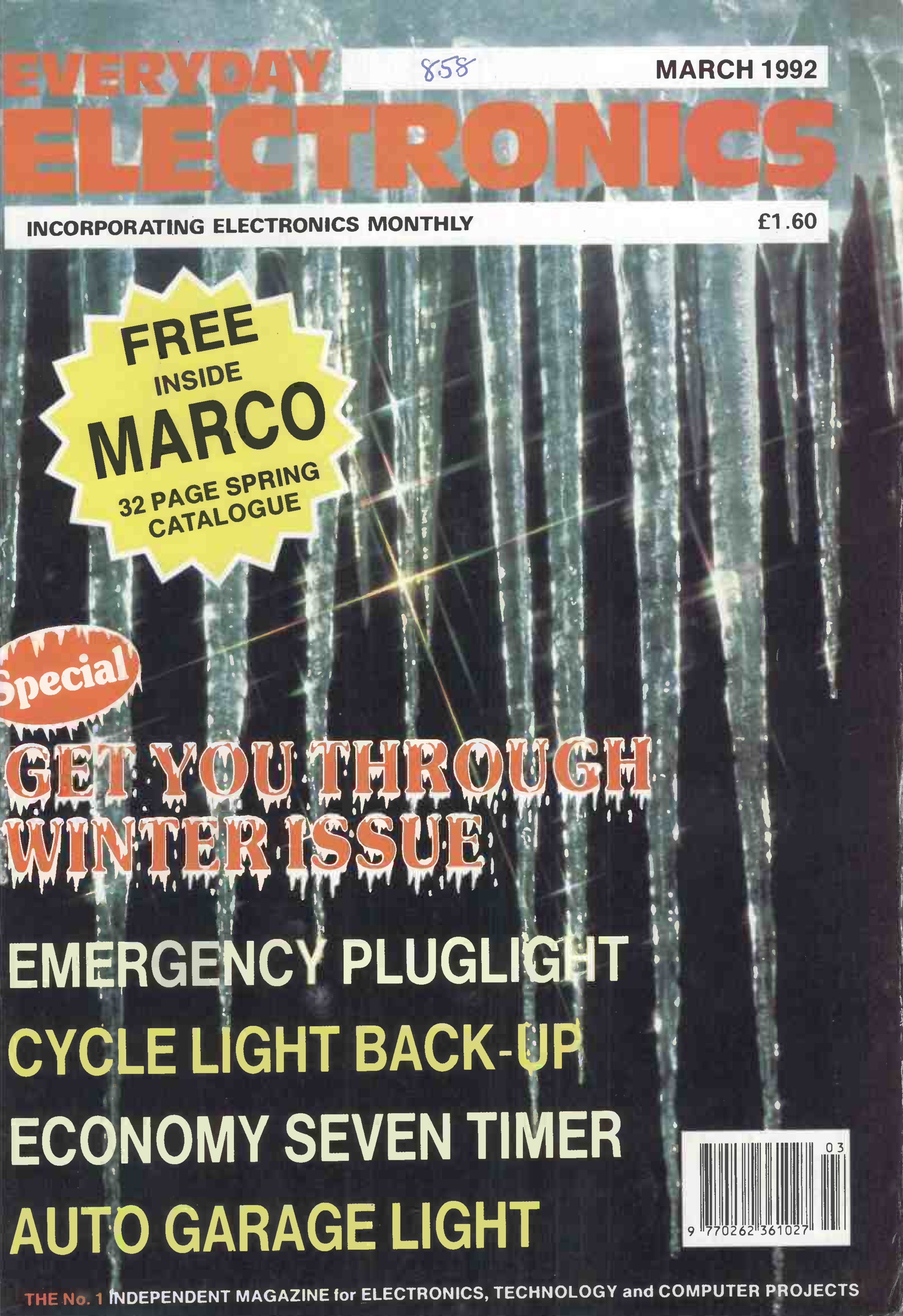


858

MARCH 1992

EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

£1.60

Special

GET YOU THROUGH WINTER ISSUE

EMERGENCY PLUGLIGHT

CYCLE LIGHT BACK-UP

ECONOMY SEVEN TIMER

AUTO GARAGE LIGHT

03

9 770262 361027

THE No. 1 INDEPENDENT MAGAZINE for ELECTRONICS, TECHNOLOGY and COMPUTER PROJECTS

VOL. 21 No. 3 MARCH 1992

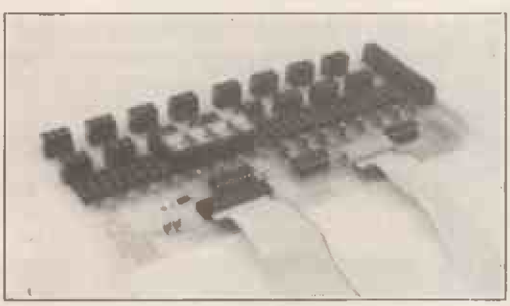
EVERYDAY ELECTRONICS

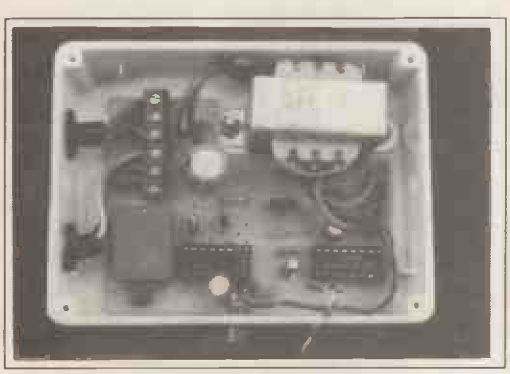
INCORPORATING ELECTRONICS MONTHLY

The No. 1 Independent Magazine for Electronics, Technology and Computer Projects

ISSN 0262 3617

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





Our April '92 Issue will be published on Friday, 6 March 1992. See page 131 for details.

Projects

EMERGENCY PLUG LIGHT by Ivor Sadler — 138
Comes on when the mains goes off, doubles as a rechargeable torch

ECONOMY SEVEN TIMER by Chris Brown — 142
Use your appliances on cheap rate electricity

AUTO GARAGE LIGHT by A. R. Winstanley — 154
Turns the light on when it sees your car headlights

CYCLE LIGHT BACKUP by T. R. de Vaux Balbirnie — 170
Keeps the lights on when the dynamo stops turning

VERSATILE BBC INTERFACE by Mark Stuart — 176
Eight programmable input/output lines plus eight output lines all with relay switching if required

Series

INFORMATION TECHNOLOGY AND THE NATIONAL CURRICULUM by T. R. de Vaux-Balbirnie — 146
Part Five: Microelectronic Experiments.

INTERFACE by Robert Penfold — 160
The place for computer fans – controlling d.c. motors

MAGNETIC RECORDING by Vivian Capel — 162
Part Six: Recording Tape

AMATEUR RADIO by Tony Smith G4FAI — 168
Listening on v.h.f.; Loft Antennas; Cable Problems; More Novices

ACTUALLY DOING IT by Robert Penfold — 174
Screening and screened leads

Features

EDITORIAL — 137

FOR YOUR ENTERTAINMENT by Barry Fox — 144
Double Coated; Jukebox Technology; Fax Killer

EVERYDAY NEWS — 152
What's happening in the world of electronics

ANIMATED CIRCUITS FOR ELECTRONICS — 166
Mike Tooley reviews a novel software package

SHOPTALK with David Barrington — 181
Component buying for projects

PLEASE TAKE NOTE — 181
MARC System chip-encoder

DOWN TO EARTH by George Hylton — 182
Fault Finding

DIRECT BOOK SERVICE — 184
Selected technical books and all the EE books by mail order

PRINTED CIRCUIT BOARD SERVICE — 188
P.C.B.s for EE projects past and present

FREE WITH THIS ISSUE — Between pages 160 and 161
MARCO TRADING CATALOGUE SUPPLEMENT

ADVERTISER'S INDEX — *192*

Readers Services • Editorial and Advertisement Departments — *137*

NEXT MONTH

AUDIO TELESCOPE

An audio device, which simply amplifies sounds so that weak sounds can be heard more clearly. A sort of audio equivalent to a telescope in fact, or it could be regarded as a hearing aid, but for those with healthy hearing. The output of the unit feeds a pair of personal stereo type headphones.

FREE GREENWELD 32 page spring Catalogue Supplement

VERSATILE AUDIO AMPLIFIER

An inexpensive hybrid amplifier designed as a general purpose power amp. The unit can be supplied with d.c. from 9V to 35V and will give up to 80W output.

EASY SWITCH

This circuit was originally designed to replace the standard switch on an elderly person's electric lawn mower. Due to arthritis, he was unable to maintain sufficient hand pressure to keep it on.

Many lawn mowers have a switch which requires quite a large hand pressure – even people with normal hands can find it difficult keeping it pressed for long periods. This electronic replacement solves the problem.

CIRCUIT SURGERY

Our new clinic especially for **Everyday Electronics'** ***constructors. Circuit Surgery aims to provide a regular cocktail of practical hints and tips. It also intends to act as a "self-help" forum for readers as well as a means of providing rapid feedback (including modifications and trouble-shooting information) on the projects which appear in*** **Everyday Electronics.** ***For good measure, we also hope to put paid to some popular myths and misconceptions. This column will rely heavily on your input!***

EVERYDAY ELECTRONICS

APRIL ISSUE ON SALE FRIDAY 6TH MARCH 1992

MAGENTA ELECTRONICS LTD

MAIL ORDER AND SHOP
EE118
135 Hunter St
Burton-on-Trent
Staffs, DE14 2ST
Tel: 0283 65435
Fax: 0283 46932

VISA SWITCH

VERSATILE BBC INTERFACE

A comprehensive interface which allows the BBC Model B computer to be connected safely to a wide range of input and output devices. Two leads connect the interface to the User port and Printer port. Up to 16 outputs (all via single pole change-over relay contacts) and 8 inputs. All inputs are fully protected. LED indication is provided on all lines. Requires an independent 12V supply

Full Kit Ref: 844 £51.95

STEPPING MOTOR DRIVER/INTERFACE

EE Jan '92
A single board, stand alone, stepping motor driver with built-in oscillator for variable low speed, high speed, and acceleration control. Suitable for all Magenta's four-phase unipolar motors and most others – up to 35V and 1·5A per phase. Half step, Full step and Wave-drive modes – switch selectable. LED mimic display and connector for computer port.
Kit includes MD35 motor
Kit Ref: 843 £29.95
Or Built £44.95

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

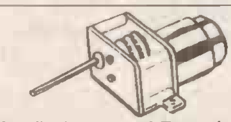
CATALOGUE AVAILABLE PRICE £1.00 INC. P&P

All prices include VAT at 17·5%
Shop open 9-5 Mon.-Fri.
9-2 Saturday
Official orders welcome
Add £2 p&p to all orders

HAMEG HM 203-7 OSCILLOSCOPE

High quality reliable instrument made in W. Germany. Outstanding performance. Full two year parts and labour warranty. 20MHz-2 channels 1mV sensitivity. Easy to operate and high performance
(Cheques must be cleared) £338 + £59.15 VAT
Next day Delivery £10.00

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 £4.08
Speed range 3-2200 rpm. Size: 37 x 43 x 25mm
Large Unit Type MGL £4.65
Speed range 2-1150 rpm..Size: 57 x 43 x 29mm

STEPPING MOTORS

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

ID36 Permanent Magnet Motor £16.86
48 steps per rev
MD200 Hybrid Motor £17.10
200 steps per rev
MD35¼ Permament Magnet Motor £12.98
48 steps per rev.
MD38 Permanent Magnet Motor £9.15
48 steps per rev.

EVERYDAY ELECTRONICS KIT PROJECTS

ALL KITS HERE HAVE BEEN FEATURED IN EE AND ARE SUPPLIED WITH MAGAZINE ARTICLE REPRINTS. SEPARATE REPRINTS ALSO AVAILABLE PRICE 80p EACH INCLUSIVE P&P. KITS INCLUDE CASES, PCB's HARDWARE AND ALL COMPONENTS (UNLESS STATED OTHERWISE) CASES ARE NOT DRILLED OR LABELS SUPPLIED UNLESS STATED.

Ref		Price
844	VERSATILE BBC INTERFACE Mar 92	£51.95
843	STEPPING MOTOR DRIVER/INTERFACE Jan 92 or built	£29.95 £44.95
842	PORTABLE ULTRASONIC PEsT SCARER, Aug '91	£22.56
841	DIGITAL LCD THERMOSTAT May 91 with punched and printed case	£29.95
840	DIGITAL COMBINATION LOCK Mar 91 with drilled case	£19.86
839	ANALOGIC TEST PROBE Jan 91	£13.23
838	MICROCONTROLLER LIGHT SEQUENCER Dec 90. With drilled and labelled case	£57.17
835	SUPERHET BROADCAST RECEIVER Mar 90 With drilled panels and dial	£17.16
834	QUICK CAP TESTER Feb 90	£10.39
833	EE 4 CHANNEL LIGHT CHASER Jan 90	£32.13
815	EE TREASURE HUNTER Aug 89	Full Kit £45.95
814	BAT DETECTOR June 89	£21.44
812	ULTRASONIC PET SCARER May 89	£14.81
800	SPECTRUM EPROM PROGRAMMER Dec 88	£30.60
796	SEASHELL SYNTHESISER Nov 88	£28.55
790	EPROM ERASER Oct 88	£28.51
769	VARIABLE 25V-2A BENCH POWER SUPPLY Feb 88	£56.82
744	VIDEO CONTROLLER Oct 87	£33.29
740	ACOUSTIC PROBE Nov 87	£20.01
739	ACCENTED BEAT METRONOME Nov 87	£23.94
734	AUTOMATIC PORCH LIGHT Oct 87	£19.62
730	BURST-FIRE MAINS CONTROLLER Sep 87	£15.50
728	PERSONAL STEREO AMP Sep 87	£16.34
724	SUPER SOUND ADAPTOR Aug 87	£43.86
722	FERMOSTAT July 87	£13.88
719	BUCCANEER I.B. METAL DETECTOR July 87	£30.22
718	3-BAND 1.6-30MHz RADIO Aug 87	£30.30
715	MINI DISCO LIGHTS June 87	£14.39
707	EQUALIZER (IONISER) May 87	£17.75

Ref		Price
700	ACTIVE I/R BURGLAR ALARM Mar 87	£40.74
584	SPECTRUM SPEECH SYNTH (no case) Feb 87	£23.90
581	VIDEO GUARD Feb 87	£9.59
569	CAR ALARM Dec 86	£14.24
561	LIGHT RIDER LAPEL BADGE Oct 86	£11.65
560	LIGHT RIDER DISCO VERSION Oct 86	£22.41
559	LIGHT RIDER 16 LED VERSION Oct 86	£15.58
556	INFRA-RED BEAM ALARM Sep 86	£32.39
544	TILT ALARM July 86	£8.94
542	PERSONAL RADIO June 86	£13.17
528	PA AMPLIFIER May 86	£30.60
523	STEREO REVERB Apr 86	£30.21
513	BBC MIDI INTERFACE Mar 86	£31.93
512	MAINS TESTER & FUSE FINDER Mar 86	£10.07
497	MUSICAL DOOR BELL Jan 86	£21.41
493	DIGITAL CAPACITANCE METER Dec 85	£49.95
481	SOLDERING IRON CONTROLLER Oct 85	£6.25
464	STEPPER MOTOR INTERFACE FOR THE BBC COMPUTER less case Aug 85 1D35 STEPPER MOTOR EXTRA OPTIONAL POWER SUPPLY PARTS	£9.60 £9.15 £5.86
461	CONTINUITY TESTER July 85	£7.08
455	ELECTRONIC DOORBELL June 85	£8.63
444	INSULATION TESTER Apr 85	£22.37
392	BBC MICRO AUDIO STORAGE SCOPE INTERFACE Nov 84	£40.82
387	MAINS CABLE DETECTOR Oct 84	£6.31
386	DRILL SPEED CONTROLLER Oct 84	£9.91
362	VARICAP AM RADIO May 84	£15.02
337	BIOLOGICAL AMPLIFIER Jan 84	£27.59
263	BUZZ OFF Mar 83	£6.49
242	INTERCOM no case July 82	£6.50
240	EGG TIMER June 82	£7.85
108	IN SITU TRANSISTOR TESTER June 78	£10.76
106	WIERD SOUND EFFECTS GEN Mar 78	£8.94
101	ELECTRONIC DICE Mar 77	£7.15

EDUCATIONAL BOOKS & BOOK PROJECTS

ADVENTURE 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 £5.75
Component Pack (less book) £22.83

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 and how they work). Also full details of how to build 6 projects – burglar alarm, radio, games, 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 £2.95
Component pack (less book) £17.93

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, MW Radio, Fuzz unit, etc.

30 Solderless Breadboard Projects (Book 1) £2.95
Component Pack £27.74

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 £22.37

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 £2.02

£14.81

DIGITAL LCD THERMOSTAT

EE MAY '91

A versatile thermostat with LCD read out. MIN/MAX temperature recording, clock and individually settable upper and lower switching points. Covers -10 to 110 degrees Celsius, accurate to within 0.1 degrees. Submersible probe on 3 meter lead. Kit includes punched and printed case. Save on energy bills by improved control of your hot water system. Also ideal for greenhouse soil temperature and aquarium control. Complete kit includes thermostat and probe, mains power supply and relay output, PCB's and punched and printed case.

KIT REF 841 £29.95

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 £30.30

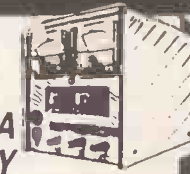
DIGITAL COMBINATION LOCK

EE MAR '91

Digital combination lock with a 12 key keypad. 4 digit code operates 250V-16A SPCO relay. A special anti-tamper circuit allows the relay to be mounted remotely from the keypad without any loss of security. Can be operated in many modes (latching/unlatching, manual/automatic setting, continuous/momentary output, etc.). Article describes operation as Vehicle Immobilising security system. Low current drain.
Kit includes drilled case.

KIT REF 840 £19.86

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 £56.82

PORTABLE ULTRASONIC PEsT SCARER

EE AUG '91

A powerful 23kHz Ultrasonic generator in a compact hand-held case. A MOSFET output drives a weatherproof transducer at up to 300V peak to peak via a special tuned transformer. Sweeping frequency output requires no setting up or alignment. Kit includes all components, PCB, transducer and case.

KIT REF 842 £22.56

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!

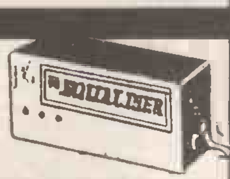
KIT REF 740 £20.01

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 £32.13



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 £17.75

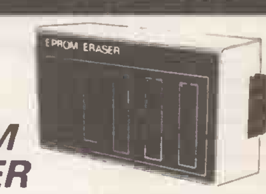
MICROCONTROLLER LIGHT SEQUENCER

EE DEC '90

A superb kit with pre-drilled painted and silk screen printed case for a really professional finish. This kit uses a microcontroller I.C. to generate 8-channel light sequences.. Sequences are selected by keypad from over 100 stored in memory. Space for 10 user programmed sequences up to 16 steps long also available. 1000 watts per channel, zero volt switching, inductive load capability. Opto-isolated for total safety. Many other features.
Complete kit includes case, PCBs, all components and hardware.

£57.17

KIT REF 838



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 £28.51

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	£15.58
KIT REF 560 DISCO LIGHTS	£22.41
KIT REF 561 LAPEL BADGE	£11.65

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

Including headphones £45.95

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.

£17.16

KIT REF 835

EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

VOL. 21 No. 3 **MARCH '92**

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/Fax: (0255) 850596

SEASONAL CHANGE

A bit of a strange mixture this month, with a *Get You Through Winter Special* and a Free Spring Catalogue. Of course it is the March issue which "comes in like a lion and goes out like a lamb", but then we publish it at the beginning of February – it's all done just to confuse everyone!

Anyway even if there is not much winter left by the time you read this, all the projects can be built, tested and ready for the next one! Having said that I bet we will be knee deep in snow and/or freezing cold well into March: You just can't tell these days!

ECONOMY

When we did some research into Economy Seven electricity to check the validity of the timer in this issue I was surprised to find that no timers are used for heating circuits these days, the whole house simply goes on to a cheap rate after 11.30 p.m. (12.30 in Summer Time). Perhaps I am not to well informed on this, or maybe the electricity boards have not publicised the way the system works (the times may vary in different regions).

Apparently, because of the different charging structure you need to use about seventeen per cent or more of your electricity at night to make changing to Economy Seven worthwhile (it costs nothing to have the new meter fitted). What this means is that if you are using Economy Seven then it is obviously worthwhile using as many of your appliances at night as possible.

Our timer will give you the chance to switch on washing machines, tumble driers, dishwashers, etc. after you have gone to bed without any hassle. I suppose with automatic cookers it would also be possible to bake while you are asleep if you really want to save every penny!

If you do not use electricity for any form of heating it might still be worthwhile checking how much power you could use at night to see if a change might be worthwhile. With a pre-set timer on each appliance it is simply necessary to turn on the appliance at any time within the preset delay time, before 11.30 p.m. i.e. with a pre-set delay of two hours simply switch on at any time after 9.30 p.m. (10.30 p.m. during Summer Time).

Mike Kenward

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 however 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 first address them to the advertiser.

TRANSMITTERS/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.

SUBSCRIPTIONS

Annual subscriptions for delivery direct to any address in the UK: £18.50. Overseas: £23 (£40.50 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. Tel: 0202 881749. **Subscriptions start with the next available issue.** We accept Access (MasterCard) or Visa payments, minimum credit card order £5.

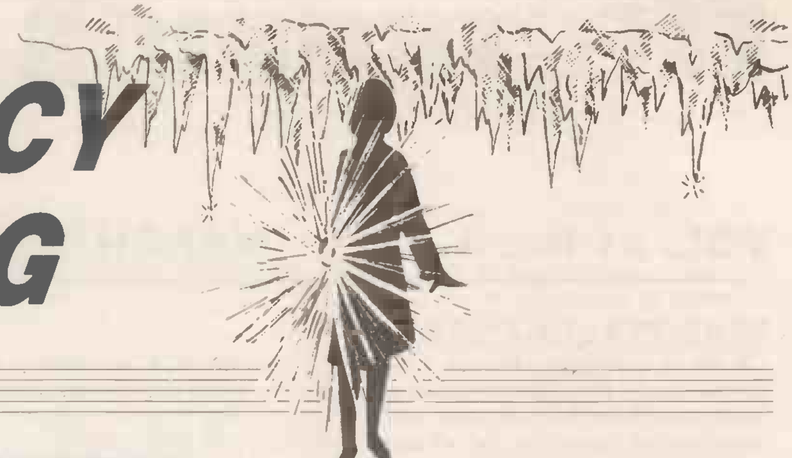
BACK ISSUES

Certain back issues of EVERYDAY ELECTRONICS are available price £1.80 (£2.30 overseas surface mail) inclusive of postage and packing per copy – **£ sterling only please.** Visa and Access (MasterCard) accepted, minimum credit card order £5. Enquiries with remittance, made payable to Everyday Electronics, should be sent to Post Sales Department, Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH Tel: 0202 881749. In the event of non-availability one article can be photostatted for the same price. *Normally sent within seven days but please allow 28 days for delivery.* **We have sold out of Jan, Feb, Mar, Apr, June, Oct, & Dec. 88, Mar & May 89 & Mar 90.**

BINDERS

Binders to hold one volume (12 issues) are available from the above address for £5.95 (£6.95 to European countries and £8.00 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. Visa and Access (MasterCard) accepted, minimum credit card order £5. Tel: 0202 881749



EMERGENCY LIGHTPLUG

IVOR SADLER

An emergency light which comes on automatically in case of mains failure, it also doubles as a rechargeable hand lamp.

THE pluglight operates in much the same manner as the emergency lights which are mandatory in public places, coming on automatically in the event of a power failure. It has the advantage over such emergency lights of being portable so it will double as a hand lamp if required.

In the normal standby mode the internal batteries are charged continuously at 25 milliamps. In the event of a power failure or when used as a hand lamp the internal batteries will last for half an hour. To double this time you could if preferred fit one bulb only.

CIRCUIT DESCRIPTION

From Fig. 1 it can be seen that a full wave rectifier provides the power source, and the batteries are charged through R1. An l.e.d. (D5) indicates that charging is in progress and the current for it is taken through the bulbs to provide continuous confirmation that they are in working order. A positive voltage is applied through diode D4 to the base of transistor TR2 keeping it turned on, thus grounding the base of transistor TR1 which is consequently held off.

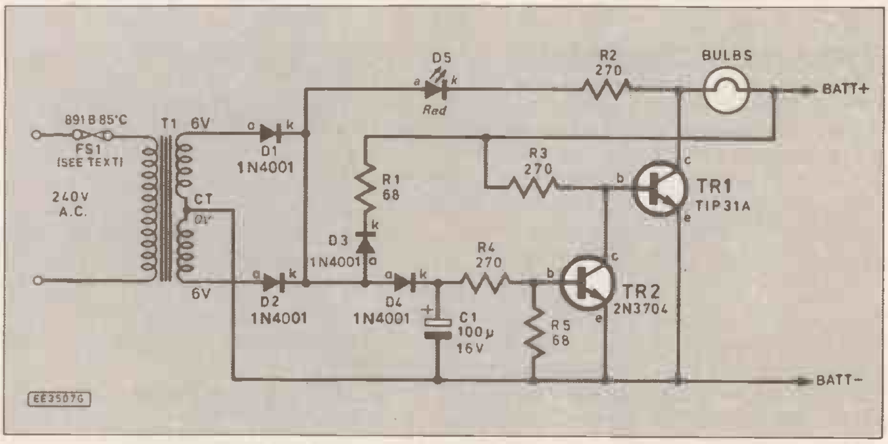
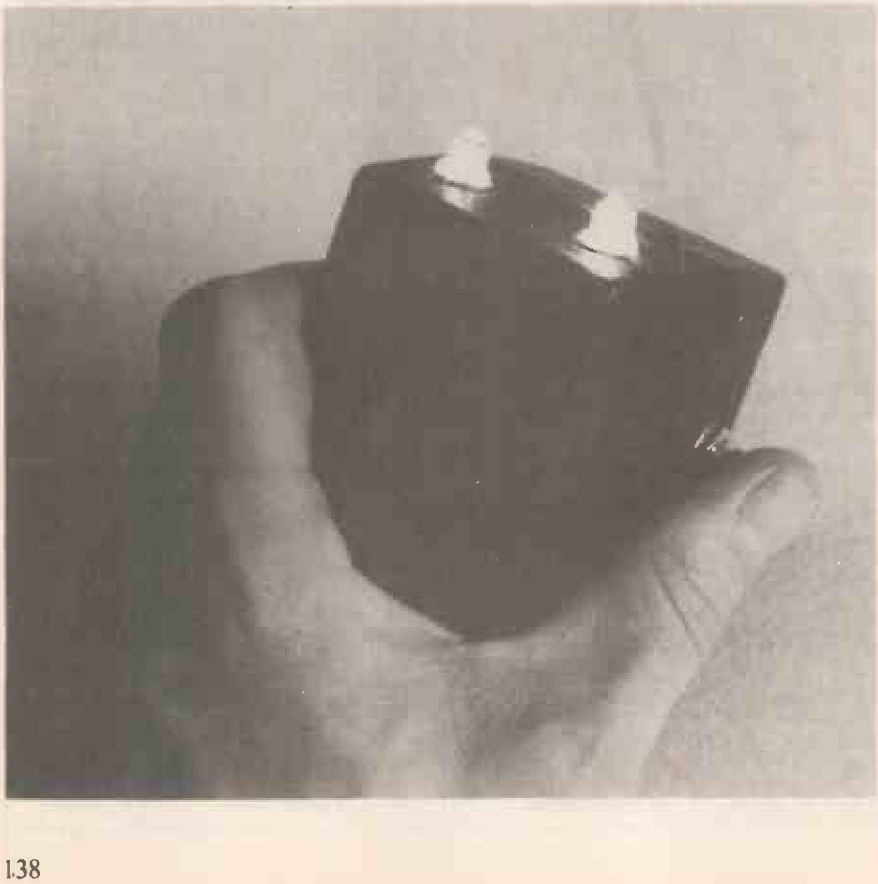


Fig. 1. Circuit diagram of the Emergency Pluglight.



If the supply to the transformer is broken the base bias to transistor TR2 is removed causing it to turn off thus allowing the voltage on the base of transistor TR1 to rise which then turns hard on allowing the current from the battery to flow through the bulb. As soon as the power supply is restored the circuit reverts to the charging state.

Perhaps the type of transformer chosen deserves some justification as it is a 6-0-6 volt 250mA type which on the face of it seems on the generous side to supply approximately 30 milliamps all told. One reason for this is that transformers tend to run warm even with no load and, as the transformer in this device will be running continuously in a confined space, it is as well for it to be lightly loaded to minimise heat output. Another reason is that a physically smaller transformer would present mounting problems.

CONSTRUCTION

The project can be conveniently housed in a larger "PSU Box and Plug" provided that the two sections of the box are held together by screws not glue, as it will be necessary to open the box every few years to replace the batteries.

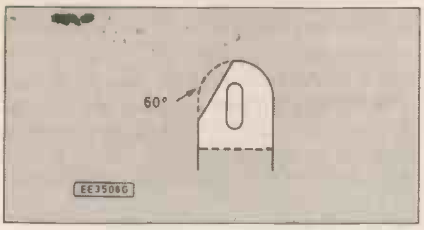


Fig. 2. Modification of the transformer mounting.

Included with the box is an internal moulding to hold the mains pins in place and to isolate the mains input from the low voltage circuitry. All the projecting pieces will have to be removed from the top side of this moulding leaving a flat plate on which the transformer will be mounted, but since the transformer will be screwed or bolted through this plate to the bottom of the box, the plate will serve both purposes for which the internal moulding was designed. Incidentally it is better not to push the mains pins into place until all the mechanical work has been completed on the box.

MAINS TRANSFORMER

The screws to fix the transformer need to be approximately 50mm apart to straddle the recess in the plug box where the mains pins are located and this must be borne in mind when choosing the transformer. The mounting slots can usually be extended outwards and those on the prototype were, by about 2mm, using a small round file. The transformer will have to be mounted as close as it will go to the left hand side of the box and as near as possible to what will be the top of the box when it is plugged into a socket. Any subsequent reference to the "top" will have the same meaning and left and right will be relative to it.

The primary wires are best positioned on the left hand side of the transformer from where they can be led round the left hand pillar and in due course under the platform to where the mains pins will fit. Locating the transformer will be facilitated by positioning the battery box with the batteries in it along the right hand side of the box using a little Blue Tack or something similar to hold it in place.

Cut or file a corner off the top foot of the transformer at an angle of 60 degrees without breaking into the mounting slot (Fig. 2) to allow the foot to clear the left hand pillar. Hold the transformer firmly in place with the bobbins as close as possible to the left hand side of the box and drill the holes for the screws or bolts as far apart as the mounting slots will allow, it is advisable to put a small pilot drill through first to make sure that you are completely clear of the well, and screw the transformer in place for now.

The holes for the lampholders can now be drilled in the bottom of the upper section, these are 11mm in diameter and their suggested positions are shown in Fig. 3 but this is very much a matter of choice. Fix the lampholders in place with any suitable adhesive around the flange and front of the holder. Wire them in parallel with two

COMPONENTS

Resistors
R1, R5 — 68 (2 off)
R2 to R4 — 270 (3 off)
All ¼ watt metal film

See SHOP TALK Page

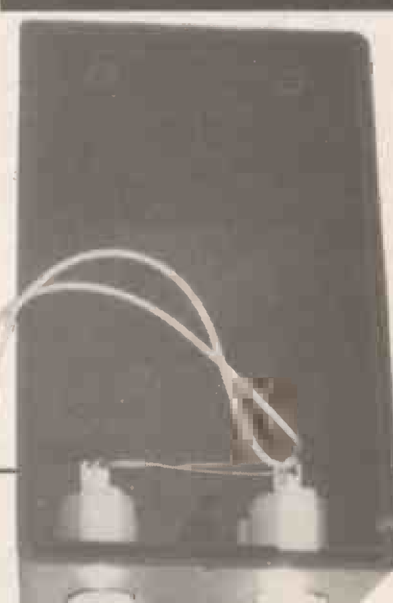
Capacitor
C1 — 100µ elect. 16V

Semiconductors
D1 to D4 — 1N4001 (4 off)
D5 — 5mm l.e.d. 2mA
TR1 — TIP31A *npn* transistor
TR2 — 2N3704 *npn* transistor

Miscellaneous
FS1 — Thermal fuse 891B 85°C
T1 — Mains transformer miniature 250mA 6-0-6V

Batteries, Nicad type AA (2 off); battery holder 2 x AA; stripboard, 24 holes by 10 strips; battery connector PP3; bulb(s) MES lens bulb 2·2 volt (2 off – see text); lampholders, MES clip-on holder; P.S.U. box with plug; connecting wire; fixings etc.

Approx cost guidance only **£12**



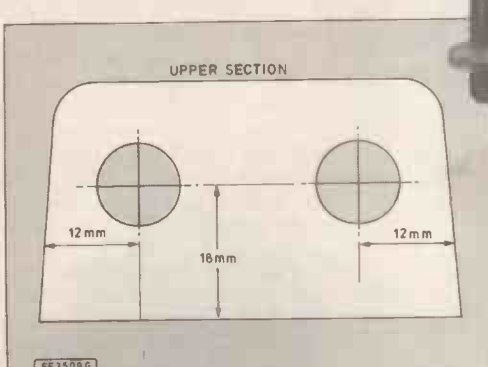


Fig. 3. Hole positions for the twin lamps. The lamps are wired in parallel.

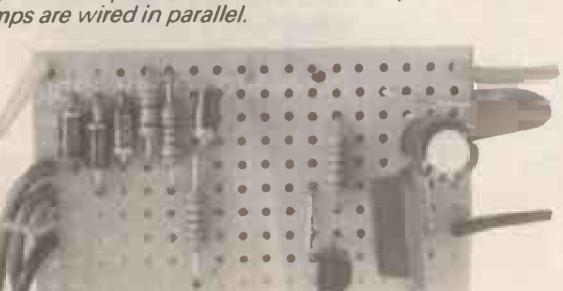
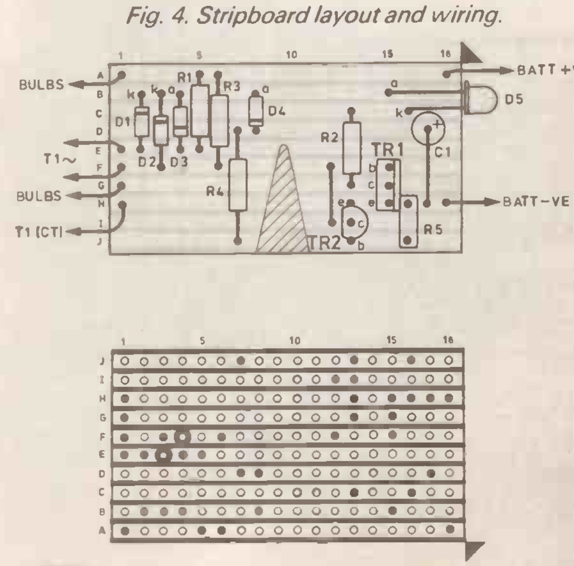


Fig. 4. Stripboard layout and wiring.



short leads (about 10cm) for connecting to the strip board.

The two halves of the box should now be screwed together temporarily and, gripping them tightly, a 5mm hole should be drilled through the joint in the box 6mm from the bottom left hand corner this is for D5. A clamp would be useful but gripping by hand should be satisfactory, using a 1mm drill as a pilot.

STRIPBOARD

The piece of stripboard 10 strips by 24 holes should be cut into two pieces one with eighteen holes and the other with six, this smaller piece will be required later for the transformer primary circuit. Taking the large piece first, track breaks are required on track *E* hole 3 and track *F* hole 4.

From the layout diagram Fig. 4 it can be seen that the centre holes of the board are not used, this is because this part of the board, with some slight adjustment, fits behind the bottom centre pillar. This provides the main support for the board.

The adjustment which should be made before fixing any components consists of a small hollow in the lower part of the top face of the board between holes 9 and 10 (the shaded area in the layout diagram Fig. 4). This can be made with a small half round file checking from time to time that it fits neatly behind the pillar. Make sure you do not file too much of the board away, it is essential that the copper strips remain unbroken and well supported.

Wiring the components should present no problems provided surplus leads are cropped close to the board. TR1 should be inserted with only the broader part of its pins protruding above the board and the l.e.d., D5 should be mounted with the bottom of the bulb flush with the edge of the board thus when the box is assembled the l.e.d. will just protrude through the side and this, together with the support provided by the pillar, will hold the board in place quite securely.

TESTING

Having connected the PP3 battery clip, the lampholders and the three connections from the secondary of the mains transformer the circuit can be tested by fitting the batteries and bulbs and connecting the transformer to the mains using two segments of strip connector wired to a three pin plug. Switch on the power and the l.e.d. should light up at more or less full brilliance.

If you have a milliameter check that the current flowing to the batteries is about 30mA, disconnect the milliametre otherwise the meter will be subjected to a heavy reverse overload, and reconnect the batteries before switching the mains supply off, when the bulbs should light up. The unit could be left running for a while at this stage to make sure there is no overheating and, if the batteries are new and uncharged, it would be as well to do this before testing that the bulbs do light up.

If you do not have a milliameter a voltmeter connected across R1 should read about 2·2 volts, this represents a current slightly higher than the charging current because of the small unavoidable current drain via R3.

MAINS CONNECTION

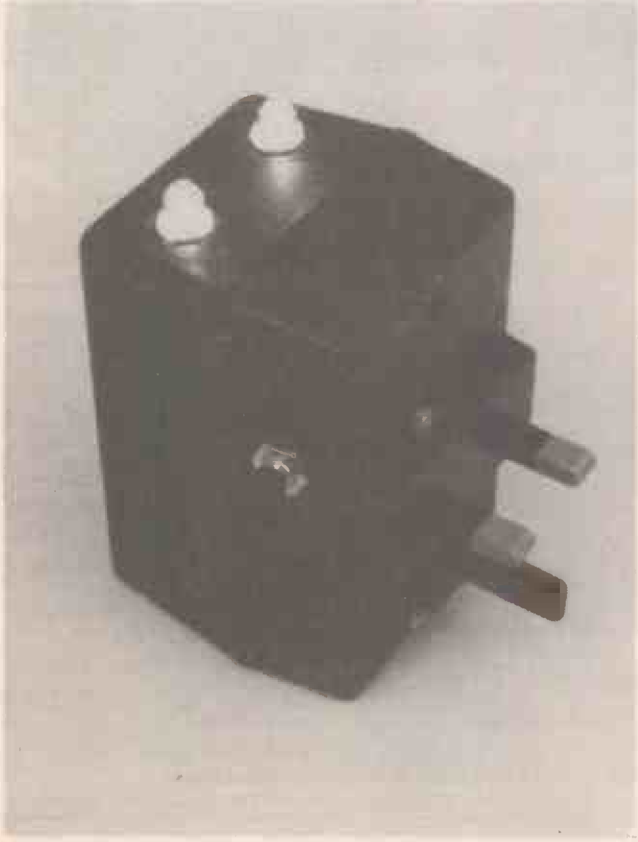
Turning now to the mains primary circuit, disconnect the unit from the mains and prepare to mount the small piece of stripboard at the top of the plug box by drilling a hole in the centre 4mm down from the outer edge of the lower section to take an 8BA or similar screw. Drill a corresponding hole in the board between strips 4 and 5 then cut the brown wire at a convenient point and solder the length from the transformer to the left hand hole in the second strip up and the other length to the right hand hole in the next but one strip higher.

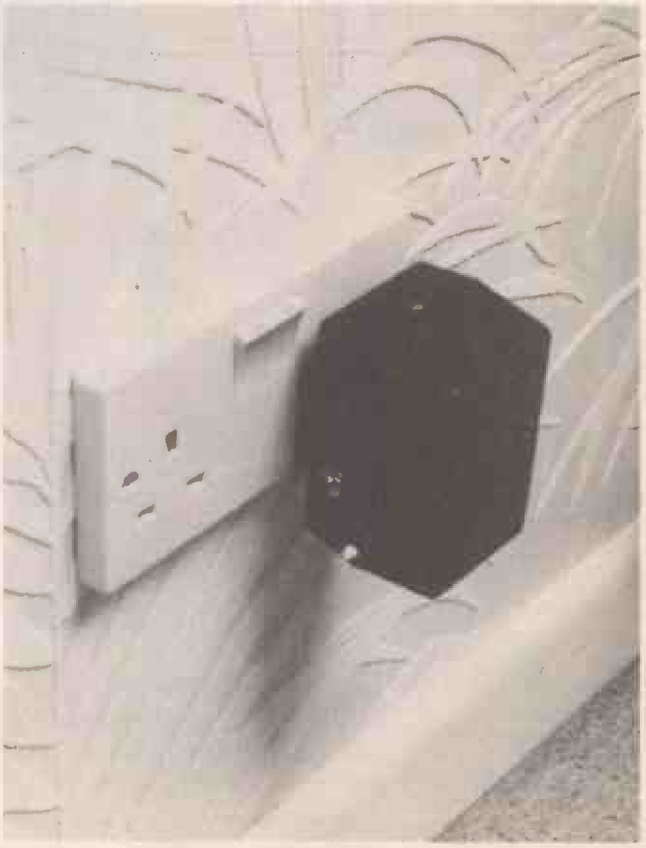
Slide pieces of insulating sleeve on the leads of the thermal fuse and connect it between the two strips taking care **not to overheat the fuse and thus destroy it** (tinning round the holes to be used will speed up the jointing and holding the wires in position with a heat shunt helps, if you don't possess one a ladies pin curl clip will do nicely!) then screw the board in place **using only a nylon screw and nut.**

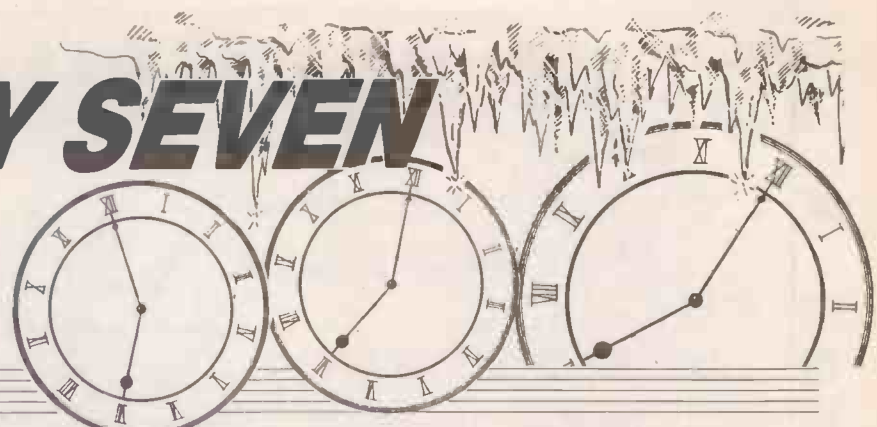
Connecting the primary wires to the mains pins is best done with the pins not in place as it is all too easy to touch the sides of the box with a hot iron which can be disastrous. Remove the transformer, battery box and circuit board etc and solder the transformer primary wires to the mains pins, noting the angle they should make with the pins to marry up with the under side of the moulding designed to hold the pins in place. One way of doing this is to solder a 6BA solder tag to each pin set at the correct angle then solder the wires to the tags.

Finally push the three mains pins into their holes, slide the internal moulding into place leading the wires under it and screw the transformer down firmly. The ceramic body of the thermal fuse can now be tucked between the primary winding and the side of the box. Assemble the other units in the plugbox and screw the two sections together to complete the project.

According to the use you might make of the device, for example if you are likely to want to make use of it frequently as a hand lamp, there is ample room to fit a momentary push off switch on the left hand side of the box (see photos) between the transformer and the stripboard, making sure you clear TR1, the tallest component. Clearly it must be a momentary action switch otherwise there would be a danger of negating the main purpose of the device. This switch should be wired in the lead from *A*18 to battery positive. □







ECONOMY SEVEN TIMER

CHRIS BROWN

Allows you to use more appliances at night – dishwasher or washing machine – and save you money!

GENERATING electricity is a 24-hour a day business. Obviously, during the day and evening, most of the power is consumed by you and I, but during the night, when demand drops, surplus electricity is wasted, burnt off as heat by the miles of cable en route.

To help reduce this wasteful practise, the electricity companies introduced a special reduced night-rate tariff known as "Economy Seven". Storage heaters use this energy to warm up special radiators, which then release this heat during the day. So if you're using this tariff, why not save even more pennies by using other electrical appliances during this cheaper rate period?

The problem is that the cheaper rate only comes into effect after 11.30 p.m.(12.30 a.m. in summer). Note: Tis time may vary in different regions. Most people will not want to sit up just to turn on the washing machine/dishwasher once the rate has started. So this simple timer was devised. The timer is marginally cheaper to build than the usual mechanical type time switch.

CIRCUIT

Basically the circuit, Fig. 1, consists of an hour timer, a counter, and a switch (plus a little something to make calibration easier). Since the unit uses a low voltage transformer, it will only add an n'th of a penny to your fuel bill each time it is used.

The 4060, IC1 (Fig. 1) is an oscillator and 14 stage divider all on one chip, arranged here so that the 13th stage goes high after one hour. This output pulse resets the 4060 to initiate another timing period, and at the same time clocks IC2, a 4017. To achieve this, the components on pins 9 to 11 of IC1 have to be set to produce a timing period of 0·8789062 secs! It would not be easy to set that with any degree of accuracy.

Fortunately, at that speed, the 4th stage changes state every seven seconds and this causes D4 to flash, via C3 every 14 seconds. Thus, if the unit is calibrated so that the l.e.d. flashes once every 14 seconds, we have the correct timing period. Even if one was very lax in setting this time, an error of ± 1 second would only mean a difference of plus or minus eight minutes per hour – and a one second error is a large discrepancy!

Once an hour then, IC1 clocks IC2, a ten stage counter. At switch on, stage 0 (pin 3), is high. The counter is reset by C5 and R5 at switch on. After one hour stage 1 (pin 2), goes high. Thus when you are considering the delay time, it is best to think of each stage as "hours elapsed", i.e. stage 1 is one hour, stage 2 is two hours, etc.

DELAY TIME

In the prototype, a two hour delay was required, and a two hour run time. Stages 0 and 1 were left open, and stages 2 and 3 connected to the base of TR1 via two diodes. When the latter stages go high, they supply base drive, and thus turn on the relay, which in turn switches on the external appliance.

Depending on which outputs are left open, and which are wired to TR1 the user can set his own desired delay/run time settings. For instance if a three hour delay and a four hour run time is required wire stages 3 to 6 to TR1 using four diodes.

A few extra items help the circuit along. R1, Zener D3 and C1 smooth the a.c. supplied by the transformer, providing approximately 15 volts to the circuit. Diode D5 avoids any back e.m.f. damaging TR1 when the relay switches off, whilst resistors R4 and R5 hold IC2's inhibit and reset pins low during run time.

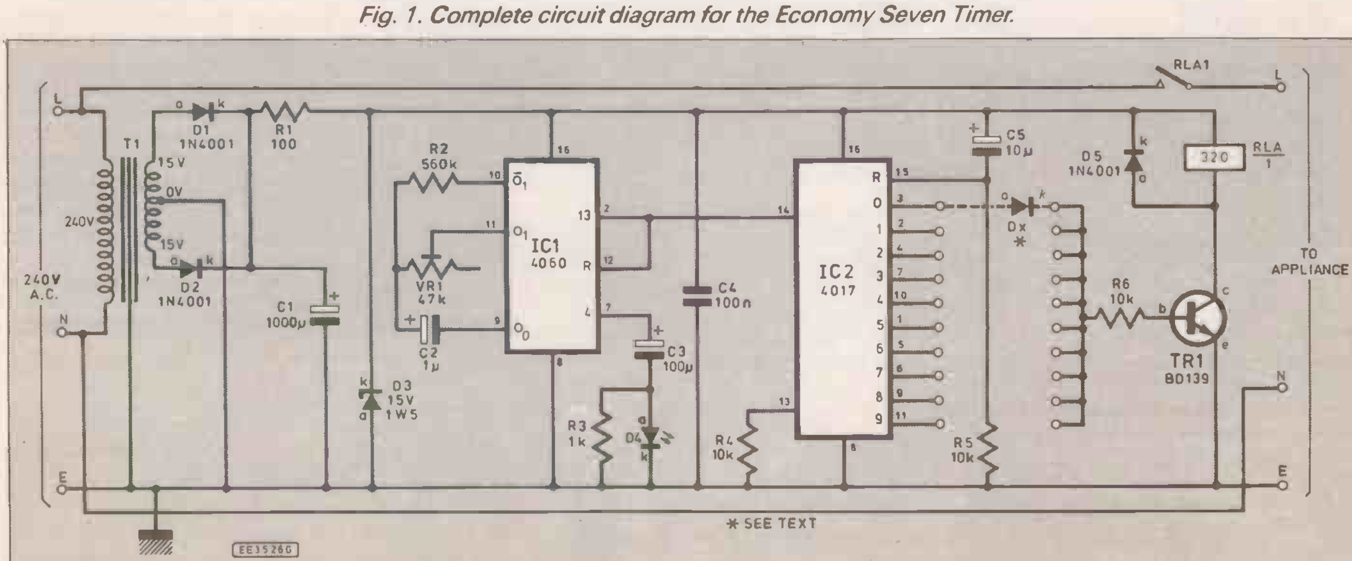
CONSTRUCTION

Construction should present few problems. The p.c.b. component layout is shown in Fig. 2.

Note, VR1 is glued to the case lid, which has a hole in to access the core. This is a safety feature; you can screw the lid onto the case and ensure those "nasty" 240 volt mains connections cannot be accidentally touched, but still be able to adjust the flash rate of D1.

The unit must be housed in an Earthed metal case or ***fully insulated*** plastic case. If using plastic make sure that the screws/fixings used for mounting the p.c.b. and the transformer are nylon; no metal

Fig. 1. Complete circuit diagram for the Economy Seven Timer.



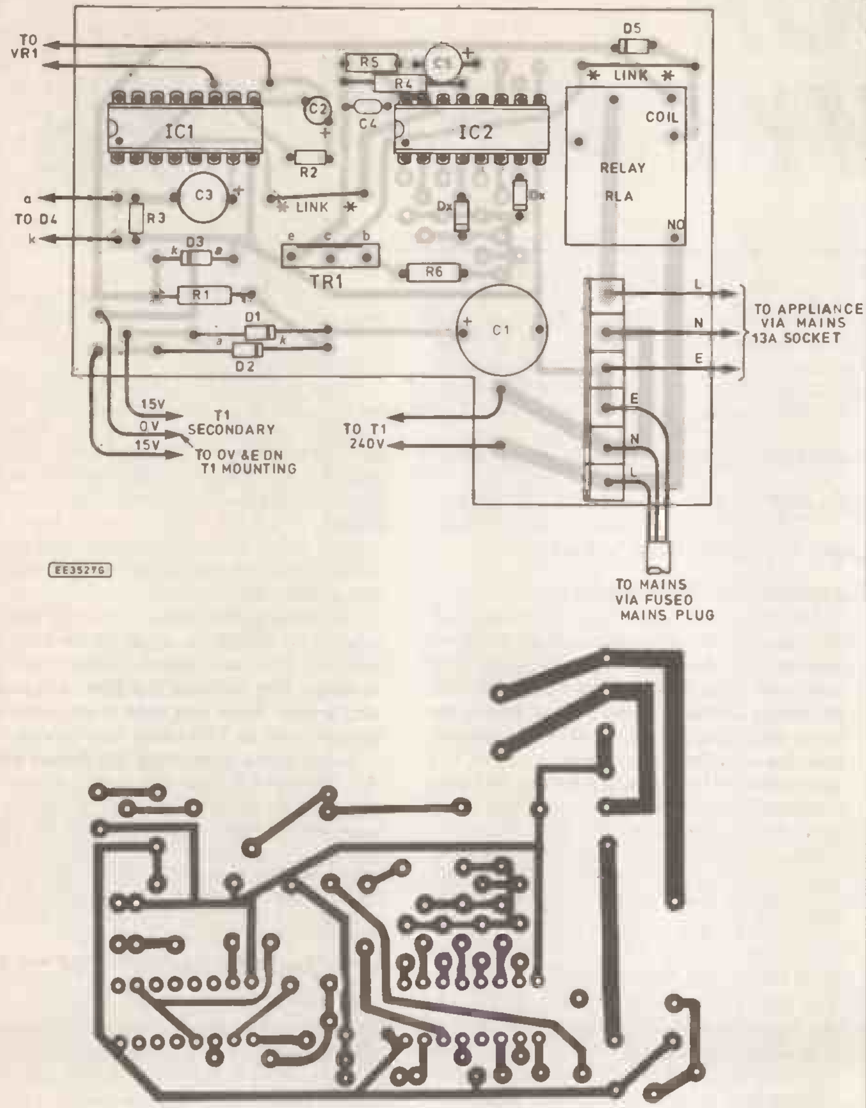
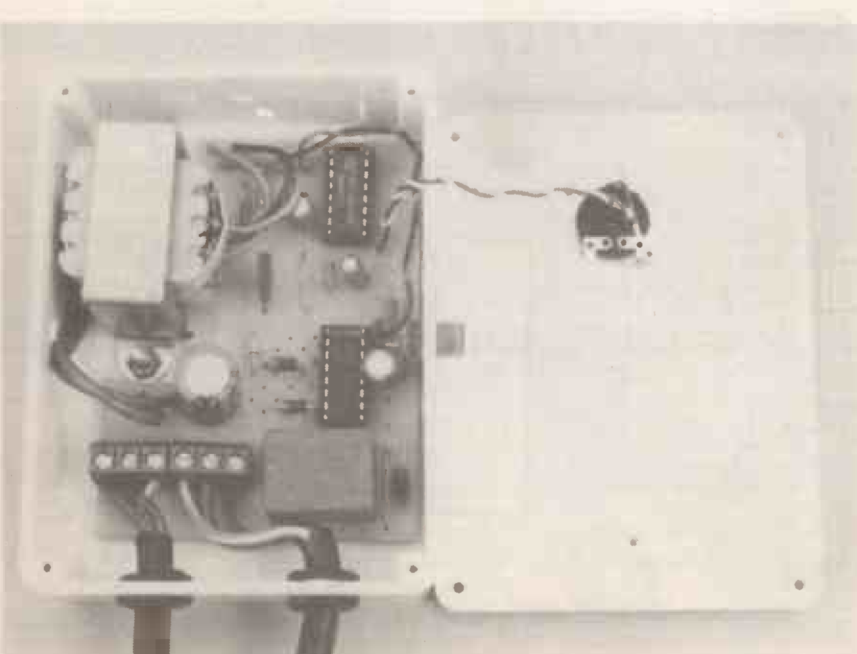


Fig. 2. Printed circuit board component layout and full size copper foil master pattern. This board is available from the EE PCB Service code EE788.

Layout of components inside the completed unit. The timing control VR1 is glued over a small hole drilled in the case lid.



COMPONENTS

Resistors

R1	100
R2	560k
R3	1k
R4 to R6	10k (3 off)

All ¼W ±10% carbon

See SHOP TALK Page

Potentiometer

VR1	47k miniature enclosed carbon preset

Capacitors

C1	1000µ radial elect. 25V
C2	1µ radial elect. 16V
C3	100µ radial elect. 16V
C4	100n ceramic
C5	10µ radial elect. 16V

Semiconductors

IC1	4060 14 stage counter
IC2	4017 decade counter
D1, D2, D5	1N4001 1A 50V diode (3 off)
D3	15V 1·5W Zener
D4	miniature red l.e.d. with mounting bezel
Dx	1N4001 (number as required – see text)
TR1	BD139 *npn* transistor

Miscellaneous

T1	miniature mains transformer with 15V-0V-15V secondary rated at 100mA (3VA)
RLA	ultra miniature high power mains relay, 320 ohm coil with changover contact rated at 240V a.c. – see text

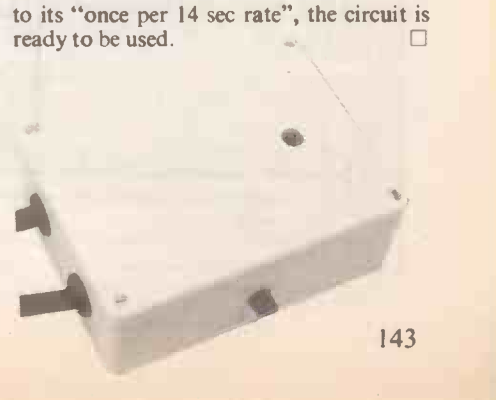
Three-way p.c.b. terminal block (2 off); printed circuit board, available from the *EE PCB Service*, order code EE788; mains 13A three-way connecting cable; fused 13A mains plug (see text); mains 13A trailing single socket; connecting wire; metal or platic case (see text) approx. 100mm x 75mm x 40mm; Earth tag (for T1); fixings – see text.

Approx cost guidance only **£18**

fixings should pass through the case. The two connecting leads must be secured with strain relief clamps and a correctly fused mains plug must be used.

It is important that the rating of the relay is not exceeded, the mains fuse should be rated accordingly so that the relay contacts cannot be overloaded by the appliance. The specified relay, which fits on the p.c.b., is rated at 10A a.c. (resistive) and 3A a.c. (inductive); since a dishwasher or washing machine represents a mainly inductive load (the motor) the unit should not be used to switch such an appliance rated at more than about 1kW with this relay.

Setting VR1 is the only adjustment you need to make to the circuit. Once it is set to its "once per 14 sec rate", the circuit is ready to be used. □



FOR YOUR ENTERTAINMENT

by Barry Fox

Double-Coated

Fuji is advertising "double-coated" video tape. What's that?

In short Fuji has taken an old and none-too-successful idea for improving the quality of audio tape and combined it with film technology to improve the quality of home video tape at little or no extra cost. The tape has a double layer coating of magnetic material instead of the single layer used on all video tapes so far. This gets round the long-standing problem that a video recording is really several different recordings made at the same time onto the same tape, all requiring different compromises in the magnetic material.

The highest frequency component of a video signal, which conveys fine detail black and white information, always records near the surface of a magnetic tape, because short wavelengths penetrate less than one micrometre into the material. Lower frequencies, which convey colour information, sound and picture synchronisation pulses, have longer wavelengths which penetrate deeper into the tape coating.

The high frequencies are best recorded with magnetic material made up from very small particles, and high magnetic coercivity (which strenuously resist magnetic change), while the lower frequencies are best recorded with larger particles which have lower coercivity (and change magnetic state more easily).

The same problem afflicts audio recorders, too, and over the last fifteen years many tape makers have tried to coat tapes with two layers, a top layer of fine particles with high coercivity and a lower layer of larger particles with lower coercivity. Early attempts at making two-layer tapes failed because the two layers did not stick together well enough and the top layer shed. Later two layer tapes are stable, but their cost is high because the tape has to pass twice through the machine which applies a liquid suspension of magnetic particles. This almost doubles production time and cost.

Now Fuji, which was originally in the film business and turned later to tape manufacture, has adapted film coating technology to video tape coating and coats both layers in one pass.

Modern colour film is made up from over ten separate layers, all applied in one pass through the coating machine. The trick is to squirt all the different light sensitive and dye chemicals from separate nozzles, and use laminar flow phenonena to prevent them mixing before drying in a multi-layer coating. Fuji now plays the same trick with two quite separate suspensions of magnetic particles in resin binder applied at the same time, without mixing.

The benefit of two layer coating, as seen on the screen of a TV, is less random noise or "snow" in the picture and less streaking on strong, saturated colours. This benefit is particularly noticeable when tape shot with a video camera is edited, by copying from one recorder to another through several generations, each of which adds some extra noise. Because the double coating is a one pass process, Fuji plans to offer two layer tapes at the same price as today's single layer tapes.

Jukebox Technology

Anyone with an Astra satellite system, tuning in at night to the Lifestyle Channel (previously owned by W. H. Smith TV and now sold to a consortium which calls itself European Television Networks) will see the result of some very clever technology.

During the night hours ETN is broadcasting a satellite video jukebox. At the Jukebox headquarters near Carnaby Street in London, Philips professional video disc players can search out music video tracks from custom-pressed discs within one second of a computer instruction. The discs are changed every month to keep up with popular music tastes. The search command is under the control of a computer system which cost ETN and electronics company Telsis £1.5 million to design.

At any point during the day or night viewers can call in and phone the juke box. Their call is routed by Mercury line to a computer centre in Bristol which can handle around sixty calls a minute. A woman's voice, recorded digitally on Winchester hard computer disk, replies and offers the caller a choice of music titles. Each title has a number and the caller keys that number in a keypad, if they are on a digital telephone exchange, or a rotary dial if they are on an old pulse exchange.

The computer then registers the number and selection and stacks it in a queue. Two and a half minutes later (if the call has been made during the night hours) the screen displays a notice saying the time when the tune will be played.

The original plan was to make the system voice responsive, so that callers could talk the number of the selected tune down the line. The designers achieved 98.5% accuracy, but never could build a system which would reliably cope with all accents across the UK; words like "five and nine" are just too hard to distinguish, especially in a city like Birmingham with a wide variety of different accents; ("five" becomes "fiver" and "nine" becomes "niner").

So the system was switched to work by MF or pulse dialled numbers. The Lifestyle channel has never been successful, but Jukebox has become a nice little earner. Children can order up music from ETN's Jukebox after their parents have gone to bed, or while they are out. The charge goes on the house phone bill.

Each Jukebox call is charged at 33p per minute (cheap rate) and 44p per minute at other times. Although there is a one minute cut-off, that means at least 33p per call. And if several people choose the same tune, the computer simply records all requests and takes the money, but plays the tune only once. Only then, when the tune has been played, does the computer schedule it again when the next paid request comes in.

FAX KILLER

It has happened to everyone. The house or shop or office phone rings and it is a fax machine.

Several times recently I have been driven to distraction by people who kept trying to send me a fax message on my ordinary speech line. Sometimes it has been in the middle of the night, from distant time zones. Another time it was over a Bank Holiday. Each time the sequence is the same. I answer the phone, hear a fax tone whistle, and hang up. A minute later the same thing happens. And it happens over and over and over again, at different intervals. The dimbo at the other end has keyed a number into their fax machine and left it at work. The fax machine cannot tell the difference between an angry human and a failed connection.

Twice recently the only way I could get any peace was to re-wire my telephone system temporarily to connect the fax to my speech line. I could then receive the fax and silence the calls. On one occasion the message was a waffling release from a communications consultancy.

After vowing to kill with my bare hands, I had a constructive thought.

There is clearly a need for a fax machine which can recognise speech response. Apart from anything else this would help people who are trying to send a fax to a number which is answered by a recording which explains that the number has changed e.g. needs an extra digit. But so far I have seen no such machine, not even from British Telecom which both sells fax machines and intercepts calls with recorded announcements.

Until the likes of BT wake up to the market need for a smarter fax machine, the answer must be a new kind of "fax switch". This would connect to two lines, and automatically route incoming calls between the lines, e.g. from either phone line to fax machine, computer modem, ordinary telephone or answering machine.

REALISTIC®

...PROGRAMMABLE SCANNERS..

200-CHANNELS WITH 800 MHZ

£199.95

Realistic PRO-2022. Covers 68-88, 108-136 (AM), 136.005-174, 380-512 and 806-960 MHz. Selectable priority channel, two speed scan, lockout, scan delay. Jacks: 3.5mm headphones, external speaker, external DC power, BNC aerial input. Mains operation or 13.8 VDC neg. gnd. (Power cord extra). Memory backup requires 9v battery.
20-9127 .... **£199.95**

AM/FM SCANNER COUPLER

Converts your AM/FM mobile car aerial into a full range monitor-scanner aerial, without harming AM/FM radio reception. Frequency range 25-1300 MHz.
20-9710 .... **£14.95**

16-CHANNEL MOBILE SCANNER

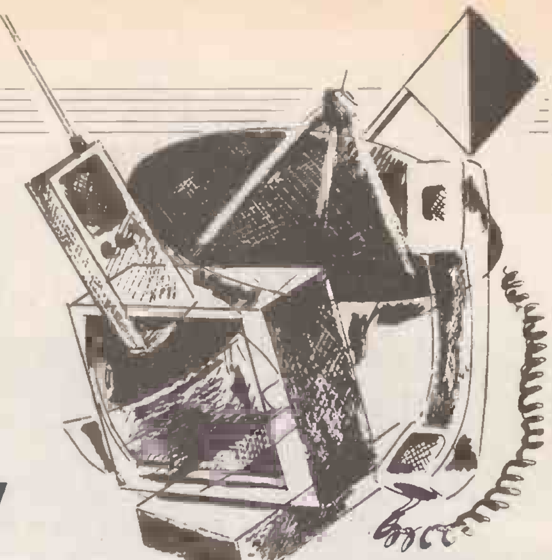
£99.95

Realistic PRO-2025. Covers 68-88, 136-174 and 406-512 MHz. Select up to 16-channels to scan and change your selection at any time. Features automatic two-second scan delay, memory backup, priority channel, lockout function, squelch and volume controls. Jacks: power, external speaker and aerial. 12 VDC neg. gnd. only. Measures: 45 x 140 x 175mm. **20-9146** **£99.95**

Tandy®

InterTAN U.K. Ltd., Tandy Centre, Leamore Lane, Walsall, West Midlands. WS2 7PS Tel: 0922-710000

Special Series



INFORMATION TECHNOLOGY

AND THE NATIONAL CURRICULUM

T. R. de VAUX BALBIRNIE

PART 5

THIS is the fifth in a 12-part series concerning Information Technology, Microelectronics and related matters in the Science National Curriculum. Readers are reminded that there is far more material presented here than is needed to satisfy the requirements of the National Curriculum. Much of it may be regarded as resource material from which ideas may be drawn as required. Those who have not been following the series are advised to read Part 1 (November issue) because this gives certain useful background information.

Last month we ended by looking at the range and uses of some microelectronic devices found in everyday life. This month we shall do some experiments using microelectronics than look at some means of detecting and measuring environmental changes using a variety of home-made instruments.

There are two approaches to doing microelectronic experiments. The first is to use ready-made modules and for anyone feeling his or her way this is probably the best way of proceeding. However, some cost may be saved and, perhaps, more experience and satisfaction gained by using basic components on a prototype board – most of the following details are given assuming that you are going to do this.

THE 555 TIMER

Microelectronics involves using *integrated circuits* (this point was made last month). One of the most versatile of these – and one which has been around for many years – is called the 555 *timer*. Although there are now 555 timers based on different technologies, we shall be using the traditional type which is robust and well suited to amateur experimentation. There are some interesting investigations to be done using this. However, although the chip itself is very inexpensive, you will need a few other components to make it work. These are listed later.

The 555 timer can operate in two distinct modes – as a *monstable* and as an *astable*. A monostable is a circuit which, once triggered, will switch on for a certain time then go off. It will then remain off until re-triggered. This could be used for all manner of timing operations – as a darkroom or kitchen timer, for example. Time periods may range from a fraction of a second to several minutes depending on the values of a pair of external components.

An astable, on the other hand keeps switching on and off continuously as long as a supply exists. With a slow pulse rate, this could be used for a flashing motorway sign. By using a higher speed – several hundred or thousand pulses per second – it could operate a loudspeaker and give a musical sound. This could provide the warning signal for a pelican crossing or, by using a keyboard to change the note, could be the basis of a musical instrument.

This latter use will be described in more detail later and could provide a useful link with other National Curriculum areas. Ready-made modules based on the 555 timer or a similar integrated circuit are available as monostables and astables. These are listed in science education suppliers' catalogues.

TIMER CIRCUIT BUILDING

Building circuits using a 555 timer in both monostable and astable modes makes a good exercise and one which can be related very easily to devices used in real life. It also gives confidence in handling integrated circuits and other electronic components.

One problem with using i.c.'s is making connections to the pins. It is not really practical to make these *direct* even if you are good at soldering. For making temporary circuits, it is best to use a solderless prototype board. There are several different types available but here the *Vero Plugblock* is specified.

After building the circuits, the components are simply removed from the board and may be used again indefinitely. Note that if any other type of breadboard is used, it will be necessary to translate the layout diagram into the new scheme. The Vero Plugblock has most of its contacts arranged in two sections of 29 rows, each having five holes (see Fig. 1). The spacing of the holes is 2.5mm making them suitable for direct plugging-in of integrated circuits.

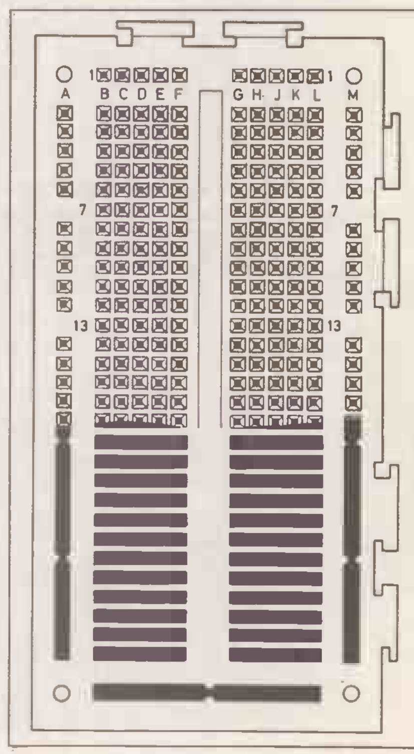


Fig. 1. Layout of the Vero Plugblock. The bold lines on the lower part of the drawing indicate how the holes are connected together.

The bold lines show how the holes are interconnected thus, component leads inserted into any of the five holes in a row will be connected together. Note that rows are not connected together across the centre line – if this is necessary, short bridging wires will be needed. Link wires are also needed to inter-connect separate rows of holes as required. The holes along the top are all connected together as are those to the left, right and bottom of the board – these are useful for the battery connections.

For the following experiments, you will need the components listed below. Note that the starred ones have been used in previous experiments and should already be part of your kit. Connections to the loudspeaker may be made using small crocodile clips, firm twisting of the wires

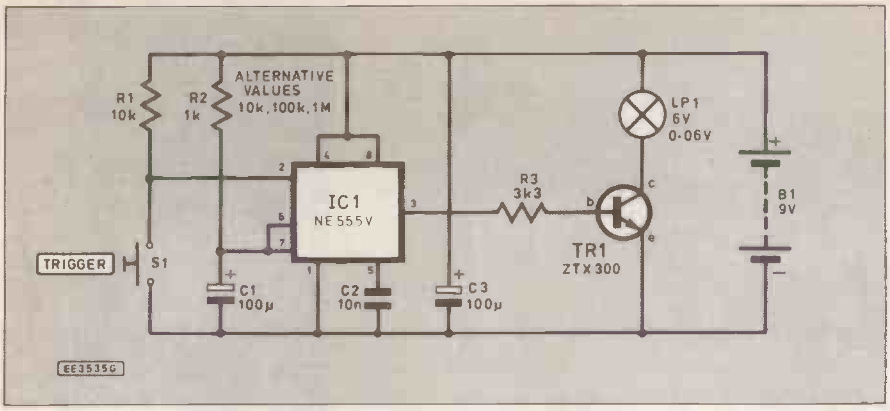


Fig. 2. Monostable circuit diagram.

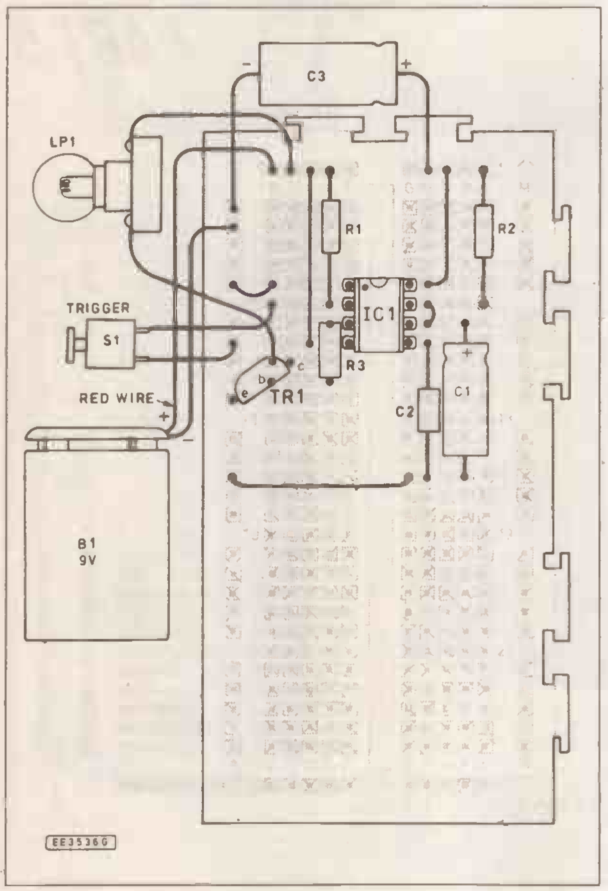
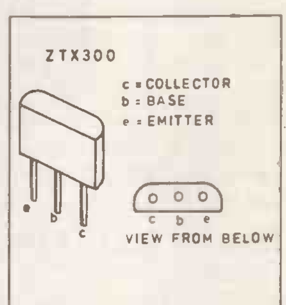


Fig. 3 (left). The Plugblock layout of the monostable circuit. It is essential that TR1 is connected correctly and that C1, C3 and IC1 are the correct way around.

Fig. 4 (below). The connections to TR1, compare this with Fig. 3.



onto the terminals or, of course, the wires may soldered into position.

Resistors

Note: it is now usual to express resistor values without the "Ω" (the unit of resistance) sign and without the decimal point – for example, 1k or 1k0 is 1 kilohm or 1000 ohms. 3k3 means 3.3k or 3300Ω. 1M is 1 megohm or 1 million ohms.

1k – 2 off
3k3
10k – 2 off
100k
1M
All 0.25W 5% carbon.

Capacitors

Note: 1n is 1 nanofarad or 1 thousand-millionth of a farad (the unit of capacitance). 1µ is 1 microfarad (one millionth of a farad). An axial capacitor has one lead protruding from each end as shown in Fig. 5.

100µ axial electrolytic 10V (2 off)
10n ceramic
100n ceramic

Semiconductors

NE555V timer
ZTX300 transistor

Miscellaneous

Vero Plugblock
*6V 0.06A lamp and lamp holder
*PP3 battery and battery connector
*miniature loudspeaker – 60 to 80 ohms impedance
*miniature push-to-make switch

You will also need some short pieces of light-duty single strand wire of various lengths with the last 5mm of insulation removed from both ends to use as link wires. Do not use scissors to remove insulation – buy a pair of proper wire strippers.

THE MONOSTABLE

The circuit diagram for the monostable is shown in Fig. 2 – this may be helpful to some readers but it is not essential to understand it. It is only necessary to be able to build the circuit by putting the components in the right places on the breadboard, to be able to control it and to investigate what it does and the range of uses it could have in everyday life. This last point is very open-ended and may be used for countless activities of the investigative type.

According to convention, R1 and R2 are the *resistors*, C1 C2 and C3 are the *capacitors*, IC1 the *integrated circuit* and so on.

The Plugblock layout for the monostable circuit is shown in Fig. 3. The following four parts should be identified: (a) the push-button switch, S1, which is the *input device* and used to trigger the monostable (b) the integrated circuit, IC1, which carries out the *process* (c) the transistor, TR1, which *amplifies* the small output current from the i.c. and (d) the lamp, LP1, which is the *output device* and lights when the i.c. is on. In next month's article we shall see how an alternative output device – a *relay* – may be used instead of a bulb. This makes the circuit more versatile.

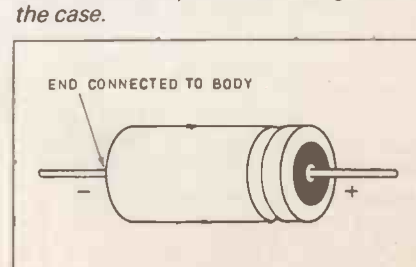
Refer to Fig. 3 and insert the components as shown taking care over the orientation of transistor, TR1 (see Fig. 4) and the integrated circuit (note the cutout and/or spot on the body – see last month). The components may not be all exactly the same size as those shown in the diagram – however, by gently bending the end leads, they should fit the holes without difficulty.

Wire ends may be cropped so that the components fit more tidily and closer to the board and this also helps in avoiding bare wires touching one another and causing short-circuits. Do not remove too much end wire or you may find that the component will not fit into a subsequent layout.

Note that components C1 and C3 are a type of capacitor called an *electrolytic* capacitor and for this reason it is essential to connect them the correct way round. Body markings identify the negative end – if this is not clear for any reason, then the negative end is the one which is connected *direct* to the metal body (see Fig. 5).

Connect the battery holder, taking care over the polarity, and insert the battery itself. Trigger the circuit by pressing switch, S1, for an instant. The bulb, LP1, should light and go off soon afterwards. The alternative values of R2 will alter the

Fig. 5. An axial lead electrolytic capacitor. The negative end is usually marked on the plastic covering around the case.



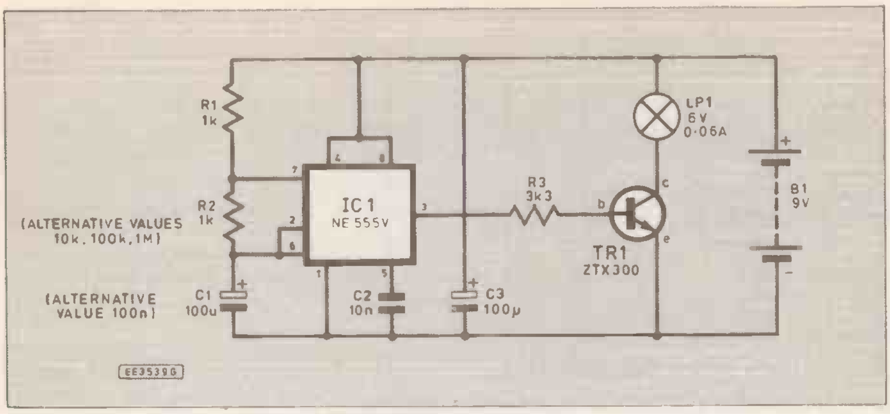


Fig. 6. Astable circuit diagram.

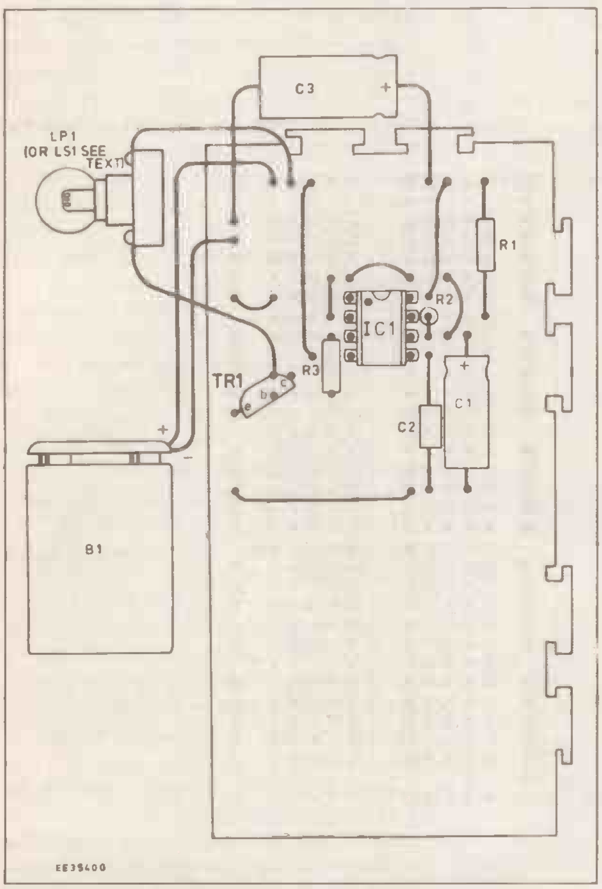
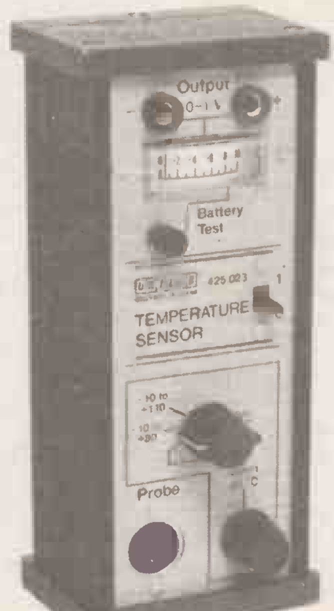
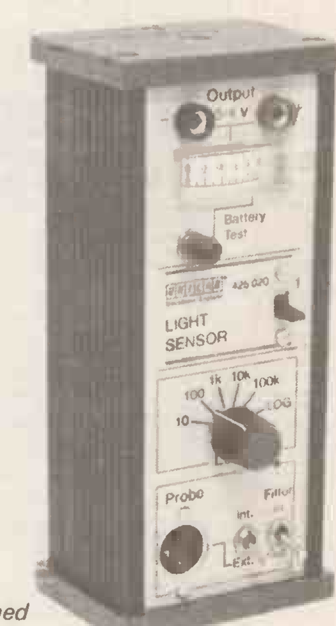


Fig. 7. Plugblock layout for the astable.





A range of Unilab sensors designed to allow environmental measurements. These can be used with computer interfaces or data loggers if required (Unilab Ltd., Blackburn).

timing period – the larger the value the longer the timing will be. Insert these one by one to check this point.

THE ASTABLE

The astable shares most of the Plugblock layout with the monstable circuit. The circuit diagram is shown in Fig. 6 and the practical layout in Fig. 7. Build the circuit using C1 = 100μ to begin with. Connect the battery – the lamp should light, go off, come on and repeat rapidly. By changing R2 to the alternative values, the operating time may be altered – the higher the value, the slower the flash rate will be.

By returning to R2 = 1k and the alternative value, 100n, for capacitor C1, the time period will be so fast that the bulb appears to be on all the time. This is because the individual flashes are too fast for the eye to follow. Prove this by removing the lamp and lampholder and connecting the miniature loudspeaker in its place. This will now give a high-pitched tone because the output pulses move the cone rapidly backwards and forwards – this vibration produces a musical note.

The values of R2 and C1 determine the rate of vibration of the loudspeaker cone and hence the pitch of the note produced – the faster the vibration the higher the pitch (there is a link here with National Curriculum music topics). Use the alternative values for R2 and check that various notes may be obtained. It would be possible to use a set of resistors to produce a musical scale. Push-button switches could be used to make a keyboard and connect the correct resistor for the note required.

Now we come to the second part of this month's work. This is to show how Microelectronics helps in the detection and measurement of environmental changes.

ENVIRONMENTAL CHANGES

Environmental changes suitable for study include: light, temperature, sound level, radioactivity, pH, earthquake, oxygen and moisture content. However, we shall not look at all of these – the following are sufficient: Light intensity, Temperature, Moisture content and Sound level. This work could provide links with other areas – particularly biological ones – in the National Curriculum.

There is a difference between *detecting* and *measuring* and this point should be made clear to the children. If we notice, for example, that there is light in the room, we have *detected* light. If we notice there is a change in the light intensity – that is, it becomes brighter or darker, then we have *detected a change* in light intensity. If we come out of the cold into a warm room, we notice that it is hotter –

we have detected a rise in temperature.

Detection does not involve actual figures – for this we need a *measuring instrument* and this will tell us the quantity in appropriate units. For example, to measure the length of a piece of string, we use a ruler and this will tell us the length in metres or centimetres. To measure a temperature, we need a thermometer and this will read in degrees Celsius (centigrade) and so on. To measure environmental changes using an electronic circuit we need *sensors* – devices which respond electrically to the change being considered.

Our senses are good at *detecting* certain changes but not very good at *measuring* them. One reason for this is that our senses, unlike measuring instruments, are easily influenced by what they detected previously. For example, if someone came into a room from a warmer place, they would think that it was cool. If they came into the same room from somewhere even colder, they would think it was warm. It can't be warm and cool at the same time – only a thermometer will tell us what the temperature really is.

There are several excellent ready-made electronic instruments which may be used to measure environmental changes (see photographs). If these are available, they should be used. Unilab, for example, produce a wide range of such devices. An oxygen meter would be useful for several experiments in biology.

It is fun, though, and instructive to use microelectronics to make some instruments for yourself and this may be done very cheaply. Home-made instruments may then be compared with commercial ones in terms of accuracy, reliability, size, ease of use, cost, etc. They may also be compared in terms of ruggedness, range, cost, speed of operation, etc. with traditional instruments – an electronic thermometer with a mercury one, for example.

Since all the home-made circuits to be described are battery-operated, they are entirely safe in operation and may be freely handled by anyone. For those requiring a half-way stage – that is, something between purpose-made commercial instruments and those built using basic components – modular kits may be used. The Unilab Alpha system is an example. By connecting together the various modules, many different types of circuit can be made. Although complete kits are expensive, costs may be saved by buying only one of each module required. These are robust and, with careful use, will last indefinitely.

BUILDING CIRCUITS

The following assumes that you are going to build the circuits using basic components on the Vero Plugblock. Three of the circuits – for light, temperature and moisture level measurement – share a basic circuit. Which one of the environmental changes is to be measured simply depends on which sensor is used. The sound level measuring circuit needs some additional circuitry at the sensor end but still uses much of the basic circuit.

When using an electronic circuit to measure the above changes the system may be regarded as having four parts – a *sensor*, a *processing circuit*, an *output device* and a *power supply* (see Fig. 8).

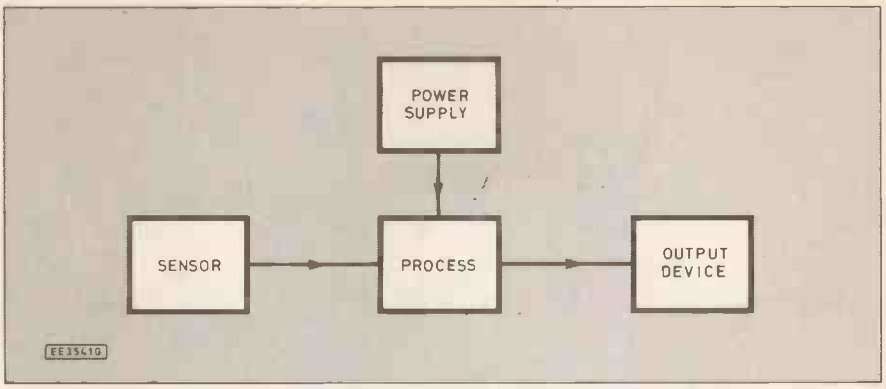


Fig. 8. Block diagram showing the basic parts of the measurement circuit.

Most commercial instruments use a meter or digital display as the output device – readings are then given directly. In these circuits the cost of a meter or display has been avoided by using a rotary control and the measurement read off using a pointer-type knob and scale.

MEASURING ENVIRONMENTAL CHANGES

To measure light, temperature and moisture level you will need the following components. Remember to check your existing kit of parts – the starred ones have been used in previous experiments. For sound level measurements you will need some additional components which are listed later.

Resistors

ORP12 light dependent resistor (light sensor) or bead thermistor (temperature sensor) – resistance 150k at 25°C.
100k – 2 off
3k3 – 2 off
1M standard linear-track potentiometer and pointer-type control knob

Semiconductors

µA741C operational amplifier
*ZTX300 transistor

Miscellaneous

*Vero Plugblock
*6V 0.06A lamp in lampholder
*PP3 battery and connector
Single-core connecting wire
Knob with pointer for the potentiometer

The 741 operational amplifier (op-amp) looks very much like the 555 timer used previously, both being housed in an 8 pin d.i.l. package but here the similarity ends. The op-amp is a very different device.

Like the 555 timer, the 741 op-amp has been around for many years. A brief explanation of its action is given below but understanding this is not essential for making the circuits.

An op-amp has two inputs, the non-inverting (+) one and the inverting (−) one (pins 3 and 2 respectively for the 741) and one output (pin 6). It also has positive and negative supply connections (pins 7 and 4 respectively). Here, it is being used in *comparator mode*. Consider the light or temperature measuring circuits (see Fig. 9). R1 is a light-dependent resistor (LDR) for light or a thermistor for temperature measurement; these act as the sensor. VR1 is a potentiometer – this is familiar as the volume control on a radio.

In the circuit shown the LDR or thermistor, in conjunction with VR1, provides a certain voltage at the inverting (−) op-amp input. The value of this voltage depends on the light or temperature being sensed and the adjustment of VR1. A fixed voltage of approximately 4.5V is applied to the non-inverting input by the two resistors, R2 and R3.

When the (+) input voltage exceeds the (−) one, the op-amp switches on and the output is at positive battery voltage. When the (−) voltage exceeds the (+) one, the op-amp gives no output. Thus, under a range of lighting or temperature conditions, VR1 control knob may be rotated until the (+) input *just* exceeds the (−) one and the op-amp will switch on.

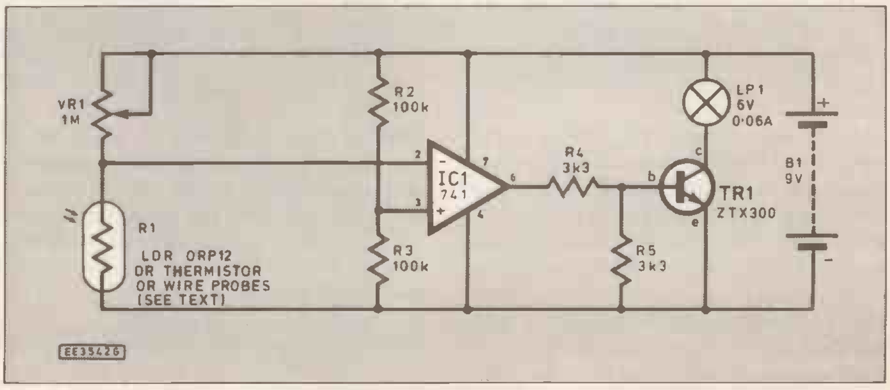
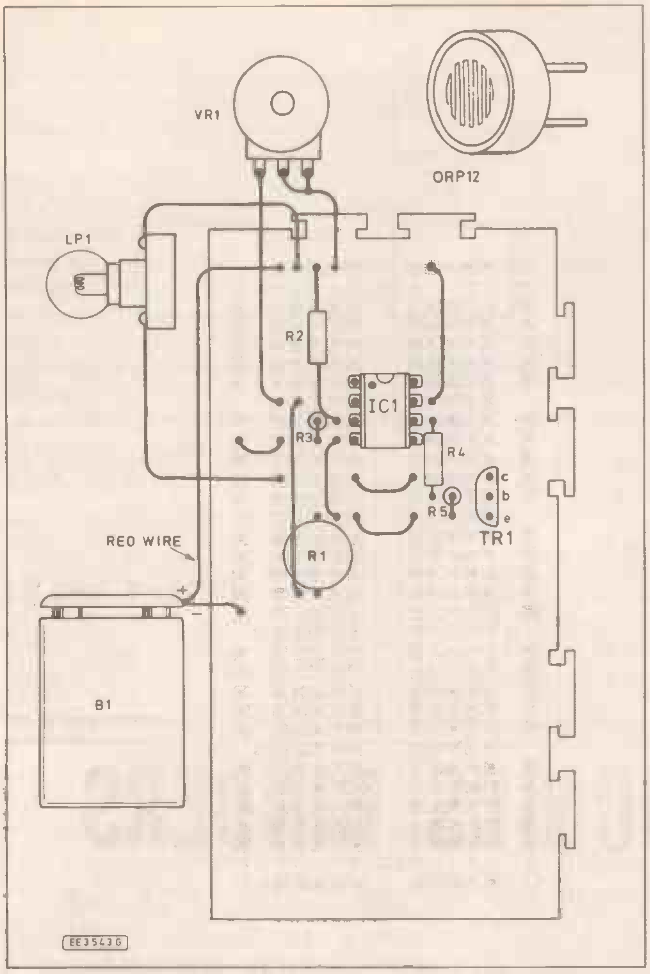


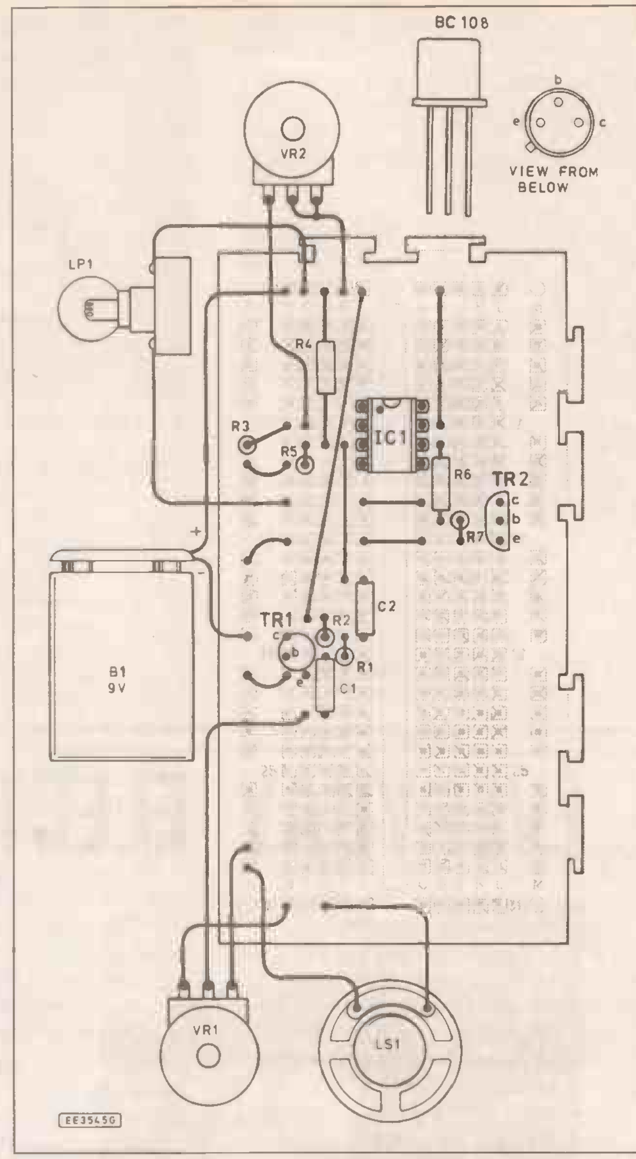
Fig. 9. Basic circuit for measuring environmental changes – light, temperature and moisture.

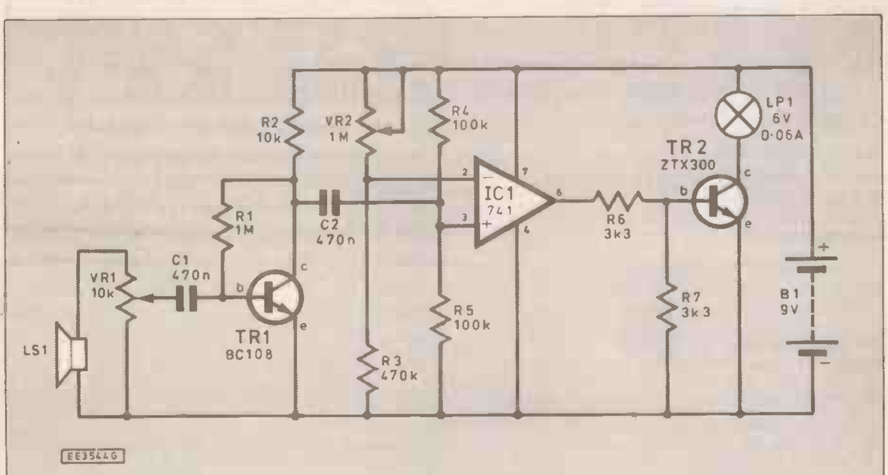


.Fig. 10. Plugblock layout for light, temperature or moisture measurement.

Fig. 12 (right). Plugblock layout for sound level measurement.

Fig. 11 (below). Basic circuit for measuring environmental changes – sound levels.





By reading from a scale drawn under the control knob, the value of light level or temperature may be read off. The op-amp output is not sufficient to operate the lamp direct, so transistor TR1 amplifies the small output current for this purpose. Anyone wanting a more detailed explanation of op-amps should consult a text book.

To measure moisture content, two wire probes are used in place of R1. These are simply pushed into the soil, etc. whose moisture is to be measured. The damp soil conducts electricity and acts as a resistor. The more water there is present, the lower its value will be. A voltage will then appear at the non-inverting input depending on the amount of water present and the rest of the circuit works in the manner already described.

BUILDING THE CIRCUIT

The Plugblock layout for measuring light, temperature or moisture content is shown in Fig. 10. Insert the components into the holders as indicated using the LDR for light or the thermistor for temperature sensing. For moisture measurement, use two short wire probes with the last 5mm of insulation removed from each end. The exact arrangement could be the subject of experiment later.

Do not bend the end leads of an LDR or a thermistor too close to the body – they have a nasty habit of breaking off, rendering the device useless. Remember, the components you buy may not be exactly the same size of shape as those shown but they should still fit into position without difficulty.

Note the small cut out and/or spot on the op-amp body – this ensures that it is inserted the correct way round as shown. Note also the shape of the transistor, TR1, outline – again, this makes sure that it has the correct orientation.

Make the inter-row links using the short pieces of single-core connecting wire. Fit the control knob and leave VR1 adjusted to approximately mid-track position. Now make a careful check for errors before proceeding. Check particularly that IC1 and TR1 are the right way round. ***Note that certain components can be damaged if connected incorrectly.***

Connect the battery holder **with the correct polarity** and insert the battery itself. Rotate the potentiometer spindle and check that a "balance" may be obtained where the lamp is just off. Carry the circuit into different places and check that a new balance position may be obtained for differing light intensities or temperatures (according to which sensor has been used). If measuring moisture, check by dampening the fingers and touching the probes.

When the circuit is working correctly, VR1 may be attached to a piece of cardboard. A scale is then drawn showing brightness, temperature or moisture levels. It will probably be sufficient to use an arbitrary scale marked 0-10 but for temperature, the device could be calibrated against a mercury thermometer and a scale of true values used.

It is a good exercise to decide what light intensity or temperature is sufficient for normal working then check various places in the building to find out if each area is receiving enough light or heat. Note that when making light measurements, it is necessary to prevent the light from the bulb reaching the LDR or you may obtain some curious results.

Note: If you want to use the thermistor sensor for measuring the temperature of *water* rather than air, you will need to waterproof the body and leads completely. This is because water conducts electricity and would lead to false results.

SOUND LEVEL

For measuring sound levels, most of the basic circuit for light, temperature or moisture levels is used. However, some modification to the input stage is needed and you will need the following additional components. Note that stars have the same meaning as previously.

Resistors: *10k, 470k, *1M
Capacitors: 470n – 2 off
Semiconductor: BC108 transistor
*Miniature loudspeaker – 60 to 80 ohms impedance.

The miniature loudspeaker is the sound sensor – in this application it is being used in reverse – that is, as a *microphone*. The sound vibrates the cone and converts it into an *electrical signal* (readers who have been following the series will remember this from the *simple telephone* described in Part 1). The signal is very small and needs to be amplified before it can be used as a practical sound level sensor. For this purpose, the BC108 transistor and associated components are used.

Build the circuit shown in Fig. 11 onto the Plugblock as shown in Fig. 12. Set VR1 to approximately mid-position and connect the battery. Adjust VR2 and find the point where the lamp is just off – after that, leave it alone. The 10k potentiometer is the *level adjustment* whereby the lamp can be made to operate at any chosen sound intensity. This circuit could be used for comparing the sound near, say, a main road, in a classroom, in the playground, near a source of music, etc. It could thus be used to study noise pollution.

Next month we shall begin by looking at the use of switches and relays in simple circuits. We shall also look at logic gates and their use in decision-making and simple control circuits.

EVERYDAY NEWS

MESSAGE FROM QUEEN VICTORIA

The British Library has a major new acquisition to add to its collections: A recording taken from a Graphophone cylinder that belongs to the Science Museum. Originally recorded 103 years ago and recently rediscovered, the cylinder may have the only surviving recording of Queen Victoria.

The Graphophone was invented in the United States, where it succumbed rapidly to the rival cylinder recording system developed by Thomas Edison. There are very few surviving Graphophone cylinders – made of cardboard with a wax-like coating – and this is the only one known in Britain.

The cylinder belongs to the Science Museum, which received it in 1929 from Sydney Morse's son. Morse is known to have gone to Balmoral to show the Queen the newly invented Graphophone cylinder recording system. He later described a cylinder made at Balmoral as "my most cherished possession and chiefest treasure". This may be the same cylinder.

Restoration

Using the custom-built technology of the National Sound Archive, a department of the British Library, this voice can be heard again through the Archive's listening facilities.

The National Sound Archive was initially called in because the technology to play the cylinder had disappeared. Using a modern electric phonograph and a variety of filtering techniques, including a new Computer Enhanced Digital Audio Restoration (CEDAR) system developed in association with the British Library, Conservation Manager Peter Copeland has been able to reveal what may be the Queen's voice.

The cylinder has three bands recorded on it. One has the shadow of a woman's voice but no words are distinguishable. Another has a man's voice and some whistling, which may correspond to accounts of Queen Victoria's recording session at Balmoral. The third band has a woman's voice, and through heavy surface noise the words "Greetings . . . the answer must be . . . I have never forgotten" can be discerned.

Sight and Sound

The cylinder itself, together with the electric phonograph and a model of the Graphophone, are on display at the Science Museum, Exhibition Road, London SW7.

This recording (along with two million others) can be heard free of charge at the British Library National Sound Archive, 29 Exhibition Road, London SW7, open Monday-Friday 10am to 5pm (Thursday to 9pm). All listening is by appointment except a five minute programme featuring the "Queen Victoria" cylinder which can be heard on demand. There is also a fuller programme giving technical information.

MOBILE FAX

Being able to send written messages and receive faxes while you are on the move from location to location, in your car or even on a train, is no longer a science fiction pipedream claims British Telecom. With the launch of BT's new PF-1 portable fax, claimed by some to be the smallest A4 machine in the world, the fax no longer needs to be *wired* in to the telephone network.

Designed specifically for use over the Cellphone network, the machine incorporates features such as automatic answering – allows you to receive faxes while you are away from your car – and error correction facilities. You can also run off quick copies of important documents.

Using a data interface unit to link into the Cellphone network, the PF-1 is smaller than a sheet of A4, only a couple of inches deep, weighs just 6lbs and will work with most car or transportable phones. In the car, it draws power from the cigar lighter socket.

When you are on site, or for that matter on a train or boat, it uses its own rechargeable battery pack. With the addition of an optional mains adapter it can be plugged into an ordinary BT socket.

"Its taken a while to come up with a genuinely portable mobile fax, at a price small businesses can afford", says BT's Les Huett. "But it has been worth the wait. Everyone who has tried it has been impressed by the extra freedom it offers", he said.

I.C.s Shrinking

A range of personal communications i.c.s in the Shrink Small Outline Package (SSOP) are being marketed by Philips Semiconductors. Claimed to be the world's smallest commercially available 20-pin package for this type of i.c., with a p.c. board footprint measuring only 4.5mm x 6.75mm, the SSOP occupies a mere one-third of the board space required by predecessors. In addition, its 1.5mm height makes it thinner; a key advantage in space-sensitive applications such as cordless telephones, pagers and pocket wireless systems.

The first products offered in the space-saving SSOP package are the NE/SA575DK low voltage compandor and the NE/SA605DK/615DK high-performance low-power FM i.f. system i.c.s, allowing designers currently using the SOL versions of these i.c.s to miniaturize equipment without changing the circuit design.

The compandor, which features a precision dual-gain control circuit and low supply voltage operation, can be used to reduce noise and boost dynamic range in a wide range of audio and radio communications applications. The FM i.f. system i.c. incorporates a mixer, oscillator, i.f. and limiter amplifiers, plus a quadrature detector, muting circuit, logarithmic received-signal-strength indicator (RSSI) and voltage regulator.

Philip Tizzard has been appointed Managing Director of Siemens' Electronic Components Group based in Sunbury-on-Thames. He succeeds Alan Wood, who was recently appointed the managing Director of the Company's Energy & Automation Group in Manchester.

* * *

New Franchise

Alpha Industries have appointed Cirkit as their first UK distributor. Chosen from stiff competition, Cirkit will be stocking a carefully selected range of Alpha's u.h.f. and microwave diodes, Gunn oscillators and MMICs. All are featured in the latest Cirkit 1992 catalogue.

With a turnover of more than $60 million, the Boston based company have been expanding into the consumer market from a largely military background. Bob Nichols, Alpha's UK Director of Sales said, "we were particularly impressed by Cirkit's understanding of how the UK r.f. market is developing, which fits in well with our own plans, not just for the UK but Europe as well". "We have a fantastic product range, but targeting potential users has to be very specific, which is why Cirkit won the right to distribute Alpha's components."

Emphasising the need for service, Richard Bulgin added "we will be holding stock of all the components featured in our new catalogue and working closely with Alpha for any special requirements". The Alpha range is set to compliment Cirkit's existing r.f. franchises from Toko, Micrometals and Uniden.

. . . from the world of electronics

TOP MARKS

The professional outlet of Maplin Supplies has been awarded the prestigious British Standards Institute "Kitemark" for their products and components. The award is the Institute's BS5750 Certificate of Quality.

To mark the occasion and to present the award, David Tripper, Minister for the Environment and Countryside, paid a visit to the Maplin warehouse in Wombwell, Barnsley. When presenting the BSI award, the Minister congratulated managing director, Roger Allen, on the companys achievement. "The Award" he said "marks a significant milestone in the fortunes of Maplin."

In reply, Roger said that "customers are increasingly demanding BS standards for their components. The already high quality of our products will be enhanced by the award of the certificate – the culmination of extensive assessment by the BSI Quality Assurance team."

The Wombwell warehouse services over 7,000 product lines from over 500 suppliers, to meet over 10,000 orders a week and some 500,000 customers world-wide.

US/RUSSIAN UNION

The California company that has been pioneering the commercial development of the Russian television industry, Comspan Inc., has been selected as the exclusive US representative of the Union of Electronics of Russia.

Sanctioned by the Russian Parliament under former Prime Minister I.S. Silaev, the Union of Electronics operates under the administration of the Innovation Council of Russia, which was formed to help selected industries in the transition to a free-market economy.

The Electronics Union was formed in January, 1991 by a group of electronics engineers and entrepreneurs, many of whom were associated with the USSR's sophisticated defence industry. The Union is headed by Dr. Eugene Bugaetz, a member of the Russian Parliament and well-respected Soviet scientist.

Comspan, Inc., through its Business Development Consulting Division, headed by Phillip Quetschke, will provide business development and strategic planning guidance to the Union. In addition, Comspan will organize the Union's activities in the United States in regards to licensing technology from or to Russia, and in establishing business relationships or joint ventures between entities of the two countries.

The first major goal of the Union is to create a database of inventions, technological research and engineering expertise. According to Mr. Bugaetz, "Because the defence and electronics industries' priority claim on resources has now been nullified, there is a great resource of highly-qualified engineers and scientists with innumerable technologies and inventions available for commercial adaptation and exploitation. There is enormous intellectual potential among Russian electronic professionals just waiting to be tapped and put to good use."

Briticent International, one of the UK's leading electrical and lighting distributors, has been purchased by Otra, the Amsterdam based wholesaling group in a deal worth over £23 million.

Otra has 150 branches in Germany and Holland with sales in excess of £800 million. The company's main shareholder is the French electrical distributor Sonepar, which has 450 branches in France, Spain, Italy, Portugal, Canada and Russia. With a combined turnover of £2 billion Otra and Sonepar together claim to have over 10 per cent of the Western electrical distribution market.

WIDESCREEN VIDEO

A top-end Super VHS VCR capable of recording and playback in 16 by 9 "widescreen" mode has just been announced by Ferguson. Priced at around £799.99, the Videostar FV59S is a state-of-the-art Super VHS machine with NICAM hi-fi stereo, 8-hour long play and a sophisticated "Jog Shuttle" control on its remote handset providing the precise frame control of a video editing machine.

A principal benefit of the "widescreen capability" is its ability to play back pre-recorded 16 by 9 format tapes. As it senses a "widescreen" tape, the VCR will also automatically send a code to switch a "widescreen" compatible TV to 16 by 9 mode. Ferguson is working closely with a number of major software companies to ensure that a comprehensive supply of video titles will be available in "widescreen" format in the near future.

In addition to playback of "widescreen" tapes, it is also fully capable of recording and playback from 16 by 9 broadcasts when they commence. Other features include 4-head dual azimuth operation, an automatic head cleaner to maintain optimum picture quality, and a on-screen timer.

Editing

The jog shuttle remote unit is claimed to simplify cueing and invisible editing by providing variable tape speed control for editing purposes, and can also be used for convenient timer programming, setting the clock and channel selection. In addition, a "Retake" function which shuttles videotape backwards or forwards whilst in record pause mode can also be accessed from the jog shuttle, permitting editing without having to return to tape playback search modes. An assemble edit control allows easy, accurate tape eiditing when re-recording or assembling footage from a camcorder or perhaps another VCR, and is particularly useful when editing out commercials whilst recording a film.

Diary Dates

March '92

9-11 — *10th International Zurich Symposium and Tech. Exhibition on Electromagnetic Compatibility, Switzerland.* (..4137) 82 1131)

All Formats Computer Fairs (0926 613047)

8 Scotland	- City Hall, Candleriggs, Glasgow.
14 London	- Horticultural Hall, Greycoat Street, Westminster.
15 West	- Brunel Centre, Temple Meads, Bristol.
21 East Midlands	- Donington Park, J23A, M1.
22 North	- University Sports Centre, Calverley Street, Leeds.

April '92

12 North East	- Northumbria Centre, Washington, A194 (M).
26 West Midlands	- National Motorcycle Museum, J6, M42.

May '92

16 London	- Horticultural Hall, Greycoat Street, Westminster.
17 West	- Brunel Centre, Temple Meads, Bristol.

National Vintage Communications Fair (0398 331532)

3 — Pavilions Hall, National Exhibition Centre, Birmingham.

A one-day event for specialist collectors and others interested in buying and selling vintage radios, telephones, televisions, jukeboxes, gramophones, records and other related mechanical-music items, ancient or modern, in order to pursue the enjoyment of their hobby.

Constructional Project

AUTO GARAGE LIGHT

A. R. WINSTANLEY

No more fumbling around in the dark when parking the car in the garage at night. The headlights trigger the garage light for a preset time period – daytime overide included.

WINTER is upon us at the time of writing, which highlights the inconvenience that the author experiences when garaging the car at night after a hard day's work at the office. After parking the car at night, it can be quite a job to fumble around in the dark garage in search of briefcase, coat and house keys, and so this project was designed in order to throw a little light on the matter (literally).

This garage light control unit will automatically operate the garage's electric light for a pre-set period, and is activated by the car's headlamps as the vehicle enters the garage. It is also automatic in that it will only operate during the night-time hours, once ambient light levels have dropped below a pre-determined level.

The Auto Garage Light has been designed to be versatile to allow simple installation in several configurations, as shall be seen. The device is a mains-operated project and may require some experience or knowledge of domestic wiring, but installation is quite straightforward and involves minimal interference with existing wiring.

HOW IT WORKS

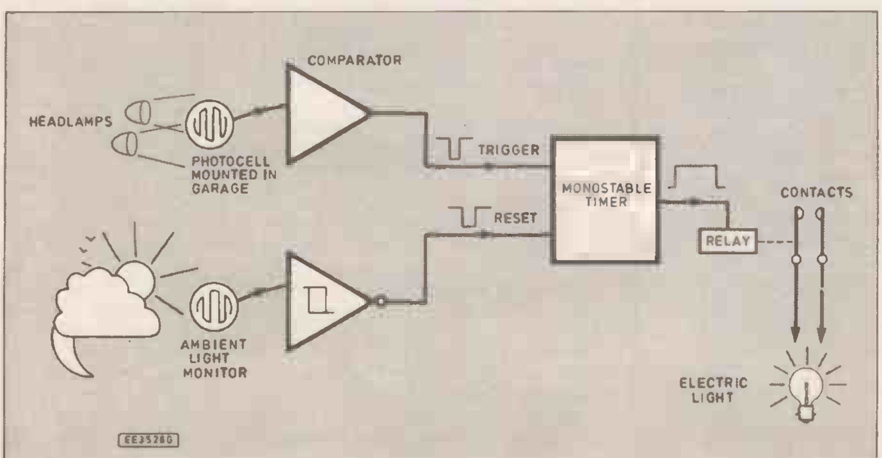
The unit to be described incorporates several distinct sections as detailed in Fig. 1. To outline the principles of operation, when the car is driven into the garage, the light from the headlamps falls upon a photo-sensitive device mounted inside the garage. This sends a triggering signal to a monostable ("one-shot") timer which starts timing for a period of up to about five minutes or so.

The timer is connected to a mains-rated relay, the contacts of which are in parallel with the existing light switch. Hence, the electric light in the garage will illuminate for a preset time period (the monostable period), long enough to get one's coat etc. out of the car and to lock up with the convenience of actually being able to see what you are doing for a change!

Precautions have to be taken to ensure that the system is not "fooled" by daylight, which would cause the device to mistake sunlight for the car headlamps and trigger the electric light.

A daylight override is therefore included in this design. This takes the simple form of a second photocell which is mounted near the window, for example, or if the garage does not have one, outside where it can watch for dusk and dawn. This second photocell sends a "reset" signal to the timer to prevent it from operating during daylight hours and will automatically activate the circuit again when the ambient light has dropped to a preset level.

Fig. 1. Block diagram of the Auto Garage Light.



Variable controls are incorporated to permit adjustment of the timer period, sensitivity to the headlights and dusk/dawn switching point. A further feature permits the provision of an extra electric lamp output, in case a light is not already fitted in the garage.

The Auto Garage Light was designed to plug directly into a mains socket, although skilled and experienced constructors will be able to wire directly to a fusebox, or a spur, for example. Obviously, such installation work *MUST* be carried out by a competent electrician if any doubts exist. To simplify construction, all components are mounted on a single p.c.b. which includes most mains interwiring for added safety and ease of assembly.

CIRCUIT DESCRIPTION

The circuit diagram of the Auto Garage Light is shown in Fig. 2 where the various sections can be seen. The circuit is centred around a twin operational amplifier chip type LM358 although other pin-compatible chips have been proven to function equally well.

As indicated earlier, this circuit utilises two economical photo-conductive cells or light-dependent resistors (l.d.r.s) similar to the ORP12 type. The first l.d.r., R3, can be considered as a "daylight/night-time detector" and is connected to form a potential divider with preset resistor VR1. It is located in a position where it can monitor ambient light levels.

The "Day/Night" sensor, which detects when dusk is approaching, is formed by IC1a and associated components and will activate the Auto Garage Light circuit when the light has fallen to a predetermined level. As ambient light increases, the unit is de-activated – the circuit therefore prevents the electric light from being unnecessarily triggered during daytime.

The output from the potential divider network is taken from the wiper of VR1 and is connected to the inverting (−) input pin 6 of IC1a; a simple fixed divider comprising resistors R1 and R2 provide a reference voltage of 50 per cent of the supply rail to the non-inverting (+) input pin 5. The supply voltage is approximately 12V (see later) and thus pin 5 is held at about 6V. Ignoring R4 for a moment, the op-amp therefore forms a simple comparator circuit, since it "compares" the voltages present at its two inputs.

When pin 5 is more positive than pin 6, then the output (pin 7) swings "high", to almost the supply rail voltage. Conversely, should the potential at pin 6 exceed that at pin 5, then the output will swing "low", to approximately one volt or so.

Since the resistance of l.d.r. R3 changes inversely to incident light levels, the voltage at pin 6 will fall when the ambient light level increases, and rise when light upon it reduces. Thus, the output of IC1a can be made to switch high or low by the change of light level which is monitored by l.d.r. R3, such that in darkness (R3 resistance high) pin 7 is low, and vice versa.

The exact point at which the switch-over from high to low takes place can be determined by the setting of preset VR1. This can be trimmed so that each installation can be individually tuned to prevailing conditions.

Of course, the gradual onset of darkness is a very slow change over several hours. The gain of the op-amp is so high that, in comparator mode, only a tiny fraction of a voltage difference need exist between the

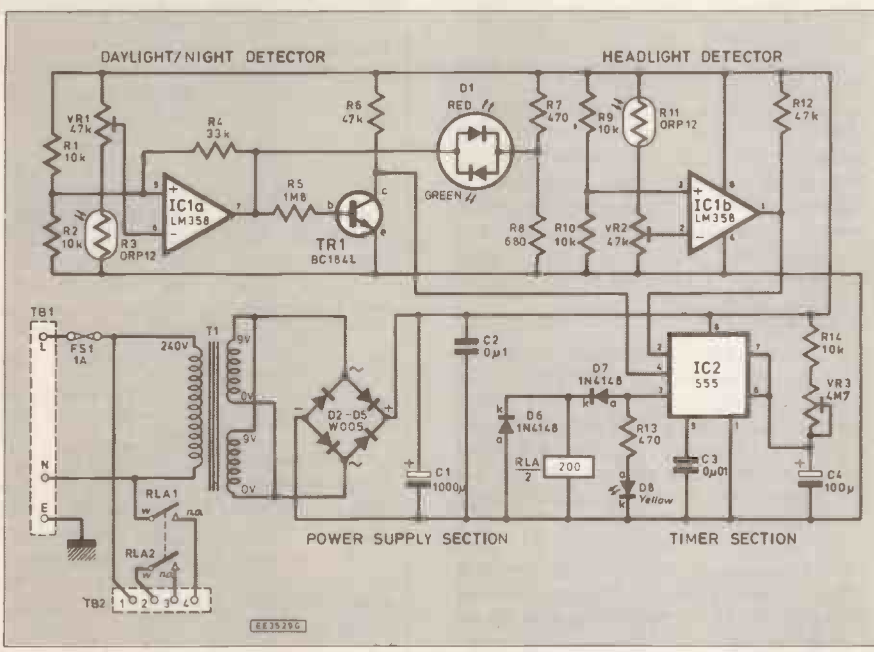
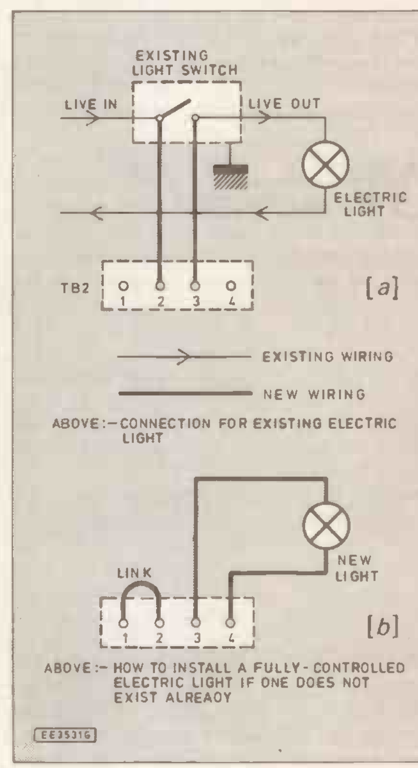


Fig. 2. Complete circuit diagram for the Auto Garage Light. The installation of the unit in an existing garage light circuit is shown in (a) and how to install a light if one does not exist is shown in (b).



non-inverting (+) and inverting (−) inputs of IC1a and the device will amplify this and switch over the state of the output. Without any feedback between the output and inputs, the amplification factor or "open loop gain" of the LM358 is up to 100,000 and so the i.c. will multiply the difference between the two inputs by this factor, making the circuit very sensitive to differences between the inputs.

POSITIVE FEEDBACK

However, it was decided to further improve the switching characteristics of the circuit by including resistor R4 to introduce positive feedback. The i.c. then forms a Schmitt trigger, a circuit which is excellent for converting a very slowly-moving signal (l.d.r. output) into a very rapid on-off switching action.

Basically, once the output starts to switch high, R4 transmits a positive-going signal back to the non-inverting input (pin 5) of the op-amp, which accelerates the positive-going tendency of the output even more. This removes any tendency for the comparator to "jitter" in an intermediate state where the l.d.r. R3 resistance is just approaching the triggering level (itself set by VR1).

Resistor R4 introduces an additional side-effect in the operation of the Schmitt trigger. When the output switches either high or low, this effectively places R4 parallel with resistors R1 or R2 respectively. This can be considered as altering the values of R1 and R2 (to roughly 7.6k), and has an important effect upon the reference voltage at pin 5.

When IC1a output is low, resistor R4 can be considered as parallel with R2. By voltage divider action, the output voltage from the divider connected to pin 5 is:-

$$V_{ref} = \frac{\text{(combined value of R2 and R4 in } \parallel\text{)}}{\text{(total resistance of voltage divider)}} \times \text{Supply Voltage}$$

R2 and R4 in parallel are 7.6k and thus the reference voltage at pin 5 is now not 6V but 5.18V i.e. (7.6k ÷ 17.6k) x 12.

Alternatively, when pin 7 is high, R4 is now in parallel with R1, and the reference voltage becomes:-

$$V_{ref} = \frac{\text{R2}}{\text{R2 Plus (value of R1 and R4 in } \parallel\text{)}} \times \text{Supply Voltage}$$

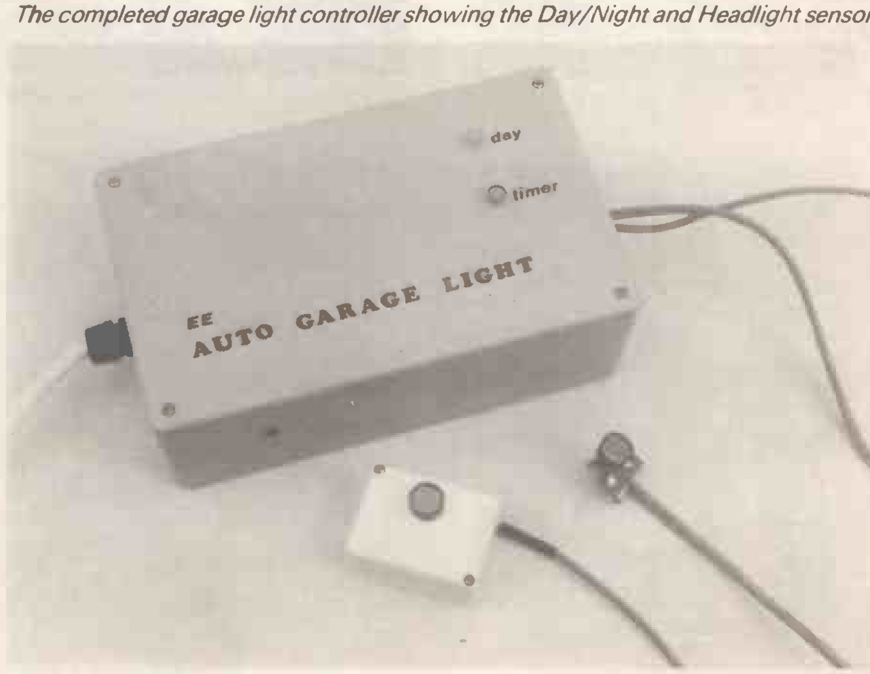
Hence the reference voltage is now about 6.8V: (10k ÷ 17.6k) x 12.

Note: to calculate the value of two resistors in parallel, the formula is:

$$R\,\text{total} = \text{Ra x Rb/(Ra + Rb)}$$

There is now a difference between the point at which the circuit can switch high and the point when it must switch low, because the reference voltage at pin 5 (against which the signal voltage from l.d.r. R3 is compared) is changed by the inclusion of R4. This difference in switching points is called "hysteresis" and is a fundamental characteristic of Schmitt triggers.

The completed garage light controller showing the Day/Night and Headlight sensors.



A graphical summary of operation of this Schmitt trigger is shown in Fig. 3 which plots output against the input from the l.d.r. R3, and is a classical characteristic of this type of circuit. In practice the circuit will trigger when the ambient light level has fallen to a certain level but the light must increase back beyond that level before the circuit switches back again.

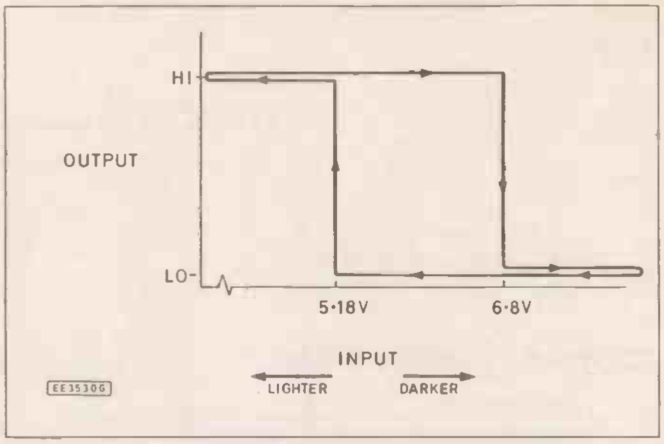


Fig. 3. Graph of Schmitt trigger characteristics.

Connected to the output of IC1a is a bi-colour l.e.d. D1 and this will glow red when the op-amp output is high (daylight conditions) to indicate that the circuit is disabled, and green when the op-amp output is low (circuit operational). This will prove especially useful during setting up. Resistors R7 and R8 provide a voltage drop for each l.e.d. chip.

HEADLIGHTS DETECTOR

The other op-amp, IC1b, is also connected as a comparator circuit but this time it was not considered necessary to add positive feedback. R11 is another photoconductive cell (l.d.r.) which is mounted in the garage at a spot where the car's headlamps will shine on it. This time, when light falls upon the photo-resistor, the inverting input (pin 2) will be forced towards the positive supply rail and the output will swing low.

Resistors R9 and R10 set up a reference voltage at pin 3 (the non-inverting input) and VR2 is another preset which controls the sensitivity of the circuit, i.e. how brightly R11 must be illuminated by the car headlamps before the comparator switches over.

The output from IC1b ("headlights detector") drives the trigger terminal (pin 2) of the 555 timer chip, IC2. The timer requires a voltage of two-thirds of the supply rail or less in order to commence timing, and so the 555 is triggered when l.d.r. R11 detects the car headlights, the trigger terminal being driven low by IC1b.

Unlike the trigger input, the reset terminal (pin 4) of IC2 requires a voltage of 0.7V maximum for the device to reset. The output of IC1a can be well over one volt when "low" and so a transistor switch TR1 was included which also inverts the output signal from pin 7.

Therefore, when IC1a output goes high (daytime conditions), transistor TR1 saturates and the collector falls to about 100mV or so. This provides a suitable reset signal for the timer chip, with the result that during daylight hours, the timer is disabled (reset pin held low by TR1) and cannot operate; this will override any signals present at the timer's trigger terminal.

TIMER

The timer itself is a standard monostable arrangement which will generate a fixed period delay when triggered at pin 2, unless the reset pin 4 is low. The period is determined by resistor R14, preset VR3 and capacitor C4 and is about eight minutes maximum. VR3 can be trimmed to change the period as required.

The output of the timer, pin 3, goes high during timing and this will illuminate l.e.d. D8 – a useful indicator during initial installation. The relay RLA is also energised during timing, diode D7 preventing latching up or relay chatter which sometimes occurs, and D6 shunts away any reverse voltage ("back e.m.f.") generated by the relay coil when it de-energises.

POWER SUPPLY/MAINS SWITCHING

Turning to the power supply and mains switching section, mains input voltage is applied to a three-way terminal block TB1, via protective fuse FS1 and is stepped down by transformer T1 to 9V a.c. and both secondary windings are in parallel. This is then full-wave rectified by the bridge rectifier D2-D5; this is smoothed by the reservoir capacitor C1, C2 helping to decouple any noise and spikes. The result is a d.c. unregulated supply of approximately 12V-13V which is the main supply rail for the circuit.

The specified relay RLA has two sets of changeover contacts, of which the normally-open contacts are employed to switch the electric light. In fact, the circuit has been arranged to be more versatile, and will permit not only an *existing* lamp to be operated, but also enables the constructor

COMPONENTS

Resistors

R1, R2	10k (2 off)
R3, R11	ORP12 light dependent resistor (2 off)
R4	33k
R5	1M8
R6	47k
R7	470
R8	680
R9, R10	10k (2 off)
R12	47k
R13	470
R14	10k

All 0.25W 5% carbon film

See SHOP TALK Page

Potentiometers

VR1,VR2	47k min. preset, horizontal
VR3	4M7 min. preset, horizontal

Capacitors

C1	1000µ axial elect., 25V
C2	0µ1 polyester
C3	0µ01 polyester
C4	100µ axial elect., 25V

Semiconductors

D1	bi-colour l.e.d.
D2-D5	W005 50V 1.5A bridge rect.
D6, D7	1N4148 signal diode (2 off)
D8	yellow l.e.d.
TR1	BC184L *npn* silicon transistor
IC1	LM358 or 1458 or TL082CP twin op-amp
IC2	NE555 bipolar timer

Miscellaneous

T1	Mains transformer: 240V primary; twin 9V 3VA secondaries (6VA total)
FS1	20mm p.c.b. mounting fuseholder c/w 1A fuse
RLA	Min. p.c.b. mounting 12V 200ohm coil relay, with d.p.d.t. mains rated (240V a.c. 5A) contacts
TB1	3-way mains rated p.c.b. mounting screw terminal block
TB2	4-way mains rated p.c.b. mounting screw terminal block

Plastic box, size 115mm x 185mm x 62mm; insulated p.c.b. mounting pillars (4 off); l.e.d. lens-clips, 1 clear, 1 yellow; 1.00mm² twin-core and Earth wire; cable, solder etc.

Printed circuit board available from *EE PCB Service*, code EE786.

Approx cost guidance only **£19** *plus case* to connect a light to the unit if the garage does not already have lighting installed.

The electric light is connected to the four-way terminal block TB2. To automate an existing light, simply connect terminals TB2/2 and TB2/3 in parallel across the light switch. Contacts RLA2 will then close when IC2 is timing, and this will in effect short out the light switch to illuminate the electric light.

If however no light and/or light switch exists, then a link wire can be inserted between terminals TB2/1 and TB2/2 which connects the live (L) supply to RLA2. The live output is taken from terminal TB2/3 to a new light which can be installed by the constructor in the garage. The circuit returns to terminal TB2/4 where it is connected to neutral (N) through relay contacts RLA1.

The mains supply can be taken from a fused 13A outlet (as in the case of the prototype) or experienced constructors will be able to take a suitable supply from the domestic fusebox. In its basic configuration using the existing light switch, installation is kept very straightforward and the modifications to any existing electrical wiring are very simple, but this depends on whether a 240V supply already exists in the garage.

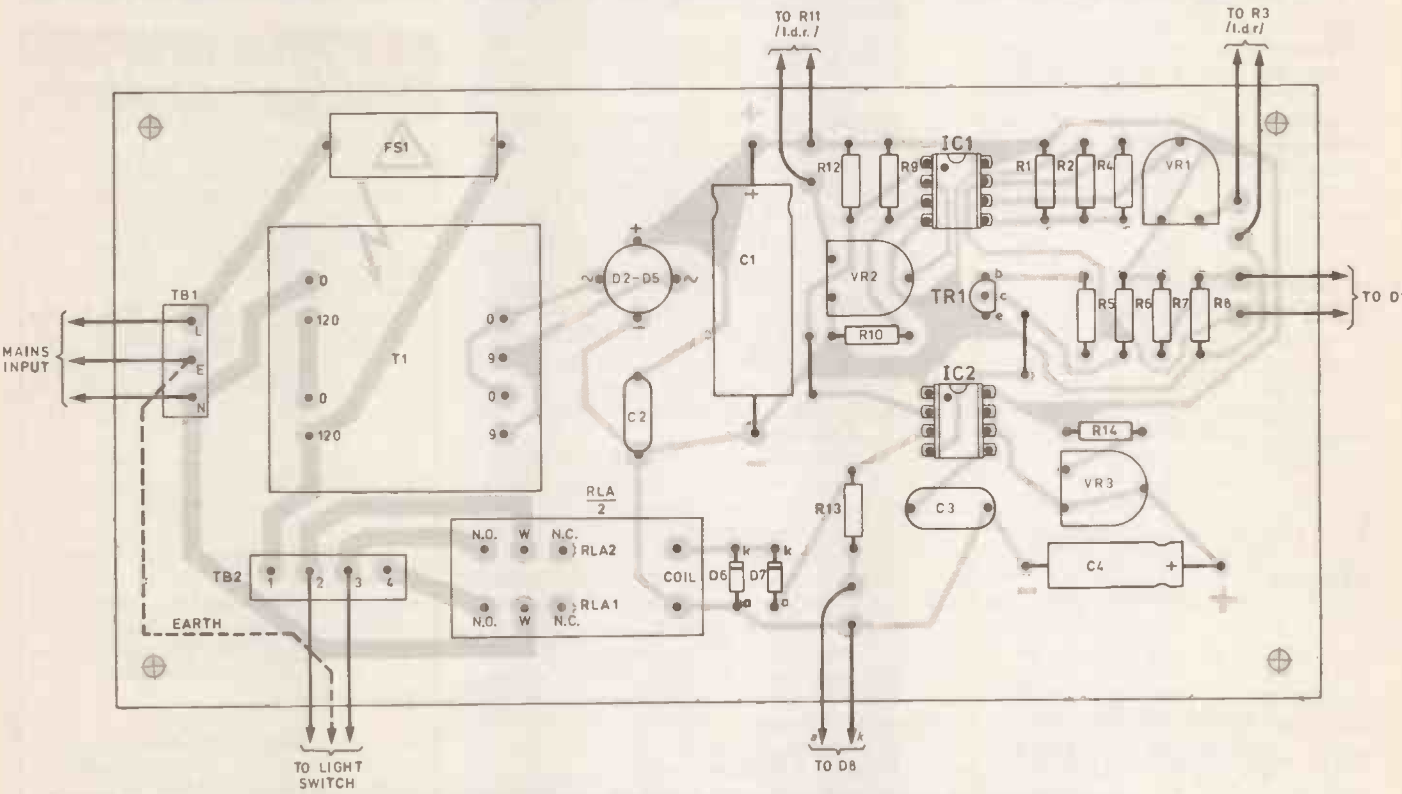
CONSTRUCTION

The whole of the circuit for the Auto Garage Light is constructed on a specially designed printed circuit board (p.c.b.). This includes all mains interwiring which simplifies assembly.

However, due to the presence of mains voltages, extreme care must be taken when finally installing and setting up the unit. The board should be tested using the low voltage method outlined under the "Testing" heading.

The printed circuit board component layout and full-size copper foil master pattern is shown in Fig. 4. This board is available from the *EE PCB Service*, code EE786.

The p.c.b. measures 160mm x 82mm and the prototype unit was housed in a plastic box of dimensions 185mm x 115mm x 62mm approximately. Before commencing work on the circuit board, simply use the empty p.c.b. as a template for drilling the p.c.b. mounting centres in the box.



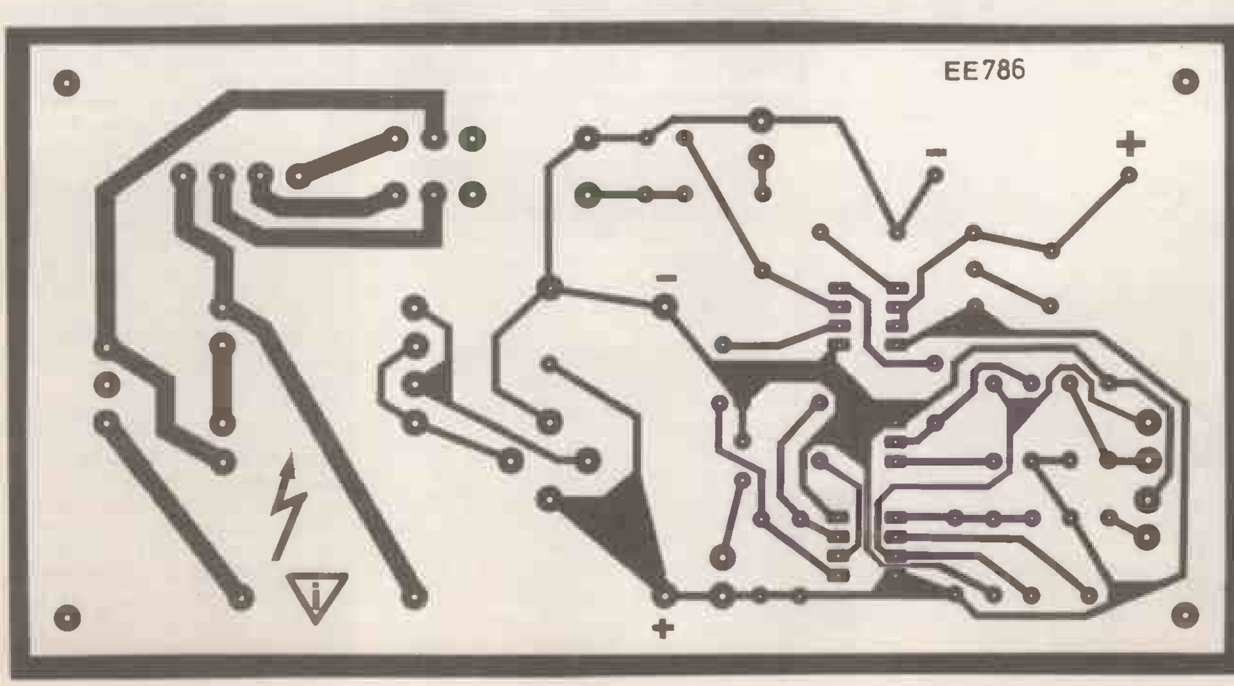


Fig. 4. Printed circuit board component layout and full size copper foil master pattern.

Assembly should start with soldering into position the smallest components first, see Fig. 4. The constructor may wish to utilise 8-pin d.i.l. sockets for IC1 and IC2. Continue by fitting the larger components, soldering the transformer in last of all. It is essential that the transistor, electrolytic capacitors, bridge rectifier and diodes are correctly polarised; also note the two link wires which need soldering into place.

It should be noted that the p.c.b. is designed to a 0.1in. pitch throughout, and it is therefore very important to purchase a transformer of the same pitch (5.08mm), as well as general pin configuration, to fit correctly on the circuit board. Metric pitch (5.00mm) transformers will not fit snugly on the p.c.b. and should not be used.

The same applies to the relay and two terminal blocks; again these are 5.08mm/0.1in. pitch and metric versions would not ensure an adequate fit. Bearing in mind that these items are at mains voltage, and the unit is designed to be left unattended, it is advisable to employ the recommended components.

After mounting all the components on the p.c.b., the board can be installed into the box. If a plastic housing is used, it is very important to mount the p.c.b. with *FULLY* insulated mounting pillars, such as p.v.c. stand-offs. These must be strong enough to carry the weight of the transformer and can be fixed into place with self-tapping screws at each end.

The use of a plastic box means that "Earthing" of the case is not required but none the less, any *exposed* metal screws should either be earthed or fully insulated from any mains circuitry inside – hence the plastic mounting pillars. If a metal case is used, this *MUST* be soundly Earthed.

The flying leads for the l.d.r. photocells and light-emitting diodes were soldered directly to the p.c.b. as per Fig. 5, though the mains connections are taken to the screw terminals. At this stage, do not connect anything to the 4-way block, and do not connect the board to the mains supply.

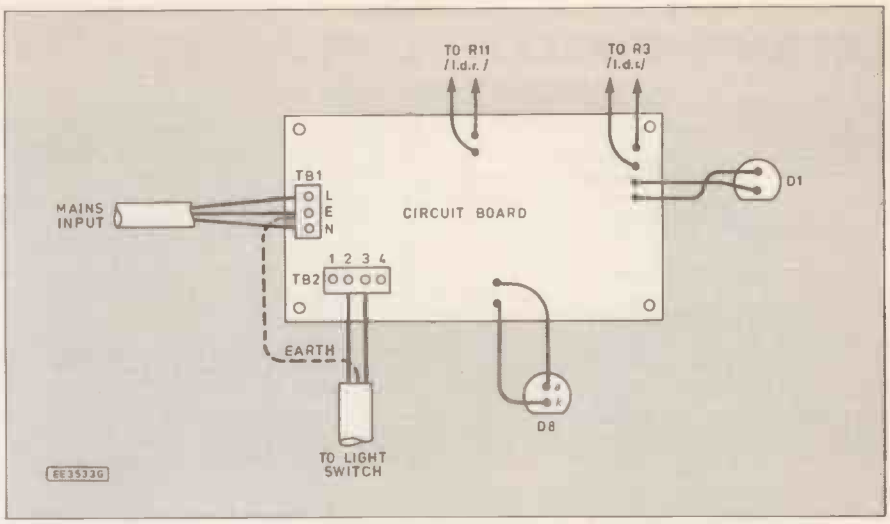


Fig. 5. Interwiring from the printed circuit board to the off-board components.

LIGHT SENSORS

On the prototype, l.d.r. R3 (Daylight detector) was mounted on a small tagstrip, with fixing lugs, and was located flush against the garage window; it was connected by a length of twin-core cable. The cable could be five metres long or more, if required.

It is obviously necessary that this photocell (R3) has an unobstructed view of ambient light levels. If no window is available, then it is very easy to construct an "outdoor" unit which could be mounted say on a door frame or near the eaves (if any). The suggested outdoor unit is built into a small plastic housing with a clip-on lid – an Aspirin container, for example.

If the housing has thin enough walls, it will act as a weatherproof light diffuser for the photocell which is mounted within on a piece of tagstrip. The interconnecting cable is routed through into the garage to the Auto Garage Light. Obviously, there is plenty of room for improvisation using any materials to hand.

On the other hand, l.d.r. R11 must be mounted in the garage in a location where light from the car's headlamps will fall onto it. This photocell could be glued directly on a small plastic box as per the prototype, or indeed could be affixed to the box of the main unit itself if this is in a suitable position. Both photocells must be positioned where light from the electric light does not fall onto them to avoid feedback, and trial and error will determine the best location.

TESTING

With assembly now complete, inspect the board for any errors or omissions. Pay special attention to the polarity of the bridge rectifier and smoothing capacitor C1. Insert the two integrated circuits into their sockets, right way round, if you have not already done so.

Prior to operating the system, it might be an idea to keep the photocell assemblies to hand and not mount them permanently until the unit has been tested.

By far the best way of checking the unit before permanently installing it is to connect the board to a bench power supply if one is available. With the l.e.d.'s and photocells wired to the board *(but not the mains)*, set presets VR1 and VR2 to midway, VR3 to nearly fully anti-clockwise, and clip a 12V d.c. supply across capacitor C1.

If the bicolour l.e.d.. D1 is red ("daytime") then it should be possible to change the colour by covering up R3. This simulates night-time conditions, and preset VR1 might require adjustment to achieve this.

When the l.e.d. D1 turns green ("night-time"), temporarily exposing R11 to light will simulate car headlamps (adjust VR2 if necessary) and the relay should be heard to click into operation with the yellow l.e.d. D8 illuminating. After a period determined by preset VR3, the relay will switch out again.

The main thing to ensure at this stage is that if D1 is red then it should not be possible to activate the relay and D8 because the timer should be in a disabled state due to the resetting action of transistor TR1 upon IC1a.

If the board correctly operates as above, it can now be installed in the garage. Initially it would be better to run the board on the mains without connecting it to the light switch, so connect a 240V outlet via TB1. **It is extremely important to connect the Live, Neutral and Earth the right way round. Mains cables need to be secured with "P" clips or cable glands, for example,** so that they cannot be pulled out.

CAUTION! When the board is running from the mains, **certain components, notably the fuseholder, are live!**

FINAL INSTALLATION

Since no two garages are alike, installation is likely to be a matter of trial and error as far as the settings of the presets and locations of the two photocells are concerned. Testing of the prototype involved much flashing of headlights!

The link to the light switch can be effected with 1.00mm² flat twin core and earth (TC&E) electrical cable of the required length, with cables firmly fixed to the wall using cable clips. A modern light switch may already be earthed and an Earth connection can be linked to the earth (E) terminal of TB1, for continuity. Carefully bend the TC&E wiring to shape so as to avoid undue strain on the 4-way terminal block.

Finally, if the constructor is using the unit to install a light where one does not already exist, then a short link wire (made from 6A wire) is fitted to join terminals TB2/1 and TB2/2 – see circuit diagram – and then an electric light can be wired in to terminals TB2/3 and TB2/4, again employing 1.00mm² flat twin core. If required, an Earth can be taken from TB1 (middle terminal) to earth any additional light fittings or switches which may be installed by the constructor. □

INTERFACE

Robert Penfold

LAST month we looked at digital to analogue converters for PCs. This month we continue with the same subject, but concentrate on how to get the basic signal from the converter to do something useful. It should be pointed out that most of the information provided here is not specific to PCs, and applies equally to other computers that are equipped with an add-on digital to analogue converter.

STEPPING UP

Most practical applications for digital to analogue converters involve the control of much higher powers than the converter itself can handle. A typical application would be the control of a d.c. electric motor. This might only involve power levels of a few watts, but this is still well beyond the capabilities of normal digital to analogue converters. The ZN426E for instance, can provide an output of up to 2·55 volts and must feed into a high load impedance. A typical small d.c. motor requires something like 12 volts at 1 to 2 amps when running at full speed.

Obviously a large amount of amplification is needed to permit a d.c. motor to be controlled. However, only a modest amount of voltage gain is required. The maximum output voltage of the ZN426E is 2·55 volts, which requires a boost by a factor of just under five in order to permit a 12 volt motor to be driven properly.

The current amplification is a different matter though, and a massive amount of gain is needed in order to permit the fairly high output impedance of a digital to analogue converter to control loads which draw an amp or two of current.

AMPLIFIER

The circuit diagram for an amplifier that will permit a ZN426E converter to control a d.c. electric motor that draws up to about 1A is shown in Fig. 1. As will be discussed in detail later, the circuit is easily modified to accommodate higher currents.

Operational amplifier IC1 is used in the non-inverting mode with its voltage gain set at 4·9 times by R1 and R2. With a 0 to 2·55 volt input this gives an output voltage range of 0 to 12·495 volts. It is advisable to use one per cent or two per cent resistors for R1 and R2. Any errors in the output voltage range should then be small enough to permit a maximum output potential of at least 12 volts to be achieved. Alternatively, R2 could be replaced with a 4k7 preset which would then be adjusted to give a maximum output potential of precisely 12 volts.

The current amplification is provided by TR2, which is a Darlington power device. This acts as an emitter follower buffer stage at the output of IC1, effectively enabling IC1 to provide output currents of an amp or two. R3, R5, and TR1 form a conventional current limiting circuit, and these prevent output currents of much over one amp from flowing.

The parallel resistance of R3 and R5 sets the maximum output current available from the circuit, and by using a lower resistance here it is possible to have higher output currents. For example, three one ohm resistors in parallel would permit currents of up to about 2A to be accommodated. I would not recommend trying to use this circuit for higher output currents.

The load resistor for TR2 is R4, and this ensures that the circuit functions properly with no load connected to the circuit. C1 enables the circuit to provide brief pulses at high currents if required, and D1 protects the circuit from any high reverse voltages generated by the coils in the motor.

I have given the supply potential of the circuit as 15 volts, but this is an absolute minimum value. Ideally it would never fall below about 16 to 17 volts. Note that the input voltage does not have to be well regulated or highly smoothed.

Note also that TR2 will generate a substantial amount of heat, particularly when the unit is used at about half to two thirds of full speed. It must therefore be fitted on a substantial heatsink. One having a rating of about four degrees Centigrade per watt or lower should suffice.

REVERSING DECISIONS

Many motor speed control applications also involve controlling the direction of the motor. The direction of an ordinary d.c. electric motor is governed by the polarity of the supply. There is more than one way of placing the supply polarity under computer control. One method is to have a circuit that can provide positive and negative output voltages, with a central 0 volt setting at a value of about 128.

Increasing the value above 128 would then give increasing speed in one direction, while decreasing values below 128 would give increasing speed in the opposite direction. A circuit based on the DAC0801 could handle this type of control (see last month's *Interface* article).

A problem with this method of speed control is that it is very wasteful. You have what are effectively separate supplies for forward and reverse operation, and to some extent separate control circuits as well. My preferred method is to simply have a relay with d.p.d.t. contacts to switch the polarity of the output. A suitable circuit is shown in Fig. 2.

With this method a latching digital output is needed to control the relay via a simple driver circuit (TR3 etc.). The relay's

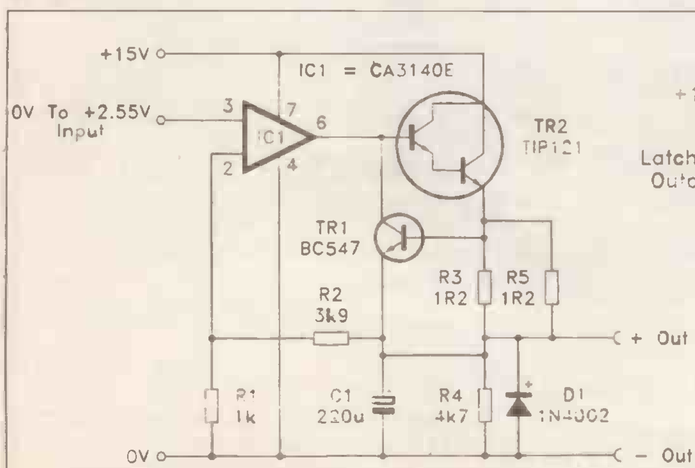


Fig. 2. Simple method of providing direction control.

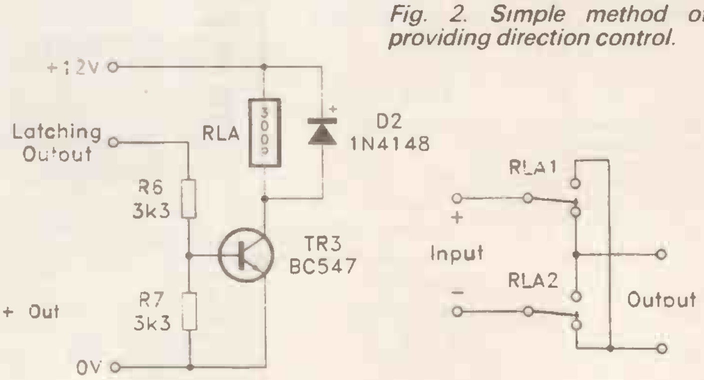


Fig. 1 (left). Circuit diagram of the d.c. motor interface.

coil resistance is given as 300 ohms in Fig. 2, but anything above about 200 ohms should be satisfactory. The PC's +12 volt supply should be able to power one or two relay drivers without any problems.

Make sure that the relay contacts have adequate ratings. These contacts must be break before make types or they will short circuit the output of the controller each time they are activated! Fortunately, relay changeover contacts invariably seem to be of the break before make variety.

CONTROL

The digital output to control this port can be "borrowed" from the eight bit port driving the converter. For instance, input D0 of the converter can be connected to the 0 volt supply rail, and output D0 of the port can then be used to control the relay driver circuit. Odd numbers from 1 to 255 will then turn the motor in one direction, while even numbers from 2 to 254 will operate the motor in the other direction. A value of 0 switches off the motor, as usual.

A slight drawback of this method is that it gives only half as many motor speeds. In fairness, this is also true of any simple 8 bit method of speed control which also includes direction control. Being realistic about it, there are still over one hundred speeds in each direction. Even allowing for the fact that low values will probably fail to activate the motor and are of no practical use, this still gives a range of speeds that is more than adequate for most purposes. There is no obvious change in speed from one value to the next when using this method of control.

This type of controller is adequate for many applications, but it is less than ideal for something like a model train controller. This is due to the poor starting performance of simple controllers. Next month we will consider more sophisticated motor control using a pulsed type controller.

PORT CONTROL

Most current microprocessors are descended either from the 6800 or the 8080. The 6800 used memory-mapped I/O, and the 8080 a separate I/O space. The 80X86 processors used in PCs are descendants of the 8080, and thus use separate I/O addressing. The various processors in the 80X86 series can address differing amounts of memory, and memory addressing involves the rather complicated and infamous segmented addressing scheme.

Fortunately, the situation for I/O addressing is simpler, as all versions use straightforward 16-bit addressing. This means that there are a possible 65536 port addresses, but on PCs only 1024 are used, and add-on cards will always appear in the top 512 addresses. At the assembly- language level, the two instructions for I/O are simply IN and OUT. These have the syntax

IN *accumulator*, {*portnumber*|DX}
OUT {*portnumber*|DX}, *accumulator*

The number of the port can be either an eight-bit immediate value or the DX register. Obviously, the DX register must be used for ports with a number higher than 255. For these instructions, the value to be sent to the port must be in the AX register for word values, or in AL for byte values, and these same instructions are used to receive values from ports.

In higher level languages, instructions with similar names may be found, though in some cases, where the language already uses IN as a keyword for something else, the input instruction usually becomes INP. For example, in Microsoft QBASIC, as supplied with MS-DOS 5, the instructions are:

```
x% = INP(port%)
OUT port%, data%
```

These instructions will also be found in many other PC dialects of BASIC.

C AND PASCAL

Strangely, the popular languages C and Pascal are less good in this respect than the higher-level language BASIC. Neither of these has input and output instructions as part of the basic language. This is largely because these languages are supposed to be portable across machines to some extent, and this tends to involve omitting features which are not portable! Support for I/O in the libraries depends on what the producer of the language supplies as extensions to the standard.

In the case of Microsoft C (and Quick C), four functions are provided. These are inp, inpw, outp, and outpw. The versions with the 'w' read or write a word value (16 bits), whereas those without read or write a byte value. The details are as follows.

```
Syntax: int inp( unsigned port );
        unsigned inpw( unsigned port );
        int outp( unsigned port, int
        databyte );
        unsigned outpw( unsigned port,
        unsigned dataword);
Returns: (inp) the byte read from the port.
        (inpw) the word read from the
        port.
        (outp) the byte output.
        (outpw) the word output.
```

Other compilers provide similar functions, though there may be detail differences. For example, the functions provided in the Zortech C++ compiler library are declared as follows.

```
Syntax: int inp(int port-address);
        int inpw(int port-address);
        void outp(int port-address, int
        value);
        void outpw(int port-address, int
        value);
Returns: (inp) the byte read from the port.
        (inpw) the word read from the
        port.
```

In Pascal, the effective standard in the PC world is really the Borland Turbo Pascal standard. Even Microsoft Quick Pascal follows this, except as regards object-oriented extensions. In Turbo Pascal, the ports are addressed as a pre-defined array, rather than through functions. This is consistent with the way in which direct access to memory is provided. As in C, byte or word access is possible. The details are as follows.

```
Syntax: Port[portnum]
        PortW[portnum]
```

As this is an array, it can appear on either side of an assignment statement, depending whether you want to write to or read from the port.

```
Examples: Read byte from port $61
          retval := Port[$61];
          Write word to port $B6
          PortW[$B6] := $1120;
```

CARE

When dealing with any of these port-addressing methods, care is obviously necessary. Some of the ports are used for specific purposes in the functioning of the computer, and writing to these could cause the machine to hang up, or, in some cases could result in loss of data. You should make sure you are always reading from or writing to safe addresses.

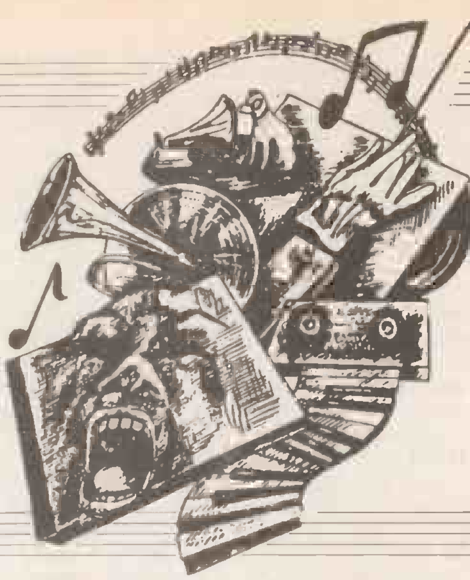
If you want to experiment, some suitable safe addresses are 61H and 42H. These are the ports which control the speaker on IBM PC's and compatibles. Bits 0 and 1 of port 61H turn the speaker on and off, and port 42H is a timer which controls the pitch. The higher the value written to this port, the lower the pitch.

Next time we will give some example programs in the languages mentioned here, demonstrating the basics of port addressing. We will be looking at some of the shareware languages available for the PC, with special regard as to how well they provide for interfacing to hardware.

Special Series

MAGNETIC RECORDING

Part 6: Tape Parameters and Tape Groups



VIVIAN CAPEL

Life today would be difficult to imagine without magnetic recording: No audio or video recorders; no computer disks; no payphone cards; no bank cash cards or magnetic security pass cards. In spite of its universal use, magnetic recording and the principles of magnetism are still little understood by most people.

PUBLISHED audio recording tape specifications can be rather perplexing for the ordinary user. Some makers provide quite a lot of technical data, which is commendable, but it often leaves the user confused as to which are the significant ones and what effect they have. We will take a look at those that are generally given and what they mean.

Reference level

Many of the specifications such as sensitivity, MOL, and frequency response are given in dB (decibels). These values are related to the figures shown on the recording level meters when you record.

The reference level above which you should not record with ordinary tape if distortion is to be kept low is 0dB. It represents a recording flux of 250 nano Webers/metre to which the meters are set during the tape deck's manufacture. A level of −3dB is thus 177nWb/m.

The reference level to which dolby noise reduction circuits must be set is 200nWb/m, which is just under −2dB. Both record and playback circuits must be set to this otherwise there will be mistracking.

Bias

An industry DIN standard bias setting has been established for each tape group, so the specification for a particular tape is usually given as a plus or minus dB value relative to this standard or to a specified reference tape.

In a previous article we saw that the recording bias in a recorder can be set to give either maximum frequency response or lowest distortion for a particular tape because the two do not coincide. Usually the machine is set for a compromise. As most machines have the bias preset, it cannot be adjusted by the user, so a tape must be selected that has a bias specification which corresponds to the recorder setting.

A tape with a value below that to which the recorder is set, will be overbiased and will have a reduced h.f. response, although it will also produce less distortion. One that has a higher value will have a better h.f. response, but it will also have a higher distortion level.

Usually, a tape is recommended for the tape deck or recorder by the maker because the machine's bias has been set for it. It will therefore give optimum h.f. and distortion figures. However, any other make of tape will give comparable results providing it has the same bias specification.

Generally though, modern tapes are formulated to avoid sharp humps in their bias/distortion and bias/frequency response curves, so they are not all that critical. A small deviation from the set bias has little audible effect although it can be measured with test equipment. Greater deviations may be noticeable if the reproducing equipment is capable of resolving it.

Coercivity

Readers of the first article (Oct '91) in the series may remember that coercivity is the reverse magnetic field required to reduce to zero a material that has been magnetized to saturation. Think of it as being coerced to give up its magnetism when it doesn't want to! The unit of coercivity is the oersted or the kAmp/metre. To convert, 1 kA/m = 12.5 oersteds.

Applied to recording tape it indicates the force required to erase a previously recorded tape. It also indicates the tape's resistance to self-demagnetization or demagnetization from external fields. Recordings made on a high coercivity tape are likely to be more permanent and less vulnerable than those on tape with a lower coercivity.

Higher coercivity requires high recording and erase currents, so the recorder must be capable of supplying them. Metal tapes have high coercivity, and cannot be recorded on non-metallic machines. But providing the recorder is designed to record tapes in that particular group, it is unlikely that it will encounter a tape it cannot record.

Distortion

Nearly all of the distortion generated by recording on tape is *third harmonic*, so the quoted figure is usually for that. As we have seen, distortion varies with bias, so the figure is for the optimum bias level for lowest distortion. This means that if a compromise bias setting has been made between distortion and h.f. response, the distortion will be slightly higher than that quoted.

Some makers provide a graph showing the distortion at various bias levels. An informed choice can then be made of bias level, if it is user variable. The increase in distortion may be so small at optimum h.f. setting that it may be considered undetectable and the bias set for maximum h.f. response.

Another factor affecting the distortion is the recording level; the higher it is, the greater distortion. The 0dB level is often used for measuring distortion, but −3dB or even −4dB is frequently preferred by tape makers as it produces a lower distortion figure – which looks better on paper!

Having said this though, the −3dB figure is probably the most realistic as the greater part of most recordings are around or below this point. Only on rare peaks should the level swing to 0dB.

Dynamic range

The term dynamic range is the difference between the largest and smallest recordable signals. It affects the *realism* of the reproduction because a wide range is needed to reproduce both the loudest and softest sounds made by a large orchestra. For speech and most non-musical sources, dynamic range is of less importance.

The loudest sounds that can be recorded are limited by the *saturation point* of the magnetic material. But before this, the *hysteresis loop* (see Oct '91) deviates from the straight part into a curve, thereby compressing and distorting the signal over this portion. Practically, then, it is the start of this curve where distortion increases rapidly, that sets the limit for the largest recordable signal.

In the opposite direction, the lowest signal is limited by the noise level. Noise was a problem with recording tape in the early days, which is why noise reduction circuits proliferated. There are three main causes of noise: *modulation noise; asperity noise; and non-uniform particle noise*.

With modulation noise, different numbers of magnetic particles are magnetized as the tape leaves the gap because of the changing signal level. As the distribution of particles in the binder cannot be exactly equal per unit of area, the result is unevenness in the recorded waveform.

This appears as noise which is greater for large signal excursions than for small ones. To some extent then it is masked by the large signals, but as the largest signals are usually bass notes, and the noise is of higher frequency, masking is not total. However, it is less noticeable than other types of noise which are heard in quiet or silent passages.

Asperity (roughness or hardness of a surface) noise arises from unevenness of the coating. Displacements are thereby produced as the asperities lift the tape from the head. Random signal variations result causing amplitude modulation of the signal. The sidebands of this modulation are heard as noise.

Non-uniformity in the size and shape of the magnetic particles, in their crystalline structure and in their interaction with adjacent particles produces localised variations in remanance and coercivity. Thus each is left in a slightly different magnetic state irrespective of the applied signal waveform. The result is noise.

All these causes of noise have been reduced by developments and improved manufacturing techniques over the years until with present high quality tapes they have been reduced to levels that would have been a cause of wonderment a decade or so ago. Often now, the recorder's erase, bias and playback circuits produce much more noise than the tape.

This has produced a situation where noise reduction circuits are virtually redundant. Originally they were essential to combat the high noise levels then experienced, but there were always snags. Inevitably, any complex signal processing produces distortion, and to this was added "noise pumping", the audible variations of noise with signal level.

Circuits have to be carefully set up so that recording and playback sections exactly mirrored each other, and any missetting produced even more distortion. It is with some relief then, that now the noise reduction circuits can be thrown out or left switched off.

Of course, tape noise has not disappeared altogether, and a tape that is grossly under-recorded will still sound noisy. So the need to maintain a good recording level with the peaks coming to just below 0dB remains. To be unobtrusive, noise should be at least 10dB below the level of the quietest sound. In practice then, the usable dynamic range is from 0dB down to 10dB above noise level.

The loudest volume generated by a large orchestra as heard from a good seat in a concert hall has been measured at 86dB, while the quietest was 45dB. The dynamic range was thus 41dB. A large choral work with full choir can generate up to 94dB so giving a range of 49dB. Compression is applied to broadcast music, so recordings made from the radio would have a smaller range than these.

Frequency Response

The quoted frequency response will not be the one you obtain. As we have seen, the response depends on the bias and also the head gap, so the type of machine will greatly affect results. In addition h.f. response depends on the recording level; it is reduced as the level increases due to the fringe field and other losses.

As a result, the response often quoted by the makers is that obtained at a level of −20dB. Now we can accept them giving us a distortion level specification taken at −3dB, but a −20dB level is well below average, and its use as a measuring standard is really rather naughty. The h.f. response you actually get will therefore be well below the quoted figure. However, it can serve to compare the response of different tapes.

MOL

The term MOL has nothing to do with a gangster's girlfriend! It means Maximum Output Level, sometimes called MML, Maximum Modulation Level. It is the maximum level you can record for a given amount of distortion which is usually 3 per cent, but sometimes 5 per cent. The rating is in dB and two figures are often given, one for high and another for medium frequencies.

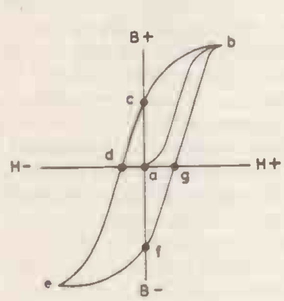
The high frequency is 10kHz at which the MOL is usually quoted for saturation point. This may seem unrealistic as the distortion at saturation is very high and no one records at that level. Actually though, harmonic distortion is low at high frequencies near the limit of the frequency range.

The reason is simple. Harmonic distortion consists of spurious harmonics at two, three, four times the fundamental frequency and so on. So at 10kHz, the second harmonic is at 20kHz and the third at 30kHz which is the principal one for tape recording. These are well outside the recordable limits so, at 10kHz, no harmonic distortion can be actually recorded.

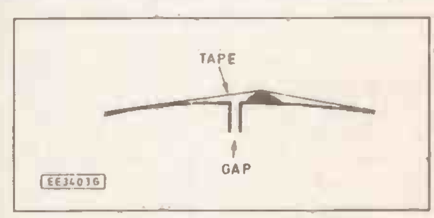
Print-through

Print-through is the transference of a recording to adjacent layers thereby producing echo or pre-echo. It is more likely to occur when a tape has been wound without playing or winding on for a long period. It could thus be a problem with archive material. The specification is given in dBs and is the ratio of the level of the original recording to that of the transferred one.

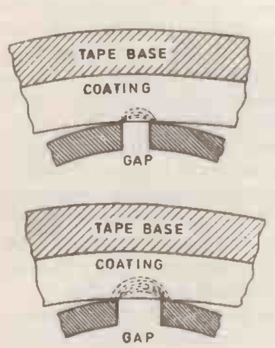
TECHNIQUES AND PROBLEMS OF MAGNETIC RECORDING



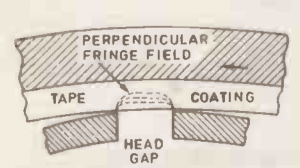
Hysteresis loop. After initial magnetization a-b,the flux falls from saturation when field is removed b-c, then requires a reverse field to restore it to zero, c-d; further applied reverse field builds up to satration point e; then a removal causes drop e-f. A forward field now reduces the flux to zero, f-g; whereupon increased forward field raises the flux to forward saturation, g-b.



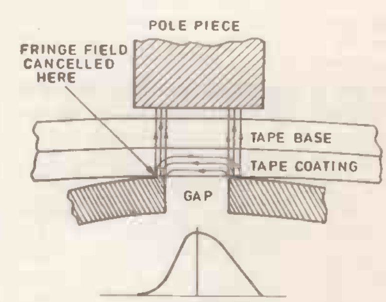
'Tenting' effect. A blob of dirt holds the tape off from the gap producing low-level recordings, and loss of field from short magnetic zones (high frequencies) during playback.



A wide recording head gap produces a field that penetrates deeper into the tape coating than a narrow one because the radius of the field is proportional to it.



The perpendicular field at the trailing edge tries to change the longitudinal magnetic orientation achieved in the gap. Short magnetic zones are more affected than long ones, so short-wavelength high-frequencies are partly erased while long-wavelengths are unaffected.



Crossfield bias. An auxiliary signal field established between the head and a pole piece behind the tape. The direction of the flux reinforces the head flux at the leading edge but cancels it at the trailing edge. This eliminates the perpendicular field and so permits higher frequencies to be recorded. The assymetrical flux distortion accross the gap is shown.

Early colbalt doped tapes were prone to it, but improved methods which give even distribution of the dopant, have largely overcome the problem. Magnetic particle size is a major factor, small particles being more easily magnetized. When particles were of random granular shape, print-through was common, but the needle-shaped or ellipsoid particles which are now generally used ofter a much higher resistance to it, especially since bead milling has reduced the incidence of particle break-up in the milling process.

All told then, print-through is not a big problem and the ordinary user can ignore it, but archive tapes should be chosen to have a low specified print-through as they may have to lie for very long periods without playing. Even so, it is good practice for them to be re-spooled occasionally.

Remanence

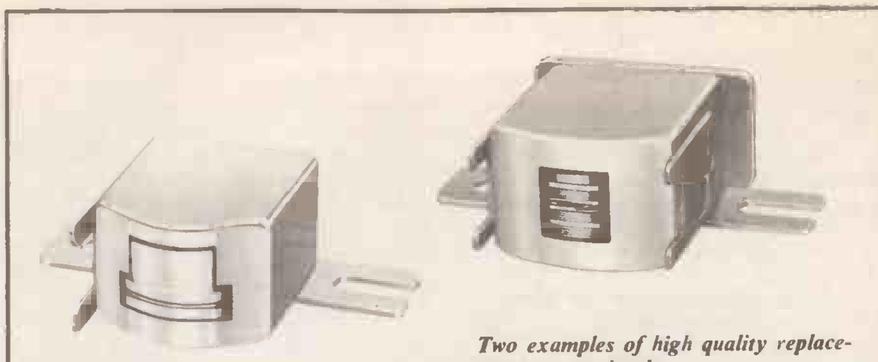
Remanence specifies the amount of magnetism remaining on the tape after the magnetizing force has been removed. It thus directly affects the sensitivity. The unit is the gauss or the milliTesla. (1 mT = 10 gauss.)

Sensitivity

Sensitivity figures stipulate the output at various frequencies that is obtained for a specified recording level which is generally −20dB. This is 25nWb/m, and the frequencies generally used ar 315Hz, 3150Hz, 10kHz and 16kHz.

Usually, most tape users buy a tape that they have previously found to give good results on their recorder. This is not at all a bad criterion, in fact it is the best as it is the results that really matter.

A tape that gives excellent results on one machine may give poor results on another, while a tape that seemed disappointing on the first recorder may sound well on the second. While there are good and bad tapes on the market, it is not always that one tape is better than another, but that the machine has been set up to suit that tape.



Two examples of high quality replacement cassette heads.
(Courtesy of Hart Electronic Kits.)

If then you find a tape that suits your machine, it is as well to stick to it, although sometimes the trial of another make can bring a pleasant surprise.

We will now deal with the four groups of tape and their subdivisions. It is a knowledge of these that really offers the best prospect of upgrading.

TAPE GROUPS

As we have just seen tape characteristics vary considerably according to the factors governing the magnetic properties of the coating. To produce a degree of uniformity enabling different brands to be used with not too great a difference in performance, coatings are classified into four main groups, with the first in particular, having sub-divisions.

Group One – Ferric

Group one tape consists of ferric types having 120μS equalization. It is the most common group and a cassette can be assumed to be group one unless otherwise stated. Pre-recorded musicassettes are made on this type although usually to a special formulation.

There are three basic grades. The lowest appears under various descriptions including *standard*, *dynamic*, *ferric*, and *low-noise*. Within this grade though there can be considerable differences which can be loosely related to price.

Some cheap unknown brands sold on market stalls have low remanence which means that the resulting recording is of low volume when played back. Tape noise tends to be high, and as playback volume must be well advanced because of the low recorded level, the noise is further increased. Frequency response is also poor.

These tapes are probably satisfactory for audio note taking or dictation, but little else. Having said that, sometimes a cheap brand turns up that is surprisingly good although not in the same class as the reputable ones. The snag is that another sample of the same brand may be bad, so there is no consistency and it cannot be relied on.

Turning to the well-known reputable names such as Sony (my personal favourite), excellent results can be obtained from even the standard grade. The fact is that over the years the performance of most reputable brands have improved so much that now better results can be obtained from their lowest grade than were available from their top grades of a decade or so ago.

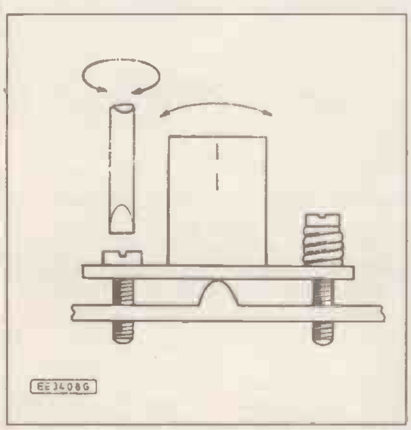
One visible improvement is in the almost mirror-like smoothness of the playing surface compared to the matt finish of a few years ago. Apart from reduced head-wear, this produces less flutter (the distortion caused by snatch-and-drag effects of the tape sticking to the head or pressure pad), a generally smoother flow, and minimal asperity noise.

Another area of improvement is in the mechanics of the cassette, which is noticeable during fast winding. Nowadays this is accomplished silently and smoothly, but at one time and indeed still is with the cheapy cassettes, was carried out with much noise, rattling, and slowing down.

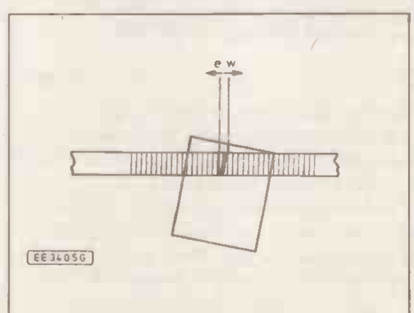
This improvement reduces the possibility of wow, the short-term cyclic speed variations at one time common, but now rarely heard. Also it eliminates long-term speed changes, with the tape slowing down towards the end when the take-up spool is nearly full.

It is certainly a waste of money to use a

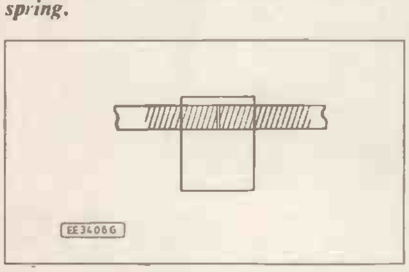
TAPE HEAD ALIGNMENT



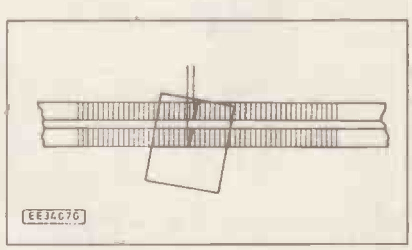
Azimuth is adjusted by rocking the head over a central pivot against the tension of a spring.



Incorrect azimuth. The gap of the tilted head spans more than one vertical recorded zone thereby increaing its effective width (e.w.), so reducing resolution and losing high frequencies.



A tape recorded with an incorrect azimuth head has slanting magnetic zones and so results in high frequency loss when played with a head that is correct. There is no loss when played with the same head that recorded it.



Playback with a stereo head of incorrect azimuth not only suffers loss of h.f., but has one channel lagging in time behind the other, so producing phase errors between channels and thereby impaired stereo.

higher grade in a portable tape recorder, car player, or average music centre. The standard grade of a good brand is more than adequate.

Though characteristics vary between makes, typical parameters for this grade are: coercivity, 380 oersteds; remanence, 140mT.

Microferric

The next grade in group one is often termed *microferric*, because it uses smaller more densely packed particles. Coercivity is the same as for the standard grade, but remanence is higher at around 160mT. This increases sensitivity by about 1dB over most of the curve, rising to over 2dB at the h.f. end. MOL (maximum output level) is also some 2dB higher.

Though technically better, there is little audible difference between this grade and the standard. The slight increase in sensitivity means a slightly lower playback volume setting is required. There is marginally less noise although in most cases this will not be noticed except at high volume levels.

One factor to note is that "print-through" tends to be worse by some 3dB to 6dB than for standard tapes. This grade should not therefore be used for archive recordings or any that will be dormant for long periods.

High Energy

The top grade in group one is frequently described as the *high energy* type. These usually have some additive such as cobalt to the coating. The coating is not heavily doped for this group as it would then have a high coercivity, requiring higher recording, bias, and erase current levels, as well as different equalizing characteristics. It would then not be compatible with other group one tapes.

Actual coercivity is about the same as for the lower grades, and the remanence is around 175mT. Sensitivity is some 2dB greater than standard tape, rising to 3dB at the h.f. end. MOL is about 4dB higher.

Noise is about the same as for the microferric grade, but the higher MOL gives a better signal/noise ratio. The greatest benefit from these improvements will be obtained when used on hi-fi systems at high volume levels.

Group Two – Chromium Dioxide

Group two originally described CrO_2 (chromium dioxide) coatings. While magnetically little different from gamma ferric oxide, a form having tetragonal lattice was produced using a hydrothermal process. This gave particles of more uniform shape which resulted in a superior h.f. response.

Consequently, CrO_2 tape needs less h.f. equalizing boost on playback than group one, namely 70µS, and it is applied higher up the frequency range, at 2·2kHz instead of 1·2kHz. Thus noise is also reduced, but some 3dB extra recording level is required.

With early chrome tape low-frequency response was poor, but the principal objection was that of high head wear. This was strenuously denied by one of the main manufacturers, BASF, and improvements on both counts were made. However, the mud stuck, and chrome fell from favour.

Its demise was hastened by the appearance of ferric tapes with a higher cobalt doping than used for the high energy group one tapes. These have a similar coercivity to chrome of around 650 oersteds, and the same equalizing characteristics. They are intended for use with the recorder set to the "chrome" position, and give similar results but without the previously mentioned drawbacks of chrome.

The noise level of group two tapes is around 3dB – 5dB less than group one, this mainly being due to the smaller amount of treble boost, but this is partly offset by the lower MOL which is some 2dB down on comparable group one formulations.

Early cobalt doped tapes suffered from print-through due to uneven distribution of the dopant. The use of epitaxial oxides in which the cobalt is diffused into the surface area of the oxide particles seems to have improved matters. However, the possibility should be kept in mind when choosing tapes for archive purposes.

Group Three – Ferrochrome

Ferrochrome (group three) has virtually disappeared. It consisted of tape having a ferrochrome coating, that is a dual layer of ferric particles topped by one of chromium dioxide.

The purpose was to overcome the poor low-frequency performance of chrome. Long low-frequency magnetizing flux lines penetrate further into the tape coating than short high-frequency flux ones. Thus the low frequencies were recorded by the deeper ferric layer as with normal tape, while the h.f. was recorded on the top chrome layer.

The result was a tape giving the best of both worlds, but the abrasiveness of the upper chrome layer remained to accelerate head wear. With the disappearance of chrome tape and the dominance of group two with cobalt, the necessity for double layers has disappeared.

Group Four – Metal

Pure metal tape forms group four. It must be virtually the ultimate in tape coatings and with it, it seems that magnetic recording has gone full circle.

In the original wire recorders, the recording was made on steel wire which was stored on one reel and paid out to another. The transport mechanism not only had to drive the reels, and move the wire through a notch in the record head, but also layer it neatly up and down the take-up reel.

The wire tended to be springy and if any slipped off the reel, it was almost impossible to disentangle and wind it back on by hand. There was no question of editing by cutting and inserting as can be done so easily with tape. It was also heavy.

Although greatly superior to the tape then available as a recording medium, wire lost out to it mainly because of inconvenience of handling and cost. Just as well it did, because as we have seen, tape ha since steadily progressed to be the highly developed and effective medium it now is, and we are virtually back to the ultimate medium magnetically, with metal tape.

As to the obvious question as to why hasn't it been done before, the tiny particles oxidize almost immediately on exposure to air, sometimes explosively. So every one must be coated to protect it.

Typical characteristics of metal tape are: coercivity, 1100 oersteds; remanence 330mT. An equalization of 70µS, the same as group two is used. The h.f. MOL is some 4dB – 10dB higher than the highest non-metal tape and there is a better balance between the low and high frequencies.

Bias some 3dB – 6dB higher than group two is required and also higher erase currents are required to completely wipe the tape. Thus it can be seen that they cannot be successfully used on any machine not designed for them.

They are also rather expensive, and heavy. So in view of the excellent results obtained with the other groups, it is questionable whether the technical improvement of metal tape is really worth it at present, other than for special applications such as video camcorder tape.

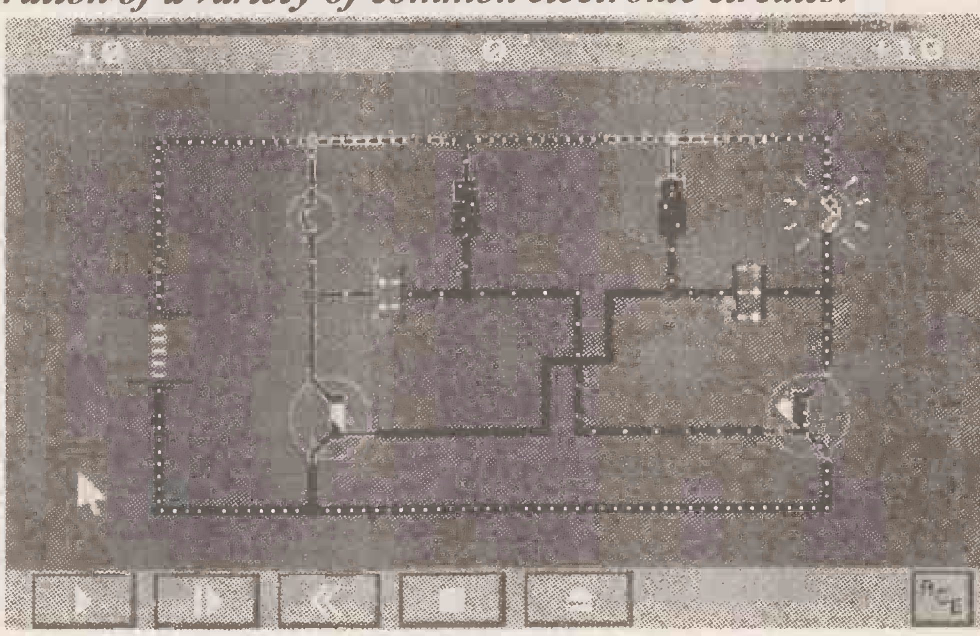
Some metal tapes have been produced to work in the group two category. These have lower remanence and coercivity than group four metal, but have a higher MOL than non-metal group two types. Thus they afford some of the advantages of metal tape to users of decks without the metal facility.

Over this series on *Magnetic Recording* we have explored a considerable area from basic magnetic theory to modern recording tape manufacture and its characteristics. It is hoped that readers who have followed it will not only have found it interesting but that it has enhanced their practical knowledge of recording tape and all things magnetic. □

The next step – the Philips Digital Compact Cassette (DCC).

ANIMATED CIRCUITS FOR ELETRONICS

Mike Tooley emerges briefly from the classroom to investigate a novel software package which uses computer animation to illustrate the operation of a variety of common electronic circuits.



The astable multivibrator simulation. The dots show the magnitude and flow of current while the colour of each part of the circuit indicates voltage potential.

Six months, or so, ago I spent some considerable time explaining (in great detail) the operation of an astable multivibrator to a group of second year BTEC students. The point which several students found most difficult to comprehend was the fact that the base voltage is driven negative for part of the time. After all, how was it possible to have a negative voltage at the base of the transistor when the circuit was only supplied with a positive voltage?

After much debate and several hastily drawn circuits showing the path of current and magnitude of voltage within the circuit at various points in the cycle, I seemed to have all but the most doubting (and, as luck would have it, also the most vociferous) members of the class convinced.

At that point, I decided to press home my advantage and enlist the services of some visual aids. After a quick dash down to the lab two floors below, I was able to obtain the appropriate circuit board, power supply and oscilloscope.

Some fifteen or twenty minutes later, after battling with a mains lead that was too short and a 'scope that refused to trigger, I had very nearly convinced everyone in the group when it became clear that, in the students' minds, the need for a coffee break far exceeded the need to understand this particular electronic puzzle. Upon this realisation, I gave in gracefully (if a little grudgingly) and returned to my office to lick my wounds and generally feel sorry for myself!

More recently, with the arrival of Animated Circuits for Education, I have discovered the ideal solution to this and similar problems. After all, what could be better than an animated circuit diagram which uses colour and motion to bring a circuit diagram to life?

Animated circuits

Animated Circuits for Education (ACE) is a completely new concept in the teaching of electricity and electronics. It combines simulation with animation to produce animated circuit diagrams. Colour shows voltage whilst dot motion shows current flow. The result is an easily comprehensible view of circuit operation.

What makes this even more exciting in comparison with conventional visual aids based on transparencies, 35mm slides, film and video is that the ACE software package is fully interactive. The user can operate the switches and adjust the variable potentiometers by simply pointing the mouse and clicking.

Animated Circuits includes 78 basic circuits. Topics covered include conductors and insulators, series and parallel circuits, measuring voltage current and resistance, fuses, variable resistors and potentiometers, current-voltage characteristics, internal resistance, capacitors, diodes and rectification, and basic transistor circuits.

Further circuit packs are currently under development and Ace Technologies can also develop sets of circuits to individual requirements for those who may find the 78 basic circuits insufficient for their needs.

Hardware requirements

It has to be stated at the outset that Animated Circuits for Electronics requires some reasonably powerful hardware. Indeed, equipment to this specification may well not be available in *every* classroom or laboratory!

As a minimum, Animated Circuits requires an IBM PC compatible with an 80286, 80386 or 80486 CPU and a minimum of 640Kbytes of RAM. The system should support VGA graphics and have a hard disk with at least 3MB of free space. The system must also have a Microsoft compatible mouse, appropriate MOUSE.COM software driver and a colour VGA (or SVGA) monitor.

Unfortunately (and despite the fact that competition is very rapidly forcing the price of 386 and 486 based systems down) someone investing in a system with this sort of specification would receive very little change from £1000 (even with educational discount). It must be evident that *many* schools and colleges have older equipment (XT and AT compatibles) and these will not run the Animated Circuits package unless they are suitably upgraded.

Installation

I must confess to having a little difficulty with the installation routine. Indeed, I failed at the very first hurdle as the large hard disk fitted to my 80386SX system just didn't have the space required to accommodate the programme (it always pays to read the manual **first**). After hastily pruning some 3Mbyte of unwanted .BAK files I was back in business and more than able to make up for my false start.

The next problem arose when I decided to delete the installed program and files and transfer the software to a newly acquired '486 machine. Once again I neglected to read the manual and, as a consequence, immediately fell foul of the copy protection mechanism (this requires that the installed software is properly removed and not simply deleted).

Copy protection

Animated Circuits is copy protected such that it is not possible to install the software on more than one machine. To quote the manual: "You have bought a licence to use the software on a single machine; you do not own the software."

When the time comes to transfer the package to another microcomputer, it must be removed using the REMOVE utility program which restores a copy protection token on the original master disk. Failure to observe this requirement (i.e. to restore the token) renders the master disk unusable - ***you have been warned!***

It is not clear whether ACE Technologies would grant a site licence so that the software could be used on several machines at a particular location. In larger educational establishments this could be worth thinking about.

In use

I put the ACE package to the test over a period of about six weeks. It took next to no time to get to grips with the package and its highly intuitive user interface proved to be exceptionally straightforward. The mouse and VCR-style controls make it a dream to use (anyone who has used the popular Superbase database package will be familiar with this notion).

After selecting the required circuit from an initial menu screen, the circuit is displayed in large scale on the screen complete with a coloured voltage scale (calibrated over the range −10V to +10V) at the top and a strip of VCR-style controls along the bottom edge of the screen.

Where more positive potentials exist, the respective conductors are coloured red. Where more negative potentials are present, these are indicated in green. The colour transition between negative and positive is reasonably gradual and it is easy to identify points in a circuit where the voltage is subject to change and roughly by how much.

Current flow is indicated by moving dots. It should be noted that these dots indicate the conventional flow of current and not the flow of electrons. The magnitidue of the current is indicated by the relative density of the dots (more dots per unit length indicates greater current). The direction and magnitude of current flow is thus easy to ascertain.

The simulation includes several very nice touches which indicate that the developers know what they are doing. Magnetic fields build up slowly, fuses take time to rupture, positive charge carriers "trickle" through resistors impeded by a series of internal baffles, voltmeter needles respond to minor fluctuations in voltage, transistors are shown with internal valves opening and shutting according to the applied base current.

All of this is very graphic and accurate. Indeed, I could only find two tiny flaws in the operation of the simulated circuits (in one case a forward biased diode appeared to have a considerable voltage developed across it, whilst in the other an ammeter needle did not respond to the peak of current which occurs when a reservoir capacitor is "topped up" by a full-wave rectifier).

It is perhaps worth mentioning the simulations which I felt were quite outstanding in getting over some difficult to grasp concepts. One of these was none other than the dreaded astable multivibrator mentioned earlier. The other was an L-C tuned circuit which very effectively showed the way in which energy is transferred alternately between the two components with current oscillating and gradually decaying. This simulation could drive home the fundamental principles of oscillation in minutes rather than hours. Well done ACE Technologies!

In the classroom

Whilst the software was in my possession, I took the opportunity to show Animated Circuits for Electronics to several colleagues and also to a number of students. The general consensus of opinion was that the package could be extremely useful though several of the teachers indicated that they would still be reluctant to abandon their handouts and overhead transparencies in favour of "mere" animated software.

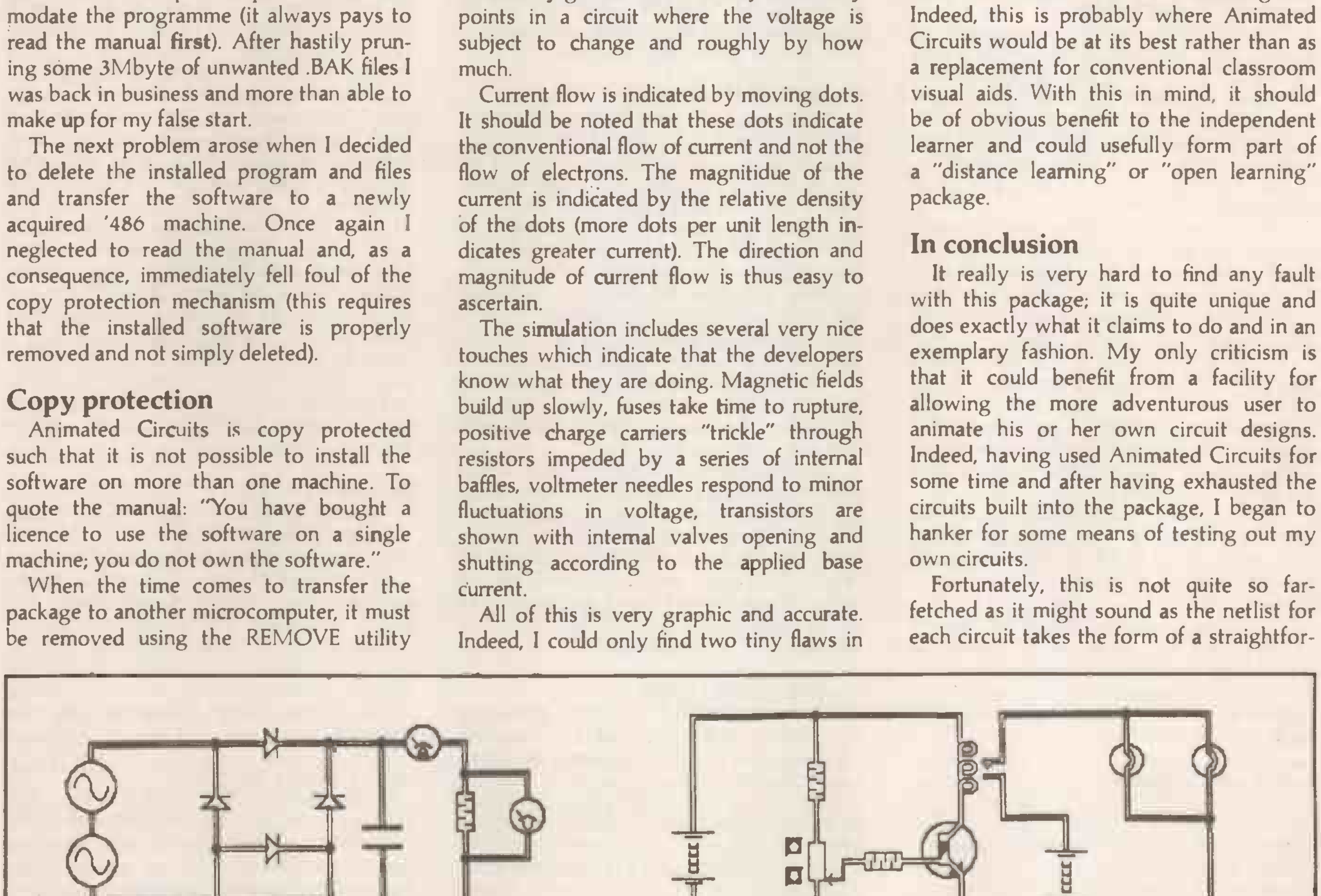
Most people felt that the package would be more useful when used by an individual than when used as a class teaching aid. Indeed, this is probably where Animated Circuits would be at its best rather than as a replacement for conventional classroom visual aids. With this in mind, it should be of obvious benefit to the independent learner and could usefully form part of a "distance learning" or "open learning" package.

In conclusion

It really is very hard to find any fault with this package; it is quite unique and does exactly what it claims to do and in an exemplary fashion. My only criticism is that it could benefit from a facility for allowing the more adventurous user to animate his or her own circuit designs. Indeed, having used Animated Circuits for some time and after having exhausted the circuits built into the package, I began to hanker for some means of testing out my own circuits.

Fortunately, this is not quite so far-fetched as it might sound as the netlist for each circuit takes the form of a straightforward ASCII file. Having made this discovery, I must confess that I couldn't resist the temptation to "have a go"! As an experiment, I tried editing one of the netlist files in order to substitute some of my own circuitry. After one or two false starts and much to my delight, this worked well and I was duly rewarded with a fully animated version of my creation. Ace Technologies are apparently giving this some consideration and it is possible that such a facility may be incorporated into a future version of the software.

Animated Circuits for Electronics is available from Latcenter Electronics, 14 Mariner's Drive, Bradford, BD9 4JT. Tel: 0274 542868. Fax: 0274 481078. The package costs £199 plus VAT.



Two of the basic circuits. These are for diodes and rectifiers, and transistor circuits.

REPORTING AMATEUR RADIO

Tony Smith G4FAI

LISTENING ON VHF

I have previously mentioned that by using a 2m converter it is possible to listen to amateur v.h.f. transmissions on an h.f. receiver. Such a converter can be made as a home construction project or purchased commercially.

The converter has three sections, a tuned radio frequency amplifier covering 144MHz to 146MHz; a crystal oscillator providing a signal at 116MHz; and a mixer stage which combines an incoming signal at v.h.f., for example 145MHz, with the oscillator's signal at 116MHz, to produce an output at the difference frequency of 29MHz.

This output is fed to the antenna socket of an h.f. receiver tuned to 29MHz to receive the 145MHz signal. The amateur two metre band of 144-146MHz can then be tuned over the 28-30MHz range of the receiver.

A shortwave receiver which covers 28-30MHz, especially one with an s.s.b. facility, should receive many of the transmissions available quite satisfactorily, but a purpose built communications receiver would obviously be better for serious listening.

A directional multi-element antenna as high as possible is needed if distant signals are to be received. Again this can be home-made or purchased commercially.

There also needs to be some means of rotating the antenna. Commercial electrically powered rotators are available but sometimes it is possible to devise a means to turn the antenna by hand.

LOFT ANTENNAS

The width of an antenna for 2m is relatively small. A basic dipole is 1m wide, and if a quad antenna is used the square section is only 50cm across. Accordingly, a rotatable loft installation is often feasible, especially in a tall house or one located on high ground. For local signals a simple omni-directional vertical antenna will usually suffice.

The setup can be tested by tuning to a continuously transmitting beacon, such as GB3VHF at Wrotham on 144·925MHz, which should appear on the h.f. receiver as 28·925MHz. The transmissions are in Morse but all it sends is its callsign followed by a continuous tone for a short period sufficient to tune in properly for frequency checking.

Preferably, all signals heard should be recorded in a logbook. It will be noted that signals from a distant beacon vary in strength from time to time, and if the receiver has a signal strength meter (S-meter) it will be possible to record the strength of the signals on a scale ranging from one to nine, with the variations noted representing changes in propagation conditions.

Various modes can be heard on the band, including f.m. (frequency modulation), s.s.b. (single sideband), and c.w. (Morse), plus various strange noises representing amateur T.V., fax, r.t.t.y., AMTOR, packet, and so on. Local, and not so local, amateurs will be heard working through repeaters on fixed frequencies, and other contacts will be heard in particular segments of the band reserved by gentleman's agreement (the "bandplan" – see Table 1) for particular modes.

VARIED ACTIVITIES

Although v.h.f. is conventionally considered to provide "line of sight" communications, stations will sometimes be heard many hundreds of miles away. These "lift" conditions create extra activity and excitement on the band and are caused by various factors which I will return to in a later column.

Other activities or events to be heard from time to time include satellite communications, moonbounce, auroral and meteor scatter propagation, RAYNET emergency communications, contests, news bulletins, and "nets" of clubs, etc, gathering together for regular "meetings on the air".

Of course these notes can only touch briefly on what, for some operators, is an all-absorbing branch of amateur radio. Last October I reviewed Ian Poole's book *An Introduction to VHF/UHF for Radio Amateurs"* (available from the *EE Direct Book Service*), and this continues to be one of the best introductions to the subject for beginners.

CABLE PROBLEMS

Many holes and trenches appeared recently in the roads of my locality, causing much inconvenience to both residents and passing traffic. Trenches were then cut through the pavements up to the boundary line of every dwelling. We were asked to be tolerant of the inconvenience because it was all for our own good. Cable TV had come to town!

What has this to do with amateur radio? Hopefully, nothing, but there have been problems elsewhere. In some countries the signals passing through the cables are on frequencies allocated exclusively for amatuer radio use. The cable TV operators claim that their system is totally shielded so that cable signals cannot be picked up by amateur radio receivers and, conversely, amateur signals cannot be picked up by their cables and superimposed on their TV programmes.

Unfortunately, low quality cables and coaxial connectors have sometimes been used for the lines branching off to consumers and these have not always provided the required level of protection. The result has been interference both ways even when the amateur stations concerned have been operating perfectly legally and correctly within the regulations.

I wondered why we were having this flurry of activity when I read some time ago, in the *W5YI Report*, that in the States things did not look good for the future of cable thanks to the advent of new systems such as "wireless cable". This apparently broadcasts cable programming from a microwave tower to housetop antennas without the need to dig up entire localities and run cables into individual houses.

MORE NOVICES

In the September 1991 Novice Radio Amateur's Examination, set by the City & Guilds of London Institute, 151 out of 186 candidates were successful, representing a pass rate of 80·3 per cent. For those interested in this new route into amateur radio, a free Beginner's Pack, giving full details, is obtainable from the Radio Society of Great Britain, Lambda House, Cranborne Road, Potters bar EN6 3JE.

WELL DONE COMET!

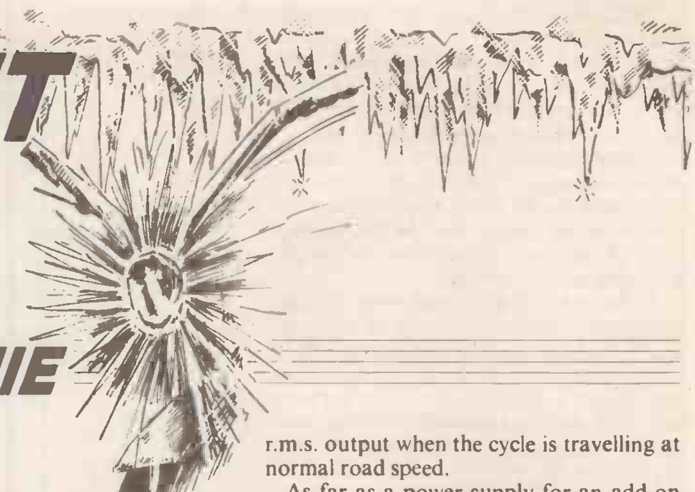
I reported recently that a reader was having difficulty in getting his Sangean ATS 803A world band receiver repaired by Comet Group PLC as spares were running out for this discontinued model. As a result of the enquiries made by this column on our reader's behalf, I am happy to report that Comet have come up trumps after all. They have located the necessary components and repaired the set, apparently free of charge, even providing a full complement of batteries. Result, one very satisfied EE reader!

Table 1: 2 Metre Bandplan

144·000MHz	–	144·150MHz	c.w. only
144·000	–	144·025	moonbounce
144·100			meteor scatter (c.w.)
144·150	–	144·500	s.s.b. and c.w.
144·400			meteor scatter (s.s.b.)
144·500	–	144·845	all modes
144·500			slow scan TV calling frequency
144·600			RTTY
144·675			data modes calling frequency
144·700			fax calling frequency
144·750			amateur TV calling and talkback
144·845	–	144·990	beacons
145·000	–	145·800	f.m. simplex and repeaters
145·800	–	146·000	satellites

Constructional Project

CYCLE LIGHT BACK-UP



T. R. de VAUX-BALBIRNIE

Be safe – be seen!

ANYONE who regularly rides a bicycle at night will know that cycle lamp batteries are a very expensive way of obtaining energy. One way of reducing costs is to use a dynamo lighting set but here the brightness of the lights is speed dependent.

At normal road speed they give good light. Unfortunately, they go off or become dim at times when you need to be most conspicuous – when stopped at a junction, for example, and this can be extremely dangerous.

BASIC OPERATION

On the other hand, a dynamo provides free energy and avoids the high cost of batteries. This circuit is a hybrid design which uses a dynamo to provide power while the output is sufficient, but switches over to battery operation when it falls below a certain level.

A pack of four "C" size alkaline cells are used for the back-up supply. These will last for a long time because they have only light duty use. The battery pack is housed in an aluminium or plastic box, together with the control circuitry. This box is clipped or bolted to the bicycle frame.

There is an ON-OFF switch on the unit (this is necessary to switch off the lights when the cycle is left standing). The dynamo will still operate when the circuit is switched off but, of course, there will be no back-up supply available. Note that most of the space inside the box is taken up by the battery pack. Even so, it would not be advisable to reduce the size of the unit by using smaller batteries.

The circuit is *fail safe* – in the event of the dynamo supply not working for any reason, the lights will assume *back-up* operation. In such use, the batteries should give several hours of operation.

MAKING WAVES

A bicycle dynamo is better described as an *a.c. (alternating current) generator*. In use, the rim of the tyre turns a wheel and spindle which rotates a magnet rapidly, close to a coil of copper wire wrapped on a soft-iron core. This produces the voltage which drives current through the bulb.

The value of this voltage rises and falls with the position of the magnet – that is, it performs *sine waves* (see Fig. 1a). In a complete 360 degrees, it rises to a maximum in one direction and falls to zero then repeats in the opposite direction. The number of times it does this each second is called the *frequency*.

The dynamo output is rather like the household mains supply but, of course, of a much lower average voltage – some 6V rather than 240V. Note that the word "average" is used here because the voltage is continually rising and falling and never has a steady value.

The term "r.m.s. voltage" is a better one – this is the value that a *steady* voltage would have if it produced the same effect. Thus, if the dynamo output was 6V r.m.s., a lamp connected to it would have the same brightness as when connected to a steady 6V supply such as a battery.

An a.c. supply is perfectly suitable for operating bicycle lights – at normal speeds the frequency is sufficient for there to be no noticeable flicker. However when travelling very slowly, the lamp becomes dim and flickering becomes apparent.

DYNAMO OUTPUT

The r.m.s. voltage output of a dynamo depends on several factors – chiefly the strength of the magnet, the number of turns on the coil and the speed of rotation. In a given system, these are all fixed apart from the rate of rotation of the magnet which in turn depends on the road speed. The bicycle lamp bulbs are of 6V rating and the dynamo is designed to match this with 6V r.m.s. output when the cycle is travelling at normal road speed.

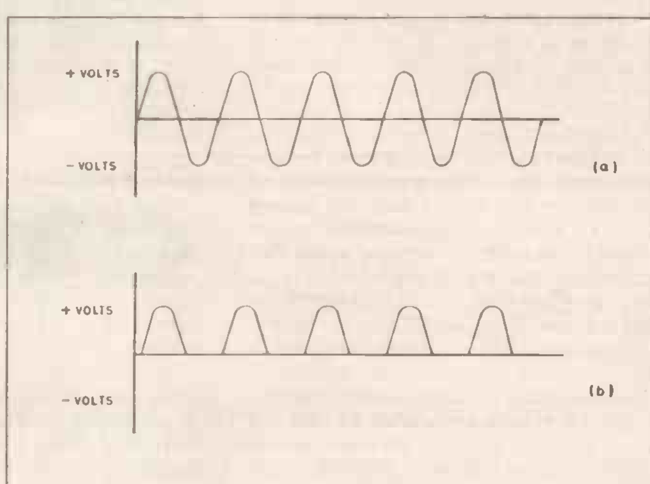


Fig. 1a. Sine wave output (a.c.) produced by the cycle dynamo.

Fig. 1b. Half-wave rectification of the a.c. sinewave by diode D1

Fig. 1c. The effect of the "fill-in" capacitor C1 on the half-wave cycle. This keeps the relay energised during dynamo operation and hence feeds the dynamo supply to the cycle lights.

As far as a power supply for an add-on circuit is concerned, the bicycle dynamo must rank as one of the most difficult to use successfully. There are a number of reasons for this. Firstly, the voltage fluctuates randomly as well as rising and falling with speed (due to variations in spindle speed on account of the poor drive arrangement on the wall of the tyre) also, the frequency varies in the same way and for the same reasons. Thirdly, and as it turns out most importantly, the off-load voltage output is markedly greater than the on-load one.

Measurements show that the typical resistance of a dynamo coil (the internal resistance) is five ohms approximately. When 500mA (the normal total operating current) flows through this resistance, Ohm's Law predicts that there will be a voltage of:

$$V = I \times R = 0{\cdot}5 \times 5 = 2{\cdot}5V$$

appearing across it.

This voltage is "lost" as far as the bulbs are concerned. Thus, the dynamo output must be some 8·5V for 6V to be applied to the bulbs. The importance of this point will be explained presently since it turns out that it causes the greatest problem.

CIRCUIT DESCRIPTION

The entire circuit for the Cycle Light Back-Up is shown in Fig. 2. Assume for the moment that the dynamo is turning at normal road speed and that the coil of relay, RLA, is energized. The normally-open contacts, (n.o.) RLA1, are therefore *closed*.

Current from the dynamo flows through these contacts and hence to the front and rear lights in the usual way. The current completes the circuit back to the dynamo through the metal frame of the bicycle and the lights operate normally.

At the same time, current flows through diode, D1, which half-wave rectifies the a.c. by allowing only the positive half-cycles through (see Fig. 1b). This charges capacitor, C1. Zener diode, D2, in conjunction with fixed resistor, R1, limit the voltage across C1 to 5·1V which is just a little higher than the relay operating voltage (6V is the nominal operating voltage but the relay cuts in at a lower voltage than this – typically 4·5V).

Capacitor C1 acts as a reservoir of electric charge which can "fill in" with current when the dynamo output falls off between half-cycles (Fig. 1c). The relay coil therefore receives current continuously and is kept energized.

When the road speed and hence the dynamo output falls, there will come a time when the voltage across C1 matches the Zener voltage and the voltage across it will now fall. The relay therefore "drops out" and the normally-closed contacts, (n.c.) close. This allows current to flow through the lamps from the back-up (battery) supply.

PROBLEM

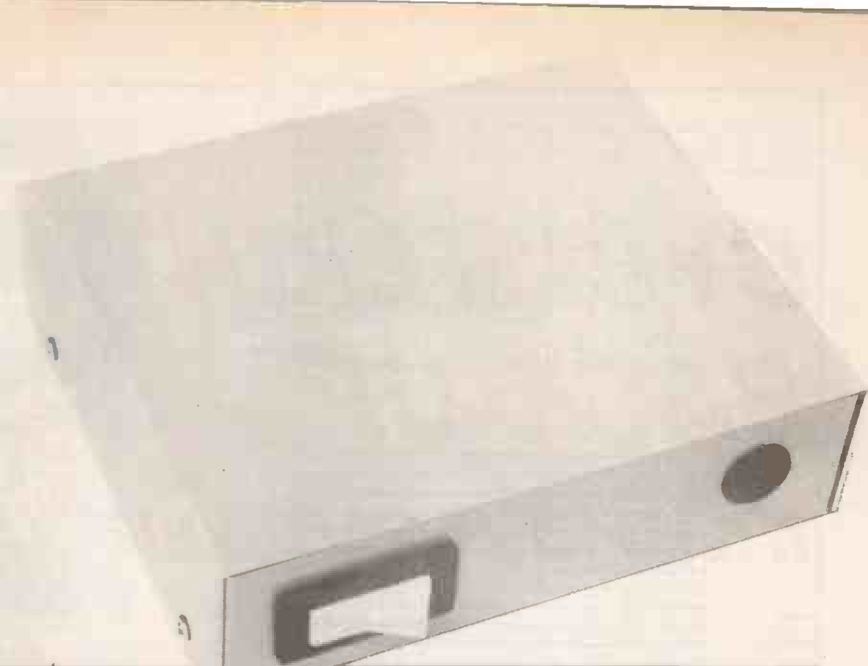
A problem occurs when the voltage across C1 falls to the switching point. At the instant of the relay operating and the bulb switching over from dynamo to back-up supply, the dynamo voltage will suddenly rise as the load is removed (as explained earlier). This could cause the relay coil to energize once again. The voltage would then fall and the cycle repeat.

The outcome would be *relay chatter* which would be a nuisance as well as causing unnecessary operation and possible early failure of the relay. Reducing this effect is the purpose of the Zener diode, D2.

While the dynamo voltage is sufficient, this "locks" the voltage across C1 to 5·1V maximum so, as the switching point is reached and the dynamo output rises, the voltage across C1 remains virtually constant and the relay is prevented from operating again. Preset VR1 acts as a "fine tuning" control of the switching point and this will be adjusted for correct operation at the end of construction.

There is a further complication which arises from the operating characteristics of relays.It is found that a relay which operates as the coil voltage approaches 5V will not switch off again until a much lower voltage (the *must release* voltage) is reached – typically between 0·5V and 1·5V. In the above simplified explanation, the lights would have to become dangerously dim before the back-up supply took over.

To overcome this problem, the value of capacitor C1 is carefully chosen. Thus, when the dynamo output cannot maintain the Zener diode and the voltage across C1 falls below 5·1V, the voltage between the peaks is allowed to fall to the *must release* voltage (Fig. 1c). This is helped by the reducing dynamo output frequency since it becomes more difficult for the capacitor to "fill in" the increasing space between successive peaks.



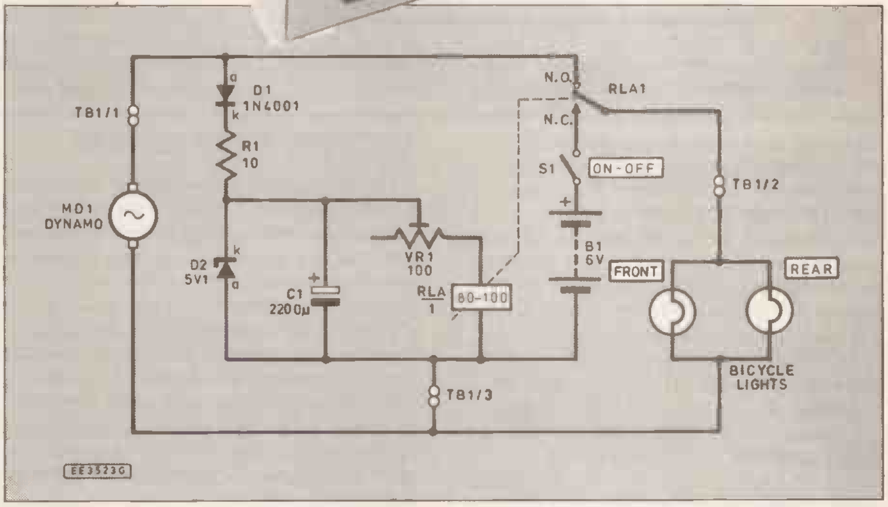


Fig. 2. Complete circuit diagram for the Cycle Light Back-Up.

The value of C1 specified in the components list give good results when used in conjunction with the specified relay. However, electrolytic capacitors have a wide tolerance range and varying the value of C1 could be the subject of experiment later if a different relay is used.

CONSTRUCTION

Note that an ordinary aluminium box was used to house the prototype unit. However, it may be necessary to use a *waterproof* metal or plastic one – it depends on the type of use it will have. It may also be necessary to waterproof the switch and the entry point for the wires into the box.

Construction of the Cycle Light Back-Up is based on a circuit panel made from a piece of 0·1 inch matrix stripboard size 12 strips x 21 holes. Fig. 3 shows full topside details and breaks required in the underside copper strips. Begin by cutting the material to size, drilling the two mounting holes and making all track breaks and the inter-strip link as indicated. Follow with the soldered on-board components.

Note that diodes, D1 and D2, also capacitor, C1, are *polarised* components and must be connected the correct way round. The specified relay fits the 0·1 inch matrix – if any other type of relay is used, some modifications may be needed. Solder

COMPONENTS

See SHOP TALK Page

Resistor
R1 10 carbon film 1W

Potentiometer
VR1 100 0·25W vertical preset

Capacitor
C1 2200µ radial elect. 16V

Semiconductors
D1 1N4001 50V 1A rectifier diode
D2 5V1 1W Zener diode

Miscellaneous
B1 "C" size alkaline cells – 4 off, plus cell holder and connector
S1 Miniature s.p.s.t. rocker, toggle or slide switch
RLA Sub-miniature relay with 100 ohm 6V coil and single-pole changeover contacts rated at 2A d.c.
TB1 3A screw terminal block – three sections required

Aluminium or plastic box, size 125mm x 105mm x 35mm approx.; 0·1in matrix stripboard, size 12 strips x 21 holes; small fixings; connecting wire; rubber grommet; solder, etc.

Approx cost guidance only **£8.50** excl. batts.

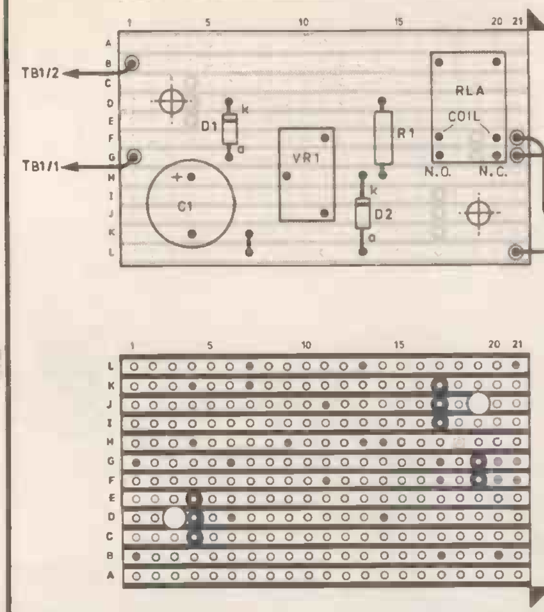
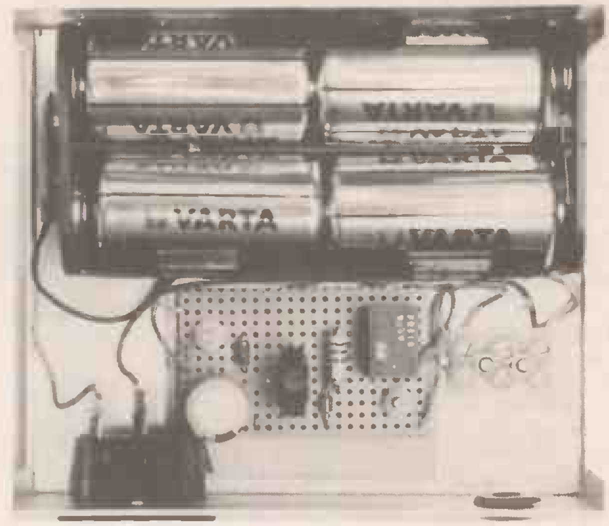


Fig. 3. Stripboard component layout and details of breaks required in the underside copper tracks.


Completed unit showing layout and wiring of components inside the metal case. Suitable clips, such as "Terry" clips, for attaching the case to the cycle frame must be fixed to one of the side panels.

10cm pieces of light-duty stranded connecting wire to copper strips *B* and *G* on the left-hand side and to strips *F, G* and *L* to the right as indicated.

Drill holes in the box for switch S1, battery pack B1, terminal block TB1 and for circuit panel mounting. Drill also a hole for the three wires which will pass through the box to TB1. Fit this hole with a rubber grommet.

Drill a hole for the spring clip or other attachment which will hold the unit in position on the bicycle frame. Mount all remaining components and, referring to Fig. 4, complete the internal wiring.

If an aluminium box is used, the circuit panel should be mounted on a piece of thick cardboard so that the soldered connections on the copper strip side cannot touch the metalwork. Note that everything is mounted in the main section of the box with nothing on the lid. This imposes least strain on the interconnecting wires.

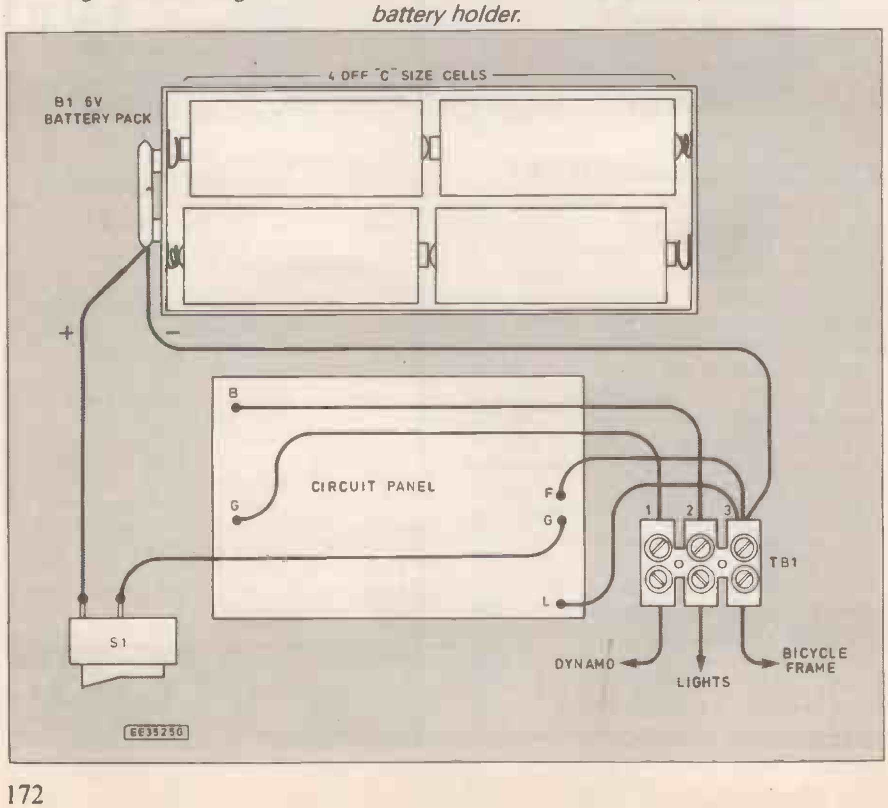
CONNECTIONS

Fit the dynamo and lights to the bicycle if they are not fitted already. Do not connect the wire leading from the dynamo terminal to the lights. Using light-duty stranded connecting wire, connect the dynamo terminal to TB1/1 on the unit.

Connect the wire leading to the lights to TB1/2 and connect TB1/3 to the bicycle frame. This connection could be made by drilling a small hole and using an eyelet secured with a self-tapping screw. Alternatively, a wire may be run to either the dynamo or a lamp casing which is already connected to the frame,

Tie a piece of string firmly or fix a strain relief bush around the wires inside the box at the point where they pass through the rubber grommet to provide strain relief. Leave preset VR1 adjusted to approximately mid-track position.

Fig. 4. Interwiring from the circuit board to the terminal block, switch and battery holder.



TESTING

Insert the batteries into their holder but leave S1 switched *off* for the moment. Engage the dynamo. Now, with the bicycle upside-down and with the help of an assistant, turn the bicycle wheel and increase the speed smoothly.

At some point, the relay should click and the lights come on. If nothing happens, adjust VR1 slightly anti-clockwise (as viewed from C1 position). Check that the cut-in happens smoothly and the relay does not chatter. Adjust VR1 for best effect – clockwise rotation raises the cut-in speed.

Now, switch S1 on. The lights should operate from the back-up supply. Turn the bicycle wheel again and check that the dynamo takes over reliably. When this happens, the relay will click and you will see a change in brightness at the switching point. If all is well, the unit may be attached permanently to the bicycle frame.

RE-CHARGEABLE

Some readers may wish to carry cost saving one step further and use *nickel-cadmium* (rechargeable) batteries for the back-up supply. This is not really advisable for the following reasons. Firstly, towards the end of their charge, the voltage of a nickel-cadmium battery, unlike a standard alkaline one, falls off quickly and this could result in sudden failure.

Ni-Cad batteries also tend to self-discharge fairly rapidly and they have a lower capacity than the alkaline variety. Another point is that four nickel cadmium cells give an output voltage of only 4·8V normal rather than 6V for alkaline ones (although this would hardly be a problem in practise).

Any reader who is determined to use nickel-cadmium batteries will need to recharge them before each trip and carry a set of alkaline ones too "just in case". Alternatively alkaline ones can be recharged using the *Dry Cell Recharger* from EE, September 1991 issue.

It only remains to give the bicycle a road test and to make any final adjustments to preset VR1. Don't be surprised if there is a slight tendency for relay chatter when the road speed dithers around the switching point. This will not happen very often and will do no harm. Happy cycling! □

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

HART AUDIO KITS give you the opportunity to build the very best engineered hifi equipment there is, designed by the leaders in their field, using the best components that are available.
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.
In short HART is your 'friend in the trade' giving you, as a knowledgeable constructor, access to better equipment at lower prices than the man in the street.
You can buy the reprints and construction manual for any kit 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.
Our list will give you fuller details of all our Audio Kits, components and special offers.

AUDIO DESIGN 80 WATT POWER AMPLIFIER.

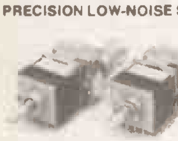
This fantastic John Linsley Hood designed amplifier is the flagship of our range, and the ideal powerhouse for your ultimate hifi system. This kit is your way to get £K performance for a few tenths of the cost!. Featured on the front cover of 'Electronics Today International' this complete stereo power 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. Options include a stereo LED power meter and a versatile passive front end giving switched inputs using ALPS precision, low-noise volume and balance controls. A new relay switched front end option also gives a tape input and output facility so 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/heatsink fitted with IEC mains input and output sockets. All the circuitry is on professional grade printed circuit boards with roller tinned finish and green solder resist on the component ident side, the power amplifiers feature an advanced double sided layout for maximum performance. All wiring in this kit is pre- terminated, ready for instant use!.

RLH11 Reprints of latest articles........£1.80
K1100CM HART Construction Manual........£4.50

LINSLEY HOOD 'SHUNT FEEDBACK' R.I.A.A. MOVING COIL & MOVING MAGNET PICKUP PREAMPLIFIER

Modern, ultimate sound systems are evolving towards a built-in RIAA preamplifier within the turntable unit, keeping noise pickup to a minimum. This new circuit by John Linsley Hood uses latest generation integrated circuits in the sonically preferred shunt feedback configuration to give an accurate and musical sound, with the ability to use both moving magnet and moving coil cartridges. Power comes from two 9v PP3 size batteries or a mains power supply. This HART kit is exceptionally easy to build with detailed instructions and all the specially selected components fitting directly on to the roller tinned fibreglass printed circuit board. Even the gold plated phono sockets mount directly on the board.
This Kit now comes with latest generation low-noise front end IC and onboard power stabilisers for any DC input voltage between 9v and 30v.
K1500 Special Discount Price for complete Kit........£67.99

ALPS PRECISION LOW-NOISE STEREO POTS.



To fulfil the need for higher quality controls we are now importing an exciting new range of precision audio pots in values to cover most quality amplifier applications. All in 2-gang stereo format, with 20mm long 6mm dia. steel shafts. 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. The improvement in track accuracy and matching really is incredible giving better tonal balance between channels and rock solid image stability. Motorised versions have 5v DC Drive motor.

2-Gang 100K Lin........£8.86
2-Gang 10K, 50K & 100K Log........£9.60
2-Gang 10K Special Balance........£10.71
2-Gang 20K Log MOTORISED........£19.20
2-Gang 10K Special Balance, MOTORISED, zero crosstalk and < 10% centre loss with near Log/Antilog Tracks)........£19.98

HIGH QUALITY REPLACEMENT CASSETTE HEADS

Do you tapes lack treble?. A worn head could be the problem. For top performance cassette recorder heads should be replaced every 1,500 hours. Fitting one of our high quality replacement heads could restore performance to better than new!. Standard inductances and mountings make fitting easy on nearly all machines (Sony are special, see below) 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.

HM120 Standard Mono R/P Head........£3.51
HC15 Standard Quality Stereo R/P Head........£2.49
HC66 High Quality Stereo R/P Head, Permalloy........£7.98
HS16 Sendust Alloy Stereo Head........£16.85
HC80 NEW RANGE High Beta Permalloy Stereo head. Modern space saver design for easy fitting and lower cost. Suitable for chrome metal and ferric tapes, truly a universal replacement head for everything from hi-fi decks to car players and at an incredible price too!........£8.30
HQ551 4-Track RECORD & Play Permalloy Head for auto-reverse car players or quadraphonic recording £14.90
H524 Standard Erase Head........£1.90
H561 Hi Field Erase Head for METAL Tapes........£3.49
HRP373 Downstream Monitor Stereo Combination Head........£47.90

Many other SPECIAL cassette Heads In stock, see our LIST.

REEL TO REEL HEADS

999R 2/4 Record/Play 110mH. Suits Stuart Tape Circuits........£13.64
998E 2/4 Erase Head 1mH. Universal Mount. Suits Stuart........£11.98

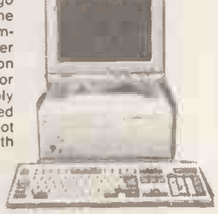
TAPE RECORDER CARE PRODUCTS

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........£4.48
DEM115 Electronic, Cassette Type, demagnetizer........£8.91

COMPUTER CORNER

The following are a selection of our new range of VERY competitively priced, High Quality, computer systems. Due to our long experience of importing we have the necessary contacts in the Far East to buy at very advantageous prices and can pass the savings on to you. All hard disc machines ordered with DOS are fully formatted and ready to use.

HART MODEL AT-286/16WP COMPUTER



Fully fledged AT286 machine, cheap enough to use as the fastest wordprocessor in the west! Only a few years ago the AT-286 machine was the fastest standard office computer known. Now we can offer the superfast 16MHz version (earlier ones were only 10 or 12MHz) at such an incredibly low price that it can be used in any office or home. Not only that but ours comes with ultrafast memory so that the machine can run in 'zero wait state'.
Advanced features are:- Full 1MB of memory (Expandable to 4MB), 102 key UK keyboard, compact desktop case, 1.2MB 5¼" High Density Disk Drive and interface card for extra drive, Graphics/Printer Card, built in Hard Disk Interface.

HART AT-286/16WP........ONLY £277.25
14" FST Hercules monitor, Amber........£83
14" Paper White Hercules Monitor. (Both have T/S Base)........£86
Trust Writer W/P Software uses Wordstar commands.£19.50

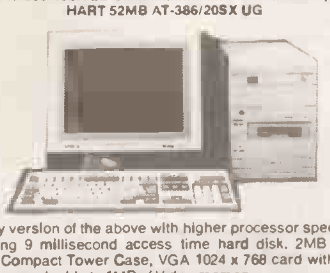
40MB AT-286/16UG Hard Disk Computer

Specification as above but with 45MB 25ms hard disk, VGA Colour Graphics Card with 512K RAM, parallel printer port, 2 serial ports, 1 game port........£523.50
14" VGA Mono Monitor, Amber £86.70 Paper White £89

HART 40MB AT-386/16SX EL

Entry level 386 machine for demanding applications at moderate cost. Spec as our AT286/16WP with 1MB Dram memory, Mini Tower case, 45MB 25ms hard disk drive, VGA Colour Graphics Card with 256K RAM
40MB AT-386/16SX EL is........ONLY £634.30 (Ex Vat)

HART 52MB AT-386/20SX UG



Luxury version of the above with higher processor speed and amazing 9 millisecond access time hard disk, 2MB SIMM RAM, Compact Tower Case, VGA 1024 x 768 card with 512K RAM, upgradeable to 1MB of Video memory.
40MB AT-386/20SX UG........ONLY £853.10

OPTIONAL EXTRAS

HART Computers can be 'custom made' to fit your personal requirements, at NO extra cost!. Simply select the options you require. If replacing any item in the standard specification for that model then deduct the cost of the part not needed.

SOFTWARE

MS-DOS 5 Latest Release. Full version. 3.5" or 5.25"........£59
DR DOS 6........£77
Microsoft Windows 3. 3.5" or 5.25" Disks........£65

MONITORS

SM1421 AM TU Hercules Mono with FST Tube and Stand, Amber........£83
SM1421 PW TU As Above but Paper White Screen........£86
SM1416A VGA Mono Monitor c/w tilt and swivel stand, Amber........£86.70
SM1416W As Above, Paper white........£89
SM1485-00 Super VGA Multisync Colour Monitor, ·28" dot pitch, 50MHz Bandwidth, up to 1024 x 768, c/w stand........£235

KEYBOARDS

K261 102 Key Enhanced UK Layout. Tactile Click, AT/XT Switchable with dual slope feet.(Standard Keyboard supplied with systems)........£31
K108 Similar to above, single slope feet, Alps switches........£36
KB6153A As above but with heavy metal base........£44

I/O and GRAPHIC CARDS

AT Super I/O Card 2 x FDD, IxIDE, 2 Serial, 1 Parallel, 1 Game Ports........£21.20
Hercules Mono Graphic & Printer card........£11.70
16-Bit VGA Card, 256K........£46.50
Trident 8900 VGA Card, 512K........£67.30
Trident 8900 VGA Card with 1Mb........£86.90

DISK DRIVES

5.25" 1.2Mb Floppy Disk Drive........£49
3.5" 1.44Mb Floppy Disk Drive........£45
Adapter to fit 3.5" drive in 5.25" slot, c/w power adapter........£9
45MB 25ms Hard Disk Drive........£165
52MB Quantum Hard Disk, Lightning Fast 9ms Access time........£261

CASES

WE 611P Desktop Case, Flip Top, 200W PSU........£56.40
WE727P Mini Tower Case, 200W PSU........£84.70
108MP Mini Tower Case, Compact Style........£89
CT107 Midi Tower Case........£108

MOTHERBOARDS

AT-286/16 0K.RAM........£89
AT-386-16SX 0K.RAM........£195
AT-386-20SX 0K.RAM........£245

PLEASE NOTE THAT ALL ITEMS IN THIS SECTION ARE PRICED EX VAT.

Send or 'phone for your copy of our List (50p) of these and many other Kits & Components. Enquiries from Overseas customers are equally welcome, but PLEASE send 2 IRCs if you want a list sent surface post, or 5 for Airmail.
Ordering is easy. Just write, telephone or fax your requirements to sample the friendly and efficient HART service. Payment by cheque, cash or credit card. A telephoned or faxed order with your credit card number will get your order on its way to you THAT DAY.
Please add part cost of carriage and insurance as follows:–INLAND Orders up to £20 - £1.50
Orders over £20 - £3.50 Express Courier, next working day. £10 (For safety all computer parts are only sent by courier) OVERSEAS – Please see the ordering information with our lists.

MANUFACTURERS OF QUALITY AUDIO KITS AND COMPUTERS

24 hr. SALES LINE (0691) 652894

AUDIO KIT PRICES are VAT INCLUSIVE. COMPUTER PRICES EXCLUDE VAT

HART ELECTRONIC KITS LTD
6 PENYLAN MILL
OSWESTRY, SHROPSHIRE
SY10 9AF

ACTUALLY DOING IT!

by Robert Penfold

THIS month's *Actually Doing It* article has been written in response to a letter from a confused reader. His letter was basically a request for an explanation of screening, which is an important topic, but one that receives little attention. I suppose that it is one of those things that tends to be considered too simple to be worthy of much explanation, but which nevertheless manages to confuse many newcomers to the hobby.

STRAY COUPLING

This is not the place for a technical discussion about screening, but it is something that is easier to deal with if you understand the basic problem. This is simply one of an unwelcome electrical signal finding its way into one of your circuits. There are plenty of sources of electrical signals that can cause problems. The two most common ones are the mains supply (and appliances connected to it), and radio transmitters. The average house is awash with signals of both types.

In the case of radio transmissions, the signals are picked up by the wiring in your project which acts as a crude aerial. These signals might actually go unnoticed, but they will often cause problems. I once had a hi-fi system which over a period of time picked up Radio Sweden, Radio Moscow, The BBC World Service, and several unidentified stations. This would not be remarkable except that it happened when I was listening to the record player!

Stray coupling of signals into one of your projects can occur just as easily at audio frequencies. Two wires, even if they are some distance apart, will effectively form a low value capacitor. This capacitance can couple a signal from one wire to the other. The same two wires can also act as a very basic transformer, again providing a link from one to the other.

We are talking here about very weak and inefficient links from one wire to another, but bear in mind that electronic circuits are often dealing with minute signals. Even a millionth of a volt at the input of a sensitive audio amplifier can produce an audible output. The circuits that are most vulnerable to stray pick-up are ones which work with very small signals, very high impedance signals, or worst of all, very small and very high impedance signals.

FEEDBACK

Signals in the outside world are not the only problem. There can be stray pickup from one part of a circuit to another. In particular, there can be severe problems if there is significant stray coupling from the output to the input of an amplifier. This can easily result in the circuit breaking into oscillation.

As stray feedback occurs more readily at high frequencies, the amplifier will usually oscillate at an ultrasonic frequency, giving a tone from the speaker that is inaudible. However, the output quality will probably suffer quite noticeably, and with multi-way speakers there could well be smoke from the overloaded tweeters!

This type of stray pickup is difficult to deal with because the small size of modern electronic equipment tends to result in small distances between the input and output wiring. This makes it relatively easy for signals to make an unwanted trip from one part of the circuit to another. Screening can help, but the designer must produce a carefully worked-out layout that provides no easy paths for stray feedback.

SCREENING

Screening is basically just a layer of earthed metal between sensitive wiring and any possible sources of electrical interference. The easiest way to keep signals in the outside world away from your circuits is to house your projects in metal cases.

Diecast aluminium boxes are generally regarded as providing the best screening, but any case of all-metal construction should do the job quite well. The case should be connected to the earth rail of the circuit, which these days almost invariably means connecting it to the negative supply rail.

This earthing is often provided via sockets on the front panel without the need for any deliberate connection. For example, most jack sockets which have metal mounting bushes have these bushes in electrical contact with their earth tags. However, where necessary a connection can be made to the case via a soldertag bolted to an otherwise vacant spot on the base panel.

Soldering direct to a metal case is very difficult even if you have the right kind of solder. The bit of the iron and the solder tend to instantly "freeze" as they come into contact with the case, which acts as a large heatsink.

SCREENED LEADS

Leads that carry low level signals between devices, such as from a record deck or microphone to an amplifier, must be screened types. In some cases it is necessary for some of the leads within a project to be of the screened variety. This is sometimes to prevent stray pickup of mains "hum" from an internal mains power supply, while in other cases it is necessary to avoid stray feedback.

The most simple type of screened lead is the quaintly named "twisted pair". A cable of this type is just two insulated leads which are twisted together to produce a crude form of two way cable. One wire is connected to earth and the other carries the signal. This type of cable does not seem to be used much in practice, and I have never used this method of screening. I did once review a hi-fi amplifier which was devoid of ordinary screened cables, and instead used a number of twisted pairs. This amplifier was free from mains "hum", so it would seem to work quite well.

Normal screened cables have an inner conductor, which for audio cables is normally in the form of multi-strand wire. This is surrounded by the usual p.v.c. insulation, and this is in turn covered by a sort of mesh of wire. Finally, there is an overall sheath of plastic. In use the mesh of wire connects to earth and screens the inner conductor from electrical signals.

The wire mesh can take a number of forms. Sometimes it is woven to form a braiding, while in other cases the wires are simply laid side by side and twisted around the inner conductor and sleeving. This second method is known as lap-screening.

These are the only types of screened cable you will normally need to use, but there are other types. One you might encounter is cable which has a thin metal foil to back-up the normal braid or lapped screen, and give greater immunity to stray pickup. These days there seems to be a trend towards cables which have braiding plus a semiconducting plastic material such as metallised mylar. Like the metal foil, this is used to improve the quality of the screening.

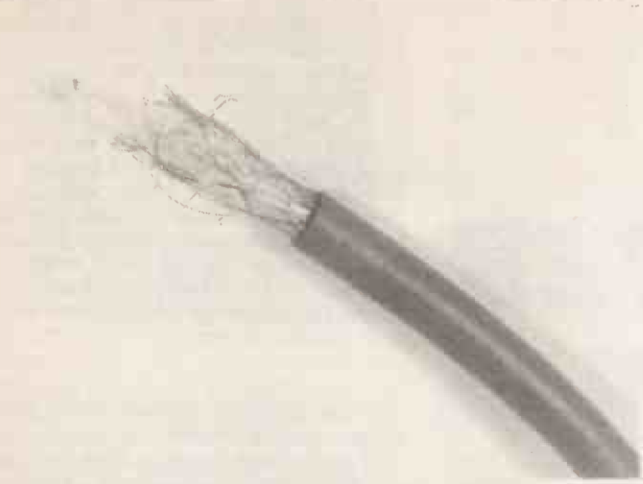
COAXIAL CABLE

There are special "coaxial" screened cables for carrying radio frequency signals. These are actually much like audio screened cables in their general make-up, but they are designed to have a certain impedance (75 ohms in the case of ordinary television aerial cable for instance). At radio frequencies the wavelengths are quite short, and there can be problems with standing waves. What this means in practice is that the source, cable, and load impedances all have to be properly matched, or a substantial percentage of the input signal will be lost in the cable.

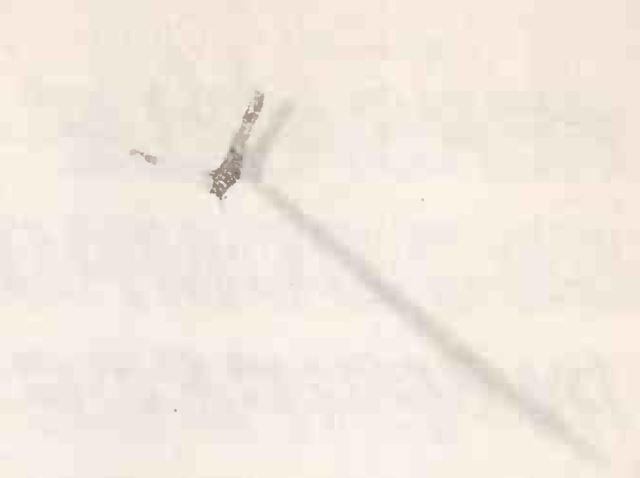
If a components list specifies that a coaxial cable of a particular impedance should be used, then it is important to do so. At audio frequencies the wavelengths are much longer, and cable impedances are not something that you have to worry about when building audio circuits. In fact for normal audio use practically any screened cable should suffice. For something critical like a long microphone lead which will carry minute signals, it would probably be worthwhile investing in a very high quality cable. For most purposes though, a thin and inexpensive screened lead is probably the most practical choice.

MULTI-WAY CABLES

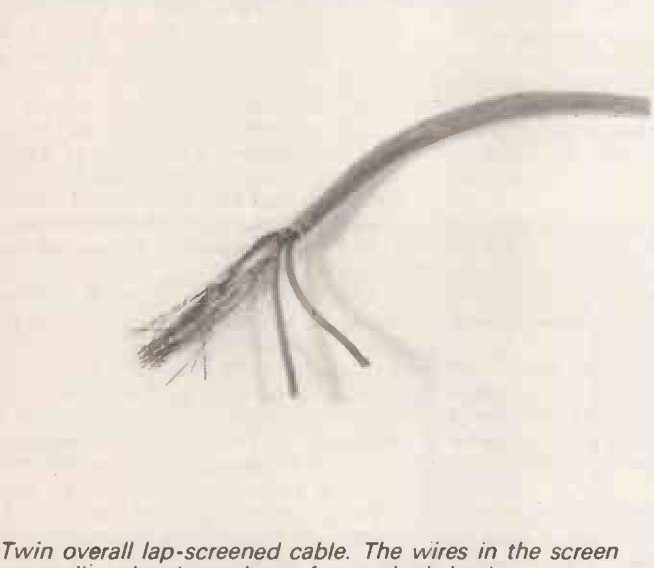
In most component catalogues you will find several types of multi-way screened cable listed. Basically though,



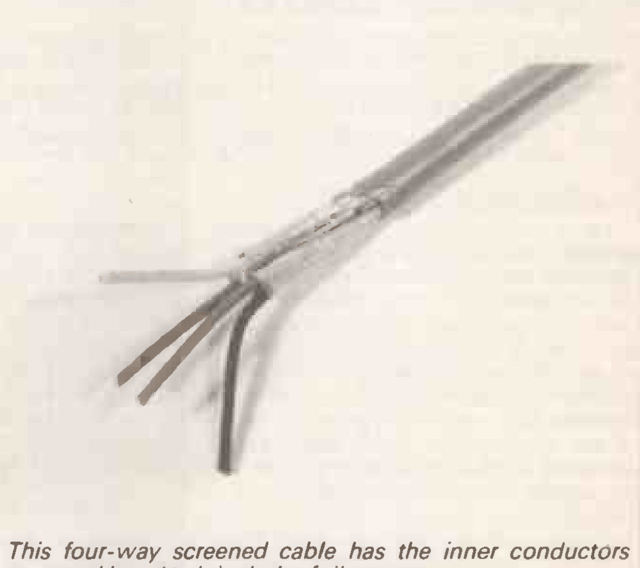
A single screened lead with a braided screen. Some braided screens are much more substantial than this one.



A single screened lead with its end prepared and ready for connection.



Twin overall lap-screened cable. The wires in the screen are easily twisted together to form a single lead.



This four-way screened cable has the inner conductors screened in pairs. It includes foil screens.

there are just two different types of multi-way screened cable. These are the individually and overall screened varieties. Individually screened cable is the more expensive type, and it is effectively just two or more ordinary screened cables, but with a common sheath to bind everything together as a single cable. Overall screened cable has one screen covering two or more inner conductors.

There is an important difference in the electrical characteristics of these two types of cable. With the individually screened type the inner conductors are not just screened from the outside world, they are also screened from each other. This type of cable is used in an application where it is important that there is no stray coupling from one lead to another. The most common example of this is a stereo system, where any stray coupling from one channel to the other would obviously reduce the stereo separation.

OVERALL SCREEN

With an overall screen there is nothing to prevent stray coupling between the inner conductors. With the leads in such close proximity to one another there is likely to be very strong coupling between them, particularly if a long cable is involved. This renders overall screened leads unsuitable for most audio applications.

They are mainly used in computer applications, wiring-up MIDI electronic music systems, and this sort of thing. It is perhaps worth pointing out that in these applications the purpose of the screening is not to keep out signals from the outside world. It is needed to prevent the inner conductors from radiating radio frequency interference. Screening will keep signals in as well as out.

If a components list specifies overall screened cable, it is perfectly all right to use an individually screened type. However, you would be using a more expensive cable than was really needed. It is not a good idea to use overall screened cable where an individually screened type is specified. To do so would probably not prevent the project from working, but it could seriously degrade certain aspects of its performance.

CONNECTIONS

Connecting screened leads to sockets etc. is a bit fiddly, but is not really too difficult. About 10 to 15 millimetres of the outer sheath must first be removed from the end of the cable. With the thinner cables this can be done using ordinary wire strippers provided you proceed carefully. On the larger cables the sheath can be quite thick, and it is then usually necessary to carefully cut it away using a sharp modelling knife. Either way, try not to damage the wires in the screen.

With lap-screened cable the exposed screen wires are twisted together to form a single lead, and then they are tinned with plenty of solder to hold them all together properly. This gives you a lead which can be connected to most tags, pins, etc. without difficulty. The inner conductor is treated in the same way as any insulated connecting wire. Check for any odd wires sticking out from the screen, and trim off any that you find. Otherwise these could easily cause short circuits.

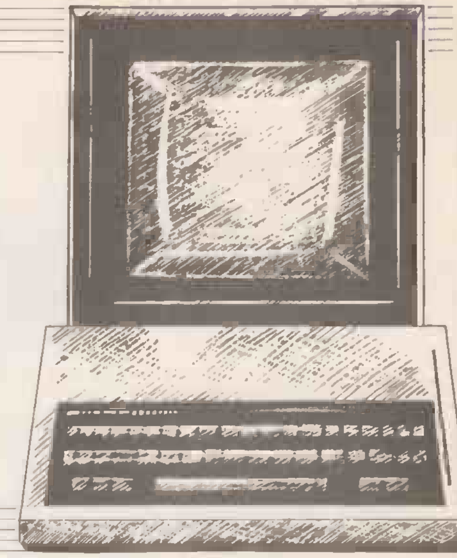
Braided cable can be slightly more awkward to deal with. With many braided cables it is not difficult to use your thumbnail to comb out the braiding, after which it can be treated just like lapped cable.

Where the braiding is thick and tightly woven the correct method of stripping it is to remove the outer insulation, fold over the inner with the braid, make a "hole" between the conductors in the braid on the outside of the fold using a small screwdriver, without breaking the conductors, and then pull out the inner. The braid can then be squeezed together and tinned ready for connection.

If a screened cable has a metal foil, the exposed foil is simply torn away. The connections are always made to the wire screens, not the foils which are far too insubstantial.

Constructional Project

VERSATILE BBC COMPUTER INTERFACE



MARK STUART

Field tested in schools, this single-board interface allows up to 16 outputs, via relays etc., to be controlled by the BBC model B home computer.

THIS BBC Interface project is based on a design that has been supplied to schools for some time. It was originally designed to allow a standard BBC model B computer to control motors and solenoids and to read relays, switches and other input sensors in a classroom environment.

Eight output lines and eight programmable input/output lines are provided by using the User Port and parallel Printer Port. All sixteen possible outputs can be fitted with relays if required. Care was taken to protect the computer from externally connected power supplies and components so that pupils could be given as much freedom as possible to make their own circuits and test them under computer control.

In the course of its development a number of additional features were added, including l.e.d. indicators for the input and output states, plug-in relays, and inverted logic levels for the user port to prevent relays being operated by I/O lines set as inputs.

Standard IDC leads are used to make the connections to the computer. These are fitted to the interface board using soldered in connectors so that they cannot be "borrowed" for other jobs – a feature that will be appreciated by all involved in technology teaching. Connections to the inputs and outputs are made via p.c.b. mounted terminal blocks with internal wire protection springs which will tolerate reasonable usage and can be replaced individually if necessary.

CIRCUIT DETAILS

The circuit diagram of the Printer Port section is shown in Fig 1 and the User Port section in Fig. 2. Fig. 3 shows the BBC model B internal connections to the two ports and the pin connections to the 20-way and 26-way IDC connectors.

The Printer Port provides a latched TTL logic level output from a standard tri-state buffer i.c. (74LS244 - see Fig. 3). The outputs from this can be either logic "0" level, logic "1" level, or open circuit. The logic 1 condition is required to light the l.e.d. and operate the relay, both of the other conditions must have no effect.

The TTL output which is capable of supplying only a low current is amplified by a Darlington driver IC1 (Fig. 1) which has eight identical sections each capable of

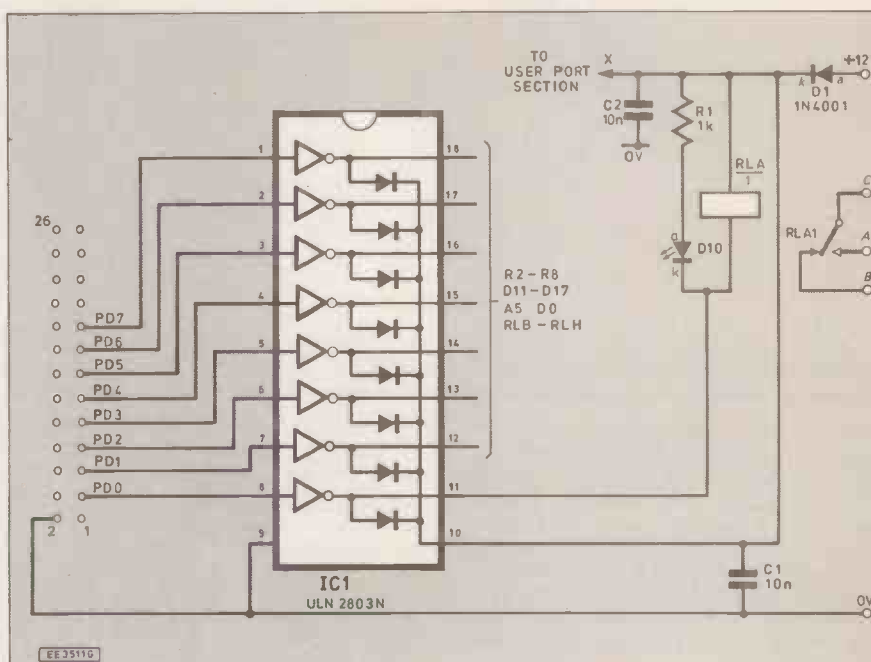
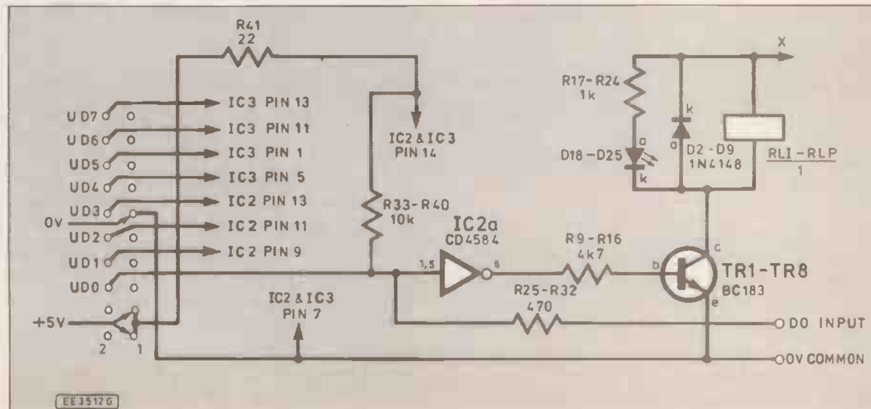


Fig. 1. Circuit diagram of the Printer Port section. The components, except C1, C2 and D1 are repeated for each output pin of IC1.

Fig. 2. Circuit diagram of the User Port section. The circuit is repeated for the buffers of IC2 and IC3, see Fig. 5.



switching 500mA at up to 50V. The internal circuit diagram of this i.c. is shown in Fig. 4.

Each output drives a relay RLA to RLH and an l.e.d. and series resistor, D10 to D17 and R1 to R8. Additional protection diodes are not required across the relay coils as they are included inside IC1.

Power to the relay coils and l.e.d.s is not taken from the computer, so an external 12V supply is required. This is connected via diode D1 to protect the circuit from reverse polarity. A small decoupling capacitor C1 removes any high frequency noise from the supply which might be coupled into the computer and cause problems.

The User Port section of the circuit is more complicated as it has to handle both inputs and outputs directly from the 6522

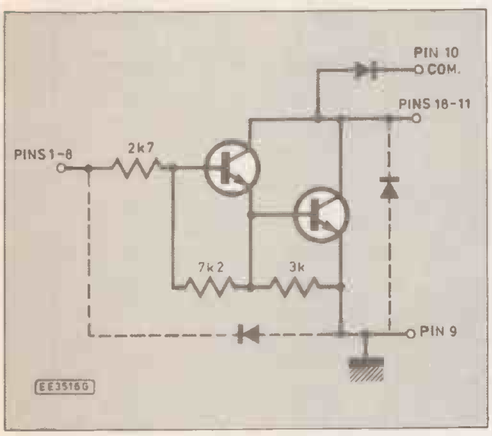


Fig. 4. Internal Darlington drive circuit for the ULN2803N i.c.

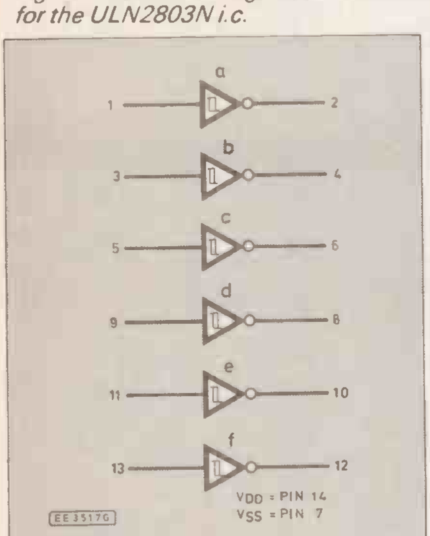


Fig. 5. Internal buffers of IC2 and IC3.

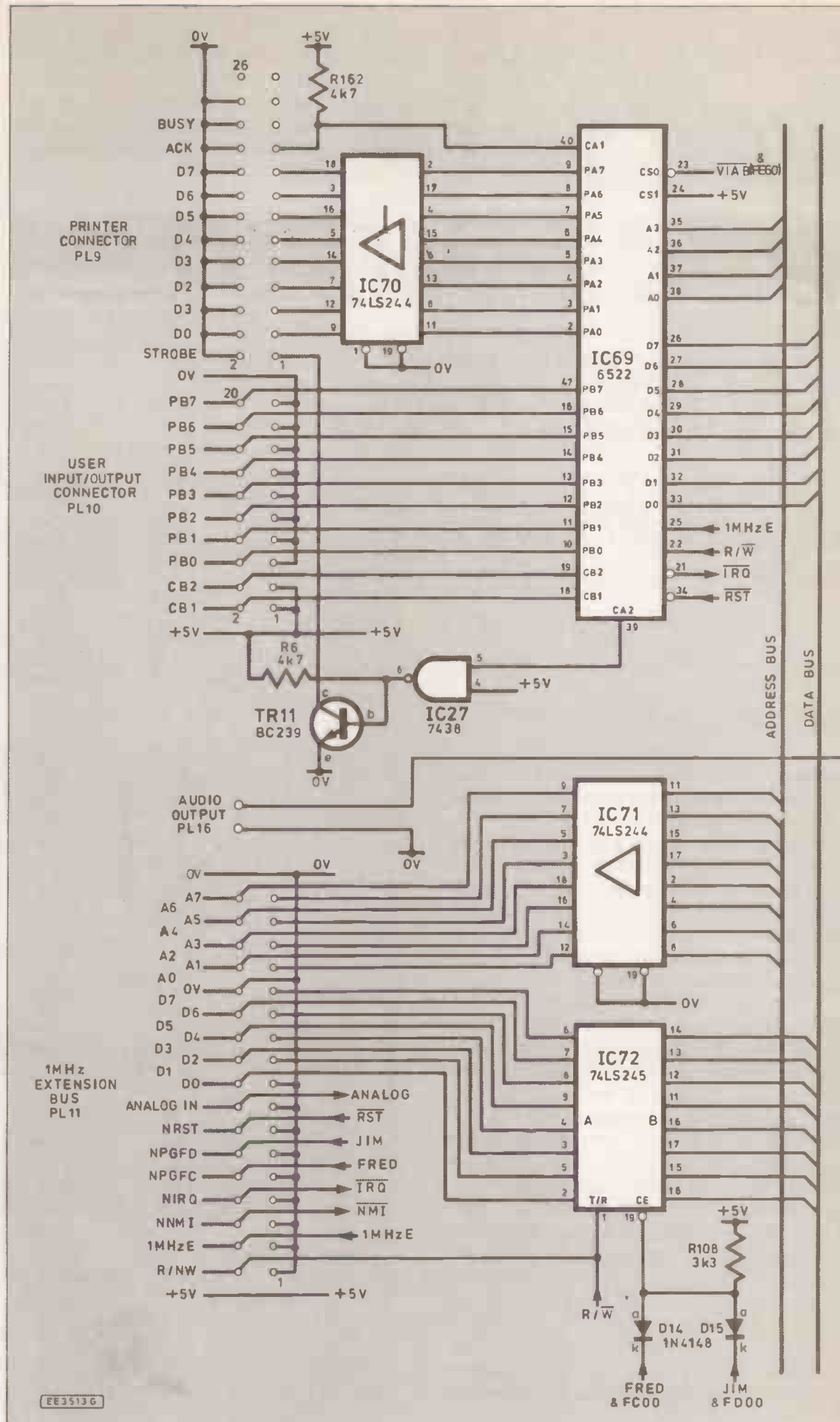
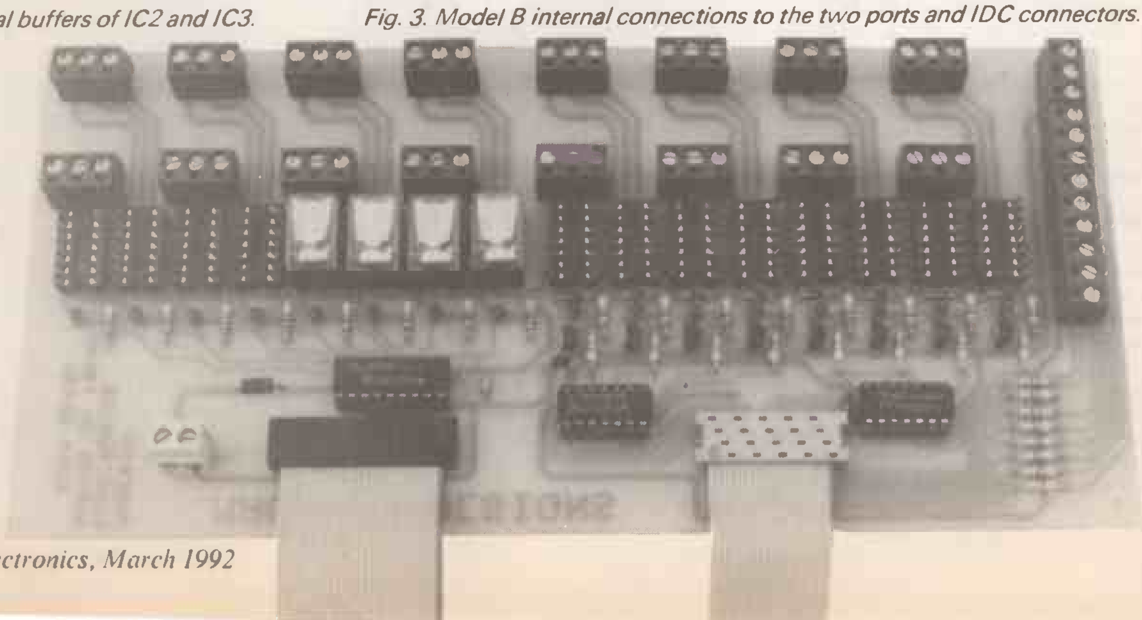


Fig. 3. Model B internal connections to the two ports and IDC connectors.



PIO i.c. in the computer. The outputs from the computer are amplified to drive relays via the CMOS Hexinverting buffers, contained in, IC2 and IC3 and transistors TR1 to TR8. This arrangement is chosen because the CMOS buffers have negligible loading effect and so can remain connected to port lines which are programmed as inputs.

Unlike the Printer Port a logic 0 level is required to turn on the l.e.d. and operate the relay. This has been done because the User Port I/O lines float at logic 1 levels when not set as outputs. A situation which would result in all relays being energised upon switching on the computer until the control program could be loaded and run. As it is, switching the computer on leaves all l.e.d.s out and all relays released.

Each section of the CMOS buffer i.c.s drives the relevant transistor via a current limiting resistor R9 to R16. The relays RL1 to RLP are driven directly from these transistors and are powered from the external 12V supply. Diodes D2 to D9 are required across the relay coils to prevent high voltage spikes being generated as the relays are turned off. The l.e.d.s D18 to D25, fed via resistors R17 to R24, indicate the states of the lines.

The computer's 5V supply rail is used to power IC2 and IC3. Only a very small current is required. Limiting resistor R41 is connected in series with the supply to limit the potential short circuit current to a level that will not damage the computer.

Pull up resistors R33 to R40 hold the inputs of IC2 and IC3 high when the User Port lead is not connected to the computer, keeping all relays released and all l.e.d.s off. Without this the CMOS inputs float at random and cause the relays to chatter or operate when not required.

When the User port lines are programmed as inputs, resistors R33 to R40 have no effect because the inputs are already pulled up internally by the computer. Resistors R25 to R32 in series with each input limit the current that would otherwise flow if high voltages were to be applied.

The inputs work at standard logic levels based on 5V for a "1" and 0V for a "0". Up to 12V can be applied to each input without any harm being done.

As IC2 and IC3 are in circuit the logic levels on the inputs can be read on l.e.d.s D18 to D25, and if relays are left plugged in they will operate. It is best to decide which User port lines are being used as Inputs and Outputs and fit relays only in the Output positions.

CONSTRUCTION

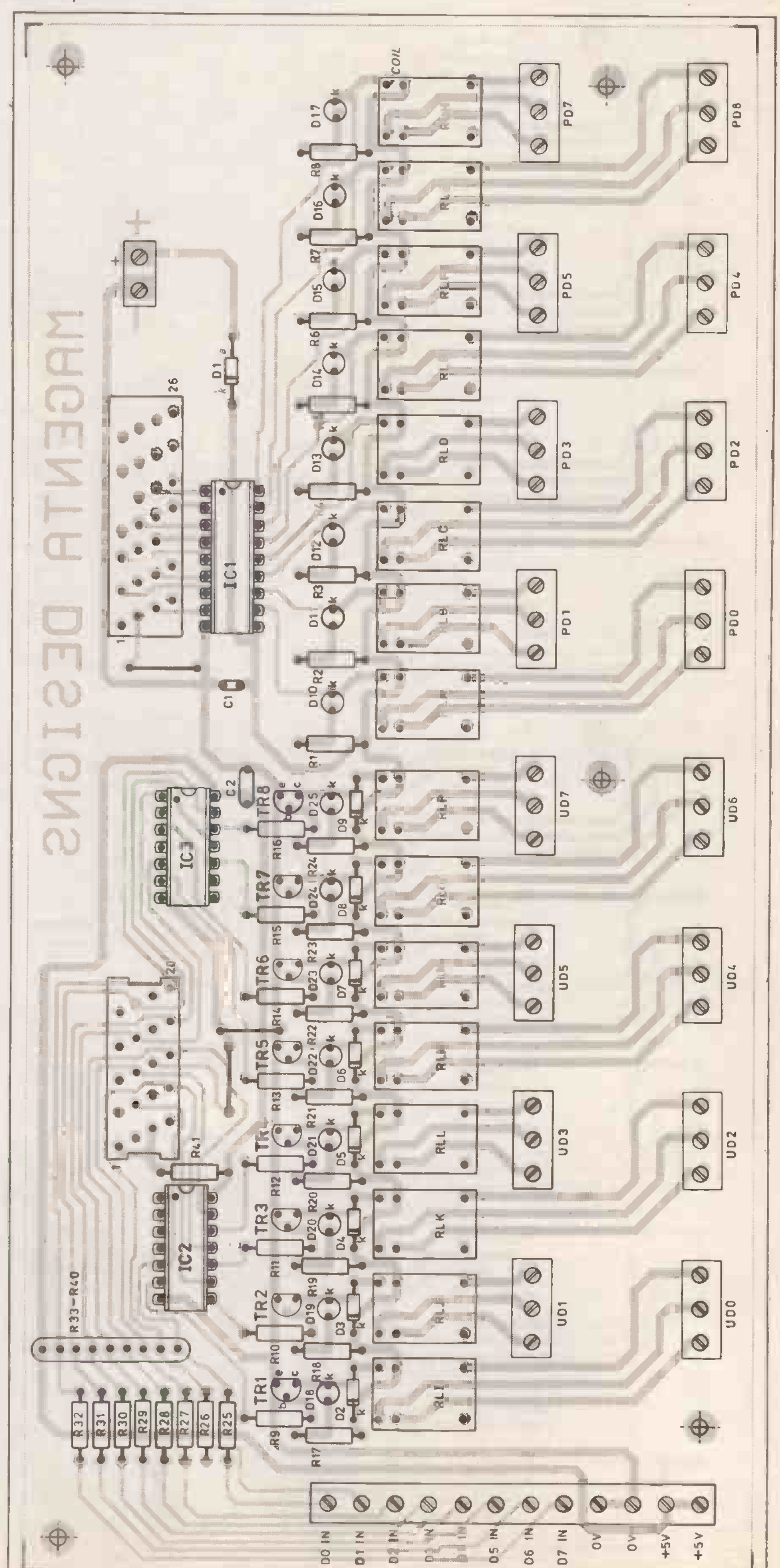
The Versatile BBC Computer Interface is built on a single printed circuit board which also accommodates the p.c.b. plug-in relays. This board is available from the *EE PCB Service*, code EE787. The printed circuit board component layout and full size copper foil master pattern are shown in Fig. 6.

Begin by fitting all of the resistors, diodes, and the three wire links. The polarity of the diodes is marked by the band which indicates the cathode (k) end.

The relays fit into standard i.c. sockets but use only some of the pins. As the board is not drilled for the unused pins they must be removed or cut off before the sockets can be fitted. Some sockets have pins which can be pulled or pushed out easily. Take care to remove only the unwanted pins and to fit the sockets the same way round to give a neat appearance. Sockets are also required for the i.c.s, and should be fitted with their polarity indicators (marking pin one) as shown.

The l.e.d.s should be fitted next with their shorter leads in the position marked "k" indicating the cathode connection. Be careful to keep them flush to the board and in line, and not to overheat them during soldering. Now fit the transistors with their flat sides in the correct position and fit capacitors C1 and C2 either way round. The pull up resistors are in a resistor network R33 to R40. Note that the common

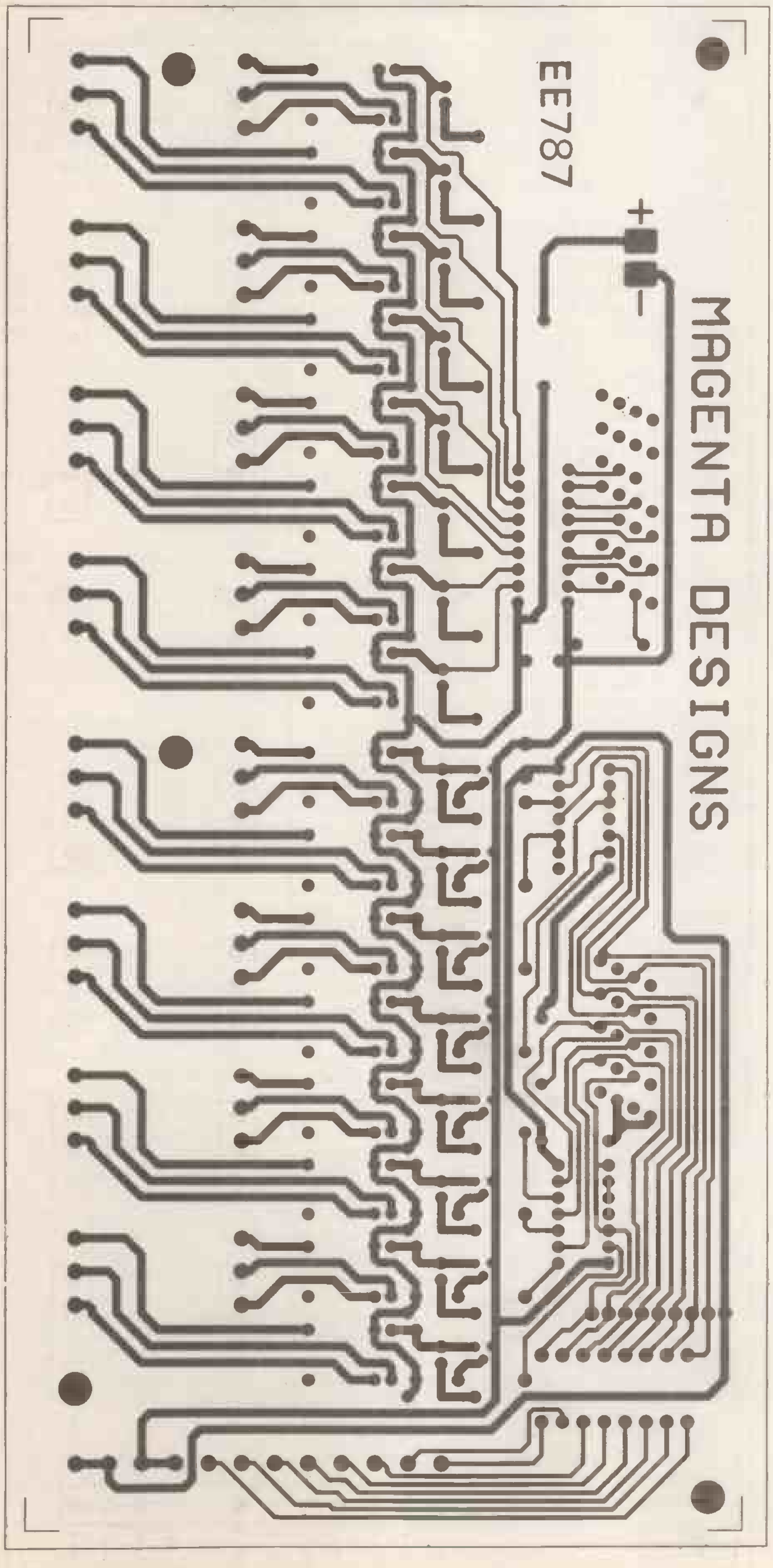
Fig. 6. Printed circuit board component layout and (right) full size copper foil master pattern.



end of this is marked with a dot which must be fitted nearest to the edge of the board.

The p.c.b. terminal blocks are of the type which dovetail together, four three-way ones must be joined for the input connectors, another sixteen being used individually for the relay connections and a two-way one for the 12V power connections. Make sure that these are pushed right into the board when soldering so that they are held firmly and resist moving when being used.

The final connections required are to the ribbon cable headers. These are available complete with assembled leads – see *Shop Talk* – which can be fitted and soldered directly to the board. If leads are to be made up, take care to fit the correct type of board transition connector and to fit it and the computer connector the right way round. This can be a baffling business and is not recommended except for experienced constructors.



When assembly is complete insert the i.c.s in their sockets and thoroughly inspect the soldering for dry joints and solder bridges. Check that the correct resistor values have been fitted and the transistor types are correct, and the board is ready for testing.

TESTING

Most of the tests can be carried out without a computer as the relays and l.e.d.s are powered from an external 12V supply. This can be any regulated or unregulated d.c. supply between 10V and 18V with 500mA rating.

Leave all relays and the computer connections out and connect the d.c. supply. All l.e.d.s should remain out and the circuit should draw very little current.

First test the Printer Port section. Connect a 1k resistor from pin one of IC1 to the incoming 12V supply and check that l.e.d. D17 lights. Fit a relay in RLH position and check that it operates and releases as the resistor is disconnected.

Repeat the test for IC1 pins two to eight and l.e.d.s D16 to D10 and relay positions RLG to RLA. Curious results should di-

COMPONENTS

Resistors

R1 to R8, R17 to R24	1k (16 off)
R9 to R16	4k7 (8 off)
R25 to R32	470 (8 off)
R33 to R40	10k x 8 SIL network
R41	22

All 0.25W 5% carbon, except resistor network R33 to R40.

See SHOP TALK Page

Capacitors

C1, C2	10nF ceramic plate, 50V (2 off)

Semiconductors

TR1 to TR8	BC183 *npn* silicon transistor (8 off)
D1	1N4001 1A 50V rec. diode
D2 to D9	1N4148 signal diode (8 off)
D10 to D25	TLUR5100 3mm Red diffused l.e.d. (16 off)
IC1	ULN2803N Octal Darlington driver array, TTL
IC2, IC3	CD4584 Hex Schmitt trigger (2 off)

Miscellaneous

RLA-RLP12V d.i.l. relay, with s.p.c.o. contacts (16 off).

Ribbon cable lead sets, 20-way female IDC to p.c.b. transition connector and 26-way female IDC to p.c.b. transition connector, both 0.5m long; 14-pin d.i.l. sockets (18 off); 18-pin d.i.l. socket; 3-way p.c.b. terminal block (20 off); 2-way p.c.b. terminal block; connecting wire; solder etc. Printed circuit board available from the *EE PCB Service*, code EE787.

Approx cost guidance only **£52**

rect attention to the appropriate section which should be inspected carefully.

The User Port section is more complicated as it requires a temporary connection of the 12V supply positive to power IC2 and IC3. This can be done by adding a link between the incoming 12V positive terminal and the end of resistor R41 nearer to the ribbon cable connector. The l.e.d.s should all remain out as this connection is made.

Link the input terminals to the 0V terminal one by one and the appropriate l.e.d. should light. Fit a relay into a socket and check that it operates and releases as expected. The connection and operation of the relay contacts can also be checked with a multimeter reading ohms.

When all of these tests have been completed the temporary 12V connection can be removed and the supply *disconnected* whilst the board is connected to a computer. It is wise to *switch off* the computer before connecting *any* type of peripheral and this is no exception. Once it is connected the computer can be switched on and off as required, as can the external 12V supply. The board is now ready for use with the computer.

PROGRAMMING

The Versatile BBC Computer Interface can be operated from within any program written by the user. The Printer Port is an output only port from which the interface is controlled by sending decimal numbers in the range 0 to 255 corresponding to binary values of 00000000 to 11111111 or hexadecimal 00 to FF.

Using BBC BASIC on a computer fitted with OS 1.2 the printer port is operated as follows:

```
10 REM CLEAR PRINTER
   BUFFER
20 *FX21 3
30 INPUT "ENTER VALUE FOR
   OUTPUT PORT: "A$
40 A% = EVAL A$
50 REM SEND CODE TO
   PRINTER ONLY
60 VDU 2,1,A%,3
```

Line 20 makes sure that no unwanted codes are already in the printer buffer. Line 30 asks for an input string which is evaluated in line 40 and sent to the printer in line 60.

Line 60 starts with a 2 which enables the printer port, followed by 1 which directs the following code to the printer followed by the code (A%) and then a 3 which disables the printer. Only the key lines 20 and 60 may be needed when the program is incorporated into other programs, provided A is defined somewhere.

Operating the User Port section of the interface is different as both inputs and outputs can be accommodated. There is a considerable amount of information that has been published in EE and elsewhere and so only brief notes are given here.

There are two addresses of importance &FE62 and &FE60. The data direction (input or output) is set by the value loaded into &FE62. Loading 0 sets all eight data lines to the input state, whilst loading 255 sets all outputs. Any combination of the two can be set by the appropriate number, for example loading decimal 15 (hexadecimal 0F) sets the four upper data lines as inputs and the four lower lines as outputs. Output values are set and input values read from location &FE60.

Care is needed to make sure that the data is correctly interpreted by reading only the input data Bits and writing only to the output data Bits. Eliminating the unwanted Bits is achieved in the programming and is not difficult. Reading outputs and writing to inputs causes confusion but cannot damage the interface or the computer.

The following simple program sets the User Port to all inputs and prints the incoming data value:

```
10 ?&FE62 = 0
20 X = ?&FE60
30 PRINT X
40 GOTO 60
```

When this program is running the value printed should be 255 as all inputs are pulled up internally. Link the input terminals to negative one by one and the numbers will change, becoming zero when all inputs are connected to negative at the same time. Throughout this test the indicator l.e.d.s will light for each input connected to negative, and the corresponding relay (if fitted) will operate. As the port is only reading inputs the external 12V supply is not really necessary, and the computer will read accurate values either way. The l.e.d.s and relays will not operate, of course, without the 12V supply.

To operate the User Port as outputs the following program can be used. Note that the l.e.d.s are lit and relays operated by logic 0's and not 1's as discussed earlier.

```
10 ?&FE62 = &FF
20 INPUT "ENTER VALUE FOR
   OUTPUT PORT: "A$
30 A% = EVAL A$
40 ?&FE60 = A%
```

This program begins by setting the port lines as outputs in line 10 and then prompts for a value which is loaded in line 40. Setting the outputs to 0 will light all l.e.d.s and close all relays.

From this the fuller operation of the Interface can be developed. Trial and error will soon produce results and it is a simple step to add a few switches to the inputs and motors to the outputs and enter the world of computer control. A separate power supply is recommended for motors etc. connected to the relay outputs, but it is possible to use batteries or to take the current from the existing 12V supply provided it is capable of supplying the necessary current.

USE

The outputs from the Interface are relatively easy to use as the relay contacts can be considered as simple switches. Fig. 7 shows the connection of a solenoid, with the necessary parallel protection diode, and Fig. 8 shows how two outputs can be connected to drive a reversible motor.

Inputs from photocells and opto-sensors are easily accommodated as shown in Fig. 9 which also shows the connection of a simple switch.

The BBC analogue input port is also available and can be incorporated into more elaborate control schemes, allowing analogue inputs from thermistors and photocells to be read and compared with pre-set values in the computer memory and used to drive output devices via the interface. In this way environmental control projects can be designed which control heating and ventilation in response to inside and outside temperatures, wind speed and direction, and time of day (derived from the computer real time clock).

The range of projects that can be built using this approach is practically endless, providing a new area use for BBC computers which in some applications are becoming rather outdated. □

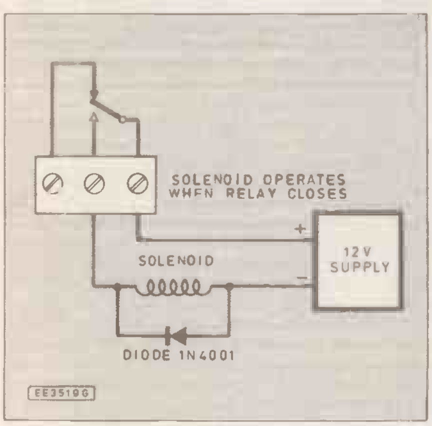


Fig. 7. Arrangement for driving a solenoid.

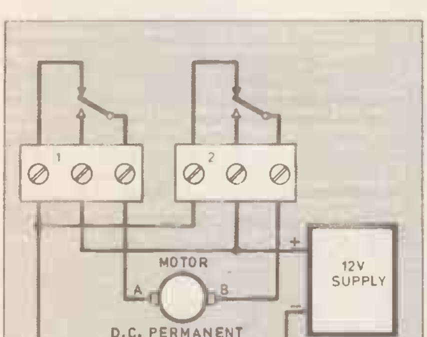


Fig. 8. Driving a reversible motor. When relay 1 contacts operate motor terminal A is positive and motor runs clockwise. When relay 2 contacts operate motor terminal B is positive and motor runs anticlockwise.

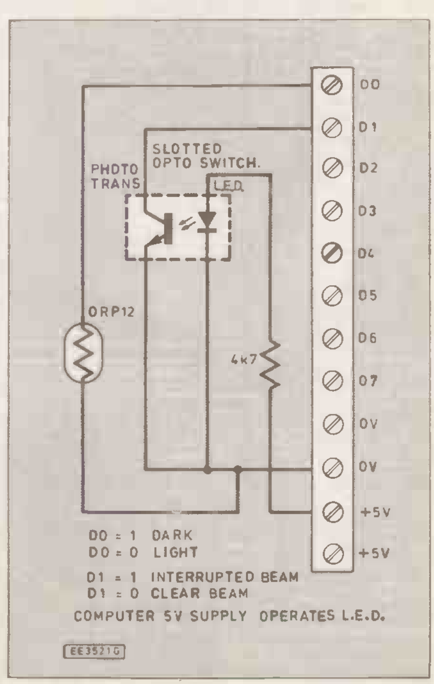


Fig. 9. Using an l.d.r. and an opto-transistor isolator to form a simple switch arrangement.

SHOP TALK

with David Barrington

Emergency Plug Light

A couple of items required for the *Emergency Plug Light* project require further comment. Although several advertisers stock the plug type p.s.u. boxes these all seem to be of the wrong dimensions and, because of the tight fit of components, are not really suitable. The p.s.u. box used in the model was purchased from **Maplin**, code FG41U.

The choice of rating (250mA) for the mains transformer has deliberately been kept on the high side so that it runs cool in the confined space inside the case during operation. The one chosen was also obtained from the above company and is listed as: Miniature type 250mA Tr6V, code YN14Q.

The only source we have been able to locate for the "flat oblong type" thermal fuse type 891B 85°C is from **Omni Electronics** (☎ *031 667 2611*). Once again due to space limitations, the fuse squeezes between the transformer windings and the case side, it is recommended that this type be used. The fuse is connected in series with the transformer live (brown) lead which also goes to the mains live pin on the plug section.

Economy Seven Timer

We do not expect any component buying problems to be encountered by readers undertaking the construction of the *Economy Seven Timer*. However, it is most important that due attention is paid to the rating of the switching relay and the "earthing" and/or insulation of the case.

It is important that the rating of the relay is not exceeded, the mains fuse should be rated so that the relay contacts cannot be overloaded by the appliance. The specified relay, which fits on the p.c.b., is the Ultra Miniature High Power type from **Maplin**, code YX97F.

The relay is rated at 10A a.c. (resistive) at 240V a.c. and 3A a.c. (inductive). Since a dishwasher and washing machine represents a mainly inductive load (the motor), the unit should NOT be used to switch an appliance rated at more than about 1kW with this relay.

The printed circuit board is available from the *EE PCB Service*, code EE788. Finally, the "Economy Seven" nightime cheap rate switch over times seem to vary in differing areas, so you will have to check with your local authority.

Versatile BBC Interface

Some of the devices called for in the *Versatile BBC Interface* board may prove difficult to obtain. The diffused l.e.d., octal Darlington array i.c., relays and special lead sets are available from **Magenta Electronics**. Lead sets of this type are never cheap, but it might be worth asking about a "special price" if purchasing a "set" of sixteen relays.

A complete kit of parts (£51.95) including printed circuit board, relays and connecting lead sets is available from **Magenta Electronics, Dept EE, 135 Hunter Street, Burton-on-Trent, Staffs, DE14 2ST** (☎ *0283 65435*). Add £2 for post and packing.

The printed circuit board is available from the *EE PCB Service*, code EE787 (see page 188).

Cycle Light Backup

We cannot foresee any component purchasing problems when ordering parts for the *Cycle Light Backup* project.

Plastic waterproof boxes, about the correct size, are available from most of our advertisers and cost around £3 each. Also available are waterproof toggle switch covers ranging form as much as £1.30 down to as little as 75p each. You can, of course, use any suitable plastic case and seal the lid joints with waterproof adhesive tape and fill the leadout and fixing holes with a suitable sealant.

You can use practically any relay, provided it will fit inside the case, sit on the stripboard (with an *identical* pinout arrangement) and have similar electrical ratings.

Auto Garage Light

One or two points need highlighting for those about to undertake the construction of the *Auto Garage Light* project.

A 0.1in. (5.08mm) pitch layout is used throughout on the p.c.b. artwork. The use of metric pitch (5.00mm) components is unacceptable with this artwork (bad fit may strain the pins and enamelled copper wire leads on the transformer; if the transformer is not comfortably flush with the p.c.b. then the copper track may eventually lift away). The printed circuit board is available from the *EE PCB Service*, code EE 786 (see page 188).

Using p.c.b. mounting transformers is a real headache, because there is no standard configuration for the pin-outs. Different manufacturers all have their own style and the artwork may need changing if another device is used.

The prototype used a 3VA p.c.b. mounted mains transformer, made by OEP type G3809. This one is now discontinued by **Verospeed** and its replacement G3809E ("E" for encapsulated) won't fit because the pins are offset the other way.

The good news is that other types of transformer with imperial pitch are readily available which will fit the board. The RS, code 208-080, mains transformer from **Electromail** (☎ *0536 204555*), is a 6VA type, which is more than enough for this application but will fit directly on the board. The same applies to the **Verospeed** (☎ *0703 644555*) M1809E 6VA Encapsulated (code 289-51571D) or M1809 same, but open wound (code 289-51557E).

The relay used is available from **Maplin** (YX98G) or **Cirkit** (type OM1, part no. 46-70060). Ensure that a "back-to-back" device is used for the bicolour l.e.d., (e.g. **Maplin** QY83E).

It is **most** important that the BC184L transistor be used in the circuit and when placing your order for parts, make sure your supplier understands this.

Hot Tip

The soldering and de-soldering specialist Ungar has announced a special offer based on its ESD-safe, electronically-controlled 2110 solder station.

Not content with simply providing a value-for-money package (normally at just under £80) for a high performance station (tip leakage below 2mV, ceramic 60W 24V heater for rapid heat-up and adjustable temperature), they have decided to make their 2100 available on a three-for-the price-of-two-basis, for a limited period only.

That's right: pay for two Ungar 2110 solder stations and they will send you three. No, there isn't a catch: just write to them first for full details but act quickly, the offer won't last for ever.

UNGAR, Eldon Industries (UK) Ltd, Dept EE, Clifton Road, Shefford, Beds SG17 5AB.

PLEASE TAKE NOTE

Mains Appliance Remote Control (MARC) Encoder. *(July 1991)*

The ML927 decoder i.c. (IC2) is no longer manufactured. This update suggests a modification to the MARC Encoder unit which will allow up to seven Decoders to be switched ON or OFF using the handheld IR remote unit. The UP/DOWN functions from the IR transmitter are no longer available, although full control can still be achieved via the opto-isolated 8-bit Encoder input port.

Modifications

1) Make sure that IC2 is *not* in its socket.
2) Cut the p.c.b. track between IC1 pin 8 and IC3 pin 11, but make sure resistor R13 remains connected to IC3 pin 11.
3) Solder a wire between IC1 pin 8 and IC4 pin 5.
4) Solder another wire between IC8 pin 1 and IC4 pin 2.

When a receiver number button between 1 and 7 on the transmitter is pressed, the relevant Decoder unit will switch OFF. If, however, button number 8 is pressed *at the same time* as the receiver number is pressed, then that Decoder will switch ON.

Example

Pressing '3' and '8' simultaneously will switch Decoder 3 ON
Pressing '3' on its own will switch Decoder 3 OFF.

It *may* be necessary to change capacitor C7 to a value of 150nF if difficulty is encountered controlling some Decoder units.

DOWN TO EARTH

George Hylton

Fault Finding

MY digital frequency meter developed an intermittent fault. On switching on it worked perfectly and then, quite suddenly, it either stopped working or produced an unstable reading; irritating.

I hate fault finding, so I shelved the problem until we went on our annual holiday to France. There, in what used to be the hayloft of a farmhouse, I have a work bench, and plenty of time. Starting with basics, I monitored the d.c. supply to the TTL logic. Nominally this was 5V, supplied from a mains unit (Fig. 1).

Low Voltage

Half an hour's monitoring produced one significant result. When the meter was working properly the stabilizer delivered 5V d.c. When the fault appeared the voltage dropped to 4V d.c. Not a huge fall, but enough to upset TTL, which is fussy about supply voltage.

This was good news, because it suggested that the fault lay in the power supply unit (p.s.u.), which in principle was repairable, rather than in the digital part of the circuit board which, being full of soldered-in i.c.s, probably wasn't (with my limited equipment). The need was to track down the cause, doing the minimum amount of unsoldering in the process. The p.s.u. components were also on the main p.c.b. and its copper tracks were thin and looked easily damageable.

Mains Supply

The trouble might be due to a varying mains voltage. If this were to fall too low there might not be enough d.c. to operate the stabilizer. French mains voltage is 220V a.c. Low (the nominal input required by the meter is 240V) but not that low. Monitoring showed that the 220V remained rock steady during periods when the meter was faulty, so the mains voltage couldn't be the real problem.

At this point there seemed to be several possibilities:

1. A faulty mains transformer, e.g. with an intermittent internal short.
2. Faulty stabilizer.
3. Faulty rectifiers.
4. Reservoir capacitor C1. A reduction in capacitance, due to some internal bad connection, might cause the d.c. voltage to fall. So might internal leakage, by imposing an extra current drain.
5. Something else, including poor connections such as cracked tracks on the p.c.b.

Problem, find out which. I had a good French dinner with a glass or two of red wine then slept on it.

Resistance measurements on the transformer windings gave stable readings. The rectifier diodes D1 and D2 are in parallel to d.c., because the low-resistance transformer secondary windings connects their anodes. Measuring with an ohmmeter gave normal results; conduction one way, no conduction the other way. But this didn't rule out the possibility of one rectifier being open-circuit.

The capacitor showed no abnormally low leakage resistance, on my ohmmeter, but since the applied voltage in this test is low the result wasn't conclusive.

Waveforms

Time to take a closer look, with something more revealing than a voltmeter. An oscilloscope gave the waveforms shown in Fig. 2. Those in the left hand column are for periods of fault-free operation. They are typical. During the peaks of half cycles when the anode of a diode is positive a large current flows into C1. This produces a voltage drop in the effective resistance of the transformer half-secondary, hence the flattening of the peak. The resistance is not quite the same for both half-secondaries.

If one half of the secondary is wound on top of the other then for the same number of turns a greater length of wire is needed, so the resistance is greater. This could account for the unequal ripple waveforms, though they looked a bit too unequal to me.

It was, in fact, the ripple that provided the decisive clue. Under fault conditions (right hand column) the ripple frequency was halved (V3). One diode was not conducting. Rectification had changed from full-wave (push-pull) to half-wave. The half-secondary voltages showed which. During a fault, V2 no longer had flattened peaks, so its associated winding was not delivering pulses of current; diode D2 was faulty; or badly connected.

Thermal Effects

Replacing D2 cured the trouble. The ripple voltage became more even and the rectified voltage increased, but what was wrong with the original D2? An ohmmeter test said it was OK. Infinite reverse resistance, low forward resistance.

I left the ohmmeter across it, showing the forward resistance. When the diode was warmed with a soldering iron the resistance dithered, rose, and finally became very high. Thermal expansion was evidently pulling the diode apart.

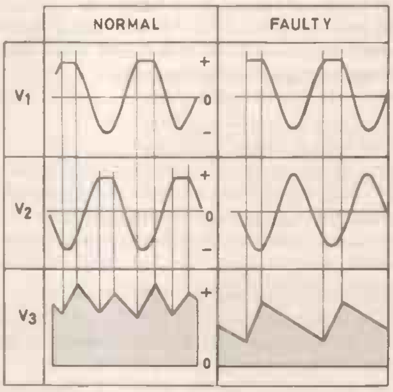


Fig. 2. Waveforms obtained from the power unit using an oscilloscope.

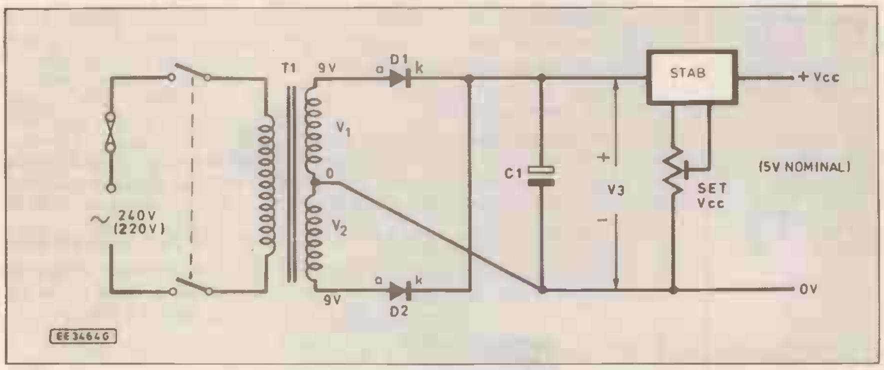


Fig. 1. Mains stabilised power unit circuit diagram.

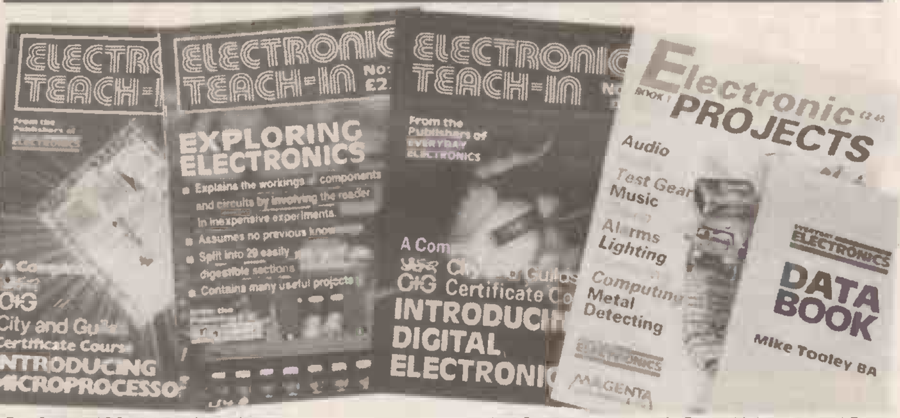
Safety First

While I was congratulating myself on a neat bit of detective work (Elémentaire, mon cher Watson) I noticed that the digital meter was giving the wrong reading. It can be set to measure period as well as frequency, and I'd been using the stepped-down 50Hz mains voltage as a handy test signal. The period should be 20 milliseconds; the meter range selected gave this in tens of microseconds. The normal reading was then 2000 ±1, but I was now getting 2005.

I knew that the mains frequency in France doesn't vary; it's crystal-controlled. So the timing oscillator in my meter must be running fast. A sudden thought made me switch off quickly. Earlier, I'd turned up the voltage control on the stabilizer, in an attempt to get the correct V_{CC}. I hadn't turned it down, and now it was perhaps dangerously high and wrecking the TTL chips.

In fact it was only 5.2V, but this apparently was enough to upset the oscillator. Readjusting to 5V restored the status quo. But my carelessness could have been disastrous. A shaking experience, necessitating calming treatment. Encore du vin rouge, s'il vous plaît, chérie.

SPECIAL EVERYDAY ELECTRONICS BOOKS



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, Micro-processors, 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

ELECTRONIC PROJECTS BOOK 1
Published by *Everyday Electronics* in association with Magenta Electronics.
Contains twenty of the best projects from previous issues of EE each backed with a kit of components. The projects are: Seashell Sea Synthesiser, EE Treasure Hunter, Mini Strobe, Digital Capacitance Meter, Three Channel Sound to Light, BBC 16K sideways Ram, Simple Short Wave Radio, Insulation Tester, Stepper Motor interface, Eprom Eraser, 200MHz Digital Frequency Meter, Infra Red Alarm EE Equaliser Ioniser, Bat Detector, Acoustic Probe, Mainstester and Fuse Finder, Light Rider – (Lapel Badge, Disco Lights, Chaser Light), Musical Doorbell, Function Generator, Tilt Alarm, 10W Audio Amplifier, EE Buccaneer Induction Balance Metal Detector, BBC Midi Interface, Variable Bench Power Supply, Pet Scarer, Audio Signal Generator.
128 pages (A4 size) Order code EP1 £2.45

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 TEACH-IN No. 4 INTRODUCING DIGITAL ELECTRONICS (published by *Everyday Electronics*)
Michael J. Cockcroft
Although this book is primarily a City & Guilds Introductory level course (726/301), approximately 80% of the information forms a very basic introduction to electronics in general, it therefore provides an excellent introductory text for beginners and a course and reference book for GCSE students.
Full details on registering for C&G assessment, details of assessment centres, components required and information on the course in general are given.
The City & Guilds introduction to module 726/301 reads: "A candidate who satisfactorily completes this module will have a competence to identify basic components and digital integrated circuits and connect them together to form simple working circuits and logic units." This provides an excellent introduction to the book.
112 pages (A4 size) Order code TI4 £2.95

ELECTRONICS TEACH-IN No.5 GUIDE TO BUILDING ELECTRONIC PROJECTS
Published by EVERYDAY ELECTRONICS
Due to the demand from students, teachers and hobbyists we have put together a range of articles from past issues of *Everyday Electronics* that will assist those involved with the construction of electronic projects.
The book contains the complete *Project Development for GCSE* series.
Contents: Features – First Steps in Project Building; Building with Vero; Project Development for GCSE; Getting your Projects Working; Guide to Printed Circuit Boards; Choosing and Using Test Equipment – The Multimeter, The Oscilloscope, P.S.U.s, Logic Probes, Digital Frequency Meters, Signal Generators, etc; **Data** – Circuit Symbols; Component Codes; Resistors; Identifying Components; Capacitors; Actually Doing It – Understanding the Circuit Diagram, Component Codes, Mounting circuit boards and controls, Understanding Capacitors; **Projects** – Lie Detector; Personal Stereo Amplifier; Digital Experimentsr's Unit; Quizmaster; Siren Effects Unit; UV Exposure Unit; Low-cost Capacitance Meter; Personal Radio.
88 pages (A4 size) Order code TI5 £2.95

EVERDAY 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

DIRECT BOOK SERVICE

The books listed have been selected by Everyday Electronics editorial staff 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. For another selection of books see next month's issue

TESTING, THEORY AND REFERENCE

ELECTRONIC TEST EQUIPMENT HANDBOOK
Steve Money
The principles of operation of the various types of test instrument are explained in simple terms with a minimum of mathematical analysis. The book covers analogue and digital meters, bridges, oscilloscopes, signal generators, counters, timers and frequency measurement. The practical uses of the instruments are also examined.
Everything from Audio oscillators, through R, C & L measurements (and a whole lot more) to Waveform Generators and testing Zeners. A truly comprehensive book for the hobbyist, student, technician and engineer.
206 pages Order code PC109 £8.95

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 extended 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

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 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 Temporarily out of print

ELECTRONICS – A "MADE SIMPLE" BOOK
G. H. Olsen
This book provides excellent background reading for our *Introducing Digital Electronics* series and will be of interest to everyone studying electronics. The subject is simply explained and well illustrated and the book assumes only a very basic knowledge of electricity.
330 pages Order code NE10 £4.95

PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE
F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.
Bridges the gap between complicated technical theory, and "cut-and-tried" methods which may bring success in design but leave the experimenter unfulfilled. A strong practical bias – tedious and higher mathematics have been avoided where possible and many tables have been included.
The book is divided into six basic sections: Units and Constants, Direct-current Circuits, Passive Components, Alternating-current Circuits, Networks and Theorems, Measurements.
256 pages Order code BP53 £3.95

PRACTICAL DIGITAL ELECTRONICS HANDBOOK
Mike Tooley (Published in association with *Everyday Electronics*)
The vast majority of modern electronic systems rely heavily on the application of digital electronics, and the *Practical Digital Electronics Handbook* aims to provide readers with a practically based introduction to this subject. The book will prove invaluable to anyone involved with the design, manufacture or servicing of digital circuitry, as well as to those wishing to update their knowledge of modern digital devices and techniques. Contents: Introduction to integrated circuits; basic logic gates; monostable and bistable devices; timers; microprocessors; memories; input and output devices; interfaces; microprocessor buses. Appendix 1: Data. Appendix 2: Digital test gear projects; tools and test equipment; regulated bench power supply; logic probe; logic pulser; versatile pulse generator; digital IC tester; current tracer; audio logic tracer; RS-232C breakout box; versatile digital counter/frequency meter. Appendix 3: The oscilloscope. Appendix 4: Suggested reading. Appendix 5: Further study.
208 pages Order code PC100 £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

AUDIO AND MUSIC

LOUDSPEAKERS FOR MUSICIANS NEW
Vivian Capel
This book contains all that a working musician needs to know about loudspeakers; the different types, how they work, the most suitable for different instruments, for cabaret work, and for vocals. It gives tips on constructing cabinets, wiring up, when and where to use wadding, and when not to, what fittings are available, finishing, how to ensure they travel well, how to connect multi-speaker arrays and much more.
Ten practical enclosure designs with plans and comments are given in the last chapter, but by the time you've read that far you should be able to design your own!
164 pages Order code BP297 £3.95

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

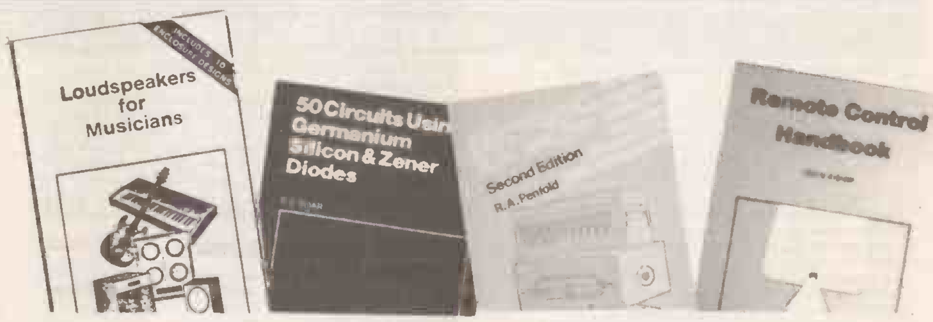
INTRODUCTION TO DIGITAL AUDIO (Second Edition)
Ian Sinclair
Digital recording methods have existed for many years and have become familiar to the professional recording engineer, but the compact disc (CD) was the first device to bring digital audio methods into the home. The next step is the appearance 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 £6.95

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 PC101 £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

CIRCUITS AND DESIGN

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 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. Whenever possible, the components used are common to several projects, hence with only a modest number of reasonably inexpensive components, it is possible to build in turn, every project shown. Recommended by BICC-Vero.
160 pages Order code BP107 £2.95

BOOK 2 –
All projects use CMOS i.c.s. but the items on component identification etc., are not repeated from Book 1.
160 pages Order code BP113 £2.25

ELECTRONIC CIRCUITS HANDBOOK
Michael Tooley BA
This book aims to explode two popular misconceptions concerning the design of electronic circuits: that only those with many years of experience should undertake circuit design and that the process relies on an understanding of advanced mathematics. Provided one is not too ambitious, neither of these popularly held beliefs is true.
Specifically, this book aims to provide the reader with a unique collection of practical working circuits together with supporting information so that circuits can be produced in the shortest possible time and without recourse to theoretical texts.
Furthermore, information has been included so that the circuits can readily be modified and extended by readers to meet their own individual needs. Related circuits have been grouped together and cross-referenced within the text (and also in the index) so that readers are aware of which circuits can be readily connected together to form more complex systems. As far as possible, a common range of supply voltages, signal levels and impedances has been adopted.
As a bonus, ten test gear projects have been included. These not only serve to illustrate the techniques described but also provide a range of test equipment which is useful in its own right.
277 pages Order code NE05 £16.95

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 £12.95

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 £1.95

DESIGNING WITH LINEAR ICs SALE PRICE
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.
64 pages Order code BP36 Special Price £6.95

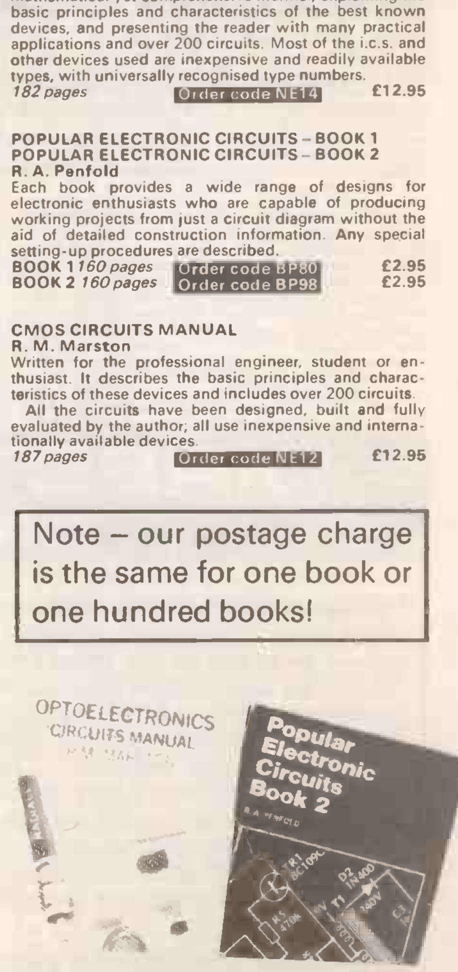
TIMER/GENERATOR CIRCUITS MANUAL
R. M. Marston
This manual is concerned mainly with waveform generator techniques and circuits. Waveform generators are used somewhere or other in most types of electronic equipment, and thus form one of the most widely used classes of circuit. They may be designed to produce outputs with sine, square, triangle, ramp, pulse, staircase, or a variety of other forms. The generators may produce modulated or unmodulated outputs, and the outputs may be of single or multiple form.
Waveform generator circuits may be built using transistors, op-amps, standard digital ICs, or dedicated waveform or "function" generator ICs.
The manual is divided into eleven chapters, and presents over 300 practical circuits, diagrams and tables. The subjects covered include: Basic principles; Sine wave generators; Square wave generators; Pulse generator circuits; "Timer IC" generator circuits; Triangle and sawtooth generators; Multi-waveform generation; Waveform synthesizer ICs; Special waveform generators; Phaselocked loop circuits; Miscellaneous "555" circuits.
267 pages Order code NE18 £12.95

OPTOELECTRONICS CIRCUITS MANUAL
R. M. Marston
A useful single-volume guide to the optoelectronics device user, specifically aimed at the practical design engineer, technician, and the experimenter, as well as the electronics student and amateur. It deals with the subject in an easy-to-read, down-to-earth, and non-mathematical yet comprehensive manner, explaining the basic principles and characteristics of the best known devices, and presenting the reader with many practical applications and over 200 circuits. Most of the i.c.s. and other devices used are inexpensive and readily available types, with universally recognised type numbers.
182 pages Order code NE14 £12.95

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.
187 pages Order code NE12 £12.95

Note – our postage charge is the same for one book or one hundred books!



PROJECT CONSTRUCTION

HOW TO DESIGN AND MAKE YOUR OWN P.C.B.s
R. A. Penfold
Deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple p.c.b. construction including photographic methods and designing your own p.c.b.s.
80 pages Order code BP121 £2.50

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
R. A. Penfold
We have all built projects only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.
96 pages Order code BP110 £2.50

ELECTRONIC SCIENCE PROJECTS
O. Bishop
These projects range in complexity from a simple colour temperature meter to an infra-red laser. There are novelties such as an electronic clock regulated by a resonating spring, and an oscilloscope with solid-state display. There are scientific measuring instruments such as a pH meter and an electro-cardiometer. All projects have a strong scientific flavour. The way they work, and how to build and use them are fully explained.
144 pages Order code BP104 £2.95

BEGINNER'S GUIDE TO BUILDING ELECTRONICS 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 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

DATA AND COMPONENT IDENTIFICATION

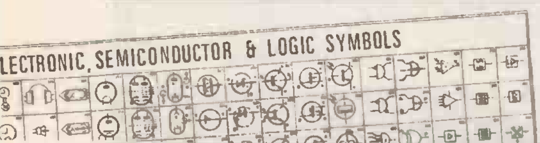


CHART OF RADIO, ELECTRONIC, SEMICONDUCTOR AND LOGIC SYMBOLS
M. H. Banani B.Sc.(Eng.)
Illustrates the common, and many of the not-so-common, radio, electronic, semiconductor and logic symbols that are used in books, magazines and instruction manuals, etc., in most countries throughout the world.
Chart Order code BP27 £0.95

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 £3.95

RADIO, TV, SATELLITE

SETTING UP AN AMATEUR RADIO STATION
I. D. Poole
The aim of this book is to give guidance on the decisions which have to be made when setting up any amateur radio or short wave listening station. Often the experience which is needed is learned by one's mistakes, however, this can be expensive. To help overcome this, guidance is given on many aspects of setting up and running an efficient station. It then proceeds to the steps that need to be taken in gaining a full transmitting licence.
Topics covered include: The equipment that is needed; Setting up the shack; Which aerials to use; Methods of construction; Preparing for the licence.
An essential addition to the library of all those taking their first steps in amateur radio
86 pages Order code BP300 £3.95

BEGINNER'S GUIDE TO RADIO – 9th EDITION
Gordon J. King
Radio signals, transmitters, receivers, antennas, components, valves and semiconductors, CB and amateur radio.
266 pages Order code NE08 £6.95

AN INTRODUCTION TO RADIO DXING
R. A. Penfold
Anyone can switch on a short wave receiver and play with the controls until they pick up something, but to find a particular station, country or type of broadcast and to receive it as clearly as possible requires a little more skill and knowledge. The object of this book is to help the reader to do just that, which in essence is the fascinating hobby of radio DXing.
112 pages Order code BP91 £1.95

EXPERIMENTAL ANTENNA TOPICS
H. C. Wright
Although nearly a century has passed since Marconi's first demonstration of radio communication, there is still research and experiment to be carried out in the field of antenna design and behaviour.
The aim of the experimenter will be to make a measurement or confirm a principle, and this can be done with relatively fragile, short-life apparatus. Because of this, devices described in this book make liberal use of cardboard, cooking foil, plastic bottles, cat food tins, etc. These materials are, in general, cheap to obtain and easily worked with simple tools, encouraging the trial-and-error philosophy which leads to innovation and discovery.
Although primarily a practical book with text closely supported by diagrams, some formulae which can be used by straightforward substitution and some simple graphs have also been included.
72 pages Order code BP278 £3.50

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 or 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 £14.95

COMPUTING

SERVICING PERSONAL COMPUTERS – 2nd EDITION
Mike Tooley BA
The revised and enlarged second edition contains a new chapter on the IBM PC, AT, TX and compatibles. It is essential for anyone concerned with the maintenance of personal computer equipment or peripherals, whether professional service technician, student or enthusiast.
240 pages (Hard cover) Order code NE15 £25

HOW TO EXPAND, MODERNISE AND REPAIR PCs AND COMPATIBLES
R. A. Penfold
Not only are PC and compatible computers very expandable, but before long most users actually wish to take advantage of that expandability and start upgrading their PC systems. Some aspects of PC upgrading can be a bit confusing, but this book provides advice and guidance on the popular forms of internal PC expansion, and should help to make things reasonably straightforward and painless. Little knowledge of computing is assumed. The only assumption is that you can operate, a standard PC of some kind (PC, PC XT, PC AT, or a 80386 based PC).
The subjects covered include: PC overview; Memory upgrades; Adding a hard disk drive; Adding a floppy disk drive; Display adaptors and monitors; Fitting a maths co-processor; Keyboards; Ports; Mice and digitisers; Maintenance (including preventative maintenance) and Repairs, and the increasingly popular subject of d.i.y. PCs.
156 pages Order code BP271 £4.95

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 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, BBC and also the Commodore 64.
112 pages Order code BP147 £2.95

The PRE-BASIC BOOK
F. A. Wilson, C.G.I.A., C.ENG., F.I.E.E., F.I.E.R.E., F.B.I.M.
Another book on BASIC but with a difference. This one does not skip through the whole of the subject and thereby leave many would-be programmers floundering but instead concentrates on introducing the technique by looking in depth at the most frequently used and more easily understood computer instructions. For all new and potential micro users.
192 pages Order code BP146 £2.95

DIRECT BOOK SERVICE
ORDERING DETAILS

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 £2.50** for all countries outside Europe, surface mail postage) and send a PO, cheque, international money order (£ sterling only) made payable to **Direct Book Service** or credit card details (including card expiry date), Visa or Mastercard (Access) – minimum credit card order is £5 – quoting your name and address, the order code and quantities required to **DIRECT BOOK SERVICE, 33 GRAVEL HILL, WIMBORNE, DORSET BH21 1RW** (mail order only).

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!

MORE BOOKS NEXT MONTH

DIRECT BOOK SERVICE IS A DIVISION OF WIMBORNE PUBLISHING LTD.

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 airmail outside of Europe. 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).**

NOTE: While 95% 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 in the latest issue.

Boards can only be supplied on a payment with order basis.

We do have older boards in stock – please enquire.

PROJECT TITLE		Order Code	Cost
Spectrum EPROM Programmer	JUN'89	628	£7.87
Bat Detector		647	£4.95
Power Supplies – Fixed Voltage	SEP'89	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
Logo/Lego & Spectrum Interface		664	£5.60
EEG Electrode Impedance Meter	DEC'89	665	£3.98
Biofeedback Signal Generator	JAN'90	666	£4.08
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	MAY'90	689	£4.68
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 697's ordered *together* £3.25 each)			
Simple Metronome		698	£3.94
Hand Tally	SEP'90		
Main Board (double-sided) and Display Board		699, 700	£10.95
Alarm Bell Time-Out		701	£4.10
Mains Appliance Remote Control			
Temperature Controller (p.c.b. only)		702	£5.20
Ghost Waker	OCT'90	703	£4.32
Frequency Meter		704	£5.25
Freq. Meter/Tachometer	NOV'90	705	£3.98
EE Musketeer (TV/Video/Audio)		706	£5.78
Colour Changing Christmas Lights	DEC'90	707	£4.39
Microcontroller Light Sequencer		708/709	£10.90
Versatile Bench Power Supply Unit		710	£4.24
Teach-In '91, Part 1 – L200 Module		711	£3.93
Dual Output Module		712	£4.13
LM723 Module		713	£4.21
Spatial Power Display	JAN'91	714	£5.33
Amstrad PCW Sound Generator		715	£5.03
Teach-In '91, Part 2 – G.P. Transistor Amp		717	£3.77
Dual Op.Amp Module		718	£3.83
Intercom (Teach-In '91 Project 2)	JAN'91	719	£4.41
Analogic Test Probe		720	£3.24

PROJECT TITLE		Order Code	Cost
MARC Phone-In	FEB'91	721	£6.87
Teach-In '91 Part 3 – TBA820M Amplifier		723	£4.05
High Quality Power Amp		724	£4.93
Bench Amplifier (Teach-In '91 Project 3)		725	£4.45
Gingernut 80m Receiver			
R.F. section (726), Voltage Regulator (727)		726/7/8	£3.06
Audio Amplifier (728)			per board
		all 3 together	£8.16
Pocket Tone Dialler	MAR'91	729	£4.36
Battery To Mains Inverter		730	£4.97
Simple Basic Alarm		731	£4.50
Car Code Lock (pair)		732a/b	£4.69
Teach-In '91 Part 4 – Sinusoidal Oscillator		733	£4.39
8038 Oscillator		734	£4.15
Waveform Generator (Teach-In '91 Project 4)		735	£4.72
Humidity Tester	APR'91	716	£4.97
Model Train Controller (double-sided)		736	£9.75
Electronic Die (Teach-In '91 Project 5)		737	£4.93
Teach-In '91 Part 5 – Digital Counter Module		738	£4.35
Modular Disco Lighting System	MAY'91		
Switched Power Output Module		739	£5.91
Digital LCD Thermostat–Control Board	£5 for pair	740	£4.05
–Power/Relay Board		741	£3.76
Pulse Generator (Teach-In '91 Project 6)		742	£4.97
Teach-In '91 Part 6 – Timer Module		743	£4.62
Digilogue Car Tachometer	JUN'91	744	£5.63
Modular Disco Lights – Simple Chaser		745	£5.00
Sweeper Module		746	£5.17
Automatic Light Control – PSU Board		747	£4.88
Logic Board		748	£5.17
Radio Receiver (Teach-In '91 Project 7)		749	£4.57
Teach-In '91 Part 7 – R.F. Amplifier Module		750	£4.23
Modular Disco Lights – Masterlink	JULY'91	752	£6.36
Ultrasonic Proximity Meter			
Display Unit (753) & Sensor Unit (754)		753/754	£7.06
Disco Lights (Teach-In '91 Project 8)			
PSU and Pre-amplifier		755	£4.54
Low, Mid, High Filter/Triac (set of 3 boards)		756	£11.00
Teach-In '91 Part 8 – Solid State Switch Module		757	£4.24
Mod. Disco Lights – Pattern Gen	AUG'91	760	£6.79
Teach-In '91 Part 8 – Light Sensitive Switch		761	£4.74
Opto-Link (Teach-In '91 Project 9) – Transmitter		762	£4.85
Receiver		763	£4.88
Portable PEsT Scarer		764	£3.77
Capacitance Meter	SEP'91	751	£5.17
Modular Disco Lights – Dimmer Interface		765	£8.17
Mod. Disco Lights	OCT'91		
VU Sound Module (Double-sided)		767	£8.68
UV Exposure Unit		768	£4.63
PC-Scope Interface – Main Board		769	£6.95
Expansion Plug (Double-sided)		770	£5.96
Mod. Disco Lights	NOV'91		
Superchaser (Double-sided)		771	£6.91
Supersweep (Double-sided)		772	£8.26
Bicycle Alarm		773	£5.01
Darts Scorer		774	£7.90
Knockerbox	DEC'91	775	£5.35
Signal Generator – Main Board		776	£7.46
PSU		777	£4.73
Mind Machine – Main Board		778	£7.00
Auto Nightlight		779	£5.03
Mind Machine – Programmer Board	JAN'92	780	£7.39
Transistor Checker		781	£4.63
Stepping Motor Driver/Interface		782	£10.39
Micro-Sense Alarm		783	£5.42
Telesound	FEB'92	EE784	£4.66
Programmable Timer		EE785	£4.63
Auto Garage Light	MAR'92	786	£6.10
Versatile BBC Computer Interface		787	£11.59
Economy Seven Timer		788	£5.20

EE PRINTED CIRCUIT BOARD SERVICE

Order Code Project Quantity Price

....

Name...

Address...

....

I enclose payment of £ .... (cheque/PO in £ sterling only payable to Everyday Electronics) Access (MasterCard) or Visa No.

Minimum order for credit cards £5

Signature..Card Ex. Date..............................

Please supply name and address of card-holder if different from the address shown

BLOCK CAPITALS PLEASE

Carbon Film resistors ¼W 5% E24 series 0.51 R to 10MO ... 1p
100 off per value – 75p. even hundreds per value totalling 1000 ... £6.00p
Metal Film resistors ¼W 10R to 1 MO 5% E12 series – 2p. 1% E24 series ... 3p
Mixed metal/carbon film resistors ½W E24 series 1RO to 10MO ... 1½p
1 watt mixed metal/Carbon Film 5% E12 series 4R7 to 10 Megohms ... 5p
Linear Carbon pre-sets-100mW and ¼W 100R to 4M7 E6 series ... 7p

Miniature polyster 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. 0.68 - 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% 56pf to 330pf - 4p. 10% 390p-4700p ... 4p
Disc/plate ceramics 50V E12 series 1PO to 1000P, E6 Series 1500P to 47000P ... 2p

Polystyrene capacitors 63V working E12 series long axial wires
10pf to 820pf - 4p. 1000pf to 10,000pf - 5p. 12,000pf ... 6p
741 Op Amp - 20p. 555 Timer ... 22p
cmos 4001 - 20p. 4011 - 22p. 4017 ... 40p

ALUMINIUM ELECTROLYTICS (Mfds/Volts)
1/50, 2.2/50, 4.7/50, 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 electrolyics (Mfds/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. 100mA. 5.8, 12, 15, V + ... 30p

DIODES (piv/amps)
75/25mA 1N4148 2p. 800/1A 1N4006 4½p. 400/3A 1N5404 14p. 115/15mA OA91 .. 8p
100/1A 1N4002 3½p. 1000/1A 1N4007 5p. 60/1.5A S1M1 5p. 100/1A bridge ... 25p
400/1A 1N4004 4p. 1250/1A BY 127 10p. 30/15A OA47 ... 10p
Zener diodes E24 series 3V3 to 33V 400mW - 8p. 1 watt ... 12p
Battery snaps for PP3 - 6p for PP9 ... 12p
L.E.D.'s 3mm. & 5mm. Red, Green, Yellow - 10p. Grommets 3mm - 2p. 5mm ... 2p
Red flashing L.E.D.'s require 9-12V supply only ... 50p
Mains indicator neons with 220k resistor ... 10p
20mm fuses 100mA to 5A. O. blow 5p.A/surge 10p. Holders, chassis, mounting ... 6p
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 90p each. Universal charger unit ... £6.50p
Glass reed switches with single pole make contacts - 8p. Magnets ... 12p
0.1" Stripboard 2½" x 1" 9 rows 25 holes - 25p. 3¾ x 2½" 24 rows 37 holes ... 70p
Jack plugs 2.5 & 3.5m ... 14p
Sockets Panel Mtg. 2.5 & 3.5m ... 10p

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 - 18p. BFY50/51/52 - 20p.
BFX88 - 15p, 2N3055 - 50p, TIP31, 32 - 30p, TIP41, 42 - 40p. BU208A - £1.20, BF195, 197 - 12p
Ionisers with seven year guarantee, list price £16.95 ... £12.00

All prices are inclusive of VAT. Postage 30p (free over £5). Lists Free.

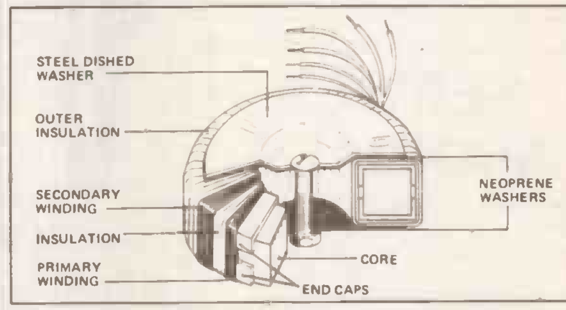
THE CR SUPPLY CO

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

OLP TRANSFORMERS FROM JAYTEE

The UK Distributor for Standard Toroidal Transformers

* 106 types available from stock
* Sizes from 15VA to 625VA



Write or phone for free Data Pack

Jaytee Electronic Services

143 Reculver Road, Beltinge, Herne Bay, Kent CT6 6PL
Telephone: (0227) 375254

NEW FROM HIGH-Q

30 VELLEMAN KITS

Added To Our Range

NOW "130" KITS AVAILABLE
For all Electronic Enthusiasts

Sole UK Importers •Trade Enquiries contact below

NEW KITS INCLUDE:

CODELOCK
CAR ACCESSORIES
COUNTERS
CAR ALARM
DIMMERS
HOUSEHOLD APPLICATIONS
POWER SUPPLIES
SENSORS
AUDIO
DIGITAL CONTROLLED PRE-AMPLIFIER
TIMERS
COMMUNICATIONS
1-CHANNEL INFRA-RED RECEIVER
ALARMS
LIGHT-EFFECTS
COMPUTER INTERFACE
MEASURING DEVICES
GADGETS
15-CHANNEL INFRA-RED TRANSMITTER

For 1991 Catalogue & Price List, please sent 75p (UK) or £2.00 (Overseas) to:

HIGH-Q-ELECTRONICS

VISA
P.O. BOX 142, Hatfield, Herts AL9 7JH
Tel: 0707 263562 Fax: 0707 276746

JOIN UP WITH LITESOLD

Professional Soldering Equipment at Special Mail-Order Prices.

SK18 Soldering Kit. £17.28
Build or repair any electronic project. LC18 240v 18w iron with 3.2, 2.4, and 1.6mm bits. Pack of 18 swg flux-cored 60/40 solder. Tweezers. 3 soldering aids. Reel of De-Solder braid.

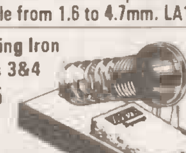
ADAMIN Miniature Iron £7.90

Possibly smallest mains iron in the world. Ideal for fine work. Slim nylon handle with finger grip. Interchangeable bits available Fitted with 2.4mm. 240v 12w

'L' Series Lightweight Irons. 12w £8.34

18w £8.41
High efficiency irons for all electronic hobby work. Non-roll handles with finger guards. Stainlessl steel element shafts. Screw-connected elements. Slip-on bits available from 1.6 to 4.7mm. LA12 model, 12w, 2.4mm bit. LC 18 Model, 18w, 3.2mm bit. 240v Std

Soldering Iron Stands 3&4 £6.85



Designed specially for LITESOLD irons. Heavy, solid-plastic base with non-slip pads. Won't tip over, holds iron safely. With wiping sponge and location for spare (hot) bits.
No 4 stand for ADAMIN miniature Iron
No 3 stand for LA12 and LC18 Irons.

De-Solder Pumps £8.03

High Quality version of increasingly popular type of tool. Precision made anodised aluminium body, plunger guard and high-seal piston. Easy thumb operation. Automatic solder ejection. Conductive PTFE nozzle – no static problems.

Prices include p&p and VAT. Send order with Cheque/PO. Ring for Access/Visa sales

Access VISA

LIGHT SOLDERING DEVELOPMENTS LTD.
97-99 GLOUCESTER ROAD, CROYDON CRO 2DN. 081 689 0574

EVERYDAY ELECTRONICS

CLASSIFIED

EE reaches 40% more UK readers than any other independent monthly hobby electronics magazine, our audited ABC sales figures prove it. EE has been the leading independent monthly magazine in this market for the last six years

If you want your advertisements to be seen by the largest readership at the most economical price our classified and semi-display pages offer the best value. The prepaid rate for semi-display space is £8 (+VAT) per single column centimetre (minimum 2.5cm). The prepaid rate for classified adverts is 30p (+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.
For rates and information on display advertisements ('8th page and larger spaces) please contact our Advertisement Manager, Peter Mew on 0255 850596.

THE BRITISH AMATEUR ELECTRONICS CLUB exists to help electronics enthusiasts by personal contact and through a quarterly Newsletter. For details, write to the Chairman:

Mr H. F. Howard, 41 Thingwall Park
Fishponds, Bristol BS16 2AJ

SERVICE MANUALS

Available for most equipment. TV, Video, Audio, Test, Amateur Radio, Military Surplus, Kitchen, etc. Any Video Recorder, Video Camera or Oscilloscope Manual £15.00
(subject to stock).
All other Manuals £10.00
(subject to stock).
State Make and Model required with order.
Over 100,000 manuals available for equipment from 1930's to the present.
Circuit sections supplied on full size sheets up to A1 size (33" x 24") if applicable. Originals or photostats supplied as available.
FREE Repair and Data Guide Catalogue with all orders or send SAE for your copy today

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

BTEC ELECTRONICS TECHNICIAN FULL-TIME TRAINING

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

O.N.C., O.N.D. and H.N.C.

Next course commences
Monday 27th April 1992
FULL PROSPECTUS FROM

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

IT PAYS TO ADVERTISE WITH
EVERYDAY ELECTRONICS
Your advert will reach 40% more readers than with any other independent monthly hobby electronics magazine

---

Rechargable Batteries

Quantity	1-99	100-499
AA (HP7) 500mAH	£0.99	£0.77 + VAT
AA 500mAH solder tags	£1.55	£0.95 + VAT
AA 700mAH high capacity	£1.95	£1.20 + VAT
C (HP11), 1.2AH	£2.20	£1.69 + VAT
C 2AH with solder tags	£3.60	£2.25 + VAT
D (HP2) 1.2AH	£2.60	£1.96 + VAT
D 4AH with solder tags	£4.95	£3.59 + VAT
PP3 8.4V 110mAH	£4.95	£3.85 + VAT
Sub C with solder tags 1.2AH	£2.50	£1.70 + VAT
1/2 AA with solder tags	£1.55	£1.17 + VAT
AAA (HP16) 180mAH	£1.75	£1.15 + VAT

Special offers for unusual sizes only while stocks last. Please check availability before ordering.

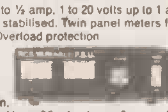
Quantity	1-99	100-499
F cell 7AH 32 x 87mm with flat top	£3.95	£2.80 + VAT
F cell with solder tags	£4.30	£3.00 + VAT
Cellular telephone battery 42mm long x 16mm dia	£1.45	£0.95 + VAT
Stick of 4 171 x 16 dia with 150mm red & black leads	£5.95	£4.00 + VAT
4 cell battery 94 x 25mm 4.8V	£3.50	£2.30 + VAT

All 1 to 99 prices include VAT
Please add 95p postage & packing per order

JPG Electronics
276-278 Chatsworth Road, Chesterfield S40 2BH
Access & Visa orders tel: (0246) 211202

RCS VARIABLE VOLTAGE D.C. BENCH POWER SUPPLY

1 to 24 volts up to ½ amp. 1 to 20 volts up to 1 amp. 1 to 16 volts up to 1½ amps d.c. Fully stabilised. Twin panel meters for instant voltage and current readings. Overload protection
Fully variable.
Operates from 240V a.c.
Compact Unit.
Size 9 x 5½ x 3in.



£45 inc. VAT
+ Post and

NEW MODEL. Up to 38volts d.c. at 6 amps 10 amps peak. Fully variable. Twin panel meters. Size 14½ x 11 x 4½in. £96 inc VAT. Carr £6.

RADIO COMPONENT SPECIALISTS
337 WHITEHORSE ROAD, CROYDON
SURREY, U.K. Tel: 081-684 1665
List, Large SAE. Delivery 7 days. Callers welcome. Closed Wednesday

---

PLEASE MENTION
EVERYDAY ELECTRONICS
WHEN REPLYING TO ADVERTISEMENTS

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
Send 2x1st class stamps for Catalogue. Cheques/P.O.s payable to:
QUANTEK ELECTRONICS LTD
Kits Dept. (EE), 3 Houldey Road, West Heath, Birmingham B31 3HL
SHOP NOW OPEN – CALLERS WELCOME

Typefit

The Typesetting programme for all your Typesetting needs.
If you need typesetting for your Adverts, Brochures, etc. Typefit can help you.

Please telephone
0202 882299

N. R. BARDWELL LTD (EE)

200	Signal diodes 1N4148	£1.00
75	Rectifier Diodes 1N4001	£1.00
75	Rectifier Diodes 1N4003	£1.00
50	Rectifier Diodes 1N4007	£1.00
56	Rectifier Diodes 1N5401	£1.00
10	NE555 Timer i.c.s	£1.00
5	741 Op Amp i.c.s	£1.00
8	C106D1 400V 6 amp thyristors	£1.00
8	BFY51 Transistors	£1.00
30	BC478 Transistors	£1.00
30	MPSA92 Transistors	£1.00
25	Asstd. high brightness l.e.d.s	£1.00
50	Axial l.e.d.s (Diode package) wide angle red	£1.00
50	Rectangular red l.e.d.s	£1.00
20	Miniature axial l.e.d.s super bright red	£1.00
24	Miniature red l.e.d.s 3mm dia	£1.00
12	Asstd. seven segment displays	£1.00
4	.43" Com. anode seven segment displays	£1.00
100	22NF 100V radial film capacitors	£1.00
100	33NF 50V radial film capacitors	£1.00
200	Asstd. disc ceramic capacitors	£1.00
80	4U7 16V Radial electrolytics	£1.00
75	4U7 63V Radial electrolytics	£1.00
80	10UF 16V Radial electrolytics	£1.00
50	10UF 50V Radial electrolytics	£1.00
80	22UF 25V Radial electrolytics	£1.00
60	33UF 16V Radial electrolytics	£1.00
80	47UF 16V Radial electrolytics	£1.00
50	47UF 50V Radial electrolytics	£1.00
80	100UF 10V Radial eletrolytics	£1.00
50	220UF 16V Radial electrolytics	£1.00
60	470UF 10V Radial electrolytics	£1.00
40	1000UF 10V Radial electrolytics	£1.00
30	Asstd. IF transformers	£1.00
48	Asstd. coil formers	£1.00
100	Asstd. RF chokes	£1.00
30	Asstd. dil sockets up to 40 pin	£1.00
30	Assorted socket/conns/edge-dil-sil-etc	£1.00
20	1 inch Glass reed switches	£1.00
10	4P 3W MBB min. rotary switches	£1.00
20	Min SP/CO slide switches	£1.00
20	Magnetic ear pips plus lead & plug	£1.00
1	Peltier effect heat pump	£1.95
1	10 watt Stereo amplifier, 4 controls plus data	£2.95
1	10mm Flashing l.e.d. red	£0.75
1	10mm Ultra bright l.e.d. red 300 MCD	£0.60

Prices include VAT, postage £1.00. Stamp for Lists
288 Abbeydale Road, Sheffield S7 1FL
Phone (0742) 552886. Fax (0742) 500689

Miscellaneous

KITS, PLANS, ETC for surveillance, protection (sonic, HV), "007" gear. Send 2 x 22p stamps for list. ACE(EE), 53 Woodland Way, Burntwood, Staffs.

G.C.S.E. ELECTRONICS KITS at pocket money prices. S.A.E. for FREE catalogue. SIR-KIT ELECTRONICS, 70 Oxford Road, Clacton CO15 3TE.

PROTOTYPE PRINTED CIRCUIT BOARDS one offs and quantities, for details send s.a.e. to B.M.A. Circuits, 38 Poynings Drive, Sussex BN3 8GR, or phone Brighton 720203.

BUMPER COMPONENT PACKS only £1.50 inc p&p. 16 Rollestons, Writtle, Essex (0860) 821440. Callers welcome by appointment.

EPROM programming, copying and updating from any device or software format. 10 day turnaround. Call/Fax: FTL 0491 681502/681944.

LIGHTING CONTROLLER KITS

For the serious Mobile Disco

SWITCHABLE 3-4 CHANNEL CONTROLLER with Beatchase and Speed Controls
PCB + Components Kit £21.00
Hardware Kit £12.00

MULTICHASE 4 CHANNEL CONTROLLER with Beatchase, Speed and Chase-Select Controls.
PCB + Components Kit £26.00
Hardware Kit £13.00

COMPUTER CHASE 4 CHANNEL CONTROLLER
A Controller designed to achieve very good results from many types of lighting display. Perfect for pinspots, super on screens, can even revitalize spotlamp boxes. Fast tracking autolevel audio input and choice of sound modes ensure accurate and varied interpretation of music.
PCB + Components Kit £35.00
Hardware Kit £15.00

Postage & Packing £1.50 per order

LOUDSPEAKER KITS

High Powered Speakers for P.A. and Disco Use ready made black Vynide covered cabinets, cutout ready for fitting of wide dispersion horn and 12" 100 watt RMS Driver or 15" 200watt RMS Driver. Kit contains all fixings, clamps, sockets, labels etc.
MAGNUM 100 (1 x 12" + 7" x 3" Horn) £165 pair
Size 540mm x 380mm x 300mm
MAGNUM 200 (1 x 15" + 7" x 3" Horn) £235 pair
Size 635mm x 460mm x 330mm

Carrier Delivery £12.00 pair

TEST EQUIPMENT KITS

LED DISPLAY OSCILLOSCOPE with 9x9 grid of high efficiency LEDs with trigger/freerun, brightness, sensitivity, position and timebase.
£19.95

WAVEFORM GENERATOR with sine, triangle and square wave output. Range, frequency and amplitude.
£9.95

Postage & Packing 50p

FAST FRIENDLY SERVICE — ALL PRICES INCLUDE VAT

NORTECH electronic

98 School Street, Wolverhampton, West Midlands WV3 0NR.
Tel: (0902) 23275

TEST EQUIPMENT MAINTENANCE AND TECHNICAL CONSULTANCY

☐ **Service manuals**
☐ **Spare parts**
☐ **Comprehensive repair service including complete instrument refurbishment at highly competitive rates for radio amateurs**

Distributors for:
WAUGH INSTRUMENTS
RAMTEST LTD
KRENZ-ELECTRONICS

☐ We support scientific, commercial and industrial equipment manufactured by over 100 different companies
☐ New and second-hand test equipment also available at competitive prices
☐ Components, valves and miscellaneous items

Hesing Technology

41 Bushmead Road, Eaton Socon, St. Neots, Cambs PE19 3BT
Telephone and Fax: (0480) 214488

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	☐	TV, Video & Hi-Fi Servicing	☐
Basic Electronic Engineering (City & Guilds)	☐	Refrigeration & Air Conditioning	☐
Electrical Engineering	☐	Car Mechanics	☐
Electrical Contracting/ Installation	☐	Computer Programming	☐
GCSE/GCE/SCE over 40 examination subjects to choose from			☐

Name ______________________ Address ______________________

ICS

International Correspondence Schools Dept ECS 32 312/314 High Street Sutton Surrey SM1 1PR
Telephone 081-643 9568 or 041-221 2926 (24 hours)

ADVERTISERS INDEX

ANTEX (ELECTRONICS) 132
N. R. BARDWELL 190
BK ELECTRONICS .... Cover (iii)
BRIAN J. REED 192
BULL ELECTRICAL .... Cover (ii)
CAMBRIDGE COMP. SCIENCE 191
CIRKIT DISTRIBUTION 141
COMPELEC 192
CRICKLEWOOD ELECTRONICS 169
CR SUPPLY COMPANY 189
EAGLE PUBLICATIONS 169
ELECTRONIZE DESIGN 132
ESR ELECTRONIC COMP. 133
ELECTROVALUE 132
FJP KITS & COMPONENTS 187
GREENWELD ELECTRONICS 136
HAPPY MEMORIES 169
HART ELECTRONIC KITS 173
HESING TECHNOLOGY 192
HIGH-Q-ELECTRONICS 189
HOBBYKIT 130
ICS 192
JAYTEE ELECTRONIC SERVICES 187/189
JPG ELECTRONICS 190
LITESOLD 189
M&B ELECT. SUPPLIES 159
MAGENTA ELECTRONICS 134/135
MAPLIN ELECTRONICS .... Cover (iv)
MARAPET 191
MAURITRON TECH. SERV'S 190
NATIONAL COLLEGE OF TECH 191
NORTECH ELECTRONIC 192
NUMBER ONE SYSTEMS 141
OMNI ELECTRONICS 191
PICO TECHNOLOGY 169
SHERWOOD ELECTRONICS 169
SUMA DESIGNS 183
TANDY 145
TECHNICAL INFO. SERVICES 191
TK ELECTRONICS 132
TYPESETTING BUREAU 187

Millions of quality components at lowest ever prices!

Plus Tools, Watches, Fancy Goods, Toys.
Mail order UK only.

All inclusive prices –
NO post, or VAT etc to add on.
Send 34p stamped self addressed label or envelope for catalogue/clearance list.

At least 2,100 offers to amaze you.

Brian J Reed
6 Queensmead Avenue, East Ewell
Epsom, Surrey KT17 3EQ
Tel: 081-393 9055

Metal detector boards with Data has tuner, mode, discriminate, headphone jack, on/off volume & push button facilities .... £7.95 ea*
Dictaphone cassette, mech/record erase playback heads, 6V solenoid, motor, hall effect switch .... £2.00 ea*
T.V./Printer stands .... £3.95 ea
Bicc-Vero Easiwire construction kit .... £4.95 ea*
TTL/CMOS short circuit snooper £4.95*
Dot matrix LCD 10x2 lines .... £3.75 ea*
Dot matrix LCD 16 x 1 lines with Data £4.95*
20 characters x 2 lines dot matrix LCD with data £7.95*
40 characters x 1 line dot matrix LCD with data £15.00*
2 digit 16 segment VF display with data .... £2.95 ea*
4 digit Intelligent dot matrix display £6.00*
17 segment V.F. display with driver board and data .... £2.99 ea*
8 digit liquid crystal display .... £1.75 ea*
4 digit LCD with 7211 driver chip .... £3.50 ea*
Digital clock display £2.50*
11 key membrane keypad .... £1.50 ea*
Keyboard 392mm x 180mm/100 keys on board + LCD + 74HC05/80C49 easily removable £4.95
19" 3U sub rack enclosures £8.95
12V stepper motor, 48 steps per rev, 7.3° step angle .... £3.95 ea*
Stepper motor board with 2 slotted opto + 2 mercury tilt switches .... £3.95 ea*
1000 mixed ¼ watt 1% resistors .... £4.95 ea
250 electrolyic axial + radial caps .... £4.95 ea
200 off mixed polyester caps £7.95*
100 Mixed trimmer caps popular values .. £4.95*
50 off MC 78M12CT Volt Regs £2.95*
20 off W02M Volt Regs £1.50*
25 off asst. buzzers & sounders £4.95*
Cable box UHF modulator/video preamp/transformer/R's + C's/leads £6.95
1000 off mixed Multilayer Ceramic Caps £7.95
Solar cell modules 0.45V 700mA .... £2.95 ea*
B.B.C. Micro to disc drive lead £1.50*
Car Burglar alarm vibration auto entry/exit delay .... £5.95 ea*
Single zone alarm panel auto entry/exit delay housed in domestic light socket .... £9.95 ea*

P.C. P.S.U. 50 watt 115-230V input + 5V 4A + 12V 2.5A output with built in fan, IEC inlet + on off .... £9.95 ea
STC P.S.U. 240V input 5V 6A output (converts to 12V 3A details available) .... £5.95 ea
240V input 5V 10A output (converts to 12V 5A no details) .... £5.95 ea
600Ω line output transformers ..... £1.25 ea*
240V in 0-12V 0.75A out transformer £1.75*
240V in 0-28V 62VA out transformer. £2.75
Transformer + PCB gives 2x7.5V 32VA with skt for 5 or 12V regulator, will power floppy drive .... £3.75 ea
Ultrasonic transducers (transmit + receive) .... £1.50 pair
3 to 16V Piezoelectric sounders 50p*
9VDC electromechanical sounder 50p*
24V DC electromechanical sounder 50p*
2A 250V keyswitch 3 position key removable in two positions £1.50*
DIL switches PCB MT 3/4/6 way 35p*
5V SPCO SIL reed relay 40p*
5V 2PCO DIL miniature relay 60p*
12V 2PCO or 4PCO continental relay .. 60p*
12V 10A PCB MT (to make contact) relay 95p*
3 to 12V electro magnetic acoustic transducer with data 75p*
2.4576/8.8329/21.10 MHz crystals .... 50p ea*
Bridges 25A 200V £1.00*
2A 100V 50p*
3lb Mixed components pack £4.95
25 off mixed relays £5.95*
40 off mixed toggle switches £9.95*
50 off mixed switches, toggle, rocker, slide, micro £9.95
Miniature axial chokes 0.1, 0.18, 0.12, 0.33, 0.39, 0.15, 1, 3.3UH .... 10p ea., 100 for £7.50*
50 Mixed terminal blocks £2.95
250off 16/22/24/40 way IC Skts £4.95*
100 off Phono plugs (red/black/grey) £3.50*

QUANTITY DISCOUNTS AVAILABLE PLEASE RING

ALL PRICES INCLUDE V.A.T. PLEASE ADD £2.00 p&p EXCEPT ITEMS MARKED WHICH ARE 50P. SAE FOR BULK BUYING LIST PAYMENT WITH ORDER TO:*

Dept EE, COMPELEC,
14 Constable Road
St. Ives, Huntingdon,
Cambs PE17 6EQ
Tel/Fax: 0480 300819

Published on approximately the first Friday of each month by Wimborne Publishing Ltd., 6 Church Street, Wimborne, Dorset BH21 1JH. Printed in England by Benham & Co. Limited, Colchester, Essex. Distributed by Seymour, Windsor House, 1270 London Road, Norbury, London SW16 4DH. Sole Agents for Australia and New Zealand –Gordon & Gotch (Asia) Ltd., South Africa –Central News Agency Ltd. Subscriptions INLAND £18.50 and OVERSEAS £23 (£40.50 airmail) payable to "Everyday Electronics" Subscription Department, 6 Church Street, Wimborne, Dorset BH21 1JH. EVERYDAY ELECTRONICS is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

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

★ PRICES INCLUDE V.A.T. ★ PROMPT DELIVERIES ★ FRIENDLY SERVICE ★ LARGE (A4) S.A.E. 50p STAMPED FOR CATALOGUE ★

MP MOS-FET POWER AMPLIFIERS
IGH POWER, TWO CHANNEL 19 INCH RACK

THOUSANDS PURCHASED BY PROFESSIONAL USERS

THE RENOWNED MXF SERIES OF POWER AMPLIFIERS

FOUR MODELS:- MXF200 (100W + 100W) MXF400 (200W + 200W) MXF600 (300W + 300W) MXF900 (450W + 450W)

ALL POWER RATINGS R.M.S. INTO 4 OHMS, BOTH CHANNELS DRIVEN

EATURES: ★Independent power supplies with two toroidal transformers ★ Twin L.E.D. Vu meters ★ evel controls ★ Illuminated on/off switch ★ XLR connectors ★ Standard 775mV inputs ★ Open and short circuit roof ★ Latest Mos-Fets for stress free power delivery into virtually any load ★ High slew rate ★ Very low listortion ★ Aluminium cases ★ MXF600 & MXF900 fan cooled with D.C. loudspeaker and thermal protection.

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

SIZES:- MXF200 W19"xH3½" (2U)xD11"
MXF400 W19"xH5¼" (3U)xD12"
MXF600 W19"xH5¼" (3U)xD13"
MXF900 W19"xH5¼" (3U)xD14¾"

PRICES:- MXF200 £175.00 MXF400 £233.85
MXF600 £329.00 MXF900 £449.15

SPECIALIST CARRIER DEL. £12.50 EACH

OMP VARISPEED TURNTABLE CHASSIS

★ Manual arm ★ Steel chassis ★ Electronic speed control 33 & 45 R.P.M. ★ Vari pitch control ★ High torque servo driven DC motor ★ Transit screws ★ 12" die cast platter ★ Neon strobe ★ Calibrated balance weight ★ Removable head shell ★ ½" cartridge fixings ★ Cue lever★ 220/240V 50/60Hz ★ 390x305mm ★ Supplied with mounting cut-out template.

PRICE £61.30 + £3.70 P&P

PTIONAL MAGNETIC CARTRIDGES **STANTON AL500MkII** PRICE £16.95 + 50P P&P **GOLDRING G950** PRICE £7.15 + 50P P&P

STEREO DISCO MIXER DJ6500

★ WITH ECHO ★

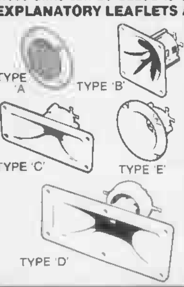
STEREO DISCO MIXER with 2 x 7 band & R graphic equalisers with bar graph ED Vu meters. **MANY OUTSTANDING FEATURES:-** including Echo with repeat & peed control, DJ Mic with tone control talk-over switch, 7 Channels with individual faders plus cross fade, Cue Headphone Monitor. Useful combination of he following Inputs:- 3 turntables (mag), 3 mics, 5 Line for CD, Tape, Video etc.

Price £134.99 + £5.00 P&P

SIZE: 482 x 240 x 120mm

PIEZO ELECTRIC TWEETERS - MOTOROLA

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



TYPE 'A' (KSN1036A) 3" round with protective wire mesh. Ideal for bookshelf and medium sized Hi-Fi apeakers. **Price £4.90 + 50p P&P.**
TYPE 'B' (KSN1005A) 3½" super horn for general purpose speakers, disco and P.A. systems etc. **Price £5.99 + 50p P&P.**
TYPE 'C' (KSN1016A) 2"x5" wide dispersion horn for quality Hi-Fi systems and quality discos etc. **Price £6.99 + 50p P&P.**
TYPE 'D' (KSN1025A) 2"x6" 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 + 50p P&P.**
TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. **Price £5.99 + 50p P&P.**
LEVEL CONTROL Combines, on a recessed mounting plate, level control and cabinet input jack socket. 85x85mm. **Price £4.10 + 50p P&P.**

OMP LINNET LOUDSPEAKERS

THE VERY BEST IN QUALITY AND VALUE

Made especially to suit today's need for compactness with high output sound levels, finished in hard wearing black vynide with protective corners, grille and carrying handle. Each unit incorporates a 12" driver plus high frequency horn for a full frequency range of 45Hz-20KHz. Both models are 8 Ohm impedance. Size: H20" x W15" x D12".

CHOICE OF TWO MODELS

POWER RATINGS QUOTED IN WATTS RMS FOR EACH CABINET

OMP 12-100WATTS (100dB) PRICE £163.50 PER PAIR
OMP 12-200WATTS (200dB) PRICE £214.55 PER PAIR

SPECIALIST CARRIER DEL. £12.50 PER PAIR

IN-CAR STEREO BOOSTER AMPS

THREE SUPERB HIGH POWER CAR STEREO BOOSTER AMPLIFIERS
150 WATTS (75 + 75) Stereo, 150W Bridged Mono
250 WATTS (125 + 125) Stereo, 250W Bridged Mono
400 WATTS (200 + 200) Stereo, 400W Bridged Mono
ALL POWERS INTO 4 OHMS
Features:
★ Stereo, bridgable mono ★ Choice of high & low level inputs ★ L & R level controls ★ Remote on-off ★ Speaker & thermal protection.

PRICES: 150W £49.99 250W £99.99
400W £109.95 P&P £2.00 EACH

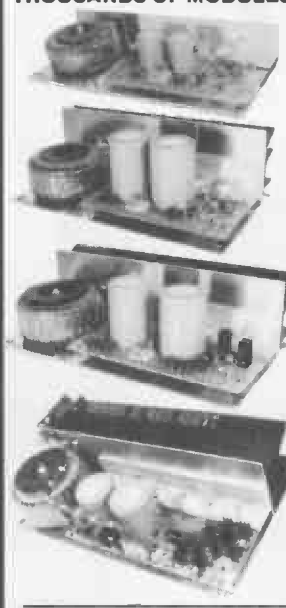
POSTAL CHARGES PER ORDER £1.00 MINIMUM. OFFICIAL ORDERS FROM SCHOOLS, COLLEGES, GOVT. BODIES, PLCs ETC. PRICES INCLUSIVE OF V.A.T. SALES COUNTER. VISA AND ACCESS ACCEPTED BY POST, PHONE OR FAX.

OMP MOS-FET POWER AMPLIFIER MODULES

SUPPLIED READY BUILT AND TESTED.

These modules now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models are available to suit the needs of the professional and hobby market i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE that all models include toroidat power supply, integral heat sink, glass fibre P.C.B. and drive circuits to power a compatible Vu meter. All models are open and short circuit proof.

THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS



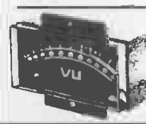
OMP/MF 100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 45V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 123 x 60mm.
PRICE £40.85 + £3.50 P&P

OMP/MF 200 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. -110 dB. Size 300 x 155 x 100mm.
PRICE £64.35 + £4.00 P&P

OMP/MF 300 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 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 330 x 175 x 100mm.
PRICE £81.75 + £5.00 P&P

OMP/MF 450 Mos-Fet Output power 450 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 385 x 210 x 105mm.
PRICE £132.85 + £5.00 P&P

NOTE: MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.



Vu METER Compatible with our four amplifiers detailed above. A very accurate visual display employing 11 L.E.D.s (7 green, 4 red) plus an additional on/off indicator. Sophisticated logic control for very fast rise and decay times. Tough moulded plastic case, with acrylic tinted front. Size 84 x 27 x 45mm.
PRICE £8.70 + 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 (A4) S.A.E. (50p STAMPED) FOR COMPLETE LIST.

P - From McKenzie Professional Series
S - From McKenzie Studio Series

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

ALL McKENZIE UNITS 8 OHMS IMPEDANCE

8" 100 WATT P C8-100GP GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID, DISCO.
RES. FREQ. 80Hz, FREQ. RESP. TO 7KHz, SENS 96dB. **PRICE £31.45 + £2.00 P&P**
10" 100WATT S C10-100GP GUITAR, VOICE, KEYBOARD, DISCO, EXCELLENT MID.
RES. FREQ. 72Hz, FREQ. RESP. TO 6KHz, SENS97dB. **PRICE £38.89 + £2.50 P&P**
10" 200WATT S C10-200GP GUITAR, KEYB'D, DISCO, EXCELLENT HIGH POWER MID.
RES. FREQ. 69Hz, FREQ. RESP. TO 5KHz, SENS 97dB. **PRICE £53.21 + £2.50 P&P**
12" 100WATT P C12-100GP HIGH POWER GEN. PURPOSE, LEAD GUITAR, DISCO.
RES.FREQ. 49Hz, FREQ. RESP. TO 7KHz, SENS 98dB. **PRICE £40.35 + £3.50 P&P**
12" 100WATT P C12-100TC (TWIN CONE) HIGH POWER, WIDE RESPONSE, P.A., VOICE, DISCO.
RES. FREQ 45Hz, FREQ. RESP. TO 12KHz, SENS 97dB. **PRICE £41.39 + £3.50 P&P**
12" 200WATT S C12-200B HIGH POWER BASS, KEYBOARDS, DISCO, P.A.
RES. FREQ. 45Hz, FREQ. RESP. TO 5KHz, SENS 99dB. **PRICE £71.91 + £3.50 P&P**
12" 300WATT S C12-300GP HIGH POWER BASS, LEAD GUITAR, KEYBOARDS, DISCO ETC.
RES. FREQ. 49Hz, FREQ. RESP. TO 7KHz, SENS 100dB. **PRICE £95.66 + £3.50 P&P**
15" 100WATT P C15-100BS BASS GUITAR, LOW FREQUENCY, P.A., DISCO.
RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS 98dB. **PRICE £ 59.05 + £4.00 P&P**
15" 200WATT P C15-200BS VERY HIGH POWER BASS.
RES. FREQ. 40Hz, FREQ. RESP. TO 3KHz, SENS 98dB. **PRICE £80.57 + £4.00 P&P**
15" 250WATT S C15-250BS VERY HIGH POWER BASS.
RES. FREQ. 39Hz, FREQ. RESP. TO 4KHz, SENS 99dB. **PRICE £90.23 + £4.50 P&P**
15" 400WATT S C15-400BS VERY HIGH POWER, LOW FREQUENCY BASS.
RES. FREQ. 40Hz, FREQ. RESP. TO 4 KHz, SENS 100dB. **PRICE £105.46 + £4.50 P&P**
18" 500WATT S C18-500BS EXTREMELY HIGH POWER, LOW FREQUENCY BASS.
RES. FREQ. 27Hz, FREQ. RESP. TO 2KHz, SENS. 98dB. **PRICE £174.97 + £5.00 P&P**

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

ALL EARBENDER UNITS 8 OHMS (Except EB8-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)
BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND
8" 50watt EB8-50 DUAL IMPEDENCE, 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" 50WATT EB10-50 DUAL IMPEDENCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS. 99dB. **PRICE £13.65 + £2.50 P&P**
10" 100WATT EB10-100 BASS, HI-FI, STUDIO.
RES. FREQ. 35Hz, FREQ. RESP. TO 3KHz, SENS 96dB. **PRICE £30.39 + £3.50 P&P**
12" 100WATT EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO.
RES. FREQ. 26Hz, FREQ. RESP. TO 3 KHz, SENS 93dB. **PRICE £42.12 + £3.50 P&P**
FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND
5¼" 60WATT 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**
6½" 60WATT 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" 60WATT EB8-60TC (TWIN CONE) HI-FI, MILTI-ARRAY DISCO ETC.
RES. FREQ. 40Hz, FREQ. RESP. TO 18KHz, SENS 89dB. **PRICE £12.99 + £1.50 P&P**
10" 60WATT EB10-60TC (TWIN CONE) HI-FI, MULTI ARRAY DISCO ETC.
RES. FREQ. 35Hz, FREQ. RESP. TO 12KHz, SENS 98dB. **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 TRANSMITTER 80-108MHz, VARICAP CONTROLLED PROFESSIONAL PERFORMANCE, RANGE UP TO 3 MILES, SIZE 38 x 123mm, SUPPLY 12V @ 0.5AMP.
PRICE £14.85 + £1.00 P&P

FM MICRO TRANSMITTER 100-108MHz, VARICAP TUNED, COMPLETE WITH VERY SENS FET MIC, RANGE 100-300m, SIZE 56 x 46mm, SUPPLY 9V BATTERY.
PRICE £8.00 + £1.00 P&P

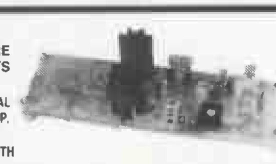


PHOTO: 3W FM TRANSMITTER

B.K. ELECTRONICS

UNITS 1 & 5 COMET WAY, SOUTHEND-ON-SEA, ESSEX, SS2 6TR.
Tel.: 0702 - 527572 Fax.: 0702 - 420243

★ SALE ★ SALE ★ SALE ★

SALE ★ SALE ★ SALE ★ SALE

SALE ★ SALE ★ SALE ★ SALE

MARCO TRADING

INCORPORATING
EAST CORNWALL COMPONENTS

CATALOGUE SUPPLEMENT AND SPRING SALE 1992

SPECIAL OFFERS

FREE
PAIR OF SIDECUTTERS
(cat. price £2.50)
with every order
over £20 —
details inside

★ SALE ★ SALE ★

MARCO TRADING

******************* INCORPORATING *******************

EAST CORNWALL COMPONENTS

THE MALTINGS, HIGH ST. WEM, SHREWSBURY, SY4 5EN

TEL: 0939 232763 TEL: 0939 232689 FAX: 0939 233800

We are pleased to present our 1992 Catalogue supplement, Spring Sale and Special Offers. Some of the Sale items will only be available on orders received before end March 1992. (See inside supplement).
To avoid disappointment we strongly recommend placing your order early!!

All prices include 17½% VAT - simply add £2-25 P&P to your order.
(Overseas customers do not pay UK VAT. Simply divide total by 1.175, giving the amount due excluding UK VAT. (Books are exempt of VAT)

FREE GIFT!!!!!!! Simply request the Free Gift on THE ENCLOSED ORDER FORM (Only the enclosed order form...Sorry...NO PHOTO-COPIES). and providing your order is over **£20** we will send you a pair of super quality side-cutters. These are in our 1992 catalogue and priced £2-50!!!!
They are excellent quality. This offer is only available on orders received before end of **MARCH 92.**

NEW TELEPHONE & FAX NUMBERS...... All the numbers had a '2' added, please make a note of our new numbers.....see at the top of the page.

All Terms & Conditions apply as per our full 1992 catalogue.

1992 MAIL ORDER CATALOGUE

GOT YOUR COPY YET?

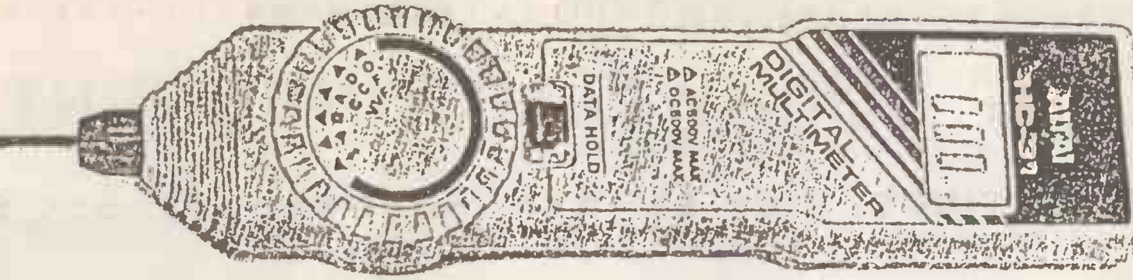
* 132 illustrated pages
* Pages of 'Special Offers'
* Free Pre-Paid Envelope
* Free 'Latest Special Offers' Info.
* Free Gifts Offer
* Order Form included
* Full Video & TV Spares Section
* New Computer Accessories
* Special Quanity Prices shown
* 5 pages of Kits to suit all levels.
* 8 pages of Books
* Full colour Velleman Kit catalogue
* Details of our 3 shops
* And Lot's, Lot's more!!

ONLY £2-00 per copy UK (£4 Overseas)

FREE WITH ORDERS OVER £20 on request!!

ACCESS & VISA WELCOME

LESS THAN HALF PRICE....!!!!!!!!



SALE PRICE £15-00

(NORMAL PRICE £31-65)

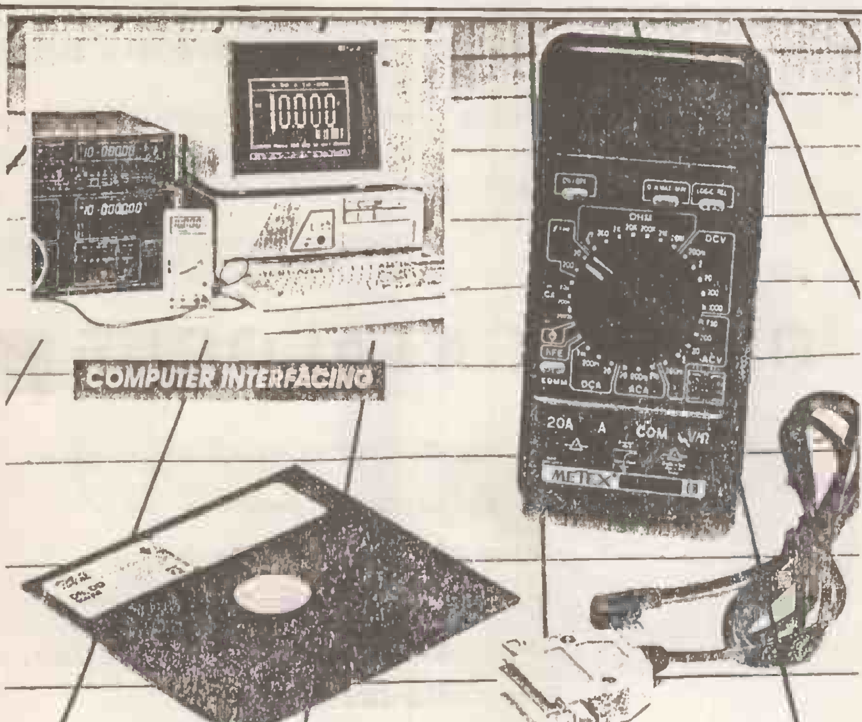
Y123PA

20MΩ PROBE MULTIMETER

★ 3.5 digit 8mm LCD display
★ Fully autoranging
★ Display hold facility
★ Probe styling
★ Auto polarity and zero

Complete with extended probe, fully shrouded test leads and vinyl carrying wallet

AC volts ....0-2-20-200-500Vac ± 1.2%
DC volts..................0-200m-2-20-200-500Vdc ± 1.0%
Resistance...0-200-2K-20K-200K-2M-20Meg±1%
Dims..160 x 35 x 20mm



Y122HR **SALE PRICE £79-99**

The Y122HR (M3650CR) multimeter is capable of communicating either the current LCD readout or up to 5 stored measurement values direct to data acquisition systems, PC's, pen plotter, printer, etc. via its MT/RS232C interface cable. Interface cable and program disc included with meter.

★ 3.5 digit 17mm LCD display
★ 30 ranges including 20A ac/dc
★ Data hold
★ Max/min value capture
★ 40 point analog bargraph
★ Frequency counter
★ Logic test with auto level
★ Capacitance test
★ Continuity test with buzzer
★ Transistor and diode test
★ Built and tested to IEC 348
★ Fully shrouded test leads

Battery, instruction manual and carrying case included.

AC volts ....0-200m-2-20-200-750Vac ± 0.8%
DC volts........................0-200m-2-20-200-1000Vdc ± 0.3%
AC current................................0-2m-200m-20Aac ± 1.8%
DC current.......................0-200μ-2m-200m-20Adc ± 0.5%
Resistance.................0-200-2k-20k-200k-2M-20MΩ ± 0.5%
Capacitance..........................0-2000pf-200n-20μF ± 2.0%
Frequency...0-20k-200kHz ± 2.0%
Transistor hFE..0-1000 NPN/PNP
Dims...176 x 90 x 36mm

Packed: BOX

Y132 **HYT07**

LOGIC PROBE

Logic probe suitable for displaying the logic state of each gate of TTL, CMOS, etc. devices. Logic state displayed in light and sound. Pulse enlargement capability allows pulse detection down to 25nsec. Supplied with comprehensive instruction manual.

Working voltage..4-16Vdc
Thresholds: Hi...70% Vcc
Lo...30% Vcc
Input impedance...1MΩ
Max. input freq...20MHz

(NORMAL PRICE £10-50)

SALE PRICE

£5-99

MORE SUPER SAVERS.....ORDER NOW..WHILE STOCKS LAST.....

T143A

UHF/VHF/FM ANTENNA WITH AMP

The T143A antenna has many useful features, not least of which is the dual voltage input which allows it to be used in the home or whilst camping, boating, etc. The antenna dish can be rotated left or right to pick up the best signal which can then be boosted using the built-in amplifier and gain control. May be used as an amplifier for an external (roof) aerial. LED indicators indicate which aerial is in use (red = integral antenna, green = external antenna). As the amplifier gain is increased, the amplifier will automatically switch from external to integral aerial.

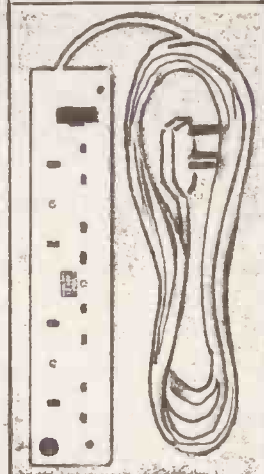
Gain	20dB VHF, 30dB UHF
Gain control	0-30dB
Max. output level	100dBμV
Power	220/240Vac or 12Vdc
Dims	340 x 220 x 1100mm

DESOLDERING TOOL

Very high quality, made in Malta and assembled in U.K. Very powerful fitted with Teflon Micro nozzle. Length: 190mm.Dia:20mm.

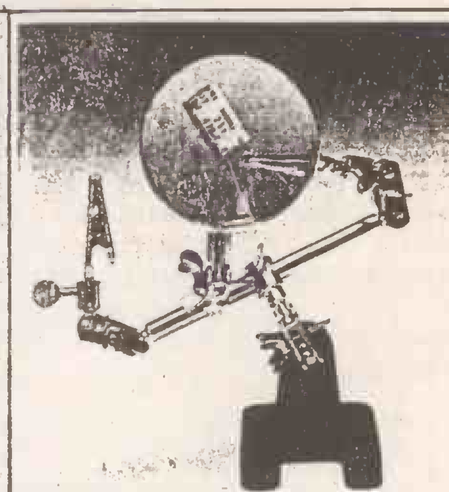
SOLD/DESOL ~~Price: £3-50~~

SALE PRICE £2-99



4-WAY EXTENSION
+ 3MTR LEAD
+ 13A PLUG

£5-99



SALE PRICE £5-99

Y057

HELPING HANDS

Top quality "Made in Japan" version with glass 2.5" dia. magnifier in steel frame. (Magnification x 2.5).

SALE PRICE £16-50

MOBILE UHF/VHF/FM ANTENNA with built-in amplifier HT143C

The EU670SDC is a mesh dish antenna designed primarily for use with caravans, mobile homes, commercial vehicles, etc. The antenna dish can be rotated left or right to pick up the best signal, which can then be boosted using the built-in amplifier and gain control. The amplifier may also be used to boost the signal from an external aerial. The integral LEDs indicate which aerial is in use.

Gain	20dBVHF, 30dBVHF
Gain control	0-30dB
Max. output level	100dBμV
Power	12 or 24Vdc
Dims	230 x 110 x 340mm (approx.)

Y122AJ **MX190**

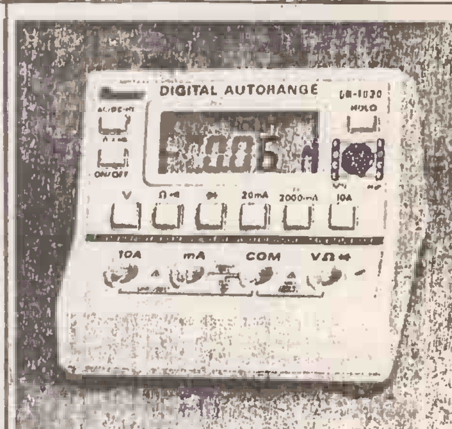
10MΩ

★ 19 ranges
★ 3.5 digit 12mm LCD display
★ Signal injector function
★ Diode test
★ Fuse protection
★ Automatic polarity and zero
★ Test leads with 4mm plugs

Battery and instruction manual included.

AC volts	0-200-750Vac ± 1.2%
DC volts	0-200m-2-20-1000Vdc ± 0.8%
DC current	0-200μ-2m-20m-200m-2Adc ± 1.0%
Resistance	0-200-2k-20k-200k-2MΩ ±0.8%
Signal injector	50Hz square wave
	5V peak to peak
Dims	126 x 70 x 24mm

SALE PRICE £15-50



10MΩ

★ Unique bench top design
★ 12mm 3.5 digit LCD display
★ Fully autoranging voltage and resistance ranges
★ 21 ranges including 10A acdc
★ Transistor and diode test
★ Display hold
★ Full overload protection
★ High impact ABS body

Supplied complete with fully shrouded test leads, battery and instruction manual.

AC volts	0-2-20-200-700V ± 1%
DC volts	0-200m-2-20-200-1000Vdc ± 0.8%
AC current	0-20m-2-10Aac ± 1.5%
DC current	0-20m-2-10Adc ± 1.2%
Resistance	0-200-2k-20k-200k-2M-20MΩ ± 1%
Transistor hFE	0-1000 NPN/PNP
Dims	94 x 90 x 74mm

SALE PRICE £38-00

ALL PRICES INCLUDE V.A.T.

ADD £2.25 P&P PER ORDER

ANOTHER ILLUMINATING OFFER

12V FLUORESCENT LIGHT

A very attractive **twin** tube fluorescent light complete with two 12Volt 8Watt fluorescent standard type & size tubes.
White plastic case with clear plastic ribbed diffuser and ON/OFF switch.
The light is fitted with approx. 90cms. of twin flex for connection to 12V battery or other 12V power supply. Cable is colour coded for polarity identification.
These lights are ideal for **Caravans, Boats, Vans,** Camping **etc etc.**

	1+	10+	50+	100+
Overall dimensions: 370 X 65 X 41mm				
ORDER CODE: **OPTO/TFL12**	**£5-99**	£5-50	£5-00	£4-75

SINGLE 12Volt Fluorescent Light

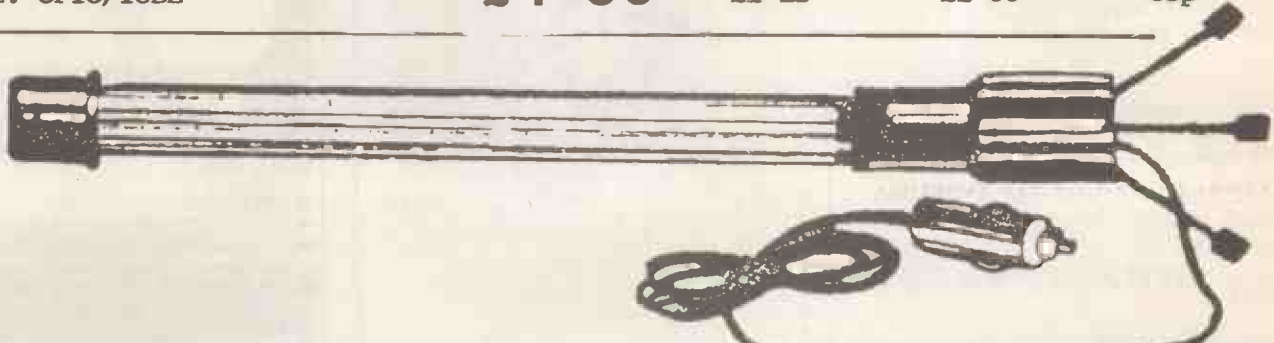
Identical to the above unit but **SINGLE** tube fitting.

ORDER CODE: OPTO/SFL12	**£5-50**	£5-00	£4-50	£4-25

SPARE TUBES

Standard 12V fluorescent tube suitable not only for our lights above but for most other makes. Tube length is approx: 300mm incl. pins.
Colour: White.

	1+	10+	50+	100+
ORDER CODE: **OPTO/TUBE**	**£1-50**	£1-25	£1-00	85p



PORTABLE 12V FLUORESCENT LIGHT - 12Volt
Free-standind or hanging (Hanging hook supplied), with approx. 5 Metres lead terminating in standard car type cigar plug. Ideal for use in Car, Boat, Caravan, Van, Camping etc.
Sealed unit therefor completely weatherproof, they even float on water!!
The fluorescent light is 12Volt & 10Watts.

	1+	10+	50+	100+
Overall dimensions: 430 X 30MM dia.				
ORDER CODE: OPTO/PEL12	**£5-99**	£5-50	£5-00	£4-75

WE ARE THE IMPORTERS OF THESE ITEMS. LARGER QTY. PRICES AVAIL.

CAR GRAPHIC & BOOSTER SALE

COBRA EQUALIZER

UNIQUE "COBRA" STYLING

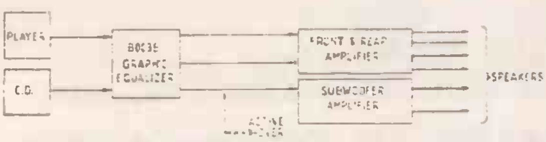
B003B

£59-99

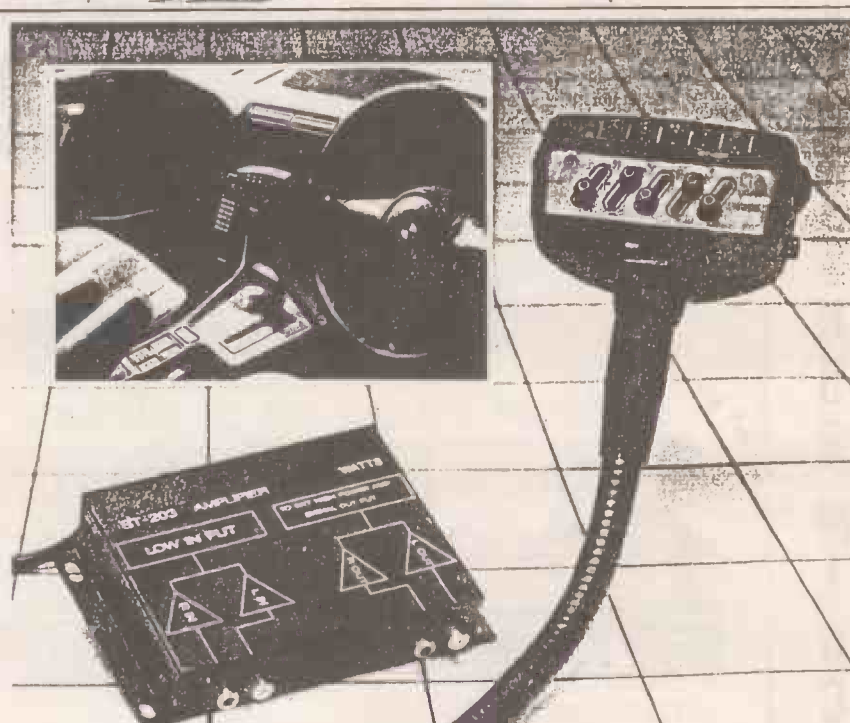
COBRA EQUALIZER

Stem mounted 7-band graphic equalizer with CD inputs, sub-woofer outputs with adjustable cut-off frequency, front/rear face and volume control. Inputs are via speaker leads from the car radio/cassette or low level via phono sockets or a 5-pin DIN socket. Outputs to front, rear, amplifer and sub-woofer are via phono sockets or a 5-pin DIN socket. Complete with mounting kit and fitting and wiring instructions.

Frequency response	20 - 30000Hz
Control frequencies	60, 150, 400, 1k, 2.4k, 6.3k, 12kHz
Control range	12dB boost or cut
S/N ratio	70dB
Channel separation	55dB
Output	3.5V max
Input impedance	Low 15kΩ
	High 100Ω
Power	11 - 16Vdc



EQUALIZER/BOOSTER



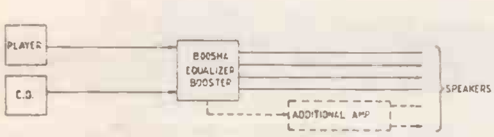
B005HA

£55-99

EQUALIZER/BOOSTER

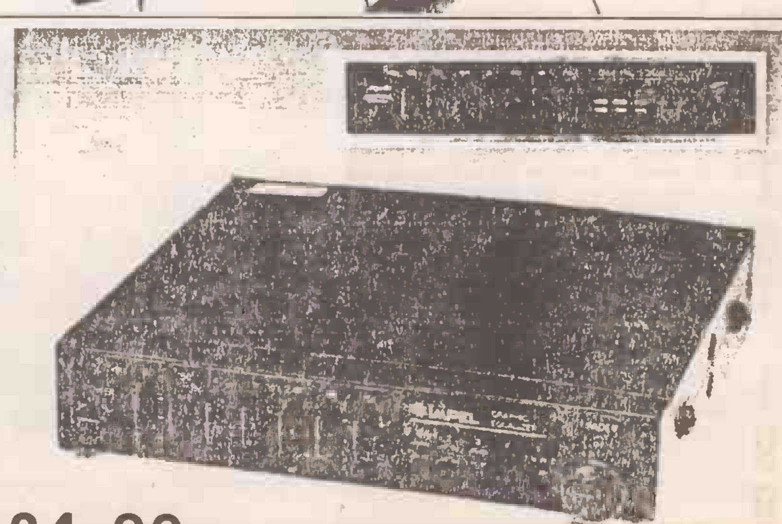
5-band gooseneck style graphic equalizer/booster with volume control, front/rear fader, CD Input, power on and equalizer insert/defect controls. The booster amp is located in a separate module from the equalizer and will accept high or low level outputs, boosting the signal to four speakers or low level output to further booster amplifiers.

Output power	10W per channel
Frequency response	20 - 30000Hz
Control frequencies	50, 250, 1k, 2k, 12kHz
Control range	12dB cut or boost
S/N ratio	70dB
Channel separation	55dB
Power	11 - 16Vdc 3A



B004

EQUALIZER/BOOSTER



EQUALIZER/BOOSTER

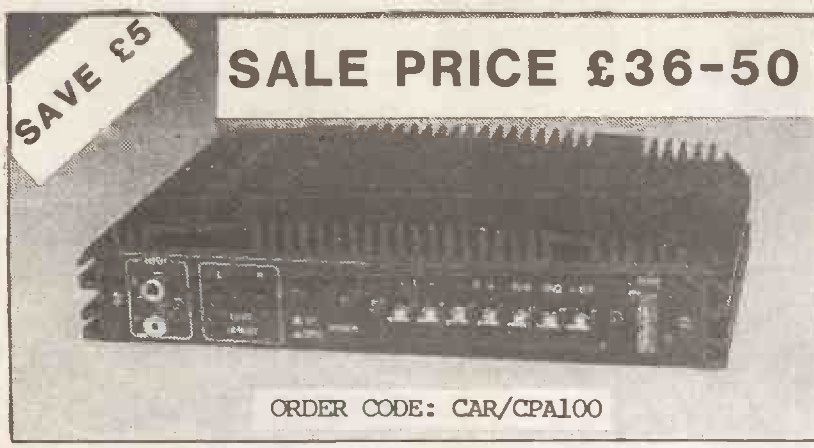
Slimline 7-band equalizer/booster with 60W total output power into 4 speakers. Built-in 3.5mm stereo headphone socket. Twin 5 LED power level indicators. Front/rear fader control. Mounting hardware included.

Output power	30W per channel
Frequency response	20 - 20000Hz
Input impedance	23Ω
Control frequencies	60, 150, 400, 1k, 2.4k, 6kHz, 15kHz
Control range	12dB boost or cut
Output impedance	4 - 8Ω
Power	12 - 14Vdc negative earth
Dims	149 x 133 x 28mm

SUPER SALE PRICE £24-99

CAR AMPLIFIER SALE ENDS MARCH 31ST 1992

CAR AMPLIFIER GRAND SALE



2 x 60W CLASS A AMPLIFIER B005LA (CPA100)

Class A stereo in-car amplifier capable of delivering 2 x 60W stereo or 120W mono in bridge mode. Inputs are low level phono, with left and right level controls. Full thermal and overload protection.

Output power	2 x 60W stereo 0.1%THD 120W mono 0.1%THD
Signal to noise ratio	>80dB
Frequency response	20-20000Hz
Input sensitivity	100mV-3V adjustable
Input impedance	Low level input 20kΩ
Output impedance	4Ω
Power	14.4Vdc 15A
Dims	240 x 120 x 50mm

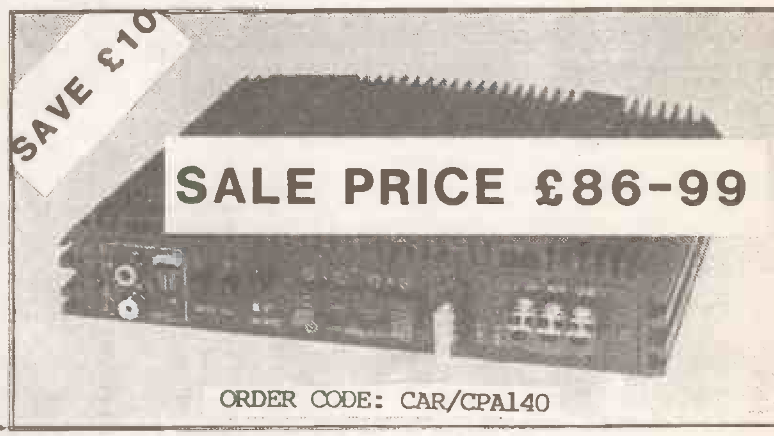
~~PRICE - £41-50~~

2x 125W CLASS A AMPLIFIER B005L CPA140

High power class A amplifier capable of delivering 2x 125W stereo or 250W mono in bridge mode. Inputs are direct from the speaker outputs of the car radio/cassette or low level phono inputs, with left and right level controls. Full thermal and overload protection.

Output power	2x 125W stereo 0.08%THD 250W mono 0.2% THD
Signal to noise ratio	>90dB
Frequency response	10-50000Hz
Input sensitivity	100mV-3V adjustable
Input impedance	High level input 100Ω Low level input 20kΩ
Output impedance	4Ω
Damping factor	>180 into 4Ω
Power	14.4Vdc 23A nom
Dims	240 x 180 x 50mm

~~PRICE - £96-99~~



2x 200W CLASS A AMPLIFIER B005M CPA200

High power class A amplifier capable of delivering 2x 200W stereo or 400W mono in bridge mode. Inputs are direct from the speaker outputs of the car radio/cassette or low level phono inputs, with left and right level controls. Full thermal and overload protection.

Output power	2x 200W stereo 0.08%THD 400W mono 0.2% THD
Signal to noise ratio	>90dB
Frequency response	10-50000Hz
Input sensitivity	100mV-3V adjustable
Input impedance	High level input 100Ω Low level input 20kΩ
Output impedance	4Ω
Damping factor	>180 into 4Ω
Power	14.4Vdc 43A nom
Dims	240 x 180 x 50mm

~~PRICE - £109-50~~

4 x 120W CLASS A AMPLIFIER B005N (CPA504)

High power 4-channel class A amplifier, capable of delivering 4 x 120W or 2 x 240W in bridge mode. Inputs are direct from the speaker outputs of the car radio cassette, or low level phono inputs with left and right level controls. Full thermal overload protection.

Output power	4 x 120W or 2 x 240W (bridged)
Signal to noise ratio	>90dB
Frequency response	10-50000Hz
Input sensitivity	100mV-3V adjustable
Input impedance	High level input 100Ω
	Low level input 20kΩ
Power	14.4Vdc 60A
Dims	400 x 240 x 50mm

~~PRICE - £120-75~~

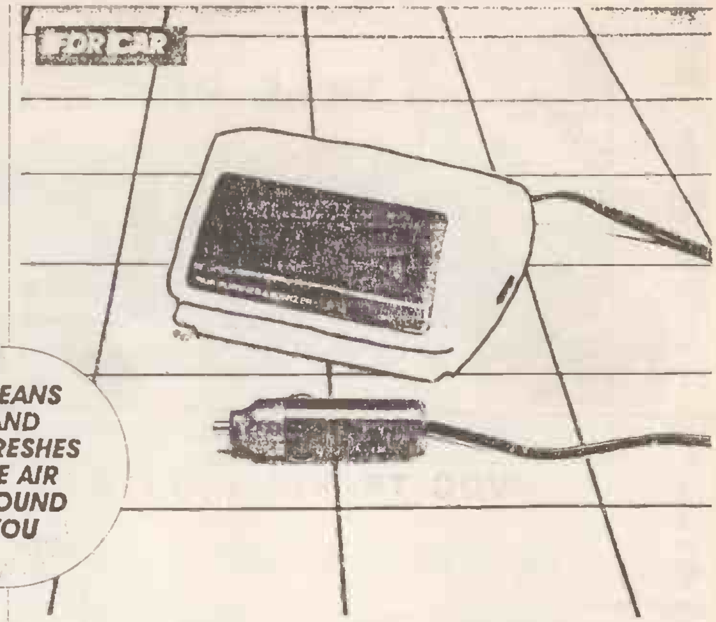
12V ACCESSORIES

B047D

AIR PURIFIER AND IONIZER **£11-75**

A compact, stylish ionizer and air purifier with a coverage volume of 14m³. Ideal for in car use with the DC lead provided or as a room purifier with the AC adaptor provided. Removes unpleasant smells, airborne dust, bacteria, tobacco smoke etc.

Power .... 9-15Vdc or 220/240Vac via adaptor
Dims .... 160 x 95 x 43mm



B047E

AIR PURIFIER AND IONIZER **£8-75**

A compact, stylish ionizer and air purifier designed specifically for car, truck and bus use with a coverage volume of 14m³. Removes unpleasant smells, airborne dust, bacteria, tobacco smoke etc. Supplied with a double sided self adhesive pad.

Power 12Vdc 1.5W
Dims .... 110 x 110 x 65mm

PROTECT YOUR CAR NOW..........

FOR ONLY £15-00

CAR ANTI-THEFT UNIT MADE IN U.K. BY COMDEK UK

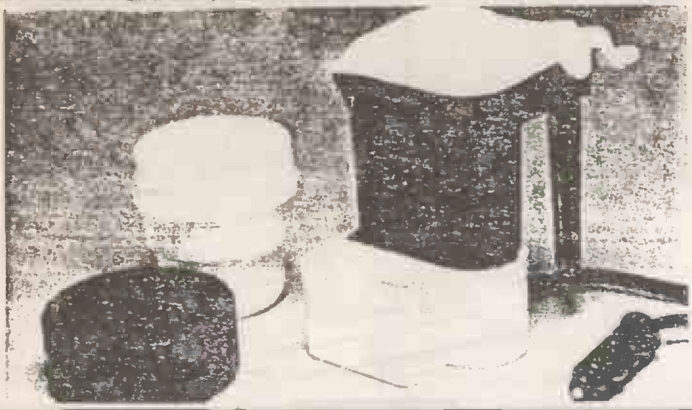
COMDEK AT1 - CAR ANTI-THEFT UNIT
A brand new design, 100% designed in the UK. A very clever device giving 100% peace of mind to the car owner and causing 100% frustration to the would be car thief!
This unit may be used alongside an existing alarm or simply on its own.

Most alarms require the owner to activate them when you exit the vehicle which can easily be overlooked or simply forgotten. The AT1 circuit overcomes this by activating the moment the ignition is switched on or the vehicle is 'Hot Wired' making it impossible to forget.
From the moment the ignition is first switched on the AT1 circuit starts timing. When the engine has started the unit must be de-activated otherwise after a pre-set time the engine will simply cut-out.
The method of de-activating the unit is set by the installer. We recommend either wiring up to one or more switches i.e. rear window de-mist, interior light, wipers etc. but you may of course wire it to a concealed switch . Therefore, until the chosen switch/switches are 'switched' on/off, the AT1 will NOT de-activate and the engine will stop after the pre-set time!
Every AT1 is pre-set at approx. 21 seconds but this time may be shortned or lengthened to suit your requirements up to 130 seconds. This time governs how far your vehicle will travel before the engine cuts out.
Any car thief will then be faced with the problem of the engine cutting out and refusing to re-start. Simple. The thief will not wish to attempt to 'repair' the vehicle..
We also supply a red LED which when installed in the car, remains lit all the time acting as a deterrent to any would be car thief.
Supplied in Kit form, full instruction etc supplied.

		1+	10+
ORDER CODE: CAR/COMDEK	PRICE:	£15-00	12-00

(We have installed one of these units to a company vehicle - they DO work and are very simple to use.)

12V & 24V ACCESSORIES



12VDC TRAVEL KETTLE

B049A

12Vdc kettle complete with mounting stand, cup and cup holder with a self-adhesive base. Plugs directly into a car cigar lighter socket for power. A power-on light is provided at the base of the kettle. Ideal for cars, vans, campers etc.

Capacity..0.5 pints (0.3lts
Power..12Vdc 9A, 14Vdc 11A
Dims..143 x 125 x 112mm (approx

£12-99 4 FOR £46-00

24VDC TRAVEL KETTLE

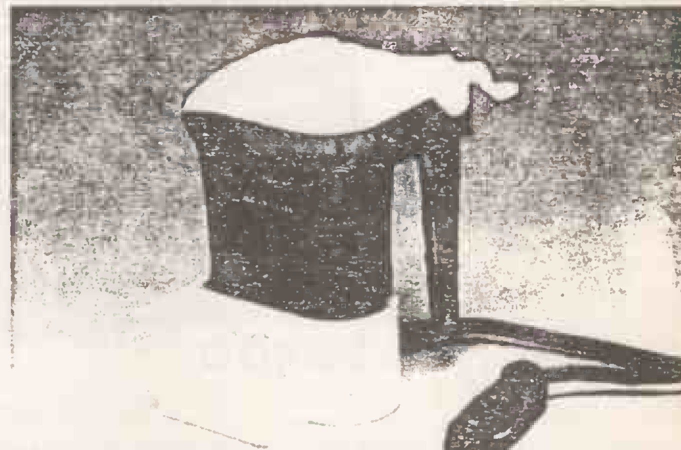
B049B

24Vdc TRAVEL KETTLE

24Vdc travel kettle complete with mounting stand. Plugs directly into a cigar lighter socket for power. A power-on light is provided in the base of the kettle. Ideal for trucks, buses, etc.

Capacity..0.5 pints (0.3lts)
Power..24Vdc 5A, 28Vdc 6A
Dims..143 x 125 x 112mm (approx)

£13-99 4 FOR £50-00

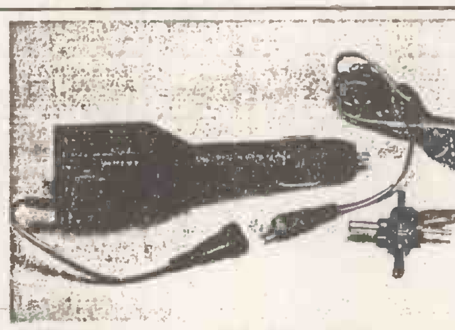


B034B

DC/DC CONVERTER

A plug in DC/DC converter with 3, 4.5, 6, 7.5, 9 and 12V outputs at 800mA. Plugs directly into a car cigar lighter socket. Output via a polarity reversible lead to a 'spider' plug with 1.3, 2.1 and 2.5mm DC power plugs and a 3.5mm plug

Input voltage..12Vdc nom
Output voltages..................3, 4.5, 6, 7.5, 9 and 12Vdc
Output current..800mA max



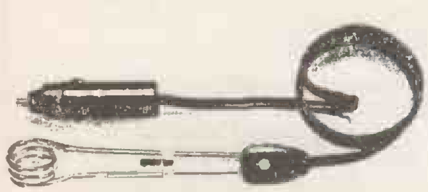
1+.... £3-99 4 FOR £14-00

£4-50

B047

12Vdc CAR FAN **4 FOR £16-00**

A 12Vdc oscillating car fan with a large suction cup for attaching the fan to the dashboard. Fully adjustable for tilt and angle. Supplied with a 1.7m lead fitted with a cigar lighter plug.



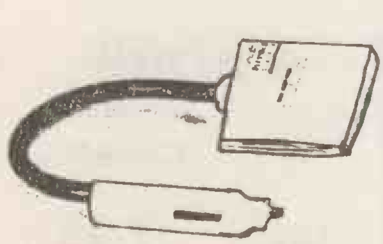
B049

IMMERSION HEATER

A handy mobile immersion heater for boiling water, soup, etc. Plugs into cigar lighter socket. Lead length 1m.

Power ..12Vdc 120W

1+.....£2-99 4 FOR £10-00



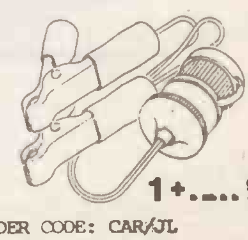
B034A

BATTERY ANALYSER /MAP LIGHT

A plug-in car battery charge analyser with built-in two-colour map light. Three LEDs indicate the battery level. A switch on the side switches on the map light with either green or white illumination. Flexible stem allows adjustment for best view. Plugs directly into a cigar lighter socket.

1+.....£3-99 4 FOR £14-00

A 12 V car cigarette lighter socket connected to 2 × battery crocodile clips.

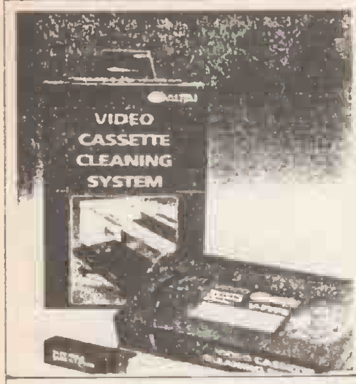


1+.....£2-99

ORDER CODE: CAR/JL

4 FOR £10-00

VIDEO ACCESSORIES SALE

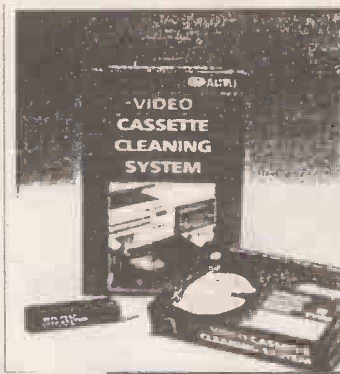


T121

VHS **£2-50**

Video cassette recorder head cleaner for VHS-type systems. Contains all that is required for routine cleaning of VCR heads. Uses the WET-TYPE system; cleaning fluid supplied. Simple to use. Full instructions provided. Approximately 40 cleaning applications.

Dims........................188 x 103 x 25mm



T122 **£2-25**

BETAMAX

Video cassette recorder head cleaner for BETAMAX-type systems. WET-TYPE. Contains all that is required for routine cleaning of Betamax heads. Simple to use. Full instructions and cleaning fluid supplied. Approximately 25 cleaning applications.

Dims........................156 x 96 x 25mm

T130A

STEREO VIDEO SOUND MIXER

3-channel portable stereo video sound mixer. Inputs from camera audio, stereo microphone and music source. Output to video recorder controlled by master volume. Earphone monitor socket. Powered by internal battery or external power supply. Supplied complete with four connecting leads and a 6.35mm stereo adaptor.

£35-00

Packed: BOX

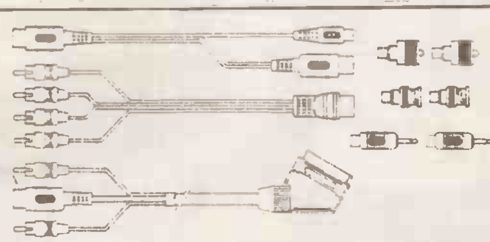
T128D **£37-50**

VIDEO ENHANCER/AUDIO MIXER

A 3-channel stereo video sound mixer with a built-in video enhancer, specificially designed for video dubbing. The audio input from the camera/VCR, mic and music sources can be mixed at will, with overall output conrolled by a master slider. The video enhancer will clean up the picture on older recordings. Powered by an external 12Vdc power supply (not supplied). Complete with all connecting leads and adaptors.

SALE PRICE

£5-99

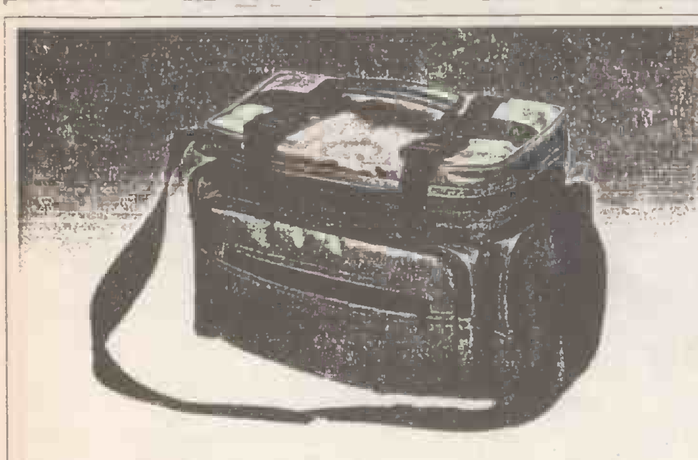


T113S

SCART LEAD KIT

Audiovideo dubbing kit consisting of:

1 lead scart plug to 5-pin DIN plug and 2x phono plugs. 1.5m
1 lead 6-pin DIN plug to 5-pin DIN socket and phono socket. 0.2m
1 lead 5-pin DIN socket to 4x phono plugs. 0.2m
2 phono socket to BNC plug adaptors
2 phono socket to PL259 plug adaptors
2 phono socket to 3.5mm plug adaptors



T089A **£16-99**

CAMCORDER BAG

Soft padded camcorder bag with shoulder strap. One internal pocket and four zipped external pockets. Silver weatherproof material.

Packed: SHRINK PACK

VHS VIDEO TAPES

Top quality blank 3hr and 4hr VHS video tape. Manufactured under licence of Victor Company of Japan. Each packed in attractive cardboard sleeve and cellophane wrapped.

3 HOUR

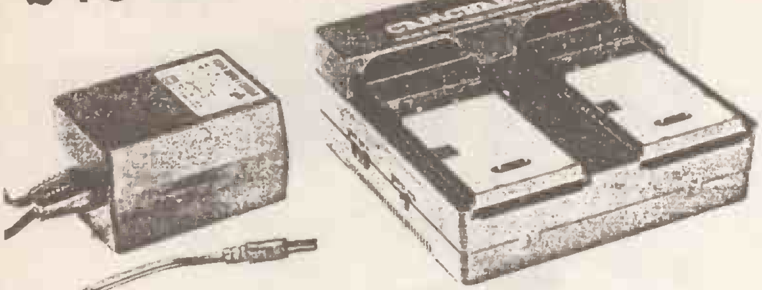
1+	£1-99
10+	£1-75

4 HOUR

1+	£2-99
10+	£2-75

VIDEO ACCESSORIES SALE

£45-00



T080

CAMCORDER BATTERY AUTOCHARGER

A universal camcorder battery autocharger capable of charging a wide range of batteries 6, 7.2 and 9V. Two batteries can be consecutively charged in approximately 3 hours either at home via the AC adaptor or in the car via the DC power lead. Auto cut-off prevents overcharging.

Charging method	Constant voltage with current limiting
Charge current	1A
Battery types	6V, 7.2V, 9.6V Ni-Cad pack (Sony, NP-22, NP-55, NP-77, JVC and Olympus typical)
Operating voltage	220/240Vac or 12-15Vac 1.5A
Dims	153 x 150 x 63mm

Packed: BOX

T080M **£19-99**

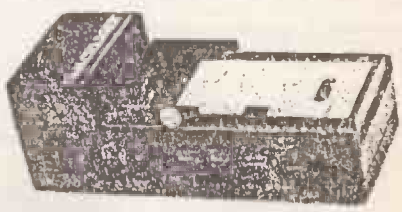
UNIVERSAL BATTERY PACK

Universal Ni-Cad battery pack designed to fit both Sony and JVC camcorders.

Output Voltage	6V
Rating	2000mAh
Dims	90 x 46 x 45mm

Packed: BOX

CHARGE YOUR VIDEO BATTERY FROM YOUR CAR



T080B **£22-00**

CAMCORDER BATTERY CHARGER KIT

A universal camcorder battery charger/power supply kit consisting of the charger, cigar lighter socket connecting lead, camcorder power lead, 4 adaptor plugs and a pouch. Compatible with the majority of 6, 7.2 and 9V camcorder batteries.

CHARGER

SALE PRICE

£9-99

VIDEO ENHANCER

A stereo sound and picture enhancer designed to improve picture and sound quality when recording from tape to tape or from camera to tape. Audio and video gain controls and picture stabilizer. Input and outputs via phono sockets. Requires an external 12Vdc 100mA power supply.

Audio frequency range	100Hz - 1kHz
Video frequency range	0.5MHz - 5MHz
Audio gain	15dB min.
Video gain	4dB min. 8dB nor.
Audio gain adjust	20dB min.
Video gain adjust	20dB min.

NORMAL PRICE £27-00

DISCHARGER

T080C **£19-99**

CAMCORDER BATTERY RECONDITIONER

A universal camcorder battery discharger designed to discharge the batteries to 1V per cell prior to recharging, preventing the memory effect of Ni-Cad batteries. A 5-LED bargraph display indicates state of charge and a beeper indicates full discharge. Compatible with the majority of 6, 7.2 and 9V batteries.

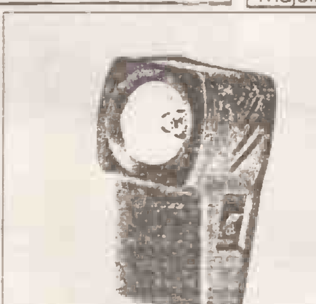
T081 **£45-00**

VIDEO LIGHT

30W halogen video light with 6V 1700mAh battery pack. The video light is provided with a synchronisation lead which, when the light is switched to "remote", allows the light to switch on when the camcorder is switched on (Sony, and Panasonic camcorder). The on/off, remote switch has a lock button to prevent accidental movement.

Packed: BOX

T081AA Spare bulb **£5-99**



T081A **£15-99**

VIDEO LIGHT

30W video camera light with hot shoe fitting and power on/off switch. Accepts 6V 1700mAh battery pack (Sony NP55 and NP77 typically)

Packed: BOX

T081AA **£5-99** Spare bulb

£69-99

T081B

VIDEO LIGHT KIT

A semi-professional video light kit comprising 100W halogen lamp, remote 12Vdc 7Ah sealed lead acid battery in carrying case with shoulder strap, 220/240Vac operated battery charger and camcorder power supply adaptor.

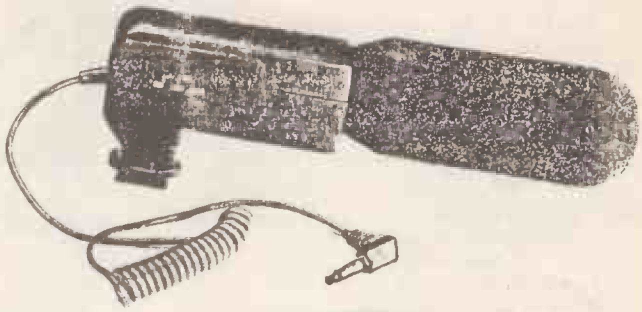
Packed: BOX

T081BA Spare bulb **£5-99**

VIDEO CAMERA MICROPHONE SALE

G164F

CAMCORDER MIC

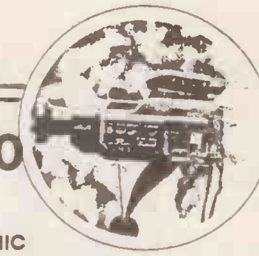


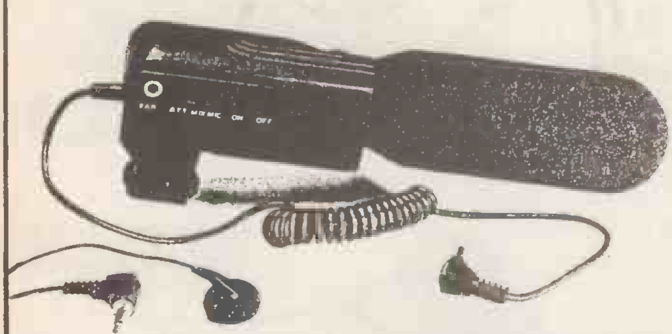
Super uni-directional electret condenser mic designed for use with camcorders. The range (sensitivity) is switchable from low (normal) to high (for distance or quick source). Lightweight plastic body with hot shoe fitting onto camcorder. Short, coiled lead with 3.5mm max. plug.

Type	Super uni-directional electret condenser
Impedance	1kΩ
Response	80-15000Hz
Sensitivity:	Low -65dB. High -52dB
Length	185mm

£19-99

Packed: BOX ★





£32-50

G164G

CAMCORDER DUBBING MIC

A unique mic designed for direct dubbing of an external soundtrack voice-over, etc. at source, whilst the camcorder is recording. A stereo 3.5mm input is provided in the side of the mic for insertion of the soundtrack and a rotary control provides balance between mic and soundtrack. An earphone jack is provided for monitoring the mix. Supplied with a mono in-ear phone.

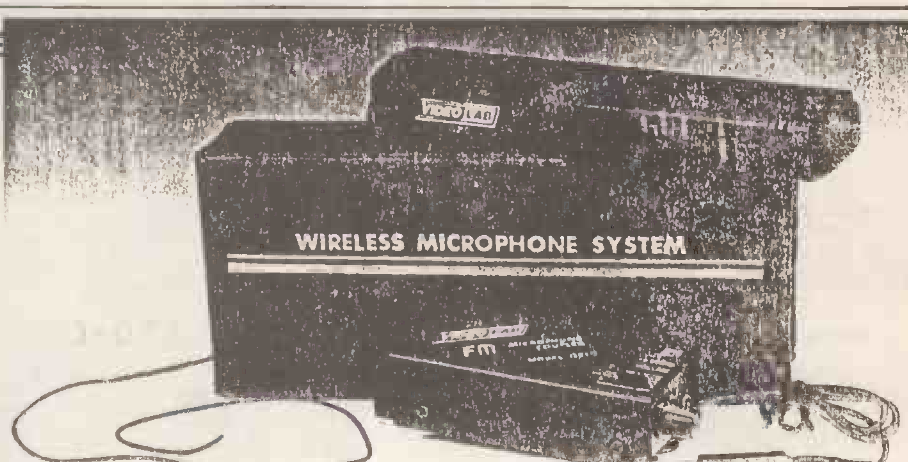
Type	Super uni-directional electret condenser
Impedance	1kΩ
Response	80-15000Hz
Sensitivity	-48dB (@ mix max
Length	155mm

LIST PRICE £45-99

SALE PRICE £35-99

G210

WIRELESS MICROPHONE



2-part wireless microphone system designed for use with video cameras. The hand-held microphone has a high/low power switch to select the transmission range (up to 200ft). The receiver has a video camera mounting shoe, volume control and integral output lead to 3.5mm mono plug. The system allows for greater flexibility with the microphone than can be achieved with a conventional microphone. Complete with vinyl carrying case.

SAVE £10-00

Packed: BOX

WITH VINYL CARRYING CASE

LIST PRICE £49-50

SALE PRICE £39-50

G211

WIRELESS MICROPHONE

A 3-channel 2-part wireless microphone system designed for use with video cameras. The tie-clip mic has a remote belt clip transmitter with on/off switch. The receiver has a hot shoe for mounting on the video camera. The system allows greater mobility with a microphone than can be achieved with the camcorder mic.

SAVE £10-00

Packed: BOX ★

WITH VINYL CARRYING CASE

SECURITY EQUIPMENT - SURVEILLANCE

FM MINI TRANSMITTER - Made in UK - COMDEK

Very high quality Mini-bug, ideal for baby alarms etc!!

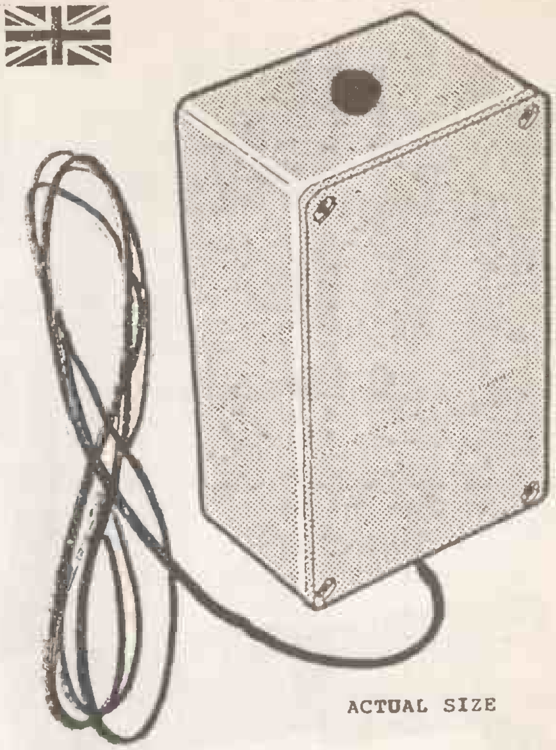
These units are well tried and tested. They may be the best on the market!

Range is difficult to quote because it depends on conditions, but we have acheived almost ½ a mile.

Simply remove cover, insert AA battery (not included) - and you're ready to go.

Reception can be obtained on any FM radio.
Adjustable frequency.
One AA battery can last 5 days continuous!
Frequency range................95-110MHz FM
Power.......................AA 1.5V Battery
Dimensions...................72 x 46 x 22mm

	1+	10+
ORDER CODE: SEC/FMB1	**£9-99**	**£7-50**



ACTUAL SIZE

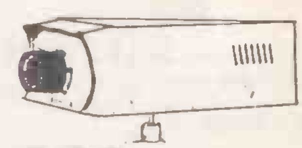
FM MINI TRANSMITTER KIT
The above transmitter in kit form - for those of you who like to build your own! Please note: the box is NOT included. We suggst BOX/T3 in our Box section.

Full instructions are included and this kit is very easy to construct - BUT - please read the instructions before you start!!

	1+	10+
ORDER CODE: SEC/FMKIT	**£7-50**	**£6-00**

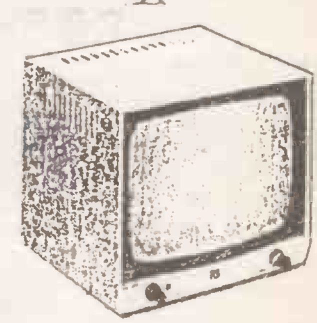
C.C.T.V.

C.C.T.V. CAMERA - (USED)
A steel cased, closed-circuit monochrome TV camera. Ideal for internal or outside (using the weatherproof housing) security and for industrial surveillance.
All camera's are supplied with lens fitted - normally **16MM**
These units are secondhand the style and overall design may change to the illustration shown. All camera's are thoroughly tested before despatch and should give very long trouble free service. Never mount the camera facing a window or bright light as this wilburn the camera tube. Voltage generally 240V, if lower we will supply a suitable PSU



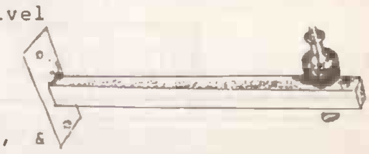
SEC/CAMERA/USED PRICE: **£120-00**

C.C.T.V. MONITOR - (USED)
Steel cased, good quality black & white monitors. Depending on availability we can offer sizes from 9" up to 17". State your preferred size and we will send nearest size available.
Voltage: 240V



SEC/MON/USED PRICE: **£70-00**

C.C.T.V. CAMERA BRACKET - (NEW)
Quality, British made mounting bracket to suit not only our camera's but any standard CCTV camera.
White, plastic coated steel with standard ¼"-20 mount. Locking swivel allows camera to be adjusted and fixed in any position.



SEC/CB PRICE: **£7-75**

SPECIAL OFFER

BUY THE COMPLETE PACKAGE ABOVE i.e. 1 x Camera, 1 x Monitor, & 1 x Bracket

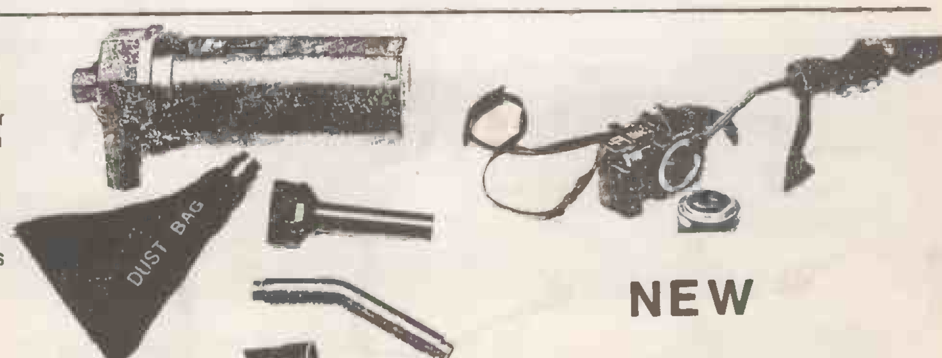
AND PAY ONLY -------**£185-00** (Extra Carr. £10-00)

A150B

MINI VACUUM CLEANER

A battery powered mini vacuum cleaner which is ideal for removing the dust from turntables, cameras, video recorders, computer keyboards etc. 5 piece kit. Powered by four AA alkaline batteries (not supplied).

Power................4 x AA alkaline batteries



NEW

£6-99

RECHARGEABLE BATTERIES - NI-CADS

A range of Nickel Cadmium batteries that will replace dry cell batteries. Capable of being recharged some 1000 times they are very economical in all applications.
(We offer a suitable charger for these Ni-Cads at the end of this section)

Type	Volt	Ah	Order Code	Price 1+	Price 10+
AAA	1.2V	180mAh	BAT/AAA	£1-50	£1-30
AA	1.2V	500mAh	BAT/AA	95p	85p
C	1.2V	1.2Ah	BAT/C	£1-95	£1-80
C	1.2V	2.0Ah	BAT/CI	£3-40	£3-20
D	1.2V	1.2Ah	BAT/D	£2-00	£1-85
D	1.2V	4.0Ah	BAT/DI	£4-75	£4-50
PP3	9V	110mAh	BAT/PP3	£3-90	£3-75

DRY CELL BATTERIES

A comprehensive range of Ever Ready dry cell batteries.

BLUE SEAL Standard Life

Size	Volt	Pack Qty	Ord.Code	Price
AA	1.5V	4	BAT/R6B	£1-10
C	1.5V	2	BAT/R14B	98p
D	1.5V	2	BAT/R20B	£1-08
PP3	9V	1	BAT/PP3B	£1-10

SILVER SEAL Extra Life

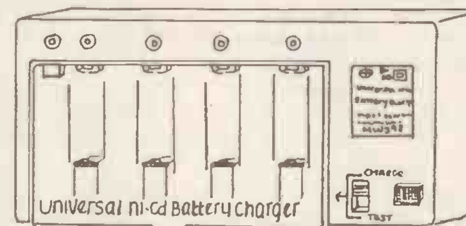
Size	Volt	Pack Qty	Ord.Code	Price
AA	1.5V	4	BAT/R6S	£1-71
C	1.5V	2	BAT/R14S	£1-50
D	1.5V	2	BAT/R20S	£1-75
PP3	9V	1	BAT/PP3S	£1-50

BATTERY CHARGER (Universal Nickel Cadmium)

An attractive nickel cadmium battery charger ideal for charging to rechargeable batteries detailed above. The charger will charge all the sizes listed: AAA, AA, C, D and PP3 and up to four AAA, AA, C and D types and one PP3 can be charged at the same time. The charger has a hinged plastic dust cover for easy viewing. The five battery positions have L.E.D. 'CHARGE' indicators. The unit also has a switch allowing batteries to be checked for current state of charge.

SPECIFICATION

Power	240V a.c.
Dimensions	210 x 100 x 50mm



ORDER CODE
BAT/CHARGE/UNI

PRICE - **£4-99**

STAR BUY

P010A **£3-99**

PLUG-IN CHARGER

Compact plug-in charger for up to 4 "AA"-type NI-CAD batteries. Unit plugs directly into 13A socket and can charge 2 or 4 penlight cells simultaneously. Separate LED indicators show when charging point is working. Tough black plastic case with transparent lid. Built-in thermal fuse for extra protection.

Input voltage	220/240Vac 50Hz
Charging current	4 x 45mA
Charging time	10-16 hours
Charges	4 x AA batteries
Dims	108 x 64 x 51mm

Packed: BOX

P010B **£6-99**

PLUG-IN FAST CHARGER

Compact plug-in charger for up to 4 "AA"-type NI-CAD batteries. High charging current cuts charging time from 15 hours to approximately 3 hours. AUTO CUT-OFF switches charger off automatically when batteries are fully charged. Touch sensitive reset plate. Tough plastic case with sleeved pins.

Input voltage	220/240Vac 50Hz
Charging current	150mA
Charging time	2 -3hrs
Charges	4 x "AA" batteries
Dims	107 x 65 x 53mm

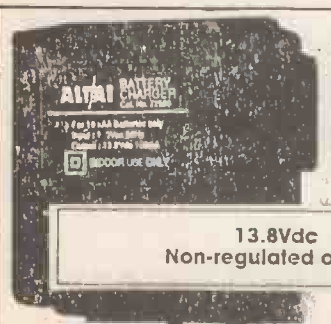
Packed: BOX

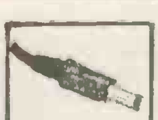
P010F **£9-99**

NICAD FAST CHARGER

Fast charging universal Ni-Cad battery charger with auto cut off. Capable of charging four AAA, AA, C, or D cells and two PP3 batteries. Separate LED indicators at each of the points indicate charging. A charge/test switch together with a built-in filament lamp is provided for testing the degree of charge of 1.5V batteries. Charges 4 x AAA, AA, C or D cells and 2 x PP3.

Power	220/240Vac 50Hz
Dims	250 x 125 x 55mm





13.8Vdc
Non-regulated output

Plug-in 13.8Vdc 100mA power supply designed to charge 10 x AA NICad batteries found in mobile CB rigs, etc. Plugs directly into a 13A socket. Output via integral lead with 2.5mm DC power plug, tip positive. Thermal fuse overload protection.

Input voltage	220/240Vac 50Hz
Output voltage	13.8Vdc
Output current	100mA
Stability	40%
Ripple	1V
Dims	62 x 51 x 49mm

BATTERY HOLDER NOT INCLUDED

£2-99

COMPONENT KIT SALE ENDS 31-3-92

RESISTOR KIT - 0.25W (5 OFF)

A pack containing 305 resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 5 OFF EACH VALUE:

10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M.

ORDER CODE 1+ 5+
KIT/RES/25/5 ~~£3.75 £3.25~~

SALE PRICE £2-99 ANY QTY.

RESISTOR KIT - 0.25W (10 OFF)

A pack containing 610 resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 10 OFF EACH VALUE:

10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M.

ORDER CODE 1+ 5+
KIT/RES/25/10 ~~£5.10 £4.60~~

SALE PRICE £4-00 ANY QTY.

RESISTOR KIT - 0.25W POPULAR

A pack containing a total of 1,000 ¼W 5% carbon film resistors ranging in value from 10R to 10M.

In this pack we have included larger quantities of the more popular values.

Each value individually packed.

CONTENTS:

No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE
10 x	10R	10 x	82R	10 x	390R	10 x	1K8	10 x	8K2	10 x	39K	15 x	180K	5 x	820K
10 x	12R	20 x	100R	30 x	470R	25 x	2K2	30 x	10K	30 x	47K	20 x	220K	20 x	1M
10 x	18R	10 x	120R	20 x	560R	20 x	2K7	15 x	12K	20 x	56K	15 x	270K	10 x	2M2
10 x	22R	10 x	150R	20 x	680R	20 x	3K3	15 x	15K	15 x	68K	15 x	330K	5 x	3M3
10 x	33R	10 x	180R	10 x	820R	15 x	3K9	15 x	18K	10 x	82K	10 x	390K	10 x	4M7
20 x	47R	20 x	220R	40 x	1K	25 x	4K7	20 x	22K	30 x	100K	20 x	470K	5 x	6M8
10 x	56R	20 x	270R	15 x	1K2	20 x	5K6	15 x	27K	20 x	120K	10 x	560K	20 x	10M
10 x	68R	20 x	330R	15 x	1K5	15 x	6K8	20 x	33K	15 x	150K	10 x	680K		

ORDER CODE 1+ 5+
KIT/RES/25/POP ~~£6.99 £5.99~~

SALE PRICE £5-00 ANY QTY

RESISTOR KIT - 0.5W POPULAR

A pack containing a total of 1,000 ½W 5% carbon film resistors ranging in value from 2R2 to 10M.

In this pack we have included larger quantities of the more popular values. Each value individually packed.

CONTENTS:

No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE
5 x	2R2	10 x	12R	10 x	120R	20 x	680R	10 x	3K9	20 x	22K	20 x	120K	10 x	680K
5 x	2R7	10 x	15R	10 x	150R	10 x	820R	25 x	4K7	10 x	27K	10 x	150K	5 x	820K
5 x	3R3	10 x	22R	10 x	180R	40 x	1K	20 x	5K6	20 x	33K	10 x	180K	20 x	1M
5 x	3R9	10 x	33R	20 x	220R	10 x	1K2	10 x	6K8	10 x	39K	20 x	220K	10 x	2M2
10 x	4R7	20 x	47R	20 x	270R	10 x	1K5	10 x	8K2	30 x	47K	15 x	270K	5 x	3M3
5 x	5R6	10 x	56R	20 x	330R	10 x	1K8	30 x	10K	20 x	56K	15 x	330K	10 x	4M7
5 x	6R8	10 x	68R	10 x	390R	25 x	2K2	15 x	12K	10 x	68K	10 x	390K	5 x	6M8
5 x	8R2	10 x	82R	30 x	470R	20 x	2K7	15 x	15K	10 x	82K	20 x	470K	20 x	10M
10 x	10R	20 x	100R	2- x	560R	20 x	3K3	10 x	18K	30 x	100K	10 x	560K		

ORDER CODE 1+ 5+
KIT/RES/5/POP ~~£10.75 £9.75~~

SALE PRICE £9-00 ANY QTY.

RESISTOR KIT - 0.5W (10 OFF)

A pack containing 730 resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 10 OFF EACH VALUE:

2R2, 2R7, 3R3, 3R9, 4R7, 5R6, 6R8, 8R2, 10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M, 1M2, 1M5, 1M8, 2M2.

ORDER CODE 1+ 5+
KIT/RES/5/10 ~~£8.75 £7.75~~

SALE PRICE £7-00 ANY QTY.

COMPONENT KIT SALE ENDS 31-3-92

RESISTOR KIT - 0.5W (5 OFF)

A pack containing 365 resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 5 OFF EACH VALUE:

2R2, 2R7, 3R3, 3R9, 4R7, 5R6, 6R8, 8R2, 10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M, 1M2, 1M5, 1M8, 2M2.

ORDER CODE	1+	5+
KIT/RES/5/5	£5.40	£5.00

SALE PRICE £4-00 ANY QTY.

RESISTOR KIT - 1W

A pack containing 365 1W resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 5 OFF EACH VALUE:

10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M, 1M2, 1M5, 1M8, 2M2, 2M7, 3M3, 3M9, 4M7, 5M6, 6M8, 8M2, 10M.

ORDER CODE	1+	5+
KIT/RES/1/5	£15.25	£14.00

SALE PRICE £13-00 ANY QTY.

RESISTOR KIT - 2W

A pack containing 365 2W resistors. Values as listed below. Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 5 OFF EACH VALUE:

10R, 12R, 15R, 18R, 22R, 27R, 33R, 39R, 47R, 56R, 68R, 82R, 100R, 120R, 150R, 180R, 220R, 270R, 330R, 390R, 470R, 560R, 680R, 820R, 1K, 1K2, 1K5, 1K8, 2K2, 2K7, 3K3, 3K9, 4K7, 5K6, 6K8, 8K2, 10K, 12K, 15K, 18K, 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K, 150K, 180K, 220K, 270K, 330K, 390K, 470K, 560K, 680K, 820K, 1M, 1M2, 1M5, 1M8, 2M2, 2M7, 3M3, 3M9, 4M7, 5M6, 6M8, 8M2, 10M.

ORDER CODE	1+	5+
KIT/RES/2/5	£25.00	£23.00

SALE PRICE £22-00 ANY QTY.

CERAMIC KIT - 50V - Over £9.70 worth at catalogue prices - Saving you £5.71!!

A pack containing 125 50V disc and plate ceramics ranging in value from 1pF to 10nF (0.01mF).

Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 5 OFF EACH VALUE:

1.0pF, 1.8pF, 2.7pF, 3.3pF, 4.7pF, 5.6pF, 6.8pF, 8.2pF, 10pF, 12pF, 22pF, 27pF, 47pF, 68pF, 82pF, 100pF, 150pF, 180pF, 270pF, 470pF, 560pF, 1000pF, 2200pF, 4700pF, 10nF.

ORDER CODE	1+	5+
KIT/CER/50V	£3.99	£3.50

SALE PRICE £3-00 ANY QTY.

ELECTROLYTIC KIT - RADIAL - Over £11.00 worth at catalogue prices - Saving you £2.50.

A pack containing 100 miniature radial lead electrolytic capacitors. 12 different values.

Each value individually packed.

CONTENTS:

No.	VALUE	VOLTAGE	No.	VALUE	VOLTAGE	No.	VALUE	VOLTAGE	No.	VALUE	VOLTAGE
10	1mF	63V	15	10mF	25V	15	100mF	16V	5	1000mF	16V
10	2.2mF	63V	10	22mF	25V	5	220mF	16V	2	1000mF	25V
10	4.7mF	63V	10	47mF	25V	5	470mF	16V	3	2200mF	16V

ORDER CODE	1+	5+
KIT/ELEC/RAD	£8.50	£7.50

SALE PRICE £7-00 ANY QTY.

FUSE KIT - 20mm QUICK-BLOW

A pack containing 80 Quick-Blow 20mm Fuses.

Each value individually packed.

Contents:

No.	VALUE	No.	VALUE	No.	VALUE
5 x	100mA	10 x	500mA	10 x	3.15A
5 x	250mA	20 x	1A	5 x	5A
5 x	315mA	5 x	1.6A	5 x	6.3A
		10 x	2A		

ORDER CODE	1+	5+
KIT/FUSE/QB2	£4.75	£4.25

SALE PRICE £3-50

FUSE KIT - 20mm ANTI-SURGE

A pack containing 80 Anti-Surge 20mm Fuses.

Each value individually packed.

CONTENTS:

No.	VALUE	No.	VALUE	No.	VALUE
5 x	100mA	10 x	500mA	10 x	3.15A
5 x	250mA	20 x	1A	5 x	5A
5 x	315mA	5 x	1.6A	5 x	6.3A
		10 x	2A		

ORDER CODE	1+	5+
KIT/FUSE/AS2	£8.50	£7.50

SALE PRICE £7-00

COMPONENT KIT SALE ENDS 31-3-92

A pack containing a total of 120 miniature horizontal mounting pre-set potentiometers. A total of 13 different values. Each value individually packed.

CONTENTS:

No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE
5 x	100R	5 x	2K2	10 x	47K	5 x	1M
5 x	220R	15 x	4K7	20 x	100K		
5 x	470R	20 x	10K	5 x	220K		
15 x	1K	5 x	22K	5 x	470K		

ORDER CODE KIT/POT/HORIZ

SALE PRICE £6-50 1+ ~~£7.75~~ 5+ ~~£7.25~~

A pack containing a total of 120 miniature vertical mounting pre-set potentiometers. A total of 13 different values. Each value individually packed.

CONTENTS:

No.	VALUE	No.	VALUE	No.	VALUE	No.	VALUE
5 x	100R	5 x	2K2	10 x	47K	5 x	1M
5 x	220R	15 x	4K7	20 x	100K		
5 x	470R	20 x	10K	5 x	220K		
15 x	1K	5 x	22K	5 x	470K		

ORDER CODE KIT/POT/VERT

SALE PRICE £6-50 1+ ~~£7.75~~ 5+ ~~£7.25~~

ZENER DIODE KIT - 400 M/W

A pack containing 55 zener diodes. 400M/W. Ranging from 3V6 to 30V. Each value individually packed and each bag marked with the value enclosed.

CONTENTS: 5 OFF EACH VALUE:

3V3, 4V7, 7V5, 8V2, 11V, 12V, 13V, 15V, 16V, 20V, 24V.

ORDER CODE KIT/ZEN/400 1+ ~~£3.99~~ 5+ ~~£3.50~~

SALE PRICE £3-00 ANY QTY.

POLYESTER CAPACITOR KIT

ITT PMT type 100V miniature or similar. Pack contains 110 capacitors. Each value individually packed and each bag marked with the value.

10 each value: 0.01uF, 0.015uF, 0.022uF, 0.033uF, 0.047uF, 0.068uF, 0.1uF, 0.15uF, 0.22uF, 0.33uF 0.47uF.

Order Code: KIT/POLY PRICE: ~~£5-00~~ **SALE PRICE £4-00 ANY QTY.**

NUT & BOLT KIT

A useful pack containing 800 assorted BA nuts, bolts and washers. Bolts are cheesehead type. All cadmium plated steel. All types are individually packed.

100 each: 6BA ¼" bolts, 6BA ½" bolts, 6BA nuts, 6BA washers.
100 each: 4BA ¼" bolts, 4BA ½" bolts, 4BA nuts, 4BA washers.

ORDER CODE: KIT/NB PRICE: £5-99

SALE PRICE £4-00 ANY QTY.

SELF TAPPING SCREW KIT

A choice of 3 kits, all slotted pan head self-tapping screws. Type AB screws finished in clear passivated zinc plate.

SALE PRICES

No. @ Size
Thread dia. 2.9mm. 200 screws: 50 x 12.7mm, 100 x 9.5mm, 50 x 6.4mm. **£3-00**
No. 6 Size
Thread dia. 3.5mm. 220 screws: 20 x 19.1mm, 100 x 12.7mm, 50 x 9.5mm, 50 x 6.4mm. **£2-50**
NO. 10 SIZE
Thread dia. 4.8mm. 170 screws: 20 x 25.4mm, 50 x 19.1mm, 50 x 12.6mm, 50 x 9.5mm. **£3-00**

ORDER CODE: KIT/ST4 ~~£3-75~~ · ORDER CODE: KIT/ST6 ~~£3-25~~ · ORDER CODE: KIT/ST10 ~~£4-00~~

SUPER SOLDER SALE

High grade 60/40 tin/lead alloy solder available in a choice of diameters and reel sizes. Contains 5 cores of type 362 non-corrosive flux. Melting temperature is 188°C. Manufactured to BS219. Recommended min. bit temp. is 300°C.

18SWG (1.22mm)

REEL WEIGHT	Approx. Length	ORDER CODE	1+	10+	100+
18gms	3 MTRS	SOLD/18/3Y	65p	50p	40p
200gms	21 MTRS	SOLD/18/200	£2-25	£2-00	£1-60
500gms	52 MTRS	SOLD/18/500	£4-75	£4-25	£3-50

22SWG (0.71mm)

REEL WEIGHT	Approx. Length	ORDER CODE	1+	10+	100+
200gms	62 MTRS	SOLD/22/200	£2-35	£2-10	£1-75
500gms	153 MTRS	SOLD/22/500	£4-79	£4-30	£3-60

REMEMBER: ALL OUR PRICES INCLUDE VAT.
(Buy 100 reels 500gm 18swg & pay only £2-98 per reel + VAT!!!!!)

SOLDERING IRON STAND - Heavy Duty

Suitable for use with Antex and most other soldering iron stands. Heavy base making it very stable. Supplied complete with sponge.

ORDER CODE: SOLD/814 1+ £2-99 10+ £2-75

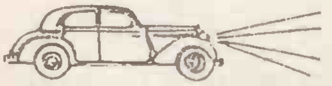
ECONOMY KITS

A range of Economy Electronic Kits for hobbyists, schools etc. Each kit contains electronic components which must be soldered to the P.C.B. provided. The modules are ready made units and most have connections brought out to screw terminals.

Many of the kits & modules require the purchase of additional items.

Car-Light Warning (B001)

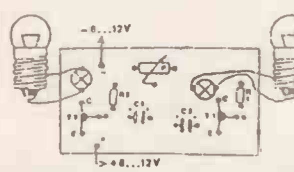
This circuit will attract your attention by producing a noisy 'Honk' signal, should you turn off the car ignition but leave the lights on, and will therefore save you the problem of a drained battery. Works off the car battery, 6-12 V.



KIT/B001 £7-50

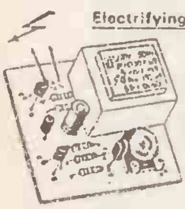
Alternate Flashing Signal (B003)

.. lights up alternately 2 light bulbs or a set of lamps. Adjustable blinking speed. For model construction.



KIT/B003 £2-99

Electrifying Apparatus (B007)



... generates a weak adjustable high tension of approx. 80-300 V out of 3-6 V (max. 9 V). May be used by anglers to catch worms. Maximum current 50-250 mA.

KIT/B007 £8-35

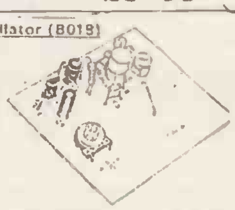
Fog Horn 5 W (B015)

... generates a deep, noisy sound similar to the fog-horns of ships. Operating voltage: 4.5-12 V. wattage: max. 5 W depending on the voltage. For 8 Ω-loudspeakers

KIT/B015 £5-99

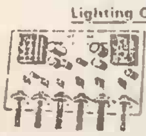
Test Oscillator (B018)

This is a close range test only transmitter, which can be tuned between 88 and 108 MHz and used to service radio receivers by using the unmodulated carrier. This kit must not be used to transmit over any distance.



KIT/B018 £6-85

Lighting Console (6 Way) (B022)

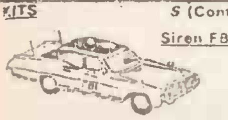


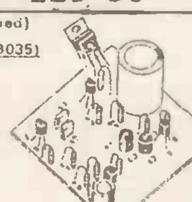
Each channel is independently adjustable. Lamps up to max. 500 W, 240 V can be connected per channel. High input sensitivity: Adapts to stereo or mono equipment. For discotheques, party-rooms, and the like.

KIT/B022 £20-50

KITS (Continued)

Siren FBI (B035)

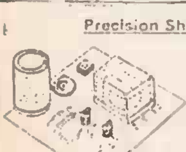




Noisy, electronic siren imitating the sound of the American police siren. Operating voltage: 12 V. For loudspeakers: 8-32 Ω. Wattage: 3-15 W, depending on the loudspeaker used.

KIT/B035 £9-50

Precision Short Period Timer (B042)



Adjustable time periods of 0-4 min. can be obtained by adjustment of the preset pot. The press of a button will switch the relay on for the set period. Max. relay contact 3 A. Requires 12 V supply.

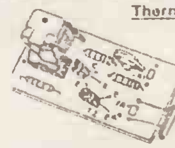
KIT/B042 £9-85

Light Barrier 12 V (B045)

A light barrier kit which uses an LDR (Light Dependent Resistor) to trigger the relay on. Can be used to switch on an alarm, open a door or as a twilight switch etc. A light source is required which shines onto the LDR of the kit, if this light source is interrupted the relay will pull on. Max. relay current is 5 A. Requires a 12 V supply.

KIT/B045 £9-75

Thermo Switch (B048)



Turns the relay on or off at a pre-fixed temperature. This instrument may be used as a thermostat, as an ice-warning system, as a fire-alarm system, etc. Operating voltage: 12 V. Temperature range: approx. –30° to +150°C. Relay switching capacity: 5 A.

KIT/B048 £9-85

Gas Sensor (B051)

This instrument detects gases like alcohol, acetone, benzol, propane, carbon monoxide (contained in smoke of fire). Ideal as a gas and fire warning instrument. For 12 V.

KIT/B051 £27-50

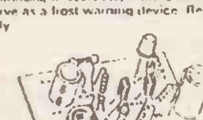
Siren Warship (B052)

'Decks clear for action'-warship siren. Creates a short swelling up sound (uuit ... uuit ...) in short intervals. Wattage: 3-15 W, depending on the operating voltage. For 6-12 V. Loudspeaker impedance: 8 Ω.

KIT/B052 £12-50

Ice Warning Instrument (B057)

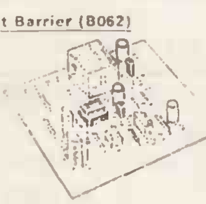
This instrument will indicate undesirable temperature changes in refrigerators, freezers etc. If fitted to a car bumper it will serve as a frost warning device. Requires 9-12 V DC supply.



KIT/B057 £6-95

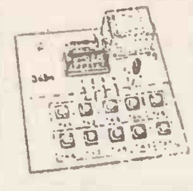
Infra-Red Light Barrier (B062)

Light-barrier with invisible infra-red light-beam. Complete kit with transmitter and receiver. Range: over 6 m. Operating voltage: transmitter 9-12 V, receiver 12 V. Relay contact: 3 A switching capacity. Ideal for warning systems.



KIT/B062 £19-75

Combination Digital Lock (B063)

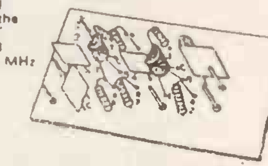


After keying-in a 4-digit number, the relay switches on. The code is independently programmable and can be easily modified. Relay contact: 3 A, 1 × change over. For 6 V. Application: keyless door-lock, to switch on equipment (radio, TV-set, etc.) which is not to be used by other people, for safe doors, etc.

KIT/B063 £22-75

Car Antenna Amplifier (B068)

This amplifier is connected between the antenna and the radio, using co-axial cable 60-75 Ω. Gain max: 22 dB Frequency range: 0.5-150 MHz (approx.).

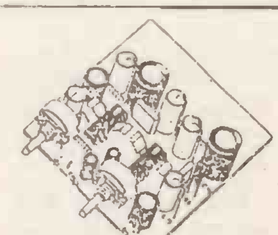


KIT/B068 £5-99

Spy Stethoscope (B069)

Using an earpiece the spy stethoscope allows you to listen through thin walls, doors, windows etc. due to a highly sensitive pre-amplifier and microphone. Suitable for monitoring animals etc.

KIT/B069 £20-50

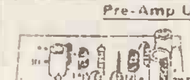


Acoustic Water Detector (B070)

... raises a loud alarm signal on contact with water. This instrument signals broken water pipes, overflowing washing machines and bath tubs, etc. The sensor can be connected by a longer cable of up to 100 m. Power supply: 9 V battery.

KIT/B070 £5-99

Pre-Amp Universal Mono (B073)



Frequency range 10 Hz-150 kHz. 2-step pre-amplifier for 9-30 V operating voltage. Input: 2-20 mV, output: 200 mV-2 V. Application: pre-amplifier for high-power amplifier 'headphones-amplifier', etc.

KIT/B073 £4-85

Diode Receiver MW and SW (B076)

'Detector-Receiver' for middle-wave or short-wave, approx. 3-9 MHz. This radio operates on the same principle as the very first radio receivers. It does not require an operating voltage. This kit is educational for beginners.

KIT/B076 £10-75

T

Twilight Switch (M013)

This waterproof, electronic twilight switch will automatically control 240 V light bulbs from 25 W up to 200 W, by switching on at dusk and switching off again at dawn.

52-3026 £7.40

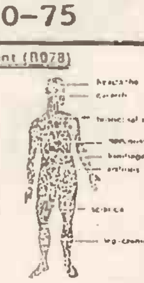
Micro-Wave Indicator (M058)

This module is used as a microwave oven leakage tester, and will light up the LED if any radiation escapes through defective door hinges, rubber seals or shieldings. Requires a 9 V battery.

52-3033 £4.00

Mesmeric Instrument (B078)

This magnetic field instrument operates on the same principle as curative instruments offered on the medical market. Alternating currents of magnetic-fields are said to have a soothing effect on various kinds of sicknesses.



KIT/B078 £9-25

ECONOMY KITS

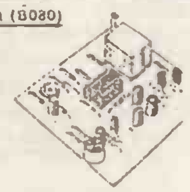
Battery charger, Ni-Cad (Universal) (B079)

Automatic accu-charger for accumulators of 1.2–15 V. The charging current will automatically adjust, to remain constant as the battery charges. Has a selection of seven settings 5–600 mA. Additional requirement: 1 transformer. Output capacity: 18–20 V, 0.5 A

KIT/B079 £9-25

Clap Circuit (B080)

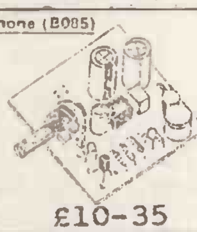
This acoustic circuit turns on a relay, can be triggered by a hand clap. The relay will be cut-off on repeated clapping. The sensitivity is adjustable. For 12 V operating voltage. Application: to switch on and off lamps or equipment by simply clapping the hands, as an alarm system responding to noise, as a party-joke, etc.



KIT/B080 £15-75

Parabolic Microphone (B085)

Highly sensitive microphone. If mounted into a semi-circular reflector (e.g., half of a plastic ball), noise and voices in a distance of several hundred metres may be recorded. Ideal for animal observance, for detectives, etc. For headphone-connection 8 Ω. Requires 5 V supply.



KIT/B085 £10-35

Lie-Detector (B087)

This lie detector will monitor changes of the skins resistance due to sweating caused by lies and fear etc. which is then indicated by an LED. Requires 4.5 V.

KIT/B087 £5-95

Microphone Pre-Amp (B090)

The impedance load can be adapted for each microphone from 4 Ω to 100 kΩ. Input voltage: 2–40 mV. Output max. 1.8 V. Adjustable gain. Frequency: approx. 20–40,000 Hz. Operating voltage: 6–20 V, approx. 1 mA.

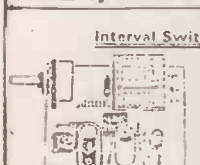
KIT/B090 £6-95

Alternate Flashing Signal LED (B092)

Two differently coloured LEDs alternately blink. Adjustable blinking speed. Operating voltage: 6–12 V, approx. 10 mA. Suited for battery operation 9 V. Application: for flashing fun-jewellery, disco-caps, name signs, model construction, etc.

KIT/B092 £4-95

Interval Switch (Universal) (B098)



Interval time: approx. 1–140 sec. Interval length: approx. 0.2–12 sec. adjustable. Operating voltage: 7.5–15 V. Relay capacity: max. 5 A. Interval indication by LED. Application: Screen-wiper interval switch for cars, pulsator for lamps, motors, etc. Delay switch for alarm systems, etc.

KIT/B098 £13-85

Telephone Amplifier (B105)

Suitable to monitor telephone conversations via the pick up coil. The kit requires a loudspeaker of 3 Ω and an operating voltage of 9 V.

KIT/B105 £9-95

Robot Voice (B107)

This kit modulates the human voice with an adjustable frequency to produce robot like sounds. This sound then requires amplification, i.e. by an amplifier or a tape recorder. Requires 9–12 V supply.

KIT/B107 £9-60

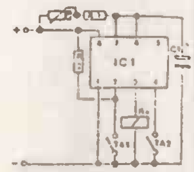
Flasher 6–24 V @ 1 A (B132)

Flash-light generator for light bulbs of max. 1 A. Short very bright and adjustable flash sequence. The voltage of the lamp must be approx. half of the operating voltage for the circuit.

KIT/B132 £5-65

Precision Timer (B133)

Very precise time switch for switching sequences from approx. 0.2 sec to 1 hour. The instrument turns on upon pressing a button and turns off again after a pre-set time. The timing may be interrupted at any time by the reset-button. Operating voltage: 12 V. Includes a precision Reed-relay.



KIT/B133 £15-04

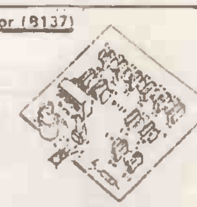
Accupuncture, Electronic (B136)

Electronical accupuncture has an effect on many sicknesses. This kit operates in accordance with the electronical accupuncture-method. An illustrated description for the treatment is enclosed. 3–12 V.

KIT/B136 £9-85

Ion Generator (B137)

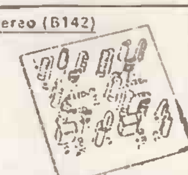
Regenerates negatively loaded air particles (air-ions) and helps to produce a healthy climate which can reduce troubled sleep, aggressiveness, headaches and weather related dispositions etc. Input: 6–18 V DC. Output: 2–7 kV. Current limit protection <200 μA.



KIT/B137 £9-95

Pre-Amp Universal Stereo (B142)

2-step stereo universal pre-amplifier for operating voltages between 9–30 V. Input: approx. 2–20 mV. Output: approx. 200 mV–2 V. Frequency response: approx. 10 Hz–150 kHz. Application: Pre-amplifier for power amplifiers, stereo-headphones amplifier, etc.



KIT/B142 £8-45

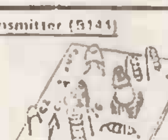
Dog Barking, Electronic (B155)

Generates a dog barking sound. Suitable for use with an 8 Ω speaker. Operating voltage 9–12 V. The barking is stored on a special speech-synthesizer IC.

KIT/B155 £19-50

MW Testing Transmitter (B144)

A close range test only oscillator which can be used as an unmodulated carrier to test radio receivers in the MW band. This kit must not be used to transmit over any distance.

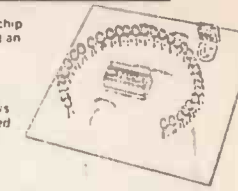


KIT/B144 £4-99

MANY MORE KITS IN OUR 1992 CATALOGUE

LED VU Meter (30 LEDs) (B160)

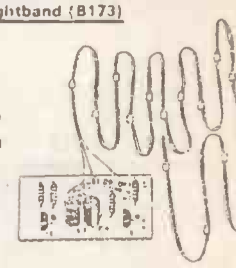
A thirty LED voltage display which uses the new U1096B chip making it possible to construct an LED control display with 30 LEDs. The circuit can be connected directly to the loudspeaker output of an amplifier. A trimming pot allows exact setting within the required range. The display can also be used as a voltmeter etc.



KIT/B160 £19-25

LED Lightband (B173)

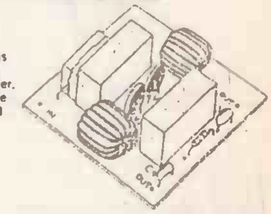
A decorative lighting band of approx. 1.5 m with 14 light emitting diodes, which light up alternately to give the appearance of movement. Ideal for decorations at parties, carnivals etc. Requires 18 V power supply.



KIT/B173 £9-45

Filter, Electronic (B176)

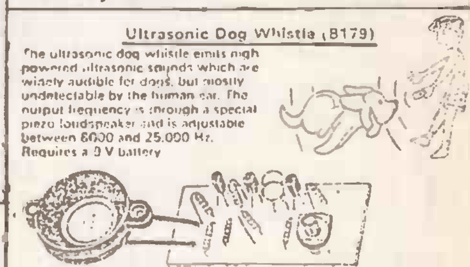
This highly effective anti-interference device has to be connected into the mains lead of your computer, telefax, video or TV set. The kit is overvoltage protected. Max. load: 750 W. 110–250 V AC.



KIT/B176 £13-25

Ultrasonic Dog Whistle (B179)

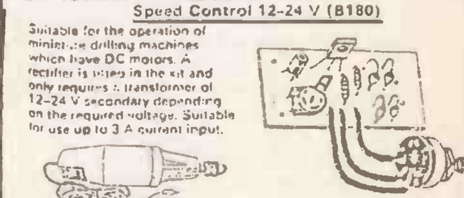
The ultrasonic dog whistle emits high powered ultrasonic sounds which are widely audible for dogs, but mostly undetectable by the human ear. The output frequency is through a special piezo loudspeaker and is adjustable between 6000 and 25,000 Hz. Requires a 9 V battery.



KIT/B179 £7-50

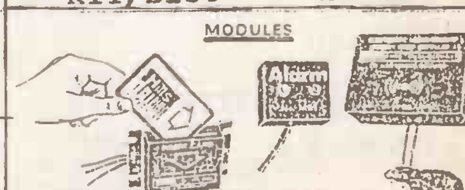
Speed Control 12–24 V (B180)

Suitable for the operation of miniature drilling machines which have DC motors. A rectifier is used in the kit and only requires a transformer of 12–24 V secondary depending on the required voltage. Suitable for use up to 3 A current input.



KIT/B180 £6-45

MODULES

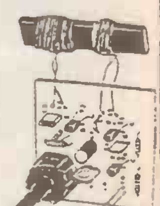


Alarm, Motorbike (M073)

This waterproof and shakeproof module will automatically switch on a horn or siren if the motorbike is moved, can also be used to protect other objects from theft. Additional items required: power supply (i.e. bike battery), SPST switch, horn or siren. Max. current 1 A.

KIT/M073 £4-50

Metal Detector (B055)



This device uses a mini ferrite antenna and will detect metal in walls, floors or beneath the surface of the ground, down to a depth of 6 cm approx. Indication is by LED. Requires a 9 V supply.

£6-50

SPECIAL OFFER

SWITCH MODE POWER SUPPLIES

ALL THE POWER SUPPLIES ON THIS PAGE ARE OFFERED AT A ONCE ONLY PRICE !!!

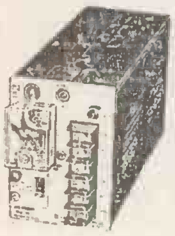
FARNELL ELECTRONICS 'G' SERIES — INPUT VOLTAGE: 115-120/220-240Vac

Mostly still in sealed Farnell boxes, unused and complete with instructions and service/pcb diagram. Two types available, being offered at a fraction of the normal trade price. Both these units are still in the Farnell Catalogue!! If you require a copy of the full technical specifications, please send a S.A.E. and ask for a copy.

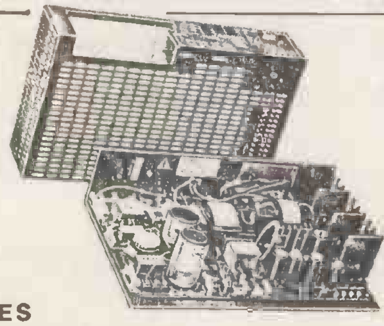
Farnell Code	WATTS	VOLTAGE RANGE	CURRENT	H	X	W	X	D	Farnell Price	CODE	PRICE
G12 5S	60W	8-12.6V	5Amps	88		60		165	£203-27 !!	SO/431	~~£65~~

ORDER BEFORE MARCH 31ST & PAY ONLY £50-00

THIS OFFER CANNOT BE REPEATED!! DON'T DELAY BUY NOW AND PAY LESS THAN 50% OF THE NORMAL PRICE!!



FARNELL 'G' SERIES



FARNELL N350/F4184

FARNELL MODEL N350/F4184 - 350WATTS!!

Custom built for FERRANTI ELECTRONICS, they didn't use them all and so we purchased what they had left!! Mainly still boxed and unused. Once again these are made to the highest specification.

INPUT: 240Vac. Dimensions: 320 X 190 X 75mm

VOLTAGE	CURRENT	ORDER CODE	PRICE 1+	PRICE 10+
+5V	11Amps			
-5V	3Amps			
+24V	7Amps			
		SO/430	£18-00	£15

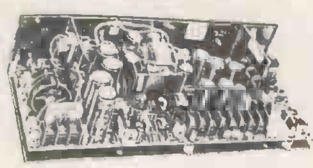
(These units originally cost over £220 each!!!)

MONITOR BOARD - WEIR
Model: M5009/1
Custom built by Weir UK. Board seems complete, EHT unit fitted.
Dims: 200 X 160mm
All boards seem Brand New.

BARGAIN PRICE

ORDER CODE: SO/435

PRICE: £5-00



ASTEC BM-41001

ASTEC - MODEL BM-41001 110 WATTS

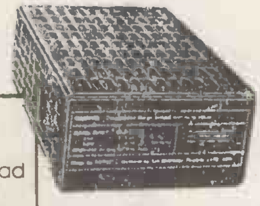
Another custom built unit, made of course to the highest specification and quality. These units are all brand new and we now only have a few hundred left. Hurry, last year we sold OVER 300 units!!.

DIMENSIONS: 415 X 120mm

INPUT: 115-240Vac

V1...........+5V @ 3A V2.......+38V @ 2.5A

ORDER CODE: SO/ASTEC/BM4 PRICE: £9-99



WEIR UK

WEIR - UK -200WATTS 120V @ 60Hz

Another custom built unit, by WEIR ELECTRONICS UK. Mostly brand new units, highest quality etc, etc.
Originally intended for USA, hence the 120V input, however, we know you can make use of these units at a real bargain price.
Units fitted with a 4-way Molex plug - no extra charge!! These units are fully enclosed

V1.......+5V @ 4A V3.........+16V @ 3.4A

V2.......-5V @ 4.5A V4.........-16V @ 3.4A

Original cost of these units was over £200 ea!

ORDER CODE: SO/WEIR/2 PRICE: £12-00

P004A **BENCH TYPE**

Variable regulated power supply with overload protection. Meter reads voltage or current (switched). Output voltage adjustable between 5 and 15Vdc. Output and power on/off switches. Ideal for laboratory use.

Input voltage	220/240Vac 50Hz
Output voltage	5-15Vdc variable
Output current	4A continuous
Stability	0.1%
Ripple	5mV
Dims	190 x 132 x 101mm

SALE PRICE £49-99

5 - 15Vdc - 4A Variable regulated output

GREENDALE

GREENDALE 19A-BOE-M137-TG ! 53WATTS

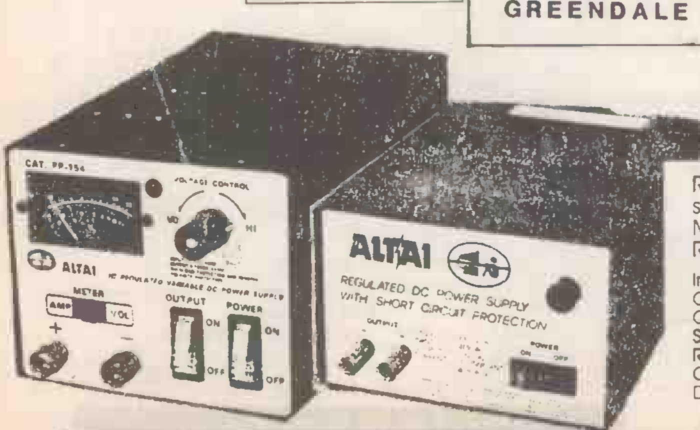
A partially cased unit made to commercial standard. Dimensions: 195 X 125 X 60mm

INPUT: 120-240Vac Outputs are on flyong leads

OUTPUTS: +5V @ 3A
-12V @ 1A
+12V @ 1A
+24V @ 0.5A

ORDER CODE: SO/434

PRICE: £12-50



REGULATED POWER SUPPLIES

SALE PRICE £19-99

Regulated power supply for use with CB rigs, auto equipment. High stability circuitry with high surge current capability. Overload protection Manufactured according to the requirements of the Electrical Safety Regulations for domestic use.

Input voltage	220/240Vac 50Hz
Output voltage	13.8Vdc
Output current	5A continuous, 7A max.
Stability	1%
Ripple	25mV
Connections	4mm banana socket (screw terminals)
Dims	195 x 140 x 90mm

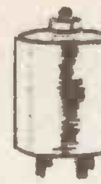
13.8Vdc - 5A Regulated output

* * * * * * * * SPECIAL OFFERS * * * * * * * *

FILTER - Siemens - B84150-A-A110
Stud Mount one end, 4 tags the other.
Markings as follows:

0.33uF(X1) + 2X2500pF(Y)
+680K + 2X1.8mH

250V 10A 50/60Hz
Dimensions: Length 65mm Dia: 35mm



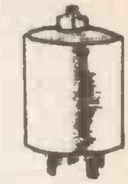
ORDER CODE: SO/SIE/A110

	1+	10+
PRICE	£3-50	£3-00

FILTER - Siemens - B84150-A-A115
Stud mounting one end, 4 tags the other.
Markings as follows:

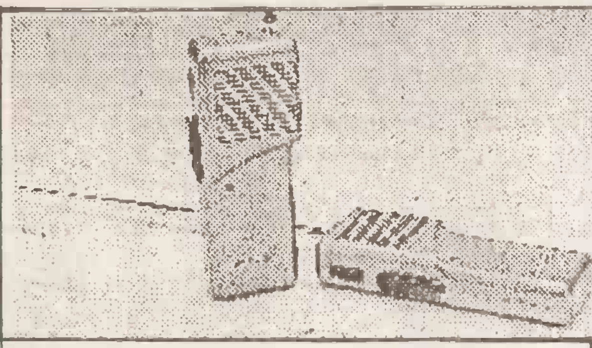
0.47uF(X1) + 2X5000pF(Y)
+680K + 2X1mH

250V 10A 50/60Hz
Dimensions: Length: 75mm Dia: 35mm



ORDER CODE: SO/SIE/A115

	1+	10+
PRICE	£4-00	£3-50



WALKIE TALKIE

B 123

2-way Hand Held Crystal Control Tranceivers. Built-in Telescopic Aerial, call button, transmitter receive key, on air indicator. Each unit requires PP3 Battery for operation (not supplied.

Operating Frequency		49 MHz
Transition Power		100 MHz
Frequency Tolerance		+ or - -0.005%
RangeRange	1-2 Kilo, open field (Depends on cond	
Oscillation	Crystal Control.	
Power		9V DC (PP3 Battery)
Pack	£27-50	1 pair in box

CABLE KITS

CABLE KITS SPECIAL OFFER.......

A choice of two packs of British Made equipment wire. 10/0.1mm and 7/0.2mm.
We also offer this cable in 100mtr reels. See below.

10/0.1mm Pack
Dia. approx 1.05mm. Max voltage RMS 1000V. Nominal current is 0.5Amps.
Each pack contains 10Metres of each of the following colours: RED, BLACK, BLUE, BROWN, GREEN.
A total pack of 50Metres.

ORDER CODE: SO/CBL/P1 PRICE: £1-50 per pack

(Price per 100mtr reel is £1-95.)

7/0.2mm Pack
Dia. approx 1.2mm. Max voltage 1000Volts RMS. Nominal Current 1.4Amps.
Each pack contains 10Metres of each of the following colours: RED, BLACK, BLUE, GREEN, WHITE, GREEN/YELLOW.
A total pack of 60Metres.

ORDER CODE: SO/CBL/P2 PRICE: £1-80 per pack

(Price per 100Metre reel is £2-00)

500V CERAMIC KIT

Very high quality, single layer type.

These capacitors are normally very expensive and therefore not available to the hobbyist.
We priced this kit up at current trade prices, the price manufacturers pay, and it was over **£60 !!!!!!**
You really cannot afford to miss this super offer.
Physical sizes: 3.3pF to 3N3 8mm Dia.
4.7nF to 10n 10mm Dia.
20nF to 220n 16mm Dia.

Each kit contains 5 off each value. Total Qty 125pcs.

Values: 3.3pF, 3.9pF, 10pF, 15pF, 22pF, 27pF, 33pF, 47pF, 56pF, 68pF, 82pF, 100pF, 120pF, 180pF, 220pF, 270pF, 680pF, 1N2, 1N5, 3N3, 4N7, 8N2, 10nF, 20nF, 47nF, 220nF.

ORDER CODE: SO/HVKIT PRICE: £6-00

RADIO RECIEVER

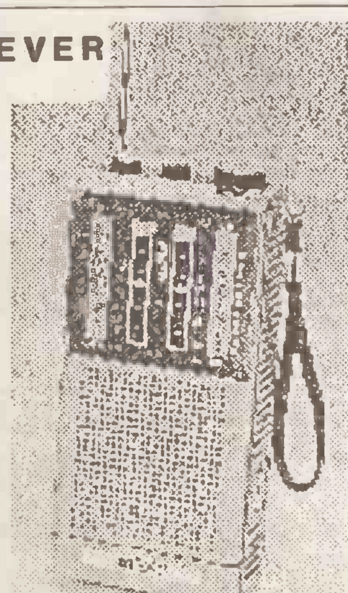
B 118 B

A handheld broadband radio receiver with a range covering CB, FM radio, TV, Air and PB bands. Built-in telescopic aerial. Squelch, volume and tuning controls and band selector switch.

Frequency range:

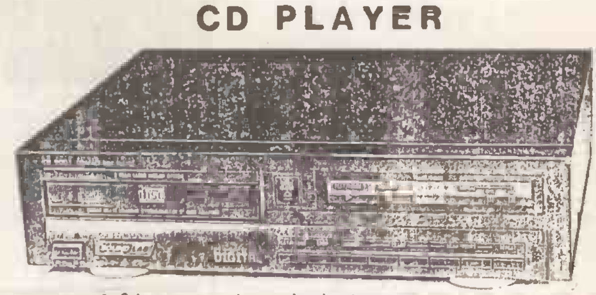
Air	108 - 145MHz
PB	145 - 176MHz
WB	162.5MHz
TV	54 - 87MHz
FM	88 - 108MHz
CB	1 - 80 channels

Power....................................6Vdc
(4x "AA" batteries, not included)
Dims.........................93 x 198 x 50



PRICE: £17-50

CD PLAYER



- 3-beam semi-conductor laser
- 6 track programmable memory
- Repeat one - repeat all facility
- Built-in 3 disc adaptor
- Track search and index

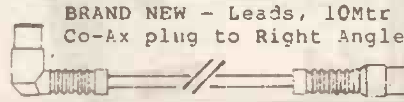
System	Compact disc digital audio system
Optical pick-up	3-beam semi-conductor laser
Error correction	CIRC
Sampling frequency	41.1kHz
D/A conversion	16-bit linear
Filter	Digital filter + active filter
Frequence response	20-20000Hz
Harmonic distortion	<0.09%
S/N ratio	>80dB
Channel separation	>70dB
Max. output voltage	2Vrms
Power	240Vac 10W
Dims	350 x 90 x 290mm

	1+	2+
CD PLAYER	£99-00	£90-00

EPROM SPECIAL - 27C256
Brand new, 250ns. Limited quantity, approx 800 pcs. First come first etc

	1+	10+
ORDER CODE: SO/EPROM	£3-00	£2-50

BRAND NEW - Leads, 10Mtr long.
Co-Ax plug to Right Angle Co-Ax plug.



£1-50

ALL PRICES INCLUDE V.A.T.

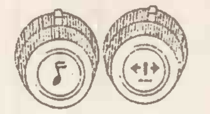
ADD £2.25 P&P PER ORDER

Dimensions: Length: 135mm Width: 50mm
Height: 45mm

Very high quality, Brand New, Unused. These really are a true bargain.
Ideal for Computer, Radio, which require an electrical noise free supply. Each filter is constructed using toroidal chokes and a combination of safety X2 and Y capacitors configured in a delta formation.

ORDER CODE: SO/SIE/10A £7-50 each 2 for £10

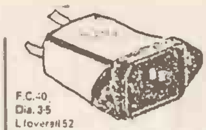
CAR STEREO KNOBS



F209A SK05

Complete set of silver knobs for car stereo radio/cassette player. 4 knobs gives one each for volume, tuning, balance and tone. Serrated edges. Push on with anti-rotation spigots.
Max. dia:- 34mm

	1+	10+
PRICE:	50p	40p



IEC filter plug units
2Amp

IEC FILTER PLUG UNIT - BELLING LEE
TYPE- L2133C/L

Current Rating: 2Amp Operating Volt: 250
Line Frequency: 0-400Hz
Inductance 3mH per line.

ORDER CODE: SO/262 PRICE: £4-50

IEC FILTER PLUG UNIT - BELLING LEE
TYPE - L2131C/L
Chassis style as above but: 6A

ORDER CODE: SO/262A PRICE: £4-75

TOROIDAL TRANSFORMER
Made in UK
Manufactured to very high standard by 'St. Ives Windings'.
Primary: 0-120 Secondary: 9V @ 4A
0-120 15v-0-15v @ 500m/A

Dimensions: Dia: 75mm Thickness: 38mm

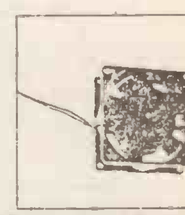
Subject to availability we will supply fixing hardware. (Only while stocks last)
Original Price in tens, : £24-00 each!!

ORDER CODE: SO/268 PRICE: £10-00

PAPST FAN - TYPE 6124 12V-32VDC
172 x 55mm 206CFM
Metal Fan housing, impeller of fibreglass reinforced plastic (PA). Electronically commutated dc motor. Counterclockwise rotation viewed from rotor, air output over struts.
Super quality. ORDER CODE: SO/256A
List Price: £82-00 each !!! PRICE: £25-00

EBM FAN - TYPE W2G075-AE21
80mm Depth: 38mm
Super quality, latest model. 12V (8-16V) 2.6W 3450u/min. Made in West Germany.
All aluminium construction. Would cost you over £30-00 each!!

ORDER CODE: SO/257 PRICE: £15-00



TORIN FAN - TYPE TA300
80mm. Depth: 38mm
MADE IN UK ! Aluminium Body
240VAC 0.060/.052 Amps
Impedance protected. Super quality

ORDER CODE: SO/258 PRICE: £5-95

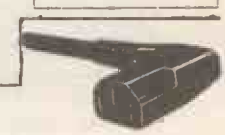
HI RES MONITOR Made in UK GREEN SCREEN
Very high quality monitor, complete apart from the case.
Resolution at Centre is 900 lines therefore ideal for computer applications.
Simply input 12V @ 1.2A.
COMPOSITE VIDEO!
Supplied complete with full handbook and circuit diagram and full parts list.
(Manual available seperately £2-00 each)

SPEC:

CRT Size	7" (178mm)
Power	12V/1.2A
Line Frequency	15-19KHz
Vertical Frequency	50-60Hz
Resolution at Centre	900 lines
Linearity	<2%
EHT Typical	12.0Kv
Line Blanking	12-7.5uS
Vertical Blanking	750uS
Video Input unterminated	12K
terminated	75R
Video Response	22MHz
Video Rise/Fall	17nS
Video in for 35V output	1Vp-p

ORDER CODE: SO/MONITOR PRICE: £19-99
2 for £35-00

BELDEN LEADS



IEC LEAD 250V 10A Right Angle
Made By BELDEN
This may be the highest quality lead available.
Fully screened cable, moulded IEC socket one end with USA plug on the other.
To use in UK, simply cut off the USA plug and wire up a standard 13A plug.
At time of printing we have over 12,000 of these leads and therefore able to offer very attractive quantity prices.
Markings on cable: 18-3 Type SJT E-3462 LL-7874 Shielded GE
Colour: BLACK
Length: 2 Mts

	1+	10+	100+
ORDER CODE: SO/307	£1-00	85p	60p

TERMINAL BOX

Terminal junction box for powering d.c. accessories. Gives three pairs of pillar screw terminals, colour coded red and black. 90cm lead fed from cigar lighter plug.
Current:- .... 3A max.
Dims:- .... 84 x 55 x 32mm

PRICE: £1-50

ORDER CODE: SO/158

P.C.B. TRAYS

P.C.B. STORAGE TRAYS - ALLIBERT
General purpose, high quality storage trays. Can be used for all sorts of uses. They are interlocking therefore stackable. Ideal for PCB production storage, component storage, Desk in/out trays etc etc.
Current price in Keys Catalogue £3-50 ea + VAT!

Dimensions: 300 X 395mm Depth: 75mm

Colour: GREY

At time of printing we have approx. 1000 pcs.

ORDER CODE: SO/TRAY	1+	25+	100+
PRICE	£1-50	£1-25	£1-00

POWER SUPPLIES - EUROPEAN - 2 PIN

Manufactured by Commodore Business Machines (CBM) ltd. These power supplies are ideal for running radio's, cassette recorders, calculators etc etc. They fit the UK shaver adaptor (See our Electrical section). We have substantial quantities of these items and can offer attractive discounts for bulk buyers.

TYPE: EOB -DC
Input: 220/240V
Output: 4.5V @ 200mA
Plug: 2.5mm Jack
SO/POW/EOB

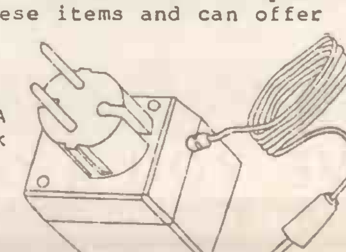
1+	10+	100+
70p	60p	50p

TYPE: MM3-AC
Input: 220/240V
Output: 6V @ 200mA
Plug: 3.5mm Jack
SO/POW/MM3

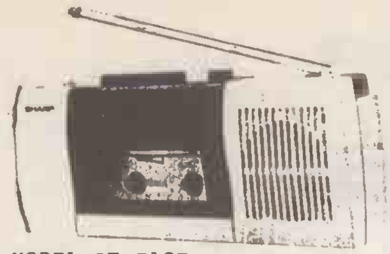
1+	10+	100+
95p	90p	75p

TYPE: EO9-DC
Input: 220/240V
Output: 6V @ 400mA
Plug: 3.5mm Jack
SO/POW/EO9

1+	10+	100+
£1-20	£1-10	90p



* * * * * * * *SPECIAL OFFERS * * * * * * * *



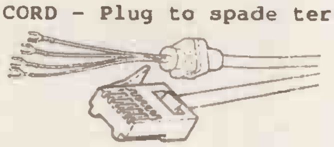
S H A R P

SHARP MODEL QT-F10E
A super quality Radio Cassette Recorder offered at a fraction of the normal price. Although some of these units are refurbished, they are all guaranteed by us for 3 months from date of purchase. Should you have cause for complaint we would repair or exchange at our discretion.
Features include:
* Auto Stop
* Battery Operated (5 X AA) Not included.
* Recording from Built-in Radio possible.
* Recording external sound possible.
* Earphone socket fitted.
* FM Range 87.6MHz-108MHz
* AM Range 526.5kHz-1606.5kHz
* Some are complete with carrying belt.

Only a couple of hundred available, order NOW

PRICE – £12-50

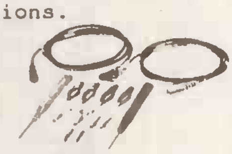
BT LINE CORD - Plug to spade terminals.



Standard BT cord set with 4 way BT plug.
Overall length approx. 3 Metres.

ORDER CODE: SO/BT LEAD	1+	25+	100+
A TRULY ONCE ONLY DEAL!	£1-00	85p	55p

UNIVERSAL TEST LEAD SET
An extremely versatile universal test lead set with screw on accessories offering a wide variety of probe/test options.
Overall lead length 0.9Mtr.



Contents:
* Pair Red & Black test leads.
* Pair Red & Black probes.
* Pair 4mm connectors
* Pair 2mm connectors.
* 2 pairs red & black crocodile clips.
* Pair of spade connectors.

Normal Catalogue Price: £3-25

ORDER CODE: TEST/UTL SALE PRICE: £2-50

TELECOM - Housing
Very smart, light tan colour with dark brown base. Two 'quick fix' screws hold on cover. Many cut-outs both ends.
Dimensions: 210 X 320 X 125mm

ORDER CODE: SO/462 PRICE - £3-50

TRANSFORMER - 100VA
Very high quality at a very silly low price.

PRIMARY: 0-120v 0-120v

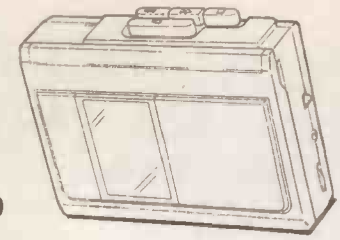
SECONDARY: 0-24v, 28v, 32v, 36v 100VA

DIMS: H - 120mm D - 90mm W - 100mm

Only a couple of hundred left, over 400 sold to date!

ORDER CODE: SO/470		1+	10+
	PRICE -	£5-50	£5-00

AIWA WALKMAN. Model: HS-P12



PRICE £9-99

A I W A

A very smart walkman. Once again, offered at a fraction of the normal price.
Although some units are refurbished, all are guaranteed by us for 3 months on a repair or exchange basis at our discretion.
Features Include:
* Complete with headphones.
* Auto Stop
* Choice of CrO^2 / Normal setting.
* Uses 2 X AA batteries (Not included)
* Socket for external 3V power supply.
* Many have belt clips.

Limited quantity order now......

BT 4 WAY TELEPHONE PLUG
Standard 4 way BT plug suitable for use with a wide range of communication equipment, including telephones, keyboards & audio applications.
These plugs are British Telecom approved.
British Telecom Ref: 431A.

		1+	25+	100+
ORDER CODE: SO/BT PLUG	PRICE:	18p	16p	12p

Z80 BOARD
Brand new boards, still wrapped. Sorry, no info but we have listed major chips on the board.

PLUG IN (Non Soldered)
1 X Z80-CPU 1 X 2764
1 X Z80B-DART 1 X HD46505SP
1 X z80B-CTC

Soldered In Chips etc:
Over 50 assorted 74LS IC's
Various resistors, capacitors, D plugs etc.

Board Size: 250 X 225mm

ORDER CODE: SO/471 PRICE - £5-50

KEYBOARD - BRAND NEW -(UNCASED)
Still in original boxes, manufactured by Clare General Instrument Corp.
Alphanumeric - seperate numeric keypad.

107 keys with a buzzer and several chips on the rear:
2 X 7406PC, 1 X 74LS373N, 1 X 8528, 1 X 2516JL-45, 1 X ET8035N-6, 1 X Crystal 6Mhz.
Various resistors & capacitors.

Overall dimensions: 480 X 160mm

	1+	10+
ORDR CODE: SO/472	£5-00	£4-50

B.T. MODEM UNIT
Brand new, still in sealed manufacturers packs. Sorry, no info but we have listed the major components on the 2 sandwich style boards.
PLUG IN CHIPS: 1 X C875 1H-11 Intel 40 pin
3 X P8051AH-0121 Intel 40 pin.

SOLDERED IN: 3 X LM348 1 X 74ALS74N,
1 X ULN2033A, 1X ULN2002A, 1XLF353
1 X AD7528JN, 1X AD7574KN
Various relays, BT sockets, crystals, switches

Both boards same size: 160 X 100 X 55mm

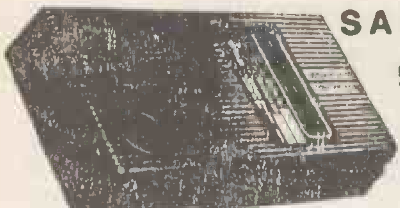
	1+	10+
ORDR CODE: SO/485	£9-50	£7-85

HAVE YOU A COPY OF OUR 1992 CATALOGUE?

ALL PRICES INCLUDE V.A.T.

ADD £2.25 P&P PER ORDER

GOULD - SWITCH MODE Power Supply 24V 1.4A
Model: MMG24-1.4



SALE PRICE £50-00

Gould need no introduction. Maybe the highest quality.

Input: 110V - 120V / 220V - 240V
OUTPUT: 24V 1.4A
Dims: 160 x 35 x 85mm

Current list price over £200 each!!

ORDER CODE: SO/487 ~~PRICE: £90-00~~

EPROM LABELS W 16.5mm D 5.08mm
OK INDUSTRIES TYPE CODE: 1/100A/10

A dual purpose label desighned for use on eproms or similar devices where the chip requires protection from the effects of light.
These labels may be also used as a means of device or junction identification.
Supplied on roll sheets which have pin-feed holes along the edge thus allowing them to be printed on a computer.

Total quantity per reel: Approx 3350 labels!

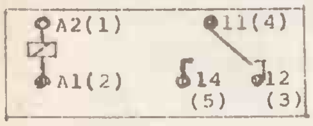
	QTY	PRICE
ORDER CODE: SO/600	60 labels	50p
	180 labels	£1-40
ONE REEL	3350 labels	£22-50

PHOTOTRANSISTOR
Siemens Type: SFH309-5

Case: T1 (3mm)
Sensitivity: 1.0-2.0 @ 0.5mW/cm²
Half Angle: 32°
Peak Response: 900nm
Response: 10 tr(US)
Short Lead Collector
Lead Pitch: 2.54

	1+	10+	50+	100+	1000+
ORDER CODE: SO/601	38p	35p	30p	25p	20p

SCHRACK RELAY TYPE: RP-031012



Internationally approved heavy duty PCB mounting relays in industry standard dimensions with 1 form C contact rated at 8A. Mounted on 0.1" grid.
These really are very high quality.

Switching voltage: 380V AC max.
8A 250V DIMS: 28 x 25 x 11MM

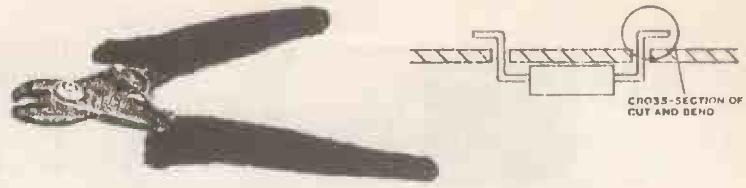
Nominal V DC: 12V 270 ohm

	1+	10+	50+	100+
ORDER CODE: SO/602	£1-00	90p	80p	65p

ATT: MANUFACTURERS. At time of printing we have approx. 5000pcs available. All still boxed etc.

IEC CURLY LEAD
6A 240V Right angle IEC plug fitted to 3 core 0.75mm black curly lead. Stretches to approx. 2.5Metres.

	1+	10+
ORDER CODE: SO/604	£1-00	90p

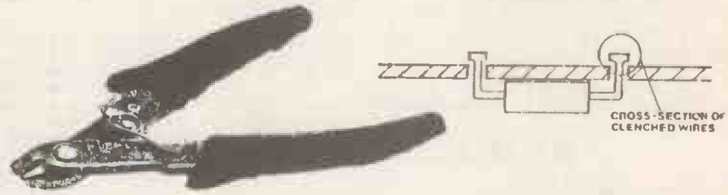


CUT and BEND
Cuts & bends component leads in one action (see drawing). A quick & easy method of retaining mounted components. Ideal for development work, components can be removed and reused after desoldering at a later time. Cutting capacity 1mm dia. copper wire.
Special cushion grip handles. Very high quality, manufactured in Italy.

Weight: 70gms Length: 128mm

Normal catalogue Price £4-95

ORDER CODE: TOOL/SC/TP30 SALE PRICE: £2-99



CUT and CLENCH
A stepped edge provides a cutting & clenching action which will cut & splay copper leads out to approx. twice the original diameter. (See drawing). Provides a permanent & secure method of retaining components, particularly useful in production. Cutting capacity 1mm dia. copper wire.

Weight: 70gms Length: 128mm

Special cushion grip handles. Very high quality, manufactured in Italy.

Normal catalogue Price £4-99

ORDER CODE: TOOL/SC/TS30 SALE PRICE: £2-99

SALE PRICE

£25-99

L132

PIR FLOODLIGHT
A high power security floodlight with built-in PIR detector which reacts to body heat, switching on the floodlight whenever somebody is within the detection zone. The PIR detector is adjustable for horizontal and vertical angle and contains a photo detector to prevent daylight operation.
Power: 220/240Vac 50Hz.

HALOGEN LAMPS
Standard length lamps avail. in 3 values.

200W	SEC/200W	PRICE - £3-50
300W	SEC/300W	PRICE - £3-75
500W	SEC/500W	PRICE - £4-00

50 (FET) FIELD EFFECT TRANSISTOR PROJECTS BP39
£2.95 F.G. Rayer
Field-effect transistors (FETs) find applications in a wide variety of circuits. The projects described here include radio-frequency amplifiers and converters, test equipment and receiver aids, tuners, receivers, mixers and tone controls, as well as various miscellaneous devices which are useful in the home.
The actual FET to be used, in most cases, is not critical and many suitable types will perform satisfactorily. The FET is a low-noise, high gain device with a multitude of uses, the dual gate being of particular use in mixers and other applications.
0 85934 042 2 1977 178 x 111 mm 112 pages

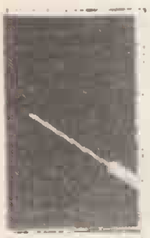
MINI-MATRIX BOARD PROJECTS BP99
£2.50 R. A. Penfold
Although there are obviously limitations to the amount of circuitry that can be accommodated on a small circuit board, the versatility of modern components is such that it is possible to design a wide range of projects that can be easily built using just a handful of components including the stripboard.
This book does just that, in providing a selection of 20 useful and interesting circuits, all that can be built on a mini-matrix board which is just 24 holes by 10 copper strips in size.
0 85934 074 0 1982 178 x 111 mm 112 pages

REMOTE CONTROL HANDBOOK BP240
£3.95 O. Bishop
Replaces our original book BP73 and is aimed at the electronics enthusiast who wishes to experiment with remote control in its many aspects and forms.
0 85934 185 2 1988 178 x 111 mm 240 pages

ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS BP180
£2.95 R. A. Penfold
Shows the reader practical ways of using a number of the more popular micros for controlling, running and adding effects to model railways.
0 85934 154 2 1987 178 x 111 mm 96 pages

ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS BP179
£2.95 R. A. Penfold
Provides information and circuits on computer control of electric motors (including stepper types), plus a range of useful sensors including visible light, infra-red, and ultrasonic types.
0 85934 153 4 1986 178 x 111 mm 96 pages

25 SIMPLE AMATEUR BAND AERIALS BP125
£1.95 E. M. Noll



This concise book describes how to build 25 amateur band aerials that are simple and inexpensive to construct and perform well. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic made from four TV masts and about 400 feet of wire.
After the aerial discussion you will find a complete set of dimension tables that will help you spot an aerial on a particular frequency. Dimensions are given for various style aerials and other data needed for spacing and cutting phasing lengths. Also included are dimensions for the new WARC bands.
0 85934 100 3 1983 178 x 111 mm 80 pages

10. FAULT-FINDING

See also book numbers BP169, BP248 and BP249

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING BP110
£2.50 R. A. Penfold
We have all built circuits from magazines and books 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.
Chapter 1 deals with the mechanical faults such as tracing dry joints, short-circuits, broken PCB tracks, etc. The construction and use of a tristate continuity tester, to help in the above, is also covered.
Chapter 2 deals with linear analogue circuits and also covers the use and construction of a signal injector/tracer which can be used to locate and isolate the faulty areas in a project.
Chapter 3 considers ways of testing the more common components such as resistors, capacitors, op amps, diodes, transistors, SCRs, unijunctions, etc., with the aid of only a limited amount of test equipment.
Chapter 4 deals with both TTL and CMOS logic circuits and includes the use and construction of a pulse generator to help fault-finding.
0 85934 085 6 1982 178 x 111 mm 96 pages

TRANSISTOR RADIO FAULT-FINDING CHART BP70
£0.95 C.E. Miller
Used properly, it should enable the reader to trace most common faults reasonably quickly. Across the top of the chart will be found four rectangles containing brief descriptions of these faults, *vis* sound weak but undistorted, set dead, sound low or distorted and background noises. One then selects the most appropriate of these and following the arrows, carries out the suggested checks in sequence until the fault is cleared.
0 900162 84 4 1980 Chart

AUDIO AMPLIFIER FAULT-FINDING CHART BP120
£0.95 C.E. Miller
This chart will help the reader to trace most common faults that might occur in audio amplifiers. Across the top of the chart are two "starting" rectangles, *vis* Low/Distorted Sound Reproduction and No Sound Reproduction: after selecting the most appropriate one of these, the reader simply follows the arrows and carries out the suggested checks until the fault is located and rectified.
0 85934 095 3 1987 Chart

GETTING THE MOST FROM YOUR MULTIMETER BP239
£2.95 R. A. Penfold
It is amazing just what you can check and test with a simple multimeter if you know what you are doing. This book tells the story, with Chapter 1 covering the basics and relative merits of analogue and digital instruments. Chapter 2 discussing component checking and Chapter 3 dealing with circuit testing.
0 85934 184 4 1988 178 x 111 mm 112 pages

MORE ADVANCED USES OF THE MULTIMETER BP265
£2.95 R. A. Penfold
A sequel to book BP239 showing the reader some more advanced and unusual applications of that humble test instrument the simple multimeter.
0 85934 210 7 1989 178 x 111 mm 96 pages

AUDIO BP111
(Elements of Electronics-Book 6)
£3.95 F. A. Wilson
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.
Books 1-5 in this series are described in this catalogue under the book numbers BP62, BP63, BP64, BP77 and BP89.
0 85934 086 4 1985 178 x 111 mm 320 pages

AUDIO PROJECTS BP90
£2.50 F. G. Rayer
This book covers in detail the construction of a wide range of audio projects. The text has been divided into the following main sections: Pre-amplifiers and Mixers, Power Amplifiers, Tone Controls and Matching, Miscellaneous Projects.
All the projects are fairly simple to build and to assist the newcomer to the hobby, the author has included a number of board layouts and wiring diagrams.
0 85934 065 1 1981 178 x 111 mm 96 pages

PRACTICAL STEREO AND QUADROPHONY HANDBOOK 208
£0.75 B.B. Babani
A reference book for all interested in modern stereophonic and multisound channel equipment. The subjects covered include explanations of many of the technical terms used in this audio field, stereo equipment and techniques, positioning of multiple loudspeakers for best results, stereo and four-channel pick-ups. etc.
0 900162 43 0 1975 178 x 111 mm 96 pages

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST 228
£2.50 G. T. Rubaroe
Written to supply the hobbyist with a background knowledge tailored to meet his or her specific requirements and the author has brought together the relevant material and presented it in a readable manner with minimum recourse to mathematics.
Many formulae having a practical bearing are presented in this book and purpose designed examples are employed to illustrate their applications.
0 900162 69 4 1977 178 x 111 mm 128 pages

HOW TO DESIGN AND MAKE YOUR OWN P.C.B.s BP121
£2.50 R. A. Penfold
Chapter 1 deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple PCB construction as comprehensively as possible.
Chapter 2 covers photographic methods of producing PCB's and Chapter 3 deals with most aspects of designing your own printed circuit board layouts.
0 85934 096 1 1983 178 x 111 mm 80 pages

AN INTRODUCTION TO DESK TOP PUBLISHING BP269
£5.95 R. A. & J. W. Penfold
Introduces the reader to the general principles and practicalities of desk top publishing. Illustrated by some of the popular low cost DTP programs such as Fantasy and Timeworks, etc.
0 85934 214 X 1990 264 x 195 mm 96 pages

SIMPLE SHORTWAVE RECEIVER CONSTRUCTION BP275
£3.95 R. A. Penfold
Contains practical designs for building a number of simple S.W. receivers including full coil winding details.
0 85934 220 4 1990 178 x 111 mm 96 pages

ADVANCED SHORTWAVE RECEIVER CONSTRUCTION BP276
£3.95 R. A. Penfold
Gives the reader full constructional details, including coil winding, of a number of advanced design receivers which should have levels of performance at least equal to that of commercially built sets of similar complexity.
0 85934 221 2 1990 178 x 111 mm 96 pages

EXPERIMENTAL ANTENNA TOPICS BP278
£3.50 H. C. Wright

Contains 28 fascinating sections and includes many unusual practical designs which utilise such things as cardboard, cooking foil, plastic bottles, cat food tins, etc.
1990 178 x 111 mm 96 pages

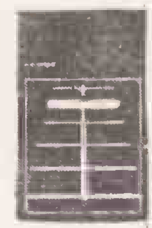
AN INTRODUCTION TO AMATEUR COMMUNICATIONS SATELLITES BP290
£3.95 A.Pickard
All the information you are likely to need to get started in this fascinating aspect of amateur radio.
0 85934 235 2 1990 178 x 111mm 160 pages

PUBLIC ADDRESS LOUDSPEAKER SYSTEMS BP292
£3.95 V. Capel
Covers the moving coil loudspeaker, baffles, the basic requirements of a P. A. system, sound patterns, line-source, horn loudspeakers, LISCA, low-impedance matching, 100V line systems, transmission lines, and induction loops etc.
0 85934 237 9 1990 178 x 111mm 128 pages

AN INTRODUCTION TO RADIO DXING BP91
£1.95 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 with the minimum of distortion and interference requires a little more skill and knowledge. The object of this book is to help the reader do just that, which in essence is the fascinating hobby of radio DXing.
0 85934 066 X 1981 178 x 111 mm 112 pages

AERIAL PROJECTS BP105
£2.50 R. A. Penfold
Whether you have built a very simple short wave receiver or have purchased a most sophisticated piece of equipment, the performance you achieve will ultimately depend on the aerial to which your set is connected. The subject of aerials is vast but in this book the author has considered practical aerial designs, including active, loop and ferrite aerials which give good performances and are relatively simple and inexpensive to build. The complex theory and mathematics of aerial design have been avoided. Also included are constructional details of a number of aerial accessories including a pre-selector, attenuator, filters and tuning unit.
0 85934 080 5 1982 178 x 111 mm 96 pages

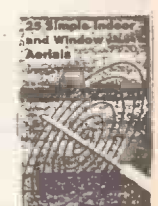
AN INTRODUCTION TO ANTENNA THEORY BP198
£2.95 H.C. Wright



Deals with the basic concepts relevant to receiving and transmitting antennas in a manner which emphasises the mechanism involved and with strong diagramatic support minimises the mathematics used.
The bibliography provided offers the next stage of reading and understanding, while the outline set of original papers listed should allow a particular interest to be followed up in detail.
1987 178 x 111 mm 96 pages

25 SIMPLE SHORTWAVE BROADCAST BAND AERIALS BP132
£1.95 E. M. Noll
Fortunately good aerials can be erected at low cost, and for a small fractional part of the cost of your receiving equipment.
This book tells the story. A series of 25 aerials of many different types are covered, ranging from a simple dipole through helical designs to a multi-band umbrella.
0 85934 107 0 1984 178 x 111 mm 80 pages

25 SIMPLE INDOOR AND WINDOW AERIALS BP136
£1.75 E. M. Noll
Written for those people who live in flats or have no gardens or other space-limiting restrictions which prevent them from constructing a conventional aerial system.
The 25 aerials included in this book have been especially designed, built and tested by Mr. Noll to be sure performers and give surprisingly good results considering their limited dimensions.



0 85934 111 9 1984 178 x 111 mm 64 pages

25 SIMPLE TROPICAL AND MW BAND AERIALS BP145
£1.75 E. M. Noll
Shows you how to build 25 simple and inexpensive aerials for operation on the medium wave broadcast band and on 60, 75, 90 and 120 metre tropical bands. Designs for the 49 metre band are included as well.
0 85934 120 8 1984 178 x 111 mm 64 pages

AN INTRODUCTION TO AMATEUR RADIO BP257
£3.50 I. D. Poole

Gets you started with the fascinating hobby that enthrals so many people the world over.
This book gives the newcomer a comprehensive and easy to understand guide through the subject so that the reader can gain the most from the hobby. It then remains an essential reference volume to be used time and again.
Topics include the basic aspects of the hobby, such as operating procedures, jargon and setting up a station. Technical topics covered include propagation, receivers, transmitters and aerials etc.
0 85934 202 6 1989 178 x 111 mm 160 pages

AN INTRODUCTION TO VHF/UHF FOR RADIO AMATEURS BP281
£3.50 I. D. Poole
This book covers the essentials required to gain the most from using the VHF and UHF bands. Topics covered include propagation, descriptions of the bands with outlines of the band plans and channels, aerials, receivers, transmitters and a special chapter on scanners. In addition to this repeater and mobile operation are included as well as DXing and data modes together with a section on packet radio.
0 85934 226 3 1990 178 x 111mm 112 pages

BOOKS

THE ART OF PROGRAMMING THE ZX SPECTRUM BP119
£2.50 M. James
It is one thing to have learnt how to use all the Spectrum's commands and functions, but a very different one to be able to combine them into programs that do exactly what you want them to. This is just what this book is all about – teaching you the art of effective programming with your Spectrum.
0 85934 094 5 1983 178 x 111 mm 144 pages

20 PROGRAMS FOR THE ZX SPECTRUM AND 16K ZX81 BP128
£1.95 S. Daly

Don't be put off by the title if you are a non-Sinclair enthusiast. All these programs were written and tested on the ZX81 and Spectrum machines but most will run on any computer with a good BASIC interpreter and at least 5K of RAM. Copious notes are given on each of the programs including the changes required on non-Sinclair systems.
0 85934 103 8 1983 178 x 111 mm 128 pages

HOW TO WRITE ZX SPECTRUM AND SPECTRUM + GAMES PROGRAMS BP157
£2.50 W. Simister
A crystal-clear step-by-step guide to writing your own graphics games programs, starting at the most simple level and progressing to a 3-D game.
0 85934 132 1 1985 178 x 111 mm 128 pages

THE ART OF PROGRAMMING THE 1K ZX81 BP109
£1.95 M. James
This book shows you how to use the features of the ZX81 in programs that fit into the 1K machine and are still fun to use.
0 85934 084 8 1982 178 x 111 mm 96 pages

THE ART OF PROGRAMMING THE 16K ZX81 BP114
£2.50 M. James & S.M. Gee
This book introduces the possibilities that are opened up by adding the 16K RAM pack to the ZX81.
0 85934 089 9 1982 178 x 111 mm 144 pages

AN INTRODUCTION TO MSX BASIC BP154
£2.50 R. A. & J. W. Penfold
MSX BASIC is the so-called "universal" Japanese version of the BASIC language that will enable the same software to be simply run on machines manufactured by a number of different makers. This book helps you get to grips with this revolutionary and fascinating concept.
0 85934 129 1 1985 178 x 111 mm 128 pages

AN INTRODUCTION TO PROGRAMMING THE DRAGON 32 BP133
£1.95 R. A. & J. W. Penfold
A gradual approach that helps the reader get the most out of the DRAGON 32. Expands and supplements the user's handbook rather than simply duplicating it.
0 85934 108 9 1983 178 x 111 mm 128 pages

AN INTRODUCTION TO PROGRAMMING THE ORIC-1. BP129
£1.95 R. A. & J. W. Penfold
Written for readers wanting to learn more about programming and how to make the best use of the ORIC-1 microcomputer's many powerful features. Most aspects of the ORIC-1 are covered; the omissions being where little could usefully be added to the information provided by the manufacturer's own manual.
0 85934 104 6 1983 178 x 111 mm 112 pages

LOGO FOR BEGINNERS BP193
£2.95 J. W. Penfold
The ideal book for all those who want to start programming in LOGO which commences at the absolute beginning and progresses right up to the elements of artificial intelligence.
0 85934 167 4 1988 178 x 111 mm 96 pages

A CONCISE INTRODUCTION TO MS-DOS BP232
£2.95 N. Kantaris
This guide is written with the non-expert, busy person in mind and, as such, it has an underlying structure based on "what you need to know first, appears first". Nonetheless, the guide is also designed to be circular, which means that you don't have to start at the beginning and go to the end. The more experienced user can start from any section.

The guide explains:

How the DOS operating system is structured so that you understand what happens when you first switch on your computer.

How to use the DOS commands to perform various housekeeping operations on your disc files.

How to use the EDLIN line editor to fully configure your system by writing your own CONFIG.SYS and AUTOEXEC. BAT files.

How directories and sub-directories can be employed to organize the way you keep files on your disc so that your system's efficiency is maximized.

How to write batch files to automate the operation and use of your system.

How to manage your system's environment.

The guide covers versions 3.0, 3.1 and 3.2 of both PC-DOS and MS-DOS as implemented by IBM and other manufacturers of "compatible" microcomputers, including the AMSTRAD PC's. It covers both floppy disc-based systems and hard disc-based systems.
0 85934 177 1 1987 198 x 130 mm 64 pages

BASIC & PASCAL IN PARALLEL BP126
£1.50 S. J. Wainwright
Takes the two languages – BASIC and PASCAL, and develops programs in both languages simultaneously. The common ground between the two languages is covered and emphasis is placed on the similarities rather than the differences between them.
0 85934 101 1 1983 178 x 111 mm 64 pages

PROGRAMMING IN FORTRAN 77 BP250
£4.95 N. Kantaris
This book is a guide to Fortran programming. Although similarities between Fortran commands and/or statements and those of other languages are occasionally highlighted in the text, the reader is not expected to have any familiarity with such languages.

Fortran statements are introduced and explained with the help of simple programs. The user is encouraged to type these into the computer, save them, and keep improving them as more complex language statements and commands are encountered.

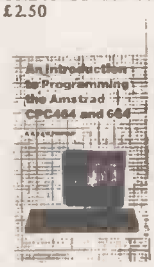
Graded problems are set throughout the book, with full working solutions appearing at the back of the book. At the end of each Chapter, additional graded exercises are presented, some with financial or scientific bend, so that users can choose their own level of problem difficulty on which to practice with some additional choice in the preference of the field of application.
0 85934 195 X 1988 198 x 130 mm 160 pages

BASIC & FORTRAN IN PARALLEL BP137
£1.95 S. J. Wainwright & A. Grant
Similar in nature to books BP126 and BP138. Includes a FORTRAN interpreter written for the 16K Spectrum.
0 85934 112 7 1984 178 x 111 mm 96 pages

BASIC & FORTH IN PARALLEL BP138
£1.95 S. J. Wainwright
Similar in style to books BP126 and BP137 but this time the computer languages BASIC and FORTH are considered simultaneously; again, the emphasis being placed on their common ground rather than their differences. Includes a FORTH stack simulator that will run on either a 16K or 48K Spectrum.
0 85934 113 5 1984 178 x 111 mm 112 pages

BASIC & LOGO IN PARALLEL BP196
£2.95 S. J. Wainwright
Again similar in style to the three previous books but BASIC and LOGO are compared and contrasted. LOGO is not only an educational language but it can also be used for more serious applications as it is hoped this book will show. Included is a LOGO Graphics interpreter written in BBC BASIC.
0 85934 171 2 1987 178 x 111 mm 96 pages

AN INTRODUCTION TO PROGRAMMING THE AMSTRAD CPC 464 AND 664 BP153
£2.50 R. A. & J. W. Penfold



The Amstrad CPC 464 or 664 running with Locomotive BASIC makes an extremely potent and versatile machine and this book is designed to help the reader get the most from this powerful combination. Written to complement rather than duplicate the information already given in the manufacturers own manual. Also applicable to the CPC 6128.
0 85934 128 3 1984 178 x 111 mm 144 pages

HOW TO WRITE AMSTRAD CPC 464 GAMES PROGRAMS BP159
£2.50 W. Simister
Written as a step-by-step guide to help you write your own graphics games programs. Starts at the most simple level and progresses to a 3-Dimensional game. Also applicable to the CPC 664 and 6128 as well.
0 85934 134 8 1985 178 x 111 mm 144 pages

HOW TO WRITE WORD GAME PROGRAMS FOR THE AMSTRAD CPC 464, 664 AND 6128 BP175
£2.95 W. Simister

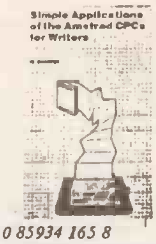
The excellent facilities of the Amstrad computers are of great help in handling the words or letters in the many programs in this book. Included are ways to sort words alphabetically, to scramble them into anagrams, to select letters from words for various purposes, to locate missing letters from words, to place letters randomly on the screen, and even ways to help in the writing or solving of crossword puzzles.

The many routines used for all these different ways of handling words or letters are clearly explained, and are inserted into programs in such a way that they can easily be extracted to be used in games of your own devising.
0 85934 149 6 1985 178 x 111 mm 112 pages

USING YOUR AMSTRAD CPC DISC DRIVES BP189
£2.95 J. W. Penfold
Everything you are likely to need to know to enable you to get the maximum benefit and minimum of problems when using discs and disc drives on your Amstrad.

Covers such things as tracks, sectors and formatting; AMDOS and CP/M operating systems including rules and regulations, filing from BASIC, file copying and transfer; program development including MERGE and CHAIN MERGE; CP/M turnkey discs etc.
0 85934 163 1 1986 178 x 111 mm 96 pages

SIMPLE APPLICATIONS OF THE AMSTRAD CPCs FOR WRITERS BP191
£2.95 W. Simister



This book shows how an Amstrad CPC 464, 664 or 6128 with disc drive's and DMP 1 or DMP 2000 printer can be turned into a simple but adequate word processor by using a BASIC program of only fifteen lines. Each of the program lines are dealt with in detail so that even someone with no knowledge of BASIC programming will be able to use it with the minimum of difficulty. The program should be fairly easily adaptable for use on other micros.
0 85934 165 8 1986 178 x 111 mm 80 pages

AN INTRODUCTION TO PROGRAMMING THE ATARI 600/800 XL BP143
£1.95 R. A. & J. W. Penfold
Especially written to supplement the manufacturer's own handbook. The information supplied will help the reader to master BASIC programming and to make best use of the ATARI's many powerful features.
0 85934 118 6 1984 178 x 111 mm 128 pages

AN INTRODUCTION TO PROGRAMMING THE BBC MODEL B MICRO BP139
£1.95 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.

0 85934 114 3 1984 178 x 111 mm 144 pages

PROGRAMMING IN QUICKBASIC BP284
£4.95 N. Kantaris
QuickBASIC is one of the most popular structured dialects of BASIC running on the IBM and compatible computers. QuickBASIC statements are introduced and explained with the help of simple programs. This enables the user to build up a considerable library of their own programs and procedures which become building blocks of advanced programming techniques.
0 85934 229 8 1990 198 x 130 mm 160 pages

A CONCISE INTRODUCTION TO VENTURA BP291
£3.95 J. W. Penfold
Gets the PC user started with this incredible DTP package.
0 85934 236 0 1990 198 x 130 mm 80 pages

A CONCISE INTRODUCTION TO GEM BP230
£2.95 J. W. Penfold
GEM is a system of computer control consisting of pictorial representations of files and operations which are then manipulated by the user with a device called a "mouse" which is pushed around on a desk so moving a pointer on screen.

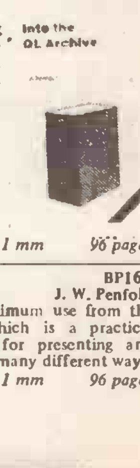
This book explains to the beginner all he or she is likely to need to know about GEM.
0 85934 175 5 1989 198 x 130 mm 80 pages

A CONCISE INTRODUCTION TO WINDOWS386 BP288
£3.95 N. Kantaris
Shows the PC user all he or she needs to know when using WINDOWS (Version 3).
0 85934 233 6 1990 198 x 130 mm 80 pages

AN INTRODUCTION TO PROGRAMMING THE COMMODORE 16 & PLUS 4 BP158
£2.50 R. A. Penfold
Helps you to learn to use and program these two Commodore machines with the minimum of difficulty by expanding and complementing the information supplied in the manufacturer's own manuals.
0 85934 133 X 1985 178 x 111 mm 128 pages

AN INTRODUCTION TO QL MACHINE CODE BP156
£2.50 R. A. & J. W. Penfold
Shows the reader how to get to the very "heart" of the QL by programming directly the 68008 chip. An obvious progression once you have mastered SuperBASIC.
0 85934 131 3 1985 178 x 111 mm 96 pages

INTO THE QL ARCHIVE BP161
£2.50 J. W. Penfold
Gives the reader a better understanding in the use and application of the powerful database program QL Archive. A step-by-step approach has been adopted which also includes essentially practical examples.



0 85934 135 6 1985 178 x 111 mm 96 pages

COUNTING ON QL ABACUS BP162
£2.50 J. W. Penfold
Shows the reader how to get the maximum use from the enormously powerful QL Abacus which is a practical spreadsheet-type of program. Useful for presenting and manipulating information and data in so many different ways.
0 85934 136 4 1986 178 x 111 mm 96 pages

HOW TO IDENTIFY UNMARKED ICs BP101
£0.95 K. H. Recorr
Shows the reader how, with just a test-meter, to go about recording the particular signature of an unmarked IC which should enable the IC to then be identified with reference to manufacturers' or other data. By now you are probably wondering what an IC signature is. It is a specially plotted chart produced by measuring the resistances between all terminal pairs of an IC. Originally published as an article in "*Radio-Electronics*", one of the leading magazines in the U.S.A.
0 85934 070 7 1982 Chart

50 PROJECTS USING RELAYS, SCRs AND TRIACs BP37
£2.95 F.G. Rayer

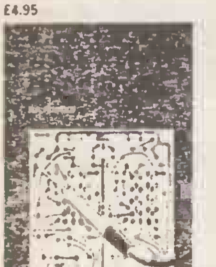
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIAC's) have a wide range of applications in electronics. These may extend over the whole field of motor control; dimming and heat control; delayed, timing and light sensitive circuits and include warning devices, various novelties, light modulators, priority indicators, excess voltage breakers etc. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct. In most of the circuits there is a wide latitude in component values and types, allowing easy modification of circuits or ready adaptation of them to individual needs.
0 85934 040 6 1977 178 x 111 mm 112 pages

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART BP7
£0.95 B. B. Babani
Covers many colour codes in use throughout the world, for most radio and electronic components. Includes resistors, capacitors, transformers, field coils, fuses, battery leads, speakers, etc.
0 85934 006 6 1971 Chart

CHART OF RADIO, ELECTRONIC, SEMICONDUCTOR AND LOGIC SYMBOLS BP27
£0.95 M. H. Babani
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
0 85934 029 5 1975 Chart

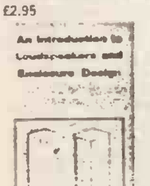
RESISTOR SELECTION HANDBOOK BP28
£0.60 B. B. Babani
Shows how to combine two preferred values of resistors to obtain virtually any required value of resistance. Also includes information about fixed resistors, standard ranges, colour codes and markings, power ratings and resistor calculations.
0 85934 031 7 1976 165 x 113mm 48 pages

ELECTRONIC HOBBYISTS HANDBOOK BP233
£4.95 R. A. Penfold



Mr. R. A. Penfold has used his vast knowledge of hobby electronics to provide a useful collection of data for the amateur electronics enthusiast in a single source where it can be quickly and easily located. It includes a great deal of data on likely topics of interest, such as colour codes, integrated circuit pinouts, transistor leadout diagrams and data, basic circuit building blocks, etc. Some knowledge of electronics may be needed in order to make use of the information, but, in most cases, the reader is not simply provided with raw data, and where appropriate background information and explanatory notes are provided
0 85934 178 \ 1987 284 x 195mm 96 pages

AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN BP256
£2.95 V. Capel



All you need to know about the theory and operation of loudspeakers and the various types of boxes that they may be fitted into. Also includes the complete design and constructional details of how to make an inexpensive but high quality enclosure called the "Kapellmeister"
0 85934 201 3 1988 178 x 111 mm 160 pages

ELECTRONIC MODULES AND SYSTEMS FOR BEGINNERS BP266
£3.95 O. Bishop
Shows the reader how to build a number of simple analogue and digital circuit modules, all suitable for battery operation, and all based on only 1 or 2 [illegible] ICs. For each module there is a circuit diagram and description [illegible] as well as constructional details.
0 85934 211 5 1989 [illegible] 208 pages

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE BP85
£3.95 A. Michaels
Helps the reader to find possible substitutes for a popular user-orientated selection of European, American and Japanese transistors. Also shows material type, polarity, manufacturer and use
0 85934 060 0 1981 178 x 111 mm 320 pages

ELECTRONIC PROJECTS FOR CARS AND BOATS BP94
£1.95 R. A. Penfold
Describes fifteen fairly simple projects for use with a car and/or boat. Each project has an explanation of how the circuit works as well as constructional details including a stripboard layout.
0 85934 069 4 1981 178 x 111 mm 96 pages

7. ELECTRONIC & COMPUTER MUSIC

ELECTRONIC MUSIC PROJECTS BP74
£2.50 R. A. Penfold
Provides the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as fuzz box, waa-waa pedal, sustain unit, reverberation and phaser units, tremelo generator, etc.
The text is divided into four chapters as follows: Chapter 1, Guitar Effects Units; Chapter 2, General Effects Units; Chapter 3, Sound Generator Projects; Chapter 4, Accessories.
0 900162 94 5 1980 178 x 111 mm 112 pages

MORE ADVANCED ELECTRONIC MUSIC PROJECTS BP174
£2.95 R. A. Penfold
Intended to complement the first book (BP74) by carrying on where it left off and providing a range of slightly more advanced and complex projects. Included are popular effects units such as flanger, phaser, mini-chorus and ring-modulator units. Some useful percussion synthesisers are also described and together these provide a comprehensive range of effects including drum, cymbal and gong-type sounds.
0 85934 148 8 1986 178 x 111 mm 96 pages

MUSICAL APPLICATIONS OF THE ATARI ST's BP246
£5.95 R. A. & J. W. Penfold
The Atari ST's are fast becoming the first choice of computer for the electronic music enthusiast due to their relatively low cost and MIDI interface. The Penfolds show you how to make the most of these machines musically, with simple add-on circuits and program routines.
0 85934 191 7 1988 198 x 130 mm 144 pages

MIDI PROJECTS BP182
£2.95 R. A. Penfold
Provides practical details of how to interface many popular home computers with MIDI systems. Also covers interfacing MIDI equipment to analogue and percussion synthesisers.
0 85934 156 9 1986 178 x 111 mm 112 pages

A BEGINNERS GUIDE TO MODERN ELECTRONIC COMPONENTS BP285
£3.95 R. A. Penfold
It is easy for newcomers to electronics to become confused by the wide range of components currently available. There are now a great many different types of components on offer in shops and catalogues, often with numerous variations on each type. It can be difficult to know your carbon compositions from your metal films and your diacs from your triacs! This book presents the reader with a vast amount of invaluable information to enable the right component to be selected every time.
0 85934 230 1 1990 178 x 111mm 176 pages

MODERN OP-AMP PROJECTS BP106
£1.95 R. A. Penfold
Includes a wide range of constructional projects which make use of the specialised operational amplifiers that are available today, including low noise, low distortion, ultra-high input impedance, low slew rate and high output current types. Circuits using transconductance types are also included.
0 85934 081 3 1982 178 x 111 mm 112 pages

HOW TO USE OP-AMPS BP88
£2.95 E. A. Parr

This book has been written as a designer's guide covering many operational amplifiers, serving both as a source book of circuits and a reference book for design calculations. The approach has been made as non-mathematical as possible and it is hoped, easily understandable by most readers, be they engineers or hobbyists.
0 85934 063 5 1982 178 x 111 mm 160 pages

IC 555 PROJECTS BP44
£2.95 E. A. Parr
Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer is such a device. Included in this book are basic and general circuits, motorcar and model railway circuits, alarms and noise-makers as well as a section on the 556, 558 and 559 timers
0 85934 047 3 1982 178 x 111 mm 176 pages

A PRACTICAL INTRODUCTION TO DIGITAL ICs 225
£2.50 D. W. Easterling
Introduces the reader practically to digital ICs, this book is mainly concerned with the TTL types such as the 7400 series. Besides a number of simple projects, the author has included the full practical construction of a logic circuit test set which will enable the reader to identify and test his own digital ICs. Also included are the full constructional details and ways of using a more ambitious project – the digital counter timer.
0 900162 66 X 1977 178 x 111 mm 80 pages

MODEL RAILWAY PROJECTS BP95
£1.95 R. A. Penfold
Provides a number of useful but reasonably simple projects for the model railway enthusiast to build, based on inexpensive and easily obtainable components.
The projects covered include such things as controllers, signal and sound effects units, and to help simplify construction, stripboard layouts are provided for each project.
0 85934 070 8 1981 178 x 111 mm 112 pages

DIGITAL IC PROJECTS BP84
£1.95 F. G. Rayer
Contains both simple and more advanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits.
To help the newcomer to the hobby, the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be built and tested section by section and this should help avoid or correct faults that could otherwise be troublesome.
0 85934 059 7 1981 178 x 111 mm 96 pages

2.1 ABSOLUTE BEGINNERS
See also book numbers BP92, BP99 and BP110

BEGINNERS GUIDE TO BUILDING ELECTRONIC PROJECTS 227
£1.95 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 the popular magazines and books. Also includes examples in the form of simple projects that you can build.
0 900162 68 6 1977 178 x 111 mm 112 pages

ELECTRONIC PROJECTS FOR BEGINNERS BP48
£1.95 F. G. Rayer
Contains a wide range of easily made projects (including some that require no soldering) for the newcomer to electronics. Includes many actual component and wiring layouts to aid easy and successful construction.
0 85934 054 6 1978 178 x 111 mm 128 pages

IC PROJECTS FOR BEGINNERS BP97
£1.95 F. G. Rayer
Offers a range of simple projects based around a number of popular and inexpensive linear and digital integrated circuits. With most projects, complete layout and/or point-to-point wiring diagrams are included to help simplify construction.
0 85934 072 4 1982 178 x 111 mm 112 pages

30 SOLDERLESS BREADBOARD PROJECTS–BOOK 1 BP107
£2.95 R. A. Penfold
Each project, which is designed to be built on a "Verobloc" breadboard, is presented in a similar fashion with a brief circuit description, circuit diagram, component layout diagram, components list and notes on construction and use where necessary. Wherever possible, the components used are common to several projects, hence with only a modest number of reasonably inexpensive components, it is possible to build in turn, every project shown. Recommended by BICC-VERO.
0 85934 082 1 1982 178 x 111 mm 160 pages

30 SOLDERLESS BREADBOARD PROJECTS–BOOK 2 BP113
£2.25 R. A. Penfold

The companion volume to Book 1 (BP107) and presented in exactly the same style using "Verobloc". However, all the projects in this book are based on CMOS logic integrated circuits, whereas those in the first book were all designed using linear devices. The information contained in Book 1 about identifying components and using breadboards is not repeated here so that it is suggested that the absolute beginner start with the first book.
Recommended by BICC-Vero.
0 85934 088 0 1983 178 x 111 mm 160 pages

2.2 GENERAL ASSORTED
See also book numbers BP117 and BP118

POPULAR ELECTRONIC CIRCUITS–BOOK 1 BP80
£2.95 R. A. Penfold
Contains a wide range of circuits which are accompanied by a short text giving a brief introduction, circuit description and any special notes on construction and setting-up that may be necessary.
0 85934 055 4 1980 178 x 111 mm 160 pages

POPULAR ELECTRONIC CIRCUITS–BOOK 2 BP98
£2.95 R. A. Penfold
Again, 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 constructional information. However, where relevant, any special setting-up procedures are described.
0 85934 073 2 1982 178 x 111 mm 160 pages

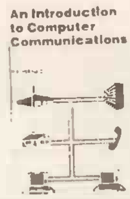
POPULAR ELECTRONIC PROJECTS BP49
£2.50 R. A. Penfold
Provides a collection of the most popular types of circuits and projects covering a very wide range of interests, including Radio, Audio, Household and Test Equipment projects.
0 85934 053 8 1978 178 x 111 mm 144 pages

50 CIRCUITS USING GERMANIUM SILICON AND ZENER DIODES BP36
£1.50 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.
0 85934 039 2 1977 178 x 111 mm 64 pages

50 SIMPLE LED CIRCUITS BP42
£1.95 R. N. Soar
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components – the light-emitting diode (LED). Also includes circuits for the 707 common anode display.
0 85934 043 4 1977 178 x 111 mm 64 pages

AN INTRODUCTION TO COMPUTER COMMUNICATIONS BP177
£2.95 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.



0 85934 151 8 1986 178 x 111 mm 80 pages

AUDIO AMPLIFIER CONSTRUCTION BP122
£2.95 R. A. Penfold
The following practical designs are featured and include circuit diagram and description, Veroboard or PCB layout and any necessary constructional or setting up notes.

Chapter 1—Pre-amplifiers: versatile microphone type based on the NE5534; tape type using the LM3802; RIAA pre-amp; simple guitar pre-amp; ceramic or crystal pick-up type; active tone controls using an LF351; general purpose pre-amp.

Chapter 2 — Power amplifiers: simple low power battery type using a 2283 IC; 2 watt using the TBA820, 8 watt using the TDA2030; 16 watt 12 volt P.A. amplifier; 20 watt using a MOSFET output stage; 100 watt D.C. coupled amplifier using four MOSFETs in the output stage.
0 85934 097 X 1983 178 x 111 mm 128 pages

GETTING THE MOST FROM YOUR PC'S HARD DISK BP280
£3.95 J. W. Penfold
Just as the title describes, it shows the reader in simple terms, how to best manage their PC's hard disk and make most use of it.
0 85934 225 5 1990 198 x 130 mm 96 pages

HOW TO EXPAND, MODERNISE AND REPAIR PC'S AND COMPATIBLES BP271
£4.95 R. A. Penfold

All the practical information you are likely to need to upgrade your PC and compatible. Also contains useful information to help you with repairs.

0 85934 216 6 1990 198 x 130 mm 176 pages

AN INTRODUCTION TO BASIC PROGRAMMING TECHNIQUES BP86
£1.95 S. Daly
Based on the author's own experience in learning BASIC and in helping others, mostly beginners – to program and understand the language. This book includes a program library and finishes with a number of appendices which include a glossary and test questions and answers on each chapter.
0 85934 061 9 1981 178 x 111 mm 96 pages

A CONCISE INTRODUCTION TO THE LANGUAGE OF BBC BASIC BP149
£1.95 T. J. E. Murphy
A clear and concise introduction to BBC BASIC as used by the BBC micros and the ACORN ELECTRON etc.
0 85934 124 0 1985 178 x 111 mm 64 pages

BBC BASIC86 ON THE AMSTRAD PC's AND IBM COMPATIBLES
Book 1 – LANGUAGE BP243
£3.95
Book 2 – GRAPHICS AND DISC FILES BP244
£3.95
N. Kantaris & K. Thompson
Book 1: This book is specifically designed for use with the AMSTRAD PC's and IBM compatibles running BBCBASIC86 – the structured language that users of the BBC computer have learned to love. BBC BASIC statements are introduced and explained with the help of simple programs. This enables the user to build up a considerable library of his own programs and procedures which become the building blocks of advanced programming techniques.

Book 2: The book explores the Graphics and Disc Filing capabilities of BBCBASIC86 running on the AMSTRAD PC's and IBM compatibles. It is ideal for those users who would like to be led through the intricate path of multi-screen graphics, error-handling routines and database filing systems, all of which are illustrated and incorporated into working programs.
Book 1: 0 85934 188 7 1988 198 x 130 mm 112 pages
Book 2: 0 85934 189 5 1988 198 x 130 mm 112 pages

MICRO INTERFACING CIRCUITS-Book 1 BP130
£2.25
MICRO INTERFACING CIRCUITS-Book 2 BP131
£2.75 R. A. Penfold
Both books include practical circuits together with details of the circuit operation and useful background information. Any special constructional points are covered but PCB layouts and other detailed constructional information are not included.

BOOK 1 is mainly concerned with getting signals in and out of the computer.

BOOK 2 deals primarily with circuits for practical applications.
Book 1: 0 85934 105 4 1984 178 x 111 mm 112 pages
Book 2: 0 85934 106 2 1984 178 x 111 mm 112 pages

EASY ADD-ON PROJECTS FOR AMSTRAD CPC 464, 664, 6128 AND MSX COMPUTERS BP171
£3.50 O. Bishop
The projects in book BP124 adapted for use with the Amstrad CPC 464, 664, 6128 and the MSX range of machines. But this time there is no need to construct an address decoder as these computers are accessed via their joystick or printer ports.
0 85934 145 3 1986 178 x 111 mm 160 pages

9.6. GENERAL & PRACTICAL INTRODUCTIONS

COMPUTER TERMINOLOGY EXPLAINED BP148
£1.95 I. D. Poole

Explains a wide range of terms that form the computer jargon used by enthusiasts and which also appears in books and magazines. Also includes a reference guide to the more commonly used BASIC commands found on most microcomputers.

0 85934 123 2 1984 178 x 111 mm 96 pages

THE PRE-COMPUTER BOOK BP115
£1.95 F. A. Wilson
Aimed at the absolute beginner with no knowledge of computing. An entirely non-technical discussion on computer bits and pieces and programming.
0 85934 090 2 1983 178 x 111 mm 96 pages

PRACTICAL COMPUTER EXPERIMENTS BP78
£1.75 E. A. Parr
This book aims to fill in the background to the microprocessor by constructing typical computer circuits in discrete logic and it is hoped that this will form a useful introduction to devices such as adders, stores, etc, as well as a general source book of logic circuits.
0 900162 98 8 1980 178 x 111 mm 96 pages

ELECTRONICS SIMPLIFIED —CRYSTAL SET CONSTRUCTION BP92
£1.75 F. A. Wilson
Especially written for those who wish to participate in the intricacies of electronics more through practical construction than by theoretical study. It is designed for all ages upwards from the day one can read intelligently and handle simple tools
0 85934 067 8 1982 178 x 111 mm 80 pages

POWER SUPPLY PROJECTS BP76
£2.50 R. A. Penfold

Mains power supplies are an essential part of many electronic projects.

This book gives a number of power supply designs, including simple unstabilised types, fixed-voltage regulated types, and variable-voltage stabilised designs, the latter being primarily intended for use as bench supplies for the electronics workshop. The designs provided are all low-voltage types for semi-conductor circuits.

The book should also help the reader to design his own power supplies.

There are other types of power supply apart from the mains to low voltage type and a number of these are dealt with in the final chapter, including a cassette power supply, ni-cad battery charger, voltage step-up circuit and a simple inverter.
0 900162 96 1 1980 178 x 111 mm 96 pages

MORE ADVANCED POWER SUPPLY PROJECTS BP192
£2.95 R. A. Penfold
Covers more advanced topics than those dealt with in the original book BP76 and also covers developments since the original book was written.

Includes designs and circuitry for precision supplies, switch mode power supplies and computer controlled supplies as well as a number of miscellaneous circuits.
0 85934 166 6 1988 178 x 111 mm 96 pages

TEST EQUIPMENT CONSTRUCTION BP248
£2.95 R. A. Penfold
Shows you how to build a wide range of simple test equipment that will be useful in the pursuance of your hobby after you have had the enjoyment of constructing it.
0 85934 193 3 1988 178 x 111 mm 96 pages

MORE ADVANCED TEST EQUIPMENT CONSTRUCTION BP249
£3.50 R. A. Penfold
Follows on from book BP248 with constructional details of more advanced projects that will help you with your hobby.
0 85934 194 1 1989 178 x 111 mm 112 pages

PROJECTS IN OPTO-ELECTRONICS BP45
£1.95 R. A. Penfold
Although many people tend to take opto-electronic devices and circuits for granted, it is hoped that this book will show even the most experienced reader that they can be used in a surprisingly wide range of applications.

The purpose of this book is to describe a number of projects which may be of interest to all electronics enthusiasts. Included are simple circuits using ordinary light emitting diodes (LEDs) as well as more sophisticated designs such as infra-red transmitters and detectors, modulated light transmission and also photographic projects, etc.
0 85934 049 X 1978 178 x 111 mm 112 pages

MODERN OPTO DEVICE PROJECTS BP194
£2.95 R. A. Penfold
Provides a number of circuits using more modern devices than book number BP45.

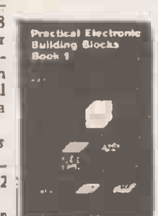
Includes designs for:- simple fibre optic audio link; equivalent circuit for RS232C type data transmission and reception; light pen for BBC, Atari, Commodore and Amstrad computers; presence detector; broken beam detector; infra red reflected light sensor; LED stroboscope; etc. PCB layouts are included for more critical designs.

0 85934 168 2 1987 178 x 111 mm 96 pages

SOLID STATE NOVELTY PROJECTS 219
£0.85 M. H. Babani
The reader is shown how to build a number of different novelty projects using ICs and transistors. Included are the "Optomin", a musical instrument that is played by reflecting a light beam with your hand, water warbler for pot plants, musical tone generator, LEDs and ladders game, touch switch, electronic roulette wheel, etc.
0 900162 60 0 1976 178 x 111 mm 96 pages

2.5 METHODS OF DESIGN AND CONSTRUCTION

PRACTICAL ELECTRONIC BUILDING BLOCKS–BOOK 1 BP117 £1.95
PRACTICAL ELECTRONIC BUILDING BLOCKS–BOOK 2 BP118 £1.95
R. A. Penfold



Virtually any electronic circuit will be found to consist of a number of distinct stages when analysed. Some circuits inevitably have unusual stages using specialised circuitry, but in most cases circuits are built up from electronic building blocks of standard types. These books are designed to aid electronic enthusiasts who like to experiment with circuits and produce their own projects, rather than simply following published project designs. The circuits for a number of building blocks are included in each book, and component values and type numbers are provided in each case. Where relevant, details of how to change the parameters of each circuit (voltage gain of amplifiers, cut-off frequencies of filters, etc.) are given so that they can be easily modified to suit individual requirements. No difficult mathematics is involved.

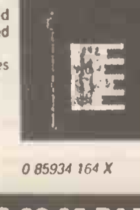
BOOK 1 contains: Oscillators – sinewave, triangular, squarewave, sawtooth, and pulse waveform generators operating at audio frequencies, including simple voltage-controlled types. L-C and crystal RF oscillators. Timers – simple monostable circuits using ICs, and 555 and 7555 devices, etc. Also precision long timers using the ZN1034E. Miscellaneous – noise generators, rectifiers, comparators and triggers, etc.

BOOK 2 contains: Amplifiers – low level discrete and op-amp circuits, voltage and buffer amplifiers including DC types. Also low-noise audio and voltage controlled amplifiers. Filters – high-pass, low-pass, 6, 12, and 24 dB per octave types. Also voltage controlled filters. Miscellaneous – IC power amplifiers, mixers, voltage and current regulators, etc.
Book 1: 0 85934 092 9 1983 178 x 111 mm 128 pages
Book 2: 0 85934 093 7 1983 178 x 111 mm 112 pages

ELECTRONIC GAMES BP69
£1.75 R. A. Penfold
Contains a number of interesting electronic games projects using modern integrated circuits. The text is divided into two sections, the first dealing with simple games and the latter dealing with more complex circuits thus making the book ideal for both beginner and more advanced enthusiast alike.
0 900162 90 2 1980 178 x 111 mm 96 pages

ELECTRONIC SECURITY DEVICES BP56
£2.50 R. A. Penfold
This book, besides including both simple and more sophisticated burglar alarm circuits using light, infra-red and ultrasonics, also includes many other types of circuit as well, such as gas and smoke detectors, flood alarms, doorphone and baby alarms, etc.
0 900162 76 7 1979 178 x 111 mm 112 pages

MORE ADVANCED ELECTRONIC SECURITY PROJECTS BP190
£2.95 R. A. Penfold



Contains a number of more up-to-date and sophisticated projects, complete with PCB or stripboard layout, than our original book number BP56.

Covers:- Opto alarms including pyro-sensor, infra-red and fibre-optic loop types. A computer based system showing how a home micro fitted with a user port can form the basis of a sophisticated alarm and monitoring system. Various alarms using mercury switches, magnetic dependent resistors, doppler shift and capacity effect on an RF oscillator etc, are included.

0 85934 164 X 1988 178 x 111 mm 112 pages

MARCO TRADING —1992 SPRING SALE —ORDER FORM

003EE
003TV

INCORPORATING 'EAST CORNWALL COMPONENTS'

The Maltings, High Street,
WEM, Shrewsbury, SY4 5EN.

TEL: 0939-232763(3 lines)
0939-232689(2 lines)

FAX: 0939-233800

CUSTOMER NAME & ADDRESS

DATE:

DESCRIPTION	QTY.	UNIT PRICE	TOTAL PRICE
MINIMUM ORDER VALUE £5.00			
MY ORDER IS OVER £20 PLEASE SEND MY FREE SIDECUTTERS ☐			
SUB.TOTAL FROM OVERLEAF			
ADD P & P			£2-25
SUB.TOTAL			
TOTAL			

FREE GIFT NOT AVAILABLE AFTER 31/3/92

IF PAYING BY CREDIT CARD, PLEASE STATE:

NO.:

EXPIRY DATE:

SIGNATURE:

PAYMENT ENCLOSED: VISA/ACCESS, CHEQUE, POSTAL ORDER, CASH, CREDIT NOTE. (Delete As Applicable.)

If any items are not available from stock, tick appropriate box for action required.

Send Order Balance To Follow A. S. A. P. ☐ Hold Order Until Complete ☐ Credit for Out of Stock Items ☐

DESCRIPTION	QTY.	UNIT PRICE	TOTAL PRICE
		SUB.TOTAL	

POCKET GUIDES
A new range of technical books of very high quality and good value for money.
Easy to use and packed full of all the information you could want.

TTL Volume 1 (7400-74200)
Listing all commonly used TTL describing their structure, operation & typical applications. Products from all major manufacturers are included & are clearly summarised in reference charts at the end of each guide.

ORDER CODE: BK/TTL1 PRICE £11-95

TTL Volume 2 (74201-74640)
This book carries on where Volume 1 stops.
Again the last section of the book includes reference charts showing which manufacturer supplies which components in which technology.

ORDER CODE: BK/TTL2 PRICE £11-95

TTL Volume 3 (74641-7430640)
Large numbers of new components (especially ALS, AS and Fast) of the rapidly growing TTL family are included in Volume 3 of the TTL pocket guides.

ORDER CODE: BK/TTL3 PRICE £11-95

SPECIAL OFFER.....
Purchase all six books (List Price £71-70) and pay only £65-00 !!

CMOS Pocket Guide

CMOS Volume 1
Volume 1 provides a clearly laid out listing of standard types for all integrated CMOS components.

ORDER CODE: BK/CMOS1 PRICE £11-95

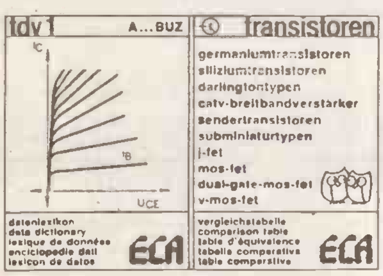
CMOS Volume 2
As per CMOS 1 this book covers CMOS analog switches, multiplexers, industrial process control components, smoke detectors, timers & counters, voltage transformers, delta modulators, PCM components, tone decoders, PLL frequency synthesisers etc etc.

ORDER CODE: BK/CMOS2 PRICE £11-95

HCMOS (Out November 1991)
Same format as the other books, but covering high speed HCMOS components.

ORDER CODE: BK/HCMOS PRICE £11-95

EQUIVALENT BOOKS



A..to BUZ
Maximum ratings and characteristic data of European transistors.
Over 700 pages in 5 languages Including English!
Including selector tables and case outline drawings.

ORDER CODE: BK/DAT1 PRICE £13-99

C..to Z
Maximum ratings etc as above.
800 pages in 5 languages including English!

ORDER CODE: BK/DAT2 PRICE £14-45

2N21..6776
Maximum ratings and characteristic data of USA transistors.
544 pages

ORDER CODE: BK/DAT3 PRICE: £13-99

2S..to 40 000
Max. ratings & characteristic data of Japanese transistors.
944 pages.

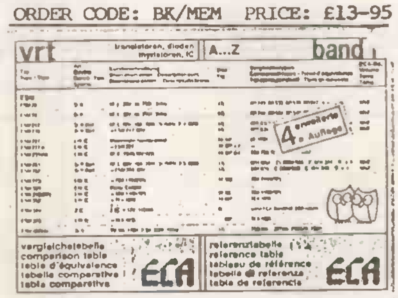
ORDER CODE: BK/DAT4 PRICE £15-99

Order all 4 books, list price £58-42 and save money.

ORDER CODE: BK/DAT1-4 £52-00

MEMORY
Memory data dictionary & comparison tables for static, dynamic & bipolar RAM, VideoRAM, EPROM, EEPROM, PROM & FIFO with input/output wiring and corresponding programme instructions.
320 pages

ORDER CODE: BK/MEM PRICE: £13-95



A-Z
Comparison tables transistors, diodes, thyristors, IC. Approx. 28,000 types with brief data, pin assignments about 80,000 type comparisons & relevant reference books listed.
Approx: 500 pages.

ORDER CODE: BK/VRT1 PRICE £14-95

OPTO
Data dictionary & comparison tables for optical switching elements. Containing optical switching elements with output elements such as phototransistors, photodiodes, photocells & photoresistors. With all important electrical values, corresponding comparison types, complete inner circuits & exact case outline drawings.

ORDER CODE: BK/OPTO PRICE £9-99

A-Z
Data dictionary & comparison tables containing the most important characteristic data. Transistors & FET's from A-Z with selected substitutes for each type.

ORDER CODE: BK/TRAN1
PRICE: £9-60

2 O-μ
Data dictionary & comparison tables containing the most important characteristic data. Transistors & FET's from O-U with selected substitutes for each type.

ORDER CODE: BK/TRAN2
PRICE: £9-60

Order both books & save money.
CODE: BK/TRAN1/2 PRICE £17-50

1N..60 000..μ
Comparison tables transistors, diodes, thyristors, IC. Approx 28,000 types with brief data, pin assignments, about 80,000 type comparisons and relevant reference books listed.
Approx 496 pages.

ORDER CODE: BK/VRT2 PRICE £14-95

HEAD OFFICE

MARCO TRADING

INCORPORATING EAST CORNWALL COMPONENTS

THE MALTINGS, HIGH STREET, WEM, SHREWSBURY. SY4 5EN

TEL: 0939-232763 TEL: 0939-232689

FAX: 0939-233800

HOURS OF BUSINESS

MON.	9.00–5.30
TUES.	9.00–5.30
WED.	9.00–5.30
THURS.	9.00–5.30
FRI.	9.00–5.00
SAT.	9.00–12.0
SUN.	CLOSED

BRANCHES

SUPERTRONICS, 65 HURST STREET, BIRMINGHAM. B5 4TE

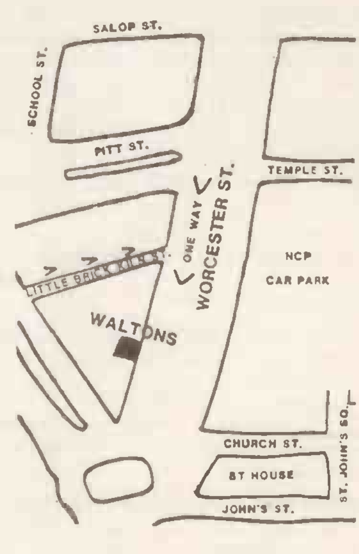
TEL: 021 666 6504

HOURS OF BUSINESS

MON.	9.00-6.00
TUES.	9.00-6.00
WED.	Closed
THURS.	9.00-6.00
FRI.	9.00-6.00
SAT.	9.00-6.00
SUN.	CLOSED

WALTONS, 55A WORCESTER STREET, WOLVERHAMPTON. WV2 4LL

TEL: 0902 22039



HOURS OF BUSINESS

MON.	9.00-6.00
TUES.	9.00-6.00
WED.	9.00-6.00
THURS.	9.00-6.00
FRI.	9.00-6.00
SAT.	9.00-6.00
SUN.	CLOSED