

EVERYDAY

SEPTEMBER 1990

ELECTRONICS

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



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 upright mounting with fixing clamps.
- BD11 1 6 1/2in 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 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 tin 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 DK.
- BD252 1 Panostat, controls output of boiling ring from simmer up boil.
- BD259 50 Leads with push-on 1/4in 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 4 1/2". Louvered for ventilation. Price £3.00. Ref. 3P75.

FLOPPY DISCS 5 1/4" pack of 10 £5.00 Ref. 168 3 1/2" 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 8 1/2in wide. Double sided on fibreglass middle which is quite thick (about 1.6in) 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, workshop 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. 40hm impedance and consisting of 6 1/2" 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. 10P61

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. 12P21

3 1/2in FLOPPY DRIVES We still have two models in stock: Single sided, 80 track, by Chinton. 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. 1/2hp. Yord power. 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 snoothing 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 popu-ar square shape (4 1/2in x 4 1/2in x 1 3/4in). 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.



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 Small 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 hi-fi 6 1/2" 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 1.35mm and 1.25mm 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 x 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 0-10m 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 HI-FI 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 4 1/2" 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 impedance 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 Siimline 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 40W. 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

EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

ABC

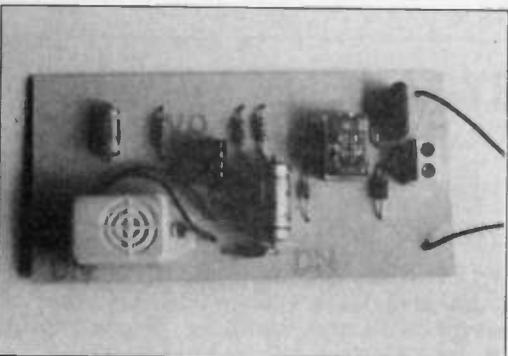
MEMBER OF THE ASSOCIATION OF PUBLISHERS

VOL. 19 No. 9 SEPTEMBER 1990

The Magazine for Electronic & Computer Projects

ISBN 0262 3617

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

© Wimborne Publishing Ltd 1990. Copyright in all drawings, photographs and articles published in EVERYDAY ELECTRONICS is fully protected, and reproduction or imitations in whole or in part are expressly forbidden.

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

Everyday Electronics, September 1990

Projects

- METAL MATE** by T. R. de Vaux-Balbirnie **570**
Pipe and wire detector with a continuity tester built in
- ALARM BELL TIMEOUT** by G. Jackson **574**
Bring your alarm system in line with the latest requirements
- VALVE DISTORTION UNIT** by Jonathan P. Oliver **582**
Get the "valve sound" for your guitar
- MAINS APPLIANCE REMOTE CONTROL SYSTEM - 4** by Chris Walker **596**
The room temperature controller rounds off the present series
- ELECTRONIC HAND TALLY** by Chris Bowes **606**
A hand held counter with many applications

Series

- INTERFACING THE RML NIMBUS - 1** by Andrew Channerley **578**
We take a look at the Nimbus and its BBC-type parallel card
- MICRO IN CONTROL - 10** by John Hughes **586**
The 6502 microprocessor
- ROBOT ROUNDUP** by Nigel Clark **595**
Robot facts and figures
- BBC MICRO** by Robert Penfold **604**
Morse practice program
- ON SPEC** by Mike Tooley **610**
For Spectrum and Sam micro enthusiasts
- AMATEUR RADIO** by Tony Smith G4FA1 **614**
Repeater Operators Banned, King Hussein, Slow Morse

Features

- EDITORIAL** **569**
- FOR YOUR ENTERTAINMENT** by Barry Fox **576**
As You Like It, Hi Fi Tweaks, Beware Predictions
- SHOP TALK** with David Barrington **612**
Product news and component buying for projects
- DIRECT BOOK SERVICE** **616**
Selected technical books by mail order
- PRINTED CIRCUIT BOARD SERVICE** **620**
P.C.B.s for EE projects
- ADVERTISER'S INDEX** **624**

Readers Service • Editorial and Advertisement Departments **569**

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



GHOST WAKER

This sound triggered Halloween 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

EXEMPT

We deliver from stock - The fastest way to order is a fax !

ULTRASONIC CAR ALARM

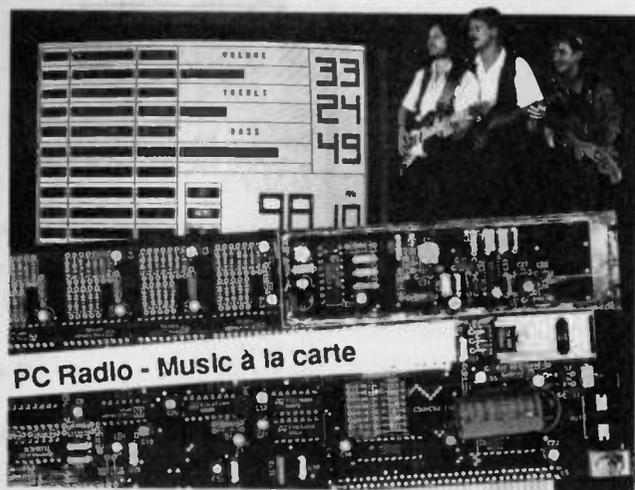


This system is specially designed to protect your car and its contents against potential thieves. Low current consumption and high noise immunity are just two of its distinguishing features.

Complete kit including case
44.367BKL £ 30.40

In addition the system has a voltage sensing device i.e. the alarm is also triggered if appliances are switched on by an unauthorised person (e.g. the interior lighting when the door is opened).

PC Radio (Elektronik February 1990)



PC Radio - Music à la carte

VM 1000 Video-Modulator (Elektronik March 90)



Many inexpensive or older TV sets lack a SCART or other composite video input, and can only be connected to a video recorder or other equipment via an RF modulator. The modulator operates at a UHF TV channel between 30 and 40. Use is made of a single-chip RF modulator that couples low cost to excellent sound and picture quality.

Complete kit
44.546BKL £ 36.90

Ordering and payment:

- all prices excluding V.A.T. (french customers add 18.6%T.V.A.)
- send Euro-cheque, Bank Draft or Visa card number with order. Please add £ 3.00 for p & p (up to 2 kg total weight)
- postage charged at cost at higher weight Air/Surface -
- we deliver worldwide except USA and Canada
- dealer inquiries welcome

DIGITAL PROFESSIONAL ECHO 1000

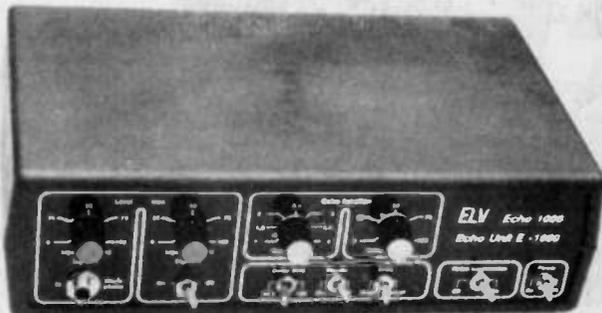
(Elektronik June 89)

This low cost echo unit is certain to impress music lovers - amateur and professional - everywhere. Excellent specification and top performance make the EU 1000 a winner and despite meeting professional requirements the unit will not make too big a hole in your pocket. Working on the delta modulation prin-

ciple on a digital base, delay times up to one second are possible at full bandwidth and large signal to noise ratio.

Complete kit
44.255BKL £ 99.50

Ready assembled module
44.255F £ 134.50



Specification

Input sensitivity:

Input 1 : 2 mV
Input 2 : 200 mV

Delay Time:

variable from 60 ms to 1 s

Bandwidth :

100 Hz to 12 kHz

Additional features:

- inputs mixable
- single and multiple echo
- adjustable delay level
- switchable vibrator
- switch-controlled noise suppression

This FM radio consists of an insertion card for IBM PC-XTs, ATs and compatibles and is available as a kit or a ready-built and aligned unit. The radio has an on-board AF power amplifier for driving a loudspeaker or a headphone set, and is powered by the computer. A menu-driven program is supplied to control the radio settings.

Complete kit
44.544BKL £ 82.75

Ready assembled module
44.544F £ 137.30

RFK 700 RGB-CVBS Converter

(Elektronik October 89)

Nearly all computers supply as an output signal for colour monitors RGB signals. With the help of the RFK 7000 it is possible to record this signals with a videorecorder or to give them onto a colour TV (This is only possible, if the

computer delivers a vertical sync. of 50 Hz and a horizontal sync. of 15.625 Hz).

The voltage supply is gained from a 12V/300mA-DC voltage mains adaptor.

Complete kit
44.525BKL £ 66.50

Ready assembled module
44.525F £ 119.50

FRK 7000 CVBS-RGB Converter

With the help of the FRK 7000 e.g. it is possible to use a cheap colour monitor with RGB input on a video recorder. The voltage supply is gained from a 12V/300mA-DC voltage mains adaptor.

Complete kit
44.509BKL £ 66.50

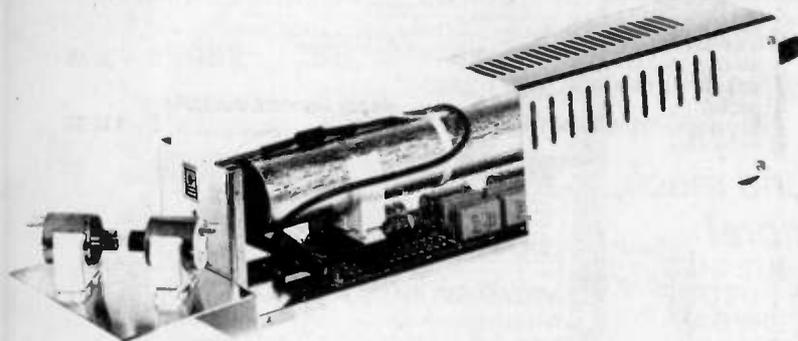
Ready assembled module
44.509F £ 119.50



We deliver from stock - The fastest way to order is a fax!

LPS 8000 / LC 7000 Low Cost Show Laser

(Electronics The Maplin Magazine Dec 88 + Feb-Mar 90)



An almost infinite number of circular patterns can be projected onto a wall or ceiling with this super laser show equipment.

The complete project includes a laser tube and accompanying power supply, housed in a metal case, and a laser controller, LC 7000. The laser controller drives the accompanying deflection unit, fixed onto the laser power supply case, which produces the numerous configurations.

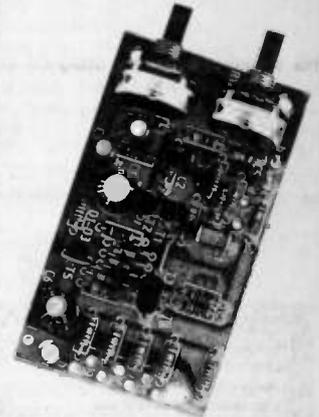
Naturally the laser tube, together with the power supply, can produce beams without the laser controller and the controller can be used with other, similar lasers.

VIDEO RECORDING AMPLIFIER

(Elektronik April 89)

Losses can easily occur when copying video tapes resulting in a distinct reduction in quality. By using this video recording amplifier, with no less than four (!) outputs, the modulation range is enlarged and the contrast range of the copy increases.

Two level controllers for edge definition (contour) and amplification (contrast range) allow individual and precise adaptation.



Complete Kit (including Box, PCB and all parts)
44.324BKL £ 14.75

LPS 8000 Laser Power Supply, complete kit
Version 240 Volts AC
44.428BKL220 £ 86.90
Version 220 Volts AC
44.428BKL240 £ 86.90

LPS 8000 Laser Power Supply, ready assembled module
Version 240 Volts AC
44.428F240 £ 156.50
Version 220 Volts AC
44.428F220 £ 156.50

LC 7000 Laser Controller, complete kit
Version 12 Volts DC
44.427BKL £ 60.80

LC 7000 Laser Controller, ready assembled module
Version 12 Volts DC
44.427F £ 104.30

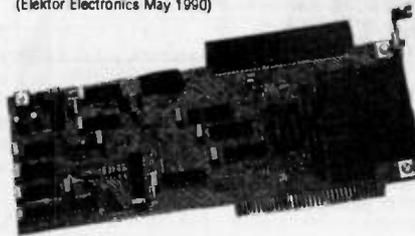
H-N Laser Tube 2 mW
44.428LR £ 60.80

Laser Motor-Mirror Set, complete kit
44.506M £ 22.95

IBM PC Service Card

(Elektronik May 1990)

This card was developed for assistance in the field of service, development and test. The card is used as a bus-extension to reach the measurement points very easy. It is also possible to change cards without having a "hanging computer".



Complete kit
44.517BKL £ 77.95

Ready assembled module
44.517F £ 137.95

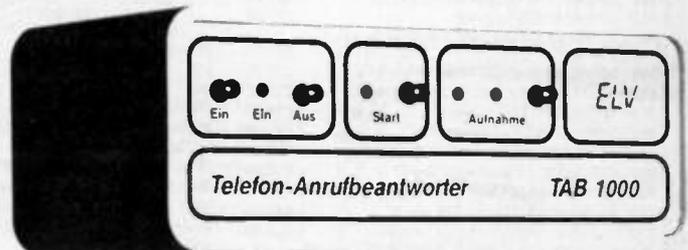
TA 1000 Telephone Answering Unit

(Elektronik January 1990)

This automatic telephone answering unit uses a 256-kbit voice recording circuit to store and replay your spoken message of up to 15 seconds. Noteworthy features are that it is available as a complete kit, provides a battery back-up facility and does not require alignment. No provision is made, however, to record incoming calls.

Complete kit
44.433BKL £ 45.65

Ready assembled module
44.433F £ 87.25

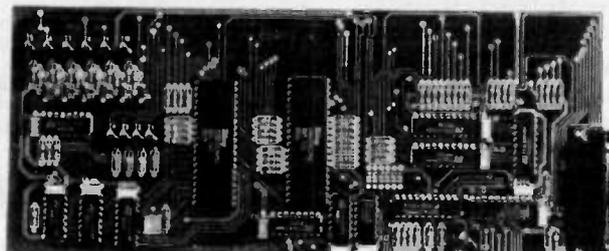


IC TESTER for IBM-PC-XT/AT

(Electronics The Maplin Magazine Jun-Jul 89 +

Elektronik December 89)

With the ELV IC tester logic function tests can be carried out on nearly all CMOS and TTL standard components, accommodated in DIL packages up to 20 pin. The tester is designed as an insertion card for IBM-PC-XT/AT and compatibles. A small ZIF test socket PCB is connected via a flat band cable. Over 500 standard components can be tested using the accompanying comprehensive test software.



Complete Kit including Textool socket, connectors, sockets, Flat band cable, PCB, Software
44.474BKL £ 60.85

Ready Assembled Module
4.474F £ 113.00

Software, single
44.474SW £ 17.85

MAGENTA ELECTRONICS LTD

MAIL ORDER AND SHOP
EE92 135 Hunter Street
Burton-on-Trent
Staffs, DE14 2ST
Tel: 0283 65435
Fax: 0283 46932



All prices include VAT
Shop open 9-5 Mon-Fri;
9-2 Saturday
Official orders welcome

Add £2
p&p to
all orders

SUPERHET BROADCAST RECEIVER

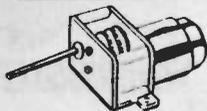
EE MAR '90

At last, an easy to build SUPERHET A.M. radio kit. Covers Long and medium Wave bands. built in loudspeaker with 1 watt output. Excellent sensitivity and selectivity provided by ceramic I.F. filter. Simple alignment and tuning without special equipment. Kit available less case, or with pre-cut and drilled transparent plastic panels and dial for a striking see-through effect.

£16.79

KIT REF 835

D.C. MOTOR GEARBOXES



Ideal for Robots and Buggies. A miniature plastic reduction gearbox coupled with a 1.5-4.5 Volt mini motor. Variable gearbox reduction ratios are obtained by fitting from 1 to 6 gearwheels (supplied). Two types available:

SMALL UNIT TYPE MGS £3.99

Speed range 3-2200 rpm. Size 37x43x25mm

LARGE UNIT TYPE MGL £4.55

Speed range 2-1150 rpm. Size 57x43x29mm

Supplying Electronics for Education, Robotics, Music, Computing and much, much more!

NEW CATALOGUE OUT
OCTOBER. SEE FUTURE
ISSUES OF EVERYDAY
ELECTRONICS FOR
DETAILS

STEPPING MOTORS

A range of top quality stepping motors suitable for driving a wide range of mechanisms under computer control using simple interfacing techniques.

ID35 PERMANENT MAGNET MOTOR — 48 steps per rev. £16.50

MD200 HYBRID MOTOR — 200 steps per rev. £16.80

MD35 1/4 PERMANENT MAGNET MOTOR — 48 steps per rev. £12.70

MD38 PERMANENT MAGNET MOTOR — 48 steps per rev. £8.95

HAMEG HM 203-7 OSCILLOSCOPE

New model just arrived. Special summer discount price. Full two year parts and labour warranty.

£309

20MHz-2 channels 1mV sensitivity.
Easy to operate and high performance + **£46.35 VAT**
Next Day Delivery **£8.50**

EDUCATIONAL BOOKS & BOOK PROJECTS

ADVENTURES WITH ELECTRONICS

The classic Easy to Follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-DEC breadboard. Gives clear instructions with lots of pictures. 16 projects — including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-DEC breadboard and all the components for the series.

ADVENTURES WITH ELECTRONICS COMPONENT PACK (less book) £5.25 £23.49

FUN WITH ELECTRONICS

From the USBORNE Pocket Scientist series — An enjoyable introduction to electronics. Full of very clear full colour pictures accompanied by easy to follow text. Ideal for all beginners — children and adults. Only basic tools are needed. 64 full colour pages cover all aspects — soldering — fault finding — components (identification & how they work). Also full details of how to build 6 projects — burglar alarm, radio, game, etc. Requires soldering — 4 pages clearly show you how.

The components supplied in our pack allows all the projects to be built and kept. The book is available separately.

FUN WITH ELECTRONICS Book £2.50
COMPONENT PACK (less book) £18.45

30 SOLDERLESS BREADBOARD PROJECTS

A book of projects by R. A. Penfold covering a wide range of interests. All projects are built on a Verobloc breadboard. Full layout drawings and component identification diagrams enable the projects to be built by beginners. Each circuit can be dismantled and rebuilt several times using the same components. The component pack allows all projects in the book to be built one at a time.

Projects covered include amplifiers, light actuated switches, timers, metronome, touch switch, sound activated switch, moisture detector, M.W. Radio, Fuzz unit, etc.

30 SOLDERLESS BREADBOARD PROJECTS Book 1 £2.95
COMPONENT PACK £28.50

ENJOYING ELECTRONICS

A more advanced book which introduces some arithmetic and calculations to electronic circuits. 48 chapters covering elements of electronics such as current, transistor switches, flip-flops, oscillators, charge, pulses, etc. An excellent follow-up to Teach-in or any other of our series. Extremely well explained by Owen Bishop who has written many excellent beginners' articles in numerous electronics magazines.

ENJOYING ELECTRONICS Book £3.60
COMPONENT PACK £15.05

Note — A simple multimeter is needed to fully follow this book. The M102 BZ is ideal. **£13.98**

A FIRST ELECTRONICS COURSE

A copiously illustrated book that explains the principles of electronics by relating them to everyday objects. At the end of each chapter a set of questions and word puzzles allow progress to be checked in an entertaining way. An S-DEC breadboard is used for this series — soldering is not required.

A FIRST ELECTRONICS COURSE BOOK £3.75
PACK £23.47

EVERYDAY ELECTRONICS KIT PROJECTS

ALL KITS HERE HAVE BEEN FEATURED IN EE. IF YOU DO NOT HAVE THE MAGAZINE WITH THE ORIGINAL ARTICLE, YOU WILL NEED TO ORDER THE REPRINT FOR 80p EXTRA. REPRINTS ALSO AVAILABLE SEPARATELY. KITS INCLUDE CASES, PCB'S HARDWARE AND ALL COMPONENTS (UNLESS STATED OTHERWISE) CASES ARE NOT DRILLED, LABELS ARE NOT SUPPLIED.

Ref	Price	Ref	Price
835	£16.79	542	£12.89
With drilled panels and dial	£13.64	528	£29.95
Without above	£10.17	523	£29.57
834	£10.17	513	£31.25
QUICK CAP TESTER Feb 90	£31.45	512	£9.86
833	£31.45	497	£20.95
EE 4 CHANNEL LIGHT CHASER Jan 90	£20.98	493	£46.46
815	£41.95	481	£6.12
EE TREASURE HUNTER Aug 89	£14.49	464	£9.40
814	£20.98	COMPUTER less case Aug 85	£8.95
BAT DETECTOR June 89	£29.95	1035 STEPPER MOTOR EXTRA	£5.74
812	£14.49	OPTIONAL POWER SUPPLY PARTS	£6.93
ULTRASONIC PET SCARER May 89	£27.94	461	£8.45
800	£29.95	455	£29.98
SPECTRUM EPROM PROGRAMMER Dec 88	£27.94	444	£21.89
796	£27.94	392	£39.95
SEASHELL SYNTHESISER Nov 88	£27.90	387	£6.18
790	£27.90	386	£9.70
EPROM ERASER Oct 88	£55.61	362	£14.70
VARIABLE 25V-2A BENCH POWER SUPPLY	£15.66	337	£27.00
Feb 88	£15.66	263	£6.35
763	£15.66	242	£6.36
AUDIO SIGNAL GENERATOR Dec 87	£23.43	240	£7.68
739	£23.43	108	£10.53
ACCENTED BEAT METRONOME Nov 87	£19.58	106	£8.75
740	£19.58	101	£7.00
ACCOUSTIC PROBE Nov 87 (less bolt & probe)	£32.58		
744	£32.58		
VIDEO CONTROLLER Oct 87	£19.20		
734	£19.20		
AUTOMATIC PORCH LIGHT Oct 87	£15.99		
728	£15.99		
PERSONAL STEREO AMP Sep 87	£15.17		
730	£15.17		
BURST-FIRE MAINS CONTROLLER Sep 87	£42.93		
724	£42.93		
SUPER SOUND ADAPTOR Aug 87	£29.66		
718	£29.66		
3-BAND 1.6-30MHz RADIO Aug 87	£29.58		
719	£29.58		
BUCCANEER I.B. METAL DETECTOR July 87	£13.58		
Inc coils, and case, less handle and hardware	£14.08		
722	£13.58		
FERMOSTAT July 87	£17.37		
715	£17.37		
MINI DISCO LIGHTS June 87	£39.87		
707	£39.87		
EQUALIZER (IONISER) May 87	£9.39		
700	£9.39		
ACTIVE I/R BURGLAR ALARM Mar 87	£23.39		
581	£23.39		
VIDEO GUARD Feb 87	£10.55		
584	£10.55		
SPECTRUM SPEECH SYNTH (no case) Feb 87	£13.94		
578	£13.94		
SPECTRUM I/O PORT less case Feb 87	£69.95		
569	£69.95		
CAR ALARM Dec 86	£11.40		
563	£11.40		
200MHz DIG. FREQUENCY METER Nov 86	£21.93		
561	£21.93		
LIGHT RIDER LAPEL BADGE Oct 86	£15.25		
560	£15.25		
LIGHT RIDER DISCO VERSION	£31.70		
559	£31.70		
LIGHT RIDER 16 LED VERSION	£8.75		
556	£8.75		
INFRA-RED BEAM ALARM Sep 86			
544			
TILT ALARM July 86			

TEACH-IN 1 PROJECTS

591	REGULATOR UNIT & SAFE POWER SUPPLY	£29.95
592	UNIVERSAL LCR BRIDGE	£28.89
593	DIODE/TRANSISTOR TESTER	£21.22
594	AUDIO SIGNAL TRACER	£18.73
595	AUDIO SIGNAL GENERATOR	£29.31
596	R.F. SIGNAL GENERATOR	£27.37
597	FET VOLTMETER	£24.02
598	DIGITAL PULSE GENERATOR	£18.65

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 μ F. Clear 5-digit LED display indicates exact value. Three ranges - pF, nF, and μ 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

Headphones

£41.95

£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. **£21.95**
XK125

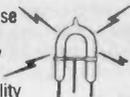
DISCO LIGHTING KITS



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**

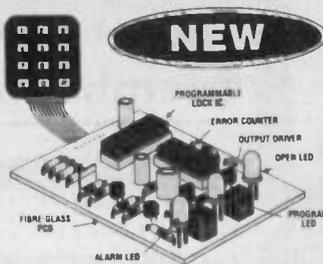
POWER STROBE KIT

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. **£17.25**
XK124 STROBOSCOPE KIT

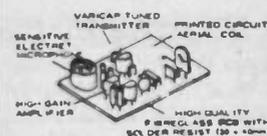


PROGRAMMABLE ELECTRONIC LOCK KIT

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. **£19.95**
XK131



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. **£6.35**
XK128

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). **£19.95**
XK132

IR TRANSMITTER KIT

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



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.

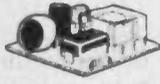
MK12 IR Receiver..... **£19.55**
MK18 Transmitter..... **£8.95**
MK 9 4-way Keyboard..... **£2.75**
MK10 16-way Keyboard..... **£7.95**
601 133 Box for transmitter **£2.95**

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 component identification and function is included, enabling the beginner to build the circuits with confidence **£17.25**

ELECTRONIC WEIGHING SCALE

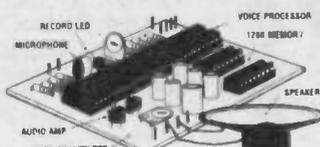


Kit contains a single chip microprocessor. PCB, displays and all electronics to produce a digital LED readout of weight in Kgs or Sts/Lbs. A PCB link selects the scale-bathroom/two types of kitchen scales. A low cost digital ruler could also be made. **£8.25**
ES1

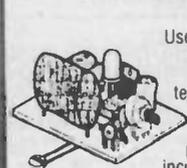
VOICE RECORD/PLAYBACK KIT

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 taking doll!

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



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. **£8.95**
XK140

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.



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.

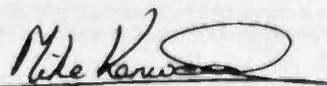
NEW FEATURES?

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!



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 photostated 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.

Editor: MIKE KENWARD

Secretary: PAMELA BROWN

Deputy Editor: DAVID BARRINGTON

Business Manager: DAVID J. LEAVER

Editorial: WIMBORNE (0202) 881749

Advertisement Manager:
PETER J. MEW, Frinton (0255) 850596

Classified Advertisements:
Wimborne (0202) 881749

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 from 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.

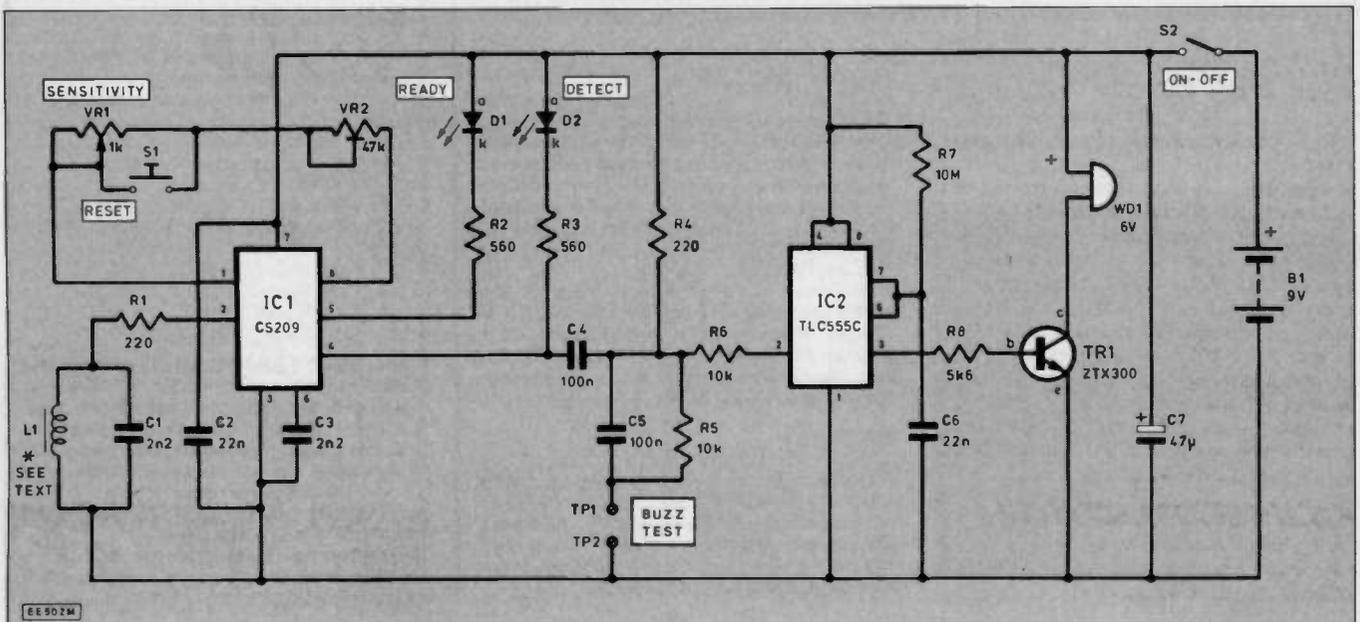
The front panel control VR1 will normally be adjusted for maximum sensitivity at the beginning of each period of use. Push-button switch, S1 (Reset) temporarily reduces the resistance presented to IC1 pins 1 and 8 by short-circuiting VR1. The purpose of this will be explained later.

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 beep is delivered. A further beep 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 beep from WD1 in the manner already described.

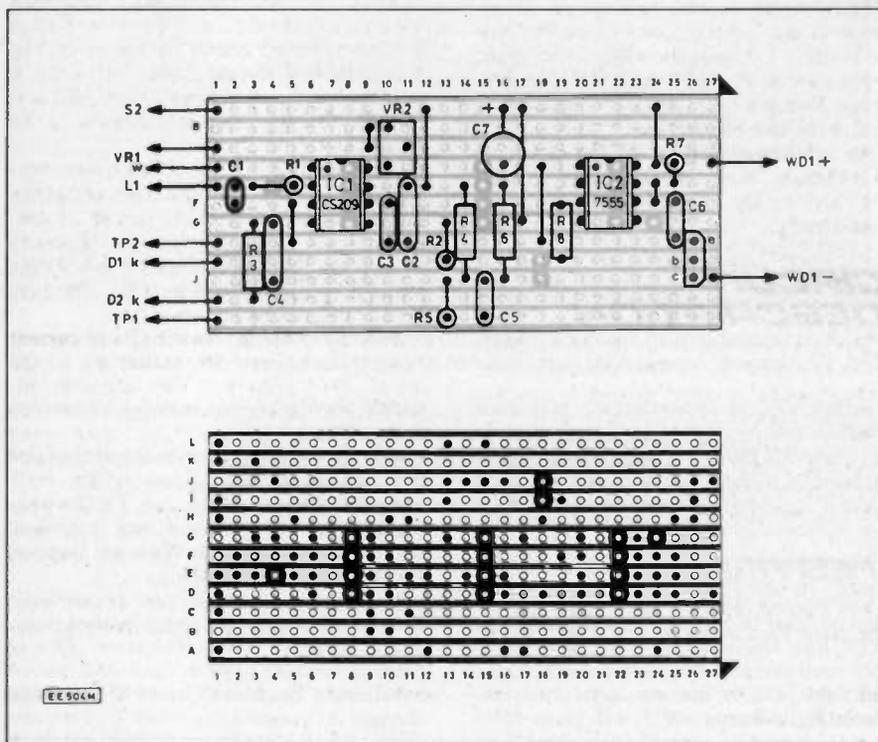


Fig. 2. Stripboard component layout and details of breaks required in the underside copper tracks. IC1 and IC2 should be mounted in i.c. sockets.

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

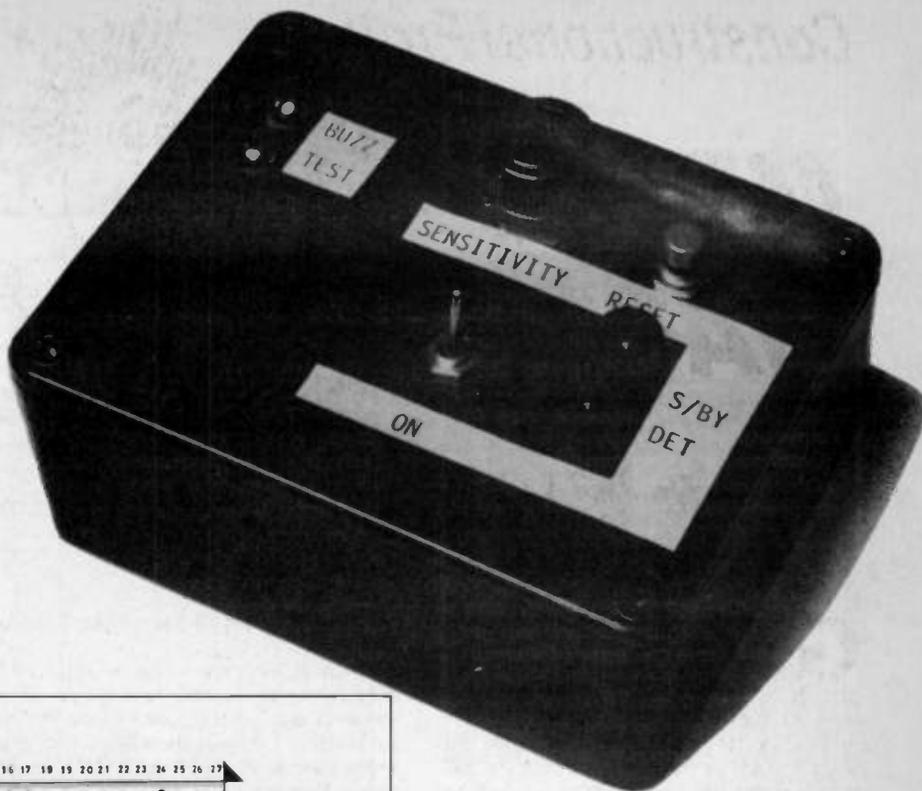
Construction of the Metal Mate is based on a main circuit panel made from a piece of 0.1in matrix stripboard, size 12 strips ×

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.

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

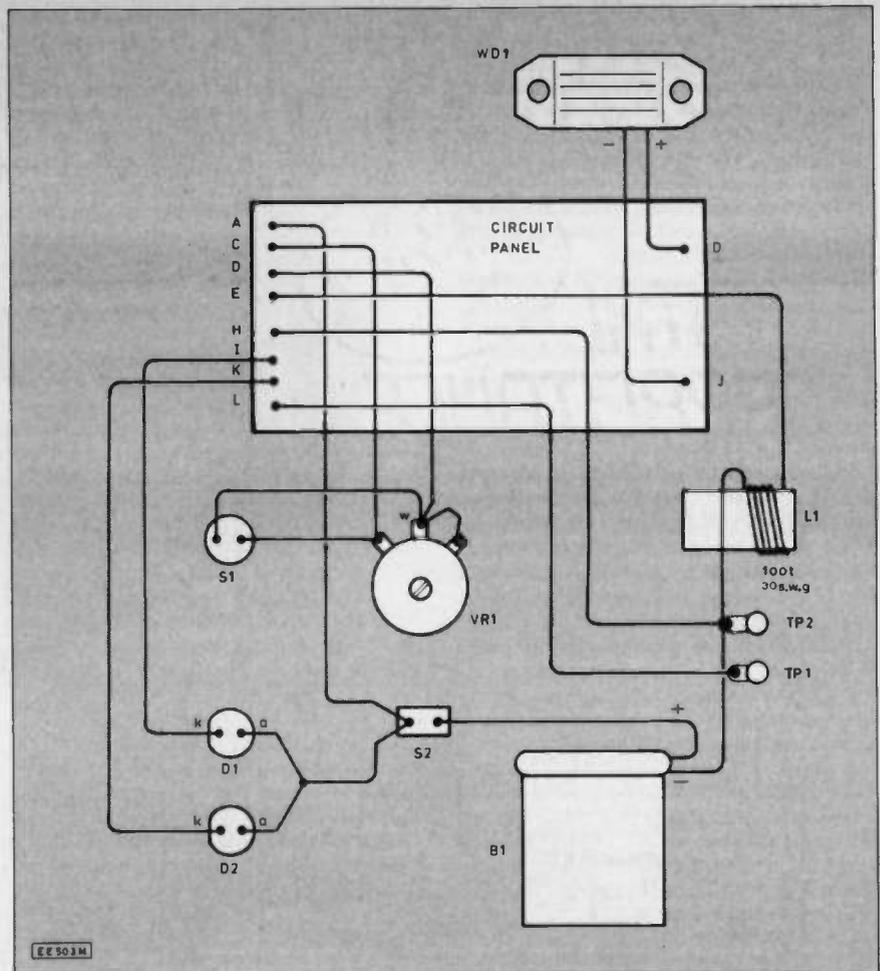
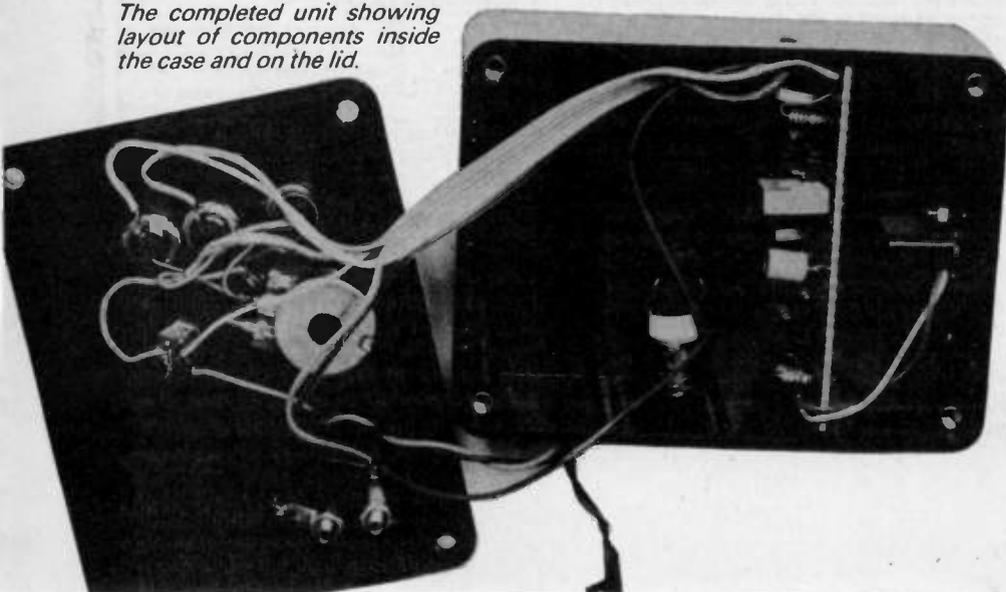


Fig. 3. Interwiring from the circuit board to all off-board components. The terminals TP1/TP2 should have solder tags under their fixing nuts – see photo below.

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.

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. □

A HANDY NEW ADDITION TO OUR VERSATILE MULTIMETER RANGE

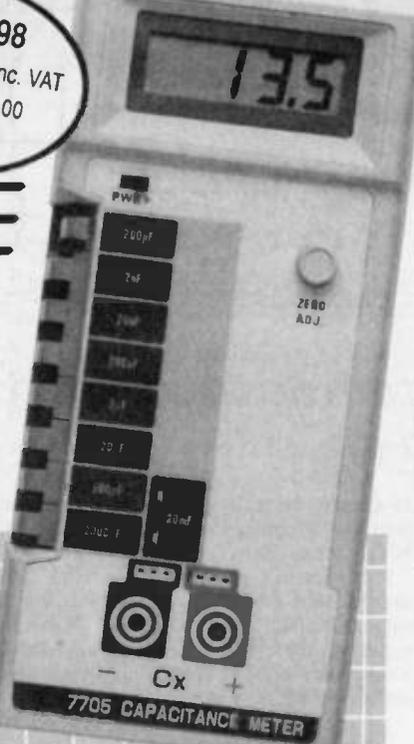
£38.98 inc. VAT
please add £1.00 for p+p

DIGITAL CAPACITANCE METER

An extremely useful hand-held capacitance meter measuring from 1pF to 20,000µF in nine ranges.

Features Include:

- 13mm, 3.5 digit LCD
- Zero adjustment
- Low battery indicator
- One year warranty
- Supplied with battery (PP3), manual and test leads
- Just one of our many low cost Digital Multimeters - send for full details



Specification

ranges	res.	accuracy
200pF	0.1pF	+(0.5% + 1 digit + 0.5pF)
2nF	1.0pF	+(0.5% + 1 digit)
20nF	10pF	+(0.5% + 1 digit)
200nF	100pF	+(0.5% + 1 digit)
2µF	1.0nF	+(0.5% + 1 digit)
20µF	10nF	+(0.5% + 1 digit)
200µF	100nF	+(0.5% + 1 digit)
2000µF	1µF	±(1.0% + 1 digit)
20,000µF	10µF	+(2.0% + 1 digit)
Overload protection	0.25A 250V fuse	
Excitation voltage	3.2V, all ranges	
Dimensions	180 x 85 x 38mm	

OUT NOW!

The new Cirkit Catalogue

- 184 pages
- Discount vouchers
- 1,000's of products



Cirkit

£1.60 inc.

SAME DAY DESPATCH - 0992 444111

Cirkit Distribution Ltd.

Park Lane, Broxbourne, Herts. EN10 7NQ

Tel. Enquiries (0992) 441306 Fax. (0992) 464457



HART AUDIO KITS – YOUR VALUE FOR MONEY ROUTE TO ULTIMATE HI-FI

HART KITS give you the opportunity to build the very best engineered hi-fi equipment there is, designed by the leaders in their field, using the best components that are available.

With a HART KIT you have direct access to the friendly HART service, you are not dealing through, or paying for, any middlemen. Every HART KIT is not just a new equipment acquisition but a valuable investment in knowledge, giving you guided hands-on experience of modern electronic techniques. Telephone or write for our FREE LISTS giving full details of all our Kits, components and special offers. Here are a few selected items: -

AUDIO DESIGN 80 WATT POWER AMPLIFIER



This fantastic John Linsley Hood designed amplifier is the flagship of our range, and the ideal powerhouse for your ultimate hi-fi system. This kit is your way to get EK performance for a few tenths of the cost! Featured on the front cover of "Electronics Today International" this complete stereo power amplifier offers World Class performance allied to the famous HART quality and ease of construction. John Linsley Hood's comments on seeing a complete unit were enthusiastic: - "The external view is that of a thoroughly professional piece of audio gear, neat, elegant and functional. This impression is greatly reinforced by the internal appearance, which is redolent of quality, both in components and in layout."

The standard amplifier comes with the option of a stereo LED power meter and a versatile passive front end giving switched inputs, and ALPS precision, low-noise volume and balance controls. A new relay switched front end option also gives a tape input and output facility. This means that for use with tuners, tape and CD players, or indeed any other 'flat' inputs the power amplifier may be used on its own, without the need for any external signal handling stages. 'Slave' and 'monobloc' versions without the passive input stage and power meter are also available.

All versions fit within our standard 420 x 260 x 75mm case to match our 400 Series Tuner range. ALL six power supply rails are fully stabilised and the complete power supply, using a toroidal transformer, is contained within a heavy gauge aluminium chassis/heat-sink fitted with IEC mains input and output sockets. All the circuitry is on a proper printed circuit with low-resistance blade connectors for the six stabilised DC outputs.

HART KITS don't leave you to fatten a few capacitors to the floor of the main chassis and wire the power supply the hard way! HART wiring is even pre-terminated, ready for instant use! Remember with a HART KIT you get the performance you want at the price quoted through proper engineering design and the right components. We do not insult your intelligence by offering a kit at what seems a fair price and then tell you that you have to spend three times as much to get an

upgraded model!

RLH Reprints of latest 'Audio Design Amplifier' articles.....£2.70
KI 100CM HART Construction Manual with full parts list.....£4.50
Why not buy the reprints and construction manual to see how easy it is to build your own equipment the HART way. The FULL cost can be credited against your subsequent kit purchase.

SPECIAL OFFERS FOR THE NEXT MONTH

All orders for complete kits will get the ALPS Precision Pots in the Passive Input Stage included FREE. We can also include the new Relay Switched Input Stage, normally £57.28, for only £30!

ALPS PRECISION LOW-NOISE STEREO POTS



Now back in stock, the last batch sold out months ago! Exciting range of precision audio pots in values to cover most quality amplifier applications. All are in 2-gang stereo format, with 20mm long 6mm dia. steel shafts, smooth rotation type with no indentations. Now you can throw out those noisy ill-matched carbon pots and replace with the real hi-fi components only used selectively in the very top flight of World Class amplifiers, and HART Kits! The improvement in track accuracy and matching really is incredible giving better tonal balance between channels and rock solid image stability. Values available are 10K and 100K Log, 100K Lin and 10K Special Balance. (Zero loss in centre position). Our prices are incredibly low for pots of this quality due to large purchases for our quality kits.

2-Gang Lin.....£7.59
2-Gang Log.....£8.67
2-Gang Special Balance, zero crosstalk and zero centre loss.....£9.40

LINSLEY HOOD 400 SERIES SUPER HIGH QUALITY AM/FM TUNER SYSTEM

This ultra high quality analogue tuner system is the ideal companion to the 80W Audio Design Amplifier in any ultimate hi-fi setup, with case size, front panel layout and even control pitches unified for stacking. Like the 80W Audio Design Amplifier this is your route to ultimate performance at incredibly low cost! Two designs by John Linsley Hood make up this combination of his ultra high quality FM tuner and stereo decoder and the Synchronyne AM receiver. Novel circuit features in the FM section include ready built pre-aligned front end, phase locked loop demodulator with a response down to DC and advanced sample and hold stereo decoder together making a tuner which sounds better than the best of the high-priced exotic but, thanks to HART engineering, remains very easy to build and set up. The Synchronyne AM section with its selectable bandwidth provides the best possible results from Long and Medium wave channels, so necessary in these days of split programming. If you want the very best in real hi-fi listening then this is the tuner for you. Since all components are selected by the designer to give the very best sound this tuner is

not cheap, but in terms of its sheer sound quality it is incredible value for money. To cater for all needs AM only and FM only versions are available as well as the full AM/FM model, with any unit being upgradeable at any time. For further details see our fully illustrated lists.

RLH7 Reprints of articles describing the 'Synchronyne' Section.....£2.60
INS450 Construction Manual for 'Synchronyne' AM Section.....£2.90
RLH8 Reprints of 3 articles covering the FM Tuner Section.....£2.70
INS400 Construction Manual for FM Section.....£4.90
Don't forget you can buy the construction manual and reprints to see how easy it is and the cost will be credited IN FULL when you buy your kit.

HIGH QUALITY REPLACEMENT CASSETTE HEADS



Do your tapes lack treble? A worn head could be the problem. Fitting one of our replacement heads could restore performance to better than new! Standard inductances and mountings make fitting easy on nearly all machines and our TC1 Test Cassette helps you set the azimuth spot on. As we are the actual importers you get prime parts at lower prices, compare our prices with other suppliers and see! All our heads are suitable for use with any Dolby system and are normally available ex stock. We also stock a wide range of special heads for home construction and industrial users.

HS16 Sennat Alloy Stereo Head, high quality head with excellent frequency response and hyperbolic face for good tape contact.....£17.86
HC40 NEW RANGE High Beta Permalloy Stereo Head, Modern space saver design gives excellent high-frequency response with easy fitting and lower cost. Suitable for chrome, metal and ferric tapes, truly a universal replacement head, with ample quality for hi-fi decks and cheap enough for car players!.....£6.65
HX100 Special Offer Stereo permalloy Head.....£2.86
HRP373 Downstream Monitor Stereo Combination Head.....£44.39
HQ551 4-Track Record & Play Permalloy Head for auto-reverse car players or quadraphonic recording.....£16.79
H524 Standard Erase Head.....£2.59
HQ751E 4/4 AC Erase Head, tracks compatible with HQ551.....£57.06
REEL TO REEL HEADS
999R 2/4 Record/Play 110mH.....£13.34
998E 2/4 Erase Head 1mH, Universal Mount.....£11.96
TAPE RECORDER CARE PRODUCTS
HART TC1 TEST CASSETTE Our famous triple purpose test cassette. Sets tape azimuth, VU level and tape speed.....£5.36
DEM1 Mains Powered Tape Head Demagnetizer, prevents noise on playback due to residual head magnetisation.....£4.08
DEM115 Electronic Cassette Type, demagnetizer.....£8.61

Our new Summer '90 price list is FREE. Send for your copy now. Overseas customers welcome, please send 2 IRCs to cover surface post or 5 for Airmail. We now accept inland and overseas order by post or telephone on all Access, Master and Visa Credit Cards.

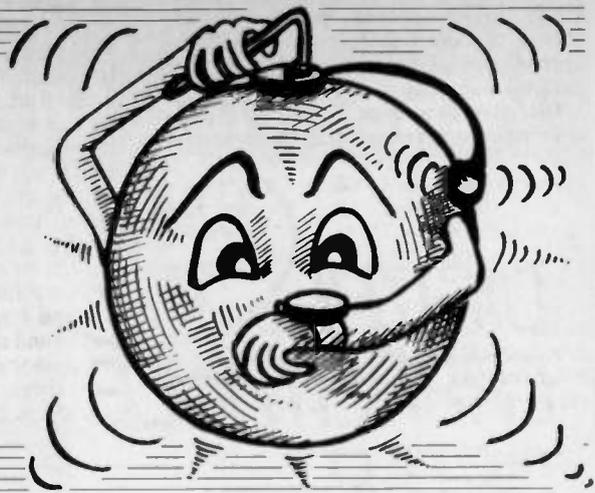
Please add part cost of carriage and insurance as follows:
INLAND: Orders up to £20 - £1; Orders over £20 - £2.50.
Next day - £2 OVERSEAS: Please see the ordering information with our lists.

24hr SALES LINE
QUALITY AUDIO KITS

(0691) 652894

ALL PRICES INCLUDE VAT





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 strip-board.

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:

$$t = 1.1 \times 4.7 \times 10^6 \times 125 \times 10^{-6} = 646.25 \text{ secs} = 10.77 \text{ mins.}$$

Alternative values could be C1 = 100 μ , 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.

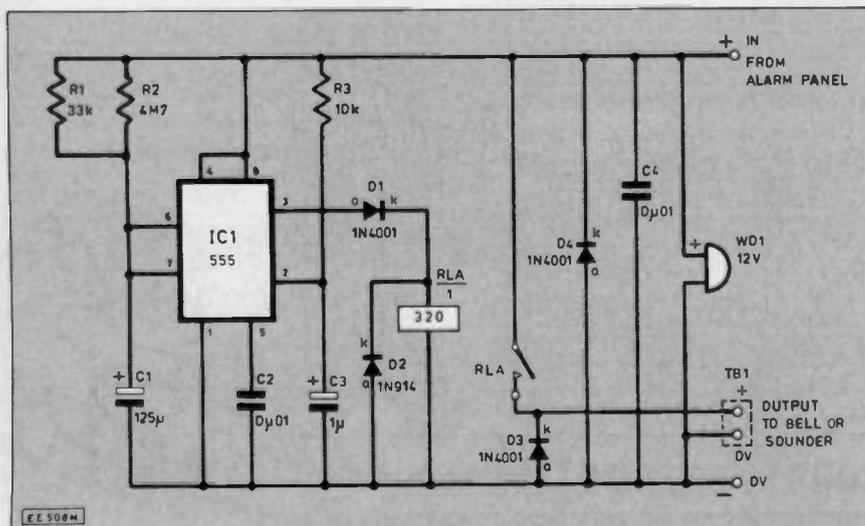
CONSTRUCTION

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 125 μ axial elec. 16V
C2, C4 0 μ 01 polyester (2 off)
C3 1 μ axial elec 16V

Semiconductors

D1, D3 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 it 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.

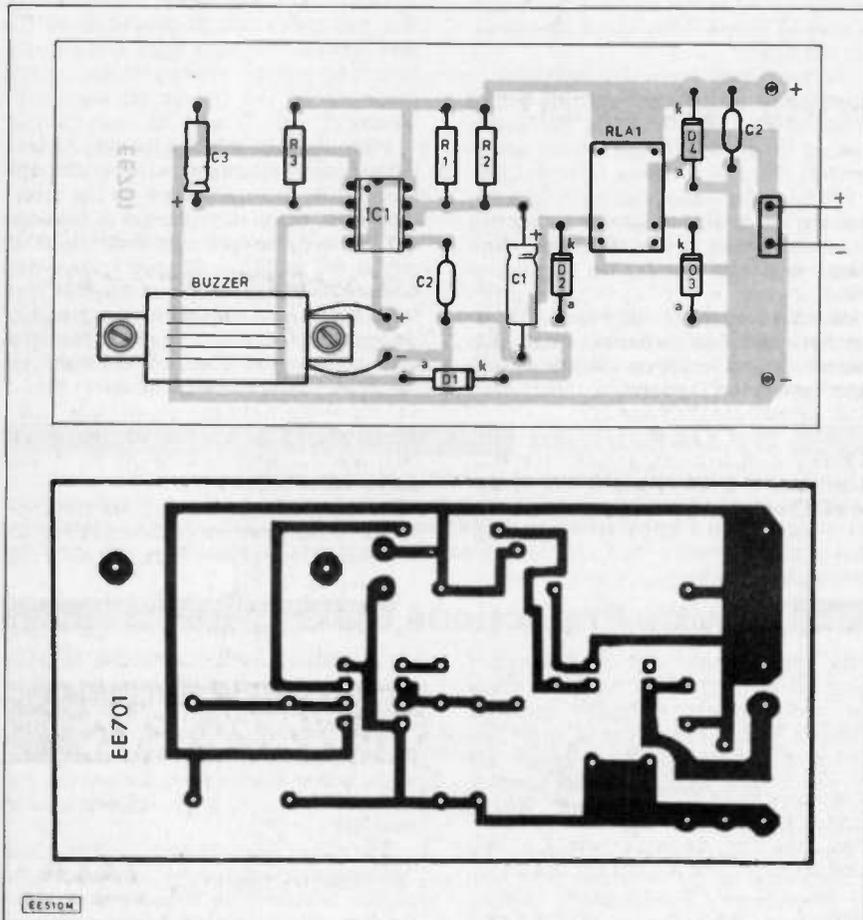


Fig. 2. Printed circuit board component layout and full size copper foil master pattern. The completed circuit board showing the buzzer and relay can be seen below.

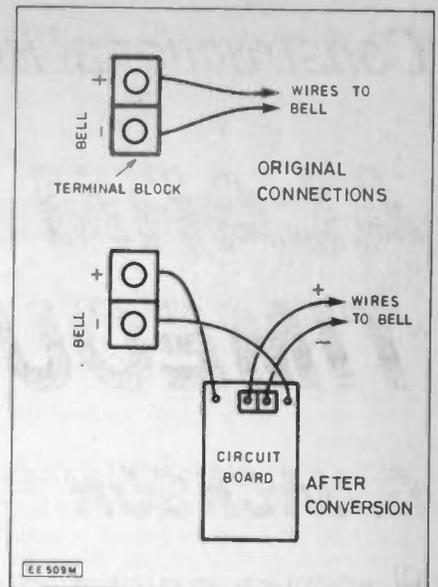
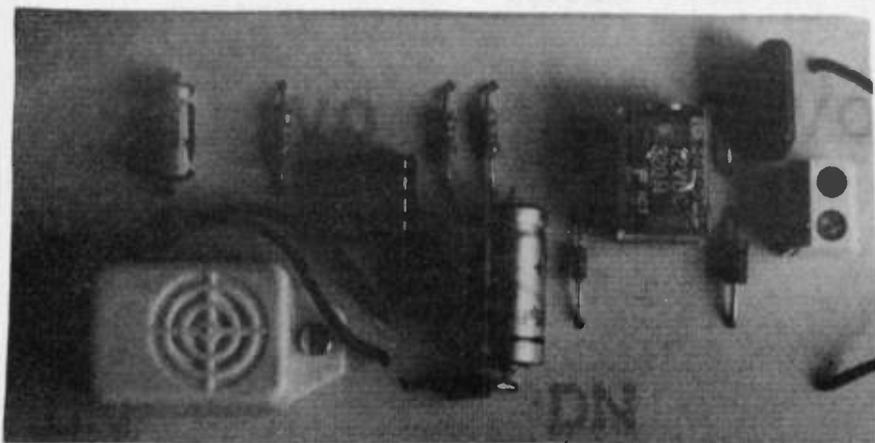


Fig. 3. Connecting the circuit board into the master alarm system.

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 0 μ 1) 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! □



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 played?" 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.

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.

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?

"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.

MARCO Trading

ELECTRONIC COMPONENTS & EQUIPMENT

24HR
ANSAPHONE



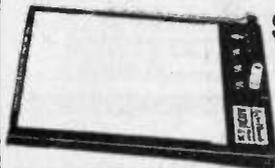
SEND ORDERS TO -
MARCO TRADING
THE MALTINGS, HIGH STREET, WEM
SHROPSHIRE SY4 5EN DEPT 9
Tel: (0939) 32763 Telex: 35565
Fax: (0939) 33800
ELECTRICAL & ELECTRONIC
COMPONENT SUPPLIERS

NEW CATALOGUE
200+ PAGE ELECTRONIC
COMPONENT CATALOGUE
(INCLUDING DISCOUNT
TICKETS) SEND **£1.00**

VISIT OUR SHOPS AT
SUPERTRONICS, 65 HURST STREET, BIRMINGHAM. 021 6666504
WALTONS, 55A WORCESTER STREET, WOLVERHAMPTON. 0902 22039

ALL
PRICES
INCL. VAT

SEPTEMBER SPECIAL OFFER

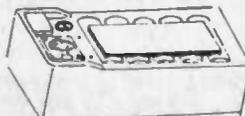


**SOLDERLESS
BREAD
BOARD
£18.99**

YQ35G
Solderless breadboard with a total of 2420 contacts arranged in six blocks of 64 rows of 5 interconnected sockets and ten rows of 50 interconnected sockets on a standard 0.1" pitch. Supplied mounted on a baseboard with four 4mm sockets.
No of contacts.....2420
Contact material.....Silver plated nickel silver
Dims.....243 x 195 x 20mm

12V RECHARGEABLE UNITS

Order Code: SO/132
Price: 1 + **£9.20** (+£2.12 P&P)



10 x 'D' size ni-cads (4ah) encapsulated in black plastic case. Fuse holder. Gives 12V output when charged. Ex-equipment. Fully guaranteed.
Dimensions: 245 x 75 x 75mm
This unit is supplied, depending on availability either in 4-pin or 6-pin version. The price is the same for either version

Please add £1.50 P&P unless stated

FM TRANSMITTER

Very High Quality "MINI-BUG" - Ideal for baby alarms etc! A very good range is obtainable - we have obtained over 1/2 mile, but it does depend on conditions. Simply remove cover - insert battery - and you're ready to go. Reception can be obtained on any FM radio. Frequency: 105-109MHz FM. Power: PP3 9V battery (not included). Dimensions: 4.25 x 2.25" x 0.75". Order Code - 50.004.



Price **£9.99**

FULL RANGE OF
BABANI BOOKS IN STOCK

"CLOSE-CIRCUIT" TELEVISION SYSTEM

1 X CAMERA 1 X MONITOR 1 X CAMERA BRACKET



Price **£175 Plus £12.00 carriage**

AVO 8 METER

Complete with leads and carrying case. In good condition
ONLY £49.00 PLUS £3.50 P&P

OSCILLOSCOPES

TEKTRONIX 2215. Dual Trace 16MHz, Delay Sweep with manual. New Probes. Limited quantity
£500
Inc. VAT (Carriage £12)

TELEQUIPMENT D755 OSCILLOSCOPE
Dual Trace, 50MHz Delay Sweep, Secondhand - Excellent Value - Solid State Full Manuals Supplied.
£300
Inc. VAT (Carriage £12)
ALSO OTHER SCOPES IN STOCK. PLEASE RING

TEST PROBES - X1.X10 ONLY £14.99

JUST ARRIVED TEST EQUIPMENT

Philips (PM3263) Scope (second hand)
100 Meg Dual Beam Delayed Time Base
Price **£950** Plus carriage **£15**

HARTLEY SCOPE 6 MEG

(CT436) Dual Beam (with manual)
£50 Plus carriage £15

RED LED'S 5MM

100 PACK **£4.00**
1000 PACK **£25.00**
Special price on 100's and 1,000 off Limited offer while stocks last

22SWG RESIN SOLDER

500gm. REEL. 1+ 10+
£4.99 £4.75

ALSO 18SWG at **£4.95** 500gm

Orders of 5 or more reels please add a further 75p P&P

DESOLDERING PUMP

£2.99 ORDER CODE TOOL/DESOL



IEC MAINS LEADS

BLACK - 6A 250V
1 + 85P 100 + 65P
(2 metres)

ANTEX IRONS

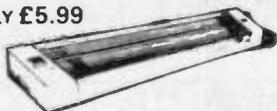
C-15W IRON.....£8.37
CS-17W IRON.....£8.48
XS-25W IRON.....£8.59
XS-KIT 25W.....£11.98
CS-KIT 17W.....£11.87
C-KIT 15W.....£11.98

ALL BITS FOR IRONS - £1.62
ELEMENTS £4.10 STANDS £3.24

ORYX PORTASOL GAS
SOLDERING IRON
£18.75 TIPS £5.50

12V TWIN FLUORESCENT LAMP 12" DOUBLE TUBES

ONLY **£5.99**



ATTRACTIVE WHITE FITTING, RIBBED PERSPEX DIFFUSER, ON/OFF SWITCH, 3FT CABLE, TRANSISTORISED CIRCUITRY, KEYHOLE FIXING 12V DC 8W TUBES, DIMENSIONS: 368 x 67 x 43MM
IDEAL FOR BOATS, CARAVANS, VANS, ETC

QUARTZ HALOGEN SPOT-LIGHT

Hand-held or hanging. 12ft Curly cable. 5 times normal headlamp intensity. On/off switch. Simply plugs into cigar lighter socket

£5.99



NI-CAD CHARGER

Charges AAA, AA, C, D & PP3 Ni-Cads 240V AC



£4.99

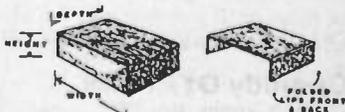
NI-CAD RECHARGEABLE BATTERIES

	PRICE	EACH
AAA	1+	10+
AAA	£1.50	£1.30
AA	95p	85p
C	£1.95	£1.80
D	£2.00	£1.85
PP3	£3.90	£3.75

ABS BOXES BLACK PLASTIC

INTERNAL DIMENSIONS mm	ORDER CODE	PRICE 1+
A B C		
76 58 35	BOX/MB1	£1.24
95 71 35	BOX/MB2	£1.32
115 95 37	BOX/MB3	£1.58
145 95 55	BOX/MB5	£2.20
165 119 75	BOX/MB7	£3.20
207 122 77	BOX/MB4	£4.96
213 142 57	BOX/MB6	£3.78

BOXES P.V.C. COVERED STEEL



WD	DEP	HT	WD	DEP	HT	ORDER CODE	PRICE
INCHES			MILLIMETRES				
4.5	2.25	2.0	114	57	51	BOX/J2	£1.70
6.0	4.0	2.0	153	102	51	BOX/J6	£2.30
8.0	5.5	2.0	204	140	51	BOX/J9	£3.10
11.0	11.0	2.0	280	280	51	BOX/J26	£5.40
4.0	3.0	2.5	102	76	64	BOX/J3	£2.00
6.0	3.0	2.5	153	76	64	BOX/J5	£2.40
8.0	4.0	2.5	204	102	64	BOX/J8	£3.00
9.0	5.25	2.5	230	134	64	BOX/J12	£3.40
5.0	6.0	3.0	127	153	76	BOX/J11	£3.10
8.0	6.0	3.0	204	153	76	BOX/J14	£3.70
8.0	8.0	3.0	204	204	76	BOX/J19	£4.40
11.0	6.0	3.0	280	153	76	BOX/J20	£4.80
11.0	7.5	3.5	280	190	90	BOX/J29	£5.80
17.0	7.5	3.5	433	190	90	BOX/J46	£8.20
8.0	4.0	4.0	153	102	102	BOX/J10	£3.10
6.0	6.0	4.0	153	153	102	BOX/J15	£3.70
6.0	9.0	4.0	153	230	102	BOX/J22	£4.80
8.0	7.0	4.0	204	178	102	BOX/J33	£4.80
8.0	8.0	5.0	204	153	127	BOX/J24	£4.90
11.0	6.0	8.0	280	153	127	BOX/J33	£5.90
18.0	6.0	5.0	380	153	127	BOX/J45	£7.10
8.0	11.0	5.0	204	280	127	BOX/J44	£6.80
11.0	11.0	5.0	280	280	127	BOX/J60	£8.70
15.0	11.0	5.0	380	280	127	BOX/J83	£10.80
7.0	10.0	7.0	178	254	178	BOX/J49	£7.80
10.0	10.0	7.0	254	254	178	BOX/J70	£9.80
17.0	10.0	7.0	433	254	178	BOX/J119	£13.80

MARCO KITS

Ceramic 50V (125).....£3.99
Electrolytics Red (100).....£8.50
Fuse 20mm Q.B. (80).....£4.75
Fuse 20mm A.S. (80).....£8.50
Pre-set Pots Horiz (120).....£7.75
Pre-set Pots Vert (120).....£7.75

RESISTORS

0.25W Popular (1000).....£6.99
0.25W 5 off (305).....£3.75
0.25W 10 off (610).....£5.10
0.5W Popular (1000).....£10.75
0.5W 5 off (365).....£5.40
0.5W 10 off (730).....£8.75
1W 5 off (365).....£16.25
2W 5 off (365).....£25.00
Zener Diodes 5 off (55).....£3.99

HOME ALARM PACKAGE

Includes:
★ Optima Alarm Control Panel
★ External Red Bell Box
★ 2 x 1 Internal Passive I.R.
★ 2 x Door Contacts
★ Siren for bell box
★ 100 mtrs. cable and clips
★ Full fitting instructions
ONLY £115
+ £2.50 CARRIAGE

TDK CASSETTES

AD 90, used once. Bulk erased, good as new, fully guaranteed.
£7.50 for 10 £60.00 for 100
BASF 90 cassettes, used once. Bulk erased, good as new, fully guaranteed.
£5.00 for 10 £30.00 for 100

EIGHTWAY SPLITTER

8-way splitter amplifier to supply 8 TV's from one antenna. White plastic box with aluminium panel. On/off switch with neon.
Band width.....40MHz 860MHz
Gain.....3dB per channel. Total 21dB
Impedance.....75Ω
Max. output.....80mV (38dBmV) signal/cross modulation = 6dB
Noise.....60dB
Isolation between outputs 40dB min
Power.....240Vac 50Hz
Dims.....250 x 100 x 60mm
£29.99

BT APPROVED

Master Socket (Flush).....£3.30
Master Socket (Surface).....£3.25
Secondary Socket (Flush).....£2.05
Secondary Socket (Surface).....£2.50
B.T. Cable (per metre).....15p
100M.....£12.00
Line Jack Cord with Plug.....£2.20
Extn. Lead 5 metres.....£4.30

SERVICE MANUALS

SONY SL-C5/6/7/9
FERGUSON VMSTJ1/3V00/MR3330EK
FERGUSON VMSTJ1/3V22/MR3320EK
ALL £8.00 EACH

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.

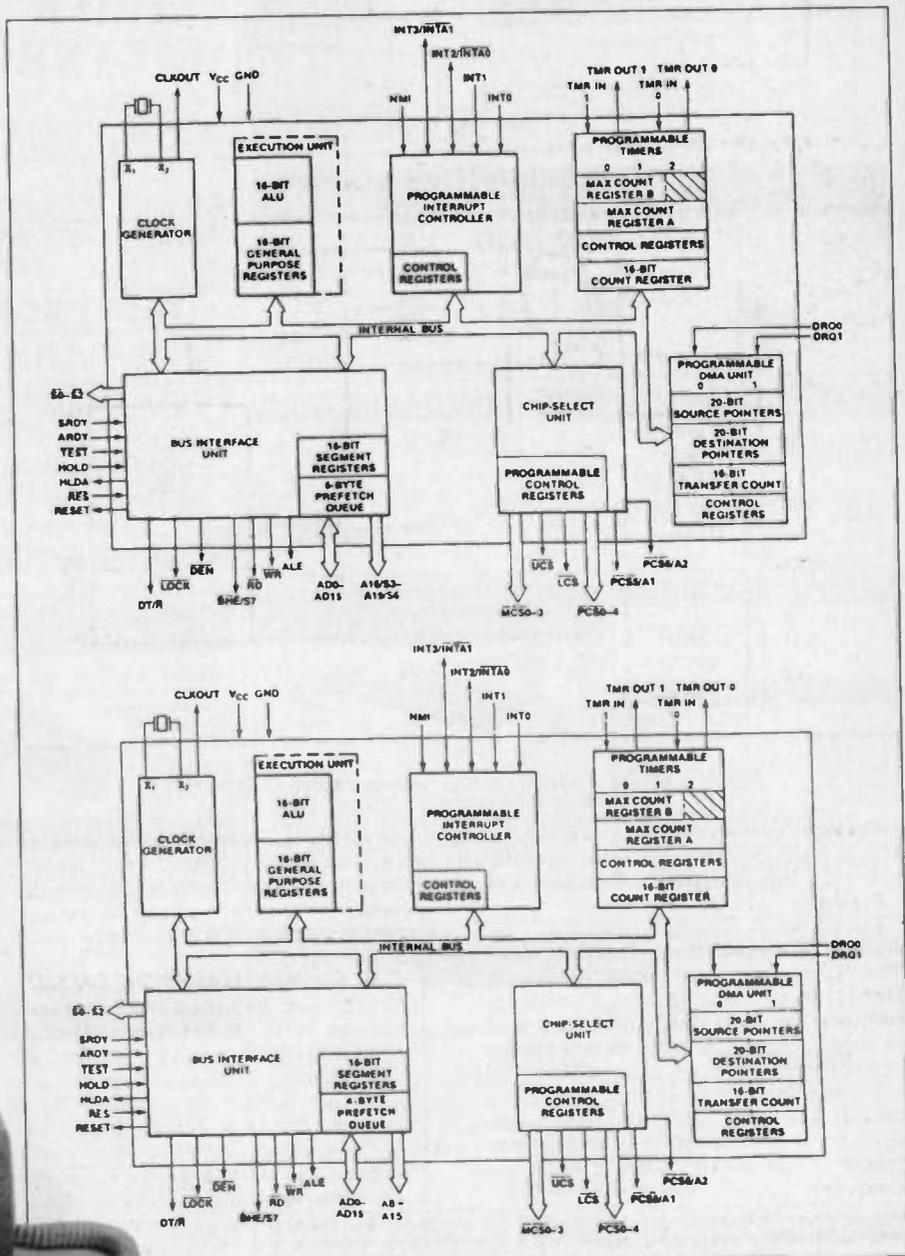


Fig. 1. 80186 and 80188 block diagrams.

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

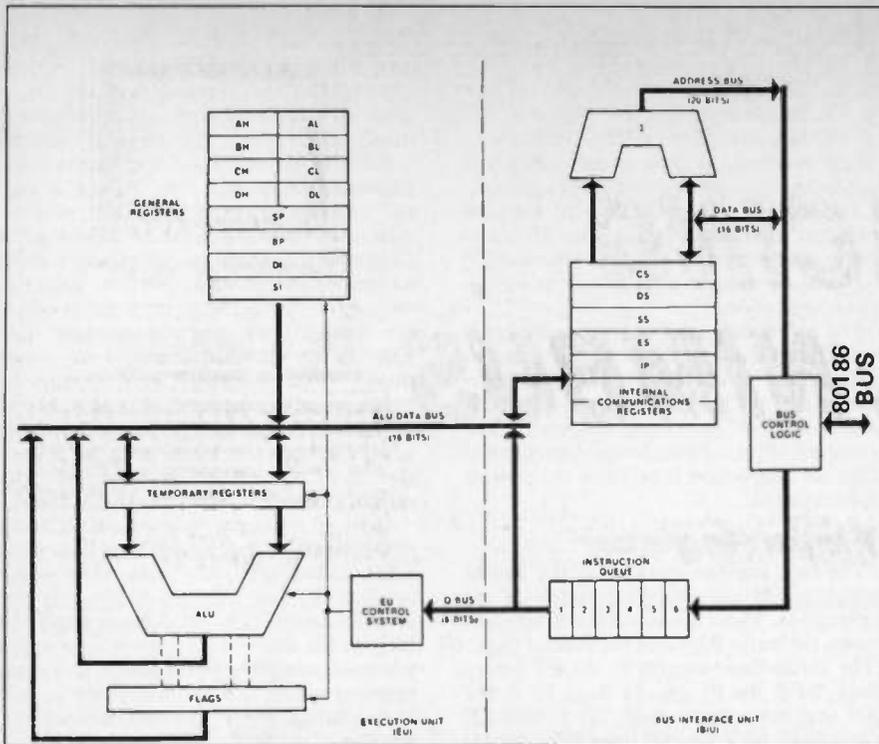


Fig. 2. 80186 architectural schematics.

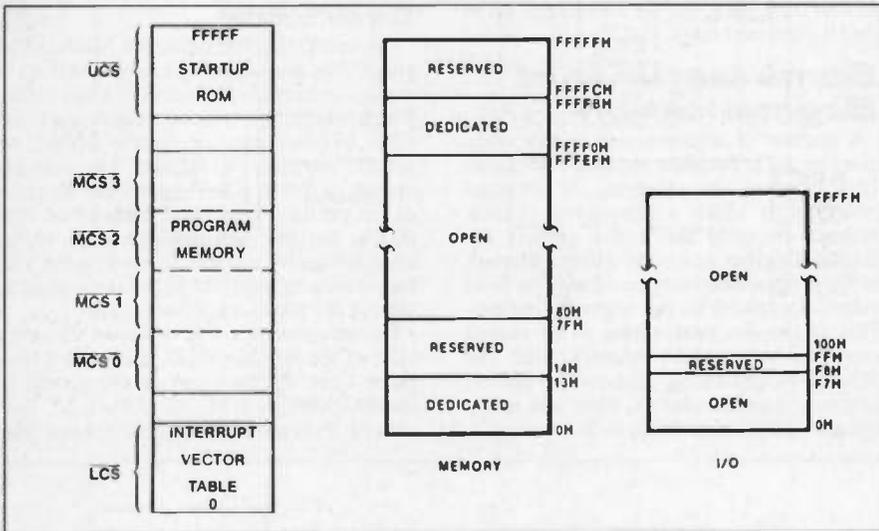


Fig. 3. and Fig. 4. (right) CPU, memory and I/O allocation.

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 FFFFH 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

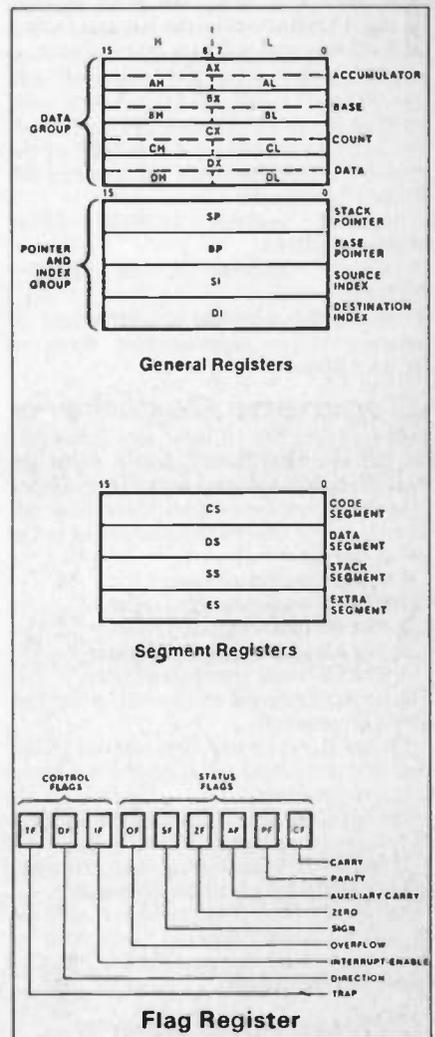


Fig. 5. Available register structure.

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 its 16-bits which reflect the processor status of its 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 \times 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

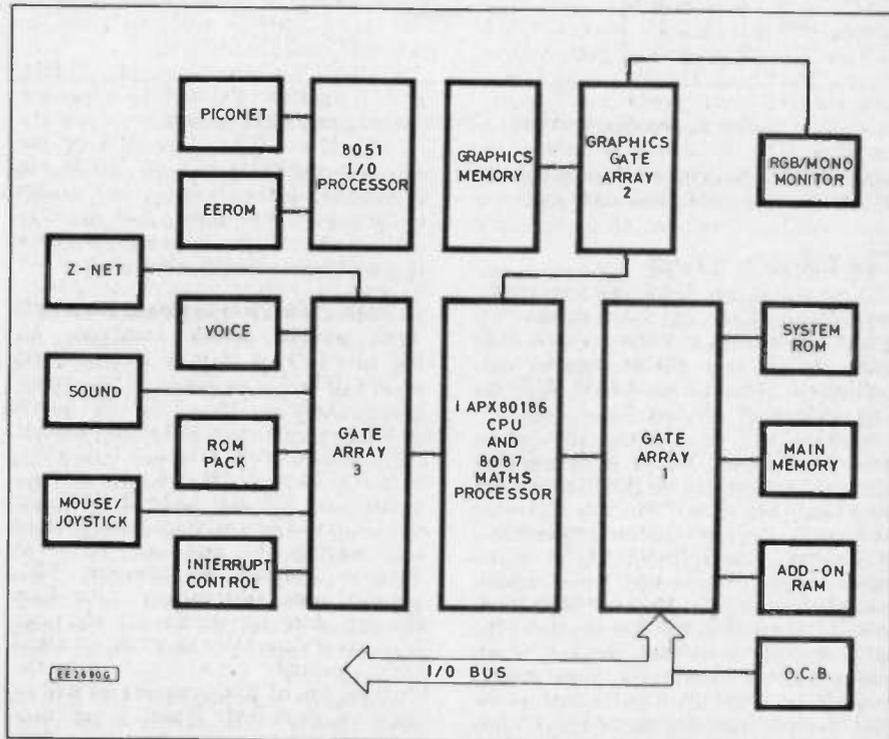


Fig. 6. Nimbus BCU schematic.

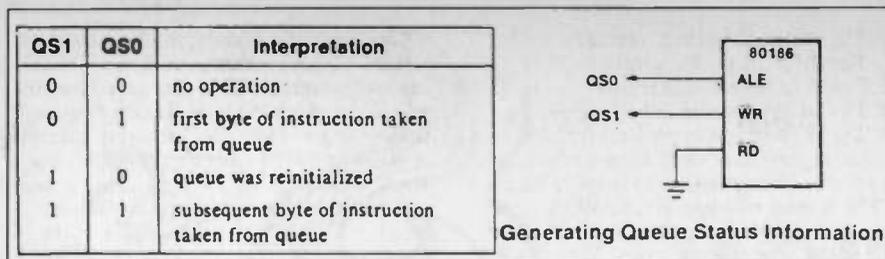


Fig. 7. 80186 queue status.

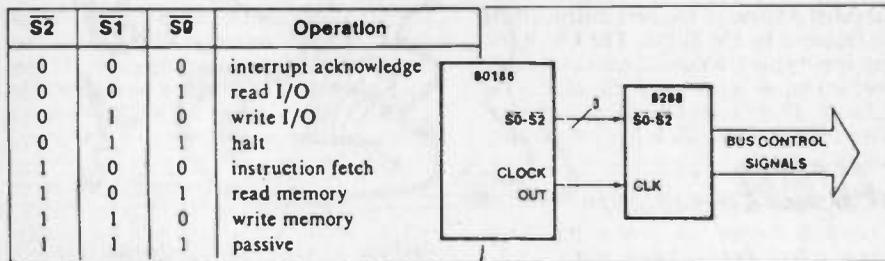


Fig. 8. Generating bus control signals.

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:

- the 8051 interface (ports C0, C2)
- the Rompacks (ports D2, D6, E0, E2)
- the voice output (ports B0, B2)
- the mouse/joystick (ports A0, A2, A4)
- the sound chip (ports E0, E2)
- the CHAIN logic/Z80-SIO (ports F0, F2, F4, F6)
- 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 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 transceivers 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.

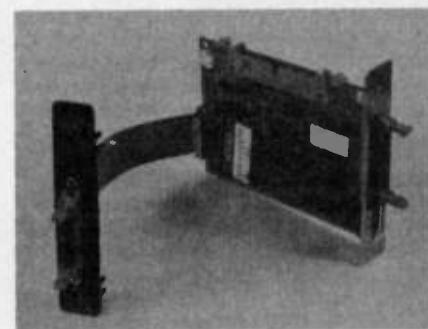
The 80186 has four interrupt channels, these are the input pins INT0, INT1, INT2 and INT3. However, INT2 can be used as an acknowledge (INTA0 - therefore output) for INT0, and INT3 an acknowledge (INTA1) for INT1.

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, thermionic valves were used for amplification of any sort. Despite the obvious drawbacks of valve audio equipment, it is often still used because of its 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.

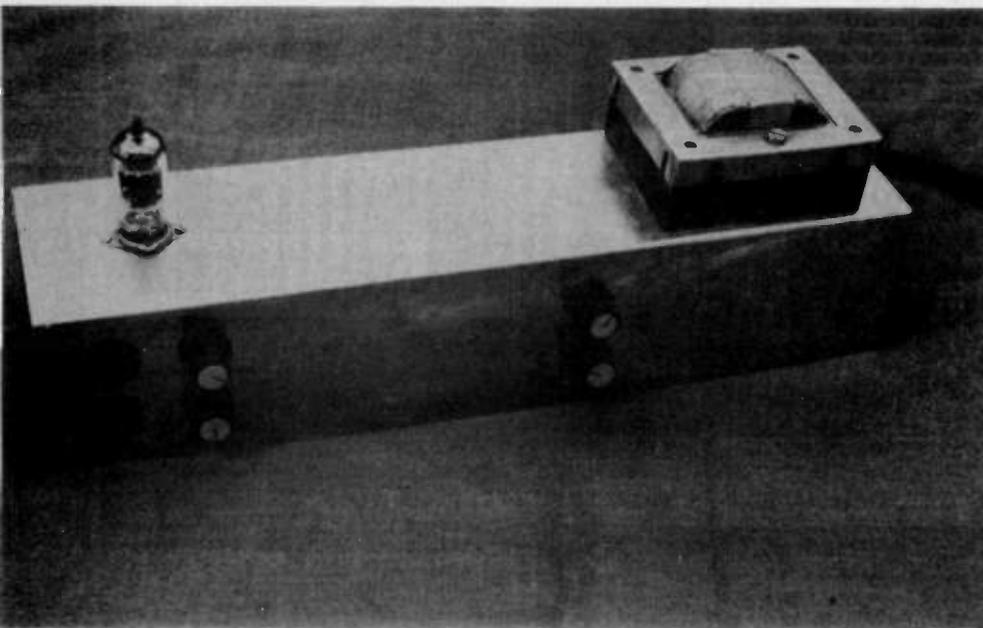
The ECC83 requires a h.t. voltage of over 240V d.c. and 6.3V a.c. to power the heater filaments, so a special transformer must be used. Due care must be given when building and testing the unit - *the high voltages are dangerous especially if you do not know what you are doing*. Apart from the valve, 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



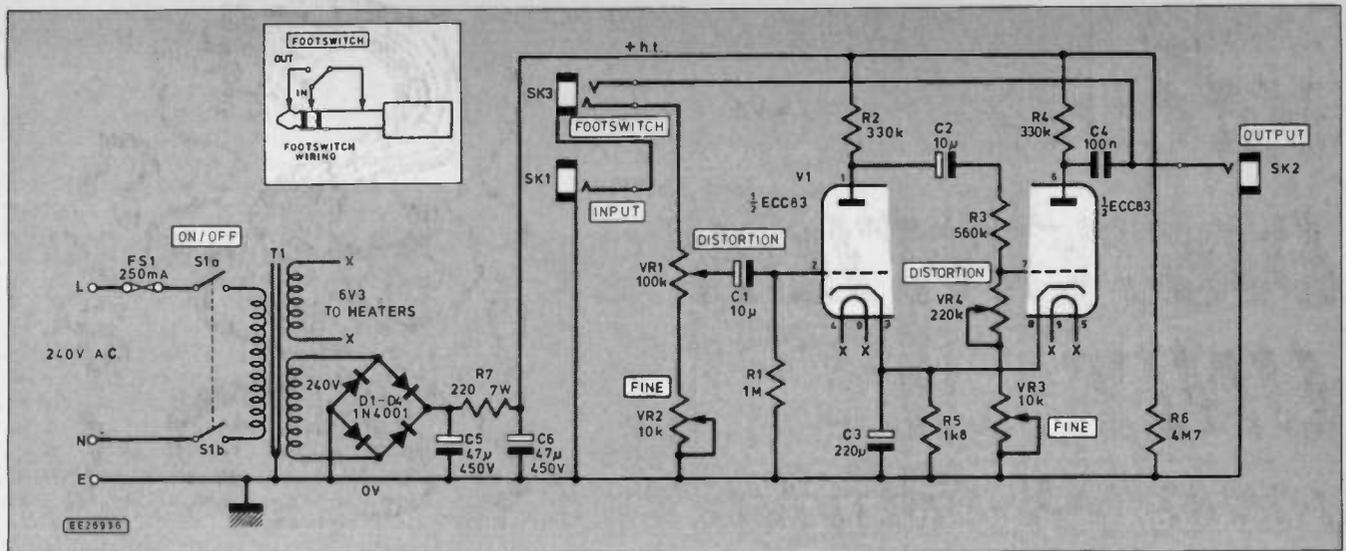


Fig. 1. Complete circuit diagram of the Valve Distortion Unit.

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 Switch 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 10 μ elect. 63V
- C2 10 μ elect. 450V
- C3 220 μ elect. 100V
- C4 100n polyester 400V
- C5, C6 47 μ 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 1/4in. jack socket (2 off)
 - SK3 Stereo 1/4in. 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

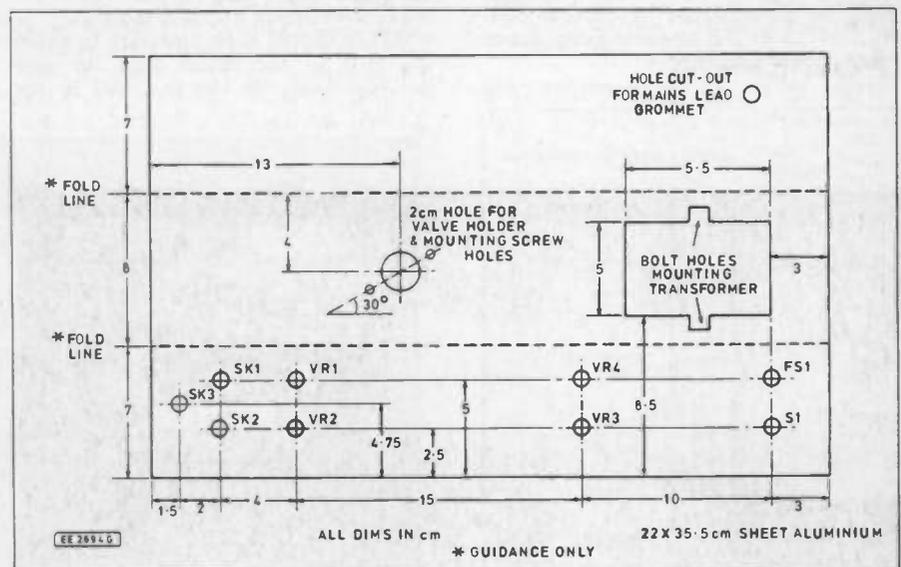
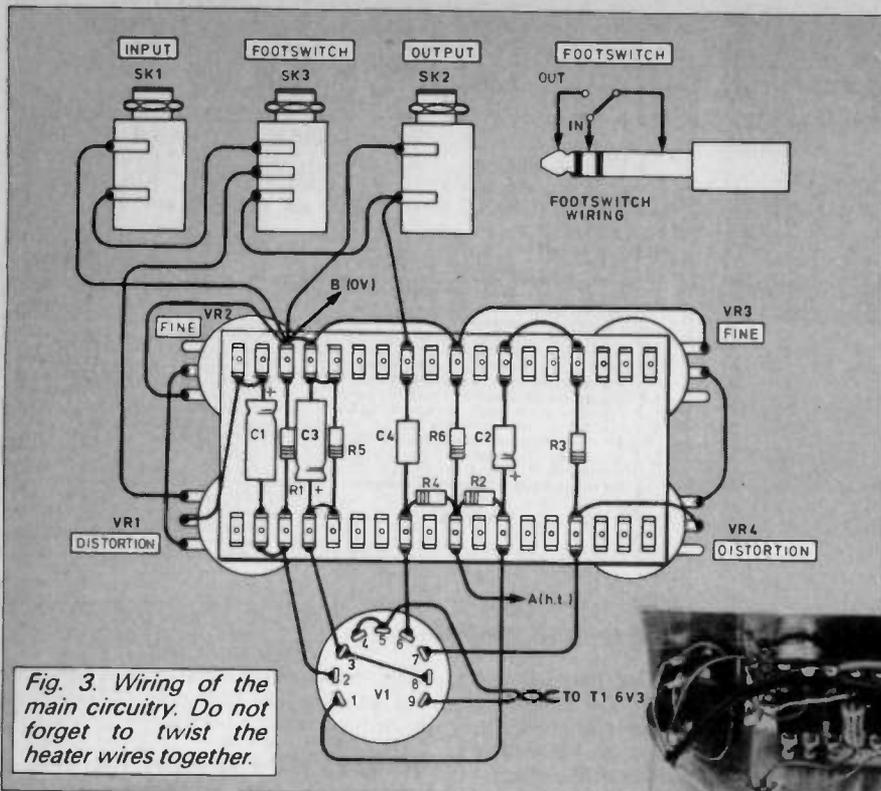


Fig. 2. Chassis drilling, the valve has been moved since construction of the prototype to make the wiring neater.



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

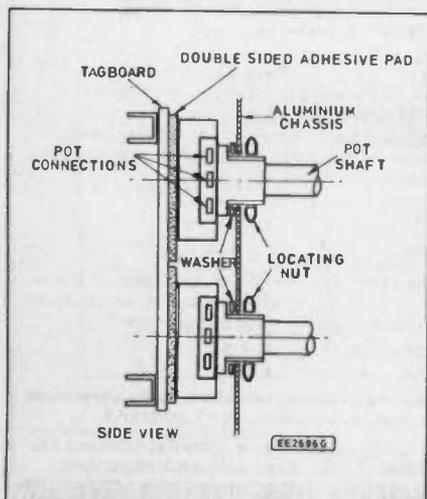


Fig. 4. Mounting of the potentiometers and tagboard.

capacitors to the tagboard. Then add the variable resistors. These are mounted on the reverse side 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

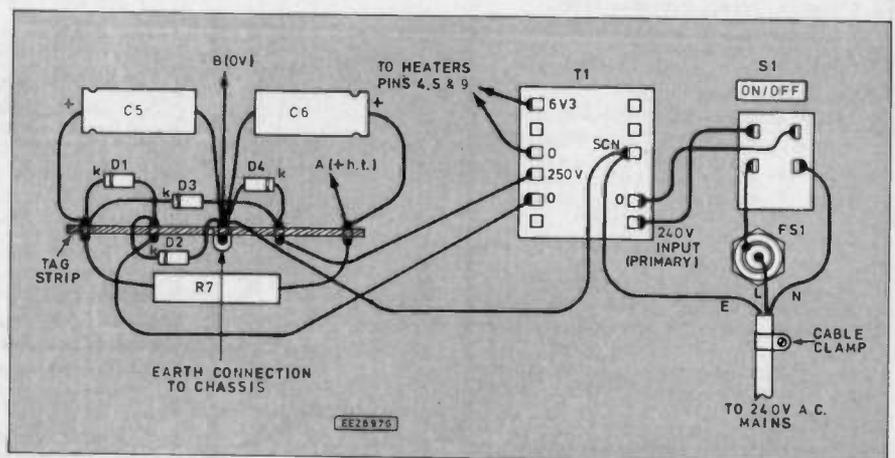


Fig. 5. Wiring of the power supply. Make sure the centre tag on the tag strip is properly earthed.

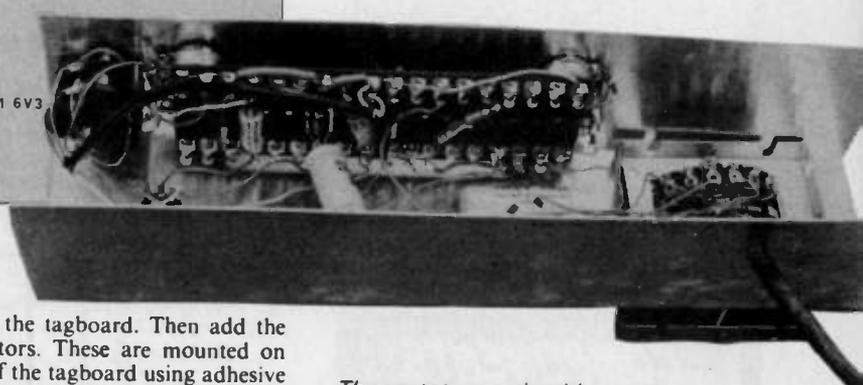
smoothing capacitors should not be ignored. Make sure that the capacitors have had time to discharge through the 4M7 resistor R6 – DO NOT short out the capacitors, as this is dangerous.

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



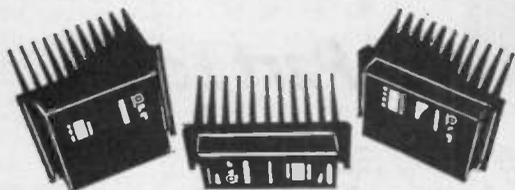
The prototype unit with the underside of the chassis removed.

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 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.	£36.80
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



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
Mitsubishi 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 1 1/2 digit display ref. MAN 6730	30p	each
Murata Piezo transmit PKD 33EQ	£2.50	each
Schaffner filters Ref FN-346-DT to BS613 110/250V 50/60Hz	£5.00	each
Bourms turns counting dials H490 series 1" dial	£2.50	each
Aromat DX2 1 2V 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
115/240V a.c.	80mm sq x 20mm deep	£6.00
	119mm sq x 38mm deep	£6.00
	92mm sq x 15mm deep	£6.00
	92mm sq x 24.4mm deep	£6.00
Subminiature precision p/b switch 0.4A 20V		25p
Mabuchi 12-24V small electric motors		£2.00
Takamisawa MAT4ZB-CR 24V AC coil relays		50p
Memory DAC 9356-12		£2.00
MCM 6164C45 Static Ram		£2.00
CY7C 2452-35PC Ram		£5.00
CD 4044 8CN CMOS		£5.00
TMS 44C56 D Ram		£2.00
AD 8515 Analogue device		£5.00
AD574KD		£5.00
AD 625CA		£5.00

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

ELECTRONIZE DESIGN tel. 021 308 5877
2 Hillside Road, Four Oaks, Sutton Coldfield, B74 4DQ

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

I 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?

I 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 "sub-routines" are available in ROM.

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

I 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?

I 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?

I 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.

I 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)

MNEM.	Description	IMMED.	ABS.	MODES		
				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 logic gates (CARDS 2, 3).
F9CB		NAND/NOR GATES	
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 centisecc., 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.

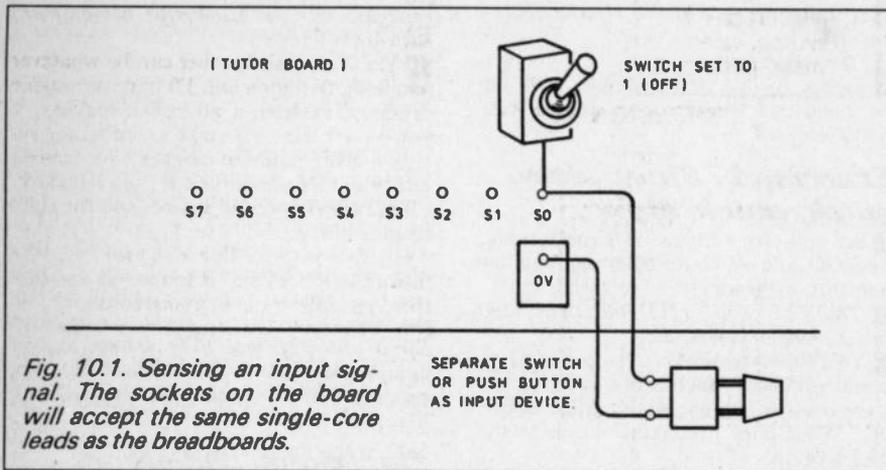


Fig. 10.1. Sensing an input signal. The sockets on the board will accept the same single-core leads as the breadboards.

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?

I 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.

I 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?

I 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?

I 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?

I 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:

ADDRESS	LABEL	CONTENTS		MNEMONIC	COMMENT
		op-code	data		
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.

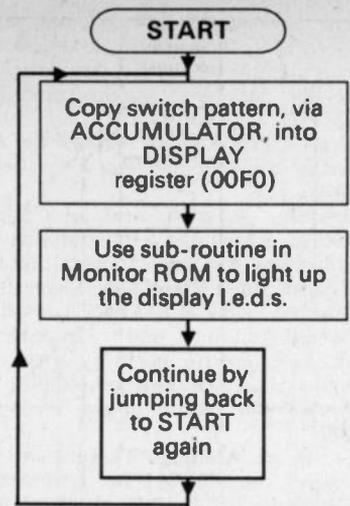


Fig. 10.2. Flow diagram for showing switch pattern on selected display l.e.d.s. In our case "status" display Monitor display S/R starts at F887.

I 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?

I 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.

- 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.

I Good. before we leave it, let's look further into the way the program works. Can you see what the first two instructions do?

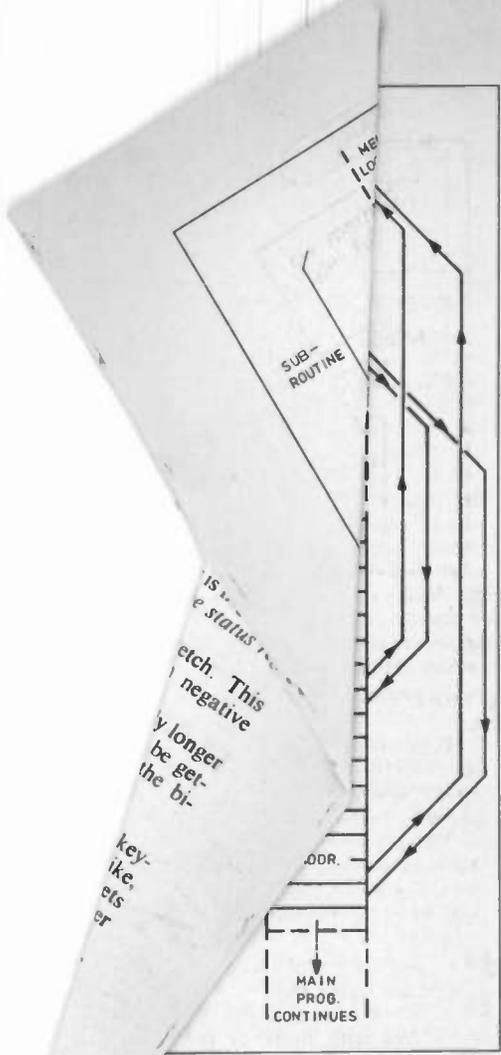


Fig. 10.3. Operation of calling a sub-routine. The same S/R may be called more than once.

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.

I 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?

I 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?

I 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?

I 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.

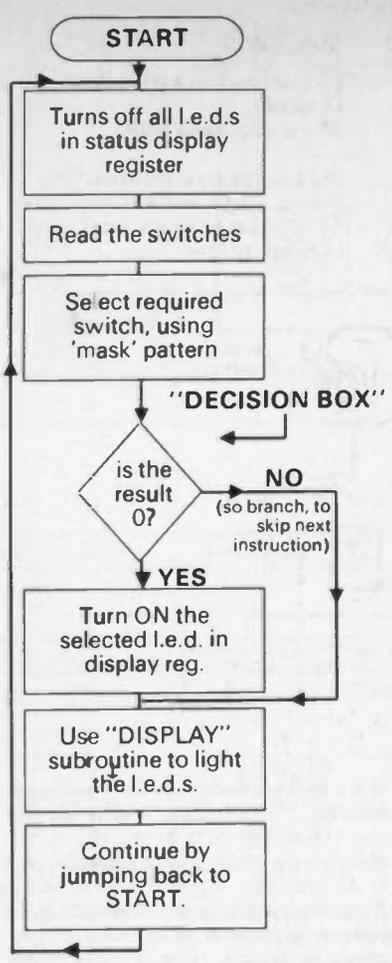


Fig. 10.4. Flow diagram for testing a switch, e.g. to demonstrate NOT gate action.

ADDRESS	LABEL	op-code	CONTENTS 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!

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?

I 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?
I 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 imi-
tate 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?
I 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 deci-
sion box?
I Let's look at the listing in more detail:
(This is for my version, a NOT gate simula-
tion).
S You've read the switches into the accum-
ulator BEFORE using the AND instruction.
I I have. It doesn't matter which you do
first, as long as you AND the switch pat-
tern with the mask pattern. The result of
this operation is what determines the out-
come of the BRANCH instruction.
S Does it use a flag in the status register?
I 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.
I 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.

```

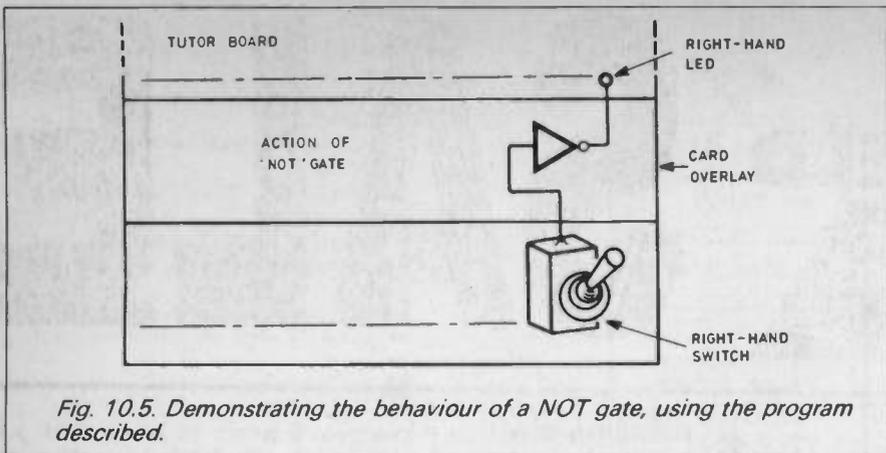


Fig. 10.5. Demonstrating the behaviour of a NOT gate, using the program described.

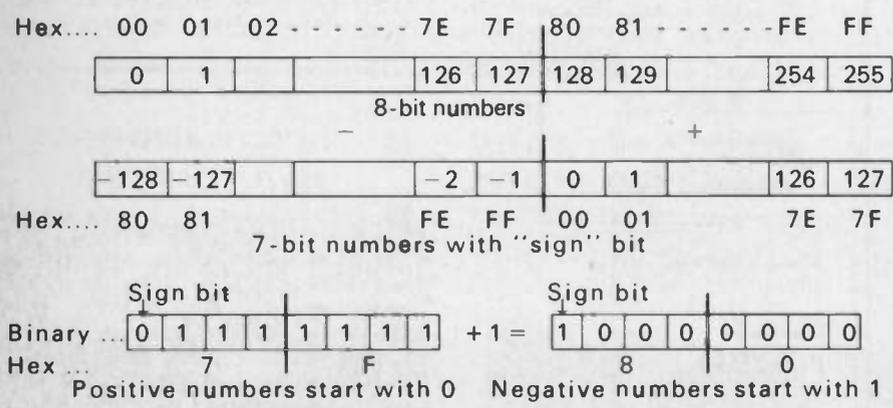


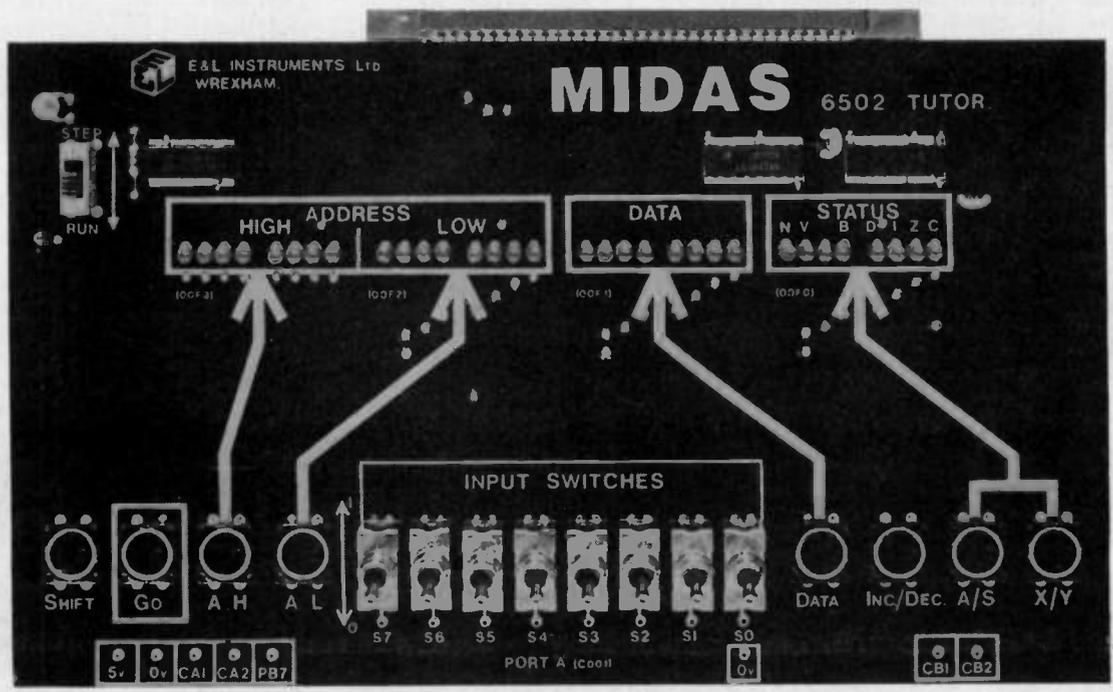
Fig. 10.6. The use of the Most Significant Bit (MSB) as a SIGN BIT, with a 7-bit value following. Used by micro in arithmetic and branch instructions.

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?
T It can, because this instruction uses "di-

rected number
 negative value
 them now, before
S (most) Yes, you want to say, positive or
T Well, as we need? that is to say, positive or
 numbers in this case? you want to discuss
 255, as usual, but tricky!
S That's still 256 a bit does, is
T Yes, and it then a 7-bit binary
 with everything less than 0 to
 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 only
 way 127 places. In effect, the
 number is a "sign bit", if it's
 is positive, if it's 1, the number
S There's a negative flag in the
 ister.
T Yes, the N flag in our st
 is how the micro can deal with
 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 the
 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 con-
 nected.
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

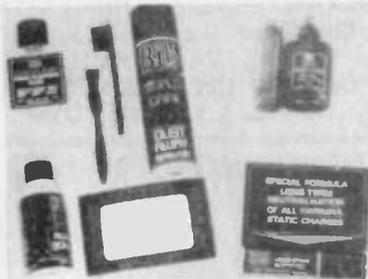


Z9001 Over the years we've purchased large quantities of various flash units - these must now all go. In this parcel you'll find all sorts of flash units from the pages of our catalogue plus some never previously listed!

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

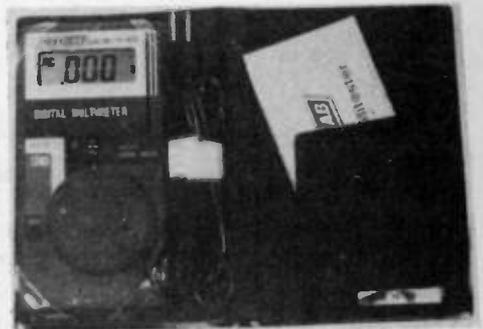


Z9005 Put the fun back into music! - this turns the computer screen into a music stand, complete with scrolling. Plus a stereo cassette with 6 recorded backing tracks including Ghostbusters and Superman. Available for keyboard, concert plth and B^b (state which required). Was £17.25

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)

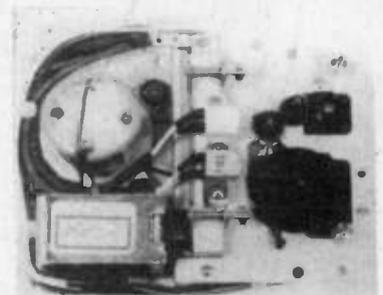
Resistance: 200R 2k 20k 200k 2M 20M

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

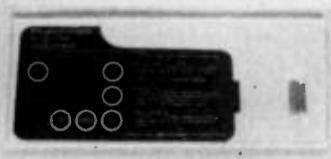
£1.00

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 alloy 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 case! £9.95

SALE PRICE £5.00

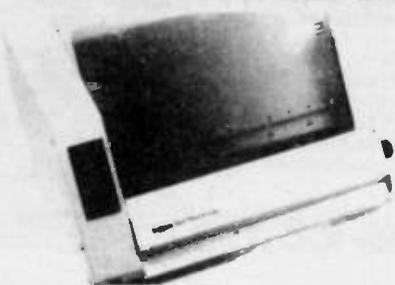
AUTO DIALLER



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



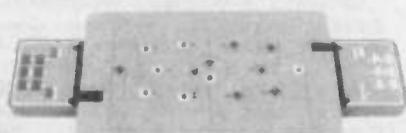
Z8837 Exxon Dual Sheet Feeder Z200. Overall 395x210x285mm. Brand new and containing some very high class electronics. Although of little practical use as it stands, it makes a great break down unit. It contains: 3x12V 36R 7.5" stepper motors by Airpax and associated gear trains drive belt etc. 2x12V 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'

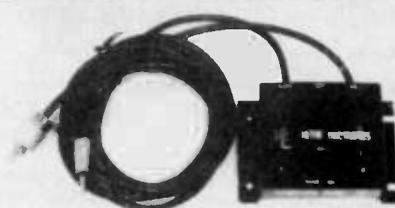
the electronic football game of skill



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!

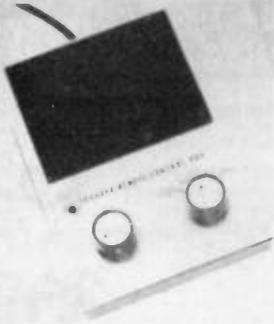
HEADPHONES



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

SALE PRICE £1.00

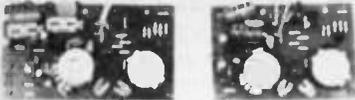
REMOTE CONTROL



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

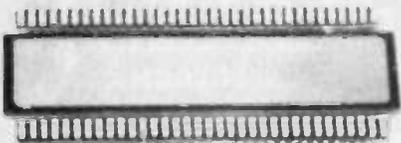
1W Amplifier - stereo

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

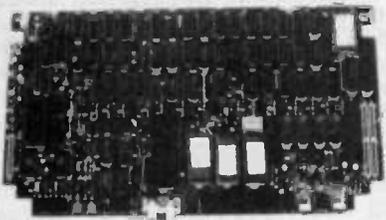
DISPLAYS



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

SALE PRICE **£1.00**

MICROPROCESSOR PANEL



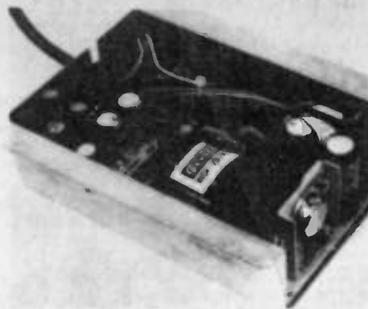
Z494 Newbrain Motherboard. Micro-processor panel 265x155mm. Complete PCB for computer, Z80, EPROM, etc. 68 chips altogether + other associated components, plugs, sockets, etc. Brand new in original packing. £5.50

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

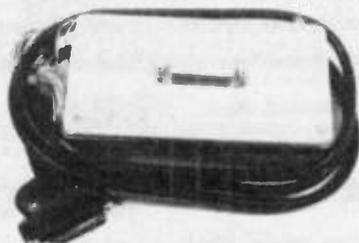
Size: 160x104x45mm

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.

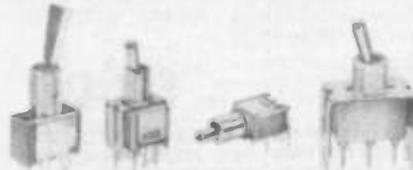
SALE PRICE **£6.95**

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

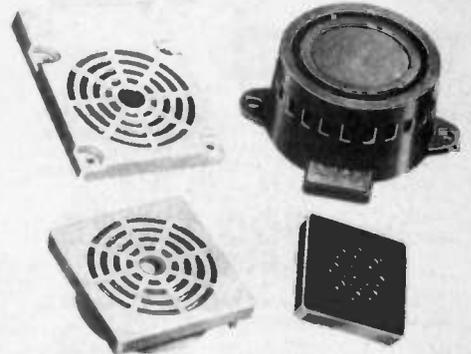


K586 This one's an absolute gem! Contains a selection of conventional and switch mode power supplies, including AA12531, Z4215, Z4302 + 7 others!! Parcel of 10 originally selling for £40+.

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**



COMPONENT PACKS - ALL 1/2 PRICE

GREENWELD - THE PACK PEOPLE!

More packs - more in them - more value!
All our packs contain brand new, marked full spec. components (unless otherwise stated) at a fraction of the normal price and offer constructors the widest range of parts at the lowest cost! How do we do it? By buying manufacturers end-of-run and surplus components. Because we purchase from many sources, we have an extremely wide range of top quality parts - too costly to sort hence the packs described below. Our larger packs are ideal for schools, groups or clubs.

SEMICONDUCTORS

K517 Transistor Pack - 50 assorted full spec. marked plastic devices PNP NPN RF AF. Type numbers include BC114 117 172 182 183 198 239 251 255 320 BF198 255 394 2N3904 etc., etc. Retail cost £7+ Special low price £2.75

SALE PRICE **£1.37**

K547 Zener Diodes - Glass and plastic, 250mW to 5W ranging from 3V to 180V. All readily identifiable. 100 for £4.50

SALE PRICE **£2.25**

K537 I.C. Pack - a mix of linear and logic chips, from 6 to 40 pin. All are new and marked, but some may not be full spec. 100 £6.75

SALE PRICE **£3.37**

K538 Diode Pack - untested small signal diodes like IN4148 etc. at a price never before seen!! 1,000 £2.50

SALE PRICE **£1.25**

RESISTORS

K540 Resistor Pack - mostly 1/8W, 1/4W and 1/2W, also some 1W and 2W in carbon, film, oxide etc. All have full length leads. Tolerances from 5% to 20%. Excellent range of values: 500 £2.50; 2,500 £11.00

SALE PRICES **500 £1.25**
2,500 £5.50

K503 100 Wirewound Resistors - From 1W to 12W, with a good range of values. £2.00

SALE PRICE **£1.00**

K531 Precision Resistor Pack - High quality, close tolerance R's with an extremely varied selection of values mostly 1/4W and 1/2W tolerances from 0.1% to 2% - ideal for meters, test gear etc. 250 £3.00 1,000 £10.00

SALE PRICES **250 £1.50**
1,000 £5.00

K505 20 Assorted Potentiometers - All types including single, ganged, rotary and slider. £1.70

SALE PRICE **£0.85**

K525 Preset Pack - Big, big variety of types and sizes - submin, min and std, MP slider, multirun and cermet are all included. Wide range of values from 20R to 5M. 100 assorted £8.75; 250 £12.95

SALE PRICES **100 assorted £3.37**
250 £6.50

CAPACITORS

K544 Mullard Polyester Caps - Cosmetic imperfections, electrically OK. Wide range of values from 0.01 µF to 0.47 µF in 100, 250 and 400V working. 200 for £4.75

SALE PRICE **£2.37**

K546 Polystyrene/mica/ceramic caps - Lots of useful small value caps up to about 0.01 µF in voltages up to 8kV. Good variety. 100 £2.75

SALE PRICE **£1.37**

K528 Electrolytic Pack - Both cropped for PCB mounting and full length lead, this pack offers excellent value for money. Good range of values and voltages from 0.47 µF to 1000 µF, 6V to 100V. 100 £3.95 250 £8.95

SALE PRICES **100 £2.00**
250 £4.50

K518 200 Disc Ceramic Caps - Big variety of values and voltages from a few pF to 2.2 µF: 3V to 3kV. £1.00

SALE PRICE **£0.50**

K530 100 Assorted Polyester Caps - All new modern components, radial and axial leads. All values from 0.01 µF to 1 µF at voltages from 63V to 1000V!! Super value at £3.95

SALE PRICE **£2.00**

SWITCHES & RELAYS

K520 Switch Pack - 20 different assorted switches - rocker, slide, push, rotary, toggle, micro, etc. Amazing value at only £2.00

SALE PRICE **£1.00**

W4700 Push Button Banks - An assortment of latching and independent switches on banks from 2 to 7 way, DPCO to 6PCO. A total of at least 40 switches for £2.95 100 £6.50

SALE PRICES **40 £1.50**
100 £3.25

K532 Relays - Wide selection of styles - voltages and contacts. 4V-240V, AC/DC, SP to 4PCO 20 for £6.00

SALE PRICE **£3.00**

K542 Reed Relays - Mostly DIL, single pole and double pole also some changeover, these are manufacturers rejects, but a good proportion work. 5V-50V coils 50 assorted £3.30

SALE PRICE **£1.65**

K569 Reed Switch Pack - A selection of about 15 types of reed switch from submin 12mm long to 5A rated 50mm long, mostly form A (make), few form C (Changeover). Pack of 30: £2.75

SALE PRICE **£1.37**

OPTO

K539 LED Pack - Not only round but many shaped LEDs in this pack in red, yellow, green, orange, and clear. Fantastic mix. 100 £5.95

SALE PRICE **100 £3.00**

K524 Opto Pack - A variety of single point and 7 segment LEDs (incl. dual types) of various colours and sizes, opto isolators, numicators, multi digit gas discharge displays, photo transistors, infra red emitters and receivers. 25 assorted £3.95.

SALE PRICE **£2.00**

HARDWARE

K535 Spring Pack - Approx 100 assorted compression, extension and torsion springs up to 22mm diameter and 30mm long. £1.70

SALE PRICE **£0.85**

K564 PCB stand-offs - A mixture of 8 different styles and sizes from 4.75 to 12.7mm high. 100 £2.40

SALE PRICE **£1.20**

K567 Wire Ties - 5 types to take 4-15mm diameter cable bundles. 100 £1.70

SALE PRICE **£0.85**

K565 Miniature PCB supports - in nylon. 6 different styles - sizes from 6.35mm to 13.24mm high. 100 £2.20

SALE PRICE **£1.10**

K566 Self adhesive cord clips - in moulded nylon. 5 styles/sizes. Base size from 15.9mm to 31.8mm square. Pack of 100 £2.70

SALE PRICE **£1.35**

K568 Giant Plastic Pack - Approx 1,000 pieces - standard and miniature PCB supports, self adhesive ribbon cable clips, straps, ties, cord clips. This lot would normally cost around £50.00. Our special price £12.00

SALE PRICE **£6.00**

PHONE YOUR ORDER THROUGH NOW - VISA & ACCESS ACCEPTED. (0703) 236363



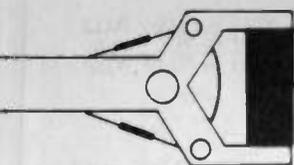
27 D PARK ROAD, SOUTHAMPTON, SO1 3TB

ORDERING INFORMATION

All prices include VAT; just add **£3.00 P&P**; Min order value **£10.00**. Official orders from schools welcome - Min invoice charge £10.00. Our warehouse has enormous stocks of components and is open 9-5.30 Mon-Sat. Come and see us!

Overseas - deduct 13% from prices and send ample postage - order by fax (+ 44 703 236307) using a credit card.

HOW TO CONTACT US:
By post using the address above;
By phone (0703) 236363 (answerphone out of business hours);
By FAX (0703) 236307;
By E Mail MAG36026;
By Telex 9312131093 (GW G)



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."

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 from the safety of your armchair.

Can be linked to the home computer.



control; computer-linked central heating system to operate boiler, pump, valves etc. ... The possibilities are endless!

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:

- the control panel, display and temperature sensor which is mounted on the wall in the room.
- 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).

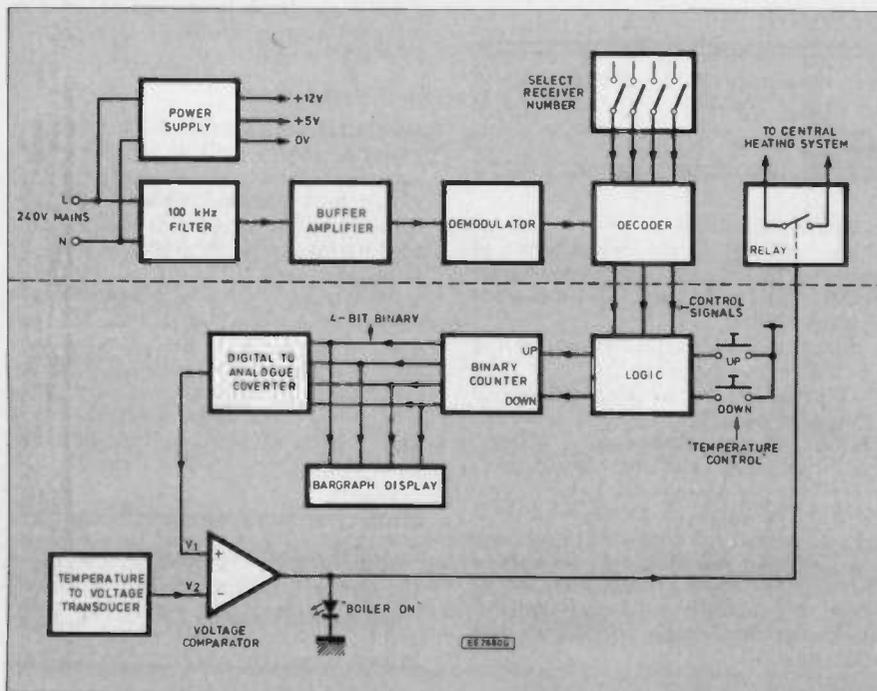
IN THIS final article of the series, the Mains Appliance Remote Control (MARC) system is further enhanced by the digitally controlled Room Thermostat intended to be wired into the house central heating system.

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

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



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

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

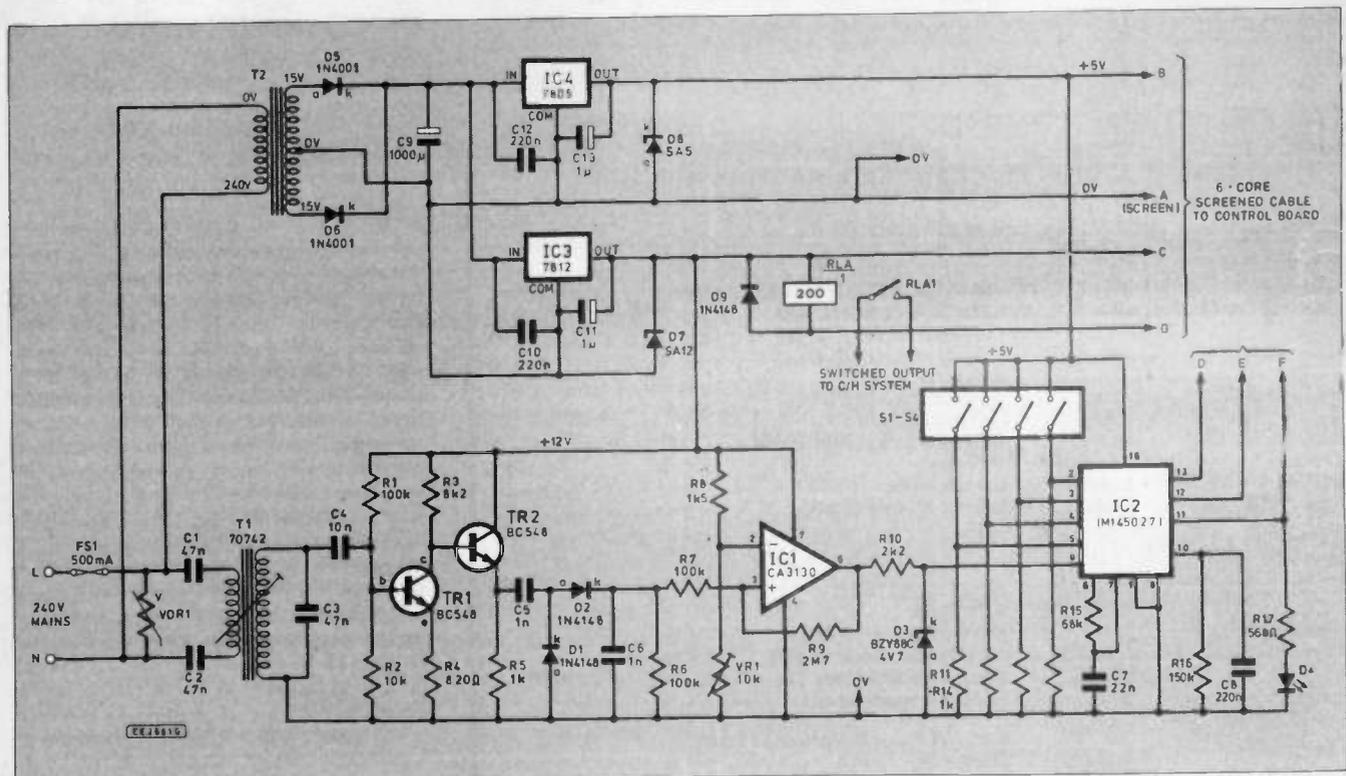
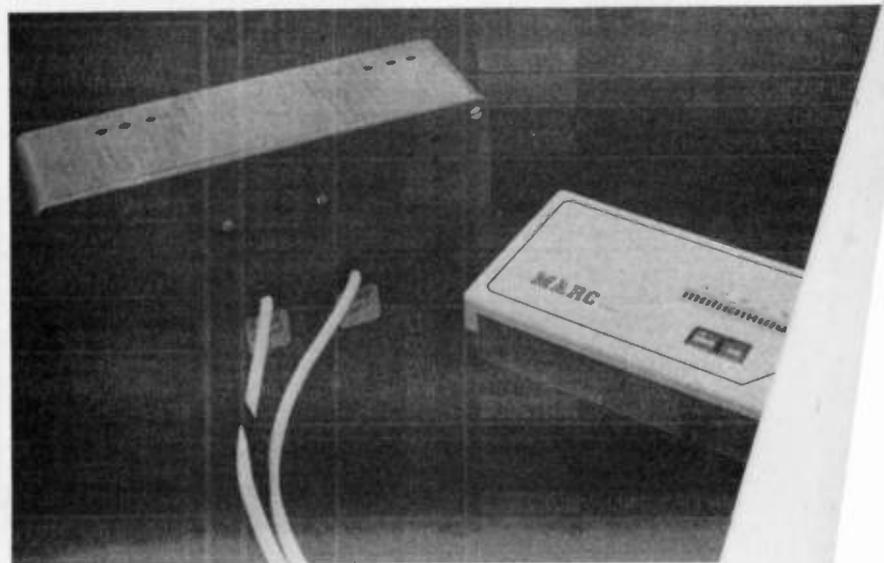


Fig. 4.2. Circuit diagram for the Decoder/Power Supply stages.

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



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

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 I.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.

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!

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	

See
SHOP
TALK
Page

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

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 I.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-I.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
5	4001BE	CMOS quad NOR
6	4011BE	CMOS quad NAND
7	4516BE	CMOS binary counter
8	74LS154	4-to-16 line decoder
9	ZN426E	digital-to-analogue converter
10	LM35DZ	temperature transducer
11	LF351	op.-amp

Accessories

- 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
- 24-pin matrix, 32 strips by 71 holes; printed circuit board available from
- code EE702; ABS case, 190mm x 110mm x 60mm; Verobox type
- pin x 84mm x 40mm; turned pin d.i.l. sockets, 8-pin (3 off), 14-pin (3
- sockets, 20-pin (2 off), 24-pin (1 off); 10-way terminal block; 7-pin DIN
- mounting socket; small heatsinks for T0220 style case (2 off); 6-core
- sockets; mains connecting cable; nylon nuts and bolts.

App
guide



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.

Six 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.

£50

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-bouncing 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.

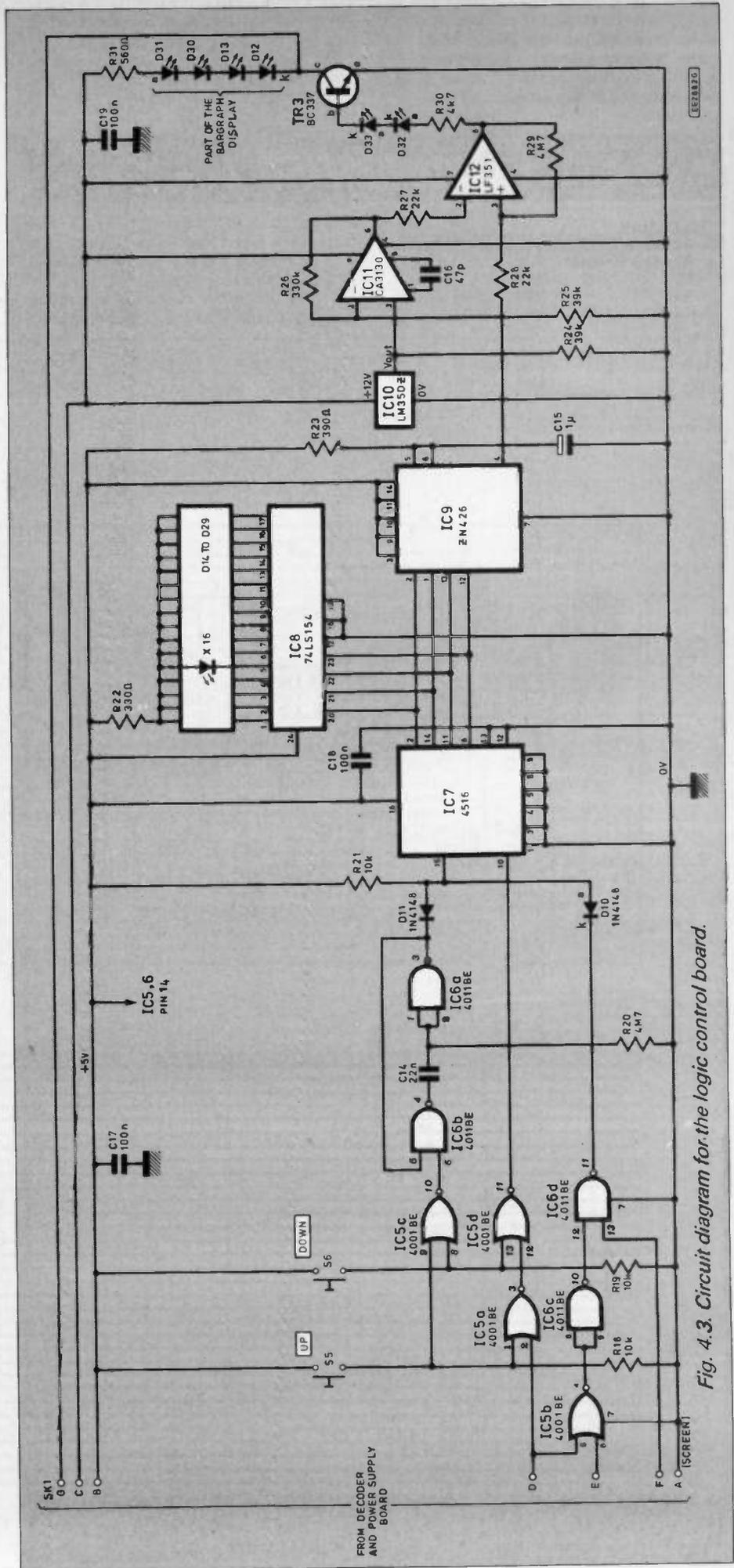


Fig. 4.3. Circuit diagram for the logic control board.

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 operat-

ing 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

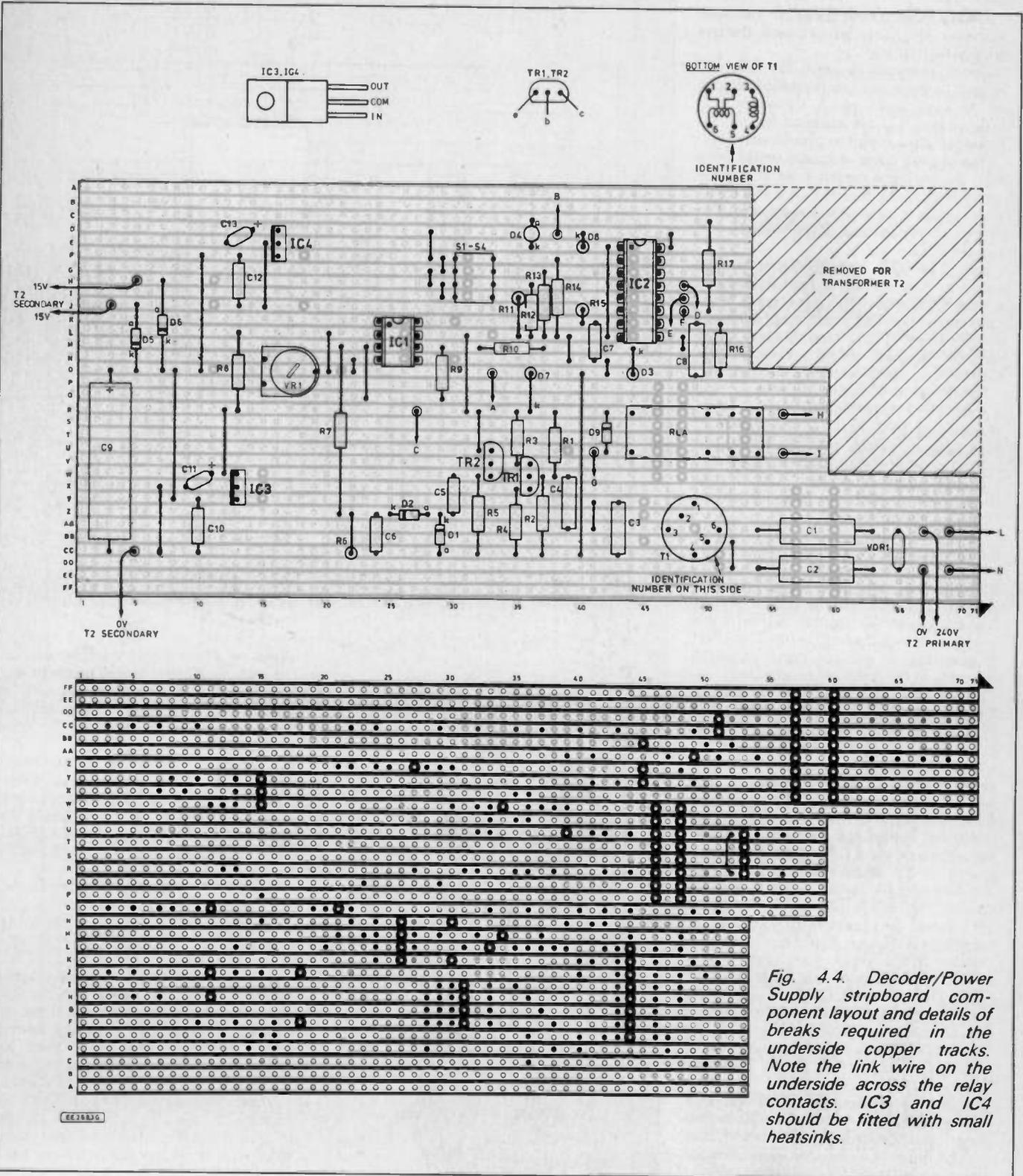


Fig. 4.4. Decoder/Power Supply stripboard component layout and details of breaks required in the underside copper tracks. Note the link wire on the underside across the relay contacts. IC3 and IC4 should be fitted with small heatsinks.

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.

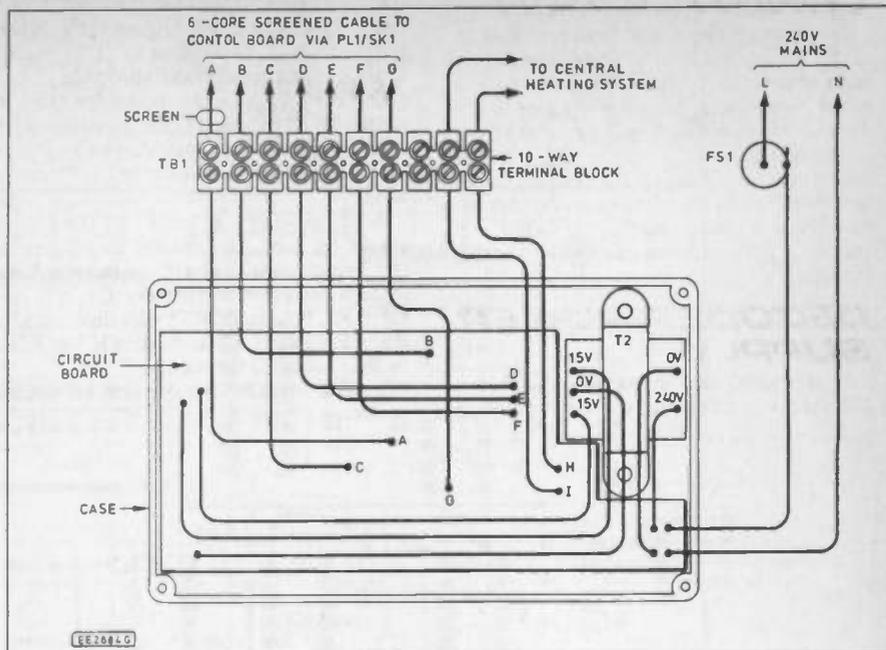
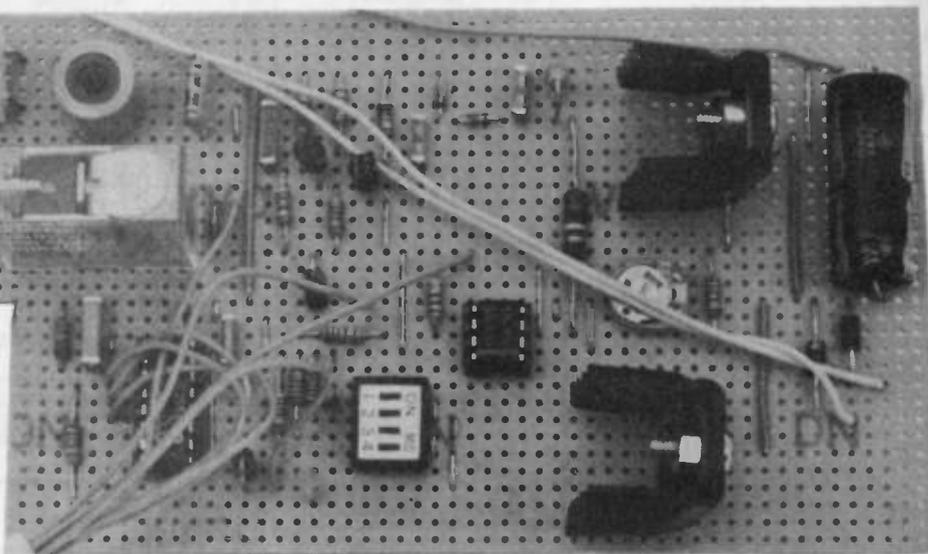


Fig. 4.5. Interwiring from the stripboard to the terminal block, transformer and fuse.

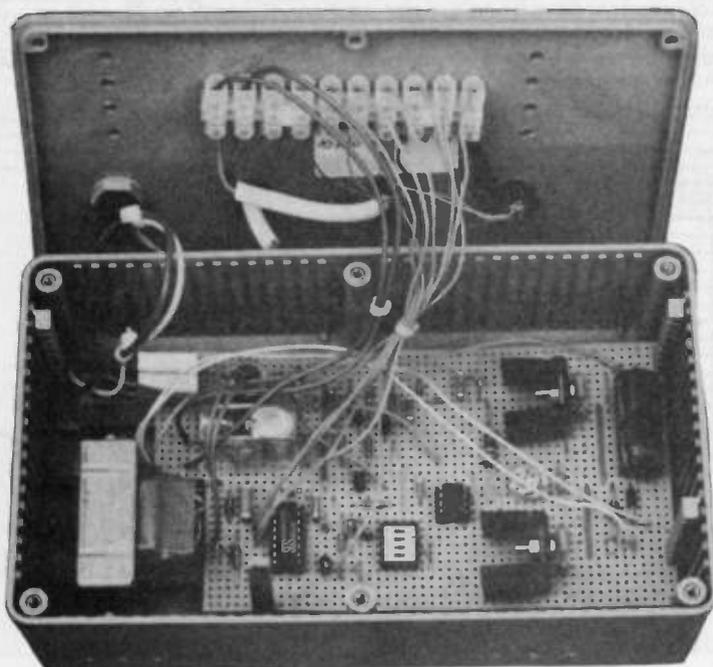
Completed stripboard showing the relay, d.i.l. switch, heatsinks. Note the insulation tape around the edges where mains enters.

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,



(Below) Completed Decoder/Power Supply.



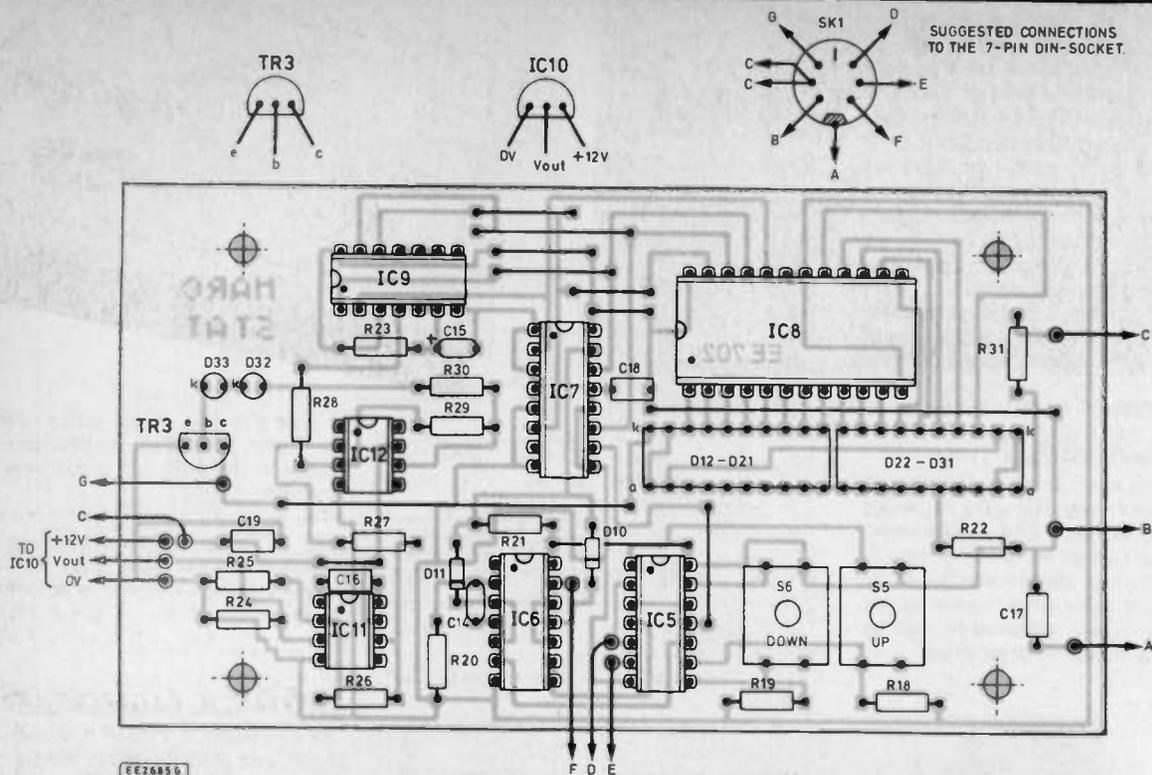
slowly turn preset VR1 anticlockwise until the meter suddenly swings to about 4.5V. The voltage at this point should now "follow" the carrier wave, it must be "low" when the carrier is off and "high" when the carrier is on.

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 x 110mm x 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.



EE2685 G

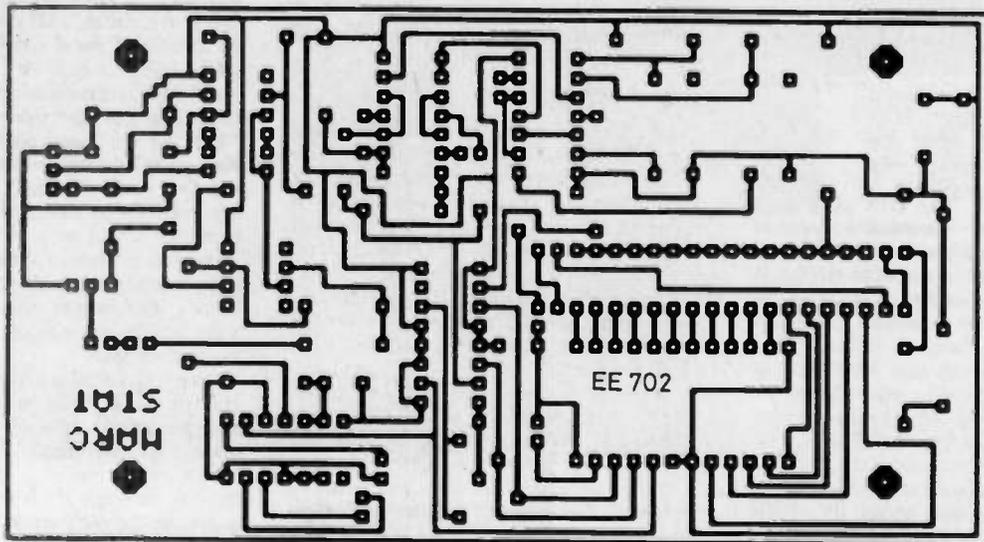


Fig. 4.6. Control Panel printed circuit board component layout and full size copper foil master pattern. Note the insulated link wire running under diode D10.

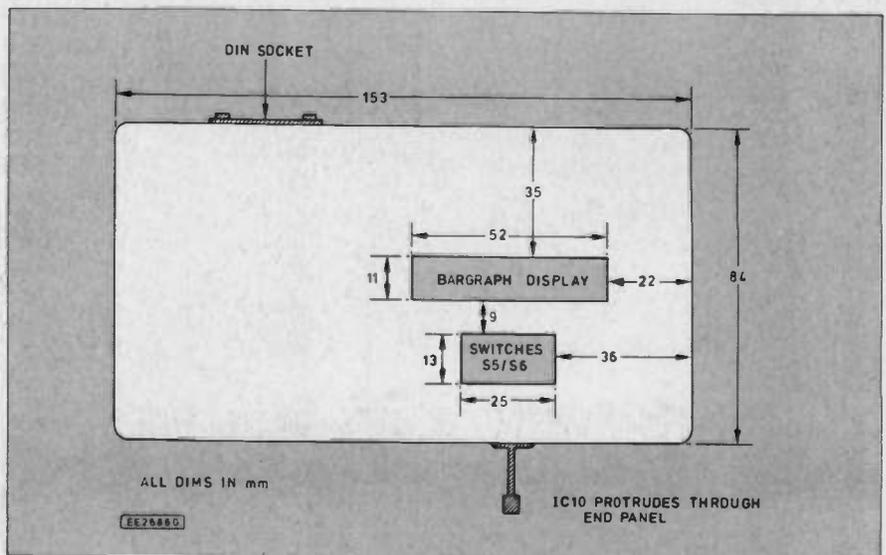
Fig. 4.7. Cutout and drilling details for the Control unit case.

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 i.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 x 84mm x 40mm.

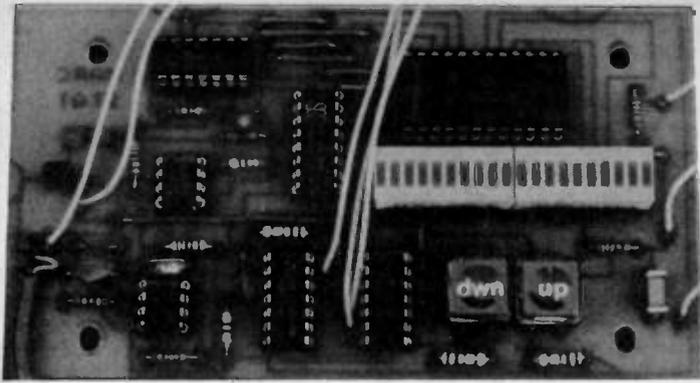
The front panel is cut out as detailed in Fig. 4.7. A hole should be drilled in the bottom aluminium panel and fitted with a grommet through which the temperature sensor IC10 protrudes. A 7-pin DIN socket for connection to the screened cable is mounted in the top aluminium panel.



ALL DIMS IN mm

EE2685 G

IC10 PROTRUDES THROUGH END PANEL



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 from 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.

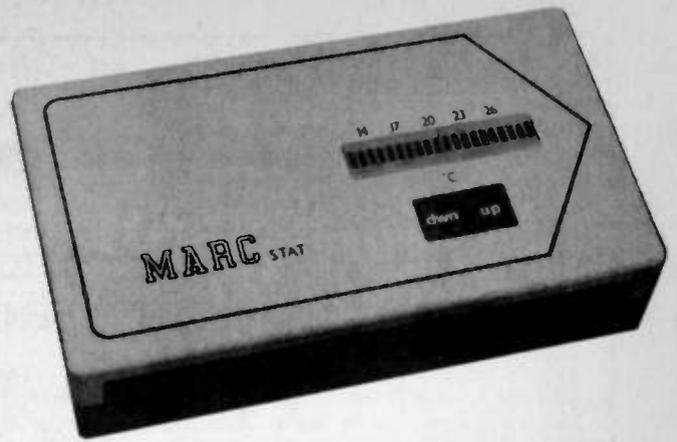
Take care when inserting the bargraph displays (D12-D21, D22-D31) into their sockets as the leads bend easily. The anode (a) connections down one side of the array are identified by a small chamfer on the adjacent corner.

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!

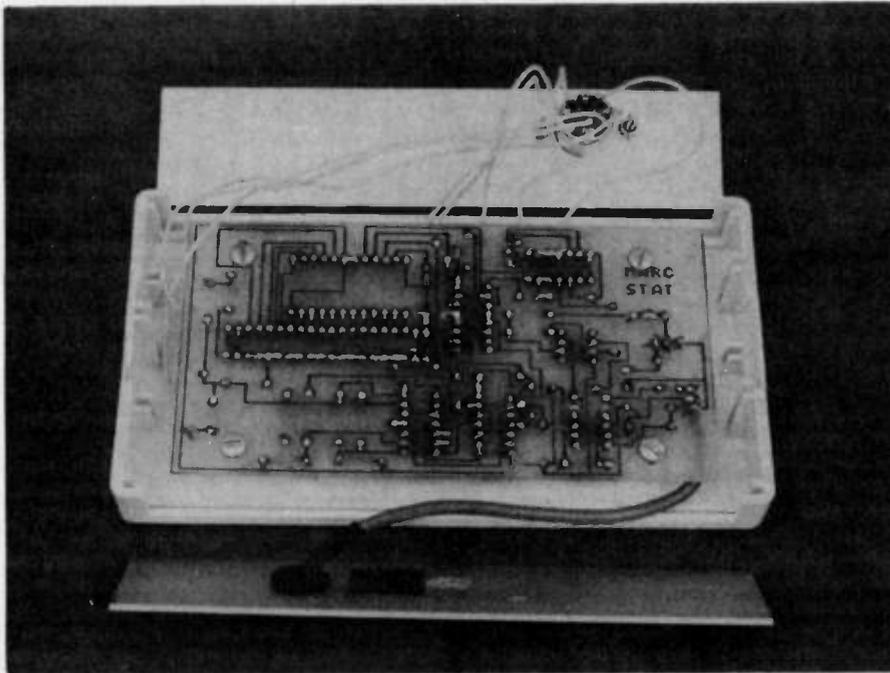
A few years on, and with a more formal training in electronics design, I have been able to do away with all the trailing wires and introduce a high degree of flexibility into remote control by integrating the *MARC* system into my home. - Also, the point of relaxation has moved from the bed to the armchair!

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. □



eb...Beeb...Beeb...Beeb...Beeb

.. 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 TheChars=""
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,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 1,5,2,6,6,6,2,5,2,2,6,6,6
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 9,5,6,6,6,2,0,5,6,6,6,6,6
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_Chars(38)
570 ENDPROC
580
590 DEF PROCTheCode_Fill_Buffer
600 FOR ccount = 1 TO 38
610 READ TheCode_Chars(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 TheChars=TheCode_Chars(char)
760 ENDPROC
770
780 REM Screen Methods
790 DEF PROCTheScreen_Init
800 DIM TheScreen_Buffers(Screenful)
810 TheScreen_Chars=""
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_Chars = ""
910 ENDPROC
920 DEF PROCTheScreen_Store_Char
930 TheScreen_Chars=TheScreen_Chars+TheChars
940 ENDPROC
950
960 DEF PROCTheScreen_Store_Word
970 TheScreen_WordCount=TheScreen_WordCount+1
980 TheScreen_Buffers(TheScreen_WordCount)=TheScreen_Chars
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 Buffers(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 choices=GETs
1380 choice%=VAL(choices)
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 choices=GETs
1500 choice%=VAL(choices)
1510 UNTIL (choice% = 1) OR (choice% = 2)
1520 IF choice%=1 PRINT "Slow"
1530 IF choice%=2 PRINT "Fast"
1540 speed% = choice%
1550 ENDPROC
```

CAMBRIDGE COMPUTER SCIENCE LIMITED

☆ 10MByte Winchester, used 3 months Wty.	£42.00 each
☆ 5 25" Disk Drives, 80 Tk. DSDD.	£34.00 each
☆ 5 25" drive cases, room for drive, PSU & Fan	£10.00 each
☆ 5 25" Disk Drives, 80 Tk. DSDD, used, no Wty (Sold on a strictly "as is" basis)	£15.00 each
☆ 5 25" Disks, DSDD, 48tpi boxes of 10	£3.00 box
☆ 40W PSU 5V 3.75A, 12V 1.5A -12V 0.4A, cased with on/off switch	£10.00 each
☆ Single Data lead (BBC Micro to Disk Drive)	£2.00 each
☆ Dual Data lead (BBC Micro to 2 Disk Drives)	£4.00 each
☆ Power lead (BBC Micro to Disk Drive)	£2.00 each
☆ Dual power lead (BBC Micro to 2 Disk Drives)	£4.00 each
☆ 68000 CPUs (The first orders get 10MHz chips)	£3.50 each
☆ 8086 CPU chips	£2.00 each
☆ 74LS TTL, pick and mix, buy 10 or more for	£0.12 each
Types available: 00 02 04 08 11 12 13 15 20 21 26 27 30 32 33 38 42 74 83 96 107 109 122 132 136 139 145 151 153 157 158 162 163 164 165 174 191 193 253 257 298 353 365 670	
☆ 2764 EPROMS (Ex-equipment)	£1.00 each
☆ 27128 EPROMS	£2.50 each
☆ 27C256-25 EPROMS	£3.50 each
☆ 256K Byte DRAM Modules, removed from equipment	£6.00 each
☆ 6116 2K Byte SRAM	£1.10 each
☆ 6264 8K Byte SRAM	-15 £3.00 each - 12 £3.80 each
☆ 65256 32K Byte rams	£7.00 each
☆ 8K Byte NV ram chips	£3.00 each
☆ CPU cards (Newbrain) Z80 CPU, 3 EPROMS & 60+ mostly 74LS ICs	£10.00 four
☆ CPU cards (Newbrain) Z80 CPU, 3 EPROMS & 60+ mostly 74LS ICs	£2.00 each
☆ Metal project boxes drilled and painted but unused 28 x 32.5 x 5cm	£5.00 each

Prices include postage, add 50p (plus VAT) to orders below £5.00
All items new unless stated. Add 15% VAT to all prices
Send an SAE for our latest list or for more info

Dept EE, 374 Milton Road, Cambridge CB4 1SU
Tel: 0223 424602 or 0831 430496 (Please note mail order only)

C.E.S.N.W.
FOR ELECTRONIC COMPONENTS

TEST EQUIPMENT REPAIRS
IBM PC ACCESSORIES
AT DISCOUNT PRICES

Let us source that difficult to find component
for your kit or project

Send for details of all our services.

Appt. 2, No 8 Meirion Gardens
Colwyn Bay, Clwyd
North Wales LL29 7PR

Tel: 0492 533083 Fax: 0492 534716

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.

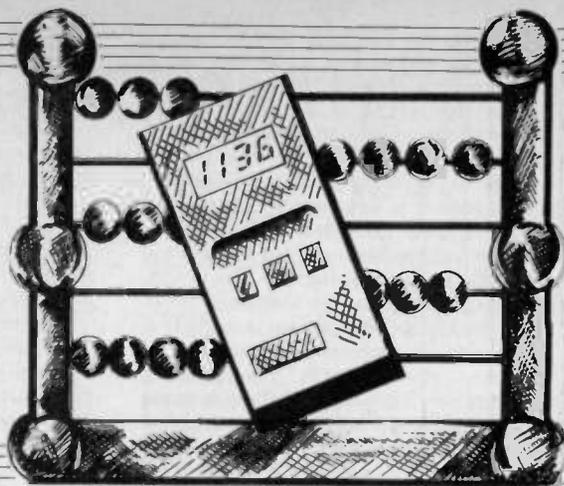
The output of IC1a is connected to the CP₀ input of IC2a whilst the CP₁ inputs of IC2a and the two halves of IC4 are connected to logic 0 (0 volts). In this configuration the counter circuit advances by one, for each operation of S2.

The CP₀ inputs of IC2b, IC4a and IC4b are connected to output O₃ of the previous counter in the chain. This provides a "carry" function in which the counter advances by one every time that the O₃ 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 (O₀ to O₃) of both halves of IC2 and IC4 are fed to the inputs (I₀ to I₃) 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 I₀ to I₃ 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

Resistors

R1-R4 10k (4 off)
R5 8k2
R6 3k3
All 0.6W 1% metal film

See
SHOP
TALK
Page

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. keyboard 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



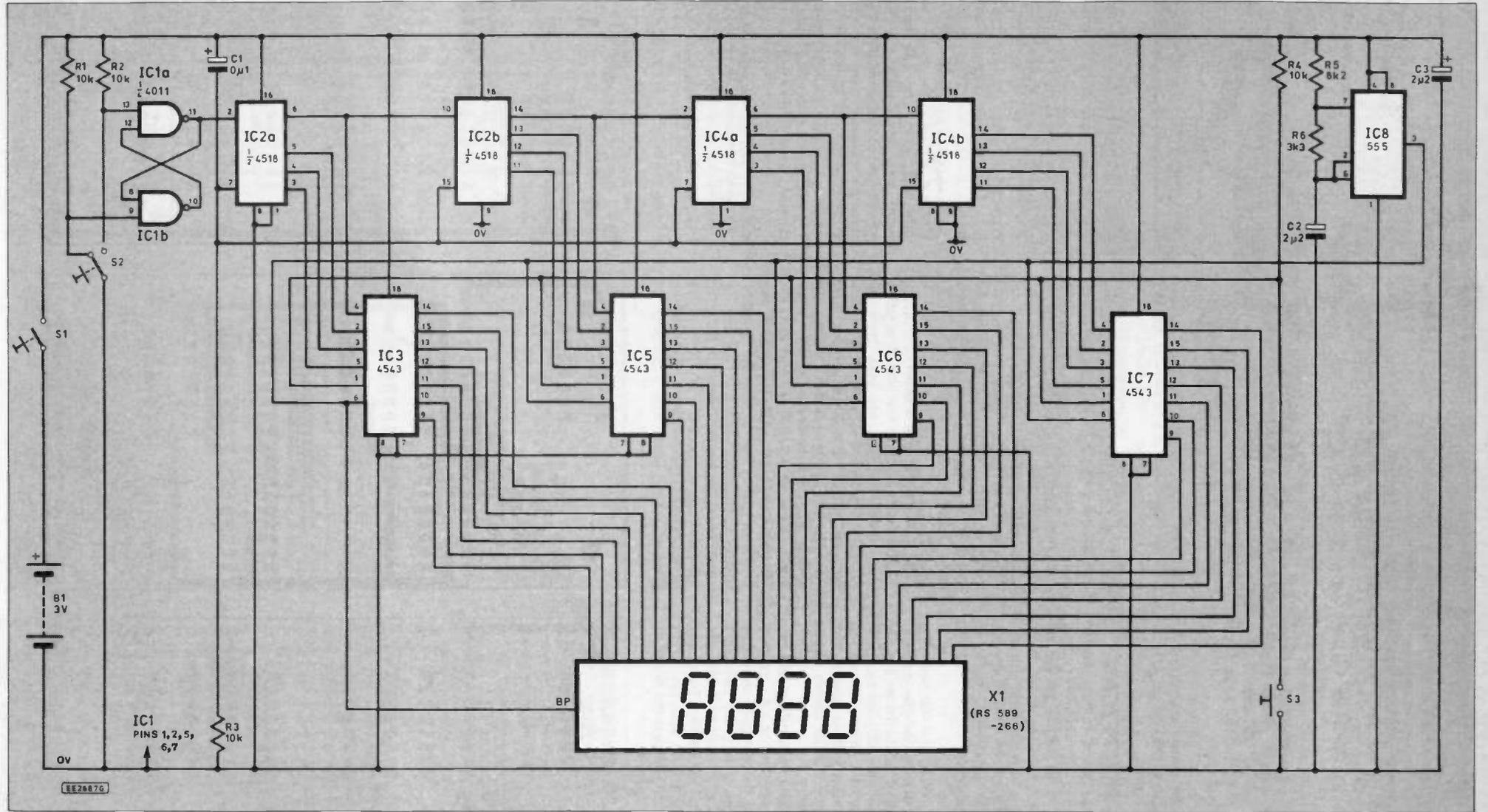


Fig. 1. Complete circuit diagram for the Electronic Hand Tally.

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 2 μ 2 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 its 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.

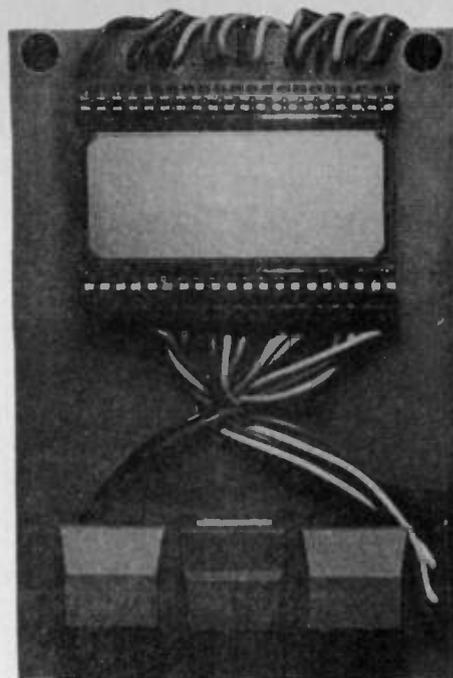
Because many of the i.c. pins on the Counter board are used to transfer connections from one side of the board to the other, they cannot be accommodated in sockets but must be soldered in place along with the other components. It is important that all connections on both sides of the p.c.b. are soldered 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 inserted 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

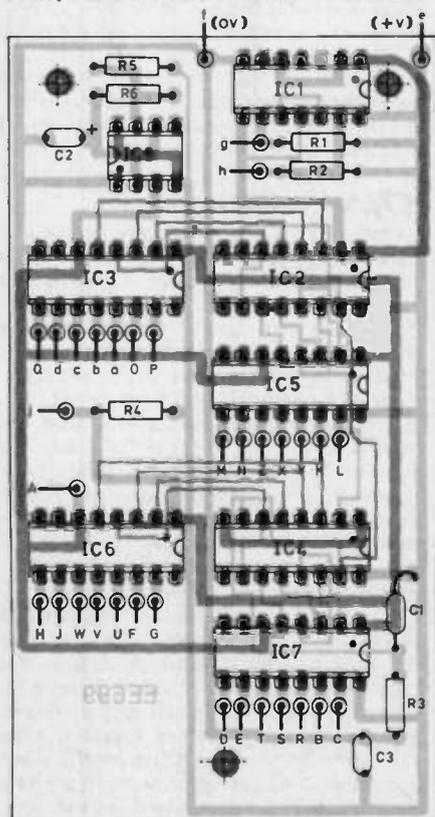


Fig. 2a. Component layout on the Counter double-sided printed circuit board.

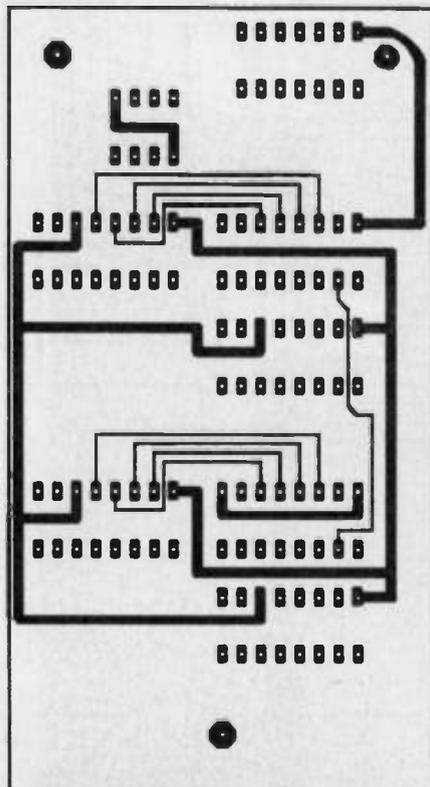


Fig. 2b. Full size copper foil master pattern for the component side.

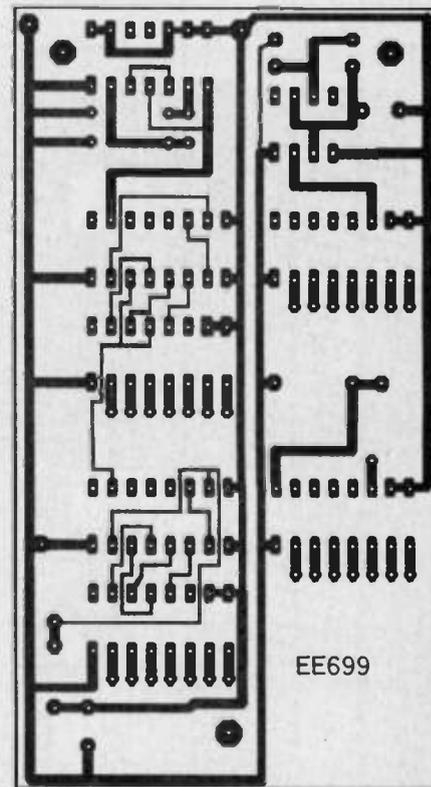
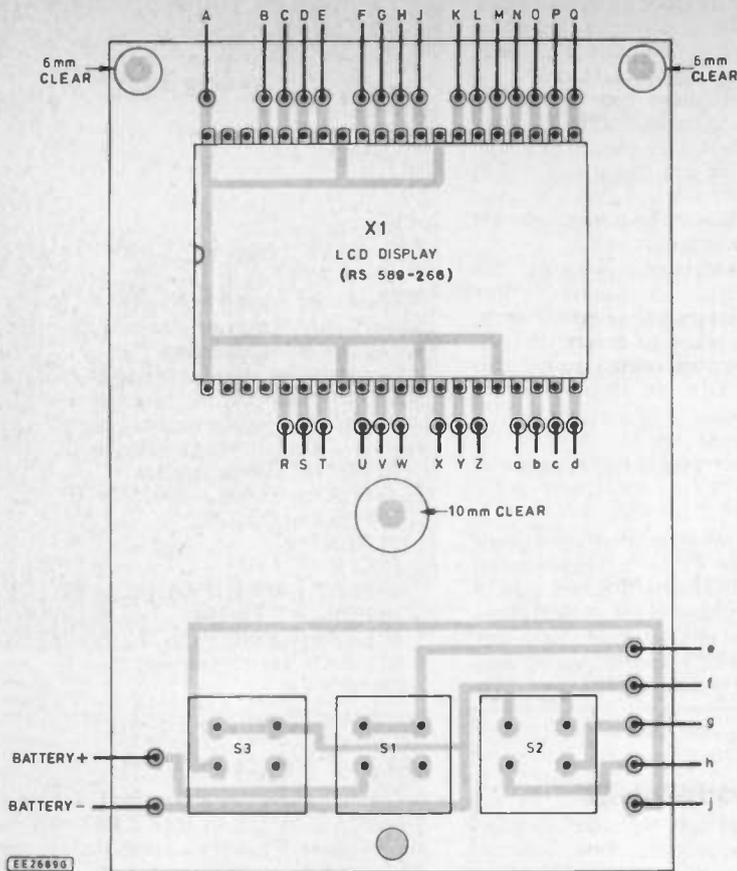


Fig. 2c. Non-component side full size copper foil master pattern.



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 *The completed unit opened-out to show the "sandwich" arrangement of the two boards and the battery compartment.*

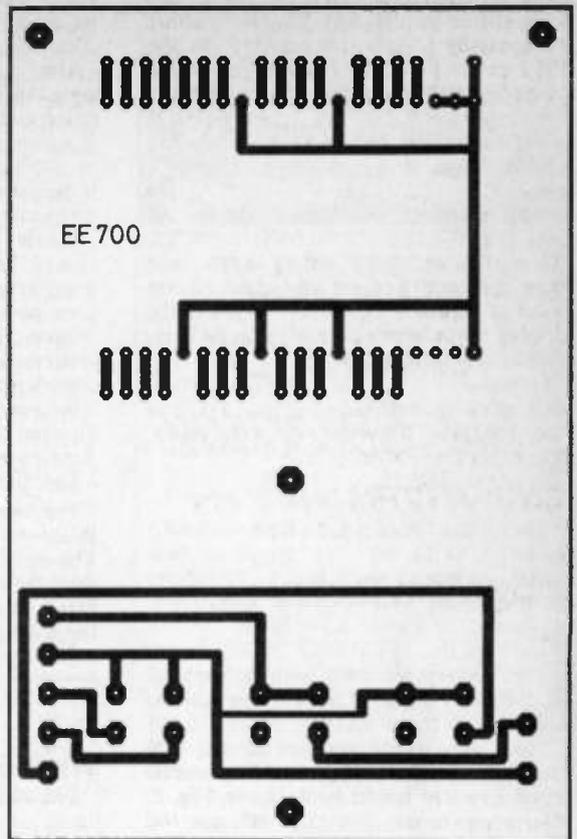
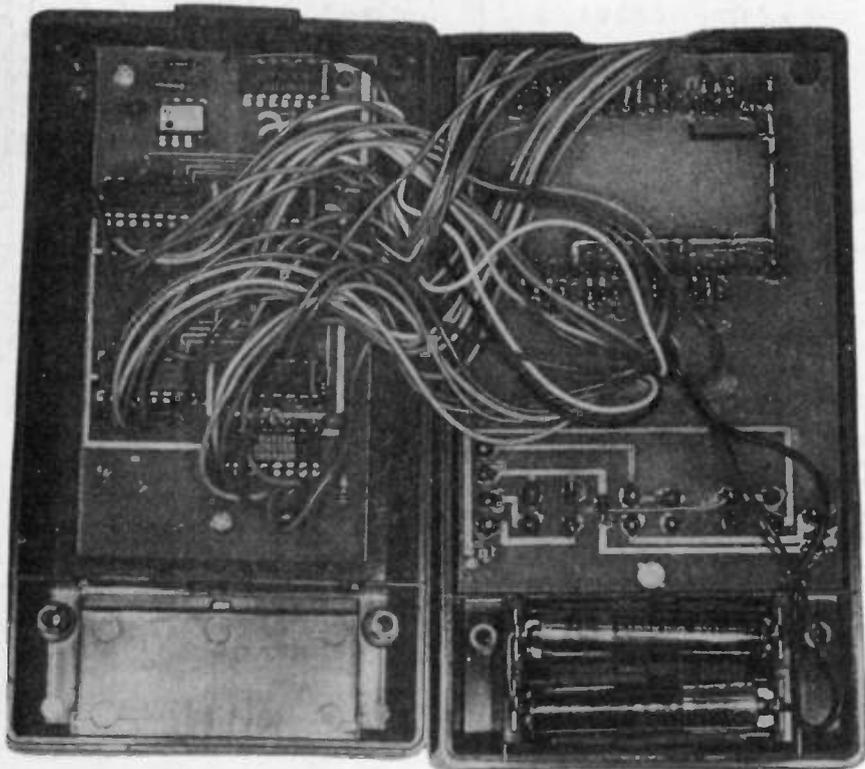


Fig. 3. Display printed circuit board component layout and full-size copper foil master.

carefully insert the l.c.d. display into its 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 S2, 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.

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$ = INKEYS
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$ = INKEYS
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.

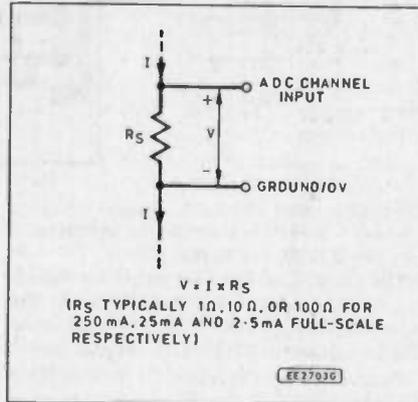


Fig. 1. Current measurement

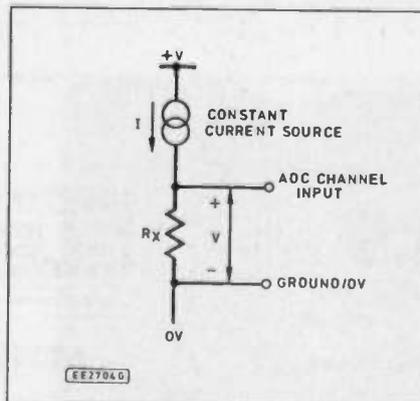


Fig. 2. Using a constant current source for resistance measurement

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 POKing 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
```

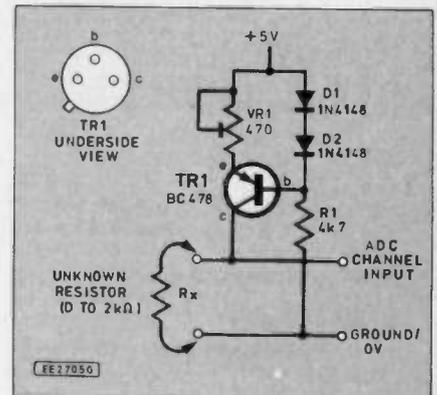


Fig. 3. Practical 1mA constant current source

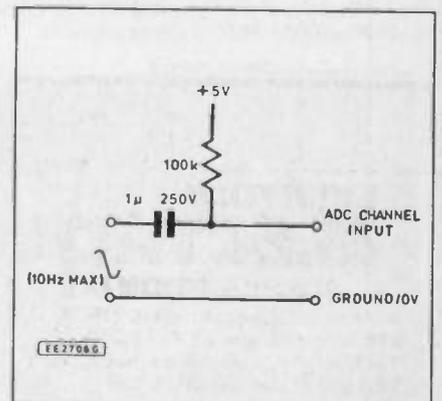


Fig. 4. Input bias and coupling for the oscilloscope display

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



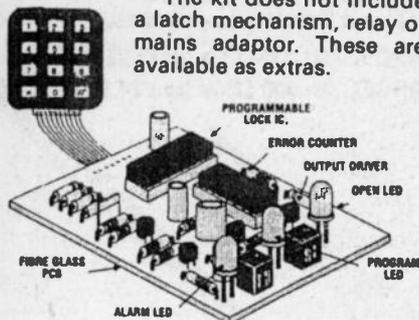
Programmable Lock

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 i.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 ECC83 "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 20455).

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 from *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

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).

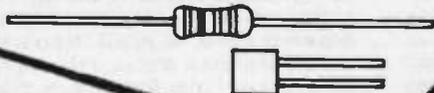
**EVERYTHING
MUST
GO!**

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

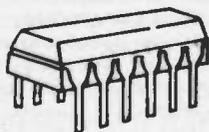


INTEGRATED CIRCUITS

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**

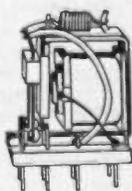


RELAYS

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**



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



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**



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+)

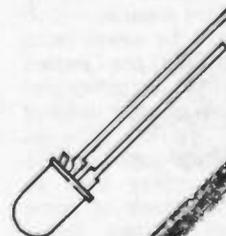


LEDs

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

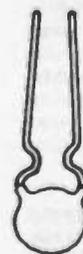


CAPACITORS

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**



**HIGHGRADE
COMPONENTS LTD**

Unit 111, 8 Woburn Road, Eastville, Bristol BS5 6TT

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

...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 Harrow and has

a UK callsign GODEY/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, GOBBD, who's signals were well known and well received in the Middle East. During the visit the King went on air as GODEY/JY1/GOBBD 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 D_x 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.*

TRANSISTORS		BD238		BF869		MPS9015		2N.3705		78L08		MC-3302		74LS28		COMPUTER IC'S	
AA52	9p	BD239	30p	BF870	22p	MPSA05	15p	2N.3706	9p	78L12	28p	MC-3401	45p	74LS30	14p	2114	200p
AC107	40p	BD240	40p	BF871	22p	MPSA06	15p	2N.3707	9p	78L15	28p	MC-3403	60p	74LS32	15p	2532	330p
AC126	25p	BD241A	40p	BF872	22p	MPSA13	15p	2N.3708	9p	78L18	28p	NE-511	115p	74LS33	15p	2716	200p
AC128	25p	BD243A	50p	BF880	38p	MPSA20	15p	2N.3710	24p	78L24	53p	NE-544	170p	74LS38	15p	2732	280p
AC176	21p	BD245	50p	BF951	35p	MPSA42	15p	2N.3711	12p	78L05	40p	NE-555	20p	74LS40	15p	2732A	300p
AC128	21p	BD246A	50p	BF964	40p	MPSA43	15p	2N.3771	85p	79L08	40p	NE-556	20p	74LS42	25p	2764	240p
AC128K	26p	BD265	45p	BF966	40p	MPSA66	25p	2N.3772	110p	79L15	40p	NE-565	110p	74LS47	52p	2764A	550p
AC141K	30p	BD267	45p	BF969	40p	MPSA70	15p	2N.3799	18p	7818KC	100p	NE-566	130p	74LS48	48p	27128	310p
AC142K	30p	BD269	45p	BF979	25p	MPSA92	20p	2N.3819	29p	7824KC	100p	NE-567	115p	74LS51	13p	27256-25	400p
AC176K	22p	BD278	50p	BF990	50p	MPSA93	38p	2N.3903	11p	LM317K	220p	NE-570	360p	74LS54	13p	41256-15	400p
AC187	28p	BD311	100p	BF993	95p	MR810	35p	2N.3904	11p	LM317T	180p	NE-571	290p	74LS55	15p	4116	75p
AC187K	28p	BD312	100p	BF997	130p	OC28	250p	2N.3905	11p	LM723	40p	NE-592	85p	74LS73	24p	4164-15	150p
AC188	21p	BD314	100p	BF998	30p	OC29	250p	2N.3906	11p	78HGKC	670p	NE-553P	140p	74LS74	18p	6116	160p
AC188K	21p	BD315	150p	BF999	35p	OC35	250p	2N.4031	25p	78H05KC	800p	NE-553P	140p	74LS75	24p	6264-12	300p
AC1918	48p	BD317	150p	BF999	35p	OC45	250p	2N.4032	25p	78L12KC	700p	74LS76	24p	74LS76	24p	6502A	400p
AD149	60p	BD318	150p	BF999	35p	OC71	30p	2N.4062	12p	78G1UC	190p	74LS83	37p	74LS83	37p	6502C	930p
AF124	50p	BD318	150p	BF999	35p	OC72	50p	2N.4062	12p	79G1UC	215p	74LS85	37p	74LS85	37p	6503	670p
AF125	50p	BD332	40p	BF999	35p	OT121	120p	2N.4401	12p	79H1UC	800p	74LS86	25p	74LS86	25p	6520	170p
AF127	50p	BD361	60p	BF999	35p	R2008B	100p	2N.4403	12p			74LS90	26p	74LS90	26p	6522	330p
AF139	30p	BD362	60p	BF999	35p	R2010B	100p	2N.4443	70p			74LS91	55p	74LS91	55p	6532	460p
AF239	30p	BD371	30p	BF999	35p	S2800D	52p	2N.5088	20p			74LS92	32p	74LS92	32p	6545	880p
AF379	45p	BD371	30p	BF999	35p	S2800M	52p	2N.5163	45p			74LS93	26p	74LS93	26p	6551	530p
BA145	10p	BD410	50p	BF999	35p	T2800D	72p	2N.5192	50p			74LS96	52p	74LS96	52p	6800	220p
BA148	10p	BD433	28p	BF999	35p	TIP29	24p	2N.5241	50p			74LS107	28p	74LS107	28p	6803	800p
BA154	6p	BD434	30p	BF999	35p	TIP29A	22p	2N.5245	45p			74LS109	28p	74LS109	28p	6808	500p
BA157	12p	BD435	31p	BF999	35p	TIP29C	25p	2N.5294	30p			74LS113	28p	74LS113	28p	6809	600p
BB105B	18p	BD436	30p	BF999	35p	TIP30	25p	2N.5320	30p			74LS114	28p	74LS114	28p	6810	150p
BB205B	24p	BD437	28p	BF999	35p	TIP30A	24p	2N.5321	60p			74LS114	28p	74LS114	28p	6818	380p
BC107	8p	BD438	38p	BF999	35p	TIP31A	24p	2N.5366	25p			74LS122	35p	74LS122	35p	6820	140p
BC108	8p	BD439	40p	BF999	35p	TIP31C	24p	2N.5401	12p			74LS123	35p	74LS123	35p	6821	140p
BC109	8p	BD440	40p	BF999	35p	TIP32	24p	2N.5448	12p			74LS124	35p	74LS124	35p	6840	310p
BC109C	10p	BD441	40p	BF999	35p	TIP32A	24p	2N.5496	80p			74LS125	30p	74LS125	30p	6840	310p
BC115	10p	BD442	40p	BF999	35p	TIP32C	28p	2N.6107	40p			74LS132	30p	74LS132	30p	6850	110p
BC118	11p	BD520	20p	BF999	35p	TIP33	24p	2N.6109	40p			74LS133	30p	74LS133	30p	8080A	400p
BC140	20p	BD533	50p	BF999	35p	TIP34	50p	2N.6254	110p			74LS136	30p	74LS136	30p	8085A	300p
BC141	20p	BD534	38p	BF999	35p	TIP34C	60p	2N.6292	40p			74LS138	28p	74LS138	28p	8088	500p
BC142	20p	BD535	38p	BF999	35p	TIP35	24p	2N.6384	120p			74LS139	28p	74LS139	28p	8156	360p
BC143	20p	BD536	38p	BF999	35p	TIP35C	60p	2N.6385	120p			74LS145	65p	74LS145	65p	8156	300p
BC147	8p	BD537	40p	BF999	35p	TIP41A	22p	2N.6403	160p			74LS147	90p	74LS147	90p	81LS95	120p
BC148	8p	BD538	40p	BF999	35p	TIP41C	25p					74LS148	75p	74LS148	75p	81LS96	130p
BC149	8p	BD543	50p	BF999	35p	TIP42A	22p					74LS151	27p	74LS151	27p	81LS97	130p
BC157	8p	BD645	50p	BF999	35p	TIP42C	22p					74LS153	31p	74LS153	31p	81LS98	130p
BC159	8p	BD647	50p	BF999	35p	TIP44	40p					74LS154	78p	74LS154	78p	8156	360p
BC160	30p	BD649	50p	BF999	35p	TIP48	40p					74LS156	36p	74LS156	36p	8226	240p
BC171	10p	BD651	100p	BF999	35p	TIP49	45p					74LS157	22p	74LS157	22p	8243	250p
BC172	14p	BD675	40p	BF999	35p	TIP50	60p					74LS158	27p	74LS158	27p	8250	850p
BC177	10p	BD676	40p	BF999	35p	TIP51	120p					74LS160	38p	74LS160	38p	8253	230p
BC178	14p	BD677	38p	BF999	35p	TIP52	120p					74LS161	38p	74LS161	38p	8255	200p
BC179	14p	BD678	40p	BF999	35p	TIP53	120p					74LS162	38p	74LS162	38p	8256	1200p
BC182	7p	BD680	40p	BF999	35p	TIP54	140p					74LS163	36p	74LS163	36p	8257	220p
BC182L	7p	BD681	45p	BF999	35p	TIP55	120p					74LS164	36p	74LS164	36p	8259	280p
BC183	7p	BD682	45p	BF999	35p	TIP56	140p					74LS165	50p	74LS165	50p	8271	3400p
BC184	7p	BD705	50p	BF999	35p	TIP57	120p					74LS166	55p	74LS166	55p	8279	270p
BC184L	7p	BD707	50p	BF999	35p	TIP58	140p					74LS168	60p	74LS168	60p	8284	440p
BC212	7p	BD709	50p	BF999	35p	TIP59	100p					74LS169	55p	74LS169	55p	8288	650p
BC212L	7p	BD711	50p	BF999	35p	TIP60	65p					74LS170	68p	74LS170	68p	8748	1100p
BC213	7p	BD736	50p	BF999	35p	TIP61	47p					74LS174	30p	74LS174	30p	8755	1400p
BC213L	7p	BD826	50p	BF999	35p	TIP62	47p					74LS175	32p	74LS175	32p	AY3-1015	290p
BC214	7p	BD828	50p	BF999	35p	TIP63	45p					74LS190	47p	74LS190	47p	SPO256AL2	500p
BC214L	7p	BD875	50p	BF999	35p	TIP64	45p					74LS191	43p	74LS191	43p	Z80ACPU	150p
BC237	7p	BD897	50p	BF999	35p	TIP65	45p					74LS192	41p	74LS192	41p	Z80BDM	500p
BC238	7p	BD899	50p	BF999	35p	TIP66	45p					74LS194	41p	74LS194	41p	Z80ADMA	500p
BC239	7p	BD901	50p	BF999	35p	TIP67	45p					74LS194	41p	74LS194	41p	Z80AIP	220p
BC300	20p	BD977	50p	BF999	35p	TIP68	45p					74LS193	44p	74LS193	44p	Z80BPI	340p
BC301	20p	BD978	50p	BF999	35p	TIP69	45p					74LS196	45p	74LS196	45p	Z80ACTC	200p
BC302	20p	BD979	50p	BF999	35p	TIP70	45p					74LS197	42p	74LS197	42p	Z80BCTC	320p
BC303	20p	BD980	50p	BF999	35p	TIP71	45p					74LS222	45p	74LS222	45p	Z80AS10	460p
BC304	25p	BD981	50p	BF999	35p	TIP72	45p					74LS240	40p	74LS240	40p	Z80AS10-1	580p
BC308	10p	BDW23	55p	BF999	35p	TIP73	45p					74LS241	42p	74LS241	42p	Z80AS10-2	580p
BC327	7p	BDW24	55p	BF999	35p	TIP74	45p					74LS242	43p	74LS242	43p	Z80ADART	500p
BC328	7p	BDW33	55p	BF999	35p	TIP75	45p					74LS243	50p	74LS243	50p		
BC337	7p	BDW34	55p	BF999	35p	TIP76	45p					74LS244	50p	74LS244	50p		
BC338	7p	BDW35	55p	BF999	35p	TIP77	45p					74LS245	40p	74LS245	40p		
BC349	28p	BDY92	100p	BF999	35p	TIP78	45p					74LS247	40p	74LS247	40p		
BC446	8p	BF137	35p	BF999	35p	T											

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

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 Everyday 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 micro-processing 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-try" 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

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

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

CIRCUITS & DESIGN

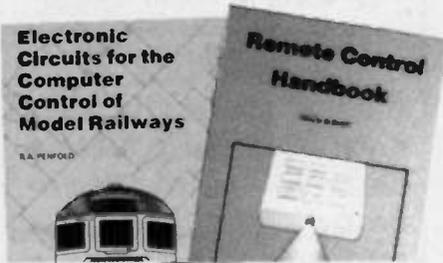
ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS

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 set-ups.

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-Verobloc.

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, discrete 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

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.

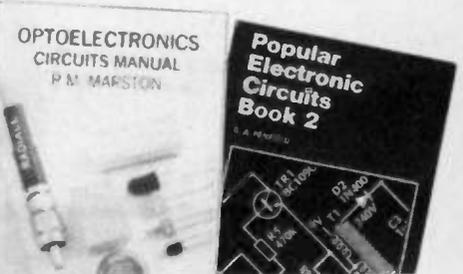
Chart Order Code BP27 £0.95

OPTOELECTRONICS CIRCUITS MANUAL

R. M. Marston

A useful single-volume guide to the optoelectronic 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 15K 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.

126 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 photo-

graphic 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. Kling
Radio signals, transmitters, receivers, antennas, components, valves and semiconductors, CB and amateur radio.

266 pages Order code NE98 £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

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!



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

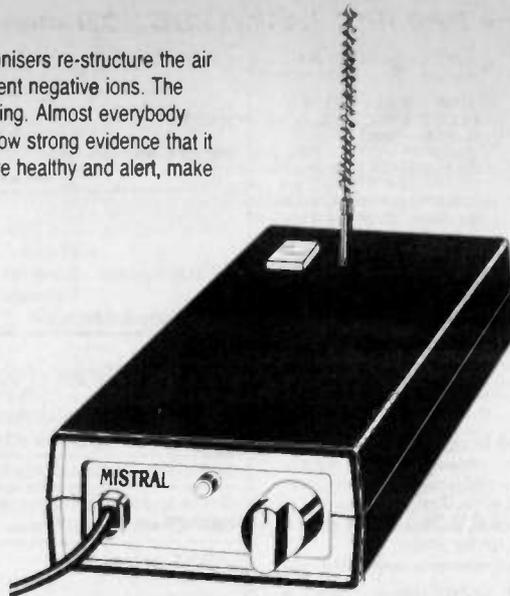
AIR IONISERS

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.

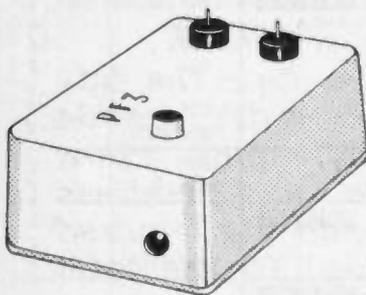
The parts set contains everything you need to build the Mistral: components, PCB, case, emitter and full instructions. If you're keen to increase the output still further, there's an optional eight-point internal emitter set to give extra ionising capability, and an almost silent piezo-electric ion fan 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

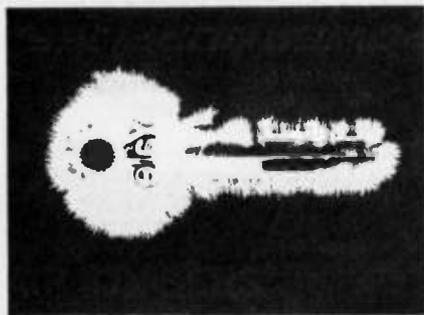
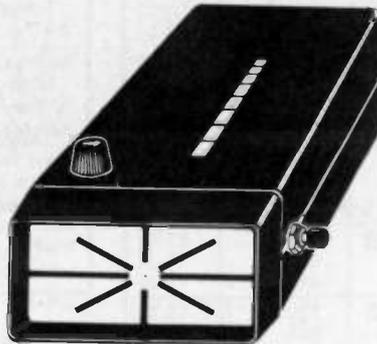
The Prophet performs its own special miracle on the dashboard of your car. First reports are most impressive: driving becomes a positive pleasure, easier to stay alert on long motorway journeys, a child cured of travel sickness. The ion effect is not to be underestimated. Don't forget the experiments either: there's the smoke trick, truffids, 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**



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**

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!)

Specialist
SEMICONDUCTORS

Tel: (0600) 3715

SALES DEPT., ROOM 111, FOUNDERS HOUSE, REDBROOK, MONMOUTH, GWENT.

LIMITED

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 1BX. 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 Transmitter	MAY 88	599 £3.00
Receiver		600 £3.07
Door Sentinel		605 £3.00
Multi-Chan Remote Light Dim Relay/Decoder	JUN 88	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 Receiver Display	£9.28 as a set	622 £4.61 623 £3.23 624 £3.05 625 £4.84
Seashell Sea Synthesiser		
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/Logo & 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)		699, 700 £10.95
Display		701 £4.10
Alarm Bell Time-Out		
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

SHERWOOD ELECTRONIC COMPONENTS
45 Rutland Street, Mansfield, Notts NG18 4AP
SPECIAL PACKS — All at £1.00 each

SP1 12x5mm Red LEDs	SP32 4xCmos 4077
SP2 12x5mm Green LEDs	SP33 4xCmos 4081
SP3 12x5mm Yellow LEDs	SP34 2xCmos 4510
SP4 10x6mm Amber LEDs	SP35 2xCmos 4511
SP5 36x5mm 1 part LED clips	SP36 20x10µF/25V Rad.Elect.Caps.
SP6 12x3mm Red LEDs	SP37 15x100µF/35V Rad.Elect.Caps.
SP7 12x3mm Green LEDs	SP38 20x47µF/25V Rad.Elect.Caps.
SP8 10x3mm Yellow LEDs	SP39 12x470µF/16V Rad.Elect.Caps.
SP9 40x3mm 1 part LED clips	SP40 15x8C237 Transistors
SP10 50x1N4148 signal diodes	SP41 25xmixed Transistors
SP11 25x1N4001 rectifier diodes	SP43 2xLM1458
SP12 25x1N4002 rectifier diodes	SP44 12x5mm Leds-4 each, Rec, Green
SP13 25xRad.Elec.Caps. (1-1000µF)	Yellow
SP18 15xBC182 Transistors	SP45 25x1N4000 series rect. diodes
SP19 15xBC183 Transistors	SP46 15x400mW zeners — assorted values
SP20 15xBC184 Transistors	SP47 5xminiature push button switches
SP21 15xBC212 Transistors	SP101 15 metres of 22SWG 60-40 solder
SP22 15xBC214 Transistors	SP102 15x8 pin DIL sockets
SP23 15xBC549 Transistors	SP103 12x14 pin DIL sockets
SP24 5xCmos 4001	SP104 12x16 pin DIL sockets
SP25 5x555 Timer	SP105 5x74LS00 I.C.s
SP26 5x741 Op-Amp	SP106 5x74LS02 I.C.s
SP27 5xCmos 4002	SP107 20xmixed presets — Hor. +Vertical
SP28 5xCmos 4011	SP108 15xBC382 Transistors
SP29 3xCmos 4013	SP109 15xBC557 Transistors
SP30 5xCmos 4025	SP110 4x74LS13 I.C.s
SP31 4xCmos 4071	

1 pack of your choice FREE when you buy any 10 of the above £1.00 packs.

ADDITIONAL PACKS

SP50 25x5mm Red LEDs	£2.00
SP51 25x5mm Green LEDs	£2.00
SP52 50xRad. Elec. Caps.	£1.95
SP53 30xDIL sockets 8, 14, 16	£2.00
SP54 1xTIL38+1xTIL100	£1.80
SP57 100x1N4148 diodes	£1.75
SP65 60x3mm+5mm Leds	£4.80

RESISTOR PACKS

0.25W Carbon Film resistors 10R-10M	£2.75
5 each value — total 365	£4.50
10 each value — total 730	£6.00
1000 popular values	2p ea.
Individual resistors	1p ea.
10+ one value	75p
100 one value	

CMOS

4000 20p	4070 24p
4001 20p	4071 24p
4002 20p	4072 24p
4006 60p	4075 27p
4011 20p	4077 27p
4013 34p	4081 24p
4017 50p	4093 24p
4023 27p	4510 60p
4025 20p	4511 60p
4027 47p	4514 120p
4040 65p	4515 120p
4047 60p	4516 60p
4049 37p	4518 60p
4060 75p	4528 65p
4066 37p	4538 90p

LINEAR

555 20p
556 75p
741 21p
747 67p
CA3140E 45p
CA3240E 120p
LM339 50p
LM380 120p
LM723 55p
LM1458 50p
TL071 55p
TL072 75p
TL081 35p
TL082 50p

TRANSISTORS

BC182 10p
BC183 10p
BC184 10p
BC212 10p
BC214 10p
BC239 12p
BC337 12p
BC547 12p
BC549 10p
BC557 12p
BC559 12p
2N3702 11p
2N3703 11p
2N3705 11p
2N3706 11p

Cheques or P.O. to:
SHERWOOD ELECTRONIC COMPONENTS
 Please add £1 P&P to orders under £20.00

This only a small sample of components stocked, send 75p for new 1990 catalogue, contains vouchers redeemable against orders over £5.00. NO VAT

B.C.E ELECTRONICS



4000 CMOS

4000 22p	4023 22p	4071 23p	4526 64p
4001 23p	4027 28p	4077 23p	4534 354p
4011 23p	4035 80p	4081 23p	4541 53p
4013 28p	4047 41p	40106 37p	4554 354p
4017 44p	4050 32p	4502 67p	4561 221p
4021 48p	4069 23p	4511 53p	4585 53p

LINEAR

CA3046 71p	LM387 192p	NE5534 80p	TL082 62p
CA3240E 159p	LM393 39p	SL560C 268p	TL084 78p
ICM7555 71p	LM710 80p	SP8629 265p	UA709C 62p
ICM7556 124p	LM723 44p	TBA120S 95p	UA741 28p
LF351 48p	LM3914 336p	TBA810 103p	UA747C 78p
LF356 103p	LM3915 336p	TDA2030H 177p	UA748C 45p
LM311 39p	MC3302 133p	TDA7000 225p	ULN2003 71p
LM317T 85p	MC3340 203p	TL071 53p	ULN2004 71p
LM339 39p	NE555 28p	TL072 62p	ULN2803 118p
LM380 142p	NE556 53p	TL074 78p	XR2206CP 540p
LM381N 300p	NE565 159p	TL081 48p	ZN414 142p
			ZN1034E 295p

TRANSISTORS

AC127/128 58p	BFY50 35p	TIP42 150p
AD161/162 90p	BFY51 35p	TIP141 106p
BC107/8/9 19p	BFY52 35p	TIP142 150p
BC182/182L 13p	BU208/208A 177p	TIP2955 95p
BC184 13p	BU508 168p	TIP3055 95p
BC184L 13p	MJ2955 115p	ZTX300 21p
BC212/212L 13p	MJE2955 71p	ZTX500 21p
BC548 11p	MJE3055 71p	2N2222A 30p
BF194 32p	TIP29A 46p	2N3053 41p
BF196 32p	TIP29C 48p	2N3055 78p
BF198 25p	TIP41 106p	2N3703 14p

FULL RANGE OF CMOS, TTL & LINEAR I.C.S. LARGE RANGE OF TRANSISTORS, RESISTORS, CAPACITORS, BOXES, PLUGS, SOCKETS, SWITCHES, P.C.B. MATERIALS, SERVICE AIDS, TOOLS AND LOTS MORE FOR THE ELECTRONICS ENTHUSIAST.

Send 20p stamp for lists. All prices include VAT. Please add 60p p&p Mon., Tues., Wed., Fri., Sat. 10.00-6.00. CLOSED THURSDAYS



(0543) 277572



Unit 3, Chasewood Park Business Centre
 Hednesford Road, Heath Hayes
 Cannock, Staffs WS12 5HL

Remember
 The Cricklewood
 Service is Fast
 and Efficient

CRICKLEWOOD ELECTRONICS

BIGGER AND BETTER 1990 COMPONENTS CATALOGUE



- ONE OF THE LARGEST RANGES OF COMPONENTS IN THE UK
- FAST AND EFFICIENT SAME DAY PERSONAL SERVICE
- VERY COMPETITIVE PRICES; QUANTITY DISCOUNTS AVAILABLE
- DISCOUNT VOUCHERS INCLUDED
- NO MINIMUM ORDER

JUST LIKE A NEW CAR! YOU CAN ONLY JUDGE THE 1990 CATALOGUE BY LOOKING UNDER THE COVER. WITH OVER 13,000 STOCK LINES, CRICKLEWOOD ARE ABLE TO SUPPLY MOST OF THE COMPONENTS NEEDED FOR E.E. PROJECTS. PHONE US FOR YOUR SPECIAL NEEDS.

FILL IN THE COUPON AND POST IT WITH YOUR CHEQUE, PO ETC FOR £1.50 TO RECEIVE YOUR 1990 CRICKLEWOOD ELECTRONICS CATALOGUE AND VOUCHERS WHICH YOU CAN USE AGAINST YOUR NEXT PURCHASE

Cricklewood Electronics Ltd
 40 CRICKLEWOOD BROADWAY, LONDON, NW2 3ET
 Tel: 081-450 0995/452 0161
 Fax: 081-208 1441 Telex: 914977



TELEPHONE ORDERS OUR SPECIALITY

CRICKLEWOOD ELECTRONICS 1990 COMPONENTS CATALOGUE

PLEASE SEND COPIES OF THE 1990 CRICKLEWOOD ELECTRONICS CATALOGUE AT £1.50 TO:

NAME

ADDRESS

.....

.....

.....

Remittance enclosed £..... E

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.

DCS VARIABLE VOLTAGE D.C. BENCH POWER SUPPLY
1 to 24 volts up to 1/2 amp. 1 to 20 volts up to 1 amp. 1 to 16 volts up to 1 1/2 amps A.C. Fully stabilised. Twin panel meters for instant voltage and current readings. Overload protection.
Fully variable.
Operates from 240V AC.
Compact Unit, size 9 x 5 1/2 x 3in.



£42 inc. VAT + Post £2

RADIO COMPONENT SPECIALISTS
337 WHITEHORSE ROAD, CROAYON
SURREY, U.K. Tel: 081-6841665

List Large SAE Delivery 7 days. Callers welcome. Closed Wednesday

SERVICE MANUALS

Available for most Video Recorders, Colour & Mono Televisions, Cameras, Test Equipment, Amateur Radio, Vintage Valve Wireless, Any Audio, Music Systems, Computers, Kitchen Appliances, etc.

Equipment from the 1930's to the present and beyond.

Over 100,000 models stocked, originals & photostats.

FREE Catalogue Repair & Data Guides with all orders.

MAURITRON TECHNICAL SERVICES (EE)
8 Cherry Tree Road, Chinnor, Oxfordshire OX9 4QY.
Tel: (0844) 51694. Fax: (0844) 52554

N. R. BARDWELL LTD

200 — Signal diodes 1N4148.....	£1.00
100 — Rectifier diodes 1N4001.....	£1.00
100 — Zener diodes 6V8 400mW.....	£1.00
30 — Assorted DIL sockets up to 40 pin.....	£1.00
30 — Assorted Sockets/Cons. Dil. Edge. I.D.C. Header etc.....	£1.00
30 — Transistors BC478.....	£1.00
20 — Miniature SP/CO Slide switches.....	£1.00
20 — Magnetic ear pips + lead and Plug.....	£1.00
75 — Electrolytics 4.7µF 63V.....	£1.00
1 — 10watt stereo amplifier — controls + data.....	£2.95

Prices include VAT, postage 60p. All items new.
Many other lines in stock.
Shop open Mon/Sat 9.30-5.30. Lists S.A.E.

288 ABBEYDALE ROAD, SHEFFIELD S71FL
Tel: (0742) 552886. Fax: (0742) 500689

TEST EQUIPMENT MAINTENANCE

Spare Parts, Service Manuals and a comprehensive Repair Service now available for all makes of Electronic Test Equipment (Scopes, Generators, PSU's, Counters, DMM's, AVO's etc, etc)

We support equipment manufactured by over 100 different companies.

New and secondhand Test equipment also supplied.

Building a Project? Contact us with all your component requirements.

Trade enquiries welcome.

Hesing Technology

41 Bushmead Road, Eaton Socon, St. Neots, Cambs PE19 3BT
Tel: (0480) 214488/216870

Personal Stereo Tape Players, complete with headphones, ex shop stock, so sealed boxes but work OK. £3.50 inc post.
Mini FM Baby Listener/Transmitter, 107MHz, 100 yards range. Runs for months on 2 cheap batteries. Ready to use £6.50. Many more items in list free with order or sent on request. Mail order only please to:

LIVEWIRELESS
25 Halsall Road, Birkdale, Southport, Lancs PR8 3DB

ELECTRONIC COMPONENTS

SEND FOR OUR 1991 CATALOGUE CONTAINS 000's OF PRODUCT LINES INCLUDING SMD COMPONENTS
SEND CHEQUE OR P.O. FOR £1.80 TO:

SARM DIGITAL

13 Pearle Street, Macclesfield Cheshire SK10 2AL
Mail Order Only. Prop N. Farrar

ELECTRONIC COMPONENTS

EVERYTHING FOR YOUR NEXT PROJECT

THE BIGGEST DISPLAY IN THE SOUTH IS AT

FRASER ELECTRONICS

42 ELM GROVE * SOUTHSEA * HANTS
Telephone 0705-815584

TECHNICAL INFO SERVICES (EE)
76 Church St, Larkhall, Lanarkshire ML9 1HE
Phone 0638 884585 Mon-Fri, 9-5.

any other time 0638 883334. FOR FAST QUOTES

WORLD'S LARGEST COLLECTION SERVICE MANUALS - Most unobtainable elsewhere. Prices range from only £4.50 - large s.a.e. any quotation, no obligation to buy.

WORLD'S SOLE Suppliers of TV & Video Repair manuals, etc. from TV TECHNIC, also such publishers as Henemann, News, TV Technic, Thom etc. Every published service sheet in stock, supplied full size, not bits & pieces. CTV's or any combination £3.50 plus Lsae, any other single item £2.50 plus Lsae. Complete Circuit Sets for most Video Recorders only £7 set (no sery this made).

LSAE for QUOTATIONS plus GIANT CATALOGUE NEWSLETTERS - BARGAINS - FREE S/Sht as available.

Comprehensive TV Repair Manual £9.50. Complete Radio Service and Repair Course £9.50. Complete Repair & Service Manuals - Mono TV £12.50. CTV £17.00. Video £19.50. Complete Repair Data with circuit - Mono TV £9.50. CTV £12.50. Video £10.50.

£3.00 plus LSAE BRINGS THE ONLY COMPREHENSIVE SERVICE SHEETS & MANUALS. CATALOGUES plus FREE CHASSIS GUIDE and £4.00 OF VOUCHERS

Manufacturers Original Spares

SINCLAIR MODULATOR UM 1233.....	£4.75
Spectrum 48K Keyboard MEMBRANE.....	£4.50
Spectrum 48K Keyboard TEMPLATE.....	£4.25
Spectrum 48K ROM.....	£6.39
Spectrum ULA 6C001E.....	£15.99
Spectrum ULA 7C001 (128K & +).....	£16.34

WE CAN SUPPLY A VAST RANGE OF SPECIFIC SPARES for many makes of TV, Video & Audio Equipment. Also Sinclair, Amstrad, Commodore & Atari Computers. Write (S.A.E. please) or phone for a price and availability on your requirements. **0452 26883**

AMSTRAD Original Service Manuals
CPC464 - £8.49 PCW8256/8512 - £13.59
COMMODORE CUSTOM CHIPS
6510 CPU - £9.87 6526 CIA - £10.86 6581/8580 (alt) SID - £14.94
For Catalogue/Lists, please send 45p stamps/cheque etc.
Mail Order Only. Please add 75p (UK) P&P to above orders.

MARAPET (EE), 1 Hornbeam Mews Gloucester GL2 0UE

FM Transmitter Kits also a Telephone Bug Detector Kit
Ready built FM transmitter £5.00 including P&P
These are commercial kits
We also stock a selection of Scanning receivers so Telephone for latest stock or ask for a free catalogue

HOTLINE ELECTRONICS
97 LEIGH ROAD, AThERTON, GT MANCHESTER
Tel: (0942) 891140
Mail Order Only

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.

LOUDSPEAKERS

Large selection of specialist and general purpose chassis speakers from subminiature through high-quality bass, midrange and high frequency units to large discos, P.A. and guitar types. Also cabinets, fittings, grilles etc.

MONACOR SP-90 70 Watt 8" full range \$45.99 + £2 P&P ALTAI 20 Watt 4" bass \$8.40 + £2 P&P 15 Watt 6 1/2" bass/mid cloth edge 1" coil \$7 + £2 P&P SOUNDLAB 60 Watt 6 1/2" full range \$14 + £2 P&P MONACOR SP-250 200 Watt 10" bass unit \$34.50 + £2.50 P&P MPT-1000 75 Watt piezo tweeter 40 10Hz \$5.99 + £1 P&P DM-20 300 Watt 2 way crossover 2,000Hz \$44.37 + £1 P&P DM-5 100 Watt 3 way crossover 1,500/6,500Hz \$42 + £1 P&P HILLS 100 Watt 2 way crossover 3,000Hz \$4.83 + £1 P&P MONACOR DT-50 50 Watt full range tweeter \$7.80 + £1 P&P SP-250G 70 Watt 10" guitar speaker \$17.99 + £2.50 P&P

LARGE SAE FOR LISTS-FAST BY-RETURN SERVICE

STRACHAN ELECTRONICS (EE)
9 Croall Place, Leith Walk, Edinburgh EH7 4LT

CUSTOM ENGRAVING

NAMEPLATES, CONTROL PANELS AND BADGES IN METAL OR PLASTIC
SPECIALISTS IN TEXT AND GRAPHIC ENGRAVING

The Sign Studio
182 FREISTON ROAD, BOSTON, Lincs PE21 0JR
TEL: 0205 368276 FAX: 0205 358030

NEW VHF MICROTRANSMITTER KIT
Tuneable 80-135MHz, 500 metre range, sensitive electret microphone, high quality PCB.

SPECIAL OFFER complete kit ONLY £5.95
Assembled and ready to use £9.95 post free.
Access/Visa orders telephone 021 411 1821 (24 hrs)
Cheques/P.O.s payable to:

QUANTEK ELECTRONICS LTD
(Dept. EE), 45a Station Road Northfield, Birmingham B31 3TE

COMPONENT PACKS/COMPUTER PARTS

Intel 80286 8MHz at £50, 128k Memory Expansion at £65, 2M Memory Expansion Board at £299, MC 14514 CMOS at £2 for 2, 74175 £1 for 2. Ribbon cables, trans, res, caps, switches, etc. Send SAE for lists. Access/Visa cards.

LANGHAM SOFTWARE
Shaftesbury Centre, Percy Street, Swindon SN2 2AZ.
Tel (0793) 514055 (Day) (0793) 491098 (Night)
Fax: (0793) 512477

Carbon Film resistors 1/4W 5% E24 series 0.51R to 10MΩ	1p
100 off per value—75p, even hundreds per value totalling 1000	£6.00p
Metal Film resistors 1/4W 10R to 1MΩ 5% E12 series—2p, 1% E24 series	3p
Mixed metal/carbon film resistors 1/2W E24 series 1R0 to 10MΩ	1 1/2p
1 watt mixed metal/Carbon Film 5% E12 series 4R7 to 10 Megohms	5p
Linear Carbon pre-sets 100mW and 1/4W 100R to 4M7 E6 series	7p
Miniature polyester capacitors 250V working for vertical mounting	
.015, .022, .033, .047, .068-4p, 0.1-5p, 0.12, 0.15, 0.22-6p, 0.47-8p, 1.0-12p	
Mylar (polyester) capacitors 100V working E12 series vertical mounting	
1000p to 8200p - 3p, .01 to .068 - 4p, 0.1 - 5p, 0.12, 0.15, 0.22-6p, 0.47/50V-8p	
Submin ceramic plate capacitors 100V wkg vertical mountings E12 series	
2% 1.8pf to 47pf - 3p, 2% 56 pf to 330pf - 4p, 10% 390p - 4700p	4p
Disc/plate ceramics 50V E12 series 1P0 to 1000P, E6 Series 1500P to 47000P	2p
Polystyrene capacitors 63V working E12 series long axial wires	
10pf to 820pf - 3p, 1000 pf to 10,000pf - 4p, 12,000 pf	5p
741 Op Amp - 20p, 555 Timer	22p
cmos 4001 - 20p, 4011 - 22p, 4017	40p
ALUMINIUM ELECTROLYTICS (Mfids/Volts)	
1/50, 2/250, 4/750, 10/25, 10/50	5p
22/16, 22/25, 22/50, 47/16, 47/25, 47/50	6p
100/16, 100/25 7p; 100/50 12p; 100/100	14p
220/16 8p; 220/25, 220/50 10p; 470/16, 470/25	11p
1000/25 25p; 1000/35, 2200/25 35p; 4700/25	70p
Submin, tantalum bead electrolytics (Mfids/Volts)	
0.1/35, 0.22/35, 0.47/35, 1.0/35, 3.3/16, 4.7/16	14p
2.2/35, 4.7/25, 4.7/35, 6.8/16 15p; 10/16, 22/6	20p
33/10, 47/6, 22/16 30p; 47/10 35p; 47/16 60p; 47/35	80p
VOLTAGE REGULATORS	
1A + or - 5V, 8V, 12V, 15V, 18V & 24V	55p
DIODES (piv/amps)	
75/25mA 1N4148 2p, 800/1A 1N4006 6p, 400/3A 1N5404 14p, 115/15mA OA91	6p
100/1A 1N4002 4p, 1000/1A 1N4007 7p, 60/1.5A S1M1 5p, 100/1A bridge	25p
400/1A 1N 4004 5p, 1250/1A BY127 10p, 30/1.5A OA47	8p
Zener diodes E24 series 3V3 to 33V 400mW - 8p, 1 watt	12p
Battery snaps for PPS - 6p for PPS	12p
L.E.D.'s 3mm, & 5mm, Red, Green, Yellow - 10p, Grommets 3mm - 2p, 5mm	2p
Red flashing L.E.D.'s require 5V supply only	50p
Mains indicator neons with 220k resistor	10p
20mm fuses 100mA to 5A Q/blow 5p, A/surge 8p, Holders pc or chassis	5p
High speed pc drill 0.8, 1.0, 1.3, 1.5, 2.0mm - 30p, Machines 12V dc	£7.00
HELPING HANDS 6 ball joints and 2 croc clips to hold awkward jobs	£3.50p
AA/HP7 Nicad rechargeable cells 80p each, Universal charger unit	£6.50p
Glass reed switches with single pole make contacts - 8p, Magnets	12p
0.1" Stripboard 2 1/2" x 1" 9 rows 25 holes—20p, 3 1/4" x 2 1/2" 24 rows 37 holes	60p
TRANSISTORS	
BC107/8/9-12p, BC547/8/9-8p, BC557/8/9-8p, BC182, 182L, BC183, 183L, BC184, 184L, BC212, 212L-10p, BC327, 337, 337L-12p, BC727, 737-12p, BD135/6/7/8/9-25p, BCY70-15p, BFY50/51/52-20p, BFX88-15p, 2N3055-50p, TIP31, 32-30p, TIP41, 42-40p, BU208A-£1.20, BF195, 197-12p	
All prices are inclusive of VAT. Postage 25p (free over £5). Lists Free.	

THE CR SUPPLY CO

127 Chesterfield Rd., Sheffield S8 0RN
Tel: 0742 557771 Return posting

SURVEILLANCE PROFESSIONAL QUALITY KITS

A range of high quality kits as supplied to leading UK security companies, all in-house designed and produced, not to be confused with cheap imports. All kits come fully documented with concise assembly and setting-up details, fibreglass PCB and all components. All transmitters are fully tuneable and can be monitored on a normal VHF radio or tuned higher for greater security. Build up service available if required.

MTX. Micro-miniature audio transmitter. 17mm x 17mm. 9V operation. 1000m range	£12.95
VT500. Hi-power audio transmitter. 250mW output. 20mm x 40mm 9-12V operation. 2-3000m range	£15.95
VOX75. Voice activated transmitter. Variable sensitivity. 30mm x 40mm. 9V operation. 1000m range	£18.95
CTX900. Sub-carrier scrambled audio transmitter. Cannot be monitored without decoder fitted to radio. 30mm x 40mm. 9V operation. 1000m range	£21.95
DSX900. Sub-carrier decoder unit for monitoring CTX900. Connects to radio earphone socket. Provides output for headphones. 35mm x 50mm. 9-12V operation	£21.95
HVX400. Mains powered audio transmitter. Connects directly to 240V AC supply. 30mm x 35mm. 500m range	£18.95
XT89. Crystal controlled audio transmitter. High performance. 100mW output. Supplied with xtal for 108MHz. Others available to 116MHz. 85mm x 28mm. 9V operation. 2-3000m range	£36.95
TKX900. Tracker/Beeper transmitter. Transmits continuous stream of audio pulses. Variable tone and rate. Powerful 200mW output. 63mm x 25mm. 9V operation. 2-3000m range	£21.95
ATR2. Micro size telephone recording interface. Connects between telephone line (anywhere) and cassette recorder. Tape switches automatically with use of phone. All conversations recorded. Powered from line 10mm x 35mm	£12.95
TLX700. Micro miniature telephone transmitter. Connects to line (anywhere) switches on and off with phone use. All conversations transmitted.	
20mm x 20mm. Powered from line 1000m range	£12.95
XML900. RF bug detector. Variable sensitivity. Triggers LED and beeper when in presence of RF field. Detects MTX 15-20 feet. 55mm x 55mm. 9V operation	£26.95
XL7000. Professional bug detector/locator. Variable sensitivity. Twin mode ten segment LED readout of signal strength with variable rate beeper. Second mode AUDIO CONFIRM distinguishes between localised bug transmission and normal legitimate signal such as pagers, cellular etc. 70mm x 100mm. 9V operation	£54.95

UK customers please send cheques, PO's or registered cash. Please add £1.50 per order for P&P. Goods despatched ASAP allowing for cheque clearance. Overseas customers send sterling bank draft or Eurocheque and add £5.00 per order for shipment. Credit card orders accepted on 0827 714476. Trade enquiries welcome.

Send 28p stamp for New 1990 Full Catalogue



The Workshops, 95 Main Rd
Baxterley, Nr. Atherstone
Warks CV9 2LE



Page Make-up for £185 plus VAT

IF YOU are looking for a superb, page make-up system complete with over 200 typefaces, that really works and won't cost you an arm and a leg, Typefit is the system for you.

Why? Because for only £185 you get:

- Access to over £60k hard/software, and over 200 genuine Monotype and ITC fonts from 1 - 1000 pt. Disc processing through our typesetting bureau from £2.50 for an A4 page.
 - Page make-up, on screen. Clear, accurate WYSIWYG.
 - A system that's easy to learn and simple to use. Full on-screen help, and telephone back-up. Software that runs on IBM PCs and compatibles.
- Send us your discs or modem your files and your typesetting will be returned the same day.

EVERYDAY
ELECTRONICS
is produced
entirely on
Typefit

Typefit

THE TYPESETTING BUREAU LTD

6 Church Street, Wimborne, Dorset BH21 1JH. Tel: (0202) 882299.
Fax: 841692. Modem: 882270. DX: 45314 Wimborne. Datalinx: TYPBUR

Interested? Please 'phone
Terry or Paul for further
information or a
demonstration
disc. Please
state disc
size and
density.



AGE

A & G ELECTRONICS LTD

ELECTRONIC COMPONENTS MAIL ORDER COMPANY.

1990 COMPONENTS

Lowest prices for
quality components.

CATALOGUE IS

AVAILABLE NOW.



This offer is for a limited period.



Dont miss out !!!



Order a catalogue now and we send you a

0.5" ORANGE DUAL LED DISPLAY

Value £ 2.00 absolutely free !!!

Simply complete and return the order form below and we will send your free gift!

PLEASE SEND COPIE(S) OF THE A & G ELECTRONICS CATALOGUE AT £1.00 (REFUNDABLE WITH MY FIRST ORDER) AND MY FREE GIFT(S) TO:

NAME

ADDRESS

.....

.....

I HAVE ENCLOSED £

A & G ELECTRONICS LTD.

Free Post ,100 Park Avenue

London E 6 2BR. (No Stamp Required)

TEL : 081-552 2386 Fax : 081 - 519 3419.

MAKE YOUR INTERESTS PAY!

Over the past 100 years more than 9 million students throughout the world have found it worth their while! An ICS home-study course can help you get a better job, make more money and have more fun out of life! ICS has over 90 years experience in home-study courses and is the largest correspondence school in the world. You learn at your own pace, when and where you want under the guidance of expert personal tutors. Find out how we can help YOU. Post or phone today for your **FREE INFORMATION PACK** on the course of your choice. (Tick one box only)

Electronics	<input type="checkbox"/>	TV, Video & HI-FI Servicing	<input type="checkbox"/>
Basic Electronic Engineering (ICity & Guilds)	<input type="checkbox"/>	Refrigeration & Air Conditioning	<input type="checkbox"/>
Electrical Engineering	<input type="checkbox"/>	Car Mechanics	<input type="checkbox"/>
Electrical Contracting/Installation	<input type="checkbox"/>	Computer Programming	<input type="checkbox"/>
GCSE/GCE/SCE over 40 examination subjects to choose from			
Name	Address		

ICS International Correspondence Schools Dept ECS 90
Telephone 081-643 9568 or 041-221 2926 (24 hours) 312/314 Street, Sutton, Surrey SM1 1PR

VELLEMAN KITS

Over 100 Project Kits in stock
Send 50p for 1990 Catalogue + Price List

RETAILERS WANTED

Why not be one of our many retailers who carry our top range of high quality kits (Discounts to be arranged)
Send Details and Letterhead to:

HIGH-Q-ELECTRONICS
PO BOX 1481 LONDON NW7 4RF

TEL: **0707 263562**

FAX: **081-209 1231**

SCHOOLS AND COLLEGES WELCOME

ADVERTISERS INDEX

A&G ELECTRONICS.....	623
B.C. ELECTRONICS.....	621
BK ELECTRONICS.....	Cover (iii)
BULL ELECTRICAL.....	Cover (ii)
CAMBRIDGE COMP.SCIENCE.....	605
CES.....	605
CIRKIT DISTRIBUTION.....	573
CRICKLEWOOD ELECTRONICS.....	621
CR SUPPLY COMPANY.....	623
ELECTRONIZE DESIGN.....	585
ELV FRANCE.....	564/565
GRANDATA.....	615
GREENWELD ELECTRONICS.....	591-594
HART ELECTRONIC KITS.....	573
HIGH-Q-ELECTRONICS.....	624
HIGHGRADE COMPONENTS.....	613
ICS.....	624
JAYTEE ELECTRONIC SERVICES.....	585
KB COMPONENTS.....	585
LONDON ELECTRONICS COLLEGE.....	624
MAGENTA ELECTRONICS.....	566/567
MAPLIN ELECTRONICS.....	Cover (iv)
MARCO TRADING.....	577
OMNI ELECTRONICS.....	624
SHERWOOD ELEC. COMP.....	621
SPECIALIST SEMICONDUCTORS.....	619
STEWART OF READING.....	624
SUMA DESIGNS.....	623
THE TYPESETTING BUREAU.....	623
TK ELECTRONICS.....	568

BTEC ELECTRONICS TECHNICIAN FULL-TIME TRAINING

2 YEAR
BTEC National Diploma (OND)
ELECTRONIC & COMMUNICATIONS ENGINEERING
(Electronics, Computing, Television, Video, Testing & Fault Diagnosis)

1 YEAR
BTEC National Certificate (ONC)
ELECTRONIC ENGINEERING
1—INFORMATION TECHNOLOGY
(Electronics, Satellite TV, Networks, Telecomms)

2—ELECTRONIC EQUIPMENT SERVICING
(Electronics, Television, Video Cassette Recorders, CCTV, Testing and Fault Diagnosis)

3—SOFTWARE ENGINEERING
(Electronics, Assembler, BASIC, Pascal, CAD/CAM)

4—COMPUTING TECHNOLOGY
(Electronics, Computing Software/Hardware, Microelectronics)

10 MONTHS
BTEC Higher National Certificate (HNC)
COMPUTING TECHNOLOGY & ROBOTICS
(Microprocessor Based Systems, Control, Robotics)

These courses include a high percentage of college based practical work to enhance future employment prospects
No additional fees for overseas students
Shortened courses of from 3 to 6 months can be arranged for applicants with previous electronics knowledge

THOSE ELIGIBLE CAN APPLY FOR E.T. GRANT SUPPORT
AN EQUAL OPPORTUNITIES PROGRAMME

O.N.C. and O.N.D.
Next Course Commences

Monday 17th September 1990
FULL PROSPECTUS FROM

LONDON ELECTRONICS COLLEGE
(Dept. EE) 20 PENYERN ROAD
EARLS COURT, LONDON SW5 9SU
TEL 071-373 8721

OMNI ELECTRONICS

174 Dalkeith Road, Edinburgh EH16 5DX • 031 667 2611

A COMPREHENSIVE RANGE WITH SERVICE SECOND TO NONE

OUR MUCH EXPANDED, BETTER ILLUSTRATED CATALOGUE WILL COST £1.50 - TO INCLUDE VOUCHERS TO USE AGAINST FUTURE PURCHASES. TO RECEIVE A COPY AS SOON AS THEY ARE READY, PLEASE SEND YOUR REMITTANCE WITH THE VOUCHER BELOW.

New 1990/91 Catalogue available soon

Please send me a copy of the 1990/91 OMNI catalogue as soon as it is ready. Payment of £1.50 enclosed.

NAME:

ADDRESS:

TELEPHONE:

Open: Monday-Friday 9.00-6.00
Saturday 9.00-5.00

VISA

WE HAVE THE WIDEST CHOICE OF USED OSCILLOSCOPES IN THE COUNTRY

TEKTRONIX OSCILLOSCOPE 2235 Dual Trace 100MHz Delay Sweep	£650
PHILIPS OSCILLOSCOPE PM3217 Dual Trace 50MHz Delay Sweep	£450
GOULD ODS300 Oscilloscope Dual Trace 20MHz	£750
GOULD 1421 Digital Storage Dual Trace 20MHz	£400
H.P. 1740A Dual Trace 100MHz Delay Sweep Trig	£400
TELEQUIPMENT D83 Dual Trace 50MHz Delay Sweep	£300
GOULD ODS3000A Dual Trace 40MHz Delay Sweep TV Trig	£275
TELEQUIPMENT D755 Dual Trace 50MHz Delay Sweep	£130
S.E. LABS SM111 Dual Trace 15MHz	£150
GOULD DS350B Dual Trace 15MHz TV Trig	£150
PHILIPS PM3233 Dual Beam 10MHz TV Trig	£150
GOULD ODS258 Dual Trace 15MHz TV Trig	£150

THIS IS JUST A SAMPLE - MANY OTHERS AVAILABLE

TEKTRONIX 2215 Dual Trace 60MHz Sweep Delay	With manual, Probes, Front Cover Pouch	£500
---	--	------

MARCONI TF2015 AM/FM 10.520MHz Sig Gen with TF2171	£450
MARCONI TF2015 without Synchroniser TF2171	£250
MARCONI TF2016 AM/FM 10MHz-120MHz Sig Gen	£400
MARCONI TF2016 without Synchroniser TF2173	£175
MARCONI MD3 Meters TF2300, TF2300B, TF2300C	from £100
PERROGRAPH RTS Recorder Test Set	£100
LEADER LMV186A Two Channel Millivoltmeter 500uA 10mV 300V	£100
MARCONI TF2337A Automatic Distortion Meter 400Hz-100Hz	£100
MARCONI TF2700 Universal LCR Bridge Battery	from £120

TEKTRONIX 491 SPECTRUM ANALYSER 1.5-12.4GHz	£1,500
SYSTEM DOWNER 1702 Sig Gen 100Hz-1GHz	£1,500
POLARAD Sig Gen type 1105B 0.8-4.5GHz	£500
POLARAD Sig Gen type 1107A 3.7-4.5GHz	£500
POLARAD Sig Gen 1208A 0.85-11GHz with Freq Doubler 1510 15-21GHz	£750
POLARAD 1207A Sig Gen 3.7-8.4GHz with Freq Doubler 1509 10-15.5GHz	£750

THANABR TA2000 Logic Analyser 20MHz 8 CHANNEL	£375
THURLEY PL3000A 0.30V 2A Trace Dual Mode Digital Meters	£200
FEEBROOK P5600 Sweep Function Generator 0.01Hz-1MHz (P&P £7)	£175
FARNELL Oscillator LF43 10Hz-10MHz Sine Square	£200
RACAL 9915 Freq Counter 10Hz-520MHz (Crystal Oven)	£150
RACAL 9900 Series Universal Counter Instrument	from £150
MARCONI ATTENUATORS TF2162 DC 1MHz 600 ohm 0 111dB (P&P £7)	£35

FARNELL GUS50 Isolating transformer 240V in 240V out 500VA Cased with lead & 13 Amp socket (P&P £7).....	ONLY £45 EACH
VARIAC 2 Amp.....	from £20 (P&P £5)
VARIAC 8 Amp.....	from £30 (P&P £7)
VARIOUS BENCH PSUS.....	PLEASE INQUIRE

TELEPHONES

YES! REAL DUAL TYPE TELEPHONES that don't slide around the desk. Type no 746 supplied with standard B.T. plug (used) Quantity Discount. Only £3 each (P&P £3)

Used Equipment - With 30 days guarantee. Manuals supplied if possible. This is a VERY SMALL SAMPLE OF STOCK. SAE or Telephone for lists. Please check availability before ordering. CARRIAGE all units £16. VAT to be added to Total of Goods and Carriage.

STEWART OF READING

110 WYKHAM ROAD, READING, BERKS RG6 1PL
Telephone: (0734) 68041 Fax: (0734) 351696
Callers Welcome 9am-5.30pm Mon-Fri (until 8pm Thurs)

"SUMMER SALE"

TEKTRONIX 475 Dual Trace 200MHz Delay Sweep	£550
TEKTRONIX 465 Dual Trace 100MHz Delay Sweep	£400
GOULD ODS1100 Dual Trace 30MHz TV Trig	£180
GOULD ODS1150 Dual Trace 35MHz Delay Sweep from £180-£190	
TELEQUIPMENT C771 Curve Tracer	£175
MARCONI TF2603 RF Millivoltmeter 500Hz-1.5GHz 1mV 3V F50	£175
MARCONI TF2430 Digital Freq Counter 10Hz-80MHz	£150
MARCONI AF Power Meter TF1053A 20Hz-350Hz 20mW 10W 50 ohm	£20
MARCONI RF Power Meter TF11521 DC-500MHz 0.5-25W 50 ohm	£25
FARNELL Pulse Generator System 1Hz-10MHz Single Double	£48
KIKUSUI AVM23 AC Voltmeter Dual Chan 10Hz-500kHz 300uV 100V	£35
SOLARTRON 7045 Multimeter 4.5 digit LED 30 ranges Auto Manual (P&P £7)	£35
AVO 8 Multimeters with Batteries & Leads	from £35
AVO CT446 Transistor Analyser M22 Surface style With Batteries & operation instructions	£20

COLOUR BAR GENERATOR-KG1 8 PATTERNS (RP £4) Only £25

LEVELL TM38 AC Microvoltmeter 1Hz-3MHz 5uV-500V	£40
LEVELL TM3A AC Microvoltmeter 1Hz-3MHz 5uV-500V	£40
LEVELL Oscillator TG152 1MHz-200kHz Sine Sq	from £55
LEVELL Oscillator TG150M 1.5Hz-150kHz Sine Sq Wave	£20
LEVELL Oscillator TG150M 1.5Hz-150kHz Sine Sq Wave £25	
LEVELL decade Osc TG66A 0.2Hz-1.27MHz Low Distortion	from £35
FARNELL TMA RF Millivoltmeter 500kHz-1.5GHz 1mV 300V £80 LOGIC PROBE type 3000A TTL CMOS (P&P £3)	£10

MANY MORE ITEMS AT RIDICULOUS PRICES - List available.

NEW EQUIPMENT

HAMEG OSCILLOSCOPE HM1005 Triple Trace 100MHz Delay Timebase	£795
HAMEG OSCILLOSCOPE HM604 Dual Trace 60MHz Delay Sweep	£610
HAMEG OSCILLOSCOPE HM203 7 Dual Trace 20MHz Component Tester	£338
HAMEG OSCILLOSCOPE HM205 3 Dual Trace 20MHz Digital Storage	£610
All other models available	
All oscilloscopes supplied with 2 probes	
BLACK STAR EQUIPMENT (p&p all units £5)	
APOLLO 10-100MHz Counter Timer Ratio/Period/Time interval etc	£222
APOLLO 100-100MHz (As above with more functions)	£295
METTER 100 FREQUENCY COUNTER 100MHz	£199
METTER 500 FREQUENCY COUNTER 100MHz	£135
METTER 1000 FREQUENCY COUNTER 10Hz	£178
JUPITOR 500 FUNCTION GENERATOR 0.1Hz-500kHz Sine Sq Tri	£118
ORION COLOUR BAR GENERATOR P&P/Video	£299
All other Black Star Equipment available	

HAMEG CHANG DM4M 7030 3 digit Hand held 28 ranges including 10kHz AC/DC 0.1% Acc (p&p £4)	£39.50
As above DM4M 6010 0.2% AC	£33.50
Carrying Cases for above	£3
OSCILLOSCOPE PROBES Switchable x1 x10 (P&P £3)	£11

OMP POWER AMPLIFIER MODULES-TURNABLES-DIMMERS-LOUDSPEAKERS-19 INCH STEREO RACK AMPLIFIERS

OMP POWER AMPLIFIER MODULES

Supplied ready built and tested.

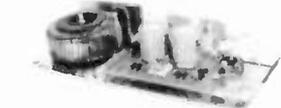
OMP POWER AMPLIFIER MODULES Now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models available to suit the needs of the professional and hobby market, i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE all models include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

THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS



OMP100 Mk 11 Bi-Polar Output power 110 watts R.M.S. into 4 ohms. Frequency Response 15Hz - 30KHz - 3dB, T.H.D. 0.01%, S.N.R. - 118dB, Sens. for Max. output 500mV at 10K, Size 355 x 115x65mm. PRICE £33.99 + £3.00 P&P.

NEW SERIES II MOS-FET MODULES



OMP/MF 100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms. Frequency Response 1Hz - 100KHz - 3dB, Damping Factor >300, Slew Rate 45V uS, T.H.D. Typical 0.002%, Input Sensitivity 500mV, S.N.R. - 125dB, Size 300 x 123 x 60mm. PRICE £39.99 + £3.00 P&P.

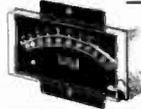


OMP/MF200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms. Frequency Response 1Hz - 100KHz - 3dB, Damping Factor >300, Slew Rate 50V uS, T.H.D. Typical 0.001%, Input Sensitivity 500mV, S.N.R. - 130dB, Size 300 x 155 x 100mm. PRICE £62.99 + £3.50 P&P.



OMP/MF300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms. Frequency Response 1Hz - 100KHz - 3dB, Damping Factor >300, Slew Rate 60V uS, T.H.D. Typical 0.0008%, Input Sensitivity 500mV, S.N.R. - 130dB, Size 330 x 175 x 100mm. PRICE £79.99 + £4.50 P&P.

NOTE:— MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS, STANDARD — INPUT SENS. 500mV BAND WIDTH 100KHz, PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) — INPUT SENS. 75mV BAND WIDTH 30KHz, ORDER STANDARD OR PEC



Vu METER Compatible with our four amplifiers detailed above. A very accurate visual display employing 11 LED diodes (7 green, 4 red) plus an additional on/off indicator. Sophisticated logic control circuits for very fast rise and decay times. Tough moulded plastic case, with tinted acrylic front. Size 84 x 27 x 45mm. PRICE £8.50 + 50p P&P.

LOUDSPEAKERS



LARGE SELECTION OF SPECIALIST LOUDSPEAKERS AVAILABLE, INCLUDING CABINET FITTINGS, SPEAKER GRILLES, CROSS-OVERS AND HIGH POWER, HIGH FREQUENCY BULLETS AND HORNS, LARGE S.A.E. (30p STAMPED) FOR COMPLETE LIST.

McKENZIE:— INSTRUMENTS, P.A., DISCO, ETC.

- ALL MCKENZIE UNITS 8 OHMS IMPEDANCE**
- 8" 100 WATT C8100GPM GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID, DISCO. RES. FREQ. 80Hz FREQ. RESP. TO 14KHz SENS. 99dB. PRICE £29.30 + £2.00 P&P
 - 10" 100 WATT C10100GP GUITAR, VOICE, ORGAN, KEYBOARD, DISCO, EXCELLENT MID. RES. FREQ. 70Hz FREQ. RESP. TO 6KHz SENS. 100dB. PRICE £35.58 + £2.50 P&P
 - 12" 200 WATT C10200GP GUITAR, KEYBOARD, DISCO, EXCELLENT HIGH POWER MID. RES. FREQ. 45Hz FREQ. RESP. TO 7KHz SENS. 103dB. PRICE £48.67 + £2.50 P&P
 - 12" 100 WATT C12100GP HIGH POWER GEN. PURPOSE, LEAD GUITAR, DISCO. RES. FREQ. 45Hz FREQ. RESP. TO 7KHz SENS. 98dB. PRICE £37.59 + £3.50 P&P
 - 12" 100 WATT C12100TC TWIN CONE) HIGH POWER WIDE RESPONSE, P.A., VOICE, DISCO. RES. FREQ. 45Hz FREQ. RESP. TO 14KHz SENS. 100dB. PRICE £38.58 + £3.50 P&P
 - 12" 200 WATT C12200B HIGH POWER BASS, KEYBOARDS, DISCO, P.A. RES. FREQ. 40Hz FREQ. RESP. TO 7KHz SENS. 100dB. PRICE £65.79 + £3.50 P&P
 - 12" 300 WATT C12300CP HIGH POWER BASS, LEAD GUITAR, KEYBOARDS, DISCO, ETC. RES. FREQ. 45Hz FREQ. RESP. TO 5KHz SENS. 100dB. PRICE £87.51 + £3.50 P&P
 - 15" 100 WATT C15100BS BASS GUITAR, LOW FREQUENCY, P.A., DISCO. RES. FREQ. 40Hz FREQ. RESP. TO 5KHz SENS. 98dB. PRICE £55.05 + £4.00 P&P
 - 15" 200 WATT C15200BS VERY HIGH POWER BASS. RES. FREQ. 40Hz FREQ. RESP. TO 4KHz SENS. 99dB. PRICE £75.10 + £4.00 P&P
 - 15" 250 WATT C15250BS VERY HIGH POWER BASS. RES. FREQ. 40Hz FREQ. RESP. TO 4KHz SENS. 99dB. PRICE £82.54 + £4.50 P&P
 - 15" 400 WATT C15400BS VERY HIGH POWER, LOW FREQUENCY BASS. RES. FREQ. 40Hz FREQ. RESP. TO 4KHz SENS. 102dB. PRICE £96.47 + £4.50 P&P
 - 18" 400 WATT C18404BS EXTREMELY HIGH POWER, LOW FREQUENCY BASS. RES. FREQ. 27Hz FREQ. RESP. TO 3KHz SENS. 99dB. PRICE £172.06 + £5.00 P&P

EARBENDERS:— HI-FI, STUDIO, IN-CAR, ETC.

- ALL EARBENDER UNITS 8 OHMS**
- BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED FOAM SURROUND**
- 8" 50 WATT EB8-50 DUAL IMPEDANCE, TAPPED 4 8 OHM BASS, HI-FI, IN-CAR. RES. FREQ. 40Hz FREQ. RESP. TO 7KHz SENS. 97dB. PRICE £8.90 + £2.00 P&P
 - 10" 50 WATT EB10-50 DUAL IMPEDANCE, TAPPED 4 8 OHM BASS, HI-FI, IN-CAR. RES. FREQ. 40Hz FREQ. RESP. TO 5KHz SENS. 99dB. PRICE £12.00 + £2.50 P&P
 - 10" 100 WATT EB10-100 BASS, HI-FI, STUDIO. RES. FREQ. 35Hz FREQ. RESP. TO 3KHz SENS. 96dB. PRICE £27.76 + £3.50 P&P
 - 12" 60 WATT EB12-60 BASS, HI-FI, STUDIO. RES. FREQ. 28Hz FREQ. RESP. TO 3KHz SENS. 92dB. PRICE £21.00 + £3.00 P&P
 - 12" 100 WATT EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO. RES. FREQ. 26Hz FREQ. RESP. TO 3KHz SENS. 93dB. PRICE £38.75 + £3.50 P&P
- FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND**
- 5 1/2" 60 WATT EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 63Hz FREQ. RESP. TO 20KHz SENS. 92dB. PRICE £9.99 + £1.50 P&P
 - 6 1/2" 60 WATT EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 38Hz FREQ. RESP. TO 20KHz SENS. 94dB. PRICE £10.99 + £1.50 P&P
 - 8" 60 WATT EB8-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 40Hz FREQ. RESP. TO 18KHz SENS. 89dB. PRICE £12.99 + £1.50 P&P
 - 10" 60 WATT EB10-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 35Hz FREQ. RESP. TO 12KHz SENS. 86dB. PRICE £16.49 + £2.00 P&P

TRANSMITTER HOBBY KITS

PROVEN TRANSMITTER DESIGNS INCLUDING GLASS FIBRE PRINTED CIRCUIT BOARD AND HIGH QUALITY COMPONENTS COMPLETE WITH CIRCUIT AND INSTRUCTIONS

- 3W FM TRANSMITTER 80-108MHz VARICAP CONTROLLED PROFESSIONAL PERFORMANCE RANGE UP TO 3 MILES. SIZE 38 x 123mm SUPPLY 12V @ 0.5AMP. PRICE £14.49 + £1.00 P&P
- FM MICRO TRANSMITTER (BUG) 100-108MHz VARICAP TUNED COMPLETE WITH VERY SENS FET MIC. RANGE 100-300m. SIZE 56 x 46mm SUPPLY 9V BATT. PRICE £8.62 + £1.00 P&P



3 watt FM Transmitter



POSTAL CHARGES PER ORDER £1.00 MINIMUM OFFICIAL ORDERS WELCOME FROM SCHOOLS COLLEGES GOVT BODIES ETC PRICES INCLUSIVE OF V.A.T. SALES COUNTER VISA ACCESS ACCEPTED BY POST PHONE OR FAX



* PRICES INCLUDE V.A.T. * PROMPT DELIVERIES * FRIENDLY SERVICE * LARGE S.A.E., 30p STAMPED FOR CURRENT LIST.

OMP VARISPEED TURNTABLE CHASSIS



- * MANUAL ARM
- * STEEL CHASSIS
- * ELECTRONIC SPEED CONTROL 33 & 45
- * VARI PITCH CONTROL
- * HIGH TORQUE SERVO DRIVEN DC MOTOR
- * TRANSIT SCREWS
- * 12" DIE CAST PLATTER
- * NEON STROBE
- * CALIBRATED BAL WEIGHT
- * REMOVABLE HEAD SHELL
- * CARTRIDGE FIXINGS
- * CUE LEVER
- * POWER 220 240V 50/60Hz
- * 390 x 305mm
- * SUPPLIED WITH MOUNTING CUT-OUT TEMPLATE

PRICE £59.99 + £3.50 P&P.

OPTIONAL MAGNETIC CARTRIDGES

- STANTON AL500 PRICE £16.99 + 50p P&P
- GOLDRING G850 PRICE £6.99 + 50p P&P

OMP MOS-FET POWER AMPLIFIERS, HIGH POWER, TWO CHANNEL 19 INCH RACK

THOUSANDS PURCHASED BY PROFESSIONAL USERS



NEW MXF SERIES OF POWER AMPLIFIERS

THREE MODELS:— MXF200 (100w + 100w) MXF400 (200w + 200w) MXF600 (300w + 300w) All power ratings R.M.S. into 4 ohms.

FEATURES: * Independent power supplies with two Toroidal Transformers * Twin L.E.D. Vu meters * Rotary indexed level controls * Illuminated on/off switch * XLR connectors * Standard 775mV inputs * Open and short circuit proof * Latest Mos-Fets for stress free power delivery into virtually any load * High slew rate * Very low distortion * Aluminium cases * MXF600 Fan Cooled with D.C. Loudspeaker and Thermal Protection.

USED THE WORLD OVER IN CLUBS, PUBS, CINEMAS, DISCOS ETC.

- SIZES:— MXF 200 W19 - H3 1/2" (2U) x D11"
- MXF 400 W19 - H5 1/4" (3U) x D12"
- MXF 600 W19 - H5 1/4" (3U) x D13"

- MXF200 £171.35
- MXF400 £228.85
- MXF600 £322.00

SECURICOR DELIVERY £12.00 EACH



OMP LINNET LOUDSPEAKERS

THE VERY BEST IN QUALITY AND VALUE



POWER RATINGS QUOTED IN WATTS RMS FOR EACH CABINET

- OMP 12-100 (100W 100dB) PRICE £159.99 PER PAIR
- OMP 12-200 (200W 102dB) PRICE £209.99 PER PAIR

SECURICOR DEL. — £12.00 PER PAIR

IN CAR STEREO BOOSTER AMPLIFIER



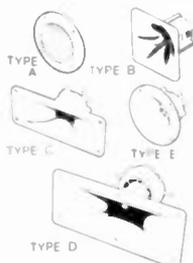
TWO SUPERB HIGH POWER CAR STEREO BOOSTER AMPLIFIERS

- 150 WATTS (75+75) INTO 4 OHMS
- 300 WATTS (150+150) INTO 4 OHMS
- FEATURES:
 - * HIGH & LOW INPUT IMPEDANCES
 - * HIGH & LOW INPUT SENSITIVITIES
 - * VARIABLE INPUT GAIN CONTROL
 - * SHORT CIRCUIT OUTPUT PROTECTION
 - * POWER REQUIREMENT 12V D.C.
- PRICES: 150 WATT £43.00
- 300 WATT £95.00 + £3.00 P&P EACH

PIEZO ELECTRIC TWEETERS—MOTOROLA

PIEZO ELECTRIC TWEETERS — MOTOROLA

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

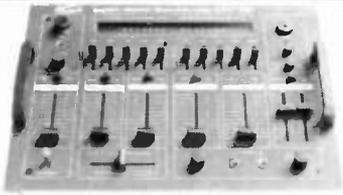


- TYPE 'A' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-Fi speakers. Price £4.90 each + 50p P&P
- TYPE 'B' (KSN1005A) 3" super horn. For general purpose speakers, disco and P.A. systems etc. Price £5.99 each + 50p P&P
- TYPE 'C' (KSN6016A) 2" x 5" wide dispersion horn. For quality Hi-Fi systems and quality discos etc. Price £6.99 each + 50p P&P
- TYPE 'D' (KSN1025A) 2" x 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. Price £9.99 each + 50p P&P
- TYPE 'E' (KSN1038A) 3" x 4" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. Price £5.99 each + 50p P&P

LEVEL CONTROL Combines on a recessed mounting plate, level control and cabinet input jack socket. 85 x 85mm. Price £3.99 + 50p P&P

STEREO DISCO MIXER

STEREO DISCO MIXER with 2 x 5 band L & R graphic equalisers and twin 10 segment L.E.D. Vu Meters. Many outstanding features 5 inputs with individual faders providing a useful combination of the following — 3 Turntables (Mag) 3 Mics 4 Line including CD plus Mic with talk over switch Headphone Monitor Pan Pot L & R Master Output controls. Output 775mV Size 360 x 280 x 90mm. Supply 220-240V. Price £134.99 — £4.00 P&P



B. K. ELECTRONICS Dept EE
UNIT 5, COMET WAY, SOUTHWEND-ON-SEA, ESSEX. SS2 6TR
TEL: 0702-527572 FAX: 0702-420243

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



ROD BROWN '83

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, Royleigh,
Essex SS6 8LR.

PERFORMANCES DAILY
At your local branch
of WHSMITH
ONLY £2.45

EE91