: current, voltage and resistance. These three things are inextricably tied together by such a basic electronic law that, in order to get anywhere in electronics, you must know how to use the law and you must also know what the three things actually mean. The law is called Ohm's law and is named after the discovering scientist. But before we look at Ohm's law let's study another, even simpler circuit — it's shown in Figure 7.

In the circuit you can see that the picture of a battery has been replaced by the standard circuit symbol for a battery. In electronics circuits symbols are always used because they provide a neat and standard way of drawing components — it's easy to understand and also easy to draw. For your reference there is a list of some of the more common components in Figure 13. Incidentally the resistors drawn in Figure 6 and 7 were already symbolised, in case you hadn't noticed!

The EMF of the battery in Figure 7 is 10V and the current is labelled by the symbol *I*; the arrow head beside *I* shows current direction. The resistance we'll call *R* for the time being. Now, if *R* is a measure of the resistor's resistance to current flow, it stands to reason that if we increase *R* we automatically decrease the current, *I*. In terms of a mathematical formula it just so happens that:

$$I \propto \frac{1}{R} \quad (\propto \text{ means 'is proportional to'})$$

In other words, if the resistance is doubled the current is halved, or if the resistance is quartered the current

increases fourfold etc etc.

We can include the voltage across the resistor in this discussion, now, by considering what happens to the current if the voltage changes. Logically, we would expect the current to increase if the 'pushing-force', ie the EMF, increases. The change is in fact directly proportional and so:

$$I \propto V$$

Putting the two formulae together we can conclude that:

$$I = \frac{V}{R}$$

And, by multiplying both sides of the equation by *R*:

$$V = IR$$

Likewise, by dividing both sides by *I*:

$$R = \frac{V}{I}$$

So, what we've done is work out a set of formulae which, given any two of the three variables of current, potential difference or resistance, will provide us with the third.

Ohm's Law Rules

These written formulae are a convenient and useful way to remind us of the law I spoke about earlier on: Ohm's Law. The law actually states that the voltage across something is directly proportional to the current through it, and the constant of proportionality is its resistance! I'm sure you'll agree that the three forms of the formula:

$$V = IR, \text{ or, } I = V/R, \text{ or, } R = V/I$$

give us a much simpler method of remembering and using the law.

If you recall, way back in Figure 6 the EMF (ie the voltage) of the battery was defined as 1V5 (where 'V' stands for the unit, Volts). But, up to now, there has been no mention of the units of current and resistance. The units were simply named after two scientists of the time who had done some of the great pioneering work in the study of electricity. The units of current are 'amperes' (abbreviated to 'amps') and those of resistance are 'ohms' (named after — guess who). Actually the units of EMF and PD, volts, are also named after a scientist — Volta — but in practice we tend to simply use 'volts' and 'voltage', whether speaking of a PD or an EMF.

We can now put values into the circuit of Figure 7 to show how the three terms of voltage, current and resistance are interdependent. For example, let's have a resistance, *R*, of 5 ohms (written as 5R because '0' is ambiguous). We know that the EMF of the battery, and hence the voltage across the resistor, is 10V and so, using one of the three formulae which can be used to express Ohm's law:

$$I = \frac{V}{R} = \frac{10}{5} = 2 \text{ amps (abbreviated to 2A).}$$

Similarly, if we know the current and the voltage we can calculate the

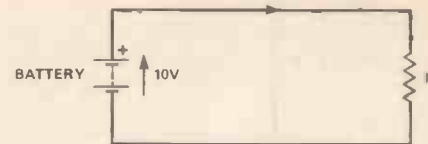


Figure 7. Showing an electric circuit, but using symbols for each component, not drawings.

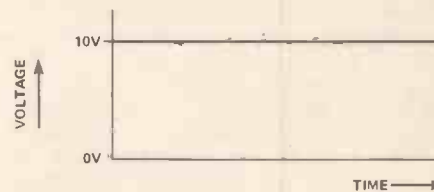


Figure 8. Output voltage of a dry-cell battery is steady with time. We call this a direct current (DC) voltage.

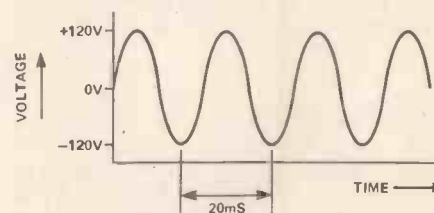


Figure 9. A graph of the voltage obtained from the mains supply. This is an alternating current (AC) voltage with a frequency of 50Hz.

resistance. For example if the current *I*, = 0A1 then:

$$R = \frac{V}{I} = \frac{10}{0.1} = 100 \text{ ohms (ie, 100R)}$$

Easy isn't it?

In electrical terms, quantities like 2A and 100R are commonplace, but when we get into the world of electronics, things differ. High amperage currents cause quite a heating effect, for example in an electric bar fire or even a simple light bulb (it's the filament glowing white hot which causes the bulb to light up). In electronics we're not at all interested in the heating effect and in most cases we want to reduce this as much as possible, so we use very low currents and very high resistances. Currents in milliamps, ie 1/1000ths of an amp or even microamps, ie millionths of an amp, are commonplace. Likewise resistances of thousands of ohms or even millions of ohms are often used. It's as well to get used to using such values in Ohm's Law calculations. For instance the current in a simple circuit, like that in Figure 7 if a 50,000R resistor is used, is:

$$I = \frac{V}{R} = \frac{10}{50000} = \frac{2}{10000} = 2 \times 10^{-3} \text{A}$$

Incidentally, the usual abbreviation in electronics for a value such as 50000R is 50k, where the symbol 'k' tells you that the value is whatever the number is (ie, 50) multiplied by one thousand. The term '50k' stands for 'fifty kilohms'. Similarly, 'million' is represented by the letter M and stands for 'megohm'.

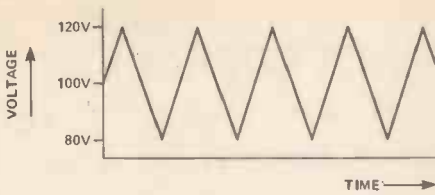


Figure 10. A triangular AC voltage of 40V, with a DC bias of 100V added to it.

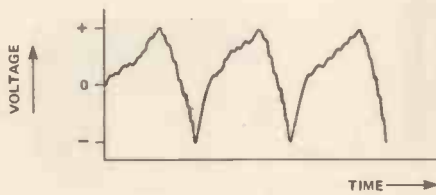


Figure 11. A 'piano-wave' AC voltage. It's the shape of the waveform which makes it sound like a piano.

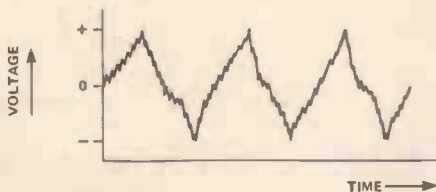


Figure 12. The waveform obtained from a violin.

In the same vein small values such as 1/1000 and 1/1000000 have letters: 'm' for 'milli' and μ (usually a printed 'u') for 'micro'. It probably all seems a bit daunting now, but don't worry you will get used to it — eventually it will become second nature to you.

AC/DC: Which Way To Turn?

So far we have discussed only one particular type of EMF. It's the type we get from a battery, where one terminal is always positive and the other is always negative. If we plotted the EMF on a graph with time along the bottom we would see something like that in Figure 8.

The voltage remains the same at all times; it is steady, and we call the current this type of EMF produces a Direct Current (DC). Similarly we call the EMF that produces such a current a DC voltage, because it creates a steady DC current.

But there is another type of current called Alternating Current (AC). A typical form of AC is that supplied on the national grid electric system, ie that used in house electric systems. The graph of the house electric EMF would be similar to that in Figure 9.

From this graph you'll see that the voltage swings between positive and negative peaks of 120V; it is constantly changing, or oscillating. One 'cycle' of

the voltage starts at 0V, then goes positive, then back to 0V, then goes negative and finally back to 0V. If this takes 20ms (ie 20/1000ths of a second) then with a quick bit of mental arithmetic we can calculate that there are 50 cycles of the waveform in one second. This is the frequency of the waveform and is expressed as 50 Hertz (abbreviated to 50Hz), named after a famous scientist (no, he didn't invent rental cars).

The sort of voltage used in mains electricity supplies has a 'smooth' alternation of the style shown in Figure 9 and is known as a sinewave voltage. There are other types, as you might expect, and they don't always oscillate around 0V: sometimes an AC voltage can have a DC component in them and could, for example, oscillate around 100V, as in Figure 10. Here you can see a triangular shaped waveform of 40V peak to peak (ie from top to bottom), but oscillating around 100V, so that we say that the waveform has a DC bias of 100V. There are obviously thousands of possibilities, many of which we'll explore in the months to come.

Sound Scene

The sound we hear is caused by minute differences in pressure being transmitted through the air. Our ears detect these air pressure variations and change them into signals which the brain can respond to, so we know that one sound is the sound of breaking glass, or another is a piano playing, for example. Now if we had a device which could change the air pressure variations which correspond to a sound into electrical signals, we could then plot a graph, which could be something like those in Figures 9 and 10. The device does exist, by the way, and is called a microphone. If we plotted the graphs for different sounds, we would then find that each sound produces a distinctive graph. Take, for example, a single piano note: its waveform might look a bit like that in Figure 11.

Yes, it's another form of AC waveform, but it's certainly not a sinewave or a triangular wave. In fact, we would be quite correct in calling it a 'piano wave', because all notes played on a piano, anywhere on its keyboard, would create a waveform similar in appearance to our example. It's the shape of the waveform which gives the sound the special characteristics (known as timbre) which allows us to say definitely "Yes, that's a note played on a piano". A note played on a different musical instrument, for example a violin, might look something like that in Figure 12. It's still AC, but is different again in appearance and hence sound, to that of a piano.

Electric Versus Electronic

We've now looked at a few typical circuits which are very common when studying electricity. But of course, this series isn't just about electricity is it? It's about electronics. One question you

should have been asking yourselves all the while you have been reading this is — what is the difference between an electric and an electronic circuit? They are obviously very similar because they both rely on the flow of electricity, so where do we draw the dividing line?

Well, the answer is not simple. It is very difficult to give a cut and dried statement, but here are a few guidelines which will help:

- Electric systems are usually, but not always, high-voltage AC (eg, house mains systems) and electronic systems tend to be, but again are not always, low-voltage DC.
- Certain devices are used in both systems to control the flow of electric current. In electric systems these are always 'passive' devices (because they are acted upon) whereas electronic systems also use 'active' devices, which can positively influence a voltage or a current.
- In electric systems, inputs are generally EMFs which are used to create physical effects such as to heat a bar fire, turn a motor or light a bulb. In electronic systems, inputs can be signals (such as that from a microphone when a piano note is played).

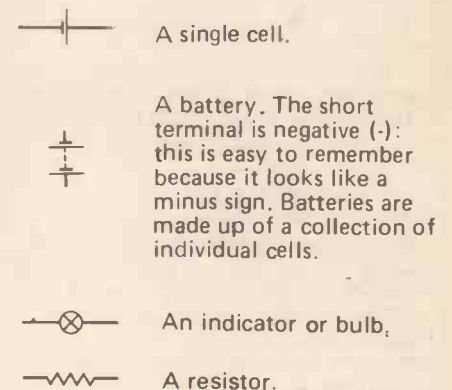


Figure 13. Symbols we've met in this instalment.

Summary

That's a lot, this month, especially if you've never studied electronics before, and there's an awful lot more to go. But the world of electronics is fascinating, and that always makes learning that much easier, because it's enjoyable.

All the topics we've looked at so far will be studied in greater depth over the months to come, so if there's anything you are not too sure about — don't worry — you'll get another crack at it later. You will find that everything in electronics has a simple explanation and the things which appear a mystery now will all become clear as you learn All About Electronics.

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FORWARD BIAS

Questions, answers and errata from readers and writers.

EVER SINCE physical science established that the electron flows around the electronic circuit in exactly the reverse direction to the one adopted for the sake of convenience by physical scientists, electronics has proved a contrary art. The precision implied by Boolean algebra, Ohm's Law and M.O.D. specifications has very little in common with the everyday constructor (or, come to that, the everyday designer) labouring painstakingly with off-the-shelf components.

Things have been known not to work! And despite the most careful testing, debugging and resoldering, things have been known to continue not to work.

Mysterious grollies have been known to creep undetected into Hobby Electronics projects, no less, without even mentioning the dreaded scrambled circuit layout which rises up to haunt editors and designers, both of them striving to produce a perfect project to an economically viable deadline (bring on the violins!).

The agonies of the backroom boys are of little consolation to Hobby readers, trying to shake the bugs out of their precious projects without a clue to where the bugs are hiding. Very often, curing the obvious error doesn't provide the answer, and progress becomes (seemingly incurably) arrested.

The aim of this page is to help unstick the stuck by bringing together on one page circuit errors, readers' queries, modifications, readers' solutions and general advice directly relating to Hobby Electronics projects.

So that everyone can benefit from the feedback, we would like readers to write in not only with queries about projects but also with news of any successful or unsuccessful tussles they have had with a Hobby project, any methods or minor modifications they have adopted to get a project to work or work better, any responses to other readers' queries, or any errors they think they have detected which we may not know about. As many of the most useful letters as possible will be recorded here, along with any modifications from our own designers and any errata which we become aware of. This will include a regular listing of errata published in recent months to aid the occasional reader.

So don't keep your agonies to yourself. Share them! For personal replies please send an SAE as usual with technical enquiries (make it second class — first class is a trifle optimistic for this overworked office);

Beasties

THE AVALANCHE VOLTAGE OF THIS ONE IS SO HIGH THE SPEC. INCLUDES THE 'PHONE NUMBER OF THE NEAREST MOUNTAIN RESCUE TEAM!!



we will still publish your communique if it's generally interesting.

And for a kickoff; a note from Owen Bishop, designer of the **BBC Micro/HEBOT Interface** (HE May '83). Owen writes:

"Yesterday we put HEBOT through its paces with the BBC micro again. It works very well, but looking back I think that one point needs clarifying."

"The input from HEBOT's sensors arrives at the computer along data lines D0 and D3. Data lines D4 to D7 carry no information at this time. Normally, a data line which is not connected behaves as if it has a high input, but it has been found that there is a tendency for unconnected data lines on the BBC machine to float when used with this interface. That is to say, the line may sometimes read as 1 and sometimes as a 0. It is 1 more often than it is 0, and there is a tendency for the effect to be most noticeable on line D4. This is possibly due to electromagnetic disturbances picked up from adjacent line D2 of the cable."

"This effect is easily eliminated by bit-wise ANDing of the data input with the value 15 (0000 1111, in binary). Variations in the most significant four bits thus disappear and we are left with a number which indicates the states of the lower four bits only."

"If the address of HEBOT is represented by the variable HEBOT, as in the sample programmes, the

command for reading HEBOT's sensors becomes:

X = ?HEBOT AND 15

The variable X then takes a value between 0 and 10, depending upon which sensors are activated (see Table 2, p. 11, HE November '82)."

Recent Errata

HE Starburst (HE September '79) see *Projects From The Past*, Points of View HE May '83.

Big Ear (HE December '82) see *Ear Errata*, Points of View HE March '83.

Microlog (HE December '82) see *Microlog Mistake*, Points of View HE March '83, and *Microlog Errata*, Monitor and PCB Printout HE January '83.

HE Echo-Reverb (HE May '82) see *Designer On The Dole*, Points of View, HE December '82.

Past Project Progress

There is now a PCB available from our PCB service for the **Low Cost Alarm** (HE December '82) — see the PCB Printout, HE June '83.

The troublesome **Telephone Timer** (HE June/July '82) is being re-examined from the bottom up by our technical team (all of him), but the solution is not yet on schedule for publication and probably won't be for some time. The **Echo Reverb** (HE May '82) may also be coming in for scrutiny shortly.

BUYLINES

HRG Board

A complete kit, which includes all the components, the PCB and a case for the project along with a software tape, is being made available by Cambridge Computing, 1 Benson Street, Cambridge. The total cost of the package, including VAT, post and packaging, is £17.50.

The tape includes programs both for technical purposes and for games, and enables the user to immediately use the HRG unit to its full extent. Machine code programs for SAVEing and LOADing user-defined graphics, such as those generated by the Program 2 listing in the article, are included on the tape.

If any reader cannot successfully build the HRG Project, it may be sent back to Cambridge Computing, and for a nominal fee of £8.00 they will return it in working order.

In some Sinclair ZX81s the ROM is soldered directly to the board rather than plugged into a socket, so an alternative method of connecting the HRG unit must be used. The simplest

safe method is to solder a 24-pin DIL header on top of the ROM; the DIL plug leading to the HRG can then be plugged in and the board itself tucked away neatly under the keyboard. In addition another wire must be run from the HRG board and soldered into the ZX81 PCB. Full instructions for this modification will be provided with the kit of parts supplied by Cambridge Computing.

Soft Fuzz

With a simple (but interesting!) project like this, all the components can easily be obtained from one supplier such as Cricklewood Electronics.

Everything is more or less standard and the usual substitutions can be made for the specified transistors if required — BC157, 177 or 307 for the BC212 or a BC237 or 317 for the BC182.

The component costs work out at around £5.00 excluding the PCB, case and the smaller odds and ends. The PCB can be obtained from the HE PCB

Service (or you could make it yourself) and a suitable aluminium case (type RB1, 150x120x45mm) will come out at £2.70.

Stereo Spreader

No problem with this one, either. Around £5.00 will buy all the parts and components, including the case — and that's cheaper than rearranging the walls! Try Europa Electronics, 160 High Road, Willesden NW10 2PB, who stock all the components needed. Their cases are aluminium rather than plastic, but this is preferable, anyway, as a measure of insurance against hum.

Pop Amps

All of the components and parts used for these simple circuits are readily available from suppliers advertising in HE. Dedicated experimentors will already have most of the bits and pieces in their 'junk box', but newcomers trying out these circuits for the first time should try to build up a collection of components and parts; the best buys are available from bargain-pack dealers such as BI-PAK, who provide low-cost selections of resistors, capacitors and so on to the electronics world at large. Their address is BI-PAK, PO Box 6, Ware, Herts., or phone 0920 3182.

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Mike Lord

WHEN Sinclair released the Spectrum in April 1982, the smell of sour grapes quickly filled the air. Several manufacturers immediately announced "me too" products to be available within six months. But now — over a year later — the only serious competitors to the Spectrum that have emerged are the Dragon and the ORIC-1.

The ORIC-1 is manufactured by a new company, Oric Products International, but the design was by Tangerine, who have been active in the computing scene for some time. Up to the time of writing this review, ORIC had been sold by mail order as well as through retail shops. But Oric are dropping the mail order side, presumably because of the growing sophistication of the buying public who are now realising that "Delivery within 28 days" is computer jargon for "Sometime this year or next" and therefore prefer to purchase what is actually available at their local computer shops.

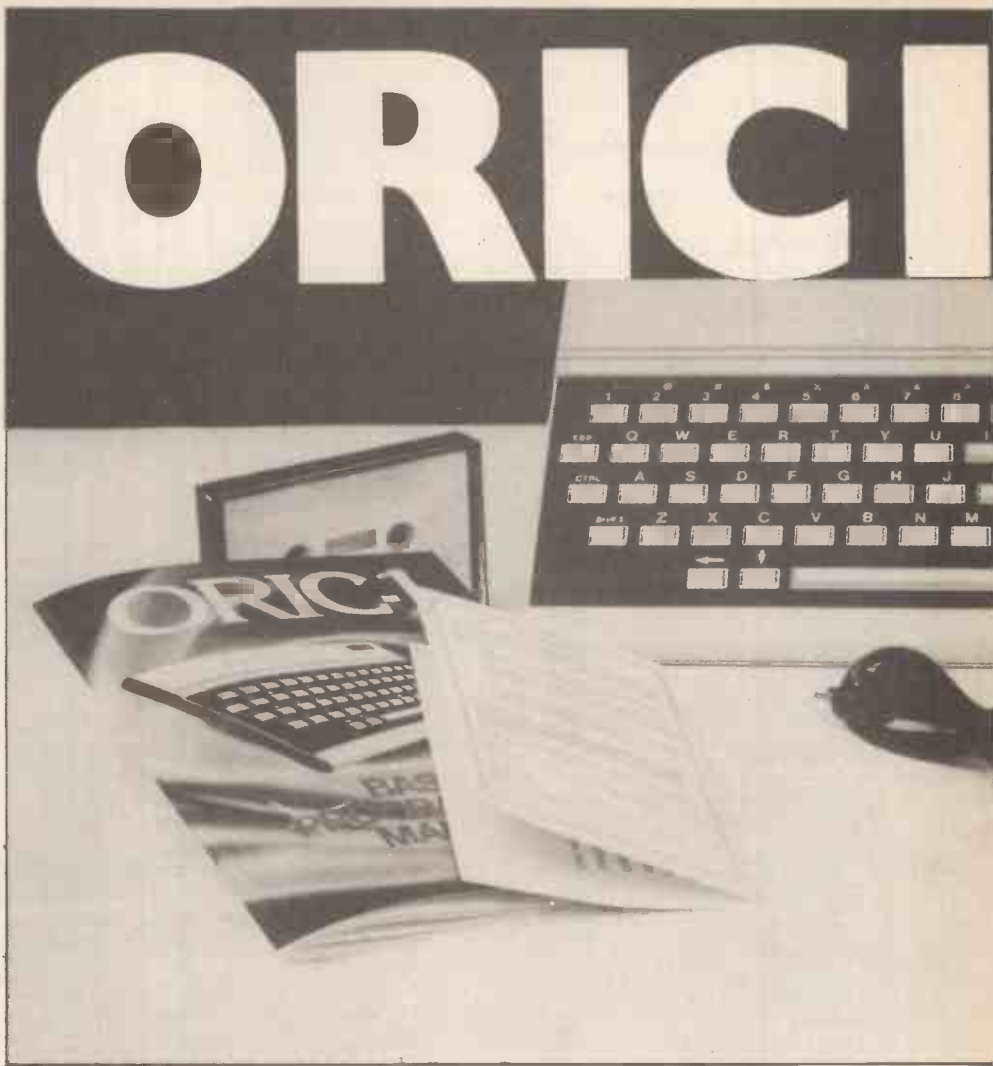
A consequence of this move away from mail order will be a rise in the price of the 16K version to give sufficient margin to the retailer. It had been advertised (although not actually available) for £99.95, which was a lot lower than the £169.95 being asked for the 48K machines, or than could be explained by an estimated £15 difference in manufacturing costs.

One last comment before looking at the ORIC-1 in detail. Because of a natural desire to get the news to their readers as quickly as possible, most reviews of new machines are done on "pre-release" or "production prototype" models. This review is different; it has been written from experience with two real "production" machines, one purchased by mail order, the other from a local retailer. Any deficiencies reported will also have been experienced by the general buying public.

The Hardware

The first thing that strikes most people about ORIC-1 is the styling of the case and keyboard: it looks very smart. The case is a tough injection moulded assembly in light grey plastic with a black area for the keyboard legends and blue "go faster" stripes. The top of the case is tilted forwards — making the keyboard easier to use — by a wedge shaped piece which houses most of the electronics.

As usual, power is provided by a separate mains adaptor; in this case it comes with an integral 13A mains plug. Contrary to usual practice with small computers, ORIC-1 runs cool, with no signs of any overheating problems. One word of warning to anyone who has both an ORIC and a Spectrum; although their mains adaptors both give about nine volts out and both use the same type of plug to connect with the computer, *they are NOT compatible*. The polarity of the plug connections to the computer differs, so using the wrong adaptor with the wrong computer is bound to blow up something!



Key Facts

The keyboard layout is similar to that of a normal typewriter, with a proper space bar and the shift keys roughly where a typist would expect them. But you can't touch type on it; the hard plastic keytops are too small and you have to press each key with a slow, deliberate, action. The key legends are very clear and — like a normal typewriter — each key is normally only used to produce two symbols, shifted and unshifted. ORIC-1 hasn't adopted Sinclair's "single key" entry for BASIC words, which must be typed in letter by letter; the only abbreviation allowed is the use of ? for PRINT. All of the keys auto-repeat if you keep them held down.

As well as the normal shift keys, ORIC-1 has a CTRL key that can be used in conjunction with other keys to perform certain functions. For example CTRL/F switches the rather loud keyboard click on and off, and CTRL/T switches the keyboard between the Caps Lock and Typewriter modes. There are some potentially annoying combinations here for someone who accidentally presses the CTRL key instead of the SHIFT key below it; CTRL/O for example, which turns off the output to the display. These CTRL functions are not shown on the keyboard.

The keyboard also has four cursor movement keys — placed two at each end of the spacebar — which are used in program editing but could also be useful in the games programs.

An ESCAPE key lets you halt a BASIC program, but to halt the computer when it is running a machine code program or when it has hung-up because you have inadvertently POKEd one of the critical system variables, a Reset switch is cunningly hidden where it can only be operated by pushing a pencil through a small hole, cut for this purpose in the bottom of the case. It doesn't always work. Similarly, the power-on reset circuitry doesn't work properly on the author's machine, so after switching on the mains it is usually necessary to pull the power plug out of the socket on the back of the computer and plug it in again before ORIC-1 will set itself up properly.

Lighting Up

The display has two basic modes; a low resolution one which uses just over 1K of RAM, and a high resolution mode which takes up about 8K.

In the low resolution mode the hardware actually produces a display of 28 rows of 40 characters each, but the top row is reserved for an annoying

Hobby Electronics reviews the long-awaited new low-cost microcomputer.



CAPS message to show whether or not the keyboard is in the Caps Lock mode (as if you couldn't guess from looking at what you have typed in), and you can't normally print in the two left hand columns. When you reach the bottom of the screen it automatically scrolls up to make room for a new line.

ORIC-1 has two character sets, each of 96 characters plus their inverse video versions. At power-on one character set contains alpha-numeric characters — including both upper and lower case letters — and the other holds 'chunky' graphics symbols. Both sets use a 6 x 8 dot pattern for each character, and these are held in RAM so that you can easily define your own characters to replace any of the standard ones. You can select either one or the other of the character sets as "standard" for the whole screen or — by using a slightly complicated procedure — you can mix the two.

There are actually three variants of the low resolution mode: TEXT, in which you can get black printing on a white background, and LORES0 and LORES1, which set the screen up for white printing on a black background using one or the other of the character sets. There are other differences but they are minor, and anyway the new lines introduced when the screen scrolls up are always in TEXT mode.

Characters can be made to appear in any combination of double height and flashing, and in different colours.

The unusual feature of ORIC's display is the way these various attributes (colour, flashing etc.) are produced. Computers such as the Spectrum divide the screen areas of RAM into two parts, one containing the character to be displayed, the other containing data about the attributes to be used in displaying that character. To generate the TV signal, the hardware reads the contents of both areas in parallel.

The ORIC, on the other hand, has only one area of RAM to hold all of the information about the screen. Each byte of this memory area corresponds to one character position on the screen, and contains either the code of the character to be displayed or an "attribute" code. In generating the display, the hardware reads each byte in turn. If it sees a character code, it sends the pattern of dots which make up that character to the TV screen, but if it reads an attribute code, it uses the new value of that attribute for all of the following characters in that row. The character position on the screen corresponding to that byte in memory is shown as a blank space of the current background colour.

This technique — known as "serial attributes" — is used in Prestel and Viewdata and has the advantage of using the least memory space, but is more limited in terms of display versatility, as a blank space is left on the screen each time an attribute is changed.

In the HIRES mode you get a high resolution (200 x 240 pixel) graphics screen on which you can plot points, lines, or circles, with three rows of text at the bottom of the screen. These three text lines can be scrolled without affecting the high resolution area. The high resolution screen uses one byte of RAM for each six pixels, ie 40 bytes for each row of dots, or 40 x 200 bytes altogether. When you select HIRES mode, the screen background colour is set to black and the foreground colour to white, although you can change these using serial attributes just as in the low resolution modes; each attribute byte, then, gives a blank space six dots wide in that dot row on the screen.

In all modes, you have eight colours available for background or foreground: Black, White, Red, Green, Yellow, Blue, Magenta and Cyan. The border around the display area is always black. The TV display is clear and very stable except when a loud sound is being produced. The colour on a standard TV set is good when the TV and ORIC have both been tuned properly, but to tune ORIC's colour modulator takes very careful adjustment through a very small hole in the bottom of the case using a proper trimming tool. Hopefully this should not normally be necessary.

Sounding Out

Sound comes from an internal loudspeaker driven by the three channel 8912 sound generator chip. The level is more than adequate, and a

wide range of sounds can be produced by an experienced programmer. For the less experienced, pre-defined sounds can be produced by the delightfully named words ZAP, PING, SHOOT and EXPLODE. Once programmed, the 8912 chip will generate all but the most complex sounds by itself, leaving the computer to get on with something else.

Like all other low priced machines, ORIC-1 uses your cassette recorder for back-up storage, and as with its competitors you need to experiment with the recorder settings to get reliable performance. A DIN-to-DIN cassette recorder connecting lead is provided, but you may have to modify it if you have one of those recorders that doesn't like simultaneous connections to input and output. Relay contacts are connected to the socket to control the cassette motor, where this is allowed by your recorder. Two recording rates are provided: the normal 1200 baud (about 150 bytes/second) and the "Super Reliable" 300 baud (30 bytes/second).

Surprisingly, there is no provision for verifying what has been recorded, although ORIC does appear to do some form of check when loading, as a poor quality recording will often give you a FILE ERROR — LOAD ABORTED message. You can save programs and defined memory areas (including the screen and character set areas of RAM) but the only way to save data is by working out where the variables are being held in memory.

Back Of The Bus

The back of the case holds the connectors for the mains adaptor and UHF TV output, plus two circular DIN connectors and two good quality ribbon cable connectors. One of the DIN connectors is used for the cassette recorder, the other provides TTL level R,G,B and Sync outputs for driving a colour monitor.

One of the ribbon cable connectors is intended for use with a printer having a standard Centronics interface, but on the models tested it wouldn't work properly with any of the three types of printer available unless the keyboard scanning routine was disabled by invoking a special machine language routine.

The other ribbon cable connector carries the system bus, and will be very useful for adding external devices. Control lines on this bus let you turn off the internal 16K ROM, and it would seem possible to replace it with external memory or with the "spare" 16K of RAM from inside the ORIC (48K ORICs use 64K RAM chips, the top 16K being normally disabled to make room for the ROM).

If you ignore the warning label and open up the case, you will find a very clean layout inside. The keyboard is on a large single-sided PCB which carries a smaller double sided plated through board holding most of the electronics.

ORIC-1 uses the 6502 processor chip, running at 1MHz, supported by a 6522 VIA to handle most of the I/O, the 8912 sound generator, and a 40-pin custom

IC which looks after the RAM refresh and the display. Memory is provided by eight 64K-bit dynamic RAM chips — presumably the 16K models will be fitted with 16K-bit chips — and two 8K byte ROMs. There are also several smaller chips used for various miscellaneous functions, an ASTEC UHF modulator, and a robust looking loudspeaker. Overall it looks as if ORIC-1 is more expensive to produce than the Spectrum, which could prove an important point when the price wars start in earnest!

ORIC BASIC

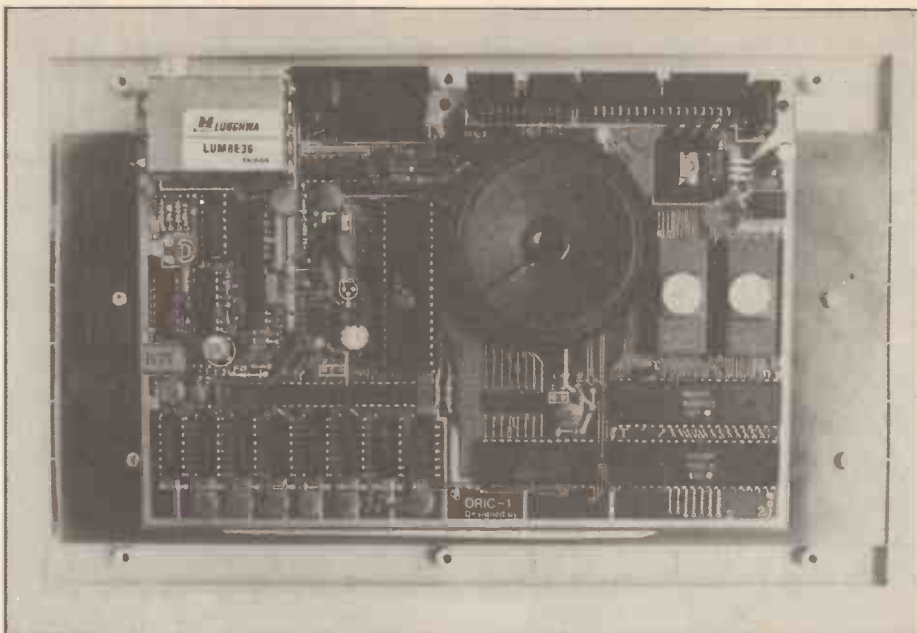
Is a bit like my garden: some nice spots, some that should have been done differently, and a fair population of bugs. It is a Microsoft-style BASIC with a considerable number of "enhancements".

Multi-statement lines can be used, but you are limited to a maximum of 78 characters; if you attempt to enter more ORIC beeps at you then — if you persist — ignores the whole line. The facilities for editing a program line are rather old-fashioned and much more error prone than the techniques used by the Spectrum or BBC machines; they are similar to those used on the Apple II. You edit by using the cursor movement keys to position the flashing cursor to the start of the line you want to change, then copy the good bits by typing CTRL/A and change the bits you want changed by typing in the new character(s). If you want to insert something in to the middle of a line you must first use CTRL/A to copy the line up to the point where you want to insert, then move the cursor to a spare part of the screen where you can type in the new part, then move the cursor back to copy the remainder of the original title line. Unlike the BBC machine, ORIC doesn't show you a 'fresh' version of what you are doing, so having edited a line it is always prudent to list it again to make sure that you have done what you wanted to do. You can list a single line, or part or all of the program, but there is no DELETE command.

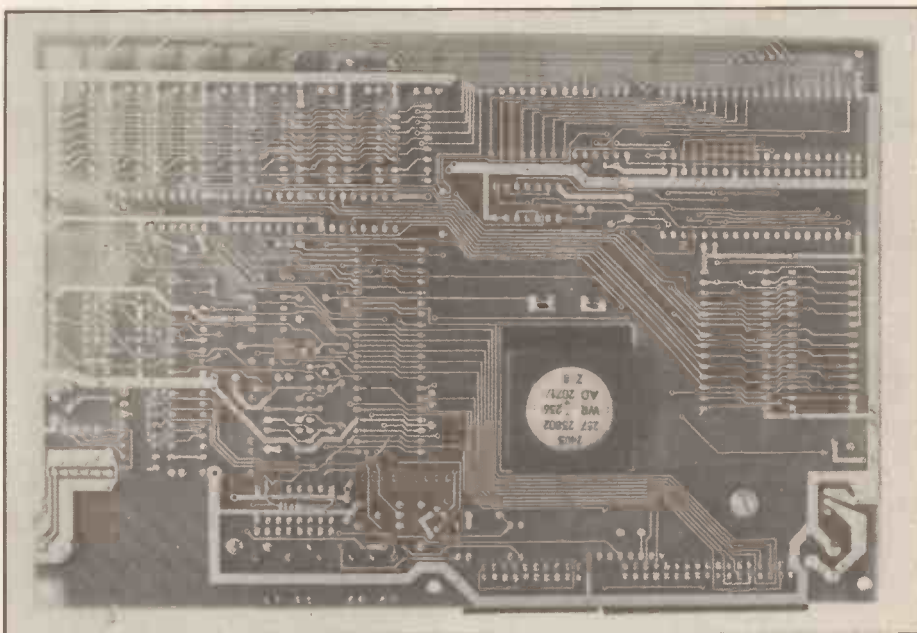
Variables can be Floating Point, 16-bit Integer, or strings of up to 255 characters, and both numeric and string multi-dimension arrays may be used. Strings — even in array form — only take as many memory bytes as are actually needed; you don't have to declare the maximum length of strings. Variable names can be any numbers of characters long, but ORIC only uses the first two so that HE and HELL would be treated as the same variable. Lower case letters can't be used in variable names.

If you don't need high resolution graphics, you can GRAB the area of RAM it uses for your program and its variables. But it tends to GRAB too much, so that any strings used will overwrite the character sets!

REPEAT-UNTIL loops are provided as well as FOR-NEXT, but there is no WHILE construct. As seems common with most 6502 based BASICs, you are limited in the amount of nesting of FOR-



The component side of Oric's PCB, with their custom RAM refresh chip to the left of the loudspeaker.



The elegantly laid-out track side.

NEXT or REPEAT-UNTIL loops or subroutines, and to the complexity of expressions, but in practice the restriction doesn't appear to be a very stringent one. PULL and POP instructions are provided to clean up the stack if you have to jump out of REPEAT loops or subroutines.

As well as IF-THEN, you can also use the IF-THEN-ELSE construct, but its use is limited by the number of characters you can have in a program line and because you have to be careful about exactly what you put before the ELSE word:

```
IF A > 9 THEN END ELSE GOTO 100
```

for example, will never stop the program regardless of the value of A.

```
READ, DATA and RESTORE
```

commands are provided for handling lists of fixed data, but you can only RESTORE the data pointer to the start of the first DATA statement in the program, not to the start of any chosen DATA line. Single line user-defined functions are provided by DEF FN.

Some new words have been added to BASIC to control the 8912 sound chip. As well as ZAP, PING, SHOOT and EXPLODE, there are three general purpose words: SOUND, which lets you set any of the three sound channels to produce a tone of defined frequency and amplitude, or noise; MUSIC, which is similar but uses musical note and octave numbers to define the frequency, and PLAY which is more complex but lets you control the 8912 chip's envelope generator.

Some nice features of ORIC-1 BASIC

for the machine code enthusiast are DEEK and DOKE, which are like PEEK and POKE but operate on two consecutive memory locations to handle a 16-bit value, and the ability to input or print numbers in either decimal or hexadecimal. You can invoke a machine code routine with either CALL(X), which runs a machine code routine starting at location X, or with USR(0) which runs a machine code routine that returns a value to the calling program.

Even nicer are the "words" 'I' and '&'. The first is interpreted as a command to execute the machine code whose starting address is held at 2F5/6, while '&' is interpreted as an instruction to perform the machine code routine whose starting address is held at 2FC/D and which returns a value to the calling BASIC program. Using these two words, a skilled 6502 machine code programmer could extend ORIC-1 BASIC to include new commands and functions.

Print Where?

Perhaps the worst part of ORIC-1 BASIC is that concerned with printing onto the screen. The PRINT command itself does not have any equivalent to AT (although a machine code routine to partially overcome this lack is included in the manual), and there are bugs with TAB and with using commas as print item separators, so it is very difficult to print in a defined position on the screen. You can get round this by using the PLOT statement (I) as this puts a single character or a string at a defined position on the low resolution screen, but this means that you have to use something like:

```
PLOT 18,13 STR$(V)
```

to just print the value of the variable V in the middle of the screen, and it doesn't control the printing positions used by INPUT statements. I can't fall in love with a BASIC that forces you to do things like this! In the high resolution mode, the only way to print characters on the screen above the bottom three text lines is by using the CHAR command which plots a single character at a defined position.

The other high resolution mode commands are CURMOV and CURSET, which move the high resolution plotting cursor to a new position; DRAW, which draws a straight line; CIRCLE, which draws a squashed circle, and PATTERN, which is a fascinating new command that lets you draw different types of dotted lines. A FILL command is also documented and is supposed to fill in a rectangular area of the high resolution screen, but I am unable to get it to work sensibly. POINT tells you whether a given pixel of the high resolution screen is set to the foreground or the background colour.

PAPER and INK commands are available in the low resolution modes, but they only work properly in the TEXT mode, where they change the colour of

the whole screen at once. To do anything more sophisticated, you have to include attribute control codes in PRINT statements as letters preceded by CHR\$(27), eg

```
PRINT CHR$(27); "AX";CHR$(27);"@"
```

to print a red X, or POKE or PLOT the control codes directly into the right positions in the screen RAM.

Unlike the Sinclair BASIC, the ORIC doesn't do any checking of the program when you key it in, although it does translate any BASIC words it can find to single byte "tokens". Once you are ready to run the program, ORIC's "Trace" feature can help you check it out by displaying the line number of each line executed in part or all of the program as it runs. In practice, the most likely causes of problems will be ORIC's habit of only taking notice of the first two characters of a variable name — so that what you casually think of as two separate variables are actually being treated as the same one — and the diligent way in which it searches for BASIC words in your line, even to the extent of ignoring the presence or absence of spaces, so that the line

```
10 LET VIOLET$="BLUE"
```

gives an error because ORIC mistakenly sees two occurrences of the word LET, interpreting the line as

```
10 LET V10 LET $="BLUE"
```

As far as other features are concerned, ORIC-1 BASIC has the usual mathematical, trigonometrical and string functions, and seems to run about 50% faster than Spectrum BASIC — although that machine is not noted for its speed.

The Manual

Apparently the ORIC manual had to be produced in a hurry, just before the first machines were due to be shipped. As a result it contains a fair number of

errors, but the company were quick to include an errata sheet.

Because of the speed with which it had to be produced, the manual is quite brief for such a complex machine, and sometimes you wish that more information had been included. But, overall it is well written and quite humorous; the section on Using a Printer advises you on what to do if you get Japanese characters appearing!

To Come

Oric have been advertising a Communications Modem to go with the computer for some months now, but nothing has yet appeared. Similarly the FORTH language cassette which should have accompanied the computer didn't — but we live in hope. For the more distant future, Oric are talking of a fairly cheap disc drive and printer.

In Conclusion

It is a pity that ORIC had to be rushed out with a number of deficiencies in the software, and it will be interesting to see whether they simply ignore them or — as Acorn do with the BBC machine — charge you a "nominal" fee to replace the ROM with an updated version.

In theory, the ORIC-1 should appeal most to machine code and hardware enthusiasts who will be prepared to put up with the messiness of the BASIC to get a computer with a reliable bus connector and one in which machine code routines can be easily mixed with — or even replace — the ROM firmware. And given a good range of supporting software, its price and styling should also make ORIC-1 attractive to those whose primary interest is in playing games.

But because of the intricacies and inconsistencies of ORIC BASIC, I can't unreservedly recommend it to anyone whose main reason for buying a computer is to learn about BASIC — it may well put him off computing for life!

HE

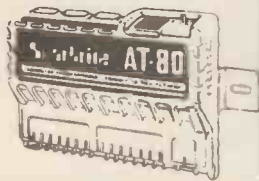


Step-by-step fully illustrated assembly and fitting instructions are included together with circuit descriptions. Highest quality components are used throughout.

Sparkrite

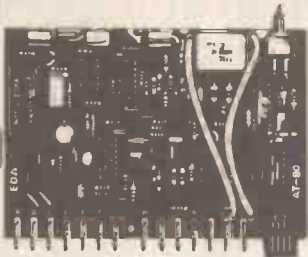
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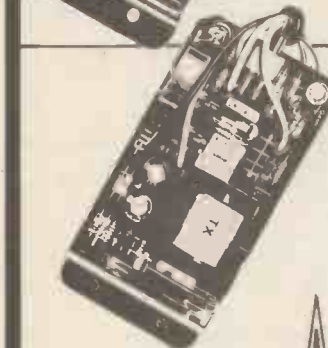


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- Contact breaker driven
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- Over 65 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles

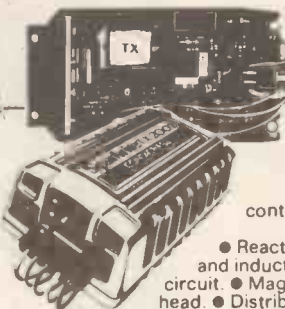
TX1002 Electronic Ignition

- Contactless or contact triggered
- Extended coil energy storage circuit
- Inductive Discharge
- Three position changeover switch
- Distributor triggerhead adaptors included
- Die cast weatherproof case
- Clip-to-coil or remote mounting facility
- Fits majority of 4 & 6 cyl. 12V. neg. earth vehicles
- Over 145 components to assemble.



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- Three position changeover switch
- Over 130 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles



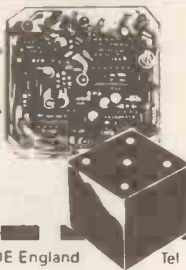
TX2002 Electronic Ignition

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

G. V. Whitney, G8RS1

TREMOLO EFFECT is suitable for most electric guitars or organs, and it has the virtues of being both simple and cheap to build, using only two integrated circuits and a handful of components.

Circuit Description

IC1, a 566, is a digital waveform generator device that can be used as a VCO; normally it can deliver both triangular and square waveshapes but in this application only the former shape is used.

The repetition rate of the waveform is set by RV1 and C3, and with the chosen components a range of one to ten cycles is available — probably adequate for most applications.

IC2 is an MC3340 electronic attenuator IC, originally designed as a remote volume control for TVs etc., with a 50k pot attached via a long length of cable; however attenuation can also be achieved by varying the voltage on pin 2.

The output of IC1 is applied to IC2 via RV2, which allows the depth of tremolo to be adjusted for the best effect; the decoupling capacitor, C5, is deliberately large to allow operation down to low settings of RV1. The value of R1 is a compromise between maximum gain from IC2 (with SW1 open) and best variation of depth.

Component Selection

The prototype unit was constructed in a die-cast box, which happened to be about at the time! It actually had more holes in it than metal, so the largest hole was used to mount the foot switch (this was obtained during a local garage clearance and was intended as the "Dip-Main" headlamp switch on a Morris Minor! This type of switch is to be recommended as it is very strong!) Whatever type of switch or box is used, though, it must be capable of being abused: remember, you're going to stand on it!

In the prototype unit the on/off switch was combined with the input jack socket by modifying the earthing contacts on the socket; the negative battery connection was attached to the fixed switch contact and the moving "finger" arranged to contact with it when the plug was inserted. If you do not need this convenience, the switch can be combined with RV1 or RV2.

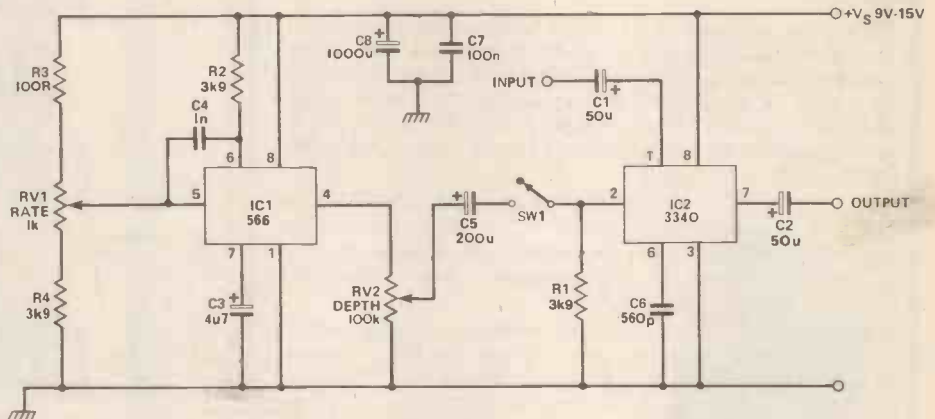
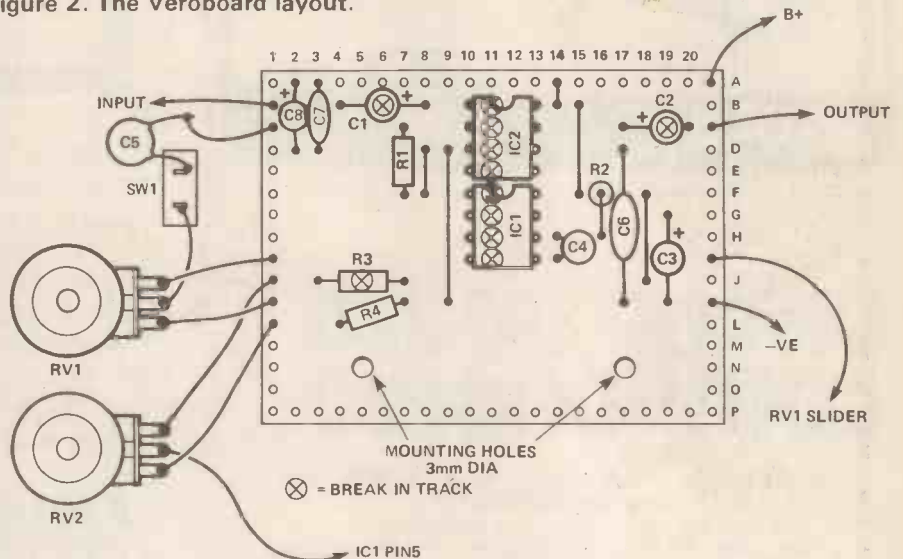


Figure 1. The circuit.

Figure 2. The Veroboard layout.



Hobby Electronics cannot undertake to answer queries on Reader's Projects.

Parts List

RESISTORS

(All 1/4 W, 5% carbon)
 R1, 2, 4 3k9
 R3 100R

POTENTIOMETERS

RV1 1k linear
 RV2 100k linear

CAPACITORS

C1, 2 50u 10V
 aerial electro
 C3 4u7 16V
 axial electro
 C4 1n
 disc ceramic
 C5 220u 10V
 axial electro
 C6 560p
 polystyrene

C7 100n
 polyester
 C8 1000u 16V
 axial electro

SEMICONDUCTORS

IC1 566
 VCO/waveform generator
 IC2 3340
 VCA

MISCELLANEOUS

SW1 SPST
 heavy-duty foot switch
 SK1, 2 1/4" jack sockets
 SW2 see text
 Case, approx. 110 x 100 x 50mm;
 Veroboard, 21 holes x 16 strips
 (110 x 90mm); nuts, bolts, wire,
 solder etc.

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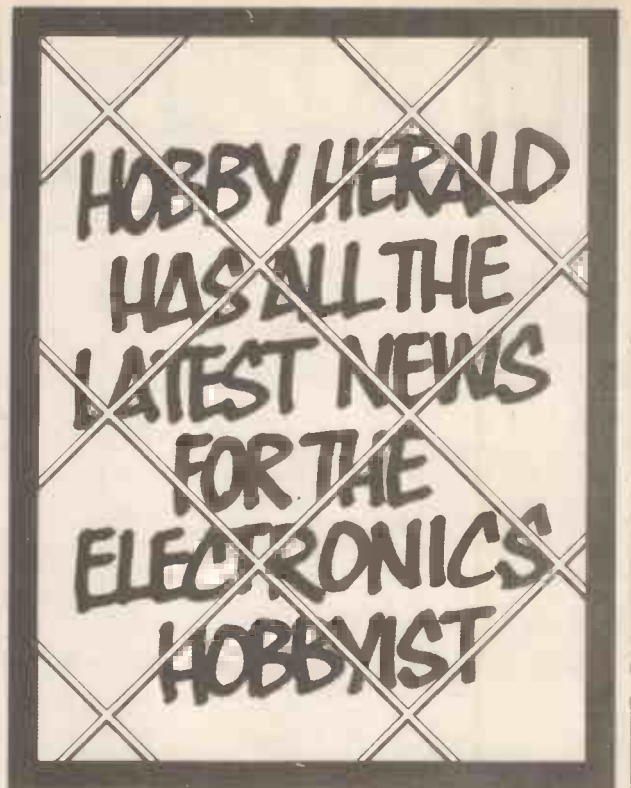
7400	11p	7427	18p	7474	19p
7401	11p	7428	25p	7475	26p
7402	11p	7430	13p	7478	25p
7403	12p	7432	20p	7480	45p
7404	12p	7433	20p	7482	65p
7405	14p	7437	23p	7483	30p
7406	19p	7438	24p	7485	80p
7407	19p	7440	14p	7486	19p
7408	13p	7442	30p	7489	180p
7409	13p	7444	85p	7490	19p
7410	13p	7446	56p	7491	34p
7411	15p	7447	36p	7491	24p
7412	17p	7448	43p	7493	24p
7413	17p	7450	14p	7494	33p
7414	23p	7451	14p	7495	33p
7416	19p	7453	14p	7496	38p
7417	19p	7454	14p	7497	88p
7420	14p	7480	14p	74100	78p
7421	19p	7472	22p	74107	22p
7422	19p	7473	24p	74109	24p

CMOS

4000	10p	4020	42p	4042	38p
4001	10p	4021	40p	4043	40p
4002	12p	4022	49p	4044	40p
4006	50p	4023	18p	4046	40p
4007	14p	4024	33p	4047	35p
4008	36p	4025	19p	4048	38p
4009	24p	4026	75p	4049	21p
4010	24p	4027	20p	4050	21p
4011	10p	4028	40p	4051	42p
4012	15p	4029	45p	4052	48p
4013	20p	4030	14p	4053	49p
4014	45p	4031	125p	4054	78p
4015	40p	4034	140p	4055	80p
4016	20p	4036	24p	4059	430p
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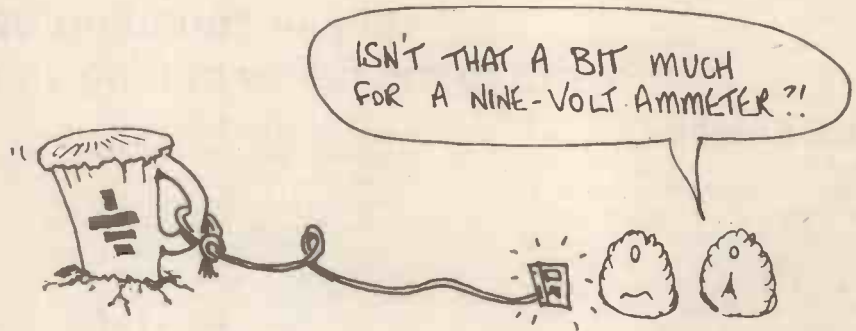


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SO5 3ZR.



READERS' SERVICES

Feeling stumped?
Looking for the
right connection?
It must be time to
reach for HOBBY
ELECTRONICS!
Here's how . . .



Letters

While we are always happy to receive correspondence from readers, it is simply not possible for the editorial staff to reply to every letter. Because of staff limitations and the fact that producing the monthly editions of HE must take precedence, *we cannot even guarantee to answer letters accompanied by an SAE*. Hopefully this situation will prove temporary and we can shortly resume a full service to readers.

In the meantime, to reduce the amount of mail to which we attempt a reply, certain guidelines have had to be imposed:

- Letters from readers who have been unable to successfully build a Hobby project will receive first claim on our attention. But we urge readers to first make sure they understand the problem, and to read all parts of the article thoroughly: it is wasting our time (which is better spent ensuring that current projects are error free) to reply (to pick a common case) that the supplier of certain components is given in Buylines, on page 34.

- Many enquiries are concerned with drafting errors in circuit diagrams or component overlays; corrections for most errors have been published in subsequent issues, so please check your back numbers before writing to us — the information may already be in your hands.

- Where there is a definite problem, we ask that readers first try to solve the problem themselves; again, reading the article carefully will often resolve what appears to be a contradiction between, say a Veroboard layout and the circuit diagram.

- If it is necessary to write, please try to supply useful information: it is impossible to give constructive advice to the reader who says "My project doesn't work. Can you help?". The short answer, and the only one possible, is *no!*

- We would like to hear from any reader who has had difficulty with a Hobby project and who has come up with a solution, but we cannot advise when a project has been modified and fails to work: if you decide to make

changes you will have to live with the consequences. Similarly, we are pleased to take readers suggestions for projects they would like to see in the magazine, or for modifications to improve a published project, but we cannot design circuits on request or re-design a project to suit the requirements of a single reader.

- We will try to answer any readers' questions on electronics in general, to suggest sources for components for old projects or to offer whatever advice we can when circumstances permit; however, we cannot advise on the purchase, use or modification of commercial equipment.

- We are unable to advise on the purchase of components in foreign countries; overseas readers are advised to read carefully the advertisements placed in HE by mail-order component suppliers and to write to them directly (this advice also applies to many UK readers wishing to obtain components for projects!).

- Unless specifically requested to the contrary, any letter to Hobby Electronics may be selected for publication in the magazine, including letters with an SAE if they are sufficiently interesting; in such a case a copy of the editorial comment will be returned to the reader prior to publication.

- Letters not accompanied by a stamped, self-addressed envelope may be selected for publication but will not receive a personal reply. We will attempt to reply to all enquiries backed by an SAE (if writing from outside the UK please include the correct number of International Reply Coupons, available from Post Offices) but we cannot guarantee a reply, nor can the publishers, Argus Specialist Publications, be held legally responsible for the accuracy of the information supplied.

Writing For HE

- Hobby Electronics' editor is continually looking for good projects, ideas for projects and designers to

develop an idea into working project.

However unless you are already a seasoned contributor, it is unlikely that your first effort will reach the standard required for publication in the magazine. So if you have an idea or a design and you personally think it would be suitable as a Hobby project, write and tell us about it — and please include a telephone number (night or day, we're open all hours here) where you can be contacted.

Similarly if you are a designer, perhaps with time to develop someone else's ideas, please write or phone the editor!

Any Old Rope?

We will also undertake to publish any suitable but undeveloped ideas as experimental "Reader's Projects". The article will generally fill one page when published and should include a circuit diagram and description, parts list, component overlay (the projects should generally be on Veroboard) and some brief suggestions as to how the device might be constructed by the adventurous reader! A working prototype will not be needed, and the flat rate for Reader's Projects will be £20.

Simple circuits are also needed for publication as "Short Circuits"; no constructional information is needed, and contributors of "Shorts" will be rewarded with £10 per idea.

The Back-Log

The above guidelines for writing to Hobby Electronics have had to be drawn up in response to the growing pile of yet un-answered letters from readers.

We apologise to all those still awaiting a reply; we are doing everything possible to clear the jam, but to enable us to do so in reasonable time we are retrospectively imposing the above restrictions on the type of enquiry with which we will deal. Therefore, any letter or question not relating to a Hobby Electronics project or a general electronics enquiry will be returned, with the SAE, to the reader.

POINTS OF VIEW

Feel like sounding off?

Then write to the Editor stating your Point of View!

Gerbil Grumbles

Dear Sir,

Our team have recently acquired a copy of the April edition of your electronics magazine. One project detailed caused some very grave concern and is now receiving attention in our laboratories. We understand that "Hobby Electronics" is mainly aimed at the amateur enthusiast and, in view of this, we would like to draw your attention to the "Radio-controlled Gerbil" article, which we consider highly unsuitable for the average constructor. Insufficient construction data is given and we consider the advice on a Grid power supply unsafe and irresponsible on your part.

It is no wonder that British Technology cannot progress if this project reflects the standard of British engineering. Furthermore, we can assure you and your readers that NATO missiles have sufficient fail-safe devices to prevent any blanket radio signal from launching them prematurely.

Finally, we would appreciate any information as to where we can obtain the old bed spring.

Yours faithfully,
Winston Weinberger,
Shuttle Command Navigation Lab.,
National Aeronautics and Space
Administration,
Alabama,
USA,
via Wimbledon, SW19

We're deeply honoured that the Shuttle Command Navigation Team from NASA have found the Radio-Controlled Gerbil fascinating. Yes, boys! We have a lot in common — they said the gerbil would never get off the ground, either.

About the power supply: our technical teams make a point of scouring junk shops and dumps for inexpensive components, and I have it on good authority that we obtained the last dozen or so of this unit; everyone else will have to make do with digital watch batteries.

As for the old bed springs, we must stress *old* new springs are too powerful for the bounce/weight ratio of the gerbil and are only suitable for Radio-Controlled Fleas, a project I would not recommend to anybody who does not have a gerbil. So it's back to the dump. If you should meet Mr. Bradshaw there, please introduce yourself. He may be able to help you on the subject of valve technology.

As I said, we are deeply honoured and humbled by your kind interest and

would like to mail this reply to you personally, but what can you do with people who just won't send an SAE?

Bearing that in mind, please pass on the following messages: To Mr. Scuttle: well done! You are only the second person, after my six-year-old niece, to spot our little joke about the Eprom Programmer! All the rest of our readers have taken it quite literally, and most of them have actually got it working, poor ignorant fools! To Mr. Bumphrey: Go on! See if we care. It'll hurt you more than it hurts us. To Mr. Smyth of British Telecom: why don't you sort out the Ham and CB interference before you pick on defenceless rodents? To Miss Hopeful: The Editor has his gerbil working nicely, thank you, and so gracefully declines your own offer to nibble his toes for him. As for the so-called Mr. Wakely of Wimbledon: You don't expect us to be taken in by a stupid pseudonym like that do you? And someone who sends his binders to the vet? Do us a favour. Stick to getting your shuttles off the ground and don't try to fool the experts. Now, onto some real business:

Dear Sir,
As a regular reader of your mag, I bought a copy of the April '83 issue while dashing for the train. The bit that caught my eye was that round red bit on the cover. I've been into radio control models for some time, and thought to educate myself some more. If I'd required the mickey taken, I would have bought a comic. As it is I think you should refund my money for selling me something under false pretences. I expect that a lot of other readers like me will think twice before buying rubbish like this again.
Yours most sincerely,
G. G. Bullivant,
Gospport,
Hants.

Dear Sir or Madam,
I have two sons both at school, both interested in electronics including electrical circuits. In fact one spends most weekends tinkering about with such things.

His pocket money is £1.50 per week plus any money he saves by walking to school rather than taking the bus; most is spent on basic things which I know little about such as capacitors, transistors, copper enamelled wire, etc.

However, older son sees March issue of Hobby Electronics, and buys same for the first time, seeing that on page 18 that there is a "Radio Controlled

Gerbil" project for next month, great, thinks young son, waits for publication, beamingly walks into paper shop and buys April issue, what disappointment, whole thing appears to be a joke. Perhaps to ardent publication supporters it is and they expected it, however, I wonder whether they would feel the same had they spent 53% of their weekly wage on something treasured in the imagination, only to find it was a let down.

Your serious observations would be most welcome as I draw this matter to your attention. I wonder whether you are aware of such young subscribers and indeed their gullibility with regard to such matters having indeed not become part of our adult world yet.
Yours sincerely,
J. Hedger, Assoc. Mem. ASEE, Dip. Eng. Man.
Abbey Wood,
London SE2.

Speaking as one who has never bought so much as a copy of *The Beano* since the age of nine without first inspecting the contents, I think this may be a problem related to personal philosophy rather than age. Mr. Bullivant's plight seems to bear this out; in fact the adult commuter may be the most vulnerable of all periodical buyers, as the alternative, being stuck on a train with no reading matter, is too terrible to contemplate. But we do take your point, and hope you will forgive us for taking the mickey just once a year. Of course, every little bit helps to keep our printers, typesetters, designers, sales team — not to mention we editors — from becoming digits in the unemployment statistics, so we need you!

We would like to offer both Mr. Bullivant and Master Hedger consolation in the form of any one of our back issues, or forthcoming issues, as a replacement for the April issue, so if you will let us know which one you would like, we'll send it on to you.

Don't everybody rush! These good readers can claim their consolation prize for the determined initiative they showed in making their feelings felt. The complaints departments is now closed!

PS. We don't want mail from everybody else who has spent 53% of their weekly wage on something treasured in the imagination, only to find it was a let-down, either . . . even people who bought the Men at Work album.

(Thinks: we wonder how the gentlemen at the RS Components Technical Department are getting on with the Gerbil? can we expect to see the correctly rated liquorice allsorts in the next edition of their Catalogue?)

Shock! Horror!

Dear Sir,
Many years ago as a lad we could buy Shocking Coils run on a 4V5 battery, with a trembler and two wires and on the end two bits of brass tube.

Have you any plans for the same, or know where I could get the same?
Yours faithfully,
F. S. Clarke,
Horsham,
Sussex.

Don't tempt us! We like pranks as much as the next person (as long as we aren't the victims, of course . . .) but as celebrities and responsible members of the community we can't, alas, condone or advise on the administering of electric shocks to innocent parties (this does not include members of the Video Today staff) in case somebody has a heart attack and sues us. Besides, we have our hands full already with the Radio Controlled Gerbil terrorising the public!

Attention All Beginners

Dear Sirs,
I have been fascinated by electronics for years, but until recently all my time has been taken up by building up my own small business.

As a new reader of HE I wonder if you could recommend a method of learning about electronics, starting at the most elementary level that I could study at home, at my own pace.

I would also be very pleased if you could recommend any suitable books for the adult absolute beginner, thank you.

M Gadd,
Dudley,

Well, a new series for the complete beginner — whatever his or her age — will be starting in HE very soon. And then there was the first series of all, Into Electronics, which appeared in HE between November '78 and June '79 (inclusive). These issues are out of print, but photostats are available at £1.50 per article (ie per issue) from our Backnumbers service (see page 47 in this issue). That series was aimed mainly at 'O' level students and was extremely popular. If you write to Bernard Babani (Publishing) Ltd., The Grampians, Shepherds Bush Rd., London W6 7NF and ask for their catalogue, you will find many small books of circuits for inexperienced constructors there and you can choose at your leisure. And there is absolutely no substitute for 'hands on' experience in construction. A book of breadboard projects is a good place to start because you can

build up the circuits and tear them down again without hours of desoldering. And don't be too reluctant to check out books aimed at younger readers — they are sometimes the best and easiest way to get a good grasp of the fundamentals of any new subject. Good hunting!

Solar Panels Again

A reader writes:

Referring to Points of View March 1983, 'Heat But No Light', if Mr. O'Neill is referring to the BPX47A panel, I notice that the panels which are identical to the BPX47A (except that they have thirty-six cells instead of the BPX47A's thirty-four) are used in Chichester Harbour for charging up batteries on navigation beacons. I believe the harbour is under the control of the Portsmouth Harbour Authorities who might be able to tell you where they got the panels from. If it appears that they do not maintain the lights, then try Trinity House.

EPROM Interfacing

Dear Sir,
I would like to know the way to interface the EPROM programmer to my BBC Model B. As a regular reader of Hobby Electronics, I find that article most interesting. I have already bought all the parts for the project, but now I am confused because I don't know how to interface the programmer to my BBC micro and I don't know how to write a simple software to drive it.

Thanks.
Yours faithfully,
Joseph Obi,
London N16.

We do have plans for a variety of interfaces for the HE EPROM Programmer in due course, so keep watching.

Personal Project

Dear Sir,
I'm a regular reader of your magazine, ever since I picked up your November '82 issue at the local newsagent. Your magazine is very interesting, especially your page.

I haven't built any of your projects so far because I haven't found any that suit my requirements. I'm particularly interested in the personal stereo cassette recorder and I'm looking forward to building one. I hope my idea will be considered. It will be different to play a machine that you made yourself!
Yours sincerely,
Wing Lee.

Certainly no shortage of ambition here! What can I say to this

determined gent, who not only reads his Hobby even when he isn't building a project, but plans to build his own personal stereo? I positively quail to admit that we are not very likely to do a personal stereo project, because the commercial companies have got it down to such a fine art that no magazine could possibly compete with them — not a hope! By the time all the parts which are too complicated to make at home had been provided (including the case) there would be little left but the assembly, and it would still be more expensive and less reliable than the ones you can buy in the shops. So it's not feasible as a magazine project. Sorry!

Looking At TV

Dear Sir,
Recently I came across an article on Narrow Band TV. Unfortunately it was only the first article.

I have developed an interest in NBT. Therefore, I wonder if you can supply me with any information or with a source of information.
Yours faithfully,
R E Dixon,
Putnoe,
Bedford.

Two articles in HE April and May '80 will tell you how to set up and use NBT. You can purchase these articles for £1.50 each from our Backnumbers service. Alternatively, try the Encyclopaedia Britannica at your nearest library — they have detailed information on many technical subjects.

Soldering Iron Kit

Dear Sir,
Wishing to build the temperature controlled soldering iron (HE October '80) I wrote to the address given in Buylines at the end of the article, enquiring if the kit was still available.

Although I enclosed an SAE I have received no reply to my letter.

I'd be grateful if you would inform me (a) if Compu-Tech are still in business and (b) where the kit can be obtained if they are no longer in a position to supply it?

Yours faithfully,
H J Holland,
Salisbury,
Wilts.

Enquiries have revealed that Compu-Tech are still alive and well but have changed address. They are now at Worstead Labs, North Walsham, Norfolk NR28 9FA. Tel: (0692) 405600. They tell me that the kit now costs £15.38. Try giving them a call to start with; they may have received your letter by now. If no joy, write again.

Well, isn't that nice! A happy ending, by the look of it.

electronize

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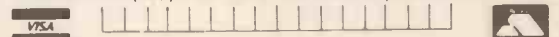
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MiniClocks, 5080 Preamp, Model Railway Track Cleaner, 5080 Loudspeakers, Loudspeaker Crossover Design, Radio Controlled Model Survey.

June 1980

Microbe Radio Control System, Egg Timer, Two Watt Amplifier, Fog Horn, Short Circuits, LEDs and LED Displays.

July 1980

Sound-Operated Flash Trigger, 18+18 Car Stereo Booster, Hazard Flasher, Electronics in Photography, Electronic Espionage, Piezo Electricity.

August 1980

EquiTone Car Equaliser, Pass-The-Loop Game, Gaztec Gas Detector, OP-Amp Checker, In-Car Entertainment Survey, Introducing Microprocessors.

September 1980

MicroMixer, Reaction Tester, Guitar Phaser, Development Timer, Teletext Explained, Into Digital Electronics Part 1.

October 1980

Kitchen Timer, Tug 'o' War Game, Light Dimmer, Freezer Alarm, Intruder Alarm, Temperature-Controlled Soldering Iron.

January 1981

Car Rev-Counter, Bench Amplifier, Sound-Into-Light Converter, Chuffer, Electronic Games reviewed.

February 1981

Heartbeat Monitor, High-Impedance Voltmeter, Medium Wave Radio, Two-Tone Train Horn, Audio Signal Generator.

March 1981

Public Address Amplifier, Windscreen Wiper Controller, Bicycle Speedometer, Photographic Timer, Microcassettes.

April 1981

Pre-Amplifier Part 1, Super Siren, Guitar Tremolo, Russian Roulette Game, Doorbell Monitor, Anatomy of a Space Shuttle.

May 1981

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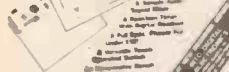
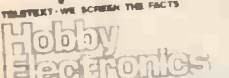
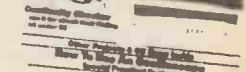
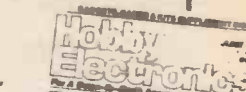
Power Amplifier Part 1, Continuity Checker, Envelope Generator, Early Radio, Gadgets, Games and Kits Supplement.

July 1981

Burglar Alarm, Doorbuzzer, Treble Booster, Electronic Aids for the Disabled, Power Amplifier Part 2.

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Electronic Ignition, Thermometer, Electronic Organ (final part), RPM Meter, Bench Power Supply, Radio Control Survey, Into Electronic Components Part 1.

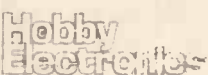


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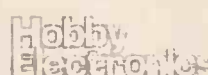
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CAREERS IN ELECTRONICS

'83

This month we look at the multi-layered career opportunities in British Telecom.



Graham McMorrin
British Telecom Features Bureau

THERE IS a great deal more to the telephone business than installing 'phones and chasing up faulty lines. British Telecom is an extremely large and diverse organisation at the forefront of world telecommunications. It offers a vast range of technical, engineering and electronics opportunities, as well as the scope to develop these skills further, both on the management side, and the purely technical. The convergence of telephony, computing and television technologies made possible by silicon chips microelectronics and advanced "macroelectronic" systems promises to make the next decade one of the most exciting in the history of tele-

communications. British Telecom reckons itself to be well-equipped to meet the challenges that lie ahead: operating the world's fourth largest telecommunications system, Telecom is responsible for the planning, provision and maintenance of the country's local, trunk and international networks. It employs 246,000 people and invests £1,500 million a year. Technological developments have moved so fast over the past decade that today's telecommunications industry embraces a great variety of products, services and facilities — everything from satellite transmission to aids for the disabled; from radiopaging to installing domestic telephones — as well as executive technical management and high technology research programmes.

Telephone Numbers

There are already 28.5 million telephones throughout the country, as well as 6,600 telephone exchanges, 93,000 telex and 95,000 data connections, 77,000 public kiosks, and 300,000 rented payphones. A further 2,200 new telephones are installed every hour of the working day. About 57 million inland telephone calls are made every day.

Many skills and disciplines are needed to operate a business on such a scale, especially since British Telecom's current exchange modernisation programme means that four new electronic exchanges are being brought into service each week. As Britain's telecommunications system becomes fully digital, with the introduction of computerised System X switching systems, a faster and more flexible network will evolve, able to carry speech, text, data and television pictures. The importance of the electronics technician and research engineer will accordingly increase in proportion. In order to compete in a tough, rapidly evolving market, British Telecom has structured its business into four main divisions: Inland, Major Systems, British Telecom International (BTI) and British Telecom Enterprises, with further specialised sections in each. These are self-contained units, each demanding different combinations of technical and electronics expertise; together they represent a comprehensive approach to electronic telecommunications.

Planning Ahead

The Inland Division is the largest element, working on Telecom's existing electro-mechanical exchange systems, which will have to cope with the new microprocessor-controlled applications, making the best use of the massive financial investments which the organisation represents. Specialised technical and electronic engineering skills are also needed for the specification and definition of the planned Integrated Services Digital Network (ISDN), evaluating its possibilities and launching new services.

Another main technical role is preparing for a totally digital network by maintaining the performance of the existing transmission networks. Inland's engineering and scientific staff also provide sophisticated power supplies capable of the higher performance and efficiency required by modern digital switching systems. Generally, this division has the responsibility for developing policies to ensure that British Telecom's network makes a smooth transition towards its own microelectronics revolution.

The Major Systems Division covers the broad disciplines needed for Research and Development, Procurement, Overseas Liaison and Consultancy. Its aim is to research, identify and exploit major new openings in communications technology, and its



BT runs a motor fleet of over 75,000 vehicles, from heavy duty maintenance trucks to delivery vans. Their 650 motor transport workshops are run by over 6,500 staff, most of whom are trained in their own Motor Transport Training School.



An engineer feeds a new page showing the now well-known British Telecom logo into the update computer centre for Prestel, the world's first public viewdata service, developed at BT's Research Laboratories at Martlesham.

work is centred at British Telecom's Research Laboratories at Martlesham Heath, near Ipswich.

Over 2,000 staff at the laboratories are involved in research; this includes the Advanced Switching Unit or Systems Evolution and Standards Department, and small formations of staff on other projects. The range of skills involved is vast, from objective and applied research, through advanced development, up to field trials, and the testing of new techniques, services and systems.

A Choice Of Fields

Current work includes: advanced semiconductor devices, materials, submarine cable systems, digital radio and line systems, telephone design, electronic office automation, video services, optical fibre systems, Prestel viewdata development, voice synthesis for computer-controlled exchanges, advanced Private Automatic Branch

Exchanges (PABXs), packet switching, and general reliability studies.

Other centres for British Telecom's development handle such major projects as the entire System X development programme, signalling system development, local, junction and trunk transmission studies, and external plant and general customer apparatus. The development and co-ordination of Systems Evolution and Standards includes skilled staff necessary to establish the architecture and topology of future signal switching and related systems, with responsibility for engineering such services and Radiopaging and small digital exchanges and sub systems that are part of the System X family of exchanges.

Technicians representing the broad spectrum of computing and electronics are engaged in determining the best standards for components' manufacturers and suppliers, establishing servicing practices for daily use by Telecom's 126,000 general engineers, systems software engineering and

designing data processing equipment. British Telecom designs are internationally competitive, so that as well as serving UK customers, a foundation is also laid for British exports. Teams of technical specialists are maintained to advise overseas administrations on British Telecom's technology, and to seek, develop and enhance UK export opportunities.

Across The Waves

The planning, provision and effective running of Britain's international and maritime telecommunications is the responsibility of British Telecom International (BTI). BTI's services range from international telephony, telex, telegram and Telemessage services, direct, privately-leased circuits from Britain to most parts of the world, data transmission via IPSS (the International Packet Switching Service), to Europe and North America, to the provision of specialist business communications with Western Europe, using satellites and small dish aerials located close to customers' premises.

In the field of maritime communications, BTI provides main telecommunications to and from ships at sea using conventional radio, and by satellite to suitably equipped vessels. Oil and gas in the North Sea are linked to the shore by trans-horizon microwave radio. To carry out its job efficiently BTI has developed a growing range of facilities, including operator exchanges and automatic switching centres for telephone and telex services, a variety of specialist coastal radio stations, satellite earth stations and a fleet of cable ships.

Covering such a range of activities, BTI needs a complete collection of engineering disciplines. Much of the engineering work is similar to that done by the Inland Division, including day to day running of the communication network, re-configuration and planning its growth and technical advancement. But there are also several specialist areas such as satellite communications.

Other jobs include the maintenance of submarine cables, servicing the dish aerials at Goonhilly Downs and Madley, and general administration. Each international service has its own management team and technical support staff.

Business Services

British Telecom Enterprises covers a variety of specialised national business services, including Radiopaging, Radiophone, Prestel, Yellow Pages, new range and extension telephones and the installation of PABXs and office automation. BTE itself consists of four major, separate businesses.

Firstly, British Telecom Information Services runs Yellow Pages and Prestel viewdata, and uses these as a core for a growing business in publishing, information and advertising (both on paper and in electronic form). The latter

is rapidly expanding as publishing costs increase, and the technology is developing to meet the change in advertising markets away from general to highly specialised campaigns, using different media for differing target audiences.

Secondly, Business Products and Systems provides all the telecommunications equipment business customers need on their own sites. Engineering staff install fully electronic PABXs, telex terminals, modems for data transfer between computers, and a complete range of new microprocessor controlled integrated office communications terminals and systems. These office systems are designed to meet the rapid growth in the data handling needs of businesses.

The third section BT Spectrum, provides value added services such as Telecom Gold's electronic mail and Telecom Tan's computerised business answering service. Other Spectrum services include Telecom Silver's Cardcheck service, for the verification of credit card transactions, and Telecom Red's security alarm services, where a central station receives alarm calls automatically and forwards them to the appropriate emergency service. Telecom Violet provides teleconferencing and high-quality multi-audio-conferencing over normal telephone lines. All of these new facilities use microelectronic circuitry to provide a series of services more sophisticated and elaborate than the main telephone network.

Lastly, Customer Services deals with what can be bought from any British Telecom Phoneshop — new telephones and small attachments (answering machines and call makers) meeting a growing demand for more complex telephones with intelligence, memory and display facilities. In all these areas British Telecom engineers are actively involved in product development, from initial specification through to finished product. To do the job effectively, engineers have to be able to co-ordinate electronic design, mechanical layout, selection of materials and software design — quite a challenge.

Just The Job

Telecom's technicians are also called upon to evaluate existing products and, if necessary, make modifications to meet the required standards. Electronic engineering plays a leading role in today's microchip telecommunications, and engineers are needed to design new integrated circuits for a vast array of functions. Such design work involves studying the latest research literature, writing programs for, and then using, both computer simulation and computer design aids, as well as building and testing prototype hardware models.

Qualifications needed differ according to the technical discipline involved and the age and experience of the applicant. Almost all A-level subjects are welcome as entrance qualifications for people who show some potential for management. In the



Going up in the world: many different kinds of long-distance communications receivers fall within British Telecom's territory. Testing and maintaining them calls for skills which can be put to use in the open air, as well as in a workshop!

An organisation like British Telecom is continually updating its equipment to compete on the world communications market, and digital electronics skills are increasingly important as more systems become computer-controlled.



areas of planning and customer service the minimum requirement is four GCE passes, at least two being at A-level, but at one level or other these must include English, Maths and a science subject — Physics or Chemistry or a combination of both. A-level passes in Maths and Physics are preferred.

For those interested in engineering, as highly-skilled technical officers. Apprentices are usually aged between 16 and 18, and British Telecom prefers them to have O-level or CSE grade 1 in Maths, and a technical or scientific subject. In engineering, in particular, there are courses leading to various formal qualifications. For graduates there are three main technical streams. Each of these streams also covers a number of work areas, and these may call for people with specialist training.

The first stream involves management, customer services, marketing, planning and forecasting, under the general title of Telecom Staff. Any degree is acceptable, so long as it is accompanied by GCE passes in Maths and English, and preferably Physics and Chemistry.

The second stream has the general title of Data Processing Staff, covering systems analysis and programming, and the preferred degree is Computer Science.

Finally, the Engineering stream covers all technical and research staff. The main work areas are research, development and the planning of switching and transmission systems. Degree qualifications should preferably

be Electrical, Electronic or Communications Engineering.

Getting In Touch

The era of the "information society" is upon us, and it is timely that British Telecom has been created as a corporation to meet the country's growing demand for telecommunications services. The information "explosion" means a growing and exciting list of products and services, and the promise of new concepts in communications such as home banking, electronic mail and the fully automated office.

The Government now allows private firms to compete with British Telecom in many of its activities, but Telecom can face the future with confidence, knowing that its knowledge and experience of telecommunications is unrivalled and its staff highly skilled to meet the challenges of the future.

If you are interested in joining Telecom, your first move is to contact your local Telecom Recruitment Manager's office at the Regional Headquarters. You will find the phone number in the introductory pages to your telephone directory, or dialling code book. Tell them what you are looking for and what qualifications or training you already have, or hope to gain. They will tell you where to proceed. It all starts with a phone call.

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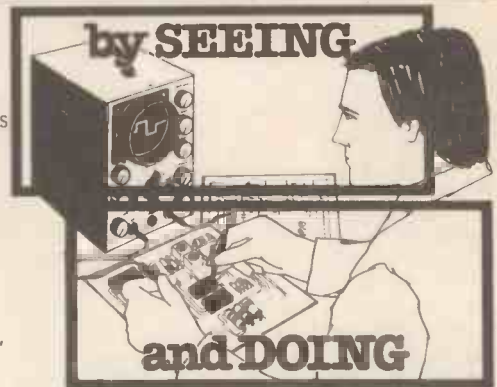
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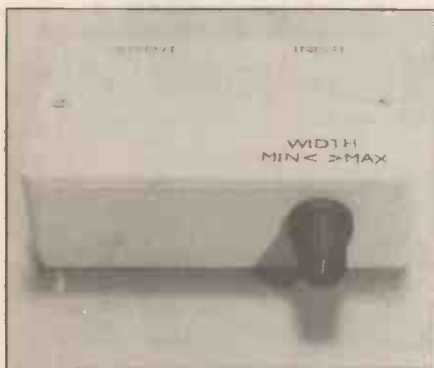
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STEREO SPREADER

Geoff Maçaulay



A little more treble on the West Wing, please!

IN the early days of stereo, the channel separation used to be enormous. Stereo effect records can still be found in second hand shops that demonstrate this; a table-tennis match recorded so that the sound ping-pongs from side to side, or trains that pass through the middle of the house and so on. And anyone who has an early Beatles album in their collection will know that the vocals sound out from one side and the instruments from the other!

In those days, however, separate speakers were a novelty and the maximum separation of the speakers in a 'hifi' radiogram was of the order of a few feet; then, they needed all the electronic spacing they could cram onto a record. Since then the physical separation of the speakers has increased, while the electronic separation has decreased. So much so that many modern recordings sound like they were made by dedicated member of the "Back-to-Mono" club.

Since one cannot easily pull the walls apart to get increased separation, speaker placement is generally a matter of compromise between acceptable channel separation and the size and shape of the listening room. There is an alternative, however. It is possible to

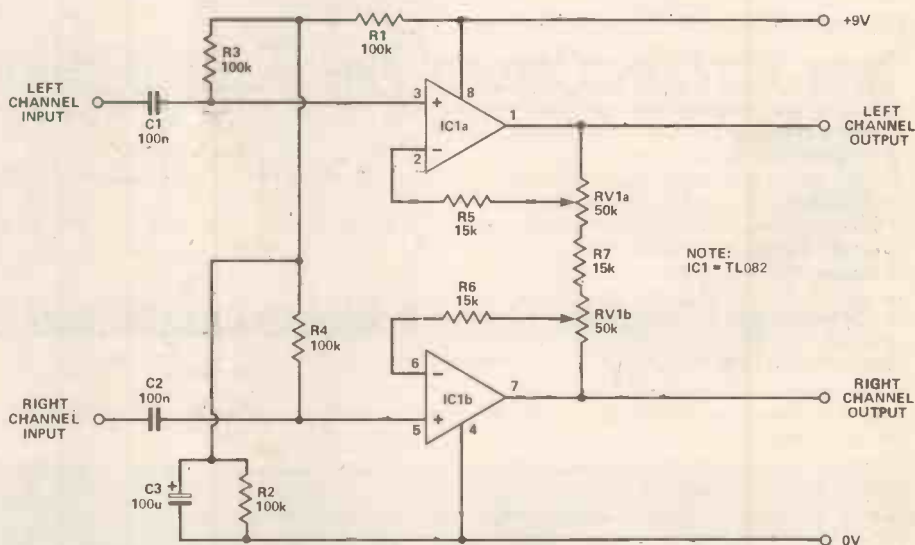


Figure 1. The circuit.

electronically separate the channels during playback, and this has the same effect as physically spacing out the speakers.

Sound In Space

A simple but effective circuit for achieving this is the subject of this article. But first to understand how it works it is necessary to understand the difference between stereo and mono sound recordings.

A mono recording is quite simple; all the information — vocals, instruments etc — are all recorded as one signal. A stereo recording on the other hand consists of two signals or channels, which between them contain all the information. When the recording is made a single instrument can be placed on either the left channel or the right channel by means of a 'Pan' control, (actually a simple potentiometer); rotating the Pan pot to the left puts all that signal onto the left channel, while rotating it hard to the right puts the sound on the right. Leaving the control set to the middle position effectively places the sound in the centre of the stereo image because the sound levels recorded on the left and right channels are equal.

However the perception of stereophony also depends on the

phase difference between the signals on each channel and it is this phase difference, which is imparted when the instrument is recorded in stereo, that enables us to further separate the sound *after* it has been recorded; if these phase differences are emphasised we can effectively increase the stereo separation.

Spaced Out Circuit

The diagram of Figure 1 shows the complete circuit of the Stereo Spreader. The Left and Right channel inputs are directly coupled by C1 and C2 to the non-inverting inputs of op-amps IC1a and IC1b. To avoid the use of two batteries the op-amps are biased to half-supply by the resistive divider network R1, 2 and 3; capacitor C3 by-passes to ground any AC signal at the junction.

The op-amp outputs are connected together via the two halves of RV1 and R7. Now both are connected as non-inverting amplifiers, with feedback from each output to the respective inverting input via RV1a or b. Like all op-amps, they will attempt to keep their inputs balanced by adjusting the output until the voltage fed back to the inverting input equals that present at the non-inverting input.

If the input to both op-amps is the same — ie, in phase — then the

outputs will be the same and normal op-amp action will apply. However if the inputs are out of phase then the outputs will no longer be identical, so that part of the output of one op-amp will be coupled via RV1a, b and R7 to the inverting input of the other amplifier. This will then compensate for the extra voltage and, in doing so, will produce a larger out-of-phase 'difference' signal.

The amount by which the difference signal is amplified is determined by RV1, which sets the amount of difference signal coupled from one op-amp to the other and therefore functions as a width control. A dual potentiometer is used here for convenience, so that it is not necessary to have to adjust two controls.

Construction

The Veroboard layout is shown in Figure 2 and, as long as the cuts are made in the right places and the board checked after assembly for unwanted solder bridges across tracks, there should be no difficulty in completing this part of the project.

For maximum flexibility the unit has been designed to be connected between the audio system's pre-amplifier output and the power amp input. If these are not separate components in your set, check the back of the amplifier; most modern amps bring out the preamp outputs and the main amp inputs on pairs of phono sockets on the rear panel. If there is no way you can connect the Stereo Spreader between preamp and power amp, you will have to consider some other method of increasing your stereo separation, such as moving house or demolishing some walls! The only other alternative is to use the spreader with taped music only, in which case it can be connected between the recorder output and the amplifier inputs.

Parts List

RESISTORS

(All 1/4 watt 5% carbon)

R1, 2, 3, 4 100k
R5, 6, 7 15k

POTENTIOMETERS

RV1 50k

CAPACITORS

C1, 2 100n polyester
C3 100u 10V radial electro

SEMICONDUCTORS

IC1 TL082 dual BIFET op-amp

MISCELLANEOUS

Veroboard, 17 strips x 20 holes; 4 x phono (RCA) sockets; case, 115 x 80 x 35mm; wire, solder, nuts and bolts etc.

BUYLINES page 34

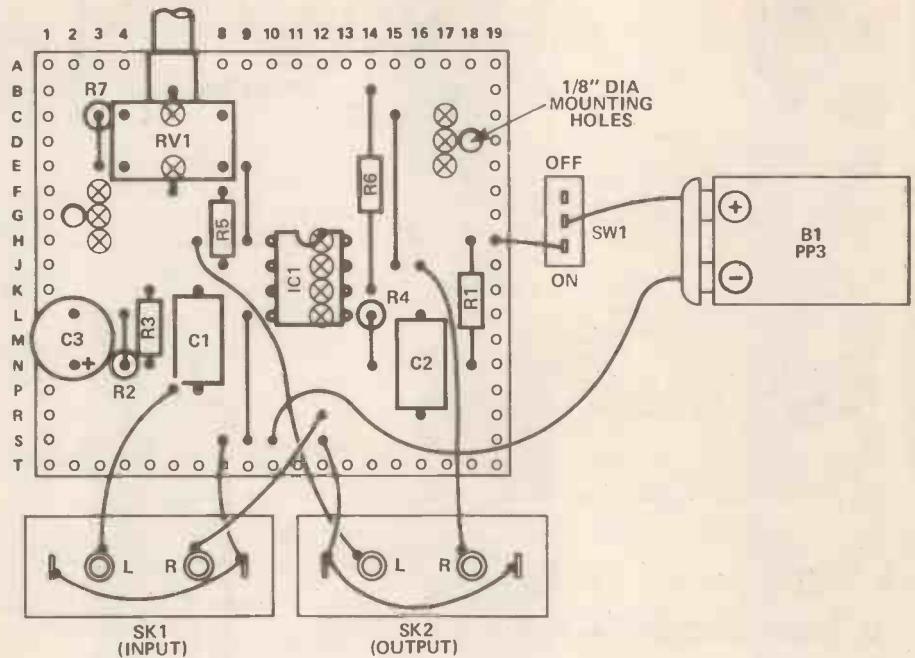
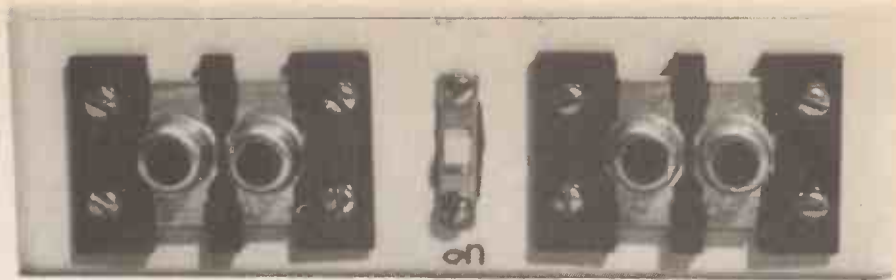
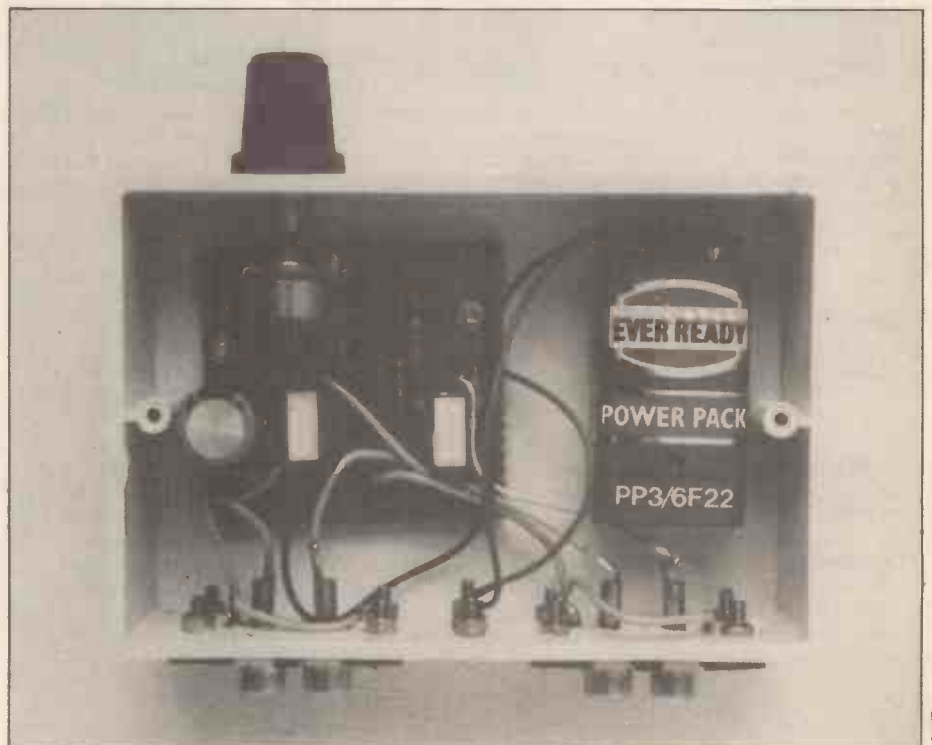


Figure 2. The Veroboard layout. The Stereo Spreader must be connected between the preamp and the power amp.



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David Sarnoff

Ian Sinclair

Very much a name belonging to twentieth century electronics.

WHO WAS DAVID SARNOFF? His name isn't familiar to British ears, yet this was a man who was in contact with every important electronics development of our time. In addition, his life story is almost the classic rags-to-riches American dream, the story of the poor immigrant who by hard work and the ability to recognise a unique opportunity, made a million dollars — but Sarnoff made nearer a billion!

He was born in Minsk in Russia, to an orthodox Jewish family, and was educated as a religious scholar. Russia at the turn of the century, as now, was no place for a Jewish family, and the Sarnoffs emigrated to Albany, New York, in 1900. David, sent to a school in which the language was unfamiliar, worked hard, and earned extra money by selling papers, running errands, and by singing in the synagogue.

By 1906 his school days were over, and he became a messenger boy for a telegraph company. Sensing that skill was the key to success, he used his first wages to buy a telegraph key so that he could teach himself Morse Code, the essential skill of the telegraph operator.

A Self-Made Man

Through constant practice, he became thoroughly proficient at Morse Code, and jumped at the opportunity to join the New York branch of the Marconi Wireless Telegraph Company. Wireless Telegraphy was by then considered to be a glamorous career, and a Marconi operator in those days had the sort of standing that a Concorde pilot might enjoy now. The Marconi Company took his training seriously (a tradition that is still maintained), with several spells at sea and on various shore stations.

His proficiency was such that he landed the plum job, the aim of every Marconi operator in the USA. The site was the world's most powerful radio station, on top of the Wanamaker store in Manhattan, and it was there that David Sarnoff became overnight the world's most famous radio operator.

On the night of April 14th, 1912, the "unsinkable" Titanic, on its first voyage, hit an iceberg and sank. The Titanic was a vast ship, built with a large number of watertight compartments, and fitted out in the most lavish way — a style we now find almost unimaginable. You can get a whiff of it from Walter Lord's famous book "A Night To Remember". Among its luxurious fittings was the latest device — a Marconi transmitter and receiver. At the first sign that the



A far, far cry from Wireless Telegraphy: David Sarnoff's company, American consumer electronics giant RCA, laboured to put domestic radio and TV on the road, laying the path for the 80s video boom.

'unsinkable' ship was in distress the radio operator started to send out calls, hoping that one of the number of ships in the neighbourhood would respond.

They didn't, because they were busy sending and receiving congratulations telegrams. David Sarnoff, in his cabin at the top of the Wanamaker Store, did. He remained on duty for 72 hours, receiving and passing on messages which were eventually to lead to survivors being picked up.

Up And Away

He was rewarded by the Marconi Company with rapid promotion — there's a joke among present day Marconi men that they're all waiting for the next Titanic. Curiously enough, this was to lead to a disagreement which would lead Sarnoff to immense wealth and opportunity. In 1915, Sarnoff, now managing the Marconi business in the U.S.A., and also acting for the Army Signals Corps proposed what he called a 'music box'. This was to be a domestic radio.

Marconi himself, who saw radio as a method of saving lives and maintaining essential communications, thought that this suggestion was trivial, and an unworthy use of radio. The two argued fiercely, neither giving ground. Sarnoff resigned to form his own Company, the Radio Corporation of America (RCA). Marconi would never agree to any proposal to manufacture domestic radio, and the company even sold its rights in the name of Marconi as far as receivers were concerned — which is why Marconi transmitters are made by

Marconi, and Marconi receivers by Thorn-EMI!

As general manager of RCA, Sarnoff immediately started constructing radio transmitters and receivers. In 1921, he created a sensation by broadcasting the big fight, Dempsey versus Carpentier, so that radio owners knew the result many hours before the papers hit the streets. America went radio mad. By 1924 RCA had sold receivers to a value of \$80,000,000. The radio boom had started.

In 1926, Sarnoff formed the National Broadcasting Company (NBC), with the aim of covering the whole of the USA by a chain of radio stations. The first portable radios and car radios appeared, and the boom continued. Sarnoff saw that the new technology would never stay still, and in 1928 built the first experimental NBC TV station.

Towards TV

The development of television was to be slower than he anticipated, to some extent because of the false tracks laid by Baird, who by reproducing a picture of sorts with mechanical equipment diverted attention from the real research which was needed. In 1939, however, at the New York World's Fair, RCA were able to demonstrate live television, using the all-electronic system which was already in use in London, and which was continued after the War.

In the 1940-46 period, Sarnoff, with the rank of Brigadier-General, served on General Eisenhower's staff. His work at RCA had not ceased, however, because the team which developed colour TV was already being assembled in the RCA research laboratories. The painstaking efforts of these researchers developed the shadowmask tube and the NTSC colour system, which laid the foundations for all the colour TV systems used all over the world. None of this could have happened had Sarnoff not supported the research effort wholeheartedly.

No-one knows how much it cost RCA to put colour TV on the road. One guess is that over \$80,000,000 was sunk into research and production before a cent was recouped in sales — and it was a long uphill struggle before the immense investment paid off. Once again, however, Sarnoff's foresight had resulted in an immense success.

He retired in 1970, and like so many men whose tireless drive has sustained them, died in the next year. His monuments, RCA and NBC, live on.

CLEVER DICK

The publishers of Hobby Electronics wish to offer their sincere apologies to the reader who missed Clever Dick's column in the last issue. He missed it too.

Alright, I'm back.

But did anyone notice that I went away? Do I hear screams in the night, the lamenting of women and the pitiful wailing of strong men crying in their beer because Clever Dick did not appear in last month's Hobby Electronics? No, I must be imagining it.

Our first correspondent this month would like to fly the flag . . .

Dear Clever Dick,
Recently the public have been asked to Buy British, where this is possible. Now, can you tell me if there is any British built hand-held multimeter on the market?

By British I mean built in Britain, using British components, by a British company which is not a subsidiary of a foreign company. The kind of accuracy I am looking for is about 0.5%, or less on a digital meter.

I hope such an instrument can be found. Thank you for your help.
W. Jackson,
Cirencester,
Glos.

Unfortunately I can't help you directly, but perhaps some patriotic-minded reader out there will be able to tell us where such a paragon of British craftsmanship may be purchased. Any takers?

And since we're into the matter of assistance from readers, here's another.

Dear Sir Dick,
There I was probing about inside my latest Hobby project with the probe of my oscilloscope when the trace faded from the screen and a puff of blue smoke rose from the back of the 'scope. A short time later the back was off and my AVO was put into service. The problem - a burnt out transformer.

As you will appreciate this is the worst thing that could have gone wrong, as no-one sells them off the shelf. Now here comes the plea: does anyone know where I can get a transformer for an ELMAC 4810 Oscilloscope, distributed by Elex Control Systems and made by Yizreel (sic) Electronics?
Unfortunately the manufacturer

has not seen fit to put his address anywhere on the thing.

Yours Hopefully,
S. Rainey,
Latham,
Lancs.

PS Keep up the good work.
PPS Notice, not a gravel in sight.
PPSP How about a binder, as I'll not be able to afford one after buying a new transformer.

Indeed, finding new transformers for old 'scopes is about as hopeless an enterprise as could be attempted. Nevertheless, we have had some success in such quests in the past, so how about it, readers? Someone must know Elex Control Systems, or possibly even Yizreel Electronics (that's how it was spelt, I swear).

I say, I say. What ho, pip pip and all that . . .

Dear Dickie old chap,
Could you possibly tell me where I can obtain a spiffing one volt FSD moving coil meter and how much the jolly thing would cost, as I can't seem to find any jolly mail order companies that do them.

Keep up the good work old bean.
Yours spiffingly,
P. Roberts,
Yeovil,
Somerset.

PS You're always complaining about people not using typewriters to type their letters, so I hope you are satisfied with me old chap.
PPS I wouldn't mind one of those spiffing binders.

Terribly sorry, old man, but a quick flip through our catalogue collection has completely failed to turn up the item you're looking for. No one lists a "spiffing 1V FAD meter". You could try your local electrical shop - I happened to notice the other day that the other one near me carries quite a range of meters. On the other hand you could convert an easily obtainable 1mA FSD meter to read 1V by adding sufficient resistance in series with the coil to raise the total to 1000R. Then, by Ohm's Law, one volt will produce a current of 1mA for a full scale

reading. Easy when you know how, isn't it old bean.

Dear C.D.,
I built the Switch Tuned Radio featured in the January issue of HE and when I switched it on, all I got was a very faint constant hiss, even after adjusting RV1.

When you touch the centre pin of the volume control you get a strong whirring noise. I used an oscilloscope to check the output of the IC1 and there was only a very small signal on the lowest possible range.

I am using two general purpose diodes instead of the 1N4148s and a ferrite aerial out of an old transistor radio. I wonder if you might help me - what is wrong with it?
P.R. Brown,
Bristol.

What a mess. Just imagine all the complaints I'd get if I decided to change the components . . . well, alright then.

First of all, check that the audio stage is working correctly by injecting a low-level audio signal (about 0.5 mV) into IC2. Next, check the DC voltage on pin 5 (the output) of IC1; it should be around 1V3. Now check that the voltage on the wipers of the preset potentiometers are all in the range OV65 to 7 V. Check that the voltage at the centre-pin of the Varicap diode (the junction of the cathodes, in the circuit) also tracks as the switch is rotated. Now if the radio still doesn't work, after checking all these points and adjusting as necessary, the fault probably lies with your substitute aerial coil; try different taps, if it has them, or different windings, perhaps. If all else fails - GET THE ONE WE RECOMMENDED!

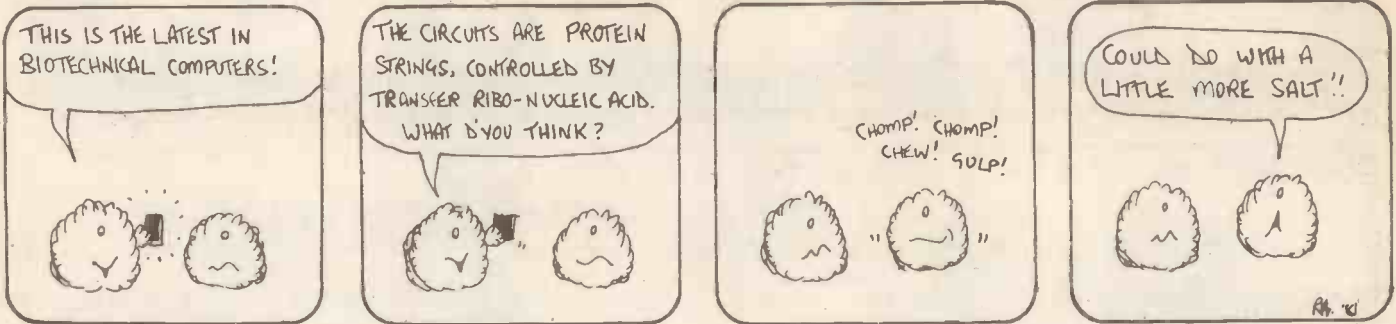
Components come and components go, but of some there is not a trace . . .

Dear Clever Dick,
In the August '82 issue of Hobby Electronics, there appeared in connection with the Digital Millivoltmeter project an IC type LH0070. This appeared in Figure 7 of the project.

I am writing to ask whether your back room boys could tell me where I could obtain this and another IC (Type LH0075) as soon as possible, and also would it be possible to include more technical information on the project?

BEASTIES

BY RH



I would like to say that *Hobby Electronics* is the best practical electronics magazine around. S. Cairns, Cleckheaton, West Yorkshire.

I'm sorry but we can't re-write the article for you! However if you have specific questions we'll try to answer them through the (much overloaded) technical enquiry service.

The LH0070 is a precision voltage reference IC; unfortunately it doesn't appear in any of our retail catalogues, but is available from RS Components and so can be ordered through your local dealer. You could also try MS Components Ltd., Zephyr House, Waring Street, West Norwood, London SE27 9LH.

On the other hand, we can find no reference at all to an LH0075. Are you sure that's the number?

And now it's correction time (again). I can't help it if I'm old fashioned . . .

Dear Clever Dick,
Your answer to a reader's question in the March issue sent me into a state of shock from which I have only just recovered. Back to school, friend, to learn the unit of conductance. Please consult (or insult as the mood takes you) B.S.I. 1991 and IEC Symbols for Electrotechnics, where the conductance unit is SIEMENS, symbol G, unit-symbol S. Of course unit-symbol S clashes with the symbol for magnetic reluctance, also S. Are you confused enough to send me a binder? If not, it's a great magazine and please, no more out of character answers. It's not like you.
Yours faithfully,
G. Cox,
Southampton,
Hants.

PS Just seen your April issue: ref. cryptic comment, Paul Jenkin and six-pin DIL MOC 3020 8017. This is a triac opto-isolator/switch type MOC 3020. The number 8017 means it was manufactured in 1980, week 17. Consult R.S. Catalogue page 175 or Maplin's catalogue page 186, triac opto-isolator.

Who's confused? Not me, I can tell you. I know who I am . . . I think. However, it has to be admitted: the IEC term for conductance is truly Siemens, symbol G and unit-symbol S. It is not to be confused with reluctance, (symbol S), admittance (unit-symbol S); apparent power (symbol S); gain (symbol G); rating (symbol S, unit-symbol VA or W); or either the Poynting Vector symbol (S) or the symbol for Signal (S). Who's confused? Not me chief.

I have no idea why or how the gentlemen of the IEC chose this particular set of symbols, just that they seem to have been selected according to some obscure standard that has little to do with the day-to-day practice of electronics. It may be old fashioned but the term 'mho' is both logical and mnemonic, and I'll stick to it.

And since we're on the subject, let's go for one mho time . . .

Dear Mr Clever Dick,
I was disgusted to see in the March issue of HE that you thought the unit of conductance is the 'mho' when, as you should know, it is measured in Siemens (symbol S). This is a disgusting error on your part and I feel that I should receive a Binder for pointing out your unforgivable mistake.
B. Voss,
Crewkerne,
Somerset.

PS Where can you find 240V/20W fluorescent tubes as used in your 12/240V inverter feature?

The most disgusting thing is the way some people try to scrounge a Binder. Where would you usually go for fluorescent tubes? Your local sparks, naturally. Disgusting.

What's this . . . ANOTHER jokester?

Dear Smarty Pants (or whatever),
Just a short note (♪) to correct a statement you made in the March issue of HE.

In answer to a query regarding the unit measurement of conductance,

you wrongly suggested that the inverse of OHM was MHO. MHO is, in fact, the reverse of OHM. The inverse of OHM is OHW.

A little quiz:
If $R = \text{OHM}$, $\text{M} = \text{MHO}$ and $1/R + \text{OHW}$, then;
what does $1/\text{M}$ equal?

(Clue: What the editor said when first having the name Clever Dick mentioned to him.)

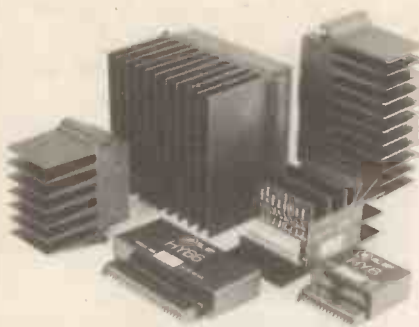
Also, I think your answer may have confused those who do not know the real unit measurement of conductance. The term slips my mind at the moment but, I recall, it has something to do with matelots, or something.

Having never purchased, borrowed, read, or been within a transistorised barge pole's distance of a copy of *Hobby Electronics* (a silly name anyway) I am not going to get down on one knee like the rest of your Plebeian, sycophantic writers and plead for a Binder. I simply cannot think of a use for . . . although, hang on. My favourite girlie magazine is roughly the same size as your *Hobby Electronics* (though much more interesting). Therefore, I suppose, if pushed, I could take one of the wretched things off your hands; but only one! I will do anyone a favour, but there are limits.

May the source (gate, drain) be with you.
Paul Ure,
New Brighton,
Merseyside.

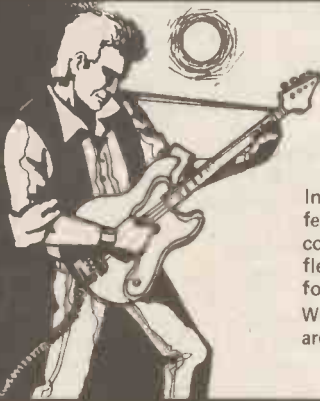
Give it a rest (♫). The reverse of OHM is obviously OHW, not MHO, and the symbol, it must be plain, is B. Your clue is therefore not only misleading but misplaced. And with all those references to silly sailors, barge poles and girlie magazines, I'm not sure if you're the kind of person I want reading my column, anyway. However, I'll make an exception just this once, on the condition that you immediately dispose of all those terrible magazines. Send them to me at once and I will see that they're destroyed. Then you can start collecting a morally pure, up-lifting and educational magazine: Video Today. HE

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			T.H.D. Typ at 1KHz	I.M.D. 60Hz/7KHz 4:1				
HY30	15	4-8	0.015%	<0.006%	± 18	76 x 68 x 40	240	£8.40
HY60	30	4-8	0.015%	<0.006%	± 25	76 x 68 x 40	240	£9.55
HY6060	30 + 30	4-8	0.015%	<0.006%	± 25	120 x 78 x 40	420	£18.69
HY124	60	4	0.01%	<0.006%	± 26	120 x 78 x 40	410	£20.75
HY128	60	8	0.01%	<0.006%	± 35	120 x 78 x 40	410	£20.75
HY244	120	4	0.01%	<0.006%	± 35	120 x 78 x 50	520	£25.47
HY248	120	8	0.01%	<0.006%	± 50	120 x 78 x 50	520	£25.47
HY364	180	4	0.01%	<0.006%	± 45	120 x 78 x 100	1030	£38.41
HY368	180	8	0.01%	<0.006%	± 60	120 x 78 x 100	1030	£38.41

Protection: Full load line. Slew Rate: 15v/ μ s. Rise time: 5 μ s. S/N ratio: 100db. Frequency response (-3dB) 15Hz - 50KHz, Input sensitivity: 500mV rms. Input Impedance: 100K Ω . Damping factor: 100Hz >400.

PRE-AMP SYSTEMS

Module Number	Module	Functions	Current Required	Price inc. VAT
HY6	Mono pre amp	Mic/Mag. Cartridge/Tuner/Tape/Aux + Vol/Bass/Treble	10mA	£7.60
HY66	Stereo pre amp	Mic/Mag. Cartridge/Tuner/Tape/Aux + Vol/Bass/Treble/Balance	20mA	£14.32
HY73	Guitar pre amp	Two Guitar (Bass Lead) and Mic + separate Volume Bass Treble + Mix	20mA	£15.36
HY78	Stereo pre amp	As HY66 less tone controls	20mA	£14.20

Most pre-amp modules can be driven by the PSU driving the main power amp. A separate PSU 30 is available purely for pre amp modules if required for £5.47 (inc. VAT). Pre-amp and mixing modules in 18 different variations. Please send for details.

Mounting Boards

For ease of construction we recommend the B6 for modules HY6-HY13 £1.05 (inc. VAT) and the B66 for modules HY66-HY78 £1.29 (inc. VAT).

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Model Number	For Use With	Price inc. VAT
PSU 21X	1 or 2 HY30	£11.93
PSU 41X	1 or 2 HY60, 1 x HY6060, 1 x HY124	£13.83
PSU 42X	1 x HY128	£15.90
PSU 43X	1 x MOS128	£16.70
PSU 51X	2 x HY128, 1 x HY244	£17.07

Model Number	For Use With	Price inc. VAT
PSU 52X	2 x HY124	£17.07
PSU 53X	2 x MOS128	£17.86
PSU 54X	1 x HY248	£17.86
PSU 55X	1 x MOS248	£19.52
PSU 71X	2 x HY244	£21.75

Model Number	For Use With	Price inc. VAT
PSU 72X	2 x HY248	£22.54
PSU 73X	1 x HY364	£22.54
PSU 74X	1 x HY368	£24.20
PSU 75X	2 x MOS248, 1 x MOS368	£24.20

Please note: X In part no., indicates primary voltage. Please insert "0" in place of X for 110V, "1" in place of X for 220V, and "2" in place of X for 240V.

MOSFET MODULES

Module Number	Output Power Watts rms	Load Impedance Ω	DISTORTION		Supply Voltage Typ	Size mm	WT gms	Price inc. VAT
			T.H.D. Typ at 1KHz	I.M.D. 60Hz/7KHz 4:1				
MOS 128	60	4-8	<0.005%	<0.006%	± 45	120 x 78 x 40	420	£30.41
MOS 248	120	4-8	<0.005%	<0.006%	± 55	120 x 78 x 80	850	£39.86
MOS 364	180	4	<0.005%	<0.006%	± 55	120 x 78 x 100	1025	£45.54

Protection: Able to cope with complex loads without the need for very special protection circuitry (fuses will suffice).

Slew rate: 20v/ μ s. Rise time: 3 μ s. S/N ratio: 100db. Frequency response (-3dB): 15Hz - 100KHz. Input sensitivity: 500mV rms. Input impedance: 100K Ω . Damping factor: 100Hz >400.

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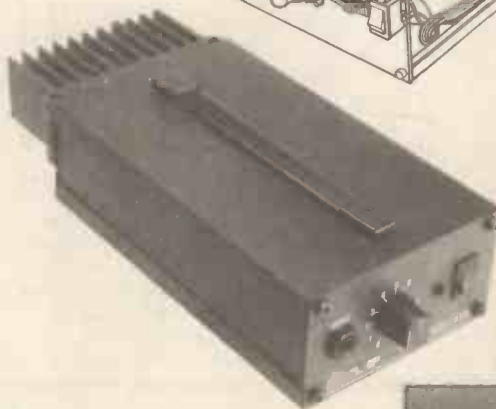
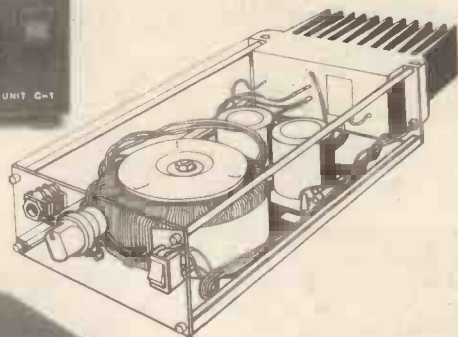
Hi Fi Separates

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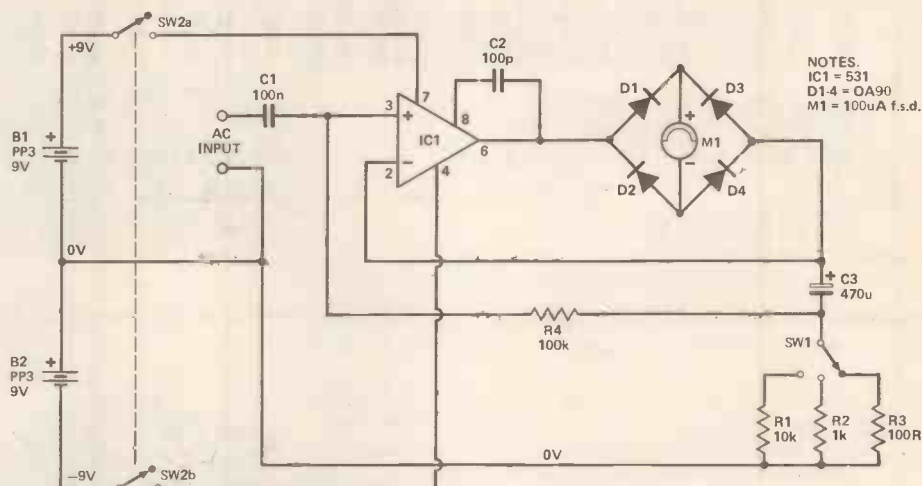
Simple circuits based on operational amplifiers.

No. 9: High-Impedance AC Millivoltmeter

ONE of the troubles with AC is that it alternates! No sooner has the current rushed around the circuit in one direction than it changes its mind and starts surging around in the opposite direction. Thus if you have an ammeter connected in the circuit to measure the currents, or the voltages they generate, the needle of the meter has had no time to swing in one direction before it is being forced to swing in the opposite direction. Even the lightest of meter movements has a certain amount of inertia, so it can not respond to alternating current — unless the frequency happens to be about 1Hz or less. Consequently with most alternating currents, which have frequencies in the audio or radio ranges, the needle hovers more or less motionless at the zero point of the scale. There may be several amperes of current and several hundreds of volts in the circuit, yet the meter shows nothing of all this activity.

You *can* use a hot-wire ammeter or a moving-iron ammeter, but these have extremely non-linear scales and in any event cannot measure small currents. Most people prefer to use a multimeter, switched to an AC range!

When you switch to the AC range of a multimeter, this generally brings a rectifying bridge of diodes into the circuit so that the current always passes through the meter in a constant direction. Currents or voltages then can be measured fairly easily but even so, there are errors introduced, due to the forward voltage drop across two diodes. With germanium diodes this amounts to an error of about 0V2 per diode. Now this does not matter if the voltages to be measured are in tens or hundreds, but makes it impossible to work in the millivolt range. Worse than that, the diodes refuse to conduct at all if the voltage across them is less than 200mV for germanium diodes or 700mV for silicon diodes. Then, when the voltage across the diode is enough to make them conduct but is still only a volt or so above the minimum, the ratio of current to voltage is non-linear. Such a meter will not measure voltages below about 200mV, and has a non-linear scale at its lower end.



NOTES:
IC1 = 531
D1-4 = OA90
M1 = 100uA f.s.d.

This Pop-Amp presents a simple circuit which has none of these disadvantages. It gives a linear reading of AC voltages in three ranges, 0-1V, 0-100mV and 0-10mV. As a bonus, it has very high input impedance of the order of several tens of megohms. It is based on the 531 op-amp which has a slew rate (35v/μs) considerably higher than most others. A typical op-amp, such as the popular 741, has a slew rate of only 0V5/μs. This ability to swing its output voltage at high speed means that it is able to respond better to high-frequency signals. As a result, the circuit does not show any fall-off due to frequency until about 500kHz — with a 741, the upper limit is about 10kHz!

How It Works

Ignoring the diodes for the moment, the output from the op-amp is fed directly back to the inverting input (Figure 1). In this connection, the op-amp is being used as a unity gain voltage follower, and it acts to maintain zero voltage difference between its input terminals. Thus, as the input voltage varies, its output voltage varies by exactly the same amount. This maintains the required zero difference between the two input terminals and the result is a gain of one. This may seem pointless, but we are not actually worried about gain here. The point is that the input of the op-amp has very high impedance, and so draws very little current from the signal source (eg, a crystal microphone). Yet the output of the op-amp has low impedance and can

Figure 2. The circuit.

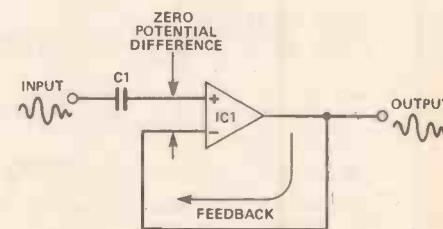


Figure 1. Block diagram of the op-amp unit.

provide more than enough current to drive the movement of a meter.

The input line has a capacitor (C1) which is there to prevent direct current voltages from reaching the amplifier; if the AC voltage we want to measure is a small signal superimposed on a steady DC level, the DC is blocked by the capacitor. Of course as far as the AC signal is concerned, the capacitor might just as well not be there.

This property of capacitors is also of use in another part of the circuit (Figure 2). As the output voltage varies (in sympathy with input voltage), the variations are passed across C3, causing a varying current to flow through one of the resistors R1-R3 to the 0V rail. However, the current flowing through the resistors gets there by way of the rectifying bridge and meter.

Now let us see what happens when R1 is switched into circuit. Suppose the input is 1V, then output is 1V, and a voltage of 1V appears across R1.

Parts List

RESISTORS

(All 1/4 watt 5% carbon)

R1	.....	10k
R2	.....	1k
R3	.....	100R
R4	.....	100k

CAPACITORS

C1	.....	100n	polyester
C2	.....	100p	ceramic
C3	.....	470u 10V	radial electro

SEMICONDUCTORS

IC1	.....	531	op-amp
D1,2,3,4	.....	0A90 or 0A91	germanium diodes

MISCELLANEOUS

SW1	.....	rotary switch	single pole, 3-way
SW2	.....	DPST switch	slide or toggle
M1	.....	microammeter	100uA FSD, panel mounting

Stripboard, 85 x 45mm (17 strips x 33 holes); 8-pin IC socket; 12 x 1mm terminal pins; 2 x PP3 battery connectors; nuts and bolts, wire, solder etc.

BUYLINES page 34

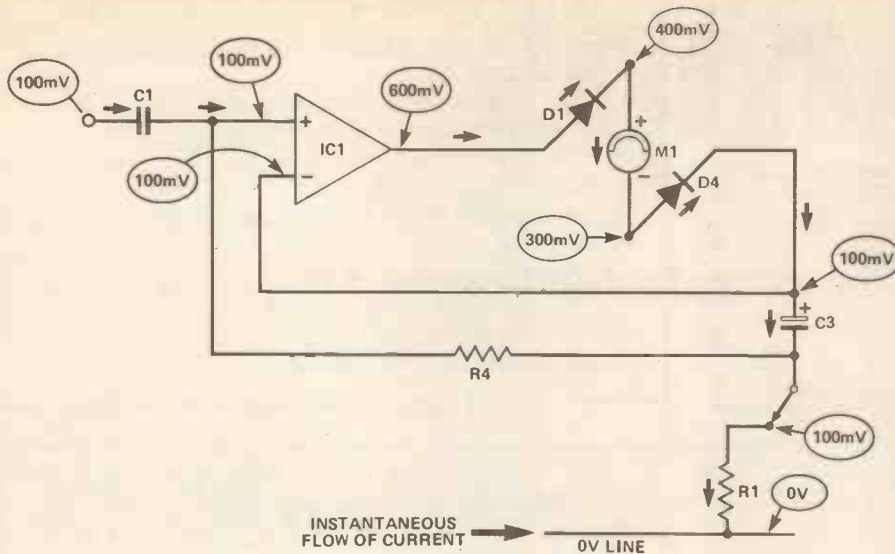
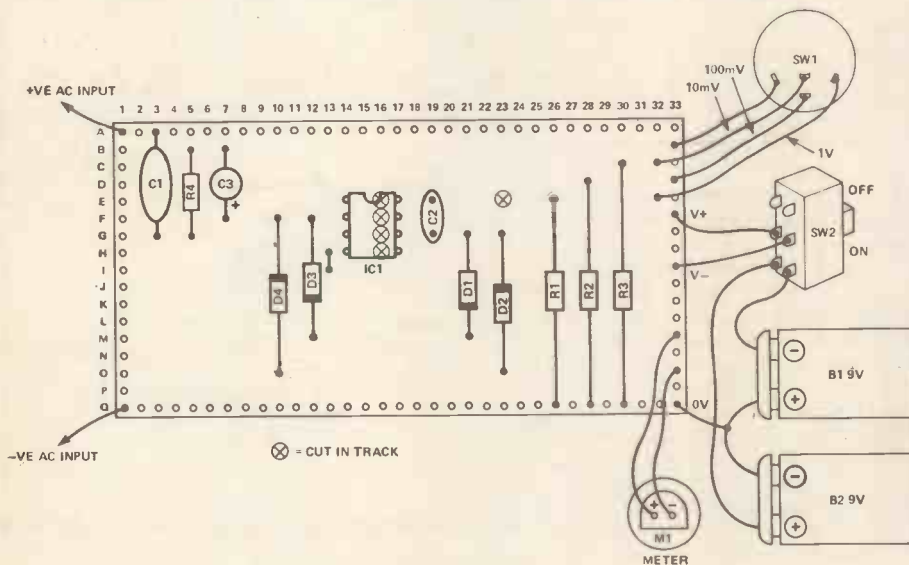


Figure 3. Voltages at various points in the millivoltmeter circuit.

Figure 4. The Veroboard layout. Take care that the diodes are correctly orientated.



The current through R1 is $I = V/R = 1/10000 = 0.0001A$, or 100A and this is just enough to give full scale deflection on the meter. Similar calculations show that with R2 or R3 switched into circuit, full-scale deflection is obtained with input voltages of 100mV and 10mV respectively. Thus, alternating input voltage causes an alternating current to flow from the op-amp (rectified while passing through the meter), in and out of the plates of the capacitor, and through one of the resistors. The reading shown on the meter is the root mean square (RMS) value of this current.

The input resistor R4 has an alternating voltage at one end of it (as the signal comes to it from C1) but since the amplifier has unity gain, an equal alternating voltage appears at its other end. Consequently, alternating signals cause no flow of current through R4 and as far as AC is concerned, R4 is an open circuit. Thus the circuit does not have the low

input impedance that R4 would otherwise produce.

Bridging the Gap

So far, we have ignored the effects of the diodes which were mentioned earlier — their non-linear conduction at low voltages and their failure to conduct at all for voltages below 200mV: this problem is overcome by the op-amp! Suppose the input voltage increases to a value (say 100mV) which is not enough to make the diodes begin to conduct. The op-amp now has its non-inverting input at 100mV, but because the diodes are not conducting this increase has not got back to the inverting input, which is still at 0V. The op-amp has plenty of amplification available, so it increases its output voltage by as much as is necessary to bring its inverting input to the same level as the other input. If the voltage drops are taken to be 200mV across each of the germanium diodes and 100mV

across the meter, the voltages at various points in the circuit are as shown in Figure 3. You can see that the input voltage, the PD across the meter and the PD across R1 are all equal to 100mV, so the effect of the diodes is eliminated! The same applies over the whole range of voltages, and also the non-linearity of diode conduction has no effect on the reading. Virtually no current flows to the inverting input because of its high impedance. None flows through R4 because both ends of it are at 100mV.

Construction

The circuit is built up on a small piece of strip-board (Figure 4) housed in the case which carries the meter and the switches. The case will also hold the two PP3 batteries required for the power supply. It is advisable to use a heat-sink when soldering in the diodes, and take care to insert them with the correct orientation.

C2 is required for frequency stabilization of the op-amp; its precise value does not matter, so if you do not have a 100pf capacitor handy, it is in order to use one of lower value (for example, 56pF). We often use 1% or 2% tolerance resistors as standard resistors in measurement circuits, but such a degree of accuracy is not usually required in the applications of this circuit. This is why only 5% tolerance is specified, but use resistors of higher tolerance if you think you need them!

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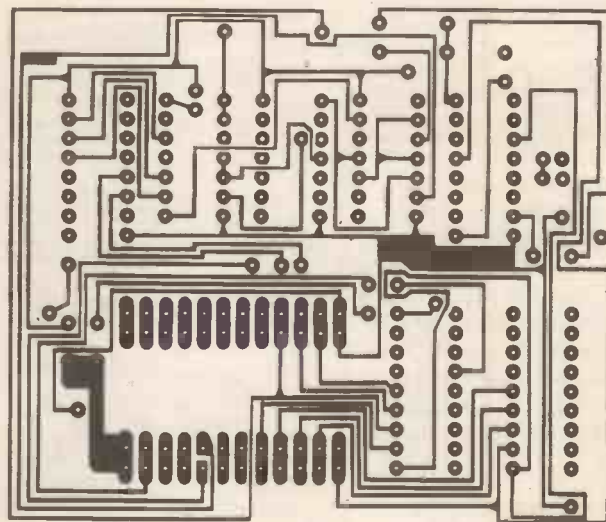
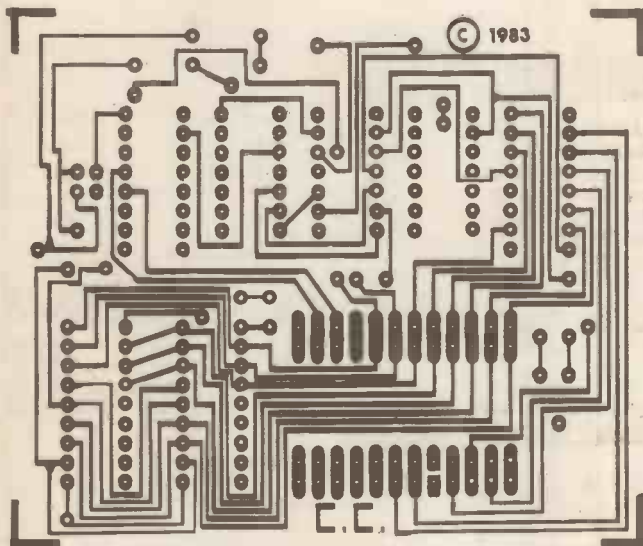
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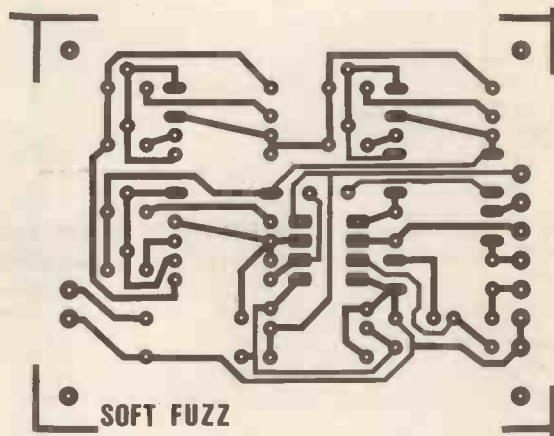
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6840 390p	2716-450S	TIL32 PN Gallium Arsenide IR Emitting Diode	EC911 0.189" Pads	200mV Full Scale Input	★ Up to 8 Styles which can be layered for 30 effects	SPRITE GRAPHICS	
6880 580p	2532-450S	Power Output Typ 1.2mW	EC940 0.016" Lines	True Differential Input	★ 9 different bit Image modes up to 1920 dots per line	High resolution movable object blocks 24 pixels wide by 21 pixels deep	
6885 785p	2732-450S	TIL38 PN Gallium Arsenide IR Emitting Diode	EC941 0.031" Lines	Guaranteed '0' Reading	★ Print styles emphasised, condensed, proportional, elite, italic and all MX80 styles	Up to 8 Styles which can be layered for 30 effects	
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6920 900p		Resistor for 350V	45p 180p 280p 400p 500p			Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite	
6921 900p		Resistor for 350V	85p 100p 150p 200p 250p 300p 350p 400p 450p 500p			Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite	
6922 900p		Resistor for 350V	60V 2.4 6V at 250Ma 2.1 2V at 150Ma 2.2 2V at 150Ma 2.3 2V at 150Ma 2.4 2V at 150Ma			Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite	
6923 900p		Resistor for 350V	4.0V-6V 120p 100p 125p 150p 175p 200p 225p 250p 275p 300p 325p 350p 375p 400p 425p 450p 475p 500p			Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite	
6924 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6925 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6926 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6927 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6928 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6929 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6930 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6931 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6932 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6933 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6934 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6935 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6936 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V 450-0-6V 460-0-6V 470-0-6V 480-0-6V 490-0-6V 500-0-6V				Sprite can be one of 8 colours or multicoulor upto 4 different colours per sprite
6937 900p		Resistor for 350V	30-0-6V 80-0-6V 90-0-6V 100-0-6V 110-0-6V 120-0-6V 130-0-6V 140-0-6V 150-0-6V 160-0-6V 170-0-6V 180-0-6V 190-0-6V 200-0-6V 210-0-6V 220-0-6V 230-0-6V 240-0-6V 250-0-6V 260-0-6V 270-0-6V 280-0-6V 290-0-6V 300-0-6V 310-0-6V 320-0-6V 330-0-6V 340-0-6V 350-0-6V 360-0-6V 370-0-6V 380-0-6V 390-0-6V 400-0-6V 410-0-6V 420-0-6V 430-0-6V 440-0-6V				

PCB FOIL PATTERNS



The printed circuit for the ZX81 High Resolution Graphics Project uses a double-sided board; on the left is the foil pattern for the component side and on the right is the bottom foil pattern. The PCB supplied by Cambridge Computing will be a through-hole-plated type, but home constructors will need to solder links to connect the top and bottom tracks. Do this very carefully as faults, especially dry joints, can be extremely difficult to locate!



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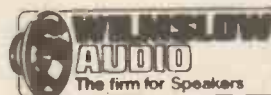
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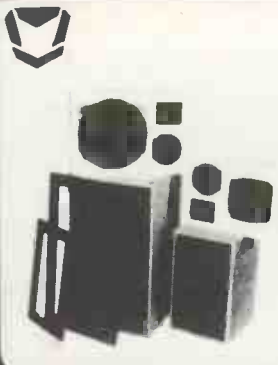
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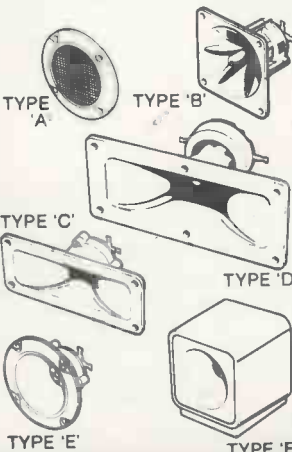
12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2" aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 6.5KHz., Sens. 96dB. Price: £22.00 + £3 carriage.

12" 85 watt R.M.S. McKENZIE C1285TC (P.A., DISCO) 2" aluminium voice coil. Twin cone, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 14KHz. Price: £22 + £3 carriage.
15" 150 watt R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil. Die cast chassis, 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. Price: £47 + £4 carriage.



PIEZO ELECTRIC TWEETERS - MOTOROLA

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



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

TYPE 'B' (KSN1005A) 3 1/2" super horn. For general purpose speakers, disco and P.A. systems etc. Price £4.99 each.

TYPE 'C' (KSN6016A) 2" x 5" wide dispersion horn. For quality Hi-Fi systems and quality discos etc. Price £5.99 each.

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

TYPE 'E' (KSN1038A) 3 1/2" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. Price £4.99 each.

TYPE 'F' (KSN1057A) Cased version of type 'E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. Price £10.75 each
P&P 20p ea. (or SAE for Piezo leaflets).



MP 80 LOUDSPEAKER

The very best in quality and value.

Ported tuned cabinet in hard-wearing black vinylite with protective corners and carry handle. Built and tested, employing 10in British driver and Piezo tweeter. Spec: 80 watts RMS; 8 ohms: 45Hz-20KHz; Size: 20in x 15in x 12in; Weight: 30 pounds.

Price: £49.00 each
£90 per pair
Carriage: £5 each £7 per pair

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HOBBY KITS. Proven designs including glass fibre printed circuit board and high quality components complete with instructions.

FM MICROTRANSMITTER (BUG) 90/105MHz with very sensitive microphone. Range 100/300 metres. 5 x 46 x 14mm (9 volt)
Price: £7.99p

DIGITAL THERMOMETER -9.9°C to +99.9°C. LED display. Complete with sensor. 70 x 70 mm (9 volt) Price: £27.60p
3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled. professional performance. Range up to 3 miles 35 x 84 x 12 mm (12 volt) Price: £12.49p

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



3 watt FM Transmitter

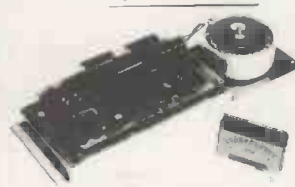
BSR P256 TURNTABLE

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

Price: £31.35 each. £2.50 P&P



OMP POWER AMPLIFIER MODULE



New model.
Improved specification

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

SPECIFICATION

Output Power:— 110 watts R.M.S.
Loads:— Open and short circuit proof 4/16 ohms.
Frequency Response:— 15Hz - 30KHz -3dB.
T.H.D.:— 0.01%
S.N.R. (Unweighted):— -118dB ±3.5dB.
Sensitivity for Max. Output:— 500mV @ 10K.
Price:— £31.99 + £2.00 R&P
Vu Meter Price:— £7.00 + 50p P&P.

HOME PROTECTION SYSTEM

Better to be 'Alarmed' than terrified. Thandar's famous 'Minder' Burglar Alarm System. Superior microwave principle. Supplied as three units, complete with interconnection cable. FULLY GUARANTEED.

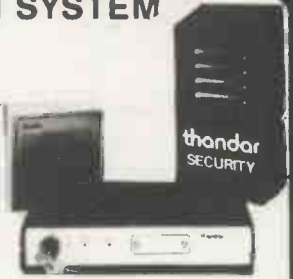
Control Unit — Houses microwave radar unit, range up to 15 metres adjustable by sensitivity control. Three position, key operated fascia switch — off — test — armed. 30 second exit and entry delay.

Indoor alarm — Electronic swept freq. siren. 104dB output.

Outdoor Alarm — Electronic swept freq. siren. 98dB output. Housed in a tamper-proof heavy duty metal case.

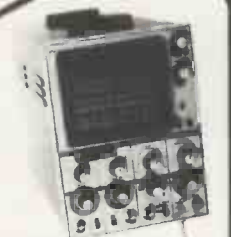
Both the control unit and outdoor alarm contain rechargeable batteries which provide full protection during mains failure. Power requirement 200/260 Volt AC 50/60Hz. Expandable with door sensors, panic buttons etc. Complete with instructions.

SAVE OVER £100 Usual price £228.85 — B.K.E.'s BARGAIN PRICE £128.00 + £5.00 P&P.
S.A.E. for colour brochure.



SAFGAN DT-520 DUAL TRACE OSCILLOSCOPE. New British model. 12 month guarantee. 20 MHz Band Width.

Specification: ● CH1, CH2: 5mV/div-20V/div. ● Time Base: 1 Sec/div-100ns/div. ● XY Facility: Matched XY inputs. ● Trigger: Level control ± slope selection. ● Auto, normal, TV-Trigging. ● Z-Modulation. ● CAL output 1V 1KHz. ● Sweep output 0-9V. ● Graticule blue ruled 10 x 8 cm. (5" C.R.T.) Very sharp trace. ● Size: H235mm, W177mm, D360mm. ● Weight: 6.5 Kgs. ● Supply: 200-240V. 40-60Hz. ● Price: £241.50 FREE Securicor Delivery. Probes: X1 £8.05, X1/X10 Switched £10.93.



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