# EVERYDAY ELECTRONICS

SEPTEMBER 1990

INCORPORATING ELECTRONICS MONTHLY

£1.40


## ALARM BELL TIMEOUT
**Update your Alarm System**

## VALVE DISTORTION UNIT
**Guitar Effects Box**

## METAL MATE
**Pipe and Wire Detector**

## PLUS
**INTERFACING THE RML NIMBUS**


ISSN 0262-3617

09

9 770262 361003


The Magazine for Electronic & Computer Projects

## ONE POUND PACKS

All packs are £1 each. Note the figure on the extreme left of the pack ref number and the next figure is the quantity of items in the pack, finally a short description.

BD2 5 13A spurs provide a fused outlet to a ring main where devices such as a clock must not be switched off.
BD9 2 6V 1A mains transformers uorioht mountino with fixing clamps.
BD11 1 6½in speaker cabinet ideal for extensions, takes our speaker. Ref BD137.
BD13 12 30 watt reed switches, it's surprising what you can make with these—burglar alarms, secret switches, relay, etc., etc.
BD22 2 25 watt loudspeaker two unit crossovers.
BD30 2 Nicad constant current chargers adapt to charge almost any nicad battery.
BD32 2 Humidity switches, as the air becomes damper the membrane stretches and operates a microswitch.
BD42 5 13A rocker switch three tags so on/off, or change over with centre off.
BD45 1 24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day, original cost £40 each.
BD49 5 Neon valves, with series resistor, these make good night lights.
BD56 1 Mini uniselector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole.
BD67 1 Suck or blow operated pressure switch, or it can be operated by any low pressure variation such as water level in water tanks.
BD103A 1 6V 750mA power supply, nicely cased with mains input and 6V output leads.
BD120 2 Stripper boards, each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc.
BD132 2 Plastic boxes approx 3in cube with square hole through top so ideal for interrupted beam switch.
BD134 10 Motors for model aeroplanes, spin to start so needs no switch.
BD139 6 Microphone inserts—magnetic 400 ohm also act as speakers.
BD148 4 Reed relay kits, you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets.
BD149 6 Safety cover for 13A sockets—prevent those inquisitive little fingers getting nasty shocks.
BD180 6 Neon indicators in panel mounting holders with lens.
BD193 6 5 amp 3 pin flush mounting sockets make a low cost disco panel.
BD199 1 Mains solenoid, very powerful, has 1in pull or could push if modified.
BD201 8 Keyboard switches—made for computers but have many other applications.
BD211 1 Electric clock, mains operated, put this in a box and you need never be late.
BD221 5 12V alarms, make a noise about as loud as a car horn. Slightly soiled but OK.
BD252 1 Panostat, controls output of boiling ring from simmer up boil.
BD259 50 Leads with push-on ¼in tags—a must for hook ups—mains connections etc.
BD263 2 Oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into pattress.
BD268 1 Mini 1 watt amp for record player. Will also change speed of record player motor.
BD305 1 Tubular dynamic mic with optional table rest.
BD653 2 Miniature driver transformers. Ref. LT44. 20k to 1k centre tapped.
BD548 2 3.5V relays each with 2 pairs changeover contacts.
BD667 2 4.7 µf non-polarised block capacitors, pcb mounting.

**There are over 1,000 items in our Catalogue. If you want a complete copy please request this when ordering.**

**METAL PROJECT BOX** Ideal for battery charger, power supply etc. Sprayed grey size 8" x 4" x 4½". Louvred for ventilation. Price £3.00. Ref. 3P75.

**FLOPPY DISCS** 5¼" pack of 10 £5.00 Ref 168 3½" pack of 15 £10.00 Ref 10P88.

**PERSONAL STEREOS** Again customer returns but complete and with stereo head phones. A bargain at only £3.00 each. Our ref 3P83.

**MICROWAVE CONTROL PANEL** Mains operated, with touch switches. This unit has a 4 digit display with a built in clock and 2 relay outputs — one for power and one for pulsed power level. Could be used for all sorts of timer control applications. Only £6.00. Our ref 6P18.

**EQUIPMENT WALL MOUNT** Multi adjustable metal bracket ideal for speakers, lights, etc. 2 for £5.00. Our ref 5P152.

**NEW MAINS MOTORS** 25 watt 3000 rpm made by Framco. Approx 6" x 3" x 4". Priced at only £4.00 each. Our ref 4P54.

**SHADED POLE MOTORS** Approx 3" square. Available in 24V and 240V AC. Both with threaded output shaft and 2 fixing bolts. Price is £2.00 each. 24V Ref 2P65, 240V Ref 2P66.

**SUB-MIN TOGGLE SWITCH** Body size 8mm x 4mm x 7mm SBDT with chrome dolly fixing nuts. 3 for £1. Order ref BD649.

**COPPER CLAD PANEL** for making PCB. Size approx 12in long x 8½in wide. Double-sided on fibreglass middle which is quite thick (about 1 16in) so this would support quite heavy components and could even form a chassis to hold a mains transformer, etc. Price £1 each. Our ref BD683.

## POWERFUL IONISER

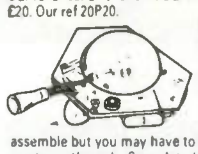
Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, workroom etc. Makes you feel better and work harder – a complete mains operated kit, case included. **£18**. Our ref 18P2.

**2KV 500 WATT MAINS TRANSFORMERS.** Suitable for high voltage experiments or as a spare for a microwave oven etc. £10.00 Ref 10P93.

**REAL POWER AMPLIFIER** for your car, it has 150 watts output. Frequency response 20hz to 20Khz and signal to noise ratio better than 60dB. Has built in short circuit protection and adjustable input level to suit your existing car stereo, so needs no pre-amp. Works into speakers ref. 30P7 described below. A real bargain at only £57.00. Order ref: 57P1.

**REAL POWER CAR SPEAKERS.** Stereo pair output 100W each. 4Ohm impedance and consisting of 6½" woofer, 2" mid range and 1" tweeter. Ideal to work with the amplifier described above. Price per pair £30.00. Order ref: 30P7.

**VIDEO TAPES** These are three hour tapes of superior quality, made under licence from the famous JVC Company. Offered at only £3 each. Our ref 3P63. Or 5 for £11. Our ref 11P3. Or for the really big user 10 for £20. Our ref 20P20.



**ELECTRONIC SPACESHIP.** Sound and impact controlled, responds to claps and shouts and reverses when it hits anything. Kit with really detailed instructions. Ideal present for budding young electrician. A youngster should be able to assemble but you may have to help with the soldering of the components on the pcb. Complete kit £10. Our ref. 10P81.

**COMPUTER KEYBOARDS** Brand new, uncased. £3.00 each. ref 3P89.

**12" HIGH RESOLUTION MONITOR.** Amber screen, beautifully cased for free standing, needs only 12V 1.5 amp supply. TTL input separate syncs. Brand new in makers' cartons. Price £22.00. Order ref. 22P2.

**SINCLAIR C5 WHEELS**

Including inner tubes and tyres. 13" and 16" diameter spoked poly carbonate wheels. Finished in black. Only £6.00 each. 13" Ref 6P10, 16" Ref 6P11.

**COMPOSITE VIDEO KITS** These convert composite video into separate H sync, V sync and video. Price £8.00. Our ref 8P39.

**LINEAR POWER SUPPLY** Brand new +5v 3A, +/−12v 1A. Complete with circuit diagram. Short circuit protected. Our price £12.00 Ref 12 P21.

**3½in FLOPPY DRIVES** We still have two models in stock: Single sided, 80 track, by Chinon. This is in the manufacturers metal case with leads and IDC connectors. Price £40, reference 40P1. Also a double sided, 80 track, by NEC. This is uncased. Price £60.00, reference 60P2. Both are brand new.

**10 MEMORY PUSHBUTTON TELEPHONES** These are customer returns and "sold as seen". They are complete and may need slight attention. Price £6.00. Ref. 6P16 or 2 for £10.00. Ref. 10P77. BT approved.

**INDUCTIVE PROXIMITY SWITCHES** These will detect ferrous or nonferrous metals at approx. 10mm and are 10-36V operation. Ideal for alarms position sensors, etc. RS price is £64.00 each! Ours £12.00. Ref. 12P19.

**BOSCHERT SWITCHED MODE POWER SUPPLIES** +5V at 15A, +12V at 3A, −12V at 2A+24V at 2A, 220V or 110V input. Brand new and guaranteed. Retail price is £180!! Ours £20. Ref 20P30.

**TV SOUND DECODER.** Nicely cased, mains powered with 8 channels. Will drive a small speaker directly or could be fed into HI FI system etc. £12.00 each. Ref 12P22.

**PC POWER SUPPLIES** Brand new with built in fan and power switch on the back +5, −5, +12, −12V 150 watt made by AZTEC £25.00 each. Ref 25P18.

**VERY POWERFUL 12 VOLT MOTORS.** ⅓rd Horsepower. Made to drive the Sinclair C5 electric car but adaptable to power a go-kart, a mower, a rail car, model railway, etc. Brand new. Price £20. Our ref 20P22.

**PHILIPS LASER**

This is helium-neon and has a power rating of 2mW. Completely safe as long as you do not look directly into the beam when eye damage could result. Brand new, full spec. £35. Our ref. 35P1. Mains operated power supply for this tube gives 8kv striking and 1.25kv at 5mA running. Complete kit with case £15.

**PANEL METERS** 270 deg movement. New. £3.00 each. Our ref 3P87.

**SURFACE MOUNT KIT** Makes a super high gain snooping amplifier on a PCB less than an inch square! £7.00. Our ref 7P15.

**CB CONVERTERS** Converts a car radio into an AM CB receiver. £4.00. Our ref 4P48.

**GEIGER COUNTER KIT** Includes PCB, tube, loudspeaker, and all components to build a 9v battery operated geiger counter. Only £39. Our ref 39P1.

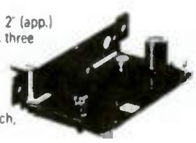
**12V TO 220V INVERTER KIT** This kit will convert 12v DC to 220v AC. It will supply up to 130 watts by using a larger transformer. As supplied it will handle about 15 watts. Price is £12. Our ref 12P17.

**SPECTRUM AND COMMODORE SOFTWARE** Pack of 5 different tapes only £3.00. Ref. 3P96 for Spectrum and 3P97 for Commodore 64.

**HIGH RESOLUTION MONITOR** 9in black and white, used Philips tube M24/360W. Made up in a lacquered frame and has open sides. Made for use with OPD computer but suitable for most others. Brand new. £20. Our ref 20P26.

**12 VOLT BRUSHLESS FAN.** Japanese made. The popular square shape (4½in x 4½in x 1¾in). The electronically run fans not only consume very little current but also they do not cause interference as the brush type motors do. Ideal for cooling computers, etc., or for a caravan. **£8 each.** Our ref 8P26.

**MINI MONO AMP** on p.c.b. size 4" x 2" (app.) Fitted Volume control. The amplifier has three transistors and we estimate the output to be 2W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of £1.15 each, or 13 for £12.00.



## BULL ELECTRICAL

Dept. EE 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT.

VISA

MAIL ORDER TERMS: Cash, PO or cheque with order. Monthly account orders accepted from schools and public companies. Please add £2.50 postage to orders. Minimum order £5.
Phone (0273) 203500. Fax No. (0273) 23077

## POPULAR ITEMS — MANY NEW THIS MONTH

**MAINS FANS** Snail type construction. Approx. 5" x 4" mounted on a metal plate for easy fixing. New. £5.00 each. Our ref 5P166.

**MICROWAVE TURNTABLE MOTOR** Complete with weight sensing electronics that would have varied the cooking time. Ideal for window displays, etc. Only £5.00. Our ref 5P165.

**JOYSTICKS** for BBC Atari, Dragon Commodore, etc. All £5.00 each. All brand new, state which required.

**PC STYLE CASES 18" X 18" X 6"** Complete with fan and grill illuminated power switch and IEC filtered power input plug. Priced at only £15.00. Ref 15P38.

**SUB-MIN PUSH SWITCHES** Not much bigger than a plastic transistor but double pole PCB mounting. 3 for £1.00. Our ref BD688.

**AA CELLS** Probably the most popular of the rechargeable NICAD types. 4 for £4.00. Our ref. 4P44.

**20 WATT 4 OHM SPEAKER** With built in tweeter. Really well made unit which has the power and the quality for hifi 6½" dia. Price £5.00. Our ref. 5P155 or 10 for £40.00 ref. 40P7.

**MINI RADIO MODULE** Only 2in square with ferrite aerial and solid dia. tuner with own knob. It is superhet and operates from a PP3 battery and would drive a crystal headphone. Price £1.00. Our ref. BD716.

**BULGIN MAINS PLUG AND SOCKET** The old and faithful 3 pin with screw terminals. The plug is panel mounted and the socket is cable mounted. 2 pairs for £1.00 or 4 plugs or 4 sockets for £1.00. Our ref. BD715, BD715P, or BD715S.

**MICROPHONE** Low cost hand held dynamic microphone with on/off switch in handle. Lead terminates in 1 3.5mm and 1 2.5mm plug. Only £1.00. Ref. BD711.

**MOSFETS FOR POWER AMPLIFIERS AND HIGH CURRENT DEVICES** 140V 100 watt pair made by Hitachi. Ref.2SJ99 and its complement 2SK343. Only £4.00 a pair. Our ref. 4P51.

**TIME AND TEMPERATURE LCD MODULE** A 12 hour clock a Celsius and Fahrenheit thermometer a too hot alarm and a too cold alarm. Approx 50×20mm with 12.7mm digits. Requires 1AA battery and a few switches. Comes with full data and diagram. Price £9.00. Our ref. 9P5.

**REMOTE TEMPERATURE PROBE FOR ABOVE.** £3.00. Our ref. 3P60.

**PAPST** fan 80 x 80mm 230V. Our ref 9P7. Price £9.

**PAPST** fan 120 x 120mm 230V. Our ref 6P6. Price £6.

**600 WATT AIR OR LIQUID MAINS HEATER** Small coil heater made for heating air or liquids. Will not corrode, lasts for years. Coil size 3" x 2" mounted on a metal plate for easy fixing. 4" dia. Price £3.00. Ref. 3P78 or 4 for £10.00. Our ref. 10P76.

**EX-EQUIPMENT POWER SUPPLIES** Various makes and specs, ideal bench supply. Only £8.00. Our ref. 8P36.

**ACORN DATA RECORDER** Made for the Electron or BBC computer but suitable for others. Includes mains adaptor, leads and book. £12.00. Ref. 12P15.

**PTFE COATED SILVER PLATED CABLE** 19 strands of .45mm copper will carry up to 30A and is virtually indestructible. Available in red or black. Regular price is over £120 per reel. Our price only £20.00 for 100m reel. Ref 20P21 or 1 of each for £35.00. Ref 35P2. Makes absolutely superb speaker cable!

**NEW PIR SENSORS** Infra red movement sensors will switch up to 1000W mains. UK made, 12 months manufacturers warranty. 15-20m range with a 0-10mm timer, adjustable wall bracket. Our ref 25P16. Price £25.

**GEARBOX KITS** Ideal for models, etc. Contains 18 gears (2 of each size), 4 x 50mm axles and a powerful adjustable speed motor. 9-12V operation. All the gears, etc. are 2mm push fit. £3.00 for the complete kit. Ref. 3P93.

**MINI HIFI SPEAKERS** Made for televisions, etc. Two sizes available. 70mm x 57mm 3W 8 ohm, 2 for £3.00. Ref 3P99. 127mm x 57mm 5W 8 ohm, 2 for £3.00. Ref. 3P100.

**SPECTRUM SOUND BOX** Add sound to your Spectrum with this device. Just plug in. Complete with speaker, volume control and nicely boxed. A snip at only £4.00. Our ref. 4P53.

**BBC JOYSTICK INTERFACE** Converts a BBC joystick port to an Atari type port. Price £2.00. Our ref. 2P261.

**TELEPHONE EXTENSION LEAD** 5m phone extension lead with plug on one end, socket on the other. White. Price £3.00. Our ref. 3P70 or 10 leads for only £19.00! Ref. 19P2.

**LCD DISPLAY** 4½" digits supplied with connection data £3.00. Ref. 3P77 or 5 for £10. Ref. 10P78.

**CROSS OVER NETWORK** 8 Ohm 3 way for tweeter midrange and woofer nicely cased with connections marked. Only £2.00. Our ref. 2P255 or 10 for £15.00. Ref. 15P32.

**BASE STATION MICROPHONE** Top quality uni-directional electret condenser mic 600r impedence sensitivity 16-18KHz – 68db built in chime complete with mic stand bracket. £15.00. Ref. 15P28.

**MICROPHONE STAND** Very heavy chromed mic stand, magnetic base 4" high. £3.00 if ordered with above mic. Our ref. 3P80.

**SOLAR POWERED NICAD CHARGER** 4 Nicad AA battery charger. Charges 4 batteries in 8 hours. Price £6.00. Our ref. 6P3.

**YUASHA SEALED LEAD ACID BATTERIES.** 6V 10AH only £9.00 each or 2 for £15.00. Ref. 15P37.

**STC SWITCHED MODE POWER SUPPLY.** 220V or 110V operation giving 5V at 2A + 24V at 0.25A + 12V at 0.15A and + 90V at 0.4A £12.00 each. Ref 12P27.

**SOLDERING IRON STAND** Price £3.00. Our ref. 3P66.

**INCAR GRAPHIC EQUALIZER/BOOSTER** Slimline 7 band with built in 30 watts per channel amplifier. 12V operation, twin 5 LED power indicators, 20-21KHz with front and rear fader plus headphone output! Brand new and guaranteed. Only £25.00. Ref. 25P14.

**SHARP PLOTTER PRINTER.** New 4 colour printer originally intended for Sharp computers but may be adaptable for other machines. Complete with pens, paper, etc. Price £16.00. Our ref. 16P3.

**CENTRONICS ADAPTER KIT** Converts the above plotter/printer to Centronics compatible. Price £4.00. Our ref. 4P57.

**CAR IONIZER KIT** Improve the air in your car, clears smoke and helps prevent fatigue. Case req. Price £12.00. Our ref. 12P8.

**NEW FM BUG KIT** New design with PCB embedded coil 9v operation. Priced at £5.00. Our ref. 5P158.

**NEW PANEL METERS 50UA** movement with three different scales that are brought into view with a lever. Price only £3.00. Ref. 3P81.

**STROBE LIGHTS** Fit a standard edison screw light fitting 240V 40/min. flash rate available in yellow, blue, green and red. Complete with socket. Price £10 each. Ref. 10p80 (state colour required).

**ELECTRONIC SPEED CONTROL KIT** Suitable for controlling our powerful 12v motors. Price £17.00. Ref. 17P3 (heatsink required).

**EXTENSION CABLE WITH A DIFFERENCE** It is flat on one side making it easy to fix and look tidy. 4 core, suitable for alarms, phones etc. Our price only £5.00 for 50m reel. Ref. 5P153.

**1990 CATALOGUE NOW AVAILABLE PLEASE SEND 6" X 9" SAE FOR FREE COPY**

VOL. 19 No. 9 SEPTEMBER 1990

# EVERYDAY ELECTRONICS

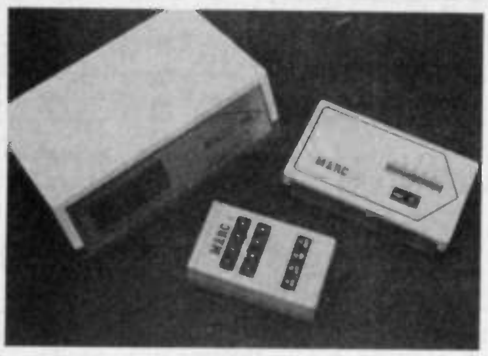
INCORPORATING ELECTRONICS MONTHLY

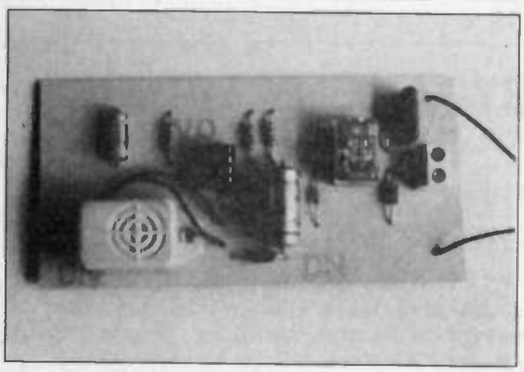
ABC

The Magazine for Electronic & Computer Projects

ISBN 0262 3617

PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .





## Projects



## Series



## Features



**FREE** NEXT MONTH
(and with the November Issue)
**132 PAGE CATALOGUES**
Don't miss out, place an order with your newsagent for EE **NOW**



*Our October '90 Issue will be published on Friday, 7 September 1990. See page 563 for details.*

TEACH-IN, DATA & PROJECTS

# FOUR SPECIAL PUBLICATIONS

FROM EVERYDAY ELECTRONICS


**SEE *DIRECT BOOK SERVICE* pages—for full ordering details**

## TEACH-IN 88/89

### INTRODUCING MICROPROCESSORS

**£2.45** plus P & P

**A complete City and Guilds Certificate Course for 726/303 Introductory Microprocessors**

Written by Mike Tooley BA this course can lead successful readers to a City and Guilds Certificate. Everything you need to know is included—even pre-test papers, etc.

From Terminology, Integrated Circuits and Logic Families in Part One, the course progresses in easy stages up to High- and Low-level Languages, Flow Charts and Assembly Language. Also featured is a range of eight Data Pages giving information on popular microprocessor chips. A comprehensive index is included, making this a valuable reference manual.

***ORDER CODE: TI 88/89***

## TEACH-IN No. 3

### EXPLORING ELECTRONICS

**£2.45** plus P & P

**By Owen Bishop**

Designed to explain the workings of electronic components and circuits by involving the reader in experimenting with them. The book does not contain masses of theory or formulae but straightforward explanations and circuits to build and experiment with.

The text is split into 28 easily digestible sections, each with a separate project. The breadboard experiments assume no previous knowledge, start at semiconductor diodes and progress through bistables, timers, amplifiers, binary etc up to f.e.t.s and shift registers.

The projects include radio receivers, various timers and alarms, plus temperature sensors and water detectors etc.

**An excellent source book for GCSE courses.**

***ORDER CODE TI3***

## ELECTRONIC PROJECTS Book 1

**£2.45** plus P & P

Contains twenty of our best projects from previous issues of EE, each backed with a kit of components. The projects are:

Seashell Sea Synthesiser, EE Treasure Hunter, Mini Strobe, Digital Capacitance Meter, Three Channel Sound to Light, BBC 16K Sideways Ram, Simple Short Wave Radio, Insulation Tester, Stepper Motor Interface, Eprom Eraser, 200MHz Digital Frequency Meter, Infra Red Alarm, EE Equaliser Ioniser, Bat Detector, Acoustic Probe, Mains Tester and Fuse Finder, Light Rider – (Lapel Badge, Disco Lights, Chaser Light), Musical Doorbell, Function Generator, Tilt Alarm, 10W Audio Amplifier, EE Buccaneer Induction Balance Metal Detector, BBC Midi Interface, Variable Bench Power Supply, Pet Scarer, Audio Signal Generator.

***ORDER CODE EP1***

## EVERYDAY ELECTRONICS DATA BOOK

**£8.95** plus P&P

**By Mike Tooley BA**

Published by EE in association with PC Publishing, this book is an invaluable source of information of everyday relevance in the world of electronics. It contains not only sections which deal with the essential theory of electronic circuits, but it also deals with a wide range of practical electronic applications.

It is ideal for the hobbyist, student, technician and engineer. The information is presented in the form of a basic electronic recipe book with numerous worked examples showing how theory can be put into practice using a range of commonly available components and devices.

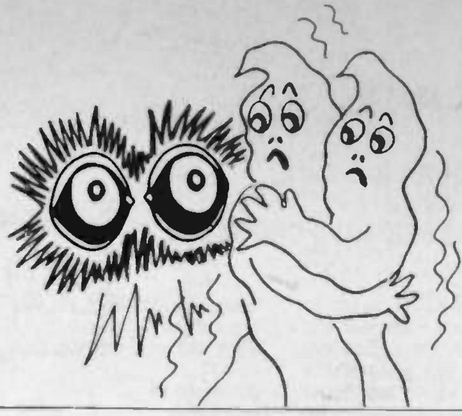
A must for everyone involved in electronics!

**Available from your local component supplier or direct from us.**

***ORDER CODE DATA***

**SEE *DIRECT BOOK SERVICE* pages—for full ordering details**

# NEXT MONTH



## GHOST WAKER

*This sound triggered Holloween mask is not guaranteed to wake every ghost, but it might make you feel as though you have seen a ghost! The sound trigger opens the eyes and flashes green l.e.d.s on a Halloween mask.*

**FREE**

**WITH THIS ISSUE OF EVERYDAY ELECTRONICS**

**MARCO TRADING 132 PAGE ELECTRONIC COMPONENTS & EQUIPMENT CATALOGUE**

**WORTH £1.50**

## FREQUENCY METER/TACHOMETER

*A neat cheap and simple analogue frequency meter with six ranges providing frequency measurement from about 10Hz to 100kHz at an accuracy of two per cent. In addition there is a simple optical sensor that will turn the meter into a tachometer capable of measuring the speed of most rotating objects.*

## FRIDGE ALERT

*Recent statistics reveal that only one in ten people ever check the temperature of their fridge. This is unfortunate since, unless it is cool enough, bacteria multiply rapidly and can cause food poisoning. This simple device produces a continuous check and warns the user if the temperature rises above a "safe" level.*

**EVERYDAY ELECTRONICS**

**OCTOBER ISSUE ON SALE FRIDAY 7 SEPTEMBER 1990**

### INSULATION TESTER

EE APRIL 85

A reliable electronic tester which checks insulation resistance of wiring appliances etc., at 500 volts. The unit is battery powered simple and safe to operate. Leakage resistance of up to 100 Megohms can be read easily. One of our own designs and extremely popular.

KIT REF 444

**£21.89**

### PET SCARER

EE MAY 89

Produces high power ultrasound pulses. L.E.D. flashes to indicate power output and level. Battery powered (9V–12V or via Mains Adaptor).

KIT REF 812

Mains Adaptor £1.98

**£14.49**

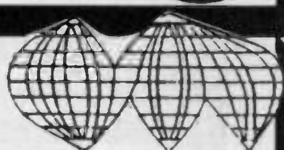
### DIGITAL CAPACITANCE METER

EE DEC 85

Simple and accurate (1%) measurement of capacitors from a few pF up to 1,000 $\mu$F. Clear 5-digit LED display indicates exact value. Three ranges – pF, nF, and $\mu$F. Just connect the capacitor, press the button and read the value.

KIT REF 493

**£46.46**



### 3 BAND SHORT WAVE RADIO

EE AUG 87

Covers 1.6–30 MHz in 3 bands using modern miniature coils. Audio output is via a built-in loudspeaker. Advanced design gives excellent stability, sensitivity and selectivity. Simple to build.

KIT REF 718

**£29.66**

### DIGITAL FREQUENCY 200 MHz METER

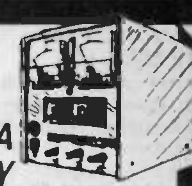
EE NOV 86

An 8 digit meter reading from AF up to 200 MHz in two ranges. Large 0.5" Red LED display. Ideal for AF and RF measurements. Amateur and C.B. frequencies.

KIT REF 563

**£69.95**

### MOSFET VARIABLE BENCH 25V 2.5A POWER SUPPLY



EE FEB 88

A superb design giving 0.25V and 0-2.5A. Twin panel meters indicate Voltage and Current. Voltage is variable from zero to 25V. A Toroidal transformer MOSFET power output device, and Quad op-amp IC design give excellent performance.

KIT REF 769

**£55.61**

### MINI STROBE

EE MAY '86

A hand held stroboscope which uses 6 "ultra bright" LEDs as the light source. Designed to demonstrate the principles of stroboscope examination, the unit is also suitable for measuring the speed of moving shafts etc. The flash rate control covers 170–20,000 RPM in two ranges.

KIT REF 529

**£15.50**

### ACOUSTIC PROBE

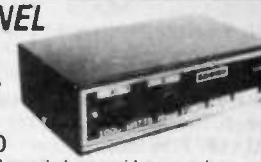
EE NOV '87

A very popular project which picks up vibrations by means of a contact probe and passes them on to a pair of headphones or an amplifier. Sounds from engines, watches and speech travelling through walls can be amplified and heard clearly. Useful for mechanics, instrument engineers and nosey parkers!

KIT REF 740

**£19.58**

### 4 CHANNEL LIGHT CHASER



EE Jan '90

A 1000W per channel chaser with zero volt switching, hard drive, inductive load capability, mic sound sensor and sophisticated 'beat' detector. Chase steps to music or auto when quiet. Variable speed and mic. sens. LED mimic on front panel. Switchable for 3 or 4 channels. P552 output. Ideal for rope lights, pin spots, disco and display lighting.

KIT REF 833

**£31.45**



### EE EQUALISER

EE MAY '87

A mains powered Ioniser with an output of negative ions that give a refreshing feeling to the surrounding atmosphere. Negligible current consumption and all-insulated construction ensure that the unit is safe and economical in use. Easy to build on a simple PCB.

KIT REF 707

**£17.37**

### MUSICAL DOORBELL

EE JAN '86

This project uses a special I.C. pre-programmed with 25 tunes and 3 chimes. A Magenta design, the circuit is battery powered and only draws current whilst producing sounds. Two rotary switches select the tune required. Provision is made for three bell pushes, each of which sounds a different tune, so that three points of entry can be identified.

KIT REF 497

**£20.95**



### EPROM ERASER

EE OCT '88

Safe low-cost unit capable of erasing up to four EPROM's simultaneously in less than twenty minutes. Operates from a 12V supply. Safety interlock. Convenient and simple to build and use.

KIT REF 790

**£27.90**

### LIGHT RIDERS

EE OCT '86

Three projects under one title – all simulations of the Knight Rider lights from the TV series. The three are a lapel badge using six LEDs, a larger LED unit with 16 LEDs and a mains version capable of driving six main lamps totalling over 500 watts.

| | |
|---|---|
| KIT REF 559 CHASER LIGHT | £15.25 |
| KIT REF 560 DISCO LIGHTS | £21.93 |
| KIT REF 561 LAPEL BADGE | £11.40 |

### EE TREASURE HUNTER

EE AUG '89

A sensitive pulse induction Metal Detector. Picks up coins and rings etc., up to 20cms deep. Low "ground effect". Can be used with search-head underwater. Easy to use and build, kit includes search-head, handle, case, PCB and all parts as shown.

KIT REF 815 **£41.95**

Headphones **£1.99**

### STEPPING MOTOR INTERFACE

EE AUG '85

This interface enables 4 phase unipolar stepping motors to be driven from four output lines of any computer user port. The circuit is especially suitable for the ID35 motor and our MD200 which are commonly used in buggies and robot arms. Supplied complete with ribbon cable and connector for the BBC user port.

KIT REF 464

**£9.40**

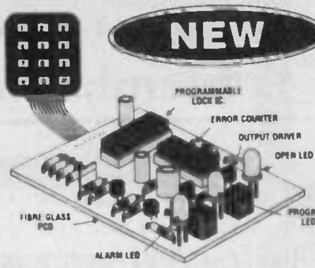
# TK FOR KITS

### GUARD DOG KIT


One of the best burglar deterrents is a guard dog and this kit provides the barking without the bite! Can be connected to a doorbell, pressure mat or any other intruder detector and produces random threatening barks. Includes mains supply and horn speaker.
**XK125** **£21.95**

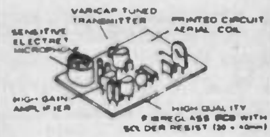
### PROGRAMMABLE ELECTRONIC LOCK KIT

**NEW**




Keys could be a thing of the past with this new high security lock. Secure doors to sheds, garages, even your home or prevent the unauthorised use of computers, burglar alarms or cars. One 4-digit sequence will operate the lock while incorrect entries will sound an alarm. The number of incorrect entries allowed before the alarm is triggered is selected by you. Further entries will be ignored for a time also set by you. Only the correct sequence will open the lock and switch off the alarm. The sequence may easily be changed by entering a special number and code on the supplied keyboard. Kit includes; keyboard, alarm buzzer, high quality PCB and all electronic components. Supply 5–15V DC. Will drive our Latch Mechanism (701 150 @ £18.98) or relay directly.
**XK131** **£19.95**

### SUPER-SENSITIVE MICROBUG




Only 45x25x15mm, including built-in mic. 88–100MHz (standard FM radio). Range approx. 300m depending on terrain. Powered by 9V PP3 (7mA). Ideal for surveillance, baby alarm etc. **XK128** **£6.35**

### DISCO LIGHTING KITS

**DL8000K** 8-way sequencer kit with built-in opto-isolated sound to light input. Only requires a box and control knob to complete .... **£39.95**
**DL1000K** 4-way chaser features bi-directional sequence and dimming 1kW per channel .. **£23.95**
DLA/1 (for DZ1000K) Optional op-to input allowing audio beat/light response.................. **95p**
**DL3000K** 3-channel sound to light kit, zero voltage switching, automatic level control and built-in mic. 1kW per channel ........ **£19.55**
**XK139** Uni-directional chaser. Zero switching and built-in audio input.................................... **£12.95**

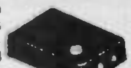
### POWER STROBE KIT

Produces an intense light pulse at a variable frequency of 1 to 15Hz. Includes high quality PCB, components, connectors, 5Ws strobe tube and assembly instructions. Supply: 240V ac. Size: 80x50x45.
**XK124** STROBOSCOPE KIT. **£17.25**

### NEW
### REMOTE CONTROL DIMMER KIT

Imagine controlling the brightness of your lights or switching them on or off from the comfort of your armchair! This kit contains all the components from front panel to the last screw to enable you to do just that and fit the shallowest wall boxes. Max power 300W (not fluorescents).
XK132............................................... £19.95

### IR TRANSMITTER KIT



Designed for use with the XK132 and comes complete with a pre-drilled box. A PP3 9 volt battery is required.
MK 6................ £4.95

XK136 TOUCH DIMMER KIT......... £12.95

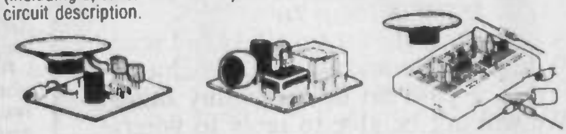
### VERSATILE REMOTE CONTROL SYSTEM

These kits can switch up to 16 pieces of equipment on and off or control 16 functions depending on the keyboard selected for the MK18 transmitter. MK12 receiver has 16 logic outputs and operates from 12 to 24V d.c. or 240V a.c. via the transformer supplied. The MK18 requires a 9V battery and keyboard. Great for controlling lights, TVs, garage doors etc.

| | |
|---|---|
| MK12 IR Receiver | £19.55 |
| MK18 Transmitter | £8.95 |
| MK 9 4-way Keyboard | £2.75 |
| MK10 16-way Keyboard | £7.95 |
| 601 133 Box for transmitter | £2.95 |

### SIMPLE KITS FOR BEGINNERS

Especially aimed at the beginner. Have fun with your project even after you have built it and also learn a little from building it. These kits include high quality solder resist printed circuit boards, all electronic components (including speaker where used) and full construction instructions with circuit description.



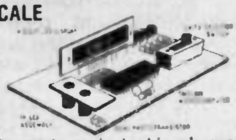
**SK1** DOOR CHIME plays a tune when activated by a pushbutton **£4.50**

**SK2** WHISTLE SWITCH switches a relay on and off in response to whistle command **£4.50**

**SK3** SOUND GENERATOR produces FOUR different sounds, including police/ambulance/fire-engine siren and machine gun **£4.50**

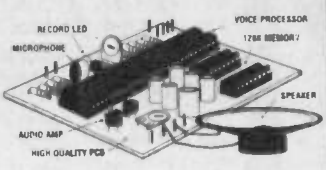
**XK118** TEN EXCITING PROJECTS FOR BEGINNERS this kit contains a solderless breadboard, components and a booklet with instructions to enable the absolute novice to build ten fascinating projects including a light operated switch, intercom, burglar alarm and electronic lock. Each project includes a circuit diagram, description of operation and an easy to follow layout diagram. A section on component identification and function is included, enabling the beginner to build the circuits with confidence ..... **£17.25**

### ELECTRONIC WEIGHING SCALE



Kit contains a single chip microprocessor. PCB, displays and all electronics to produce a digital LED readout of weight in Kgs or Sts/Lbs. A PCB link selects the scale-bathroom/two types of kitchen scales. A low cost digital ruler could also be made.
**ES1** **£8.25**

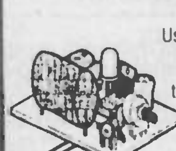
### VOICE RECORD/ PLAYBACK KIT




This simple to construct and even simpler to operate kit will record and playback short messages or tunes. It has many uses – seatbelt or light reminder in the car, welcome messages to visitors at home or at work, warning messages in factories and public places. In fact anywhere where a spoken message is announced and which needs to be changed from time to time. Also suitable for toys – why not convert your daughter's £8 doll to an £80 talking doll!!

Size ........................................................ 76 x 60 x 15mm
Message time ................................ 1–5 secs normal speed, 2–10 secs slow speed
**XK129** **£25.95**

### PROPORTIONAL TEMPERATURE CONTROLLER KIT



Uses 'burst fire' technique to maintain temperature to within 0.5°C. Ideal for photography, incubators, wine making, etc. Maximum load 3kW (240V AC). Temperature range up to 60°C. Size 50x40x25mm. **XK140**..... **£8.95**

**TK ELECTRONICS**

**TK ELECTRONICS**
**13 Boston Road**
**London W7 3SJ**
**Tel: 081-579 9794**
**Fax: 081-566 1916**

ORDERING INFORMATION All prices INCLUDE VAT. Free P & P on orders over £60 (UK only), otherwise add £1.15. Overseas Customers divide total order by 1.15 then add P & P: Europe £3.50, elsewhere £10.00. Send cheque/PO/Visa/Access No. with order. Giro No. 529314002. Local Authority and educational institutions orders welcome. Shop Open: Tuesday–Thursday 10 am – 5 pm. Saturday 10 am – 4 pm.

VISA

***ORDERS: 081-567 8910*** **24 HOURS**

# EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

**The Magazine for Electronic & Computer Projects**

**VOL. 19 No. 9 September '90**



**Editorial Offices:**
EVERYDAY ELECTRONICS EDITORIAL,
6 CHURCH STREET, WIMBORNE,
DORSET BH21 1JH
Phone: Wimborne (0202) 881749
Fax: (0202) 841692. DX: Wimborne 45314.
See notes on **Readers' Enquiries** below – we regret that lengthy technical enquiries cannot be answered over the telephone.

**Advertisement Offices:**
EVERYDAY ELECTRONICS ADVERTISEMENTS,
HOLLAND WOOD HOUSE, CHURCH LANE,
GREAT HOLLAND, ESSEX CO13 0JS.
Phone (0255) 850596


## DYING FEATURES

Sad to say that I feel the time is fast approaching that our *On Spec* and *BBC Micro* features will die a natural death. It's not that there is nothing left to write about, it's simply that fewer and fewer people are continuing to use these machines. The Spectrum looked as though it would get an extension, so to speak, from the SAM Coupé but with MGT going into liquidation its future looks decidedly uncertain.

Of course, both features have been running for many years (*On Spec* started in the March '85 issue and *BBC Micro* in April '86). Most of the published material is still very useful to the enthusiast so for those who have only comparatively recently started following these features there is much to be gained from our back numbers.

## NEW FEATURES?

The question is, do we replace these features with anything new? The answer can only come from you, our readers. If you would like to see a regular feature devoted to your particular favourite computer – a similar type of page to those mentioned above – then let us know.

Please put your vote on the back of a sealed down envelope and send it to EE COMPUTER PAGE, Wimborne Publishing Ltd., 6 Church Street, Wimborne, Dorset BH21 1JH. Please do not send any other correspondence with your vote. We will not be able to reply to voters but I will put a note about the result (even if we get nothing back) in the November Editorial. Of course you could encourage us to continue either of the above if you feel our decision is not a good one!

## DEMAND

The next three issues of EE will all carry substantial suppliers' catalogues from three companies that, between them, cover a very wide range of products for the electronics enthusiast. As usual this will mean a heavy demand for these issues – please don't be disappointed – *place a firm order with your newsagent now* – **you have been warned!**

Mike Kenward

### SUBSCRIPTIONS

Annual subscriptions for delivery direct to any address in the UK: £16.00. Overseas: £19.50 (£37 airmail). Cheques or bank drafts **(in £ sterling only)** payable to Everyday Electronics and sent to EE Subscriptions Dept., 6 Church Street, Wimborne, Dorset BH21 1JH. **Subscriptions can only start with the next available issue.** For back numbers see below.


### BACK ISSUES

Certain back issues of EVERYDAY ELECTRONICS are available price £1.50 (£2.00 overseas surface mail) – **£ sterling only please** – inclusive of postage and packing per copy. Enquiries with remittance, made payable to Everyday Electronics, should be sent to Post Sales Department, Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH. In the event of non-availability one article can be photostatted for the same price. *Normally sent within seven days but please allow 28 days for delivery.* **We have sold out of Sept., Oct. & Dec. 85, April, May, Oct. & Dec. 86, Jan., April, May & Nov. 87, Jan., March, April, June & Oct. 88, & March 90.**

### BINDERS

Binders to hold one volume (12 issues) are available from the above address for £4.95 (£6.95 to European countries and £9.00 to other countries, surface mail) inclusive of post and packing. *Normally sent within seven days but please allow 28 days for delivery.* **Payment in £ sterling only please.**



### READERS' ENQUIRIES

We are unable to offer any advice on the use, purchase, repair or modification of commercial equipment or the incorporation or modification of designs published in the magazine. We regret that we cannot provide data or answer queries on articles or projects that are more than five years old. Letters requiring a personal reply must be accompanied by a **stamped self-addressed envelope** or a **self addressed envelope and international reply coupons.**

All reasonable precautions are taken to ensure that the advice and data given to readers is reliable. We cannot guarantee it and we cannot accept legal responsibility for it.

### COMPONENT SUPPLIES

**We do not supply electronic components or kits** for building the projects featured, these can be supplied by advertisers.

We advise readers to check that all parts are still available before commencing any project in a back-dated issue.

We regret that we **cannot provide data or answer queries on projects that are more than five years old.**

### ADVERTISEMENTS

Although the proprietors and staff of EVERYDAY ELECTRONICS take reasonable precautions to protect the interests of readers by ensuring as far as practicable that advertisements are *bona fide*, the magazine and its Publishers cannot give any undertakings in respect of statements or claims made by advertisers, whether these advertisements are printed as part of the magazine, or are in the form of inserts.

The Publishers regret that under no circumstances will the magazine accept liability for non-receipt of goods ordered, or for late delivery, or for faults in manufacture. Legal remedies are available in respect of some of these circumstances, and readers who have complaints should address them to the advertiser or should consult a local trading standards office, or a Citizen's Advice Bureau, or a solicitor.

### TRANSMITTER/BUGS/TELEPHONE EQUIPMENT

We would like to advise readers that certain items of radio transmitting and telephone equipment which may be advertised in our pages cannot be legally used in the U.K. Readers should check the law before using any transmitting or telephone equipment as a fine, confiscation of equipment and/or imprisonment can result from illegal use. The laws vary from country to country; overseas readers should check local laws.

# METAL MATE

T. R. de VAUX-BALBIRNIE

*Check before you drill!*

GREAT CARE must be taken when drilling holes in walls to avoid an unexpected encounter with a water pipe or live wire. The Metal Mate is first used to check the area of wall before drilling. As well as metal water pipes and objects such as nails and screws, it will detect mains wiring (whether switched on or not).

Best results are obtained where the wires are run in metal conduit according to normal practice. Here, the prototype unit gives reliable results to a depth of at least 3cm. Where wiring has been simply buried in the plaster, the sensitivity of the circuit is less but still adequate.

A further interesting application is to distinguish between sound car bodywork and that which has been made to look good by extensive use of filler.

In use, the unit is switched on and a green (Ready or Standby) l.e.d. lights. A sensitivity control is now adjusted. When the unit is brought close to a metallic object, a red (Detect) l.e.d. will light and a buzzer emit a short bleep.

The system is most sensitive to iron and steel but less so to non-ferrous metals – copper and aluminium, for example. The response also depends on the area of metal and the distance of the object from the device.

Power is obtained form a lithium PP3 battery which should give years of occasional use. It is important to use this type of battery – despite its cost – since other types have a relatively short shelf life. The green Ready l.e.d. acts as a reminder to switch the unit off after use.

An additional feature of the circuit is a continuity buzz test. This may be used for checking the soundness of fuses, bulbs, audio leads.

## CIRCUIT DESCRIPTION

The complete circuit for the Metal Mate is shown in Fig. 1. The principle component is IC1, a metal proximity detector integrated circuit.

This is a sophisticated device despite its low cost. It contains an on-chip oscillator operating in conjunction with an external circuit consisting of coil, L1, and capacitor, C1.

The strength of the output signal depends greatly on the characteristics of L1. Thus, when a metal object is moved near the coil the inductance increases and results in one output, pin 4, going from high to low and the other, pin 5, going from low to high (supply positive voltage).

The sensitivity of the circuit is determined by VR1 and VR2. VR2 is a preset which is adjusted so that the balance condition occurs near the centre of VR1 scale. VR1 is a knob-operated control mounted on the front panel of the unit. It covers a much narrower range of resistance than VR2 and this enables accurate adjustments to be made.

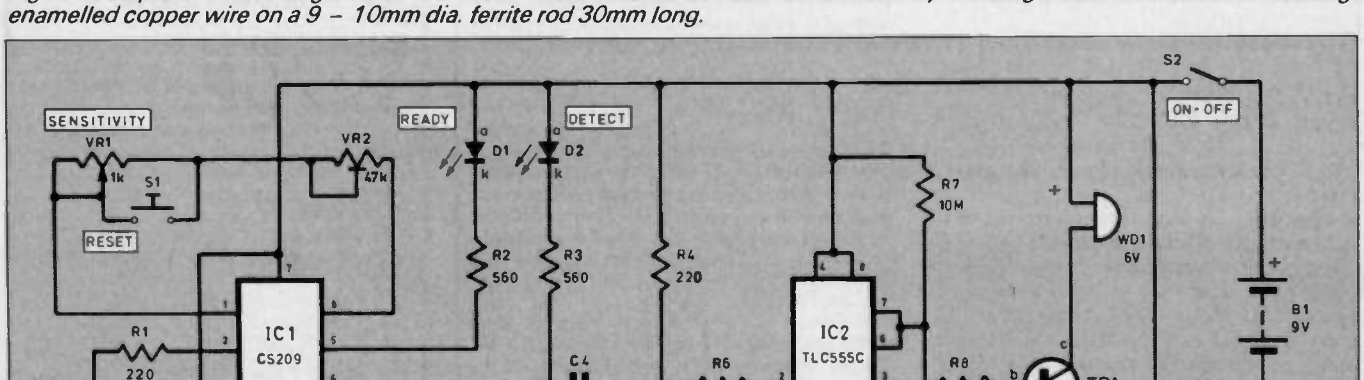
The front panel control VR1 will normally be adjusted for maximum sensitivity at the beginning of each period of use. Push-button switch, S1 (Reset) temporarily reduces the resistance presented to IC1 pins 1 and 8 by short-circuiting VR1. The purpose of this will be explained later.

With S2 (On-Off) switched on current flows from battery, B1, to the rest of the circuit. With VR1 and VR2 correctly adjusted and in the absence of any metal near coil L1, IC1 pin 5 is "low" and green light-emitting diode, D1 (Ready), operates through current-limiting resistor, R2.

When the circuit senses metal, pin 5 goes "high" and D1 goes off. Pin 4 is now "low" and red l.e.d., D2 (Detect), operates through current-limiting resistor, R3.

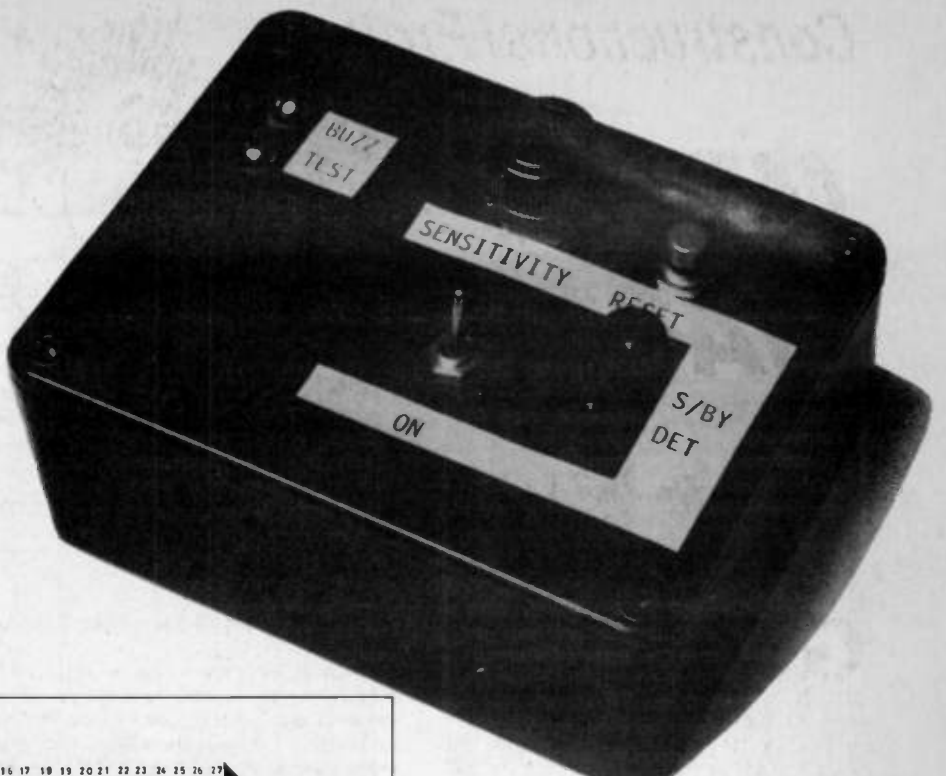
With pin 4 low, the monostable consisting of IC2 and associated components is trig-

*Fig. 1. Complete circuit diagram for the Metal Mate. The sensor coil L1 is made by winding about 100 turns of 30s.w.g. enamelled copper wire on a 9 – 10mm dia. ferrite rod 30mm long.*



gered by making IC2 pin 2 low momentarily through capacitor, C4 and resistor, R6. A pulse is then delivered from IC2 output, pin 3. The pulse length depends on the values of resistor R7 and capacitor C6 and with those specified this is 0.25s approximately. The output from IC2 pin 3 is connected to the base of transistor TR1 through current-limiting resistor R8 which then operates the audible warning device, WD1, in its collector circuit.

The purpose of capacitor C4 is to allow only a single brief pulse to IC2 trigger input, pin 2. Thus, in the event of IC1 pin 4 remaining low, only one bleep is delivered. A further bleep will be given only when IC1 pin 4 goes high then low again.




## CONTINUITY TEST

The monostable (IC2) described above is also used as the basis for the continuity buzz test. When the "Buzz Test" terminals TP1 and TP2 are interconnected through a low resistance, they trigger IC2 by making pin 2 low momentarily through capacitor C5 and resistor R6. This results in a bleep from WD1 in the manner already described.

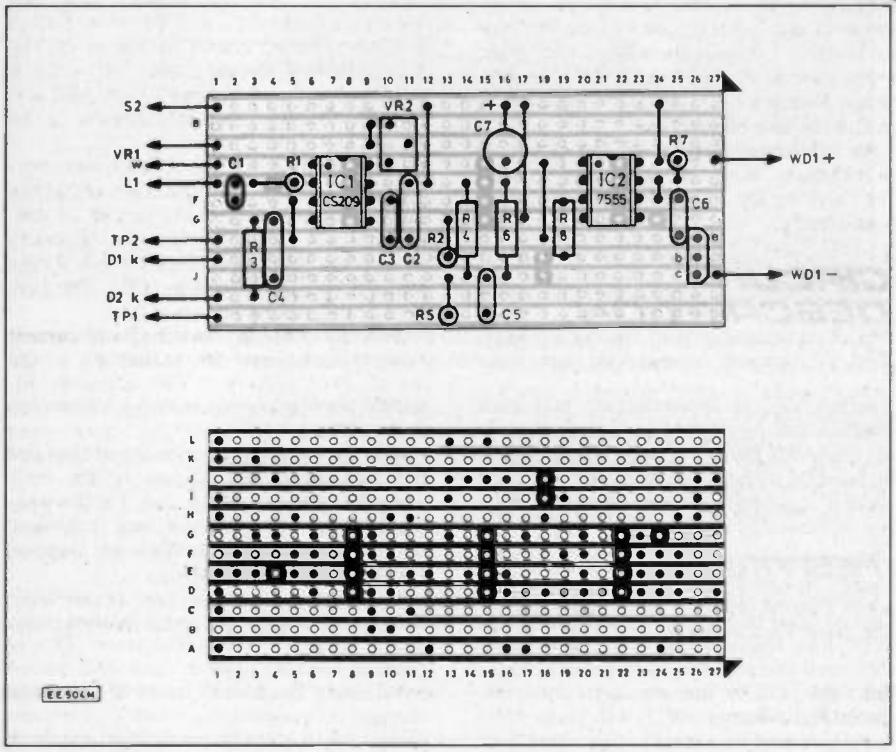



*Fig. 2. Stripboard component layout and details of breaks required in the underside copper tracks. IC1 and IC2 should be mounted in i.c. sockets.*

Resistor R5 allows C5 to discharge rapidly ready for further use. Pin 2 of IC2 is kept normally high through resistor R4 to prevent possible false operation.

Triggering occurs if the voltage at IC2 pin 2 falls below one-third of the supply voltage, so with the value of R4 specified the test object will need to have a resistance of approximately 110 ohms maximum to trigger IC2. This value allows checking of items having near-zero resistance – switches, fuses and pieces of wire, for example, as well as filament lamps, motors, transformer windings and similar items which may have a higher resistance.

## CONSTRUCTION

Construction of the Metal Mate is based on a main circuit panel made from a piece of 0.1in matrix stripboard, size 12 strips × 27 holes. The component layout and details of breaks required in the underside copper tracks is shown in Fig. 2.

Cut the board, before inserting components, slightly too large then file it to fit the slots of the plastic box. Make all breaks and inter-strip links then solder the on-board components into position.

Note that some types of capacitors, C1-C6, have very short end leads. Rather than bending and spreading these excessively, which could cause damage, solder short extension leads to them. Take care to observe the polarity of capacitor C7. Do not insert the i.c.s into their sockets until the end of construction.

Connect 10cm pieces of light-duty stranded connecting wire to each of copper strips *A, C, D, H, I, K* and *L* on the left side of the circuit panel. The use of "rainbow"

## COMPONENTS

**Resistors**

R1, R4 — 220 (2 off)
R2, R3 — 560 (2 off)
R5, R6 — 10k (2 off))
R7 — 10M
R8 — 5k6
All 0.25W 5% carbon.

See SHOP TALK Page

**Potentiometer**

VR1 — 1k rotary carbon, lin.
VR2 — 47k min. enclosed preset, vert.

**Capacitors**

C1, C3 — 2n2 ceramic (2 off)
C2, C6 — 22n ceramic (2 off)
C4, C5 — 100n polyester layer (2 off)
C7 — 47μ radial elec. 16V

**Semiconductors**

D1 — Green l.e.d. indicator
D2 — Red l.e.d. indicator
TR1 — ZTX300 *npn* silicon
IC1 — CS209 proximity detector
IC2 — TLC555C low-power timer

**Miscellaneous**

S1 — Min. push-to-make switch
S2 — Min. s.p.s.t. toggle switch
WD1 — 6V solid-state buzzer
B1 — PP3 Lithium battery and connector

Stripboard, 0.1in matrix, size 12 strips × 27 holes; plastic case (MB2), size 100mm × 76mm × 41mm; ferrite rod, 9/10mm dia. approx. 30mm long; spring clip for rod; approx. 3m of 30s.w.g. enamelled copper wire; 8-pin d.i.l. socket (2 off); 4BA nuts, bolts and solder tags (2 off each); stranded connecting wire or ribbon cable; solder etc.

*Approx cost guidance only* **£13** *(excl. Bat.)*

ribbon cable here will keep the wiring neat and help in avoiding errors.

Cut a piece of ferrite rod 9mm in diameter and 30mm long approximately. The best way to do this is to score it right round with a hacksaw – it will then break off when tapped sharply. The rough broken end will not be seen but could be smoothed using a grindstone if desired.

## COIL

Wind coil L1 on to the prepared ferrite rod. To do this, wrap a piece of paper 1cm wide approximately around the rod near one end and wind the coil on this.

The winding consists of 100 turns of 30s.w.g. enamelled copper wire closewound and done in such a way that the end of the winding lies approximately 3mm from one end of the rod. About 8cm of free wire should be left at each end with which to make the connections.

Carefully scrape the insulation from the ends of the coil, sleeve the wires using insulation removed from connecting wire, then solder one end to copper strip *E* on the circuit panel and the other to TP2 as indicated in Fig. 3. Solder the buzzer WD1 to strips *D* (positive) and *J* (negative) at the right-hand side of the panel noting that this component is polarized so must be connected the correct way round.

## CASE

Drill holes in the box for mounting S1 (Reset), S2 (On-Off), D1 (Ready), D2 (Detect), VR1 (Sensitivity), WD1, TP1/TP2 and also for the outer end of the ferrite rod (see photograph). In the prototype unit, TP1 and TP2 consisted of 4BA nuts and bolts. By placing these approximately 3mm apart, they can be "bridged" with fuses, lamp terminals, etc.

The hole for the ferrite rod should make a tight push fit. Drill a small hole for the spring clip used to secure the inner end of the rod.

With the circuit panel temporarily in position, drill a 3mm dia hole in the side of the box opposite preset VR2. This will allow adjustment to this component using a small screwdriver at the end of construction.

Cut VR1 spindle to a length of 5mm approximately. Grip the spindle in a vice – not the potentiometer body which is easily damaged – and cut it gently with a hacksaw. During this operation, the body should be supported by hand.

Referring to Fig. 3, mount all remaining components and complete the internal wiring using solder tags for TP1 and TP2 connections. Take care over the polarity of D1, D2 and C7.

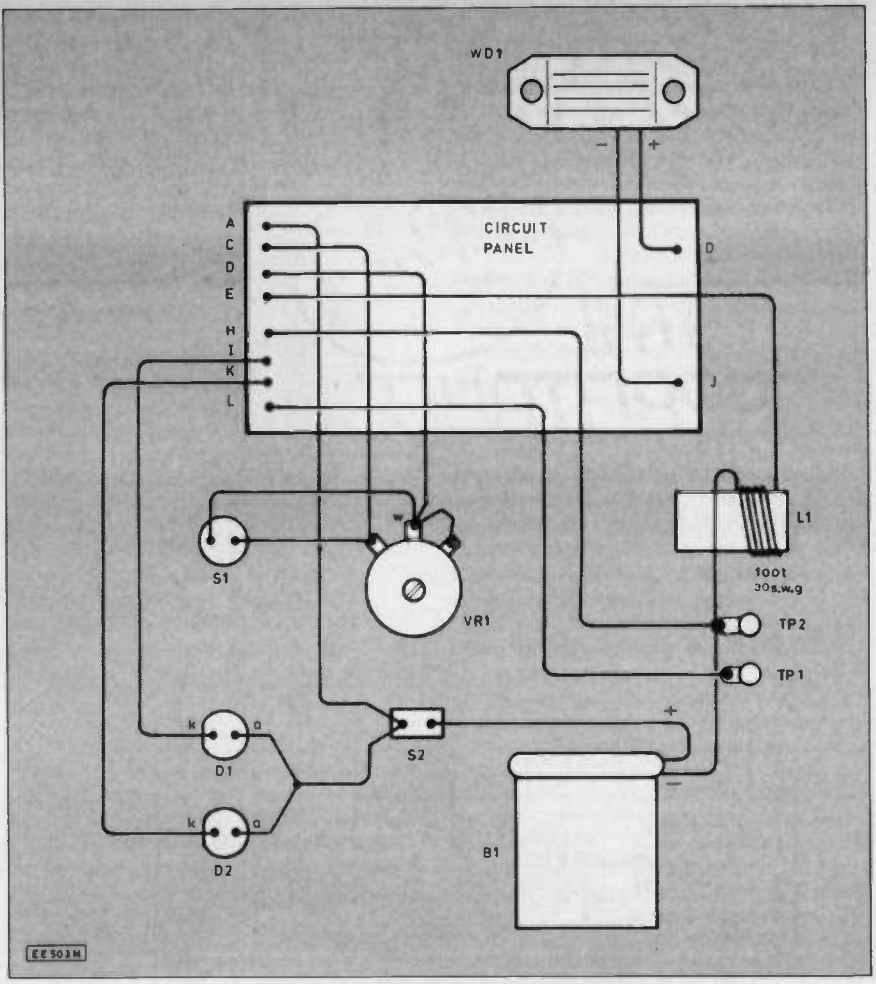



*Fig. 3. Interwiring from the circuit board to all off-board components. The terminals TP1/TP2 should have solder tags under their fixing nuts – see photo below.*

Adjust VR2 to approximately mid-track position and insert the i.c.s into their sockets observing the orientation. These should be handled without touching the pins since there is some possibility of damage if there is a static charge on the body.

## TESTING

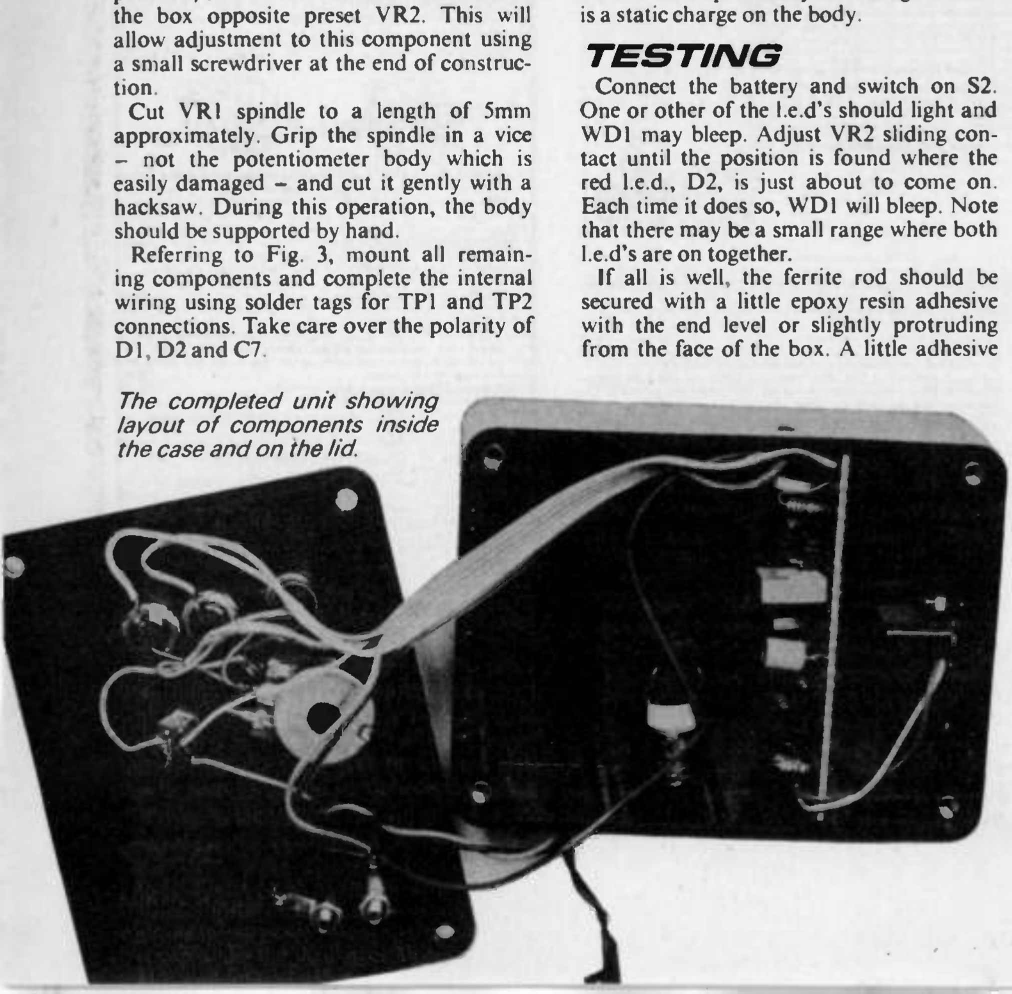
Connect the battery and switch on S2. One or other of the l.e.d's should light and WD1 may bleep. Adjust VR2 sliding contact until the position is found where the red l.e.d., D2, is just about to come on. Each time it does so, WD1 will bleep. Note that there may be a small range where both l.e.d's are on together.

If all is well, the ferrite rod should be secured with a little epoxy resin adhesive with the end level or slightly protruding from the face of the box. A little adhesive should also be applied to coil L1 to secure the winding.

Slide the circuit panel into the slots of the box and attach the battery to the base using an adhesive fixing pad. Fit the control knob to VR1 spindle. Check that when the lid is in position, no wires are trapped and no short-circuits caused.

It will now be found that preset VR2 needs trimming to bring the balance point to the centre of VR1 adjustment. This is because metallic objects inside the box – particularly the battery and VR1 – cause changes in the operating point. This is done using a small screwdriver through a hole in the side of the box.

*The completed unit showing layout of components inside the case and on the lid.*



## OPERATION

Switch on S2 (On-Off), the buzzer will bleep, and adjust VR1 (Sensitivity) so that the red l.e.d, D2, is just off. The green l.e.d. (Ready) should now be on.

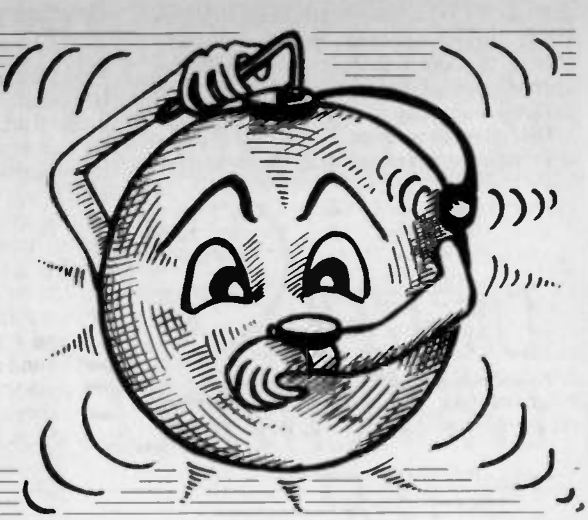
Bring a piece of metal near the exposed end of the ferrite rod. Diode D1 should go off, D2 come on and WD1 bleep.

At maximum sensitivity, the circuit tends to "latch" that is, the red l.e.d. tends to remain on even when the metal has been removed. When this happens, reset the circuit by pressing S1 (Reset).

Check the Buzz Test by inter-connecting the "test point" bolt heads, TP1 and TP2, using a short piece of wire – WD1 should bleep. Note that the buzz test will only work if the red l.e.d. is off.

The Metal Mate may now be placed in a handy place ready for use. The lithium battery should ensure that the circuit will work correctly even when the device has not been used for many months. □

*Constructional Project*



# ALARM BELL TIMEOUT


## G. JACKSON


*Bring your alarm system up to standard with this low cost add-on*

CURRENT British Standard legislation requires that burglar alarm sounders (bells, sirens etc) should be shut off after a maximum of 20 minutes rather than sounding continuously. This was brought about by the high incidence of false alarms causing great annoyance to those living nearby.

All alarms presently manufactured have this facility built in (and are far more reliable) but there are many older models still in use that do not meet the present standard. This device modifies all 12 volt alarms to the required level and, in addition, a low level buzzer continues to operate after the main sounder has been shut off thus indicating that the alarm has been triggered.

Construction and installation are very straightforward, a printed circuit board is shown but, as layout is not critical, the circuit could quite easily be built on stripboard.

## CIRCUIT OPERATION

The full circuit diagram for the Alarm Bell Time-Out is shown in Fig. 1. A 555 i.c. is operated in its timer (monostable) mode, the time being set by resistors R1, R2 and capacitor C1. Resistor R1 is a test resistor to ensure correct operation after construction and is removed from the circuit when testing is complete.

With resistor R1 in circuit, the time period that the bell will sound for is approximately four seconds. With R1 removed, the time is approx. 10 minutes. If longer time periods are required, they may be calculated from the formula:

$$t = 1.1\,RC$$

Where $t$ is in seconds, $R$ is R1 (or R2) (Ohms) and $C$ is C1 (Farads). So, in the case of R2 only being in circuit:
$t = 1.1 \times 4.7 \times 10^6 \times 125 \times 10^{-6} = 646.25$ secs $= 10.77$ mins.

Alternative values could be C1 = 100μ, R1 = 47k and R2 = 5M6.

The calculations do not of course take account of component tolerances which may vary the figures by as much as 20 per cent.

When the board is in place and the alarm triggered, pin 2 of IC1 is held low momentarily by capacitor C3 thus triggering the 555 into its timer state and sending pin 3 (the output) to 12 volts. The relay is thus operated and power is applied to the bell. At the same time, the buzzer, which is connected directly to the power rails, operates.

At the end of the time period, pin 3 returns to 0V, the relay is de-energised and the sounder stops but the buzzer continues to sound. Diodes D1 and D2 are to prevent the back-e.m.f. from the relay coil damaging the integrated circuit, whereas D3, D4 and capacitor C4 are to prevent any voltage spikes generated by the bell or sounder from affecting the operation of the circuit.

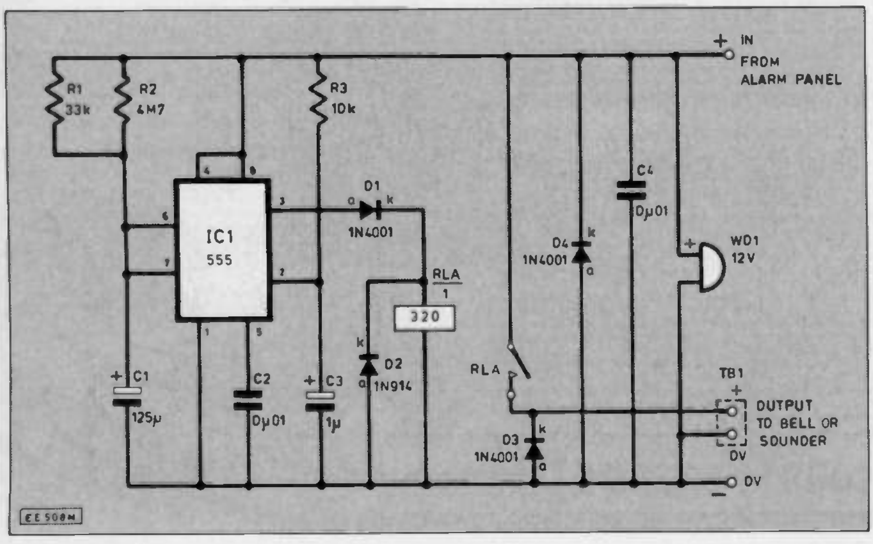
## CONSTRUCTION

The Alarm Bell Time-Out circuit is laid out on a small printed circuit board and the construction is fairly straightforward. The d.i.l. relay is mounted directly on the board and the output voltage from the relay contacts is routed via a screw terminal block TB1, also mounted on the p.c.b., to the master alarm bell or siren.

The component layout and full size copper foil master pattern is shown in Fig. 2. This board is available from the *EE PCB Service*, code EE701.

Commence construction by working from the smallest components up to the

*Fig. 1. Complete circuit diagram for the Alarm Bell Time-Out.*




## COMPONENTS

**Resistors**
R1 33k
R2 4M7
R3 10k
All 0.25W 5% carbon

See SHOP TALK Page

**Capacitors**
C1 125μ axial elec. 16V
C2, C4 0μ01 polyester (2 off)
C3 1μ axial elec 16V

**Semiconductors**
D1, D3, D4 1N4001 to 1N4007 rec. diode (3 off)
D2 1N914, 1N4148 or similar signal diode
IC1 555 timer

**Miscellaneous**
RLA 12V 320 ohm coil sub-min d.i.l. relay, with 1A changeover contacts
WD1 12V solid-state miniature buzzer

Printed circuit board available from *EE PCB Service*, code EE701; 8-pin i.c socket; 2-way p.c.b. mounting screw terminal block; connecting wire; solder, etc.

*Approx cost guidance only* **£8**

largest. Pay particular attention, at this stage, to make sure that all polarity conscious components are inserted the correct way round and double checked before soldering them in position.

The relay can be any 12V type with a coils resistance greater than 60 ohms (the higher, the better) and a normally open contact rating of 1A. Diode D2 can be a 1N914, 1N4148 or similar. All the other diodes can be 1N4001 to 1N4007 or anything remotely similar).

The buzzer is a solid-state type available from burglar alarm suppliers, such as Riscomp or Suma Designs. A piezoelectric buzzer could also be used. Do *NOT* use a magnetic type of buzzer as the electrical interference generated can upset the circuit.

## TESTING

It is a good idea to test the circuit board before installing it into the main alarm control panel. This can be done by applying 12 volts (from a power supply or battery) to the two input leads. The relay should click in immediately and come out again after about four seconds.

If it doesn't, check your soldering and all connections (particularly if building it on stripboard). Better still, have someone else check if for you.

Ensure that IC1, the polarised capacitors (C1 and C3) and the diodes are the right way round and that pins 6 and 7 of the i.c. are connected together. If all connections are correct, try a higher value of resistor (say 15k or 22k) in the place of R3.

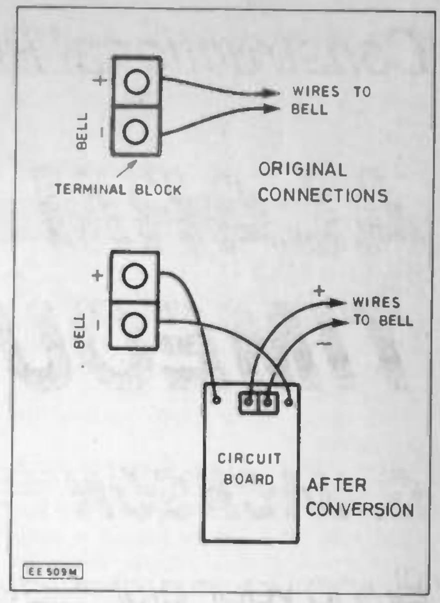



*Fig. 3. Connecting the circuit board into the master alarm system.*

The board is connected inside the main alarm control panel to the terminals labelled "Bell" or "Sounder" taking care to ensure correct polarity. The wires that were originally connected to these terminals are then connected to the new board, see Fig. 3.

When working inside the alarm control panel, there may be a microswitch inside which senses the panel being opened and will trigger the alarm. To prevent this, it is usual to insert the key and turn it to the "Test" position.

Opening the panel should not now trigger the alarm (except that an internal buzzer may sound). The microswitch may now be located and held closed by a piece of adhesive tape whilst the panel is worked on.

After connecting the p.c.b. output leads to the "bell" or "sounder" terminals, trigger the alarm. After about four seconds, the bell should stop and the buzzer continue. If it does not stop, try a larger value of capacitor (say 0μ1) in the place of C4.

If all is well, cut resistor R1 out of the circuit board (to give you the longer delay) and fix the board in place (double-sided foam adhesive is sufficient provided that none of the soldered connections on the underside of the board make contact with any metal inside the panel) and close the panel.

*Don't forget to remove the tape from the microswitch!* □

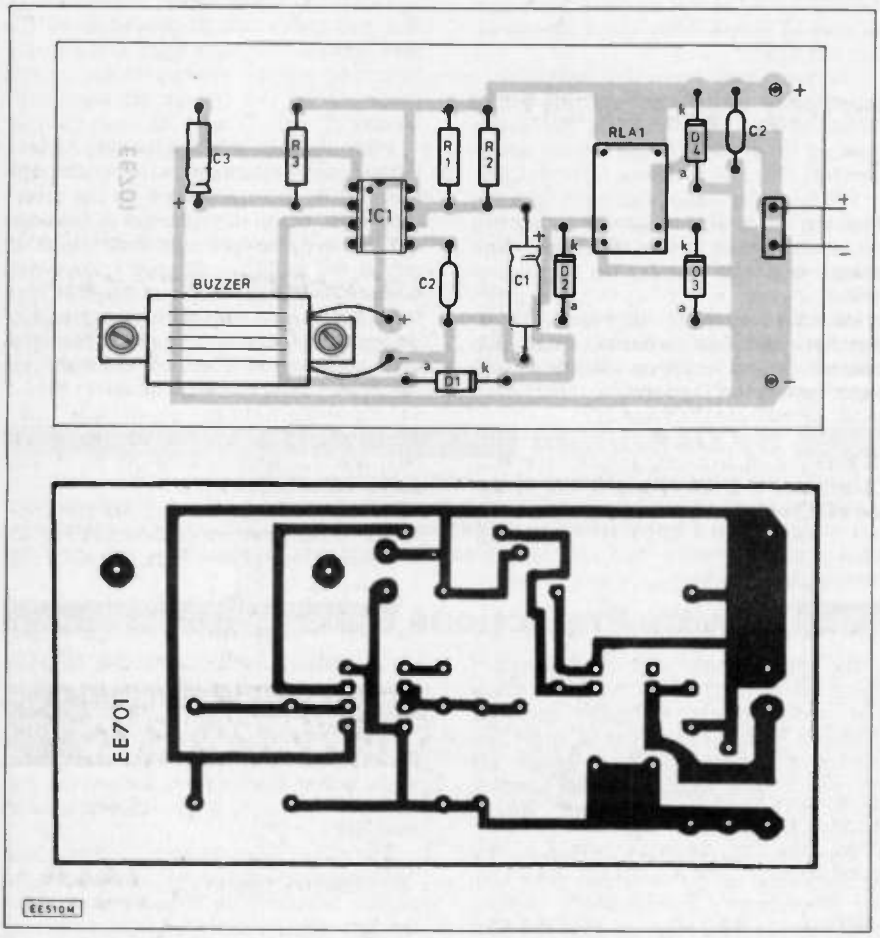
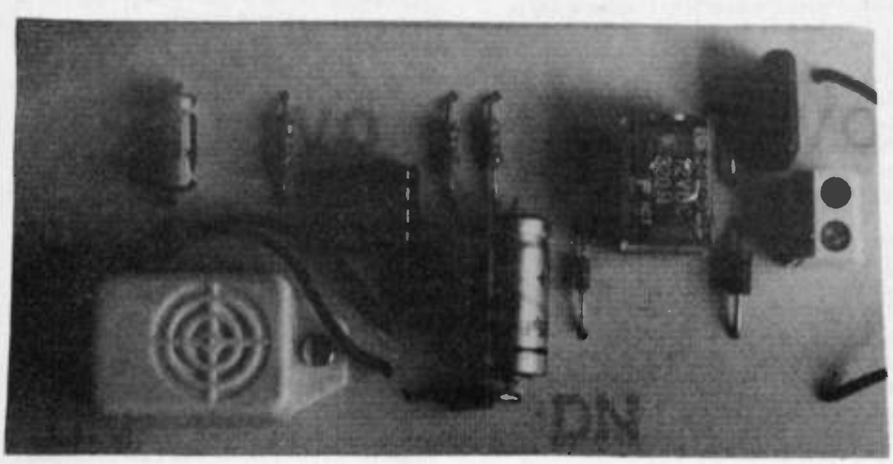



*Fig. 2. Printed circuit board component layout and full size copper foil master pattern. The completed circuit board showing the buzzer and relay can be seen below.*



# FOR YOUR ENTERTAINMENT

BY BARRY FOX

## As You Like It

There has been an outcry over the governments plans to change the English language curriculum in schools. Educationalists warn that children will end up learning about the classics from a video tape, rather than reading the original book.

This may be closer than you think. A patent application recently filed throughout Europe by the BBC (EP 349 106) talks of students having a video cassette of a Shakespeare play, for instance Hamlet, and a set of floppy disks for use with a desk top computer. As the student watches the Hamlet tape on a TV screen, the computer runs through the floppy disks displaying footnote information on a separate screen.

The difficult part is keeping the video recorder and computer in step, even when the pupil pauses the video, or winds the tape fast forward or backwards. Professional video systems work with time-coded synchronisation pulses but low cost domestic recorders, as used for education, cannot retrieve pulses when fast-winding tape.

The BBC gets round the problem by building a log of the pictorial content of the video tape. The average level of the picture signal for different scenes is sensed and the length of each scene timed.

This log is stored on the floppy disk, along with the footnote text. As soon as the video tape starts playing, the computer checks the picture content and timing for a few seconds, compares these readings with the stored readings and hunts through the disk for the appropriate footnotes. From then onwards, until the tape is fast wound again, the pictures on the screen and the footnotes on another stay in synchronism.

## Comedy Of Errors

Don't knock the BBC. It won't need technology like this to create an illiterate population. The seaside town of Littlehampton is one of many along the Sussex coastline controlled by the Arun District Council. The car park in Littlehampton is self-service, drivers must buy a ticket from a machine.

Two large notices have for years carried the same lettering. "Have you payed?" they demand.

## Tweak Tweak

North American hi fi tweaks, those wonderful people who can never resist tweaking their audio systems to make them sound just a little bit better, are the tweakiest of all. Four or five years ago they started coating their compact discs with a protective sealant material called Armor All which is sold for use on cars. This, they said, lets the laser in the player read the digital pits on the disc more accurately. True or false, there are tweaks who would rather die than admit otherwise.

After a while the British hi fi press took up the story, and a whole lot of people in the UK have now Armor All'd their precious CDs.

Then came a frantic fax from Sam Tellig of the US specialist hi fi magazine *Stereophile*. Tellig has been getting reports from people who have Armor All'd their discs and now find that the first ones treated are starting to disintegrate. Everyone is at pains to say that the manufacturers of the magic potion is in no way to blame. They sell it for use on cars not CDs.

The tweaks still insist that treated discs sound better. But, faced with the risk of no sound at all after five years, the hunt is now on for another magic potion which removes all traces of Armor All from CDs.

The favourite remedy so far is ordinary washing-up liquid, which under normal circumstances no-one in their right mind would dream of putting on a precious record.

Have the tweaks learned a lesson? Have they heck! *Stereophile* has now started to publish readers' letters on another miracle improvement to CD sound.

Last year, someone, somewhere, somehow, found that CDs sounded better if the inner and outer edge and rim are coated with green ink from a felt tip pen. At first it sounded like a joke, but now readers are writing to *Stereophile* claiming chalk and cheese differences in the sound of greened and ungreened discs. The bass is tighter they say, the treble sharper and the voice of Leonard Cohen is "transformed".

There is now a "scientific" theory to explain this new miracle. It goes like this. The laser in a CD player emits infra red light, and a little of it is inevitably reflected and refracted in the wrong direction, and ends up bouncing around in the clear protective layer of the disc.

This can upset music reproduction. But the green ink at the edge of the disc absorbs the laser light and stops it bouncing around. So the music sounds better. Or so the tweaks are now convinced.

I don't doubt that the tweaks believe what they are sure they can hear, although I would be more receptive to the theory that green discs sound better if someone did some statistically significant tests in which the subjects did not know what colour discs they were hearing. But how long before we see panicky correspondence on how to remove green dye from discs after someone somewhere discovers that it somehow damages them?

## *By Definition*

Until recently the best definition of "consumer electronics" I had heard was "electronic equipment which people buy with their own money, without tax relief". A Philips engineer just came up with a better definition, "Professional and industrial electronic equipment is what you use between 9am and 5pm. Consumer electronic equipment is what you use between 5pm and 9am".

## Beware Predictions

By one of those odd coincidences, I found an old copy of the American music and entertainment industry magazine *Billboard* while browsing in a street flea market in Amsterdam. What caught my eye was a news item, datelined London, April 1937, with the headline "*Britain regrets tele*".

Remember that Britain's first regular TV service kicked off in November 1936, with the government's extraordinary requirement that the BBC must use both the EMI 405 all-electronics system and Baird's' system as a public test. The BBC had to broadcast the same programme twice, once in each system. Their engineers hated the Baird system, comparing it with clockwork, and were only too pleased when it was officially dropped in February 1937.

For several years after that, there were only ten hours of transmission a week from Alexandra Palace and the v.h.f. transmitters only reached out to around 60 miles from London. TV sets cost around 65 guineas, a fortune at the time and, at the exchange rate of the day, equivalent to 325 US dollars (five bob was later nicknamed a dollar).

In America early experiments with mechanical television in the early 30s had finished, and the Americans also had an all-electronic system ready to go. It was delayed by a squabble over standards, and patents on the technology owned by different inventors.

"American manufacturers played smarter hand in holding back on sale of sets until prices are low", wrote *Billboard* "Official opinion in British broadcasting circles, reported strictly on an unofficial basis, is that England has jumped the gun on television and the sale of television receivers".

The report went on to warn that it was "possible that within a year advances in the picture broadcasting industry may make the sets sold recently of little value . . . purchasers would be more than justified if they complained about finding that the sets they have just bought have little use soon after purchase".

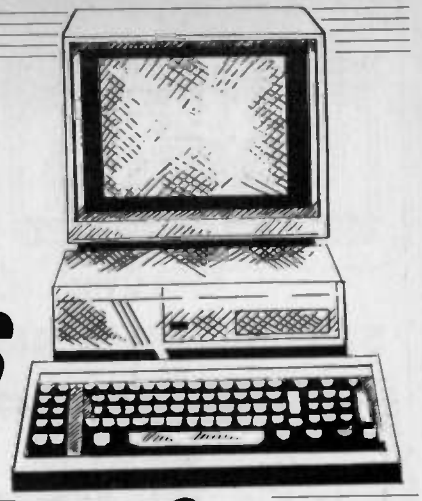
"Antiques soon?", wondered *Billboard.*

Well, just for the record, *Billboard's* prediction proved just about the most inaccurate of all time. The 405-line TV system which became the British standard in February 1937 lasted through until January 7, 1985, when the last VHF 405 line transmitters closed down. Of course by then the 625-line system was well established: it started in black and white in April 1964 with colour added in July 1967. But far from becoming the antiques predicted by Billboard, TV sets bought in Britain in 1937 could still have been working up until January 1985.

Mind you, I expect some of my predictions will be proved equally off-beam in 50 years time.

*Special Feature*

# INTERFACING THE RML NIMBUS



**ANDREW CHANNERLEY**

**Part One**

*The Nimbus is replacing the BBC micros in many schools, we take a look at it and its BBC-type parallel card.*

IN ORDER to discuss some of the interfacing (I/O) features of the Nimbus from a hardware and software point of view, it is worthwhile examining the architecture of the Intel 80186, the CPU which drives the Nimbus. A comprehensive description of the CPU and how it's configured in the Nimbus, is beyond the scope of this brief article. All that one can do here is present an overview as an aid to understanding some of these I/O capabilities of the Nimbus.

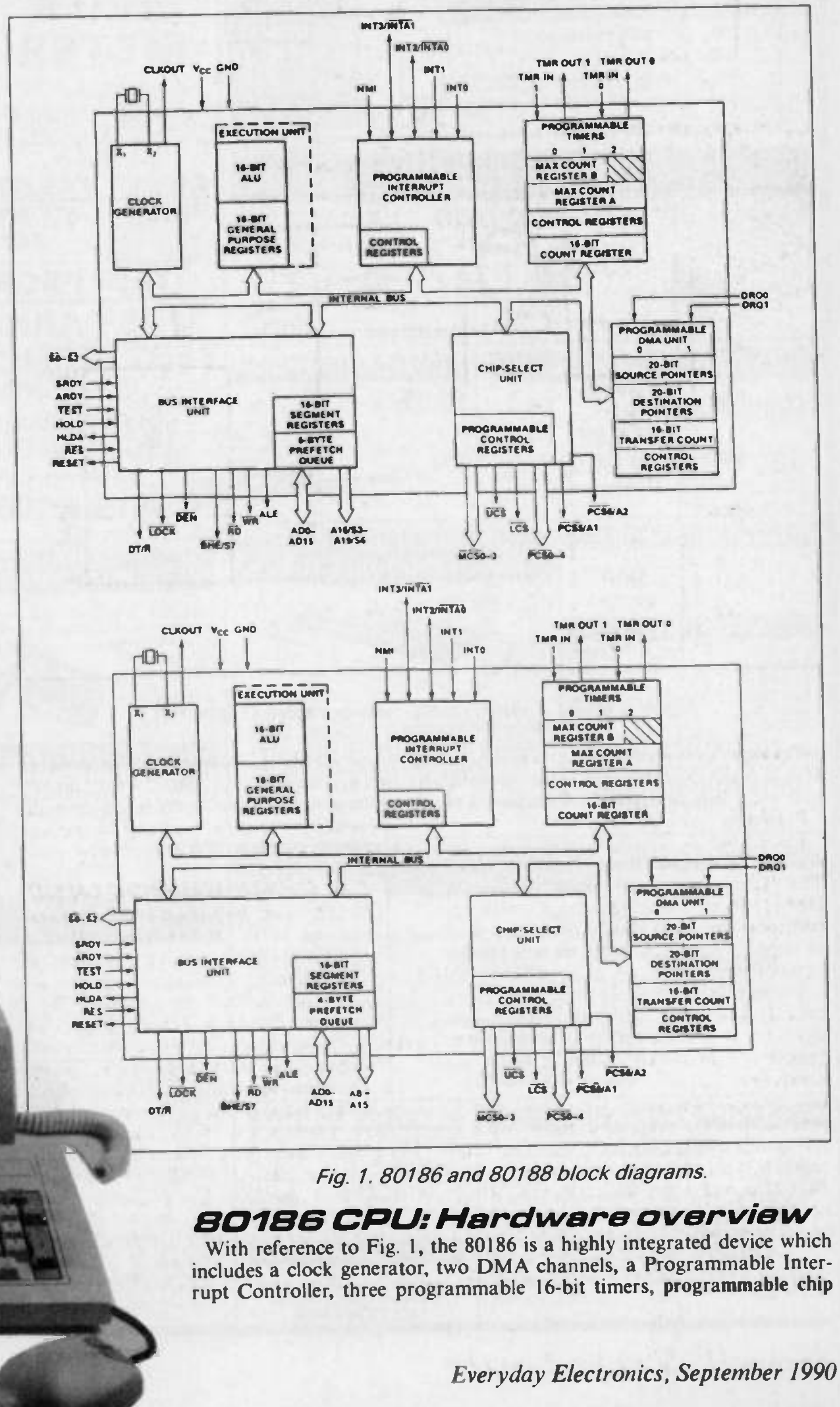



*Fig. 1. 80186 and 80188 block diagrams.*

## 80186 CPU: Hardware overview

With reference to Fig. 1, the 80186 is a highly integrated device which includes a clock generator, two DMA channels, a Programmable Interrupt Controller, three programmable 16-bit timers, **programmable chip**

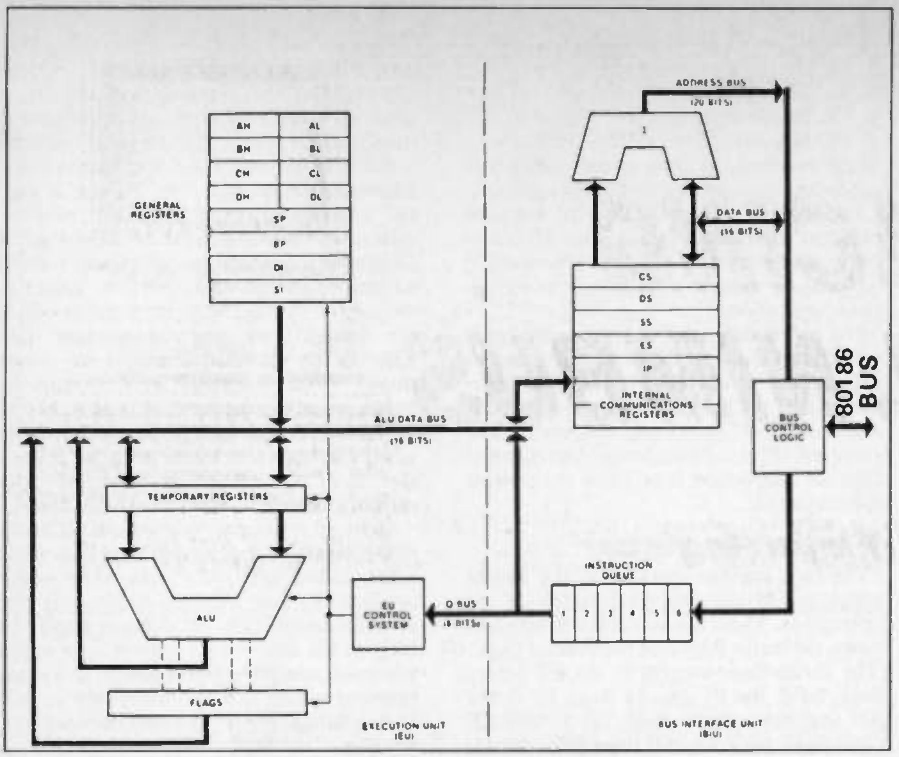



*Fig. 2. 80186 architectural schematics.*

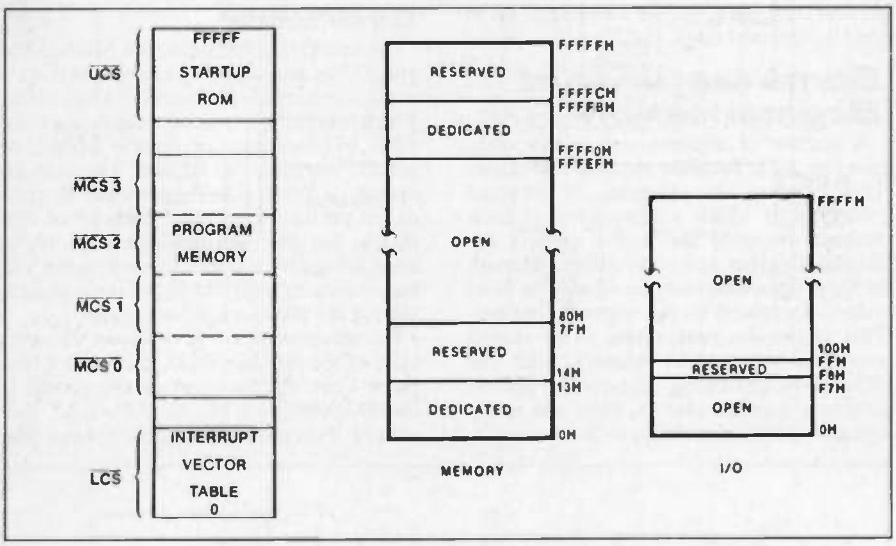



*Fig. 3. and Fig. 4. (right) CPU, memory and I/O allocation.*

**select logic** for both memory and **peripheral I/O**, a programmable wait state generator and local bus controller, all on the same CPU chip.

The 80186 is the next generation, upwardly compatible from the 8086 CPU. This latter device would need to have the DMA, timer, clock generator, interrupt controller etc. individually connected to it as support chips, in order to achieve the same degree of hardware compatibility.

Architecturally (Fig. 2) the CPU can be broadly separated into two independent units, the **Execution Unit (EU)** and the **Bus Interface Unit (BIU)**. From a hardware viewpoint, the BIU executes all external bus cycles, generating the 20-bit multiplex addresses, read and write signals, status information, latch enable signals and others too numerous to mention here. The BIU also has a pre-fetch pipeline, which pre-fetches six instruction bytes into a queue from which they are fetched by the EU, thereby reducing the elapsed times required to execute the instructions. Thus, whenever the EU completes executing an instruction, the next instruction is already in the queue for immediate execution without a dead-time penalty caused by instruction fetching from external memory.

## The chip-select unit

The chip-select unit is an interesting feature of the 80186. It has integrated chip select logic to enable memory or peripheral devices. Memory addressing can use six chip select/enable lines designated MCS0-3 (Mid-range CS), LCS (Lower range CS), UCS (Upper range CS). These chip selects are entirely programmable within an internal offset register control block which itself may be mapped to memory or I/O. These registers are 16-bit, therefore programming these bits defines, for example, the address bits AD19-AD4 of the upper chip-select memory block above which UCS is active.

Writing, for example, FF80 Hex into the offset register A0H, defines a 2K upper block from FF800H to FFFFFH within which the UCS signal is active. Similar considerations apply to the MCS and LCS, as shown in Figs. 3 and 4. It should be pointed out however that designers do not have to use this memory select scheme, but can decode a memory address with AD0 to AD19, together with one of the status signals, S2, acting as a memory (high) or I/O (low) indicator. Indeed the Nimbus only uses the UCS to decode the ROM's.

There are also seven Peripheral Chip Select lines designated PCS0-4, PCS5, PCS6. These are of more immediate interest since they are used by Nimbus to select I/O devices or cards. For example PCS0 selects and enables the Disk Controller board and **PCS1** selects the **printer/user port card** which we shall look at in more detail. The seven PCS's occupy seven continuous blocks of 128 bytes of either memory or I/O address space. The base address of the block is user programmable at two registers in the internal offset register control-block, but the manufacturers have allocated the base address to 0400H of I/O space. Therefore, the **printer/user port** card at **PCS1 is active from 0480H**, 128 bytes up from the start of PCS0 at **0400H**. PCS5, 6 are not used by Nimbus.

## CPU register allocation: segment addressing

The available register structure of the 80186 is shown in Fig. 5. It has fourteen 16-bit registers which are grouped

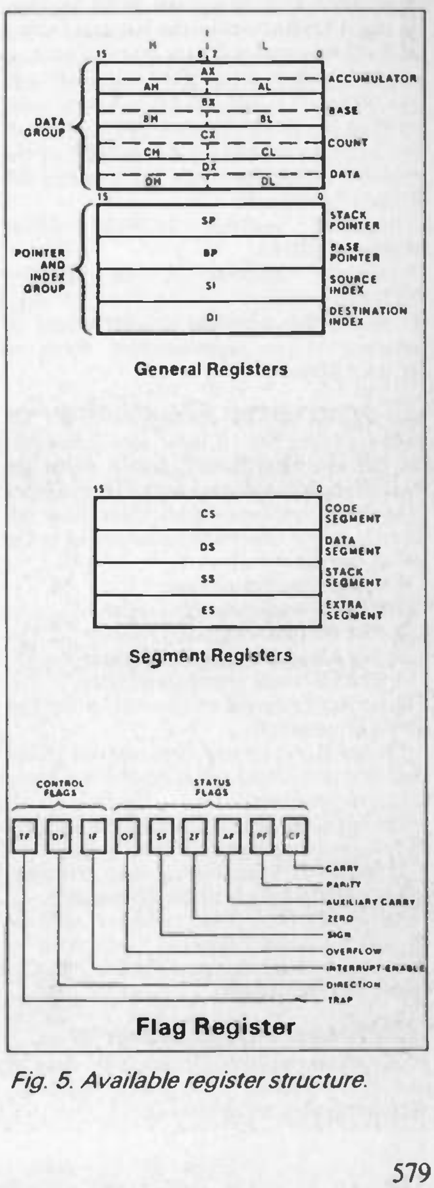



*Fig. 5. Available register structure.*

into general registers, offset registers and **segment registers** and of course there is the flags register. Generally registers are analogous to the accumulators of first and second generation microprocessors, but the **segment registers** are a novel architectural feature for microprocessors.

The 20-bit address value, AD0-AD19, generates one megabyte (1,048,576) of **physical memory address space** and up to 64K bytes (65,535) of I/O space. How then do we represent 20-bit address values using 16-bit registers in the 80186? The solution is to divide an absolute memory address into chunks which can be individually stored in the 16-bit registers.

Memory, therefore, can be considered as comprising an arbitrary number of **segments**, each containing a maximum of **64K bytes**. The starting address of each segment is evenly divisible by 16 (the 4 LSB's are 0's). The address of each location in a segment can be expressed as an **offset** from where the segment begins, with the first location at offset address 0000. The convention for writing addresses takes the form **segment:offset**, and is always expressed in hexadecimal notation. For example, the last location of the first segment, at 0000:FFFFh is followed by the first location of the next segment, at 0001:0000h and so on. The segmented architecture facilitates the implementation of virtual memory schemes, considered later, whose logical (or offset) memory is greater than the physical memory addressable by the CPU.

In order to work out the **20-bit absolute** physical address, the 16-bit contents of the segment registers are regarded as the **most significant bits** of the 20-bit address, with the four least significant bits taken as zero. Adding the 16-bit contents of an offset address, to the 16-bits (+4 zero bits) of the segment register provides the absolute address. For example:

**Segment register = 2CBAh, offset register = 1BDEh**

**Absolute address = 2CBA0 + 1BDE = 2E77Eh**

However, this absolute address would be referred to in **segment:offset** form as **2CBA:1BDE**.

## Segment Registers

These store the 16 most significant bits of the absolute 20-bit address (with the lower four bits assumed zero). The memory addressing hardware adds these base addresses to the offset addresses stored in the offset registers.

The segment registers are:
1. The **CS** (code segment) register
2. The **DS** (data segment) register
3. The **ES** (extra segment) register
4. The **SS** (stack segment) register

These are designed to be used in the following manner:

**CS** holds the current base address of the segment containing the code which is being currently executed.

**DS** holds the base address of the segment containing the program's data.

**ES** holds the base address of an extra segment supplementary to the **DS** register.

**SS** holds the base address of the program's stack memory, which is a temporary store during CALL's PROCedures and INTerrupts.

## Offset Registers

The offset registers are generally used as the offset portion of memory addresses. These registers are as follows:

1. The **SP** (stack pointer) register
2. The **BP** (base pointer) register
3. The **SI** (source index) register
4. The **DI** (destination index) register
5. The **IP** (instruction pointer) register

These registers, as their names imply, are subdivided into **pointer and index registers**.

The **pointer** registers SP and BP, are used to access the stack segment, with SP pointing to the current top of stack. Whereas BP, typically, is used as a base pointer for indexed operations.

The **instruction pointer**, IP, register holds the offset address of the next instruction to be executed by the 80186. The CS:IP format specify the absolute address of the next instruction, as previously discussed. The value of IP is automatically incremented after an instruction fetch from the current code segment.

## Flags Register

The flags register uses nine of it's 16-bits which reflect the processor status of it's operations. These are sub-divided into two types, the status flags and the control flags.

The status flags are: bit 0: the CF (carry flag), bit 2: the PF (parity flag), bit 4: the AF (auxiliary carry flag), bit 6: the ZF (zero flag), bit 7: the SF (sign flag), bit 11: the OF (overflow flag).

The control flags are: bit 10: the DF (direction flag), bit 8: the TF (trap flag), bit 9: the IF (interrupt flag).

## Some features of Segmentation

A feature of segmentation worth commenting on is **dynamic physical relocation**. This involves the changing of physical addresses at which a programme resides without changing the logical (offset) addresses. In other words, all offset addresses in the programme must be relative to fixed values contained in the segment register. This allows the programme to be moved anywhere in physical memory, with the offset addresses added, as described before, to a new segment address, their sum specifying the physical memory to be used.

Another useful feature, in particular, is in virtual memory systems, used in multitasking environments. This uses an addressing scheme in which the logical address space is much larger than the physical address space. The 80186 CPU, for example, has a **physical** address of $2^{20}$ bytes, but a **logical** address space of (segment base × offset) = $2^{16} \times 2^{16}$, a total of $2^{32}$ bytes (4 Gigabytes). Sections of the logical (offset) address space can correspond to blocks in secondary storage, (e.g. hard disks) which are brought into physical memory only when a programme attempts to access them. Virtual memory systems can be based on either segments or pages, but in both cases the advantages are considerable since it's more cost effective to use a hard disk than the equivalent semiconductor-memory boards.

A virtual memory operating system stores all segments or pages in a large disk area, often called the swap area. The much smaller physical memory holds only the most frequently used segments or pages. As long as the disk-stored segments or pages are used relatively infrequently, a virtual memory system will perform nearly as well as one with far more physical memory at a **fraction** of the cost.

## General hardware overview

For interfacing purposes the Nimbus has an I/O bus. This is a set of signals terminating in a connector at the end of a bus cable, which enable the user to interface to the CPU I/O hardware of specific design, or general purpose I/O boards. These might include a DCB (Disk Controller Board), or, in particular, for the purpose of this article, the **BBC parallel I/O card**. However, before we specifically discuss the I/O bus, it may be worthwhile to take a general view of the Nimbus hardware first.

The schematic of Fig. 6 shows an overview of the Nimbus BCU, the Basic Computer Unit. At the heart of the system is the iAPX80186 CPU (iAPX = Intel Advanced Processor Architecture) and the

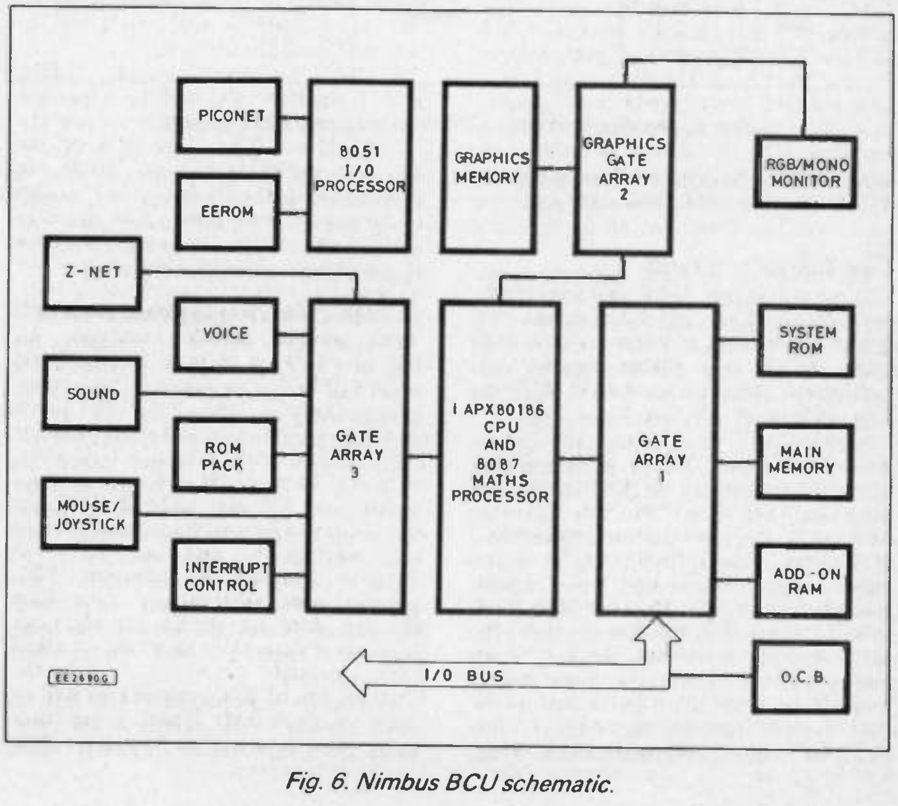
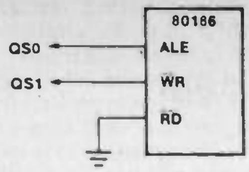



*Fig. 6. Nimbus BCU schematic.*

| QS1 | QS0 | Interpretation |
|---|---|---|
| 0 | 0 | no operation |
| 0 | 1 | first byte of instruction taken from queue |
| 1 | 0 | queue was reinitialized |
| 1 | 1 | subsequent byte of instruction taken from queue |




Generating Queue Status Information

*Fig. 7. 80186 queue status.*

| $\overline{S2}$ | $\overline{S1}$ | $\overline{S0}$ | Operation |
|---|---|---|---|
| 0 | 0 | 0 | interrupt acknowledge |
| 0 | 0 | 1 | read I/O |
| 0 | 1 | 0 | write I/O |
| 0 | 1 | 1 | halt |
| 1 | 0 | 0 | instruction fetch |
| 1 | 0 | 1 | read memory |
| 1 | 1 | 0 | write memory |
| 1 | 1 | 1 | passive |

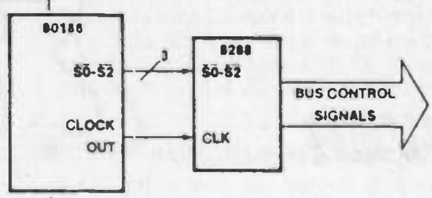



*Fig. 8. Generating bus control signals.*

8087 maths co-processor. Though the latter is an option rather than standard PC hardware. Of particular interest are the Gate Arrays GA1, GA2 and GA3.

The 80186 CPU has a multiplexed address/data bus, when using random logic it's necessary to latch and buffer the address and/or data bits using the gating/latching signals provided, normally, DT/R, ALE, DEN, RD, WR and others. The Nimbus CPU however, is used in **queue status mode** because it's configured with the maths co-processor, the 8087. This mode enables the 8087 to monitor execution of instructions within the 80186 instruction queue and is utilised by grounding the RD pin on the CPU. This changes the, normally, ALE and WR signals to QS0 and QS1 respectively (see Fig. 7). RD, WR and ALE then have to be derived externally. One solution is to use an 8288 bus controller, but Nimbus hardware uses an alternative.

The alternative is to design one's own custom timing and logic with a CAD package for programming gate arrays. These are widely used by industry and their programmability can provide various combinational, sequential, decoding and timing functions with the added advantage of design protection. The Nimbus has three such gate arrays, GA1, GA2, and GA3.

## Gate arrays

The gate array GA1, for example, provides the RAS and CAS signals for dynamic memories and their refresh rate (every 16μs), also enable signals and multiplexed address lines for the ROM's. This gate array is actually a memory control unit (MCU), which provides basic bus control signals for the BCU and the I/O bus. As discussed, the 80186 is used in queue status mode and so RD, WR and ALE signals need to be derived externally, in this case by GA1, from the CPU status signals S0, S1 and S2 (see Fig. 8). Also generated are various special signals such as a Z80 type IORQ, which is an active low signal with data-enabling timing used to select peripheral devices. This signal is also used in an interrupt acknowledge cycle used by a Z80 series device, the SIO, on the BCU. GA1 is itself mapped to I/O location 80H as a byte-wide, write only port which enables the selection of various wait state schemes and memory maps.

Another gate array of interest is GA3, this controls most of the I/O devices on the Nimbus BCU. These are the following:

a. the 8051 interface (ports C0, C2)
b. the Rompacks (ports D2, D6, E0, E2)
c. the voice output (ports B0, B2)
d. the mouse/joystick (ports A0, A2, A4)
e. the sound chip (ports E0, E2)
f. the CHAIN logic/Z80-SIO (ports F0, F2, F4, F6)
h. an interrupt controller (port 92)

This gate array occupies part of the top half of page 0 of the 80186 I/O address space, these are read/write port locations 90H to 0F7H. Because the lower address/data bits are used (AD0-AD7), only the even port addresses between 90H and 0F7H are accessible, as shown above. These ports are decoded by a special signal designated PAGE $\overline{0}$ and derived by GA1. Then when IORQ is active with WR or NOT WR, data is transferred.

The 8051, for example is an 11MHz, highly integrated CPU with an integrated serial communications port providing the usual RXD and TXD. The 8051 on the BCU communicates with the 80186 via the specified ports on GA3, but it also communicates with other 8051 or 8031 CPU's via an external, local serial network call the **piconet**. Piconet communicates via 75176 line tranceivers and can enable communication with up to **30 piconet modules**.

Each **piconet module** comprises an 8051/8031 CPU, a 16 word EEROM and the NECμPD7002 analogue-to-digital converter used on the BBC, an 8255 PPI which has three by 8-bit ports and some standard TTL buffer and latches (74LS373, 74LS244). Together these devices emulate the BBC user port and the 380Z/480Z user port which can be used for printing and/or data logging. In addition, the A-D converter provides an identical **BBC analogue port** environment with four channels, since the devices are identical. Moreover it's accessible under the standard BBC commands Y = ADVAL( ) in the RML version of BBCBasic(86), as well as PROCedure's in RML Basic2. A very user friendly and easy module to use for data logging applications.

To discuss all the aspects of GA3, in relation to the mentioned I/O devices is beyond the scope of this introductory article. However, it's worth examining some of the interrupt features of the 80186 in relation to GA3.

## GA3 Interrupt Control

Interrupts can be generated by externally occurring events which can be quite ordinary e.g. a disk-drive or a timer, or extraordinary e.g. a fire or a burglar. These, and other events, can interrupt the processor during its programme execution and force it to divert its computing power to another task, subsequently returning to the task it was originally expediting. One way in which to interrupt a processor, is either to ground or change the logic state of one or more of its input pins.

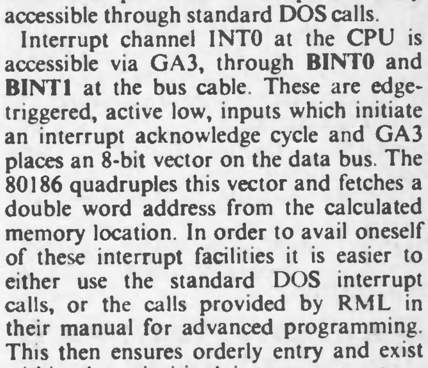
The 80186 has four interrupt channels, these are the input pins INT0, INT1, INT2 and INT3. However, INT2 can be used as an acknowledge (INTA0 – therefore output) for INT0, and INT3 an acknowledge (INTA1) for INT1.

The Nimbus 80186, has INT0, INT1 and INT3 as three interrupt channels and INT2 as the acknowledge (INTA0) in response to INT0. The interrupt channel INT3 is directly accessible from one of the I/O slots which connect to the I/O bus connector, though at the connector it is designated as **BINT2**. This notation signifying that the input is buffered, by a 74LS240, between the user at the bus cable, and the INT3 channel of the CPU. BINT2 is programmable to be edge or level triggered and is used by the **BBC parallel interface-card**. This particular interrupt is readily accessible through standard DOS calls.

Interrupt channel INT0 at the CPU is accessible via GA3, through **BINT0** and **BINT1** at the bus cable. These are edge-triggered, active low, inputs which initiate an interrupt acknowledge cycle and GA3 places an 8-bit vector on the data bus. The 80186 quadruples this vector and fetches a double word address from the calculated memory location. In order to avail oneself of these interrupt facilities it is easier to either use the standard DOS interrupt calls, or the calls provided by RML in their manual for advanced programming. This then ensures orderly entry and exist within the prioritised interrupt structure. The 8051, mouse and voice are all interrupt driven via the gate array GA3.

Finally, BINT0, BINT1 and BINT2 are assigned the interrupt vectors 80h, 82h and 0Fh. The last vector being the IBM assigned vector for printer controllers.

**Next month:** The BBC-type printer/user port parallel card.



*The BBC-type parallel printer/user port card.*

Constructional Project

# VALVE DISTORTION UNIT

## JONATHAN P. OLIVER

*Get that distinctive "valve sound" with this simple single valve unit*

BEFORE transistors came onto the electronics scene, thermonic valves were used for amplification of any sort. Despite the obvious drawbacks of valve audio equipment, it is often still used because of it's distinctive mellow sound.

Many guitarists use valve equipment because of the "unsurpassed warmth, depth and soul" the "fat, creamy, brassy, punchy or raunchy" sound. Personally, I would not like to try to describe valve sound with a single adjective – let us just say that it possesses a certain quality that is not easy to reproduce with transistor equipment.

Some people would deny that any difference between valve and transistor sound exists; but, when overdriven, they have two very different sounds. An overdriven valve produces overtones that are much more likely to be euphonic (agreeable in sound).

Transistor devices produce mostly odd harmonics (3rd, 5th, 7th etc.) which tend to make the sound thin and metallic, this is rather harsh to the ear. Valve devices produce both odd and even harmonics, giving the fat, warmer "valve sound".

### FUZZBOX

The unit to be described consists of a two-stage valve pre-amp, both stages having fixed gain. Depending on the magnitude of the input signal to both stages, either-one or both of the amplifiers can be driven into clipping ("overdrive").

The unit is however operable within a linear pre-amp region giving a "tonally enhanced" amplified replica of the input signal. The input signal can be distorted by increasing the proportion of signal which is allowed to enter each stage of the amp. This is achieved by adjustment of the GAIN and DISTORTION controls of each stage. We have chosen to call the unit a Valve Distortion Unit rather than a "Fuzzbox" to distinguish it from run-of-the-mill solid state products.

### THE VALVE

This particular project uses only one valve – the ECC83, one of the more popular, more readily available valves. Valves are still available – even though I believe valve production has stopped in this country. Valves are still being produced in the Eastern bloc.

The ECC83 (high quality double triode) is available under many different numbers. UK/European numbers include: Mullard ECC83; 6057; M8136 (special quality); CV4004 (MoD). USA/Japanese numbers include: 12AX7; 12AX7S (special quality); 12AXWA (US Military).

Failing these the M8137, 6L13, B339, 7025 or 12AX7A may do the trick. Some mail order companies do still sell valves and we have given a supplier of both the valve and the valveholder in *Shop Talk*.

### OTHER COMPONENTS

This project derives power from the mains, and hence, the circuit contains a transformer, bridge rectifier and large high voltage smoothing capacitors.

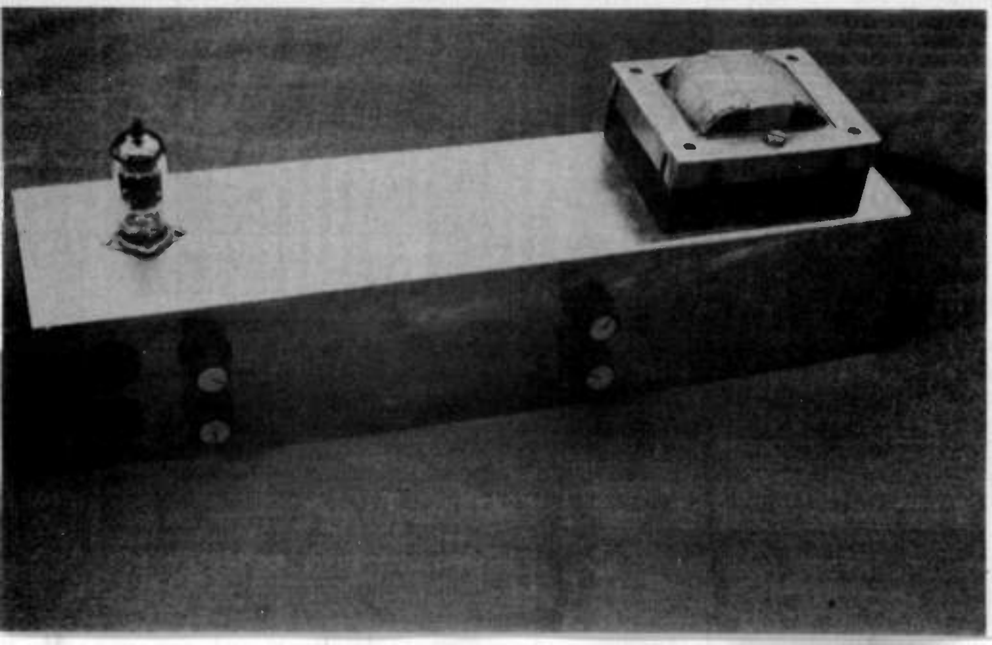
The ECC83 requires a h.t. voltage of over 240V d.c. and 6.3V a.c. to power the heater filaments, so a special transformer must be used. Due care must be given when building and testing the unit – *the high voltages are dangerous especially if you do not know what you are doing*. Apart from the valve, holder and transformer, all the other components are readily available. The components are mounted on tagboard, although this is a rather unusual form of construction for an EE project the tagboard is also readily available.

### CIRCUIT

Capacitors C1, C2 and C4 (Fig. 1) are coupling capacitors – they couple the audio signal to the next stage but block any d.c. voltage. Resistors R1 and VR3/VR4 hold the grids of triode A and triode B, respectively, at earth potential – thus allowing the capacitor to settle without causing loud crackling at switch on. VR3/VR4 are also used to set the signal level applied to the grid of triode B. Components C3 and R5 form the autobias network. In a valve amp circuit, the grid is supposed to be negative with respect to the cathode – hence, if the cathode is positive with respect to the grid, the same end is achieved. Resistors R2 and R4 are the anode resistors – similar to the collector resistors in a transistor amp circuit.

The signal enters via a jack socket (SK1). The proportion of the signal to be processed can be stepped off using the potential divider network formed by VR1 and VR2. If both DISTORTION pots (VR1 and VR4) are set to zero, a small amount of the signal can be allowed to pass by the adjustment of the FINE pots (VR2 and VR3). By using the FINE pots only, the low gain valve pre-amp reproduces the input signal without distortion.

One drawback of valves is their high output impedance, it is for this reason



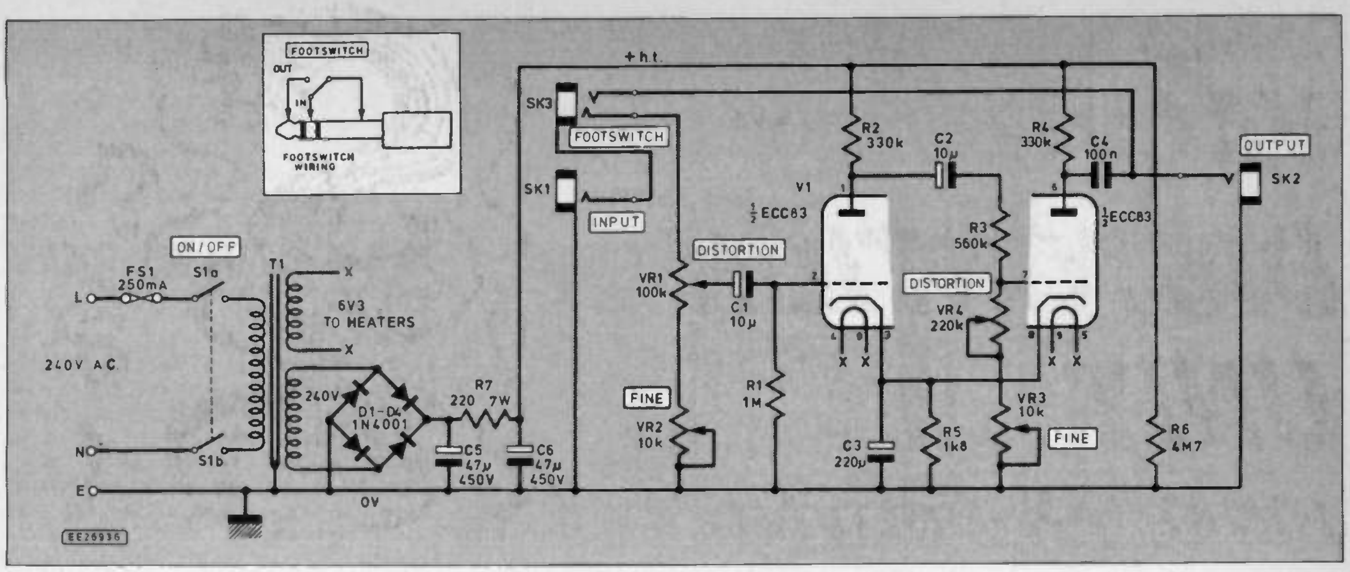


*Fig. 1. Complete circuit diagram of the Valve Distortion Unit.*

that valve output stages are transformer coupled. In this case, the high output impedance means that the device could be loaded by whatever it is driving, via jack socket (SK2). However this effects unit will be feeding into an amplifier with a relatively high input impedance, rendering this particular characteristic inconsequential.

Socket SK3 is provided so that a foot operated switch can be used to switch the Distortion Unit in and out. The footswitch will either connect the input socket SK1 to the effects unit or directly to the output socket SK2, this bypassing the effects unit.

## CONSTRUCTION

There are certain ground rules to the construction of valve equipment:

1. Use good quality valves and good quality valveholders.
2. The transformer and valveholder should be mounted on an earthed aluminium chassis or box.
3. It is general practice to mount the smaller components on tagboard. One row of pins on the tagboard can be used as a "bus bar" or negative rail.
4. Only one connection should be made from busbar to chassis and to earth – as eddy currents can be set up in the chassis and hum voltages induced in the sensitive parts of the equipment.
5. Wires from the transformer to the heater connections on the valveholder should be twisted together to minimize any magnetic field they produce. These wires should be run close to the chassis, away from the tagboard, and may be screened for extra noise immunity. (The valve heaters are fed with 6.3V a.c.).

## IMPORTANT

**GREAT CARE MUST BE TAKEN WHEN THE UNIT IS TURNED ON. IN ORDER TO REMOVE THE RIPPLE VOLTAGE FROM THE D.C. SUPPLY LINE, TWO LARGE CAPACITORS HAVE BEEN USED. THE D.C. SUPPLY VOLTAGE AND THE CHARGE STORED BY THESE SMOOTHING CAPACITORS – WHICH IS RETAINED FOR SOME TIME AFTER SWITCH OFF – IS VERY DANGEROUS. DO NOT DABBLE WITH THE CIRCUIT WHEN IT IS IN USE. REMEMBER THAT MOST OF THE CIRCUIT IS AT HIGH VOLTAGE (AROUND 300V D.C.).**

**DO NOT TOUCH THE CIRCUIT WHEN IT IS ON. THE COMPULSIVE DABBLER MAY BECOME A CONVULSIVE DABBLER. ... DO NOT BUILD THIS UNIT IF YOU DO NOT HAVE EXPERIENCE OF CONSTRUCTING MAINS POWERED EQUIPMENT.**

## COMPONENTS

**Resistors**

| | |
|---|---|
| R1 | 1M |
| R2, R4 | 330k (2 off) |
| R5 | 1k8 |
| R6 | 4M7 |
| R7 | 220 7W wirewound |

All 0.6W metal film except R7

**Potentiometers**

| | |
|---|---|
| VR1 | 100k log. |
| VR2, VR3 | 10k log. |
| VR4 | 220k log. |

See SHOP TALK Page

**Capacitors**

| | |
|---|---|
| C1 | 10µ elect. 63V |
| C2 | 10µ elect. 450V |
| C3 | 220µ elect. 100V |
| C4 | 100n polyester 400V |
| C5, C6 | 47µ elect. 450V axial. |

**Semiconductors/Valve**

| | |
|---|---|
| D1 to D4 | 1N4001 diodes (4 off) |
| V1 | ECC83 or equivalent valve (see text) |

**Miscellaneous**

| | |
|---|---|
| T1 | mains transformer with 250V a.c. 75mA secondary and 6.3V 1A secondary |
| S1 | d.p.s.t. mains toggle switch |
| FS1 | panel mounting fuseholder and 250mA fuse |
| SK1, SK2 | Mono ¼in. jack socket (2 off) |
| SK3 | Stereo ¼in. jack socket |

36-way tagboard; 5-way tag strip; aluminium chassis or box or sheet (see text); knobs for VR1 to VR4 (4 off); B9A valveholder; mains cable clip and grommet; connecting wire and mains cable; fixings etc.

*Approx cost guidance only* **£33** *plus case*

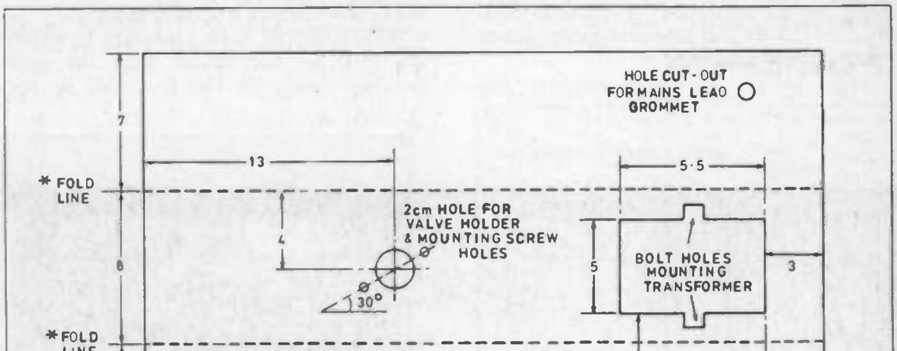


*Fig. 2. Chassis drilling, the valve has been moved since construction of the prototype to make the wiring neater.*

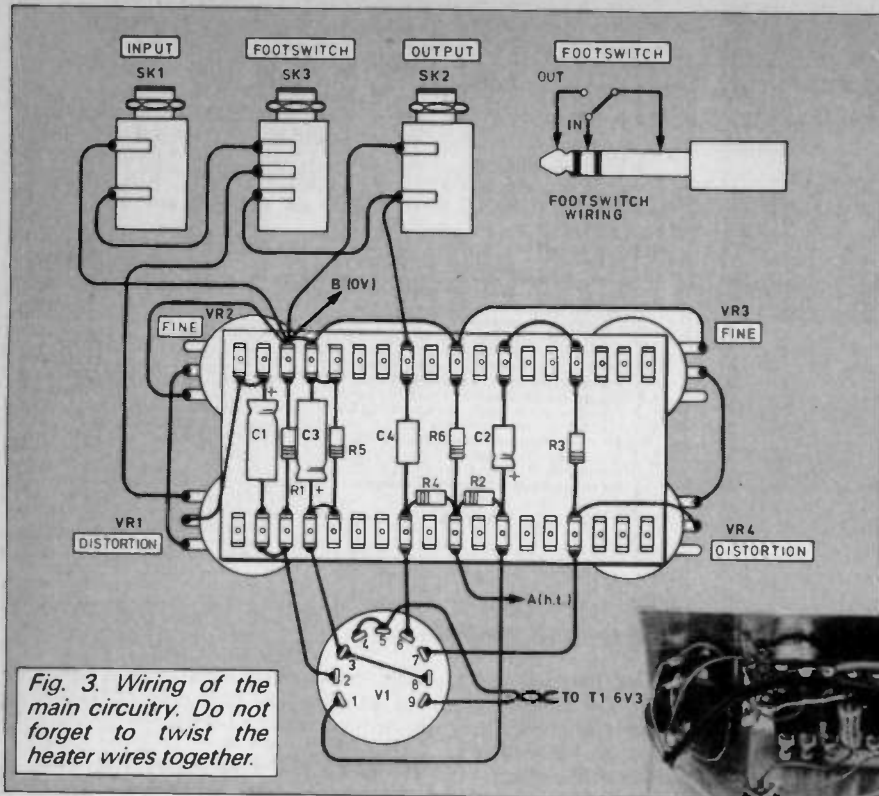



*Fig. 3. Wiring of the main circuitry. Do not forget to twist the heater wires together.*

smoothing capacitors should not be ignored. Make sure that the capacitors have had time to discharge through the 4M7 resistor R6 – DO NOT short out the capacitors, as this is dangerous.

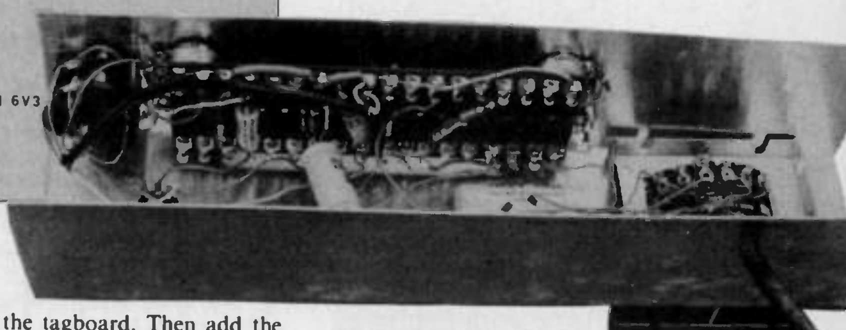
All that remains now is to mount the jack sockets, and solder them into the circuit. Mount the valveholder and solder the wires onto the connecting tags. Fix a bottom panel to the chassis to ensure **all live parts are enclosed and check that all parts of the metal chassis are properly earthed.**

## IN USE

Once construction is complete, insert the valve. Do not insert any jack leads yet. Switch on and, using a multimeter, check the potential across the input and output sockets and the footswitch socket carefully. Any a.c. or d.c. voltage present indicates incorrect wiring. Switch off and check the circuit very carefully.

About thirty seconds after switching on the valve should begin to glow – this can be seen if viewed away from a direct light source. If there are not two thin columns inside the valve glowing orange, then the valve is no good, or the heater connections are incorrect. Note that the valve has to warm up before it will start to operate so the unit will not give an output until about 30 seconds after it has been turned on.

Assuming that the equipment is ready, insert the jack leads and twiddle the knobs to obtain the sound you want. Finally mount the whole unit in a suitable case, not forgetting that the valve produces a reasonable amount of heat. A wooden box covered in suitable plastic material with air holes, to let the heat escape should be quite suitable. □



*The prototype unit with the underside of the chassis removed.*

## CONSTRUCTION

Traditionally, all valve equipment is mounted on a fully enclosed earthed metal chassis – usually made of aluminium. For safety reasons, so is this project. The original circuit was mounted on a U channel chassis made from a piece of 22 s.w.g. aluminium, 22cm by 35.5cm. The sheet was cut, when flat, as shown in Fig. 2, using twist drills, Q-Max cutters, and a coarse file. A second sheet is then used to make a base panel and ends to fully enclose the circuitry. Alternatively a ready made aluminium chassis with a base could be used. This may require a change of layout for the major components. If the layout is to be changed it may be necessary to try various options, to find the positions which give minimum hum.

The tagboard is laid out as in Fig. 3. Ensure that the negative rail wire does not touch any tags that it should not. This can easily be accomplished by using uninsulated solid wire and plastic sleeving, cut to length, where required.

First, solder all the resistors and capacitors to the tagboard. Then add the variable resistors. These are mounted on the rearside of the tagboard using adhesive pads, as illustrated in Fig. 4, *make sure they are well insulated from the tags.* The pots are affixed in such a way as to allow the shafts to pass through the holes cut in the aluminium chassis.

## POWER SUPPLY

The power supply is very simple and is shown in Fig. 1. Construction of this part of the circuit is shown in Fig. 5. The transformer should be mounted first, so that the heater wires can be run along close to the chassis, and away from the tagboard. The capacitors are mounted on a small tag strip and fixed to the chassis using double sided sticky pads. The bridge rectifier is also assembled on the tag strip as illustrated.

**NOTE:** Should it be necessary to touch any part of the circuit after the unit has been used, the charge stored by the

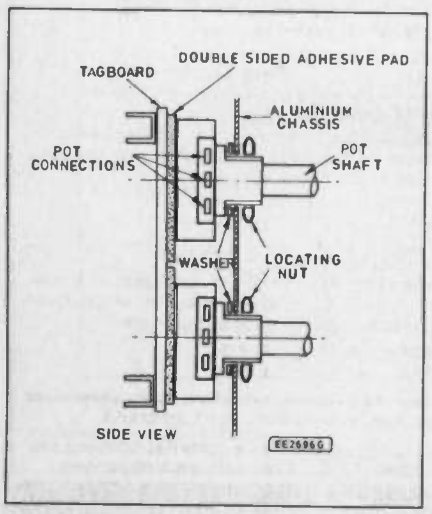



*Fig. 4. Mounting of the potentiometers and tagboard.*

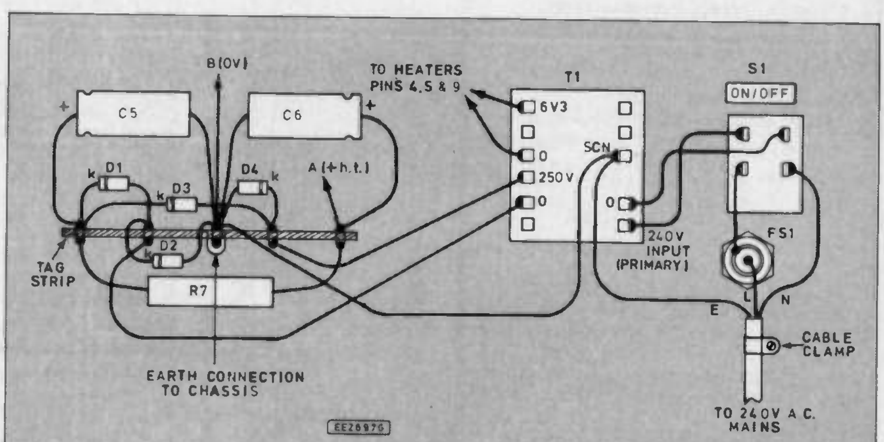


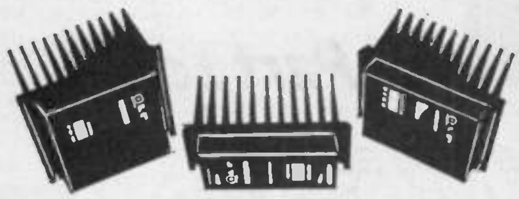

*Fig. 5. Wiring of the power supply. Make sure the centre tag on the tag strip is properly earthed.*

ILP

AMPLIFIERS FROM

JAYTEE

# The UK Distributor for the complete ILP Audio Range



## BIPOLAR AND MOSFET MODULES

**The unique range of encapsulated amplifier modules with integral heatsink.**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HY30 | 15W | Bipolar amp | £11.50 | HY248 | 120W | Bipolar amp (8ohm) | £25.20 |
| HY60 | 30W | Bipolar amp | £11.50 | HY364 | 180W | Bipolar amp (4ohm) | £39.25 |
| HY6060 | 30W | Stereo Bipolar amp | £24.45 | HY368 | 180W | Bipolar amp (8ohm) | £39.25 |
| HY124 | 60W | Bipolar amp (4ohm) | £19.00 | MOS128 | 60W | Mosfet amp | £40.70 |
| HY128 | 60W | Bipolar amp (8ohm) | £19.00 | MOS248 | 120W | Mosfet amp | £46.35 |
| HY244 | 120W | Bipolar amp (4ohm) | £25.20 | MOS364 | 180W | Mosfet amp | £75.75 |

## PLATE AMPLIFIERS

**Bipolar and Mosfet modules with the same electronics as above amplifiers housed in a different extrusion without heatsink.**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HY6060P | 30W | Stereo Bipolar amp. | £20.10 | HY364P | 180W | Bipolar amp (4 ohm) | £25.99 |
| HY124P | 60W | Bipolar amp (4 ohm) | £14.85 | HY368P | 180W | Bipolar amp (8 ohm) | £25.99 |
| HY128P | 60W | Bipolar amp (8 ohm) | £14.85 | MOS128P | 60W | Mosfet amp. | £36.60 |
| HY244P | 120W | Bipolar amp (4 ohm) | £20.10 | MOS248P | 120W | Mosfet amp. | £39.95 |
| HY248P | 120W | Bipolar amp (8 ohm) | £20.10 | MOS364P | 180W | Mosfet amp. | £66.65 |

**Note: These modules require additional heatsinks**

## POWER SUPPLIES

**Comprising toroidal transformer and DC board to power the ILP amplifier modules.**

| | | | | | |
|---|---|---|---|---|---|
| PSU30 | Pre-amplifier | £10.80 | PSU542 | HY248 | £27.40 |
| PSU212 | 1 or 2 HY30 | £19.25 | PSU552 | MOS248 | £29.60 |
| PSU412 | HY6060, HY124, 1 or 2 HY60 | £21.45 | PSU712 | HY244 (2) | £31.75 |
| PSU422 | HY128 | £23.70 | PSU722 | HY248 (2) | £32.80 |
| PSU432 | MOS128 | £24.75 | PSU732 | HY364 | £32.80 |
| PSU512 | HY244, HY128 (2) | £26.35 | PSU742 | HY368 | £34.95 |
| PSU522 | HY124 (2) | £26.35 | PSU752 | MOS364, MOS248 (2) | £34.95 |
| PSU532 | MOS128 (2) | £27.40 | | | |

## PRE-AMP and MIXER MODULES

**These encapsulated modules are supplied with in-line connectors but require potentiometers, switches etc.**

| | | |
|---|---|---|
| HY6 | Mono pre-amp with bass and treble | £9.30 |
| HY66 | Stereo pre-amp with bass and treble | £15.50 |
| HY83 | Guitar pre-amp with special effects | £18.95 |
| B6 | Mounting board for HY6 | £1.15 |
| B66 | Mounting board for HY66 or HY83 | £1.75 |

## POWER SLAVES

**These cased amplifiers are supplied assembled and tested in 60 and 120 watt Bipolar or Mosfet versions.**

| | | | | | |
|---|---|---|---|---|---|
| US12 | 60 watt Bipolar (4ohm) | £77.50 | US32 | 60 watt Mosfet | £105.95 |
| US22 | 120 watt Bipolar (4ohm) | £85.95 | US42 | 120 watt Mosfet | £115.95 |

Prices include VAT and carriage

VISA

Quantity prices available on request

**Write or phone for free Data Pack**

Jaytee Electronic Services

143 Reculver Road, Beltinge, Herne Bay, Kent CT6 6PL

Telephone: (0227) 375254 Fax: 0227 365104

# WATCH THIS SPACE ... MONTHLY ...

**for just a few examples from our extensive and changing stocks of COMPONENTS, CAPACITORS, CONNECTORS, FUSES, HARDWARE, TEST EQUIPMENT, RELAYS, SWITCHES, SEMICONDUCTORS, MINI CIRCUITS, BAND FILTERS, etc. etc. etc. etc.**

| | | |
|---|---|---|
| CML FX 4070 module. Industry standard | £12.00 | each |
| Mitsibushi power module amplifier IC 25W 12V 145-170MHz M57710 | £12.00 | each |
| Crystal Filters 21.4 megohm 15KT band width | £7.00 | each |
| 3 Pole Helical Filters 405 meg | £3.50 | each |
| Siemens Intelligent Alphanumeric displays DL 3416 & DL 2416T | £3.00 | each |
| Siemens Intelligent Alphanumeric displays DL 461T | £2.00 | each |
| Motorola Static Ram MCM6164C45 8K x 8 | £2.00 | each |
| Power Products PM 5932 power supply 115V-240mA in 15V-150mA out | £8.00 | each |
| Speakers 8" diameter 8 ohm | £2.00 | each |
| Speakers 57mm diameter Toptone Mylar | £1.50 | each |
| Transceiver Fist microphone fitted flexilead and 12 pin din | £2.95 | each |
| Davall relays 25/2MS/185 ohm PCB mount | 50p | each |
| Gen. instruments 1½ digit display ref. MAN 6730 | 50p | each |
| Murata Piezo transmit PKD 33EQ | 30p | each |
| Schaffner filters Ref FN-346-OT to BS613 110/250V 50/60Hz | £5.00 | each |
| Bourns turns counting dials H490 series 1" dial | £2.50 | each |
| Aromat DX2 12V solid state relays | £4.00 | each |
| Burgess Microswitches VCF1 lever action | 50p | each |
| Cooling fans 12/24V d.c. 60mm sq x 20mm deep | £6.00 | each |
| 115/240V a.c. 80mm sq x 20mm deep | £6.00 | each |
| 119mm sq x 38mm deep | £6.00 | each |
| 92mm sq x 15mm deep | £6.00 | each |
| 92mm sq x 24.4mm deep | £6.00 | each |
| Subminiature precision p/b switch 0.4A 20V | 25p | each |
| Mabuchi 12-24V small electric motors | £2.00 | each |
| Takamisawa MAT4Z8-CR 24V AC coil relays | 50p | each |
| Memory DAC 9356-12 | £2.00 | each |
| MCM 6164C45 Static Ram | £2.00 | each |
| CY7C 2452-35PC Ram | £5.00 | each |
| CD 4044 BCN CMOS | £5.00 | each |
| TMS 44C56 D Ram | £5.00 | each |
| AD 8616 Analogue device | £5.00 | each |
| AD574KD | £5.00 | each |
| AD 625CA | £5.00 | each |

**ALL PRICES INCLUDE VAT.**

Add £2 postage/packing. Allow 14 days for delivery Payment. Cash/cheque/P.O. with order

A MONTHLY comprehensive list is available showing varying and changing stocks. More comprehensive stock lists will be sent with each order on despatch. Surplus stocks purchased for cash

## K.B.COMPONENTS

21 Playle Chase, Gt. Totham, Maldon, Essex CM9 8UT

**Tel: 0621 893204**

# *electronize* *Car Electronics*

### *MICRO-PRESSURE CAR ALARM*

This new type of alarm is triggered by a unique pressure sensing system. As any vehicle door is opened, air is drawn out, causing a minute drop in air pressure. A sensor detects this sudden pressure change and sets off the alarm.

A sophisticated arrangement of electronic filters and timers provide features to match ultra-sonic systems but at a fraction of the cost.

- ★ 1 Micro-Pressure Intruder detection.
- ★ 2 Operates on all doors and tailgate.
- ★ 3 No door switches needed.
- ★ 4 Automatically armed 1 minute after leaving vehicle.
- ★ 5 10 second entry delay with audible warning.
- ★ 6 Sounds horn intermittently for 1 minute.
- ★ 7 Easy fitting - only 3 wires to connect - no holes to drill.
- ★ 8 Compact design can be hidden below dashboard.
- ★ 9 All solid state Power MOSFET output - no relays.

| | |
|---|---|
| MICRO-PRESSURE ALARM KIT | £12.95 |
| ASSEMBLED READY TO FIT | £18.95 |

### *VOLT DROP CAR ALARM*

Our latest alarm using the popular voltage drop method of triggering. Based on the timers of the micro-pressure alarm it offers features 4 to 9 above but relies on the existing door switch operation for triggering.

| | |
|---|---|
| VOLT DROP ALARM KIT | £11.75 |
| ASSEMBLED READY TO FIT | £17.75 |

### *TOTAL ENERGY DISCHARGE IGNITION*

Our long established Extended CDI system retains the contacts to allow easy fitting whilst the electronics removes the adverse effects. The unique spark generating system still out performs the latest all electronic systems.

| | |
|---|---|
| TOTAL ENERGY DISCHARGE IGNITION | £18.95 |
| ASSEMBLED READY TO FIT | £24.90 |

All Electronize kits include clear, easy to follow instructions, quality components and everything needed, right down to solder and heatsink compound.

Order direct or send for more details from:- (Please quote Ref. C010 and add £1 post and packing per item.)

*ELECTRONIZE DESIGN* tel. 021 308 5877

2 Hillside Road, Four Oaks, Sutton Coldfield, B74 4DQ

Special Series

# MICRO IN CONTROL

JOHN HUGHES — Part Ten

*Starting from very basic principles this series quickly builds through logic to simple microprocessor control.*

## "Driving Test" for the 6502

**T** We've seen that, to "RUN" a program, the micro has to be directed to the START ADDRESS of that program, assuming of course it's already stored in memory. Now we shall look in more detail at how exactly it is stored and what the contents of the various locations actually mean to the CPU.

**S** *Can we have a go at putting our own programs in?*

**T** Indeed you can. We'll look at some "ready-made" ones to start with, and perhaps test our skill by altering them in various ways. One useful trick we can adopt is to make use of whatever "subroutines" are available in ROM.

**S** *That's the read-only stuff already there/in an EPROM/put in by the system designers?*

**T** That's so. We may as well use them, as some of them were put in for that very purpose.

Now let's consider the INSTRUCTION SET of the 6502:

**S** *Will this be the same for, say, a Z80?*

**T** Sadly not. However, there are many similar kinds of instruction. It's the codes for them that differ. We can learn the principles with one micro, then, with a little more effort, learn the extra aspects for another CPU, should we need to.

Rather than trying to study the whole instruction set, we'll get to know a few at a time, starting with the most widely used ones (Table 10.1), though you should have to hand a full list as supplied by the manufacturers.

- Every instruction occupies one, two, or three bytes of memory (some CPUs can also have 4-byte instructions, for example, but not the 6502.
- For *our* convenience (the CPU only uses binary codes, OK?) each instruction is written in hex code. It's much easier to write or to remember A9 than 1010 1001. I wonder if any of you spotted this as the contents of the very first memory location we investigated in Exercise 15?

**S** *And the second location held 22, didn't it?*

**T** Right, in binary, 0010 0010. Incidentally, we should note – though we shan't need it in practice – that the 22 is HEX, not decimal. Best say "two-two" and not be tempted to call it "twenty-two". For the record, what IS its (decimal) value?

**S** *(eventually) Thirty-four. Two sixteens and two units.*

**T** Very good. However, as I said, if we stick to hex, we don't really need to bother with decimal values unless we wish to.

A couple more points about the Instruction Set:

- Every instruction has a MNEMONIC (memory jogger) which is much easier to remember than the operation code (op-code).
- Finally, in a program, every instruction MUST be stored in memory in the correct sequence. We sometimes become so impressed with the "cleverness" of a micro that we may forget that it is really carrying out a number of small tasks very very quickly, and EACH ONE must be right.

As we've just met A9, we'll take it as our first op-code. It has the mnemonic LDA, which means "Load the Accumulator". It's also in the category of "immediate mode" instructions, which means "with the value following immediately", i.e. in the next location.

**S** *In our earlier example, that would be hex 22?*

**Table 10.1 Part of 6502 Instruction Set**
(There are 56 mnemonics in all, with 13 possible modes)

| | | MODES | | | | |
|---|---|---|---|---|---|---|
| MNEM. | Description | IMMED. | ABS. | Z/PAGE | IMPLIED | RELATIVE |
| | Total bytes | 2 | 3 | 2 | 1 | 2 |
| ADC | Add to accum. & carry | 69 | 6D | 65 | | |
| AND | 'AND' with accum. | 29 | 2D | 25 | | |
| BCC | Branch if C=0 | | | | | 90 |
| BCS | Branch if C=1 | | | | | 80 |
| BEQ | Branch if Z=1 | | | | | F0 |
| BNE | Branch if Z=0 | | | | | D0 |
| BMI | Branch if N=1 | | | | | 30 |
| BPL | Branch if N=0 | | | | | 10 |
| CLC | Clear Carry flag | | | | 18 | |
| CLD | Clear Decimal flag | | | | D8 | |
| CMP | Compare with accum. | C9 | CD | C5 | | |
| DEC | Decrement contents | | CE | C6 | | |
| EOR | 'EX-OR' with accum. | 49 | 4D | 45 | | |
| INC | Increment contents | | EE | E6 | | |
| JMP | Jump to new address | | 4C | | | |
| JSR | Jump, save ret.add. | | 20 | | | |
| LDA | Load into accum. | A9 | AD | A5 | | |
| NOP | No oper, (mk. time) | | | | EA | |
| ORA | 'OR' with accum. | 09 | 0D | 05 | | |
| RTS | Return from s/r | | | | 60 | |
| SBC | Subt. from accum. | E9 | ED | E5 | | |
| SEC | Set Carry flag | | | | 38 | |
| SED | Set Decimal flag | | | | F8 | |
| STA | Store accum. to | | 8D | 85 | | |

Further instructions will be introduced as needed. A full account is published in various texts, including of course the manufacturer's "6502 Programming Manual".

**T** Exactly. So those first two bytes are telling the CPU to copy into its accumulator whatever is in the second location. We can call this the "data byte", the first being the op-code itself.

**S** *So the CPU "knows" that A9 will be followed by one more byte/that it's a Two-Byte Instruction.*

**T** It does. A great deal of "prior knowledge" is built into a microprocessor, as you can see. It follows, though, that if, for instance, we unthinkingly forget the second value, or put in two data bytes, the CPU would be thrown, and try to process an op-code as data, or, probably worse, to carry out a data value as an operation!.

**S** *Are we now talking about "machine language"?*

**T** Yes, we are. Although it's a menace in some ways, mainly because errors are NEVER forgiven, and also because it's tedious to write, it does have some very great advantages at the moment. Not only is it giving us an insight into the working of the micro in its own terms, but it also lends itself readily to control signal processing, and is also very fast, when this may be important. Later on though, we'll look at how BASIC programming can be used, if you like.

**S** *There's also Assembly Language, isn't there?*

**T** There is. In fact, that's really what we shall be using with our grass-roots system. Unless we graduate to the use of an Assembler (such as that in the BBC Micro), however, we shall have to "hand-assemble" our programs. There is one other advantage to machine code, though. Programs can be quite short, as it's very efficient in its use of memory!

**S** *Why does that first instruction copy a number into the accumulator?*

**T** Many programs start this way. In fact, as you can imagine, numbers are constantly being shuffled from here to there, added, subtracted and so on, in a micro system. The 6502, like many other CPUs, reads (loads) a number into its accumulator in order to process it in some way, or merely in order to store it (a copy of it, really) in some other location. For control purposes this is often a "Port" such as port A we've already seen.

Another useful instruction is the "reverse" of loading, i.e. "storing" a value FROM the accumulator into a specified location. Can you see why an "immediate mode" won't do now?

**S** *Because it would be putting the value into the middle of the program/clobbering what's already stored there.*

**T** Well done. How many bytes do we need for an ADDRESS?

**S** *Two in this system.*

**T** Right, so a "store from accumulator" (mnemonic STA) instruction will normally be a three-byte one; the op-code followed by the two data bytes containing the address itself in two halves. As it happens, the 6502 REVERSES the order of these data bytes. For a reason, other than just to bother us. It makes it possible, much of the time, to deal only with ONE of the data bytes, taking the high half for granted and thus reducing the instruction in these special cases, to just two bytes. More saving of memory and time.

**S** *How does the CPU know which is which?*

**S** *(another) different op-codes?*

**T** Right again, as you can see when you study the instruction set carefully.

**S** *So, if we wanted to put a certain value in a certain location, we could do it with these two instructions, LDA in immediate mode, then STA.*

**T** Exactly so. We'll soon get there. Now let's spend a few minutes practising how to "drive" our 6502, so that we can build up our skills towards writing programs of our own.

To gain familiarity with the ideas so far, and with the unit itself, we'll look at one or two programs and sub-routines more closely. Remember how to "run" a program?

**S** *(chorus) Set up START ADDRESS and press GO*

**S** *(few) unshifted!*

**T** Good. In this next example, we'll try our hand at altering values to see how things work:

## Exercise 17 Slow, slow, quick, quick, slow...

**T** Set up Start Address F97C once more, press GO, and watch the counting for a few moments, to get an idea of its speed.

**S** *That's as before 1111 1001 0111 1100 isn't it?/What a mouthful!*

**T** Yes. Now press RST to stop it, and go to address 0006, which is not in ROM but in the read/write area usually called RAM. OK? What does it contain? Look at the DATA l.e.d.s.

**S** *0010 0010/That's 22 in hex/34 in ordinary numbers.*

**T** OK. Fine. This number controls the SPEED of the counter; the larger its value, the longer it takes between the counts. So let's see the effect of increasing it to, say 35 (hex) or, well, you work it out. . . .

**S** *0011 0101 I think.*

**T** Spot on. Now to enter this value into that location:

– Step 1: Check that the location is correct (0006).

– Step 2: Set the manual switches to the required value (35)

– Step 3: Press the A key, and see the value on the DATA l.e.d.s. So both address and data are what we intend. Right?

Now, CAREFUL. If we return to the original start address, the program will put back the 22 value, so we'll fox it by starting a couple of steps later. So, go to address F980 instead (that's 1111 1001 1000 0000, OK?), then press GO.

**S** *It is counting more slowly now.*

**T** Right. If you wish, you can make it go more quickly, using say 10 (hex) as the timer value. Take your time(!) and enter this instead (remember the later start address). Try other values if you like. You may be surprised at the possible variations in speed.

**S** *The micro takes its time from whatever is at 0006?*

**T** In this program, yes. Another program might use a value stored at a different location.

For further practice, before we continue, you may like to run a few more of the "ready-made" examples in ROM. Here's a list of some of them (Table 10.2). Many of them use a card overlay to re-label the keys and switches. Remember, not only can you run them, but, if you wish, you can study the listings, or part of them, by repeated use of the INC key. (The listings are, of course, also in the "Tutor" manual). The program we've just been studying is listed here (List 10.1).

## Decisions, decisions!

**T** Now that you know what most of the keys on the MIDAS board are for, let's set ourselves a little task or two, and see how to make the micro do what we wish.

## Exercise 18 Copy the pattern

Suppose we want to show, on the l.e.d.s, the pattern to which the switches are set. There's a very easy way, and there's a harder way, involving a short program.

**S** *Let's have the easy one first.*

**T** Right. Look at the switches again, and note that they are connected to Port A. Note also that this port, just like a memory location, has its own address. Can you see it?

**S** *(studying board) Is it C001?*

**Table 10.2 Some useful START ADDRESSES in ROM**
(Note that a subroutine CANNOT be run on its own)

| | | | |
|---|---|---|---|
| F887 | s/r | DISPLAY | Shows on l.e.d.s the values stored in 00F0, 00F1, 00F2, 00F3 (right to left). |
| F97C | | BINARY COUNTER | Preset speed (slow). |
| F980 | | BINARY COUNTER | User sets speed beforehand in 0006. |
| F98C | | BCD COUNTER | Preset (can be started with shift/GO). |
| F990 | | BCD COUNTER | User sets speed in 0006. |
| F9A1 | | AND/OR GATES | These two show action of three-input |
| F9CB | | NAND/NOR GATES | logic gates (CARDS 2, 3). |
| FA28 | s/r | DDX | Short fixed delay/display, saving X value. |
| F9F5 | | TIMER | Indicates time interval between switch (or input)7 being set to 0 and switch (or input) 0 being set to 0, i.e. a "stopwatch" (CARD 4). |
| FA38 | | SWITCHES | A solution to the "switch pattern" problem. |
| FA93 | | A TO D | With hardware, shows "Voltmeter" action (CARD 4) |
| FB82 | | ALARM! | BCD clock runs one minute, then alarm. Also gives output on PAO. |
| FB8F | | SET ALARM | Similar, but user sets delay time (CARD 7). |
| FB9E | s/r | DDV | Delay with display, uses value in 0006. |
| FC60 | s/r | READKEYS | Returns with key code in accum. (08 = no key) |
| FCF0 | | THIEF! | Game to recognise hex letters (CARD 1). |
| FD4A | | SHOW LETTER | Displays hex values for prior practice. |
| FDC0 | | MARK/SPACE | Demonstrates how D to A averaging done with user values entered into 0000, 0001 |
| FDEA | | SLOW D/A | Shows slow variation of M/S ratio at low frequency. Just watch. RST to stop. |
| FE0D | | FAST D/A | Same, faster, to reduce flicker. L.E.D. fades. |
| FE7D | | CLOCK | 24-hour clock with BCD display. User can "set" by entering centisec., sec., minutes and hours into 0040, 0041, 0042, 0043 first. Or just let it run from zeroes or random (CARD 1). |
| FF40 | | TRAIN CONTROL | Preset train demo. with 8 "actions" (CARD 5). |

Some of these have been discussed and analysed in the text. Others may be described in more detail later.
FD4A and FCF0 are very useful when learning hex.

## List 10.1 Slow binary Counter

| ADDRESS | LABEL | CONTENTS | MNEMONIC | | COMMENTS |
|---|---|---|---|---|---|
| F97C | START | A9 22 | LDA | #22 | Put suitable constant in timer location |
| F97E | | 85 06 | STA | 06 | i.e. in 0006. |
| F980 | USER | A9 00 | LDA | #00 | Clear display register (00F0) |
| F982 | | 85 F0 | STA | F0 | |
| F984 | DISP | 20 9E FB | JSR | FB9E | Use delay/display subroutine at FB9E. |
| F987 | | E6 F0 | INC | F0 | Start counting in 00F0 and carry on until |
| F989 | | Do F9 | BNE | DISP | it is full, when it will then "drop through" |
| | | EA (a spare byte!) | | | to the next program. |

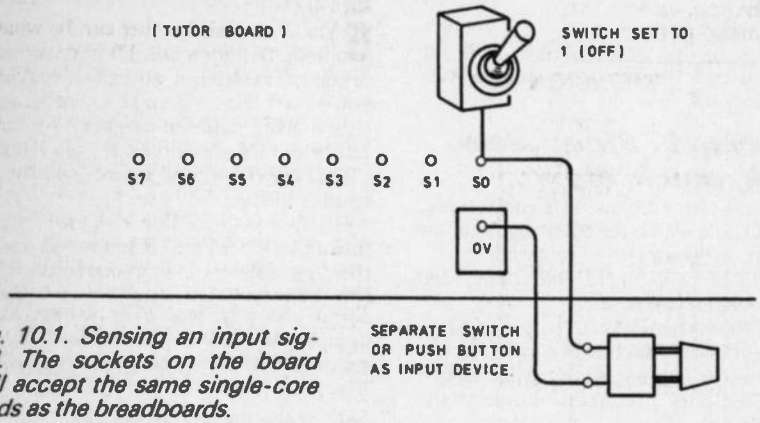



*Fig. 10.1. Sensing an input signal. The sockets on the board will accept the same single-core leads as the breadboards.*

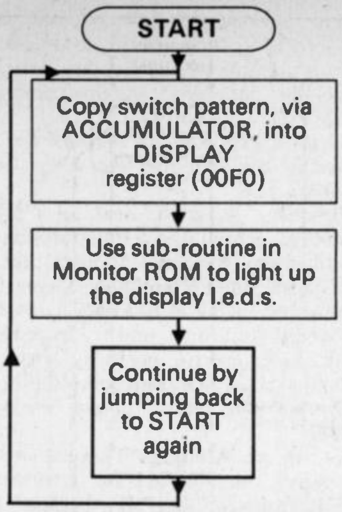



*Fig. 10.2. Flow diagram for showing switch pattern on selected display l.e.d.s. In our case "status" display. Monitor display S/R starts at F887.*

**T** That's it. It's actually a location within the 6522 VIA chip; the interfacing chip, right?

So, the easy way to show the switch settings is to go to this location and have a look! Let's try. Top half and bottom half set up separately, of course, as usual. That's

1100 0000 0000 0001

Now as you operate the switches, the DATA l.e.d.s will follow.

**S** *Would they also follow input signals connected to the eight input/output sockets?*

**T** Yes. You can try the switch units you used earlier with the logic boards. There's a 5V supply available on the Tutor board. And 0V too, of course. (Fig. 10.1).

**S** *You have to make sure the on-board switches are "off" or they short out the other signals.*

**T** That's right. Set them to logic 1. Remember this when you eventually link up to sensors etc.

**S** *Are they all inputs, or are some of them outputs?*

**T** At present they're all inputs, as you can check, but one of the really useful features of the 6522 is that its ports are fully programmable. Each line (socket) can be made to be EITHER an input OR an output by means of the program. We'll see how later on. But I want to set you the second, and slightly harder task, to involve some programming.

I'd like to see the switch patterns appear, not on the DATA l.e.d.s, as now, but on the status display l.e.d.s, the right-hand ones. Otherwise, I want the patterns to follow the switches just as they do now. How about it?

**S** *We'll need to write a program/where will it go in memory?/what exactly must it DO?*

**T** All good questions. It sometimes helps to sketch a "flow diagram". This is a sort of plan based on the kind of steps we know the micro can take, and the end result we seek. So not too much detail, but enough to relate to the instruction set. And a clear realisation that the logic of the CPU is two-state, that is, it can say YES or NO only! As with logic circuits, no "perhaps" allowed.

Then a trial program is written, using the mnemonics of the micro, and translated into op-codes and data bytes. If it looks sensible, we can enter it into memory, and try it. At this stage, it will almost certainly need "de-bugging", or at least it may be possible to improve it or enhance its performance by adding extra features (more de-bugging!).

**S** *Is there a sub-routine for operating the display/there must be/can we use it?*

**T** Well done again. The monitor listing shows two things.

– The display sub-routine starts at F887.

It will display, on the four bytes of l.e.d.s, the contents of locations 00F0, 00F1, 00F2, and 00F3 respectively, from RIGHT to LEFT. So the status display we want will be "fed" from 00F0.

Now let's draw a possible flow diagram (Fig. 10.2), and note how it compares with this program:

**T** We all have that problem at times. Also note:

– As mentioned before, the 6502 expects the LOWER byte of an address first, so C001 is written as 01 C0. There are more examples in the program. OK?

– There is a "Zero-page" mode, where the high address is always 00, so only the lower byte is needed. The special op-code 85 "tells" the micro this, so it stores in 00F0.

**S** *The program is really a continuous looping round and round, then?*

**T** Yes. Most programs are, to allow us time to deal with them, or just to keep an eye on things (hence "Monitor", which watches the keys all the time).

Now we'd better ENTER the program into memory, and try it. The "Display" sub-routine is already there, of course, in ROM, but we'll have to enter our routine into RAM. That's why it starts at 0300, which is in the read/write part.

To enter, then, proceed as follows:

– Go to the start ADDRESS (here 0000 0011 0000 0000, right)?

– Enter the DATA for this address (here 1010 1101 for AD)

– Press the INC key just ONCE, to move to next address.

| ADDRESS | LABEL | CONTENTS op-code | data | MNEMONIC | COMMENT |
|---|---|---|---|---|---|
| 0300 | Start | AD | 01 C0 | LDA C001 | Read switches into acc. |
| 0303 | | 85 | F0 | STA F0 | and transfer to displ. |
| 0305 | | 20 | 87 F8 | JSR F887 | Jump to DISPLAY S/R (and back!) |
| 0308 | | 4C | 00 03 | JMP 0300 | Jump to START (i.e. keep going round) |

There are some important points to note about the way it is written, for it helps us to understand how it is "assembled":

– There is ONE INSTRUCTION per line, taking two or three bytes as needed (no single-byte instructions used). Thus locations 0300, 0301, 0302 are loaded respectively with AD, 01, C0 to complete the first instruction, so the next instruction has its op-code at 0303, and so on.

– Important points in the program (here only the START) are given a label, for use in assembling later on, or for other reference. Data can also be labelled, e.g. LDA SW, JSR DISP, or JMP START.

**S** *Sounds like my car.*

– Enter the next DATA value (here 0000 0001 for 01 hex).

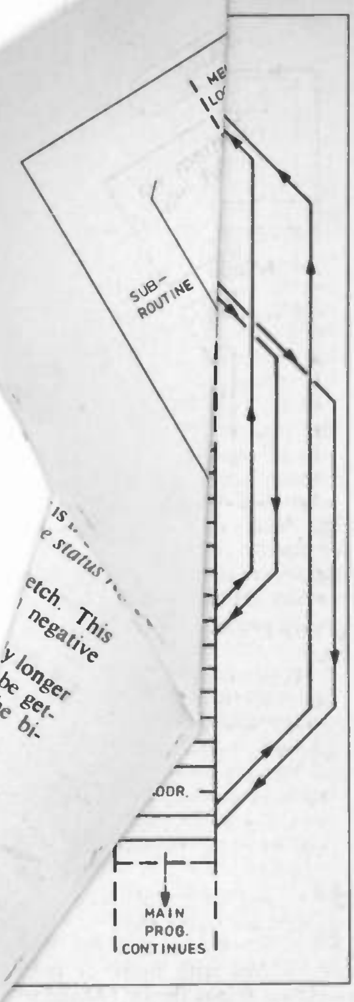
– Repeat these last two steps until the whole program is stored (by which time the address will be 030A, OK?).

– Finally, return to the START ADDRESS, and step (using INC) through the list, checking (and correcting if necessary) each value.

To RUN the program, of course, return to START address, and press GO.

**S** *(eventually) It seems to work OK/as planned.*

**T** Good. before we leave it, let's look further into the way the program works. Can you see what the first two instructions do?




. 10.3. Operation of calling a sub-
.outine. The same S/R may be called more than once.

**S** *The contents of Port A (the switch pattern) is copied, via the accumulator, into the location 00F0.*

**S** *(another) And this is the special location (one of four) which "feeds" the display.*

**T** Spot on. What's next?

**S** *The program jumps to a sub-routine (another program?) already in ROM/at F887/which lights up the display l.e.d.s. But how does it get back to our program?*

**T** Got it, right again. It returns because the code for JSR (Jump, Saving Return address, or jump to sub-routine) tells the micro to note where to return to. Any sub-routine itself always ends with the instruction RTA (return from sub-routine). Remember this when you come to write your own sub-routines. So the micro returns to where it left off. A sub-routine can be "called" several times if necessary. The sketch (Fig. 10.3) may help.

**S** *The JMP means "don't return" then?*

**T** Yes. "Jump to . . . wherever it's told, and blow the consequences!" In our case, it just repeats the same steps over and over, until we press RST.

There are also "conditional" jump instructions or "branches", which we'll see a great deal of, because they are the ones which make the CPU "decide" which branch (of two) to follow.

**S** *This is where the logic comes in?*

**T** Yes, and it's what makes computers seem so intelligent. The 6502 branch instructions all start with B as their mnemonic, as we'll see.

Now for an Exercise requiring such a decision.

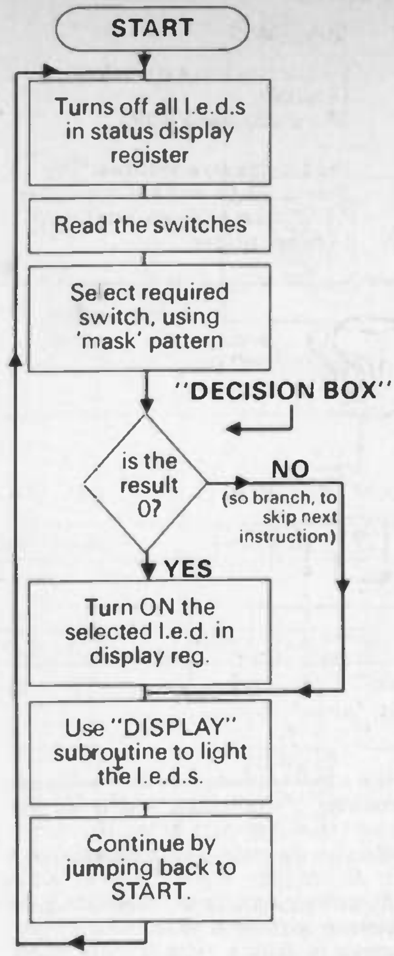



*Fig. 10.4. Flow diagram for testing a switch, e.g. to demonstrate NOT gate action.*

## Exercise 19 Which switch?

Our task is to write a program which will light up the display (or part of it if we prefer) when a particular switch is operated, ignoring all the others. It would clearly have relevance to a control application.

**S** *How can we select a particular switch?*

**T** This is very important for selecting a line in a control system, for example. The trick is to use logic functions. Suppose we wish to test switch S1, the second from the right, and ignore the others. We AND the switch value (call it XXXX XXXX where X is either 0 or 1, OK?) with the binary number 0000 0010. The result will be 0000 00X0, if you think about it.

Each column is the result of the AND performed upon the corresponding values in the original pair so that only the second from the right will respond, as the AND result of all the others is bound to be zero.

Here it is written down for you to use in the program:

Number loaded into accumulator....0000 0010

Number read from switches.........XXXX XXXX

Result of AND instruction (in accumulator)...........................0000 00X0

It's as if a "mask" had been used to filter out everything except the switch setting we want.

**S** *We could use a different switch by changing the first number/or two/or more switches?*

**T** Yes, the mask number can be whatever you wish. In a moment, I'll write a possible program, so have a go before looking, if you wish. I think I'll make my program imitate a NOT gate (an inverter), by turning one l.e.d. ON whenever one switch is OFF. I'll use the right-hand switch, and the right hand l.e.d., too.

Here's a possible flow diagram Fig. 10.4 (my use of "possible" is to remind you that there's usually more than one solution).

**S** *I have a 6502 board at home. I think it's called a "SYM" board. Could I use it for practising on?*

**T** The SYM took off, especially in America, along with a few other 6502-based systems (KIM, AIM65). They had excellent documentation, and inspired books and popular journals. Yes you could use it, but, as with other development systems, you have to refer to its manual to find Port addresses and details of available sub-routines. However, the main feature of a program will be the same as for the MIDAS, though you won't, of course, find the same monitor routines. It's good practice to ferret through a strange system!

**S** *How do we use the "branch" as the decision box?*

**T** Let's look at the listing in more detail: (This is for my version, a NOT gate simulation).

| ADDRESS | LABEL | CONTENTS op-code | data | MNEMONIC | COMMENT |
|---|---|---|---|---|---|
| 0250 | START | A9 | 00 | LDA #00 | Clear all bits of |
| 0252 | | 85 | F0 | STA F0 | display reg. (00F0). |
| 0254 | | AD | 01 C0 | LDA C001 | Read switch reg., |
| 0257 | | 29 | 01 | AND #01 | selecting bit 0. |
| 0259 | | D0 | 04 | BNE 04 | If zero, carry on, if not, move to DISP. |
| 025B | skip, if | A9 | 01 | LDA #01 | Set bit 1 of 00F0. |
| 025D | not zero | 85 | F0 | STA F0 | |
| 025F | DISP | 20 | 87 F8 | JSR F887 | Call display s/r. |
| 0262 | | 4C | 50 02 | JMP 0250 | Keep going! |

**S** *You've read the switches into the accumulator BEFORE using the AND instruction.*

**T** I have. It doesn't matter which you do first, as long as you AND the switch pattern with the mask pattern. The result of this operation is what determines the outcome of the BRANCH instruction.

**S** *Does it use a flag in the status register?*

**T** Exactly. The ZERO FLAG is always set if the result is zero; in this case the BNE (Branch if NOT equal to zero) instruction means that if bit 0 IS zero, the l.e.d. will be lit, if the bit is 1, the l.e.d. will NOT be lit.

**S** *Just as it should be for a NOT gate.*

**T** Right. In fact, you could make a little card – like the ones with the Midas unit, to place over the board (Fig. 10.5).

You may already have spotted the ROM programs to demonstrate the action of AND, OR, NAND and NOR gates, with their own cards. You could, if you wished, try to write your own programs for these, before delving into ROM to see how they are done.

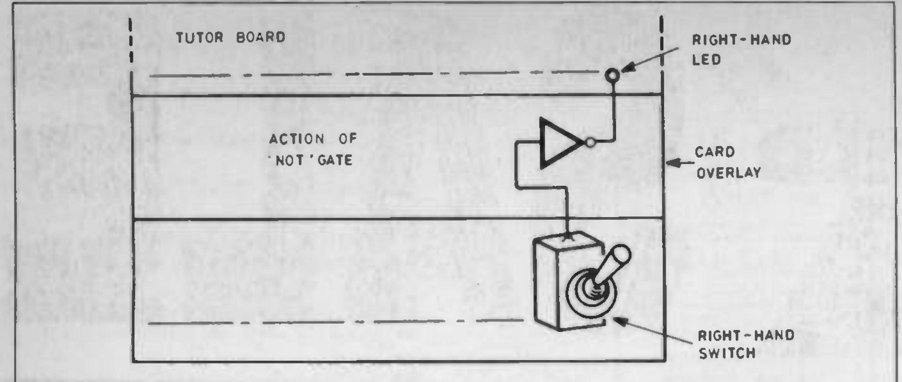



*Fig. 10.5. Demonstrating the behaviour of a NOT gate, using the program described.*

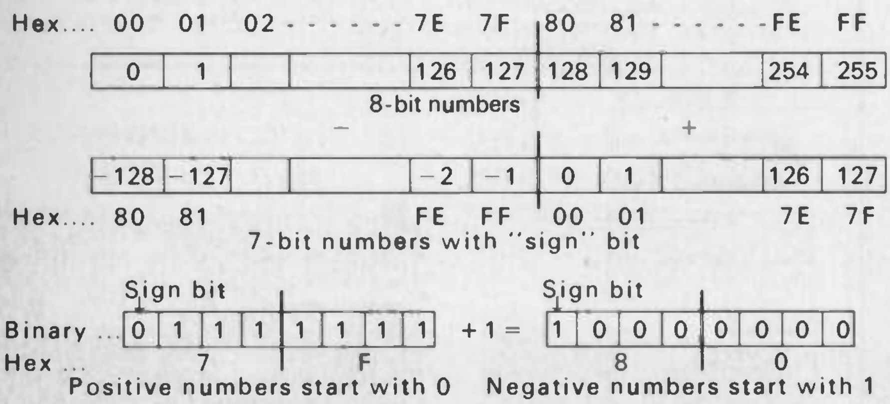



*Fig. 10.6. The use of the Most Significant Bit (MSB) as a SIGN BIT, with a 7-bit value following. Used by micro in arithmetic and branch instructions.*

**S** *What does the # symbol mean?*

**T** It's used to denote a numerical value (read it as "number"). We usually refer to it as a "hatch" or "hash" symbol. Assemblers will recognise it as meaning the Immediate mode, which we denote before LDA . . . I (which they probably wouldn't recognise). In our case, of course, we can use either, as we haven't, as yet, been using assembler programs.

**S** *Why is there an 04 as data after the D0 op-code?*

**T** This is the number of places (locations) we want the micro to branch forward to IF its condition is met. It takes it on to the Display sub-routine and "skips" the lines between (the instruction to light the l.e.d.).

**S** *Can it be made to branch backwards instead of forwards?*

It can, because this instruction uses "di-rected numb[...] negative valu[...] them now, bef[...]

**S** *(most) Yes,*[...]

**T** Well, as we[...] numbers in this c[...] to regard the num[...] 255, as usual, but f[...]

**S** *That's still 256* [...]

**T** Yes, and it then [...] with everything less [...] So, to cause a branch [...] put in a "negative" [...] course, which may req[...] We'll see some examples [...] but suppose we want [...] five places. The dodge [...] "FF,FE,FD,FC,FB" inst[...] But remember, we can on[...] way 127 places. In effect, the [...] number is a "sign bit", if it's [...] is positive, if it's 1, the numbe[...]

**S** *There's a negative flag in t[...] ister.*

**T** Yes, the N flag in our s[...] is how the micro can deal wit[...] values whenever they crop up.

Now that you are entering slight[...] programs into the Tutor, you may [...] ting tired of constantly operating [...] nary switches.

**S** *Hear, hear!*

**T** Now the good news. There is a hex [...] board available for the Midas. If you [...] you can link this to the eight input sock[...] (leaving all switches at 1, OK?), add pow[...] links, and key in our values instead.

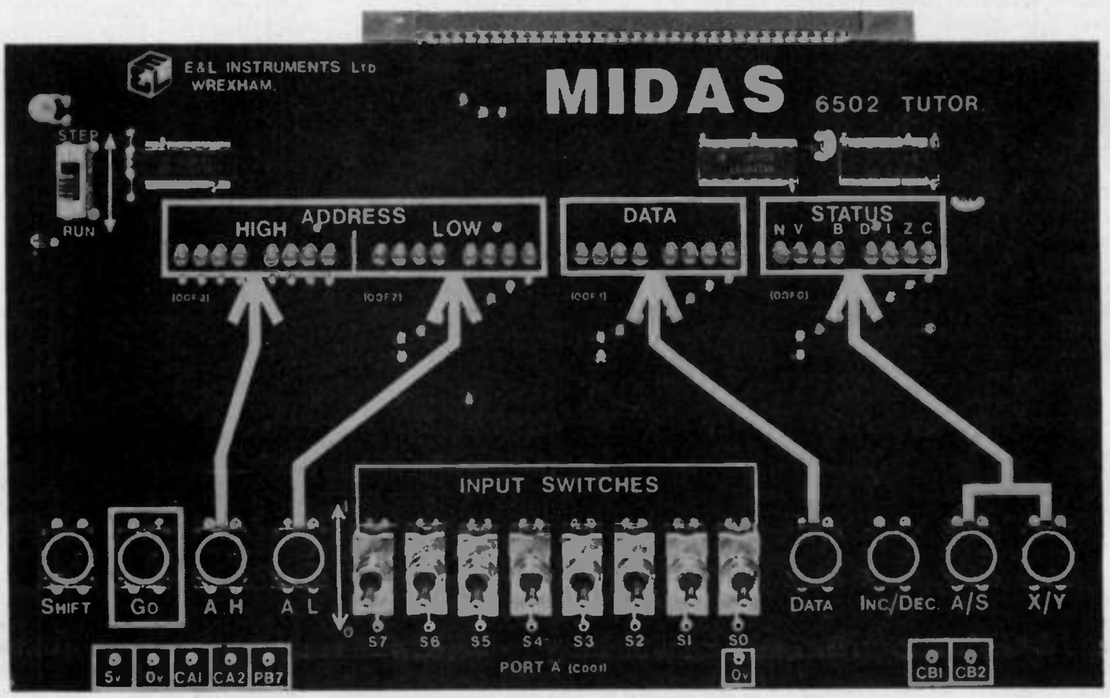
**S** *Now he tells us/the chips convert th[...] keypad signals into the binary values, then?*

**T** That's it. They hold the two hex values as you key them in, and send the eight-bit value to the links. So you just key in two hex digits, press DA and INC on the Tutor, and so on until you've entered the whole program. There's a socket on it, too, which can be linked to a BBC micro if you need to, later.

**S** *If we leave the value FF in it, it shouldn't short-circuit the switches if we leave it connected.*

**T** For most purposes, yes, so do make use of it.

**Next month: Outputs.**




*The MIDAS Controller and Tutor boards connected together.*

# GREENWELD ELECTRONIC COMPONENTS SALE

NEARLY EVERYTHING ON THESE PAGES IS

**HALF PRICE OR LESS!!**

Last year's sale was extremely successful - since then we have moved into larger premises and acquired a great deal more stock, which must be cleared! So order at once - most goods will not be available again once existing stocks are sold!
In order to sell at these low, low prices and cover our costs,**the minimum order value is £10 & postage is £3.00** regardless of quantity (orders can be made up with non-sale goods if required) state "Sale prices" when you order whether by post, phone or fax. See back page for more information.

## FLASH UNIT CLEARANCE

**Z9001** Over the years we've purchased large quantities of various flash units - these must now all go. In this parcel you'll find all sorts of flash units from the pages of our catalogue plus some never previously listed!

**PARCEL OF 10** **£10.00**

## BIB ACCESSORY CLEARANCE

**Z9002** These 3 items are featured on page 93 of our catalogue - but we've got boxfuls to clear! What a Bargain!! - Lens care kit, computer terminal maintenance kit and static eliminator for less than the price of just one of them!!

**ALL 3 FOR** **£2.75**

## BBC MUSIC SOFTWARE (FOR THE BBC 'B' COMPUTER)

This just has to be the 'Deal of the Decade' - These BBC titles are being sold for not much more than the price of the media!

### MUSIC MASTER


**Z9003** Recorder Tutoring System - mic to attach to recorder, a processor, and software in 4 sections to develop playing skills -
(a) Learn the note;
(b) Listen to a tune;
(c) Learn a tune;
(d) Play your own tune.
Originally sold for £52.78

**SALE PRICE** **£6.00**

### MUPADOS


**Z9004**Recorder Tutor - Supplied with an hour long stereo cassette with 52 tunes, disk and handbook. Superb graphics and carefully thought out teaching sequences.

Original price £30.94

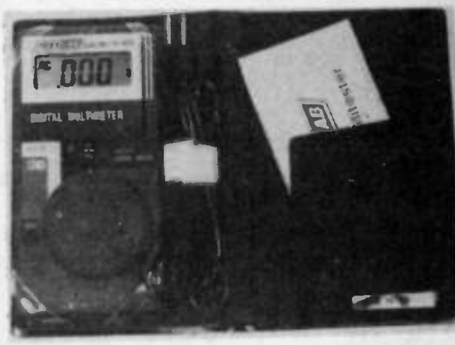
**SALE PRICE** **£3.50**

### MICRO MAESTRO


**Z9005** Put the fun back into music! - this turns the computer screen into a music stand, complete with scrolling. Plus a stereo cassette with 6 recorded backing tracks including Ghostbusters and Superman. Available for keyboard, concert pitch and B $^b$ (state which required). Was £17.25

**SALE PRICE** **£2.50**

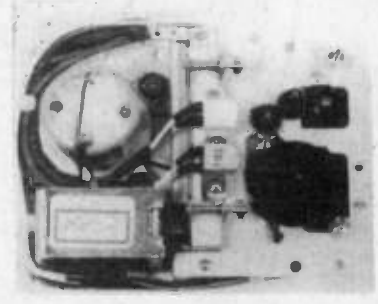
## AUTO RANGING MULTIMETER



**Z9006** Wow! where else can you buy an autoranging multimeter for as little as this?!! Features 3½ digit 10mm LCD and 2.5% accuracy on most ranges; continuity buzzer and diode check; AC and DC volts and resistance.
Ranges:
DC Volts: 200mV 2V 20V 200V 500V
AC Volts: 2V 20V 200V 500V (40-500 Hz)
Resistance: 200R 2k 20k 200k 2M 20M
Measures just 120x80x15mm and comes with its own wallet, weighing less than 100gm - only a few hundred so order now!!

**SALE PRICE** **£12.00**

## MINI CASSETTE DECK



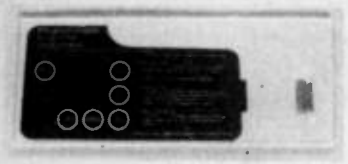
**Z4274** Micro cassette mechanism 100x74x35mm as used in dictaphones/ answerphones etc. Complete with head, optical sensing and hall effect switch, solenoid and motor.
Was £2.00

**SALE PRICE** **£1.00**

# KRAZY KEYBOARD KLEARANCE

**Z8842** Tatung VT4100 keyboard. Cased 85 key units with separate numeric keypad. With circuit. Has 2 or 3 broken keys. 450x65x125mm. Was £9.95

**SALE PRICE** **£5.00**



**Z4116** 24 way (8 x 3) membrane keypad. Large (200 x 90mm) area - these were originally used as a teaching aid. Overlay template and pinout supplied. Now only £2.00

**SALE PRICE** **£1.00**

**Z8857** High quality on ally frame - contactless keys - originally sold for £100 +. Fully ASCII encoded output with data. Needs + 5V and -12V @35mA. Was £14.95

**SALE PRICE** **£7.50**

**Z8852** Superb keyboard 392x181mm with LCD displaying 1 line of 10 characters + another line of symbols. 100 keys. Has 2 x 74HCO5 and 80C48. Was £15.00

**SALE PRICE** **£7.50**

**Z8856**Slim model 340x130x14mm. 67 keys. Pale/ dark brown. Was £4.00

**SALE PRICE** **£2.00**

**Z8848** Keyboard by Cherry. Room for 104 keys, all normal keys (65) fitted. Chips on board: LS373x2 LS374, LM3086x2. LS138x3, 555, LS08, 6805. Size 442x175mm.

**SALE PRICE** **£4.00**

**Z8863** Keyboard. High quality unit made by Micro Switch. 69 pale grey and blue keys. 6 red 5mm LED's, 15 various LS chips and socketed D8048 by Intel. Output via 7 way plug and there's a 4 way edge connector too. Keyboard frame is 317 x 128mm. PCB on which it's mounted is 285 x 170mm. Excellent value at £12.00

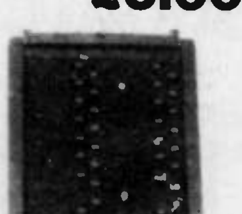
**SALE PRICE** **£6.00**

## VIDEO GAME

**Z8862** Video game unit with 10 games, utilising, the AY-3-8610 chip. Consists of 2 handheld units 145x60x45mm made of light and dark grey high impact plastic. Unit 1 has a control panel with 0-9, serve and reset buttons, 3 switches for bat size, ball speed and sound on or off, and built in joystick. Unit 2 has a serve button and joystick. The 2 units have 2m of 5 core cable between them, and the 3m lead from Unit 1 has 3x3.5mm plugs: 1) 7.5V input: 2) audio out: 3) composite video out. Worth what we're asking just for the cases! £9.95

**SALE PRICE** **£5.00**

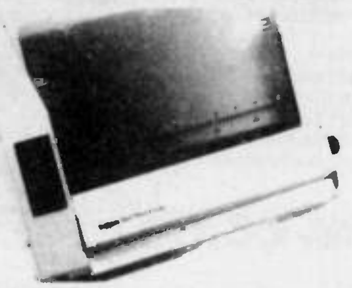
## AUTO DIALLER



**Z803 Auto Dialler** - Sloping front case 240x145x90/50mm contains 2PCBs: one has 4 keypads (total 54 switches) + 14 digit LED display. 2 x ULN2004, ULN2033 and 4067: the other has 12 chips + 4 power devices etc. Case contains speaker. For use with PABXs, could probably be modified for exchange line. Needs 12V ac supply. £9.00

**SALE PRICE** **£4.50**

## DUAL SHEET FEEDER



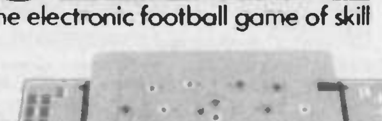
**Z8837** Exxon Dual Sheet Feeder Z200. Overall 395x210x285mm. Brand new and containing some very high class electronics. Although of little practical use as it stands, it makes a great break down unit. It contains:
3x12V 36R 7.5° stepper motors by Airpax and associated gear trains drive belt etc.
2x12V Solenoids
1x12V Electronic buzzer
2 extremely sensitive micro switches.
1 PCB containing 4xTIP115; 4XTIP110; 2X7407; LM3302 comparator + T's, R's, C's, plugs, sockets etc.
1 Control panel containing 4 LED illuminated push buttons + green LED on small PCB
1 x OPB703A opto coupler
1 x OPB711 opto coupler.

Obviously, a very expensive piece of machinery to produce - but once again our contacts in the trade have enabled GREENWELD to procure a few hundred for a fairly modest sum, allowing us to offer them at the bargain price of £24.95

**SALE PRICE** **£12.50**

## 'JIMMY'

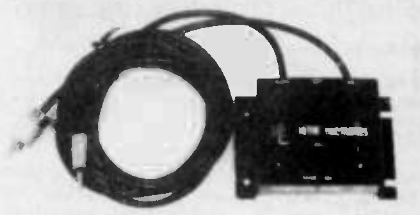
the electronic football game of skill



**Z817** Great fun to play or take it apart for bits. Originally £19.95

**SALE PRICE** **£2.00**

## CB AERIAL ELIMINATOR



**Z4081** Enables any ordinary car radio aerial to be used with a CB set. Originally sold at £7.95.

**SALE PRICE** **2 FOR £1.00**

OUR 16-PAGE SALE SUPPLEMENT IS FREE AND LISTS ALL CATALOGUE ITEMS THAT ARE DISCOUNTED + 4 PAGES OF BULK BUYERS BARGAINS – GET YOURS NOW!

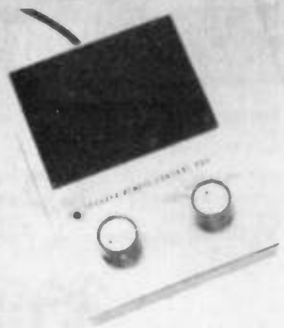
OUR 1990 132-PAGE CATALOGUE + SUPPLEMENTS GIVING FULL DETAILS OF ALL ITEMS IN THIS PULL-OUT COSTS JUST £1.50 POST FREE – GET YOURS NOW!

## HEADPHONES

**Z4135** 'STETHOPHONE' mini stereo headphones, complete with stereo jack plugs, 8R. Hinged headband. £1.75

**SALE PRICE** **£1.00**

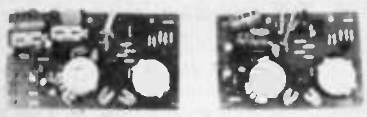
## REMOTE CONTROL



**Z4134** Speaker remote control box. This is a cream case 125x95x42mm housing a 57mm diameter speaker and 2 control knobs, one for volume and one to switch main-remote-dual, the 3 core 6m long lead enables volume to be controlled from chair or bed. Simple to fit, instructions included. £3.95

**SALE PRICE** **£2.00**

## AUDIO AMPLIFIERS



**1W Amplifier - mono**

**Z914** Audio amp panel 95x65mm with TBA820 chip. Gives 1W output with 9V supply. Switch and volume control. Just connect battery and speaker. Full details supplied. Only £1.50: 10 for £12.00: 25 for £25.00: 100 for £75.00

**SALE PRICES** **£0.75 each**

**10 £6.00: 25 £12.50: 100 £37.50**

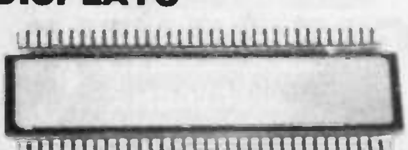
**1W Amplifier - stereo**

**Z915** - Stereo version of above 115x65mm featuring 2xTBA820M and dual volume control. £3.50: 10 for £30.00: 25 for £65.00: 100 for £200.00

**SALE PRICES** **£1.75 each**

**10 £15.00: 25 £32.50: 100 £100.00**

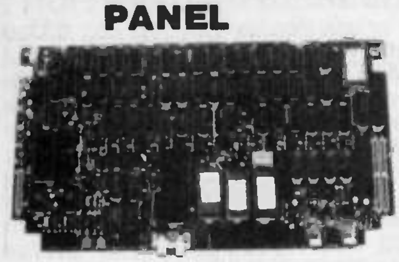
## DISPLAYS



**Z4115** 8 digit 12.7mm high LCD and holder. 14 segment. Normally £4.50

**SALE PRICE** **£1.00**

## MICROPROCESSOR PANEL



**Z494** Newbrain Motherboard. Microprocessor panel 265x155mm. Complete PCB for computer, Z80, EPROM, etc. 68 chips altogether + other associated components, plugs, sockets, etc. Brand new in original packing. £5.50

**SALE PRICE** **£2.75**

**Z672** Newbrain Motherboards. Complete but probably faulty. £3.50

**SALE PRICE** **£1.75**

## SWITCH MODE PSU BARGAIN

**ASTEC Model AA12531**

I/P : 115/230V ac 50/60Hz
O/P : V1 + 5V 5A
V2 + 12V 0.15A
Size: 160x104x45mm

Partially enclosed panel with fixing holes in steel case on 120x125mm centres.

Inputs and Outputs are on colour coded leads; there is also an EEC socket on a flying lead.

**SALE PRICE** **£6.95**

## DIECAST BOX

**Z8827** Interface in diecast box 150x80x50mm. 25 way 'D' socket mounted on top. Inside: PCB with 12 fuses and 24 12V 1W zener. 2m long 13 core cable terminated in 25W 'D' plug. Was £4.00

**NOW** **£2.00**

## TOGGLE SWITCH PACK

**K587** A selection of toggle switches, mainly from page 122 of our 1990 Catalogue. Includes single pole to 4 pole sub min and min. Pack of 50, £30+ at cat prices.

**SALE PRICE** **£7.50**

## POWER SUPPLY PARCEL

**K586** This one's an absolute gem! Contains a selection of conventional and switch mode power supplies, including AA12531, Z4215, Z4302 + 7 others!! Parcel of 10 originally selling for £40+.

**SALE PRICE** **£15.00**

## SOUNDERS

It's time we cleared our stocks of STC 'U' series Piezo ceramic sounders, so here's an offer you'll find hard to refuse!

**K583** Pack of 10 assorted sounders from page 114 of the 1990 Catalogue, may include any of Z101-Z112. 12 / 24V, up to 100dBm. Original cost over £60.!!

**SALE PRICE** **£10.00**

# EASIWIRE CLEARANCE!!!

VERO HAVE OFFERED US THIS EXCITING PRODUCT AT A REMARKABLY LOW PRICE IF WE BUY A LARGE QUANTITY. SO WE'RE PASSING THIS SAVING ON TO YOU – A COMPLETE EASIWIRE KIT CODE 428-63625 USUALLY RETAILING AT £15.00 – LESS THAN HALF PRICE!!


ONLY **£7.00**

# Robot Roundup

**NIGEL CLARK**

## ROBOT POPULATION

Did you know that in total in 1988 Italy exported robots worth three times more than those it imports? You have guessed that the Japanese would have the world's largest population of robots with 176,000 or 63 per cent of the total. But did you know that the electrical industry accounts for 79 per cent of the intelligent robots, which in turn make up 9 per cent of the country's total usage, and 51 per cent of the CNC-robots, which make up 28 per cent of the total?

Regular readers recognise that it is that time of the year again when Robot Facts, the Wisden of the robotics world, is issued by the British Robot Association. Their thin green book is stuffed with interesting snippets, along-side the standard facts for 1989, sufficient to keep a compiler of Trivial Pursuits questions happy for a long time.

***"Only five robots were installed in Northern Ireland last year and only 12 extras were put in use in Wales."***

Other nuggets include the fact that of Switzerland's total robot population education and research accounts for 23 per cent. This is a higher proportion than for any other country mentioned in the review. The UK for example manages only six per cent of the total.

The Swiss figure is described by the BRA as noteworthy. All of which may say a lot about the countries concerned. It certainly can give rise to a great deal of speculation.

## SPECULATION

Why do the Japanese have so many robots? Are all those stories true about one-person companies operating with five robots punching out widgets in a tool shed at the bottom of the garden? And if they are why don't the neighbours complain?

Is it social? Japanese managers prefer employing robots to people. It is economic? Japanese wages are so high that it is cheaper to invest in a machine than a human being.

Or could it be self-perpetuating? If the manufacture of robots comes under the electrical industries which uses such a high proportion of Japanese robots, could they be being used to make robots? That brings forth the thought that robots are being used to make robots so that more robots can be made to make more robots.

In general though it would appear that the bigger the economy the larger the number of robots used. After Japan the order runs: USA, West Germany, Italy, France, Britain and Sweden.

Of the present and former Communist economies the USSR claims the top spot with 59,000 units. That would put it ahead of the US but the BRA states that the figure includes "classifications not compatible with European and US definitions".

## DEFINITION

The BRA is quite strict in its definition which would exclude a large number of machines regularly featured in these columns. "An industrial robot is a reprogrammable device designed both to manipulate and transport parts, tools or specialised manufacturing implements through variable programmed motions for the performance of specific manufacturing tasks."

Which is a long way of saying that it covers all those large machines which attend Automan, complete with glossy brochures and even glossier sales teams. The definition also stands for many of the education arms such as the Armdroid and the range from Cybernetic Applications.

For the committed figure buff there are lots of interesting calculations to be made. For example over the past three years the growth rate of robot numbers in Britain has barely changed. That suggests that robot investment decisions are unaffected by the general economic climate, or the weather. The chances of winning a test series seem to have the same steadiness however.

The economy may be slowing with a number of companies, especially those in building and specialist retailing, suffering but the robot growth rate in 1989 was 17.4 per cent, compared with 17 per cent in 1988 and 16.8 per cent in 1987.

Some other countries are not as consistent. Japan's growth rate fell in 1986 before picking up in 1987 and hitting 26 per cent in 1988. In the same period US growth fell from 25 per cent to 16 per cent and finally to 12 per cent while Germany say its increase halved from 40 per cent to 20 per cent.

***"Over the past three years the growth of robots in the UK has barely changed."***

## HIGHER GROWTH

The International Federation of Robotics however is predicting higher growth rates all-round. It gives four reasons:

- New rationalisation period in the automotive industry.
- Adaptation to a wider range of processes.
- Technological advances.
- Increased international competition.

The automotive industry is mentioned specifically because that is the industry in most countries which makes the most use of robots. Last year 401 or 46 per cent of the robots installed in Britain were for the automotive industry, taking its percentage for the total number installed to date to 33 per cent.

## FIGURES

Now for those who like lots of statistics in a small block here are a few of the detailed figures relating to Britain last year. Those who do not appreciate back to back numbers can skip the next five paragraphs.

In 1989 873 robots were installed in Britain of which the most went into the automotive industry with rubber and plastics coming second. These two together accounted for almost three-quarters of the total.

The most popular applications during the year were the spot welding, injection moulding and arc welding. This mirrored the total number of installations although injection moulding was still the most popular with spot welding having taken second place overall from arc welding.

Education and research increased its share of the total installation with a 1989 figure of 47, making it the fifth most popular application in the year. In the overall total it came sixth behind assembly which had a bad year with only three robots installed to take its total to 496.

British companies took the largest share of supplying the home market with 316 robots supplied, ahead of Japan's 220. However with British suppliers concentrating on the £10,000 to £30,000 sector the value of supplies from Japan, the EC and the rest of Europe outstripped that of home-produced robots. The EC, with its concentration on supplying robots worth more than £50,000, was the top in terms of value. Surprisingly only eight machines came from the States in the year.

The machines used in education and research were at the lower end of the value scale. Out of a total of 47 installations 28 cost less than £10,000 with a further 17 in the next £10,000 to £30,000 bracket.

## GETTING AWAY FROM IT ALL

If after all this you would like to get away from robots the best place in the UK would be Northern Ireland where only five were installed last year. Wales would be the next possibility where an extra 12 were put into use.

On the other hand if you would like to see one of last year's robots you are more likely to bump into one in northern England. The North West, which covers Lancashire and the Lake District had 25 per cent of last year's figures while the North East, Cleveland, Durham and Northumberland accounted for 23 per cent.

***Last year British companies supplied the home market with 316 robots compared to Japan's 220."***

## Constructional Project

# MARC

## MAINS APPLIANCE REMOTE CONTROL SYSTEM


## CHRIS WALKER


### Part Four: Digital Room Thermostat

*Allows up to 15 different household mains appliances, placed anywhere in the house to be controlled form the safety of your armchair. Can be linked to the home computer.*

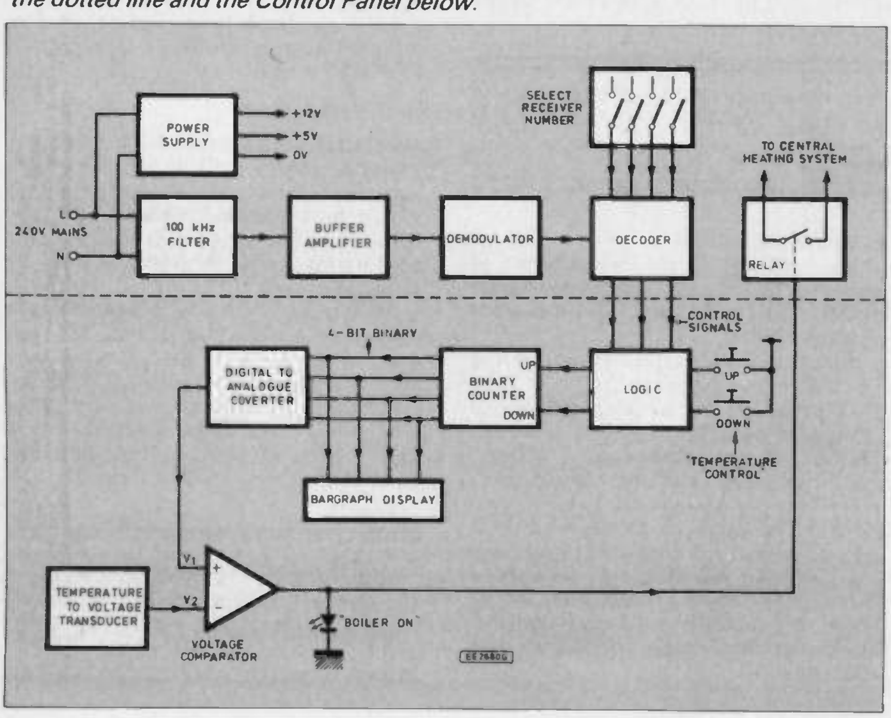
IN THIS final article of the series, the *Mains Appliance Remote Control (MARC)* system is further enhanced by the digitally controlled *Room Thermostat* intended to be wired into the house central heating system.

Apart from the advantages that an electronic thermostat possesses over its conventional mechanical predecessors, namely improved sensitivity and reliability, the switching temperature of the MARC Digital Room Thermostat can be remotely varied using the "UP" and "DOWN" buttons on the *Handheld Infra-Red Transmitter* (June '90) or by using a microcomputer linked to the *MARC Encoder* (July '90) as described in part two. Signals from the *Encoder* pass through the household mains wiring and cause the thermostat to raise or lower the room temperature as desired.

In the author's home, this remote control facility merely allows the householder to adjust the temperature to his or her comfort without getting up from the armchair. It goes without saying, however, that a system such as this (which requires *NO* additional wiring in the home) would be of enormous benefit to elderly people or to disabled folk who might otherwise suffer the cold rather than have to get up to adjust the temperature control.

Apart from describing the operation and construction of the Digital Room Thermostat, it is hoped that this article will also give some constructors ideas for developing the MARC system and customising it for their own homes. Other applications for wireless remote control might include: electrically drawn curtains; electronic garage doors or driveway gates; outside lights; greenhouse environmental control; computer-linked central heating system to operate boiler, pump, valves etc. . . . The possibilities are endless!

*Fig. 4.1. The room thermostat block diagram. The Decoder/Power Supply is above the dotted line and the Control Panel below.*




### TWO SECTIONS

From the onset it was realised that the Room Thermostat would entail a fair amount of circuitry and the decision was taken to construct the unit in two parts:

a) the control panel, display and temperature sensor which is mounted on the wall in the room.
b) the mains interface, decoder, power supply and central heating switching relay concealed somewhere nearby.

In the author's bungalow it is easy to conceal the decoder circuit in the loft but it could be positioned between floorboards or in a cupboard etc. However, the unit should be easily accessible in case the need ever arises to carry out some servicing.

Splitting up the circuit has two advantages over a single-board design. Firstly, because it is not necessary to cram the whole circuit into one case, a small and aesthetically pleasing unit can be mounted in the room.

Secondly, no dangerous mains voltages are present in the control unit or the cable which links the two circuits together.

On the front panel of the control box are two buttons marked "UP" and "DOWN". These provide manual control of the preset temperature if the infra-red transmitter is not immediately to hand. A 16-l.e.d. bargraph display indicates the current preset temperature which can be adjusted over the range 14°C to 27°C. Four l.e.d's at either end of the bargraph show if the central heating is switched on, meaning that the room temperature is below the desired level.

### HOW IT WORKS

The systematic diagram of the Digital Room Thermostat is shown in Fig. 4.1. Pulsed 100kHz signals placed on the 240V Live and Neutral conductors by the Encoder unit are filtered out from the 50Hz mains and then amplified. The demodulator converts the bursts of carrier wave into "*high*" and "*low*" logic signals which are fed to the decoder.

Readers should, by now, be familiar with the fact that transmitted codes are formed of eight binary bits; the first four bits contain the "receiver number" and if this matches the binary code set on the decoder switches then the decoder responds by latching the last four bits (the "function code") onto its outputs. The function codes utilised by this circuit are "UP" (0101) and "DOWN" (1001).

The MARC decoders for all applications will require these first four basic building blocks, the 100kHz filter, amplifier, demodulator and decoder. The variation arises in how the fifteen combinations of the four decoded function code bits (0000 is not allowed) are then utilised.

A regulated power supply generates 5V and 12V rails for the rest of the circuit.

## CONTROL BOX

The circuit so far described will be referred to as the "Decoder and Power Supply". The section below the dotted line in Fig. 4.1 is the thermostatic circuit itself and is called the "Control Section", so named because it is mounted on the wall and contains the control and display elements. The two circuit sections are linked by a multicore cable.

The UP and DOWN commands, from either the decoder circuitry or the front panel switches, are used to increment or decrement a four bit binary counter whose output can exist in one of sixteen possible states between 0000 and 1111. The current value in the counter is decoded and displayed on the sixteen l.e.d. linear bargraph display to indicate the current preselected temperature.

A digital to analogue converter (DAC) uses the binary output from the counter to generate an analogue voltage; the larger the binary value the larger the voltage and vice-versa. This voltage ($V_1$) is presented to the non-inverting input of the comparator.

A transducer senses the temperature of the air in the room and converts this to an analogue voltage ($V_2$) which feeds the inverting input of the comparator. If the air temperature is below the selected temperature (set on the binary counter) then $V_1$ will exceed $V_2$ and the output of the comparator will be "high". This lights the Boiler On l.e.d. and closes the relay contacts to switch on the central heating. Notice that the relay is situated in the Decoder and Power Supply section.

As the room warms up, or if the preselected temperature is reduced by decrementing the binary counter with a DOWN command, then a point is reached where $V_2$ will just exceed $V_1$ and the comparator output will go "low" switching off the relay and central heating.

## CIRCUIT DIAGRAM

Two circuit diagrams are given for the two separate circuit boards. Fig. 4.2 describes the Decoder and Power Supply which is built on stripboard.

Since the thermostat will probably be wired directly into the house wiring (not via a 13A plug) it is important to protect the unit with fuse FS1. VDR1 is a transient suppressor, a protection device present in all the MARC circuits.

Capacitors C1 and C2 couple the 100kHz carrier (more precisely a 104kHz carrier) into the impedance matching transformer T1. ***These two capacitors must be of Class X rating since they are connected directly across the mains.***

Along with capacitor C3 the secondary winding of transformer T1 forms a parallel tuned circuit tuned to resonate at 104kHz. Transistor TR1 and associated components form a voltage amplifier with a gain of about ten and the output impedance of this circuit is lowered by emitter follower TR2 which drives the signal into the diode pump containing diodes D1/D2, capacitors C5/C6 and resistor R6.

The diode pump demodulates the keyed carrier and the Schmitt trigger comparator IC1 "cleans up" the demodulated signal and presents nice sharp edges to the decoder integrated circuit IC2.

The amplifier circuits run off a +12V power supply rail whilst it is necessary to supply +5V to the DAC and, thus, to the remainder of the "digital" components in the circuit. Zener diode D3, therefore, ensures that a logic "1" (high) output from IC1 cannot exceed 4.7V otherwise IC2 would be damaged. Logic "0" (low) remains at 0V.

The d.i.l. switches S1 to S4 are used to set the "receiver number" in binary on pins 2

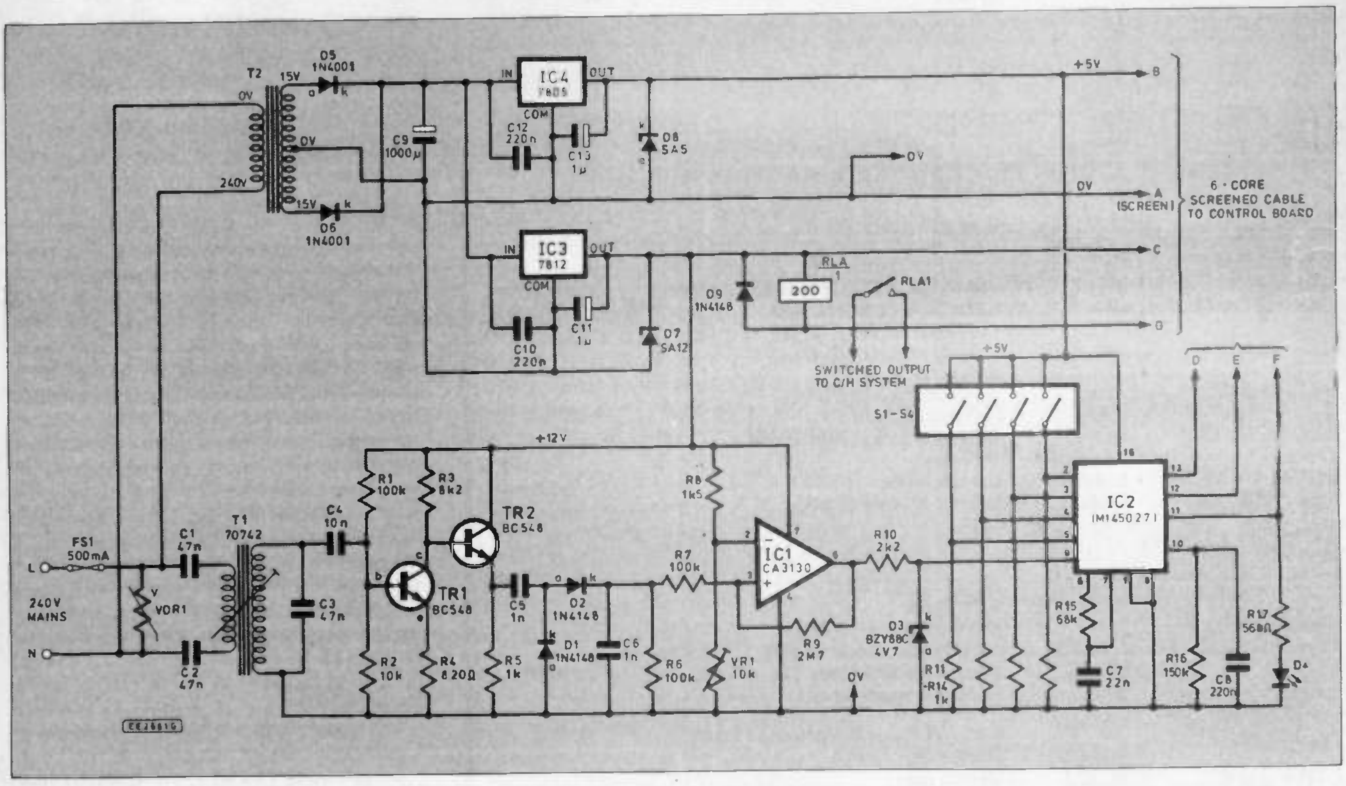
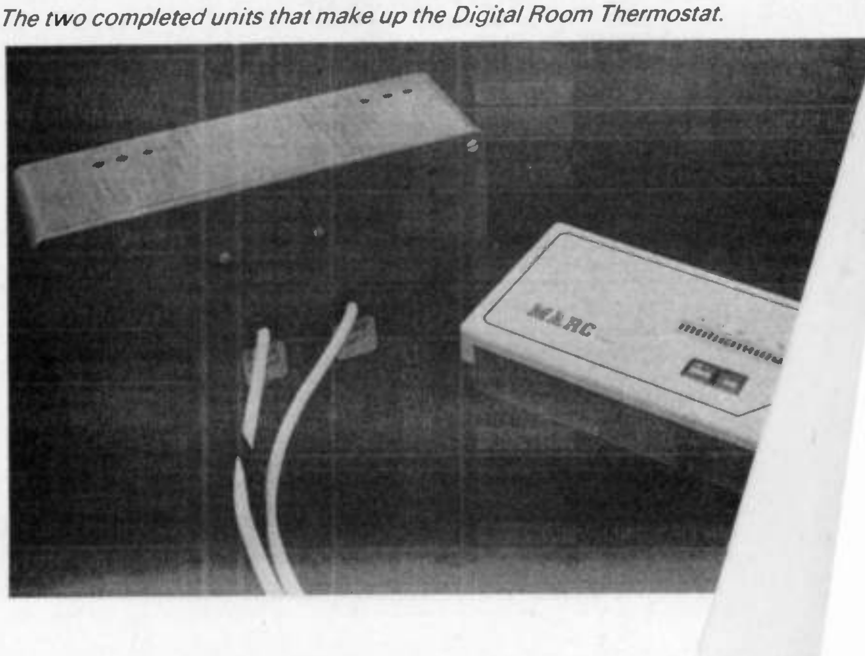



*Fig. 4.2. Circuit diagram for the Decoder/Power Supply stages.*

*The two completed units that make up the Digital Room Thermostat.*



to 5 of IC2. Capacitors C7/C8 and resistors R15/R16 are timing components used by IC2 in order to decode the Pulse-Width-Modulated signal at its data input pin 9.

The "valid transmission" output (pin 11) is used as a clock signal to increment or decrement the binary counter on the control circuit board but it also drives l.e.d. D4. This output briefly goes high and lights D4 if a valid receiver number code is recognised and this can be of assistance when setting up the circuit.

The received function code is latched onto pins 12 (most significant), 13, 14 and 15 (least significant) of IC2. Pins 14 and 15 are not connected in circuit.

## COMPONENTS

**Resistors**

| | | |
|---|---|---|
| R1, R6, R7 | 100k | (3 off) |
| R2, R18, R19, R21 | 10k | (4 off) |
| R3 | 8k2 | |
| R4 | 820 | |
| R5, R11 to R14 | 1k | (5 off) |
| R8 | 1k5 | |
| R9 | 2M7 | |
| R10 | 2k2 | |
| R15 | 68k | |
| R16 | 150k | |
| R17, R31 | 560 | (2 off) |
| R20, R29 | 4M7 | (2 off) |
| R22 | 330 | |
| R23 | 390 | |
| R24 | 39k | |
| R25 | 39k | 1% |
| R26 | 330k | 1% |
| R27, R28 | 22k | (2 off) |
| R30 | 4k7 | |

All 0.25W 5% carbon, except where stated otherwise.

**See SHOP TALK Page**

**Potentiometer**

| | | |
|---|---|---|
| VR1 | 10k | skeleton preset, horiz. |

**Capacitors**

| | | |
|---|---|---|
| C1, C2 | 47n | metallised PETP (Class X) (2 off) |
| C3 | 47n | metallised polyester film |
| C4 | 10n | Polyester layer |
| C5, C6 | 1n | polyester layer (2 off) |
| C7 | 22n | polyester layer |
| C8, C10, C12 | 220n | polyester layer (3 off) |
| C9 | 1000μ | electrolytic 35V |
| C11, C13, C15 | 1μ | tantalum bead, 35V (3 off) |
| C14 | 22n | ceramic |
| C16 | 47p | polystyrene |
| C17, C18, C19 | 100n | polyester layer (3 off) |

**Semiconductors**

| | | |
|---|---|---|
| D1, D2, D9, D10, D11 | 1N4148 | signal diode (5 off) |
| D3 | BZY88C4V7 | 4.7v Zener |
| D4, D32, D33 | | any small l.e.d. (3 off) |
| D5, D6 | 1N4001 | 1A 50V rec. diode (2 off) |
| D7 | SA12 | transient suppressor |
| D8 | SA5 | transient suppressor |
| D12, to D21, D22 to D31 | | 10-l.e.d. bargraph display (2 off) |
| TR1, TR2 | BC548 | silicon *npn* (2 off) |
| TR3 | BC337 | silicon *npn* |
| IC1, IC11 | CA3130 | Mosfet I/P CMOS O/P op. amp (2 off) |
| C2 | M145027 | remote control decoder |
| 3 | 7812 | +12V voltage regulator |
| 4 | 7805 | +5V voltage regulator |
| | 4001BE | CMOS quad NOR |
| | 4011BE | CMOS quad NAND |
| | 4516BE | CMOS binary counter |
| | 74LS154 | 4-to-16 line decoder |
| | ZN426E | digital-to-analogue converter |
| | LM35DZ | temperature transducer |
| | LF351 | op.-amp |

**neous**

12V 200ohm coil relay, with 240V 5A a.c. contacts
Quad d.i.l. switches
P.C.B. keyboard switch, with cap (type KHC10901) (2 off)
707 VXA 0242 YUK matching transformer
Mains transformer 15V-0-15V 200mA secondary
Mains transient suppressor
500mA 20mm fuse with panel mounting holder
2. matrix, 32 strips by 71 holes; printed circuit board . available from ode EE702; ABS case, 190mm × 110mm × 60mm; Verobox type n × 84mm × 40mm; turned pin d.i.l. sockets, 8-pin (3 off), 14-pin (3 20-pin (2 off), 24-pin (1 off); 10-way terminal block; 7-pin DIN nting socket; small heatsinks for T0220 style case (2 off); 6-core ets; mains connecting cable; nylon nuts and bolts.

App guic

**£50**

## POWER SUPPLIES

Two voltage regulators IC3 and IC4 are used to derive the stabilised +12V and +5V supplies from mains transformer T2. Even though the whole circuit only draws current in the region of a hundred milliamps, the regulators used are 1A versions because, in the authors experience, these devices become very unreliable when run close to their limits, even though the manufacturers claim they are equipped with current overload, thermal shutdown and a host of other "anti-death" features!

A very fast-switching type of Zener diode D7 prevents the +12V rail from rising significantly above this voltage. Interference spikes from the mains wiring are easily coupled into this circuit via transformer T1 and would wreck the components if this voltage clamp was not fitted. Diode D8 provides similar protection for the +5V rail.

Seven conductors, *A* to *G*, carry power and control signals to the Control Section board via a six-core screened cable. The screen connects to 0V (conductor *A*) and helps to prevent electrical interference from being picked up. On test, the circuit worked satisfactorily with a 3m length of multicore cable. Longer lengths may be possible, it mainly depends on the amount of electrical noise in the vicinity.

## LOGIC

The circuit diagram for the wall-mounted Control Box is given in Fig. 4.3.

Connections *D* and *E* from the decoder board carry the function code data bits containing the UP and DOWN commands. These are OR-ed (by the gates within IC5) with the UP/DOWN signals from switches S5 and S6 mounted on the front panel of the control box.

The composite output from gate IC5d is "low" when a DOWN signal is presented to the UP/DOWN control input (pin 10) of the binary counter IC7. The counter increments or decrements according to the state of pin 10 every time the level at pin 15 (clock input) falls from a logic 1 to a logic 0. This can be achieved in two ways:

a) when an UP/DOWN command is received from the MARC Encoder, connection *F* from the decoder board (valid transmission) pulses high and this generates a negative-going pulse at the output of NAND gate IC6d which is OR-ed via diode D10 to pin 15 of IC7.

b) every time switch S5 or S6 is pressed this triggers the monostable created by NAND gates IC6a and IC6b to produce a negative-going pulse which is OR-ed to pin 15 of IC7 through diode D11.

Please note that switches S5 and S6 are not "debounced" and this may cause counter IC7 to jump more than one count for every press of the button. In practice, this was not found to be a major problem with the particular switches used and it did not warrant extra de-bounding circuitry especially as the thermostat is primarily designed to be controlled using signals from the MARC Encoder which clocks the counter perfectly.

IC8 is a 74154 4-to-16 line decoder. One of its sixteen outputs goes low and lights an l.e.d. in the bargraph display (diodes D14 to D29) to indicate the currently selected temperature as set on binary counter IC7.

## DAC

IC9 is a ZN426 8-bit digital to analogue converter. Only four bits are used, the rest are tied high to +5V.

This i.c. generates its own 2.55V reference voltage at pin 6 and this is applied directly to the $V_{REF}$ input, pin 5. Capacitor C15 and resistor R23 are required for the internal reference circuit to operate correctly.

Over the full range of binary inputs from IC7, the analogue output from IC9 pin 4 varies from 1.35V to 2.55V in 0.08V steps. This voltage is applied via resistor R28 to the non-inverting input of the voltage comparator IC12.

The LM35DZ temperature-to-voltage converter IC10 is a very convenient device to use since it supplies 0.01V per degree Celsius at its output pin. This rather small voltage is amplified by IC11, an op-amp using negative feedback through resistor R26. Capacitor C16 helps to stabilise the output.

The d.c. gain of the amplifier is 9.5 and so, as IC10 experiences a temperature range from 14°C to 27°C the output of IC11 (pin 6) swings between 1.35V and 2.55V to match the analogue voltage from IC9. The value of resistor R26 may be changed, if desired, to vary the usable temperature range.

Resistor R29 provides positive feedback for the voltage comparator IC12. This creates a small amount of "hysteresis" which means that, once the temperature drops to a level where the central heating cuts in it has to rise about 0.5°C above this level before switching off again. This effect is necessary to prevent rapid on/off/on switching at the threshold temperature.

Diodes D32 and D33 have an unusual function. Although they are l.e.d's their light output is not used. Instead they act as "voltage droppers", each one having a potential difference of about two volts across it when lit. More importantly, they will not conduct until the p.d. (potential difference) across the pair rises to 4V.

Now, in common with many op-amps, the output of the LF351 (pin 6) saturates low at 1V-2V above the negative supply rail (which is 0V in this design). Without diodes D32/D33 in the circuit, transistor TR3 would be continuously switched on regardless of the state of IC12.

When IC12 output goes high (about 10V), TR3 switches on and lights indicator l.e.d's D12/D13 and D30/D31 and energises the coil of relay RLA, via conductor G in the multicore cable (see Fig. 4.2). The "Boiler On" l.e.d's form the two pairs of indicators at each end of the bargraph display.

Finally, capacitors C17, C18 and C19 provide further power supply rail decoupling, especially around IC7 where they prevent spurious counts due to interference picked up on the 6-core connecting cable.

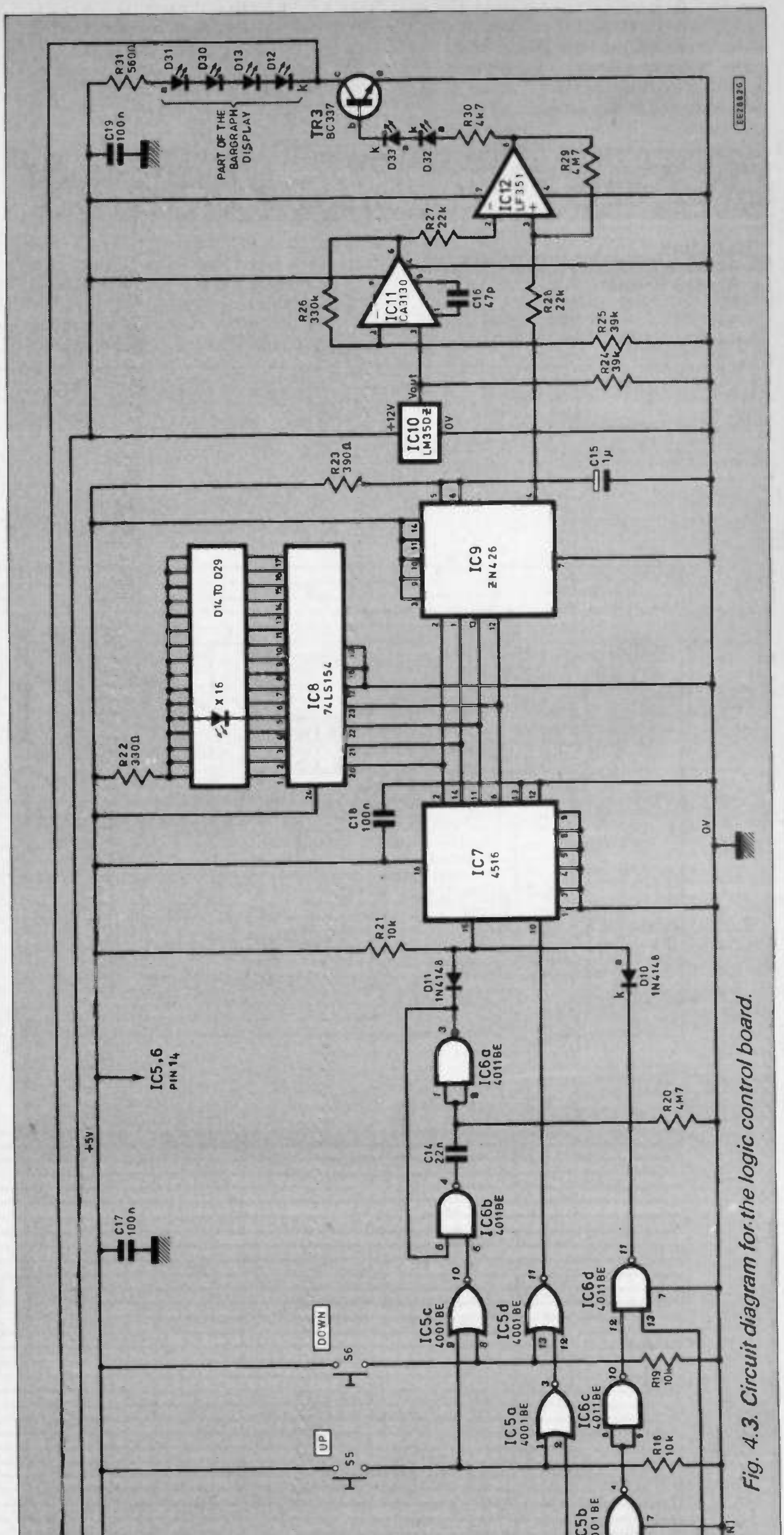



Fig. 4.3. Circuit diagram for the logic control board.

## CONSTRUCTION

*By its nature, this project connects directly to the mains and there is 240V present on parts of the circuit boards. Insulate ALL exposed connections and stick a layer of insulating tape over high-voltage parts of the copper tracks.*

*Transformer T1 is NOT a certified isolation transformer and in the case of an insulation failure it could render the WHOLE circuit live. Take extreme care when making live tests.*

## DECODER/POWER SUPPLY

As described above the Digital Room Thermostat is constructed on two separate circuit boards. The Decoder and Power Supply should be built first and this section is constructed on a piece of 0.1in matrix stripboard as detailed in Fig. 4.4.

Begin by cutting the board to size, 32 strips by 71 holes. In the prototype one corner of the board was shaped as shown to accommodate transformer T2 within the case.

When making the breaks in the copper tracks be especially careful to remove all the bits of copper swarf around the high-voltage areas of capacitors C1, C2 and relay RLA. Insert the 22 wire links and the d.i.l. i.c. holders. Do not insert IC1 and IC2 in their sockets at this stage.

A small amount of alignment is required to set the circuit in its most efficient operating mode and these adjustments are easiest if carried out as detailed below *during* the construction process.

Insert all the components concerned with the power supply i.e. diodes D5 to D8 capacitors C10 to C13 and regulators IC3, IC4. These latter components each need to be fitted with a heatsink. There is sufficient room on the circuit board for a small bolt-on type, e.g. 17°C per watt.

Link the primary and secondary windings of transformer T2 to the circuit board and carefully apply mains power via a fused 13A plug. Using a voltmeter, check for about 12V between pins 4 and 7 of IC1's socket and 5V between pins 8 and 16 of IC2's socket. *Disconnect power before continuing with construction*

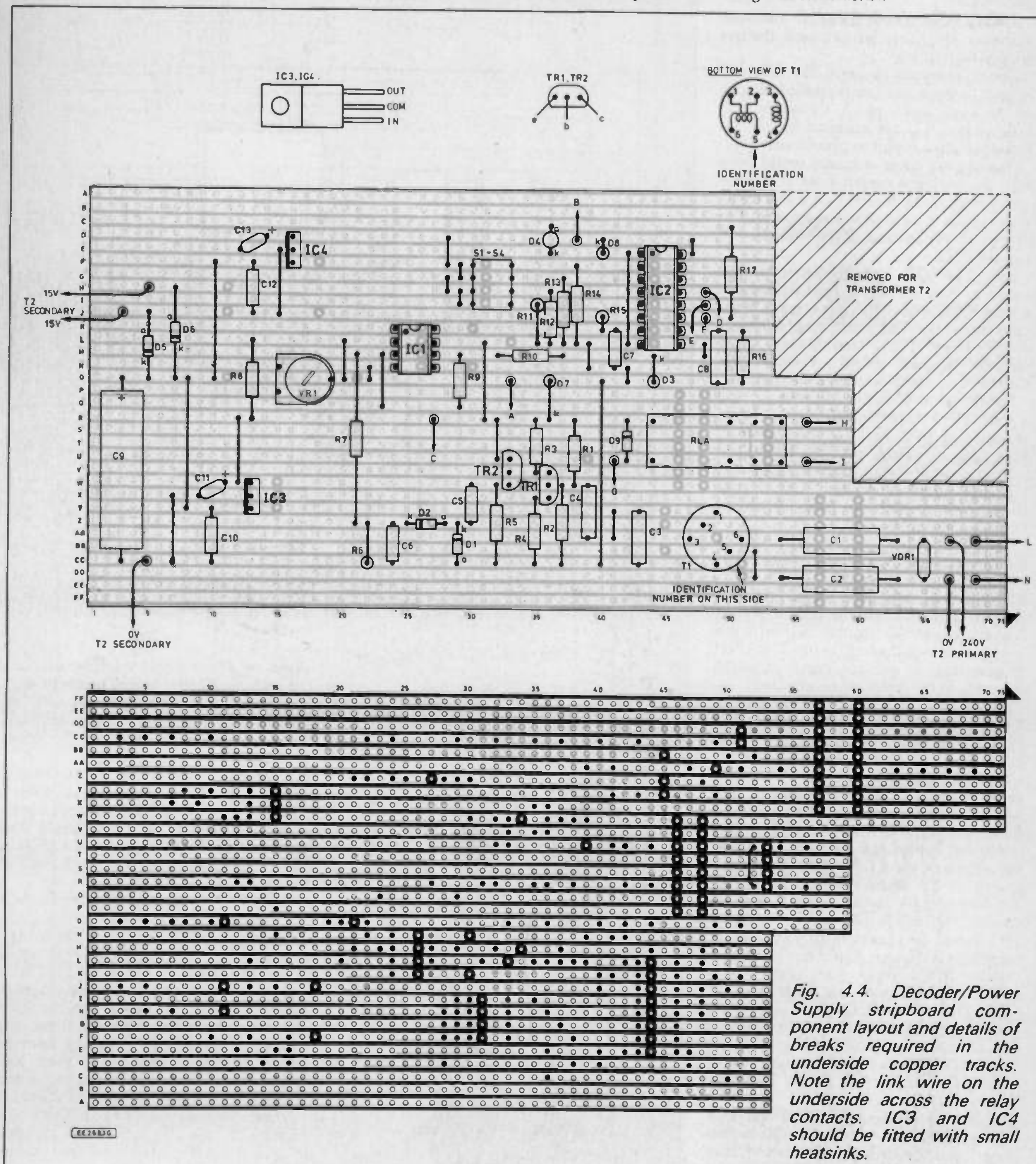



*Fig. 4.4. Decoder/Power Supply stripboard component layout and details of breaks required in the underside copper tracks. Note the link wire on the underside across the relay contacts. IC3 and IC4 should be fitted with small heatsinks.*

Solder in all the remaining components paying careful attention to diode polarity and transistor orientation. It is essential that transformer T1 is inserted correctly. Refer to its pinout of Fig. 4.4 and check the connections with a multimeter. On all components used in the prototype units the identification number has been printed on the side shown. When soldered in place there should be NO continuity between the transformer pins connected to capacitors C1, C2 and those connected to C3.

Notice that there is a wire link required on the underside of the board between the pins of relay RLA. Of course, if a different relay is used then the pin arrangement will probably be different to that shown.

## ALIGNMENT

You are now ready to make the first adjustment. Insert only IC1 into its socket and set potentiometer VR1 fully clockwise. Re-apply mains power to the circuit board.

The Encoder unit should now be set to generate a permanent carrier wave on the mains wiring. This is achieved by moving the wire link as described in part two.

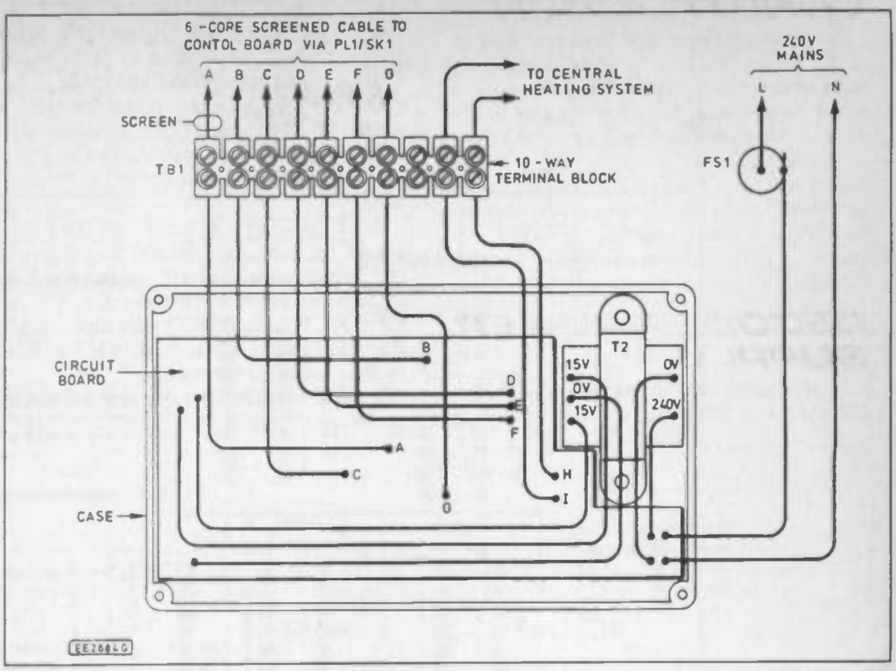
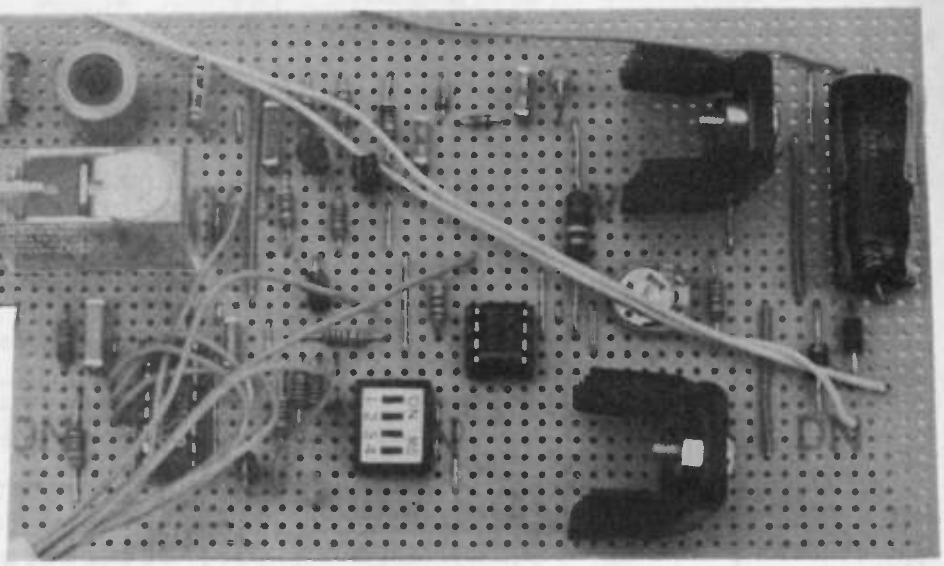



*Fig. 4.5. Interwiring from the stripboard to the terminal block, transformer and fuse.*

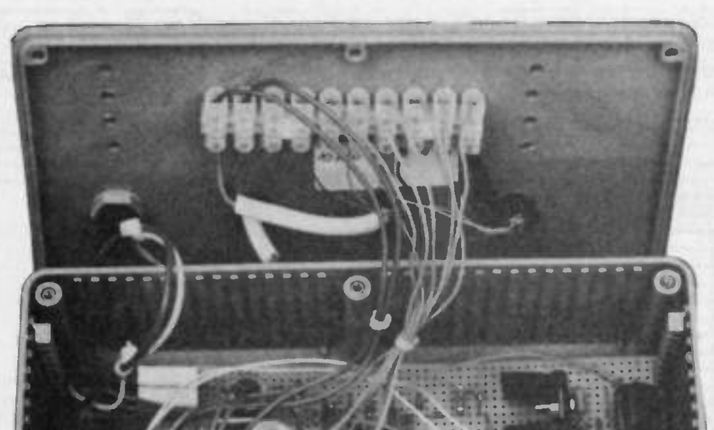


*Completed stripboard showing the relay, d.i.l. switch, heatsinks. Note the insulation tape around the edges where mains enters.*

As oscilloscope connected across capacitor C3 on the Decoder board should display the 104kHz waveform. Using a non-metallic tool, adjust the core of transformer T1 to obtain maximum amplitude of the received carrier. This brings the tuned circuit into resonance. If you don't have access to an oscilloscope then just set the core of T1 in a similar position to that in the Encoder Unit.

The next stage is to connect a voltmeter between 0V and pin 9 of IC2's socket. The meter should read about 0V. With the Encoder still generating a carrier wave, slowly turn preset VR1 anticlockwise until the meter suddenly swings to about 4.5V. The voltage at this point should now "follow" the carrier wave, it must be "low" when the carrier is off and "high" when the carrier is on.

*(Below) Completed Decoder/Power Supply.*



Disconnect power whilst IC2 is placed in its socket and then test that the decoder is receiving and responding to codes from the Encoder unit. The l.e.d. D4 should flash when the "receiver code" from the Encoder matches that set in binary on d.i.l. switches S1 to S4.

This completes assembly of the Decoder and Power Supply circuit board. The prototype was housed in an ABS case measuring 190mm × 110mm × 60mm as shown in Fig. 4.5.

External connections to the Control Board and central heating system enter through holes drilled in the lid of the case and are connected to a 10-way terminal block fastened in the lid. Flying lead connections between the circuit board and terminal block should be made as shown.

To avoid the need to bring an Earth connection into the box, nylon bolts are used to anchor transformer T2 and the terminal block so that no exposed metal parts exist on the outside.

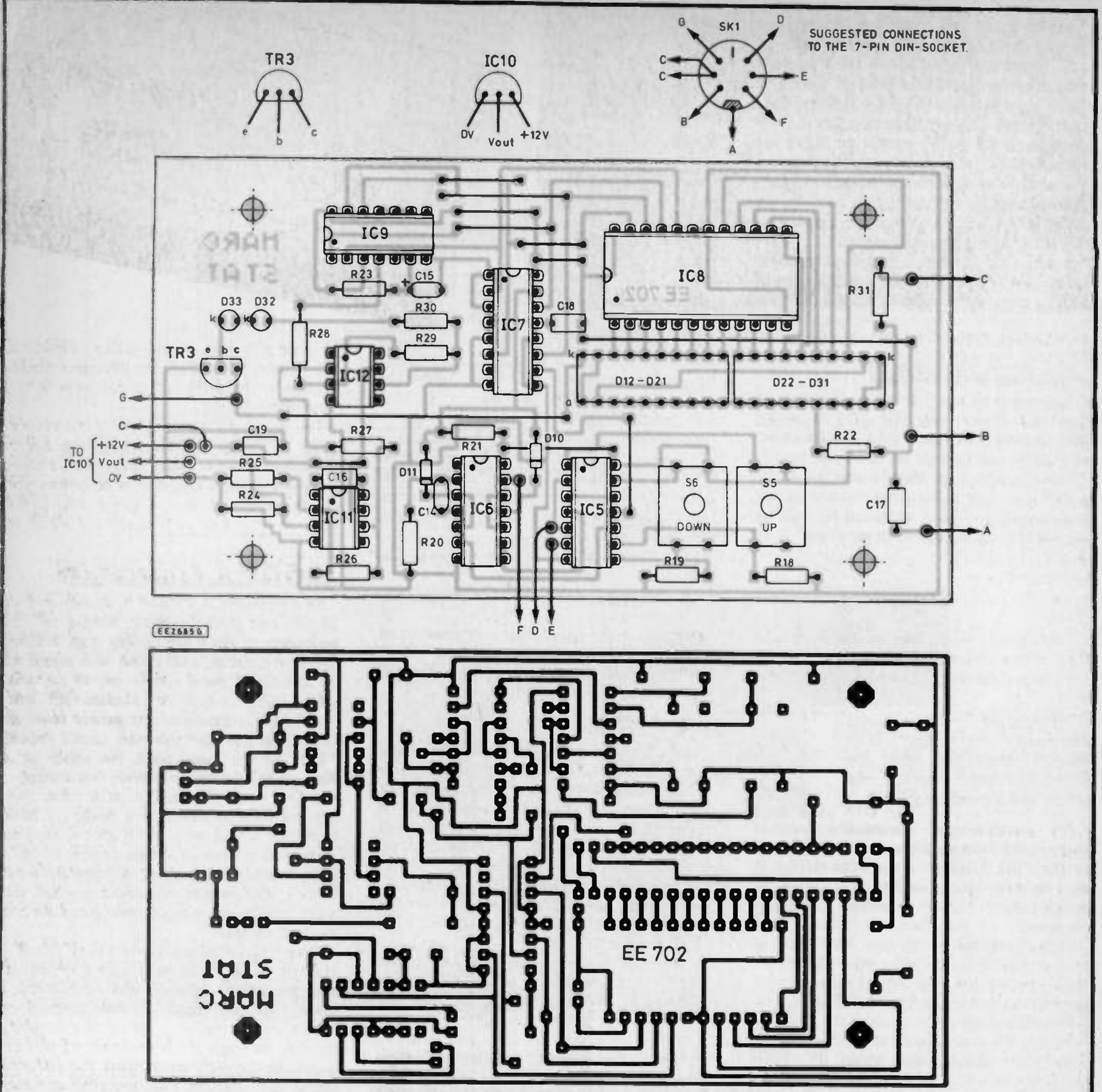



*Fig. 4.6. Control Panel printed circuit board component layout and full size copper foil master patern. Note the insulated link wire running under diode D10.*

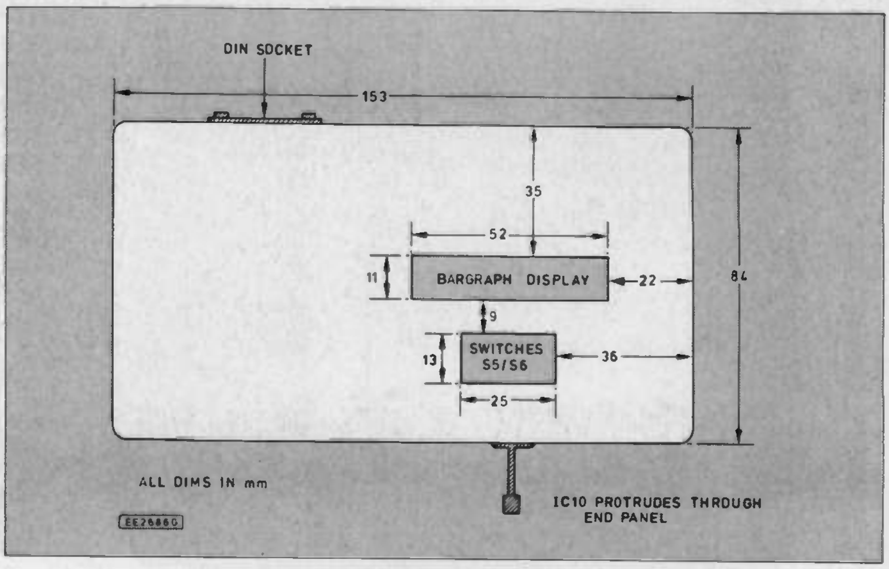
## CONTROL BOARD

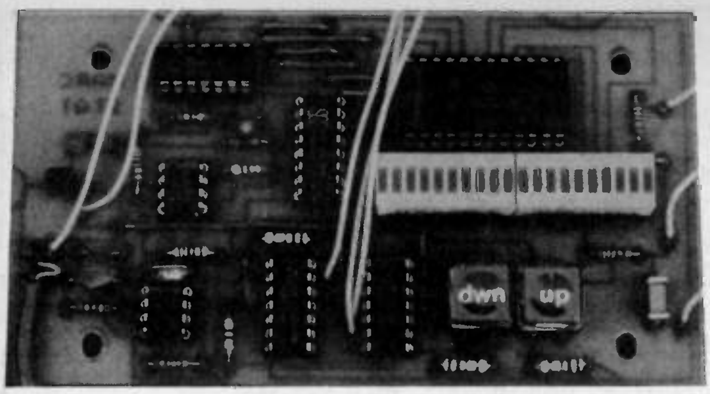
Due to the large number of i.c's on the Control Board, and the need to construct a reasonably compact unit for wall mounting, this section of the thermostat is constructed on a printed circuit board (p.c.b.). The component layout and full size copper foil pattern is shown in Fig. 4.6.

Construction is straightforward but a few points are worth a mention. Firstly, the bargraph l.e.d's and UP/DOWN switches are mounted directly on the board and are designed to protrude through the front panel of the case when the board is in position. The recommended case is a clip-together plastic Verobox type 202-21040F measuring 153mm × 84mm × 40mm.

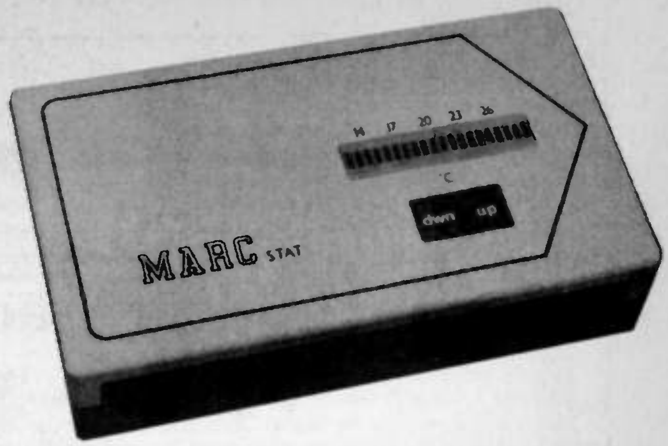
The front panel is cut out as detailed in Fig. 4.7. A hole should be drilled in the bottom aluminium panel and fitted with a grommet through which the temperature sensor IC10 protrudes. A 7-pin DIN socket for connection to the screened cable is mounted in the top aluminium panel.

*Fig. 4.7. Cutout and drilling details for the Control unit case.*






*Completed printed circuit board showing the two bargraph displays and keyswitches.*




The circuit board is screwed to the anchor points on the inside of the front panel so that the display and switches protrude through the cut-outs. The rear half of the case is screwed to the wall.

If the components stand too high off the p.c.b. they will prevent the circuit board from sitting properly in the case. For this reason it is necessary to use "turned pin" d.i.l. sockets for IC5 to IC12 which have a lower profile than standard sockets. Also fit two 20-pin d.i.l. sockets for the bargraph display.

Insert the 11 wire links on the p.c.b. and then solder in the remaining components. Notice that diode D10 straddles one of the wire links.

Eight flying leads connect to the DIN socket SK1 as shown (there are two connections to point *C*) and a mating DIN plug PL1 needs to be fastened on the end of the screened cable from the Decoder and Power Supply unit. **The DIN plug must NOT be connected or disconnected form its socket whilst power is applied to the circuit or the CMOS chips on the Control Board may be damaged.** Isolate the unit from the mains before making or breaking any connections.

Three 15cm wires connect the temperature sensor IC10 to the circuit board; the sensor then protrudes about 2cm out of the case enabling it to sample the air temperature reliably.

Pushbuttons S5 and S6 are the same type of keyswitches as those used in the infra-red transmitter, type KHC10901 obtainable from Cirkit. The removable tops can be labelled with rub-down lettering.

Take care when inserting the bargraph displays (D12-D21, D22-D31) into their sockets as the leads bend easily. The anode (a) connections down one side of the array are identified by a small chamfer on the adjacent corner.

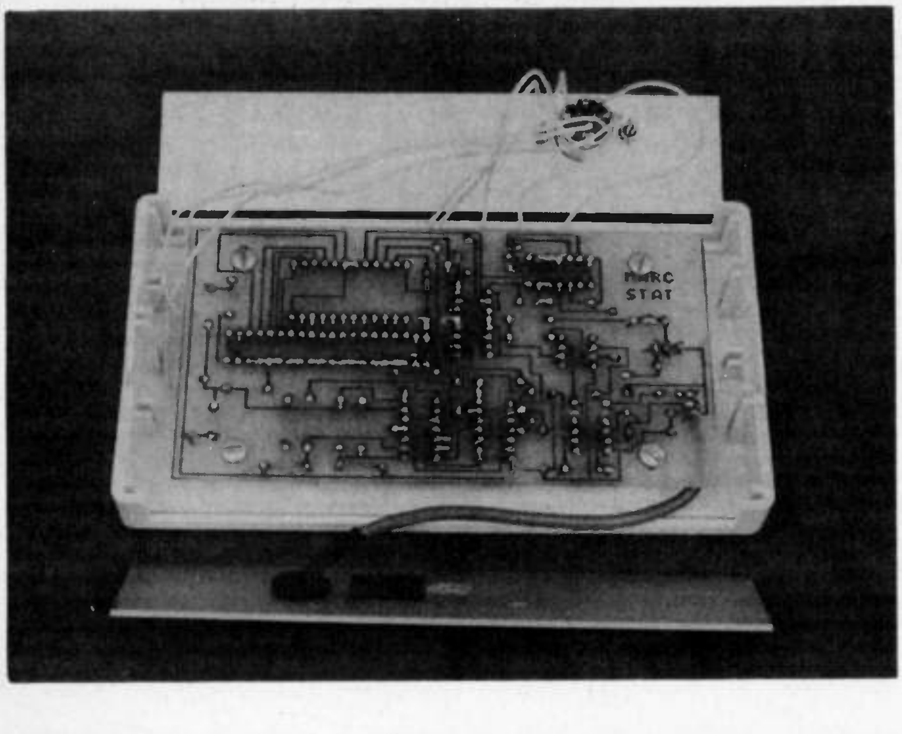
The temperature display may be calibrated theoretically from the previous technical data; minimum temperature is 14°C and this rises linearly over 15 divisions to the maximum temperature of 27°C. Alternatively a standard thermometer can be used if a high level of accuracy is required.

## IN USE

The Digital Room Thermostat has been found to be exceptionally good at maintaining a constant room temperature. In comparison, the "bi-metal" version that it replaced was very sluggish to respond and frequently one had to manually switch it on or off if the room became too cold or too hot. As with all thermostats, position the control unit away from draughts and at about shoulder height in the room to be monitored.

A novel trick is possible with the *MARC* thermostat that cannot be achieved conventionally. When the winter months arrive and one leaves the central heating system on overnight the thermostat has to be turned down otherwise the occupants become too hot whilst asleep. However, this lower nocturnal temperature makes the house very cold for the early-risers next morning.

The solution? Connect your microcomputer to the MARC Encoder and program it to increase the thermostat temperature by a few degrees an hour or so before you get up. Why not also program it to sound your reveille and switch on the lights as well? I have!



## CONCLUSIONS

As a teenager, I remember spending a lot of time and pocket money "wiring up" my bedroom so that the ceiling and bedside lights, television, radio and hi-fi could all be controlled (in a simple on/off fashion) whilst lying in bed. A "Master Off" button instantly disconnected power from all the appliances and this was useful should "The Parents" approach the room at a time when I should have been fast asleep!

A few years on, and with a more formal training in electronics design, I have been able to do away with all the trailing wires and introduce a high degree of flexibility into remote control by integrating the MARC system into my home. – Also, the point of relaxation has moved from the bed to the armchair!

Many of the house lights are on MARC control along with the room thermostat, and the outside light. Whilst on holiday, I allow the BBC micro to take control of the lights and radio to simulate occupants moving through the house but we still require the neighbour to draw the curtains every day. Electrically operated curtains are the top of my design list!

Rather a large amount of research was carried out on a prototype "Power Controlling Decoder Unit" for the *MARC System*, i.e. one that would allow, for example, lights to be dimmed by remote control. Such a circuit, however, would almost certainly require triac "wave-chopping" and it was found that the mains borne interference generated by such a technique prevented carrier signals from reaching the Decoder Units.

A dimmer unit was constructed, but even with extensive filtering and interference suppression it was found that only *very light* loads could be controlled without causing jamming. A 40W lamp worked successfully but, in my opinion, such a light hardly requires dimming anyway!

If you have some experience in electronics then please experiment with the *MARC System* and customise decoder units to perform the functions you require. Obviously, *beware of the dangers involved with direct connection to the mains* and take great care but I would be very interested to hear from readers who have found a new and exciting application for this project. □

# . . Morse . . . Morse Practice Program . . . Morse . . .

IN SOME previous *Beeb Micro* articles we looked at ways in which the BBC computers could be used for Morse Code and RTTY reception. There are other ways in which computers can be used as aids for those interested in radio communications.

Communications applications include computerised log books, distance calculators, and Morse code training. Some software of this type is available for the BBC model B etc., and a great deal of public domain shareware communications software is available for the IBM PCs (and should run all right on the Master 512). Much software of this type does not need to be particularly complex, as the accompanying program, Listing. 1, demonstrates.

## Dotty Program

This program is designed to give practice in understanding Morse code by generating sequences of random characters. The random method prevents "cheating" by guessing what will come next when a common word-pattern becomes apparent.

As a point of interest, Morse tests are usually based on random characters rather than proper text, for exactly the same reason. The program generates sequences of 40 "words" of up to nine characters length, and then prints them on the screen so that you can check your results.

Not surprisingly, the program is a set of nested loops. The innermost, lines 240 to 280, generates the groups of characters, the loop between lines 230 and 320 is responsible for the 40 word limit, and the outermost loop, between lines 200 and 350, repeats for as many screensful as you care to endure!

The Morse code is contained in data statements in lines 380 to 530. Each character is followed by the number of Morse "digits" (i.e. dots and dashes) comprising the character, followed by 2's for dots and 6's for dashes, giving these the correct ratio.

As each character is generated by line 700, the data for it is copied into a temporary array. The dot and dash timings are then used by the speaker control procedure as the time values in a SOUND statement.

The BBC SOUND statement only allows control of sounds in intervals of 1/20 of a second. This does not allow a great deal of scope for speed control, but in this program, two speeds are provided. The slow speed is indeed slow, and should be good for beginners. The faster speed is perhaps not as fast as it could be, but does provide a useful step up.

The literal form of each character is added to a string variable (line 270 and 920-940), and at the end of each group, the "word" is stored in an array (line 290 and 960-990). At the end of each set of

## Listing. 1: Morse Practice Program

```
10 REM Morse Practice Program
20 REM for E.E. 6/90
30
40 REM Global Variables
50 Screenful = 40
60 Pitch = 200
70 MaxWordLength = 9
80 DIM TheChar(6)
90 TheChar$=""
100
110 REM Main Program
120 MODE 7
130 PROCTheScreen_Say_Program
140 PROCTheCode_Init
150 PROCTheScreen_Init
160 PROCTheSpeaker_Get_Volume
170 PROCTheSpeaker_Get_Speed
180 PROCTheScreen_Say_Press
190 PROCTheCode_Fill_Buffer
200 REPEAT
210   REPEAT UNTIL GET
220   PROCTheScreen_New
230   FOR count = 1 TO Screenful
240     FOR char_count = 1 TO RND(MaxWordLength)
250       PROCTheCode_Get_Char
260       PROCTheSpeaker_Sound_Char
270       PROCTheScreen_Store_Char
280       NEXT char_count
290     PROCTheScreen_Store_Word
300     PROCTheSpeaker_Word_Pause
310     PROCTheScreen_Reset
320   NEXT count
330   PROCTheScreen_Show_Buffer
340   PROCTheScreen_Say_Press
350 UNTIL FALSE
360
370 REM TheCode Methods
380 DATA A,2,2,6,B,4,6,2,2,2,C,4,6,2,6,2
390 DATA D,3,6,2,2,E,1,2,F,4,2,2,6,2
400 DATA G,3,6,6,2,H,4,2,2,2,2,I,2,2,2
410 DATA J,4,2,6,6,6,K,3,6,2,6,L,4,2,6,2,2
420 DATA M,2,6,6,N,2,6,2,O,3,6,6,6
430 DATA P,4,2,6,6,2,Q,4,6,6,2,6,R,3,2,6,2
440 DATA S,3,2,2,2,T,1,6,U,3,2,2,6
450 DATA V,4,2,2,2,6,W,3,2,6,6,X,4,6,2,2,6
460 DATA Y,4,6,2,2,6,Z,4,6,6,2,2
470 DATA 1,5,2,6,6,6,6,2,5,2,2,6,6,6
480 DATA 3,5,2,2,2,6,6,4,5,2,2,2,2,6
490 DATA 5,5,2,2,2,2,2,6,5,6,2,2,2,2
500 DATA 7,5,6,6,2,2,2,8,5,6,6,6,2,2
510 DATA 9,5,6,6,6,6,2,0,5,6,6,6,6,6
520 DATA ".",6,2,6,2,6,2,6
```

```
530 DATA ",",6,6,6,2,2,6,6
540 DEF PROCTheCode_Init
550 DIM TheCode_Buffer(38,6)
560 DIM TheCode_Char$(38)
570 ENDPROC
580
590 DEF PROCTheCode_Fill_Buffer
600 FOR ccount = 1 TO 38
610   READ TheCode_Char$(ccount)
620   READ TheCode_Buffer(ccount,0)
630   FOR dcount= 1 TO TheCode_Buffer(ccount,0)
640     READ TheCode_Buffer(ccount,dcount)
650   NEXT dcount
660 NEXT ccount
670 ENDPROC
680
690 DEF PROCTheCode_Get_Char
700 char=RND(38)
710 TheChar(0)=TheCode_Buffer(char,0)
720 FOR dcount=1 TO TheChar(0)
730   TheChar(dcount)=TheCode_Buffer(char,dcount) DIV speed%
740 NEXT dcount
750 TheChar$=TheCode_Char$(char)
760 ENDPROC
770
780 REM Screen Methods
790 DEF PROCTheScreen_Init
800 DIM TheScreen_Buffer$(Screenful)
810 TheScreen_Char$=""
820 ENDPROC
830
840 DEF PROCTheScreen_Say_Program
850 CLS
860 PRINTTAB(9,5);"Morse Practice Program"
870 ENDPROC
880
890 DEF PROCTheScreen_Reset
900 TheScreen_Char$ = ""
910 ENDPROC
920 DEF PROCTheScreen_Store_Char
930 TheScreen_Char$=TheScreen_Char$+TheChar$
940 ENDPROC
950
960 DEF PROCTheScreen_Store_Word
970 TheScreen_WordCount=TheScreen_WordCount+1
980 TheScreen_Buffer$(TheScreen_WordCount)=TheScreen_Char$
990 ENDPROC
1000
1010 DEF PROCTheScreen_Show_Buffer
1020 CLS
1030 word = 1
1040 FOR row = 2 TO 20 STEP 2
```

40 words, the contents of this array is printed on the screen in 10 rows of 4 columns (line 330 and 1010-1100).

The pitch setting of 200 gives the sort of sound frequency at which Morse is usually heard. However, this may prove a bit wearing for long practice sessions, in which case it is easy enough to set the pitch to a lower value in line 60.

Three volume settings may be selected when the program is started. The lowest should be adequate for individual practice. The higher volumes are provided for group practice, perhaps in a classroom.

Those interested in programming methods may observe that there is some attempt here to apply object-oriented methods to BBC BASIC. The program is based around a *screen* object, a *code* object, and a *speaker* object, each of which has its own methods and, with the exception of the speaker, its own private data.

"Messages" are passed between the objects using the global variables, so that they do not directly access each other's private data. The intention of this is that it prevents such data being unintentionally modified.

The main complaint about the object-oriented method is that it results in long, slow programs. It has to be admitted that this program could be rewritten in shorter form. However, speed is not a problem here. On the other hand, I did write this program in a much shorter time than I anticipated, and it gave many fewer problems in testing and debugging than I would normally expect in a 155 line BASIC job.

## Practice Oscillator

One advantage of computer based Morse code training is that it can provide Morse that has perfect timing, or something very close to it. If you learn Morse code by listening to code generated with a high degree of precision, it is likely that you will produce good quality code when you learn to send Morse.

Current thinking is that you should learn to receive Morse first, and then learn to send it once you have become competent at decoding it. I would endorse this view, as I learnt to send morse first, and subsequently found learning to decode Morse very difficult.

Although you might think that having learned to code one way you would in the process have also learned to handle it in the other direction as well, it does not necessarily work this way. Having learned to send Morse proficiently, when you receive a set of dots and dashes for a Morse character, you tend to run through the alphabet trying to find the letter that matches it. By the time you have worked out the first character you have probably missed the next four or five!

Apparently there is a similar problem whereby some people learn to speak a language via lessons on the radio (or some similar means), and may well speak the language very well. Upon going to the country in question they then discovered that they cannot understand a word that is being said. Anyway, learning Morse code is a two stage process, and it is probably best to start with the receiving side of things.

When you do start learning to send Morse code, the BBC computer can easily be made to function as a practice oscillator. This simple four line program is all that is needed.

```
10 X = ADVAL(0) AND 1
20 IF X = 1 THEN SOUND
        &12,-12,100,10
30 IF X = 0 THEN SOUND
        &12,0,100,10
40 GOTO 10
```

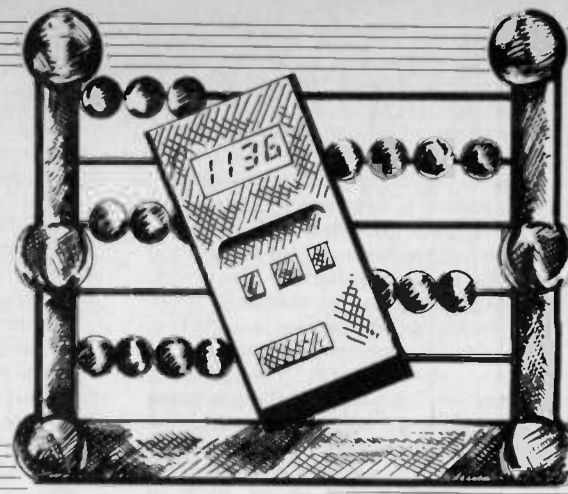
The Morse key should be connected to the Analogue Port in place of the left fire button (i.e. from pin 13 to a 0V or analogue ground pin, such as pin 2 or pin 3). The ADVAL(0) function is used to read the firebuttons, with an AND function being used to mask off all but the required bit from the answer. This is 0 when the key is up, or 1 when it is down. One SOUND instruction starts each "beep" of tone when the key is pressed, while a second one ends each "beep" when the key is released.

The program makes use of the computer's ability to have one SOUND instruction override any previous ones on the same channel. This is achieved using &12 as the channel parameter. The "beeps" of tone therefore switch on and off almost immediately in response to operations of the Morse keys, with no noticeable delays.

```
1050    FOR col = 0 TO 30 STEP 10
1060      PRINTTAB(col,row);TheScreen_Buffer$(word);
1070      word = word + 1
1080    NEXT col
1090 NEXT row
1100 ENDPROC
1110
1120 DEF PROCTheScreen_Say_Press
1130 PRINTTAB(0,24);"Press any key to practice...";
1140 ENDPROC
1150
1160 DEF PROCTheScreen_New
1170 TheScreen_WordCount = 0
1180 ENDPROC
1190
1200 REM Speaker Methods
1210 DEF PROCTheSpeaker_Sound_Char
1220 FOR digit = 1 TO TheChar(0)
1230   SOUND 1,vol,200,TheChar(digit)
1240   SOUND 1,0,200,2 DIV speed%
1250 NEXT digit
1260 SOUND 1,0,200,4 DIV speed%
1270 ENDPROC
1280
1290 DEF PROCTheSpeaker_Word_Pause
1300 SOUND 1,0,200,8 DIV speed%
1310 ENDPROC
1320
1330 DEF PROCTheSpeaker_Get_Volume
1340 PRINTTAB(5,11);"Please select volume"
1350 PRINTTAB(5,12);"(1-quiet,2-normal,3-loud) ";
1360 REPEAT
1370  choice$=GET$
1380  choice%=VAL(choice$)
1390 UNTIL (choice% > 0) AND (choice% < 4)
1400 IF choice% = 1 THEN vol = -8 :PRINT "Quiet"
1410 IF choice% = 2 THEN vol = -11:PRINT "Normal"
1420 IF choice% = 3 THEN vol = -15:PRINT "Loud"
1430 ENDPROC
1440
1450 DEF PROCTheSpeaker_Get_Speed
1460 PRINTTAB(5,14);"Please select speed"
1470 PRINTTAB(5,15);"(1-slow,2-fast) ";
1480 REPEAT
1490   choice$=GET$
1500   choice%=VAL(choice$)
1510 UNTIL (choice% = 1) OR (choice% = 2)
1520 IF choice%=1 PRINT "Slow"
1530 IF choice%=2 PRINT "Fast"
1540 speed% = choice%
1550 ENDPROC
```

Constructional Project

# ELECTRONIC HAND TALLY




## CHRIS BOWES

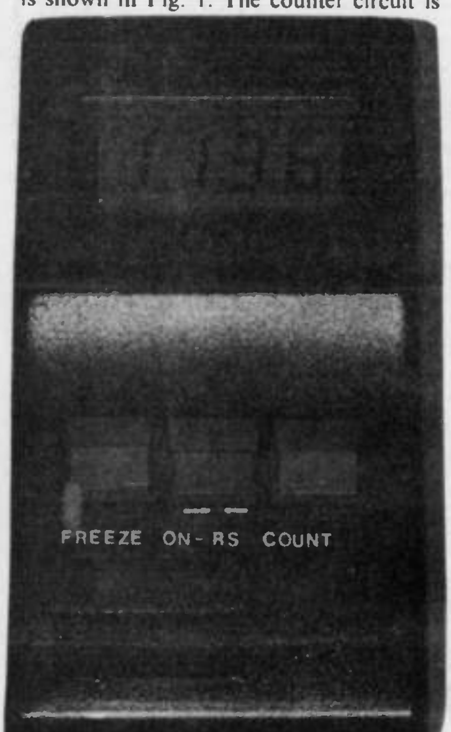

*Logging vehicles at black spots, counting migrating birds and people entering a public event are just some applications for this hand-held unit.*

THE DEVICE described in this article was originally developed as an aid to counting the number of words in a piece of text. There are, however, countless other occasions when it is necessary to count a large number of items, for example – people entering a room, bacteria on a culture plate, cars travelling past a given point, the number of nuts in a box and so on. On occasions such as these, a hand tally such as that described in this article will be found to be very useful.

This project is battery operated and uses a liquid crystal display in order to optimise power consumption. The project is designed to fit into a small calculator case in order to make it easy to carry and operate even in "the field". A "Freeze Display" switch has been incorporated so that readings can be taken whilst data is still being put into the memory.

## CIRCUIT DESCRIPTION

The circuit diagram for the Hand Tally is shown in Fig. 1. The counter circuit is advanced by a series of pulses which are obtained from the operation of switch S2 through an "anti bounce circuit" which is made up of S2, resistors R1, R2 and IC1a and IC1b.





Because of the high speed operation of logic circuits it is necessary to incorporate such a circuit since the counter would otherwise count the number of times that the switch contacts "bounce" as they close. With the circuit configured as shown the output from IC1a is forced to the logic "1" state when switch S2 is operated and remains in this state until S2 is released, at which point the output of IC1a returns to the logic "0" state.

The pulses from the input circuit are fed to a four-stage counter circuit which is made up of IC2 and IC4. These are both 4518 dual BCD counters.

The output of IC1a is connected to the $CP_0$ input of IC2a whilst the $CP_1$ inputs of IC2a and the two halves of IC4 are connected to logic 0 (0 volts). In this configuration the counter circuit advances by one, for each operation of S2.

The $CP_0$ inputs of IC2b, IC4a and IC4b are connected to output $O_3$ of the previous counter in the chain. This provides a "carry" function in which the counter advances by one every time that the $O_3$ returns to the logic 0 state when the counter resets to zero, after reaching "nine". The four counters provided by IC2 and IC4 give the tally a capacity to count up to 9999.

## DISPLAY CIRCUIT

The output ($O_0$ to $O_3$) of both halves of IC2 and IC4 are fed to the inputs ($I_0$ to $I_3$) of IC3, IC5, IC6 and IC7. These are all 4543 latched decoder/drivers which decode the binary output from the counters into the correct form for the display to show the information as a decimal number on the seven segment l.c.d. X1.

The "Freeze" function is obtained by connecting the LD inputs of the driver i.c.s to the junction of resistor R4 and switch S3. As long as S3 is not operated R4 acts as a pull up resistor which keeps the LD inputs of the driver i.c.s at logic 1. This allows the display to show the decimal number corresponding to the binary number which is present at the inputs $I_0$ to $I_3$ of the driver i.c.s.

When S3 is operated the junction of R4 and S3 is pulled down by 0 volts (the logic "0" state). This latches the display/drivers and causes the display to show the number which was present at the outputs of the counters immediately before the state of the LD inputs was changed from logic 0 to logic 1.

The counters are, however, not affected and continue to count up at every operation of S2. As soon as S3 is released the LD inputs return to the logic 1 state and the drivers once more display the output corresponding to the binary number present in the counter.

The l.c.d. cannot be connected directly to logic outputs since a continuous flow of current through the display segments in

## COMPONENTS

See SHOP TALK Page

**Resistors**

| | | |
|---|---|---|
| R1-R4 | 10k (4 off) | |
| R5 | 8k2 | |
| R6 | 3k3 | |

All 0.6W 1% metal film

**Capacitors**

| | |
|---|---|
| C1 | 0µ1 tantalum 16V |
| C2, C3 | 2µ2 tantalum 16V (2 off) |

**Semiconductors**

| | |
|---|---|
| IC1 | 4011 quad 2-input NAND gate |
| IC2, IC4 | 4518 dual BCD Counter (2 off) |
| IC3, IC5 IC6, IC7 | 4543 decoder/driver/latch (4 off) |
| IC8 | 555 CMOS timer |
| X1 | 4-digit direct drive liquid crystal display |

**Miscellaneous**

| | |
|---|---|
| S1 | Latching p.c.b. keybord switch |
| S2, S3 | Non-latching p.c.b. keyboard switch |

Calculator style case; printed circuit boards available from the *EE PCB Service*, codes EE699 and EE700; battery holder, size AAA (2 off); two AAA size Alkaline batteries; socket strips for l.e.d. display (20 pins at 0.1in spacing) (2 off); multi-coloured connecting wire; solder, etc.

*Approx cost guidance only* **£30**

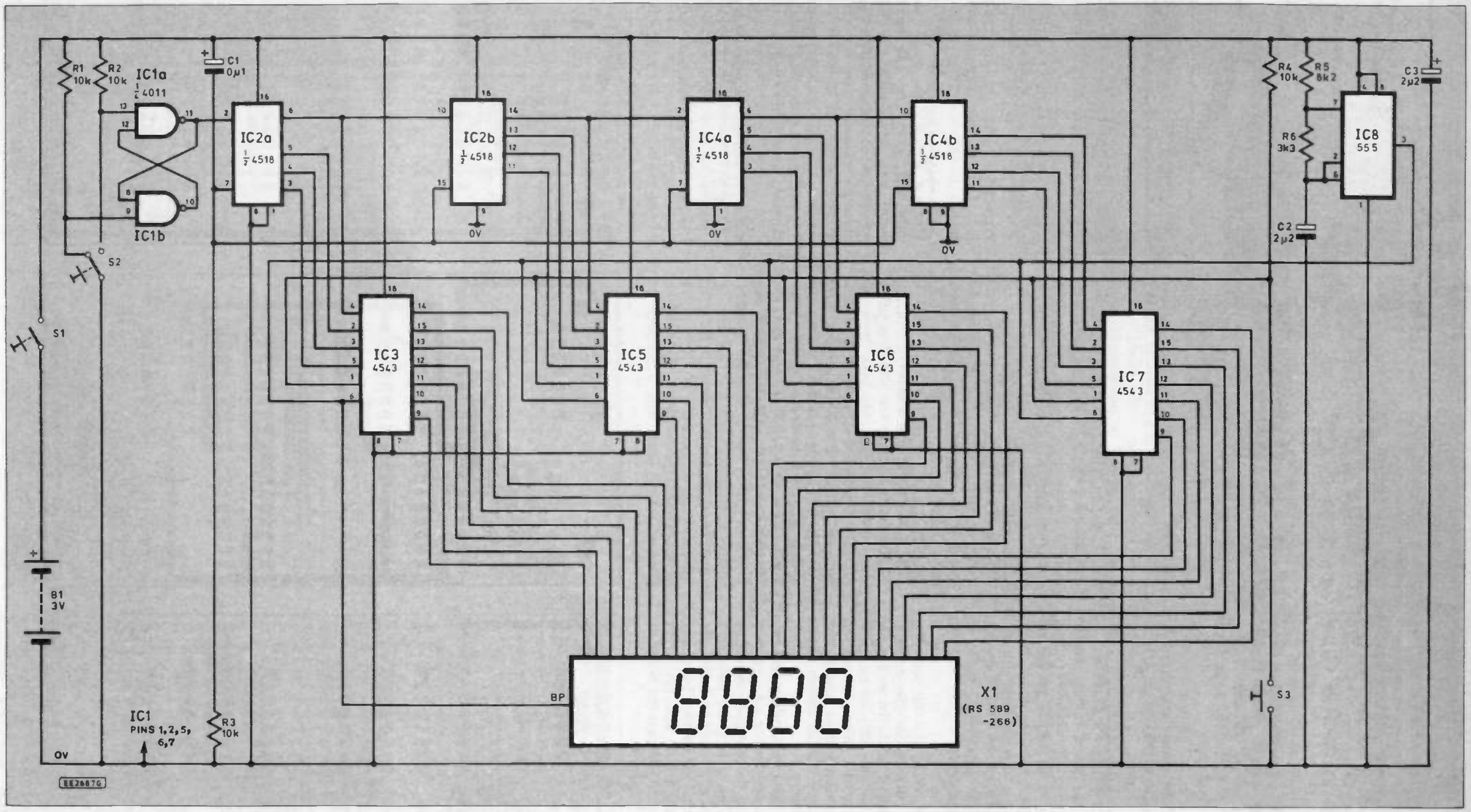



Fig. 1. Complete circuit diagram for the Electronic Hand Tally.

one direction causes irreparable damage. To overcome this problem, the display has to be driven in a slightly complex manner by applying a square wave both to the PH input of the display drivers and to the backplane (BP) connection of the display.

In the Hand Tally, the requisite square wave is obtained from IC8, which is a 555 CMOS timer connected in the astable mode. The shape and frequency of the output waveform obtained at the output (pin 3) of IC8 is governed by resistors R5, R6, and capacitor C2, whose values have been chosen to provide an output square wave of approximately 37Hz, which is the display manufacturer's recommended optimum operating frequency.

Capacitor C3 is a 2µ2 tantalum which decouples the entire circuit and prevents false triggering being caused by the operation of the logic circuits.

## CONSTRUCTION

The circuit for the Hand Tally has been designed to fit into the calculator case specified. Because of the restrictions caused by the limited space available it has been necessary to use a double-sided printed circuit board (p.c.b.) for the Counter Board. A separate, single-sided p.c.b. is used to accommodate the display and the switches.

The component layout and full size copper foil master patterns for the double-sided Counter Board is shown in Fig. 2. The component layout and full size foil master pattern for the Display Board is shown in Fig. 3. Both these boards are available from the *EE PCB Service*, code EE699 and EE700.

As well as the holes required for mounting the components, both p.c.b.s require mounting holes in the positions shown in Figs. 2 and 3. The main p.c.b. has three mounting holes which should be drilled out to be 4mm clear and the Display board has one 4mm mounting hole and two 6mm holes, which are used to locate the board in the case lid. The Display p.c.b. also has a 10mm clear hole in it's centre which is required to facilitate the passage of wires connecting the two boards together.

After the p.c.b.s have been drilled the components can be inserted into the correct holes and soldered into place. Although this process can be carried out in any convenient order, you will find that it is easier to perform this task if the components are inserted in ascending order of size.

All the components of a particular size should be soldered into position before going onto the larger size of components. Care should be taken to ensure that the polarity sensitive components, such as the capacitors and i.c.s are inserted in the correct orientation.

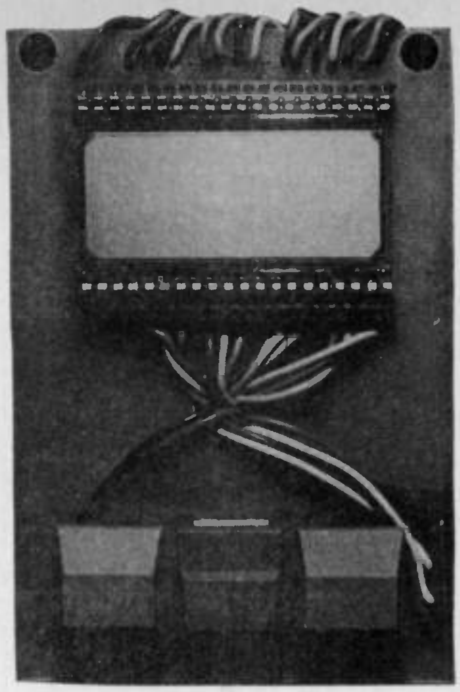
Because many of the i.c. pins on the Counter board are used to transfer connections from one side of the board to the other, they cannot be accommodated in sockets but must be soldered in place along with the other components. It is important that all connections on **both sides** of the p.c.b. are soldered carefully – care being taken to ensure that the i.c.s are not subjected to excessive heating.

**The l.c.d. must not be soldered** but is connected to the p.c.b. by means of the special socket strips specified in the components list.

## INTERWIRING

The boards are best not wired together until *all* the components have been insterted and soldered in position. The connections between the Display Board and the Counter Board are best made with flexible wires cut to approximately 15cm lengths.

In the case of the Display Board you should note that the wires to the switches, battery connections and the l.c.d display connections, on the row nearest to the three switches, are connected with their wires passed through the hole in the centre of the Display p.c.b. There are a number of



connections to be made and the use of as many coloured wires as possible will reduce the risk of confusion at this stage.

## BATTERY

The calculator case specified for this project is designed to take a PP3 battery but this type of battery is unsuitable for use with this project, since the 9V that it provides causes the display to change far too slowly. The 3V required by this project is supplied by two AAA sized alkaline batteries. These are accommodated by two single battery holders which are wired in series and glued, with polystyrene cement, into the battery compartment of the case.

The holders should be glued in place after first carefully removing any excess plastic moulding in the battery compartment, such as that provided to keep the PP3 battery

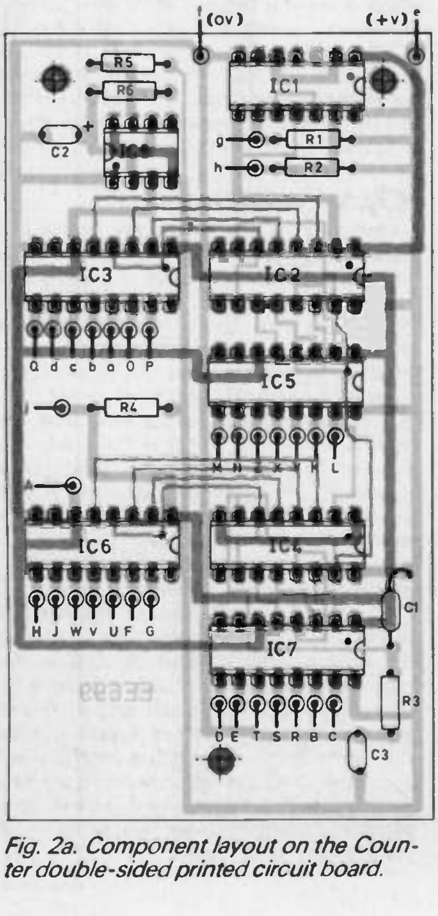



*Fig. 2a. Component layout on the Counter double-sided printed circuit board.*

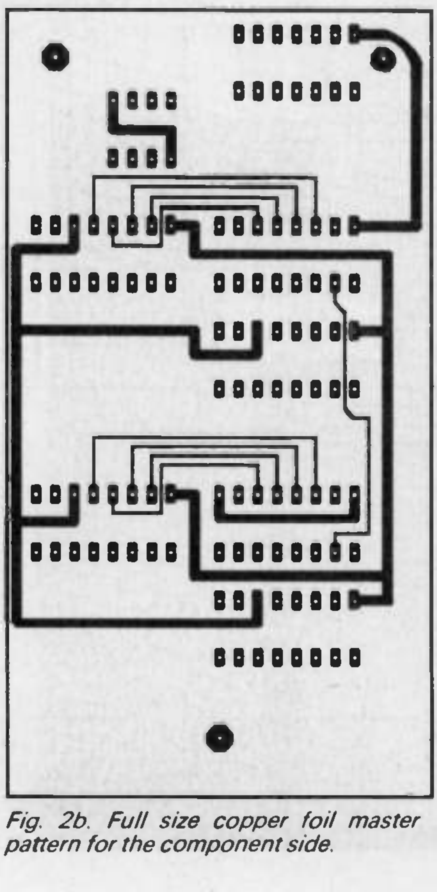


*Fig. 2b. Full size copper foil master pattern for the component side.*

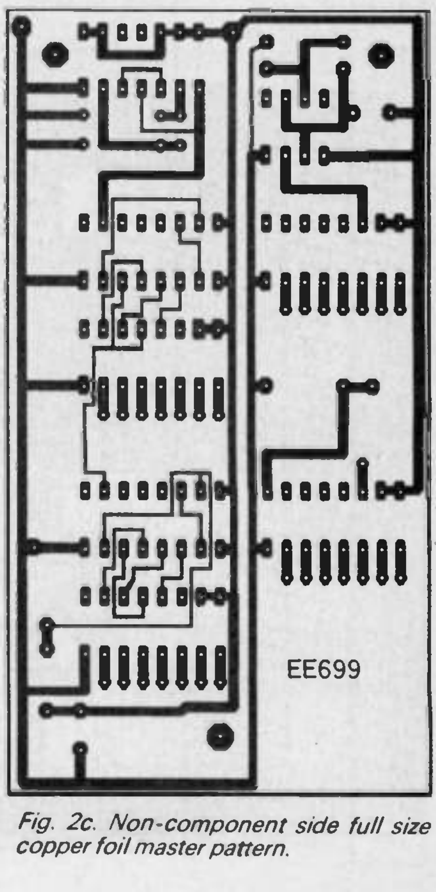



*Fig. 2c. Non-component side full size copper foil master pattern.*

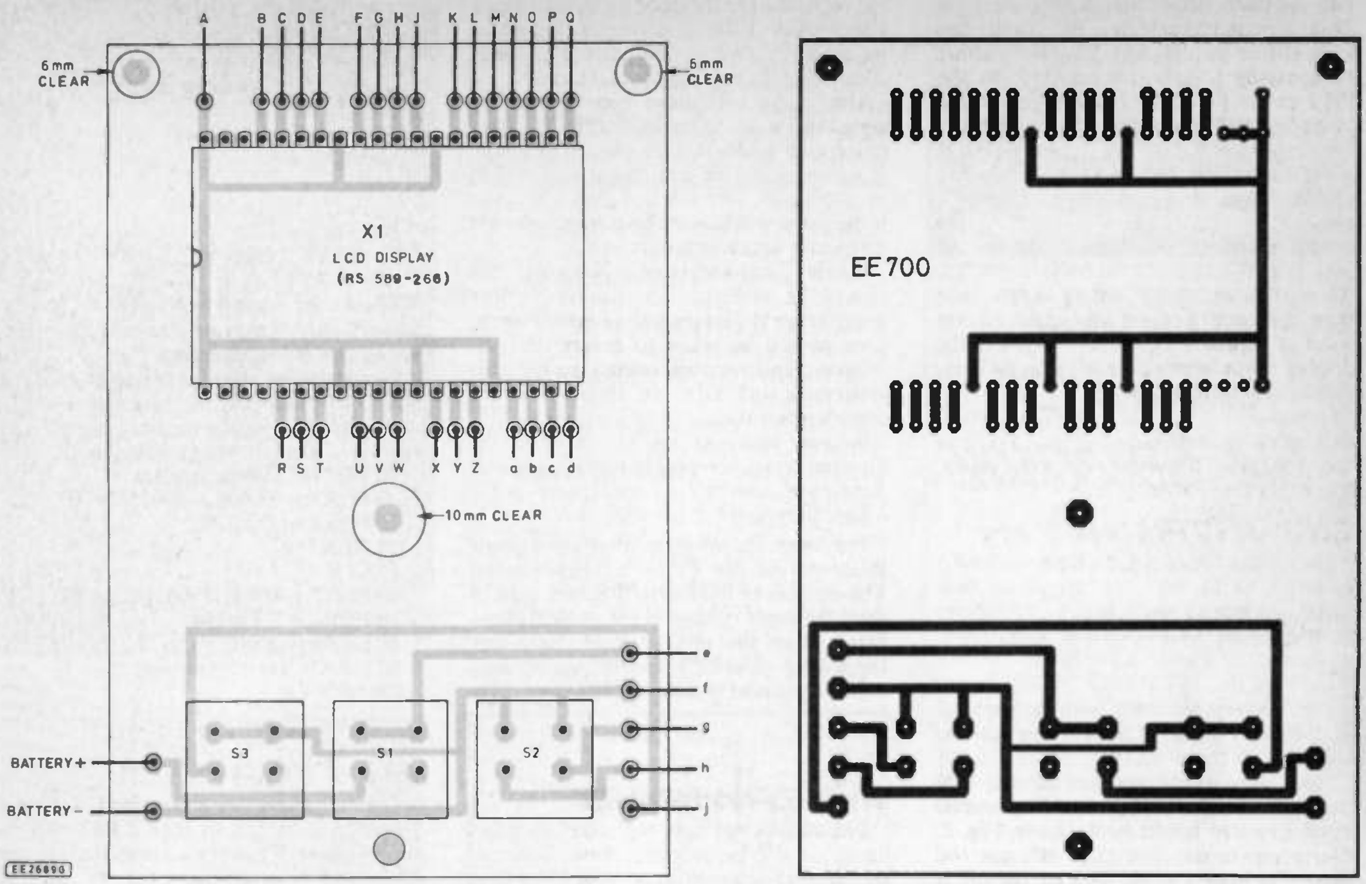



*Fig. 3. Display printed circuit board component layout and full-size copper foil master.*

in place. The connections between the two battery holders and the Display p.c.b. are made with flexible wire in the same way as the interboard connections.

## TESTING

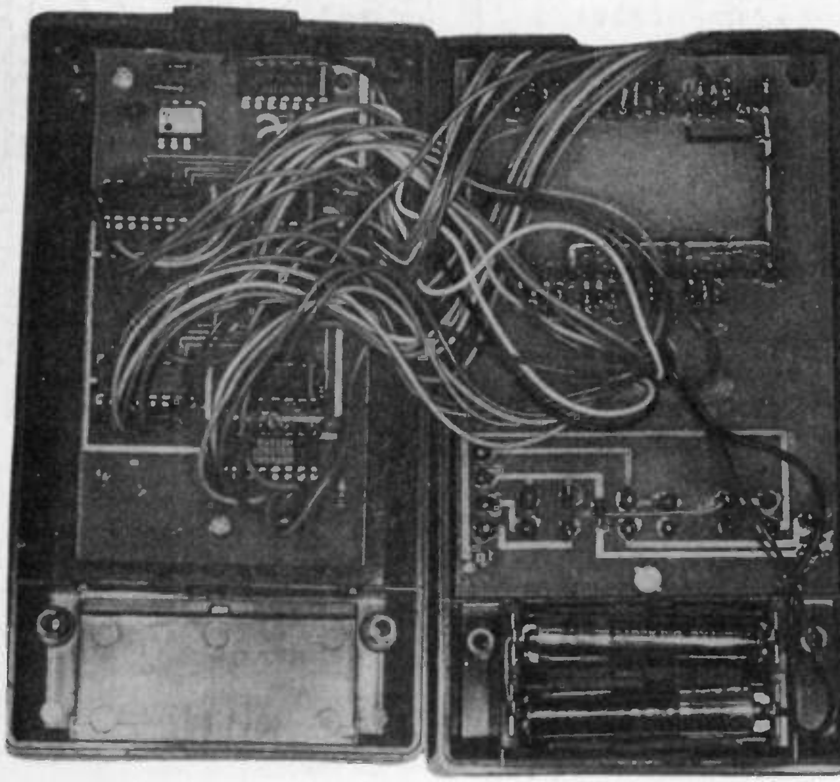
Once all the connections have been made, the board should be carefully checked for broken tracks, solder blobs and incorrectly placed components, before attempting to insert the battery and test the unit. The final task before testing the circuit is to carefully insert the l.c.d. display into it's sockets – ensuring that the backplane connection is closest to switch S3.

The circuit can now be tested by switching it on, by operating switch S1. At this point the display should be activated showing an output of 0000. The counter circuit is then tested by operating S2 several times and checking that the display counts up in the correct fashion.

The action of the "freeze" function is tested by operating S3 and at the same time putting in a number of pulses by means of S2. The count should remain at the last value, prior to the operation of switch S3, irrespective of the operation of S2, for as long as S3 is actuated. As soon as S3 is released the display should catch up and display the new cumulative count.

Finally the resetting action of capacitor C1 and resistor R3 can be tested by operating switch S1 twice. On the first operation of S1 the display should be deactivated and on the second operation the display should reappear – reset to 0000.

*The completed unit opened-out to show the "sandwich" arrangement of the two boards and the battery compartment.*



## Operation

Operation of the unit is very simple and follows the sequence detailed above in so far that the unit is switched off and on and reset by switch S1, the counter is advanced by one for each operation of S2 and that S3 freezes the display, whilst allowing the count to be advanced by operation of S2.

Once the circuit has been tested, the p.c.b.s are mounted in the case with the main Counter board being fitted into the base of the case by means of self-tapping screws which are screwed into the bushes provided in the case moulding. The front of the case will have to be cut out to accommodate the three switches before the Display p.c.b. can be fitted into it.

After cutting out the case front the board is fitted by placing the two 6mm holes over the sleeves in the case which contain the case fixing screws and securing the bottom of the p.c.b. with a self-tapping screw. The case is then screwed together, with the inter-board wiring being carefully accommodated in the space between the two p.c.b.s. The batteries can be fitted into their place by sliding open the battery cover lid incorporated in the case. □


*a regular feature for the Spectrum Owner...*

**by Mike Tooley BA**

LAST MONTH we dealt with testing and calibrating our 8-Channel Analogue to Digital Converter (ADC) for the SAM Coupé. This month we shall develop this theme a little further by providing several applications in which the 8-Channel ADC can be put to use. For good measure, we shall also take a close look at the latest version of ELECTRODRAW, BESofT's powerful Electronic CAD package for the Spectrum.

## ADC Applications

The 8-Channel ADC can be used in single or multi-channel d.c. voltage measuring applications with minimal external circuitry. In most cases, the only additional components required are fixed or variable pre-set resistors to appropriately scale the input voltage.

Current (rather than voltage) may be measured simply by sensing the voltage drop across a shunt resistor of appropriate value. In practice, the arrangement shown in Fig. 1 will prove satisfactory for currents in the range 1μA to 2.5A, depending upon the value of shunt resistor selected.

Resistance can be measured using the 8-Channel ADC in conjunction with a simple constant current source (see Fig. 2).

Figure 3 shows a practical constant current source (1mA) which will produce reasonably accurate indications over the range 0 to 2.5 kilohms with a resolution of 10 ohm.

The preset resistor, VR1, should be adjusted in conjunction with an accurate milliammeter (preferably a digital type) as shown in Fig. 3. If such a device is not available, an accurate 1k resistor (1 per cent tolerance) can be connected as the unknown resistor and VR1 adjusted for a reading of 1000 ohm using the following program:

```
10 PRINT "Resistance = "
20 PRINT AT 0,13;IN (120)*10
30 PRINT AT 0,18; "ohms"
40 PAUSE 10
50 PRINT AT 0,13; "  "
60 GO TO 20
```

The 8-Channel ADC can also be used as the basis of a single or multi-channel low-frequency oscilloscope. Since the input voltage may have a d.c. level imposed upon it, a capacitor should be incorporated in the ADC input together with a resistor to suitably bias the input voltage. Fig. 4 shows a typical arrangement which will prove adequate for input voltages of up to approximately 2V pk-pk.

The following program shows how the waveform applied to Channel 1 (I/O address 120 decimal) can be displayed:

```
10 CLS
20 PRINT "Press SPACE to start"
30 LET r$ = INKEY$
40 IF r$ < > " " THEN GO TO 30
50 CLS
60 PLOT 0, IN (120)/2.5 + 50
70 FOR x = 0 TO 255
80 DRAW TO x, IN (120)/2.5 + 50
90 NEXT x
100 PRINT "Press SPACE" to clear"
110 LET r$ = INKEY$
120 IF r$ < > " " THEN GO TO 110
130 CLS
140 GO TO 10
```

The foregoing program produces a single sweep across the TV or monitor screen. The divisors in lines 60 and 80 are used to scale the input voltage in the vertical direction and set the vertical offset. Note that the scaling value (2.5) and offset (50) may need adjustment in some applications.

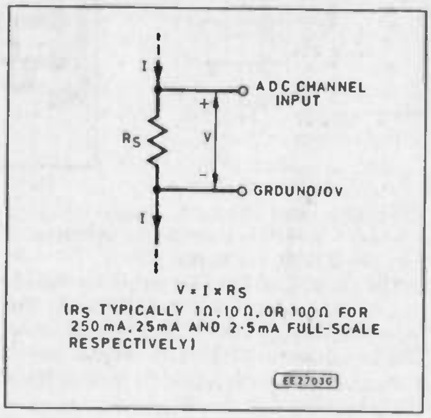



*Fig. 1. Current measurement*

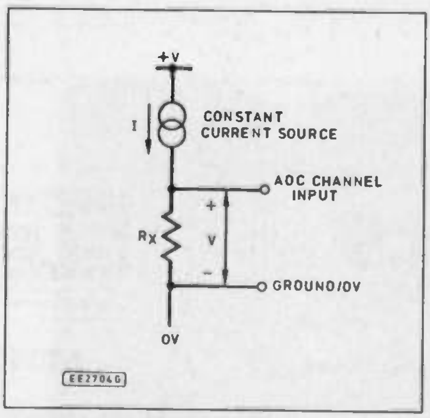



*Fig. 2. Using a constant current source for resistance measurement*

The SPACE key must be pressed to start the sweep. Once completed, the waveform sample is held on the screen until the SPACE key is, once again, pressed to clear the display. If the SPACE key is held down, the sweep is continuous and the screen is cleared at the start of each sweep.

In many occasions, it may be necessary to capture the oscilloscope data for further analysis. This can be done by transferring the input data from the ADC to an array. The data contained in the array can later be drawn on the screen to reconstitute the signal waveform or saved on disk or tape.

The following simple code shows how this can be achieved:

```
10 DIM v(256)
20 PRINT "Capturing data..."
30 FOR x = 1 TO 255
40 LET v(x) = IN (120)
50 NEXT x
60 CLS
70 PLOT 1,v(1)/2.5 + 50
80 FOR x = 2 TO 255
90 DRAW TO x,v(x)/2.5 + 50
100 NEXT x
```

Again, the scaling and offset values in lines 70 and 90 may need some adjustment for a particular application.

An alternative method of storing data is simply that of POKEing data into memory and then PEEKing the memory locations to recover it. The following routine shows how:

```
10 PRINT "Capturing data..."
20 FOR m = 50000 TO 50255
30 POKE m,IN (120)
40 NEXT m
50 CLS
60 PLOT 1,PEEK (50001)/2.5 + 50
70 FOR x = 1 TO 254
80 LET m = 50001 + x
90 DRAW TO x,PEEK (m)/2.5 + 50
100 NEXT x
```

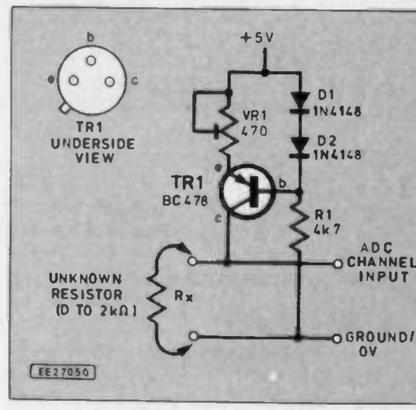



*Fig. 3. Practical 1mA constant current source*

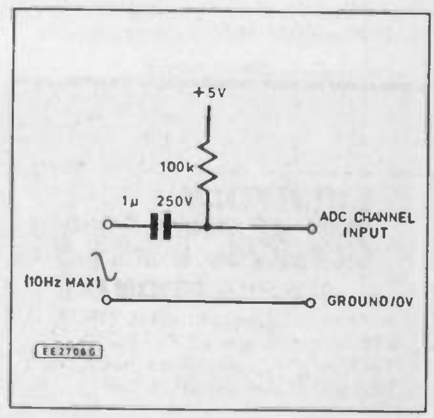



*Fig. 4. Input bias and coupling for the oscilloscope display*

In practice, all three of the foregoing oscilloscope routines are only suitable for relatively low-frequency signals. Machine code routines (based on the Z80's IN instruction) can, however, be used to overcome the speed limitations inherent in interpreted BASIC. By this means, a meaningful oscilloscope display can be achieved for frequencies up to several hundred Hertz.

## ELECTRODRAW Revisited

Eleven months ago, I reviewed ELECTRODRAW, BESofT's powerful

Electronic CAD package for the Spectrum. For those who were not around at the time, ELECTRODRAW is a versatile electronic drawing aid which allows users to draw, edit, store, and print electronic circuit diagrams.

The original program was available in either tape or microdrive versions but this latest version (Version 1.3) is supplied in one of the following formats:

* 5.25" Disciple/Plus-D disk
* 3.5" Disciple/Plus-D disk
* Microdrive cartridge
* Tape (with option to save to Microdrive)
* Tape (with option to save to Disciple/Plus-D disk)

ELECTRODRAW contains a number of features which make it extremely easy to use. The program has symbol, label, line and box drawing facilities and includes a magnifier which produces a four-times normal size image of the area around the cursor for precise alignment of symbols and conductors.

Symbol editing and creation can be carried out from within the main program and a "symbol merge" facility allows symbols from one diagram to be transferred to another. All microdrive functions (except MOVE ) are supported from within the main program.

The main changes to the program in Version 1.3 are as follows:

* Symbols or labels can be rotated either clockwise or anticlockwise.
* Line drawing now uses "rubber banding". The "d" key is pressed to start drawing and the cursor keys are used to move the cursor/end point. Once the required end point has been located, the "ENTER" key is used to fix the line.
* A new menu option allows the use of a joystick rather than the cursor keys. The fire button then replicates the "ENTER" key.
* A new rapid cursor move command is available (this reduces the time taken to move the cursor from one end of the paper to the other).
* The help display (previously at the bottom of the screen) has been replaced by a full-screen help display. Users may toggle from one screen to the other by means of the "EDIT" key.
* Screens may now be SAVEd in standard Spectrum SCREEN$ format. Screens stored in this way can subsequently be loaded into a graphics or DTP package for further work.
* Users are prompted to SAVE screens before printing.
* The keyboard click may be disabled when required.

(Note that the cursor speed is increased when the keyboard click has been disabled).

It is worth noting that all of these improvements to ELECTRODRAW have been achieved without significantly reducing the symbol memory area. The program now has many of the features that will be provided on the forthcoming 128K version.

ELECTRODRAW runs on any 48K or 128K Spectrum (including the Plus-2 in 48K mode) without any add-ons (but some facilities require a printer and some require a microdrive or disk drive). The following printer interface opions are supported: ZX or Alphacom-32, Centronics interface, and Sinclair Interface One RS-232 output. ELECTRODRAW is supplied with a 12-page A5 format manual. The manual is neatly presented and includes sections entitled "Getting Started", "The Main Menu Options", "The Drawing Process", "The Symbol Design Routine", "Tape/Microdrive Options", and "Handling Very Long Diagrams".

ELECTRODRAW contains a library of fifty electronic symbols which are immediately available whenever the program is loaded. These symbols (which can be mirrored and rotated) will be adequate for most drawings however definition of additional symbols is extremely straightforward.

As before, my overall impression of ELECTRODRAW is that it is a pleasure to use; most of the operations are quite intuitive, the cursor control is good, and the mirror and rotate facilities are excellent. This latest version of the software contains a number of improvements and is a real boon to the Disciple/Plus-D user since it provides for full access to disk storage facilities.

One small shortcoming is that it still does not support output to a plotter. This, however, is not likely to concern many users since the cost of a plotter is normally considered prohibitive to the "hobbyist". In any event, the quality of printed output is perfectly adequate for most applications.

## In Conclusion

This latest version of ELECTRODRAW offers several significant improvements over earlier versions, particularly for Disciple and Plus-D users for whom disk-based save and load operations represent a very significant enhancement over the tape-based program. It is still in a class of its own. It lacks several of the features found in more expensive CAD packages (such a scaling and multi-layer drawings) but is perfectly adequate for most purposes. At £20 the package represents exceptional value for money.

*ELECTRODRAW costs £20 (any format) including postage and packing. The cost to overseas customers is £21.00 (any format) including air mail postage and packing. BESofT are at 20, Ashville Road, Leytonstone, London, E11 4DT. Tel: 081-558-3469 (evenings only). Note that purchasers should specify the required format when ordering.*

**Next Month** is our last *On Spec*. To round the series off, we shall be dealing with a number of odds and ends, hints and tips, and queries sent in by readers as well as taking a look back over the past six years to identify some of the milestones in the development of the Spectrum and SAM computers.

In the meantime, if you have any comments or suggestions for inclusion in a possible future series, please don't hesitate to drop me a line at the address below: Mike Tooley, Faculty of Technology, Brooklands College, Heath Road, Weybridge, Surrey, KT13 8TT.

# SHOP TALK

**with David Barrington**

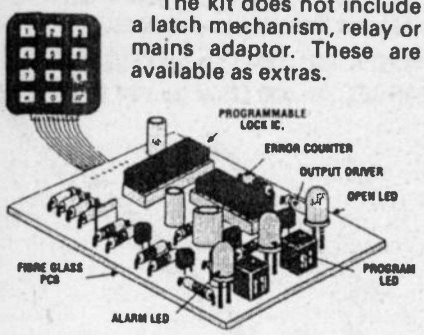
## Programmable Lock

If during the recent hot spell you kept leaving your keys in a change of clothes, or, as the evenings are now "drawing in", you want to be less friendly towards our local burglar, you might like to investigate the latest Programmable Digital Lock Kit from **TK Electronics** (☎ *081 567 8910*). Price £19.95 plus £1.15 post and packing.

One 4-digit sequence, "tapped out on the keypad", will operate the lock while incorrect entries will sound the alarm. The number of incorrect entries allowed, before the alarm triggers, is set by the owner.

The kit comes complete with comprehensive instructions, printed circuit board and all components including keyboard, piezo buzzer and special logic i.c.s and will interface with most 6V to 12V relays and solenoids. The lock can be powered from any 5V to 15V source, but a mains supply is recommended as the relay or solenoid is likely to draw a heavy current. On standby the lock draws only 200µA.

The kit does not include a latch mechanism, relay or mains adaptor. These are available as extras.




## Please Note

We would like to inform readers that **Advanced Electronic Products Ltd**, who advertised in our May, June and July 1990 issues have gone into liquidation. Any orders sent to them recently will be returned, readers should *not* send any further orders to them

## Alarm Bell Time-Out

The d.i.l. single-pole changeover relay specified in the components list for the *Alarm Bell Time-Out* project is an RS component and is available through their "mail order" outlet *Electromail* (☎ *0536 20455*), stock code 348 510.

There are several other, non d.i.l. package, relays on the market which should work in this circuit, but the p.c.b. design will need modifying or the relay will have to be mounted off-board and "hard-wired" to the circuit board. The rating of the relay contacts should be at least 1A or compatible with the master siren.

The 125µF electrolytic capacitor C1 seems to be in short supply and may prove difficult to locate. The alternative is to use the more standard 100µF 16V electrolytic capacitor and substitute R1 and R2 with 47 kilohm and 5.6 megohm resistors respectively.

The small printed circuit board is obtainable from the *EE PCB Service*, code 701.

## Hand Tally

The only item that is likely to prove difficult for constructors of the *Hand Tally* to obtain is the liquid crystal display. The four-digit direct drive display in the prototype model was purchased from **Electromail**, order code 589-266.

The display printed circuit board has been built around the l.c.d., so it can become quite a problem if a different one to that specified is used. It would almost certainly entail changes to the track layout or a lot of rerouting of the ribbon cable leads.

The calculator style case is not essential but most of our advertisers seem to stock this type of case. A similar one to that shown in the article is currently listed by **Maplin**, code YK24B (Calc-Style Box).

The p.c.b. pins for mounting the display chip on the board are the Soldercon type and should be generally available. The terminal pins usually come in strips of 100 and can be easily cut to produce an i.c. socket of any desired size.

The range of latching and non-latching p.c.b. mounting keyboard switches is fairly extensive and should not be a problem to obtain. However, because of the switch contact arrangement it is suggested that the RS (Electromail) 335-097 (S1) and 337-368 (S2 & S3) types used in the prototype model be used. The final choice is left to the individual but check that the switch terminals are identical or, at least, can be accommodated on the board *before* ordering.

Some readers may experience problems locating a suitable supply for the driver i.c.s. The latch decoder/driver i.c. type 4543 is currently listed by **Cricklewood** (☎ *081 452 0161*).

The double-sided Counter board and the single-sided Display board are both available from the *EE PCB Service*, codes EE699 and EE700 (see page 620).

## Metal Mate

The metal proximity detector i.c. (CS209) used in the *Metal Mate* is the only component that may cause concern regarding a source of purchase. The one used in the prototype model was obtained from **Maplin**, code UH59P (CS209).

The ferrite rod is fairly widely stocked and it should not be hard to find a supplier. It may be wise to purchase a piece longer than specified as it is very hard to cut and is very easily shattered, you may need two attempts before you are successful. The approach outlined for cutting the rod in the article is probably the best way and readers are advised to stick to this method.

## Valve Distortion Unit

The valve used in the *Valve Distortion Unit* can come in many guises and may be a little difficult to locate locally. Not many "radio shops" stock valves nowadays!

The valve may be quoted as one of the following: UK, ECC83, 6057; MoD no, CV4004; US/Japanese, 12AX7, 12AX7S. The EEC83 "double triode" is the most popular type stocked and is listed by **Marco, Cricklewood** and **Fraser Electronics**.

The valve and valveholder are being offered together by **Fraser** (☎ *0705 815584*) for the competitive price of £2, including VAT and p&p.

The mains "h.t." transformer used in the prototype model was obtained from RS components (code 196 072 – £17.11 and £2.50 carriage, plus VAT). We understand that a very similar transformer, with almost identical electrical characteristics, is being made available at a "special price" to EE readers by **Barrie Electronics** (☎ *081 551 8454*) of £15.44, £2.30 p&p plus VAT. Quote reference V1 when ordering.

## Mains Appliance Remote Control

The Toko matching transformer 707VXA0242UK used in the *MARC Encoder* and the *ON/OFF Decoder* (parts two and three) has been causing readers some supply problems. The reason for this has been that **Cirkit**, the Toko UK supplier has "industrial orders" for *all* their stocks and only a "few" spares for mail order customers.

Having spoken to Cirkit, they have agreed to put aside about 50 coils for mail orders until new stocks arrive. So if you were unlucky the first time, we suggest you re-order quickly. The matching transformer (code 37-70742) is also required for the *Digital Room Thermostat*, this month's project.

Once again we must reiterate the warning about using only Class-X capacitors where specified. The capacitors are designed to withstand *continuous* mains voltages and other types MUST NOT be used as replacements. These capacitors were purchased from **Maplin**, code JR33L (IS Cap 0.047µF).

The remote control decoder i.c. M145027 (Code UJ50E), the 8-bit Digital to Analogue Converter ZN426E chip (code UF39N) and the mains transient suppressor VDR1 (code HW13P Mains Trans Supp) were also obtained from the above company.

The high speed transient suppressors D7 and D8 may cause some confusion when ordering these parts. These are RS component devices and are available from their retail "mail order" outlet **Electromail** (☎ *0536 204555*).

However, in their Feb '90 catalogue they are listed as SA5 and SA12 devices but in their latest edition (July-Oct '90) they are designated ZP1006A and ZP1015A. Fortunately, the order code remains the same (239-488 and 239-494), but some suppliers may still know them by their old type numbers.

The miniature double-pole mains relay used in the prototype model was purchased form **Maplin**, code YX98G (5A Mains Relay). Other 12V relays can be used provided the contacts are rated at a minimum of 5A and a coil resistance of about 200 ohms. Some relays may not fit onto the board and will have to be mounted on one side, if you can find space, and "hard wired" to the p.c.b.

The printed circuit board for the wall-mounted Controller is available from the *EE PCB Service*, code EE702 (see page 620).

We hope to have some good news for constructors of the *MARC* system in the near future. We have put Chris Walker, the designer, in touch with a company to develop a unit which will allow users to "phone in" instructions to MARC i.e. switch on the lights, electric blanket, central heating and so on. – Ideal if you are going to be late home from a party.

An approved interface for 'phone connection will be available if we are successful with this project. We will keep you informed as work progresses and will announce the publication date when we can.

# HIGH GRADE COMPONENT PARCELS

## EVERYTHING MUST GO!

Unless otherwise stated, all the clearance parcels we offer contain brand new, top grade components. If some of the offers look too good to be true, all I can say is that the optimists will get some stunning bargains, the cynics will never know what they've missed, so everybody will be happy! All offers apply only while current stocks last – watch out for next month's parcels or, better still, be the first to hear about any new offers by putting your name on our mailing list. (Please write in, or 'phone Pete Leah on 0272 522703 after 6.30 pm).

### UNIVERSAL EVERYTHING PARCEL

This one contains some of just about any component you care to name! There are passives (resistors, capacitors, tants, presets), opto devices (couplers, LEDs of all shapes and sizes, infra-red components, 7-segment displays), semiconductors (transistors, diodes, ICs, rectifiers), and all kinds of other odds and ends (relays, VDRs, neons, battery connectors, mixed components packs). A stunning range of components – enough to get a workshop or lab. started – at a ridiculously low price.

The components are of excellent quality, in packs originally intended to sell at £1 each. To make sure you get a good variety, the 20-pack parcel will have no more than two of any one pack, the 100 pack parcel will have at most five of any one pack. Packs supplied as they come – our choice.

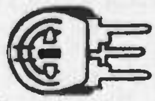
**PARCEL 1A: 20 PACKS for £10 + VAT**
**PARCEL 1B: 100 PACKS for £39! + VAT**

### MASSIVE CLEARANCE SALE

Once again, a general purpose parcel containing a huge variety of components: resistors, capacitors, ICs, transistors, electrolytics, tants, triacs, LEDs, diodes, thermistors, trimmers, VDRs, all sorts. All new, top quality components. This is mostly remainders from our own stock – stuff we forgot to advertise, or have in too small a quantity to sell individually. Guaranteed to be worth at least eight times the price if valued from any standard component catalogue! What more can I say?

**PARCEL 2A: 1000+ top grade components for £12! + VAT (Value £100+)**

**PARCEL 2B: 5000+ top grade components for £49! + VAT (Value £500+)**

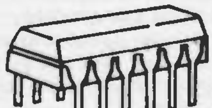


### INTEGRATED CIRCUITS

This parcel contains nothing but ICs. The mixture offers TTL and CMOS logic, interface ICs, linear, data converters, op-amps, special functions, and so on. Some of the ICs are pre-packed with data sheets, some (TTL, CMOS, op-amps) we expect you to identify for yourself, others will be covered by the free *data pack* provided, and the rest you'll have to identify under your own steam. If you know your ICs you'll be in for a few nice surprises.

**PARCEL 3A: 100 ICs for £12! + VAT**

**PARCEL 3B: 500 ICs for £49! + VAT**

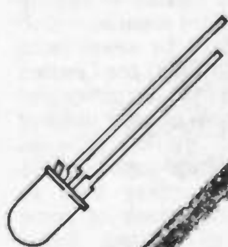


### LEDs

All shapes, sizes and colours of LEDs. Round ones in various sizes, rectangular ones, red, green, amber and yellow ones, clear and tinted lenses, all sorts.

**PARCEL 7A: 100 LEDs for £5.90 + VAT**

**PARCEL 7B: 500 LEDs for £24.90 + VAT**

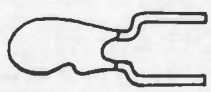


### TANTALUM CAPACITORS

A nice range of tants in values up to 47μF. Lots of useful caps, and we're not mean with the most expensive ones. A fine selection.

**PARCEL 4A: 100 TANTS for £6.80 + VAT**

**PARCEL 4B: 500 TANTS for £29! + VAT**

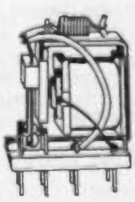


### RELAYS

All kinds of relays: plug-in, PCB mounting, low voltage (down to 3V coils), miniature, reeds, heavy duty contacts, signal contacts, you name it. A fantastic selection. You'll be back for more!

**PARCEL 16A: 50 RELAYS for £12 + VAT**

**PARCEL 16B: 200 RELAYS for £38 + VAT**



### CAPACITORS

An exciting selection of capacitors. There are ceramics for decoupling and general use, Polystyrenes for high performance circuits, dipped and moulded polyesters in values from a few nF up to 2.2μF (very expensive!), tants and aluminium electrolytics – just about any capacitor you'll ever need. Don't miss this one!

**PARCEL 8A: 1000 CAPACITORS for £6.50 + VAT**

**PARCEL 8B: 2500 CAPACITORS for £14.90 + VAT**

### TRANSISTORS

A mix of general purpose silicon transistors, mostly bipolar NPN and PNP, with a few FETs and unijunctions thrown in (when available) to spice the mixture. The contents vary from month to month – at the moment there are BC212s, BC213s, BC548s, BC238Bs, MTJ210s, and so on. Next month – who knows? All top quality components.

**PARCEL 6A: 200 TRANSISTORS for £7.80! + VAT**

**UK Orders:** Please add £2.50 towards postage and packing and 15% VAT to the total
**Europe and Eire:** Please add £6.00 carriage and insurance. No VAT
**Outside Europe:** Please add £12.00 carriage and insurance. No VAT

## HIGHGRADE COMPONENTS LTD

Unit 111, 8 Woburn Road, Eastville, Bristol BS5 6TT

# ...REPORTING AMATEUR RADIO...

**TONY SMITH G4FAI**

## REPEATER OPERATORS BANNED

In a previous column (October 1989) I mentioned the activities of a small section of disruptive operators using amateur radio repeaters. I wrote, "there is one area of activity within amateur radio where problems have existed for years and no-one seems to know how to deal with them".

The situation now seems to be changing and many users of repeaters throughout the UK have welcomed the recent publication of a letter in *Radio Communication*, journal of the RSGB, addressed to the president of the Society, from Mr M. V. Coolican, Head of Branch (Licensing) at the DTI. This letter stated that the DTI has varied the licences of three radio amateurs to preclude their use of the London repeaters. A fourth, whose licence has lapsed had been advised that any renewal will involve the same restriction.

The reasons for this decision are "that those concerned behaved irresponsibly in the use of radio by sending messages while pursuing a personal dispute which included offensive material, which was likely to be heard by other radio users, and by making use of the London repeaters for periods of time so prolonged as to disregard the rights of other users of amateur radio."

"The Secretary of State regards these matters as serious ... they tend to call into question the fitness of some licensees to hold an amateur Radio Licence ... if any licensee does not use amateur radio responsibly in future, their licence may be revoked, or varied to further incorporate restrictions on use ... I do not want any radio amateur licensees to be under the slightest illusion about our readiness to act vigorously and forcefully against the irresponsible minority who spoil the enjoyment of other licensees ..."

"... I am sure that the vast majority of amateurs view the activities of an irresponsible minority with deep distaste. I look to the RSGB to do all it can to encourage high operating standards and to discourage the type of behaviour that is bringing the hobby into disrepute. Self discipline has traditionally been one of amateur radio's outstanding features and we should like to see this approach maintained ..."

## CANADIAN CALL FOR KING HUSSEIN

The *Canadian Amateur Radio Magazine*, January 1990, reports that when King Hussein of Jordan, JY1, toured Alberta last year radio amateurs in the province organised a reception and amateur radio facilities for him. He was also formally allocated a Canadian callsign, VE6JY1, which later caused confusion over the air since Canadian calls usually end with a letter and not a figure.

When the tour began, on October 13, the Alberta government's official photographer, Victor Post, VE6VIP, equipped his car with a Kenwood TS440s transceiver to enable the King to talk to Canadian amateurs if he wished. At Lake Louise His Majesty, using Post's callsign plus his own Jordanian call, went on air in a specially arranged net and spoke to thirteen stations.

At the reception the King was introduced to a number of leading Albertan operators. He brought QSL cards for those he had spoken to from Lake Louise, and shook hands with every amateur in the room. He received his official Canadian callsign and a large framed presentation QSL card bearing the new call.

The Albertan amateurs presented him with a Yaesu FT411 handheld transceiver. As he received the radio the King heard a voice calling him over the air as "VE6JY1". This was VE6PA, standing in a corner of the room, with another handheld, who had been waiting for the signal to be the first Canadian amateur to speak to the royal visitor using his new call!

The King expressed a wish to contact his hosts during his flight from Canada that night and a "sked" was arranged for 14.135MHz, about an hour after take off. From a Calgary club station Victor Post called "VE6JY1 from VE6VIP" causing stations from various parts of Canada to break in to question the strange call he was putting out.

Conditions were poor on the 20m band so the King suggested they QSY (change frequency) to the 40m band, where all present at the Calgary station were able to speak to him and wish him "bon voyage". They then opened a 40m net to enable a further eighteen amateurs to make contact with the airborne station. VE6JY1 subsequently QSY'd back to 20m and worked many other parts of the country as he flew across Canada.

This memorable event attracted a lot of media attention. According to the report, King Hussein's visit has done more to rejuvenate interest in amateur radio than any other event in recent memory. It is hoped that it may be possible to maintain the link now established by arranging a set schedule for future contacts with JY1 by satellite through *Oscar 13* and on the 20m band.

## BARRIERS OVERCOME

It might seem from the reports which appear in this column that such interesting and intriguing events always occur in some other country, never in the UK, but that is not always the case. King Hussein, JY1, is an honorary life member of the Radio Society of Harow and has a UK callsign G0DEY/JY1. He actively encourages the development of amateur radio in his own country and goes on the air whenever possible.

An interesting situation developed one afternoon in April 1987 when JY1, accompanied by his son and by his adjutant, JY3AK, visited the home of a British licensee, G0BBD, who's signals were well known and well received in the Middle East. During the visit the King went on air as G0DEY/JY1/G0BBD and made a number of contacts on the 14MHz band, mainly with stations in Israel.

The significance of these contacts was not lost on "Ko1 Israel", the Voice of Israel, which reported in its English language Dx programme, " ... once again the amateur radio shortwave bands have been used in a most striking fashion to display international goodwill. For the first time in the history of amateur radio, the King of Jordan has appeared on the amateur bands to greet Israeli radio operators."

"King Hussein, an enthusiastic amateur radio operator for nearly 20 years ... was on a private visit to England eight days ago when he visited the home of a well known London radio amateur ... (who) at that time happened to be in contact with a number of radio friends in Israel. Without the slightest hesitation the Jordanian monarch took over the microphone and exchanged greetings with several of the Israeli hams on frequency at the time."

"Except for Egypt, there are no amateur exchanges allowed between Israel and the surrounding countries in the Middle East. Normally, therefore, King Hussein does not speak to Israeli hams from Jordan. In this case, however, he was transmitting from England with his UK callsign ... consequently the Israeli hams speaking to him were not violating any rules."

## SLOW MORSE TRANSMISSIONS

Volunteer members of the RSGB in all parts of the UK spend many hours each week broadcasting slow Morse practice transmissions to help those preparing for the 12 w.p.m. test which is part of the process of obtaining an amateur "A" licence.

Until now these transmissions have been made under the individual callsigns of the members concerned but as from 1st June 1990 they have all been using the special callsign GB2CW, enabling them to be easily identified as authentic transmissions co-ordinated by the RSGB.

Up-to-date schedules of these sessions can be obtained by sending an s.a.e. to the *Morse Practice Co-ordinator, Mike Thayne G3GMS, 14 Tynesdale Avenue, Monkseaton, Whitley Bay, NE26 3BA.*

# DIRECT BOOK SERVICE

**The books listed have been selected as being of special interest to everyone involved in electronics and computing. They are supplied by mail order direct to your door. Full ordering details are given on the last book page.**

**MORE BOOKS NEXT MONTH—MORE BOOKS NEXT MONTH**

## AUDIO & MUSIC

**SYNTHESIZERS FOR MUSICIANS**
**R. A. Penfold**
Modern synthesizers are extremely complex, but they mostly work on principles that are not too difficult to understand. If you want to go beyond using the factory presets or the random poking of buttons, this is the book for you.

It covers the principles of modern synthesis—linear arithmetic as used by Roland, phase distortion (Casio), Yamaha's frequency modulation, and sampling—and then describes how the instruments are adjusted to produce various types of sound—strings, brass, percussion, etc. The theoretical side of synthesis is treated in an easy to understand way—the technical information being restricted to what you need to know to use your instrument effectively.
*168 pages* **Order code PC105** **£6.95**

**AUDIO**
**F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.**
Analysis of the sound wave and an explanation of acoustical quantities prepare the way. These are followed by a study of the mechanism of hearing and examination of the various sounds we hear. A look at room acoustics with a subsequent chapter on microphones and loudspeakers then sets the scene for the main chapter on audio systems—amplifiers, oscillators, disc and magnetic recording and electronic music.
*320 pages* **Order code BP111** **£3.95**

**INTRODUCTION TO DIGITAL AUDIO**
**Ian Sinclair**
Digital recording methods have existed for many years and have become familiar to the professional recording engineer, but the compact disc (CD) was the first device to bring digital audio methods into the home. The next step is the appearance of digital audio tape (DAT) equipment.
All this development has involved methods and circuits that are totally alien to the technician or keen amateur who has previously worked with audio circuits. The principles and practices of digital audio owe little or nothing to the traditional linear circuits of the past, and are much more comprehensible to today's computer engineer than the older generation of audio engineers.
This book is intended to bridge the gap of understanding for the technician and enthusiast. The principles and methods are explained, but the mathematical background and theory is avoided, other than to state the end product
*128 pages* **Order code PC102** **£5.95**

**MAKE MONEY FROM HOME RECORDING**
**Clive Brooks**
Now that you've spent a fortune on all that recording gear, MIDI and all, wouldn't it be nice to get some of it back? Well here's the book to show you how,

It's packed with money making ideas, any one of which will recoup the price of the book many times over. Whether you have a fully fledged recording studio at home, or just a couple of stereo cassette recorders and a microphone, you'll be able to put the ideas in this book into practice and make money.
*105 pages* **Order code PC104** **£5.95**

## TESTING & TEST GEAR

**HOW TO TEST ALMOST EVERYTHING ELECTRONIC—2nd EDITION**
**Jack Darr and Delton T. Horn**
Describes electronic tests and measurements—how to make them with all kinds of test equipment, and how to interpret the results. New sections in this edition include logic probes, frequency counters, capacitance meters, and more. (An American book.)
*190 pages* **Order code T2925** **£9.05**

**GETTING THE MOST FROM YOUR MULTIMETER**
**R.A. Penfold**
This book is primarily aimed at beginners and those of limited experience of electronics. Chapter 1 covers the basics of analogue and digital multimeters, discussing the relative merits and the limitations of the two types. In Chapter 2 various methods of component checking are described, including tests for transistors, thyristors, resistors, capacitors and diodes. Circuit testing is covered in Chapter 3, with subjects such as voltage, current and continuity checks being discussed.
In the main little or no previous knowledge or experience is assumed. Using these simple component and circuit testing techniques the reader should be able to confidently tackle servicing of most electronic projects.
*96 pages* **Order code BP239** **£2.95**

**MORE ADVANCED USES OF THE MULTIMETER**
**R.A. Penfold**
This book is primarily intended as a follow-up to BP239, (see above), and should also be of value to anyone who already understands the basics of voltage testing and simple component testing. By using the techniques described in chapter 1 you can test and analyse the performance of a range of components with just a multimeter (plus a very few inexpensive components in some cases). Some useful quick check methods are also covered.

While a multimeter is supremely versatile, it does have its limitations. The simple add-ons described in chapter 2 extend the capabilities of a multimeter to make it even more useful. The add-ons described include an active r.f. probe, a high resistance probe, an a.c. sensitivity booster, and a current tracer unit.
*84 pages* **Order code BP265** **£2.95**

## TEACH-IN THEORY & REFERENCE


**EVERYDAY ELECTRONICS DATA BOOK**
**Mike Tooley BA**
**(published by EE in association with PC Publishing)**
This book is an invaluable source of information of everyday relevance in the world of electronics. It contains not only sections which deal with the essential theory of electronic circuits, but it also deals with a wide range of practical electronic applications.

It is ideal for the hobbyist, student, technician and engineer. The information is presented in the form of a basic electronic recipe book with numerous examples showing how theory can be put into practice using a range of commonly available "industry standard" components and devices.

A must for everyone involved in electronics!
*256 pages* **Order code DATA** **£8.95**

**ELECTRONICS TEACH-IN 88/89— INTRODUCING MICROPROCESSORS**
**Mike Tooley BA (published by *Everday Electronics*)**
A complete course that can lead successful readers to the award of a City and Guilds Certificate in Introductory Microprocessors (726/303). The book contains everything you need to know including full details on registering for assessment, etc.

Sections cover Microcomputer Systems, Microprocessors, Memories, Input/Output, Interfacing and Programming. There are various practical assignments and eight Data Pages covering the most popular microprocessor chips.

An excellent introduction to the subject even for those who do not wish to take the City and Guilds assessment.
*80 pages (A4 size)* **Order code TI-88/89** **£2.45**

**THE ILLUSTRATED DICTIONARY OF ELECTRONICS—4th EDITION**
**Rufus P. Turner and Stan Gibilisco**
With more than 27,000 terms used in electronics today, this collection is THE most comprehensive dictionary available. Including all practical electronics and computer terms, it is as up-to-date as the latest advances in the field itself! Tables and data on subjects most often consulted for projects and experiments are included. Other conversion tables include English/metric and metric/English conversions for units of measurement of energy, power and volume, and Fahrenheit/Celsius temperature conversion charts.

Setting this edition apart from other electronic dictionaries is its emphasis on illustration. Featuring more than complete definitions, this fourth edition includes over 450 detailed drawings and diagrams.

All entries are listed in alphabetical order. Abbreviations and initials are listed in sequence with whole words. All terms of more than one word are treated as one word. (An American book.)
*648 pages* **Order code T2900** **£23.65**

**MICROPROCESSING SYSTEMS AND CIRCUITS**
**F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.**
A truly comprehensive guide to the elements of microprocessing systems which really starts at the beginning. Teaches the reader the essential fundamentals that are so important for a sound understanding of the subject.
*256 pages* **Temporarily out of print**

**ELECTRONICS TEACH-IN No. 3 — EXPLORING ELECTRONICS (published by *Everyday Electronics*)**
**Owen Bishop**
Another EE value for money publication aimed at students of electronics. The course is designed to explain the workings of electronic components and circuits by involving the reader in experimenting with them. The book does not contain masses of theory or formulae but straightforward explanations and circuits to build and experiment with.

Exploring Electronics contains more than 25 useful projects, assumes no previous knowledge of electronics and is split into 28 easily digestible sections.
*88 pages (A4 size)* **Order code TI3** **£2.45**

**ELECTRONICS—A "MADE SIMPLE" BOOK**
**G. H. Olsen**
This book provides excellent background reading for our *Introducing Digital Electronics* series and will be of interest to everyone studying electronics. The subject is simply explained and well illustrated and the book assumes only a very basic knowledge of electricity.
*330 pages* **Order code NE10** **£4.95**

**PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE**
**F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.**
Bridges the gap between complicated technical theory, and "cut-and-tried" methods which may bring success in design but leave the experimenter unfulfilled. A strong practical bias—tedious and higher mathematics have been avoided where possible and many tables have been included.

The book is divided into six basic sections: Units and Constants, Direct-current Circuits, Passive Components, Alternating-current Circuits, Networks and Theorems, Measurements.
*256 pages* **Order code BP53** **£3.95**

**MICROELECTRONIC SYSTEMS N2 CHECKBOOK**
**R. Vears**
The aim of this book is to provide a foundation in microcomputer hardware, software and interfacing techniques. Each topic is presented in a way that assumes only an elementary knowledge of microelectronic systems and logic functions. The book concentrates on 6502, Z80 and 6800 microprocessors and contains 60 tested programs, 160 worked problems and 250 further problems.
**Order code NE04N** **£6.95**

## TEACH-IN, THEORY & REFERENCE

**ELECTRONICS-BUILD AND LEARN**
**R. A. Penfold**
The first chapter gives full constructional details of a circuit demonstrator unit that is used in subsequent chapters to introduce common electronic components–resistors, capacitors, transformers, diodes, transistors, thyristors, fets and op amps. Later chapters go on to describe how these components are built up into useful circuits, oscillators, multivibrators, bistables and logic circuits.
At every stage in the book there are practical tests and experiments that you can carry out on the demonstrator unit to investigate the points described and to help you understand the principles involved. You will soon be able to go on to more complex circuits and tackle fault finding logically in other circuits you build.
*120 pages* Order Code PC103 £5.95

**PRACTICAL ELECTRONICS HANDBOOK**
**Ian Sinclair**
Ian Sinclair has now revised this useful and carefully selected collection of standard circuits, rules-of-thumb, and design data for professional engineers, students and enthusiasts involved in radio and electronics. Covering passive and active components, discrete component circuits (such as amplifiers, filters and oscillators) and linear and digital i.c.s, the book includes many items which are not elsewhere available in a single handy volume. The operation and functions of typical circuits are described, while mathematics is limited to that necessary for deciding component values for any application.
This revised edition contains more details on computers and microprocessors and has been brought up to date throughout.
*199 pages* Order Code NE06 £7.95

## DATA & COMPONENT IDENTIFICATION

**TRANSISTOR SELECTOR GUIDE**
This unique guide offers a range of selection tables compiled so as to be of maximum use to all electronics engineers, designers and hobbyists.
Section 1: Covers component markings, codings and standards, as well as explaining the symbols used.
Section 2: Tabulates in alpha-numeric sequence the comprehensive specifications of over 1400 devices.
Section 3: Tabulates the devices by case type.
Section 4: Considers particular limits to the electrical parameters when compiling the tables.
Section 5: Illustrates package outlines and leadouts.
Section 6: Consists of a surface mounting device markings conversion list.
*192 pages* **Temporarily out of print**

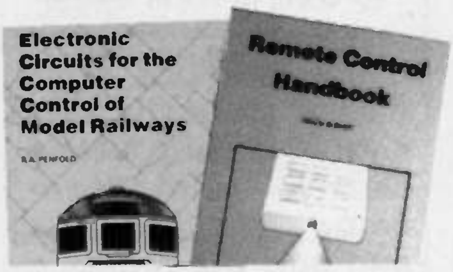
**DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS**
**A. Michaels**
Shows equivalents and pin connections of a popular selection of European, American and Japanese digital i.c.s. Also includes details of packaging, families, functions, manufacturer and country of origin.
*256 pages* **Temporarily out of print**

**INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE**
**A. Michaels**
Helps the reader to find possible substitutes for a popular selection of European, American and Japanese transistors. Also shows material type, polarity, manufacturer and use.
*320 pages* **Order code BP85** £3.50

**CHART OF RADIO, ELECTRONIC, SEMICONDUCTOR AND LOGIC SYMBOLS**
**M. H. Banani, B.Sc.(Eng.)**
Illustrates the common, and many of the not-so-common, radio, electronic, semiconductor and logic symbols that are used in books, magazines and instruction manuals, etc., in most countries throughout the world.
*Chart* **Order Code BP27** **£0.95**

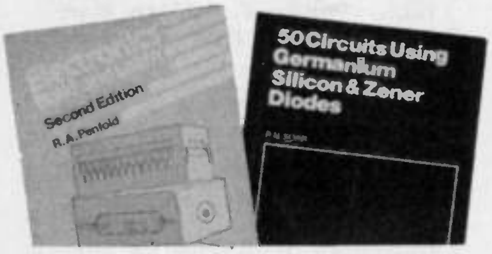
## CIRCUITS & DESIGN

**ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS**
**R.A. Penfold**
Home computers may easily be applied to the control of model railways and really quite sophisticated control, which needs only simple programming, is not too difficult to achieve. The main problem lies in interfacing the computer to the layout, but fortunately it is not too difficult or expensive to build suitable interfaces, and this book shows you how.
The projects consist of various types of controller, including a high quality pulse type, as well as circuits for train position sensing, signal and electric points control etc. The use of computers does not have to be restricted to massive layouts. Something as simple as an oval of track with a single siding can be given a new dimension by adding computer control and much fun can be had from these relatively simple setups.
*88 pages* Order code BP180 £2.95




**REMOTE CONTROL HANDBOOK**
**Owen Bishop**
Remote control systems lend themselves to a modular approach. This makes it possible for a wide range of systems, from the simplest to the most complex, to be built up from a number of relatively simple modules. The author has tried to ensure that, as far as possible, the circuit modules in this book are compatible with one another. They can be linked together in many different configurations to produce remote control systems tailored to individual requirements. Whether you wish simply to switch a table lamp on and off, or to operate an industrial robot, this book should provide the circuit you require.
*226 pages* Order code BP240 £3.95

**COIL DESIGN AND CONSTRUCTION MANUAL**
**B. B. Babani**
A complete book for the home constructor on "how to make" RF, IF, audio and power coils, chokes and transformers. Practically every possible type is discussed and calculations necessary are given and explained in detail. Although this book is now rather old, with the exception of torroids and pulse transformers little has changed in coil design since it was written.
*96 pages* **Order Code 160** **£2.50**




**30 SOLDERLESS BREADBOARD PROJECTS – BOOK 1**
**R. A. Penfold.**
Each project, which is designed to be built on a "Verobloc" breadboard, is presented in a similar fashion with a brief circuit description, circuit diagram, component layout diagram, components list and notes on construction and use where necessary. Wherever possible, the components used are common to several projects, hence with only a modest number of reasonably inexpensive components, it is possible to build in turn, every project shown. Recommended by BICC-Vero.
*160 pages* Order Code BP107 £2.95
BOOK 2 – All projects use CMOS i.c.s but the items on component identification etc., are not repeated from Book 1
*160 pages* Order code BP113 £2.25

**ELECTRONIC CIRCUITS HANDBOOK**
**Michael Tooley BA**
This book aims to explode two popular misconceptions concerning the design of electronic circuits: that only those with many years of experience should undertake circuit design and that the process relies on an understanding of advanced mathematics. Provided one is not too ambitious, neither of these popularly held beliefs is true.
Specifically, this book aims to provide the reader with a unique collection of practical working circuits together with supporting information so that circuits can be produced in the shortest possible time and without recourse to theoretical texts.
Furthermore, information has been included so that the circuits can readily be modified and extended by readers to meet their own individual needs. Related circuits have been grouped together and cross-referenced within the text (and also in the index) so that readers are aware of which circuits can be readily connected together to form more complex systems. As far as possible, a common range of supply voltages, signal levels and impedances has been adopted.
As a bonus, ten test gear projects have been included. These not only serve to illustrate the techniques described but also provide a range of test equipment which is useful in its own right.
*277 pages* Order code NE05 £14.95

**AUDIO IC CIRCUITS MANUAL**
**R. M. Marston**
A vast range of audio and audio-associated i.c.s are readily available for use by amateur and professional design engineers and technicians. This manual is a guide to the most popular and useful of these devices, with over 240 diagrams. It deals with i.c.s such as low frequency linear amplifiers, dual pre-amplifiers, audio power amplifiers, charge coupled device delay lines, bar-graph display drivers, and power supply regulators, and shows how to use these devices in circuits ranging from simple signal conditioners and filters to complex graphic equalizers, stereo amplifier systems, and echo/reverb delay line systems etc.
*168 pages* Order code NE13 £11.95

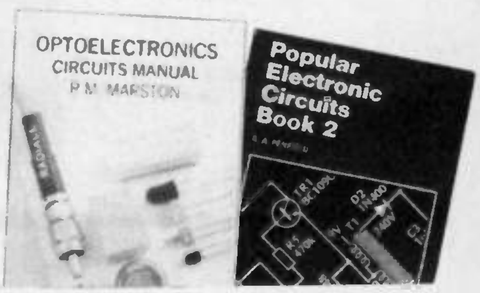
**HOW TO DESIGN ELECTRONIC PROJECTS**
**R. A. Penfold**
The aim of this book is to help the reader to put together projects from standard circuit blocks with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements are also provided.
*128 pages* **Order code BP127** **£2.25**

**50 CIRCUITS USING GERMANIUM SILICON AND ZENER DIODES**
**R. N. Soar**
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most simple and inexpensive of components—the diode. Includes the use of germanium and silicon signal diodes, silicon rectifier diodes and Zener diodes, etc.
*64 pages* **Order Code BP36** **£1.50**

**KEY TECHNIQUES FOR CIRCUIT DESIGN**
**C. G. Loveday C.Eng MIERE**
Deals with designing electronic circuits from scratch covering concepts such as target specifications, component selection (passive, discretes and i.c.s), the design cycle, derating and so on. Numerous design examples are given and several reader exercises all with fully worked solutions. The approach is essentially non-mathematical.
*128 pages* Order code BM1 £6.95

**DESIGNING WITH LINEAR ICs**
**G.C. Loveday**
A book that deals with the design of the vital area of analog circuitry covering design with modern linear integrated circuit devices. The first chapter introduces the reader to important design techniques, test strategies, layout, and protection and also includes a section on the use of a typical CAD tool. There are separate chapters that cover in depth the use of op-amps, comparators and timers each with detailed design examples and reader exercises. A final chapter brings all the previous work together in a number of complete design problems with fully worked solutions. The text is essentially non-mathematical and is supported by many diagrams.
*180 pages* Order code BM3 £8.75

**OPTOELECTRONICS CIRCUITS MANUAL**
**R. M. Marston**
A useful single-volume guide to the optoelectronics device user, specifically aimed at the practical design engineer, technician, and the experimenter, as well as the electronics student and amateur. It deals with the subject in an easy-to-read, down-to-earth, and non-mathematical yet comprehensive manner, explaining the basic principles and characteristics of the best known devices, and presenting the reader with many practical applications and over 200 circuits. Most of the i.c.s and other devices used are inexpensive and readily available types, with universally recognised type numbers.
*182 pages* Order code NE14 £12.95




**A MICROPROCESSOR PRIMER**
**E. A. Parr, B.SC., C.Eng., M.I.E.E.**
Starts by designing a small computer which, because of its simplicity and logical structure, enables the language to be easily learnt and understood. The shortcomings are then discussed and the reader is shown how these can be overcome by changes and additions to the instruction set. In this way, such ideas as relative addressing, index registers, etc., are developed.
*96 pages* Order code BP72 £1.75

**POPULAR ELECTRONIC CIRCUITS –BOOK 1**
**POPULAR ELECTRONIC CIRCUITS –BOOK 2**
**R. A. Penfold**
Each book provides a wide range of designs for electronic enthusiasts who are capable of producing working projects from just a circuit diagram without the aid of detailed construction information. Any special setting-up procedures are described.
BOOK 1 *160 pages* Order code BP80 £2.95
BOOK 2 *160 pages* Order code BP98 £2.95

**CMOS CIRCUITS MANUAL**
**R. M. Marston**
Written for the professional engineer, student or enthusiast. It describes the basic principles and characteristics of these devices and includes over 200 circuits.
All the circuits have been designed, built and fully evaluated by the author; all use inexpensive and internationally available devices.
*pages* Order code NE12 £9.95

## PROJECT CONSTRUCTION

Published by *Everyday Electronics* in association with Magenta Electronics.
Contains twenty of the best projects from previous issues of EE each backed with a kit of components. The projects are: Seashell Sea Synthesiser, EE Treasure Hunter, Mini Strobe, Digital Capacitance Meter, Three Channel Sound to Light, BBC 16K Sideways Ram, Simple Short Wave Radio, Insulation Tester, Stepper Motor interface, Eprom Eraser, 200MHz Digital Frequency Meter, Infra Red Alarm, EE Equaliser Ioniser, Bat Detector, Acoustic Probe, Mainstester and Fuse Finder, Light Rider – (Lapel Badge, Disco Lights, Chaser Light), Musical Doorbell, Function Generator, Tilt Alarm, 10W Audio Amplifier, EE Buccaneer Induction Balance Metal Detector, BBC Midi Interface, Variable Bench Power Supply, Pet Scarer, Audio Signal Generator.
*128 pages* **Order code EP1** **£2.45**

**HOW TO DESIGN AND MAKE YOUR OWN P.C.B.s**
**R. A. Penfold**
Deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple p.c.b. construction including photographic methods and designing your own p.c.b.s.
*80 pages* **Order code BP121** **£2.50**

**HOW TO GET YOUR ELECTRONIC PROJECTS WORKING**
**R. A. Penfold**
We have all built projects only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects
*96 pages* **Order code BP110** **£2.50**

**ELECTRONIC SCIENCE PROJECTS**
**O. Bishop**
These projects range in complexity from a simple colour temperature meter to an infra-red laser. There are novelties such as an electronic clock regulated by a resonating spring, and an oscilloscope with solid-state display. There are scientific measuring instruments such as a pH meter and an electro-cardiometer. All projects have a strong scientific flavour. The way they work, and how to build and use them are fully explained.
*144 pages* **Order code BP104** **£2.95**

**BEGINNER'S GUIDE TO BUILDING ELECTRONIC PROJECTS**
**R. A. Penfold**
Shows the complete beginner how to tackle the practical side of electronics, so that he or she can confidently build the electronic projects that are regularly featured in magazines and books. Also includes examples in the form of simple projects.
*112 pages* **Order code No. 227** **£1.95**

**TEST EQUIPMENT CONSTRUCTION**
**R.A. Penfold**
This book describes in detail how to construct some simple and inexpensive but extremely useful, pieces of test equipment. Stripboard layouts are provided for all designs, together with wiring diagrams where appropriate, plus notes on construction and use.
The following designs are included:- AF Generator, Capacitance Meter, Test Bench Amplifier, AF Frequency Meter, Audio Millivoltmeter, Analogue Probe, High Resistance Voltmeter, CMOS Probe, Transistor Tester, TTL Probe. The designs are suitable for both newcomers and more experienced hobbyists.
*104 pages* **Order code BP248** **£2.95**

## RADIO, TV, SATELLITE

**BEGINNER'S GUIDE TO RADIO–9th EDITION**
**Gordon J. King**
Radio signals, transmitters, receivers, antennas, components, valves and semiconductors, CB and amateur radio.
*266 pages* **Order code NE08** **£6.95**

**AN INTRODUCTION TO RADIO DXING**
**R. A. Penfold**
Anyone can switch on a short wave receiver and play with the controls until they pick up something, but to find a particular station, country or type of broadcast and to receive it as clearly as possible requires a little more skill and knowledge. The object of this book is to help the reader to do just that, which in essence is the fascinating hobby of radio DXing.
*112 pages* **Order code BP91** **£1.95**

**A TV-DXERS HANDBOOK**
**R. Bunney**
Roger Bunney is probably one of the leading authorities in this country on the subject. Includes many units and devices which have been designed and used by active enthusiasts, and often, considerable ingenuity and thought have gone into the development of such units to overcome individual problems. A practical and authoritative reference to this unusual aspect of electronics.
*128 pages* **Order code BP176** **£5.95**

**SATELLITE TELEVISION INSTALLATION GUIDE–2nd EDITION**
**John Breeds**
This book is now firmly established as a leading study manual for satellite TV installers, technical colleges who run City & Guilds courses, and training schools in major companies. It will be invaluable to anyone who wants to set up a dish receiver.
It covers all aspects of satellite dish installation: Installation of indoor unit, Geostationary satellites, Site survey, Dish assembly, Signal polarisation, Setting up the dish, Polar mount dish, TV downlead and relay cable and F-connectors, EIRP footprint contours, Trouble-shooting guide, Glossary of terms and Useful addresses.
*56 pages (large format)* **Order code JB1** **£11.95**

**NEWNES SHORTWAVE LISTENING HANDBOOK**
**Joe Pritchard G1UQW**
Part One covers the "science" side of the subject, going from a few simple electrical "first principles", through a brief treatment of radio transmission methods to simple receivers. The emphasis is on practical receiver designs and how to build and modify them, with several circuits in the book.
Part Two covers the use of sets, what can be heard, the various bands, propagation, identification of stations, sources of information, QSLing of stations and listening to amateurs. Some computer techniques, such as computer morse decoding and radio teletype decoding are also covered.
*224 pages* **Order code NE16** **£12.95**


## COMPUTING

**SERVICING PERSONAL COMPUTERS–2nd EDITION**
**Mike Tooley BA**
The revised and enlarged second edition contains a new chapter on the IBM PC, AT, TX and compatibles. It is essential for anyone concerned with the maintenance of personal computer equipment or peripherals, whether professional service technician, student or enthusiast.
*240 pages (hard cover)* **Order code NE15** **£25**

**AN INTRODUCTION TO 6502 MACHINE CODE**
**R. A. & J. W. Penfold**
No previous knowledge of microprocessors or machine code is assumed. Topics covered are: assembly language and assemblers, the register set and memory, binary and hexadecimal numbering systems, addressing modes and the instruction set, and also mixing machine code with BASIC. Some simple programming examples are given for 6502-based home computers like the VIC-20, ORIC-1/Atmos, Electron, BCC and also the Commodore 64.
*112 pages* **Order code BP147** **£2.95**

**AN INTRODUCTION TO COMPUTER PERIPHERALS**
**J. W. Penfold**
Covers such items as monitors, printers, disc drives, cassette recorders, modems, etc., explaining what they are, how to use them and the various types and standards. Helps you to make sure that the peripherals you buy will work with your computer.
*80 pages* **Order code BP170** **£2.50**

**AN INTRODUCTION TO PROGRAMMING THE BBC MODEL B MICRO**
**R. A. & J. W. Penfold**
Written for readers wanting to learn more about programming and how to make best use of the incredibly powerful model B's versatile features. Most aspects of the BBC micro are covered, the omissions being where little could usefully be added to the information provided by the manufacturer's own manual.
*144 pages* **Order code BP139** **£1.95**

**AN INTRODUCTION TO COMPUTER COMMUNICATIONS**
**R. A. Penfold**
Provides details of the various types of modem and their suitability for specific applications, plus details of connecting various computers to modems, and modems to the telephone system. Also information on common networking systems and RTTY.
*96 pages* **Order code BP177** **£2.95**

**THE PRE-BASIC BOOK**
**F. A. Wilson, C.G.I.A., C.ENG., F.I.E.E., F.I.E.R.E., F.B.I.M.**
Another book on BASIC but with a difference. This one does not skip through the whole of the subject and thereby leave many would-be programmers floundering but instead concentrates on introducing the technique by looking in depth at the most frequently used and more easily understood computer instructions. For all new and potential micro users.
*192 pages* **Order code BP146** **£2.95**

# DIRECT BOOK SERVICE

(A Division of Wimborne Publishing Ltd.)

## *TO ORDER*

**Please state the title and order code clearly, print your name and address and *add the required postage* to the total order.**

**Add 75p *to your total order*** for postage and packing (overseas readers add **£1.50** for countries in Europe, or add **£2.00** for all countries outside Europe, surface mail postage) and send a PO, cheque or international money order (£ sterling only) made **payable to *Direct Book Service*** **quoting your name and address,** the order code and quantities required to **DIRECT BOOK SERVICE, 33 GRAVEL HILL, MERLEY, WIMBORNE, DORSET, BH21 1RW** (mail order only).

**See next month's issue for another three page selection of books.**

Although books are normally sent within seven days of receipt of your order, please allow a maximum of 28 days for delivery. Overseas readers allow extra time for surface mail post.

***Please check price and availability (see latest issue of Everyday Electronics) before ordering from old lists.***

**Note–our postage charge is the same for one book or one hundred books!**

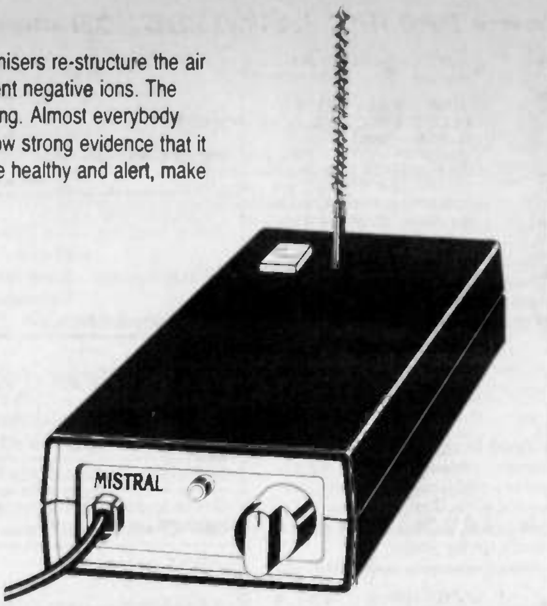
# AIR IONISERS

By means of points raised to a very high voltage, ionisers re-structure the air you breathe, turning ordinary air molecules into potent negative ions. The effects of breathing in these ions can be quite startling. Almost everybody reports that it makes them feel good, and there is now strong evidence that it can also improve your concentration, make you more healthy and alert, make you sleep better, and even raise your IQ.

## THE MISTRAL AIR ▷ IONISER

The ultimate air ioniser. The Mistral has variable ion drive, built-in ion counter and enough power to drive five multi-point emitters with ease. Its nine main drive stages, five secondary drives and four booster stages give an immense 15 billion ions per minute output – enough to fill the largest room in a matter of seconds.

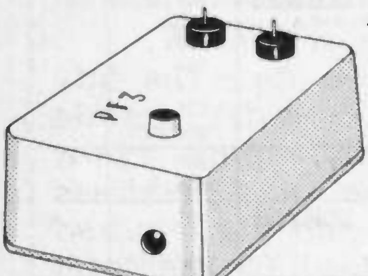
The parts set contains everything you need to build the Mistral: components, PCB, case, emitter and full instructions. If you're keen to increase the output still further, there's an optional eight-point internal emitter set to give extra ionising capability, and an almost silent piezo-electric ion fan to drive the ions away from the emitter and into the room.




MISTRAL IONISER PARTS SET **£32.66** ☐

INTERNAL EMITTER PARTS SET (optional) **£3.22** ☐

ION FAN (optional) **£11.27** ☐




## ◁ PROPHET PF3

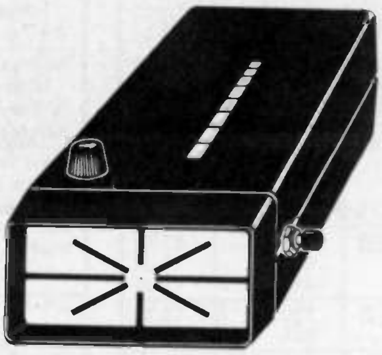
The Prophet performs its own special miracle on the dashboard of your car. First reports are most impressive: driving becomes a positive pleasure, easier to stay alert on long motorway journeys, a child cured of travel sickness. The ion effect is not to be underestimated. Don't forget the experiments either: there's the smoke trick, triffids, the living emitter, and more. The Prophet can be used anywhere with a supply of 9V to 12V DC, so don't restrict it to the car alone!

PROPHET PF3 PARTS SET **£21.39** ☐

## THE Q-ION ▷

Check out the ion levels around your house. The Q-Ion will measure the output of any ioniser, test the air to see where the ions are concentrating, help you set up fans and position your ioniser for best effect, and generally tell you anything you want to know about ion levels in the air. The readout is in the form of a bar graph which moves up and down as the Q-Ion sniffs the air in different parts of the room. Readings up to $10^{10}$ ions per second, positive or negative.

Q-ION COMPLETE PARTS SET **£21.16** ☐



## IONISER EXPERIMENTS

### * The Vanishing Smoke Trick

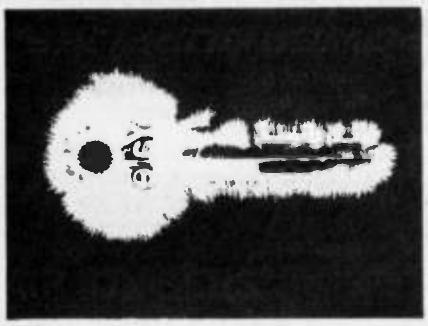
Light up a cigarette and gently puff smoke into a glass jar until the air inside is a thick, grey smog. Carefully invert the jar over the ioniser so that the emitter is inside. Within seconds the smoke will vanish! This is one of the best demonstrations of an ioniser's air cleaning action and with a large jar the effect is quite dramatic.

### * Triffids

Connect a length of wire from the ioniser emitter to the soil in the pot of a houseplant. One with sharp, pointy leaves is best. Hold your hand close to the plant and the leaves will reach out to touch you! In the dark you may see a faint blue glow around the leaf tips – this works better with some plants than with others, so try several different types. The plants don't object to this treatment at all, by the way, and often seem to thrive on it.

### * The Electric Handshake

Wear rubber soled shoes. Touch the ioniser emitter for a few seconds until your body is thoroughly charged up. When your hair stands on end, that's just about enough. Then give everyone you meet a jolly electric handshake. Just think, you could lose all your friends in a single evening! (A meaner trick still is to charge up a glass of water or a pint of beer. Even your family won't speak to you after that!)



## ◁ KIRLIAN CAMERA

Bioplasmic fields, auras, or just plain corona discharge? No matter how you explain them, the effects are strange and spectacular. Can you really photograph the missing portion of a torn leaf? Can you really see energy radiating from your finger tips? Most researchers would answer 'yes' to both questions.

Our Kirlian photography set contains everything you need to turn the Mistral into a Kirlian camera, your bedroom or spare room into a darkroom, and to expose, develop and print Kirlian photographs (photographs made with high voltage electricity instead of light). The set includes exposure bed, safelight bulb, developing and fixing chemicals, trays, imaging paper and full instructions. A Mistral ioniser parts set is also required.

KIRLIAN CAMERA SET **£19.78** ☐

Specialist SEMICONDUCTORS LIMITED

Tel: (0600) 3715

SALES DEPT., ROOM 111, FOUNDERS HOUSE, REDBROOK, MONMOUTH, GWENT.

**ORDERING**

All prices include VAT

UK orders: please add £1.15 postage and packing.

Eire and overseas: please deduct VAT and add £5.00 carriage and insurance.

**ACCESS**

Phone 0600 3715 for immediate attention to your Access order.

# PCB SERVICE

Printed circuit boards for certain constructional projects are available from the PCB Service, see list. These are fabricated in glass fibre, and are fully drilled and roller tinned. All prices include VAT and postage and packing. Add £1 per board for overseas airmail. Remittances should be sent to The **PCB Service, *Everyday Electronics,* 6 Church Street, Wimborne, Dorset BH21 1JH.** Cheques should be crossed and made payable to *Everyday Electronics* (**Payment in £ sterling only**).

*Boards for some older projects – not listed here – can often be obtained from Magenta Electronics, 135 Hunter St., Burton-on-Trent, Staffs DE14 2ST. Tel: 0283 65435 or Lake Electronics, 7 Middleton Close, Nuthall, Nottingham NG16 18X. Tel: 0602 382509.*

**NOTE: While 90% of our boards are now held in stock and are dispatched within seven days of receipt of order, please allow a maximum of 28 days for delivery – overseas readers allow extra if ordered by surface mail. Please check price and availability in the latest issue before ordering. We can only supply boards listed in the latest issue. Boards can only be supplied on a payment with order basis.**

| PROJECT TITLE | | Order Code | Cost |
|---|---|---|---|
| Spectrum I/O | FEB'87 | 557 | £5.35 |
| Noise Gate | SEP'87 | 577 | £4.41 |
| Transtest | OCT'87 | 580 | £3.32 |
| BBC Sideways RAM/ROM | NOV'87 | 585 | £4.10 |
| Stereo Noise Gate | APR'88 | 597 | £6.65 |
| Pipe & Cable Locator | | 598 | £3.00 |
| Inductive Proximity Detector | | 574 | £3.00 |
| Multi-Channel Remote Light Dim | MAY'88 | | |
| Transmitter | | 599 | £3.00 |
| Receiver | | 600 | £3.07 |
| Door Sentinel | | 605 | £3.00 |
| Multi-Chan Remote Light Dim | JUN'88 | | |
| Relay/Decoder | | 601 | £4.86 |
| Dimmer Board | | 602 | £3.07 |
| Power Supply | | 603 | £3.00 |
| Headlight Reminder | | 611 | £3.00 |
| Video Wiper | JUL'88 | 612 | £6.75 |
| Isolink | | 613 | £4.21 |
| Tea Tune | AUG'88 | 609 | £3.00 |
| Time Switch | | 614 | £4.84 |
| Suntan Timer | | 610 | £3.07 |
| Car Alarm | | 615 | £3.12 |
| Breaking Glass Alarm | SEP'88 | 617 | £4.27 |
| Amstrad PIO | | 618 | £6.77 |
| EPROM Eraser | OCT'88 | 620 | £4.07 |
| Doorbell Delay | NOV'88 | 616 | £3.56 |
| Micro Alarm | | 621 | £3.12 |
| Infra-Red Object Counter Trans | £9.28 as a set | 622 | £4.61 |
| Receiver | | 623 | £3.23 |
| Display | | 624 | £3.05 |
| Seashell Sea Synthesiser | | 625 | £4.84 |
| Reaction Timer Main Board | DEC'88 | 626 | £3.46 |
| Display Board | | 627 | £3.00 |
| Downbeat Metronome | | 629 | £4.84 |
| EPROM Programmer *(On Spec)* | DEC'88 | 630 | £8.29 |
| Phasor | | 631 | £5.64 |
| Monkey/Hunter Game | JAN'89 | 634 | £3.36 |
| Continuity Tester | FEB'89 | 619 | £2.67 |
| 4-Channel Light Dimmer | | 635 | £7.67 |
| Mini PSU | | 636 | £3.23 |
| Sound-to-Light Interface | MAR'89 | 637 | £6.24 |
| Midi Pedal | | 639 | £7.00 |
| Midi Merge | | 640 | £3.00 |
| Audio Lead Tester | | 641 | £5.77 |
| Light Sentinel | APR'89 | | |
| Main Control Board | | 632 | £9.20 |
| Remote Interface (4 boards) | | 633 | £4.59 |
| Electron User Port | | 638 | £6.64 |
| 4-Channel Auto-Fade Interface | | 642 | £6.80 |
| Pet Scarer | MAY'89 | 644 | £3.00 |
| Electron A/D Interface | | 645 | £4.84 |
| Spectrum EPROM Programmer | JUN'89 | 628 | £7.87 |
| Bat Detector | | 647 | £4.95 |
| Programmable Pocket Timer | JUL'89 | 648 | £3.82 |
| Electronic Spirit Level | AUG'89 | 649 | £3.85 |
| Distance Recorder | | 651 | £5.23 |
| Treasure Hunter | | 652 | £3.73 |

| PROJECT TITLE | | Order Code | Cost |
|---|---|---|---|
| Xenon Beacon | SEP'89 | 650 | £4.13 |
| Probe Pocket Treasure Finder | | 653 | £4.12 |
| Power Supplies – Fixed Voltage | | 654 | £4.08 |
| Variable Voltage | | .655 | £4.48 |
| Music on Hold | OCT'89 | 646 | £3.85 |
| Power Supplies – 25V 700mA | | 656 | £4.35 |
| 30V 1A | | 657 | £4.55 |
| EE Seismograph – Control | | 658 | £4.08 |
| Detector | | 659 | £4.22 |
| Lego/Logo & Spectrum | | 660 | £6.49 |
| Wash Pro | NOV'89 | 643 | £3.83 |
| Biofeedback Monitor – Front End | | 661 | £4.52 |
| Processor | | 662 | £4.56 |
| Power Supplies – 1.5V-25V 2A | | 663 | £4.78 |
| Logo/Lego & Spectrum Interface | | 664 | £5.60 |
| EEG Electrode Impedance Meter | DEC'89 | 665 | £3.98 |
| Biofeedback Signal Generator | JAN'90 | 666 | £4.08 |
| Four-Channel Light Chaser | | 667 | £6.70 |
| Quick Cap Tester | FEB'90 | 668 | £3.92 |
| Weather Station | | | |
| Anemometer – Freq./Volt Board | | 670 | £3.94 |
| Optional Display | | 669 | £3.73 |
| Wind Direction | | 673/674 | £4.22 |
| System Power Supply | | 675 | £3.59 |
| Prophet In-Car Ioniser | | 676 | £3.18 |
| EE Weather Station | MAR'90 | | |
| Display Driver | | 672 & 678 | £4.22 |
| Display and Sensor | | 671 | £4.47 |
| Fermostat Mk2 | | 677 | £4.28 |
| Superhet Broadcast Receiver-Tuner/Amp | | 679/680 | £4.22 |
| Stereo Noise Generator | APR'90 | 681 | £4.24 |
| Digital Experimenter's Unit – Pulse Generator | | 682 | £4.46 |
| Power Supply | | 683 | £3.66 |
| Enlarger Timer | | 684 | £4.28 |
| EE Weather Station | | | |
| Rainfall/Sunlight Display | | 685 | £4.27 |
| Rainfall Sen and Sunlight Sen | | 686/687 | £4.16 |
| Amstrad Speech Synthesiser | | 689 | £4.68 |
| Quizmaster | | 690 | £4.74 |
| 80 Metre Direct Conversion Radio | JUN'90 | 691 | £4.95 |
| Mains Appliance Remote Control | | | |
| Infra-Red Transmitter | | 692/693 | £4.75 |
| Mains Appliance Remote Control | JUL'90 | | |
| Encoder Board A | | 694 | £6.61 |
| Encoder Board B | | 695 | £4.78 |
| The Tester | | 696 | £4.15 |
| Mains Appliance Remote Control | AUG'90 | | |
| Mains ON/OFF Decoder | | 697 | £4.55 |
| (5 or more 698's ordered ***together*** £3.25 each) | | | |
| Simple Metronome | | 698 | £3.94 |
| Hand Tally | SEP'90 | | |
| Main Board (double-sided) | | | |
| Display | | 699, 700 | £10.95 |
| Alarm Bell Time-Out | | 701 | £4.10 |
| Mains Appliance Remote Control | | | |
| Temperature Controller (p.c.b. only) | | 702 | £5.20 |

*Please note it is important to give project title as well as order code.*

**EE PRINTED CIRCUIT BOARD SERVICE**

Please send me the following p.c.b.s.

**Order Code Project Quantity Price**

..........

..........

I enclose cheque/PO for £..........

Name..........

Address..........

..........

**Please allow 28 days for delivery (see note above)**

**BLOCK CAPITALS PLEASE**

# EVERYDAY ELECTRONICS

## CLASSIFIED

**Reach effectively and economically today's enthusiasts anxious to know of your products and services through our semi-display and classified pages.** The prepaid rate for semi-display spaces is £8.00 (plus VAT) per single column centimetre (minimum 2.5 cm). The prepaid rate for classified advertisements is 30 pence (plus VAT) per word (minimum 12 words).
All cheques, postal orders, etc., to be made payable to Everyday Electronics. **VAT must be added.** Advertisements, together with remittance, should be sent to the Classified Advertisement Dept., Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH. Tel: (0202) 881749.



### Kits

**G.C.S.E. ELECTRONIC KITS.** Ten different, £10.50 (+70p p&p) or SAE for details. SIR-KIT ELECTRONICS, 70 Oxford Road, Clacton CO15 3TE.

**KITS.** Microtransmitter with free mic, £3.99. Telephone transmitter £4.99. Automatic telephone recording switch, £8.99. Plans for protection devices, surveillance, etc. Sae list. P.O. Box 55, Cannock, Staffs. (05438 71902, 24 hrs).

**T.M. ELECTRONIC** kits transmitters, receivers plus many more. Sae plus 50p (A4) New 1990 Catalogue. Under New Management, 39 Mayeswood Road, Grove Park, London SE12 9RR.

### Miscellaneous

**MESSAGE DISPLAY HARDWARE.** Moving message, character kits, large displays. All controlled from your computer port. Details SAE Caddis Systems Ltd, PO Box 859 Basildon, Essex SS15 5JE.

**PHONE OR WRITE** for my catalogue of top quality tools and components at unbeatable prices and receive a **FREE** retractable snap off blade knife, worth 60p. Tel: 0925 811103. E.D.S., 2 College Close, Fearnhead, Warrington, Cheshire WA2 0DD.

**TEST EQUIPMENT** for sale. Signal generators, bridges, standards, cheap. Sae for list. P. Wilkinson, 18 High Sparrowmire, Kendal, Cumbria.

## ADVERTISERS INDEX



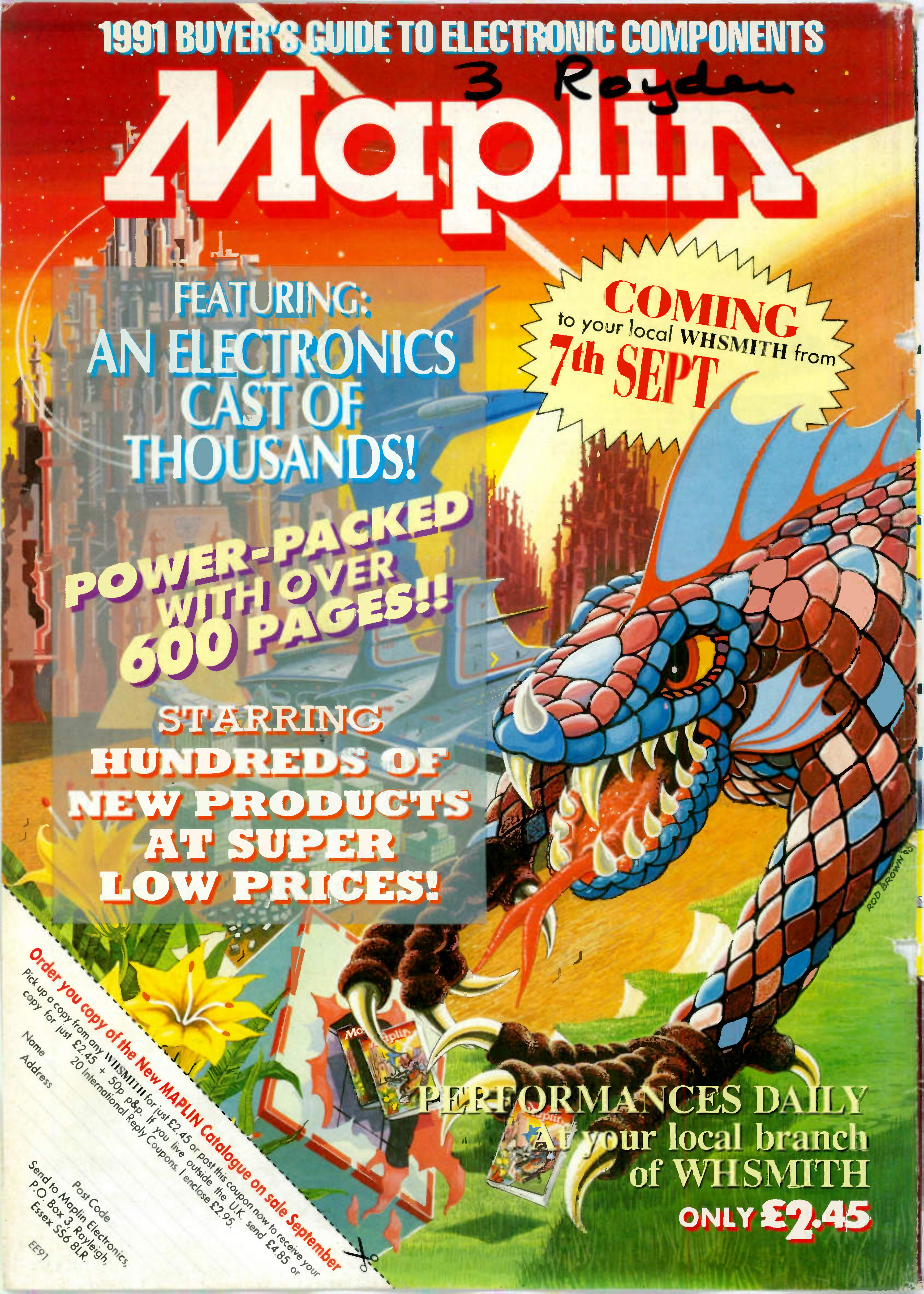









Published on approximately the first Friday of each month by Wimborne Publishing Ltd., 6 Church Street, Wimborne, Dorset BH21 1JH. Printed in England by Benham & Co. Limited, Colchester, Essex. Distributed by Seymour, Windsor House, 1270 London Road, Norbury, London SW16 4DH. Sole Agents for Australia and New Zealand –Gordon & Gotch (Asia) Ltd., South Africa –Central News Agency Ltd. Subscriptions INLAND £16.00 and OVERSEAS £19.50 (£37 airmail) payable to "Everyday Electronics" Subscription Department, 6 Church Street, Wimborne, Dorset BH21 1JH. EVERYDAY ELECTRONICS is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.


1991 BUYER'S GUIDE TO ELECTRONIC COMPONENTS
3 Royden
Maplin
FEATURING:
AN ELECTRONICS CAST OF THOUSANDS!
POWER-PACKED WITH OVER 600 PAGES!!
STARRING
HUNDREDS OF NEW PRODUCTS AT SUPER LOW PRICES!
COMING to your local WHSMITH from 7th SEPT
PERFORMANCES DAILY At your local branch of WHSMITH
ONLY £2.45
Order you copy of the New MAPLIN Catalogue on sale September
Pick up a copy from any WHSMITH for just £2.45 or post this coupon now to receive your copy for just £2.45 + 50p p&p. If you live outside the U.K. send £4.85 or 20 International Reply Coupons. I enclose £2.95.
Name
Address
Post Code
Send to Maplin Electronics, P.O. Box 3, Rayleigh, Essex SS6 8LR.
EE91