

EVERYDAY ELECTRONICS

FEBRUARY 1989

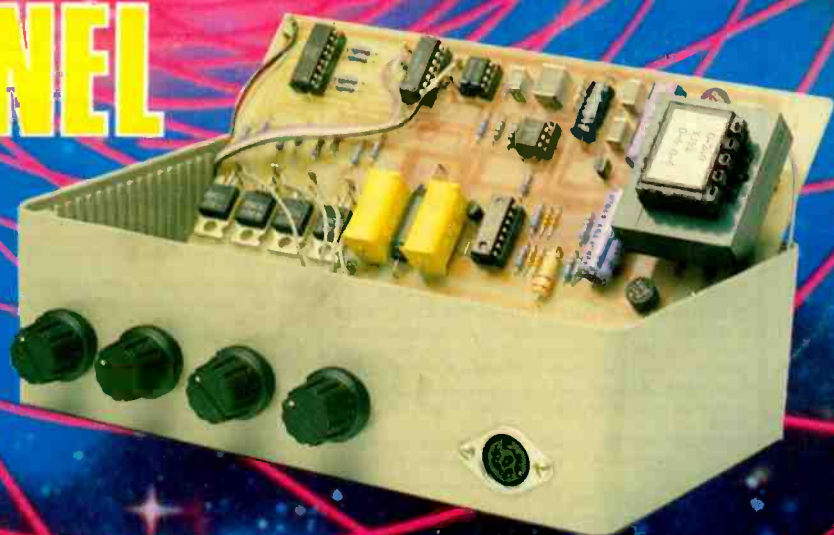
INCORPORATING ELECTRONICS MONTHLY

£1.30

FIRE ALARM

SIMPLE PSU

FOUR CHANNEL LIGHT DIMMER



The Magazine for Electronic & Computer Projects



No. 1 LIST BAKERS DOZEN PACKS

All packs are £1 each, if you order 12 then you are entitled to another free. Please state which one you want. Note the figure on the extreme left of the pack ref number and the next figure is the quantity of items in the pack, finally a short description.

- BD2 5 13A spurs provide a fused outlet to a ring main where devices such as a clock must not be switched off.
 - BD7 4 In flex switches with neon on/off lights, saves leaving things switched on.
 - BD9 2 6V 1A mains transformers upright mounting with fixed clamps.
 - BD11 1 6 1/2in speaker cabinet ideal for extensions, takes our speaker. Ref BD137.
 - BD13 12 30 watt reed switches, it's surprising what you can make with these—burglar alarms, secret switches, relay, etc., etc.
 - BD22 2 25 watt loudspeaker two unit crossovers.
 - BD29 1 B.O.A.C. stereo unit is wonderful value.
 - BD30 2 Nicad constant current chargers adapt to charge almost any nicad battery.
 - BD32 2 Humidity switches, as the air becomes damper the membrane stretches and operates a microswitch.
 - BD34 4 2 meter length of connecting wire all colour coded.
 - BD42 5 13A rocker switch three tags so on/off, or change over with centre off.
 - BD45 1 24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day, original cost £40 each.
 - BD49 10 Neon valves, with series resistor, these make good night lights.
 - BD56 1 Mini uniselector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole.
 - BD59 2 Flat solenoids—you could make your multi-tester read AC amps with this.
 - BD67 1 Suck or blow operated pressure switch, or it can be operated by any low pressure variation such as water level in water tanks.
 - BD91 1 Mains operated motors with gearbox. Final speed 16 rpm, 2 watt rated.
 - BD103A 1 6V 750mA power supply, nicely cased with mains input and 6V output leads.
 - BD120 2 Stripper boards, each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc.
 - BD122 10m Twin screened flex with white pvc cover.
 - BD128 10 Very fine drills for pcb boards etc. Normal cost about 80p each.
 - BD132 2 Plastic boxes approx 3in cube with square hole through top so ideal for interrupted beam switch.
 - BD134 10 Motors for model aeroplanes, spin to start so needs no switch.
 - BD139 6 Microphone inserts—magnetic 400 ohm also act as speakers.
 - BD148 4 Reed relay kits, you get 16 reed switches and 4 coils sets with notes on making c/o relays and other gadgets.
 - BD149 6 Safety cover for 13A sockets—prevent those inquisitive little fingers getting nasty shocks.
 - BD180 6 Neon indicators in panel mounting holders with lens.
 - BD193 6 5 amp 3 pin flush mounting sockets make a low cost disco panel.
 - BD196 1 in flex simmerstat—keeps your soldering iron etc. always at the ready.
 - BD199 1 Mains solenoid, very powerful, has 1in pull or could push if modified.
 - BD201 8 Keyboard switches—made for computers but have many other applications.
 - BD210 4 Transistors type 2N3055, probably the most useful power transistor.
 - BD211 1 Electric clock, mains operated, put this in a box and you need never be late.
 - BD221 5 12V alarms, make a noise about as loud as a car horn. Slightly soiled but OK.
 - BD242 2 6in x 4in speakers, 4 ohm made from Radiomobile so very good quality.
 - BD252 1 Panostat, controls output of boiling ring from simmer up boil.
 - BD259 50 Leads with push-on 1/4in tags—a must for hook-ups—mains connections etc.
 - BD263 2 Oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into pattress.
 - BD268 1 Mini 1 watt amp for record player. Will also change speed of record player motor.
 - BD283 3 Mild steel boxes approx 3in x 3in x 1in deep—standard electrical.
 - BD293 50 Mixed silicon diodes.
 - BD305 1 Tubular dynamic mic with optional table rest.
- VERY POWERFUL 12 VOLT MOTORS—1/2rd HORSEPOWER.** Made to drive the Sinclair C5 electric car but adaptable to power a go-kart, a mower, a rail car, model railway, etc. Brand new. Price £15.00 plus £2.00 postage. Our ref. 158.
- WHITE CEILING SWITCH** 5 amp 2 way surface mounting with cord and tassel. Made by the famous Crabtree Company. Price £1 each. Our ref BD528.
- 13A SWITCH SOCKETS** Top quality made by Crabtree, fitted in metal box with outlets so ideal for garage, workshop, cellar, etc. Price £2 each. Our ref 2P37.

THREE CAMERAS All by famous makers, Kodak, etc. One disc and two different instant cameras. All in first class condition, believed to be in perfect working order but sold as untested. You can have them for £10 the three, including VAT, which must be a bargain—if only for the lenses, flash gear, etc. Our ref 10P58.



ATARI 65XE COMPUTER At 64k this is most powerful and suitable for home and business. Brand new, complete with PSU, TV lead, owner's manual and six games. Can be yours for only £45 plus £3 insured delivery.

DATA RECORDERS ACORN for Acorn Electron, etc., reference number ALF03, with TV lead, manual and PSU. Brand new. Price £10 plus £1.50 post. Order ref 10P44.

ATARI XC12 for all their home computers. With leads and handbook. Brand new. Price £10 plus £2 post. Order ref 10P53.

JOYSTICK FOR ATARI OR COMMODORE for all Atari and Commodore 64 and Vic20. New. Price £5. Order ref 5P126.

EXTRA SPECIAL OFFER We will supply the Atari 65XE, data recorder XC12, joystick and six games for £57.50 plus £4 insured delivery.

SUB-MIN TOGGLE SWITCH Body size 8mm x 4mm x 7mm SBOT with chrome dolly fixing nuts. 4 for £1. Order Ref. BD649.

VENNER TIME SWITCH. Mains operated with 20 amp switch, one on and off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95 without case, metal case—£2.95, adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/off per 24hrs. This makes an ideal controller for the immersion heater. Price of the adaptor kit is £2.30.

SOUND TO LIGHT UNIT. Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are 1/4in. sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form.

MINI MONO AMP on pcb, size 4in x 2in approximately. Fitted with volume control and place for a tone control should you require it. The amplifier has three transistors and we estimate output to be 3w. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of £1. Our ref BD495.

RE-CHARGEABLE NICADS 'D' SIZE These are tagged for easy joining together but tags, being spot welded, are easy to remove. Virtually unused, tested and guaranteed. £2.00 ref 2P141 or 6 wired together for £10.00 ref 10P47.

LEAD LAMP Normal hand-grip type plastic holder, with glass cover to protect the lamp and further protection in the form of a wire guard with a hook for hanging. Ideal as light for or car repairs, etc. Takes 60w lamp. Has good length flex. Price £4. Our ref 4P31.

2.5kw TANGENTIAL BLOW HEATER has an approximate width of 3in. (plus motor), elements made up of two 1.2kw sections so with switch available you can have 2.5kw, 1.2kw or cold blow. Over-heat cutout eliminates fire risk should fan stop or air flow be impeded. Fan blades are metal. Price £5 plus £2.50 post. Our ref 5P62. Switch 50p.

ALBA TWIN CASSETTE RECORDER AND PLAYER WITH STEREO RADIO This is a mains/battery portable made to sell, we understand, at about £50 but the ones we have are line rejects. They are brand new still in the manufacturers' boxes but have a slight defect associated with the cassette section. The radio and amplifier section, both mono and stereo, is perfectly OK. If you are handy at mending things then this should be for you. Price £20 or two for £38 plus £3 insured post, either package. Our ref 20P7 or 2 x 20P7.

LASER TUBE

Made by Philips Electronic. New and unused. This is helium-neon and has a typical power rating of 1.6mW. It emits random polarised light and is completely safe provided you do not look directly into the beam when eye damage could result. **DON'T MISS THIS SPECIAL BARGAIN!** Price £29.95 plus £3 insured delivery.

POWER SUPPLY FOR PHILIPS LASER available in kit form, Price £15 plus £2 postage.

PAPST AXIAL FAN—MANUFACTURERS REF NO. TYP4580N. This is mains operated. 15 watt rating and in a metal frame with metal blades so OK in high temperatures. Body size approx. 4 3/4" square x 1 5/8" thick. £6.00 each, plus £1.00 postage. Our ref 6P6.

VERY THICK FLEX MAGNETS Although only less than 1" long and not much thicker than a pencil these are very difficult to pull apart. Could be used to operate embedded reed switches, etc. Price 50p each, 2 for £1.00. Ref BD642.



ORGAN MASTER is a three octave musical keyboard. It is beautifully made, has gold plated contacts and is complete with ribbon cable and edge connector. Brand new, only £12 plus £3 postage. Order ref. 12P5.

MUSIC FROM YOUR SPECTRUM 128 We offer the Organ Master three octave keyboard, complete with leads and the interface which plugs into your 128. You can then compose, play, record, store, etc., your own music. Price £19 plus £3 special packing and postage. Order ref. 19P1.

20A DOUBLE POLE RELAY WITH 12V COIL complete with mounting brackets. Made by the Japanese Omron Company. Price £2 each. Our Ref. 2P173A.

TOROIDAL MAINS TRANSFORMER with twin outputs. 6.3V 2A and 12V 600mA, so ideal for F00 power supply. Price £5. Our Ref. 5P122.

QUICK FIX MAINS CONNECTOR A must for your workshop. Saves putting on plugs as you just push the wires under the spring clips. Automatically off when lid is up. Price £7.50. Our Ref. 7P5/1.

BT HANOSSET with curly lead terminating with flat BT plug. Colour cream. Price £5. Our Ref. 5P123.

RUBBER FEET Stick on. Ideal for small instruments and cabinets. Pack of 56 for £1. Our ref BD603.

J & N BULL ELECTRICAL

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

MAIL ORDER TERMS: Cash, PO or cheque with order. Orders under £20 add £1.50 service charge. Monthly account orders accepted from schools and public companies. Access and B/card orders accepted. Brighton (0273) 734648 or 203500

POPULAR ITEMS

Some of the many items described in our current list which you will receive if you request it

3 1/2in FDD CHINON 80 track 500k. Shugart compatible interface. Standard connections, interchangeable with most other 3 1/2in and 5 1/4in drives. Brand new. £28.50 plus £3 insured post.

CASE NOW AVAILABLE FOR THE CHINON F353 This is the 80 track, single sided one which we have been selling at £28.50. The case is sheet metal, finished in hammer-beige with ample ventilation and rubber feet. Overall size 4 1/4in x 7in x 1 1/2in approx. Designed to take the ribbon cable and 3 core power lead. Price £8. Our ref 8P21.

3in FDD HITACHI HFD3055XA Shugart compatible interface. 500k on 3in disc. Recommended for many Amstrads but interchangeable with most drives. £29.50 plus £3 insured post.

FDD CASE AND POWER SUPPLY KIT for the 3in or 3 1/2in. £11.00. Ref 11P2 for the Chinon, 11P3 for the Hitachi.

5in MONITOR made for ICL, uses Philips black and white tube. Brand new and complete but untested. £16.00 plus £5.00 post.

ACORN COMPUTER DATA RECORDER REF ALF03 Made for the Electron or BBC computers but suitable for most others. Complete with mains adaptor, leads and handbook. £10.00. Ref. 10P44.

POWERFUL IONISER Uses mains transformer. Generates approx. 10 times more ions than the normal diode/cap ladder circuits. Complete kit £11.50 plus £3.00 post.

FREE POWER! Can be yours if you use our solar cells—sturdy made modules with new system bubble magnifiers to concentrate the light and so eliminate the need for actual sunshine—they work just as well in bright light. Voltage input is .45—50 joule in series to get desired voltage—and in parallel for more amps. **Module A** gives 100mA, Price £1, Our ref. BD631. **Module C** gives 400mA, Price £2. Our ref. 2P199. **Module D** gives 700mA, Price £3. Our ref. 3P42.

SOLAR POWERED NI-CAD CHARGER 4 Ni-Cad batteries AA (HP7) charged in eight hours or two in only 4 hours. It is a complete, boxed ready to use unit. Price £6. Our ref. 6P3.

50V 20A TRANSFORMER 'C' Core construction so quite easy to adapt for other outputs—tapped mains input. Only £25 but very heavy so please add £5 if not collecting. Order Ref. 25P4.

SWITCH AC LOADS WITH YOUR COMPUTER This is easy and reliable if you use our solid state relay. This has no moving parts, has high input resistance and acts as a noise barrier and provides 4kW isolation between logic terminals. The turn-on voltage is not critical, anything between 3 and 30V, internal resistance is about 1k ohm. AC loads up to 10A can be switched. Price is £2 each. Ref. 2P183.

METAL PROJECT BOX Ideal size for battery charger, power supply, etc., sprayed grey, size 8in x 4 1/4in x 4in high, ends are louvred for ventilation other sides are flat and undrilled. Price £2. Order ref. 2P191.

BIG SMOOTHING CAPACITOR. Sprague powerlytic 38,000uF at 50V. £3. Our ref. 3P41.

4-CORE FLEX CABLE. Cores separately insulated and grey PVC covered overall. Each copper core size 7/0.2mm. Ideal for long telephone runs or similar applications even at mains voltage. 20 metres £2. Our ref. 2P196 or 100 metres coil £8. Order ref. 8P19.

6-CORE FLEX CABLE. Description same as the 4-core above. Price 15 metres for £2. Our ref. 2P197 or 100 metres £9. Our ref. 9P1.

TWIN GANG TUNING CAPACITOR. Each section is 0005uF with trimmers and good length 1/4in spindle. Price £1 each. Our ref BD630.

13A PLUGS Pins sleeved for extra safety, parcel of 5 for £2. Our ref. 2P185.

13A ADAPTERS Takes 2 13A plugs, packet of 3 for £2. Order ref. 2P187. **20V-0-20V** Mains transformers 2 1/2 amp (100 watt) loading, tapped primary, 200-245 upright mountings £4. Order ref. 4P24.

BURGLAR ALARM BELL—6" gong OK for outside use if protected from rain. 12V battery operated. Price £8. Ref. 8P2.

VERY RELIABLE CAPACITOR 4.7uF 400V not electrolytic so not polarised, potted in ali can, size 1 3/4 x 3/4 x 1 1/2in high, with axial leads. A top grade capacitor made for high class instrument work. Ideal for PCB mounting. 2 for £1. Our ref BD667.

USEFUL MAINS TRANSFORMER Upright mounting, normal tapped primary, has two secondaries. One gives 20v at 1.5 amps if used alone, or the other gives 10V at 3 amps if used alone. Join the two in series for 30v at 1 amp. Price £2. Our ref 2P214.

CAPACITOR BARGAIN—axial ended, 4700uF at 25V. Jap made, normally 50p each, you get 4 for £1. Our ref. 613.

SINGLE SCREENED FLEX 7.02 copper conductors, pvc insulated then with copper screen, finally outer insulation. In fact quite normal screened flex. 10m for £1. Our ref BD668. Ditto, but solid conductor. 10m for £1. Our ref BD668a.

M.E.S. BULB HOLDERS Circular, base batten type fitting. 4 for £1. Our ref BD127a.

SPRING LOADED TEST PRODS—Heavy duty, made by the famous Bulgin company. Very good quality. Price 4 for £1. Ref. BD597.

ASTEK P.S.U.—Switch mode type. Input set for +230V. Output 3.5 amps at +5V, 1.5 amps at +12V, and 3 amps at +5V. Should be OK for floppy disc drives. Regular price £30. Our price only £10. Ref. 10T34. Brand new and unused.

APPLIANCE THERMOSTATS—Spindle adjust type suitable for convector heaters or similar. Price 2 for £1. Ref. BD582.

3-CORE FLEX BARGAIN No. 1—Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15mm for £2. Ref. 2P189.

3-CORE FLEX BARGAIN No. 2—Core size 1.25mm so suitable for long extension leads carrying up to 13 amps, or short leads up to 25A. 10m for £2. Ref. 2P190.

ALPHA-NUMERIC KEYBOARD—This keyboard has 73 keys giving trouble free life and no contact bounce. The keys are arranged in two groups, the main area is a QWERTY array and on the right is a 15 key number pad, board size is approx. 13" x 4"—brand new but offered at only a fraction of its cost, namely £3, plus £1 post. Ref. 3P27.

WIRE BARGAIN—500 metres 0.7mm solid copper tinned and p.v.c. covered. Only £3 plus £1 post. Ref. 3P31—that's well under 1p per metre, and this wire is ideal for push on connections.

INTERRUPTED BEAM KIT—This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components—relay, photo transistor, resistors and caps, etc. Circuit diagram but no case. Price £2. Ref. 2P15.

1/8th HORSEPOWER 12 VOLT MOTOR Made by Smiths, the body length of this is approximately 3in, the diameter 3in and the spindle 5/16th of an inch diameter. It has a centre flange for fixing or can be fixed from the end by means of 2 nuts. A very powerful little motor which revs at 3,000rpm. We have a large quantity of them so if you have any projects in mind then you could rely on supplies for at least two years. Price £6. Our ref 6P1, discount for quantities of 10 or more.

OVER 400 GIFTS YOU CAN CHOOSE FROM

There is a total of over 400 packs in our Baker's Dozen range and you become entitled to a free gift with each dozen packs. A classified list of these packs and our latest 'News Letter' will be enclosed with your goods, and you will automatically receive our next news letter.



VOL 18 No 2 FEBRUARY 1989

EVERYDAY ELECTRONICS

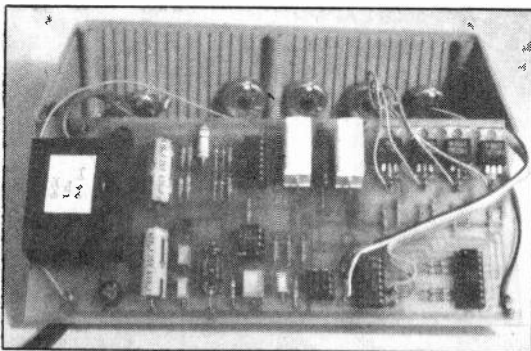
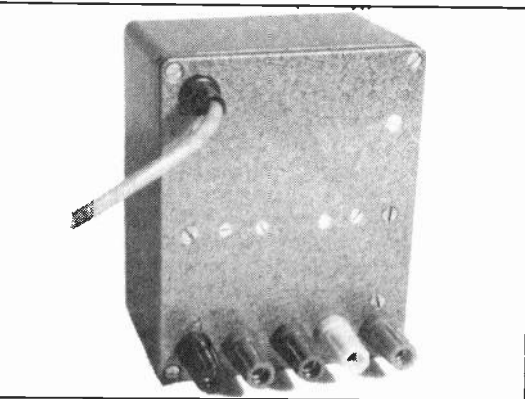
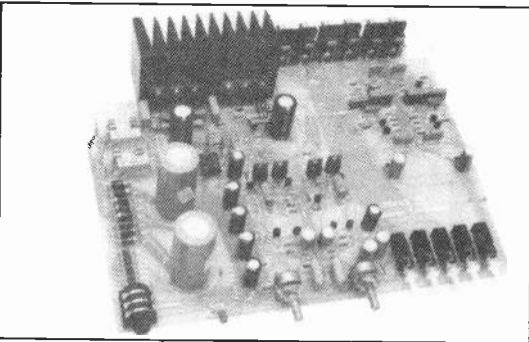
INCORPORATING ELECTRONICS MONTHLY

ABC

The Magazine for Electronic & Computer Projects

ISSN 0262-3617

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



© Wimborne Publishing Ltd 1989. Copyright in all drawings, photographs and articles published in EVERYDAY ELECTRONICS is fully protected, and reproduction or imitations in whole or in part are expressly forbidden.

Our March '89 issue will be published on
Friday, 3 February 1989. See page 75 for details
Everyday Electronics, February 1989

Projects

- FIRE ALARM** by Gary Calland **82**
An extremely versatile system that can monitor several rooms and the garage
- MINI PSU** by David Silvester **88**
A low voltage power supply ideal for powering digital and analogue circuits
- FOUR-CHANNEL LIGHT DIMMER** by Andy Flind **96**
Will control mains lamps from zero to full brilliance, up to 100W per channel
- CLASS ONE SOUND AMPLIFIER-2** by Graham Nalty **106**
High quality, 20W per channel amplifier for under £100
- CONTINUITY TESTER** by John Rugg **124**
An improvement on the simple buzzer type tester
- LITTLE NODDY** by Michael Perrow **136**
A fun project that can have a variety of applications

Series

- BBC MICRO** by R. A. & J. W. Penfold **102**
Regular spot for BEEB fanatics
- ON SPEC** by Mike Tooley BA **104**
Readers Sinclair Spectrum page
- INTRODUCING DIGITAL ELECTRONICS**
by Michael Cockcroft **110**
Part Five: Measurement and Testing, plus Prototyping and Component Assembly
- AMATEUR RADIO** by Tony Smith G4FA1 **128**
Student Licence; Restrictions; Sinister Plot?
- ACTUALLY DOING IT** by Robert Penfold **134**
Care of components
- ROBOT ROUNDUP** by Nigel Clark **138**
Investigating the world of robotics

Features

- EDITORIAL** **81**
- FOR YOUR ENTERTAINMENT** by Barry Fox **86**
Satellite Reception; Wonder of Electronics
- SHOPTALK** by David Barrington **91**
Product news and component buying
- THREEPENNY AMPLIFIERS** by George Hylton **92**
Spelling out some of the virtues and limitations of using inverter i.c.s as amplifiers
- MARKET PLACE** **95**
Free reader's buy and sell spot
- DIRECT BOOK SERVICE** **130**
Special service to EE readers
- PRINTED CIRCUIT BOARD SERVICE** **139**
- ADVERTISER'S INDEX** **144**
- SPECIAL OFFER** **101**
ILP Amplifier Modules

Readers' Services • Editorial and Advertisement Departments **81**

HIGH GRADE COMPONENT PARCELS

Unless otherwise stated, all the clearance parcels we offer contain brand new, top grade components. If some of the offers look too good to be true, all I can say is that the optimists will get some stunning bargains, the cynics will never know what they've missed, so everybody will be happy! All offers apply only while current stocks last - watch out for next month's parcels or, better still, be the first to hear about any new offers by putting your name on our mailing list. (Please write in, or phone Pete Leah on 0272 522703 after 6.30 pm).

EVERYTHING MUST GO!

UNIVERSAL EVERYTHING PARCEL

This one contains some of just about any component you care to name! There are passives (resistors, capacitors, tants, presets), opto devices (couplers, LEDs of all shapes and sizes, infra-red components, 7-segment displays), semiconductors (transistors, diodes, ICs, rectifiers), and all kinds of other odds and ends (relays, VDRs, neons, battery connectors, mixed components packs). A stunning range of components - enough to get a workshop or lab. started - at a ridiculously low price.

The components are of excellent quality, in packs originally intended to sell at £1 each. To make sure you get a good variety, the 20-pack parcel will have no more than two of any one pack, the 100 pack parcel will have at most five of any one pack. Packs supplied as they come - our choice.

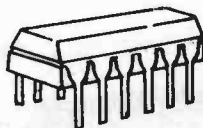
PARCEL 1A: 20 PACKS for £10
PARCEL 1B: 100 PACKS for £39!



INTEGRATED CIRCUITS

This parcel contains nothing but ICs. The mixture offers TTL and CMOS logic, interface ICs, linear, data converters, op-amps, special functions, and so on. Some of the ICs are pre-packed with data sheets, some (TTL, CMOS, op-amps) we expect you to identify for yourself, others will be covered by the free *data pack* provided, and the rest you'll have to identify under your own steam. If you know your ICs you'll be in for a few nice surprises.

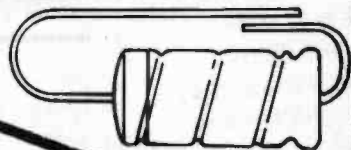
PARCEL 3A: 200 ICs for £12!
PARCEL 3B: 500 ICs for £49!



ELECTROLYTICS

A first class selection of good, modern electrolytics. The mixture ranges from small coupling caps up to huge power supply electrolytics - you'll be hard pressed to find any value between 1µF and 2200µF that isn't represented. A wide range of very useful components. Go for it!

PARCEL 5A: 1000 ELECTROLYTICS for £8
PARCEL 5B: 2500 ELECTROLYTICS for £16



TANTALUM CAPACITORS

A nice range of tants in values up to 47µF. Lots of useful caps, and we're not mean with the most expensive ones. A fine selection.

PARCEL 4A: 100 TANTS for £6.80
PARCEL 4B: 500 TANTS for £29!



TRANSISTORS

A mix of general purpose silicon transistors, mostly bipolar NPN and PNP, with a few FETs and unijunctions thrown in (when available) to spice the mixture. The contents vary from month to month - at the moment there are BC212s, BC213s, BC548s, BC238Bs, MTJ210s, and so on. Next month - who knows? All top quality components.

PARCEL 6A: 200 TRANSISTORS for £6!



MASSIVE CLEARANCE SALE

Once again, a general purpose parcel containing a huge variety of components: resistors, capacitors, ICs, transistors, electrolytics, tants, triacs, LEDs, diodes, thermistors, trimmers, VDRs, all sorts. All new, top quality components. This is mostly remainders from our own stock - stuff we forgot to advertise, or have in too small a quantity to sell individually. Guaranteed to be worth at least eight times the price if valued from any standard component catalogue! What more can I say?

PARCEL 2A: 1000+ top grade components for £12!
(Value £100+)

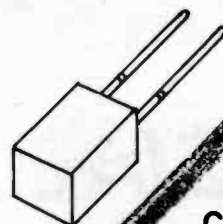
PARCEL 2B: 5000+ top grade components for £49!
(Value £500+)



LEDs

All shapes, sizes and colours of LEDs. Round ones in various sizes, rectangular ones, red, green, amber and yellow ones, clear and tinted lenses, all sorts.

PARCEL 7A: 100 LEDs for £5.90
PARCEL 7B: 500 LEDs for £24.90



CAPACITORS

An exciting selection of capacitors. There are ceramics for decoupling and general use, Polystyrenes for high performance circuits, dipped and moulded polyesters in values from a few nF up to 2.2µF (very expensive!), tants and aluminium electrolytics - just about any capacitor you'll ever need. Don't miss this one!

PARCEL 8A: 1000 CAPACITORS for £6.50

PARCEL 8B: 2500 CAPACITORS for £14.90



HIGHGRADE COMPONENTS LTD

Unit 11, 8 Woburn Road, Eastville, Bristol BS5 6TT

UK Orders:

Please add £2.50 towards postage and packing

Europe and Eire:

Please add £6.00 carriage and insurance

Outside Europe:

Please add £12.00 carriage and insurance

LEAD TEST

Anyone who plays an electric guitar, keyboard, or other electronic musical instrument, or who uses hi-fi or recording equipment, will have had the frustrating experience of having a jack lead with an intermittent fault of some kind. Typical is the lead which buzzes and crackles, but works fine if it is held in a particular position.

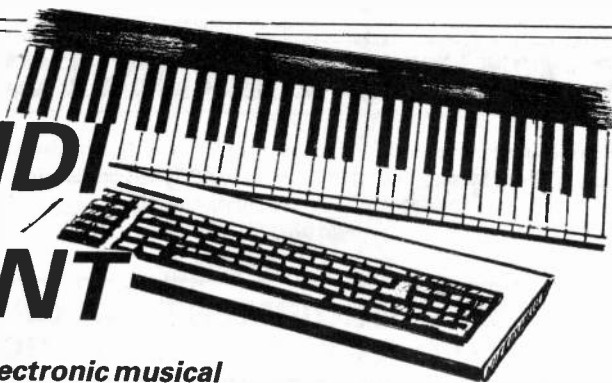
The simple piece of test equipment presented here allows quick diagnosis of faulty mono audio leads. The lead is simply plugged in, and the tester reset. A permanent fault is immediately indicated, an intermittent fault being latched as soon as it occurs. Three types of fault are indicated; core to screen short circuit, open circuit core, and open circuit screen.



CALL ALERT

This doorbell warning device was designed as an aid for the deaf. However, it will also be of interest to those working out of earshot of the doorbell—when gardening, for example. In use a flashing mains lamp, or lamps, come on when the bell push is operated. Flashes continue at two second intervals for some preset time between 3 and 30 seconds approximately—these timings are easily increased if required.

SPECIAL MIDI SUPPLEMENT



The adoption of MIDI by all the major electronic musical instrument manufacturers, and the inclusion of MIDI sockets on an increasingly wide range of equipment, has certainly revolutionised electronic music making. MIDI stands for "Musical Instruments Digital Interface", and it is a means of exchanging information between electronic musical instruments, or any equipment related to electronic music production.

Although MIDI is regarded by many as nothing more than a more modern alternative to the old gate/CV method of interfacing synthesisers, or a means of synchronising drum machines, it actually has capabilities which go well beyond this.

Next month we devote extra pages to three different MIDI projects which can take you into this fascinating area quite cheaply.

EVERYDAY ELECTRONICS

MARCH ISSUE ON SALE FEBRUARY 3

EVERYDAY ELECTRONICS

PROFESSIONAL SURVEILLANCE EQUIPMENT KITS

- **MTX** Micro-miniature VHF transmitter. The smallest kit on the market, measuring an incredible 17mm x 17mm including on-board mic. Super sensitive. Fully tuneable over FM band. 9V operation with range up to 1000m. **£10.95**
- **VT500** High power version of the MTX with on-board PA stage providing 250mW of RF. Measures just 20mm x 40mm, power requirements 9-15V. Excellent sensitivity and stability. Fully tuneable over FM band. Ranges over 3000m can be expected. **£12.95**
- **VOX75** Voice-activated transmitter. Variable sensitivity trigger level switches transmitter on when sounds are detected. Stays on for time delay variable between 1-20 sec. Fully tuneable output covers all FM band. Vary sensitive and low standby current through CMOS circuitry. 9V operation, range up to 1000m. Measures 30mm x 40mm. **£18.95**
- **CTX900** Sub-carrier scrambled transmitter. Audio is double modulated providing very secure transmissions. Any unauthorised listener will not be able to demodulate signal without DSX900 Decoder unit. Variable modulation on-board. Fully tuneable output covering FM band. 9V operation, range up to 1000m. Measures 30mm x 40mm. **£18.95**
- **DSX900** Decoder unit for CTX900. Connects to earphone output of receiver to descramble signal from CTX900. Monitor using small speaker or headphones. Variable decode frequency on-board for best resolution. 9-12V operation. Measures 35mm x 50mm. **£17.95**
- **TLX700** Micro size telephone transmitter. Connects onto line at any point and requires no batteries. Clearly transmits both sides of conversations on both incoming and outgoing calls. Undetectable by phone users. Fully tuneable output covering FM band. Range up to 1000m. Measures just 20mm x 20mm. **£5.95**
- **ATR2** Micro size telephone recording unit. Connects onto line at any point and connects into ANY normal cassette recorder, standard or micro having MIC and REM sockets. Requires no batteries. Switches recorder on silently when phone is used for incoming or outgoing calls, switches off when phone replaced. Clearly records both sides of conversations. Undetectable by phone users. Measures 10mm x 35mm. **£10.95**
- **XML900** RF Bug Detector/Locator. Wide band input circuitry detects presence of RF field and triggers flashing LED and piezo bleeper. Variable sensitivity enables source of transmission to be pinpointed to within 6 inches. Max sensitivity will detect MTX or similar transmitter at around 15-20 feet. 9V operation. Measures 55mm x 55mm. **£21.95**

All kits come fully documented with concise assembly and setting-up instructions, high quality fibreglass PCB and all components necessary to complete the module. All prices are inclusive but please add £1.50 to cover P&P. Orders over £50.00 post free. Please state requirements clearly and enclose cheque or PO to cover.

Phone orders on ACCESS or AMEX accepted. Tel: 0827 714476
NOTE: It is illegal to operate a transmitter in the UK without a licence
Send 9x4 SAE for full catalogue of these and other surveillance kits

SUMA DESIGNS (Dept. EE), THE WORKSHOPS, 95 MAIN ROAD
BAXTERLEY, Nr ATHERSTONE, WARCS CV9 2LE. TEL 0827 714476

TRANSFORMERS

MAINS ISOLATORS
Pri 120V x 2 or 220/240V or 415/440V Sec 440 or 240V or 110V Centre Tapped Secs

20VA	£	7.58	P	2.28
60	12.37	&	2.45	
100	14.43	P	2.65	
200	20.45		3.20	
250	24.73		3.30	
500	38.10		3.85	
1000	69.10		4.85	
1500	89.13		5.95	
2000	107.24		5.95	
3000	150.38		D/A	
6000	321.20		D/A	

30/15V or 15-0-15V 2x15V Tapped Secs
Volts available: 3, 4, 5, 6, 8, 9, 10, 18, 18, 20, 27 or 30V

30V	15V	£	P&P	
0.5	1	1.4	1.65	
1	2	5.63	1.80	
2	A	9.10	2.00	
3	M	10.55	2.20	
4	P	8	12.59	2.30
5	S	10	16.11	2.40
6	12	17.65	2.65	
8	16	23.59	2.75	
10	20	27.22	2.95	
12	24	30.39	3.05	
15	30	34.03	3.65	
20	40	46.46	5.95	

50/25V or 25-0-25V 2x25V Tapped Secs
Volts available: 5, 7, 8, 10, 13, 17, 20, 25, 33, 40, 50V or 20-0-20V or 25-0-25V

50V	25V	£	P&P	
0.5	1	5.38	1.90	
1	2	6.54	2.00	
2	A	11.65	2.50	
3	M	13.48	2.50	
4	P	18.46	2.95	
6	S	12	23.47	2.95
8	16	33.20	3.25	
10	20	39.40	3.70	
12	24	47.16	3.90	

60/30V or 30-0-30V 2x30V Tapped Secs
Volts available: 16, 18, 36, 40, 60, 24-0-24 or 30-0-30V

60V	30V	£	P&P	
0.5	1	6.11	1.90	
1	2	9.32	2.00	
2	A	11.98	2.30	
3	M	17.32	2.40	
4	P	8	19.75	2.50
5	S	10	24.97	2.90
6	12	28.48	3.10	
8	16	40.04	3.75	
10	20	46.62	4.00	
12	24	53.72	4.75	

INVERTERS
12/24V DC to 240V AC
Sine-Wave or Square Wave
Outputs from 60VA

TRANSFORMER WINDING SERVICE
3VA to 18KVA

CONSTANT VOLTAGE TRANSFORMERS
For Spike-free Stable Mains

Also Valve Mains Output & Matching transformers

UNIT 211,
STRATFORD WORKSHOPS,
BURFORD ROAD,
LONDON E15 2SP

EX STOCK

24/12V or 12-0-12V 2x12V Secs Pri 240V

24V	12V	£	P&P	
0.15	0.03	3.13	1.70	
0.25	0.05	3.31	1.70	
0.5	1	3.97	11.70	
1	2	5.53	1.90	
2	A	6.38	2.00	
3	M	10.99	2.15	
4	P	8	11.70	2.20
6	S	12	14.20	2.40
8	16	16.90	2.80	
10	20	22.75	3.20	
15	30	28.38	3.30	
20	40	40.37	3.75	
30	60	57.96	4.45	
41	83	66.74	5.75	

AUTOS

105, 115, 220, 230, 240V For step-up or down

80VA	£	6.29	P&P	1.75
150	9.12			1.90
250	11.14			2.10
500	17.32			2.80
1000	30.94			3.35
1500	36.73			3.80
2000	54.92			4.65
3000	93.39			5.75
4000	121.23			D/A
5000	141.17			D/A
7500	217.91			D/A
10kVA	257.49			D/A

CASED AUTOS

240V Cable Input 3-pin 115V USA Skt Outlets

20VA	£	8.96	P&P	1.85
80	12.17			1.95
150	15.77			2.30
250	19.21			3.25
500	31.51			3.25
1000	44.23			4.55
2000	78.82			5.58
3000	113.15			D/A

EMERGENCY STAND-BY LIGHTING OR POWER SYSTEM, PLUS UPS SYSTEMS

PE OSCILLOSCOPE TRANSFORMER Y1
£12.82 inclusive

TORIIDS
Batches Wound to Order

Stock items by return Please add 15% to all items after P&P

BARRIE ELECTRONICS LTD
Tel: 01-555 0228 (3 lines)

S.P.K ELECTRONICS

Please send large SAE for Comprehensive list of equipment & components that can be supplied. Westbury Mill, Westbury, Nr. Brackley, Northants NN13 5JS. Tel 0280-701691 or 0836 209923
GOOD Discounts available for schools & colleges with multiple orders. Telex: 94011054 (=Mill G) Fax: 0280 701228

ELECTRONIC TEST EQUIPMENT — CALIBRATION CERTIFICATES SUPPLIED AT EXTRA COST PHONE FOR DETAILS

This is just a small sample of our vast range of equipment. If the instrument you require is not listed please give us a call as we can probably help you.

BECHMAN Digital Multimeter model DM20L (we recommend this as excellent value for money) 3½ digit display, 28 RANGES, 20MHz logic probe built in, transistor gain testing. Direct reading 200-2000Mohm ranges, Continuity Bleeper 10Mohm input impedance, Pocket size. Ideal for the home constructor or experienced engineer, extremely versatile and exceptionally easy to use. **PRICE £46.00**

THANDAR Oscilloscope model SC110. Bench. Portable, low power, 10MHz band width, 10mV, 10mV sensitivity, 12 attenuator/voltage settings, 21 time base ranges. Small screen (1in x 1¼in) but very useful instrument operates on batteries or mains. Comes with mains adaptor and x 1 probe. **PRICE £209.95**

ROBIN Analogue multimeter model OM20NB. 2000ohm per volt multimeter DC Voltage to 1000V AC. Voltage to 500V DC current to 250mA. Resistance to 500kohms. **PRICE £10.00**

FLOPPY DISKS Double sided, double density, 96 tpi, high quality. Pretested computer disks suitable for Amstrad and any other P.C.'s with 5¼in drives. **PRICE** per box of 10 disks **£7.00** Inclusive of price — **FREE** labels & Notch stickers & the box acts as a stand. Please add £1 for postage.

HITACHI Oscilloscope model V212. Large clear 6in screen DC to 20MHz Dual channel, max vertical sensitivity = 1mV/DIV, Fastest sweep rate = 100ns/DIV Calibrator output. This instrument has in our experience proved to be an exceptional piece of equipment, being very reliable and durable. We were impressed by its bright clear and crisp display making the instrument a pleasure to use. **PRICE** inclusive of 2 probes **£334.00**

Optional Extras
Hard front cover price £16.
Soft dust cover price £26.

*
* **CHRISTMAS IS NEARER THAN YOU THINK!** *
* **VHS VIDEO TAPES** *
* **Kodak 3hr tape pack of 3 £8.25** *
* **JVC 4hr tape pack of 3 £12.00** *
*

ELECTROVALVE

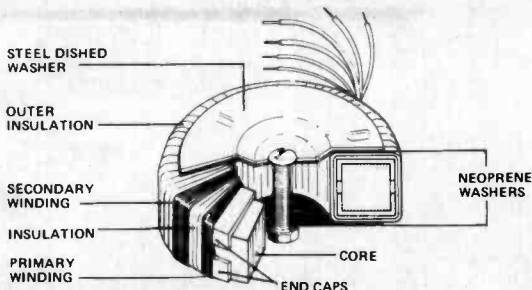
Distributors of high quality components since 1965

POLYESTER CAPACITORS		ELECTROLYTIC RADIAL		ELECTROLYTIC CANS		CONNECTORS		BRIDGES		BUZ		CFY19-18		7491		Variable		I.C. analogue		Dual	
5mm PCM	63v 10%	µF	V	µF	V	DIN AUDIO	SOCKETS	250V ac	1A W04 0.20	BF254 0.17	BUX26 3.78	BUX26 3.78	7491	7492	7493	LS259 0.80	LS266 0.50	LS273 0.80	SAS2317K 2.40	ILD1 0.86	ILD30 1.40
4.7nF	0.06	1	100	0.06	100	350	1.65	BC141 0.40	3A BF34 0.80	BF254 0.17	BUX26 3.78	7491	7492	7493	LS259 0.80	LS266 0.50	LS273 0.80	SAS2317K 2.40	ILD1 0.86	ILD30 1.40	
6.8nF	0.06	1	100	0.06	100	350	2.21	BC149 0.18	3A BF64 0.75	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ1 1.79	ILQ30 2.80	
10nF	0.06	10	63	0.07	47	100	2.01	BC159 0.15	25A BF2506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
15nF	0.07	22	63	0.06	1000	63	1.98	BC160 0.35	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
22nF	0.07	47	18	0.06	2200	40	1.70	BC161 0.40	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
33nF	0.07	47	18	0.06	2200	40	2.05	BC162 0.21	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
47nF	0.07	100	16	0.07	2200	100	4.01	BC167B 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
68nF	0.08	100	25	0.08	4700	40	2.11	BC168C 0.21	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
150nF	0.12	100	63	0.12	4700	100	6.78	BC169C 0.27	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
220nF	0.10	220	25	0.12	10000	18	2.02	BC177B 0.21	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
330nF	0.17	220	63	0.16	10000	26	2.61	BC181 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
470nF	0.22	470	6	0.08	10000	40	3.99	BC182L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
680nF	0.22	470	16	0.12	10000	63	6.57	BC183 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
1µF	0.32	470	25	0.16	22000	16	3.36	BC184 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
1.5µF	0.40	470	40	0.30	22000	25	5.48	BC184L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
1000µF	0.08	1000	16	0.33	22000	25	5.48	BC212 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
1500µF	0.10	1000	25	0.36	22000	25	5.48	BC213 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
2200µF	0.13	1000	35	0.10	22000	25	5.48	BC213L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
3300µF	0.17	1000	35	0.10	22000	25	5.48	BC214 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
4700µF	0.23	1000	35	0.10	22000	25	5.48	BC214L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
7.5mm PCM	400V 10%	2.2	16	0.10	2.2	16	0.10	BC217 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
15nF	0.08	3.3	35	0.13	3.3	35	0.13	BC218 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
2.2nF	0.08	4.7	18	0.13	4.7	18	0.13	BC218L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
3.3nF	0.08	6.8	16	0.15	6.8	16	0.15	BC219 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
4.7nF	0.06	6.8	16	0.15	6.8	16	0.15	BC219L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
6.8nF	0.06	6.8	16	0.15	6.8	16	0.15	BC220 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
10nF	0.06	10	16	0.13	10	16	0.13	BC220L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
15nF	0.08	10	25	0.20	10	25	0.20	BC221 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
22nF	0.06	22	6	0.16	22	6	0.16	BC221L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
33nF	0.06	22	18	0.26	22	18	0.26	BC222 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
47nF	0.07	22	25	0.42	22	25	0.42	BC222L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
68nF	0.07	33	6	0.14	33	6	0.14	BC223 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
100nF	0.07	33	16	0.38	33	16	0.38	BC223L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
150nF	0.07	47	3	0.25	47	3	0.25	BC224 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
220nF	0.09	100	10	0.84	100	10	0.84	BC224L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
330nF	0.11	100	10	0.84	100	10	0.84	BC225 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
470nF	0.11	100	10	0.84	100	10	0.84	BC225L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
680nF	0.11	100	10	0.84	100	10	0.84	BC226 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
1µF	0.11	100	10	0.84	100	10	0.84	BC226L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
1.5µF	0.11	100	10	0.84	100	10	0.84	BC227 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
2.2µF	0.11	100	10	0.84	100	10	0.84	BC227L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
3.3µF	0.11	100	10	0.84	100	10	0.84	BC228 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
4.7µF	0.11	100	10	0.84	100	10	0.84	BC228L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
6.8µF	0.11	100	10	0.84	100	10	0.84	BC229 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
10µF	0.11	100	10	0.84	100	10	0.84	BC229L 0.17	3A BF3506	BF254 0.17	BUX26 3.78	MJ2955 0.95	MJ2955 0.95	MJ2955 0.95	LS279 0.55	LS280 0.55	LS281 0.55	SAS2317K 2.40	ILQ10 1.79	ILQ30 2.80	
15µF	0.11	100	10	0.84	100	10	0.84	BC230 0.17	3A BF3506	BF254 0.17	BUX26 3.78										



The UK Distributor for Standard Toroidal Transformers

- * 106 types available from stock
- * Sizes from 15VA to 625VA
- * Dual 120v primaries allowing 110/120v or 220/240v operation



TYPE	SERIES NO.	SEC VOLTS	RMS CURRENT	TYPE	SERIES NO.	SEC VOLTS	RMS CURRENT
15VA £9.30	03010	6+6	1.25	160VA £16.85	53011	9+9	8.89
	03011	9+9	0.83		53012	12+12	6.66
	03012	12+12	0.63		53013	15+15	5.33
	03013	15+15	0.50		53014	18+18	4.44
	03014	18+18	0.42		53015	22+22	3.63
	03015	22+22	0.34		53016	25+25	3.20
	03016	25+25	0.30		53017	30+30	2.66
30VA £10.60	03017	30+30	0.25	53018	35+35	2.28	
	13010	6+6	2.50	53026	40+40	2.00	
	13011	9+9	1.66	53028	110	1.45	
	13012	12+12	1.25	53029	220	0.72	
	13013	15+15	1.00	53030	240	0.66	
	13014	18+18	0.83	225VA £18.40	63012	12+12	9.38
	13015	22+22	0.68		63013	15+15	7.50
13016	25+25	0.60	63014		18+18	6.25	
13017	30+30	0.50	63015		22+22	5.11	
50VA £12.20	23010	6+6	4.16		63016	25+25	4.50
	23011	9+9	2.77		63017	30+30	3.75
	23012	12+12	2.08		63018	35+35	3.21
	23013	15+15	1.66	63026	40+40	2.81	
	23014	18+18	1.38	63025	45+45	2.50	
	23015	22+22	1.13	63033	50+50	2.25	
	23016	25+25	1.00	63028	110	2.04	
	23017	30+30	0.83	63029	220	1.02	
	23028	110	0.45	63030	240	0.93	
	23029	220	0.22	300VA £20.10	73013	15+15	10.0
23030	240	0.20	73014		18+18	8.33	
80VA £13.50	33010	6+6	6.66		73015	22+22	6.82
	33011	9+9	4.44		73016	25+25	6.00
	33012	12+12	3.33		73017	30+30	5.00
	33013	15+15	2.66		73018	35+35	4.28
	33014	18+18	2.22		73026	40+40	3.75
	33015	22+22	1.81	73025	45+45	3.33	
	33016	25+25	1.60	73033	50+50	3.00	
	33017	30+30	1.33	73028	110	2.72	
	33028	110	0.72	73029	220	1.36	
	33029	220	0.36	73030	240	1.25	
33030	240	0.33	500VA £26.55	83016	25+25	10.0	
120VA £14.35	43010	6+6		10.0	83017	30+30	8.33
	43011	9+9		6.66	83018	35+35	7.14
	43012	12+12		5.00	83026	40+40	6.25
	43013	15+15		4.00	83025	45+45	5.55
	43014	18+18		3.33	83033	50+50	5.00
	43015	22+22		2.72	83042	55+55	4.54
	43016	25+25	2.40	83028	110	4.54	
	43017	30+30	2.00	83029	220	2.27	
	43018	35+35	1.71	83030	240	2.08	
	43028	110	1.09	625VA £29.30	93017	30+30	10.41
43029	220	0.54	93018		35+35	8.92	
43030	240	0.50	93026		40+40	7.81	
			93025		45+45	6.94	
			93033		50+50	6.25	
			93042		55+55	5.68	
			93028		110	5.68	
			93029	220	2.84		
			93030	240	2.60		



Prices include VAT and carriage

Quantity prices available on request
Write or phone for free Data Pack

Jaytee Electronic Services

143 Reculver Road, Beltinge, Herne Bay, Kent CT6 6PL
Telephone: (0227) 375254 Fax: 0227 365104

NEW THIS MONTH

CURRAH MICROSPEECH FOR SPECTRUM
Z4136 Complete boxed set containing Speech Unit with leads, demo cassette + FREE game and full instructions. Originally sold for £19.95.

Our price **£8.95**
Z4137 As above, but "return", so probably not fully functional, but complete. **£3.95**

Z4138 Currah microslot—"T" connector (1 female, 2 male) for Spectrum to allow peripherals to be added. New and boxed. **£2.00**

Z4139 As above, but skeleton version—no plastic case. **£1.50**

SEMICONDUCTORS
0.8in. 7 seg CC displays **50p**
78M05 (5V 1/2A reg.) **10 for £1.00**
LM317K £1; 68008L8 £3; 27C256 £5; 555 20p; 741 20p.
Lots more in Bargain List.

SWITCH
Z1522 40 position CB switch. Alps SRS. 7 bits per step. **£1.00**

★STAR BUY★

GREEN SCREEN HI-RES 12in. MONITOR CHASSIS
Brand new and complete except for case, the super high definition (100 lines at centre) makes this monitor ideal for computer applications. Operates from 12V d.c. at 1.1A. Supplied complete with circuit diagram and 2 pots for brilliance/contrast, plus connecting instructions. Standard input from IBM machines, slight mod (details included) for other computers. **Only £24.95+£3 carr.**

MONITOR INTERFACE KIT
Enables our hi-res monitor (above) and most others to be used with virtually any computer, PCB **£3.00**
Complete set of on-board components plus regulator and heatsink **£9.95**
Suitable transformer for interface and above monitor **£5.31**



Introducing DIGITAL ELECTRONICS

This exciting new series can lead to a worthwhile qualification—and we can supply all the components you need! The first six parts: Everything as listed in the booklet given free with EE. **Just £12.95!**

Low cost tool kit:
15 Watt mains soldering iron, screwdriver, cutters, snipe nose pliers, wire strippers. **All for £9.95**

FREE!!!

With every Vero Easiwire kit purchased for £15, we're giving away, absolutely FREE, a complete set of components for either of last month's projects. Tilt Alarm or Siren! Limited supplies, so order NOW!

PARTS FOR PROJECTS SO FAR
IR Receiver (inc. case) **£6.00**
IR Transmitter (inc. case) **£2.00**
SIREN (inc. case) **£3.00**
TILT ALARM (inc. case) **£5.30**
MINIDRILL for circuit cards (better than punching holes) **£1.69**

AM/FM STEREO TUNER
Z497 Complete radio chassis with push-button selection for LW/MW/FM and ON/OFF. Ferrite rod for LW and MW selection, co-ax socket for FM aerial. Supplied with mains transformer and rectifier/smoothing cap, and wiring details. PCB is 333 x 90mm. **Only £7.95**

1989 CATALOGUE

- ★ 100 BIG pages of components and equipment
- ★ Low, low prices
- ★ Fast "by return" service
- ★ 28 pages of Surplus Bargains
- ★ Only £1—send for yours now!

JOYSTICKS
Z004 Skeleton Joystick, switch type. Good quality, made by AB. Brass spindle has 44mm long black plastic handle attached. Body has 4 mounting holes. These really are a fantastic bargain! **Only £1.00**

Z8831 Dragon Joystick. Made by Dragon Data. Hand-held with fire button. 2m lead with 5 pin DIN plug. Uses 2 x 100k pots. **£3.00**

Z615 BBC Joystick. Internal resistors give the required voltage levels. 2 fire buttons. Rubber suction feet. 120 x 110 x 155 **£3.00**

SPECIAL OFFER ON DIL SOCKETS
Must clear excess stocks—1/4 million low profile top quality IC sockets to dispose of!

Pins	10	100	1000
8	40p	£3.00	£20
14	68p	£5.10	£34
16	72p	£5.40	£36
18	76p	£5.70	£38
20	80p	£6.00	£40
22	84p	£6.30	£42
24	88p	£6.60	£44
28	92p	£6.90	£46
40	96p	£7.20	£48

HEADPHONES AND SPEAKERS
Combination pack of Walkman type player units, consisting of stereo headphones and a pair of micro speakers in yellow, blue or green. Packed on a clear display card. **£2.50**

POWER SUPPLIES
Z4117 Special low price switch mode PSU. 50W unit on PCB 160 x 100mm. Mains input, outputs 5V at 5A; +12V at 1A; -12V at 1A. **Our price £9.50**

List £40+
Z4113 BBC Computer PSU (early models). Steel case 158 x 72 x 55mm, 2m long mains lead, rocker switch, fused. Outputs: +5V at 2.5A; -5V at 100mA. **£3.95**

Z4112 Another switch mode PSU. Same size as Z4117. Outputs 24V at 1.7A; 12V at 0.8A. **£9.95**

KEYBOARDS
Z8848 Alphanumeric plus separate numeric keyboard. 104 keys plus 11 chips. 442 x 175mm. **£12.00**

Z4116 24 way (8 x 3) membrane keypad. Large (200 x 90mm) area—they were used in a teaching aid. Overlay template and pinout supplied **£3.00**

NOTICE TO RETAILERS

Greenweld Electronics Ltd. have been appointed Official Wholesalers of Verobloc, Veroboard, Easiwire and Accessories by Vero. We will be only too happy to supply all your Veroboard requirements at Trade Price. Ring, write or fax us for full information and prices.



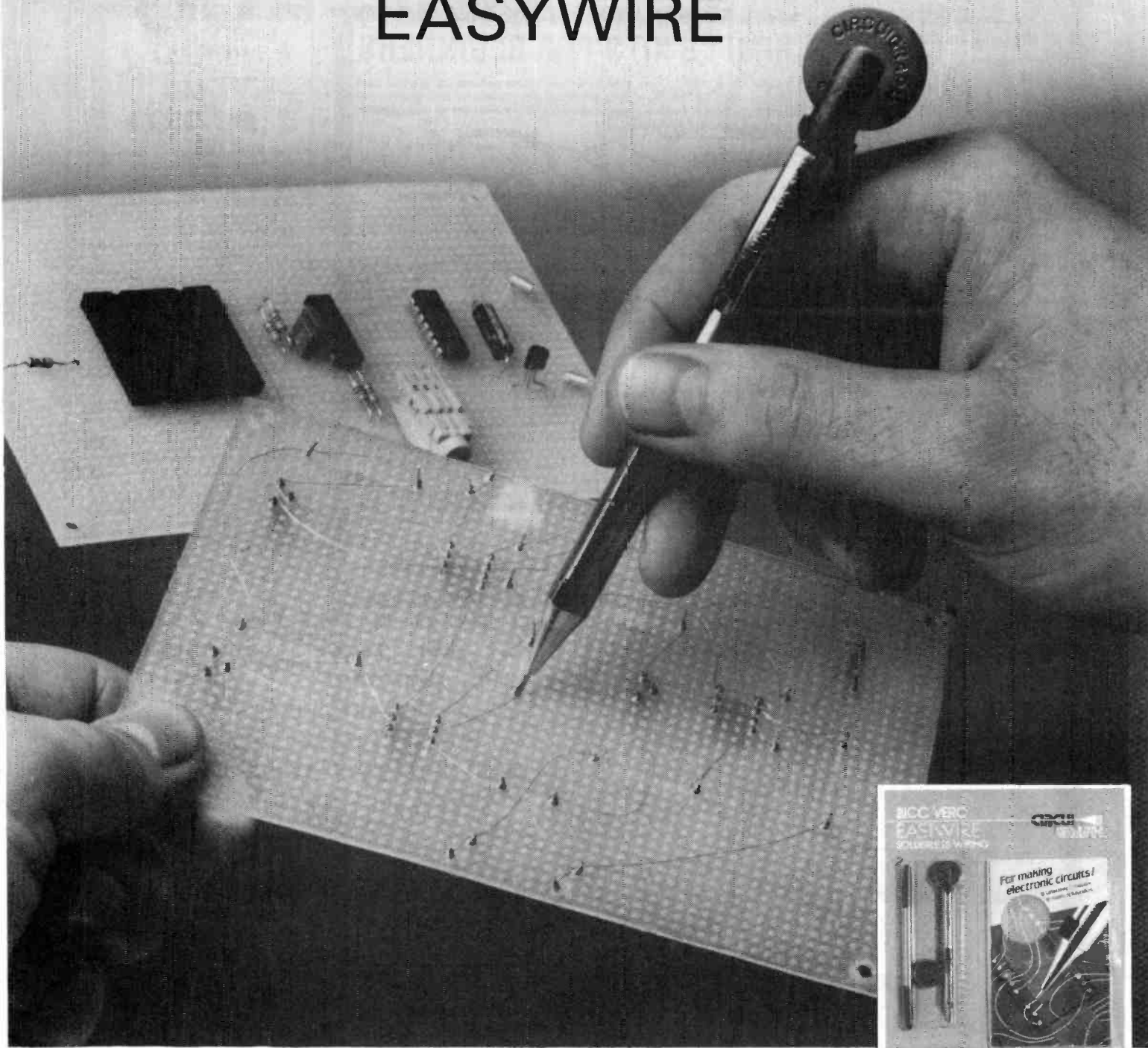
All prices include VAT; just add £1.00 P&P; Min Credit Card £5. No CWO min. Official orders from schools welcome—Min invoice charge £10.00. Our shop has enormous stocks of components and is open 9-5 Mon.-Sat. Come and see us!

HOW TO CONTACT US
By post using the address below; by phone (0703) 772501 or 783740 (ansaphone out of business hours); by FAX (0703) 787555; by Email Telecom Grid 72:MAG36026; by Telex 265871 MONREF G quoting 72:MAG36026.

443D MILLBROOK ROAD, SOUTHAMPTON SO1 0HX

SOLDERLESS WIRING

EASYWIRE



Construct your electronic circuits the new, quick and easy-to-learn way, **WITHOUT** solder: with Circuigraph Easiwire from BICC-VERO

With Easiwire all you do is wind the circuit wire tightly around the component pins. No soldering, no chemicals, no extras, simplicity itself. Circuits can be changed easily, and components re-used.

Easiwire comes in kit form. It contains all you need to construct circuits: a high-quality wiring pen with integral wire cutter, 2 reels of wire, a tool for component positioning and removal, a flexible injection moulded wiring board, double-sided adhesive sheets, spring-loaded terminals and jacks for power connections and an instruction book. Of course, all these components are available separately too.

To take advantage of the special introductory offer, complete the coupon on the right and send it to:

BICC-VERO ELECTRONICS LIMITED,
Flanders Road,
Hedge End,
Southampton, SO3 3LG



Please rush me.....Easiwire kits, retail price £18.-;
special introductory offer £15.- (includes p & p and VAT).

I enclose cheque/postal order for....., made payable to
BICC-VERO Electronics Limited

Please debit my credit card as follows:



Card Number

Expiry Date

Name

Address

Signature

or phone 04892 88774 now with your credit card number
(24-hour answering service).

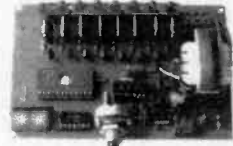
KITS & COMPONENTS

ELECTRONIC GUARD DOG



One of the best burglar deterrents is a guard dog and this kit provides the barking. Can be connected to a doorbell, pressure mat or any other intruder detector and produces random threatening barks. All you need is a mains supply, intruder detector and a little time.
XK125 £24.00

DISCO LIGHTING KITS



DL8000K 8-way sequencer kit with built-in opto-isolated sound to light input. Only requires a box and control knob to complete. £31.50
DL1000K 4-way chaser features bi-directional sequence and dimming 1kW per channel. £19.25
DLZ1000K Uni-directional version of the above. Zero switching to reduce interference. £10.80
DLA/1 (for DL & DLZ1000K) Optional opto input allowing audio 'beat'/light response. 77p
DL3000K 3-channel sound to light kit, zero voltage switching, automatic level control and built-in mic. 1kW per channel. £15.60

POWER STROBE KIT

Produces an intense light pulse at a variable frequency of 1 to 15Hz. Includes high quality PCB, components, connectors, 5Ws strobe tube and assembly instructions. Supply: 240V ac. Size: 80x50x45.
XK124 STROBOSCOPE KIT £13.75

PROPORTIONAL TEMPERATURE CONTROL KIT



Uses 'burst fire' technique to maintain temperature to within 0.5°C. Ideal for photography, incubators, wine-making, etc. Max. load 3kW (240V ac) Temp range up to 90°C. Size: 7x4x2.5cms.
MK4 £7.80

SIMPLE KITS FOR BEGINNERS

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



SPECIAL OFFERS ON SK KITS FOR SCHOOLS AND TRAINING CENTRES

- contact Sales Office for discounts and samples

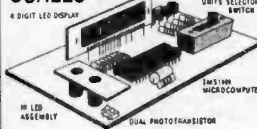
SK1 DOOR CHIME plays a tune when activated by a pushbutton. £3.90
SK2 WHISTLE SWITCH switches a relay on and off in response to whistle command. £3.90
SK3 SOUND GENERATOR produces FOUR different sounds, including police/ambulance/fire-engine siren and machine gun. £3.90
XK113 MW RADIO KIT based on ZN414 IC. kit includes PCB, wound aerial and crystal earpiece and all components to make a sensitive miniature radio. Size: 5.5x2.7x2 cms. Requires PP3 9V battery. £6.60
XK118 TEN EXCITING PROJECTS FOR BEGINNERS this kit contains a solderless breadboard, components, and a booklet with instructions to enable the absolute novice to build ten fascinating projects including a light operated switch, intercom, burglar alarm, and electronic lock. Each project includes a circuit diagram, description of operation and an easy to follow layout diagram. A section on component identification and function is included, enabling the beginner to build the circuits with confidence. £15.00

SOLID STATE RELAY BARGAIN



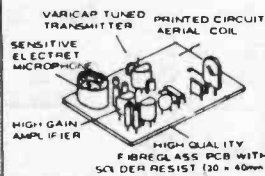
Zero voltage switching - no radio interference. 2.5KV input to output isolation. 4 KV terminals to heatsink isolation. 3V to 32V input voltage easily interlaced to TTL or CMOS logic. 24V to 240V rms load voltage. Inductive load switching. Built-in snubber network. 10A max. 4A with no heatsink at 40°C.
CD240/10 £2.25

ELECTRONIC WEIGHING SCALES



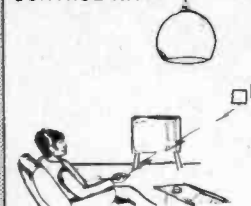
Kit contains a single chip microprocessor, PCB, displays and all electronics to produce a digital LED readout of weight in Kgs or Sts/lbs. A PCB link selects the scale - bathroom/ two types of kitchen scales. A low cost digital ruler could also be made.
ES1 £6.50

SUPER-SENSITIVE MICROBUG



Only 45x25x15mm, including built-in mic. 88-100MHz (standard FM radio). Range approx. 300m depending on terrain. Powered by 9V PP3 (7mA). Ideal for surveillance, baby alarm etc. £5.50

VERSATILE REMOTE CONTROL KIT



Includes all components (+transformer) for a sensitive IR receiver with 16 logic outputs (0-15V) which with suitable interface circuitry (relays, triacs, etc - details supplied) can switch up to 16 items of equipment on or off remotely. Outputs may be latched to the last received code or momentary (on during transmission) by specifying the decoder IC and a 15V stabilised supply is available to power external circuits. Supply: 240V AC or 15-24V DC at 10mA. Size (exc. transformer) 9x4x2 cms. Companion transmitter is the MK18 which operates from a 9V PP3 battery and gives a range of up to 60ft. Two keyboards are available - MK9 (4-way) and MK10 (16-way).
MK12 IR Receiver £16.30
MK18 Transmitter £7.50
MK9 4-way Keyboard £2.20
MK10 16-way Keyboard £6.55
601133 Box for Transmitter £2.60

★ ★ ★ BARGAIN COMPONENT PACKS ★ ★ ★

Refill those empty component drawers at a fraction of the normal price and don't be caught out. All components supplied are to full spec, and are not seconds or surplus stock. Prices exclude VAT (15%).
Pack A: 650x25 watt resistor 47R-10M £4.25
Pack B: 60xRadial electrolytes 1uf-1000uf £3.25
Pack C: 30xPolyester capacitors a or 0.01uf-1uf £4.50
Pack D: 35xhorizontal presets 1k-1M £3.00
Pack E: 30xIC sockets 8, 14, 16 pin £2.00
Pack F: 25xRed 5mm LEDs £1.75
Pack G: 25xGreen LEDs £2.00
Pack H: 30x5mm LEDs 10 Red, 10 Green, 10 Yellow £2.50
Pack J: 50x1N4148 silicon diodes £1.00
Pack K: 40xnpn/pnp transistors BC/548/558 General Purpose £2.25
FREE Solderless Breadboard (verobloc type) when you buy all ten packs.

MICROPROCESSOR TIMER

Kit controls 4 outputs independently switching on/off at 18 preset times over a 7-day cycle. LED display of time/day easily programmed. Includes box.
CT6000K £47.20
XK114 Relay kit for CT6000 includes PCB, connectors and one relay. Will accept up to 4 relays. 3A/240V c/o contacts £4.30
701115 Additional relays £1.80

TK ELECTRONICS
13 Boston Road
London W7 3SJ
Tel: 01-567 8910
Fax: 01-566 1916

ORDERING INFORMATION All prices exclude VAT. Free p&p on orders over £50 (UK only), otherwise add £1+VAT. Overseas p&p: Europe £3.50, elsewhere £10. Send cheque/PO/Barclaycard/Access No. with order. Giro No. 529314002. Local authority and export orders welcome. Goods by return subject to availability.



ORDERS: 01-5678910 24 HOURS

TK ELECTRONICS

EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

The Magazine for Electronic & Computer Projects
VOL. 18 No. 2 February '89

Editorial Offices
EVERYDAY ELECTRONICS EDITORIAL,
6 CHURCH STREET, WIMBORNE,
DORSET BH21 1JH
Phone: Wimborne (0202) 881749
FAX: (0202) 841692

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. Clacton
(0255) 850596

AVAILABILITY

As is witnessed by our lack of many 1988 back issues, readers all over the UK are having occasional difficulties in obtaining copies. There have been rationalisations in the newspaper and magazine wholesale trade during the year and changes will continue to be implemented for some time to come. This has meant many newsagents being forced to change to new wholesalers and has led to a number of associated problems.

With so many magazines available to the consumer (around 3,000 different titles in the UK) we cannot expect every newsagent to keep every title, or even to have knowledge of one particular specialist publication. Of course EE is fairly widely known and available but if you live away from a large newsagent, it is likely that you will not always find copies available off the shelf. However EE is available from any newsagent in the UK, they only have to order a copy from their wholesaler and our distributor—Seymour—will do the rest. The key to making sure of a copy is to *place an order*. Even if you do not have a newspaper delivered by the newsagent they will order a copy and save it in the shop for your collection.

STORIES

Over the past year we have heard many stories that readers have been told:

EE has merged with and it's the same magazine now.

EE has not published this month/has stopped publishing.

EE is always late coming out.

Let me say clearly that none of these are true. We have published every month on time for at least the last five years—not one issue has been missed and not one issue has been published late. But please don't blame your newsagent, very often the problems are not of his making—he is the last man in a long supply chain.

I know that occasionally readers have failed to get a copy that they have ordered, in such cases we try to investigate and solve any problems, but a regular order will normally guarantee delivery of EE on time. A newsagent order form is on page 127.

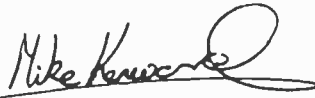
DON'T MISS OUT

In short, *don't rely on copies just being there*, they usually will be in large newsagents situated in main towns, but elsewhere you may be out of luck. While we have tried to make sure we can supply back numbers by increasing our stock, many 1988 issues have now sold out. EE is the best selling magazine in this market and sometimes this means copies sell out quickly—don't miss out!

You can of course take out a subscription. Your copy will then be delivered by the publishing date, by post—Post Office willing! An order form for subscriptions appears on page 127.

PRICE

I'm sorry to say that from next month EE will go up by 10p. However, EE will still be cheaper than its nearest rival and will, I believe, still represent the best value for money in this market.



SUBSCRIPTIONS (SEE ABOVE)

Annual subscriptions for delivery direct to any address in the UK: £15.70. Overseas: £19.00 (£36 airmail). Cheques or bank drafts (in £ sterling only) payable to Everyday Electronics and sent to EE Subscriptions Dept., 6 Church Street, Wimborne, Dorset BH21 1JH.

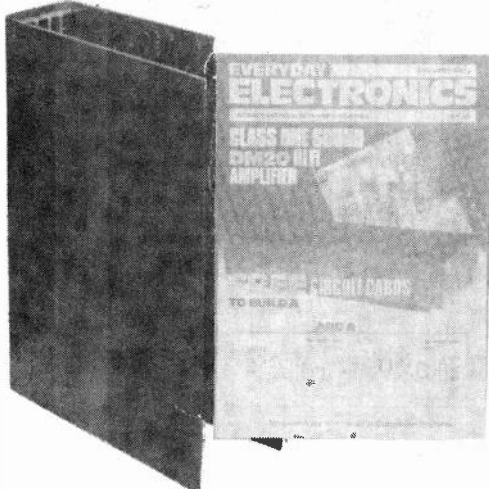
Subscriptions can only start with the next available issue. For back numbers see below.

BACK ISSUES

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

BINDERS

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



Editor MIKE KENWARD

Secretary PAMELA BROWN

Deputy Editor
DAVID BARRINGTON

Editorial Assistant
COLETTE MCKENZIE

Editorial: WIMBORNE (0202) 881749

Advertisement Manager
PETER J. MEW Clacton (0255) 850596

Classified Advertisements
Wimborne (0202) 881749

READERS' ENQUIRIES

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

All reasonable precautions are taken to ensure that the advice and data given to readers is reliable. We cannot, 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.

OLD PROJECTS

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

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

ADVERTISEMENTS

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

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

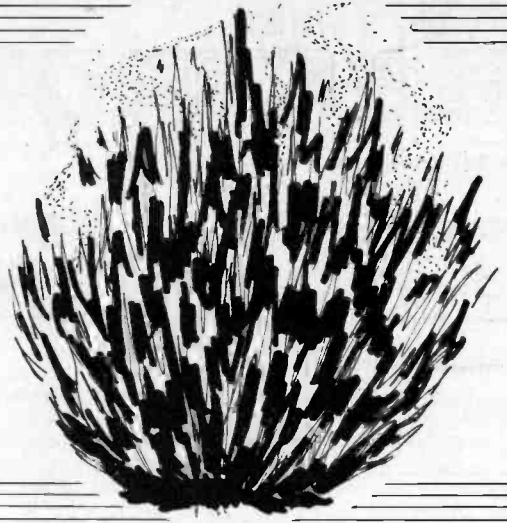
TRANSMITTERS/BUGS

We would like to advise readers that certain items of radio transmitting 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 equipment as a fine, confiscation of equipment and/or imprisonment can result from illegal use.

The law relating to this subject varies from country to country; overseas readers should check local laws.

FIRE ALARM

GARY CALLAND



Add invaluable protection to your home. An inexpensive system that will detect a fire in any room, garage etc.

IT SEEMS as if it were every week that we hear of the tragic news of house fires. Usually at night when the occupants are asleep, the fortunate ones awaken to find their house full of smoke, and have to come to terms with the prospect of a gutted carcass where their home once stood. For the less fortunate ones. . . .

Lives and property could be saved by fitting an effective fire alarm system. However, commercially available fire alarm systems are expensive and very few people think the risk of fire in their house warrants such a large expenditure.

There have been quite a few fire alarm projects in electronics magazines over the years, but nearly all depend on using expensive and hard to obtain gas sensors. The fire alarm described here however,

uses a simple, cheap, reliable and novel method of fire detection, is extremely versatile in that as many detectors as required can be added and will give enough warning to perhaps avoid another tragic disaster.

FIRE ALARM

The fire alarm consists of two units. The master unit which sounds an alarm and displays where the fire is, and the detector units, one of which is mounted in each room.

The master unit is intended to be mounted by the bedside in the main bedroom and to be switched on before a night's sleep. The unit has provision for six detector units, but this can be extended to any number if required. The unit supplies the

power to the detectors, and when triggered sounds quite a loud warning device and illuminates an appropriate l.e.d. to show which detector has been triggered.

The detectors use a beam of infra-red light supplied by an infra-red l.e.d. to detect the presence of smoke particles. As the room fills with smoke, the intensity of the infra-red (IR) beam reaching the IR detector transistor decreases, as the smoke particles scatter and absorb the IR light. This drop in intensity is detected and used to trigger the master unit.

When smoke is detected, a low signal is sent to the master unit, otherwise the signal is high. As the master unit expects to see a high voltage signal when in normal operation, any faults with the detectors and any breaks in the detector cables, which might be caused by fire burning through the cables, will be detected as the signal will go low and will trigger the alarm. This is an added safety feature which detects faults, as it is useless having a broken detector unit when you think it works perfectly.

CIRCUIT DESCRIPTION —MASTER UNIT

Power is obtained from the mains transformer (Fig. 1) through a fuse and is rectified and smoothed by D1, D2 and C1 to give a d.c. voltage of about 12V. This supplies IC1 the 555 timer which is set to oscillate at about 1.5Hz. When TR1 is conducting the signal from IC1 switches TR2 on and off which in turn switches the audible warning device (WD1) on and off. (If desired this warning device could be replaced by a relay which could drive a more elaborate alarm system — see Fig. 2.)

The signals from the detectors are fed to IC2 a CMOS hex inverter/buffer chip. The output voltage from this chip is the inverse of the input and is fed to the base of TR1 via R3 and diodes D11 to D16. A low voltage in produces a high voltage out which switches TR1 on and the alarm sounds.



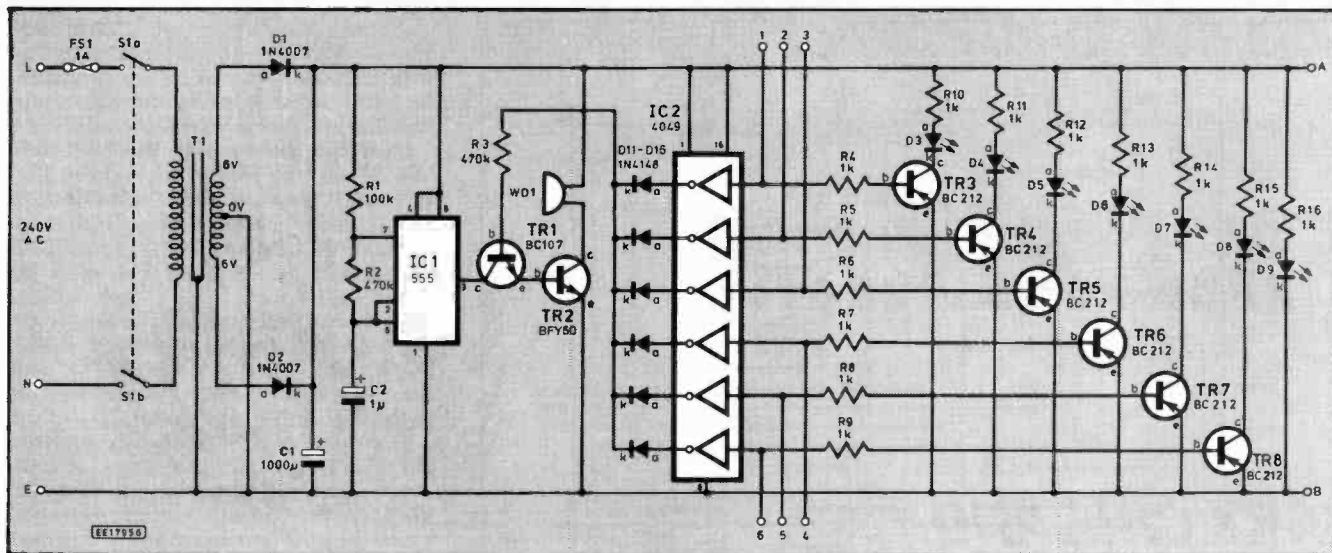


Fig. 1. Circuit of the Fire Alarm master unit.

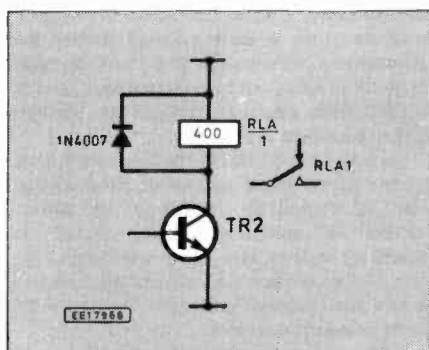


Fig. 2. Addition of a relay to drive other alarm output devices.

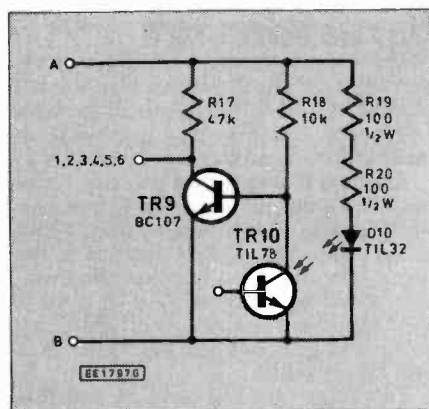


Fig. 3. Circuit of the alarm detector.

The detector signals are also sent via R4 to R9 to a set of transistors (TR3 to TR8) which switch on l.e.d.s D3 to D8 when the voltage to their bases goes low, hence showing which detector has been triggered. Resistor R16 and l.e.d. D9 are present to indicate when the unit is turned on.

DETECTOR

The detector circuit is shown in Fig. 3, about 50mA flows through the infra-red l.e.d. D10 via R19 and R20 so that a high output of IR light is obtained. In the absence of smoke, this high intensity beam switches the IR transistor TR10 fully on so that the full supply voltage is dropped

across R18 and so the base of TR9 is at zero potential. Hence TR9 is not switched on, no current flows through R17 and there is no potential drop across it. The signal to the master unit is high.

When the intensity of the beam is reduced by the slightest amount, due to smoke particles, TR10 conducts less and so the base of TR9 sees a voltage. As the two transistors are directly coupled, this voltage switches TR9 fully on, the full supply voltage is dropped across R17 and the output signal is low.

CONSTRUCTION

The circuit board was made out of Veroboard as this is the most available form of circuit board and this allows the project to be made by less experienced builders who may not wish to purchase a ready-made p.c.b. and who may be unfamiliar with p.c.b. construction. As a result, however, there are quite a number of breaks in the tracks, and a large number of links are present so the layout shown in Fig. 4 will have to be carefully followed.

COMPONENTS

£30 incl. 6 detectors

Master Unit

Resistors

R1	100k
R2	470k
R3	470k
R4 to R16	1k (13 off)

All ¼ watt ±5%

**Shop
Talk**

see page 91

Capacitors

C1	1000µ elect. 16V
C2	1µ elect. 16V

Semiconductors

D1, D2	1N4007
D3 to D9	red l.e.d.'s (7 off—see text)
D11 to D16	1N4148 (6 off)
TR1	BC107
TR2	BFY50
TR3 to TR8	BC212 (6 off)
IC1	555 timer
IC2	4049 CMOS hex inverter

Miscellaneous

FS1	1A 20mm fuse and holder
-----	----------------------------

S1	d.p.d.t. 240V toggle switch
T1	6-0-6V 400mA mains transformer
WD1	audible warning device L7009

Mains grommet; 16 pin d.i.l. i.c. holder; Veroboard 3.75 inch by 5 inch; case—Bimbox range 152 × 82 × 50mm; p.c.b. mounting 3.5mm stereo jack sockets (6 off); cable clamp; fixings; wire etc.

Detector Unit

(Items for one unit)

Resistors

R17	47k ¼W carbon
R18	10k ¼W carbon
R19	100 ½W carbon
R20	100 ½W carbon

Semiconductors

D10	TIL 32 I.R.l.e.d.
TR9	BC107
TR10	TIL 78

Miscellaneous

Verocase 72 × 47 × 25mm; Veroboard (see text); three core mains cable; 3.5mm stereo jack plug; grommet.

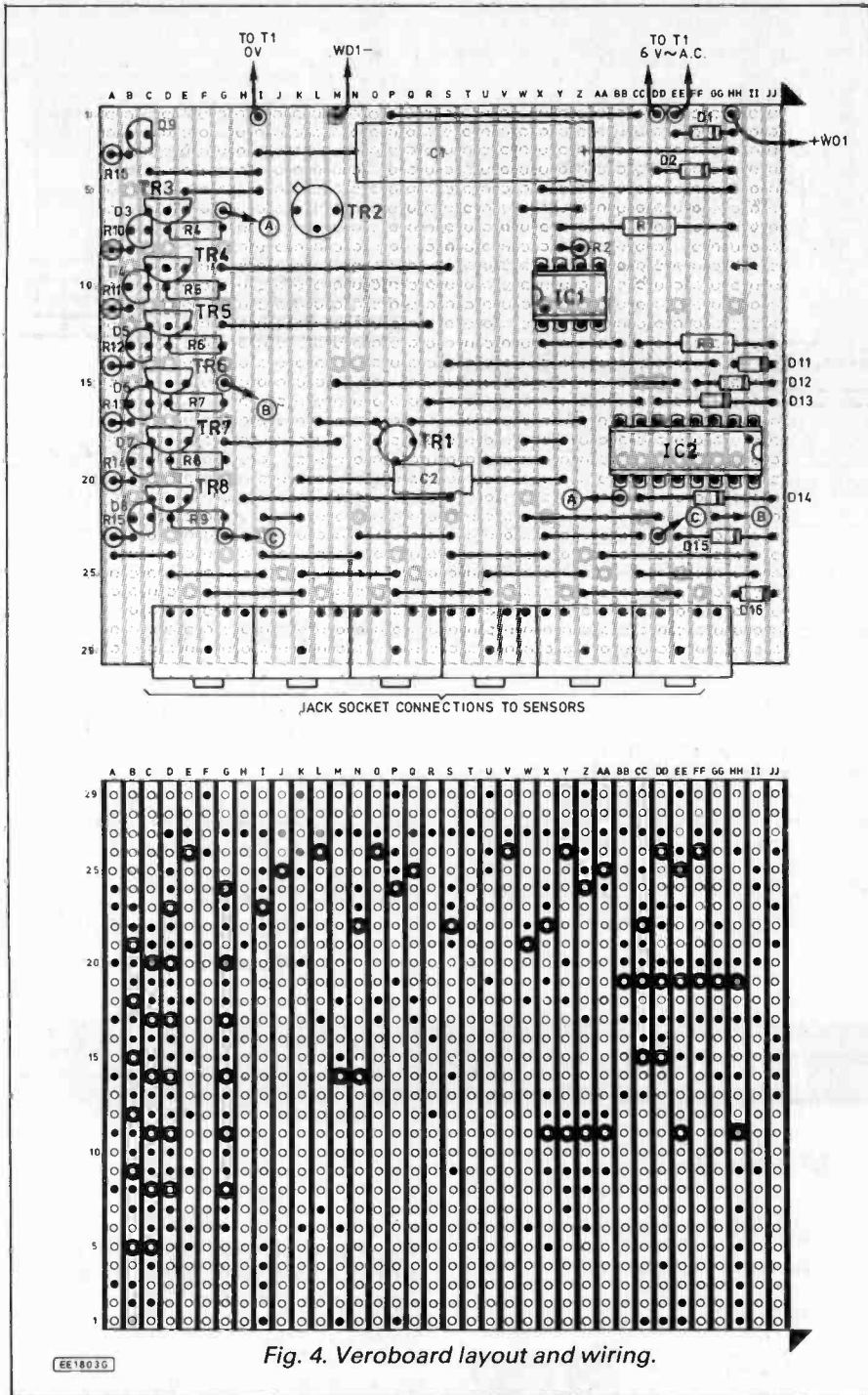


Fig. 4. Veroboard layout and wiring.

A standard 3.75 inch \times 5 inch Veroboard is cut to 29 holes and the off cut kept for the detector circuit board. Very carefully mark the breaks in the tracks and cut them with a spot face cutter or twist drill.

Start construction with the links, followed by the six stereo jack sockets. The resistors, capacitors and semiconductors can then be soldered into place. Care must be taken with the orientation of polarized components (see Fig. 4). IC2 must be placed into a socket rather than directly soldered into the board (damage may occur due to the heat from the soldering iron, but IC2 is a CMOS device and none of the pins must be touched as this may cause damage to the chip due to static electricity).

Once the circuit board is complete, attention is now turned to the case construction and mains connections. The case is a 152 \times 82 \times 50 mm Bimbox range case which is quite attractive and accommodates the components snugly.

The mains transformer is mounted in the left hand corner using 6BA bolts and the fuse holder mounted at the back. The mains cable enters the case through a grommet and a cable clamp should be included to prevent the mains cable accidentally pulling out and weakening solder joints which could be dangerous. Mains wiring is shown in Fig. 5.

Six holes are drilled in the side of the case for the jack sockets and seven holes in the case lid should be drilled for the seven l.e.d.s. The mains switch S1 should be mounted in line with the power on l.e.d. (see Fig. 6). A hole will also have to be cut in the case lid for WD1 which should be fixed using epoxy resin.

After wiring up the circuit board, WD1, mains transformer, switch etc. (see Figs. 5 and 6) the circuit board can be mounted using bolts or the plastic spacers supplied with the case. All that remains is for the lid to be labelled with rub down letters.

DETECTOR UNIT

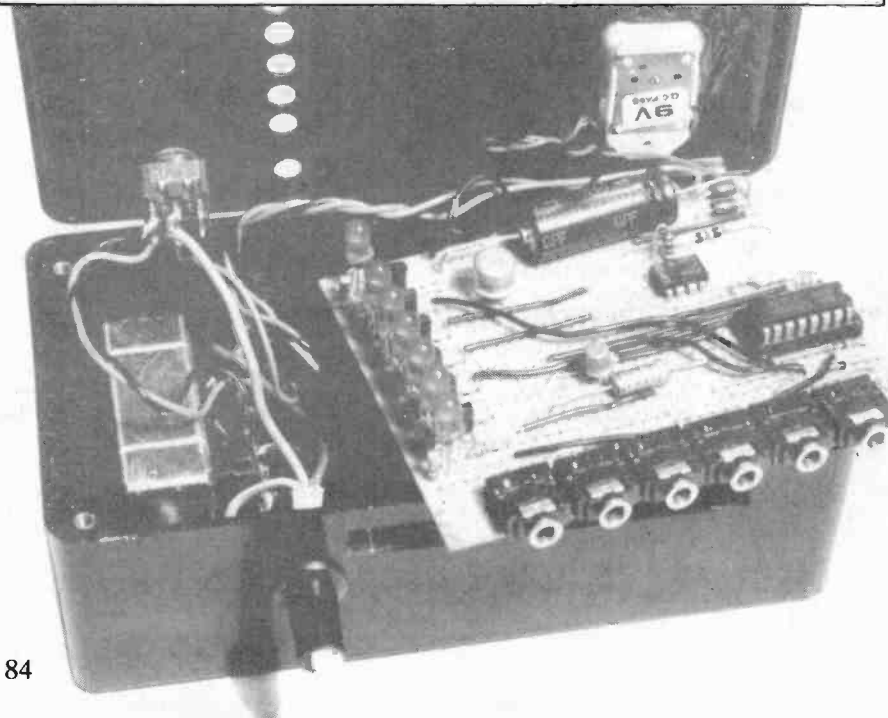
The few components which make up the detector unit are all mounted on a small piece of Veroboard left over from the main Veroboard. There is only one break to make and no links this time.

After construction of the circuit board has been completed (see Fig. 7) it is connected to the master unit via thin, 3-core mains cable. The cable is attached to the circuit board as shown, fed through a grommet in the side of the case, and attached to a 3.5 mm stereo jack plug, carefully noting which wire goes to which part of the plug (see Figs. 8 and 9).

Two holes should be carefully drilled in the case lid so that the IR l.e.d. and transistor can poke through when the lid is placed on the case. The l.e.d. and transistor are then bent through 90 degrees so that they are facing each other, and are shielded from daylight, either by using a piece of pen case or rubber tubing. Particular attention should be made to shielding the transistor as external IR sources may interfere with the detector.

Plug the detector into the main unit and if the alarm is triggered, it means the l.e.d. and transistor are not correctly lined up with each other. If this happens, small movements of either the transistor or l.e.d. should be made until the alarm is silent.

Once alignment has been completed, the transistor and l.e.d. can be glued into place using epoxy resin. This also holds the circuit board in place. The detector is now complete.



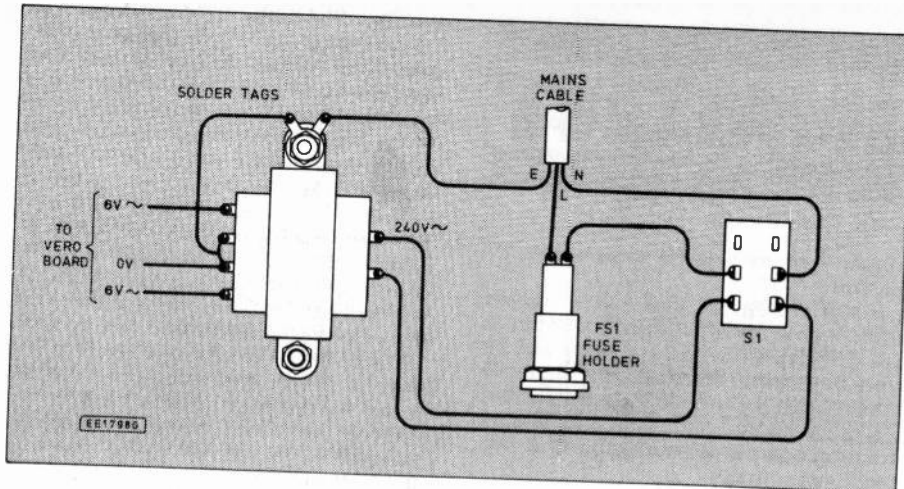


Fig. 5. Mains supply wiring.

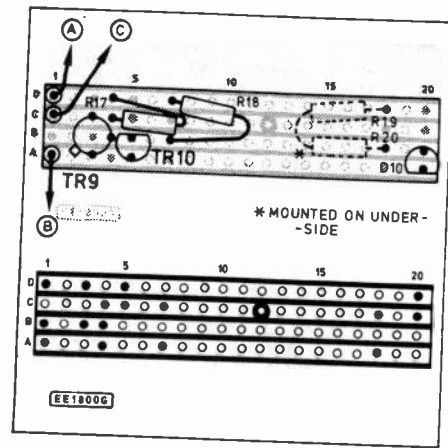


Fig. 7. Veroboard construction of the detector units. Note that point C goes to the jack plug tip (1, 2, 3, 4, 5, 6), see Fig. 9.

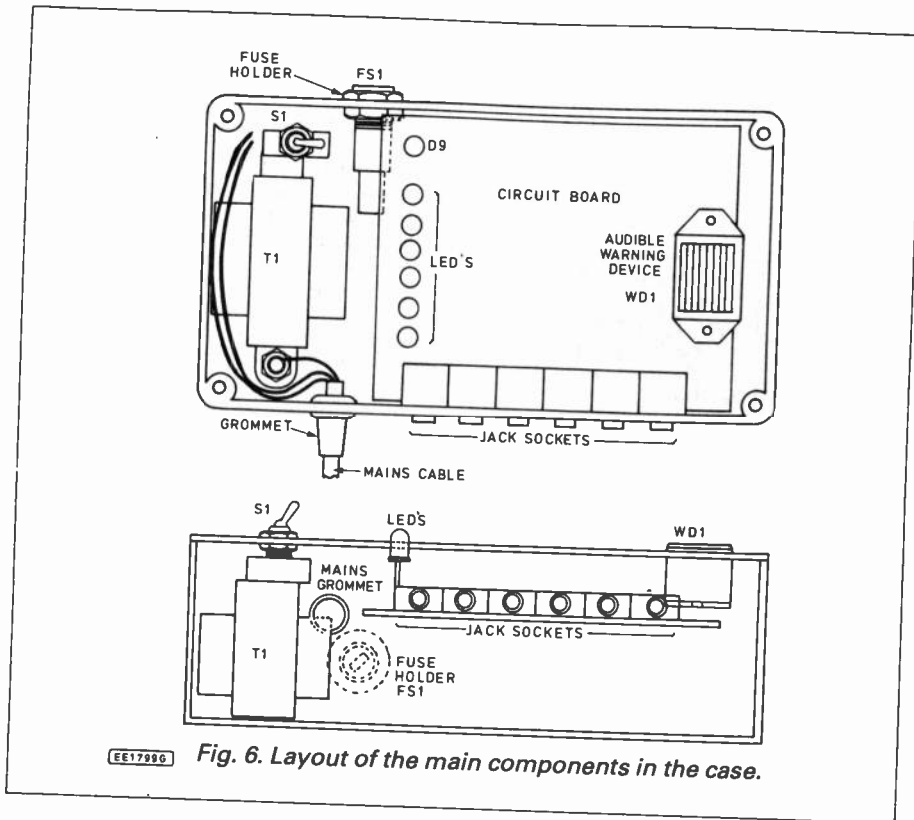


Fig. 6. Layout of the main components in the case.

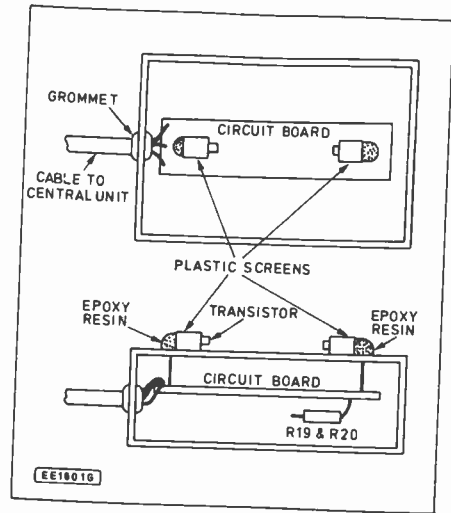
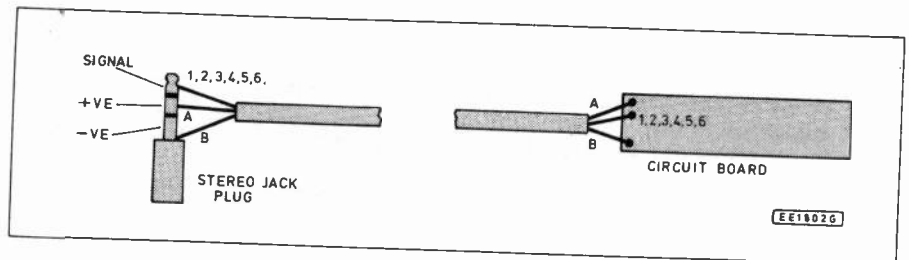
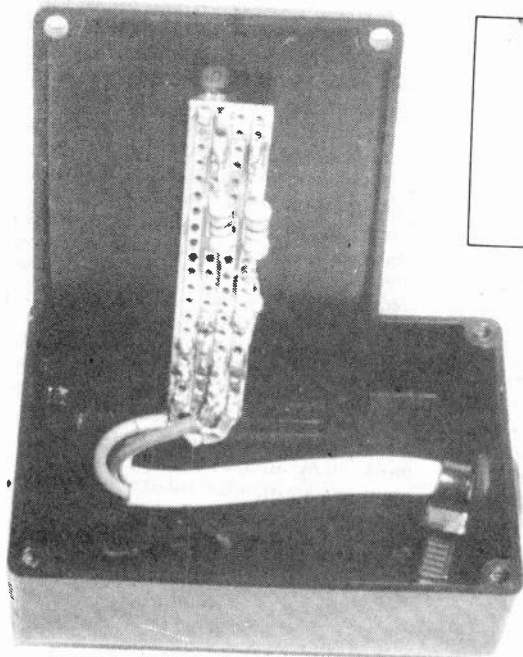


Fig. 8. Layout of the detectors.

Fig. 9. (below) Wiring of the detectors to the stereo jack plugs for connection to the master unit.



MOUNTING AND TESTING

The detector units should be mounted high up on a room wall or on the ceiling as smoke tends to accumulate at the top of a room. Best positions are near potential fire hazards e.g. near ash trays, electric fires, above sofas, near electrical equipment etc. and detectors should be located as near to these as possible.

Testing is simply a case of cutting off the IR beam of each detector by placing a finger in the path of the beam, and checking to see if the corresponding l.e.d. lights. (You can also allow a little smoke from a cigarette to pass through the beam to check sensitivity.) If all is well, the project is now ready to protect your home from the dangers of fire. □

FOR YOUR ENTERTAINMENT

BY BARRY FOX

To Fit . . .

Around 300,000 homes in Britain are connected to a cable station, and around two million flat-dwellers are receiving signals from a shared dish aerial on the roof, according to estimates by Astra, the satellite broadcasting consortium. That leaves around 20 million homes theoretically in the market for a dish system to receive programmes direct from satellite.

So far around 80 companies in Europe are offering dish systems capable of receiving *Astra*, at prices ranging from £149 for a Sinclair system, £199 for Amstrad and Alba and £300 or £400 from electronic majors like Grundig and the Japanese. These 80 companies promise to deliver two million dish systems in the first year, 1989.

Dixons, the high street chain, talk of selling half a million. The Astra publicity video, which dealers will be asked to show in their shops describes receiving satellite programmes as "easy as ABC—all you need is a dish on a wall or roof, a set-top tuner and a TV set."

This may well turn out to be an oversimplification and understatement. A dish aerial needs to have a direct line of sight on a satellite without any obstruction from buildings or trees. It must be aligned on the invisible satellite to an accuracy of around one degree!

Because satellite signals are f.m. (whereas terrestrial TV signals are a.m.) slight misalignment of the dish may pass unnoticed on a sunny day when the incoming microwave signal is strong. As long as the signal is over the tuner's reception threshold, slight adjustments of the dish will not make any noticeable difference on the screen.

But on wet days, when the incoming signal is attenuated by water in the air, the signal from a misaligned dish system may drop below the threshold for clear pictures. So viewers will find their pictures change with the weather. This is in addition to the problem which can occur if water gets into the coaxial cable, e.g. through poorly made connections, and reduces the signal—as can already happen with u.h.f. aerials.

There will also be a problem if snow collects in a dish and blocks the signal. Flat aerials score here, either genuine flat plate aerials (like BSB's promised Squarial) or the dish-disguised-as-a-plate system developed by Sir Clive Sinclair.

Snow is unlikely to be a significant problem—the UK doesn't get much and it will soon slide from most dishes—but misalignment will show every time it rains.

The only way to be sure that a dish system works as well in wet weather as fine weather, is to align it using a signal strength meter. This technique is already used by reputable firms fitting conventional u.h.f. aerials. The exact position for the aerial is found by looking for the peak reading on a meter,

rather than the clearest picture on a TV screen.

Astra knows full well that if people start finding that their signals disappear on wet days, the bad publicity will be very damaging. Development Manager Robin Crossley announced recently that Astra is sponsoring City and Guilds training courses for aerial fitters at five technical colleges.

. . . or Not to Fit

But the programmers are impatient. After the training schemes were announced at a press briefing, someone in the audience pointedly asked Marcus Bicknell, Commercial Director of Astra, whether people could fit their own aerials. The man who asked the question, Nick Austin, admitted afterwards that he knew full well that Marcus Bicknell had already tried fitting an aerial, and had pictures to prove it.

Many of the press have already seen these pictures. They thus know that Bicknell had fitted a dish to the wall of a house deep in the country, with unobstructed view of the satellite orbit from low level. Would-be viewers who live in towns and cities will need to fit their dishes much higher.

Nick Austin wants to publicise the

message that dish-fitting is easy. Why?

Nick Austin started the *Beggars' Banquet* small record label and is now running the *Landscape* video programme which goes out for a few hours a night on the Sky satellite channel. Landscape Video is a music programme, with background pictures.

Austin fears that there will be a shortage of professional aerial fitters, and he does not want the public put off satellite by the need to wait. "Putting up a dish is as easy as putting up a shelf", Nick told *ERT* "Just four Rawplugs".

But Robin Crossley prefers to play safe. He wants people who buy dishes to pay a fitter to fit them. He worries about people in urban areas climbing high ladders or clambering on the roof. At best they risk poor pictures. At worst they risk death. The tabloids will have a field day—and justifiably so.

In practice it will be dealers and manufacturers, not Astra or programme providers like Landscape, who call the shots. Few people fit their own u.h.f. aerials on a roof because when you buy a TV set or a video recorder it does not come packaged with an aerial and chimney mount. But it looks as if satellite systems will be sold in just this way, with a set-top tuner and roof top dish packaged together.

Someone who buys the package on a Saturday morning hoping to watch films and sports programmes that night may well be tempted to have a go at fitting it on Saturday afternoon, instead of waiting perhaps weeks for an engineer to come and charge to do the job.

The buck on this one stops with the satellite trade.

Wonder of Electronics

Here's some ammunition for anyone who wants to argue that music is becoming too heavily dependent on electronics.

Stevie Wonder flew over from Los Angeles to take part in the Nelson Mandela concert at Wembley Stadium. At the last moment his appearance was delayed. At first the announcers on TV said it was because he had technical problems with his computer; then they said it was because his music computer had been stolen; and then that the computer software had been stolen.

This is what happened.

Stevie uses a Synclavier system to store sound patterns of "samples" on hard Winchester magnetic disk. The patterns are triggered by a keyboard.

The samples which come packaged with the machine are pretty basic and sound only vaguely like the instruments they are intended to mimic. The real skill of the user is in doctoring existing samples or producing new ones. Musicians spend years building up their own library of samples. Often they are derived from brief snatches of real sound, recorded digitally and then processed to taste.

At the Wembley concert, five artists, including Sting, were using Synclavier systems. Michael Jackson used four for his concerts. There is no need for musicians to carry their own Synclavier hardware round the world, they just take a library of samples, and software, to program hired hardware.

Stevie Wonder brought over an optical disc, with two gigabyte capacity, and tape back-up streamers, for use with one of the Synclaviers installed at Wembley. These units have optical disc drive, as well as a tape streamer drive and a 5.25in floppy disc drive for booting up the system with its operating system.

Just before he went on stage, someone who had conned their way backstage stole a DAT recorder being used to tape the event. With mindless stupidity, the thief also grabbed the 5.25in magnetic drive sitting on top of the Synclavier. It was no use to him whatsoever, but he just took it anyway.

This meant that the Synclavier could not be booted up with the operating system needed to load his samples from the optical discs. Apparently it was a musician from pop group UB40 who finally found the thief, made a citizen's arrest and brought back the drive so that Stevie Wonder could go on stage.

Incidentally, although more and more musicians are using Synclavier equipment, the real money is in the use of this equipment for post production work. Film and TV programme producers are able to add and edit music, sound effects and dialogue much more easily using magnetic disk storage than tape, because there is no time lost on re-winding the recording. The magnetic disk can be switched to replay "from the top" in a fraction of a second.

MAGENTA ELECTRONICS Ltd.

A SELECTION OF OUR BEST PROJECT KITS

As usual these kits come complete with printed circuit boards, cases, all components, nuts, screws, wire etc. All have been tested by our engineers (many of them are our own designs) to ensure that you get excellent results.

INSULATION TESTER

An electronic High Voltage tester for mains appliances and wiring. An inverter circuit produces 500 volts from a PP3 battery and applies it to the circuit under test. Reads insulation up to 100 Megohms. Completely safe in use.

OUR KIT REF 444 £19.58



'EQUALISER' IONISER



KIT REF 707 £15.53

A mains powered ioniser that produces a breeze of negative ions in the air. A compact, safe, simple unit that uses a negligible amount of electricity.

3 BAND SHORTWAVE RADIO



OUR KIT REF 718 £26.53

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.

DIGITAL CAPACITANCE METER

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

**£41.55
OUR KIT
REF 493**



SUPER SOUND-EFFECTS GENERATOR



A wide range SN76477 sound effects board giving: Bird Chirps, Sirens, Helicopters, Explosions, Phaser Guns, Steam Train sounds, and more. Supplied without a case.

KIT REF 781 £12.99

VISUAL GUITAR TUNER



Crystal controlled, with a super rotating LED display. Indicates high, low, and exact degree of mistuning. Use with pick-up or mic. Also has audible output.

KIT REF E711 £21.99

MOSFET VARIABLE BENCH 25V 2.5A POWER SUPPLY



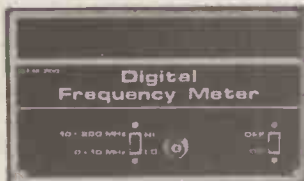
OUR KIT REF. 769 £49.73

A superb design giving 0-25V and 0-2.5A. Twin panel meters indicate Voltage and Current. Voltage is variable from zero to 25V. Current-limit control allows Constant Current charging of NiCAD batteries, and protects circuits from overload. A Toroidal transformer MOSFET power output device, and Quad op-amp IC design give excellent performance.

DIGITAL FREQUENCY 200 MHz METER

KIT REF 563 £62.98

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



TOP KITS

COMPONENTS, KITS, BOOKS, TOOLS, MOTORS, GEARS, PULLEYS, OPTICAL FIBRES, ROBOTICS, AND MUCH MUCH MORE--IN OUR NEW CATALOGUE £1.00

PROJECT KITS FOR E.E.

(Just a selection more in our catalogue)

Magenta supply Full Kits: Including PCB's (or Stripboard), Hardware, Components, and Cases (unless stated). Please state Kit Reference Number, Kit Title, and Price, when ordering. REPRINTS: If you do not have the issue of E.E. which includes the project, you will need to order the instruction reprint as an extra: 80p each. Reprints are also available separately--Send £1 in stamps.

REF NO.	KIT-TITLE	PRICE	REF NO.	KIT-TITLE	PRICE
803	REACTION TIMER Dec. 88	£29.98	569	CAR ALARM Dec 86	£12.47
802	PHASOR (Light Controller) Dec 88	£25.61	563	200MHz DIG. FREQUENCY METER Nov 86	£62.98
801	DOWNBEAT METRONOME Dec 88	£17.57	561	LIGHT RIDER LAPEL BADGE Oct 86	£10.20
800	SPECTRUM EPROM PROGRAMMER Dec 88	£26.87	560	LIGHT RIDER DISCO VERSION	£19.62
796	SEASHELL SYNTHESIZER Nov 88	£24.99	559	LIGHT RIDER 16 LED VERSION	£13.64
795	I.R. OBJECT COUNTER Nov 88	£29.63	556	INFRA-RED BEAM ALARM Sept 86	£28.95
790	EPROM ERASER Oct 88	£24.95	544	TILT ALARM July 86	£7.82
786	UNIVERSAL NICAD CHARGER July 88	£6.99	542	PERSONAL RADIO June 86	£11.53
781	SUPER SOUND EFFECTS GENERATOR May 88	£12.99	528	PA AMPLIFIER May 86	£26.95
780	CABLE & PIPE LOCATOR April 88	£15.35	523	STEREO REVERB Apr 86	£26.44
775	ENVELOPE SHAPER Mar 88	£14.99	513	BBC MIDI INTERFACE Mar 86	£27.94
769	VARIABLE 25V-2A BENCH POWER SUPPLY Feb 88	£49.73	512	MAINS TESTER & FUSE FINDER Mar 86	£8.82
763	CAR LAMP CHECKING SYST. Feb 88	£7.10	497	MUSICAL DOOR BELL Jan 86	£18.72
759	AUDIO SIGNAL GENERATOR Dec 87	£13.64	493	DIGITAL CAPACITANCE METER Dec 85	£41.55
758	ACCENTED BEAT METRONOME Nov 87	£20.95	481	SOLDERING IRON CONTROLLER Oct 85	£5.47
749	ACOUSTIC PROBE Nov 87 (less bolt & probe)	£16.26	464	STEPPER MOTOR INTERFACE FOR THE BBC COMPUTER less case Aug 85	£11.68
744	VIDEO CONTROLLER Oct 87	£29.14		1035STEPPER MOTOR EXTRA	£14.50
745	TRANSTEST Oct 87	£9.70		OPTIONAL POWER SUPPLY PARTS	£5.14
734	AUTOMATIC PORCH LIGHT Oct 87	£17.17	461	CONTINUITY TESTER July 85	£6.20
736	STATIC MONITOR Oct 87	£8.66	455	ELECTRONIC DOORBELL June 85	£7.56
723	ELECTRONIC MULTIMETER Sept 87	£46.96	453	GRAPHIC EQUALISER June 85	£26.94
728	PERSONAL STEREO AMP Sept 87	£14.31	444	INSULATION TESTER Apr 85	£19.58
730	BURST-FIRE MAINS CONTROLLER Sept 87	£13.57	430	SPECTRUM AMPLIFIER Jan 85	£6.91
724	SUPER SOUND ADAPTOR Aug 87	£38.39	392	BBC MICRO AUDIO STORAGE SCOPE INTERFACE Nov 84	£36.25
718	3 BAND 1.6-30MHz RADIO Aug 87	£26.53	387	MAINS CABLE DETECTOR Oct 84	£5.53
719	BUCANEER I.B. METAL DETECTOR inc. coils and case, less handle and hardware July 87	£26.45	386	DRILL SPEED CONTROLLER Oct 84	£8.68
720	DIGITAL COUNTER/FREQ METER (10MHz) Inc. case July 87	£67.07	362	VARICAP AM RADIO May 84	£13.15
722	FERMOSTAT July 87	£12.14	337	BIOLOGICAL AMPLIFIER Jan 84	£24.14
711	VISUAL GUITAR TUNER Jun 87	£22.99	263	BUZZ OFF Mar 83	£5.68
715	MINI DISCO LIGHT Jun 87	£12.59	242	2-WAY INTERCOM no case July 82	£5.69
707	EQUALIZER (IONISER) May 87	£15.53	240	EGG TIMER June 82	£6.86
700	ACTIVE I/R BURGLAR ALARM Mar 87	£35.65	205	SUSTAIN UNIT Oct 81	£17.63
581	VIDEO GUARD Feb 87	£8.39	108	IN SITU TRANSISTOR TESTER Jun 78	£9.42
584	SPECTRUM SPEECH SYNTH. (no case) Feb 87	£20.92	106	WEIRD SOUND EFFECTS GEN Mar 78	£7.82
578	SPECTRUM I/O PORT less case Feb 87	£9.44	101	ELECTRONIC DICE Mar 77	£6.26



EE74 135 HUNTER STREET
BURTON-ON-TRENT, STAFFS DE14 2ST
ADD £1.00 P&P TO ALL ORDERS

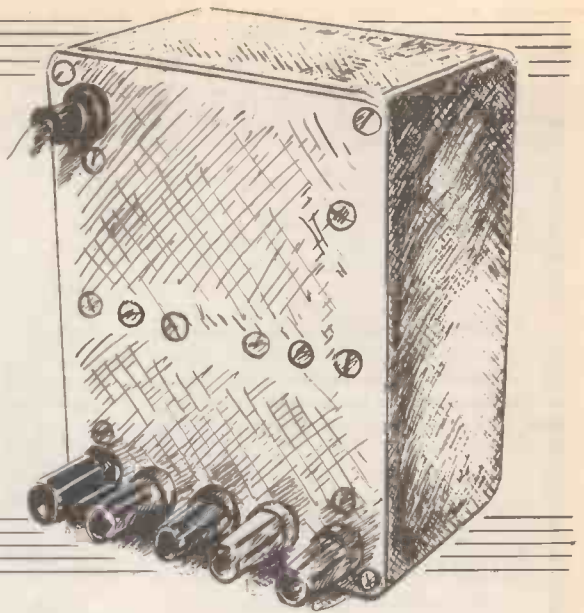
PRICES INCLUDE VAT
SHOP OPEN 9-5 MON-FRI
OFFICIAL ORDERS WELCOME

0283 65435



MINI PSU

DAVID SILVESTER



A versatile low voltage power supply for the workshop.

FOR ANY electronics amateur a small versatile power supply is probably one of the first items that he or she will consider building. Such a supply should offer a number of outputs so that the unit can be used for both digital and analogue experiments.

The Mini PSU to be described was initially designed so that it would give +5V for work with TTL devices and a balanced supply of plus (+) and minus (-) 12 to 15V for use with op. amps and CMOS digital circuits. The idea was then extended to include a -5V supply to allow experimentation with more complicated devices like digital to analogue and analogue to digital converters.

To keep the circuit simple two three terminal regulators were used for the fixed + and - 5V and three terminal adjustable regulators for the higher voltages. In fact, at no additional cost the high voltage supply was converted into an adjustable 2.5V to 20V dual tracking supply, in which as one output voltage falls then the other falls in sympathy. The whole supply fits in a 116mm by 91mm by 56mm internal dimension diecast aluminium box which acts as a heatsink for the regulators and as a safety screen for the unit.

HOW IT WORKS

The full circuit diagram for the Mini PSU is shown in Fig. 1. The mains transformer T1 has two 0V to 15V windings which are connected in series, the centre tap being the ground/earth connection. (For safety reasons the mains Earth lead connects securely to one of the transformer mounting screws, via a solder tag, and to the ground/earth output rail.)

The other connections from the transformer go to the rectifier bridge REC1 and then to the reservoir capacitors C1 and C2 to give unregulated supplies of about +21V and -21V with respect to "earth". The positive supply passes to regulators IC1, the 317T and IC3, the 7805, whilst the negative supply passes IC2 and IC4, the 337T and 7905 negative voltage regulators.

The two 5V supplies are extremely simple. The only addition is the use of the diodes D3 and D4 which give protection to

the two regulators from external power sources and the capacitors C7 and C8 which assist with smoothing of transients and with noise suppression from the regulator.

HIGH VOLTAGE STAGE

The high voltage supply presents an interesting use of the three terminal voltage regulators. The 317T and 337T regulators IC1, IC2 always attempt to maintain 1.2V between their output and adjust terminals. In the simple regulator system two resistors between the output and adjust and between the adjust and ground control the available output voltage.

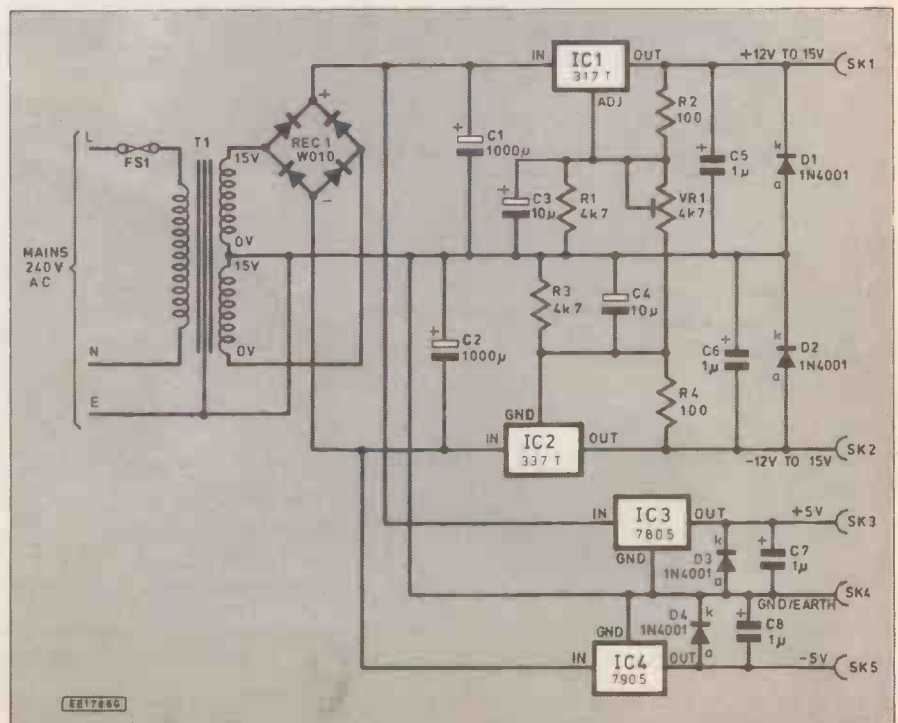
In this project however the system is converted into a dual tracking regulator and as in the case of the 5V supplies, diodes D1 and D2 give device protection and the capacitors C3, C4, C5 and C6 assist with

smoothing and noise rejection. Due to the balanced nature of the circuit the preset potentiometer VR1, which has its wiper and one end jointed to give a variable resistor, will have equal positive and negative voltages at each end, all voltages being measured with respect to earth.

Now consider the two extremes of the setting of VR1. If the variable resistor is a "short circuit", then the resistors R2 and R4 will be shorted together and the two regulator adjust terminals will be connected to a virtual earth and the output voltages will be +/- 1.2V. If VR1 is an "open circuit", then each separate regulator has its output voltage set by the values of the resistors R1 and R2 for the positive and R3 and R4 for the negative supplies. The values of resistor are chosen so that with VR1 at its maximum then the output voltage is about 20V.

Due to manufacturing tolerances there is a variation in the reference voltage, i.e. the voltage between the output and adjust

Fig. 1. Complete circuit diagram for the Mini PSU.



Resistors

R1, R3 4k7 (2 off)
R2, R4 100 (2 off)
All 0.6W 1% metal film

Potentiometer

VR1 4k7 18-turn
preset

Capacitors

C1, C2 1000 μ elec. 63V (2 off)
C3, C4 10 μ elec. 25V (2 off)
C5, C6 1 μ tantalum
C7, C8 bead 25V (4 off)

Semiconductors

REC1 W010 100V 1A
bridge rectifier
D1-D4 1N4001 silicon diode
(4 off)
IC1 317T adjustable positive
voltage reg., 1.5A
IC2 337T adjustable negative
voltage reg., 1.5A
IC3 7805C voltage
regulator, +5V
IC4 7905 voltage
regulator, -5V

Miscellaneous

SK1- 4mm sockets, red,
SK5 yellow, green, blue
and black.
T1 Mains transformer 10W,
0-15V, 0-15V sec.

Diecast aluminium box, size
116mm x 91mm x 56mm;
printed circuit board, available
from *EE PCB Service* code EE636;
insulating kits for regulators (4
off); rubber grommet; coloured
connecting wire; 4BA solder
tags; 4BA 1/2in. screws, nuts and
washers (2 off); 4BA 1in. screws,
nuts and washers (4 off); 1/4in.
spacers for 4BA (x off); 6BA 1/4in.
screws, nuts and washers (4 off);
solder etc.

Approx. cost
Guidance only

£20

pins, from 1.2V to 1.3V so that unless two regulators are selected carefully there will be a small difference between the two output voltage rails. In all cases for which this supply was designed such as experimenting with op. amp circuits then this difference is of no consequence and no attempt was made to correct for this error.

However, if the constructor must have two identical output voltages then either resistor R2 or R4 can be replaced by an 82 ohm fixed resistor and a 47 ohm potentiometer to give an 82 to 129 ohm variable resistor. The voltage error in the prototype with outputs of +14.76 and -15.23 is well within the tolerance limits of the usual 7815 and 7915 regulators with limits of 14.4 to 15.6 volts.

CONSTRUCTION

All the components except the transformer T1, regulator chips IC1-IC4, output sockets and the 5V supply output protection diodes D3, D4 and smoothing capacitors C7, C8 are mounted on a small printed circuit board (p.c.b.). This board is available from the *EE PCB Service*, code EE636. The board is designed to be used for the dual tracking supply only and the two 5V supplies are optional extras.

The building of the Mini PSU is extremely simple. Do not solder any of the components on the circuit board yet, you will need to use it to mark the position of the p.c.b.s mounting screws at a later stage. Construction takes place on the box lid with the bottom used as a cover.

Position the mains transformer at one end of the lid with the connection terminals inwards so that the "cover" or base of the box can be fitted over the top. Mark the position of the 4BA by half-inch mounting screws and drill the holes. Drill a hole for the mains lead grommet in the free space between the transformer and the top of the lid.

At the other end of the lid mark the position of the five output sockets SK1-SK5, being careful to ensure the insulators will not foul the lip on the lid, then drill the holes and file out the notches for the locators. These locators prevent rotation of the sockets when in use.

Position the p.c.b. between the transformer and the output sockets and mark and drill holes for the 4BA by one inch mounting screws. Finally mark and drill the four holes for the 6BA by quarter-inch mounting screws for the regulator i.c.s.

Now paint the box if required and fit the mains transformer remembering to add the solder tag washer for the mains Earth connection. Next fit the output sockets, the rubber grommet and the regulator i.c.s.

The regulators should all have mica washers between the lid and the metal part of the regulator and an insulator bush around the screw to prevent shorting to the lid. It is a good idea to check with a multimeter that the regulators are indeed isolated from the case as damage to the devices will occur if they are shorted to earth.

CIRCUIT BOARD

Assemble the printed circuit-board using the component layout diagram Fig. 2 as a guide. There are no difficult soldering joints to make so there should be few problems.

Pass the mains cable through the rubber grommet, fit a strain relief clamp to the cable to stop it pulling back and then solder the Earth lead to the transformer mounting screws solder tag. (Do NOT tie a knot in the mains cable as a strain relief). Then solder the brown and blue wires to the transformers mains input connection tags.

To assist with the rest of the wiring you will need short lengths of ten different coloured wires, see Fig. 3. Fit the 5V protection diodes and capacitors directly across

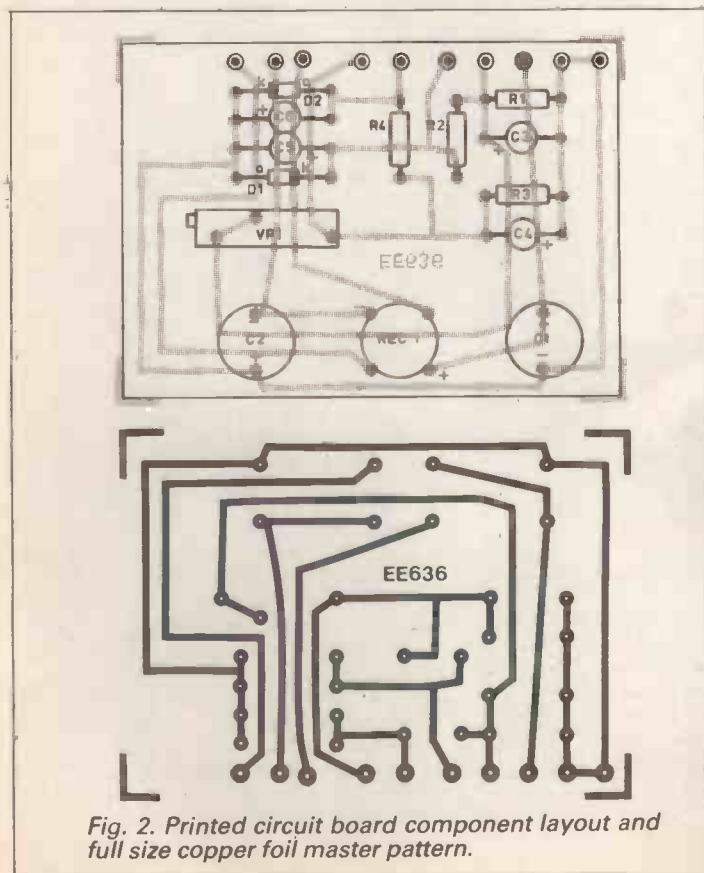
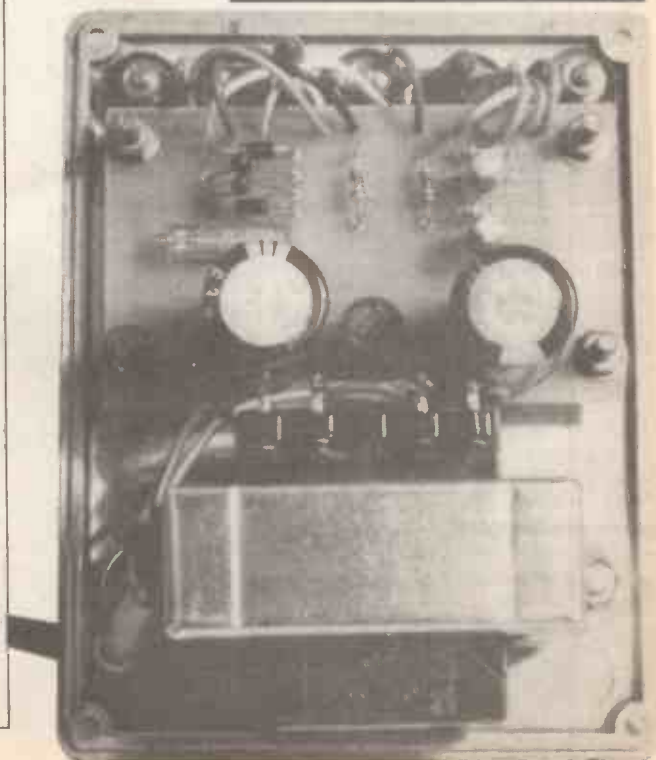


Fig. 2. Printed circuit board component layout and full size copper foil master pattern.



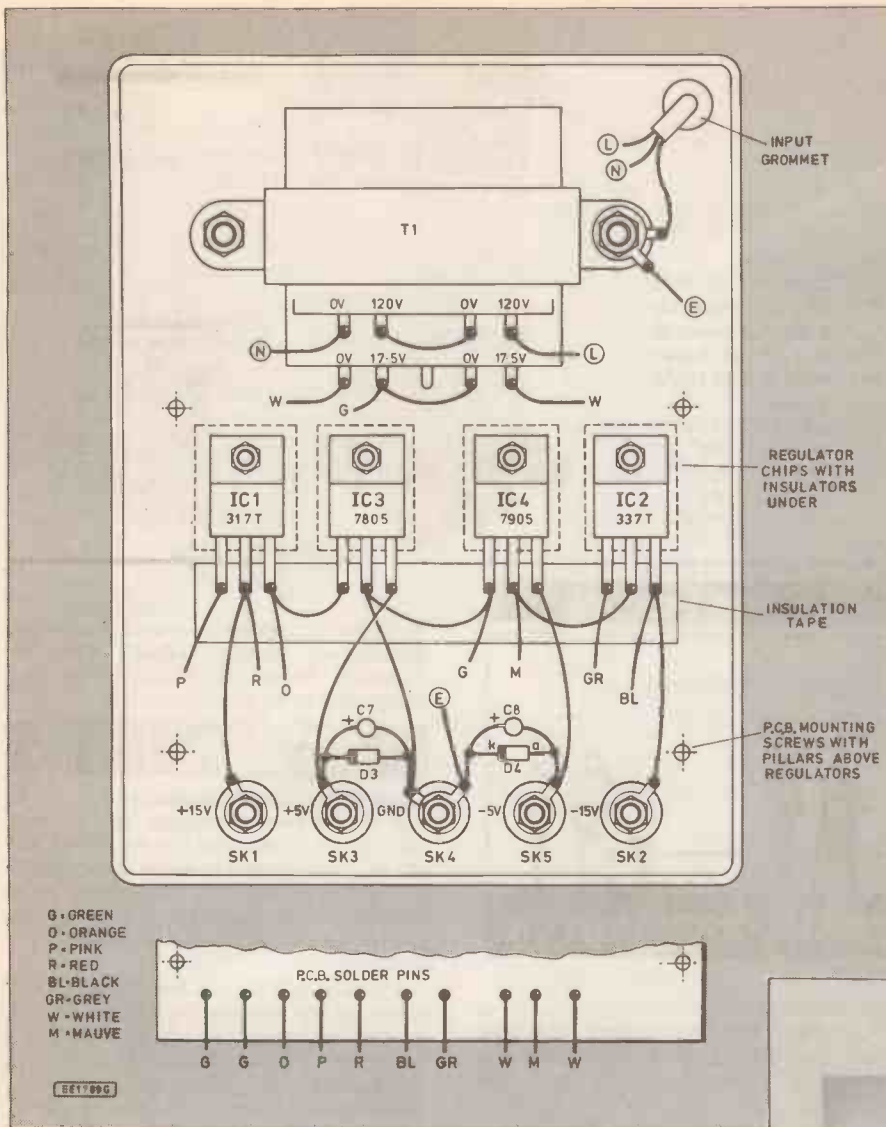
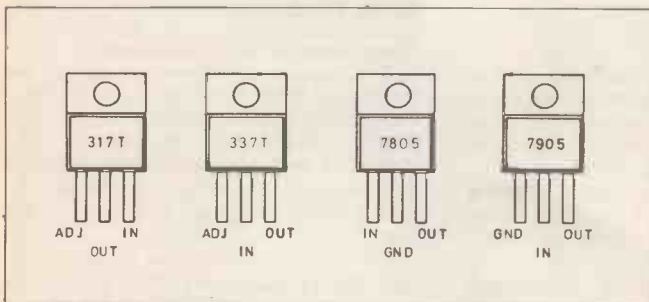


Fig. 3. Layout of components on the case lid and interwiring details from the printed circuit board to the regulator i.c.s.



the output and "ground" terminals and solder into place. Be careful to observe the polarity of the diodes and capacitors.

Add wires in the same colour to the +5V yellow, -5V blue and ground green terminals, and solder to the output terminal tags. The yellow and blue wires go to IC3 (7805) and IC4 (7905) regulator output terminal pins respectively (see Fig. 3 and Fig. 4 for connections).

The green wire goes to the ground or common pins of the 7805 and the 7905 leaving a free green wire from one of these regulators for connection to the p.c.b. A second green wire goes from the transformer mounting solder tag to its low voltage centre tap leaving a second long wire for connection to the p.c.b.

Fig. 4 (above) Pin connection details for the four regulator i.c.s.

(right) The completed PSU with the circuit board laid back to reveal the wiring to the voltage regulators.

Further wires to the p.c.b. come from the 317T adjust, the 337T adjust, the joined 317T and 7805 input terminals and the joined 337T and 7905 input terminals and the remaining transformer tags. The 317T and 337T output terminals have one wire to the correct output socket and a second wire to the p.c.b.

Solder all of the connections to the printed circuit board leaving enough free wire so that the board can be fitted above the regulators. Also, at some later stage it may be necessary to service the unit and unless sufficient lengths of wire are used it will be difficult to turn the board over to gain access to the components.

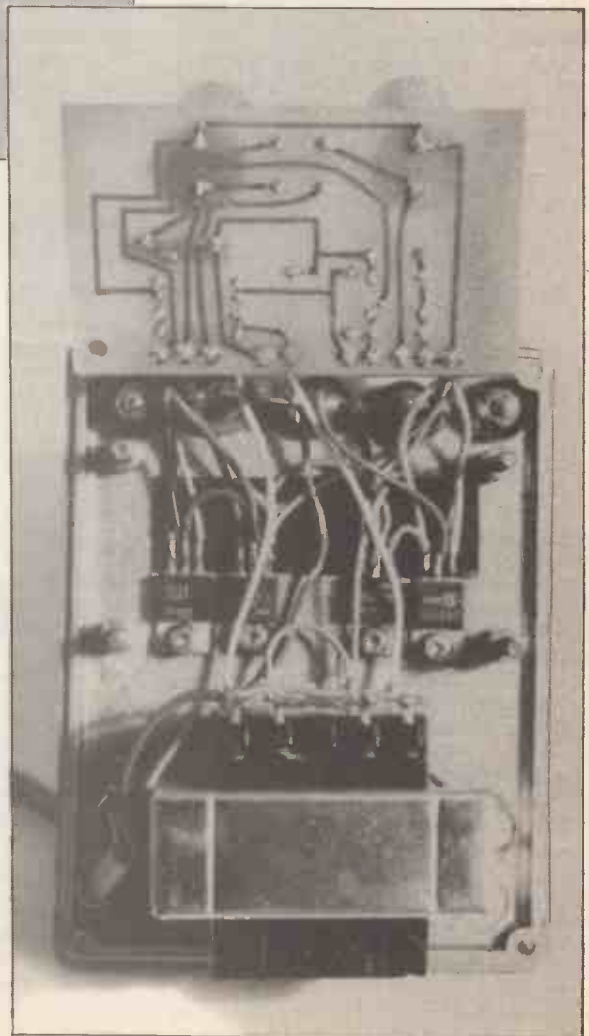
The p.c.b. is mounted in position using 4BA by one inch screws with a quarter-inch spacer and nut fitted before the washers and nuts to hold the board. There is also a washer below as well as above the board.

TESTING

Because of the presence of mains voltages, be extremely careful when carrying out any tests on the power supply.

Testing the unit is very simple. The most likely mistake is that the diodes will be fitted the wrong way round causing a very high current to flow in the regulators. Check this point very carefully before switching on. The mains plug needs a 1A or 2A fuse as there is no separate fuse fitted in the supply.

Set the preset potentiometer VR1 to mid position. Switch on and measure the voltages at the output sockets with respect to



"ground". This only needs to be a rough test at this stage.

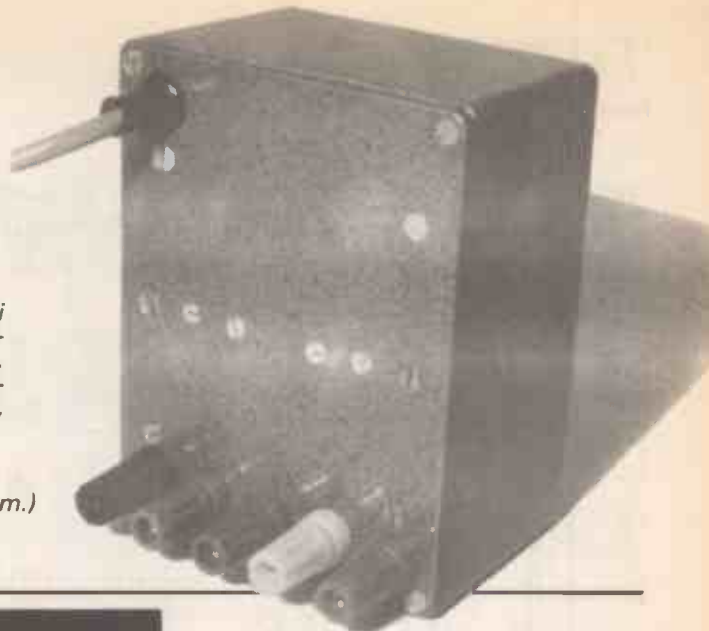
If any component gets hot or one of the voltages seems to be missing then turn off immediately and correct the fault. If all appears to be in working order then adjust the preset VR1 whilst measuring one of the adjustable output voltages. The output may be set between 1.2V to 20V although we would recommend a setting of between 12V to 15V.

If both adjustable outputs are monitored it may be found that there is a small difference in the outputs due to the tolerance in the reference voltages of IC1 and IC2. In this case set the outputs with equal errors above and below the required voltage.

Leave the unit running for some time and again check for components becoming hot but unplug before this test because of the mains supply present. Finally fit the lid to the rest of the box. □

The completed Mini PSU showing the coloured output sockets. These can be labelled, from left to right, as follows:

Black : -15V
Blue : -5V
Green : GND(Com.)
Yellow : +5V
Red : +15V



SHOP TALK



BY DAVID BARRINGTON

Catalogues Received

It was not so long ago that the Cricklewood components catalogue was a small, 148mm×210mm, 24-page affair and carried fairly limited stocks. We see that their latest fourteenth edition is now twice as large (210mm×296mm) and contains 100-pages, and is obviously the result of the excellent service being run by Sid and his team.

Always a good source for hard to find semiconductor devices, this section is now made up of well over forty pages. Nearly all pages of the catalogue have a column down the page in which the listed items are pictured or the relevant technical information, such as pin details, is given.

Copies of the 1989 Cricklewood Components catalogue are available direct and cost £1. Redeemable discount vouchers also come with the catalogue and are useable on pre-paid orders over £30. Cricklewood Electronics Ltd., Dept EE, 40 Cricklewood Broadway, London NW2 3ET. ☎ 01 452 0161 or 01 450 0995.

It was only recently we were reading reports in the press that paperboys should be paid extra for delivering all the new Saturday and Sunday colour supplements. Well, with the delivery of our copy of the new Maplin 1989 Components catalogue we think they should pay the postman extra for deliveries. As for the poor paperboy—have a heart Doug!

Last year, at £1.60 and with 512-pages, we thought they had reached their limit, but no, this year you get an extra 28-pages and it costs £1.95. Also there are over 500 new products and as

an introduction to their new range of Maplin cassette tapes, every catalogue purchaser can send off a card for two free C60 Ferric tapes or one C60 Chrome.

Copies of the Maplin 1989 Components Catalogue (£1.95) should be available from most of the larger W. H. Smith's stores or direct from Maplin Supplies (see back cover).

Courses

The response to our C&G course has been very encouraging both from readers and assessment centres alike. This just goes to show that there is a general need for further education in electronics, and the importance now being attached to a "qualified" training in the various disciplines within the electronics field.

We now carry several advertisers who run specialist training courses and a look through the advertising pages should highlight a particular course for most peoples needs. Most of these "opening learning colleges" have been established for a number of years now and, as far as we are aware, give an excellent service to would be pupils.

Among these is the long established London Electronics College who run courses ranging from Information Technology (IT) to Computer Software Engineering. The College has received Business & Technical Education Council approval and the courses are usually on ONC, HNC and OND levels.

Most courses are based on unit-by-unit work and assessment is by practical and written assignment work, combined with work-based projects. For

further information write or call London Electronics College, Dept EE, 20 Peywern Road, Earls Court, London SW5 9SU. ☎ 01 373 8721.

CONSTRUCTIONAL PROJECTS

Class One Sound Amplifier

Without compromising its performance the *Class One Sound Amplifier* has been budgeted to sell as a complete kit for under £100. This has been achieved by Audiokits bulk purchasing certain items and passing the savings on.

Because of the size and closeness of some of the copper tracking, we feel that for readers to attempt to make their own printed circuit board could lead to all sorts of problems. We, therefore, recommend that constructors purchase a board from Audiokits. This will cost £12.50 plus p&p.

For full details of all component kits and various options contact: Audiokits, Dept EE, 6 Mill Close, Borrowash, Derby, PE7 3GU.

Four-Channel Light Dimmer

The mains transformer used in the prototype *Four-Channel Light Dimmer* was purchased from Maplin, code YJ52. Other 6VA transformers may be used provided they have separate secondary windings and, in some cases, constructors are prepared to "hard-wire" to the p.c.b.

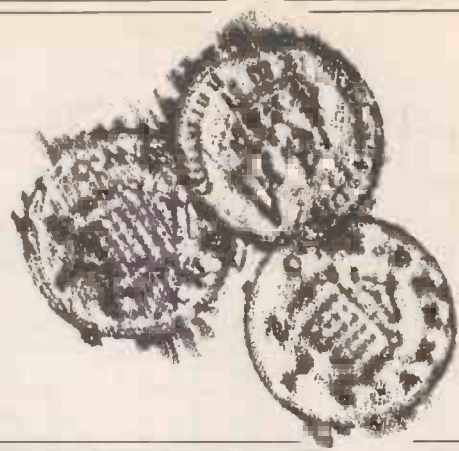
It is very important that the high voltage mains suppression type capacitors are used where specified; most advertisers stock suitable types. The high current (3A) r.f. suppression choke was also obtained from Maplin, code HW06G (Black).

Mini PSU

The 10W mains transformer used by the designer of the *Mini PSU*, was a Drake transformer type C1217. However, no doubt many of our advertisers, such as Barrie Electronics, will be able to suggest a suitable equivalent.

We cannot foresee any component buying problems for the rest of this month's projects. The printed circuit board for the *Four-Channel Light Dimmer*, *Mini PSU* and the *Continuity Tester* are all available from the *EE PCB Service*, see page 139 for prices.

THREEPENNY AMPLIFIERS



GEORGE HYLTON

A CMOS hex inverter chip such as the 4069 can be bought for under twenty pence, or about three pence per amplifier.

Not surprisingly, people try to use these inverters for non-digital purposes. The aim of this article is to increase the chance of success by spelling out both the virtues and the limitations of these i.c.s.

IN THEIR digital applications CMOS inverters are often of the buffered type. This means that the inverter proper is followed by an extra amplifier to increase switching speed or provide more output current. This extra buffer amplifier is itself composed of inverters.

To maintain an overall inversion, two extra stages are needed. This means that a buffered inverter really consists of three inverters in cascade (Fig. 1b) though on circuit diagrams it is usually shown as if it were a single-stage item (Fig. 1a).

Note that the d.c. power supply is usually omitted from the diagram. In fact, the supply is common to all the six inverters on the chip. In data sheets it may be referred to as V_{CC} + and - (as in bipolar transistor data) or the positive side may be labelled V_{DD} and the negative, V_{SS} . The supply is normally single-ended, negative common, so in reality the V_{SS} line is just the zero-volts or "earth" line. For traditional CMOS the supply voltage range is 3V to 15V.

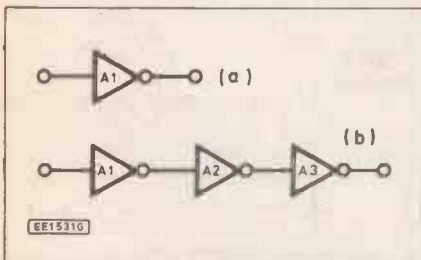


Fig. 1a. Inverter symbol. Power supply is not usually marked. (b) A buffered inverter is actually three. This can cause problems when it is used as an amplifier.

When you try to use a buffered inverter as a linear amplifier it frequently turns itself into an oscillator. Let's see why. The typical characteristics of a CMOS inverter are shown in Fig. 2. In its normal, digital use the amplifier is either turned hard off (output high, working point X) or hard on (output low, working point Z).

For linear applications it must be biased to work on the straight central part of the input/output curve, at point Y. This is easily arranged, in theory, by connecting a resistance R_B from output to input. This gives negative voltage feedback and the circuit automatically biases itself to Y.

At least, it tries to. If it's a single-stage (unbuffered) device, it succeeds, settling down to

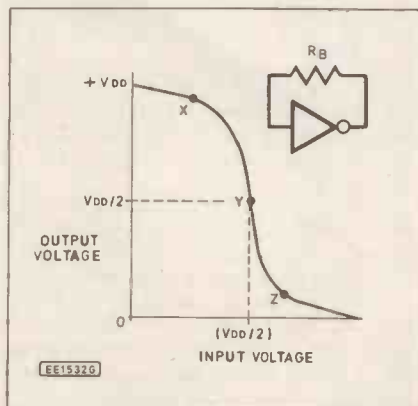


Fig. 2. Inverter characteristics. When R_B is connected the d.c. input and output voltage is about half the supply voltage.

a working point which may not be precisely at Y but is close. But a buffered (three-stage) inverter often oscillates.

Looking at Fig. 3, the reason is that each amplifier has an output resistance R and an input capacitance C . When the third-stage output is coupled back to the first-stage input via R_B a loop is created back to the first-stage input via RC phase-shifting networks. At some frequency their combined phase shifts add up to 180 degrees; i.e., they phase-invert signals at that frequency.

So, at this critical frequency the signal is inverted four times: three times by the amplifier stages and once by the RC phase shifts. An even number of phase inversions means that the feedback in the circuit is positive. If the gain is high enough (and with three stages it usually is) the circuit oscillates.

What can be done about it? In theory oscillation could be prevented by making R_B very large or adding to the input capacitance. In practice these measures either don't work or if they do they conflict with the use you want to make of the inverter.

The only reliable solution is to avoid buffered inverters like the 4049B and stick to unbuffered ones like the 4069UB (Fig. 4). The corresponding chip in the new high-speed CMOS range is the HCU04 ("U" for "unbuffered"). Within its supply voltage ratings (2V-7V) it should be usable in the types of circuit described here.

VOLTAGE CONTROLLED OSCILLATORS

Before writing off buffered inverters as a dead loss it's only fair to say that if you want an oscillator and aren't fussy about its frequency they can be a cheap way of getting one. No external components are needed. Just connecting output directly to input ($R_B=0$) maximises the frequency.

For various reasons (including the fact that the output resistance of the individual stages in Fig. 3 are supply-voltage-dependent) the frequency is very sensitive to changes in V_{DD} . Three-stage inverters used this way are therefore voltage-controlled oscillators (VCOs), of a sort.

The frequency is likely to vary from chip to chip. It can be reduced by increasing C . If a genuine buffered inverter is used only the first C can be augmented, since the other two are buried inside the chip. But if three of the inverters in the 4069 are connected together in a ring you can add to any or all of the C s and

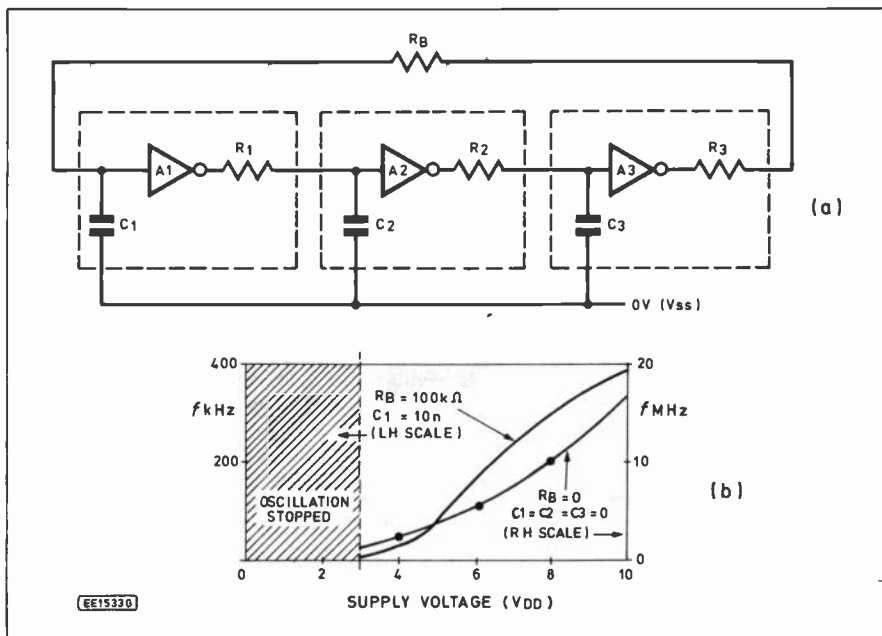


Fig. 3a. In a three-stage (buffered) inverter the input capacitances C_1 - C_3 and output resistances R_1 - R_3 plus bias resistance R_B act as phase-shift networks. (b) Supply-voltage-control of frequency for three inverters of a 4069UB.

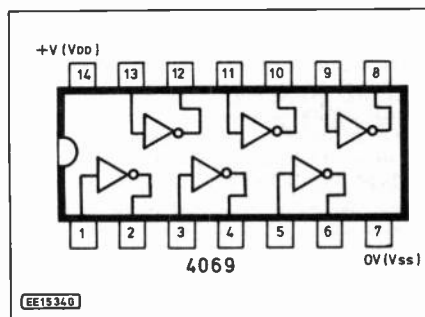


Fig. 4. Arrangement of CMOS 4069 in d.i.l. package.

set the centre frequency by trial and error to almost anything you like, below the upper limit. You can also add to the R s but this restricts the tuning range.

The current drawn increases with frequency in CMOS circuits and a check should be made on dissipation. This is *Supply Voltage* \times *Supply Current* and must not exceed 400mW for the 4069. As always with CMOS any unused inputs should be connected to the 0V or positive supply line to avoid spurious switching by stray voltages, which increases dissipation.

PROTECTION DIODES

The individual inverters in a 4069 have their inputs protected from excess voltages, usually by a built-in resistor and two diodes as shown in Fig. 5. In normal use the diodes are reverse-biased by the supply and play no part. Their intended function is to conduct when an abnormally large input is applied. The resistance then absorbs the unwanted energy and protects the f.e.t.s. ... up to a point.

Very large inputs can destroy the diodes and wreck the chip. To reduce the risk, before touching a CMOS circuit you should first discharge any static on your person by "earthing" yourself to the common side of the supply; i.e. to negative battery. A finger touch is enough.

Similarly, the bits of soldering irons should be connected to battery negative throughout use on the circuit, to provide a safe path for

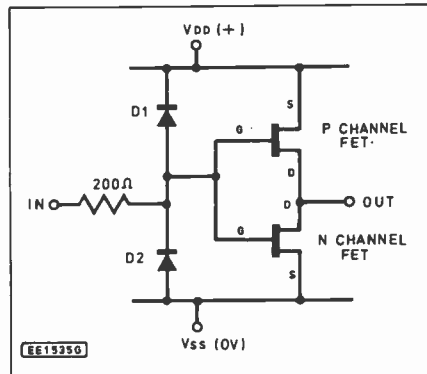


Fig. 5. One inverter of a 4069UB showing the usual type of diode protection.

mains leakage. (In practice, if your iron has a low leakage this may not be necessary. Measure the leakage from bit to mains earth; it should not be more than a few tens of microamps).

We said that the diodes don't normally conduct. This is not completely true. When two inverters are connected as a simple RC relaxation oscillator (Fig. 6a) momentary conduction takes place each time the circuit changes state. This affects the charging and discharging rates of capacitor C_1 and reduces the period (increases the frequency). This may not matter but it does make the frequency change rather a lot as the supply voltage changes.

In applications where frequency stability is important the effect can be reduced by connecting a swamping resistance R_2 (Fig. 6b) to restrict the diode current of the first inverter. Received wisdom says that if resistor R_2 is at least ten times resistor R_1 the effect of diode conduction is negligible for most purposes. Don't expect perfect stability: supply variations have other effects which R_2 cannot compensate.

These simple and reliable oscillators give 50/50 (approximately) square waves at the output of A2. The frequency is approximately $0.45/(R_1.C_1)$. If R_1 is in megohms and C_1 in microfarads the frequency is in hertz. The

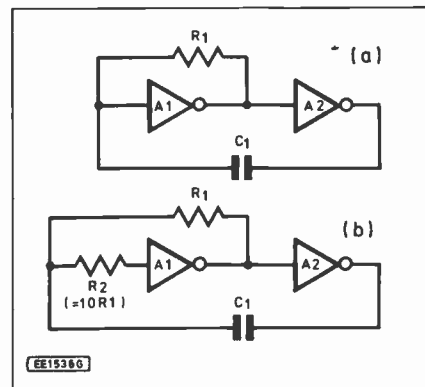


Fig. 6. Two-inverter RC relaxation oscillators. Adding R_2 reduces the effect of supply voltage on frequency.

corresponding period (duration of one full cycle) is $2.2 R_1.C_1$ seconds.

In many applications the output of A2 during one half-period (e.g. the positive half cycle) is used to control some other circuit. In this case the relevant time is $1.1 R_1.C_1$ seconds. For example if you want the positive outputs of A2 to turn on a further circuit for periods of one second and $C_1 = 1\mu F$, then $R_1 = C_1/1.1 = 0.9M$. In practice, use a trimming resistance of somewhat higher value for R_1 (or part of R_1) and set to the correct time if precision is needed.

The frequency can be predicted with fair accuracy only up to a few tens of kHz. Higher up, stray capacitance and the variability of amplifier output resistance introduce uncertainty. At low frequencies, very large values of R_1 can be used.

AUDIO AMPLIFIERS

At first sight CMOS inverters seem to offer the prospect of cheap, simple audio voltage amplification. In practice they can be disappointing.

One limitation is noise, which is much higher than with proper audio transistors and i.c.s. Another is that, although the input resistance of a f.e.t. is virtually infinite, the input impedance of an inverter amplifier is drastically reduced by connecting the bias resistance R_B .

If the voltage gain is A , then with R_B in place the input resistance becomes $R_B/(A+1)$. So if $R_B = 10M$ and $A = 9$ the input resistance is $1M$.

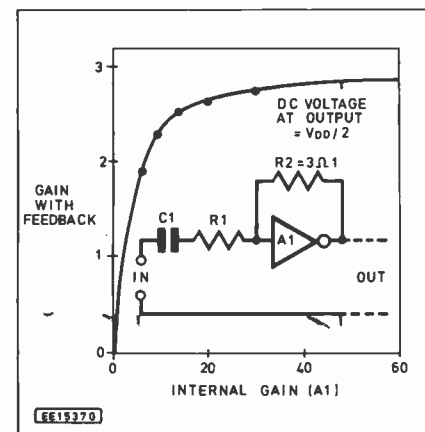


Fig. 7. Voltage amplifier showing the gain stabilization obtained from negative feedback. Target gain = 3.

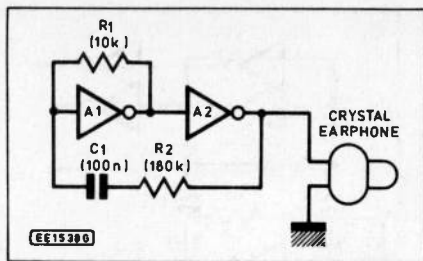


Fig. 8. Test for gain. The circuit oscillates if A2 exceeds 20.

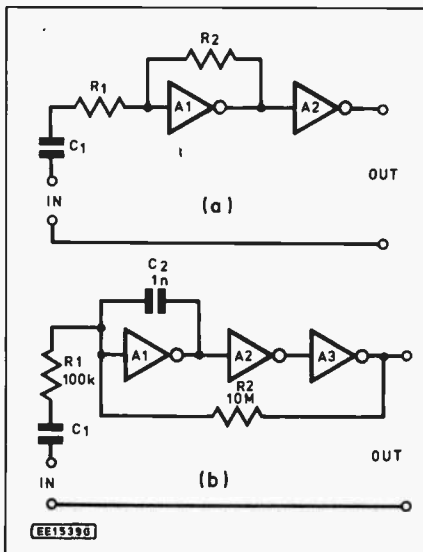


Fig. 9. Higher voltage gain is obtained by cascading (a) two stages or (b) three. Capacitor C2 helps to prevent oscillation.

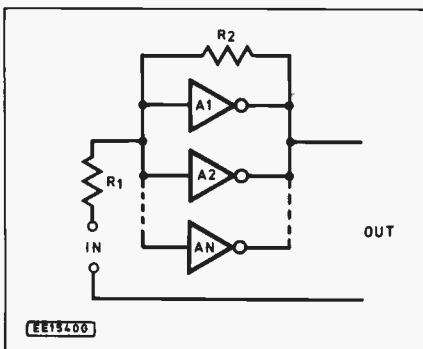


Fig. 10. Paralleled inverters for increased output current.

But what is A? Here again, you run into a problem. Chips are very variable. The gain can be under 10 or it can be very much greater.

To get reasonably repeatable results you have to use negative feedback to limit the effect of chip variability. The voltage gain tries to set itself to $R2/R1$. It never quite gets there but if $R2/R1$ is fairly small (say 3) and the internal gain of A1 is fairly large (say 30) it gets close.

You may want to select chips to make sure that the internal gain is reasonably high. The circuit of Fig. 8 oscillates (at about 300Hz) if the gain of A2 exceeds about 20. (The gain of A1 has little effect.) It's usually sufficient to test one pair of inverters per chip; the rest are likely to be similar.

To get more gain you need more stages. A

simple two-stage circuit (Fig. 9a) has no feedback to A2 so the gain is A2 times $R2/R1$. Three-stage feedback amplifiers (Fig. 9b) can oscillate as explained earlier, but may be stable if the gain ($=R2/R1$) is set high and capacitor C2 is connected to discourage h.f. oscillation (it has little effect at audio frequencies).

However, gains of much more than 100 may be impracticable because of noise. The noise output with a gain of 100 can easily be 100mV peak-to-peak, which is quite awful by hi-fi standards. But in other applications it may not matter. The lesson is: don't use CMOS inverters for anything approaching hi-fi uses.

MORE OUTPUT CURRENT

A single inverter in a 4069 may deliver a very modest output current (less than 1mA at low supply voltage). To get more, connect inverters in parallel (Fig. 10).

MANUAL GAIN CONTROL

By making resistor R2 (Fig. 11) variable, the gain can be adjusted. If VR is a "log. law"

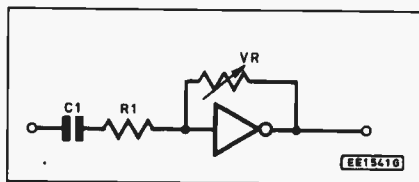


Fig. 11. Manual gain control. Maximum gain tends to $R2/R1$.

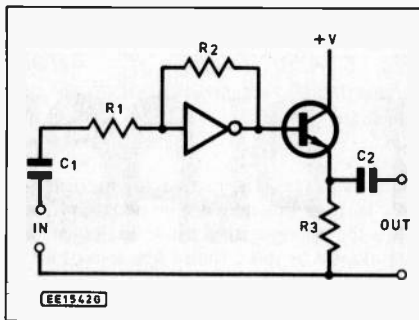


Fig. 12. Reducing output resistance by adding an emitter follower.

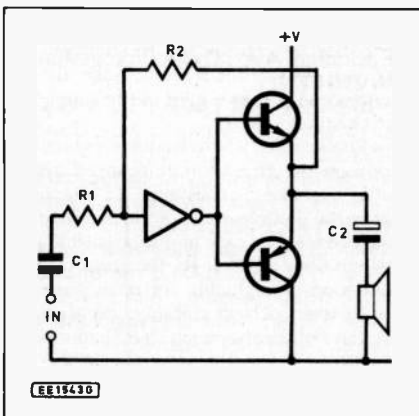


Fig. 13. Arrangement for greater output current.

potentiometer gain increases in the usual way when the pot is connected so that resistance increases with clockwise rotation. There is no d.c. through VR.

LOW OUTPUT IMPEDANCE

The output impedance (or resistance) of an inverter falls as $R2/R1$ falls and as the supply voltage is increased. It may be too high for some types of load.

Where only modest load currents are required, add a simple emitter-follower (Fig. 12). The d.c. through the transistor is a bit less than $V_{DD}/2R3$ and the peak undistorted output current cannot exceed the d.c.

If distortion is unimportant, much larger output currents can be provided by adding a complementary pair of bipolar transistors (Fig. 13). Uses include driving a loudspeaker with an alarm signal such as a bleep tone.

The distortion can be reduced by using germanium transistors instead of the usual silicon ones.

LIMITERS

Most CMOS inverters have nice symmetrical characteristics (Fig. 2). If overdriven by a sine wave both peaks are flattened.

Heavy overdrive or cascading several inverters gives an output which is an approximation to a 50-50 square wave.

SINE WAVE OSCILLATORS

Inverters make excellent oscillators and regenerative amplifiers at audio and low radio frequencies. Their characteristic makes for stable operation with little risk of "squegging."

Oscillation calls for positive feedback. A single inverter cannot oscillate unless the associated circuitry provides a further inversion. A traditional way of obtaining this in an LC oscillator is to put a second winding on L to make a phase inverting transformer.

This can be done with inverter oscillators but a neater way is to use the Colpitts form of tuned circuit (a π network with shunt Cs and series L, Fig. 14a). This fits in nicely with the inverter because the L provides a bias path.

The only drawback is that the waveform may not be very good. Adding a variable

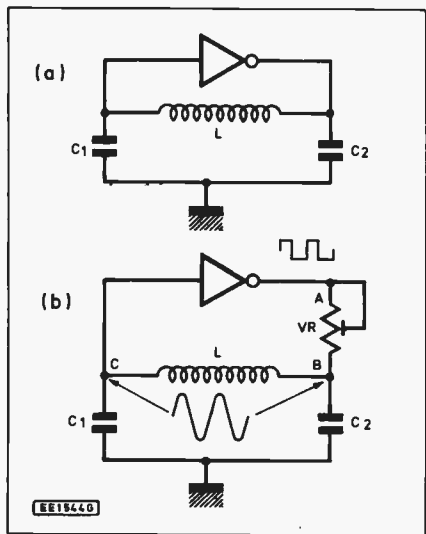


Fig. 14a. Simple Colpitts oscillator. (b) This gives improved waveform.

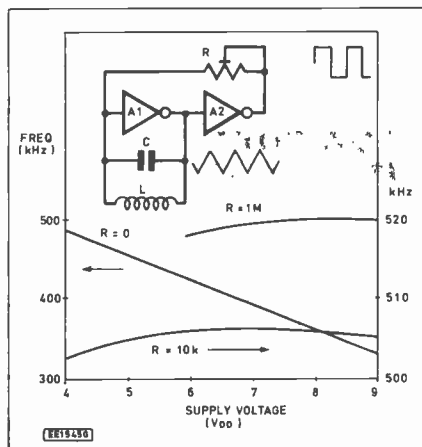


Fig. 15. Two stage LC oscillator: effect of supply voltage.

resistance (VR) to control the amount of feedback yields a good sine wave at either end of the tuning network (B or C) and a flat-topped output at A (Fig. 14b).

TWO STAGE OSCILLATORS

The alternative way of getting the two inversions needed for positive feedback is to cascade two inverters. The job of the tuning network is then to ensure that oscillation takes place at the right frequency.

A simple form of LC oscillator (Fig. 15) has a parallel-tuned LC circuit as a negative feedback path over the first stage. Because the impedance of the LC is highest at its resonant frequency negative feedback is minimum at this frequency, and increases as the frequency moves away from resonance. The result is that gain is highest at the resonant frequency. If some positive feedback is applied overall,

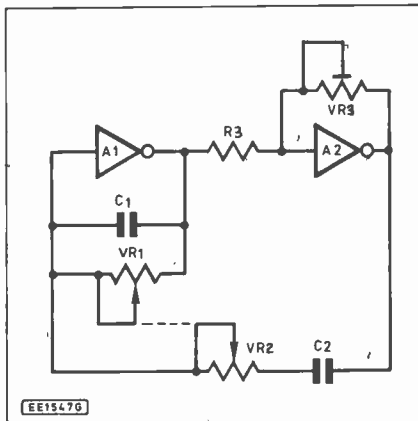


Fig. 16. RC tuned i.f. oscillator.

oscillation occurs at the tuned frequency.

The gain required from A2 is roughly R divided by the LC impedance at resonance. Thus if the LC looks like $100k$ and R is $200k$ the gain (A2) needed is 2. (The gain of A1 has little effect.) If desired the gain of A2 may be stabilized by local negative feedback.

Some practical results with an oscillator in which LC was the tuned winding of a $455kHz$ (nominal) i.f. transformer is shown in Fig. 15. For good frequency stability R must clearly be high. On the other hand, making R low or zero enable the frequency to be adjusted by changing the supply voltage.

RC SINE WAVE OSCILLATOR

At low frequencies LC oscillators are impractical because of the large values of inductance and capacitance and the difficulty of making these variable. RC tuning networks are used instead. These have very poor frequency selectivity and to get good sine waves

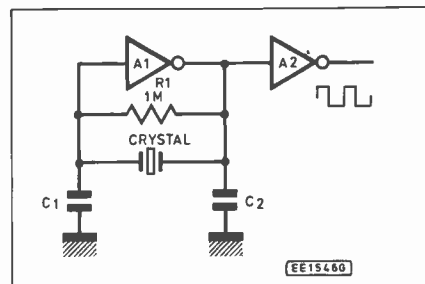


Fig. 17. Crystal oscillator.

calls for adjusting the gain so that the circuit just oscillates.

In the oscillator of Fig. 16, the tuning is done by the series RC and parallel RC networks familiar in the Wien bridge, but connected in a different way. In the usual case when the two Rs (VR1, VR2) are equal and the two Cs are equal, the gain required of A2 is about 2. (A1 has little effect.)

In theory, the circuit could be automatically set up for good waveform by making preset VR3 a thermistor whose working resistance is $2R3$. But most thermistors require fairly large operating currents, so it might be necessary to parallel a number of inverters to provide them.

By setting the feedback just short of the oscillating point the circuit becomes a highly selective amplifier. Input signals can be injected into A1 input via a high impedance.

CRYSTAL OSCILLATOR

Inverters are often used for the crystal oscillators used as clocks in computers. The usual circuit (Fig. 17) is a form of Colpitts oscillator in which the crystal behaves as the inductance. Stray capacitances may provide sufficient C1 and C2 to sustain oscillation, but if precise frequency setting is needed at least one of these must be a real trimmer capacitor. □

MARKET PLACE

WANTED Everyday Electronics April 1988 issue. Mr. W. J. Weight, 7 Queens Road, Littlestone, New Romney, Kent TN28 8LT. Tel. 0679 63700.

APRIL 1988 issue required please. Mr. T. Keen, 26 Betties' Close, Newton Longville, Milton Keynes MK17 0AN. Tel. 367302.

DATA SHEET and info. reqd. for AM7905 ADC World Chip. Free chip to first reply. Urgent. A. Welch, 106 Leamington Court, Louis Botha Ave., Gresswold 2090, R.S.A.

WILL BUY any circuit diagram for reasonable price. Special interest: transmitters, audio, music, home, car projects. Leonard Briffa, 54 Kent Street, Fgura, Malta.

VTX 5000 modem for Sinclair Spectrum (not 128K +2/3). £25 o.n.o. Howarth 0625 873685.

WANTED D43 Double Beam Scope for spares also service manual for Xerox model 2202 photo copier. Mr. W. Marshall, 43 Pilton Road, Westerhope, Newcastle-upon-Tyne, NE5 4PP. Tel. Tyneside 2715215.

WANTED CBM Pet or Vic for spares. Send details please. Must be cheap. Pref. Bradford area. Mr. Graham Mitchell, 43 Cranbrook Ave., Odsall, Bradford BD6 1JF.

WANTED 16K RAM pack for ZX81 or circuit diagram, also circuit diagram of TV oscilloscope. Mr. D. Harries, 17 Eccleshall Ave., Oxley, Wolverhampton WV10 6TN.

VARIABLE VOLTAGE PSU'S. Sound to Light unit £40. both inc. p&p Geoff 0205 760222.

WANTED any info./manual/circuit diagram for Marconi Canadian 52 receiver circa 1944. 0425 55566.

WANTED circuit diagrams for Global GDM 1-11 Digital Multimeter and Bush 9827 music centre. Will pay £5 each. Paul Brown, 48 Lanndale Lawns, Talaght, Dublin 24, Eire.

WANTED circuit diagram for GEC Sounddeck music centre also 5 Spectrum power supplies 9V. 1.4 amps. £15. Postage paid. J. Bakewell, 21 Newbarns Road, Barrow-in-Furness, Cumbria LA13 9SF.

FREE READERS ADS.

RULES Maximum of 16 words plus address and/or phone no. Private advertisers only (trade or business ads. can be placed in our classified columns). Items related to electronics only. No computer software. EE cannot accept responsibility for the accuracy of ads. or for any transaction arising between readers as a result of a free ad. We reserve the right to refuse advertisements. Each ad. must be accompanied by a **cut-out valid "date corner"**. Ads. will not appear (or be returned) if these rules are broken.

WANTED Oric 1. Will pay up to £20. Must be in working order. Contact Ian on (091) 5652833.

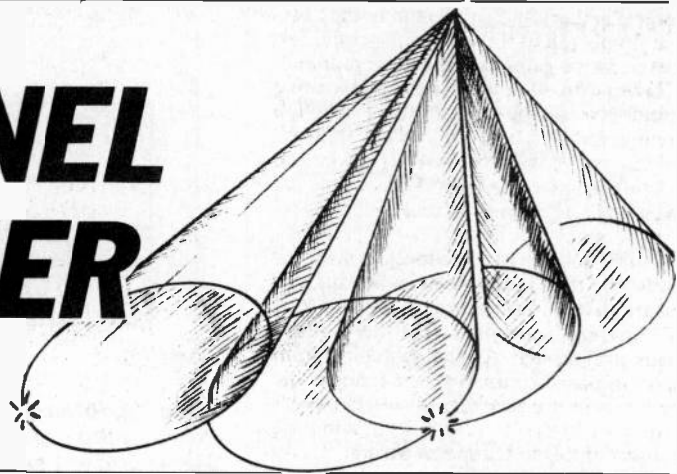
A & R CAMBRIDGE A60 Amp plus T21 Tuner £160. Swap with Rogers LS3/5 speakers considered. Dronfield 410843.

WANTED service manual for Hewlett Packard scope 125B approx. 10 years old. A. Wiltshchut, PA0UV, Deimospad 3, 320N TB Spykenisse, Holland.

HEATSINK for sale. Very large 11.7cm x 3.1cm x 38.2cm. £5+£3 post and packing (holds 4xT03). D. Green-shields, 132 Prince Rupert Drive, Tockwith, York YO5 8QS.

CLEAR OUT. Components, panel meters, valves, manuals. S.a.e. lists. Everything cheap. B. C. Meek, 92 Stopples Lane, Hordle, Lymington, Hants SO41 0JA.

FOUR-CHANNEL LIGHT DIMMER



ANDY FLIND

A safe and versatile, voltage controlled, lamp dimmer that enables up to four 0-1V d.c. inputs to control 240V a.c. mains lamps from zero to full brilliance, at up to 100W per channel.

THE voltage-controlled dimmer to be described here is an ideal project for constructors who like to experiment, which should include all readers of E.E.! It enables up to four 0-1V d.c. inputs to control 240V a.c. mains lamps from zero to full brilliance, up to 100 watts per channel.

Over the next couple of months we shall be adding a *4-Channel Sound-to-Light Interface*, to enable constructors to create their own "light shows". This will be followed by a *4-Channel Auto-Fader Interface* to allow slow, continuous changes in brilliance of lamps to be driven through the dimmer.

As the 4-Channel Voltage-Controlled Dimmer may be used with all kinds of driving circuitry, safety is a prime consideration and the inputs are totally isolated from the "live" sections through "opto-isolator" chips. The areas of the circuit intended to be accessible may in fact be earthed, or they can be left "floating", for operation at some common potential other than earth.

An auxiliary supply is available from the board for powering other circuitry, and this too is isolated and may be earthed for safety.

CIRCUIT DESCRIPTION

The full circuit diagram for the 4-Channel Voltage-Controlled Dimmer appears in Fig. 1, and operates as follows. Phase-control is used to determine the brilliance of the lamps driven by the outputs. In a phase-control circuit, the output switches off at each mains zero-crossing (100 times per second), and the point in each half-cycle where it is turned on again determines the average power delivered to the lamp.

Most dimmer switches operate on this principle, though their circuitry is simpler since they are not voltage-controlled. To achieve voltage control, this circuit generates a linear ramp waveform that is set to one volt at the start of each half-cycle and falls to zero during the half-cycle period of 10mS.

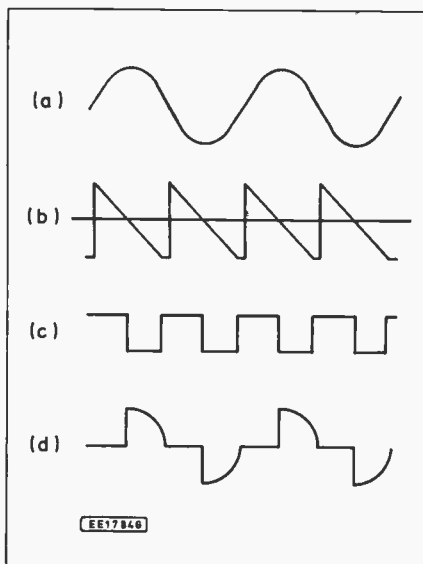


Fig. 2. Typical waveforms to be expected at various stages of the circuit.

The ramp voltage is compared with the input signal, and as soon as it drops below it the associated output is turned on. It follows that the higher the input, the sooner this will happen and the brighter will be the lamp.

The waveforms shown in Fig. 2 illustrate this more clearly: The a.c. mains waveform is shown at (a) and the ramp, synchronised to it, at (b). Superimposed on the ramp is a straight line representing the current input voltage. The comparator output (negative for "on" in this circuit) is shown at (c) and, finally, the resulting output waveform delivered to the load is shown at (d).

ZERO-CROSSING

The first objective of the circuit is to detect the mains zero-crossing points and use them to reset the ramp generator. In

fact, resetting should occur slightly before each crossing to allow time for the triac gate currents to stop and the devices themselves to turn off.

What is needed are brief pulses straddling the zero crossings, and this is achieved with an "exclusive-OR" gate in IC1 connected to the resistor network R1 to R5. Without going too deeply into the maths of this network, it can be stated that whilst the mains voltage is less than about 20V, positive or negative, one of the inputs to IC1 will be above and one below half the supply voltage.

The EX-OR gate's output is high only for this condition, so the output is a positive pulse, about 400 μ S long, centred on each zero-crossing. Diodes D1 to D4 clamp the inputs to prevent large excursions above and below the supply rail potentials. Since there are also internal clamping diodes in IC1, resistors R6 and R7 are included to limit current flow into these should they turn on first.

The remaining three gates in IC1 are simply used as a buffer to drive transistor TR1, which pulses the l.e.d. in the single opto-isolator IC2. IC2's transistor resets the ramp, by pulling capacitor C8 up to a regulated 5V supply rail. Capacitor C8 then begins discharging through resistor R17, dropping about 1V in the 10mS before the next reset pulse arrives.

The ramp isn't perfectly linear of course, being part of an exponential discharge curve, but over this small initial portion of the curve it's good enough for the intended purpose. The ramp signal is made symmetrical, about 0.5V with coupling capacitor C9 and reference resistors R18 to R19, and then buffered by IC4 before being passed to the four comparators contained in IC5. The input signals are applied directly to the other inputs of these.

COMPARATOR OUTPUTS

Unlike op-amps, the outputs of the comparators are single npn transistors, or their collectors, to be precise. The inputs in this design are arranged so that these transistors are normally "off", and turn "on" when an output is required.

Each collector drives an l.e.d. in the quad opto-isolator IC6, and the corresponding transistor in each isolator supplies gate current to the appropriate triac. The triacs employed are C206D's, which the author

has found to be more reliable when operated with negative gate drive. The mains Neutral is therefore connected to the positive supply rail of this part of the circuit, so that negative gate current can be supplied.

Triacs turn off automatically if gate drive is removed and the current passing through them is reduced below a small, "holding" value. As the ramp is reset slightly before each mains zero-crossing, there is time for the gate drive to turn off and triac turn-off to take place.

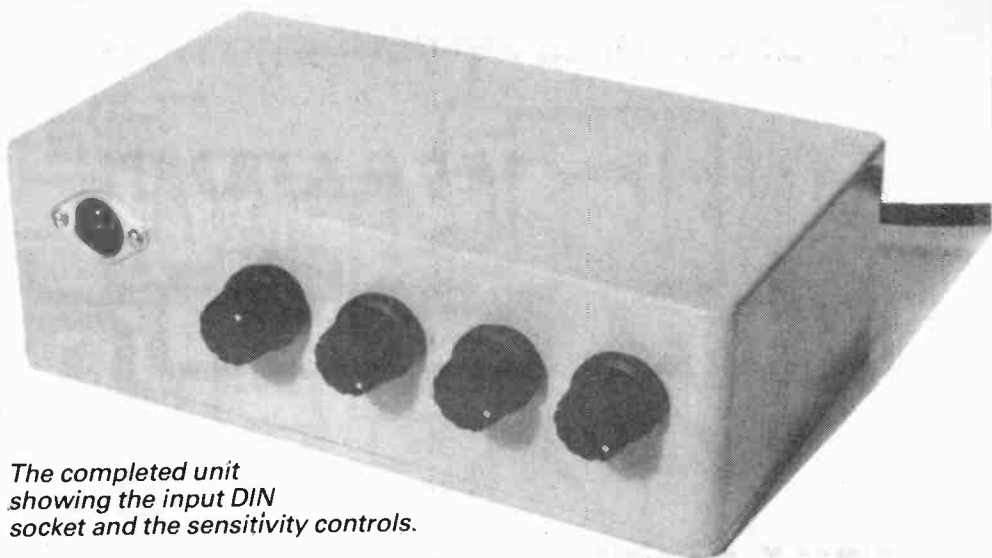
Continuous drive is supplied however whilst the triac is supposed to be "on", to ensure that it doesn't turn off through lack of "holding" current if very low wattage loads are driven. As the switching transients of phase-control cause r.f. noise, the load circuits are suppressed with choke L1 and capacitors C2 and C3 to minimise transfer of this to the mains wiring.

POWER SUPPLY

Low voltage supplies for the circuit are obtained from a transformer (T1) with two completely separate secondaries. One of these supplies the circuit containing the triacs and zero-crossing detection, which has a direct connection to one side of the mains and so offers a safety hazard.

The other secondary winding feeds the ramp generation and comparator circuits, which are connected to the inputs which will be handled by the user or connected to other equipment. The auxiliary power for driving interface boards, input signal generators etc. is also taken from this supply.

Signals between the two sections of the circuit are transferred entirely through opto-isolators, so it should be safe under all normal circumstances. A regulated 5V supply for the ramp generator is derived from IC3, a 78L05 5V 100mA positive regulator i.c.



The completed unit showing the input DIN socket and the sensitivity controls.

A note regarding the type of transformer used may be of interest. The type used in the prototype was supplied by "Maplin" and is intended for direct mounting on a printed circuit board (p.c.b.). Originally a 9V version was fitted to the prototype, the intention being that after rectification and smoothing a supply of about 11V to 12V (peak value less a bit for the rectifier) would be available.

In fact, the voltage obtained was over 15V; a check on the transformer revealed the output as being around 12V r.m.s. Accordingly it was replaced with the 6V version of the same transformer, which was found to produce 8V r.m.s. and about 10V of rectified and smoothed d.c.

CONSTRUCTION

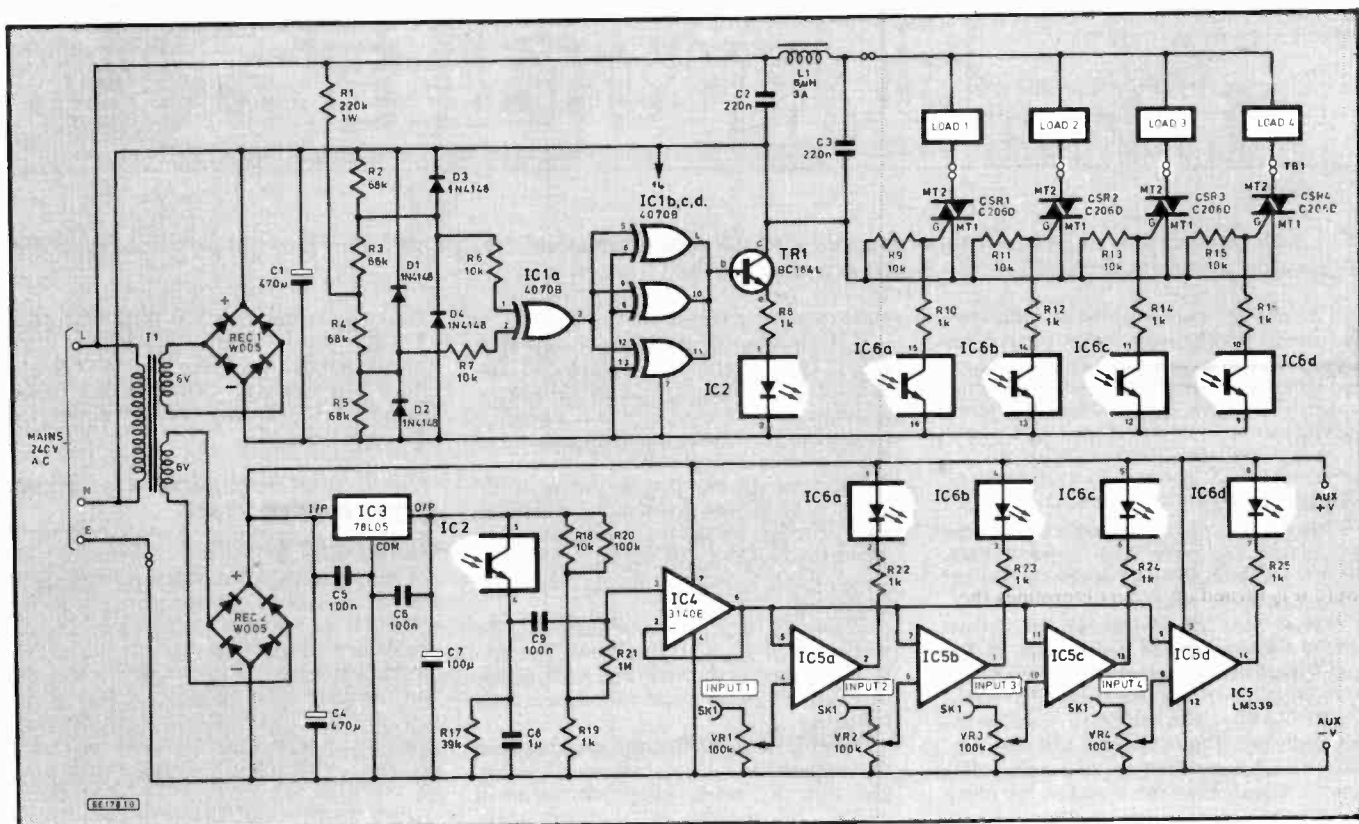
For simplicity of construction, all the components for this project are contained on a single printed circuit board. This

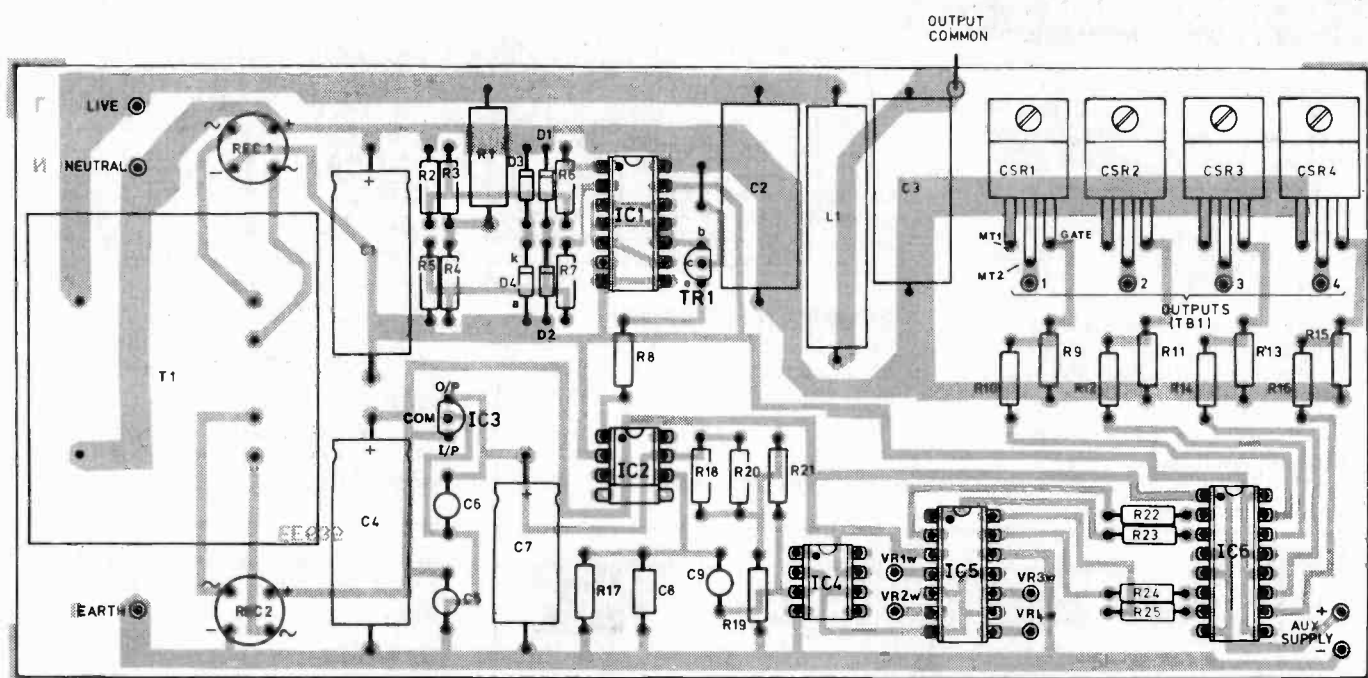
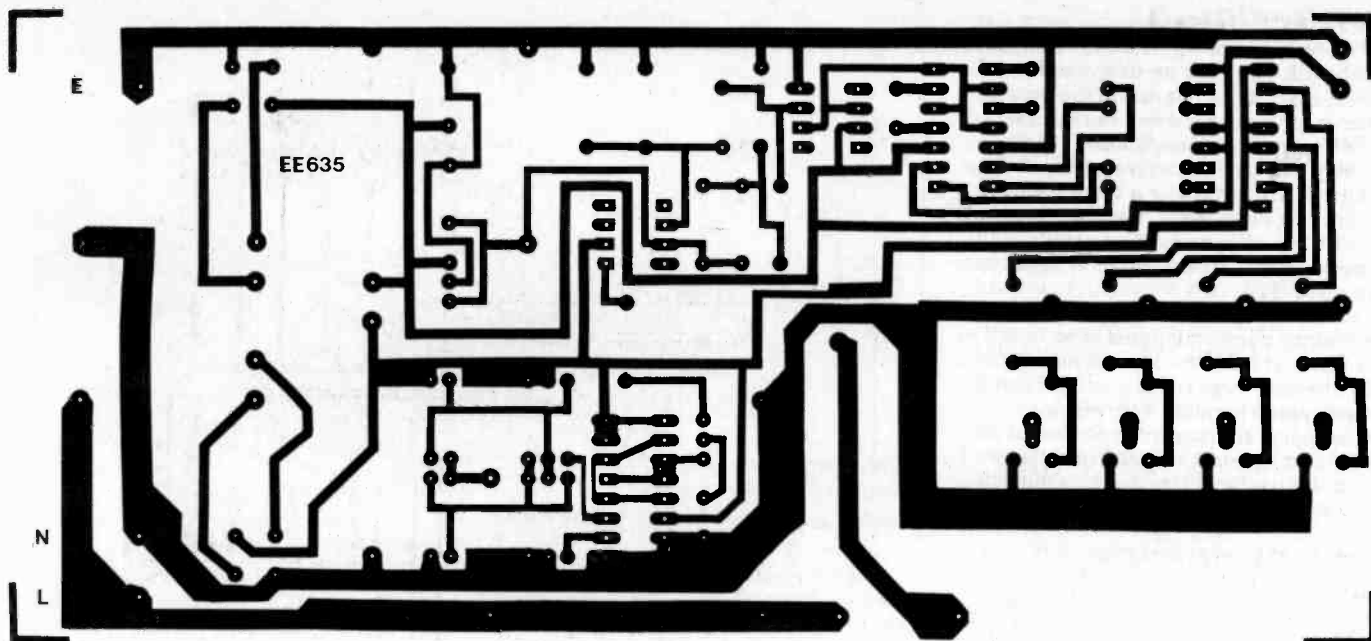
board is available through the *EE PCB Service*, code EE635. The component layout, Fig. 3, is not particularly compact, so building and testing should present no special problems.

The use of sockets for all i.c.s is recommended as, should a problem arise at any time, it does make testing much easier. Even the opto-isolators should have sockets; IC2, which is a six-pin device, is fitted in an 8-pin socket leaving the bottom two holes empty.

Under full load, the areas of p.c.b. track connecting mains Neutral to the triacs and mains Live through the filter to the load "common" may carry quite heavy current, so these should preferably be reinforced in some way. One way of thickening up these areas, which proved quite sufficient, was by heavy solder tinning, though it would be possible to solder tinned copper wire along their surfaces.

Fig. 1. Complete circuit diagram for the 4-Channel Voltage Controlled Dimmer.





EE17820

Fig. 3. Printed circuit board component layout and full size copper foil master pattern. Note the positioning of the 6-pin single opto-isolator IC2 in the 8-pin i.c. socket.

To make life easier, all the external connection points on the prototype p.c.b. were fitted with 1mm Veropins. This is strongly recommended, if only because it avoids the need to access the copper side of the board during testing.

TESTING

Although it is not possible to test the board fully due to the "live" nature of parts of it, some useful checks can be carried out before full power-up.

Please take all reasonable precautions whilst working on the board itself, as live 240V mains is present on some areas of it.

To begin with, the board can be powered up before any chips are fitted, save for the regchips are fitted, save for the regulator IC3. The two supplies, across capacitors C1 and C4, can then be checked as being around 10V, whilst the regulated supply

across capacitor C7 should be 5V.

If IC4 is now plugged in the voltage at its output (pin 6) should be about 0.5V. The voltage across capacitor C8 should be zero at this point of course, but with IC1 and IC2 plugged in (IC2 at the top of its socket, see Fig. 3) it should rise to about 4.3V.

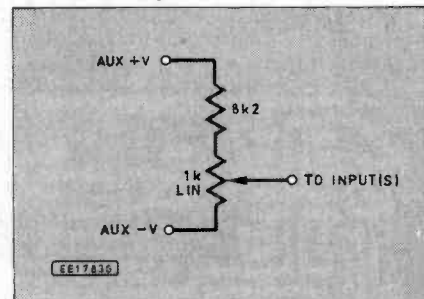
The ramp waveform at the output of IC4 can now be viewed if you have an oscilloscope. Finally, for safety the resistance between the two sides of the circuit may be checked with a meter. It should, of course, be infinity.

Following this, it's a matter of setting the whole circuit up and trying it out. The simple arrangement shown in Fig. 4 allows any or all of the inputs to be varied over their full range.

Suitable loads can be connected between the outputs and their "common" point, and with the mains supply connected it should be possible to control them

smoothly from zero to full brilliance. Unlike most dimmer switches, there should not be any sudden "on-off" effect at very low settings. Any unused inputs should be grounded, either directly or through a resistor.

Fig. 4. Input arrangement for circuit board testing.



INTERWIRING

The final connection and use of the circuit board is entirely up to the individual constructor. It can be incorporated into other equipment, used as part of a design, or boxed up as a project in its own right.

The prototype was intended mainly for use in the workshop so it was fitted into an inexpensive ABS plastic box, size 190mm x 110mm x 60mm. The inputs and auxiliary power supply were brought out through a 6-pin DIN socket SK1, and the outputs taken to a terminal block TB1 at the rear for quick, safe connection to various loads. The Earth connections are also taken to this block, where a link is fitted if internal mains earthing is desired.

The inputs are coupled to the board via 100k linear attenuator potentiometers, giving sensitivity adjustment and automatic grounding when not in use but still presenting reasonably high impedance to driving circuitry. The general layout can be seen from the photograph, whilst the interconnections and wiring are detailed in Fig. 5.

COMPONENTS

Resistors

R1	220k 1W
R2, R3, R4, R5	68k (4 off)
R6, R7, R9, R11, R13, R15, R18	10k (7 off)
R8, R10, R12, R14, R16, R19, R22, R23, R24, R25	1k (10 off)
R17	39k
R20	100k
R21	1M

All 0.6W 1% metal film, except R1

Potentiometers

VR1-VR4	100k rotary carbon, lin. (4 off)
---------	----------------------------------

Capacitors

C1, C4	470 μ axial elec. 25V (2 off)
C2, C3	0.22 μ mains suppression type (2 off)
C5, C6, C9	100n min. polyester layer (3 off)
C7	100 μ single-ended elec. 10V
C8	1 μ min. polyester layer.

Semiconductors

Rec 1, Rec 2	W005 bridge rectifier 50V 1.5A, case style B2 (2 off)
D1, D2, D3, D4	1N4148 silicon diode (4 off)
TR1	BC184L npn silicon.
CSR1, CSR2, CSR3, CSR4	C206D 400V 3A triac (4 off)
IC1	4070BE CMOS quad Exclusive-OR
IC2	Single opto-transistor isolator.
IC3	78L05 5V 100mA positive regulator
IC4	CA3140E MOSFET input op-amp
IC5	LM339 quad comparator.
IC6	Quad opto-transistor isolator.

Miscellaneous

T1	Min. mains transformer, p.c.b. mounting, 240V primary; 0-6V, 0-6V 0.5A separate secondaries.
L1	6 μ H 3A r.f. suppressor choke (Maplin, code black)
	Printed circuit board, available from <i>EE PCB Service</i> , code EE635; case, ABS plastic, 190mm x 110mm x 60mm; 6-pin DIN socket and plug; 8-pin d.i.l. socket (2 off); 14-pin d.i.l. socket (2 off); 16-pin d.i.l. socket; plastic knobs (4 off); 5-way screw-terminal block; Vero solder pins; connecting wire; solder etc.

Approx. cost
Guidance only

£31

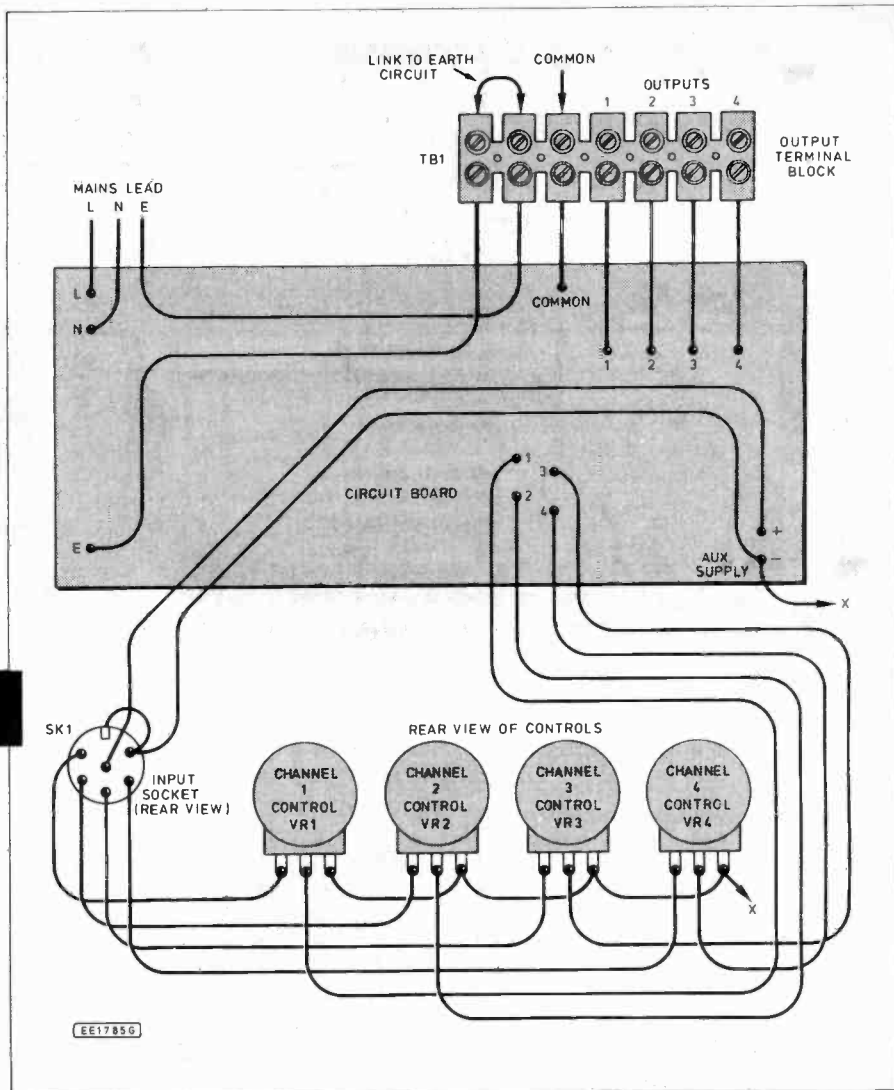


Fig. 5. Interwiring details from the p.c.b. to the input DIN socket, sensitivity controls and the "load" terminal block.

The board itself is attached to the base of the box with strips of double-sided sticky foam.

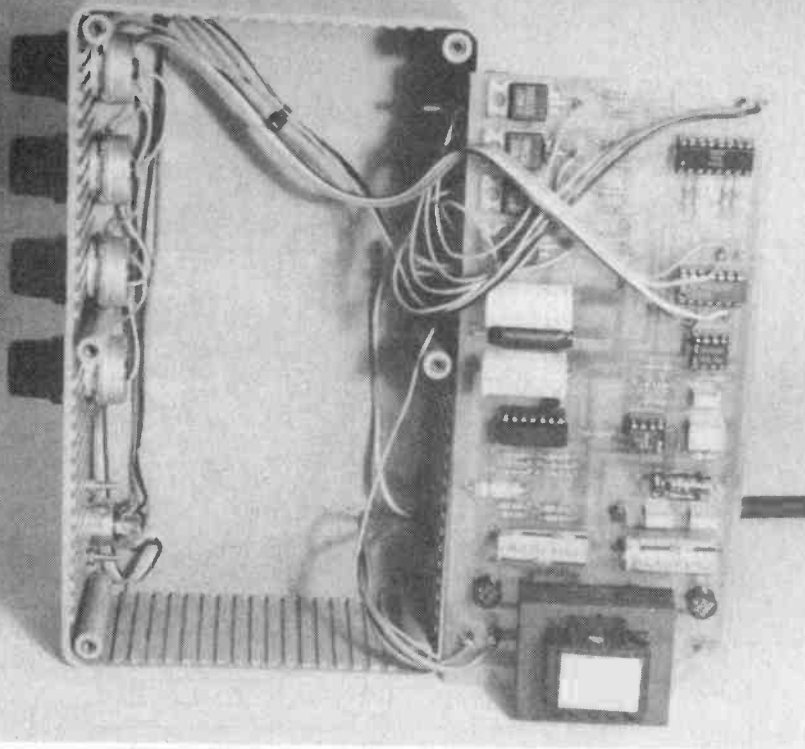
IN USE

Loads used with this project should be resistive, such as incandescent light bulbs, and should not exceed 100W. These limits are set by the current carrying ability of the printed circuit board track and the choke L1, which is rated at 3A.

It should be noted that lamps take a heavy current at switch-on as the resistance of the filament is much less when it is cold. Also, though the triacs are rated at more than 100W, if used above this they will need heatsinks.

The dimmer has four channels primarily because the comparator and opto-isolator chips are available in quad versions. The ramp signal and d.c. supplies are quite capable of supplying another four channels for anyone capable of constructing these separately.

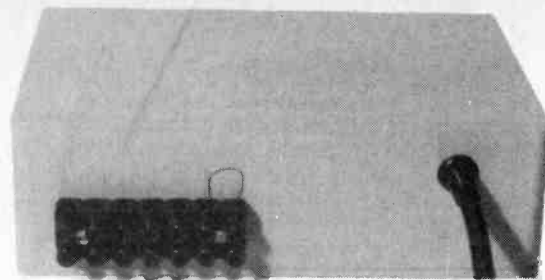
Suppression of the h.f. noise generated is quite good, better than most dimmer switches in fact, but it should be noted that some noise may still escape and affect sensitive radio or audio equipment. In particular the leads to the loads can radiate like aerials; it may be advisable in some applications to keep them short or screen them.



The finished Dimmer showing the wiring loom to the sensitivity controls and the mains transformer mounted directly on the circuit board.

Uses for this project are obviously limited only by imagination. Almost any signal may be converted into a 0 to 1-volt output. Sound is the obvious, and a wide variety of "disco" effects can be easily produced to liven up parties. Colourful advertising displays could also be built with it.

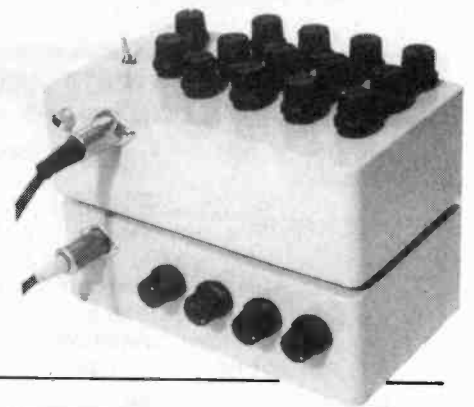
Various signal patterns can be produced by generator circuits, even a lamp that just fades slowly up and down can be astonishingly effective. With four channels, the fading could apply to four colours, making a "lamp" that gradually changes colour and intensity.



Rear of the unit showing the screw terminal block and the Earth link.

The control signals could be generated by a computer, allowing the effects to be easily changed or altered from software. For the really adventurous of course, there is a bio-feedback for which an excellent display could be made, though battery power and an extra safety isolator link is to be recommended for this.

Next month details will be given of a Four-Channel Sound-to-Light Interface and a Simple Auto-Fader, capable of a variety of interesting and attractive effects.



CONQUERING NEW HEIGHTS

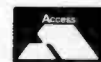


- ★ Component Comparator
- ★ Variable Hold Off
- ★ Triple DC Source
- ★ DC - 25 MHz
- ★ 40ns/div
- ★ 2mV/div
- ★ Low Cost

Full 2 Year Warranty

£319*

To scale the heights, just call us for your FREE copy of our catalogue

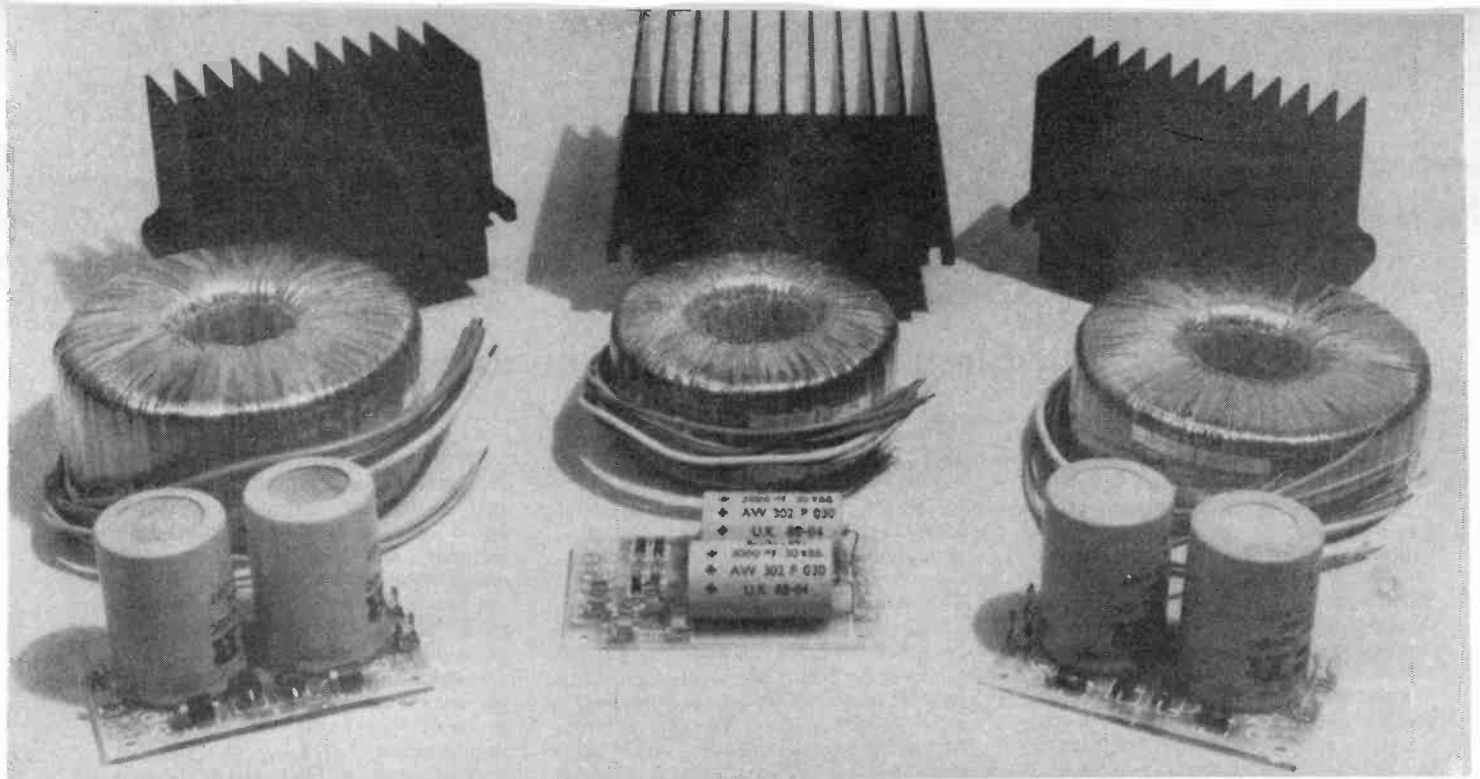


*(Ex VAT & Delivery)

Yes its 25MHz for £319

Crotech Instruments Limited

2 Stephenson Road, St. Ives, Huntingdon, Cambs. PE17 4WJ
Telephone: (0480) 301818



SPECIAL OFFER

We are pleased to be able to arrange this EE Special Offer with Jaytee – probably the most comprehensive audio offer we have ever published! Jaytee Electronic Services are the sole UK distributors for the range of audio products manufactured by ILP Electronics Ltd.

A range of modular kits is offered at substantial discounts to build mono or stereo power amplifiers of 60, 120 or 180 watts with the option of 4 or 8 ohm output impedance.

THE unique encapsulated ILP modules require a maximum of 500mV audio input to give maximum output power. The power supplies consist of a toroidal transformer and a d.c. supply board (for rectification and smoothing). Construction is straightforward as the amplifier modules are supplied fully assembled and tested. All that is required is to provide case and connectors and wire-up the necessary input/outputs and interconnections.

Also on offer, when an amplifier kit is ordered, are the HY6 (mono) or HY66 (stereo) pre-amplifiers. These are suitable for a variety of inputs to drive the power amplifier stage and can be run from the same p.s.u.

Full data and information is provided with each kit.

Payment should be by cheque (made payable to Jaytee Electronic Services) or credit card (Access or Visa).

Send payment together with the coupon to EE Audio Offer, Jaytee Electronic Services, 143 Reculver Rd., Herne Bay, Kent CT6 6PL. Tel 0227 375254.

Offer closes Friday March 31, 1989

ORDER CODE	DESCRIPTION	PRICE	
		STANDARD	OFFER
KIT124	60 watt mono (4 ohm) (HY124 & PSU412)	£38.95	£33.75
KIT124S	60 watt stereo (4 ohm) (2 off HY124 & PSU522)	£62.15	£54.00
KIT128	60 watt mono (8 ohm) (HY128 & PSU422)	£41.10	£35.75
KIT128S	60 watt stereo (8 ohm) (2 off HY128 & PSU512)	£62.15	£54.00
KIT244	120 watt mono (4 ohm) (HY244 & PSU512)	£49.30	£42.75
KIT244S	120 watt stereo (4 ohm) (2 off HY244 & PSU712)	£78.55	£68.25
KIT248	120 watt mono (8 ohm) (HY248 & PSU542)	£50.30	£43.75
KIT248S	120 watt stereo (8 ohm) (2 off HY248 & PSU722)	£79.55	£69.25
KIT364	180 watt mono (4 ohm) (HY364 & PSU732)	£68.80	£59.75
KIT368	180 watt mono (8 ohm) (HY368 & PSU742)	£70.85	£61.50

Everyday Electronics, February 1989

P-AMP	Mono pre-amplifier (HY6 & B6)	£10.40	£8.45
P-AMP/S	stereo pre-amplifier (HY66 & B66)	£16.75	£13.95

Please note that the pre-amplifiers are only available at offer price if ordered with an amplifier kit.

ALL PRICES INCLUDE VAT, POST & PACKING (UK ONLY)
Sorry this offer is not available to overseas readers.

Quantity	Please Supply Order Code	Value (£'s)

TOTAL VALUE £

Please make cheques payable to Jaytee Electronic Services.

Please charge by Access/Visa card (Ex. date)

No.

Signature

Name

Address

OFFER CLOSES FRIDAY MARCH 31, 1989
UK READERS ONLY

BLOCK CAPS PLEASE

b...Beeb...Beeb...Beeb...Beeb

... Harmonic Locking Circuit ... Phase locked loop i.c. 74HC4046 ...

IN LAST month's *Beeb Micro* article we considered the subject of using the BBC micro as an audio frequency signal generator. We also looked at the subject of harmonic locking, in the context of using it to boost the output frequency range of the VIA timer/counters by a factor of ten. The theory of harmonic locking was discussed last month, but no practical circuit was provided.

This situation is remedied this month by Fig. 1, which is a simple harmonic locking circuit based on the CMOS 4046BE "micro power" phase locked loop. In fact the circuit uses the 74HC4046, which is the high speed CMOS version of the device. This seems better able to handle the higher output frequencies which the standard 4046BE did not seem to be able to reach reliably.

Circuit Operation

Resistor R1 and capacitor C2 are the timing components for the v.c.o. section of IC2. The specified values permit operation to beyond 1MHz, but might not permit the full 2.5MHz theoretical maximum output frequency to be achieved.

This does not necessarily matter, as the circuit is primarily intended as a clock generator for the MF10CN switched capacitor filter (see last month). This is only guaranteed to operate at clock frequencies of up to 1MHz (but it will typically operate at frequencies of up to 1.5MHz). It is advisable to have C2 no higher in value than is really necessary as this might compromise low frequency performance.

The 74HC4046 has two phase comparators, and in this case it is phase comparator two that is utilized. The difference between the two phase comparators is basically that comparator one is of the usual type, where under standby conditions the v.c.o. is taken to its centre frequency. Phase comparator two has a more unusual method of operation, whereby under standby conditions the v.c.o. sweeps down to a very low frequency and eventually cuts off altogether.

Coupled with the very wide operating frequency range of the v.c.o., this second mode of operation allows a very wide lock-in range to be provided. A frequency span of 100 to 1 is easily accommodated, and pushing the device to its limits it seems to be possible to exceed a 1000 to 1 range.

However, when using any 4046 series device over a very wide frequency range it has to be borne in mind that the charge/discharge current of the v.c.o. at very low frequencies is minuscule. The practical consequence of this is that the device is very vulnerable to any stray pick up of electrical noise, and it should be kept away from any obvious source of such noise. In the present context this means keeping the device away from the immediate vicinity of the BBC computer, and the circuit should prefer-

ably be contained in an earthed metal case to provide screening.

The lowpass filter is comprised of R2, R3, and C3. The very high input impedance of IC2's v.c.o. simplifies the lowpass filter design, and a basic single pole RC filter will normally suffice.

This is essentially what is used in this case, but R3 has been added in order to minimise problems with over-shoot. Without this resistor there is a tendency for the v.c.o. to waver either side of the correct frequency rather than locking onto it properly. This resistor is not normally required, but seems to be essential when the 4046 is used over a wide frequency range.

At the lower end of the output frequency range there is a reduction in the coverage. In theory a minimum clock frequency of about 76Hz can be achieved, but the v.c.o. might not actually operate this low in frequency in practice. This is not particularly important as it would provide an audio output frequency well below the lower limit of the audio frequency range (which is 20Hz). The circuit should operate properly at frequencies down to about 20Hz, and it will probably be capable of achieving output frequencies substantially lower than this.

Apart from enabling output frequencies to be set with good accuracy without the need for any calibration, another advan-

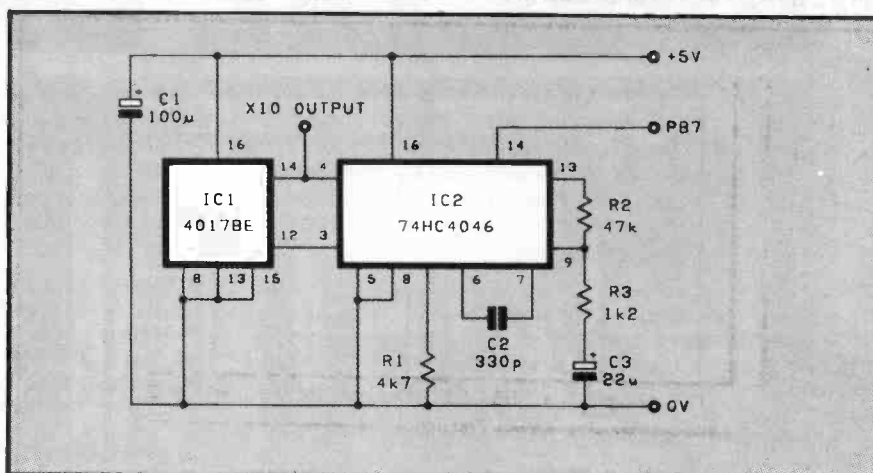


Fig. 1. Simple Harmonic Locking circuit

IC1 is a CMOS 4017BE one of ten decoder. In this case it is only the "carry out" output (pin 12) that is used, and it operates as a straightforward divide by ten counter. It connects between the output of the v.c.o. and the input of the phase comparators, so that the required harmonic locking is obtained, with the v.c.o. providing an output at ten times the input frequency.

A.F. Generator

When used in conjunction with the Digital Sinewave Oscillator described in last month's article this unit provides a more useful range of output frequencies. As pointed out earlier, the MF10CN is only guaranteed to operate at clock frequencies of up to 1MHz. An output at this frequency can be achieved using a timer 1 value of 0 for high byte and 3 for the low byte (giving a 100kHz output on PB7).

This provides an output frequency from the sinewave generator of 20kHz in the 1:50 mode, or 10kHz in the 1:100 mode. This permits the upper limit of the audio frequency range to be reached, which is something that is impossible without the aid of the harmonic locking circuit. It also gives more output frequencies at the upper end of the audio range.

One of the advantages of this approach to audio signal generation is that it provides opportunities for producing automatic test equipment. You can do such things as outputting a series of frequencies, using the analogue port to monitor the output level from the circuit under test, and then have the computer draw up a frequency response graph from the results.

There are also possibilities for using the MF10CN as a sweep filter to give a simple spectrum analyser action. However, for the moment we will not consider these ideas in any more detail, but will first go on to a second method of generating sinewaves from timer 1's squarewave output.

Filtered Waves

Probably many readers will already be familiar with "Fourier Analysis". For those who are new to the concept, it should perhaps be explained that all signals, however complex, are effectively a number of sinewave signals. The exception is the sinewave itself.

As explained in last month's article, a sinewave has the all important feature of containing just a single frequency, and can clearly not be broken down into more than one constituent sinewave. By analysing the

frequency content of a signal, and then recreating it using a number of sinewave signals having the correct phase and amplitude relationships, any signal can be synthesised.

With non-repetitive signals their spectra tend to be quite complex in that they change significantly from one instant to the next. Repetitive waveforms are relatively simple, and their spectra are constant. In the case of a squarewave signal it has the fundamental plus odd order harmonics (Fig. 2). In other words, the fundamental signal plus components at three times, five times, seven times, etc. the fundamental frequency.

Each successive harmonic is a little weaker than the one beneath it, but in theory the harmonics stretch to infinity. In reality it is the switching speed of the device generating the signal that determines just how far into the spectrum the harmonics extend.

Synthesis

The conventional method of sound synthesis (known as "subtractive" synthesis) is to start with a signal having the required harmonics in abundance, and to then use filtering to trim them back to the

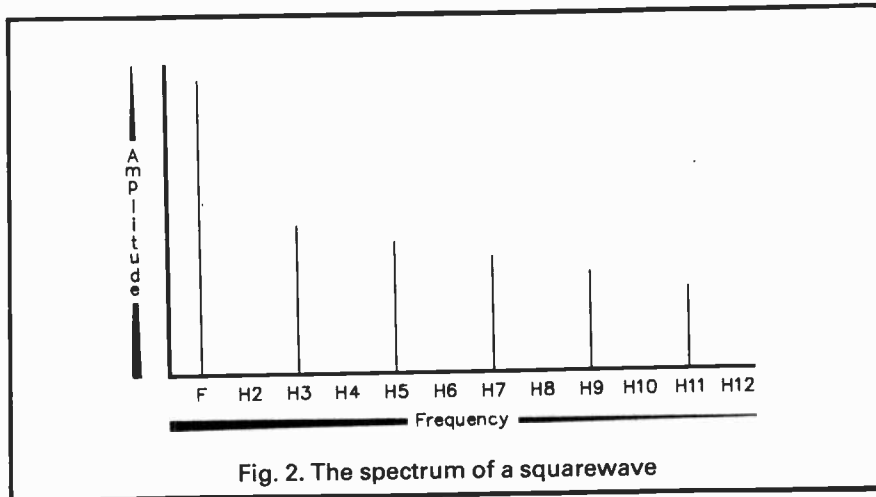


Fig. 2. The spectrum of a squarewave

required levels so that the desired wave shape is obtained. We can use what is essentially the same method in order to turn a squarewave into a reasonably pure sinewave.

It is just a matter of using lowpass filtering to attenuate the harmonics with respect to the fundamental signal. Attenuating the higher frequency harmonics is not too difficult, as they are many octaves above the fundamental frequency, and are relatively weak anyway.

The main problem is the lowest of the harmonics, which is just three times the fundamental frequency and quite strong. With it one and a half octaves above the fundamental frequency, a 24dB per octave filter would give some 36dB of attenuation. Bearing in mind that the third harmonic is somewhat lower in level than the fundamental anyway, this gives a distortion level of about one per cent.

We have ignored the other harmonics which will obviously contribute some distortion to the output signal. Also, the filter circuit might add significantly to the distortion level. However, even with one to two per cent distortion, this still gives an adequate level of performance for most frequency response testing and other audio checks.

Keeping Track

Although filtering seems like a very simple method of converting a squarewave into a reasonable sinewave signal, there is a very big problem to overcome. Matters are easy enough when a single frequency is involved, but things are much more difficult if a wide range of frequencies has to be accommodated.

A filter having a fixed frequency is then inadequate, as the degree of filtering would depend on the input frequency. Setting a filter frequency that would suit the lowest input frequency would ensure that a sinewave output was produced at other frequencies, but the output level would be far from constant.

Assuming the use of a 24dB per octave filter, stepping up the input frequency by a factor of ten would result in the output level reducing by a factor of more than ten!

In order to give usable results it is necessary to use some form of tracking filter. In other words, a filter where the cutoff frequency varies in sympathy with the input frequency. Provided the amplitude of the input signal remains constant, and the filter tracks accurately, the output level will remain constant.

There are several types of tracking filter, and a common approach to the problem is

shows the general make up of such a system. This is a rather unconventional approach to the problem, but one which I prefer for the current application.

V.C.F.s

There is a series of four v.c.f.s (voltage controlled filters), and with each one giving a 6dB per octave roll-off this gives the required overall attenuation rate of 24dB per octave. A buffer amplifier at the output of the circuit ensures that there is a low output impedance, and that there are no problems with loading on the final filter stage. The control voltage for the filters is obtained by rectifying and smoothing the output of the circuit, and then feeding this signal to a d.c. amplifier.

If, for the moment, we consider the v.c.f.s as a v.c.a. (voltage controlled amplifier) instead, this gives what is really just a standard audio a.g.c. system. The gain of the amplifier is normally quite high, but in the presence of a strong output signal a large d.c. control voltage is generated.

The trick here is to have the d.c. amplifier provide an inverting action. A strong output signal then generates a large positive output signal at the smoothing circuit, which is converted to a strong negative change in voltage by the d.c. amplifier. This reduces the gain of the v.c.a., and reduces the output level. A standard negative feedback action tends to stabilise the output at a certain level.

This circuit operates in much the same way, since the v.c.f.s provide an action which is not, in certain respects, dissimilar to a v.c.a. With a high control voltage there is a high cutoff frequency, and no attenuation of the input signal. With a low control voltage there is a very low cutoff frequency, and unless the input signal is at a very low frequency it will be substantially attenuated. Therefore, provided the circuit is designed to provide a suitably low output level and the input frequency is not made too low, a negative feedback action will stabilise the output level.

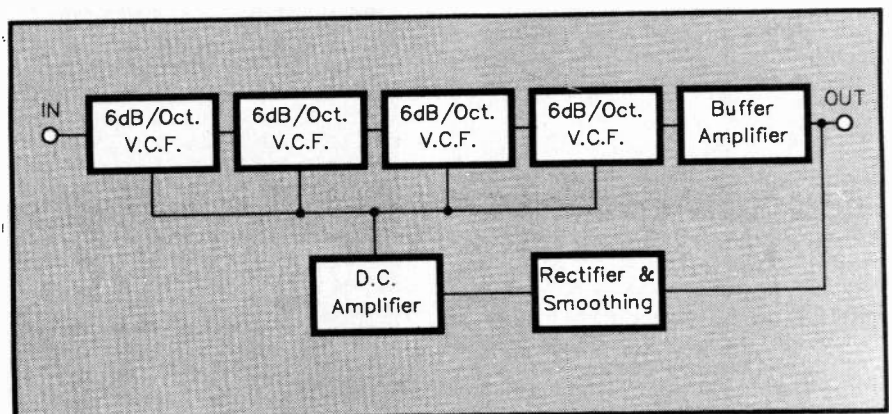
The point to note here is that the circuit is keeping the output signal at this low level by heavily filtering it. As the input frequency is raised and lowered, the feedback increases and decreases the filter's cutoff frequency in order to maintain an almost constant output level. This gives just the action we require, with the filtering giving the square to sinewave conversion, and the feedback maintaining an almost constant output level.

In next month's article a suitable filter circuit based on operational transconductance amplifiers will be described.

to use a phase locked loop and a switched capacitor filter. There would seem to be little point in adopting this approach in the current context, since it would seem to be easier to use the filter as a digital oscillator, as in the design described previously.

A simple but effective method is to use a voltage controlled filter in a what is essentially a form of a.g.c. (automatic gain control) circuit. The block diagram of Fig. 3

Fig. 3. Block diagram for a tracking filter





a regular feature for the Spectrum Owner...

by Mike Tooley BA

WITH Christmas 1988 now just a happy memory and with New Year's resolutions firmly in mind, we shall take this opportunity to catch up with the backlog of queries received from readers. We also have a review of the versatile *Interspec* interface system which is available from DCP Microdevelopments.

We begin, however, with details of a simple device which could well be instrumental in eliminating many hours of frustration for cassette tape users.

SAVE/LOAD Accessory

Kenneth Murray-Taylor writes from Redruth, Cornwall, with details of a workstation which he has developed for the Spectrum. Part of this set-up involves an improved cassette tape interface.

Kenneth writes:

"For the last couple of years I have been using a cassette interface which obviates the need to mess with the plugs between LOAD and SAVE. This interface plugs into the DIN socket on the recorder (instead of the jack sockets) and works because there is a switch in the recorder that turns off the output at the DIN socket during record. The reason it does this is to stop feedback when recording from another recorder.

Unfortunately it is not quite as simple as that; the output level from the DIN socket is too low for the Spectrum so an amplifier is required to boost the signal to an acceptable level (a gain of about five is required)."

Kenneth's LOAD/SAVE amplifier is housed in a plastic box (measuring 75mm x 50mm x 25mm) and includes a reset switch which is fitted in-line with the positive supply. The circuit (Fig. 1) should not be too critical of minor variations in components and almost any npn small signal transistor would be used in place of the BC108 specified.

The gain of the unit can be easily modified by adjusting the value of resistor R4. Readers may wish to substitute a 220 ohm skeleton pre-set resistor in place of R4, in which case the stage gain will be variable from about two (maximum resistance setting) to about 100 (depending upon the current gain of the transistor used).

Three connections are made to the rear of the Spectrum (two miniature jacks for MIC and EAR plus the power connector) whilst a single connection is made to the cassette recorder (via a lead fitted with a three-pin 180 degree DIN plug). Circuit construction is very straightforward and a matrix board layout is available in the current *On Spec Update*.

Agony Column

A. Combes from Burgess Hill writes to ask if there is any way of getting round the infamous Lenslok software production which several software houses seem so fond of. This topic has been discussed at some length in the popular computer press and it would appear that many people find it far from satisfactory.

My own way round the problem is simply that of making "snapshot" files of my software using an MGT plus-D interface. However, several other interfaces with "magic buttons" or "snapshot" facilities will work just as well.

Simply load the offending software, enter the Lenslok code and wait until the opening screen is displayed before taking the snapshot. Thereafter, the program can be reloaded from tape or disk and it will restart from the point at which it was left (i.e. after the Lenslok procedure). I have used this technique successfully with all of the lens protected software in my possession and I can thoroughly recommend the purchase of an interface with backup or snapshot facilities for this purpose alone!

D. Hudley has asked me to recommend an I/O port for the Spectrum 128. There are several to choose from but the most versatile system is that available from DCP Microelectronics (reviewed in this issue).

The Interspec (a dedicated Spectrum I/O port also from DCP) provides eight digital (TTL compatible) inputs, eight analogue inputs, and eight TTL outputs. In addition, the Interspec has four relay switched outputs (for high currents) and four switch inputs and thus should provide nearly all of the facilities one should require of an I/O port with the exception of analogue output!

Harold Lunson of East Sussex has written to ask whether we have ever published details of a home constructed disk interface in a past instalment of *On Spec*. This is a regular query raised by readers and, apart from several reviews of proprietary Spectrum disk interfaces, I must confess that we have not tackled this subject.

The hardware aspects of a disk interface would not prove to be too problematic however the task of developing an effective operating system would be daunting for all but a few of our readers. The only solution would be that of supplying the required disk operating system software in EPROM (it would not be feasible to publish it in EE and then expect readers to key it in!)

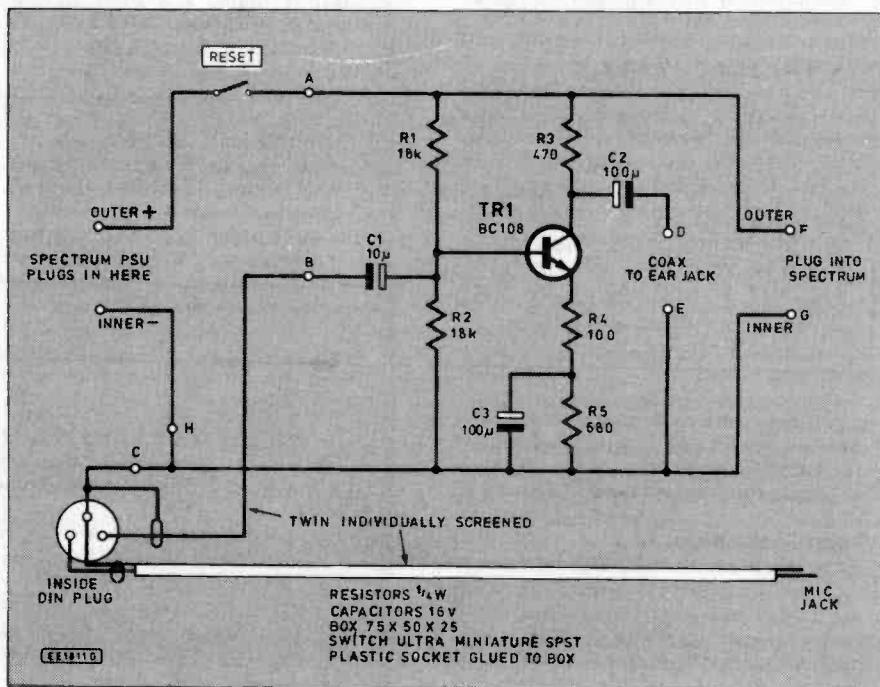
Having said all that, April's *On Spec* will contain information for readers who wish to add a budget-priced disk drive to the Spectrum. This project will be based on a proprietary disk interface (complete with disk operating system software) but will include details of interface and power supply wiring as well as recommending a source of inexpensive disk drives. The total cost of adding a disk system (including the ready-built disk interface) will be less than £100.

Mr S. Davies writes from Oswestry with two queries, the first of which concerns the *Rotronics* Wafadrive. Mr Davies wishes to perform a screen dump, via the parallel interface on the Wafadrive unit, but the Spectrum's resident COPY command does not appear to work.

The second problem is that of upgrading the Spectrum's keyboard. Readers will doubtless recall that there were at least half a dozen suppliers of keyboard upgrade kits in existence several years ago but advertisements for this type of accessory seem to have completely disappeared from the popular computing press! If anyone can suggest either a source for Wafadrive screen dump software or provide details of a source of keyboard upgrades, please let me know so that I can pass on the information to Mr Davies.

Finally, a reader in Ardrossan wishes to interface his Spectrum to a TV receiver with Teletext. The aim is that of printing

Fig. 1. Suggested cassette tape interface circuit from Kenneth Murray-Taylor.



INTERPACK 1

THE *Interpack 1* from DCP Microdevelopments follows on from two well established products from the same company; the *Interspec* and *Interbeeb*. *Interpack*, however, is something of a new concept—a versatile interface card which accepts a range of customised “personality modules”. It thus provides the same range of facilities as its popular predecessors but has the added advantage that it can easily be configured to work with other systems.

In the case of the Spectrum, the required personality module is known as the *ZX Inter-card*. This card is fitted with a 23-way double-sided open-ended edge connector (which mates with the expansion bus connector at the rear of the Spectrum) and a 20-way 0.1in pitch connector which mates with the *Interpack 1*. The *Inter-card* fits neatly into a notch in the *Interpack* p.c.b. and the entire assembly is housed in a black plastic enclosure.

The *Interpack* printed circuit board (including *Inter-card* personality module) measures approximately 130mm×84mm. The board contains ten integrated circuits together with a handful of transistors and other components.

The largest i.c. (a 28-pin d.i.l. device) is fitted into a low-profile d.i.l. socket whilst the remaining devices are soldered into the double-sided p.c.b. Inputs and outputs are terminated using either 10-way 0.1in pitch Molex connectors (TTL I/O) or 0.2in. colour-coded plugs and sockets (relays, switches, and analogue inputs).

The board is very neatly arranged and the connectors are sensibly laid out and clearly labelled. This, together with a clear and understandable manual, is an important consideration with a unit which has educational use and the *Interpack* scores very highly on this account!

SPECIFICATIONS

The *Interpack* provides a range of I/O capability including eight digital (TTL compatible) I/O lines; eight analogue inputs (2.5V full-scale input); four relay outputs (suitable for loads rated at 24V 1A maximum), and four switch inputs (pulled low so that a switch closure will generate a logical 1 on the appropriate data line).

The eight-channel analogue to digital converter (ADC) is based on the National Semiconductor ADC0809 and this device offers a conversion time of less than 10ms. A precision voltage reference (ZN404) is used to provide the analogue reference voltage and thus accuracy and temperature stability are both of a very high order.

Interpack 1 uses five of the Spectrum's I/O port addresses and these are allocated on the following basis:

Port designation	Port address (decimal)	Port function	Number of lines
A	31	Analogue inputs	8
B	63	Relay outputs	4
C	95	TTL I/O	8
D	127	(available for expansion)	
E	159	(available for expansion)	

EXPANSION

Where further I/O capability is required, the *Interpack* may be expanded with the aid of one or more additional modules. These modules are connected to the *Interpack* by means of the *DCB Bus* and include a digital to analogue converter, a fast (1 μ s) digital analogue converter, a fast (10 μ s) analogue to digital converter, and a board which allows up to two ADC and two DAC packs to be simultaneously present on the DCP bus.

Software control of these additional modules relies on the same techniques as those used in conjunction with the basic *Interpack* and address decoding details are fully described in the handbook supplied. Users may also wish to add their own external hardware (for control via the *Interpack*). This is a relatively simple process but will require users to have some digital design experience in order to ensure that circuits will operate correctly.

Since add-on modules derive their power from the DCP Bus (which, in turn, takes its power from the host computer) there is a limit to the number of interface packs that can be present. The basic system will supply a maximum of one *Inter-card* and *Interpack* plus two additional accessories.

Where this limit will be exceeded, a *Powerbus* pack will be required. All data and control lines are extended through the *Powerbus* but the +5V and +9V supply rails are isolated and the *Powerbus* supply (rated at 500mA maximum) is fed to any further packs present on the bus.

ON TEST

I put the *Interpack* on test with my faithful Spectrum Plus and MGT Plus-D disk interface. With the aid of a few lines of BASIC, each port was checked and then a short program was devised in order to make the system function as a low-frequency (analogue input) oscilloscope with the sweep controlled by switches connected to two of the digital input lines. The whole system performed admirably and the program was

later modified and extended so that captured data for each sweep was stored in a disk file (thus allowing later analysis).

The 26-page *Interpack* handbook describes the operation of the system as a whole before providing details of each port in turn (including outlining basic techniques for interfacing common transducers such as photo-sensitive resistors, light emitting diodes, lamps, switches and motors). The handbook also makes reference to a stepper motor interface but does not supply complete circuit information. In any event, users will almost certainly find that they need to make reference to one, or more, texts on transducers and interfacing in order to cope with anything other than the most elementary of applications.

In conclusion, I can thoroughly recommend the *Interpack* system from DCP; it is well thought out, performs extremely well, and is very reasonably priced. The interface is easily expandable and, what's more, can be readily configured for operation with other popular home computers.

DCP Microdevelopments are at Dept EE, 2 Station Close, Lingwood, Norwich, Norfolk, NR13 4AX ☎ Norwich (0603) 712482.

(Important Note: DCP still have a limited stock of the original *Interspec* and these may be available at a special price to EE readers—call or write to DCP for details!)

pages using an Epson printer and storing them on floppy disk via an MGT plus-D interface. If anyone can provide any information on this topic please get in touch!

Four Years On . . .

On Spec celebrates its fourth anniversary with this issue of *Everyday Electronics*. Those of you who have been with us since 1984 will recall that the original aim of this column was that of providing a forum for those wishing to interface the Spectrum to

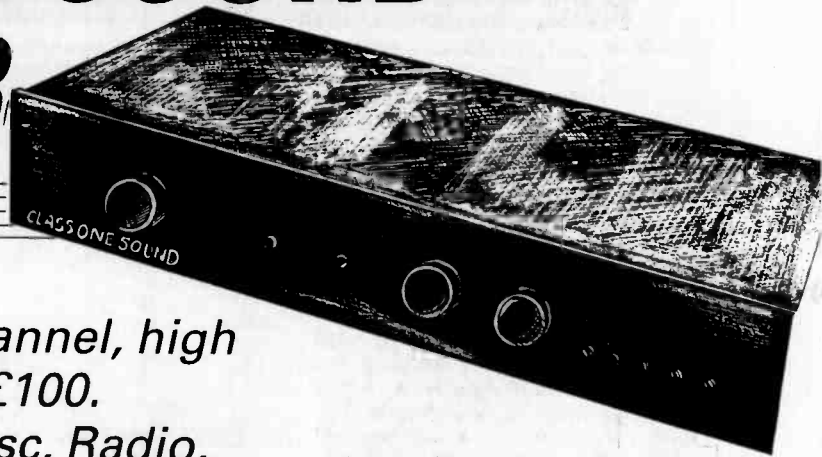
“real world” applications. More than 25 practical projects and interface circuits have appeared in *On Spec* since then and we hope that most of you have found time to try at least some of them.

Over the years, it has been heartening to receive so many letters from regular readers. To all of you, I extend my thanks and good wishes for your help and support; here's hoping that you will find something of interest in future instalments of *On Spec* just as you have in the past!

Next Month: We shall show how a budget-priced composite monochrome monitor can be easily connected to a Spectrum (of any vintage!). In the meantime, if you would like a copy of our “*On Spec Update*”, please drop me a line enclosing a large (250mm×300mm) adequately (i.e. 42p for UK postage) stamped addressed envelope. Mike Tooley, Department of Technology, Brooklands Technical College, Heath Road, Weybridge, Surrey, KT13 8TT.

CLASS ONE SOUND AMPLIFIER

GRAHAM NALTY



A single board, 20W per channel, high quality amplifier for under £100. Inputs for Disc, Compact Disc, Radio, Video and Tape.

LAST month we discussed the problems associated with amplifier design and looked at the circuit stages in detail. This month we conclude by setting out the construction procedure and final testing.

EARTHING

In audio amplifiers the earthing circuits are a very important part of the design. Ideally, every single earth return should be taken separately to a central "star" earth. In practice, some grouping is permissible, but poor earthing techniques in an amplifier will result in hum, instability and degradation of the sound. In this amplifier, all the earth returns have been looked at in far more detail than I can write about here, and the result can be seen in the way in which they have been connected in the printed circuit board (p.c.b.) layout.

If the amplifier is built in modular form,

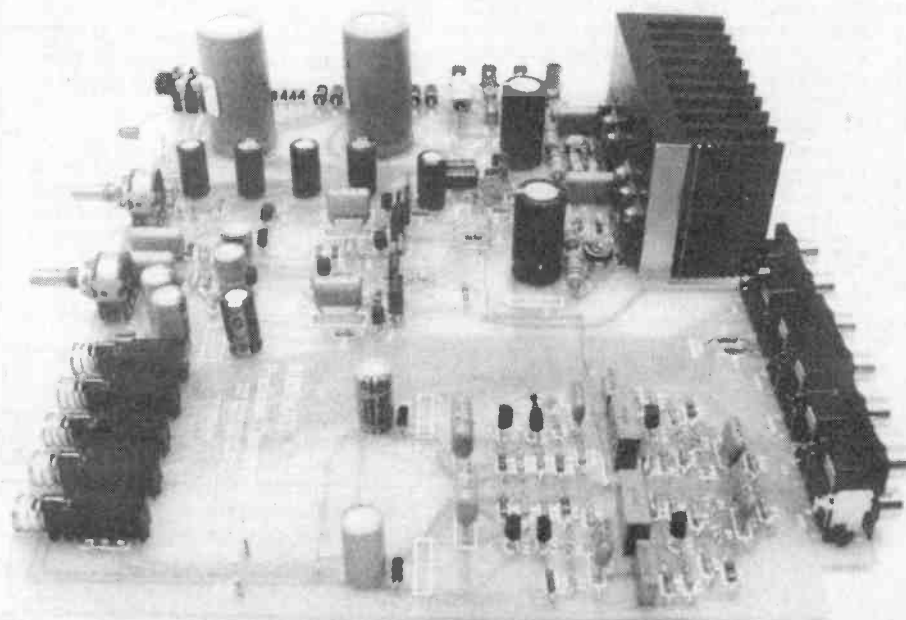
special earthing techniques will need to be applied. These can be covered separately if the demand exists for separate boards to build the amplifier in a modular form.

BUILDING THE AMPLIFIER

The printed circuit board component layout for the *DM20 Class One Sound Amplifier* is shown in Fig. 10. Being of single board construction and as you can see from the tinted areas the copper tracking is quite complex, we would not recommend constructors attempt making their own boards.

Due to the extra closeness of some of the copper tracking and the physical size of the board, we have not attempted to reproduce the usual full size master pattern. Instead, we would recommend that any would be constructors purchase a ready-made p.c.b. from Audiokits.

The completed circuit board ready for installation in its metal case.



A great deal of thought has gone into making the amplifier easy to build and test. But there are easier ways to build it and you will find things easier if you follow this construction order:

1. Insert and solder all p.c.b. pins.
2. All diodes except D16 (l.e.d.).
3. All 1/4 watt metal film resistors.
4. Insert all wire links using resistor lead offcuts, except for L1 and L10 which should be made from tinned copper wire.
5. All polystyrene capacitors.
6. Attach heat sink to p.c.b. using 6BA by 3/8 inch bolts and insulating washers.
7. Slot TR10-TR12, TR110-TR112 into the board and line up the holes in the tabs with the threaded holes in the heatsink.
8. Attach the transistors to the heat-sink using a 6BA by 3/8 inch bolt, 6BA washer and nylon bush, after placing a thermally conducting electrically insulating washer between transistor and heatsink.
9. Attach VR1, VR101, C22, C116, C122 to p.c.b.
10. Attach R27, R28, R127, R128 to p.c.b.
11. Attach all remaining semiconductors including D16.
12. Attach all polyester capacitors (NB, C7, C18, C20, C23, C107, C118, C120, C123 are optional).
13. Attach all 1/4 inch blade connectors, fuse and remaining resistors.
14. Attach all electrolytic capacitors.
15. Make certain that each and every electrolytic is connected in the right polarity. Check a second time because a wrongly connected capacitor can be damaged when the power is connected.
16. Attach phono sockets, switches, potentiometers and headphone socket.

Now the board is complete, set VR1 and VR101 fully clockwise and remove fuses FS1 and FS101.

CASE

Next assemble the case, leaving the rear panel off, and attach the mains transformer and all the parts shown in Fig. 11. The

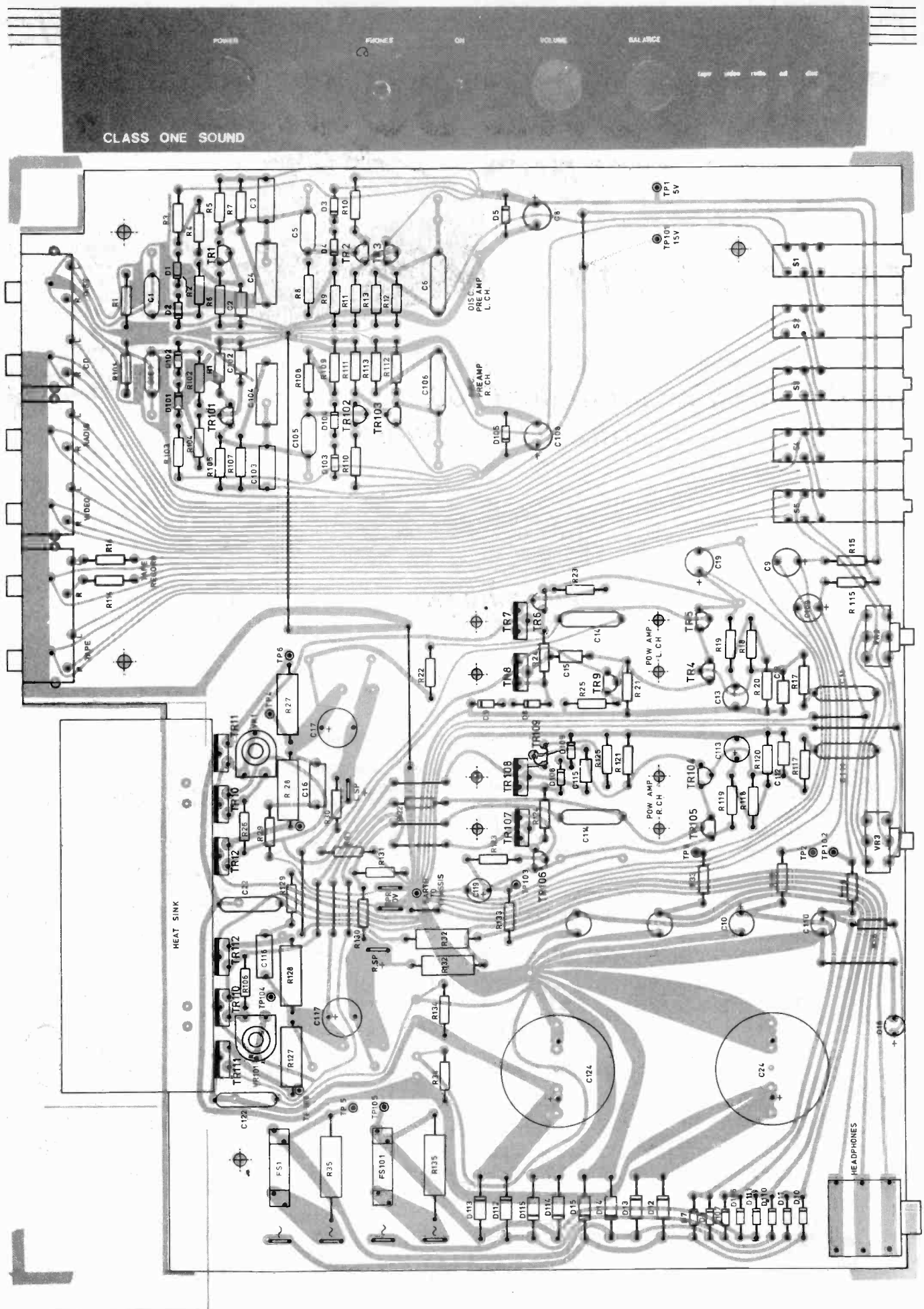


Fig. 10. Printed circuit board component layout for the Class One Amplifier. This board measures approximately 270mm×215mm and is NOT shown full size. The front panel layout and lettering is shown in the photograph above.

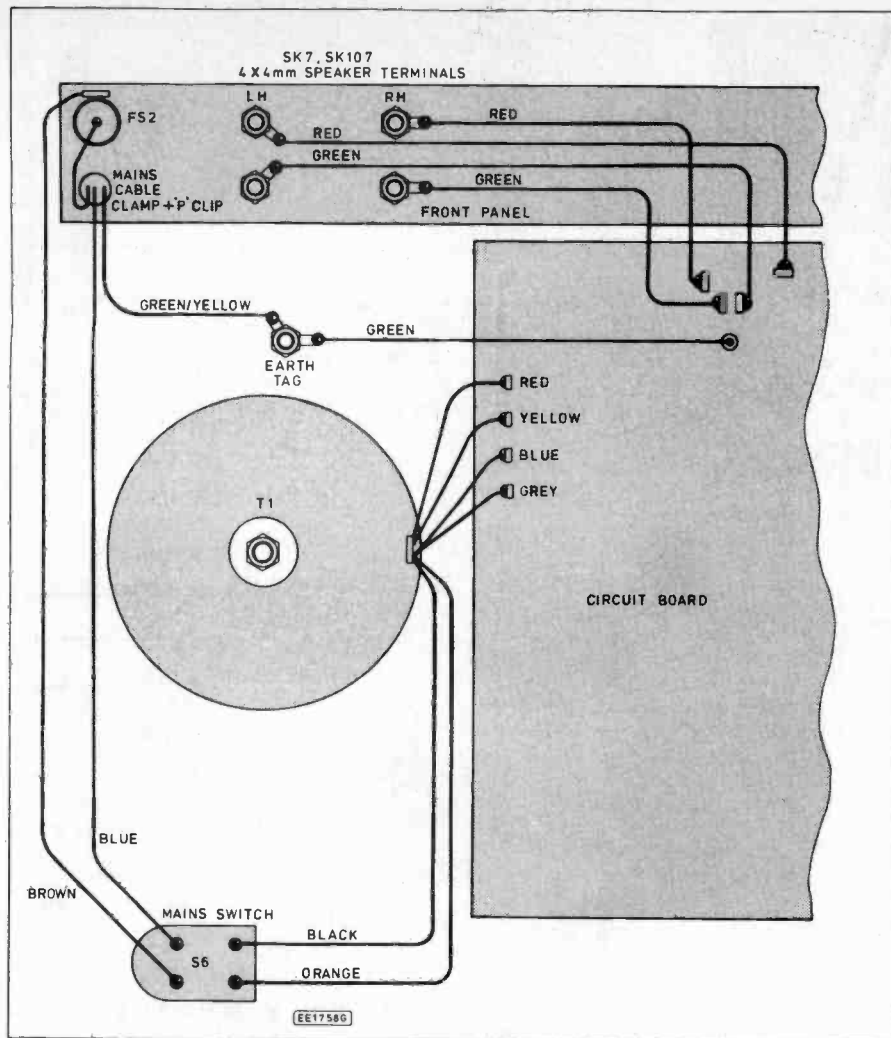


Fig. 11. Interwiring from case mounted components to the p.c.b.

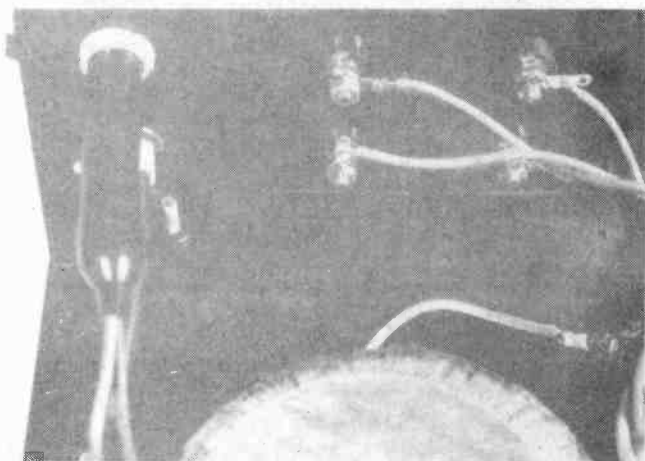
p.c.b. can now be attached to the floor of the case using 3/4 inch threaded pillars with 6BA by 1/4 inch bolts at each end. Attach the rear panel to the case and make all the necessary connections to the p.c.b. (Four 1/4 inch blade connections from the transformer, four 1/4 inch blade connections from the speaker terminals and the chassis earth connection, which is soldered to the 1mm dia. pin.

TESTING THE AMPLIFIER

Check that fuses FS1 and FS101 have been removed from the board and that VR1 and VR2 are turned fully clockwise.

Switch on and measure the voltages at test points TP1 to TP4 and TP101 to TP104. The slightly lower readings on the right channel (TP101 to TP104) are due to the effect of the l.e.d. drawing current from the right channel supply only.

The most difficult part of building the amplifier is setting the output stage quiescent current. This is achieved on the left channel by turning VR1 anticlockwise, and on the right channel by turning VR101 anticlockwise. If you have digital meter or oscilloscope you can set the current by turning VR1 (VR101) until about 40mV is observed across R27/R28 and R127/R128. Alternatively, you can set the output stage quiescent current using only a moving coil meter on its a.c. voltage range. Connect the meter across R35 (left channel) and R135 (right channel) and adjust VR1(L) and VR101(R) until the reading across each resistor increases by one volt a.c. This will give a quiescent current of 20mA through the output stages. If all the readings appear correct, switch off, replace fuses FS1 and FS101, switch on again and start listening.



Wiring to the speaker terminals and mains fuse FS2. The fuse and mains switch should be covered with insulating "boots".

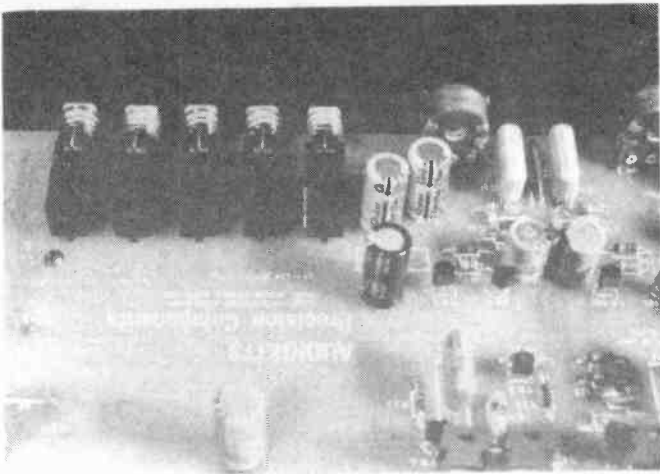


The speaker leads attached to the board "spade" terminals. Also note the insulating washers behind the transistors.

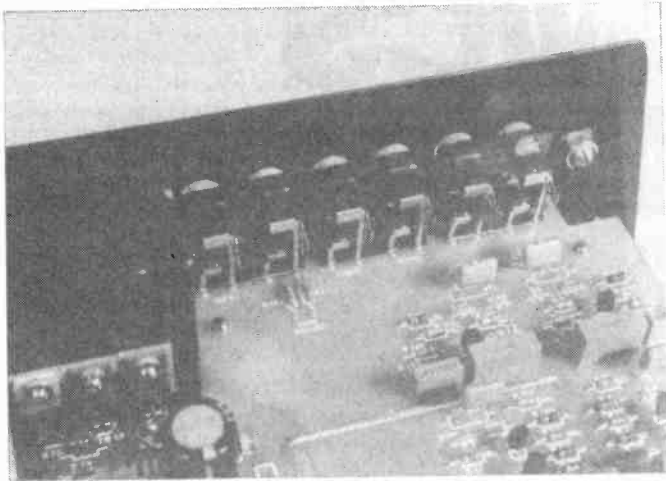
TEST VOLTAGES

	TP1	TP101	TP2	T201	TP3	TP103	TP4	TP104	Across R35	Across R135
	L	R	L	R	L	R	L	R	L	R
A With fuses removed and VR1, VR101 set fully clockwise	14.5	14.7	31.5	31.3	45.7	45.2	23.2	28.8	1.4	1.55
B With fuses removed and VR1, VR101 set to 20mA output stage current	14.6	14.7	30.2	30.1	42.9	42.8	22.0	22.0	2.4	2.5
C With fuses inserted and 20mA output stage current	14.6	14.7	33.5	33.5	49.5	49.5	24.9	24.7		

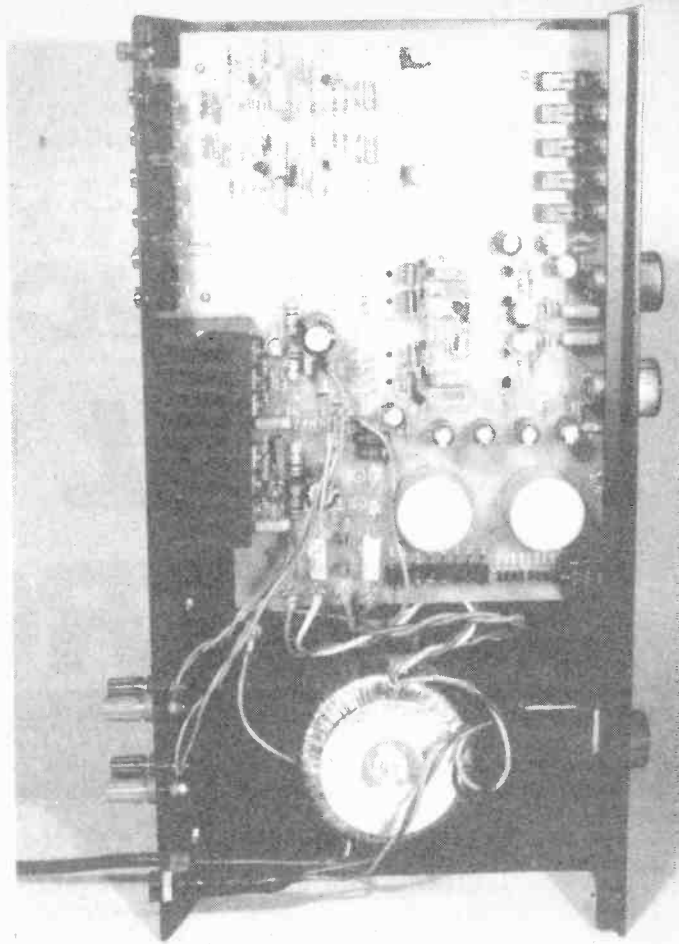
* All measurements from TP1 to TP4, TP01 to TP104 are made using a digital meter. Measurements across R35, R135 with a moving coil meter on a.c. volts range.



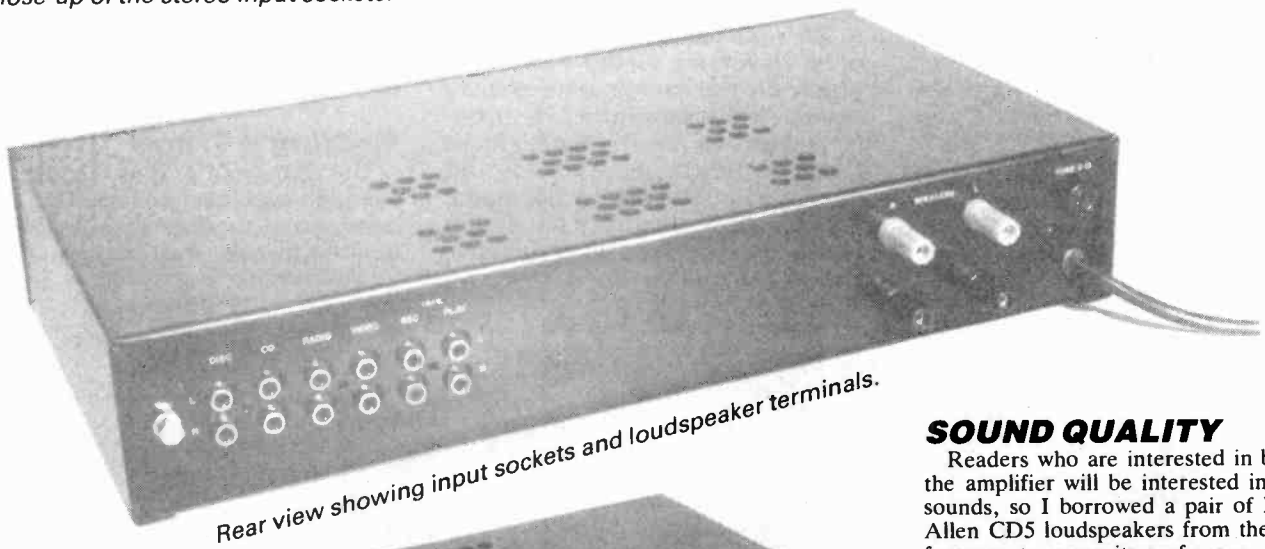
Close-up view of the p.c.b. push-button input mode selection switches.



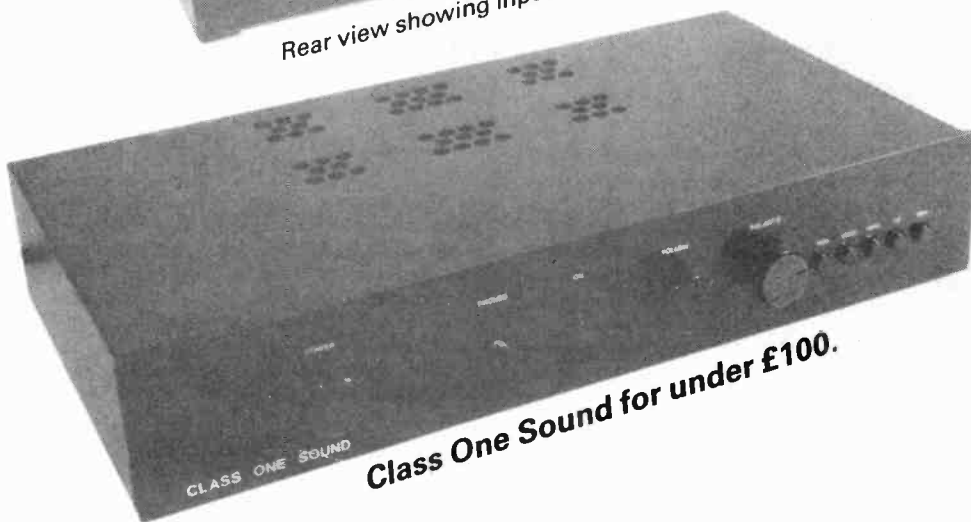
Close-up of the stereo input sockets.



The completed amplifier showing layout of components and interwiring.



Rear view showing input sockets and loudspeaker terminals.



Class One Sound for under £100.

SOUND QUALITY

Readers who are interested in building the amplifier will be interested in how it sounds, so I borrowed a pair of Richard Allen CD5 loudspeakers from the manufacturers to assess its performance with a high quality speaker of recent design. The results were very rewarding. Stereo imagery was really good compared with one of my earlier designs, which shared the same power supplies for each channel.

In short I was really impressed by the ability of the amplifier to make all kinds of music sound interesting and involving, at both high and low sound levels with far better portrayal of dynamics between loud and quiet sounds than my experience would expect from low power amplifiers. This is very much an amplifier which you can use and enjoy, even if you also own an amplifier costing ten times the price. I am certainly pleased with the results and hope readers will also be equally happy. □

Introducing DIGITAL ELECTRONICS

Part 5: Measurement, Testing, Prototyping and Circuit Assembly

By **Michael J. Cockcroft**
Training Manager, Peterborough ITeC

BEFORE getting into Prototyping and Circuit Assembly we will finish up Part 4 (The Oscilloscope and Logic Probes) and go through some questions and Exercises relating to it.

The Oscilloscope

Meters, as useful as they are, are limited in their application. Often we are interested in very fast moving signals, like the waveforms discussed earlier, the dimensions of which could not possibly be registered by meters. For serious elec-

tronic testing we need an instrument which can measure and display signals which vary very rapidly with time or with respect to other signals; such an instrument is called an **oscilloscope**.

The oscilloscope draws a picture of a waveform in the form of a graph on the instruments display screen. A **graticule** (grid of horizontal and vertical lines) is always fitted to the display to allow voltage and time measurements to be made. Fig. 5.1 shows the front panel of a typical oscilloscope; although your

own oscilloscope (or the one you will be using) will be different, it will contain most, if not all, of the labelled parts in this diagram. The following discussion makes reference to all of these parts and you will need to study the operators manual of your 'scope to compare the differences.

Getting a Trace

The beginner's first hurdle in using an oscilloscope is getting the instrument to display something (anything) on the screen. The

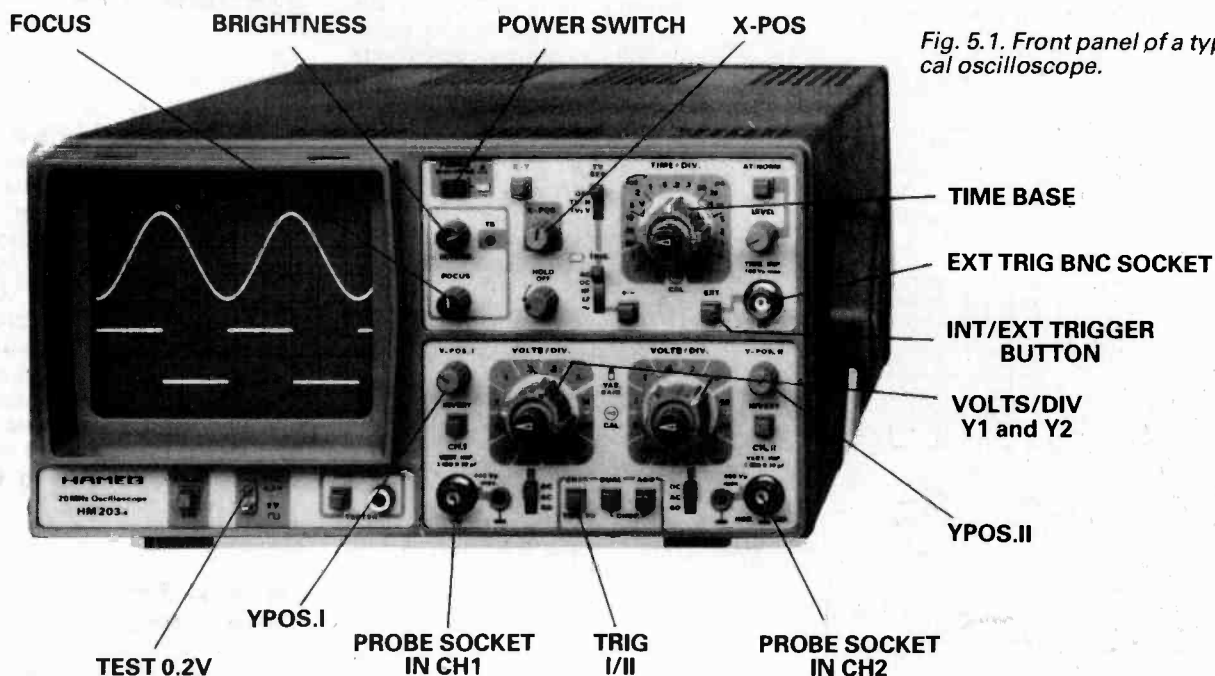


Fig. 5.1. Front panel of a typical oscilloscope.

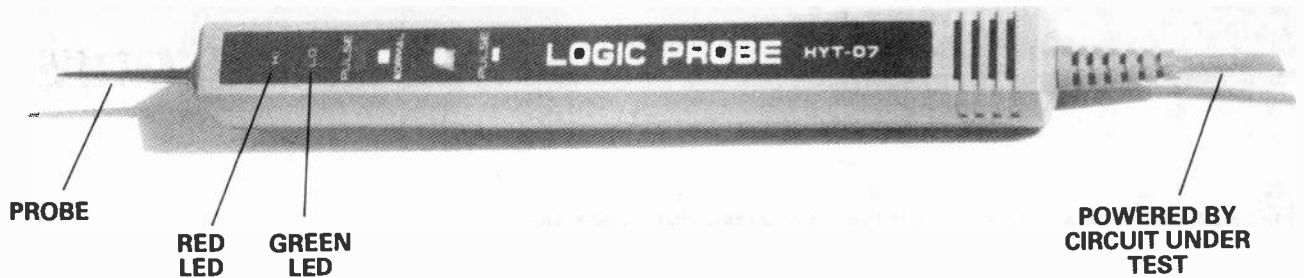


Fig. 5.4. A logic probe.

operators manual almost always explains how to do this. In general, setting the POWER switch on, all the rest of the switches off, and all control knobs to their mid or off position usually puts one or two lines on the screen, or sends one or two spots, from left to right, across the screen.

Once you have some type of trace on the display, adjust the brightness (INTENS) and (FOCUS) controls until the image is comfortable to your eyes. Avoid having too bright an image as this can burn the

inside of the screen. Plug a 'scope probe into the socket marked IN-CH1. You are now ready to take a reading through channel 1 of the 'scope (the 'scope of Fig. 5.1 has two channels—this allows two signals to be displayed at the same time.)

Measuring a waveform

Set the timebase and channel 1 sensitivity controls as follows:

TIMEBASE to 0.5 (milliseconds)

VOLTS/DIV-Y1 to 0.2 (volts)

Touch the 'scope probe to the calibration point, positioned below the screen in the figure, marked TEST. A square wave should appear on the screen. Adjust the XPOS and YPOS controls and observe what happens: these controls allow the waveform to be positioned anywhere on the graticule. Use these "SHIFT" controls to position the square wave as shown in Fig. 5.2.

The graticule is usually laid out, as shown in Fig. 5.3, in an eight by ten grid. The TIME-BASE and the two VOLTS/DIV controls refer to major divisions on the graticule; the present settings, for example, display the dimensions of the input waveform as 0.5 milliseconds for every centimetre on the X axis and 0.2 volts for every centimetre on the Y axis of the graticule.

The square wave signal on the TEST pin, therefore, has a pulse duration of 0.5ms and an amplitude of 0.2 volts; it has a 50 per cent duty cycle (which is a mark/space ratio of 1) and a frequency of 1000Hz:

Pulse = 0.5ms

Period = 1ms

Frequency = 1/1ms = 1kHz

Triggering the Timebase

The graph displayed on the oscilloscope is not a single stationary picture, but many traces drawn one after the other at a rate determined by the timebase setting. It is important, therefore, that the oscilloscope draws the graph from the same point of the signal each time—otherwise the display would show a muddled confusion of patterns on the screen. Timing the point at which the oscilloscope starts to draw the graph each time is called "triggering" and can be set

by the user or triggered automatically.

Depending on the INT/EXT button setting, trigger signals can be provided either internal or external to the oscilloscope. Internal triggering means that the trigger signal is derived from the signal itself at the channel input. The push button TRIG I/I determines which channel is the trigger source if both channels are in use. External triggering requires a signal, at the BNC socket marked EXT. TRIG, from an external circuit.

Logic Probes

For many *digital* circuit testing applications, the oscilloscope can be very much an overkill. Digital circuits recognise only two voltage levels (high and low) and, often, all that is needed is a simple device which can indicate as to whether a point in the circuit is high or low. Such a device is depicted in Fig. 5.4 and is called a **logic probe**.

The logic probe is used for analysing or fault finding in digital circuits; the tip of the probe is touched to the point of interest and one of two l.e.d.s illuminates to indicate either a high or a low logic level (exactly what constitutes a high or a low level depends on the logic family in use; we deal with logic families in Part 11).

Most logic probes facilitate the detection of fast going pulses. Pulses that would normally go undetected by the naked eye are electronically stretched to about 1/10th of a second. Many good logic probes also use a variety of techniques, combining the two l.e.d.s, to provide additional functions; Table 5.1 shows some examples.

Considering logic probes are easy to use, portable, and particularly useful for a number of projects and experiments in this course, you will be pleased to know that your first (optional) practical circuit construction exercise is to build one (albeit a humble one!).

Exercises and Questions

If you intend to take 301 examinations, it is important that

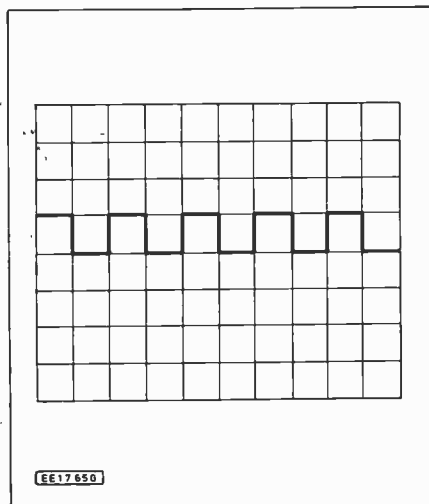


Fig. 5.2. Squarewave positioning.

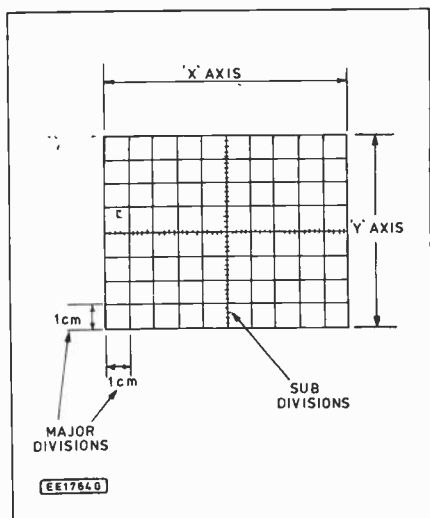


Fig. 5.3. Normal graticule marking.

TABLE 5.1
Additional Functions of Logic Probes

I.e.d.s	Input
Both off	Open circuit or between "low" and "high" threshold
"low" on bright	Below logic "low" threshold
"high" on bright	Above logic "high" threshold
Both Flash	Square wave or repetitive wide pulses (>100ms) frequency <100Hz I.e.d.s follow input waveform
Both on Dim	Square wave or repetitive wide pulses frequency >100Hz. Relative brightness gives indication of mark space ratio
"low" Flashes	Repetitive, narrow, positive going pulse at repetition rate <100Hz. Single pulses to below 30ns cause "low" I.e.d. to flash off for approximately 100ms
"high" Flashes	Repetitive, narrow, negative going pulse at repetition rate <100Hz. Single pulses to below 30ns cause "high" I.e.d. to flash off for approximately 100ms
"low" on Dim	Repetitive, narrow, positive going pulses at repetition rate >100Hz
"high" on Dim	Repetitive, narrow, negative going pulses at repetition rate >100Hz

you do all the exercises here and attempt to answer all of the following questions.

Exercises

Because the practical work for these sections of the course is quite time consuming and many students are studying on top of full-time work, some of the exercises are carried over to next month. This month we concentrate on investigations involving the oscilloscope, function generator, and pulse generator;

The exercises are laid out in tables (labelled Exercise 5.1 to 5.4) for easy reference; if you don't have access to the equipment, contact your local Assessment Centre and ask how they can help.

Questions

1. Which range setting (of the meter in Fig. 5.5) would be most appropriate for measuring the current flow through the resistor in the circuit of Fig. 5.6.
2. State the polarity of the meter leads for the above operation:
Red lead to point
Black lead to point

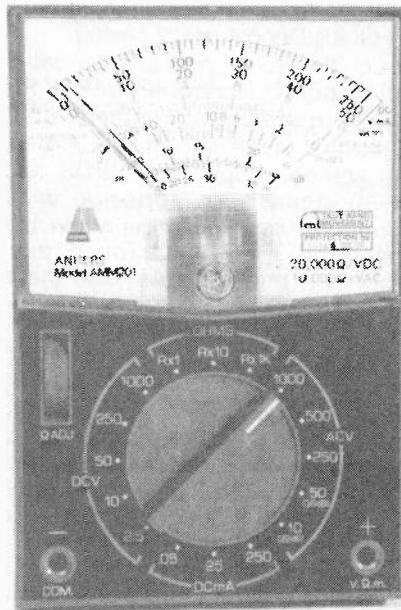


Fig. 5.5. Typical multimeter.

3. Which range setting (of the meter in Fig. 5.5) would be most appropriate for measuring the voltage across the resistor in the circuit of Fig.5.6

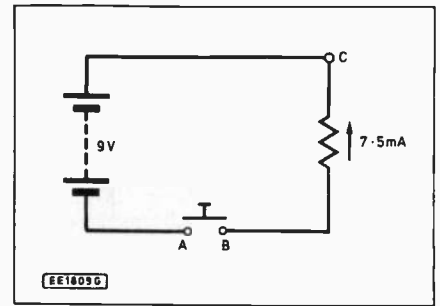


Fig. 5.6. Test circuit.

4. State the polarity of the meter leads for the above question:
Red lead to point
Black lead to point
5. Interpret the voltage readings displayed on the five analogue multimeters of Fig. 5.7.
6. Interpret the current readings displayed on the five analogue multimeters of fig. 5.8.
7. In what sequence would you use the following oscilloscope controls in order to obtain a trace on the screen:
X SHIFT
Y SHIFT
INTENS
FOCUS
TIMEBASE
8. To which settings would the pulse generator controls of Fig. 4.7 (last month) be adjusted in order to produce the output waveform in Fig. 5.9.
9. What would happen to the oscilloscope displayed waveform of Fig. 5.10 if you were to adjust the trigger level?
10. State the periodic time of the oscilloscope output sine wave shown in Fig. 5.11. The oscilloscope is set to 50ms/cm.
11. State the duty cycle and mark/space ratio of the waveform of Fig. 5.12.
12. The periodic time of an alternating voltage is 10μs, what is its frequency?
13. Draw, on graph paper, a triangle wave with a periodic time of 2ms.
14. What is the frequency of a 50μs alternating voltage?
15. State the essential requirements of a d.c. supply for use with digital electronic circuits.
16. Referring to the diagram of Fig. 5.13 which label (A, B, C, D or E) represents the mark/space ratio of the waveform?
17. What is the duty cycle of a waveform having a pulse width of 1ms and a periodic time of 3ms?
18. Your oscilloscope is set to 20ms/cm, how long would it take for the beam (spot) to move across three major divisions of the graticule?
19. To what timebase setting would you adjust your oscilloscope in order for the beam to take 100μs to move across five major graticule divisions?

A note to College and ITeC tutors

It is impossible to generalise on measuring instruments such as oscilloscopes and signal generators when they differ so much between manufacturers; the exercises are somewhat impaired because of this. If your students are following the course and you would like to tailor the exercises to your particular equipment, you may like to contact the author at Peterborough ITeC for a copy of the text in the form of an ASCII file on computer disk (please supply a blank IBM PC/MSDOS 5.25in formatted disk).

Exercise 5.1

INITIALISING THE OSCILLOSCOPE

The oscilloscope represents a piece of very large electronic graph paper, the graticule of which is just a small viewfinder rather like a window through which only a portion of the entire sheet can be seen. The instruments drawing implement may be thought of as a light beam: this moves from left to right across the graticule at a speed, determined by the TIMEBASE switch settings, and moves up and down relative to the size of voltage at the input terminals (IN-CH1 and IN-CH2 are the two input channels of the 'scope in Fig. 5.1).

Before we can use the 'scope we need to position the beam appropriately on the graticule; initially, depending on the control panel switch settings, the beam may not be visible *anywhere* on the screen. This exercise is designed to help you locate the beam, position it on the graticule, and set its speed.

Instructions

Unplug any probes from IN-CH1 or IN-CH2 and switch the 'scope on.

Turn the TIMEBASE switch fully anti-clockwise.

If you are using a dual trace oscilloscope, set CH1/DUAL/CH2 switch to CH1.

Turn the INTENS control fully clockwise.

Switch the input coupling switch (AC/DC/GND) to GND.

Adjust the channel 1 XPOS and YPOS controls until you can see a spot of coloured light moving across the graticule. If the beam still isn't visible, consult your manual and find out how to switch to the automatic trigger mode. Adjust the FOCUS and INTENS controls to obtain a sharp image that is comfortable to the eyes.

Align the beam to run along the centre graticule line (XPOS) starting from the leftmost vertical graticule line (YPOS). You should now have a spot running across the centre of the screen. If you have a stopwatch on your wrist, time how long it takes for the spot to travel from extreme left of the screen to extreme right.

Turn the TIMEBASE clockwise until the spot transforms into a line.

Leave the oscilloscope settings for the next exercise.

Comments

Most oscilloscopes need a minute or so to warm up after switching on. While you are waiting, set all knobs, switches, and buttons to their mid, off, or out positions.

This reduces the speed of the beam to its slowest rate which is usually 0.2 or 0.5 sec/cm, depending on the oscilloscope. Do not worry if you can't see the beam yet.

This is to ensure that, for the moment, we only get one beam.

If a bright line or spot appears on the screen immediately, reduce the brightness (INTENS) a little.

Because we are not measuring anything, this sets the voltage level (amplitude) to zero volts ground.

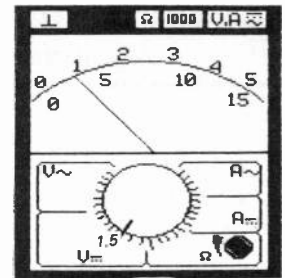
XPOS and YPOS are called the 'shift' controls; they determine where the beam starts its cycle from the left of the graticule, and where it starts in the up or down direction.

Do not have a very bright image on the screen for too long as this may burn the inside surface of the screen.

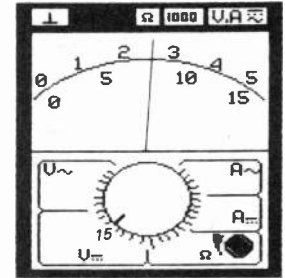
If the beam is not steady, adjust the control labelled 'sync' or 'level'.

What is the channel 1 TIMEBASE switch setting labelled for its present (fully anti-clockwise) position? If it is labelled 200ms (0.2 sec), the spot should have taken two seconds to travel the distance (0.2 secs per centimetre for ten major divisions = $0.2 \times 10 = 2$).

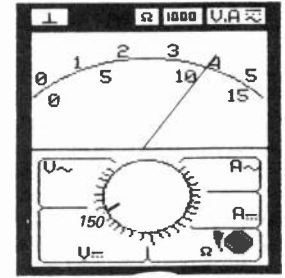
The spot is moving so fast it looks like a stationary line. How long does the spot now take to travel *halfway* across the graticule? (Look at the timebase setting and multiply it by five).



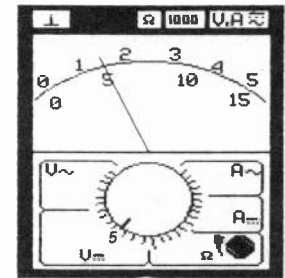
(a)



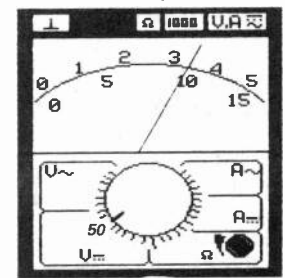
(c)



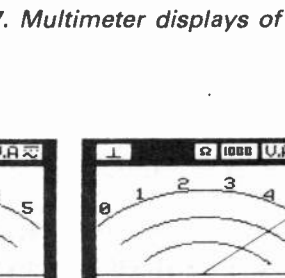
(e)



(b)

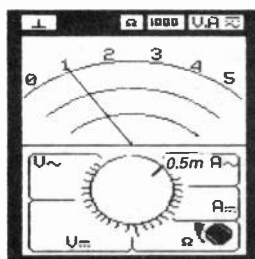


(d)

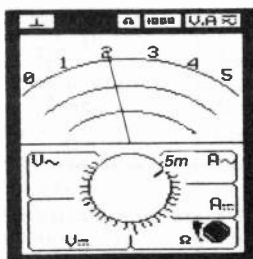


(e)

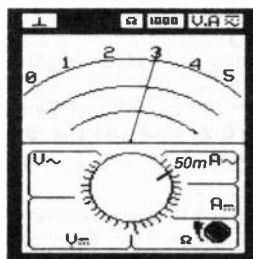
Fig. 5.7. Multimeter displays of voltage.



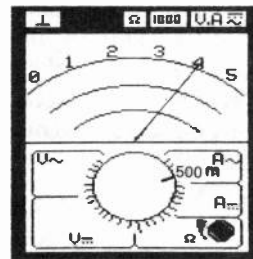
(a)



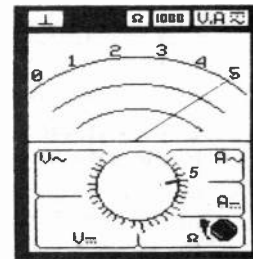
(b)



(c)



(d)



(e)

Fig. 5.8. Multimeter displays of current.

Exercise 5.2

MEASURING AC AND DC ON THE OSCILLOSCOPE

The oscilloscope's beam moves up and down a distance on the graticule relative to the voltage being measured. If the voltage is positive the beam will move upwards, and if the voltage is negative the beam will move downwards. The point in the circuit being measured is connected to the input connector (or connectors: a dual trace scope has two input channels making it possible to look at two signals at the same time) of the oscilloscope by special probes, as explained in the text.

This exercise examines the measurement of a.c. and d.c. voltage on the oscilloscope; but first, we investigate an important property of probes.

Instructions

Connect a length of insulated copper wire (1/0.6) to the channel 1 input terminal (IN-CH1) of the scope.

Comments

It is not necessary to put a BNC plug on the wire, just strip about 10mm of insulation from the end of the wire and push the conductor into the centre hole of the socket. This is a makeshift scope probe.

Switch the TIMEBASE to 50ms/cm, channel 1 sensitivity to 0.2V/cm, and the input coupling to DC.

Hold the other end of the wire on (or close to) the insulation of the nearest active mains cable (e.g. the mains lead of the scope).

All other settings should be preserved from the previous exercise.

There should be a sine wave on the screen. The wire is acting as an aerial and picking up electromagnetic waves* from the air.

Vary the distance between the wire and the mains lead, and watch the screen as you do so.

The closer the wire gets to the cable, the larger (vertically) the signal becomes. What is the peak to peak amplitude of this wave at its greatest?: if it covers 3 or 4 major vertical divisions at 0.2V/cm it is between 0.6 and 0.8 volts.

Work out the frequency of this signal.

This is the frequency of the mains. Refer to last month's text if you need to.

Remove this home-made probe and plug an oscilloscope probe into the socket.

Now try and pick up air waves. The probe is screened to prevent this from happening or, at least, minimise it!). It also has other properties but these are beyond the scope of the course.

Touch the probe tip to the test point (TEST).

Some 'scopes call this test point 'probe adjust' or 'cal'.

Adjust the timebase and sensitivity until you get a reasonable picture of the square wave.

It is usual to display at least one or two full cycles of the waveform.

With a screwdriver, turn the calibration screw in the probe back and forth a few times observing the displayed waveform at the same time.

The adjuster screw is usually in the body of the probe or in a box at the base of it.

Adjust the probe until the top and bottom horizontal lines of the square wave are parallel.

This is called "compensating" or "calibrating" the probe.

Read the frequency and amplitude of the square wave signal.

The reading should match the TEST pin label (e.g. 1kHz 0.2Vpp).

Adjust the sensitivity to 5V/cm and screw an earth lead into the probe. Set the beam to the centre of the graticule.

Measure the voltage of your PP3 battery.

Clip the earth lead to the negative terminal and touch the probe to the positive terminal.

Spend some time adjusting the oscilloscope controls and reading the user manual until you fully understand the operation of all that we have used so far.

The next exercise assumes this knowledge.

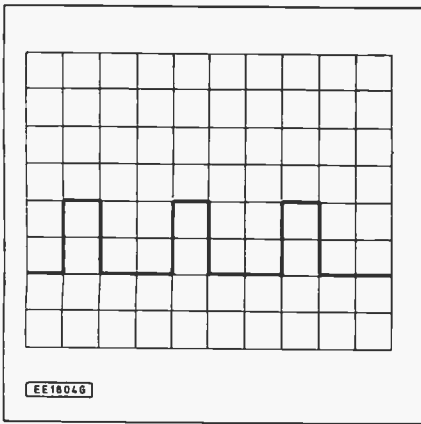


Fig. 5.9. Waveform of the pulse generator output. Timebase setting 10ms/cm.

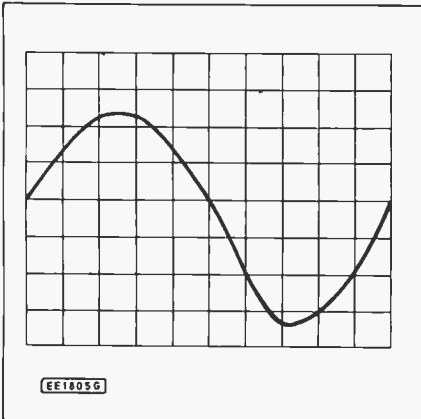


Fig. 5.10. Sinewave display.

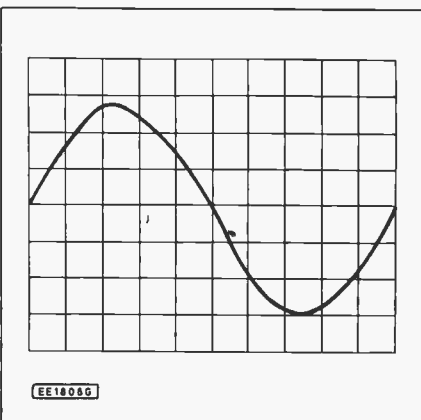


Fig. 5.11. Display for periodic time calculation.

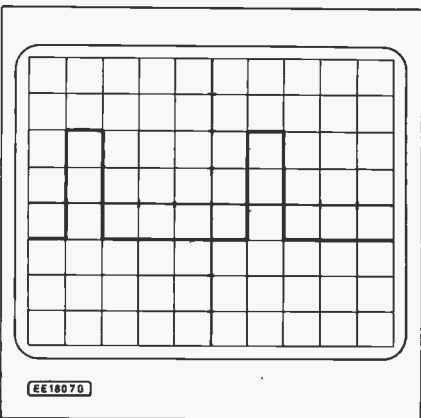


Fig. 5.12. Display for duty cycle and mark/space calculation.

*An electromagnetic wave is energy radiating from a source: radio transmitters produce such waves. Alternating current in a wire transmit electromagnetic waves (of the same frequency as the signal in the wire) into the air. After you have completed this exercise, if you have a nearby window and a little imagination, you may be able to display a signal on your scope from a local radio station.

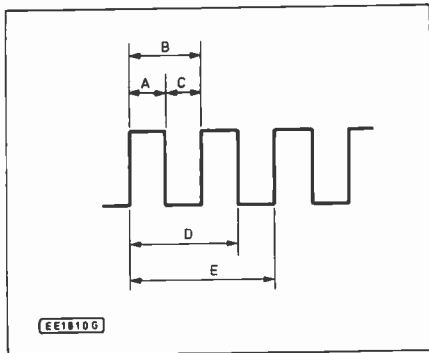


Fig. 5.13. Labelled squarewave.

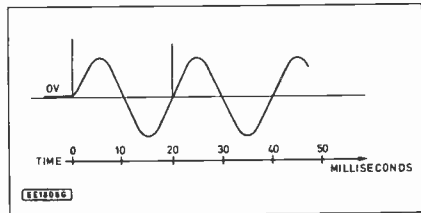


Fig. 5.14. Time dimensions of the a.c. mains supply.

20. Fig. 5.14 gives the time dimensions of the a.c. mains signal in Great Britain, what is the frequency of the waveform?

We now proceed with the lesson that embarks on the following City and Guilds objectives:

3.1 Circuits and block diagrams

3.1.1 State the purpose of, and distinguish between, circuit diagrams, block diagrams, and layout physical diagrams.

3.1.2 Use standard conventions to draw very simple circuit, block, and layout diagrams.

3.1.3 Compile a components list from a given simple circuit diagram.

3.1.4 Devise a component layout for the breadboard construction of at least one of the circuits given in Appendix D.

3.2 Breadboarding

3.2.1 Identify a breadboard system.

3.2.2 Identify common interconnections provided internally within a breadboard system.

3.2.3 State the advantages and disadvantages of using a breadboard system for the development of digital circuits.

3.3 Logic Tutors

3.3.1 Identify a logic tutor.

3.3.2 Identify the various interconnections provided internally within a logic tutor.

3.3.3 Construct and test a simple logic arrangement using not more than TWO logic gates assembled on a logic tutor. Sketch the circuit and write a brief report on the test carried out.

Exercise 5.3

LOOKING AT WAVEFORMS ON THE OSCILLOSCOPE

Function generators are used to produce square, triangle, and sine waves of a range of amplitudes and frequencies. Connect a function generator to the oscilloscope, power up both instruments, and proceed with the following exercise.

Instructions

Set the amplitude control of the function generator to produce a 10 volt signal. Adjust the 'scope' appropriately to receive it.

Turn the function selector switch of the function generator to 'sine' and select a frequency range that will produce a 1kHz sine wave.

Adjust the 'd.c. offset' control of the function generator and watch the 'scope screen.

Change the 'scope's' input coupling switch to AC and adjust the 'd.c. offset' control again.

Change the function selector of the function generator to 'triangle'.

Change the function selector of the function generator to 'square'.

Use a pulse generator to produce a 1kHz signal with a 10% duty cycle.

Comments

Set the 'd.c. offset' control of the function generator to its mid position and the 'scopes' into coupling to DC.

What timebase settings will display two full cycles of a 1kHz signal on the graticule? Set the timebase so that you can see two cycles.

The signal moves vertically.

What happens? The 'd.c. offset' no longer moves the signal because the AC setting of the input coupling switch blocks the d.c. component of the signal (more about d.c. blocking — in Part 8).

Observe the time and amplitude relationship between this signal and the previous sine wave. Could you draw a 1kHz triangle wave on graph paper?

Is there any means of changing the duty cycle of this signal? No, the square wave is also time related to the sine wave.

Remove the BNC to BNC lead at the function generator end and plug it into the pulse generator. The controls of the pulse generator are labelled and you should now be able to produce the signal on your own.

Exercise 5.4

TRIGGERING THE TIMEBASE OF THE OSCILLOSCOPE

If you had difficulty in getting *exactly* two cycles of a waveform on the graticule when you were doing the previous exercise, the reason was that you had not made the correct trigger system adjustments on the oscilloscope. Trigger settings tell the 'scope' the exact point of the waveform at which to start tracing the image: what is displayed on the screen is all the cycles of the waveform overlaid into what looks like one picture. This exercise investigates triggering.

Instructions

Turn on the oscilloscope and get a signal from the test point TEST.

Move the trace away from the left hand side of the graticule so that you can see where the signal starts (XPOS). Watch the display while you operate the +/- switch.

Remove the probe from TEST and put a 1kHz sine wave into channel 1 using a signal or function generator. Depress the INT/EXT push button.

Adjust the amplitude of the signal so that the signal height is at least 2 or 3cm.

Now, with a sensitive touch, adjust the level control back and forth.

Comments

The waveform display starts at the positive or negative leading edge of the signal depending on the +/- switch setting.

If you can't see the trace adjust the "level" control until you can. At this point it may also be necessary to re-adjust YPOS.

You can do this from either the function generator amplitude control or the oscilloscope YINP-1 control.

You will see the leading edge of the signal move along relative to the control setting.

Diagrams

In addition to written documentation in the form of descriptions and specifications, electronic systems are expressed graphically as diagrams. There are a number of technical drawings used in electronics and it is important to be able to use some of them; in particular, we need to be able to read and draw:

- Circuit Diagrams
- Physical Layout Diagrams
- Block Diagrams

Circuit Diagrams

Circuit diagrams show electronic system interconnections using component symbols and ruled lines. Although there is no one correct way to draw a particular circuit, there are conventions with respect to format; for example, consider the following points about the three circuit diagrams of Fig. 5.15 (taken from the City and Guilds Resource Document). **Note:** These diagrams are reproduced exactly as shown by City and Guilds, they are not drawn to the normal EE style and do include some symbols and mark-

ings that we would not normally use.

- The power supply lines are always positive to the top and negative to the bottom of the diagrams.
- British Standard symbols are used.
- Component part numbers or values are clearly labelled.
- Input electronics (temperature sensing in circuit (a), light sensing in (b), and touch sensing in (c)) is drawn to the left and output electronics (bell (a), bulb (b), and relay (c)) is drawn to the right of the diagrams.

These are the conventions adopted by most electronic establishments in the UK and, in particular, by City and Guilds as their marking criteria for some of the tests and assignments in this course. It is important to note that point (d) above is not a prescript but rather a general rule that is governed by readability and sensible use of area on the diagram as a whole; for example, if drawing

input to the left, processing to the middle, and output to the right produces a circuit diagram like that of Fig. 5.16a then the format would be rearranged to sensibly fill the available space on the paper, as shown in Fig. 5.16b.

Physical Layout Diagrams

The circuit diagram tells nothing of how a system is physically constructed; it expresses exactly how the circuit works with respect to how the electronic components are connected together, but how it is assembled on printed circuit board, stripboard, or **breadboard** (explained later) is drawn as physical layout diagrams.

Physical layout diagrams must show the precise positioning of components on the circuit boards with component parts clearly labelled, as shown in the p.c.b., stripboard, and breadboard layouts of Fig. 5.17. (NOTE: these do not all show the same unit).

Block Diagrams

Block diagrams, sometimes called "system diagrams", illustrate

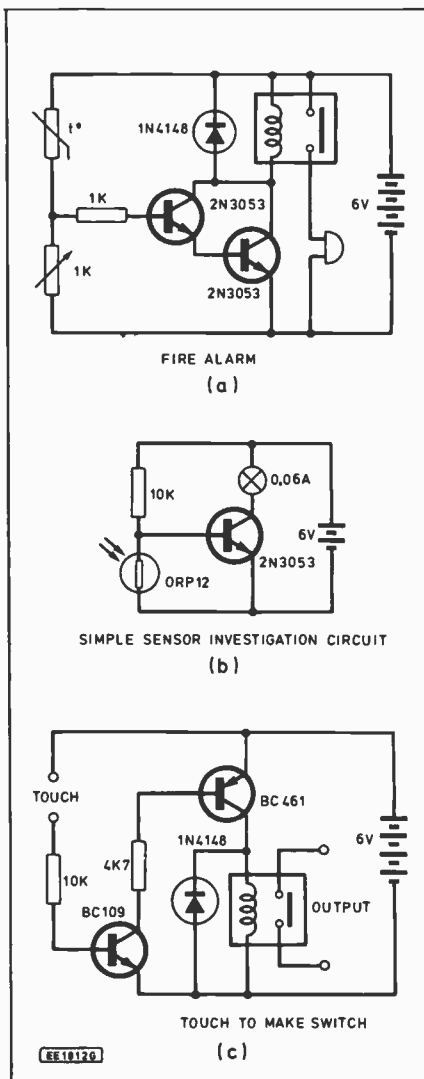
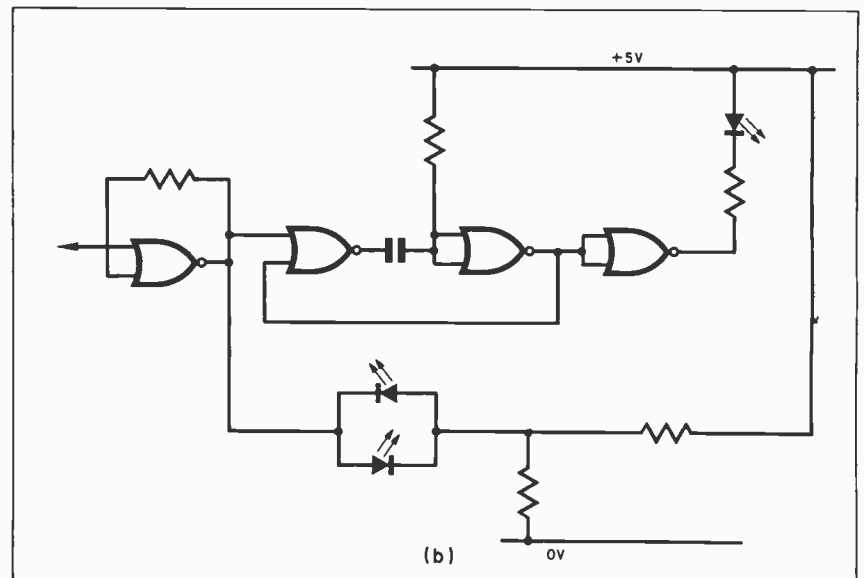
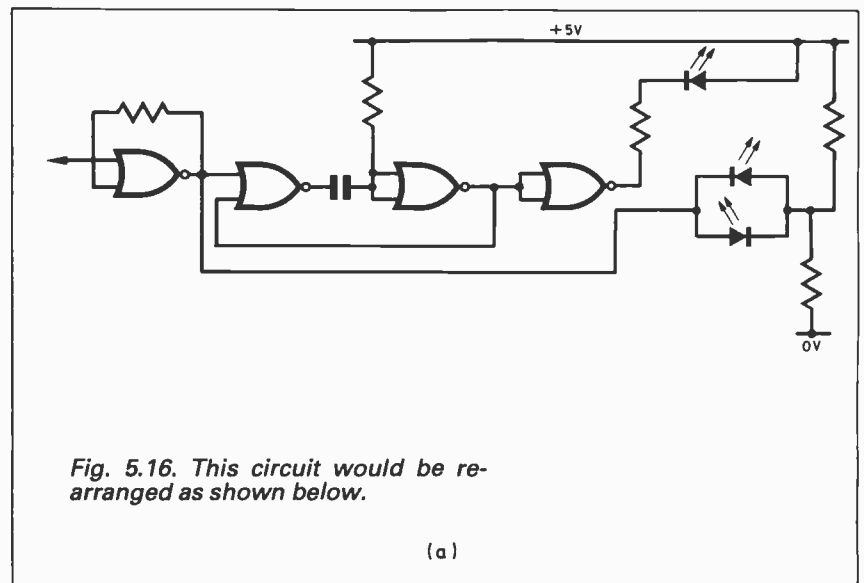


Fig. 5.15. Three "City and Guilds" circuit diagrams.



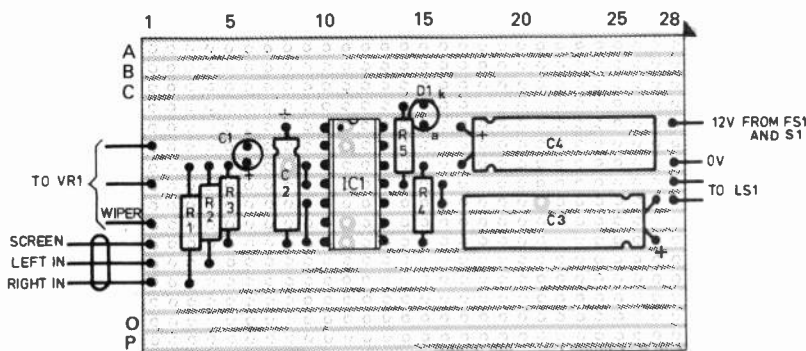
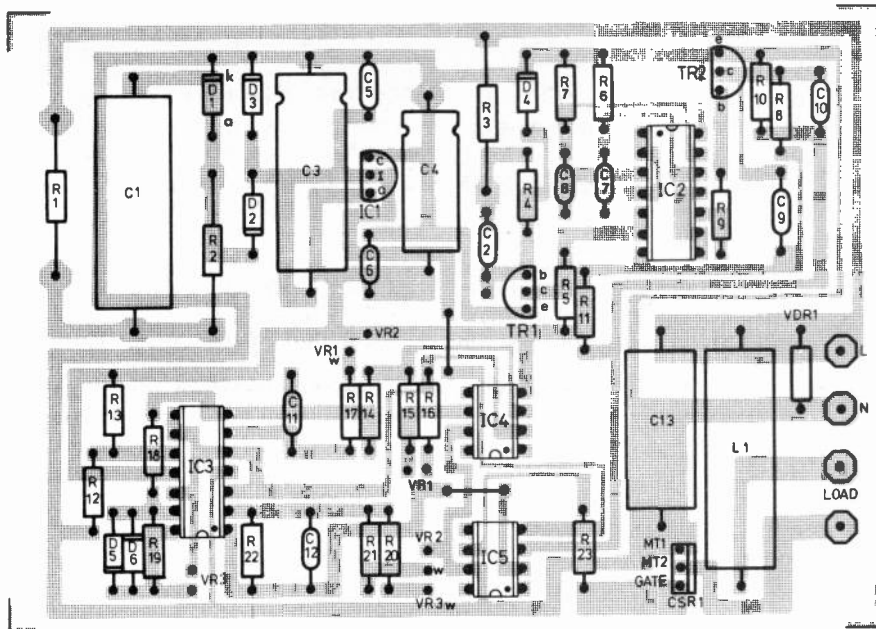
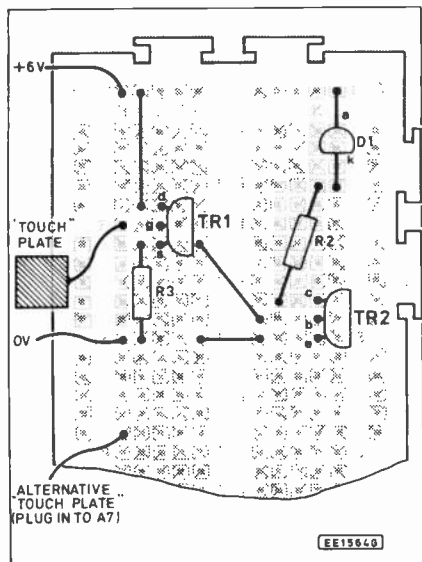


Fig. 5.17. Examples of p.c.b. (top), stripboard (above) and breadboard (below) construction.

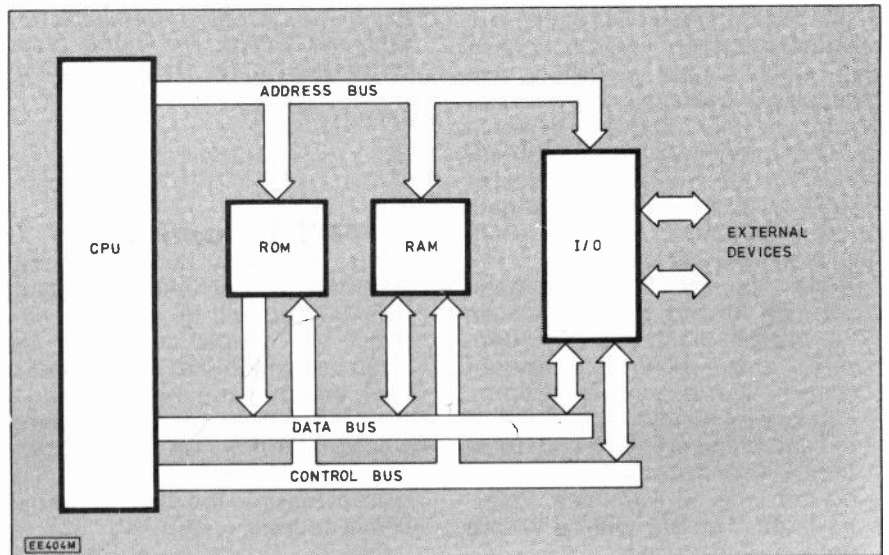


how a system works in a very general way: they show how the sub-systems are put together to form the whole system. Such diagrams show the system details using a minimum of technical information, making them useful for conveying an overview or an initial idea of how a system works very quickly. An example block diagram of a microprocessor based system is given in Fig. 5.18

Prototype Wiring

A prototype circuit is the original model on which the final version of the circuit is based. Prototypes are usually built as a first stage in testing the theory of a design: only by putting theory into practice can the circuit be tested under real world conditions.

Fig. 5.18. A block diagram of a microprocessor system.



In industry, prototype wiremen/wirewomen are employed in the research, design, and development departments within electronics companies to construct (and sometimes test) trial models. Once the design is validated, if the system is to be mass produced, printed circuit board artwork (copper foil masters—see page 89 for an example of a p.c.b. master) are developed.

It would not be wise to go to the trouble of developing p.c.b. artworks at the development stage, however, since the design is very likely to be changed. What is needed is a fast and cost effective method of construction which does not involve the manufacture of a printed circuit board. Stripboard is one solution if the prototype circuit is going to be developed into a full-blown prototype model. If, on the other hand, the prototype circuit is only intended to try out the design, there are distinct disadvantages of stripboard over other prototyping systems: the breadboard system, for example.

Breadboarding

Breadboard, as an alternative to stripboard, has the following advantages:

- (a) Components are not soldered
- (b) Changes can quickly and easily be made to the circuit
- (c) Components can be re-used over and over again
- (c) Fewer wire links are required between components
- (d) Much faster method of assembly

A number of breadboarding systems are shown in Fig. 5.19. Circuit assembly on breadboard is quick and simple: wires or component leads are connected together by inserting them into adjacent holes (they are held in place by spring contacts) as shown in Fig. 5.20—the internal connections of a bread-

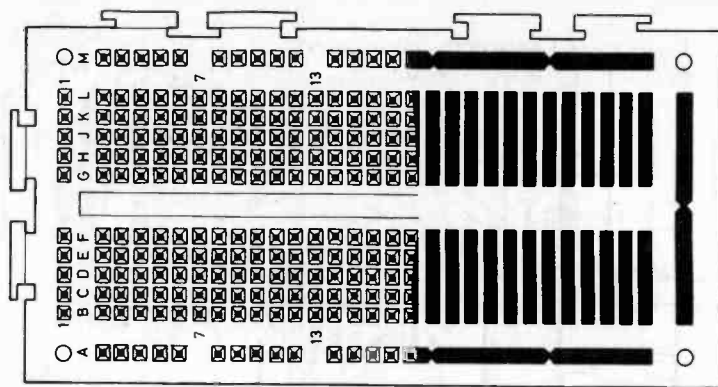
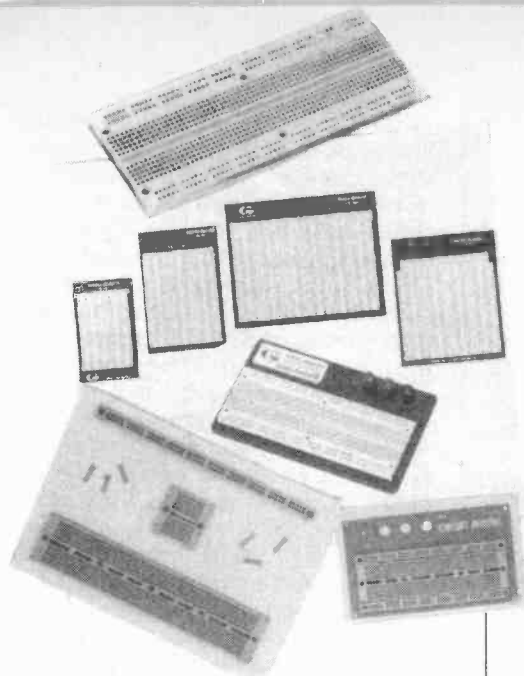


Fig. 5.19 (above). Examples of various breadboards.

Fig. 5.20 (right). Construction of a breadboard (top right) and the method of connecting a simple circuit.

board system are shown (in black) in (a) and the method of connecting two resistors together in (b).

A breadboard physical layout diagram for the logic probe circuit of Fig. 5.21a (reproduced from Appendix D of the City and Guilds Resource Document) is shown in Fig. 5.21b. Fig. 5.21c relates some of the physical connections of the 4001 integrated circuit to the layout diagram.

Logic Tutors

A natural extension to the breadboard for prototype work is a system with built-in functions such as logic switches and indicators which may be simply "wired in" as part of prototype circuits. These systems are called Logic Designers or, because they are useful for teaching digital electronics, Logic Tutors.

We will be using the Pencilbox Logic Tutor (Fig. 5.22a), a block diagram of which is given in Fig. 5.22b. The Pencilbox has eight l.e.d. indicators (which can be latched on), eight toggle switches, two push button switches, and a square wave generator (clock); all of which can be connected to the breadboard via the interconnect socket (see Fig. 5.22b). We will investigate the various functions of the Pencilbox in an exercise later.

Note: The pencilbox has been selected for this course because the product is relatively inexpensive and most assessment centres own a number of them. Purchasing details are given at the end of the article. If your local Centre does not own one and you do not wish to purchase, Peterborough ITec are willing to hire out a couple by post.

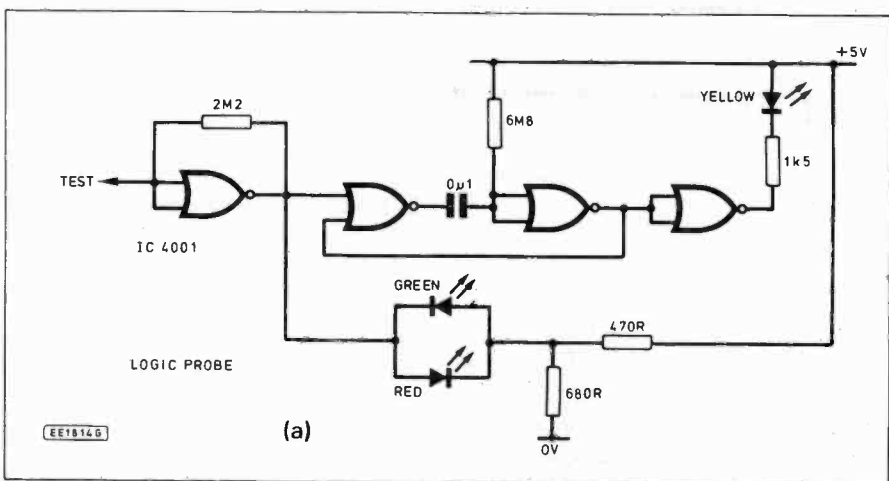
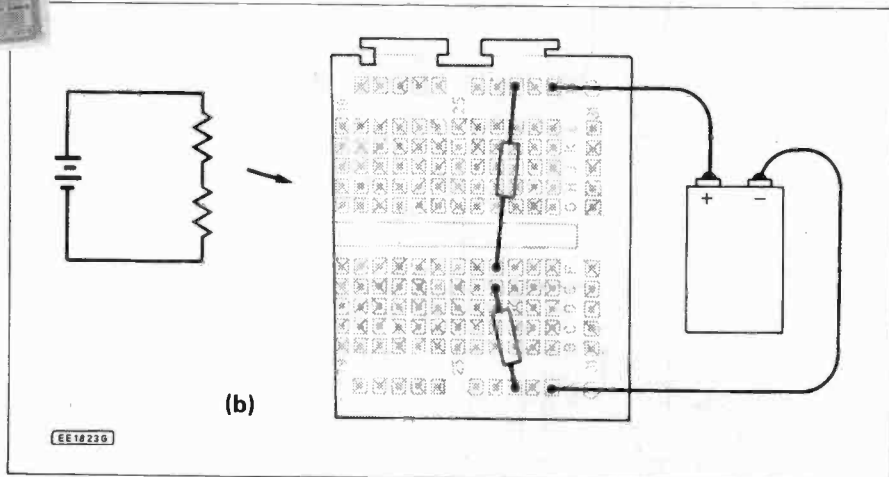
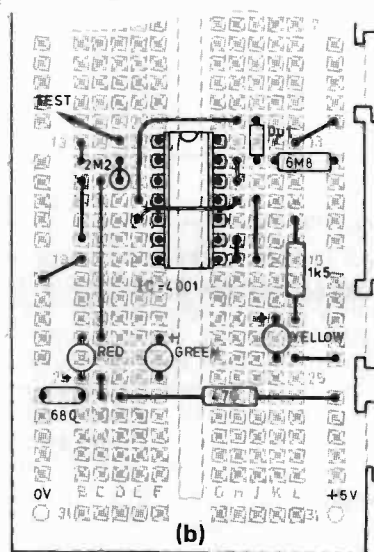


Fig. 5.21(a). A logic probe circuit from City and Guilds. (b) (right) breadboard layout of (a). The power supply connections to the i.c. (pin 7 and 14) are not shown.

Circuit Assembly

The only way to learn circuit assembly is by actually assembling circuits. You will be asked to construct the simple sensor of Fig. 5.15b on breadboard as an exercise later; whether you then continue to build it on stripboard and put it into a case is entirely up to you but, if you are taking the certificate, you must at least do the exercise as part of this course.

Building circuits on stripboard is



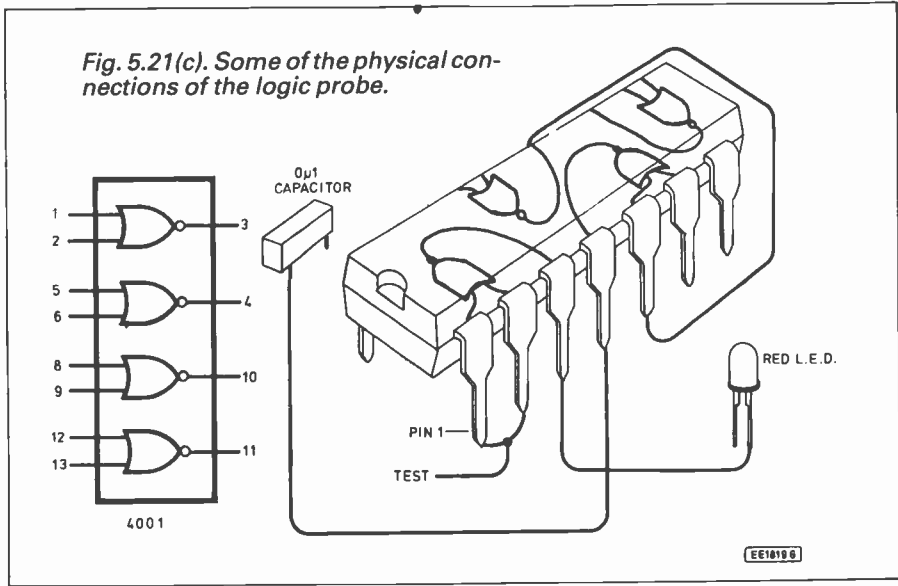


Fig. 5.21(c). Some of the physical connections of the logic probe.

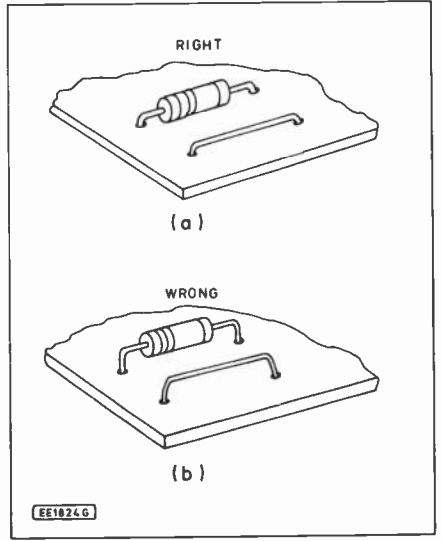
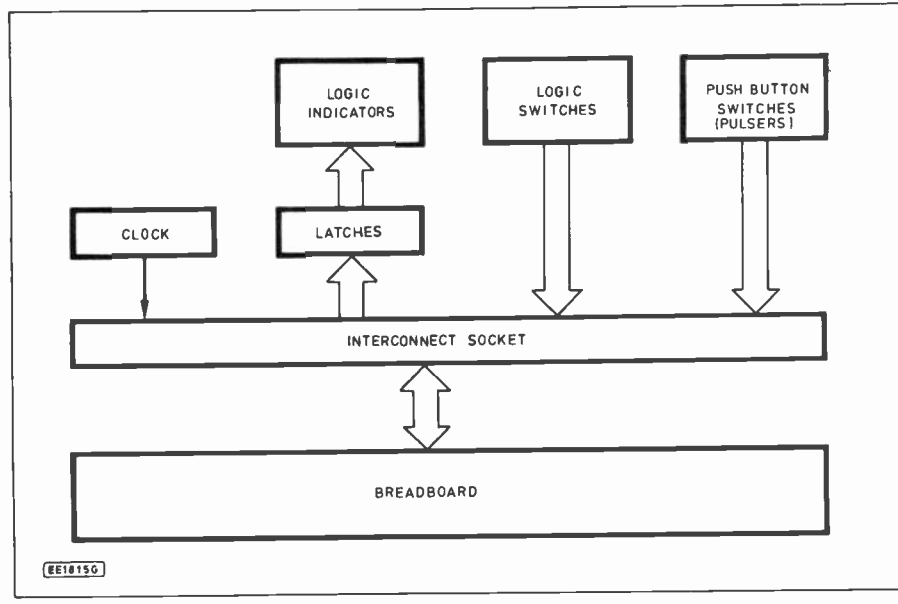
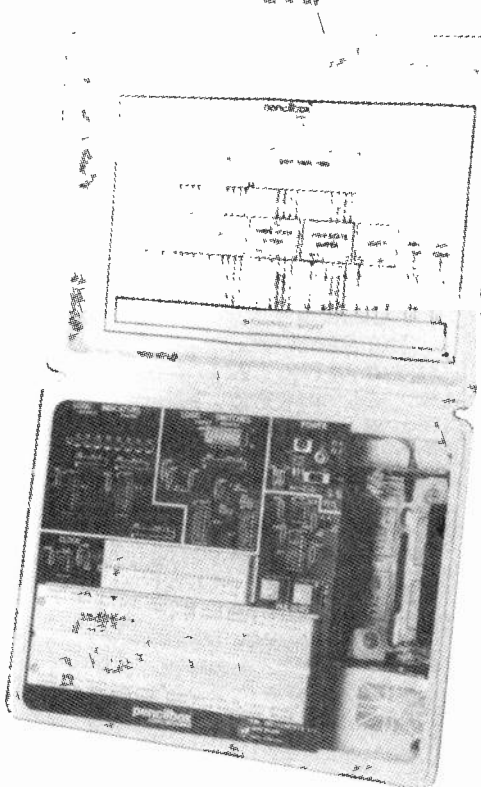


Fig. 5.23. Component and link mounting.



(b)

Fig. 5.22. The Pencilbox Logic Tutor (left) and a block diagram of it (above).



(a)

a little more difficult: the components need to be mounted properly and soldered in place neatly. The soldered joints must make a good electrical connection without causing shorts.

Mounting Components

Components and linking wires should (where possible) sit completely down on the circuit board, as shown in Fig. 5.23a. Where this is not possible the component should be mounted as low as possible without putting a strain on the connecting leads; for example, the transistor in Fig. 5.24a is fine but in Fig. 5.24b it is mounted too high.

The wires and component leads are bent at about 45 degrees on the copper strip side (Fig. 5.25) to hold

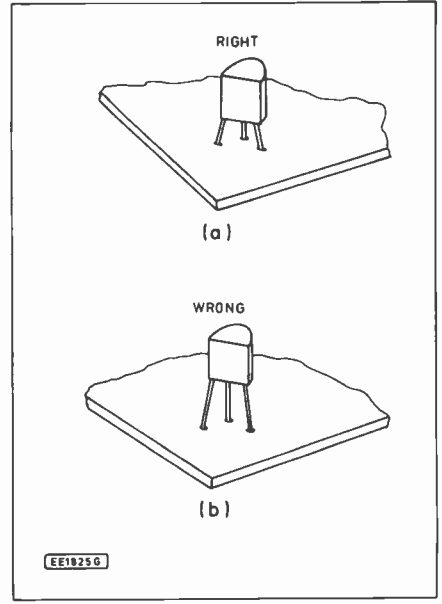


Fig. 5.24. Transistor mounting.

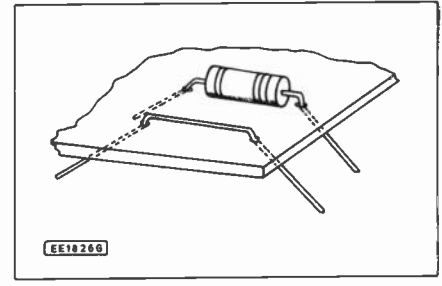


Fig. 5.25. Bend the leads to hold the component in place.

them in place when the board is turned upside-down for soldering.

Soldering

To make good soldered joints the iron must be clean and well tinned, and the component leads should be free from rust or other foreign matter. Component leads can be cleaned with a cleaning tool or an ink eraser if necessary.

Safety Notes

1. A proper earth connection must be made to all mains powered soldering irons.
2. Keep the iron in its holder or on a purpose built metal stand when not in use.
3. Switch off the iron when not in use.
4. Keep the hot part of the iron well away from its own mains lead.
5. Inspect the iron and its lead regularly for damage.

Position yourself and your work as shown in Fig. 5.26: hold the iron like a pencil and rest one or both elbows on the table (if it is comfortable to do so) while soldering. In the beginning stages you may find it difficult to keep the soldering iron steady; this will not be a problem after a time as you learn to relax.

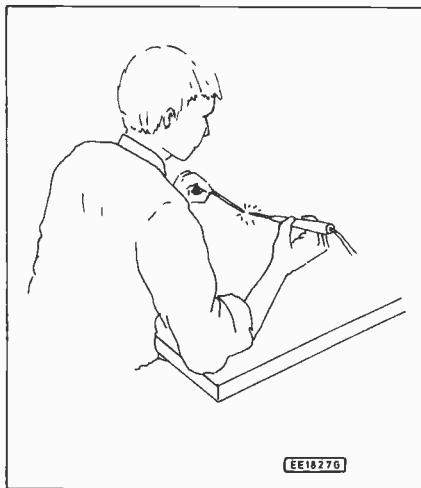


Fig. 5.26. Comfortable position for soldering.

Follow these steps to make soldered joints to stripboard:

1. Clean the hot "bit" of the iron on a damp sponge.
2. Tin the iron (apply a little solder to the hot bit).
3. Touch the iron tip to the joint until the whole area to be soldered (both the component lead and the copper strip of the stripboard) is hot enough to melt solder.
4. Apply rosin cored solder to the joint (not to the iron). The molten solder should readily flow over the joint. Apply just enough solder to cover the joint (see Fig. 5.27).
5. Remove the solder wire keeping the iron in place until the solder forms a neat joint then remove the iron (the whole soldering process should only take a few seconds), then snip off the component lead as close to the solder as possible with side cutters.
6. Examine the joint. The solder should be smooth and bright without rough patches or spikes. Fig. 5.28 shows the

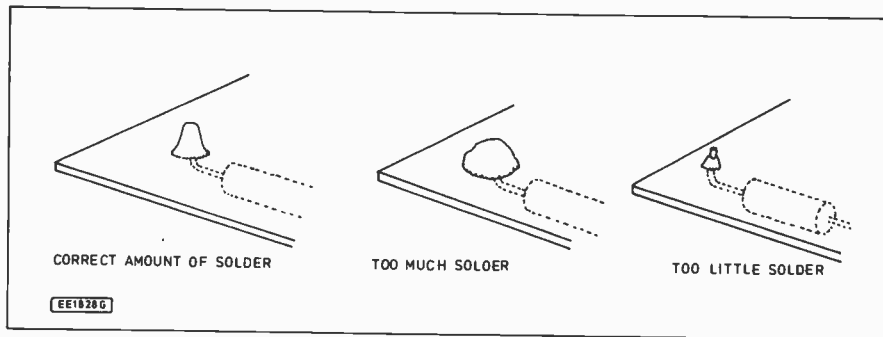


Fig. 5.27. The soldered joint.

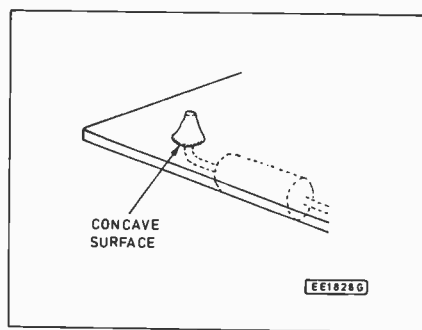


Fig. 5.28. Correct soldering.

concave surface of a perfect soldered joint. If the joint is dull, pitted, or spikey it should be soldered again.

Short Circuits

After soldering, all the joints should be thoroughly inspected for short circuits. Some common causes of shorts are shown in Fig. 5.29: loose strands of wire (a), excessive solder bringing two or more joints into contact (b), spikes (c), and splashes of solder (d). These shorts can be easily removed: shorting strands of wire can be cut, excessive solder can be removed using a desoldering tool, a "spike" can be reheated with an iron to remove it, and solder splashes can be scraped away with a small screwdriver.

For practice try making some joints on stripboard,

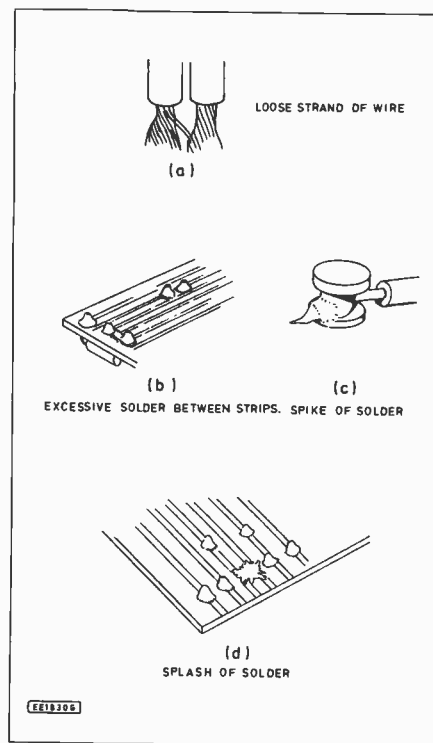
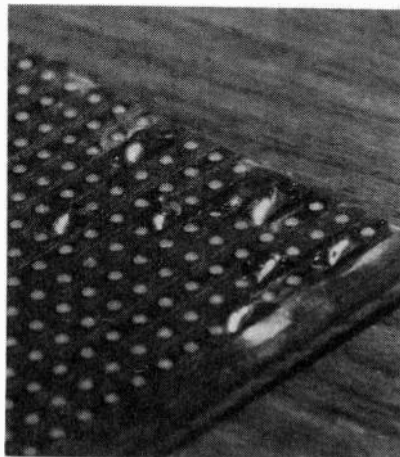


Fig. 5.29. Soldering faults.

Next month: We go on to build and test a light sensor on stripboard and include various exercises relating to component layout and logic testing on the Pencilbox (or a similar logic tutor) before getting into Switches and Relays.

PENCILBOX

The Pencilbox Logic Tutor shown in Fig. 5.22 is available to all teaching establishments, companies or private individuals direct from E & L Instruments, Dept. EE, Whitegate Industrial Estate, Whitegate Road, Wrexham, Clwyd, LL13 8UG. Tel. 0978 291030. The unit costs £79.80 plus £1.50 p&p plus VAT. It is available to overseas customers; please write for a quote.

E & L issue a free catalogue showing their range of products.



City and Guilds

ASSESSMENT CENTERS

The following letters have been received from Assessment Centres for City and Guilds courses:

DIGITAL ELECTRONICS for readers of EVERYDAY ELECTRONICS
City and Guilds 726 Information Technology Scheme Module 301—Introductory Digital Electronics

We are able to offer external candidate registration for the above scheme as well as conduct the required assessment and assignment supervision necessary for completion of the module and attainment of the Certificate.

See below for a list of costs and facilities offered, but please note that these costs are based on a minimum of 5 (FIVE) candidates so, if you're interested, persuade a couple of friends to join the scheme too!

Candidate Registration: £12.50
Covers registration with City and Guilds and with BCTC and all scheme administration costs

Written Assessment Fee £3.00
This is payable for each assessment taken or re-taken. Each candidate must take THREE

Practical Assignment Fee £12.50
This is payable for each assignment taken or re-take. Each candidate must take FOUR.

Components Set (FOUR assignments) £15.00

Components Set (per assignment) £4.00

This is payable if the candidate requires BCTC to supply components for the practical assignments. You can save by paying for the FOUR assignments at registration, if required.

Written and Practical fees are payable at the time of taking the test. It is not necessary to pay in advance.

ALL PRICES ARE EXCLUSIVE OF V.A.T., therefore ADD 15% to everything!

To register and sit all the above assessments and assignments (but no re-takes!) and use BCTC components would cost £99.50 (including VAT).
Bournemouth Computer and Technology Centre
63 Cavendish Road,
Bournemouth, Dorset, BH1 1RA
Tel. (0202) 290943

Mainport Training is engaged in both Y.T.S. and R.T. programmes; offering in-House Training for Clerical, Motor Vehicle and Engineering candidates. We are an MSC approved Training Centre and have approval from RSA and City and Guilds to run a full range of Information Technology subjects and to act as an external Examination Centre.

Mainport Training Ltd
Ferry Lane,
Pembroke, Dyfed SA71 4RE
Tel. (0646) 681431/681381
Telex: 48494

We refer to the Introductory Notes and Assessment Centres supplement included with the October 1988 edition of *Everyday Electronics*.

Upon examination it was noted that the entry against our organisation is incorrect; please note that for the past two years our telephone has been changed to 07842 42885.

We shall be obliged if you will please arrange to update the information and publish the current telephone number in a future issue of the magazine.

Acorn
ITeC
Short Lane,
Stanwell,
Staines. TW19 7BJ.
Tel. 07842 42885

I would like to confirm that this College should be included on your list of approved centres for the City and Guilds 726 Information Technology scheme.

Dewsbury College
Halifax Road,
Dewsbury,
West Yorkshire WF13 2AS
Tel. 0924 465916

Please note that this College is **not** a centre for external examination candidates. Only registered students of the College can be accepted for entry.

Reading College of Technology
Crescent Road,
Reading RG1 5SR
Tel. (0734) 583501

The only negative letter we have received?—Ed.

Since this ITeC has been omitted from the list of approved centres given in the booklet, it is doubtful if we will have many approaches from your readers on this subject.

GEC Glenrothes Information Technology Centre
Flemington Road,
Queensway Industrial Estate,
Glenrothes, Fife KY7 5QF
Tel. Glenrothes (0592)751512

The updated list was delayed by the postage strike—we apologise for any omissions—all assessment centres on the latest list were sent a letter about the series (after the strike)—Ed.

We would like to be included in your list, under Staffordshire, as a Centre which is approved for City and Guilds 726.

Cannock Chase Technical College
The Green,
Cannock, Staffordshire WS11 1UE
Tel. Cannock (0543) 462200

With reference to your publication on approved centres for City and Guilds 726 courses, I find that our college is not listed. As we are an approved centre could you please include our name in your list. If any of your readers, or yourself, wish to contact me they can do so at the address below.

Mr. J. J. Stanton,
W. R. Tuson College,
Trinity Annex,
Great Shaw Street,
Preston. PR1 2HH
Tel. (0772) 53558 Extn 202

Further to your letter concerning City and Guilds 726/301 Introductory Digital Electronics, Ipswich ITeC Ltd. would be pleased to accept registration for candidates and would be grateful if you would include our details in your next issue as they were omitted from the booklet. If possible could you include the contact names Sue Butcher/Ted Shawki and "prices on application".

Ipswich ITeC Limited
Argyle Street,
Ipswich. IP4 2NA
Tel. (0473) 21645

With reference to your letter dated 26th September, I am pleased to confirm that we are prepared to register candidates for the C & G 726/301 Assessments.

We also see opportunities to attract a different group of clients into the Department by offering tutorials providing we can attract sufficient numbers. Perhaps you would be able to publicise this if we gave you dates starting in January. We envisage perhaps one mainly practical tutorial per month, running as a drop-in facility between 6.00 pm and 9.00 p.m. Naturally, we would have a lecturer knowledgeable in Digital Electronics and a Technician on hand in

a well equipped Laboratory/Workshop. We would have to charge a fee, but this would not be excessive.

We wish you well with this initiative and hope that it will make worthwhile the treatment of other C and G 726 modules in the same way.

De Havilland College
The Campus,
Welwyn Garden City,
Hertfordshire. AL8 6AH
Tel. (0707) 326318

We note with pleasure the course that is to be offered in your magazine *Everyday Electronics*. East Birmingham College is willing to offer a complete package to support any readers of your magazine who wish to follow the series:-

This package would consist of:-

- * Registration fee
- * Access to electronic workshops, tools and equipment
- * Written and practical assignments
- * Support time in our electronics learning development centre.

The cost of the package would be between £30 to £60 depending upon the amount of support time required.

East Birmingham College
Garrets Green Lane,
Birmingham. B33 0TS
Tel. (021) 743 4471

I am pleased to be able to tell you that we can offer the following facilities for the 726/301 certificate.

I would estimate the services and costs to be:

- 1) Registration of candidate, course booklets and logbook provided, £10.00.
- 2) Testing of candidate for three written and four practical tests assuming 1 hour/written, 2 hour/practical duration, at a cost of £12.50.
- 3) Retakes for either written or practical tests £2.00 per test.
- 4) "Drop in" facility to cover elements of the course with ITeC equipment and on ITeC premises with skilled tutor assistance, at £1.50 per hour.

Doncaster ITeC provides quality training at all levels for both computing and electronic vocational qualifications. We also provide consultancy and business services in computing to the local community.

Doncaster ITeC
St. Wilfrid's Road,
Cantley,
Doncaster. DN4 6AH
Tel. (0302) 537341/2

We are not listed in your booklet and I would ask you to amend this situation as soon as possible. A similar situation occurred with "Introducing Microprocessors Course" published by your magazine last year.

As a college we are most eager to par-

ticipate in the scheme and fully support your innovative stand, but if people do not know where we are, they cannot come to us.

Watford College
Hempstead Road,
Watford,
Hertfordshire WD1 3EZ
Tel. Watford 57500

We are pleased to concur—Ed.

This is to confirm that Reading ITeC are pleased to be able to offer a comprehensive service to all applicants to the C and G 726/301 course in Digital Electronics and we welcome your initiative in encouraging beginners to the subject.

We have already had a number of enquiries and are soon to commence a specially timed course.

At least one company have indicated their interest to support employees in this scheme financially and we hope to extend this involvement to include more advanced units at a later time. Would you be considering doing the same?

The details in the October issue regarding Reading ITeC are correct.

Reading Information Technology Centre
Liverpool-Victoria House,
3rd Floor, 7 Cheapside,
Reading. RG1 7AQ
Tel. (0734) 598515
Fax: (0734) 508315

We are considering going on to more advanced levels in future publications. Of course our Introductory Microprocessors book is now available—see the Direct Book Service pages for full details.—Ed.

Please note the 'phone number for Gateshead ITeC is incorrect in your booklet. It should be: 091 4785096.

May I inform you of the actual address of the centre, in your magazine you quoted the telephone number of the Civic Centre.

Alex Fenyvesi
Middlesex Training Centre,
Futures House,
Clayton Road,
Hayes, Middlesex.
Tel. (01) 756 1516

The booklet enclosed with your circular letter (and issued with EE) does not list this College as approved centre. I therefore confirm the telephone request, and would be grateful if you could add this college to your list of centres and also publish the fact as soon as it is convenient.

W. Crompton
Lecturer
Bridgend College of Technology,
Cowbridge Road,
Bridgend,
Mid Glamorgan, CF31 3DF
Tel. Bridgend 766588

The Gloucestershire ITeC is the only centre in the county offering the facilities for 726/301 Introductory Digital Electronics or 726/303 Introductory Microprocessors.

Open Learning Students to contact Mr. D. Griffin or Mr. E. Johnson on Gloucester 0452 613141. (Our telephone number is 0452 613141. Not as stated by City and Guilds).

Gloucestershire Information
Technology Centre
Larkhay Road,
Hucclecoat,
Gloucester
GL3 3NT.
Tel. (0452) 613141

The Open Learning Support Unit (OLSU) has been created to serve the needs of participants in Open Learning courses. The unit provides an examination centre for City and Guilds and other distance learning qualifications, and offers unsupervised use of specialist electronic and computer equipment.

For those without the necessary equipment, fully equipped support facilities are available on an unsupervised basis for a fee of £2.50 per hour. Hot and cold drinks and snacks can be purchased on the premises. The Support Unit is currently open from 10am to 4pm Monday to Thursday.

Registration fees (non returnable £10.00 per course
Support, administration,
examination and certificate
fees (payable on completion
..... £40.00 per course

Registration may be made in person during normal opening hours or by post—enclosing the registration fee and stating which course is required.

Peterborough Information
Technology Centre,
Vicarage Farm Road,
Peterborough,
PE1 5TP
Tel. (0733) 312120

PLEASE NOTE

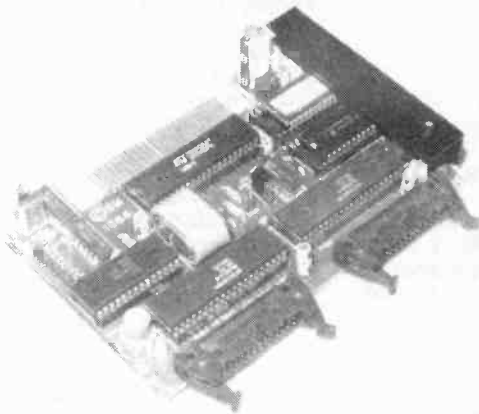
This is by no means a complete list of centres that will assess readers. It is simply those centres that have written to us.

Response to the course has been exceptional and we believe that most readers have been able to find a relatively local assessment centre that will take them.

We would like to thank the many readers, instructors and centres who have offered their assistance and encouragement with this series. By the way our previous series for City and Guilds (726/303) *Introducing Microprocessors* is now available in book form price £2.45. See *Direct Book Service* pages for ordering this and "Electronics"—the book recommended for background reading for *Introducing Digital Electronics*.

Z80A MICROCONTROLLER

A low cost single board micro-system providing all the requirements needed for many applications in industrial, experimental and educational fields.



Just some of its extensive features include:

- * Z80A CPU operating at 4MHz
- * EPROM socket—jumper link selectable as 2, 4, 8, 16 or 32K accepts 2716/2732/2764/27128/27256 EPROMS
- * RAM socket—jumper link selectable as 2, 8, 32K accepts 6116/6264/62256 CMOS static RAMS—battery back up included
- * INPUT/OUTPUT—2 Z80A PIOs providing 32 programmable I/O lines
- * HARDWARE COUNTER/TIMER—a Z80A CTC providing four independent counter/timer circuits
- * Expansion boards available—DtoA, 8 channel AtoD, RS232 serial I/O etc
- * Full documentation and user notes

Z80A Single Board Controller fitted with 2Kx8 CMOS static RAM ONLY £94.95+VAT—BUILT AND TESTED!!

Specialising in microprocessor data logging and control applications, we provide a complete service covering any or all of the stages from initial hardware and software design through manufacture to final installation. Phone/send for full details—OEM, trade and overseas enquiries welcome

SM ENGINEERING
Telephone 0323-766262

'St Georges' Lion Hill, Stone Cross
Pevensey, East Sussex BN24 5ED

QUALITY... SECURITY SUPPLIES FOR DIY & TRADE

...AT LOWEST PRICES

CONTROL UNITS

- Automatic ■ Modular
- Lighting ■ Timer

SENSORS

- Passive Infra-Red
- Ultrasonic
- Infra-Red Beam

ACCESSORIES

- Contacts ■ Pressure Pads

CARS & VANS

- Security Lighting
- Cable Etc. Etc.

HOMES & FACTORIES

PRODUCT OF THE MONTH



CA 1382 LOW COST FULL FEATURE ALARM CONTROL UNIT SUITABLE FOR ALL TYPES OF INSTALLATIONS

- Automatic Loop Test
- 24hr Personal Attack Protection
- Audible Exit/Entry Warning
- Audio, Siren Re-Set
- Easily Installed.

ONLY £44.95 + VAT

The Security Specialist

RISCOMP LIMITED

Dept. EE2, 51 Poppy Road,
Princes Risborough, Bucks.
HP17 9DB

Callers by Appointment
Office hours Mon-Fri
9am-5pm



(084 44) 6326

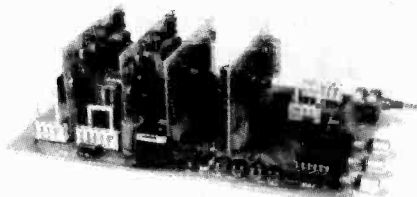


TELEPHONE
OR SEND FOR
FREE
LITERATURE
TODAY

HART

HART ELECTRONICS are specialist producers of kits for designs by JOHN LINSLEY-HOOD. All kits are APPROVED by the designer.

LINSLEY-HOOD CASSETTE RECORDER CIRCUITS



Complete record and replay circuits for very high quality low noise stereo cassette recorder. Circuits are optimised for our HS16 Super Quality Sendust Alloy Head. Switched bias and equalisation to cater for chrome and ferric tapes. Very easy to assemble on plug-in PCBs. Complete with full instructions.

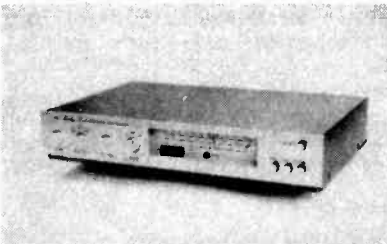
Complete Stereo Record/Play Kit £33.70
VU Meters to suit £2.30 each
Reprints of Original Articles 75p no VAT
860X Stereo Mic Amplifier £8.70

LINSLEY HOOD 300 SERIES AMPLIFIER KITS

Superb integrated amplifier kits derived from John Linsley-Hood's articles in 'Hi-Fi News'. Ultra easy assembly and set-up with sound quality to please the most discerning listener. Ideal basis for any domestic sound system if quality matters to you. Buy the kit complete and save pounds off the individual component price.

K300-35 35 Watt Discount price for Complete Kit £98.79
K300-45 45 Watt. Discount price for Complete Kit £102.36
RLH4&5. Reprints of Original Articles from 'Hi-Fi News' £1.05 no VAT

LINSLEY-HOOD SUPER HIGH QUALITY AM/FM TUNER SYSTEM.



Our very latest kit for the discerning enthusiast of quality sound and an exotic feast for lovers of designs by John Linsley-Hood. A combination of his ultra high quality FM tuner and stereo decoder described in "ELECTRONICS TODAY INTERNATIONAL" and the Synchrondyne AM receiver described in "Wireless World". The complete unit is cased to match our 300 Series amplifiers. Novel circuit features in the FM section to include ready built pre-aligned front-end phase locked loop demodulator with a response down to DC and advanced sample and hold stereo decoder together make a tuner which sounds better than the best of the high-priced exotica but, thanks to HART engineering, remains easy to build. The Synchrondyne section with its selectable bandwidth provides the best possible results from Long and Medium wave channels, so necessary in these days of split programming. If you want the very best in real HiFi listening then this is the tuner for you. Since all components are selected by the designer to give the very best sound this tuner is not cheap, but in terms of it's sound it is incredible value for money. To cater for all needs four versions are available with variations up to the top of the range full AM/FM model, with any unit being upgradeable at any time. Send for our fully illustrated details.

DIGITAL ELECTRONICS COURSE
Send for your FREE list of the tools and components you will need for this exciting new series.

With every set of course components purchased we give a free £5 discount voucher, valid for six months.

HIGH QUALITY REPLACEMENT CASSETTE HEADS



Do your tapes lack treble? A worn head could be the problem. Fitting one of our replacement heads could restore performance to better than new! Standard mountings make fitting easy and our TC1 Test Cassette helps you set the azimuth spot-on. We are the actual importers which means you get the benefit of lower prices for prime parts. Compare us with other suppliers and see! The following is a list of our most popular heads, all are suitable for use on Dolby machines and are ex-stock.

HC20 Permalloy Stereo Head. This is the standard head fitted as original equipment on most decks £7.66
HS16 Sendust Alloy Super Head. The best head we can find. Longer life than Permalloy, higher output than Ferrite, fantastic frequency response £14.86
HQ551 4-Track Head for auto-reverse or quadrophonic use. Full specification record and playback head £14.60
HX100 Stereo Permalloy R/P head. Special Offer £2.49
MA481 2/2 Language Lab R/P head £13.35
SM166 2/2 Erase Head. Standard mounting, AC type £8.85
SM150 2/2 Erase Head. DC Type £3.60
HQ751E 4/4 Erase Head for Portastudio etc. £46.80
Full specifications of these and other special purpose heads in our lists.

HART TRIPLE-PURPOSE TEST CASSETTE TC1

One inexpensive test cassette enables you to set up VU level, head azimuth and tape speed. Invaluable when fitting new heads. Only £4.66 plus VAT and 50p postage.

Tape Head De-magnetiser. Handy size mains operated unit prevents build up of residual head magnetisation causing noise on playback £4.54
Curved Pole Type for inaccessible heads £4.85

Send for your free copy of our *LISTS*. Overseas please send 2 IRCs to cover surface Post of 3 IRCs for Airmail.

Please add part cost of post, packing and insurance as follows:

INLAND
Orders up to £10 - 50p
Orders £10 to £49 - £1
Orders over £50 - £1.50

OVERSEAS
Please send sufficient to cover Surface or Air Post as required.

Personal callers are always very welcome but please note that we are closed all day Saturday

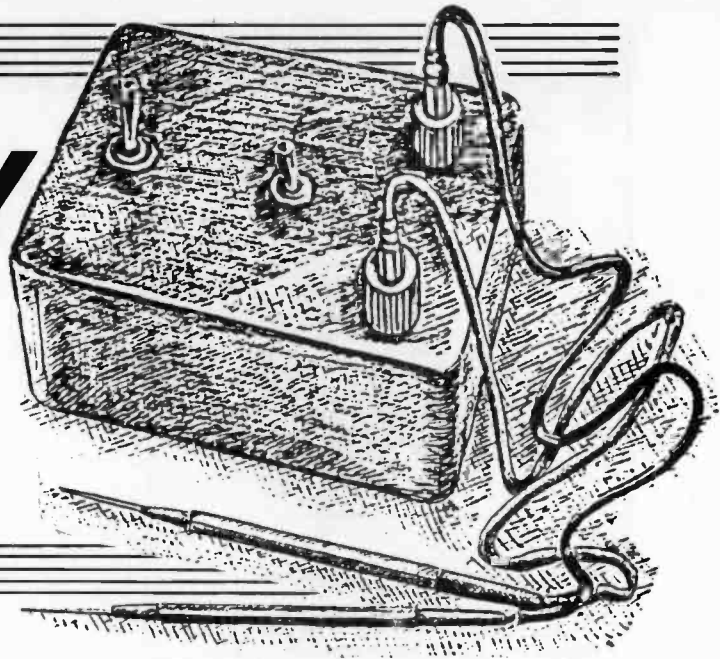
24hr SALES LINE
(0691) 652894

ALL PRICES EXCLUDE VAT
UNLESS STATED



CONTINUITY TESTER

JOHN RUGG



A simple but invaluable testing device that is a vast improvement on simple buzzer type continuity testers.

MOST of us have at one time or another had cause to use a continuity tester. Perhaps the most common domestic example is that of testing whether or not a fuse has blown in the plug of some household appliance. In this sort of situation, where the resistance of the component under test can be one of two widely separated values (i.e. zero ohms for a good fuse, infinity ohms for a dud one), all circuit testers will perform satisfactorily.

For the home electronics enthusiast, things are never so simple. In any circuit, normal resistances are scattered over a very large range, so tracking down a fault is more tricky. For example, a continuity tester which operates a l.e.d. for resistances of less than 100 ohms, will be useless if you are trying to confirm that a 47 ohm resistor is correctly connected.

Can continuity testers be this bad, I hear you ask? The answer is most definitely YES! Continuity buzzers fitted to Digital Multimeters (DMM's) typically show continuity for resistances up to a couple of hundred ohms, and one tester I used showed continuity for resistances of several kilohms!

This really begs the question of what we expect a continuity tester to do. What might the characteristics of the ideal device be?

(a)—The most important is that the device should be able to detect a short circuit. By my definition this means resistances of less than about one ohm (not 200 ohms!). With this sort of performance we will for example be able to find bad connections that have resistances greater than one ohm, and check that very low value resistors are correctly connected in any circuit.

(b)—As well as short circuits, the device must be able to detect open

circuits (say greater than about one megohm). This is ideal for checking isolation between tracks on a board (e.g. Verostrip cut with a spot face cutter).

(c)—Diodes and transistors should not cause the device to give false readings (a diode is not a short circuit!),

(d)—The device should consume no power and occupy no space. This means you don't have to buy batteries very often and it fits in your pocket.

BASIC PRINCIPLE

The fact that we have to decide whether the resistance between the test probes is greater than or less than a certain value (i.e. one ohm or one megohm), means that we are performing a comparison. This immediately suggests that we might be able to use a comparator. A standard bridge network is ideal for this sort of application and the circuit diagram Fig. 1 shows the basic scheme.

When resistors $R1/R2=Rx/R3$, the input voltages to the comparator are equal. If we make $R1=R2=R3=$ one ohm, then if Rx is less than one ohm the comparator's positive input is highest, and the output is high. Conversely, if Rx is greater than one ohm, then the output will be low. If we now change $R3$ to one megohm by using a switch, then we have a device that will detect open circuits too.

The "sense voltage" is the voltage that appears between the test probes for an open circuit. If the sense voltage was 2V, diodes would appear as a short circuit, since with a forward voltage drop of 0.7V, the positive input of the comparator would be highest.

This is clearly no good (unless we wish to use the device to check diode polarity). Another reason for reducing the sense voltage is that we do not want to damage the circuit under test by applying large voltage biases between two parts of an unpowered circuit. Therefore, a sense voltage of 0.2V has been chosen for this design.

Moving on to consider power consumption, since we are using a linear i.c. (the comparator) we will probably need a supply voltage of at least 6V. A PP3 9V battery is appropriate since they are small and easily available.

With the circuit so far described, a short circuit between the probes will cause a current of $I=V/R=0.2V/1\text{ ohm}=200\text{mA}$ to flow. This is far too large if we want the battery to last very long.

The other thing we must consider is how to generate the sense voltage in the first place. Fig. 2 shows how these problems can be overcome.

In order to reduce the current, resistor $R5$ has been added. Both $R3$ and $R5$ are 220 ohms. We have now complicated the issue by trying to resolve the difference between 220 ohms and 221 ohms. In this situation the input offset voltage of the comparator has a direct impact on the resistance resolution. Varying Rx from 0 to 1 ohm will change the voltage on the comparator positive input by

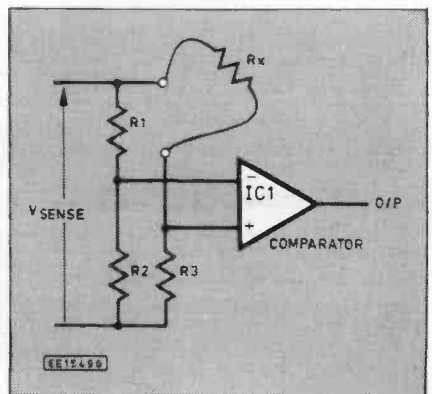


Fig. 1. Basic comparator principle.

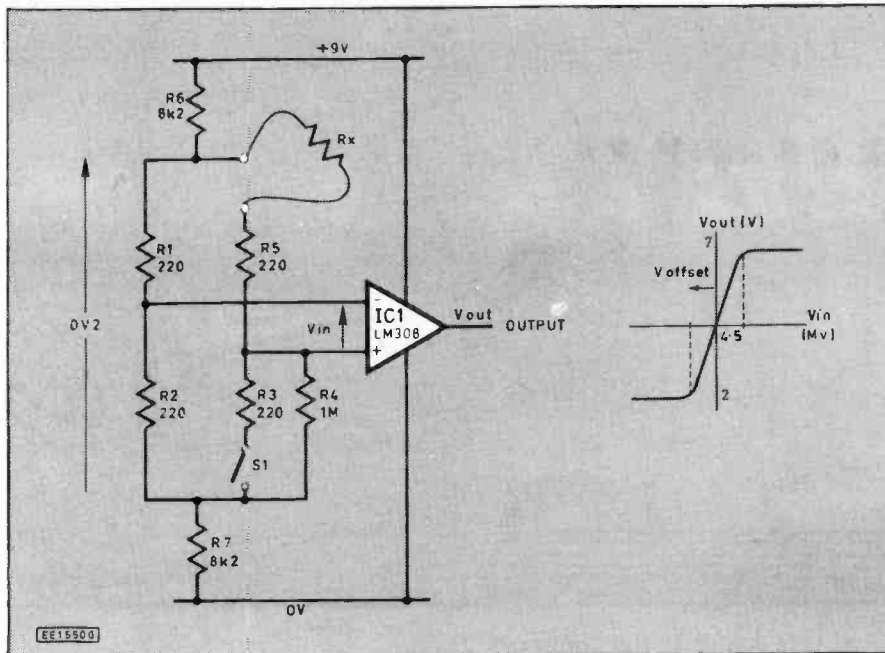


Fig. 2. Improved sense network.

one $\text{ohm} \times 0.2\text{V} / (R3 + R5) = 0.5\text{mV}$. This has to be sufficient difference for the comparator to change state.

Comparators are normally optimised for fast switching applications. Since we do not need fast switching performance in this application, we can use an op-amp instead. An ideal power economic op-amp i.c. is the LM308. It has a current consumption of just 0.3mA and an input offset voltage of 2mV. The offset looks too large for our needs but in fact this does not turn out to be a difficulty.

OUTPUT

An important consideration is the type of output we require from the tester. LED outputs are simple to implement, but take a lot of current (10mA–15mA). Also, and perhaps more importantly, it is often difficult to look at the test probes (to keep them in the right place) and an l.e.d. indicator some distance away, at the same time. An audio output, however, is just what the doctor ordered to reduce this sort of eye strain.

Using a conventional eight ohm speaker will be wasteful of power, and a preferable method is to use a piezo-electric transducer. A suitable audio interface circuit diagram is shown in Fig 3.

Since the output of the op-amp will be neither high (9V) or low (0V) for marginal values of resistance but somewhere in

between, a Schmitt trigger buffer is needed to turn it into a clean on/off signal. See Fig. 4.

By effectively introducing this threshold on the op-amp output, the resolution of the device is increased over what one might expect given the input offset of the op-amp. The CMOS CD40106 (IC2) is a good choice here since it consumes virtually no power and will run happily from a 9V rail.

There are six Schmitt inverters on the chip and we can use one of the others to make a square wave oscillator. The values of R and C are chosen to give an audio output of about 1kHz but the exact frequency can vary depending on the thresholds provided by the Schmitt inverter. By varying R or C slightly you will be able to produce a tone you are happy with.

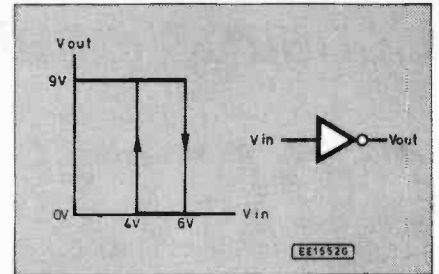


Fig. 4. Schmitt trigger characteristics.

The piezo-electric transducer WD1 is driven directly by the oscillator output. The oscillator output is disabled when the first inverter output is high.

This leaves four other inverters that are spare. If you wish these can be used to drive an l.e.d. indicator (all connected in a parallel configuration), or to produce two tones (one for one megohm, one for one ohm).

IDIOT PROOFING

The design given so far will perform well in tests on unpowered circuitry. However, it is inevitable that eventually it will be used on powered circuitry by mistake. We have to make sure that the tester is not destroyed. One might expect the worst case to be connection across a plus and minus 15V supply, i.e. 30V between the test probes!

From Fig. 2 there are several ways in which damage could occur:

- (a)–Resistors R1, R2, R3, R5 get hot. 30V across 4×220 ohms gives $\frac{1}{4}\text{W}$ of power dissipation in each resistor.
- (b)–Current will try to get pumped into the battery.
- (c)–Op-amp input pins may be biased at voltages outside the voltage appearing at the supply pins.
- (d)–If the supply rail exceeds 20V, the CMOS chip will fail.

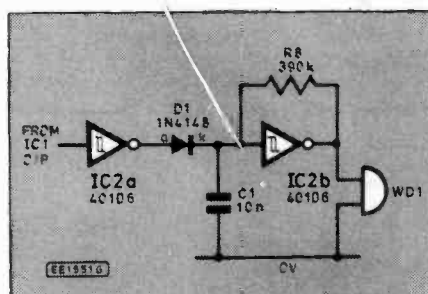


Fig. 3. Audio output stage.



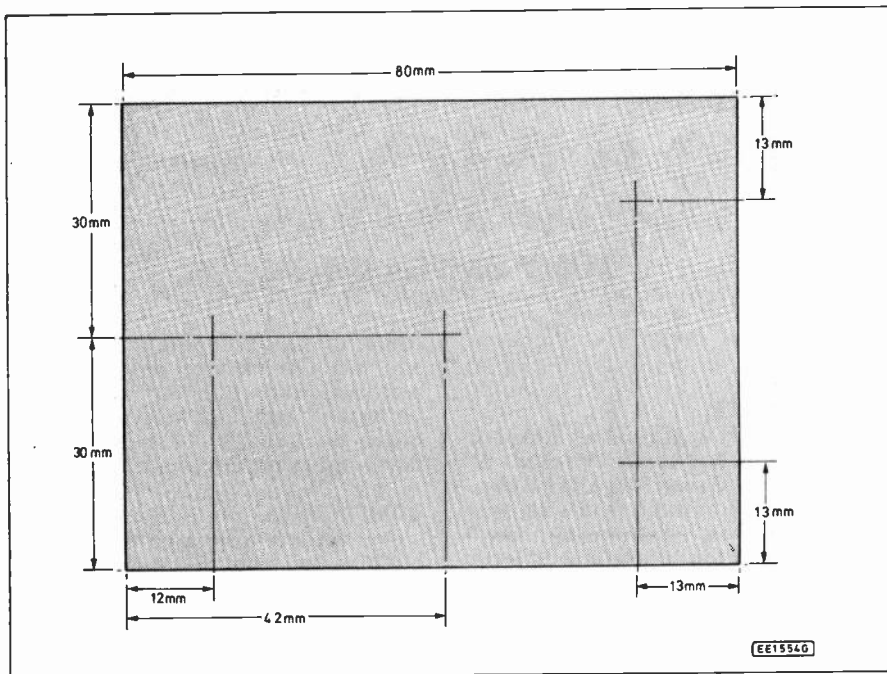
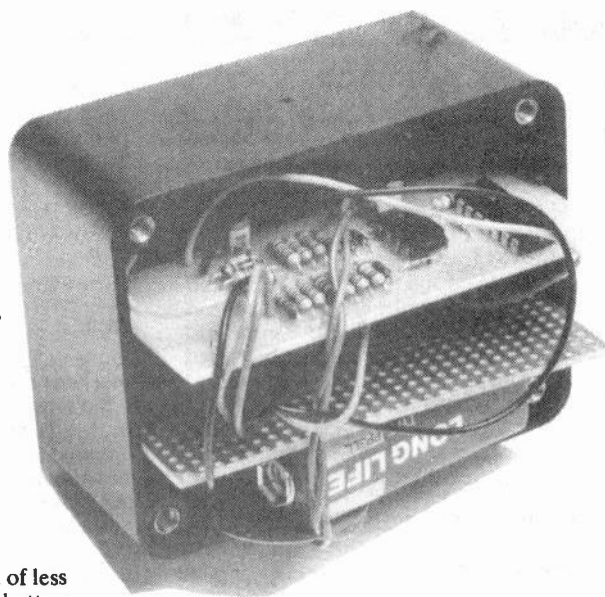
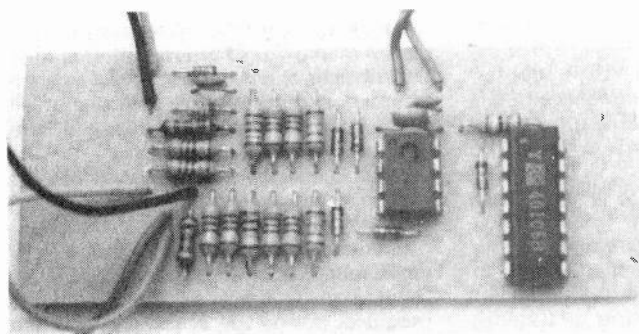


Fig. 7. Case drilling details.

Apart from testing for open and short circuits, the design also allows us to make measurements of capacitance. With the device set to detect resistances of less than one megohm a discharged capacitor connected between the test probes will cause it to buzz. This will continue until the capacitor has charged above 50 per cent of the sense voltage, when the buzzing will stop.

This behaviour can be well described mathematically, and it turns out that for the circuit values we have used the duration of the buzz (seconds) = $0.7 \times C$, where C is in microfarads. With the aid of a watch then, capacitors in excess of $1 \mu F$ can be measured. However, larger electrolytic capacitors can be leaky and if the leakage current exceeds $100 \mu A$ then the Continuity Tester will not stop buzzing.

The tester is ideal for testing domestic fuses, but be careful when it comes to testing very low current fuses (typically 20mm types), since these often have a normal impedance of more than 1 ohm. If you think this is likely to be a problem it may be worth increasing the resistance threshold to a larger value (say 10 ohms). □



size and place it across the box in the slots provided. This leaves a space just large enough for the PP3 battery.

The piezo-transducer can be jammed between the battery and the side of the box (make a few small holes in the case here to let the sound out!). The transducer is supplied without leads and extreme care must be taken when making connections to it; use the minimum of heat and solder.

IN USE

The current consumption of the entire circuit comprises about 0.5mA through the main resistor network, and 0.3mA for the LM308. With a total current of less than 1mA it is clear that the battery will last for a very long time.

EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

NEWSAGENT ORDER FORM

Please reserve/deliver a copy of *Everyday Electronics* for me each month.

Signed

Name and Address

(BLOCK CAPITALS PLEASE)

.....

.....

Everyday Electronics is published on the first Friday of each month and distributed by Seymour.

Make sure of your copy of EE each month—cut out this form, fill it in and hand it to your newsagent.

EVERYDAY ELECTRONICS

SUBSCRIPTION ORDER FORM



Annual subscription rates (1989): UK £15.70. Overseas £19 (surface mail) £36 (air mail)
To: Everyday Electronics, Subs. Dept., 6 Church Street, Wimborne, Dorset BH21 1JH.

Name

Address

.....

I enclose payment of £ (cheque/PO in £ sterling only payable to Everyday Electronics)

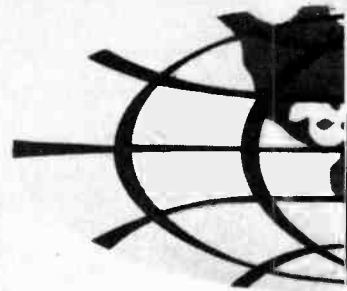
Access or Barclaycard No.  

.....

Signature Card Expiry Date

Please supply name and address of card-holder if different from the subscription address shown above.
Subscriptions can only start with the next available issue. For back numbers see the Editorial page.

...REPORTING AMATEUR RADIO... TONY SMITH G4FAI



STUDENT LICENCE?

The Radio Society of Great Britain has published a consultation document containing its proposals for a Student licence as part of Project YEAR, "Youth into Electronics via Amateur Radio". The Society proposes to provide basic training in electronics by means of a simple study course leading to the acquisition of a "Student Licence". This, it is hoped, will permit holders to operate low power amateur radio equipment using Morse code and, in some cases, speech, computer-based or other modes, on designated frequencies. This, says the Society, will provide world-wide communication and a freedom to develop skills "in a manner that is prohibited to holders of the Citizens Band Licence."

It is envisaged that the course will involve no more than 30 hours of classroom and home study, plus the time necessary to learn to use Morse code at 5 words per minute. The examination would be of the multiple-choice type, relying heavily on visual presentation such as block and pictorial diagrams.

A draft syllabus has been published and this covers eight areas of study on practical subjects — Components and units of measurement; Concepts of communication practice; Measurements; Interference, and how to avoid it; Electrical safety; Propagation theory; Antennas/feed lines/test equipment; Operating an amateur station.

IN SCHOOL CURRICULUM?

It is visualised that apart from providing the necessary qualification to obtain a "Student" amateur radio licence, the passing of this examination would be of significance to the education activities of youth movements and to young people seeking employment in the electronics field. Encouraged by news that the State of New York is about to introduce amateur radio as a subject in its schools, the RSGB even dreams of the eventual inclusion of basic amateur radio in the UK school curriculum!

Of course, everything is still at the discussion stage and no proposals have yet been put to the licensing authority, the DTI. There is much discussion to take place amongst the membership of the RSGB before final proposals can be put forward and already there is disagreement in the ranks.

The main objection is that a student licence would admit unskilled operators to already overcrowded bands but the RSGB argues that successful completion of the proposed syllabus, with its emphasis on practical procedures, would ensure a satisfactory standard of operating among those qualifying for the new licence. They would not, in any case, be allowed to operate in the popular sections of the bands but would be

allocated small sections of the less-used bands.

LOW-COST KITS

The objective is to provide an inexpensive entry into the hobby by means of low cost easy-to-assemble kits for simple receivers, transmitters, aerials and appropriate test instruments, constructed under the supervision of local instructors. Much work will need to be done to bring the various proposals to fruition, to set up the necessary training and examination procedures both nationally and locally, and to get the student licence formally recognised.

The RSGB hopes for support from government bodies, the electronics and communications industries, and broadcasting organisations. They are proposing to call an "Industry YEAR" conference to discuss their proposals and it is presumably a mark of DTI approval to the basic idea that this will be held at the DTI conference centre.

The Society seeks involvement from educationalists, youth movements, publishers, and organisations for the retired and the disabled. It also looks to its own members who will play an important role in assisting or training those wishing to enter amateur radio by this new route.

So when will it all happen? the RSGB is optimistic that if all goes well DTI approval will be given in time for student licensing to begin "sometime during 1989". I will report on progress in due course.

CONSTRUCTION RESTRICTIONS

One of the attractive features of holding an amateur licence is that a radio amateur is legally permitted to construct transmitting equipment for use on the bands covered by his licence. It seems paradoxical, therefore, at a time when there are active proposals to permit "student" entrants to amateur radio to build such transmitters, that the new amateur licence effective from 1st January 1989 (see this column, November 1988) should contain a footnote which apparently forbids home construction of transmitters for the amateur 10 metre band.

Members are taking the RSGB to task for negotiating a new licence on their behalf which contains such a restriction and many are unhappy about the explanation they have received. The ban arises from the Wireless Telegraphy (Citizens Band and Amateur Apparatus) (Various Provisions) Order 1988, which restricts the importation, manufacture or assembly of apparatus covering 26.1 to 28MHz to type-approved equipment.

The RSGB says that it objects strongly to the inclusion of the amateur band in this Order, the purpose of which was to prevent the import or manufacture of

illegal CB equipment. However, they say, the DTI insisted on linking the amateur with the CB frequencies because of the possibility of amateur 10 metre (ie, 28.00-29.7MHz) equipment being converted for illegal CB use.

COMPROMISE

The Society also says that a compromise has been negotiated with the DTI whereby *bona-fide* amateurs may make individual applications to the Radio Investigation Service for a "readily available" authority to be exempt from the provisions of the Order.

It is this "compromise" which has caused the upset. Licensed amateurs, who are permitted by the terms of their licence to construct or modify equipment to use on all other amateur bands, cannot see the point of having to apply for an exemption which will automatically be given because they are already licensed.

If possession of an amateur licence automatically ensures exemption, they ask, why cannot the Order simply say so instead of creating the possibility of thousands of unnecessary applications having to be processed? Some cynics suggest that all this is just an excuse to increase the price of the amateur licence since the cost of the licence reflects the amount of work necessary to administer it!

SINISTER PLOT?

A more alarming suggestion is that it is the thin end of the wedge, the beginning of a sinister plot to erode traditional hard-earned amateur privileges, a hardening of official attitude to amateur radio leading, even, to a loss of allocated frequencies as part of the coming process of privatising the radio spectrum. When I heard this suggestion I felt that I should put the matter to the test. I duly wrote to the DTI as advised by the RSGB, seeking authority, as a licensed radio amateur, to construct a single-band transmitter for use on the amateur 28.0 to 29.7MHz band. I gave no further information.

In theory, I should receive an automatic, no-questions-asked, authority by return. If everything was above board, the fact that I possess an amateur licence would provide all the information required. I can already construct any transmitter I like on the other bands, provided the finished product is in accordance with the terms and conditions of my licence.

I sent my application at the beginning of November and I received a prompt acknowledgement stating that the Department would be contacting me again as soon as possible. At the time of writing, mid-November, I have heard nothing further. Why is this, I wonder? Have I called their bluff?

NATIONAL COMPONENT CLUB

SPECIAL OFFERS * SPECIAL OFFERS

5	555 TIMER (IC's)	£1
5	741 OP-AMPS	£1
12	LED's (5mm red or green)	£1
25	GENERAL PURPOSE TRANSISTORS (BC 548, BC182 etc)	£1
15	BATTERY CLIPS (PP3)	£1
25	ASSORTED POTS & PRESETS	£1
70	ASSORTED CAPACITORS (Picofarads-2200uf)	£1
25	ELECTROLYTIC CAPACITORS (1uf-2200uf)	£1
1	6V 1.8VA POWER SUPPLY	£1
?	MYSTERY PACK	£1
10	CROCODILE CLIPS (5 red and 5 black)	£1
1	90db PIEZO SOUNDER	£1

**ANY SIX PACKS FOR A FIVER !
ALL TWELVE FOR A TENNER !**

P.O. or Cheque to: NATIONAL COMPONENT CLUB, DEPT.EE,
HIGHER ANSFORD, CASTLE CARY, SOMERSET BA7 7JG.
Please add £1 P & P but do not add VAT.

✪ **FREE CLUB MEMBERSHIP** ✪

TOTAL ENERGY DISCHARGE ELECTRONIC IGNITION

IS YOUR CAR AS GOOD AS IT COULD BE ?

- ★ Is it **EASY TO START** in the cold and damp? Total Energy Discharge will give the most powerful spark and maintain full output even with a near flat battery.
- ★ Is it **ECONOMICAL** or does it "go off" between services as the ignition performance deteriorates? Total Energy Discharge gives much more output to fire lean fuel mixtures.
- ★ Has it **PEAK PERFORMANCE** or is it flat at high and low revs. where ignition output is marginal? Total Energy Discharge gives a more powerful spark from idle to the engines maximum (even with 8 cylinders).
- ★ Is the **PERFORMANCE SMOOTH**? The more powerful spark of Total Energy Discharge eliminates the near "misfires" whilst an electronic filter smoothes out the effects of contact bounce etc.
- ★ Do the **PLUGS AND POINTS** always need changing to bring the engine back to its best? Total Energy Discharge eliminates contact arcing and erosion by removing the heavy electrical load. The timing stays "spot on" and the contact condition does not affect the performance either. Larger plug gaps can be used, even wet or badly fouled plugs can be fired with this system.
- ★ **TOTAL ENERGY DISCHARGE** is a unique system and the most powerful on the market - 3.5 times the power of inductive systems - 3 times the energy and 3 times the duration of ordinary capacitive systems. Send for full technical details
- ★ **ALSO FEATURES**
EASY FITTING, STANDARD/ELECTRONIC CHANGE-OVER SWITCH,
STATIC TIMING LIGHT and DESIGNED IN RELIABILITY (14 years experience and a 3 year guarantee)
- ★ In **KIT FORM** it provides a top performance system at less than half the price of a comparable ready built unit. The kit includes: pre-drilled fibreglass PCB, pre-wound and varnished ferrite transformer, high quality 2µl discharge capacitor, case, easy to follow instructions, solder and everything you need to build and fit to your car. All you need is a soldering iron and a few basic tools.

TOTAL ENERGY DISCHARGE KIT £17.95 { Prices include VAT
ASSEMBLED READY TO FIT £23.90 { Add £1.00 P & P

NEW car alarm kit £11.95

Order now or send for further details:

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

THE **Cirkit** WINTER '88-89 CATALOGUE IS OUT **NOW!**



and features many new products:

- Books - 12 Latest Titles
- Navico 2m Transceiver
- Miniature Mains Rocker Switches
- 8 Channel Logic Analyser
- Collet Knobs and Caps
- 2.4GHz Frequency Meter
- 10.7MHz Ceramic Filters
- Broadcast Band FM Tunersets
- RF Dip Meter
- IEC Mains Connectors
- Scanning Receivers - New Models
- 100MHz 3 Ch Oscilloscope
- RF and AF Signal Generators
- Pyropen - Cordless Gas Iron
- High Temp Elec Capacitors
- Miniature Analogue Multimeter

Plus discount vouchers, easy to enter competition and feature project. Available from your newsagent or directly from Cirkit.

PRICE **£1.30**

Cirkit



Cirkit Distribution Ltd.

Park Lane, Broxbourne, Herts EN10 7NQ
Telephone (0992) 444111 Telex: 22478

DIRECT BOOK SERVICE

The books listed have been selected as being of special interest to everyone involved in electronics and computing. They are supplied by mail order direct to your door. Full ordering details are given on the last book page.

PROJECT CONSTRUCTION

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

£1.50

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

BEGINNER'S GUIDE TO BUILDING ELECTRONIC PROJECTS

R. A. Penfold

Shows the complete beginner how to tackle the practical side of electronics, so that he or she can confidently build the electronic projects that are regularly featured in magazines and books. Also includes examples in the form of simple projects.

112 pages Order code No. 227 £2.25

PRACTICAL ELECTRONIC BUILDING BLOCKS—BOOK 1 PRACTICAL ELECTRONIC BUILDING BLOCKS—BOOK 2

R. A. Penfold

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.

BOOK 1 contains: Oscillators—sinewave, triangular, squarewave, sawtooth, and pulse waveform generators operating at audio frequencies. Timers—simple monostable circuits using i.c.s, the 555 and 7555 devices, etc. Miscellaneous—noise generators, rectifiers, comparators and triggers, etc.

BOOK 2 contains: Amplifiers—low level discrete and op-amp circuits, voltage and buffer amplifiers including d.c. types. Also low-noise audio and voltage controlled amplifiers. Filters—high-pass, low-pass, 6, 12, and 24dB per octave types. Miscellaneous—i.c. power amplifiers, mixers, voltage and current regulators, etc.

BOOK 1 128 pages Order code BP117 £1.95
BOOK 2 112 pages Order code BP118 £1.95

CIRCUITS AND DESIGN

ELECTRONICS SIMPLIFIED—CRYSTAL SET CONSTRUCTION

F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.

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.

80 pages Order Code BP92 £1.75

MICRO INTERFACING CIRCUITS—BOOK 1 MICRO INTERFACING CIRCUITS—BOOK 2

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 p.c.b. 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 1 112 pages Order code BP130 £2.25
Book 2 112 pages Order code BP131 £2.75

ELECTRONIC CIRCUITS HANDBOOK

Michael Tooley BA

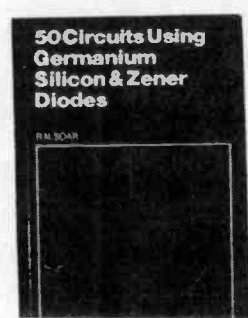
This book aims to explode two popular misconceptions concerning the design of electronic circuits: that only those with many years of experience should undertake circuit design and that the process relies on an understanding of advanced mathematics. Provided one is not too ambitious, neither of these popularly held beliefs is true.

Specifically, this book aims to provide the reader with a unique collection of practical working circuits together with supporting information so that circuits can be produced in the shortest possible time and without recourse to theoretical texts.

Furthermore, information has been included so that the circuits can readily be modified and extended by readers to meet their own individual needs. Related circuits have been grouped together and cross-referenced within the text (and also in the index) so that readers are aware of which circuits can be readily connected together to form more complex systems. As far as possible, a common range of supply voltages, signal levels and impedances has been adopted.

As a bonus, ten test gear projects have been included. These not only serve to illustrate the techniques described but also provide a range of test equipment which is useful in its own right.

277 pages Order code NE05 £14.95



50 CIRCUITS USING GERMANIUM SILICON AND ZENER DIODES

R. N. Soar

Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most simple and inexpensive of components—the diode. Includes the use of germanium and silicon signal diodes, silicon rectifier diodes and Zener diodes, etc.

64 pages Order Code BP36 £1.50

A MICROPROCESSOR PRIMER

E. A. Parr, B.Sc., C.Eng., M.I.E.E.

Starts by designing a small computer which, because of its simplicity and logical structure, enables the language to be easily learnt and understood. The shortcomings are then discussed and the reader is shown how these can be overcome by changes and additions to the instruction set. In this way, such ideas as relative addressing, index registers, etc., are developed.

96 pages Order code BP72 £1.75

50 SIMPLE LED CIRCUITS

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.

64 pages Order Code BP42 £1.95

BOOK 2 50 more l.e.d. circuits Order code BP87 £1.35

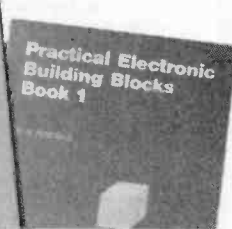
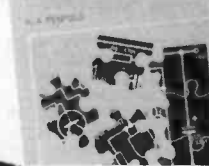
COIL DESIGN AND CONSTRUCTION MANUAL

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

How to Design Electronic Projects



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

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 £2.25

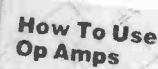


AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN

V. Capel

This book explores the various features, good points and snags of speaker designs. It examines the whys and wherefores so that the reader can understand the principles involved and so make an informed choice of design, or even design loudspeaker enclosures for him or herself. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them. Finally, there is a step-by-step description of the construction of the Kapellmeister loudspeaker enclosure.

148 pages Order Code BP256 £2.95



HOW TO USE OP-AMPS

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.

160 pages Order code BP88 £2.95

ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS
R.A. Penfold

Home computers may easily be applied to the control of model railways and really quite sophisticated control, which needs only simple programming, is not too difficult to achieve. The main problem lies in interfacing the computer to the layout, but fortunately it is not too difficult or expensive to build suitable interfaces, and this book shows you how.

The projects consist of various types of controller, including a high quality pulse type, as well as circuits for train position sensing, signal and electric points control etc. The use of computers does not have to be restricted to massive layouts. Something as simple as an oval of track with a single siding can be given a new dimension by adding computer control and much fun can be had from these relatively simple set-ups.

88 pages Order code BP180 £2.95

MODERN OPTO DEVICE PROJECTS
R.A. Penfold

In recent years, the range of opto devices available to the home constructor has expanded and changed radically. These devices now represent one of the more interesting areas of modern electronics for the hobbyist to experiment in, and many of these devices have useful practical applications as well. This book provides a number of practical

designs which utilize a range of modern opto-electric devices, including such things as fibre optics, ultra bright I.e.d.s and passive IR detectors etc. While many of these designs are not in the "dead simple" category, they should be within the capabilities of anyone with a reasonable amount of experience in electronics construction and some of the more simple designs are suitable for beginners.

104 pages Temporarily out of print

ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS
Robert Penfold

Robots and robotics offer one of the most interesting areas for the electronics hobbyist to experiment in. Today the mechanical side of robots is not too difficult, as there are robotics kits and a wide range of mechanical components available. The micro controller is not too much of a problem either, since the software need not be terribly complex and many inexpensive home computers are well suited to the task.

The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge this gap.

92 pages Order code BP179 £2.95



DATA AND REFERENCE

RECOMMENDED READING

FOR INTRODUCING DIGITAL ELECTRONICS

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 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 TEACH-IN
Michael Tooley BA and David Whitfield MA MSc
CEng MIEE (published by *Everyday Electronics*)

This value for money *EE* book provides a comprehensive background to modern electronics including test gear projects. A complete course in basic electronics; designed for the complete newcomer it will however also be of value to those with some previous experience of electronics. Wherever possible the course is related to "real life" working circuits and each part includes a set of detailed practical assignments. Includes details of eight items of related test gear giving full constructional information and diagrams for each one. They are: Safe Power Supply; Universal LCR Bridge; Diode/Transistor Tester; Audio Signal Tracer; Audio Signal Generator; RF Signal Generator; FET Voltmeter; Pulse Generator. An excellent companion for anyone interested in electronics and invaluable for those taking G.C.S.E. and BTEC electronics courses.

104 pages (A4 size) Order code EE/T-1 £1.95

PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE
F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.

Bridges the gap between complicated technical theory, and "cut-and-try" methods which may bring success in design but leave the experimenter unfulfilled. A strong practical bias—tedious and higher mathematics have been avoided where possible and many tables have been included.

The book is divided into six basic sections: Units and Constants, Direct-current Circuits, Passive Components, Alternating-current Circuits, Networks and Theorems, Measurements.

256 pages Order code BP53 £3.95

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST

G. T. Rubaroe, T.Eng (C.E.I.), Assoc.I.E.R.E.

The object of this book is 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.

128 pages Order Code 228 £2.50

MICROPROCESSING SYSTEMS AND CIRCUITS
F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.

A truly comprehensive guide to the elements of micro-processing systems which really starts at the beginning. Teaches the reader the essential fundamentals that are so important for a sound understanding of the subject.

256 pages Order Code BP77 £2.95

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

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.

80 pages (A4 size) Order code TI-88/89 £2.45

ELECTRONIC HOBBYISTS HANDBOOK

R.A. Penfold

Provides an inexpensive single source of easily located information that the amateur electronics enthusiast is likely to need for the day-to-day pursuance of this fascinating hobby. Covers common component colour codes. Details the characteristics and pinouts of many popular semiconductor devices, including various types of logic ICs, operational amplifiers, transistors, FETs, unijunctions, diodes, rectifiers, SCRs, diacs, triacs, regulators and SMDs, etc. Illustrates many useful types of circuits, such as timers and oscillators, audio amplifiers and filters, as well as including a separate section on power supplies. Also contains a multitude of other useful data.

88 pages Order code BP233 £4.95

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 £3.50

HOW TO IDENTIFY UNMARKED ICs

K. H. Recorr

Shows the reader how, with just a test-meter, to go about recording the particular signature of an unmarked i.c. which should enable the i.c. to then be identified with reference to manufacturers' or other data. An i.c. signature is a specially plotted chart produced by measuring the resistances between all terminal pairs of an i.c.

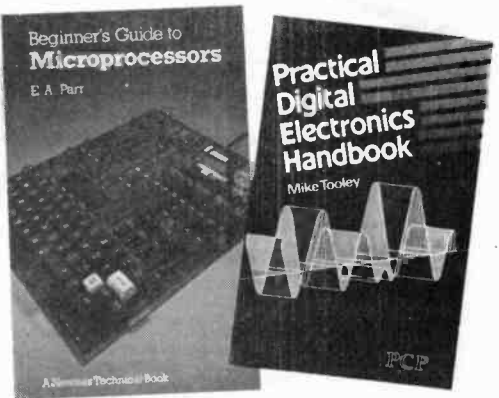
Chart Order code BP101 £0.95

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART

B. B. Babani

Although this chart was first published in 1971 it provides basic information on 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. It is particularly useful for finding the values of old components.

Chart Order code BP7 £0.95



BEGINNERS GUIDE TO MICROPROCESSORS

E. A. Parr

An excellent grounding in microprocessors, this book is broadly relevant to the whole of our *Introducing Microprocessors* course. It is easy to read and well illustrated.

224 pages Order code NE03 £5.95

MICROELECTRONIC SYSTEMS 2 CHECKBOOK

R. Vears

The aim of this book is to provide a foundation in microcomputer hardware, software and interfacing techniques. Each topic is presented in a way that assumes only an elementary knowledge of microelectronic systems and logic functions. The book concentrates on 6502, Z80 and 6800 microprocessors and contains 60 tested programs, 160 worked problems and 250 further problems.

Now replaced by *Microelectronic Systems N2 Checkbook*
 Order code NE04N £6.95

DATA AND REFERENCE

OSCILLOSCOPES: HOW TO USE THEM—HOW THEY WORK

Ian Hickman

Oscilloscopes are essential tools for checking circuit operation and diagnosing faults, and an enormous range of models is available. But which is the right 'scope for a particular application? Which features are essential, which not so important? What techniques will get the best out of the instrument?

Ian Hickman, experienced in both professional and hobbyist electronics, has revised this well-established book to help all oscilloscope users—and potential users.

133 pages Order code NE09 £6.95



PRACTICAL ELECTRONICS HANDBOOK

Ian Sinclair

Ian Sinclair has now revised this useful and carefully selected collection of standard circuits, rules-of-thumb, and design data for professional engineers, students and enthusiasts involved in radio and electronics. Covering passive and active components, discrete component circuits (such as amplifiers, filters and oscillators) and linear and digital i.c.s, the book includes many items which are not elsewhere available in a single handy volume. The operation and functions of typical circuits are described, while mathematics is limited to that necessary for deciding component values for any application.

This revised edition contains more details on computers and microprocessors and has been brought up to date throughout.

199 pages Order Code NE06 £7.95

BEGINNER'S GUIDE TO HI-FI

Ian Sinclair

The *Beginner's Guide to Hi-Fi* will appeal to the audio enthusiast, whether newly won over by advances in technology or well established and wondering whether to update equipment. The book deals with the sound from its sources in the studio to its ultimate end in your ears, and shows what sound is, how it is recorded and how it is reproduced.

Every aspect of Hi-Fi, from pickup cartridges to loudspeakers, has been covered, and the emphasis has been on explaining design aims. Cassette systems have been given considerable prominence, including the more modern Dolby C and dbx noise reduction systems. The CD record has been covered in detail so that you can find out just why this system of sound reproduction is so superior.

134 pages Order Code NE07 £5.95

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, fetts 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

COMMUNICATION

F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.

A look at the electronic fundamentals over the whole of the communication scene. This book aims to teach the important elements of each branch of the subject in a style as interesting and practical as possible. While not getting involved in the more complicated theory and mathematics, most of the modern transmission system techniques are examined including line, microwave, submarine, satellite and digital multiplex systems, radio and telegraphy. To assist in understanding these more thoroughly, chapters on signal processing, the electromagnetic wave, networks and transmissions assessment are included, finally a short chapter on optical transmission.

256 pages Order Code BP89 £2.95

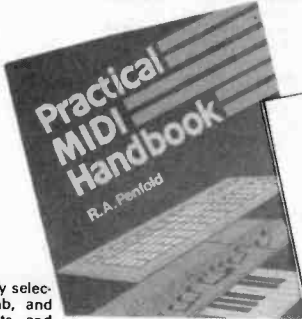
GETTING THE MOST FROM YOUR MULTIMETER

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



PRACTICAL MIDI HANDBOOK

R.A. Penfold

The Musical Instrument Digital Interface (MIDI) is surrounded by a great deal of misunderstanding, and many of the user manuals that accompany MIDI equipment are quite incomprehensible to the reader.

The Practical MIDI Handbook is aimed primarily at musicians, enthusiasts and technicians who want to exploit the vast capabilities of MIDI, but who have no previous knowledge of electronics or computing. The majority of the book is devoted to an explanation of what MIDI can do and how to exploit it to the full, with practical advice on connecting up a MIDI system and getting it to work, as well as deciphering the technical information in those equipment manuals.

128 pages Order code PC101 £5.95

INTRODUCTION TO DIGITAL AUDIO

Ian Sinclair

Digital recording methods have existed for many years and have become familiar to the professional recording engineer, but the compact disc (CD) was the first device to bring digital audio methods into the home. The next step is the appearance of digital audio tape (DAT) equipment.

All this development has involved methods and circuits that are totally alien to the technician or keen amateur who has previously worked with audio circuits. The principles and practices of digital audio owe little or nothing to the traditional linear circuits of the past, and are much more comprehensible to today's computer engineer than the older generation of audio engineers.

This book is intended to bridge the gap of understanding for the technician and enthusiast. The principles and methods are explained, but the mathematical background and theory is avoided, other than to state the end product.

128 pages Order code PC102 £5.95



INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE

A. Michaels

Helps the reader to find possible substitutes for a popular selection of European, American and Japanese transistors. Also shows material type, polarity, manufacturer and use.

320 pages Order code BP85 £3.50

TRANSISTOR RADIO FAULT-FINDING CHART

C. E. Miller

Used properly, should enable the reader to trace most common faults reasonably quickly. Across the top of the chart will be found four rectangles containing brief description of these faults, viz—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.

Chart Order code BP70 £0.95

DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS

A. Michaels

Shows equivalents and pin connections of a popular selection of European, American and Japanese digital i.c.s. Also includes details of packaging, families, functions, manufacturer and country of origin.

256 pages Order code BP140 £5.95

LINEAR IC EQUIVALENTS AND PIN CONNECTIONS

A. Michaels

Shows equivalents and pin connections of a popular selection of European, American and Japanese linear i.c.s. Also includes details of functions, manufacturer and country of origin.

320 pages Temporarily out of print

INTERNATIONAL DIODE EQUIVALENTS GUIDE

A. Michaels

Designed to help the user in finding possible substitutes for a large selection of the many different types of diodes that are available. Besides simple rectifier diodes, also included are Zener diodes, i.e.d.s, diacs, triacs, thyristors, OCIs, photo and display diodes.

144 pages Order code BP108 £2.25

NEWNES ELECTRONICS POCKET BOOK

E. A. Parr

Newnes Electronics Pocket Book has been in print for over twenty years and has covered the development of electronics from valve to semiconductor technology and from transistors to LSI integrated circuits and microprocessors. To keep up to date with the rapidly changing world of electronics, continuous revision has been necessary. This new Fifth Edition takes account of recent changes and includes material suggested by readers of previous editions. New descriptions of op amp applications and the design of digital circuits have been added, along with a totally new chapter on computing, plus other revisions throughout.

315 pages (hard cover) Order Code NE02 £9.95

TRANSISTOR SELECTOR GUIDE

This unique guide offers a range of selection tables compiled so as to be of maximum use to all electronics engineers, designers and hobbyists.

Section 1: Covers component markings, codings and standards, as well as explaining the symbols used.

Section 2: Tabulates in alpha-numeric sequence the comprehensive specifications of over 1400 devices.

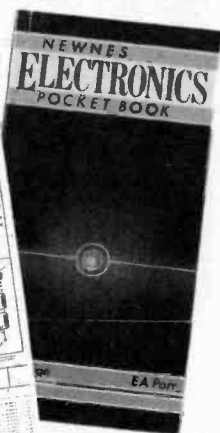
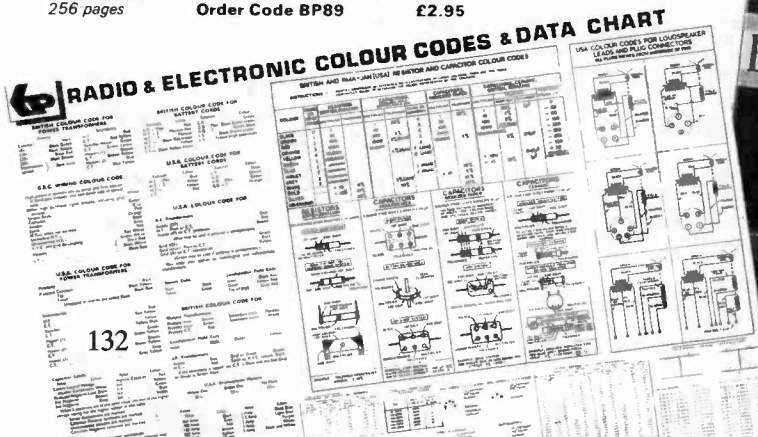
Section 3: Tabulates the devices by case type.

Section 4: Considers particular limits to the electrical parameters when compiling the tables.

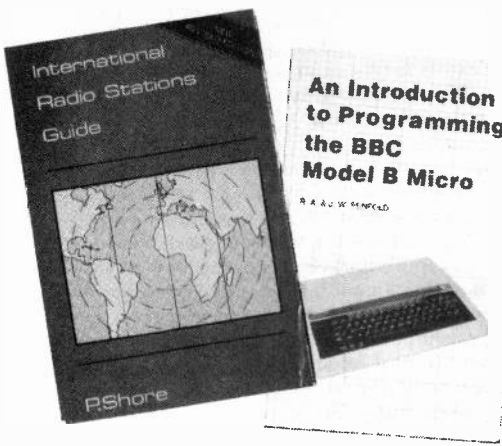
Section 5: Illustrates package outlines and leadouts.

Section 6: Consists of a surface mounting device markings conversion list.

192 pages Temporarily out of print



RADIO/TELEVISION



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

INTERNATIONAL RADIO STATIONS GUIDE

P. Shore
Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed to guide him or her around the ever more complex radio bands. This new edition has been completely revised and rewritten and incorporates much more information which is divided into the following sections: Listening to Short Wave Radio; ITU Country Codes; World-wide Short Wave Radio Stations; European, Middle East and North African Long Wave Radio Stations; European, Near East and North African Medium Wave Radio Stations; Canadian Medium Wave Radio Stations; USA Medium Wave Radio Stations; Broadcasts in English; Programmes for DXers and Short Wave Listeners; UK FM Radio Stations; Time differences from GMT; Abbreviations; Wavelength/Frequency Conversion.

320 pages Order code BP255 £4.95

A TV-DXERS HANDBOOK

R. Bunney
Roger Bunney is probably one of the leading authorities in this country on the subject. Includes many units and devices which have been designed and used by active enthusiasts, and often, considerable ingenuity and thought have gone into the development of such units to overcome individual problems. A practical and authoritative reference to this unusual aspect of electronics.

128 pages Order code BP176 £5.95

AN INTRODUCTION TO SATELLITE TELEVISION

F.A. Wilson
As a definitive introduction to the subject this book is presented on two levels. For the absolute beginner or anyone thinking about purchasing or hiring a satellite TV system, the story is told as simply as such a complex one can be in the main text.

For the professional engineer, electronics enthusiast, student or others with technical backgrounds, there are numerous appendices backing up the main text with additional technical and scientific detail formulae, calculations, tables etc.

There is also plenty for the DIY enthusiast with practical advice on choosing and installing the most problematic part of the system—the dish antenna.

104 pages Order Code BP195 £5.95

COMPUTING

GETTING THE MOST FROM YOUR PRINTER

J. W. Penfold
Details how to use all the features provided on most dot-matrix printers from programs and popular word processor packages like Wordwise, Visawrite and Quill, etc. Shows exactly what must be typed in to achieve a given effect.

96 pages Order Code BP181 £2.95

A Z80 WORKSHOP MANUAL

E. A. Parr, B.Sc., C.Eng., M.I.E.E.
This book is intended for people who wish to progress beyond the stage of BASIC programming to topics such as machine code and assembly language programming, or need hardware details of a Z80 based computer.

192 pages Order Code BP112 £3.50

AN INTRODUCTION TO 68000 ASSEMBLY LANGUAGE

R. A. & J. W. Penfold
Obtain a vast increase in running speed by writing programs for 68000 based micros such as the Commodore Amiga, Atari ST range or Apple Macintosh range etc., in assembly language. It is not as difficult as one might think and this book covers the fundamentals.

112 pages Order code BP184 £2.95

THE ART OF PROGRAMMING THE ZX SPECTRUM

M. James, B.Sc., M.B.C.S.
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.

144 pages Order code BP119 £2.50

AN INTRODUCTION TO PROGRAMMING THE COMMODORE 16 & PLUS 4

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.

128 pages Order code BP158 £2.50

AN INTRODUCTION TO PROGRAMMING THE BBC MODEL B MICRO

R. A. & J. W. Penfold
Written for readers wanting to learn more about programming and how to make best use of the incredibly powerful model B's versatile features. Most aspects of the BBC micro are covered, the omissions being where little could usefully be added to the information provided by the manufacturer's own manual.

144 pages Order code BP139 £1.95

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

AN INTRODUCTION TO COMPUTER PERIPHERALS

J. W. Penfold
Covers such items as monitors, printers, disc drives, cassette recorders, modems, etc., explaining what they are, how to use them and the various types and standards. Helps you to make sure that the peripherals you buy will work with your computer.

80 pages Order code BP170 £2.50

COMPUTER TERMINOLOGY EXPLAINED

I. D. Poole
Explains a wide range of terms that form the computer jargon used by enthusiasts. Includes a reference guide to the more commonly used BASIC commands.

96 pages Order code BP148 £1.95

AN INTRODUCTION TO PROGRAMMING THE ACORN ELECTRON

R. A. & J. W. Penfold
Designed to help the reader learn more about programming and to make best use of the Electron's many features. Adds considerably to the information already supplied in the manufacturer's own instruction manual.

144 pages Order code BP142 £1.95

AN INTRODUCTION TO PROGRAMMING THE ATARI 600/800 XL

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.

128 pages Order code BP143 £1.95

AN INTRODUCTION TO PROGRAMMING THE AMSTRAD CPC 464 AND 664

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 manufacturer's own manual. Also applicable to the CPC 6128.

144 pages Order Code BP153 £2.50

AN INTRODUCTION TO PROGRAMMING THE SINCLAIR QL

R. A. & J. W. Penfold
Helps the reader to make best use of the fantastic Sinclair QL's almost unlimited range of features. Designed to complement the manufacturer's handbook.

112 pages Order code BP150 £1.95

AN INTRODUCTION TO Z80 MACHINE CODE

R. A. & J. W. Penfold
Takes the reader through the basics of microprocessors and machine code programming with no previous knowledge of these being assumed. The Z80 is used in many popular home computers and simple programming examples are given for Z80-based machines including the Sinclair ZX-81 and Spectrum, Memotech and the Amstrad CPC 464. Also applicable to the Amstrad CPC 664 and 6128.

144 pages Order code BP152 £2.75

AN INTRODUCTION TO 6502 MACHINE CODE

R. A. & J. W. Penfold
No previous knowledge of microprocessors or machine code is assumed. Topics covered are: assembly language and assemblers, the register set and memory, binary and hexadecimal numbering systems, addressing modes and the instruction set, and also mixing machine code with BASIC. Some simple programming examples are given for 6502-based home computers like the VIC-20, ORIC-1/Atmos, Electron, BCC and also the Commodore 64.

112 pages Order code BP147 £2.50

HOW TO GET YOUR COMPUTER PROGRAMS RUNNING

J. W. Penfold
Have you ever written your own programs only to find that they did not work? Help is now at hand with this book which shows you how to go about looking for your errors, and helps you to avoid the common bugs and pitfalls of program writing. Applicable to all dialects of the BASIC language.

144 pages Order code BP169 £2.50

AN INTRODUCTION TO COMPUTER COMMUNICATIONS

R. A. Penfold
Provides details of the various types of modem and their suitability for specific applications, plus details of connecting various computers to modems, and modems to the telephone system. Also information on common networking systems and RTTY.

96 pages Order code BP177 £2.95

NEWNES COMPUTER ENGINEER'S POCKETBOOK

Michael Tooley
An invaluable compendium of facts, figures, circuits and data, indispensable to the designer, student, service engineer and all those interested in computer and microcomputer systems. It will appeal equally to the hardware or software specialist and to the new band of "software engineers". This first edition covers a vast range of subjects at a practical level, with the necessary explanatory text. The data is presented in a succinct and rapidly accessible form so that the book can become part of an everyday toolkit.

205 pages (hard cover) Order code NE01 £8.95

DIRECT BOOK SERVICE

(A Division of Wimborne Publishing Ltd.)

TO ORDER

Please state the order code clearly, print your name and address and add the required postage to the total order.

Add 75p to your total order for postage and packing (overseas readers add £1.50 for countries in Europe, or add £2.00 for all countries outside Europe, surface mail postage) and send a PO, cheque or international money order (£ sterling only) made payable to **Direct Book Service** quoting your name and address, the order code and quantities required to **DIRECT BOOK SERVICE, 33 GRAVEL HILL, MERLEY, WIMBORNE, DORSET, BH21 1RW** (mail order only).

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!

ACTUALLY DOING IT!

by Robert Penfold

THIS month's *Actually Doing It* article is about taking care of your delicate parts (electronic ones of course). In the days when valves reigned supreme most components were pretty tough, both electrically and mechanically. Even the glass encased valves were physically a lot tougher than you might think. The miniaturisation of modern components, plus the trend towards ever more complex integrated circuits, has tended to make components rather vulnerable both physically and electrically.

About the only way in which modern components are tougher than those of twenty or so years ago is that they are much more tolerant to having the supply connected around the wrong way. Usually a reversal of the supply will result in a few heated components, but provided the supply is disconnected and corrected reasonably quickly, it is quite likely that everything will work properly. This contrasts with the early semiconductors (which were germanium rather than silicon devices). Getting the supply wrong with one of these often resulted in the destruction of every semiconductor in the circuit.

There is a characteristic smell to hot electronic components. A useful tip is to be on the alert for this when first switching on a newly constructed project. Unless the circuit has some power devices that are meant to run hot, at the first sign of this smell switch off at once and recheck the wiring, etc. A common cause of problems is an integrated circuit plugged in round the wrong way. A quick dab of a finger tip on the integrated circuits will usually reveal the over-heating component or components.

HOLDERS

I am occasionally asked why I, and others, recommend the use of holders for all d.i.l. integrated circuits, even those that are not particularly expensive or vulnerable to static. There are two main advantages to the use of holders. One is simply that if a mistake is made, and the device is fitted round the wrong way, it is easily removed and refitted around the right way. Desoldering integrated circuits from a printed circuit board can be very awkward even if you do have the right tools. It is virtually impossible if you do not have any proper desoldering equipment. The second advantage is that when fault finding it can often be very useful to be able to unplug some of the semiconductors.

When you do have occasion to remove an integrated circuit from a holder, I would strongly advise against trying to pull it out using your fingers. This usually results in

one end of the component coming free and the other end remaining in the socket. Apart from severely buckling some of the pins, you can also end up with the pins at the free end of the device embedded in a finger! It is much better to slide the blade of a small screwdriver under the integrated circuit and to then prise it free (Fig. 1), or use an i.c. removal tool.

With small projects it can be difficult to find sufficient space to accommodate even the smallest of screwdrivers. The tweezer type extractor tools that were once readily available seem to be more difficult to find these days. However, it is not too difficult to improvise a small 'L' shaped lever which can be fabricated from a piece of thin metal. With one of these it should be possible to lever integrated circuits out of their holders even if they are in very awkward positions.

Even with careful handling, sooner or later you are still likely to be faced with an integrated circuit having some severely bent pins. In most cases they can be bent straight without too much difficulty. I find an easy way of doing this is to place the blade of a screwdriver along-side the bent pin, and to then press the pin firmly back in place up against the blade. If you simply try pushing the pin back into place without anything to support it, as the bottom end is straightened the top part will probably twist out of shape.

If a pin is very badly deformed it may well snap when straightened out. Usually this will leave the top part of the pin intact, and a piece of 24 s.w.g. tinned copper wire can then be carefully soldered to it. After this has been trimmed to length and aligned with the other pins the device should plug into a holder without any difficulty.

HEAT STROKE

Most modern electronic components are not easily damaged by heat when soldering them into place. I suspect that modern automated production methods have resulted in components having to be made reasonably heat-proof, and this has made life that much easier for the home constructor. There are still some components which are vulnerable to heat damage, and these are mainly the germanium semiconductors. These have largely been replaced by silicon devices which are much more hardy, but if you build an old project it might include one of these components. Germanium transistors mostly have AC**, AD**, and OC** type numbers.

What you are more likely to encounter are germanium diodes. These have lower forward voltage drops than silicon types, and because of this germanium diodes are

still preferable to silicon types in some applications. Germanium diodes usually have AA** or OA** type numbers (OA90 and OA91 diodes are still quite common in designs for the home constructor).

The standard solution to the overheating problem is to use a simple tool called a heatshunt. This should not be confused with a heatsink, which is a piece of metal which acts as a cooling fin for semiconductor devices that have to dissipate power of about one watt or more. A heatshunt is a small tool which clips onto the leadout wire of a component between its body and the end of the leadout wire. The idea is for the heatshunt to conduct away much of the heat from a soldered joint so that it never reaches the semiconductor chip.

Heatshunts can be very effective, but in practice can be a little fiddly to use. If you can complete soldered joints quite quickly a heatshunt is probably not worthwhile, since there will be little risk of damage anyway. In the past I have occasionally seen the suggestion that a crocodile clip can be used as quite a good heatshunt. Modern crocodile clips are mainly of very light construction, and even with a heat-film added they do not always work very well in this role. There is a real risk that this method will lull you into a false sense of security and result in more damaged components rather than less. If you can obtain one of the older types of crocodile clip, particularly those of copper construction, they will almost certainly work very well as heatshunts.

SEEING THE LIGHT

The other main category of heat sensitive components are l.e.d.s. Some of the early l.e.d.s seem to be even more heat-sensitive than germanium semiconductors. The problem seems at least in part to be due to the use of thick leadout wires on many l.e.d.s, which provide an excellent thermal contact between the soldering iron and the chip.

Modern l.e.d.s seem to be much improved, but reasonable care still needs to be taken when using l.e.d.s with their leadout wires cut short. Where possible it is best to leave the leadout wires fairly long so that there is a relatively poor thermal contact between the bit of the iron and the semiconductor chip.

With seven segment and bargraph l.e.d.s the pins are quite short and it is not feasible to use a heatshunt. If they are soldered into circuit with each joint being completed fairly swiftly it is unlikely that any problems will occur. Wherever possible I always use sockets for these components though. The small (0.3 inch) seven segment displays and most of the bargraph types will fit into standard d.i.l. integrated circuit holders without too much difficulty.

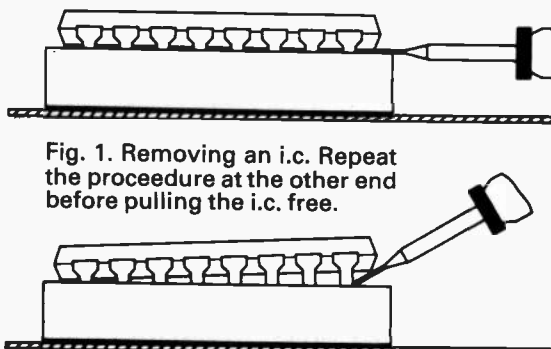


Fig. 1. Removing an i.c. Repeat the procedure at the other end before pulling the i.c. free.

The larger seven segment displays such as the 0.5 and 0.56 inch types have the rows of pins too far apart to permit them to fit into the smaller d.i.l. holders, but their 0.6 inch row spacing is correct for d.i.l. holders having 24 pins or more. A little trimming down to size using a junior hacksaw is likely to be needed in order to produce holders having the right number of ways, but it is not too difficult to improvise something. An alternative is to cut sockets having 0.3 inch row spacing into two s.i.l. strips of pins. These can then be placed 0.6 inches apart, or given virtually any other spacing that is required. Soldercon pins can be used in much the same way and offer another alternative.

It is as well to bear in mind that virtually any component can be damaged by excessive heat from a soldering iron. Apart from damage to the materials from which the component is constructed, there is a risk of desoldering joints within a component. Crystals need to be soldered into place reasonably quickly, as do many types of non-electrolytic printed circuit mounting capacitors. In fact many printed circuit mounting capacitors are something less than tough, and need to be treated with reasonable care.

STATIC PROBLEMS

The dire warnings about static electricity and its consequences that are to be found in some catalogues, manufacturers data, etc., can be a little off-putting to say the least. You may occasionally obtain an exotic integrated circuit in a lot of anti-static packing which is covered in warnings not to remove the device from the packing except in an anti-static chamber, or with the protection of some other elaborate piece of equipment. This type of thing can tend to give the newcomer to electronics the

impression that static sensitive devices are simply too delicate to be used in a normal environment.

In truth it is probable that careless handling of static sensitive components brings a greater risk of physical damage than damage due to static electricity. A lot of constructors treat static sensitive devices no differently to other components and have no reason to regret it. On the other hand, there is no point in taking unnecessary risks, especially with the more expensive components that are vulnerable to this problem.

For the beginner it can be difficult to know which components are prone to this problem. It is mainly MOS semiconductors, which include MOSFETs, CMOS logic integrated circuits, and a lot of other integrated circuits including some operational amplifiers and a substantial proportion of the larger and expensive types. Some liquid crystal displays also seem vulnerable to static charges. Most modern MOS devices have built-in static protection circuits that render them much less easily damaged than many of the early devices. Some even have protection circuits that make them no more vulnerable to static damage than non-MOS components.

HANDLING PRECAUTIONS

Normally the article or book in which a project is described will give details of any components that need handling precautions. The fact that a component is supplied in some form of anti-static packaging does not necessarily mean that any handling precautions are needed. A lot of suppliers seem to have standardised on this type of packing which is used for all integrated circuits. However, if there is any doubt as to whether or not a component requires any special handling precautions, common sense would dictate that the appropriate

precautions should be taken just in case they are required.

So what are the standard anti-static handling precautions? Rule number one is to use sockets wherever possible. Rule number two is to leave any static sensitive components in their anti-static packaging until they are the only items needed to complete the project. They should then be plugged into place using a minimum of handling. Avoid having any obvious sources of static charges in the vicinity when fitting these components in place.

The main sources of static electricity in homes are plastics, which can include such things as clothing, storage boxes, and carpets. Choose a work area that is free from anything that is known to generate the familiar "clicks" and sparks of static discharges.

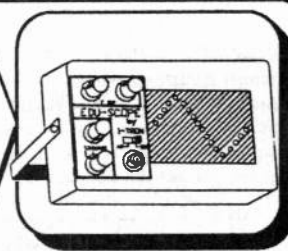
There are numerous items of anti-static equipment on sale. These range from cleaning sprays through to such things as anti-static mats and furniture. The expense of much of this equipment is not really justified for home use, and most of these items are aimed at professional users. If you follow the simple rules outlined above you should not encounter any difficulties with semiconductors getting "zapped" by static charges.

Note that some dual gate MOSFETs are supplied with a metal clip that short circuits their leadouts together. These devices do not need any special handling precautions, but obviously the clip must be removed *after* soldering the device into circuit and before switching on the completed project. If, for some reason, you have to solder a non-protected MOS device into circuit, you should use a low leakage iron having an earthed bit. Any iron which includes an earth lead in its mains cable almost certainly has an earthed bit, but check that the earth lead is connected.

Carbon Film resistors 1/4W 5% E24 series 0.51R to 10MΩ	1p
100 off per value—75p, even hundreds per value totalling 1000	£6.00p
Metal Film resistors 1/4W 10R to 1MΩ 5% E12 series—2p, 1% E24 series	3p
Mixed metal/carbon film resistors 1/2W E24 series 1R0 to 10MΩ	1 1/2p
1 watt mixed metal/Carbon Film 5% E12 series 4R7 to 10 Megohms	5p
Linear Carbon pre-sets 100mW and 1/4W 100R to 4M7 E6 series	7p
Miniature polyester capacitors 250V working for vertical mounting	
.015, .022, .033, .047, .068-4p, 0.1-5p, 0.12, 0.15, 0.22-6p, 0.47—8p	
Mylar (polyester) capacitors 100V working E12 series vertical mounting	
1000p to 8200p - 3p, .01 to .068 - 4p, 0.1 - 5p, 0.12, 0.15, 0.22-6p, 0.47/50V-8p	
Submin ceramic plate capacitors 100V wkg vertical mountings. E12 series	
2% 1.8pf to 47pf - 3p, 2% 56 pf to 330pf - 4p, 10% 390p - 4700p	4p
Disc/plate ceramics 50V E12 series 1P0 to 1000P, E6 Series 1500P to 47000P	2p
Polystyrene capacitors 63V working E12 series long axial wires	
10pf to 820pf - 3p, 1000 pf to 10,000pf - 4p, 12,000 pf	5p
741 Op Amp - 20p, 555 Timer	22p
cmos 4001 - 20p, 4011 - 22p, 4017	40p
ALUMINIUM ELECTROLYTICS (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 electrolytics (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, 22/16	20p
33/10, 47/16, 22/16 30p; 47/10 35p; 47/16 60p; 47/35	80p
VOLTAGE REGULATORS	
1A + or - 5V, 8V, 12V, 15V, 18V & 24V	55p
DIODES (piv/amps)	
75/25mA 1N4148 2p, 800/1A 1N4006 6p, 400/3A 1N5404 14p, 115/15mA OA91	6p
100/1A 1N4002 4p, 1000/1A 1N4007 7p, 60/1.5A 51M1 5p, 100/1A bridge	25p
400/1A 1N 4004 5p, 1250/1A BY127 10p, 30V, 15A OA47	8p
Zener diodes E24 series 3V3 to 33V 400 mW - 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 5V supply only	50p
Mains indicator neons with 220k resistor	10p
20mm fuses 100mA to 5A O/blow 5p, A/surge 8p, Holders pc or chassis	5p
High speed pc drill 0.8, 1.0, 1.3, 1.5, 2.0mm - 30p, Machines 12V dc	£6.50p
HELPING HANDS 6 ball joints and 2 croc clips to hold awkward jobs	£3.50p
AA/HP7 Nicad rechargeable cells 80p each, Universal charger unit	£6.50p
Glass reed switches with single pole make contacts - 8p, Magnets	12p
TRANSISTORS	
BC547/8/9-8p, BC557/8/9-8p, BC182L/4L-10p, BC183, 183L-10p, BC212,212L-10p,	
BC337,337L-12p, BC727/737-12p, BD135/67/8/9-25p, BCY70-15p, BFY50,52-20p,	
BFX88-15p, 2N3055-50p, TIP31,32-30p, TIP41,42-40p, BU208A-£1.20, BF195,197-12p	
All prices are inclusive of VAT. Postage 25p (free over £5). Lists Free.	

THE CR SUPPLY CO
127 Chesterfield Rd, Sheffield S8 0RN
Return posting

EDU-SCOPE Build your own solid state oscilloscope - complete kit of parts excluding case £29.99
EDU-SCOPE CASE KIT . . . £11.95
LOW COST LEAD/PROBE . £3.95



BUG-89 Micro sized surveillance transmitter - can be received by any FM/VHS radio or our MICRO-FM - PCB size only 50x20mm £5.25
MICRO-FM A micro miniature personal FM receiver - High quality IC design (no alignment problems) - Great for surveillance work or for just listening to your favourite radio shows! (cased) £7.99
ROBO-VOX Instantly transforms your voice into into Dalek/Robot type - also amazing feedback sound effects possible (cased) £11.95
ROBOT CIRCULAR Unique radio controlled robot - can also be converted to control via computer £18.95
THERAMIN MUSIC GENERATOR An electronic device based on an ancient legendary mystical instrument (cased) £12.75
SOLARTRONICS-88 Enter the exciting world of Solar Electronics with our Solar Designer's experimenter kit £7.75
SUPER SOUND-FX MICROCOMPUTER An easy to use and program single chip sound effects Micro completely self contained - Incredible sound routines already masked programmed into the device - this is our most popular kit at present £9.95
SOUND-FX PRO CONSOLE CASE KIT £3.99

Please add £0.95 per order for P&P. For FREE Datapack on all our Kits/Products send SAE. - Allow up to 14 days for delivery - Make Cheques/Po's payable to :-

ITRON U.K.
Castle Mill, Lower Kings Road
BERKHAMSTED
Hertfordshire HP4 2AD



LITTLE NODDY



MICHAEL PERROW

There is no chance of nodding off when Noddy's about.

A fun project that can have serious applications.

CHOOSING a title to accurately describe this article proved rather difficult so perhaps a more detailed explanation is called for.

If you've ever driven long distances on motorways I'm sure you must have experienced the very dangerous effect of driver fatigue especially at night or when travelling alone. Advanced warning of the effect usually comes in the form of the head gradually drooping and then a quick reflex brings you back, hopefully to full awareness.

This is where Little Noddy comes to the rescue. With this device fitted to either ordinary glasses or an old frame (or even, on extra bright days, sunglasses) when the head tilts a musical tune is automatically played until the head is lifted again.

This project uses very few components and makes use of one of those annoying novelty musical birthday cards — you know — the ones that play tunes when they are opened. Even if you are lucky enough not to receive one of these cards and you fancy having a stab at this project then you can buy one at any market for about 75p and that price includes the battery!

It would cost at least three times as much to buy and build the equivalent circuit using discrete components. The other main item is a mercury tilt switch, everything else is out of the spares box.

HOW IT WORKS

There is very little to be said about the circuit diagram Fig. 1. The mercury switch S1 acts as an on/off switch,

which is on when the liquid mercury covers the contacts; by "tilting" the switch. This switch replaces the original contacts on the small printed circuit board and turns on IC1, the melody chip.

The output from IC1 drives the small transducer LS1. On some boards the choice of melody is selected by connecting the leads from the transducer across different pins (via solder pads on the circuit board) of IC1.

CONSTRUCTION

The first part of the construction is actually dismantling the musical card. Carefully remove the printed circuit board and "loudspeaker" after separating the two pieces of card.

By referring to Fig. 2, Fig. 3 and photograph a good idea of the construction method will be appreciated. Only the basic format is given as the constructor can adapt this to his/her requirements.

The original on/off switch is a pair of contacts which are closed when the card is opened. In our application these contacts must be bent to be permanently open and the mercury tilt switch connected directly across the contacts.

The tilt switch is best adjusted by a second person whilst you are wearing the device with your head in the normal driving position. When you dip your head forward the contacts of the switch should close and initiate the alarm.

The prototype used double-sided sticky tape to secure most items but other methods may be used if the constructor wishes. To keep the total weight down no power switch has been incorporated and the unit is stored upright when not in use.

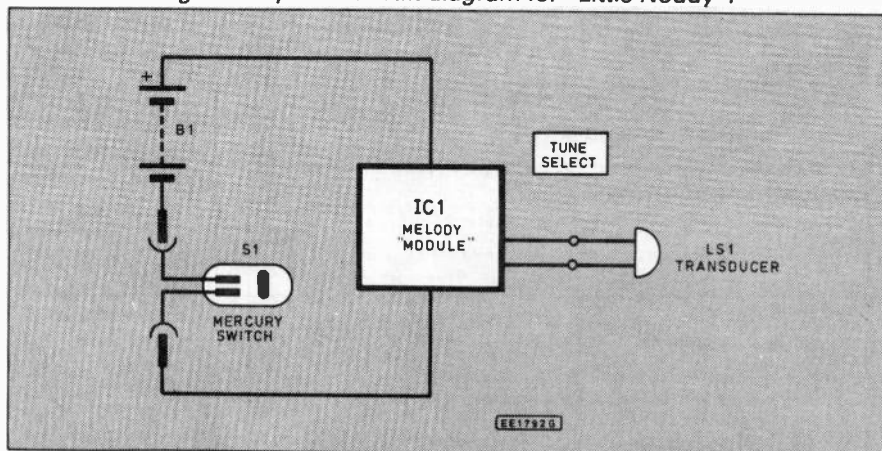
WARNING

Mercury is a toxic substance and on no account must the tilt switch S1 be opened up.

OTHER IDEAS

This project shows how easy it is to adapt a cheap ready made circuit to give another function. We are sure most readers will have ideas of their own and will find many other uses for this or similar devices.

Fig. 1. Simplified circuit diagram for "Little Noddy".



In addition to the musical greetings card, there is a whistle responsive key ring and a minute mini organ on the market both of which use similar, small ready made printed circuit boards.

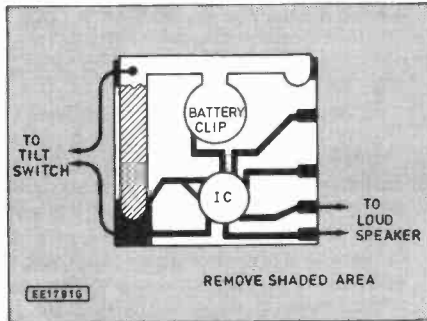


Fig. 2. Circuit board removed from musical greetings card.

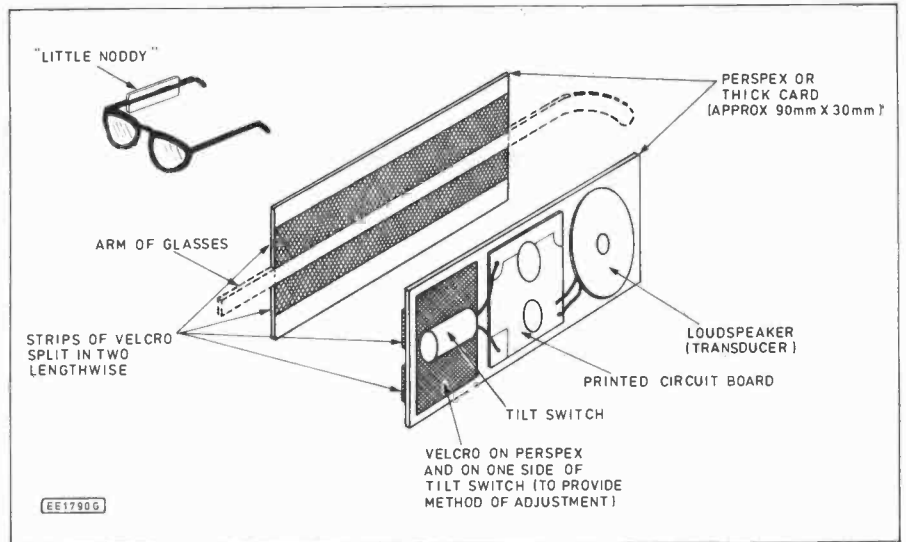
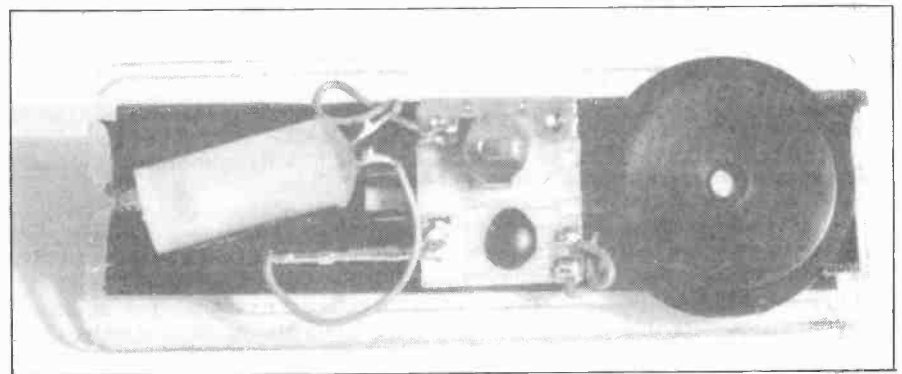


Fig. 3. Basic method of construction using Perspex and Velcro strips. The completed project is shown below.



Materials ...

Musical birthday card.
Mercury Tilt Switch.
Spectacles or Spectacle Frames.
Card or Perspex, for mounting circuit components.
Length of Velcro (approx. 2in.)

Approx. cost
Guidance only **£2.50**

MARCO TRADING

THE MALTINGS, HIGH STREET, WEM, SHROPSHIRE SY4 5EN DEPT EE2.
Tel: 0939 32763 Telex 35565 Fax 0939 33800

Electronic Component Mail Order Company—Established 1972
100+ PAGE CATALOGUE AVAILABLE—SEND £1 FOR YOUR COPY
Including Discount Tickets—50p off £5+ order; £1 off £10+ order; £5 off £50+ order.

Tel: (0939) 32763. Telex: 35565. Fax: 0939 33800
Please add 85p P&P & 15% VAT

VISIT OUR RETAIL SHOPS

WEM (MARCO), The Maltings, High Street (0939) 32763
WOLVERHAMPTON (WALTONS), 55A Worcester Street (0902) 22039
BIRMINGHAM (SUPERTRONICS), 65 Hurst Street (021) 666 6504

NI-CAD RECHARGEABLE BATTERIES

AAA	£1.25 (10+£1.20ea.)
AA	90p (10+ 85p ea.)
C	£2.10 (10+£1.90ea.)
D	£2.50 (10+£2.20ea.)
PP3	£4.10 (10+£3.90ea.)

SOLDER 60/40
A 500g reel of 22 swg multicore solder
60% tin 40% alloy non-corrosive. **ONLY £4.99**

12V RECHARGEABLE UNIT
10 x D size Ni-Cads (4Ah) encapsulated in a black plastic case. fuse holder. gives 12V output when fully charged. Ex-equipment—fully tested and guaranteed. 245 x 75 x 75mm.
£6.99 plus £1.85 P&P plus 15% VAT

CHARGER FOR NI-CAD BATTERIES
Charges AAA, AA, C, D & PP3 NI-CADS
£4.50

ANTEX SOLDERING

C Iron 15W	£5.40	SK2	Kit £8.30
CS Iron 17W	£5.50	SK5	Kit £7.99
XS Iron 25W	£5.80	SK6	Kit £8.20

ST4 Stand £2.20
TCSU-D Soldering Station £72.50
Spare Elements from £3.50
Spare tips for above irons £1.20

JUST ARRIVED
High quality
Desoldering Pump, European made
ONLY £2.99
(Normally £8.99). Spare tip 60p

ORYX PORTASOL GAS SOLDERING IRON
Price (1+) £16.00
(5+) £15.30
Spare tips: 1, 2, 4, 3, 2, 4mm E4

LATEST CATALOGUE £1

FULL RANGE OF TRANSISTORS/IC's-CMOS VALVES ETC
Boxes transformers
Audio over 7,000 lines

VOLTAGE REGULATORS

78L05	0.26
78L08	0.28
78L12	0.28
78L15	0.28
7905	0.36
7908	0.36
7812	0.36
7815	0.36
7818	0.36
7824	0.36
7905	0.36
7912	0.38
7915	0.38
7918	0.38
7924	0.38
LM305H	1.45
LM317T	0.95
LM723	0.65

WE RESERVE THE RIGHT TO CHANGE THE PRICES WITHOUT PRIOR NOTICE

SERVISOL PRODUCTS

Supa Freeze-it	£1.40
Switch cleaner	£1.24
Foam cleanser	£1.22
Super 40	£1.88
Fire extinguisher	£3.30
Tape head cleaner	£1.10
Anti-static spray	£1.20
Silicone grease	£1.38
Plastic seal	£1.35

FEBRUARY SPECIAL OFFER

ONLY £5.99

QUARTZ-HALOGEN SPOTLIGHT



Hand held or hanging. Heat resistant polycarbonate housing; highly polished reflector. Protective lens cover, doubles as base stand. With On/Off switch and 12ft curly cable terminating in cigar lighter plug. Produces 250000 candle power - 5 times the intensity of average car headlamps.
Power: 12Vd.c. 4.5A. 55W
Dims: 160 x 88 x 110mm

12V Twin Fluorescent lamp 12" Double Tubes

IDEAL FOR BOATS, CARAVANS, VANS, ETC.



£5.99 EACH
10 OFF £4.99

ATTRACTIVE WHITE FITTING, RIBBED PERSPEX DIFFUSER. ON/OFF SWITCH. 3ft. CABLE. TRANSISTORISED CIRCUITRY. KEYHOLE FIXING. 12V D.C. 8W TUBES. 368 x 67 x 43mm

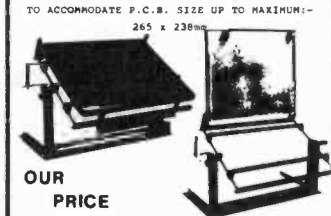
FM TRANSMITTER

Very High Quality
"MINI-BUG"
- Ideal for Baby Alarm, etc!
£8.50



FULL RANGE OF BABANI BOOKS IN STOCK

SPECIAL OFFER
UNIVERSAL P.C.B. ASSEMBLY JIG
TO ACCOMMODATE P.C.B. SIZE UP TO MAXIMUM: -
265 x 238mm



OUR PRICE
£15.00
(NORMAL PRICE OVER £50.00)

MARCO KITS

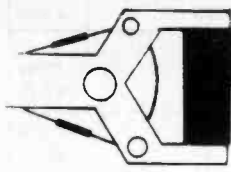
Ceramic 50V (125)	£3.50
Electrolytics Rad. (100)	£7.25
Fuse 20mm Q/B (80)	£3.75
Fuse 20mm A/S (80)	£7.50
Nut and Bolt (800)	£3.00
Pre-set Pots Horiz. (120)	£6.75
Pre-set Pots Vert. (120)	£6.75
Resistors	
0.25W Popular (1000)	£6.50
0.25W 5 off (305)	£2.95
0.25W 10 off (610)	£4.50
0.5W Popular (1000)	£9.50
0.5W 5 off (365)	£4.70
0.5W 10 off (730)	£7.75
1W 5 off (365)	£13.75
2W 5 off (365)	£21.75
Zener Diodes 5 off (55)£3.50	
0.25W Resistors 1+2p, 10+1.5p	
0.5W Resistors 1+2p, 10+1.5p	

"CLOSED-CIRCUIT" TELEVISION SYSTEM
PRICES £150.00

COMPRISING:
1 x CAMERA **1 x MONITOR** **1 x CAMERA BRACKET**

USED USED NEW

COMPLETE WITH LENS



Robot Roundup

NIGEL CLARK

FISCHERTECHNIK was one of the first kit companies to realise there was a market for kits which could demonstrate the properties of robotics and control technology. However after its initial moves it seemed to stand still, letting other suppliers, particularly Lego, develop similar ideas and then take a lead in the variety of items provided.

Lego was the first to produce a buggy and then develop a step-by-step approach, leading people into the investigation of robotics, introducing them to simple gearing and motors, which were then used in more complex devices, and then into keyboard and computer-control. The company also produces kits aimed at specific parts of schools' curricula.

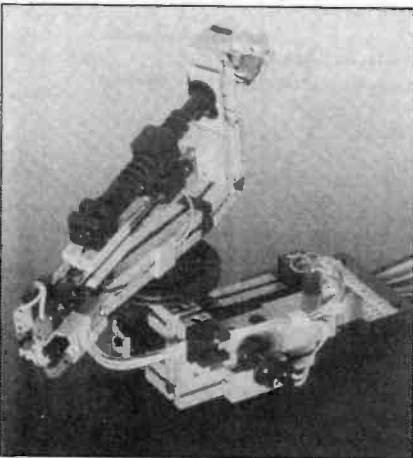
Fischertechnik, however is aiming to redress the balance with a new kit known as Computing Experimental. It contains parts to build a number of devices, an interface and user literature. The models which can be built include a buggy, winch, radar scanner and an ingenious "welding" robot.

The importer and main distributor of Fischertechnik in Britain is Economatics Educational based in Sheffield. The company has added its own software for the BBC series of computers and is selling the whole package to educational establishments for a price of about £190 (retail prices are higher).

"WELDING"

The "welding" robot has two degrees of freedom, being able to rotate until it points in the desired direction and then the "welding" unit moves to the required point on an arm which extends and contracts. At the end is a device which flashes when the "weld" signal is given.

As with the software for most of the other models a moving display of the "welders" movements are shown on screen. One of the examples given by



Welding Robot

Economatics involves the replication of welding on a car production line.

The models can be instructed to make "welds" at particular points on the body. If an outline of the car has been built up on the screen the display will show where the "welds" have been made. There are three different programs for use with the "welder".

BUGGY

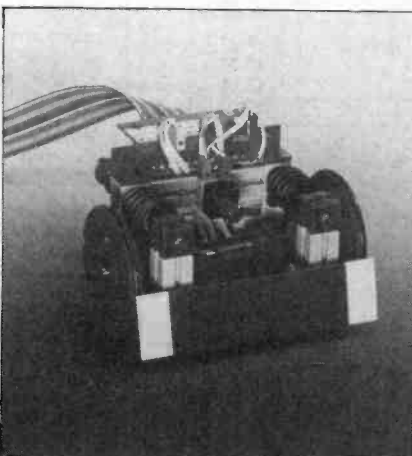
The other main model is the buggy which has eleven programs written for it. It also has a moving simulation on screen. The two-wheeled mobile has bump sensors and light detectors and looks like a stripped-down version of the BBC Buggy, which Economatics used to sell until problems with the supply of the electronic components resulted in its withdrawal around 18 months ago.

Economatics say that the new buggy can detect and follow a light beam, read bar code instructions and solve mazes. The Fischertechnik interface has eight digital and two analogue inputs and four pairs of outputs thus allowing it to be used to control models more complex than those for which building instructions are given. It also has a three-colour i.e.d. display of the input and output lines which are in use.

Economatics say that a feature of the new kit is a colour-coded connector, built into each model. The wiring plugs are also colour-coded to make checking and fault-finding easier.

The *Computing Experimental* kit joins Fischertechnik's older products in this area, the *Computing Kit* the 4-motor robot arm and the plotter/scanner.

The computing kit was the first of its type in this country with instructions on the building of ten models, including a simple two-axis arm with magnetic gripper, a plotter and an arm which can solve the Towers of Hanoi problem. However for computer control an interface and software is required.



Buggy

SOFTWARE

Economatics supplies separately the Fischertechnik interface and a control program, which can be used on the BBC series, and which can control up to four motors or magnets. It allows the computer to read the switches and the potentiometers providing feedback for control.

Software is supplied with both the four motor arm and the plotter/scanner but again the Fischertechnik interface is needed. The arm has three axes powered by d.c. motors with digital encoders for feedback, and a gripper which can be altered by adding more parts to it depending on what it is required to pick up.

The plotter/scanner uses two stepper motors with either a pen in an up/down mechanism for plotting or a sensor for scanning.

TECHNOLOGY SHOW

The new kit was on show at the Design and Technology Education Exhibition at the NEC, Birmingham in November. From the robotics point of view it was one of the few notable displays at the show, being held in Birmingham for the second time.

As usual the most impressive display was that of Cybernetic Applications which had its full range on view including the recently-launched Kestrel gantry robot—making its public working debut. Support was available from the other arms in the range working together under the control of Cybernetics' Walli system.

Tribotics was also at the NEC, displaying its re-engineered drainpipes and getting attention by running its buggy around the floor near the stand.

The only other robot was on the Proops Distributors stand, not to be confused with that of Proops Brothers, where the Department of Cybernetics of Reading University were putting on a display.

The arm looked just like any other seen at many other exhibition displays except that it was not operating under computer control. The arm is not electronic but a sequential machine controlled by limit switches and relays; the purpose being to show that simple technology could be used to achieve what appeared to be complex results.

On the display stand the arm picked up a ball bearing with a magnetic gripper, dropped it in a chute, down which it travelled into a box from where it was picked up by the arm again.

There were other exhibitors who had robots to show but most appeared to be keeping them in the background, particularly Shestotech with its Armtech 2000, based on the Colne Armadroid. Richard Shestopal said he preferred to promote his other products for the time being.

EVERYDAY ELECTRONICS

CLASSIFIED

Reach effectively and economically today's enthusiasts anxious to know of your products and services through our semi-display and classified pages. The prepaid rate for semi-display spaces is £8.00 (plus VAT) per single column centimetre (minimum 2.5 cm). The prepaid rate for classified advertisements is 30 pence (plus VAT) per word (minimum 12 words).

All cheques, postal orders, etc., to be made payable to Everyday Electronics. VAT must be added. Advertisements, together with remittance, should be sent to the Classified Advertisement Dept., Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH. Tel: (0202) 881749.

Electronic Components

A & G ELECTRONICS LTD.

If you are buying Electronic Components elsewhere you are almost certainly paying too much! Write to us for a free 1988 catalogue and start saving money. (Please send two 19p stamps towards postage.)
P.O. Box 443, London E15 6JU Tel: 01-519 6149

WALTONS OF WOLVERHAMPTON

Established since 1947 - offering a complete range - I.C.s, transformers, switches, pots, capacitors, resistors, kits, speakers, test equipment, books and lots, lots more!

COME AND SEE US AT: MON-SAT 9-6.00 pm
55A WORCESTER STREET, WOLVERHAMPTON TEL: 0902 22039

ELECTRONIC COMPONENTS

EVERYTHING FOR YOUR NEXT PROJECT

THE BIGGEST DISPLAY IN THE SOUTH IS AT

FRASER ELECTRONICS

42 ELM GROVE * SOUTHSEA * HANTS

Telephone 0705-815584

ICS VARIABLE VOLTAGE D.C. BENCH POWER SUPPLY

1 to 24 volts up to 1/2 amp. 1 to 20 volts up to 1 amp. 1 to 16 volts up to 1 1/2 amps A.C. Fully stabilised. Twin panel meters for instant voltage and current readings. Overload protection.

Fully variable.

Operates from 240V AC. Compact Unit. size 9 x 5 1/2 x 3 in.



£39 inc. VAT + Post £2

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, CROYDON SURREY, U.K. Tel: 01-684 1665

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

Miscellaneous

NEW VHF MICROTRANSMITTER KIT tuneable 88-115 MHz, 500 metre range, sensitive electret microphone, high quality p.c.b. **SPECIAL OFFER** complete kit ONLY £5 POST FREE. Access orders telephone 021-411 1821 (24 hrs).

Cheques/P.O.s payable to: **QUANTEK ELECTRONICS LTD.** (Dept. EE), 45a Station Road, Northfield, Birmingham B31 3TE.

REPAIR YOUR OWN HI-FI SPEAKERS

send large stamped addressed envelope for catalogue of replacement drive units from stock to:

RTVCLTD.

21 High Street, Acton, London W3 6NG
Tel: 01-992 8430 and 323 Edgware Road, London W2. Tel: 01-723 8432

TV-UHF/VHF Preamplifiers, Power Units, Antenna Rotator Components. Suppliers are wanted for completely or partially knocked down parts of above products for assembly in Nigeria. Forward detailed technical specifications and quantity price quotations to The Advertiser, GPO Box 5350, ABA, Nigeria.

PRINTED CIRCUIT BOARDS made to own requirements. For details send s.a.e. to Mr. B. M. Ansbro, 38 Poynings Drive, Hove, Sussex BN3 8GR.

OSCILLOSCOPE 3133 dual trace 25MHz to 10x8 div. display new unused, 2 years guarantee £300. Tel. 0246 472817.

OSCILLOSCOPE WANTED dual beam 20MHz or greater. Tektronix or similar. Folkestone (0303) 76188.

ACTIVE CROSSOVERS, equalizers, echo reverber, Velleman kits, sound to light, f.m. tuners, decoders, half price all unused. 01-422 2294 South Harrow, Middlesex.

TECHNICAL INFO SERVICES (EE)

76 Church St., Larkhall, Lanarkshire ML9 1HE

Phone 0698-884585 Mon-Fri, 9-5.
any other time 0698-883334 FOR FAST QUOTES
WORLD'S LARGEST COLLECTION SERVICE MANUALS - Most unobtainable elsewhere. Prices range from only £4.50 - large s.a.e. any quotation, no obligation to buy.
WORLD'S SOLE Suppliers of TV & Video Repair manuals, etc. from TV TECHNICAL, also such publishers as Heinemann, Newnes, TV Technician, Thorn etc. Every published service sheet in stock, supplied full size, not bits & pieces. CTV's or any combination £3.50 plus LSae; any other single item £2.50 plus LSae. Complete Circuit Sets for most Videorecorders only £7 set (no sary shis made).
LSAE for QUOTATIONS plus GIFT CATALOGUE - NEWSLETTERS - BARGAINS - FREE S/Sht as available.
Comprehensive TV Repair Manual £9.50. Complete Radio Service and Repair Course £9.50. Complete Repair & Service Manuals - Mono TV £12.50. CTV £17.00. Video £19.50. Complete Repair Data with circuit - Mono TV £9.50. CTV £12.50. Video £10.50.
£3.00 plus LSAE BRINGS THE ONLY COMPREHENSIVE SERVICE SHEETS & MANUALS, CATALOGUES plus FREE CHASSIS GUIDE and £4.00 OF VOUCHERS

CIRCUIT DIAGRAMS

Most Makes, Models, Types. Audio, Music Systems, Colour, Mono Televisions, Amateur Radio, Test Equipment, Vintage etc. £3.50 plus LSAE. State Make/Model/Type with order.

Full Workshop Manual prices on request with LSAE

MAURITRON (EE), 8 Cherry Tree Road, Chinnor, Oxfordshire OX9 4QY

POWER SUPPLY: 15 volts at 1 amp; 8 volts at 1.2 amps 40W. £18.00. Tel. 0993 775677.

ARCADE VIDEO game p.c.b.s. Working with information. Many useful parts. Various types from £20. J. L. Chambers, 11 Cooper Street, Nuneaton, Warks CV11 4BP.

TURN YOUR Spectrum with an a.d.c. into an oscilloscope for just £9.95. Timebase 100µs/pixel and triggering. Program supplied on tape. Mr. J. R. Curtis, 45 Kingsway, Dunstable, Beds LU5 4HE.

Kits

INTRODUCING DIGITAL ELECTRONICS. Kit for first six parts E.E. series. Includes alkaline battery £12 (+70p, p&p). GCSE Technology, Electronics Kits. Includes study notes, project ideas, £10.50 (+70p, p&p) for all ten different kits (or s.a.e. for details). Sir-Kit Electronics, 70 Oxford Road, Clacton-on-Sea, CO15 3TE.

OMNI ELECTRONICS

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



Have you sent for your copy of our catalogue yet?

If not, simply send 2x19p stamps for a copy by return.

A COMPREHENSIVE RANGE WITH SERVICE SECOND TO NONE

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

MAKE YOUR INTERESTS PAY!

More than 8 million students throughout the world have found it worth their while! An ICS home-study course can help you get a better job, make more money and have more fun out of life! ICS has over 90 years experience in home-study courses and is the largest correspondence school in the world. You learn at your own pace, when and where you want under the guidance of expert 'personal' tutors. Find out how we can help YOU. Post or phone today for your **FREE INFORMATION PACK** on the course of your choice. (Tick one box only!)

Electronics	<input type="checkbox"/>	Radio, Audio and TV Servicing	<input type="checkbox"/>
Basic Electronic Engineering (City & Guilds)	<input type="checkbox"/>	Radio Amateur Licence Exam (City & Guilds)	<input type="checkbox"/>
Electrical Engineering	<input type="checkbox"/>	Car Mechanics	<input type="checkbox"/>
Electrical Contracting/Installation	<input type="checkbox"/>	Computer Programming	<input type="checkbox"/>
GCE over 40 'O' and 'A' level subjects		<input type="checkbox"/>	

Name _____
Address _____
International Correspondence Schools, Dept ECS29 312/314 High St., Sutton, Surrey SM1 1PR. Tel: 01-643 9568 or 01-221 2926(24 hrs.)

POWER CONDITIONER

FEATURED IN ETI
JANUARY 1988

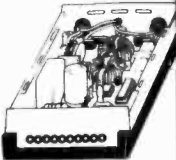
The ultimate mains purifier. Intended mainly for lowering the noise floor and improving the analytical qualities of top-flight audio equipment.

The massive filter section contains thirteen capacitors and two current balanced inductors, together with a bank of six VDRs, to remove every last trace of impulsive and RF interference. A ten LED logarithmic display gives a second by second indication of the amount of interference removed.

Our approved parts set consists of case, PCB, all components (including high permeability toroidal cores, ICs, transistors, class X and Y suppression capacitors, VDRs, etc.) and full instructions.

PARTS SET £28.50 + VAT

A low cost (but high performance) mains conditioner is also available.
MAINS CONDITIONER PARTS SET £5.40 + VAT
RUGGED PLASTIC CASE £1.80 + VAT



KNIGHT RAIDER

FEATURED IN ETI JULY 1987

The ultimate in lighting effects for your Lamborghini, Maserati, BMW (or any other car, for that matter). Picture this: eight powerful lights in line along the front and eight along the rear. You flick a switch on the dashboard control box and a point of light moves lazily from left to right leaving a comet's tail behind it. Flip the switch again and the point of light becomes a bar, bouncing backwards and forwards along the row. Press again and try one of the other six patterns. An LED display on the control box lets you see what the main lights are doing.

The Knight Raider can be fitted to any car (it makes an excellent log light) or with low powered bulbs it can turn any child's pedal car or bicycle into a spectacular TV-age toy!

The parts set consists of box, PCB and components for control, PCB and components for sequence board, and full instructions. Lamps not included.

PARTS SET £19.90 + VAT

RAINY DAY PROJECTS



All can be built in an afternoon!

- JUMPIN' JACK FLASH (ETI March 1988)
Spectacular rock, stage and disco lighting effect! **£6.90 + VAT**
- CREDIT CARD CASINO (ETI March 1987)
The wicked pocket gambling machine **£5.90 + VAT**
- MAINS CONTROLLER (ETI January 1987)
Isolated logic to mains interface **£6.20 + VAT**
- MATCHBOX AMPLIFIERS (ETI April 1986)
Listen: 50W of Hi-Fi power from an amp small enough to fit in a matchbox!
Matchbox Amplifier (20W) **£8.50 + VAT**
Matchbox Bridge Amplifier (50W) **£8.90 + VAT**
L165V Power Amplifier IC, with data and circuits **£3.90 + VAT**
- TACHO/DWELL METER (ETI January 1987)
Turn your Metro into a Porsche! **£16.40 + VAT**
- HI-FI POWER METER (ETI May 1987)
Measures Hi-Fi output power up to 100W
— Includes PCB, components, meters
Mono power meter **£3.90 + VAT**
Stereo power meter **£7.20 + VAT**



FEATURED
IN ETI
AUGUST 1988

There's nothing quite so encouraging as having a quantifiable result to show for your training efforts. If you are not particularly fit, your resting heart rate will be around 80 beats per minute. As your jogging, aerobics or sport strengthens your heart, the rate will drop dramatically — possibly to 60bpm or less. With the S101, you can watch your progress day by day.

Breathing is important too. How efficiently do you take up oxygen? How quickly do you recover from 'oxygen debt' after strenuous activity? The S101 will let you know.

The approved parts set consists of case, 3 printed circuit boards, all components (including 17 ICs, quartz crystal, 75 transistors, resistors, diodes and capacitors), LCD, switches, plugs, sockets, electrodes, and full instructions for construction and use.

PARTS SET £33.80 + VAT

Some parts are available separately. Please send SAE for lists or SAE + £2 for lists, construction details and training plan (free with parts set).



THE DREAM MACHINE

FEATURED IN ETI
DECEMBER 1987

Adjust the controls to suit your mood and let the gentle, relaxing sound drift over you. At first you might hear soft rain, sea surf, or the wind through distant trees. Almost hypnotic, the sound draws you irresistibly into a peaceful, refreshing sleep.

For many, the thought of waking refreshed and alert from perhaps the first truly restful sleep in years is exciting enough in itself. For more adventurous souls there are strange and mysterious dream experiences waiting. Take lucid dreams, for instance. Imagine being in control of your dreams and able to change them at will to act out your wishes and fantasies. With the Dream Machine it's easy!

The approved parts set consists of PCB, all components, controls, loudspeaker, knobs, lamp, fuseholders, fuse, mains power supply, prestige case and full instructions.

PARTS SET £16.50 + VAT

Ben Swainston's best seller GROW RICH WHILE YOU SLEEP is now in stock. **£2.95 (NO VAT)**



THE MISTRAL AIR IONISER

The best ioniser design yet — this one has variable ion drive, built-in ion counter and enough power to drive five multi-point emitters. For the technically minded, it has nine main drive stages, five secondary drives, and a four section booster to give an output capability of almost fifteen billion (1.47 x 10¹⁰) ions every minute, or 2.45 x 10¹¹ ions per second. With extra emitters this can be increased still further!

PARTS SET £24.80 + VAT

The parts set includes case, printed circuit boards, 126 top grade components, all controls, lamps, hardware, a multi-point phosphor-bronze emitter and full instructions.

Some parts are available separately — please send SAE for lists, or SAE + £1 for lists, circuit and construction details and further information (free with parts set).



READY-BUILT MISTRAL

The Mistral Ioniser (and most of our other projects) can now be supplied built, tested and ready to go. For details, please contact Peter Leah at P.L. Electronics, 8 Woburn Road, Eastville, Bristol BS5 6TT. Tel: 0272 522703. Evenings Only

INTERNAL EMITTER £2.69 + VAT

Can be used in place of the P-B external emitter, or both can be used together for the highest ion output. Parts set includes PCB, ion emitters, components and instructions.

IPA BOARD CLEANER

Essential for removing grease and flux residues from the Mistral PCB to achieve peak performance. Applicator brush supplied. **£0.98 + VAT**

ION FAN

An almost silent piezo-electric fan, mains operated, to pump ions away from the emitter and into the room. Increases the effectiveness of any ioniser by five times! **£9.80 + VAT**

TV BOOSTER

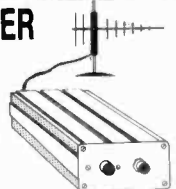
Good TV pictures from poor aerials is what this project is all about. Keith Brimbleby's Aerial Booster gives a massive 20dB gain to ensure good viewing for campers and caravaners, from indoor aerials, or wherever a properly positioned high-gain antenna is not practical.

Based on the OM335 hybrid amplifier, the booster has specifications to rival the best, widespread operation from 10MHz to 1.4GHz, mid-band gain of up to 20dB and a wide supply range of 9V to 20V (it will run from car batteries for campers, dry batteries for campers, or a mains 'battery eliminator' in the home). No special UHF construction skills are needed — the project could be made by a careful beginner.

There are two parts sets for the project. AA1 contains the printed circuit board, OM335 hybrid amplifier, components and instructions. AA2 is the optional case set, rugged screened box, front and rear panels, waterproofing gaskets, feet, sockets and hardware.

AA1 PARTS SET £12.80 + VAT

AA2 PARTS SET £4.80 + VAT



POWERFUL AIR IONISER

FEATURED IN ETI
JULY 1986

Ions have been described as 'vitamins of the air' by the health magazines, and have been credited with everything from curing hay fever and asthma to improving concentration and putting an end to insomnia. Although some of the claims may be exaggerated, there is no doubt that ionised air is much cleaner and purer, and seems much more invigorating than 'dead' air.

The DIRECT ION ioniser caused a great deal of excitement when it appeared as a constructional project in ETI. At last, an ioniser that was comparable with (better than?) commercial products, was reliable, good to build, ... and fun! Apart from the serious applications, some of the suggested experiments were outrageous! We can supply a matched set of parts, fully approved by the designer, to build this unique project. The set includes a roller lined printed circuit board, 66 components, case, mains lead, and even the parts for the tester. According to one customer, the set costs about a third of the price of the individual components. What more can we say?

PARTS SET WITH BLACK CASE £11.50 + VAT
PARTS SET WITH WHITE CASE £11.80 + VAT



BURGLAR BUSTER

Be safe from intruders with our Burglar Buster alarm system! It has all the features you'd expect from a high-tech alarm: entry and exit delay, anti-lamp loop, delay warning and control-box protection.

The parts set includes all four PCBs and all components to go on them. Other parts (case, switches, etc.) are available separately, if you haven't got anything suitable in your spare box. Set contains 4 PCBs, ICs, transistors, relays, capacitors, resistors, diodes, regulator, piezo sounder and full instructions.

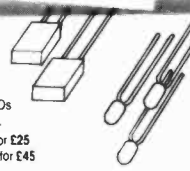
BB1 PARTS SET £12.80 + VAT

LEDs

Green rectangular LEDs for bar-graph displays.
50 for £3.50 500 for £25
100 for £6 1000 for £45

DIGITAL AND AUDIO EQUIPMENT LEDs
Assorted 3mm LEDs: red, green, yellow and orange
25 of each (100 LEDs) for **£6.80**

U.K. orders: please add 80p post and packing and 15% VAT to total.
Else and overseas:
no VAT. Carnage and insurance £4.50.
Please allow up to 14 days for delivery.



BRAINWAVE MONITOR



FEATURED IN ETI
AUGUST 1987

The most astonishing project ever to have appeared in the electronics magazine. Similar in principle to a medical EEG machine, this project allows you to hear the characteristic rhythms of your own mind! The alpha, beta and theta forms can be selected for study and the three articles give masses of information on their interpretation and powers.

In conjunction with Dr. Lewis's Alpha Plan, the monitor can be used to overcome shyness, to help you feel confident in stressful situations, and to train yourself to excel at things you're 'no good at'.

Our approved parts set contains case, two PCBs, screening can for bio-amplifier, all components (including three PMI precision amplifiers), leads, brass electrodes and full instructions.

PARTS SET £36.90 + VAT ALPHA PLAN BOOK £2.50 SILVER SOLUTION (for plating electrodes) £3.60 + VAT

Parts set available separately. We also have a range of accessories professional electrodes, books, etc. Please send SAE for lists, or SAE + £2 for lists, construction details and further information (free with parts set).

Specialist
SEMICONDUCTORS
LIMITED

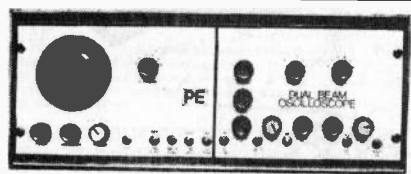
Tel: (0600) 3715
SALES DEPT., ROOM 111, FOUNDERS HOUSE, REDBROOK, MONMOUTH, GWENT.



★ LEARN BY BUILDING ★ ENJOY BY USING ★

PROJECT KITS

★ BE CREATIVE ★ RAISE YOUR SKILLS ★ GET KITED! ★



DUAL BEAM OSCILLOSCOPE

2Y-amps, 6 ranges, variable level, DC to over 1MHz. 4 modes - Y1, Y2, Y1 & Y2, Y1 & Y2 to X. Time base variable from 0.05Hz to 20KHz. Variable sync level, polarity and source. Separate bright-line, brilliance and focus controls. Independent trace deflection controls. Details in catalogue.

BURGLAR ALARM CONTROLLERS

MULTIZONE CONTROL

SET280 £22.77
Two entry-zones, anti-tamper loop, personal attack, entry-exit timing, timed duration, automatic resetting, latching LED monitors.

SINGLE ZONE CONTROL

SET279 £9.32
With timed duration control and latching LED monitor. Both units can be used with any standard detection devices, such as contact or magnetic switches, pressure pads, tremblers, ultrasonics, infrared etc., and will activate standard bells, strobes or sirens.

COMPUTER KITS

The software listings published with the computer kit projects are for use with C64, PET and BBC computers.

CHIP TESTER SET258F £39.30

Computer controlled logic and chip analyser.

EPROM PROGRAMMER SET277 £25.25

Computer controlled unit for 4K Eproms.

MICRO-CHAT SET276 £64.50

Computer controlled speech synthesiser.

MICRO-SCOPE SET247 £44.50

Turns a computer into an oscilloscope.

MICRO-TUNER SET257 £55.32

Computer controlled, tuning aid and freq counter.

MORSE DECODER SET269 £22.16

Computer controlled morse code-decoder.

SEND 9"x4" S.A.E. FOR CATALOGUE AND WITH ALL ENQUIRIES (OVERSEAS SEND £1.00)

VARIOUS

VOICE SCRAMBLER SET287 £42.22
32 switchable channels to keep your communications confidential.

STORMS! £29.50 each unit

Raw nature under panel control! Wind & Rain SET250W. Thunder & Lightning SET250T.

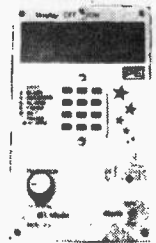
DISCO-LIGHTS SET245F £62.50

3 chan sound to light, chasers, auto level.

EVENT COUNTER SET278 £31.50

4-digit display counting for any logic source.

ASTRONOMY



SIDEREAL CLOCK

SET295 £49.50

Dual purpose star-time and solar-time digital clock with alarm.

ENVIRONMENT

WEATHER CENTRE

Keep the Met Office in check and monitor the wind speed and direction, rain, temperature, soil moisture and sunny days.

Six detector circuits - KIT 275.1 £18.07

Automatic metered control monitor circuit - KIT 275.2 £40.95

Optional computer control circuit - KIT 275.3 £14.20

ELECTRONIC BAROMETER

SET285 £35.55

Computer controlled unit for monitoring atmospheric pressure.

GEIGER COUNTER SET264 £59.50

A nuclear radiation detector for environmental and geological monitoring. With built in speaker, meter and digital output. This project was demonstrated on BBC TV.

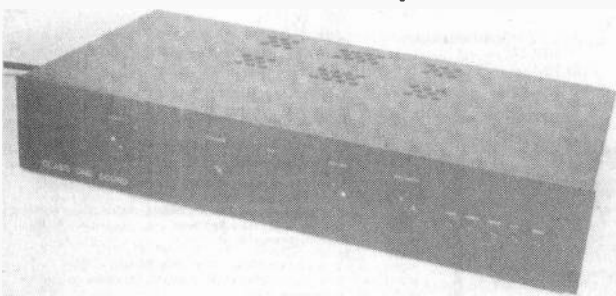
ORDERING

Send 9"x4" SAE for detailed catalogue, and with all enquiries (overseas send £1.00 or 5 I.R.C.'s). Add 15% VAT. Add P&P - Sets over £5 add £2.50. Others add £1.50. Overseas P&P in catalogue. Text photocopies - Geiger 264 and Weather 275 £1.50, others 50p, plus 50p post or large SAE. Insurance 50p per £50. MAIL ORDER, CWO, CHQ, PO, ACCESS VISA. Telephone orders: Mon-Fri, 9am - 6pm. 0689 37821. (Usually answering machine).

PHONOSONICS, DEPT PE92, 8 FINUCANE DRIVE, ORPINGTON, KENT, BR5 4ED.

MAIL ORDER

AUDIOKITS PRECISION COMPONENTS



CLASS ONE SOUND

The Class One Sound DM20 is the very latest amplifier kit from Audiokits. It is very easy to build (full instructions in *Everyday Electronics* Jan/Feb '89 issue) yet its sound quality is really good. And you can build it complete for under £100.

DM20 PRICES

Resistor Component Pack £7.50

Capacitor Component Pack £11.00

Semiconductor Component Pack £9.00

PCB Only £12.50

PCB Component Pack £55.00

PCB Component Board built and tested £90.00

COMPLETE KIT (including P&P) £99.50

COMPLETE AMPLIFIER (built and tested) £149.50

All parts available separately—send SAE for list
Send cheque/PO or Access No. (phone orders accepted)
to place your order

Delivery 2 to 3 weeks, but some metal parts may have longer
delivery time if demand exceeds prediction

FOR DETAILS OF ALL AUDIOKITS AUDIOPHILE
COMPONENTS AND KITS, PLEASE SEND LARGE 9 x 4in.
SAE (Overseas, 3 IRCs) to:

6 MILL CLOSE, BORROWASH, DERBY DE7 3GU. Tel: 0332 674929

BARGAIN

£1 COMPONENT PACKS

100 polyester Capacitors, Assorted values 10nF to 680nF.

2 Etch Resist Pens for making printed boards.

100 Silicon Diodes equivalent to 1N4148.

1 Surplus equipment panel containing lots of bits.

20 x 270 ohm Horiz Sub-miniature Preset Pots.

Order all 5 packs for £5 plus £1 p/p and receive
a FREE mystery pack.

FULL WORKSHOP SERVICE MANUALS SUPPLIED

Any Video recorder—£12 inclusive.

Any Colour TV, Audio, Test, Amateur Radio, Vintage etc.
£6.00 inclusive.

FREE catalogue with all orders or LSAE for your copy.

**MAURITRON
ELECTRONICS LTD. (EE)**
8 Cherrytree Road, Chinnor, Oxon OX9 4QY
(0844) 51694

CRICKLEWOOD

OUT NOW!

ELECTRONICS

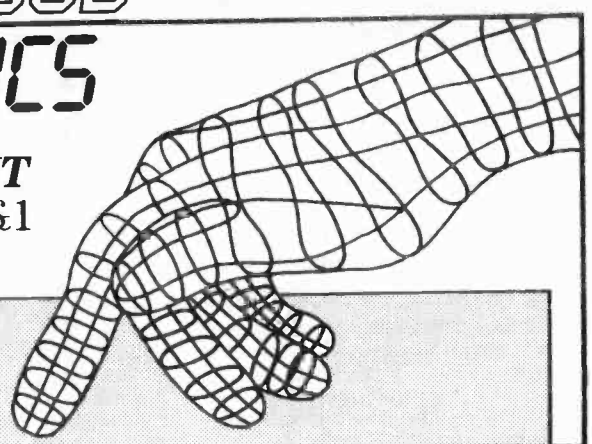
1989 100 PAGE COMPONENT CATALOGUE PRICE £1

SEND OFF FOR YOUR COPY TODAY...

- WE STOCK AN UNRIVALLED RANGE
- ALL OUR COMPONENTS ARE FIRST CLASS BRANDED ITEMS
- WE OFFER A SAME DAY SERVICE ON ALL STOCK ITEMS
- NO MINIMUM ORDER—IF YOU NEED ONE COMPONENT WE CAN SUPPLY ONE COMPONENT
- WE HAVE ADOPTED A NEW LOWER PRICING POLICY + QUANTITY DISCOUNTS
- FREE VOUCHERS WITH YOUR CATALOGUE—ORDER ONE NOW!...

JUST FILL IN THE COUPON OPPOSITE AND POST IT WITH YOUR £1 PAYMENT TO THE ADDRESS BELOW. YOU WILL RECEIVE NOT ONLY OUR SUPERB 100 PAGE CATALOGUE, BUT ALSO FREE VOUCHERS WHICH YOU CAN USE ON YOUR NEXT COMPONENTS ORDER.

CRICKLEWOOD ELECTRONICS LTD 40 CRICKLEWOOD BROADWAY LONDON NW2 3ET TEL: 01-450 0995/452 0161 FAX: 01-208 1441 TELEX: 914977



FREE VOUCHERS!

SEND OFF FOR YOUR CATALOGUE AND VOUCHERS TODAY.

I WOULD LIKE TO RECEIVE..... COPY(COPIES) OF THE 1989 CRICKLEWOOD ELECTRONICS COMPONENT CATALOGUE. I ENCLOSE £..... PLEASE ENCLOSE MY FREE VOUCHERS.

Tape your £1 coin here, or send a cheque or postal order for £1.00 for every catalogue you require.

NAME.....

ADDRESS.....



THE UNDISPUTED PACK KING FOR OVER 20 YEARS, we offer you the very best in Electronic Components and Semiconductors that your money can buy. Look at our lists and prices, they are unbeatable in value and quantity and you always have our "Satisfaction or money back guarantee". For 1989 we offer more and more Super Value Packs. All goods advertised in stock at time of going to press. This is just a small part of our stocks. Send a stamped SAE for our FREE CATALOGUE. Please note our new mail order address: BI-PAK, PO BOX 33, ROYSTON, HERTS SG8 5DF. Telephone 0763 248851.

MISCELLANEOUS

Pak No	Qty	Description	Price
VP17	50	Metres PVC single strand Wire, mixed colours	£1.00
VP18	30	Metres PVC multi strand Wire, mixed colours	£1.00
VP19	40	Metres PVC single/multi strand Wire, mixed colours	£1.00
VP21	10	Assorted Switches, slider, push, rocker, etc	£1.50
VP22	4	Sheets Copper Clad Board, approx. 14x12cm	£1.00
VP23	10	40mm track Slider Pots, 100K Lin	£1.00
VP26	100	50, Ins total Copper Clad Fibre Glass Board	£1.50
VP42	10	Black Heatsinks, fit T03 and T0220, drilled	£1.00
VP43	4	Power-fit Heatsinks, 2xT03, 2xT066	£1.00
VP44	15	Assorted Heatsinks, T01/3/5/18/200	£1.00
VP45	20	Assorted I.C. DIL Sockets, 8-40 pin	£2.50
VP82	1	Electronic Buzzer 3V 25MA	£0.95
VP83	1	Electronic Buzzer 6V 25MA	£0.95
VP84	1	Electronic Buzzer 9V 25MA	£0.95
VP85	1	Electronic Buzzer 12V 25MA	£0.95
VP87	1	Telephone Pick-up Coil with 3.5mm jack plug	£1.25
VP88	1	Fillow Speaker with 3.5mm jack plug	£1.45
VP107	1	Piezo Buzzer miniature, 12V	£1.25
VP108	1	Piezo Buzzer miniature, 240V	£1.25
VP114	1	Coax Antenna Switch, 3 way	£4.75
VP115	1	High Pass Filter/Suppressor, CB/TV	£0.50
VP116	1	Low Pass Filter, VHS/TV Band	£3.00
VP122	1	Precision Morse key, fully adjustable	£1.85
VP144	4	100K Lin multi turn Pots, ideal variable cap. tuning	£1.00
VP145	10	Assorted Pots, inc. dual and switched types	£1.00
VP148	30	Presets, horizontal and vertical, mixed values	£1.00
VP174	5	DIL Switches, 1 and 2 way slide, 6 way SPST assorted	£1.00
VP176	30	Fuses, 20mm and 1/4in glass, assorted values	£1.00
VP177	1	Pack assorted Hardware, nuts, bolts, etc	£1.00
VP178	5	Assorted Battery Holders and Clips, PP3/9, AA/D, etc	£1.00
VP223A	6	Tag Board, 10 way parallel	£1.00
VP225	20	DIN Plugs, plastic 2-8 pin 180°/240°/360° mixed	£2.50
VP227	18	DIN In-line Sockets, plastic 2-8 pin 180°/240°/360° mixed	£2.50
VP228	10	C15 Computer Cassette Tapes, leadless	£3.00
VP232	1	Cassette Head Cleaner/Demagnetizer, in case	£2.00
VP233	1	Revolving Cassette Rack, holds 32, smokely peripack	£2.50
VP235	1	VHS Video Head Cleaner Cassette, wet type	£2.50
VP236	1	Beta Video Head Cleaner Cassette, wet type	£2.50
VP237	1	Universal Ni-Cad Battery Charger, AA-HP1-HP2-PP3	£6.00
VP238	4	AA Ni-Cad Batteries, 1.25V 500mAh CR HA	£4.00
VP239	2	C-HP11 Ni-Cad Batteries, rechargeable	£3.50
VP240	2	D-HP2 Ni-Cad Batteries, rechargeable	£4.00
VP244	1	High power Piezo Electric Siren, emits ear piercing warbling sound. Ideal alarms. White plastic body with mounting bracket. Power: 12V dc 150mA. Output 100db (A) at 1m dup. freq. 2.5KHz. Size: 57x42x37mm	£6.00

VP245	1	Automatic Lighting Switch, photo electric, weatherproof, switched lights or equipment "ON" at dusk and "OFF" at dawn. Loads up to 1amp 240V ac. Size: 50x45mm	£5.50
VP260	1	9in x 6in Elliptical 8 ohms 10W RMS Speaker. Freq. res. 60-10000Hz. Gauss 10000. Centre HF cone	£4.50
VP260A	1	2 1/4in Transducer Waterproof Speaker. Polyester film diaphragm. Moisture resistant. 8ohms 300mW RMS Freq. res. 20-20000Hz	£1.00
VP273	10	10K Lin Rotary Potentiometers, slim spindle	£1.00
VP281	4	Plug-in Relays, mixed volts, etc	£1.00
VP286	2	Etch Resist PCB Transfer sheets, asst symbols/lines, etc	£1.00
VP254	1	250 grams Etchant Granules (Ferric Chloride) makes 1/2 pint	£1.00
VP255	1	Etching Pen, etch resistant, spare tip, blue	£1.00
VP258	1	Multicore Solder, 5m total, 10 and 22SWG	£1.00

MISCELLANEOUS

Pak No	Qty	Description	Price
VP470	8	Dual Pots, linear, all different values	£1.00
VP471	8	Dual Pots, Log, all different values	£1.00
VP472	8	Switched Pots, Linear, all different values	£1.00
VP473	8	Switched Pots, Log, all different values	£1.00
VP474	12	Slider Pots, Insulob, black/chrome, push fit	£1.00
VP475	1	100 Sq. Ins. Double-sided Copper Clad Board	£1.50
VP475A	2	Sheets 20 x 15cm, extra thin 1/2mm, double-sided Copper Clad	£1.50
VP484	1	pair Line Socket and Chassis Plug Euro style GA 250V ac	£1.00
VP485	1	Scart Plug, 21 way Euro Video Plug	£1.00
VP486	1	2 x 23 way Edge Connector and matching PCB Board, plated at pin 3 as for ZX81, etc	£1.00
VP519	1	4in Round Dome Tweeter, 8ohms 50w RMS 2000-20000Hz. Dia. 98mm, depth 32mm, black metal and plastic front, mesh centre	£5.50
VP520	1	Uni-directional Dynamic Microphone, high imp 50K ohms	£6.50
VP521	1	Uni-directional Dynamic Microphone, low imp 500 ohms, response 80-12000Hz: sens. -77db at 1kHz. All plastic body black metal mesh, head dia. 53mm. On/Off switch holder inc.	£6.50

DIODES & SCRS

VP29	30	Assorted volt Zeners, 500W-2W	£1.00
VP30	30	Assorted volt Zeners, 10W, coded	£1.00
VP31	10	5A SCRs, T066, 50-400V, coded	£1.00
VP32	20	3A SCRs, T066, up to 400V, uncoded	£1.00
VP33	100	Silicon Diodes like IN4148	£1.00
VP34	200	Silicon Diodes like OA200/BAK13-16, 40V	£1.00
VP35	50	1A IN4000 Diodes, all good, uncoded	£1.00
VP49	30	Assorted Silicon Rectifiers, 1A-10A, mixed volts	£1.00
VP141	40	IN4002 Sil. Rectifiers, 1A 100V, performed p/tech	£1.00

VP142	4	40A Power Rectifiers, silicon, T048, 300 PV	£1.00
VP184	3	4A 400V Triacs, plastic	£1.00
VP187	10	SCR's 800mA, 200V, 2N5064, plastic T092	£1.00
VP194	50	OA91 point contact germanium Diodes, uncoded	£1.00
VP195	50	OA47 gold bonded germanium Diodes, coded	£1.00
VP196	50	OA70-79 detector germanium Diodes	£1.00
VP197	50	OA80 type germanium Diodes, uncoded	£1.00
VP198	40	BA248 Silicon Diode, 350V, 2A, fast recovery	£1.00
VP222	20	3A stud Rectifiers, 50-400V, assorted	£1.00
VP262	10	BY127 Silicon Rectifiers, 5A, 1200V	£1.00
VP263	5	Bridge Rectifiers, 2A, 50V, 2W005, plastic	£1.00
VP264	4	2amp 400V Bridge Rectifiers	£1.00
VP265	25	OA10 germanium Diodes	£1.00
VP274	12	SCR's (Thyristors) 1A, 100-400V, T039	£1.00
VP275	3	50amp 400V SCR's, T0220, T0106D	£1.00
VP276	5	SCR's standard type, 5-16A to 400V	£1.00
VP277	4	Triacs 2A 400V, T039	£1.00
VP278	4	6amp 1000V plastic silicon Rectifiers	£1.00
VP283	5	Diac BR100 Triac trigger	£1.00
VP460	1	Triac 6A 600V, isolated case T0220	£1.00
VP460A	1	Triac 10A 600V, isolated case T0220	£1.25
VP482	50	Assorted IN4001-IN4007 1A 50-1000V Diodes, coded	£2.00
VP483	50	Assorted IN5400-IN5408 3A 50-1000V Diodes, coded	£3.00

TOOLS

Pak No	Qty	Description	Price
VP93	1	Miniature Anvil for model makers and jewellers	£2.95
VP94	1	Miniature Steel Vice, bench fixings, jaw width 50mm	£5.50
VP95	1	Plastic Miniature Vice, with suction base	£1.75
VP97	1	Logic Probe/Tester, supply 4.5V-18V, DTL, TTL, CMOS	£8.50
VP99	1	Universal Tester, with ceramic buzzer	£5.00
VP103	1	Spec STANLEY Screwdriver Set, flat and crosspoint	£3.50
VP139	1	Pick-up Tool, spring loaded	£1.75
VP217	1	Helping Hand	£4.00
VP218	1	Watchmakers Screwdriver Set, 6 pieces	£1.55
VP219	1	Miniature Side Cutters	£1.55
VP221	1	Miniature Long-nose Pliers	£1.55
VP246	1	25W High Quality Low Cost Soldering Iron 240V ac, long life element, 1.7m lead	£3.50
VP247	1	15W "lightweight" High Quality Low Cost Soldering Iron, 240V ac, 1.7m lead	£3.50
VP248	1	High Suction Desoldering Pump, Teflon nozzle auto eject, heavy duty return spring	£4.00
VP248A	1	Antistatic High Suction Desoldering Pump. Auto eject, metal body, antistatic nozzle	£4.50
VP249	1	High Quality Soldering Iron Stand, cast iron base with cleaning sponge. Very stable unit	£4.00

BI-PAK

Send your orders to: BI-PAK, DEPT EE, PO BOX 33 ROYSTON, HERTS SG8 5DF. TERMS: CASH WITH ORDER, PERSONAL CHEQUE, ACCESS AND BARCLAYCARD, GIRO 388 7006, SAME DAY DESPATCH. TEL: 0763 248851. ADD £1.50 P&P PER ORDER AND 15% VAT.



REMEMBER YOU MUST ADD £1.50 P&P AND 15% VAT TO TOTAL ORDER

ELECTRONICS TECHNICIAN FULL-TIME TRAINING

(FULL TIME COURSES APPROVED BY THE BUSINESS
& TECHNICIAN EDUCATION COUNCIL)

2 YEAR

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

1 YEAR

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

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

3—SOFTWARE ENGINEERING

(Electronics, Assembler, BASIC, PASCAL, CAD/CAM)

4—COMPUTING TECHNOLOGY

(Electronics, Computing Software/Hardware, Microelectronic
Testing Methods)

10 MONTHS

**BTEC Higher National Certificate (HNC)
COMPUTING TECHNOLOGY & ROBOTICS**
(Microprocessor Based Systems, Fault Diagnosis, ATE, Robotics)
(Those eligible can apply for E.T. grant support)

*These courses include a high percentage of college based
practical work to enhance future employment prospects
No additional fees for overseas students*

*Shortened courses of from 3 to 6 months can be arranged for
applicants with previous electronics knowledge*

O.N.C. Monday 24th April 1989

FULL PROSPECTUS FROM

LONDON ELECTRONICS COLLEGE
(Dept. EE), 20 PENYVERN ROAD
EARLS COURT, LONDON SW5 9SU
Tel: 01-373 8721

ADVERTISERS INDEX

AUDIOKITS	142	JAYTEE ELECTRONICS SERVICES	78
BARRIE ELECTRONICS	76	LONDON ELECTRONICS COLLEGE	144
BICC-VERO ELECTRONICS	79	MAGENTA ELECTRONICS	87
BI-PAK	143	MAPLIN ELECTRONICS	Cover (iv)
B K ELECTRONIC	Cover (iii)	MARCO TRADING	137
BULL, J. N.	Cover (ii)	MAURITRON	142
CIRKIT DISTRIBUTION	129	NATIONAL COMPONENT CLUB	129
CR SUPPLY CO.	135	OMNI ELECTRONICS	140
CRICKLEWOOD ELECTRONICS	143	PHONOSONICS	142
CROTECH INSTRUMENTS	100	PVS ELECTRONIC COMPONENTS	144
ELECTRONIZE DESIGN	129	RISCOMP	123
ELECTROVALUE	77	SHERWOOD ELECT. COMPONENTS	144
EVERETT WORKSHOP ACCESS	144	SM ENGINEERING	123
GREENWELD ELECTRONICS	78	SPECIALIST SEMICONDUCTORS	141
HART ELECTRONIC KITS	123	SPK ELECTRONICS	76
HIGHGRADE COMPONENTS	74	SUMA DESIGNS	76
ICS	140	TK ELECTRONICS	80
I-TRON UK	135		

MEMORIES

EPROM, SRAM, DRAM, EEPROM, 2716,
2732, 2764, 27128, 27256, 27512, 4116
4164, 41256, 2114, 6116, 6264, CMOS
and low power

MICROPROCESSORS

NEC, INTEL, MOTOROLA, AMD, 8085
68000, Z80A, 80186, 8086

Semiconductor sensors, Ferrite
Cores, Optoelectronics, Semi-
conductors, Thermistors, Inte-
grated Circuits, Potentiometers,
LEDs, Connectors, Suppression
Switches



LOWEST PRICES WORLDWIDE FOR MEMORIES, DIGITAL,
LINEAR ICs. Send for Complete Components Catalogue — UK £1.50, Export £2.50

PVS ELECTRONIC COMPONENTS

244 Deansgate Court, Deansgate, Manchester M3 4BQ

Tel. 061 831-7086 & 0860 399945 24 hrs.
Telex 668986 Fax 061 832-6934



SHERWOOD ELECTRONIC COMPONENTS

45 Rutland St., Mansfield
Notts. NG18 4AP

RESISTOR PACKS

0.25W C.Film 10 each (610)	425p
0.25W C.Film 5 each (305)	265p
0.25W C. Film Popular (1000)	600p
0.25W Metal Glaze 2% (250)	150p
Min. Hor. Presets 5 ea (65)	385p
Min. Vert. Presets 5 ea (65)	385p

3mm LEDs

Red	12p	5mm LEDs	
Green	15p	Red	9p
Yellow	15p	Green	10p
CLip	3p	Yellow	12p
		Amber	12p
		Clip	4p
12x5mm Red or Green LED,s	100p		
12x5mm Clips	40p		

Diodes

1N4001	5p
1N4002	5p
1N4003	5p
1N4004	6p
1N4005	6p
1N4006	7p
1N4007	8p
1N4148	3p

Zener Diodes

5p	BZY88 400 mW
5p	2V7 to 36V
6p	all at 10p each

Voltage Regulators

100mA	1A		
78L05	25p	7805	35p
78L12	26p	7812	35p
78L15	26p	7815	36p
79L05	30p	7905	36p
79L12	30p	7912	38p
79L15	30p	7915	38p

Low Profile DIL Sockets

8 Pin 8p, 10 off	75p
14 pin 9p, 10 off	85p
16 pin 10p, 10 off	95p
24 pin 20p, 10 off	180p

CMOS

4000	25p	4073	27p
4001	25p	4075	27p
4011	25p	4077	30p
4013	38p	4081	27p
4017	55p	4093	35p
4023	30p	4510	65p
4025	25p	4511	65p
4027	50p	4514	125p
4047	65p	4515	130p
4070	27p	4516	65p
4071	27p	4528	70p
4072	27p		

I.C.s

555	22p, 5 off	100p
741	22p, 5 off	100p
CA3140E		45p
CA3240E		125p
TL071		60p
TL072		80p
TL081		40p
TL082		55p

Cheque or P.O. to:

SHERWOOD ELECTRONIC COMPONENTS

Please add £1 P&P

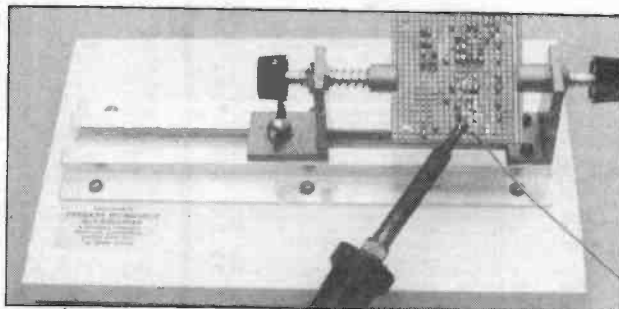
NO VAT

Need an extra pair of hands?

It's often the case that conventional methods just won't do. Fortunately there is now an alternative with the

MULTI-PURPOSE JIG

It will hold a circuit board steady for assembly and wiring—
It can hold things while glue sets—
It can hold models for painting and repair—
All its interchangeable heads rotate through 360 degrees so
you can position your workpiece to best advantage—no need
to take it out to turn it over either—just rotate it to where you
want it.
Precision spring loaded head for holding pressures of up to
5.5lbs.



Each jig is hand built for a lifetime of use.

Due to improved production techniques we have also
been able to reduce the prices!

Standard jig takes items up to 310 x 145mm **£19.50**
Mini jig takes items up to 148 x 85mm **£16.50**
inc. VAT and carriage

EVERETT WORKSHOP ACCESSORIES
5 Railway Terrace, Henllan, Llandysul,
Dyfed SA44 5TH

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

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

THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS



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

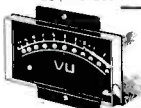
NEW SERIES II MOS-FET MODULES

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

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

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

NOTE:— MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS, STANDARD — INPUT SENS. 500mV BAND WIDTH 100KHz, P.E.C (PROFESSIONAL EQUIPMENT COMPATIBLE) — INPUT SENS. 775mV, BAND WIDTH 50KHz, ORDER STANDARD OR P.E.C.



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

LOUDSPEAKERS



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

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

ALL MCKENZIE UNITS 8 OHMS IMPEDANCE
 8" 100 WATT C8100GPM GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID., DISCO. **PRICE £28.59 + £2.00 P&P.**
 RES. FREQ. 80Hz. FREQ. RESP. TO 14KHz. SENS. 99dB.
 10" 100 WATT C10100GP GUITAR, VOICE, ORGAN, KEYBOARD, DISCO, EXCELLENT MID. **PRICE £34.70 + £2.50 P&P.**
 RES. FREQ. 70Hz. FREQ. RESP. TO 6KHz. SENS. 100dB.
 10" 200 WATT C10200GP GUITAR, KEYBOARD, DISCO, EXCELLENT HIGH POWER MID. **PRICE £47.48 + £2.50 P&P.**
 RES. FREQ. 45Hz. FREQ. RESP. TO 7KHz. SENS. 103dB.
 12" 100 WATT C12100GP HIGH POWER GEN. PURPOSE, LEAD GUITAR, DISCO. **PRICE £36.66 + £3.50 P&P.**
 RES. FREQ. 45Hz. FREQ. RESP. TO 7KHz. SENS. 98dB.
 12" 100 WATT C12100TC TWIN CONE) HIGH POWER WIDE RESPONSE, P.A., VOICE, DISCO. **PRICE £37.63 + £3.50 P&P.**
 RES. FREQ. 45Hz. FREQ. RESP. TO 14KHz. SENS. 100dB.
 12" 200 WATT C12200B HIGH POWER BASS, KEYBOARDS, DISCO, P.A. **PRICE £64.17 + £3.50 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 7KHz. SENS. 100dB.
 12" 300 WATT C12300GP HIGH POWER BASS LEAD GUITAR, KEYBOARDS, DISCO, ETC. **PRICE £85.79 + £3.50 P&P.**
 RES. FREQ. 45Hz. FREQ. RESP. TO 5KHz. SENS. 100dB.
 15" 100 WATT C15100BS BASS GUITAR, LOW FREQUENCY, P.A., DISCO. **PRICE £53.70 + £4.00 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 5KHz. SENS. 98dB.
 15" 200 WATT C15200BS VERY HIGH POWER BASS. **PRICE £73.26 + £4.00 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 4KHz. SENS. 99dB.
 15" 250 WATT C15250BS VERY HIGH POWER BASS. **PRICE £80.53 + £4.50 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 4KHz. SENS. 99dB.
 15" 400 WATT C15400BS VERY HIGH POWER, LOW FREQUENCY BASS. **PRICE £94.12 + £4.50 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 4KHz. SENS. 102dB.
 18" 400 WATT C18400BS EXTREMELY HIGH POWER, LOW FREQUENCY BASS. **PRICE £167.85 + £5.00 P&P.**
 RES. FREQ. 27Hz. FREQ. RESP. TO 3KHz. SENS. 99dB.

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

ALL EARBENDER UNITS 8 OHMS EXCEPT EB8-50 AND EB10-50 DUAL 4 AND 8 OHM. BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED FOAM SURROUND
 8" 50 WATT EB8-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. **PRICE £8.90 + £2.00 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 7KHz. SENS. 97dB.
 10" 50 WATT EB10-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. **PRICE £12.00 + £2.50 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 5KHz. SENS. 99dB.
 10" 100 WATT EB10-100 BASS, HI-FI, STUDIO. **PRICE £27.50 + £3.50 P&P.**
 RES. FREQ. 35Hz. FREQ. RESP. TO 3KHz. SENS. 96dB.
 12" 60 WATT EB12-60 BASS, HI-FI, STUDIO. **PRICE £21.00 + £3.00 P&P.**
 RES. FREQ. 28Hz. FREQ. RESP. TO 3KHz. SENS. 92dB.
 12" 100 WATT EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO. **PRICE £32.00 + £3.50 P&P.**
 RES. FREQ. 26Hz. FREQ. RESP. TO 3KHz. SENS. 93dB.
FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND
 5 1/2" 60 WATT EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. **PRICE £9.99 + £1.50 P&P.**
 RES. FREQ. 63Hz. FREQ. RESP. TO 20KHz. SENS. 92dB.
 6 1/2" 60 WATT EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. **PRICE £10.99 + £1.50 P&P.**
 RES. FREQ. 38Hz. FREQ. RESP. TO 20KHz. SENS. 94dB.
 8" 60 WATT EB8-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. **PRICE £12.99 + £1.50 P&P.**
 RES. FREQ. 40Hz. FREQ. RESP. TO 18KHz. SENS. 89dB.
 10" 60 WATT EB10-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. **PRICE £16.49 + £2.00 P&P.**
 RES. FREQ. 35Hz. FREQ. RESP. TO 12KHz. SENS. 86dB.

TRANSMITTER HOBBY KITS

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

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



3 watt FM Transmitter

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

OMP VARISPEED TURNTABLE CHASSIS.



★ MANUAL ARM ★ STEEL CHASSIS ★ ELECTRONIC SPEED CONTROL 33 & 45 ★ VARI PITCH CONTROL ★ HIGH TORQUE SERVO DRIVEN DC MOTOR ★ TRANSIT SCREWS ★ 12 DIE CAST PLATTER ★ NEON STROBE ★ CALIBRATED BAL WEIGHT ★ REMOVABLE HEAD SHELL ★ 1" CARTRIDGE FIXINGS ★ CUE LEVER ★ POWER 220 240V 50 60Hz ★ 390x305mm ★ SUPPLIED WITH MOUNTING CUT-OUT TEMPLATE **PRICE £59.99 + £3.50 P&P.**

OPTIONAL MAGNETIC CARTRIDGES

STANTON AL500
PRICE £16.99 + 50p P&P

GOLDRING G850
PRICE £6.99 + 50p P&P

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

THOUSANDS PURCHASED BY PROFESSIONAL USERS



NEW MXF SERIES OF POWER AMPLIFIERS

THREE MODELS:— MXF200 (100w + 100w) MXF400 (200w + 200w) MXF600 (300w + 300w)

All power ratings R.M.S. into 4 ohms.

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

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

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

**MXF200 £171.35
 MXF400 £228.85
 MXF600 £322.00**

SECURICOR DELIVERY £12.00 EACH



OMP LINNET LOUDSPEAKERS

THE VERY BEST IN QUALITY AND VALUE



MADE ESPECIALLY TO SUIT TODAY'S NEED FOR COMPACTNESS WITH HIGH OUTPUT SOUND LEVELS, FINISHED IN HARDWEARING BLACK VYNIDE WITH PROTECTIVE CORNERS GRILLE AND CARRYING HANDLE. INCORPORATES 12" DRIVER PLUS HIGH FREQ. HORN FOR FULL FREQ. RANGE 45Hz-20KHz BOTH MODELS 8 OHM. SIZE H18" x W15" x D12"

CHOICE OF TWO MODELS

POWER RATINGS QUOTED IN WATTS RMS FOR EACH CABINET

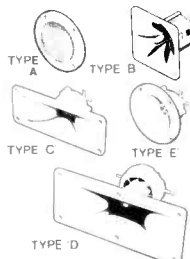
**OMP 12-100 (100W 100dB) PRICE £159.99 PER PAIR
 OMP 12-200 (200W 102dB) PRICE £209.99 PER PAIR**

SECURICOR DEL.— £12.00 PER PAIR

PIEZO ELECTRIC TWEETERS-MOTOROLA

PIEZO ELECTRIC TWEETERS — MOTOROLA

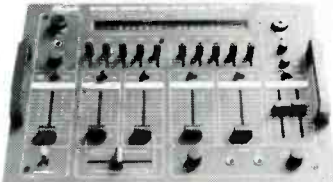
Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put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



TYPE 'A' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-Fi speakers. **Price £4.90 each + 50p P&P**
TYPE 'B' (KSN1005A) 3 1/2" super horn. For general purpose speakers, disco and P.A. systems etc. **Price £5.00 each + 50p P&P**
TYPE 'C' (KSN6016A) 2" x 5 1/2" wide dispersion horn. For quality Hi-Fi systems and quality discos etc. **Price £6.99 each + 50p P&P**
TYPE 'D' (KSN1025A) 2" x 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. **Price £9.99 each + 50p P&P**
TYPE 'E' (KSN1038A) 3 3/4" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. **Price £5.99 each + 50p P&P**
LEVEL CONTROL Combines on a recessed mounting plate level control and cabinet input jack socket. 85x85mm. **Price £3.99 + 50p P&P**

STEREO DISCO MIXER

STEREO DISCO MIXER with 2 x 5 band L & R graphic equalisers and twin 10 segment L.E.D. Vu Meters. Many outstanding features 5 inputs with individual faders providing a useful combination of the following:— 3 Turntables (Mag) 3 Mics 4 Line including CD plus Mic with talk over switch Headphone Monitor. Pan Pot L & R. Master Output controls. Output 775mV. Size 360x280x90mm. Supply 220-240V. **Price £134.99 — £4.00 P&P**



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



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



THE NEW MAPPLIN CATALOGUE IT'S OUT OF THIS WORLD SEND FOR YOUR COPY TODAY

ORDER YOUR COPY OF THE NEW MAPPLIN CATALOGUE ON SALE NOW

Pick up a copy from any W.H. Smith for just £1.95 or post this coupon now to receive your copy by post for just £1.95 + 50p p & p. If you live outside the U.K. send £3.40 or 15 International Reply Coupons. I enclose £2.45.

Name: _____
Address: _____
Post Code: _____

Send to Maplin Electronics, P.O. Box 3, Rayleigh, Essex SS6 8LR.
AVAILABLE FROM 11th NOVEMBER 1988 IN ALL W.H. SMITH STORES

EE 89



Evening on the planet Oldana, as the Maplin Juice train thunders along the highway, captured on canvas by galaxy famous artist Lionel Leans and featured on the cover of the new Maplin Catalogue.