An Argus Specialist Publication

electronics today INTERNATIONAL

MAY 1984 95p

FIRM UP YOUR CODE

Turn your ZX81 into an EPROM programmer — copy, list or write afresh using PEEK and POKE commands

PLUS

Automatic light switch to build — keep the burglars guessing

Go boom-bang-bip with our midi drum synth project

Microtanic profile — a computer for the electronics enthusiast?

BRITAIN'S LEADING ELECTRONICS MAGAZINE

AUDIO....COMPUTING....MUSIC....RA OTICS.

High performance, low price kits for today's musicians

DIGITAL DELAY LINE

Digital delay circuitry is an absolute necessity for high quality studio work, but usually comes with a four-figure price tag.

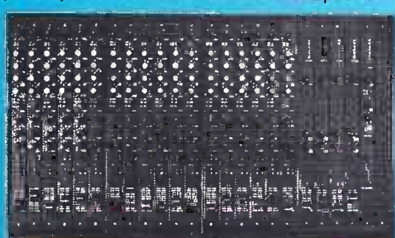
Powertran can now offer you digital quality for the price of a high analog unit. The unit gives delay times from 1.6mSecs to 1.6 secs with many powerful effects including phasing, flanging, A.D.T., chorus, echo and vibrato. The basic kit is extended in 400mSec steps up to 1.6 seconds simply by adding more parts to the PCB.

Complete kit (400mS delay) **£179**

Parts for extra 400mS delay (up to 3) **£19.50**

'DESTINY' MIXER

This versatile mixer offers a maximum of 24 inputs, 4 outputs, and an auxiliary channel. Input channels have Mic/Line, variable gain, bass/treble, and middle frequency equaliser. Output channels have PPM displays and record/studio outputs. There are send/return jacks, auxiliary, pan and fader controls, and output and group switching. There is also a headphone jack and built-in talk-back microphone.



Input channel	**£23.00**
Output channel	**£23.00**
Aux. channel	**£26.00**
Blank panel	**£3.50**
Base unit and front	**£33.00**
Pair of end cheeks	**£25.00**
Power supply and cabinet	**£22.50**

TRANSCENDENT 2000

ETI single board synthesizer.

This professional quality 3-octave instrument is transposable 2 octaves up or down, giving an effective 7-octave range.

There is portemento pitch bending, VCO with shape and pitch modulation, VCF with high and low pass outputs and separate dynamic sweep control, noise generator and an ADSR envelope shaper. Other features include special circuitry with precision components to ensure tuning stability.

Complete kit **£150**

MPA 200

100 watt mixer/amplifier

Here's a rugged, professionally finished mixer amp designed for adaptability, stability and easy assembly. Using new super-strength power transistors and a minimum of wiring, it offers a wide range of inputs (extra components are supplied for additional inputs), 3 tone controls, each with 15dB boost and 15dB cut, and a master volume control.

Complete kit **£79.50**

SP2-200

2-channel, 100-watt amplifer

The SP2-200 uses two of the power amplifier sections of the MPA 200 (above), each with its own power supply. A custom designed toroidal transformer enables both channels to simultaneously deliver over 100W rms into 8 ohms. Each channel has its own volume control, and a sensitivity of 0.775mV (OdBm) makes this amplifer suitable for virtually all pre-amps or mixers.

Complete kit **£99.50**

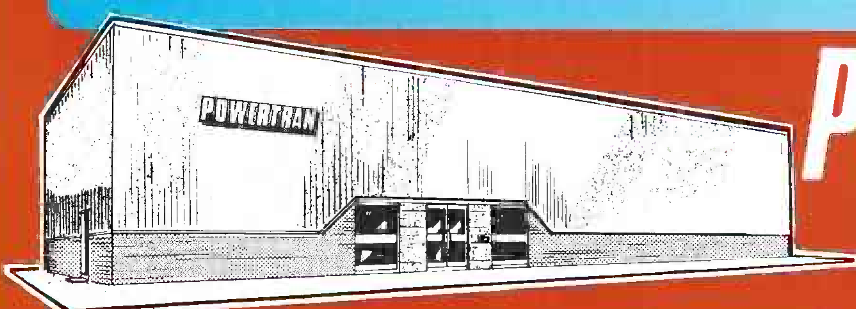
CHROMATHEQUE 5000

ETI 5-channel lighting effects system

Many lighting control units are now available. Some perform switching and others modulation of light output according to musical input. The Chromatheque combines both functions. It controls 5 banks of lamps up to 500W each in either analog or digital mode. And the 5 channels give more colours and more exciting linear and random sequencing than is possible with 3 or 4-channel systems. Versatile light level controls enable the lights to be partially on to suit the mood of the occasion. Wiring is minimal and construction straightforward.

Complete kit **£79.50**

Allow 21 days for delivery   Access   VISA



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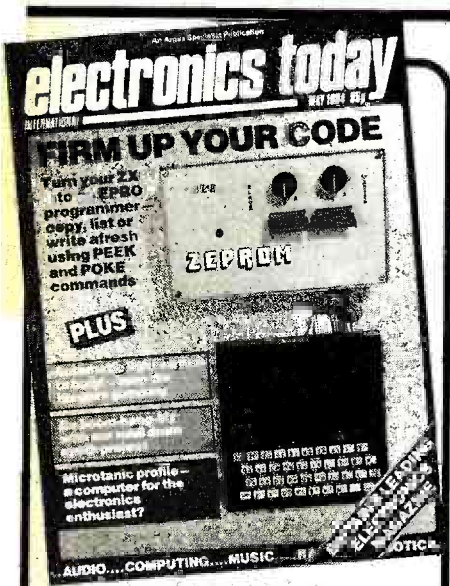
MAY 1984 VOL 13 NO 5



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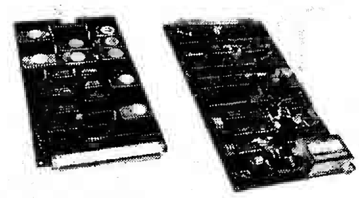

PROJECTS

INFORMATION

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AUDIO SPECIAL TIME!

'AUDIO DESIGN' AMPLIFIER

Since the end of the series 'Audio Design', we've had a steady stream of enquiries to ask when the amplifier mentioned then will be hitting the pages. Well, the answer to all you who've asked that of us is that the first part, featuring the preamp, will appear next month. It promises to be a goody, too — your very own editor is already first in the queue for the complete kit, when this becomes available.

You would think that preamp/power amp complementary units had been around for so long that no new innovations in the basic format could be found — but you'd be wrong! Whilst we cannot claim that no one had thought of the idea before, John Linsley Hood has made a modification to the basic format that seems so obvious as to make you wonder why you didn't think of it yourself — and this is not to mention all the top-class circuitry (there will be a few surprises in the power amp circuitry in the following issue).

EPROM CARD FOR THE ORIC/ATMOS

There has been a lack of projects on these pages for the Oric (and, consequently, for the new Atmos as well), but we're just about to fix all that! This EPROM card will allow you to program EPROMs and then read and verify them, and then, if desired, to actually run the software inside them on the computer. For ease of construction, only one location on the card can be used for programming, but the card is reconfigurable, so EPROM (and the on-board RAM) can be placed as desired in the memory map, making this card a very flexible tool for firmware development.

NOVEL LOUDSPEAKER PROJECT

A new type of drive unit from a company based in Liverpool has been raising a certain amount of interest. The drive units actually have a 'lozenge-shaped flat diaphragm, driven round the edges, which should, in theory, overcome the problem of different bits of the diaphragm on a conventional speaker moving out of phase with one another — apparently the Japanese have been working on the same idea for quite some time but have yet to deliver the goods. Readers of ETI will have their chance to reach the fore-front of technology with this project.

ALL IN THE JUNE ISSUE OF ETI — ON SALE FRIDAY MAY 4th. PLACE YOUR ORDER NOW OR RISK MISSING OUT!

DIGEST

April fools, May be true. . .

Unaccustomed as we are, etc, etc, we feel it's only fair to come clean about the extent of our duplicity in the April issue — preferably whilst there are a few readers still on speaking terms with us.

What can we say about "The Saga of Silly Cow Valley"? Its appeal is ageless; the epic narrative, pierced with shafts of wry humour and pure enlightenment spoke directly to our human condition, uniting ETI readers in all reaches of society in one long-suffering groan of disbelief.

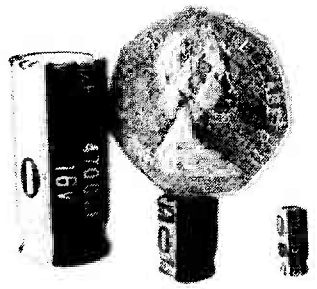
Some of our other April offerings deserve a little more comment. Hands up all those who are still hunting high and low for a dual peak filter, haven't yet sorted out the cold starting on their Duo Decimal Sub-Phrase Repetition Detector or are fast losing patience with the budgie's apparent inability to respond meaningfully to multiple glissandos. Give Up? It may be of some comfort to know that Paul Wollover's "Super Selective Music Filter" caught some very prestigious April fools. No names, no pack drill, but our first telephone call on the subject came from the producers of a certain television programme, who obviously though tomorrow's world had arrived a day early. We did our best to explain the various complex technical difficulties which would prevent us lending them a prototype for use on the programme, until unnatural hilarity got the better of us and the sound of editorial sides splitting alerted them to our deception. For others, disillusion came less readily; one puzzled newsagent went through his entire stock with a toothcomb after an irate reader had complained about the non-delivery of the rest of his magazine with its elusive page 109. Complaints should be directed to Phil Walker, the literary giant who hides behind the pseudonym Paul Wollover (pull-the-wool-over: geddit?).

Finally, we have the item which graced our news page under the heading "Not An April Fool". Despite this reassuring start and the well known veracity of all ETI writers, people just didn't believe us. This lack of trust came as a complete surprise and we would like to say that we are shocked, deeply hurt, and have never laughed so much in our lives. For the whol story is true — well, everything except the quadraphonic water-beds and so-on. We trust the Acoustic Chair Company will forgive us our little jest, and hope they made the most of their opportunities by quickly selling examples of their product to all those ETI readers who rang up and said 'And April fool to you too!'.

Typewriter Interface

We said in the update article on the Typewriter Interface which appeared in our March issue that we would try and organise an EPROM programming service. We are pleased to be able to tell you that Magenta Electronics are now offering ready programmed EPROMs and complete kits for this project. When we contacted them just before this issue went to press they were unable to confirm prices, but said that the items should be ready by the time this issue went on sale. For details contact Magenta Electronics Ltd, 135 Hunter Street, Burton-on-Trent, Staffordshire DE14 2ST, tel 0283-65435.

We have also had a letter from Tapesoft who have EA42s available for £235 including carriage. Their address is 55 Morley Road, Twickenham, Middlesex TW1 2HO, tel 01-892 1909.



Less For Your Money

Panasonic claim that their new SU series electrolytic capacitors are up to 60% smaller than conventional types. Available in both radial and axial forms, they are expected to find favour wherever high component packing density and small board size are desirable, and in industry where they will enable higher capacitance values to be handled by automatic insertion equipment.

The SU series capacitors are available with working voltages from 6.3 to 100 volts DC and in capacitance values from 0.47u to 15,000u (radial) and 22,000u (axial). Panasonic say that a typical SU capacitor is about half the size of a conventional capacitor with the same electrical value. They are specified for operation over the temperature range −40 C to +85 C and have a life expectancy of 2000 hours at +85 C . DC leakage current is equal to 0.01CVuA or 3uA, whichever is the greater. Radial types larger than 6.3 mm diameter and axial types larger than 10 mm diameter have specially designed safety vents in their cases, and all types are claimed to be resistant to the majority of modern solvents.

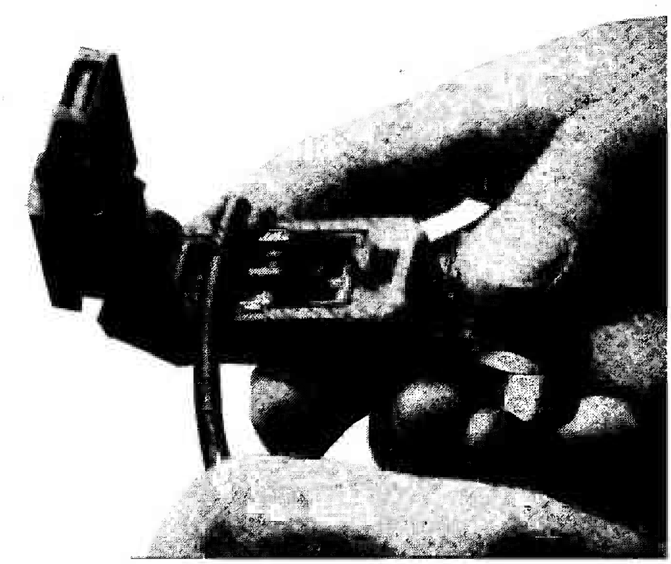
Further details of the SU electrolytic capacitor range are available from Panasonic Industrial (UK) Ltd, Electronic Components Department, 280-290 Bath Road, Slough, Berkshire SL1 6JB, tel 0753-34522.

● Market research company Mintel Publications Ltd say that only 32% of people in this country now spend an hour or more a week listening to records and tapes, a drop of 6% over last year's figure. The percentage listening to radio on the same basis fell from 62 to 49 over the same period. The same research also found that 19% of those who have hi-fi and stereo equipment do not know how to use it properly and a further 6% think it too complicated.

● We had hoped to have something positive to tell you about events within the Tangerine Users Group, the more so since we are running a feature on Microtan peripherals in this issue. However, despite making repeated 'phone calls right up until we went to press, we can only report that things are still moving but that no final decisions have yet been reached. We hope to be able to tell you rather more in next month's issue.

Coaxial Cable Stripper

OK Industries have patented a cable stripper which will quickly and cleanly prepare the ends of coaxial cables. The new device, designated the CX series cable stripper, consists of a hinged assembly which traps the cable and forces it down onto a series of blades. The blades are set at different heights according to the type and diameter of cable being stripped. The device is then rotated around the cable so that a uniform cut is produced. Two versions are available, one with two blades and one with three, allowing outside insulation, braid and dielectric to be removed in any combination simultaneously. The blade height is adjusted for different cable diameters by means of colour-coded interchangeable cassettes, making changes quick and simple. The two blade version costs £15.89 and the three blade version £18.66, and both are supplied with three cassettes. Further details are available from OK Industries Ltd, Dutton Lane, Eastleigh, Hampshire SO5 4AA, tel 0703 619841.

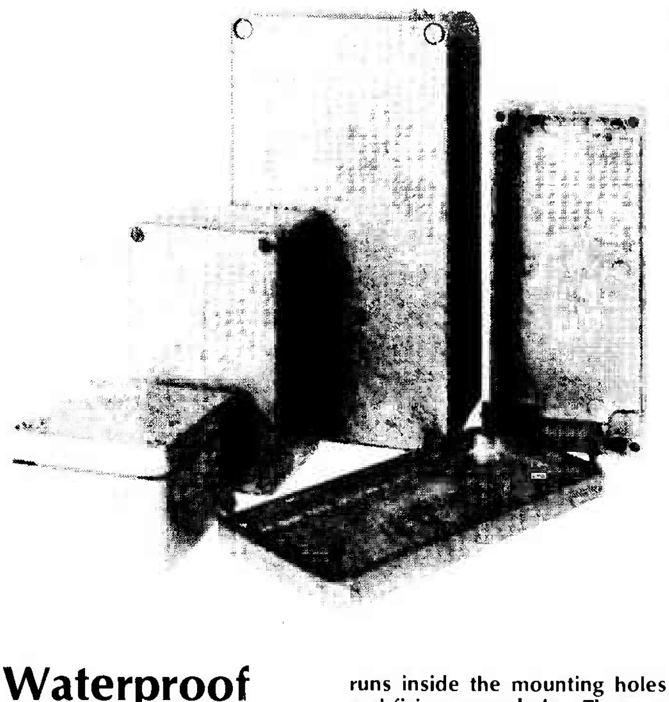


Resistor LEDs

Hewlett Packard have introduced a new series of LEDs which have integral current limiting resistors. Called simply resistor-LED or RLED lamps, they are available in 5 V and 12 V versions in T-1 and T-1¾ packages. This allows them to be soldered directly to PCBs in the normal way or used in panel mounting LES lampholders by means of a simple adaptor. In either case, the absence of an external current limiting resistor should save space and cost. For further details contact the Literature Section, Hewlett-Packard Ltd, Eskdale Road, Winnersh, Wokingham, Berkshire RG11 5DZ, tel 0734-696622.

Electronics Shop Opens

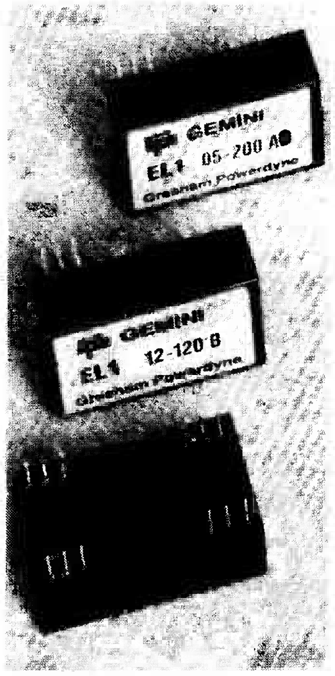
Good news for electronics enthusiasts who live in or near Daventry, Northamptonshire — Emos Ltd have opened a new electronics shop in the Sheaf Street Shopping area. The shop is open from 9.00 a.m. to 5.00 p.m. Monday to Saturday with the exception of Thursday when it is closed all day, and intends to offer everything from a thirteen amp plug to a microcomputer. Emos already offer a mail order service and have previously operated from a warehouse on the High March Industrial Estate; they say the move is in response to an increasing interest in electronics and computers in the Daventry area. For further information contact Emos Ltd, 17 Sheaf Street, Daventry, Northamptonshire, tel 032 72 - 5524.



Waterproof Diecast Boxes

Boss Industrial Mouldings have introduced a new range of diecast aluminium boxes which are protected against water ingress in accordance with the requirements of Industrial Standard IP65. IP65 protection is defined as hoseproof, and the boxes are thus ideally suited to use in equipment which is subject to periodic cleaning.

The new boxes incorporate an oil and petrol resistant neoprene gasket seal which is recessed and runs inside the mounting holes and fixing screw holes. They are manufactured from LM6 aluminium alloy (whatever that is!) and feature non-magnetic stainless steel fixing screws which are held captive in the lid so that you can't lose them. A copper plated earthing screw is incorporated and the boxes can be supplied to special order with EMI shielding which covers the spectrum from 14kHz to 20GHz. Four sizes of box are available, ranging from 75 x 40 x 52 mm to 220 x 120 x 80 mm, and further details are available from Boss Industrial Mouldings Ltd, James Carter Road, Mildenhall, Suffolk IP28 7DE, tel 0638-716101.



DIL DC/DC Converters

Gresham Powerdyne's EL series DC/DC converters are housed in standard 24 pin DIL packages and offer a range of single and dual rail outputs from 5 and 12V inputs. Three ratings are available, 1.5 watt (EL1 series), 3 watt (EL3 series) and 4 watt (EL4 series), and typical efficiencies are as high as 75%. The EL1 series provides outputs of 5, 12, 15, ±12 and ±15 volts with a line and load regulation of ±0.2% and a setting accuracy of ±5%. The EL3 series includes a 24V input version and offers fifteen output configurations with a regulation of 0.5% or 1% and a maximum of 50mV ripple and noise. The EL4 series are unregulated units available in fifteen output configurations and offering a ripple and noise figure of less than 150mV peak-to-peak. EL1 and EL4 series converters have full output short circuit protection.

The EL series converters feature full six-sided RFI shielding and a wide operating temperature range. Anticipated applications include interfaces and other equipment in which op-amps and similar devices have to be driven from microcomputer derived and other single rail supplies. For further information contact Gresham Powerdyne Ltd, Osborne Way, Station Road, Hook, Hampshire, tel 025 672 - 4246.

● Bulgin have introduced a new range of battery holders including panel mounting, PCB and base-board mounting versions capable of accommodating one or more AAA, AA, C, D, or PP3 size cells. The new range is described in an eight-page fully-illustrated catalogue which includes dimensional drawings and fixing details. Contact Brian Diggle, A.F. Bulgin and Co PLC, Bypass Road, Barking, Essex IG11 0AZ, tel 01-594 5588.

● Copperfoil Enterprises (well, what else could they be called?) have produced a self-adhesive copper tape which can be used to repair PCBs and to produce prototypes. The tape conforms to BS safety regulations, is rated at 5A, 24V DC, is not affected by the heat produced during soldering and comes in a range of tape widths from 4 to 8mm. Details from Copperfoil Enterprises, 141 Lyndhurst Drive, Hornchurch, Essex RM11 1JP, tel 040 24-56697.

● Motorola have published three new CMOS data books, their first new CMOS books for four years. The High Speed CMOS Logic Data Book, ref. B002C, has 540 pages and covers 147 devices, 71 of them with full circuit descriptions. The CMOS Standard Logic Data Manual, ref. B002A has 530 pages, contains detailed information on 119 standard CMOS devices and is complementary to the CMOS Special Functions Data Manual, ref. B002B which has 423 pages and covers 60 special function devices. Motorola Ltd, The European Literature Centre,88 Tanners Drive, Blakelands, Milton Keynes, tel 0908-514614.

● Superswitch manufacture a range of electronic appliances for use around the home, including a mains borne remote control system, a rechargeble torch, security equipment, touch and dimmer controls, etc. They have just brought out a new, full colour brochure, copies of which are free from Superswitch Electric Appliances Ltd, 7 Station Trading Estate, Camberley, Surrey GU17 9AH, tel 0276 34556.

● Belden Unreel packaging is a novel alternative to the usual metal drum used for cable distribution. It consists of a simple box in which the cable is so loaded that it will pull out through a single eyelet without kinking or twisting, doing away with the need for a spindle on which to mount the drum while unwinding. For Details contact Anixter (UK) Ltd, 632-652 London Road, Isleworth, Middlesex TW7 4EY, tel 01-568 1681.

Aces Low

Not only is the Jupiter Ace home computer back on sale again, it's also available at a very low price. The Ace, which uses the FORTH programming language and for which we featured an add-on colour board in last month's ETI, can now be bought for £26.00 plus VAT or complete with a 16K RAM pack for £44.00 plus VAT.

Regular readers of these pages will be aware that Jupiter Cantab, manufacturers of the Ace, ceased production and went into liquidation late last year. A receiver was appointed to wind-up the company's affairs, and although Jupiter Cantab has not been resurrected or production restarted, a company called Boldfield Ltd, Computing, has been given the go-ahead to retail the remaining stock. Boldfield also say they intend to develop new software for the Ace and will act as selling agents for other companies who wish to produce add-ons, interfaces, etc. The stock Boldfield are selling includes existing Jupiter software.

The Ace is available by mail order only and costs £26.00 complete with power supply, 182 page manual, demonstration cassette, leads and a 12 month guarantee. The 16K RAM pack costs £20 and the various software cassettes £3.00 each. If an Ace and a RAM pack are purchased together the total cost will be just £44.00 plus VAT. VAT and £3 postage should be added to all the above prices. To place an order or for further information, contact Boldfield Limited, Computing, Sussex House, Hobson Street, Cambridge, tel 0487-840740.

DMM Incorporates Frequency Meter

The model 1504 from Thurlby Electronics is a bench DMM which offers the bonus of a built-in frequency meter. Frequencies up to 3,999.9 kHz can be measured directly with a resolution of 100 Hz and the accuracy figure of ±0.0025% over 10-30 C is guaranteed by the 6MHz crystal timebase. Sensitivity is typically 30mV rms.

As a conventional multimeter, the 1504 has a 4¾ digit liquid crystal display. 32 ranges are provided enabling measurement of AC and DC voltage, resistance, diode test, and AC and DC current up to 25 amps. All AC ranges are True RMS responding which enables accurate measurements to be made on non-sinusoidal waveforms. The meter has sensitivity figures of 10µV, 10mΩ and 1nA and an accuracy of 0.05%.

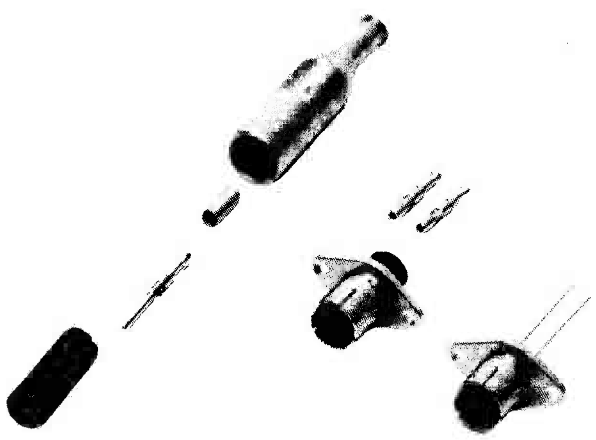
The 1504 is housed in a high impact ABS case which incorporates a multi-position tilt-stand/handle. An ever-ready carrying case is available for portable applications. The meter operates from internal batteries or from the mains and weighs 2¼ lbs.

The UK price is £185 plus VAT, and full details are available from Thurlby Electronics Ltd, New Road, St. Ives, Huntingdon, Cambridgeshire PE17 4BG, tel 0480-63570.

● One way of spotting when your amplifier is about to overheat is to put a temperature sensitive spot on it. A new range of temperature sensitive self-adhesive labels includes continuously indicating strips, dots which indicate when a specific temperature is exceeded and dial-a-temperature indicators, all with a response time of one second or less. They are available from the Electronic and Computer Workshop, 171 Broomfield Road, Chelmsford, Essex CM1 1RY, tel 0245-262149.

● The latest Electrovalue catalogue has 36 A5 pages listing a wide range of electronics components and is valid until the end of May. The catalogue is single colour but includes many illustrations and is available free of charge from Electrovalue Ltd, 28 St. Judes Road, Englefield Green, Surrey TW20 0HB, tel 0784 33603.

Twin Screened Connector



A new screened connector from Eldon Group Products allows simple crimped connections to be made to shielded twin co-axial cable, making the cable a viable alternative in certain situations to the more expensive twin screened cables. The connectors, known as type OSSI, are said to provide protection against noise and radiation. They are available in cable and chassis mounting forms and the chassis mounting types can also be supplied with integral leads for direct PCB mounting. The plug and socket inserts are designed to be crimped onto the cable shield, both operations being performed by the same tool. Details from Eldon Group Products, Lovett Road, Staines, Middlesex, tel Staines 61851.

● Ambit International's Spring 1984 mail-order components catalogue is now on sale at newsagents and available by post from the company. It costs 80p and includes three £1 discount vouchers and an order form. Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG, tel 0277-230909.

● TK Electronics have issued a new yellow catalogue which replaces their earlier green one. It has 28 pages in an A5 format and includes a section on kits and modules. Copies are available free of charge from TK Electronics, 11 Boston Road, London W7 3SJ, tel 01-579 9794.

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Also available **LESS PSU**, with FANS etc. Internal dim. 19"w. 16"d. 10.5"h. *£19.95*. Carriage & insurance £9.50.

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250,000 other relays **EX STOCK** call for details.

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Cure those unnerving hang ups and data glitches caused by mains interference.
SD5A As recommended by **ZX81** news letter, matchbox size up to 1000 watt load *£5.95*
L2127 compact completely cased unit with 3 pin fitted socket. Up to 750 watts *£9.99*

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MUFFIN-CENTAUR standard 4" x 4" x 1.25" fan supplied tested EX EQUIPMENT 240 v at £6.25 or 110 v at £4.95 or BRAND NEW 240 v at £10.50. 1000's of other fans Ex Stock. Call for Details. Post & Packing on all fans £1.60

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BRAND NEW CENTRONICS 739-2

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Options. Interface cable (specify) for BBC, ORIC, DRAGON or CENTRONICS 36 way plg £12.50. Spare ribbon £3.00 each. BBC graphics screen dump utility program £8.50. Carriage and Ins. £10.00 + VAT

VIDEO MONITORS

5" CASED Superb little unit made by **HITACHI** in ergonimcally designed free standing case. Very high definition will display small but readable 132 columns wide! 12v DC opp. @ 800 ma, so ideal for mobile use. Supplied in AS NEW condition complete with data. Composite 75 ohm vid inp. Black & White CRT *£45.00* or Green CRT *£55.00* Carr & Ins £5.00.
12" CASED. Made by the British KGM Co. Designed for continuous use as a data display station, unit is totally housed in an attractive brushed aluminium case with ON-OFF, BRIGHTNESS and CONTRAST controls mounted to one side. Much attention was given to construction and reliability of this unit with features such as, internal transformer isolated regulated DC supply, all components mounted on two fibre glass PCB boards – which hinge out for ease of service, many internal controls for linearity etc. The monitor accepts standard 75 ohm composite video signal via SO239 socket on rear panel. Bandwidth of the unit is estimated around 20 Mhz and will display most high def graphics and 132 x 24 lines. Units are secondhand and may have screen burns. However where burns exist they are only apparent when monitor is switched off. Although unguaranteed all monitors are tested prior to despatch. Dimensions approx. 14" high x 14" wide by 11" deep. Supplied complete with circuit. 240 volt AC operation. *ONLY £45.00 PLUS £9.50 CARR.*
24" CASED Again made by the KGM Co with a similar spec as the 12" monitor. Originally used for large screen data display. Very compact unit in lightweight alloy case dim. 19" H x 17" D x 22" W. All silicon electronics and composite video input make an ideal unit for schools, clubs, shops etc. Supplied in a used but working condition.
ONLY £55.00 PLUS £9.50 CARR & INS.

EPROM COPIERS

The amazing **SOFTY 2**. The 'Complete Toolkit' for writing, copying, modifying, and listing EPROMS of the 2516, 2716, 2532, 2732 range. Many other functions include integral keyboard, cassette interface, serial and parallel data i/o, UHF modulator.
ONLY £169.00 + PP £2.50
NEW 'GANG OF EIGHT' intelligent Z80 controlled gang bang programmer for ALL single 5V rail EPROMS. Copies up to 8, 27128 in typ. **ONLY 2 MINUTES!!** Internal LCD display and checking routines for **IDIOT PROOF** operation. **ONLY £395.00 + PP £3.00**
Data sheets on request.

GE TERMIPRINTER

A massive purchase of these desk top printer-terminals enables us to offer you these quality 30 cps printers at a **SUPER LOW PRICE** against their original cost of over £1000. Unit comprises of full QWERTY, electronic keyboard and printer mech with print face similar to correspondence quality typewriter. Variable forms tractor unit enables full width – up to 13.5" 120 column paper, upper – lower case, standard RS232 serial interface, internal vertical and horizontal tab settings, standard ribbon adjustable baud rates, quiet operation plus many other features. Supplied complete with manual. Guaranteed working *£130.00* or untested *£85.00*, optional floor stand £12.50 Carr & Ins £10.00.

TELETYPE ASR33 I/O TERMINALS

FROM £195 + CAR. + VAT
Fully fledged industry standard ASR33 data terminal. Many features including ASCII keyboard and printer for data I/O auto data detect circuitry. RS232 serial interface. 110 baud. 8 bit paper tape punch and reader for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order.
Options: Floor stand *£12.50* + VAT
KSR33 with 20ma loop interface *£125.00* +
Sound proof enclosure *£25.00* + VAT

PROFESSIONAL KEYBOARD OFFER

An advantageous purchase of brand new surplus allows a great **QWERTY**, full travel, chassis keyboard offer at fractions of their original costs.
ALPHAMERIC 7204/60 full **ASCII** 60 key, upper, lower + control key, parallel TTL output plus strobe. Dim 12" x 6" +5 & −12 DC. *£39.50.*
DEC LA34 Uncoded keyboard with 67 quality, **GOLD**, normally open switches on standard X, Y matrix. Complete with 3 LED indicators & i/o cable – ideal micro conversions etc. pcb DIM 15" x 4.5" *£24.95* Carriage on keyboards £3.00.

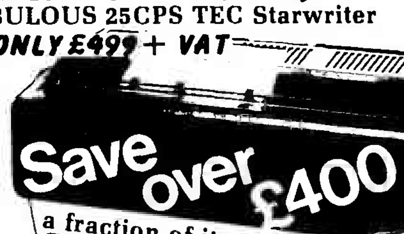
COLOUR MONITORS

NOVEX NC-1414-CL Fully cased brand new 14" colour monitor. Many exacting features such as **RGB TTL** and **PAL** composite video inputs, Internal speaker and audio amp, **"GREEN TEXT"** switch for high def text applications and matching **BBC** colour scheme make this monitor ideal for the most exacting user. Brand new and Fully Guaranteed only £199.00 + £10.00 carr.

SUPER DEAL? NO — SUPER STEAL!!

The FABULOUS 25CPS TEC Starwriter

BRAND NEW AT ONLY £499 + VAT



Made to the very highest spec the **TEC Starwriter FP1500-25** features a heavy duty die cast chassis and DIABLO type print mechanism giving superb registration and print quality. Micro-processor electronics offer full DIABLO/QUME command compatability and full control via CPM Wordstar etc.

a fraction of its original cost.

Many other features include bi directional printing, switchable 10 or 12 pitch, full width 381 mm paper handling with upto 163 characters per line, friction feed rollers for single sheet or continuous paper, internal buffer, standard RS232 serial interface with handshake.
Supplied absolutly **BRAND NEW** with 90 day guarantee and **FREE** daisy wheel and dust cover. Order **NOW** or contact sales office for more information.
Optional extras: RS232 data cable £10.00. Tech manual £7.50. Tractor feed £140.00. Spare daisy wheel £3.00 Carriage & Ins. (UK Mainland) £10.00.

SEMICONDUCTOR 'GRAB BAGS'

Mixed Semis amazing value contents include transistors, digital, linear, I.C.'s triacs, diodes, bridge recs., etc. etc. All devices guaranteed brand new full spec. with manufacturer's markings, fully guaranteed, 50+ *£2.95* 100+ *£5.15.*
TTL 74 Series A gigantic purchase of an "across the board" range of 74 TTL series I.C.'s enables us to offer 100+ mixed "mostly TTL" grab bags at a price which two or three chips in the bag would normally cost to buy. Fully guaranteed all I.C.'s full spec. 100+ *£6.90* 200+ *£12.30* 300+ *£19.50*

DATA MODEMS

Join the communications revolution with our range of EX TELECOM data modems. Made to most stringent spec and designed to operate for 24 hrs per day. Units are made to the CCITT tone spec. With RS232 i/o levels via a 25 way 'D' skt. Units are sold in a tested and working condition with data. Permission may be required for connection to PO lines.
MODEM 2B "Hackers Special" fully fledged up to 300 baud full duplex, **ANSWER** or **CALL** modes. **AUTO ANSWER.** Data i/o via standard **RS232** 25 way 'D' socket. Just 2 wire connection to comms line. Ideal networks etc. Complete with data, tested, ready to run at a **NEW SUPER LOW PRICE** of *ONLY £65.00* + VAT + Carr.
MODEM 20-1 Compact unit for use with **MICRONET, PRESTEL** or **TELECOM GOLD** etc. 2 wire direct connect. 75 baud transmit 1200 baud receive. Data i/o via RS232 'D' socket. Guaranteed working with data *£49.95*
MODEM 20-2 same as 20-1 but 75 baud receive 1200 baud transmit *£130.00*
DATEL 4800 sync service. RACAL type **MPS4800** ex TELECOM good condition. *£295.00* + VAT.
NEW DSL2123 Multi Standard modem selectable V21 300-300 bps, V23 75-1200, V23 1200-75 full duplex. Or 1200-1200 half duplex modes. Full auto answer via modem or CPU. LED status indicators. CALL or ANS modes Switchable **CCITT** or **BELL 103 & 202**. Housed in ABS case size only 2.5" x 8.5" x 9". *£286.00* + VAT
For further data or details on other EX STOCK modems contact sales office.
Carriage on all modems £10.00 + VAT.

66% DISCOUNT ELECTRONIC COMPONENTS EQUIPMENT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains, we have thousands of I.C.'s, Transistors, Relays, Cap's, P.C.B.'s, Sub-assemblies, Switches, etc. etc. surplus to our requirements. Because we don't have sufficient stocks of any one item to include in our ads. we are packing all these items into the *"BARGAIN PARCEL OF A LIFETIME"*. Thousands of components at giveaway prices! Guaranteed to be worth at least *3 times* what you pay. Unbeatable value!! Sold by weight.
2.5kls *£4.25* + pp £1.25 5kls *£5.90* + £1.80
10kls *£10.25* + pp £2.25 20 kls *£17.50* + £4.75

DEC CORNER

MOSTEK CRT 80E Brand new dual eurocard, Z80 based VT100 PLUS emulator with graphics etc *£499.00*
BA11-MB 3.5" Box, PSU, LTC *£385.00*
DLV11-J 4 x EIA interface *£310.00*
RK05-J 2.5 Mb disk drives *£650.00*
PDP1105 Cpu, Ram, i/o, etc. *£450.00*
RT11 ver. 3B doc kit *£70.00*
LA36 Decwriter EIA or 20 ma *£270.00*
KL8JA PDP 8 async i/o *£175.00*
MI8E PDP 8 Bootstrap option *£75.00*
DILOG DQ100 RK05 LSI 4 x RK05 disk controller *£450.00*
LAXX-NW LA180 RS232 serial interface and buffer option *£230.00*
LAX34-AL LA34 tractor feed *£85.00*
1000's of **EX STOCK** spares for **DEC PDP8 PDP11 PDP15** & periperhals. Call for details. All types of Computer equipment and spares wanted for prompt **CASH PAYMENT**

ALL PRICES PLUS VAT

All prices quoted are for U.K. Mainland, paid cash with order in Pounds Stirling PLUS VAT. Minimum order value *£2.00*. Minimum Credit Card order *£10.00*. Minimum BONA FIDE account orders from Government depts., Schools, Universities and established companies *£20.00* Where post and packing not indicated please ADD £1.00. + VAT Warehouse open Mon-Fri 9.30 – 5.30. Sat. 10.15 – 5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export enquiries welcome.

DISPLAY -ELECTRONICS-

32 Biggin Way, Upper Norwood, London SE19 3XF
Telephone 01-679 4414 Telex 27924

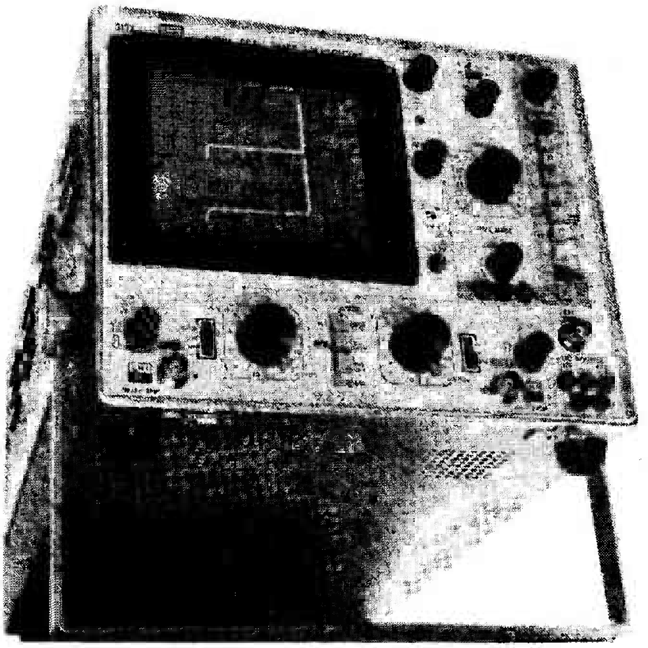
Crotech's Second First

In 1981, Crotech claimed a first with their 3131 dual trace oscilloscope incorporating a component tester. Since then a number of other manufacturers have followed suit. Now Crotech are launching a successor, the 3132, which they claim puts them ahead again. The 3132 is a 20 MHz dual trace design which, in addition to the component tester, incorporates a component comparator which allows an unknown component to be compared with a known one, and a triple output regulated supply on the front panel.

The 3132 has a maximum deflection coefficient of 2mV/division selected on the main attenuator switch, and a maximum timebase speed of 40ns/division. Fourteen trigger functions are available including AC and DC trigger coupling, and there are TV frame and line sync modes and an HF reject function which allows triggering on low frequency signals containing some high frequency content.

The component tester allows checking of both passive and semiconductor devices and the comparator function can be used to check complete circuits using signature techniques. Current limiting is included to remove the risk of damage to the device under test. The triple output supply provides −12V, +12V and +5V, and the 12-0-12V supply is left floating so that it can be used to supply plus or minus 24V relative to ground. The 12V outputs are rated at 200mA and the 5V output is rated at 1A. All of the outputs are protected against short circuit and overload conditions.

The Crotech 3132 is priced at £283.00 plus VAT. Crotech Instruments Ltd, 5 Nimrod Way, Elgar Road, Reading, Berkshire RG2 0EB, tel 0734-866945.



● Whether you seriously intend to spend your life's savings on some sophisticated test gear or just want to find a quiet corner and drool away to yourself, the 1984 Philips Test and Measurement catalogue is for you. Aside from the usual oscilloscopes, meters, analysers and the like and an extended section on bussable instruments, the catalogue comes complete with a pull-out full colour year planner. Contact Steve Taylor, Philips Test and Measurement Sales Office Manager, Pye Unicam Ltd, York Street CB1 2PX, tel 0223-358866.

● Thorn EMI Electronics Ltd, manufacturers of the Megger range of electrical insulation testers, have brought out a 90 page paperback book entitled "A Simple Guide to Insulation and Continuity Testing". The book is aimed at the user and at engineering students and covers such topics as types of test, testing to the requirements of the IEE wiring regulations, 15th edition, and portable appliance tests. It costs £2.75 from the Sales Department, Thorn EMI Instruments Ltd, Archcliffe Road, Dover, Kent CT17 9EN, tel 0304-202620.

● Ferranti have published a series of Applications Notes which give full constructional details of projects which can be built using their Super E-line transistors and other semiconductor products. The projects are a flash gun inverter, a 120 watt flourescent tube inverter, a 12V 8 watt flourescent tube inverter and a capacitor discharge car ignition system, and the notes are available free of charge from The Sales Department, Ferranti Electronics Ltd, Fields New Road, Chadderton, Oldham, Lancashire OL9 8NP, tel 061 624-0515.

64K x 8 EPROM

Advanced Micro Devices have introduced a 512K UV-light eraseable and electrically programmable ROM. Designated the Am27512, the device is organised as 65,536 eight bit words and features access times as low as 25nS.

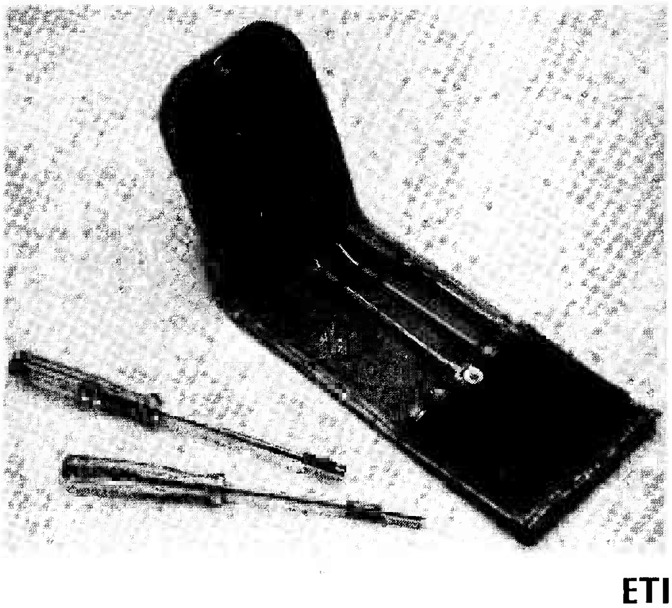
The Am27512 uses the standard 12.5V programming voltage and has an auto select mode which ensures that programming automatically takes place at this voltage. AMD's interactive programming algorithm brings programming time down to ten minutes. The Am27512 operates from a single 5V rail and dissipates 132mW in standby mode and 525mW when active. There are separate output enable and chip enable pins to simplify routing arrangements in multiple bus systems. The Am27512 comes in a 28 pin package and uses the standard JEDEC approved pin-out. 250ns and 300ns versions are available, but with a 100 off price for the 250ns version of £324 each its going to be a while before most of us get a chance to play with one.

Advanced Micro Devices (UK) Ltd, AMD House, Goldsworth Road, Woking, Surrey GU21 1JT, tel 048 62 - 22121.

Hold It

For everyone who has ever wasted countless precious minutes attempting to line up nut and bolt on opposite sides of an all-but-inaccessible panel, Toolrange have come up with an answer. Their Miniature Screw and Nut Holding Set consists of five tools, each 180 mm long with a 100 mm shank, which will securely hold small parts during fixing and soldering. There is a screw fastener, two nut fasteners, one horizontal and one vertical, and two soldering and fastening tweezers, one straight and one curved. The tools are all made of steel except for the straight tweezers which are brass, and have insulated handles. The set comes complete with a storage wallet.

Also available from Toolrange is a series of trays and PCB racks which are conductive and thus ideal for the storage of static sensitive components. The trays are made from carbon loaded polypropylene and come in five sizes ranging from 343 x 210 x 152 mm to 89 x 102 x 57 mm. Further information on these items and over 3000 other tools and production aids is to be found in the Toolrange catalogue which is available from Toolrange Ltd, Upton Road, Reading, Berkshire RG3 4JA, tel 0734 22245.



ETI

74 SERIES

7400	POA
7401	30p
7402	30p
7403	30p
7404	POA
7405	36p
7406	POA
7407	POA
7408	36p
7409	36p
7410	30p
7411	36p
7412	30p
7413	40p
7414	60p
7416	POA
7417	POA
7420	30p
7421	36p
7422	36p
7423	36p
7425	40p
7426	36p
7427	36p
7428	36p
7430	30p
7432	POA
7433	36p
7437	36p
7438	100p
7439	36p
7440	30p
7441	90p
7442A	60p
7444	70p
7445	90p
7446A	90p
7447A	90p
7448	90p
7450	30p
7451	30p
7453	30p
7454	30p
7460	60p
7470	60p
7472	40p
7473	36p
7474	60p
7475	50p
7476	40p
7480	60p
7481	180p
7482	120p
7483A	90p
7484A	180p
7485	120p
7486	40p
7489	250p
7490A	50p
7491	70p
7492A	60p
7493A	50p
7494	120p
7495A	55p
7496	75p
7497	250p
74100	180p
74107	45p
74109	45p
74110	90p
74111	55p
74116	150p
74118	150p
74119	150p
74120	100p
74121	45p
74122	55p
74123	90p
74125	50p
74126	60p
74128	70p
74132	60p
74136	60p
74141	90p
74142	225p
74143	250p
74144	250p
74145	90p
74147	120p
74148	120p
74150	150p
74151A	60p
74153	60p
74154	200p
74155	60p
74156	80p
74157	60p
74159	180p
74160	90p
74161	75p
74162	90p
74163	90p
74164	90p
74165	100p
74166	120p
74167	250p
74170	150p
74172	250p
74173	90p
74174	90p
74175	75p
74176	90p
74177	75p
74178	120p
74179	120p
74180	70p
74181	180p
74182	75p
74184	150p
74185A	150p
74190	90p
74191	90p
74192	90p
74193	75p
74194	80p
74195	65p
74196	60p
74197	90p
74198	150p
74199	150p
74221	100p
74251	80p
74259	150p
74265	70p
74273	170p
74276	150p
74278	150p
74279	70p
74283	70p
74285	225p
74290	100p
74293	90p
74298	120p
74351	150p
74365A	48p
74366A	60p
74367A	60p
74368A	60p
74376	120p
74390	100p
74393	150p
74490	150p

74LS SERIES

74LS00	POA
74LS01	36p
74LS02	36p
74LS03	36p
74LS04	POA
74LS05	36p
74LS08	36p
74LS09	36p
74LS10	36p
74LS11	36p
74LS12	36p
74LS13	40p
74LS14	50p
74LS15	36p
74LS20	36p
74LS21	36p
74LS22	36p
74LS26	36p
74LS27	40p
74LS28	36p
74LS30	36p
74LS32	POA
74LS33	36p
74LS37	36p
74LS38	60p
74LS40	40p
74LS42	55p
74LS47	90p
74LS48	90p
74LS51	36p
74LS54	36p
74LS55	36p
74LS73A	36p
74LS74A	100p
74LS75	50p
74LS76A	36p
74LS83A	60p
74LS85	100p
74LS86	40p
74LS90	40p
74LS91	75p
74LS92	55p
74LS93	40p
74LS95B	70p
74LS96	75p
74LS107	48p
74LS109	48p
74LS112	48p
74LS113	48p
74LS114	48p
74LS122	60p
74LS123	120p
74LS124/619	180p
74LS125	60p
74LS126	60p
74LS132	55p
74LS133	48p
74LS136	60p
74LS138	90p
74LS139	60p
74LS145	100p
74LS147	150p
74LS148	150p
74LS151	70p
74LS153	70p
74LS154	250p
74LS155	70p
74LS156	70p
74LS157	70p
74LS158	70p
74LS160A	90p
74LS161A	90p
74LS162A	90p
74LS163A	90p
74LS164	90p
74LS165A	120p
74LS166A	120p
74LS168	140p
74LS169	140p
74LS170	120p
74LS173A	120p
74LS174	75p
74LS175	75p
74LS183	180p
74LS190	75p
74LS191	75p
74LS192	75p
74LS193	75p
74LS194A	70p
74LS195A	70p
74LA196	80p
74LS197	70p
74LS221	120p
74LS240	120p
74LS241	120p
74LS242	75p
74LS243	75p
74LS244	300p
74LS245	350p
74LS247	70p
74LS248	70p
74LS249	70p
74LS251	70p
74LS253	70p
74LS256	200p
74LS257A	70p
74LS258A	70p
74LS259	120p
74LS260	70p
74LS261	90p
74LS266	70p
74LS273	140p
74LS275	175p
74LS279	75p
74LS280	180p
74LS283	80p
74LS290	80p
74LS292	900p
74LS293	75p
74LS295	100p
74LS297	900p
74LS298	90p
74LS299	200p
74LS321	240p
74LS323	250p
74LS324/624	200p
74LS348	200p
74LS352	100p
74LS353	100p
74LS356	220p
74LS363	180p
74LS364	180p
74LS365A	55p
74LS366A	55p
74LS367A	55p
74LS368A	55p
74LS373	POA
74LS374	POA
74LS375	75p
74LS377	140p
74LS378	120p
74LS379	120p
74LS390	90p
74LS393	150p
74LS395A	120p
74LS399	150p
74LS445	100p
74LS465	180p
74LS466	150p
74LS467	180p
74LS490	130p
74LS540	120p
74LS741	150p
74LS608	700p
74LS610	1900p
74LS612	1900p
74LS624	150p
74LS626	180p
74LS628	180p
74LS629	180p
74LS640	250p
74LS640-1	300p
74LS641	250p
74LS642-1	300p
74LS643	250p
74LS643-1	300p
74LS644	350p
74LS645	350p
74LS645-1	400p
74LS668	80p
74LS669	80p
74LS670	130p
74LS674	550p
74LS682	350p
74LS684	400p
74LS687	450p

74S SERIES

74S00	45p
74S02	45p
74S04	60p
74S05	60p
74S08	60p
74S10	45p
74S11	50p
74S20	45p
74S22	50p
74S30	45p
74S32	70p
74S37	60p
74S51	75p
74S74	75p
74S85	250p
74S86	90p
74S112	90p
74S113	90p
74S114	90p
74S124	400p
74S132	110p
74S133	60p
74S138	150p
74S139	120p
74S140	60p
74S151	180p
74S153	180p
74S157	250p
74S158	195p
74S163	300p
74S174	250p
74S175	320p
74S188	180p
74S189	225p
74S194	300p
74S195	300p
74S196	300p
74S200	450p
74S201	320p
74S225	650p
74S240	250p
74S241	300p
74S244	300p
74S251	250p
74S257	250p
74S258	250p
74S260	70p
74S261	300p
74S262	850p
74S283	300p
74S287	225p
74S288	180p
74S289	225p
74S299	650p
74S373	400p
74S374	400p
74S387	225p
74S472	475p
74S474	400p
74S475	450p
74S570	650p
74S571	300p
74S573	500p

4000 CMOS

4000	30p
4001	30p
4002	30p
4006	90p
4007	30p
4008	90p
4009	60p
4010	30p
4011	30p
4012	30p
4013	60p
4014	80p
4015	80p
4016	50p
4017	75p
4018	75p
4019	60p
4020	90p
4021	80p
4022	80p
4023	50p
4024	50p
4025	30p
4026	100p
4027	50p
4028	60p
4029	90p
4030	45p
4031	180p
4032	80p
4033	160p
4034	200p
4035	80p
4036	270p
4037	150p
4038	80p
4039	250p
4040	80p
4041	60p
4042	75p
4043	75p
4044	75p
4045	120p
4046	90p
4047	85p
4048	60p
4049	48p
4050	48p
4051	80p
4052	80p
4053	80p
4054	90p
4055	90p
4056	100p
4059	450p
4060	90p
4063	90p
4066	45p
4067	290p
4068	30p
4069	30p
4070	30p
4071	30p
4072	30p
4073	30p
4075	30p
4076	90p
4077	30p
4078	30p
4081	30p
4082	30p
4085	60p
4086	70p
4089	125p
4093	48p
4094	100p
4095	90p
4096	90p
4097	290p
4098	90p
4099	90p
4501	40p
4502	60p
4503	60p
4504	90p
4505	400p
4506	120p
4507	45p
4508	180p
4510	75p
4511	75p
4512	75p
4513	140p
4514	130p
4515	130p
4516	75
4517	200p
4518	75p
4519	75p
4520	75p
4521	125p
4522	90p
4526	90p
4527	90p
4528	75p
4529	90p
4531	75p
4532	80p
4534	400p
4536	220p
4538	90p
4539	90p
4541	90p
4543	100p
4553	220p
4555	60p
4556	70p
4557	250p
4560	120p
4566	200p
4568	300p
4569	200p
4572	50p
4583	75p
4584	46p
4585	65p
4599	290p
4724	150p
14411	750p
14412	850p
14416	300p
14419	300p
14490	550p
14495	400p
14500	700p
14599	350p
22100	350p
22101	700p
22102	700p
40014	48p
40085	90p
40097	60p
40098	60p
40100	120p

LINEAR ICs

AD7581	£15
ADC0808	1190p
AN103	200p
AY-1-5050	99p
AY-3-1270	750p
AY-3-1350	350p
AY-3-8910	400p
AY-3-8912	550p
CA3019A	100p
CA3028A	150p
CA3046	70p
CA3059	350p
CA3060	350p
CA3080E	80p
CA3086	60p
CA3089E	250p
CA3130E	90p
CA3130T	110
CA3140E	60p
CA3140T	110
CA3160E	100p
CA3161E	150p
CA3162E	450p
CA3189E	300p
CA3240E	120
CA3280G	225
D7002	450p
DAC1408-8	200p
DAC0808	200p
DG308	300p
HA1366	190p
HA1388	250p
ICL7106	700p
ICL7511	95p
ICL7650	400p
ICL7660	250p
ICL8038	300p
ICM7216B	£24
ICM7217	900p
ICM7555	100p
ICM7556	140p
LC7120	300p
LC7130	325p
LC7137	350p
LF347	150p
LF351	80p
LF353	100p
LF355	100p
LF356P	100p
LF357	100p
LF13331	350p
LM10C	325p
LM301A	25p
LM307	45p
LM308CN	75p
LM310	120p
LM311	70p
LM318	150p
LM319	180p
LM319N	160p
LM324	30p
LM334Z	90p
LM335Z	140p
LM339	40p
LM348	65p
LM358p	60p
LM377	225p
LM380N-8	100p
LM380	120p
LM381AN	180p
LM382	120p
LM386	90p
LM387	120p
LM389	180p
LM391	180p
LM392	60p
LM393	100p
LM394CH	350p
LM709	50p
LM710	50p
LM711	70p
LM725C	300p
LM733	75p
LM741	20p
LM747	70p
LM748	40p
LM1011	480p
LM1014	150p
LM1801	300p
LM1830	250p
LM1871	300p
LM1872	300p
LM1886	500p
LM1889	350p
LM2917	250p
LM3302	75p
LM3900	50p
LM3909	120p
LM3911	180p
LM3914	350p
LM3915	350p
LM3916	350p
LM13600	110p
M51513L	230p
M51516L	500p
MB3712	200p
MB3730	400p
MC1310P	150p
MC1413	100p
MC1458	40p
MC1493	100p
MC1495L	350p
MC1496	70p
MC3340P	200p
MC3401	50p
MC3403	65p
MF10CN	380p
MK50240	900p
MK50398	790p
ML920	500p
ML922	400p
MM57160	620p
MM6221A	300p
NE531	150p
NE544	190p
NE555	22p
NE556	50p
NE564	400p
NE565	150
NE566	150p
NE567	140p
NE570	400p
NE571	400p
NE592	75p
NE5532P	200p
NE5533P	180p
NE5534P	120p
NE5534AP	200p
OP-07EP	600p
PLL02A	500p
S566B	300p
SAA1900	£16
SAD1024A	1150p
SFF96364	800p
SN76488	500p
SN76489	400p
SN76495	400p
SP0256AL2	800p
TA7120	150p
TA7130	150p
TA7204	150p
TA7205	90p
TA7222	150p
TA7310	150p
TBA231	120p
TBA800	80p
TBA810	100p
TBA820	80p
TBA950	225p
TC9109	500p
TCA210	350p
TCA220	350p
TCA940	175p
TCA965	120p
TDA1004A	£4
TDA1008	320p
TDA1010	250p
TDA1022	500p
TDA1024	120p
TDA1170	300p
TDA2002	325p
TDA2003	325p
TDA2004	300p
TDA2006	320p
TDA2020	320p
TD20300	250p
TDA7000	350p
TL061CP	50p
TL062	75p
TL064	100p
TL071	45p
TL072	60p
TL074	100p
TL081	45p
TL082	55p
TL083	75p
TL084	90p
TL094	200p
TL170	50p
TL430C	120p
UA2240	120p
UAA170	200p
ULN2003A	100p
ULN2004	100p
ULN2068	290p
ULN2802	200p
ULN2803	200p
ULN2804	200p
UPC575	275p
UPC592H	200p
UPC1156H	£3
UPC1185H	350p
XR210	400p
XR2206	400p
XR2211	575p
XR2240	120p
ZN414	80p
ZN419C	190p
ZN423E	130p
ZN424E	130p
ZN425E	350p
ZN426E	300p
ZN427E	600p
ZN428E	450p
ZN429E	210p
ZN450E	750p
ZN459CP	300p
ZN1034E	200p
ZN1040E	200p
ZNA134J	£23
ZNA234E	950p

VOLTAGE REGULATORS

FIXED PLASTIC

1A	+ve		-ve	
5V	7805	40p	7905	45p
6V	7806	50p	7906	50p
8V	7808	50p	7908	50p
12V	7812	40p	7912	45p
15V	7815	40p	7915	45p
18V	7818	50p	7918	50p
24V	7824	50p	7924	50p
5V 100mA	78L05	30p	79L05	45p
6V 100mA	78L06	30p		
8V 100mA	78L08	30p		
12V 100mA	78L12	30p	79L12	50p
15V 100mA	78L15	30p	79L15	50p

OTHER REGULATORS

Fixed Regulators		
LM309K	1A 5V	140p
LM323K	3A 5V	450p
78H05KC	5A 5V	600p
78H12	5A 12V	750p
78P05	10A 5V	900p
Variable Regulators		
LM305AH		250p
LM317T	TO-220	100p
LM317K	TO3	250p
LM337T		225p
LM350T	10A+VAR	400p
LM396K	10A+VAR	1500p
LM723N		45p
78HGKC	5A+VAR	700
78GUIC	1A+VAR	200p
79HGGKC	5A-VAR	775p
79GUIC	1A-VAR	225p
Switching Regulators		
ICL7660		250p
SG3524		300p
TL494		300p
TL497		300p
78S40		250p

OPTO ELECTRONICS

2N5777	48p	TIL32	55p
OCP71	180p	TIL78	55p
ORP12	120p	TIL31A	120p
ORP60	120p	TIL81	120p
ORP61	120p	TIL100	75p

OPTO ISOLATORS

ILD74	130p	TIL111	70p
MCT26	100p	TIL112	70p
MCS2400	190p	TIL113	70p
MOC3020	150p	TIL116	70p
ILQ74	180p		
6N137	400p		

LEDS

0.125"		FND357	120p
TIL209 Red	10p	MAN72	140p
TIL211 Gr	12p	MAN74	140p
TIL212 Yel	15p	MAN4640	200p
0.2"		MAN8910	250p
TIL220 Red	10p	NSB5881	570p
TIL222 Gr	12p	TIL311	600p
TIL228 Yel	15p	TIL321/3	130p
Rectangular		TIL330	140p
LEDs R,G,Y	30p	TIL729	140p
		TIL730	140p
		7750/60	200p
		TIL730	140p

DISPLAYS

DL704	140p
DL707Red	140p

DRIVERS

9368	250p
9370	300p

DIL SWITCHES

4-way	90p
8-way	120p
6-way	105p
10-way	150p

WIRE WRAP SOCKETS BY TI

8 pin	30p
14 pin	42p
16 pin	45p
18 pin	50p
20 pin	66p
22 pin	75p
24 pin	75p
28 pin	100p
40 pin	130p

DIODES

BY127	12p
BYX36300	20p
OA47	10p
OA90/91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/2	12p
1N5403/4	14p
1N5404/5	14p
1N5404/7	19p
IS920	9p

BRIDGE RECTIFIERS

1A 50V	19p
1A 100V	20p
1A 400V	25p
1A 600V	30p
2A 50V	30p
2A 100V	35p
2A 400V	45p
3A 200V	60p
3A 600V	72p
4A 100V	95p
4A 400V	100p
6A 50V	80p
6A 100V	100p
6A 400V	120p
10A 400V	200p
25A 400V	400p

COUNTERS

74C925	£4
74C926	£5
74C928	£6
72168	£22
ZN1040	670p

REAL TIME CLOCK

MC6818P	550p
MM58174AN	800p
MSM5832RS	350p

TELETEXT DECODER

SAA5020	600p
SAA5030	700p
SAA5041	£16
SAA5050	900p

LOW PROFILE SOCKETS BY TI

8 PIN	9p
14 pin	10p
16 pin	11p
18 pin	16p
20 pin	18p
22 pin	22p
24 pin	24p
28 pin	26p
40 pin	30p

COMPUTER COMPONENTS

CPUs

1802CE	650p
2650A	£12
6502	400p
6502A	650p
6800	290p
6802	300p
6809	650p
6809E	£12
68B09	£12
68B09E	£16
68000-LB	£48
68705-P3	£26
8035	550p
8039	550p
8080A	350p
8085A	950p
8086	£22
8088	£18
8748	£36
TMS1601	£12
TMS9980	£20
TMS9995	£12
WD55	£14.50
Z80	300p
Z80A	400p
Z80B	950p
TMS5220	£12
TMS9901	350p
TMS9902	350p
TMS9903	£25
TMS9911	£18
TMS9914	£14
Z80PIO	300p
Z80APIO	350p
Z80CTC	300p
Z80ACTC	350p
Z80DART	700p
Z80ADART	850p
Z80DMA	900p
Z80ADMA	£10
Z80ASIO-0/1/2/9	900p

SUPPORT DEVICES

2651	£12
3242	800p
3245	450p
6520	300p
6522	350p
6522A	550p
6532	650p
6551	650p
6821	200p
68B21	250p
6829	£12.50
6840	375p
68B40	600p
6850	200p
68B50	250p
68705P3S	£26
6852	250p
6854	700p
68B54	850p
6875	570p
8154	950p
8155	£11
8156	750p
8212	300p
8216	200p
8224	200p
8226	250p
8228	250p
8243	550p
8251A	£10
8253C-5	£10
8255AC-5	£11.50
8256	£36
8257C-5	750
8259C-5	750p
8271	£45
8275	£29
8279	750p
8284	600p
8288D	£11
8755A	£18
TMS4500	£14

MEMORIES

2016-150	350p
2101	400p
2102	200p
2107B	500p
211A-35	300p
2112A-35	300p
2114-2L	220p
2114-4L	170p
2147	450p
4027-3	300p
4116-15	140p
4116-20	120p
4118-3	450p
4164-15	500p
4164-20	450p
4416-15	500p
4532-20	250p
4816AP-3	450p
5101/5501	300p
5516	£10
6116P3	700p
6116LP-3	800p
6264-15	£35
6514-45	300p

PROMs

74S188	180p
74S287	160p
74S288	140p
74S387	225p
74S473	475p
74S570	650p

EPROMs

2516 +5v	350p
2516-35	550p
2532	450p
2532 30	700p
2564	700p
2708	400p
2716 +5v	350p
2716-35	550p
2732	450p
2732A-2	900p
2732A-35	550p
2764-25	900p
27128-25	£22
27128-30	£25
TMS2716	700p

CRT CONTROLLER

CRT5027	£18
CRT5037	£18
CRT6545	£9
EF9364	£8
EF9365	£36
EF9366	£36
EF9367	£36
MC6845	650p
MC6845SP	750p
MC6847	650p
SFF96364	£8
TMS9918	£30
TMS9927	£18
TMS9928	£20
TMS9929	£16

INTERFACE ICs

AD558CJ	775p
AD561J	£20
AD7581	£15
ADC0808	1190p
AM25S10	350p
AM25LS2521	250p
AM25LS2538	250p
AM26LS31	160p
AM26LS32	160p
D7002	450p
DAC80-CB1-V	£28
DM8131	275p
DP8304	250p
DS3691	350p
DS8830	140p
DS8831	150p
DS8832	150p
DS8833	225p
DS8835	280p
DS8836	150p
DS8838	225p
DS8880	170p
LF13201	450p
MC1488	100p
MC1489	100p
MC3446	250p
MC3459	450p
MC3470	650p
MC3480	850p
MC3486	500p
MC3487	300p
MC4024	325p
MC4044	325p
MC14411	700p
MC14412	750p
ML922	400p
ULN2001	100p
ULN2003A	100p
ULN2004A	100p
ULN2068	290p
ULN2802	200p
ULN2803	200p
ULN2804	150p
75107	90p
75108	90p
75109	90p
75110	160p
75112	160p
75113	120p
75114	160p
75115	160p
75121	140p
75122	140p
75150P	120p
75154	140p
75159	220p
75161	350p
75162	400p
7536	150p
75451	72p
75452	72p
75453	72p
75454	72p
75480	150p
75491	65p
75492	65p
8T26	120p
8T28	120p
8T95	90p
8T96	90p
8T97	90p
8T98	90p
81LS95	180p
81LS96	180p
81LS97	180p
81LS98	160p
88LS120	400p
9602	220p
9636A	180p
9637AP	160p
9638	160p
ZN425E8	350p
ZN426E8	350p
ZN427E	600p
ZN428E8	450p
ZN429E	210p
ZN447E	900p
ZN459CP	300p

DISC CONTROLLER ICs

6843	£8
8271	£45
8272	£20
FD1771	£20
FD1791	£22
FD1793	£23
FD1795	£28
FD1797	£28
TMS9909	£12
WD2793	£42
WD2797	£42
WD1691	£15
WD2143	£8

CHARACTER GENERATORS

RO3-32513	
U.C.	750p
L.C.	700p
DM86S64	£12
MC66760	750p
SN74S262AN	1000p

KEYBOARD ENCODERS

AY523761	150p
AY53600	750p
74C922	420p
74C923	500p

BAUD RATE GENERATORS

MC14411	£7
COMB116	£8
4702B	750p

UARTS

AY-3-1015P	300p
AY-5-1013P	300p
COM8017	300p
IM6402	380p
TR1602	300p

ZIF SKTS

(TEXTOOL)

24 pin	575p
28 pin	800p
40 pin	975p

MODULATORS

6MHz UHF	375p
8MHz UHF	450p
Sound & Vision	
12MHz	£12

CRYSTALS

32 768 KHz	100p
100 KHz	400p
200 KHz	400p
Freq in MHz	
1.00	325p
1.8432	300p
2.00	250p
2.45760(L)	210p
2.45760(S)	275p
2.5	250p
2.662	250p
3.276	150p
3.5795	120p
4.00	150p
4.194	200p
4.43	125p
4.608	250p
4.9152	250p
5.000	175p
6.00	150p
6.144	175p
7.00	150p
7.168	175p
8.00	175p
8.867	175p
10.00	175p
10.50	250p
10.70	200p
11.00	300p
12.00	150p
14.00	175p
14.318	175p
14.756	250p
15.00	200p
16.00	200p
18.00	200p
18.432	150p
19.969	150p
20.000	450p
24.000	300p
48.00	175p
116	300p
PX01000	£12

TRANSISTORS

AD161/2	45p
BC107/8	18p
BC109C	20p
BC169C	18p
BC172	18p
BC177/8	30p
BC179	30p
BC182/3	15p
BC184	16p
BC187	30p
BC212/3	16p
BC214	18p
BC237	16p
BC327	16p
BC337	16p
BC338	16p
BC461	40p
BC477/8	36p
BC516/7	50p
BC547B	20p
BC548C	12p
BC549C	16p
BC557B	14p
BC559C	24p
BCY70	30p
BCY71	36p
BD131	75p
BD132	80p
BD135/6	40p
BD139	40p
BD140	40p
BD189	60p
BD232	60p
BD233	75p
BD235	85p
BD241	60p
BD242	60p
BD379	60p
BD380	60p
BD677	40p
BF244B	40p
BF256B	50p
BF257/8	40p
BF337	36p
BFR39	32p
BFR40/1	32p
BFR79	32p
BFR80/1	32p
BFR96	180p
BFX29	45p
BFX30	45p
BFX84/5	30p
BFX86/7	30p
BFX88	30p
BFX89	180p
BFY50	30p
BFY51/2	30p
BFY56	33p
BFY90	90p
BRY39	45p
BSX19/20	30p
BU104	225p
BU105	190p
BU108	250p
BU109	225p
BU126	150p
BU180A	120p
BU205	200p
BU208	200p
BU406	145p
BUX80	600p
BUY69C	350p
E310	50p
MJ413	250p
MJ802	400p
MJ2501	225p
MJ2955	90p
MJ3001	225p
MJ4502	400p
MJE340	60p
MJE2955	150p
MJE3055	120p
MPF102	40p
MPF103/4	40p
MPF105	40p
MPSA06	30p
MPSA12	50p
MPSA13	50p
MPSA20	50p
MPSA42	50p
MPSA43	50p
MPSA56	30p
MPSA70	50p
MPSA93	40p
MPSU06	63p
MPSU07	60p
MPSU45	90p
MPSU65	78p
TIP29A	35p
TIP29C	40p
TIP30A	35p
TIP30C	40p
TIP31A	40p
TIP31C	45p
TIP32A	45p
TIP32C	40p
TIP33A	70p
TIP33C	80p
TIP34A	90p
TIP34C	120p
TIP35A	120p
TIP35C	140p
TIP36A	140p
TIP36C	150p
TIP41A	50p
Ti41C	55p
TIP42A	60p
TIP42C	65p
TIP54	160p
TIP55	180p
TIP120	75p
TIP121	75p
TIP122	80p
TIP125	75p
TIP126	80p
TIP142	120p
TIP147	120p
TIP2955	90p
TIP3055	70p
TIS93	30p
VN10KM	50p
VN66AF	90p
VN88AF	£1
ZTX108	16p
ZTX300	18p
ZTX452	45p
ZTX500	20p
ZTX502	20p
ZTX504	22p
ZTX552	55p
ZTX652	60p
ZTX752	70p
2N697	35p
2N698	45p
2N706A	36p
2N708	36p
2N918	45p
2N930	30p
2N1131/2	50p
2N1613	36p
2N1711	36p
2N2102	70p
2N2160	350p
2N2219A	30p
2N2222A	30p
2N2369A	30p
2N2484	30p
2N2646	50p
2N2904/5	30p
2N2906A	30p
2N2907A	30p
2N2926	12p
2N3053	36p
2N3054	60p
2N3055	55p
2N3442	140p
2N3553	240p
2N3584	250p
2N3643/4	48p
2N3702/3	16p
2N3704/5	16p
2N3706/7	16p
2N3708	16p
2N3773	200p
2N3819	40p
2N3823	30p
2N3866	90p
2N3902	700p
2N3904	18p
2N3906	18p
2N4036	65p
2N4037	65p
2N4123/4	27p
2N4125/6	27p
2N4401/3	25p
2N4427	90p
2N4871	50p
2N5087	27p
2N5089	27p
2N5172	27p
2N5191	90p
2N5245	40p
2N5401	60p
2N5459	30p
2N5460	60p
2N5485	36p
2N5875	250p
2N5883	375p
2N6027	30p
2N6052	300p
2N6059	325p
2N6107	65p
2N6247	190p
2N6254	130p
2N6290	65p
2SC1306	100p
2SC1307	150p
2SC1957	90p
2SC1969	150p
2SC2028	60p
2SC2029	200p
2SC2078	160p
2SC2335	200p
2SC2612	200p
3N128	200p
3N140	200p
3N141	200p
3N201	200p
3N204	200p
40290	250p
40361/2	75p
40595	120p
40673	75p
40871/2	100p

TRIACS PLASTIC

3A400V	60p
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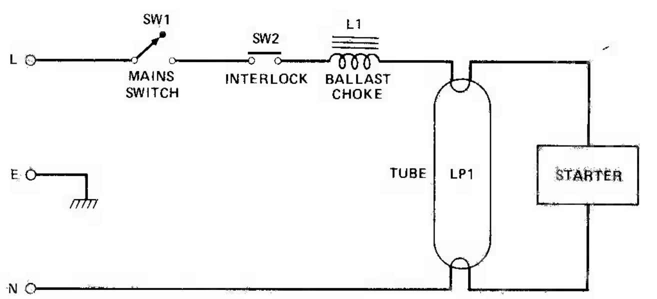
EPROM ERASER

'Wipe that PROM and what do you get? Lots more space and the bits all set!' Phil Walker, ETI's Ode-er in chief, proves yet again that he knows a lot more about electronics than he does about poetry.

The DEPROM is intended as a complement to the EPROM programmer which appears elsewhere in this issue, and must surely rank as one of the simplest projects ever to appear in ETI. The prototype was built to erase just one EPROM at a time but the design can easily be altered to accommodate two EPROMs and possibly even more. In spite of this it is more compact than most commercial units because it uses a six inch, four watt tube rather than the more usual twelve inch, eight watt tube. The complete unit is contained within a light-tight box and a safety interlock system ensures that the potentially harmful ultra-violet light is switched off whenever the lid is raised to load or remove EPROMs.

EPROM erasers use short wavelength ultra-violet light to make the tiny charges stored in the memory matrix drain away. The ultra-violet tube used in the DEPROM is designed to emit a significant amount of light at a wavelength of 2537 angstroms. When an EPROM has been exposed to such a light source for a suitable length of time, the memory locations within it will all read as logic high level. The literature supplied by the manufacturers of the EPROMs you are using should give some idea of the time required for erasure, but in general, half-an-hour or so should be about right.

Fig. 1 Circuit digram of the DEPROM.



HOW IT WORKS

The live connection from the mains is taken via the on/off switch and the interlock micro-switch to the ballast choke. This serves to limit the current flowing in the circuit; without it, the lamp would draw all the current it could until either it or the supply failed. A resistor could be used instead but would dissipate a substantial amount of power. The choke, thanks to its inductive properties, is able to limit the AC current without dissipating lots of power.

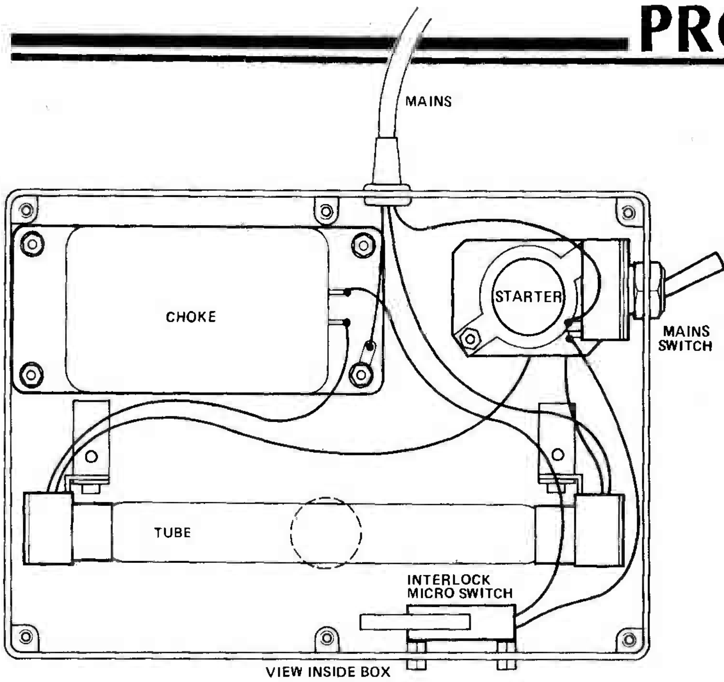
The other side of the choke is taken to one of the filament pins at one end of the ultra-violet tube, and one of the pins at the other end is taken to mains neutral. This completes the mains circuit, but no current will flow yet because the tube will not conduct when it is cold.

The remaining two filament connections, one from each end of the tube, are taken to the starter. The starter consists of two electrodes connected to a bi-metallic strip which short circuits them when it gets hot, the whole assembly sealed inside a small, gas-filled glass bulb. At switch-on, because the tube is cold and therefore presents a high resistance, all the available voltage will appear across the starter. The gas in the starter bulb ionises and gets hot, heating up the bi-metallic strip which then short circuits the two electrodes. This completes the mains path, applying power via the choke to the two filaments in the tube which start to heat up. Meanwhile, because there is now no voltage across the starter, the gas cools until the bi-metallic strip removes the short circuit, thus repeating the cycle. After a few such cycles, the tube filaments will be hot enough to emit electrons, whereupon the gas in the tube will ionise, becoming conductive, and the tube will light. The voltage across the conducting tube will then be too low to ionise the gas in the starter which thus takes no further part.

Construction

The prototype DEPROM was built in a handy sized diecast box. The main requirement is that the box be light-tight, but plastic is not particularly recommended because it may be degraded by the ultra-violet light and the heat produced. If you must use a plastic box, line it with aluminium foil stuck down well and then earth it.

All of the major components of the DEPROM are built into the base of the box with the ultra-violet tube on one side. How you support the tube depends upon the type of end connectors you use, but it is best to make the mounting adjustable so that the tube can be set to the optimum 1" distance from the EPROM. We used screw mounting end connectors and bolted them to two 'V' shaped metal brackets which in turn were bolted to the base of the diecast box. It was then a simple matter to adjust the tube position by bending the brackets to the desired shape.



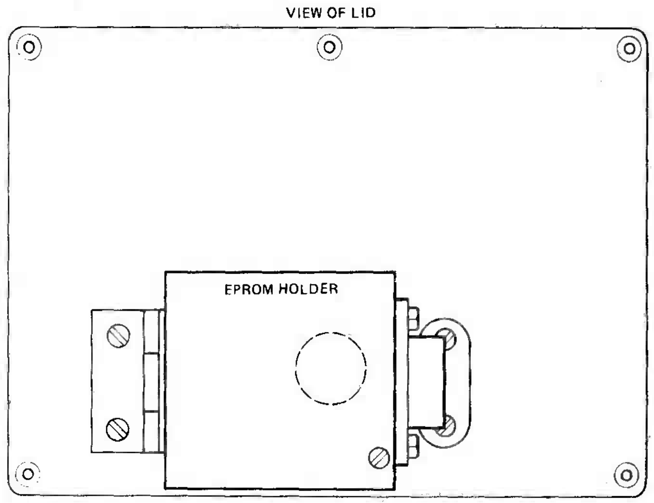


Fig. 2 Internal layout of the DEPROM.

Fig. 4 The EPROM holder mounted on the lid of the main case.

PARTS LIST

LP1	6", 4 watt ultra-violet tube (2537 angstroms, for EPROM erasure)
SW1	SPST mains toggle
SW2	small mains micro-switch with lever
L1	4 watt fluorescent ballast choke

4-20 watt starter and socket; pair of end connectors for tube; diecast box, 171x-121x55mm; plastic box, 72x47x25mm, no lid; hinge; magnetic catch; strain relief bush; mains cable; conductive foam; nuts, bolts, solder tag, etc.

A hole must be punched in the lid of the box to allow light to reach the EPROM. We used a single 18mm hole which is sufficient for one EPROM, but there is no reason why you should not punch more than one hole if you wish to be able to erase several EPROMs simultaneously. Take care when measuring up prior to drilling to ensure that you place the hole or holes directly above the lamp.

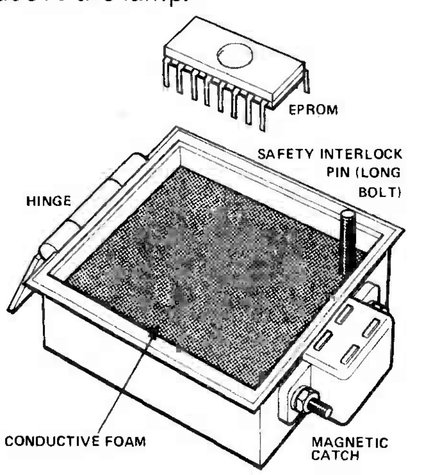


Fig. 3 Construction of the EPROM holder.

A small, light-tight plastic box is placed over the hole to carry the EPROM during erasure. The box is fixed to the lid of the main box with a hinge at one end and a magnetic catch at the other so that it can be raised and lowered. The box should be deep enough to hold an EPROM and a layer of conductive foam, and its length will depend upon the number of EPROMs you wish it to hold. A small potting box or similar would be suitable, but almost any small plastic container would probably do. We used an old battery container and just trimmed off the parts we didn't need.

The small box must be mounted almost flush with one side of the main diecast box, directly above the ultra-violet tube. Placing the tube and the small box to one side allows the micro-switch which forms the safety interlock to be mounted directly to the side of the main box. The micro-switch should be just outside of the light path through the 18mm hole but well within the area covered by the small box. If necessary, you could space it away from the side of the case with washers or nuts until you get it in the right position. A small hole must then be drilled in the lid directly in line with the micro-switch actuating arm. By careful measuring, skill or just plain luck, drill another hole in the top of the small box directly in line with the first hole and the actuating arm of the micro-switch. A long bolt can then be inserted through the hole in the lid and held in place with two nuts. By adjusting the height of the bolt, you should be able to arrange things so that the micro-switch is just activated by the end of the bolt when the lid is fully closed.

With the metalwork out of the way, it only remains to mount the choke, starter and other components and wire the unit up. If the micro-switch you use is of the normal changeover type, make sure you use the normally open (NO) contacts or you will find the safety interlock working in reverse, switching the lamp on when the lid is raised and off when it is lowered. Finally, cut out a suitable piece of conductive foam and secure it in position in the base of the small box. Before you assemble the lid onto the main box, it's quite a good idea to mark the foam to show where it lines up with the light hole. If you close the small box down onto the main box lid, you will be able to see the conductive foam through the light hole and can mark the spot at the centre of the hole with a dab of white paint. Assemble the lid of the main box and the DEPROM is ready for use.

BUYLINES

The six inch tube used in the prototype came from L.B. Electronics, 11 Hercies Road, Hillingdon, Middlesex UB10 9LS. The starter, choke and end connectors should be available locally but in case of real difficulty, a kit of starter, choke, lamp and end connectors is available from the Service Trading Company, 57 Bridgman Road, London W4 5BB. Unfortunately, the tube in this kit is 12" rather than 6" so you would have to use a larger case. A suitable diecast box for the 6" tube version described is available from Greenweld, who also stock potting boxes and ABS boxes suitable for use as the hinged cover (eg., Vero 21024).

ETI

AUTOMATIC LIGHT SWITCH

It may not be the most sophisticated security system imaginable but for fit-it-and-forget-it simplicity it's hard to beat. Design by Phil Walker.

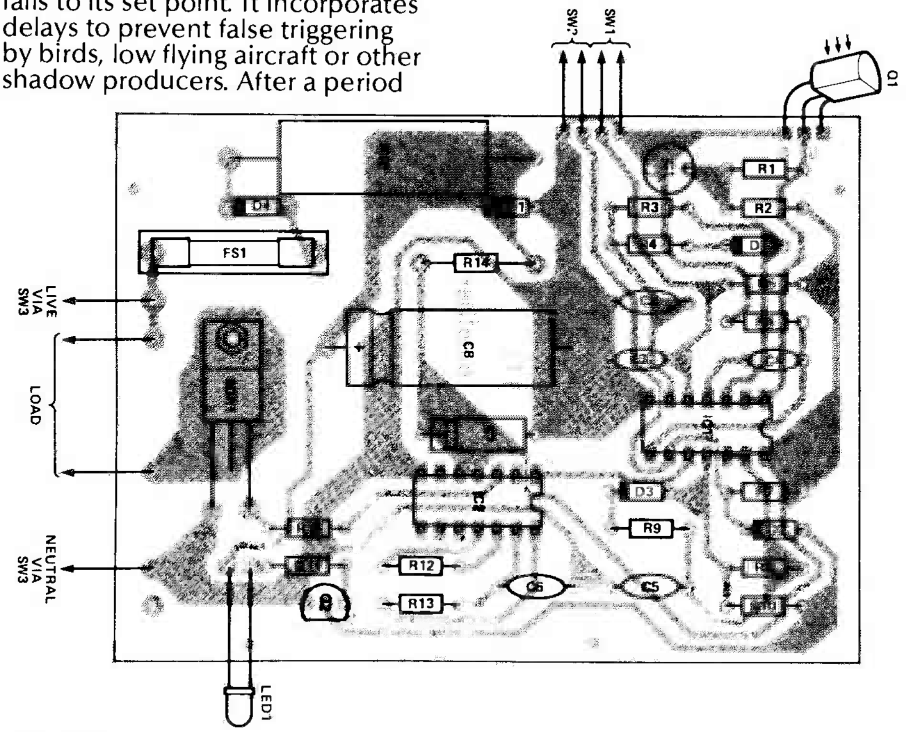
When you are out for the evening, or have gone away for the weekend and forgotten to cancel the milk and papers, this little project can deter the would-be thief.

When you go out for a short period the most noticeable sign of your absence is the lack of lights as dusk approaches. If you could arrange for one or two lights to come on as darkness fell and turn off again some time later, it would appear as if there were someone at home. This, of course, would not be any protection against someone knocking at the door to see if you are in fact at home but may well put them off trying your particular door in the first place.

This project is designed to do just that. It senses the ambient light level and switches on any lights attached to it when the level falls to its set point. It incorporates delays to prevent false triggering by birds, low flying aircraft or other shadow producers. After a period of some four hours, the unit switches off the attached lights and resets itself.

The circuit is reasonably straightforward and uses only two ICs. The light sensitive phototransistor feeds one section of a quad Schmitt trigger NAND gate. The output from this passes via a couple of gating stages to the input of a precision timer IC. When triggered, the output from this device turns on a triac and applies power to the load. After a time determined by components attached to the timer, the triac is turned off again. This is to conserve power and credibility. (How often do you leave lights on all night?)

Power for the logic circuits is derived directly from the mains input via dropping resistors and regulated by circuitry inside the timer chip. This does entail dis-



BUYLINES

Everything here is widely available except the PCB, and that is available exclusively from us! See page 65.

PARTS LIST

RESISTORS
(¼W 5% carbon film unless otherwise stated)

R1,5,6,7	100k
R2,11	1k0
R3	10M
R4,9	10k
R8	3M3
R10	22k
R12	150k
R13	1M5
R14	1k2 1W
R15	470R
R16	10k 5W ww

CAPACITORS
(PCB mounting layer polyester unless otherwise stated)

C1	10µ 16V Tantalum
C2,5,6	1µ
C3,4	10n
C7	100µ 16V axial electrolytic
C8	100µ 63V axial electrolytic

SEMICONDUCTORS

IC1	4093
IC2	ZN1034
Q1	2N5777
Q2	VN10KM
SCR1	TIC206D
D1,2,3	1N4148
D4	1N4007
ZD1	BZX61C30 30V 1W3 Zener
LED1	Red 5mm LED (Preferably insulated panel mounting)

MISCELLANEOUS

SW1	single pole push button
SW2	single pole toggle switch
SW3	two pole mains switch
FS1	1A 20mm mains fuse and PCB holder

PCB; plastic box; free mains socket (if required); grommets/cable glands; wire, nylon bolts, nuts etc.

sipating a couple of watts as heat but saves the cost of a transformer. As an extra, a light emitting diode flashes to show that the device is operating and ready for service.

Construction

Construction should be quite straightforward as all the main components are on the PCB. Start with the resistors, IC sockets (if used), other semiconductors and capacitors, and finish with the fuse-holder and wiring to switches and mains input and output. Care should be taken to get all semiconductors the right way round and great care should be taken in the area around the mains input. The phototransistor should be mounted such that its active face is directed towards a cut out in the box, and can be covered with a piece of transparent plastic to keep fingers out. The switches must be rated for mains operation and the LED mounting must be insulated so that it is not possible to gain access to the wiring.

Mains wiring to the unit should be well secured inside the case, preferably using cable glands or, if unavailable, grommetts and cable ties. We recommend that the PCB should be bolted to the box with nylon or similar non-metallic screws; do not use metal bolts. The output cable would be terminated in a free socket for greatest convenience. Make sure that the earth conductor is connected through.

When everything is ready, plug in the ICs (if not soldered), close the box and plug in. If everything is working the LED should flash when SW2 is open, and covering the phototransistor for a minute or so should turn on a lamp connected to the output for about four hours. If the input is too sensitive (ie, it has to be pitch dark before it comes on), partially cover the phototransistor aperture with black tape or paint and make sure that the box is lightproof. If you cannot get it to work this way, check that SW1 triggers the timer. If this does not work then you will have to check the circuit again, but use an isolated low voltage (24 volt) supply fed in at C9 +ve instead of the mains and connect an LED in place of SCR1.

In use the unit would normally be placed so that it received light from the outside of the building and not from the lamp it controls. This is so that it is not re-triggered when its time period ends and the lamp goes out. Note that the device will usually turn on for its time period when first connected to the mains. This might prove to be a slight nuisance if you only use it on odd occasions, but there is no reason why the unit cannot be left connected all the time, automatically switching on the hall lights, for example, whether you are there or not. ETI

HOW IT WORKS

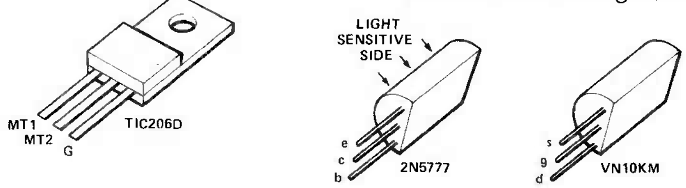
The mains neutral wire is directly connected to the circuitry and is the 0 volt rail as far as the components are concerned. The live wire is connected via FS1, D4 and R16 to ZD1 and C8. This forms a current limited, half-wave rectified supply which charges C8 and supplies current via R14 to an on-chip regulator in IC2. ZD1 is only present to prevent the voltage across C8 becoming too great in the event of IC2 being faulty or removed.

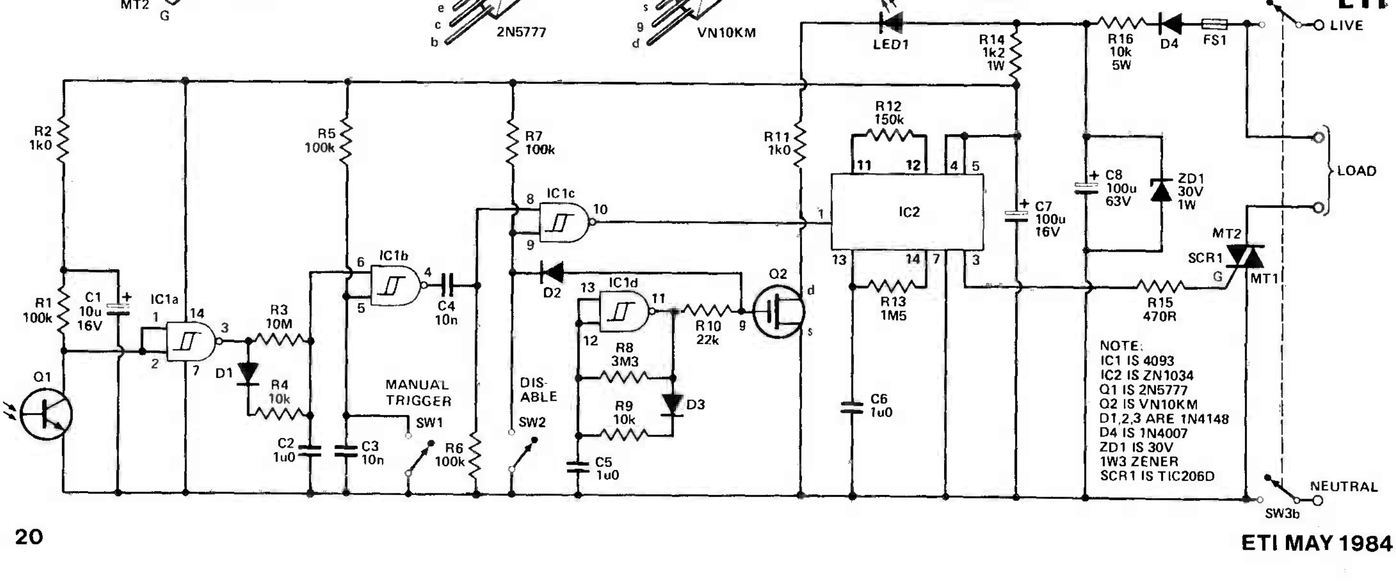
The light sensitive device used in this project is a 2N5777 photo-transistor. This is quite sensitive when used in this circuit and may well require reduction of the amount of light falling on it to set the switch-on point. The collector of the transistor is connected directly to the input of one section of IC1, a 4093 quad NAND Schmitt trigger, and R1 provides a high impedence load. As the light level falls, Q1 conducts less current until the voltage at its collector rises to a little over half the supply voltage. At this point the output of IC1a will go low quite rapidly. C2 will discharge quite slowly via R3 and if the light level remains low for long enough the output of IC1b will go high. If the light level rises significantly before C2 has discharged, the output of IC1a will go high and recharge C2 via R4 and D1 very rapidly. This reduces the sensitivity to shadows, etc.

If and when the output of IC1b goes high, this transition is coupled via C4 to IC1c input. Provided that SW2 is open, the output of IC1c will go low for a period determined by C4 and R6, pulling pin 1 of IC2 low and thus triggering it. SW2, C3 and R5 are provided to permit manual triggering.

IC2 is a ZN1034 precision timer, a device well-suited to applications requiring long time delays because it incorporates a 12-stage binary counter, the output changing state only after 4095 oscillator cycles. The frequency of the internal oscillator, and hence the timing period, is set by R12, R13 and C6. The ZN1034 has complementary outputs, and the output which is high while timing is in progress is used here to drive the triac via R15, thus controlling the mains load.

The circuitry around IC1d forms a low frequency oscillator with a highly asymetric duty cycle. The output from this drives Q2 which is a low power VMOS device to switch power to the LED. The circuit is arranged such that the LED is on for only a short time in the cycle. The power for the flashing LED is taken directly from C8 in order to reduce the dissipation in R14 and IC2 as some 25 mA are required by the LED but only in short pulses. This current would have to be taken by IC2's regulator rail. By connecting it to C8, the voltage across the capacitor can be allowed to drop a little during the "on" period without affecting the regulated supply.





Component Filing
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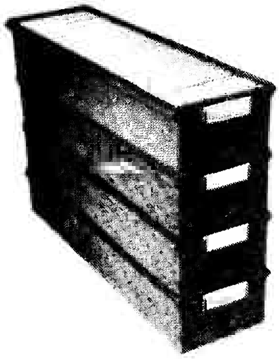

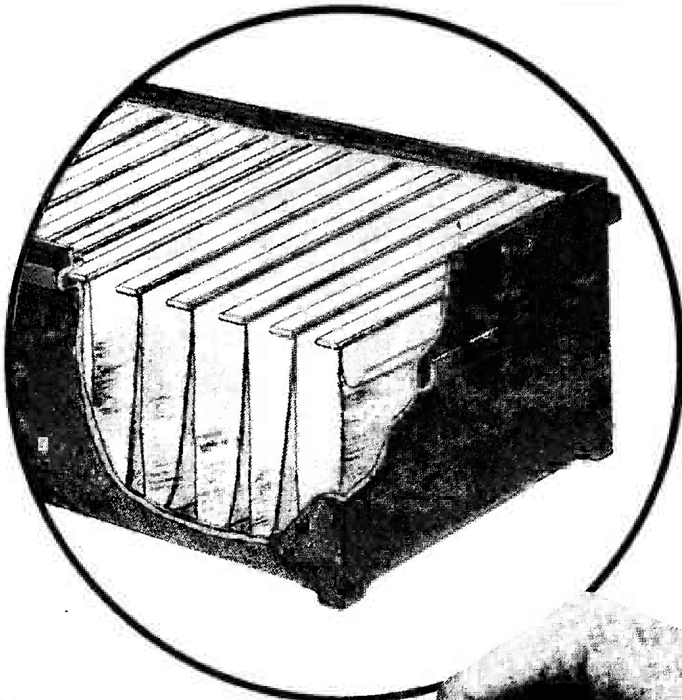

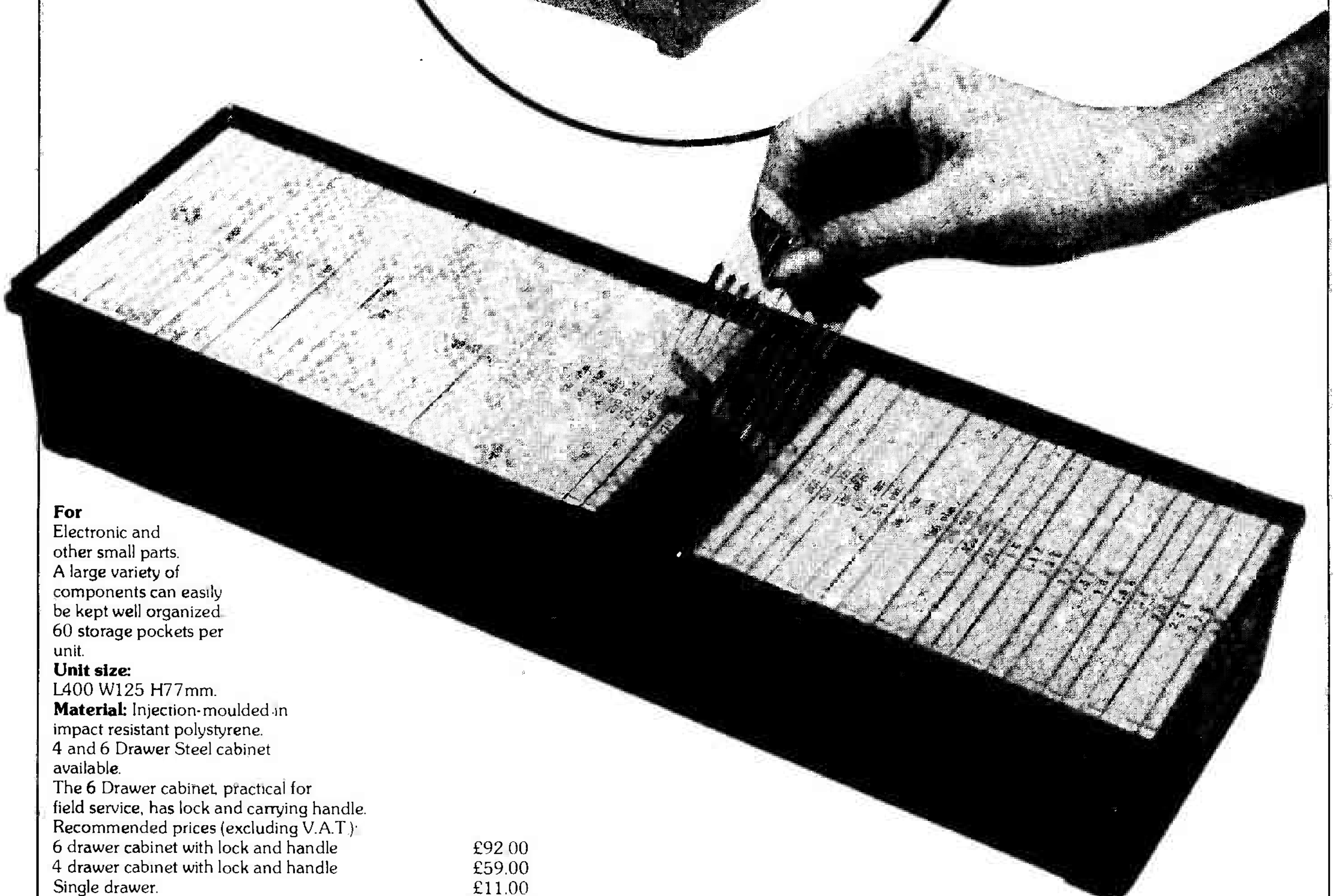

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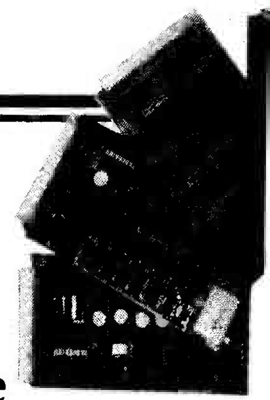
THE WORLD OF



ETI is not the only place that you can find add-ons for the

In 1980, a new type of home computer using the popular 6502 processor made an appearance in the market place. It is essentially a board-based system rather than the more common type of computer packaged within a keyboard enclosure and this product soon gained popularity amongst those wishing go get to grips with computer hardware. The computer in question is the Microtan-65 which has recently been re-released by Microtan Computer Systems Ltd.

The major feature of the Microtan system which sets it apart from most other home computers is that it is modular. Circuit boards are of a 8" x 4½" format with a 64-way indirect edge connector and they connect together by use of a system mother board. Although the most basic system possible does not have many of the features available as standard on some other home computers, the modular approach means that someone can make a start in home computing for a very modest outlay and yet have the opportunity to expand the system.

This magazine has supported the system by publishing designs for a number of Tanbus compatible modules; in addition the fact that Microtan is generally accepted as the 'hardware man's machine' makes it appropriate at this time to carry out a review of the Microtan-65 system in ETI. In the 3 or so years since the launch of Microtan-65 a number of other companies have developed and marketed boards for the system and the intention of this article is to include hardware from all such sources.

MICROTANIC COMPUTER SYSTEMS LTD.

The Microtan-65 was first launched by Tangerine Computer Systems Ltd. who marketed the product until their involvement with the Oric computer forced the Microtan into the back seat. Microtanic Software, a company who had sold software and some hardware add-ons for Microtan, recognising the vacuum being created by the phasing out of Microtan, and negotaited with Tangerine for the licence and rights to the system. The company, which by this time had changed its name to Microtanic Computer Systems Ltd., re-released the Microtan early in 1983. Since then, a number of new products have been announced and ambitious plans exist to guarantee a future for the system.

Before going on to describe the individual products, some comments can be made which refer to all Microtanic boards. When the system was first launched by Tangerine, the first two boards in the system were available either ready built or in kit form, whilst the remainder were sold only as complete boards. Microtanic have now extended the philosophy of providing kits and as a result, most boards are now available in three forms: 1. ready built; 2. as a kit including all parts and documentation; 3. as simply a bare board plus documentation at a cost of £22.00 each (unless stated to the contrary).

The latter two options will be of particular interest to those with a hardware bias as the investment of a little time in building up a board and, perhaps, obtaining components can result in a worthwhile saving in cost. With regard to the kits, anyone with a minimum of constructional experience should have no difficulty at all as the standard of documentation is very good. In some cases boards are also available as either a minimum configuration or fully populated, all options being fitted, although in some cases it is probably less expensive to buy a minimum board and obtain the additional components separately. The mail order address of Microtan Computer Systems Ltd. is 235, Friern Road, Dulwich, London SE22.

Microtan-65

This is the first board in the system. In addition to being the starting point for a larger system, Microtan-65 can be used as a stand-alone board to give a very basic computer allowing machine code programming under the control of the TANBUG monitor. This intitial board includes a 6502 processor, a 2716 EPROM containing the monitor, 1K RAM, VDU circuitry giving a 32 x 16 line monochrome display with lower case characters and chunky graphics as options and a UHF modulator. The Microtan-65 board requries connection to a power supply (various options being available from MCS), either a hex keypad or an ASCII encoded keyboard (both available from MCS) and a TV receiver. The low price of this board (especially if purchased in kit form or as a bare board) must place it as virtually the lowest price entry point into real computing.

References:
1. Kit Survey, ETI, May 1980, p59 (p74 in particular);
2. Microtan-65 review, Computing Today, June 1980, p28;
3. Micron Review, Computing Today, October 1980, p12;
4. Microtan-65, Electronics & Computing Monthly, Dec 1983, p94.

Prices: assembled — £69.96; kit — £59.95.

Tanex

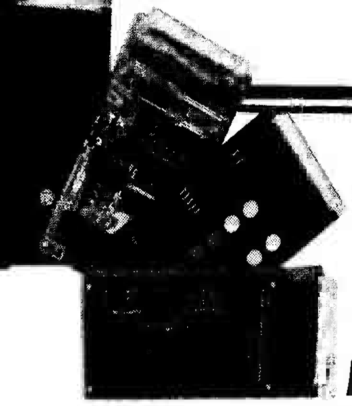
The Tanex board in effect gives the Microtan-65 those facilities which it lacks but which people would expect from a home computer. In other words it provides the minimum upgrade required by those wishing to develop more than small machine code programs. These extra facilities include sockets to take 12K of EPROM memory, sockets for an extra 7K of RAM memory (of 1K is standard), sockets for two 6522 VIAs (of which one is standard), a 300 baud or 2400 baud cassette interface and optionally an RS232, 20mA current loop or TTL serial port. Firmware optionally available for this board includes a 10K Microsoft BASIC and X-Bug, an extension to the TANBUG monitor giving cassette file handling routines and a mnemonic assembler and dissassembler. A two slot mini-mother board is available to provide an inexpensive means of connecting together Microtan-65 and Tanex, but for those intending to extend the system further, the full 12 slot mother board would be required.

References:
1. Micron review, Computing Today, October 1980, p12.

Prices: assembled — £60.95 (minimum configuration), £99.95 (expanded); kit — £49.95 (min. config.), £89.95 (expanded).

Tanram

For users wishing to expand beyond the 8K of RAM memory provided by the combination of Microtan-65



MICROTAN-65

Microtan-65. Mike Bedford reveals other sources.

and Tanex, the Tanram offers 39K of random access memory. This memory is a combination of 7K static and 32K dynamic RAM and expands the system to the maximum amount of RAM memory possible within the memory map of Microtan without going to a paged system. Of this 39K, 16K dynamic RAM is available on the minimum configuration system. If 47K of RAM is not sufficient, however, multiple Tanram cards may be used in conjunction with the system mother board to give a paged memory configuration with up to 328K of RAM which should be more then adequate for the vast majority of users.
Prices:
assembled — £59.95 (min. config.), £109.95 (expanded); kit — £49.95 (min. config.), £99.95 (expanded).

Disc Controller Card

This card allows up to four floppy disc drives to be connected to the Microtan system. These drives may be either 5¼" or 8", single sided or double sided and either single or double density, making the controller very versatile. These facilities are provided using the 1793 controller chip. Also included on board is an EPROM socket which is included to provide a patch for the EPROM based BASIC to give it disc handling routines.This patch works in conjunction with TANDOS, the Microtan disc operating system which is purchased separately from the hardware. One other facility provided on the board is a GPIB interface — this makes use of the 9914 IC and is completely independent from the disc interfacing.
Prices: assembled board — £109.95; TANDOS — £39.95.

Hi-res Graphics Board

For serious graphics applications, the 64 x 64 chunky graphics given by the Microtan-65 board is quite inadequate and a resolution of at least 256 x 256 pixel display given by the high resolution graphics board is a must. The board has an on-board high-bandwidth UHF modulator and also a video output connector so that it may be connected to either a TV receiver or a dedicated monitor. Alternatively, the video signal from the Microtan-65 board may be patched through to the modulator on the hi-res graphics board to give a combined text and graphics display. The board provides monochrome graphics but it is quite feasible to use three cards, connecting the outputs to the red, green and blue inputs of a colour monitor and hence obtaining a full colour display. The display is memory mapped, occupying 8K in the memory map of the Microtan system and may therefore be used as an expansion RAM card when not in use as a graphics card. On some systems this could be a problem in that using a high resolution display effectively reduces the amount of memory available for program storage. In a Microtan sytem, however, this is not the case as it is page selectable and could therefore be placed in a different page to the main RAM memory.
Prices: assembled — £79.95; kit — £69.95.

Real Time Clock

This board provides a battery backed-up real time clock and calender which may be read under program control. Using the 146818 IC it provides read out of second, minute, hour, day or week, day of month, month and year. Additionally there is a 50 byte area of uncommitted CMOS static RAM which is also preserved on power down by the on-board battery supply. There is also a comprehensive interrupt facility which includes the ability to generate a time of day alarm.
Prices: assembled — £39.95; kit — £32.95.

Sound Board

Using two AY-3-8912 programmable sound generation chips, this board provides six independent sound channels. Each of these chanels can be controlled in frequency, amplitude and envelope shape and variable pitch white noise source can be mixed in. This effectively gives the ability to produce an almost infinite variety of complex sounds under program control and may find application in the areas of music and games programs as well as for more serious purposes.
Price: £19.95

Universal Eprom Programmer

As this board is supplied as part of a complete package which includes the necessary operating system software, this description of the product will assume that this software is used. The devices which are supported are the 2516, 2716, 2532, 2732, 2732A and 2764 and the utilities provided are program, read, test for erasure and compare. All functions are controlled by software so that no personality modules are required, nor are there any switches which need setting in order to change from one EPROM type to another. The programmer requires no special power supplies to operate as the +25V or +21V programming voltage is generated by use of a DC-DC convertor. From an ergonomics point of view, the programmer includes a separate socket module onto which a zero insersion force socket is fitted, the module being connected to the main board by a length of ribbon cable.
Prices: assembled — £55.95; kit — £45.95.

Interface Boards

For a system to be truly flexible, it not only requires a powerful data processing capability but also facilities which allow it to control the real world. This is where the serial I/O board and the parallel I/O boards play their part. The parallel board has sockets for eight 6522 VIAs of which one is fitted as standard. These VIAs give a total of 16 bi-directional 8-bit data ports (a total of 160 bits of I/O), sixteen 16-bit programmable counter/timers and eight serial TTL data ports. The serial I/O board, on the other hand, gives 8 serial ports using the 6551 UART, of which two are fitted as standard on the minimum configuration board. These eight ports may be configured to TTL, 20mA current loop or RS232 with full modem control.
Prices: serial assembled — £59.95; parallel assembled — £49.95.

System Controller

This particular product represents the most fundamental addition to the system since it was first launched over three years ago. The system controller is a processor card which is intended to replace the combination of Microtan-65 and Tanex. The following facilities are provided on board: a 6502, 6802, 6808 or 6809 processor running at a clock frequency of 750 KHz, 1 MHz, 1.5 MHz, 2 MHz or 3 MHz; nine 28-pin JEDEC sockets which may contain any combination of 2K, 4K or 8K RAMs or EPROMs as selected by the programming of a bipolar PROM; two 6522 VIAs one of which provides a cassette interface; and a 6551 giving RS232, 20mA current loop or TTL serial interface.

The card does not have any video circuitry, however, which means that in order to communicate with it, either an external VDU should be connected to the RS232 interface or alternatively one of the Tanbus compatible VDU cards should be included in the system. At the moment the only JEDEC RAMs which are available at a resonable price are the 2K x 8 types which means that likely memory configurations for this card would be 8K RAM and 16K EPROM or 16K RAM and 4K EPROM, bipolar PROMs for both these options being available from Microtanic. In the near future, however, the prices of 8K x 8 static RAMs should start to fall which means, of course, that a 56K RAM, 8K EPROM system utilising the full memory map of an 8 bit processor could be achieved on one card.

These considerations of space compression alone, however, would not induce an existing user to change to using the system controller — the attraction here would be the availability of different processors running at higher frequencies. A 6809 running at 2MHz, for example, by far out performs a 6502 running at even the same frequency, let alone the 750KHz of Microtan-65. As regards software, combined version of TANBUG and XBUG called CBUG is available in EPROM for 6502 users whiles a 4K monitor has recently been released for the 6809. It was considered that many users of this card with the 6809 processor would be interested in a disc system and as a result the FLEX and OS-9 disc operating system should be available shortly.

Prices: 6502A (assembled) min — £99.00, expanded — £125.00; 68B09 (assembled) min — £109.00, expanded — £135.00.

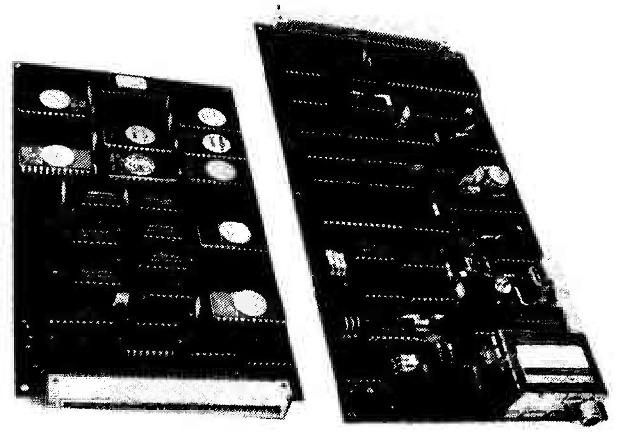
MOUSEPACKET DESIGNS

Mousepacket is a small-scale operation, you might call it a cottage industry. They produce both hardware, as detailed below, and two items of software: a three-pass assembler and a word processor; for details of these, contact Mousepacket at 7, Cedar Close, Grafham, Huntingdon PE18 0DZ.

Colour VDU Board

This card represents yet another different approach to overcoming the limitations imposed by the Microtan-65 display. The philosophy here is to provide colour on a single card and to improve the text display by giving 25 lines of 64 characters. Graphics have not been neglected since a resolution of 128 x 75 is certainly an improvement on 64 x 64 but in all truth must still be described as chunky graphics rather than high resolution. These features are achived by use of a teletext character generator which also provides the following features: foreground and background may be specified from a colour set of eight, characters may be flashing or reverse video and the chunky graphics may be contiguous or separated.

The board has both a video output and a UHF modulator hence allowing connection to either a monitor or a TV receiver, but the manufacturers point out that, as with all computer video displays, a TV may give disappointing



results. A monochrome monitor or TV may also be used, in which case the colours appear as different shades of grey. Mousepacket provide, as part of the package, two EPROMs which replace TANBUG and one of the BASIC EPROMs, hence allowing the system to handle the new display in a way which will be transparent to the user.

Reference:

1. Add-on video board. Computing Today, October 1982. p58.

Prices: £74.95 (monitor version); £84.95 (including PAL encoder and UHF modulator).

EPROM Switching Board

This board is a solution to the problem of the very limited EPROM space available in the Microtan system. The Tanex card has sockets for two 2K EPROMs and two 4K EPROMs, a total of 12K which is mapped into the system from C000 to EFFF. The EPROM switching board occupies this same portion of the memory map but has room for four EPROMs for each of the sockets on Tanex, one EPROM out of each set being selectable at any one time by the circuitry on board. This gives a total EPROM storage space of 48K.

The method of using this card is to remove all the EPROMs from Tanex, replacing them on this card together with whatever other firmware is required to be switched into the memory map on occasions. By writing a value to a single byte location on the card, either from the keyboard or under program control, it is then possible to select whichever EPROM is required in each of the four slots.

Price; £19.95 (board only); £49.95 (assembled).

ELECTRONICS TODAY INTERNATIONAL (Who? — Ed)

ETI have published designs for a number of Microtan add-on boards. Although it is not the intention here to reprint descriptions of these boards it was considered that references should be given for the benefit of those missing the original projects.

Analogue and Audio Output Board: March 1983, p.48
Real Time Clock: April 1983, p31.
Universal EPROM Programmer: Aug83 p45, Sep 83 p37, Jan 84 p61, and p00 this issue.
64K Dynamic RAM Card: September 1983, p64.
16-Channel A to D Board: December 1983, p19.

Prices

Please note that the prices printed here were correct to the best of our knowledge at the time of going to print; however, the world shortage of TTL may have forced some prices up since then, so we urge readers to check prices before ordering any items.

This survey will be concluded next month. **ETI**

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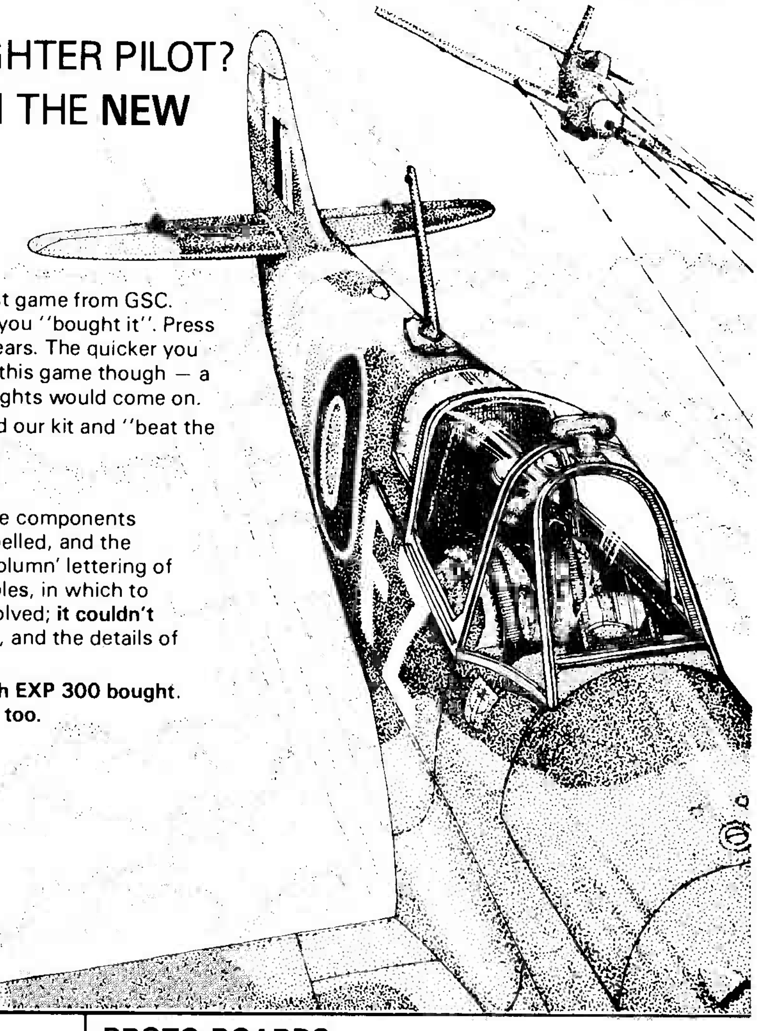

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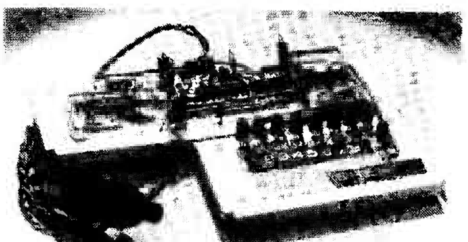

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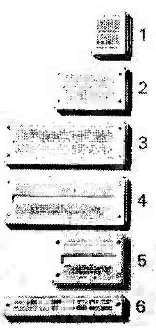

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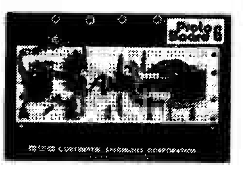

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ZX81 EPROM PROGRAMMER

Take out your ZX81, dust it off, and turn it into a useful piece of electronic gear. Design and development by John Barker.

The ETI ZEPROM computer add-on was designed to provide the ZX81 user with a simple way of storing often-used machine code subroutines so that they would be available on power-up. However, of interest to many more people will be the facility of copying or programming single-rail 2K and 4K EPROMS.

Although copying takes approximately twice as long as the theoretical minimum time of 205 seconds for a full 4K, this should pose no great inconvenience for the average amateur user, but rather give him or her time for a leisurely cup of tea, or whatever, in between frenzied sessions of keyboard bashing. Ease of use was considered one of the main points of design, and anybody who can PEEK, POKE and USR with the best of them should find the ZEPROM helpful in their everyday relationship with their computer.

Anybody thinking of shelling out for an EPROM programmer may find it financially viable to buy a ZX81 and build the ZEPROM instead of buying a stand-alone programmer with a similar specification. The unit, which plugs into the expansion port of a ZX81 or the expansion port of a suitable mother board, can be used with 2516, 2716, 2532 and 2732 type EPROMs, and offers the following facilities:-

1. all the address and data lines are fully buffered, and the EPROM address space is fully decoded;
2. programs EPROMS directly from the keyboard;
3. copy any of the above EPROMS to any other, and check against each other;
4. copy from anywhere in ROM or static RAM;
5. reads and lists EPROMs;
6. enables the user to run up to 8K of machine code held in EPROMs, with simple USR calls;
7. the unit is totally transparent from a user point of view, using POKE commands to program EPROMs, and PEEK commands to read them.

When programming or copying EPROMs it is recommended that any dynamic RAM extension pack is removed because the unit makes use of the Z80 WAIT line and does not provide REFRESH for dynamic memory whilst programming. This does not apply to static RAM packs and no such restrictions apply when running machine code from the unit, or reading EPROMs.

The unit has two 24-pin ZIF sockets, labelled "slave" and "master", and two associated rotary switches. It uses the spare memory space between addresses 8192 and 16383 within the ZX81. The slave EPROM occupies the 4K of memory between 8192 and 122287, and can be written to and read from. The master occupes the 4K from 122288 to 16383 and can only be read from.

Construction

First of all, the copper tracks on the top side of the PCB must be connected through the board. This is done with PCB pins, or, where a component passes through the hole, with a component lead. Check which holes require PCB pins and which do not from the component overlay diagram.

Next connect the ZX81 edge connector to the board, using insulated sleeving on the connector, and breaking off any unused pins. Fit resistors, diodes, transistors capacitors (note orientation of C1), bridge rectifier and regulator. Fit the IC sockets; the wire-wrap sockets for the two EPROMs should not be cut down, but should be mounted about 1" proud of the board. From *one* rotary switch remove the pins for the wiper and three poles for one complete section (this is for SW1). From *both* rotary switches, cut off the looped ends, leaving as much of the pins as possible, and fit both switches to the board. This takes some time and gentle persuasion! Note that SW1 and 2 must be break before make types, or you will end up destroying some of the ICs in the project when the switches are operated.

This project may use only a little mains transformer, but big

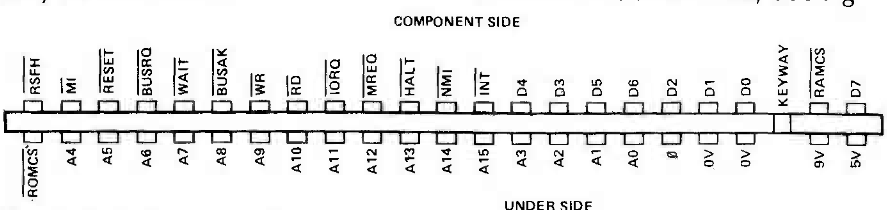


Fig. 1 ZX81 Edge connections, rear view.

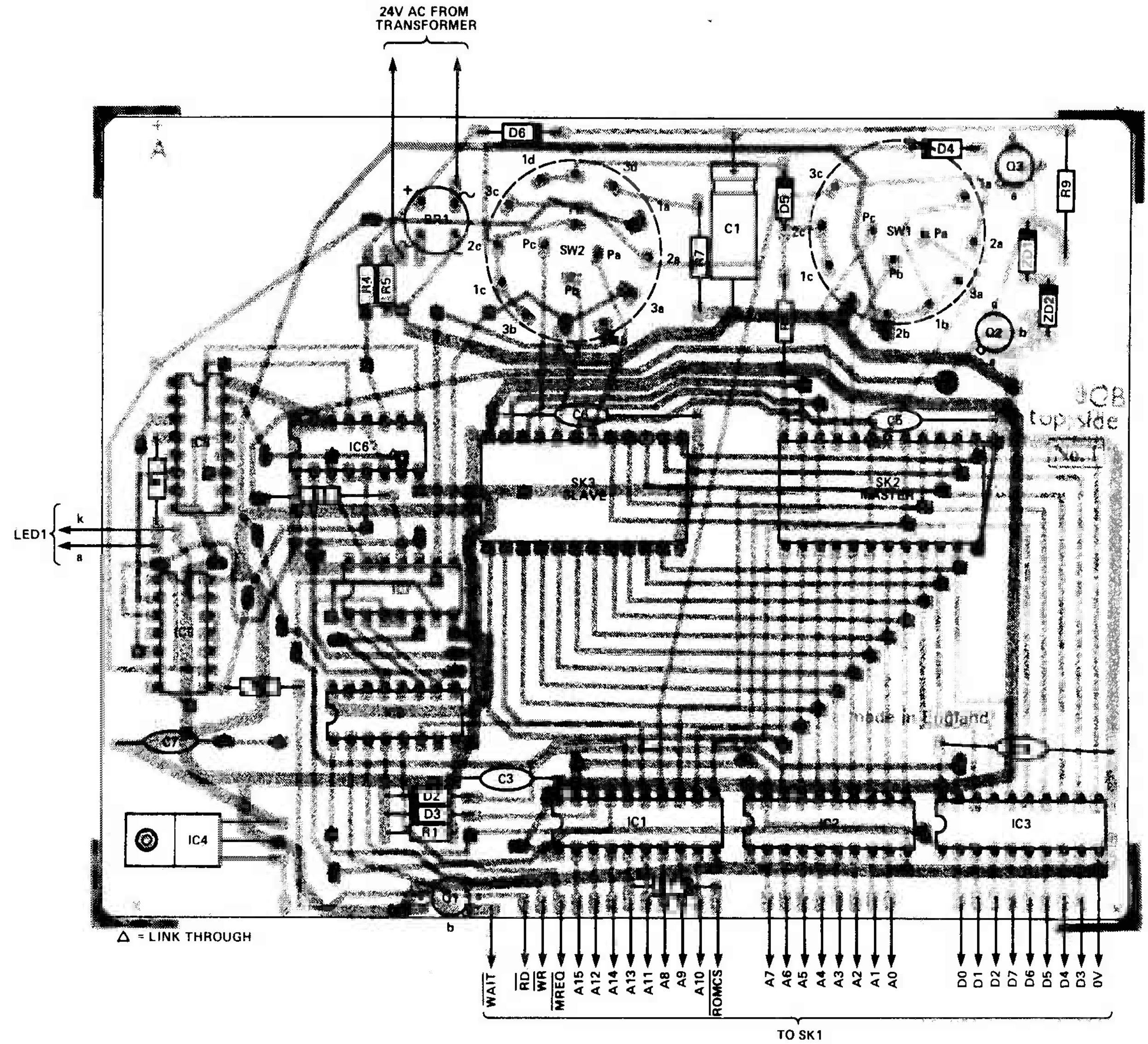


Fig. 2 Component overlay of the PCB.

PARTS LIST

RESISTORS (all ¼W 5% unless stated)		Q3	BFY51
R1	2k7	D1-5	1N4148
R2,8	2k2	D6	1N4001
R3	see text	BR1	1A 100V bridge rectifier
R4	8k2		
R6,5	1k0	ZD1,2	13V zener diodes, 400 mW
R7,9	2k7 1W		
		LED1	any red LED
CAPACITORS		**MISCELLANEOUS**	
C1	22 µF 40V electrolytic	SW1,2	4p 3w rotary switches, break before make
C2-6	100 nF ceramic or polyester		
		SW3	mains switch, double pole
SEMICONDUCTORS		SK1	ZX81 edge connector
IC1,2,3	74LS245		
IC4	7805	SK2,3	24-pin wire-wrap sockets+24 pin ZIF sockets
IC5	74LS138		
IC6	74LS132		
IC7	74LS08	T1	24V 100mA mains transformer
IC8	CD4017		
IC9	74LS02	PCB, case to suit, mains fuse (100 mA)	
Q1,2	BC108	and holder; wire, solder, etc.	

precautions are necessary with regard to safety. We strongly recommend earthing the transformer body as well as the screen connection if it has one. If the case is metal or has a metal front panel, this should be earthed as well. A 24 V type transformer is specified; obviously a 12-0-12 type can be used, or a 0-12, 0-12 with the secondaries in series. Unused flying leads, if there are any, should be trimmed well back to keep them out of trouble.

The unit can be mounted in virtually any case, provided that it is large enough to accommodate the PCB and transformer. In the prototype, the PCB is mounted so that SK2 and 3 project through the lid of the box; the PCB is actually supported by SW1 and 2, which are bolted to the panel, and a cork block underneath glued to the bottom of the case. The ZIF sockets should be pushed carefully home into the wire-wrap sockets after the board is attached to the panel.

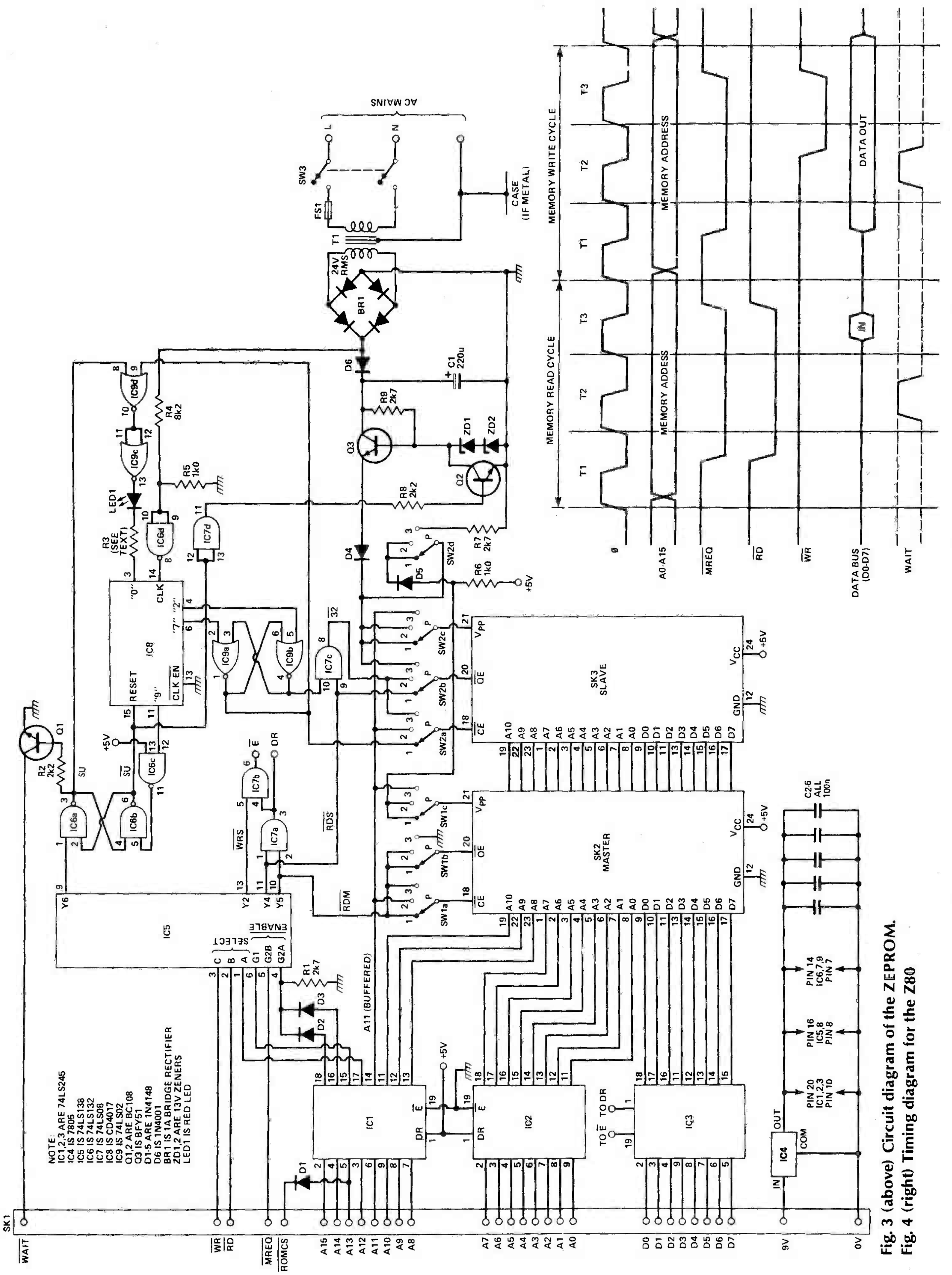


Fig. 3 (above) Circuit diagram of the ZEPROM.
Fig. 4 (right) Timing diagram for the Z80

HOW IT WORKS

The unit is treated as an 8K block of memory, the spare 8K between 8192 and 16383, which is an image of the Sinclair ROM, and it is the job of D5 to deselect the ROM when the unit is in use. IC1 and IC2 buffer the 16 address lines and are continuously enabled. IC3 buffers the eight data lines, and is normally disabled. IC4 uses the four highest address lines to decode and enable the unit, and depends on the fact that in Z80 timing for a WRITE command the WR line goes low one 'T' state after the MREQ line. In the quiescent condition the control lines are as follows:

SU, W and IC9 output are low;

$\overline{SL}$, $\overline{SU}$, $\overline{WRS}$, $\overline{RDS}$, $\overline{RDM}$, DR, $\overline{E}$, $\overline{W}$ and $\overline{32}$ are high;

IC6d is pulsing at a frequency of 100 Hz.

Q1 is turned off, Q3 is on, Q2 emitter is at 0V, and the counter IC8 is reset with its "O" output high. The LED is lit giving a visual indication that the unit is correct and ready to use. Figure 2 shows the required conditions for correct operation; it is the job of IC5, 6, 7, 8 and 9 to provide these, as follows.

When a READ command is made to an address between 8192 and 12287, $\overline{RDS}$, $\overline{32}$, $\overline{E}$ and DR all go low. $\overline{RDS}$ or $\overline{32}$, depending on the setting of SW2, will enable the slave EPROM, $\overline{E}$ will enable IC3 and sets the direction of data transfer from the EPROM to the CPU. When a READ command is made to an address between 12288 and 16383, $\overline{RDM}$, $\overline{E}$ and DR go low. $\overline{RDM}$ enables the master EPROM, whilst the functioning of $\overline{E}$ and DR is identical to the above.

When a WRITE command is made to the slave EPROM, SL goes low for approximately 300ns, setting the latch IC6a/b followed by $\overline{WRS}$ and $\overline{E}$ going low. The latch turns Q1 on, which pulls the WAIT line low, forcing the CPU to hold its address and data lines stable, and also enables IC8 to count.

This also turns Q1 off via IC7d, providing a V_{PP} voltage of 25 V to the slave EPROM. IC8 now starts to count from "0" and in incremented every 10ms by IC6d. On the count of "2", the latch IC9a/b is set. This latch gives a precisely defined pulse of 50ms, being reset by IC8 at a count of "7". When it reaches a count of "9", IC6c resets the latch IC6a/b, removing the V_{PP} voltage, resetting the counter to "0" and releasing the CPU from its WAIT condition. The cycle is completed and one location of the EPROM has now been programmed with the unit ready for another cycle to commence.

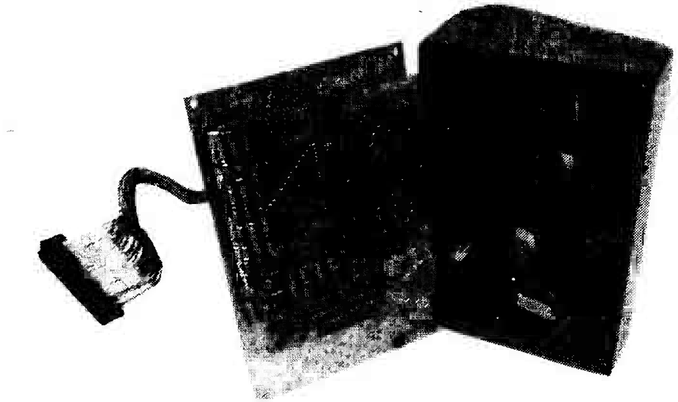
INPUT			O/P PIN
A12	$\overline{RD}$	$\overline{WR}$	
0	0	0	15
1	0	0	14
0	1	0	13 $\overline{WRS}$
1	1	0	12
0	0	1	11 $\overline{RDS}$
1	0	1	10 $\overline{RDM}$
0	1	1	9 $\overline{SL}$
1	1	1	7

NOTE:
IC5 IS ENABLED WHEN A13 IS HIGH AND A14, A15 AND $\overline{MREQ}$ ARE LOW

	PIN	2516 2716		2532		2732		
SLAVE	18	0	W	A11	A11		$\overline{32}$	READ
	20		$\overline{RDS}$		$\overline{32}$	0	V_{PP}	
	21	1	V_{PP}	1	V_{PP}	A11	A11	
	18	50 mS	W	A11	A11	50 mS	$\overline{32}$	PROGRAM
	20	1	$\overline{RDS}$	50 mS	$\overline{32}$	25V 0V 90mS	V_{PP}	
	21	25V 5V 90mS	V_{PP}	25V 5V 90mS	V_{PP}	A11	A11	
MASTER	18		$\overline{RDM}$	A11	A11		$\overline{RDM}$	READ
	20		$\overline{RDM}$		$\overline{RDM}$	0	0V	
	21	1	5V	1	5V	A11	A11	

Fig. 5 (above) IC5 operation.

Fig. 6 (right) EPROM requirements.



Internal view of the ZEPROM — note the other use that the cork support is put to (storage of fishing line, optional)!

Making The Connection

Before connecting the unit to the ZX81, a thorough check of construction should be undertaken, looking for dry joints, solder-blob shorts, correct orientation of components and correct connection from the boards to the edge connector. Mistakes in construction may damage the ZX81, as well as the ZEPROM.

With no EPROMs fitted, connect the unit to the ZX81 and apply power to both (the unit should never be connected or disconnected with power applied to either). If the unit is normal, the LED should be lit, and the usual "K" should be visible on the screen. If the LED is not lit, the unit can be initialized by using the direct command POKE 8888,255.

A PEEK command to any location between 8192 and 16383 should return a value of 255. A POKE command to any location between 8192 and 122287 should flash the screen and the LED. A POKE command to any location between 122288 and 16383 should have no effect.

After connecting power, always initialize the unit (ie, light the LED) with the direct command POKE 8888,255. If at any time whilst the unit is being used (ie when inserting or removing EPROMs) the LED goes out, the unit must be initialized. The unit cannot be properly used unless reset.

To copy and check EPROMs, proceed as follows:

1. set personality switches to type of EPROM in each socket, where:-
   A=2516 or 2716
   B=2532
   C=2732;
2. insert master EPROM;
3. enter program 1. On line 10, 2047 is for a 2716 or 2516 type EPROM, and should be changed to 4095 for 2732 or 2532 types, or changed to the number of bytes to

BUYLINES

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```
1 PRINT "SET PERSONALITY SWITCHES"
2 STOP
3 POKE 8888,255
10 FOR N=0 TO 2047
12 LET A=N+8192
14 LET B=N+12288
20 POKE A, PEEK B
30 IF PEEK A<>PEEK B THEN PRINT N; TAB 7; PEEK A, PEEK B
40 NEXT N
```

Program 1.

```
10 LET X=8192
20 INPUT A$
25 POKE 8888,255
30 IF A$=" " THEN GOTO 20
40 POKE X,16*CODE A$ + CODE A$(2)-476
50 LET X = X+1
60 LET A$=A$(3 TO )
70 GOTO 30
```

Program 2.

be copied. On line 12, 8192 is the first address of the slave EPROM and on line 14, 122288 is the first address of the master EPROM;
4. run the program.

When copying EPROMs, the above software is best run in FAST mode. When the program is run, the screen should go blank and the LED should pulse. When the program has finished, the screen should reappear and there should be no discrepancies listed. To load EPROMs from the keyboard, do the following:
1. insert the EPROM into the slave socket, set the personality switch, and initialize the unit as necessary;
2. load program 2. This program is best run in slow mode. When running, you should enter the data in hexadecimal (with no spaces between characters) in response to the string input prompt, about 10 bytes at a time; then press newline, and then continue entering data. In line 10, 8192 is the first location of the EPROM, and can be changed to any value in the range 8192 to 12287.

If at any time the LED goes out, the unit can be initialized by inputting a null string (i.e. press NEWLINE). To escape from the program, input S.

Machine code subroutines can be called anywhere between 8192 and 16383 by the simple command:-
RAND USR H
where H is the start address of the particular subroutine being called. As an example, load program 2 and run it. Input the five bytes:- 3E07D718FB in response to the input prompt, press NEWLINE, then input S to escape, and return to BASIC. Input the direct command RAND USR 8192, and the screen should fill with character "6"s. **ETI**

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13	48p
14	56p
15	71p
16	37p
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27	31p
30	31p
32	32p
38	32p
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AC141B	25p	BC547/B	7p	BU406	£1.02	2N2222A	18p
AC141K	33p	BC548/B	7p	BUY87	£1.82	2N2368A	21p
AC142K	33p	BC549C	7p	MEO404	9p	2N2369A	21p
AC153	30p	BC556	8p	MEO412	7p	2N2646	43p
AC171	27p	BC557	7p	MEO6102	11p	2N2647	96p
AC175	33p	BC558/B	8p	MEU21	48p	2N2904	18p
AC176	27p	BC559	8p	MJ423	£3.30	2N2905A	22p
AC181K	48p	BC636	18p	MJ2251	90p	2N2906	18p
AC184	45p	BCX33	22p	MJ2501	£1.20	2N2907	22p
AC185	45p	BCX58	18p	MJ3001	£1.35	2N3012	45p
AC186	45p	BCY42	27p	MJE340	32p	2N3019	48p
AC187K	30p	BCY70/1	16p	MJE520	48p	2N3053	27p
AC188	22p	BCY72/B	15p	MPS404	22p	2N3054	36p
AC193K	33p	BCY91	22p	MPS3640	22p	2N3055	39p
AC194K	33p	BD112	£1.05	MPSA05	22p	2N3440	58p
ACY17	£1.19	BD115	27p	MPSA06	18p	2N3442	£1.08
ACY18	£1.19	BD116	38p	MPSA12	20p	2N3546	97p
ACY22	£1.19	BD131/2	24p	MPSA14	25p	2N3583	78p
ACY44	52p	BD135/6	27p	MPSA42	15p	2N3638	22p
AD140/2	97p	BD139	38p	MPSA43	18p	2N3641/2	30p
AD149	97p	BD140	35p	MPSA56	22p	2N3702/3	9p
AD161/2	38p	BD176	38p	MPSA92	28p	2N3704/5	10p
AF126C	25p	BD232	44p	MPSU04	81p	2N3706/7	9p
AF139	38p	BD236	41p	MPSU10	87p	2N3710/11	7p
ASY27	£1.88	BD371B	25p	OC25	87p	2N3724	45p
AU110	£2.55	BD436	38p	OC28	£1.04	2N3771	£1.44
BC107	8p	BD439	41p	MC29	£1.27	2N3772	£1.44
BC108	7p	BD675	64p	OC45	54p	2N3773	£1.58
BC108c	10p	BD877	64p	OC71	27p	2N3819	25p
BC109	9p	BDY55	£1.73	OC75	33p	2N3820	45p
BC109c	11p	BF180	28p	OC76	27p	2N3903	12p
BC118	10p	BF194	9p	OC205	£2.70	2N3904	10p
BC119	22p	BF195	12p	SE3453	89p	2N3905	12p
BC125B	12p	BF196	12p	TIP29	25p	2N3906	10p
BC134/7	10p	BF197	14p	TIP30	23p	2N3947	£1.08
BC140	22p	BF198	18p	TIP31A	25p	2N4061	12p
BC141	25p	BF199	14p	TIP31C	33p	2N4126	18p
BC142/3	23p	BF224	33p	TIP32A	25p	2N4340	91p
BC147	8p	BF241	18p	TIP32C	33p	2N4347	£1.34
BC148	9p	BF244	28p	TIP33A	57p	2N4358	59p
BC149	8p	BF245	28p	TIP34A	77p	2N4402	18p
BC158	9p	BF255	22p	TIP35A	£1.57	2N4871	66p
BC159	8p	BF256A	43p	TIP36A	£1.67	2N5246	38p
BC161	25p	BF258	28p	TIP41A	24p	2N5308	23p
BC167A	8p	BF259	30p	TIP42A	24p	2N5320/2	38p
BC171	8p	BF274	27p	TIP42B	32p	2N5416	57p
BC172	7p	BF337/8	25p	TIP47	38p	2N5447/9	9p
BC173	8p	BF391	27p	TIP110/2	38p	2N5457/9	38p
BC177	15p	BF459	38p	TIP115	25p	2N5550	18p
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BC327/8	9p	BSX93	48p	2N1303	83p	2SK135	£3.13
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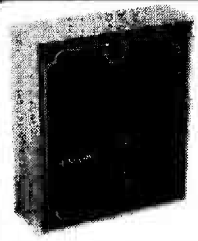

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DIGITAL ULTRASONIC DETECTOR US 5063

only £13.95 + V.A.T.

NEW

- 3 levels of discrimination against false alarms
- Crystal control for greater stability
- Adjustable range up to 25ft.
- Built-in delays
- 12V operation

This advanced new module uses digital signal processing to provide the highest level of sensitivity whilst discriminating against potential false alarm conditions. The module has a built-in exit delay and timed alarm period, together with a selectable entrance delay, plus many more outstanding features.

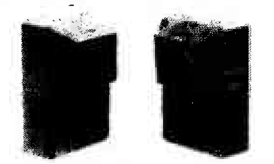
ULTRASONIC MODULE US 4012

£10.95 +V.A.T.

- Adjustable range from 5-25ft.

This popular low cost ultrasonic detector is already used in a wider range of applications from intruder detectors to automatic light switches and door opening equipment, featuring 2 LED indicators for ease of setting up.

INFRA-RED SYSTEM IR 1470 only £25.61 +V.A.T.



Consisting of separate transmitter and receiver both of which are housed in attractive moulded cases, the system provides an invisible modulated beam over distances of up to 50ft. operating a relay when the beam is broken. Intended for use in security systems, but also ideal for photographic and measurement applications. Size 80 by 50 by 35mm.

POWER SUPPLY & RELAY UNIT PS 4012

Provides stabilised 12V output at 85mA and contains a relay with 3 amp contacts. The unit is designed to operate with up to 2 ultrasonic units or 1 infra-red unit IR 1470. Price £4.25 + V.A.T.

SIREN MODULE SL 157

Produces a loud penetrating sliding tone which, when coupled to a suitable horn speaker, produces S.P.L.'s of 110dbs at 2 metres. Operating from 9-15V. Price £2.95 + V.A.T.

5½" HORN SPEAKER HS 588

This weather-proof horn speaker provides extremely high sound pressure levels (110dbs at 2 metres) when used with the CA 1250, PS 1865 or SL 157. Price £4.95 + V.A.T.

3-POS. KEY SWITCH 3901

Single pole, 3-pos. key switch intended for use with the CA 1250. Price £3.43 + V.A.T.

ALARM CONTROL UNIT CA 1250

Price £19.95 + V.A.T.

The heart of any alarm system is the control unit. The CA 1250 offers every possible feature that is likely to be required when constructing a system whether a highly sophisticated installation or simply controlling a single magnetic switch on the front door.

- Built-in electronic siren drives 2 loud speakers
- Provides exit and entrance delays together with fixed alarm time
- Battery back-up with trickle charging facility
- Operates with magnetic switches, pressure pads, ultrasonic or I.R. units
- Anti-tamper and panic facility
- Stabilised output voltage
- 2 operating modes - full alarm/anti-tamper and panic facility
- Screw connections for ease of installation
- Separate relay contacts for external loads
- Test loop facility

SIREN & POWER SUPPLY MODULE PSL 1865

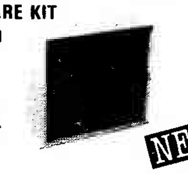
only £9.95 + V.A.T.

NEW

A complete siren and power supply module which is capable of providing sound levels of 110dbs at 2 metres when used with a horn speaker. In addition, the unit provides a stabilised 12V output up to 100mA. A switching relay is also included so that the unit may be used in conjunction with the US 5063 to form a complete alarm.

HARDWARE KIT HW 1250

only £9.50 + V.A.T.



NEW

This attractive case is designed to house the control unit CA 1250, together with the appropriate LED indicators and key switch. Supplied with the necessary mounting pillars and punched front panel, the unit is given a professional appearance by an adhesive silk screened label. Size 200 by 180 by 70mm.

ULTRASONIC MODULE ENCLOSURE

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NEW

Suitable metal enclosure for housing an individual ultrasonic module type US 5063 or US 4012. Supplied with the necessary mounting pillars and screws etc. For US 5063 order SC 5063; for US 4012 order SC 4012.

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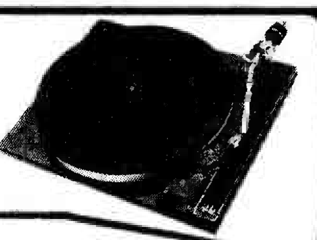
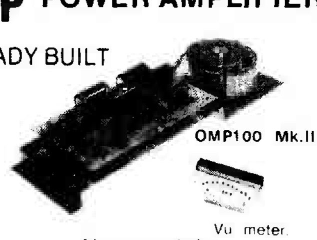


OMP POWER AMPLIFIER MODULE

READY BUILT



New model.
Improved specification

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

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

MOS-FET HIGH SPEC. MODULES

MOS-FET VERSIONS AVAILABLE UP TO 300 W. R.M.S.
100 Watt 300mm × 123mm × 60mm Price: £39.99 + £2.50 P&P.
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FM MICROTRANSMITTER (BUG) 90/105MHz with very sensitive microphone. Range 100/300 metres. 57 × 46 × 14mm (9 volt) **Price: £7.99 + 75p P&P.**

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

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3 watt FM Transmitter

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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.**

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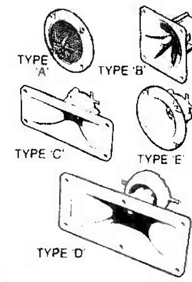

TYPE 'A' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-fi speakers. **Price £4.29 each** + 30p P&P.
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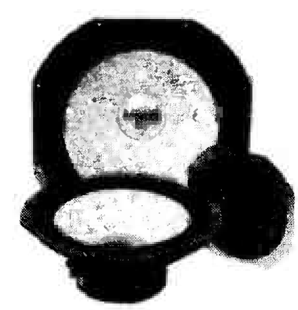
TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. **Price £7.99 each** + 30p P&P.
TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-fi monitor systems etc. **Price £4.99 each** + 30p P&P.

LOUDSPEAKERS POWER RANGE

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

15" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 20 Hz. Freq. Resp. to 2.5KHz. Sens 97dB. **Price: £34.00 each** + £3.00 P&P.
12" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 25Hz. Freq. Resp. to 4 KHz Sens. 95dB. **Price: £24.50 each** + £3.00 P&P.
8" 50 watt R.M.S. Impedance 8 ohms. 20 oz. magnet. 1½" aluminium voice coil. Res. Freq. 40Hz. Freq Resp. to 6 KHz Sens. 92dB. Black Cone. **Price: £9.50 each.** Also available with black protective grille. **Price: £10.50 each.** P&P £1.50



12" 85 watts R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2" aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq 45Hz., Freq. Resp. to 6.5kHz., Sens. 98dB. **Price £24.99** + £3 carriage.
12" 85 watt R.M.S. McKENZIE C1285TC (P.A., DISCO) 2" aluminium voice coil. Twin cone. 8 ohm. imp., Res. Freq. 45HZ., Freq. Resp. to 14KHz. **Price £24.99** + £3 carriage.
15" 150 watt R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil. Die cast chassis. 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. **Price £49** + £4 carriage. Cabinets fixings in stock S.A.E.

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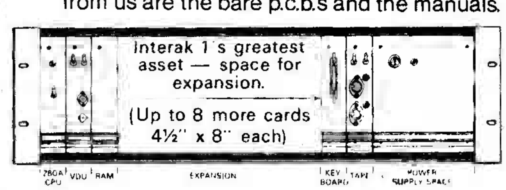

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READ/WRITE

We were slightly disappointed by the poor response to Alan Todd's request for help in the March issue of ETI. For the benefit of those who didn't see the March issue, Alan is an ex-professional bass guitarist who suffered a stroke and now has only limited movement in his right hand. He wrote asking if anyone could suggest a means by which he might play his guitar using only his left hand and the little remaining movement in his right. We set a time limit on replies, partly because we intended to organise things along the lines of a competition, but in view of the meagre response we have decided to invite further suggestions. So get thinking, send in your ideas, and if anyone comes up with a worthwhile solution we will publish it in the normal way and pay the author accordingly.

Cable Television

Dear Sir,

Having read your 'Special Report' in the March 84 issue of ETI, I would like to offer a few constructive comments about its content, particularly with respect to the references to Thorn EMI.

There has been much publicity surrounding Cable TV activities when the ITAP and Hunt Reports and the Governments White Paper were published, and mainly this publicity has centred around the 30 channels of television programmes that Cable TV can bring to the home. The viability or otherwise of cable has been viewed in the light of how much a subscriber can afford to pay for premium movies, and little consideration has been given to the other services that cable can offer.

New cable systems which will be constructed as a result of the granting of franchises will generally have a usable bandwidth of about 420 MHz for a single coaxial cable and of this only about 260 MHz will be taken up by 30 TV channels and FM radio, leaving almost 40% of the spectrum available for other services. Unused bandwidth is an asset which no cable operator can afford to waste, so I have no doubt that all operators will be looking for new services that can be carried on cable in a cost effective way. Two uses that immediately spring to mind are high speed data for business users transported at competitive prices, and interactive services for the home. Interactive services include shopping, security, banking, betting and access to prestel and similar databases using only the subscribers TV set and a keypad. Such services are expected to be largely financed by the service providers so the subscriber to cable will be able to obtain a comprehensive range of services and television programmes at a relatively modest cost.

Regarding the content of the television programmes, it is not intended that cable should compete with the excellent BBC and IBA programmes — it is mainly a question of giving viewers a much wider choice, and particularly for minority groups, a number of alternative programmes which complement the off air channels. Some of these programmes will cover local events and news that would not be carried by the national broadcasts anyway. If viewers want "wall to wall Dallas" then the cable operator will provide it, but there is no reason to believe that this will cause the broadcasters to lower their standards to compete — Top of the Pops on TV has not emptied the concert halls!

Off air programmes including satellite broadcasts (DBS) must be carried on a cable network under the Government 'must cary' rule, and cable will save the subscriber the cost of a satellite receiving dish and down-converter. If Government legislation permits DBS will also be converted at the cable head end into PAL-I so that these broadcasts can be received on the subscribers existing TV set.

Turning now to technical aspects, the Thorn EMI position you describe was that which obtained about a year ago. It is true that we had developed our TACCS system for tree structured systems. It was an advanced teletext based system capable of providing all the interactive facilities outlined in the White Paper, and it was more comprehensive than any of its contemporaries. We have since changed our plans to a switch oriented design, mainly because the DBS standards had not (and still have not) been determined, and because the DOTI restricted to 12 years the franchise for tree systems, but will extend the period for those cable networks laid with the final distribution in star format, and which are switchable.

Enlarging on those points respectively: equipment that has to carry DBS on a tree structured cable cannot be designed until the standards are known; 12 years is too short a period to depreciate the costs of cable equipment; and the increased costs of cable for star layout eroded the tree/switched cost differential.

Our current switched design is equally advanced and retains all the virtues of TACCS, ie. high speed teletext data transport, within the TV channel where appropriate, albeit with data now routed through the switch rather than direct to the subscriber.

On the question of fibre optics, much has been written about this inexpensive transmission medium with its very high bandwidth. This is true where monomode fibre is used for long haul links — typically for inter-city use. But this is no use to the cable operator who wants to carry many services and programmes over relatively short distances, the opto-electronic couplers at each end of the short lengths of fibre are far too expensive at present.

What is required is a wide bodied air bus — not Concord! Where a point to point link is required across a city to feed a remote head end, then fibre will possibly be the best medium, but for short distances broadband copper wins hands down.

I hope this may have cleared up any misconceptions regarding the Thorn EMI role in Cable TV.

Yours faithfully,
Peter Barnes,
Technical Development Manager,
Radio Rentals Cable TV Limited

Of Microtans And Men

Dear Dave,

Firstly may I say how delighted we are in the North West now that Mike Bedford has ironed out the software snags to produce an effective and versatile Eprom Programmer for the correspondingly versatile 6502 based development system known as the Microtan. We now look forward eagerly to the intelligent programming version of the software. To date we have successfully programmed 2716's, 2732's, 2732A's and 2764's.

Secondly, may I say how flattering it is to be mentioned in despatches. Frankly however, praise should really go to my North West friends Andy Michael and Graham Fishwick who did much of the work. Actually, this is a good example of how the informal association of North West Microtan users help each other over both hardware and software difficulties.

Thirdly, having followed recent TUG events from close up and having shared the concern at first hand with friends country wide, I would like to extend our encouragement to Colin Nowells in his difficult task of raising a new group from the ashes. We really do need the resurrection of the 'TUG' newsletter as it complements so well the other thriving journal produced by David Northway and Deryck Sutton of Microtanic Computer Systems.

Finally, I would like to extend an invitation to North West users to communicate with our informal 'self help' group and enjoy the sense of comfort and security offered by the proximity of like and experienced minds. Please phone me on Bolton 654145 or write to 15 Newland Drive, Over Hulton, Bolton, Lancs.

Yours etc.
Graham Davies,
Department of Mechanical Engineering,
Bolton Insitutute of Higher Education

April Issues

Dear ETI,

On building your Super Selective Music Filter, certain problems arose. The first was that supplies of the modulo 12 counter from Watford Electronics had dried up, and it was necessary to use an inverted reciprocal modulo n counter in its place, this being pin compatible. Secondly, the ZX80 real time auto correlator program on page 109 had a syntax error in line 1484, causing a loss of tracking at the equivalence detector. Thirdly, the dual peak filters frequently swept the band and did not lock at the start of a glissando; this was later found to be due to the drawing on page 109 being upside down, thus producing dual notches.

On test the unit worked well, but had the annoying habit of suddenly shifting channel when recording concerts. After much experimentation I discovered that, due to my proximity to the railway, the phase shift of the multipath from passing trains was producing multiple glissandos (a type of 'chuff chuff' that, being partially tone deaf, I was unable to detect by ear).

I have since extended the project to include an ultrasonic space detector with precision rate of change convertor. This automatically detects the presence in the room of reggae dancers and shifts to the appropriate channel, thus avoiding the otherwise unavoidable damage to furniture. My thanks to Mr. W. Pullover for an excellent article.

Yours faithfully,
P. Staker

We are grateful to the above reader for pointing out the errors in this article, and have published a full list of corrections in News Digest. **ETI**

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4164-15	D2	4.33
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4416-20	D2	6.60
4564-15		5.25
5516-25		7.73
6116-3	D1	3.72
6116-LP3	D2	4.67
2532-45	D2	3.50
2708-45	D2	3.25
2716-35	D1	4.50
2716-45	D1	3.50
2716-3	D1	4.50
2732-35	D1	4.58
2732-45	D1	3.75
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ZN425E-8	D1	3.13
ZN426E-8	D1	1.67
ZN427E-8	D1	5.75
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ZN429E-8	D1	1.33
ZN432CJ-10	D1	25.98
ZN432E-10	D1	10.88
ZN433CJ-10	D1	20.98
ZN440	D1	47.43
ZN447	D1	6.70
ZN448	D1	5.75
ZN449	D1	2.35
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A111B 1MHz	4.22
A112A 1.008MHz	3.42
A113A 1.8432MHz	2.88
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78L05	0.26
78L12	0.26
78L15	0.26
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7812	0.33
7815	0.33
7905	0.46
7912	0.46
7915	0.46
LM309K	0.98
LM317K	1.92
LM323K	4.58
LM338K	5.21
78HGASC	8.13
78H05SC	6.28
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78S40DM	6.28
78S40PC	2.50

6800 Family

6800	D7	2.87
6802	D5	2.61
6803C		5.83
6809	D6	7.13
6810	D1	1.25
6821	D3	1.31
6840	D4	3.92
6843L		20.88
6845	D5	5.88
6850	D2	1.31
6862		0.00
6871-A1		14.17
68488	D2	5.78
6875		7.13
68B00	D7	4.30
68B09	D6	9.96
68B21	D3	1.88
68B10	D1	1.80
68B40	D4	5.50
68B50	D2	1.83
MC68B54P		7.75

Z80 Family

Z80A CPU	D2	2.42
Z80B CPU	D1	7.78
Z80A CTC	D1	2.20
Z80B CTC	D1	7.78
Z80A DART	D1	5.50
Z80A DMA	D2	6.95
Z80A P10	D1	2.20
Z80B P10	D1	7.78
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Z80A SIO-0	D4	9.00
Z80B SIO-0	D4	29.78
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8216		1.37
8224		1.92
8228		3.25
8251A	D5	2.60
8253		3.33
8255A	D5	2.50

6500 Family

6502	D3	4.40
6502A	D3	4.67
6520	D1	2.67
6520A	D1	2.80
6522	D5	3.47
6522A	D5	4.40
6532	D2	5.33
6532A	D2	5.87

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L203		0.80
LF398		3.17
LM301AN		0.24
LM308AN		0.73
LM308N		0.47
LM311N		0.84
LM319		2.23
LM324N		0.32
LM339N		0.37
LM348N		0.53
LM358N		0.28
LM393N		0.34
LM725CN		1.33
LM741CP		0.18
LM747CP		0.48
LM748CP		0.22
MC1413P	D1	0.66
MC1416	D1	0.66
MC1458CPL		0.26
MC1495L		7.13
MC1496P		0.65
MC1723P		0.32
MC3242A		5.25
MC3302P		0.40
MC3340P		1.97
MC3357P		1.56
MC3423PL		0.67
MC3441AP		2.40
MC3446AP	D1	2.40
MC3447P		3.58
MC3448AP	D1	3.32
MC3470P		5.23
MC3480P	D5	6.47
MC3487P	D1	1.50
MC14411	D1	8.52
MC14412		11.87
NE555P		0.19
NE556CP		0.45
RO3-2513L	D1	7.82
RO3-2513U	D1	7.82
SN75107BN		0.58
SN75110AN		0.68
SN75150P		0.72
SN75154N		0.87
SN75159N		1.19
SN75160AN		2.15
SN75161AN		2.35
SN75162AN		3.31
SN75172NG		1.64
SN75173N		1.21
SN75174		1.64
SN75175		1.21
SN75182		0.62
SN75183		0.62
SN75188		0.44
SN75189		0.44
SN75451BP		0.24
SN75452BP		0.24
SN75453BP		0.24
SN75454BP		0.24
SN75468N		1.08
SN75491AN		0.46
SN75492AN		0.61
TL010CP		0.38
TL061CLP		0.28
TL062CP		0.47
TL064CN		0.89
TL066CP		0.28
TL071CP		0.28
TL072CP		0.47
TL074CN		0.91
TL081CP		0.24
TL082CP		0.41
TL084CN		0.85
TL091CP		0.41
TL092CP		0.60
TL094CN		1.37
TL487CP		0.55
TL489CP		0.55
TL494CN		1.66
TL496CP		0.30
TL507CP		1.02
ZN450E		5.25
ZN451E		6.38
ZN451KIT		25.65

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Pin	Tin	Gold	W/W
8	0.10	0.24	0.58
14	0.12	0.28	0.77
16	0.13	0.32	0.86
18	0.16	0.32	1.08
20	0.17	0.41	1.23
22	0.17	0.48	1.31
24	0.20	0.63	1.44
28	0.23	0.57	1.59
40	0.33	0.99	1.96

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28 Pin	6.35
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MAINS BORNE REMOTE CONTROL

Last month we described the operation of the system and the construction of the receiver unit. This month's concluding article describes the construction of the transmitter, alignment of the two units and the method of interfacing the completed system to your microcomputer. Design by John Bawden.

The entire transmitter is contained on one 147 x 71 mm PCB. This includes the various mains isolation components which are grouped at one end of the board and covered with a small plastic box. The prototype was originally built on a eurocard using wire wrapping techniques, but the final PCB layout is smaller than a eurocard and readers who require a plug-in card construction should have no difficulty adapting it.

The bulk of the construction is perfectly straightforward. We recommend the use of IC sockets since most of the ICs are CMOS, and it is a good idea to solder the sockets into place before moving onto the other components. Install the three wire links and then the resistors and the capacitors, taking care with the tantalum types which must be inserted the correct way around. Similar care should be taken with the diodes and transistors. Do not solder R13, C14 and FS1 into place until the alignment procedure has been completed. The ICs can be inserted into their sockets when everything else is in place.

The only component on the PCB which requires any preparation is T1. This can easily be hand wound, but great care should be taken in the construction. T1 provides isolation between the transmitter circuitry and the mains supply via C14, FS1 and R13, and if these fail or the mains connections are reversed it will have to withstand the full supply voltage between primary and secondary.

The primary should be wound first. This consists of 20 + 20 turns of 26 SWG enamelled copper wire, bifiliar wound. This means that the two 20-turn halves are wound simultaneously using a length of wire doubled up. Estimate the length of wire you will need to produce 20 turns (no, of course we're not going to tell you! Use your calculator and a little imagination), add a little for the lead-outs, then bend the wire back and pull-out another, equal length. Do not separate the two lengths but wind them onto the former as they are; the loop will help you to sort out the ends later. Cover the primary winding with two layers of

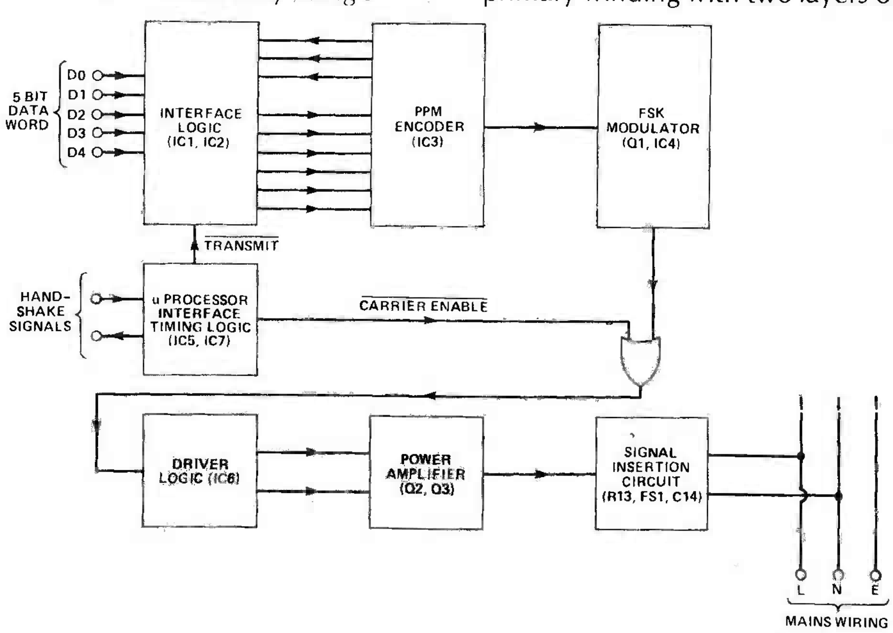

Fig. 1 Block diagram of the transmitter.

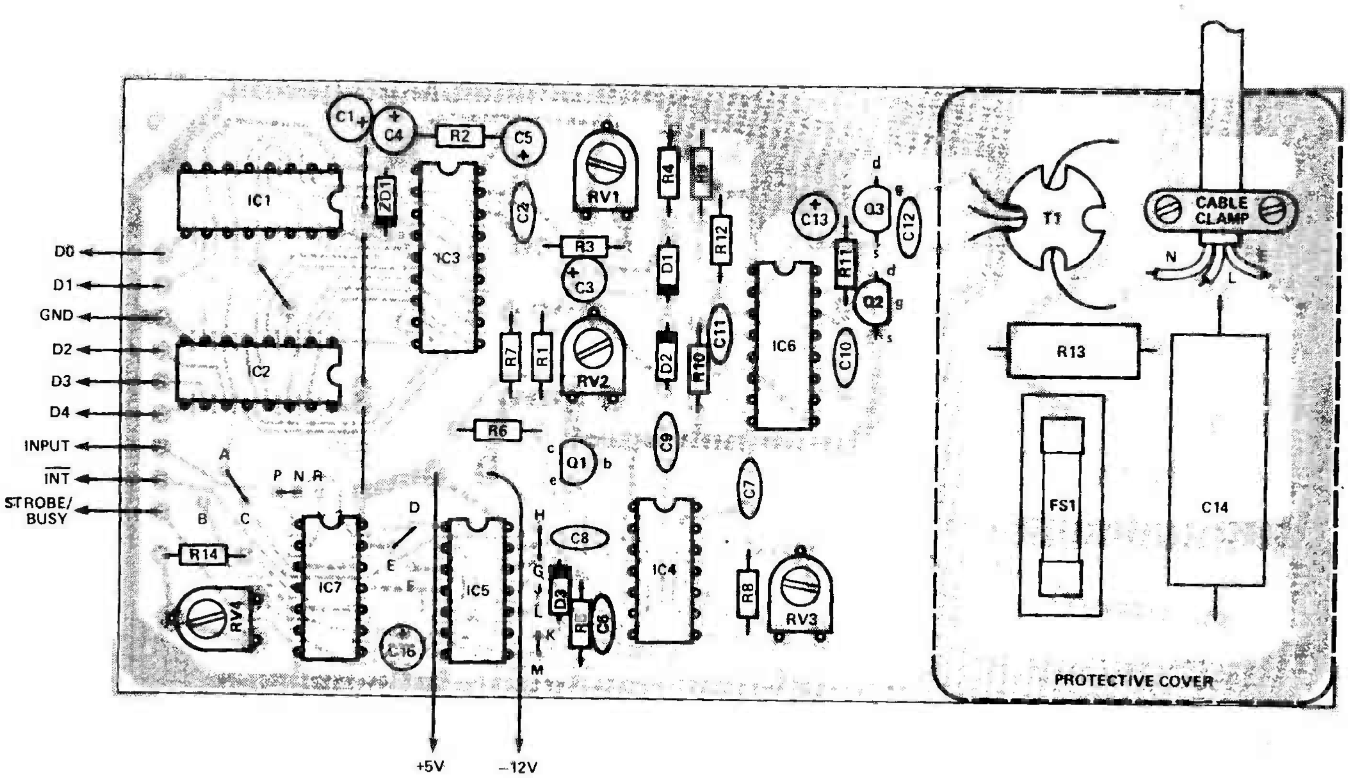

Fig. 2 Overlay diagram of the PCB.

PARTS LIST — THE TRANSMITTER

RESISTORS (all ¼W, 5% unless otherwise stated)

R1, 4, 7	1k
R2, 8, 14	2k2
R3, 9, 10	22k
R5	39k
R6	150k
R11,12	820R
R13	100R 1W wirewound
RV1, 2	100k horizontal skeleton preset
RV3, 4	4k7 horizontal skeleton preset

CAPACITORS

C1, 4	22u 16V tantalum
C2	4n7
C3, 5, 13, 15	10u 16V tantalum
C6, 8, 9	1n 100V ceramic
C7	470p 2% silver mica or polystyrene
C10, 11	390p 2% silver mica or polystyrene
C12	2n2 2% silver mica or polystyrene
C14	100n 1000V polyester

SEMICONDUCTORS

IC1	4052
IC2	4051
IC3	SL490
IC4	NE565
IC5	4001
IC6	4049
IC7	40106
Q1	BCY72
Q2, 3	VN10KM
D1, 2, 3	1N4148
ZD1	8V2 400mW zener

MISCELLANEOUS

T1	Pot core RM10, core Al=400 (see text for winding details)
FS1	500mA fuse and PC mounting holder

PCB; small plastic box, Vero type 202-21024B; 20 SWG PVC covered wire and 26 SWG enamelled copper wire; IC sockets; cable clamp for mains wiring; connecting cable, etc.

insulation tape and then add one and a half turns of PVC covered 20 SWG wire to form the secondary. Arrange the primary and secondary connections so that they appear on opposite sides of the transformer and then seal the whole assembly with a further layer of insulating tape.

Assemble the ferrite core onto the former, insert the tuning slug and mount the assembly on the PCB. How you attach it depends upon which type of core you purchase, but we simply used two holes drilled on either side of the core and a piece of insulated wire passed through them, over the core, and secured on the underside of the PCB. Make sure you mount the transformer with the primary connections adjacent to Q2, Q3 and C12.

If you followed the winding instructions correctly, your primary lead-outs should consist of a loop and two free ends. Temporarily mark the two free ends in some way and then cut the loop. Using a multimeter, identify which of the free ends is connected to each of the two new ends you have created by cutting the loop, then take *one* of the new ends and connect it to the *other* free end. By this means you will connect the start of one winding to the finish of the other and so form a centre tap. Solder this centre tap into the middle hole provided and the other two ends into the remaining holes. Solder the two secondary connections into the two holes provided on the opposite side of the transformer.

To complete the construction, solder the mains lead into place and secure it with a cable clamp.

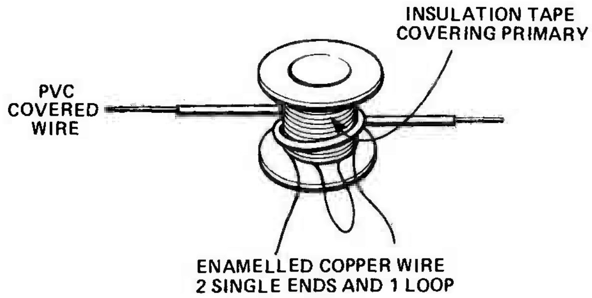

Fig. 3 Constructional details of the transformer.

Cut a suitable hole into the small plastic box and feed the mains lead through it. The box can then be assembled over the mains circuitry using its own securing screws through the holes provided, the box on the component side and its lid on the copper side.

Alignment

Both the transmitter and the receiver in this system are normally connected to the mains, but you should not attempt to work on them while they are so connected. The procedure described allows you to align the units without taking unnecessary risks.

The only special equipment required for the setting-up procedure is a test meter, an oscilloscope and some form of power supply so that the two units can be operated without a mains input. The transmitter is set up first so that it can be used as a signal generator when you come to set up the receiver. Begin setting-up by connecting the transmitter to the power supply or the +5 and −12 volt rails of a computer.

The initial stage in setting up the transmitter is the adjustment of the rate of the PPM data generated by the SL490. The critical timing element of the PPM data stream is the period of the logic '0' interpulse space. This parameter can easily be measured and set up using an oscilliscope, provided the data stream consists of PPM words which contain all logic '0's. A data stream containing a mixture of '1's and '0's is difficult to trigger and to interpret when displayed on an oscilloscope.

The SL490 can be persuaded to generate a data stream suitable for this adjustment by connecting to ground the five transmitter data inputs, DO-D4. This will ensure that a series of words containing all '0's is generated. The data stream can be checked by monitoring pin 2 of the SL490 on an oscilloscope whilst the TRANSMIT input is also held low. Under these conditions, RV1 can be adjusted to set the required interpulse period. This is 5ms for the standard MainsCom system.

The carrier frequency and the frequency shift deviation can be set up using a similar test arrangement. In addition to the five data lines and the TRANSMIT signal line the CARRIER ENABLE input must also be grounded. This should result in the modulated carrier appearing at the output of the transmitter. The output of T1 should be temporarily loaded with a 10 Ohm resistor and the oscilloscope connected across it. The oscilloscope timebase must now be adjusted to display a few cycles of the approximately sinusoidal signal appearing there.

The display should actually be of two sinewaves of differing frequency, one of which should be brighter than the other. If only a single sinewave is present, this could indicate a fault in the frequency shift modulator, or, more likely, that RV1 is at one end of its track. Try adjusting this control to the halfway position. The brighter trace is produced by the frequency used to transmit the interpulse period, and the dimmer trace results from the frequency used to transmit the PPM pulses. It should now be possible to set the period of the brighter waveform to 7.5 microseconds by adjusting RV3. This will have set the carrier to the required frequency of 133 kHz. The deviation control, RV2, is similarly used to set the period of the dimmer trace to 7.0 microseconds. This corresponds to a deviation of 10 kHz, with the shifted frequency at 143 kHz. Check the carrier frequency and if necessary readjust RV1 and RV2 to correct for the effects of any interaction between them.

The core of T1 should be adjusted for the best approximation to a sine wave at both the carrier and the 'pulse' frequencies. This transformer forms part of a very low Q tuned circuit, so little change in signal amplitude will occur. This adjustment should be repeated with the unit in its operational form because of the reactive impedance presented by R13, C14 and FS1.

The receiver cannot be worked on whilst connected to the mains supply for obvious safety reasons. The recommended procedure for this unit is to run it from a 12 Volt power supply connected directly to its internal supply rail, and to provide a signal feed from the transmitter which looks as if it has come over the mains wiring. This can be produced by placing the test fixture shown in Fig. 4 between the previously aligned transmitter and the receiver unit. The attenuated signal from the transmitter is applied across the 'Mains In' terminals of the receiver.

The conditions used in aligning the transmitter can be used again to generate the test signal for receiver alignment. This logic requires '0's on the transmitter data inputs and both TRANSMIT and CARRIER ENABLE pulled low into their active states.

L1 is adjusted whilst monitoring the filtered and amplified FSK signal at the junction of R14 and R15. The resonant circuit consisting of L1 and C1, when incorrectly

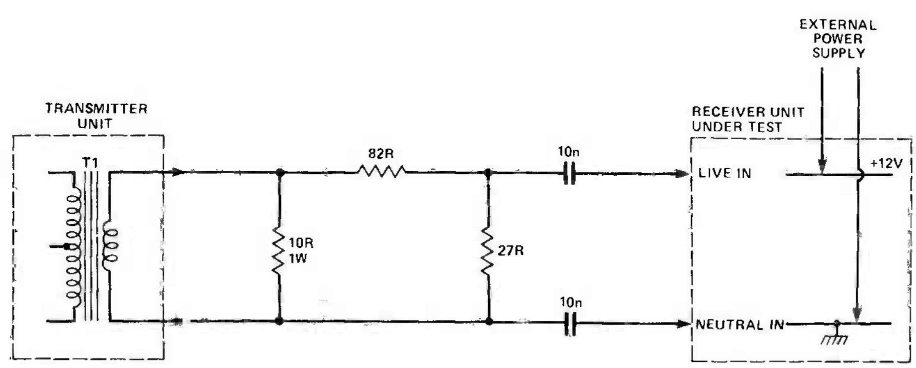

Fig. 4 Circuit for use in receiver test and alignment.

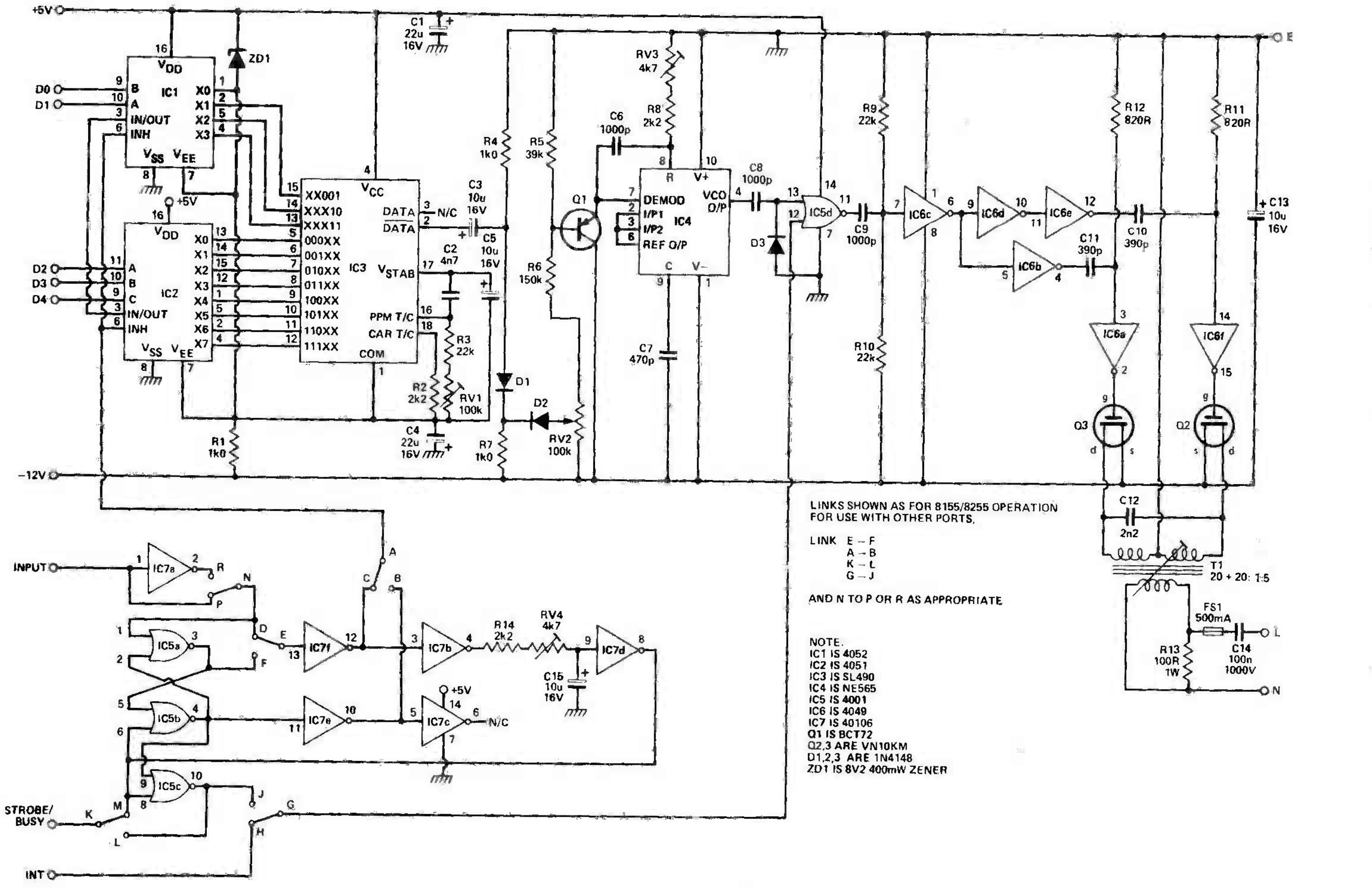

Fig. 5 Circuit diagram of the transmitter.

HOW IT WORKS — THE TRANSMITTER

The transmitter is based on the Plessey SL490 remote control encoder IC. The SL490 is intended primarily for use in hand-held remote control transmitters and is therefore designed to operate from a 9V battery supply and to scan a keypad consisting of an 8 x 4 matrix of push button switches. In the MainsCom transmitter, the SL490 has to be driven from a microcomputer parallel port. IC1 and IC2, which are two CMOS analogue switches, are used to simulate the action of a matrix of push button switches. IC1 is a two pole four way switch, of which only half is used, whilst IC2 is a single pole eight way switch. These are connected to IC3 in such a way that it is possible to simulate the closure of any one of the 32 switch positions scanned by the SL490. The switch closure simulated, and hence the PPM word generated by the SL490, is controlled by the 5 bit parallel input which is split between IC1 and IC2. The generation of the PPM data is controlled by the INHIBIT inputs of IC1 and IC2. When these INHIBIT inputs are pulled low, the switch positions selected by the binary input to IC1 and IC2 are closed. This will be seen by the SL490 which will then generate a steady stream of PPM words. The INHIBIT inputs to IC1 and IC2 are driven by the active low TRANSMIT signal.

The rather unconventional power supply arrangements for IC1, IC2, and IC3 are necessary in order to accommodate the following factors. First, the power supply required by IC3 must be 9 volts or just under. IC3 is driven from IC1 and IC2 and these devices have to operate with inputs at the normal 5 Volt logic levels coming from a microcomputer parallel port. IC1 and IC2 must therefore operate from dual polarity supplies and the actual voltages of +5 volts and −12 volts were chosen as being readily available from most microcomputer systems.

The timing of the PPM data generated by IC3 is set by the time constant of C2 with R3 and RV1. This data stream, which appears at pin 3 of IC3, is clipped by D1 and D2 to ensure a constant amplitude. It is then used to drive the frequency shift keyer, comprising the voltage controlled oscillator part of IC4. This IC, a 565, is usually used as a phase locked loop, particularly in FM demodulator applications. It is used as a frequency modulator in this case as it is inexpensive and easy to obtain. Q1 is used to drive what would normally be the 'demod' output with the PPM signal. C7, with R8 and RV3, set the carrier frequency and RV2 is used to set the level of PPM signal and therefore the frequency deviation.

IC5d and its associated components interface the squarewave output of IC4 to the CMOS levels required by the power amplifier stage. It is also used as a gate in order to disable the transmission of carrier when there is no control signal being sent. This is done through the 'Carrier Enable' input to the unit and serves to save a little power and minimise the possibility of interference being caused by the system.

IC6 is used as a buffer and as a pulse shaper to drive the power amplifier stage. This employs a pair of VMOS transistors in push-pull and operates in a low duty-cycle switching mode, similar to a class C valve amplifier. IC6 generates the short pulses with the required timing to ensure correct operation. T1 acts as a low Q tuned transformer and matches the output of this stage to the low impedance presented by the mains at this frequency. C12 resonates with the inductance of T1 to produce a nearly sinusoidal output waveform. The output impedance is of the order of 0.5 ohm and can easily put a signal across the few ohms presented by the mains wiring.

tuned, will generate amplitude modulation on the FSK signal which will correspond to the frequency modulation on that signal. The sense of the amplitude modulation will depend on the adjustment error. When L1 and C1 resonate at too high a frequency, modulation peaks appear on the carrier corresponding to PPM pulses. If mistuned in the opposite direction, dips appear in the envelope of the signal. The correct adjustment of L1 is the setting which minimises the amplitude modulation of the FSK signal at this test point (Fig.6).

RV2 adjusts the natural frequency of the oscillator in the phase locked loop FM demodulator, IC3. This control is used both to set this frequency close to that of the FSK carrier, so that the loop can lock up, and to cancel any imbalance in the comparator circuit built around IC1d.

Adjustment of RV2 is used to produce the 'cleanest' PPM signal at the output of IC1d. Offsetting this control away from the correct point will cause either the logic low or the logic high part of the PPM signal to become noisy. RV2 is therefore adjusted until a PPM data stream appears on pin 1 of IC1d, and then set to halfway between the points where noise begins to appear on the logic high and logic low parts of that data stream.

The oscillator in the ML924 PPM decoder, IC1, is set by RV1. This is most easily adjusted with the FSK signal disconnected from the receiver, so that the incoming data stream does not disturb the oscillator frequency. For safety's sake, the temporary 12 volt supply should be retained.

When correctly adjusted, the oscillator period should be 1/40th of the logic '0' period in the received data. The latter is set at 5 milliseconds at the transmitter, so RV1 should be used to set the period of the sawtooth waveform at pin 1 of IC1 to 125 microseconds.

This completes the setting up of the transmitter and the receiver. It should now be possible to check their operation by reconnecting them via the test circuit. Suitable sequences of 'on' and 'off' codes loaded into the transmitter should result in the receiver switching on and off. The operation of the receiver will be indicated, even in the absence of a mains supply and load, by the indicator LED.

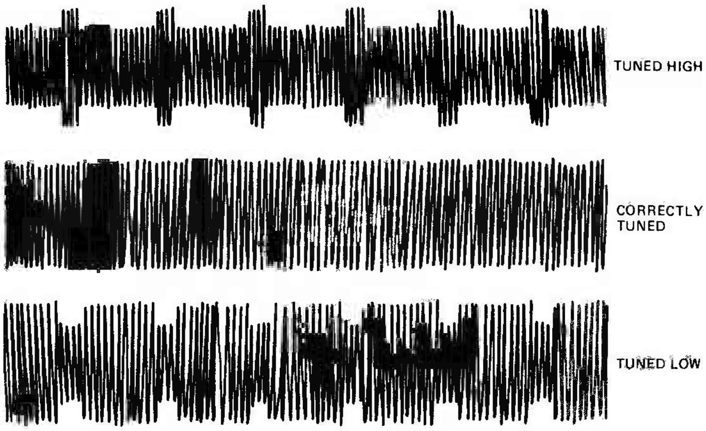

Fig. 6 Tuning L1.

Interfacing

The MainsCom receiver can easily be interfaced with most types of parallel port device. It was designed specifically for use with the Intel family of parallel port devices, the 8155 and the 8255. The interfacing of the transmitter with this type of port is described below, together with some suggestions for interfacing with other types of parallel port device. The D0 to D4 inputs to the transmitter are driven by the lower five bits of any parallel output port which has TTL compatible outputs.

As with any type of output port, some form of "handshake" arrangement is necessary, in this case to ensure that the 5 bit word on the inputs of IC1 and IC2 in the transmitter is not replaced by another until the first has been transmitted. The SL490 IC gives no indication that a message has been sent, so the handshake logic must use a simple timing circuit to indicate when the transmitter is ready for another message.

This timing logic can conveniently act as a source of the TRANSMIT and CARRIER ENABLE signals which activate the generation of PPM signals and enable the FSK carrier. The timing of these two signals is critical to the transmission of an intelligible message. Each message consists of two PPM words, the minimum required by the error checking logic in the receiver. If more than two PPM words were to be transmitted, this would greatly increase the time taken to transmit updates to a group of receivers.

TRANSMIT must be active for a long enough period for the SL490 to generate the two PPM words. CARRIER ENABLE must remain active long enough for those two words to be transmitted. The timing of these signals is not identical because of the way in which the SL490 operates. If TRANSMIT becomes false after the SL490 has started to generate a PPM word, it will complete that word. CARRIER ENABLE must then be held true until after the completion of the word, so the whole of the last word is sent. The timing of TRANSMIT and CARRIER ENABLE necessary for the correct transmission of PPM messages is shown in Fig. 7 and Fig. 8.

These two control signals could be generated by timing loops in the controlling program, but the use of this technique would be wasteful of CPU time, a precious commodity in microcomputer based control systems. The alternative is the use of a simple hardware timer as suggested above.

If the parallel port is an 8155 or an 8255 it should be programmed to operate in the strobed output mode. The circuit logic shown will take care of the handshake signals and generate the TRANSMIT and CARRIER ENABLE signals.

The controller program initiates the transmission of the message by writing the word to be transmitted to the output port. This will set BF ("Buffer Full"), or IBF on an 8255, to the high state and INTR ("Interrupt") to the low state. After a period determined by the timing circuit, STB will go low. The internal logic of the port will use this transaction to restore BF to the low state. A further delay period later, STB will return to the high state, signalling the end of the message transmission. INTR will remain low until this occurs. The timing of BF, in inverted form, and of INTR allow these two signals to be used as the source of TRANSMIT and CARRIER ENABLE respectively. See Fig. 7 for the timing of these signals.

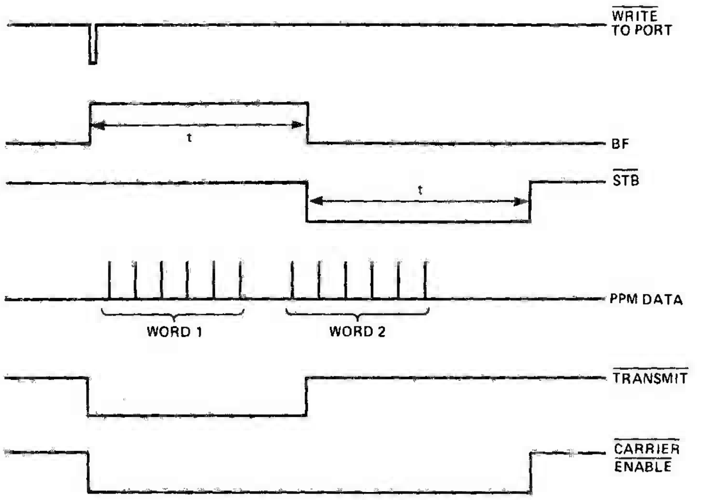

Fig. 7 Timing diagram for the logic used with 8155 and 8255 ports.

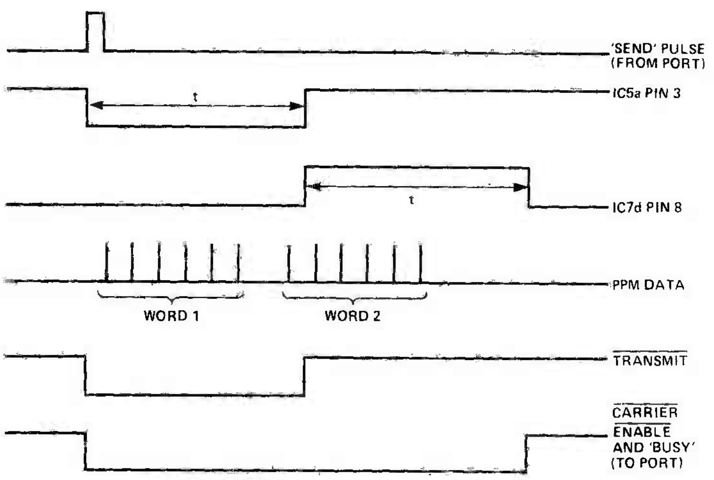

Fig. 8 Timing diagram for the logic used with other ports.

The program operating the MainsCom transmitter can detect when a new message may be sent either by polling the status register in the port to see when the INTR bit becomes true or by using the INTR signal as a "Transmitter Empty" interrupt.

If your microcomputer system does not use one of the Intel parallel ports mentioned above, some simple logic is needed to mimic the action of the 8155 or 8255 and generate TRANSMIT, CARRIER ENABLE, and handshake signals suitable for most types of parallel port, such as the 6821 and the Z80-PIO.

This logic is provided in the circuit given by removing the links from the positions indicated and replacing them in the alternative positions listed. The data representing the PPM message to be transmitted should be written to the parallel output port and the handshake line pulsed high for a few microseconds to initiate the send process. This pulse will set the latch formed by IC5a and IC5b. The latch will be reset after an appropriate period of time by the circuit consisting of R14, RV4, C15 and IC7d. IC5c generates a signal which is used as CARRIER ENABLE and TRANSMIT is produced by IC7e which inverts the output of the latch. CARRIER ENABLE may be connected to an input handshake line on the parallel output port and the device programmed to generate an interrupt on the positive going edge. Alternatively, this signal can be polled to see if the transmitter is still busy. If this polarity of signal is inconvenient for use with a particular port configuration, IC7a may be used to invert the signal. The timing of signals associated with this circuit are shown in Fig.8.

The timing of the hand shake logic is set by RV4, and this is most easily adjusted whilst a fixed message is being repeatedly transmitted. This can be checked by using an oscilloscope to examine the (inverted) PPM data stream on pin 2 of IC3, and the CARRIER ENABLE signal. RV4 should be adjusted so that two PPM words occur in each period of CARRIER ENABLE being low. The actual message used in setting the transmit timing is important because the period of a PPM word varies with its data content. A word consisting of all 0s is the longest and this should be used in setting up the timing as described above.

From the software point of view, the receivers used in this system can be controlled by writing suitable data to the parallel port used to drive the transmitter. The port used will probably be eight bits wide, but only the five least significant bits are used by the transmitter. The controlling program should generate these output bit patterns according to the following format:—

To switch a receiver, or a group of receivers ON, this two word sequence must be used:—

X	X	X	0	A3	A2	A1	A0
X	X	X	1	0	0	0	0

To switch the receivers OFF, this sequence must be transmitted:—

X	X	X	0	A3	A2	A1	A0
X	X	X	1	0	0	0	1

A3, A2, A1 and A0 form the bit pattern corresponding to the binary address assigned to each receiver and set up on the C0 to C3 inputs of the ML924 PPM decoder. The three most significant bits of each byte, shown as the three Xs, are not used and can conveniently be left as logic '0's.

BUYLINES

Dealing with the receiver first, both Watford and T.K. Electronics stock the ML924, Cricklewood can supply the TIC225D and Ambit the Toko coil. The only other component likely to cause any problems is the hexadecimal rotary switch. As explained in the text, you can use links to set the address but if you want to make it adjustable you could try and find a local retailer who is prepared to order the part from RS for you. Alternatively, Ambit do stock a hexadecimal rotary switch but it is larger than the RS item and has a different pin-out, so you would have to alter the PCB tracking slightly. Note that the extra components required for the two modifications do not appear in the parts list.

Turning to the transmitter, all of the semiconductors are readily available as are most of the other components. The RM10 pot core assembly is available from Ambit and the Verobox is available from Maplin. Ambit also supply enamelled copper wire.

The PCBs for both the transmitter and the receiver are available from our PCB service, see page 65.

ETI

BOOK PAGE

Phil Walker has been burning the midnight oil lately — here are his thoughts on some of the latest offerings for the workshop shelf.

Operational Amplifier Experimental Manual
G. B. Clayton BSc. FInst.P.
Butterworths
130 pages/£13.95 (hardback)
£6.95 (paperback)

This is a nice friendly book with clear diagrams and text to guide the student through the basics (and further) of operational amplifiers.

The book shows, by means of practical experiments, most of the common (and sometimes forgotten) configurations of op-amp circuits. It sets out to show how they work and why in some circumstances they don't. This process is reinforced by excercises at the end of each chapter.

In the main I would think that the book will be of most use in schools or training colleges where oscilloscopes, power supplies and signal sources are easily obtainable as these are assumed throughout the text. However the book will serve as a useful reference long after its initial purpose is served.

Towers' International MOSPOWER And Other FET Selector
T.D. Towers, MBE, MA, BSc, C.Eng, MIERE and N.S. Towers, BA(Cantab)
W. Foulsham & Co. Ltd.
104 pages/£9.95

In the past few years there has been a great surge forward in the technology of field effect devices. This has been very noticeable in the digital field but has been just as great in the analogue and power switching areas. Reliability and power handling capability have enabled amplifiers and especially switch mode power supplies to be made better and cheaper.

This book sets out the major characteristics of some 6000 assorted types of FET in a clear tabular form as well as basic information on package, lead out, manufacturer and typical applications. The Selector claims to cover all MOSPOWER FET types known to be commercially available at the time of writing.

A very useful feature of the book is that where practicable it offers commercially available substitutes for the MOSPOWER and other devices listed.

At less than 10p per page (just!) it should find a place on many engineer's or technician's book shelf.

PJW

16 Bit Microprocessors
Ian R. Whitworth
Granada
381 pages/£18.00

Starting with a brief run down on the ancestry of the current 16-bit micros, the book deals with the development of the 8-bit and 8/16 bit devices before considering the older and newer 16-bit units. This turns out to be quite interesting in it's own right giving useful comparisons in hardware and software.

Moving on to the early 16-bit devices shows how simple in concept some of them were (and still are). Also, it demonstrates how some manufacturers attacked similar problems in very different ways.

In the remaining three-quarters of the book the author first considers the current generation of 16-bit micros including the 8086, Z8000 and 68000 devices. He takes us through the register and bus structures, memory management and operating system support including interrupt handling and multi-user operation.

After this he moves on to give typical interface structures and requirements. Also we meet the concept of co-processors or special purpose devices which extend or speed up the capabilities of the main processor.

Next to be examined are instruction sets, development systems, system software and, high level languages taking a chapter for each. A chapter on multiple processor systems is followed by one on applications before the final one which considers future developments in the field.

I found the book quite readable, interesting and informative. Its many illustrations were usually relevant to the immediate text and certainly help with grasping the concepts involved. I think the book would be very useful to someone who has some 8-bit hardware knowledge and some experience of larger systems from a users point of view.

Microprocessor Instruction Sets And Software Principles
D.L. Heiseman
Prentice Hall
440 pages/circa £27 hardback

This is a very interesting and seemingly useful book, covering in some detail the various instructions available to four of the most popular eight-bit microprocessors available, the 8080 (and 8085), Z80, 6502 and 6800.

Each chapter of the book is devoted to a particular instruction type and explores the similarities and differences of the various processors. It also shows how particular simple tasks may be performed by each processor and where differences in the instruction sets may force alternative approaches.

The exercises at the end of each chapter are useful for reinforcing what is learned in the main text throughout the book, there are also many examples of short sections of machine code routines for all the processors, with explanations of how they work.

One or two apparent errors have crept into the text but I would still think that this book is good value for money especially for someone wanting comparative information on the four processor types mentioned. This book is entirely concerned with software and contains no hardware information. **ETI**

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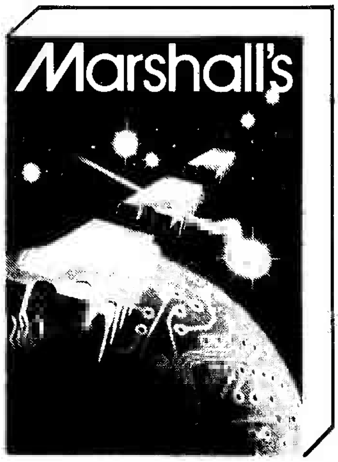

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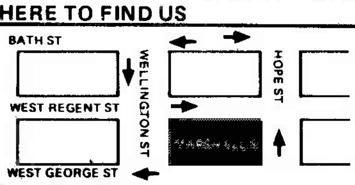

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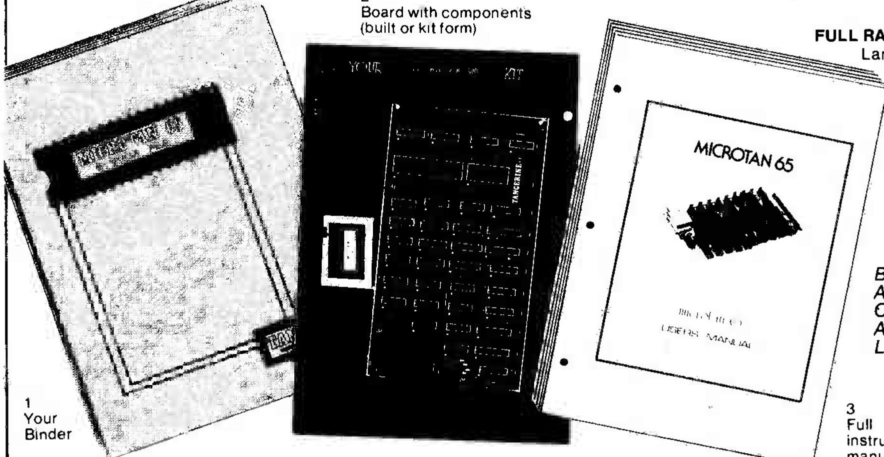

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CENTRONICS INTERFACE

Designed for use with the Sharp MZ-80K but readily adapted to work with other machines, this interface provides a simple, low-cost method of connecting a printer to your micro. Design by Matthew Dunn.

The problem with trying to connect your micro to a printer is that the printer you like (or can afford!) is almost certain not to interface directly with your micro. You can get round this by purchasing a suitable interface, assuming one to be available for your particular purposes, but that will add to the cost considerably and may even end up costing more than an expensive printer purpose built for use with your micro.

The interface described in this article is designed to match the I/O port of the Sharp MZ-80K microcomputer to the Centronics port found on many printers. With minimal hardware modifications and appropriate software, the interface should work with any other Z80-based system, including the ZX81 and Spectrum. It is not within the scope of this article to consider all the changes necessary to make the interface operate with other machines, but a few brief notes have been included to help those who wish to try.

A Centronics port requires 8 bits of parallel data and a Strobe signal to be sent to it, after which an acknowledge pulse is returned to the microcomputer. Sharp's BASIC sends character data to the printer using the I/O port FF hex. This is strobed by toggling bit 7 of port FE hex, after which the processor waits for bit 1 to go high to indicate that the data has been received. The interface uses an 8 bit latch which holds the information on the data lines when the address lines indicate port FF (all high). When the computer sets bit 7 high and indicates port FE (A0 low), data line D7 is inverted and sent to the printer's strobe input. This should result in the printer sending an acknowledge pulse which is then held in a bistable latch until the computer sets bit 7 on port FE and thus resets it. A tri-state buffer sets D0 to indicate the state of the latch and also sets D1, 2 and 3 low when the address lines indicate port FE. By monitoring bit 0 of port FE, the microcomputer can tell when the acknowledge pulse has been sent and the latch makes sure it isn't missed. Bits 1, 2 and 3 are held low because Sharp use them to indicate the condition of their own printer, and if this is not done the computer will assume a printer failure.

Pin	A	B
1	A15	Gnd
2	A14	INT
3	A13	Gnd
4	A12	MRRQ
5	A11	Gnd
6	A10	IORQ
7	A9	Gnd
8	A8	RD
9	A7	Gnd
10	A6	WR
11	A5	Gnd
12	A4	M1
13	A3	Gnd
14	A2	HALT
15	A1	Gnd
16	A0	RESET
17	GND	Gnd
18	D7	Gnd
19	D6	Gnd
20	D5	Gnd
21	D4	Gnd
22	D3	Gnd
23	D2	Gnd
24	D1	Gnd
25	D0	Gnd

Table 1 Locations of signal connections on the Sharp 50-way bus.

Construction

The prototype was constructed in a Verobox type 21390, although any box about 75 x 110 mm should do. Construction of the PCB is fairly straight forward; there are 9 wire links, two resistors and three capacitors to fit. All the IC's face the same way and we recommend the use of IC sockets. Care must be taken when fitting the two diodes to ensure correct polarity.

If the board is then fixed solder side up in the box, the connections to the Sharp 50-way bus can be made. A length of 40-way ribbon cable should be placed such that the first wire connects to A25 and the last wire connects to B6 of the IDC connector. Holding the cable against the IDC spikes, place the clamp in position and put the whole lot in a vice. Tighten the jaws of the vice so that the clamp forces the cable over the spikes.

At the other end, all the connections are in order along the width of the cable with the exception of the RESET signal. If you are not using an MZ-80K and

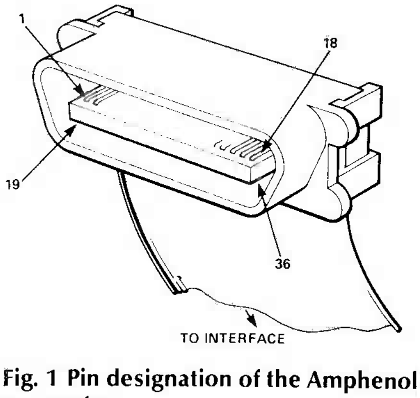


Fig. 1 Pin designation of the Amphenol connector.

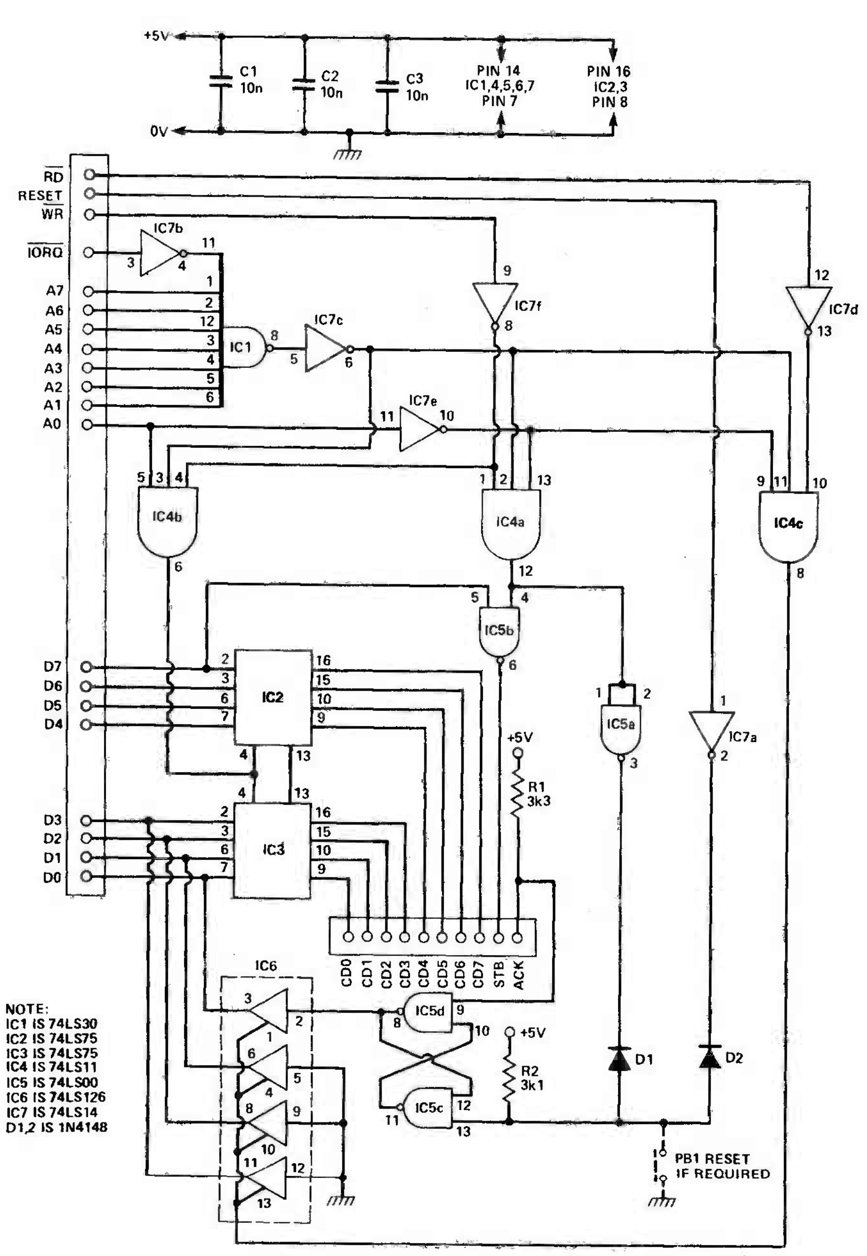


Fig. 2 Circuit diagram of the interface.

Pin	Description
1	Strobe
2	Data 1
3	Data 2
4	Data 3
5	Data 4
6	Data 5
7	Data 6
8	Data 7
9	Acknowledge
19	Pin 1 ground
20	Pin 2 ground
21	Pin 3 ground
22	Pin 4 ground
23	Pin 5 ground
24	Pin 6 ground
25	Pin 7 ground
26	Pin 8 ground
27	Pin 9 ground
28	Pin 10 ground
29	Pin 11 ground
30	Ground

Table 2 Locations of signal connections on the Centronics/Amphenol plug.

your computer doesn't supply a RESET signal, a manual interface reset can be made by omitting D2 and connecting a push switch as shown on the overlay.

Next connect the 36-way Amphenol connector to the interface using a multiway cable. Again, it is probably easier to make the connections to the solder side of the board. The relevant connections to the Amphenol plug are shown in Fig 1. Pins 19-30 can be shorted together, but pin 30 must be connected to the ground/ 0V of the interface.

With assembly complete, all components in place and the board thoroughly checked, it is time to connect the interface to

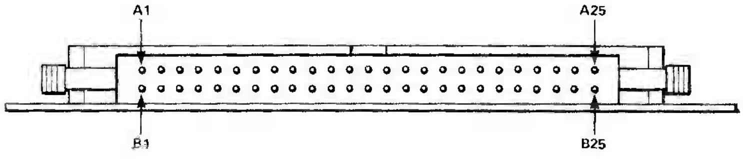


Fig. 3 Pin designation of the Sharp 50-way bus.

HOW IT WORKS

IC1 is an 8 input NAND gate which monitors address lines A1 to A7 and the inverted IORQ line. Its output goes low whenever the computer requests an input/output and defines either port FE or port FF on the address lines. The output is inverted by IC7c and used to enable the three, 3 input AND gates IC4a, b and c.

IC4b combines the inverted output of IC1 with the inverted WR line and address line A0, which will be high when port FF is defined and low when port FE is defined. IC4b thus detects when port FF is being written to and enables the latches, IC2 and IC3, so that data is transferred to the latch outputs.

A0 is inverted by IC7e before being combined with the output of IC1 and the inverted WR line by IC4a. IC4a thus detects when port FE is being written to and resets the bistable latch IC5c,d via IC5a. D1 and D2 prevent the outputs of IC5a and IC7a driving each other low. The output of IC4a is also combined with data line D7 by IC5b; bit 7 is toggled by the microcomputer when port FE is indicated, and the output of IC5b can thus be used to strobe the printer. The printer should respond to the strobe by sending an acknowledge pulse, which is caught by the latch IC5c,d.

When port FE is read from, the inverted signals from IC1, RD and A0 are combined in IC4c which enables the tri-state buffer, IC6, placing the output of the latch onto data line D0. The other three sections of the buffer have their inputs held low so that, when enabled, they pull data lines D1 to D3 low. This satisfies a particular requirement of Sharp BASIC which uses the three lines to monitor printer condition.

the printer and computer. Having done this, turn the printer on and then turn the computer on. If either device fails to operate as expected then turn it off and re-check the wiring for shorts.

If both computer and printer function as expected it only remains to connect the interface to a 5 volt supply. Since, in their wisdom, Sharp don't supply 5 volts on the 50-way bus, it must be obtained from somewhere else. Some printers supply 5 volts through the Amphenol connector, or you could use an external 5 volt supply, but it is fairly easy to get a supply from the MZ-80K. To do this, connect a wire to the top of R47,R48 at the front right of the MZ80K's main PCB (see Fig. 4). The wire can be brought out through the hole around the 50-way connector. If a crocodile clip is used to connect the wire, the interface unit can be completely disconnected from the MZ-80K without having to desolder wires.

Now power up the printer and the computer in that order (to ensure the bistable is reset by the computer). If a manual rest switch is fitted this should be pressed before the first print.

In Use

To use the interface, load in Sharp BASIC, or enter a program similar to listing 1. Before Sharp BASIC will print properly the routine that interrogates the Sharp printer for its status needs to be disabled. This is done simply by POKEing 15542,201 (Note that this routine usually only exists in Sharp's software). Having POKEd this location type PRINT/P "TEST MESSAGE"; this should result in the printer outputting the message. If you are using program 1, call it a couple of times with different ASCII codes in the accumulator and then call it with the RETURN character code (usually 13) in the accumulator. Alternatively, program 2 will send the message indefinitely. Finally, to use Sharp Edito-Assembler, three alterations need to be made. Change 2B89 to C9, change 2B2F to B7 and 2B30 to C9.

As we pointed out earlier, it is not possible in this article to describe all the modifications necessary to make this interface work with other machines. The following notes, however, should be of some help to those with other Z80 based machines, particularly the ZX81 and the Spectrum, who wish to try and adapt this circuit.

The first thing to note is that the Sinclair machines use a simplified port addressing system in which A0, 1, 2, 3, or 4 are taken low to indicate specific peripherals. Because of this, A0 cannot be used to detect the difference between port addresses and one of the unused lines, A5, 6 or 7, must be used instead with the appropriate address written in the software. Assuming the use of A5, the new addresses of the data and control ports should be 65504 and 65535 respectively on the Spectrum and 233 and 255 on the ZX81. The other important point to note is that you will, of course, have to re-write the software to ensure that ASCII values of characters are sent to the printer. Note that, while the Spectrum uses BASIC on its I/O port, the ZX81 uses machine code.

```
0000 D3FF      PRINT:    OUT   (255),A
0002 3E80                LD    A,80H
0004 D3FE                OUT   (254),A
0006 DBFE      PRINT1:   IN    A,(254)
0008 E60F                AND   0FH
000A 28FA                JR    Z,PRINT1
000C AF        PRINT2:   XOR   A
000D D3FE                OUT   (254),A
000F DBFE                IN    A,(254)
0011 E60F                AND   0FH
0013 20F7                JR    NZ,PRINT2
0015 C9                  RET
0016
```

Table 3 Program 1

```
0000 210F00    START:    LD    HL,MESSAGE
0003 7E        LOOP:     LD    A,(HL)
0004 CD1C00              CALL  PRINT
0007 7E                  LD    A,(HL)
0008 FE0D                CP    13
000A 28F4                JR    Z,START
000C 23                  INC   HL
000D 18F4                JR    LOOP
000F
000F 54455354  MESSAGE:  DEFM  "TEST MESSAGE"
0013 204D4553
0017 53414745
001B 0D                  DEFB  13
001C
001C D3FF      PRINT:    OUT   (255),A
001E 3E80                LD    A,80H
0020 D3FE                OUT   (254),A
0022 DBFE      PRINT1:   IN    A,(254)
0024 E60F                AND   0FH
0026 28FA                JR    Z,PRINT1
0028 AF        PRINT2:   XOR   A
0029 D3FE                OUT   (254),A
002B DBFE                IN    A,(254)
002D E60F                AND   0FH
002F 20F7                JR    NZ,PRINT2
0031 C9                  RET
```

Table 4 Program 2

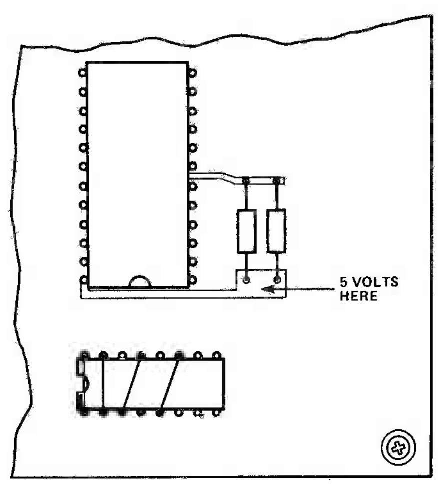
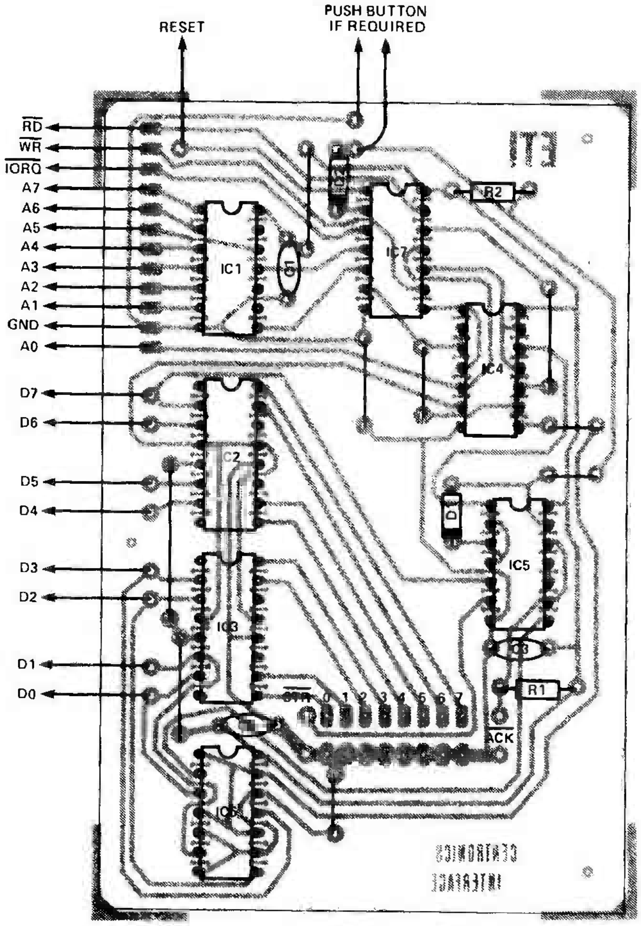


Fig. 4 Location of a suitable 5V tapping point on the MZ-80K PCB.



PARTS LIST

RESISTORS	
R1, R2	3k3
CAPACITORS	
C1, 2, 3	10n ceramic
SEMICONDUCTORS	
IC1	74LS30
IC2, 3	74LS75
IC4	74LS11
IC5	74LS00
IC6	74LS126
IC7	74LS14
D1, D2	IN4148

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BUYLINES

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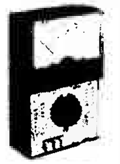
Fig. 5 Overlay diagram of the PCB.

ETI

MARCO TRADING



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1N4148	**4p**	78/05/08/12/15/18/ 24	**55p**
1N5401	**15p**		
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MACHINE CODE PROGRAMMING

Bob Bennett offers some general advice on de-bugging machine code programs before taking us step-by-step through the development of a program to convert decimal to hex.

Throughout this series I have tried to show that there is no mystery attached to machine code, no more so than when you first encountered BASIC as a computer language. And, just as you learned to use BASIC, the only way to learn machine code programming is to have a go, or, as it is sometimes put, to gain 'hands on' experience.

At times I have shown machine code instructions as though they were part of a program, in order to demonstrate the effect of the instruction. To remind you: if you were to place the Z80 instruction C9h — Ret in an address and then call that address from BASIC, the computer would execute the instruction and return you immediately to the BASIC program. Nothing very spectacular about that, you might say, but that single instruction constituted a program. Obviously you will want to write programs which are longer than one byte, but somewhere in that program will be at least one RETurn instruction.

This brings me to two very important things you must always keep at the back of your mind . . . crashes and infinite loops, which are not the same thing. The simplest crash will produce an error report, while more complex ones give rise to some very exotic displays. With infinite loops, the most usual form leaves you staring at a blank screen, but the solution is always the same, just pull the plug out. This should not really be so since there should always be some form of escape route, but of course, you wrote the program in the first place, didn't you? To help you avoid problems of the kind I've just mentioned here are a few tips and pointer, which, although I have covered them in this series, you may not recognise.

It might be stating the obvious, but you should always make sure the program starts at the correct entry point, which may not be the first address of the program. I made it clear earlier that a byte could be either an instruction or a data byte, so consider the following example. The Z80 instruction to load register A with the ASCII code (of which more later) for the capital letter A would be 3E,41, with the comma representing the division between two adjacent addresses. If by chance (or accident!) the program started at the byte 41, the computer would now read this as Load B,C. The program following would then be interpreted in a completely different manner to that intended.

The main cause of this type of error is the miscalculation of offset bytes and addresses for JUMPing or CALLing. It is always worth doing the calculation in two different ways, for example, counting from each end of the jump in turn. Failure to include a RET in a program can cause some interesting effects, the results depending upon what the computer meets after zooming past the

Character	ASCII	Character	ASCII	Character	ASCII	Character	ASCII
NUL	00	SPACE	20	@	40		60
SOH	01	!	21	A	41	a	61
STX	02	"	22	B	42	b	62
ETX	03	#	23	C	43	c	63
EOT	04	$	24	D	44	d	64
ENQ	05	%	25	E	45	e	65
ACK	06	&	26	F	46	f	66
BEL	07	'	27	G	47	g	67
BS(←)	08	(	28	H	48	h	68
HT(→)	09	)	29	I	49	i	69
LF(↓)	0A	*	2A	J	4A	j	6A
VT(↑)	0B	+	2B	K	4B	k	6B
FF(home)	0C	,	2C	L	4C	l	6C
CR (return)	0D	—	2D	M	4D	m	6D
SO	0E	.	2E	N	4E	n	6E
SI	0F	/	2F	O	4F	o	6F
DLE	10	0	30	P	50	p	70
X-ON	11	1	31	Q	51	q	71
TAPE	12	2	32	R	52	r	72
X-OFF	13	3	33	S	53	s	73
TAPE	14	4	34	T	54	t	74
NAK	15	5	35	U	55	u	75
SYN	16	6	36	V	56	v	76
ETB	17	7	37	W	57	w	77
CAN	18	8	38	X	58	x	78
EM	19	9	39	Y	59	y	79
SUB	1A	:	3A	Z	5A	z	7A
ESC	1B	;	3B	[	5B	{	7B
FS	1C	<	3C	\	5C	=	7C
GS	1D	=	3D	]	5D	}	7D
RS	1E	>	3E	∧	5E	~	7E
US	1F	?	3F	_	5F	DEL	7F

Table 1 The ASCII code.

```
23332 00  two reserved
      00  bytes
23334 3E  Ld A,n
      02  count
      01  Ld BC,nn to point
      25  to address
      5B  23333
      21  Ld HL,nn to point
      4F  to start of table
      5B  23375
      F5  Push count
      E5  Push table address
      0A  Ld A, (BC) with byte
      F5  preserve it
      E6  AND,n to mask off first
      F0  part
      1F  RRA four times
      1F  over to the
      1F  right to get offset
      1F  to index
      11  Ld DE,nn with zero
      00  ready for first offset
      00  byte
      5F  Ld E,A first offset
      19  ADD HL,DE HL now indexed
      7E  Ld A.(HL) first ASCII code
      D7  print it
23359 F1  retrieve first byte
      E1  retrieve table start
      E6  mask off
      0F  second part
      5F  second offset
      19  now added to table
      7E  get second ASCII code
      D7  and print it
      F1  retrieve count
      3D  decrement it
      28  jump if zero
      03  to finish
      08  Dec BC — point BC to low byte
      18  now jump
      DD  back to address 23339
          to process low byte
      C9  Return
23375 30  start of ASCII code table
      31
      32
      33
      34
      35
      36
      37
      38
      39
      41
      42
      43
      44
      45
      46  end of table letter F
```

Fig. 1 Machine code program.

place where the RET should have been. Calling routines based in ROM is another potential disaster area. Quite often these routines use the full register set to work on, so before calling, preserve any register contents by PUSHing.

Even if you have got all your calculations right and your RET in, failure to match all your POPS with the PUSHES will almost certainly end in disaster. During a program, unless done deliberately, POPping in a different order to PUSHing can raise the old blood pressure. Follow the rules for nested loops and you can't go wrong (cue maniac laughter). One final point on this subject, don't blithely decrement a register pair and expect the zero flag to inform you when zero has been reached, because it won't. By way of consolation, expert programmers will have made most, if not all, of the mistakes I've mentioned, and still do! Just remember, a computer only follows orders . . . yours.

But now for something completely different: I would like to show you how to develop a useful program. The one I have in mind is a decimal to hex conversion routine which I wrote for my own Spectrum machine code loader tape. I don't use a printer on my Spectrum so small routines, like the one I am going to show you, I put into the printer buffer. The program could be written entirely in machine code, but, at least for now, I'll keep the techniques simple and just give you a few lines of BASIC.

Because I will need to refer to it, and because some of you may not be familiar with it, the full ASCII code is shown in Table 1. The American Standard Code for Information Interchange (ASCII) uses the first 7 data bits (bits 0 to 6) to generate printable character or data communication codes. An example of each code would be 41h to print the capital letter A, and 0Dh to act on a printer attached to the computer to cause a carriage return. Most computers, including the Spectrum, use either all or some of the ASCII codes. In fact, on the Spectrum, we could use those same codes in a machine code program to print A to the screen and cause the next print position to start at the beginning of the next line, in which case 0Dh is referred to as a control code.

Now, getting back to that decimal in/hex out problem, what range of decimal numbers will I need to convert? Well, there's no need to spoil the ship for a ha-porth of bytes, so to speak, so lets go the whole hog; any positive whole number up to 65536 it is. This will mean two addresses to hold the number as shown in Fig. 2, with line 30 storing the low byte (LSB) first, and line 40 the high byte (MSB) as is usual; the hex conversion representation will cover the range 0000 to FFFF.

So far I haven't put pencil to paper, but now the time has come to do so, and if you intend to follow my reasoning I suggest you do the same. What I am looking for is a possible connection between any decimal number within the range and the ASCII code for the hex conversion. This is because I want to print these characters to the screen in the machine code part of the program. Having once done the conversion the hard way, I remember that decimal 30,000 is 7530h, so I decide to use that as my starting point. Licking my pencil, I dutifully write at the top of the page 30,000 — 7530h; so far, so good. After admiring my handiwork for fully ten minutes, I suddenly realise what I am supposed to be doing. Well, I think, the MSB of the hex would be first on the screen, so I'll work on that first. Using my (t) rusty calculator I divide 30,000 by 256, and the answer is 117.18. Because I only want the INTeger, the decimal for the MSB is 117. My Spectrum manual tells me this is 75 hex, so I write down 117-75h. Aha, that's just what I want, but a quick look at the ASCII codes shows that the required numbers are 37h and 35h. Well, at least I'm getting nearer. So now the problem is to make the MSB — 75h into two bytes of ASCII

```
10 INPUT "Enter decimal number" ;n
20 IF n<1 OR n>65536 THEN GOTO 10
30 POKE 23332, n-256* INT (n/256)
40 POKE 2333, INT (n/256)
50 CLS:PRINT n; "=" : RANDOMIZE USR 23334
60 GOTO menu
```

Fig. 2 BASIC program.

code ready for printing. This means that both the MSB and the LSB will have to be worked on twice. You can see that the difference between the ASCII code and the MSB is 30h, so it's a question of isolating the 7 and the 5 and then adding 30h. That's it then, a little more work and I'm home and dry. Hang on though, what's this?, another look at the ASCII set shows that some clown has added extra characters between 39h and letter A, which is 41h. That makes a right mess of the 30h difference.

So far, I have presented the problem as a beginner to machine code programming might see it, and, so far, the reasoning looks fairly sound. But let's re-think the problem using slightly different reasoning. I have found that problems of this nature are best approached with two things in mind. The first is to look at the best and worst cases, in this instance the upper and lower limits which have already been defined. Secondly, examine what you already have and can be sure of, and our example of that is decimal 117 which we know is 75 hex. The position of the hex character determines the equivalent decimal value, for example, 0F is less in value than F0. However, no matter which position the hex character occupies, the one constant is that 0 to F represents decimal 0 to 15, and thereby lies a clue. Bearing in mind that there are two hex characters per byte I can write down 00-0F=0 to 15, and then the binary representation of each byte. The pattern looks like this — 0000 0000 and 0000 1111, and immediately I see the answer to the problem.

Now you must remember that a computer doesn't know the first thing about decimal or hex; the only things it 'sees' are the bit patterns. Next I write down the binary for the MSB of decimal 117—75h—0111 0101. Earlier I said that all that was needed was to isolate the 7 and the 5 and add 30h, which is only half right because the 30h is useless. In this series I have covered a method for isolating or masking off numbers, and this is the logical AND operation. If we AND with F0 — 1111 0000, this will isolate the 7, and similarly AND 0F for the 5. This, then, is a method of obtaining two separate bytes from one byte (think about it).

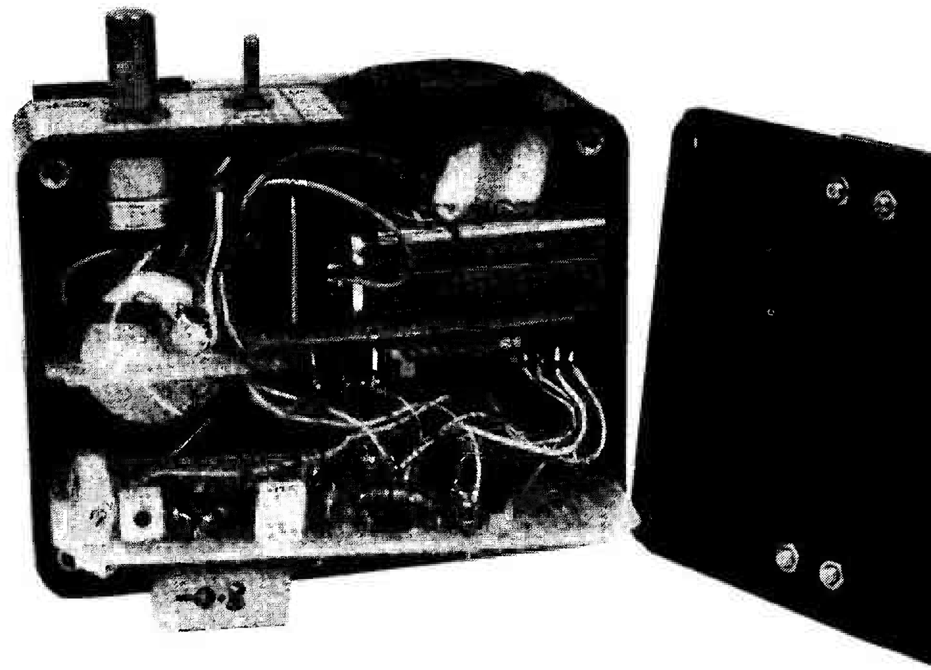
At this point I had better reveal the answer to the problem, which is a table of ASCII codes representing the characters 0 to F. The principle of using the table is very simple indeed. By pointing a register pair to the start of the table, any number added to that register will index into the table by the amount of the number. To make things easier, once indexed, the register pair would be pointing to the ASCII code for the number that was added. To make things clearer, the register pair is pointing to the start of the ASCII table which is 30h — 0; nothing added would cause the character 0 to be printed for the hex character, which is correct. The only problem lies with that first AND operation; AND F0 — 1111 0000 left us with 0111 0000 — 70h. Moving that bit pattern over to the right four times would solve our problem, so that's exactly what we do. The Z80 instruction we use is 1F — RRA which means Rotate Right Accumulator (register A). The full machine code listing is in Fig. 3, but please remember that the addresses given are for the printer buffer. If you want to re-locate the program, the addresses in HL and BC plus the ones in BASIC will have to be altered. Regarding the BASIC, I have given just enough lines to run it; my own version is a bit more user friendly. One last parting shot — if you want to write a hex to decimal program the clue lies in the difference of 30h and 40h! **ETI**

VERTICAL SPEED INDICATOR

Coming down to earth a bit after last month's high-flown introduction, this concluding article describes the construction and setting-up.

The gain in this circuit is very high (over 100,000) so the actual layout is quite critical. The PCB layout given has been well tested so no stability problems should be encountered if it is used. If, for any reason, you decide to produce your own PCB layout, do make sure you include the guard tracks around the input pins of ICs 2, 3 and 4. Without guard tracks the circuit may appear to be drift free in dry weather, but a little moisture will soon show up the drift. Note that if a double sided board is used, guard tracks should be run on both sides. The other point to remember if you produce your own layout is that all the unused inputs of IC10 should be connected to a defined level.

The transducer board should be built first, starting with the resistors and other passive components and moving on to the active components. Note that capacitors C1 and C3 are mounted on the underside of the board but do not solder C1 into place yet. The SOT (select on test) resistor, R7, should also be left off until you come to the setting up. Make sure you insert the diodes, the transistor and the ICs the right way around. Before soldering ICs 2, 3 and 4 into place, refer to the circuit and overlay diagrams and cut all the unused pins off short so that they do not reach the PCB. Bend pin 4 on each of these ICs away from the PCB and extend it with a piece of wire to reach the pads on the far side of the guard tracks. The layout given can accommodate either the LX0503A transducer or the alternative MPX-100A, and Fig. 7 shows the amended overlay arrangement and the links needed if you are using the latter device. If you are using the LX0503A, note that the IC is



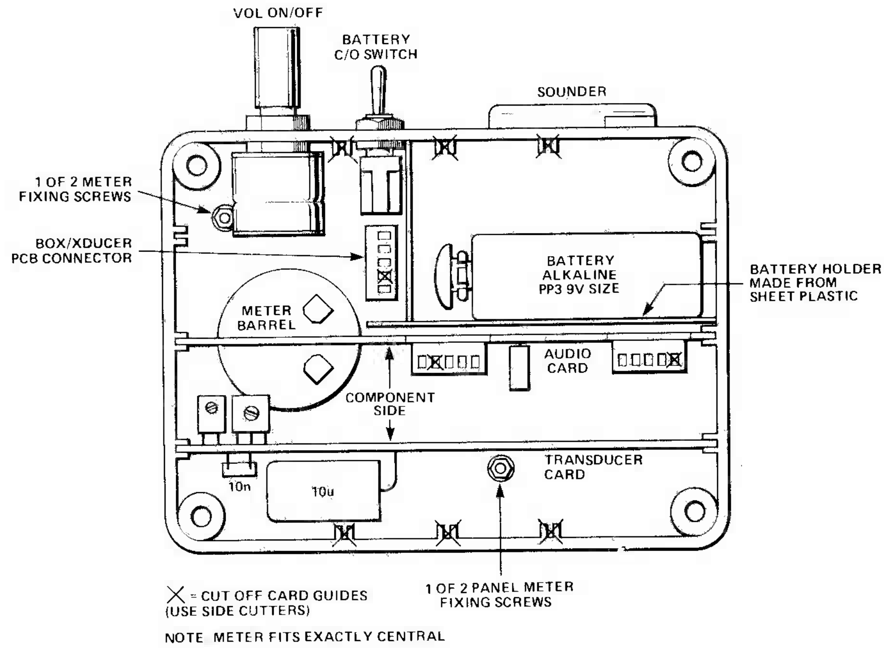


Fig. 5 Layout of the principal components in the case.

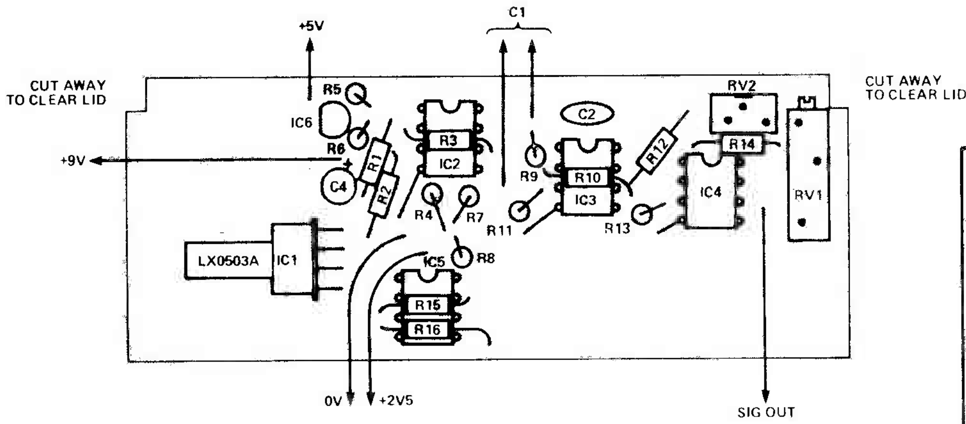


Fig. 6 Overlay diagram of the transducer PCB.

mounted on its side so as to save space on the PCB. Cut off pins 1, 2, 4 and 7 and then solder it into place, making sure that it is the right way up.

All semiconductor piezoresistive transducers must be shielded from light. The action of light on a semiconductor releases extra charge carriers and affects the conductivity which is what we are measuring in the strain gauge pressure transducer. In the case of the LX0503A, the input pipe should be plugged with a non-absorbent porous foam material, but one third of the filter from a tipped cigarette works well and has saved at least one transducer during a brief immersion in the sea. The design of the LX0503A package includes a barrier across the bottom of the pipe which prevents you pushing the filter down on to the delicate IC itself, but check this in case the package design varies from manufacturer to manufacturer. If you are using the alternative MPX100A transducer, you will have to make up a little hood for it from some non absorbent foam material and some tape.

For lightness and ease of assembly, the vario is built into a plastic box. For the majority of hang glider pilots this is the most convenient packaging, but a few pilots have begun to use CB for retrieval. It is illegal to transmit CB from an aircraft, but nevertheless some people will want to do it. The problem is that the signal levels are of the order of a microvolt in the early stages of the vario, and a strong RF field from a CB transmitter only a few feet away will easily radiate into an unscreened circuit.

When the transmit PTT switch is pressed, the vario output kicks and continues to read wrongly while the pilot is talking. It is not too much of a problem as talking can be kept to moments when nothing much is happening, but the complete solution is to build the vario in a diecast alloy box. This completely eliminates problems with RFI without further measures. The alloy box construction is useful, too, when flying within 500 feet of powerful radar

PARTS LIST

RESISTORS	
R1,2	16k 1% 0.4W metal film
R3,4	680k 1% 0.4W metal film
R5,10,11,14	1M 1% 0.4W metal film
R6	220k 1% 0.4W metal film
R7	see text
R8	4k7 1% 0.4W metal film
R9,15,16	75k 1% 0.4W metal film
R12,13	1k5 1% 0.4W metal film
R17,26,28	1M 2%
R18	2M7 2%
R19,20	47k 2%
R21	10M 5%
R22,23,29	100k 2%
R24	6M8 5%
R25	390k 2%
R27	18k 2%
R30	1k 2%
R31	12k 2%
R32	2k2 2%
R33	470R (see text)
RV1	50k ¾" 20-turn cermet preset
RV2	500k sub-miniature enclosed vertical preset
RV3	4k7 sub-miniature logarithmic potentiometer with switch
CAPACITORS	
C1	10u polyester
C2	220n polyester
C3,6,7,8	10n polyester
C4	100u radial electrolytic (see text)
C5	100n polyester
C9	100p
SEMICONDUCTORS	
IC1	LX0503A or MPX100A*
IC2,3,4,5	OP2OHP*
IC6	78L05A*
IC7	7621*
IC8,9	7555*
IC10	4049UB*
Q1	BC182L
D1	1N916

* see text and Buylines

MISCELLANEOUS	
SK1,2,4	5 way PCB plug
SK3,5,6	5 way PCB socket
LS1	piezo-sounder type PB2720
SW1	SPDT miniature toggle switch
M1	50-0-50uA panel meter, 60 x 75mm

PCBs; plastic or ABS box, 100 x 75 x 40mm; PP3 size battery connectors, 2 off; knob to suit RV3; 1" diameter plastic spring clips; realeasable cable tie with sticky base.

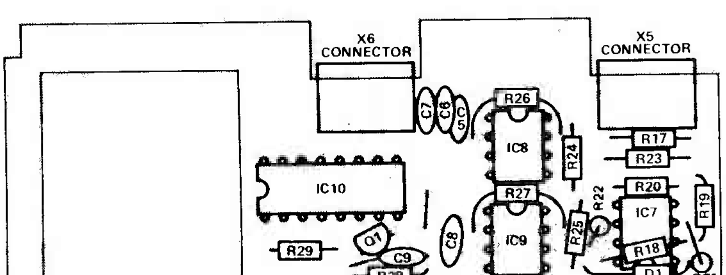


Fig. 7 Overlay diagram of the audio PCB.

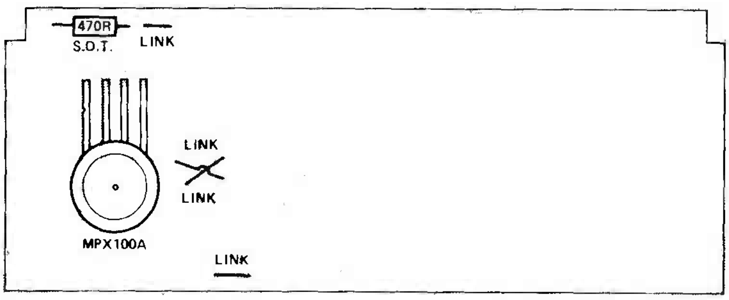


Fig. 8 Overlay diagram of the transducer PCB showing the modified arrangement to accommodate the MPX100A.

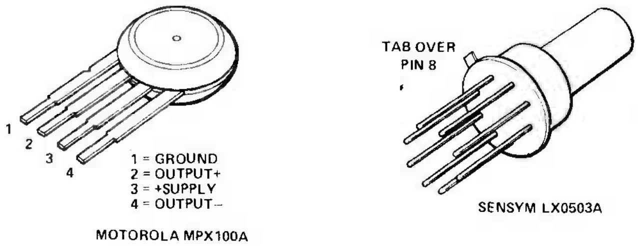


Fig. 9 The LX0503A and MPX100A packages.

and TV transmitters.

The piezoceramic sounder should be glued down with a dab of clear Bostik on each fixing lug. Do not glue the central part of the sounder down or you will spoil the sound volume and quality. The fixing lugs have holes for screws but the sounder resonates better when glued down as described.

To prevent rain getting in at the meter barrel, the joint with the box should be sealed with silicone rubber. Do not seal the entire box unless the instrument is only to be used at very low altitudes. A small quantity of air must be able to get in and out somewhere — the intention is that this will happen at the imperfect joint between the box and its lid.

Setting Up

Test the transducer card first. Apply the 9V supply and check the +5V line and the +2.5V signal ground. Remember that alkaline 9V PP3 size batteries are recommended. The SOT resistor R7 can now be selected. Monitor the output of IC2 and select R7 such that the output of IC2 is at 0.25V ±0.05V below signal ground. R7 should, of course, be a 1% metal film type like the other resistors on the transducer board. Since it would be very expensive to buy in a whole range of these from which to select, it might be better to determine the value required when it is known. It is suggested that you start out with a value of around 22k.

Moving on to the audio card, turn the gain pot RV2 to max, set the audio input voltage to about 100mV using the zero pot RV1, and check the interrupt oscillator frequency by counting the number of beeps in 10 seconds. Solder C6 and C7 into the circuit if necessary to bring the interrupt frequency down to 2Hz or just under. Check that the audio switches on and off at a threshold of about 50mV with a very small amount of hysteresis. Finally, check that the audio pitch is progressive to +1.25V and that the volume control functions.

Next set the zero. Turn the gain pot RV2 fully counter-clockwise and check that the output goes to zero. Then turn it fully clockwise again and zero the output using RV1.

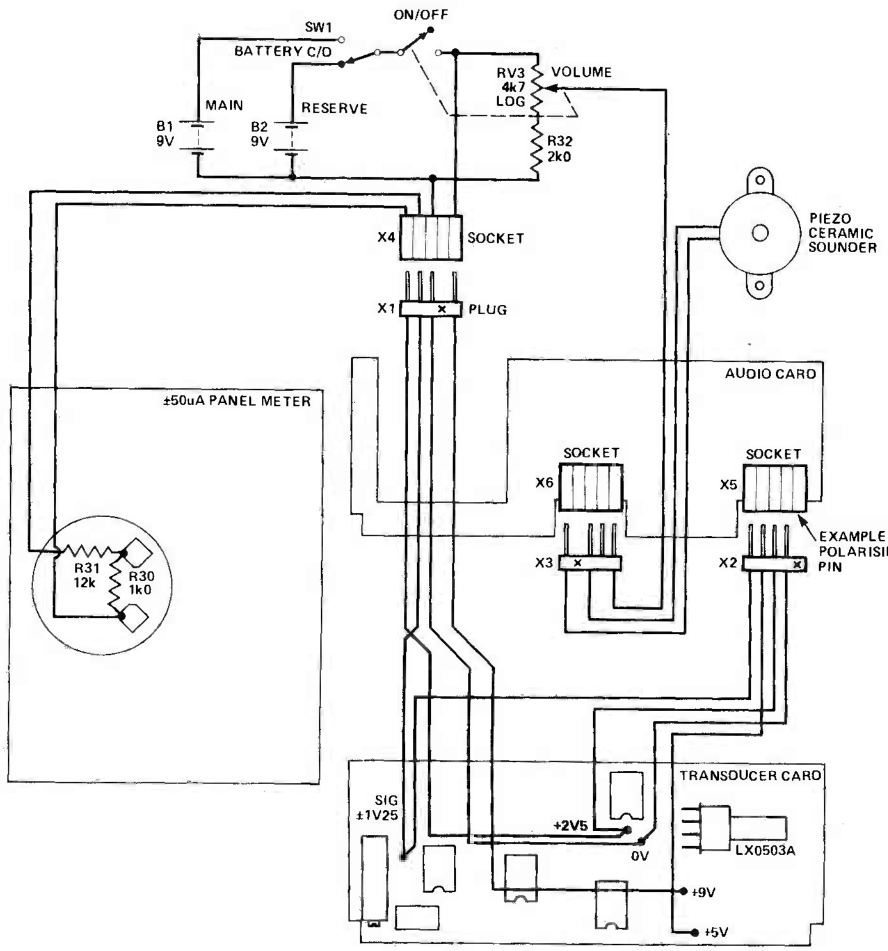


Fig. 10 Interwiring of the circuit boards and external components.

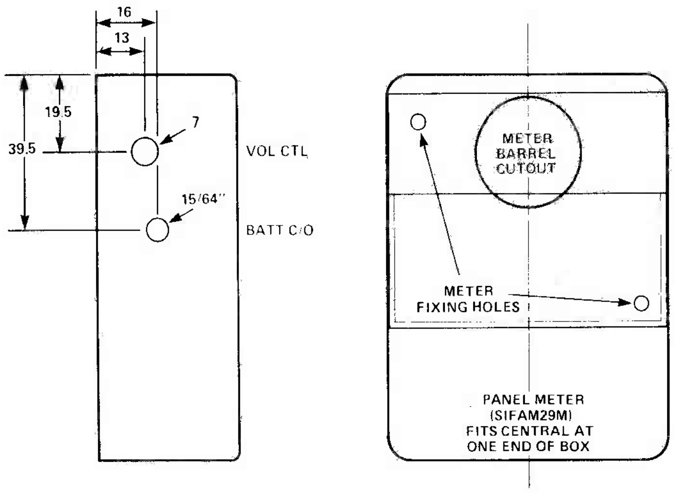


Fig. 11 Case drilling details.

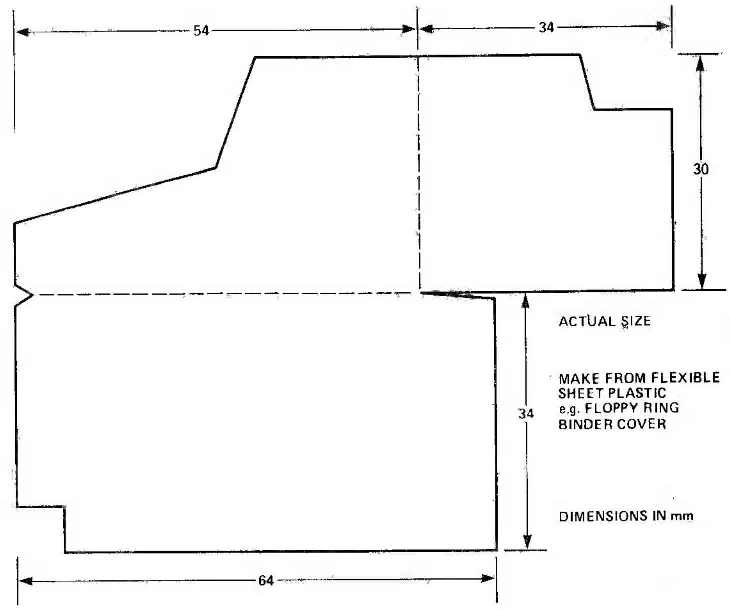


Fig. 12 Pattern for the battery holder. This should be cut out of thin plastic sheet, an old ring binder cover, for example.

Solder in the 10uF capacitor C1. Turn the gain (calibration) pot RV2 to mid position and check that the instrument is functional by putting it in a large plastic bag and squeezing gently. Squeezing the bag should cause the vario to read sink, while releasing the pressure should cause a strong lift reading.

If you have used an MPX100A transducer, you can adjust the temperature compensation by altering the value of the series resistor, R33. Expose the transducer to a mild temperature rise (not too hot, please!) and note the

BUYLINES

The LX0503A transducer is available from Hitek, Trafalgar way, Bar Hill, Cambridge CB3 8SG, tel 0954 81996. Alternatively, you can use the MPX100A transducer which offers better temperature compensation and is available from Macro Marketing, Burnham Lane, Slough SL1 6LN, tel 06286 4422. The drawbacks with the MPX100A are that it costs a little more and that it draws more current, about 5mA compared with 1mA for the LX0503A, thus shortening battery life to about 25 hours.

The OP20HP op-amp is available from Hitek at the address above. Cheaper op-amps might be used in the IC3, 4 and 5 positions but they should be chosen with care if the drift is not to become excessive. The principal requirements for all four op-amps (IC2,3,4 and 5) is that they be micropower, will work off a 2.5V supply, have excellent offset drift specifications and very low noise.

As explained in the text, the regulator is a potential source of noise and a poor component here will impair the resolution of the vario. 78L05s made by Texas Instruments proved to be the best in this respect and these are also available from Hitek.

An Intersil 7621 has been specified in the IC7 position since it will work quite happily as a Schmitt trigger with $\pm$2.5V across its inputs. Other op-amps may not but the solution is to connect a pair of protection diodes across the input pins 2 and 3. The 7621 is available from RS Components, who do not accept cash orders so you would have to find a friendly dealer, and from LRL Electronics whose address is given at the end of Buylines.

The 7555 is a CMOS version of the standard 555 timer and ICs described simply as CMOS 555 are available from a number of our regular advertisers. IC10, the 4049, has to be chosen carefully to reduce the risk of oscillation in the buffer stage, and suffix UB (Unbuffered, 'B' spec.) devices were found to be best in this respect. 4049s supplied by RS are of this type (order no. 306-667, pack of 5), assuming you can find someone who will order for you. Most of our regular advertisers do not specify which type their CMOS devices are so you should check first if ordering from one of them.

The 1% 0.4W metal film resistors are available from both Maplin and Electrovalue. The 2% types are not so easy to come by but you can always use 1% types here as well (if your wallet will stand it!) The 20-turn preset, RV1, is an RS part (162-259) but a 15-turn preset which is otherwise identical is available from Maplin and Electrovalue. RV2 is also an RS part (185-959), but a miniature vertical skeleton preset could be used here at a pinch. The spacing will then be quite tight and you will have to choose a preset which can be adjusted from either side since it will be mounted with its back outwards.

RV3 is again an RS part (162-120) and was chosen because it is the smallest potentiometer with integral switch that could be found. Ambit sell some miniature potentiometers with push-pull rather than rotary switch action and one of these might fit, but we should point out that we have not tried this. The value used in the prototype (4k7) was chosen because it is the only value offered by RS, but if you do manage to find another source of subminiature switched pots you might wish to choose a higher value and then buffer it with a transistor so as to gain 1mA or so reduction in battery current. Alternatively, you could use an unswitched miniature potentiometer and achieve on-off switching by some other means, perhaps by making SW1 a centre-off toggle.

The meter used in the prototype was a Sifam 'Presentor' model 29M. This uses a taut band coil suspension system which is much more robust than the conventional pivot and hair spring suspension system. Other 50-0-50uA meters could be used provided their scale area fits on the vario's case, the barrel is 25mm diameter or less, and the depth behind the scale is not more than 35mm including pins (bent-over pins?)

The only capacitor likely to cause any problems is the 10u polyester, C1. This is an RS part (113-623) but an equivalent is available from Electrovalue. The PB2720 piezo-sounder is available from Ambit, 5-way PCB connectors from Maplin, and the 1" diameter plastic spring clips from most boating shops. The case is widely available, and if you're not too worried about the size of the finished unit you could use a slightly larger one. This would ease a number of the component supply problems since a lot of the difficulty stems from the need to use miniature components.

Finally, if all this chasing around for parts sounds a bit too much like hard work, the author's own company, LRL Electronics, can supply all the parts. Their address is Fairhaven Cottage, Ridgemead Road, Englefield Green, Surrey TW20 0YG, tel 0784 34740, and an SAE will bring you full details and prices. The PCB will be available through our PCB service, see page 00.

change in reading, if any, on the meter. The optimum value of the resistor is found experimentally by increasing the resistance if the temperature rise causes a lift to be indicated on the meter and vice versa.

The final setting up operation is the calibration, using RV2. Fairly good results can be had by timing a lift through a number of floors, but if you can borrow a calibrated vario you can match the calibrations using the plastic bag method. Place both varios in a large clear plastic bag and squeeze gently but with increasing pressure while adjusting the gain pot between squeezes. If you are really stuck, Mr. M. Hutchinson (Reading 696491) will calibrate your vario professionally.

The MPX100A used with a 470R series resistor will generally be more sensitive than the LX0503A. If it is found that the calibration pot has to be set less than a third of the way up, reduce the resistors R3 and R4 by an amount sufficient to bring the calibration pot up to about mid position. This will prevent the first amplifier saturating below 20,000 feet.

The settling time of the vario after switch on should be less than a minute. The delay is largely a result of dielectric absorption in the 10uF capacitor in the differentiator, C1, an effect whereby a dielectric takes time to acquire a charge when voltage is applied and subsequently releases charge when the voltage is removed. The effect is related to the voltage applied across the capacitor and should not be confused with leakage current. With 1V across C1 the output could take as long as five minutes to settle, but this has been reduced by restricting the voltage swing at the output of the transducer buffer op-amp to within 0.25V of the signal ground at switch on, assuming a take off height between sea level and 8000 feet.

When the circuit is working correctly, a light ticking sound should still get through from the interrupt oscillator driving the tone oscillator reset. The ticking serves as a handy means of knowing the instrument is switched on, but if it is not liked, it can be gated out by killing the interrupt oscillator at the same time as the tone oscillator. Wire another diode from IC7 pin 1 to the junction of R24 and R26.

No decoupling was found necessary in the prototype but a position has been left on the PCB for a 100uF capacitor (C4) to decouple the 9V input lead if necessary. The response time of the circuit is fixed by R9 and C2 and with the values given (75k and 220n) is quite fast, but if heavier damping is preferred the value of C2 can be increased to 470n.

When the circuit is working correctly and any necessary component changes have been made, the transducer PCB should be well cleaned. Solder flux residues as well as other deposits can present problems so use a good flux solvent for this. The clean board should then be given two coats of lacquer to prevent further moisture ingress. The transducer input port and all connectors, etc, should be sealed with tape during the lacquering operation to remove the risk of damage. **ETI**

MIDI DRUM SYNTH

Are you still hiding your creativity behind that all-encompassing maxi? Or is that skimpy mini revealing the inadequacies of your rhythm section? ETI unveils its Midi, the drum synth to be seen with!

We have published a number of drum synthesisers in the past, both full-featured, multi-voiced monsters (eg, June 80, April 1981) and simple, single-voiced modules (eg, November 1983), but so far, we have never featured anything which falls between these two extremes. As its name implies, the Midi Drum Synth is an attempt to put that right.

The Midi is a single-voiced unit which also has a sequencer input, allowing several to be used together. It has a variable decay rate, variable pitch, and a variable sweep facility which causes the pitch to fall sharply from its starting point. When not required, this can be switched out so that only a single tone is produced. Further variety of sound is provided by an active filter whose centre frequency and pass band are adjustable. The input device is a small transducer which triggers a drum beat when hit; the harder you hit it, the louder the sound produced. A level control is also provided, and the completed unit runs from an external battery or other 9-16 volt supply. The range of facilities allows the Midi to imitate everything from a bass drum to a triangle, as well as some less obviously percussive instruments, for example, a strummed guitar.

Construction

The complete unit is housed in an aluminium diecast box, and the drilling details for this are shown in Fig. 3. The only hole likely to cause any problems is the 23 mm diameter hole for the piezo transducer. The size is not too critical, but if you don't have a metal punch around that size you will either have to burr out a smaller hole or else drill a series of small holes in a circle and then link them up with a small file. It does not matter if the finished hole has a rough edge since it will be hidden by the pad of the transducer. The case should then be painted, the legends added using dry transfer lettering, and a coat of varnish applied to protect the lettering.

Start assembling the PCB by inserting the three wire links. Note that one of these is under IC2 and either use an insulated link on the underside of the board or choose an IC socket which allows room for the link to pass under it. IC sockets are recommended for all the ICs since three of them are MOS devices and the fourth is fairly expensive. Do not insert the ICs into their sockets yet but carry on soldering the resistors and capacitors into place, taking care to mount C1, 8 and 9 the right way around. Take care also with the two diodes.

It is best to tackle the wiring up in a methodical manner, perhaps working from one end of the PCB to the other. Using many different colours of wire will help, and it is a good idea to allocate each potentiometer its own colour so as to make sorting out the leads at the front panel easier. Cut the potentiometer shafts to their

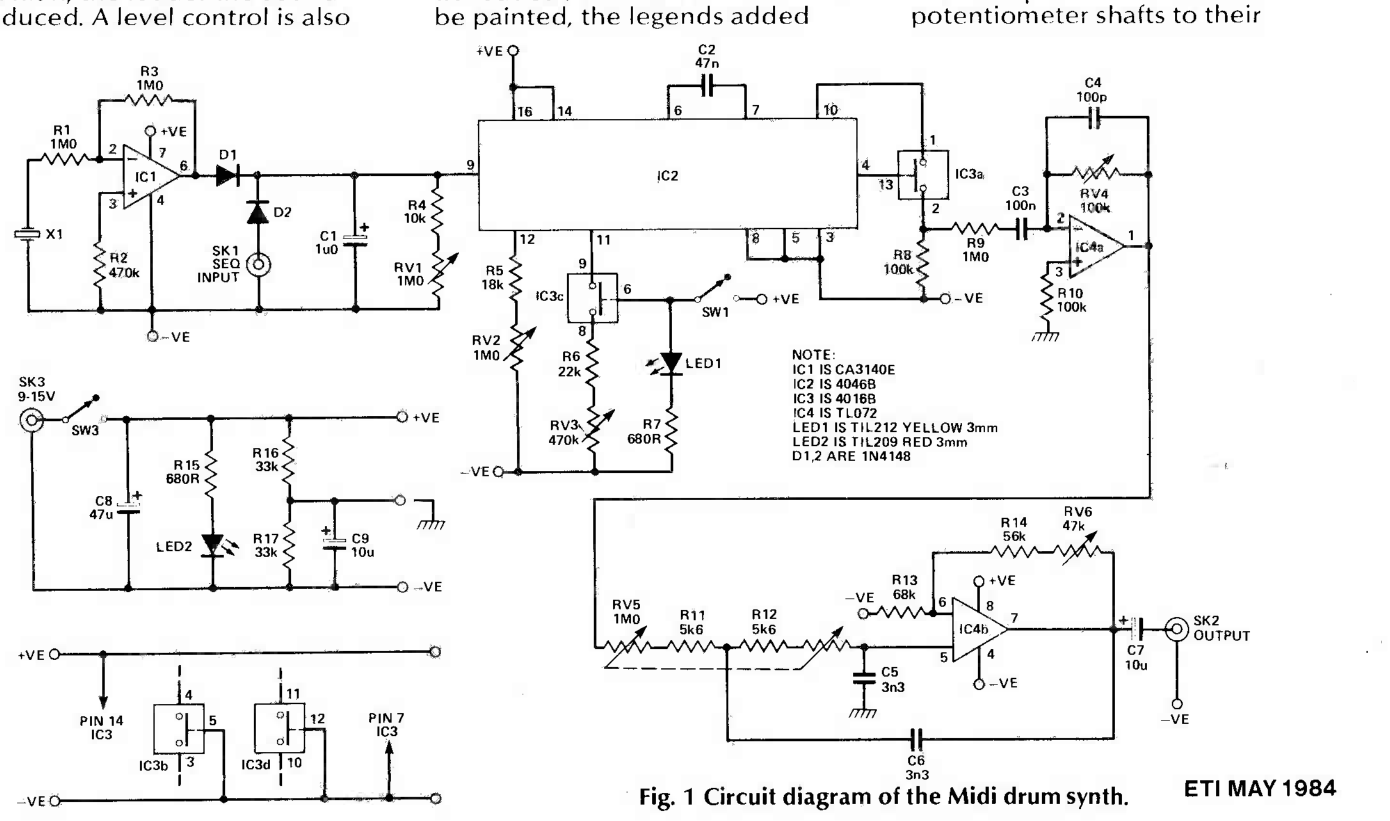


Fig. 1 Circuit diagram of the Midi drum synth.

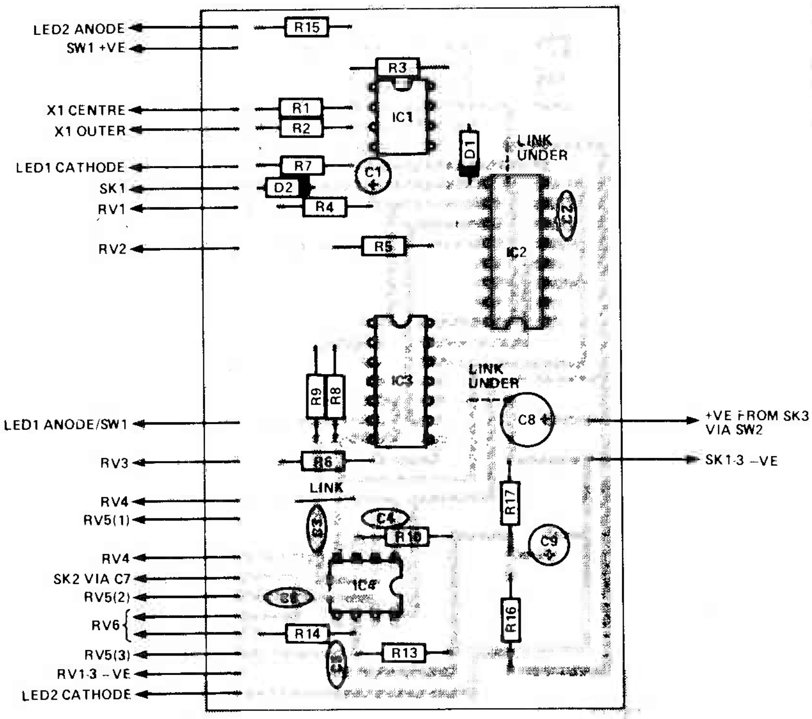


Fig. 2 Overlay diagram of the PCB.

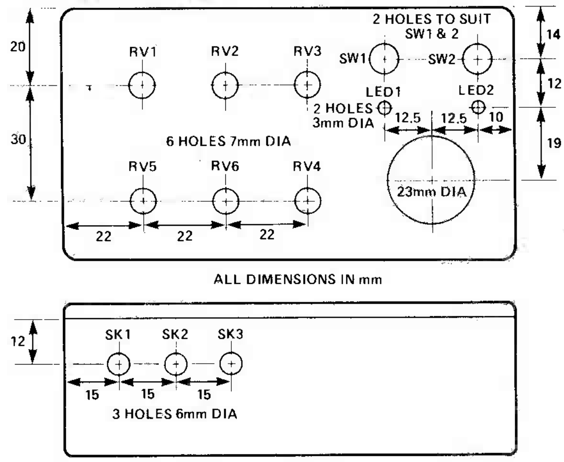


Fig. 3 Case drilling details.

PARTS LIST

RESISTORS (all ¼W, 5%)	
R1, 3, 9	1M0
R2	470k
R4	10k
R5	18k
R6	22k
R7, 15	680R
R8, 10	100k
R11, 12	5k6
R13	68k
R14	56k
R16, 17	33k
RV1, 2	1M0*
RV3	470k*
RV4	100k*
RV5	1M0* dual gang
RV6	47k*

(* All potentiometers are miniature types with 7mm bushes)

CAPACITORS	
C1	1µ0 25V radial electrolytic
C2	47n
C3	100n
C4	100p polystyrene
C5, 6	3n3 mylar
C7, 9	10µ 25V radial electrolytic
C8	47µ 25V radial electrolytic

SEMICONDUCTORS	
IC1	CA3140E
IC2	4046B
IC3	4016B
IC4	TL072
D1, 2	1N4148
LED1	TIL212 yellow 3mm LED
LED2	TIL209 red 3mm LED

MISCELLANEOUS	
SK1, 2, 3	3.5mm open jack socket
X1	PBN2720 piezo transducer and pad
SW1, 2	SPST toggle switch

PCB; knobs, 6 off; case, BIM5004 or similar; 2 off 8 pin DIL sockets, 1 off 14 pin and 1 off 16 pin; thin plastic or card to line box; screened and un-screened wire, etc.

HOW IT WORKS

When X1 is hit, a short, negative-going pulse is generated whose amplitude is proportional to the force of the hit. IC1 inverts and buffers this pulse and charges C1. D1 ensures that the only discharge path for C1 is via R4 and the decay control potentiometer, RV1. IC2 is a 4046 phase-locked loop which consists of a voltage controlled oscillator (VCO), a source follower, a zener diode and two phase comparators. The decaying voltage across C1 is taken to the input of the VCO and the source follower. C2 sets the VCO frequency in combination with the resistance networks connected between pins 11 and 12 and the negative supply rail. Pin 12 sets the frequency offset; placing a voltage on this pin compresses the frequency range of the VCO towards its maximum value, thus setting the minimum value. Pin 11 sets the frequency range; with SW1 open, IC3c presents what is effectively an open circuit, with the result that no frequency range is set and the VCO produces a single tone at its centre frequency regardless of the varying input voltage. With SW1 closed, IC3c connects RV3 and R6 into circuit and thus sets a frequency range, causing the VCO frequency to fall as the voltage on its input falls.

The outputs from the VCO and the source follower are combined by IC3a and R8 as shown in Fig. 5 (overpage). The resulting waveform is fed to the buffer, IC4a, which incorporates the level control, RV4, and then to a second order Sallen and Key active filter configured around IC4b. The buffer ensures that the filter is driven by a low impedance source and by integrating the level control with it, an output potentiometer is not needed and the output impedance can also be kept low.

The power supply is perfectly straightforward; R16 and 17 set the earth rail halfway between the positive and negative supply rails, C9 decouples this rail from 0V and C8 provides decoupling for the two main supply rails.

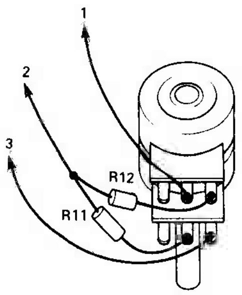


Fig. 4 The wiring around RV5.

correct lengths before wiring them up. Take care with LED1 and 2 which must be mounted the right way around, and note the wiring of C7 on SK2. Screened lead should be used to connect up the piezo transducer, and remember to thread the lead through the hole in the case before soldering.

With all the wiring done, bolt the potentiometers, sockets and switches into place and insert the ICs into the PCB. Stick the rubber pad onto the transducer and mount it over the large hole using a contact adhesive. It was not found necessary to secure the PCB inside the box. Instead, a sheet of thin plastic was folded and wrapped around the PCB to prevent it shorting to the case at any point.

After checking everything carefully, apply between 9 and 16 volts to SK3 and check that none of the ICs get hot. If all seems well, connect the output to the line input of an amplifier and try a few practice hits. If nothing happens (or worse, the wrong thing happens), an oscilloscope will be very useful, and the correct waveforms at various parts of the circuit are shown in Fig. 5. Finally, check the sequencer input by applying a positive-going pulse at the supply potential to SK1.

ETI

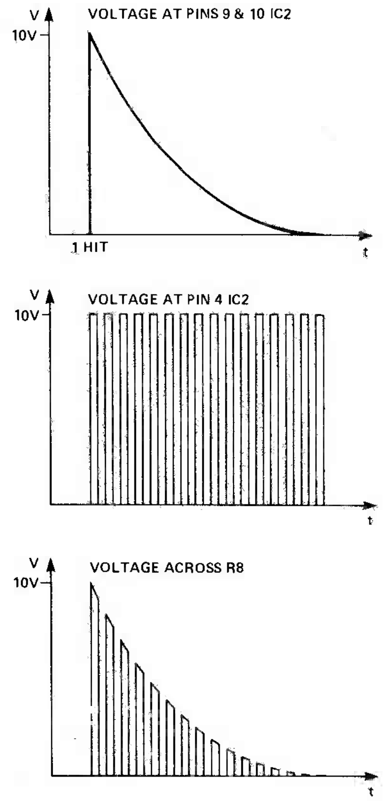


Fig. 5 Modulation of the VCO output by the decay voltage.

BUYLINES

The transducer and its rubber pad are available from Maplin, as is the case. The potentiometers are available from Ambit, and if you obtain them from any other source you should check the size carefully or you may have difficulty fitting them into the case. We used monolithic type capacitors for C2 and 3 but any other type will do provided they have a pitch of 5mm and are non-polarised. The PCB is available from our PCB service, for which see page 65.

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

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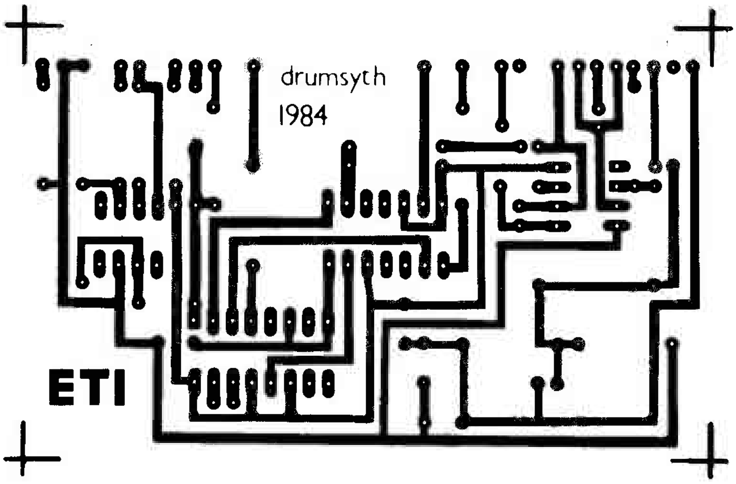
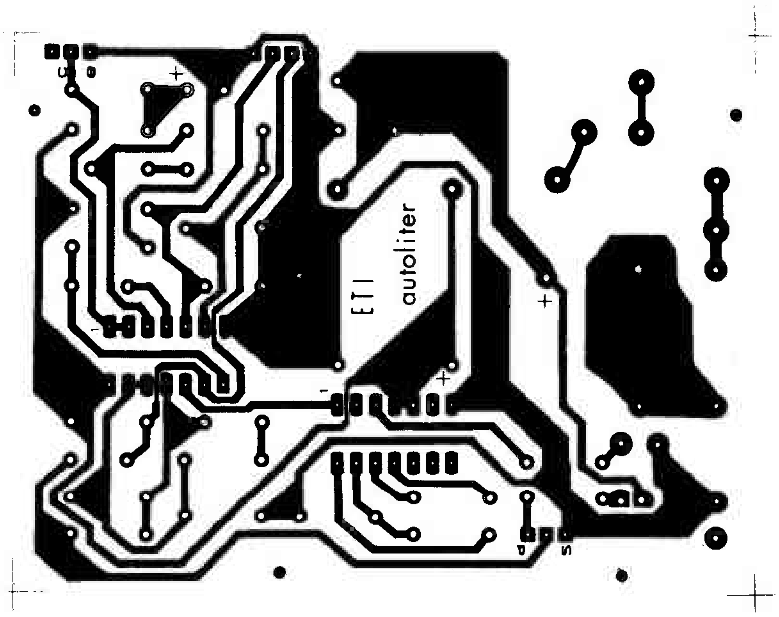


The Midi Drum Synth.



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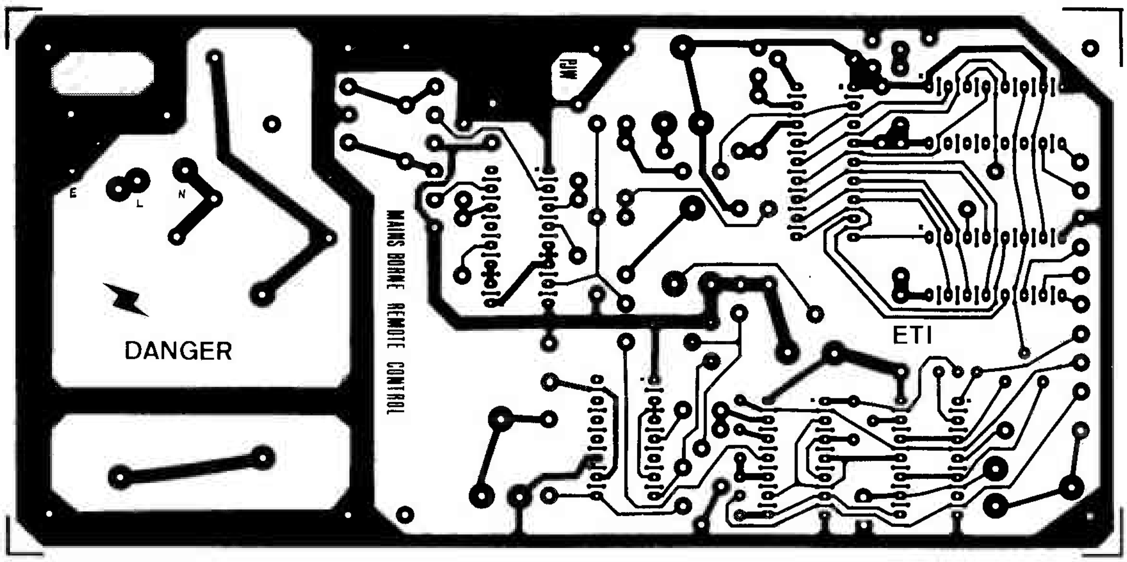

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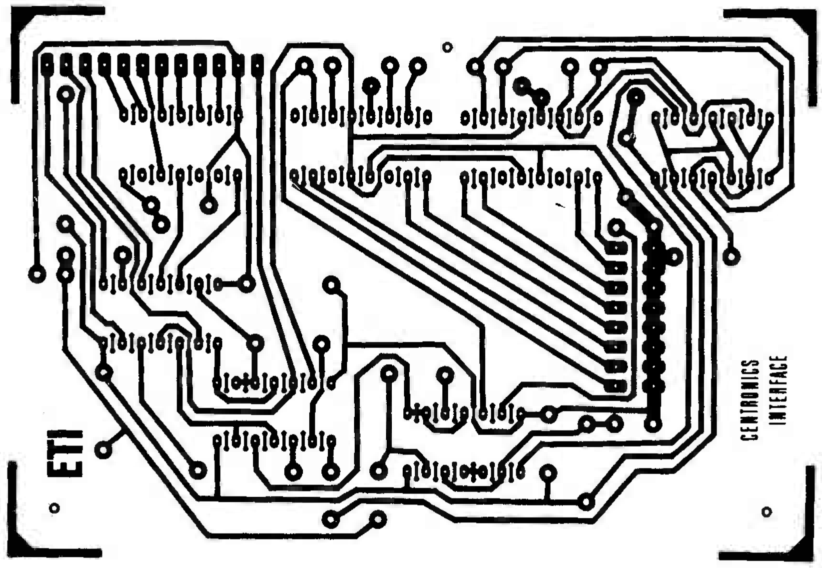

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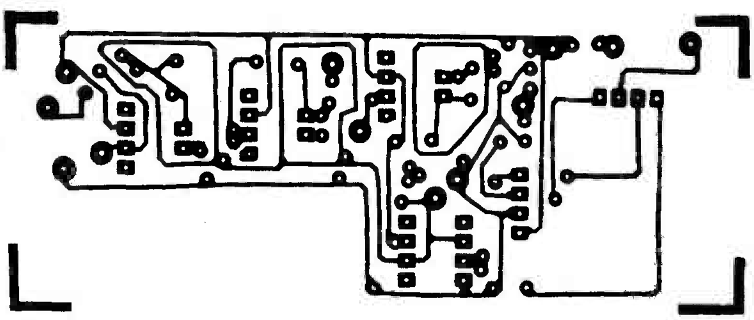
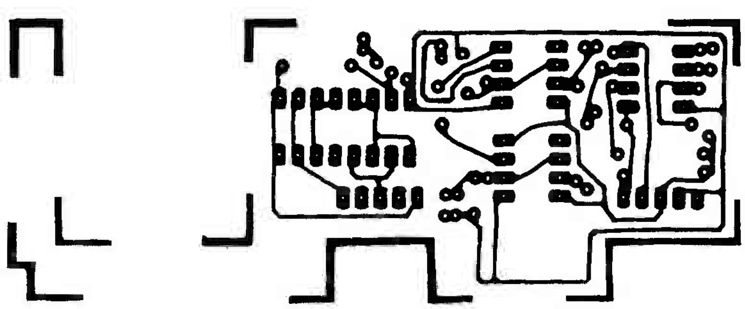
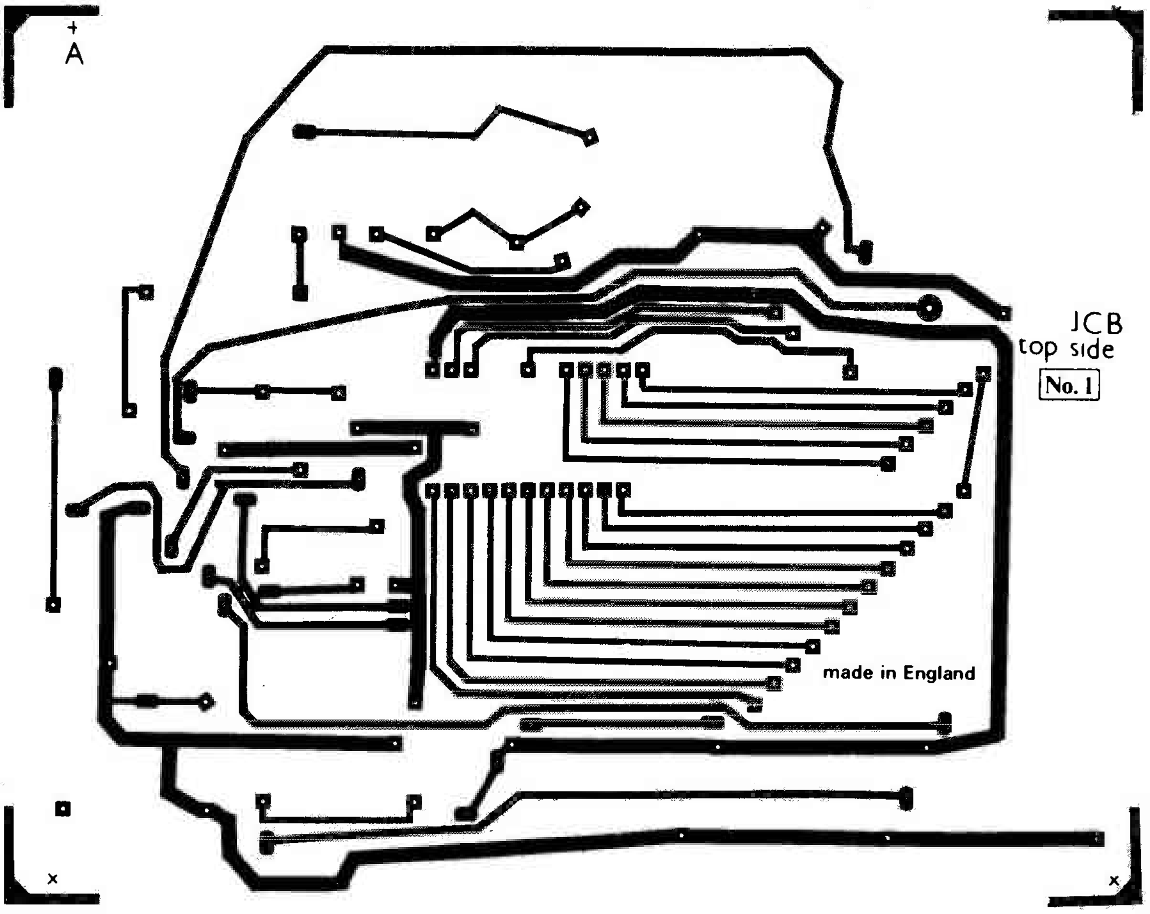


The Vario transducer board.



The Vario audio board.



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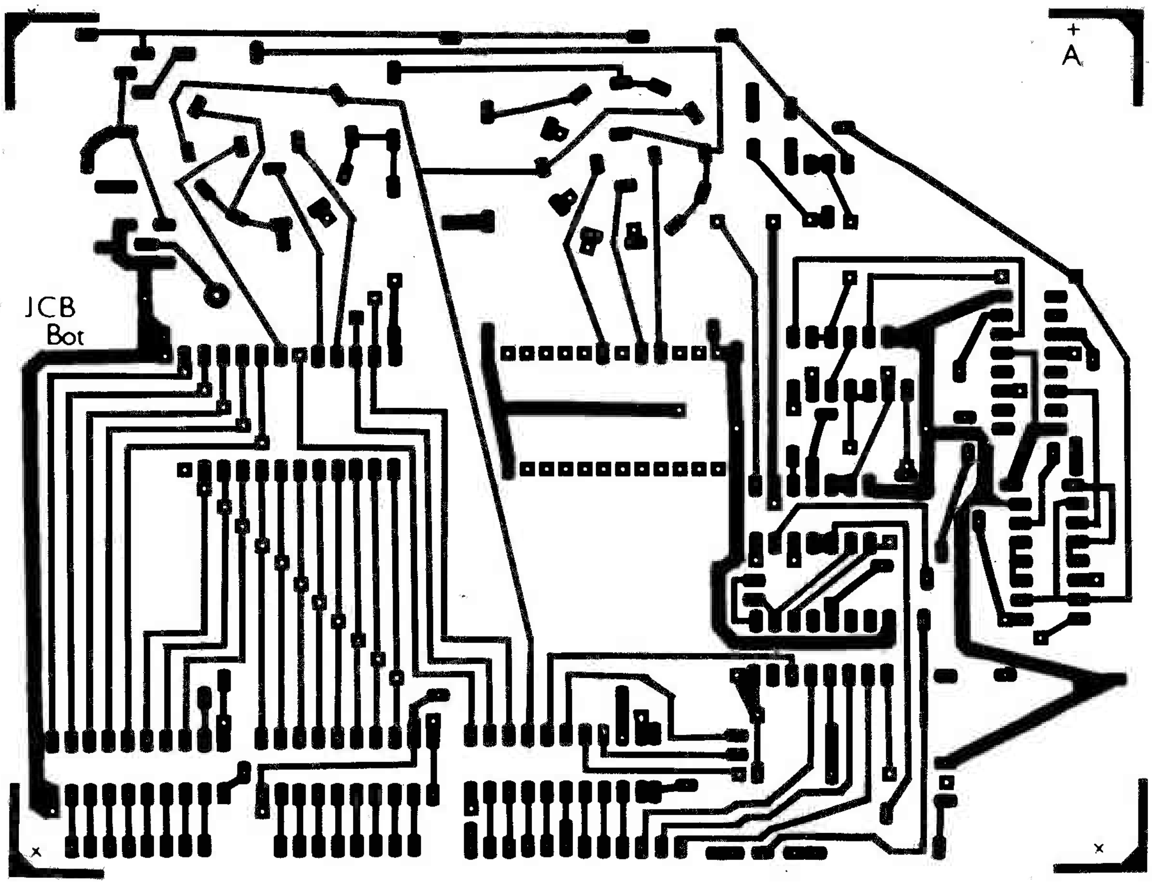

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- Other than through our letters page, Read/Write, we will not reply to enquiries relating to other types of article in ETI. We may make some exceptions where the enquiry is very straightforward or where it is important to electronics as a whole;
- We receive a large number of letters asking if we have published projects for particular items of equipment. Whilst some of these can be answered simply and quickly, others would seem to demand the compiling of a long and detailed list of past projects. To help both you and us, we have made a full index of past ETI projects and features available (see under Backnumbers, below) and we trust that, wherever possible, readers will refer to this before getting in touch with us.
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ETI should be available through newsagents, and if readers have difficulty in obtaining issues, we'd like to hear about it.

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We don't bother with the bureaucracy for Tech Tips — all you do is to send in your idea, stating clearly if you want an acknowledgement or receipt. If possible, please *type* your explanation of why the circuit is different, what it does and how it works, on a separate sheet from the circuit diagram; both sheets should carry your name, address and the circuit title. We'll let you know (within a month or so) if we want to use your Tech Tip.

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OOPS!

Corrections to projects are listed below and normally appear for several months. Large corrections are published just once, after which a note will be inserted to say that a correction exists and that copies can be obtained by sending in an SAE.

Active Loudspeaker (November 1983)
Gremlins attacked the parts list on page 72 leaving a trail of 00s in their wake. The ceramic tiles should be 150mm (6") square and you need six of them. The BAF wadding should be 21" wide and long enough to loosely fill the space inside the enclosure when rolled up, with a bit left over to cover the back of the bass unit; the thinner the wadding you use, the greater the length you will need. There were also some errors on the circuit diagram, etc. C13 should be shown connected to pin 4 of IC2, not ground. C13 is correctly shown below IC2 on the overlay diagram but a second C13 has been shown to the right of IC2; the second C13 should be omitted. The parts list and the PCB pattern are correct. Finally, a number of readers have reported difficulty in obtaining the 3040 op-amps specified for IC2 and IC3. Any op-amp with the same pin-out should work in the circuit but we cannot guarantee the performance with other types. We have, however, tried the popular 3140 and found its performance quite satisfactory.

Programmable Speech Board — Mini Mynah (February 1984)
The PCB for this project is double sided but only the underside pattern appears on the overlay drawing on page 26 and on the Foil Patterns page. The component side pattern appears on the PCB Foil Patterns page in the March'84 issue. The error does not affect PCBs supplied by our PCB service. There are also a number of errors in the circuit diagram on page 22. Pin 10 on IC11 should be connected to 0V along with pins 1 and 11, not pin 12 as shown; pin 12 should be left unconnected. On the same IC, pin 25 rather than pin 23 should be connected to pin 2 and R12/C4; pin 23 is Vcc and should be connected to the +5V supply. R5 has been missed off of the circuit diagram; it should be shown connecting IC4a pin 8 and IC5 pin 21 to the +5V supply. In each of the above cases the PCB and the overlay diagram are correct.

Adding Colour to the Ace (April 1984)
We renumbered the components in this article to make things easier for you (!) and ended up with utter confusion. In the third paragraph of the construction section on page 43, IC4 should read IC14. In the first column of the How It Works section on page 44, lines 3-4 should read "... via tri-state buffer *IC9...*". In the third column of the same section, the capacitor in the differentiator network (lines 13-14) is C6, not C9, and the line sync pulse mentioned at the start of the next paragraph is applied via IC1e, not R1d. In the first column of How it Works on page 45, C6/R15/R10 on line 9 should read C6/*R9*/R10, and the list of resistors given three lines further down should start with R29 not R21. In the second column on page 45, the colour modulator is IC14 not IC13 and the second phase shift network mentioned a few lines further down should be C16/*R32*, not C16/R17. On the circuit diagram on page 44, there are two C7s, the lower one of which should be C8 and have a value of 4n7, not 47n as stated in the parts list; C9 is listed as being 100n both on the circuit diagram and in the parts list but should actually be 1n. In the other half of the circuit diagram on page 45, C17 should be 33p not 10p and again the parts list is also wrong, and pin 16 of IC14 should be shown connected to pins 15 and 12, not to the +5V supply; the PCB overlay is correct. In the timing diagram at top left on page 45, read IC1 for IC13, IC5 for IC12, IC10 for IC9, IC11 for IC5, R14/C12 for R29/C19, and C9/R11 for C5/R6. In the timing diagram at top right on page 45, read IC5 for IC12 throughout, and in the regenerate clock signal diagram below it, read IC6b for IC2a, IC11 for IC5, and IC6c for IC2d. The same three ICs are mentioned in the delay timing diagram on the same page and should be similarly amended. In the setting up section on page 46, read RV1 for RV2 and vice versa, and in the software section read f0 for £0.

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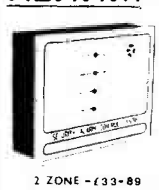

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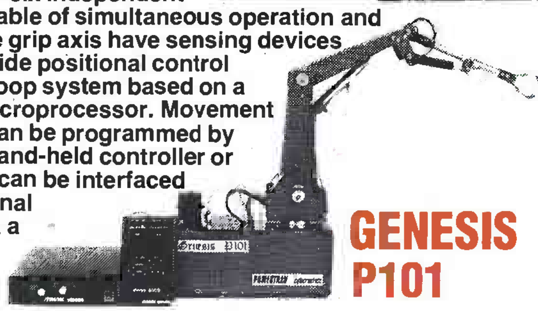

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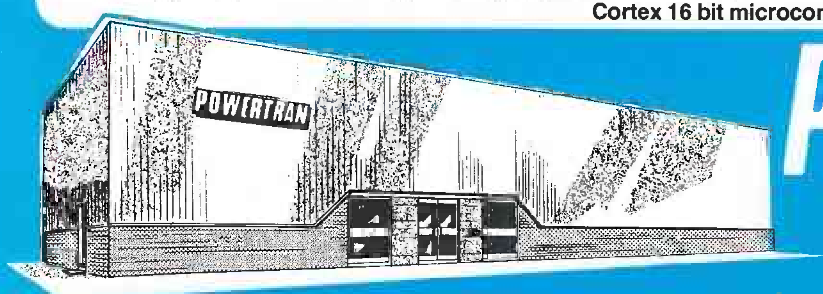

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