EVERYDAY ELECTRONICS

JULY 1988

INCORPORATING ELECTRONICS MONTHLY

£1.30

UNIVERSAL CHARGER/P.S.U.

ISOLINK

SPIKE EATER

VIDEO WIPER

The Magazine for Electronic & Computer Projects

POPULAR BAKERS DOZEN PACKS (still available)

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.

BD1	5	13A junction boxes for adding extra points to your ring main circuit.
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	6½in speaker cabinet ideal for extensions, takes our speaker. Ref BD137.
BD13	12	30 watt reed switches, it's surprising what you can make with these—burglar alarms, secret switches, relay, etc., etc.
BD22	2	25 watt loudspeaker two unit crossovers.
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	48	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	2	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 coil sets with notes on making c/o relays and other gadgets.
BD149	6	Safety cover for 13A sockets—prevent those inquisitive little fingers getting nasty shocks.
BD180	6	Neon indicators in panel mounting holders with lens.
BD193	6	5 amp 3 pin flush mounting sockets make a low cost disco panel.
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.
BD200	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.
BD246	2	Tacho generators, generate one volt per 100 revs.
BD252	1	Panostat, controls output of boiling ring from simmer up boil.
BD259	50	Leads with push-on ¼in tags—a must for hook-ups—mains connections etc.
BD263	2	Oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into pattress.
BD268	1	Mini 1 watt amp for record player. Will also change speed of record player motor.
BD275	1	Guitar mic—clip-on type suits most amps.
BD283	3	Mild steel boxes approx 3in x 3in x 1in deep—standard electrical.
BD293	50	Mixed silicon diodes.
BD296	3	Car plugs with lead, fit into lighter socket.
BD305	1	Tubular dynamic mic with optional table rest.

Most other packs still available and you can choose any as your free one.

5A BATTERY CHARGER KIT

All parts, including case, Only **£5** plus £1 postage

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.

F.D.D. BARGAIN

3½in Floppy Disc Drive, made by the Chinon Company of Japan Beautifully made and probably the most compact device of its kind as it weighs only 600g and measures only 104mm wide, 162mm deep and has a height of only 32mm. Other features are 80 track, high precision head positioning—single push loading and eject—direct drive brushless motor—Shugart compatible interface—standard connections—interchangeable with most other 3½ and 5¼ drives. Brand new with copy of maker's manual. Offered this month at £28.50 post and VAT included.

CASE—adaptable for 3½" FDD, has room for power supply components. Price only £4 includes circuit of PSU. Our Ref 4P7.

POWER SUPPLY FOR FDD—5V and 12V voltage regulated outputs, complete kit of parts will fit into case 4P7 price £8 or with case £11. Our ref. 11P2

9" MONITOR

Ideal to work with computer or video camera uses Philips black and white tube ref M24/306W. Which tube is implosion and X-ray radiation protected. VDU is brand new and has a time base and EHT circuitry. Requires only a 16V dc supply to set it going. It's made up in a lacquered metal framework but has open sides so should be cased. Offered a a lot less than some firms are asking for the tube alone, only £16 plus £5 post.

CASE FOR 9" MONITOR

We have arranged with a metal worker to make cases for the 9" Monitor. Delivery promised for the end of May and the price £12 plus £2 post. The case will be made from coated sheet steel, overall size approx 10in x 10in x 7in high which will give ample space for the Power Supply and external controls if you fit them.

PROBLEM SOLVED!

We have obtained from the manufacturers of the 9" Monitor, the TTL converter which makes it composite input suitable to work with any computer. We have had the printed circuit board made and have all the components and can supply this converter in kit form price £6. Our ref. 6P4.

AN ALLADIN'S CAVE

We have opened another shop in Hove, the address is number 12 Boundary Road which is between Hove and Portslade fairly close to the seafront. When you want to see before you buy and when you want to browse around the special bargains available, this is where you should make for as the Portland Road shop in future will be just mail order. You can of course collect from Portland Road but you should bring in an order complete with reference numbers so that the stores can attend to it easily.

MINI MONO AMP on p.c.b. size 4" x 2" (app.)

Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of £1.15 each, or £13 for 12.

THIS MONTH'S SNIP

ACORN COMPUTER OATA RECORDER (CASSETTE). This is a mono data recorder with switchable motor control intended for use with the Acorn Electron or BBC computers but also functions with almost any other computer and can be used for normal record and play-back of music and speech.

Six key controls give "PAUSE" "STOP" and "EJECT" "CUE/FAST FORWARD" "REVUE/REWIND" and "RECORD", fast forward and rewimnd (100 seconds for C60). Also tape counter with reset button. Input signal range 5mV to 500mV. Input impedance 40k ohm Can be battery operated but is supplied with a mains adaptor. Brand new still in manufacturer's wrapping £8. Order Ref. 8P18 add £2 postage

VENNER TIME SWITCH

Ex-Electricity Board. Guaranteed 12 months

Mains operated with 20 amp switch, one on and one 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/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of the adaptor kit is £2.30.

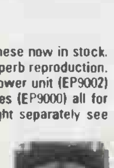
AKAI RV-UM300 MIDI-RACK

Is a really excellent piece of furniture, ideal to hold your computer or audio equipment. Has three shelves in the upper section and a hinged glass fronted lower section. Height approximately 3ft, width 13½in, depth 14in, on castors, dark walnut veneer finish. £15 plus £8 for Securicor delivery. Order Ref. 15P11.

MULLARD UNILEX AMPLIFIERS

We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules—i.e. Mains power unit (EP9002) Pre-amp module (EP9001) and two amplifier modules (EP9000) all for £6.00 plus £2 postage. For prices of modules bought separately see TWO POUNDERS.

25A ELECTRICAL PROGRAMMER



Learn in your sleep. Have radio playing and kettle boiling as you wake—switch on lights to warn off intruders—have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. A beautiful unit at £2.50.

POWERFUL IONISER

Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, workroom etc. Makes you feel better and work harder—a complete mains operated kit, case included. £11.50+£3 P&P

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

NEW ITEMS
Some of the many items described in our current list which you will receive with your parcel

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.

FREE POWER! Can be yours if you use our solar cells—sturdily 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—you join 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.

15A PANEL METER These have been stripped from Government surplus battery charger units made originally for army use. Unused, tested but of course rather old, diameter 2in can be surface or flush mounted. £3 each. Our Ref. 3P40.

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 4¼in x 4in high, ends are louvred for ventilation other sides are flat and undrilled. Order Ref. 2P191. Price £2.

BIG SMOOTHING CAPACITOR. Sprague powerlytic 39,000uF at 50V. £3. Our ref. 3P41.

HEAVY DUTY CURLY MAINS LEAD. Can be loaded up to 13A, stretces to almost 3 metres fitted with 13A plug. £3. Order ref. 3P42.

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.

BULK-HEAD MOUNTING LOUDSPEAKER. Metal case with chrome grill front and with mounting lugs for screwing to ceiling, 8in. speaker. £10 each. Order ref. 10P43 add £2 post.

TWIN GANG TUNING CAPACITOR. Each section is .0005uF with trimmers and good length ¼in spindle. Old but unuse3d and in very good condition. £1 each. Our ref. BD630.

13A PLUGS Good British make complete with fuse, parcel of 5 for £2. Order ref. 2P185.

13A ADAPTERS Takes 2 13A plugs, packet of 3 for £2. Order ref. 2P187.

20V-0-20V Mains transformers 2½ amp (100 watt) loading, tapped primary. 200-245 upright mountings £4. Order ref. 4P24.

BENCH ISOLATION TRANSFORMERS 250 watt 230V in and out with plenty of tappings to give exact volts. £5 plus £2. Order ref. 5P5.

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

24 HOUR TIME SWITCH—16A changeover contacts, up to 6 on/offs per day. Nicely cased, intebnded for wall mounting. Price £8. Ref. 8P6.

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

CLEANING FLUID—Extra good quality—intended for video and tape heads. Regular price £1.50 per spray can. Our price 2 cans for £1. Ref. BD604.

PIEZO ELECTRIC FAN—An unusual fan, more like the one used by Madame Butterfly than the conventional type, it does not rotate. The air movement is caused by two vibrating arms. It is American made, mains operated, very economical and causes no interference, so is ideal for computer and instrument cooling. Price is only £1 each. Ref. BD605.

SPRING LOADED TEST PROOS—Heavy duty, made by the famous Bulgin company, very good quality. Price 4 for £1. Ref. BD599.

CURLY LEAD—Four core, standard replacement for telephone handset, extends to nearly 2 metres. Price £1 each. Ref. BD599.

TELEPHONE BELLS—These will work off our standard mains through a transformer, but to sound exactly like a telephone, they then must be fed with 25Hz 50V. So with these bells we give a circuit for a suitable power supply. Price 2 bells for £1. Ref. BD600.

ASTEC 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.

CASE WITH 13A PRONGS—To go into 13A socket, nice size and suitable for plenty of projects such as battery trickle charger, speed controller, time switch, night light, noise suppressor, dimmers etc. Price—2 for £1. Ref. BD565.

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.

TELEPHONE EXTENSIONS—It is now legal for you to undertake the wiring of telephone extensions. For this we can supply 4-core telephone cable, 100m coil £8.50. Extension BT sockets £2.95. Packet of 50 plastic headed staples £2. Dual adaptor for taking two appliances from one socket £3.95. Leads with BT plug for changing old phones, 3 for £2.

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.

3-30V VARIABLE VOLTAGE POWER SUPPLY UNIT—with 1 amp DC output. Intended for use on the bench for experimenters, students, inventors, service engineers etc. This is probably the most important piece of equipment you can own (after a multi range test meter). It gives a variable output from 3-30 volts and has an automatic short circuit and overload protection, which operates at 1.1 amp approximately.) Other features are very low ripple output, a typical ripple is 3mV pk-pk, 1mV rms. Mounted in a metal fronted plastic case, this has a voltmeter on the front panel in addition to the output control knob and the output terminals. Price for complete kit with full instructions is £15. Ref. 15P7.

TRANSMITTER SURVEILLANCE (BUG)—Tiny, easily hidden, but which will enable conversation to be picked up with FM radio. Can be housed in a matchbox, all electronic parts and circuit. Price £2. Ref. 2P52.

VOL 17 No 7 JULY '88

EVERYDAY ELECTRONICS

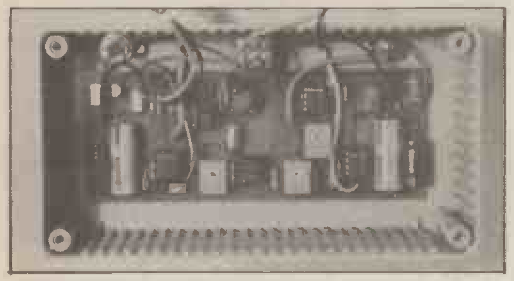
INCORPORATING ELECTRONICS MONTHLY

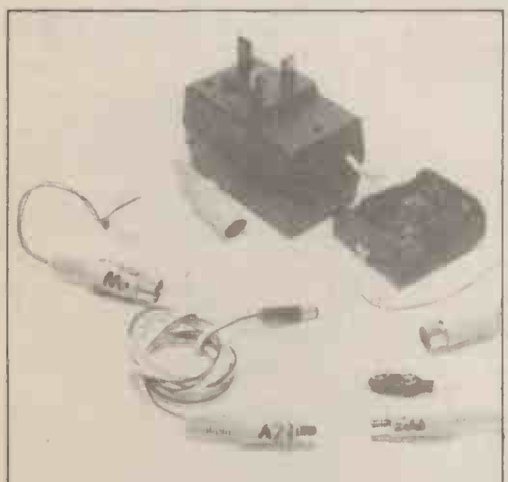
ABC

The Magazine for Electronic & Computer Projects

ISSN 0262-3617

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





Projects

Series

Features

Our August '88 issue will be published on Friday, 1 July 1988. See page 411 for details.

EE CROSSWORD 6

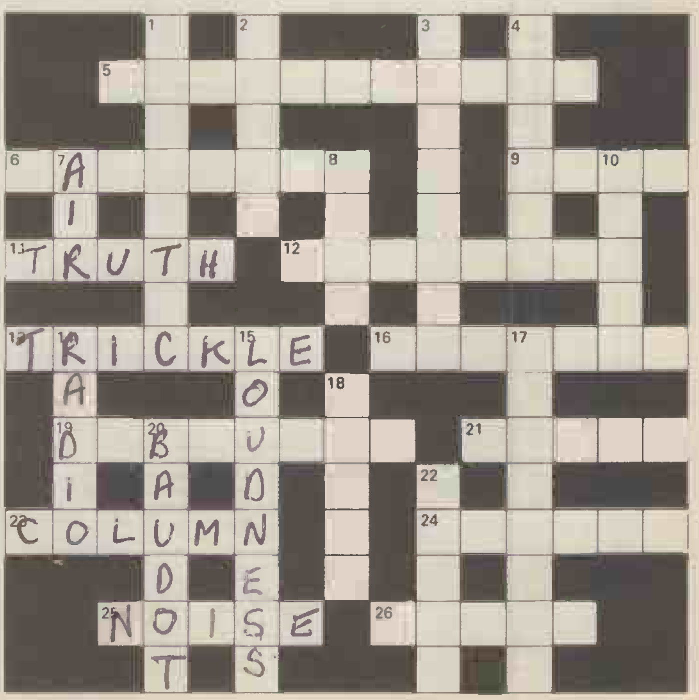
CLUES ACROSS

5 You are left with this after removing the harmonics. (11)
6 Form of gain control used in t.v. (5, 1, 1, 1)
9 Bulk transfer of data. (4)
11 To be honest, a table. (5)
12 Power when the current and voltage are in quadrature. (8)
13 Only a small charge is made. (7)
16 When a signal undergoes any change. (7)
19 Circuit that takes the uncertainty out of a switch. (8)
21 See 26.
23 Vertical line of data. (6)
24 One volt through one ohm produces this unit of measurement. (6)
25 Unwanted addition to a signal. (5)
26 and 21 This determines the secondary voltage. (5, 5)

DOWN

1 State that solder goes through. (8)
2 The perfect transformer. (5)
3 A reactance coil. (8)
4 Logically, don't be up the creek without this. (6)
7 Can be used as a dielectric. (3)
8 Add blue and green. (4)
10 These cause a shadow in c.r.t's. (5)
14 Formerly the wireless. (5)
15 Compensated volume control. (8)
17 A circuit that maintains a signal at a fixed reference. (8)
16 A million times the basic unit of resistance. (6)
18 Plenty of room for this instrument. (5)
20 Step backwards to daub this code. (6)
22 A balancing transformer. (5)

For fun only—answers on page 420.



For KITS & COMPONENTS - Choose the easy way – with TK

*refundable with first order

Send 50p* & SAE for CATALOGUE

ORDERS: RING (01) 567 8910 – 24 HRS.

BARGAIN COMPONENT PACKS

Refill those empty component drawers at a fraction of the normal price and don't be caught without that odd resistor or capacitor to complete your project. All components supplied are full specification and not seconds or surplus stock.

PACK A: 650x0.25W resistors 47R to 10M £4.25
PACK B: 60xElectrolytics 1uF-1000uF £3.25
PACK C: 30xPolyester Capacitors 0.01-1uF £4.50
PACK D: 36xHorizontal presets 1k-1M £3.00
PACK E: 30xIC sockets 8, 14 & 16 Pin £2.00
PACK F: 25xRed LEDs 5mm £1.75
PACK G: 25xGreen LEDs 5mm £2.00
PACK H: 30x5mm LEDs – red, green, yellow £2.50
PACK J: 50x1N4148 Si. diodes £1.00
PACK K: 40xNPN/PNP transistors BC182/212 General Purpose £2.25

10% OFF when you buy ALL 10 PACKS

NEW GIANT SOLAR CELLS

NOW IN STOCK these giant size solar panels 12 x 12in will deliver 12 volts 200mA in bright sunlight and 11.5 volts 60mA on a typical British summer day (dull and overcast). **HUNDREDS OF USES** in the car or caravan, e.g. Charging NiCads, powering low voltage circuits where mains or battery supplies are inconvenient or coupled to a lead acid battery and a simple inverter you could build yourself a self contained mains supply for low power appliances. Stock No. 303 145. £14.50 (plus £1.75 for p&p on total order).

SOLID STATE RELAY BARGAIN

*Zero Voltage Switching: No radio interference problems *2.5KV Input to Output Isolation: No risk of damage to your computer or driver circuits. *4KV Terminals to Heatsink Isolation: Simply bolt onto a heatsink. *3V to 32V Input Voltage: easily interfaced to TTl or CMOS Logic. *24V to 240V rms Load Voltage: Allowing mains loads to be switched. *Built In Snubber Network: Enabling switching of inductive loads. *10A Maximum Current: 4A with no heatsink fitted at 40 deg C.

CD240/10 £2.25

ELECTRONIC GUARD DOG KIT

One of the best deterrents to a burglar is a guard dog and this new kit provides the barking without the bite! The kit when assembled can be connected to a doorbell, pressure mat or any other intruder detector and will produce a random series of threatening barks making the would be intruder think again and try his luck elsewhere. The kit is supplied complete with high quality PCB, transformer, all components and instructions. All you need is a mains supply, intruder detector and a little time. The kit even includes a horn speaker which is essential to produce the loud sound required. The "dog" can be adjusted to produce barks ranging from a Terrier to an Alsatian and contains circuitry to produce a random series of barks giving a more realistic effect.

XK125 Complete kit of parts £24.00

DISCO LIGHTING KITS

DL1000K – This value-for-money 4-way chaser features bi-directional sequence and dimming. 1kW per channel £19.25
DLZ1000K – A lower cost uni-directional version of the above. Zero switching to reduce interference.................£10.80
OLA/1 (for DL & DLZ1000K) Optional opto input allowing audio 'beat'/light response 77p
DL3000K – 3-channel sound to light kit features zero voltage switching, automatic level control and built-in microphone. 1kW per channel £15.60

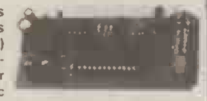
The DL8000K is an 8-way sequencer kit with built in opto-isolated sound to light input which comes complete with a pre-programmed EPROM containing EIGHTY – YES 80! different sequences including standard flashing and chase routines. The KIT includes full instructions and all components (even the PCB connectors) and requires only a box and a control knob to complete. Other features include manual sequence speed adjustment, zero voltage switching. LED mimic lamps and sound to light LED and a 300 W output per channel. And the best thing about it is the price.

ONLY £31.50

TEN EXCITING PROJECTS FOR BEGINNERS

This Kit has been specially designed for the beginner and 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. **ORDER NO. XK118** £15.00

VERSATILE REMOTE CONTROL KIT



This kit includes all components (+ transformer) to make a sensitive IR receiver with 16 logic outputs (0-15V) which with suitable interface circuitry (relays, triacs, etc – details supplied) can be used to switch up to 16 items of equipment on or off remotely. The 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 (excluding transformer) 9 x 4 x 2 cms. The 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), depending on the number of outputs to be used.

MK12 IR Receiver (incl. transformer)	£16.30
MK18 Transmitter	£7.50
MK9 4-Way Keyboard	£2.20
MK10 16-Way Keyboard	£6.55
601 133 Box for Transmitter	£2.60

HOME LIGHTING KITS

These kits contain all necessary components and full instructions and are designed to replace a standard wall switch and control up to 300W of lighting.

TDR300K	Remote Control Dimmer	£18.00
MK6	Transmitter for above	£5.10
TD300K	Touchdimmer	£9.30
TS300K	Touchswitch	£9.30
TDE/K	Extension kit for 2-way switching for TD300K	£2.95
LD 300K	Light Dimmer	£4.75

NEW POWER STROBE KIT

Designed to produce a high intensity light pulse at a variable frequency of 1 to 15Hz this kit also includes circuitry to trigger the light from an external voltage source (eg. a loudspeaker) via an opto isolator. Instructions are also supplied on modifying the unit for manual triggering, as a slave flash in photographic applications or as a warning beacon in security applications. The kit includes a high quality pcb, components, connectors, 5Ws strobe tube and full assembly instructions. Supply: 240V ac. Size: 80 x 50 x 45.

XK124 STROBOSCOPE KIT £13.75

NEW HIGH SECURITY LOCK KIT

Designed for use with our lock mechanism (701 150) this kit will operate from a 9V to 15V supply drawing a standby current of only 50μA. There are over 5000 possible 4-digit combinations and the sequence can be easily changed. To make things even more difficult for an unauthorised user an alarm can be sounded after 3 to 9 incorrect entries—selectable by means of a link. The alarm can sound for a few seconds to over 3 minutes during which time the keyboard is disabled preventing further entries. A latched or momentary output is available making the unit ideal for door locks, burglar alarms, car immobilisers, etc. A membrane keyboard or pushbutton switches may be used and a beep sounds when a key is depressed. Kit includes high quality PCB, all components, connectors, high power piezo buzzer and full assembly and user instructions.

XK121	LOCK KIT	£15.95
350 118	Set of Keyboard Switches	£4.00
701 150	Electric Lock Mechanism 12 volt	£16.50

PROPORTIONAL TEMPERATURE CONTROLLER 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

Good quality tools selected to offer outstanding value for money.

650 004 6in mini. Snipe Nose Pliers. Serrated jaws and return spring. £2.10
650 005 6in lap jointed side cutters. Insulated handles and return spring. £2.10
650 006 Light duty cutters. Cutting capacity 0.22–1.2mm copper wire. £1.60
TOOL KIT – Contains: side cutters, snipe nose pliers, wire strippers, flat blade screwdriver, phillips screwdriver in black textured, reinforced and padded case which when opened out measures 240x205mm £6.80

650 007 Self-adjustable automatic wire stripper with built-in cable cutter. £3.95
650 012 Watchmakers Screwdriver Set. 1.0/1.4/2.0/2.4/3.0/3.8mm £1.75
650 019 Set of 4 Stainless Steel Tweezers. Straight nosed, straight noosed-reverse action, bent nosed, flat nosed. 110mm long. £3.65
650 502 Reliant 9–12V dc Drill. £6.90
650 500 Titan 12V dc Drill. £10.25
650 570 Saturn Mains Drill. £16.50
WE ALSO STOCK ANTEX IRONS AND ACCESSORIES

LOGIC PROBE

A MUST for working with TTL & CMOS devices. Displays logic levels and pulses down to 25nS with LEDs and sound. Comprehensive instruction booklet supplied.

Working voltage	4-16V dc
Input Impedance	1M
Max. i/p frequency	20MHz

ONLY £9.50

RECHARGEABLE SOLDERING IRON

Powerful cordless iron complete with table-top/wall-mounting charging bracket. Reaches soldering temperature in 10 seconds. Includes lamp which lights when soldering. Comes with mains charging unit and 12V car battery adaptor.

Special offer £15.95

HELPING HANDS

Magnifier and crocodile clips on ball and socket joints mounted on a heavy base. Ideal for holding and inspecting PCBs during soldering, fault finding, etc.
(650 035) £3.95

NEW SUPER-SENSITIVE FM MICROBUG

Highly sensitive FM transmitter measuring only 45x25x15mm, including the built-in microphone. Frequency 88-100MHz enabling reception on a standard domestic FM radio. Range approximately 300m depending on terrain. Powered by 9V PP3 (7mA). Its small size and highly sensitive electret microphone makes it ideal for surveillance, baby alarm, etc.

INTRODUCTORY PRICE £5.50

LOW COST MULTIMETER

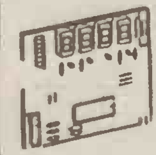
A versatile meter with 19 ranges including 10A DC & BATTERY TEST. Case is tilted for easy reading. Supplied complete with batteries, test leads and a manual. Ideal meter for the beginner. Input impedance 20K ohm per volt. AC Volts: 0-10-25-1000V 5%. DC Volts: 0-2.5-20-25-250 + 1000V + 5%. DC Current: 0-2.5-25m 250mA-10A + 4%. Resistance: 0-10K-100K-10M Battery test: 9V-1.5V AA-1.5V C & D Protection: Fuse Dimensions: 154 x 77 x 43mm

405 103 £8.62

SOLAR POWERED NICAD CHARGER

Takes up to 4 x AA size. Charges 2 batteries in 4-6 hrs. depending on strength of sunlight. Ideal for boating, caravanning, modellers, etc. £6.50

ELECTRONIC WEIGHING SCALES



This kit contains a Single Chip Microprocessor, PCB, displays and all electronics to produce a digital readout of weight in Kgs. or Sts. and Lbs. in normal use a toothed wheel (pattern provided) is made to rotate when a weight is placed onto the scales, interrupting two infra-red beams. The processor counts the number of teeth passing the sensor (up or down, depending on which beam is broken first), and shows the reading on the LED display in Sts. and Lbs., Lbs or Kgms. A PCB link selects the scale for bathroom or two types of Kitchen Scales. A linear version of the toothed wheel could also be used. Other uses include up/down counters. A low cost digital ruler could be made by using a wheel with the correct tooth to diameter ratio. ES1 £6.50

TK ELECTRONICS
13 BOSTON RD
LONDON W7 3SJ
Tel: 01-567 8910

SEND 9"x 6" S.A.E.& 50p FOR CATALOGUE OR CALL AT SHOP MON–FRI 9–5pm SATURDAY 10–4pm

ORDERING INFORMATION: ALL PRICES EXCLUDE VAT

FREE P&P on orders over £20 (UK only), otherwise add 75p + VAT. Overseas P&P: Europe £2.75. Elsewhere £6.50. Send cheque/PO/Barclaycard/Access No. with order. Giro No. 529314002.

LOCAL AUTHORITY AND EXPORT ORDERS WELCOME
GOODS BY RETURN SUBJECT TO AVAILABILITY

EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

The Magazine for Electronic & Computer Projects

VOL. 17 No. 7 July '88

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
4 NEASDEN AVE., CLACTON-ON-SEA, ESSEX
CO16 7HG. Clacton (0255) 436471

VIDEO IMPROVEMENTS

WITH the ever increasing use of video cameras to make home video recordings we find many readers are now keen to improve the quality of the finished video with better methods of editing. In this issue we describe a unit that is relatively simple to build but which will provide a professional style "top to bottom" wipe effect between scenes.

Camcorders become more sophisticated almost every month and prices seem set to fall with the introduction of an Amstrad camera at less then £500 in the near future. Little wonder that almost every amateur sporting event is now avidly videoed either for later dissection to aid training or simply for future enjoyment. We hope the projects we have published will add to the enjoyment of making your own videos.

KEEPING YOUR PROPERTY

One problem with owning a large range of consumer equipment—most households now have a colour TV (or two) a video and hi-fi system—is that such items attract the attention of a seemingly growing band of burglars.

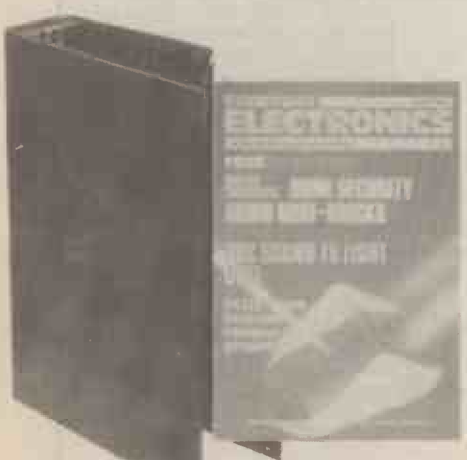
There cannot now be many home owners who have not had the experience of being burgled or of knowing of neighbours, friends or relatives who have been. While it seems that little can be done to apprehend the casual thief, it is quite easy to protect our homes from his unwanted attentions.

With this in mind the *Home Security Systems* series shows some simple but efficient circuits for the protection of house and contents. The series also describes a fire alarm add-on so the protection afforded is quite wide. Why not build and install an alarm system instead of waiting until "after the horse has bolted" as I did?

Mike Kenward

SUBSCRIPTIONS

Annual subscriptions for delivery direct to any address in the UK: £14.50. Overseas: £17.50 (£34 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 & BINDERS

Certain back issues of EVERYDAY ELECTRONICS are available price £1.50 (£2.00 overseas surface mail) 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 87 & April 88.)**

Binders to hold one volume (12 issues) are available from the above address for £4.95 (£9.00 overseas surface mail) inclusive of p&p. *Please allow 28 days for delivery.*

Payment in £ sterling only please.

READERS' ENQUIRIES

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

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

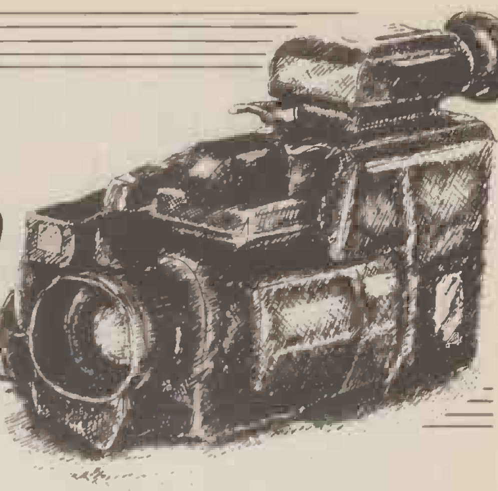
The Publishers regret that under no circumstances will the magazine accept liability for non-receipt of goods ordered, or for late delivery, or for faults in manufacture. Legal remedies are available in respect of some of these circumstances, and readers who have complaints should address them to the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

TRANSMITTERS

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.

Constructional Project



VIDEO WIPER

ROBERT PENFOLD

Add the professional touch to your videos. This wiper will blank the screen from top to bottom then restore the new scene from bottom to top or vice-versa.

THE most basic method of editing a home video is simply to cut straight from one scene to the next, but much more professional results can be obtained using some form of fader or wiper. With a video fader the picture is faded down at the end of one scene, and faded back up again at the beginning of the next one. This gives a much smoother transition from one scene to the next, and is generally much better from the viewer's point of view.

Wipers take various forms, and some units can provide a whole range of wipe effects. What is probably the best general purpose wipe effect, and the one provided by this unit, is the top to bottom type. In other words, at the end of a scene the screen is progressively blanked from the top downwards until it is fully blanked. At the beginning of the next scene the screen is progressively restored from the bottom upwards.

An added feature of this wiper is that it will do an inverse of the standard wipe effect, where the screen is blanked from the bottom upwards, and restored from the top downwards. It also incorporates an audio fader control so that, if required, the audio and video signals can be faded up and down in unison.

The audio fader is purely passive incidentally, and is just a volume control style variable attenuator. Although only a mono type on the prototype, there should be no difficulty in using a twin gang control to accommodate a stereo audio signal. The unit operates with a standard PAL composite video signal at 75 ohms impedance (not a u.h.f. television signal).

VIDEO BASICS

A video signal, if viewed in slightly oversimplified fashion, consists of two basic parts. There is a positive going picture modulation signal, and negative going synchronisation pulses. A television picture is, of course, produced by scanning an electron beam in a series of lines across the screen, starting at the top and working downwards. The modulation signal varies the strength of the electron beam, which has the effect of varying the intensity of light produced at the point where it hits the screen (we will ignore the complications of a colour system).

There are two types of synchronisation signal; the line synchronisation pulses and the longer frame synchronisation variety. A frame pulse is produced prior to each complete scan of the screen, and the line pulses are produced prior to each line being scanned. This permits very accurate synchronisation of the transmitting and receiving equipment, with minimal picture distortion. There is a slight complication in that a system of interlacing is used. All this means is that on the first frame scan only every other line is produced, with the missing lines (and only these lines) being scanned on the next frame.

The British PAL system has fifty frames per second, but only twenty-five complete pictures each second. The purpose of the interlacing is to reduce picture flicker. The scanning process is certainly too fast for the dot of light being scanned over the screen to be seen as such, but close scrutiny of a television screen will clearly show the individual lines of the picture. Also, some screen flicker may be apparent on parts of the screen where there is high contrast.

The general nature of a television signal, albeit in greatly simplified form, is shown in Fig. 1. In reality the modulation signal is very complex, and has a bandwidth of a few megahertz. Also, there are over three hundred lines per frame.

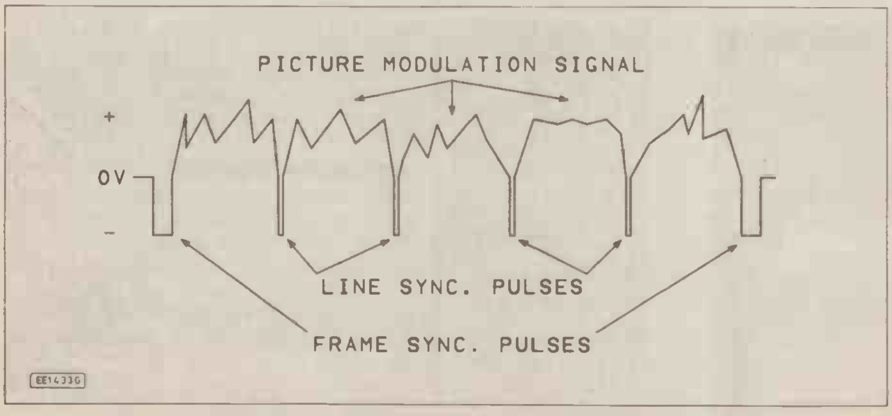


Fig. 1. Simplified representation of a composite video signal.

SYSTEM OPERATION

A video wiper must blank out the modulation signal at the beginning of each frame, progressively increasing the blanking period until each frame is entirely removed. However, the synchronisation signal must be left fully intact, and it is not just a matter of switching out the entire signal during the blanking periods.

The block diagram of Fig. 2 shows the arrangement used in this video wiper unit. The video input signal is split three ways. One route is via a diode clipper circuit which clips off the modulation signal but leaves the synchronisation signal intact. The output of the clipper circuit is fed to one input of an electronic changeover switch. The other input of the switch is fed with the video input signal. The output of the switch is fed through to the output by way of a video amplifier, which really just acts as a buffer stage and provides the unit with the right output characteristics.

The wipe effect can be obtained by applying a suitable signal to the control input of the electronic switch. The direct video signal must be switched through to the output during the periods when the picture is required, and the clipped signal must be fed through to the output during the periods when a blanked screen is required.

A large part of the unit is devoted to producing the control signal, and this is the function of the top row of blocks. The basic

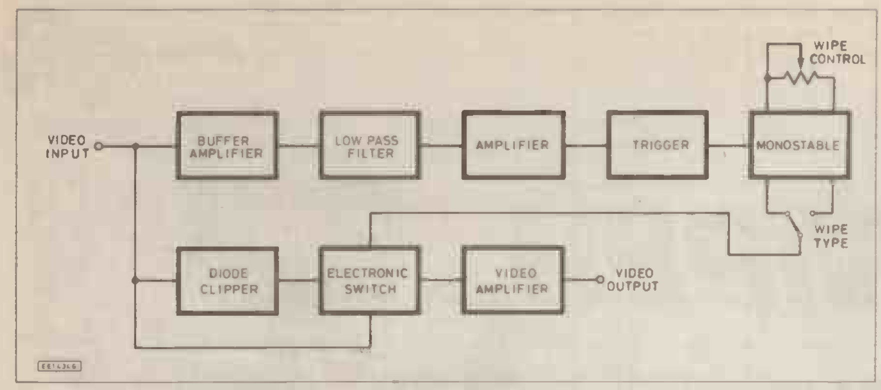


Fig. 2. The video wiper block diagram.

function of these is to filter out the frame synchronisation pulses and to use these to trigger a pulse generator which provides the control signal.

First the input signal is taken to a buffer amplifier, and from here it is fed to a lowpass filter. The frame synchronisation signals are relatively long, and contain a large low frequency component. The line synchronisation pulses, being much shorter and at a substantially higher frequency, have comparatively little content at low frequencies. The effect of the filtering is therefore to leave the frame synchronisation pulses largely unaltered, but to severely attenuate the line pulses.

The next stage of the unit is an amplifier, but this has its bias level set much higher than the normal mid-supply level. As a result of this it tends to clip off the modulation signal, and provides an output that is virtually just the negative going frame synchronisation pulses.

TRIGGER CIRCUIT

The next stage is a trigger circuit, and this provides trigger pulses to the monostable multivibrator when the input signal goes below a certain threshold voltage. In practice the trigger level is adjusted so that the frame pulses reliably operate the unit, but there are no problems with spurious triggering by other signals.

A monostable multivibrator provides an output pulse of a duration that is controlled by a C-R timing circuit, and which is independent of the input pulse duration. Normally this circuit provides a very brief output pulse, and it blanks only a small section at the top of each frame. This does not actually remove any of the picture at all, as there are so-called "spare" lines at the beginning of each frame, and it is only some of these that are removed.

There is a variable resistor in the monostable's C-R timing circuit, and by adjusting this for increased resistance the length of the output pulses can be increased. This results in more and more of the top section of the screen being blanked off. If the variable resistance is set at maximum value, the length of each output pulse becomes equal to the duration of one complete frame, and the screen is fully blanked. Adjusting the variable resistance back to its original (minimum) setting gradually reduces the output pulse length, and "wipes" the picture back on to the screen.

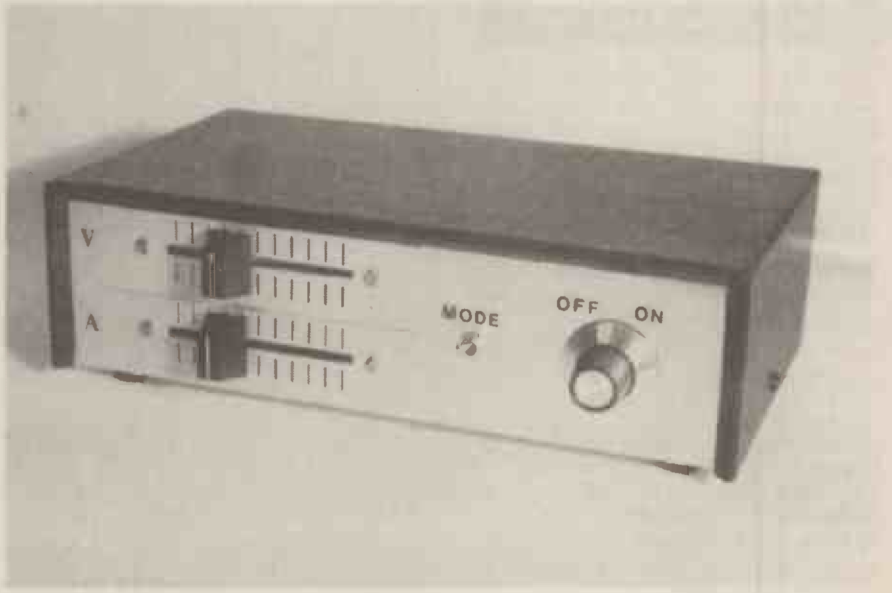
The opposite wipe effect is obtained simply by using the complementary output of the monostable. Whereas the main ("Q") output is normally low and provides positive output pulses, this second output (the "not Q" output) is normally high and provides negative output pulses. With the wipe control at minimum resistance, the screen is blanked. As the wipe control is set for higher resistance, the negative output pulses become longer, and the screen is gradually "unwiped" from top to bottom. A switch is used to select the appropriate output for the required wipe effect.

CIRCUIT OPERATION

The main circuit diagram for the Video Wiper is shown in Fig. 3. The circuit diagram for the mains power supply is shown separately in Fig. 4.

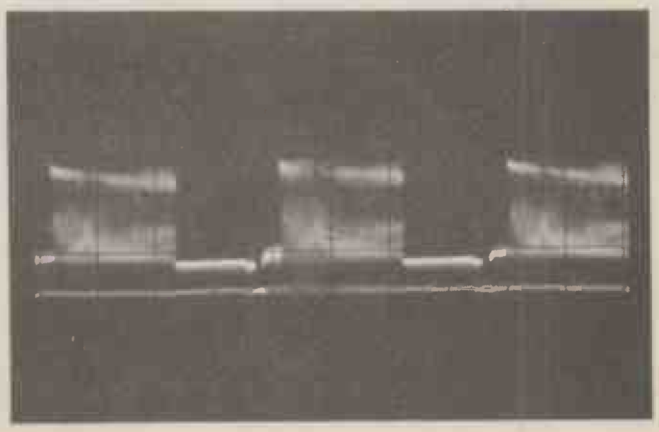
Taking Fig. 3 first, the input signal is applied to two simple video fader circuits. One of these is based on D1 and D2 while the other is based on D3 and D4. Both the faders have preset controls (VR4 and VR6), and one of these is set to fade the signal right down so that only the synchronisation signal is allowed to pass. The other one is set at maximum output, but it can be backed off slightly if the non-blanked output of the unit proves to be slightly excessive.

Potentiometer VR5 is adjusted so that the d.c. output levels of the two fader circuits are



The semi-wiped screen.

The semi-wiped output waveform.



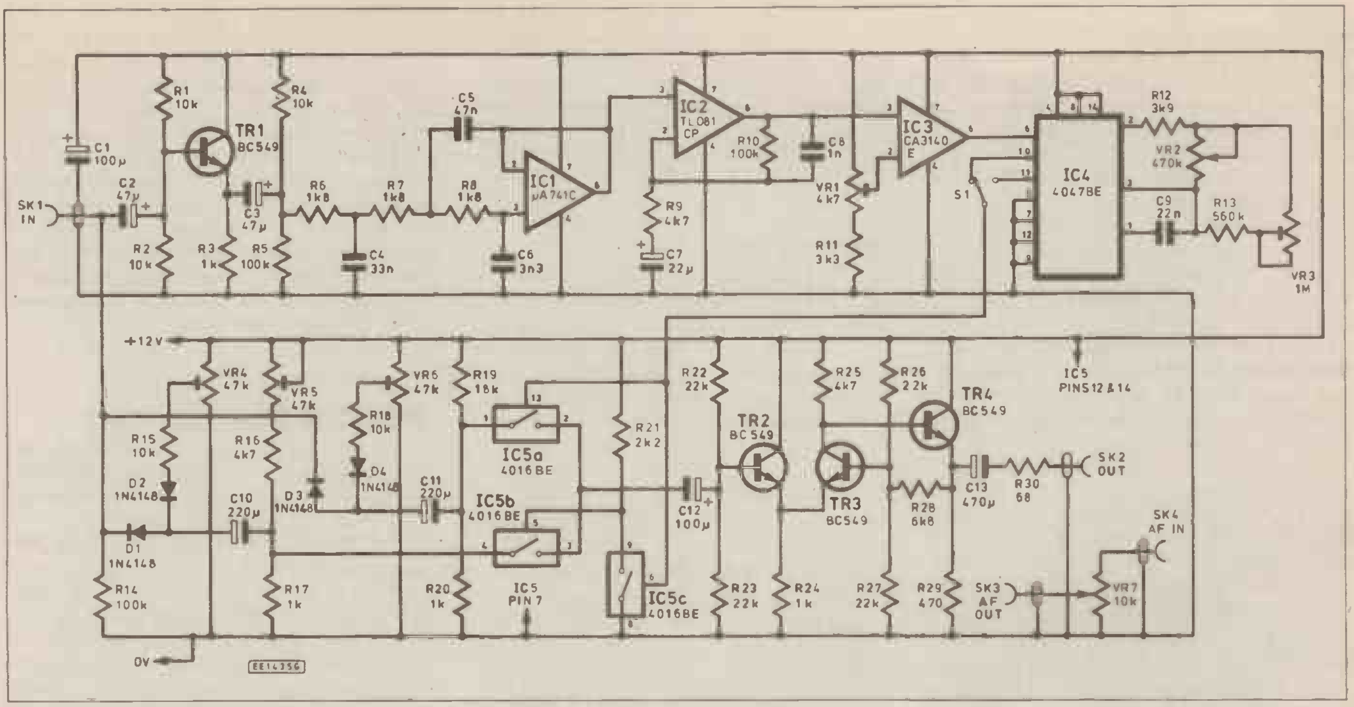


Fig. 3. Circuit diagram of the Video Wiper.

COMPONENTS

Resistors

R1, R2, R4, R15, R18	10k (5 off)
R3, R17, R20, R24	1k (4 off)
R5, R10, R14	100k (3 off)
R6, R7, R8	1k8 (3 off)
R9, R16, R25	4k7 (3 off)
R11	3k3
R12	3k9
R13	560k
R19	18k
R21	2k2
R22, R23, R26, R27	22k (4 off)
R28	6k8
R29	470
R30	68

All ¼ watt 5% carbon

Potentiometers

VR1	4k7 sub-min hor. preset
VR2	470k lin. slider
VR3	1M sub-min hor. preset
VR4, VR5, VR6	47k sub-min hor. preset
VR7	10k log. slider

Capacitors

C1, C12	100μ radial elect. 16V (2 off)
C2, C3	47μ radial elect. 25V (2 off)
C4	33n polyester
C5	47n polyester
C6	3n3 polyester
C7	22μ radial elect. 25V
C8	1n ceramic or mylar
C9	22n polyester
C10, C11	220μ radial elect. 16V (2 off)
C13	470μ radial elect. 16V
C14	1000μ radial elect. 25V
C15, C16	100n ceramic (2 off)

Semiconductors

IC1	μA741C op. amp.
IC2	TL081CP bifet op. amp.
IC3	CA3140E PMOS op. amp.
IC4	4047BE CMOS astable monostable
IC5	4016BE or 4066BE CMOS quad switch
IC6	7812 12V 1A regulator
TR1 to TR4	BC549 *npn* silicon (4 off)
D1 to D4	1N4148 silicon signal diode (4 off)
D5, D6	1N4002 100V 1A rectifier

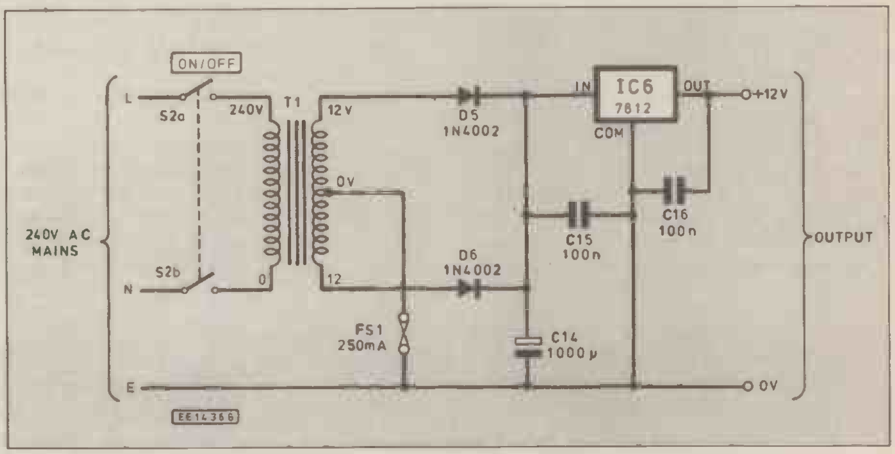


Fig. 4. Power supply circuit.

Shop Talk
See page 415

Miscellaneous

SK1 to SK4	phono socket (4 off)
S1	s.p.d.t. miniature toggle switch
S2	rotary mains switch
T1	12-0-12V 250mA mains transformer
FS1	250mA anti-surge fuse, 20 mm.

Case 230×133×63mm; printed circuit board, available from the *EE PCB Service,* order code EE612; 20mm fuse-clips; slider potentiometer bezel (2 off); slider control knob (2 off); rotary control knob; 8 pin d.i.l. i.c. holder (3 off); 14 pin d.i.l. i.c. holder (2 off); mains lead and plug; screened lead; wire; fixings; etc.

Approx. cost Guidance only **£25**

identical. This is essential, as the output signal will otherwise jump from one d.c. bias level to another as it is switched backwards and forwards between the two signal sources. This would effectively modulate the output signal with a 50Hz pulse signal that could upset both the synchronisation and picture processing circuits of the unit fed with the output signal.

The 4016BE (IC5) is a CMOS quad s.p.s.t. analogue switch. The pin compatible 4066BE also seems to function properly in the IC5 position incidentally. In order to obtain the required s.p.d.t. action from s.p.s.t. switches, two switches must have their outputs wired together, and their control inputs must be driven with anti-phase signals. In this case the two switches are IC5a and IC5b. IC5c is merely used as an inverter ahead of the control input of IC5b. Thus, when the control input is high, IC5a is switched on and IC5b is switched off. Taking the control inputs low reverses the states of the switches.

Note that the fourth switch in IC5 is left unused, but its control input is connected to the positive supply rail to prevent spurious operation and to avoid the risk of damage due to static charges.

The output of the switching circuit is fed to a standard three transistor video amplifier. This has TR2 as an emitter follower input stage, TR3 as a common base amplifier, and TR4 as an emitter follower output stage. R30 attenuates the output signal to the correct level, and provides the unit with the correct output impedance.

Transistor TR1 is the buffer stage at the input of the frame pulse stripper circuit, and this is an emitter follower stage. The lowpass filter is a standard three stage (18dB per octave) type based on IC1. The filter's cutoff frequency is at about 5 to 6kHz. Although it might seem that a much lower frequency could be used as the frame synchronisation pulses are at a frequency of just 50Hz, it has to be borne in mind that the mark-space ratio is far from one-to-one. As a result of this, the pulses consist mainly of harmonics at frequencies many times higher than the 50Hz fundamental frequency. A cutoff frequency of 5 to 6kHz is quite adequate to discriminate well between the frame and line synchronisation pulses.

AMPLIFIER

IC2 operates as the amplifier, and this is an operational amplifier non-inverting type which is direct coupled to IC1. Its voltage gain is set at about 26dB (20 times) by the negative feedback resistors (R9 and R10). C8 introduces some further lowpass filtering.

As explained previously, the bias level of the amplifier is purposely set very high so that the positive going content of the signal is severely clipped. Accordingly, R4 has been made much lower in value than R5. This network also controls the biasing of the lowpass filter stage, but this factor is not of any real practical significance.

The trigger circuit has operational amplifier IC3 connected as a straightforward voltage comparator. VR1 is used to set the optimum trigger threshold level. Under most signal conditions the setting of VR1 is far from critical, and the unit will trigger reliably regardless of its setting. Unusually bright or dark pictures effectively produce shifts in the circuit's bias levels, although the clipping action counteracts these to some degree. For reliable operation with a wide variety of picture brightnesses it is still necessary to set up VR1 quite carefully.

Integrated circuit IC4 is a CMOS 4047BE monostable/astable which is used here in the negative edge triggered monostable mode. C9 is the timing capacitor and VR2 is the wipe control. It is important that the pulse length from IC4 should never exceed the time taken per frame. If this should occur, IC4 will fail to trigger on alternate trigger pulses as it will not respond to trigger pulses while an output pulse is still in progress. VR3 is adjusted so that, with VR2 set at maximum value, the output pulse duration is just below the critical point. It is then impossible to set VR2 for an excessive output pulse duration.

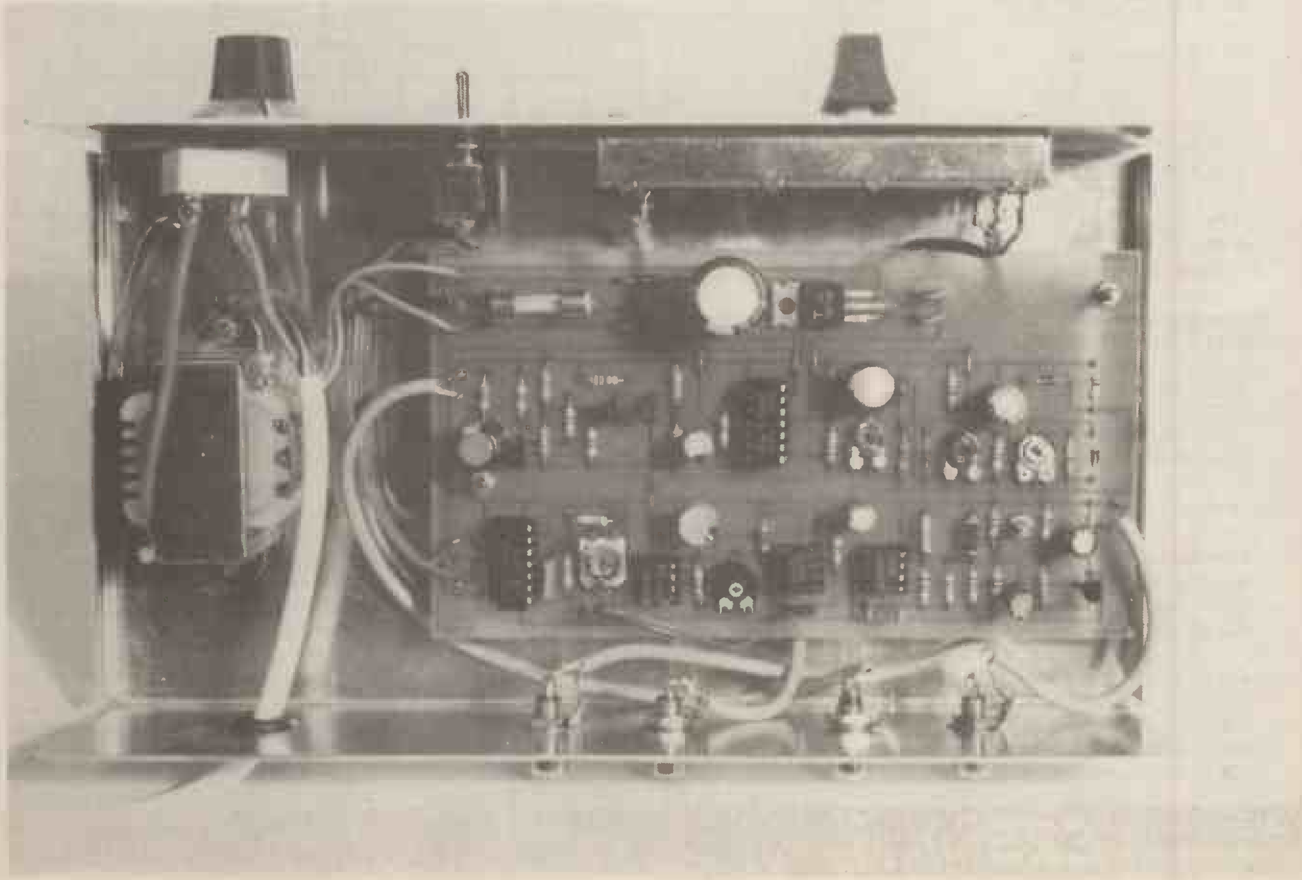
Potentiometer VR7 is the audio fader, and this is a passive circuit that is really totally separate from the video wiper circuit. For stereo operation a twin gang potentiometer is required, plus an extra set of input and output sockets. The second gang and pair of sockets are wired in exactly the same way as VR7, SK3, and SK4.

POWER SUPPLY

Turning to the circuit diagram of the power supply (Fig. 4.), this is a simple design having full-wave push-pull rectification and a monolithic regulator to provide a well smoothed and stabilised output. On the prototype T1 is a 12-0-12 volt type with a secondary rating of 250 milliamps. A type having twin secondaries wired to give 12-0-12 volt operation should be equally suitable. A 15-0-15 volt transformer (or twin secondary type) with a secondary rating of 150 milliamps or more should also be suitable.

The current consumption of the video wiper circuit is around 80 milliamps, although it could be somewhat higher than this under worse case conditions. A low power (100 milliamp) regulator could be used for IC6, but there would be a slight risk that it would not be able to supply enough current. There would be a greater risk of it having excessive heat dissipation, and a standard (1 amp) 12 volt regulator is a better choice. It should not require a heatsink.

Fuse FS1 should be an anti-surge type. Using an ordinary quick-blow fuse there would be a strong likelihood of this blowing at switch-on due to the initial surge of current as smoothing capacitor C14 charges up.



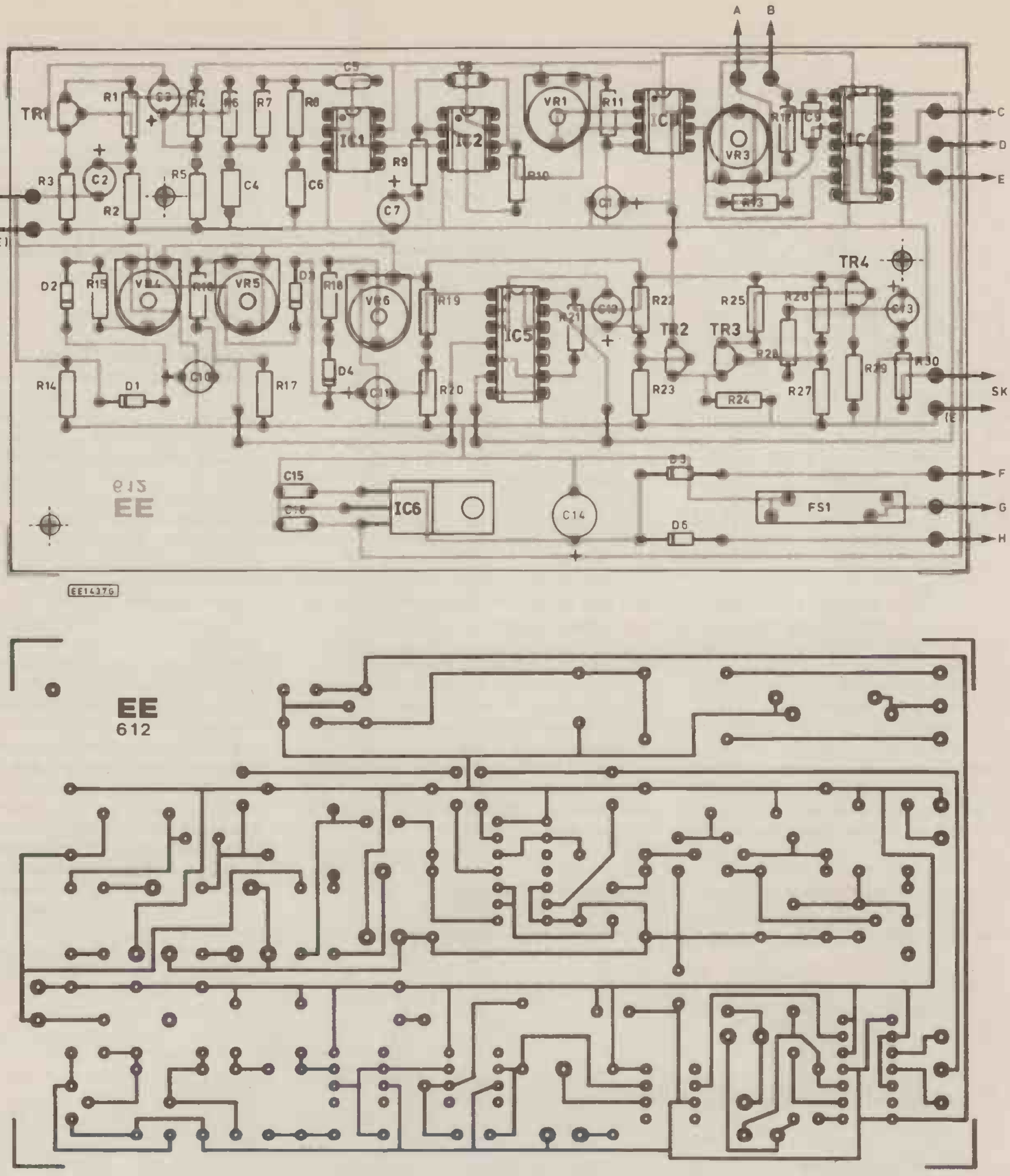


Fig. 5. P.c.b. layout for the Video Wiper.

CONSTRUCTION

The main and power supply circuits are accommodated by a single printed circuit board (Fig. 5). IC3, IC4 and IC5 are MOS types, and require the standard anti-static handling precautions to be observed. Fit them in holders, but do not plug them in place until the unit is in other respects complete. Handle these devices as little as possible.

Component IC6 is mounted horizontally, and its leadouts should be preformed prior to fitting it on the board and soldering it in place. Do not connect it and then bend the leadouts to shape as this is quite likely to damage the board. The fuse is mounted in a pair of fuse- clips soldered to the board.

Five link-wires are required, and they can be made from 22 s.w.g. tinned copper wire, or pieces of wire trimmed from the resistors will do just as well.

The preset potentiometers must be subminiature horizontal types if they are to fit on to the board properly. Similarly, the electrolytic capacitors must be miniature radial (single-ended) types, and the polyester capacitors must have a pitch of 7.5 millimetres. At this stage only pins are fitted to the board at the points where connections to off-board components will be made.

CONTROLS

The prototype was constructed in a metal instrument case, with slider controls for the wipe and audio fader controls. Slider controls operate in-phase, but with S1 in the to operate the two controls in unison. Note that with S1 in one position these two controls operate in- phase, but with S1 in the other position they must be moved in opposite directions.

Provided both hands are available this anti-phase operation is not too difficult with slider controls. Alternatively, using a d.p.d.t. component for S1, the extra section could be used to switch the track conneC-tiuons of VR2 so that it always operates with the same sense as VR7. In any event, I would not recommend the use of rotary potentiometers in this particular application.

Two slits are required in the left hand section of the front panel for the slider controls, and for most slider potentiometers these will need to be 65 millimetres long and only about 3 or 4 millimetres wide. In the absence of special tools for this kind of job, probably the easiest way of making these slits is to first drill a series of closely spaced 3 millimetre diameter holes along the length of each slit. A miniature round file is then used to join up the holes and produce the finished slits.

Self-adhesive slide control bezels are now readily available, and these can give a really neat finish, even if the slits in the panel are slightly less than expertly made. The bezels will probably be a little too wide to fit into the available space, but they can easily be trimmed down to a suitable size. The slider

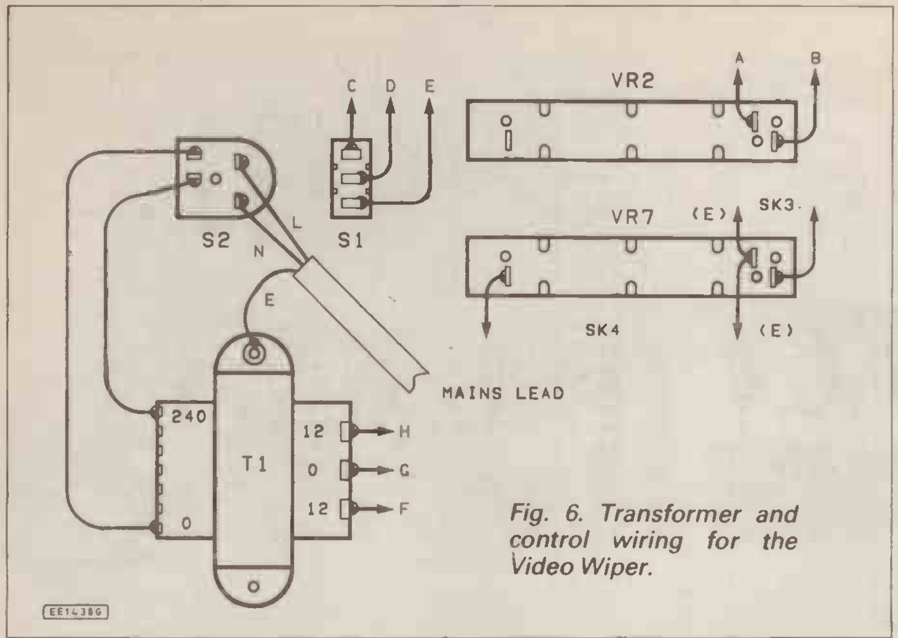


Fig. 6. Transformer and control wiring for the Video Wiper.

potentiometers each require two short M3 panhead mounting screws. Note that these are not normally supplied with the potentiometers.

Switch S1 is mounted to the right of the slider potentiometers, with S2 to the right of this. The sockets are mounted on the rear panel. I used phono sockets for both the audio and video signals, but these can be changed for any other types which are more suitable for your particular setup.

The printed circuit board is mounted on

the base panel of the case as far to the left as possible. The fixings should include spacers about 12 millimetres long so that the board is held well clear of the base panel. It must also be held clear of the fixing screws for the outer casing (one of these will damage the board if 6 millimetre spacers are used, as I learnt the hard way).

Transformer T1 is mounted on the base panel in the vacant area to the right of the printed circuit board. A soldertag fitted on one of its mounting bolts acts as a chassis connection point for the mains earth lead. An entrance hole for the mains cable is made in the rear panel, close to T1, and this should be fitted with a grommet and cable clamp to protect the cable.

Details of the point-to-point style wiring are shown in Fig. 6 (in conjunction with Fig. 5). This wiring is mostly quite easy, but it is advisable to use screened leads for the connections between VR7 and the audio input/output sockets. Take due care with the mains wiring where a mistake could be very dangerous.

The case must be a metal type with a screw-on lid (not a clip-on type) and the case must be connected to the mains earth lead. It is a good idea to insulate the tags of S2 and the connections to them.

ADJUSTMENT AND USE

Start with VR1, VR3, and VR5 at a mid setting, VR4 set well in a clockwise direction, and VR6 set fully anticlockwise. For initial testing the best setup is to have the video input of the wiper fed from the output of a video recorder, and the output of the wiper feeding a monitor (or a television set via a second video recorder).

The unit might work reasonably well with these settings, but some trimming of VR5 will probably be needed before a stable picture is obtained. If a stable picture cannot be obtained try backing off VR4 slightly, or reverse the settings of VR4 and VR6, and then try readjusting VR5.

For optimum results the fader used to provide the blanked part of the screen should be backed off no further than is really necessary. The fader used to provide the direct video signal will normally need to be set at maximum, but it can be backed-off slightly if the output of the unit seems to be excessive. It should only be backed-off slightly though, as there is otherwise a risk of upsetting the colour balance of the signal.

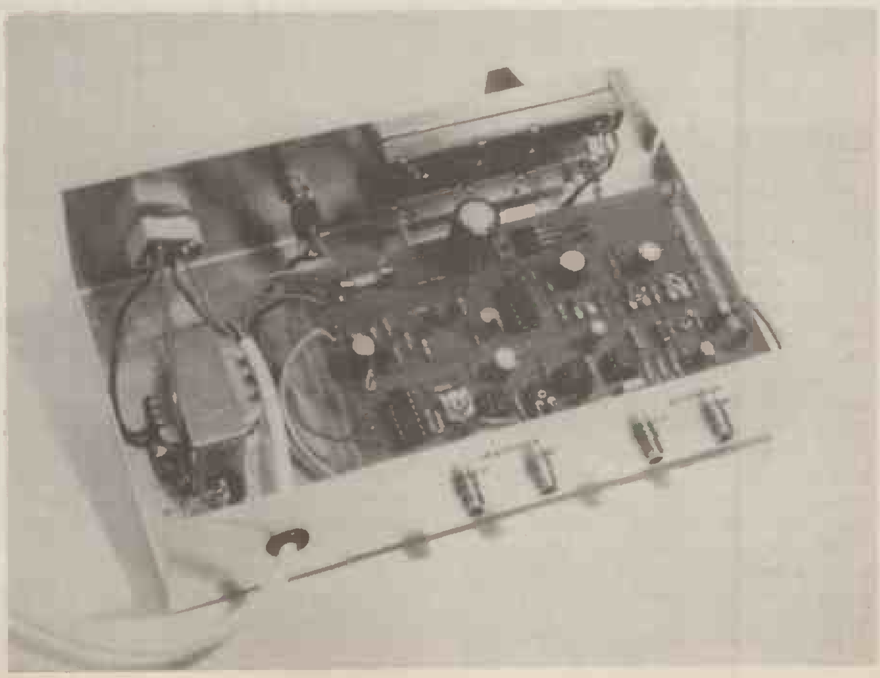
Adjustments to VR4 and VR6 will necessitate slight readjustment of VR5 incidentally.

If you have access to an oscilloscope that can display video signals, using this to monitor the output can make precise adjustment of these presets much easier. This is especially the case with VR5 where any mismatching of the d.c. signal levels will be immediately evident, and easily trimmed out. Without the aid of an oscilloscope a certain amount of patience may be needed in order to optimise results.

When the unit is adjusted correctly and the screen semi-blanked, changing the setting of S1 should swop the blanked and normal parts of the screen without any "jumping" of the picture. Operating the wipe control should not produce any picture scroll or roll.

In order to give VR3 the correct setting first set VR2 at maximum resistance. VR3 is then set for very nearly the highest resistance (most clockwise setting) that does not cause the picture to flicker. It is possible that this flicker will not occur even with VR3 at maximum resistance, and R13 must then be raised in value (1M2 should suffice). If the flicker occurs when VR3 is at minimum resistance (which is unlikely), then simply replace R13 with a link-wire.

A certain amount of trial and error is needed in order to give VR1 the optimum setting. Try feeding the unit with unusually light and dark material, and find a setting for VR1 that gives reliable triggering with both types of scene. A setting that just about provides reliable triggering on very dark scenes will probably be the optimum one. □



Constructional Project

HOME SECURITY SYSTEMS Part 2,

OWEN BISHOP

Part 2 Construction—Extending the system

In this series our main concern will be securing the home against intruders, but we shall also describe devices for securing it against fire. The system is modular, so that you can adapt it to your needs.

CONSTRUCTION details of the control system are given below, followed by two circuits which are "optional extras" to Part 1, (which outlined the Home Security System).

CONSTRUCTION

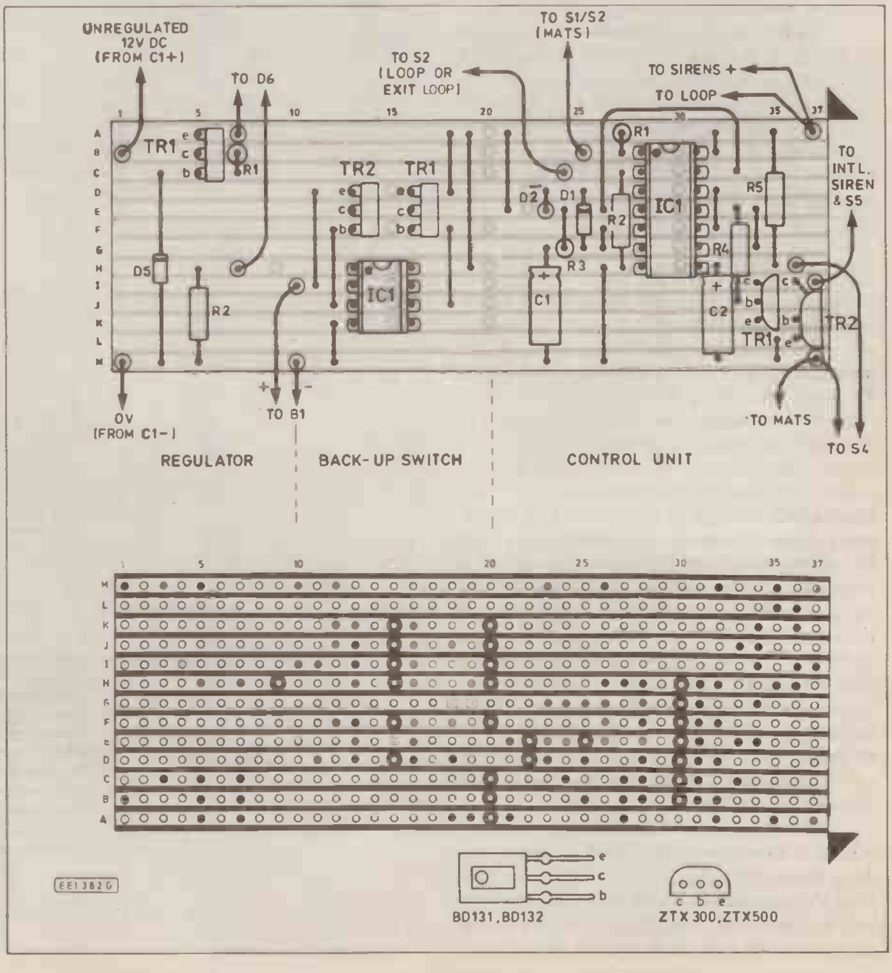
If you are building the p.s.u., the case should be large enough to hold this, the control circuit board and possibly the back-up battery as well. If the system uses a mains adapter or is battery-powered a much smaller case will suffice.

The stripboard diagram (Fig. 2.1) shows components for stabilizing an unstabilized supply, battery back-up circuit and the control circuit (sections may be omitted if not required). Construction presents no problems apart from taking the usual precautions in handling the CMOS 4011 i.c. Sockets are recommended for i.c.s to make replacement easier in case of failure. If your system has ISDs, the power transistor(s) may need small heat sinks.

The remainder of the wiring depends on the exact facilities provided. Mount the toggle switches in a row on the side of the case. These switches, which include the main power switch, should *not* be labelled (just to make things difficult for any intruder who finds the unit). You may prefer to have a key-operated switch as the main power switch.

There should be a row of sockets at the back of the case for connecting to the external wiring. Again, these sockets should not be labelled, but it is convenient to have them of different colours, to match with plugs of corresponding colours on the external wiring. Opportunities abound for confusing the intruder who manages to discover the control unit. For instance you could mount a distinctive toggle switch on the front of the case and label it "Power". The switch could actually be part of the peripheral loop. Turning it off immediately sounds the alarm!

Fig. 2.1. Construction of the Control Unit.



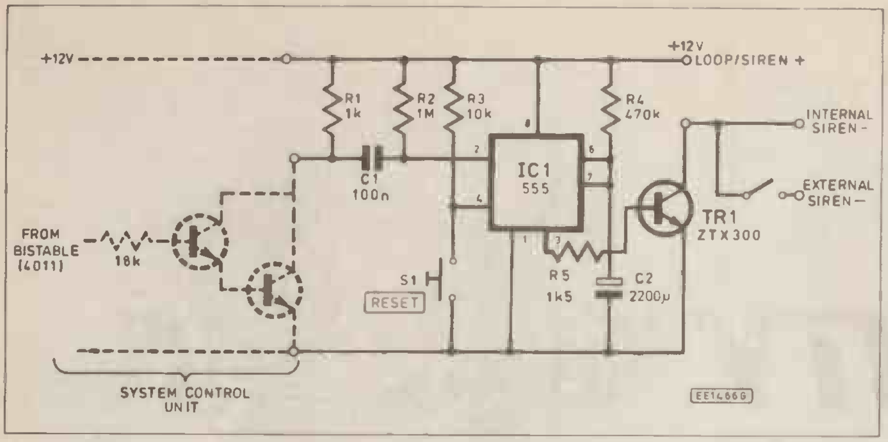


Fig. 2.2. Time-Limited alarm circuit.

TIME-LIMITED ALARM

The purpose of the time-limited alarm circuit is to limit the sounding of the siren or sirens to a period of fixed length. In most situations there is little point in allowing the alarm to sound indefinitely. Action needs to be taken within a few minutes of the alarm being triggered. If not, the thieves will have escaped, or the building been burnt down, depending on what caused the alarm to sound.

If it was a false alarm, perhaps the result of a faulty or over-sensitive sensor, then allowing the alarm to continue is an unwarranted public nuisance. Moreover, neighbours tend to ignore a system that is forever "crying wolf" for hours on end. An alarm that sounds frequently for no good reason loses most of its effectiveness. Although we have claimed that our basic system never gives false alarms, there still remains the possibility of *something* triggering it off!

If you live in a quiet neighbourhood, you probably do not relish the idea of shattering the calm, should your system be set off accidentally while you are away on a fortnight's holiday. Moreover, there are moves afoot to make it illegal for an external alarm to sound for more than 20 minutes, so this extension to the system will help you comply with the law.

TIME CIRCUIT

The circuit in Fig 2.2 is an addition to the control unit (see Fig. 1.9 last month). It takes its power supply from the unit. Its input comes from the collector terminals of TR1 and TR2 of the unit.

Instead of wiring the siren (or sirens) as the collector load of these transistors, we replace them by a resistor (R1). When the alarm is triggered, the potential at the collectors falls sharply. This causes a negative-going pulse to pass across capacitor C1. The trigger input of the 555 timer i.c. (IC1) is normally held high by R2, but the low pulse triggers it. Its output at pin 3 rises from low to high. This turns on TR1, which has the siren or sirens in its collector circuit. When TR1 is turned on, the siren(s) sounds.

The values of R4 and C2 are chosen so that the output of IC1 remains high for about 20 minutes. If you wish to calculate values for periods of other lengths, the time in seconds is given by:

$$t = 1.1RC,$$

where R is the resistance of R4, in ohms, and C is the capacitance of C2, in *farads*. Note that the period obtained depends upon the *actual* value of C2, which may be 20 per cent greater or less than its nominal value.

At the end of the period the output goes low again and the siren is silenced. Note that IC1 is triggered by the pulse that is generated when the input potential *falls*. The fact that the main system may still be activated at the end of the 20 minutes (i.e. the peripheral loop is still broken, or a pressure pad is still under pressure) does not cause the alarm to be re-triggered.

RESET

The reset button is provided to allow the siren to be silenced should it inadvertently be turned on when the system is being set.

The timer circuit is assembled on a small piece of stripboard (Fig. 2.3) which is housed in the same enclosure as the control unit board. The only additional off-board component is S1, which is mounted alongside the other switches. It makes testing quicker if a capacitor of lower value (say, 22μ) is used for C2 to begin with. The period for which the output of IC1 is high is then only about 11 seconds.

Do not connect the siren(s) at this stage. A voltmeter connected as the load to TR1 will read 0V normally, and about 12V when the circuit is triggered. When all has been assembled and tested, wire the 2200μ capacitor in place. Now the voltmeter should register 12V for about 20 minutes after the circuit is triggered. If the period is too long, try another capacitor of the same or smaller nominal value, or decrease the value of R4. Finally, disconnect the voltmeter and connect the siren(s) and the external siren switch, if installed previously in the control unit.

COMPONENTS

TIME-LIMITED ALARM

Shop Talk
See page 415

Resistors
R1 1k
R2 1M
R3 10k
R4 470k
R5 1k5
All ¼W carbon

Capacitors
C1 100n polyester
C2 2200μ elec. 16 or 25V

Semiconductors
TR1 ZTX300 *npn* transistor

Integrated circuits
IC1 555 timer

Miscellaneous
S1 SPST switch
2.5mm matrix stripboard (10 strips×24 holes); 1mm terminal pins (7 off), 8-pin d.i.l. i.c. socket; connecting wire; fixings; etc.

EXIT DOOR PROTECTION
S3 3-pole 4-way rotary switch
Knob for S3; mains-switch case (or similar); Formica for panel (see text); connecting wire.

Approx. cost Guidance only **£5**

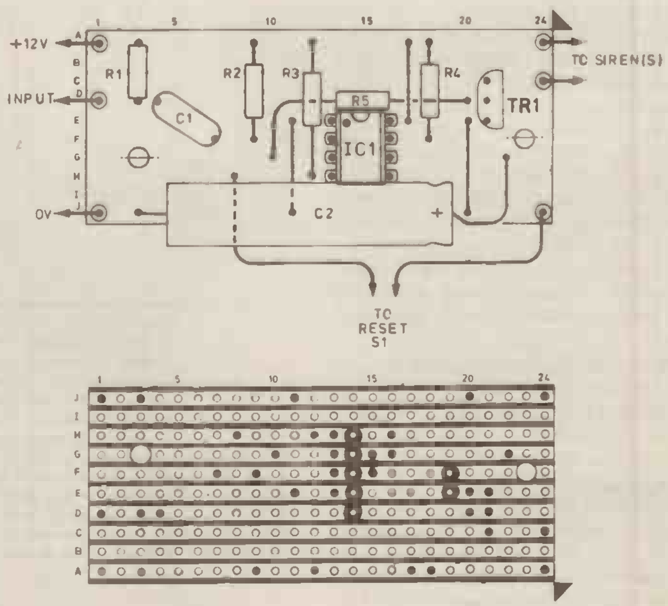


Fig. 2.3. Construction of the Time-Limited Alarm.

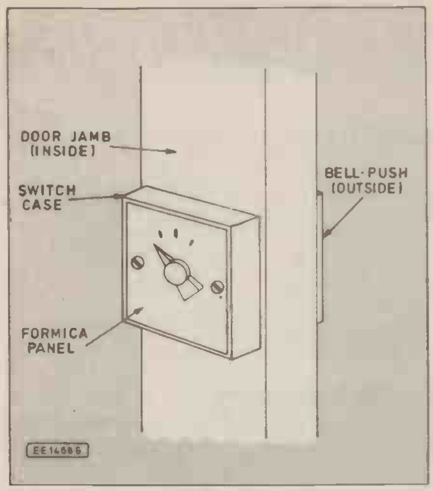


Fig. 2.4. Positioning of the exit door switch.

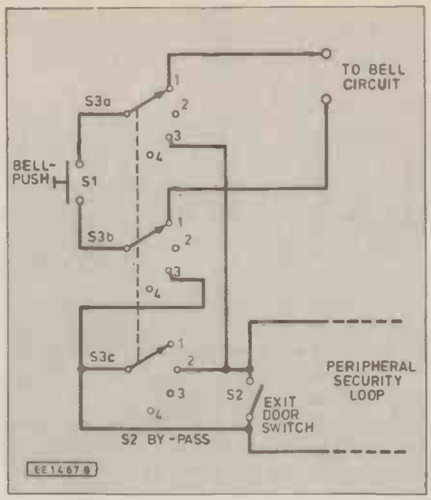


Fig. 2.5. Circuit for Exit Door Protection.

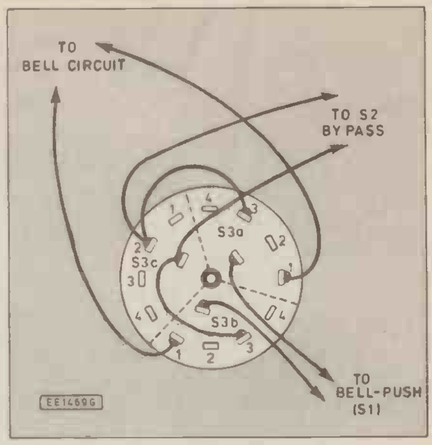


Fig. 2.6. Wiring of the exit door switch.

EXIT DOOR PROTECTION

The exit door is always a problem in any security system. This is the door that you leave by when you go out. Other doors can be heavily bolted and barred from the inside, but the exit door depends only on its lock which is accessible from the outside. Inherently, the exit door is the least secure outside door of the house. It is obvious that a strongly constructed exit door with a lock conforming to BS standards will minimise the risks of a break-in. Indeed, having installed such a door, you may decide that it is so secure physically that it need not be further protected. However, with the aid of drills, sledge-hammers and the like, the determined intruder can usually breach the stoutest of doors. Electronic security is an important additional protection.

A simple and reliable system for the exit door was described last month, but this had some disadvantages. The rather more elaborate circuit given here overcomes most of these. The circuit is based on a rotary switch placed just inside the exit door (Fig. 2.4). This has three positions:

(1) Inactive—used while you are at home.
(2) Leaving—while you are leaving or returning to the house.
(3) Unoccupied—when you have left the house.

You need to have an electric door-bell installed, with a bell-push just outside the door. This can be any ordinary low-voltage electric bell system and may be powered by battery or mains transformer. Use Fig. 2.5 in conjunction with Fig. 1.9 (from part 1) to follow the explanation below.

In position 1, the bell-push is connected to its bell circuit by way of S3a and S3b. There is no electrical connection between the bell circuit and the security system. When the bell-push is pressed the door-bell rings. S3c is open, so the exit door switch (S2, usually a magnetic one, in the peripheral security loop or the special exit-door loop) operates normally when the system is activated (for example, at night when the house is occupied).

EXIT PROCEDURE

When you are about to leave the house unoccupied, turn the switch to position 2. In this position, the bell-push is disconnected from the bell circuit. Switch S3c closes, bypassing S2. The exit door may now be opened or closed without affecting the security system. Set the security system, preparatory to leaving the house. Leave the house when the system is set. In contrast to the original system there is no need to vacate it within 20 seconds.

After leaving the house, but before closing the door, press and hold the bell-push. Reach in through the door and turn the switch to position 3. In this position, S2 is no longer by—passed by S3c. Instead it is bypassed by the bell-push, through switches S3a and S3b. *Keeping your finger on the bell-push,* close the door. Release the bell-push button. Since the exit door is now closed, S2 is closed. The alarm does not sound. Lock the door before leaving.

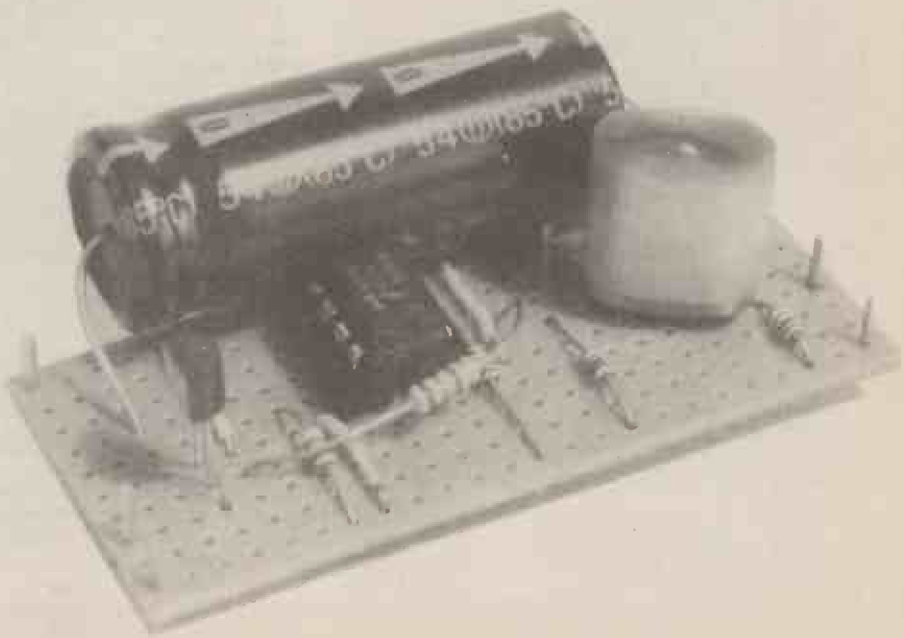
While you are away the bell-push button is not connected to the door-bell. If a potential intruder tries ringing the bell to test if anyone is at home, it will seem that the bell is out of order.

When you return home, the operations are repeated in the reverse order. Unlock the door, press the bell-push, open the door, reach inside and turn the switch to position 2. Release the bell-push, enter the house (no need to hurry!) and turn off the security system. Remember to turn the switch back to position 1 soon afterward, to reinstate the door-bell.

The wiring of the switch is shown in Fig. 2.6. The rotary switch is a 3-pole 4-way switch, with the "stop" set so that it cannot rotate to position 4. Any small plastic case can be used to house it. For the prototype, a neat housing was made from a white wall-mounting mains-switch case. The switch was mounted on a square panel of white Formica, bolted into the case where the mains switch unit would normally go. The existing wiring of the door-bell was easily intercepted and run into the housing.

The sequence for operating the switch is simple to learn yet must be carried out exactly. Any incorrect step triggers the alarm. It is unlikely that an intruder would know precisely what to do. However, in a busy area it would be as well if the exit door was not readily visible from the street, so that the sequence cannot be observed by unauthorised persons.

Next month: Smoke Alarm and Temperature Monitor.



SOLDERLESS WIRING
EASIWIRE

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

VERO
BICC ELECTRONICS

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:

BARCLAYCARD VISA

Card Number ....

Expiry Date ....

Name ....

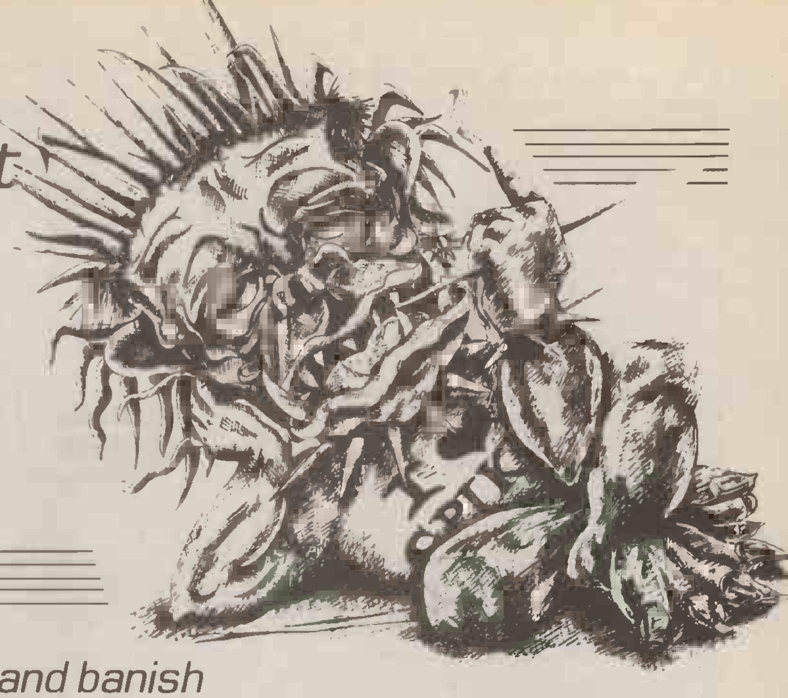
Address ....

....

Signature ....

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

Constructional Project



SPIKE EATER

P. E. ROBERTS

Build this low-cost suppressor and banish mains spikes and noise to the land of the Trolls. —It will devour them for breakfast and dinner!

EVER had the experience of hearing a loud CRAAAK! from your stereo system when the 'fridge switches on? Or spent all afternoon entering a long listing into your computer only to have the whole lot corrupt?.

Perhaps you've come home looking forward to watching *EastEnders* which you set the video to record while you were out, only to find a blank tape as the machine somehow "forgot" its settings. These are all actual mishaps the author has come across which have been caused by spikes and noise on the mains, see Fig. 1.

These come from both natural and man-made sources, with r.f. noise generally due to switch arcing, discharge lamps (neon signs and fluorescent lamps) and r.f. pickup by overhead lines. Spikes are high voltage transients caused by nearby lightning strikes and switching large inductive loads such as motors and transformers. Spikes of nearly 2kV on the mains near an installation using large d.c. motors controlled by thyristor drives have been seen on an oscilloscope display.

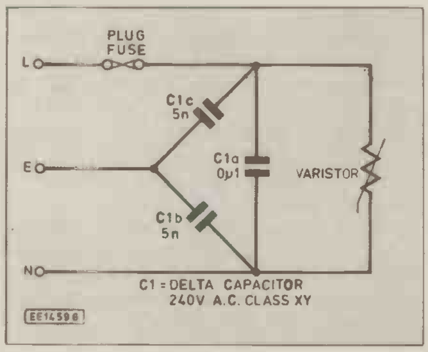


Fig. 2. Circuit diagram for the Spikeater.

Whilst suppressing your own appliances may help, there's not much you can do about your neighbours', particularly should you live in a block of flats. Any nearby industrial estates will add their sixpen'orth, and those who live in the back of beyond needn't gloat either as farm equipment can be just as noisy. Overhead power cables and pole transformers are particularly vulnerable to nearby lightning strikes.

Commercial computer systems use sophisticated filter systems in the mains supplies to remove noise. These devices use *LC* filters and transient suppressors and in really critical applications constant voltage transformers are often employed. Unfortunately, these devices (especially CVT's) also have sophisticated price tags.

The device to be described is very simple, using only two components, and should cost less than three quid to make. It can be used anywhere and needs no modification to the equipment to be protected and like a certain bleach, should kill 99 percent of household noise! The components used could also be incorporated in any mains powered project which may be sensitive to mains noise.

CIRCUIT

The circuit diagram, which uses a varistor and a capacitor network, for the Spikeater is shown in Fig. 2. The varistor clips incoming transients and is wired across live (L) and neutral (N). It is a semiconductor device of a similar physical construction to a ceramic capacitor, with a cocktail of metal oxides taking the place of the ceramic dielectric.

The varistor presents a very high resistance as long as the applied voltage does not exceed the rated working voltage. As

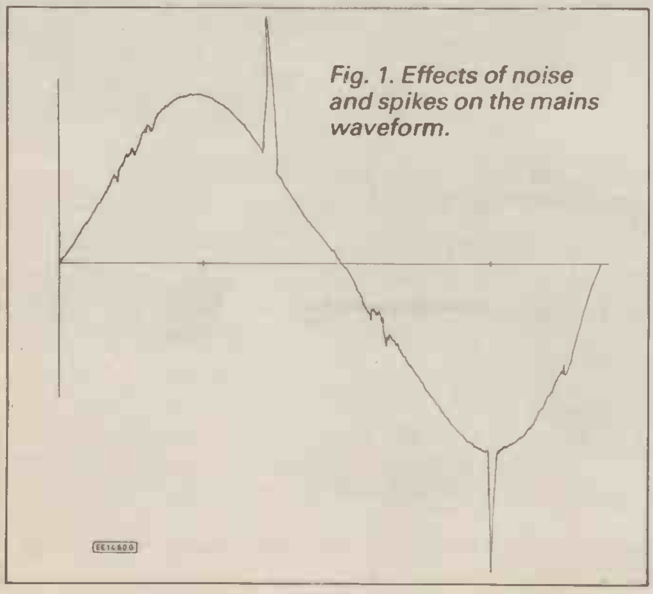


Fig. 1. Effects of noise and spikes on the mains waveform.

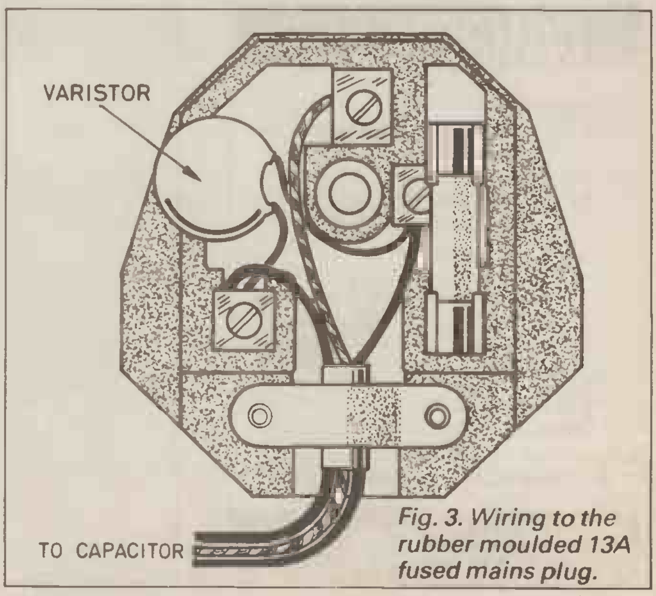


Fig. 3. Wiring to the rubber moulded 13A fused mains plug.

soon as a transient happens along, the device switches to a low resistance state, dissipates the transient's energy as heat, and then reverts to its virtually non-conductive state.

Incidentally, metal oxide varistors switch far more rapidly than the voltage dependant resistors previously used in this application. Varistors are available in a wide range of operating voltages, and the one used in this project is rated at 275V a.c.

Whilst the varistor takes care of transients much over 275V we've still got smaller spikes and noise to deal with. This is the job of the three capacitors C1a, C1b and C1c. These all take the form of a multiple capacitor in a single package, known as a "Delta" capacitor because of its appearance in the circuit diagram.

Delta capacitors are usually fitted to appliances to suppress interference at source, but they will help to remove incoming noise. For example, when i.c. power amplifiers first came out in the early 70's (remember the Sinclair IC10 and Plessey SL103D?), a stereo amplifier was built for a friend using two of these devices. The first time his elderly 'fridge switched on one of these expensive new devices went to that big p.c.b. in the sky! After fitting a new device, a delta capacitor was wired across the incoming mains supply which prevented any further occurrence.

Wiring to the rubber moulded 13A mains plug. The varistor leads should be covered with insulating sleeving.

SAFETY

Before leaving the subject of the capacitor, a word or two of warning. The mains supply carries the risks of both high voltage and high fault currents. This means that components connected to the mains supply must be suitable.

NEVER connect any old capacitor, whatever the working voltage, across the mains supply. Mains capacitors are specially made and conform to one or both of two standards.

The lower standard is class "X" which defines a capacitor intended to be connected across the mains supply, between live and neutral. Such a capacitor must be designed for continuous operation at 250V r.m.s., be self-healing, and under catastrophic failure *must not* explode and have limited flammability.

Class "X" capacitors must not be used where failure could expose someone to a shock hazard. Where such a hazard would exist a class "Y" capacitor must be used. These capacitors conform to all class "X" requirements but, putting it simply, are made to an even higher standard. They are intended for connection between live or neutral and earth.

Whilst separate capacitors could be used in this project, they would be considerably more expensive than the delta unit. Also, the nest of capacitors would be bulky and need enclosing to cover the interconnections, defeating the simplicity of this project. *The delta capacitor has approval to both class "X" and "Y" standards.*

The final item for consideration is the plug itself. I used a rubber industrial type which had sufficient room inside to mount the varistor. Some of the all plastic domestic types will not have sufficient room.

CONSTRUCTION

Assembling the device is very simple. Firstly bend the varistor leads as shown in Fig. 3, push short pieces of rubber or plastic insulating sleeving over the varistor's leads and connect the device between live and neutral. The varistor is not polarity conscious and may be connected either way round.

Next the delta capacitor has to be connected. This has three leads; usually two are the same colour but one is always different. Where different colours are used these are brown, blue and green/yellow and are connected exactly as a mains lead.

Where there is only one different coloured lead, which may be green/yellow or just plain, this is the "earth" lead. The other two leads connect to live and neutral, either way round. When wiring the delta capacitor take particular care when routing the leads in particular the earth lead where it has to find its way past the varistor.

Don't forget to thread the capacitor's leads through the cable entry in the plug top before wiring up. It would probably be a good idea to change the plug fuse to a 5A or even a 3A.

After checking tightness of all connections, and that the delta capacitor's leads are secured by the cable clamp, fit the plug top. If the top won't fit check your lead routing. Finally, Superglue the delta capacitor in place on the plug top as shown in the photograph, and the unit is ready for use.

COMPONENTS

Capacitors

C1 0.1µ+5n+5n delta suppression 250V a.c.

or

C1 0.1µ 250V a.c. Class "X" (Non-earthed suppression)

Shop Talk
See page 415

Miscellaneous

Varistor, 275V a.c.; standard industrial rubber 13A fused plug; insulating sleeving and Superglue.

Approx. cost Guidance only £3

The completed Spikeater with the delta capacitor glued to plug top.

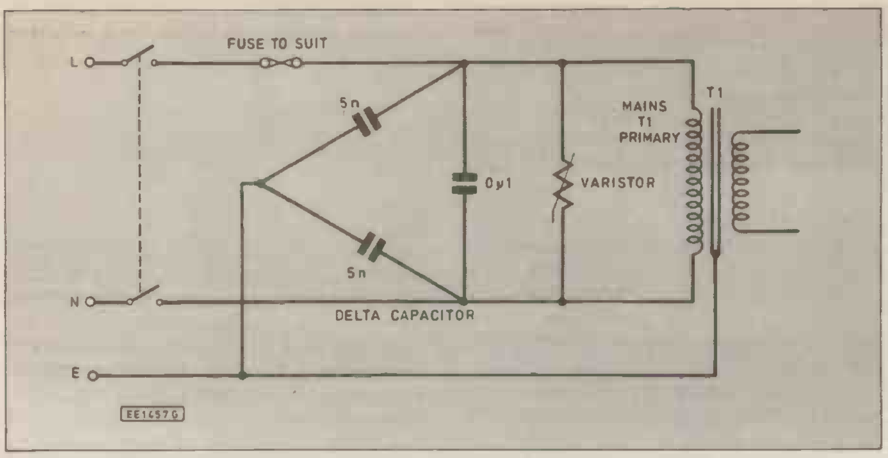


Fig. 4. Mains input suppression of earthed equipment.

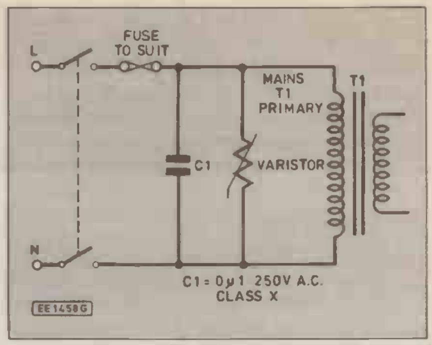


Fig. 5. Mains input suppression of NON-earthed equipment.

IN USE

Actually using the device couldn't be easier. Many houses have double mains sockets in which case the equipment to be protected is plugged into one socket and the device into the other. Don't forget that both switches, where fitted, must be turned on.

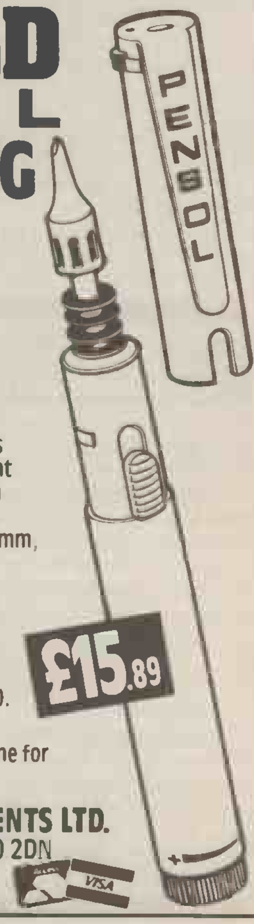
Where single sockets are fitted a two-way adapter may be used. Best of all is where equipment is fed via a multi-way socket set which is the usual method of powering hi-fi systems or computers. Here the device is plugged into the socket nearest the cable entry.

Next, a word or two about safety. Little fingers would no doubt find trying to dislodge the capacitor irresistable, so it's best to keep the device out of harm's way. It must only be used where a proper earth connection exists.

Incidentally, the small amount of earth leakage current passed by the capacitor is insufficient to trip a domestic earth leakage trip. The prototype is in daily use in my own home where an ELCB is fitted.

Finally, there's no reason why the ideas set out in this article cannot be incorporated into potentially sensitive mains powered projects. Where the equipment is earthed, the delta capacitor and varistor are wired as shown in Fig. 4.

Where the equipment is double-insulated and an earth connection not used the delta capacitor cannot be used. Instead connect the varistor as before but a single class "X" capacitor wired across live and neutral is used instead as in Fig. 5. □



FOR YOUR ENTERTAINMENT

BY BARRY FOX

Death Ray

Radar was born in 1935 out of an idea for a death ray. The government asked Robert Watson-Watt of the Radio Research Stations at Slough to see whether it would be possible to generate an electromagnetic beam strong enough to cook human flesh or heat an aircraft in flight and explode its bombs. Watson-Watt calculated that there was no way of generating the power needed, but went on to prove that it was possible to detect aircraft by beaming radio waves at them and receiving the reflections.

It is only now, with nuclear power sources and lasers, that there is a chance of making a working death ray. President Reagan's Strategic Defence Initiative or "Star Wars" project will rely on high power lasers to destroy missiles in flight.

The German government was still trying to make death rays work in World War II. The army built a high frequency radio transmitter near Frankfurt. The plan was to beam signals at aircraft and their electronic ignition. The system did not work, because the signals were of insufficient power.

After the war, the US army Signals Corp sent specialists to examine the failed equipment. Their journey was not wasted; they found and confiscated, Telefunken tape recorders which had been used to broadcast Hitler's speeches from one city while he was safely in another.

During the Falklands War, TV news teams found that their video cameras and recorders would not work on the task force ships. The pictures and sound were blemished with cyclic blips and bleeps as the radar aerials turned. The Marantz sound recorders routinely used by many radio news reporters quite literally burned out, as currents induced in the circuit wiring by the ship's radar signals fried transistors.

The recorders have plastic cases, which are fine for domestic use and most reporting. But only a metal chassis can screen against the field from a megawatt radar. It exceeds 100 volts/metre. The military used to test equipment immunity only to fields of five volts/metre; some modern equipment is now tested at 200 volts/metre.

One news crew in the Falklands even asked the ship's captain to switch off his radar for a while. . . .

News on Home Video

First, some interesting "how it works" from Mitsubishi in Japan. "Digital Tracking" is found on new Mitsubishi VHS machines.

VHS relies on a linear control track along the edge of the tape which carries pulses at the picture frame rate (25Hz for Europe). These control the tape transport and keep the rotating video heads in line with the magnetic tracks which are recorded obliquely across the tape width. For accurate tracking the stationary head reading the pulse track must remain 79mm apart from the video head which is reading the helical track. Any error will cause misalignment of the heads over the tracks and poor pictures on screen.

Difficulties arise for hi-fi recordings, where the f.m. audio and video signals are superimposed on the tape by two separate heads on the rotating drum. Adjusting tracking for a perfect picture may upset tracking for sound and vice-versa.

Mitsubishi's digital tracking system detects the audio and video waveform envelopes, converts them into digital code and sums the two codes. A microprocessor then varies the tracking control backwards and forwards until it finds the tracking point at which the summed envelope is at its largest. This is the optimum tracking setting for sound and vision. The whole process takes only three seconds.

"Theoretically we can do away with all manual tracking controls", says inventor Yasuo Mitsuhashi, "But so far the public is not ready for that, so we leave manual control for people to use if they want to—and for shop demonstrations".

The next step is to give the video heads small freedom for movement, under servo control so that they physically follow the line of the tracks on tape even in fast search replay. This is Dynamic Track Following. Sounds familiar? Yes, DTF was used by Philips, in the ill-fated V2000 system, by Panasonic in a one-off prototype VHS deck and by Sony and Ampex in professional 1 inch C format machines. But whereas previous DTF machines have used heads mounted on piezo crystals, Mitsubishi is mounting the heads on a moving coil, like a gramophone cartridge.

A piezo crystal needs several hundred volts to move it, but a magnetic coil requires only about 10 volts. Also a head mounted on a piezo crystal twists from side to side, thus touching only part of the tape surface as it tilts; but a magnetically mounted head can move parallel to the tape surface, maintaining full contact. This improves signal pick-up and thus signal-to-noise ratio.

So far the magnetic heads move only at a fixed rate, for tracking at a fixed speed in fast search mode, known as "noise erase search". For automatic tracking in normal play, the head will need to adjust continually under control of the servo system. This is much more difficult.

Mitsuhashi makes an interesting point. Sony's Video 8 system (like Philips V2000) has no linear control pulse track and relies for tracking on pilot tones buried in the video signal. With digital tracking circuitry it would in theory be possible to do away with both the pulse track and pilot tones.

"If this system had been developed two years ago", says Mitsuhashi, "the 8mm format would probably have been quite different".

VIS and VAS

An increasing number of new VHS recorders, from all makers, now use the Video Index and Video Access Search facilities recently standardized for the VHS format. Here's how VIS and VAS work.

The linear control track contains 25 square wave pulses per second. Normally these are symmetrically shaped. But because the servo control system is governed by the leading edge of each pulse, it is possible to modify the trailing edge without upsetting the servo control. For VIS and VAS the pulse is shortened, to represent a digital one, and left at its normal length to represent a digital zero.

The pulse track can thus carry 25 bits of data per second. This is arranged in 64 bit words to label the start and end index points of selected sections of the tape. To add extra information on sections of a recording, for instance a numbered address point on the tape, an extra 92 bits are added to the standard 64 bit word.

With the 25 bps data rate, it takes the machine around 2.5 seconds to read an index start or stop point code and around 6.25 seconds to read a numbered address point. Inevitably the recorder overshoots, but it then automatically back tracks to the exact index or acess point.

Smart Money

Shortly before the last Budget the DTI, Britain's Department for Enterprise, put out a statement by Francis Maude, Minister for Corporate Affairs. Maude was warning people to think twice before buying on credit. In a speech to the National Consumer Council, Maude came across as a smart man with money.

As an example he took a three piece suite, costing £1,000 and paid for it on credit over two years.

"With a bank loan at 19.7% Annual Percentage Rate the total cost would be £1,200—and £1233 using a credit card" he explained.

By coincidence I had just been asked by a magazine to review the *Formulator* software pack recently released for the *Organiser*. This is a ROM pack containing just about every scientific, mathematical, electronic and engineering formula you will ever need. As a convenient practical test I tried to enter Maude's figures and found I needed extra information, e.g. on how often the repayments were made.

"The figures came from one of our specialists", said Maude's spokesperson. So I spoke to the Specialists' department. They couldn't help either.

So I spoke to the Office of Fair Trading, who said they had got them from some tables and weren't too sure how the tables were concocted.

Eventually I got an answer that tallied with the Formulator software.

'It's a difficult concept to explain", confided the OFT. "We had to give the DTI the figures because no-one there could work it out".

It is nice to know that the country is in safe hands.

City and Guilds
C+G

INTRODUCING MICROPROCESSORS

MIKE TOOLEY B.A.

Part 9

REVISION

In the last part we dealt with programming of microprocessor systems, introduced flow charts and languages, and also gave details of the third Introductory Microprocessors Practical Assignment. In this part we shall bring our series to a conclusion by preparing readers for the second Written Assessment and fourth Practical Assignment. Our final Readers' Forum provides answers to just a few of the many questions raised by readers.

LEARNING OBJECTIVES

The general learning objectives for Part Nine of Introducing Microprocessors are encompassed in those already stated for Parts Five to Eight of the series.

FOURTH PRACTICAL ASSIGNMENT

Readers who have successfully carried out the third Practical Assignment and who have also followed the text in part eight will now be ready to undertake the fourth (and final) Practical Assignment. This assignment is entitled "Assembly Language Programming" and the objective reference is 6.2.6 (see part eight).

As usual, the practical assignment must be undertaken at an approved local centre where candidates will be provided with supervision and appropriate working conditions. Candidates should, however, provide their own A4 note paper, pens and pencils. For its part, the Centre will provide candidates with any hardware, data sheets, books or handbooks required (including full documentation for the microprocessor-based system, a full instruction set for the microprocessor and details of port connections and addresses).

Candidates will be supplied with an 8-bit microprocessor-based system with (at least) four l.e.d.s fitted to an input port and (at least) four switches fitted to an output port. These switches and l.e.d.s are invariably fitted to I/O modules and applications boards designed for use with educational microprocessor-based systems. The circuits shown in Figs. 9.1 and 9.2 respectively show typical arrangements employed for switch input and l.e.d. output and centres may wish to construct boards specifically for use in this assignment.

Note that the four least-significant lines of Port A (which must be con-

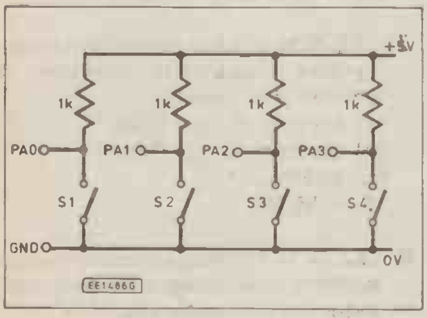


Fig. 9.1. Representative switch input arrangement.

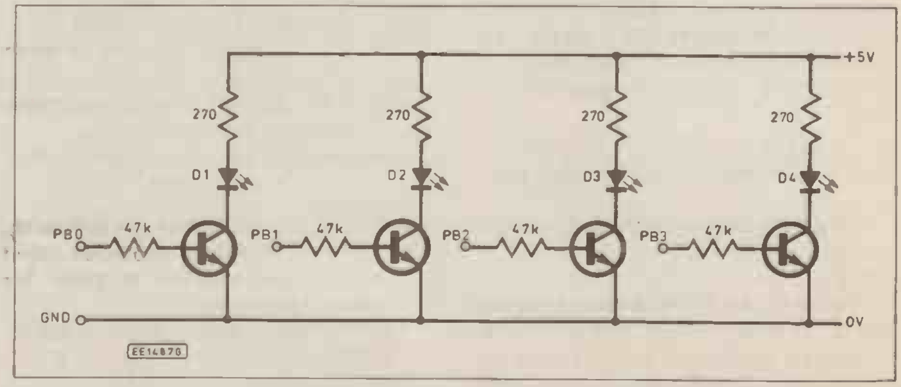


Fig. 9.2. Representative l.e.d. driver arrangement.

figured for input) are connected to the switches whilst the four least-significant lines of Port B (which must be configured for output) are connected to the l.e.d.s. The remaining four lines on each port may be treated in a similar manner or simply left floating (i.e. unused).

Candidates are required to write an assembly language program which will continually read the state of the four switches and write the result to the l.e.d. bank.

The following sub-tasks are involved:

(a) Producing an algorithm for solving the problem.
(b) Draw a flowchart to illustrate the sequence of processes.
(c) Provide details of the necessary software routine for configuring the port (your tutor will help with this). The routine should appear as a process within the flowchart and should be included in your assembly language program (together with appropriate comments).
(d) Write (using the instruction set provided), hand-assemble, enter, test, and debug the program.
(e) Demonstrate the program to your tutor (who will check that each switch correctly controls its respective l.e.d.).
(f) Hand-in the complete documentation package to your tutor for marking. Note that this assignment should be completed in 2 hours 30 minutes and a requirement for additional time may prejudice your chances of success.

Marking

Candidates will have satisfactorily completed the Practical Assignment if they can demonstrate success in all items marked with a square and at least ONE of the TWO items marked with a circle in the list below:

Completed within 2 hours 30 minutes ○
Appropriate algorithm or flowchart developed □
Assembler mnemonics produced using instruction subset □
Program correctly hand assembled from assembler codes □
Program reads all switches on input port □
Program correctly illuminates all corresponding l.e.d.s on output port □
Program repeats function continually ○

As usual, a period of at least seven days should elapse before candidates are permitted to retake the assignment. Candidates should also note that centres may require that a retake is carried out using a different microprocessor-based system (and instruction set!).

SECOND WRITTEN ASSESSMENT

By now, readers should be adequately prepared for the second written assessment which again takes the form of a straightforward multiple choice test. The test contains 34 questions and the candidate is again asked to select the answer which they think is correct from the four answers provided. Answers should be transferred to the standard City and Guilds Answer Sheet. Candidates are reminded that there is only ONE correct answer to each question.

The following Pre-Test has been provided in order to assist readers with preparation for the assessment: the questions are similar (though not identical!) to those with which candidates will be confronted.

SECOND WRITTEN ASSESSMENT PRE-TEST

The following questions are provided in order to prepare readers for the style and format of the second written assessment. Prospective candidates should carefully read through and then answer each question in turn. When completed, answers should be compared with those given on page 403.

The time allowed for the test is extremely generous and has been set so that candidates should not be constrained by having to answer questions in a hurry. Adequately prepared candidates should be capable of answering the questions within approximately 45 minutes.

Candidates Instructions

This test contains 34 multiple-choice questions. In order to pass you must answer a minimum of 24 of them correctly. The first number for each question is the question number whilst the number in brackets relates to the module reference.

1. (3.1.2) Which one of the following is an application for read-only memory (ROM) within a microprocessor-based system?
(a) Storage of transient data
(b) Storage of binary screen images
(c) Storage of control/monitor programs
(d) Storage of user-programs and program variables.

2. (3.1.2) Which one of the following types of memory provides rapid access non-volatile storage for control programs?
(a) Semiconductor dynamic RAM
(b) Semiconductor static RAM
(c) Semiconductor ROM
(d) Magnetic tape.

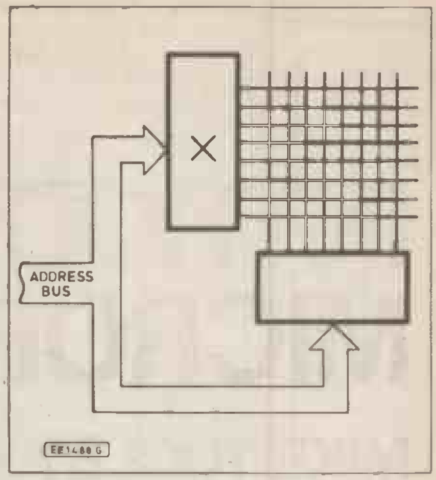


Fig. 9.3. See question 3.

3. (3.1.3) Fig. 9.3 shows the simplified arrangement of a memory cell matrix. The feature marked "X" is a
(a) shift-register
(b) decoder/latch
(c) a parallel to serial converter
(d) a serial to parallel converter.

4. (3.1.4) A ROM is to be fitted into a mass-produced TV games console. What type of ROM is most suited to this application?
(a) Mask-programmed ROM
(b) Fusible-link PROM
(c) UV-erasable PROM (EPROM)
(d) Electrically programmable ROM (PROM).

5. (3.1.5) A mask-programmed ROM is programmed
(a) during production of the semiconductor wafer
(b) by exposing the device to UV light after manufacture
(c) using a special programming device which delivers pulses of current
(d) by a bank of dual-in-line switches fitted to the ROM's data bus input.

6. (3.2.1) Transient data present in a microprocessor system is stored in
(a) one, or more, I/O devices
(b) a read-only memory (ROM)
(c) a read/write memory
(d) a write-only memory.

7. (3.2.2) In a microprocessor-based system, read/write memory is usually provided by
(a) semiconductor ROM
(b) semiconductor RAM
(c) an EPROM
(d) a PROM.

8. (3.2.3) In a microprocessor-based system, user-programs and variables are generally stored in
(a) fusible-link ROM
(b) mask-programmed ROM
(c) either dynamic or static RAM
(d) dynamic RAM only.

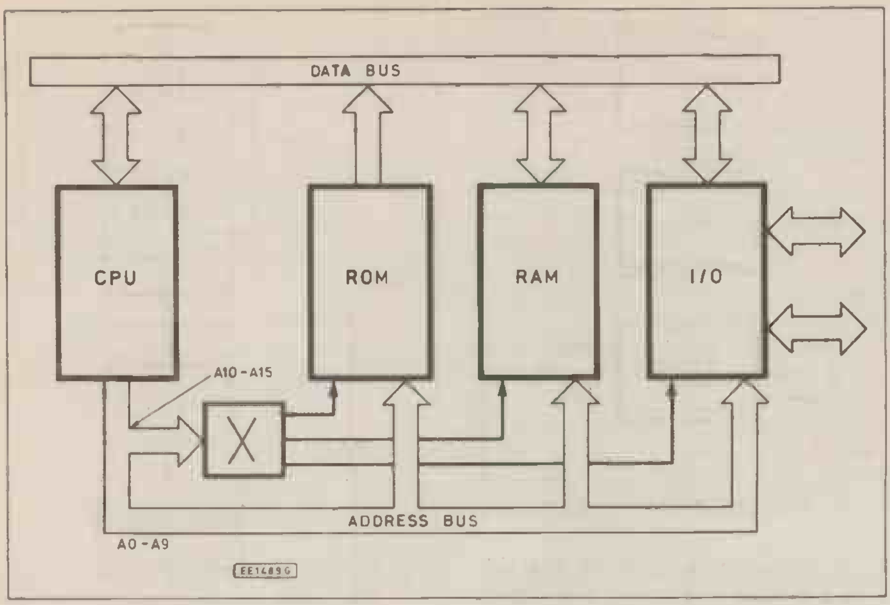


Fig. 9.4. See questions 10 and 15.

9. (3.2.4) Which one of the following types of memory needs constant refreshing?
 (a) Static RAM
 (b) Dynamic RAM
 (c) Magnetic tape
 (d) Magnetic disk.

10. (3.2.5) The block marked "X" in Fig. 9.4 represents
 (a) a dynamic RAM
 (b) a static RAM
 (c) an I/O device
 (d) an address decoder.

11. (3.3.1) Fig. 9.5 represents a
 (a) Truth Table
 (b) Flowchart
 (c) Memory Map
 (d) Trace Table.

12. (2.1.3) In the diagram shown in Fig. 9.5, the highest address (expressed in decimal) within the System ROM is
 (a) 49151
 (b) 49152
 (c) 65535
 (d) 65536.

13. (3.3.2) In the diagram shown in Fig. 9.5, the memory space occupied by the BASIC ROM (expressed in bytes) is
 (a) 3.5K
 (b) 16K
 (c) 28.5K
 (d) 32K.

14. (4.1.2) One feature which distinguishes a system which uses port I/O from one which employs memory-mapped I/O is the need for
 (a) IN and OUT instructions
 (b) fast dynamic RAM
 (c) external disk storage
 (d) specialised I/O devices

15. (4.1.2) In the memory-mapped system shown in Fig. 9.4, the output signals from the block marked "X" are
 (a) chip-select signals
 (b) memory read/write signals
 (c) memory request signals
 (d) I/O request signals.

16. (4.1.3) In the system shown in Fig. 9.6,
 (a) block X is ROM and block Y is I/O
 (b) block X is RAM and block Y is I/O
 (c) block X is I/O and block Y is ROM
 (d) block X is I/O and block Y is RAM.

17. (4.2.1) A two-wire connection is employed for the transfer of data between a microcomputer and a distant peripheral device. This system employs
 (a) a serial data transfer method and is likely to operate at a relatively slow speed
 (b) a serial data transfer method and is likely to operate at a relatively high speed

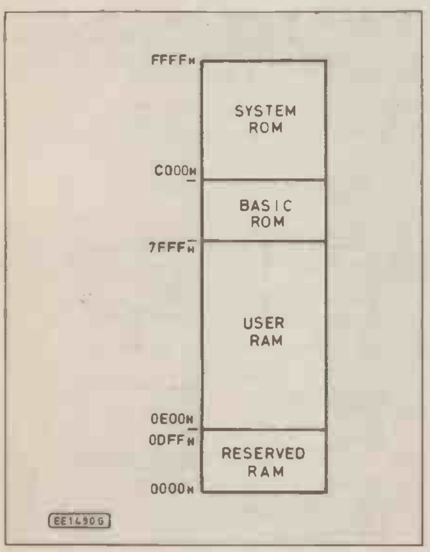


Fig. 9.5. See questions 11, 12 and 13.

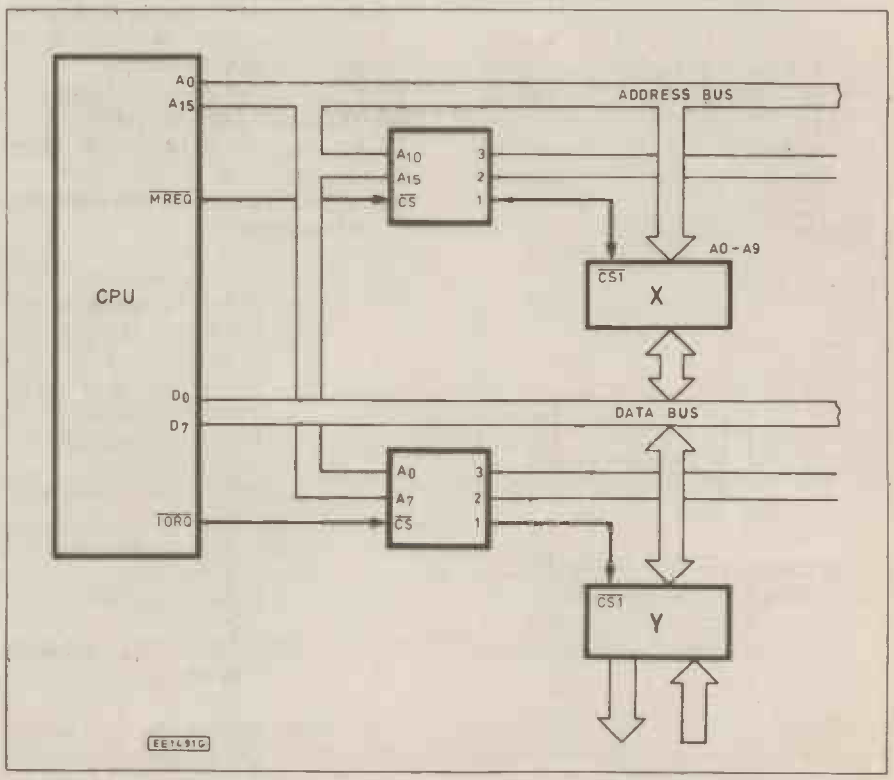


Fig. 9.6. See question 16.

(c) a parallel data transfer method and is likely to operate at a relatively slow speed
(d) a parallel data transfer method and is likely to operate at a relatively high speed.

18. (4.2.2) In order to program a PIO device a
(a) sequence of software commands must be issued by the CPU
(b) special external programming device is required
(c) hexadecimal keyboard is required
(d) serial I/O port must be provided.

19. (4.2.3) Which one of the following gives the function of the lines marked CA1 and CA2 in Fig. 9.7?
(a) Read/Write control lines
(b) Peripheral control lines
(c) Register select lines
(d) Serial data I/O lines.

20. (4.2.4) Which one of the following describes the function of the control register in Fig. 9.7?
(a) To determine the mode of operation for the port in question
(b) To determine whether individual I/O lines within a port are configured as inputs or outputs
(c) To provide a means of continuing I/O operation in the event of a CPU failure
(d) To decode commands received from peripheral devices and pass these on to the CPU for subsequent execution.

21. (5.1.1) Which one of the following gives the typical maximum source current for a PIO output line?
(a) 1mA
(b) 10mA
(c) 100mA
(d) 1A

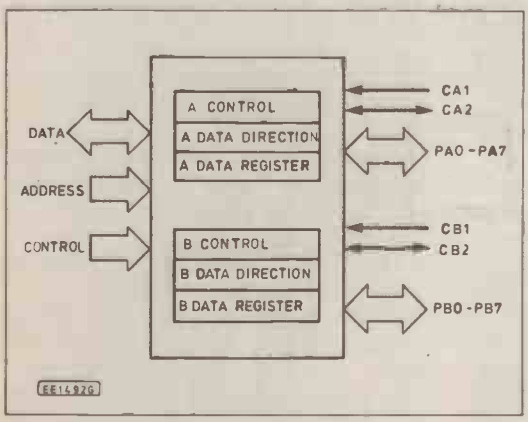


Fig. 9.7. See questions 19 and 20.

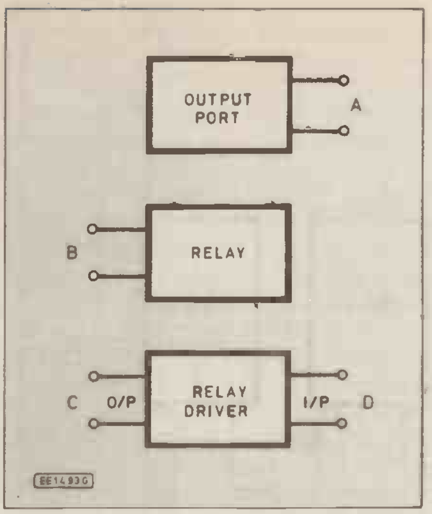


Fig. 9.8. See question 23.

22. (5.1.2) Which one of the following output loads will NOT normally require the services of an output driver when connected to a PIO?
(a) A CMOS logic gate
(b) A conventional relay
(c) An l.e.d.
(d) A filament lamp.

23. (5.1.3) Fig. 9.8 shows the blocks required to interface a relay to a microprocessor-based system. Which one of the following gives the connections required?
(a) A to C and B to D
(b) A to B and C to D
(c) A to D and B to C
(d) A to D and B to D.

24. (5.1.2) Which one of the following is a characteristic of programs written in a low-level language when compared with their equivalent written in a high-level language?
(a) Easy to read and understand
(b) Written in plain English
(c) Operate at a relatively slow speed
(d) Generally require less memory for storage.

25. (6.1.2) In which of the following applications is the speed at which a program executes usually considered to be of paramount importance?
(a) Data processing software
(b) Word processing software
(c) Spreadsheet programs
(d) Real-time control systems.

26. (6.2.1) The operations involved in developing a program may be stated as:

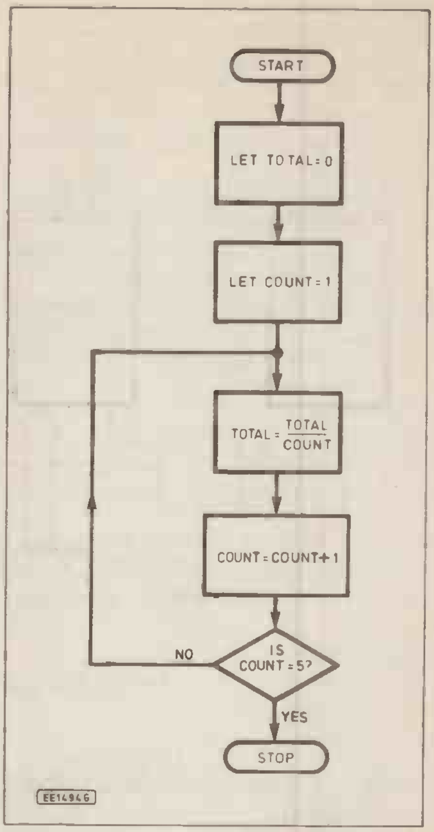


Fig. 9.9. See question 27.

A Write and enter code
B Formulate an algorithm
C Test and debug
D Construct a flowchart.

Which one of the following gives the correct sequence of events?
(a) A B C D
(b) A B D C
(c) B D A C
(d) B D C A.

27. (6.2.3) Which one of the following gives the final value of "total" produced by the flowchart shown in Fig. 9.9?
(a) 0 (c) 3
(b) 1 (d) 7

28. (6.2.3) Which one of the flowchart symbols shown in Fig. 9.10 represents a subroutine?
(a) A (c) C
(b) B (d) D.

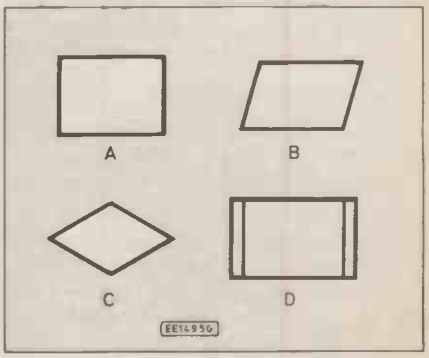


Fig. 9.10. See question 28.

29. (6.2.4) Mnemonics are used in assembly language programs to
 (a) make programs difficult to read
 (b) make hexadecimal arithmetic easier
 (c) represent operations in a form of shorthand
 (d) represent addresses with easy to remember symbols.
30. (6.2.5) Which one of the following assembly language instructions transfers data from the CPU to a port?
 (a) INC A
 (b) DEC A
 (c) IN A. (FEH)
 (d) OUT (FEH) ,A

31. (7.1.1) Which one of the following gives the name of the numbering system which uses base 16?
 (a) binary
 (b) decimal
 (c) hexadecimal
 (d) octal.

32. (7.1.2) Which one of the following gives the hexadecimal representation of the decimal number 114?
 (a) 68
 (b) 6E
 (c) 72
 (d) 7E.

33. (7.1.3) Which of the following describes a method of representing negative numbers in a microprocessor-based system?
 (a) Placing a negative sign in front of the number
 (b) Placing a negative sign behind the number
 (c) Using the most significant bit as a sign bit
 (d) Using the least significant bit as a sign bit.

34. (7.1.4) Which one of the following gives the result of adding together the hexadecimal numbers 47 and 3C?
 (a) 77
 (b) 7C
 (c) 83
 (d) 8E

Now **CHECK YOUR ANSWERS** before looking to see how you scored!

READERS' FORUM

Several readers have taken me to task over not giving a sufficiently rigorous explanation of the internal workings of a microprocessor. In particular, it would appear that several of you would have liked further details of how internal control is applied. This is, unfortunately, a rather "meaty" topic and one which could require quite a lengthy explanation.

Furthermore, there are quite a number of differences between popular 8-bit CPUs and any text on this topic would have to explore the detailed architecture of several types in order to be reasonably comprehensive. However, for the benefit of those who would like further information on this (and other) topics I have suggested some further reading at the end of this instalment.

R. W. Davis writes from Dorchester to point out that the gate circuits shown in Fig. 3 of Part One should have been referred to as NAND and not AND. *Roger Seymour-Lee* has written from Oyster Bay, New York, to mention several errors which cropped up in Part Four. In particular, the answers to questions 1 and 7 of the First Pre-Test should have been shown as (c) and (a) and not (d) in both cases.

Roger also says that he found Figs. 4.1, 4.2 and 4.3 totally incomprehensible. In fairness, these were included simply as typical examples of the displays produced by a monitor program to which I added a few hand-written notes. readers are not meant to extract any particular information from them and they were provided simply to indicate the typical format employed.

When using a monitor it is, of course, essential to follow the instructions provided for the program concerned. Indeed, it will usually take some time to become familiar with the displays produced.

Lastly, Roger has expressed some concern over the fact that some of the *incorrect* answers (known rather aptly as distractors by those responsible for writing City and Guilds multi-choice questions) were terms that he was not familiar with. In general, incorrect answers are chosen so as to be plausible but it is not always possible to produce three (incorrect) answers based on correct terminology. Sometimes the examiner has to use phrases and expressions which may sound plausible to a weak candidate but which can quickly be discounted by those having a little more knowledge!

A number of centres have written to offer support for Introductory Microprocessors. These include ITECs (Information Technology Centres) as well as several Colleges having Open-Learning Units. In particular Gloucestershire, Rochdale and Basildon ITEC are hoping to offer assessment and tutorial/workshop groups as are colleges at Brighton, Hall Green and Darlington.

Unfortunately, despite this increasing interest from educational and training providers, it still appears that some readers are having difficulties with finding an assessment centre. Introductory Microprocessors is a brand new City and Guilds scheme and, despite a joint letter from EE and C & G sent last October, many colleges are only just finding out about it. So, if this has been your problem, please don't give up; an enquiry later this year may bring success where it has previously failed to produce any reaction.

Finally, I would like to offer sincere thanks to all those who have written with comments, suggestions, and queries. Indeed, my "in-tray" has been kept full to overflowing during the last nine months and this has made it impossible for me to answer each and every letter.

WHAT NEXT?

By the time that you read this, a follow-up module (Elementary Microprocessors) should be available from City and Guilds. This module should be available from most colleges and centres currently offering Introductory Microprocessors and is designed to provide further study in the field of microprocessors and microprocessor-based systems.

Readers may also like to know that a further E.E. series linked to a City and Guilds scheme is planned for the autumn. This series will be devoted to the rather more general field of Digital Electronics (another module in the City and Guilds 726 Information technology series). So, as the saying goes, watch this space. . . .

FURTHER READING

The following reading is recommended for those who wish to progress beyond Introductory Microprocessors:

Microprocessors and Digital Systems by Douglas Hall (published by McGraw Hill, ISBN 0-07-025552-0).

This book provides an excellent and very comprehensive introduction to microprocessor-based systems and includes chapters on the use of test equipment, digital logic, interfacing, microprocessor architecture, programming, as well as prototyping and troubleshooting. Several popular 8-bit microprocessors are described in some detail. This book can be very highly recommended.

Microelectronics and Microprocessor-based Systems by Noel Morris (published by Macmillan, ISBN 0-333-36190).

This book covers both hardware and software and includes chapters devoted to memory systems, interfacing, timing, and program creation. The book makes extensive reference to the Intel 8085 and thus should suit readers who wish to gain further experience of this particular microprocessor.

Microprocessor Engineering by B. Holdsworth (published by Butterworths, ISBN 0-408-013261-3).

This book provides a useful introduction to microprocessor systems and, like the previous title, makes extensive reference to the Intel 8085 though some other popular 8-bit microprocessors also get a mention. The book contains chapters which deal with logic, memory, small computer architecture, instruction sets, assembly language, and data conversion.

16-Bit Microprocessors by Ian R. Whitworth (published by Collins, ISBN 0-00-383113-2).

This book will be useful for those who wish to get to grips with 16-bit microprocessors and it provides a comprehensive introduction to a variety of popular 16-bit processor families. Chapters are also devoted to interfacing, instruction sets, assembly code software and development, system software and operating systems.

Digital and Microprocessor Electronics by Byron Putman (published by Prentice-Hall, ISBN 0-13-214354-2).

This book provides a comprehensive guide to the design and troubleshooting of modern digital and microprocessor based systems. This book also uses the 8085 as a representative microprocessor and several chapters deal with this device (the Z80 and 6800 are covered only rather briefly). The last two chapters deal with an analysis of a microcomputer system (the IBM-PC) and troubleshooting methods are discussed.

Microprocessor Systems Engineering by J. Ferguson (published by Addison-Wesley, ISBN 0-201-14657-6).

This book describes the basic skills, tools and techniques required to devise, develop and implement a microprocessor-based project. The 6502, Z80, 8086 and 68000 microprocessors are considered and useful chapters are included on software production, testing and debugging, system development, and interfaces and peripherals.

PRE-TEST ANSWERS

1. c	12. c	23. c
2. c	13. b	24. d
3. b	14. a	25. d
4. a	15. a	26. c
5. a	16. b	27. a
6. c	17. a	28. d
7. b	18. a	29. c
8. c	19. b	30. d
9. b	20. a	31. c
10. d	21. a	32. c
11. c	22. a	33. c
		34. c

How well did you do?

Score less than **17**: Don't underestimate the amount of work that you still need to do! We suggest that you carefully work through Parts Five to Eight before making a second attempt at the Pre-Test.

Score **18** to **27**: You have still got plenty of work to do before you are ready to sit the Written Test! Check the answers to those which you answered incorrectly, referring to the relevant part of Introducing Microprocessors in order to see where you went wrong.

Score **28** to **34**: Well done! You should be well able to cope with the Written Test. It is, however, still worth checking the answers to any questions which you answered incorrectly.

PLEASE NOTE

The *Introducing Microprocessors* series has proved to be very popular with both readers and lecturers/teaching establishments etc.

To meet this on-going demand for the series we will be republishing it in book form. The book will be available from Newsagents and from the Direct Book Service during October—watch out for full details.

ON SPEC

a regular feature for the Spectrum Owner...

by Mike Tooley BA

THIS month, as promised, we embark on another constructional project in the form of a Dual Digital-to-Analogue Converter (DAC). This device can be used to generate analogue voltages on two independent output channels yet only requires minimal additional circuitry in order to interface with the Spectrum.

Before we begin, however, there's just time to deal with a query raised by two readers who, it seems, may be considering taking their Spectrums "out and about" this summer!

Portable Spectrum?

A. Holland and *J. Thorpe* both wish to operate a Spectrum directly from a 12V car battery. Happily, this does not present any real problem since the Spectrum power supply delivers a nominal +12V (actually nearer 10V!); the mains unit can be dispensed with and d.c. fed directly from the car battery to the Spectrum's d.c. power connector.

There are, however, two pitfalls to avoid. firstly, since the Spectrum's mains unit delivers nearer 10V than the nominal 12V, dissipation within the Spectrum's +5V regulator may increase somewhat.

Overheating was a perennial problem with older versions of the Spectrum (Issue 3, and earlier) and thus it would be useful to incorporate some circuitry to reduce the d.c. supply by a volt, or so. Secondly, since inadvertent reversal of the Spectrum's d.c. supply will undoubtedly result in permanent damage, some form of reverse polarity protection is highly desirable.

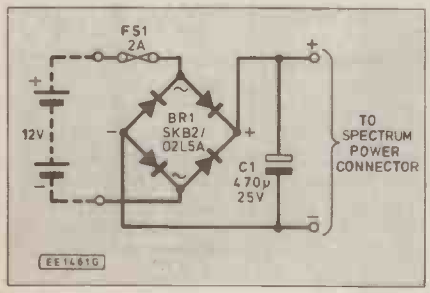


Fig. 1. Suggested 12V d.c. power adaptor.

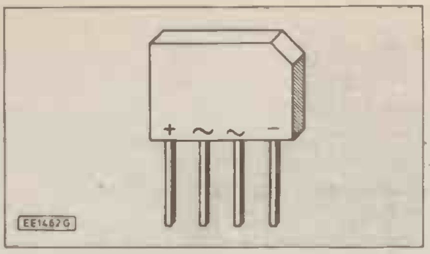


Fig. 2. Connections for the SKB2/02L5A bridge rectifier.

Both of these minor problems can be solved using nothing more than an encapsulated bridge rectifier, as shown in Fig. 1. The rectifier ensures that the Spectrum receives the correct supply polarity regardless of the actual connection of the battery (the 2A fuse is added merely to provide over-current protection in the event of misconnection of, or failure within the bridge rectifier itself). Furthermore, the total forward voltage drop within the rectifier is approximately 1.4V and it is thus instrumental in reducing the supply voltage to the d.c. power connector of the Spectrum to a more manageable 10.6V.

Provided it is rated at 1.5A, or more, almost any encapsulated bridge rectifier will operate satisfactorily in Fig. 1. The pin connections for the suggested rectifier (an SKB2/02L5A) are shown in Fig. 2.

DUAL DAC

Almost three years ago (in September 1985) we described a Simple Digital-to-Analogue Converter based on the ZN428E. Since then, a number of other DAC chips have become available including the 7528 which offers two identical converters housed in a compact 20-pin DIL package.

Separate internal data latches are provided for each DAC which greatly simplifies the task of interfacing the device to a microcomputer bus. The 7528 operates from a single supply rail (of between +5V and +15V) with extremely low power consumption. The individual converters employed within the 7528 operate using the technique of four quadrant multiplication and separate reference voltage inputs are provided for each.

The internal arrangement of the 7528 is shown in Fig. 3. Data from the system data bus is fed, via an input buffer and internal 8-bit data bus, to the two internal 8-bit data latches. Data is clocked into a latch when selected by internal control logic (note that only one latch can be enabled at any given time and that data is held within the latch and the analogue output voltage maintained at the corresponding level, until new data is written to the latch).

The summed output of each converter's "R−2R" ladder network appears at the output (pin-2 for Channel A and pin-20 for Channel B). Outputs must be taken to the inverting input of an external operational amplifier for which an internal feedback resistor is provided. This component is fitted between pins 2 and 3 in the case of Channel A and between pins 20 and 19 in the case of Channel B and it is accurately matched to those within the "R−2R" ladder network.

Circuit Description

The complete circuit of the Spectrum Dual DAC is shown in Fig. 4. IC2d and IC2a constitute summing amplifiers for the internal "R−2R" resistor networks whilst IC2b and IC2c act simply as unity gain inverting amplifiers. The outputs of Channels A and B are respectively available at SK1 and SK2.

IC3 provides address decoding such that the 7528 is selected whenever an I/O write operation is performed with A7 low. Address line A6 is used to determine which Channel data latch is selected and this results in the address decoding shown in Table 1.

Table 1: Address decoding for the Dual DAC

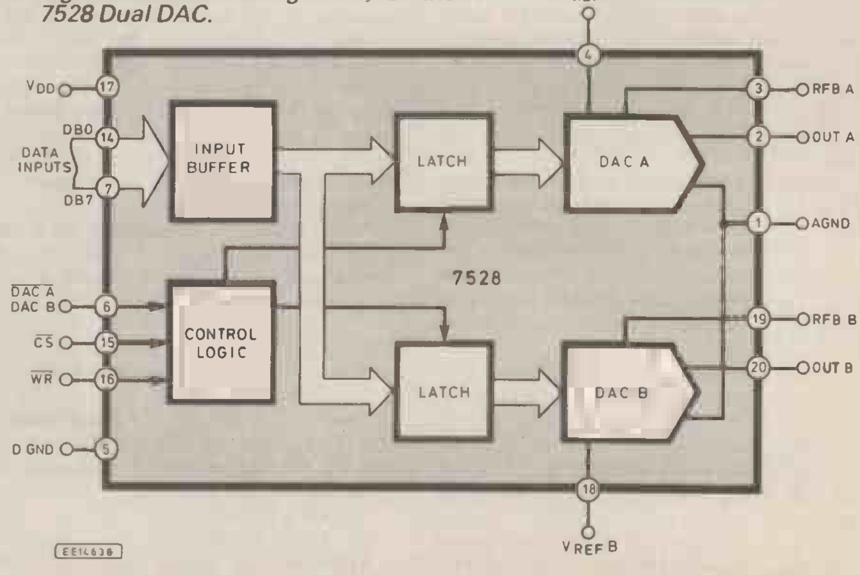
Address Lines*		DAC Selected	Address	
A7	A6		HEX.	DEC.
0	0	A	3F	63
0	1	B	7F	127

*N.B.: Address lines A0–A5 MUST all be at logic 1.

Construction

The Dual DAC may be assembled on a piece of stripboard measuring approximately 80mm×100mm. The precise dimensions of

Fig. 3. Internal arrangement of the 7528 Dual DAC.



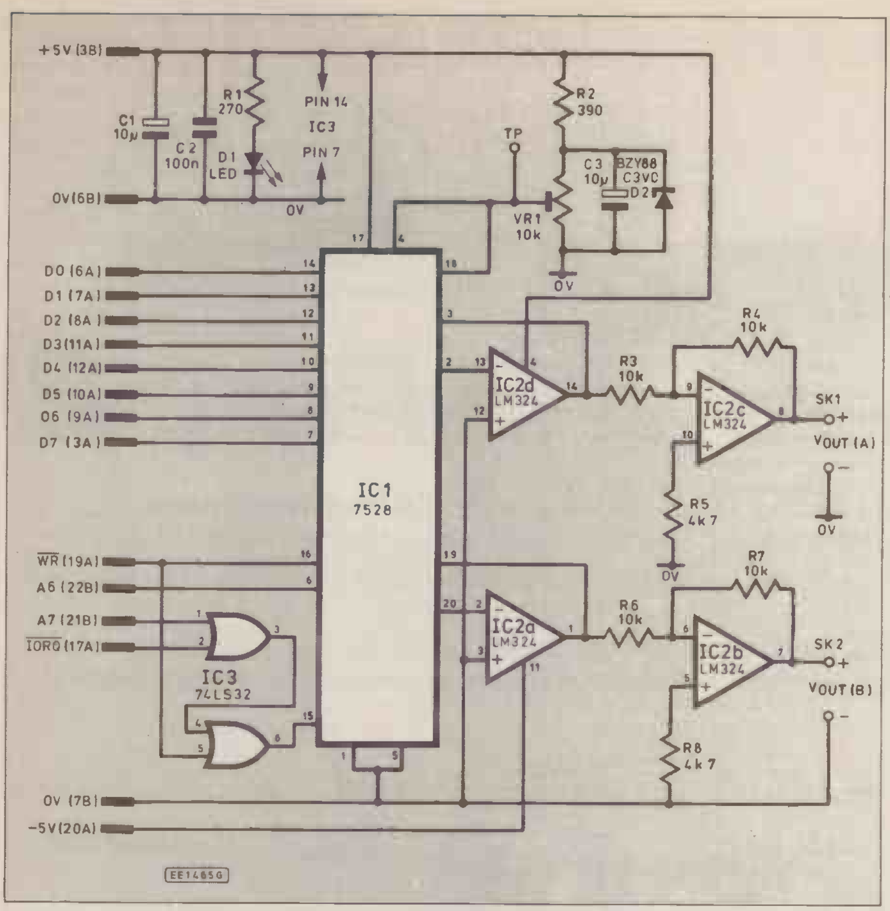


Fig. 4. Complete circuit of the Spectrum Dual DAC.

COMPONENTS

Resistors

R1	270
R2	390
R3	10k
R4	10k
R5	4k7
R6	10k
R7	10k
R8	4k7

All 0.25W 5% carbon

Shop Talk See page 415

Potentiometer

VR1 10k min. pre-set (preferably multi-turn)

Capacitors

C1	10µ p.c. elec. 16V
C2	100n polyester
C3	10µ p.c. elec. 16V

Semiconductors

D1	Red l.e.d.
D2	BZY88 C3VO
IC1	AD7528
IC2	LM324
IC3	74LS32

Miscellaneous

14-pin low-profile d.i.l. socket (2 required); 20-way low-profile d.i.l. socket; 2-way 0.1in pitch p.c.b. mounting connectors (2 required); stripboard, 0.1in pitch, measuring approx. 80mm×100mm; 28-way open end double-sided 2.54mm (0.1in) pitch edge connector (e.g. Vero part number 838-24826A); connecting wire; solder etc.

Approx. cost Guidance only **£18**

the board are unimportant provided that it has a minimum of 28 tracks aligned in the vertical plane sufficient to allow the mounting of a 28-way double sided edge connector. This connector should be fitted to the lower edge of the board and will require five holes across the full width of the stripboard so that the board stands vertically when the connector is mated with the Spectrum.

Before soldering any of the components (including the three i.c. sockets) it is important to allow some clearance for the rear overhang of the case. For the Spectrum this gap should correspond to 8 rows of holes (20mm approx.) whilst for the Spectrum Plus and 128, the gap should be increased to 12 rows of holes (30mm approx.).

Component layout is generally uncritical though, as with most of our *On Spec* projects, considerable economies can be made by carefully planning the layout in advance of mounting the components and i.c. sockets. Readers are advised to carry out this exercise on paper first (using, if desired, the layout sheet provided with our *On Spec Update*).

After mounting the i.c. sockets, great care must be taken to ensure that all unwanted tracks are cut (including, in particular, those which link the upper and lower sides of the 28-way connector). A purpose designed spot- face cutter is ideal for this purpose or, if such a tool is not obtainable, a small sharp drill bit may be used.

The remaining components (diodes, fixed resistors, capacitors, connectors and pre-set resistor) should then be fitted to the board. As usual, the decoupling capacitors (C1 and C2) should be distributed around the board with C2 being placed in close proximity to the supply input of IC1.

Links on the underside of the board should make use of appropriate lengths of miniature insulated wire (of the wirewrapping type).

When the stripboard wiring has been completed, the three integrated circuits should be inserted into their sockets (taking care to ensure correct orientation of each device). Finally, the entire board and wiring should be very carefully checked before attempting to connect it to the Spectrum. (Note that the Spectrum should ALWAYS be disconnected from its supply before either connecting or disconnecting any interface module). If all is well, when power is re-applied, the normal copyright message should appear. If not, disconnect the power, remove the interface and carefully check again!

Initial Adjustment

The procedure for adjusting and testing the Dual DAC is extremely straightforward and simply requires the services of an accurate (preferably digital) voltmeter or digital multimeter switched to the d.c. voltage ranges. The interface should be connected to the Spectrum (as before) and power applied. The voltmeter should be connected with its positive lead to the test point (marked "TP" in Fig. 4) and its negative lead to 0V. VR1 should then be adjusted for a reading of exactly 2.56V.

Now transfer the voltmeter leads to SK1 (the output of Channel A) and enter the following BASIC commands and, at each stage, note down the voltage produced:

OUT 63,0
OUT 63,255

The voltmeter should read 0.00V and 2.55V, respectively.

Finally, transfer the voltmeter leads to SK2 (the output of Channel B), enter the following BASIC commands and again note down the voltages produced:

OUT 127,0
OUT 127,255

The voltmeter should again read 0.00V and 2.55V, respectively.

This completes the adjustment and testing of the Dual DAC and the interface is now ready for use!

Next month: We shall provide some demonstration software for the Dual DAC and we shall also be describing an I/O Address Selector.

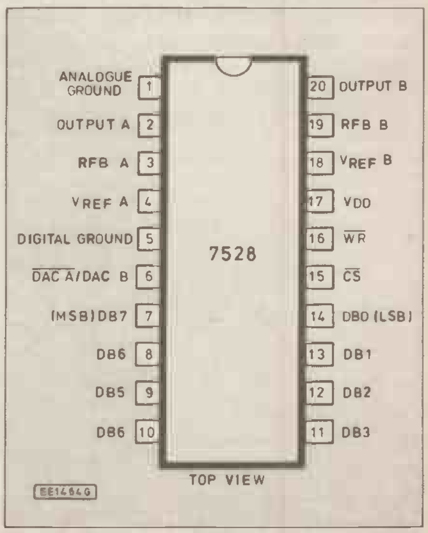
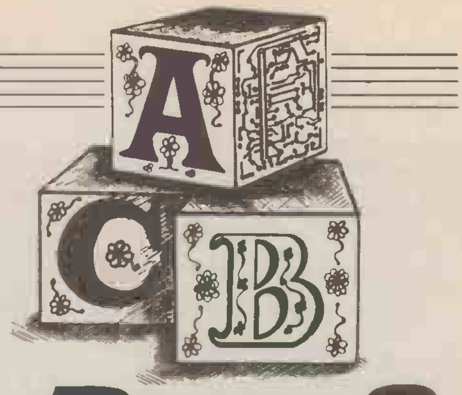


Fig. 5. Pin connections for the 7528 Dual DAC.

Constructional Project

AUDIO MINI-BRICKS

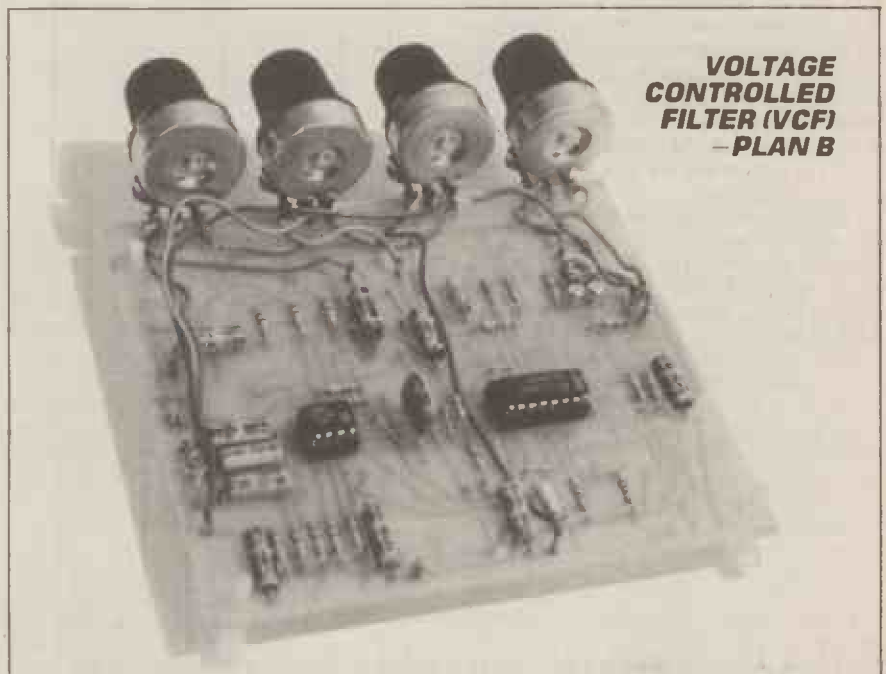


JOHN BECKER

Part 2

A planned series of audio building "bricks" that can be connected together in numerous different ways to produce all kinds of sound effects. These basic building modules are examined in detail and, with one exception, all the circuits use identical i.c.s and a master printed circuit board.

The circuits are all self-contained and you can select whichever circuits you want to build. All projects are suited to assembly by novice and experienced constructor alike.



VOLTAGE CONTROLLED FILTER (VCF) –PLAN B

THIS month we turn our attention to creating sound effects using the Voltage Controlled Filter and also investigate the Ring Modulator.

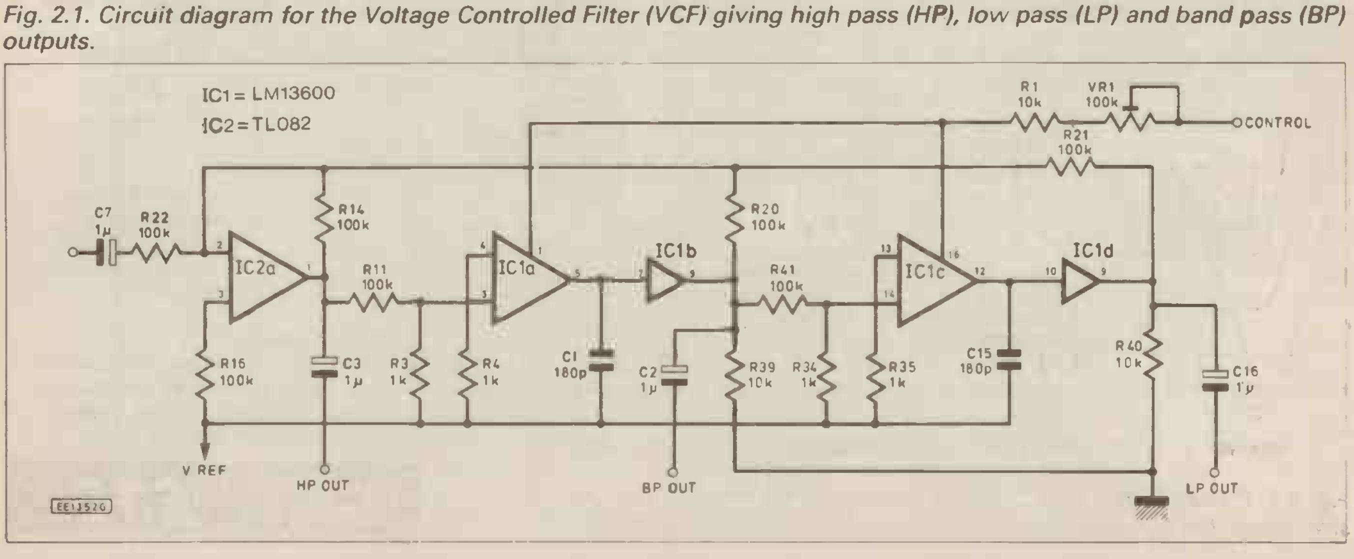
VOLTAGE CONTROLLED FILTER

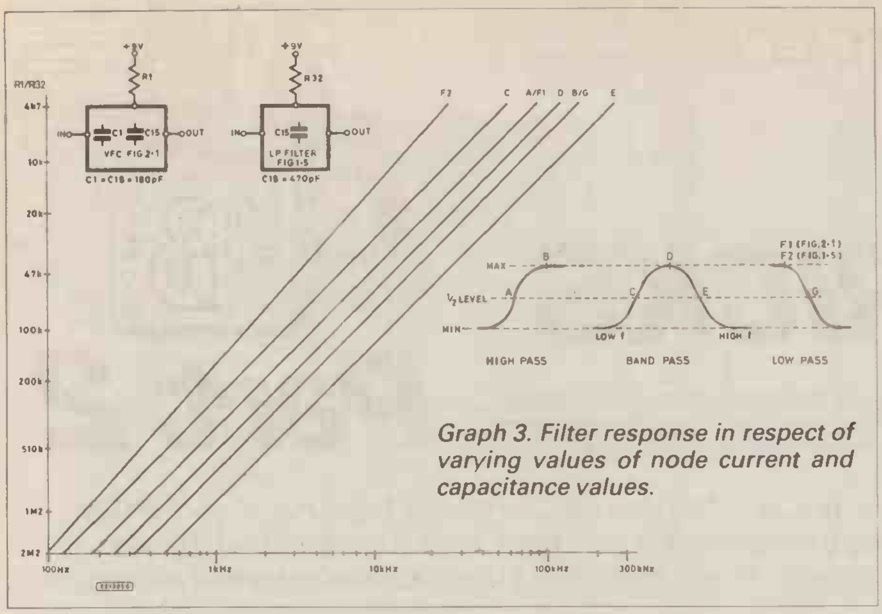
The principle of operation of the Voltage Controlled Filter (VCF) is shown in the circuit diagram Fig. 2.1, and is similar to that for the Low Pass Filter. Frequencies are extracted from an a.c. signal by varying capacitor charge rates. In this case there are two capacitors and three stages.

The signal comes into op. amp IC2a which acts as a mixer stage. Its output is taken in by the first filter stage around IC1a and IC1b. Capacitor C1 absorbs some of the upper frequencies. Part of the output is fed back to IC2a, another part is fed forward to the second filter stage at IC1c and IC1d. More of the upper frequencies are taken out by capacitor C15, and further feedback is made to IC2a.

Due to the nature of the current transfer three frequency pass parameters are developed. Upper frequencies appear at IC2a, and this is the High Pass (HP) output.

Fig. 2.1. Circuit diagram for the Voltage Controlled Filter (VCF) giving high pass (HP), low pass (LP) and band pass (BP) outputs.





Graph 3. Filter response in respect of varying values of node current and capacitance values.

At first sight this may seem odd as it might be expected that the signal here should contain low frequencies as well. The fact that it does not is due to the current transfer characteristics of the entire network.

The far end of the circuit at IC1d is the Low Pass (LP) output. In the middle at IC1b, frequencies between high and low pass appear. This is the Band Pass (BP) output.

The spectral range of the three sections is governed by the amount of current going into the control nodes at pins 1 and 16. Since these are coupled, they both see the same current as delivered from the chosen sources previously discussed.

Filter response in respect of varying values of node current and capacitance value is shown in Graph 3. The maximum and half level regions shown relate to the signal strength seen at the outputs compared to the original level.

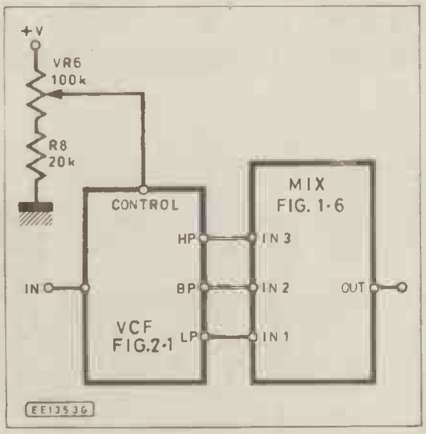


Fig. 2.3. Block diagram showing the arrangement for a tone control/equaliser.

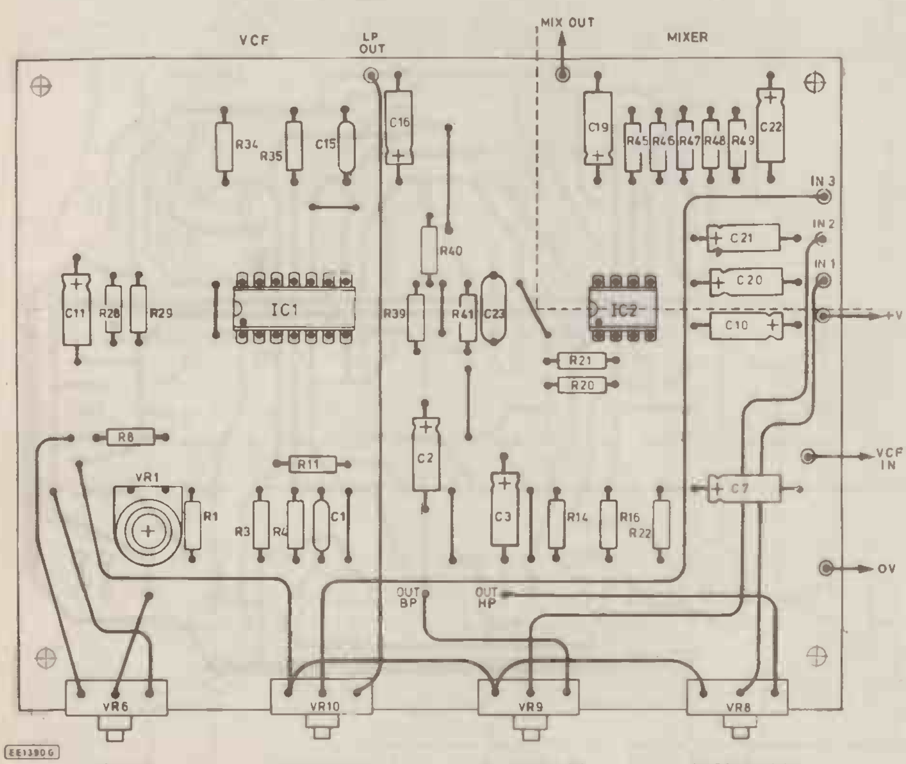


Fig. 2.2. Printed circuit board component layout for the VCF and Mixer. A full size copper foil master pattern was given in Part One, last month.

CONSTRUCTION – PLAN B

The positioning of the VCF components on the printed circuit board is shown in Fig. 2.2 (Plan B). It is optional whether the outputs are taken via the potentiometers. They could equally well be switched to further circuits or equipment.

TONE EQUALISING

With the wiring shown the outputs are taken to a mixer stage. This is identical to that used for the Hex VCO and the configuration becomes the Tone Control/Equaliser shown in Fig. 2.3.

By varying the signal level passed to the mixer inputs, so the output will consist only of those frequency bands selected in conjunction with VR6. Between them the four controls allow the VCF to be used as a powerful frequency correction tool.

One useful side effect of this set-up is that notch filtering can be introduced. This results in the ability to extract frequencies in a narrow middle range by only using the low pass and high pass regions. The positioning of the notch is variable by adjusting VR6. Several VCFs may be coupled for increased filtering.

Another use of a VCF comes from its ability to change the characteristics of a signal by emphasising its upper harmonics. As

COMPONENTS

VCF and MIXER

Shop Talk

See page 415

Resistors

R1, R39, R40	10k (3 off)
R3, R4, R34, R35	1k (4 off)
R8	20k
R11, R14, R16, R20-R22, R41, R45-R49	100k (12 off)
R28, R29	4k7 (2 off)

All 0.25 W 5% carbon

Potentiometers

VR1	100k skeleton
VR6	100k mono rotary
VR8-VR10	100k log mono rotary (3 off)

Capacitors

C1, C15	180p polysty. (2 off)
C2, C3, C7, C10, C16, C19-C22	1µ 63 elec. (9 off)
C11	22µ 16V elec.
C23	100n polyester

Semiconductors

IC1	LM13600 Transductance op. amp
IC2	TL082 Dual BIFET op. amp.

Miscellaneous

Printed circuit board, 255A, p.c.b. clips (4 off); 8-pin i.c. socket; 16-pin i.c. socket; knobs (4 off); connecting wire; solder etc.

Approx. cost Guidance only **£16**

previously mentioned, waveforms other than sine waves contain upper harmonics. Using a VCF, the basic or fundamental frequency can be tuned out leaving only a selected harmonic.

As any synthesiser owner will know, this can dramatically change the nature of the sound. This can also be shown by feeding the non-sinusoidal outputs of the VCO into the VCF and experimenting with different settings of the controls.

The effect can be further enhanced by coupling the control nodes of both a VCO and VCF so that they track in unison. An obvious control source is to use the voltage output of a synthesiser to produce total and harmonic manipulation.

MOCK STEREO

An interesting effect can be produced by feeding the VCF to two mixers, as in Fig. 2.4. This results in a mono signal being split into a simple stereo simulation.

Only two of the inputs on each of the mixers are used. The low pass output goes to one input of Mixer 1 and the high pass to one input of Mixer 2. The band pass though is fed to the second inputs of each mixer. The outputs can be fed to separate channels of a stereo amplifier.

Thus bass frequencies will be heard on one side and high frequencies on the other. Middle frequencies form the central image, and their two level controls can be used for panning or balance. A dual-ganged pot could be used instead of two separate controls. The stereo image can also be shifted by using the band pass control VR6.

SIMPLE PHASER

The VCF can be coupled to the VCO in another way, so producing a phasing effect, as in Fig. 2.5. The familiar phasing or "skying" sound as it is sometimes called, comes about when two signals of identical basic content, but varying in relative phase, are mixed across each other.

The change of phase can be achieved by using a delay module, as will be seen later. It is also readily obtained by changing the characteristics of a filter. It is inherent in a simple filter design that a signal phase shift occurs during filtering.

Since the VCF can be controlled by a changing voltage source the phase shift can be varied in response to the control level. A VCO produces a changing voltage at its output and this can be used to automatically vary the phase change.

On its own a phase changed signal will not sound any different. But as soon as it is mixed in similar proportions with the original the phasing effect will occur.

PHASING

The triangle wave output of the VCO in Fig. 1.4 is coupled to the control node of the VCF. Music is fed simultaneously to both the VCF and one channel of the mixer from Fig. 1.6. The VCF output goes to the second mixer channel.

Phase shift rate is controlled by VR6, and is best when at a cycle period of several seconds. Basic phase shift regions are variable by VR7.

Mixer input controls should be set so that the two levels are identical. This will result in almost complete cancellation of the relevent frequencies as the phases become directly opposed.

When they shift into total phase agreement, a doubling of the output level will

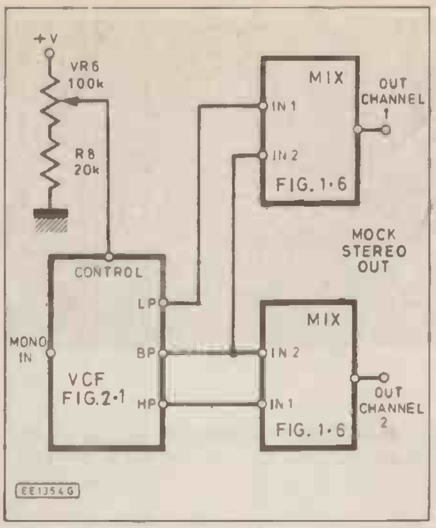


Fig. 2.4. Arrangement for producing mock stereo. The bass frequencies will be heard one side and high frequencies the other.

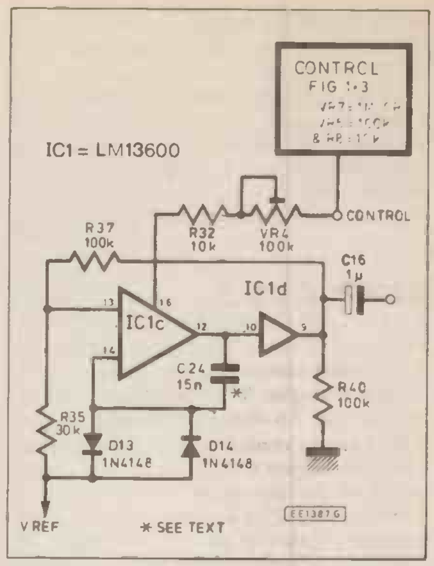


Fig. 2.6. Circuit diagram for a simple voltage controlled oscillator (VCO). The output waveform is shown in photograph 6.

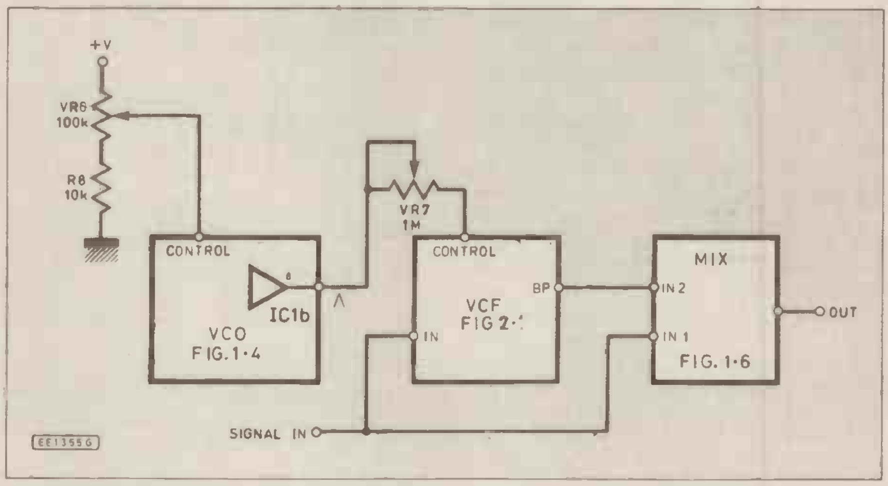
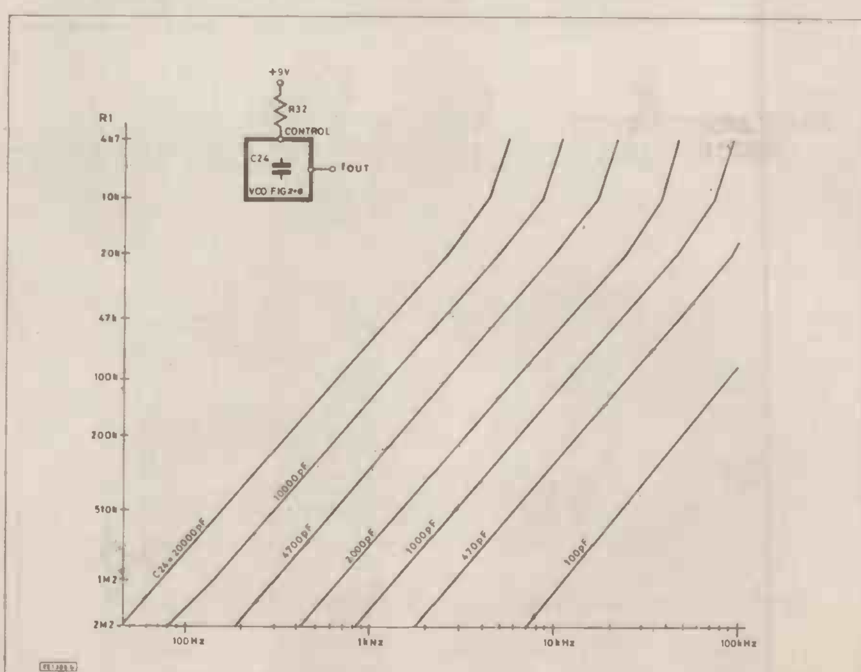


Fig. 2.5. Block diagram showing how the VCF can be coupled to the VCO to produce phasing.

Graph 4. Control resistance/capacitor against frequency for the simple VCO



result. The mixer controls must therefore be set down a bit to avoid overload distortion.

The phasing effect will be most apparent with complex waveforms, particularly in the upper frequency ranges. With smoother waveforms of a more sinusoidal nature the effect will be less noticeable to the ear, though it will be seen on a scope, and perhaps on the VU meter of an amplifier system.

SIMPLE VCO

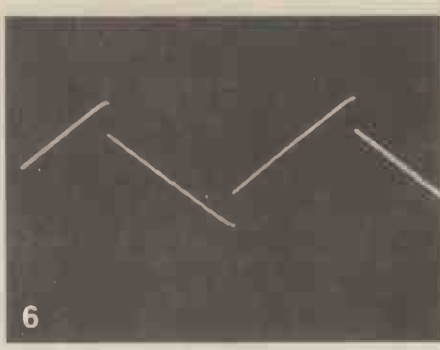
Earlier, details of a multiwaveform VCO were given. There are though, many instances when waveform shape is not too critical and a simpler VCO can equally well do the job. Fig. 2.6 shows how a single stage of a TCA can be connected to produce a somewhat mis-shaped triangle wave. The output waveform for the simple VCO is shown in photograph 6. This is perfectly suitable as a frequency source in all sorts of applications ranging from signal tracing, to sound effects production. It is also usable as a modulation control source.

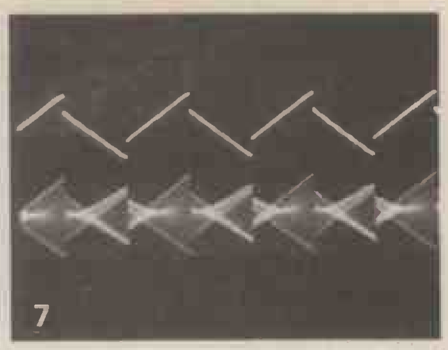
As before, the frequency is determined by the rate at which a capacitor varies its charge in response to a control current. Here capacitor C24 is connected for positive feedback to IC1c with the threshold trip point set by the back-to-back diodes D13 and D14.

IC1d buffers the capacitor charge, and the resulting waveform is available at C16. Graph 4 shows the plots of frequencies produced by different values of C24 and control resistance.

RING MODULATOR

Ring modulation effects are second only to delay effects in popularity. Much has been written on the subject, including a lengthy article by the author some months ago. Even in its simplest form a ring mod can impose most profound changes on a music or voice signal.





6–Simple VCO output waveform.

7–Ring Modulator: Upper trace, l.f. modulation. Lower trace, combined h.f. and l.f. modulation.

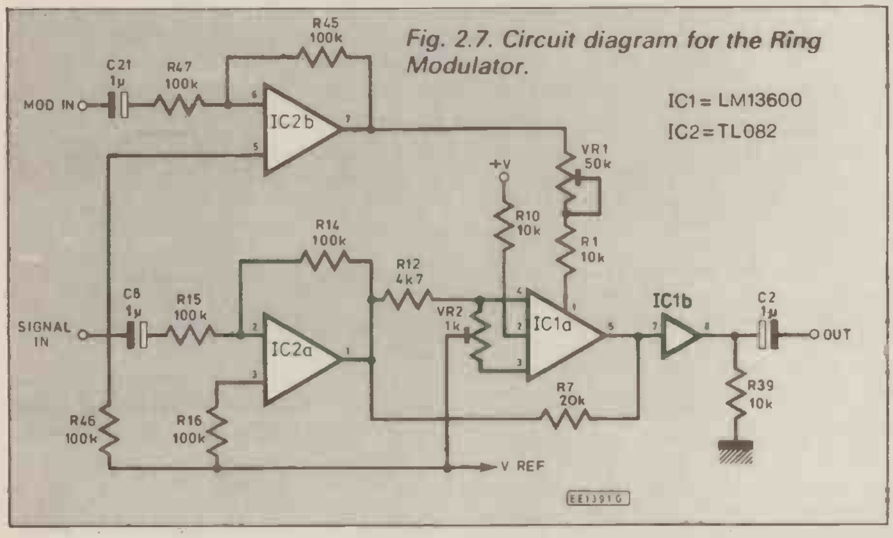
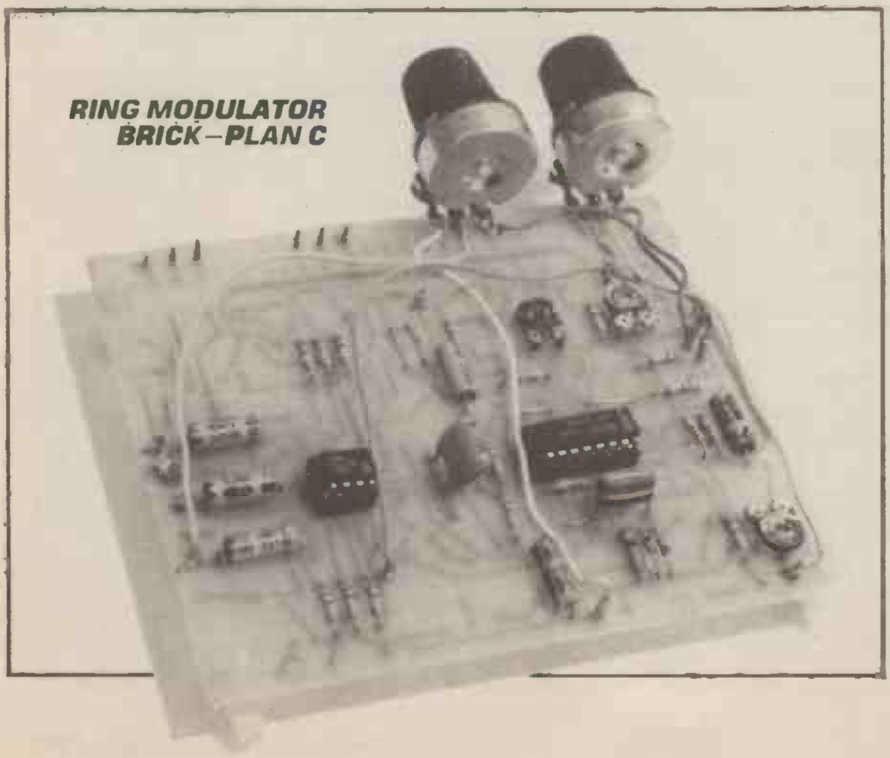


Fig. 2.7. Circuit diagram for the Ring Modulator.



RING MODULATOR BRICK–PLAN C

COMPONENTS

RING MOD AND SIMPLE VCO

Resistors

R1, R8, R10, R32, R39, R40	10k (6 off)
R7	20k
R12, R28, R29	4k7 (3 off)
R13-R15, R37, R45-R47	100k (7 off)
R35	33k

All 0.25W 5% carbon

Potentiometers

VR1	50k skeleton
VR2	1k skeleton
VR3	100k skeleton
VR6	100k mono rotary
VR8	100k log. mono rotary

Shop Talk

See page 415

Capacitors

C2, C8, C10, C16, C21	1µ elec. 63V (5 off)
C11	22µ elec. 16V
C14	15n polyester
C23	100n polyester

Semiconductors

D13, D14	1N4148 (2 off)
IC1	LM13600 transconductance op. amp
IC2	TL082 dual BIFET op. amp

Miscellaneous

Printed circuit baord, 2551; p.c,b. clips (4 off); 8-pin i.c. socket; 16-pin i.c. socket; knobs (2 off); connecting wire and solder, etc.

Approx. cost Guidance only **£15**

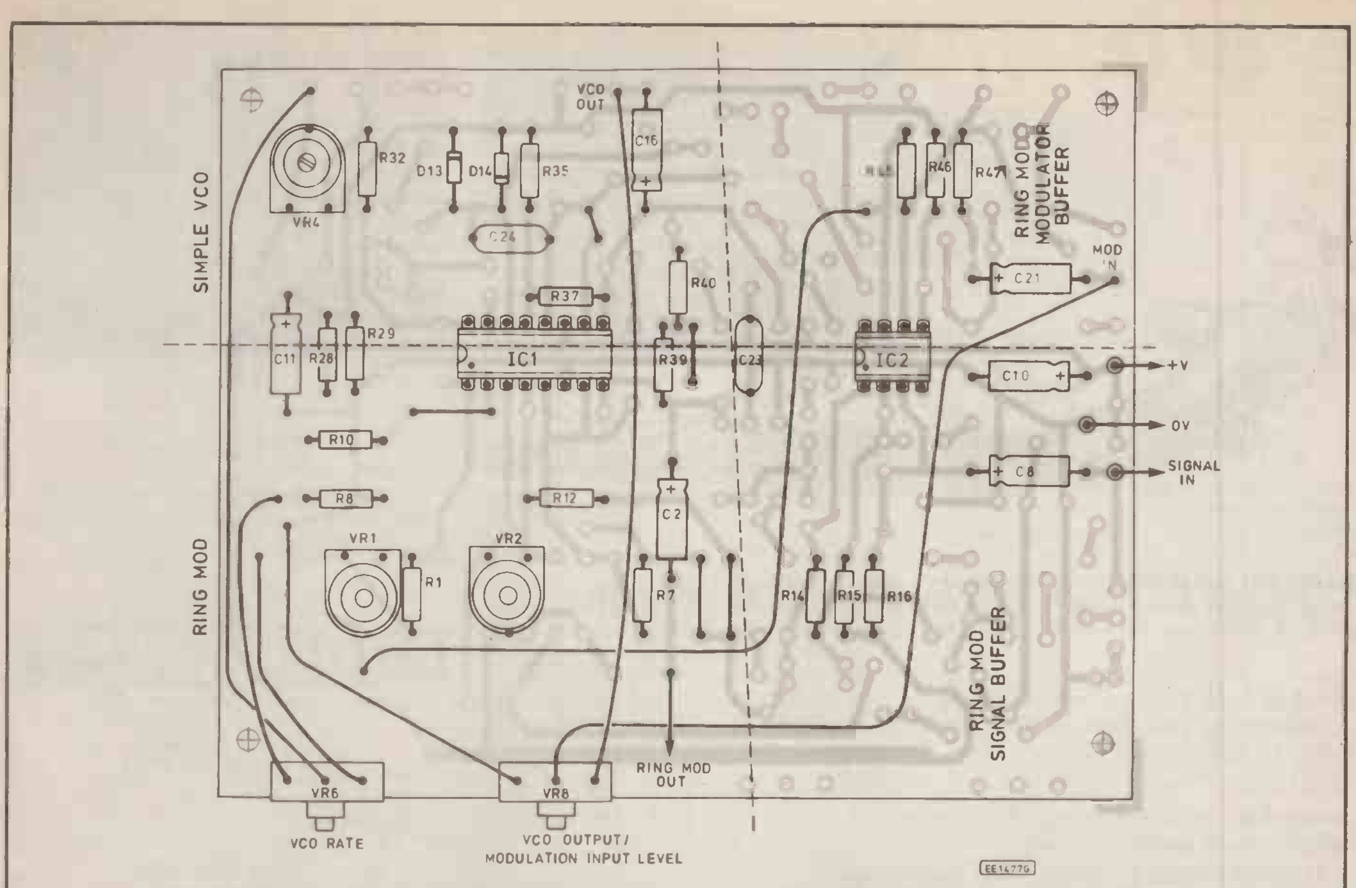


Fig. 2.8. Printed circuit board component layout for the Ring Modulator and the Simple VCO.

In essence two signals are brought together. They are not combined as happens in a mixer, but instead they intermodulate. Normally the speech or music signal goes to one input and an oscillator signal to the other.

The method of combination results in extra harmonics being produced. A typical Ring Modulator waveform is shown in photograph 7. These are related to the sum and the difference of the two. In this way it is possible to build up rich chord structures from otherwise unremarkable sounds. Simpler effects can also be easily produced, such as robot or Dalek type voices.

The circuit diagram for a Ring Modulator is shown in Fig. 2.7. This circuit shows a basic way of producing ring modulation by using the transconductance amplifier (TCA) i.e. as a four quadrant multiplier.

The two signals to be combined are brought in via the op. amps IC2a and IC2b. They are simply buffers, and play no active part in the modulation. The voice or music signal goes to the inverting input of IC1. The modulating signal goes to IC1 control node and varies the gain factor in response to changes in the waveform amplitude.

The gain of the TCA (IC1) is also governed by the current going into resistor R7. Since this is connected to the output of IC2a, the gain is additionally controlled by variations in the signal level.

Preset VR2 sets a bias level to both the inverting and non-inverting inputs of IC1a. With careful adjustment a balance point can be set so that in the absence of a modulating signal the TCA will not pass the primary signal.

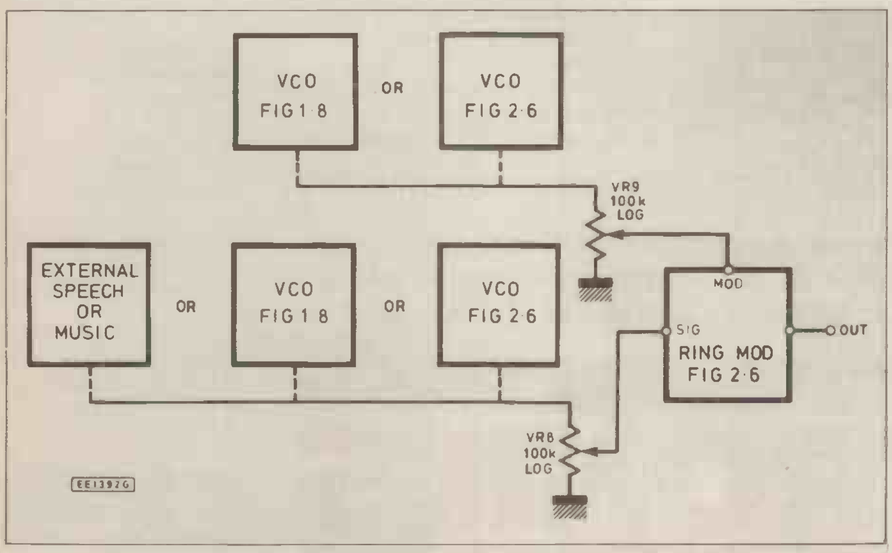
Likewise, preset VR1 needs to be set so that the modulator signal does not pass through in the absence of the primary. The balance precision is not as accurate as will be found in more complex ring modulators, but the unit is a worthwhile addition to a sound effects armoury.

CONSTRUCTION -PLAN C

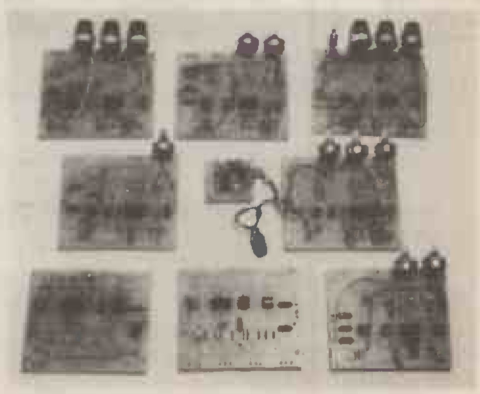
The printed circuit board component layout for the Ring Modulator and the Simple VCO is shown in Fig. 2.8.

Some of the ways in which the module can be connected to various speech, music and VCO sources is shown in Fig. 2.9 and the p.c.b. layout combines this arrangement to form one unit (Plan-C). Robot voices and music modulation effects can be directly produced from the unit connections shown. More complex results can be created by feeding synthesiser VCOs into the two inputs.

Fig. 2.9. Showing how the Ring Mod and Simple VCO can be connected to produce robot voices and music modulation.



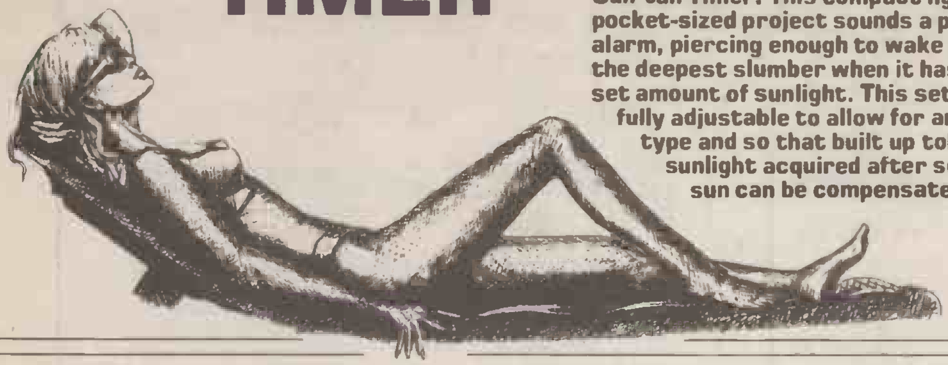
Next Month: Frequency Doubler, Fuzz, Tremolo, Wobble Wah and an Envelope Shaper.



NEXT MONTH

SUN-TAN TIMER

Sunburn, sunstroke and peeling could all be avoided if there was a device to let you know when you have just the right amount of sunlight to develop a tan but not enough to cause damage. Such a device now exists in the form of the Sun-tan Timer. This compact lightweight pocket-sized project sounds a penetrating alarm, piercing enough to wake anyone from the deepest slumber when it has received a set amount of sunlight. This set amount is fully adjustable to allow for any sort of skin type and so that built up tolerances to sunlight acquired after several days in the sun can be compensated for.



STREET-WISE CARS

Motorists should find it more difficult to get lost in the 1990s thanks to electronic navigation systems. Several car manufacturers and electronics companies have already demonstrated prototypes. Systems employing satellite receivers and CD data storage plus Radio Data System traffic and road reports will soon be possible.

TEA-TUNE

The Tea-Tune is designed to hang on the side of a cup where it monitors the drink until the temperature falls below a preset level, upon which it loudly plays a medley of popular tunes. Of course, the device has other applications; being pocket-sized it can be used to monitor and signal a fall in temperature in almost any liquid (fish tanks, photographic processing etc.) or even ambient air temperature, e.g. it could be used as a personal temperature monitor for the elderly—warning of a fall in room temperature below a "safe" level, or as an ice warning etc.

All this plus our regular features and parts 3 of Home Security Systems and Audio Mini-Bricks. Make sure of your copy—place an order with your newsagent or take out a subscription now!

EVERYDAY ELECTRONICS

AUGUST ISSUE ON SALE FRIDAY JULY 1

b...Beeb...Beeb...Beeb...Be

...EPROM Programming ...EPROM Programming ...

THE accompanying listing is the programme for the EPROM programmer described in the previous two BEEB Micro articles. It is menu driven and is largely self explanatory when run, but a few notes to clarify things are in order. Option 1 allows you to enter data into the buffer used to store the programme.

The actual BBC memory addresses and the relative addresses (i.e. the offsets from the base address, which are effectively the EPROM addresses) are both displayed, together with the value in each location. The latter are given in both hexadecimal and decimal, but can only be entered in hexadecimal. You can scroll up and down to get to any desired address, or the jump facility can be used to move straight to any (relative) address.

Option 2 is essentially the same, but it allows data to be entered in decimal form. With option 3 you have access to operating system commands. This is primarily so that the contents of a disc can be displayed, and the buffer can be saved to disc and reloaded.

Option 4 is used to blow an EPROM, having first selected 8 or 16K operation using option 5 (and having remembered to set the right programming voltage on the programmer). The programme gives a scrolling display which shows how far it has progressed, and it will indicate a programming error if one should occur.

Option 6 simply stops the programme and takes the computer back to the BASIC CLI.

Improvements

The programmer does not use a fast programming algorithm, and it will take a few minutes to programme even an 8K EPROM. Line 2130 controls the time for which the programme waits while each byte is programmed. You can try values lower than 8 in an attempt to speed things up slightly.

There are two obvious additions to make to the programme, or to have as separate programmes. The first is to have an erasure checking facility. This only requires a very simple programme. It is basically just a matter of setting the user port lines as inputs, enabling the output enable terminal of the EPROM, and then reading in the value from each address of the EPROM. Each byte should be &FF (255 decimal), and the programme must indicate that erasure is imperfect if any other value is detected at any address. The setup procedure followed by a reading procedure based on a FOR . . . NEXT loop should suffice.

Reading in the contents of an EPROM for copying purposes is much the same, but the values obtained must be written into a block of free RAM. This is again just a matter of using the setup procedure plus a routine based on a FOR . . . NEXT loop (with the upper and lower RAM addresses being used as the maximum and minimum values in the loop). It is then a matter of using another FOR . . . NEXT loop to output the contents of the RAM block to the new EPROM, using a blowing/checking routine of the type used in the listing shown here.

Morley EPROM Programmer

The BBC Micro has one of the largest range of readily available commercial add-ons—possibly the biggest range of all. It seems especially rich in the number and variety of add-on EPROM programmers. It seems as though every manufacturer of BBC add-ons produces at least one of these devices. It is probably a popular add-on for the BBC micro due to its sideways ROM facility, rather than because a lot of BBC micro owners are into developing their own micro based systems.

Prices and facilities vary enormously from one unit to another. Some seem able to programme any EPROM under the sun (including some that I have never heard of before), while others are strictly for the 27*** series, as used for the sideways ROMs. The unit I have been using for the last few months is the Morley EPROM programmer V2, which is in the low cost category. It can programme 2764, 27128, and 27256 EPROMs, with both 12.5 and 21 volt programming potentials available. In this respect it is similar to the EPROM programmer described in the previous two articles in this series, but my design cannot handle the 27256 (32k) devices.

This unit seems to have been designed with simplicity of operation very much in mind. The nearest thing it has to a control is the lever on the 28 way ZIF socket! It is fully software controlled. In common with most commercial EPROM programmers for the BBC micro, it connects to the user port, and this is the only port that is used. Clearly a fair amount of multiplexing and demultiplexing is required in order to control everything from the nine output lines of the user port, but it seems to work flawlessly.

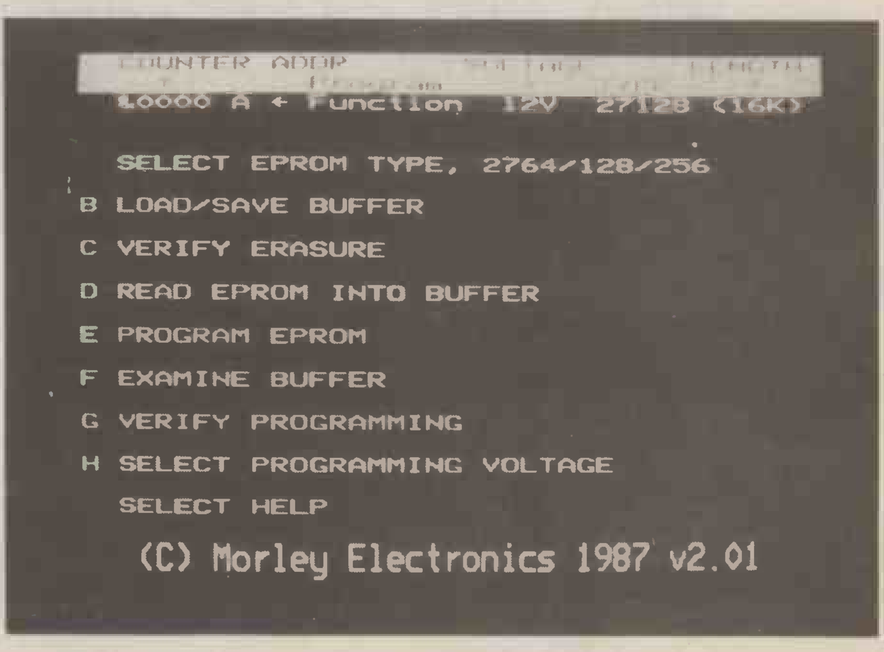
Software

The manual for this device does not exist as such. There is a photocopied A4 sheet giving some basic details, including how to obtain help screens when running the software supplied with the unit. This software can be on disc or EPROM. I obtained the disc software and tried out the unit by transferring this onto a 27128 EPROM (the ROM image is included on the disc). The help screens are brief but concise.

While documentation is not a strong point of this product, the unit and software are very easy to use, and I had no real difficulties in using the unit. It is not one of the programmes where you tend to keep getting stuck, and have to reset the computer to get back in control! It should also be borne in mind that an EPROM programmer is not really a beginner's add-on, and most EPROM programmer documentation seems to (quite reasonably) assume a fair amount of technical knowledge on the part of the user.

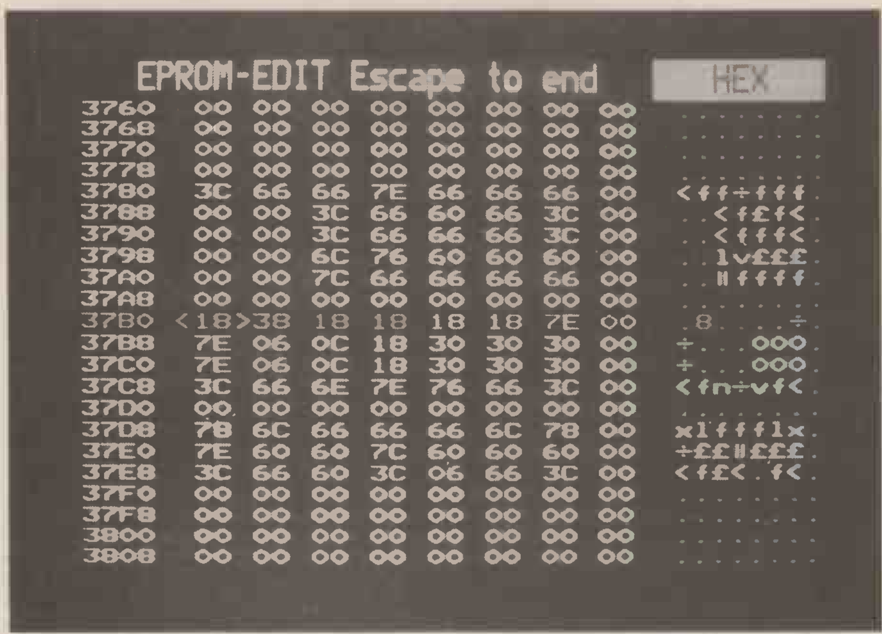
The programme is menu driven, and you are presented with the main menu as soon as it is up and running. You can select the desired EPROM type, and alter the programming voltage if the default voltage is

The main menu screen.



EPROM SOFTWARE

```
10 REM EPROM BLOWER PROGRAM
20 REM J.W.P. 4/88
30 MODE 7
40 DIM BUFFER 16384
50 dec$="1234567890"
60 hex$="1234567890ABCDEF"
70 BASE=BUFFER:LIMIT=BUFFER+8191:S=BUFFER:C=BUFFER:F=BUFFER+16
80 ON ERROR GOTO 370
90 *FX4,1
100
110 VDU26,12:REM menu start
120 PRINTTAB(13,4)CHR$(141);"EPROM BLOWER"
130 PRINTTAB(13,5)CHR$(141);"EPROM BLOWER"
140 PRINTTAB(5,9)"1.  ENTER HEX DATA TO BUFFER"
150 PRINTTAB(5,10)"2.  ENTER DECIMAL DATA TO BUFFER"
160 PRINTTAB(5,11)"3.  O.S. COMMANDS (LOAD/SAVE, ETC.)"
170 PRINTTAB(5,12)"4.  BLOW EPROM"
180 PRINTTAB(5,13)"5.  CONFIGURE 8/16K BUFFER"
190 PRINTTAB(5,14)"6.  QUIT PROGRAM"
200 PRINTTAB(5,18)"Select by number keys";
210 REPEAT
220   K$=GET$
230   K=VAL(K$)
240   UNTIL (K>0) AND (K<7)
250 IF K=1 HEX=TRUE:PROCenter
260 IF K=2 HEX=FALSE:PROCenter
270 IF K=3 PROCoscli
280 IF K=4 PROCblow
290 IF K=5PROCconfigure
300 IF K=6 GOTO 350
310 GOTO 110
320 END
330
340
350 *FX4,0
360 STOP
370 *FX4,1
380 IF ERR=17 GOTO 110
390  REPORT:PRINT " at line ";ERL
400  PROCkey
410  GOTO 110
420  END
430 DEF FNvir(length,valid$)
440 LOCAL out$
450 *FX21,0
460  in=GET:in$=CHR$(in)
470 IF in>127 PROCline(in):GOTO 450
480 IF in=74 PROCjump:GOTO 450
490 IF in=13 THEN=out$
500 IF in=127 AND LEN(out$)<>0 THEN out$=LEFT$(out$,LEN(out$)-1):VDU 127:GOTO 450
510 IF INSTR(valid$,in$)=0 OR LEN(out$)=length THEN VDU7:GOTO450
520 out$=out$+in$
530 VDU in
540 GOTO 450
550
560
570 DEF PROCscreen
580 CLS
590 PRINT "Enter values and press RETURN"
600 PRINT "'J' to jump to (relative) address"
610 PRINT "ESCAPE to end"
620 PRINTTAB(6,6)"ADDRESS"
630 PRINTTAB(3,7)"ABS";TAB(7)"REL";TAB(18)"HEX";TAB(31)"DEC"
640 VDU28,3,23,37,8
650 PROCfillscreen
660 ENDPROC
670
680
690 DEF PROCprintline(line,addr)
700 PRINTTAB(0,line)SPC(35);
710 PRINTTAB(0,line);~addr;TAB(8,line);~addr-BASE;TAB(19,line)~?addr;TAB(32,line)?addr;
720 ENDPROC
730
740
750 DEF PROCfillscreen
760 FOR lines=0 TO 15
770   PROCprintline(lines,S+lines)
780   NEXT lines
790 ENDPROC
800
810
820 DEF PROCenter
830 PROCscreen
840 IF HEX col=19:length=2:valid$=hex$ ELSE col=32:length=3:valid$=dec$
850 VDU31,col,C-S
860 inp$=FNvir(length,valid$)
870 IF inp$="" GOTO 920
880 IF HEX inp$="&"+inp$
890 inval=EVAL(inp$)
900 ?C=inval
910 PROCprintline(C-S,C):IF inval>255 VDU7:GOTO 850
920 C=C+1:PROConscreen
930 GOTO 860
940 ENDPROC
950
960
970 DEF PROConscreen
980 IF (C<S) AND (S>BASE) PROCscrolldown
990 IF (C=F) AND (F<=LIMIT) PROCscrollup
1000 IF C<BASE C=BASE
1010 IF C>LIMIT C=LIMIT
1020 VDU31,col,C-S
1030 ENDPROC
1040
1050
1060 DEF PROCscrolldown
1070 VDU30,11
1080 F=F-1:S=S-1
1090 PROCprintline(0,C)
1100 VDU31,col,0
1110 ENDPROC
1120
1130
1140 DEF PROCscrollup
1150 VDU31,0,15,10
1160 F=F+1:S=S+1
1170 PROCprintline(15,C)
1180 VDU31,col,15
1190 ENDPROC
1200
1210
1220 DEF PROCline(code)
1230 PROCprintline(C-S,C)
1240 IF code=138 C=C+1
1250 IF code=139 C=C-1
1260 PROConscreen
1270 ENDPROC
1280
1290
1300 DEF PROCconfigure
1310 CLS
1320 PRINT:PRINT
1330 PRINT "Buffer can be configured as :-"
1340 PRINT "1 x 16K block"
1350 PRINT "OR 2 x 8K blocks."
1360 PRINT:PRINT
1370 PRINT "Please select:-"
1380 PRINTTAB(5,12)"1.  BOTTOM 8K BLOCK"
1390 PRINTTAB(5,13)"2.  TOP 8K BLOCK"
1400 PRINTTAB(5,14)"3.  16K BLOCK"
1410 REPEAT
1420   K$=GET$
1430   K=VAL(K$)
1440   UNTIL (K>0) AND (K<4)
1450 IF K=1 BASE=BUFFER:LIMIT=BASE+8191
1460 IF K=2 BASE=BUFFER+8192:LIMIT=BASE+8191
1470 IF K=3 BASE=BUFFER:LIMIT=BUFFER+16383
1480 S=BASE:C=BASE:F=BASE+16
1490 ENDPROC
1500
1510
1520 DEF PROCjump
1530 line=VPOS
1540 PRINTTAB(0,line)SPC(35);
1550 VDU31,8,line
1560 addr$=FNvir(4,hex$)
1570 IF addr$="" PROCprintline(C-S,C):VDU 31,col,C-S:ENDPROC
1580 addr=EVAL("&"+addr$)+BASE
1590 IF addr<C PROCjumpup
1600 IF addr>C PROCjumpdown
1610 CLS
1620 PROCfillscreen
1630 VDU31,col,C-S
1640 ENDPROC
1650
1660
1670 DEF PROCjumpup
1680 IF addr<BASE addr=BASE
1690 IF addr-line<=BASE S=BASE ELSE S=addr-line
1700 C=addr
1710 F=S+16
1720 ENDPROC
1730
1740
1750 DEF PROCjumpdown
1760 IF addr>LIMIT addr=LIMIT
1770 IF addr-line+16>=LIMIT F=LIMIT+1 ELSE F=addr-line+16
1780 IF addr-line+16<LIMIT F=addr-line+16
1790 C=addr
1800 S=F-16
1810 ENDPROC
1820
1830
1840 DEF PROCoscli
1850 CLS
1860 *FX4,0
1870 PRINT "Enter MOS (*) commands at * prompt."
1880 PRINT "(*LOAD,*SAVE,*CAT etc.)"
1890 PRINT "All addresses in HEX"
1900 PRINT "Current block starts at ";~BASE;" length ";~LIMIT-BASE
1910 PRINT "Null entry or ESCAPE to exit."
1920 VDU 28,0,24,39,5
1930 INPUT "*"cmd$
1940 IF cmd$="" THEN *FX4,1
1950 IF cmd$=""ENDPROC
1960 OSCLI cmd$
1970 GOTO 1930
1980
1990
2000 DEF PROCblow
2010 CLS
2020 PRINT "Blowing EPROM..."
2030 ?&FE62 = 255
2040 ?&FE63 = 255
2050 ?&FE6C = 224
2060 ?&FE61 = 6
2070 ?&FE61 = 4
2080 FOR byte=BASE TO LIMIT
2090   PRINT "Memory addr. ";~byte;" EPROM addr. ";~byte-BASE
2100   ?&FE60=?byte
2110   ?&FE6C = 192
2120   ?&FE6C = 224
2130   T=TIME:REPEAT UNTIL TIME-T>8
2140   ?&FE62 = 0
2150   ?&FE61 = 0
2160   IF ?&FE60<>?byte PRINT "Failed at ";~byte:PROCkey:ENDPROC
2170   ?&FE61 = 4
2180   ?&FE62 = 255
2190   ?&FE61 = 5
2200   ?&FE61 = 4
2210   NEXT byte
2220 PRINT "Operation successful."
2230 PROCkey
2240 ENDPROC
2250
2260
2270 DEF PROCkey
2280 PRINT "PRESS ANY KEY TO CONTINUE"
2290 REPEAT UNTIL GET
2300 ENDPROC
>
```



The EPROM edit screen. You must scroll to the desired address.

wrong for the device you wish to programme. You can also load or save data to disc, verify erasure, load data from an EPROM into memory, examine the block of memory used for data storage (and edit its contents), verify correct programming, or go into the help pages.

Editing

Editing the buffer is very straightforward. You are presented with a display that shows lines of eight bytes of data in hexadecimal. Addresses are shown to the left of these, with ASCII characters for the bytes displayed on the right hand portion of the screen. This ASCII display is useful for checking purposes when entering data that is text for a screen display, or something of this nature. Maybe I am misinterpreting the display, but the ASCII data seems to be headed "HEX"! Changing byte values is very easy. It is just a matter of moving the cursor using the cursor keys, and typing in new values. The screen scrolls vertically and seems to be able to display any part of memory if you scroll it far enough. It seems to be continually reading values from memory, and will show changing values if you display (say) the input/output area of the memory map!

I had no difficulties in using the Morley programmer and software to copy EPROMs, or to load EPROMs with my own programmes entered into the buffer. The unit uses a fast programming algorithm, and claims to programme a 16K EPROM in an average time of under 30 seconds. I did not take any programming times to check this, but programming was being completed in a matter of seconds rather than minutes.

Conclusion

The Morley EPROM programmer is a very neat and efficient product, as is the software supplied with it. Building your own EPROM programmer can certainly be cheaper, but the Morley unit represents very good value for money. The do-it-yourself approach is likely to provide worthwhile but not really massive savings when compared to this unit. It you only wish to programme 2764, 27128, and 27256 EPROMs this package is certainly worthwhile considering, and I have no hesitation in recommending it.

If you require a unit that can handle a wider range of devices you will need to look elsewhere, but you will probably have to pay about twice as much (or more) to satisfy your requirements. When comparing EPROM programmer prices bear in mind that the software is sold separately in some cases, and sometimes at quite a high price. Make sure you know exactly what you are buying before parting with hard earned cash.

Further details from: Morley Electronics, Unit 3, Maurice Road Industrial Estate, Tyne and Wear, NE28 6BY (Tel. 091 2627507).

SHOP TALK

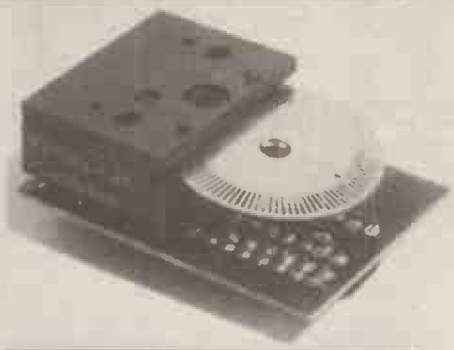
BY DAVID BARRINGTON

Optical Encoder

A product that should appeal to the experimenter, and being offered at a special price, is announced by **Greenweld**.

The Optical Shaft Encoder, made by Sharp, produces two phase-shifted outputs plus a sync pulse once every revolution. It is claimed that the optical encoder is ideal for use in robotics applications or anywhere the position and speed of a rotating shaft needs to be known.

The complete unit, with comprehensive data, costs just £8.50 inclusive and is available from: **Greenweld Electronics Ltd., Dept EE, 443D Millbrook Road, Southampton, S01 OHX. ☏0703 772501.**



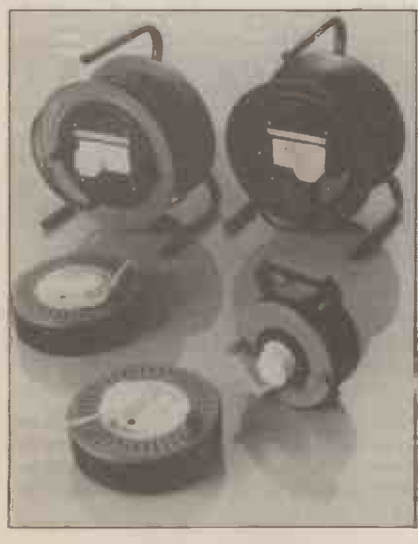
Extension Lead

Why is it that whenever there's an electrical breakdown around the home, or in the car, it nearly always happens well away from the nearest electric power point and you end up cursing that the soldering iron lead or electric drill lead falls short by inches! This is certainly a case where the purchase of an extension cable reel more than makes up for the initial outlay.

The latest cable reel range of products from **Briticent** include models which incorporate a safety cutout to protect against overloads and a neon light to indicate mains on. The cable reels are supplied with cable and fused plug.

The 1500W version comes with 10m of cable and the 3250W version with 8m of cable. Both versions are fitted with twin socket outlets.

For further information and addresses of nearest stockists write to: **Briticent International Ltd., Dept EE, Crow Arch Lane, Ringwood, Hants, BH24 1NZ (☏0425 474617).**



CONSTRUCTIONAL PROJECTS

Video Wiper

The slider potentiometers required for the *Video Wiper* project are about twice the price of rotary types but do add that "professional" touch to the finished unit and are certainly worth the extra outlay. You can, of course, use rotary types if you wish.

Looking at the author's prototype model, we see that a 4066BE quad bilateral switch has been used for IC5 instead of the 4-pole 1-way analogue switch type 4016BE specified. The 4066 is pin-for-pin compatible with the 4016, but has a lower "on" resistance. The 4016 is recommended for sample and hold circuits. Both devices should work in this circuit.

The rest of the components seem to be standard items and should not cause any purchasing difficulties. The printed circuit board for the Video Wiper is available from the *EE PCB Service*, code EE612

Audio Mini-Bricks

The master printed circuit board (£7.90) for the *Audio Mini-Bricks* series of projects is available from **Phonosonics, 8 Finucane Drive, Orpington, Kent, BR5 4ED.**

Universal Charger/Power Supply

Most component suppliers should carry stocks of the 3-pin DIN "In-Line" socket called up in the comp list for the *Universal Charger/Power Supply*. Provided a larger case is used, you can, of course, use a chassis mounting DIN socket.

The type and physical size of mains transformer purchased will also govern the size of case used. The one used in the prototype model was a miniature p.c.b. mounting type and just about fitted into the "PSU box", fitted with an integral 3-pin 13A plug. These type of cases are now quite common and stocked by most component advertisers.

It should be noted that the "tab" of the voltage regulator i.c., type LM317M, is also connected to the V_{out} pin and care should be taken to avoid shorting it to other components. Because of the presence of mains voltages it is important to take extreme care when carrying out any work on the unit.

Spikeater

The three-in-one 250V a.c. suppression capacitor used in the *Spikeater* was purchased from **Maplin**. This three lead delta capacitor is listed as a "Motor Suppressor", code HW07H (Delta Cap).

If readers experience any difficulties in locating a local source for the Varistor, it is currently listed by Maplin as a "mains transient suppressor", type HW13P (Mains Trans Supp). They are also stockists of the Class X capacitor (order code FF56L) required for "non-earthed" suppression.

Although it is suggested that the capacitor can be "Superglued" to the outside cover of the rubber mains plug, it might, for safety reasons, be a better idea to build the unit inside a PSU box, fitted with an integral plug. A typical example of this type of case is shown in the photographs of the Universal Charger/Power Supply in this issue.

Isolink

The high voltage, high sensitivity opto transistor isolator, RA57M, called for in the *Isolink* is a **Maplin** type number. It is quite possible that other advertisers, such as **Xen, Greenweld** and **Marco**, might be able to offer an equivalent. However, they have not been tried in-circuit and it is important that they have identical specifications. This means a minimum 100 per cent transfer ratio and be capable of isolation voltages of 5300V r.m.s. (7500V peak).

The p.c.b. foil pattern for this project shows an 8-pin configuration for the opto isolators, even though they are 6-pin devices. The reason for this is that 6-pin i.c. holders seem to be non-existent and the 8-pin holder is universally stocked. The i.c.s should be plugged into the top section, i.e. at pin one, usually designated by a notch or cutout in the holder. Another alternative would be to employ soldercon pins and make up a 6-pin "station".

The printed circuit board for this project is available from the *EE PCB Service*, code EE613 (see page 000).

Spectrum Dual DAC

Readers may experience difficulties in locating a source for the dual 8-bit digital-to-analogue converter i.c. specified in this month's *On Spec* feature.

The only listing for the AD7528 dual 8-bit DAC chip we have been able to locate is from **Electromail (☏0536 204555)**, order code 633-600 or 301 921.

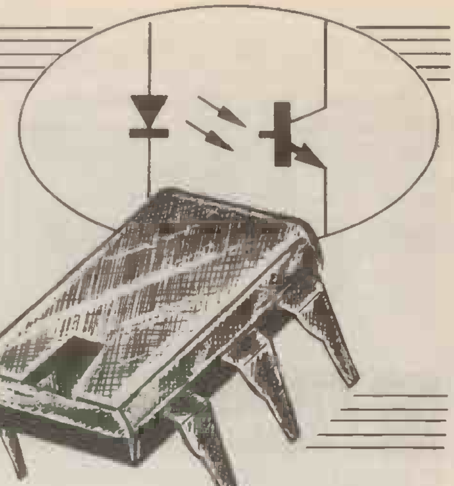
Home Security

Most of the components required for this month's circuits in our new series on *Home Security* are standard products and should be stock items. However, the battery back-up i.c. is only listed by **Maplin**, code UH36P (ICL7673).

A large range of specialist intruder sensors are stocked by **Riscomp** and they should be able to supply all of the various "detectors" called for in this series of articles. **Riscomp Ltd., Dept. EE, 51 Poppy Road, Princes Risborough, Bucks, HP17 9DB (☏084 44 6326).**

We cannot foresee any component buying problems for the *Diode Pump*, this month's *Exploring Electronics* project.

Constructional Project



ISOLINK

ANDY FLIND

Connections without contact!

THE "Isolink" conducts voltage signals from d.c. to around 30kHz between its input and output terminals. "Amazing", you might say, "but surely two bits of wire can do that?"

Well yes, but the Isolink does offer some significant advantages over wire. For a start, it will withstand high voltages between the input and output connections without passing current, allowing measurements to be made on normally inaccessible circuits such as those connected directly to live a.c. mains.

The capacitance between input and output, due mainly to stray coupling, is less than 10pF. As this presents an impedance greater than 300 megohms at 50Hz it enables investigation of sensitive battery-powered circuitry by mains powered test gear with virtually no coupling of mains "hum".

This has obvious applications in many areas of electronics, but should be of especial interest to bio-feedback enthusiasts. The prototype was in fact designed to assist with the development of a brain-wave monitor circuit.

OPTO-ISOLATOR

An "opto-isolator" device was chosen as the basis for this project as it offers efficient signal transfer with low supply current. Most other methods require tens of milliamps (at least) of transmitter drive current, and it was intended from the outset that this circuit would be battery powered.

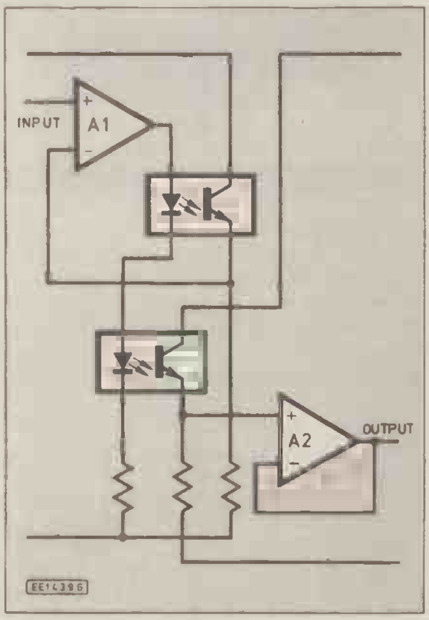


Fig. 1. Simplified representation of the opto-link circuit stage.

Another factor in this choice was avoidance of the need to "encode" signals for transmission. Fibre-optic and infra-red systems usually employ frequency or pulse width modulation, but these involve an extra oscillator which might interfere with sensitive bio-feedback circuitry. Although opto-isolators are not totally linear, the problem is quite easily overcome, as will be seen.

A simplified version of the circuit appears in Fig. 1. The input is applied to one side of amplifier A1. The output from this amplifier is routed through the input l.e.d.s of two similar opto-isolators in series, so that both receive exactly the same current, and feedback taken from the output of one of them is fed back to A1. This enables the amplifier to compensate for most errors in the isolator response, so both of the isolator outputs should be accurate copies of the input. The signal from the second isolator is buffered by A2.

CIRCUIT DESCRIPTION

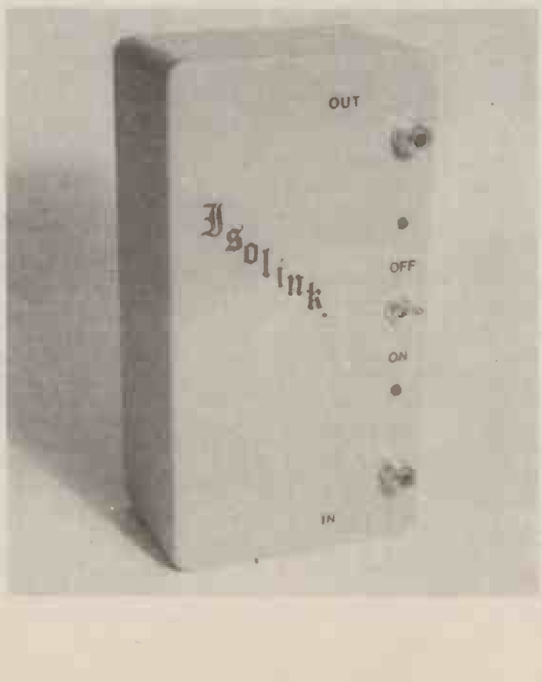
Of course, it's not quite that simple, as a glance at the full circuit diagram (Fig. 2) of the Isolink will show. To begin with, the input may be an alternating voltage. There must therefore be a quiescent current in the isolators which can both rise and fall, and the input and output "grounds" must be placed somewhere between the supply rails. IC1b with resistors R3 and R4 set the input ground to about 1V.

Stability caused a few design headaches. There seems to be a brief delay between the application of a signal to an isolator input and its appearance at the output, possibly due to charge storage in the transistor. At any rate, if the transistor is the sole source of feedback the circuit bursts into uncontrollable oscillation, so some h.f. feedback is provided from the input side through capacitor C1.

As it is taken after the l.e.d.s, at least their errors will be compensated for. Low frequency and d.c. feedback is derived entirely from an isolator output, so the performance here is excellent and even temperature-induced drift is mostly cancelled out.

The isolator type specified for this project has a stated "transfer ratio" of 100 per cent, meaning that for each milliamp of input a milliamp should be conducted by the output transistor. In practice there is a fair degree of variation between individual devices, so preset adjustment is necessary to compensate for this.

Starting with the high frequency compensation, if the ratio between the two feedback paths is adjustable, it is possible to trim the circuit for optimum high frequency response. This is carried out by preset VR1 which varies the ratio between the return resistances



from the isolator inputs and the transistor in IC2.

Next, the transfer ratios of the two isolators probably won't be exactly the same, so gain adjustment with preset VR3 sets the correct output level. The "ground" connection on the output side is also offset to permit negative signal swings and, as the d.c. outputs of the two isolators are unlikely to be exactly the same, preset VR2 gives a small range of compensatory adjustment.

COMPONENTS

Resistors

R1, R3, R5	10k (3 off)
R2	1M
R4	2k7
R6, R7, R14	220 (3 off)
R8, R15	33k (2 off)
R9, R11, R16, R18	22k (4 off)
R10, R17	68k (2 off)
R12	3k3
R13	470

All 0.6W 1% metal film

Potentiometers

VR1, VR3	470 sub-min horiz. preset (2 off)
VR2	1k sub-min. horiz. preset

Shop Talk
See page 415

Capacitors

C1	1n polyestyrene
C2, C3, C6, C7	100n polyester layer (4 off)
C4, C8	100µ axial elec. 10V (2 off)
C5, C9	470µ axial elec. 25V (2 off)

Semiconductors

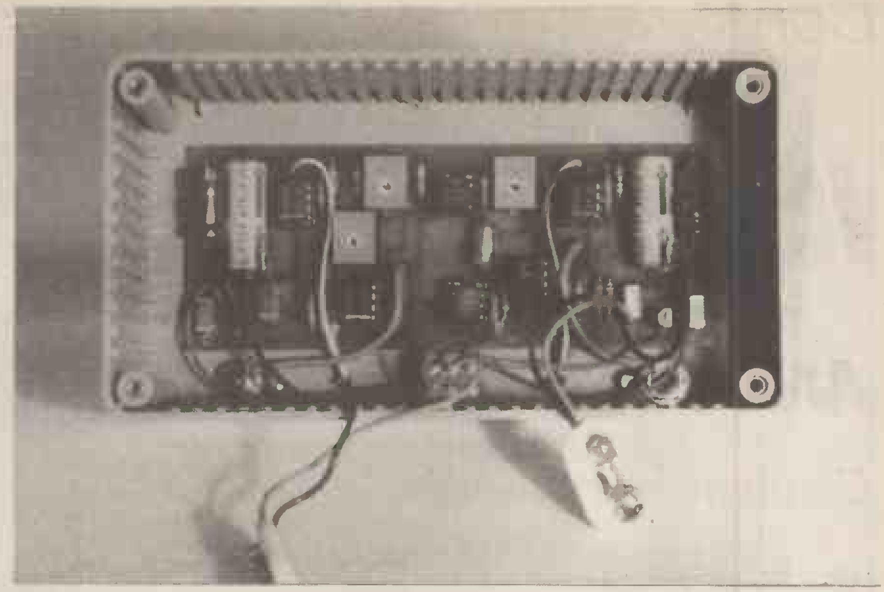
D1, D2	3mm Hi-bright l.e.d. red (2 off)
IC1, IC5	CA3240E Dual op-amp. (2 off)
IC2, IC6	High-sensitivity, high voltage Opto Isolator. (Maplin RA57M) (2 off)
IC3, IC7	CA3130 Op-amp. (2 off)
IC4, IC8	78L05 5V 100mA positive voltage regulator (2 off)

Miscellaneous

S1	Miniature d.p.s.t. toggle switch
SK1, SK2	Chassis phono sockets (2 off)

Case, ABS box, 150×80×50mm; printed circuit board, available from *EE PCB Service*, code EE613; 8-pin DIL socket (6 off); 12V battery holder (2 off) (for 8×"AA" cells each); interconnecting wire; solder; etc.

Approx. cost Guidance only £20



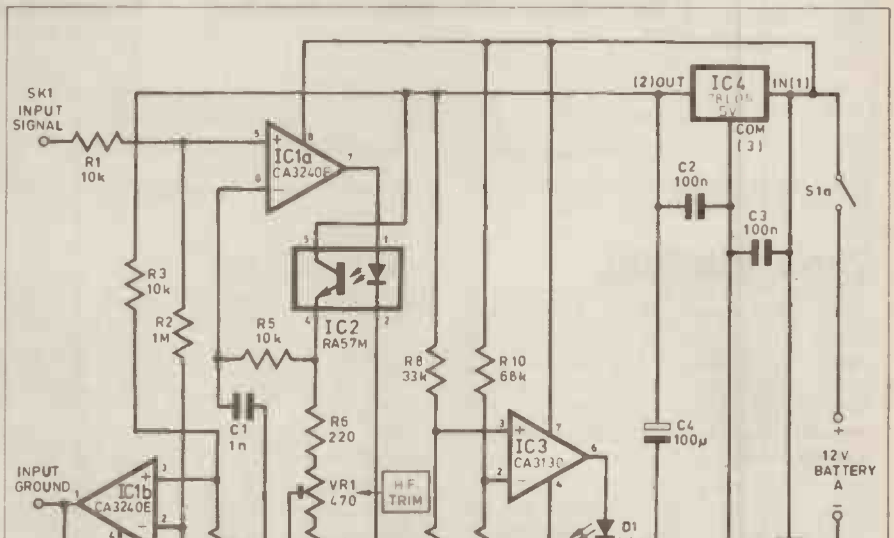
POWER SUPPLY

Regulated supplies are essential for both sections of the circuit, these being provided by two 5V 100mA "78" series regulators. As the circuit is battery operated, a warning of impending supply failure on either side is a worthwhile addition.

Two 3130 op-amps, IC3 and IC7, compare voltages derived from the battery and the stablised 5V rails. With the resistor values given, the l.e.d.s will light when the supply voltage has dropped to about 8V.

Note that the 3130's have no compensation capacitors, this being unnecessary in a switching comparator application. Also there are no series limiting resistors in their outputs, as these effectively limit the current to about 8mA anyway.

Fig. 2. Complete circuit diagram for the Isolink.



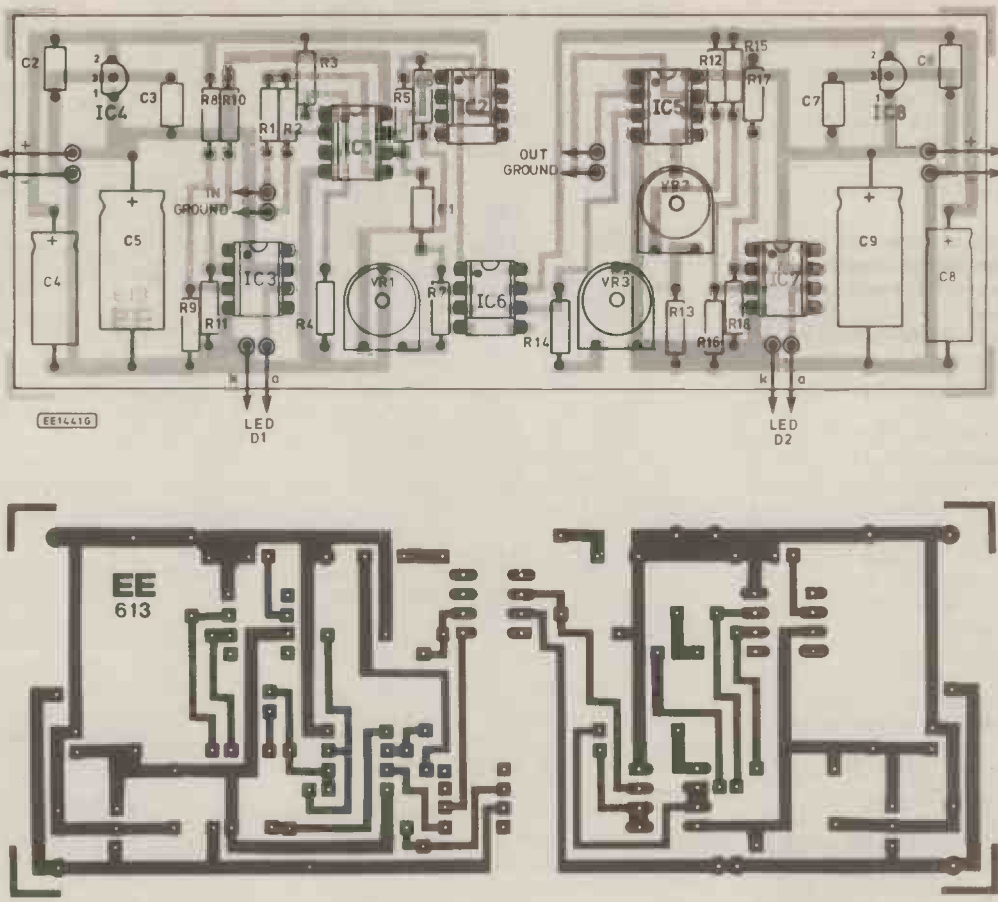


Fig. 3. Component layout and full size printed circuit board copper foil master pattern. Note that 8-pin i.c. holders have been used for the isolator chips IC2 and IC6. The i.c.s should be plugged into the top section of the holders as indicated.

CONSTRUCTION

Despite the apparent complexity this circuit is quite simple to construct on a small printed circuit board. The component layout and full size copper foil master pattern is shown in Fig. 3. This board is available from the ***EE PCB Service***, code EE613.

Sockets are recommended for all i.c.s except regulators IC4 and IC8, as this assists the test procedure. The p.c.b. has been designed to accept 8-pin sockets for the isolators although these are 6-pin devices, the reason being that 6-pin sockets are fairly hard to find. The isolators are fitted at the tops of these, leaving the bottom two holes unused. Do not fit any i.c.s at this stage as they will be added later whilst setting up.

The l.e.d.s can be connected to leads just long enough for the final installation in the case. Lengths of screened lead can be connected to the input and output points at this stage, long enough to allow easy access for testing. They can be cut short for termination to the sockets when the project is completed.

The "low supply voltage" indication is optional, by the way, if it is not required then the two 3130's (IC3/IC7) and their eight associated resistors may be omitted.

Resistor R2 provides a d.c. path to "ground" for the input so that when this is open circuit the output is zero. About one megohm is a reasonable choice of input resistance but it can be higher, lower or even omitted altogether if required.

SETTING UP

Setting up requires the use of an oscilloscope as this is the only viable way to set up the h.f. trimmer preset VR1. As this is essentially a project intended for use with a 'scope this should not pose problems to most constructors.

Before starting, set all three preset trimmers to mid-position. Power the "in" side of the circuit with a voltage between 9V and 12V and check that the 5V regulated supply appears across the capacitor C4.

The current drain at this stage should be about 4mA. If this is correct, fit IC3, a 3130. If the supply voltage is now gradually reduced, the l.e.d. (D1) should light at around 8V. This process should be repeated for the "out" side of the circuit.

When the power supplies have been checked for both sections, testing of the signal processing areas can proceed. Fit IC1, the "input" 3240, and both opto-isolators, IC2 and IC6 (at the tops of the sockets, as described above).

Power the "in" side and check the current taken, which should now be about 16mA. The input "ground" should be about 1V positive of the negative supply rail, and pin 4 of IC2 should also be at about 1V.

If this seems correct, fit the other 3240, IC5, to the "out" side, power up and check current drain, again about 16mA, and measure the output "ground", which should be adjustable from about 0.5V to 1.75V (with respect to negative supply) with preset VR2.

If all seems well at this stage, it's probably a good idea to test the complete board and try setting it up before installation. The procedure is to power both sides, apply a 1V peak-to-peak squarewave to the input, and observe the output on a 'scope. To avoid problems it is best to have both sections of the circuit operating from independent battery supplies at this stage to avoid problems if the "grounds" become connected through the scope and signal generator.

Preset VR1 is adjusted for best squarewave output; on one side there will be marked overshoot on the leading edges, on the other excessive rounding in both directions. This can be done at 1kHz, though the effect is easier to see at 10kHz.

Next, with frequency set to 1kHz, preset VR3 is adjusted for an output amplitude exactly equal to the input. Finally, with the signal removed, preset VR2 should be adjusted to remove any d.c. potential across the output.

As there is a fair degree of tolerance spread between individual opto-isolators it may be worth swapping them over and setting up again to see which arrangement gives the best performance. This applies especially if VR1 or VR3 is near the end of its range when the settings appear correct. Experiments with four different isolators in the prototype produced overall frequency responses ranging from 10kHz to nearly 30kHz, so the benefit of some patient experiment is obviously worthwhile.

INTERWIRING

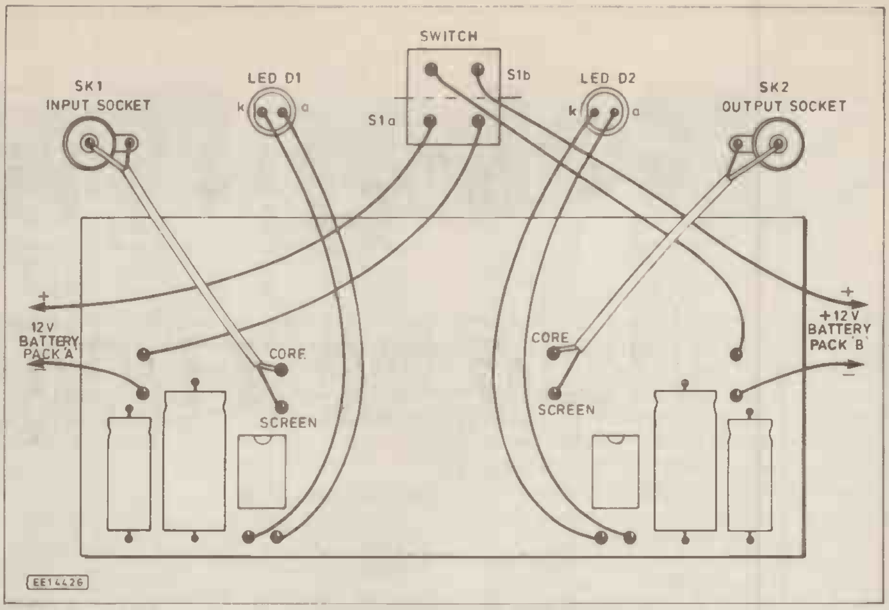


Fig. 4. Interwiring from the circuit board to the switch, l.e.d.s and sockets mounted on one side of the plastic case.

The general layout of the project in the case can be seen from the photographs, with connections as shown in Fig. 4. Most of the space is taken up by the battery packs. Batteries are a matter for the individual constructor; the circuit *will* operate from 9V, indeed two PP3's could be used. However, as it is intended as a design tool it may be used for fairly long periods so the additional life given by packs of "AA" cells seems advisable.

The maximum signal amplitude that can be handled depends on the supply voltage and the characteristics of the opto-couplers, and in the worst case a 1V r.m.s. signal will start clipping when the supply falls to 8V. In view of this 12V supplies were fitted to the prototype with indication of impending failure at 8V.

Packing this lot into the specified case is something of a shoehorn job. The p.c.b. is attached inside the top with doubled-sided sticky foam, and the sockets, l.e.d.'s and switch S1 fit alongside it.

This leaves just sufficient space for the two battery packs. A piece of foam plastic topped with stiff cardboard is placed between the board and batteries.

A larger case could be used, the only rule being that it *MUST* be a plastic type, both for SAFETY and to minimise stray capacitance between the two sections of the circuit. A larger case would allow the inclusion of extras such as switched input attenuation, which might be preferred by some users.

A final check of the adjustments should be carried out after completion. If the unit is to be used for safety isolation, a check with a "Megger" between input and output "grounds" is advisable to ensure the insulation is sound.

The Isolink is designed to handle signals up to about 1V peak-to-peak. The lower limit is governed by the inherent circuit noise, which is less than 5mV. The input impedance is about one Megohm, whilst the output impedance is low, a couple of hundred ohms.

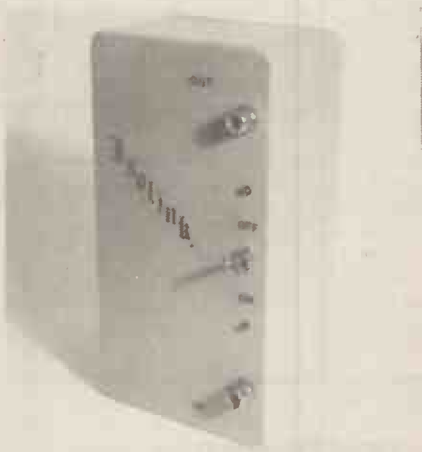
The frequency range extends from d.c. to at least 10kHz, on the prototype it is around 30kHz. This means that most audio frequency signals will pass through it virtually undistorted, and squarewaves will still look reasonably square at 1kHz.

If it is required to handle larger signals a simple resistive attenuator can be used. The input is protected to some extent by the 10k resistor R1 and the internal protection diodes of IC1, but external diode protection is not provided as it was found that this caused some signal degradation. Suitable precautions should be taken to avoid possible overload where this might occur.

IN USE

The way in which Isolink should be used depends upon the actual application. The most obvious use is investigating signals in circuitry at potentials other than earth.

The opto-isolators specified are quoted as "High Voltage", this being specified as 7500V peak, 5300V r.m.s. Whilst it might be inadvisable to operate at this sort of voltage it is quite in order to, for example, insert a low value resistor in the live lead of a mains appliance and, through Isolink, inspect the voltage developed across it with an earthed oscilloscope.

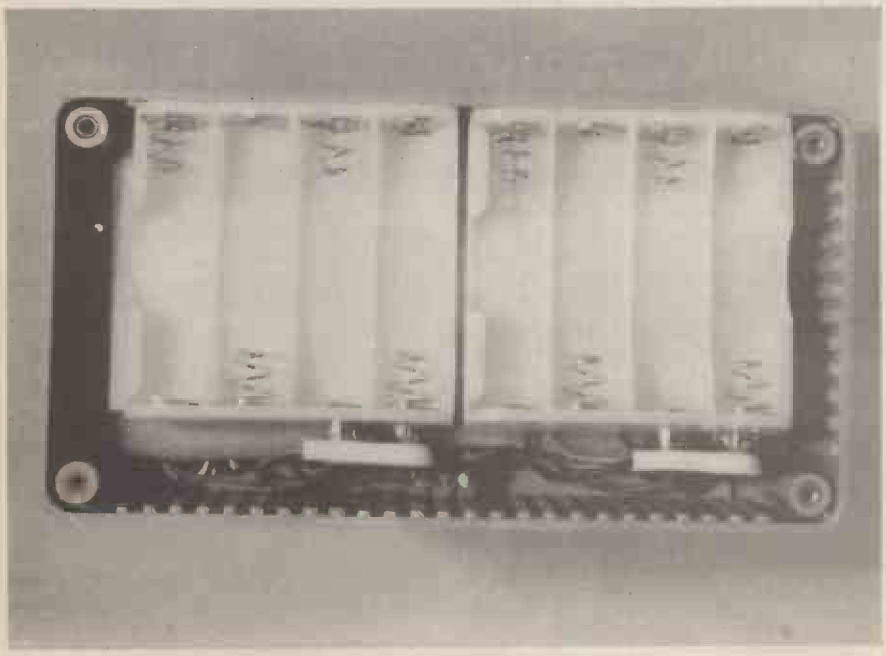


This will give an indication of the current flow. Similarly, low voltage signals in sections of h.t. circuitry could be measured. ***Always be very sure you know what you are doing and check connections carefully before switching on*** with this kind of work, though.

At a lower level, it can be used to take measurements across points that would otherwise be hard to access as neither end is grounded, and connecting them to ground through, say, the earthy side of a 'scope would cause faulty operation or damage.

In the case of sensitive battery operated equipment, earthing of any point of the circuit will often introduce a high level of mains "hum", making test measurements with mains-powered equipment difficult or even impossible. Bio-feedback circuits are a classic example of this.

The stray capacitance between the two sections of the prototype was measured with a bridge and found to be in the region of 10pF, which will offer an impedance of more than 300M to 50Hz signals. This should greatly attenuate the "hum" problem, but the actual manner in which the Isolink is used should be considered carefully in such an application. If you are measuring a signal from your own body, for example, it would be better to place the isolator on your lap than on the workbench close to mains powered equipment, where it might pick up a lot of hum in the input circuit through capacitive coupling. □



Robot Roundup

NIGEL CLARK

THE high profile enjoyed by robotics can be a doubled-edged sword. On the one hand it has a visible end product which can encourage the learning of a variety of skills, as mentioned in this column many times before. On the other hand it creates expectations which, with the present level of technology, cannot be fulfilled and results in people losing their interest as quickly as it was aroused.

Now there is a new benefit from the subject's ability to attract interest. A school in St Albans, Hertfordshire has discovered it is a good way in which to build-up close links with industry. The headmaster of Beaumont School, Mr. Colin Isted said that in their dealings with schools, companies seemed to look for projects which would have an impact on the general public and robotics was a subject which satisfied this, having educational as well as presentational value.

Although appreciating the benefits of robotics his main concern is with building links with industry at all age levels within the school. He believes that seeing what happens in the outside world helps children put their formal education into perspective.

So when Hertfordshire schools were asked to take part in competitions supported by industry, Beaumont was only too willing to join in. The projects involved making a special gripper for Rolls-Royce aero-engine manufacturer, working with children from France and Germany to set up a production line for making a remote-controlled buggy kit and designing a robotic device for British Aerospace at Hatfield which would draw the school's coat of arms.

GRIPPER

The gripper was part of Hertfordshire County Council's Engineering Education Scheme, which is sponsored by Sainsbury Trusts. Rolls-Royce required a mechanism which would transfer a wide range of ring-type components from a conveyor belt into a lathe for machining and off again.

The children, all studying maths and physics in the lower sixth, had five days' training in teamwork and problem solving and three months in which to complete the project.

Out of 17 schools in the county Beaumont came first with an ingenious design employing three discs revolving around the same axis and three pegs for gripping which move in and out across the plane of the discs by the relative movement of the discs. Pressure sensors on the pegs indicate when the component is firmly held.

Two grippers, each operated by a single d.c. motor at the axis, are mounted at right angles to each other and can be rotated together by another d.c. motor so that the one facing the chuck can take off the finished component before changing places with the other gripper to allow the next component to be placed in the lathe.

The gripper, which RR is considering for industrial use, will now go forward to the national finals in October.

PRODUCTION LINE

The production line was part of the county council's Tripartite Technology Project with schools in the Burgundy region of France and Rheinland-Pfalz in Germany. Technology weeks have been held in the last three years and this year it was the turn of Hertfordshire to prepare the project.

In the early days it was decided that each year's work should contain elements of computer applications, electronics and pneumatic control. A robotics project was an obvious area.

The end result was to be a boxed kit for making a simple buggy with a number of separate but linked stages. These included moulding and punching a basic chassis and putting the components into a box, onto which a lid was then put.

In addition the students had to prepare an instruction manual in three languages and make an interface, with the necessary software for the main computers in each country. The British one was for the RML Nimbus.

The two-wheeled buggy, driven by d.c. motors with optosensor feedback, was made in sufficient quantities for everyone involved to have one. It is planned to make it available to primary schools in Hertfordshire, at a price sufficient to cover costs, but it is not intended that it will go on general sale.

BAe PROJECT

The BAe project was the result of the school's long association with the company at nearby Hatfield. When the company set up Schooltech '88, Beaumont was asked to take part. The school hopes that it will become an annual event.

Most of the benefits to the students were seen in the context of improving their view of the outside world. Jane Measures, head of Physics and the school's industrial liaison co-ordinator, said that it gives them a chance to work with industrialists and see what was required in industry. They were able to put the theoretical and practical knowledge they gained in school to good use.

BENEFITS

In addition there were the usual benefits of robotics; artificial barriers between subjects were broken down. This is particularly noticeable in the use of communication skills (to explain what had been done in technological subjects) in the writing of the reports and working together as a team.

For the school there were the benefits of teachers also getting to know the requirement of industry so that courses could be given added interest by putting theoretical work into a practical context.

The involvement also gave the students an enthusiasm for learning by themselves. An example is the BAe project in which the students were given the details before their summer holidays. They organised meetings during the holidays to set the groundwork before tackling the work in earnest during the next school term.

At the moment the number of pupils able to take part in the projects is limited by the present resources of the school. Funds were insufficient to do all the work required on the projects described and outside help had to be sought.

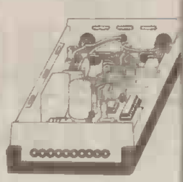
Whether greater numbers of students will be able to take part in robotics courses in the future as part of the general curriculum, rather than outside normal school hours depends on more resources being made available.

EE CROSSWORD 6 ANSWERS

ACROSS
5 FUNDAMENTAL
6 GATED AGC
9 DUMP
11 TRUTH
12 WATTLESS
13 TRICKLE
16 PROCESS
19 DEBOUNCE
23 COLUMN
24 AMPERE
25 NOISE
26 TURNS RATIO

DOWN
1 EUTECTIC
2 IDEAL
3 INDUCTOR
4 PADDLE
7 AIR
8 CYAN
10 MASKS
14 RADIO
15 LOUDNESS
17 CLAMPING
18 SCOPE
20 BAUDOT
22 BALUN

POWER CONDITIONER



FEATURED IN ETI
JANUARY 1988

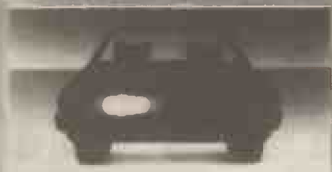
The ultimate mains purifier. Intended mainly for lowering the noise floor and improving the analytical qualities of top-flight audio equipment.

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

Some parts are available separately. Please send SAE for lists, or SAE + £1 for lists, circuit, construction details and further information (free with parts set).



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 let's you see what the main lights are doing.

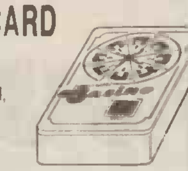
The Knight Raider can be fitted to any car (it makes an excellent fog light!) or with low powered bulbs it can turn any child's pedal car or bicycle into a spectacular TV-age toy!

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

CREDIT CARD CASINO



FEATURED IN ETI,
MARCH 1987

This wicked little pocket gambling machine measures only 3"x2"x½". It will play all kinds of casino games, including:

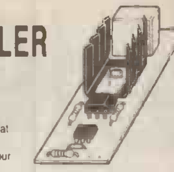
- Roulette
- Craps
- Pontoon

Our approved parts set comes complete with case; self-adhesive fascia; tinned and drilled printed circuit board; all components; hardware, full instructions and three different games to play!

PARTS SET ONLY **£5.90!** + VAT

Five extra games FREE with every order!

MAINS CONTROLLER



FEATURED IN ETI
JANUARY 1987

Have you ever wondered what people do with all those computer interfaces? 'Put your computer in control,' say the ads. 'The Spectrabeeb has eight TTL outputs.' What on earth can you control with a TTL output? A torch bulb?

The ETI Mains Controller is a logic to mains interface which allows you to control loads of up to 500W from your computer or logic circuits. An opto-coupler gives isolation of at least 2,500V, so the controller can be connected to experimental circuits, computers and control projects in complete safety. Follow your computer interface with a mains controller and you're really in business with automatic control!

The mains controller connects directly to most TTL families with external components, and can be driven by CMOS with the addition of a transistor and two resistors (supplied).

Your mains controller parts set contains high quality roller tinned PCB; MOC3021 opto-coupler; power triac with heatsink mounting hardware and heatsink compound; all components, including snubber components for switching inductive loads; transistor and resistors for CMOS interface; full instructions.

PARTS SET **£6.20** + VAT!

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 irresistably 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.

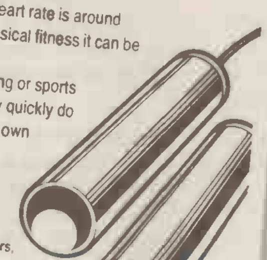
PARTS SET **£16.50** + VAT

AVAILABLE WITHOUT CASE FOR ONLY **£11.90** + VAT

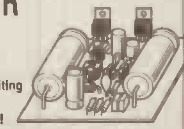
The S101 professional respiration and heart-rate monitor is the ideal instrument to keep track of your progress in any kind of fitness or sports training. The average adult resting heart rate is around 80 beats per minute. For an athlete at the peak of physical fitness it can be 50 or less.

How fit are you? How quickly is your jogging or sports training strengthening your heart and respiration? How quickly do you recover from oxygen debt after exercise? For your own sake, you need to know.

The approved parts set consists of: case, 3 printed circuit boards, all components (including 17 ICs, quartz crystal, over 75 transistors, resistors, diodes and capacitors), liquid crystal display, switches, plugs, sockets, LEDs, leads, electrodes and sensors, and full instructions.



ARMSTRONG 75W AMPLIFIER



FEATURED IN PE
JULY 1988

A.J. Armstrong's exciting new audio amplifier module is here at last!

Delivering a cool 75W (conservatively rated – you'll get nearer 100W), this MOSFET design embodies the finest minimalist design techniques, resulting in a clean, uncluttered circuit in which every component makes a precisely defined contribution to the overall sound.

You can read all about it in the July Issue of PE, but why bother with words when your ears will tell you so much more?

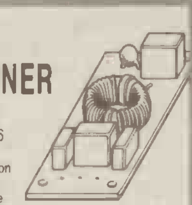
Parts set includes top grade PCB and all components.

SPECIAL INTRODUCTORY PRICE FOR FULLY UPGRADED MODULES.

SINGLE PARTS SET **£14.90** + VAT
STEREO PAIR **£25.90** + VAT

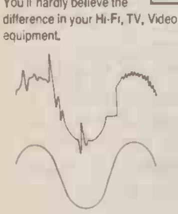
Please send SAE + £1 for data and circuits (free with parts set), including diagrams for matching pre-amp and power supply. This amplifier will not be available from your usual audio supplier – we produce the only designer approved parts set.

MAINS CONDITIONER



FEATURED IN ETI
SEPTEMBER 1986

Cleans up mains pollution easily and effectively. You'll hardly believe the difference in your Hi-Fi, TV, Video, and all other sensitive equipment.



PARTS SET **£4.90** + VAT

RUGGED PLASTIC CASE **£1.65** + VAT

BIO-FEEDBACK

FEATURED IN ETI
DECEMBER 1986

Bio-feedback comes of age with this highly responsive, self-balancing skin response monitor! The powerful circuit has found application in clinical situations as well as on the bio-feedback scene. It will open your eyes to what GSR techniques are really all about.

The complete parts set includes case, PCB, all components, leads, electrodes, conductive gel, and full instructions.

PARTS SET **£13.95** + VAT

BIO-FEEDBACK BOOK **£3.95** (no VAT)

Please note: the book, by Stern and Ray, is an authorised guide to the potential of bio-feedback techniques. It is not a hobby book, and will only be of interest to intelligent adults.

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 tester, 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 tinned 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?

Instructions are included

PARTS SET WITH BLACK CASE **£11.50** + VAT

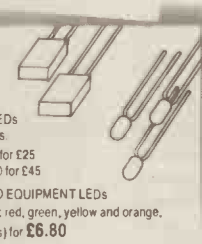
PARTS SET WITH WHITE CASE **£11.80** + VAT

LM2917 EXPERIMENTER SET

Consists of LM2917 IC, special printed circuit board and detailed instructions with data and circuits for eight different projects to build. Can be used to experiment with the circuits in the 'Next Great Little IC' feature (ETI, December 1986).

LM2917 EXPERIMENTER SET **£5.80** + 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**

Prices shown are exclusive of VAT, so please add 15% to the order total. UK postage is 70p on any order. Carriage and insurance for overseas orders £4.50. Please allow up to 14 days for delivery.

Specialist SEMICONDUCTORS LIMITED

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

BRAINWAVE MONITOR

FEATURED IN ETI
AUGUST 1987

The most astonishing project ever to have appeared in an 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** + 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).

Constructional Project

UNIVERSAL CHARGER/ POWER SUPPLY

COSTAS CALAMVOKIS

Able to charge almost any size NiCad cell, it will also double as a low-cost mains adapter so you will not have to drain batteries whilst using equipment at home.

The current is actively regulated so it does not change during use. The constant voltage is also regulated when used (unlike many cheap mains adapters whose voltage depends on the loading and which show marked voltage rises at low current).

NICKEL CADMIUM batteries (NiCads) are so cheap in the long run, that it is a wonder that ordinary non-rechargable batteries are still used. The Universal Charger/Power Supply described here will give you the opportunity to discover these savings. It is able to charge almost any size of cell, it will also double as a mains adapter so you will not have to drain your batteries whilst using the equipment at home.

The problem with NiCads is that a constant current source is needed to charge them and although there are many cheap chargers on the market this unit offers certain advantages over similarly priced commercial ones. The first is, of course, its ability to act as a mains adapter, but there are more subtle advantages.

Most cheap commercial chargers do not actively regulate the current delivered to the batteries, so this current depends to some extent on the resistance of the cell or cells under charge.

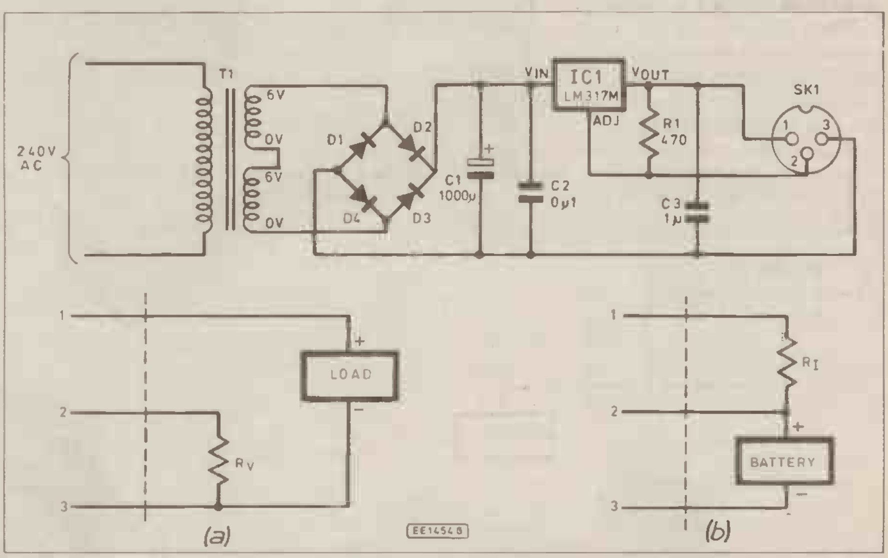


Fig. 1. Full circuit diagram for the Universal Charger/Power Supply. The two small diagrams are for (a) power supply mode and (b) charger mode.

CHARGING RATE

Another problem is that although different batteries have different recommended charging currents, these chargers usually only have one charging current (although different sized batteries can be inserted) and so often small cells are charged too fast, shortening their life. To make matters worse large cells are charged too slowly, unnecessarily increasing the charging time.

This unit avoids these pitfalls by having an "intelligent" plug socket into which a battery holder is plugged. This socket "detects" the size of the batteries to be charged from a resistor mounted in the holders plug and the current is set accordingly.

Table 1

	Current	Time
AAA/HP16	20mA	14–16 Hours
AA/HP7	50mA	12–14 Hours
C/HP11	120mA	14–16 Hours
D/HP2	120mA	14–16 Hours
PP3	11mA	12–15 Hours

Notes: These values are fairly typical, if your batteries have a different recommended charging current and time printed on them by all means use it. Calculate the value of R_I from the formula given in the text. If the charging current is higher than 200mA use a ½W resistor. R_I should NOT be decreased below three ohms.

The resistor which controls the constant voltage is also mounted in the plug so if a different lead is made for each item to be powered the correct voltage will always be delivered.

The unit will charge one PP3 battery or up to six AAA, AA, C or D cells at once (depending on the size of the battery holder used). But only one type of battery can be charged at one time (see Table 1 for typical charging rates and times). Alternatively the unit could act as a mains adapter delivering from 1.5V to 12V at up to 400mA.

CIRCUIT OPERATION

The full circuit diagram for the Universal Charger/Power Supply is shown in Fig. 1. The mains is brought down to about 12V a.c. by the transformer T1. This is then rectified by the bridge arrangement of diodes D1-D4 and smoothed by capacitor C1. Capacitors C2 and C3 remove spikes.

The only active component is an adjustable voltage regulator, IC1, which works by adjusting the voltage at the V_{out} pin so that it is 1.25V higher than the voltage on the adjust pin (ADJ).

In the Power Supply mode of operation the circuit is as shown in Fig. 2 (simplified). Between the V_{out} and ADJ pins is a 470 ohm resistor (R1). As the voltage across it is always 1.25V the current is always:

$I = V/R = 1.25/470 = 0.0027A = 2.7mA$

As the current flowing out of the ADJ pin is only $50\mu A$ it can be ignored so the current through resistor R_v is always 2.7mA. The output voltage is the sum of the voltages across resistors R1 and R_v, and can be calculated from

$$V_{out} = 1.25 + (I \times R_v)$$

$$= 1.25 + (0.0027 \times R_V)$$

$$\text{so } R_V = (V_{out} - 1.25)/0.0027$$

From this formula values for R_v can be calculated for whatever supply voltage is required, from 1.5V to 12V. See Table 2.

CONSTANT CURRENT

When the unit is acting as a Charger the circuit is as shown in Fig. 3. Resistor R_I is placed in parallel with resistor R1 and the current which flows through them also flows through the batteries being charged. As the voltage across resistors R1 and R_I is kept constant by regulator IC1, so is the current that flows through them. In this way a constant current is maintained through the batteries.

This is calculated from:

$$I_{out} = \text{R1's current} + R_I\text{'s current}$$

$$= (1.25/470) + (1.25/R_I)$$

$$= 0.0027 + 1.25/R_I$$

$$\text{So } R_I = 1.25/(I_{out} - 0.0027)$$

Values for resistor R_I are shown in Table 3 for typical NiCads.

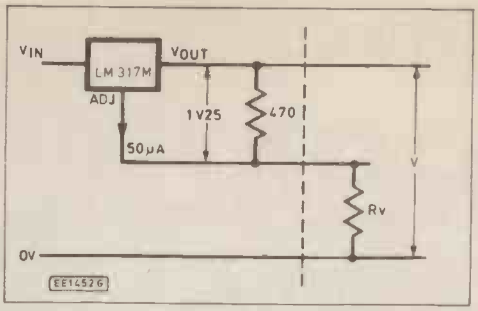


Fig. 2. Simplified regulated power supply arrangement. The value of R_V can be found by referring to Table 2.

Table 2

Voltage	R_V ⅛W, 5%
1.5V	100ohms
3V	680 ohms
4.5V	1200 ohms (1k2)
6V	1800 ohms (1k8)
9V	2700 ohms (2k7)
12V	3900 ohms (3k9)

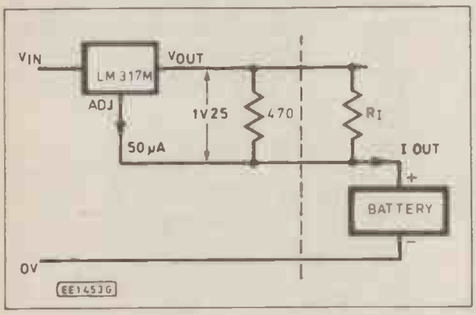


Fig. 3. Simplified arrangement for charger operation. The value of the charging resistor R_I can be found by referring to Table 3.

Table 3

Battery type	R_I
AAA	82 ohms ⅛W 5%
AA	27 ohms ⅛W 5%
C	12 ohms ¼W 5%
D	12 ohms ¼W 5%
PP3	180 ohms ⅛W 5%

Notes: These values are based on the currents given in Table 1. They are independent of the number of batteries to be charged.

COMPONENTS

Resistors
R1 470
R_I See Table 3
R_V See Table. 2
All 5% carbon

Shop Talk
See page 415

Capacitors
C1 1000µ radial elec. 35V
C2 0.1µf ceramic disc
C3 1µf tantalum bead 35V

Semiconductors
D1-D4 1N4001 1A 50V diode (4 off)
IC1 LM317M+1.2V to 37V 500mA Adj. Voltage Reg.

Miscellaneous
T1 Mains transformer 240V a.c. prim, 0-12V 500mA sec. or 0-6V, 0-6V 500mA sec.
SK1 3-pin In-line DIN socket
Stripboard, 0.1in matrix size 10 strips×10 holes; 3-pin DIN plugs (plastic covered); battery holders; PSU box with integral 13A plug; small heatsink; connecting wire; solder pins and solder etc.

£10.50
Approx. cost Guidance only (excluding batteries)

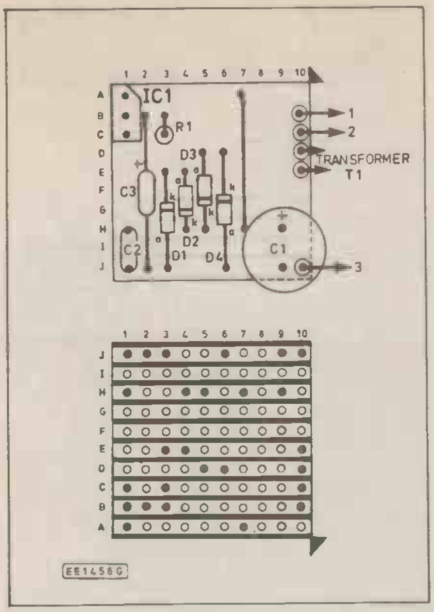


Fig. 4. Component layout and details of wiring to the mains transformer secondary winding and to the DIN socket.

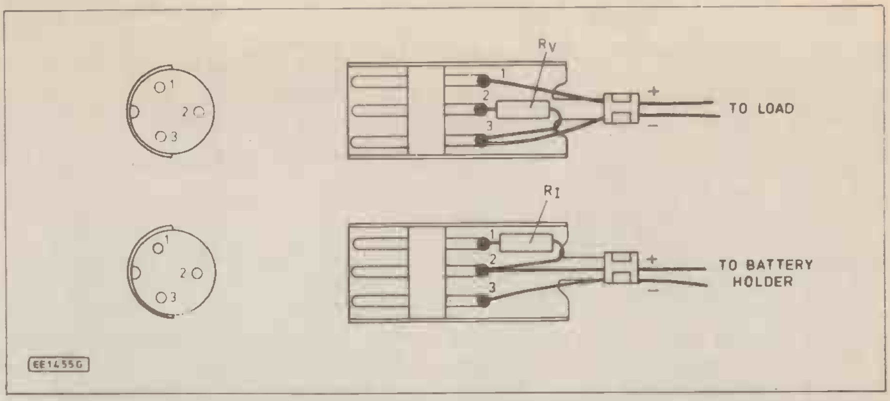
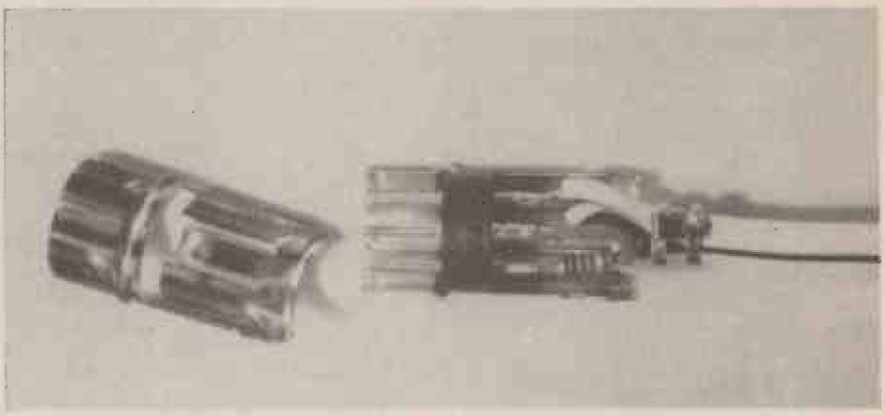


Fig. 5. Wiring to the DIN plugs for power supply and charger mode. It is suggested that the resistor leads are covered with insulating sleeving to avoid shorting to the other pins.



CONSTRUCTION

The circuit is built up on a small piece of 0.1in. matrix stripboard, size 10 strips by 10 holes. There are no track breaks on the board and the component layout is shown in Fig. 4.

Commence construction by mounting the diodes and link wire on the board followed by the capacitors. The regulator IC1 should be soldered on last and a small heatsink bolted on to it. When mounting the diodes and electrolytic capacitor C1 be sure to observe the correct polarity of these devices.

The completed circuit board is housed in a power supply unit box with an integral 3-pin, mains type, plug. The miniature mains transformer was fitted first by bending its mounting tags round the box's internal moulding and the circuit board was connected to it using stiff wires. If a 0-6V, 0-6V secondary winding is used, the wires to the circuit should be connected to the 0V of one winding and the 6V of the other, with the remaining two tags connected together.

In the prototype unit the DIN connecting socket was a non-chassis type and a short lead was attached to the "wander" socket, fed through a small hole in the case side and soldered to pins on the circuit board. If a chassis type socket is used a suitable hole should be drilled in the case and short wires soldered from the circuit board pins to the socket tags. As the components are such a tight fit inside the case it might be best if constructors kept to the "wander" type DIN socket method.

CONNECTING LEADS

The construction of the battery charging and power supply leads are shown in Fig. 5. Some care is needed when mounting the resistors in the plugs to ensure that the leads do not touch any terminals. For this reason plastic barrelled plugs should be used, wrapping the resistors in insulating tape is not a bad idea either.

For charging large batteries higher power resistors are used (half or quarter watt types—see Table 3) and these may not fit in the plug barrel. If this happens the resistor should be mounted on the battery holder, a three-wire plug lead will then be needed.

NiCADS

The life of your nicads can be drastically shortened if they are mistreated so some care is needed. They should not be used in very low current applications such as clocks and LCD calculators where a dry cell would only be replaced once a year.

NiCads should never be short circuited as they have very low internal resistance and can, if shorted, deliver very high currents which may destroy the cell itself. The recommended charging times should be kept to but no real harm results in charging for too long. ***You should never try to recharge dry cells.*** □

...REPORTING AMATEUR RADIO...

TONY SMITH G4FAI

STUDENT LICENCE

To attract younger newcomers to amateur radio, the Radio Society of Great Britain has decided to work for the creation of a new kind of transmitting licence for beginners. Provisionally titled a *"Student Licence"*, the idea is that students should be allowed access to limited sections of a few amateur bands (with low power and modest antennas) thus providing practical experience in a learning situation.

The Society says it has identified two main reasons why young people today rarely become interested in amateur radio. It says that 11 to 16 year olds see the usual one-year study period for the Radio Amateurs' Examination (RAE) as too long, and that the price of most equipment required to get on the air is too high.

While the typical RAE course involves some 150 class-hours, the Student Licence would only require about 30 hours of study, plus whatever was necessary to learn Morse code at six words per minute. The emphasis throughout would be on practical requirements—how to operate an amateur station properly, including correct procedures and band discipline—but naturally the student licensees would still have to go on to obtain their full licence in due course.

The RSGB is currently developing a syllabus and formulating proposals for the Licence to put to the Department of Trade and Industry (DTI). It plans to create a student section within the society and to produce special publications and kits for beginners.

MIXED FEELINGS

These proposals have been received with mixed feelings by the amateur radio fraternity. While most recognise the need to ensure a continuing input of newcomers to the hobby, some feel that a relaxation of the present rules and regulations to allow relatively untrained operators on the already overcrowded amateur bands will be a retrograde step.

The RSGB says that students would be limited to operating on the less-popular bands with restrictions placed on them to ensure the least possible interference with existing licensees. The concept of student-entry sounds fine but one can't help wondering how successful it will be if the "target" population already dislikes the idea of having to pass an examination to take up a hobby.

Although the RSGB doesn't seem to want to admit it, CB radio has created an enormous boost for amateur radio in recent years. Large numbers of people who discovered a liking and an aptitude for radio communication became frustrated by the various limitations of CB and were motivated to go on to take up amateur radio with its greater scope.

The CB boom created a mini-amateur radio boom, yet CB is still apparently ignored by the RSGB. The boom has long gone but CB still provides a steady source of new entrants to amateur radio which the RSGB could well cultivate.

There is, however, no mention of it ever appearing in the columns of *Radio Communication*. It's a great pity, and an opportunity lost. . . . However, I will report further on the Student Licence idea as matters progress.

POLAR RADIO

The first attempt at radio communication from polar regions was made by the Australasian Antarctic Expedition of 1912. Groups of explorers spent months trying to get massive 90ft high aerial systems to stay up in the face of howling gales, while they obtained only limited success with their 1.5kW spark transmitters. Further experiments were carried out in the 1920's and 1930's by the Americans in the South and the Russians in the North and gradually radio became an essential, life-saving, aspect of polar exploration.

Compare those 1912 experiences with what has been planned for the USSR/Canada Skitrex Expedition this year. A group of Soviet and Canadian scientists set out in March from Severnaya Zemlya for a 1750km journey via the North Pole to Cape Columbia on Ellesmere Island.

A member of the expedition is Soviet radio amateur Leonid Labutin, UA3CR, who is maintaining daily radio contact between the expedition and teams of Soviet and Canadian amateur radio operators at base stations in Severnaya Zemlya, Resolute Bay on Cornwallis Island as well as in Moscow, Dikson, Ottawa and Toronto.

The amateur radio equipment being used is provided by Icom, and includes h.f. and v.h.f. base stations as well as "handie-talkies" for two metres including communication with supply-drop aircraft. Using the facilities of *SARSAT/COSPAS*, the search and rescue satellites, as well as amateur radio satellite *UOSAT 11*, with a "talking computer" on board, the expedition can hear their location read to them via a 2-metre hand-held radio as *UOSAT* passes over about every 100 minutes.

Both licensed amateurs and short-wave listeners can obtain a fine bilingual certificate to commemorate this expedition. The Canadian Radio Relay League is awarding the *"1988 Polar Bridge Diploma"* for contacts (or SWL loggings) during the period of the expedition with a number of northerly Canadian and Russian stations, one of the base camps, and with stations in the national capitals.

A great deal of planning and effort has gone into the arrangements for the expedition. The amateur radio involvement has resulted in an unusual reciprocal and third party traffic licensing agreement between Canada and the Soviet Union, which is a recognition of the competence, ability and flexibility of which amateur radio is capable when required.

WORKED ALL BRITAIN

With amateur radio's potential for world-wide communication it may come as a surprise to non-amateurs to learn about the *"Worked All Britain"* (WAB) award scheme which is related to contacts made within the British Isles.

It is, in fact, a series of awards based on the number of contacts made with stations located in the large 100km National Grid Squares, the small 10km squares, counties, and rateable districts. There is great enthusiasm among participants in this scheme which stimulates on-the-air activity by British amateurs.

They gain a very good knowledge of the geography of the UK and some travel to the more remote parts of the mainland, or to islands, to "activate" rare squares where there is normally no amateur radio transmitting. There is a growing interest from overseas amateurs which in turn makes UK stations more popular with dx (long distance) stations who want to "work the squares".

Every participant has a special record book which lists each WAB area, county by county, together with a list of the towns and villages lying in the area. There are over 4,000 WAB areas in all so there's plenty to do in trying to make contact with each area. Awards are given for each level of achievement, eg, for working 300 areas, 500, 750, and so on.

Getting a "rare" square can be as exciting as getting a rare country and WAB mounts a number of contests and special activity weekends to keep the pot boiling. Listeners can enjoy the fun just as much as licensed amateurs and full details can be obtained by sending a large stamped addressed envelope to ***Brian Morris G4KSQ, 22 Burdell Avenue, Sandhills Estate, Headington, Oxford OX3 8ED.***

ARMADA 400

July sees the 400th anniversary of the routing of the Spanish Armada by Sir Francis Drake. The event is being celebrated not only in Plymouth, Devon, but in many other Plymouths around the world.

During July, Plymouth Radio Club will be on the air from Plymouth Hoe with a special call-sign, GB400A, to enable radio amateurs in other countries to make contact with Plymouth during the celebrations. A special commemorative QSL card will be used during the period 21 to 28 July, and on the 28 July the club hopes to put the Lord Mayor in contact with some of the 38 other Plymouths identified, so far, worldwide.

Further information can be obtained from ***Philip J. Daymond G1WVH, P.R.O. Plymouth Radio Club, Radford House, Plymstock, Plymouth, PL5 3AH.***

DOWN TO EARTH

BY GEORGE HYLTON

POWER SUPPLY LABELLING

ONE OF OUR readers says he is sometimes puzzled about the way d.c. power supply leads are labelled on circuit diagrams. In particular, the "common" side of a supply is sometimes marked "0", sometimes "−", and sometimes with a voltage, such as "−9V". Which is right?

CLARITY

Since the purpose of a diagram is to give information, the method which does so as clearly as possible must be the best. In this magazine you'll generally find that where a circuit is driven by a d.c. supply such as the 9V battery of Fig. 1a and the negative side is common or earthed then the common side is marked "0" or "**0V**" and the other side with the battery voltage and polarity (+9V).

If, in the accompanying text, a portion of the circuit such as Fig. 1b is discussed in isolation, the power-line markings are as shown. Sometimes, to make it clear that "0" is connected to battery negative, the diagram draught person puts "0 (−)" or something similar.

In diagrams found somewhere else, and especially in old texts, the common line for Fig. 1 may be labelled "−9V". This can be misleading, and the reason is that nowadays there are often "split" supplies with ***positive, negative** and **common***. A modern reader, seeing "+9V" and "−9V", will think there's also a "0V" line.

SPLIT SUPPLIES

The operational amplifier circuit of Fig. 2 illustrates the point. In order to make possible the direct interconnection of circuits, without the need for d.c. blocking capacitors, op. amps are designed so that they can be used with a split, dual, or centre-tapped supply whose mid-point is the common or "earth" line.

In the absence of an input signal, output terminal B is at "earth" potential (0V) and can if necessary be connected straight to the input of a following amplifier, or back to the input of its own amplifier (A) without upsetting the circuit.

In describing an op. amp, the power supply requirements may be specified as "±15V", or "15V−0−15V" or "30V ct" (centre-tapped). Of these, the '±15V' style is commonest. It is strictly incorrect, since the symbol "±" means, in its normal mathematical context "plus or minus", whilst the meaning in op. amp specifications is "plus AND minus". However, I've not heard of any catastrophes as a result of this ambiguity.

WITHIN LIMITS

Some recent kinds of op. amp are able to work (within limits) from a single, untapped supply voltage as well as the more usual dual voltage. I have a data sheet for the OP-90 quad op. amp. This can work from a wide range of supply voltages, single or centre-tapped. The data sheet indicates the following:

Single Supply Operations
..............+1.6V to +36V.
Dual Supply Operations
................±0.8V to ±18V

I also notice that on an accompanying diagram the positive and negative rails are labelled "V+" and "V−", meaning that, whatever voltage is actually used, this is the appropriate polarity.

MULTIPLE SUPPLIES

It's quite common for a piece of equipment to require a number of supply rails all of different voltages. A colour TV, for instance, may need a 12V line for its low-level stages, a 50V one for its frame output stage, 100V for line output, 250V for video output and 25kV for the picture tube.

Even a relatively straightforward piece of equipment like an audio amplifier may have several supplies. In Fig. 3, the power amplifier (P.A.) section works from a split supply of 30V−0−30V. The upper (+30V) part of this is used also to power the pre-amp., via a stabilizer which reduces the voltage to +20V.

In such an amplifier it is quite usual to run separate connections to the common (0V) supply from the high-level and low-level sections. This reduces the risk of instability caused by accidental feedback of small voltages dropped across the connections themselves by the high currents in the output stage. When the low-level part is drawn separately its common line may be labelled to indicate this separation.

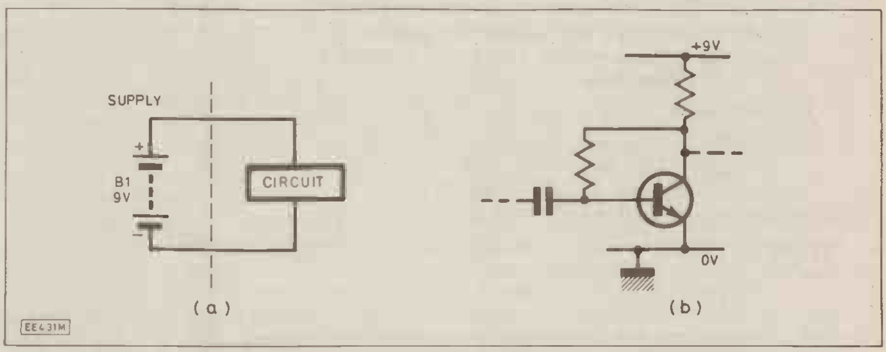


Fig. 1 (a.) Circuit with single 9V supply; (b) detail of the circuit showing one way of labelling the supply lines or rails.

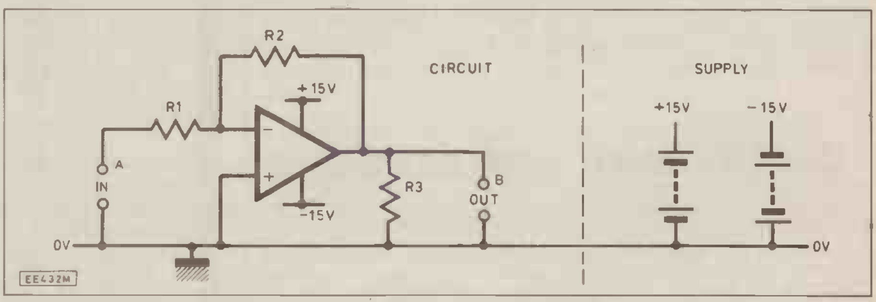


Fig. 2. Operational amplifiers usually have dual supply lines. This circuit has a +15V rail, a −15V rail and a common rail which is the junction between the two (labelled 0V).

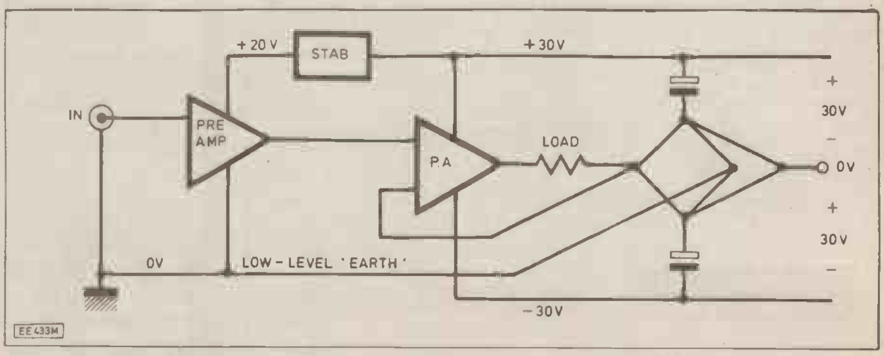


Fig. 3. Audio amplifier with split (dual, centre-tapped) supply for the power amplifier (P.A.) part and a reduced-voltage single ended supply for the low-level stages. Note the common ("earth") connections, where separate lines are provided for PA and pre-amp, joined only at the tags of the reservoir capacitors in the power supply.

TRANSFORMERS

EX STOCK

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

VA	£	P&P
20VA	£7.58	2.28
60	12.37	2.45
100	14.43	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	O A
6000	321.70	O A

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

30V	15V	£	P&P
0.5	1	4.14	1.65
1	2	5.63	1.80
2	4	9.10	2.00
3	6	10.55	2.20
4	8	12.59	2.30
5	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
2 x 25V Tapped Secs
Volts available 5, 7, 8, 10, 13, 17, 20, 25, 33, 40, 50, 20-0-20, 25-0-25V

50V	25V	£	P&P
0.5	1	5.38	1.90
1	2	6.54	2.00
2	4	11.65	2.50
3	6	13.48	2.50
4	8	18.46	2.95
6	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
2 x 30V Tapped Secs
Volts available 16, 18, 36, 40, 60, 24-0-24, 30-0-30V

60V	30V	£	P&P
0.5	1	6.11	1.90
1	2	9.32	2.00
2	4	11.98	2.30
3	6	17.32	2.40
4	8	19.75	2.50
5	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

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

24V	12V	£	P&P
0.15	0.3	3.13	1.70
0.25	.5	3.31	1.70
0.5	1	3.97	11.70
1	2	5.53	1.90
2	4	6.38	2.00
3	6	10.99	2.15
4	8	11.70	2.20
6	12	14.20	2.40
8	16	16.90	2.80
10	20	22.75	3.20
15	30	28.28	3.30
20	40	40.37	3.75
30	60	57.96	4.45
41	83	66.74	5.75

INVERTERS
12/24V DC to 240V AC
Sine Wave or Square Wave

STAND BY, U.P.S. SYSTEMS, MAINT.-FREE BATTERIES & AUTO CHARGERS

CONSTANT VOLTAGE
Transformers for Spike free Stable Mains

TRANSFORMER WINDING SERVICE
3VA to 18KVA
Stock items by return
Send stamp for lists

AUTOS
105, 115, 220, 230, 140V
For step up or down

VA	£	P&P
80VA	£6.29	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	O A
5000	141.17	O A
7500	217.91	O A
10kVA	257.49	O A

CASED AUTOS
240V Cable I/P
3-pin 115V USA Skt Outlet

VA	£	P&P
20VA	£8.96	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	O A

110V to 240V Cased Autos now available

Full range AVO's MEGGERS

TOROIDALS
Wound to Order

Also Valve Mains Output & Matching transformers

Please add 15% to all items after P&P

Unit 211, Stratford Workshops, Burford Road, London E15 2SP

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

OMNI ELECTRONICS

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

The supplier to use if you're looking for
★ A WIDE RANGE of components aimed at the hobbyist ★
★ competitive VAT inclusive prices
★ mail order – generally by return of post ★
★ fast, friendly service ★
– by mail order, telephone order or personal call
NEW CATALOGUE AVAILABLE IN JUNE
Send 2 × 18p stamps for a copy –
we do try to keep the goods we list in stock.
Whether you phone, write or call in we'll do our best to help you.

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

VISA

A & G ELECTRONICS LTD.
P.O. BOX 443
LONDON E14 6JU.
TEL: 01-519 6149

Electronic components at bargain prices !

WRITE OR PHONE FOR FREE 1988 CATALOGUE

Some of the electronic components available from our catalogue are:

SEMI-CONDUCTORS

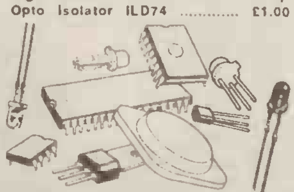
74LS00 Quad 2 Input NAND	20p
555 Timer	20p
741 OP-Amp	19p
LM 324 Quad OP-Amp	29p
4000B Dual 3 Input NOR + INV	20p
ULN2003 Transistor-Array	60p
ZN414 AM Receiver	£1.00
ZN426E 8-bit D/A Converter	£2.30

OPTO ELECTRONICS

Small Red LED,3mm	9p
Large Red LED,5mm	8p
Red Flashing LED,5mm	40p
Very Large Red LED,8mm	50p
Red 7 seg. 0.3"	£1.00
High Power IR.Sensor	70p
High Power IR.Source	26p
Opto Isolator ILD74	£1.00

RELAYS & SWITCHES

Ultra-Miniature 1Pole	75p
Ultra-Miniature 2Pole	£1.30
Sub-Miniature 1Pole	70p
Miniature Power	£1.50
Sub-Miniature SPDT	65p
Miniature DPDT	70p
Miniature Push-Button 6mm	25p
Illuminated Rocker SPST Red	90p



(Please add £1 for P & P)

Only £6.45 (P & P 90p)

SOLAR POWERED NI-CAD CHARGER

All that you need to generate electricity to charge your batteries is sunlight or artificial light from an electric bulb. The unit charges 4xAA(HP7) size Ni-cad batteries, suitable for personal stereos, shavers, flash guns and other small DC appliances.

UNIVERSAL NI-CAD BATTERY CHARGER

Battery charger complete with battery charge and test indicator charges 4 x HP2-HP11-HP7 & 1PP3 batteries.
Only £4.50 (P & P £1.60)

RECHARGEABLE BATTRIES

HP7	90 P
HP11	£1.90
HP2	£2.25
PP3	£4.20

(P & P 20P each)

PLEASE ADD 15% VAT TO ALL ORDERS & ALLOW 14 DAYS FOR DELIVERY.

READ ALL ABOUT IT!

IN THE SUMMER '88 *Cirkit* CATALOGUE

Discount vouchers, competition, free gift and, of course, the latest new products. Available at your newsagent or direct from Cirkit at the address below.

PRICE £1.30

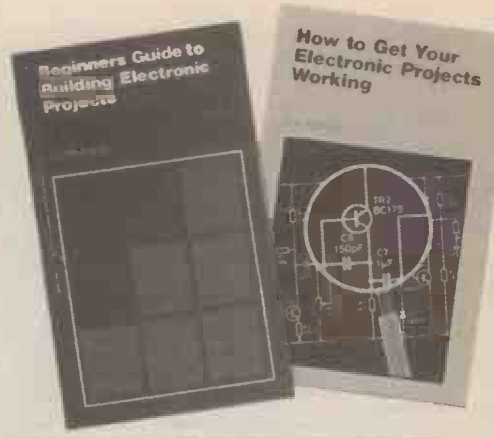
Cirkit

VISA

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** **£2.50**

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** **£1.95**

BEGINNER'S GUIDE TO BUILDING ELECTRONIC PROJECTS
R. A. Penfold
Shows the complete beginner how to tackle the practical side of electronics, so that he or she can confidently build the electronic projects that are regularly featured in magazines and books. Also includes examples in the form of simple projects.
112 pages **Order code No. 227** **£1.95**

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.

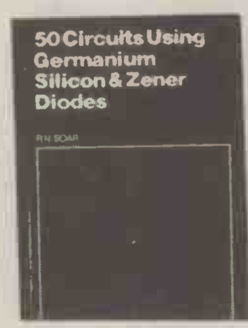
BOOK 2 contains: Amplifiers—low level discrete and op-amp circuits, voltage and buffer amplifiers including d.c. types. Also low-noise audio and voltage controlled amplifiers. Filters—high-pass, low-pass, 6, 12, and 24dB per octave types. Miscellaneous—i.c. power amplifiers, mixers, voltage and current regulators, etc.

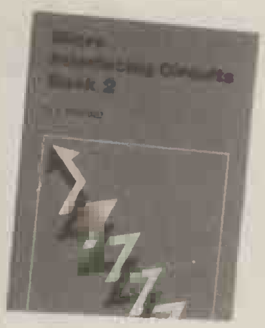
BOOK 1 *128 pages* **Order code BP117** **£1.95**
BOOK 2 *112 pages* **Order code BP118** **£1.95**

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





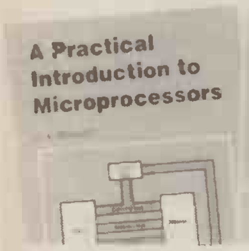
ELECTRONIC CIRCUITS HANDBOOK
Michael Tooley BA
This book aims to explode two popular misconceptions concerning the design of electronic circuits: that only those with many years of experience should undertake circuit design and that the process relies on an understanding of advanced mathematics. Provided 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**

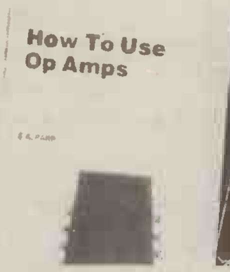
50 CIRCUITS USING GERMANIUM SILICON AND ZENER DIODES
R. N. Soar
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most simple and inexpensive of components—the diode. Includes the use of germanium and silicon signal diodes, silicon rectifier diodes and Zener diodes, etc.
64 pages **Order Code BP36** **£1.50**

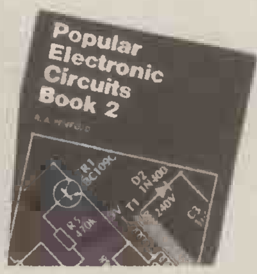
A MICROPROCESSOR PRIMER
E. A. Parr, B.SC., C.Eng., M.I.E.E.
Starts by designing a small computer which, because of its simplicity and logical structure, enables the language to be easily learnt and understood. The shortcomings are then discussed and the reader is shown how these can be overcome by changes 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**

A PRACTICAL INTRODUCTION TO MICROPROCESSORS
R. A. Penfold
Provides an introduction which includes a very simple microprocessor circuit which can be constructed so that the reader can experiment and gain practical experience.
96 pages **Order code BP123** **£1.95**







HOW TO DESIGN ELECTRONIC PROJECTS
R. A. Penfold
The aim of this book is to help the reader to put together projects from standard circuit blocks with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements are also provided.
128 pages **Order code BP127** **£2.25**

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 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**

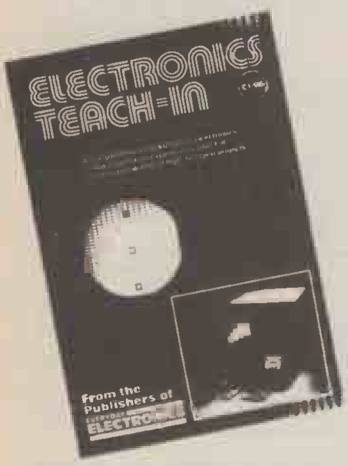
POPULAR ELECTRONIC CIRCUITS –BOOK 1
POPULAR ELECTRONIC CIRCUITS –BOOK 2
R. A. Penfold
Each book provides a wide range of designs for electronic enthusiasts who are capable of producing working projects from just a circuit diagram without the aid of detailed construction information. Any special setting-up procedures are described.
BOOK 1 *160 pages* **Order code BP80** **£1.95**
BOOK 2 *160 pages* **Order code BP98** **£2.25**

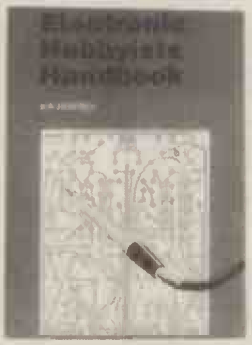
ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS
R.A. Penfold
Home computers may easily be applied to the control of model railways and really quite sophisticated control, which needs only simple programming, is not too difficult to achieve. The main problem lies in interfacing the computer 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**

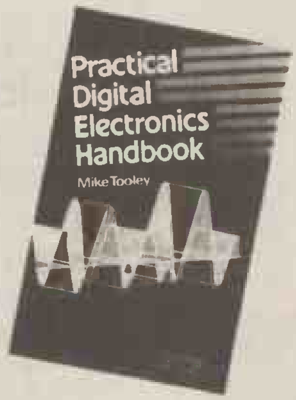
MODERN OPTO DEVICE PROJECTS
R.A. Penfold
In recent years, the range of opto devices available to the home constructor has expanded and changed radically. These devices now represent one of the more interesting areas of modern electronics for the hobbyist to experiment in, and many of these devices have 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 l.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 **Order code BP194** **£2.95**

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







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-I** **£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-tried" methods which may bring success in design but leave the experimenter unfulfilled. A strong practical bias—tedious and higher mathematics have been avoided where possible and many tables have been included.
The book is divided into six basic sections: Units and Constants, Direct-current Circuits, Passive Components, Alternating-current Circuits, Networks and Theorems, Measurements.
256 pages **Order Code BP53** **£2.95**

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 microprocessing systems which really starts at the beginning. Teaches the reader the essential fundamentals that are so important for a sound understanding of the subject.
256 pages **Order Code BP77** **£2.95**

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**

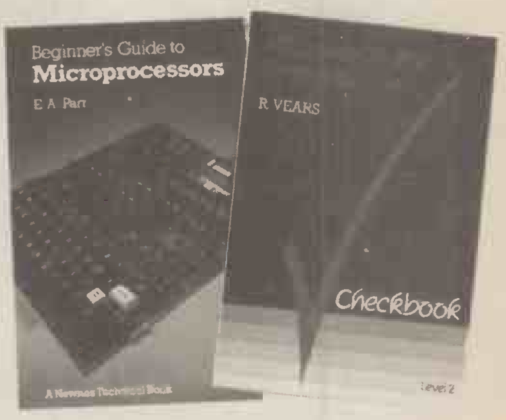
RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
B. B. Babani
Although this chart was first published in 1971 it provides basic information on many colour codes in use throughout the world, for most radio and electronic components. Includes resistors, capacitors, transformers, field coils, fuses, battery leads, speakers, etc. It is particularly useful for finding the values of old components.
Chart **Order code BP7** **£0.95**

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**

RECOMMENDED READING

FOR . . .
INTRODUCING MICROPROCESSORS
(THE EVERYDAY ELECTRONICS CITY AND GUILDS SERIES)

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**



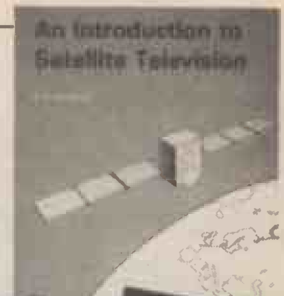
BEGINNERS GUIDE TO MICROPROCESSORS
E.A. Parr
An excellent grounding in microprocessors, this book is broadly relevent to the whole of our Introducing Microprocessors course. It is easy to read and well illustrated.
224 pages **Order code NE03** **£4.95**

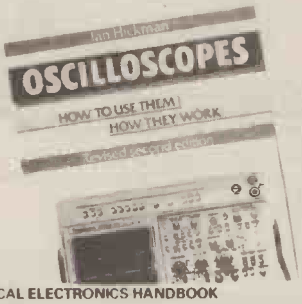
MICROELECTRONIC SYSTEMS 2 CHECKBOOK
R. Vears
The aim of this book is to provide a foundation in microcomputer hardware, software and interfacing techniques. Each topic is presented in a way that assumes only an elementary knowledge of microelectronic systems and logic functions. The book concentrates on 6502, Z80 and 6800 microprocessors and contains 60 tested programs, 160 worked problems and 250 further problems.
194 pages **Order code NE04** **£4.95**

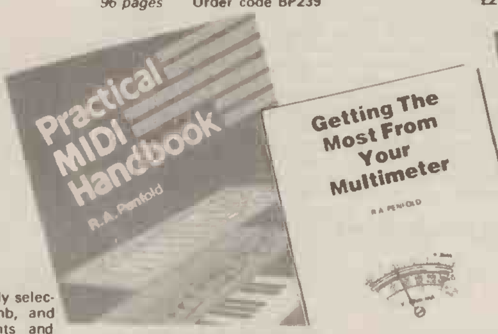
RECOMMENDED READING

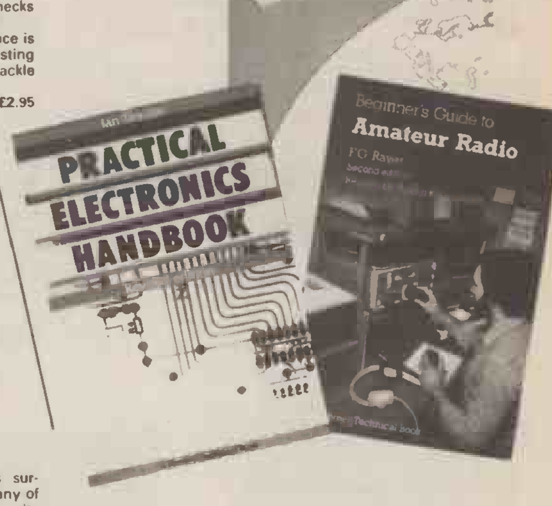
OSCILLOSCOPES: HOW TO USE THEM – HOW THEY WORK
Ian Hickman
Oscilloscopes are essential tools for checking circuit operation and diagnosing faults, and an enormous range of models is available. But which is the right 'scope for a particular application? Which features are essential, which not so important? 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** £5.95

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



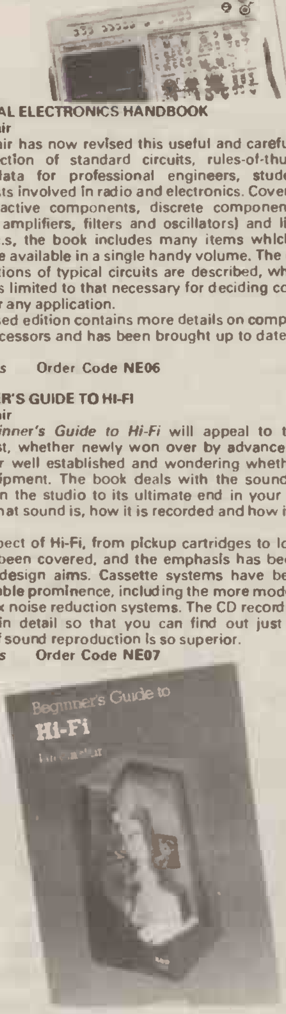






PRACTICAL ELECTRONICS HANDBOOK
Ian Sinclair
Ian Sinclair has now revised this useful and carefully selected collection of standard circuits, rules-of-thumb, and design data for professional engineers, students and enthusiasts involved in radio and electronics. Covering passive and active components, 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

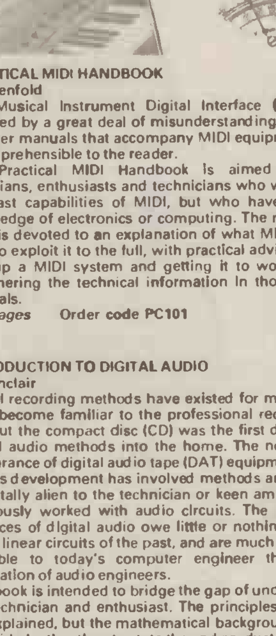
BEGINNER'S GUIDE TO HI-FI
Ian Sinclair
The *Beginner's Guide to Hi-Fi* will appeal to the audio enthusiast, whether newly won over by advances in technology or well established and wondering whether to update equipment. The book deals with the sound from its sources in the studio to its ultimate end 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.
194 pages Order Code **NE07** £4.95



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

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** £2.95

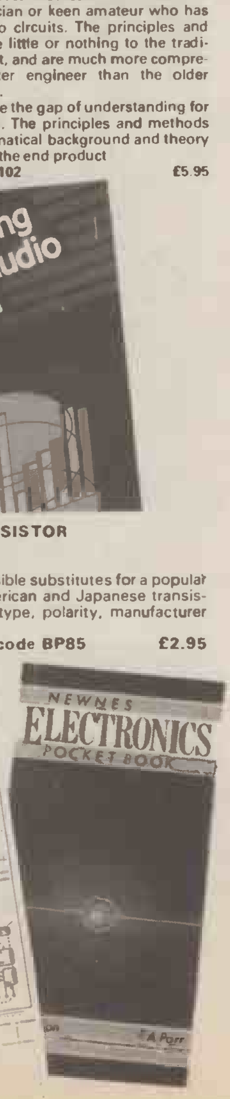
TRANSISTOR RADIO FAULT-FINDING CHART
C. E. Miller
Used properly, should enable the reader to trace most common faults reasonably quickly. Across the top of the chart will be found four rectangles containing brief description of these faults, *vis*—sound weak but undistorted, set dead, sound low or distorted and background noises. One then selects the most appropriate of these and following the arrows, carries out the suggested checks in sequence until the fault is cleared.
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** £4.95

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 Order code **BP141** £4.95

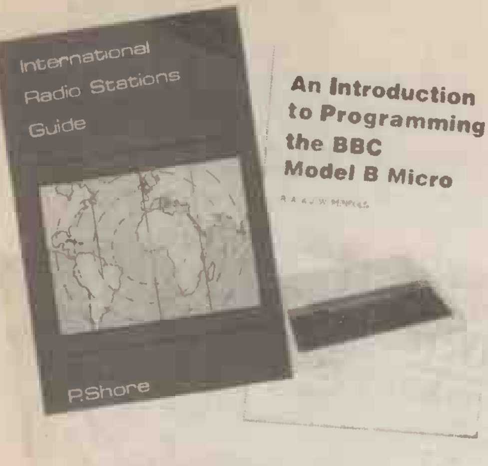
INTERNATIONAL DIODE EQUIVALENTS GUIDE
A. Michaels
Designed to help the user in finding possible substitutes for a large selection of the many different types of diodes that are available. Besides simple rectifier diodes, also included are Zener diodes, l.e.d.s, diacs, triacs, thyristors, OCIs, photo 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** £8.95



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 Order code **BP234** £4.95

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

BEGINNER'S GUIDE TO AMATEUR RADIO
F.G. Rayer Second edition revised by Gordon King G4VFV.
Whether you are new to radio, or have become interested by way of CB, it is hoped that this book, will further whet your appetite and put you in good stead for passing the Radio Amateur's Examination and becoming a licensed radio amateur.
188 pages **Temporarily out of print**

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 BP 195** **£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**

THE PRE-COMPUTER BOOK
F. A. Wilson
Aimed at the absolute beginner with no knowledge of computing. An entirely non-technical discussion of computer bits and pieces and programming.
96 pages **Order code BP115** **£1.95**

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 (overseas readers add £1.50, surface mail postage) and send a PO, cheque or international money order (£ sterling only) made payable to *Direct Book Service* (quoting 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 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

LIKE MOST hobbies, electronics is littered with difficulties for the beginner that are actually quite easy once you know how. A lot of things seem very complex at first, but are really pretty straightforward once they have been rationalised and explained properly.

A good example of this is component values. They are expressed in various units, and a given value can usually be expressed in more than one way. This second point can make it difficult to select the right components from components catalogues, and is responsible for a small but steady flow of enquiries from readers.

PICO TO TERRA

Understanding component values is very much easier once you are familiar with the prefixes used ahead of the letter that indicates the type of units. For instance, in the inductance value 33mH the "m" stands for "milli", or one thousandth in other words, and the H indicates that the units in use are Henries. The value is therefore 33 millihenries, which is thirty-three thousandths of a Henry, or 0.033 Henries.

These prefixes are used, where necessary, with any units of metric measurement, and are not restricted to use in electronics. Our "milli" example is to be found in millimetres, milligrams, and probably many other non-electronic forms of measurement.

Electronics involves very small quantities, very large quantities, and the full range of intermediate amounts. Consequently you may encounter prefixes in electronics that you will not have cause to use elsewhere.

Note that these prefix letters are not only used to indicate fractional units, but are also much used to indicate multiple units. The letter "k" (which stands for "kilo") is probably the most used of these, and it means so many thousands of the basic units. Thus 10 kilohms is 10000 ohms, and 22 kilometres is 22000 metres.

Table 1 below gives a list of prefixes and their "values".

These prefixes enable an enormous range of values to be covered without having to resort to very large numbers, or numbers having a decimal point followed by a large number of zeros. The range covered is so wide that the full range of pico to terra would not normally be utilized with one type of units. In fact only two or three prefixes are used with most types of units. With resistors for example, only kilo (k) and mega (M) are normally required. Table 2 shows the units used for various types of components, together with the normal range of values. Details of basic electrical units of measurement are also provided, including the range of values you are likely to encounter.

Note that the "R" for ohms is often replaced by the greek letter omega (Ω). The value ranges can only be a general guide, and there may be the odd component, voltage, or whatever, that has what could only be regarded as an exceptionally high or low value.

As one example of this, a few catalogues now list capacitors with a value of 1 farad (1000000µF)! This is a special ultra-high value type intended for what would normally be considered battery back-up applications. This is exceptional though, and few catalogues list capacitors above 4700µF.

If you see something like an electrolytic capacitor value given as 100pF, it is reasonable to assume that it is a misprint and that it should be 100µ. However, if in doubt you can always check with the publisher concerned, and a routine enquiry of this type will normally receive a fairly swift reply.

VALUE JUDGEMENT

A lot of confusion seems to result from the ways values are marked on components, and on the ways they are marked on capacitors in particular. It is standard practice these days for values to be expressed without the type of units (farads, ohms, etc.) being included.

Also, the prefix which indicates the multiplier/divisor is often used to indicate the position of the decimal point as well. This is a general means of expressing values, and it is not one that is confined to component value markings.

The idea is to express the value using as few digits as possible, mainly with the aim of making it easier to find space for the labels on ever more complex circuit diagrams. It is obviously more compact to specify a value as 2n2 than as 2.2nF or 2200pF.

The current "standard" for marking values on ceramic plate capacitors having values from 100p to 820p seems to be essentially as described above, but with the value given in nanofarads with what I suppose could be termed "leading zero suppression". In other words, a value of 470pF would be marked on a ceramic plate capacitor as "n47".

For some reason trailing zeros are not suppressed, and 100pF is marked as "n10". This system reduces the number of digits required from four to three, but getting used to this method of value marking can take a while if you are used to the old style markings in picofarads.

Disc ceramic capacitors seem to cause even more confusion. These use another form of three digit value marking, and the first two digits are simply the first two digits of the value. The third is a multiplier, rather like the ones used in resistor colour codes.

In this case the number simply indicates the number of zeros to be added to the first two digits in order to give the full value. For example, with a third digit of "2" it is just a matter of adding two zeros, or multiplying by one hundred if you prefer to look at it that way.

A capacitor market "473" would therefore have a value of 47 plus three zeros, or 47000 in other words. This value is in picofarads though, and not nanofarads. It must be divided by one thousand to convert from the former to the latter. The value is therefore 47000pF, or 47nF.

Table 3 provides a few examples that might help to clarify the system for you.

This method of value marking now seems to be turning up on one or two other types of capacitor, such as Mylar and some Polyester types. It is probably well worthwhile familiarising yourself

Table 1

Prefix	Letter	"Value"
Pico	p	0.000000000001
Nano	n	0.000000001
Micro	µ	0.000001
Milli	m	0.001
Kilo	k	1000
Mega	M	1000000
Giga	G	1000000000
Terra	T	1000000000000

Table 2

Component/Measurement Type	Units	Letter	Value Range
Capacitor (non-electrolytic)	Farads	F	1pF to 2µ2
Capacitor (electrolytic)	Farads	F	470nF–47000µF
Capacitor (variable)	Farads	F	5pF–500pF
Resistor	Ohms	R	0.1R–10M
Inductor	Henries	H	0.1µH–4H
Resistance (general)	Ohms	R	1mR–1TR
Impedance	Ohms	R	1mR–1TR
Voltage	Volts	V	1µV–20kV
Current	Amperes	A	1nA–10A
Power	Watts	W	1µW–1kW

with this system, as it seems likely to become a standard for medium value capacitors.

Table 3

Marking	Value in pF	Value in nF	Value in μF
102	1000	1	0.001
332	3300	3.3	0.0033
472	4700	4.7	0.0047
103	10000	10	0.01
223	22000	22	0.022
473	47000	47	0.047
104	100000	100	0.1
334	330000	330	0.33

WORKING VOLTAGE AND TOLERANCE

You may find other markings on capacitors. These are not necessarily anything of interest, and could simply be something like a manufacturer's batch number.

However, in some cases these give further information about the component. The most simple example is where something like "50V" is marked on a component, and this is merely the maximum d.c. "working" voltage to which it should be subjected.

This type of marking is quite common on electrolytic and tantalum capacitors (which often have quite low maximum voltage ratings), but are not always found on other types of capacitor. Where they are to be found, the marking is often a bit ambiguous as the "V" for volts is often omitted.

Capacitors sometimes have their tolerance rating simply written on as "5%" or whatever, but these days it seems to be more common for the tolerance simply to be omitted, or in some cases a single code letter is used to indicate the tolerance. Details of this system of coding are provided below.

Code Letter	Tolerance
F	1%
G	2%
H	2.5%
J	5%
K	10%
M	20%

While on the subject of tolerance codes, some years ago there were a lot of resistors in circulation which had the values marked using four letter codes. The first three letters gave the value in conventional form (e.g. 4R7, 2k2, 10M, etc,) and the fourth letter gave the tolerance using the coding system detailed above.

This method did not seem to catch on, but I have recently encountered a few components that have this system of marking, and there are still some resistors of this type around. In particular, you may well be supplied with components having this method of coding if you order some close tolerance resistors.

Capacitors sometimes have other markings to indicate their temperature coefficient and (or) power factor. These are not normally of any great interest or significance to the home constructor, but they can tend to shroud the main value markings.

What is the value of a capacitor marked 104K1D or 05BX472M? Reasonable guesses of 100n 10 per cent and 4n7 20 per cent respectively could be made by extracting the figures that look like value codes and ignoring the rest. In this case this would give the right values.

CAPACITOR TESTING

A capacitance meter or bridge is a very useful piece of test gear for anyone involved in a lot of project construction as it can settle any doubts about the value of an ambiguously marked component. With many types of capacitor the markings are far from indelible, and again, some form of capacitance measuring device can reliably sort out any doubts.

Unfortunately, apart from a few multipurpose digital instruments there are few multimeters that have any capacitance measuring ranges. However, one useful dodge that can sometimes be of use with an analogue multimeter is to switch the instrument to the highest resistance range and then connect it across a test capacitor. This should result in a small "kick" of the pointer with most components, due to the capacitor charging up.

With very low values of a few nanofarads or less, the initial charge may be too small to produce any significant deflection of the meter. With high value capacitors it might take a significant time for the pointer to fall back to zero.

The point here is that the "kick" from the meter is proportional to the value of the test component, and can be used to permit the value of most capacitors to be roughly gauged. It does not permit accurate measurement, but comparisons with capacitors of known value can give greater precision than you might expect.

Doubts about the values of capacitors often involve uncertainty about the position of the decimal point. This method should certainly permit you to determine whether a capacitor has a value of (say) 33nF or 330nF.

Note that with polarised capacitors the test leads are connected with what is apparently the wrong polarity (i.e. the positive probe connects to the negative terminal of the capacitor). This does in fact give a voltage of the correct polarity across the test component.

INDUCTORS

Most small inductors, or r.f. chokes as they are sometimes called, have the value marked in the standard fashion (e.g. 4μH7), often with a letter to indicate the tolerance. I have encountered a few that use different methods though.

The use of colour codes seems to be increasingly common. The system used is a four band type that is actually no different to the standard resistor colour coding. However, the value is in nanohenries, and for larger values it must be divided by one thousand to obtain a value in microhenries.

The other method is essentially the same as the three digit capacitor type. The first two digits are the first two digits of the value, and the third one indicates the number of zeros that must be added to give the full value.

The value is again in nanohenries. This value marking is usually accompanied by a letter to indicate the tolerance. Thus a component marked "103J" has a value of 10000 nanohenries (10 millihenries), and a tolerance of 5%.

exploring electronics

OWEN BISHOP

This series is designed to explain the workings of electronic components and circuits by involving the reader in experimenting with them. There will not be masses of theory or formulae but straightforward explanations and circuits to build and experiment with.

Part 25 Using diodes

THE "semiconductor diode", Fig. 25.1a and Fig. 25.1b, was the first electronic component device that we studied in this series. We showed that its characteristic property is that it conducts current in one direction only.

If it is connected as in Fig. 25.1c, current flows freely through it, provided that the voltage exceeds 0.7V for a silicon diode. But, if it is reverse-biassed as in Fig. 25.1d, then only a minute leakage current flows, even though the voltage across the diode may be several hundred volts. A high reverse voltage may cause the diode to break down. Current then flows readily but it is no longer a diode!

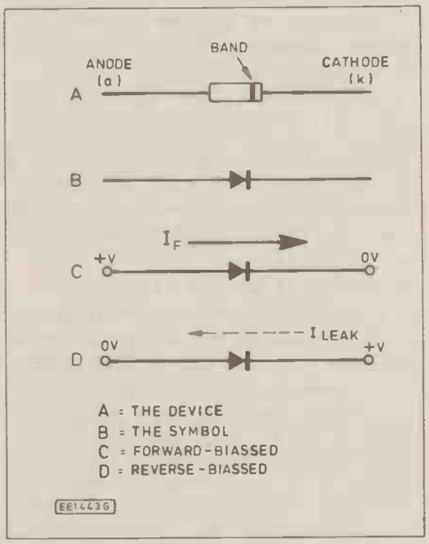


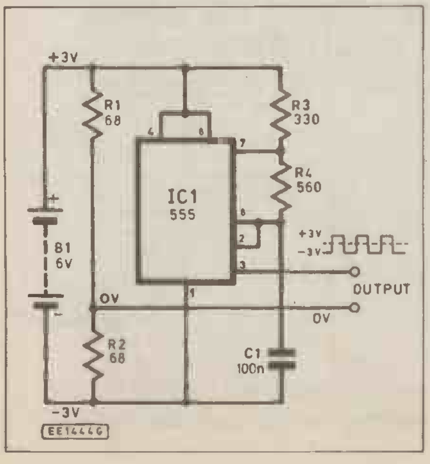
Fig. 25.1. The semiconductor diode.

ASTABLE CIRCUIT

This month's circuit requires an alternating waveform. For this purpose we use the 555 timer i.c. connected as an astable multivibrator (April 1987). With the values of resistors R3, R4 and capacitor C1 shown in Fig 25.2, the frequency is about 10kHz.

When the timer is driven by a 6V battery we normally consider the output of the astable to be a square wave alternating between +6V and 0V. For the purpose of describing the action of the circuit we are going to change the reference level from which we measure voltages. Instead of thinking of the battery terminals as 0V and +6V, we will think of them as −3V and +3V

Fig. 25.2. Pulse generator and potential divider circuit diagram.



Obviously, we need a reference line at the 0V level. This is obtained by using two equal resistors (R1, R2) as a potential divider (Fig. 25.2). Measured from this level, the output of the astable alternates between +3V and −3V.

CONSTRUCTION

Assemble the pulse generator and potential divider as in Fig. 25.3. Do not assemble the diode pump section yet.

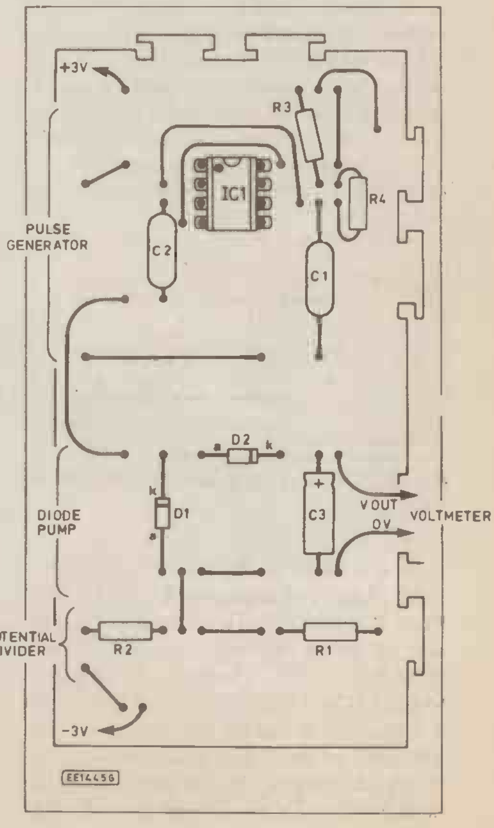
Commence construction by inserting the 8-pin i.c. holder and link wires followed by the resistors. This should include resistors R1 and R2 and the 0V and −3V link wires in the bottom half of the breadboard. At this stage, capacitor C2 can also be inserted on the board.

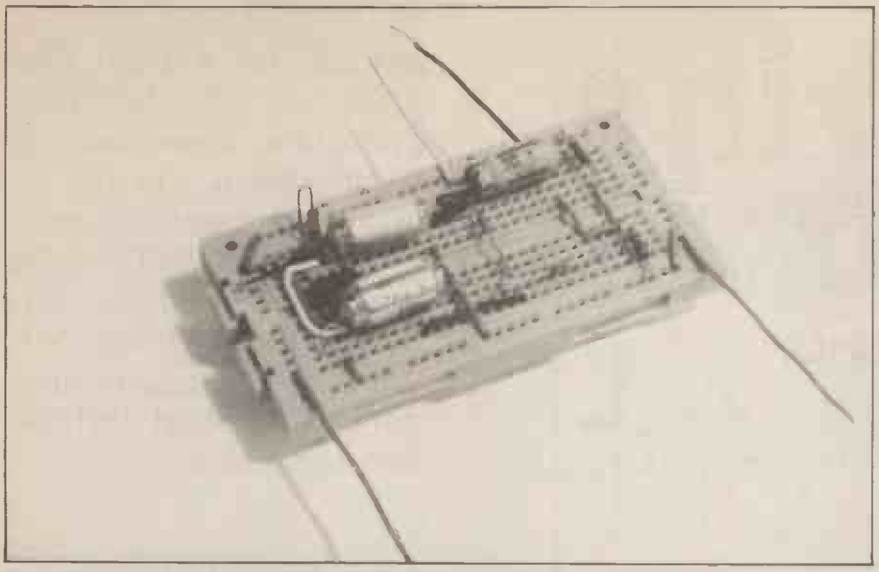
Finally, IC1 should be plugged into its holder and the supply leads inserted on the board. After one final checkover the circuit can be powered-up.

To check that the generator is working, connect a crystal earphone to IC1 pin 3 (at socket B6), its other terminal being connected to the 0V line (at F25). You will hear a high-pitched note, this being the 10kHz waveform produced by the circuit.

If you were to connect a voltmeter to the same points in the circuit, and if the voltmeter was one which has its needle in the centre of the scale when reading 0V, then the needle *might* be seen to vibrate rapidly as the voltage alternated between −3V and +3V/. This is not

Fig. 25.3. Demonstration breadboard component layout for the pulse generator, potential divider and diode pump.





COMPONENTS

Resistors
R1, R2 68 0.5W (2 off)
R3 330 0.25W
R4 560 0.25W

All 5% carbon

Shop Talk
See page 415

Capacitors
C1, C2 100n polyester (2 off)
C3 1000μ elec. 10V

Semiconductors
D1, D2 1N4148 silicon diode (2 off)
IC1 555 timer i.c.

Miscellaneous
Breadboard (Verobloc); 8-pin i.c. holder; B1 6V battery and connectors; connecting wire and Voltmeter, set to 10V d.c. scale.

Approx. cost Guidance only **£5** *(excluding meter)*

likely to happen in practice as the inertia of the needle prevents it from vibrating 10000 times a second.

If an ordinary voltmeter is connected at these points, its needle is apparently stationary, close to zero. It may read a little bit higher than this because the "low" period of the output is shorter than the "high" period.

DIODE PUMP

Now add the Diode Pump (Fig. 25.4) to the demonstration breadboard, see Fig. 25.3. Make sure that the diodes are the right way round—current leaves the diode by the cathode (k) terminal, which is the end marked with the band.

To see the "pump" in operation, the voltmeter is connected across capacitor C3, as in Fig. 25.3, and measures the output from the circuit. Switch on and measure the output voltage, V_{OUT}. Check the voltage reading at socket B19—it is still very close to zero. Where does this extra voltage come from?

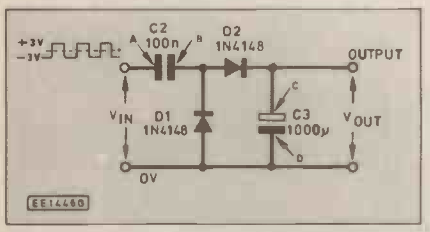


Fig. 25.4. Circuit diagram for the Diode Pump.

Imagine that in Fig 25.4, V_{IN} is −3V. Thus plate A of capacitor C2 is at −3V. Plate B is also at −3V to begin with, but current flows through diode D1 until plate B is at 0V. Then the input starts to rise. When the potential of a plate of a capacitor is suddenly changed, the potential of the other plate changes by an equal amount. As the potential at A rises from − 3V to +3V (a rise of 6V), the potential of B rises by an equal amount. Since it is at 0V to start with, it rises from 0V to +6V.

Current cannot flow back through diode D1 since D1 is now reverse-biassed. Instead, the current flows through diode D2, charging plate C of capacitor C3. Next the input falls again from +3V to −3V, but the charge that has passed to plate C cannot return through diode D2, for this is now reverse-biassed. Capacitor C3 holds its charge. Charge may pass from C3 to any circuit that may be connected to the output terminal. C3 receives more charge every time V_{IN} rises from −3V to +3V. In summary, electric charge passes from the 0V line through D1 to plate B as V_{IN} falls, and it is pumped from plate B through D2 to plate C as V_{IN} rises.

The action is very similar to that of a pump with two valves—an inlet valve and an outlet valve. The old-fashioned village pump and the modern bicycle pump are both examples of this. In the bicycle pump the rim of the piston is one valve and the valve on the inner tube is the other. Air is sucked in past the rim of the piston as we pull the pump-handle out, and is pushed out through the inner tube valve as we push the handle in.

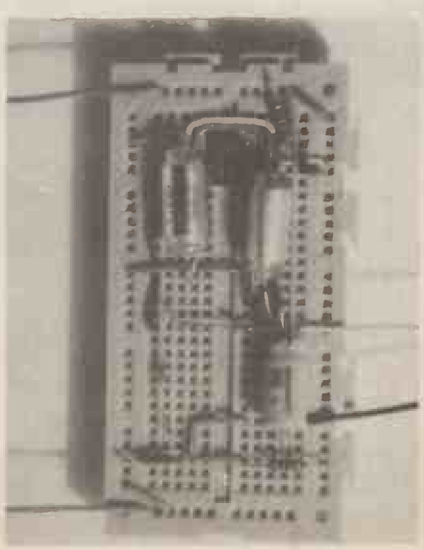
LEAKAGE

A voltmeter such as we are using, or any other external circuit connected to capacitor C3 allows charge to leak away from C3. In the bicycle analogy we can think of this as air leaking away through a small puncture in the tube. If the puncture is large, air leaks away as fast as or faster than it is being pumped. The same applies to the diode pump, and explains why it is able to supply only a limited amount of current.

Experience tells us that the faster we pump, the greater the pressure in the tyre. Conversely, if we reduce the rate of pumping, the pressure gradually falls to a lower level. Does this happen with the diode pump? Try this out by substituting 3k3 and 5k6 resistors for R3 and R4. The "pumping" frequency is now only 1kHz. What effect does this have on the voltage across capacitor C3?

You will notice the effect best with a cheap voltmeter that takes a relatively large current. If you are using an expensive moving coil voltmeter or a digital voltmeter, it may take such a small current that changing the frequency makes no appreciable difference. In this case connect a 22k resistor across C3 to increase the rate at which C3 loses charge. Insert the resistor in sockets J19 and J25.

The explanation above is an over-simplified one (for example, it does not



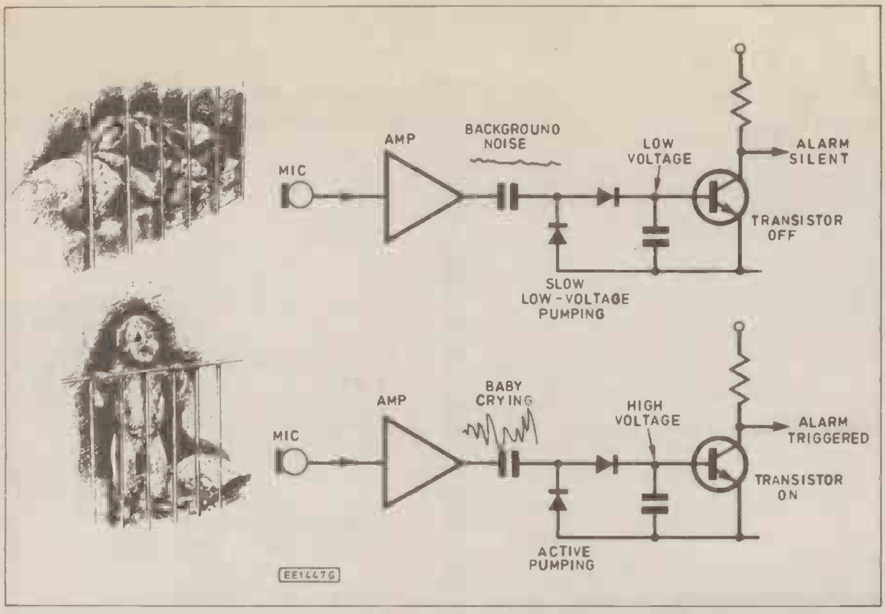


Fig. 25.5. One suggested application for the diode pump is as a Baby Alarm. With small background noise, amplifier output is low (alarm silent). When baby cries, output levels shoot up, switching transistor on and triggering alarm circuit.

take into account the voltage drop across the diodes), but it is sufficiently accurate to explain the general principle of the diode pump. If you scan though the circuit diagrams in this magazine each month, you will sometimes come across one that has two diodes connected to make a pump.

BABY ALARM

An example of a circuit in which a pump might be used is a Baby Alarm (Fig. 25.5). A microphone beside the baby's cot is connected to an amplifier, the output of the amplifier is connected to a diode pump.

With small background noises, the output of the amplifier rises and falls by small amounts, charging the capacitor of the pump slightly. The voltage changes are small and any charge pumped to the capacitor leaks away as fast as it is pumped.

But when baby cries, the output from the amplifier rises and falls rapidly and by large amounts. The increased rate and amplitude of pumping causes a steady increase in potential across the capacitor. After a few moments the potential has risen to a level at which a transistor connected to the capacitor is switched on, triggering the baby alarm to sound.

This is just one of many examples of the usefulness of this simple diode pump circuit.

Next Month: We look at the Diode /Capacitor Ladder.

PCB SERVICE

Printed circuit boards for certain constructional projects (up to two years old) are available from the PCB Service, see list. These are fabricated in glass-fibre, and are fully drilled and roller tinned. All prices include VAT and postage and packing. Add £1 per board for overseas airmail. Remittances should be sent to: The PCB Service, *Everyday Electronics* Editorial Offices, 6 Church Street, Wimborne, Dorset BH21 1JH. Cheques should be crossed and made payable to *Everyday Electronics*. *(Payment in £ sterling only.)*

Readers are advised to check with prices appearing in the current issue before ordering.

NOTE: *Boards for older projects – not listed here – can often be obtained from Magenta Electronics, 135 Hunter St., Burton-on-Trent, Staffs DE14 2ST. Tel: 0283 65435 or Lake Electronics, 7 Middleton Close, Nuthall, Nottingham NG16 1BX. Tel: 0602 382509.*

NOTE: Please allow 28 days for delivery. We can only supply boards listed in the latest issue. Boards can only be supplied by mail order and on a payment with order basis.

PROJECT TITLE	Order Code	Cost
– APRIL '86 –		
Stereo Reverb	521	£3.73
– MAY '86 –		
PA Amplifier	511	£3.34
Mini Strobe	522	£2.79
Auto Firing Joystick Adaptor	523	£3.42
– JUNE '86 –		
Watchdog	524	£3.51
Percussion Synthesiser	525	£7.06
Personal Radio	526	£2.58
– JULY '86 –		
Tilt Alarm	527	£2.65
Electronic Scarecrow	528	£2.86
VOX Box Amplifier	529	£2.93
Headphone Mixer	530	£5.71
– AUG '86 –		
Solar Heating Controller	533	£4.16
– SEPT '86 –		
Car Timer	538	£2.53
Freezer Failure Alarm	534	£2.38
Infra Red Beam Alarm (Trans)	536	£4.16
Infra Red Beam Alarm (Rec)	537	£4.16
Scratch Blanker	539	£6.80
– OCT '86 –		
10W Audio Amp (Power Amp) £4.78 Pair	543	£3.23
(Pre-Amp)	544	£3.97
Light Rider – Lapel Badge	540 & 541	£2.97
– Disco Lights	542	£5.12
– Chaser Light	546	£4.04
– NOV '86 –		
Modem Tone Decoder	547	£3.46
200MHz Digital Frequency Meter	548	£5.14
– DEC '86 –		
Dual Reading Thermometer	549	£7.34
Automatic Car Alarm	550	£2.93
BBC 16K Sideways RAM	551	£2.97
(Software Cassette)	551S	£3.88
Random Light Unit – JAN '87 –	552	£5.88
Car Voltage Monitor – FEB '87 –	553	£2.48
Mini Amp.	554 & 555	£5.68
Video Guard	556	£3.80
Spectrum I/O	557	£4.35
Spectrum Speech Synthesiser	558	£4.86
– MAR '87 –		
Computer Buffer/Interface	560	£3.32
Infra Red Alarm: Sensor head	561	£4.19
PSU/Relay Driver	562	£4.50
Alarm Thermometer – APRIL '87 –	559	£2.60
Experimental Speech Recognition	563	£4.75
Bulb Life Extender	564	£2.48
Fridge Alarm – MAY '87 –	565	£2.40
EE Equaliser – Ioniser	566	£4.10
– JUNE '87 –		
Mini Disco Light	567	£2.93
Visual Guitar/Instrument Tuner	568	£3.97
– JULY '87 –		
Fermostat	569	£3.34
EE Buccaneer Metal Detector	570	£4.10
Monomix	571	£4.75
– AUG '87 –		
Super Sound Adaptor, Main Board	572	£4.21
PSU Board	573	£3.32
Simple Shortwave Radio, Tuner	575	£3.15
Amplifier	576	£2.84
Noise Gate – SEPT '87 –	577	£4.41
Burst Fire Mains Controller	578	£3.31
Electronic Analogue/Digital Multimeter	579	£6.40
Transtest – OCT '87 –	580	£3.32
Video Controller	581	£4.83
Accented Metronome – NOV '87 –	582	£3.77
Acoustic Probe	584	£2.78
BBC Sideways RAM/ROM	585	£4.10
Pseudo Echo Unit – DEC '87 –	586	£4.60
Dual Mains Light Flasher	587	£3.66
Twinkling Star	588	£2.61
Audio Sine Wave Generator	559	£3.03
Capacitance Meter – JAN '88 –	590	£4.10
Bench Amplifier	591	£5.51
Transistor Curve Tracer	592	£2.84
Bench Power Supply Unit – FEB '88 –	593	£4.01
Game Timer	583	£3.55
Semiconductor Tester –MARCH '88–	594	£3.19
SOS Alert	595	£2.78
Guitar/Keyboard Envelope Shaper	596	£4.23
Stereo Noise Gate –APRIL '88–	597	£6.65
Pipe & Cable Locator	598	£2.72
Inductive Proximity Detector	574	£2.97
Multi-Channel remote Light Dimmer –MAY '88–		
Transmitter	599	£2.78
Receiver	600	£3.07
Door Sentinel	605	£2.60
Function Generator – Main Board	606	£5.91
Funcion Generator – Power Supply	607	£4.19
Super Sound Effects Generator	608	£4.78
Multi-Channel Remote Light Dimmer –JUNE '88–		
Relay/Decoder	601	£4.86
Dimmer Board	602	£3.07
Power Supply	603	£2.72
Mother Board	604	£7.76
Headlight Reminder	611	£2.78
–JULY '88–		
Video Wiper	612	£6.75
Isolink	613	£4.21

Please note that when ordering it is important to give project title as well as order code. Please print name and address in Block Caps. **Do not send any other correspondence with your order.**

EE PRINTED CIRCUIT BOARD SERVICE

Please send me the following p.c.b.s.

Make cheques/PO payable to: **Everyday Electronics**

(Payment in £ sterling only)

Order Code	Project	Quantity	Price

I enclose cheque/PO for £...

Name ....

Address ....

....

BLOCK CAPITALS PLEASE

Please allow 28 days for delivery

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), box number £1 extra. 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

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

Special Offers

PRINTED CIRCUIT BOARDS made to own requirements. For details send sae to Mr. B. M. Ansbro, 38 Poynings Drive, Hove, Sussex BN3 8GR.

HALF PRICE soldering iron (used, but as new) and solder. Tel 0443 681886.

MICROTRANSMITTER — Matchbox size, 500 metre range, tuneable 80-120MHZ, receive on any VHF/FM receiver. **ONLY £4.50.**
TELEPHONE MONITOR — With the addition of a tape recorder will automatically record both sides of telephone conversations. **ONLY £14.95.**
Please add 50p p&p per order. SAE for details.
Cheques/P.O.s payable to:
QUANTEK ELECTRONCS LTD
(Dept EE), 45a Station Road, Northfield, Birmingham B31 3TE

Special Offers

S.H. COMPONENTS presents 18 pages of very competitively priced semiconductors, switches, optoelectrics, etc., plus sample. Send 85p to 17 Beeley Road, Grimsby, S. Humberside.

Miscellaneous

TURN YOUR SURPLUS

ICS transistors etc., into cash, immediate settlement. We also welcome the opportunity to quote for complete factory clearance.

Contact **COLES-HARDING & CO,** 103 South Brink, Wisbech, Cambs.
ESTABLISHED OVER 10 YEARS
Tel: 0945 584188 Fax: 0945 588844

RCS VARIABLE VOLTAGE D.C. BENCH POWER SUPPLY

0 to 20 volts, up to 1.5 Amps d.c. Fully stabilised. Twin panel meters for instant voltage and current readings. Overload protection, fully variable. Operates from 240V a.c. Compact unit, size 9 x 5½ x 3in. £36 plus post £2.

VISA

BARCLAYCARD VISA

RADIO COMPONENT SPECIALISTS

RADIO COMPONENT SPECIALISTS
337 WHITEHORSE ROAD, CROYDON, SURREY, U.K.
Tel: 01-684 1665
List, large SAE Delivery 7 days Callers welcome Closed Wednesday

Service Manuals

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 TECHNIC, also such publishers as Heinemann, Newnes, TV Technic, 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 serv shts made).

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

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

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

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

Kits

GTI CAR COMPUTER (EE Jan. 88) gives MPG av. speed, trip, fuel etc. Kit £64.50, half kit £37.50. SAE to MSE, 11 Church Green Road, Bletchley, Milton Keynes. Tel (24 hrs) 0908 641548.

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of **Everyday Electronics** for .... Insertions. I enclose Cheque/P.O. for £.. (Cheques and Postal Orders should be made payable to Everyday Electronics)

The advertisement must include an address, box number, or phone number as part of the paid wordage. Please remember to add VAT.

HEADING REQUIRED:

NAME ....
ADDRESS ....
....
....

EVERYDAY ELECTRONICS
Classified Advertisement Dept.,
6 Church Street, Wimborne, Dorset BH21 1JH.
Telephone (0202) 881749
RATE: 30p per word, minimum 12 words. Box No. £1 extra. VAT MUST BE ADDED

7/88

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 ☐	Radio, Audio and TV Servicing ☐
Basic Electronic Engineering (City & Guilds) ☐	Radio Amateur Licence Exam (City & Guilds) ☐
Electrical Engineering ☐	Car Mechanics ☐
Electrical Contracting/ Installation ☐	Computer Programming ☐
GCE over 40 'O' and 'A' level subjects ☐	

ICS

Name

Address P. Code

International Correspondence Schools, Dept. ECS78, 312/314 High St., Sutton, Surrey SM1 1PR. Tel: 01-643 9568 or 041-221 2926 (24 hrs)

NATIONAL COMPONENT CLUB

★ SPECIAL OFFERS ★ SPECIAL OFFERS ★

50 ASSORTED SEMI - CONDUCTORS £1
(ICS - TRANSISTORS - DIODES)

200 RESISTORS
100 DIODES (MIXED) £1

70 ASSORTED CAPACITORS £1
(PICOFARADS - 2200uf)

? MYSTERY PACK £1

20 ASSORTED IC's £1
(TTL, LINEAR, CMOS)

10 ASSORTED HEATSINKS £1
(AT LEAST 5 HIGH - POWER TO 220 & TO3 TYPES)

★ ALL SIX PACKS FOR A FIVER! ★

P.O.or Cheque to: NATIONAL COMPONENT CLUB, DEPT EE, HIGHER ANSFORD, CASTLE CARY, SOMERSET BA7 7JG. Please add 75p P & P but do not add VAT.

✩ **FREE CLUB MEMBERSHIP** ✩

AUDIOKITS PRECISION COMPONENTS

THE 30 + 30 INTEGRATED AMPLIFIER

- ★ DESIGNED FOR OUTSTANDING SOUND QUALITY
- ★ VERY HIGH QUALITY COMPONENTS SUPPLIED
- ★ LOW TEMPERATURE GENERATED DISTORTION
- ★ ULTRA LOW NOISE MC STAGE
- ★ STAR EARTHING – MAPPED ON PCB TRACKS
- ★ CLEAN SOUND RIGHT UP TO FULL OUTPUT
- ★ 7 SEPARATELY RECTIFIED POWER SUPPLIES GIVES OUTSTANDING STEREO IMAGERY
- ★ LATEST KITS HAVE IMPROVED HEAT SINKS AND LOWER RESIDUAL NOISE

IMPROVED VERSION ALSO FEATURES

- ★ BULK FOIL RESISTOR (Temp, Coefficient 5ppm/°C) IN CRITICAL PLACES
- ★ HOLCO RESISTORS FOR OUTPUT TRANSISTOR EMITTER RESISTORS
- ★ POLPROPYLENE AND POLYSTYRENE CAPACITORS
- ★ LONG LIFE ELECTROLYTIC CAPACITORS
- ★ KIMBER CABLE FOR INTERVAL WIRING
- ★ GOLD PLATED PHONE SOCKETS
- ★ EXTRA OUTPUT TRANSISTORS FOR 40 WATT OUTPUT

PRICES Standard 30 + 30 kit £172 + £6 p&p = £178
Standard with extra o/p transistors £185 + £6 p&p = £191
Improved kit £380 + £6 p&p = £386

Export version to order with 110V or 220V primary transformers, P&P charges by quotation. Delivery 14 to 21 days, but can be longer as lead times for manufacture of case or supply of some top quality parts used in improved version is much greater.

For full parts price list of the EE Apex preamp and details of AUDIOKITS audiophile components and kits, please send 9" × 4" SAE to:

AUDIOKITS Precision Components

6 MILL CLOSE, BORROWASH, DERBY DE7 3GU. Tel: 0332 674929

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 1988 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 full lists FREE. please note our new mail order address: BI-PAK, PO BOX 33, ROYSTON, HERTS SG8 5DF. Telephone 0763 48851.

RESISTORS

Pak No	Qty	Description	Price
VP1	300	Assorted Resistors, mixed values & types	£1.00
VP2	300	Carbon Resistors, ¼-½ watt, pre-formed, mixed	£1.00
VP4	200	½-1 watt Resistors, mixed values and types	£1.00
VP16	50	Wirewound Resistors, mixed watt values	£1.00
VP140	50	Precision Resistors, 1% tolerance	£1.00
VP181	100	1 and 2 watt Resistors, assorted values	£1.00
VP287	100	Close tolerance Resistors, .05-2%, 10-910 ohms, mixed	£1.50
VP288	100	Close tolerance Resistors, .05-2%, 1K 820K, mixed	£1.50
VP289	100	Metal oxide high stab. Resistors, ¼w 2%, mixed values	£1.50

CAPACITORS

Pak No	Qty	Description	Price
VP5	200	Assorted Capacitors, all types	£1.00
VP6	200	Ceramic Capacitors, Min mixed values	£1.00
VP9	100	Assorted Polyestar/Polystyrene Capacitors	£1.00
VP10	60	C280 Capacitors, metal foil, mixed values	£1.00
VP11	50	Electrolytics, all sorts	£1.00
VP12	40	Electrolytics, 0.47mf-150mf, mixed volts	£1.00
VP13	30	Electrolytics, 150mf-1000mf, mixed volts	£1.00
VP14	50	Silver Mica Caps, mixed values	£1.00
VP15	25	.01/250v Min, Layer Metal Caps	£1.00
VP180	25	Tantalum Bead Caps, assorted values	£1.00
VP182	4	1000uf 50v Electrolytics	£1.00
VP192	30	Min. Electrolytics, mixed values, 0.47mf-1000mf 6/16v	£1.00
VP193	6	Sub Min. Electrolytics, 2 × 1000/2200/3300mf 10/16v	£1.00

OPTOS

Pak No	Qty	Description	Price
VP24	10	.125" clear showing Red LEDs	£1.00
VP25	10	Mixed shape and colour LEDs	£1.00
VP26	15	Small .125" Red LEDs	£1.00
VP27	15	Large .2" Red LEDs	£1.00
VP28	10	Rectangular .2" Red LEDs	£1.00
VP57	25	Opto special pack, Assorted, Super Value	£3.00
VP130	6	RED 7 Seg. CC 14mm × 7.5mm RDP FND353 LED Display	£2.00
VP131	4	GREEN 7 Seg. CA .6" LDP XAN6520 LED Display	£2.00
VP133	6	RED Overflow .6" 3 × CA 3 × CC 6630/50 LED Display	£2.00
VP134	5	GREEN Overflow .6" CA XAN6530 LED Display	£2.00
VP138	20	Assorted LED Displays. Our mix, with data	£5.00
VP147	1	Pair Opto Coupled Modules	£0.60
VP199	4	LD707R LED Displays CA	£1.00
VP203	15	Triangular shape LEDs. Mixed colours	£1.00
VP204	10	Large Green LEDs, 5mm	£1.00
VP205	10	Small Green LEDs, 3mm	£1.00
VP206	10	Large Yellow LEDs, 5mm	£1.00
VP207	10	Small Yellow LEDs, 3mm	£1.00
VP208	10	Large LEDs clear showing Red, .2"	£1.50
VP241	2	ORP12 Light Dependent Resistor	£1.50
VP242	4	Tri-colour LEDs. 5mm Dia 5mA 2v R.G.Y.	£1.00
VP243	3	Tri-colour LEDs. Rectangular 5mm R G.Y	£1.00
VP266	10	Orange LED's, 5mm large	£1.00
VP267	8	Stackable LED's, Rectangular, mixed, R.G.Y.	£1.00
VP268	15	LED Panel Mounting Clips, metal and plastic, 3-5mm	£1.00
VP269	2	Red Flashing LED's, 5mm	£1.00
VP284	2	Opto Isolator IL74 4N27, single	£1.00
VP285	1	Dual Opton-Isolator ILD74	£1.00

TRANSISTORS

Pak No	Qty	Description	Price
VP172	10	SM1502 PNP TO 39 Sil, Trans 100v 100mA Hfe100 +	£1.00
VP200	30	OC71 type germ. AF Transistors, uncoded	£1.00
VP201	25	OC45 germ RF Transistors	£1.00
VP261	4	Programmable Unijunction Transistors, MEU22	£1.00
VP270	10	FET's UHF/VHF Amplifiers, switching & choppers, data	£1.00
VP271	10	FET's general purpose like 2N3819-2N5457, data	£1.00
VP272	10	MOS FET's Signetics, SD304	£1.00
VP280	12	ZTX300 NPN Silicon Transistors	£1.00
VP290	15	MPSA06 Sil. Transistors NPN 80v 500mA HFE50 + T092	£1.00
VP428	10	AC128K PNP Germanium Transistor, 1A 32v	£1.00
VP429	10	AC176K NPN Germani. m Transistors, 1A 32v	£1.00
VP430	4	2N3055 Sil. Power Transistors, full spec	£2.00
VP431	25	PNP Sil. Transistors, T0-39 like 2N2905A	£1.00

I.C.S.

Pak No	Qty	Description	Price
VP40	40	TTL I.C.s all new gates – Flip Flop – MSI. Data	£4.00
VP54	20	Assorted I.C. DIL Sockets, 8 – 40 pin	£2.50
VP59	20	Assorted I.C.s linear, etc, all coded	£2.00
VP209	12	74LS00	£2.00
VP210	12	74LS74	£2.00
VP211	10	CD4001B	£2.00
VP212	10	CD4011B	£2.00
VP214	10	CD4069B	£2.00
VP215	10	741P 8 pin	£2.00
VP216	10	555 Timers 8 pin	£2.00
VP223	50	Asst 74 TTL I.C.s "ALL GATES" new and coded our mix 7400 7453	£6.00
VP224	100	Asst 74 TTL I.C.s "ALL GATES" new and coded our mix 7400 7453	£10.00
VP282	1	Prog. Sound Gen. Chip. AY-3 8912	£3.00
VP291	1	Z80ACPU Microprocessor, 40 pin DIL	£2.00
VP292	1	Z80AP10 Parallel Interface Controller, 40 pin DIL	£2.00
VP293	1	Z80ACTC Counter Timer Circuit, 28 pin DIL	£2.00
VP294	1	2732D 32K Eprom	£3.00
VP295	1	6821P Peripheral Interface Adaptor (PIA)	£1.50
VP296	6	LM324 14 pin DIL Quad Op-Amp	£2.00
VP297	5	CA3130E MOS-FET I/P, CMOS O/P, Op-Amp	£2.00
VP298	3	MC1310P Stereo Decoder, 14 pin DIL	£2.00
VP299	3	CA3085 Pos. Volt Regulator, 1.7v-46v, 8 pin TO5	£2.00
VP400	1	27128 128K Eprom	£2.50
VP401	2	LM317T Adjst Voltage Regulator, 1.5A	£1.00
VP402	1	2114 4K Static Ram	£2.00
VP403	1	TA7204 Audio Amp I.C. 4 2w, 13v, 2-4 ohms	£1.00
VP404	1	TBA461 Audio Power Amp, 4 5w	£1.50
VP432	8	CD4016B	£2.00
VP433	6	CD4017B	£2.00
VP434	10	CD4024B	£2.00
VP435	10	CD4028B	£2.00
VP7413	4	7413 Dual Nand Schmitt Trigger, 4-input	£1.00
VP7440	4	7440 Dual 4-Input, Positive-Nand Buffer	£1.00
VP7470	4	7470 And-gated Positive-edge triggered Flip Flop with preset	£1.00
VP7480	4	7480 Gated full Adder	£1.00
VP7481	4	7481 16-bit Random Access memories	£1.00
VP7490	4	7490 Decade Counter	£1.00
VP7491	4	7491 8 Bit Shift Register	£1.00

MISC.

Pak No	Qty	Description	Price
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 Boards, 18 way paxaline	£1.00
VP225	20	DIN Plugs, plastic 2 8 pin, 180°/240°/360° mixed	£2.50
VP226	20	DIN Chassis Skts, metal 2-8 pin 180°/240°/360° mixed	£2.50
VP227	18	DIN In-line Skts, 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, smokey perspex	£2.50
VP244	1	High Power Piezo Electric Siren, Emits earpiercing warbling sound, Ideal alarm. White plastic body with mounting bracket. Power 12vDC 150mA. Output 100db (A) at 1m typ. freq. 2.5KHz. Size: 57 × 42 × 37mm	£6.00
VP260	1	9" × 6" Elliptical 8 ohms 10W RMS Speaker. Freq. Res 60-10000 Hz. Gauss 10000 Centre HF cone	£4.50
VP260A	1	2¼" Transducer Waterproof Speaker. Polyester film diaphragm. Moisture res. 8 ohms 300mW Freq Res. 20-20000 Hz	£1.00
VP273	10	10K Lin Rotary Potentiometers, slim spindle	£1.00
VP281	4	Plug-in Relays. Mixed volts, etc	£1.00

TOOLS

Pak No	Qty	Description	Price
VP95	1	Plastic Vice, small, 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	6 pc 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	£1.75
VP219	1	Miniature Side Cutters	£1.55
VP220	1	Miniature Bent nose Pliers	£1.55
VP221	1	Miniature Long-nose Pliers	£1.55
VP237	1	Universal Ni-Cad Battery Charger, AA HP11 HP2-PP3	£8.00
VP238	4	AA Ni-Cad Batteries, 1.25v 500mAh C/R mA	£4.00
VP239	2	C?HP11 Ni-Cad Batteries, Rechargeable	£3.50
VP240	2	D-HP2 Ni-Cad Batteries, Rechargeable	£4.00
VP246	1	25w Quality Low Cost Soldering Iron, 240v AC	£3.50
VP247	1	15w "Lightweight" Quality Low Cost Soldering Iron 240vAC	£3.50
VP248	1	High Suction Desoldering Pump. Teflon nozzle. Auto eject. Heavy duty return spring	£4.00
VP250	1	Long Finger Grip. Soldering Aid Heavy metal use. Serrated jaws with rev Tweezer action. Ideal for holding small components Fully adjustable.	£3.00
VP254	1	250 grams Etchant Granules (Ferric Chloride) makes ½ pint	£1.00
VP255	1	Etching Pen. Etch resistant. Spare tip. Blue	£1.00
VP258	1	Multicore Solder, 5m total, 10 and 22 SWG	£1.00
VP259	1	PCB Holder. Fully adjustable from 0-320mm wide and to any angle. Complete with iron stand and sponge. Strong metal construction with rubber feet. Very high quality	£15.00
VP286	2	Etch Resist PCB Transfer Sheets, Asst. symbols/lines	£1.00
VP405	2	Steel Rules 1 × 4", 1 × 10", measuring ins and mm	£1.00
VP406	1	Junior Hacksaw & 3 blades + hobby knife & 2 blades	£1.00
VP407	1	10 Piece Needle File Set	£3.00
VP408	1	4 Piece Stainless Steel Tweezer Set	£4.00
VP409	1	Set of 4 min. low cost Side & End Cutters, snipe & combination Pliers, 5" insul handles	£4.50

BI-PAK

Send your orders to:
BI-PAK DEPT EE, PO BOX 33, ROYSTON, HERTS
Terms: Cash with order, Personal cheques, Access and Barclaycard. Giro 388 7006. Same day despatch
Tel: 0763 48851. Add £1.50 P&P per order and 15% VAT

REMEMBER YOU MUST ADD £1.50 P&P AND 15% VAT TO TOTAL ORDER

OSCILLOSCOPES

TELEQUIPMENT D83 Dual trace 50MHz Delay Swoop large Tube with manual.......£350
S.E. LABS SM111 Dual Trace 18MHz Solid State Portable AC or External DC operation 8 · 10cm display with Manual.......£150
SCOPEX 4010A Dual trace 10MHz with manual.......£150
TELEQUIPMENT S54A. Single Trace 10MHz Solid State. With Manual.......£90
GOULD ADVANCE OS255 Dual Trace 15MHz. With Manual.......£225
HAMEG 207 Single Trace 8MHz. With Manual.......£50

MULTIMETERS

AVO 8 Complete with Batteries & Leads.......From £45
AVO8 MkV Complete with Batteries & Leads.......£90
AVO TEST SET No 1 (Military version of AVO 8) Complete with batteries & leads.......£65
TEST LEADS suitable for AVOMETERS. Red & Black with 2 croc. Clips & 2 Prods (P&P £3).......£5
AVO Model 7x Complete with Batteries, leads and Carrying case.......£40
AVO72 Pocket Multimeter no AC current range. With batteries & leads.......£10
ANALOGUE POCKET MULTIMETERS Philips & Taylor etc. With Batteries and leads....... from £10

LABGEAR CROSSHATCH GENERATOR CM6038 DB. Crosshatch/Grey scale/blank raster. mains or Battery (P&P £3).......Unused £18 Used £12

LABGEAR Colour Bar Generator KG1 8 Test Patterns (P&P £4).......ONLY £40 each

AVO TRANSISTOR TESTER TT169

Hand held GO/NO GO for In situ Testing Complete with batteries, leads & instructions (p&p £3) unused....... NOW ONLY £18

ISOLATING TRANSFORMERS 240V INPUT

240V out 500VA £15 (p&p £5); 100VA £6 (p&p £3); 24V out 500VA £6 (p&p £5); 200VA £4(p&p £4)

STEPPING MOTORS

Type 1. 200 Steps per rev 4 Phase (5 wire) 12/24V. Torque 25oz inch, will run on 5V with reduced torque.......£15 ea.
Type 2. 6 12 Steps per rev. 3 phase, 12/24V (will work on 5V).......£2 ea 5 off.......£7.50
Type 3. NORTH AMERICAN PHILIPS 24 Steps per rev, 4 wire 5V 3.3 Amps 0-250rpm 0-200 PPs.......£6 ea.
Type 4. 200 Steps per rev, 120V (3 wire) Torque 25 oz inch.......£4 ea.
Type 7. WARNER 24 Steps per rev, 3 Phase (6 wire), 28V, Holding Torque 45oz inch.......£5 ea.

SPECIAL OFFERS

COSSOR OSCILLOSCOPE CDU150. Dual Trace 35MHz. Delay Sweep. Solid State. Portable 8 × 10cm Display. With Manual.......NOW ONLY £180 each
Optional Front Protection Cover containing 2 Probes & Viewing Hood.......£10
SOLARTRON OSCILLOSCOPE CD1400. Dual Beam 15MHz. With Manual.......ONLY £85 each
AVO VALVE TESTER CT160. Suitcase style. 22 Bases.......ONLY £25 each(p&p £7)

AVO TRANSISTOR ANALYSER MK 2 (CT446). Suitcase style. Complete with batteries & operating instructions.......ONLY £35 each (p&p £7)

DISK DRIVE PSU 240V in 5V 1.6A & 12V 1.5A out. Size W125mm, H75mm, D180mm cased unused Only £10 (p&p £3).
QWERTY KEYBOARD (as in LYNX MICRO) push to make. Cased....... £5 each (p&p £3)
SWITCH MODE PSU
5V 40A, ±12V 5A....... £30 each (p&p £4)

MARCONI AF POWER METER TF893A 20Hz-35kHz. 20μW-10W. With Manual (P&P £7).......ONLY £35
MARCONI RF POWER METER TF1152A/1 DC - 500MHz. 0.5 to 25 Watts 50 Ohm. With Manual (P&P £7).......ONLY £45
MARCONI AM/FM Sig Gen TF1066B 10-470MHz.......£250
MARCONI AM/FM Sig Gen TF995 range from.......£150
FARNELL SINE/SQUARE type LFM2 1Hz-1MHz Compact.......£80
ADVANCE SG62B AM 150KHz-220MHz.......£45

NEW EQUIPMENT

HAMEG OSCILLOSCOPE 604. Dual trace 60MHz Delay Sweep. Component Tester & 2 Probes.......£575
HAMEG OSCILLOSCOPE 203.6 Dual Trace 20MHz. Component Tester & 2 Probes.......£314
All Other Models Available.

BLACK STAR FREQUENCY COUNTERS P&P £4
Meteor 100 – 100MHz.......£99
Meteor 600 – 600MHz.......£126
Meteor 1000 – 1GHz.......£175
BLACK STAR, JUPITOR 500 FUNCTION GENERATOR. Sine Square/Triangle. 0.1Hz-500kHz. P&P £4.......£110
BLACK STAR ORION. PAL TV/VIDEO COLOUR PATTERN GENERATOR.......£199

HUNG CHANG DMM 7030. 3½ digit. Hand held 28 ranges including 10 Amp AC/DC 0.1%. Complete with batteries & leads. P&P £4.......£39.50
AS ABOVE. DMM 6010. 0.25%.......£33.50
CARRYING CASE FOR ABOVE.......£3 each

OSCILLOSCOPES PROBES. Switched ×1; ×10. P&P £2.......£11

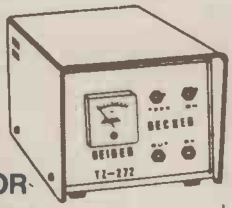
Used equipment - with 30 days guarantee Manuals supplied if possible.
This is a VERY SMALL SAMPLE OF STOCK. SAE or Telephone or Lists Please check availability before ordering. CARRIAGE all units £16. VAT to be added to Total of Goods & Carriage.

STEWART OF READING
110 WYKEHAM ROAD, READING, BERKS RG6 1PL
Telephone: 0734 68041 Callers welcome 9am – 5.30 pm Mon.-Fri. (until 8 pm Thurs.)

INDEX TO ADVERTISERS

PE + EE DESIGN FEATURES

MUSIC, EFFECTS COMPUTER AND SECURITY KITS



LOW COST GEIGER COUNTERS

NUCLEAR RADIATION DETECTORS

★ POPULAR PROJECTS FROM A LEADING AUTHOR

BURGLAR ALARM CONTROLLERS

DETECTORS DETER DELINQUENTS

MULTIZONE CONTROL (PE) SET280 £22.77
Two entry-zones, anti-tamper loop, personal attack, entry-exit timing, timed duration, automatic resetting, latching LED monitors.

SINGLE ZONE CONTROL (PE) 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.

CHIP TESTER (PE) SET258F £39.30
Computer controlled logic and chip analyser

CHORUS-FLANGER (PE) SET235 £59.99
Mono-stereo. Superb dual-mode effects.

CYBERVOX (EE) SET228 £44.76
Amazing robot type voice unit, with ring-modulator and reverb.

DISCO-LIGHTS (PE) SET245F £62.50
3 chan sound to light, chasers, auto level.

ECHO-REVERB (PE) SET218 £57.66
Mono-stereo. 200ms echo, lengthy reverb, switchable multitracking.

EPROM PROGRAMMER (PE) SET277 £25.25
Computer controlled unit for 4K Eproms.

EVENT COUNTER (PE) SET278 £31.50
4-digit display counting for any logic source.

MICRO-CHAT (PE) SET276 £64.50
Computer controlled speech synthesiser.

MICRO-SCOPE (PE) SET247 £44.50
Turns a computer into an oscilloscope.

MICRO-TUNER (PE) SET257 £55.32
Computer controlled, tuning aid and freq counter.

MORSE DECODER (EE) SET269 £22.16
Computer controlled morse code-decoder.

POLYWHATSIT! (PE) SET252 £122.69
Amazing effects unit, echo, reverb, double tracking, phasing, flanging, looping, pitch change, REVERSE tracking! 8K memory.

REVERB (EE) SET232 £27.35
Mono, with reverb to 4 secs, echo to 60ms.

RING MODULATOR (PE) SET231 £45.58
Fabulous effects generation, with ALC and VCO.

STORMS! (PE) £29.50 each unit
Raw nature under panel control! Wind & Rain SET250W. Thunder & Lightning SET250T.

★COMPUTER KITS
The software listing published with the computer kit projects are for use with C64, PET and BBC computers.

MANY MORE KITS IN CATALOGUE
KITS include PCBs and instructions. Further details in catalogue. PCBs also available separately.

NUCLEAR FREE ZONES? CHECK THEM OUT – GET A GEIGER

Detectors for environmental and geological monitoring.

THE PE GEIGER was shown on BBC TV "Take Nobody's Word For It" program.

METERED GEIGER (PE MK2)
Built-in probe, speaker, meter, digital output. Detector tube options – ZP1310 for normal sensitivity. ZP1320 for extrasensitivity.
Kit-form – SET 264 – (ZP1310) £59.50, (ZP1320) £79.50

GEIGER-MITE SET271 £39.50
Miniature geiger with ZP1310 tube, LED displays radiation impacts. Socket for headphones or digital monitoring. Kit-form only.

WEATHER CENTRE AND 32 CHANNEL VOICE SCRAMBLER DETAILS IN CATALOGUE

Send 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 £50 add £2.50. Others add £1.50. Overseas P&P in catalogue. Text photocopies – Geigers 264 & 272 £1.50 each, 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 EE87, 8 FINUCANE DRIVE, ORPINGTON, KENT BR5 4ED. MAIL ORDER

Published on approximately the first Friday of each month by Wimborne Publishing Ltd., 6 Church Street, Wimborne, Dorset BH21 1JH. Printed in England by Benham & Co. Limited, Colchester, Essex. Distributed by Seymour, 334 Brixton Road, London SW9 7AG. Sole Agents for Australia and New Zealand – Gordon & Gotch (Asia) Ltd., South Africa – Central News Agency Ltd. Subscriptions INLAND £14.50 and OVERSEAS £17.50 payable to "Everyday Electronics" Subscription Department, 6 Church Street, Wimborne, Dorset BH21 1JH. EVERYDAY ELECTRONICS is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

PROJECTS GALORE FROM Maplin

☎ SALES 0702 - 554161

PROTECT YOUR VHS VIDEO PLAYER WITH THIS VHS VIDEO ALARM PROJECT!

A self-contained alarm system disguised as a video cassette. Gives audible alarm if machine moved or cassette ejected. Full details in Project Book 24 (XA24B) Price 85p.

KIT PRICE ONLY £11.95 ORDER CODE LM27E

CHECK THOSE UNMARKED

capacitors with this versatile, low-cost, piece of test equipment. Full details in Project Book 23 (XA23A) Price 85p.

KIT PRICE ONLY £24.95 ORDER CODE LM28F

MOSFET AMPLIFIER

giving 150W of incredible power! High reliability and performance.

Full details in Best of E & MM (XH61R) Price £1.00.

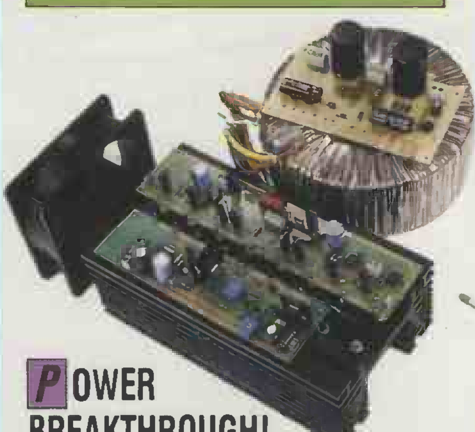
KIT PRICE ONLY £19.95 ORDER CODE LW51F

All prices include VAT. Please add 50p towards postage.

MUSICAL DOORBELL

with 28 tunes and chimes with selectable piano to organ like sounds. Note: case and front panel not in kit. For full details see Project Book 13 (XA13P) Price 85p.

KIT PRICE ONLY £14.95 ORDER CODE LK57M



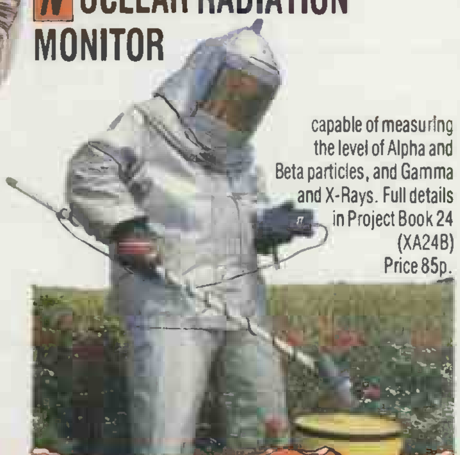
POWER BREAKTHROUGH!

A superb 1kW Mosfet amplifier, a major new source in sound! Full details in Project Book 26 (XA26D) Price 85p. This project is made up from 4 kits.

KIT PRICE

DRIVER KIT	OUTPUT KIT	MONITOR KIT	PSU KIT
LM50E	LM51F	LM52G	LM53H
£11.95	£99.95	£19.95	£89.95

NUCLEAR RADIATION MONITOR



capable of measuring the level of Alpha and Beta particles, and Gamma and X-Rays. Full details in Project Book 24 (XA24B) Price 85p.

KIT PRICE ONLY £99.95 ORDER CODE LM24B

All items subject to availability

Maplin Electronics
P.O. Box 3, Rayleigh, Essex, SS6 8LR.

MANY MORE PROJECTS INSIDE!

Pick up a copy of our giant 512 page catalogue from WHSMITH for just £1.60.

Shops at: ○ Sutton New Road, Erdington, Birmingham. ○ 302 Gloucester Road, Bristol. ○ 159-161 King Street, Hammersmith, London. ○ 8 Oxford Road, Manchester. ○ 46-48 Bevois Valley Road, Southampton. ○ 282-284 London Road, Southend-on-Sea.