EVERYDAY ELECTRONICS and computer PROJECTS

OCTOBER 1984 90p

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EVERYDAY ELECTRONICS and computer PROJECTS

VOL. 13 NO. 10 OCTOBER 1984

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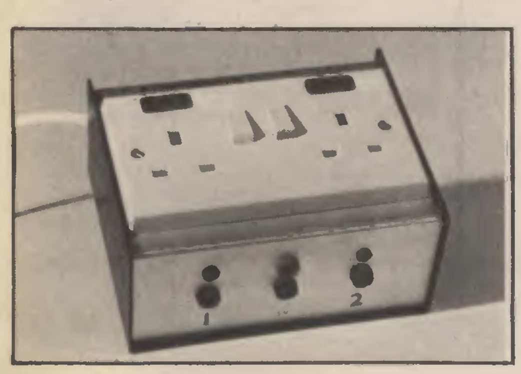
COMMENT . . . POPULAR FEATURES . . .



Our November 1984 issue will be published on Friday, October 19. See page 635 for details.

PROJECTS

SERIES

FEATURES

EVERYDAY ELECTRONICS and computer PROJECTS

VOL. 13 NO. 10 OCTOBER 1984

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MICRO-MUSIC

THIS issue of EE carries an interesting development of the microcomputer, the *Micro Memory Synthesiser*. The microcomputer is playing (excuse the pun) a big part in music production. A standard has now been set up for interfaces between instruments and control computers, etc. Even the lighting displays are computerised.

We will be keeping readers in touch with this area of interest and have a few ideas for projects in the pipeline. The *Micro Memory Synthesiser* article gives you the chance to build an instrument and learn for yourself something of the technology used. The finished project is fun to play with and if, like me, you are unable to bash out even the most simple tune, the teach mode is a great help.

If you feed the output to a power amplifier the sound is quite rewarding, with the tremolo set to please your ear. In short, fun to build and use.

ROBOTS

Next month EE moves fairly and squarely into the world of Robotics with the publication of *Alfred*. You will no doubt hear much more of *Alfred*. He is an educational robot that works just like an industrial one, won't cost an arm and a leg and can be built from a kit. *Alfred* is the first "real" robot EE will publish. A buggy type mobile was our recent start in this field; *Alfred* is the next step and from there the world is our oyster, so to speak. Again we have a number of robotics project ideas underway, so stay around—the future could be fun.

To put you right in touch with this relatively new field we will also publish a 16-page supplement on robotics next month. This supplement will carry two articles on the background of small robots and their technology, followed up by a buyer's guide to available small robots. There are now about twenty companies selling low-cost products of this type in the UK and the market is growing steadily. With this extra Free content (which will also be carried in our sister publication PRACTICAL ELECTRONICS) next month's issue is bound to be in great demand so make sure of your issue with an order at your newsagents now.

Mike Kenward

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope or international reply coupons.

We cannot undertake to engage in lengthy discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

Back Issues

Certain back issues of EVERYDAY ELECTRONICS are available worldwide price £1·00 inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.

Binders

Binders to hold one volume (12 issues) are available from the above address for £4·60 inclusive of postage and packing worldwide.
Please state which Volume.

Subscriptions

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DUAL MAINS SWITCH

MICHAEL SALES

THE mere computer cannot switch the television on, flash lights or control the heating. However, this unit allows such power. The conventional method of controlling mains electricity is to use a relay (see Fig. 1). TR1 provides base current to drive TR2, which is usually a more powerful transistor, operating the relay. The major disadvantages of this method are that mechanical parts are involved which have slow switching speeds and eventually wear out.

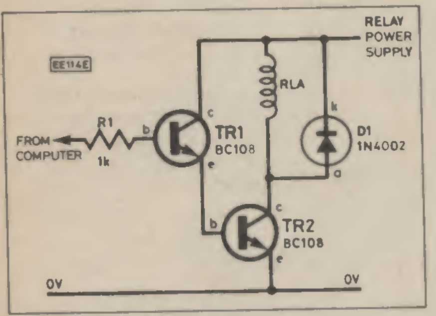


Fig. 1. Conventional mains control.

SOLID STATE

Triacs, on the other hand, can be used to switch high voltages and currents in a matter of a few microseconds without the click of a relay. However, they have to be connected to either the neutral or live of the mains along with a controlling circuit. Owing to safety considerations, transformer isolation or opto isolation needs to be employed. The latter is basically a light source and a light sensitive component (such as a thyristor, transistor or triac) enclosed in a small package. There is no electrical connection at all between the l.e.d. and, in this case, the triac as can be seen from Fig. 2.

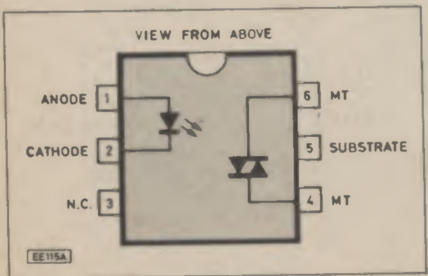


Fig. 2. Pin connections of the MOC3020.

CIRCUIT DESCRIPTION

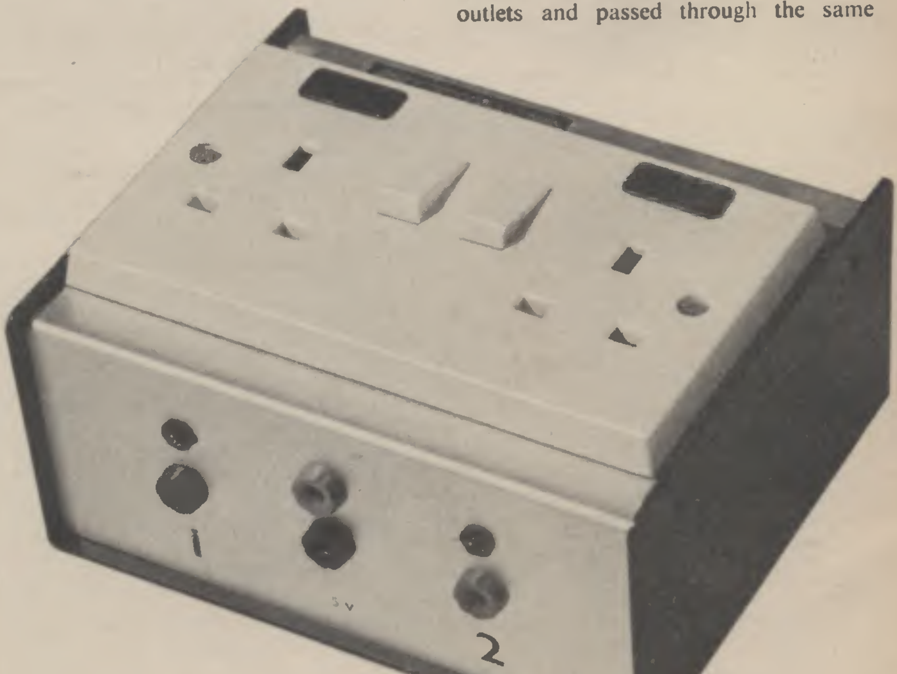
As there are essentially two identical circuits, one for each output, where a component has been repeated, such as R1, its duplicate is labelled R101. The low voltage side of the circuit is powered from the +5 volt rails present in most computers. The TTL level output from the computer is fed, via R1, to the base of TR1. If it is at logic 1 (2·4V), then TR1 switches on, lighting up D1 and the l.e.d. inside IC1. This operates the light sensitive triac and causes CSR1 to switch on. Resistor R3 protects the power triac from too much gate current, whilst R4 ensures that it is less likely to trigger on its own accord. CSR1 and the triac in IC1 remain on until the a.c. mains voltage drops near to zero volts.

Switch S1 is part of the double socket and allows the output to be switched on whatever the state of CSR1. Alternatively, this switch could be wired in series with the triac to allow the output to be manually switched off instead. There are a total of five lights on the unit, but these may be omitted if desired; when the l.e.d.s are left out R2 and R102 should be increased accordingly. The purpose of each light is shown in Table 1. C1 decouples the 5-volt rail.

CONSTRUCTION

The resistors, transistors, integrated circuits and the capacitor are all mounted on the matrix board with eleven wires connecting the rest of the components. Details of the 36 strips by 50 holes are shown in Fig. 5. After cutting this board to size, the breaks should then be made. Note the double line of breaks in the copper tracks—these keep the high voltage mains side separated from the low voltage computer connections. As 6-pin d.i.l. sockets are hard to obtain, soldercon terminals can be used when the opto isolators are not going to be soldered directly. When finished, the board must be carefully checked, especially the mains side—an error could be fatal!

In the prototype the triacs were bolted to the case but separated by insulators. Their leadouts should be insulated with sleeving. The connections to Live and Neutral were taken directly to the socket outlets and passed through the same



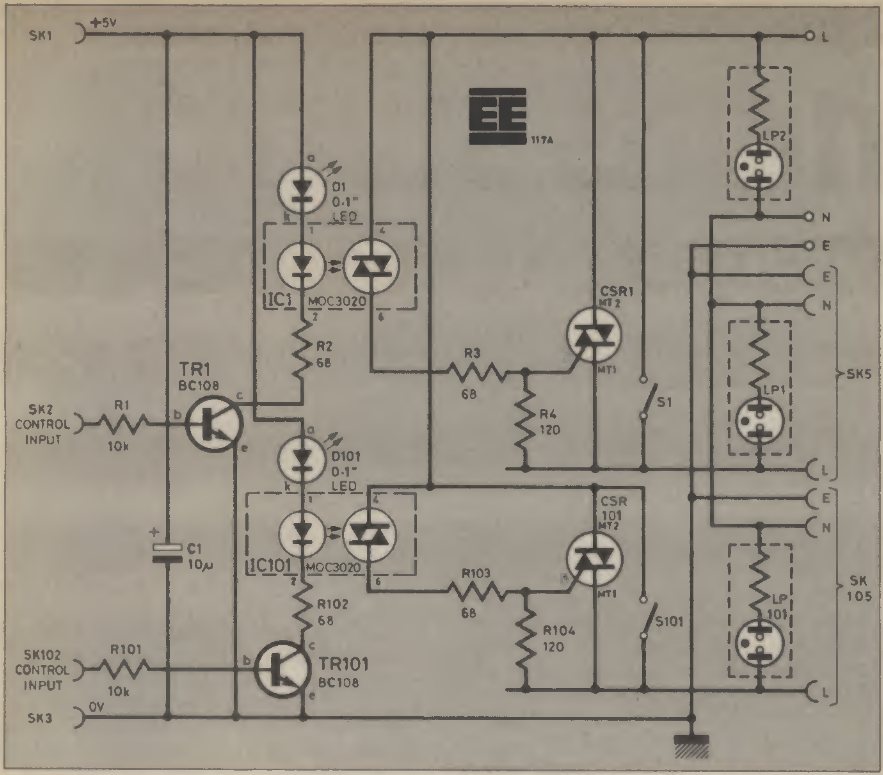


Fig. 3. Circuit diagram of the Dual Mains Switch.

holes as the neon connections. These and the wires from the live input to the triacs should be at least the current rating of FS1. The mains cable passes out through a strain-relief grommet, whilst the wires to the stripboard pass through a P-clip and are twisted together, to form a loom.

LIGHT	RECOMMENDED COLOUR	CONDITION WHEN ON
D1	Green	Input SK2 is at logic 1
D101	Green	Input SK102 is at logic 1
LP1	Red	When the output socket is live—either CSR1 or S1 is on
LP101	Red	When the output socket is live—either CSR101 or S101 is on
LP2	Orange	When the mains plug is in and FS1 has not blown

Table 1. Light indications.

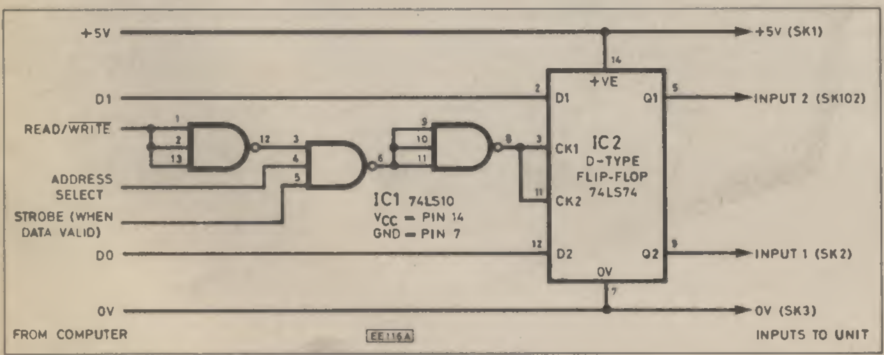


Fig. 4. ZX81 operation without a port.

COMPONENTS

Resistors

R1,R101	10k $\frac{1}{4}$W (2 off)
R2,R102	68 $\frac{1}{4}$W (2 off)
R3,R103	68 1W (2 off)
R4,R104	120 1W (2 off)

All carbon ±5%

Capacitor

C1	10µ, 10V elect. axial leads

Semiconductors

IC1, IC101	MOC3020 opto triac isolator (2 off)
CSR1, CSR101	TIC226D 8A, 400V triac (TO220 case) preferably with isolated tab (2 off)
TR1, TR101	*npn* silicon transistor e.g. BC108C, BC109C (2 off)
D1,D101	standard (0·1in) green l.e.d. (2 off)

Sockets

SK1	red wander socket
SK2, SK102	blue wander sockets (2 off)
SK3	black wander socket
SK5, SK105	double switched mains socket with neons

Miscellaneous

LP3	orange mains neon indicator having integral series resistor
FS1	5A fuse in panel mounting holder and/or 5A fuse in mains plug

6A mains three-core cable (2 metres or more); mains plug; grommet; various coloured hook-up wire; insulating sleeving; soldercon terminals for isolators (if needed); Veropins; P-clip; Veroboard 36 strips by 50 holes; means of supporting Veroboard; metal case: 150 x 115 x 70mm; l.e.d. mounting clips; electrical insulator for triac; nuts, bolts, solder, etc.

APPLICATIONS

The inputs of this unit can come from output ports in computers. For example, if the computer has a 6522 VIA (like the Atom, BBC and PET) the outputs can be from PA0 and PA1. The programming would then be:

POKE (base address of VIA+3),3

POKE (base address of VIA+1),X

where X is 0 for off; 1 for output 1 on; 2 for output 2 on; and 3 for both outputs on. On Acorn computers POKE should be replaced with a question mark. Computers without an output port (like the ZX81) will need extra circuitry such as shown in Fig. 4, and to output Use POKE (address), X

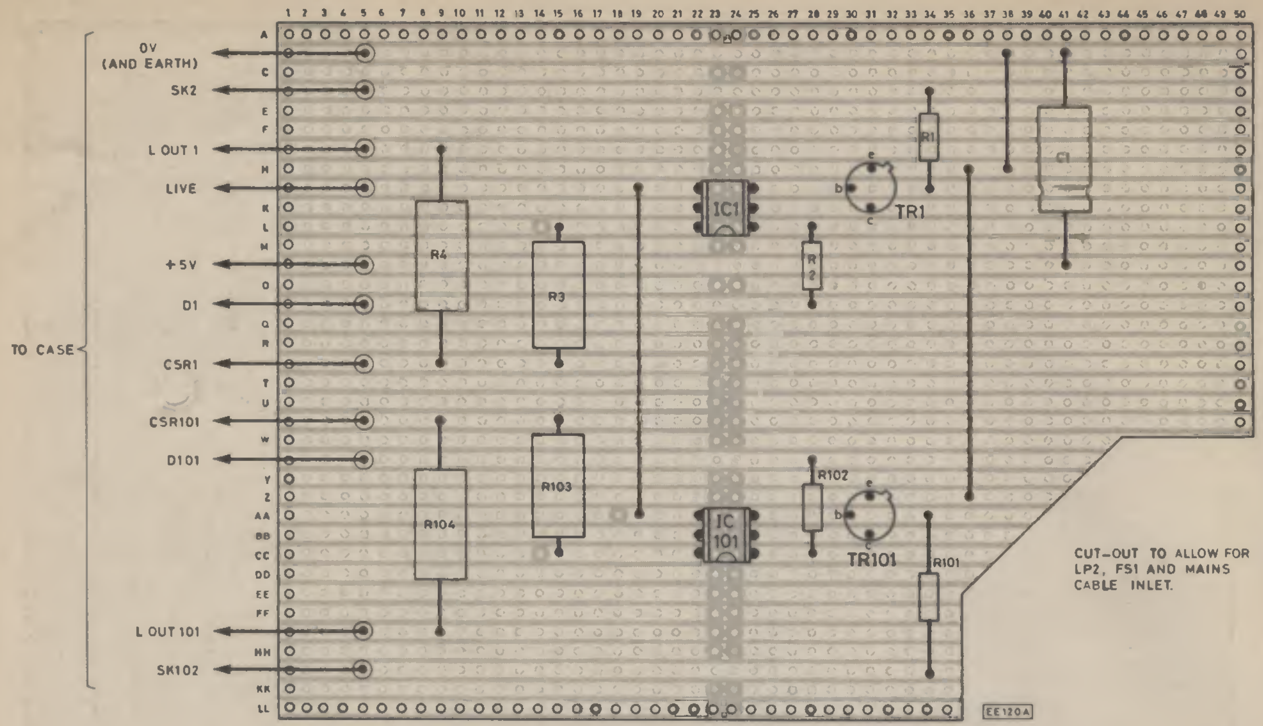


Fig. 5. The component layout of the Dual Mains Switch showing the wires to the panel connections.

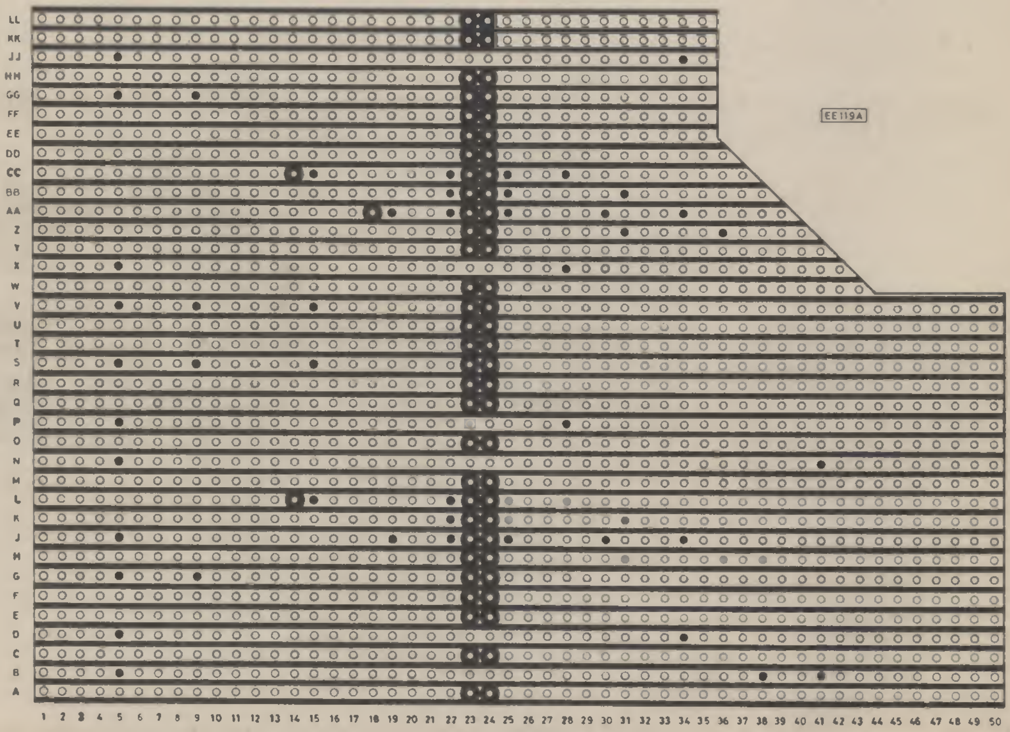


Fig. 6. Stripboard details of the Dual Mains Switch.

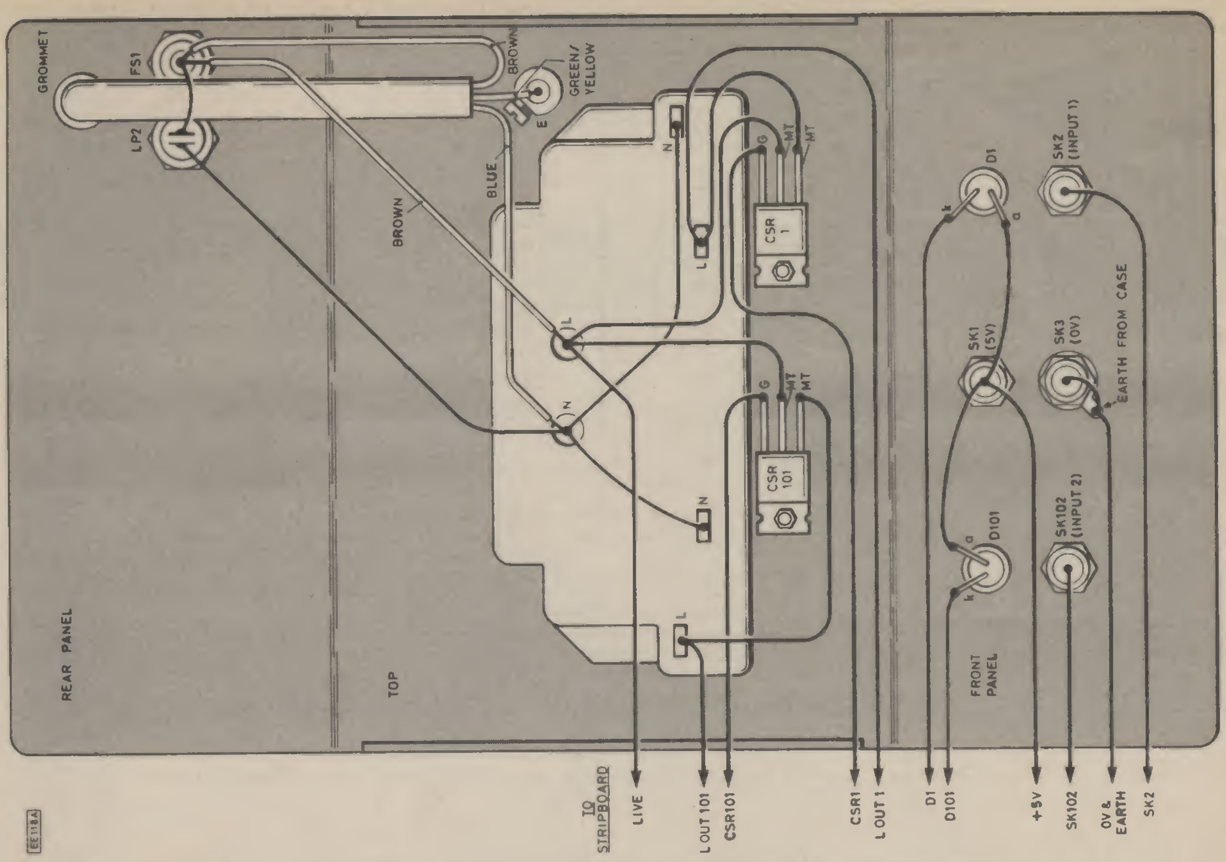
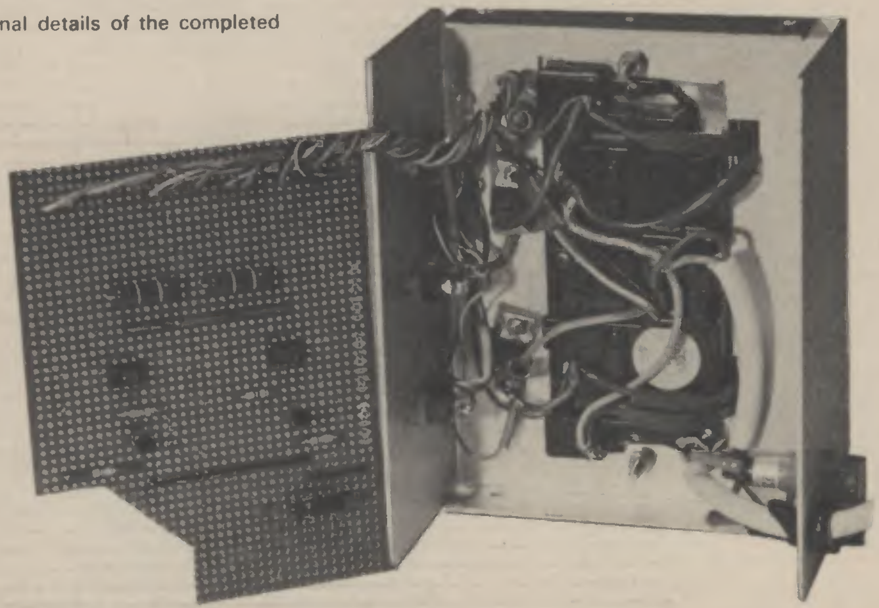


Fig. 7. Wiring details of the Dual Mains Switch showing connections to the stripboard.

Photograph showing the internal details of the completed Dual Mains Switch.



See Shop Talk page 642

TESTING

When the construction is finished, it must be tested for a short between the triacs and the case, and other shorts. The case must be reliably earthed. Before plugging into the mains, the low voltage side can be tested for correct operation. When all is correct, the case should be assembled and the mains connected via a 5A fuse in the live line. As with all mains operated equipment it is essential to take great care when testing or operating. Before removing the cover the mains should be disconnected. ★

DRILL SPEED CONTROLLER

MARK STUART

MOST people who have tackled a few DIY jobs will appreciate this project. Single speed pistol drills are fine for some jobs but can be totally unsuitable for others. Drilling large holes in metal; drilling masonry and cutting large holes using circular hole saws are just a few examples of jobs where a slower speed is needed. Even the drills fitted with two-speed gearboxes will benefit from the flexible speed control that this project provides.

CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 1. When the control/bypass switch S1 is closed the controller is out of circuit and the drill works normally. When S1 is opened power is applied only during positive half cycles of the mains via the thyristor CSR1. During negative half cycles CSR1 is cut off and power is not applied to the drill. The power fed to the drill is controlled by varying the amount of time that CSR1 conducts during each positive half cycle of the mains. This method of power control is known as phase control.

To understand phase control it is first necessary to know how a thyristor operates. The thyristor has just two states, on and off. Normally it is off; it is turned on by applying a small trigger current between the gate and cathode. Once it is turned on it remains on, even if the trigger current is removed, provided that there is some current flowing between the anode and cathode.

In an a.c. circuit the mains voltage falls to zero at the end of each half cycle. The thyristor therefore will be turned off automatically after each half cycle. Fig. 2 shows the effect of applying the trigger pulse at different parts of the half cycle. An early trigger pulse allows almost the whole half cycle to pass to the load, whilst a late trigger pulse allows only a small fraction of the half cycle through.

In Fig. 1 the trigger pulse is produced by the diac CSR2 and the capacitor C2. Whenever the voltage at point X exceeds the voltage at point Y by 30V the diac switches from open circuit to short circuit and triggers CSR1 by discharging C2 into its gate. Resistor R2 is included to prevent spurious triggering of CSR1 by mains borne interference pulses.

The supply of voltage to C2 and the diac is provided from the phase shift network R1 and C1 via potentiometer VR1 and diode D2. Diode D1 prevents C1 from being charged in the reverse direction during negative half cycles.

When VR1 is turned fully clockwise the full voltage on C1 is fed to the trigger circuit. The necessary 30V is reached quickly and so the trigger pulse occurs early in the half cycle giving the fastest speed. With VR1 fully anti-clockwise only a fraction of the voltage across C1 is fed to the trigger circuit. The 30V trigger threshold is reached only after C1 has had some time to charge. Therefore the trigger pulse occurs late in the half cycle and the drill runs at low speed. Preset VR2 sets the range of VR1 so that at minimum setting the drill is just turning. Without it there would be a dead-band on VR1.

BACK E.M.F. FEEDBACK

So far the circuit explanation has disregarded one very important aspect of the circuit. The so called "back e.m.f." of the drill, this is produced when the drill is turning without any power being applied.

Whatever the speed setting the drill only receives power for part of the time. During the whole negative half cycles and the first part of the positive half cycle (before the trigger pulse) the drill continues to rotate due to its inertia. As drills use universal motors the field magnetism is provided by field coils on the drill stator, usually connected in series with the armature. Therefore when the motor is turning without power there cannot be any field magnetism from these coils. Fortunately the stator iron core retains a residual magnetic field from the last time the field cores were energised. The motor thus acts as a dynamo generating a voltage which is proportional to the speed of rotation. This voltage is of the same polarity as the last applied pulse, so appears to oppose it—hence the title "back e.m.f.".

To see how the back e.m.f. influences the circuit refer to Fig. 1. The trigger pulse to CSR1 is produced as a result of point X being 30V more positive than point Y. If the motor is stationary there will be no back e.m.f. and point Y will be at 0V. If the motor is turning point Y will be at a positive voltage depending on the speed of the motor. More voltage will be required to trigger CSR1 when the motor is spinning because point X has to rise to 30V PLUS the back e.m.f. For point X to reach a higher voltage will take longer, therefore the trigger pulse will be delayed and less power applied. If the motor is loaded mechanically the speed drops, the

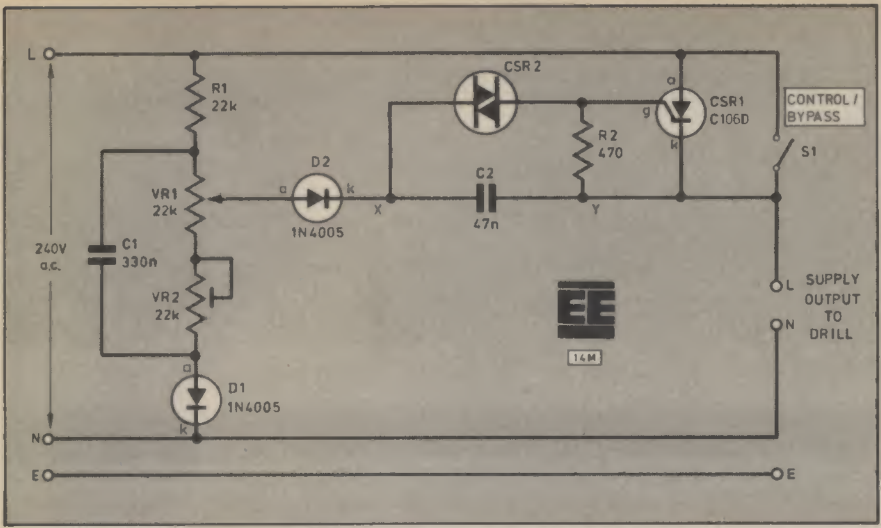


Fig. 1. Circuit diagram of the Drill Speed Controller.

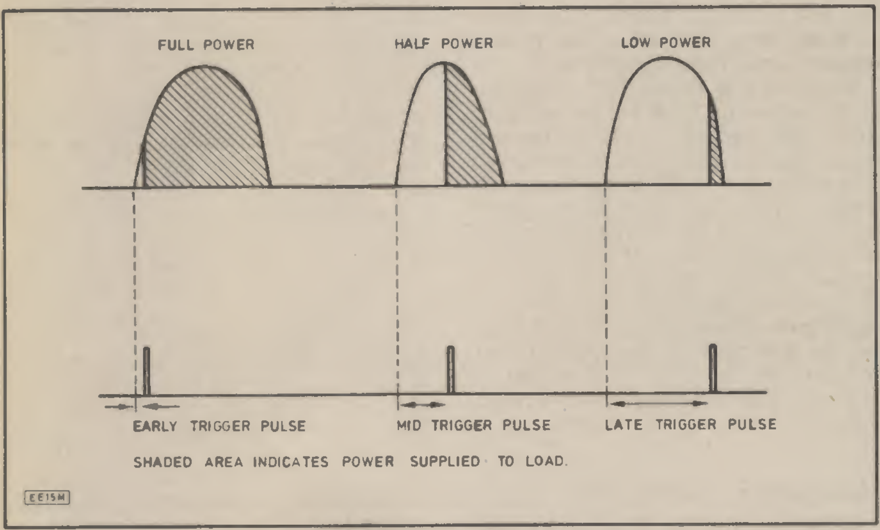


Fig. 2. The effects of applying the trigger pulse at different parts of the cycle.

COMPONENTS

Resistors

See **Shop Talk**

R1 22kΩ
R2 470Ω
VR1 22kΩ log pot with plastic spindle
VR2 22kΩ preset
All resistors ¼W 5% carbon

Capacitors

C1 330nF polyester 250V
C2 47nF polyester 250V

Semiconductors

D1,2 1N4005 (2 off)
CSR1 C106D 3A 400V thyristor
CSR2 BR100 diac

Miscellaneous

S1 s.p.s.t. mains rocker switch; plastic case; pointer knob; cable clamps (2); screws and pillars; cable; washers, etc.; printed circuit board, single-sided, size 40 x 50mm.

Approx. cost Guidance only £8.00

back e.m.f. drops, and point X does not have to rise so far. The trigger pulse therefore occurs earlier and more power is applied to the motor.

In this way the drill becomes "load sensitive" and the torque is increased as the load increases. The effect is to produce slow speed running with good torque characteristics.

CONSTRUCTION

The circuit is built on a small p.c.b. shown in Fig. 3 with the component layout shown in Fig. 4. First fit VR1 and fit a locking washer to the spindle and then pass the spindle through the board from the trackside. The pins of the potentiometer should be carefully bent forward 90 degrees to fit into the holes in the

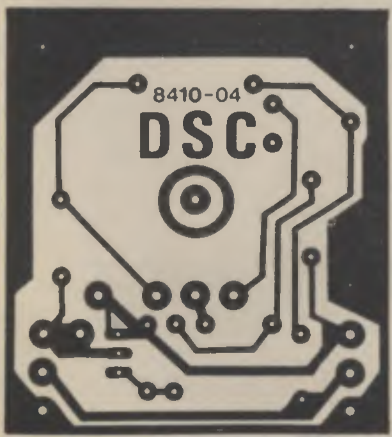


Fig. 3. Full size printed circuit board design.

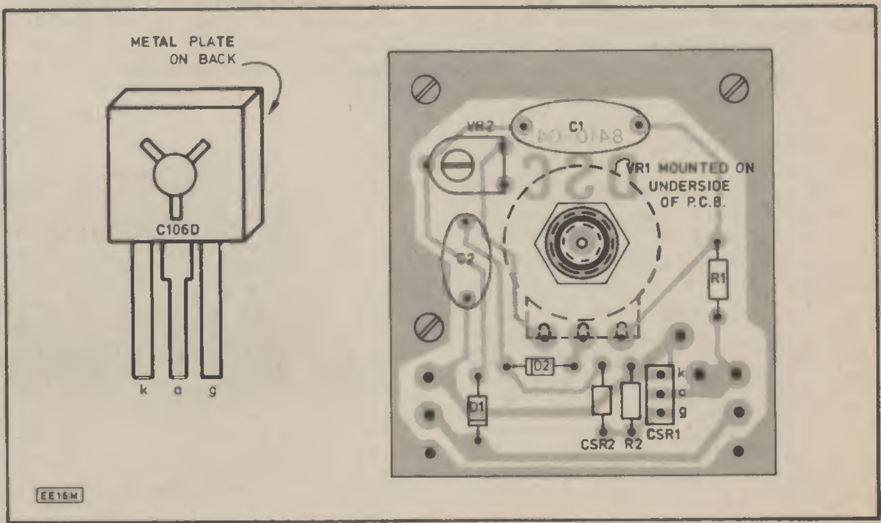


Fig. 4. Component layout.

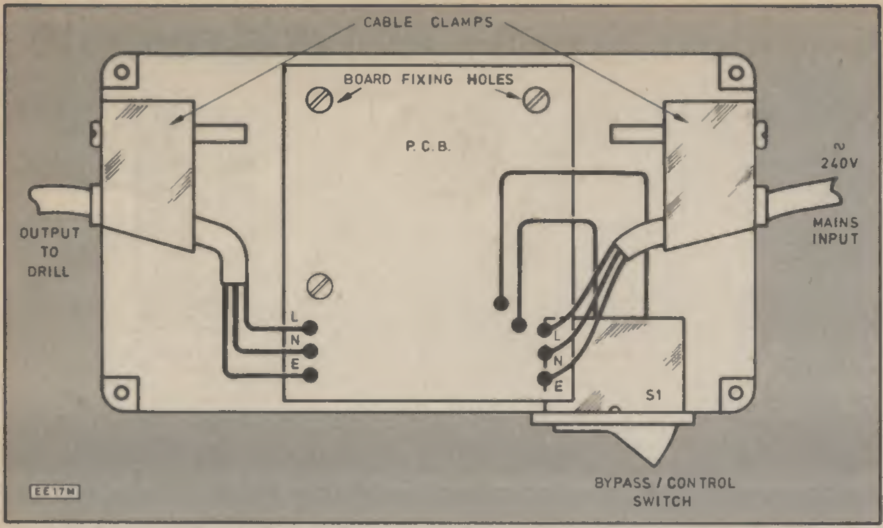
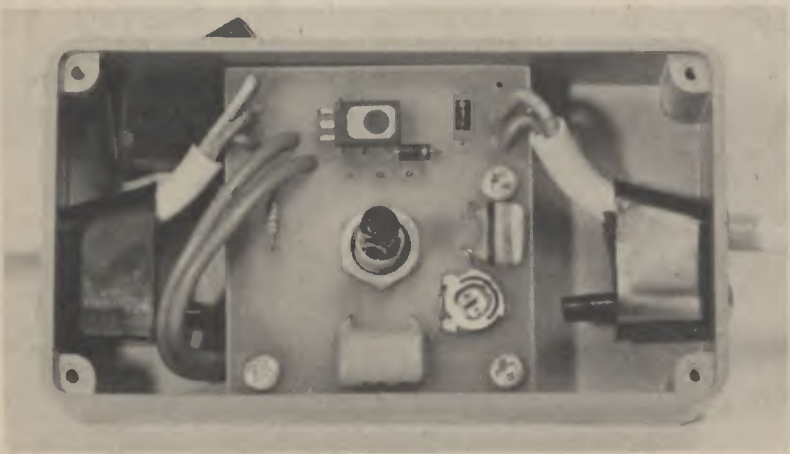


Fig. 5. Wiring diagram.



board. The other components can then be mounted. Note the polarity of D1, D2 and CSR1. CSR2 can be inserted either way round. CSR1, C1 and C2 must be bent over after fixing so ensure that sufficient lead is allowed above the board for this.

When the board is complete the case should be drilled to take two cable clamps and the bypass/control switch. The case, switch and cable clamps specified have been selected to ensure safe operation. If the unit is permanently wired into the drill lead it will be subject to considerable physical abuse so do be careful with construction.

Fig. 5 shows the arrangement of the components in the box. The case specified is a tight fit but results in a pleasant compact unit. An all-plastic case must be used for safety. The switch must be mounted right at the bottom of the case so that the board can be fitted over it. Wiring to the board should be made directly rather than by using wiring pins, to reduce the chance of accidental short circuits. The terminals of S1 should be insulated with 4mm sleeving after the leads have been connected. The input and output leads should be passed loosely through the cable clamps and then connected to the board. They can be drawn back through the clamps and the clamps tightened after the board has been mounted. Some drills will only have two core leads. In this case only the Live and Neutral output terminals will be used. A three core lead should still be used for the incoming mains, and the earth connection made to the board as usual.

When the wiring is complete the board can be mounted in the case. Insulating pillars and self-tapping screws must be used to ensure good insulation. Standard ½in pillars were found to be slightly too short and were extended using plain washers.

The board should be positioned so that the plastic spindle of VR1 will pass through the case lid whilst leaving the metal mounting bush inside the case.

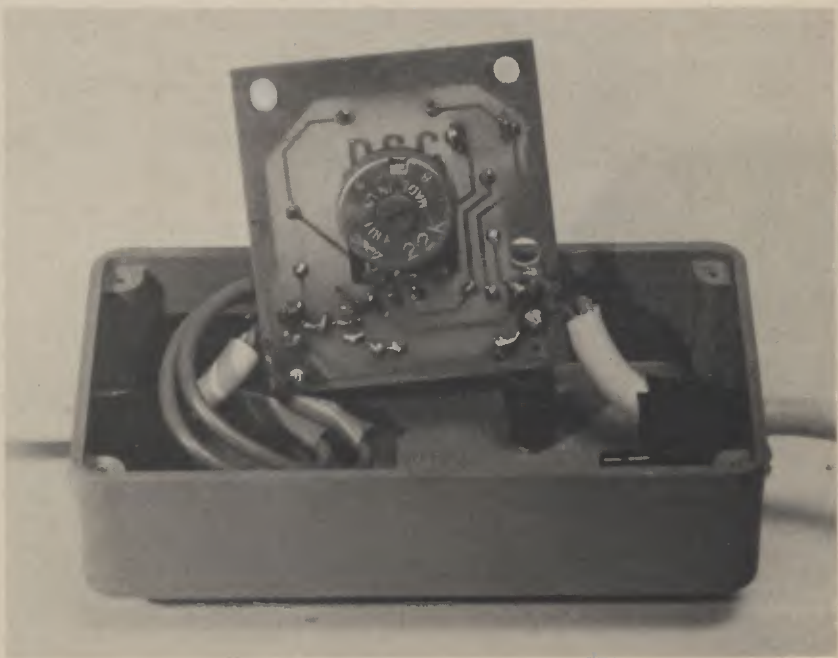
The case lid should be drilled very carefully to be a close fit on the ¼in spindle. This will minimise the ingress of dirt and moisture into the unit.

TESTING

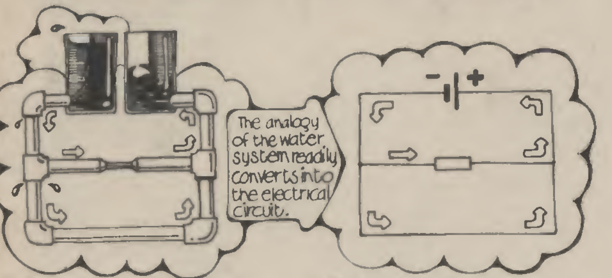
When testing remember, at all times, that the circuit is working at a.c. mains voltage and take care.

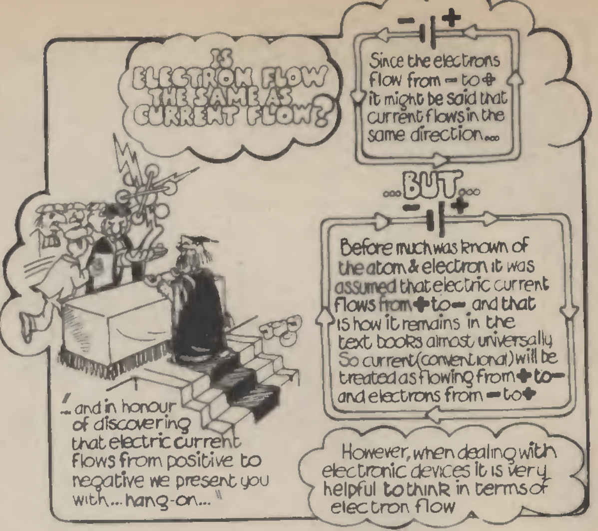
Connect the mains and a suitable drill and set S1 to the control position. Switch on the drill and check the effect of VR1. Assuming everything is OK the speed should be variable from zero to half speed. The adjustment of VR2 is carried out with VR1 set to minimum. Use an insulated screwdriver or trimming tool and turn VR2 until the drill is just turning. This setting gives the optimum range of control. The operation of the back e.m.f. feedback will become apparent when attempting to stall the drill at low speeds. Finally check that the bypass switch sets the drill to full speed/normal operation. □

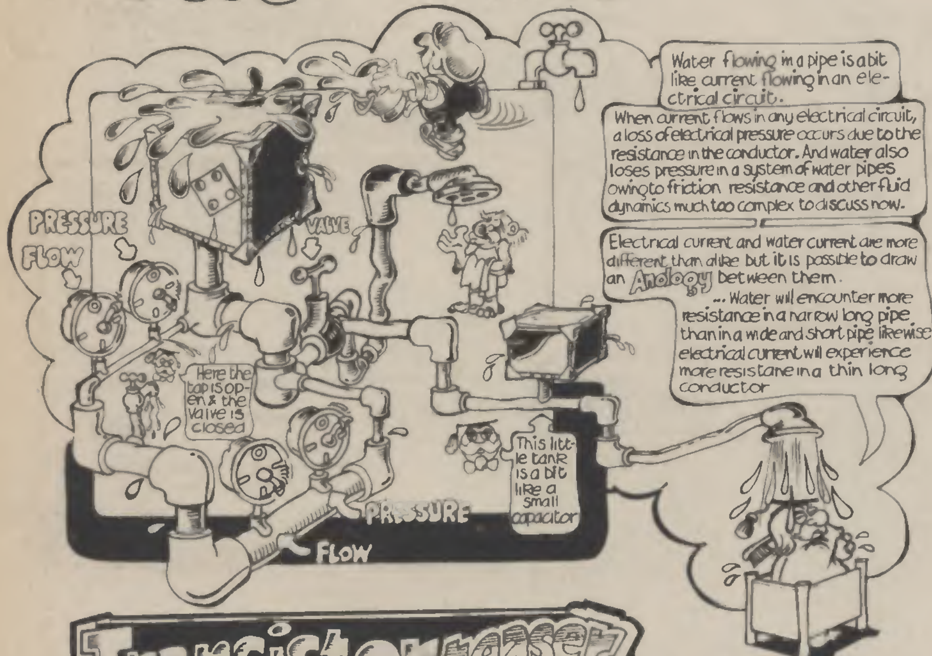
Internal views of the Drill Speed Controller.



FUNTRONICS with CURRENT







Formula Fun

Join the contents of each square into pairs to make 15 seperate formulae

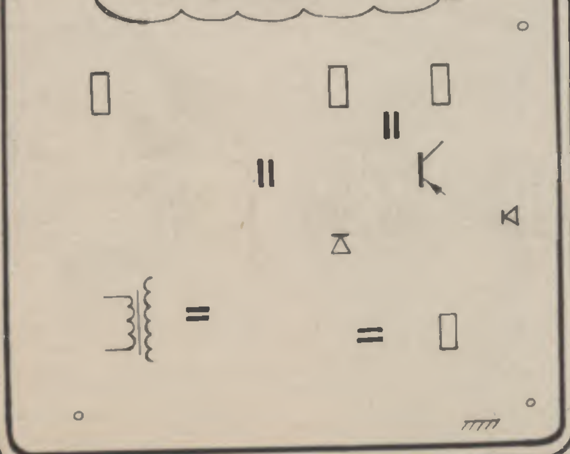
I	F	P	G	$\frac{Ra}{L}$	X_c
$\frac{I}{E}$	W	V	It	V	ma
Q	R	VIt	$\frac{1}{\omega C}$	Q	P
$E\frac{1}{R}$	IR	EG	$\frac{V}{R}$	$\frac{L}{a}P$	I
W	VQ	CV	I	$\frac{Q}{C}$	I^2R

Example

1 F=ma	6 W=	11 Q=
2 I=	7 V=	12 P=
3 Q=	8 V=	13 I=
4 G=	9 Q=	14 W=
5 X_c=	10 R=	15 I=

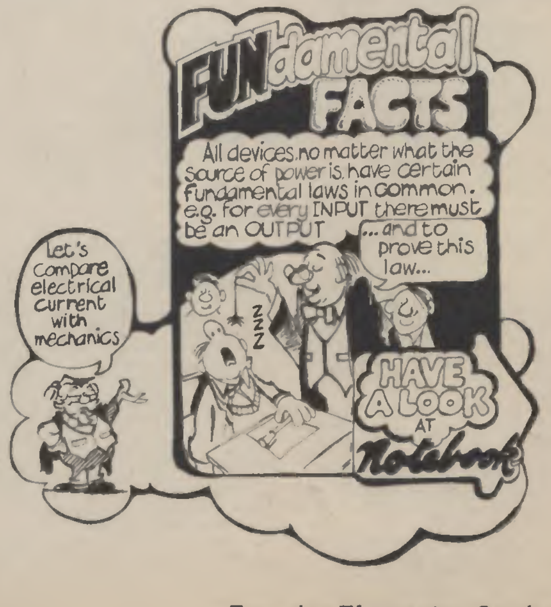
Transistor teaser

Link-up the components below to form a well known circuit ... 3 of the components are not required.



Tuned base oscillator

FUNdamental FACTS



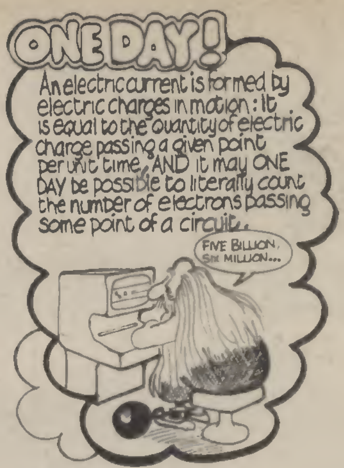
LINK-UP.

Start at R and form a chain of words related to electronics

R	E	N	O	A	L	L	A	R
O	R	G	I	M	I	N	G	D
T	I	D	S	O	S	T	A	M
G	N	O	I	I	R	O	I	O
I	O	N	V	D	M	A	D	D
R	R	T	O	A	■	N	N	E
E	D	R	T	R	■	G	I	N
O	N	A	C	O	N	A	N	E
P	S	N	O	N	I	R	T	U

CLUES

1st word. R _ _ _ _ _ You listen to it
2nd " M _ L _ _ _ D. Tactical voice communication
3rd " _ AG _ _ _ _ O _ Solid state device
4th " _ _ N _ _ NIN Manganese, Cu, Ni alloy.
5th " _ I _ _ _ _ Rectifier
6th " _ EU _ _ _ _ O Neutral particle
7th " _ OCTO _ _ _ _ _ _ _ Infrared T.V. system
8th " _ R _ unit of work.
9th " _ O _ O _ Gives N-type
10th " _ R _ N _ _ _ _ _ _ _ E _ Transmitter-receiver.
11th " _ _ _ _ _ _ O _ part of ignitron



Notebook

NEWTON'S LAWS of motion

LAW I. Every body continues in its state of rest or uniform motion in a straight line unless impressed forces act on it.

LAW II The change of momentum per unit time is proportional to the impressed force and takes place in the direction of the straight line along which the force acts.

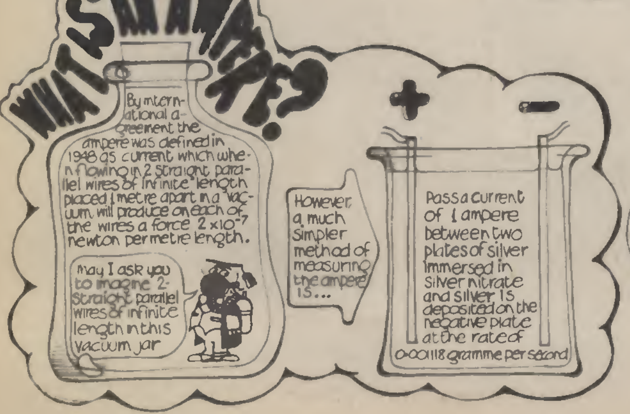
LAW III Action & reaction are always equal and opposite.

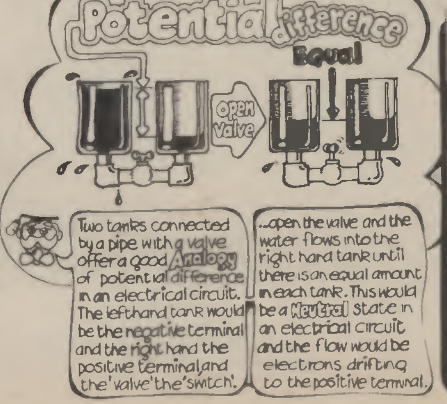
See how the electrical and mechanical formulae relate to each other...

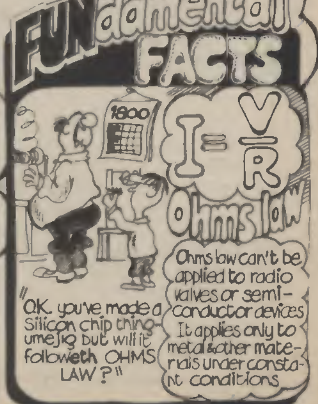
MECHANICAL	ELECTRICAL
FORCE $F=Ma$ Force = mass x acceleration	**FORCE** (electromotive force) $V=RI$ Volts = resistance x current
WORK $W=Fd$ Work = Force x distance	**WORK** $W=VQ$ Work = Volts x Coulombs
POWER $P=W \div t$ Power = work ÷ time	**POWER** $P=W \div t$ Power = work ÷ time

by Thakery

Solutions page 645







RADIO WORLD

BY PAT HAWKER G3VA

Amateurs In Space

NASA is expected to encourage further use of amateur radio equipment during flights of the Space Shuttle in 1985 and 1986. The first experiment conducted by Dr. Owen Garriott, W5LFL, during the STS–9 flight of *Columbia* in December, 1983, is generally conceded to have been technically only a qualified success but provided NASA and amateur radio with a great deal of publicity.

Because of the high noise level in the shuttle Dr. Garriott made very few two-way contacts with amateurs but tape recorded almost 300 people calling him. The most successful mode was frequency-modulation as it is much less affected by the Doppler shift caused by the rapid travel of *Columbia* than the single-sideband mode.

Unfortunately the technical difficulties were exacerbated by problems caused in some cases by poor operating discipline or lack of knowledge of the agreed procedures on the part of amateurs seeking contact with W5LFL, and in a few cases by deliberate interference. Only about five British callsigns were recorded in the shuttle and there were no two-way contacts with the UK.

Future activity on the amateur bands during shuttle flights seems assured as there are now two more NASA astronauts holding amateur licences: Anthony England, WoORE, due in space in April, 1985, and Ron Parise, WA4SIR, a NASA scientist due to make his first flight in 1986.

Technically there are few reasons why it should not be possible to make satisfactory radio contact even on very low power with a spacecraft in low orbit: but it seems essential that lessons are learned from the near-shambles of last December when people were calling W5LFL on the down channel. Since these events attract much media attention, every effort should be made to ensure that the resulting publicity reflects favourably on the hobby.

Digits In Receivers

High-performance h.f. communications receivers used by radio amateurs first emerged almost exactly 50 years ago with such designs as the National HRO, Hammarlund Super Pro and a string of models from the Hallicrafters firm set up by Bill Halligan, W9WZE. It says much for the excellence of such designs that, for example, the HRO-Senior of 1936 is still sought after not only by a few collectors but as an operational receiver that, at least for Morse operation on some bands, is still capable of forming a very good station receiver.

Although the circuitry was far less complex than that of modern communications receivers, the mechanical excellence of the HRO with its ingenious PW ("micrometer") tuning mechanism and dial, and plug-in coil assemblies was of a standard that today would be extremely costly. In 1938 an HRO Senior with four coil assemblies cost about £50, roughly the equivalent of £1000 in today's monopoly money.

Current communications receivers have greater stability, can be set very accurately to a given frequency, have superior bandpass crystal filters and, in some cases, can cope well with both very strong and very weak signals, but seldom seem to attract the same "loyalty" from the users, as the vintage models.

A new era for communications receivers may be opening up with the news that the American firm Rockwell-Collins is about to go into production with a professional model, HF2050, claimed as the first set, other than experimental prototypes, to use digital processing throughout the i.f. stages. Over 1000 of these sets are due to be delivered over the next 15 months to the Canadian Department of National Defence.

While one needs to be extremely careful not to fall into the trap that digital techniques are necessarily superior to "old-fashioned analogue electronics", and one notes that the front-end of the HF2050 stays analogue, there does seem some very important plus-points in the new approach which involves the use of four or five "off-the-shelf" signal-processing microprocessors to perform such i.f. functions as frequency conversion and selective filtering. Digital filtering, under software control, should prove more flexible and cheaper than the use, as at present, of a number of costly crystal bandpass filters each providing a fixed degree of selectivity.

In the HF2050, the 3MHz i.f. signal is sampled and digitised at a rate of 12 million samples a second. After digital processing a d/a converter at 16,000 samples per second provides the audio output.

The real attraction of digital signal processing would seem to be the smaller number of separate components, most of an "off-the-shelf" type, and making it easier to use automatic insertion of components during manufacture. It is also claimed that receivers can be significantly smaller though there are already many amateur operators who find the rather crowded controls of current h.f. receivers less easy to use than those of the old, built-like-a-battleship, models of yesteryear.

There is little doubt that digital signal processing will find increasing application in receivers of the future, possibly including—as integrated circuit devices come to operate at higher speeds—direct digitalisation of the incoming signals before initial frequency conversion.

More Amateurs

The number of British amateur licences continues to grow at a remarkable pace. Less than a year after the introduction of the G1 prefix for Class B licences, callsigns in the G1G–– sequence are exhausted, representing the issue of over 4000 new licences. Class A licences may exhaust the G4 sequence this year, so that it will not be long before the new prefix G0 makes an appearance on the h.f. bands.

The very large number of amateurs who confine their activities to 144MHz, however, is certainly creating problems in some parts of the UK. One result is that more stations appear to be ignoring the voluntary band-planning. Another is a degree of unease concerning the valuable, if at times controversial, activities of Raynet, the radio amateur's emergency network which has been given specific new powers in the present UK licence, including the right to participate in more exercises.

Not all amateurs approve of the participation of Raynet in civil defence exercises, some on the grounds that these involve the use of amateur frequencies for purposes other than those originally intended. Raynet was originally set up following the tidal flooding disaster in East Anglia and operates in conjunction with the British Red Cross Society, the St. John Ambulance Brigade, County Emergency Planning Officers and the police forces.

Amateur Radio On TV

Amateur radio, itself, has changed greatly over the years. At one time many enthusiasts spent much of their time with a soldering iron building their equipment.

Today the vast majority of stations use factory-built equipment with far more emphasis on operating than experimenting, though at least on h.f. there is still a lot of interest in trying out new types of aerials—at least by those unable to erect the massive beam arrays that undoubtedly make it easier to work over long distances.

From time-to-time amateur radio activities have been featured in films, plays and books intended for the general public. I remember a French film "Race for Life" some 25 years ago; then there was the classic TV comedy (later issued as a long-playing disc) sketch "The Radio Ham" with Tony Hancock—still as funny today as when it was made.

A more serious attempt to dramatise amateur radio will be seen this autumn on *Channel 4* when a play "CQ" by Paula Milne is screened. The play tells the story of "Norman" an insurance loss adjuster and amateur radio enthusiast who becomes the "voice" of a round-the-world lone yachtsman and so wins, if only temporarily, celebrity status on radio and TV. Unfortunately things go wrong when contact with the yacht is broken . . . but it is unfair to give away more of the plot.

A virtually complete amateur station was set up in the Limehouse Studios for the shooting of the play—but you have to look pretty closely to spot that the outside shots of the aerial rising above a suburban street really show only a model built by designer Richard Henry. Authenticity of the radio contacts, etc., stems from the technical adviser, Peter Marcham, G3YXZ.

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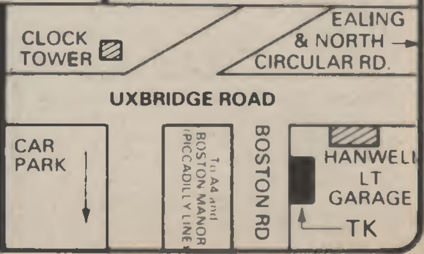
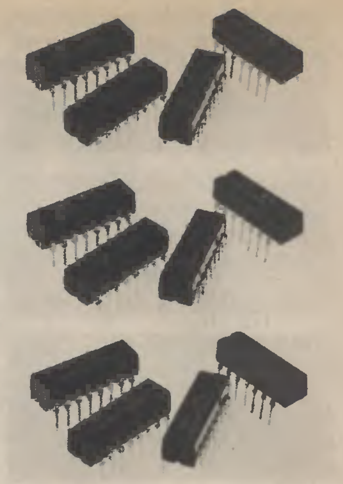


DIGITAL ELECTRONICS

D.W. CRABTREE B Sc Tech Eng (CEI)

PART ONE

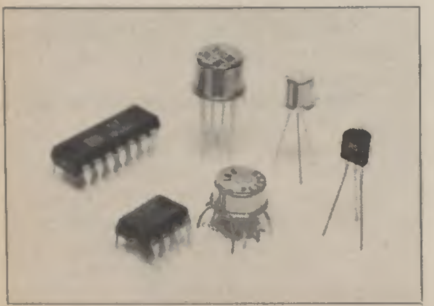


THIS article is the first of a series explaining the principles of digital electronics. Throughout the series I shall try to explain the reasons that have made digital electronics so popular. I shall give descriptions of components, logic families and their components; techniques and tips used in design of systems and circuitry; number systems used in digital systems and towards the end of the series, details of system design using microprocessors. The aim of the series is to give those people with an analogue electronics background an insight into the uses of what has now become a circuit 'building brick' with applications in just about every conceivable field of industry and commerce.

ANALOGUE AND DIGITAL ELECTRONICS—A BRIEF COMPARISON

First of all, let us look at the basic output states of a transistor. Without considering the reasons why, we can say that the transistor can be either completely switched off or completely saturated, or it can be in any state between these two extremes. It is said to be an analogue device, with all states being completely variable.

Now consider an electro-mechanical device, a relay. Under normal situations, this device can assume only two states, either energised (on) or de-energised (off). Now this cannot be an analogue component, because we do not have a completely variable set of states. Hence the relay can be considered to be a digital device, since this analogy assumes that only two states can exist, on or off.



Similarly, a switch can also be on or off. *Digital electronics* is, quite simply, a collection of switching circuits combined in such a way as to allow certain outputs with certain inputs.

ADVANTAGES OF USING DIGITAL ELECTRONICS

Digital electronics has numerous advantages over analogue circuits, some of which are listed below:

a) Increased accuracy.
b) Easier data communication: that is, we are looking for the existence (or not) of signals rather than the amplitude of those signals.
c) Sequencing of operations: circuits can be made to switch in a required sequence.
d) Easier manipulation of data: easy to perform mathematical functions, such as, add, subtract or multiply data.
e) Low cost components.
f) High availability of components.
g) 'Standard' components produced, regardless of manufacturer.
h) Complex circuits produced from basic 'building bricks'.

DISADVANTAGES

Although the advantages of using digital electronics are numerous, there are certain disadvantages, although these are few.

One such disadvantage is that special transducers may be required to convert from analogue-to-digital signals. These transducers may be expensive. Similarly, special interfaces may be required between inputs, outputs and digital systems.

Another disadvantage could be the requirement of extra special skills by designers of the more complex electronic circuits. (e.g. a knowledge of software). Also, if the designer has need to consider fail-safe requirements, there could be problems since such operations could be suspect.

TYPES OF COMPONENTS AND SYSTEM

Digital systems can be put into three main classifications:

1) Special Purpose Constructions: These circuits are designed around the requirements for the system and the relationships between the outputs and the known inputs. This is the procedure regardless of the size of the system or the type of the system. Use is made of discrete components, logic gates, programmable logic arrays (PLA's) or, say, microprocessors.
2) Digital Computer Systems: Much use is made of microprocessors with systems designed for a dedicated function.
3) Large Computing Systems: The microprocessor becomes an excellent tool for providing large computing facilities at very low cost.

DESIGN OF SYSTEMS

Digital electronics is such that, however large or complex the system becomes, to the experienced designer each system is designed from basic requirements, in simple stages. The design becomes the process of connecting together switching circuits, in the form of standard integrated circuit 'modules', in a logical way in order to meet the system criteria.

The problem of constructing the system falls into two stages. The first is to look at the relationships between the inputs and the outputs and draw up 'truth tables' if necessary. (More of this in a later Part of the series.) The second stage is to decide how best to solve the problem with regards to the design of the hardware (or hardware and software) involved.

When the hardware design is being considered, it is necessary to formulate the exact requirements and then bear in mind that the main design constraints will be cost (which should be kept to a minimum), reliability, ease of maintenance and/or ease of manufacture. It should also be considered whether a microprocessor (microcomputer) system should be used in order to keep design and design costs to a minimum. It is important that certain other factors, such as the number of on-board chips, are also taken into consideration.

LOGIC FAMILIES

Basically, there are two main types of digital families in use today, TTL and CMOS, together with a third sub-set called Wired Logic.

TTL

This is *Transistor Transistor Logic* and involves the combination of bipolar transistors (in integrated circuit networks) in such a way as to provide switching circuits by either saturating the transistors or by turning them off completely. Basically, TTL circuits require +5V inputs (logic 'high', '1', or 'true') or zero volt inputs (logic 'low', '0', or 'false') to give similar levels of outputs. The supply voltages are +5V (±0·25V) with respect to ground.

There are different sub-types of TTL:

a) Standard, e.g., 7400, typically 10mW/gate power.
b) Low Power. 'L' type, e.g., 74L00, typically 33ns propagation delay and 1mW/gate power.
c) Schottky, 'S' type, e.g., 74S00, typically 3ns propagation delay and 22mW/gate power.
d) Low Power Schottky, 'LS' type, e.g., 74LS00, typically 9·5ns propagation delay and 2mW/gate power.

CMOS

This is *Complementary Metal Oxide Semiconductor* technology, and refers to the construction of switching integrated circuits incorporating transistors with unipolar field effect configuration. CMOS requires a supply of +3V to +18V with respect to ground. It is much slower than TTL, typically 10μs propagation delay at +5V and 1μs propagation delay at +15V, but uses much less power than TTL, typically only microwatts. CMOS carries greater noise immunity than does TTL, but is subject to damage by static electricity.

Generally all types of gates available in TTL are also available in CMOS. Therefore when designing digital systems, the designer must consider:

a) Power consumption, if this is going to be a problem, CMOS may have to be used.
b) Speeds of operation, if fast devices are required, this rules out CMOS in favour of TTL.
c) If power supplies have to be of low voltage, either TTL or CMOS may be used, but CMOS will have greater immunity to fluctuations of voltage levels and to any noise present.
d) If static electricity is likely to be present, TTL may have to be used or sheathing of circuits carried out.

Hence, each system must be considered independently and TTL and CMOS must be compared on their merits.

WIRED LOGIC

Generally speaking, damage may occur to components if the outputs of gates are connected together and this practice should be avoided. However in some cases it may be required to do this and, in this case, Wired Logic is used. Here 'open-collector' gates are used and outputs can be connected together, providing these outputs are also connected to the supply rail via a 'pull-up' resistor.

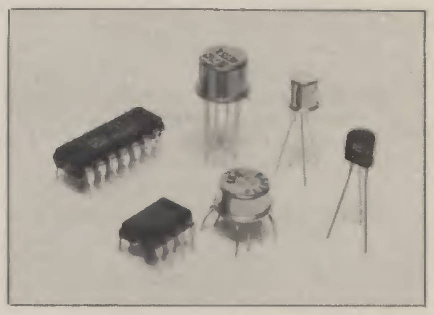
However, this wired logic circuitry is generally used only for, say, connecting peripherals to microcomputer buses, and so will not be covered in great detail in this series.

REPRESENTATION OF LOGIC INFORMATION

'Positive' logic systems will only be considered where, for TTL, +5V represents a logic '1' (or 'high' or 'true') and 0V represents a logic '0' (or 'low' or 'false'). However some tolerance must be included on these levels and so a logic '1' is taken to be between 3·3V and 5V. Logic '0' is taken to be between 0·2V to 2·4V. Manufacturers' data sheets should be consulted for exact details for CMOS, as the levels then are dependent on the supply voltage used.

Therefore all systems have information represented in this way and these levels are taken as standards throughout the digital electronics industry.

NB: 'Negative' logic is where a '1' represents a 'low' and a '0' represents a 'high'.



BOOLEAN ALGEBRA

Digital electronics incorporates the electronic inspection of the inputs to, and the outputs from, a 'black box'. The relationships between the inputs and the outputs are pre-defined and therefore must be seen to be in the form of mathematical equations, with outputs given with certain input conditions. These equations are said to be 'logic expressions' and Boolean Algebra is used to form these expressions.

Let us consider the ways in which we show these expressions. In normal algebra we have expressions similar to that in the following example:

$$A + B + C = D$$

with '+' meaning 'plus' or 'and'.

Similarly we also have expressions thus:

$$A.B.C = D$$

where the '.' means 'multiplied by'.

It is seen that we have combined functions using symbols and therefore created algebraic expressions. We can do exactly the same with Boolean Algebra, using the same symbols to join functions together but noting that the symbols have different meanings.

In Boolean Algebra '.' means 'and' whereas '+' means 'or'.

Thus A + B + C = D means: 'Either A or B or C (or any combination) equals D': **Example (1).**
Also A.B.C = D means: 'A and B and C equals D': **Example (2).**

Therefore in Example (1), if D is an output from the aforementioned 'black box' and A, B and C are the inputs, it can be shown that there will be an output D present with any of the three inputs present.

In Example (2), using the same logical descriptions, an output D is only present with all the inputs present simultaneously.

In the way described, we have therefore a method of expressing the input to other relationships of a system. Just as, in normal algebra, we can use combinations of '+' and '.' symbols, together with 'brackets' if required, we can also do this in Boolean algebra as long as we remember the meanings of the symbols.

Example (3). (A + B).C = D means we have an output D as long as we have an input C at the same time as we have *either* an input A *or* an input B.

Also, as in normal algebra, we can 'multiply out' brackets and functions or, conversely, 'factorise' functions by putting them into brackets. So, in Example (3), this expression could also be written, then multiplied out, as:

$$A.C + B.C = D$$

with exactly the same meaning as before.

Conversely, from this latter expression we can take 'C' as a common factor and restore our expression to that given in Example (3).

These methods can always be applied, in exactly the same way, regardless of the length of the expression or the number of brackets, to any expression at all. The rules are simply to treat the expressions as normal algebra until it is necessary to completely define the final expressions, in which case '+' and '.' are taken as 'or' then 'and' respectively.

Example (4). $(A + B).(C + D) = E$ is equivalent to $A.C. + A.D + B.C + B.D = E$.

There are one or two other rules to remember, besides those already mentioned:

$A.A$ is equivalent to A
$A + A$ is equivalent to A
$A.1$ is equivalent to A
$A + 1$ is equivalent to 1
$A + 0$ is equivalent to A
$A.0$ is equivalent to 0

We also have, besides the 'and' and 'or' functions, a 'not' function, where $\overline{A}$ (called 'not A' or 'A bar') is the converse of A. That is, if A is designated as a logic '1' then $\overline{A}$ would be a '0', and vice versa. This leads to a further set of rules thus:

$A.\overline{A}$ is equivalent to 0
$A + \overline{A}$ is equivalent to 1
$\overline{A}.0$ is equivalent to 0
$\overline{A} + 0$ is equivalent to $\overline{A}$
$\overline{A}.1$ is equivalent to $\overline{A}$
$\overline{A} + 1$ is equivalent to 1

As previously stated, we can therefore create any required expressions which have outputs available dependent upon the states of the inputs, and from these expressions we can go on to design the circuits that will perform the desired logical operation.

TRUTH TABLES

Before the circuits can be designed, and before the logical expressions can be created, a list of requirements must be drawn up from the known input and output relationships. This is a list of all the possible input combinations with the required outputs, against each combination, listed also. This listing is known as a 'truth table' and has a format similar to that shown in Example (5) *below*. Suppose we have the expression $A + (B.C) = D$, where D is the output function. We can draw the truth table thus:

Example (5).

A	B	C	D
0	0	0	0
1	0	0	1
0	1	0	0
1	1	0	1
0	0	1	0
1	0	1	1
0	1	1	1
1	1	1	1

We require an output D whenever A or (B.C) is true or whenever both conditions are true together. So we write a '1' in the 'D' column when this requirement is met, thus obtaining the basis of an expression for D using a '1' in the D column.

$$D = A.\overline{B}.\overline{C} + A.B.\overline{C} + A.\overline{B}.C + \overline{A}.B.C + A.B.C$$

But it can be seen that this is not the expression that we require since it is much too lengthy compared to the original. However, using the rules previously described (i.e.: 'factorising' and 'multiplying out', where necessary) we can minimise the expression as follows:

$$\begin{aligned} D &= A.\overline{B}.\overline{C} + A.B.\overline{C} + A.\overline{B}.C + \overline{A}.B.C + A.B.C \\ &= A.(\overline{B}.\overline{C} + B.\overline{C} + \overline{B}.C + B.C) + \overline{A}.B.C \\ &= A.(\overline{C} + \overline{B}.C + B.C) + \overline{A}.B.C \\ &= A.(\overline{C} + C) + \overline{A}.B.C \\ &= A + \overline{A}.B.C \\ &= A + (B.C.) \end{aligned}$$

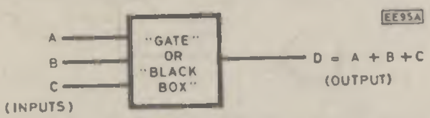
So it can be seen that the two expressions are, in fact, equivalent.

The method of minimisation shown here is for demonstration purposes only and shown 'long-winded'. With experience, short cuts may be taken to achieve the end result. Also, other methods, to be discussed later, may be used. However, for the newcomer to digital electronics, it may be of advantage to carry out all the steps until fluency is reached. Try the following exercises to gain experience in minimisation. The answers are at the end of this article.

Exercise (1): Minimise: $F1 = A.B.\overline{C} + \overline{A}.B.C + A.B.C$
Exercise (2): Minimise: $F2 = \overline{A}.\overline{B}.\overline{C} + A.\overline{B}.\overline{C} + \overline{A}.\overline{B}.C + A.\overline{B}.C$
Exercise (3): Minimise: $F3 = A.\overline{B}.C + A.B.C$

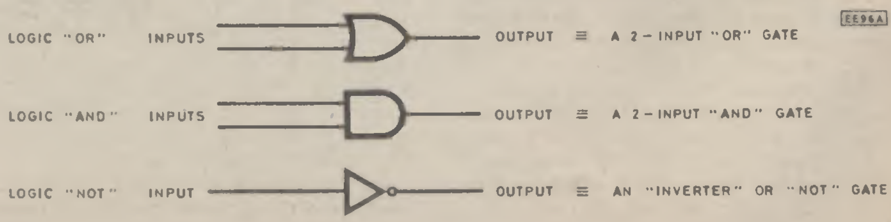
TYPES OF LOGIC GATES

Now that we have found a way to devise expressions, we need the tools to implement the circuits. These tools are industry standard 'gates', so called because they can be treated as gates that only allow certain functions to pass through. If we reconsider Example (1) and treat the gate as a 'black box' again (and, really, we do not need to consider the inside of the gate anyway), we can show this diagrammatically thus:

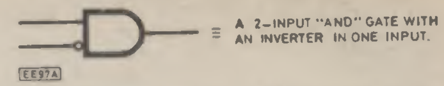


Of course, we cannot expect something for nothing so we have to provide the gate with a power supply, a couple of extra connections are required for this. (Note that these are generally not drawn on logic diagrams but the designer must be aware of this requirement.)

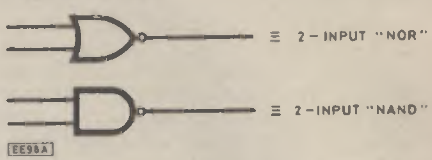
Now, we have symbols used to signify the logic 'OR', 'AND' and 'NOT' functions that we have spoken of. These are shown *below:*



Gates with 'negated' inputs are shown with a circle on the input, as shown in the example *below:*



There also exist devices known as 'NOR' gates (meaning 'NOT OR') and 'NAND' gates (meaning 'NOT AND') where the outputs are the inverted equivalent of 'OR' and 'AND' functions, respectively. Their symbols are shown *below*. (Note the circle denoting the negated output.)



It will later be shown that these latter devices will quite often be used in circuits in preference to their uninverted equivalents, in order to save the number of gates used, and 'packages' used. As far as 'gate packaging' is concerned, it is usual for one integrated circuit to contain, say:

(1) four independent 2-input gate functions.
or (2) three independent 3-input gate functions.
or (3) two independent 4-input gate functions.

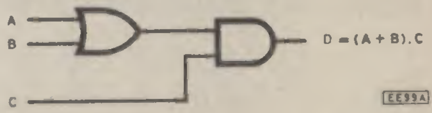
Inverters are usually found as 'hex-inverters' with six independent inverters in one package. (For more details refer to a TTL data book, 7400 series, or a CMOS data book, 4000 series.)

BASIC LOGIC CIRCUITS USING AND, OR AND NOT GATES

Let us now consider how one of the examples previously used, say Example (3), may be implemented using AND, OR and NOT gates.

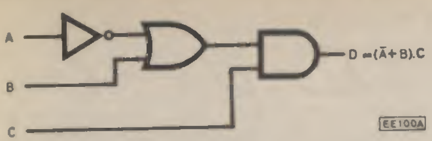
The expression is: $(A + B).C = D$

Using just one 'AND' gate and one 'OR' gate we get the following circuits:



As another example we may have an expression, say, $(A + B).C = D$.

This could be implemented using a 'NOT' gate (inverter) in addition to the circuit above, to give:

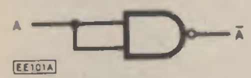


So it is seen that the gates are used as 'building-bricks' to build any amount of complexity into a circuit using the outlined rules.

USE OF NAND AND NOR GATES

The reader may wonder why there are such devices as NAND and NOR gates, when the equivalent circuits may be implemented using NOT gates in addition to AND and OR gates, respectively. The reason is not directly apparent but it can be shown that, using all-NAND or all-OR implementation, in more complex circuits, an overall saving in packages may result and, although may be not much of a saving would result on a 'one-off' circuit construction, this could make quite a considerable saving in costs to a manufacturer of printed circuit boards, who could be making thousands of circuits at a time.

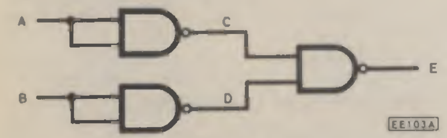
A NAND or a NOR gate can be used as an inverter by simply connecting the inputs together, thus:



USE OF A NAND AS AN INVERTER

USE OF A NOR AS AN INVERTER

Similarly, other functions may be derived from the use of all-NAND or all-NOR packages. Below is shown how three 2-input NAND gates are used to perform the OR function.



Truth Table:

Inputs A	Inputs B	Outputs C	Outputs D	Outputs E
0	0	1	1	0
0	1	1	0	1
1	0	0	1	1
1	1	0	0	1

The truth table proves that $E = A + B$

Now let us consider a previous statement, where it was said that by using all-NAND or all-NOR gates could save packages. Looking at the following expression

$$F = (\overline{A}.\overline{B}.\overline{C} + \overline{B}.\overline{C}.\overline{D}) + B.C.E + (\overline{B}.\overline{C}.\overline{D}).(B.E)$$

we can design a circuit similar to that shown in Fig. 1 using all-NAND construction—we have used only two 3-input NAND packages. The equivalent circuit, using 'mixed' packages, is shown in Fig. 2, where we are using two 3-input AND packages and one 3-input OR package. Thus, by using an all-NAND configuration, it is seen that an overall saving, in this example, of one package per circuit has been made, which is representative of a 66 per cent saving. Similarly, savings can sometimes be made by using all-NOR configurations, however, using all-NAND circuit design is to be preferred, since such circuits usually tend to be less complex and easier to design.

Exercise (1) Answer:

$$\begin{aligned} F1 &= A.B.\overline{C} + \overline{A}.B.C + A.B.C \\ &= A.(B.\overline{C} + B.C) + \overline{A}.B.C \\ &= A.B + \overline{A}.B.C \\ &= B.(A + \overline{A}.C) \\ &= B.(A + C) \end{aligned}$$

Exercise (2) Answer:

$$\begin{aligned} F2 &= \overline{A}.\overline{B}.\overline{C} + A.\overline{B}.\overline{C} + \overline{A}.\overline{B}.C + A.\overline{B}.C \\ &= \overline{B}.\overline{C}.(\overline{A} + A) + \overline{B}.C.(\overline{A} + A) \\ &= \overline{B}.\overline{C} + \overline{B}.C \\ &= \overline{B} \end{aligned}$$

Exercise (3) Answer:

$$\begin{aligned} F3 &= A.\overline{B}.C + A.B.C \\ &= A.C.(\overline{B} + B) \\ &= A.C \end{aligned}$$

Next month we will look at how circuits can be minimised, in order to save on the number of gates and/or packages used, by the use of certain techniques, such as 'Karnaugh Maps', 'De Morgans' Rules' and other useful methods.

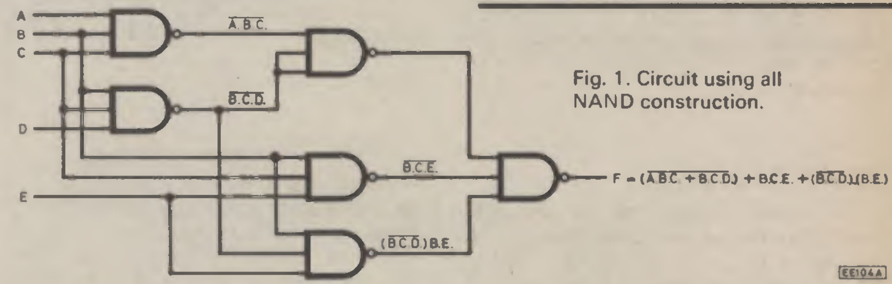


Fig. 1. Circuit using all NAND construction.

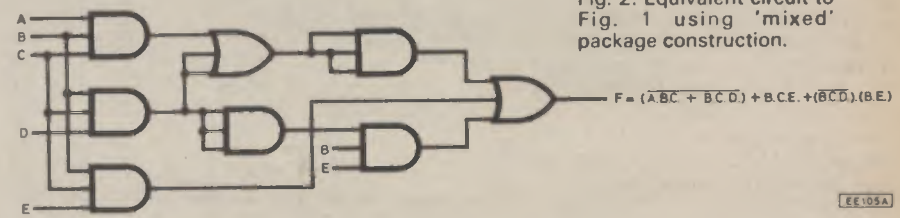


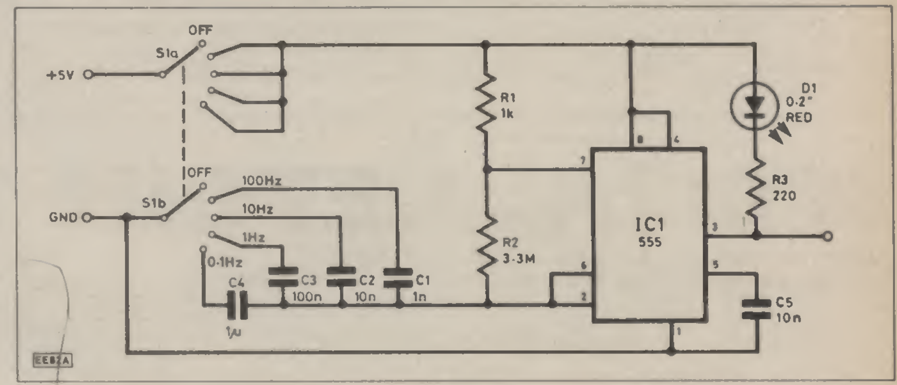
Fig. 2. Equivalent circuit to Fig. 1 using 'mixed' package construction.

CIRCUIT EXCHANGE

PULSE GENERATOR

After the power supply, the pulse generator is probably the most important piece of test equipment used in the testing and development of digital circuits. This circuit is very economical, being built around the popular 555 timer.

The 555 is configured in the standard monostable configuration to give an approximate square-wave output, the frequency of which is dependent on the R–C time constant set by S1. In this case there are four settings: 0·1, 1, 10 and 100Hz. Obviously, the accuracy of these figures is effected by the tolerance of the components used, but in most cases it will be found to be adequate.



Hamid-Reza Tajzadeh,
Tehran, Iran.

(Top). The complete package including software, manual and PSU.
(Centre left). A screen from the QL EASEL business graphics package.
(Centre right). Using the 100K microdrives on the QL.
(Bottom). Using the half Megabyte plug-in RAM pack.

SPECIAL REPORT
SINCLAIR'S QL

JUST one small step for Sinclair Research, but a Quantum Leap into the world of up-market computing. In reality it is probably more accurate to say, a few small steps and still a few more to go before the QL and its associated software is readily available as a reliable working package. Having said this, however, it does seem that the QL may eventually be an excellent "middle-range computer", representing good value for money. The many problems are being slowly weeded out and the first batch of working units have been delivered to some of the long awaiting customers. Even so it will be some time before every QL owner has the updated operating system fitted into the computers internal ROM space. Some machines are still being dispatched with a plug-in ROM pack to accommodate the oversize QDOS operating system which has now been reduced to fit the allocated space.

For around £400 the QL package comes complete with user manual, power supply, connecting leads, two built-in microdrives and an impressive collection of software. In contrast to Sinclair's previous offerings the actual computer housing is robust, professional looking and most importantly has a "proper" keyboard which in use has quite a pleasant feel. It features two-key rollover and autorepeat which incidentally could take a while to get used to as it has a very short delay before operating. At the back of the computer there are a number of connectors offering standard features such as RS232-C serial ports, control ports and network (QL Net) access. At the sides there are peripheral and microdrive expansion slots allowing up to six additional microdrives and communication with any number of peripheral devices.

The heart of the machine is a Motorola 68008 processing unit which enables the QL to be advertised as a 32-bit computer. This could be very misleading as the 68008 has very few features which could qualify this statement. The actual data bus is only eight bits wide and only its internal registers have 16-and 32-bit capability, nevertheless it is software compatible with the higher bit processors in the range. Much of the other electronic hardware functions are carried out using customised devices which has reduced the "chip count" and should in theory give rise to a more reliable machine than its competitors. The other pieces of hardware include an internal speaker and a clock with battery back-up giving a life of five years. All the features of the QL, such as the clock, speaker, microdrives and serial port baud rates are software controlled.

MEMORY

The 68008 can address up to one megabytes of memory and the QL comes with 48K of system ROM and 128K of RAM fitted as standard. Of the RAM allocation 32K is taken up by the screen leaving 96K of user RAM, which could be used up quite easily when running complex programs; bearing in mind what the machine is designed for. There is of course an add-on RAM socket which can address a half megabyte of memory, unfortunately this cannot be utilised until there is a supply of 256K dynamic RAM chips available. There is also a 32K ROM socket which on some machines is still being used to accommodate the QDOS overflow. The QL memory map is shown below.

FFFFF		
reserved	256K	Expansion I/O
C0000		
reserved	512K	Add on RAM
40000		
RAM	96K	Main RAM
28000		
video RAM	32K	Screen
20000		
reserved	16K	Expansion I/O
1C000		
I/O	16K	QL I/O
18000		
reserved	32K	Expansion I/O
10000		
ROM	16K	Plug in ROM
0C000		
ROM	48K	System ROM
00000		

MICRODRIVES

These devices are an enormous improvement on the standard cassette method of program storage, but could never be realistically compared to floppy or hard discs. Each microdrive tape contains about 100K of memory and is said to have an average access time of 3·5 seconds. They consist of a continuous tape loop running at 30 inches per second and take around seven seconds to make a complete revolution. During development there were quite a few problems encountered with these units and I suspect that they never have or will quite meet expectations. It is recommended that the programs supplied on microdrive are immediately copied onto blank cartridges and only used as a back-up should a copy become unreadable for any reason. Despite their short-comings they are versatile and easily operated. They can be used for data storage during programming, and data from one cartridge can be merged with another. It is a simple operation to load and off-load programs, but on some occasions I had to wait several minutes for a program to be successfully loaded. It is also possible to corrupt data stored on microdrives if the reset is used during a microdrive operation.

SOFTWARE AND FIRMWARE

There has obviously been a great deal of thought and hard work devoted to the operating system of the QL, making it a very "user friendly" machine. When it is first switched on, or reset, after a short memory test, and a choice of TV or monitor display, it is ready for programming. You can autoboot into a program on microdrive or alternatively type in operating system commands or a BASIC program. The QL's SUPERBASIC does not differ greatly from the standard BASIC language, but does offer a few extra commands and is more structured. The screen is split into three windows, for the current program, program output and present commands. Separate channels control the windows, and each can be changed by the user to give different colours and sizes. Features such as the easy EDIT, MERGE and RENUM commands make program development very easy. During execution programs can be stopped using the control functions and statements can be retried, which is very useful when sorting out errors. The program can then be continued with the next statement to be executed. Upper and lower case commands or text do not seem to effect the QL at all, which is useful in some applications, but on some occasions it can be confusing. It is also important to be careful when using spaces in the QL BASIC instruction format, and abbreviations are allowed on very few statements.

The graphics capability of the QL is very impressive and once again easy to use. This accounts for the rather large chunk of RAM devoted to the screen. Two user selected formats are available, giving eight colours, 256 × 256 pixels or four colours, 256 × 512 pixels, and unlike the Spectrum the QL allows each pixel to be coloured and changed at will. Lines and shapes, arcs and circles can be produced using very simple commands and can be coloured and manipulated very effectively without too much trouble. When producing lines they can be drawn relative to the cursor position or between coordinates of the screen. As with all computers, high resolution graphics are best appreciated on a colour monitor.

With most business machines it is necessary to invest a few hundred pounds on software, but with the QL, four good quality software packages are included with the computer. They are produced by Psion Ltd., which over the last few years has gained a good reputation in the software industry. Word processing, financial planning, database management and high resolution graphics are comprehensively covered by the four QL programs Quill, Abacus, Archive and Easel respectively. Similar programs are being sold by Psion for use on other machines at a cost of around £400. (The cost of the QL package complete.)

SPECIFICATION

Dimensions	138 x 46 x 472mm
Weight	1388gms
Price	£399 inc. VAT
RAM	128K
ROM	32K
CPU	Motorola 68008 + Intel 8049
Operating system	QDOS developed by Sinclair
Language	Sinclair SUPERBASIC
Video	High res. graphics TV or monitor
Keyboard	Full-size QWERTY 65-key
Microdrives	Twin 100K capacity 3·5 seconds access

EXPANSION

Internal	one Megabyte address space
Microdrives	six additional microdrives
ROM	one QL ROM cartridge up to 32K
Serial	2 x RS232-C (75 to 19200 baud)
Network	Up to 64 QL or ZX Spectrums (100K baud)

CONCLUSIONS

As I said at the beginning of this article the QL may well be an excellent middle range computer. On paper it appears to be a low-cost quality business machine or an up-market home computer. However, I find it difficult to believe that a serious businessman whose computer is essential to the efficient and profitable running of a business would opt for a QL. There are a number of well-established business computer suppliers, whose proven track record for quality products and good back-up service would far out-weigh the advantages of the QL's low cost. Anyway for the QL to be an effective business machine, it would be necessary to buy disc drives, a monitor and a printer.

It may be that the Sinclair "faithfuls" may stay; progressing from their ZX81's and Spectrums to the Quantum Leap. This too is doubtful, with the emergence of cheap new machines such as the Amstrad range and others to follow. This is not particularly a fault of Sinclair Research but a reflection of the computer market today. There are so many machines on the market and more arriving all the time, making it inevitable that some will never make it. May be the QL will, who knows? □

JANTUM LEAP

RICHARD BARRON

MICRO MEMORY SYNTHESISER

Mark Stuart

THIS musical instrument should have a wide appeal because of the range of features it offers. Twenty-five keys and l.e.d.s are provided to denote two full octaves *F* to *F*. Depression of any key will give the corresponding musical note and light up the corresponding l.e.d.

Attack and Decay controls set the envelope characteristics of each note. A Tremelo control with variable speed and depth is also built in. The whole instrument may be changed in frequency over several octaves by means of a variable Pitch control.

MEMORY

Memory is provided to store a played tune. Depression of the Clear key erases the memory leaving the circuit ready to store new notes. A maximum of 28 notes can be stored, each note can be of one to eight musical beats long. Spaces can be inserted into the memory using the Pause key. The memorised tune is replayed by depressing the Play key. In addition a Play Lock switch is provided which causes the tune to be replayed over and over again. This allows rhythm or bass accompaniment lines to be recorded and replayed as backing for other instruments.

There are ten pre-programmed tunes each an average of 55 notes long. These are selected by depressing the Tune key followed by one of the "black" notes. The tunes are listed below.

The Learn key allows the player to learn the ten pre-programmed tunes. By pressing the Learn key followed by the corresponding "black" note the l.e.d.s will light one by one to indicate the notes of the selected tune. The l.e.d. will remain on until the player presses the correct note. The l.e.d. for the next note will then light.

The Tempo control alters the speed or musical beat rate during playback.

1 Jingle Bells
2 Twinkle, Twinkle Little Star
3 Happy Birthday
4 Yankee Doodle
5 Silent Night
6 This Old Man
7 London Bridge is Falling Down
8 Auld Lang Syne
9 Oh Susanna
10 Clementine

CIRCUIT OPERATION

A block diagram of the system is shown in Fig. 1. As is expected nowadays the heart of the unit is a microcomputer i.c. This i.c. is one of a range with which the constructor will probably be unfamiliar. The single "chip" contains RAM, ROM and 16 input/output lines as well as the central processing "microprocessor" circuit.

The ROM (Read Only Memory) is pre-programmed during manufacture with the customer's own program. Once programmed the ROM cannot be altered, and the i.c. becomes "dedicated" to performing whatever functions the program contains. Similar dedicated i.c.s are used for 24 tune doorchimes, "Big Trak", television tuning systems, pocket calculators, etc. Each has its own program for its particular function.

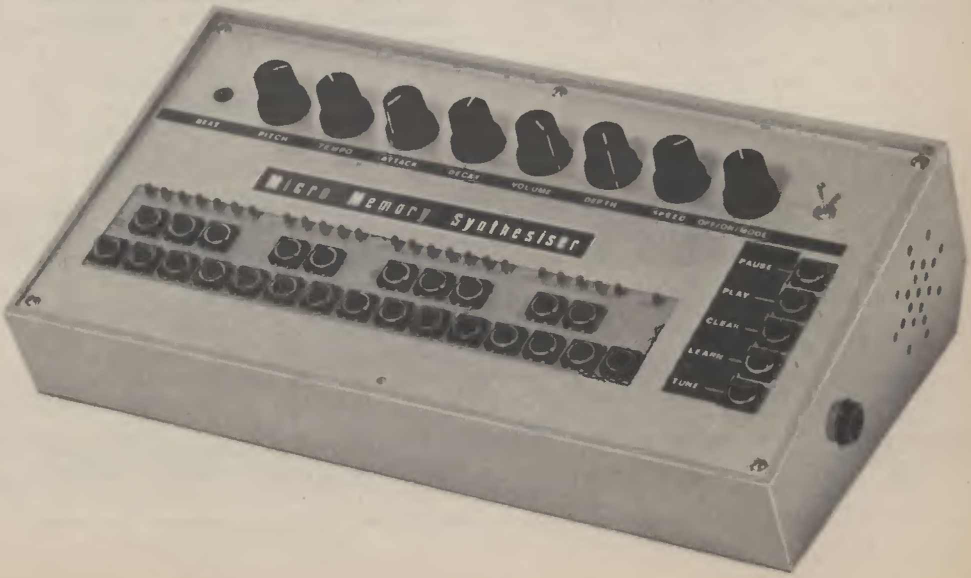
From IC1 16 Input/Output (I/O) lines are used to light the l.e.d.s and READ the keyboard. The speed at which IC1 operates is set by the clock oscillator. Altering the clock speed changes the pitch of the whole keyboard.

The pitch is altered in two ways, either by the Pitch potentiometer or by a control voltage from the low frequency Tremelo oscillator. Audio output from IC1 is picked up from pin 18 and passes through the a.f. amplifier stage to the speaker and line output socket.

Envelope control of the output is derived from pin 17 of IC1 which produces a voltage pulse at the start of each new note. This pulse is processed by the envelope controls and used to adjust the gain of the a.f. amplifier stage.

Pin 20 of IC1 is used to set the tempo of the notes. IC1 waits for a pulse on pin 20 to inform it to step on to the next note. This pulse can be derived either from the Tempo oscillator when in record/playback mode, or from the keyboard when in the manual play mode. The setting of S1b selects the mode. An external positive pulse can be used to step IC1 via the Sequencer unit. This facility allows the instrument to be synchronised with rhythm and percussion generators to produce a composite backing track.

The complete circuit diagram is shown in Fig. 2. The Clock oscillator active circuitry is incorporated in IC1. The frequency is determined by the charging and discharging of C4 via R13,14,15 and VR1, the Pitch control. When VR1 is fully clockwise it presents no resistance so C4 charges quickly via R13 and R15.



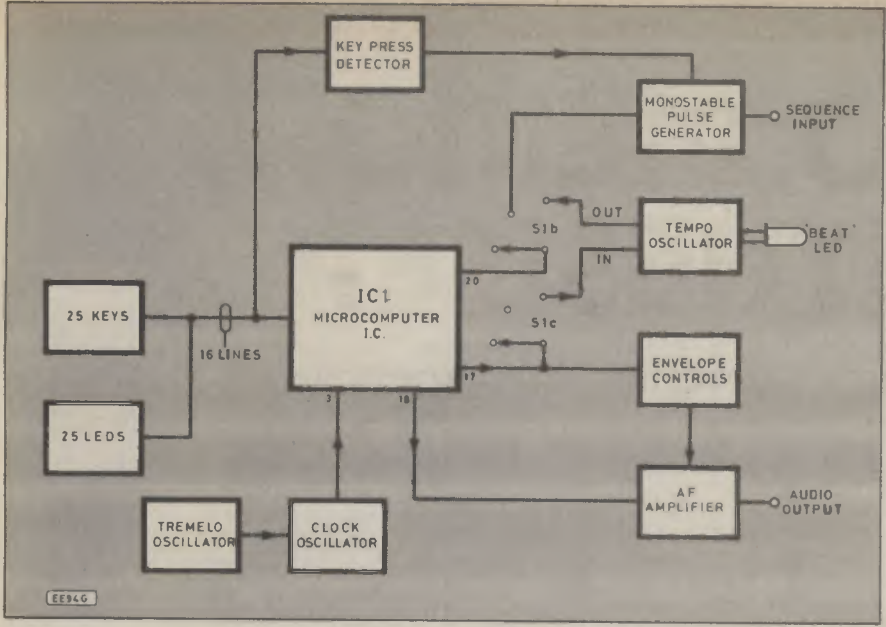


Fig. 1. Block diagram of the Micro Memory Synth.

When VR1 is fully anti-clockwise the pitch is lowered as C4 charges through the additional resistance of VR1 and R14 in parallel.

IC2 is connected as a simple low frequency oscillator which produces a triangular waveform across C7. The frequency of oscillation is set by the Tremelo speed control VR3. Transistor TR5 is used as an emitter follower. It has a voltage gain of 1, and a high input impedance so that IC2 is not heavily loaded. The output from the emitter of TR5 drives the Tremelo depth control VR2.

Capacitor C5 couples the signal from VR2 to the Clock oscillator circuit. The Tremelo signal increases and decreases the current available to charge C4, therefore, the frequency of the Clock oscillator is varied at the tremelo rate.

AUDIO AMPLIFIER

The audio output is provided by the two transistors TR10 and TR11 which are connected as a Darlington pair. This combination of two transistors produces a very high current gain which is used in this instance to provide enough current for LS1, a miniature 80-ohm speaker. VR7 functions as a high level volume control, and also provides an emitter load for TR10 and TR11 when an external amplifier is used.

The drive signal for TR10 and TR11 is connected to the base of TR10. It is derived from the collector of TR9 which is driven from IC1 via the inverting buffer IC3f. The collector load of TR9 is made up from R25 and TR8. These components enable the voltage swing of the audio amplifier stage to be varied, so giving control of the output signal envelope.

It is important to note that the amplifier is designed to handle only the square-wave signals from IC1. Transistors TR9, TR10 and TR11 are used as switches, they are only either on or off. Care has been taken in the design to ensure that TR10 and TR11 are always turned off when there is no output from IC1 to minimise battery drain.

ENVELOPE CONTROL

The term envelope is used to describe the way that a musical note builds up and then decays. A percussion instrument for example produces a sound that rises sharply and falls away gently. Wind and string instruments have a different envelope characteristic. With this circuit the rate of rise or "attack" and the rate of fall or "decay" of each new note can be varied independently.

The attack and decay rates are determined by the charging and discharging of C11. The voltage across C11 is buffered by emitter follower stage TR8 which forms part of the collector load for the output driver transistor TR9. When the voltage on TR8 base is low there will also be a low voltage on its emitter. The output swing on the collector of TR9 is restricted by the available voltage on the emitter of TR8. In this way the voltage on C11 controls the audio output voltage.

Each time a new note is produced, IC1 produces a positive pulse on pin 17. This pulse is inverted by IC3d and coupled via the pulse forming the network C8 and R17 to IC3e. IC3e inverts the pulse once more so that at the beginning of a new note D6 conducts, and C11 is charged via VR4, the Attack control. The combination of C8 and R17 is called a differentiating circuit, it allows only a short pulse to pass from IC3d to IC3e.

The length of this pulse is set so that at the slowest attack setting the output has reached full amplitude before the pulse ends. When the pulse ends the output of

COMPONENTS

Resistors

R1,3,13	4k7 (3 off)
R2,5,6,8,10,11	47k (6 off)
R4,9,15,19, 23,25	10k (6 off)
R7,21	2k2 (2 off)
R12	100k
R14	220k
R16	10M 10%
R17	2M2
R18	22k
R20	27k
R22	1k
R24	680

All $\frac{1}{4}$W carbon ±5% unless otherwise stated

Potentiometers—*all p.c.b. mounting miniature type*

VR1	100k linear
VR2,4	10k linear (2 off)
VR3	470k linear
VR7	470 reverse log
VR5	1M linear
VR6	470k reverse log

Capacitors

C1,2,8	100n C280 (3 off)
C3,9	10n C280 (2 off)
C4	56p ceramic
C5,10	470n miniature polycarbonate (2 off)
C6	470μ 10V electrolytic
C7,11	2μ2 10V electrolytic (2 off)

Semiconductors

D1–12	1N4148 (12 off)
D13	0·2in red l.e.d. and clip
D14–38	LD2–25 0·125in red l.e.d.s less clips (24 off)
TR1,2,3, 5,6	*pnp* BC213 (5 off)
TR4,7,8, 9,10,11	*npn* BC183 (6 off)
IC1	420
IC2	4093B CMOS
IC3	4049 CMOS

Switches

S1A–C	3-pole 3-way rotary
S2	s.p.s.t. miniature toggle
S3–32	s.p.s.t. miniature keyboard switches

Miscellaneous

I.c. sockets—28-pin, 16-pin and 14-pin; battery holder and clip; knobs—eight with marker line and skirt; $\frac{1}{4}$in jack sockets mono—one standard type—one with break contact; case with front panel, minimum 12 × 7in; connecting wire; miniature loudspeaker 80 ohm; feet for case; set of three printed circuit boards.

See **Shop Talk** page 642

Approx. cost Guidance only **£49.50**

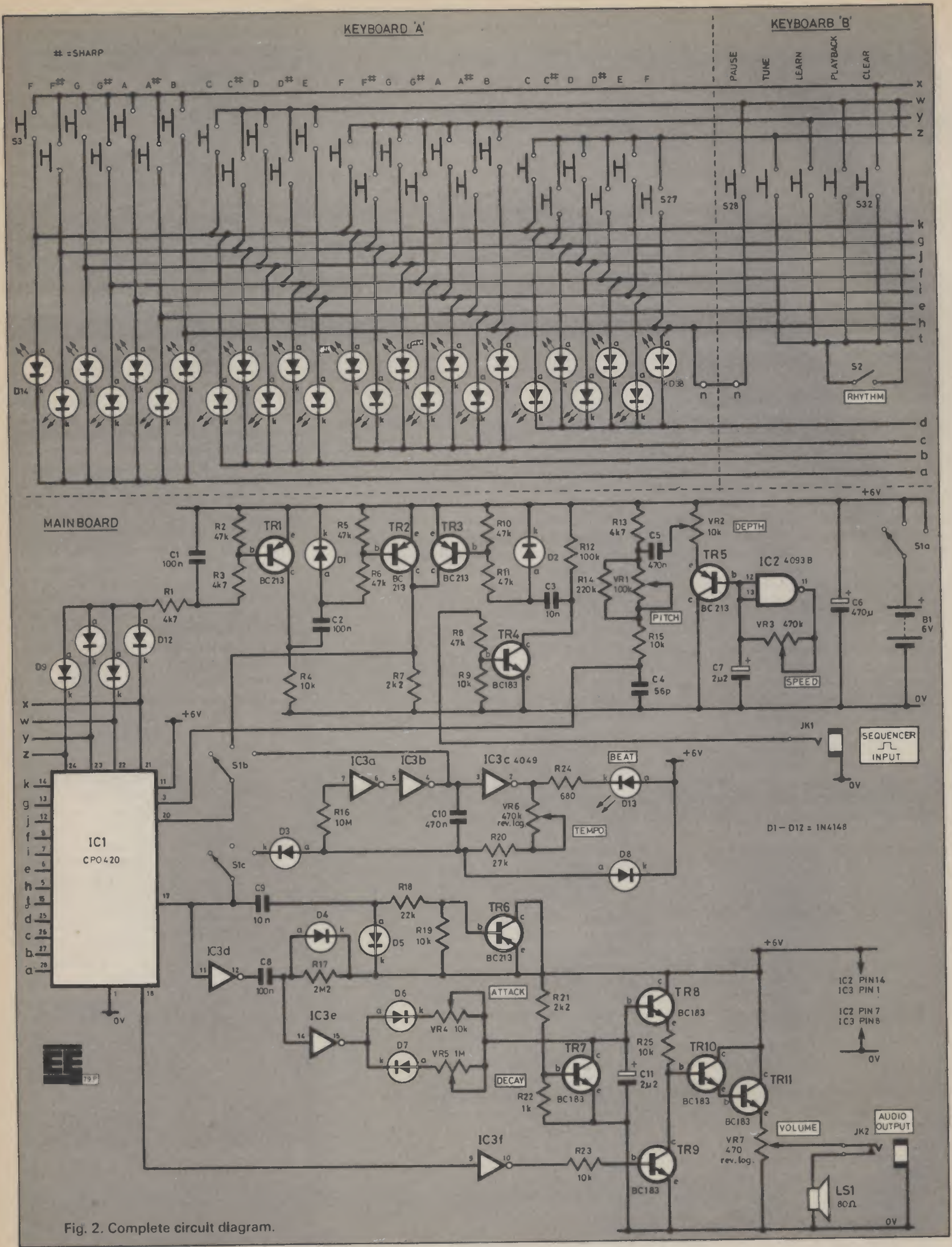


Fig. 2. Complete circuit diagram.

IC3e goes to 0V and C11 discharges through the Decay control and D7. The settings of VR4 and VR5 control the charge and discharge current for C11, so controlling the rate of rise (attack) and fall (decay) of the output note.

This arrangement works satisfactorily provided C11 discharges fully after each note. If a series of quickly repeated notes is played when the Decay control is set to maximum, C11 does not fully discharge between notes. This means that the Attack control becomes inoperative. To overcome this small problem a pulse forming network, C9, R18 and R19, is used to produce a very brief pulse at the start of each new note. During this pulse TR6 and TR7 are turned on and C11 discharges very rapidly through TR7. The result is that each new note starts from zero with C11 fully discharged.

TEMPO

When playing the instrument in manual mode the tempo is set by the player's timing. When playing back recorded tunes IC1 requires timing or "tempo" pulses to be provided on pin 20. IC3a, IC3b and IC3c are connected as a three inverter oscillator circuit. The frequency of oscillation is set by C10, R20 and VR6, the Tempo control. In the absence of an output note the oscillator is inhibited by the low voltage from IC1 pin 17, which is coupled to the oscillator via D3. Once a note commences IC1 pin 17 goes high and the Tempo oscillator starts. IC1 then counts the pulses on pin 20, and delivers the appropriate notes. Each note may occupy from one to eight cycles of the Tempo oscillator depending how it was recorded. The "Beat" l.e.d. D13 gives a flash for each cycle of the Tempo oscillator.

When a tune is being entered into memory the length of note stored is determined by holding the key down whilst counting the flashes of D13. After eight flashes IC1 assumes that a second identical note is required. It is easier to store a tune into memory if the Tempo control is set to a slow speed. Upon replay the correct speed can then be set by adjusting the Tempo control.

SEQUENCER INPUT

As an alternative to the Tempo oscillator an external source of positive pulses can be used to set the replay speed. Any source of 5-volt positive pulses will be suitable. Either a sequencer or one of the user port output lines from the BBC Microcomputer, or any computer output port would provide suitable pulses.

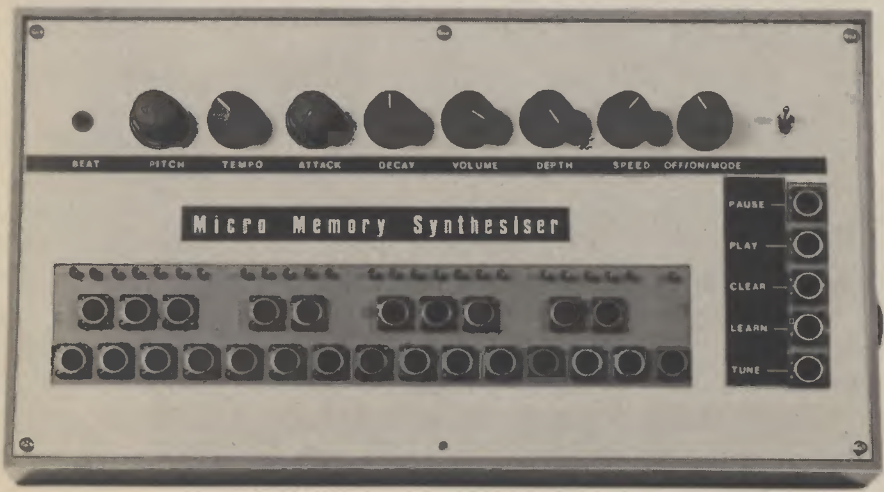
TR4 is turned on by the positive pulses which are applied to its base from JK1 via R8. The pulse is inverted by TR4 to produce a negative-going pulse across R12. This is coupled via C3 and R11 to the base of TR3. The combination of C3 and R11 is another differentiating circuit that produces a short pulse regardless of the lengths of the incoming pulse. During the short pulse, TR3 is turned on producing a positive pulse on its collector, which passes via S1b to IC1. These pulses are treated by IC1 in exactly the same way as if they had come from the Tempo oscillator.

MANUAL PLAY

When the instrument is being played manually the Tempo oscillator is left running, but is disconnected from IC1. The "Beat" l.e.d. can be used as a simple visual metronome. The necessary pulses to step IC1 from note to note are derived directly from the keyboard, by means of diodes D9 to D12. These diodes sense whether or not a key is being pressed by monitoring the state of the W, X, Y and Z keyboard scanning lines. Whilst any key is pressed one of the four lines will carry negative pulses.

These pulses pass via the associated diodes D9 to D12, and maintain a charge on C1. The charge on C1 provides base current for TR1 via R3, keeping it turned on. As soon as a key is released the pulses cease, C1 discharges and TR1 turns off. The resulting negative pulse on the collector of TR1 turns on TR2 via the differentiating network, C2, R6. The result is a short positive pulse on the collector of TR2 which steps IC1 on, to await the next note. This allows the instrument to be played without interference from the Tempo oscillator.

Front panel layout.



KEY AND L.E.D. SCANNING

The remaining 16 lines from IC1 are used to scan the keyboard and light the l.e.d.s. There are not enough lines for each l.e.d. and each key to have its own independent connection to IC1 so a method must be used to combine the 30 keys and 25 l.e.d.s to 16 lines. The method used, known as multiplexing, is also used for computer keyboard scanning, etc., where a large number of switches must be read by a computer. The keys are connected in four "banks".

Each "bank" is connected to one of the four pins numbered 21 to 24 on IC1. The opposite ends of the keys are connected to the eight lines of IC1 numbered 5 to 8 and 12 to 15. Each key links a unique combination of these two sets of connections. Top F, for example, links pins 24 and 5. The Clear key links pins 21 and 15, etc. To read the keys IC1 makes each of the eight lines (5 to 8 and 12 to 15) a logic low (0V) in turn whilst holding the other seven lines at +5V.

While each line is low the other lines are read by IC1 to check if any are low. If the middle F key is pressed, for example, IC1 will find that when pin 14 is low pin 23 becomes low. In this way all 30 keys are checked many times each second. In this application there is only allowance for one key to be pressed at a time, it could be possible to read up to four keys pressed together with this particular arrangement.

The 25 l.e.d.s are connected in a similar arrangement between the four lines 25 to 28, and the eight lines 5 to 8 and 12 to 15. When IC1 is not scanning the keys, it is energising the l.e.d.s in a similar multiplexed way. Each l.e.d. has its own unique combination of lines. Because eight of the lines are used for both reading the keyboard and driving the l.e.d.s, these two procedures take place at different times. Whilst the keyboard is being read the l.e.d.s are turned off for a brief period, too short for the eye to notice.

CONSTRUCTION

All components except the switches and l.e.d.s are mounted on the main board. Figs. 3 and 4 show the track layout and component overlay. Fit i.c. sockets for all three i.c.s. It is best to leave out the i.c.s themselves until the circuit is complete and ready for testing. Take particular care to fit the transistors in the correct places, and the right way round. Other polarity conscious parts are C6, C7, C11 and the 12 diodes. Insert the seven potentiometers last, make sure that they are pushed right through the board

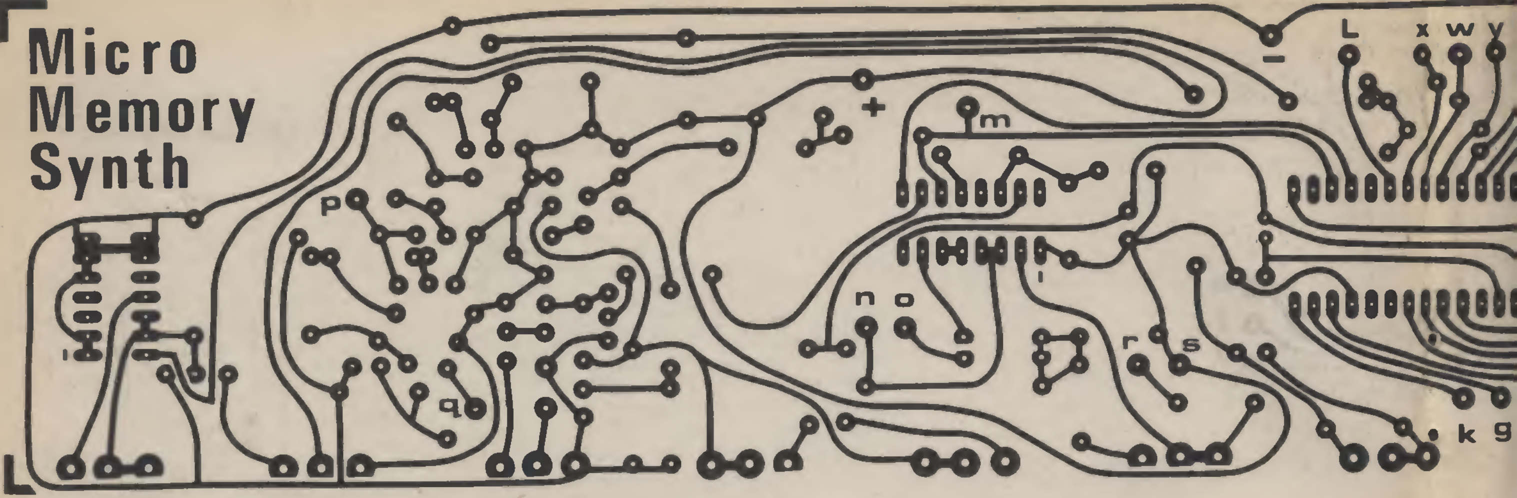


Fig. 3. Printed circuit board design for the main board.

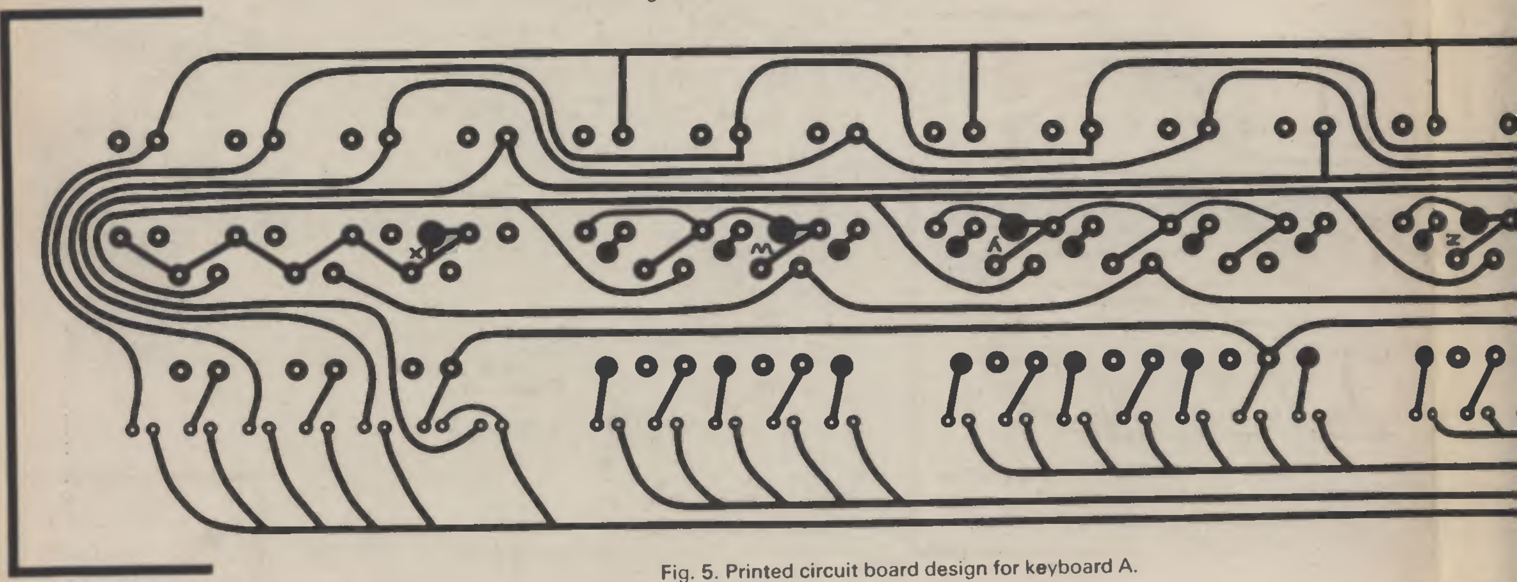


Fig. 5. Printed circuit board design for keyboard A.

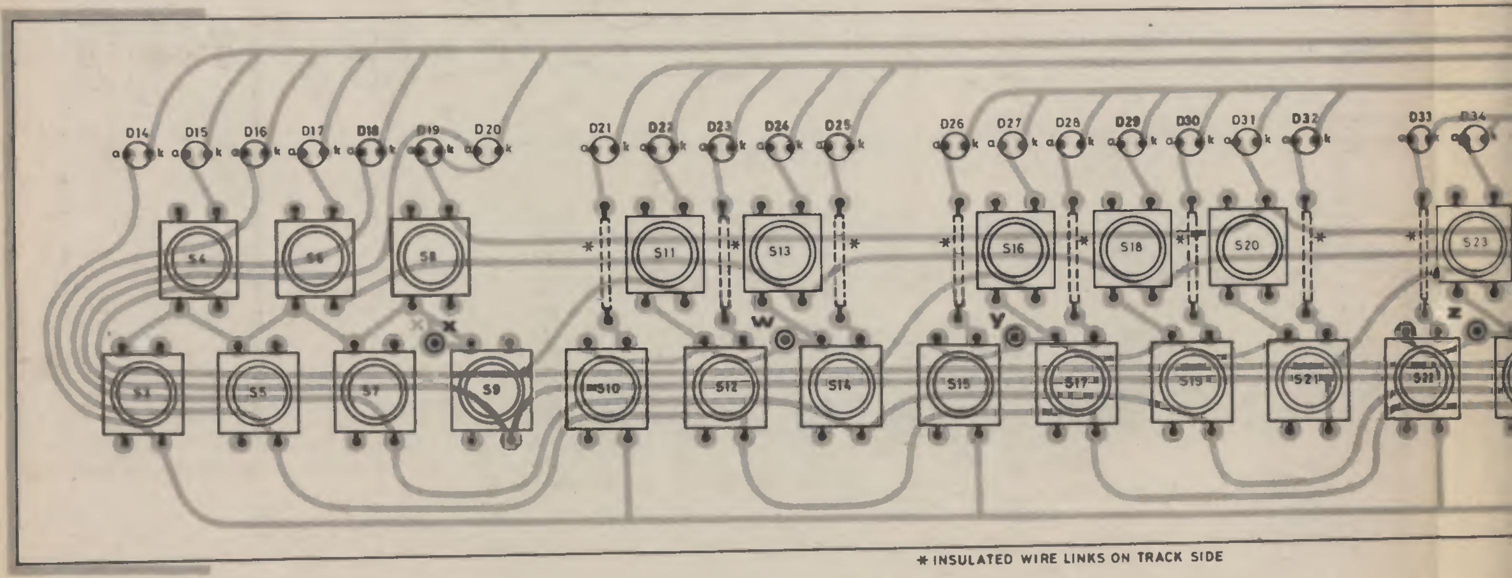
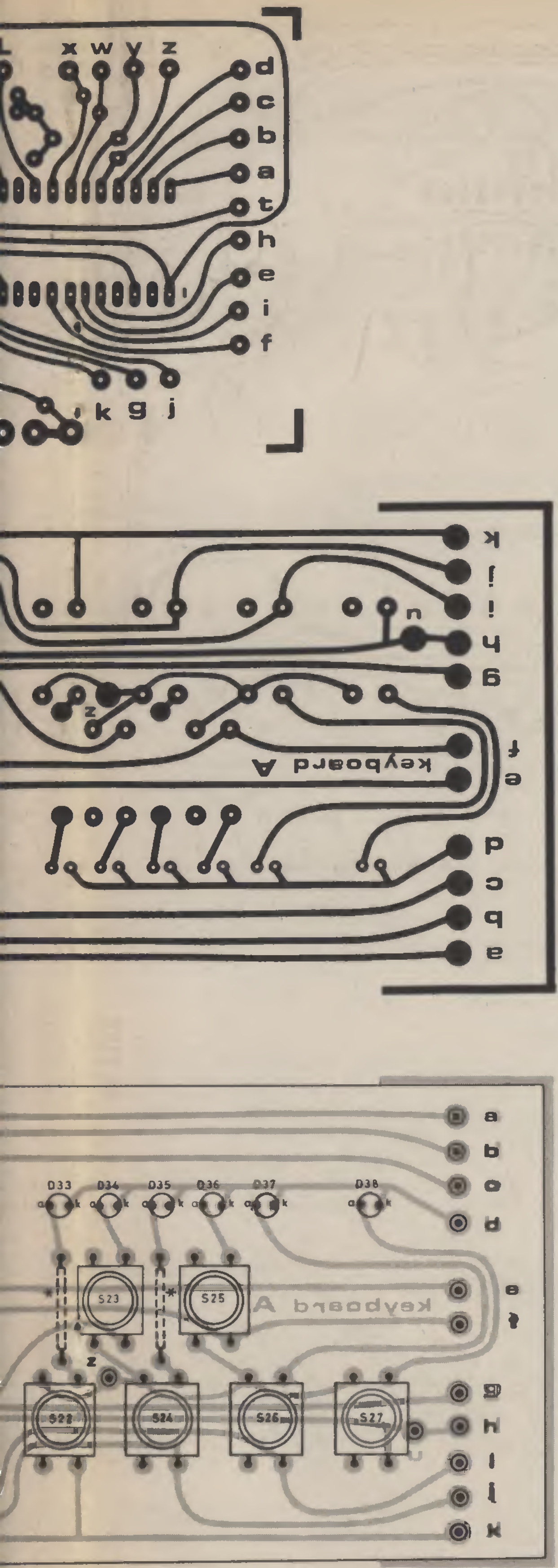


Fig. 6. Component layout for keyboard A.



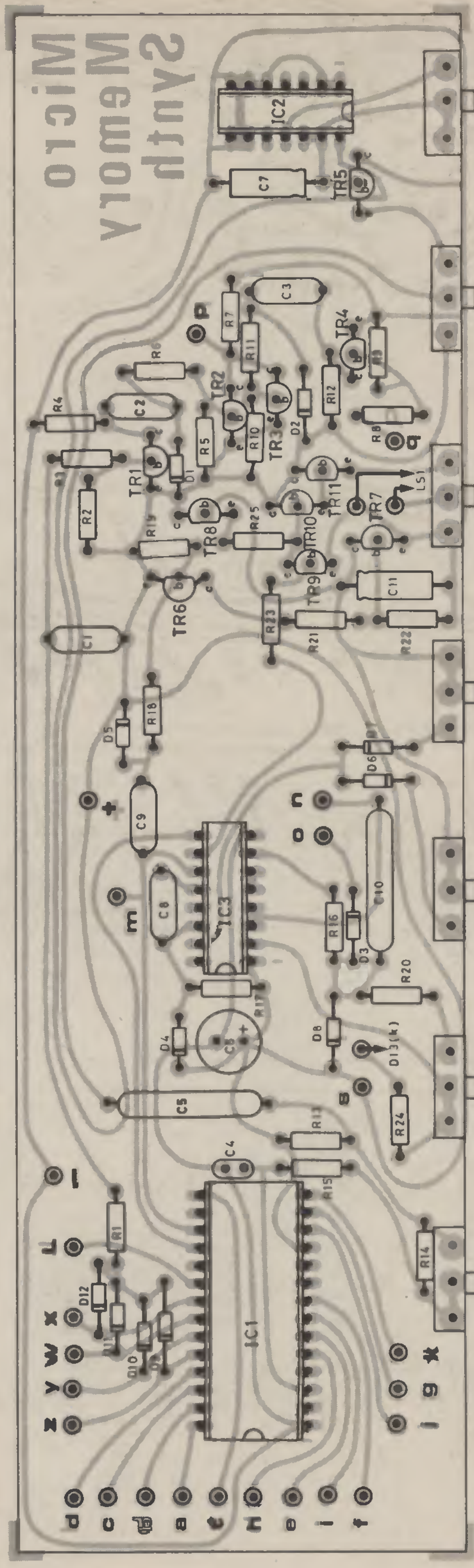
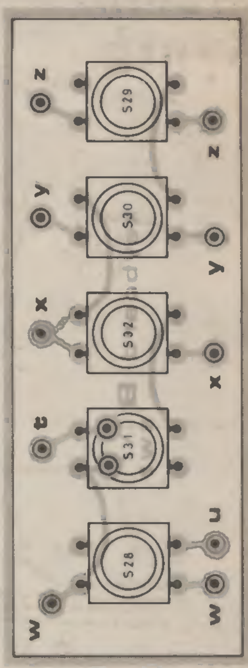


Fig. 4. Component layout for the main board.



● CONNECTION ON UNDERSIDE OF BOARD

Fig. 8. Component layout for keyboard B.

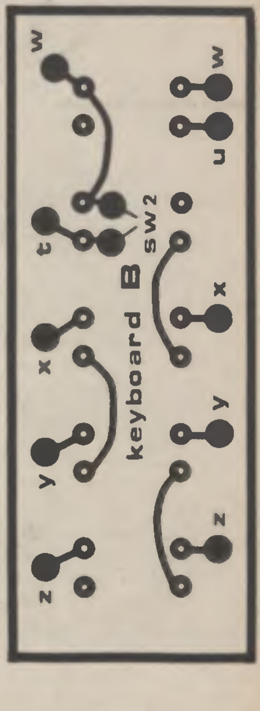


Fig. 7. Printed circuit board design for keyboard B.

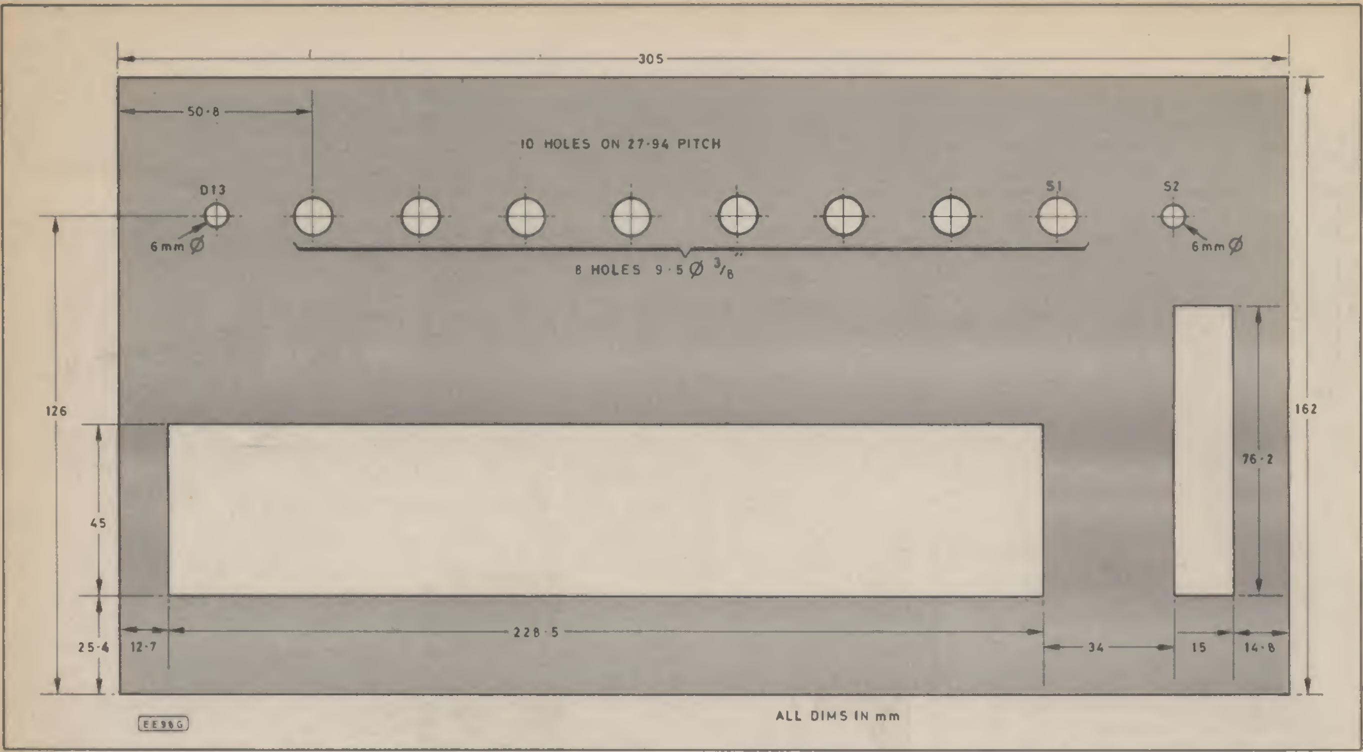


Fig. 9. Front panel cut-out and drilling details.

before soldering. All of the points for external wiring are marked on the trackside of the printed circuit board with an identifying letter. Wiring to these points is best carried out during final assembly, with the board in-situ in the case front panel.

KEYBOARD

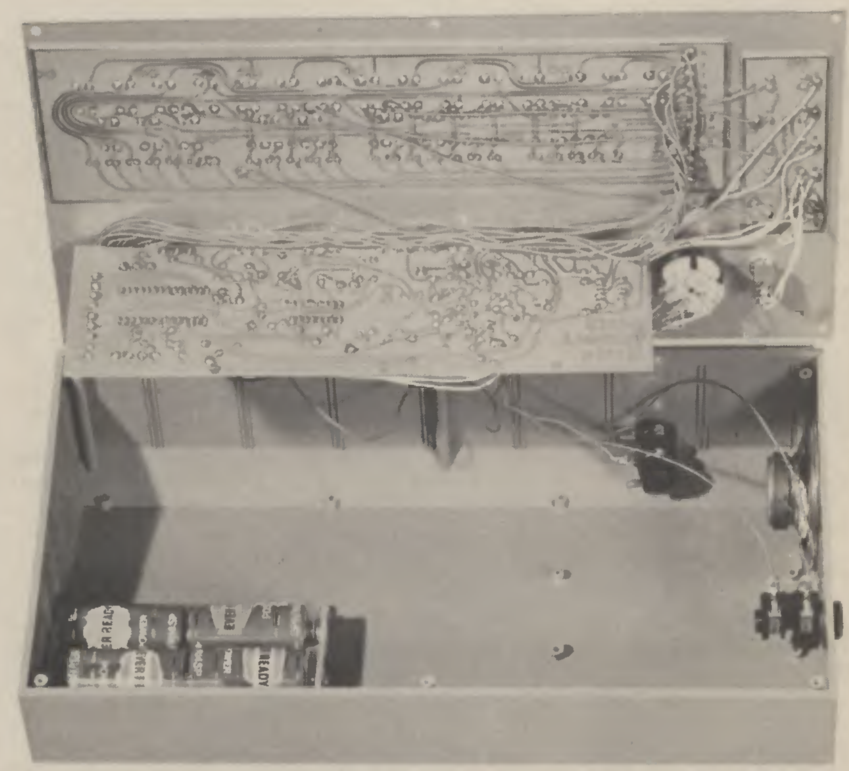
The printed circuit board design for keyboard A is shown in Fig. 5 with the component overlay shown in Fig. 6. The details of keyboard B are shown in Figs. 7 and 8. Before inserting the keyboard switches it is necessary to remove the two plastic locating pips from the rear of each switch. Take care when inserting the switches to align the small round indentation in the top of each key with all of the other keys. The 25 l.e.d.s are all mounted the same way round—the shorter lead is the cathode. L.e.d.s, particularly small ones, seem to be more heat sensitive than any other components, so solder them carefully.

Finally, fit the nine wire links. These links are fitted on the trackside of the board to give the keyboard a neat appearance. The best way to make the links is by using tinned copper wire and sleeving. First solder the end of a long piece of tinned wire to one of the printed circuit board pads. Fit a measured length of sleeving over the wire, cut the wire to the correct length, and bend it down to be soldered to the corresponding pad.

CASE

The case chosen for the prototype has an aluminium front panel of dimensions 305 × 162mm. Fig. 9 shows the necessary drilling. The rectangular holes are best cut with an Abrafile or similar tool, after having drilled out a small hole in each corner. When the panel is cut out check that there are no sharp edges, and wipe away any finger marks or grease marks from the underside with a suitable solvent.

The two keyboards are fixed to the inside of the front panel using strips of double-sided adhesive tape. Fix the tape first to the panel and then carefully align



Internal view of the Synthesiser.

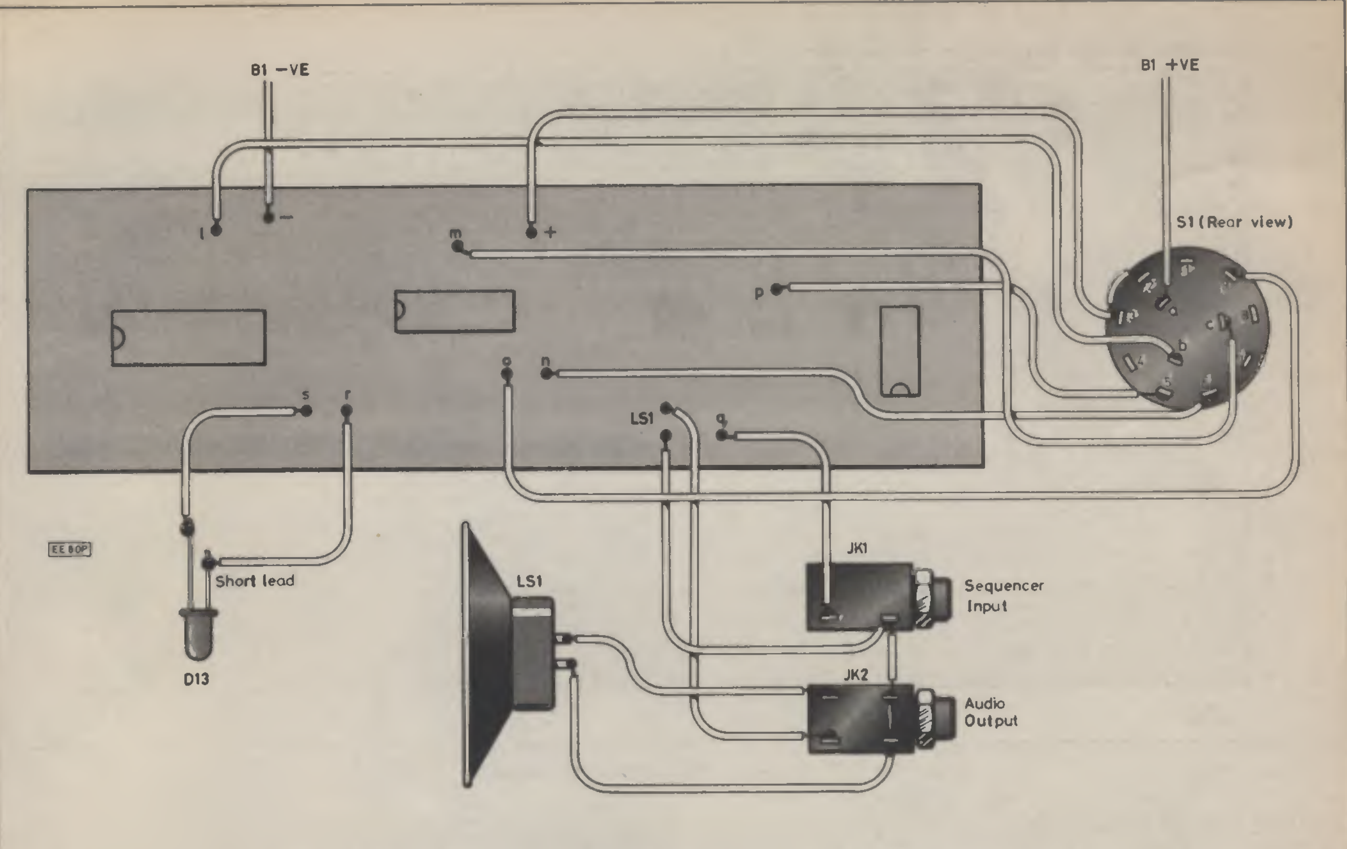


Fig. 10. Wiring diagram for the Micro Memory Synthesiser off-board components.

and press the boards into position. The main board is mounted by means of the potentiometer bushes. Fit one shakeproof washer to each bush inside the panel and one nut on each bush on the outside. The knobs used in the prototype have a small skirt which conceals the bush and mounting nut. The spindles may need shortening a little to allow the knobs to fit flush to the panel.

D13 should be fitted to the panel using a standard mounting clip. The rotary switch S1 has an adjustable end stop underneath its mounting nut. This should be prised loose and set to limit the switch to three positions (two clicks).

The loudspeaker LS1 and sockets JK1 and JK2 are mounted in the side and the rear of the case. There is just sufficient room to fit the 63mm diameter speaker in the specified case, to the rear of the right-hand end. It must be fitted at the right end to ensure that the magnet does not foul the main printed circuit board. Positioning JK1 and JK2 is largely a matter of individual choice.

WIRING

The wiring between the three printed circuit boards should be done first. All of the wire termination points are labelled on the trackside of the boards. Connections to the keyboards are made to circular pads on the rear of the boards. This method of connection is best carried out by first tinning the pad, then stripping and tinning the end 3mm of wire, and finally applying the wire and soldering iron together to the pad. The solder on the pad and the wire will melt together to form a strong joint.

Connections to the main board are made in the usual way, by inserting the tinned end of each lead into the appropriate hole from the component side and soldering on the trackside. Solid 1/0·6mm or stranded 7/0·2mm insulated wire may be used as preferred.

When the inter-board wiring is complete refer to Fig. 10, and connect the off-board components to the main board as shown. Remember, where appropriate, to allow enough wire to enable the panel to be removed from the case for battery changing, etc. Note the polarity of D9 must be observed, and JK2 must be wired exactly as shown so that it has correct switching action.

TESTING

Fit the three i.c.s, four batteries and switch S1 to the first position. Set all other controls to mid position. S2 must be off. This is the manual play mode. It should be possible to play all the keyboard notes, and the corresponding l.e.d.s should light. The Beat light should be flashing at a fairly rapid rate. Check the action of the seven potentiometers one by one.

Incorrect l.e.d.s and notes are almost certainly due to wiring errors. Other faults should be traced by assessing the area of circuitry likely to be responsible, and then checking for dry joints, incorrect components, etc. *It is very unlikely that IC1 is at fault* or any other components for that matter. More often than not errors of construction will be responsible—often of a very simple nature.

Once the circuit appears to be functioning correctly in manual play mode, switch to the second memory mode and continue the testing. In this mode the Beat light should remain out until a key is pressed. Holding a key down will cause the note to be replayed every eighth beat. Press the Clear key and then play a short sequence of notes. The sequence will be replayed by pressing the Play key. Close S2 and check that the sequence repeats endlessly, and that the Tempo control affects the replay speed. Check that the Pause key enters gaps into the memorised sequence.

Press the Tune key followed by any one of the "black" notes—the appropriate tune should play. Pressing the Learn key followed by a "black" note lights the l.e.d. corresponding to the first note of the tune. Press the appropriate key and the next note lights and so on. Note that in "Oh Susanna" the Pause key is used. □

EVERYDAY news ... from the world of

WORLD'S FIRST POCKET COMPUTER!

THE new *Psion* "Organiser" has been described as the world's first practical pocket computer. It is housed in a robust, protective sliding case and measures 142 × 77 × 30mm and weighs just 225 grams, running for up to six months on a standard PP3 battery.

Key to the power and application of the hand-held Organiser are twin thumb-sized solid-state drives. Its plug-in, solid state data and program packs play the same role as discs in desk-top micros providing open-ended, fail-safe data storage and ultra fast retrieval for repeated use.

The "heart" of the machine is the Hitachi 6301X 8-bit microprocessor, mounted as an 80-pin small outline flat pack, directly onto a hybrid double-sided PCB board which lies under the keyboard. The 6301X CMOS microprocessor features 4K ROM on chip memory, 53 I/O ports, two in built timers and a serial communications interface. A second 80-pin flat pack controls the 16K l.c.d. display.

Organiser is initially available by direct mail only from Psion Processors. The product comes complete with an 8K datapak, a 42-page handbook and battery. It carries a one-year warranty against mechanical or electrical failure. Prices are: Psion Organiser with 8K datapak, £99.95 + £2.50 p&p; 16K datapak, £19.25 + £1.25 p&p; 8K datapak, £12.95 + £1.25 p&p.

Initially, the software library includes comprehensive plug-in program packs for Financial, Science and Engineering and Mathematical calculations available at £29.95 each (plus £1.25 p&p). New packs will shortly be available for spreadsheet and other specialist applications.—*Psion Processors, Dept EE, 22 Dorset Square, London, NW1 6QG.*

TOSHIBA GOES WALKYS

Designed for performance and reliability rather than to be especially low-cost, Toshiba have just introduced a range of "Walky" personal stereos.

With its mini size Walky KT-AS10, they have succeeded in creating a personal stereo which is even smaller than the cassette it plays. In fact, it is believed to now be the world's smallest, the mini Walky covers only a part of the standard cassette.

Packed into this tiny model are features such as Dolby B noise reduction, metal tape facility and auto reverse. The machine also comes with an a.m./f.m. stereo tuner pack and l.e.d. indicators.

This top of the range model is available in silver or zappy red and white stripes. The Walky KT-AS10 "Cassette Burger" is expected to retail for about £100 which includes carrying case, belt and battery pack.

ACORN IN AGREEMENT

The BBC have announced that a contract has just been signed extending the agreement with Acorn Computers for the manufacture and distribution of the BBC Microcomputer for a further four-year period.

More than 350,000 BBC Micros have been sold to date. It is claimed that over half the micros used in education in Britain are BBC machines, and that during the last year, three quarters of the computers bought by schools were BBC Micros.

Incidently, the BBC Model A Micro, the cheaper, lower specification alternative to the Model B, will no longer be produced.

The Model A, though cheaper than the B version, offers a smaller memory and fewer features.

Another snippet of news from Acorn is that Lendac Data Systems of Ireland have signed an agreement with them that will enable Lendac to manufacture the BBC Micro.

The agreement, which involves an investment of over £500,000 by Lendac, means that the Lendac workforce will more than double to over thirty employees.

Danny McNally, joint Managing Director of Lendac Data Systems, said, "We expect demand for the BBC Micro to continue strongly from the Personal, Educational and Business Sectors. Already we have made major inroads into these markets and are confident our Irish production facility will strengthen our ability to service the Irish market more comprehensively."

Granada TV Rental (GTVR) have announced that they are to sell home computers in over 100 of their High Street showrooms.

Machines selected are: Sinclair Spectrum, Acorn Electron and BBC Micro B, and Commodore 64 and VIC-20.

Einstein On Time

Einstein, the new low-cost high-powered microcomputer with built-in disc drive, is now on the market, on time, as promised by its manufacturers Tatung (UK) Ltd. at its launch.

One of the first retailers, if not the first, to receive supplies and put them on sale "over-the-counter" are our friends at Greenweld Electronics—see their advertisement on page 656.

Space Drive

Every working day, Ford engineers and executives in Germany and England "meet" for face-to-face talks without ever leaving their own plants.

They are able to see and talk with colleagues, discuss pictures and graphics and evaluate vehicle components in detail, by using a videoconferencing link provided by British Telecom International's (BTI) Business Communications Service.

The system links, by satellite, two fully-equipped studios at Dunton in Essex and Cologne, West Germany.

The service is one of the first videoconferencing uses of transmission capacity on the European Communications Satellite, *ECS1*, and is installed on a trial basis until December this year.

FAST PROGRAM

The long awaited Quick Disk unit has just been announced by Solo Software, the Worcester-based approved software supplier for the Sharp personal computer range.

The new 3" disc drive fits neatly into the body of the Sharp MZ-700 where the cassette deck is currently located and is simply plugged in. If desired, the cassette unit can be connected at the back of the disc drive to allow existing software to be loaded from cassette and then saved onto disc.

The main complaint of MZ-700 users has always been the necessity to load BASIC from cassette before the machine is usable. This process took over three minutes but now, using Quick Disk, the BASIC loading time is around 4 seconds.

The unit is manufactured under licence by Sharp themselves in Japan. However, it appears that Solo Software will be the sole source for this unit in the UK.

The Quick Disk will retail at £249.95 including VAT, postage and packing. Further information from Solo Software Ltd, Dept EE, Unit 95B, Blackpole Trading Estate West, Worcester WR3 8TJ.

National Semiconductor Corporation plans to open a new research and development centre near Beaverton, Oregon.

Work at the laboratory will focus on microprocessor products for the original equipment manufacturer (OEM) market, combining hardware and software and using National chips.

Job Surge

Power supply manufacturer Coutant Electronics have been granted planning permission for a new 19,000 square feet factory next door to their existing 30,000 square feet site in Ilfracombe, North Devon. Work on the new building began in July for completion early in 1985.

Coutant, already the largest private employer in the area, will be recruiting more than 100 extra staff—mainly for production work, over the next three years.

Second Generation for Cirkit

The renewal recently, of an exclusive United Kingdom distribution agreement between Toko Incorporated, who are the world's largest manufacturer of wound components, and Cirkit Holdings Plc, marks the beginning of the two companies' second decade of association.

The original agreement, signed in 1974, with Ambit International, one of the principal founding members of the Cirkit Holdings group, made them the first franchised Toko distributor in the UK.

In addition to being the sole UK stockist of Toko coils, Cirkit holds a comprehensive inventory of their other components including filters of all types, fixed inductors, bi-polar i.c.s, numerically controlled l.s.i., Vari-cap diodes and push-button switches. The most recent addition to the range of Toko products being helical filters.

Commenting on the renewal of the Toko franchise, Cirkit's chief executive, Christopher Sawyer said, *"Perfected over some 30 years of development, Toko's miniature transformers are now produced in quantities of more than 100 million units per month and are used in virtually every radio and television set, hi-fi and communications system produced around the world."*

Richard Sanders (left), General Manager of Toko (UK) Ltd., is pictured with Cirkit executive Mike Sandham (centre), Sales Manager of the Industrial Division and Richard Bulgin, Head of the Consumer Division at the company's Broxbourne showroom.

NEW · NEW · NEW · NEW PRODUCTS NEW · NEW · NEW · NEW

ADJUSTABLE STRIPPERS

Two pairs of adjustable wire strippers have been added to the Knipex range of hand tools by **Draper Tools Ltd.**

Both are manufactured from special tool steel with ground and polished heads incorporating "V" cutting grooves and knurled rings to lock the screw adjusters in position.

Handles are spring-loaded and the insulation from wires up to 5mm diameter can be stripped. One model has soft p.v.c. coated handles and the other features a heavy-duty insulated p.v.c. coating.

Further details from:

Draper Tools Ltd.,
Dept EE, Hursley Road,
Chandler's Ford,
Eastleigh, Hants SO5 5YF.

CLEAN DISCS

The introduction of their first accessory product for Compact Discs is announced by **Bib Audio/Video Products.** The Bib CD 212 cleaning kit comprises a bottle of special formula cleaning liquid, applicator cloths and a high quality chamois leather polisher. All items are packed in a convenient storage wallet for dust free protection.

To maintain the high quality reproduction from CD discs, it is claimed that it is necessary to keep the surface of compact discs free from finger prints, dust and dirt and other contaminants as these prevent the laser optical system operating correctly, resulting in distortion and poor performance.

The Bib CD 212 cleaning kit has a recommended retail price of £2.99, including VAT. Bib also state that the same kit is suitable for cleaning video laser discs.

Bib Audio/Video Products Ltd.,
Dept EE, Kelsey House,
Wood Lane End,
Hemel Hempstead,
Herts HP2 4RQ.

IN THE BAG

For the "all-weather" radio and CB enthusiasts, **Aquaman (UK) Ltd.** have just marketed the AQ2, a waterproof casing for hand-held radios.

The "p.v.c. bag" allows radio communication to continue unimpaired in the roughest of conditions, be it on land or sea. This ingenious idea is extremely easy to use, allows total access to all the controls and makes your set buoyant—a priceless asset if you happen to drop it in the "drink".

The AQ2 is an ultra-violet stabilised p.v.c. casing designed to fit hand-held radios comfortably. The controls on a v.h.f. set, for instance, can be used through a finger pocket. The casing is sealed by a Aquaclip which offers quick access for insertion or removal of the radio set. An adjustable strap makes it possible to carry it either around your neck or your wrist.

It has been specially developed from corrosion resistant materials so that it won't deteriorate in conditions at sea. It's strong too, it will take about as much knocking around as a v.h.f. set will and carries a one-year guarantee.

At £12.50 it would appear to be a good purchase when you consider v.h.f. radios kick-off at around £200, and it's a British product. For more details contact:

Aquaman (UK) Ltd.,
Dept EE, 1a Broughton Street,
London, SW8 3QJ.

COMPUTER VISION

A computer Vision System, launched by **Colne Robotics** for the education and training market, is now generating interest among industrial buyers.

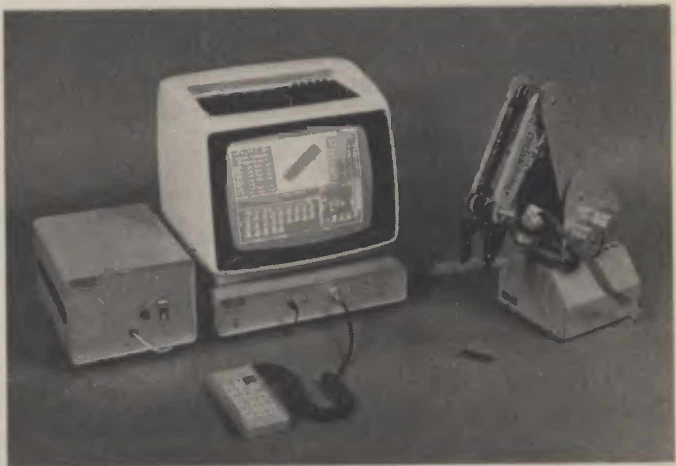
Colvis is a fully programmable VLR (very low resolution) system, readily interfaced to other computers or computer controlled equipment. It has so far been aimed at universities, polytechnics and higher education colleges, for teaching and demonstrating principles of image processing.

The system comprises a solid-state camera, dedicated microcomputer with power supply and teach pendant. With sophisticated software it extracts and learns information from the binary image produced, using parameters such as area, perimeter and centroid. Various functions are offered and there are valuable location and recognition facilities.

One project has used the system to inspect medical electrodes for damage. Other proposed applications employ Colvis as the sensor within a larger system possibly incorporating robots. As such it may be used to discriminate between similar items, for selection on the basis of visible "labels" that are "read" by the sensor.

This versatile vision system is available from Colne Robotics for under £900. Further details may be obtained from:

Colne Robotics Co. Ltd.,
Dept EE, Beaufort Road,
off Richmond Road,
East Twickenham,
Middx, TW1 2PQ.



The Colvis System comprises lightweight solid-state camera, microcomputer, power supply unit and teach pendant.

The camera can be used to give "sight" to a robot such as this, Colne's Armdroid I. In this way its position can be adjusted to centre over the object in view—a useful facility for many industrial and training applications.

NOVEMBER FEATURES...

Build ALFRED!

Alfred is designed to be built from an inexpensive kit and can be programmed by a computer. This new design is a strong, highly educational, model of an industrial robot.

BBC MICRO AUDIO STORAGE SCOPE INTERFACE

Use your television or monitor screen as a digital storage oscilloscope with this straightforward project. The interface is connected between the input signal and the BBC user port, and allows the VDU to present an analog signal as an oscilloscope-type display.

16 Page Pullout!

robotics

SUPPLEMENT

...New Series FAULT FINDING

A short series of articles looking into that frustrating world of equipment fault-finding. Covers new, failed and old equipment de-glitching techniques in a down-to-earth and practical way.

EVERYDAY ELECTRONICS and computer PROJECTS

NOVEMBER 1984 ISSUE ON SALE FRIDAY, OCTOBER 19

A Black Box Project

SCOREBOARD

Judges Points Indicator

L.A.Privett

THE object of this circuit is a type of electronic replacement of the cards held up by judges at competitions. As with the cards, they are numbered from 0–9 and so too does this larger than normal display. The number required can be obtained by pulsing the count by means of a push-button located at the top of the "Black Box". This will run through the numbers 0–9 in sequence illuminating the various sections of a 7-segment display. As there are very few components in this circuit, several could be made for judges at competitions for a fairly low cost.

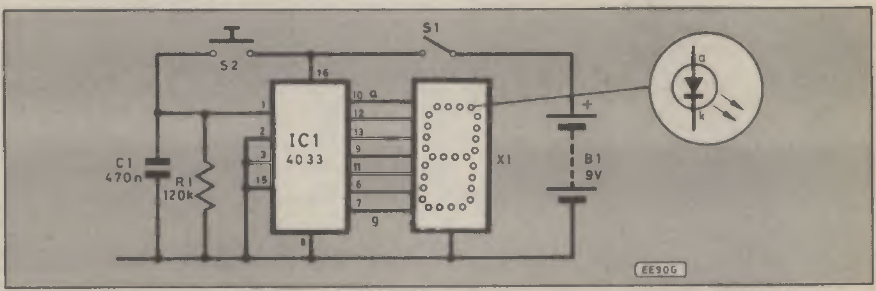


Fig. 1. Circuit diagram of the Scoreboard—Judges Points Indicator.

CIRCUIT DESCRIPTION

The circuit diagram of the Scoreboard—Judges Points Indicator is shown in Fig. 1.

The design comprises of one i.c. one resistor and capacitor and 28 l.e.d.s. It is based around the CMOS i.c. 4033 a decade counter with 7-segment output. This output to the matrix of l.e.d.s in the form of the standard 7-segment display. Four l.e.d.s are wired in series to form each bar of the display. All the cathodes of each segment are connected to a commoned ground. A push-to-make push-button is wired up between +ve and the clock in on IC1 to give the required pulse. R1 and C1 are there to eliminate contact bounce.

CONSTRUCTION

The circuit is built on a piece of stripboard 24 holes by 10 strips and the layout is shown in Fig. 2.

The stripboard mounted components are straightforward and should prove no problem. Fixing the l.e.d.s, battery and switches should take some careful thinking prior to drilling as mounting all these

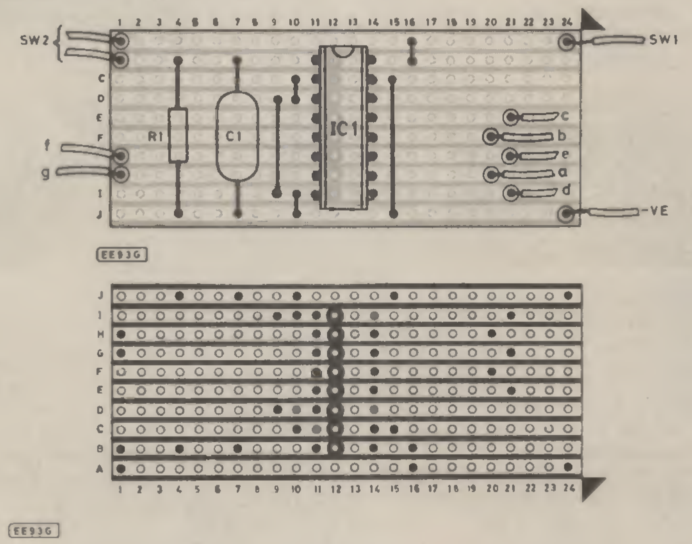


Fig. 2. The stripboard component layout and trackside view showing required breaks in the copper strips.

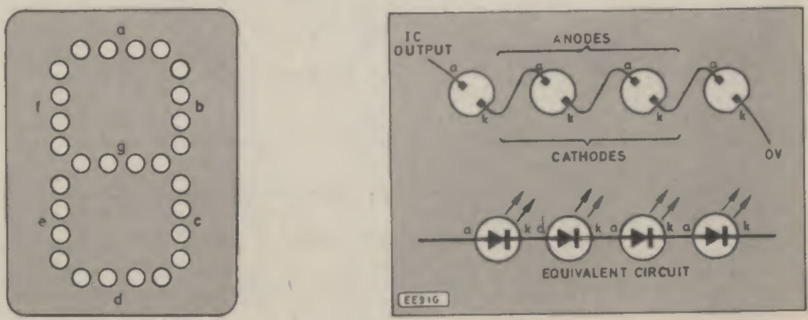


Fig. 3 (left). The l.e.d. matrix on the front panel, (centre) pin identification for the l.e.d.s and (right) wiring details for the display.

ALL DESIGNS FEATURED IN THE BLACK BOX SERIES WILL USE THE SAME BLACK PLASTICS CASE AND SAME SIZE PIECE OF STRIPBOARD

COMPONENTS

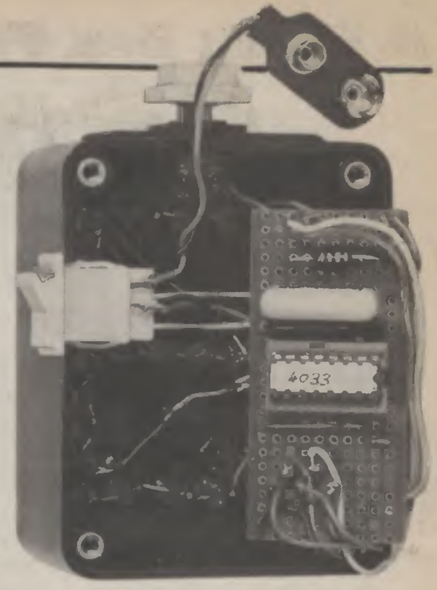
Resistor
R1 120k
¼W carbon ±5%

Capacitor
C1 470n polyester

Integrated circuit
IC1 4033 (CMOS)

Miscellaneous
S1 ON/OFF slide switch
X1 0·2in l.e.d.s (28 off)
S2 push-to-make (keyboard type)
Wire for links, connections to the display, switches, etc., Veropins, one plastic box 78 x 42 x 62mm approx., Veroboard, card for insulating the board, PP3 connector, PP3 battery, small piece of foam.

Approx. cost Guidance only £10.00



components inside the small box will be difficult, as with most of these "Black Box" projects. Check to see if you have wired the l.e.d.s correctly before fixing them in. A good point is to test them individually in their banks of four before wiring up permanently. Card was used between the exposed connections of the l.e.d.s and the rest of the box as an insulator and protector. Foam was used to keep the battery from rattling about. Check to see that the i.c. is correctly inserted not forgetting to observe the static precautions. Connect up a 9V PP3 and switch on. If correctly wired a number will be displayed by the l.e.d.s, and by pushing the push-button repeatedly the numbers should follow in sequence. It should be noted here that if it is wired as shown then the 0 will not be displayed. If it is required that the 0 is to be displayed then refer to the second diagram for alternative link arrangements. □

CIRCUIT EXCHANGE

This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised. Payment is made for all circuits published in this feature. Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.

TOUCH SWITCH

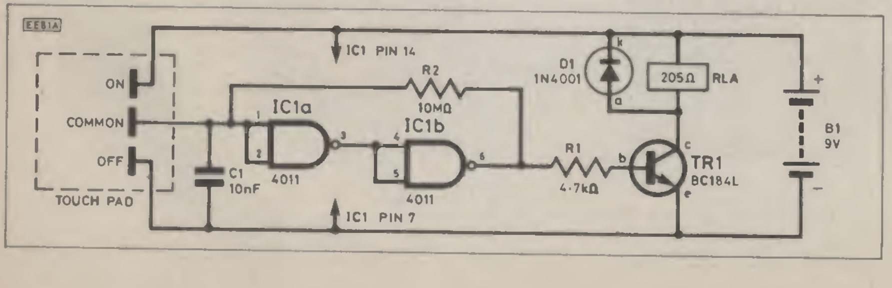
This circuit enables you to turn on something (such as a light), wired via a relay, just by simply touching two contacts with your finger. When you initially supply the power to the circuit, the input to IC1a is low, so the output is high. This means the input to IC1b is high, so the output is low, and the transistor is turned off.

When you touch the contacts a positive pulse travels from the 9V "rail", through your skin to the input to IC1a. Now the input to IC1a is high, so its output is low. The input to IC1b is now low, so its output is high and the transistor is turned on. A similar action causes the circuit to be turned off.

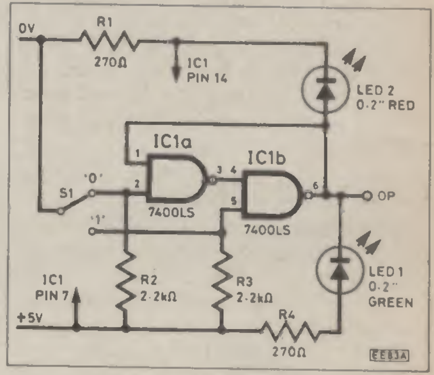
Capacitor C1 is there to filter out "electrical noise", which could falsely trigger the circuit. Resistor R2 is there to "lock on" the circuit, so when you remove your finger from the contacts the circuit stays on. This feeds back some of the high output from IC1b, to the input of IC1a. If you do not want the circuit to "lock on" then leave out R2.

If you wish to, you can use a NOR "chip" (4001) instead of a NAND (4011). This will make no difference. In any case, both of these "chips" have four gates, so the two gates not needed MUST be "tied up". To do this, connect the four inputs of the two gates not needed to the positive supply. If this is not done the unused gates will rapidly oscillate.

J. P. Blaker,
Rochester, Kent.



SIMPLE PULSER SWITCH



The trouble with all mechanical switches is 'bounce'. This circuit eliminates 'bounce' and enables the switch to be used to provide pulses for use in digital circuits. It is a simple design similar to many others, but is well worth building, as it is cheap and effective.

Its operation relies on the feedback from the output to the input of IC1a. This ensures that when the switch is in a transitional state, or 'bouncing', the output will remain stable. Two l.e.d.s are included to indicate the state of the output.

Hamid-Reza Tajzadeh,
Tehran, Iran.

What is RADIATION?

RADIATION DETECTORS

A.J. BENTLEY

THE term "radiation detector" covers a wide range of electronic devices, and includes some non-electronic ones. Most of the electronic types are not merely detectors but sophisticated scientific instruments designed to measure the energy carried by the tiny fragments of exploding atoms that we call radiation.

Some of these instruments cost upwards of £5000 and none of them are cheap. For anyone who just wants to know how much radiation can be found in his surroundings, that sort of outlay is pointless anyway. So, if you're thinking of buying or even building a detector of some sort, here is a quick guide to the basic types and their modes of operation.

GAS-FILLED DETECTORS

Radiation detectors generally depend on the fact that radiation is able to knock electrons out of their orbit around the atom's nucleus. This leaves the atom involved with a positive electric charge, and it is now called an "ion". This is where we get the term "ionising-radiation".

A gas-filled detector consists of two metal plates which have a high voltage applied across them. When radiation produces an ion in the gas between the plates, the high voltage pulls the ion one way and the freed electron the other way by electrostatic attraction (Fig. 1a). The ion moves towards the negative plate (cathode) and the electron moves towards the positive plate (anode).

To make sure that the ion can move easily towards the cathode, the gas pressure has to be kept low. With less gas atoms in the way, there is more freedom of movement in the gas.

When the ion touches the cathode, a new electron jumps out of the metal to neutralise its charge. At the same time (more or less), the old electron enters the anode plate (Fig. 1b). The net result is a transfer of electrons from the cathode to the anode which is, of course, a measurable electric current.

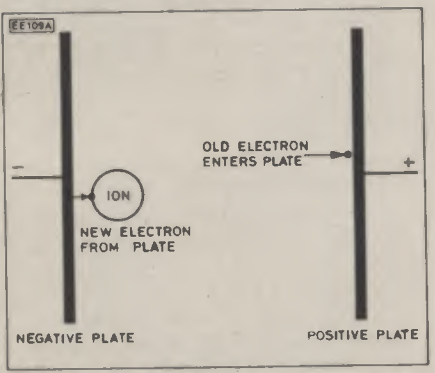


Fig. 1b. A pulse of electric current flows when the ion and the electron reach the plates.

MULTIPLICATION

Ordinarily, a pulse of electricity corresponding to the movement of one electron round the circuit is produced by each ionising "event". But, if the voltage on the plates is high enough the ion can move much faster and when it crashes into other gas atoms it can create yet more ion/electron pairs. So for each primary ion pair produced by radiation, many secondary ion pairs are produced in the gas. This effect is called gas multiplication and it results in a very strong electric pulse. This is what makes the Geiger counter so effective in detecting radiation.

THE GEIGER-MÜLLER COUNTER

A Geiger counter tube is made on a cylindrical pattern, with the anode as a thin wire down the centre of a tubular cathode. Fig. 2 shows this construction. There is a glass bead on the end of the anode wire to reduce the electrostatic stress at this point, and a thin mica "window" to allow radiation to enter the tube. The strong pulse of electric current produced by each particle of radiation causes a change of voltage across a resistor in series with the tube. This is amplified and fed to a loudspeaker, giving a

Fig. 1a. The ion is pulled one way and the electron the other way by the electrostatic force of the plates.

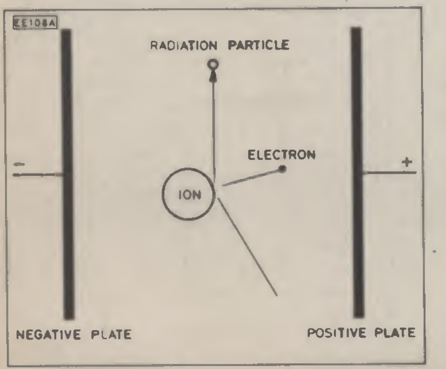
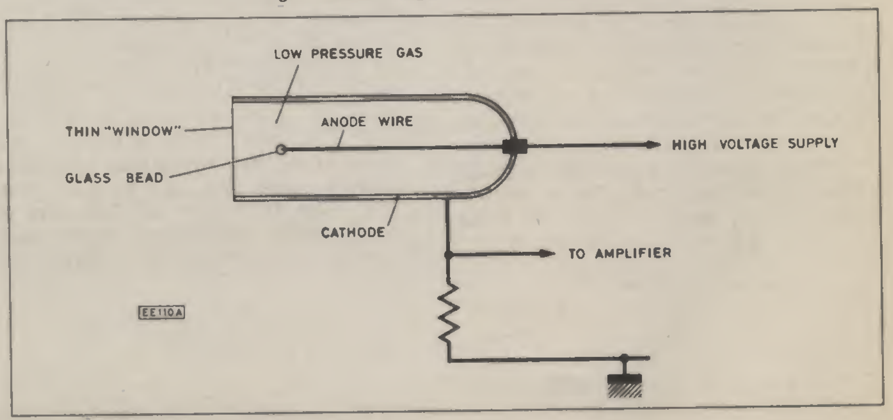


Fig. 2. Basic Geiger counter construction.



series of loud clicks whenever radiation reaches the detector. Sometimes a ratemeter is also connected to measure the strength of the radioactivity more accurately.

SOLID-STATE DETECTORS

Since the invention of silicon semiconductor devices, it has become possible to make solid-state radiation detectors. These are based on the properties of the p-n junction. A good p-n junction in reverse bias can have a resistance so high that the leakage current across the junction is virtually zero. This means that we can have a situation very similar to a gas type detector, with a voltage applied across a thin layer of non-conducting material.

When radiation passes through this "barrier layer" it raises electrons to the conduction band so that a current flows through the junction (Fig. 3). The conduction band in a semiconductor is a term used to describe a sort of intermediate orbit for electrons where they are not completely bound to a particular atom yet not entirely free (ionised) either. They do a sort of "change-your-partners" around all the atoms in the crystal. You can imagine the conduction band as a broad pathway looping round the atoms.

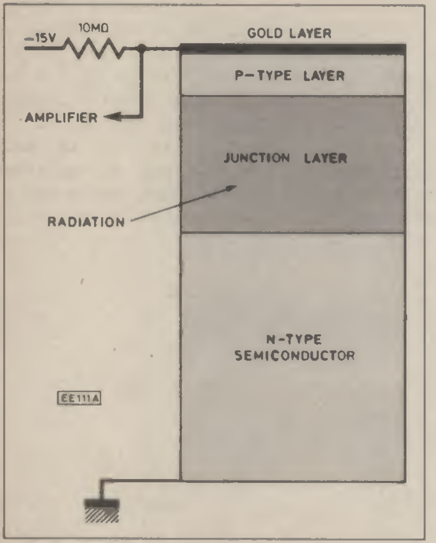


Fig. 3. Solid-state detector.

The p-n junction is made as close to the surface of the crystal as possible so that the radiation can reach it easily, and is covered by a thin layer of gold to make the electrical connection. Hence the name "surface barrier" detector.

Other types of solid-state detector, operating on similar principles but with much thicker sensitive layers are made, but these are very specialised, expensive and usually have a cooling system which employs liquid air.

Because the solid-state detector doesn't multiply the pulse like a Geiger tube, the electronic circuit associated with it has to be more sensitive pushing up the price of this kind of equipment.

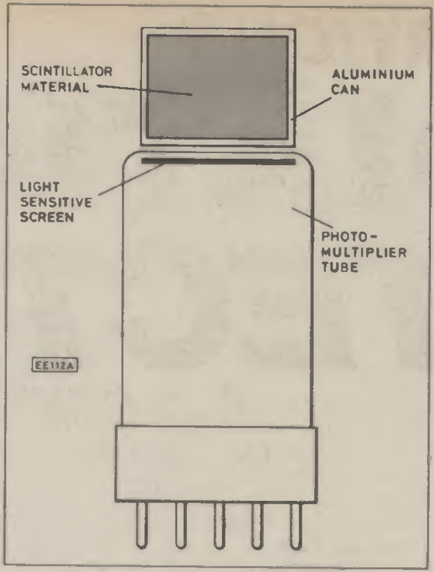


Fig. 4. Basic scintillator construction.

SCINTILLATORS

Many materials give out light when radiation strikes them. A fairly common one is zinc sulphide. This compound used to be mixed with radium to make luminous paint for watches. Because it is opaque, it can only be used in thin layers. This isn't very convenient since thin layers don't absorb radiation very well. Some other scintillator materials, as they are called, are transparent and so large chunks can be used. A photomultiplier tube is used to detect the light flashes (Fig. 4). These detectors tend to be fragile and expensive, they are really too sophisticated for everyday use.

RADIATION DOSIMETERS

For measurement of the activity of a source of radiation, electronic devices such as Geiger counters and surface barrier detectors are the most effective. Usually though, what people want to know is the total amount of radiation that a person has absorbed over a period of time. In this case, it is best to use a radiation dosimeter. Three types of radiation dosimeter are in common use nowadays: Quartz fibre electroscopes, Photographic film and Thermoluminescent dosimeters (T.L.Ds). Because they require special equipment to "read" them, T.L.Ds are not of great interest to us here. They work on the principle that some materials give out light when heated after they have been irradiated. (Sand does this quite well.) They have advantages in confined areas because they can be quite small. The other two types of dosimeter are worth considering in more detail because they are both simple to use and fairly cheap.

ELECTROSCOPES

An electroscope is a primitive voltmeter used in electrostatic experiments. It relies on the fact that like charges repel. Fig. 5 shows the more familiar gold-leaf electroscope in use. Notice that the gold-leaf "limb" is pushed away from the main arm by electrostatic force and that the amount of lift is dependent on the voltage.

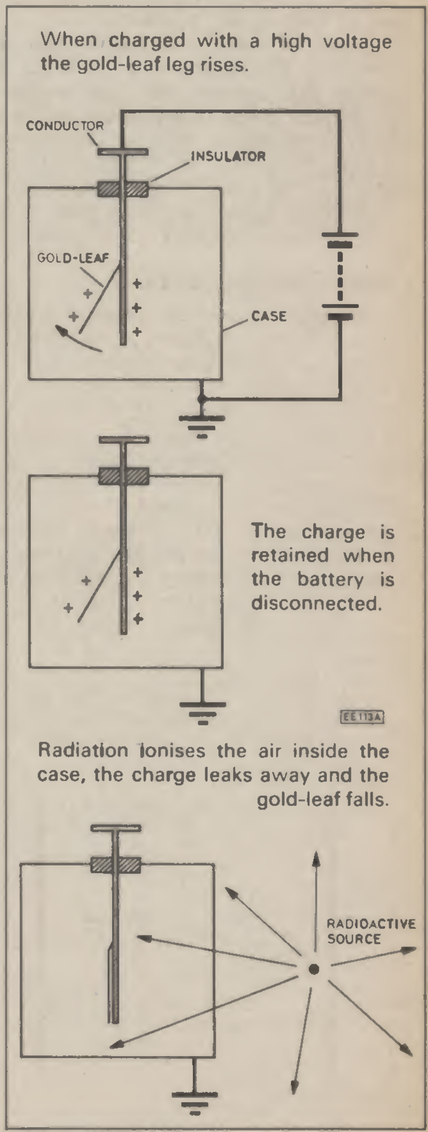
When radiation ionises the air around the charged electroscope the static charge leaks away and the gold-leaf gradually falls. The leaf shows by its position how much charge is left and so how much radiation it has experienced since it was charged.

The quartz fibre electroscope is just a more robust version of the gold-leaf type and is usually made in the shape of a pen for convenience. These "pen dosimeters" have to be charged before use to around 200 volts.

PHOTOGRAPHIC FILM DOSIMETERS

A piece of film is affected by radiation

Fig. 5. The electroscope.



just the same as by light. To make a dosimeter, a small sheet of photographic paper is placed in a light, tight wrapper inside a plastic case. Radiation filters, which are just sheets of different metals are included in the case. These filters absorb the alpha, beta or gamma rays to different extents to give an idea of what sort of radiation the dosimeter has received. The amount of fogging shown when the film is developed is a measure of the total radiation dose.

DO IT YOURSELF

A simple experiment in radiation detection can be performed at home using crystals of Uranyl Acetate. These can be obtained from most laboratory suppliers at around £2 for 25 grams. (Try the Yellow Pages.) If a few of these crystals are sprinkled onto a sheet of photographic paper and left in total darkness for a few weeks, the paper will become fogged where the crystals lie. Much more rapid results can be obtained using an old watch with luminous dial, particularly if the cover glass is removed.

If you do try this last experiment with the cover glass off, handle the watch with care and wash your hands afterwards, these old watches were painted with a highly active mixture of radium and zinc sulphide.

CONCLUSIONS

For radiation detection as opposed to dosimetry, there is really nothing to equal a Geiger counter for convenience, ease of use and price. With this sort of instrument it is possible to tell immediately if there is any radioactivity about, and to measure roughly how strong it is. Unfortunately, because public demand for them is low at present, they are not easily obtainable.

Radiation dosimeters of the quartz fibre type can often be purchased from government surplus dealers. They have two disadvantages though, in that they have to be charged before use, and they only indicate how much radiation you have already encountered. Since they are intended for use in high radiation areas, in laboratories, etc., quartz electroscopes are not generally sensitive enough to register the low level of radiation normally found in the environment. On entering a nuclear reactor, I was once handed one of these instruments and told "If you see the needle move, Run!"

Perhaps the speaker wasn't being entirely fair though. These dosimeters usually read up to 200mR, and the normal safe level of radiation for the general public is set around 10mR per week. Radiation workers are allowed ten times this, but only when subjected to regular medical check-ups. □

COUNTER INTELLIGENCE

BY PAUL YOUNG

Beginners Start Here

October, being the month when many of us switch from outdoor to indoor pursuits, we naturally expect new readers to join us by the score. Many of them will be commencing this hobby and soon they will be itching to pick up soldering iron and screwdriver and explore for the first time the wonderful world of electronic construction.

I will therefore, deliver my usual homily on the purchase of their possible requirements. The basic tools are not much of a problem (a good ironmonger can supply most of them) it is when we come to the building blocks that advice is required.

A few years ago, this advice would not have been necessary, every village of even a few thousand inhabitants would have had its little shop round the corner. Sometimes the proprietor would also be the town's local electrician who sold components as a sideline.

I well remember a holiday during that period, when I was exploring the small streets that traverse the canals in Venice. There were shops on all sides full of elegant wearing apparel, wine, perfume, delicious pastries and chocolates, and there in the middle, sticking up like a sore thumb, a little shop crammed with resistors, capacitors, speakers everything in fact, to gladden the enthusiast's heart.

Today, the scene has changed dramatically. The range of components has enlarged beyond all expectations, making it impossible for any one retailer to stock all requirements and, sadly, the recession has claimed many victims, in what, as I have often stressed, is an interesting but not very lucrative profession. What it all boils down to is this, unless you live in one of the larger cities, you will have to rely on mail order for most of your bits and pieces.

You will find plenty of addresses to write to in this magazine, and our associated publication, "Practical Electronics". Send for as many mail order catalogues as you can afford and study them, you will probably have to deal with three for four firms to satisfy all your needs. If you are price conscious you will find this preliminary work will pay off.

The smaller businesses are usually run by enthusiasts who will always try and help you. It is a good idea to join a local Radio Club if you are lucky enough to have one in your vicinity. The members often hold sales of their surplus material and this is a good chance to acquire a few bargains.

Mr. Bell And Mrs. Mopp

About one hundred and ten years ago, Alexander Graham Bell was busy inventing the Telephone. The microphone evolved as two carbon elements situated close together in a small round container and the intervening space was filled with carbon granules. The resistance between the two elements would vary as the granules were agitated by the human voice and the current passing through them would vary accordingly. When the resulting current was passed through an electromagnet with a thin steel diaphragm fixed in front, it would cause it to vibrate at the original frequencies.

I will now describe the microphone in use today, 110 years later, but no, it would be a waste of valuable space, just read the above again. In 110 years it has not altered, and why should it, it is simple, cheap, efficient and practically indestructable.

When it became a bit noisy, you simply clouted it with something heavy. Now they are replacing them with a complicated transducer microphone or a moving coil with its own built in pre-amp. The old one cost pennies, the new one over £6.

Why? you may ask. I questioned a GPO engineer about this, and he told me it was because of the "Mrs. Mopps". In other words, the cleaning ladies rushing round with their aerosol sprays cause the granules to stick together. Never mind A.G.B. it has had a good innings, but is this progress? I don't know. I do think that anything that is simple and works, should not be replaced, unless there is a very sound reason for doing so.

Which reminds me, the other day, a friend of mine was very upset because he lost his car keys. He had a spare ignition key, so I asked him, why all the fuss, because he confided, I have no key for the boot.

I was still non-plussed, and suggested that he pop round to the local agent and buy one. It was then that the real snag came to light. The boot has a special electronic lock, and a new key costs £15!! I wonder what on earth he keeps in his boot, Kruger Rands?

The Electronic Nose

I was amused to see a two-page spread in one of the Sunday supplements sponsored by the Royal Air Force, for the purpose of persuading Electronic Graduates to train as Engineering Officers. The picture shows an aircraft that the RAF call a "Nimrod" which is conspicuous by its long nose, and the caption reads: "The Electronics that will keep Britain's Nose in front".

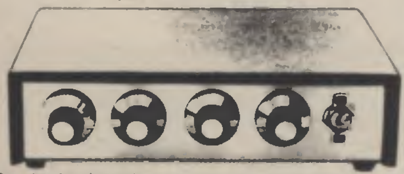
Unfortunately, if some of the would-be Engineering Officers are also aircraft buffs, they will immediately spot that the so-called "Nimrod" is none other than our old friend the "Comet" which, give or take a year or two, is twenty years old. It may make them wonder, whether the "Electronics" alluded to are more recent!!

PREVIOUSLY ADVERTISED STILL AVAILABLE

Tape punch and reader	£22.50
Bench isolating transformer 250 watt	£7.75
BOAC in-flight stereo unit	£1.50
Drill assortment 4 each 25 sizes between .25mm & 2.5mm	£11.50
Battery condition tester, less box	£1.75
Nicad chargers, mains	£0.75
Flourescent inventor 13 watt from 12v	£3.50
Ten digit stitch pad-pb phone etc.	£1.95
Uniselector 2 pole 25 way	£4.60
Water valve mains operated	£2.50
Counter 6 digit mains operated	£1.15
ditto 12v resettable	£3.45
Double glazing clear PVC sheet, 23½" wide per running ft.	£0.15
Locking mechanism with 2 keys	£1.15
Magnetic Clutch	£4.50
Mouth operated suck or blow switch	£2.30
Solenoid with slug 8 - 12v battery op.	£1.82
ditto 230v mains	£2.30
Timer Omron STP NH 110v AC Coil	£6.90
Key switch with 2 keys dp mains	£1.75
Air valve mains operated	£3.75
Latching relay mains operated	£3.50
Dry film lubricant aerosol can	£0.65
Coin op switch, cased with coin tray	£4.60

8 POWERFUL MODEL MOTORS (all different)

for robots, meccanos, drills, remote control planes, boats, etc. £2.95.

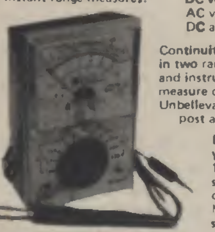


Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form or £25.00 assembled and tested.

MINI-MULTI TESTER

Deluxe pocket size precision moving coil instrument, Jewelled bearings - 2000 o.p.v. mirrored scale.

11 instant range measures: DC volts 10, 50, 250, 1000. AC volts 10, 50, 250, 1000. DC amps 0 – 100 mA.



Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only £6.75 + 60p post and insurance.

FREE Amps range kit to enable you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but if you already own a Mini-Tester and would like one, send £2.50.

EXTRA POWERFUL 12v MOTOR

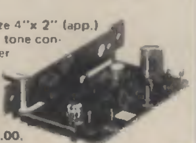
Probably develops up to ¼ h.p. so it could be used to power a go-kart or to drive a compressor, etc. £7.95 + £1.50 post.

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 – 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 - however, you can have the parcel for £2.50.

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 10 for £10.00.

– BARGAIN OF THE YEAR – The AMSTRAD Stereo Tuner.

This ready assembled unit is the ideal tuner for a music centre or an amplifier, it can also be quickly made into a personal stereo radio – easy to carry about and which will give you superb reception.

Other uses are as a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead.

Some of the features are: long wave band 115 – 270 KHz, medium wave band 525 – 1650KHz, FM band 87 – 108MHz, mono, stereo & AFC switchable, tuning meter to give you spot on stereo tuning, optional LED wave band indicator, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or head-phones and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands. All made up on very compact board.

Offered at a fraction of its cost: only £6.00 Post Free

THIS MONTH'S SNIP

Hi Fi sound from your Spectrum 1 watt amp – pm speaker & instructions £2.45

REVERSIBLE MOTOR with control gear

Made by the famous Framco Company this robust motor is approx 7½" long, 3½" dia, 3/8" shaft. Very powerful, almost impossible to stop. Ideal for operating stage curtains, doors, ventilators, etc. Even garage doors if properly balanced. Offered complete with control gear as follows:

1 Framco motor with gear box
1 manual reversing & on/off switch
1 circuit diag. of connections
1 push to start switch
2 limit stop switches

ONLY £19.50 + postage £2.50.

FOR SOMEONE SPECIAL

Why not make your greeting card play a tune? It could play 'Happy Birthday', 'Merry Christmas', 'Wedding March', etc, or 'Home Sweet Home', etc. Wafer thin 3 part assemblies, for making cards musical. Mini microchip speaker and battery with switch that operates as the card is opened. Please state tune when ordering. Complete, ready to work £1.25.

JOYSTICK

WHY PAY £10 OR MORE – Make yourself a Joystick – full details were given in Dec/Jan 'Sinclair Projects'. We will supply complete kit for £2.30. Although designed for the Spectrum or ZX81 it is equally suitable for any home computer.

TELEPHONE ITEMS (ex-GPO)

Plug and Wall socket – 4 pin or 5 pin	£3.45
Plugs only 4 pin or 5 pin	£1.15
Modern desk telephone	£7.50
Heavy black old type	£5.50
External bell unit	£6.50
Bell ringing power unit	£4.50
Pick up coil	£1.15

STABILISED POWER SUPPLY (Mains Input)

By LAMDA (USA) – Ideal for computer add-ons, d.c. output. Regulated for line volts and load current. Voltage regulation .1% with input variations up to 20% – load regulation 1% from no load to full load – or full load to no load. Complete in heavy duty case – Models available: 5v - 9A £23. 12v - 1.5A £13.25. 15v - 1.2A £13.25. 24v - 2A £23.

PRESTEL UNIT

– brand new and complete except for 7 plug in IC's – Price: £14.95 + £2.00 p&p

Note: British Telecom may not connect this equipment as there is no manufacturer to guarantee it, however it is well worth buying for its immense breakdown value – sold originally at over £150.

25A ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you wake – switch on lights to ward 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. Independent 60 minute memory jogger. A beautiful unit at £2.50.

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Hooter/Siren 6v - 12v	69p
Loud, med & soft buzzer	75p
Open buzzer ex G.P.O.	50p
12" Gong cast iron cased ALARM BELL 12v dc	£19.50
6" Gong 12v dc	£7.50

50 THINGS YOU CAN MAKE

Things you can make include Multi range meter, Low ohms tester, A.C. amps meter, Alarm clock, Soldering iron minder, Two way telephone, Memory jogger, Live line tester, Continuity checker, etc. etc., and you will still have hundreds of parts for future projects. Our 10Kg parcel contains not less than 1,000 items - panel meters, timers, thermal trips, relays, switches, motors, drills, taps, and dies, tools, thermostats, coils, condensers, resistors, neons, earphone/microphones, nicad charger, power unit, multi-turn pots and notes on the 50 projects.

YOURS FOR ONLY £11.50 plus £3.00 post.

FROZEN PIPES.

Can be avoided by winding our heating cable around them – 15 mtrs connected to mains costs only about 10p per week to run. Hundreds of other uses as it is waterproof and very flexible. Resistance 60 ohms/metre. Price 28p/metre or 15 m for £3.95

FLEXIBLE EXTENSION LEAD twin rubber

.5mm ideal grass cutters etc ,250mm coil £25.00
50 meter coil £6.75

MAINS TRANSFORMERS

4 volt	4 amp	£1.75	24 volt	4 amp	£4.85
6 volt	1 amp	£1.15	25 volt	1 amp	£2.25
12 volt	½ amp	£1.15	35 volt	2 amp	£3.95
12 volt	¾ amp	£1.55	38 volt	2½ amp	£4.95
12 volt	1 amp	£1.75	26 volt	10 amp	£9.95
15 volt	2 amp	£3.45	50 volt	2 amp	£5.50
15 volt	4 amp	£4.60	25.0.25	½ amp	£3.95
18 volt	1 amp	£1.95	12.0.12	2 amp	£4.95
20 volt	1 amp	£2.30	115v 100w auto		£3.95
24 volt	2 amp	£3.45	115v 250w auto		£5.75

J. BULL (Electrical) Ltd.

(Dept. EE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU. Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £12 add 60p service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted day or night. Haywards Heath (0444) 454563. Bulk orders: phone for quote. Shop open 9.00 — 5.30, mon to Fri, not Saturday.

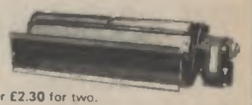
STORE CLOSING SALE

All stocks must go from one of our big warehouses. 10,000,000 items, everything from AERIALS to ZENER will be cleared at fantastically low prices - if you are a manufacturer you can save yourself a fortune - send for our Sale List, not for small buyers as minimum order £100.

EXTRACTOR FANS – MAINS OPERATED

Woods extractor.
5" – £5.75, Post £1.25.
6" – £6.95, Post £1.25.
5" Plannair extractor £6.50. Post £1.25.
4"x 4" Muffin 115v. £4.50. Post 75p.
4"x 4" Muffin 230v. £5.75. Post 75p.
All the above ex-computer, those below are unused.
4" x 4" £8.50. Post 75p.
9" American made £11.50. post £2.00.
Tangential Blower 10x3 air outlet, dual speed £4.60. Post £1.50.

TANGENTIAL BLOW HEATER



by British Solartron, as used in best blow heaters. 2Kw approx 9" wide £5.95, 3Kw either 9" or 12" wide (your choice) £6.95 complete with 'cold' 'half' and 'full' heat switch, safety cut out and connection dig. Please add post £1.50 for 1 or £2.30 for two.

2.5 Kw KIT

Still available: £4.95 + £1.50 post.

MINIATURE WAFER SWITCHES

2 pole, 2 way – 4 pole, 2 way – 3 pole, 3 way – 4 pole, 3 way – 2 pole, 4 way – 3 pole, 4 way – 2 pole, 6 way – 1 pole, 12 way.
All at 25p each or 10 for £2.00

OTHER TYPES IN STOCK – PLEASE ENQUIRE

24 HOUR TIME SWITCH

– Made for control of Randall Central Heating Boilers these give 2 on/offs per 24 hrs. Equally suitable for control of immersion heaters of heating systems. £4.60.

CONNECTING WIRE PACK

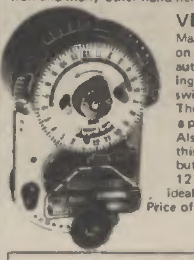
96 lengths of connecting wire, each 1 metre long and differently colour coded, a must for those difficult interconnecting jobs. 85p the lot.

RED LEDS

10 for 69p. 100 for £5.75. 1000 for £52.

IN LINE SIMMERSTAT

Ideal heat controller for soldering iron and many other hand-held appliances. £2.30. 10 for £17.25.



VENNER TIME SWITCH

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. These are without case but we can supply a plastic case - £1.75 or metal case - £2.95. Also available is adaptor kit to convert this into a normal 24 hr. time switch but with the added advantage of up to 12 on/offs per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30.

Ex-Electricity Board. Guaranteed 12 months.

IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder – a complete mains operated kit, case included.

£11.95 plus £2.00 post.

OTHER POPULAR PROJECTS

Short Wave Set – covers all the short wave bands using plug-in coils. Kit complete	£14.50
R C Bridge Kit	£9.95
3 Channel Sound to Light – with fully prepared metal case.	£14.95
Ditto – made up	£25.00
Big Ear, listen through walls	£9.50
Robot controller – receiver/transmitter	£9.50
Ignition kit – helps starting, saves petrol, improves performance	£13.95
Silent sentinel Ultra Sonic Transmitter and receiver	£9.50
Car Light 'left on' alarm	£3.50
Secret switch – fools friends and enemies alike	£1.95
3 – 30v Variable Power Supply	£13.80
2 Short & Medium wave Crystal Radio	£3.99
3v to 16v Mains Power Supply Kit	£1.95
Light Chaser – three modes	£17.50
Mullard Unilex HiFi stereo amplifier with speakers	£16.75
Radio stethoscope – fault finding aid	£4.80
Mug stop – emits piercing squark	£2.50
Morse Trainer – complete with key	£2.99
Drill control kit	£3.95
Drill control kit – made up	£6.95
Interrupted beam kit	£2.50
Transmitter surveillance kit	£2.30
Radio Mike	£6.90
FM receiver kit – for surveillance or normal FM	£3.50
Seat Belt reminder	£3.00
Car Starter Charger Kit	£15.50
Soil heater for plants and seeds	£16.50
Insulation Tester – electronic megger	£7.95
Battery shaver or fluorescent from 12v	£6.90
Matchbox Radio – receives Medium Wave	£2.95
Mixer Pre-amp – disco special with case	£16.00
Aerial Rotator – mains operated	£29.50
Aerial direction indicator	£5.50
40 watt amp – hifi 20hz – 20kHz	£9.50
Microvolt multiplier – measure very low currents with ordinary multitester	£3.95
Pure Sine Wave Generator	£5.75
Linear Power output meter	£11.50
115 Watt Amplifier 5Hz 25kHz	£13.50
Power supply for 115 watt amps	£8.50
Stereo Bass Booster, most items	£8.95

SHOP TALK

BY DAVE BARRINGTON

Cirkit's

The introduction of a comprehensive range of new kits and modules, which will cater for all electronic constructors from the beginner to the professional, has just been released by **Cirkit**. The complete range will offer the constructor a varied choice of projects, providing many practical applications around the home and workshop.

The kits are graded student, enthusiast or professional and classified according to their applications, which include audio, test, radio and general. The more advanced kits require some test equipment for alignment, but the student kits need only a few hand tools to produce a working unit.

Projects range from a swept frequency generator at £39.50 (VAT to be added) to a lamp dimmer for just £5.70 (plus VAT to be added).

For complete details of the range of kits and local stockists contact: **Cirkit, Dept EE, Park Lane, Broxbourne, Herts EN10 7NQ.**

Trackpaper

Prototype stripboard layouts can often cause many frustrating hours of deliberations before finally setting down the final version. This usually results in piles of scrap paper and "writer's cramp" from having to draw out all the copper tracks at each attempt. Also, there is the debris from constantly rubbing out and repositioning the "cuts" in the copper tracks.

Trying to work directly on the stripboard, instead of paper masters, can be even more catastrophic, with solder and scrapped boards eventually flying everywhere!

To help with this dilemma, Trackpaper has been produced by **P&S Supplies** to make it easier to layout circuits which are to be built on stripboard. The tracks and holes found on stripboard are reproduced, to the same 0·1in matrix, on printed paper sheets.

Component positions can therefore be drawn out on Trackpaper first, any mistakes in the layout can then be rectified before using the board. By drawing different configurations of the circuit on the paper the most suitable layout can be chosen.

The Trackpaper can also be cut to size, positioned over the stripboard and the components pushed through the paper onto the board. The components would then be soldered in position and the paper removed.

Trackpaper is available in packs of twenty A5 size for £1.55 plus 20p p&p. Further information may be obtained from **P&S Supplies, Dept EE, 51 Cambridge Road, Impington, Cambridge, CB4 4NU.**

Waterproof Boxes

Covering 10 different sizes, the diecast aluminium Bimboxes from Boss Industrial Mouldings are offering a waterproof version or versions with internal p.c.b. support slots.

The IP65 waterproof versions, manufactured from LM6 aluminium alloy are available in four sizes ranging from 40 x 52 x 75mm to 80 x 120 x 220mm. The cases incorporate an oil and petrol resistant neoprene gasket seal.

Details of stockists and prices are available from Boss Industrial Mouldings Ltd., Dept EE, James Carter Road, Mildenhall, Suffolk IP28 7DE.

Catalogue

A 16-page cases and components catalogue and price list has just been released by **Semiconductor Supplies.**

Items listed include small cases, racks, connectors, breadboards, Eurocards, p.c.b. etch-resistant transfers, a copper etching kit, wiring systems and hand tools.

Also available are a range of miniature round speakers between one and three inches in diameter. There are seven speakers with alnico magnets and five with larger ferrite magnets.

Copies of the catalogue/price list may be obtained from **Semiconductor Supplies International, Dept EE, 128/130 Carshalton Road, Surrey SM1 4RS.**

CONSTRUCTIONAL PROJECTS

Mains Cable Detector

We do not expect any component purchasing problems for the *Mains Cable Detector.*

The pick-up plate or "sensor" can be made from a scrap piece of printed circuit board. Alternatively, the "sensor" could be made-up from three 6mm strips of self-adhesive copper foil. Although we have not tried this in practice, the foil will easily stick to the sides of the case and form an ideal sensor plate.

The self-adhesive copper tape is known as Copperfoil and is available from **Copperfoil Enterprises, Dept EE, 141 Lyndhurst Drive, Hornchurch, Essex RM11 1JP.**

Micro Memory Synthesiser

Some difficulty may be experienced in obtaining certain components for the *Micro Memory Synthesiser.* However, Magenta Electronics are able to supply a complete kit of parts for this project for the sum of £47.98.

They are also able to supply a set of three printed circuit boards for the sum of £6.50 and the 420 microcomputer i.c. for £11.98. They will, of course, sell all parts for this project individually as required.

All prices include VAT, but an extra 60p per order will have to be added for post and packing.

For full details readers should contact **Magenta Electronics, Dept EE, 135 Hunter Street, Burton-on-Trent, Staffs DE14 2ST.**

Drill Speed Controller

When ordering components for the *Drill Speed Controller* be sure to specify a "log" law potentiometer, with plastics spindle, for VR1.

Once again, if readers experience difficulty with components, a full kit of parts is available from Magenta Electronics and costs £6.89. They are also able to supply the printed circuit board separately for the sum of £1.50.

Prices include VAT, but post and package will cost an extra 60p per order.

Dual Mains Switch

The only components likely to cause any buying problems when constructing the Dual Mains Switch are the MOC3020 opto isolator and the TIC226D.

These devices are available from Maplin Electronic Supplies and are designated TQ50 and C226D: Order codes QQ10L (Triac Isolator) and WQ25C respectively.

Suitable opto triac isolators and triacs are also available from Rapid, Magenta, TK Electronic and Bi Pak.

We cannot foresee any component buying problems for the Black Box Project—Judges Points Indicator.

MAINS CABLE DETECTOR

DAVID CORDER

THIS unit was designed to prevent the "accidental drilling" or "nailing through" of mains wires which are buried in the walls of a building. It can also be used to detect if a cable has an a.c. current flowing through it; in this case, a small current produces a low buzz and a larger one a louder buzz. This should be remembered when the unit is in use; to get a louder signal, an appliance should be connected where possible. The unit will only function for cables carrying a.c.—the reason will become clear in the circuit description.

CIRCUIT DESCRIPTION

The cable detector works on the principle that an alternating current in one wire will induce a smaller alternating current in a second wire nearby. This is the same principle as the transformer. In this circuit the first wire (or primary) is the mains cable, and the second wire (or secondary) is the copper sensor plate. The principle of induction does not work for d.c., as this induces no current other than when the power is first connected.

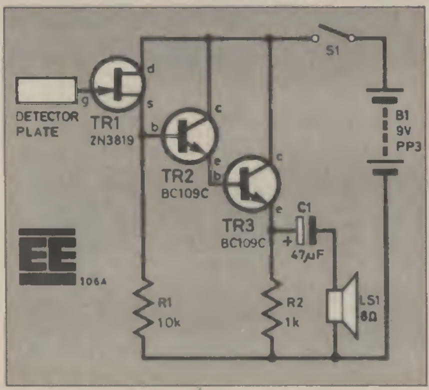


Fig. 1. Circuit diagram.

The circuit diagram of the unit can be seen in Fig. 1. The field effect transistor TR1 provides a high gain buffer stage for the tiny induced current, and the transistors TR2/TR3 are arranged in a Darlington pair to give even greater gain. The signal is then sent via d.c. blocking capacitor C1 to the loudspeaker. The signal appearing at LS1 is simply an amplified version of the induced current fed to the gate of TR1.

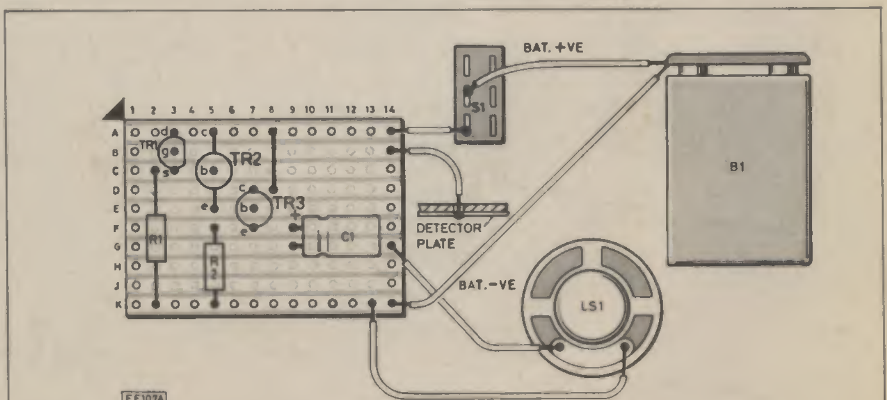
CONSTRUCTION

In the prototype, the sensing plate was made up of three strips of self-adhesive copper foil. These were simply stuck side-by-side along the side of the case. To ensure all three strips are connected as one, they should be soldered together at their ends (see photo). The overall size of the sensor is 90 × 18mm. As long as this approximate size is maintained, any suitable copper sheet may be used. This will provide a sensing depth of around 50mm, and even at 100mm a reasonable change in volume should be heard; this may vary with the individual characteristics of the components used.

The circuit is built on a piece of stripboard; the component layout can be seen in Fig. 2. There are no track-cuts necessary in this design. First, the wire link should be inserted followed by the resistors and the capacitor, the transistors being fitted last.

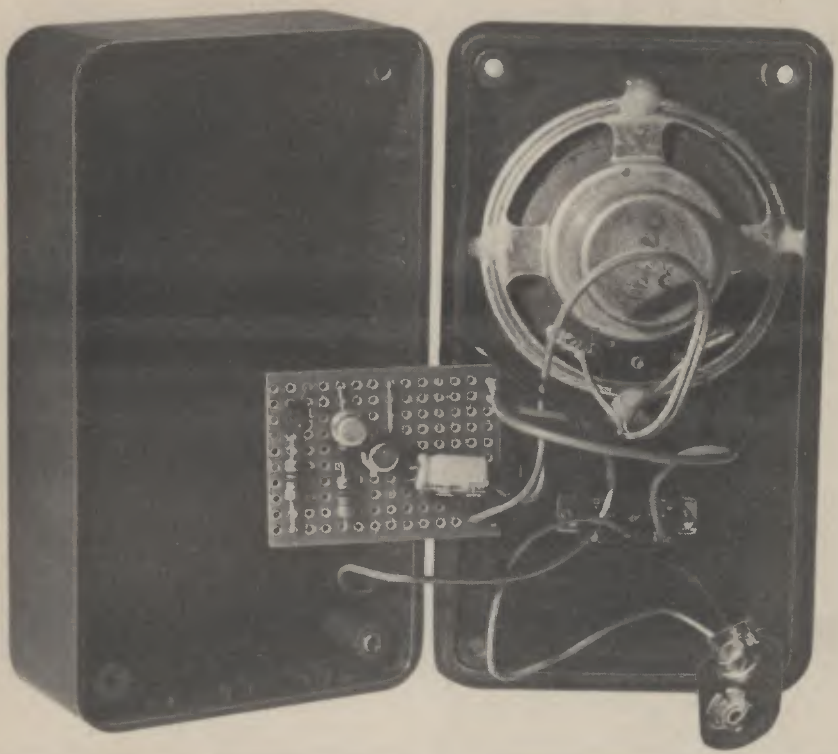
Care should be taken when soldering the transistors so that the heat does not damage them; for this a heatsink should be used. Once the board has been assembled, connect the wires to the sensor plate, speaker, switch and battery. It is important that a non-metallic case is used in this project. The plastic case used in the prototype measured 100 × 50 × 20mm.

Fig. 2. Component layout and wiring diagram.



OPERATION

When in use, care should be taken to avoid touching the pick-up plate on the outside of the case with your fingers or the wall, as this can upset the operation of the unit. The cable sensor should be swept slowly along the area of wall to be checked, at a distance of about 10mm. If the audible signal is small, then the appliance connected can be switched on in order to increase the signal strength and therefore give a louder signal. The point at which the signal is loudest is where the hidden cable lies. □



COMPONENTS

See Shop Talk page 642

Resistors
R1 10k
R2 1k
All ¼W carbon ±10%

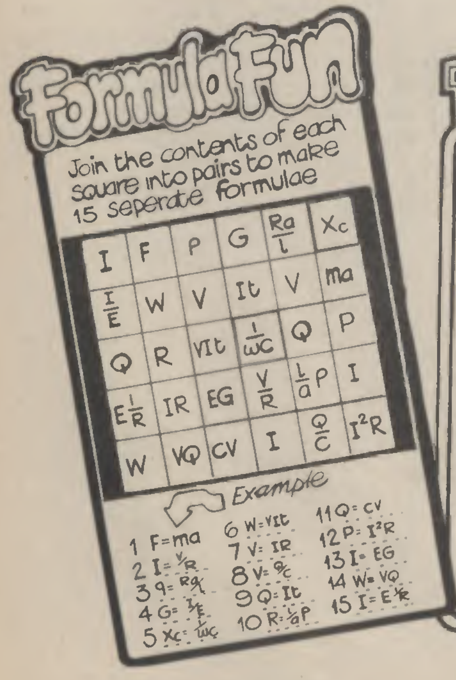
Capacitor
C1 47µ 16V elect.

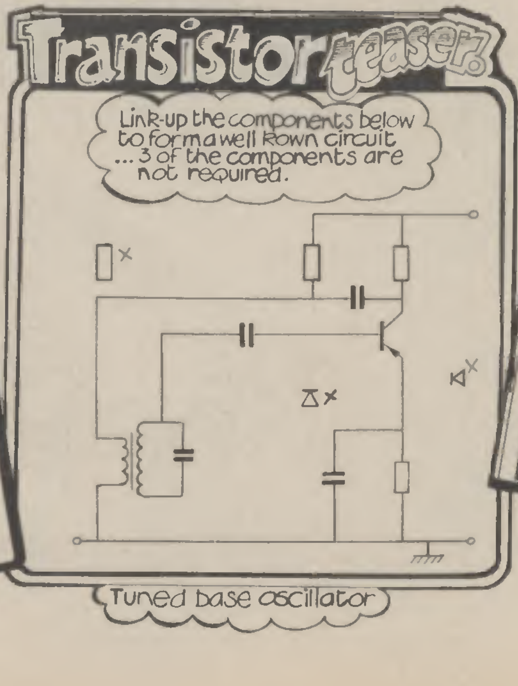
Semiconductors
TR1 2N3819
TR2–3 BC109 or BC108 (2 off)

Miscellaneous
LS1 loudspeaker 8Ω (min)
S1 s.p.s.t. slide switch (min)
B1 9V PP3 battery
Stripboard 0·1in pitch matrix, size 10 strips × 19 holes; battery clip; suitable copper plate for sensor (see text); 7/0·2mm stranded wire; non-metallic box 100 × 50 × 20mm.

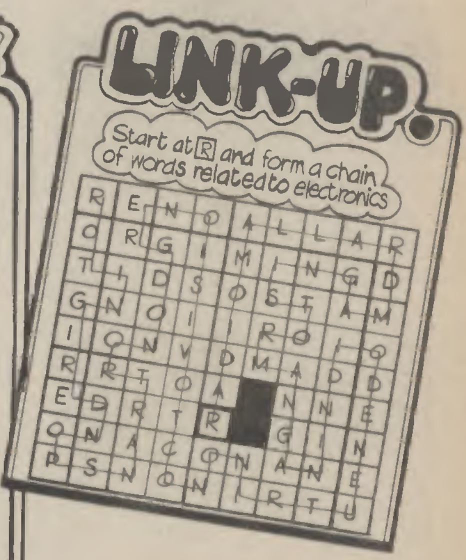
Approx. cost Guidance only £5.00

FUNTRONICS Solutions...





Tuned base oscillator



SQUARE one FOR BEGINNERS

FROM THIS MONTH, EE will have a new style of assigning passive component values. "Passive" components are such things as resistors, capacitors and inductors, as opposed to "active" components such as transistors and integrated circuits. Table 1 gives examples of the new standard, which follows that used by most of British Industry.

NEW STYLE

The omission of the decimal point in component values (for example, 6k8 rather than 6·8kΩ) means that a circuit diagram is clearer and easier to read, and it also makes the production of drawings quicker.

We are not changing the style of the circuit diagrams themselves—although a rectangle is becoming common now as a symbol for a resistor, EE will retain the traditional symbol. Similarly for capacitors, diodes, and all other components: the diagrams will look as they did before (see Fig. 1), only the component values will be in the new style.

RESISTOR COLOUR CODE

This also offers an opportunity to explain the meaning of colour codes used for resistors and capacitors, so that "6k8", for example, can be related to a physical component. Table 2 gives the meaning of the coloured bands on a resistor, and also the "preferred values" for resistors.

Table 1. Old and new component value markings for circuit diagrams

	Now	Before
Resistance	6k8	6·8kΩ
	1M5	1·5MΩ
	330	330Ω
	2Ω2	2·2Ω
	0Ω33	0·33Ω
Capacitance	220μ	220μF
	4μ7	4·7μF
	470n	0·47μF
	10n	0·01μF
	4p7	4·7pF
Inductance	3H4	3·4H
	800m	800mH
	2m6	2·6mH
	1m	1mH

NOTE
p (pico) $= 10^{-12}$
n (nano) $= 10^{-9}$
μ (micro) $= 10^{-6}$
m (milli) $= 10^{-3}$
k (kilo) $= 10^{3}$
M (mega) $= 10^{6}$

Table 2

RESISTOR COLOUR CODE

Colour of Band	Number
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

Significance of band

First	Second	Third	Fourth
1st digit	2nd digit	Number of zeros	Tolerance

Most common tolerances: Gold (±5%); Silver (±10%)

Preferred values: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82

Resistors have a series of coloured bands, bunched closer to one end than the other, to indicate their value in ohms. See Fig. 1. A resistor with coloured bands in the order blue, grey, red, gold, for instance, would have a value of 6800 ohms (6k8), plus or minus five per cent. One with bands of yellow, violet, black and gold would have a value of 47 ohms (47).

"Preferred values" are the values which are normally obtainable by the home constructor, and although a resistor of value 500 ohms, for example, is not available, this does not present a problem in practice.

CAPACITORS

The colour coding for capacitors is shown in Table 3. This scheme applies normally only to polyester or tantalum capacitors.

For values of capacitance greater than 2μ, it is usually necessary to make use of electrolytic capacitors. If these are used, they *must* be connected the correct way. If they are in circuit the wrong way round, they may actually explode.

The new style of marking passive components is meant to be both helpful, and in keeping with current general practice.

Table 3. Colour coding for tantalum and C280 capacitors

CAPACITOR COLOUR CODE

	TANTALUM microfarads (μ)				SERIES C280 picofarads (p)				
Band (ring) Colour	1st band	2nd band	Spot (Multiplier)	3rd band	1st band	2nd band	3rd band (Multiplier)	4th band	5th band
BLACK	–	0	1	10V	–	0	1	20%	–
BROWN	1	1	10	–	1	1	10	–	100V
RED	2	2	100	–	2	2	100	–	250V
ORANGE	3	3	–	–	3	3	1000	–	–
YELLOW	4	4	–	6·3V	4	4	10000	–	400V
GREEN	5	5	–	16V	5	5	100000	5%	–
BLUE	6	6	–	20V	6	6	1000000	–	–
VIOLET	7	7	–	–	7	7	0·01	–	–
GREY	8	8	0·01	25V	8	8	0·001	–	–
WHITE	9	9	0·001	3V	9	9	–	10%	–
PINK	–	–	–	35V	–	–	–		–

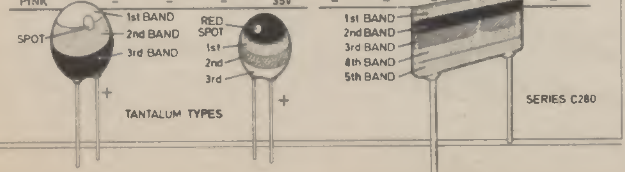
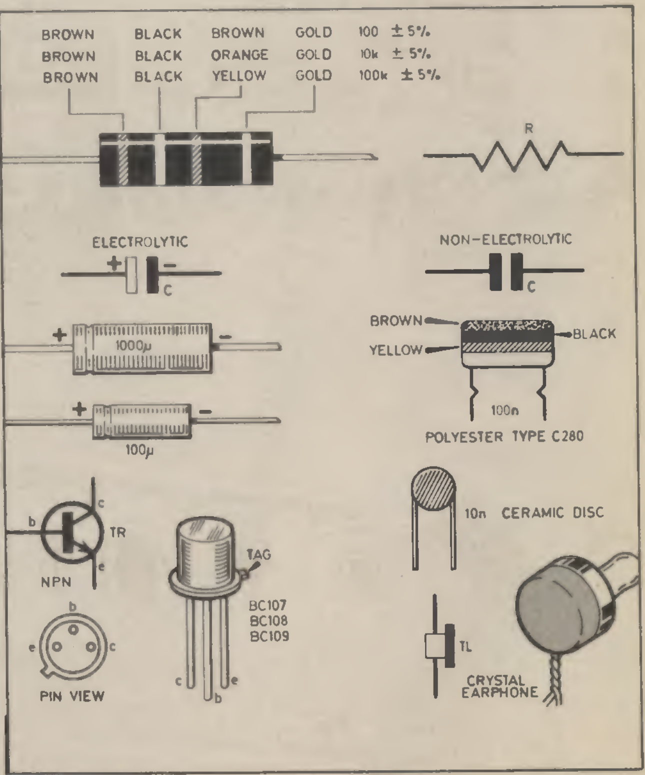


Fig. 1 (Opposite). Typical component markings.

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CONSUMER ELECTRONICS *Chicago*

BARRY FOX

EVERY year, in June, manufacturers, wholesalers, retailers and journalists from all round the world make a pilgrimage to hot, sweaty Chicago. There they spend four days trekking round the giant Consumer Electronics Show. Time is always inadequate. Almost 1500 exhibitors straggle through the main exhibition hall at McCormick Place and hotel suites dotted inconveniently around the city. New pilgrims rush desperately from place to place, usually just missing the company representative they wanted to see because he has just gone off to visit some other exhibitors' stands.

With only a few exceptions, most of the exhibition stands and hotel suites in Chicago are manned by sales people who know next to nothing about the technology of what they are showing. They have learned a few buzz words of jargon which they use with brazen bluff to fend off the majority of questions.

At the end of the show weary journalists swop notes about what they have missed and bewail the fact that there was not really that much new to see after all. Older hands, however, play the Chicago game to advantage. They know there is no chance of seeing every exhibit; they know there will be relatively few breakthrough innovations; and they don't waste time asking marketing managers questions about video writing speed or floppy disc packing density. Instead they take the Chicago CES for what it is, and no more—a barometer for the industry, with general pointers to the future and the occasional nugget of hard news as a bonus.

OVERVIEW

After Chicago, the overview is always clearer . . .

This year at Chicago, for instance, there were valuable pointers to the future of 8mm video, which may well not be what anyone yet expects. There were interesting advance signs of the way the Japanese computer industry will market MSX. Instead of generating publicity for a product not yet available (Sinclair was doing just that with a still-dongled QL at Chicago) the Japanese will play the Tandy Radio Shack game. This is to wait until the products are there in the stores and ready to be bought before stimulating a demand for them. Tandy Radio Shack does not even bother to exhibit at Chicago; the company relies on press advertising and at least one shop in every large town.

The long term future of audio clearly lies with compact disc digital sound, whatever the anti-digital hi fi buff may still be saying. Record companies, like Sheffield Lab, which have talked disparagingly of compact disc, took Chicago as the opportunity to launch a range of compact discs. The use of CD as a computer memory, a very large capacity ROM, is clearly further off than expected. No-one was demonstrating this new technology at Chicago. Nor were they demonstrating another long term possibility for compact disc, graphic designs and text for video display coded in the digital stream along with the music signal. But nor did the expected compact disc Walkman, a portable player for miniature compact discs, make its expected appearance. The industry concentrated instead on proving, or more accurately *trying* to prove, that it is now possible to build a compact disc player small enough to use in a car as a direct replacement for the standard DIN-size cassette radio. Sony's car player stopped working because it got too hot!

SHOTGUN WEDDING

As one American observer noted, the much heralded marriage of audio and video was scheduled to take place at Chicago. Nearly 100,000 people witnessed the ceremony. Video firms talked about hi fi audio, and audio firms stressed the advantage of hi fi reproduction for video sound, in stereo or surround around the room. But to pursue the analogy, it was very much a shotgun wedding. The two industries are still as far apart as ever. They think differently and have little genuine interest in the other's technology, even though modern audio technology is a direct spin off from video. Audio people are just not interested in video, they often actively resent it. Video people are only just now beginning to think about audio, with the new hi fi video systems. The division is reinforced by ignorance. It takes a lot of hard work to get to grips with a new technology. Superficially it may look like a marriage but in reality there is still a yawning gap between the two technologies.

The same is true with computer technology. Logically it should merge with audio and video. All three technologies rely on high density storage and most audio and video equipment is microprocessor controlled. The next step, already being demonstrated, is the interface of computer separates with audio and video separates. Although there are a few visionaries in the electronics industry, usually engineers with a broad overview of the whole consumer electronics field, most companies still divide their activities rigidly into the now artificial pigeon holes of audio, video and computers.

I would be a rich man, if I had a pound for every time a PR person has said to me "I didn't think you'd be interested, it's not really your field", when I have wondered why they have not told me about some new consumer electronic innovation. Firms like Philips still create an artificial division between audio and video, and even different fields of video, like disc and tape. Inside Philips there is another artificial split between Compact Disc and Car CD. Readers of hi fi magazines howl when the editor publishes a video article. The audio record industry made a fool of itself for years, pursuing the obviously impossible dream of a foolproof anti-copying or 'spoiler' system. Then the video people made all the same mistakes. Now the computer industry is exploring the same blind alleys. Each new boom industry displays a pitiful ignorance of work that has been done before in related industries.

This all helps explain why shows like the Chicago CES are so valuable. It's the only time all the partners to this unwilling marriage get together under one roof. They don't talk much to each other. But they provide anyone interested with a wonderful chance to collect some pieces of the overall picture jigsaw.

VIDEODISC

Past Chicago shows have been notable for the money and energy expended by RCA on the CED (capacitance electronic disc) videodisc system, which uses an electrode stylus tracking the superfine groove of an electrically conductive vinyl disc. This year, in keeping with the tradition of 1984 "newspeak", it was as if CED had never happened. There wasn't a player or disc to be seen. After losing half a billion dollars on the obviously doomed venture (CED came too late and didn't work too well either), RCA has stopped production of players. The company will only continue to press discs for as long as the half million or so people who have bought players over the last three years want to buy them. If the choice of discs falls off, then so will sales. When sales fall off, RCA will be able to stop pressing. Already there are signs that the supply of interesting titles is drying up so expect the whole system to be dead and gone in a couple of years.

The other videodisc system on sale in America, Laservision, is pushed hard by Pioneer, with Philips the inventor showing only marginal interest. (The opposite is true in Europe.) The big news at Chicago was that Pioneer is now selling a Laservision player which uses a solid state laser diode, instead of the bulky gas lasers still used in the Philips and Pioneer players on sale in Britain. Philips in Europe cannot switch to diodes until it has sold its embarrassingly large stock of gas players. Nor can Pioneer. But the new diode players on sale in America are quite frankly a disappointment. Picture quality is not as good as with gas lasers, especially for long play discs which run for a full hour one side. Although Pioneer is very cagey about this, and brushes questions aside, poor quality is almost certainly due to the diode emitting light with a wavelength which is just slightly too long.

The Laservision system is designed to work with a light wavelength of 0·63 microns. At this wavelength the laser beam can be tightly focused on one pit in the track, and one turn of the track spiral, at a time. If the spot is too large, it will read several pits and tracks at the same time. This does not matter for compact disc digital audio, because such crosstalk cancels out at the decoding stage as long as there is still a clear distinction between "1's" and "0's". The diode in a CD player operates at around 0·8 microns. So far it has proved difficult to produce diodes which run at 0·63 microns. Hence the use of gas lasers. The Pioneer player almost certainly uses a laser which is at a wavelength somewhere between the two values.

The pictures shown at Chicago had all the telltale characteristics of an inadequately focused spot: snow, colour noise and even crosstalk interference patterns from one track to another. The US trade has already started to notice this. Loss of confidence in Laservision at this stage, through reduced picture quality, could be very damaging to the system's long term chances. Although CED has gone and Laservision is the only disc system on the US market, video tape now offers hi fi sound of videodisc quality. Also the VHD disc system from Japan could be launched in the USA. VHD now rivals Laservision on virtually all features and facilities, and even beats it on some. This is a remarkable achievement, bearing in mind the limitations inherent in VHD when it was first put forward as an alternative toCED and Laservision.

VHD

VHD can best be described as a hybrid cross between the two other systems. Like CED, the disc is pressed from conductive material, but like Laservision, there is no groove. Like CED, the disc is read by an electrode stylus, and this is kept on track by servo control signals recorded along with the information signals. The VHD disc is smaller (10 inches instead of 12 inches) and like CED must at all times be stored in a protective caddy, because any finger marks will spoil performance by affecting the surface conductivity.

The launch of VHD has been much delayed, partly because of technical problems and partly because of the changing commercial climate. The Japanese inventors, JVC, watched Laservision and CED struggle vainly to sell as dumb carriers for feature films, when video tape had already monopolised that market. So they, along with Thorn-EMI the UK giant backing VHD, mark time on a commercial launch while the Japanese engineers improve the system, for instance by introducing world com-

The Sinclair QL: at $499, a 'quantum leap' in computing performance for the serious home, business or educational user.— For a "Special Users Report" on the QL see page 662.

patibility. A new coding system was developed, which means that a VHD disc for one country will now play on a player designed for another country, irrespective of the different tv systems used in different countries. Neither Laservision nor CED could adopt this technique, because they were already too far down the commercial road to change technical standards.

VHD engineers have also worked wonders at turning an inherent technical disadvantage, to advantage. To cram one hour of playing time on each side of a ten inch disc requires a very high information packing density. Two full tv frames, which is four fields, are recorded for each revolution of the disc. This makes still frame display a problem, because if the stylus tracking is halted, while the disc continues to rotate, it continually reproduces a four-field sequence instead of the two-field sequences needed for clear freeze frame. This causes a flutter on the screen where there is motion. It's not as bad as the flutter you get with CED, which records 8 fields per revolution; and it's not as bad as the situation with long play Laservision, where there is no still frame facility at all. This is because the disc is tracked at constant linear velocity, which means that an ever-changing number of fields is recorded as the laser tracks from centre to outer periphery. But the four-field VHD flutter is a constant irritation to software producers and users who want crisp freeze frame.

For sequences where a still frame is needed, the VHD disc now records each frame twice over, to give four matching fields. For normal playing, the stylus keels skipping to read only every other frame. At Chicago JVC showed a brilliantly clever extension of this idea.

Visitors to the JVC stand had plenty of exhibits on which to gain "hands-on" experience.

VIDEO MSX

JVC is one of the twenty odd Japanese companies which has signed to conform with the MSX computer standard, already on sale in Japan and due here this autumn or winter. Already there is a videodisc interface for MSX which lets the standard format computer control a videodisc player. Interface creates 'genlock', whereby internally generated video graphics are locked in synchronism with picture signals from the videodisc. This enables live action to be overlaid with computer graphics. It is vital for what could well turn out to be the next craze, videodisc games.

Already arcades in America have coin-in-the-slot games where the player challenges a computer as it throws up live or animated action film sequences on screen, sourced from a rapid access videodisc. So far the discs have been Laservision discs (in a few cases none-too-satisfactory CED discs) but the home system shown by JVC not surprisingly uses a VHD player.

For the game "Highway Star" the player moves a joystick control to try and steer a car driving dangerously fast down a motorway. The action seen on the screen is a movie film of the road ahead. The joystick can switch the car between centre, left and right lanes and the trick is to avoid other drivers who fumble and barrels of oil (video graphics generated by the computer) which fall with genlock on the road ahead. If the player makes a mistake there is an explosion and the screen displays live action film of a car crashing and bursting into flames. The technical mystery is how the computer and a single disc player can switch without any delay between four different parallel action film sequences.

The trick is done by capitalising on the disadvantage of VHD, namely the need to store four fields for each revolution. For all normal tv pictures two fields are interlaced to give a single full picture. But for the video game display, each of the four fields is part of a different film sequence. In other words the disc is simultaneously generating four quite different action film sequences, continually being sourced from the four fields read on each revolution. This is comparable to four cinema projectors running different films at the same time, and with the operator able to switch shutters over the lenses so that only one selected sequence is seen on screen at any one time.

Movement of the MSX computer joystick tells the disc player which of the four fields to read on each revolution and it then just skips the other three. So the action on screen can jump instantly between any of the four film sequences.

Because Japan drives on the left like the UK, the game can easily be made available in Britain by Thorn-EMI which is already selling VHD players for institutional use. If MSX takes off, and if Laservision in America fumbles its lead by degrading picture quality through the use of diode lasers, then VHD might well find a new market. It is incidentally available on the domestic market in Japan, along with Laservision, but for both systems sales are slow.

HI FI VIDEO TAPE

Pioneer recognises the threat which hi fi video tape now poses to videodisc. The Pioneer response has been to launch a range of 8 inch videodiscs which contain around 15 or 20 minutes of music video on each side. There is even a juke box which can stack 60 of these discs for use in bars, pubs and clubs.

Hi fi video tape is now big business in Japan and America. In specialist shops in Tokyo one in four video recorders sold now has hi fi sound. The idea of hi fi sound with video began two years ago, curiously enough in Chicago. It was then that Sony privately showed a modified Beta recorder which slotted stereo sound into the video waveform, using FM carriers laid down by the ordinary video heads. The system, called Beta Hi Fi, was subsequently launched on the US market around a year later. There are now many hundreds of Beta Hi Fi video tapes available for sale or hire which have the sound recorded in this form. Quality of audio reproduction is very high. But the system will not work in Europe, where there is not room in the video waveform for the extra FM carriers and where the video heads rotate at lower speed (1500r.p.m. instead of 1800r.p.m.) thereby reducing video writing speed accordingly. So the Beta manufacturers had to adopt a different technique for Beta Hi Fi in Europe. This is just now coming on sale.

For European Beta Hi Fi, the FM audio carriers are recorded by separate heads on the video drum, which are spaced slightly in advance of the video heads. The relatively low frequency FM audio carriers are laid down by wide gap heads driven with relatively high current; then a split second later the higher frequency video signal is recorded, by narrow gap heads with lower drive current. The result is a two layer sandwich, with the FM audio recorded deep down in the tape coating and the video signal layered on top. The technique is called depth multiplex recording and VHS Hi Fi uses this for all countries. In fact it was VHS Hi Fi who pioneered the depth multiplex technique. It was then adopted by Beta when Sony found that the US system would not work in Europe.

8MM VIDEO

The other big, or potentially big, news at Chicago was in the field of 8mm video. In many respects the whole business of 8mm video is a nonsense. The original wild goose chase, started around four years ago by Sony (followed smartly by Matsushita, Sanyo and Hitachi) was to produce a new video format ideally suited for use in a camcorder (combined video camera and recorder). At that time the only cassettes available were full size VHS, Beta and V2000 units. This obviously put a bottom limit on the size of any camcorder. Also camcorders had to be bulky, because the standard formats all use a relatively large video head drum. For VHS it is 62mm in diameter, for Beta, 74·5mm and for V2000, 65mm.

In March 1983 a total of 122 companies, from all round the world, agreed on a new standard for video camcording, based on a very small cassette full of 8mm tape and a 40mm head drum. This, they said, made the design of small camcorders possible. Unfortunately the standardisation has brought more problems than it has solved. For a start, it is a fallacy to think that making a tape more narrow, necessarily makes the recorder smaller. Width of tape is not important.

The switch from half inch (12·5mm) tape to 8mm is only a width saving in the camcorder of 4·5mm. What's more, the reduction in tape width means that the density of recording on the tape has to be 30% higher. This is why the 8mm format relies on pure metal tape. Although now relatively easy to produce, tape coated with metal powder (MP) requires the use of a completely new type of video head, which does not saturate with magnetism when driven with the high current needed to record on tape with a coercivity of around 1500 oersted. The alternative solution is to use metal evaporated tape (ME), using a process patented by Matsushita. A mix of cobalt and iron is vaporised, and a very thin layer deposited onto plastics film in a vacuum. ME tape will work with ordinary heads, but has so far proved very difficult to manufacture in bulk.

VHS AND BETA MOVIE

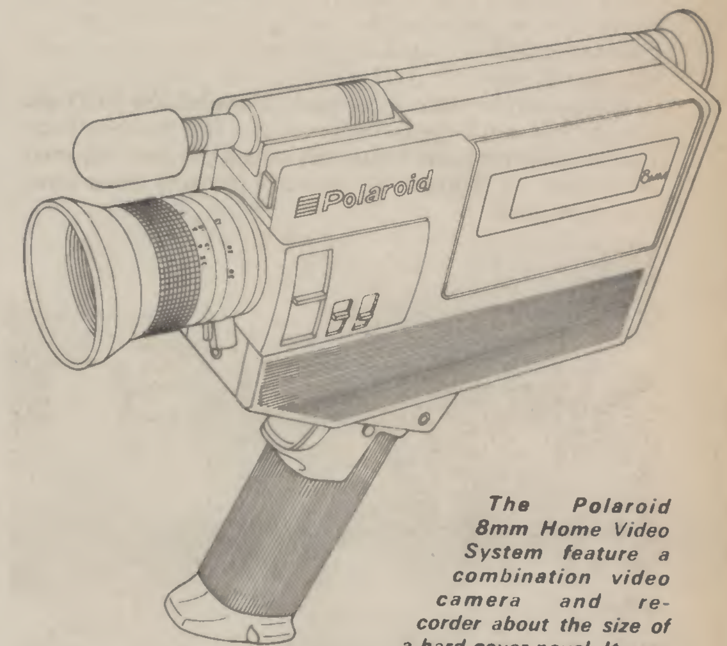
While the electronics industry was wrestling with the problems of 8mm video, Sony developed Beta Movie and JVC developed VHS Video Movie. Both these units are camcorders, which are smaller in size thanks to a completely new head technique. The head drum is reduced to around two-thirds its normal size, but rotates faster than usual. It has extra or modified heads and relies on a longer wrap of tape around the drum. This enables the small drum to maintain compatibility with existing VHS and Beta format machines. So immediately one of the main advantages of 8mm video, a smaller head drum than VHS or Beta, is lost!

The Beta Movie camcorder uses a standard size Beta cassette which can offer several hours of uninterrupted recording. In fact this is itself something of a nonsense, because the rechargeable battery can cope with at most one hour's running time. VHS Video Movie takes either a half hour or three quarter hour battery and relies on a small VHS cassette, the so-called VHS-C (C for compact). The VHS-C cassette holds around half an hour's worth of standard VHS tape which can either be replayed in a VHS-C camcorder, or in a standard VHS format machine, using a dummy cassette of standard full size. Beta Movie, incidentally, will not *replay* tapes, it can only record; whereas VHS Video Movie and other VHS-C recorder units can both play back and record.

Beta Movie has been on sale in Japan, America and Europe for some time now and at Chicago Sony showed an auto focus version. This overcomes one of the main disadvantages of the Beta camcorder, namely the absence of any tv tube viewfinder. Beta Movie has only an optical viewfinder, like a cheap still camera. So the cameraman can't be sure what is in focus. The Beta Movie auto focus forms image pairs on a mosaic of solid state photo sensors, looks for optimum line resolution, and alters the focus accordingly. It should put an end to out of focus shots on Beta Movie tapes. VHS Video Movie is already on sale in Japan and is now due in the USA and Britain. Cost of both Beta Movie and VHS Video Movie is around £1,000 a system.

KODAK AND POLAROID

With this kind of competition, it seems that 8mm video was truly dead. But not so. Kodak and Polaroid have both now said they will sell 8mm video, using cameras and tapes sourced from Japan. Kodak is buying its camcorders from Matsushita and its tape from TDK. Polaroid is buying hardware from Toshiba. Kodak plans to start selling 8mm camcorders this autumn in America and Polaroid, although so far without any firm plans, should follow soon after.



The Polaroid 8mm Home Video System feature a combination video camera and recorder about the size of a hard-cover novel. It uses pocket-size 8mm video cassettes capable of 90 minutes of recording.

Surprisingly the Kodak camcorder price is high, around 2,000 dollars a system. More to the point tape price is high, a 90 minute metal evaporated tape (90 minutes is the maximum playing time and far longer than battery life) will cost around 24 dollars. By comparison a standard VHS tape running several hours can now be bought in the US for around 6 dollars!

Frankly few people believe that 8mm now has a chance on the domestic market. Support from other US firms, and Japanese manufacturers, has melted away. This is partly for commercial reasons and partly for technical reasons. Commercially VHS, and to a lesser extent Beta, seem to have the market sewn up. Sony may possibly also back 8mm but there seems little, if any, room on the market for any extra incompatible format. Technically the problems of cramming colour tv signals and FM sound (in mono initially and stereo later) onto 8mm tape have not yet been solved. Prototype camcorders, with test samples of ME and MP tape, work fairly well. But even prototype quality is not up to current ½in format standards. Will bulk-produced camcorders and tapes produce results which are acceptable? If early models disappoint, the format may get a bad name which is hard to shake off.

The technical problems of 8mm are best summed up by the failure of anyone involved in the new format to demonstrate a version suitable for use in Europe. Whereas in America pictures are built up from 525 lines, in Europe there are 625 lines; the video head drum in the USA and Japan rotates at 1800r.p.m. whereas in Europe it rotates at 1500r.p.m. Because drum size is the same in both countries (40mm) the reduction in drum speed means a reduction in writing speed. This is the speed at which the video heads track the tape and lay down the signals. The slower the writing speed the more densely the information must be packed.

For the USA and Japan (NTSC television) the writing speed for 8mm video is 3·8 metres a second. For Europe it is 3·1 metres a second. As a "yardstick" the lowest writing speed for any existing domestic video system is 4·85 metres a second for VHS, and that is over half inch or 12·5mm tape.

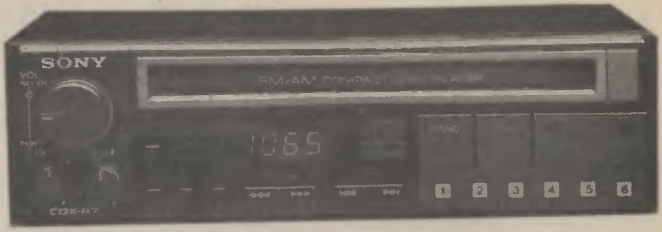
No-one is suggesting that it is impossible to make the format work in Europe, it will just be much more difficult. By the time the bugs have been ironed out there will be no market left. Already one-in-three British homes has a video recorder and sales are slowing down, much to the consternation of the Japanese. How do you sell a completely new and incompatible format to a country already committed to either Beta or VHS? More to the point, how do you sell the new and incompatible format when the first 8mm camcorders are larger, heavier and more expensive than VHS Video Movie? Don't ask me for any answers. Ask Kodak and Polaroid, and perhaps even Sony if the company does offer 8mm in 1985, as now rumoured.

RE-BORN OR AUDIO?

Whatever happens to 8mm domestic video, don't however think that the format is dead. It will surely be re-born in different forms. Most of the Japanese companies have spent so much money developing the new technology that they are not going to waste their research and development efforts. Very probably 8mm video will turn up in the future as the basis for a new professional video camcorder format for news gathering. Professional broadcast users are not so tightly locked into formats as domestic users. They can afford to move with the times and switch formats, especially when news tapes will anyway be dubbed onto another broadcast format, for editing, before broadcast.

An 8mm video cassette also provides the ideal basis for a completely new audio format. What the consumer electronics world really needs now is not another video tape format but a new audio tape recording format. The Philips compact cassette is out-dated. It has limited recording time and is in many respects a semi-silk purse constructed from an old sow's ear. Attempts at recording digital audio on a standard audio cassette have been notably lacking in success. It's possible, but the tape usually has to be run at double speed, which halves running time. Also there is then the problem of confusion between different and incompatible standards on the same cassette format.

Far better, argue long sighted audio engineers, to create a completely new cassette format for digital audio tape recording; one that won't be confused with existing cassettes and will offer longer playing time and higher packing density. What better format than 8mm video, with metal powder or metal evaporated tape? By running the tape at half speed an 8mm cassette should be able to offer two or even three hours of digital stereo or FM stereo. The same cassette format could also be used for high density data storage, for instance video graphics, text or computer programmes. Perhaps in the long term someone may think again about using 8mm cassettes for home video. In the meantime don't think of 8mm just as a domestic video medium. Think of it instead as the basis for a whole new generation of high density tape recording technology.



The latest CDX-R7 car compact disc player from Sony is the same size as a standard DIN-dimensioned car cassette tape player.

NEW FOR '85

Every year at Chicago press visitors bemoan the fact that there is not really that much to see and report. This is partly because in years gone by there has been so much new technology on show that the trade has complained. Published news of novelties kills off sales of existing products. All consumer electronic shows are in the same cleft stick. If they show nothing new they attract no visitors. If they show too much that is new, the public stops buying what is already in the shops. This year's Chicago show trod a fairly well balanced tight rope.

What is likely next year? Almost certainly MSX computers, and interfaces with all manner of other domestic electronic equipment, will be the big news. Compact disc players which reproduce video graphics from code recorded along with the music will be another consumer trend. The technology has already been demonstrated privately. All that is lacking is a sufficiently low priced memory to store the graphics as they are read from the disc. Already technically possible, but not yet formally announced, is a Laservision videodisc player which can also cope with compact disc digital audio. The trend towards solid state lasers, and smaller players, is the key factor here. Future Laservision discs will also have digital audio sound, as well as the conventional FM now used.

DIGITAL WALKMAN

Expect also portable compact disc players; a kind of digital disc Walkman. These were not shown in Chicago 1984 although they have already been developed. The key factor here is the tracking standard for Laservision and compact disc players. The laser tracks from the centre to the outside, not from the outside to the inside as on conventional gramophone records. With centre start tracking, a single player can cope with all different sizes of disc. A CD Walkman will work with coin-size discs. One snag however: coin size discs will not work in conventional drawer-load players! This leaves the obvious problem of vibration and not so obvious problem of heat. The laser must be held on track by a servo control which can withstand an external force of several G. This has already been achieved in compact disc players designed for use in cars. Sony in Chicago showed a compact disc car player the same size as a standard DIN-dimensioned car cassette player. But it still generates far too much waste heat. This, along with the greenhouse heat that normally builds up inside a car, drastically shortens the life of the solid state laser. Every 10°C rise in temperature halves the normal 5000 hours of diode life. Also if the disc warps through heat, the laser cannot keep it in focus. These are the challenges that lay ahead. Doubtless Chicago 1985, or perhaps New York 1985 if that is where the Consumer Electronics Show is moved as mooted, will see most of these challenges met. □

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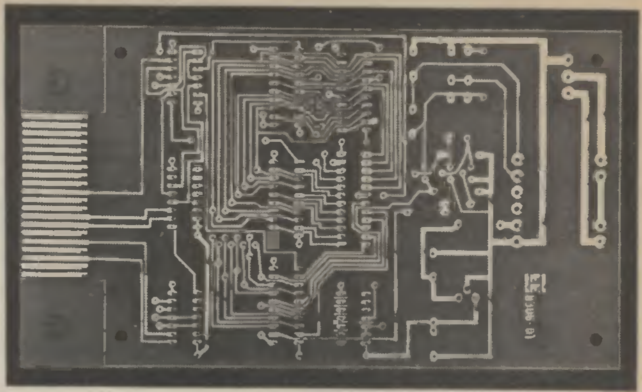

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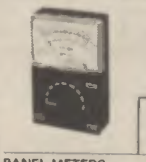

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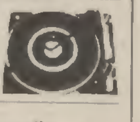

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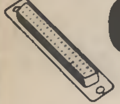

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BI-PAK BARGAINS

MINIATURE TOOLS FOR HOBBYISTS

Miniature round nose side cutters – insulated handles 4½inch length. Order No: Y043.

Miniature long nose pliers – insulated handles 5½inch length. Order No: Y044.

Miniature bend nose pliers – insulated handles 5½inch length. Order No: Y045.

Miniature end nippers – insulated handles 4½inch length. Order No: Y046.

Miniature snipe nose pliers with side cutter and serrated jaws – insulated handles 5inch length. Order No: Y042.

ALL AT £1.25 each

FLEXEY DRIVER
A flexible shaft screwdriver for those awkward to get at screws. Overall length 8½inch. Order No: FS-1 Flat blade 4mm FS-2 Cross point no. 1
£1.75 each.

GRIP-DRIVER
8inch long screwdriver with spring loaded grip on end to hold screws in position while reaching into those difficult places.
Order No: SD-1 Flat blade 4mm SD-2 Cross point no.0. £95p each.

SIGNAL INJECTOR
Simple push button operation. Oscillates at 700 – 1k Hz with harmonics to 30MHz. 1.4V p/p output. Impedance 10kΩ. Ideal for trouble shooting with audio equipment. One "AA" penlight battery supplied. O/No VP96 £2.50

LOGIC PROBE
Automatic levelling. White LED indication.
Minimum width of measuring pulse 30 millisecs. Maximum input frequency 10M Hz.
Input impedance: 100kΩ
Power consumption: 40mA maximum
Power supply: 4.5 – 18 V d.c.
ORDER No. VP97 £10.50

CURRENT/POL CHECKER
Heavy duty test prods with built-in indicators for testing polarity: indicates whether a.c. or d.c. 3.5V to 400V. O/No. VP98 £2.50

TESTER
Universal tester with ceramic buzzer. Tests diodes, transistors, resistors, capacitors and continuity. One "AA" penlight battery included.
Test current: Max 2μA
Test voltage: 1.2V
Response range: 100MΩ
Max voltage: 500V
Internal resistance: 390kΩ
Length: 135mm
£5.00 O/No. VP99

CIRCUIT TESTER
D.C. continuity tester for circuit checking on all low voltage equipment and components. Diode checking also possible. Takes two AA batteries. 90cm lead has crocodile clip. Body length 145mm. O/No. VP100 75p

ELECT & PIEZO BUZZERS

PIEZO
Miniature round piezo-electronic buzzer. White plastic. Low consumption.
Frequency: 4kHz approx.
Output: 70dB (A) @ 1, typ.
Power: 12Vd.c. 4mA
Dims: 22 (dia.) × 11.5mm
Fixing Centres: 26.5mm
O/No. VP 107
95p

PIEZO
Piezo buzzer. White plastic 90mm leads. For use on a.c mains.
Frequency: 3.5kHz approx.
Output: 85dB (A) @ 1m typ.
Power: 240Va.c. 5mA
Dims: 32 (dia.) × 14mm
Fixing centres: 38mm
O/No. VP 108
£1.15

ELECTRONIC
Miniature electronic buzzers. Solid state Ivory plastic 150 leads. Frequency: 500 Hz approx.
Dims: 22 × 16 × 15mm
Output: 82dB (A) @ 1m typ.
Fixing centres: 26mm
3V 25mA: O/No. VP 82 — 6V 25mA: VP 83
9V 25mA: O/No. VP 84 — 12V 25mA: VP 86
80p each

SUB-BOX
A neat swivelling disc provides close tolerance substitution resistors of 36 preferred values from 5ohms to 1Kohm. Simply fix clips into circuit and swivel until optimum result is achieved.
O/No. VP 112 £4.75

13 PIECE TOOL KIT AND CASE
13-piece tool set housed in attractive moulded plastic case with clear sliding cover ● 1 off 5" snipe nose "radio" pliers with side cutters ● 1 off 4½" side cutters ● 1 off 4½" end cutters ● 2 off hex. "Allen" key drivers 2mm and 2.5mm; 2 off cross-point "Phillips" drivers No. 0 and No. 1 (with tommy bar) ● 6 off precision screwdrivers. Sizes from 1mm to 3.5mm ●

ONLY £7.50 ORDER No. VP102

PRECISION JEWELLERS' TOOLS
Rustproof, Tempered Handles and Blades. Chrome Plated Handles. Swivel Heads for use on Precision Work.

5T21 SCREWDRIVER SET
6 precision screwdrivers in hinged plastic case. Sizes – 0.8, 1.4, 2, 2.4, 2.9 and 3.8mm £1.75

5T31 NUT DRIVER SET
5 precision nut drivers in hinged plastic case. With turning rod. Sizes – 3, 3.5, 4, 4.5 and 5mm £1.75

5T41 TOOL SET
5 precision instruments in hinged plastic case. Crosspoint (Philips) screwdrivers – H0 and H1 Hex key wrenches. Sizes – 1.5, 2 and 2.5mm £1.75

5T51 WRENCH SET
5 precision wrenches in hinged plastic case. Sizes – 4, 4.5, 5, 5.5 and 6mm £1.75

BI-PAK SOLDER—DESOLDER KIT
Kit comprises: O/No. VP 80
1 High Quality 25 Watt General Purpose Lightweight Soldering Iron 240v mains incl. 3/16" (4.7mm) bit.
1 Quality Desoldering Pump High Suction with automatic ejection Knurled anti-corrosive casing and Teflon nozzle 1.5 metres of De-Soldering braid on plastic dispenser.
2 yds (1.83m) Resin Cored Solder on Card
1 Heat Shunt too tweezer Type
Total Retail Value over £12.00
OUR SPECIAL KIT PRICE £9.95

MINIATURE VICE
Miniature plastic and metal vice with strong suction base for portability. Single action to secure or release suction. Plastic jaws with rubber pads 20mm wide, open out to 40mm. Dims: 85 × 65 × 60mm approx.
FANTASTIC VALUE
O/No. VP 95 ONLY £1.60

LEARN A LINGO!
PILLOW SPEAKER
Slim under pillow unit. 8ohms 2" speaker. 1.5m lead with 3.5mm mono jack plug. Black. Dims: 65 (dia.) ×17mm.
O/No VP 88 £1.25

ELECTRONIC SIREN 12v DC
Red plastic case with adjustable fixing bracket. Emits high-pitched wailing note of varying pitch - 100 cycles per minute. Dims - 90mm (dia.) 60mm (depth). Power - 12v DC. O/P 90dBA 1m type.
Our Price: £5.50 O/No. VP79

TAPE RECORDER SWITCH
Unit to control motor of tape recorder. 1.8m cord and 2.5mm plug attached. On/Off switch. Dims: 55 × 20 × 20mm.
O/No. VP 127 £1.00

METRIC & BRITISH MEASURES
Steel tapes in sturdy ABS plastic case. Silk wrist strap. These yellow coated convex tapes have inch and metric graduations. Automatic push-button return.
2m long × 13mm wide. O/No. VP 89 £1.00
3m long × 13mm wide. O/No. VP 90 £1.50
5m long × 16mm wide. O/No. VP 91 £2.00

BI-PAK PCB ETCHANT AND DRILL KIT
Complete PCB Kit comprises
1 Expo Mini Drill 10,000RPM 12Vd.c. incl. 3 collets & 3 × Twist Bits
1 Sheet PCB Transfers 210mm × 150mm
1 Etch Resist Pen
1 ½lb pack FERRIC CHLORIDE crystals
3 sheets copped clad board
2 sheets Figreglass copper clad board
Full instructions for making your own PCB boards
Retail Value over £15.00
OUR BI-PAK SPECIAL KIT PRICE £9.95
ORDER NO. VP 81

MULTITESTER
1,000 opv including test leads & Battery
AC volts - 0-15-150-500-1,000
DC volts - 0-15-150-500-1,000
DC currents - 0 -1ma-150ma
Resistance - 0 -25 K ohms 100 K ohms
Dims - 90 × 61 × 30mm.
O/No. 1322 OUR PRICE £6.50 ONLY

POWER SUPPLY OUR PRICE £4.25
Power supply fits directly into 13 amp socket Fused for safety. Polarity reversing socket. Voltage switch. Lead with multi plug Input – 240V AC 50HZ, Output – 3, 4, 5, 6, 7.5, 9 & 12V DC Rating – 300 ma VP109.

RATCHET SCREWDRIVER KIT
Comprises 2 standard screwdriver blades 5 & 7mm size. 2 cross point size 4 & 6. 1 Ratchet handle. 5-in-1 Kit. £1.45 each. O/No 329B

BATTERY TESTER
Tests all types of battery including standard, NICAD, Alkaline etc. Takes all standard sizes including 6V lantern batteries and watch/hearing aid cells. Also tests fuses and lamps by means of internal 9V (PP3) battery. Can also be used to recharge NICAD batteries by means of external 3-12Vd.c. power supply (not included)
Full instructions provided. Dims: 185 × 103 × 30mm (approx.)
O/No. VP 101 £7.00

SPEAKER PROTECTOR
Limits voltage to speaker or to the permissible max., by automatically introducing a resistor in series with speakers. When excessive voltage is reduced the unit resets itself. Electronic voltage-sensing relay circuit. Spring terminals. Cut-off level adjustable from 10W-120W. Full instructions included. Dims: 85 × 74 × 25mm.
O/No. VP 118 £9.95

HIGH PASS FILTER/SUPRESSOR
CB/TV. High pass filter. Reduces unwanted signals picked up by antenna. Dims: 45 × 25 × 17mm
O/No. VP 115 45p

LOW PASS FILTER
Designed to reduce harmonics on the VHS and TV band. Cut-off frequency: 30MHz. V.S.W.R.: Less than 1.2 to 1. Insertion loss: –0.2dB @ 27MHz. Impedance: 50 ohms. Dims: 80 × 55 × 40mm.
O/No. VP116 £2.75

ANTENNA COUPLER
Transceiver/car radio antenna coupler. With co-axial cables. One co-axial terminates in antenna plug and the other in PL259 plug. Dims: 67 × 46 × 30mm.
O/No. VP 117 £2.00

FM MONITOR
FM monitor for 2 metre band. All metal. Attached earphone. PL259/ SO239 connectors. 144MHz. 10W maximum. Dims: (Body) 55 × 30 × 23mm.
O/No VP 120 £4.20

DUMMY LOAD
50 ohms 30W. UHF co-axial plug fitting (PL259).
O/No. VP 121 £5.20

ANTENNA SWITCH 2 and 3 WAY
Co-axial switch for one transceiver to two antennae or one antenna to two transceivers. Dims: 86 × 55 × 32mm (Body).
O/No. VP 113 £4.50
As above but 3-way.
O.No. VP 114 £4.75

DC-DC POWER SUPPLY
DC to DC adaptor. Plugs into car cigar lighter aperture. Output 3, 4.5, 6, 7.5, 9, 12V @ 800mA. Has universal output spider plug, also 9V battery snap and polarity reversing facility.
O/No. VP 119 £2.45

PICK-UP COIL
Large telephone pick-up coil for high sensitivity. Suction pad to stick to telephone 90cm lead to 3.5 jack plug. Connects direct to cassette recorder. Dims: 32 (dia.) × 17mm (body) 36mm (dia.) sucker.
O/No. VP 87 £1.00

BI-PAK

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